MikroTik RouterOS™ v2.8
Reference Manual

Table Of Contents

Basic Setup Guide

Document revision 3.6 (Thu Oct 07 11:34:10 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

MikroTik RouterOS™ is independent Linux-based Operating System for IA-32 routers and thinrouters. It does not require any additional components and has no software prerequirements. It is designed with easy-to-use yet powerful interface allowing network administrators to deploy network structures and functions, that would require long education elsewhere simply by following the Reference Manual (and even without it).

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***License Management***
- ***Ping***
- ***Bandwidth Control***
- ***Firewall Filters***
- ***Winbox***

Description

MikroTik RouterOS™ turns a standard PC computer into a powerful network router. Just add standard network PC interfaces to expand the router capabilities. Remote control with easy real-time Windows application (WinBox)

- Advanced Quality of Service control with burst support
- Stateful firewall with P2P protocol filtering, tunnels and IPsec
- STP bridging with filtering capabilities
- Super high speed 802.11a/b/g wireless with WEP
- WDS and Virtual AP features
- HotSpot for Plug-and-Play access
- RIP, OSPF, BGP routing protocols
- Gigabit Ethernet ready
- V.35, X.21, T1/E1 synchronous support
- async PPP with RADIUS AAA
- IP Telephony
- remote winbox GUI admin
- telnet/ssh/serial console admin
- real-time configuration and monitoring
- and much more (please see the Specifications Sheet)

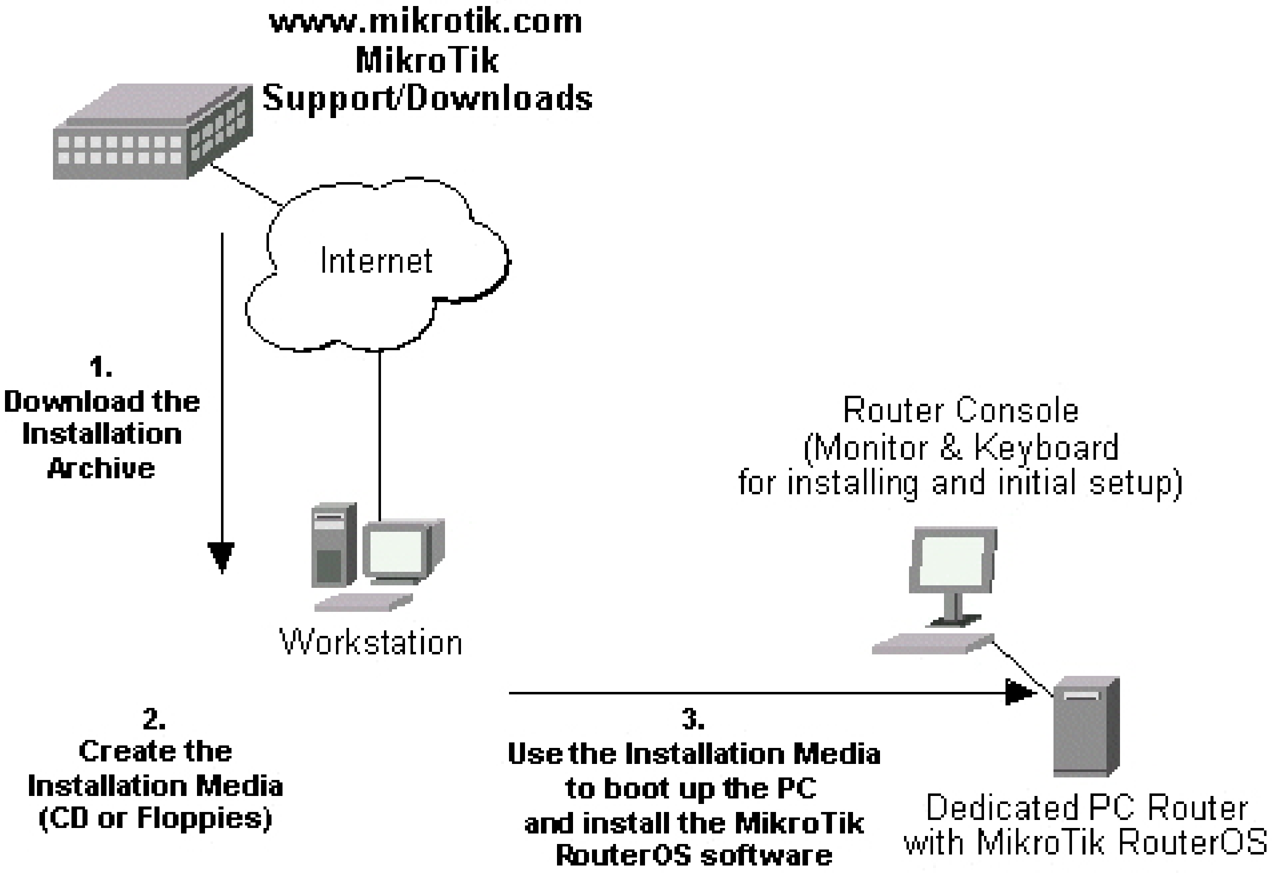
The Guide describes the basic steps of installing and configuring a dedicated PC router running MikroTik RouterOS™.

Setting up MikroTik RouterOS™

Description

Downloading and Installing the MikroTik RouterOS™

The download and installation process of the MikroTik RouterOS™ is described in the following diagram:



1. Download the basic installation archieve file.
   Depending on the desired media to be used for installing the MikroTik RouterOS™ please chose one of the following archive types for downloading:
   - **ISO image** - of the installation CD, if you have a CD writer for creating CDs. The ISO image is in the MTcdimage_v2-8-x_dd-mmm-yyyy_(build_z).zip archive file containing a bootable CD image. The CD will be used for booting up the dedicated PC and installing the MikroTik RouterOS™ on its hard-drive or flash-drive.
   - **Netinstall** - if you want to install RouterOS over a LAN with one floppy boot disk, or alternatively using PXE or EtherBoot option supported by some network interface cards, that allows truly networked installation. Netinstall program works on Windows 95/98/NT4/2K/XP.
   - **MikroTik Disk Maker** - if you want to create 3.5" installation floppies. The Disk Maker is a self-extracting archive DiskMaker_v2-8-x_dd-mmm-yyyy_(build_z).exe file, which should be run on your Windows 95/98/NT4/2K/XP workstation to create the installation floppies. The installation floppies will be used for booting up the dedicated PC and installing the MikroTik RouterOS™ on its hard-drive or flash-drive.

2. Create the installation media.
   Use the appropriate installation archive to create the Installation CD or floppies.

- For the CD, write the ISO image onto a blank CD.
- For the floppies, run the Disk Maker on your Windows workstation to create the installation floppies. Follow the instructions and insert the floppies in your FDD as requested, label them as Disk 1,2,3, etc.

3. Install the MikroTik RouterOS™ software.
   Your dedicated PC router hardware should have:
   - **CPU and motherboard** - advanced 4th generation (core frequency 100MHz or more), 5th generation (Intel Pentium, Cyrix 6X86, AMD K5 or comparable) or newer uniprocessor Intel IA-32 (i386) compatible (multiple processors are not supported)
   - **RAM** - minimum 64 MB, maximum 1 GB; 64 MB or more recommended
   - **Hard Drive/Flash** - standard ATA interface controller and drive (SCSI and USB controllers and drives are not supported; RAID controllers that require additional drivers are not supported) with minimum of 64 MB space

   Hardware needed for installation time only
   Depending on installation method chosen the router must have the following hardware:
   - **Floppy-based installation** - standard AT floppy controller and 3.5" disk drive connected as the first floppy disk drive (A); AT, PS/2 or USB keyboard; VGA-compatible video controller card and monitor
   - **CD-based installation** - standard ATA/ATAPI interface controller and CD drive supporting "El Torito" bootable CDs (you might need also to check if the router's BIOS supports booting from this type of media); AT, PS/2 or USB keyboard; VGA-compatible video controller card and monitor
   - **Floppy-based network installation** - standard AT floppy controller and 3.5" disk drive connected as the first floppy disk drive (A); PCI Ethernet network interface card supported by MikroTik RouterOS (see the Device Driver List for the list)
   - **Full network-based installation** - PCI Ethernet network interface card supported by MikroTik RouterOS (see the Device Driver List for the list) with PXE or EtherBoot extension booting ROM (you might need also to check if the router's BIOS supports booting from network)

   Note that if you use Netinstall, you can license the software during the installation procedure (the next point of this section describes how to do it).
   Boot up your dedicated PC router from the Installation Media you created and follow the instructions on the console screen while the HDD is reformatted and MikroTik RouterOS installed on it. After successful installation please remove the installation media from your CD or floppy disk drive and hit 'Enter' to reboot the router.

4. License the software.
   When booted, the software allows you to use all its features for 24 hours. If the license key will not be entered during this period of time, the router will become unusable, and will need a complete reinstallation.
   RouterOS licensing scheme is based on software IDs. To license the software, you must know the software ID. It is shown during installation procedures, and also you can get it from system console or Winbox. To get the software ID from system console, type: **/system license print** (note that you must first log in the router; by default there is user **admin** with no password (just press [Enter] key when prompted for password)). See sections below on basic configuration of your router

   Once you have the ID, you can obtain a license:

- You shoud have an account on our account server. If you do not have an account at www.mikrotik.com, just press the 'New' button on the upper right-hand corner of the MikroTik's web page to create your account
- Choose the appropriate licence level that meets your needs. Please see the ***License Manual*** or the ***Software price list***. Note that there is a free license with restricted features (no time limitation)
- There are different methods how to get a license from the accout server:
    1. Enter the software ID in the account server, and get the license key by e-mail. You can upload the file received on the router's FTP server, or drag-and-drop it into opened Winbox window
    2. You can open the file with a text editor, and copy the contents. Then paste the text into system console (in any menu - you just should be logged in), or into System->License window of Winbox
    3. If the router has Internet connection, you can obtain the license directly from within it. The commands are described in the ***License Manual***. Note that you must have **Allow to use my account in netinstall** option enabled for your account. You can set it by following **change user information** link on the main screen of the account server.

Notes

The hard disk will be entirely reformatted during the installation and all data on it will be lost!

You can move the hard drive with MikroTik RouterOS installed to a new hardware without loosing a license, but you cannot move the RouterOS to a different hard drive without purchasing an another license (except hardware failure situations). For additional information write to ***key-support@mikrotik.com***.

Note! Do not use MS-DOS format command or other disk format utilities to reinstall your MikroTik router! This will cause the Software-ID to change, so you will need to buy another license in order to get MikroTik RouterOS running.

Logging into the MikroTik Router

Description

When logging into the router via terminal console, you will be presented with the MikroTik RouterOS™ login prompt. Use 'admin' and no password (hit 'Enter') for logging in the router for the first time, for example:

```
MikroTik v2.8
Login: admin
Password:
```

The password can be changed with the **/password** command.

```
[admin@MikroTik] > password
old password:
new password: ************
```

```
retype new password: ************
[admin@MikroTik] >
```

Adding Software Packages

Description

The basic installation comes only with the **system** package. This includes basic IP routing and router administration. To have additional features such as IP Telephony, OSPF, wireless and so on, you will need to ***download*** additional software packages.

The additional software packages should have **the same version** as the system package. If not, the package won't be installed. Please consult the MikroTik RouterOS™ Software Package Installation and Upgrading Manual for more detailed information about installing additional software packages.

To upgrade the router packages, simply upload the packages to the router via ftp, using the binary transfer mode. After you have uploaded the packages, reboot the router, and the features that are provided by those packages will be available (regarding your license type, of course).

Navigating The Terminal Console

Description

Welcome Screen and Command Prompt

After logging into the router you will be presented with the MikroTik RouterOS™ Welcome Screen and command prompt, for example:

```
  MMM      MMM       KKK                          TTTTTTTTTTT      KKK
  MMMM    MMMM       KKK                          TTTTTTTTTTT      KKK
  MMM MMMM MMM  III  KKK  KKK  RRRRRR     OOOOOO      TTT     III  KKK  KKK
  MMM  MM  MMM  III  KKKKK     RRR  RRR  OOO  OOO     TTT     III  KKKKK
  MMM      MMM  III  KKK KKK   RRRRRR    OOO  OOO     TTT     III  KKK KKK
  MMM      MMM  III  KKK  KKK  RRR  RRR   OOOOOO      TTT     III  KKK  KKK

  MikroTik RouterOS 2.8 (c) 1999-2004       http://www.mikrotik.com/




Terminal xterm detected, using multiline input mode
[admin@MikroTik] >
```

The command prompt shows the identity name of the router and the current menu level, for example:

```
[admin@MikroTik] >                                 Base menu level
[admin@MikroTik] interface>                                 Interface management
[admin@MikroTik] ip address>                         IP address manangement
```

Commands

The list of available commands at any menu level can be obtained by entering the question mark '?', for example:

```
[admin@MikroTik] >

    certificate  Certificate management
         driver  Driver manageent
           file  Local router file storage.
         import  Run exported configuration script
      interface  Interface configuration
            log  System logs
       password  Change password
           ping  Send ICMP Echo packets
           port  Serial ports
           quit  Quit console
         radius  Radius client settings
           redo  Redo previosly undone action
          setup  Do basic setup of system
           snmp  SNMP settings
  special-login  Special login users
           undo  Undo previous action
           user  User management
             ip  IP options
          queue  Bandwidth management
         system  System information and utilities
           tool  Diagnostics tools
         export  Print or save an export script that can be used to restore
                 configuration
[admin@MikroTik] >
```

```
[admin@MikroTik] ip>

      accounting  Traffic accounting
         address  Address management
             arp  ARP entries management
             dns  DNS settings
        firewall  Firewall management
        neighbor  Neighbors
         packing  Packet packing settings
            pool  IP address pools
           route  Route management
         service  IP services
  policy-routing  Policy routing
            upnp  Universal Plug and Play
            vrrp  Virtual Router Redundancy Protocol
           socks  SOCKS version 4 proxy
         hotspot  HotSpot management
           ipsec  IP security
       web-proxy  HTTP proxy
          export  Print or save an export script that can be used to restore
                  configuration
[admin@MikroTik] ip>
```

The list of available commands and menus has short descriptions next to the items. You can move to the desired menu level by typing its name and hitting the [Enter] key, for example:

```
[admin@MikroTik] >                      Base level menu
[admin@MikroTik] > driver               Enter 'driver' to move to the driver level
                                       menu
[admin@MikroTik] driver> /             Enter '/' to move to the base level menu
                                       from any level
[admin@MikroTik] > interface            Enter 'interface' to move to the interface
                                       level menu
[admin@MikroTik] interface> /ip        Enter '/ip' to move to the IP level menu
                                       from any level
[admin@MikroTik] ip>
```

A command or an argument does not need to be completed, if it is not ambiguous. For example, instead of typing **interface** you can type just **in** or **int**. To complete a command use the **[Tab]** key.

The commands may be invoked from the menu level, where they are located, by typing its name. If the command is in a different menu level than the current one, then the command should be invoked using its full (absolute) or relative path, for example:

```
[admin@MikroTik] ip route> print                 Prints the routing table
[admin@MikroTik] ip route> .. address print      Prints the IP address table
[admin@MikroTik] ip route> /ip address print     Prints the IP address table
```

The commands may have arguments. The arguments have their names and values. Some commands, may have a required argument that has no name.

Summary on executing the commands and navigating the menus

Command	Action
command [Enter]	**Executes the command**
[?]	**Shows the list of all available commands**
command [?]	**Displays help on the command and the list of arguments**
command argument [?]	**Displays help on the command's argument**
[Tab]	**Completes the command/word. If the input is ambiguous, a second [Tab] gives possible options**
/	**Moves up to the base level**
/command	**Executes the base level command**
..	**Moves up one level**
""	**Specifies an empty string**
"word1 word2"	**Specifies a string of 2 words that contain a space**

You can abbreviate names of levels, commands and arguments.

For the IP address configuration, instead of using the 'address' and 'netmask' arguments, in most cases you can specify the address together with the number of true bits in the network mask, i.e., there is no need to specify the 'netmask' separately. Thus, the following two entries would be equivalent:

```
/ip address add address 10.0.0.1/24 interface ether1
/ip address add address 10.0.0.1 netmask 255.255.255.0 interface ether1
```

Notes

You must specify the size of the network mask in the address argument, even if it is the 32-bit subnet, i.e., use **10.0.0.1/32** for `address=10.0.0.1 netmask=255.255.255.255`

Basic Configuration Tasks

Description

Interface Management

Before configuring the IP addresses and routes please check the **/interface** menu to see the list of available interfaces. If you have Plug-and-Play cards installed in the router, it is most likely that the device drivers have been loaded for them automatically, and the relevant interfaces appear on the **/interface print** list, for example:

```
[admin@MikroTik] interface> print
Flags: X - disabled, D - dynamic, R - running
 #    NAME                         TYPE             RX-RATE    TX-RATE    MTU
 0  R ether1                       ether            0          0          1500
 1  R ether2                       ether            0          0          1500
 2 X  wavelan1                     wavelan          0          0          1500
 3 X  prism1                       wlan             0          0          1500
[admin@MikroTik] interface>
```

The interfaces need to be enabled, if you want to use them for communications. Use the **/interface enable name** command to enable the interface with a given name or number, for example:

```
[admin@MikroTik] interface> print
Flags: X - disabled, D - dynamic, R - running
 #    NAME                         TYPE             RX-RATE    TX-RATE    MTU
 0 X  ether1                       ether            0          0          1500
 1 X  ether2                       ether            0          0          1500
[admin@MikroTik] interface> enable 0
[admin@MikroTik] interface> enable ether2
[admin@MikroTik] interface> print
Flags: X - disabled, D - dynamic, R - running
 #    NAME                         TYPE             RX-RATE    TX-RATE    MTU
 0  R ether1                       ether            0          0          1500
 1  R ether2                       ether            0          0          1500
[admin@MikroTik] interface>
```

The interface name can be changed to a more descriptive one by using **/interface set** command:

```
[admin@MikroTik] interface> set 0 name=Local; set 1 name=Public
[admin@MikroTik] interface> print
Flags: X - disabled, D - dynamic, R - running
 #    NAME                         TYPE             RX-RATE    TX-RATE    MTU
 0  R Local                        ether            0          0          1500
 1  R Public                       ether            0          0          1500
[admin@MikroTik] interface>
```

Notes

The device drivers for NE2000 compatible ISA cards need to be loaded using the **add** command under the /drivers menu. For example, to load the driver for a card with IO address 0x280 and IRQ 5, it is enough to issue the command:

```
[admin@MikroTik] driver> add name=ne2k-isa io=0x280
[admin@MikroTik] driver> print
Flags: I - invalid, D - dynamic
 #   DRIVER                                 IRQ IO       MEMORY   ISDN-PROTOCOL
  0 D RealTek 8139
  1 D Intel EtherExpressPro
  2 D PCI NE2000
  3   ISA NE2000                            280
  4   Moxa C101 Synchronous                              C8000
[admin@MikroTik] driver>
```

There are some other drivers that should be added manually. Please refer to the respective manual sections for the detailed information on how drivers are to be loaded.

Setup Command

Command name: ***/setup***

Description

The initial setup of the router can be done by using the **/setup** command which offers the following configuration:

- reset all router configuration
- load interface driver
- configure ip address and gateway
- setup dhcp client
- setup dhcp server
- setup pppoe client
- setup pptp client

Configure IP address on router, using the Setup command

Execute the **/setup** command from command line:

```
[admin@MikroTik] > setup
  Setup uses Safe Mode. It means that all changes that are made during setup
are reverted in case of error, or if Ctrl-C is used to abort setup. To keep
changes exit setup using the 'x' key.

[Safe Mode taken]
  Choose options by pressing one of the letters in the left column, before
dash. Pressing 'x' will exit current menu, pressing Enter key will select the
entry that is marked by an '*'. You can abort setup at any time by pressing
Ctrl-C.
Entries marked by '+' are already configured.
Entries marked by '-' cannot be used yet.
Entries marked by 'X' cannot be used without installing additional packages.
   r - reset all router configuration
 + l - load interface driver
 * a - configure ip address and gateway
   d - setup dhcp client
   s - setup dhcp server
   p - setup pppoe client
   t - setup pptp client
   x - exit menu
your choice [press Enter to configure ip address and gateway]: a
```

To configure IP address and gateway, press **a** or [Enter], if the **a** choice is marked with an asterisk symbol ('*').

```
 * a - add ip address
 - g - setup default gateway
   x - exit menu
your choice [press Enter to add ip address]: a
```

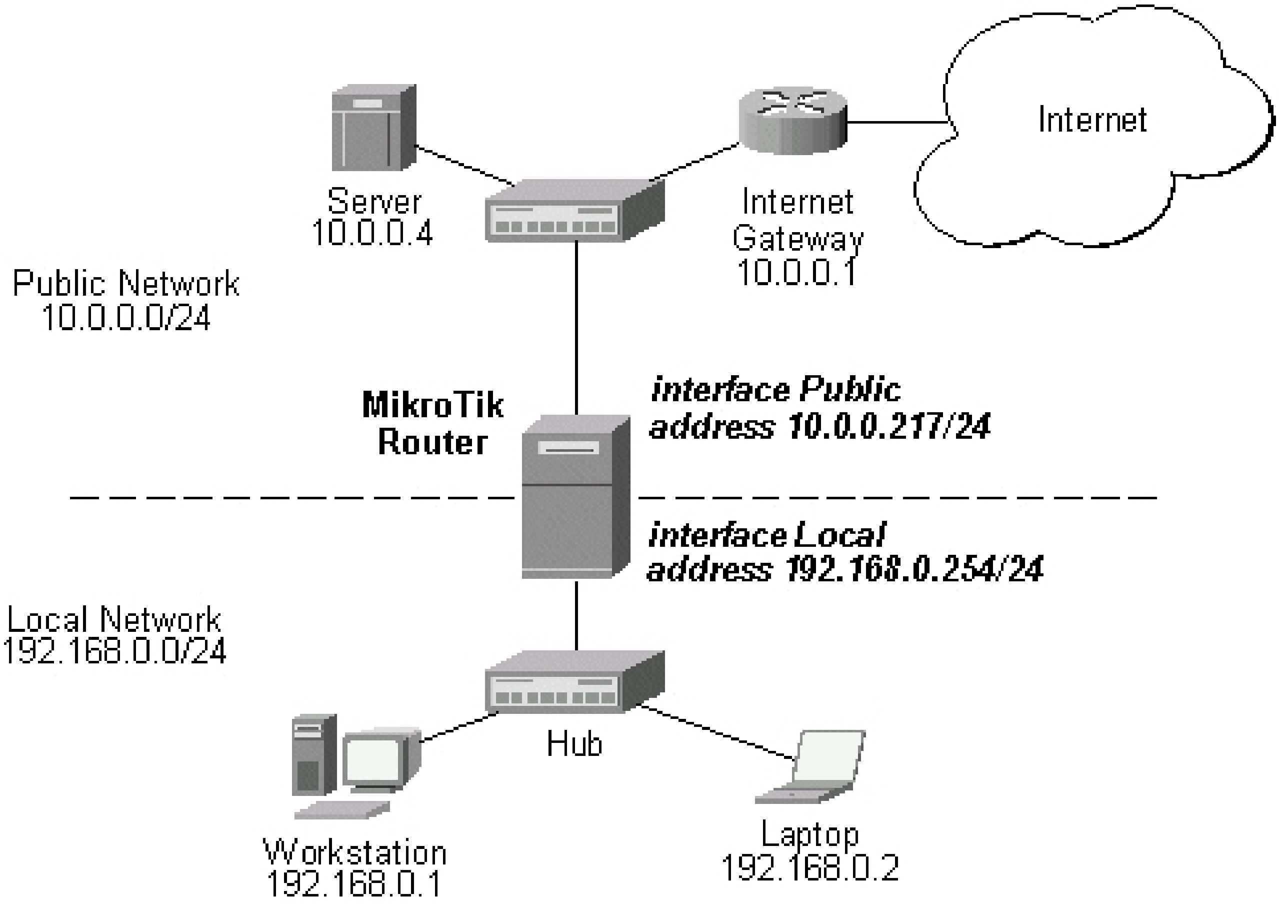
Choose **a** to add an IP address. At first, setup will ask you for an interface to which the address will be assigned. If the setup offers you an undesirable interface, erase this choice, and press the [Tab] key twice to see all available interfaces. After the interface is chosen, assign IP address and network mask on it:

```
your choice: a
enable interface:
ether1  ether2  wlan1
enable interface: ether1
ip address/netmask: 10.1.0.66/24
#Enabling interface
/interface enable ether1
#Adding IP address
/ip address add address=10.1.0.66/24 interface=ether1 comment="added by setup"
 + a - add ip address
 * g - setup default gateway
   x - exit menu
your choice: x
```

Basic Examples

Example

Assume you need to configure the MikroTik router for the following network setup:



In the current example we use two networks:

- The local LAN with network address 192.168.0.0 and 24-bit netmask: 255.255.255.0. The router's address is 192.168.0.254 in this network

- The ISP's network with address 10.0.0.0 and 24-bit netmask 255.255.255.0. The router's address is 10.0.0.217 in this network

The addresses can be added and viewed using the following commands:

```
[admin@MikroTik] ip address> add address 10.0.0.217/24 interface Public
[admin@MikroTik] ip address> add address 192.168.0.254/24 interface Local
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.217/24      10.0.0.217      10.0.0.255      Public
  1   192.168.0.254/24   192.168.0.0     192.168.0.255   Local
[admin@MikroTik] ip address>
```

Here, the network mask has been specified in the value of the address argument. Alternatively, the argument 'netmask' could have been used with the value '255.255.255.0'. The network and broadcast addresses were not specified in the input since they could be calculated automatically.

Please **note** that the addresses assigned to different interfaces of the router should belong to different networks.

Viewing Routes

You can see two dynamic (D) and connected (C) routes, which have been added automatically when the addresses were added in the example above:

```
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0 DC 192.168.0.0/24     r 0.0.0.0         0        Local
    1 DC 10.0.0.0/24        r 0.0.0.0         0        Public
[admin@MikroTik] ip route> print detail
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    0 DC dst-address=192.168.0.0/24 preferred-source=192.168.0.254
         gateway=0.0.0.0 gateway-state=reachable distance=0 interface=Local

    1 DC dst-address=10.0.0.0/24 preferred-source=10.0.0.217 gateway=0.0.0.0
         gateway-state=reachable distance=0 interface=Public

[admin@MikroTik] ip route>
```

These routes show, that IP packets with destination to 10.0.0.0/24 would be sent through the interface Public, whereas IP packets with destination to 192.168.0.0/24 would be sent through the interface Local. However, you need to specify where the router should forward packets, which have destination other than networks connected directly to the router.

Adding Default Routes

In the following example the `default route` (destination 0.0.0.0 (any), netmask 0.0.0.0 (any)) will be added. In this case it is the ISP's gateway 10.0.0.1, which can be reached through the interface **Public**

```
[admin@MikroTik] ip route> add gateway=10.0.0.1
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 10.0.0.1        1        Public
    1 DC 192.168.0.0/24     r 0.0.0.0         0        Local
    2 DC 10.0.0.0/24        r 0.0.0.0         0        Public
[admin@MikroTik] ip route>
```

Here, the default route is listed under #0. As we see, the gateway 10.0.0.1 can be reached through the interface 'Public'. If the gateway was specified incorrectly, the value for the argument 'interface' would be unknown.

Notes

You cannot add two routes to the same destination, i.e., destination-address/netmask! It applies to the default routes as well. Instead, you can enter multiple gateways for one destination. For more information on IP routes, please read the ***Routes, Equal Cost Multipath Routing, Policy Routing*** manual.

If you have added an unwanted static route accidentally, use the **remove** command to delete the unneeded one. You will not be able to delete dynamic (DC) routes. They are added automatically and represent routes to the networks the router connected directly.

Testing the Network Connectivity

From now on, the **/ping** command can be used to test the network connectivity on both interfaces. You can reach any host on both connected networks from the router.

How the **/ping** command works:

```
[admin@MikroTik] ip route> /ping 10.0.0.4
10.0.0.4 64 byte ping: ttl=255 time=7 ms
10.0.0.4 64 byte ping: ttl=255 time=5 ms
10.0.0.4 64 byte ping: ttl=255 time=5 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 5/5.6/7 ms
[admin@MikroTik] ip route>
[admin@MikroTik] ip route> /ping 192.168.0.1
192.168.0.1 64 byte ping: ttl=255 time=1 ms
192.168.0.1 64 byte ping: ttl=255 time=1 ms
192.168.0.1 64 byte ping: ttl=255 time=1 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 1/1.0/1 ms
[admin@MikroTik] ip route>
```

The workstation and the laptop can reach (ping) the router at its local address 192.168.0.254, If the router's address 192.168.0.254 is specified as the default gateway in the TCP/IP configuration of both the workstation and the laptop, then you should be able to ping the router:

```
C:\>ping 192.168.0.254
Reply from 192.168.0.254: bytes=32 time=10ms TTL=253
Reply from 192.168.0.254: bytes=32 time<10ms TTL=253
Reply from 192.168.0.254: bytes=32 time<10ms TTL=253

C:\>ping 10.0.0.217
Reply from 10.0.0.217: bytes=32 time=10ms TTL=253
Reply from 10.0.0.217: bytes=32 time<10ms TTL=253
Reply from 10.0.0.217: bytes=32 time<10ms TTL=253

C:\>ping 10.0.0.4
Request timed out.
Request timed out.
Request timed out.
```

Notes

You cannot access anything beyond the router (network 10.0.0.0/24 and the Internet), unless you do the one of the following:

- Use source network address translation (masquerading) on the MikroTik router to 'hide' your private LAN 192.168.0.0/24 (see the information below), or
- Add a static route on the ISP's gateway 10.0.0.1, which specifies the host 10.0.0.217 as the gateway to network 192.168.0.0/24. Then all hosts on the ISP's network, including the server, will be able to communicate with the hosts on the LAN

To set up routing, it is required that you have some knowledge of configuring TCP/IP networks. There is a comprehensive list of IP resources compiled by Uri Raz at ***http://www.private.org.il/tcpip_rl.html***. We strongly recommend that you obtain more knowledge, if you have difficulties configuring your network setups.

Advanced Configuration Tasks

Description

Next will be discussed situation with 'hiding' the private LAN 192.168.0.0/24 'behind' one address 10.0.0.217 given to you by the ISP.

Application Example with Masquerading

If you want to 'hide' the private LAN 192.168.0.0/24 'behind' one address 10.0.0.217 given to you by the ISP, you should use the source network address translation (masquerading) feature of the MikroTik router. Masquerading is useful, if you want to access the ISP's network and the Internet appearing as all requests coming from the host 10.0.0.217 of the ISP's network. The masquerading will change the source IP address and port of the packets originated from the network 192.168.0.0/24 to the address 10.0.0.217 of the router when the packet is routed through it.

Masquerading conserves the number of global IP addresses required and it lets the whole network use a single IP address in its communication with the world.

To use masquerading, a source NAT rule with action 'masquerade' should be added to the firewall configuration:

```
[admin@MikroTik] ip firewall src-nat> add action=masquerade out-interface=Public
[admin@MikroTik] ip firewall src-nat> print
Flags: X - disabled, I - invalid, D - dynamic
 0   out-interface=Public action=masquerade src-address=192.168.0.0/24
[admin@MikroTik] ip firewall src-nat>
```

Notes

Please consult ***Network Address Translation*** for more information on masquerading.

Example with Bandwidth Management

Assume you want to limit the bandwidth to 128kbps on downloads and 64kbps on uploads for all hosts on the LAN. Bandwidth limitation is done by applying queues for outgoing interfaces regarding the traffic flow. It is enough to add a single queue at the MikroTik router:

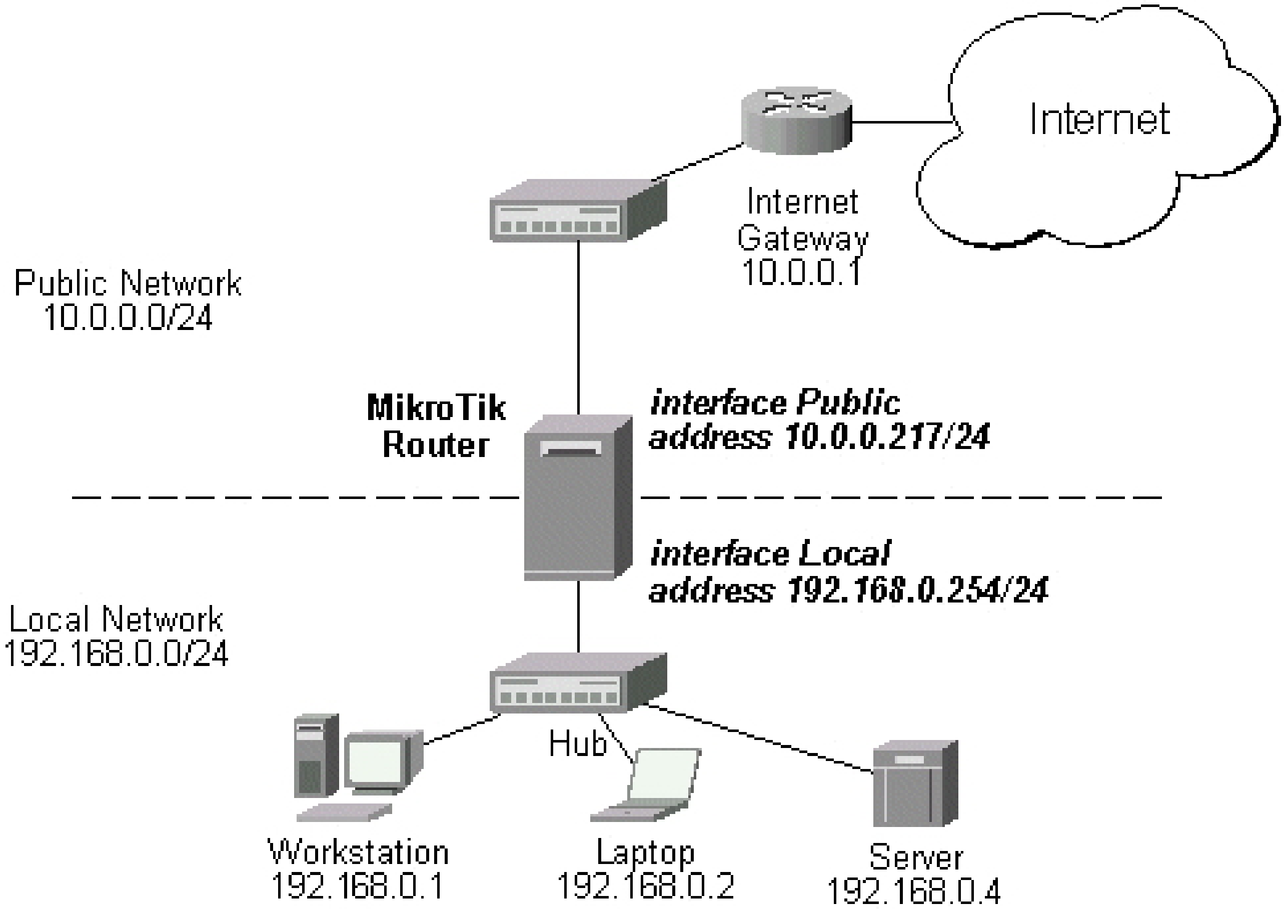
```
[admin@MikroTik] queue simple> add max-limit=64000/128000 interface=Local
[admin@MikroTik] queue simple> print
Flags: X - disabled, I - invalid, D - dynamic
 0    name="queue1" target-address=0.0.0.0/0 dst-address=0.0.0.0/0
```

```
      interface=Local queue=default priority=8 limit-at=0/0
      max-limit=64000/128000
[admin@MikroTik] queue simple>
```

Leave all other parameters as set by default. The limit is approximately 128kbps going to the LAN (download) and 64kbps leaving the client's LAN (upload).

Example with NAT

Assume we have moved the server in our previous examples from the public network to our local one:



The server's address is now 192.168.0.4, and we are running web server on it that listens to the TCP port 80. We want to make it accessible from the Internet at address:port 10.0.0.217:80. This can be done by means of Static Network Address translation (NAT) at the MikroTik Router. The Public address:port 10.0.0.217:80 will be translated to the Local address:port 192.168.0.4:80. One destination NAT rule is required for translating the destination address and port:

```
[admin@MikroTik] ip firewall dst-nat> add action=nat protocol=tcp \
dst-address=10.0.0.217/32:80 to-dst-address=192.168.0.4
[admin@MikroTik] ip firewall dst-nat> print
Flags: X - disabled, I - invalid, D - dynamic
 0   dst-address=10.0.0.217/32:80 protocol=tcp action=nat
     to-dst-address=192.168.0.4
[admin@MikroTik] ip firewall dst-nat>
```

Notes

Please consult ***Network Address Translation*** for more information on Network Address Translation.

Terminal Console

Document revision NaN (Tue Apr 20 16:17:53 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The Terminal Console is used for accessing the MikroTik Router's configuration and management features using text terminals, *id est* remote terminal clients or locally attached monitor and keyboard. The Terminal Console is also used for writing scripts. This manual describes the general console operation principles. Please consult the Scripting Manual on some advanced console commands and on how to write scripts.

Specifications

Packages required: ***system***
License required: ***level1***
Hardware usage: ***Not significant***

Related Documents

- ***Scripting Host and Complementary Tools***

Common Console Functions

Description

The console allows configuration of the router's settings using text commands. Although the command structure is similar to the Unix shell, you can get additional information about the command structure in the **Scripting Host and Complementary Tools** manual. Since there is a lot of available commands, they are split into groups organized in a way of hierarchical menu levels. The name of a menu level reflects the configuration information accessible in the relevant section, *exempli gratia* **/ip hotspot**.

In general, all menu levels hold the same commands. The difference is expressed mainly in command parameters.

Example

For example, you can issue the **/ip route print** command:

```
[admin@MikroTik] > /ip route print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 192.168.2.1     1        WAN
    1 DC 192.168.124.0/24   r 0.0.0.0         0        LAN
    2 DC 192.168.2.0/24     r 0.0.0.0         0        WAN
    3 DC 192.168.0.0/24     r 0.0.0.0         0        LAN

[admin@MikroTik] >
```

Instead of typing **ip route** path before each command, the path can be typed only once to move into this particular branch of menu hierarchy. Thus, the example above could also be executed like this:

```
[admin@MikroTik] > ip route
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 192.168.2.1     1        WAN
    1 DC 192.168.124.0/24   r 0.0.0.0         0        LAN
    2 DC 192.168.2.0/24     r 0.0.0.0         0        WAN
    3 DC 192.168.0.0/24     r 0.0.0.0         0        LAN

[admin@MikroTik] ip route>
```

Notice that the prompt changes in order to reflect where you are located in the menu hierarchy at the moment . To move to the top level again, type **/**:

```
[admin@MikroTik] > /ip route
[admin@MikroTik] ip route> /
[admin@MikroTik] >
```

To move up one command level, type **..**:

```
[admin@MikroTik] ip route> ..
[admin@MikroTik] ip>
```

You can also use **/** and **..** to execute commands from other menu levels without changing the current level:

```
[admin@MikroTik] ip route> /ping 10.0.0.1
10.0.0.1 ping timeout
2 packets transmitted, 0 packets received, 100% packet loss
[admin@MikroTik] ip route> .. firewall print
  # NAME                                                                 POLICY
  0 input                                                                accept
  1 forward                                                              accept
  2 output                                                               accept
  3 ;;; Limit unauthorized HS clients
    hs-temp                                                              none
  4 ;;; account auth HS clients
    hotspot                                                              none

[admin@MikroTik] ip route>
```

Lists and Item Names

Description

Lists

Many of the command levels operate with arrays of items: interfaces, routes, users etc. Such arrays are displayed in similarly looking lists. All items in the list have an item number followed by its parameter values.

To change parameters of an item, you have to specify it's number to the set command.

Item Names

Some lists have items that have specific names assigned to each. Examples are **interface** or **user** levels. There you can use item names instead of item numbers.

You do not have to use the **print** command before accessing items by name. As opposed to numbers, names are not assigned by the console internally, but are one of the items' properties. Thus, they would not change on their own. However, there are all kinds of obscure situations possible when several users are changing router's configuration at the same time. Generally, item names are more "stable" than the numbers, and also more informative, so you should prefer them to numbers when writing console scripts.

Notes

Item numbers are assigned by **print** command and are not constant - it is possible that two successive **print** commands will order items differently. But the results of last **print** commands are memorized and thus, once assigned, item numbers can be used even after **add**, **remove** and **move** operations (after **move** operation item numbers are moved with the items). Item numbers are assigned on per session basis, they will remain the same until you quit the console or until the next **print** command is executed. Also, numbers are assigned separately for every item list, so **ip address print** would not change numbers for **interface** list.

Example

```
[admin@MikroTik] interface> set 0 mtu=1200
```

```
ERROR: item number must be assigned by a print command
use print command before using an item number in a command
[admin@MikroTik] interface> print
Flags: X - disabled, D - dynamic, R - running
 #    NAME                         TYPE             RX-RATE    TX-RATE    MTU
 0  R Public                       ether            0          0          1500
 1  R Local                        ether            0          0          1500
 2  R wlan1                        wlan             0          0          1500
[admin@MikroTik] interface> set 0
disabled  mtu  name  rx-rate  tx-rate
[admin@MikroTik] interface> set 0 mtu=1200
[admin@MikroTik] interface> set wlan1 mtu=1300
[admin@MikroTik] interface> print
Flags: X - disabled, D - dynamic, R - running
 #    NAME                         TYPE             RX-RATE    TX-RATE    MTU
 0  R Public                       ether            0          0          1200
 1  R Local                        ether            0          0          1500
 2  R wlan1                        wlan             0          0          1300
[admin@MikroTik] interface>
```

Quick Typing

Description

There are two features in the console that help entering commands much quicker and easier - the [Tab] key completions, and abbreviations of command names. Completions work similarly to the **bash** shell in UNIX. If you press the [Tab] key after a part of a word, console tries to find the command within the current context that begins with this word. If there is only one match, it is automatically appended, followed by a space:

`/inte[Tab]_` becomes `/interface _`

If there is more than one match, but they all have a common beginning, which is longer than that what you have typed, then the word is completed to this common part, and no space is appended:

`/interface set e[Tab]_` becomes `/interface set ether_`

If you've typed just the common part, pressing the tab key once has no effect. However, pressing it for the second time shows all possible completions in compact form:

```
[admin@MikroTik] > interface set e[Tab]_
[admin@MikroTik] > interface set ether[Tab]_
[admin@MikroTik] > interface set ether[Tab]_
ether1 ether5
[admin@MikroTik] > interface set ether_
```

The [Tab] key can be used almost in any context where the console might have a clue about possible values - command names, argument names, arguments that have only several possible values (like names of items in some lists or name of protocol in firewall and NAT rules).You cannot complete numbers, IP addresses and similar values.

Another way to press fewer keys while typing is to abbreviate command and argument names. You can type only beginning of command name, and, if it is not ambiguous, console will accept it as a full name. So typing:

```
[admin@MikroTik] > pi 10.1 c 3 s 100

equals to:

[admin@MikroTik] > ping 10.0.0.1 count 3 size 100
```

Notes

Pressing [Tab] key while entering IP address will do a DNS lookup, instead of completion. If what is typed before cursor is a valid IP address, it will be resolved to a DNS name (reverse resolve), otherwise it will be resolved directly (i.e. to an IP address). To use this feature, DNS server must be configured and working. To avoid input lockups any such lookup will timeout after half a second, so you might have to press [Tab] several times, before the name is actually resolved.

It is possible to complete not only beginning, but also any distinctive substring of a name: if there is no exact match, console starts looking for words that have string being completed as first letters of a multiple word name, or that simply contain letters of this string in the same order. If single such word is found, it is completed at cursor position. For example:

```
[admin@MikroTik] > interface x[TAB]_
[admin@MikroTik] > interface export _

[admin@MikroTik] > interface mt[TAB]_
[admin@MikroTik] > interface monitor-traffic _
```

Additional Information

Description

Built-in Help

The console has a built-in help, which can be accessed by typing **?**. General rule is that help shows what you can type in position where the **?** was pressed (similarly to pressing [Tab] key twice, but in verbose form and with explanations).

Internal Item Numbers

You can specify multiple items as targets to some commands. Almost everywhere, where you can write the number of item, you can also write a list of numbers:

```
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                 TYPE             MTU
  0  R ether1               ether            1500
  1  R ether2               ether            1500
  2  R ether3               ether            1500
  3  R ether4               ether            1500
[admin@MikroTik] > interface set 0,1,2 mtu=1460
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                 TYPE             MTU
  0  R ether1               ether            1460
  1  R ether2               ether            1460
  2  R ether3               ether            1460
  3  R ether4               ether            1500
[admin@MikroTik] >
```

General Commands

Description

There are some commands that are common to nearly all menu levels, namely: **print, set, remove, add, find, get, export, enable, disable, comment, move**. These commands have similar behavior throughout different menu levels.

Command Description

print - shows all information that's accessible from particular command level. Thus, /system clock print shows system date and time, /ip route print shows all routes etc. If there's a list of items in current level and they are not read-only, i.e. you can change/remove them (example of read-only item list is /system history, which shows history of executed actions), then print command also assigns numbers that are used by all commands that operate with items in this list. - applicable only to lists of items. The action is performed with all items in this list in the same order in which they are given. - forces the print command to use tabular output form - specifies what parameters to include in printout - forces the print command to use property=value output form - shows the number of items - prints the contents of the specific submenu into a file. This file will be available in the router's ftp - shows the output from the print command for every interval seconds - prints the oid value, which is useful for SNMP - prints the output without paging, to see printed output which does not fit in the screen, use [Shift]+[PgUp] key combination

set - allows you to change values of general parameters or item parameters. The set command has arguments with names corresponding to values you can change. Use ? or double [Tab] to see list of all arguments. If there is a list of items in this command level, then set has one action argument that accepts the number of item (or list of numbers) you wish to set up. This command does not return anything.

add - this command usually has all the same arguments as set, except the action number argument. It adds a new item with values you have specified, usually to the end of list (in places where order is relevant). There are some values that you have to supply (like the interface for a new route), other values are set to defaults unless you explicity specify them. - Copies an existing item. It takes default values of new item's properties from another item. If you do not want to make exact copy, you can specify new values for some properties. When copying items that have names, you will usually have to give a new name to a copy - add command returns internal number of item it has added - places a new item before an existing item with specified position. Thus, you do not need to use the move command after adding an item to the list - controls disabled/enabled state of the newly added item(-s) - holds the description of a newly created item

remove - removes item(-s) from a list - contains number(-s) or name(-s) of item(-s) to remove.

move - changes the order of items in list where one is relevant. Item numbers after move command are left in a consistent, but hardly intuitive order, so it's better to resync them by using print after each move command. - first argument. Specifies the item(-s) being moved. - second argument. Specifies the item before which to place all items being moved (they are placed at the end of the list if the second argument is omitted).

find - The find command has the same arguments as set, and an additional from argument which works like the from argument with the print command. Plus, find command has flag arguments like disabled, invalid that take values yes or no depending on the value of respective flag. To see all flags and their names, look at the top of print command's output. The find command returns internal numbers of all items that have the same values of arguments as specified.

edit - this command is in every place that has set command, it can be used to edit values of properties, exempli gratia:

```
[admin@ID]                    ip                     route>                    print
Flags:   X    -    disabled,    I    -    invalid,    D    -    dynamic,    J    -    rejected,
C    -    connect,    S    -    static,    r    -    rip,    o    -    ospf,    b    -    bgp
     #          DST-ADDRESS           G      GATEWAY          DISTANCE     INTERFACE
     0      S      0.0.0.0/0              r      1.1.1.1             1            ether1
     1     DC      10.10.11.0/24          r      0.0.0.0             0            ether1
     2     DC      10.1.0.0/24            r      0.0.0.0             0            ether2
     3     DC      1.1.1.0/24             r      0.0.0.0             0            ether1
[admin@ID] ip route> edit 0 gateway
```

Safe Mode

Description

It is possible to change router configuration in a way that will make it not accessible except from local console. Usually this is done by accident, but there is no way to undo last change when connection to router is already cut. Safe mode can be used to minimize such risk.

Safe mode is entered by pressing **[Ctrl]+[X]**. To quit safe mode, press **[Ctrl]+[X]** again.

```
[admin@MikroTik] ip firewall rule input> [Ctrl]+[X]
[Safe Mode taken]
[admin@MikroTik] ip firewall rule input<SAFE>
```

Message **Safe Mode taken** is displayed and prompt changes to reflect that session is now in safe mode. All configuration changes that are made (also from other login sessions), while router is in safe mode, are automatically undone if safe mode session terminates abnormally. You can see all such changes that will be automatically undone tagged with an **F** flag in system history:

```
[admin@MikroTik] ip firewall rule input<SAFE> add
[admin@MikroTik] ip firewall rule input<SAFE> /system history print
Flags: U - undoable, R - redoable, F - floating-undo
   ACTION                BY            POLICY
 F rule added            admin         write
[admin@MikroTik] ip firewall rule input<SAFE>
```

Now, if telnet connection is cut, then after a while (TCP timeout is **9** minutes) all changes that were made while in safe mode will be undone. Exiting session by **[Ctrl]+[D]**emphasis> also undoes all safe mode changes, while **/quit** does not.

If another user tries to enter safe mode, he's given following message:

```
[admin@MikroTik] >
Hijacking Safe Mode from someone - unroll/release/don't take it [u/r/d]:
```

- **[u]** - undoes all safe mode changes, and puts the current session in safe mode.
- **[d]** - leaves everything as-is.
- **[r]** - keeps all current safe mode changes, and puts current session in a safe mode. Previous owner of safe mode is notified about this:

```
[admin@MikroTik] ip firewall rule input
[Safe mode released by another user]
```

If too many changes are made while in safe mode, and there's no room in history to hold them all (currently history keeps up to **100** most recent actions), then session is automatically put out of the safe mode, no changes are automatically undone. Thus, it is best to change configuration in small steps, while in safe mode. Pressing **[Ctrl]+[X]** twice is an easy way to empty safe mode action list.

Package Management

Document revision 1.2 (Thu Dec 02 12:56:28 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS is distributed in the form of software packages. The basic functionality of the router and the operating system itself is provided by the **system** software package. Other packages contain additional software features as well as support to various network interface cards.

Specifications

License required: ***level1***
Home menu level: ***/system package***
Standards and Technologies: ***FTP***
Hardware usage: ***Not significant***

Related Documents

- ***Basic Setup Guide***
- ***Driver Management***
- ***License Management***

Description

Features

The modular software package system of MikroTik RouterOS has the following features:

- Ability to extend RouterOS functions by installing additional software packages
- Optimal usage of the storage space by employing modular/compressed system
- Unused software packages can be uninstalled
- The RouterOS functions and the system itself can be easily upgraded
- Multiple packages can be installed at once
- The package dependency is checked before installing a software package. The package will not be installed, if the required software package is missing
- The version of the feature package should be the same as that of the **system** package
- The packages can be uploaded on the router using ftp and installed only when the router is going for shutdown during the reboot process
- If the software package file can be uploaded to the router, then the disk space is sufficient for the installation of the package

Installation (Upgrade)

Description

Installation or upgrade of the MikroTik RouterOS software packages can be done by uploading the newer version of the software package to the router and rebooting it.

The software package files are compressed binary files, which can be downloaded from the MikroTik's web page download section. The full name of the software package consists of a descriptive name, version number and extension **.npk**, *exempli gratia* **system-2.8rc3.npk**, **routerboard-2.8rc3.npk**.

You should check the available hard disk space prior to downloading the package file by issuing **/system resource print** command. If there is not enough free disk space for storing the upgrade packages, it can be freed up by uninstalling some software packages, which provide functionality not required for your needs. If you have a sufficient amount of free space for storing the upgrade packages, connect to the router using ftp. Use user name and password of a user with full access privileges.

Step-by-Step

- Connect to the router using ftp client
- Select the BINARY mode file transfer
- Upload the software package files to the router and disconnect

- Check the information about the uploaded software packages using the **/file print** command
- Reboot the router by issuing the **/system reboot** command or by pressing **Ctrl+Alt+Del** keys at the router's console
- After reboot, verify that the packages were installed correctly by issuing **/system package print** command

Notes

The packages uploaded to the router should retain the original name and also be in lowercase.

The installation/upgrade process is shown on the console screen (monitor) attached to the router.

The Free Demo License do not allow software upgrades using ftp. You should do a complete reinstall from floppies, or purchase the license.

Before upgrading the router, please check the current version of the system package and the additional software packages. The versions of additional packages should match the version number of the system software package. The version of the MikroTik RouterOS system software (and the build number) are shown before the console login prompt. Information about the version numbers and build time of the installed MikroTik RouterOS software packages can be obtained using the **/system package print** command.

Uninstalling

Description

Usually, you do not need to uninstall software packages. However, if you have installed a wrong package, or you need additional free space to install a new one, you have to uninstall some unused packages.

In order to uninstall software package, you have to set **uninstall** property for that package to **yes** and reboot the router.

Property Description

uninstall (yes | no; default: **no**) - If set to yes, schedules the package for uninstallation on next reboot.

Notes

If a package is marked for uninstallation, but it is required for another (dependent) package, then the marked package cannot be uninstalled. You should uninstall the dependent package too. For the list of package dependencies see the 'Software Package List; section below. The system package will not be uninstalled even if marked for uninstallation.

Example

Suppose we need to uninstall **security** package from the router:

```
[admin@MikroTik] system package> print
Flags: I - invalid
  #   NAME                  VERSION               BUILD-TIME           UNINSTALL
  0   system                2.8beta8              oct/21/2003 13:27:59 no
  1   ppp                   2.8beta8              oct/21/2003 12:31:52 no
  2   advanced-tools        2.8beta8              oct/21/2003 12:31:42 no
  3   dhcp                  2.8beta8              oct/21/2003 12:31:49 no
  4   routing               2.8beta8              oct/21/2003 12:31:55 no
  5   security              2.8beta8              oct/21/2003 12:31:47 no
  6   synchronous           2.8beta8              oct/21/2003 12:32:05 no
  7   wireless              2.8beta8              oct/21/2003 12:32:09 no

[admin@MikroTik] system package> set 5 uninstall=yes
[admin@MikroTik] > .. reboot
```

Downgrading

Command name: ***/system package downgrade***

Description

MikroTik RouterOS™ v2.8 features downgrade option. It allows you to downgrade the software via ftp without losing your license key or reinstalling the router.

You have to choose to what version of RouterOS your present version should be downgraded and upload relevant packages to your router via ftp. Then you need to issue **/system package downgrade** command.

Command Description

downgrade - this command asks your confirmation and reboots the router. After reboot the software is downgraded (if all needed packages were uploaded to the router)

Example

To downgrade the RouterOS™ (we assume that all packages needed are already uploaded):

```
[admin@MikroTik] system package> downgrade
Router will be rebooted. Continue? [y/N]: y
system will reboot shortly
[admin@MikroTik] system package>
```

Software Package List

Description

System Software Package

The **system** software package provides the basic functionality of the MikroTik RouterOS, namely:

- IP address management, ARP, static IP routing, policy routing, firewall (packet filtering, content filtering, masquerading, and static NAT), traffic shaping (queues), IP traffic accounting, MikroTik Neighbour Discovery, IP Packet Packing, DNS client settings, IP service (servers)

- Ethernet interface support
- IP over IP tunnel interface support
- Ethernet over IP tunnel interface support
- driver management for Ethernet ISA cards
- serial port management
- local user management
- export and import of router configuration scripts
- backup and restore of the router's configuration
- undo and redo of configuration changes
- network diagnostics tools (ping, traceroute, bandwidth tester, traffic monitor)
- bridge support
- system resource management
- package management
- telnet client and server
- local and remote logging facility
- winbox server as well as winbox executable with some plugins

After installing the MikroTik RouterOS, a free license should be obtained from MikroTik to enable the basic system functionality.

Additional Software Feature Packages

The table below shows additional software feature packages, extended functionality provided by them, the required prerequisites and additional licenses, if any.

Name	Contents	Prerequisites	Minimal license level
advanced-tools	**email client, pingers, netwatch and other utilities**	**none**	**1**
arlan	**support for DSSS 2.4GHz 2mbps Aironet ISA cards**	**none**	**4**
dhcp	**DHCP server and client support**	**none**	**1**
gps	**support for GPS devices**	**none**	**1**
hotspot	**HotSpot gateway**	**none**	**1**
isdn	**support for ISDN devices**	**ppp**	**1**
lcd	**support for**	**none**	**1**

	informational LCD display		
ntp	network time protocol support	none	1
ppp	support for PPP, PPTP, L2TP, PPPoE and ISDN PPP	none	1
radiolan	Provides support for 5.8GHz RadioLAN cards	none	4
routerboard	support for RouterBoard-specific functions and utilities	none	1
routing	support for RIP, OSPF and BGP4	none	3
security	support for IPSEC, SSH and secure WinBox connections	none	1
synchronous	support for Frame Relay and Moxa C101, Moxa C502, Farsync, Cyclades PC300, LMC SBE and XPeed synchronous cards	none	4
telephony	IP telephony support (H.323)	none	1
ups	APC Smart Mode UPS support	none	1
web-proxy	HTTP Web proxy support	none	3
wireless	Provides support for Cisco Aironet cards, PrismII and Atheros wireless stations and APs	none	4 (Wireless Station) / 5 (Wireless Access Point)

Specifications Sheet

Document revision 2.5 (Wed Apr 21 10:49:51 GMT 2004)
This document applies to V

Table of Contents

General Information

Description

Major features

- **Firewall and NAT** - stateful packet filtering; Peer-to-Peer protocol filtering; source and destination NAT; classification by source MAC, IP addresses, ports, protocols, protocol options, interfaces, internal marks, content, matching frequency
- **Routing** - Static routing; Equal cost multi-path routing; Policy based routing (classification by source and destination addresses and/or by firewall mark); RIP v1 / v2, OSPF v2, BGP v4
- **Data Rate Management** - per IP / protocol / subnet / port / firewall mark; HTB, PCQ, RED, SFQ, byte limited queue, packet limited queue; hierarchical limitation, CIR, MIR, contention ratios, dynamic client rate equalizing (PCQ)
- **HotSpot** - HotSpot Gateway with RADIUS authentication/accounting; data rate limitation; traffic quota; real-time status information; walled-garden; customized HTML login pages; iPass support; SSL secure authentication
- **Point-to-Point tunneling protocols** - PPTP, PPPoE and L2TP Access Concentrators and clients; PAP, CHAP, MSCHAPv1 and MSCHAPv2 authentication protocols; RADIUS authentication and accounting; MPPE encryption; compression for PPPoE; data rate limitation; PPPoE dial on demand
- **Simple tunnels** - IPIP tunnels, EoIP (Ethernet over IP)
- **IPsec** - IP security AH and ESP protocols; Diffie-Hellman groups 1,2,5; MD5 and SHA1 hashing algorithms; DES, 3DES, AES-128, AES-192, AES-256 encryption algorithms; Perfect Forwarding Secresy (PFS) groups 1,2,5
- **Web proxy** - FTP, HTTP and HTTPS caching proxy server; transparent HTTP caching proxy; SOCKS protocol support; support for caching on a separate drive; access control lists; caching lists; parent proxy support
- **Caching DNS client** - name resolving for local use; Dynamic DNS Client; local DNS cache with static entries
- **DHCP** - DHCP server per interface; DHCP relay; DHCP client; multiple DHCP networks; static and dynamic DHCP leases
- **Universal Client** - Transparent address translation not depending on the client's setup
- **VRRP** - VRRP protocol for high availability

- **UPnP** - Universal Plug-and-Play support
- **NTP** - Network Time Protocol server and client; synchronization with GPS system
- **Monitoring/Accounting** - IP traffic accounting, firewall actions logging
- **SNMP** - read-only access
- **M3P** - MikroTik Packet Packer Protocol for Wireless links and Ethernet
- **MNDP** - MikroTik Neighbor Discovery Protocol; also supports Cisco Discovery Protocol (CDP)
- **Tools** - ping; traceroute; bandwidth test; ping flood; telnet; SSH; packet sniffer

TCP/IP protocol suite:

- **Wireless** - IEEE802.11a/b/g wireless client and Access Point; Wireless Distribution System (WDS) support; virtual AP; 40 and 104 bit WEP; access control list; authentication on RADIUS server; roaming (for wireless client); Access Point bridging
- **Bridge** - spanning tree protocol; multiple bridge interfaces; bridge firewalling
- **VLAN** - IEEE802.1q Virtual LAN support on Ethernet and WLAN links; multiple VLANs; VLAN bridging
- **Synchronous** - V.35, V.24, E1/T1, X.21, DS3 (T3) media types; sync-PPP, Cisco HDLC, Frame Relay line protocols; ANSI-617d (ANDI or annex D) and Q933a (CCITT or annex A) Frame Relay LMI types
- **Asynchronous** - serial PPP dial-in / dial-out; PAP, CHAP, MSCHAPv1 and MSCHAPv2 authentication protocols; RADIUS authentication and accounting; onboard serial ports; modem pool with up to 128 ports; dial on demand
- **ISDN** - ISDN dial-in / dial-out; PAP, CHAP, MSCHAPv1 and MSCHAPv2 authentication protocols; RADIUS authentication and accounting; 128K bundle support; Cisco HDLC, x75i, x75ui, x75bui line protocols; dial on demand
- **SDSL** - Single-line DSL support; line termination and network termination modes

Layer 2 connectivity

Hardware requirements

- **CPU and motherboard** - advanced 4th generation (core frequency 100MHz or more), 5th generation (Intel Pentium, Cyrix 6X86, AMD K5 or comparable) or newer uniprocessor Intel IA-32 (i386) compatible (multiple processors are not supported)
- **RAM** - minimum 48 MB, maximum 1 GB; 64 MB or more recommended
- **Hard Drive/Flash** - standard ATA interface controller and drive (SCSI and USB controllers and drives are not supported; RAID controllers that require additional drivers are not supported) with minimum of 64 MB space

Hardware needed for installation time only

- **Floppy-based installation** - standard AT floppy controller and 3.5" disk drive connected as the first floppy disk drive (A); AT, PS/2 or USB keyboard; VGA-compatible video controller card and monitor
- **CD-based installation** - standard ATA/ATAPI interface controller and CD drive supporting

"El Torito" bootable CDs (you might need also to check if the router's BIOS supports booting from this type of media); AT, PS/2 or USB keyboard; VGA-compatible video controller card and monitor

- **Floppy-based network installation** - standard AT floppy controller and 3.5" disk drive connected as the first floppy disk drive (A); PCI Ethernet network interface card supported by MikroTik RouterOS (see the Device Driver List for the list)
- **Full network-based installation** - PCI Ethernet network interface card supported by MikroTik RouterOS (see the Device Driver List for the list) with PXE or EtherBoot extension booting ROM (you might need also to check if the router's BIOS supports booting from network)

Depending on installation method chosen the router must have the following hardware:

Configuration possibilities

RouterOS provides powerful command-line configuration interface. You can also manage the router through WinBox - the easy-to-use remote configuration GUI for Windows -, which provides all the benefits of the command-line interface, without the actual "command-line", which may scare novice users. Major features:

- Clean and consistent user interface
- Runtime configuration and monitoring
- Multiple connections
- User policies
- Action history, undo/redo actions
- safe mode operation
- Scripts can be scheduled for executing at certain times, periodically, or on events. All command-line commands are supported in scripts

- **Local terminal console** - AT, PS/2 or USB keyboard and VGA-compatible video controller card with monitor
- **Serial console** - First RS232 asynchronous serial port (usually, onboard port marked as COM1), which is by default set to 9600bit/s, 8 data bits, 1 stop bit, no parity

When router is not configured, there are only two ways to configure it:

- **Local teminal console** - AT, PS/2 or USB keyboard and VGA-compatible video controller card with monitor
- **Serial console** - any (you may choose any one; the first, also known as COM1, is used by default) RS232 asynchronous serial port, which is by default set to 9600bit/s, 8 data bits, 1 stop bit, no parity
- **Telnet** - telnet server is running on 23 TCP port by default
- **SSH** - SSH (secure shell) server is running on 22 TCP port by default (available only if security package is installed)
- **MAC Telnet** - MikroTik MAC Telnet potocol server is by default enabled on all Ethernet-like interfaces
- **Winbox** - Winbox is a RouterOS remote administration GUI for Windows, that use 3986 TCP port (or 3987 if security package is installed)

After the router is configured, it may be managed through the following interfaces:

Device Driver List

Document revision 2.8 (Wed Oct 13 11:39:39 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

The document lists the drivers, included in MikroTik RouterOS and the devices that are tested to work with MikroTik RouterOS. If a device is not listed here, it does not mean the device is not supported, it still may work. It just means that the device was not tested.

Ethernet

Packages required: ***system***

Description

3Com 509 Series

Chipset type: 3Com 509 Series ISA 10Base

Compatibility:

- 3Com EtherLink III

3Com FastEtherLink

Chipset type: 3Com 3c590/3c900 (3Com FastEtherLink and FastEtherLink XL) PCI 10/100Base

Compatibility:

- 3c590 Vortex 10BaseT
- 3c592 chip
- 3c595 Vortex 100BaseTX
- 3c595 Vortex 100BaseT4
- 3c595 Vortex 100Base-MII
- 3c597 chip
- 3Com Vortex
- 3c900 Boomerang 10BaseT
- 3c900 Boomerang 10Mbit/s Combo
- 3c900 Cyclone 10Mbit/s Combo
- 3c900B-FL Cyclone 10Base-FL
- 3c905 Boomerang 100BaseTX
- 3c905 Boomerang 100BaseT4
- 3c905B Cyclone 100BaseTX

- 3c905B Cyclone 10/100/BNC
- 3c905B-FX Cyclone 100BaseFX
- 3c905C Tornado
- 3c980 Cyclone
- 3cSOHO100-TX Hurricane
- 3CSOHO100B-TX
- 3c555 Laptop Hurricane
- 3c575 Boomerang CardBus
- 3CCFE575 Cyclone CardBus
- 3CCFE656 Cyclone CardBus
- 3c575 series CardBus
- 3Com Boomerang

ADMtek Pegasus

Chipset type: ADMtek Pegasus/Pegasus II USB 10/100BaseT

Compatibility:

- Planet 10/100Base-TX USB Ethernet Adapter UE-9500
- Linksys Instant EtherFast 10/100 USB Network Adapter USB100TX

AMD PCnet

Chipset type: AMD PCnet/PCnet II ISA/PCI 10BaseT

Compatibility:

- AMD PCnet-ISA
- AMD PCnet-ISA II
- AMD PCnet-PCI II
- AMD 79C960 based cards

AMD PCnet32

Chipset type: AMD PCnet32 PCI 10BaseT and 10/100BaseT

Compatibility:

- AMD PCnet-PCI
- AMD PCnet-32
- AMD PCnet-Fast

Broadcom Tigon3

Chipset type: Broadcom Tigon3 PCI 10/100/1000BaseT

Compatibility:

- Broadcom Tigon3 570x
- Broadcom Tigon3 5782
- Broadcom Tigon3 5788
- Broadcom Tigon3 5901
- Broadcom Tigon3 5901-2
- SysKonnect SK-9Dxx Gigabit Ethernet
- SysKonnect SK-9Mxx Gigabit Ethernet
- Altima AC100x
- Altima AC9100

Davicom DM9102

Chipset type: Davicom DM9102 PCI 10/100Base

Compatibility:

- Davicom DM9102
- Davicom DM9102A
- Davicom DM9102A+DM9801
- Davicom DM9102A+DM9802

DEC 21x4x 'Tulip'

Chipset type: DEC 21x4x "Tulip" PCI 10/100Base

Compatibility:

- Digital DC21040 Tulip
- Digital DC21041 Tulip
- Digital DS21140 Tulip
- 21140A chip
- 21142 chip
- Digital DS21143 Tulip
- D-Link DFE 570TX 4-port
- Lite-On 82c168 PNIC
- Macronix 98713 PMAC

- Macronix 98715 PMAC
- Macronix 98725 PMAC
- ASIX AX88140
- Lite-On LC82C115 PNIC-II
- ADMtek AN981 Comet
- Compex RL100-TX
- Intel 21145 Tulip
- IMC QuikNic FX
- Conexant LANfinity

Intel EtherExpressPro

Chipset type: Intel i82557 "Speedo3" (Intel EtherExpressPro) PCI 10/100Base

Compatibility:

- Intel i82557/i82558/i82559ER/i82801BA-7 EtherExpressPro PCI cards

Intel PRO/1000

Chipset type: Intel i8254x (Intel PRO/1000) PCI 10/100/1000Base

Compatibility:

- Intel PRO/1000 Gigabit Server Adapter (i82542, Board IDs: 700262-xxx, 717037-xxx)
- Intel PRO/1000 F Server Adapter (i82543, Board IDs: 738640-xxx, A38888-xxx)
- Intel PRO/1000 T Server Adapter (i82543, Board IDs: A19845-xxx, A33948-xxx)
- Intel PRO/1000 XT Server Adapter (i82544, Board IDs: A51580-xxx)
- Intel PRO/1000 XF Server Adapter (i82544, Board IDs: A50484-xxx)
- Intel PRO/1000 T Desktop Adapter (i82544, Board IDs: A62947-xxx)
- Intel PRO/1000 MT Desktop Adapter (i82540, Board IDs: A78408-xxx, C91016-xxx)
- Intel PRO/1000 MT Server Adapter (i82545, Board IDs: A92165-xxx, C31527-xxx)
- Intel PRO/1000 MT Dual Port Server Adapter (i82546, Board IDs: A92111-xxx, C29887-xxx)
- Intel PRO/1000 MT Quad Port Server Adapter (i82546, Board IDs: C32199-xxx)
- Intel PRO/1000 MF Server Adapter (i82545, Board IDs: A91622-xxx, C33915-xxx)
- Intel PRO/1000 MF Server Adapter (LX) (i82545, Board IDs: A91624-xxx, C33916-xxx)
- Intel PRO/1000 MF Dual Port Server Adapter (i82546, Board IDs: A91620-xxx, C30848-xxx)

Marvell Yukon

Chipset type: Marvell Yukon 88E80xx PCI 10/100/1000Base

Compatibility:

- 3Com 3C940 Gigabit LOM Ethernet Adapter
- 3Com 3C941 Gigabit LOM Ethernet Adapter
- Allied Telesyn AT-2970LX Gigabit Ethernet Adapter
- Allied Telesyn AT-2970LX/2SC Gigabit Ethernet Adapter
- Allied Telesyn AT-2970SX Gigabit Ethernet Adapter
- Allied Telesyn AT-2970SX/2SC Gigabit Ethernet Adapter
- Allied Telesyn AT-2970TX Gigabit Ethernet Adapter
- Allied Telesyn AT-2970TX/2TX Gigabit Ethernet Adapter
- Allied Telesyn AT-2971SX Gigabit Ethernet Adapter
- Allied Telesyn AT-2971T Gigabit Ethernet Adapter
- DGE-530T Gigabit Ethernet Adapter
- EG1032 v2 Instant Gigabit Network Adapter
- EG1064 v2 Instant Gigabit Network Adapter
- Marvell 88E8001 Gigabit LOM Ethernet Adapter
- Marvell RDK-80xx Adapter
- Marvell Yukon Gigabit Ethernet 10/100/1000Base-T Adapter
- N-Way PCI-Bus Giga-Card 1000/100/10Mbps(L)
- SK-9521 10/100/1000Base-T Adapter
- SK-98xx Gigabit Ethernet Server Adapter
- SMC EZ Card 1000
- Marvell Yukon 88E8010 based
- Marvell Yukon 88E8003 based
- Marvell Yukon 88E8001 based

National Semiconductor DP83810

Chipset type: National Semiconductor DP83810 PCI 10/100BaseT

Compatibility:

- RouterBoard 200 built-in Ethernet
- RouterBoard 24 4-port Ethernet
- NS DP8381x-based cards

National Semiconductor DP83820

Chipset type: National Semiconductor DP83820 PCI 10/100/1000BaseT

Compatibility:

- Planet ENW-9601T
- NS DP8382x-based cards

NE2000 ISA

Chipset type: NE2000 ISA 10Base

Compatibility:

- various ISA cards

NE2000 PCI

Chipset type: NE2000 PCI 10Base

Compatibility:

- RealTek RTL-8029
- Winbond 89C940 and 89C940F
- Compex RL2000
- KTI ET32P2
- NetVin NV5000SC
- Via 86C926
- SureCom NE34
- Holtek HT80232
- Holtek HT80229
- IMC EtherNic/PCI FO

NS8390

Chipset type: NS8390 PCMCIA/CardBus 10Base

Compatibility:

- D-Link DE-660 Ethernet
- NE-2000 Compatible PCMCIA Ethernet
- NS8390-based PCMCIA cards

RealTek RTL8129

Chipset type: RealTek RTL8129 PCI 10/100Base

Compatibility:

- RealTek RTL8129 Fast Ethernet
- RealTek RTL8139 Fast Ethernet
- RTL8139A/B/C chip
- RTL8130 chip
- SMC1211TX EZCard 10/100 (RealTek RTL8139)
- Accton MPX5030 (RealTek RTL8139)
- D-Link DFE 538TX

RealTek RTL8169

Chipset type: RealTek RTL8169 PCI 10/100/1000Base

Compatibility:

- RealTek RTL8169 Gigabit Ethernet

Not recommended: may lock up the router

Sundance ST201 'Alta'

Chipset type: Sundance ST201 "Alta" PCI 10/100Base

Compatibility:

- D-Link DFE-550TX Fast Ethernet Adapter
- D-Link DFE-550FX 100Mbps Fiber-optics Adapter
- D-Link DFE-580TX 4-port Server Adapter (not recommended: may lock up the system)
- D-Link DFE-530TXS Fast Ethernet Adapter
- D-Link DL10050-based FAST Ethernet Adapter
- Sundance ST201 "Alta" chip
- Kendin KS8723 chip

TI ThunderLAN

Chipset type: TI ThunderLAN PCI 10/100Base

Compatibility:

- Compaq Netelligent 10 T
- Compaq Netelligent 10 T/2
- Compaq Netelligent 10/100 TX
- Compaq NetFlex-3/P
- Olicom OC-2183
- Olicom OC-2185

- Olicom OC-2325
- Olicom OC-2326

VIA vt612x 'Velocity'

Chipset type: VIA vt612x "Velocity" PCI 10/100/1000Base

Compatibility:

- VIA VT6120
- VIA VT6121
- VIA VT6122

VIA vt86c100 'Rhine'

Chipset type: VIA vt86c100 "Rhine" PCI 10/100Base

Compatibility:

- VIA Rhine (vt3043)
- VIA Rhine II (vt3065 AKA vt86c100)
- VIA VT86C100A Rhine
- VIA VT6102 Rhine-II
- VIA VT6105 Rhine-III
- VIA VT6105M Rhine-III
- RouterBOARD 44 4-port Fast Ethernet card
- D-Link DFE 530TX

Winbond w89c840

Chipset type: Winbond w89c840 PCI 10/100Base

Compatibility:

- Winbond W89c840
- Compex RL100-ATX

Notes

For ISA cards load the driver by specifying the I/O base address. IRQ is not required.

Wireless

Packages required: ***wireless***

Description

Atheros

Chipset type: Atheros AR5001X PC/PCI 11/54Mbit/s IEEE802.11a/b/g

Compatibility:

- Intel 5000 series
- Dlink DWL-A520
- Dlink DWL-G650
- Atheros AR5000 chipset series based IEEE802.11a (AR5210 MAC plus AR5110 PHY chips) cards
- Atheros AR5001A chipset series based IEEE802.11a (AR5211 MAC plus AR5111 PHY chips) cards
- Atheros AR5001X chipset series based IEEE802.11a (AR5211 MAC plus AR5111 PHY chips), IEEE802.11b/g (AR5211 MAC plus AR2111 PHY chips), IEEE802.11a/b/g (AR5211 MAC plus AR5111 and 2111 PHY chips) cards
- Atheros AR5001X+ chipset series based IEEE802.11a (AR5212 MAC plus AR5111 PHY chips), IEEE802.11b/g (AR5212 MAC plus AR2111 PHY chips), IEEE802.11a/b/g (AR5212 MAC plus AR5111 and 2111 PHY chips) cards
- Atheros AR5002X+ chipset series based IEEE802.11b/g (AR5212 MAC plus AR2112 PHY chips), IEEE802.11a/b/g (AR5212 MAC plus AR5112 PHY chips) cards
- Atheros AR5004X+ chipset series based IEEE802.11b/g (AR5213 MAC plus AR2112 PHY chips), IEEE802.11a/b/g (AR5213 MAC plus AR5112 PHY chips) cards

Cisco/Aironet

Chipset type: Cisco/Aironet ISA/PCI/PC 11Mbit/s IEEE802.11b

Compatibility:

- Aironet ISA/PCI/PC4800 2.4GHz DS 11Mbit/s Wireless LAN Adapters (100mW)
- Aironet ISA/PCI/PC4500 2.4GHz DS 2Mbit/s Wireless LAN Adapters (100mW)
- CISCO AIR-PCI340 2.4GHz DS 11Mbit/s Wireless LAN Adapters (30mW)
- CISCO AIR-PCI/PC350/352 2.4GHz DS 11Mbit/s Wireless LAN Adapters (100mW)

Intersil Prism II

Chipset type: Intersil Prism II PC/PCI 11Mbit/s IEEE802.11b

Compatibility:

- Intersil PRISM2 Reference Design 11Mbit/s IEEE802.11b WLAN Card

- GemTek WL-211 Wireless LAN PC Card
- Compaq WL100/200 11Mbit/s 802.11b WLAN Card
- Compaq iPaq HNW-100 11Mbit/s 802.11b WLAN Card
- Samsung SWL2000-N 11Mbit/s 802.11b WLAN Card
- Z-Com XI300 11Mbit/s 802.11b WLAN Card
- ZoomAir 4100 11Mbit/s 802.11b WLAN Card
- Linksys WPC11 11Mbit/s 802.11b WLAN Card
- Addtron AWP-100 11Mbit/s 802.11b WLAN Card
- D-Link DWL-650 11Mbit/s 802.11b WLAN Card
- SMC 2632W 11Mbit/s 802.11b WLAN Card
- BroMax Freeport 11Mbit/s 802.11b WLAN Card
- Intersil PRISM2 Reference Design 11Mbit/s WLAN Card
- Bromax OEM 11Mbit/s 802.11b WLAN Card (Prism 2.5)
- corega K.K. Wireless LAN PCC-11
- corega K.K. Wireless LAN PCCA-11
- CONTEC FLEXSCAN/FX-DDS110-PCC
- PLANEX GeoWave/GW-NS110
- Ambicom WL1100 11Mbit/s 802.11b WLAN Card
- LeArtery SYNCBYAIR 11Mbit/s 802.11b WLAN Card
- Intermec MobileLAN 11Mbit/s 802.11b WLAN Card
- NETGEAR MA401 11Mbit/s 802.11 WLAN Card
- Intersil PRISM Freedom 11Mbit/s 802.11 WLAN Card
- OTC Wireless AirEZY 2411-PCC 11Mbit/s 802.11 WLAN Card
- Z-Com XI-325HP PCMCIA 200mW Card
- Z-Com XI-626 Wireless PCI Card

Note If planned to use WEP with Prism cards see link for more information: ***Wireless Security***

WaveLAN/ORiNOCO

Chipset type: Lucent/Agere/Proxim WaveLAN/ORiNOCO ISA/PC 11Mbit/s IEEE802.11b

Compatibility:

- WaveLAN Bronze/Gold/Silver ISA/PCMCIA

Aironet Arlan

Packages required: ***arlan***

Description

This is driver for legacy Aironet Arlan cards, not for newer Cisco/Aironet cards.

Chipset type: Aironet Arlan IC2200 ISA 2Mbit/s IEEE802.11b

Compatibility:

- Aironet Arlan 655

RadioLAN

Packages required: ***radiolan***

Description

This is driver for legacy RadioLAN cards.

Chipset type: RadioLAN ISA/PC 10Mbit/s 5.8GHz

Compatibility:

- RadioLAN ISA card (Model 101)
- RadioLAN PCMCIA card

Synchronous Serial

Packages required: ***synchronous***

Description

- Moxa C101 ISA and PCI V.35 (4 Mbit/s)
- Moxa C502 PCI 2-port V.35 (8 Mbit/s)
- Cyclades PCI PC-300 V.35 (5 Mbit/s)
- Cyclades PCI PC-300 E1/T1
- FarSync PCI V.35/X.21 (8.448 Mbit/s)
- LMC/SBEI wanPCI-1T1E1 PCI T1/E1 (also known as DS1 or LMC1200P, 1.544 Mbit/s or 2.048 Mbit/s)
- LMC/SBEI wanPCI-1T3 PCI T3 (also known as DS3, 44.736Mbit/s)
- Sangoma S5141 (dual-port) and S5142 (quad-port) PCI RS232/V.35/X.21 (4Mbit/s - primary port and 512Kbit/s - secondary ones)
- Sangoma S5148 (single-port) and S5147 (dual-port) PCI E1/T1

Asynchronous Serial

Packages required: ***system***

Description

- Standard Communication Ports Com1 and Com2
- Moxa Smartio C104H/PCI, CP-114, CT-114, CP-132, C168H, CP-168H, and CP-168U PCI 2/4/8 port up to 4 cards (up to 32 ports)
- Cyclades Cyclom-Y and Cyclades-Z Series PCI cards up to 64 ports per card, up to 4 cards (up to 256 ports)
- TCL DataBooster 4 or 8 PCI 4/8 port cards
- Sangoma S514/56 PCI 56 or 64Kbit/s DDS DSU with secondary 128Kbit/s RS232 port (**Note**: this card is not for modem pools or serial terminals)

ISDN

Packages required: ***isdn***

Description

PCI ISDN cards:

- Eicon.Diehl Diva PCI
- Sedlbauer Speed Card PCI
- ELSA Quickstep 1000PCI
- Traverse Technologie NETjet PCI S0 card
- Teles PCI
- Dr. Neuhaus Niccy PCI
- AVM Fritz PCI
- Gazel PCI ISDN cards
- HFC-2BS0 based PCI cards (TeleInt SA1)
- Winbond W6692 based PCI cards

VoIP

Packages required: ***telephony***

Description

H.323 Protocol VoIP Analog Gateways

- QuickNet LineJack ISA
- QuickNet PhoneJack ISA
- Voicetronix V4PCI - 4 analog telephone lines cards
- Zaptel X.100P IP telephony card (1 analog line)

xDSL

Packages required: ***synchronous***

Description

Xpeed 300 SDSL cards (up to 6.7km twisted pair wire connection, max 2.3Mbit/s)

HomePNA

Packages required: ***system***

Description

Linksys HomeLink PhoneLine Network Card (up to 10Mbit/s home network over telephone line)

LCD

Packages required: ***lcd***

Description

- Crystalfontz Intelligent Serial LCD Module 632 (16x2 characters)
- Powertip Character LCD Module PC2404 (24x4 characters)

PCMCIA Adapters

Packages required: ***system***

Description

- Vadem VG-469 PCMCIA-ISA adapter (one or two PCMCIA ports)
- RICOH PCMCIA-PCI Bridge with R5C475 II or RC476 II chip (one or two PCMCIA ports)
- CISCO/Aironet PCMCIA adapter (ISA and PCI versions) for CISCO/Aironet PCMCIA cards only

GPRS Cards

Packages required: ***wireless***

Description

- MikroTik-supplied GPRS card
  For more information, see ***interface list***.

Driver Management

Document revision 2.1.0 (Fri Mar 05 08:05:49 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Device drivers represent the software interface part of installed network devices. Some drivers are included in the system software package and some in additional feature packages.

For complete list of supported devices and respective device driver names please consult the 'Related Documents' section.

The device drivers for PCI, miniPCI, PC (PCMCIA) and CardBus cards are loaded automatically. Other network interface cards (most ISA and PCI ISDN cards) require the device drivers to be loaded manually using the **/driver add command.**

Users cannot add their own device drivers, only drivers included in the Mikrotik RouterOS software packages can be used. If you need a support for a device, which hasn't a driver yet, you are welcome to suggest it at suggestion page on our web site.

Home menu level: ***/driver***
Standards and Technologies: ***PCI, ISA, PCMCIA, miniPCI, CardBus***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***License Management***
- ***Device Driver List***

Loading Device Drivers

Home menu level: ***/driver***

Description

In order to use network interface card which has a driver that is not loaded automatically, *exempli gratia* NE2000 compatible ISA card, you need to add driver manually. This is accomplished by issuing **add** command under the **driver** submenu level.

To see system resources occupied by the installed devices, use the **/system resource io print** and **/system resource irq print** commands.

Property Description

io (*integer*) - input-output port base address

irq (*integer*) - interrupt request number

isdn-protocol (*euro* | *german*; default: **euro**) - line protocol setting for ISDN cards

memory (*integer*; default: **0**) - shared memory base address

name (*name*) - driver name

Notes

Not all combinatios of **irq** and **io** base addresses might work on your particular system. It is recommended, that you first find an acceptable irq setting and then try different i/o base addresses.

If you need to specify hexadecimal values instead of decimal for the argument values, put **0x** before the number.

To see the list of available drivers, issue the **/driver add name ?** command.

The resource list shows only those interfaces, which are enabled.

Typical io values for ISA cards are **0x280**, **0x300** and **0x320**

Example

To view the list of available drivers, do the following:

```
[admin@MikroTik] driver> add name ?
3c509  c101  lance  ne2k-isa  pc-isa
[admin@MikroTik] driver> add name
```

To see system resources occupied by the devices, use the **/system resource io print** and **/system resource irq print** commands:

```
[admin@MikroTik] system resource> io print
 PORT-RANGE         OWNER
 0x20-0x3F          APIC
 0x40-0x5F          timer
 0x60-0x6F          keyboard
 0x80-0x8F          DMA
 0xA0-0xBF          APIC
 0xC0-0xDF          DMA
 0xF0-0xFF         FPU
 0x100-0x13F       [prism2_cs]
 0x180-0x1BF       [orinoco_cs]
 0x1F0-0x1F7       IDE 1
 0x3D4-0x3D5       [cga]
 0x3F6-0x3F6       IDE 1
 0x3F8-0x3FF       serial port
 0xCF8-0xCFF       [PCI conf1]
 0x1000-0x10FF     [National Semiconductor Corporation DP83815 (MacPhyter) Et...
 0x1000-0x10FF     ether1
 0x1400-0x14FF     [National Semiconductor Corporation DP83815 (MacPhyter) Et...
 0x1400-0x14FF     ether2
 0x1800-0x18FF     [PCI device 100b:0511 (National Semiconductor Corporation)]
 0x1C00-0x1C3F     [PCI device 100b:0510 (National Semiconductor Corporation)]
 0x1C40-0x1C7F     [PCI device 100b:0510 (National Semiconductor Corporation)]
 0x1C80-0x1CBF     [PCI device 100b:0515 (National Semiconductor Corporation)]
 0x1CC0-0x1CCF     [National Semiconductor Corporation SCx200 IDE]
 0x4000-0x40FF     [PCI CardBus #01]
 0x4400-0x44FF     [PCI CardBus #01]
 0x4800-0x48FF     [PCI CardBus #05]
 0x4C00-0x4CFF     [PCI CardBus #05]

[admin@MikroTik] system resource> irq print
Flags: U - unused
   IRQ OWNER
   1   keyboard
   2   APIC
 U 3
   4   serial port
 U 5
 U 6
 U 7
 U 8
   9   ether1
   10  ether2
   11  [Texas Instruments PCI1250 PC card Cardbus Controller]
   11  [Texas Instruments PCI1250 PC card Cardbus Controller (#2)]
   11  [prism2_cs]
   11  [orinoco_cs]
   12  [usb-ohci]
 U 13
   14  IDE 1

[admin@MikroTik] system resource>
```

Suppose we need to load a driver for a NE2000 compatible ISA card. Assume we had considered the information above and have checked avalable resources in our system. To add the driver, we must do the following:

```
[admin@MikroTik] driver> add name=ne2k-isa io=0x280
[admin@MikroTik] driver> print
Flags: I - invalid, D - dynamic
  #   DRIVER                                IRQ IO       MEMORY   ISDN-PROTOCOL
  0 D RealTek 8139
  1 D Intel EtherExpressPro
  2 D PCI NE2000
  3   ISA NE2000                            280
  4   Moxa C101 Synchronous                              C8000
[admin@MikroTik] driver>
```

Removing Device Drivers

Description

You can remove only statically loaded drivers, *id est* those which do not have the **D** flag before the driver name. The device drivers can be removed only if the appropriate interface has been disabled.

To remove a device driver use the **/driver remove** command. Unloading a device driver is useful when you swap or remove a network device - it saves system resources by avoiding to load drivers for removed devices.

The device driver needs to be removed and loaded again, if some parameters (memory range, i/o base address) have been changed for the network interface card.

Notes on PCMCIA Adapters

Description

Currently only the following PCMCIA-ISA and PCMCIA-PCI adapters are tested to comply with MikroTik RouterOS:

- RICOH PCMCIA-PCI Bridge with R5C475 II or RC476 II chip (one or two PCMCIA ports)
- CISCO/Aironet PCMCIA adapter (ISA and PCI versions) for CISCO/Aironet PCMCIA cards only

Other PCMCIA-ISA and PCMCIA-PCI adapters might not function properly.

Notes

The Ricoh adapter might not work properly with some older motherboards. When recognized properly by the BIOS during the boot up of the router, it should be reported under the PCI device listing as "PCI/CardBus bridge". Try using another motherboard, if the adapter or the PCMCIA card are not recognized properly.

The maximum number of PCMCIA ports for a single system is equal to 8. If you will try to install 9 or more ports (no matter one-port or two-port adapters), no one will be recognized.

General Interface Settings

Document revision 1.1 (Fri Mar 05 08:08:52 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

MikroTik RouterOS supports a variety of Network Interface Cards as well as some virtual interfaces (like VLAN, Bridge, etc.). Each of them has its own submenu, but there is also a list of all interfaces where some common properties can be configured.

Related Documents

- *Wireless Client and Wireless Access Point Manual*
- *Bridge Interfaces*
- *ARLAN 655 Wireless Client Card*
- *CISCO/Aironet 2.4GHz 11Mbps Wireless Interface*
- *Cyclades PC300 PCI Adapters*
- *Ethernet Interfaces*
- *EoIP Tunnel Interface*
- *FarSync X.21 Interface*
- *FrameRelay (PVC, Private Virtual Circuit) Interface*
- *IPIP Tunnel Interfaces*
- *ISDN (Integrated Services Digital Network) Interface*
- *L2TP Interface*
- *MOXA C101 Synchronous Interface*

- ***MOXA C502 Dual-port Synchronous Interface***
- ***PPP and Asynchronous Interfaces***
- ***PPPoE Interface***
- ***PPTP Interface***
- ***RadioLAN 5.8GHz Wireless Interface***
- ***VLAN Interface***
- ***Xpeed SDSL Interface***

Description

The Manual describes general settings of MikroTik RouterOS interfaces.

Interface Status

Home menu level: ***/interface***

Property Description

name (*text*) - the name of the interface

status - shows the interface status

type (*read-only: arlan* | *bridge* | *cyclades* | *eoip* | *ethernet* | *farsync* | *ipip* | *isdn-client* | *isdn-server* | *l2tp-client* | *l2tp-server* | *moxa-c101* | *moxa-c502* | *mtsync* | *pc* | *ppp-client* | *ppp-server* | *pppoe-client* | *pppoe-server* | *pptp-client* | *pptp-server* | *pvc* | *radiolan* | *sbe* | *vlan* | *wavelan* | *wireless* | *xpeed*) - interface type

mtu (*integer*) - maximum transmission unit for the interface (in bytes)

rx-rate (*integer*; default: **0**) - maximum data rate for receiving data

- **0** - no limits

tx-rate (*integer*; default: **0**) - maximum data rate for transmitting data

- **0** - no limits

Example

To see the list of all available interfaces:

```
[admin@MikroTik] interface> print
Flags: X - disabled, D - dynamic, R - running
 #    NAME                         TYPE             RX-RATE    TX-RATE    MTU
 0  R ether1                       ether            0          0          1500
 1  R bridge1                      bridge           0          0          1500
 2  R ether2                       ether            0          0          1500
 3  R wlan1                        wlan             0          0          1500
[admin@MikroTik] interface>
```

Traffic Monitoring

Command name: ***/interface monitor-traffic***

Description

The traffic passing through any interface can be monitored.

Notes

One or more interfaces can be monitored at the same time.

Example

Multiple interface monitoring:

```
[admin@MikroTik] interface> monitor-traffic ether1,wlan1
    received-packets-per-second: 1        0
       received-bits-per-second: 475bps   0bps
        sent-packets-per-second: 1        1
           sent-bits-per-second: 2.43kbps 198bps
-- [Q quit|D dump|C-z pause]
```

FarSync X.21 Interface

Document revision 1.1 (Fri Mar 05 08:14:24 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS supports FarSync T-Series X.21 synchronous adapter hardware. These cards provide versatile high performance connectivity to the Internet or to corporate networks over leased lines.

Specifications

Packages required: ***synchronous***
License required: ***level4***
Home menu level: ***/interface farsync***
Standards and Technologies: ***X.21, Frame Relay, PPP***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***IP Addresses and ARP***
- ***Log Management***

Additional Documents

- *http://www.farsite.co.uk/*

Synchronous Interface Configuration

Home menu level: ***/interface farsync***

Description

You can change the interface name to a more descriptive one using the **set** command. To enable the interface, use the **enable** command.

Property Description

hdlc-keepalive (*time*; default: **10s**) - Cisco HDLC keepalive period in seconds

clock-rate (*integer*; default: **64000**) - the speed of internal clock

clock-source (*external* | *internal*; default: **external**) - clock source

disabled (*yes* | *no*; default: **yes**) - shows whether the interface is disabled

frame-relay-dce (*yes* | *no*; default: **no**) - operate in Data Communications Equipment mode

frame-relay-lmi-type (*ansi* | *ccitt*; default: **ansi**) - Frame Relay Local Management Interface type

line-protocol (*cisco-hdlc* | *frame-relay* | *sync-ppp*; default: **sync-ppp**) - line protocol

media-type (*V24* | *V35* | *X21*; default: **V35**) - type of the media

mtu (*integer*; default: **1500**) - Maximum Transmit Unit

name (*name*; default: **farsyncN**) - assigned interface name

Example

```
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                 TYPE             MTU
  0  R ether1               ether            1500
  1 X  farsync1             farsync          1500
  2 X  farsync2             farsync          1500
[admin@MikroTik] interface>
[admin@MikroTik] interface> enable 1
[admin@MikroTik] interface> enable farsync2
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                 TYPE             MTU
  0  R ether1               ether            1500
  1    farsync1             farsync          1500
  2    farsync2             farsync          1500
[admin@MikroTik] interface>farsync
[admin@MikroTik] interface farsync> print
Flags: X - disabled, R - running
  0    name="farsync1" mtu=1500 line-protocol=sync-ppp media-type=V35
       clock-rate=64000 clock-source=external chdlc-keepalive=10s
       frame-relay-lmi-type=ansi frame-relay-dce=no

  1    name="farsync2" mtu=1500 line-protocol=sync-ppp media-type=V35
       clock-rate=64000 clock-source=external chdlc-keepalive=10s
       frame-relay-lmi-type=ansi frame-relay-dce=no
```

```
[admin@MikroTik] interface farsync>
```

You can monitor the status of the synchronous interface:

```
[admin@MikroTik] interface farsync> monitor 0
           card-type: T2P FarSync T-Series
               state: running
         firmware-id: 2
    firmware-version: 0.7.0
      physical-media: V35
               cable: detected
               clock: not-detected
       input-signals: CTS
      output-signals: RTS DTR

[admin@MikroTik] interface farsync>
```

Troubleshooting

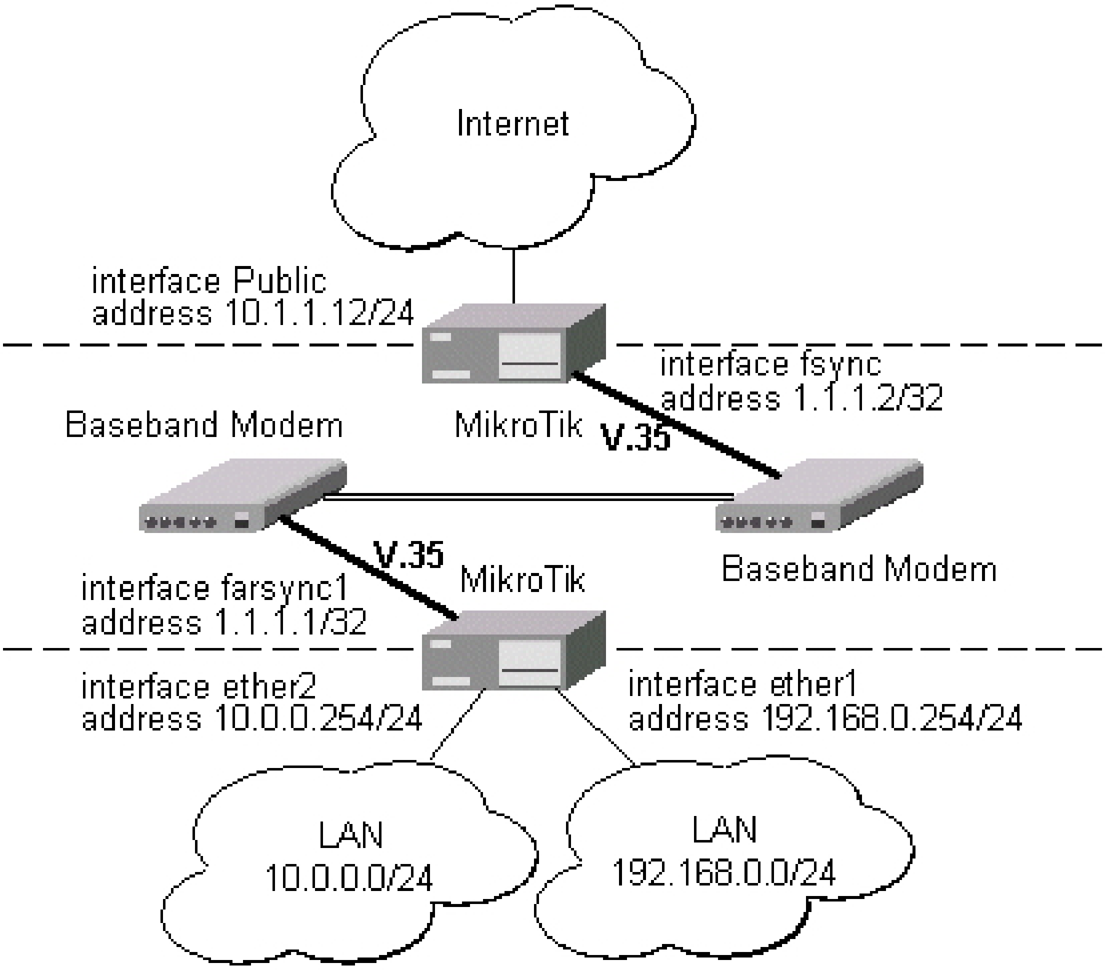
Description

- **The farsync interface does not show up under the interface list**
  Obtain the required license for synchronous feature
- **The synchronous link does not work**
  Check the cabling and the line between the modems. Read the modem manual

Synchronous Link Applications

MikroTik router to MikroTik router

Let us consider the following network setup with two MikroTik routers connected to a leased line with baseband modems:



The interface should be enabled according to the instructions given above. The **IP addresses** assigned to the synchronous interface should be as follows:

```
[admin@MikroTik] ip address> add address 1.1.1.1/32 interface farsync1 \
\... network 1.1.1.2 broadcast 255.255.255.255
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.254/24      10.0.0.254      10.0.0.255      ether2
  1   192.168.0.254/24   192.168.0.254   192.168.0.255   ether1
  2   1.1.1.1/32         1.1.1.2         255.255.255.255 farsync1
[admin@MikroTik] ip address> /ping 1.1.1.2
1.1.1.2 64 byte pong: ttl=255 time=31 ms
1.1.1.2 64 byte pong: ttl=255 time=26 ms
1.1.1.2 64 byte pong: ttl=255 time=26 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 26/27.6/31 ms
[admin@MikroTik] ip address>
```

Note that for the point-to-point link the network mask is set to 32 bits, the argument **network** is set to the **IP address** of the other end, and the broadcast address is set to 255.255.255.255. The default route should be set to the gateway router 1.1.1.2:

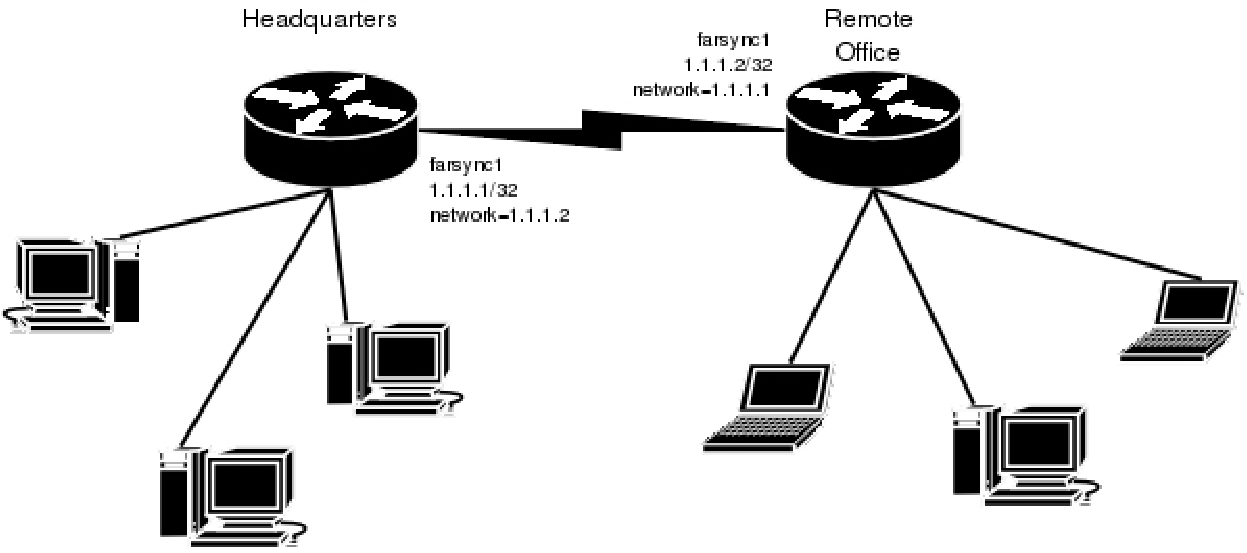
```
[admin@MikroTik] ip route> add gateway 1.1.1.2
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 1.1.1.2         1        farsync1
    1 DC 10.0.0.0/24        r 10.0.0.254      1        ether2
    2 DC 192.168.0.0/24     r 192.168.0.254   0        ether1
    3 DC 1.1.1.2/32         r 0.0.0.0         0        farsync1

[admin@MikroTik] ip route>
```

The configuration of the MikroTik router at the other end is similar:

```
[admin@MikroTik] ip address> add address 1.1.1.2/32 interface fsync \
\... network 1.1.1.1 broadcast 255.255.255.255
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.1.1.12/24       10.1.1.12       10.1.1.255      Public
  1   1.1.1.2/32         1.1.1.1         255.255.255.255 fsync
[admin@MikroTik] ip address> /ping 1.1.1.1
1.1.1.1 64 byte pong: ttl=255 time=31 ms
1.1.1.1 64 byte pong: ttl=255 time=26 ms
1.1.1.1 64 byte pong: ttl=255 time=26 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 26/27.6/31 ms
[admin@MikroTik] ip address>
```

MikroTik router to MikroTik router P2P using X.21 line

Consider the following example:



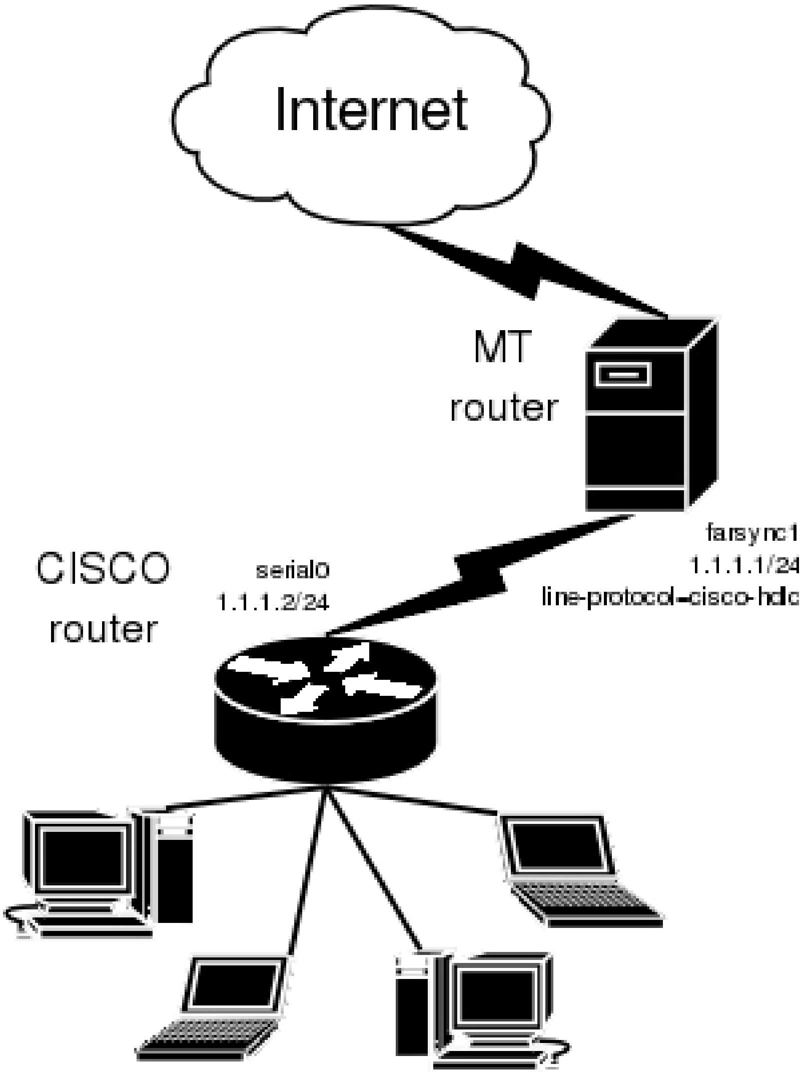
The default value of the property **clock-source** must be changed to **internal** for one of the cards. Both cards must have **media-type** property set to **X21**.

IP address configuration on both routers is as follows (by convention, the routers are named **hq** and **office** respectively):

```
[admin@hq] ip address> pri
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   192.168.0.1/24     192.168.0.0     192.168.0.255   ether1
  1   1.1.1.1/32         1.1.1.2         1.1.1.2         farsync1

[admin@hq] ip address>

[admin@office] ip address>
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.112/24      10.0.0.0        10.0.0.255      ether1
  1   1.1.1.2/32         1.1.1.1         1.1.1.1         farsync1
[admin@office] ip address>
```

MikroTik router to Cisco router using X.21 line

Assume we have the following configuration:



The configuration of MT router is as follows:

```
[admin@MikroTik] interface farsync> set farsync1 line-protocol=cisco-hdlc \
\... media-type=X21 clock-source=internal
[admin@MikroTik] interface farsync> enable farsync1
[admin@MikroTik] interface farsync> print
Flags: X - disabled, R - running
  0  R name="farsync1" mtu=1500 line-protocol=cisco-hdlc media-type=X21
       clock-rate=64000 clock-source=internal chdlc-keepalive=10s
       frame-relay-lmi-type=ansi frame-relay-dce=no

  1 X  name="farsync2" mtu=1500 line-protocol=sync-ppp media-type=V35
       clock-rate=64000 clock-source=external chdlc-keepalive=10s
       frame-relay-lmi-type=ansi frame-relay-dce=no

[admin@MikroTik] interface farsync>
```

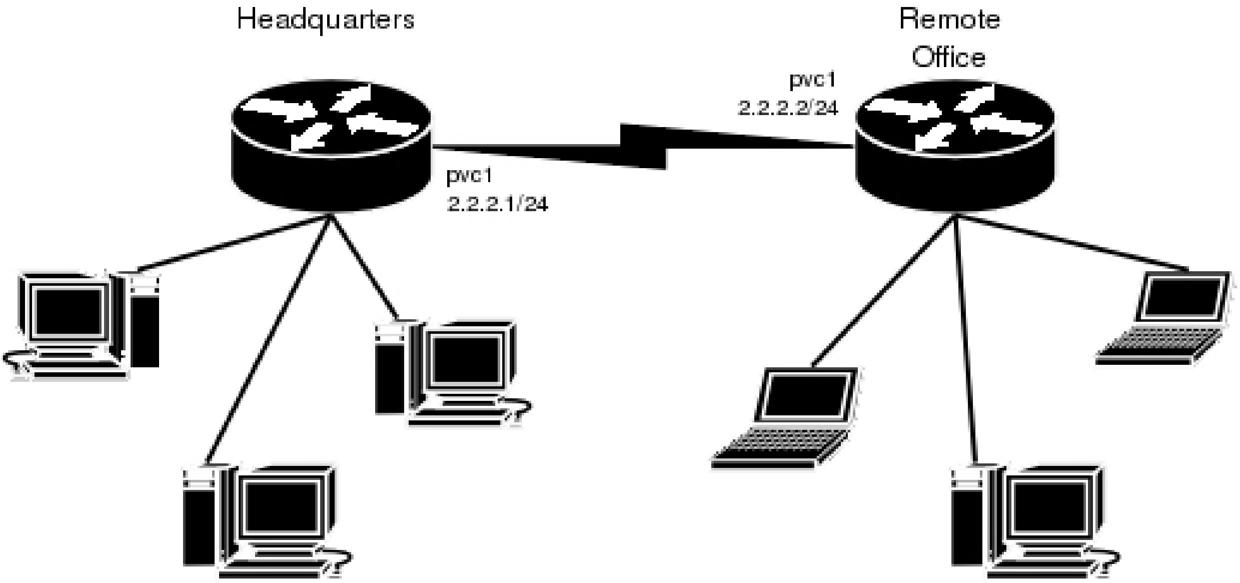
```
[admin@MikroTik] interface farsync> /ip address add address=1.1.1.1/24 \
\... interface=farsync1
```

The essential part of the configuration of Cisco router is provided below:

```
interface Serial0
 ip address 1.1.1.2 255.255.255.0
 no ip route-cache
 no ip mroute-cache
 no fair-queue
!
ip classless
ip route 0.0.0.0 0.0.0.0 1.1.1.1
```

MikroTik router to MikroTik router using Frame Relay

Consider the following example:



The default value of the property **clock-source** must be changed to **internal** for one of the cards. This card also requires the property **frame-relay-dce** set to **yes**. Both cards must have **media-type** property set to **X21** and the **line-protocol** set to **frame-relay**.

Now we need to add **pvc** interfaces:

```
[admin@hq] interface pvc> add dlci=42 interface=farsync1
[admin@hq] interface pvc> print
Flags: X - disabled, R - running
  #    NAME                                                  MTU  DLCI INTERFACE
  0 X  pvc1                                                  1500 42   farsync1

[admin@hq] interface pvc>
```

Similar routine has to be done also on **office** router:

```
[admin@office] interface pvc> add dlci=42 interface=farsync1
[admin@office] interface pvc> print
Flags: X - disabled, R - running
  #    NAME                                                  MTU  DLCI INTERFACE
  0 X  pvc1                                                  1500 42   farsync1

[admin@office] interface pvc>
```

Finally we need to add **IP addresses** to **pvc** interfaces and enable them.

On the **hq** router:

```
[admin@hq] interface pvc> /ip addr add address 2.2.2.1/24 interface pvc1
[admin@hq] interface pvc> /ip addr print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.112/24      10.0.0.0        10.0.0.255      ether1
  1   192.168.0.1/24     192.168.0.0     192.168.0.255   ether2
  2   2.2.2.1/24         2.2.2.0         2.2.2.255       pvc1

[admin@hq] interface pvc> enable 0
[admin@hq] interface pvc>
```

and on the **office** router:

```
[admin@office] interface pvc> /ip addr add address 2.2.2.2/24 interface pvc1
[admin@office] interface pvc> /ip addr print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.112/24      10.0.0.0        10.0.0.255      ether1
  1   2.2.2.2/24         2.2.2.0         2.2.2.255       pvc1

[admin@office] interface pvc> enable 0
[admin@office] interface pvc>
```

Now we can monitor the synchronous link status:

```
[admin@hq] interface pvc> /ping 2.2.2.2
2.2.2.2 64 byte ping: ttl=64 time=20 ms
2.2.2.2 64 byte ping: ttl=64 time=20 ms
2.2.2.2 64 byte ping: ttl=64 time=21 ms
2.2.2.2 64 byte ping: ttl=64 time=21 ms
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 20/20.5/21 ms
[admin@hq] interface pvc> /interface farsync monitor 0
           card-type: T2P FarSync T-Series
               state: running-normally
         firmware-id: 2
    firmware-version: 1.0.1
            physical: X.21
               cable: detected
               clock: detected
       input-signals: CTS
      output-signals: RTS,DTR

[admin@hq] interface pvc>
```

L2TP Interface

Document revision 1.1 (Fri Mar 05 08:26:01 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

L2TP (Layer 2 Tunnel Protocol) supports encrypted tunnels over IP. The MikroTik RouterOS implementation includes support for both L2TP client and server.

General applications of L2TP tunnels include:

- secure router-to-router tunnels over the Internet
- linking (bridging) local Intranets or LANs (in cooperation with EoIP)
- extending PPP user connections to a remote location (for example, to separate authentication and Internet access points for ISP)

- accessing an Intranet/LAN of a company for remote (mobile) clients (employees)

Each L2TP connection is composed of a server and a client. The MikroTik RouterOS may function as a server or client or, for various configurations, it may be the server for some connections and client for other connections.

Quick Setup Guide

To make a L2TP tunnel between 2 MikroTik routers with IP addresses **10.5.8.104** (L2TP server) and **10.1.0.172** (L2TP client), follow the next steps.

- Configuration on L2TP server router:
  1. Add a L2TP user:

```
[admin@L2TP-Server] ppp secret> add name=james password=pass \
\... local-address=10.0.0.1 remote-address=10.0.0.2
```

  2. Enable the L2TP server

```
[admin@L2TP-Server] interface l2tp-server server> set enabled=yes
```

- Configuration on L2TP client router:
  1. Add a L2TP client:

```
[admin@L2TP-Client] interface l2tp-client> add user=james password=pass \
\... connect-to=10.5.8.104
```

Specifications

Packages required: ***ppp***
License required: ***level1 (limited to 1 tunnel), level3 (limited to 200 tunnels), level5***
Home menu level: ***/interface l2tp-server, /interface l2tp-client***
Standards and Technologies: ***L2TP (RFC 2661)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***AAA***
- ***EoIP Tunnel Interface***
- ***IP Security***

Description

L2TP is a secure tunnel protocol for transporting IP traffic using PPP. L2TP encapsulates PPP in virtual lines that run over IP, Frame Relay and other protocols (that are not currently supported by MikroTik RouterOS). L2TP incorporates PPP and MPPE (Microsoft Point to Point Encryption) to make encrypted links. The purpose of this protocol is to allow the Layer 2 and PPP endpoints to reside on different devices interconnected by a packet-switched network. With L2TP, a user has a Layer 2 connection to an access concentrator - **LAC** (e.g., modem bank, ADSL DSLAM, etc.), and the concentrator then tunnels individual PPP frames to the Network Access Server - **NAS**. This allows the actual processing of PPP packets to be divorced from the termination of the Layer 2 circuit. From the user's perspective, there is no functional difference between having the L2 circuit terminate in a NAS directly or using L2TP.

It may also be useful to use L2TP just as any other tunneling protocol with or without encryption. The L2TP standard says that the most secure way to encrypt data is using L2TP over IPsec (**Note** that it is default mode for Microsoft L2TP client) as all L2TP control and data packets for a particular tunnel appear as homogeneous UDP/IP data packets to the IPsec system.

L2TP includes PPP authentication and accounting for each L2TP connection. Full authentication and accounting of each connection may be done through a RADIUS client or locally.

MPPE 40bit RC4 and MPPE 128bit RC4 encryption are supported.

L2TP traffic uses UDP protocol for both control and data packets. UDP port 1701 is used only for link establishment, further traffic is using any available UDP port (which may or may not be 1701). This means that L2TP can be used with most firewalls and routers (even with NAT) by enabling UDP traffic to be routed through the firewall or router.

L2TP Client Setup

Home menu level: ***/interface l2tp-client***

Property Description

name (*name*; default: **l2tp-outN**) - interface name for reference

mtu (*integer*; default: **1460**) - Maximum Transmission Unit. The optimal value is the MTU of the interface the tunnel is working over decreased by 40 (so, for 1500-byte Ethernet link, set the MTU to 1460 to avoid fragmentation of packets)

mru (*integer*; default: **1460**) - Maximum Receive Unit. The optimal value is the MRU of the interface the tunnel is working over decreased by 40 (so, for 1500-byte Ethernet link, set the MRU to 1460 to avoid fragmentation of packets)

connect-to (*IP address*) - The IP address of the L2TP server to connect to

user (*text*) - user name to use when logging on to the remote server

password (*text*; default: **""**) - user password to use when logging to the remote server

profile (*name*; default: **default**) - profile to use when connecting to the remote server

allow (*multiple choice: mschap2, mschap1, chap, pap*; default: **mschap2, mschap1, chap, pap**) - the protocol to allow the client to use for authentication

add-default-route (*yes* | *no*; default: **no**) - whether to use the server which this client is connected to as its default router (gateway)

Example

To set up L2TP client named **test2** using username **john** with password **john** to connect to the **10.1.1.12** L2TP server and use it as the default gateway:

```
[admin@MikroTik] interface l2tp-client> add name=test2 connect-to=10.1.1.12 \
\... user=john add-default-route=yes password=john
[admin@MikroTik] interface l2tp-client> print
Flags: X - disabled, R - running
  0 X  name="test2" mtu=1460 mru=1460 connect-to=10.1.1.12 user="john"
       password="john" profile=default add-default-route=yes


[admin@MikroTik] interface l2tp-client> enable 0
```

Monitoring L2TP Client

Command name: ***/interface l2tp-client monitor***

Property Description

status (*text*) - status of the client

- **Dialing** - attempting to make a connection
- **Verifying password...** - connection has been established to the server, password verification in progress
- **Connected** - self-explanatory
- **Terminated** - interface is not enabled or the other side will not establish a connection uptime (time) - connection time displayed in days, hours, minutes and seconds

encoding (*text*) - encryption and encoding (if asymmetric, separated with '/') being used in this connection

Example

Example of an established connection

```
[admin@MikroTik] interface l2tp-client> monitor test2
      status: "connected"
      uptime: 4m27s
    encoding: "MPPE128 stateless"
[admin@MikroTik] interface l2tp-client>
```

L2TP Server Setup

Home menu level: ***/interface l2tp-server server***

Description

The L2TP server creates a dynamic interface for each connected L2TP client. The L2TP connection count from clients depends on the license level you have. Level1 license allows 1 L2TP client, Level3 or Level4 licenses up to 200 clients, and Level5 or Level6 licenses do not have L2TP client limitations.

To create L2TP users, you should consult the ***PPP secret*** and ***PPP Profile*** manuals. It is also possible to use the MikroTik router as a RADIUS client to register the L2TP users, see the ***manual*** how to do it.

Property Description

enabled (*yes* | *no*; default: **no**) - defines whether L2TP server is enabled or not

mtu (*integer*; default: **1460**) - Maximum Transmission Unit. The optimal value is the MTU of the interface the tunnel is working over decreased by 40 (so, for 1500-byte Ethernet link, set the MTU to 1460 to avoid fragmentation of packets)

mru (*integer*; default: **1460**) - Maximum Receive Unit. The optimal value is the MRU of the interface the tunnel is working over decreased by 40 (so, for 1500-byte Ethernet link, set the MRU to 1460 to avoid fragmentation of packets)

authentication (*multiple choice: pap* | *chap* | *mschap1* | *mschap2*; default: **mschap2**) - authentication algorithm

default-profile - default profile to use

Example

To enable L2TP server:

```
[admin@MikroTik] interface l2tp-server server> set enabled=yes
[admin@MikroTik] interface l2tp-server server> print
            enabled: yes
                mtu: 1460
                mru: 1460
     authentication: mschap2
    default-profile: default
[admin@MikroTik] interface l2tp-server server>
```

L2TP Server Users

Home menu level: ***/interface l2tp-server***

Description

There are two types of items in L2TP server configuration - static users and dynamic connections. A dynamic connection can be established if the user database or the **default-profile** has its **local-address** and **remote-address** set correctly. When static users are added, the default profile may be left with its default values and only PPP user (in **/ppp secret**) should be configured. **Note** that in both cases PPP users must be configured properly.

Property Description

name (*name*) - interface name

user (*text*) - the name of the user that is configured statically or added dynamically

mtu - shows client's MTU

client-address - shows the IP of the connected client

uptime - shows how long the client is connected

encoding (*text*) - encryption and encoding (if asymmetric, separated with '/') being used in this connection

Example

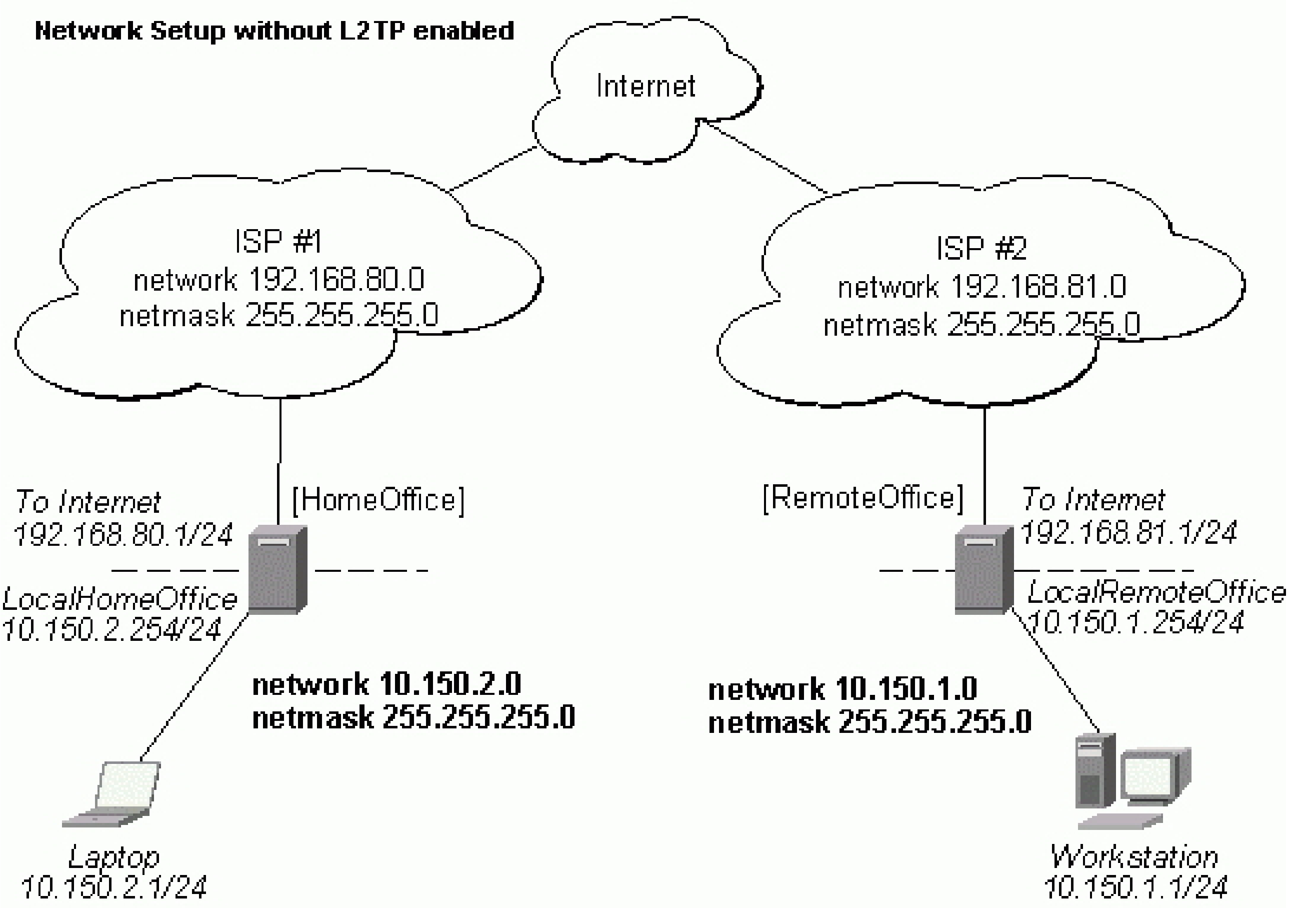
To add a static entry for **ex1** user:

```
[admin@MikroTik] interface l2tp-server> add user=ex1
[admin@MikroTik] interface l2tp-server> print
Flags: X - disabled, D - dynamic, R - running
  #     NAME                 USER         MTU   CLIENT-ADDRESS  UPTIME   ENC...
  0  DR <l2tp-ex>            ex           1460  10.0.0.202      6m32s    none
  1     l2tp-in1             ex1
[admin@MikroTik] interface l2tp-server>
```

In this example an already connected user **ex** is shown besides the one we just added.

L2TP Application Examples

Router-to-Router Secure Tunnel Example



There are two routers in this example:

- [HomeOffice]
  Interface LocalHomeOffice 10.150.2.254/24
  Interface ToInternet 192.168.80.1/24
- [RemoteOffice]
  Interface ToInternet 192.168.81.1/24
  Interface LocalRemoteOffice 10.150.1.254/24

Each router is connected to a different ISP. One router can access another router through the Internet.

On the L2TP server a user must be set up for the client:

```
[admin@HomeOffice] ppp secret> add name=ex service=l2tp password=lkjrht
local-address=10.0.103.1 remote-address=10.0.103.2
[admin@HomeOffice] ppp secret> print detail
Flags: X - disabled
  0   name="ex" service=l2tp caller-id="" password="lkjrht" profile=default
      local-address=10.0.103.1 remote-address=10.0.103.2 routes==""

[admin@HomeOffice] ppp secret>
```

Then the user should be added in the L2TP server list:

```
[admin@HomeOffice] interface l2tp-server> add user=ex
[admin@HomeOffice] interface l2tp-server> print
Flags: X - disabled, D - dynamic, R - running
  #     NAME                 USER         MTU   CLIENT-ADDRESS  UPTIME   ENC...
  0     l2tp-in1             ex
[admin@HomeOffice] interface l2tp-server>
```

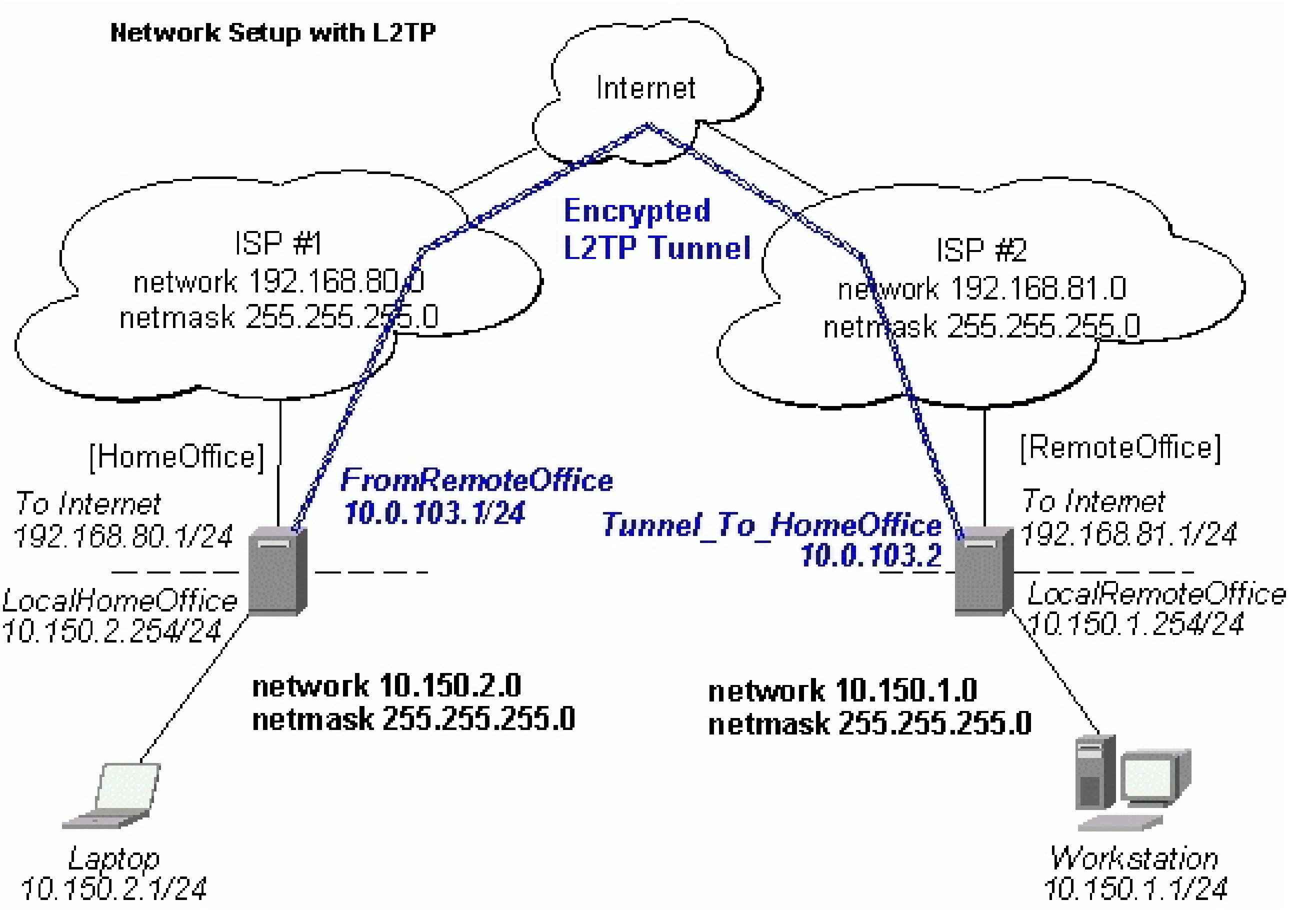
And finally, the server must be enabled:

```
[admin@HomeOffice] interface l2tp-server server> set enabled=yes
[admin@HomeOffice] interface l2tp-server server> print
            enabled: yes
                mtu: 1460
                mru: 1460
     authentication: mschap2
    default-profile: default
[admin@HomeOffice] interface l2tp-server server>
```

Add a L2TP client to the RemoteOffice router:

```
[admin@RemoteOffice] interface l2tp-client> add connect-to=192.168.80.1 user=ex \
\... password=lkjrht disabled=no
[admin@RemoteOffice] interface l2tp-client> print
Flags: X - disabled, R - running
  0  R name="l2tp-out1" mtu=1460 mru=1460 connect-to=192.168.80.1 user="ex"
       password="lkjrht" profile=default add-default-route=no


[admin@RemoteOffice] interface l2tp-client>
```

Thus, a L2TP tunnel is created between the routers. This tunnel is like an Ethernet point-to-point connection between the routers with IP addresses 10.0.103.1 and 10.0.103.2 at each router. It enables 'direct' communication between the routers over third party networks.



To route the local Intranets over the L2TP tunnel you need to add these routes:

```
[admin@HomeOffice] > ip route add dst-address 10.150.1.0/24 gateway 10.0.103.2
[admin@RemoteOffice] > ip route add dst-address 10.150.2.0/24 gateway 10.0.103.1
```

On the L2TP server it can alternatively be done using **routes** parameter of the user configuration:

```
[admin@HomeOffice] ppp secret> print detail
Flags: X - disabled
  0   name="ex" service=l2tp caller-id="" password="lkjrht" profile=default
      local-address=10.0.103.1 remote-address=10.0.103.2 routes==""

[admin@HomeOffice] ppp secret> set 0 routes="10.150.1.0/24 10.0.103.2 1"
[admin@HomeOffice] ppp secret> print detail
Flags: X - disabled
  0   name="ex" service=l2tp caller-id="" password="lkjrht" profile=default
      local-address=10.0.103.1 remote-address=10.0.103.2
      routes="10.150.1.0/24 10.0.103.2 1"

[admin@HomeOffice] ppp secret>
```

Test the L2TP tunnel connection:

```
[admin@RemoteOffice]> /ping 10.0.103.1
10.0.103.1 pong: ttl=255 time=3 ms
10.0.103.1 pong: ttl=255 time=3 ms
10.0.103.1 pong: ttl=255 time=3 ms
ping interrupted
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 3/3.0/3 ms
```

Test the connection through the L2TP tunnel to the LocalHomeOffice interface:

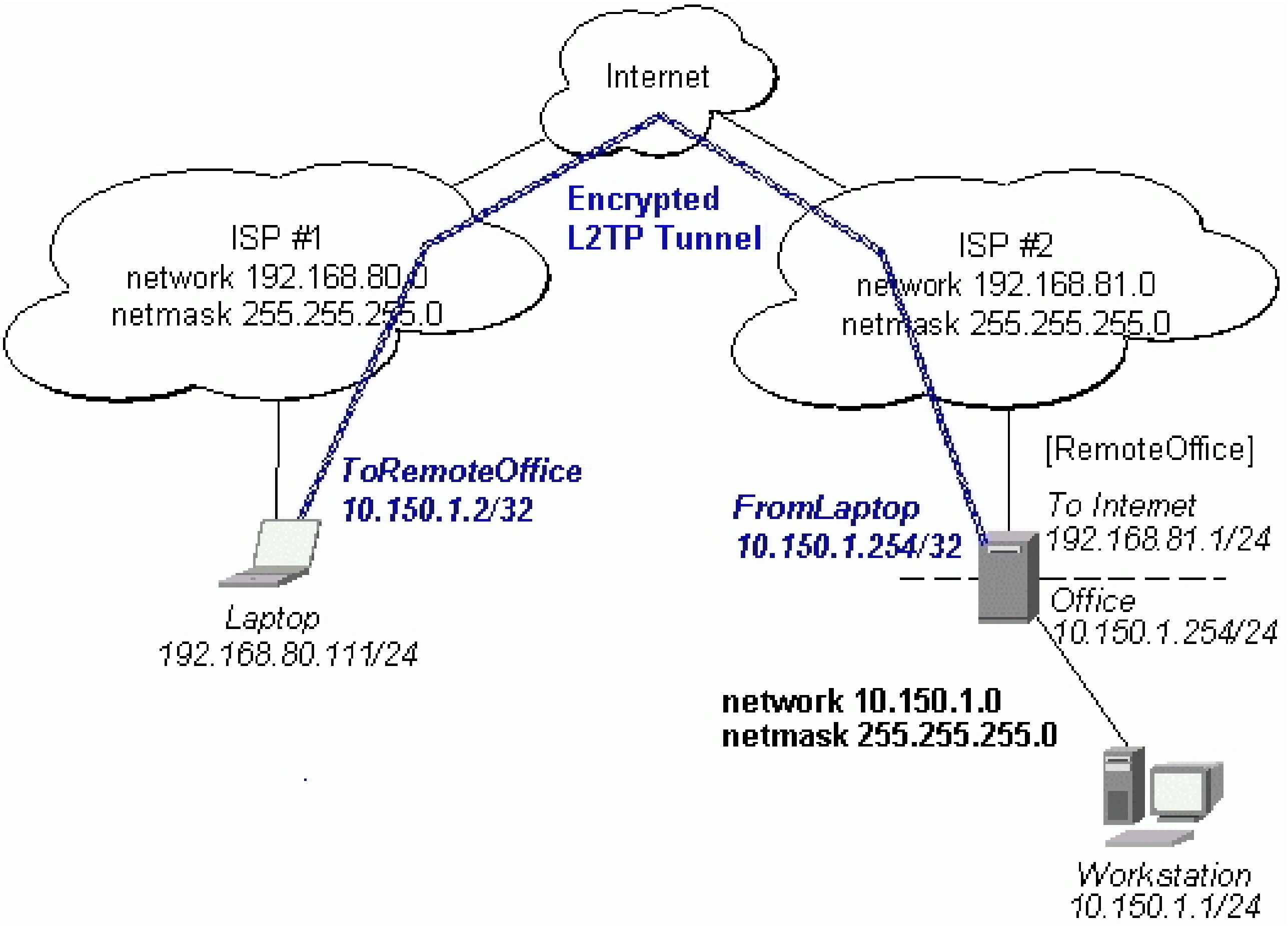
```
[admin@RemoteOffice]> /ping 10.150.2.254
10.150.2.254 pong: ttl=255 time=3 ms
10.150.2.254 pong: ttl=255 time=3 ms
10.150.2.254 pong: ttl=255 time=3 ms
ping interrupted
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 3/3.0/3 ms
```

To bridge a LAN over this secure tunnel, please see the example in the 'EoIP' section of the manual. To set the maximum speed for traffic over this tunnel, please consult the 'Queues' section.

Connecting a Remote Client via L2TP Tunnel

The following example shows how to connect a computer to a remote office network over L2TP encrypted tunnel giving that computer an IP address from the same network as the remote office has (without need of bridging over EoIP tunnels).

Please, consult the respective manual on how to set up a L2TP client with the software you are using.



The router in this example:

- [RemoteOffice]
  Interface ToInternet 192.168.81.1/24
  Interface Office 10.150.1.254/24

The client computer can access the router through the Internet.

On the L2TP server a user must be set up for the client:

```
[admin@RemoteOffice] ppp secret> add name=ex service=l2tp password=lkjrht
local-address=10.150.1.254 remote-address=10.150.1.2
[admin@RemoteOffice] ppp secret> print detail
Flags: X - disabled
  0   name="ex" service=l2tp caller-id="" password="lkjrht" profile=default
      local-address=10.150.1.254 remote-address=10.150.1.2 routes==""

[admin@RemoteOffice] ppp secret>
```

Then the user should be added in the L2TP server list:

```
[admin@RemoteOffice] interface l2tp-server> add name=FromLaptop user=ex
[admin@RemoteOffice] interface l2tp-server> print
Flags: X - disabled, D - dynamic, R - running
  #     NAME                 USER         MTU   CLIENT-ADDRESS  UPTIME   ENC...
  0     FromLaptop           ex
[admin@RemoteOffice] interface l2tp-server>
```

And the server must be enabled:

```
[admin@RemoteOffice] interface l2tp-server server> set enabled=yes
[admin@RemoteOffice] interface l2tp-server server> print
            enabled: yes
                mtu: 1460
                mru: 1460
     authentication: mschap2
    default-profile: default
[admin@RemoteOffice] interface l2tp-server server>
```

Finally, the proxy APR must be enabled on the 'Office' interface:

```
[admin@RemoteOffice] interface ethernet> set Office arp=proxy-arp
[admin@RemoteOffice] interface ethernet> print
Flags: X - disabled, R - running
  #    NAME                 MTU   MAC-ADDRESS       ARP
  0  R ToInternet           1500  00:30:4F:0B:7B:C1 enabled
  1  R Office               1500  00:30:4F:06:62:12 proxy-arp
[admin@RemoteOffice] interface ethernet>
```

L2TP Setup for Windows

Microsoft provides L2TP client support for Windows XP, 2000, NT4, ME and 98. Windows 2000 and XP include support in the Windows setup or automatically install L2TP. For 98, NT and ME, installation requires a download from Microsoft (L2TP/IPsec VPN Client).

For more information, see:

Microsoft L2TP/IPsec VPN Client Microsoft L2TP/IPsec VPN Client

On Windows 2000, L2TP setup without IPsec requires editing registry:

Disabling IPsec for the Windows 2000 Client

Disabling IPSEC Policy Used with L2TP

Troubleshooting

Description

- **I use firewall and I cannot establish L2TP connection**
  Make sure UDP connections can pass through both directions between your sites.
- **My Windows L2TP/IPsec VPN Client fails to connect to L2TP server with "Error 789" or "Error 781"**
  The error messages 789 and 781 occur when IPsec is not configured properly on both ends. See the respective documentation on how to configure IPsec in the Microsoft L2TP/IPsec VPN Client and in the MikroTik RouterOS. If you do not want to use IPsec, it can be easily switched off on the client side. Note: if you are using Windows 2000, you need to edit system registry using regedt32.exe or regedit.exe. Add the following registry value to **HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Rasman\Parameters**:

```
Value Name: ProhibitIpSec
Data Type: REG_DWORD
Value: 1
```

You must restart the Windows 2000 for the changes to take effect

For more information on configuring Windows 2000, see:

- ***Configuring Cisco IOS and Windows 2000 Clients for L2TP Using Microsoft IAS***
- ***Disabling IPSEC Policy Used with L2TP***
- ***How to Configure a L2TP/IPsec Connection Using Pre-shared Key Authentication***

CISCO/Aironet 2.4GHz 11Mbps Wireless Interface

Document revision 1.2 (Mon May 31 20:18:58 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS supports the following CISCO/Aironet 2.4GHz Wireless ISA/PCI/PC Adapter hardware:

- Aironet ISA/PCI/PC4800 2.4GHz DS 11Mbps Wireless LAN Adapters (100mW)
- Aironet ISA/PCI/PC4500 2.4GHz DS 2Mbps Wireless LAN Adapters (100mW)
- CISCO AIR-PCI340 2.4GHz DS 11Mbps Wireless LAN Adapters (30mW)
- CISCO AIR-PCI/PC350/352 2.4GHz DS 11Mbps Wireless LAN Adapters (100mW)

Specifications

Packages required: ***wireless***
License required: ***level4***
Home menu level: ***/interface pc***
Standards and Technologies: ***IEEE802.11b***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

- *Device Driver List*
- *IP Addresses and ARP*
- *Log Management*

Additional Documents

- *CISCO Aironet 350 Series*

For more information about the CISCO/Aironet PCI/ISA adapter hardware please see the relevant User's Guides and Technical Reference Manuals in PDF format:

- *710-003638a0.pdf*for PCI/ISA 4800 and 4500 series adapters
- *710-004239B0.pdf*for PC 4800 and 4500 series adapters

Documentation about CISCO/Aironet Wireless Bridges and Access Points can be found in archives:

- *AP48MAN.exe* for AP4800 Wireless Access Point
- *BR50MAN.exe* for BR500 Wireless Bridge

Wireless Interface Configuration

Home menu level: ***/interface pc***

Description

CISCO/Aironet 2.4GHz card is an interface for wireless networks operating in IEEE 802.11b standard. If the wireless interface card is not registered to an AP, the green status led is blinking fast. If the wireless interface card is registered to an AP, the green status led is blinking slow. To set the wireless interface for working with an access point (register to the AP), typically you should set the following parameters:

- The **service set identifier**. It should match the ssid of the AP. Can be blank, if you want the wireless interface card to register to an AP with any ssid. The ssid will be received from the AP, if the AP is broadcasting its ssid.
- The data-rate of the card should match one of the supported data rates of the AP. Data rate 'auto' should work in most cases.

Loading the Driver for the Wireless Adapter

PCI and PC (PCMCIA) cards do not require a 'manual' driver loading, since they are recognized automatically by the system and the driver is loaded at the system startup.

The ISA card requires the driver to be loaded by issuing the following command:

There can be several reasons for a failure to load the driver:

- **The driver cannot be loaded because other device uses the requested IRQ.**
  Try to set different IRQ using the DIP switches.
- **The requested I/O base address cannot be used on your motherboard**

Try to change the I/O base address using the DIP switches

Property Description

ap1 (*MAC address*) - forces association to the specified access point

ap2 (*MAC address*) - forces association to the specified access point

ap3 (*MAC address*) - forces association to the specified access point

ap4 (*MAC address*) - forces association to the specified access point

arp (*disabled | enabled | proxy-arp | reply-only*; default: **enabled**) - Address Resolution Protocol

beacon-period (*integer*: 20..976; default: **100**) - Specifies beaconing period (applicable to ad-hoc mode only)

card-type (*read-only: text*) - your CISCO/Aironet adapter model and type

client-name (*text*; default: **""**) - client name

data-rate - data rate in Mbit/s

fragmentation-threshold (*integer*: 256..2312; default: **2312**) - this threshold controls the packet size at which outgoing packets will be split into multiple fragments. If a single fragment transmit error occurs, only that fragment will have to be retransmitted instead of the whole packet. Use a low setting in areas with poor communication or with a great deal of radio interference

frequency - Channel Frequency in MHz (applicable to ad-hoc mode only)

join-net (*time*; default: **10**) - an amount of time,during which the interface operating in ad-hoc mode will try to connect to an existing network rather than create a new one

- **0** - do not create own network

long-retry-limit (*integer*: 0..128; default: **16**) - specifies the number of times an unfragmented packet is retried before it is dropped

mode (*infrastructure | ad-hoc*; default: **infrastructure**) - operation mode of the card

modulation (*cck | default | mbok*; default: **cck**) - modulation mode

- **cck** - Complementary Code Keying
- **mbok** - M-ary Bi-Orthogonal Keying

mtu (*integer*: 0..65536; default: **1500**) - Maximum Transmission Unit

name (*name*) - assigned interface name

rts-threshold (*integer*: 0..2312; default: **2312**) - determines the packet size at which the interface issues a request to send (RTS) before sending the packet. A low value can be useful in areas where many clients are associating with the access point or bridge, or in areas where the clients are far apart and can detect only the access point or bridge and not each other

rx-antenna (*both | default | left | right*; default: **both**) - receive antennas

short-retry-limit (*integer*: 0..128; default: **16**) - specifies the number of times a fragmented packet is retried before it is dropped

ssid1 (*text*; default: **tsunami**) - establishes the adapter's service set identifier This value must match the SSID of the system in order to operate in infrastructure mode

ssid2 (*text*; default: **""**) - service set identifier 2

ssid3 (*text*; default: **""**) - service set identifier 3

tx-antenna (*both* | *default* | *left* | *right*; default: **both**) - transmit antennas

tx-power (*1* | *5* | *20* | *50* | *100*; default: **100**) - transmit power in mW

Example

Interface informational printouts

```
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                 TYPE             MTU
  0  R ether1               ether            1500
  1  X ether2               ether            1500
  2  X pc1                  pc               1500
[admin@MikroTik] interface> set 1 name aironet
[admin@MikroTik] interface> enable aironet
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                 TYPE             MTU
  0  R ether1               ether            1500
  1  X ether2               ether            1500
  2  R aironet              pc               1500
[admin@MikroTik] > interface pc
[admin@MikroTik] interface pc> print
Flags: X - disabled, R - running
  0  R name="aironet" mtu=1500 mac-address=00:40:96:29:2F:80 arp=enabled
       client-name="" ssid1="tsunami" ssid2="" ssid3="" mode=infrastructure
       data-rate=1Mbit/s frequency=2437MHz modulation=cck tx-power=100
       ap1=00:00:00:00:00:00 ap2=00:00:00:00:00:00 ap3=00:00:00:00:00:00
       ap4=00:00:00:00:00:00 rx-antenna=right tx-antenna=right beacon-period=100
       long-retry-limit=16 short-retry-limit=16 rts-threshold=2312
       fragmentation-threshold=2312 join-net=10s card-type=PC4800A 3.65

[admin@MikroTik] interface pc>
```

Interface status monitoring

```
[admin@MikroTik] interface pc> monitor 0
         synchronized: no
           associated: no
         error-number: 0

[admin@MikroTik] interface pc>
```

Example

Suppose we want to configure the wireless interface to accomplish registration on the AP with a **ssid** 'mt'.

We need to change the value of ssid property to the corresponding value.

To view the results, we can use **monitor** feature.

```
[admin@MikroTik] interface pc> set 0 ssid1 mt
[admin@MikroTik] interface pc> monitor 0
         synchronized: yes
           associated: yes
            frequency: 2412MHz
            data-rate: 11Mbit/s
                 ssid: "mt"
         access-point: 00:02:6F:01:5D:FE
    access-point-name: ""
       signal-quality: 132
      signal-strength: -82
         error-number: 0
[admin@MikroTik] interface pc>
```

Troubleshooting

Description

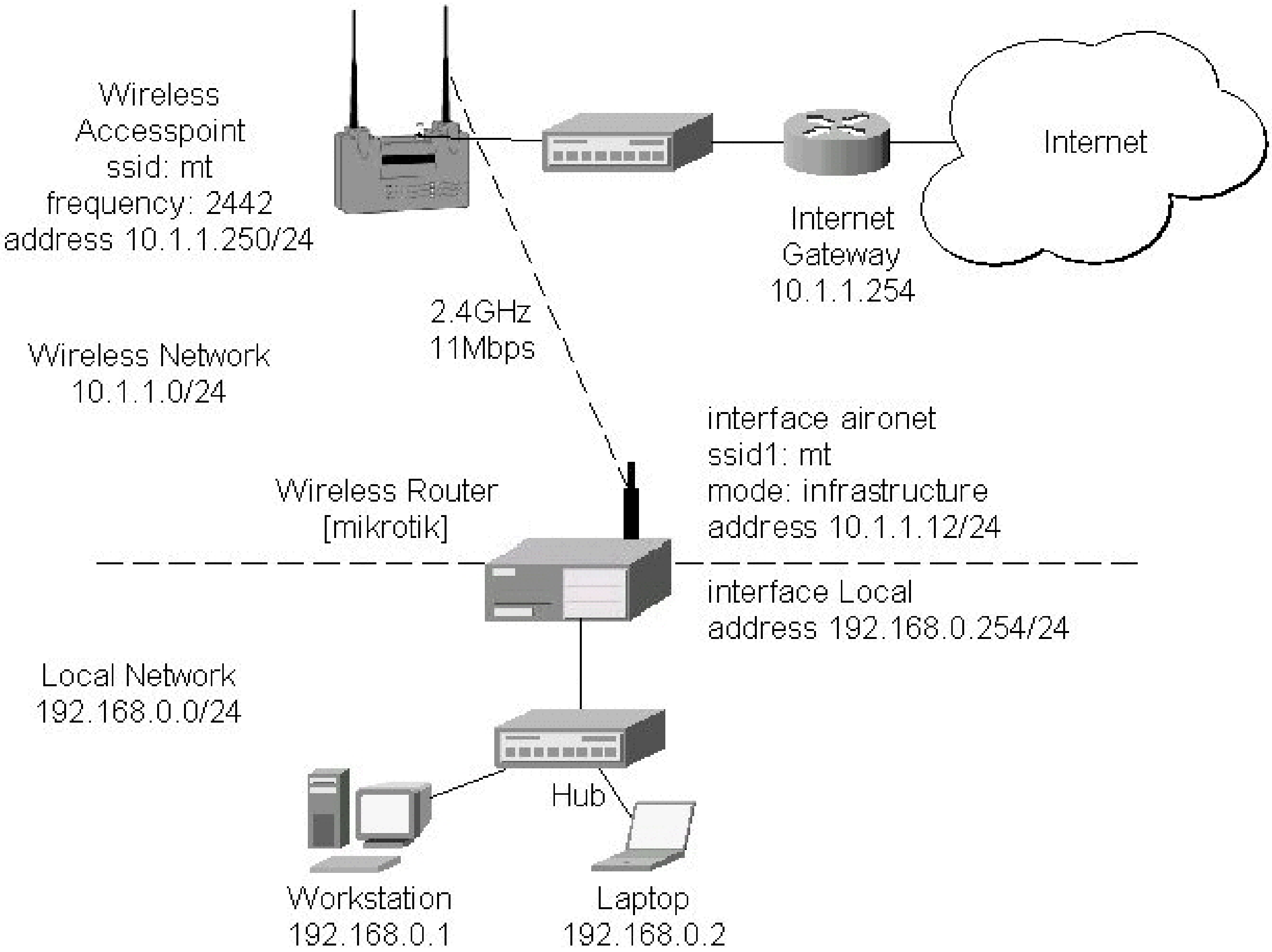
Keep in mind, that not all combinations of I/O base addresses and IRQs may work on particular motherboard. It is recommended that you choose an IRQ not used in your system, and then try to find an acceptable I/O base address setting. As it has been observed, the IRQ 5 and I/O 0x300 or 0x180 will work in most cases.

- **The driver cannot be loaded because other device uses the requested IRQ.**
  Try to set different IRQ using the DIP switches.
- **The requested I/O base address cannot be used on your motherboard.**
  Try to change the I/O base address using the DIP switches.
- **The pc interface does not show up under the interfaces list**
  Obtain the required license for 2.4/5GHz Wireless Client feature.
- **The wireless card does not register to the Access Point**
  Check the cabling and antenna alignment.

Application Examples

Point-to-Multipoint Wireless LAN

Let us consider the following network setup with CISCO/Aironet Wireless Access Point as a base station and MikroTik Wireless Router as a client:



The access point is connected to the wired network's HUB and has IP address from the network 10.1.1.0/24.

The minimum configuration required for the AP is:

1. Setting the Service Set Identifier (up to 32 alphanumeric characters). In our case we use ssid "mt".
2. Setting the allowed data rates at 1-11Mbps, and the basic rate at 1Mbps.
3. Choosing the frequency, in our case we use 2442MHz.
4. (For CISCO/Aironet Bridges only) Set Configuration/Radio/Extended/Bridge/mode=access_point. If you leave it to 'bridge_only', it wont register clients.
5. Setting the identity parameters Configuration/Ident: Inaddr, Inmask, and Gateway. These are required if you want to access the AP remotely using telnet or http.

The IP addresses assigned to the wireless interface should be from the network 10.1.1.0/24:

```
[admin@MikroTik] ip address> add address 10.1.1.12/24 interface aironet
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.1.1.12/24       10.1.1.0        10.1.1.255      aironet
  1   192.168.0.254/24   192.168.0.0     192.168.0.255   Local
[admin@MikroTik] ip address>
```

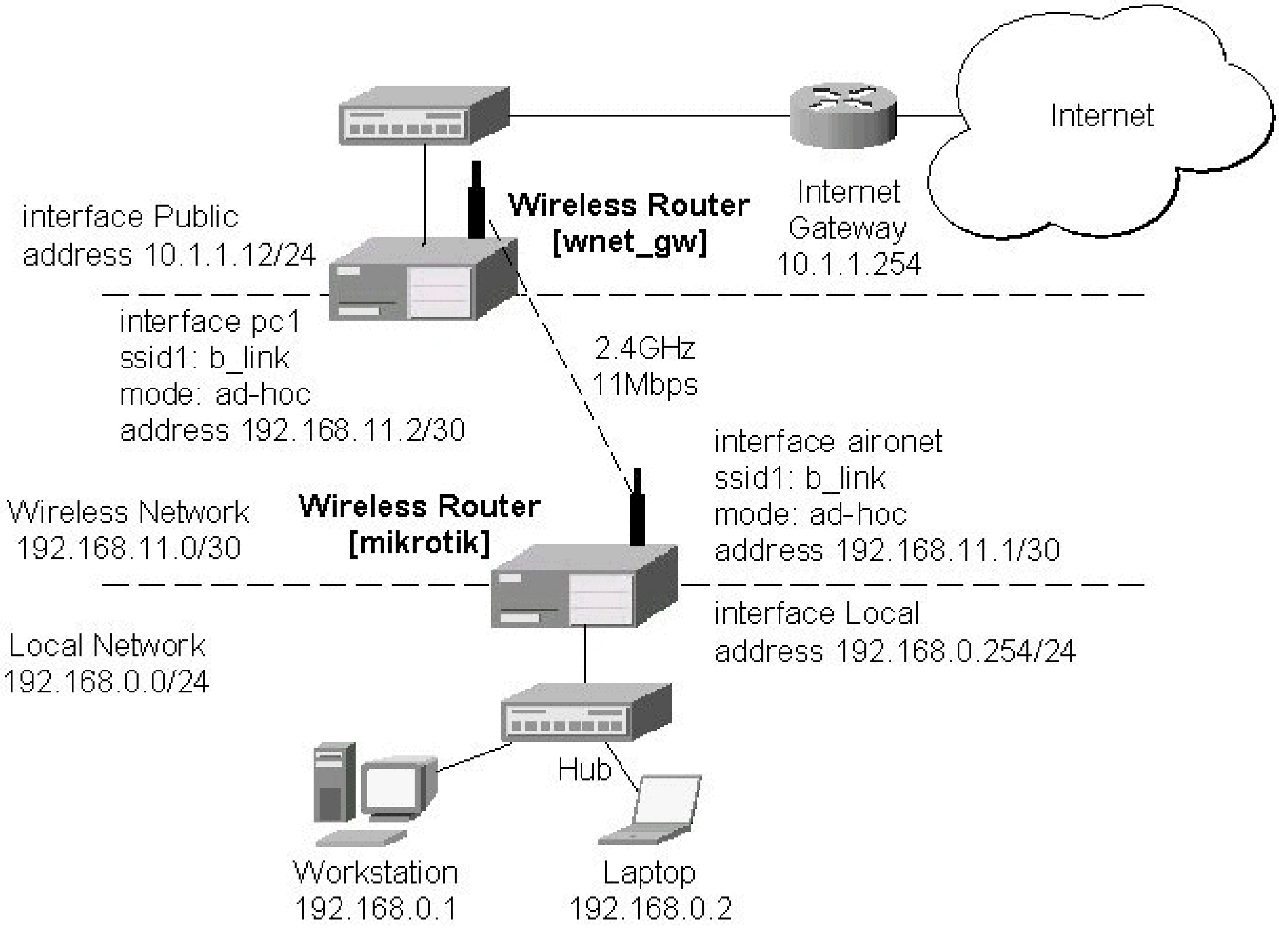
The default route should be set to the gateway router 10.1.1.254 (! not the AP 10.1.1.250 !):

```
[admin@MikroTik] ip route> add gateway=10.1.1.254
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 10.1.1.254      1        aironet
    1 DC 192.168.0.0/24     r 0.0.0.0         0        Local
    2 DC 10.1.1.0/24        r 0.0.0.0         0        aironet

[admin@MikroTik] ip route>
```

Point-to-Point Wireless LAN

Point-to-Point links provide a convenient way to connect a pair of clients on a short distance.

Let us consider the following point-to-point wireless network setup with two MikroTik wireless routers:


Internet
Internet Gateway 10.1.1.254
Wireless Router [wnet_gw]
interface Public address 10.1.1.12/24
interface pc1 ssid1: b_link mode: ad-hoc address 192.168.11.2/30
2.4GHz 11Mbps
interface aironet ssid1: b_link mode: ad-hoc address 192.168.11.1/30
Wireless Network 192.168.11.0/30
Wireless Router [mikrotik]
interface Local address 192.168.0.254/24
Local Network 192.168.0.0/24
Hub
Workstation 192.168.0.1
Laptop 192.168.0.2

To establish a point-to-point link, the configuration of the wireless interface should be as follows:

- A unique Service Set Identifier should be chosen for both ends, say "mt"
- A channel frequency should be selected for the link, say 2412MHz
- The operation mode should be set to ad-hoc

- One of the units (slave) should have wireless interface property join-net set to 0s (never create a network), the other unit (master) should be set to 1s or whatever, say 10s. This will enable the master unit to create a network and register the slave unit to it.

The following command should be issued to change the settings for the pc interface of the master unit:

```
[admin@MikroTik] interface pc> set 0 mode=ad-hoc ssid1=mt frequency=2442MHz \
\... bitrate=auto
[admin@MikroTik] interface pc>
```

For 10 seconds (this is set by the property **join-net**) the wireless card will look for a network to join. The status of the card is not synchronized, and the green status light is blinking fast. If the card cannot find a network, it creates its own network. The status of the card becomes synchronized, and the green status led becomes solid.

The monitor command shows the new status and the MAC address generated:

```
[admin@MikroTik] interface pc> monitor 0
         synchronized: yes
           associated: yes
            frequency: 2442MHz
            data-rate: 11Mbit/s
                 ssid: "mt"
         access-point: 2E:00:B8:01:98:01
    access-point-name: ""
       signal-quality: 35
      signal-strength: -62
         error-number: 0
[admin@MikroTik] interface pc>
```

The other router of the point-to-point link requires the operation mode set to **ad-hoc**, the System Service Identifier set to 'mt', and the channel frequency set to 2412MHz. If the cards are able to establish RF connection, the status of the card should become synchronized, and the green status led should become solid immediately after entering the command:

```
[admin@wnet_gw] interface pc> set 0 mode=ad-hoc ssid1=b_link frequency=2412MHz \
\... bitrate=auto
[admin@wnet_gw] interface pc> monitor 0
         synchronized: yes
           associated: no
            frequency: 2442MHz
            data-rate: 11Mbit/s
                 ssid: "b_link"
         access-point: 2E:00:B8:01:98:01
    access-point-name: ""
       signal-quality: 131
      signal-strength: -83
         error-number: 0

[admin@wnet_gw] interface pc>
```

As we see, the MAC address under the **access-point** property is the same as on the first router.

If desired, IP addresses can be assigned to the wireless interfaces of the pint-to-point linked routers using a smaller subnet, say 30-bit one:

```
[admin@MikroTik] ip address> add address 192.168.11.1/30 interface aironet
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   192.168.11.1/30    192.168.11.0    192.168.11.3    aironet
  1   192.168.0.254/24   192.168.0.0     192.168.0.255   Local
[admin@MikroTik] ip address>
```

The second router will have address 192.168.11.2. The network connectivity can be tested by using ping or bandwidth test:

```
[admin@wnet_gw] ip address> add address 192.168.11.2/30 interface aironet
[admin@wnet_gw] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   192.168.11.2/30    192.168.11.0    192.168.11.3    aironet
  1   10.1.1.12/24       10.1.1.0        10.1.1.255      Public
[admin@wnet_gw] ip address> /ping 192.168.11.1
192.168.11.1 pong: ttl=255 time=3 ms
192.168.11.1 pong: ttl=255 time=1 ms
192.168.11.1 pong: ttl=255 time=1 ms
192.168.11.1 pong: ttl=255 ping interrupted
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 1/1.5/3 ms
[admin@wnet_gw] interface pc> /tool bandwidth-test 192.168.11.1 protocol tcp
                  status: running
              rx-current: 4.61Mbps
    rx-10-second-average: 4.25Mbps
        rx-total-average: 4.27Mbps

[admin@wnet_gw] interface pc> /tool bandwidth-test 192.168.11.1 protocol udp size 1500
                  status: running
              rx-current: 5.64Mbps
    rx-10-second-average: 5.32Mbps
        rx-total-average: 4.87Mbps

[admin@wnet_gw] interface pc>
```

IPIP Tunnel Interfaces

Document revision 1.1 (Fri Mar 05 08:25:43 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The IPIP tunneling implementation on the MikroTik RouterOS is RFC 2003 compliant. IPIP tunnel is a simple protocol that encapsulates IP packets in IP to make a tunnel between two routers. The IPIP tunnel interface appears as an interface under the interface list. Many routers, including Cisco and Linux based, support this protocol. This protocol makes multiple network schemes possible.

IP tunneling protocol adds the following possibilities to a network setups:

- to tunnel Intranets over the Internet
- to use it instead of source routing

Quick Setup Guide

To make an IPIP tunnel between 2 MikroTik routers with IP addresses **10.5.8.104** and **10.1.0.172**, using IPIP tunnel addresses 10.0.0.1 and 10.0.0.2, follow the next steps.

- Configuration on router with IP address **10.5.8.104**:
  1. Add an IPIP interface (by default, its name will be **ipip1**):

```
[admin@10.5.8.104] interface ipip> add local-address=10.5.8.104 \
remote-address=10.1.0.172 disabled=no
```

  2. Add an IP address to created **ipip1** interface:

```
[admin@10.5.8.104] ip address> add address=10.0.0.1/24 interface=ipip1
```

- Configuration on router with IP address **10.1.0.172**:

1. Add an IPIP interface (by default, its name will be **ipip1**):

```
[admin@10.1.0.172] interface ipip> add local-address=10.1.0.172 \
remote-address=10.5.8.104 disabled=no
```

2. Add an IP address to created **ipip1** interface:

```
[admin@10.1.0.172] ip address> add address=10.0.0.2/24 interface=ipip1
```

Specifications

Packages required: ***system***
License required: ***level1 (limited to 1 tunnel), level3 (200 tunnels), level5 (unlimited)***
Home menu level: ***/interface ipip***
Standards and Technologies: ***IPIP (RFC 2003)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***IP Addresses and ARP***
- ***Log Management***

Additional Documents

- ***http://www.ietf.org/rfc/rfc1853.txt?number=1853***
- ***http://www.ietf.org/rfc/rfc2003.txt?number=2003***
- ***http://www.ietf.org/rfc/rfc1241.txt?number=1241***

IPIP Setup

Home menu level: ***/interface ipip***

Description

An IPIP interface should be configured on two routers that have the possibility for an IP level connection and are ***RFC 2003*** compliant. The IPIP tunnel may run over any connection that transports IP. Each IPIP tunnel interface can connect with one remote router that has a corresponding interface configured. An unlimited number of IPIP tunnels may be added to the router. For more details on IPIP tunnels, see ***RFC 2003***.

Property Description

name (*name*; default: **ipipN**) - interface name for reference

mtu (*integer*; default: **1480**) - Maximum Transmission Unit. Should be set to 1480 bytes to avoid fragmentation of packets. May be set to 1500 bytes if mtu path discovery is not working properly on links

local-address (*IP address*) - local address on router which sends IPIP traffic to the remote host

remote-address (*IP address*) - the IP address of the remote host of the IPIP tunnel - may be any RFC 2003 compliant router

Notes

Use **/ip address add** command to assign an **IP address** to the IPIP interface.

There is no authentication or 'state' for this interface. The bandwidth usage of the interface may be monitored with the **monitor** feature from the **interface** menu.

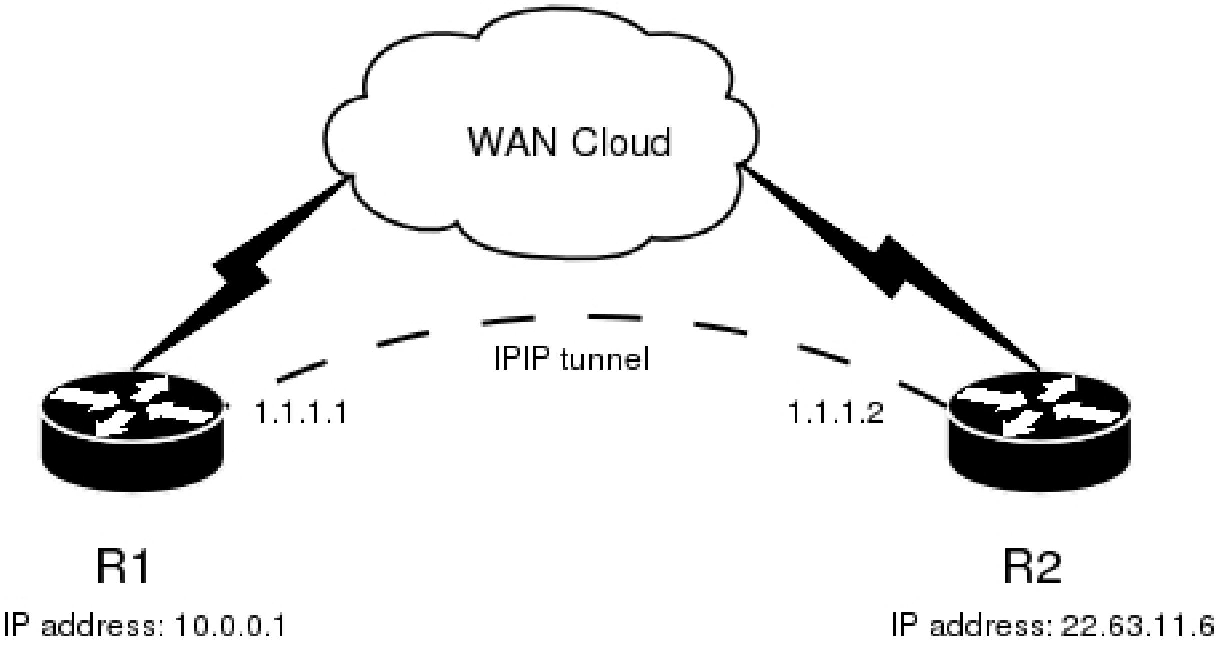
MikroTik RouterOS IPIP implementation has been tested with Cisco 1005. The sample of the Cisco 1005 configuration is given below:

```
interface Tunnel0
 ip address 10.3.0.1 255.255.255.0
 tunnel source 10.0.0.171
 tunnel destination 10.0.0.204
 tunnel mode ipip
```

General Information

Description

Suppose we want to add an IPIP tunnel between routers **R1** and **R2**:



At first, we need to configure IPIP interfaces and then add **IP addresses** to them.

The configuration for router **R1** is as follows:

```
[admin@MikroTik] interface ipip> add
local-address: 10.0.0.1
remote-address: 22.63.11.6
```

```
[admin@MikroTik] interface ipip> print
Flags: X - disabled, R - running
  #    NAME                               MTU   LOCAL-ADDRESS   REMOTE-ADDRESS
  0 X  ipip1                              1480  10.0.0.1        22.63.11.6

[admin@MikroTik] interface ipip> en 0
[admin@MikroTik] interface ipip> /ip address add address 1.1.1.1/24 interface=ipip1
```

The configuration of the **R2** is shown below:

```
[admin@MikroTik] interface ipip> add local-address=22.63.11.6 remote-address=10.
0.0.1
[admin@MikroTik] interface ipip> print
Flags: X - disabled, R - running
  #    NAME                               MTU   LOCAL-ADDRESS   REMOTE-ADDRESS
  0 X  ipip1                              1480  22.63.11.6      10.0.0.1

[admin@MikroTik] interface ipip> enable 0
[admin@MikroTik] interface ipip> /ip address add address 1.1.1.2/24 interface=ipip1
```

Now both routers can ping each other:

```
[admin@MikroTik] interface ipip> /ping 1.1.1.2
1.1.1.2 64 byte ping: ttl=64 time=24 ms
1.1.1.2 64 byte ping: ttl=64 time=19 ms
1.1.1.2 64 byte ping: ttl=64 time=20 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 19/21.0/24 ms
[admin@MikroTik] interface ipip>
```

Ethernet Interfaces

Document revision 1.2 (Fri Apr 16 12:35:37 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

MikroTik RouterOS supports various types of Ethernet Interfaces. The complete list of supported Ethernet NICs can be found in the ***Device Driver List***.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/interface ethernet***
Standards and Technologies: ***IEEE 802.3***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***IP Addresses and ARP***
- ***DHCP Client and Server***

Additional Documents

- ***http://www.ethermanage.com/ethernet/ethernet.html***
- ***http://www.dcs.gla.ac.uk/~liddellj/nct/ethernet_protocol.html***

Ethernet Interface Configuration

Home menu level: ***/interface ethernet***

Property Description

name (*name*; default: **etherN**) - assigned interface name, whrere 'N' is the number of the ethernet interface

arp (*disabled | enabled | proxy-arp | reply-only*; default: **enabled**) - Address Resolution Protocol

mtu (*integer*; default: **1500**) - Maximum Transmission Unit

disable-running-check (*yes* | *no*; default: **yes**) - disable running check. If this value is set to 'no', the router automatically detects whether the NIC is connected with a device in the network or not

mac-address (*read-only: MAC address*) - Media Access Control address of the card

auto-negotiation (*yes* | *no*; default: **yes**) - when enabled, the interface "advertises" its maximum capabilities to achieve the best connection possible

full-duplex (*yes* | *no*; default: **yes**) - defines whether the transmission of data appears in two directions simultaneously

long-cable (*yes* | *no*; default: **no**) - changes the cable length setting (only applicable to NS DP83815/6 cards). For cable lengths of more than 50m, set "long-cable=yes"

speed (*10 Mbps* | *100 Mbps* | *1000 Mbps*) - sets the data transmission speed of the interface. By default, this value is the maximal data rate supported by the interface

Notes

For some Ethernet NICs it is possible to blink the LEDs for 10s. Type **/interface ethernet blink ether1** and watch the NICs to see the one which has blinking LEDs.

When **disable-running-check** is set to **no**, the router automatically detects whether the NIC is connected to a device in the network or not. When the remote device is not connected (the leds are not blinking), the route which is set on the specific interface, becomes invalid.

Example

```
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
 #    NAME                         TYPE             RX-RATE    TX-RATE    MTU
 0  X ether1                       ether            0          0          1500
[admin@MikroTik] > interface enable ether1
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
 #    NAME                         TYPE             RX-RATE    TX-RATE    MTU
 0  R ether1                       ether            0          0          1500
[admin@MikroTik] > interface ethernet
[admin@MikroTik] interface ethernet> print
Flags: X - disabled, R - running
```

```
 #    NAME                                   MTU   MAC-ADDRESS       ARP
 0  R ether1                                 1500  00:0C:42:03:00:F2 enabled
[admin@MikroTik] interface ethernet> print detail
Flags: X - disabled, R - running
 0  R name="ether1" mtu=1500 mac-address=00:0C:42:03:00:F2 arp=enabled
      disable-running-check=yes auto-negotiation=yes full-duplex=yes
      long-cable=no speed=100Mbps
[admin@MikroTik] interface ethernet>
```

Monitoring the Interface Status

Command name: ***/interface ethernet monitor***

Property Description

status (*link-ok* | *no-link* | *unknown*) - status of the interface, one of the:

- **link-ok** - the card has connected to the network
- **no-link** - the card has not connected to the network
- **unknown** - the connection is not recognized

rate (*10 Mbps* | *100 Mbps* | *1000 Mbps*) - the actual data rate of the connection

auto-negotiation (*done* | *incomplete*) - fast link pulses (FLP) to the adjacent link station to negotiate the SPEED and MODE of the link

- **done** - negotiation done
- **incomplete** - negotiation failed

full-duplex (*yes* | *no*) - whether transmission of data occurs in two directions simultaneously

Notes

See the ***IP Addresses and ARP*** section of the manual for information how to add **IP addresses** to the interfaces.

Example

```
[admin@MikroTik] interface ethernet> monitor ether1,ether2
              status: link-ok link-ok
    auto-negotiation: done    done
                rate: 100Mbps 100Mbps
         full-duplex: yes     yes
```

Troubleshooting

Description

- **Interface monitor shows wrong information**
  In some very rare cases it is possible that the device driver does not show correct information, but it does not affect the NIC's performance (of course, if your card is not broken)

MOXA C502 Dual-port Synchronous Interface

Document revision 1.1 (Fri Mar 05 08:16:21 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS supports the MOXA C502 PCI Dual-port Synchronous 8Mb/s Adapter hardware. The V.35 synchronous interface is the standard for VSAT and other satellite modems. However, you must check with the satellite system supplier for the modem interface type.

Specifications

Packages required: ***synchronous***
License required: ***level4***
Home menu level: ***/interface moxa-c502***
Standards and Technologies: ***Cisco/HDLC-X.25 (RFC 1356)***, ***Frame Relay (RFC1490)***, ***PPP (RFC-1661)***, ***PPP (RFC-1662)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***IP Addresses and ARP***

- *Log Management*

Description

You can install up to four MOXA C502 synchronous cards in one PC box, if you have so many PCI slots available. Assuming you have all necessary packages and licences installed, in most cases it should to be done nothing at that point (all drivers are loaded automatically).

Additional Documents

For more information about the MOXA C502 Dual-port Synchronous 8Mb/s Adapter hardware please see:

- *C502 Dual Port Sync Board User's Manuall* the user's manual in PDF format

Synchronous Interface Configuration

Home menu level: ***/interface moxa-c502***

Description

Moxa c502 synchronous interface is shown under the interfaces list with the name moxa-c502-N

Property Description

name (*name*; default: **moxa-c502-N**) - interface name

cisco-hdlc-keepalive-interval (*time*; default: **10s**) - keepalive period in seconds

clock-rate (*integer*; default: **64000**) - speed of internal clock

clock-source (*external* | *internal* | *tx-from-rx* | *tx-internal*; default: **external**) - clock source

frame-relay-dce (*yes* | *no*; default: **no**) - operate or not in DCE mode

frame-relay-lmi-type (*ansi* | *ccitt*; default: **ansi**) - Frame-relay Local Management Interface type:

- **ansi** - set LMI type to ANSI-617d (also known as Annex A)
- **ccitt** - set LMI type to CCITT Q933a (also known as Annex A)

ignore-dcd (*yes* | *no*; default: **no**) - ignore or not DCD

line-protocol (*cisco-hdlc* | *frame-relay* | *sync-ppp*; default: **sync-ppp**) - line protocol name

mtu (*integer*; default: **1500**) - Maximum Transmit Unit

Notes

There will be TWO interfaces for each MOXA C502 card since the card has TWO ports.

The MikroTik driver for the MOXA C502 Dual Synchronous adapter allows you to unplug the V.35 cable from one modem and plug it into another modem with a different clock speed, and you do not need to restart the interface or router.

The default encapsulation method for CISCO is **HDLC**. If you have not changed this setting on CISCO, you should change **line-protocol** to **cisco-hdlc** for Moxa C502 interface.

Example

```
[admin@MikroTik] interface moxa-c502> set 0,1 line-protocol=cisco-hdlc
[admin@MikroTik] interface moxa-c502> print
Flags: X - disabled, R - running
  0  R name="moxa-c502-1" mtu=1500 line-protocol=cisco-hdlc clock-rate=64000
       clock-source=external frame-relay-lmi-type=ansi frame-relay-dce=no
       cisco-hdlc-keepalive-interval=10s
  1  R name="moxa-c502-2" mtu=1500 line-protocol=cisco-hdlc clock-rate=64000
       clock-source=external frame-relay-lmi-type=ansi frame-relay-dce=no
       cisco-hdlc-keepalive-interval=10s

[admin@MikroTik] interface moxa-c502>
```

You can monitor the status of the synchronous interface:

```
[admin@MikroTik] interface moxa-c502> monitor 0
    dtr: yes
    rts: yes
    cts: no
    dsr: no
    dcd: no

[admin@MikroTik] interface moxa-c502>
```

Connect a communication device, e.g., a baseband modem, to the V.35 port and turn it on. If the link is working properly the status of the interface is:

```
[admin@MikroTik] interface moxa-c502> monitor 0
    dtr: yes
    rts: yes
    cts: yes
    dsr: yes
    dcd: yes

[admin@MikroTik] interface moxa-c502>
```

Troubleshooting

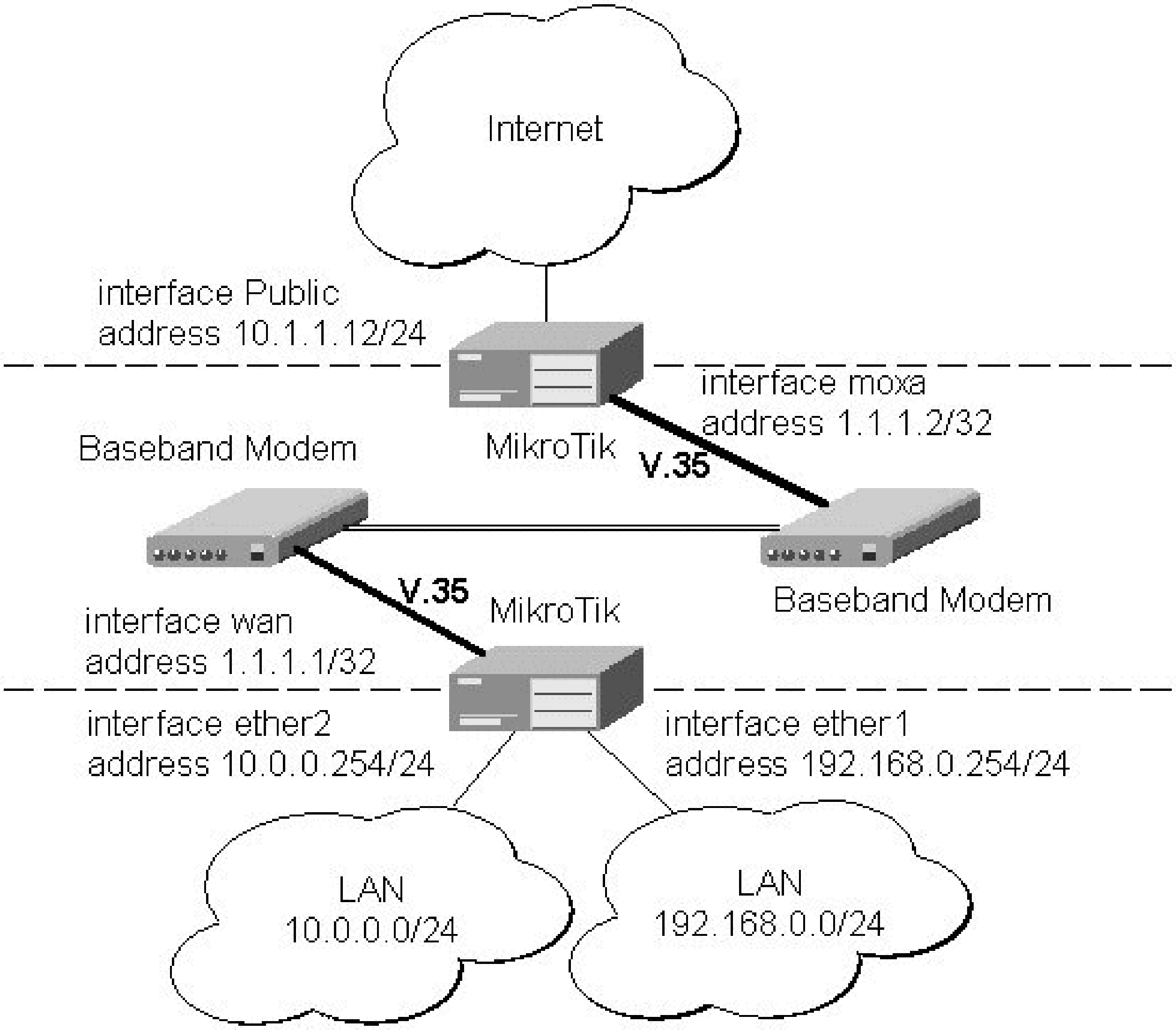
Description

- **The synchronous interface does not show up under the interfaces list**
  Obtain the required license for synchronous feature
- **The synchronous link does not work**
  Check the V.35 cabling and the line between the modems. Read the modem manual

Synchronous Link Application Examples

MikroTik Router to MikroTik Router

Let us consider the following network setup with two MikroTik Routers connected to a leased line with baseband modems:



The driver for MOXA C502 card should be loaded and the interface should be enabled according to the instructions given above. The IP addresses assigned to the synchronous interface should be as follows:

```
[admin@MikroTik] ip address> add address 1.1.1.1/32 interface wan \
\... network 1.1.1.2 broadcast 255.255.255.255

[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.254/24      10.0.0.254      10.0.0.255      ether2
  1   192.168.0.254/24   192.168.0.254   192.168.0.255   ether1
  2   1.1.1.1/32         1.1.1.2         255.255.255.255 wan
[admin@MikroTik] ip address> /ping 1.1.1.2
1.1.1.2 64 byte pong: ttl=255 time=31 ms
1.1.1.2 64 byte pong: ttl=255 time=26 ms
1.1.1.2 64 byte pong: ttl=255 time=26 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 26/27.6/31 ms
[admin@MikroTik] ip address>
```

The default route should be set to the gateway router 1.1.1.2:

```
[admin@MikroTik] ip route> add gateway 1.1.1.2 interface wan
```

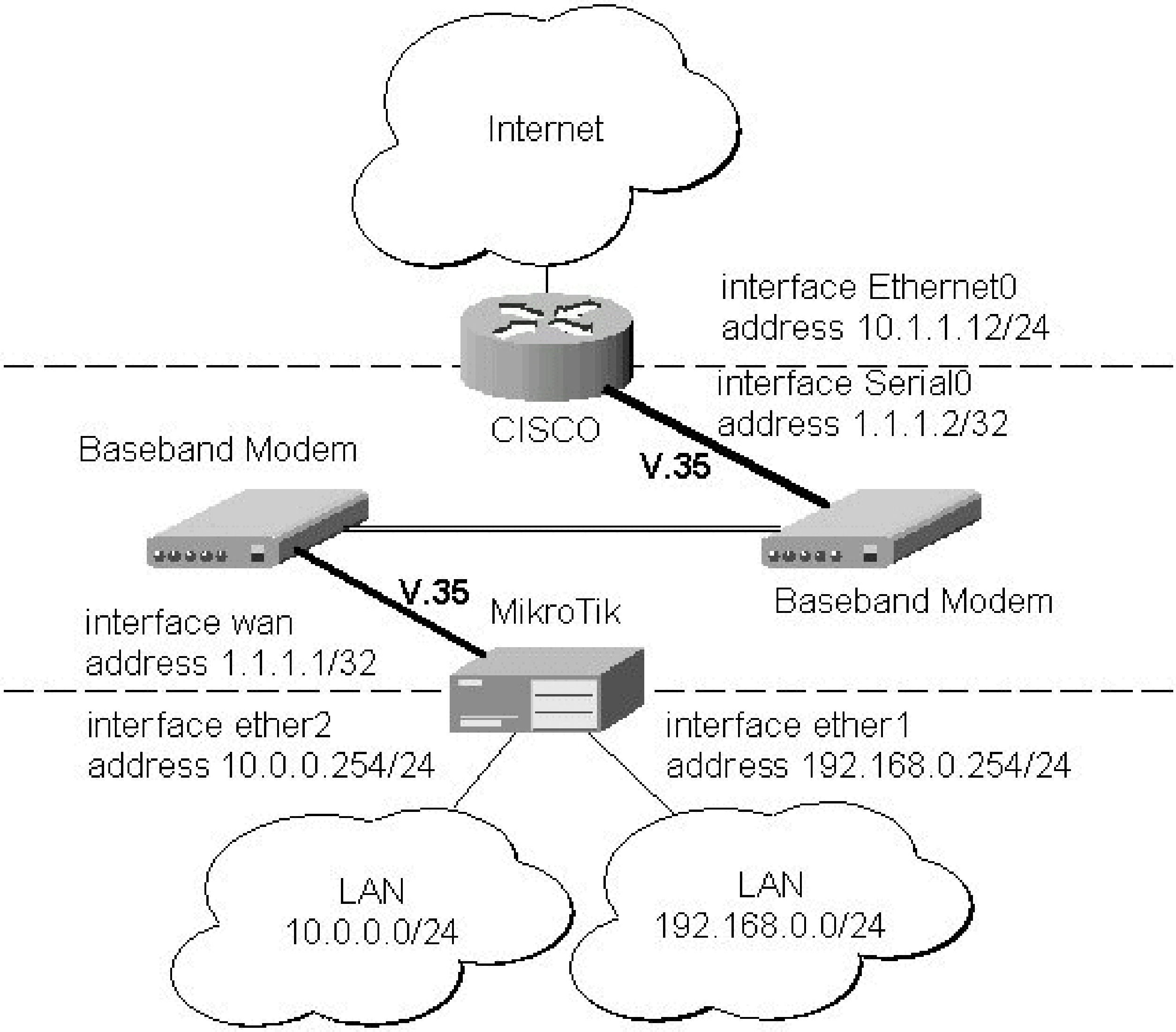
```
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 1.1.1.2         1        wan
    1 DC 10.0.0.0/24        r 10.0.0.254      1        ether2
    2 DC 192.168.0.0/24     r 192.168.0.254   0        ether1
    3 DC 1.1.1.2/32         r 0.0.0.0         0        wan

[admin@MikroTik] ip route>
```

The configuration of the MikroTik router at the other end is similar:

```
[admin@MikroTik] ip address> add address 1.1.1.2/32 interface moxa \
\... network 1.1.1.1 broadcast 255.255.255.255
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.1.1.12/24       10.1.1.12       10.1.1.255      Public
  1   1.1.1.2/32         1.1.1.1         255.255.255.255 moxa
[admin@MikroTik] ip address> /ping 1.1.1.1
1.1.1.1 64 byte pong: ttl=255 time=31 ms
1.1.1.1 64 byte pong: ttl=255 time=26 ms
1.1.1.1 64 byte pong: ttl=255 time=26 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 26/27.6/31 ms
[admin@MikroTik] ip address>
```

MikroTik Router to Cisco Router

Let us consider the following network setup with MikroTik Router connected to a leased line with baseband modems and a CISCO router at the other end:



The driver for MOXA C502 card should be loaded and the interface should be enabled according to the instructions given above. The IP addresses assigned to the synchronous interface should be as follows:

```
[admin@MikroTik] ip address> add address 1.1.1.1/32 interface wan \
\... network 1.1.1.2 broadcast 255.255.255.255
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.254/24      10.0.0.254      10.0.0.255      ether2
  1   192.168.0.254/24   192.168.0.254   192.168.0.255   ether1
  2   1.1.1.1/32         1.1.1.2         255.255.255.255 wan
[admin@MikroTik] ip address> /ping 1.1.1.2
1.1.1.2 64 byte pong: ttl=255 time=31 ms
1.1.1.2 64 byte pong: ttl=255 time=26 ms
1.1.1.2 64 byte pong: ttl=255 time=26 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 26/27.6/31 ms
[admin@MikroTik] ip address>
```

The default route should be set to the gateway router 1.1.1.2:

```
[admin@MikroTik] ip route> add gateway 1.1.1.2
[admin@MikroTik] ip route> print
```

```
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 1.1.1.2         1        wan
    1 DC 10.0.0.0/24        r 10.0.0.254      0        ether2
    2 DC 192.168.0.0/24     r 192.168.0.254   0        ether1
    3 DC 1.1.1.2/32         r 1.1.1.1         0        wan

[admin@MikroTik] ip route>
```

The configuration of the Cisco router at the other end (part of the configuration) is:

```
CISCO#show running-config
Building configuration...

Current configuration:
...
!
interface Ethernet0
 description connected to EthernetLAN
 ip address 10.1.1.12 255.255.255.0
!
interface Serial0
 description connected to MikroTik
 ip address 1.1.1.2 255.255.255.252
 serial restart-delay 1
!
ip classless
ip route 0.0.0.0 0.0.0.0 10.1.1.254
!
...
end

CISCO#
```

Send ping packets to the MikroTik router:

```
CISCO#ping 1.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/32/40 ms
CISCO#
```

Note! Keep in mind that for the point-to-point link the network mask is set to **32** bits, the argument **network** is set to the IP address of the other end, and the broadcast address is set to **255.255.255.255**.

VLAN Interface

Document revision 1.1 (Fri Mar 05 08:24:34 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

VLAN is an implementation of the 802.1Q VLAN protocol for MikroTik RouterOS. It allows you to have multiple Virtual LANs on a single ethernet cable, giving the ability to segregate LANs efficiently. It supports up to 250 vlan interfaces per ethernet device. Many routers, including Cisco and Linux based, and many Layer 2 switches also support it.

A VLAN is a logical grouping that allows end users to communicate as if they were physically connected to a single isolated LAN, independent of the physical configuration of the network. VLAN support adds a new dimension of security and cost savings permitting the sharing of a physical network while logically maintaining separation among unrelated users.

Specifications

Packages required: ***system***
License required: ***level1 (limited to 1 vlan), level3***
Home menu level: ***/interface vlan***
Standards and Technologies: ***VLAN (IEEE 802.1Q)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***

Description

VLANs are simply a way of grouping a set of switch ports together so that they form a logical network, separate from any other such group. Within a single switch this is straightforward local configuration. When the VLAN extends over more than one switch, the inter-switch links have to become trunks, on which packets are tagged to indicate which VLAN they belong to.

You can use MikroTik RouterOS (as well as Cisco IOS and Linux) to mark these packets as well as to accept and route marked ones.

As VLAN works on OSI Layer 2, it can be used just as any other network interface without any restrictions. And VLAN successfully passes through Ethernet bridges (for MikroTik RouterOS bridges you should set **forward-protocols** to **ip**, **arp** and **other**; for other bridges there should be analogical settings).

Currently Supported Interfaces

This is a list of network interfaces on which VLAN was tested and worked. Note that there might be many other interfaces that support VLAN, but they just were not checked.

- Realtek 8139
- Intel PRO/100
- Intel PRO1000 server adapter
- National Semiconductor DP83815/DP83816 based cards (RouterBOARD200 onboard Ethernet, RouterBOARD 24 card)
- VIA VT6105M based cards (RouterBOARD 44 card)
- VIA VT6105
- VIA VT6102 (VIA EPIA onboard Ethernet)

This is a list of network interfaces on which VLAN was tested and worked, but **WITHOUT LARGE PACKET (>1496 bytes) SUPPORT**:

- 3Com 3c59x PCI
- DEC 21140 (tulip)

Additional Documents

- ***http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121t/121t3/dtbridge.htm#x***
- ***http://www.cisco.com/warp/public/473/27.html#tagging***
- ***http://www.nwfusion.com/news/tech/2001/0305tech.html***

VLAN Setup

Home menu level: ***/interface vlan***

Property Description

name (*name*) - interface name for reference

mtu (*integer*; default: **1500**) - Maximum Transmission Unit

interface (*name*) - physical interface to the network where are VLANs

arp (*disabled* | *enabled* | *proxy-arp* | *reply-only*; default: **enabled**) - Address Resolution Protocol setting

- **disabled** - the interface will not use ARP protocol
- **enabled** - the interface will use ARP protocol
- **proxy-arp** - the interface will be an ARP proxy
- **reply-only** - the interface will only reply to the requests originated to its own IP addresses, but neighbor MAC addresses will be gathered from /ip arp statically set table only

vlan-id (*integer*; default: **1**) - Virtual LAN identifier or tag that is used to distinguish VLANs. Must be equal for all computers in one VLAN.

Notes

MTU should be set to 1500 bytes as on Ethernet interfaces. But this may not work with some Ethernet cards that do not support receiving/transmitting of full size Ethernet packets with VLAN header added (1500 bytes data + 4 bytes VLAN header + 14 bytes Ethernet header). In this situation MTU 1496 can be used, but note that this will cause packet fragmentation if larger packets have to be sent over interface. At the same time remember that MTU 1496 may cause problems if path MTU discovery is not working properly between source and destination.

Example

To add and enable a VLAN interface named **test** with **vlan-id**=1 on interface **ether1**:

```
[admin@MikroTik] interface vlan> add name=test vlan-id=1 interface=ether1
[admin@MikroTik] interface vlan> print
Flags: X - disabled, R - running
  #    NAME                 MTU  ARP       VLAN-ID INTERFACE
  0 X  test                 1500 enabled   1       ether1
[admin@MikroTik] interface vlan> enable 0
[admin@MikroTik] interface vlan> print
Flags: X - disabled, R - running
  #    NAME                 MTU  ARP       VLAN-ID INTERFACE
  0  R test                 1500 enabled   1       ether1
[admin@MikroTik] interface vlan>
```

Application Example

VLAN example on MikroTik Routers

Let us assume that we have two or more MikroTik RouterOS routers connected with a hub. Interfaces to the physical network, where VLAN is to be created is **ether1** for all of them (it is needed only for example simplification, it is NOT a must).

To connect computers through VLAN they must be connected physically and unique IP addresses should be assigned them so that they could ping each other. Then on each of them the VLAN interface should be created:

```
[admin@MikroTik] interface vlan> add name=test vlan-id=32 interface=ether1
```

```
[admin@MikroTik] interface vlan> print
Flags: X - disabled, R - running
  #    NAME                 MTU  ARP       VLAN-ID INTERFACE
  0  R test                 1500 enabled   32      ether1
[admin@MikroTik] interface vlan>
```

If the interfaces were successfully created, both of them will be **running**. If computers are connected incorrectly (through network device that does not retransmit or forward VLAN packets), either both or one of the interfaces will not be **running**.

When the interface is running, IP addresses can be assigned to the VLAN interfaces.

On the Router 1:

```
[admin@MikroTik] ip address> add address=10.10.10.1/24 interface=test
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.204/24      10.0.0.0        10.0.0.255      ether1
  1   10.20.0.1/24       10.20.0.0       10.20.0.255     pc1
  2   10.10.10.1/24      10.10.10.0      10.10.10.255    test
[admin@MikroTik] ip address>
```

On the Router 2:

```
[admin@MikroTik] ip address> add address=10.10.10.2/24 interface=test
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.201/24      10.0.0.0        10.0.0.255      ether1
  1   10.10.10.2/24      10.10.10.0      10.10.10.255    test
[admin@MikroTik] ip address>
```

If it set up correctly, then it is possible to ping Router 2 from Router 1 and vice versa:

```
[admin@MikroTik] ip address> /ping 10.10.10.1
10.10.10.1 64 byte pong: ttl=255 time=3 ms
10.10.10.1 64 byte pong: ttl=255 time=4 ms
10.10.10.1 64 byte pong: ttl=255 time=10 ms
10.10.10.1 64 byte pong: ttl=255 time=5 ms
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 3/10.5/10 ms
[admin@MikroTik] ip address> /ping 10.10.10.2
10.10.10.2 64 byte pong: ttl=255 time=10 ms
10.10.10.2 64 byte pong: ttl=255 time=11 ms
10.10.10.2 64 byte pong: ttl=255 time=10 ms
10.10.10.2 64 byte pong: ttl=255 time=13 ms
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 10/11/13 ms
[admin@MikroTik] ip address>
```

RadioLAN 5.8GHz Wireless Interface

Document revision 1.1 (Fri Mar 05 08:17:04 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS supports the following RadioLAN 5.8GHz Wireless Adapter hardware:

- RadioLAN ISA card (Model 101)
- RadioLAN PCMCIA card

For more information about the RadioLAN adapter hardware please see the relevant User???s Guides and Technical Reference Manuals.

Specifications

Packages required: ***radiolan***
License required: ***level4***
Home menu level: ***/interface radiolan***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***IP Addresses and ARP***
- ***Log Management***

Description

Installing the Wireless Adapter

These installation instructions apply to non-Plug-and-Play ISA cards. If You have a Plug-and-Play compliant system AND **PnP OS Installed** option in system BIOS is set to **Yes** AND you have a Plug-and-Play compliant ISA or PCI card (using PCMCIA or CardBus card with Plug-and-Play compliant adapter), the driver should be loaded automatically. If it is not, these instructions may also apply to your system.

The basic installation steps of the wireless adapter should be as follows:

1. Check the system BIOS settings for peripheral devices, like, Parallel or Serial communication ports. Disable them, if you plan to use IRQ's assigned to them by the BIOS.
2. Use the ***RLProg.exe*** to set the IRQ and Base Port address of the RadioLAN ISA card (Model 101). RLProg must not be run from a DOS window. Use a separate computer or a bootable floppy to run the RLProg utility and set the hardware parameters. The factory default values of I/O 0x300 and IRQ 10 might conflict with other devices.

Please note, that not all combinations of I/O base addresses and IRQs may work on your motherboard. As it has been observed, the IRQ 5 and I/O 0x300 work in most cases.

Wireless Interface Configuration

Home menu level: ***/interface ratiolan***

Description

To set the wireless interface for working with another wireless card in a point-to-point link, you should set the following parameters:

- The **Service Set Identifier**. It should match the sid of the other card.
- The **Distance** should be set to that of the link. For example, if you have 6 km link, use distance 4.7 km - 6.6 km.

All other parameters can be left as default. You can monitor the list of neighbors having the same sid and being within the radio range.

Property Description

name (*name*; default: **radiolanN**) - assigned interface name

mtu (*integer*; default: **1500**) - Maximum Transmission Unit

mac-address (*read-only: MAC address*) - MAC address

distance (*0-150m | 10.2km-13.0km | 2.0km-2.9km | 4.7km-6.6km | 1.1km-2.0km | 150m-1.1km | 2.9km-4.7km | 6.6km-10.2km*; default: **0-150m**) - distance setting for the link

rx-diversity (*enabled | disabled*; default: **disabled**) - receive diversity

tx-diversity (*enabled | disabled*; default: **disabled**) - transmit diversity

default-destination (*ap* | *as-specified* | *first-ap* | *first-client* | *no-destination*; default: **first-client**) - default destination. It sets the destination where to send the packet if it is not for a client in the radio network

default-address (*MAC address*; default: **00:00:00:00:00:00**) - MAC address of a host in the radio network where to send the packet, if it is for none of the radio clients

max-retries (*integer*; default: **1500**) - maximum retries before dropping the packet

sid (*text*) - Service Identifier

card-name (*text*) - card name

arp (*disabled* | *enabled* | *proxy-arp* | *reply-only*; default: **enabled**) - Address Resolution Protocol, one of the:

- **disabled** - the interface will not use ARP protocol
- **enabled** - the interface will use ARP protocol
- **proxy-arp** - the interface will be an ARP proxy (see corresponding manual)
- **reply-only** - the interface will only reply to the requests originated to its own IP addresses, but neighbor MAC addresses will be gathered from /ip arp statically set table only.

Example

```
[admin@MikroTik] interface radiolan> print
Flags: X - disabled, R - running
  0  R name="radiolan1" mtu=1500 mac-address=00:A0:D4:20:4B:E7 arp=enabled
       card-name="00A0D4204BE7" sid="bbbb" default-destination=first-client
       default-address=00:00:00:00:00:00 distance=0-150m max-retries=15
       tx-diversity=disabled rx-diversity=disabled


[admin@MikroTik] interface radiolan>
```

You can monitor the status of the wireless interface:

```
[admin@MikroTik] interface radiolan> monitor radiolan1
    default: 00:00:00:00:00:00
      valid: no

[admin@MikroTik] interface radiolan>
```

Here, the wireless interface card has not found any neighbor.

```
[admin@MikroTik] interface radiolan> set 0 sid ba72 distance 4.7km-6.6km
[admin@MikroTik] interface radiolan> print
Flags: X - disabled, R - running
  0  R name="radiolan1" mtu=1500 mac-address=00:A0:D4:20:4B:E7 arp=enabled
       card-name="00A0D4204BE7" sid="ba72" default-destination=first-client
       default-address=00:00:00:00:00:00 distance=4.7km-6.6km max-retries=15
       tx-diversity=disabled rx-diversity=disabled

[admin@MikroTik] interface radiolan> monitor 0
    default: 00:A0:D4:20:3B:7F
      valid: yes

[admin@MikroTik] interface radiolan>
```

Now we'll monitor other cards with the same **sid** within range:

```
[admin@MikroTik] interface radiolan> neighbor radiolan1 print
Flags: A - access-point, R - registered, U - registered-to-us,
D - our-default-destination
      NAME                 ADDRESS           ACCESS-POINT
    D 00A0D4203B7F         00:A0:D4:20:3B:7F
```

```
[admin@MikroTik] interface radiolan>
```

You can test the link by pinging the neighbor by its MAC address:

```
[admin@MikroTik] interface radiolan> ping 00:a0:d4:20:3b:7f radiolan1 \
\... size=1500 count=50
                 sent: 1
    successfully-sent: 1
          max-retries: 0
      average-retries: 0
          min-retries: 0

                 sent: 11
    successfully-sent: 11
          max-retries: 0
      average-retries: 0
          min-retries: 0

                 sent: 21
    successfully-sent: 21
          max-retries: 0
      average-retries: 0
          min-retries: 0

                 sent: 31
    successfully-sent: 31
          max-retries: 0
      average-retries: 0
          min-retries: 0

                 sent: 41
    successfully-sent: 41
          max-retries: 0
      average-retries: 0
          min-retries: 0

                 sent: 50
    successfully-sent: 50
          max-retries: 0
      average-retries: 0
          min-retries: 0

[admin@MikroTik] interface radiolan>
```

Troubleshooting

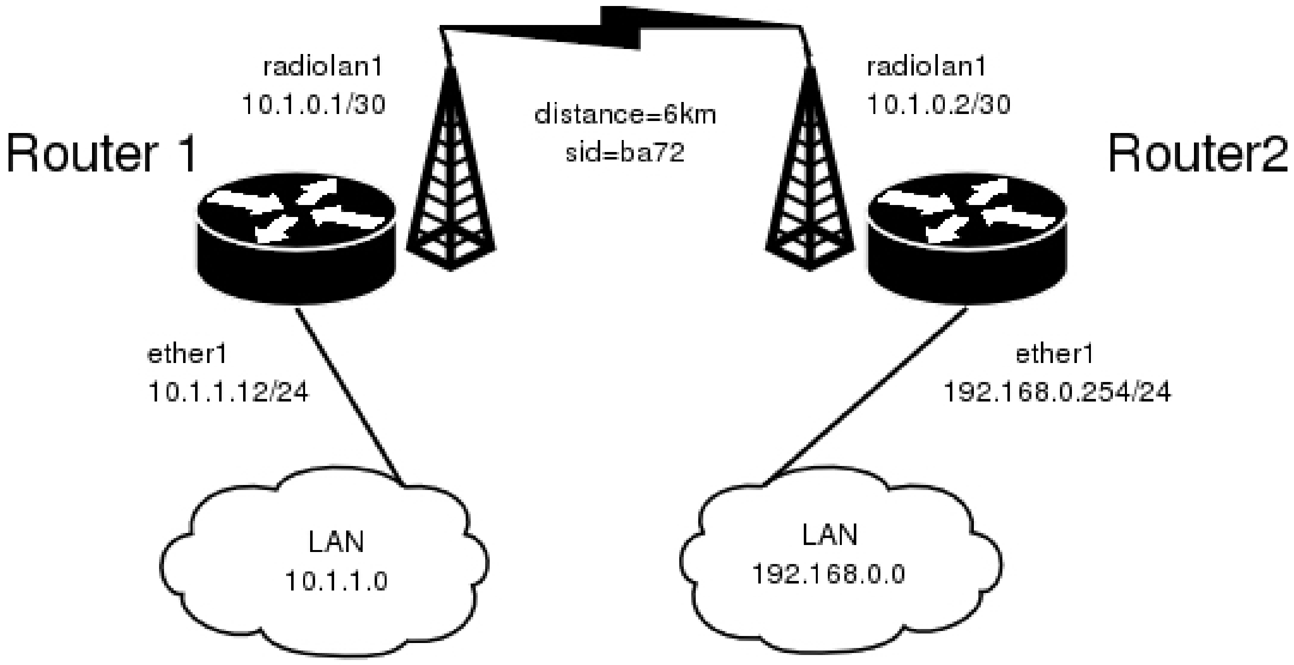
Description

- **The radiolan interface does not show up under the interfaces list**
  Obtain the required license for RadioLAN 5.8GHz wireless feature
- **The wireless card does not obtain the MAC address of the default destination**
  Check the cabling and antenna alignment

Wireless Network Applications

Point-to-Point Setup with Routing

Let us consider the following network setup:



The minimum configuration required for the RadioLAN interfaces of both routers is:

1. Setting the Service Set Identifier (up to alphanumeric characters). In our case we use SSID "ba72"
2. Setting the distance parameter, in our case we have 6km link.

The IP addresses assigned to the wireless interface of Router#1 should be from the network 10.1.0.0/30, e.g.:

```
[admin@MikroTik] ip address> add address=10.1.0.1/30 interface=radiolan1
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.1.1.12/24       10.1.1.0        10.1.1.255      ether1
  1   10.1.0.1/30        10.1.0.0        10.1.0.3        radiolan1
[admin@MikroTik] ip address>
```

The default route should be set to the gateway router 10.1.1.254. A static route should be added for the network 192.168.0.0/24:

```
[admin@MikroTik] ip route> add gateway=10.1.1.254
comment  copy-from  disabled  distance  dst-address  netmask  preferred-source
[admin@MikroTik] ip route> add gateway=10.1.1.254 preferred-source=10.1.0.1
[admin@MikroTik] ip route> add dst-address=192.168.0.0/24 gateway=10.1.0.2 \
\... preferred-source=10.1.0.1
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          u 10.1.1.254      1        radiolan1
    1  S 192.168.0.0/24     r 10.1.0.2        1        radiolan1
    2 DC 10.1.0.0/30        r 0.0.0.0         0        radiolan1
    3 DC 10.1.1.0/24        r 0.0.0.0         0        ether1
[admin@MikroTik] ip route>
```

The Router#2 should have addresses 10.1.0.2/30 and 192.168.0.254/24 assigned to the radiolan and

Ethernet interfaces respectively. The default route should be set to 10.1.0.1

FrameRelay (PVC, Private Virtual Circuit) Interface

Document revision 1.1 (Fri Mar 05 08:14:41 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

Frame Relay is a multiplexed interface to packet switched network and is a simplified form of Packet Switching similar in principle to X.25 in which synchronous frames of data are routed to different destinations depending on header information. Frame Relay uses the synchronous HDLC frame format.

Specifications

Packages required: ***synchronous***
License required: ***level4***
Home menu level: ***/interface pvc***
Standards and Technologies: ***Frame Relay (RFC1490)***
Hardware usage: ***Not significant***

Description

To use Frame Relay interface you must have already working synchronous interface. You can read how to set up synchronous boards supported by MikroTik RouterOS:

- ***Cyclades PC300 PCI Adapters***
- ***Moxa C101 Synchronous interface***

- *Moxa C502 Dual Port Synchronous interface*

Additional Documents

- *Frame Relay Forum*
- *http://www2.rad.com/networks/1994/fram_rel/frame.htm*

Configuring Frame Relay Interface

Home menu level: ***/interface pvc***

Description

To configure frame relay, at first you should set up the synchronous interface, and then the PVC interface.

Property Description

name (*name*; default: **pvcN**) - assigned name of the interface

mtu (*integer*; default: **1500**) - Maximum Transmission Unit of an interface

dlci (*integer*; default: **16**) - Data Link Connection Identifier assigned to the PVC interface

interface (*name*) - Frame Relay interface

Notes

A DLCI is a channel number (Data Link Connection Identifier) which is attached to data frames to tell the network how to route the data. Frame Relay is "statistically multiplexed", which means that only one frame can be transmitted at a time but many logical connections can co-exist on a single physical line. The DLCI allows the data to be logically tied to one of the connections so that once it gets to the network, it knows where to send it.

Frame Relay Configuration

Example with Cyclades Interface

Let us consider the following network setup with MikroTik router with Cyclades PC300 interface connected to a leased line with baseband modems and a Cisco router at the other end.

```
[admin@MikroTik] ip address> add interface=pvc1 address=1.1.1.1 netmask=255.255.255.0
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   1.1.1.1/24         1.1.1.0         1.1.1.255       pvc1
[admin@MikroTik] ip address>
```

PVC and Cyclades interface configuration

- Cyclades

```
[admin@MikroTik] interface cyclades> print
```

```
Flags: X - disabled, R - running
  0  R name="cyclades1" mtu=1500 line-protocol=frame-relay media-type=V35
       clock-rate=64000 clock-source=external line-code=B8ZS framing-mode=ESF
       line-build-out=0dB rx-sensitivity=short-haul frame-relay-lmi-type=ansi
       frame-relay-dce=no chdlc-keepalive=10s

[admin@MikroTik] interface cyclades>
```

- PVC

```
[admin@MikroTik] interface pvc> print
Flags: X - disabled, R - running
  #    NAME                 MTU  DLCI INTERFACE
  0  R pvc1                 1500 42   cyclades1
[admin@MikroTik] interface pvc>
```

- Cisco router setup

```
CISCO# show running-config

Building configuration...

Current configuration...

...
!
ip subnet-zero
no ip domain-lookup
frame-relay switching
!
interface Ethernet0
 description connected to EthernetLAN
 ip address 10.0.0.254 255.255.255.0
!
interface Serial0
 description connected to Internet
 no ip address
 encapsulation frame-relay IETF
 serial restart-delay 1
 frame-relay lmi-type ansi
 frame-relay intf-type dce
!
interface Serial0.1 point-to-point
 ip address 1.1.1.2 255.255.255.0
 no arp frame-relay
 frame-relay interface-dlci 42
!
...
end.
```

Send ping to MikroTik router

```
CISCO#ping 1.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/31/32 ms
CISCO#
```

Example with MOXA Interface

Let us consider the following network setup with MikroTik router with MOXA C502 synchronous interface connected to a leased line with baseband modems and a Cisco router at the other end.

```
[admin@MikroTik] ip address> add interface=pvc1 address=1.1.1.1 netmask=255.255.255.0
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST      INTERFACE
  0   1.1.1.1/24         1.1.1.0         1.1.1.255       pvc1
[admin@MikroTik] ip address>
```

PVC and Moxa interface configuration

- Moxa

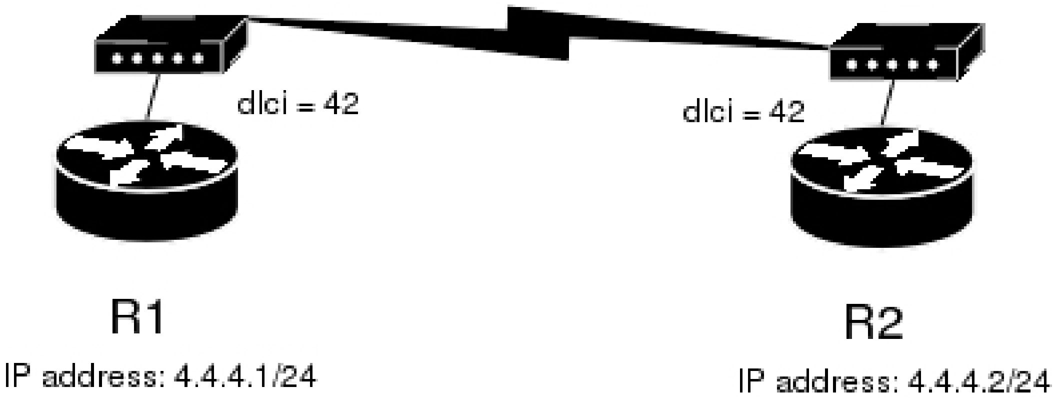
```
[admin@MikroTik] interface moxa-c502> print
Flags: X - disabled, R - running
  0  R name="moxa1" mtu=1500 line-protocol=frame-relay clock-rate=64000
       clock-source=external frame-relay-lmi-type=ansi frame-relay-dce=no
       cisco-hdlc-keepalive-interval=10s

  1 X  name="moxa-c502-2" mtu=1500 line-protocol=sync-ppp clock-rate=64000
       clock-source=external frame-relay-lmi-type=ansi frame-relay-dce=no
       cisco-hdlc-keepalive-interval=10s

[admin@MikroTik] interface moxa-c502>
```

- PVC

```
[admin@MikroTik] interface pvc> print
Flags: X - disabled, R - running
  #    NAME                 MTU  DLCI INTERFACE
  0  R pvc1                 1500 42   moxa1
[admin@MikroTik] interface pvc>

CISCO router setup

CISCO# show running-config

Building configuration...

Current configuration...

...
!
ip subnet-zero
no ip domain-lookup
frame-relay switching
!
interface Ethernet0
 description connected to EthernetLAN
 ip address 10.0.0.254 255.255.255.0
!
interface Serial0
 description connected to Internet
 no ip address
 encapsulation frame-relay IETF
 serial restart-delay 1
 frame-relay lmi-type ansi
 frame-relay intf-type dce
!
interface Serial0.1 point-to-point
 ip address 1.1.1.2 255.255.255.0
 no arp frame-relay
 frame-relay interface-dlci 42
!
...
end.

Send ping to MikroTik router

CISCO#ping 1.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/31/32 ms
CISCO#
```

Example with MikroTik Router to MikroTik Router

Let us consider the following example:



In this example we will use two Moxa C101 synchronous cards.

Do not forget to set **line-protocol** for synchronous interfaces to **frame-relay**. To achieve proper result, one of the synchronous interfaces must operate in DCE mode:

```
[admin@r1] interface moxa-c101> set 0 frame-relay-dce=yes
[admin@r1] interface moxa-c101> print
Flags: X - disabled, R - running
  0  R name="moxa-c101-1" mtu=1500 line-protocol=frame-relay clock-rate=64000
       clock-source=external frame-relay-lmi-type=ansi frame-relay-dce=yes
       cisco-hdlc-keepalive-interval=10s ignore-dcd=no

[admin@r1] interface moxa-c101>
```

Then we need to add PVC interfaces and **IP addresses**.

On the **R1**:

```
[admin@r1] interface pvc> add dlci=42 interface=moxa-c101-1
[admin@r1] interface pvc> print
Flags: X - disabled, R - running
  #    NAME                                               MTU  DLCI INTERFACE
  0 X  pvc1                                               1500 42   moxa-c101-1

[admin@r1] interface pvc> /ip address add address 4.4.4.1/24 interface pvc1
```

on the **R2**:

```
[admin@r2] interface pvc> add dlci=42 interface=moxa-c101-1
[admin@r2] interface pvc> print
Flags: X - disabled, R - running
  #    NAME                                               MTU  DLCI INTERFACE
  0 X  pvc1                                               1500 42   moxa-c101-1

[admin@r2] interface pvc> /ip address add address 4.4.4.2/24 interface pvc1
```

Finally, we must enable PVC interfaces:

```
[admin@r1] interface pvc> enable pvc1
[admin@r1] interface pvc>

[admin@r2] interface pvc> enable pvc1
[admin@r2] interface pvc>
```

Troubleshooting

Description

- **I cannot ping through the synchronous frame relay interface between MikroTik router and a Cisco router**
  Frame Relay does not support address resolving and IETF encapsulation should be used. Please check the configuration on the Cisco router

ISDN (Integrated Services Digital Network) Interface

Document revision 1.1 (Fri Mar 05 08:15:11 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik router can act as an ISDN client for dialing out, or as an ISDN server for accepting incoming calls. The dial-out connections may be set as dial-on-demand or as permanent connections (simulating a leased line). The remote **IP address** (provided by the ISP) can be used as the default gateway for the router.

Specifications

Packages required: ***isdn, ppp***
License required: ***level1***
Home menu level: ***/interface isdn-server, /interface isdn-client***
Standards and Technologies: ***PPP (RFC 1661)***

Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***Log Management***

Additional Documents

- ***PPP over ISDN***
- ***RFC3057 - ISDN Q.921-User Adaptation Layer***

ISDN Hardware and Software Installation

Command name: ***/driver add***

Description

Please install the ISDN adapter into the PC accordingly the instructions provided by the adapter manufacturer.

Appropriate packages have to be downloaded from MikroTik??????s web page ***http://www.mikrotik.com***. After all, the ISDN driver should be loaded using the **/driver add** command.

MikroTik RouterOS supports passive PCI adapters with Siemens chipset:

- Eicon. Diehl Diva - **diva**
- Sedlbauer Speed - **sedlbauer**
- ELSA Quickstep 1000 - **quickstep**
- NETjet - **netjet**
- Teles - **teles**
- Dr. Neuhaus Niccy - **niccy**
- AVM - **avm**
- Gazel - **gazel**
- HFC 2BDS0 based adapters - **hfc**
- W6692 based adapters - **w6692**

For example, for the HFC based PCI card, it is enough to use **/driver add name=hfc** command to get the driver loaded.

Note! ISDN **ISA** adapters are **not** supported!

Property Description

name (*name*) - name of the driver

isdn-protocol (*euro* | *german*; default: **euro**) - data channel protocol

ISDN Channels

ISDN channels are added to the system automatically when the ISDN card driver is loaded. Each channel corresponds to one physical 64K ISDN data channel.

The list of available ISDN channels can be viewed using the **/isdn-channels print** command. The channels are named **channel1**, **channel2**, and so on. E.g., if you have two ISDN channels, and one of them currently used by an ISDN interface, but the other available, the output should look like this:

```
[admin@MikroTik] isdn-channels> print
Flags: X - disabled, E - exclusive
  #    NAME                     CHANNEL    DIR.. TYPE  PHONE
  0    channel1                 0
  1    channel2                 1
[admin@MikroTik] isdn-channels>
```

ISDN channels are very similar to PPP serial ports. Any number of ISDN interfaces can be configured on a single channel, but only one interface can be enabled for that channel at a time. It means that every ISDN channel is either available or used by an ISDN interface.

MSN and EAZ numbers

In Euro-ISDN a subscriber can assign more than one ISDN number to an ISDN line. For example, an ISDN line could have the numbers 1234067 and 1234068. Each of these numbers can be used to dial the ISDN line. These numbers are referred to as Multiple Subscriber Numbers (MSN).

A similar, but separate concept is EAZ numbering, which is used in German ISDN networking. EAZ number can be used in addition to dialed phone number to specify the required service.

For dial-out ISDN interfaces, MSN/EAZ number specifies the outgoing phone number (the calling end). For dial-in ISDN interfaces, MSN/EAZ number specifies the phone number that will be answered. If you are unsure about your MSN/EAZ numbers, leave them blank (it is the default).

For example, if your ISDN line has numbers 1234067 and 1234068, you could configure your dial-in server to answer only calls to 1234068 by specifying **1234068** as your MSN number. In a sense, MSN is just your phone number.

ISDN Client Interface Configuration

Home menu level: ***/interface isdn-client***

Description

The ISDN client is used to connect to remote dial-in server (probably ISP) via ISDN. To set up an ISDN dial-out connection, use the ISDN dial-out configuration menu under the submenu.

Property Description

name (*name*; default: **isdn-outN**) - interface name

mtu (*integer*; default: **1500**) - Maximum Transmission Unit

mru (*integer*; default: **1500**) - Maximum Receive Unit

phone (*integer*; default: **""**) - phone number to dial

msn (*integer*; default: **""**) - MSN/EAZ of ISDN line provided by the line operator

dial-on-demand (*yes* | *no*; default: **no**) - use dialing on demand

l2-protocol (*hdlc* | *x75i* | *x75ui* | *x75bui*; default: **hdlc**) - level 2 protocol to be used

user (*text*) - user name that will be provided to the remote server

password (*text*) - password that will be provided to the remote server

allow (*multiple choice: mschap2*, *mschap1*, *chap*, *pap*; default: **mschap2, mschap1, chap, pap**) - the protocol to allow the client to use for authentication

add-default-route (*yes* | *no*; default: **no**) - add default route to remote host on connect

profile (*name*; default: **default**) - profile to use when connecting to the remote server

use-peer-dns (*yes* | *no*; default: **no**) - use or not peer DNS

bundle-128K (*yes* | *no*; default: **yes**) - use both channels instead of just one

Example

ISDN client interfaces can be added using the **add** command:

```
[admin@MikroTik] interface isdn-client> add msn="142" user="test" \
\... password="test" phone="144" bundle-128K=no
[admin@MikroTik] interface isdn-client> print
Flags: X - disabled, R - running
  0 X  name="isdn-out1" mtu=1500 mru=1500 msn="142" user="test"
       password="test" profile=default phone="144" l2-protocol=hdlc
       bundle-128K=no dial-on-demand=no add-default-route=no use-peer-dns=no

[admin@MikroTik] interface isdn-client>
```

ISDN Server Interface Configuration

Home menu level: ***/interface isdn-client***

Description

ISDN server is used to accept remote dial-in connections form ISDN clients.

Property Description

name (*name*; default: **isdn-inN**) - interface name

mtu (*integer*; default: **1500**) - Maximum Transmission Unit

mru (*integer*; default: **1500**) - Maximum Receive Unit

phone (*integer*; default: **""**) - phone number to dial

msn (*integer*; default: **""**) - MSN/EAZ of ISDN line provided by the line operator

l2-protocol (*hdlc* | *x75i* | *x75ui* | *x75bui*; default: **hdlc**) - level 2 protocol to be used

profile (*name*; default: **default**) - profile to use when connecting to the remote server

bundle-128K (*yes* | *no*; default: **yes**) - use both channels instead of just one

authentication (*pap* | *chap* | *mschap1* | *mschap2*; default: **mschap2, mschap1, chap, pap**) - used authentication

Example

ISDN server interfaces can be added using the **add** command:

```
[admin@MikroTik] interface isdn-server> add msn="142" bundle-128K=no
[admin@MikroTik] interface isdn-server> print
Flags: X - disabled, R - running
  0 X  name="isdn-in1" mtu=1500 mru=1500 msn="142"
       authentication=mschap2,chap,pap profile=default l2-protocol=x75bui
       bundle-128K=no

[admin@MikroTik] interface isdn-server>
```

ISDN Examples

ISDN Dial-out

Dial-out ISDN connections allow a local router to connect to a remote dial-in server (ISP's) via ISDN.

Let's assume you would like to set up a router that connects your local LAN with your ISP via ISDN line. First you should load the corresponding ISDN card driver. Supposing you have an ISDN card with a **W6692**-based chip:

```
[admin@MikroTik]> /driver add name=w6692
```

Now additional channels should appear. Assuming you have only one ISDN card driver loaded, you should get following:

```
[admin@MikroTik] isdn-channels> print
Flags: X - disabled, E - exclusive
  #    NAME                        CHANNEL    DIR.. TYPE  PHONE
  0    channel1                    0
  1    channel2                    1
[admin@MikroTik] isdn-channels>
```

Suppose you would like to use dial-on-demand to dial your ISP and automatically add a default route to it. Also, you would like to disconnect when there is more than 30s of network inactivity. Your ISP's phone number is 12345678 and the user name for authentication is 'john'. Your ISP assigns IP addresses automatically. Add an outgoing ISDN interface and configure it in the following way:

```
[admin@mikrotik]> /interface isdn-client add name="isdn-isp" phone="12345678"
user="john" password="31337!)" add-default-route=yes dial-on-demand=yes
[admin@MikroTik] > /interface isdn-client print
Flags: X - disabled, R - running
  0 X  name="isdn-isp" mtu=1500 mru=1500 msn="" user="john" password="31337!)"
       profile=default phone="12345678" l2-protocol=hdlc bundle-128K=no
       dial-on-demand=yes add-default-route=yes use-peer-dns=no
```

Configure PPP profile.

```
[admin@MikroTik] ppp profile> print
Flags: * - default
  0 * name="default" local-address=0.0.0.0 remote-address=0.0.0.0
```

```
      session-timeout=0s idle-timeout=0s use-compression=no
      use-vj-compression=yes use-encryption=no require-encryption=no only-one=no
      tx-bit-rate=0 rx-bit-rate=0 incoming-filter="" outgoing-filter=""
```

```
[admin@Mikrotik] ppp profile> set default idle-timeout=30s
```

If you would like to remain connected all the time, i.e., as a leased line, then set the **idle-timeout** to 0s.

All that remains is to enable the interface:

```
[admin@MikroTik] /interface set isdn-isp disabled=no
```

You can monitor the connection status with the following command:

```
[admin@MikroTik] /interface isdn-client monitor isdn-isp
```

ISDN Dial-in

Dial-in ISDN connections allow remote clients to connect to your router via ISDN.

Let us assume you would like to configure a router for accepting incoming ISDN calls from remote clients. You have an Ethernet card connected to the LAN, and an ISDN card connected to the ISDN line. First you should load the corresponding ISDN card driver. Supposing you have an ISDN card with an HFC chip:

```
[admin@MikroTik] /driver add name=hfc
```

Now additional channels should appear. Assuming you have only one ISDN card driver loaded, you should get the following:

```
[admin@MikroTik] isdn-channels> print
Flags: X - disabled, E - exclusive
  #    NAME                       CHANNEL    DIR.. TYPE  PHONE
  0    channel1                   0
  1    channel2                   1
[admin@MikroTik] isdn-channels>
```

Add an incoming ISDN interface and configure it in the following way:

```
[admin@MikroTik] interface isdn-server> add msn="7542159" \
\... authentication=chap,pap bundle-128K=no
[admin@MikroTik] interface isdn-server> print
Flags: X - disabled
  0 X  name="isdn-in1" mtu=1500 mru=1500 msn="7542159" authentication=chap,pap
       profile=default l2-protocol=hldc bundle-128K=no
```

Configure PPP settings and add users to router's database.

```
[admin@MikroTik] ppp profile> print
Flags: * - default
  0 * name="default" local-address=0.0.0.0 remote-address=0.0.0.0
      session-timeout=0s idle-timeout=0s use-compression=no
      use-vj-compression=yes use-encryption=no require-encryption=no only-one=no
      tx-bit-rate=0 rx-bit-rate=0 incoming-filter="" outgoing-filter=""
[admin@Mikrotik] ppp profile> set default idle-timeout=5s local-address=10.99.8.1 \
\... remote-address=10.9.88.1
```

Add user 'john' to the router's user database. Assuming that the password is '31337!)':

```
[admin@MikroTik] ppp secret> add name=john password="31337!)" service=isdn
[admin@MikroTik] ppp secret> print
[admin@ISDN] ppp secret> print
Flags: X - disabled
```

```
  #   NAME               SERVICE CALLER-ID        PASSWORD         PROFILE
  0   john               isdn                     31337!)          default
[admin@MikroTik] ppp secret>
```

Check the status of the ISDN server interface and wait for the call:

```
[admin@MikroTik] interface isdn-server> monitor isdn-in1

    status: Waiting for call...
```

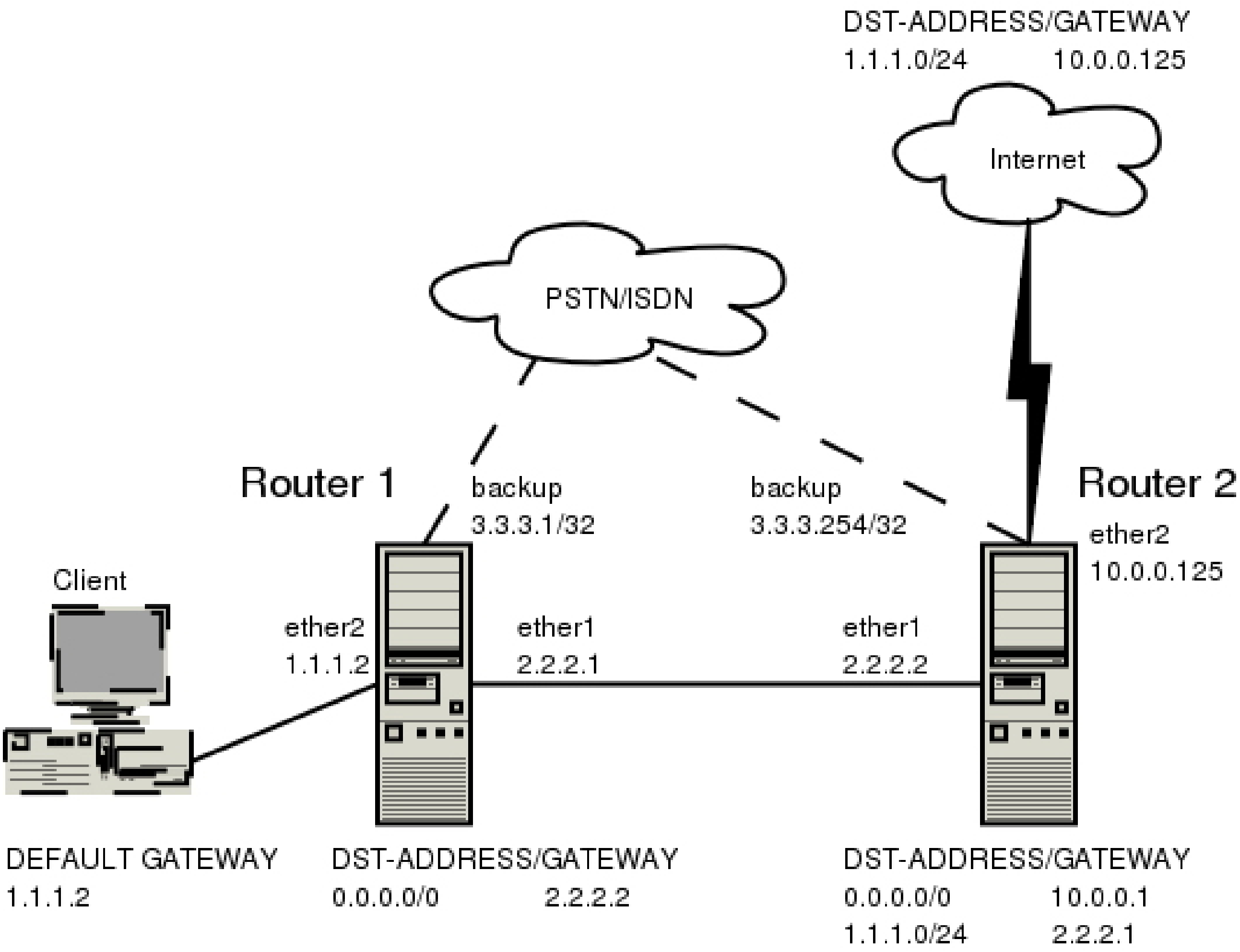
ISDN Backup

Backup systems are used in specific cases, when you need to maintain a connection, even if a fault occurs. For example, if someone cuts the wires, the router can automatically connect to a different interface to continue its work. Such a backup is based on an utility that monitors the status of the connection - netwatch, and a script, which runs the netwatch.

This is an example of how to make simple router backup system. In this example we'll use an ISDN connection for purpose to backup a standard Ethernet connection. You can, however, use instead of the ISDN connection anything you need - PPP, for example. When the Ethernet fail (the router nr.1 cannot ping the router nr.2 to 2.2.2.2 (see picture) the router nr.1 will establish an ISDN connection, so-called backup link, to continue communicating with the nr. 2.

You must keep in mind, that in our case there are just two routers, but this system can be extended to support more different networks.

The backup system example is shown in the following picture:



In this case the **backup** interface is an ISDN connection, but in real applications it can be substituted by a particular connection. Follow the instructions below on how to set up the backup link:

- At first, you need to set up ISDN connection. To use ISDN, the ISDN card driver must be loaded:

```
[admin@MikroTik] driver> add name=hfc
```

The PPP connection must have a new user added to the routers one and two:

```
[admin@Mikrotik] ppp secret> add name=backup password=backup service=isdn
```

An ISDN server and PPP profile must be set up on the second router:

```
[admin@MikroTik] ppp profile> set default local-address=3.3.3.254
remote-address=3.3.3.1
[admin@MikroTik] interface isdn-server> add name=backup msn=7801032
```

An ISDN client must be added to the first router:

```
[admin@MikroTik] interface isdn-client>
add name=backup user="backup" password="backup" phone=7801032 msn=7542159
```

- Then, you have to set up static routes
  Use the **/ip route add** command to add the required static routes and comments to them. Comments are required for references in scripts.
  The **first** router:

```
[admin@Mikrotik] ip route> add gateway 2.2.2.2 comment "route1"
```

The **second** router:

```
[admin@Mikrotik] ip route> add gateway 2.2.2.1 comment "route1" dst-address 1.1.1.0/24
```

- And finally, you have to add scripts.
  Add scripts in the submenu **/system script** using the following commands:
  The **first** router:

```
[admin@Mikrotik] system script> add name=connection_down \
\... source={/interface enable backup; /ip route set route1 gateway 3.3.3.254}
[admin@Mikrotik] system script> add name=connection_up \
\... source={/interface disable backup; /ip route set route1 gateway 2.2.2.2}
```

The **second** router:

```
[admin@Mikrotik] system script> add name=connection_down \
\... source={/ip route set route1 gateway 3.3.3.1}
[admin@Mikrotik] system script> add name=connection_up \
\... source={/ip route set route1 gateway 2.2.2.1}
```

- To get all above listed to work, set up Netwatch utility. To use netwatch, you need the advanced tools feature package installed. Please upload it to the router and reboot. When installed, the advanced-tools package should be listed under the **/system package print** list.
  Add the following settings to the first router:

```
[admin@Mikrotik] tool netwatch> add host=2.2.2.1 interval=5s \
\... up-script=connection_up down-script=connection_down
```

Add the following settings to the second router:

```
[admin@Mikrotik] tool netwatch> add host=2.2.2.2 interval=5s \
\... up-script=connection_up down-script=connection_down
```

PPTP

Document revision 1.3 (Thu May 20 13:41:11 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

PPTP (Point to Point Tunnel Protocol) supports encrypted tunnels over IP. The MikroTik RouterOS implementation includes support for PPTP client and server.

General applications of PPTP tunnels:

- For secure router-to-router tunnels over the Internet
- To link (bridge) local Intranets or LANs (when EoIP is also used)

- For mobile or remote clients to remotely access an Intranet/LAN of a company (see PPTP setup for Windows for more information)

Each PPTP connection is composed of a server and a client. The MikroTik RouterOS may function as a server or client - or, for various configurations, it may be the server for some connections and client for other connections. For example, the client created below could connect to a Windows 2000 server, another MikroTik Router, or another router which supports a PPTP server.

Quick Setup Guide

To make a PPTP tunnel between 2 MikroTik routers with IP addresses **10.5.8.104** (PPTP server) and **10.1.0.172** (PPTP client), follow the next steps.

- Setup on PPTP server:
  1. Add a user:

```
[admin@PPTP-Server] ppp secret> add name=jack password=pass \
\... local-address=10.0.0.1 remote-address=10.0.0.2
```

  2. Enable the PPTP server:

```
[admin@PPTP-Server] interface pptp-server server> set enabled=yes
```

- Setup on PPTP client:
  1. Add the PPTP client:

```
[admin@PPTP-Client] interface pptp-client> add user=jack password=pass \
\... connect-to=10.5.8.104 disabled=no
```

Specifications

Packages required: ***ppp***
License required: ***level1 (limited to 1 tunnel), level3 (limited to 200 tunnels), level5***
Home menu level: ***/interface pptp-server, /interface pptp-client***
Standards and Technologies: ***PPTP (RFC 2637)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***AAA***
- ***EoIP***

Description

PPTP is a secure tunnel for transporting IP traffic using PPP. PPTP encapsulates PPP in virtual lines that run over IP. PPTP incorporates PPP and MPPE (Microsoft Point to Point Encryption) to make encrypted links. The purpose of this protocol is to make well-managed secure connections between routers as well as between routers and PPTP clients (clients are available for and/or included in almost all OSs including Windows).

PPTP includes PPP authentication and accounting for each PPTP connection. Full authentication and accounting of each connection may be done through a RADIUS client or locally.

MPPE 40bit RC4 and MPPE 128bit RC4 encryption are supported.

PPTP traffic uses TCP port 1723 and IP protocol GRE (Generic Routing Encapsulation, IP protocol ID 47), as assigned by the Internet Assigned Numbers Authority (IANA). PPTP can be used with most firewalls and routers by enabling traffic destined for TCP port 1723 and protocol 47 traffic to be routed through the firewall or router.

PPTP connections may be limited or impossible to setup though a masqueraded/NAT IP connection. Please see the Microsoft and RFC links at the end of this section for more information.

Additional Documents

- ***http://www.ietf.org/rfc/rfc2637.txt?number=2637***
- ***http://www.ietf.org/rfc/rfc3078.txt?number=3078***
- ***http://www.ietf.org/rfc/rfc3079.txt?number=3079***

PPTP Client Setup

Home menu level: ***/interface pptp-client***

Property Description

name (*name*; default: **pptp-outN**) - interface name for reference

mtu (*integer*; default: **1460**) - Maximum Transmission Unit. The optimal value is the MTU of the interface the tunnel is working over decreased by 40 (so, for 1500-byte ethernet link, set the MTU to 1460 to avoid fragmentation of packets)

mru (*integer*; default: **1460**) - Maximum Receive Unit. The optimal value is the MRU of the interface the tunnel is working over decreased by 40 (so, for 1500-byte ethernet link, set the MRU to 1460 to avoid fragmentation of packets)

connect-to (*IP address*) - The IP address of the PPTP server to connect to

user (*text*) - user name to use when logging on to the remote server

password (*text*; default: **""**) - user password to use when logging to the remote server

profile (*name*; default: **default**) - profile to use when connecting to the remote server

allow (*multiple choice: mschap2*, *mschap1*, *chap*, *pap*; default: **mschap2, mschap1, chap, pap**) - the protocol to allow the client to use for authentication

add-default-route (*yes* | *no*; default: **no**) - whether to use the server which this client is connected to as its default router (gateway)

Example

To set up PPTP client named **test2** using unsername **john** with password **john** to connect to the

10.1.1.12 PPTP server and use it as the default gateway:

```
[admin@MikroTik] interface pptp-client> add name=test2 connect-to=10.1.1.12 \
\... user=john add-default-route=yes password=john
[admin@MikroTik] interface pptp-client> print
Flags: X - disabled, R - running
  0 X  name="test2" mtu=1460 mru=1460 connect-to=10.1.1.12 user="john"
       password="john" profile=default add-default-route=yes


[admin@MikroTik] interface pptp-client> enable 0
```

Monitoring PPTP Client

Command name: ***/interface pptp-client monitor***

Property Description

uptime (*time*) - connection time displayed in days, hours, minutes and seconds

encoding (*text*) - encryption and encoding (if asymmetric, seperated with '/') being used in this connection

status (*text*) - status of the client

- **Dialing** - attempting to make a connection
- **Verifying password...** - connection has been established to the server, password verification in progress
- **Connected** - self-explanatory
- **Terminated** - interface is not enabled or the other side will not establish a connection uptime (time) - connection time displayed in days, hours, minutes and seconds

Example

Example of an established connection:

```
[admin@MikroTik] interface pptp-client> monitor test2
      uptime: 4h35s
    encoding: MPPE 128 bit, stateless
      status: Connected
[admin@MikroTik] interface pptp-client>
```

PPTP Server Setup

Home menu level: ***/interface pptp-server server***

Description

The PPTP server creates a dynamic interface for each connected PPTP client. The PPTP connection count from clients depends on the license level you have. Level1 license allows 1 PPTP client, Level3 or Level4 licenses up to 200 clients, and Level5 or Level6 licenses do not have PPTP client limitations.

To create PPTP users, you should consult the ***PPP secret*** and ***PPP Profile*** manuals. It is also possible to use the MikroTik router as a RADIUS client to register the PPTP users, see the ***manual*** how to do it.

Property Description

enabled (*yes* | *no*; default: **no**) - defines whether PPTP server is enabled or not

mtu (*integer*; default: **1460**) - Maximum Transmission Unit. The optimal value is the MTU of the interface the tunnel is working over decreased by 40 (so, for 1500-byte ethernet link, set the MTU to 1460 to avoid fragmentation of packets)

mru (*integer*; default: **1460**) - Maximum Receive Unit. The optimal value is the MRU of the interface the tunnel is working over decreased by 40 (so, for 1500-byte ethernet link, set the MRU to 1460 to avoid fragmentation of packets)

authentication (*multiple choice: pap* | *chap* | *mschap1* | *mschap2*; default: **mschap2**) - authentication algorithm

keepalive-timeout (*time*; default: **30**) - defines the time period (in seconds) after which the router is starting to send keepalive packets every second. If no traffic and no keepalive responses has came for that period of time (i.e. 2 * keepalive-timeout), not responding client is proclaimed disconnected

default-profile - default profile to use

Example

To enable PPTP server:

```
[admin@MikroTik] interface pptp-server server> set enabled=yes
[admin@MikroTik] interface pptp-server server> print
              enabled: yes
                  mtu: 1460
                  mru: 1460
       authentication: mschap2,mschap1
    keepalive-timeout: 30
      default-profile: default
[admin@MikroTik] interface pptp-server server>
```

PPTP Server Users

Home menu level: ***/interface pptp-server***

Description

There are two types of items in PPTP server configuration - static users and dynamic connections. A dynamic connection can be established if the user database or the **default-profile** has its **local-address** and **remote-address** set correctly. When static users are added, the default profile may be left with its default values and only PPP user (in **/ppp secret**) should be configured. **Note** that in both cases PPP users must be configured properly.

Property Description

name (*name*) - interface name

user (*name*) - the name of the user that is configured statically or added dynamically

mtu (*integer*) - (cannot be set here) client's MTU

client-address (*IP address*) - shows (cannot be set here) the IP address of the connected client

uptime (*time*) - shows how long the client is connected

encoding (*text*) - encryption and encoding (if asymmetric, separated with '/') being used in this connection

Example

To add a static entry for **ex1** user:

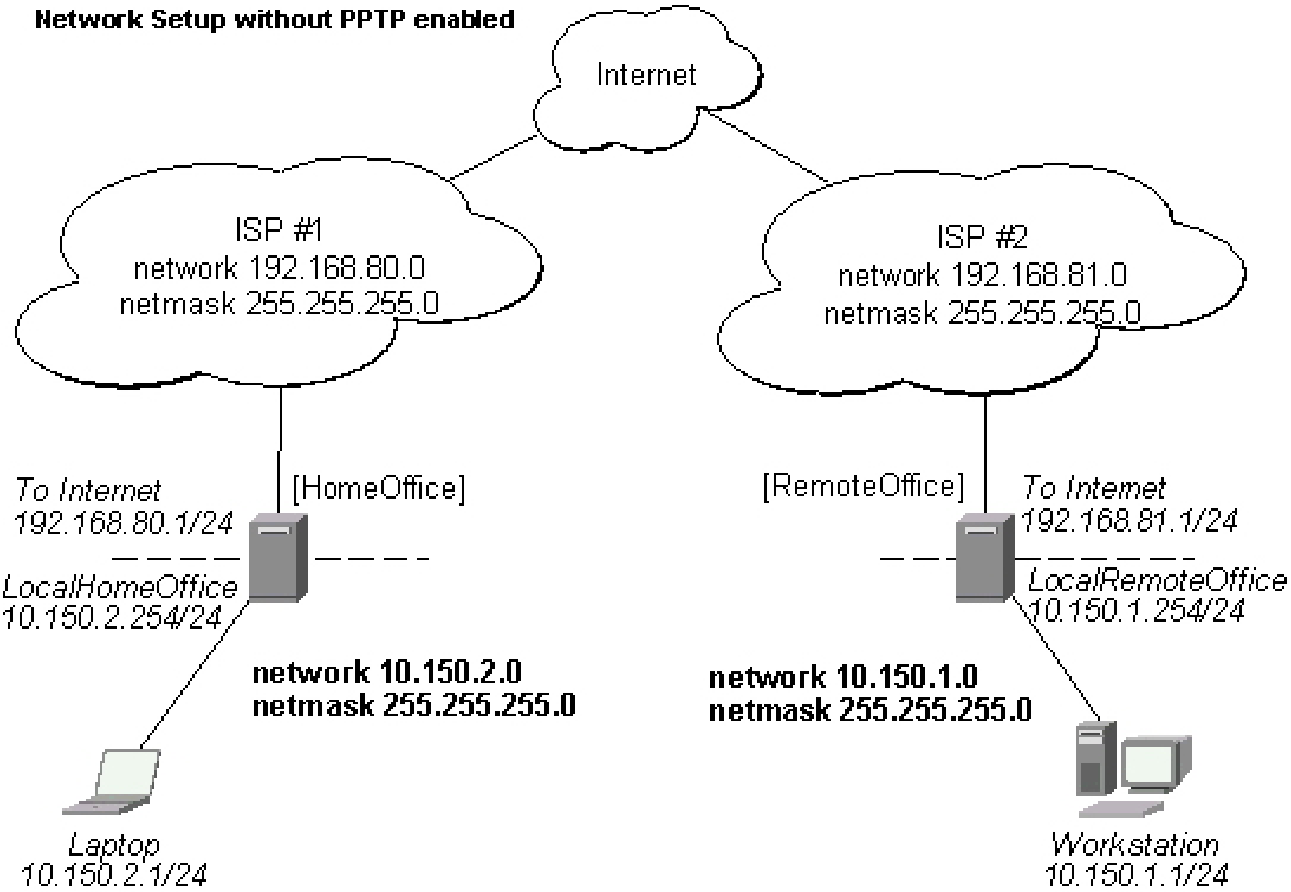
```
[admin@MikroTik] interface pptp-server> add user=ex1
[admin@MikroTik] interface pptp-server> print
Flags: X - disabled, D - dynamic, R - running
  #     NAME                 USER          MTU   CLIENT-ADDRESS  UPTIME   ENC...
  0  DR <pptp-ex>            ex            1460  10.0.0.202      6m32s    none
  1     pptp-in1             ex1
[admin@MikroTik] interface pptp-server>
```

In this example an already connected user **ex** is shown besides the one we just added.

PPTP Application Examples

Router-to-Router Secure Tunnel Example

The following is an example of connecting two Intranets using an encrypted PPTP tunnel over the Internet.



There are two routers in this example:

- [HomeOffice]
  Interface LocalHomeOffice 10.150.2.254/24
  Interface ToInternet 192.168.80.1/24

- [RemoteOffice]
  Interface ToInternet 192.168.81.1/24
  Interface LocalRemoteOffice 10.150.1.254/24

Each router is connected to a different ISP. One router can access another router through the Internet.

On the `Preforma` PPTP server a user must be set up for the client:

```
[admin@HomeOffice] ppp secret> add name=ex service=pptp password=lkjrht
local-address=10.0.103.1 remote-address=10.0.103.2
[admin@HomeOffice] ppp secret> print detail
Flags: X - disabled
  0   name="ex" service=pptp caller-id="" password="lkjrht" profile=default
      local-address=10.0.103.1 remote-address=10.0.103.2 routes==""

[admin@HomeOffice] ppp secret>
```

Then the user should be added in the PPTP server list:

```
[admin@HomeOffice] interface pptp-server> add user=ex
[admin@HomeOffice] interface pptp-server> print
Flags: X - disabled, D - dynamic, R - running
  #     NAME                 USER         MTU   CLIENT-ADDRESS  UPTIME   ENC...
  0     pptp-in1             ex
[admin@HomeOffice] interface pptp-server>
```

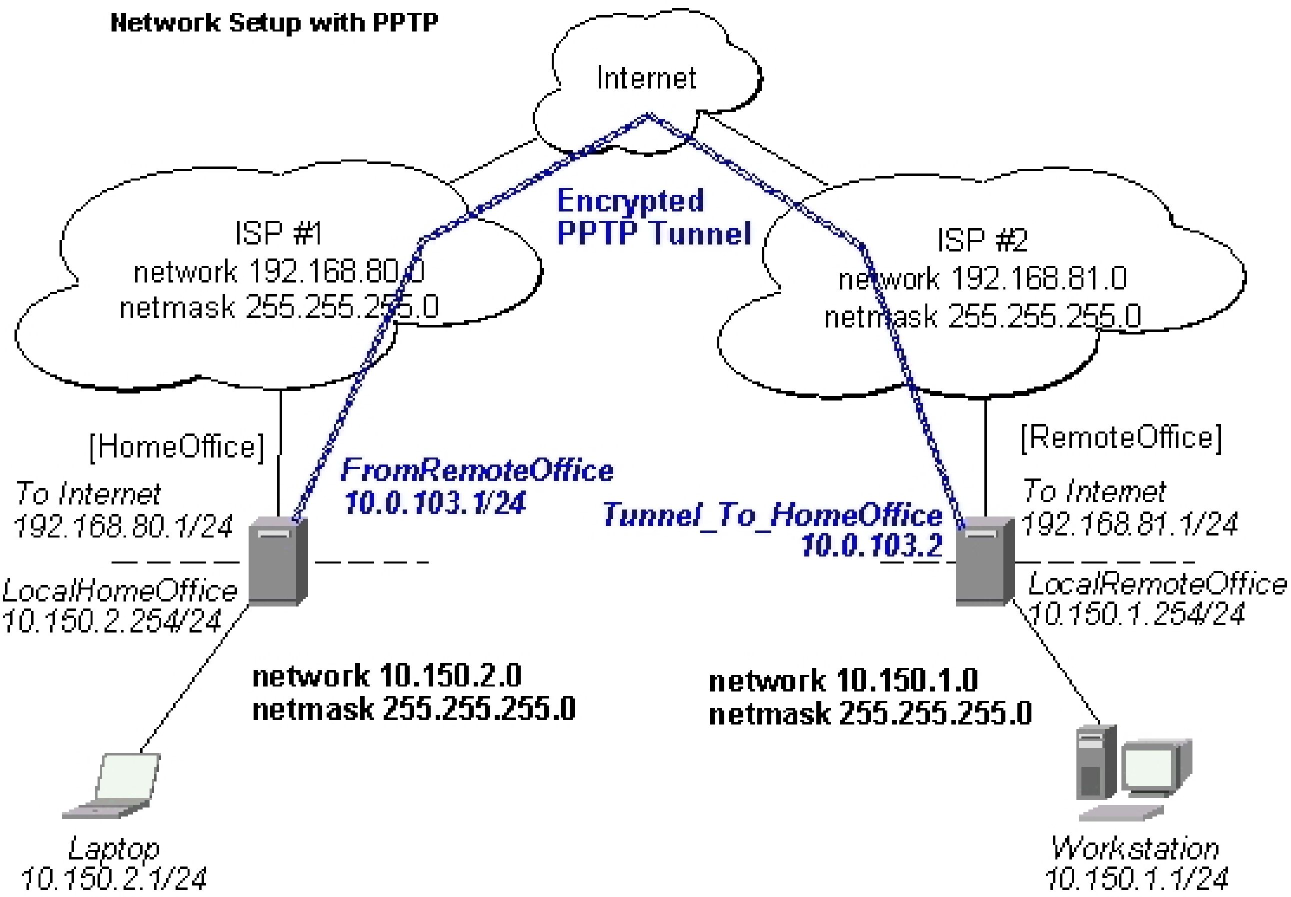
And finally, the server must be enabled:

```
[admin@HomeOffice] interface pptp-server server> set enabled=yes
[admin@HomeOffice] interface pptp-server server> print
            enabled: yes
                mtu: 1460
                mru: 1460
     authentication: mschap2
    default-profile: default
[admin@HomeOffice] interface pptp-server server>
```

Add a PPTP client to the RemoteOffice router:

```
[admin@RemoteOffice] interface pptp-client> add connect-to=192.168.80.1 user=ex \
\... password=lkjrht disabled=no
[admin@RemoteOffice] interface pptp-client> print
Flags: X - disabled, R - running
  0  R name="pptp-out1" mtu=1460 mru=1460 connect-to=192.168.80.1 user="ex"
       password="lkjrht" profile=default add-default-route=no


[admin@RemoteOffice] interface pptp-client>
```

Thus, a PPTP tunnel is created between the routers. This tunnel is like an Ethernet point-to-point connection between the routers with IP addresses 10.0.103.1 and 10.0.103.2 at each router. It enables 'direct' communication between the routers over third party networks.



To route the local Intranets over the PPTP tunnel you need to add these routes:

```
[admin@HomeOffice] > ip route add dst-address 10.150.1.0/24 gateway 10.0.103.2
[admin@RemoteOffice] > ip route add dst-address 10.150.2.0/24 gateway 10.0.103.1
```

On the PPTP server it can alternatively be done using **routes** parameter of the user configuration:

```
[admin@HomeOffice] ppp secret> print detail
Flags: X - disabled
  0   name="ex" service=pptp caller-id="" password="lkjrht" profile=default
      local-address=10.0.103.1 remote-address=10.0.103.2 routes==""

[admin@HomeOffice] ppp secret> set 0 routes="10.150.1.0/24 10.0.103.2 1"
[admin@HomeOffice] ppp secret> print detail
Flags: X - disabled
  0   name="ex" service=pptp caller-id="" password="lkjrht" profile=default
      local-address=10.0.103.1 remote-address=10.0.103.2
      routes="10.150.1.0/24 10.0.103.2 1"

[admin@HomeOffice] ppp secret>
```

Test the PPTP tunnel connection:

```
[admin@RemoteOffice]> /ping 10.0.103.1
10.0.103.1 pong: ttl=255 time=3 ms
10.0.103.1 pong: ttl=255 time=3 ms
10.0.103.1 pong: ttl=255 time=3 ms
ping interrupted
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 3/3.0/3 ms
```

Test the connection through the PPTP tunnel to the LocalHomeOffice interface:

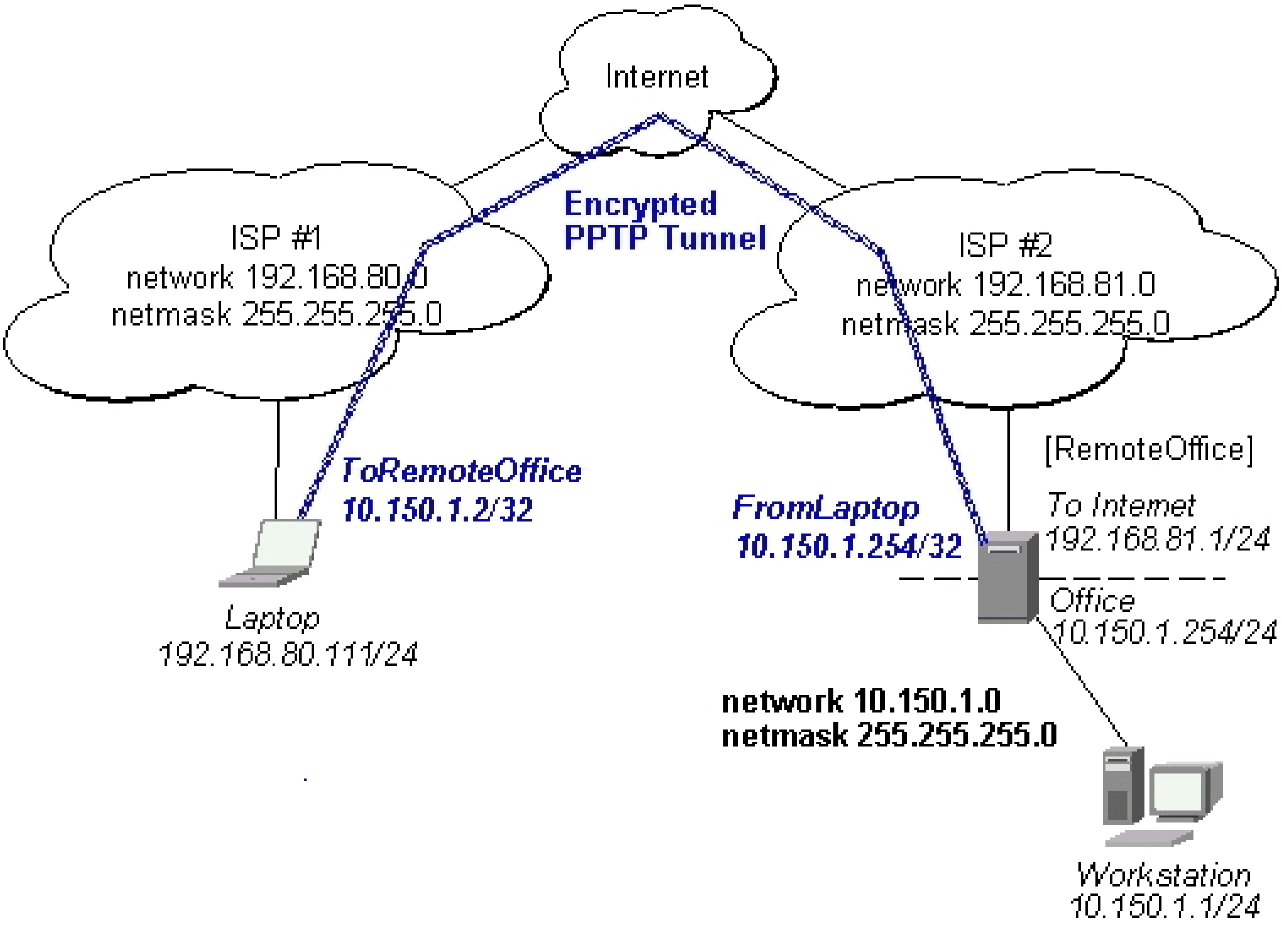
```
[admin@RemoteOffice]> /ping 10.150.2.254
10.150.2.254 pong: ttl=255 time=3 ms
10.150.2.254 pong: ttl=255 time=3 ms
10.150.2.254 pong: ttl=255 time=3 ms
ping interrupted
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 3/3.0/3 ms
```

To bridge a LAN over this secure tunnel, please see the example in the 'EoIP' section of the manual. To set the maximum speed for traffic over this tunnel, please consult the 'Queues' section.

Connecting a Remote Client via PPTP Tunnel

The following example shows how to connect a computer to a remote office network over PPTP encrypted tunnel giving that computer an IP address from the same network as the remote office has (without need of bridging over EoIP tunnels)

Please, consult the respective manual on how to set up a PPTP client with the software You are using.



The router in this example:

- [RemoteOffice]
  Interface ToInternet 192.168.81.1/24
  Interface Office 10.150.1.254/24

The client computer can access the router through the Internet.

On the PPTP server a user must be set up for the client:

```
[admin@RemoteOffice] ppp secret> add name=ex service=pptp password=lkjrht
local-address=10.150.1.254 remote-address=10.150.1.2
[admin@RemoteOffice] ppp secret> print detail
Flags: X - disabled
  0   name="ex" service=pptp caller-id="" password="lkjrht" profile=default
      local-address=10.150.1.254 remote-address=10.150.1.2 routes==""

[admin@RemoteOffice] ppp secret>
```

Then the user should be added in the PPTP server list:

```
[admin@RemoteOffice] interface pptp-server> add name=FromLaptop user=ex
[admin@RemoteOffice] interface pptp-server> print
Flags: X - disabled, D - dynamic, R - running
  #     NAME                 USER         MTU   CLIENT-ADDRESS  UPTIME   ENC...
  0     FromLaptop           ex
[admin@RemoteOffice] interface pptp-server>
```

And the server must be enabled:

```
[admin@RemoteOffice] interface pptp-server server> set enabled=yes
[admin@RemoteOffice] interface pptp-server server> print
            enabled: yes
                mtu: 1460
                mru: 1460
     authentication: mschap2
    default-profile: default
[admin@RemoteOffice] interface pptp-server server>
```

Finally, the proxy APR must be enabled on the 'Office' interface:

```
[admin@RemoteOffice] interface ethernet> set Office arp=proxy-arp
[admin@RemoteOffice] interface ethernet> print
Flags: X - disabled, R - running
  #    NAME                 MTU   MAC-ADDRESS       ARP
  0  R ToInternet           1500  00:30:4F:0B:7B:C1 enabled
  1  R Office               1500  00:30:4F:06:62:12 proxy-arp
[admin@RemoteOffice] interface ethernet>
```

PPTP Setup for Windows

Microsoft provides PPTP client support for Windows NT, 98, 98SE, ME, 2000 and XP. Windows 98SE, ME, 2000 and XP include support in the Windows setup or automatically install PPTP. For 95, NT, and 98, installation requires a download from Microsoft. Many ISPs have made help pages to assist clients with Windows PPTP installation.

- ***Step-by-step instructions how to setup PPTP on Windows 2000***
- ***PPTP setup for Windows95***

Sample instructions for PPTP (VPN) installation and client setup - Windows 98SE

If the VPN (PPTP) support is installed, select 'Dial-up Networking' and 'Create a new connection'. The option to create a 'VPN' should be selected. If there is no 'VPN' options, then follow the installation instructions below. When asked for the 'Host name or IP address of the VPN server', type the IP address of the router. Double-click on the 'new' icon and type the correct user name and password (must also be in the user database on the router or RADIUS server used for authentication).

The setup of the connections takes nine seconds after selection the 'connect' button. It is suggested that the connection properties be edited so that 'NetBEUI', 'IPX/SPX compatible', and 'Log on to network' are unselected. The setup time for the connection will then be two seconds after the 'connect' button is selected.

To install the 'Virtual Private Networking' support for Windows 98SE, go to the 'Setting' menu from the main 'Start' menu. Select 'Control Panel', select 'Add/Remove Program', select the 'Windows setup' tab, select the 'Communications' software for installation and 'Details'. Go to the bottom of the list of software and select 'Virtual Private Networking' to be installed.

Troubleshooting

Description

- **I use firewall and I cannot establish PPTP connection**
  Make sure the TCP connections to port 1723 can pass through both directions between your sites. Also, IP protocol 47 should be passed through

Wireless Client and Wireless Access Point Manual

Document revision 1.8 (Tue Nov 23 18:04:38 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

The wireless interface operates using IEEE 802.11 set of standards. It uses radio waves as a physical signal carrier and is capable of wireless data transmission with speeds up to 108 Mbps (in 5GHz turbo-mode).

MikroTik RouterOS supports the Intersil Prism II PC/PCI, Atheros AR5000, AR5001X, AR5001X+, AR5002X+, and AR5004X+ chipset based wireless adapter cards for working as wireless clients (**station** mode), wireless bridges (**bridge** mode), wireless access points (**ap-bridge** mode), and for antenna positioning (**alignment-only** mode). For further information about supported wireless adapters, see ***Device Driver List***

MikroTik RouterOS provides a complete support for IEEE 802.11a, 802.11b and 802.11g wireless networking standards. There are several features implemented for the wireless data communication in RouterOS - WEP (Wired Equivalent Privacy), AES encryption, WDS (Wireless Distribution System), DFS (Dynamic Frequency Selection), Alignment mode (for positioning antennas and monitoring wireless signal), VAP (Virtual Access Point), Fast Frames, disable packet forwarding among clients, and others. You can see the ***feature list*** which are supported by various cards.

The nstreme protocol is MikroTik proprietary (i.e., incompatible with other vendors) wireless protocol created to improve point-to-point and point-to-multipoint wireless links. Nstreme2 works with a pair of wireless cards (Atheros AR5210, AR5211, AR5212 and AR5213 MAC chips only) - one for transmitting data and one for receiving.

Benefits of nstreme protocol:

- Client polling
- Very low protocol overhead per frame allowing super-high data rates
- No protocol limits on link distance
- No protocol speed degradation for long link distances
- Dynamic protocol adjustment depending on traffic type and resource usage

Quick Setup Guide

Let's consider that you have a wireless interface, called **wlan1**.

- To set it as an Access Point, working in 802.11g standard in compatibility mode (i.e., both 802.11b and 802.11g clients are allowed to connect), using frequency **2442 MHz** and Service Set Identifier **test**:

```
/interface wireless set wlan1 ssid="test" frequency=2442 band=2.4ghz-b/g \
    mode=ap-bridge disabled=no
```

  Now your router is ready to accept wireless clients.

- To make a point-to-point connection, using 802.11a standard, frequency **5805 MHz** and Service Set Identifier **p2p**:

```
/interface wireless set wlan1 ssid="p2p" frequency=5805 band=5ghz \
    mode=bridge disabled=no
```

  The remote interface should be configured to station as showed below.

- To make the wireless interface as a wireless station, working in 802.11a standard and Service Set Identifier **p2p**:

```
/interface wireless set wlan1 ssid="p2p" band=5ghz mode=station disabled=no
```

Specifications

Packages required: ***wireless***
License required: ***level4 (station and bridge mode), level5 (station, bridge and AP mode)***
Home menu level: ***/interface wireless***
Standards and Technologies: ***IEEE802.11a***, ***IEEE802.11b***, ***IEEE802.11g***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***IP Addresses and ARP***
- ***Log Management***

Description

The Atheros card has been tested for distances up to 20 km providing connection speed up to 17Mbit/s. With appropriate antennas and cabling the maximum distance should be as far as 50 km. Nstreme has no distance limitations.

These values of **ack-timeout** were approximated from the tests done by us, as well as by some of our customers:

range	**ack-timeout**		
	5GHz	**5GHz-turbo**	**2.4GHz-G**
0km	**default**	**default**	**default**
5km	**52**	**30**	**62**
10km	**85**	**48**	**96**
15km	**121**	**67**	**133**
20km	**160**	**89**	**174**
25km	**203**	**111**	**219**
30km	**249**	**137**	**368**
35km	**298**	**168**	**320**
40km	**350**	**190**	**375**
45km	**405**	**-**	**-**

Please **note** that these are not the precise values. Depending on hardware used and many other factors they may vary up to +/- 15 microseconds.

You can also use a **dynamic** value - the router will determine the **ack-timeout** setting automatically.

The nstreme protocol may be operated in three modes:

- **Point-to-Point mode** - controlled point-to-point mode with one radio on each side
- **Dual radio Point-to-Point mode (nstreme2)** - the protocol will use two radios on both sides simultaneously (one for transmitting data and one for receiving), allowing superfast point-to-point connection
- **Point-to-Multipoint** - controlled point-to-multipoint mode with client polling (like AP-controlled TokenRing)

Hardware Notes

The MikroTik RouterOS supports as many Atheros chipset based cards as many free adapter slots are there on your system. One license is valid for all cards on your system. **Note** that maximal number of PCMCIA sockets is 8.

Some chipsets are not stable with Atheros cards and cause radio to stop working. Via Epia, MikroTik RouterBoard and systems based on Intel i815 and i845 chipsets are tested and work stable with Atheros cards. There might be many other chipsets that are working stable, but it has been reported that some older chipsets, and some systems based on AMD Duron CPU are not stable.

Only AR5212 and newer Atheros MAC chips are stable with RouterBOARD200 connected via RouterBOARD14 four-port MiniPCI-to-PCI adapter. This note only applies to the RouterBOARD200 platform with multiple Atheros-based cards.

Wireless Interface Configuration

Home menu level: ***/interface wireless***

Description

In this section we will discuss the most important part of the configuration.

Property Description

802.1x-mode (*PEAP-MSCHAPV2* | *none*; default: **none**) - whether to use Protected Extensible Authentication Protocol Microsoft Challenge Handshake Authentication Protocol version 2 for authentication

ack-timeout (*integer* | *dynamic* | *indoor*) - acknowledgment code timeout (transmission acceptance timeout) in microseconds or one of these:

- **dynamic** - ack-timeout is chosen automatically
- **indoor** - standard constant for indoor environment

antenna-mode (*ant-a* | *ant-b* | *rxa-txb* | *txa-rxb*; default: **ant-a**) - which antenna to use for transmit/receive data:

- **ant-a** - use only antenna a
- **ant-b** - use only antenna b
- **rxa-txb** - use antenna a for receiving packets, use antenna b for transmitting packets
- **txa-rxb** - use antenna a for transmitting packets, antenna b for receiving packets

arp - Address Resolution Protocol setting

band - operating band

- **2.4ghz-b** - IEEE 802.11b
- **2.4ghz-b/g** - IEEE 802.11b and IEEE 802.11g
- **2.4ghz-g-turbo** - IEEE 802.11g up to 108 Mbit
- **2.4ghz-onlyg** - IEEE 802.11g
- **5ghz** - IEEE 802.11a up to 54 Mbit
- **5ghz-turbo** - IEEE 802.11a up to 108Mbit

basic-rates-a/g (*multiple choice: 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps*; default: **6Mbps**) - basic rates in 802.11a or 802.11g standard (this should be the minimal speed all the wireless network nodes support). It is recommended to leave this as default

basic-rates-b (*multiple choice: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps*; default: **1Mbps**) - basic rates in 802.11b mode (this should be the minimal speed all the wireless network nodes support). It is recommended to leave this as default

burst-time (*time*; default: **disabled**) - time in microseconds which will be used to send data without stopping. Note that other wireless cards in that network will not be able to transmit data for burst-time microseconds. This setting is available only for AR5000, AR5001X, and AR5001X+ chipset based cards

default-authentication (yes | no; default: **yes**) - specifies the default action for clients or APs that are not in access list

- **yes** - enables AP to register a client even if it is not in access list. In turn for client it allows to associate with AP not listed in client's access list

default-forwarding (*yes* | *no*; default: **yes**) - to use data forwarding by default or not. If set to 'no', the registered clients will not be able to communicate with each other

dfs-mode (*none* | *radar-detect* | *no-radar-detect*; default: **none**) - used for APs to dynamically select frequency at which this AP will operate

- **none** - do not use DFS
- **no-radar-detect** - AP scans channel list from scan-list and chooses the frequency which is with the lowest amount of other networks detected
- **radar-detect** - AP scans channel list from scan-list and chooses the frequency which is with the lowest amount of other networks detected, if no radar is detected in this channel for 60 seconds, the AP starts to operate at this channel, if radar is detected while working in AP mode, the AP continues searching for the next available channel where no radar is detected

disable-running-check (*yes* | *no*; default: **no**) - disable running check. If value is set to 'no', the router determines whether the card is up and running - for AP one or more clients have to be registered to it, for station, it should be connected to an AP. This setting affects the records in the routing table in a way that there will be no route for the card that is not running (the same applies to dynamic routing protocols). If set to 'yes', the interface will always be shown as running

disconnect-timeout (*time*; default: **3s**) - how long after the disconnect to keep the client in the registration table and keep trying to sending packets

fast-frames (yes | no; default: **no**) - whether to pack smaller packets into a larger one, which makes larger data rates possible

frequency (*integer*; default: **5120**) - operating frequency of the card

hide-ssid (*yes* | *no*; default: **no**) - whether to hide ssid or not in the beacon frames:

- **yes** - ssid is not included in the beacon frames. AP replies only to probe-requests with the given ssid
- **no** - ssid is included in beacon frames. AP replies to probe-requests with the given ssid ant to 'broadcast ssid' (empty ssid)

interface-type (*read-only: text*) - adapter type and model

mac-address (*read-only: MAC address*) - MAC address

master-device (*name*) - physical wireless interface name that will be used by Virtual Access Point (VAP) interface

max-station-count (*integer*: 1..2007; default: **2007**) - maximal number of clients allowed to connect to AP

mode (*alignment-only* | *ap-bridge* | *bridge* | *nstreme-dual-slave* | *station* | *station-wds* | *wds-slave*; default: **station**) - operating mode:

- **alignment-only** - this mode is used for positioning antennas (to get the best direction)

- **ap-bridge** - the interface is operating as an Access Point
- **bridge** - the interface is operating as a bridge
- **nstreme-dual-slave** - the interface is used for nstreme-dual mode
- **station** - the interface is operating as a client
- **station-wds** - the interface is working as a station, but can communicate with a WDS peer
- **wds-slave** - the interface is working as it would work in ap-bridge mode, but it adapts to its WDS peer's frequency if it is changed

mtu (*integer*: 68..1600; default: **1500**) - Maximum Transmission Unit

name (*name*; default: **wlanN**) - assigned interface name

noise-floor-threshold (*integer* | *default*: -128..127; default: **default**) - value in dBm below whcih we say that it is rather noise than a normal signal

on-failure-retry-time (*time*; default: **100ms**) - in what interval keep trying to send packets in case of failure

prism-cardtype (*30mW* | *100mW* | *200mW*) - specify the output of the Prism chipset based card

radio-name (*name*) - MT proprietary extension for Atheros cards

rate-set (*default* | *configured*) - which rate set to use:

- **default** - basic and supported-rates settings are not used, instead default values are used.
- **configured** - basic and supported-rates settings are used as configured

scan-list (*multiple choice: integer* | *default-ism*; default: **default-ism**) - the list of channels to scan

- **default-ism** - for 2.4ghz mode: 2412, 2417, 2422, 2427, 2432, 2437, 2442, 2447, 2452, 2457, 2462, 2467, 2472; for 5ghz mode: 5180, 5200, 5220, 5240, 5260, 5280, 5300, 5320, 5745, 5765, 5785, 5805; for 5ghz-turbo: 5210, 5250, 5290, 5760, 5800

server-certificate - not implemented, yet

ssid (*text*; default: **MikroTik**) - Service Set Identifier. Used to separate wireless networks

supported-rates-a/g (*multiple choice: 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps*) - rates to be supported in 802.11a or 802.11g standard

supported-rates-b (*multiple choice: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps*) - rates to be supported in 802.11b standard

tx-power (*integer* | *default*; default: **default**) - transmit power in dB

- **default** - default value of the card

update-stats-interval (*integer* | *disabled*; default: **disabled**) - specifies how often the card will ask the remote end for information about connection quality.

- **default** - each time you registration-tabe print command is issued or this information queried via SNMP, the results from last similar action will be returned

wds-default-bridge (*name*; default: **none**) - the default bridge for WDS interface. If you use dynamic WDS then it is very useful in cases when wds connection is reset - the newly created dynamic WDS interface will be put in this bridge

wds-ignore-ssid (yes | no; default: **no**) - if set to 'yes', the AP will create WDS links with any other AP in this frequency. If set to 'no' the ssid values must match on both APs

wds-mode (*disabled* | *dynamic* | *static*) - WDS mode:

- **disabled** - WDS interfaces are disabled

- **dynamic** - WDS interfaces are created 'on the fly'
- **static** - WDS interfaces are created manually

Notes

It is strongly suggested to leave basic rates at the lowest setting possible.

Before it will be possible to manually control

If **disable-running-check** value is set to **no**, the router determines whether the network interface is up and running - in order to show flag **R** for AP, one or more clients have to be registered to it, for station, it should be connected to an AP. If the interface does not appear as running (**R**), its route in the routing table is shown as **invalid**! If set to **yes**, the interface will always be shown as running.

The **tx-power** default setting is the maximum tx-power that the card can use. If you want to use larger tx-rates, you are able to set them, but **do it at your own risk**! Usually, you can use this parameter to reduce the **tx-power**.

You should set **tx-power** property to an appropriate value as many cards do not have their default setting set to the maximal power it can work on. For the cards MikroTik is selling (5G/ABM), 20dB (100mW) is the maximal power in 5GHz bands and 18dB (65mW) is the maximal power in 2.4GHz bands.

For different versions of Atheros chipset there are different value range of **ack-timeout** property:

Chipset version	**5GHz**		**5GHz-turbo**		**2GHz-B**		**2GHz-G**	
	default	**max**	**default**	**max**	**default**	**max**	**default**	**max**
5000 (5.2GHz only)	**30**	**204**	**22**	**102**	**N/A**	**N/A**	**N/A**	**N/A**
5211 (802.11a/b)	**30**	**409**	**22**	**204**	**109**	**409**	**N/A**	**N/A**
5212 (802.11a/b/g)	**25**	**409**	**22**	**204**	**30**	**409**	**52**	**409**

If wireless interfaces are put in **nstreme-dual-slave** mode, all configuration will take place in **/interface wireless nstreme-dual** submenu described further on. In that case, configuration made in this submenu will be ignored.

Example

Let us consider an example: a MikroTik router is connected to an AP using Atheros card and the AP is operating in IEEE 802.11b standard with **ssid=hotspot**.

To see current interface settings:

```
[admin@MikroTik] interface wireless> print
Flags: X - disabled, R - running
 0 X  name="wlan1" mtu=1500 mac-address=00:01:24:70:3D:4E arp=enabled
      disable-running-check=no interface-type=Atheros AR5211 mode=station
      ssid="MikroTik" frequency=5180 band=5GHz scan-list=default-ism
      supported-rates-b=1Mbps,2Mbps,5.5Mbps,11Mbps
      supported-rates-a/g=6Mbps,9Mbps,12Mbps,18Mbps,24Mbps,36Mbps,48Mbps,
                          54Mbps
      basic-rates-b=1Mbps basic-rates-a/g=6Mbps max-station-count=2007
      ack-timeout=dynamic tx-power=default noise-floor-threshold=default
      burst-time=disabled fast-frames=no dfs-mode=none antenna-mode=ant-a
      wds-mode=disabled wds-default-bridge=none wds-ignore-ssid=no
      default-authentication=yes default-forwarding=yes hide-ssid=no
      802.1x-mode=none

[admin@MikroTik] interface wireless>
```

Set the **ssid** to *hotspot* and enable the interface. Use the monitor command to see the connection status.

```
[admin@MikroTik] interface wireless> set 0 ssid=hotspot band=2.4ghz-b \
disabled=no
[admin@MikroTik] interface wireless> mo 0
                 status: connected-to-ess
                   band: 2.4ghz-b
              frequency: 2442
                tx-rate: 11Mbps
                rx-rate: 11Mbps
                   ssid: hotspot
                  bssid: 00:0B:6B:31:08:22
             radio-name: 000B6B310822
        signal-strength: -55
     tx-signal-strength: -55
                 tx-ccq: 99
                 rx-ccq: 98
    current-ack-timeout: 110
       current-distance: 110
               wds-link: no
                nstreme: no
           framing-mode: none
       routeros-version: 2.8.15
                last-ip: 192.168.0.254

[admin@MikroTik] interface wireless>
```

Monitor from the Access Point:

```
[admin@AP] interface wireless> mo 0
                 status: running-ap
                   band: 2.4ghz-b
              frequency: 2442
         overall-tx-ccq: 58
     registered-clients: 2
    current-ack-timeout: 30
       current-distance: 30
                nstreme: no
```

Nstreme Settings

Home menu level: ***/interface wireless nstreme***

Description

You can switch a wireless card to the nstreme mode. In that case the card will work only with nstreme clients.

Property Description

enable-nstreme (yes | no; default: **no**) - whether to switch the card into the nstreme mode

enable-polling (yes | no; default: **yes**) - whether to use polling for clients

framer-limit (*integer*; default: **3200**) - maximal frame size

framer-policy (*none* | *best-fit* | *exact-size* | *fast-frames* | *dynamic-size*; default: **none**) - the method how to combine frames (like fast-frames setting in interface configuration). A number of frames may be combined into one bigger one to reduce the amout of protocol overhead (and thus increase speed). The card are not waiting for frames, but in case a number packets are queued for transmitting, they can be combined. There are several methods of framing:

- **none** - do nothing special, do not combine packets
- **fast-frames** - use fast-frame mode of the radio card
- **best-fit** - put as much packets as possible in one frame, until the framer-limit limit is met, but do not fragment packets
- **exact-size** - put as much packets as possible in one frame, until the framer-limit limit is met, even if fragmentation will be needed (best performance)
- **dynamic-size** - choose the best frame size dynamically

name (*name*) - reference name of the interface

Example

To enable the nstreme protocol on the **wlan1** radio with exact-size framing:

```
[admin@MikroTik] interface wireless nstreme> print
 0 name="wlan1" enable-nstreme=no enable-polling=yes framer-policy=none
   framer-limit=3200
[admin@MikroTik] interface wireless nstreme> set wlan1 enable-nstreme=yes \
\... framer-policy=exact-size
```

Nstreme2 Group Settings

Home menu level: ***/interface wireless nstreme-dual***

Description

Two radios in **nstreme-dual-slave** mode can be grouped together to make nstreme2 Point-to-Point connection

Property Description

arp (*disabled* | *enabled* | *proxy-arp* | *reply-only*; default: **enabled**) - Address Resolution Protocol setting

disable-running-check (yes | no) - whether the interface should always be treated as running even if there is no connection to a remote peer

framer-limit (*integer*; default: **4000**) - maximal frame size

framer-policy (*none* | *best-fit* | *exact-size*; default: **none**) - the method how to combine frames (like fast-frames setting in interface configuration). A number of frames may be combined into one bigger one to reduce the amout of protocol overhead (and thus increase speed). The card are not waiting for frames, but in case a number packets are queued for transmitting, they can be combined. There are several methods of framing:

- **none** - do nothing special, do not combine packets
- **best-fit** - put as much packets as possible in one frame, until the framer-limit limit is met, but do not fragment packets

- **exact-size** - put as much packets as possible in one frame, until the framer-limit limit is met, even if fragmentation will be needed (best performance)

mac-address (*read-only: MAC address*) - MAC address of the receiving wireless card in the set

mtu (*integer*: 0..65536; default: **1500**) - Maximum Transmission Unit

name (*name*) - reference name of the interface

rates-a/g (*multiple choice: 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps*) - rates to be supported in 802.11a or 802.11g standard

rates-b (*multiple choice: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps*) - rates to be supported in 802.11b standard

remote-mac (*MAC address*; default: **00:00:00:00:00:00**) - which MAC address to connect to (this would be the remote receiver card's MAC address)

rx-band - operating band of the receiving radio

- **2.4ghz-b** - IEEE 802.11b
- **2.4ghz-g** - IEEE 802.11g
- **2.4ghz-g-turbo** - IEEE 802.11g in Atheros proprietary turbo mode (up to 108Mbit)
- **5ghz** - IEEE 802.11a up to 54 Mbit
- **5ghz-turbo** - IEEE 802.11a in Atheros proprietary turbo mode (up to 108Mbit)

rx-frequency (*integer*; default: **5320**) - Frequency to use for receiving frames

rx-radio (*name*) - which radio should be used for receiving frames

tx-band - operating band of the transmitting radio

- **2.4ghz-b** - IEEE 802.11b
- **2.4ghz-g** - IEEE 802.11g
- **2.4ghz-g-turbo** - IEEE 802.11g in Atheros proprietary turbo mode (up to 108Mbit)
- **5ghz** - IEEE 802.11a up to 54 Mbit
- **5ghz-turbo** - IEEE 802.11a in Atheros proprietary turbo mode (up to 108Mbit)

tx-frequency (*integer*; default: **5180**) - Frequency to use for transmitting frames

tx-radio (*name*) - which radio should be used for transmitting frames

Example

To enable the nstreme2 protocol on a router:

1. Having two Atheros AR5212 based cards which are not used for anything else, to group them into a nstreme interface, switch both of them into **nstreme-slave** mode:

```
[admin@MikroTik] interface wireless> print
Flags: X - disabled, R - running
 0    name="wlan1" mtu=1500 mac-address=00:0B:6B:31:02:4F arp=enabled
      disable-running-check=no interface-type=Atheros AR5212
      radio-name="000B6B31024F" mode=station ssid="MikroTik" frequency=5180
      band=5GHz scan-list=default-ism
      supported-rates-b=1Mbps,2Mbps,5.5Mbps,11Mbps
      supported-rates-a/g=6Mbps,9Mbps,12Mbps,18Mbps,24Mbps,36Mbps,48Mbps,
                          54Mbps
      basic-rates-b=1Mbps basic-rates-a/g=6Mbps max-station-count=2007
      ack-timeout=dynamic tx-power=default noise-floor-threshold=default
      burst-time=disabled fast-frames=no dfs-mode=none antenna-mode=ant-a
      wds-mode=disabled wds-default-bridge=none
      update-stats-interval=disabled default-authentication=yes
      default-forwarding=yes hide-ssid=no 802.1x-mode=none

 1    name="wlan2" mtu=1500 mac-address=00:0B:6B:30:B4:A4 arp=enabled
      disable-running-check=no interface-type=Atheros AR5212
      radio-name="000B6B30B4A4" mode=station ssid="MikroTik" frequency=5180
      band=5GHz scan-list=default-ism
      supported-rates-b=1Mbps,2Mbps,5.5Mbps,11Mbps
      supported-rates-a/g=6Mbps,9Mbps,12Mbps,18Mbps,24Mbps,36Mbps,48Mbps,
                          54Mbps
      basic-rates-b=1Mbps basic-rates-a/g=6Mbps max-station-count=2007
      ack-timeout=dynamic tx-power=default noise-floor-threshold=default
      burst-time=disabled fast-frames=no dfs-mode=none antenna-mode=ant-a
      wds-mode=disabled wds-default-bridge=none
      update-stats-interval=disabled default-authentication=yes
      default-forwarding=yes hide-ssid=no 802.1x-mode=none

[admin@MikroTik] interface wireless> set 0,1 mode=nstreme-dual-slave
```

2. Then add nstreme2 interface with exact-size framing:

```
[admin@MikroTik] interface wireless nstreme-dual> add \
\... framer-policy=exact-size
```

3. And configure which card will be receiving, and wich - transmitting

```
[admin@MikroTik] interface wireless nstreme-dual> print
Flags: X - disabled, R - running
 0 X  name="n-streme1" mtu=1500 mac-address=00:00:00:00:00:00 arp=enabled
      disable-running-check=no tx-radio=(unknown) rx-radio=(unknown)
      remote-mac=00:00:00:00:00:00 tx-band=5GHz tx-frequency=5180
      rates-b=1Mbps,2Mbps,5.5Mbps,11Mbps
      rates-a/g=6Mbps,9Mbps,12Mbps,18Mbps,24Mbps,36Mbps,48Mbps,54Mbps
      rx-band=5GHz rx-frequency=5320 framer-policy=exact-size
      framer-limit=4000

[admin@MikroTik] interface wireless nstreme-dual> set 0 disabled=no \
\... tx-radio=wlan1 rx-radio=wlan2
[admin@MikroTik] interface wireless nstreme-dual>
```

Registration Table

Home menu level: ***/interface wireless registration-table***

Description

In the registration table you can see various information about currently connected clients. It is used only for Access Points.

Property Description

ack-timeout (*read-only: integer*) - acknowledgment code timeout (transmission acceptance timeout) in microseconds or one of these

ap (*read-only: no | yes*) - whether the connected node is an Access Point or not

bytes (*read-only: integer, integer*) - number of received and sent bytes

distance (*read-only: integer*) - the same as ack-timeout

framing-mode (*read-only: none* | *best-fit* | *exact-size* | *fast-frames* | *dynamic-size*; default: **none**) - the method how the frames are combined

interface (*read-only: name*) - interface that client is registered to

last-activity (*read-only: time*) - last interface data tx/rx activity

mac-address (*read-only: MAC address*) - MAC address of the registered client

nstreme (*read-only:* yes | no) - whether the client uses Nstreme protocol or not

packets (*read-only: integer, integer*) - number of received and sent packets

radio-name (*read-only: name*) - MT proprietary extension for Atheros cards

routeros-version (*read-only: text*) - if the client is a MikroTik router, this value shows its version

rx-ccq (*read-only: integer*: 0..100) - Client Connection Quality - a value in percent that shows how effective the receive bandwidth is used regarding the theoretically maximum available bandwidth

rx-rate (*read-only: integer*) - receive data rate

signal-strength (*read-only: integer*) - signal strength in dBm

tx-ccq (*read-only: integer*: 0..100) - Client Connection Quality - a value in percent that shows how effective the transmit bandwidth is used regarding the theoretically maximum available bandwidth

tx-rate (*read-only: integer*) - transmit data rate

tx-signal-strength (*read-only: integer*) - transmit signal level in dBm

uptime (*read-only: time*) - time the client is associated with the access point

wds (*read-only:* yes | no) - whether client uses WDS or not

Example

To see registration table showing all clients currently associated with the access point:

```
[admin@MikroTik] interface wireless registration-table> print
 # INTERFACE RADIO-NAME       MAC-ADDRESS       AP  SIGNAL... TX-RATE
 0 wlan1     000124703D61     00:01:24:70:3D:61 no  -66       9Mbps
```

To get additional statistics:

```
[admin@MikroTik] interface wireless> registration-table print stats
 0 interface=wlan1 radio-name="000124703D61" mac-address=00:01:24:70:3D:61
   ap=no wds=no rx-rate=54Mbps tx-rate=9Mbps packets=4,28 bytes=41,2131
   frames=4,28 frame-bytes=41,2131 hw-frames=4,92 hw-frame-bytes=137,4487
   uptime=00:11:08 last-activity=00:00:03.940 signal-strength=-66
   tx-signal-strength=-61 tx-ccq=2 rx-ccq=1 ack-timeout=28 distance=28
   nstreme=no framing-mode=none routeros-version="2.8.14"
[admin@MikroTik] interface wireless>
```

Access List

Home menu level: ***/interface wireless access-list***

Description

The access list is used by the Access Point to restrict associations of clients and by clients to restrict associations to a given list of APs. This list contains MAC address of client and associated action to take when client attempts to connect. Also, the forwarding of frames sent by the client is controlled.

The association procedure is as follows: when a new client wants to associate to the AP that is configured on interface **wlanN**, an entry with client's MAC address and interface **wlanN** is looked up in the access-list. If such entry is found, action specified in the access list is performed, else **default-authentication** and **default-forwarding** arguments of interface **wlanN** are taken.

Property Description

authentication (*yes* | *no*; default: **yes**) - whether to accept or to reject this client when it tries to connect

forwarding (*yes* | *no*; default: **yes**) - whether to forward the client's frames to other wireless clients

interface (*name*) - AP interface name

mac-address (*MAC address*) - MAC address of the client

private-algo (*104bit-wep* | *40bit-wep* | *aes-ccm* | *none*) - which encryption algorithm to use

private-key (*text*; default: **""**) - private key of the client to use for private-algo

skip-802.1x (yes | no) - not implemented, yet

Notes

If you have default authentication action for the interface set to yes, you can disallow this node to register at the AP's interface wlanN by setting authentication=no for it. Thus, all nodes except this one will be able to register to the interface wlanN.

If you have default authentication action for the interface set to no, you can allow this node to register at the AP's interface wlanN by setting authentication=yes for it. Thus, only the specified nodes will be able to register to the interface wlanN.

Example

To allow authentication and forwarding for the client 00:01:24:70:3A:BB from the wlan1 interface using WEP 40bit algorithm with the key **1234567890**:

```
[admin@MikroTik] interface wireless access-list> add mac-address= \
\... 00:01:24:70:3A:BB interface=wlan1 private-algo=40bit-wep private-key=1234567890
[admin@MikroTik] interface wireless access-list> print
Flags: X - disabled
 0   mac-address=00:01:24:70:3A:BB interface=wlan1 authentication=yes
     forwarding=yes skip-802.1x=yes private-algo=40bit-wep
     private-key="1234567890"
[admin@MikroTik] interface wireless access-list>
```

Info

Home menu level: ***/interface wireless info***

Description

This facility provides you with general wireless interface information.

Property Description

2ghz-b-channels (*multiple choice, read-only: 2312, 2317, 2322, 2327, 2332, 2337, 2342, 2347, 2352, 2357, 2362, 2367, 2372, 2412, 2417, 2422, 2427, 2432, 2437, 2442, 2447, 2452, 2457, 2462, 2467, 2472, 2484, 2512, 2532, 2552, 2572, 2592, 2612, 2632, 2652, 2672, 2692, 2712, 2732*) - the list of 2.4ghz IEEE 802.11b channels (frequencies are given in MHz)

2ghz-g-channels (*multiple choice, read-only: 2312, 2317, 2322, 2327, 2332, 2337, 2342, 2347, 2352, 2357, 2362, 2367, 2372, 2412, 2417, 2422, 2427, 2432, 2437, 2442, 2447, 2452, 2457, 2462, 2467, 2472, 2512, 2532, 2552, 2572, 2592, 2612, 2632, 2652, 2672, 2692, 2712, 2732, 2484*) - the list of 2.4ghz IEEE 802.11g channels (frequencies are given in MHz)

5ghz-channels (*multiple choice, read-only: 4920, 4925, 4930, 4935, 4940, 4945, 4950, 4955, 4960, 4965, 4970, 4975, 4980, 4985, 4990, 4995, 5000, 5005, 5010, 5015, 5020, 5025, 5030, 5035, 5040, 5045, 5050, 5055, 5060, 5065, 5070, 5075, 5080, 5085, 5090, 5095, 5100, 5105, 5110, 5115, 5120, 5125, 5130, 5135, 5140, 5145, 5150, 5155, 5160, 5165, 5170, 5175, 5180, 5185, 5190, 5195, 5200, 5205, 5210, 5215, 5220, 5225, 5230, 5235, 5240, 5245, 5250, 5255, 5260, 5265, 5270, 5275, 5280, 5285, 5290, 5295, 5300, 5305, 5310, 5315, 5320, 5325, 5330, 5335, 5340, 5345, 5350, 5355, 5360, 5365, 5370, 5375, 5380, 5385, 5390, 5395, 5400, 5405, 5410, 5415, 5420, 5425, 5430, 5435, 5440, 5445, 5450, 5455, 5460, 5465, 5470, 5475, 5480, 5485, 5490, 5495, 5500, 5505, 5510, 5515, 5520, 5525, 5530, 5535, 5540, 5545, 5550, 5555, 5560, 5565, 5570, 5575, 5580, 5585, 5590, 5595, 5600, 5605, 5610, 5615, 5620, 5625, 5630, 5635, 5640, 5645, 5650, 5655, 5660, 5665, 5670, 5675, 5680, 5685, 5690, 5695, 5700, 5705, 5710, 5715, 5720, 5725, 5730, 5735, 5740, 5745, 5750, 5755, 5760, 5765, 5770, 5775, 5780, 5785, 5790, 5795, 5800, 5805, 5810, 5815, 5820, 5825, 5830, 5835, 5840, 5845, 5850, 5855, 5860, 5865, 5870, 5875, 5880, 5885, 5890, 5895, 5900, 5905, 5910, 5915, 5920, 5925, 5930, 5935, 5940, 5945, 5950, 5955, 5960, 5965, 5970, 5975, 5980, 5985, 5990, 5995, 6000, 6005, 6010, 6015, 6020, 6025, 6030, 6035, 6040, 6045, 6050, 6055, 6060, 6065, 6070, 6075, 6080, 6085, 6090, 6095, 6100*) - the list of 5ghz channels (frequencies are given in MHz)

5ghz-turbo-channels (*multiple choice, read-only: 4920, 4925, 4930, 4935, 4940, 4945, 4950, 4955, 4960, 4965, 4970, 4975, 4980, 4985, 4990, 4995, 5000, 5005, 5010, 5015, 5020, 5025, 5030, 5035, 5040, 5045, 5050, 5055, 5060, 5065, 5070, 5075, 5080, 5085, 5090, 5095, 5100, 5105, 5110, 5115, 5120, 5125, 5130, 5135, 5140, 5145, 5150, 5155, 5160, 5165, 5170, 5175, 5180, 5185, 5190, 5195, 5200, 5205, 5210, 5215, 5220, 5225, 5230, 5235, 5240, 5245, 5250, 5255, 5260, 5265, 5270, 5275, 5280, 5285, 5290, 5295, 5300, 5305, 5310, 5315, 5320, 5325, 5330, 5335, 5340, 5345, 5350, 5355, 5360, 5365, 5370, 5375, 5380, 5385, 5390, 5395, 5400, 5405, 5410, 5415, 5420, 5425, 5430, 5435, 5440, 5445, 5450, 5455, 5460, 5465, 5470, 5475, 5480, 5485, 5490, 5495, 5500, 5505, 5510, 5515, 5520, 5525, 5530, 5535, 5540, 5545, 5550, 5555, 5560, 5565, 5570, 5575, 5580, 5585, 5590, 5595, 5600, 5605, 5610, 5615, 5620, 5625, 5630, 5635, 5640, 5645, 5650, 5655, 5660, 5665, 5670, 5675, 5680, 5685, 5690, 5695, 5700, 5705, 5710, 5715, 5720, 5725, 5730, 5735, 5740, 5745, 5750, 5755, 5760, 5765, 5770, 5775, 5780, 5785, 5790, 5795, 5800, 5805, 5810, 5815, 5820, 5825, 5830, 5835, 5840, 5845, 5850, 5855, 5860, 5865, 5870, 5875, 5880, 5885, 5890, 5895, 5900, 5905, 5910, 5915, 5920, 5925, 5930, 5935, 5940, 5945, 5950, 5955, 5960, 5965, 5970, 5975, 5980, 5985, 5990, 5995, 6000, 6005, 6010, 6015, 6020, 6025, 6030, 6035, 6040, 6045, 6050, 6055, 6060, 6065, 6070, 6075, 6080, 6085, 6090, 6095, 6100*) - the list of 5ghz-turbo channels (frequencies are given in MHz)

ack-timeout-control (*read-only: yes | no*) - provides information whether this device supports transmission acceptance timeout control

alignment-mode (*read-only: yes | no*) - is the alignment-only mode supported by this interface

burst-support (yes | no) - whether the interface supports data bursts (burst-time)

firmware (*read-only: text*) - current firmware of the interface (used only for Prism chipset based cards)

interface-type (*read-only: text*) - shows the hardware interface type

noise-floor-control (*read-only: yes | no*) - does this interface support noise-floor-thershold detection

scan-support (yes | no) - whether the interface supports scan function ('/interface wireless scan')

supported-bands (*multiple choice, read-only: 2ghz-b | 2ghz-g | 5ghz | 5ghz-turbo*) - the list of supported bands

tx-power-control (*read-only: yes | no*) - provides information whether this device supports transmission power control

virtual-aps (*read-only: yes | no*) - whether this interface supports Virtual Access Points ('/interface wireless add')

Notes

There is a special argument for the print command - print count-only. It forces the print command to print only the count of information topics.

In RouterOS v2.8 and above **/interface wireless info print** command shows only channels supported by particular card. This behaviour differs from one in v2.7, where **wireless info print** command showed all channels, even those not supported by particular card.

Example

```
[admin@MikroTik] interface wireless info> print
 0 interface-type=Atheros AR5212 tx-power-control=yes ack-timeout-control=yes
   alignment-mode=yes virtual-aps=yes noise-floor-control=yes
   scan-support=yes burst-support=yes nstreme-support=yes
   supported-bands=2ghz-b,5ghz,5ghz-turbo,2ghz-g
   2ghz-b-channels=2312,2317,2322,2327,2332,2337,2342,2347,2352,2357,2362,2367,
                   2372,2412,2417,2422,2427,2432,2437,2442,2447,2452,2457,2462,
                   2467,2472,2512,2532,2552,2572,2592,2612,2632,2652,2672,2692,
                   2712,2732,2484
   5ghz-channels=4920,4925,4930,4935,4940,4945,4950,4955,4960,4965,4970,4975,
                 4980,4985,4990,4995,5000,5005,5010,5015,5020,5025,5030,5035,
                 5040,5045,5050,5055,5060,5065,5070,5075,5080,5085,5090,5095,
                 5100,5105,5110,5115,5120,5125,5130,5135,5140,5145,5150,5155,
                 5160,5165,5170,5175,5180,5185,5190,5195,5200,5205,5210,5215,
                 5220,5225,5230,5235,5240,5245,5250,5255,5260,5265,5270,5275,
                 5280,5285,5290,5295,5300,5305,5310,5315,5320,5325,5330,5335,
                 5340,5345,5350,5355,5360,5365,5370,5375,5380,5385,5390,5395,
                 5400,5405,5410,5415,5420,5425,5430,5435,5440,5445,5450,5455,
                 5460,5465,5470,5475,5480,5485,5490,5495,5500,5505,5510,5515,
                 5520,5525,5530,5535,5540,5545,5550,5555,5560,5565,5570,5575,
                 5580,5585,5590,5595,5600,5605,5610,5615,5620,5625,5630,5635,
                 5640,5645,5650,5655,5660,5665,5670,5675,5680,5685,5690,5695,
                 5700,5705,5710,5715,5720,5725,5730,5735,5740,5745,5750,5755,
                 5760,5765,5770,5775,5780,5785,5790,5795,5800,5805,5810,5815,
                 5820,5825,5830,5835,5840,5845,5850,5855,5860,5865,5870,5875,
                 5880,5885,5890,5895,5900,5905,5910,5915,5920,5925,5930,5935,
                 5940,5945,5950,5955,5960,5965,5970,5975,5980,5985,5990,5995,
                 6000,6005,6010,6015,6020,6025,6030,6035,6040,6045,6050,6055,
                 6060,6065,6070,6075,6080,6085,6090,6095,6100
   5ghz-turbo-channels=4920,4925,4930,4935,4940,4945,4950,4955,4960,4965,4970,
                       4975,4980,4985,4990,4995,5000,5005,5010,5015,5020,5025,
                       5030,5035,5040,5045,5050,5055,5060,5065,5070,5075,5080,
                       5085,5090,5095,5100,5105,5110,5115,5120,5125,5130,5135,
                       5140,5145,5150,5155,5160,5165,5170,5175,5180,5185,5190,
                       5195,5200,5205,5210,5215,5220,5225,5230,5235,5240,5245,
                       5250,5255,5260,5265,5270,5275,5280,5285,5290,5295,5300,
                       5305,5310,5315,5320,5325,5330,5335,5340,5345,5350,5355,
                       5360,5365,5370,5375,5380,5385,5390,5395,5400,5405,5410,
                       5415,5420,5425,5430,5435,5440,5445,5450,5455,5460,5465,
                       5470,5475,5480,5485,5490,5495,5500,5505,5510,5515,5520,
                       5525,5530,5535,5540,5545,5550,5555,5560,5565,5570,5575,
                       5580,5585,5590,5595,5600,5605,5610,5615,5620,5625,5630,
                       5635,5640,5645,5650,5655,5660,5665,5670,5675,5680,5685,
                       5690,5695,5700,5705,5710,5715,5720,5725,5730,5735,5740,
                       5745,5750,5755,5760,5765,5770,5775,5780,5785,5790,5795,
                       5800,5805,5810,5815,5820,5825,5830,5835,5840,5845,5850,
                       5855,5860,5865,5870,5875,5880,5885,5890,5895,5900,5905,
                       5910,5915,5920,5925,5930,5935,5940,5945,5950,5955,5960,
                       5965,5970,5975,5980,5985,5990,5995,6000,6005,6010,6015,
                       6020,6025,6030,6035,6040,6045,6050,6055,6060,6065,6070,
                       6075,6080,6085,6090,6095,6100
   2ghz-g-channels=2312,2317,2322,2327,2332,2337,2342,2347,2352,2357,2362,2367,
                   2372,2412,2417,2422,2427,2432,2437,2442,2447,2452,2457,2462,
                   2467,2472,2512,2532,2552,2572,2592,2612,2632,2652,2672,2692,
                   2712,2732,2484
[admin@MikroTik] interface wireless info>
```

Virtual Access Point Interface

Home menu level: ***/interface wireless***

Description

Virtual Access Point (VAP) interface is used to have an additional AP. You can create a new AP with different **ssid**. It can be compared with a VLAN where the **ssid** from VAP is the VLAN **tag** and the hardware interface is the VLAN switch.

Note that you cannot use the Virtual Access Point on Prism based cards!

Property Description

802.1x-mode (*PEAP-MSCHAPV2* | *none*) - to use Protected Extensible Authentication Protocol Microsoft Challenge Handshake Authentication Protocol version 2 for authentication

arp (*disabled* | *enabled* | *proxy-arp* | *reply-only*) - ARP mode

default-authentication (*yes* | *no*; default: **yes**) - whether to accept or reject a client that wants to associate, but is not in the access-list

default-forwarding (*yes* | *no*; default: **yes**) - whether to forward frames to other AP clients or not

disabled (*yes* | *no*; default: **yes**) - whether to disable the interface or not

disable-running-check (*yes* | *no*; default: **no**) - disable running check. For 'broken' cards it is a good idea to set this value to 'yes'

hide-ssid (*yes* | *no*; default: **no**) - whether to hide ssid or not in the beacon frames:

- **yes** - ssid is not included in the beacon frames. AP replies only to probe-requests with the given ssid
- **no** - ssid is included in beacon frames. AP replies to probe-requests with the given ssid and to 'broadcast ssid'

mac-address (*read-only: MAC address*; default: **00:00:00:00:00:00**) - MAC address of VAP. Is assigned automatically when the field master interface is set

master-interface (*name*) - hardware interface to use for VAP

max-station-count (*integer*; default: **2007**) - number of clients that can connect to this AP simultaneously

mtu (*integer*: 68..1600; default: **1500**) - Maximum Transmission Unit

name (*name*; default: **wlanN**) - interface name

ssid (*text*; default: **MikroTik**) - the service set identifier

Notes

You can create a VAP only in the same frequency an the same band as specified in the **master-interface**

Example

Add a VAP:

```
/interface wireless add master-interface=wlan1 ssid=VAP1 disabled=no
[admin@MikroTik] interface wireless> print
Flags: X - disabled, R - running
 0  R name="wlan1" mtu=1500 mac-address=00:0B:6B:31:02:4B arp=enabled
      disable-running-check=no interface-type=Atheros AR5212
      radio-name="AP_172" mode=ap-bridge ssid="wtest" frequency=5805
      band=5ghz scan-list=default-ism rate-set=default
      supported-rates-b=1Mbps,2Mbps,5.5Mbps,11Mbps
      supported-rates-a/g=6Mbps,9Mbps,12Mbps,18Mbps,24Mbps,36Mbps,48Mbps,
                          54Mbps
      basic-rates-b=1Mbps basic-rates-a/g=6Mbps max-station-count=2007
      ack-timeout=dynamic tx-power=default noise-floor-threshold=default
      burst-time=disabled fast-frames=no dfs-mode=none antenna-mode=ant-a
      wds-mode=disabled wds-default-bridge=none wds-ignore-ssid=no
      update-stats-interval=disabled default-authentication=yes
      default-forwarding=yes hide-ssid=no 802.1x-mode=none

 1    name="wlan2" mtu=1500 mac-address=00:0B:6B:31:02:4B arp=enabled
      disable-running-check=no interface-type=virtual-AP
      master-interface=wlan1 ssid="VAP1" max-station-count=2007
      default-authentication=yes default-forwarding=yes hide-ssid=no
      802.1x-mode=none
[admin@MikroTik] interface wireless>
```

Now you can connect cliets to 8AP with **ssid=VAP1**

WDS Interface Configuration

Home menu level: ***/interface wireless wds***

Description

WDS (Wireless Distribution System) allows packets to pass from one wireless AP (Access Point) to another, just as if the APs were ports on a wired Ethernet switch. APs must use the same standard (802.11a, 802.11b or 802.11g) and work on the same frequencies in order to connect to each other.

There are two possibilities to create a WDS interface:

- **dynamic** - is created 'on the fly' and appers under wds menu as a dynamic interface
- **static** - is created manually

Property Description

arp (*disabled* | *enabled* | *proxy-arp* | *reply-only*; default: **enabled**) - Address Resolution Protocol

- **disabled** - the interface will not use ARP
- **enabled** - the interface will use ARP
- **proxy-arp** - the interface will use the ARP proxy feature
- **reply-only** - the interface will only reply to the requests originated to its own IP addresses. Neighbour MAC addresses will be resolved using /ip arp statically set table only

disable-running-check (*yes* | *no*; default: **no**) - disable running check. For 'broken' wireless cards it is a good idea to set this value to 'yes'

mac-address (*MAC address*; default: **00:00:00:00:00:00**) - MAC address of the master-interface. Specifying master-interface, this value will be set automatically

master-interface (*name*) - wireless interface which will be used by WDS

mtu (*integer*: 0..65336; default: **1500**) - Maximum Transmission Unit

name (*name*; default: **wdsN**) - WDS interface name

wds-address (*MAC address*) - MAC address of the remote WDS host

Notes

When the link between WDS devices, using **wds-mode=dynamic**, goes down, the dynamic WDS interfaces disappear and if there are any IP addresses set on this interface, their 'interface' setting will change to **(unknown)**. When the link comes up again, the 'interface' value will not change - it will remain as **(unknown)**. That's why it is not recommended to add IP addresses to dynamic WDS interfaces.

If you want to use dynamic WDS in a bridge, set the **wds-default-bridge** value to desired bridge interface name. When the link will go down and then it comes up, the dynamic WDS interface will be put in the specified bridge automatically.

As the routers which are in WDS mode have to communicate at equal frequencies, it is not recommended to use **WDS** and **DFS** simultaneously - it is most probable that these routers will not connect to each other.

Example

```
[admin@MikroTik] interface wireless wds> add master-interface=wlan1 \
\... wds-address=00:0B:6B:30:2B:27 disabled=no
[admin@MikroTik] interface wireless wds> print
Flags: X - disabled, R - running, D - dynamic
  0  R  name="wds1" mtu=1500 mac-address=00:0B:6B:30:2B:23 arp=enabled
        disable-running-check=no master-inteface=wlan1
        wds-address=00:0B:6B:30:2B:27

[admin@MikroTik] interface wireless wds>
```

Align

Home menu level: ***/interface wireless align***

Description

This feature is created to position wireless links. The **align** submenu describes properties which are used if **/interface wireless mode** is set to **alignment-only**. In this mode the interface 'listens' to those packets which are sent to it from other devices working on the same channel. The interface also can send special packets which contains information about its parameters.

Property Description

active-mode (*yes* | *no*; default: **yes**) - whether the interface will receive and transmit 'alignment' packets or it will only receive them

audio-max (*integer*; default: **64**) - signal-strength at which audio (beeper) frequency will be the highest

audio-min (*integer*; default: **0**) - signal-strength at which audio (beeper) frequency will be the lowest

audio-monitor (*MAC address*; default: **00:00:00:00:00:00**) - MAC address of the remote host which will be 'listened'

filter-mac (*MAC address*; default: **00:00:00:00:00:00**) - in case if you want to receive packets from only one remote host, you should specify here its MAC address

frame-size (*integer*: 200..1500; default: **300**) - size of 'alignment' packets that will be transmitted

frames-per-second (*integer*: 1..100; default: **25**) - number of frames that will be sent per second (in active-mode)

receive-all (*yes* | *no*; default: **no**) - whether the interface gathers packets about other 802.11 standard packets or it will gather only 'alignment' packets

ssid-all (*yes* | *no*; default: **no**) - whether you want to accept packets from hosts with other ssid than yours

test-audio (*integer*) - test the beeper for 10 seconds

Notes

If you are using the command **/interface wireless align monitor** then it will automatically change the wireless interface's mode from **station**, **bridge** or **ap-bridge** to **alignment-only**.

Example

```
[admin@MikroTik] interface wireless align> print
           frame-size: 300
          active-mode: yes
          receive-all: yes
        audio-monitor: 00:00:00:00:00:00
           filter-mac: 00:00:00:00:00:00
             ssid-all: no
    frames-per-second: 25
            audio-min: 0
            audio-max: 64
[admin@MikroTik] interface wireless align>
```

Align Monitor

Command name: ***/interface wireless align monitor***

Description

This command is used to monitor current signal parameters to/from a remote host.

Property Description

address (*read-only: MAC address*) - MAC address of the remote host

avg-rxq (*read-only: integer*) - average signal strength of received packets since last display update on screen

correct (*read-only: percentage*) - how many undamaged packets were received

last-rx (*read-only: time*) - time in seconds before the last packet was received

last-tx (*read-only: time*) - time in seconds when the last TXQ info was received

rxq (*read-only: integer*) - signal strength of last received packet

ssid (*read-only: text*) - service set identifier

txq (*read-only: integer*) - the last received signal strength from our host to the remote one

Example

```
[admin@MikroTik] interface wireless align> monitor wlan2
 # ADDRESS           SSID          RXQ AVG-RXQ LAST-RX TXQ LAST-TX CORRECT
 0 00:01:24:70:4B:FC wirelesa      -60 -60     0.01    -67 0.01    100 %

[admin@MikroTik] interface wireless align>
```

Network Scan

Description

This is a feature that allows you to scan all avaliable wireless networks. While scanning, the card unregisters itself from the access point (in station mode), or unregisters all clients (in bridge or ap-bridge mode). Thus, network connections are lost while scanning.

Property Description

(*name*) - interface name to use for scanning

address (*read-only: MAC address*) - MAC address of the AP

band (*read-only: text*) - in which standard does the AP operate

bss (*read-only: yes* | *no*) - basic service set

freq (*read-only: integer*) - the frequency of AP

privacy (*read-only: yes* | *no*) - whether all data is encrypted or not

refresh-interval (*time*; default: **1s**) - time in seconds to refresh the displayed data

signal-strength (*read-only: integer*) - signal strength in dBm

ssid (*read-only: text*) - service set identifier of the AP

Example

```
[admin@MikroTik] interface wireless> scan wlan1 refresh-interval=1s
 # ADDRESS           SSID           BAND       FREQ BSS PRIVACY SIGNAL-STRENGTH
 0 00:02:6F:01:69:FA wep2           2.4GHz-B   2412 yes no      -59
 0 00:02:6F:20:28:E6 r              2.4GHz-B   2422 yes no      -79
 0 00:02:6F:05:68:D3 hotspot        2.4GHz-B   2442 yes no      -95
 0 00:40:96:44:2E:16                2.4GHz-B   2457 yes no      -84
 0 00:02:6F:08:53:1F rbinstall      2.4GHz-B   2457 yes no      -93

[admin@MikroTik] interface wireless>
```

Wireless Security

Description

This section provides the WEP (Wired Equivalent Privacy) functions to wireless interfaces.

Note if you want to use Prism card with WEP security, then you should note that Prism card doesn't report that the use of WEP is required for all data type frames. Which means that some clients will not see that access point uses encryption. Atheros clients will not connect to the MikroTik Prism access point with WEP enabled if you specify security=required for this Atheros client, because clients cannot be sure that it is secure as the AP doesn't give this information. You should select security=optional to be able to connect to MikroTik Prism Access Point

Property Description

algo-0 (*40bit-wep* | *104bit-wep* | *aes-ccm* | *none*; default: **none**) - which encryption algorithm to use:

- **40bit-wep** - use the 40bit encryption (also known as 64bit-wep) and accept only these packets
- **104bit-wep** - use the 104bit encryption (also known as 128bit-wep) and accept only these packets
- **aes-ccm** - use the AES (Advanced Encryption Standard) with CCM (Counter with CBC-MAC) encryption and accept only these packets
- **none** - do not use encryption and do not accept encrypted packets

algo-1 (*40bit-wep* | *104bit-wep* | *aes-ccm* | *none*; default: **none**) - which encryption algorithm to use:

- **40bit-wep** - use the 40bit encryption (also known as 64bit-wep) and accept only these packets
- **104bit-wep** - use the 104bit encryption (also known as 128bit-wep) and accept only these packets
- **aes-ccm** - use the AES (Advanced Encryption Standard) with CCM (Counter with CBC-MAC) encryption and accept only these packets
- **none** - do not use encryption and do not accept encrypted packets

algo-2 (*40bit-wep* | *104bit-wep* | *aes-ccm* | *none*; default: **none**) - which encryption algorithm to use:

- **40bit-wep** - use the 40bit encryption (also known as 64bit-wep) and accept only these packets
- **104bit-wep** - use the 104bit encryption (also known as 128bit-wep) and accept only these packets
- **aes-ccm** - use the AES (Advanced Encryption Standard) with CCM (Counter with CBC-MAC) encryption and accept only these packets
- **none** - do not use encryption and do not accept encrypted packets

algo-3 (*40bit-wep* | *104bit-wep* | *aes-ccm* | *none*; default: **none**) - which encryption algorithm to use:

- **40bit-wep** - use the 40bit encryption (also known as 64bit-wep) and accept only these packets
- **104bit-wep** - use the 104bit encryption (also known as 128bit-wep) and accept only these

packets

- **aes-ccm** - use the AES (Advanced Encryption Standard) with CCM (Counter with CBC-MAC) encryption and accept only these packets
- **none** - do not use encryption and do not accept encrypted packets

key-0 (*text*) - hexadecimal key which will be used to encrypt packets with the 40bit-wep, 104bit-wep or aes-ccm algorithm (algo-0)

key-1 (*text*) - hexadecimal key which will be used to encrypt packets with the 40bit-wep, 104bit-wep or aes-ccm algorithm (algo-0)

key-2 (*text*) - hexadecimal key which will be used to encrypt packets with the 40bit-wep, 104bit-wep or aes-ccm algorithm (algo-0)

key-3 (*text*) - hexadecimal key which will be used to encrypt packets with the 40bit-wep, 104bit-wep or aes-ccm algorithm (algo-0)

radius-mac-authentication (*no* | *yes*; default: **no**) - whether to use Radius server MAC authentication

security (*none* | *optional* | *required*; default: **none**) - security level:

- **none** - do not encrypt packets and do not accept encrypted packets
- **optional** - if there is a sta-private-key set, use it. Otherwise, if the ap-bridge mode is set - do not use encryption, if the mode is station, use encryption if the transmit-key is set
- **required** - encrypt all packets and accept only encrypted packets

sta-private-algo (*40bit-wep* | *104bit-wep* | *aes-ccm* | *none*) - algorithm to use if the sta-private-key is set. Used to commumicate between 2 devices

sta-private-key (*text*) - if this key is set in station mode, use this key for encryption. In ap-bridge mode you have to specify private keys in the access-list or use the Radius server using radius-mac-authentication. Used to commumicate between 2 devices

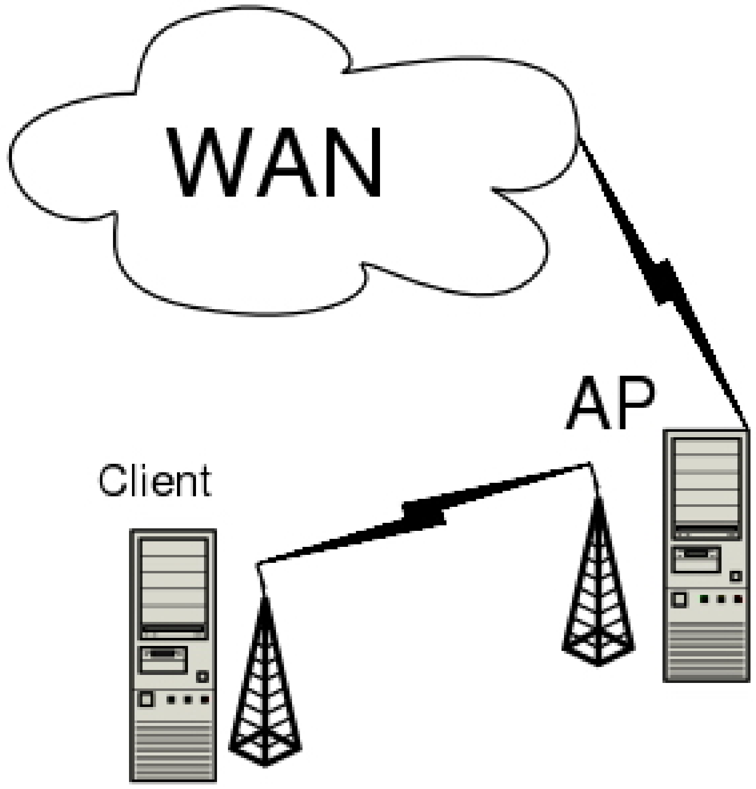
transmit-key (*key-0* | *key-1* | *key-2* | *key-3*; default: **key-0**) - which key to use for broadcast packets. Used in AP mode

Notes

The keys used for encryption are in hexadecimal form. If you use **40bit-wep**, the key has to be 10 characters long, if you use **104bit-wep**, the key has to be 26 characters long, **aes-ccm** key should contain 32 hexadecimal characters.

Wireless Aplication Examples

AP to Client Configuration Example



You need Level5 license to enable the AP mode. To make the MikroTik router to work as an access point, the configuration of the wireless interface should be as follows:

- A unique Service Set Identifier should be chosen, say "test1"
- A frequency should be selected for the link, say 5180MHz
- The operation mode should be set to **ap-bridge**

The following command should be issued to change the settings for the wireless AP interface:

```
[admin@AP] interface wireless> set 0 mode=ap-bridge ssid=test1 \
\... disabled=no frequency= 5180 band=5GHz
[admin@AP] interface wireless> print
Flags: X - disabled, R - running
 0    name="wlan1" mtu=1500 mac-address=00:0B:6B:31:01:6A arp=enabled
      disable-running-check=no interface-type=Atheros AR5212 mode=ap-bridge
      ssid="test1" frequency=5180 band=5GHz scan-list=default-ism
      supported-rates-b=1Mbps,2Mbps,5.5Mbps,11Mbps
      supported-rates-a/g=6Mbps,9Mbps,12Mbps,18Mbps,24Mbps,36Mbps,48Mbps,
                          54Mbps
      basic-rates-b=1Mbps basic-rates-a/g=6Mbps max-station-count=2007
      ack-timeout=dynamic tx-power=default noise-floor-threshold=default
      burst-time=disabled fast-frames=no antenna-mode=ant-a wds-mode=disabled
      wds-default-bridge=none default-authentication=yes
      default-forwarding=yes hide-ssid=no 802.1x-mode=none
[admin@AP] interface wireless>
```

Then we need to configure the wireless client interface:

```
[admin@MikroTik] interface wireless> set 0 mode=station ssid=test1 \
\... disabled=no
[admin@Client] interface wireless> print
Flags: X - disabled, R - running
 0  R name="wlan2" mtu=1500 mac-address=00:0B:6B:30:79:02 arp=enabled
      disable-running-check=no interface-type=Atheros AR5212 mode=station
```

```
       ssid="test1" frequency=5180 band=5GHz scan-list=default-ism
       supported-rates-b=1Mbps,2Mbps,5.5Mbps,11Mbps
       supported-rates-a/g=6Mbps,9Mbps,12Mbps,18Mbps,24Mbps,36Mbps,48Mbps,
                           54Mbps
       basic-rates-b=1Mbps basic-rates-a/g=6Mbps max-station-count=2007
       ack-timeout=dynamic tx-power=default noise-floor-threshold=default
       burst-time=disabled fast-frames=no antenna-mode=ant-a wds-mode=disabled
       wds-default-bridge=none default-authentication=yes
       default-forwarding=yes hide-ssid=no 802.1x-mode=none
 [admin@Client] interface wireless>
```

Now we can monitor our connection from the AP:

```
 [admin@AP] interface wireless> monitor 0
                  status: running-ap
      registered-clients: 1
     current-ack-timeout: 28
        current-distance: 28

 [admin@AP] interface wireless>
```

... and from the client:

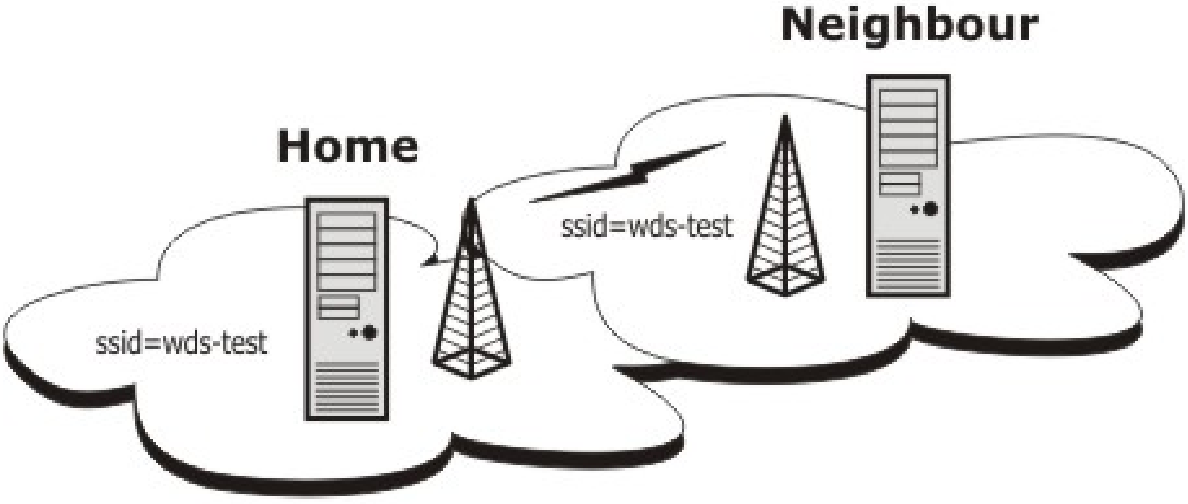
```
 [admin@Client] interface wireless> monitor 0
                  status: connected-to-ess
                    band: 5GHz
               frequency: 5180
                 tx-rate: 6Mbps
                 rx-rate: 6Mbps
                    ssid: test1
                   bssid: 00:0B:6B:31:01:6A
         signal-strength: -66
     current-ack-timeout: 28
        current-distance: 28

 [admin@Client] interface wireless>
```

WDS Configuration Example

WDS (Wireless Distribution System) makes it able to connect APs to each other with the same **ssid** and share the same network. On one physical wireless interface you can create multiple WDS interfaces which will connect to other APs.

This is just a simple example how to get a connection between APs using WDS. Afterwards you can bridge it with the wireless and/or ethernet interface.

Let us consider the following example:



Router **Home**

- ssid = wds-test
- IP Address = 192.168.0.2
- Network Mask = 255.255.255.0

Router **Neighbour**

- ssid = wds-test
- IP Address = 192.168.0.1
- Network Mask = 255.255.255.0

Router **Home** configuration.

At first we should configure the wireless interface for router **Home**:

```
[admin@Home] interface wireless> set wlan1 mode=ap-bridge ssid=wds-test \
\... wds-mode=static disabled=no
[admin@Home] interface wireless> print
Flags: X - disabled, R - running
  0    name="wlan1" mtu=1500 mac-address=00:01:24:70:3A:83 arp=enabled
       disable-running-check=no interface-type=Atheros AR5211 mode=ap-bridge
       ssid="wds-test" frequency=5120 band=5GHz scan-list=default-ism
       supported-rates-a/g=6Mbps,9Mbps,12Mbps,18Mbps,24Mbps,36Mbps,48Mbps,
                           54Mbps
       basic-rates-a/g=6Mbps supported-rates-b=1Mbps,2Mbps,5.5Mbps,11Mbps
       basic-rates-b=1Mbps max-station-count=2007 ack-timeout=default
       tx-power=default noise-floor-threshold=default wds-mode=static
       wds-default-bridge=none default-authentication=yes
       default-forwarding=yes hide-ssid=no 802.1x-mode=none

[admin@Home] interface wireless>
```

We should add and configure a **WDS** interface. Note that the value of **wds-address** is the remote wds host's wireless interface MAC address (to which we will connect to):

```
[admin@Home] interface wireless wds> add wds-address=00:01:24:70:3B:AE \
\... master-inteface=wlan1 disabled=no
[admin@Home] interface wireless wds> print
```

```
Flags: X - disabled, R - running, D - dynamic
  0     name="wds1" mtu=1500 mac-address=00:01:24:70:3A:83 arp=enabled
        disable-running-check=no master-inteface=wlan1
        wds-address=00:01:24:70:3B:AE

[admin@Home] interface wireless wds>
```

Add the IP address to the **WDS** interface:

```
[admin@Home] ip address> add address=192.168.25.2/24 interface=wds1
[admin@Home] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   192.168.25.2/24    192.168.25.0    192.168.25.255  wds1

[admin@Home] ip address>
```

Router **Neighbour** configuration.

At first we should configure the wireless interface for router **Neighbour**:

```
[admin@Neighbour] interface wireless> set wlan1 mode=ap-bridge ssid=wds-test \
\... wds-mode=static disabled=no
[admin@Neighbour] interface wireless> print
Flags: X - disabled, R - running
  0  R name="wlan1" mtu=1500 mac-address=00:01:24:70:3B:AE arp=enabled
       disable-running-check=no interface-type=Atheros AR5211 mode=ap-bridge
       ssid="wds-test" frequency=5120 band=5GHz scan-list=default-ism
       supported-rates-a/g=6Mbps,9Mbps,12Mbps,18Mbps,24Mbps,36Mbps,48Mbps,
                           54Mbps
       basic-rates-a/g=6Mbps supported-rates-b=1Mbps,2Mbps,5.5Mbps,11Mbps
       basic-rates-b=1Mbps max-station-count=2007 ack-timeout=default
       tx-power=default noise-floor-threshold=default wds-mode=static
       wds-default-bridge=none default-authentication=yes
       default-forwarding=yes hide-ssid=no 802.1x-mode=none

[admin@Neighbour] interface wireless>
```

Now the **WDS** interface configuration:

```
[admin@Neighbour] interface wireless wds> add wds-address=00:01:24:70:3A:83 \
\... master-inteface=wlan1 disabled=no
[admin@Neighbour] interface wireless wds> print
Flags: X - disabled, R - running, D - dynamic
  0  R  name="wds1" mtu=1500 mac-address=00:01:24:70:3B:AE arp=enabled
        disable-running-check=no master-inteface=wlan1
        wds-address=00:01:24:70:3A:83

[admin@Neighbour] interface wireless wds>
```

Add the IP address:

```
[admin@Neighbour] ip address> add address=192.168.25.1/24 interface=wds1
[admin@Neighbour] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   192.168.25.1/24    192.168.25.0    192.168.25.255  wds1

[admin@Neighbour] ip address>
```

And now you can check whether the **WDS** link works:

```
[admin@Neighbour] ip address> /ping 192.168.25.2
192.168.25.2 64 byte ping: ttl=64 time=6 ms
192.168.25.2 64 byte ping: ttl=64 time=4 ms
192.168.25.2 64 byte ping: ttl=64 time=4 ms
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 4/4.4/6 ms
[admin@Neighbour] ip address>
```

Wireless Security Example

Let us consider that we want to secure all data for all wireless clients that are connecting to our AP.

At first, add addresses to the wireless interfaces.

On the AP:

```
[admin@AP] ip address> add address=192.168.1.1/24 interface=wlan1
[admin@AP] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
 #   ADDRESS            NETWORK         BROADCAST       INTERFACE
 0   192.168.1.1/24     192.168.1.0     192.168.1.255   wlan1
[admin@AP] ip address>
```

And on the client:

```
[admin@Client] ip address> add address=192.168.1.2/24 interface=wlan1
[admin@AP] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
 #   ADDRESS            NETWORK         BROADCAST       INTERFACE
 0   192.168.1.2/24     192.168.1.0     192.168.1.255   wlan1
[admin@Client] ip address>
```

On the AP set the security to **required** and choose which encryption algorithm to use:

```
[admin@AP] interface wireless security> set 0 security=required \
\... algo-1=40bit-wep key-1=0123456789 transmit-key=key-1
[admin@AP] interface wireless security> print
 0 name="wlan1" security=required algo-0=none key-0=""
   algo-1=40bit-wep key-1="0123456789" algo-2=none key-2="" algo-3=none key-3=""
   transmit-key=key-1 sta-private-algo=none sta-private-key=""
   radius-mac-authentication=no
[admin@AP] interface wireless security>
```

On the client side do the same:

```
[admin@Client] interface wireless security> set 0 security=required \
\ algo-1=40bit-wep key-1=0123456789  transmit-key=key-1
[admin@AP] interface wireless security> print
 0 name="wlan1" security=required algo-0=none key-0=""
   algo-1=40bit-wep key-1="0123456789" algo-2=none key-2="" algo-3=none key-3=""
   transmit-key=key-1 sta-private-algo=none sta-private-key=""
   radius-mac-authentication=no
[admin@Client] interface wireless security>
```

Finally, test the link:

```
[admin@Client] interface wireless security> /ping 192.168.1.1
192.168.1.1 64 byte ping: ttl=64 time=22 ms
192.168.1.1 64 byte ping: ttl=64 time=16 ms
192.168.1.1 64 byte ping: ttl=64 time=15 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 15/17.6/22 ms
[admin@Client] interface wireless security>
```

Troubleshooting

Description

- **If I use WDS and DFS, the routers do not connect to each other!**
  As the WDS routers must operate at the same frequency, it is very probable that DFS will not

select the frequency that is used by the peer router.

- **MikroTik RouterOS does not send any traffic through Cisco Wireless Access Point or Wireless Bridge**
  If you use CISCO/Aironet Wireless Ethernet Bridge or Access Point, you should set the Configuration/Radio/I80211/Extended (Allow proprietary extensions) to **off**, and the Configuration/Radio/I80211/Extended/Encapsulation (Default encapsulation method) to **RFC1042**. If left to the default **on** and **802.1H**, respectively, you won't be able to pass traffic through the bridge.

EoIP Tunnel Interface

Document revision 1.3 (Tue Mar 09 08:15:37 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Ethernet over IP (EoIP) Tunneling is a MikroTik RouterOS protocol that creates an Ethernet tunnel between two routers on top of an IP connection. The EoIP interface appears as an Ethernet interface. When the bridging function of the router is enabled, all Ethernet traffic (all Ethernet protocols) will be bridged just as if there where a physical Ethernet interface and cable between the two routers (with bridging enabled). This protocol makes multiple network schemes possible.

Network setups with EoIP interfaces:

- Possibility to bridge LANs over the Internet
- Possibility to bridge LANs over encrypted tunnels
- Possibility to bridge LANs over 802.11b 'ad-hoc' wireless networks

Quick Setup Guide

To make an EoIP tunnel between 2 routers which have IP addresses **10.5.8.1** and **10.1.0.1**:

1. On router with IP address **10.5.8.1**, add an EoIP interface and set its MAC address:

```
/interface eoip add remote-address=10.1.0.1 tunnel-id=1 mac-address=00-00-5E-80-00-01 \
\... disabled=no
```

2. On router with IP address **10.1.0.1**, add an EoIP interface and set its MAC address::

```
/interface eoip add remote-address=10.5.8.1 tunnel-id=1 mac-address=00-00-5E-80-00-02 \
\... disabled=no
```

Now you can add IP addresses to the created EoIP interfaces from the same subnet.

Specifications

Packages required: ***system***
License required: ***level1 (limited to 1 tunnel), level3***
Home menu level: ***/interface eoip***
Standards and Technologies: ***GRE (RFC1701)***
Hardware usage: ***Not significant***

Related Documents

- *Package Management*
- *IP Addresses and ARP*
- *Bridge Interfaces*
- *PPTP Interface*

Description

An EoIP interface should be configured on two routers that have the possibility for an IP level connection. The EoIP tunnel may run over an IPIP tunnel, a PPTP 128bit encrypted tunnel, a PPPoE connection, or any connection that transports IP.

Specific Properties:

- Each EoIP tunnel interface can connect with one remote router which has a corresponding interface configured with the same 'Tunnel ID'.
- The EoIP interface appears as an Ethernet interface under the interface list.
- This interface supports all features of an Ethernet interface. IP addresses and other tunnels may be run over the interface.
- The EoIP protocol encapsulates Ethernet frames in GRE (IP protocol number 47) packets (just like PPTP) and sends them to the remote side of the EoIP tunnel.
- Maximal count of EoIP tunnels is 65536.

EoIP Setup

Home menu level: ***/interface eoip***

Property Description

name (*name*; default: **eoip-tunnelN**) - interface name for reference

mtu (*integer*; default: **1500**) - Maximum Transmission Unit. The default value provides maximal compatibility

arp (*disabled | enabled | proxy-arp | reply-only*; default: **enabled**) - Address Resolution Protocol

tunnel-id (*integer*) - a unique tunnel identifier

remote-address - the IP address of the other side of the EoIP tunnel - must be a MikroTik router

mac-address (*MAC address*) - MAC address of the EoIP interface. You can freely use MAC addresses that are in the range from 00-00-5E-80-00-00 to 00-00-5E-FF-FF-FF

Notes

tunnel-id is method of identifying tunnel. There should not be tunnels with the same **tunnel-id** on the same router. **tunnel-id** on both participant routers must be equal.

mtu should be set to 1500 to eliminate packet refragmentation inside the tunnel (that allows transparent bridging of Ethernet-like networks, so that it would be possible to transport full-sized Ethernet frame over the tunnel).

For **EoIP** interfaces you can use MAC addresses that are in the range from **00-00-5E-80-00-00** to **00-00-5E-FF-FF-FF**.

Example

To add and enable an EoIP tunnel named **to_mt2** to the **10.5.8.1** router, specifying **tunnel-id** of **1**:

```
[admin@MikroTik] interface eoip> add name=to_mt2 remote-address=10.5.8.1 \
\... tunnel-id 1
[admin@MikroTik] interface eoip> print
Flags: X - disabled, R - running
  0 X  name="to_mt2" mtu=1500 arp=enabled remote-address=10.5.8.1 tunnel-id=1

[admin@MikroTik] interface eoip> enable 0
[admin@MikroTik] interface eoip> print
Flags: X - disabled, R - running
  0 R  name="to_mt2" mtu=1500 arp=enabled remote-address=10.5.8.1 tunnel-id=1

[admin@MikroTik] interface eoip>
```

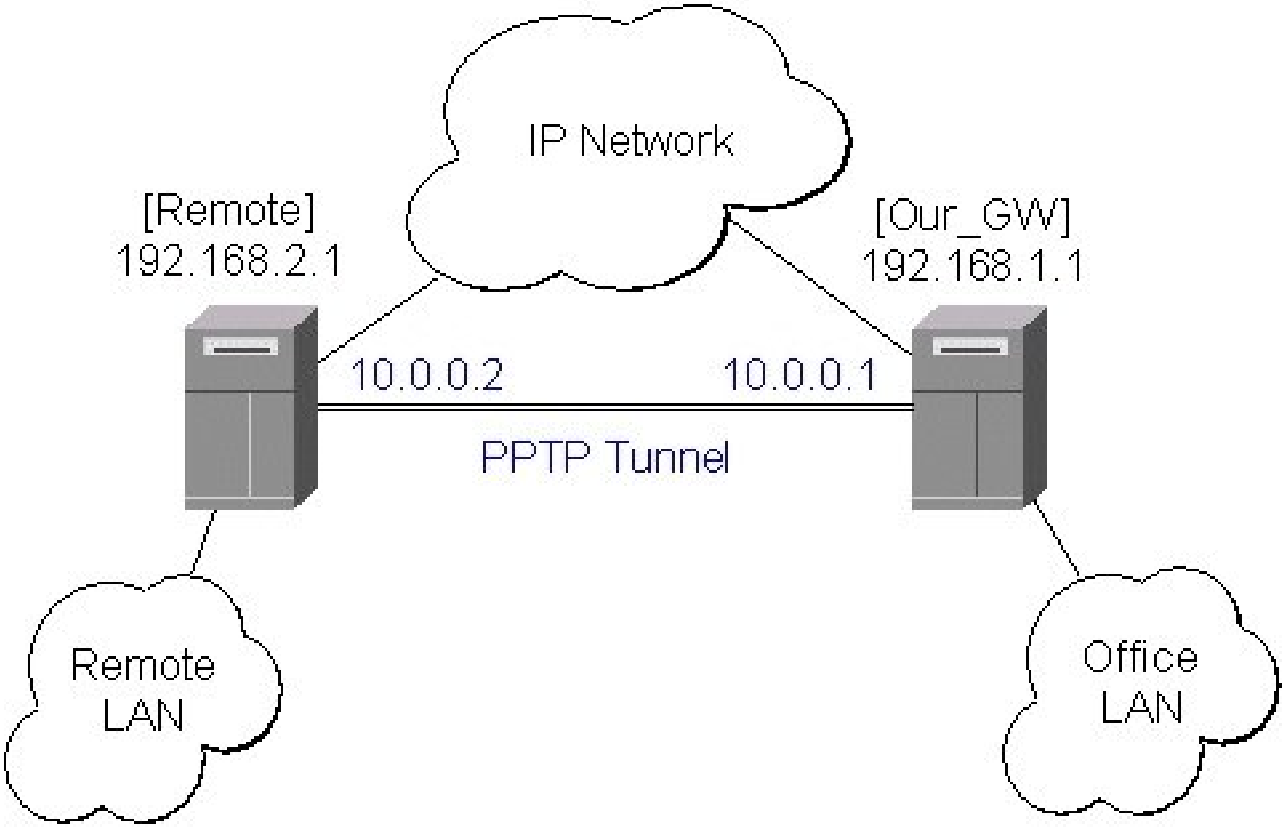
EoIP Application Example

Description

Let us assume we want to bridge two networks: 'Office LAN' and 'Remote LAN'. The networks are connected to an IP network through the routers [Our_GW] and [Remote]. The IP network can be a private intranet or the Internet. Both routers can communicate with each other through the IP network.

Example

Our goal is to create a secure channel between the routers and bridge both networks through it. The network setup diagram is as follows:



To make a secure Ethernet bridge between two routers you should:

1. Create a PPTP tunnel between them. Our_GW will be the pptp server:

```
[admin@Our_GW] interface pptp-server> /ppp secret add name=joe service=pptp \
\... password=top_s3 local-address=10.0.0.1 remote-address=10.0.0.2
[admin@Our_GW] interface pptp-server> add name=from_remote user=joe
[admin@Our_GW] interface pptp-server> server set enable=yes
[admin@Our_GW] interface pptp-server> print
Flags: X - disabled, D - dynamic, R - running
  #     NAME                 USER         MTU   CLIENT-ADDRESS  UPTIME   ENC...
  0     from_remote          joe
[admin@Our_GW] interface pptp-server>

The Remote router will be the pptp client:

[admin@Remote] interface pptp-client> add name=pptp user=joe \
\... connect-to=192.168.1.1 password=top_s3 mtu=1500 mru=1500
[admin@Remote] interface pptp-client> enable pptp
[admin@Remote] interface pptp-client> print
Flags: X - disabled, R - running
  0  R name="pptp" mtu=1500 mru=1500 connect-to=192.168.1.1 user="joe"
       password="top_s2" profile=default add-default-route=no

[admin@Remote] interface pptp-client> monitor pptp
      status: "connected"
      uptime: 39m46s
    encoding: "none"

[admin@Remote] interface pptp-client>
```

See the PPTP Interface Manual for more details on setting up encrypted channels.

2. Configure the EoIP tunnel by adding the eoip tunnel interfaces at both routers. Use the ip addresses of the pptp tunnel interfaces when specifying the argument values for the EoIP

tunnel:

```
[admin@Our_GW] interface eoip> add name="eoip-remote" tunnel-id=0 \
\... remote-address=10.0.0.2
[admin@Our_GW] interface eoip> enable eoip-remote
[admin@Our_GW] interface eoip> print
Flags: X - disabled, R - running
  0    name=eoip-remote mtu=1500 arp=enabled remote-address=10.0.0.2 tunnel-id=0
[admin@Our_GW] interface eoip>

[admin@Remote] interface eoip> add name="eoip" tunnel-id=0 \
\... remote-address=10.0.0.1
[admin@Remote] interface eoip> enable eoip-main
[admin@Remote] interface eoip> print
Flags: X - disabled, R - running
  0   name=eoip mtu=1500 arp=enabled remote-address=10.0.0.1 tunnel-id=0

[Remote] interface eoip>
```

3. Enable bridging between the EoIP and Ethernet interfaces on both routers.
   On the Our_GW:

```
[admin@Our_GW] interface bridge> add forward-protocols=ip,arp,other \
\... disabled=no
[admin@Our_GW] interface bridge> print
Flags: X - disabled, R - running
  0  R name="bridge1" mtu=1500 arp=enabled mac-address=00:00:00:00:00:00
       forward-protocols=ip,arp,other priority=1

[admin@Our_GW] interface bridge> port print
Flags: X - disabled
  #   INTERFACE                             BRIDGE
  0   eoip-remote                           none
  1   office-eth                            none
  2   isp                                   none

[admin@Our_GW] interface bridge> port set "0,1" bridge=bridge1
```

   And the same for the Remote:

```
[admin@Remote] interface bridge> add forward-protocols=ip,arp,other \
\... disabled=no
[admin@Remote] interface bridge> print
Flags: X - disabled, R - running
  0  R name="bridge1" mtu=1500 arp=enabled mac-address=00:00:00:00:00:00
       forward-protocols=ip,arp,other priority=1

[admin@Remote] interface bridge> port print
Flags: X - disabled
  #   INTERFACE                             BRIDGE
  0   ether                                 none
  1   adsl                                  none
  2   eoip-main                             none

[admin@Remote] interface bridge> port set "0,2" bridge=bridge1
```

4. Addresses from the same network can be used both in the Office LAN and in the Remote LAN.

Troubleshooting

Description

- **The routers can ping each other but EoIP tunnel does not seem to work!**
  Check the MAC addresses of the EoIP interfaces - they should not be the same!

Xpeed SDSL Interface

Document revision 1.1 (Fri Mar 05 08:18:04 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS supports the Xpeed 300 SDSL PCI Adapter hardware with speeds up to 2.32Mbps. This device can operate either using Frame Relay or PPP type of connection. SDSL (Single-line Digital Subscriber Line or Symmetric Digital Subscriber Line) stands for the type of DSL that uses only one of the two cable pairs for transmission. SDSL allows residential or small office users to share the same telephone for data transmission and voice or fax telephony.

Specifications

Packages required: ***synchronous***
License required: ***level4***
Home menu level: ***/interface xpeed***
Standards and Technologies: ***PPP (RFC 1661)***, ***Frame Relay (RFC 1490)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***IP Addresses and ARP***
- ***Xpeed SDSL Interface***

Additional Documents

- *Xpeed homepage*

Xpeed Interface Configuration

Home menu level: ***/interface xpeed***

Property Description

name (*name*) - interface name

mtu (*integer*; default: **1500**) - Maximum Transmission Unit

mac-address (*MAC address*) - MAC address of the card

arp (*disabled | enabled | proxy-arp | reply-only*; default: **enabled**) - Address Resolution Protocol

- **disabled** - the interface will not use ARP protocol
- **enabled** - the interface will use ARP protocol
- **proxy-arp** - the interface will be an ARP proxy
- **reply-only** - the interface will only reply to the requests originated to its own IP addresses, but neighbor MAC addresses will be gathered from /ip arp statically set table only

mode (*network-termination | line-termination*; default: **line-termination**) - interface mode, either line termination (LT) or network termination (NT)

sdsl-speed (*integer*; default: **2320**) - SDSL connection speed

sdsl-invert (*yes | no*; default: **no**) - whether the clock is phase inverted with respect to the Transmitted Data interchange circuit. This configuration option is useful when long cable lengths between the Termination Unit and the DTE are causing data errors

sdsl-swap (*yes | no*; default: **no**) - whether or not the Xpeed 300 SDSL Adapter performs bit swapping. Bit swapping can maximize error performance by attempting to maintain an acceptable margin for each bin by equalizing the margin across all bins through bit reallocation

bridged-ethernet (*yes | no*; default: **yes**) - if the adapter operates in bridged Ethernet mode

dlci (*integer*; default: **16**) - defines the DLCI to be used for the local interface. The DLCI field identifies which logical circuit the data travels over

lmi-mode (*off | line-termination | network-termination | network-termination-bidirectional*; default: **off**) - defines how the card will perform LMI protocol negotiation

- **off** - no LMI will be used
- **line-termination** - LMI will operate in LT (Line Termination) mode
- **network-termination** - LMI will operate in NT (Network Termination) mode
- **network-termination-bidirectional** - LMI will operate in bidirectional NT mode

cr (*0 | 2*; default: **0**) - a special mask value to be used when speaking with certain buggy vendor equipment. Can be 0 or 2

Example

To enable interface:

```
[admin@r1] interface> print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                                              TYPE             MTU
  0  R outer                                             ether            1500
  1  R inner                                             ether            1500
  2 X  xpeed1                                            xpeed            1500

[admin@r1] interface> enable 2
[admin@r1] interface> print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                                              TYPE             MTU
  0  R outer                                             ether            1500
  1  R inner                                             ether            1500
  2  R xpeed1                                            xpeed            1500

[admin@r1] interface>
```

Frame Relay Configuration Examples

MikroTik Router to MikroTik Router

Consider the following network setup with MikroTik router connected via SDSL line using Xpeed interface to another MikroTik router with Xpeed 300 SDSL adapter. SDSL line can refer a common patch cable included with the Xpeed 300 SDSL adapter (such a connection is called Back-to-Back). Lets name the first router **r1** and the second **r2**.

Router **r1** setup

The following setup is identical to one in the first example:

```
[admin@r1] ip address> add inter=xpeed1 address 1.1.1.1/24
[admin@r1] ip address> pri
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   1.1.1.1/24         1.1.1.0         1.1.1.255       xpeed1

[admin@r1] interface xpeed> print
Flags: X - disabled
  0   name="xpeed1" mtu=1500 mac-address=00:05:7A:00:00:08 arp=enabled
      mode=network-termination sdsl-speed=2320 sdsl-invert=no sdsl-swap=no
      bridged-ethernet=yes dlci=16 lmi-mode=off cr=0
[admin@r1] interface xpeed>
```

Router **r2** setup

First, we need to add a suitable IP address:

```
[admin@r2] ip address> add inter=xpeed1 address 1.1.1.2/24
[admin@r2] ip address> pri
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   1.1.1.2/24         1.1.1.0         1.1.1.255       xpeed1
```

Then, some changes in **xpeed** interface configuration should be done:

```
[admin@r2] interface xpeed> print
Flags: X - disabled
  0   name="xpeed1" mtu=1500 mac-address=00:05:7A:00:00:08 arp=enabled
      mode=network-termination sdsl-speed=2320 sdsl-invert=no sdsl-swap=no
      bridged-ethernet=yes dlci=16 lmi-mode=off cr=0
[admin@r2] interface xpeed> set 0 mode=line-termination
[admin@r2] interface xpeed>
```

Now **r1** and **r2** can ping each other.

MikroTik Router to Cisco Router

Let us consider the following network setup with MikroTik Router with Xpeed interface connected to a leased line with a CISCO router at the other end.

MikroTik router setup:

```
[admin@r1] ip address> add inter=xpeed1 address 1.1.1.1/24
[admin@r1] ip address> pri
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   1.1.1.1/24         1.1.1.0         1.1.1.255       xpeed1

[admin@r1] interface xpeed> print
Flags: X - disabled
  0   name="xpeed1" mtu=1500 mac-address=00:05:7A:00:00:08 arp=enabled
      mode=network-termination sdsl-speed=2320 sdsl-invert=no sdsl-swap=no
      bridged-ethernet=yes dlci=42 lmi-mode=off cr=0
[admin@r1] interface xpeed>
```

Cisco router setup

```
CISCO# show running-config
Building configuration...
Current configuration...

...
!
ip subnet-zero
no ip domain-lookup
frame-relay switching
!
interface Ethernet0
 description connected to EthernetLAN
 ip address 10.0.0.254 255.255.255.0
!
interface Serial0
 description connected to Internet
 no ip address
 encapsulation frame-relay IETF
 serial restart-delay 1
 frame-relay lmi-type ansi
 frame-relay intf-type dce
!
interface Serial0.1 point-to-point
 ip address 1.1.1.2 255.255.255.0
 no arp frame-relay
 frame-relay interface-dlci 42
!
...
end.

Send ping to MikroTik router

CISCO#ping 1.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/31/32 ms
CISCO#
```

Troubleshooting

Description

- **I tried to connect two routers as shown in MT-to-MT, but nothing happens**
  The link indicators on both cards must be on. If it's not, check the cable or interface configuration. One adapter should use LT mode and the other NT mode. You can also change **sdsl-swap** and **sdsl-invert** parameters on the router running LT mode if you have a very long line

ARLAN 655 Wireless Client Card

Document revision 1.1 (Fri Mar 05 08:12:25 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS supports Arlan 655 Wireless Interface client cards. This card fits in the ISA expansion slot and provides transparent wireless communications to other network nodes.

Specifications

Packages required: ***arlan***
License required: ***level4***
Home menu level: ***/interface arlan***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***IP Addresses and ARP***
- ***Log Management***

Installation

Example

To add the driver for Arlan 655 adapter, do the following:

```
[admin@MikroTik]> driver add name=arlan io=0xD000
[admin@MikroTik]> driver print
Flags: I - invalid, D - dynamic
  #   DRIVER                                IRQ IO       MEMORY   ISDN-PROTOCOL
  0 D RealTek 8139
  1   Arlan 655                                 0xD000

[admin@MikroTik] driver>
```

Wireless Interface Configuration

Home menu level: ***/interface arlan***

Description

The wireless card status can be obtained from the two LEDs: the **Status LED** and the **Activity LED**.

Status	Activity	Description
Amber	**Amber**	**ARLAN 655 is functional but nonvolatile memory is not configured**
Blinking Green	**Don't Care**	**ARLAN 655 not registered to an AP (ARLAN mode only)**
Green	**Off**	**Normal idle state**
Green	**Green Flash**	**Normal active state**
Red	**Amber**	**Hardware failure**
Red	**Red**	**Radio failure**

Property Description

name (*name*; default: **arlanN**) - assigned interface name

mtu (*integer*; default: **1500**) - Maximum Transmission Unit

mac-address (*MAC address*) - Media Access Control address

frequency (*2412 | 2427 | 2442 | 2457 | 2465*; default: **2412**) - channel frequency in MHz

bitrate (*1000 | 2000 | 354 | 500*; default: **2000**) - data rate in Kbit/s

sid (*integer*; default: **0x13816788**) - System Identifier. Should be the same for all nodes on the radio network. Must be an even number with maximum length 31 character

add-name (*text*; default: **test**) - card name (optional). Must contain less than 16 characters.

arp (*disabled | enabled | proxy-arp | reply-only*; default: **enabled**) - Address Resolution Protocol setting

tma-mode (*yes | no*; default: **no**) - Networking Registration Mode:

- **yes** - ARLAN
- **no** - NON ARLAN

Example

```
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                                                TYPE             MTU
  0  R outer                                               ether            1500
  1  X arlan1                                              arlan            1500
[admin@MikroTik] interface> enable 1
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                                                TYPE             MTU
  0  R outer                                               ether            1500
  1  R arlan1                                              arlan            1500
```

More configuration and statistics parameters can be found under the **/interface arlan** menu:

```
[admin@MikroTik] interface arlan> print
Flags: X - disabled, R - running
  0  R name="arlan1" mtu=1500 mac-address=00:40:96:22:90:C8 arp=enabled
       frequency=2412 bitrate=2000 tma-mode=no card-name="test"
       sid=0x13816788

[admin@MikroTik] interface arlan>
```

You can monitor the status of the wireless interface:

```
[admin@MikroTik] interface arlan> monitor 0
      registered: no
    access-point: 00:00:00:00:00:00
        backbone: 00:00:00:00:00:00

[admin@MikroTik] interface arlan>
```

Suppose we want to configure the wireless interface to accomplish registration on the **AP** with a sid **0x03816788**. To do this, it is enough to change the argument value of **sid** to **0x03816788** and **tma-mode** to **yes**:

```
[admin@MikroTik] interface arlan> set 0 sid=0x03816788 tma-mode=yes
[admin@MikroTik] interface arlan> monitor 0
         registered: yes
    access-point: 00:40:88:23:91:F8
        backbone: 00:40:88:23:91:F9

[admin@MikroTik] interface arlan>
```

Troubleshooting

Description

Keep in mind, that not all combinations of I/O base addresses and IRQs may work on particular motherboard. It is recommended that you choose an IRQ not used in your system, and then try to find an acceptable I/O base address setting. As it has been observed, the IRQ 5 and I/O 0x300 or 0x180 will work in most cases.

- **The driver cannot be loaded because other device uses the requested IRQ.**
  Try to set different IRQ using the DIP switches.
- **The requested I/O base address cannot be used on your motherboard.**
  Try to change the I/O base address using the DIP switches.
- **The pc interface does not show up under the interfaces list**

Obtain the required license for 2.4/5GHz Wireless Client feature.

- **The wireless card does not register to the Access Point**
  Check the cabling and antenna alignment.

Bridge

Document revision 1.3 (Mon Apr 19 12:26:55 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

MAC level bridging of Ethernet, Ethernet over IP (EoIP), Prism, Atheros and RadioLAN interfaces are supported. All 802.11b and 802.11a client wireless interfaces (both **ad-hoc** and **infrastructure** or station modes) do not support this because of the limitations of 802.11 - it is possible to bridge over them using the Ethernet over IP protocol (please see documentation on EoIP).

For preventing loops in a network, you can use the Spanning Tree Protocol (STP). This protocol also makes redundant paths possible.

Features include:

- Spanning Tree Protocol (STP)
- Multiple bridge interfaces
- Bridge associations on a per interface basis
- Protocol can be selected to be forwarded or discarded
- MAC address table can be monitored in real time
- IP address assignment for router access
- Bridge interfaces can be firewalled

Quick Setup Guide

To put interface **ether1** and **ether2** in a bridge.

1. Add a bridge interface, called **MyBridge**:

```
/interface bridge add name="MyBridge" disabled=no
```

2. Add **ether1** and **ether2** to **MyBridge** interface:

```
/interface bridge port set ether1,ether2 bridge=MyBridge
```

Specifications

Packages required: ***system***
License required: ***level4***
Home menu level: ***/interface bridge***
Standards and Technologies: ***Media Access Control***, ***IEEE801.1D***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***EoIP***
- ***Firewall Filters***

Description

Ethernet-like networks (Ethernet, Ethernet over IP, IEEE802.11 Wireless interfaces in AP mode) can be connected together using MAC Bridges. The bridge feature allows the interconnection of stations connected to separate LANs (using EoIP, geographically distributed networks can be bridged as well if any kind of IP network interconnection exists between them) as if they were attached to a single LAN. As bridges are transparent, they do not appear in traceroute list, and no utility can make a distinction between a host working in one LAN and a host working in another LAN if these LANs are bridged (depending on the way the LANs are interconnected, latency and data rate between hosts may vary).

Additional Documents

http://ebtables.sourceforge.net/

Bridge Interface Setup

Home menu level: ***/interface bridge***

Description

To bridge a number of networks into one bridge, a bridge interface should be created, that will group all the bridged interfaces. One MAC address will be assigned to all the bridged interfaces.

Property Description

name (*name*; default: **bridgeN**) - a descriptive name of the interface

mtu (*integer*; default: **1500**) - Maximum Transmission Unit

arp (*disabled | enabled | proxy-arp | reply-only*; default: **enabled**) - Address Resolution Protocol setting

mac-address (*read-only: MAC address*) - Media Access Control address for the interface

forward-protocols (*multiple choice: ip, arp, appletalk, ipx, ipv6, other*; default: **ip, arp, appletalk, ipx, ipv6, other**) - list of forwarded protocols

- **other** - all other protocols than AppleTalk, ARP, IP, IPv6, or IPX, e.g., NetBEUI, VLAN, etc.

priority (*integer*: 0..65535; default: **32768**) - bridge interface priority. The priority argument is used by Spanning Tree Protocol to determine, which port remains enabled if two (or even more) ports form a loop

stp (*no | yes*; default: **no**) - whether to enable or disable the Spanning Tree Protocol

ageing-time (*time*; default: **5m**) - how long the host information will be kept in the bridge database

forward-delay (*time*; default: **15s**) - time which is spent in listening/learning state

garbage-collection-interval (*time*; default: **4s**) - how often to drop old host entries in the bridge database

Notes

forwarded-protocols is a simple filter that also affects the locally-destined and locally-originated packets. So disabling **ip** protocol you will not be able to communicate with the router from the bridged interfaces.

Example

To add and enable a bridge interface that will forward all the protocols:

```
[admin@MikroTik] interface bridge> add; print
Flags: X - disabled, R - running
 0 X  name="bridge1" mtu=1500 arp=enabled mac-address=00:00:00:00:00:00
      forward-protocols=ip,arp,appletalk,ipx,ipv6,other stp=no priority=32768
      ageing-time=5m forward-delay=15s garbage-collection-interval=4s
      hello-time=2s max-message-age=20s
[admin@MikroTik] interface bridge> enable 0
```

Port Settings

Home menu level: ***/interface bridge port***

Description

The submenu is used to group interfaces in a particular bridge interface.

Property Description

interface (*read-only: name*) - interface name

bridge (*name*; default: **none**) - the bridge interface the respective interface is grouped in

- **none** - the interface is not grouped in a bridge

priority (*integer*: 0..255; default: **128**) - interface priority compared to other interfaces, which are destined to the same network

path-cost (*integer*: 0..65535; default: **10**) - path cost to the interface, used by STP to determine the 'best' path

Example

To group **ether1** and **ether2** in the **bridge1** bridge:

```
[admin@MikroTik] interface bridge port> set ether1,ether2 bridge=bridge1
[admin@MikroTik] interface bridge port> print
 # INTERFACE   BRIDGE PRIORITY PATH-COST
 0 ether1      bridge1   128      10
 1 ether2      bridge1   128      10
 2 wlan1       none      128      10
[admin@MikroTik] interface bridge port>
```

Bridge Monitoring

Command name: ***/interface bridge monitor***

Description

Used to monitor the current status of a bridge.

Property Description

bridge-id (*text*) - the bridge ID, which is in form of bridge-priority.bridge MAC Address

designated-root (*text*) - ID of the root bridge

root-port (*name*) - port to which the root bridge is connected to

path-cost (*integer*) - the total cost of path along to the root-bridge

Example

To monitor a bridge:

```
[admin@MikroTik] interface bridge> monitor bridge1
          bridge-id: 32768.00:02:6F:01:CE:31
    designated-root: 32768.00:02:6F:01:CE:31
          root-port: ether2
          path-cost: 180

[admin@MikroTik] interface bridge>
```

Bridge Port Monitoring

Command name: ***/interface bridge port monitor***

Description

Statistics of an interface that belongs to a bridge

Property Description

status (*disabled | blocking | listening | learning | forwarding*) - the status of the bridge port:

- **disabled** - the interface is disabled. No frames are forwarded, no Bridge Protocol Data Units (BPDUs) are heard
- **blocking** - the port does not forward any frames, but listens for BPDUs
- **listening** - the port does not forward any frames, but listens to them
- **learning** - the port does not forward any frames, but learns the MAC addresses
- **forwarding** - the port forwards frames, and learns MAC addresses

port-id (*integer*) - port ID, which represents from port priority and port number, and is unique

designated-root (*text*) - ID of bridge, which is nearest to the root-bridge

designated-port (*text*) - port of designated-root bridge

Example

To monitor a bridge port:

```
[admin@MikroTik] interface bridge port> mo 0
               status: forwarding
              port-id: 28417
      designated-root: 32768.00:02:6F:01:CE:31
    designated-bridge: 32768.00:02:6F:01:CE:31
      designated-port: 28417
      designated-cost: 0
-- [Q quit|D dump|C-z pause]
```

Bridge Host Monitoring

Command name: ***/interface bridge host***

Property Description

bridge (*read-only: name*) - the bridge the entry belongs to

mac-address (*read-only: MAC address*) - host's MAC address

on-interface (*read-only: name*) - which of the bridged interfaces the host is connected to

age (*read-only: time*) - the time since the last packet was received from the host

Example

To get the active host table:

```
[admin@MikroTik] interface bridge host> print
Flags: L - local
   BRIDGE              MAC-ADDRESS       ON-INTERFACE       AGE
   bridge1             00:00:B4:5B:A6:58 ether1             4m48s
   bridge1             00:30:4F:18:58:17 ether1             4m50s
 L bridge1             00:50:08:00:00:F5 ether1             0s
 L bridge1             00:50:08:00:00:F6 ether2             0s
   bridge1             00:60:52:0B:B4:81 ether1             4m50s
   bridge1             00:C0:DF:07:5E:E6 ether1             4m46s
   bridge1             00:E0:C5:6E:23:25 prism1             4m48s
   bridge1             00:E0:F7:7F:0A:B8 ether1             1s
[admin@MikroTik] interface bridge host>
```

Bridge Firewall

Home menu level: ***/interface bridge firewall***

Description

Traffic between bridged interfaces can be filtered.

Note that packets between bridged interfaces are also passed through the 'generic' **/ip firewall** rules, so they even can be NATted. These rules can be used with real, physical receiving/transmitting interfaces, as well as with bridge interface that simply groups bridged interfaces.

Property Description

mac-src-address (*MAC address*; default: **00:00:00:00:00:00**) - MAC address of the source host

in-interface (*name*; default: **all**) - interface the packet has entered the bridge through

- **all** - any interface

mac-dst-address (*MAC address*; default: **00:00:00:00:00:00**) - MAC address of the destination host

out-interface (*name*; default: **all**) - interface the packet is leaving the bridge through

- **all** - any interface

in-interface (*name*; default: **all**) - interface the packet is coming into the bridge

- **all** - any interface

mac-protocol (*all* | *integer*; default: **all**) - the MAC protocol of the packet. Most widely used MAC protocols are (many other exist):

- **all** - all MAC protocols
- **0x0004** - 802.2
- **0x0800** - IP
- **0x0806** - ARP
- **0x8035** - RARP
- **0x809B** - AppleTalk (EtherTalk)
- **0x80F3** - AppleTalk Address Resolution Protocol (AARP)
- **0x8037** - IPX
- **0x8100** - VLAN
- **0x8137** - Novell (old) NetWare IPX (ECONFIG E option)
- **0x8191** - NetBEUI
- **0x86DD** - IPv6

src-address (*IP address/mask*; default: **0.0.0.0/0**) - source IP address of the packet

dst-address (*IP address/mask*; default: **0.0.0.0/0**) - destination IP address of the packet

protocol (*all* | *egp* | *ggp* | *icmp* | *igmp* | *ip-encap* | *ip-sec* | *tcp* | *udp* | *integer*; default: **all**) - IP protocol name/number

- **all** - match all the IP protocols

action (*accept* | *drop* | *passthrough*; default: **accept**) - action to undertake if the packet matches the rule:

- **accept** - accept the packet. No action, i.e., the packet is passed through without undertaking any action, and no more rules are processed
- **drop** - silently drop the packet (without sending the ICMP reject message)
- **passthrough** - ignore this rule. Acts the same way as a disabled rule, except for ability to count packets

Drop broadcast packets

```
[admin@MikroTik] interface bridge firewall> add mac-dst-address=FF:FF:FF:FF:FF:FF
action=drop
[admin@MikroTik] interface bridge firewall> print
Flags: X - disabled, I - invalid
 0   mac-src-address=00:00:00:00:00:00 in-interface=all
     mac-dst-address=FF:FF:FF:FF:FF:FF out-interface=all mac-protocol=all
     src-address=0.0.0.0/0 dst-address=0.0.0.0/0 protocol=all action=drop
[admin@MikroTik] interface bridge firewall>
```

Drop IP, ARP and RARP

To make a brouter (the router that routes routable (IP in our case) protocols and bridges unroutable protocols), make a rule that drops IP, ARP, and RARP traffic (these protocols should be disabled in bridge firewall, not in **forwarded protocols** as in the other case the router will not be able to receive IP packets itself, and thus will not be able to provide routing).

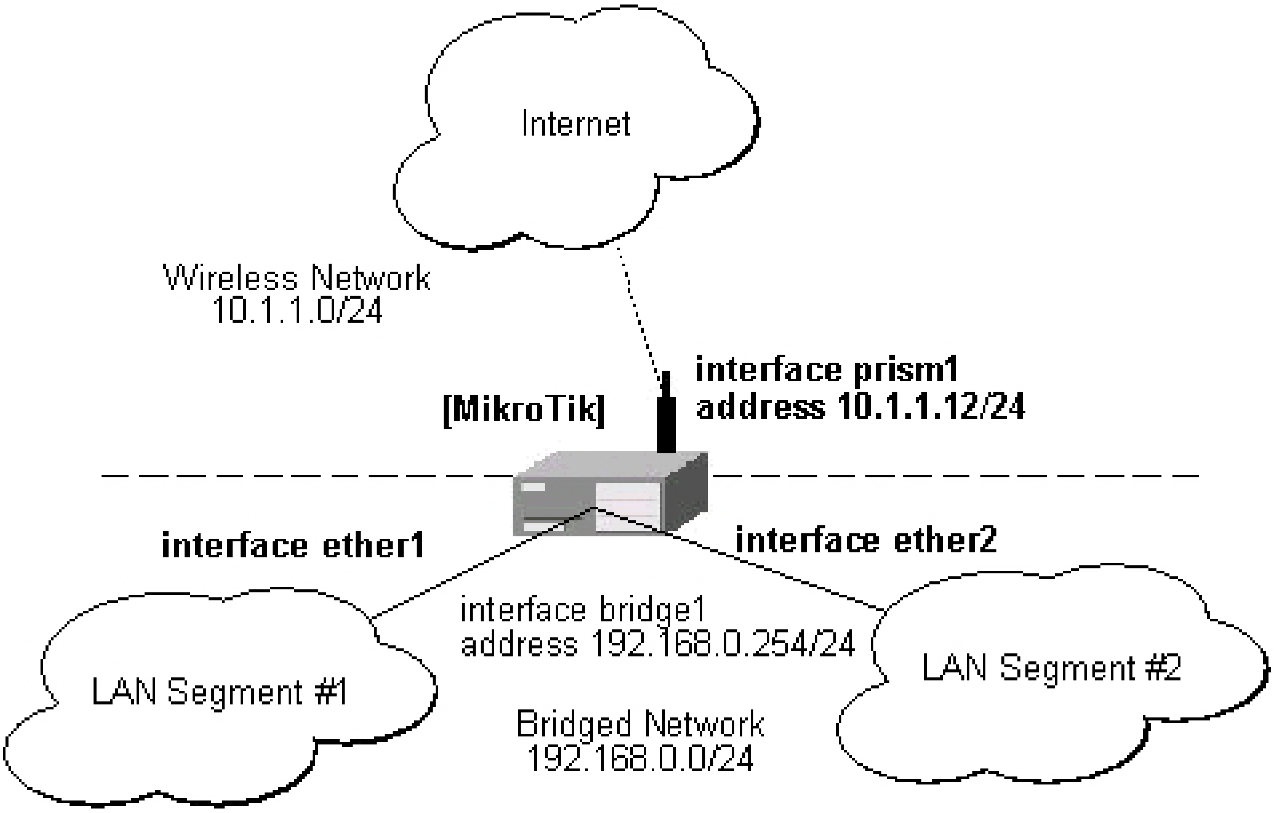
To make bridge, drop IP, ARP and RARP packets:

```
[admin@MikroTik] interface bridge firewall> add mac-protocol=2048 action=drop
[admin@MikroTik] interface bridge firewall> add mac-protocol=2054 action=drop
[admin@MikroTik] interface bridge firewall> add mac-protocol=32821 action=drop
[admin@MikroTik] interface bridge firewall> print
Flags: X - disabled, I - invalid
  0   mac-src-address=00:00:00:00:00:00 in-interface=all
      mac-dst-address=00:00:00:00:00:00 out-interface=all mac-protocol=2048
      src-address=0.0.0.0/0 dst-address=0.0.0.0/0 protocol=all action=drop

  1   mac-src-address=00:00:00:00:00:00 in-interface=all
      mac-dst-address=00:00:00:00:00:00 out-interface=all mac-protocol=2054
      src-address=0.0.0.0/0 dst-address=0.0.0.0/0 protocol=all action=drop

  2   mac-src-address=00:00:00:00:00:00 in-interface=all
      mac-dst-address=00:00:00:00:00:00 out-interface=all mac-protocol=32821
      src-address=0.0.0.0/0 dst-address=0.0.0.0/0 protocol=all action=drop

[admin@MikroTik] interface bridge firewall>
```

Application Example

Example

Assume we want to enable bridging between two Ethernet LAN segments and have the MikroTik router be the default gateway for them:



When configuring the MikroTik router for bridging you should do the following:

1. Add a bridge interface

2. Configure the bridge interface
3. Enable the bridge interface
4. Assign an **IP address** to the bridge interface, if needed

Note that there should be no **IP addresses** on the bridged interfaces. Moreover, **IP address** on the bridge interface itself is not required for the bridging to work.

When configuring the bridge settings, each protocol that should be forwarded should be added to the **forward-protocols** list. The **other** protocol includes all protocols not listed before (as VLAN).

```
[admin@MikroTik] interface bridge> add forward-protocols=ip,arp,other
[admin@MikroTik] interface bridge> print
Flags: X - disabled, R - running
 0 X  name="bridge1" mtu=1500 arp=enabled mac-address=00:00:00:00:00:00
      forward-protocols=ip,arp,other stp=no priority=32768 ageing-time=5m
      forward-delay=15s garbage-collection-interval=4s hello-time=2s
      max-message-age=20s
[admin@MikroTik] interface bridge>
```

The priority argument is used by the Spanning Tree Protocol to determine, which port remains enabled if two ports form a loop.

Next, each interface that should be included in the bridging port table:

```
[admin@MikroTik] interface bridge> port
[admin@MikroTik] interface bridge port> print
 # INTERFACE BRIDGE  PRIORITY PATH-COST
 0 ether1    none    128      10
 1 ether2    none    128      10
 2 prism1    none    128      10
[admin@MikroTik] interface bridge port> set 0,1 bridge=bridge1
[admin@MikroTik] interface bridge port> print
 # INTERFACE BRIDGE  PRIORITY PATH-COST
 0 ether1    bridge1    128      10
 1 ether2    bridge1    128      10
 2 prism1    none       128      10
[admin@MikroTik] interface bridge port>
```

After setting some interfaces for bridging, the bridge interface should be enabled in order to start using it:

```
[admin@MikroTik] interface bridge> print
Flags: X - disabled, R - running
 0 X  name="bridge1" mtu=1500 arp=enabled mac-address=00:0B:6B:31:01:6A
      forward-protocols=ip,arp,other stp=no priority=32768 ageing-time=5m
      forward-delay=15s garbage-collection-interval=4s hello-time=2s
      max-message-age=20s
[admin@MikroTik] interface bridge> enable 0
[admin@MikroTik] interface bridge> print
Flags: X - disabled, R - running
 0  R name="bridge1" mtu=1500 arp=enabled mac-address=00:0B:6B:31:01:6A
      forward-protocols=ip,arp,other stp=no priority=32768 ageing-time=5m
      forward-delay=15s garbage-collection-interval=4s hello-time=2s
      max-message-age=20s
[admin@MikroTik] interface bridge>
```

If you want to access the router through unnumbered bridged interfaces, it is required to add an **IP address** to the bridge interface:

```
[admin@MikroTik] ip address> add address=192.168.0.254/24 interface=bridge1
[admin@MikroTik] ip address> add address=10.1.1.12/24 interface=prism1
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   192.168.0.254/24   192.168.0.0     192.168.0.255   bridge1
```

```
   1   10.1.1.12/24       10.1.1.0        10.1.1.255      prism1
 [admin@MikroTik] ip address>
```

Note! Assigning an **IP address** to bridged interfaces **ether1** or **ether2** has no sense, because the actual interface will be the bridge interface to which these interfaces belong. You can check this by typing **/ip address print detail**

Hosts on LAN segments #1 and #2 should use **IP addresses** from the same network. 192.168.0.0/24 and have the default gateway set to 192.168.0.254 (MikroTik router).

Troubleshooting

Description

- **After I configure the bridge, there is no ping response from hosts on bridged networks.**
  It may take up to 20...30s for bridge to learn addresses and start responding.
- **I have added a bridge interface, but no IP traffic is passed.**
  You should include 'arp' in forwarded protocols list, e.g., 'forward-protocols=ip,arp,other'.

MOXA C101 Synchronous Interface

Document revision 1.1 (Fri Mar 05 08:15:42 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS supports MOXA C101 Synchronous 4Mb/s Adapter hardware. The V.35 synchronous interface is the standard for VSAT and other satellite modems. However, you must check with the satellite system supplier for the modem interface type.

Specifications

Packages required: ***synchronous***
License required: ***level4***
Home menu level: ***/interface moxa-c101***
Standards and Technologies: ***Cisco/HDLC-X.25 (RFC 1356)***, ***Frame Relay (RFC1490)***, ***PPP (RFC-1661)***, ***PPP (RFC-1662)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***IP Addresses and ARP***

- *Log Management*

Description

You can install up to four MOXA C101 synchronous cards in one PC box, if you have so many slots and IRQs available. Assuming you have all necessary packages and licenses installed, in most cases it should to be done nothing at that point (all drivers are loaded automatically). However, if you have a non Plug-and-Play ISA card, the corresponding driver requires to be loaded.

MOXA C101 PCI variant cabling

The MOXA C101 PCI requires different from MOXA C101 ISA cable. It can be made using the following table:

DB25f	Signal	Direction	V.35m
4	RTS	OUT	C
5	CTS	IN	D
6	DSR	IN	E
7	GND	-	B
8	DCD	IN	F
10	TxDB	OUT	S
11	TxDA	OUT	P
12	RxDB	IN	T
13	RxDA	IN	R
14	TxCB	IN	AA
16	TxCA	IN	Y
20	DTR	OUT	H
22	RxCB	IN	X
23	RxCA	IN	V
short 9 and 25 pin			

Additional Documents

For more information about the MOXA C101 synchronous 4Mb/s adapter hardware please see:

- *C101 SuperSync Board User's Manual* the user's manual in PDF format

Synchronous Interface Configuration

Home menu level: ***/interface moxa-c101***

Description

Moxa c101 synchronous interface is shown under the interfaces list with the name moxa-c101-N

Property Description

name (*name*; default: **moxa-c101-N**) - interface name

cisco-hdlc-keepalive-interval (*time*; default: **10s**) - keepalive period in seconds

clock-rate (*integer*; default: **64000**) - speed of internal clock

clock-source (*external* | *internal* | *tx-from-rx* | *tx-internal*; default: **external**) - clock source

frame-relay-dce (*yes* | *no*; default: **no**) - operate or not in DCE mode

frame-relay-lmi-type (*ansi* | *ccitt*; default: **ansi**) - Frame-relay Local Management Interface type:

- **ansi** - set LMI type to ANSI-617d (also known as Annex A)
- **ccitt** - set LMI type to CCITT Q933a (also known as Annex A)

ignore-dcd (*yes* | *no*; default: **no**) - ignore or not DCD

line-protocol (*cisco-hdlc* | *frame-relay* | *sync-ppp*; default: **sync-ppp**) - line protocol name

mtu (*integer*; default: **1500**) - Maximum Transmit Unit

Notes

If you purchased the MOXA C101 Synchronous card from MikroTik, you have received a V.35 cable with it. This cable should work for all standard modems, which have V.35 connections. For synchronous modems, which have a DB-25 connection, you should use a standard DB-25 cable.

The MikroTik driver for the MOXA C101 Synchronous adapter allows you to unplug the V.35 cable from one modem and plug it into another modem with a different clock speed, and you do not need to restart the interface or router.

The default encapsulation method for CISCO is **HDLC**. If you have not changed this setting on CISCO, you should change **line-protocol** to **cisco-hdlc** for Moxa C101 interface.

Example

```
[admin@MikroTik] interface moxa-c101> set 0 line-protocol=cisco-hdlc
[admin@MikroTik] interface moxa-c101> print
Flags: X - disabled, R - running
  0  R name="moxa-c101" mtu=1500 line-protocol=cisco-hdlc clock-rate=64000
       clock-source=external frame-relay-lmi-type=ansi frame-relay-dce=no
       cisco-hdlc-keepalive-interval=10s ignore-dcd=no

[admin@MikroTik] interface moxa-c101>
```

You can monitor the status of the synchronous interface:

```
[admin@MikroTik] interface moxa-c101> monitor 0
    dtr: yes
    rts: yes
    cts: no
    dsr: no
    dcd: no

[admin@MikroTik] interface moxa-c101>
```

Connect a communication device, e.g., a baseband modem, to the V.35 port and turn it on. If the link is working properly the status of the interface is:

```
[admin@MikroTik] interface moxa-c101> monitor 0
    dtr: yes
    rts: yes
    cts: yes
    dsr: yes
    dcd: yes

[admin@MikroTik] interface moxa-c101>
```

Troubleshooting

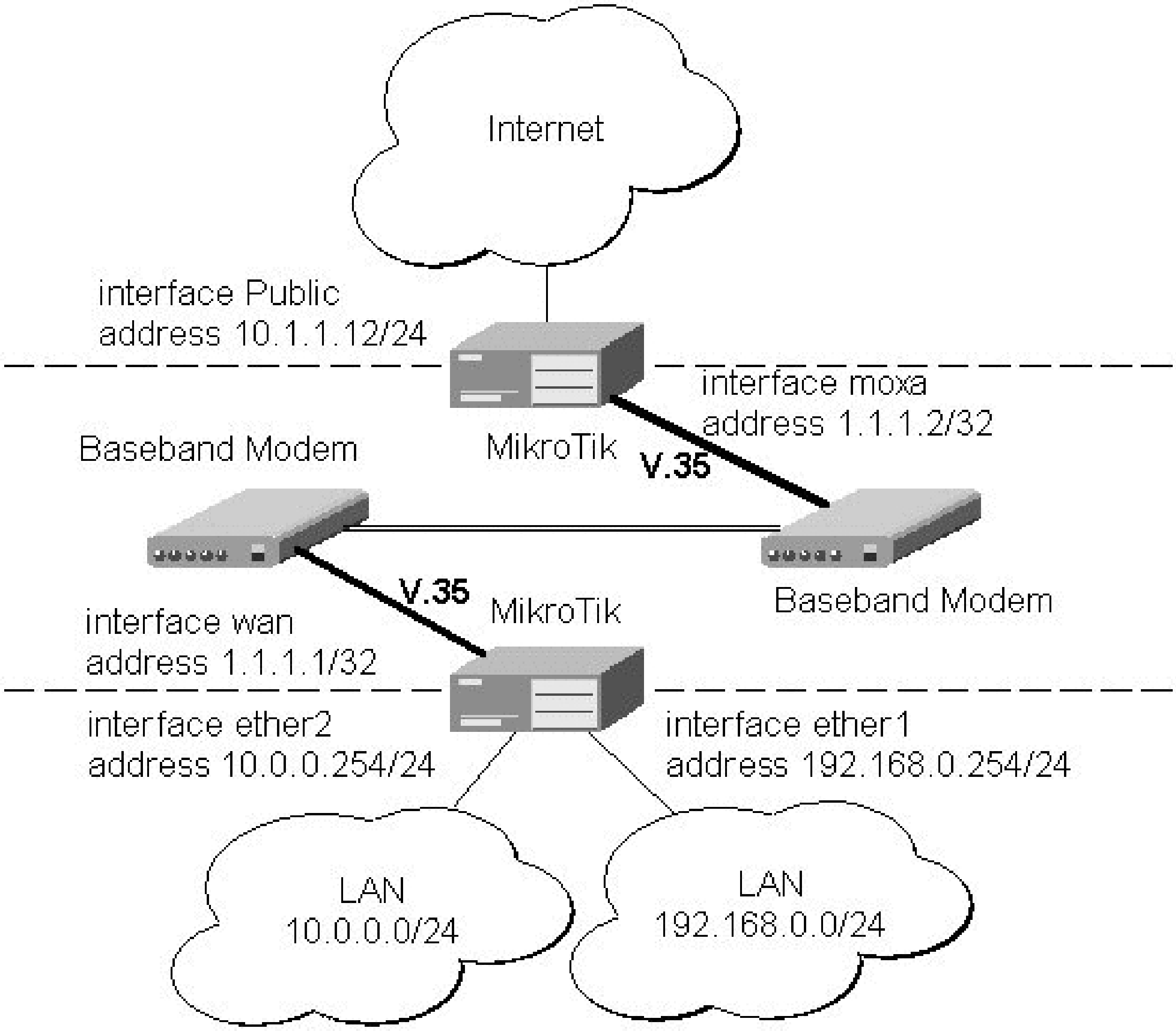
Description

- **The synchronous interface does not show up under the interfaces list**
  Obtain the required license for synchronous feature
- **The synchronous link does not work**
  Check the V.35 cabling and the line between the modems. Read the modem manual

Synchronous Link Application Examples

MikroTik Router to MikroTik Router

Let us consider the following network setup with two MikroTik Routers connected to a leased line with baseband modems:



The driver for MOXA C101 card should be loaded and the interface should be enabled according to the instructions given above. The IP addresses assigned to the synchronous interface should be as follows:

```
[admin@MikroTik] ip address> add address 1.1.1.1/32 interface wan \
\... network 1.1.1.2 broadcast 255.255.255.255

[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.254/24      10.0.0.254      10.0.0.255      ether2
  1   192.168.0.254/24   192.168.0.254   192.168.0.255   ether1
  2   1.1.1.1/32         1.1.1.2         255.255.255.255 wan
[admin@MikroTik] ip address> /ping 1.1.1.2
1.1.1.2 64 byte pong: ttl=255 time=31 ms
1.1.1.2 64 byte pong: ttl=255 time=26 ms
1.1.1.2 64 byte pong: ttl=255 time=26 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 26/27.6/31 ms
[admin@MikroTik] ip address>
```

The default route should be set to the gateway router 1.1.1.2:

```
[admin@MikroTik] ip route> add gateway 1.1.1.2
```

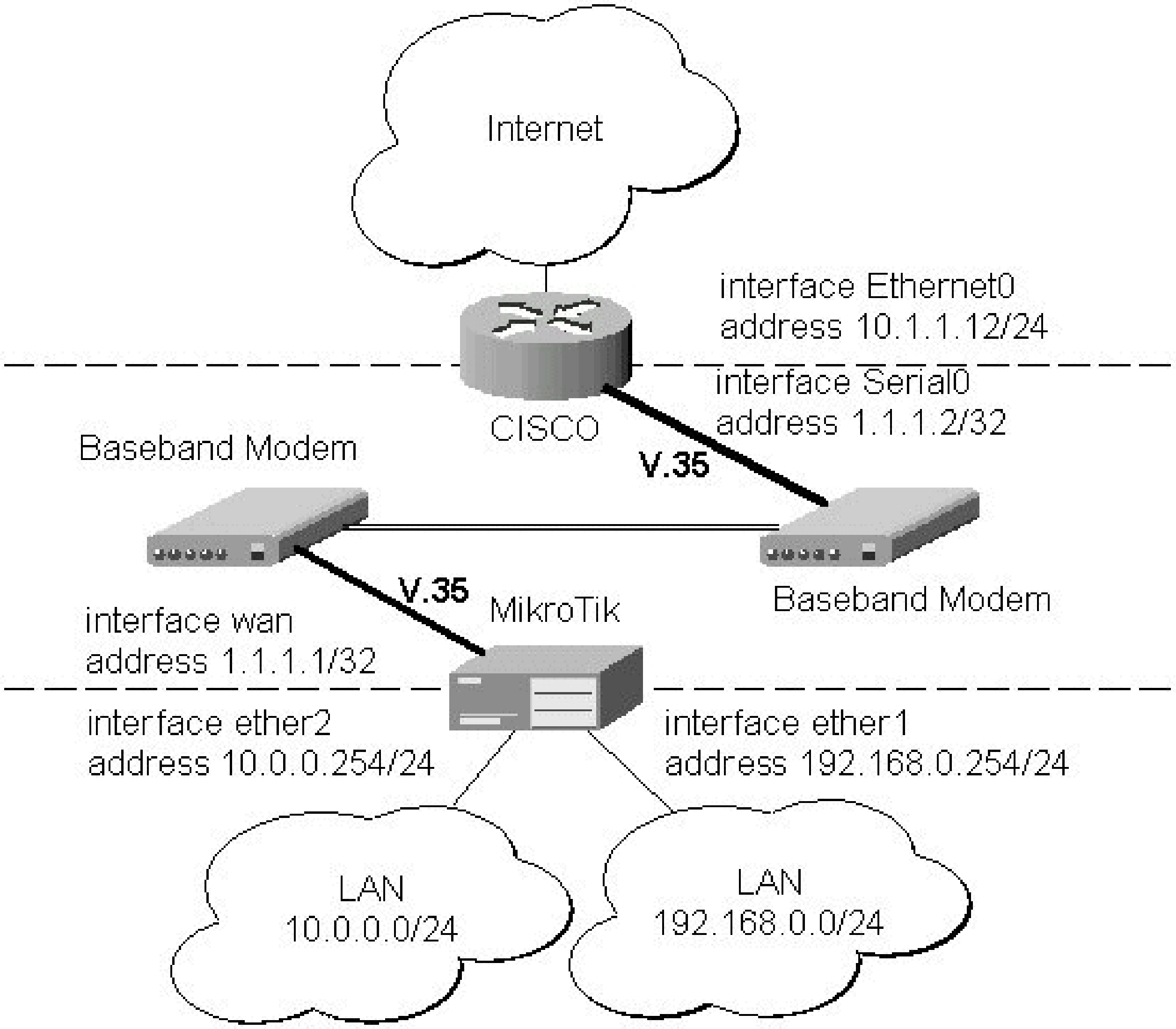
```
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 1.1.1.2         1        wan
    1 DC 10.0.0.0/24        r 10.0.0.254      1        ether2
    2 DC 192.168.0.0/24     r 192.168.0.254   0        ether1
    3 DC 1.1.1.2/32         r 0.0.0.0         0        wan

[admin@MikroTik] ip route>
```

The configuration of the MikroTik router at the other end is similar:

```
[admin@MikroTik] ip address> add address 1.1.1.2/32 interface moxa \
\... network 1.1.1.1 broadcast 255.255.255.255
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.1.1.12/24       10.1.1.12       10.1.1.255      Public
  1   1.1.1.2/32         1.1.1.1         255.255.255.255 moxa
[admin@MikroTik] ip address> /ping 1.1.1.1
1.1.1.1 64 byte pong: ttl=255 time=31 ms
1.1.1.1 64 byte pong: ttl=255 time=26 ms
1.1.1.1 64 byte pong: ttl=255 time=26 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 26/27.6/31 ms
[admin@MikroTik] ip address>
```

MikroTik Router to Cisco Router

Let us consider the following network setup with MikroTik Router connected to a leased line with baseband modems and a CISCO router at the other end:



The driver for MOXA C101 card should be loaded and the interface should be enabled according to the instructions given above. The IP addresses assigned to the synchronous interface should be as follows:

```
[admin@MikroTik] ip address> add address 1.1.1.1/32 interface wan \
\... network 1.1.1.2 broadcast 255.255.255.255
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.254/24      10.0.0.254      10.0.0.255      ether2
  1   192.168.0.254/24   192.168.0.254   192.168.0.255   ether1
  2   1.1.1.1/32         1.1.1.2         255.255.255.255 wan
[admin@MikroTik] ip address> /ping 1.1.1.2
1.1.1.2 64 byte pong: ttl=255 time=31 ms
1.1.1.2 64 byte pong: ttl=255 time=26 ms
1.1.1.2 64 byte pong: ttl=255 time=26 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 26/27.6/31 ms
[admin@MikroTik] ip address>
```

The default route should be set to the gateway router 1.1.1.2:

```
[admin@MikroTik] ip route> add gateway 1.1.1.2
[admin@MikroTik] ip route> print
```

```
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 1.1.1.2         1        wan
    1 DC 10.0.0.0/24        r 10.0.0.254      0        ether2
    2 DC 192.168.0.0/24     r 192.168.0.254   0        ether1
    3 DC 1.1.1.2/32         r 1.1.1.1         0        wan

[admin@MikroTik] ip route>
```

The configuration of the Cisco router at the other end (part of the configuration) is:

```
CISCO#show running-config
Building configuration...

Current configuration:
...
!
interface Ethernet0
 description connected to EthernetLAN
 ip address 10.1.1.12 255.255.255.0
!
interface Serial0
 description connected to MikroTik
 ip address 1.1.1.2 255.255.255.252
 serial restart-delay 1
!
ip classless
ip route 0.0.0.0 0.0.0.0 10.1.1.254
!
...
end

CISCO#
```

Send ping packets to the MikroTik router:

```
CISCO#ping 1.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/32/40 ms
CISCO#
```

Note! Keep in mind that for the point-to-point link the network mask is set to **32** bits, the argument **network** is set to the IP address of the other end, and the broadcast address is set to **255.255.255.255**.

Cyclades PC300 PCI Adapters

Document revision 1.1 (Fri Mar 05 08:13:30 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS supports the following Cyclades PC300 Adapter hardware:

- RSV/V.35 (RSV models) with 1 or 2 RS-232/V.35 interfaces on standard DB25/M.34 connector, 5Mbps, internal or external clock
- T1/E1 (TE models) with 1 or 2 T1/E1/G.703 interfaces on standard RJ48C connector, Full/Fractional, internal or external clock
- X.21 (X21 models) with 1 or 2 X.21 on standard DB-15 connector, 8Mbps, internal or external clock

Specifications

Packages required: ***synchronous***
License required: ***level4***
Home menu level: ***/interface cyclades***
Standards and Technologies: ***X.21, V.35, T1/E1/G.703, Frame Relay, PPP, Cisco-HDLC***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***

- *IP Addresses and ARP*
- *Log Management*

Additional Documents

- *http://www.cyclades.com/products/6/pc300* - the product on-line documentation
- *http://mt.lv/Documentation/pc300_21_el.pdf* - the Installation Manual in .pdf format

Synchronous Interface Configuration

Home menu level: ***/interface cyclades***

Description

You can install up to four Cyclades PC300 PCI Adapters in one PC box, if you have so many adapter slots and IRQs available.

The Cyclades PC300/RSV Synchronous PCI Adapter comes with a V.35 cable. This cable should work for all standard modems, which have V.35 connections. For synchronous modems, which have a DB-25 connection, you should use a standard DB-25 cable.

Connect a communication device, e.g., a baseband modem, to the V.35 port and turn it on. The MikroTik driver for the Cyclades Synchronous PCI Adapter allows you to unplug the V.35 cable from one modem and plug it into another modem with a different clock speed, and you do not need to restart the interface or router.

Property Description

name (*name*; default: **cycladesN**) - descriptive interface name

mtu (*integer*; default: **1500**) - Maximum Transmission Unit for the interface

line-protocol (*cisco-hdlc | frame-relay | sync-ppp*; default: **sync-ppp**) - line protocol

media-type (*E1 | T1 | V24 | V35 | X21*; default: **V35**) - the hardware media used for this interface

clock-rate (*integer*; default: **64000**) - internal clock rate in bps

clock-source (*internal | external | tx-internal*; default: **external**) - source clock

line-code (*AMI | B8ZS | HDB3 | NRZ*; default: **B8ZS**) - for T1/E1 channels only. Line modulation method:

- **AMI** - Alternate Mark Inversion
- **B8ZS** - Binary 8-Zero Substitution
- **HDB3** - High Density Bipolar 3 Code (ITU-T)
- **NRZ** - Non-Return-To-Zero

framing mode (*CRC4 | D4 | ESF | Non-CRC4 | Unframed*; default: **ESF**) - for T1/E1 channels only. The frame mode:

- **CRC4** - Cyclic Redundancy Check 4-bit (E1 Signaling, Europe)
- **D4** - Fourth Generation Channel Bank (48 Voice Channels on 2 T-1s or 1 T-1c)
- **ESF** - Extended Superframe Format

- **Non-CRC4** - plain Cyclic Redundancy Check
- **Unframed** - do not check frame integrity

line-build-out (*0dB* | *7.5dB* | *15dB* | *22.5dB*; default: **0**) - for T1 channels only. Line Build Out Signal Level.

rx-sensitivity (*long-haul* | *short-haul*; default: **short-haul**) - for T1/E1 channels only. Numbers of active channels (up to 32 for E1 and up to 24 for T1)

chdlc-keepalive (*time*; default: **10s**) - Cisco-HDLC keepalive interval in seconds

frame-relay-dce (*yes* | *no*; default: **no**) - specifies whether the device operates in Data Communication Equipment mode. The value yes is suitable only for T1 models

frame-relay-lmi-type (*ansi* | *ccitt*; default: **ansi**) - Frame Relay Line Management Interface Protocol type

Troubleshooting

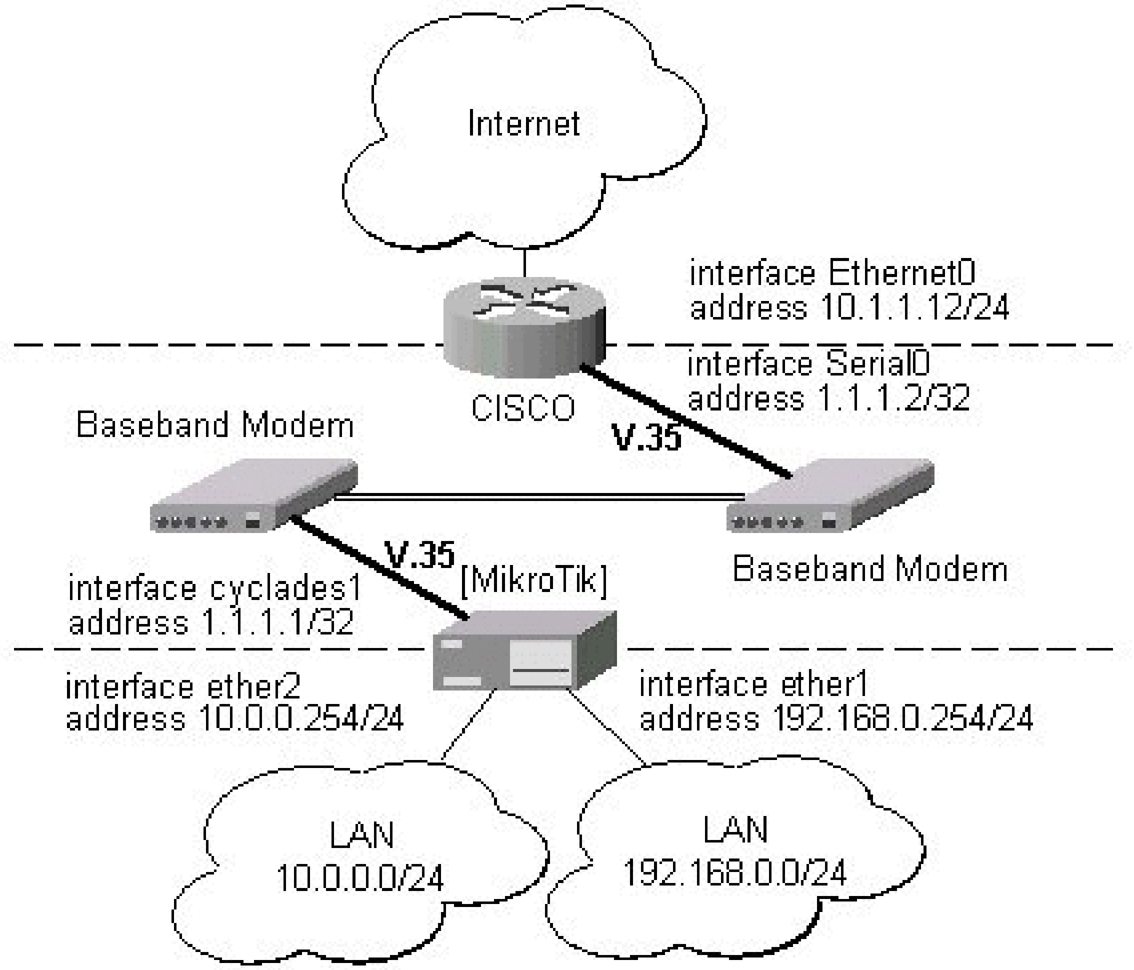
Description

- **The cyclades interface does not show up under the interfaces list**
  Obtain the required license for synchronous feature
- **The synchronous link does not work**
  Check the V.35 cabling and the line between the modems. Read the modem manual

RSV/V.35 Synchronous Link Applications

Example

Let us consider the following network setup with MikroTik Router connected to a leased line with baseband modems and a CISCO router at the other end:



The driver for the Cyclades PC300/RSV Synchronous PCI Adapter should load automatically. The interface should be enabled according to the instructions given above. The **IP addresses** assigned to the cyclades interface should be as follows:

```
[admin@MikroTik] ip address> add address=1.1.1.1/32 interface=cyclades1
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.219/24      10.0.0.0        10.0.0.255      ether1
  1   1.1.1.1/32         1.1.1.1         1.1.1.1         cyclades1
  2   192.168.0.254/24   192.168.0.0     192.168.0.255   ether2
[admin@MikroTik] ip address> /ping 1.1.1.2
1.1.1.2 64 byte pong: ttl=255 time=12 ms
1.1.1.2 64 byte pong: ttl=255 time=8 ms
1.1.1.2 64 byte pong: ttl=255 time=7 ms
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 7/9.0/12 ms
[admin@MikroTik] ip address> /tool flood-ping 1.1.1.2 size=1500 count=50
        sent: 50
    received: 50
     min-rtt: 1
     avg-rtt: 1
     max-rtt: 9

[admin@MikroTik] ip address>
```

Note that for the point-to-point link the network mask is set to 32 bits, the argument **network** is set to the **IP address** of the other end, and the broadcast address is set to 255.255.255.255. The default route should be set to gateway router 1.1.1.2:

```
[admin@MikroTik] ip route> add gateway 1.1.1.2 interface cyclades1
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 1.1.1.2         1        cyclades1
    1 DC 10.0.0.0/24        r 0.0.0.0         0        ether1
    2 DC 192.168.0.0/24     r 0.0.0.0         0        ether2
    3 DC 1.1.1.2/32         r 0.0.0.0         0        cyclades1
[admin@MikroTik] ip route>
```

The configuration of the CISCO router at the other end (part of the configuration) is:

```
CISCO#show running-config
Building configuration...

Current configuration:
...
!
interface Ethernet0
 description connected to EthernetLAN
 ip address 10.1.1.12 255.255.255.0
!
interface Serial0
 description connected to MikroTik
 ip address 1.1.1.2 255.255.255.252
 serial restart-delay 1
!
ip classless
ip route 0.0.0.0 0.0.0.0 10.1.1.254
!
...
end

CISCO#

Send ping packets to the MikroTik router:


CISCO#ping 1.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/32/40 ms
CISCO#
```

PPPoE

Document revision 1.4 (Fri Apr 30 06:43:11 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

The PPPoE (Point to Point Protocol over Ethernet) protocol provides extensive user management, network management and accounting benefits to ISPs and network administrators. Currently PPPoE is used mainly by ISPs to control client connections for xDSL and cable modems as well as plain Ethernet networks. PPPoE is an extension of the standard Point to Point Protocol (PPP). The difference between them is expressed in transport method: PPPoE employs Ethernet instead of modem connection.

Generally speaking, PPPoE is used to hand out IP addresses to clients based on the user (and workstation, if desired) authentication as opposed to workstation only authentication, when static IP addresses or DHCP are used. It is adviced not to use static IP addresses or DHCP on the same interfaces as PPPoE for security reasons.

MikroTik RouterOS can act as a RADIUS client - you can use a RADIUS server to authenticate PPPoE clients and use accounting for them.

A PPPoE connection is composed of a client and an access concentrator (server). The client may be a Windows computer that has the PPPoE client protocol installed. The MikroTik RouterOS supports both - client and access concentrator implementations of PPPoE. The PPPoE client and server work over any Ethernet level interface on the router - wireless 802.11 (Aironet, Cisco, WaveLan, Prism, Atheros), 10/100/1000 Mbit/s Ethernet, RadioLan and EoIP (Ethernet over IP tunnel). No encryption, MPPE 40bit RSA and MPPE 128bit RSA encryption is supported.

Note that when RADIUS server is authenticating a user with CHAP, MS-CHAPv1, MS-CHAPv2, it does not use shared secret, it is used only in authentication reply. So if you have a wrong shared secret, RADIUS server will accept the request. You can use **/radius monitor** command to see **bad-replies** parameter. This value should increase whenever a client tries to connect.

Supported connections

- MikroTik RouterOS PPPoE client to any PPPoE server (access concentrator)
- MikroTik RouterOS server (access concentrator) to multiple PPPoE clients (clients are avaliable for almost all operating systems and some routers)

Quick Setup Guide

- To configure MikroTik RouterOS to be a PPPoE client
    1. Just add a pppoe-client:

```
/interface pppoe-client add name=pppoe-user-mike user=mike password=123 interface=wlan1
\
\... service-name=internet disabled=no
```

- To configure MikroTik RouterOS to be an Access Concentrator (PPPoE Server)
    1. Add an address pool for the clients from **10.1.1.62** to **10.1.1.72**, called pppoe-pool:

```
/ip pool add name="pppoe-pool" ranges=10.1.1.62-10.1.1.72
```

2. Add PPP profile, called **pppoe-profile** where **local-address** will be the router's address and clients will have an address from **pppoe-pool**:

```
/ppp profile add name="pppoe-profile" local-address=10.1.1.1 remote-address=pppoe-pool
```

3. Add a user with username **mike** and password **123**:

```
/ppp secret add name=mike password=123 service=pppoe profile=pppoe-profile
```

4. Now add a pppoe server:

```
/interface pppoe-server server add service-name=internet interface=wlan1 \
\... default-profile=pppoe-profile
```

Specifications

Packages required: ***ppp***

License required: ***level1 (limited to 1 interface), level3 (limited to 200 interfaces), level4 (limited to 200 interfaces), level5 (limited to 500 interfaces), level6 (unlimited)***
Home menu level: ***/interface pppoe-server, /interface pppoe-client***
Standards and Technologies: ***PPPoE (RFC 2516)***
Hardware usage: *PPPoE server may require additional RAM (uses approx. 50kB for each connection) and CPU power. Supports maximum of 10000 connections*

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***Log Management***

Additional Documents

Links for PPPoE documentation:

- ***http://www.ietf.org/rfc/rfc2516.txt***
- ***http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120dc/120dc3/pppoe.h***

PPPoE Clients:

- RASPPPoE for Windows 95, 98, 98SE, ME, NT4, 2000, XP, .NET ***http://user.cs.tu-berlin.de/~normanb***

PPPoE Client Setup

Home menu level: ***/interface pppoe-client***

Description

The PPPoE client supports high-speed connections. It is fully compatible with the MikroTik PPPoE server (access concentrator).

Note for Windows. Some connection instructions may use the form where the "phone number" us "MikroTik_AC\mt1" to indicate that "MikroTik_AC" is the access concentrator name and "mt1" is the service name.

Property Description

name (*name*; default: **pppoe-out1**) - name of the PPPoE interface

interface (*name*) - interface the PPPoE server can be connected through

mtu (*integer*; default: **1480**) - Maximum Transmission Unit. The optimal value is the MTU of the interface the tunnel is working over decreased by 20 (so, for 1500-byte ethernet link, set the MTU to 1480 to avoid fragmentation of packets)

mru (*integer*; default: **1480**) - Maximum Receive Unit. The optimal value is the MTU of the interface the tunnel is working over decreased by 20 (so, for 1500-byte ethernet link, set the MTU to 1480 to avoid fragmentation of packets)

user (*text*; default: **""**) - a user name that is present on the PPPoE server

password (*text*; default: **""**) - a user password used to connect the PPPoE server

profile (*name*) - default profile for the connection

allow (*multiple choice: mschap2*, *mschap1*, *chap*, *pap*; default: **mschap2, mschap1, chap, pap**) - the protocol to allow the client to use for authentication

service-name (*text*; default: **""**) - specifies the service name set on the access concentrator. Leave it blank unless you have many services and need to specify the one you need to connect to

ac-name (*text*; default: **""**) - this may be left blank and the client will connect to any access concentrator that offers the "service" name selected

add-default-route (*yes* | *no*; default: **no**) - whether to add a default route automatically

dial-on-demand (*yes* | *no*; default: **no**) - connects to AC only when outbound traffic is generated and disconnects when there is no traffic for the period set in the idle-timeout value

use-peer-dns (*yes* | *no*; default: **no**) - whether to set the router's default DNS to the PPP peer DNS (i.e. whether to get DNS settings from the peer)

Notes

If there is a default route, **add-default-route** will not create a new one.

Example

To add and enable PPPoE client on the **gig** interface connecting to the AC that provides **testSN** service using user name **john** with the password **password**:

```
[admin@RemoteOffice] interface pppoe-client> add interface=gig \
\... service-name=testSN user=john password=password disabled=no
[admin@RemoteOffice] interface pppoe-client> print
Flags: X - disabled, R - running
  0  R name="pppoe-out1" mtu=1480 mru=1480 interface=gig user="john"
       password="password" profile=default service-name="testSN" ac-name=""
       add-default-route=no dial-on-demand=no use-peer-dns=no
```

Monitoring PPPoE Client

Command name: ***/interface pppoe-client monitor***

Property Description

status (*text*) - status of the client

- **Dialing** - attempting to make a connection
- **Verifying password...** - connection has been established to the server, password verification in progress
- **Connected** - self-explanatory
- **Terminated** - interface is not enabled or the other side will not establish a connection uptime (time) - connection time displayed in days, hours, minutes and seconds

encoding (*text*) - encryption and encoding (if asymmetric, separated with '/') being used in this connection

uptime (*time*) - connection time displayed in days, hours, minutes and seconds

service-name (*text*) - name of the service the client is connected to

ac-name (*text*) - name of the AC the client is connected to

ac-mac (*MAC address*) - MAC address of the access concentrator (AC) the client is connected to

Example

To monitor the **pppoe-out1** connection:

```
[admin@MikroTik] interface pppoe-client> monitor pppoe-out1
          status: "connected"
          uptime: 10s
        encoding: "none"
    service-name: "testSN"
         ac-name: "10.0.0.1"
          ac-mac: 00:C0:DF:07:5E:E6

[admin@MikroTik] interface pppoe-client>
```

PPPoE Server Setup (Access Concentrator)

Home menu level: ***/interface pppoe-server server***

Description

The PPPoE server (access concentrator) supports multiple servers for each interface - with differing service names. Currently the throughput of the PPPoE server has been tested to 160 Mb/s on a Celeron 600 CPU. Using higher speed CPUs, throughput should increase proportionately.

The **access concentrator name** and PPPoE **service name** are used by clients to identity the access concentrator to register with. The **access concentrator name** is the same as the **identity** of the router displayed before the command prompt. The identity may be set within the **/system identity** submenu.

PPPoE users are created in **/ppp secret** menu, see the ***AAA*** manual for further information.

Note that if no service name is specified in WindowsXP, it will use only service with no name. So if you want to serve WindowsXP clients, leave your service name empty.

Property Description

service-name (*text*) - the PPPoE service name

mtu (*integer*; default: **1480**) - Maximum Transmission Unit. The optimal value is the MTU of the interface the tunnel is working over decreased by 20 (so, for 1500-byte Ethernet link, set the MTU to 1480 to avoid fragmentation of packets)

mru (*integer*; default: **1480**) - Maximum Receive Unit. The optimal value is the MTU of the interface the tunnel is working over decreased by 20 (so, for 1500-byte Ethernet link, set the MTU to 1480 to avoid fragmentation of packets)

authentication (*multiple choice: mschap2 | mschap1 | chap | pap*; default: **mschap2, mschap1, chap, pap**) - authentication algorithm

keepalive-timeout - defines the time period (in seconds) after which the router is starting to send keepalive packets every second. If no traffic and no keepalive responses has came for that period of time (i.e. 2 * keepalive-timeout), not responding client is proclaimed disconnected.

one-session-per-host (*yes* | *no*; default: **no**) - allow only one session per host (determined by MAC address). If a host will try to establish a new session, the old one will be closed

default-profile (*name*; default: **default**) - default profile to use

Notes

The default **keepalive-timeout** value of **10** is OK in most cases. If you set it to **0**, the router will not disconnect clients until they log out or router is restarted. To resolve this problem, the **one-session-per-host** property can be used.

Security issue: do not assign an IP address to the interface you will be receiving the PPPoE requests on.

Example

To add PPPoE server on **ether1** interface providing **ex** service and allowing only one connection per host:

```
[admin@MikroTik] interface pppoe-server server> add interface=ether1 \
\... service-name=ex one-session-per-host=yes
[admin@MikroTik] interface pppoe-server server> print
Flags: X - disabled
  0 X service-name="ex" interface=ether1 mtu=1480 mru=1480
      authentication=mschap2,mschap,chap,pap keepalive-timeout=10
      one-session-per-host=yes default-profile=default

[admin@MikroTik] interface pppoe-server server>
```

PPPoE Server Users

Home menu level: ***/interface pppoe-server***

Property Description

name (*name*) - interface name

service-name (*name*) - name of the service the user is connected to

remote-address (*MAC address*) - MAC address of the connected client

user (*name*) - the name of the connected user

encoding (*text*) - encryption and encoding (if asymmetric, separated with '/') being used in this connection

uptime - shows how long the client is connected

Example

To view the currently connected users:

```
[admin@MikroTik] interface pppoe-server> print
Flags: R - running
  #   NAME       SERVICE REMOTE-ADDRESS    USER    ENCO... UPTIME
  0 R <pppoe-ex> ex      00:C0:CA:16:16:A5 ex              12s
```

```
[admin@MikroTik] interface pppoe-server>
```

To disconnect the user **ex**:

```
[admin@MikroTik] interface pppoe-server> remove [find user=ex]
[admin@MikroTik] interface pppoe-server> print

[admin@MikroTik] interface pppoe-server>
```

Troubleshooting

Description

- **I can connect to my PPPoE server. The ping goes even through it, but I still cannot open web pages**
  Make sure that you have specified a valid DNS server in the router (in **/ip dns** or in **/ppp profile** the **dns-server** parameter).
- **The PPPoE server shows more than one active user entry for one client, when the clients disconnect, they are still shown and active**
  Set the **keepalive-timeout** parameter (in the PPPoE server configuration) to **10** if You want clients to be considered logged off if they do not respond for 10 seconds.
  Note that if the **keepalive-timeout** parameter is set to **0** and the **only-one** parameter (in PPP profile settings) is set to **yes** then the clients might be able to connect only once. To resolve this problem **one-session-per-host** parameter in PPPoE server configuration should be set to **yes**
- **I can get through the PPPoE link only small packets (eg. pings)**
  You need to change **mss** of all the packets passing through the PPPoE link to the value of PPPoE link's MTU-40 at least on one of the peers. So for PPPoE link with MTU of 1480:

```
[admin@MikroTik] ip firewall mangle> add protocol=tcp tcp-options=syn-only \
\.. action=passthrough tcp-mss=1440
[admin@MikroTik] ip firewall mangle> print
Flags: X - disabled, I - invalid
  0   src-address=0.0.0.0/0:0-65535 in-interface=all
      dst-address=0.0.0.0/0:0-65535 protocol=tcp tcp-options=syn-only
      icmp-options=any:any flow="" src-mac-address=00:00:00:00:00:00
      limit-count=0 limit-burst=0 limit-time=0s action=passthrough
      mark-flow="" tcp-mss=1440

[admin@MikroTik] ip firewall mangle>
```

- **My windows PPPoE client obtains IP address and default gateway from the MikroTik PPPoE server, but it cannot ping beyond the PPPoE server and use the Internet**
  PPPoE server is not bridging the clients. Configure masquerading for the PPPoE client addresses, or make sure you have proper routing for the address space used by the clients, or you enable Proxy-ARP on the Ethernet interface (See the IP Addresses and Address Resolution Protocol (ARP) Manual)
- **My Windows XP client cannot connect to the PPPoE server**
  You have to specify the "Service Name" in the properties of the XP PPPoE client. If the service name is not set, or it does not match the service name of the MikroTik PPPoE server, you get the "line is busy" errors, or the system shows "verifying password - unknown error"
- **I want to have logs for PPPoE connection establishment**

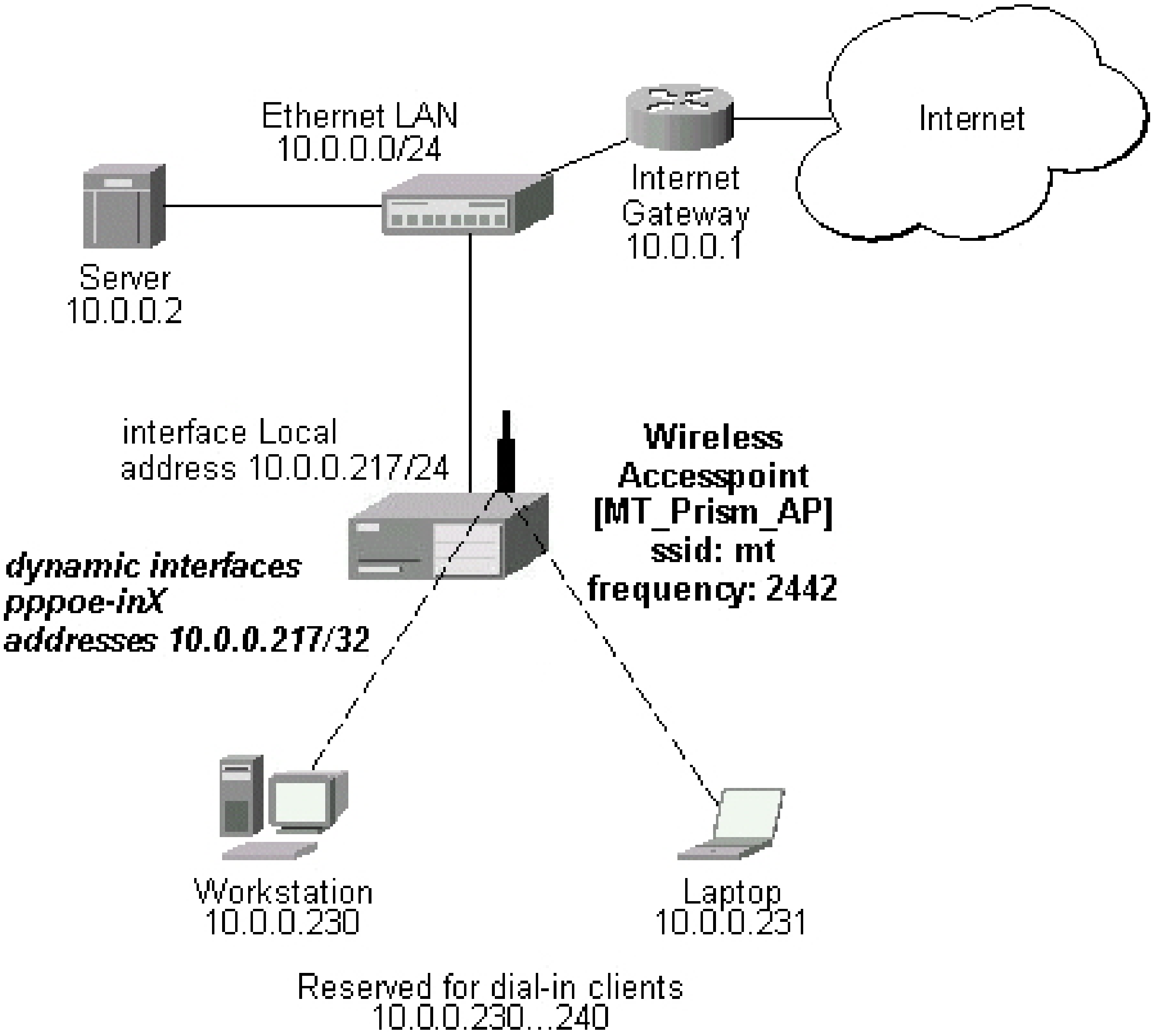
Configure the logging feature under the **/system logging facility** and enable the PPP type logs

Application Examples

PPPoE in a multipoint wireless 802.11 network

In a wireless network, the PPPoE server may be attached to an Access Point (as well as to a regular station of wireless infrastructure). Either our RouterOS client or Windows PPPoE clients may connect to the Access Point for PPPoE authentication. Further, for RouterOS clients, the radio interface may be set to MTU 1600 so that the PPPoE interface may be set to MTU 1500. This optimizes the transmission of 1500 byte packets and avoids any problems associated with MTUs lower than 1500. It has not been determined how to change the MTU of the Windows wireless interface at this moment.

Let us consider the following setup where the MikroTik Wireless AP offers wireless clients transparent access to the local network with authentication:



Note that you should have Basic + Wireless + Wireless AP licenses for this setup.

First of all, the Prism interface should be configured:

```
[admin@MT_Prism_AP] interface prism> set 0 mode=ap-bridge frequency=2442MHz \
\... ssid=mt disabled=no
[admin@MT_Prism_AP] interface prism> print
Flags: X - disabled, R - running
  0  R name="prism1" mtu=1500 mac-address=00:90:4B:02:17:E2 arp=enabled
       mode=ap-bridge root-ap=00:00:00:00:00:00 frequency=2442MHz ssid="mt"
       default-authentication=yes default-forwarding=yes max-clients=2007
       card-type=generic tx-power=auto supported-rates=1-11 basic-rates=1
       hide-ssid=no

[admin@MT_Prism_AP] interface prism> /ip address
```

Now, the Ethernet interface and IP address are to be set:

```
[admin@MT_Prism_AP] ip address> add address=10.0.0.217/24 interface=Local
[admin@MT_Prism_AP] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.217/24      10.0.0.0        10.0.0.255      Local

[admin@MT_Prism_AP] ip address> /ip route
[admin@MT_Prism_AP] ip route> add gateway=10.0.0.1
[admin@MT_Prism_AP] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 10.0.0.1        1        Local
    1 DC 10.0.0.0/24        r 0.0.0.0         0        Local

[admin@MT_Prism_AP] ip route> /interface ethernet
[admin@MT_Prism_AP] interface ethernet> set Local arp=proxy-arp
[admin@MT_Prism_AP] interface ethernet> print
Flags: X - disabled, R - running
  #    NAME                 MTU   MAC-ADDRESS       ARP
  0  R Local                1500  00:50:08:00:00:F5 proxy-arp

[admin@MT_Prism_AP] interface ethernet>
```

We should add PPPoE server to the Prism interface:

```
[admin@MT_Prism_AP] interface pppoe-server server> add interface=prism1 \
\... service-name=mt one-session-per-host=yes disabled=no
[admin@MT_Prism_AP] interface pppoe-server server> print
Flags: X - disabled
  0   service-name="mt" interface=prism1 mtu=1480 mru=1480
      authentication=mschap2,mschap,chap,pap keepalive-timeout=10
      one-session-per-host=yes default-profile=default

[admin@MT_Prism_AP] interface pppoe-server server>
```

MSS should be changed for the packets flowing through the PPPoE link:

```
[admin@MT_Prism_AP] ip firewall mangle> add protocol=tcp tcp-options=syn-only \
\.. action=passthrough tcp-mss=1440
[admin@MT_Prism_AP] ip firewall mangle> print
Flags: X - disabled, I - invalid
  0   src-address=0.0.0.0/0:0-65535 in-interface=all
      dst-address=0.0.0.0/0:0-65535 protocol=tcp tcp-options=syn-only
      icmp-options=any:any flow="" src-mac-address=00:00:00:00:00:00
      limit-count=0 limit-burst=0 limit-time=0s action=passthrough
      mark-flow="" tcp-mss=1440

[admin@MT_Prism_AP] ip firewall mangle>
```

And finally, we can set up PPPoE clients:

```
[admin@MT_Prism_AP] ip pool> add name=pppoe ranges=10.0.0.230-10.0.0.240
[admin@MT_Prism_AP] ip pool> print
  # NAME                                         RANGES
  0 pppoe                                        10.0.0.230-10.0.0.240
```

```
[admin@MT_Prism_AP] ip pool> /ppp profile
[admin@MT_Prism_AP] ppp profile> set default use-encryption=yes \
\... local-address=10.0.0.217 remote-address=pppoe
[admin@MT_Prism_AP] ppp profile> print
Flags: * - default
  0 * name="default" local-address=10.0.0.217 remote-address=pppoe
      session-timeout=0s idle-timeout=0s use-compression=no
      use-vj-compression=no use-encryption=yes require-encryption=no
      only-one=no tx-bit-rate=0 rx-bit-rate=0 incoming-filter=""
      outgoing-filter=""

[admin@MT_Prism_AP] ppp profile> .. secret
[admin@MT_Prism_AP] ppp secret> add name=w password=wkst service=pppoe
[admin@MT_Prism_AP] ppp secret> add name=l password=ltp service=pppoe
[admin@MT_Prism_AP] ppp secret> print
Flags: X - disabled
  #   NAME              SERVICE CALLER-ID       PASSWORD        PROFILE
  0   w                 pppoe                   wkst            default
  1   l                 pppoe                   ltp             default
[admin@MT_Prism_AP] ppp secret>
```

Thus we have completed the configuration and added two users: **w** and **l** who are able to connect using PPPoE client software.

Note that Windows XP built-in client supports encryption, but RASPPPOE does not. So, if it is planned not to support Windows clients older than Windows XP, it is recommended to switch **require-encryption** to **yes** value in the **default** profile configuration. In other case, the server will accept clients that do not encrypt data.

PPP and Asynchronous Interfaces

Document revision 1.1 (Fri Mar 05 08:16:45 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

PPP (Point-to-Point Protocol) provides a method for transmitting datagrams over serial point-to-point links. Physically it relies on **com1** and **com2** ports from standard PC hardware configurations. These appear as **serial0** and **serial1** automatically. You can add more serial ports to use the router for a modem pool using these adapters:

- MOXA (***http://www.moxa.com***) Smartio CP-132 2-port PCI multiport asynchronous board with maximum of 8 ports (4 cards)
- MOXA (***http://www.moxa.com***) Smartio C104H, CP-114 or CT-114 4-port PCI multiport asynchronous board with maximum of 16 ports (4 cards)
- MOXA (***http://www.moxa.com***) Smartio C168H, CP-168H or CP-168U 8-port PCI multiport asynchronous board with maximum of 32 ports (4 cards)
- Cyclades (***http://www.cyclades.com***) Cyclom-Y Series 4 to 32 port PCI multiport asynchronous board with maximum of 128 ports (4 cards)

- Cyclades (***http://www.cyclades.com***) Cyclades-Z Series 16 to 64 port PCI multiport asynchronous board with maximum of 256 ports (4 cards)
- TCL DataBooster 4 or 8 port High Speed Buffered PCI Communication Controllers

Specifications

Packages required: ***ppp***
License required: ***level1***
Home menu level: ***/interface ppp-client, /interface ppp-server***
Standards and Technologies: ***PPP (RFC 1661)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Device Driver List***
- ***IP Addresses and ARP***
- ***Log Management***
- ***AAA***

Additional Documents

- ***http://www.ietf.org/rfc/rfc2138.txt?number=2138***
- ***http://www.ietf.org/rfc/rfc2138.txt?number=2139***

Serial Port Configuration

Home menu level: ***/port***

Property Description

name (*name*; default: **serialN**) - port name

used-by (*read-only: text*) - shows the user of the port. Only free ports can be used in PPP setup

baud-rate (*integer*; default: **9600**) - maximal data rate of the port

data-bits (*7* | *8*; default: **8**) - number of bits per character transmitted

parity (*none* | *even* | *odd*; default: **none**) - character parity check method

stop-bits (*1* | *2*; default: **1**) - number of stop bits after each character transmitted

flow-control (*none* | *hardware* | *xon-xoff*; default: **hardware**) - flow control method

Notes

Keep in mind that **baud-rate**, **data-bits**, **parity**, **stop-bits** and **flow control** parameters must be the same for both communicating sides.

Example

```
[admin@MikroTik] > /port print
  # NAME                             USED-BY                          BAUD-RATE
  0 serial0                          Serial Console                   9600
  1 databooster1                                                      9600
  2 databooster2                                                      9600
  3 databooster3                                                      9600
  4 databooster4                                                      9600
  5 databooster5                                                      9600
  6 databooster6                                                      9600
  7 databooster7                                                      9600
  8 databooster8                                                      9600
  9 cycladesA1                                                        9600
 10 cycladesA2                                                        9600
 11 cycladesA3                                                        9600
 12 cycladesA4                                                        9600
 13 cycladesA5                                                        9600
 14 cycladesA6                                                        9600
 15 cycladesA7                                                        9600
 16 cycladesA8                                                        9600
[admin@MikroTik] > set 9 baud-rate=38400
[admin@MikroTik] >
```

PPP Server Setup

Home menu level: ***/interface ppp-server***

Description

PPP server provides a remode connection service for users. When dialing in, the users can be authenticated locally using the local user database in the **/user** menu, or at the RADIUS server specified in the **/ip ppp** settings.

Property Description

port (*name*; default: **(unknown)**) - serial port

authentication (*multiple choice: mschap2, mschap1, chap, pap*; default: **mschap2, mschap1, chap, pap**) - authentication protocol

profile (*name*; default: **default**) - profile name used for the link

mtu (*integer*; default: **1500**) - Maximum Transmission Unit. Maximum packet size to be transmitted

mru (*integer*; default: **1500**) - Maximum Receive Unit

null-modem (*no* | *yes*; default: **no**) - enable/disable null-modem mode (when enabled, no modem initialization strings are sent)

modem-init (*text*; default: **""**) - modem initialization string. You may use "s11=40" to improve dialing speed

ring-count (*integer*; default: **1**) - number of rings to wait before answering phone

name (*name*; default: **ppp-inN**) - interface name for reference

Example

You can add a PPP server using the **add** command:

```
[admin@MikroTik] interface ppp-server> add name=test port=serial1
[admin@MikroTik] interface ppp-server> print
Flags: X - disabled, R - running
  0 X  name="test" mtu=1500 mru=1500 port=serial1
       authentication=mschap2,chap,pap profile=default modem-init=""
       ring-count=1 null-modem=no

[admin@MikroTik] interface ppp-server> enable 0
[admin@MikroTik] interface ppp-server> monitor test
            status: "waiting for call..."

[admin@MikroTik] interface ppp-server>
```

PPP Client Setup

Home menu level: ***/interface ppp-client***

Description

The section describes PPP clients configuration routines.

Property Description

port (*name*; default: **(unknown)**) - serial port

user (*text*; default: **""**) - P2P user name on the remote server to use for dialout

password (*text*; default: **""**) - P2P user password on the remote server to use for dialout

profile (*name*; default: **default**) - local profile to use for dialout

allow (*multiple choice: mschap2*, *mschap1*, *chap*, *pap*; default: **mschap2, mschap1, chap, pap**) - the protocol to allow the client to use for authentication

phone (*integer*; default: **""**) - phone number for dialout

tone-dial (*yes* | *no*; default: **yes**) - defines whether use tone dial or pulse dial

mtu (*integer*; default: **1500**) - Maximum Transmission Unit. Maximum packet size to be transmitted

mru (*integer*; default: **1500**) - Maximum Receive Unit

null-modem (*no* | *yes*; default: **no**) - enable/disable null-modem mode (when enabled, no modem initialization strings are sent)

modem-init (*text*; default: **""**) - modem initialization strings. You may use "s11=40" to improve dialing speed

dial-on-demand (*yes* | *no*; default: **no**) - enable/disable dial on demand

add-default-route (*yes* | *no*; default: **no**) - add PPP remote address as a default route

use-peer-dns (*yes* | *no*; default: **no**) - use DNS server settings from the remote server

Notes

- Additional client profiles must be configured on the server side for clients to accomplish logon procedure. For more information see **Related Documents** section.
- PPP client profiles must match at least partially (**local-address** and values related to encryption should match) with corresponding remote server values.

Example

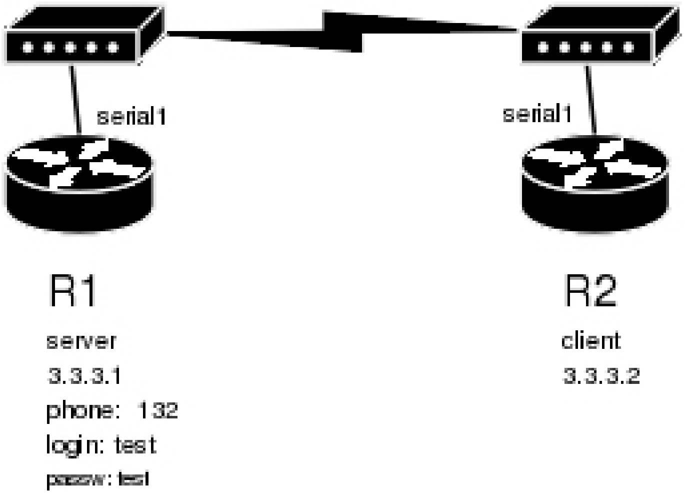
You can add a PPP client using the **add** command:

```
[admin@MikroTik] interface ppp-client> add name=test user=test port=serial1 \
\... add-default-route=yes
[admin@MikroTik] interface ppp-client> print
Flags: X - disabled, R - running
  0 X  name="test" mtu=1500 mru=1500 port=serial1 user="test" password=""
       profile=default phone="" tone-dial=yes modem-init="" null-modem=no
       dial-on-demand=no add-default-route=yes use-peer-dns=no

[admin@MikroTik] interface ppp-client> enable 0
[admin@MikroTik] interface ppp-client> monitor test
[admin@MikroTik] interface ppp-client> monitor 0
           status: "dialing out..."

[admin@MikroTik] interface ppp-client>
```

PPP Application Example

Client - Server Setup

In this example we will consider the following network setup:



For a typical server setup we need to add one user to the **R1** and configure the PPP server.

```
[admin@MikroTik] ppp secret> add name=test password=test local-address=3.3.3.1 \
\... remote-address=3.3.3.2
[admin@MikroTik] ppp secret> print
Flags: X - disabled
  0   name="test" service=any caller-id="" password="test" profile=default
      local-address=3.3.3.1 remote-address=3.3.3.2 routes=""

[admin@MikroTik] ppp secret> /int ppp-server
[admin@MikroTik] interface ppp-server> add port=serial1 disabled=no
[admin@MikroTik] interface ppp-server> print
Flags: X - disabled, R - running
  0    name="ppp-in1" mtu=1500 mru=1500 port=serial1
       authentication=mschap2,mschap1,chap,pap profile=default modem-init=""
       ring-count=1 null-modem=no

[admin@MikroTik] interface ppp-server>
```

Now we need to setup the client to connect to the server:

```
[admin@MikroTik] interface ppp-client> add port=serial1 user=test password=test \
\... phone=132
[admin@MikroTik] interface ppp-client> print
Flags: X - disabled, R - running
  0 X  name="ppp-out1" mtu=1500 mru=1500 port=serial1 user="test"
       password="test" profile=default phone="132" tone-dial=yes
       modem-init="" null-modem=no dial-on-demand=no add-default-route=no
       use-peer-dns=no

[admin@MikroTik] interface ppp-client> enable 0

After a short duration of time the routers will be able to ping each other:
[admin@MikroTik] interface ppp-client> /ping 3.3.3.1
3.3.3.1 64 byte ping: ttl=64 time=43 ms
3.3.3.1 64 byte ping: ttl=64 time=11 ms
3.3.3.1 64 byte ping: ttl=64 time=12 ms
3.3.3.1 64 byte ping: ttl=64 time=11 ms
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 11/19.2/43 ms
[admin@MikroTik] interface ppp-client>
```

IP Addresses and ARP

Document revision 0.9 (Fri Mar 05 08:35:08 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The following Manual discusses IP address management and the Address Resolution Protocol settings. IP addresses serve as identification when communicating with other network devices using the TCP/IP protocol. In turn, communication between devices in one physical network proceeds with the help of Address Resolution Protocol and ARP addresses.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip address, /ip arp***
Standards and Technologies: ***IP, ARP***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

IP Addressing

Home menu level: ***/ip address***

Description

IP addresses serve for a general host identification purposes in IP networks. Typical (IPv4) address consists of four octets. For proper addressing the router also needs the network mask value, *id est* which bits of the complete IP address refer to the address of the host, and which - to the address of the network. The network address value is calculated by binary **AND** operation from network mask and IP address values. It's also possible to specify IP address followed by slash "/" and amount of bits assigned to a network mask.

In most cases, it is enough to specify the address, the netmask, and the interface arguments. The network prefix and the broadcast address are calculated automatically.

It is possible to add multiple IP addresses to an interface or to leave the interface without any addresses assigned to it. Leaving a physical interface without an IP address is not a must when the bridging between interfaces is used (starting from RouterOS version 2.8). In case of bridging, the IP address can be assigned to any interface in the bridge, but actually the address will belong to the bridge interface. You can use **/ip address print detail** to see to which interface the address belongs to.

MikroTik RouterOS has following types of addresses:

- **Static** - manually assigned to the interface by a user
- **Dynamic** - automatically assigned to the interface by estabilished ppp, ppptp, or pppoe connections

Property Description

address (*IP address*) - IP address of the host

broadcast (*IP address*; default: **255.255.255.255**) - broadcasting IP address, calculated by default from an IP address and a network mask

disabled (yes | no; default: **no**) - specifies whether the address is disabled or not

interface (*name*) - interface name the IP address is assigned to

actual-interface (*read-only: name*) - only applicable to logical interfaces like bridges or tunnels. Holds the name of the actual hardware interface the logical one is bound to.

netmask (*IP address*; default: **0.0.0.0**) - specifies network address part of an IP address

network (*IP address*; default: **0.0.0.0**) - IP address for the network. For point-to-point links it should be the address of the remote end

Notes

You cannot have two different IP addresses from the same network assigned to the router. *Exempli gratia*, the combination of IP address **10.0.0.1/24** on the **ether1** interface and IP address **10.0.0.132/24** on the **ether2** interface is invalid, because both addresses belong to the same network **10.0.0.0/24**. Use addresses from different networks on different interfaces, or enable **proxy-arp** on

ether1 or **ether2**.

Example

```
[admin@MikroTik] ip address> add address=10.10.10.1/24 interface=ether2
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   2.2.2.1/24         2.2.2.0         2.2.2.255       ether2
  1   10.5.7.244/24      10.5.7.0        10.5.7.255      ether1
  2   10.10.10.1/24      10.10.10.0      10.10.10.255    ether2

[admin@MikroTik] ip address>
```

Address Resolution Protocol

Home menu level: ***/ip arp***

Description

Even though IP packets are addressed using IP addresses, hardware addresses must be used to actually transport data from one host to another. Address Resolution Protocol is used to map OSI level 3 IP addreses to OSI level 2 MAC addreses. A router has a table of currently used ARP entries. Normally the table is built dynamically, but to increase network security, it can be built statically by means of adding static entries.

Property Description

address (*IP address*) - IP address to be mapped

interface (*name*) - interface name the IP address is assigned to

mac-address (*MAC address*; default: **00:00:00:00:00:00**) - MAC address to be mapped to

Notes

Maximal number of ARP entries is 1024.

If arp feature is turned off on the interface, i.e., **arp=disabled** is used, ARP requests from clients are not answered by the router. Therefore, static arp entry should be added to the clients as well. For example, the router's IP and MAC addresses should be added to the Windows workstations using the **arp** command:

```
C:\> arp -s 10.5.8.254  00-aa-00-62-c6-09
```

If **arp** property is set to **reply-only** on the interface, then router only replies to ARP requests. Neighbour MAC addresses will be resolved using **/ip arp** statically set table only

Example

```
[admin@MikroTik] ip arp> add address=10.10.10.10 interface=ether2 mac-address=06 \
\... :21:00:56:00:12
[admin@MikroTik] ip arp> print
Flags: X - disabled, I - invalid, H - DHCP, D - dynamic
  #   ADDRESS         MAC-ADDRESS       INTERFACE
  0 D 2.2.2.2         00:30:4F:1B:B3:D9 ether2
  1 D 10.5.7.242      00:A0:24:9D:52:A4 ether1
  2   10.10.10.10     06:21:00:56:00:12 ether2
[admin@MikroTik] ip arp>
```

If static arp entries are used for network security on an interface, you should set arp to 'reply-only' on that interface. Do it under the relevant **/interface** menu:

```
[admin@MikroTik] ip arp> /interface ethernet set ether2 arp=reply-only
[admin@MikroTik] ip arp> print
Flags: X - disabled, I - invalid, H - DHCP, D - dynamic
  #   ADDRESS         MAC-ADDRESS       INTERFACE
  0 D 10.5.7.242      00:A0:24:9D:52:A4 ether1
  1   10.10.10.10     06:21:00:56:00:12 ether2

[admin@MikroTik] ip arp>
```

Proxy-ARP feature

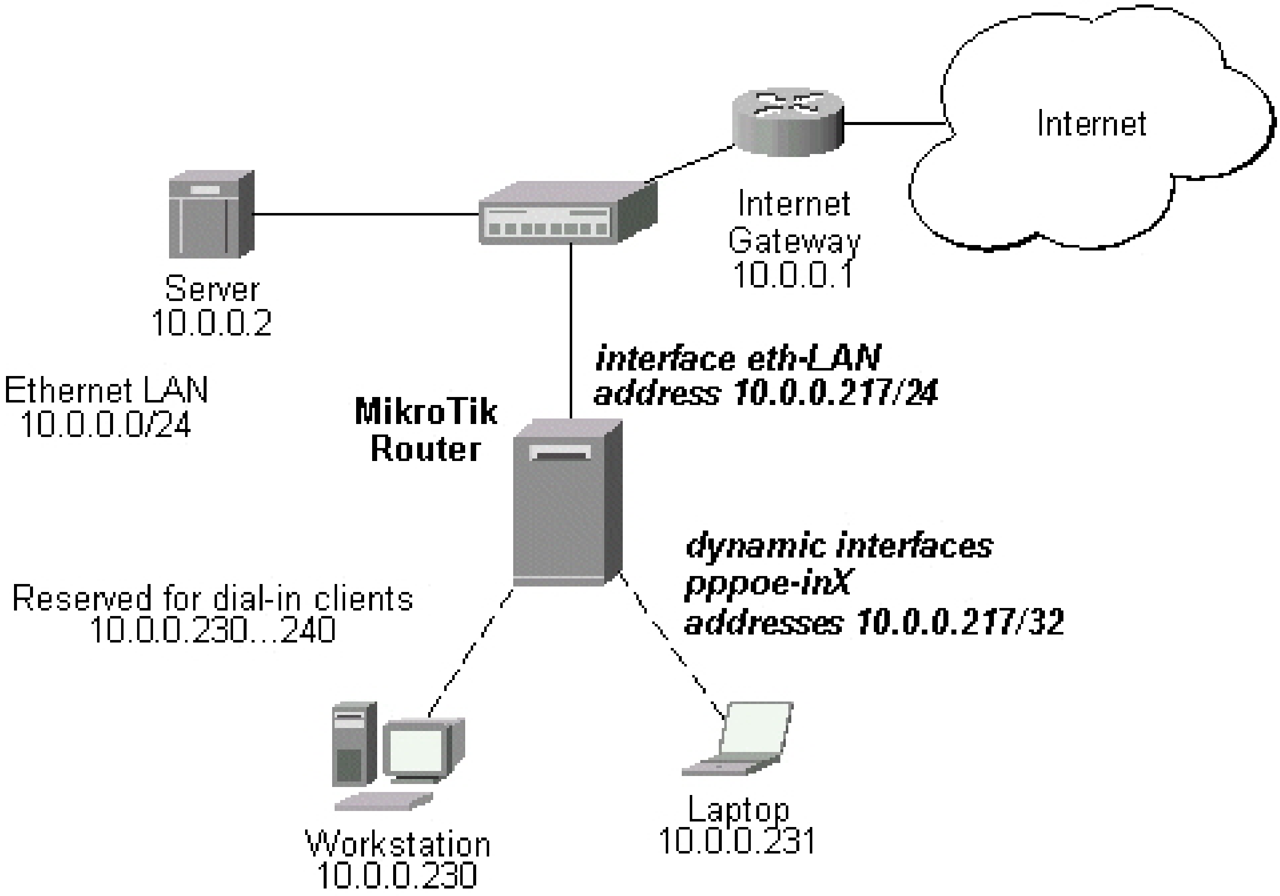
Description

All physical interfaces, like Ethernet, Atheros and Prism (wireless), Aironet (PC), WaveLAN, etc., can be set to use the Address Resolution Protocol or not. The other possible setting is to use Proxy-ARP feature. The Proxy-ARP means that the router will be listening to ARP requests on the relevant interface and respond to them with it's own MAC address, if the requests matches any other IP address of the router.

This can be usefull, for example, if you want to assign dial-in (ppp, pppoe, pptp) clients IP addresses from the same address space as used on the connected LAN.

Example

Consider the following configuration:



The MikroTik Router setup is as follows:

```
admin@MikroTik] ip arp> /interface ethernet print
Flags: X - disabled, R - running
  #    NAME                 MTU   MAC-ADDRESS       ARP
  0  R eth-LAN              1500  00:50:08:00:00:F5 proxy-arp
[admin@MikroTik] ip arp> /interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                 TYPE             MTU
  0    eth-LAN              ether            1500
  1    prism1               prism            1500
  2 D  pppoe-in25           pppoe-in
  3 D  pppoe-in26           pppoe-in
[admin@MikroTik] ip arp> /ip address print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.217/24      10.0.0.0        10.0.0.255      eth-LAN
  1 D 10.0.0.217/32      10.0.0.230      0.0.0.0         pppoe-in25
  2 D 10.0.0.217/32      10.0.0.231      0.0.0.0         pppoe-in26
[admin@MikroTik] ip arp> /ip route print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 10.0.0.1        1        eth-LAN
    1 DC 10.0.0.0/24        r 0.0.0.0         0        eth-LAN
    2 DC 10.0.0.230/32      r 0.0.0.0         0        pppoe-in25
    3 DC 10.0.0.231/32      r 0.0.0.0         0        pppoe-in26
[admin@MikroTik] ip arp>
```

Unnumbered Interfaces

Description

Unnumbered interfaces can be used on serial point-to-point links, e.g., MOXA or Cyclades interfaces. A private address should be put on the interface with the network being the same as the address on the router on the other side of the p2p link (there may be no IP on that interface, but there is an ip for that router).

Example

```
[admin@MikroTik] ip address> add address=10.0.0.214/32 network=192.168.0.1 \
\... interface=pppsync
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.214/32      192.168.0.1     192.168.0.1     pppsync
[admin@MikroTik] ip address>
[admin@MikroTik] ip address> .. route print detail
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    0  S dst-address=0.0.0.0/0 preferred-source=0.0.0.0 gateway=192.168.0.1
         gateway-state=reachable distance=1 interface=pppsync

    1 DC dst-address=192.168.0.1/32 preferred-source=10.0.0.214
         gateway=0.0.0.0 gateway-state=reachable distance=0 interface=pppsync

[admin@MikroTik] ip address>
```

As you can see, a dynamic connected route has been automatically added to the routes list. If you want the default gateway be the other router of the p2p link, just add a static route for it. It is shown as **0** in the example above.

IP Security

Document revision 3.1 (Mon May 31 14:14:16 GMT 2004)

This document applies to V

Table of Contents

General Information

Specifications

Packages required: ***security***
License required: ***level1***
Home menu level: ***/ip ipsec***

Standards and Technologies: ***IPsec***
Hardware usage: *consumes a lot of CPU time (Intel Pentium MMX or AMD K6 suggested as a minimal configuration)*

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***Firewall Filters***

Description

IPsec (IP Security) supports secure (encrypted) communications over IP networks.

Encryption

After packet is src-natted, but before putting it into interface queue, IPsec policy database is consulted to find out if packet should be encrypted. Security Policy Database (SPD) is a list of rules that have two parts:

- **Packet matching** - packet source/destination, protocol and ports (for TCP and UDP) are compared to values in policy rules, one after another
- **Action** - if rule matches action specified in rule is performed:

- - **accept** - continue with packet as if there was no IPsec
  - **drop** - drop packet
  - **encrypt** - encrypt packet

Each SPD rule can be associated with several Security Associations (SA) that determine packet encryption parameters (key, algorithm, SPI).

Note that packet can only be encrypted if there is usable SA for policy rule. By setting SPD rule security "level" user can control what happens when there is no valid SA for policy rule:

- **use** - if there is no valid SA, send packet unencrypted (like accept rule)
- **acquire** - send packet unencrypted, but ask IKE daemon to establish new SA
- **require** - drop packet, and ask IKE daemon to establish new SA.

Decryption

When encrypted packet is received for local host (after **dst-nat** and **input** filter), the appropriate SA is looked up to decrypt it (using packet source, destination, security protocol and SPI value). If no SA is found, the packet is dropped. If SA is found, packet is decrypted. Then decrypted packet's fields are compared to policy rule that SA is linked to. If the packet does not match the policy rule it is dropped. If the packet is decrypted fine (or authenticated fine) it is "received once more" - it goes through **dst-nat** and routing (which finds out what to do - either forward or deliver locally) again.

Note that before **forward** and **input** firewall chains, a packet that was not decrypted on local host is compared with SPD reversing its matching rules. If SPD requires encryption (there is valid SA associated with matching SPD rule), the packet is dropped. This is called incoming policy check.

Internet Key Exchange

The Internet Key Exchange (IKE) is a protocol that provides authenticated keying material for Internet Security Association and Key Management Protocol (ISAKMP) framework. There are other key exchange schemes that work with ISAKMP, but IKE is the most widely used one. Together they provide means for authentication of hosts and automatic management of security associations (SA).

Most of the time IKE daemon is doing nothing. There are two possible situations when it is activated:

- There is some traffic caught by a policy rule which needs to become encrypted or authenticated, but the policy doesn't have any SAs. The policy notifies IKE daemon about that, and IKE daemon initiates connection to remote host.
- IKE daemon responds to remote connection.

In both cases, peers establish connection and execute 2 phases:

- **Phase 1** - The peers agree upon algorithms they will use in the following IKE messages and authenticate. The keying material used to derive keys for all SAs and to protect following ISAKMP exchanges between hosts is generated also.
- **Phase 2** - The peers establish one or more SAs that will be used by IPsec to encrypt data. All SAs established by IKE daemon will have lifetime values (either limiting time, after which SA will become invalid, or amount of data that can be encrypted by this SA, or both).

There are two lifetime values - soft and hard. When SA reaches it's soft lifetime treshhold, the IKE daemon receives a notice and starts another phase 2 exchange to replace this SA with fresh one. If SA reaches hard lifetime, it is discarded.

IKE can optionally provide a Perfect Forward Secrecy (PFS), whish is a property of key exchanges, that, in turn, means for IKE that compromising the long term phase 1 key will not allow to easily gain access to all IPsec data that is protected by SAs established through this phase 1. It means an additional keying material is generated for each phase 2.

Generation of keying material is computationally very expensive. *Exempli gratia*, the use of modp8192 group can take several seconds even on very fast computer. It usually takes place once per phase 1 exchange, which happens only once between any host pair and then is kept for long time. PFS adds this expensive operation also to each phase 2 exchange.

Diffie-Hellman MODP Groups

Diffie-Hellman (DH) key exchange protocol allows two parties without any initial shared secret to create one securely. The following Modular Exponential (MODP) Diffie-Hellman (also known as "Oakley") Groups are supported:

Diffie-Hellman Group	Modulus	Reference
Group 1	**768 bits**	**RFC2409**
Group 2	**1024 bits**	**RFC2409**

Group 5	**1536 bits**	**RFC3526**

IKE Traffic

To avoid problems with IKE packets hit some SPD rule and require to encrypt it with not yet established SA (that this packet perhaps is trying to establish), locally originated packets with UDP source port 500 are not processed with SPD. The same way packets with UDP destination port 500 that are to be delivered locally are not processed in incoming policy check.

Setup Procedure

To get IPsec to work with automatic keying using IKE-ISAKMP you will have to configure **policy**, **peer** and **proposal** (optional) entries.

For manual keying you will have to configure **policy** and **manual-sa** entries.

Policy Settings

Home menu level: ***/ip ipsec policy***

Description

Policy table is needed to determine whether encryption should be applied to a packet.

Property Description

action (*accept* | *drop* | *encrypt*; default: **accept**) - specifies what action to undertake with a packet that matches the policy

- **accept** - pass the packet
- **drop** - drop the packet
- **encrypt** - apply transformations specified in this policyand it's SA

decrypted (*integer*) - how many incoming packets were decrypted by the policy

dont-fragment (*clear* | *inherit* | *set*; default: **clear**) - The state of the don't fragment IP header field

- **clear** - clear (unset) the fields, so that packets previously marked as don't fragment got fragmented
- **inherit** - do not change the field
- **set** - set the field, so that each packet matching the rule will not be fragmented

dst-address (*IP address/mask:port*; default: **0.0.0.0/32:any**) - destination IP address

encrypted (*integer*) - how many outgoing packets were encrypted by the policy

in-accepted (*integer*) - how many incoming packets were passed through by the policy without an attempt to decrypt

in-dropped (*integer*) - how many incoming packets were dropped by the policy without an attempt to decrypt

ipsec-protocols (*multiple choice: ah* | *esp*; default: **esp**) - specifies what combination of Authentication Header and Encapsulating Security Payload protocols you want to apply to matched traffic. AH is applied after ESP, and in case of tunnel mode ESP will be applied in tunnel mode and AH - in transport mode

level (*acquire* | *require* | *use*; default: **require**) - specifies what to do if some of the SAs for this policy cannot be found:

- **use** - skip this transform, do not drop packet and do not acquire SA from IKE daemon
- **acquire** - skip this transform, but acquire SA for it from IKE daemon
- **require** - drop packet but acquire SA

manual-sa (*name*; default: **none**) - name of manual-sa template that will be used to create SAs for this policy

- **none** - no manual keys are set

not-decrypted (*integer*) - how many incoming packets the policy attempted to decrypt. but discarded for any reason

not-encrypted (*integer*) - how many outgoing packets the policy attempted to encrypt. but discarded for any reason

out-accepted (*integer*) - how many outgoing packets were passed through by the policy without an attempt to encrypt

out-dropped (*integer*) - how many outgoing packets were dropped by the policy without an attempt to encrypt

ph2-state (*read-only: expired* | *no-phase2* | *estabilished*) - the progress of key estabilishing

- **expired** - there are some leftovers from previous phase2. In general it is similar to no-phase2
- **no-phase2** - no keys are estabilished at the moment
- **estabilished** - Appropriate SAs are in place and everything should be working fine

proposal (*name*; default: **default**) - name of proposal information that will be sent by IKE daemon to establish SAs for this policy

protocol (*name* | *integer*; default: **all**) - protocol name or number

sa-dst-address (*IP address*; default: **0.0.0.0**) - SA destination IP address

sa-src-address (*IP address*; default: **0.0.0.0**) - SA source IP address

src-address (*IP address/mask:port*; default: **0.0.0.0/32:any**) - source IP address

tunnel (yes | no; default: **no**) - specifies whether to use tunnel mode

Notes

All packets are IPIP encapsulated in tunnel mode, and their new IP header **src-address** and **dst-address** are set to **sa-src-address** and **sa-dst-address** values of this policy. If you do not use tunnel mode (*id est* you use transport mode), then only packets whose source and destination addresses are the same as **sa-src-address** and **sa-dst-address** can be processed by this policy. Transport mode can only work with packets that originate at and are destined for IPsec peers (hosts that established security associations). To encrypt traffic between networks (or a network and a host) you have to use tunnel mode.

It is good to have **dont-fragment** cleared because encrypted packets are always bigger than original and thus they may need fragmentation.

If you are using IKE to establish SAs automatically, then policies on both routers must exactly match each other, *id est* **src-address=1.2.3.0/27** on one router and **dst-address=1.2.3.0/28** on another would not work. Source address values on one router MUST be equal to destination address values on the other one, and vice versa.

Example

To add a policy to encrypt all the traffic between two hosts (10.0.0.147 and 10.0.0.148), we need do the following:

```
[admin@WiFi] ip ipsec policy> add sa-src-address=10.0.0.147 \
\... sa-dst-address=10.0.0.148 action=encrypt
[admin@WiFi] ip ipsec policy> print
Flags: X - disabled, D - dynamic, I - invalid
  0   src-address=10.0.0.147/32:any dst-address=10.0.0.148/32:any
      protocol=all action=encrypt level=require ipsec-protocols=esp tunnel=no
      sa-src-address=10.0.0.147 sa-dst-address=10.0.0.148 proposal=default
      manual-sa=none dont-fragment=clear

[admin@WiFi] ip ipsec policy>
```

to view the policy statistics, do the following:

```
[admin@WiFi] ip ipsec policy> print stats
Flags: X - disabled, D - dynamic, I - invalid
  0   src-address=10.0.0.147/32:any dst-address=10.0.0.148/32:any
      protocol=all ph2-state=no-phase2 in-accepted=0 in-dropped=0
      out-accepted=0 out-dropped=0 encrypted=0 not-encrypted=0 decrypted=0
      not-decrypted=0

[admin@WiFi] ip ipsec policy>
```

Peers

Home menu level: ***/ip ipsec peer***

Description

Peer configuration settings are used to establish connections between IKE daemons (phase 1 configuration). This connection then will be used to negotiate keys and algorithms for SAs.

Property Description

address (*IP address/mask:port*; default: **0.0.0.0/32:500**) - address prefix. If remote peer's address matches this prefix, then this peer configuration is used while authenticating and establishing phase 1. If several peer's addresses matches several configuration entries, the most specific one (i.e. the one with largest netmask) will be used

dh-group (*multiple choice: modp768* | *modp1024* | *modp1536*; default: **esp**) - Diffie-Hellman MODP group (cipher strength)

enc-algorithm (*multiple choice: des* | *3des* | *aes-128* | *aes-192* | *aes-256*; default: **3des**) - encryption algorithm. Algorithms are named in strength increasing order

exchange-mode (*multiple choice: main* | *aggressive* | *base*; default: **main**) - different ISAKMP phase 1 exchange modes according to RFC 2408.DO not use other modes then main unless you know what you are doing

generate-policy (yes | no; default: **no**) - allow this peer to establish SA for non-existing policies.

Such policies are created dynamically for the lifetime of SA. This way it is possible, for example, to create IPsec secured L2TP tunnels, or any other setup where remote peer's IP address is not known at configuration time

hash-algorithm (*multiple choice: md5* | *sha*; default: **md5**) - hashing algorithm. SHA (Secure Hash Algorithm) is stronger, but slower

lifebytes (*integer*; default: **0**) - phase 1 lifetime: specifies how much bytes can be transferred before SA is discarded

- **0** - SA expiration will not be due to byte count excess

lifetime (*time*; default: **1d**) - phase 1 lifetime: specifies how long the SA will be valid; SA will be discarded after this time

proposal-check (*multiple choice: claim* | *exact* | *obey* | *strict*; default: **strict**) - phase 2 lifetime check logic:

- **claim** - take shortest of proposed and configured lifetimes and notify initiator about it
- **exact** - require lifetimes to be the same
- **obey** - accept whatever is sent by an initiator
- **strict** - If proposed lifetime IS longer than default then reject proposal otherwise accept proposed lifetime

secret (*text*; default: **""**) - secret string. If it starts with '0x', it is parsed as a hexadecimal value

send-initial-contact (yes | no; default: **yes**) - specifies whether to send initial IKE information or wait for remote side

Notes

AES (Advanced Encryption Standard) encryption algorithms are much faster than DES, so it is recommended to use this algorithm class whenever possible. But, AES's speed is also its drawback as it potentially can be cracked faster, so use AES-256 when you need security or AES-128 when speed is also important.

Both peers MUST have the same encryption and authentication algorithms, DH group and exchange mode. Some legacy hardware may support only DES and MD5.

You should set **generate-policy** flag to **yes** only for trusted peers, because there is no verification done for the established policy. To protect yourself against possible unwanted events, add poilcies with action=accept for all networks you don't want to be encrypted at the top of policy list. Since dynamic policies are added at the bottom of the list, they will not be able to override your configuration.

Example

To define new peer configuration for **10.0.0.147** peer with **secret=gwejimezyfopmekun**:

```
[admin@WiFi] ip ipsec peer>add address=10.0.0.147/32 \
\... secret=gwejimezyfopmekun
[admin@WiFi] ip ipsec peer> print
Flags: X - disabled
  0   address=10.0.0.147/32:500 secret="gwejimezyfopmekun" generate-policy=no
      exchange-mode=main send-initial-contact=yes proposal-check=obey
      hash-algorithm=md5 enc-algorithm=3des dh-group=modp1024 lifetime=1d
      lifebytes=0
```

```
[admin@WiFi] ip ipsec peer>
```

Remote Peer Statistics

Home menu level: ***/ip ipsec remote-peers***

Description

This submenu provides you with various statistics about remote peers that curently have established phase 1 connections with this router. Note that if peer doesn't show up here, it doesn't mean that no IPsec traffic is being exchanged with it. For example, manually configured SAs will not show up here.

Property Description

estabilished (*read-only: text*) - shows date and time when phase 1 was established with the peer

local-address (*read-only: IP address*) - local ISAKMP SA address

ph2-active (*read-only: integer*) - how many phase 2 negotiations with this peer are currently taking place

ph2-total (*read-only: integer*) - how many phase 2 negotiations with this peer took place

remote-address (*read-only: IP address*) - peer's IP address

side (*multiple choice, read-only: initiator | responder*) - shows which side initiated the connection

- **initiator** - phase 1 negotiation was started by this router
- **responder** - phase 1 negotiation was started by peer

state (*read-only: text*) - state of phase 1 negotiation with the peer

- **estabilished** - normal working state

Example

To see currently estabilished SAs:

```
[admin@WiFi] ip ipsec> remote-peers print
  0 local-address=10.0.0.148 remote-address=10.0.0.147 state=established
    side=initiator established=jan/25/2003 03:34:45 ph2-active=0 ph2-total=1
[admin@WiFi] ip ipsec>
```

Installed SAs

Home menu level: ***/ip ipsec installed-sa***

Description

This facility provides information about installed security associations including the keys

Property Description

add-lifetime (*read-only: time*) - soft/hard expiration time counted from installation of SA

auth-algorithm (*multiple choice, read-only: none | md5 | sha1*) - authentication algorithm used in SA

auth-key (*read-only: text*) - authentication key presented in form of hex string

current-addtime (*read-only: text*) - time when this SA was installed

current-bytes (*read-only: integer*) - amount of data processed by this SA's crypto algorithms

current-usetime (*read-only: text*) - time when this SA was first used

direction (*multiple choice, read-only: in | out*) - SA direction

dst-address (*read-only: IP address*) - destination address of SA taken from respective policy

enc-algorithm (*multiple choice, read-only: none | des | 3des | aes*) - encryption algorithm used in SA

enc-key (*read-only: text*) - encryption key presented in form of hex string (not applicable to AH SAs)

lifebytes (*read-only: integer*) - soft/hard expiration threshold for amount of processed data

replay (*read-only: integer*) - size of replay window presented in bytes. This window protects the receiver against replay attacks by rejecting old or duplicate packets.

spi (*read-only: integer*) - SPI value of SA, represented in hexadecimal form

src-address (*read-only: IP address*) - source address of SA taken from respective policy

state (*multiple choice, read-only: larval | mature | dying | dead*) - SA living phase

use-lifetime (*read-only: time*) - soft/hard expiration time counted from the first use of SA

Example

Sample printout looks as follows:

```
[admin@WiFi] ip ipsec> installed-sa print
Flags: A - AH, E - ESP, P - pfs, M - manual
  0 E   spi=E727605 direction=in src-address=10.0.0.148
        dst-address=10.0.0.147 auth-algorithm=sha1 enc-algorithm=3des
        replay=4 state=mature
        auth-key="ecc5f4aee1b297739ec88e324d7cfb8594aa6c35"
        enc-key="d6943b8ea582582e449bde085c9471ab0b209783c9eb4bbd"
        add-lifetime=24m/30m use-lifetime=0s/0s lifebytes=0/0
        current-addtime=jan/28/2003 20:55:12
        current-usetime=jan/28/2003 20:55:23 current-bytes=128
  1 E   spi=E15CEE06 direction=out src-address=10.0.0.147
        dst-address=10.0.0.148 auth-algorithm=sha1 enc-algorithm=3des
        replay=4 state=mature
        auth-key="8ac9dc7ecebfed9cd1030ae3b07b32e8e5cb98af"
        enc-key="8a8073a7afd0f74518c10438a0023e64cc660ed69845ca3c"
        add-lifetime=24m/30m use-lifetime=0s/0s lifebytes=0/0
        current-addtime=jan/28/2003 20:55:12
        current-usetime=jan/28/2003 20:55:12 current-bytes=512
[admin@WiFi] ip ipsec>
```

Flushing Installed SA Table

Command name: ***/ip ipsec installed-sa flush***

Description

Sometimes after incorrect/incomplete negotiations took place, it is required to flush manually the installed SA table so that SA could be renegotiated. This option is provided by the **flush** command.

Property Description

sa-type (*multiple choice: ah* | *all* | *esp*; default: **all**) - specifies SA types to flush

- **ah** - delete AH protocol SAs only
- **esp** - delete ESP protocol SAs only
- **all** - delete both ESP and AH protocols SAs

Example

To flush all the SAs installed:

```
[admin@MikroTik] ip ipsec installed-sa> flush
[admin@MikroTik] ip ipsec installed-sa> print
[admin@MikroTik] ip ipsec installed-sa>
```

Counters

Home menu level: ***/ip ipsec counters***

Property Description

in-accept (*read-only: integer*) - shows how many incoming packets were matched by accept policy

in-accept-isakmp (*read-only: integer*) - shows how many incoming UDP packets on port 500 were let through without matching a policy

in-decrypted (*read-only: integer*) - shows how many incoming packets were successfully decrypted

in-drop (*read-only: integer*) - shows how many incoming packets were matched by drop policy (or encrypt policy with level=require that does not have all necessary SAs)

in-drop-encrypted-expected (*read-only: integer*) - shows how many incoming packets were matched by encrypt policy and dropped because they were not encrypted

out-accept (*read-only: integer*) - shows how many outgoing packets were matched by accept policy (including the default "accept all" case)

out-accept-isakmp (*read-only: integer*) - shows how many locally originated UDP packets on source port 500 (which is how ISAKMP packets look) were let through without policy matching

out-drop (*read-only: integer*) - shows how many outgoing packets were matched by drop policy (or encrypt policy with level=require that does not have all necessary SAs)

out-encrypt (*read-only: integer*) - shows how many outgoing packets were encrypted successfully

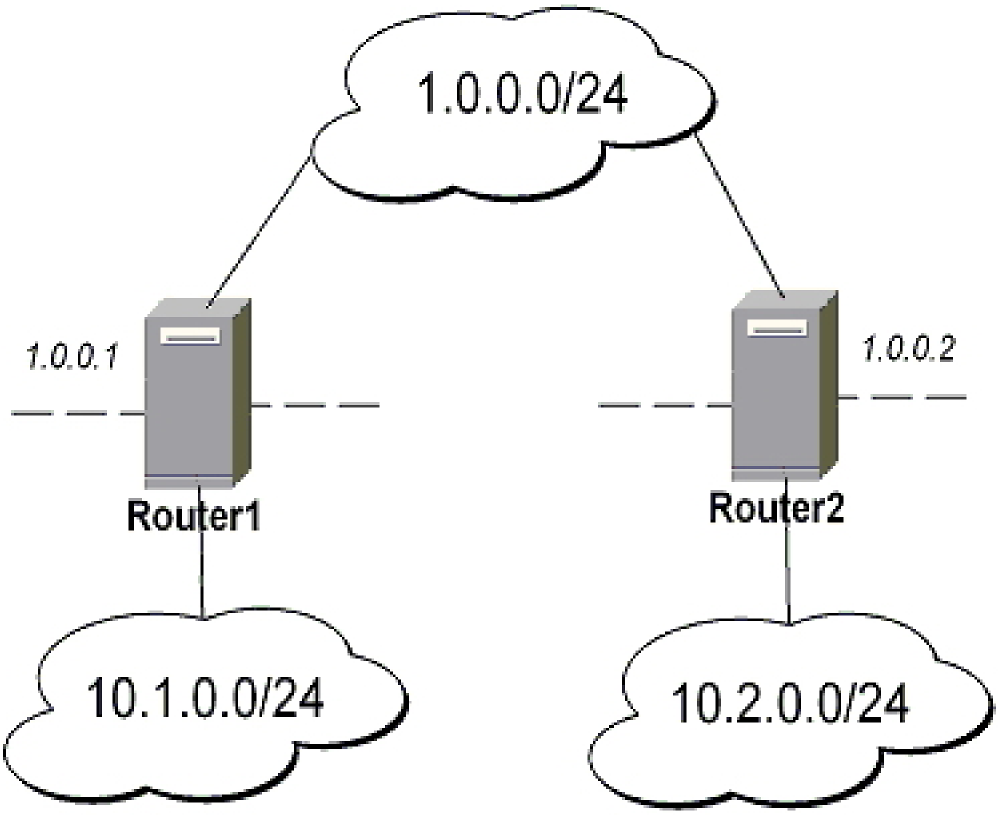
Example

To view current statistics:

```
[admin@WiFi] ip ipsec> counters print
                    out-accept: 6
             out-accept-isakmp: 0
                      out-drop: 0
                   out-encrypt: 7
                   in-accept: 12
            in-accept-isakmp: 0
                     in-drop: 0
                in-decrypted: 7
    in-drop-encrypted-expected: 0
[admin@WiFi] ip ipsec>
```

General Information

MikroTik Router to MikroTik Router



- transport mode example using ESP with automatic keying
  - for **Router1**

```
[admin@Router1] > ip ipsec policy add sa-src=1.0.0.1 sa-dst=1.0.0.2 \
\... action=encrypt
[admin@Router1] > ip ipsec peer add address=1.0.0.2 \
\... secret="gvejimezyfopmekun"
```

  - for **Router2**

```
[admin@Router2] > ip ipsec policy add sa-src=1.0.0.2 sa-dst=1.0.0.1 \
\... action=encrypt
[admin@Router2] > ip ipsec peer add address=1.0.0.1 \
\... secret="gvejimezyfopmekun"
```

- transport mode example using ESP with automatic keying and automatic policy generating on Router 1 and static policy on Router 2
  - for **Router1**

```
[admin@Router1] > ip ipsec peer add address=1.0.0.0/24 \
\... secret="gvejimezyfopmekun" generate-policy=yes
```

- for **Router2**

```
[admin@Router2] > ip ipsec policy add sa-src=1.0.0.2 sa-dst=1.0.0.1 \
\... action=encrypt
[admin@Router2] > ip ipsec peer add address=1.0.0.1 \
\... secret="gvejimezyfopmekun"
```

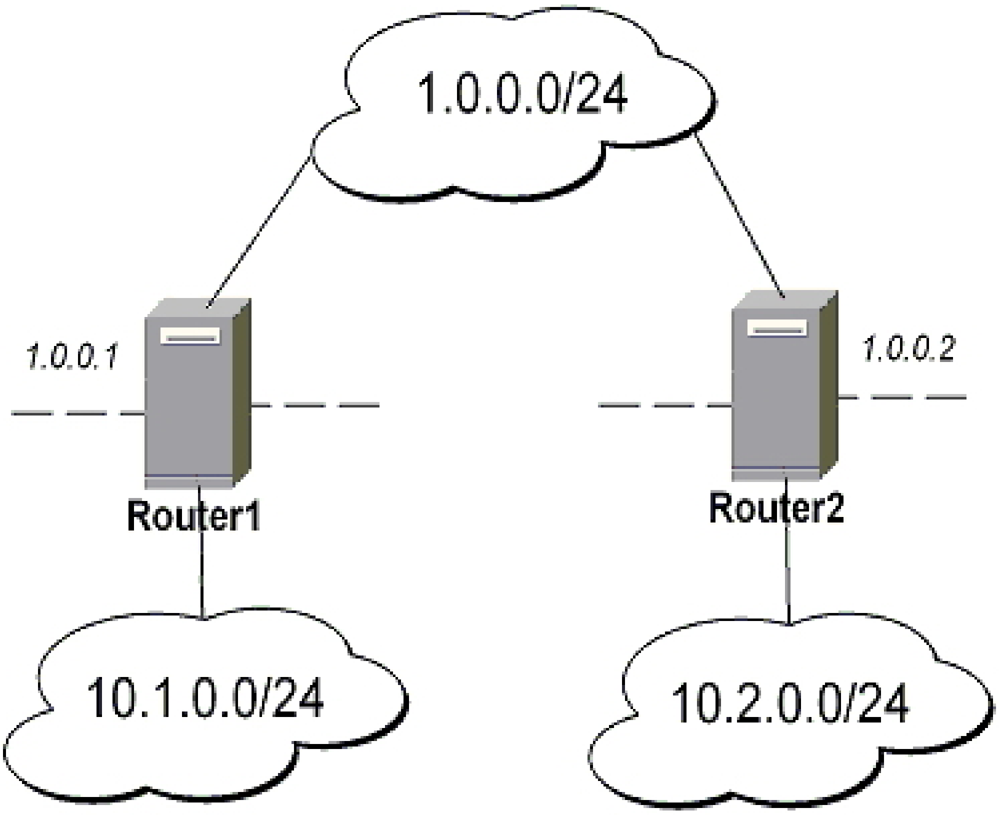
- tunnel mode example using AH with manual keying
  - for **Router1**

```
[admin@Router1] > ip ipsec manual-sa add name=ah-sa1 \
\... ah-spi=0x101/0x100 ah-key=abcfed
[admin@Router1] > ip ipsec policy add src-address=10.1.0.0/24 \
\... dst-address=10.2.0.0/24 action=encrypt ipsec-protocols=ah \
\... tunnel=yes sa-src=1.0.0.1 sa-dst=1.0.0.2 manual-sa=ah-sa1
```

  - for **Router2**

```
[admin@Router2] > ip ipsec manual-sa add name=ah-sa1 \
\... ah-spi=0x100/0x101 ah-key=abcfed
[admin@Router2] > ip ipsec policy add src-address=10.2.0.0/24 \
\... dst-address=10.1.0.0/24 action=encrypt ipsec-protocols=ah \
\... tunnel=yes sa-src=1.0.0.2 sa-dst=1.0.0.1 manual-sa=ah-sa1
```

IPsec Between two Masquerading MikroTik Routers



1. Add accept and masquerading rules in SRC-NAT
   - for **Router1**

```
[admin@Router1] > ip firewall src-nat \
\... add src-address=10.1.0.0/24 dst-address=10.2.0.0/24
[admin@Router1] > ip firewall src-nat add out-interface=public \
\... action=masquerade
```

- for **Router2**

```
[admin@Router2] > ip firewall src-nat \
\... add src-address=10.2.0.0/24 dst-address=10.1.0.0/24
[admin@Router2] > ip firewall src-nat add out-interface=public \
\... action=masquerade
```

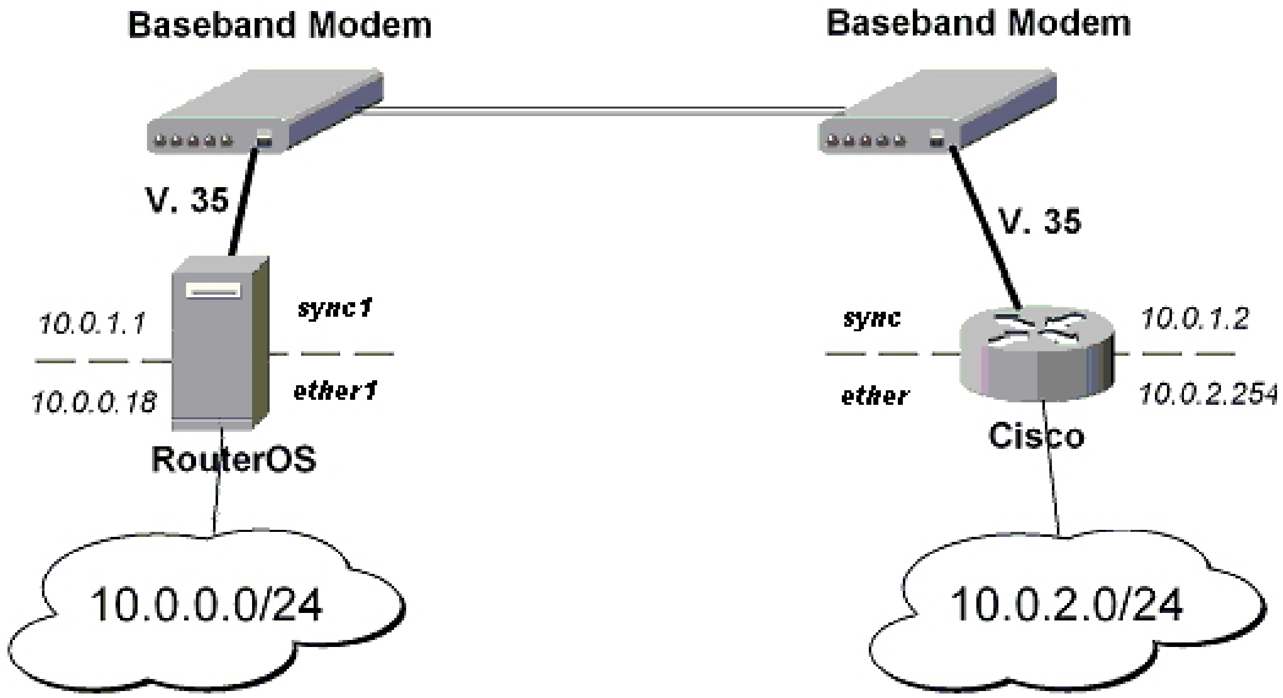
2. configure IPsec
   - for **Router1**

```
[admin@Router1] > ip ipsec policy add src-address=10.1.0.0/24 \
\... dst-address=10.2.0.0/24 action=encrypt tunnel=yes \
\... sa-src-address=1.0.0.1 sa-dst-address=1.0.0.2
[admin@Router1] > ip ipsec peer add address=1.0.0.2 \
\... exchange-mode=aggressive secret="gvejimezyfopmekun"
```

   - for **Router2**

```
[admin@Router2] > ip ipsec policy add src-address=10.2.0.0/24 \
\... dst-address=10.1.0.0/24 action=encrypt tunnel=yes \
\... sa-src-address=1.0.0.2 sa-dst-address=1.0.0.1
[admin@Router2] > ip ipsec peer add address=1.0.0.1 \
\... exchange-mode=aggressive secret="gvejimezyfopmekun"
```

MikroTik router to CISCO Router



We will configure IPsec in tunnel mode in order to protect traffic between attached subnets.

1. Add peer (with phase1 configuration parameters), DES and SHA1 will be used to protect IKE traffic

- for **MikroTik** router

```
[admin@MikroTik] > ip ipsec peer add address=10.0.1.2 \
\... secret="gvejimezyfopmekun" enc-algorithm=des
```

- for **CISCO** router

```
! Configure ISAKMP policy (phase1 config, must match configuration
! of "/ip ipsec peer" on RouterOS). Note that DES is default
! encryption algorithm on Cisco. SHA1 is default authentication
! algorithm
crypto isakmp policy 9
  encryption des
  authentication pre-share
  group 2
  hash md5
  exit

! Add preshared key to be used when talking to RouterOS
crypto isakmp key gvejimezyfopmekun address 10.0.1.1 255.255.255.255
```

2. Set encryption proposal (phase2 proposal - settings that will be used to encrypt actual data) to use DES to encrypt data

- for **MikroTik** router

```
[admin@MikroTik] > ip ipsec proposal set default enc-algorithms=des
```

- for **CISCO** router

```
! Create IPsec transform set - transformations that should be applied to
! traffic - ESP encryption with DES and ESP authentication with SHA1
! This must match "/ip ipsec proposal"
crypto ipsec transform-set myset esp-des esp-sha-hmac
  mode tunnel
  exit
```

3. Add policy rule that matches traffic between subnets and requires encryption with ESP in tunnel mode

- for **MikroTik** router

```
[admin@MikroTik] > ip ipsec policy add \
\... src-address=10.0.0.0/24 dst-address=10.0.2.0/24 action=encrypt \
\... tunnel=yes sa-src=10.0.1.1 sa-dst=10.0.1.2
```

- for **CISCO** router

```
! Create access list that matches traffic that should be encrypted
access-list 101 permit ip 10.0.2.0 0.0.0.255 10.0.0.0 0.0.0.255
! Create crypto map that will use transform set "myset", use peer 10.0.1.1
! to establish SAs and encapsulate traffic and use access-list 101 to
! match traffic that should be encrypted
crypto map mymap 10 ipsec-isakmp
  set peer 10.0.1.1
  set transform-set myset
  set pfs group2
  match address 101
  exit
! And finally apply crypto map to serial interface:
interface Serial 0
  crypto map mymap
  exit
```

4. Testing the IPsec tunnel

- on **MikroTik** router we can see installed SAs

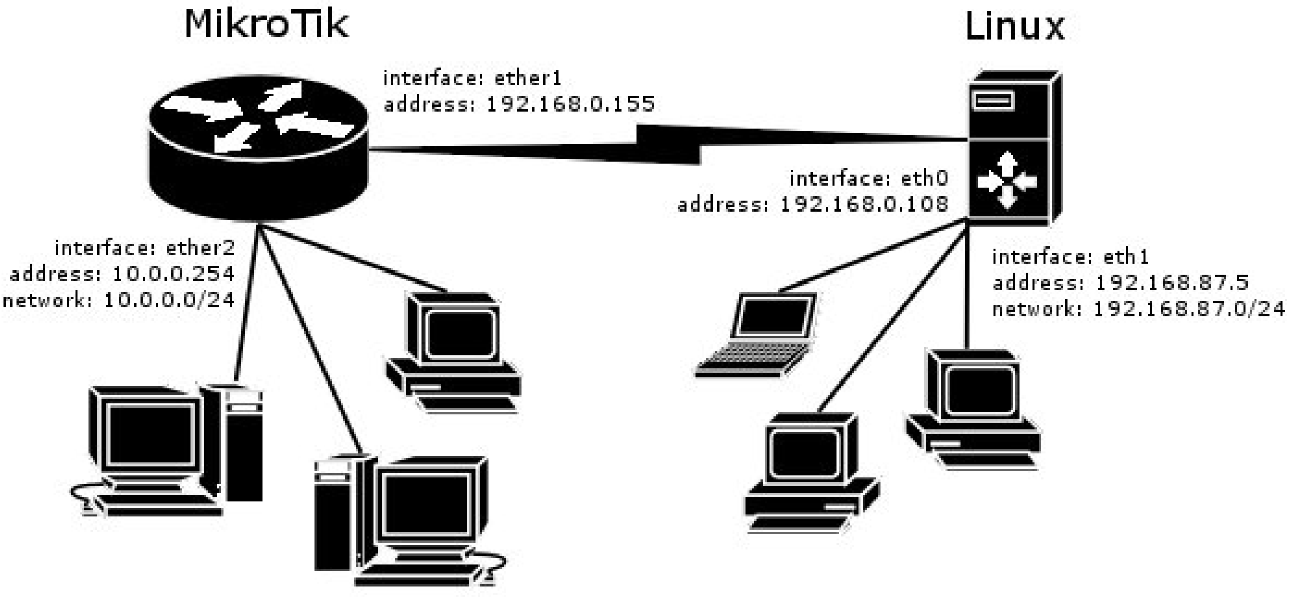
```
[admin@MikroTik] ip ipsec installed-sa> print
Flags: A - AH, E - ESP, P - pfs, M - manual
  0 E   spi=9437482 direction=out src-address=10.0.1.1
        dst-address=10.0.1.2 auth-algorithm=sha1 enc-algorithm=des
        replay=4 state=mature
        auth-key="9cf2123b8b5add950e3e67b9eac79421d406aa09"
        enc-key="ffe7ec65b7a385c3" add-lifetime=24m/30m use-lifetime=0s/0s
        lifebytes=0/0 current-addtime=jul/12/2002 16:13:21
        current-usetime=jul/12/2002 16:13:21 current-bytes=71896
  1 E   spi=319317260 direction=in src-address=10.0.1.2
        dst-address=10.0.1.1 auth-algorithm=sha1 enc-algorithm=des
        replay=4 state=mature
        auth-key="7575f5624914dd312839694db2622a318030bc3b"
        enc-key="633593f809c9d6af" add-lifetime=24m/30m use-lifetime=0s/0s
        lifebytes=0/0 current-addtime=jul/12/2002 16:13:21
        current-usetime=jul/12/2002 16:13:21 current-bytes=0
[admin@MikroTik] ip ipsec installed-sa>
```

- on **CISCO** router

```
cisco# show interface Serial 0
interface: Serial1
    Crypto map tag: mymap, local addr. 10.0.1.2
   local  ident (addr/mask/prot/port): (10.0.2.0/255.255.255.0/0/0)
   remote ident (addr/mask/prot/port): (10.0.0.0/255.255.255.0/0/0)
   current_peer: 10.0.1.1
     PERMIT, flags={origin_is_acl,}
    #pkts encaps: 1810, #pkts encrypt: 1810, #pkts digest 1810
    #pkts decaps: 1861, #pkts decrypt: 1861, #pkts verify 1861
    #pkts compressed: 0, #pkts decompressed: 0
    #pkts not compressed: 0, #pkts compr. failed: 0, #pkts decompress failed: 0
    #send errors 0, #recv errors 0
     local crypto endpt.: 10.0.1.2, remote crypto endpt.: 10.0.1.1
     path mtu 1500, media mtu 1500
     current outbound spi: 1308650C
     inbound esp sas:
      spi: 0x90012A(9437482)
        transform: esp-des esp-sha-hmac ,
        in use settings ={Tunnel, }
        slot: 0, conn id: 2000, flow_id: 1, crypto map: mymap
        sa timing: remaining key lifetime (k/sec): (4607891/1034)
        IV size: 8 bytes
        replay detection support: Y
     inbound ah sas:
     inbound pcp sas:
     outbound esp sas:
      spi: 0x1308650C(319317260)
        transform: esp-des esp-sha-hmac ,
        in use settings ={Tunnel, }
        slot: 0, conn id: 2001, flow_id: 2, crypto map: mymap
        sa timing: remaining key lifetime (k/sec): (4607893/1034)
        IV size: 8 bytes
        replay detection support: Y
     outbound ah sas:
     outbound pcp sas:
```

MikroTik Router and Linux FreeS/WAN

In the test scenario we have 2 private networks: 10.0.0.0/24 connected to the MT and 192.168.87.0/24 connected to Linux. MT and Linux are connected together over the "public" network 192.168.0.0/24:



- FreeS/WAN configuration:

```
config setup
    interfaces="ipsec0=eth0"
    klipsdebug=none
    plutodebug=all
    plutoload=%search
    plutostart=%search
    uniqueids=yes

conn %default
    keyingtries=0
    disablearrivalcheck=no
    authby=rsasig

conn mt
    left=192.168.0.108
    leftsubnet=192.168.87.0/24
    right=192.168.0.155
    rightsubnet=10.0.0.0/24
    authby=secret
    pfs=no
    auto=add
```

- **ipsec.secrets** config file:

```
192.168.0.108 192.168.0.155 : PSK "gvejimezyfopmekun"
```

- MikroTik Router configuration:

```
[admin@MikroTik] > /ip ipsec peer add address=192.168.0.108 \
\... secret="gvejimezyfopmekun" hash-algorithm=md5  enc-algorithm=3des \
\... dh-group=modp1024 lifetime=28800s

[admin@MikroTik] > /ip ipsec proposal auth-algorithms=md5 \
\... enc-algorithms=3des pfs-group=none

[admin@MikroTik] > /ip ipsec policy add sa-src-address=192.168.0.155 \
\... sa-dst-address=192.168.0.108 src-address=10.0.0.0/24 \
\... dst-address=192.168.87.0/24 tunnel=yes
```

Routes, Equal Cost Multipath Routing, Policy Routing

Document revision 1.6 (Mon Mar 22 09:10:18 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The following manual surveys the IP routes management, equal-cost multi-path (ECMP) routing technique, and policy-based routing, which gives the opportunity to select routes in order to restrict the use of network resources to certain classes of customers.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip route, /ip policy-routing***
Standards and Technologies: ***IP (RFC 791)***
Hardware usage: ***Not significant***

Related Documents

- *Package Management*
- *IP Addresses and ARP*
- *Firewall Filters*
- *Network Address Translation*

Description

MikroTik RouterOS has following types of routes:

- **Connected Routes** are created automatically when adding address to an interface. These routes specify networks, which can be accessed directly through the interface.
- **Static routes** are user-defined routes that specify the router that can forward traffic to the specified network. They are useful for specifying the default gateway.

You do not need to add routes to networks directly connected to the router, since they are added automatically when adding the IP addresses. However, unless you use some routing protocol (RIP or OSPF), you may want to specify static routes to specific networks, or the default route.

More than one gateway for one destination network may be used. This approach is called 'Equal-Cost Multi-Path Routing' and is used for load balancing (**Note** that this does not provide failover). With ECMP, a router potentially has several available next hops towards any given destination. A new gateway is chosen for each new source/destination IP pair. This means that, for example, one FTP connection will use only one link, but new connection to a different server will use other link. This also means that routes to often-used sites will always be over the same provider. But on big backbones this should distribute traffic fine. Also this has another good feature - single connection packets do not get reordered and therefore do not kill TCP performance.

Equal cost multipath routes can be created by routing protocols (RIP or OSPF), or adding a static route with multiple gateways (in the form **gateway=x.x.x.x,y.y.y.y**) The routing protocols may create routes with equal cost automatically, if the cost of the interfaces is adjusted properly. For more information on using the routing protocols, please read the corresponding section of the Manual.

Note! In routing process, the router decides which route it will use to send out the packet. Afterwards, when the packet is masqueraded, its source address is taken from the **preferred-source** field.

Additional Documents

- *RFC 2328*
- *RFC 2992*
- *RFC 1102*

Static Routes

Home menu level: ***/ip route***

Property Description

dst-address (*IP address/mask*; default: **0.0.0.0/0**) - destination address and network mask, where netmask is number of bits which indicate network number

netmask (*IP address*) - network mask

gateway (*IP address*) - gateway host, that can be reached directly through some of the interfaces. You can specify multiple gateways separated by comma "," for ECMP routes. See more information on that below

preferred-source (*IP address*; default: **0.0.0.0**) - source address of packets, leaving the router via this route. Must be a valid address of the router, which is assigned to the router's interface, through which the packet leaves

- **0.0.0.0** - determined at the time of sending the packet out through the interface

distance (*integer*; default: **1**) - administrative distance of the route. When forwarding a packet, the router will use the route with the lowest administrative distance and reachable gateway

gateway-state (*read-only: r | u*) - shows the status of the next hop. Can be r (reachable) or u (unreachable)

- **(unknown)** - the gateway cannot be reached directly, or the route has been disabled

Notes

You can specify more than one or two gateways in the route. This is called Equal-cost multipath routing. Moreover, you can repeat some routes in the list several times to do a kind of cost setting for gateways.

Note also that if there are more than one public interface and more than one address on any of these interfaces, then policy-routing and equal-cost multipath routing may not work correctly if masquerading is used. To avoid this problem, use action=nat instead of action=masquerade.

Example

To add two static routes to networks 192.168.0.0/16 and 0.0.0.0/0 (the default destination address) on a router with two interfaces and two IP addresses:

```
[admin@MikroTik] ip route> add dst-address=192.168.0.0/16 gateway=10.10.10.2
[admin@MikroTik] ip route> add gateway 10.10.10.1
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0   S 192.168.0.0/16     r 10.10.10.2      1        Local
    1   S 0.0.0.0/0          r 10.10.10.1      1        Public
    2 DC 10.10.10.0/24      r 0.0.0.0         0        Public

[admin@MikroTik] ip route> print detail
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
    0   S dst-address=192.168.0.0/16 preferred-source=0.0.0.0
         gateway=10.10.10.2 gateway-state=reachable distance=1
         interface=Local

    1   S dst-address=0.0.0.0/0 preferred-source=0.0.0.0 gateway=10.10.10.1
         gateway-state=reachable distance=1 interface=Public

    2 DC dst-address=10.10.10.0/24 preferred-source=10.10.10.1
         gateway=0.0.0.0 gateway-state=reachable distance=0 interface=Public
[admin@MikroTik] ip route>
```

To set the **192.168.0.0/16** network is reachable via both **10.10.10.2** and **10.10.10.254** gateways:

```
[admin@MikroTik] ip route> set 0 gateway=10.10.10.2,10.10.10.254
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
    #    DST-ADDRESS        G GATEWAY          DISTANCE INTERFACE
    0  S 192.168.0.0/16     r 10.10.10.2       1        Local
                            r 10.10.10.254              Local
    1  S 0.0.0.0/0          r 10.10.10.1       1        Public
    2 DC 10.10.10.0/24      r 0.0.0.0          0        Public
[admin@MikroTik] ip route>
```

Routing Tables

Home menu level: ***/ip policy-routing***

Description

Policy routing allows to select routes in order to variate the use of network resources to certain classes of users (in other words, you can set different routes to the same networks depending on some classifiers). This is implemented using multiple routing tables and a list of rules specifying how these tables should be used.

The Policy Routing is implemented in the MikroTik RouterOS based on source and destination addresses of a packet, the interface the packet arrives to the router and the firewall mark that may be associated with some packets.

When finding the route for a packet, the packet is matched against policy routing rules one after another, until some rule matches the packet. Then action specified in that rule is executed. If no rule matches the packet, it is assumed that there is no route to given host and appropriate action is taken (packet dropped and ICMP error sent back to the source).

If a routing table does not have a route for the packet, next rule after the one that directed to the current table is examined, until the route is found, end of rule list is reached or some rule with action drop or unreachable is hit. Thus it is good to have last rule say "from everywhere to everywhere, all interfaces, lookup main route table", because then gateways can be found (connected routes are entered in the main table only).

Note that the only way for packet to be forwarded is to have some rule direct to some routing table that contains route to packet destination.

Note also that if there are more than one public interface and more than one address on any of these interfaces, then policy-routing and equal-cost multipath routing may not work correctly if masquerading is used. To avoid this problem, use action=nat instead of action=masquerade.

Routing Tables

Routing tables is a way to organize routing rules into groups for a purpose of easy management. These tables can be created/deleted in the **/ip policy-routing** menu.

The routes in the routing tables are managed the same way as the static routes described above, but in the submenu **/ip policy-routing table name** submenu, where **name** is the name of the table.

Property Description

name (*name*) - table name

Example

There is always a table called **main**, this table cannot be deleted and its name cannot be changed. The **main** table can be managed in the **/ip route** submenu as well:

```
[admin@MikroTik] ip policy-routing> table main
[admin@MikroTik] ip policy-routing table main> print
Flags: X - disabled, I - invalid, D - dynamic, R - rejected
  #    TYPE    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
  0    static  192.168.1.0/24     r 192.168.0.50    1        Local
  1    static  0.0.0.0/0          r 10.0.0.1        1        Public
  2 D  connect 192.168.0.0/24     r 0.0.0.0         0        Local
  3 D  connect 10.0.0.0/24        r 0.0.0.0         0        Public
[admin@MikroTik] ip policy-routing table main>
[admin@MikroTik] ip policy-routing table main> /ip route print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #   DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 192.168.1.0/24     r 192.168.0.50    1        Local
    1  S 0.0.0.0/0          r 10.0.0.1        1        Public
    2 DC 192.168.0.0/24     r 0.0.0.0         0        Local
    3 DC 10.0.0.0/24        r 0.0.0.0         0        Public
[admin@MikroTik] ip policy-routing table main>
```

To add a new table named **mt**:

```
[admin@MikroTik] ip policy-routing> add name=mt
[admin@MikroTik] ip policy-routing> print
Flags: D - dynamic
 #   NAME
 0   mt
 1 D main
[admin@MikroTik] ip policy-routing>
```

To add the route to the **10.5.5.0/24** network via **10.0.0.22** gateway to the **mt** table:

```
[admin@MikroTik] ip policy-routing> table mt
[admin@MikroTik] ip policy-routing table mt> add dst-address=10.5.5.0/24 \
\... gateway=10.0.0.22
[admin@MikroTik] ip policy-routing table mt> print
Flags: X - disabled, I - invalid, D - dynamic, R - rejected
  #    TYPE    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
  0    static  10.5.5.0/24        r 10.0.0.22       1        Public
[admin@MikroTik] ip policy-routing table mt>
```

Policy Rules

Home menu level: ***/ip policy-routing rule***

Property Description

src-address (*IP address/mask*) - source IP address/mask

dst-address (*IP address/mask*) - destination IP address/mask

interface (*name* | *all*; default: **all**) - interface name through which the packet arrives. Should be 'all' for the rule that should match locally generated or masqueraded packets, since at the moment of processing the routing table these packets have interface name set to loopback

flow (*name*; default: **""**) - flow mask of the packet to be mached by this rule. To add a flow, use '/ip firewall mangle' commands

action (*drop* | *unreachable* | *lookup*; default: **unreachable**) - action to be processed on packets matched by this rule:

- **drop** - silently drop packet
- **unreachable** - reply that destination host is unreachable
- **lookup** - lookup route in given routing table

Notes

You can use policy routing even if you use masquerading on your private networks. The source address will be the same as it is in the local network. In previous versions of RouterOS the source address changed to **0.0.0.0**

Example

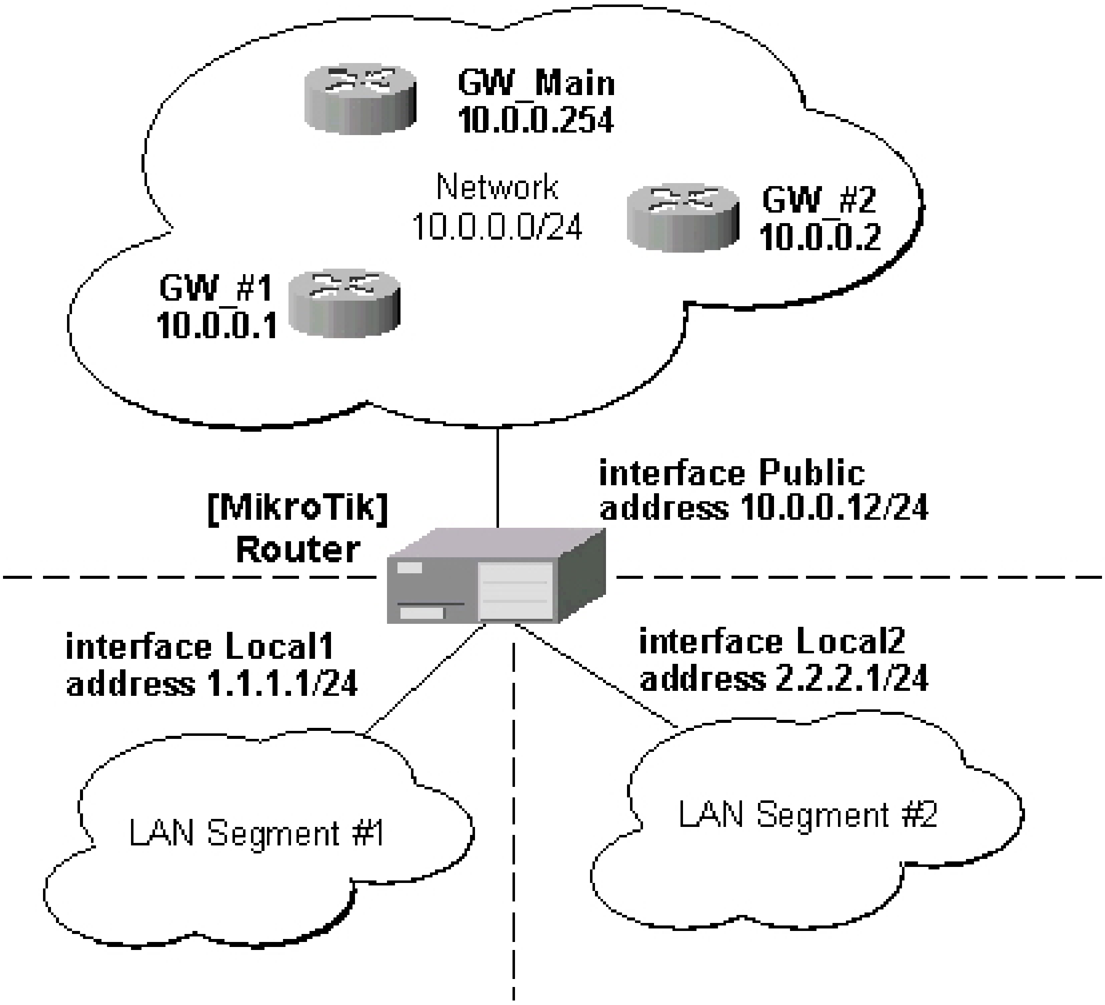
To add the rule specifying that all the packets from the 10.0.0.144 host should lookup the **mt** routing table:

```
[admin@MikroTik] ip policy-routing rule> add src-address=10.0.0.144/32 \
\... table=mt action=lookup
[admin@MikroTik] ip policy-routing rule> print
Flags: X - disabled, I - invalid
  #   SRC-ADDRESS        DST-ADDRESS        INTE... FLOW    ACTION      TABLE
  0   0.0.0.0/0          0.0.0.0/0          all             lookup      main
  1   10.0.0.144/32      0.0.0.0/0          all             lookup      mt
[admin@MikroTik] ip policy-routing rule>
```

Application Examples

Standard Policy-Routing Setup

Suppose we want packets coming from 1.1.1.0/24 to use gateway 10.0.0.1 and packets from 2.2.2.0/24 to use gateway 10.0.0.2. And the rest of packets will use gateway 10.0.0.254:



Command sequence to achieve this:

1. Add 3 new routing tables. One for local network **1.1.1.0/24**, one for network **2.2.2.0/24** and the rest for all other networks (**0.0.0.0/0**):

```
[admin@MikroTik] ip policy-routing> add name=from_net1; add name=from_net2; add
name=rest
[admin@MikroTik] ip policy-routing> print
Flags: D - dynamic
  #   NAME
  0   from_net1
  1   from_net2
  2   rest
  2 D main
[admin@MikroTik] ip policy-routing>
```

2. Create the default route in each of the tables:

```
[admin@MikroTik] ip policy-routing> table from_net1 add gateway=10.0.0.1
[admin@MikroTik] ip policy-routing> table from_net2 add gateway=10.0.0.2
[admin@MikroTik] ip policy-routing> table rest add gateway=10.0.0.254
[admin@MikroTik] ip policy-routing> table from_net1 print
Flags: X - disabled, I - invalid, D - dynamic, R - rejected
 #    TYPE    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
 0    static  0.0.0.0/0          u 10.0.0.1        1        Public
[admin@MikroTik] ip policy-routing>
[admin@MikroTik] ip policy-routing> table from_net2 print
Flags: X - disabled, I - invalid, D - dynamic, R - rejected
```

```
 #    TYPE    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
 0    static  0.0.0.0/0          u 10.0.0.2        1        Public
[admin@MikroTik] ip policy-routing>
[admin@MikroTik] ip policy-routing> table rest print
Flags: X - disabled, I - invalid, D - dynamic, R - rejected
 #    TYPE    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
 0    static  0.0.0.0/0          u 10.0.0.254      1        Public
[admin@MikroTik] ip policy-routing>
```

3. Create rules that will direct traffic from sources to given tables, and arrange them in the desired order:

```
[admin@MikroTik] ip policy-routing> rule
[admin@MikroTik] ip policy-routing rule> print
Flags: X - disabled, I - invalid
  #   SRC-ADDRESS        DST-ADDRESS        INT... FLOW       ACTION
  0   0.0.0.0/0          0.0.0.0/0          all               lookup
[admin@MikroTik] ip policy-routing rule> add src-address=1.1.1.0/24 \
\... action=lookup table=from_net1
[admin@MikroTik] ip policy-routing rule> add src-address=2.2.2.0/24 \
\... action=lookup table=from_net2
[admin@MikroTik] ip policy-routing rule> add src-address=0.0.0.0/0 \
\... action=lookup table=rest
[admin@MikroTik] ip policy-routing rule> print
Flags: X - disabled, I - invalid
 #   SRC-ADDRESS        DST-ADDRESS        INTERFACE    FLOW         ACTION
 0   0.0.0.0/0          0.0.0.0/0          all                      lookup
 1   1.1.1.0/24         0.0.0.0/0          all                      lookup
 2   2.2.2.0/24         0.0.0.0/0          all                      lookup
 3   0.0.0.0/0          0.0.0.0/0          all                      lookup
[admin@MikroTik] ip policy-routing rule>
```

Here the rule #0 is needed to reach directly connected networks. Note that there (in table main) is only directly connected routes! The rules #1 and #2 process local networks **1.1.1.0/24**, which is routed through the gateway **10.0.0.1**, and **2.2.2.0/24**, which is routed through the gateway **10.0.0.2**. Rule #3 handles packets originated from other networks (**0.0.0.0/0**).

Connection Tracking and Service Ports

Document revision 1.0 (Fri Mar 05 08:34:03 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

Connection tracking or conntrack provides a facility for monitoring connections made through the router and respective state information.In turn, service port submenu allows to configure conntrack 'helpers' for various protocols. They are used to provide correct NAT traversal for these protocols.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip firewall connection, /ip firewall service-port***
Standards and Technologies: ***IP***
Hardware usage: *Increases with connections count*

Related Documents

- ***IP Addresses and ARP***
- ***Routes, Equal Cost Multipath Routing, Policy Routing***
- ***Network Address Translation***

Notes

Connection tracking must be enabled in order to use NAT.

Connection Tracking

Home menu level: ***/ip firewall connection***

Description

Using Connection Tracking, you can observe connections passing through the router.

Connection Timeouts

Here comes a list of connection timeouts:

- **TCP SYN sent** - (first stage in establishing a connection) = 2min
- **TCP SYN recvd** - (second stage in establishing a connection) = 60sec
- **Established TCP connections** - (third stage) = 5 days
- **TCP FIN wait** - (connection termination) = 2min
- **TCP TIME wait** - (connection termination) = 2min
- **TCP CLOSE** - (remote party sends RTS) = 10sec
- **TCP CLOSE wait** - (sent RTS) = 60sec
- **TCP LAST ACK** - (received ACK) = 30sec
- **TCP Listen** - (ftp server waiting for client to establish data connection) = 2min
- **UDP timeout** - 30sec
- **UDP with reply timeout** - (remote party has responded) = 180sec
- **ICMP timeout** - 30sec
- **All other** - 10min

Property Description

dst-address (*read-only: IP address:port*) - the destination address and port the connection is established to

src-address (*read-only: IP address:port*) - the source address and port the connection is established from

protocol (*read-only: text*) - IP protocol name or number

tcp-state (*read-only: text*) - the state of TCP connection

timeout (*read-only: time*) - the amount of time until the connection will be timed out

reply-src-address (*read-only: IP address:port*) - the source address and port the reply connection is established from

reply-dst-address (*read-only: IP address:port*) - the destination address and port the reply connection is established to

assured (*read-only: true | false*) - shows whether the connection is assured

icmp-id (*read-only: integer*) - contains the ICMP ID. Each ICMP packet gets an ID set to it when it is sent, and when the receiver gets the ICMP message, it sets the same ID within the new ICMP message so that the sender will recognize the reply and will be able to connect it with the appropriate ICMP request

icmp-option (*read-only: integer*) - the ICMP type and code fields

reply-icmp-id (*read-only: integer*) - contains the ICMP ID of received packet

reply-icmp-option (*read-only: integer*) - the ICMP type and code fields of received packet

unreplied (*read-only: true | false*) - shows whether the request was unreplied

Example

```
[admin@test_1] ip firewall connection> print
Flags: U - unreplied, A - assured
  #    SRC-ADDRESS           DST-ADDRESS           PR.. TCP-STATE   TIMEOUT
  0 U  0.0.0.0:5678          255.255.255.255:5678  udp              1s
  1 U  1.1.1.1:49679         255.255.255.255:69    udp              11s
  2 U  1.1.1.1:56635         255.255.255.255:69    udp              27s
  3  A 10.1.0.128:2413       10.10.1.1:23          tcp  established 4d22h24m14s
  4 U  10.1.0.157:5678       255.255.255.255:5678  udp              0s
  5 U  10.1.0.172:5678       255.255.255.255:5678  udp              24s
  6 U  10.1.0.175:5678       255.255.255.255:5678  udp              25s
  7 U  10.1.0.209:5678       255.255.255.255:5678  udp              25s
  8 U  10.1.0.212:5678       255.255.255.255:5678  udp              22s
  9  A 10.5.7.242:32846      10.10.1.1:23          tcp  established 4d23h59m59s
 10  A 10.5.7.242:32933      10.10.1.1:23          tcp  established 4d23h59m59s
 11 U  10.10.1.11:5678       255.255.255.255:5678  udp              12s
 12 U  10.10.10.1:5678       255.255.255.255:5678  udp              24s

[admin@test_1] ip firewall connection>
```

Service Ports

Home menu level: ***/ip firewall service-port***

Description

Some network protocols require direct two-sided connection between endpoints. This is not always possible, as network address translation is widely used to connect clients to the network. This submenu allows to configure Connection Tracking 'helpers' for above mentioned protocols. These 'helpers' are used to provide correct NAT traversal.

Property Description

name - protocol name

ports (*read-only: integer*) - port range that is used by the protocol

Example

Suppose we want to disable **h323**service port:

```
[admin@test_1] ip firewall service-port> set h323 disabled=yes
[admin@test_1] ip firewall service-port> print
Flags: X - disabled
  #   NAME                                                           PORTS
  0   ftp                                                            21
  1   pptp
  2   gre
  3 X h323
  4   mms
  5   irc                                                            6667
  6   quake3
[admin@test_1] ip firewall service-port>
```

Packet Marking (Mangle)

Document revision 2.5 (Mon May 17 12:52:24 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Mangle is a kind of 'marker' to mark packets for future processing. Many other facilities in RouterOS make use of these marks, e.g. queue trees and NAT. In general mangle marks exist only within the router, they are not transmitted across the network.

Two special cases when mangle alters actual packets are MSS and TOS fields of an IP packet changing.

Quick Setup Guide

Let us consider that we want to mangle all packets which are leaving the network 192.168.0.0/24 and are destined to a HTTP web-server (protocol TCP, port 80), with a flow, labeled **http-traffic**:

```
[admin@MikroTik] ip firewall mangle> src-address=192.168.0.0/24 \
\... dst-port=80 mark-flow=http-traffic
```

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip firefall mangle***
Standards and Technologies: ***IP***
Hardware usage: *Increases with rules and connections count*

Related Documents

- ***Package Management***

- *IP Addresses and ARP*
- *Routes, Equal Cost Multipath Routing, Policy Routing*
- *Firewall Filters*
- *Network Address Translation*

Mangle

Description

Packets entering the router can be marked for further processing them against the rules of firewall chains, source or destination NAT rules, as well as for applying queuing to them.

It is also possible to mark the packets associated (including related) with the same connection as the marked packet (in other words, to mark a connection with all related connections, you need to mark only one packet belonging to that connection).

You may also want to change the TCP Maximum Segment Size (MSS), to a value which is your desired MTU value less 40. The MSS can be set only for TCP SYN packets.

Type of Service

Internet paths vary in quality of service they provide. They can differ in cost, reliability, delay and throughput. This situation imposes some tradeoffs, *exempli gratia* the path with the lowest delay may be among the slowest. Therefore, the "optimal" path for a packet to follow through the Internet may depend on the needs of the application and its user.

Because the network itself has no knowledge on how to optimize path choosing for a particular application or user, the IP protocol provides a facility for upper layer protocols to convey hints to the Internet Layer about how the tradeoffs should be made for the particular packet. This facility is called the "Type of Service" facility.

The fundamental rule is that if a host makes appropriate use of the TOS facility, its network service should be at least as good as it would have been if the host had not used this facility.

The TOS can be one of five types, each of them is an instruction to:

- **low-cost** - minimize monetary cost
- **low-delay** - minimize delay
- **normal** - normal service
- **max-reliability** - maximize reliability
- **max-throughput** - maximize throughput

Property Description

action (*accept* | *passthrough*; default: **accept**) - action to undertake if the packet matches the rule, one of the:

- **accept** - accept the packet applying the appropriate attributes (marks, MSS), and no more rules are processed in the list

- **passthrough** - apply the appropriate attributes (marks, MSS), and go on to the next rule

disabled (yes | no; default: **no**) - specifies, whether the rule is disabled or not

in-interface (*name*; default: **all**) - interface the packet has entered the router through. If the default value all is used, it may include the local loopback interface for packets originated from the router

src-address (*IP address*; default: **0.0.0.0/0:0-65535**) - source IP address

src-netmask (*IP address*; default: **accept**) - source netmask in decimal form x.x.x.x

src-port (*integer*: 0..65535; default: **0-65535**) - source port number or range

- **0** - all ports from 01 to 65535

comment (*text*; default: **""**) - a descriptive comment for the rule

dst-address (*IP address*; default: **0.0.0.0/0:0-65535**) - destination IP address

dst-netmask (*IP address*; default: **accept**) - destination netmask in decimal form x.x.x.x

dst-port (*integer*: 0..65535; default: **0-65535**) - destination port number or range

- **0** - all ports from 1 to 65535

icmp-options (*integer*; default: **any:any**) - matches ICMP Type:Code fields

tcp-options (*any* | *syn-only* | *non-syn-only*; default: **any**) - TCP options

protocol (*ah* | *egp* | *ggp* | *icmp* | *ipencap* | *ospf* | *rspf* | *udp* | *xtp* | *all* | *encap* | *gre* | *idpr-cmtp* | *ipip* | *pup* | *st* | *vmtp* | *ddp* | *esp* | *hmp* | *igmp* | *iso-tp4* | *rdp* | *tcp* | *xns-idp*; default: **all**) - protocol setting

- **all** - cannot be used, if you want to specify ports

content (*text*; default: **""**) - the text packets should contain in order to match the rule

flow (*text*) - flow mark to match. Only packets marked in the MANGLE would be matched

p2p (*any* | *all-p2p* | *bit-torrent* | *direct-connect* | *fasttrack* | *soulseek* | *blubster* | *edonkey* | *gnutella* | *warez*; default: **any**) - match Peer-to-Peer (P2P) connections:

- **all-p2p** - match all known P2P traffic
- **any** - match any packet (i.e., do not check this property)

connection (*text*; default: **""**) - connection mark to match. Only connections (including related) marked in the MANGLE would be matched

limit-burst (*integer*; default: **0**) - allowed burst regarding the limit-count/limit-time

limit-time (*time*; default: **0**) - time interval, used in limit-count

- **0** - forever

limit-count (*integer*; default: **0**) - how many times to use the rule during the limit-time period

src-mac-address (*MAC address*; default: **00:00:00:00:00:00**) - host's MAC address the packet has been received from

log (yes | no; default: **no**) - specifies to log the action or not

mark-flow (*text*; default: **""**) - change flow mark of the packet to this value

mark-connection (*text*; default: **""**) - change connection mark of the packet to this value

tcp-mss (*integer* | *dont-change*; default: **dont-change**) - change MSS of the packet

- **dont-change** - leave MSS of the packet as is

tos (*any* | *max-reliability* | *max-throughput* | *min-cost* | *min-delay* | *normal* | *integer*; default: **any**) - specifies a match for Type-of-Service field of an IP packet

- **any** - matches any ToS value

set-tos (*max-reliability* | *max-throughput* | *min-cost* | *min-delay* | *normal* | *dont-change*; default: **dont-change**) - changes the value of Type-of-Service field of an IP packet

- **dont-change** - do not change the value of Type-of-Service field
- **normal (ToS=0)** - router will treat datagram as normal traffic
- **min-cost (ToS=2)** - router will try to pass datagrams using routes with the lowest cost possible
- **max-reliability (ToS=4)** - router will try to pass datagrams using routes which have propognated themselves as reliable regarding the loss of the datagrams. Useful for important traffic such as routing information
- **max-throughput (ToS=8)** - router will try to choose routes with the highest bandwidth available. Useful for applications that use much traffic, such as FTP (when sending data)
- **min-delay (ToS=16)** - router will try to pass the datagrams with lowest delay possible. Useful for interactive applications, for example, telnet

Example

Specify the value for the **mark-flow** argument and use **action=passthrough**, for example:

```
[admin@test_1] ip firewall mangle> add action=passthrough mark-flow=myflow
[admin@test_1] ip firewall mangle> print
Flags: X - disabled, I - invalid, D - dynamic
  0   src-address=0.0.0.0/0:0-65535 in-interface=all
      dst-address=0.0.0.0/0:0-65535 protocol=all tcp-options=any
      icmp-options=any:any flow="" connection="" content=""
      src-mac-address=00:00:00:00:00:00 limit-count=0 limit-burst=0
      limit-time=0s action=passthrough mark-flow=myflow tcp-mss=dont-change
      mark-connection=""

[admin@test_1] ip firewall mangle>
```

In order to change the MSS, adjust the **tcp-mss** argument. For example, if you have encrypted PPPoE link with MTU = 1492, you can set the mangle rule as follows:

```
[admin@test_1] ip firewall mangle> add protocol=tcp\
\.. tcp-options=syn-only action=passthrough tcp-mss=1448
[admin@test_1] ip firewall mangle> print
Flags: X - disabled, I - invalid, D - dynamic
  0   src-address=0.0.0.0/0:0-65535 in-interface=all
      dst-address=0.0.0.0/0:0-65535 protocol=all tcp-options=any
      icmp-options=any:any flow="" connection="" content=""
      src-mac-address=00:00:00:00:00:00 limit-count=0 limit-burst=0
      limit-time=0s action=passthrough mark-flow=myflow tcp-mss=dont-change
      mark-connection=""

  1   src-address=0.0.0.0/0:0-65535 in-interface=all
      dst-address=0.0.0.0/0:0-65535 protocol=tcp tcp-options=syn-only
      icmp-options=any:any flow="" connection="" content=""
      src-mac-address=00:00:00:00:00:00 limit-count=0 limit-burst=0
      limit-time=0s action=passthrough mark-flow="" tcp-mss=1448
      mark-connection=""

[admin@test_1] ip firewall mangle>
```

General Information

How to Mangle NATted Traffic

Suppose you need to limit both download and upload peer-to-peer data rate for NATted local users. It can be achieved using queue trees and mangle facility.

To mangle traffic from NATted users, do the following:

```
/ip firewall mangle add src-address=192.168.0.0/24 action=passthrough
mark-connection=nat_conn
/ip firewall mangle add connection=nat_conn mark-flow=my_clients
```

Now you can add queues to **/queue tree** submenu matching **my_clients** flowmark.

MNDP

Document revision 0.3.0 (Fri Mar 05 08:36:57 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik Neighbor Discovery Protocol (MNDP) eases network configuration and management by enabling each MikroTik router to discover other connected MikroTik routers and learn information about the system along with features which are enabled. The MikroTik routers can then automatically use learned information to set up some features with minimal or no configuration.

MNDP features:

- works on IP level connections
- works on all non-dynamic interfaces
- distributes basic information on the software version
- distributes information on configured features that should interoperate with other MikroTik routers

MikroTik RouterOS is able to discover both MNDP and CDP (Cisco Discovery Protocol) devices.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip neighbor***
Standards and Technologies: ***MNDP***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***M3P***

Description

MNDP basic function is to assist with automatic configuration of features that are only available between MikroTik routers. Currently this is used for the 'Packet Packer' feature. The 'Packet Packer' may be enabled on a per interface basis. The MNDP protocol will then keep information about what routers have enabled the 'unpack' feature and the 'Packet Packer' will be used for traffic between these routers.

Specific features

- works on interfaces that support IP protocol and have at least one IP address and on all ethernet-like interfaces even without IP addresses
- is enabled by default for all new Ethernet-like interfaces -- Ethernet, wireless, EoIP, IPIP tunnels, PPTP-static-server
- when older version on the RouterOS are upgraded from a version without discovery to a version with discovery, current Ethernet like interfaces will not be automatically enabled for MNDP
- uses UDP protocol port 5678
- an UDP packet with router info is broadcasted over the interface every 60 seconds
- every 30 seconds, the router checks if some of the neighbor entries are not stale
- if no info is received from a neighbor for more than 180 seconds the neighbor information is discarded

Setup

Home menu level: ***/ip neighbor discovery***

Property Description

name (*read-only: name*) - interface name for reference

discover (yes | no; default: **yes**) - specifies whether the neighbour discovery is enabled or not

Example

To disable MNDP protocol on Public interface:

```
[admin@MikroTik] ip neighbor discovery> set Public discover=no
[admin@MikroTik] ip neighbor discovery> print
  # NAME      DISCOVER
  0 Public    no
  1 Local     yes
```

Neighbour List

Home menu level: ***/ip neigbor***

Description

This submenu allows you to see the list of neighbours discovered

Property Description

interface (*read-only: name*) - local interface name the neighbour is connected to

address (*read-only: IP address*) - IP address of the neighbour router

mac-address (*read-only: MAC address*) - MAC address of the neighbour router

identity (*read-only: text*) - identity of the neighbour router

version (*read-only: text*) - operating system or firmware version of the neighbour router

unpack (*read-only: none | simple | compress-headers | compress-all*) - identifies if the interface of the neighbour router is unpacking packets packed with M3P

platform (*read-only: text*) - hardware/software platworm type of neighbour router

age (*read-only: time*) - specifies the record's age in seconds (time from last update)

Example

To view the table of discovered neighbours:

```
[admin@MikroTik] ip neighbor> pri
 # INTERFACE ADDRESS         MAC-ADDRESS       IDENTITY   VERSION
 0 ether2    10.1.0.113      00:0C:42:00:02:06 ID         2.8
 1 ether2    1.1.1.3         00:0C:42:03:02:ED MikroTik   2.8
[admin@MikroTik] ip neighbor>
```

Firewall Filters

Document revision 1.10 (Sun Dec 05 12:41:37 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

The firewall implements packet filtering and thereby provides security functions that are used to manage data flow to, from and through the router. Along with the Network Address Translation it serve as a tool for preventing unauthorized access to directly attached networks and the router itself as well as a filter for outgoing traffic.

Quick Setup Guide

- To add a firewall rule which drops all TCP packets that are destined to port 135 and going through the router, use the following command:

```
/ip firewall rule forward add dst-port=135 protocol=tcp action=drop
```

- To deny acces to router via Telnet (protocol TCP, port 23), type the following command:

```
/ip firewall rule input add protocol=tcp dst-port=23 action=drop
```

Specifications

Packages required: ***system***
License required: ***level1 (P2P filters limited to 1), level3***
Home menu level: ***/ip firewall***
Standards and Technologies: ***IP***
Hardware usage: *Increases with filtering rules count*

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***Routes, Equal Cost Multipath Routing, Policy Routing***
- ***Network Address Translation***
- ***Packet Marking (Mangle)***

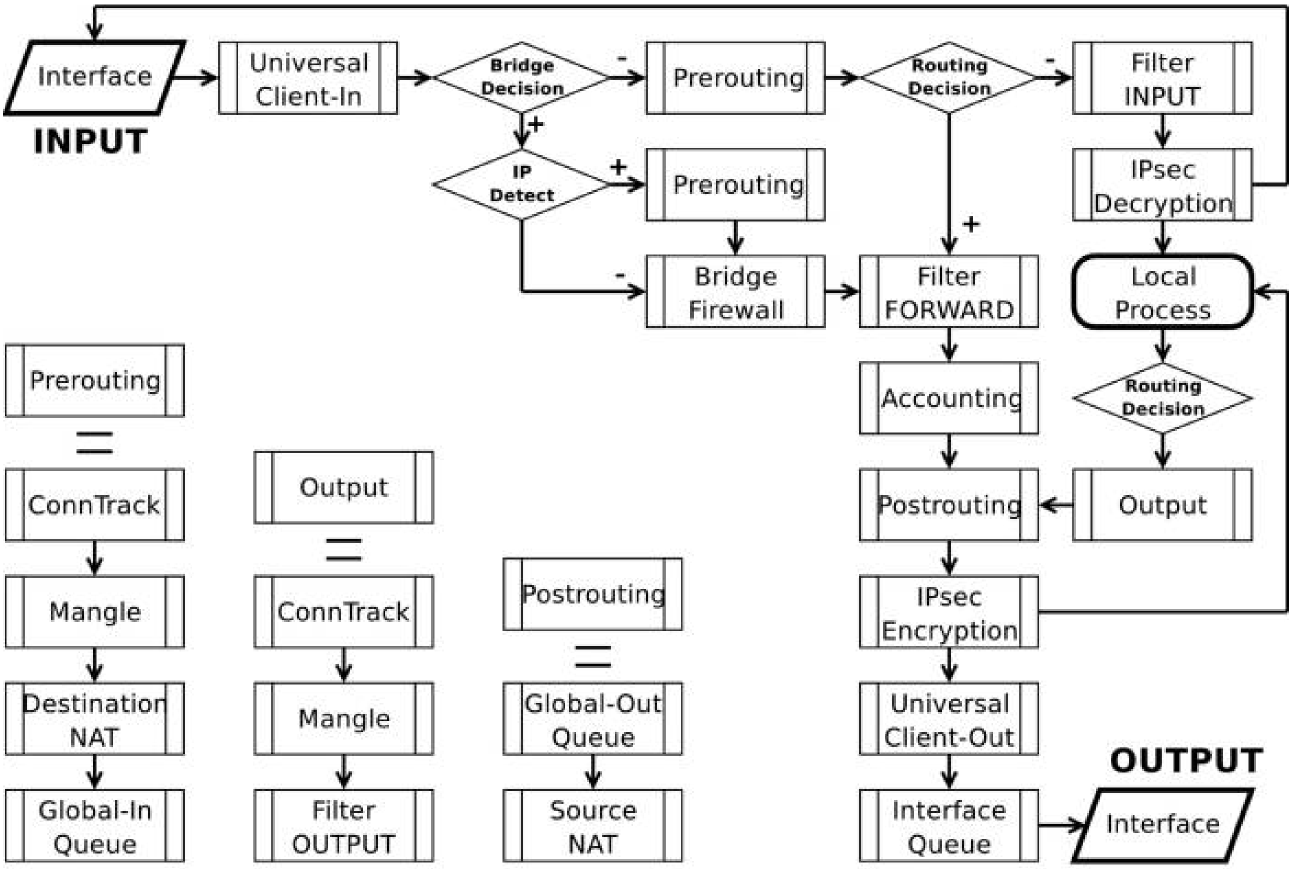
Description

Network firewalls keep outside threats away from sensitive data available inside the network. Whenever different networks are joined together, there is always a threat that someone from outside of your network will break into your LAN. Such break-ins may result in private data being stolen and distributed, valuable data being altered or destroyed, or entire hard drives being erased. Firewalls are used as a means of preventing or minimizing the security risks inherent in connecting to other networks. MikroTik RouterOS implements wide firewalling features as well as masquerading capabilities, which allows you to hide your network infrastructure from the outside world.

Packet Flow

Description

MikroTik RouterOS simplifies the creation and deployment of sophisticated firewall policies. In fact, you can easily create a simple one to filter your traffic or enable source NAT without need to know how packets are processed in the router. But in case you want to deploy more complicated policies, it is worth to know the underlying process details. IP packet flow through the router is depicted in the following diagram:



As we can see, a packet can enter the conveyer in two ways: whether the packet has come from an interface or whether it has been originated by the router. Analogically, a packet has two ways to leave the conveyer: through an outgoing interface or, in case the packet is locally destined, in the local process.

When the packet arrives to the router's interface, firewall rules are applied in the following order:

- The NAT rules are applied first. The firewall rules of the input chain and routing are applied after the packet has passed the NAT rule set.
- If the packet should be forwarded through the router, the firewall rules of the forward chain are applied next.
- When a packet leaves an interface, firewall rules of the output chain are applied first, then the NAT rules and queuing.

Additional arrows from IPsec boxes shows the processing of encrypted packets (they need to be encrypted / decrypted first and then processed as usual, *id est* from the point an ordinal packet enters the router).

If the packet is bridged one, the 'Routing Decision' changes to 'Bridge Forwarding Decision'. In case the bridge is forwarding non-IP packets, all things regarding IP protocol are not applicable ('Universal Client', 'Conntrack', 'Mangle', *et cetera*).

Firewall Rules

Home menu level: ***/ip firewall rule <chain name>***

Description

A rule is an expression in a definite form that tells the router what to do with a particular packet. The rule consists of two logical parts: the matcher set and the action set. For each packet you need to define a rule with appropriate match and action.

Management of the firewall rules can be accessed by selecting the desired chain. If you use the WinBox console, select the desired chain and then press the List button on the toolbar to open the window with the rules.

Peer-to-Peer Traffic Filtering

MikroTik RouterOS provides a way to filter traffic from most popular peer-to-peer programs that uses different P2P protocols.

ICMP TYPE:CODE values

In order to protect your router and attached private networks, you need to configure firewall to drop or reject most of ICMP traffic. However, some ICMP packets are vital to maintain network reliability or provide troubleshooting services.

The following is a list of ICMP TYPE:CODE values found in good packets. It is generally suggested to allow these types of ICMP traffic.

- - **8:0** - echo request
  - **0:0** - echo reply

  Ping

- - **11:0** - TTL exceeded
  - **3:3** - Port unreachable

  Trace

- - **3:4** - Fragmentation-DF-Set

  Path MTU discovery

General suggestion to apply ICMP filtering

- Allow ping—ICMP Echo-Request outbound and Echo-Reply messages inbound
- Allow traceroute—TTL-Exceeded and Port-Unreachable messages inbound
- Allow path MTU—ICMP Fragmentation-DF-Set messages inbound
- Block everything else

Type of Service

Internet paths vary in quality of service they provide. They can differ in cost, reliability, delay and throughput. This situation imposes some tradeoffs, *exempli gratia* the path with the lowest delay may be among the slowest. Therefore, the "optimal" path for a packet to follow through the Internet may depend on the needs of the application and its user.

Because the network itself has no knowledge on how to optimize path choosing for a particular application or user, the IP protocol provides a facility for upper layer protocols to convey hints to the Internet Layer about how the tradeoffs should be made for the particular packet. This facility is called the "Type of Service" facility.

The fundamental rule is that if a host makes appropriate use of the TOS facility, its network service should be at least as good as it would have been if the host had not used this facility.

Type of Service (ToS) is a standard field of IP packet and it is used by many network applications and hardware to specify how the traffic should be treated by the gateway.

MikroTik RouterOS works with the full ToS byte. It does not take account of reserverd bits in this byte (because they have been redefined many times and this approach provides more flexibility). It means that it is possible to work with DiffServ marks (Differentiated Services Codepoint, DSCP as defined in RFC2474) and ECN codepoints (Explicit Congestion Notification, ECN as defined in RFC3168), which are using the same field in IP protocol header. Note that it does not mean that RouterOS supports DiffServ or ECN, it is just possible to access and change the marks used by these protocols.

RFC1349 defines these standard values:

- **normal** - normal service (ToS=0)
- **low-cost** - minimize monetary cost (ToS=2)
- **max-reliability** - maximize reliability (ToS=4)
- **max-throughput** - maximize throughput (ToS=8)
- **low-delay** - minimize delay (ToS=16)

Property Description

action (*accept* | *drop* | *jump* | *passthrough* | *reject* | *return*; default: **accept**) - action to undertake if the packet matches the rule, one of the:

- **accept** - accept the packet. No action, i.e., the packet is passed through without undertaking any action, except for mangle, and no more rules are processed in the relevant list/chain
- **drop** - silently drop the packet (without sending the ICMP reject message)
- **jump** - jump to the chain specified by the value of the jump-target argument
- **passthrough** - ignore this rule, except for mangle, go on to the next one. Acts the same way as a disabled rule, except for ability to count and mangle packets
- **reject** - reject the packet and send an ICMP reject message
- **return** - return to the previous chain, from where the jump took place

comment (*text*; default: **""**) - a descriptive comment for the rule

connection (*text*; default: **""**) - connection mark to match. Only connections (including related) marked in the MANGLE would be matched

connection-limit (*integer*; default: **0**) - match the number of concurrent connections from each particular IP address

connection-state (*any* | *established* | *invalid* | *new* | *related*; default: **any**) - connection state

content (*text*; default: **""**) - the text packets should contain in order to match the rule

disabled (yes | no; default: **no**) - specifies whether the rule is disabled or not

dst-address (*IP address/mask:port*; default: **0.0.0.0/0:0-65535**) - destination IP address

dst-netmask (*IP address*) - destination netmask in decimal form x.x.x.x

dst-port (*integer*: 0..65535) - destination port number or range

- **0** - all ports 1-65535

flow (*text*) - flow mark to match. Only packets marked in the MANGLE would be matched

icmp-options (*integer*; default: **any:any**) - matches ICMP Type:Code fields

in-interface (*name*; default: **all**) - interface the packet has entered the router through.

- **all** - may include the local loopback interface for packets originated from the router

jump-target (*name*) - name of the target chain, if the action=jump is used

limit-burst (*integer*; default: **0**) - allowed burst regarding the limit-count/limit-time, measuret in bits/s

limit-count (*integer*; default: **0**) - how many times to use the rule during the limit-time period

limit-time (*time*; default: **0**) - time interval measured in seconds, used in conjunction with limit-count

- **0** - forever

log (yes | no; default: **no**) - specifies to log the action or not

out-interface (*name*; default: **name**) - interface the packet is leaving the router from

- **all** - may include the local loopback interface for packets with destination to the router

p2p (*any* | *all-p2p* | *bit-torrent* | *direct-connect* | *fasttrack* | *soulseek* | *blubster* | *edonkey* | *gnutella* | *warez*; default: **any**) - match Peer-to-Peer (P2P) connections:

- **all-p2p** - match all known P2P traffic
- **any** - match any packet (i.e., do not check this property)

protocol (*ah* | *egp* | *ggp* | *icmp* | *ipencap* | *ospf* | *rspf* | *udp* | *xtp* | *all* | *encap* | *gre* | *idpr-cmtp* | *ipip* | *pup* | *st* | *vmtp* | *ddp* | *esp* | *hmp* | *igmp* | *iso-tp4* | *rdp* | *tcp* | *xns-idp*; default: **all**) - protocol setting

- **all** - cannot be used, if you want to specify ports

src-address (*IP address/mask:port*; default: **0.0.0.0/0:0-65535**) - source IP address

src-mac-address (*MAC address*; default: **00:00:00:00:00:00**) - host's MAC address the packet has been received from

src-netmask (*IP address*) - source netmask in decimal form x.x.x.x

src-port (*integer*: 0..65535) - source port number or range (0-65535)

- **0** - all ports 1-65535

tcp-options (*any* | *syn-only* | *non-syn-only*; default: **any**) - TCP options

tos (*<integer>* | *dont-change* | *low-cost* | *low-delay* | *max-reliability* | *max-throughput* | *normal* | *any* | *integer*; default: **any**) - specifies a match to the value of Type of Service (ToS) field of IP header:

- **any** - match any packet (i.e., do not check this property)

Notes

Keep in mind, that **protocol** must be explicity specified, if you want to select **port**.

Example

For instance, we want to reject packets with **dst-port=8080**:

```
/ip firewall rule input add dst-port=8080 protocol=tcp action=reject
[admin@MikroTik] ip firewall rule input> print
Flags: X - disabled, I - invalid
  0   src-address=0.0.0.0/0:0-65535 in-interface=all
      dst-address=0.0.0.0/0:8080 out-interface=all protocol=tcp
      icmp-options=any:any tcp-options=any connection-state=any flow=""
      sconnection="" content="" rc-mac-address=00:00:00:00:00:00 limit-count=0
      limit-burst=0 limit-time=0s action=reject log=no
```

To allow not more than 4 concurrent connection from each particular IP address, you can use this rule:

```
/ip firewall rule forward add protocol=tcp tcp-options=syn-only connection-limit=5 \
action=drop
```

Firewall Chains

Home menu level: ***/ip firewall***

Description

The firewall filtering rules are grouped together in chains. It allows a packets to be matched against one common criterion in one chain, and then passed over for processing against some other common criteria to another chain. Let us assume that, for example, packets must be matched against the IP addresses and ports. Then matching against the IP addresses can be done in one chain without specifying the protocol ports. Matching against the protocol ports can be done in a separate chain without specifying the IP addresses.

There are three predefined chains, which cannot be deleted:

- The chain **input** is used to process packets entering the router through one of the interfaces with the destination of the router. Packets passing through the router are not processed against the rules of the **input** chain.
- The chain **forward** is used to process packets passing through the router.
- The chain **output** is used to process packets originated from the router and leaving it through one of the interfaces. Packets passing through the router are not processed against the rules of the **output** chain.

When processing a chain, rules are taken from the chain in the order they are listed there from top to bottom. If a packet matches the criteria of the rule, then the specified action is performed on it, and no more rules are processed in that chain. If the packet has not matched any rule within the chain, then the default policy action of the chain is performed.

Available default policy actions include:

- **accept** - accept the packet
- **drop** - silently drop the packet (without sending the ICMP reject message)

- **none** - not applicable

Usually packets should be matched against several criteria. More general filtering rules can be grouped together in a separate chain. To process the rules of additional chains, the **jump** action should be used with destination to this chain from a rule within another chain.

The policy of user added chains is **none**, and it cannot be changed. Chains cannot be removed, if they contain rules (are not empty).

Notes

Because the NAT rules are applied first, it is important to hold this in mind when setting up firewall rules, since the original packets might be already modified by the NAT.

The packets passing through the router are not processed against the rules of neither the input, nor output chains.

Be careful about changing the default policy action to **input** and **output** chains! You may lose the connection to the router, if you change the policy to **drop**, and there are no additional rules that allow connection to the router.

Example

```
[admin@MikroTik] ip firewall> print
  # NAME                                                                   POLICY
  0 input                                                                  accept
  1 forward                                                                accept
  2 output                                                                 accept

[admin@MikroTik] ip firewall> add name=router
[admin@MikroTik] ip firewall> print
  # NAME                                                                   POLICY
  0 input                                                                  accept
  1 forward                                                                accept
  2 output                                                                 accept
  3 router                                                                 none
```

IP Firewall Applications

Description

In this section some IP firewalling common applications and examples of them are discussed.

Basic Firewall Building Principles

Assume we have a router that connects a customer's network to the Internet. The basic firewall building principles can be grouped as follows:

- **Protect the router from unauthorized access**
  Connections to the addresses assigned to the router itself should be monitored. Only access from certain hosts to certain TCP ports of the router should be allowed.
  This can be done by putting rules in the input chain to match packets with the destination address of the router entering the router through all interfaces.

- **Protect the customer's hosts**
  Connections to the addresses assigned to the customer's network should be monitored. Only access to certain hosts and services should be allowed.
  This can be done by putting rules in the forward chain to match packets passing through the router with the destination addresses of customer's network.
- **Use source NAT (masquerading) to 'Hide' the Private Network behind one External Address**
  All connections form the private addresses are masqueraded, and appear as coming from one external address - that of the router.
  This can be done by enabling the masquerading action for source NAT rules.
- **Enforce the Internet Usage Policy from the Customer's Network**
  Connections from the customer's network should be monitored.
  This can be done by putting rules in the forward chain, or/and by masquerading (source NAT) only those connections, that are allowed.

Filtering has some impact on the router's performance. To minimize it, the filtering rules that match packets for established connections should be placed on top of the chain. These are TCP packets with options **non-syn-only**.

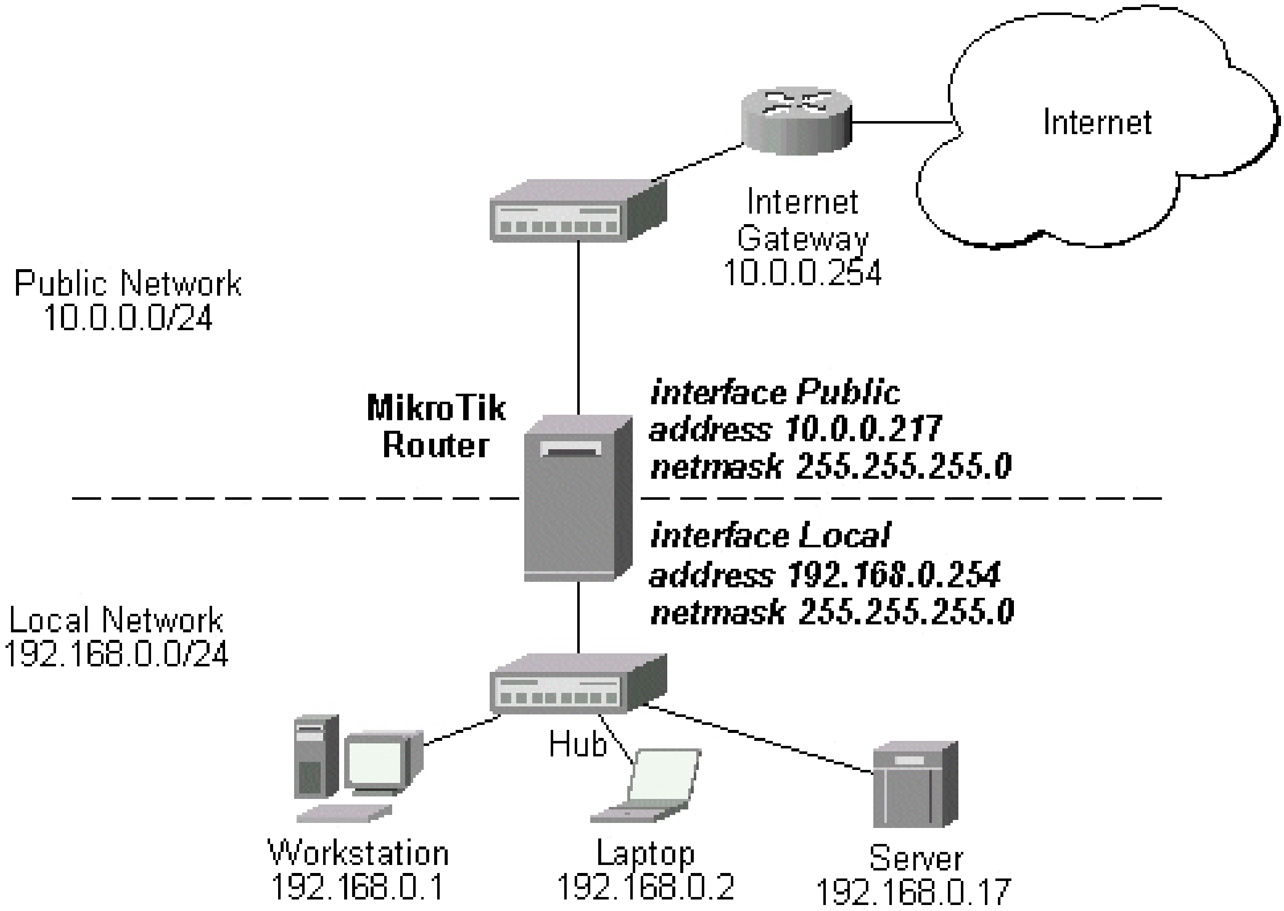
Examples of setting up firewalls are discussed below.

Example of Firewall Filters

Assume we want to create a firewall that:

- protects the MikroTik router from unauthorized access from anywhere. Only access from the 'trusted' network 10.5.8.0/24 is allowed
- protects the customer's hosts within the network 192.168.0.0/24 from unauthorized access from anywhere
- gives access from the Internet to the http and smtp services on 192.168.0.17
- allows only ICMP ping from all customer's hosts and forces use of the proxy server on 192.168.0.17

The basic network setup is illustraded in the following diagram:



The IP addresses and routes of the MikroTik router are as follows:

```
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.217/24      10.0.0.0        10.0.0.255      Public
  1   192.168.0.254/24   192.168.0.0     192.168.0.255   Local

[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  S 0.0.0.0/0          r 10.0.0.254      1        Public
    1 DC 192.168.0.0/24     r 0.0.0.0         0        Local
    2 DC 10.0.0.0/24        r 0.0.0.0         0        Public
```

To protect the router from unauthorized access, we should filter out all packets with the destination addresses of the router, and accept only those which are allowed. Since all packets with destination to the router's address are processed against the input chain, we can add the following rules to it:

```
/ip firewall rule input
add connection-state=invalid action=drop \
    comment="Drop invalid connection packets"
add connection-state=established \
    comment="Allow established connections"
add connection-state=related \
    comment="Allow related connections"
add protocol=udp comment="Allow UDP connections"
add protocol=icmp comment="Allow ICMP messages"
add src-addr=10.5.8.0/24 \
    comment="Allow access from 'trusted' network 10.5.8.0/24"
add action=drop log=yes \
    comment="Reject and log everything else"
```

Thus, the input chain will accept only allowed connections and drop, and log everything else.

Protecting the Customer's Network

To protect the customer's network, we should match all packets with destination address 192.168.0.0/24 that are passing through the router. This can be done in the forward chain. We can match the packets against the IP addresses in the forward chain, and then jump to another chain, say, **customer**. We create the new chain and add rules to it:

```
/ip firewall add name=customer
/ip firewall rule customer
add connection-state=invalid action=drop \
    comment="Drop invalid connection packets"
add connection-state=established \
    comment="Allow established connections"
add connection-state=related \
    comment="Allow related connections"
add protocol=udp \
    comment="Allow UDP connections"
add protocol=icmp \
    comment="Allow ICMP messages"
add protocol=tcp dst-address=192.168.0.17/32:80 \
    comment="Allow http connections to the server at 192.168.0.17"
add protocol=tcp dst-address=192.168.0.17/32:25 \
    comment="Allow SMTP connections to the server at 192.168.0.17"
add action=drop log=yes comment="Drop and log everything else"
```

All we have to do now is to put rules in the forward chain, that match the IP addresses of the customer's hosts on the Local interface and jump to the customer chain:

```
/ip firewall rule forward
add out-interface=Local action=jump \
    jump-target=customer
```

Thus, everything that passes the router and leaves the **Local** interface (destination of the customer's network) will be processed against the firewall rules of the **customer** chain.

Enforcing the 'Internet Policy'

To force the customer's hosts to access the Internet only through the proxy server at 192.168.0.17, we should put following rules in the forward chain:

```
/ip firewall rule forward
add connection-state=invalid action=drop \
    comment="Drop invalid connection packets"
add connection-state=established \
    comment="Allow established connections"
add connection-state=related \
    comment="Allow related connections"
add protocol=icmp out-interface=Public \
    comment="Allow ICMP ping packets"
add src-address=192.168.0.17/32 out-interface=Public \
    comment="Allow outgoing connections from the server at 192.168.0.17"
add action=drop out-interface=Public log=yes \
    comment="Drop and log everything else"
```

Example of Source NAT (Masquerading)

If you want to "hide" the private LAN 192.168.0.0/24 "behind" one address 10.0.0.217 given to you by the ISP (see the network diagram in the Application Example above), you should use the source network address translation (masquerading) feature of the MikroTik router. The masquerading will change the source IP address and port of the packets originated from the network 192.168.0.0/24 to the address 10.0.0.217 of the router when the packet is routed through it.

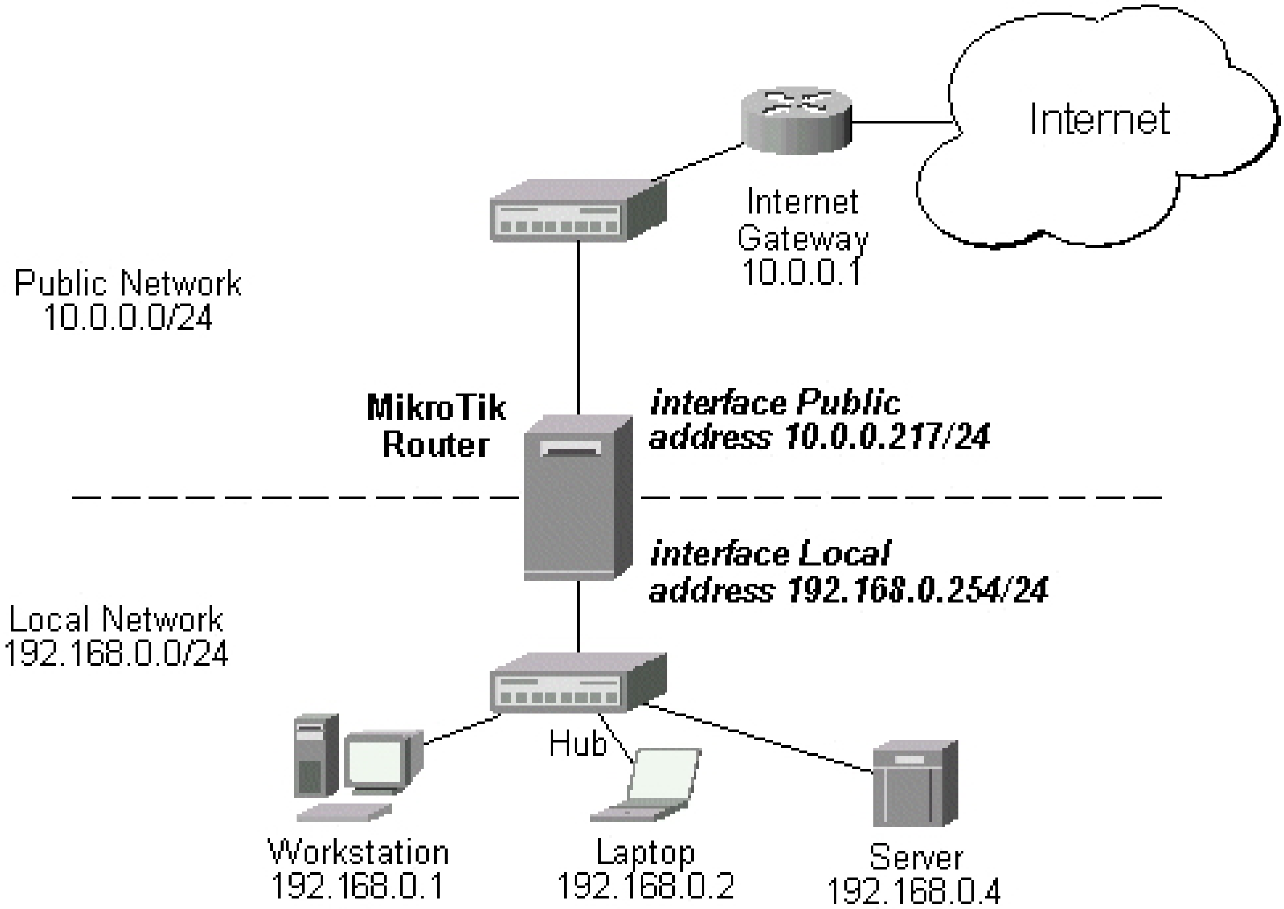
To use masquerading, a source NAT rule with action 'masquerade' should be added to the firewall configuration:

```
/ip firewall src-nat action=masquerade out-interface=Public
```

All outgoing connections from the network 192.168.0.0/24 will have source address 10.0.0.217 of the router and source port above 1024. No access from the Internet will be possible to the Local addresses. If you want to allow connections to the server on the local network, you should use destination Network Address Translation (NAT).

Example of Destination NAT

Assume you need to configure the MikroTik router for the following network setup, where the server is located in the private network area:


Internet
Internet Gateway 10.0.0.1
Public Network 10.0.0.0/24
MikroTik Router
interface Public address 10.0.0.217/24
interface Local address 192.168.0.254/24
Local Network 192.168.0.0/24
Hub
Workstation 192.168.0.1
Laptop 192.168.0.2
Server 192.168.0.4

The server has address 192.168.0.4, and we are running web server on it that listens to the TCP port 80. We want to make it accessible from the Internet at address:port 10.0.0.217:80. This can be done by means of destination Network Address Translation (NAT) at the MikroTik Router. The Public address:port 10.0.0.217:80 will be translated to the Local address:port 192.168.0.4:80. One destination NAT rule is required for translating the destination address and port:

```
/ip firewall dst-nat add action=nat protocol=tcp \
    dst-address=10.0.0.217/32:80 to-dst-address=192.168.0.4
```

IP Pools

Document revision 0.0 (Thu Mar 04 20:47:26 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

IP pools are used to define range of IP addresses that is used for DHCP server and Point-to-Point servers

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip pool***
Standards and Technologies: ***none***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***AAA***
- ***DHCP Client and Server***
- ***HotSpot Gateway***
- ***Universal Client Interface***

Description

IP pools simply group IP addresses for further usage. It is a single configuration point for all features that assign IP addresses to clients.

Notes

Whenever possible, the same ip address is given out to each client (OWNER/INFO pair).

Setup

Home menu level: ***/ip pool***

Property Description

name (*name*) - the name of the pool

ranges (*IP address*) - IP address list of non-overlapping IP address ranges in form of: from1-to1,from2-to2,...,fromN-toN. For example, 10.0.0.1-10.0.0.27,10.0.0.32-10.0.0.47

Example

To define a pool named **ip-pool** with the **10.0.0.1-10.0.0.125** address range excluding gateway's address **10.0.0.1** and server's address **10.0.0.100**, and the other pool **dhcp-pool**, with the **10.0.0.200-10.0.0.250** address range:

```
[admin@MikroTik] ip pool> add name=ip-pool ranges=10.0.0.2-10.0.0.99,10.0.0.101
10.0.0.126
[admin@MikroTik] ip pool> add name=dhcp-pool ranges=10.0.0.200-10.0.0.250
[admin@MikroTik] ip pool> print
  # NAME                                        RANGES
  0 ip-pool                                     10.0.0.2-10.0.0.99
                                                10.0.0.101-10.0.0.126

  1 dhcp-pool                                   10.0.0.200-10.0.0.250

[admin@MikroTik] ip pool>
```

Peer to Peer Traffic Control

Document revision 1.5 (Thu Sep 16 11:03:16 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

This manual section describes techniques needed to control traffic from peer-to-peer (P2P) networks. Peer-to-peer is a concept whereby one individual host directly communicates with another, as opposed to each client referring to a common hub or server. This type of network connection allows users to share various information, including audio and video files and application programs. Uncontrolled P2P connections take all the available bandwith and left no space for other activities (like mail or HTTP browsing).

Quick Setup Guide

To drop all p2p application packets:

```
[admin@MikroTik] ip firewall rule forward> add action=drop p2p=all-p2p
```

Specifications

Packages required: ***system***
License required: ***level1 (Limited to 1 firewall rule), level3***
Home menu level: ***/ip firewall, /ip firewall mangle, /queue***

Hardware usage: *Increases with rule count*

Related Documents

- ***Firewall Filters***
- ***Bandwidth Control***
- ***Packet Marking (Mangle)***

Description

RouterOS is able to recognize connections of the most popular P2P protocols:

- **Fasttrack** (Kazaa, KazaaLite, Diet Kazaa, Grokster, iMesh, giFT, Poisoned, mlMac)
- **Gnutella** (Shareaza, XoLoX, , Gnucleus, BearShare, LimeWire (java), Morpheus, Phex, Swapper, Gtk-Gnutella (linux), Mutella (linux), Qtella (linux), MLDonkey, Acquisition (Mac OS), Poisoned, Swapper, Shareaza, XoloX, mlMac)
- **Gnutella2** (Shareaza, MLDonkey, Gnucleus, Morpheus, Adagio, mlMac)
- **DirectConnect** (DirectConnect (AKA DC++), MLDonkey, NeoModus Direct Connect, BCDC++, CZDC++)
- **eDonkey** (eDonkey2000, eMule, xMule (linux), Shareaza, MLDonkey, mlMac, Overnet)
- **Soulseek** (Soulseek, MLDonkey)
- **BitTorrent** (BitTorrent, BitTorrent++, Shareaza, MLDonkey, ABC, Azureus, BitAnarch, SimpleBT, BitTorrent.Net, mlMac)
- **Blubster** (Blubster, Piolet)
- **WPNP** (WinMX)
- **Warez** (Warez; starting from 2.8.18)

Notes

The **Connection Tracking** facility (**/ip firewall connection tracking**) must be enabled if you want to track Peet-to-Peer protocols.

It is impossible to recognize peer-to-peer traffic from the first packet. Only already establilished connections can be matched.

The filter will work only if it sees the traffic coming from both directions.

Traffic Marking

Home menu level: ***/ip firewall mangle***

Description

Peer-to-peer traffic marking provided by **Mangle** facility labels the traffic for future processing aginst the firewall filters or queues.

Property Description

mark-connection (*text*; default: **""**) - change connection mark of the packet to this value

mark-flow (*text*; default: **""**) - change flow mark of the packet to this value

p2p (*any* | *all-p2p* | *bit-torrent* | *direct-connect* | *fasttrack* | *soulseek* | *blubster* | *edonkey* | *gnutella* | *warez*; default: **any**) - match Peer-to-Peer (P2P) connections:

- **all-p2p** - match all known P2P traffic
- **any** - match any packet (i.e., do not check this property)

Traffic Filtering

Home menu level: ***/ip firewall***

Description

RouterOS gives you ability to filter out traffic generated by P2P networks.

Property Description

action (*accept* | *drop* | *jump* | *passthrough* | *reject* | *return*; default: **accept**) - ation to undertake if the packet matches the rule, one of the:

- **accept** - accept the packet. No action, i.e., the packet is passed through without undertaking any action, except for mangle, and no more rules are processed in the relevant list/chain
- **drop** - silently drop the packet (without sending the ICMP reject message)
- **jump** - jump to the chain specified by the value of the jump-target argument
- **passthrough** - ignore this rule, except for mangle, go on to the next one. Acts the same way as a disabled rule, except for ability to count and mangle packets
- **reject** - reject the packet and send an ICMP reject message
- **return** - return to the previous chain, from where the jump took place

connection (*text*; default: **""**) - connection mark to match. Only connections (including related) marked in the MANGLE would be matched

flow (*text*) - flow mark to match. Only packets marked in the MANGLE would be matched

jump-target (*name*) - name of the target chain, if the action=jump is used

p2p (*any* | *all-p2p* | *bit-torrent* | *direct-connect* | *fasttrack* | *soulseek* | *blubster* | *edonkey* | *gnutella* | *warez*; default: **any**) - match Peer-to-Peer (P2P) connections:

- **all-p2p** - match all known P2P traffic
- **any** - match any packet (i.e., do not check this property)

Traffic Limiting

Home menu level: ***/queue***

Description

You can limit peer-to-peer traffic to a given amount of Kbits per second or give it lower priority than, for example HTTP traffic.

It is also possible to prioritize small file downloading over large ones using queue bursts.

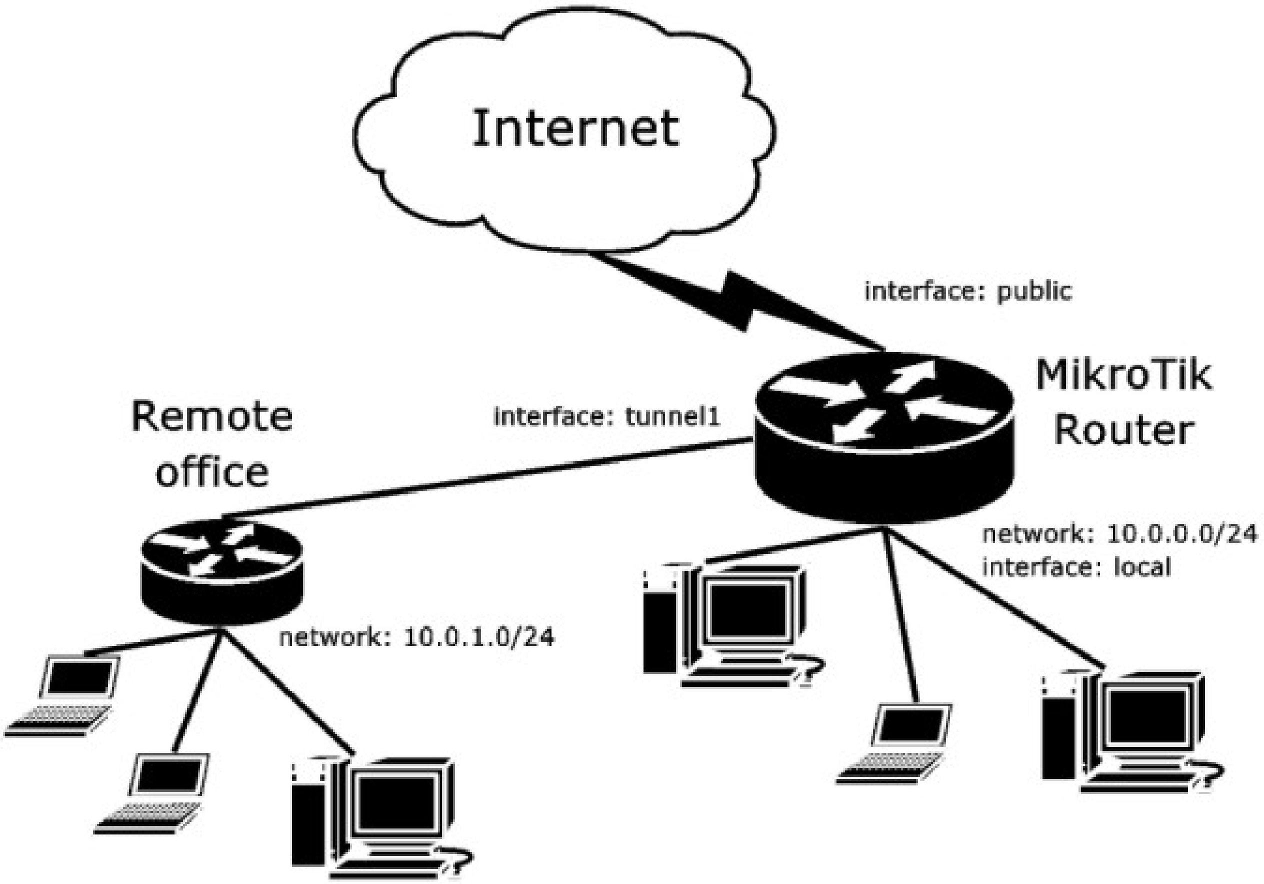
General Information

Summary

This section will give you two examples of typical peer-to-peer traffic control configurations.

Cumulative Bandwith Limiting

Consider the following example:



Suppose we need to drop all the P2P traffic coming from the Internet, but allow the use of WinMX client between two offices limiting it to 284 Kbps in both directions. You need to do the following:

- Allow WinMX client to be used between two offices

```
[admin@MikroTik] ip firewall rule forward> add p2p=winmx action=accept
src-address=10.0.0.0/24 dst-address=10.0.1.0/24
[admin@MikroTik] ip firewall rule forward> add p2p=winmx action=accept
dst-address=10.0.0.0/24 src-address=10.0.1.0/24
```

- Drop all other P2P traffic

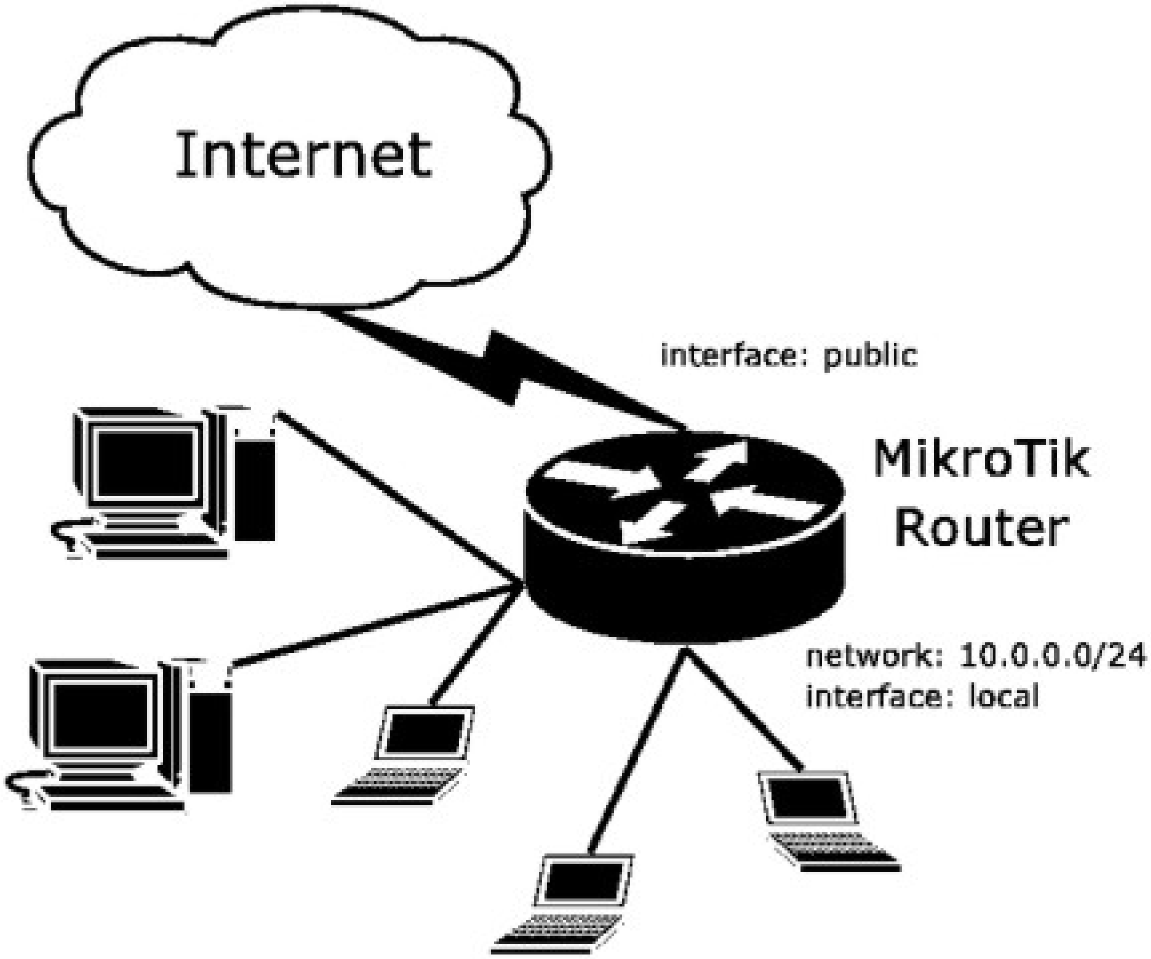
```
[admin@MikroTik] ip firewall rule forward> add p2p=all-p2p action=drop
```

- Limit the traffic to 284 Kbps

```
[admin@MikroTik] queue simple> add dst-address=10.0.1.0/24 max-limit=290816/290816
```

Per Address Queuing

Suppose we want to limit each P2P user to a given amount of Kbps. This can be done on a per-address basis.



We should define custom queue type **kind=pcq** to accomplish the task. Each user upload and download rates would be limited to the **pcq-rate** value in the relevant queue.

- First we need to mark the P2P traffic:

```
[admin@MikroTik] ip firewall mangle> add src-address=10.0.0.0/24 mark-flow=p2p-out \
\... p2p=all-p2p action=passthrough
[admin@MikroTik] ip firewall mangle> add dst-address=10.0.0.0/24 mark-flow=p2p-in \
\... p2p=all-p2p action=passthrough
[admin@MikroTik] ip firewall mangle>
```

- Then create custom queue type with **kind=pcq**:

```
[admin@MikroTik] queue type> add name="p2p-out" kind=pcq \
\... pcq-rate=65536 pcq-classifier=src-address
[admin@MikroTik] queue type> add name="p2p-in" kind=pcq pcq-rate=65536 \
\... pcq-classifier=dst-address
[admin@MikroTik] queue type>
```

- Finally, add two queues to the queue tree:

```
[admin@MikroTik] queue tree> add name="p2p-in" \
\... parent=global-in flow=p2p-in queue=p2p-in
[admin@MikroTik] queue tree> add name="p2p-out" \
\... parent=global-out flow=p2p-out queue=p2p-out
[admin@MikroTik] queue tree>
```

VRRP

Document revision 1.4 (Fri Mar 05 08:42:58 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Virtual Router Redundancy Protocol (VRRP) implementation in the MikroTik RouterOS is RFC2338 compliant. VRRP protocol is used to ensure constant access to some resources. Two or more routers (referred as VRRP Routers in this context) create a highly available cluster (also referred as Virtual routers) with dynamic fail over. Each router can participate in not more than 255 virtual routers per interface. Many modern routers support this protocol.

Network setups with VRRP clusters provide high availability for routers without using clumsy ping-based scripts.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip vrrp***
Standards and Technologies: ***VRRP**, **AH**, **HMAC-MD5-96 within ESP and AH***
Hardware usage: ***Not significant***

Related Documents

- *Package Management*
- *IP Addresses and ARP*

Description

Virtual Router Redundancy Protocol is an election protocol that provides high availability for routers. A number of routers may participate in one or more virtual routers. One or more IP addresses may be assigned to a virtual router. A node of a virtual router can be in one of the following states:

- **MASTER** state, when the node answers all the requests to the instance's IP addresses. There may only be one MASTER node in a virtual router. This node sends VRRP advertisement packets to all the backup routers (using multicast address) every once in a while (set in **interval** property).
- **BACKUP** state, when the VRRP router monitors the availability and state of the Master Router. It does not answer any requests to the instance's IP addresses. Should master become unavailable (if at least three sequential VRRP packets are lost), election process happens, and new master is proclaimed based on its priority. For more details on virtual routers, see RFC2338.

VRRP Routers

Home menu level: ***/ip vrrp***

Description

A number of VRRP routers may form a virtual router. The maximal number of clusters on one network is 255 each having a unique VRID (Virtual Router ID). Each router participating in a VRRP cluster must have it priority set to a valid value.

Property Description

name (*name*) - assigned name of the VRRP instance

interface (*name*) - interface name the instance is running on

vrid (*integer*: 0..255; default: **1**) - Virtual Router Identifier (must be unique on one interface)

priority (*integer*: 1..255; default: **100**) - priority of the current node (higher values mean higher priority)

- **255** - RFC requires that the router that owns the IP addresses assigned to this instance had the priority of 255

interval (*integer*: 1..255; default: **1**) - VRRP update interval in seconds. Defines how frequently the master of the given cluster sends VRRP advertisement packets

preemption-mode (yes | no; default: **yes**) - whether preemption mode is enabled

- **no** - a backup node will not be elected to be a master until the current master fail even if the backup node has higher priority than the current master
- **yes** - the master node always has the priority

authentication (*none* | *simple* | *ah*; default: **none**) - authentication method to use for VRRP advertisement packets

- **none** - no authentication
- **simple** - plain text authentication
- **ah** - Authentication Header using HMAC-MD5-96 algorithm

password (*text*; default: "") - password required for authentication depending on method used can be ignored (if no authentication used), 8-character long text string (for plain-text authentication) or 16-character long text string (128-bit key required for AH authentication)

on-backup (*name*; default: "") - script to execute when the node switch to backup state

on-master (*name*; default: "") - script to execute when the node switch to master state

Notes

All the nodes of one cluster must have the same **vrid**, **interval**, **preemption-mode**, **authentication** and **password**.

As said before, priority of 255 is reserved for the real owner of the virtual router's IP addresses. Theoretically, the owner should have the IP address added statically to its IP address list and also to the VRRP virtual address list, but you should never do this! Any addresses that you are using as virtual addresses (i.e. they are added in **/ip vrrp address**) must not appear in **/ip address** list as they otherwise can cause IP address conflict, which will not be resolved automatically.

Also You must have an IP address (no matter what) on the interface you want to run VRRP on.

Example

To add a VRRP instance on **ether1** interface, forming (because **priority** is **255**) a virtual router with **vrid** of **1**:

```
[admin@MikroTik] ip vrrp> add interface=ether1 vrid=1 priority=255
[admin@MikroTik] ip vrrp> print
Flags: X - disabled, I - invalid, M - master, B - backup
  0  I  name="vr1" interface=ether1 vrid=1 priority=255 interval=1
        preemption-mode=yes authentication=none password="" on-backup=""
        on-master=""

[admin@MikroTik] ip vrrp>
```

Virtual IP addresses

Home menu level: ***/ip vrrp address***

Property Description

address (*IP address*) - IP address belongs to the virtual router

network (*IP address*) - IP address of the network

broadcast (*IP address*) - broadcasting IP address

virtual-router (*name*) - VRRP router's name the address belongs to

Notes

The virtual IP addresses should be the same for each node of a virtual router.

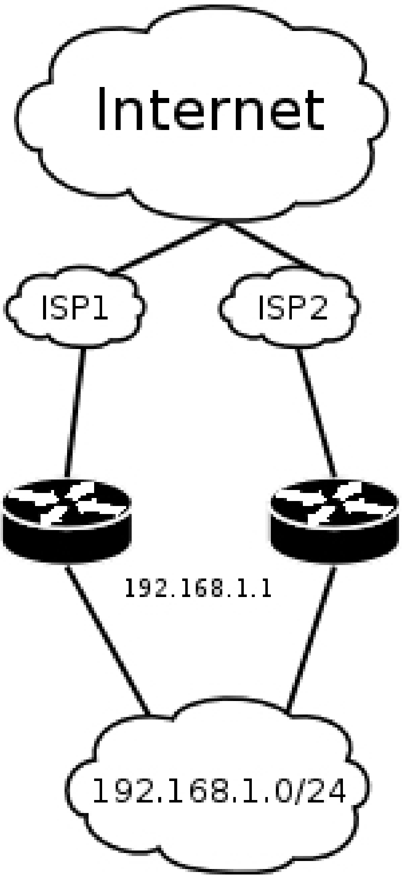
Example

To add a virtual address of **192.168.1.1/24** to the **vr1** VRRP router:

```
[admin@MikroTik] ip vrrp> address add address=192.168.1.1/24 \
\... virtual-router=vr1
[admin@MikroTik] ip vrrp> address print
Flags: X - disabled, A - active
  #    ADDRESS            NETWORK         BROADCAST       VIRUAL-ROUTER
  0    192.168.1.1/24     192.168.1.0     192.168.1.255   vr1

[admin@MikroTik] ip vrrp>
```

A simple example of VRRP fail over

Description



VRRP protocol may be used to make a redundant Internet connection with seamless fail-over. Let us assume that we have 192.168.1.0/24 network and we need to provide highly available Internet connection for it. This network should be NATted (to make fail-over with public IPs, use such dynamic routing protocols as BGP or OSPF together with VRRP). We have connections to two different Internet Service Providers (ISPs), and one of them is preferred (for example, it is cheaper or faster).

This example shows how to configure VRRP on the two routers shown on the diagram. The routers must have initial configuration: interfaces are enabled, each interface have appropriate IP address (note that each of the two interfaces should have an IP address), routing table is set correctly (it should have at least a default route). SRC-NAT or masquerading should also be configured before. See the respective manual chapters on how to make this configuration.

We will assume that the interface the 192.168.1.0/24 network is connected to is named **local** on both VRRP routers

Configuring Master VRRP router

First of all we should create a VRRP instance on this router. We will use the priority of 255 for this router as it should be preferred router.

```
[admin@MikroTik] ip vrrp> add interface=local priority=255
[admin@MikroTik] ip vrrp> print
Flags: X - disabled, I - invalid, M - master, B - backup
  0   M name="vr1" interface=local vrid=1 priority=255 interval=1
        preemption-mode=yes authentication=none password="" on-backup=""
        on-master=""

[admin@MikroTik] ip vrrp>
```

Next the virtual IP address should be added to this VRRP instance

```
[admin@MikroTik] ip vrrp> address add address=192.168.1.1/24 \
\... virtual-router=vr1
[admin@MikroTik] ip vrrp> address print
Flags: X - disabled, A - active
  #    ADDRESS            NETWORK         BROADCAST       VIRTUAL-ROUTER
  0    192.168.1.1/24     192.168.1.0     192.168.1.255   vr1

[admin@MikroTik] ip vrrp>
```

Now this address should appear in **/ip address** list:

```
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.1/24        10.0.0.0        10.0.0.255      public
  1   192.168.1.2/24     192.168.1.0     192.168.1.255   local
  2 D 192.168.1.1/24     192.168.1.0     192.168.1.255   local

[admin@MikroTik] ip address>
```

Configuring Backup VRRP router

Now we will create VRRP instance with lower priority (we can use the default value of **100**), so this router will back up the preferred one:

```
[admin@MikroTik] ip vrrp> add interface=local
[admin@MikroTik] ip vrrp> print
Flags: X - disabled, I - invalid, M - master, B - backup
  0   B name="vr1" interface=local vrid=1 priority=100 interval=1
        preemption-mode=yes authentication=none password="" on-backup=""
        on-master=""

[admin@MikroTik] ip vrrp>
```

Now we should add the same virtual address as was added to the master node:

```
[admin@MikroTik] ip vrrp> address add address=192.168.1.1/24 \
\... virtual-router=vr1
[admin@MikroTik] ip vrrp> address print
Flags: X - disabled, A - active
  #    ADDRESS            NETWORK         BROADCAST       VIRTUAL-ROUTER
  0    192.168.1.1/24     192.168.1.0     192.168.1.255   vr1

[admin@MikroTik] ip vrrp>
```

Note that this address will not appear in **/ip address** list:

```
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.1.0.1/24        10.0.0.0        10.0.0.255      public
  1   192.168.1.3/24     192.168.1.0     192.168.1.255   local

[admin@MikroTik] ip address>
```

Testing fail over

Now, when we will disconnect the master router, the backup one will switch to the master state:

```
[admin@MikroTik] ip vrrp> print
Flags: X - disabled, I - invalid, M - master, B - backup
  0   M name="vr1" interface=local vrid=1 priority=100 interval=1
        preemption-mode=yes authentication=none password="" on-backup=""
        on-master=""

[admin@MikroTik] ip vrrp> /ip address print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.1.0.1/24        10.0.0.0        10.0.0.255      public
  1   192.168.1.3/24     192.168.1.0     192.168.1.255   local
  2 D 192.168.1.1/24     192.168.1.0     192.168.1.255   local

[admin@MikroTik] ip vrrp>
```

Network Address Translation

Document revision 1.4 (Fri Apr 23 14:25:45 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Network Address Translation (NAT) provides ways for hiding local networks as well as to maintain public services on servers from these networks. Besides, through NAT additional applications like transparent proxy service can be made.

Quick Setup Guide

- Let us consider that we have a private network **192.168.0.0/24** and we want it to be able to use a single public IP address, which is assigned to interface **Public**. This can be done with masquerading:

```
[admin@MikroTik] ip firewall src-nat> add src-address=192.168.0.0/24
\... out-interface=Public action=masquerade
```

- Let us consider that we have a Web-Server in our private network **192.168.0.0/24** with IP address **192.168.0.2**. To redirect all HTTP traffic from the router's address (**10.5.8.104**) to the Web-Server, use the following command:

```
[admin@MikroTik] ip firewall dst-nat> add dst-address=10.5.8.104/32 dst-port=80 \
\... to-dst-address=192.168.0.2 protocol=tcp action=nat
```

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip firefall src-nat, /ip firewall dst-nat***
Standards and Technologies: ***IP***
Hardware usage: *Increases with rules and connections count*

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***Routes, Equal Cost Multipath Routing, Policy Routing***
- ***Firewall Filters***

Description

NAT subdivision

Network Address Translation is subdivided into two separate facilities:

- Source NAT
  This type of NAT allows 'hiding' of private networks beyond the router. It alters forwarded IP packets' source addresses.
- Destination NAT
  This one is used for accessing public services on the local servers from outside the intranet. It can also help to accomplish some additional tasks like transparent proxying. Destination NAT alters forwarded IP packets' destination addresses.

Redirect and Masquerade

REDIRECT is similar to regular destination NAT in the same way as MASQUERADING is similar to source NAT - masquerading is source NAT, except you do not have to specify **to-src-address** - outgoing interface address is used automatically. The same is for REDIRECT - it is destination NAT where **to-dst-address** is not used - incoming interface address is used instead. So there is no use of specifying **to-src-address** for **src-nat** rules with **action=masquerade**, as well as no use of specifying **to-dst-address** for **dst-nat** rules with **action=redirect**. Note that **to-dst-port** is meaningful for REDIRECT rules - this is the port on which the service on router that will handle these requests is sitting (e.g. web proxy).

When packet is dst-natted (no matter - **action=nat** or **action=redirect**), dst address is changed. Information about translation of addresses (including original dst address) is kept in router's internal tables. Transparent web proxy working on router (when web requests get redirected to proxy port on router) can access this information from internal tables and get address of web server from them. If you are dst-natting to some different proxy server, it has no way to find web server's address from IP header (because dst address of IP packet that previously was address of web server has changed to address of proxy server). Starting from HTTP/1.1 there is special header in HTTP request which tells web server address, so proxy server can use it, instead of dst address of IP packet. If there is no such header (older HTTP version on client), proxy server can not determine web server address and therefore can not work.

It means, that it is impossible to correctly transparently redirect HTTP traffic from router to some other transparent-proxy box. Only correct way is to add transparent proxy on the router itself, and configure it so that your "real" proxy is parent-proxy. In this situation your "real" proxy does not have to be transparent any more, as proxy on router will be transparent and will forward proxy-style requests (according to standard; these requests include all necessary information about web server) to "real" proxy.

Notes

The **Connection Tracking** facility (**/ip firewall connection tracking**) must be enabled if you want to use NAT.

Source NAT

Description

Source NAT is a firewall function that can be used to 'hide' private networks behind one external IP address of the router. For example, it is useful, if you want to access the ISP's network and the Internet appearing as all requests coming from one single IP address given to you by the ISP. The Source NAT will change the source IP address and port of the packets originated from the private network to the external address of the router, when the packet is routed through it.

Source NAT helps to ensure security since each outgoing or incoming request must go through a translation process that also offers the opportunity to qualify or authenticate the request or match it to a previous request. It also conserves the number of global IP addresses required and it lets the whole network use a single IP address in its communication with the world.

Property Description

dst-address (*IP address*; default: **0.0.0.0/0:0-65535**) - destination IP address

src-address (*IP address*; default: **0.0.0.0/0:0-65535**) - source IP address

flow - flow mark to match. Only packets marked in the mangle facility would be matched

limit-time (*time*; default: **0**) - time interval, used in limit-count

protocol (*ah* | *all* | *ddp* | *egp* | *encap* | *esp* | *ggp* | *gre* | *hmp* | *icmp* | *idpr-cmtp* | *igmp* | *ipencap* | *ipip* | *iso-tp4* | *ospf* | *pup* | *rdp* | *rspf* | *st* | *tcp* | *udp* | *vmtp* | *xns-idp* | *xtp*; default: **any**) - protocol setting

- **all** - cannot be used, if you want to match packets by ports

icmp-options - ICMP options

content (*text*; default: **""**) - the text packets should contain in order to match the rule

comment (*text*; default: **""**) - a descriptive comment for the rule

connection (*text*; default: **""**) - connection mark to match. Only packets marked in the mangle facility would be matched

limit-burst (*integer*; default: **0**) - allowed burst for the limit-count during the limit-time

limit-count (*integer*; default: **0**) - specifies how many times to use the rule during the limit-time period

src-netmask (*IP address*) - source netmask in decimal form x.x.x.x

src-port (*integer*: 0..65535) - source port number or range

- **0** - means all ports from 0 to 65535

dst-netmask (*IP address*) - destination netmask in decimal form x.x.x.x

dst-port (*integer*: 0..65535) - destination port number or range

- **0** - means all ports from 0 to 65535

tos (*any* | *max-reliability* | *max-throughput* | *min-cost* | *min-delay* | *normal* | *integer*; default: **any**) - specifies a match for Type-of-Service field of an IP packet (see Firewall Filters manual for detailed description)

action (*accept* | *masquerade* | *nat*; default: **accept**) - action to undertake if a packed matched a particular src-nat rule, one of the:

- **accept** - accept the packet without undertaking any action, except for mangle. No more rules are processed in the relevant list/chain
- **masquerade** - use masquerading for the packet and substitute the source address:port of the packet with the ones of the router. In this case, the to-src-address argument value is not taken into account and it does not need to be specified, since the router's local address is used
- **nat** - perform Network Address Translation. The to-src-address should be specified (ignored when action=masquerade)

out-interface (*name*; default: **all**) - interface the packet is leaving the router from.

- **all** - may include the local loopback interface for packets with destination to the router

to-src-address (*IP address*; default: **0.0.0.0**) - source address to replace original source address with

to-src-port (*integer*: 0..65535) - source port to replace original source port with

Notes

The source nat can masquerade several private networks, and use individual **to-src-address** for each of them.

Masquerading chooses outgoing packets' source addresses according to the **preferred-address** property of the relevant route.

Example

To use masquerading, a source NAT rule with **action=masquerade** should be added to the **src-nat** rule set:

```
[admin@test_1] ip firewall src-nat> add src-address=192.168.0.0/24 \
\... out-interface=wlan1 action=masquerade
[admin@test_1] ip firewall src-nat> print
Flags: X - disabled, I - invalid, D - dynamic
  0   src-address=192.168.0.0/24:0-65535 dst-address=0.0.0.0/0:0-65535
      out-interface=wlan1 protocol=all icmp-options=any:any flow=""
      connection="" content="" limit-count=0 limit-burst=0 limit-time=0s
      action=masquerade to-src-address=0.0.0.0 to-src-port=0-65535

[admin@test_1] ip firewall src-nat>
```

If the packet matches the **masquerade** rule, then the router opens a connection to the destination, and sends out a modified packet with its own address and a port allocated for this connection. The router keeps track about masqueraded connections and performs the "demasquerading" of packets, which arrive for the opened connections. For filtering purposes, you may want to specify the **to-src-ports** argument value, say, to 60000-65535

If you want to change the source address:port to specific adress:port, use the **action=nat** instead of **action=masquerade**:

```
[admin@test_1] ip firewall src-nat> add src-address=192.168.0.1/32 out-interface
=wlan1 action=nat to-src-address=1.1.1.1
[admin@test_1] ip firewall src-nat> print
Flags: X - disabled, I - invalid, D - dynamic
  0   src-address=192.168.0.1/32:0-65535 dst-address=0.0.0.0/0:0-65535
      out-interface=wlan1 protocol=all icmp-options=any:any flow=""
      connection="" content="" limit-count=0 limit-burst=0 limit-time=0s
      action=nat to-src-address=1.1.1.1 to-src-port=0-65535

[admin@test_1] ip firewall src-nat>
```

Here, the:

- **src-address** - can be IP host's address, for example, 192.168.0.1/32, or network address 192.168.0.0/24
- **to-src-address** - can be one address, or a range, say 10.0.0.217-10.0.0.219. The addresses should be added to the router's interface, or should be routed to it from the gateway router.

Destination NAT

Home menu level: ***/ip firewall dst-nat***

Description

Redirection and destination NAT should be used when you need to give access to services located on a private network from the outside world

Property Description

dst-address (*IP address*; default: **0.0.0.0/0:0-65535**) - destination IP address

src-address (*IP address*; default: **0.0.0.0/0:0-65535**) - source IP address

flow - flow mark to match. Only packets marked in the mangle facility would be matched

limit-time (*time*; default: **0**) - time interval, used in limit-count

protocol (*ah* | *all* | *ddp* | *egp* | *encap* | *esp* | *ggp* | *gre* | *hmp* | *icmp* | *idpr-cmtp* | *igmp* | *ipencap* | *ipip* | *iso-tp4* | *ospf* | *pup* | *rdp* | *rspf* | *st* | *tcp* | *udp* | *vmtp* | *xns-idp* | *xtp*; default: **any**) - protocol setting

- **all** - cannot be used, if you want to match packets by ports

icmp-options - ICMP options

content (*text*; default: "") - the text packets should contain in order to match the rule

comment (*text*; default: "") - a descriptive comment for the rule

connection (*text*; default: "") - connection mark to match. Only packets marked in the mangle facility would be matched

limit-burst (*integer*; default: **0**) - allowed burst for the limit-count during the limit-time

limit-count (*integer*; default: **0**) - specifies how many times to use the rule during the limit-time period

src-netmask (*IP address*) - source netmask in decimal form x.x.x.x

src-port (*integer*: 0..65535) - source port number or range

- **0** - means all ports from 0 to 65535

dst-netmask (*IP address*) - destination netmask in decimal form x.x.x.x

dst-port (*integer*: 0..65535) - destination port number or range

- **0** - means all ports from 0 to 65535

tos (*any* | *max-reliability* | *max-throughput* | *min-cost* | *min-delay* | *normal* | *integer*; default: **any**) - specifies a match for Type-of-Service field of an IP packet (see Firewall Filters manual for detailed description)

action (*accept* | *redirect* | *nat*; default: **accept**) - action to undertake if a packed matched a particular dst-nat rule, one of the:

- **accept** - accept the packet without undertaking any action, except for mangle. No more rules are processed in the relevant list/chain
- **redirect** - redirects to the local address:port of the router. In this case, the to-dst-address argument value is not taken into account and it does not need to be specified, since the router's local address is used.
- **nat** - perform Network Address Translation. The to-dst-address should be specified (not required with action=redirect)

in-interface (*name*; default: **all**) - interface the packet has entered the router through

- **all** - may include the local loopback interface for packets with destination to the router

to-dst-address (*IP address*; default: **0.0.0.0**) - destination IP address to replace original with

to-dst-port (*integer*: 0..65535; default: **0-65535**) - destination port to replace original with

src-mac-address (*MAC address*; default: **00:00:00:00:00:00**) - host's MAC address the packet has been received from

Example

This example shows how to add a dst-NAT rule that gives access to the http server 192.168.0.4 on the local network via external address 10.0.0.217:

```
[admin@MikroTik] ip firewall dst-nat> add action=nat protocol=tcp \
\... dst-address=10.0.0.217/32:80 to-dst-address=192.168.0.4
[admin@MikroTik] ip firewall dst-nat> print
Flags: X - disabled, I - invalid, D - dynamic
  0   src-address=0.0.0.0/0:0-65535 in-interface=all
      dst-address=10.0.0.217/32:80 protocol=tcp icmp-options=any:any flow=""
      connection="" content="" src-mac-address=00:00:00:00:00:00
      limit-count=0 limit-burst=0 limit-time=0s action=nat
      to-dst-address=192.168.0.4 to-dst-port=0-65535

[admin@MikroTik] ip firewall dst-nat>
```

UPnP

Document revision 2.1 (Fri Mar 05 08:40:48 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS supports Universal Plug and Play architecture for transparent peer-to-peer network connectivity of personal computers and network-enabled intelligent devices or appliances. UPnP builds enables these devices to automatically connect with one another and work together to make networking possible for more people.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip upnp***
Standards and Technologies: ***TCP/IP***, ***HTTP***, ***XML***, ***IGD***
Hardware usage: ***Not significant***

Description

UPnP enables data communication between any two devices under the command of any control device on the network. Universal Plug and Play is completely independent of any particular physical medium. It supports networking with automatic discovery without any initial configuration, whereby a device can dynamically join a network. DHCP and DNS servers are optional and will be used if available on the network. UPnP implements simple yet powerfull NAT traversal solution, that enables the client to get full peer-to-peer network support from behind the NAT.

There are two interface types for UPnP: internal (the one local clients are connected to) and external (the one the Internet is connected to). A router may only have one external interface with a 'public'

IP address on it, and as many internal IP addresses as needed, all with source-NATted 'internal' IP addresses.

The UPnP protocol is used for most of DirectX games as well as for various Windows Messenger features (remote asisstance, application sharing, file transfer, voice, video) from behind a firewall.

Additional Documents

Enabling Universal Plug-n-Play

Home menu level: ***/ip upnp***

Property Description

enabled (yes | no; default: **no**) - whether UPnP feature is enabled

Example

To enable UPnP feature:

```
[admin@MikroTik] ip upnp> set enable=yes
[admin@MikroTik] ip upnp> print
    enabled: yes
[admin@MikroTik] ip upnp>
```

UPnP Interfaces

Home menu level: ***/ip upnp interfaces***

Property Description

interface (*name*) - interface name UPnP will be run on

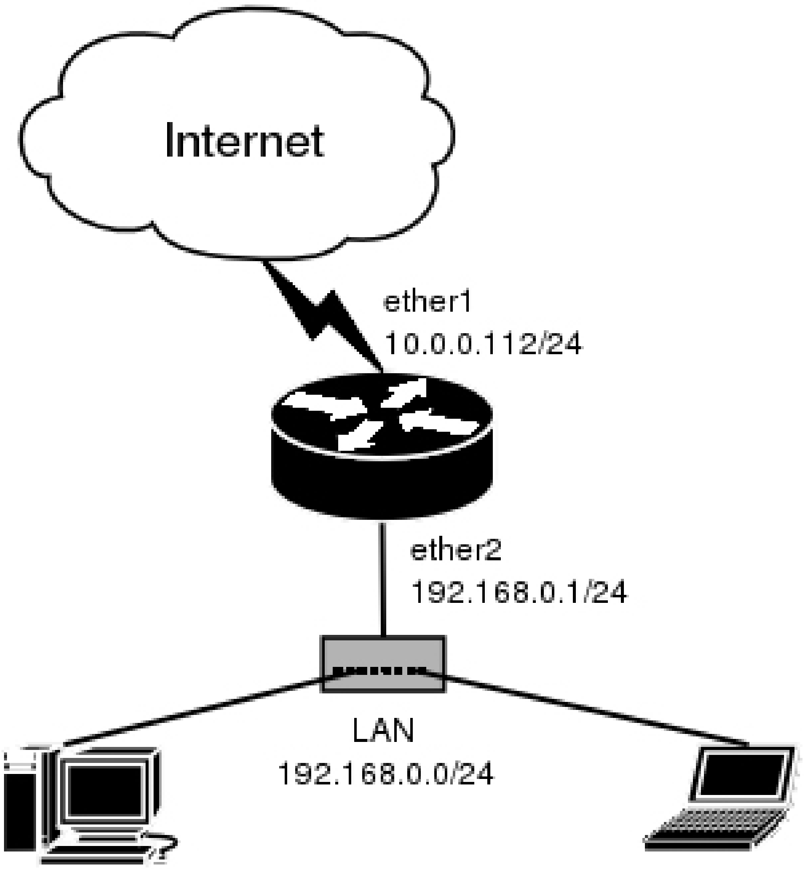
type (*external* | *internal*) - interface type, one of the:

- **external** - the interface global IP address is assigned to
- **internal** - router's local interface

Notes

It is highly recommended to upgrade DirectX runtime libraries to version ***DirectX 9.0a*** or higher and Windows Messenger to version***Windows Messenger 5.0*** or higher in order to get UPnP to work properly.

Example



We have masquerading already enabled on our router:

```
[admin@MikroTik] ip upnp interfaces> /ip firewall src-nat print
Flags: X - disabled, I - invalid, D - dynamic
  0   src-address=0.0.0.0/0:0-65535 dst-address=0.0.0.0/0:0-65535
      out-interface=ether1 protocol=all icmp-options=any:any flow=""
      connection="" content="" limit-count=0 limit-burst=0 limit-time=0s
      action=masquerade to-src-address=0.0.0.0 to-src-port=0-65535

[admin@MikroTik] ip upnp interfaces>
```

Now all we have to do is to add interfaces and enable UPnP:

```
[admin@MikroTik] ip upnp interfaces> add interface=ether1 type=external
[admin@MikroTik] ip upnp interfaces> add interface=ether2 type=internal
[admin@MikroTik] ip upnp interfaces> print
Flags: X - disabled
  #   INTERFACE TYPE
  0 X ether1    external
  1 X ether2    internal

[admin@MikroTik] ip upnp interfaces> enable 0,1
[admin@MikroTik] ip upnp interfaces> .. set enabled=yes
[admin@MikroTik] ip upnp interfaces>
```

M3P

Document revision 0.3.0 (Wed Mar 03 16:07:55 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The MikroTik Packet Packer Protocol (M3P) optimizes the data rate usage of links using protocols that have a high overhead per packet transmitted. The basic purpose of this protocol is to better enable wireless networks to transport VoIP traffic and other traffic that uses small packet sizes of around 100 bytes.

M3P features:

- enabled by a per interface setting
- other routers with MikroTik Discovery Protocol enabled will broadcast M3P settings
- significantly increases bandwidth availability over some wireless links ? by approximately four times
- offer configuration settings to customize this feature

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip packing***
Standards and Technologies: ***M3P***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***MNDP***

Description

The wireless protocol IEEE 802.11 and, to a lesser extent, Ethernet protocol have a high overhead per packet as for each packet it is necessary to access the media, check for errors, resend in case of errors occured, and send network maintenance messages (network maintenance is applicable only for wireless). The MikroTik Packet Packer Protocol improves network performance by aggregating many small packets into a big packet, thereby minimizing the network per packet overhead cost. The M3P is very effective when the average packet size is 50-300 bytes ? the common size of VoIP packets.

Features:

- may work on any Ethernet-like media
- is disabled by default for all interfaces
- when older version on the RouterOS are upgraded from a version without M3P to a version with discovery, current wireless interfaces will not be automatically enabled for M3P
- small packets going to the same MAC level destination (regardless of IP destination) are collected according to the set configuration and aggregated into a large packet according to the set size
- the packet is sent as soon as the maximum aggregated-packet packet size is reached or a maximum time of 15ms (+/-5ms)

Setup

Home menu level: ***/ip packing***

Description

M3P is working only between MikroTik routers, which are discovered with MikroTik Neighbor Discovery Protocol (MNDP). When M3P is enabled router needs to know which of its neighbouring hosts have enabled M3P. MNDP is used to negotiate unpacking settings of neighbours, therefore it has to be enabled on interfaces you wish to enable M3P. Consult MNDP manual on how to do it.

Property Description

aggregated-size (*integer*; default: **1500**) - the maximum aggregated packet's size

interface (*name*) - interface to enable M3P on

packing (*none* | *simple* | *compress-all* | *compress-headers*; default: **simple**) - specifies the packing mode

- **none** - no packing is applied to packets
- **simple** - aggregate many small packets into one large packet, minimizing network overhead per packet
- **compress-headers** - further increase network performance by compressing IP packet header (consumes more CPU resources)
- **compress-all** - increase network performance even more by using header and data compression (extensive CPU usage)

unpacking (*none* | *simple* | *compress-all* | *compress-headers*; default: **simple**) - specifies the unpacking mode

- **none** - accept only usual packets
- **simple** - accept usual packets and aggregated packets without compression
- **compress-headers** - accept all packets except those with payload compression
- **compress-all** - accept all packets

Notes

Level of packet compression increases like this: **none** -> **simple** -> **compress-headers** -> **compress-all**.

When router has to send a packet it choses minimum level of packet compression from what its own **packing** type is set and what other router's **unpacking** type is set. Same is with **aggregated-size** setting - minimum value of both ends is actual maximum size of aggregated packet used.

aggregated-size can be bigger than interface MTU if network device allows it to be (i.e., it supports sending and receiving frames bigger than 1514 bytes)

Example

To enable maximal compression on the **ether1** interface:

```
[admin@MikroTik] ip packing> add interface=ether1 packing=compress-all \
\... unpacking=compress-all
[admin@MikroTik] ip packing> print
Flags: X - disabled
  #   INTERFACE PACKING          UNPACKING        AGGREGATED-SIZE
  0   ether1    compress-all     compress-all     1500

[admin@MikroTik] ip packing>
```

DNS Client and Cache

Document revision 1.1 (Mon Mar 22 09:23:47 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

DNS cache is used to minimize DNS requests to an external DNS server as well as to minimize DNS resolution time. This is a simple recursive DNS server with local items.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip dns***
Standards and Technologies: ***DNS***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***HotSpot Gateway***

- *AAA*

Description

The MikroTik router with DNS cache feature enabled can be set as a primary DNS server for any DNS-compliant clients. Moreover, MikroTik router can be specified as a primary DNS server under its dhcp-server settings. When the DNS cache is enabled, the MikroTik router responds to DNS TCP and UDP requests on port 53.

Additional Documents

- ***http://www.freesoft.org/CIE/Course/Section2/3.htm***
- ***http://www.networksorcery.com/enp/protocol/dns.htm***
- ***RFC1035***

Client Configuration and Cache Setup

Home menu level: ***/ip dns***

Description

DNS client is used to provide domain name resolution for router itself as well as for the P2P clients connected to the router.

Property Description

allow-remote-requests (yes | no) - specifies whether to allow network requests

primary-dns (*IP address*; default: **0.0.0.0**) - primary DNS server

secondary-dns (*IP address*; default: **0.0.0.0**) - secondary DNS server

cache-size (*integer*: 512..10240; default: **2048 kB**) - specifies the size of DNS cache in kB

cache-max-ttl (*time*; default: **7d**) - specifies maximum time-to-live for cahce records. In other words, cache records will expire after cache-max-ttl time.

cache-used (*read-only: integer*) - displays the currently used cache size in kB

Notes

If the property **use-peer-dns** under **/ip dhcp-client** is set to **yes** then **primary-dns** under **/ip dns** will change to a DNS address given by DHCP Server.

Example

To set 159.148.60.2 as the primary DNS server, do the following:

```
[admin@MikroTik] ip dns> set primary-dns=159.148.60.2
[admin@MikroTik] ip dns> print
     resolve-mode: remote-dns
      primary-dns: 159.148.60.2
    secondary-dns: 0.0.0.0
```

```
[admin@MikroTik] ip dns>
```

Cache Monitoring

Home menu level: ***/ip dns cache***

Property Description

name (*read-only: name*) - DNS name of the host

address (*read-only: IP address*) - IP address of the host

ttl (*time*) - remaining time-to-live for the record

Static DNS Entries

Home menu level: ***/ip dns static***

Description

The MikroTik RouterOS has an embedded DNS server feature in DNS cache. It allows you to link the particular domain names with the respective IP addresses and advertize these links to the DNS clients using the router as their DNS server.

Property Description

name (*text*) - DNS name to be resolved to a given IP address

address (*IP address*) - IP address to resolve domain name with

Example

To add a static DNS entry for **www.example.com** to be resolved to **10.0.0.1** IP address:

```
[admin@MikroTik] ip dns static> add name www.example.com address=10.0.0.1
[admin@MikroTik] ip dns static> print
 # NAME                                                   ADDRESS         TTL
 0 aaa.aaa.a                                              123.123.123.123 1d
 1 www.example.com                                        10.0.0.1        1d
[admin@MikroTik] ip dns static>
```

Flushing DNS cache

Command name: ***/ip dns cache flush***

Command Description

flush - clears internal DNS cache

Example

```
[admin@MikroTik] ip dns> cache flush
[admin@MikroTik] ip dns> print
              primary-dns: 159.148.60.2
            secondary-dns: 0.0.0.0
```

```
    allow-remote-requests: no
               cache-size: 2048 kB
            cache-max-ttl: 7d
               cache-used: 10 kB
[admin@MikroTik] ip dns>
```

Services, Protocols, and Ports

Document revision 1.0.0 (Fri Mar 05 08:38:56 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

This document lists protocols and ports used by various MikroTik RouterOS services. It helps you to determine why your MikroTik router listens to certain ports, and what you need to block/allow in case you want to prevent or grant access to the certain services. Please see the relevant sections of the Manual for more explanations.

Home menu level: ***/ip service***

Related Documents

- ***Firewall Filters***
- ***Packet Marking (Mangle)***
- ***Certificate Management***

Modifying Service Settings

Home menu level: ***/ip service***

Property Description

name - service name

port (*integer*: 1..65535) - the port particular service listens on

address (*IP address/mask*; default: **0.0.0.0/0**) - IP address(-es) from which the service is accessible

certificate (*name* | *none*; default: **none**) - the name of the certificate used by particular service (absent for the services that do not need certificates)

Example

To set **www** service to use **8081** port accesible from the **10.10.10.0/24** network:

```
[admin@MikroTik] ip service> print
Flags: X - disabled, I - invalid
 #   NAME                                 PORT  ADDRESS            CERTIFICATE
 0   telnet                               23    0.0.0.0/0
 1   ftp                                  21    0.0.0.0/0
 2   www                                  80    0.0.0.0/0
 3   hotspot                              8088  0.0.0.0/0
 4   ssh                                  22    0.0.0.0/0
 5   hotspot-ssl                          443   0.0.0.0/0          hotspot
[admin@MikroTik] ip service> set www port=8081 address=10.10.10.0/24
[admin@MikroTik] ip service> print
Flags: X - disabled, I - invalid
  #   NAME                                PORT  ADDRESS            CERTIFICATE
  0   telnet                              23    0.0.0.0/0
  1   ftp                                 21    0.0.0.0/0
  2   www                                 8081  10.10.10.0/24
  3   hotspot                             8088  0.0.0.0/0
  4   ssh                                 22    0.0.0.0/0
  5   hotspot-ssl                         443   0.0.0.0/0          hotspot
[admin@MikroTik] ip service>
```

List of Services

Description

Below is the list of protocols and ports used by MikoTik RouterOS services. Some services require additional package to be installed, as well as to be enabled by administrator, *exempli gratia* bandwidth server.

Port/Protocol	Description
20/tcp	**File Transfer [Default Data]**
21/tcp	**File Transfer [Control]**
22/tcp	**SSH Remote Login Protocol (Only with security package)**
23/tcp	**Domain Name Server**
53/tcp	**Domain Name Server**
67/udp	**Bootstrap Protocol Server, DHCP Client (only with dhcp package)**
68/udp	**Bootstrap Protocol Client, DHCP Client (only with dhcp package)**
80/tcp	**World Wide Web HTTP**
123/tcp	**Network Time Protocol (Only with ntp package)**
161/tcp	**SNMP (Only with snmp package)**
443/tcp	**Secure Socket Layer Encrypted HTTP(Only with hotspot package)**
500/udp	**IKE protocol (Only with ipsec package)**
179/tcp	**Border Gateway Protocol (Only with routing**

	package)
1719/udp	**h323gatestat (Only with telephony package)**
1720/tcp	**h323hostcall (Only with telephony package)**
1723/tcp	**pptp (Only with ppp package)**
2000/tcp	**bandwidth-test server**
3986/tcp	**proxy for winbox**
3987/tcp	**sslproxy for secure winbox (Only with security package)**
5678/udp	**MikroTik Neighbor Discovery Protocol**
8080/tcp	**HTTP Alternate (Only with web-proxy package)**
/1	**ICMP - Internet Control Message**
/4	**IP - IP in IP (encapsulation)**
/47	**GRE - General Routing Encapsulation (Only for PPTP and EoIP)**
/50	**ESP - Encapsulating Security Payload for IPv4 (Only with security package)**
/51	**AH - Authentication Header for IPv4 (Only with security package)**
/89	**OSPFIGP - OSPF Interior Gateway Protocol**

HotSpot Gateway

Document revision 3.4 (Sat May 29 07:57:03 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

The MikroTik HotSpot Gateway enables providing of public network access for clients using wireless or wired network connections.

HotSpot Gateway features:

- authentication of clients using local client database, or RADIUS server
- accounting using local database, or RADIUS server
- Walled-garden system (accessing some web pages without authorization)
- HotSpot Gateway can provide access for authorized clients using two different methods:
  - **dhcp-pool** method uses DHCP server to assign temporary (not valid in outer networks) IP addresses to clients prior to authentication. After successful authentication the DHCP server assigns an IP address to the client from a different IP pool. This method may be used to assign a fixed IP address to each user (i.e. no matter which computer does the user use, he/she will always use the same IP address)
  - **enabled-address** method enables traffic for authorized clients without need of IP address change
- traffic and connection time accounting
- clients can be limited by:
  - download/upload speed (tx/rx bitrate)
  - connection time
  - downloaded/uploaded traffic (bytes)

Universal Client feature may be used with HotSpot enabled-address method to provide IP network services regardless of client computers' IP network settings

Specifications

Packages required: ***hotspot, dhcp (optional)***
License required: ***level1 (Limited to 1 active user), level3 (Limited to 1 active user), level4 (Limited to 200 active users), level5 (Limited to 500 active users), level6***
Home menu level: ***/ip hotspot***
Standards and Technologies: ***ICMP*, *DHCP***
Hardware usage: ***Not significant***

Related Documents

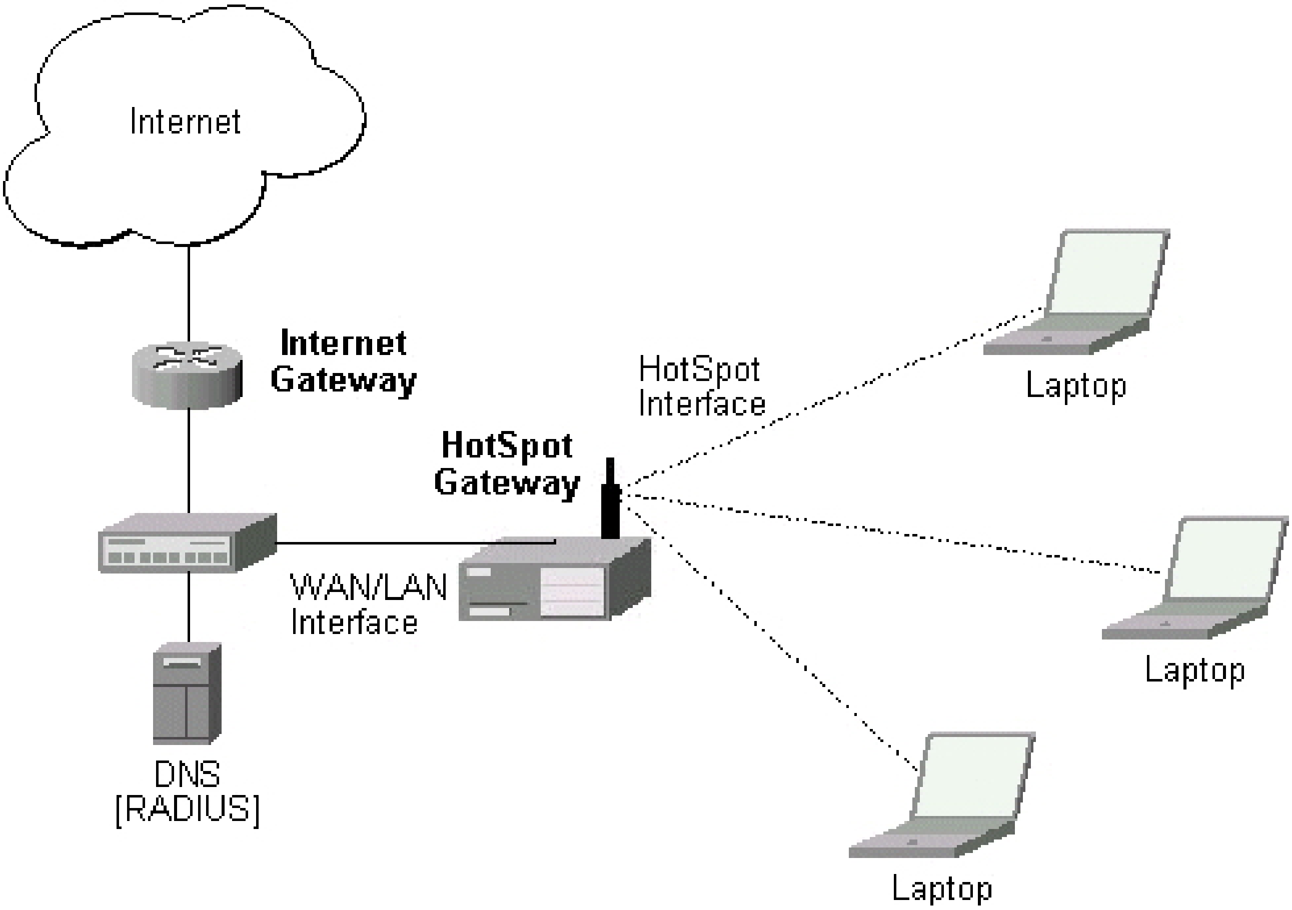
- ***Package Management***
- ***IP Addresses and ARP***
- ***IP Pools***
- ***DHCP Client and Server***
- ***AAA***
- ***Firewall Filters***
- ***Packet Marking (Mangle)***
- ***Network Address Translation***
- ***Connection Tracking and Service Ports***

Description

MikroTik HotSpot Gateway should have at least two network interfaces:

1. HotSpot interface, which is used to connect HotSpot clients
2. LAN/WAN interface, which is used to access network resources. For example, DNS and RADIUS server(s) should be accessible

The diagram below shows a sample HotSpot setup.



The HotSpot interface should have an IP address assigned to it. To use **dhcp-pool** method, there should be two IP addresses: one as the gateway for the temporary IP address pool used prior to authentication, and second as the gateway for the permanent IP address pool used by authenticated clients. **Note**, that you have to provide routing for these address pools, unless you plan to use masquerading (source NAT). Physical network connection has to be established between the HotSpot user's computer and the gateway. It can be wireless (the wireless card should be registered to AP), or wired (the NIC card should be connected to a hub or a switch).

In **dhcp-pool** case, the arp mode of the HotSpot interface should be set to **reply-only** to prevent network access using static IP addresses (the DHCP server should add static ARP entries for each DHCP client). **Note** also that Universal Client feature can not be used with **dhcp-pool** method.

Introduction to HotSpot

HotSpot is a way to authorize users to access some network resources. It does not provide traffic encryption. To log in, users may use almost any web browser (either HTTP or HTTPS protocol), so they are not required to install additional software. The gateway is accounting the uptime and amount of traffic each of its clients have used, and also can send this information to a RADIUS server. The HotSpot system may limit each particular user's bitrate, total amount of traffic, uptime and some other parameters mentioned further in this document.

The HotSpot system is targeted to provide authentication within a local network, but may as well be used to authorize access from outer networks to local networks. Configuring firewall rules, it is possible to exclude some IP networks and protocols from authentication and/or accounting. The walled garden feature allows users to access some web pages without the need of prior authentication.

HotSpot system is rather simple by itself, but it must be used in conjunction with other features of RouterOS. Using many RouterOS features together it is possible to make a Plug-and-Play access system.

There are two login methods for HotSpot users - **dhcp-pool** and **enabled-address**. The **enabled-address** is the preferred one in most cases, but if you want to bind together usernames and IP addresses (i.e. if you want a user to get the same IP address no matter which computer is he/she using), then the **dhcp-pool** method is the only possibility.

The Initial Contact

First, a client gets an IP address. It may be set statically or be given out by a DHCP server. If the client tries to access network resources using a web browser, the destination NAT rule redirects that TCP connection request to the HotSpot servlet (TCP port 8088 for HTTP by default; HTTPS may also be used on its default TCP port 443). This brings up the HotSpot Welcome/Login page where the user should input his/her username and password (the page may be customized as described later on).

It is very important to understand that login method for a particular user is determined only after the user is authenticated and no assumptions are made by the router before.

Walled Garden

It is possilbe to specify a number of domains which can be accessed without prior registration. This feature is called Walled Garden. When a not logged-in user sends a HTTP request to an allowed web page, the HotSpot gateway redirects the request to the original destination (or to a specified parent proxy). When a user is logged in, there is no effect of this table for him/her.

To implement the Walled Garden feature an embedded web proxy server has been designed, so all the requests from not authorized users are really going through this proxy. **Note** that the embedded proxy server does not have caching function yet. Also note that this embedded proxy server is in the **hotspot** software package and does not require **web-proxy** package.

Authentication

In case of HTTP protocol, HotSpot servlet generates an MD5 hash challenge to be used together with the user's password for computing the string which will be sent to the HotSpot gateway. The hash result together with username is sent over network to HotSpot service (so, password is never sent in plain text over IP network). On the client side, MD5 algorithm is implemented in JavaScript applet, so if a browser does not support JavaScript (like, for example, Internet Explorer 2.0 or some PDA browsers), it will not be able to authenticate users. It is possible to allow unencrypted passwords to be accepted, but it is not recommended to use this feature.

If HTTPS protocol is used, HotSpot user just send his/her password without additional hashing. In either case, HTTP POST method (if not possible, then - HTTP GET method) is used to send data to the HotSpot gateway.

HotSpot can authenticate users using local user database or a RADIUS server (local database is consulted first, then - a RADIUS server). If authentication is done locally, profile corresponding to that user is used, otherwise (in case of RADIUS) default profile is used to set default values for parameters, which are not set in RADIUS access-accept message. For more information on how the interaction with a RADIUS server works, see the respective manual section.

If authentication by HTTP cookie is enabled, then after each successful login cookie is sent to web browser and the same cookie is added to active HTTP cookie list. Next time a user will try to log in, web browser will send http cookie. This cookie will be compared to the one stored on the HotSpot gateway and only if there is the same source MAC address and the same randomly generated ID, user will be automatically logged in. Otherwise, the user will be prompted to log in, and in the case authentication was successfull, old cookie will be removed from the local HotSpot active cookie list and the new one with different random ID and expiration time will be added to the list and sent to the web browser.

RADIUS authentication is CHAP by defalt, but it is possible to force the HotSpot gateway to use PAP. To do this, you should enable unencrypted passwords, and remove the possibility for the servlet to hash the passwords (see **Customizing HotSpot servlet** chapter on how to do it).

Authorization

One of the two login methods is to be used for each client individually (you may choose one or allow it to be done automatically in user profile configuration). The **enabled-address** method is the preferred one, so if it is configured correctly and the client has a proper IP address (that matches the one set in the user database), this method will be used. If the **enabled-address** method is not enabled or the client's IP address should be changed, the HotSpot Gateway tries to use **dhcp-pool** method. In that case, MikroTik HotSpot Gateway's DHCP server tries to change the DHCP address lease the client might have received before the authentication. It is possible to specify what IP addresses each particular user will receive after he/she logs in (that way a user will always get the same IP no matter what computer he/she has logged in from)

Address assignment with dhcp-pool login method

To create a HotSpot infrastructure with **dhcp-pool** method, DHCP server should be configured to lease IP addresses from a temporary IP address pool for a very short period of time (lease time at about 14 seconds; lesser values may cause problems with some DHCP clients). This temporary subnet should have some restrictions, so that the users received a temporary IP address could only access the HotSpot login page.

Once a user is authenticated, the HotSpot gateway changes the lease assigned to the user so that he/she will receive an IP address from a different IP address pool when the lease time of the current temporary lease will be over (it is not possible to recall DHCP lease, so the address will only change when the temporary lease expires).

Accounting

The HotSpot system makes user accounting through firewall rules. You should create a **hotspot** firewall chain, and the system will put there two dynamic rules for each active user (one for upload, and one for download). You shold make all the traffic you need accounting for to pass through this firewall table.

Question&Answer-Based Setup

Command name: ***/ip hotspot setup***

Command Description

hotspot interface (*name*) - interface to run HotSpot on

interface already configured (yes | no; default: **no**) - whether to add hotspot authentication for the existing interface setup or otherwise interface setup should be configured from the scratch

enable universal client (yes | no; default: **no**) - whether to enable Universal Client on the HotSpot interface

login method (*dhcp-pool* | *enabled-address* | *smart*; default: **enabled-address**) - login method to use

local address of temporary network (*IP address*; default: **192.168.0.1/24**) - temporary HotSpot address for the interface (for dhcp-pool method)

masquerade temporary network (yes | no; default: **yes**) - whether to masquerade the temporary network

address pool of temporary network (*name*) - IP address pool the for temporary HotSpot network

local address of hotspot network (*IP address*; default: **10.5.50.1/24**) - HotSpot address for the interface

masquerade hotspot network (yes | no; default: **yes**) - whether to masquerade the HotSpot network

address pool of hotspot network (*name*) - IP address pool for the HotSpot network

use ssl (yes | no; default: **no**) - whether to use secure SSL authentication

import and setup certificate (yes | no; default: **yes**) - if the setup should try to import and set up a certificate

passphrase (*text*) - the passphrase of the certificate

select certificate (*name*) - which certificate to use

another port for service (*integer*; default: **4430**) - if there is already a service on the 443 TCP port, setup will move that service on an another port, so that HotSpot secure authentication page would be on standard port for SSL

ip address of smtp server (*IP address*; default: **0.0.0.0**) - IP address of the SMTP server to redirect SMTP requests (TCP port 25) to

- **0.0.0.0** - no redirect

use transparent web proxy (yes | no; default: **no**) - whether to use transparent web proxy for hotspot clients

use local dns cache (yes | no) - whether to redirect all DNS requests (UDP port 53) to the local DNS cache

dns servers (*IP address* | *IP address*) - DNS servers for HotSpot clients

dns name (*text*) - DNS domain name of the HotSpot gateway

another port for service (*integer*; default: **8081**) - another port for www service (so that hotspot service could be put on port 80)

name of local hotspot user (*text*; default: **admin**) - username of one automatically created user

password for the user (*text*) - password for the automatically created user

Notes

Depending on current settings and answers to the previous questions, default values of following questions may be different. Some questions may disappear if they become redundant (for example, there is no use of setting up temporary network when login method is **enabled-address**)

If Universal Client is enabled, and DNS cache is not used, DNS requests are redirected to the first DNS server configured.

Example

To configure HotSpot on ether1 interface (which is already configured), enabling transparent web proxy and adding user admin with password rubbish:

```
[admin@MikroTik] ip hotspot> setup
Select interface to run HotSpot on

hotspot interface: ether1
Use SSL authentication?

use ssl: no
Add hotspot authentication for existing interface setup?

interface already configured: yes
Create local hotspot user

name of local hotspot user: admin
password for the user: rubbish
Use transparent web proxy for hotspot clients?

use transparent web proxy: yes
[admin@MikroTik] ip hotspot>
```

HotSpot Gateway Setup

Home menu level: ***/ip hotspot***

Property Description

allow-unencrypted-passwords (yes | no; default: **no**) - whether to authenticate user if plain-text password is received

auth-http-cookie (yes | no; default: **no**) - defines whether HTTP authentication by cookie is enabled

auth-mac (yes | no; default: **no**) - defines whether authentication by Ethernet MAC address is enabled

auth-mac-password (yes | no; default: **no**) - use MAC address as a password if MAC authorization is enabled

auth-requires-mac (yes | no; default: **yes**) - whether to require client's IP address to resolve to MAC address (i.e. whether to require that all the clients are in the same Ethernet-like network (as opposed to IP network, Ethernet-like network is bounded by routers) as the HotSpot gateway)

dns-name (*text*) - DNS name of the HotSpot server

hotspot-address (*IP address*; default: **0.0.0.0**) - IP address for HotSpot service (used for www access)

http-cookie-lifetime (*time*; default: **1d**) - validity time of HTTP cookies

login-mac-universal (yes | no; default: **no**) - whether to log in every host of Universal client instantly in case it has its MAC address listed in HotSpot user list

parent-proxy (*IP address*; default: **0.0.0.0**) - the address of the proxy server the HotSpot service will use as a parent proxy

split-user-domain (yes | no; default: **no**) - whether to split username from domain name when the username is given in "user@domain" or in "domain\user" format

status-autorefresh (*time*; default: **1m**) - WWW status page autorefresh time

universal-proxy (yes | no; default: **no**) - whether to intercept the requests to HTTP proxy servers

use-ssl (yes | no; default: **no**) - whether the servlet allows only HTTPS:

- **yes** - the registration may only occur using the Secure HTTP (HTTPS) protocol
- **no** - the registration may be accomplished using both HTTP and HTTPS protocols

Command Description

reset-html - overwrite the existing HotSpot servlet with the original HTML files. It is used if you have changed the servlet and it is not working after that.

Notes

If **dns-name** property is not specified, **hotspot-address** is used instead. If **hotspot-address** is also absent, then both are to be detected automatically.

If **auth-mac** is enabled, then a client is not prompted for username and password if the MAC address of this computer is in the HotSpot user database (either local or on RADIUS). Nevertheless this method does not excuse clients from the common login procedure, just from filling out the registration form (i.e. regardless of whether MAC authorization is applicable for a client, he/she should open the Login page in order to get registered). The only exception is the users of Universal Client - if **login-mac-universal** property is enabled, they will not even have to open a web browser if their MAC addresses are listed in the user database.

The **universal-proxy** feature automatically creates DST-NAT rules to redirect requests of each particular user to a proxy server he/she is using (it may be set in his/her settings to use an unknown to us proxy server) to the local embedded proxy server. This feature may be used in combination with Universal Client feature to provide Internet access for users regardless of their network settings.

allow-unencrypted-passwords property makes it possible to authenticate with the browsers not supporting JavaScript (for example, Internet Explorer 2.0 or some PDA browsers). It is also possible to log in using telnet connection, just requesting the page `/login?user=username&password=password`. An another use of this property is the possibility of hard-coded authentication information in the servlet's login page simply creating the appropriate link.

auth-requires-mac property makes it possible to make a 'reverse HotSpot' - to authenticate users accessing the local network from the Internet.

Example

To enable cookie support:

```
[admin@MikroTik] ip hotspot> set auth-http-cookie=yes
[admin@MikroTik] ip hotspot> print
                        use-ssl: no
                hotspot-address: 0.0.0.0
                       dns-name: ""
             status-autorefresh: 1m
                universal-proxy: no
                   parent-proxy: 0.0.0.0:0
              auth-requires-mac: yes
                       auth-mac: no
              auth-mac-password: no
               auth-http-cookie: yes
           http-cookie-lifetime: 1d
    allow-unencrypted-passwords: no
            login-mac-universal: no
              split-user-domain: no
[admin@MikroTik] ip hotspot>
```

HotSpot User Profiles

Home menu level: ***/ip hotspot profile***

Description

HotSpot User profiles are used for common user settings. Profiles are like user groups, they are grouping users with the same limits.

Property Description

idle-timeout (*time*; default: **0s**) - idle timeout (maximal period of inactivity) for client

- **0** - no timeout

incoming-filter (*name*) - name of the firewall chain applied to incoming packets

keepalive-timeout (*time*; default: **2m**) - keepalive timeout for client

- **0** - no timeout

login-method - the login method user will be using

- **dhcp-pool** - login by changing IP address via DHCP server
- **enabled-address** - login by enabling access for client's existing IP address
- **smart** - choose best login method for each case

mark-flow (*name*) - traffic from authorized users will be marked by firewall mangle with this flow name

name (*name*) - profile reference name

outgoing-filter (*name*) - name of the firewall chain applied to outgoing packets

rx-bit-rate (*integer*; default: **0**) - receive bitrate (for users it is upload bitrate)

- **0** - no limitation

session-timeout (*time*; default: **0s**) - session timeout (maximal session time) for client
- **0** - no timeout

shared-users (*integer*; default: **1**) - maximal number of simultaneously logged in users with the same username

tx-bit-rate (*integer*; default: **0**) - transmit bitrate (for users it is download bitrate)
- **0** - no limitation

Notes

To use **enabled-address** method, **mark-flow** should be set. To use **dhcp-pool** method, **dhcp** software package must be installed

idle-timeout is used to detect, that client is not using outer networks (e.g. Internet), i.e., there is NO TRAFFIC coming from that client and going through the router. **keepalive-timeout** is used to detect, that the computer of the client is still alive and reachable. If check will fail during this period, client will be logged out. **session-timeout** is an unconditional uptime limit

To choose the login method to be used if **smart** method is set as the value of **login-method** property, the following algorithm is used:

- If a client has a dynamic DHCP address lease received from the router, correct HotSpot server is set for the DHCP server issued that lease, and the client has specific IP address set in the **/ip hotspot user** configuration, **dhcp-pool** method will be used
- else, if **mark-flow** property is defined in the client's profile), **enabled-address**method will be used
- else, if the client has a dynamic DHCP lease, **dhcp-pool**method will be used
- else, an error message will be displayed, and the client will not be logged in

Example

To use **enabled-address** method that uses **logged-in** mark and logs a client off if he disappears for more then a minute:

```
[admin@MikroTik] ip hotspot profile> set default login-method=enabled-address \
\... mark-flow=logged-in keepalive-timeout=1m
[admin@MikroTik] ip hotspot profile> print
Flags: * - default
  0 * name="default" session-timeout=0s idle-timeout=0s only-one=yes
      tx-bit-rate=0 rx-bit-rate=0 incoming-filter="" outgoing-filter=""
      mark-flow="logged-in" login-method=enabled-address keepalive-timeout=1m

[admin@MikroTik] ip hotspot profile>
```

To define an additional profile that will also limit download speed to 64 kilobyte/s and upload data rate to 32 kilobyte/s, and call it **limited**:

```
[admin@MikroTik] ip hotspot profile> add copy-from=default tx-bit-rate=65536 \
\... rx-bit-rate=32768 name=limited
[admin@MikroTik] ip hotspot profile> print
Flags: * - default
  0 * name="default" session-timeout=0s idle-timeout=0s only-one=yes
```

```
       tx-bit-rate=0 rx-bit-rate=0 incoming-filter="" outgoing-filter=""
       mark-flow="logged-in" login-method=enabled-address keepalive-timeout=1m


   1   name="limited" session-timeout=0s idle-timeout=0s only-one=yes
       tx-bit-rate=65536 rx-bit-rate=32768 incoming-filter=""
       outgoing-filter="" mark-flow="logged-in" login-method=enabled-address
       keepalive-timeout=1m

[admin@MikroTik] ip hotspot profile>
```

HotSpot Users

Home menu level: ***/ip hotspot user***

Property Description

address (*IP address*; default: **0.0.0.0**) - static IP address. If not 0.0.0.0, client will always get the same IP address. It implies, that only one simultaneous login for that user is allowed

bytes-in (*read-only: integer*) - total amount of bytes received from user

bytes-out (*read-only: integer*) - total amount of bytes sent to user

limit-bytes-in (*integer*; default: **0**) - maximum amount of bytes user can transmit

- **0** - no limit

limit-bytes-out (*integer*; default: **0**) - maximum amount of bytes user can receive

- **0** - no limit

limit-uptime (*time*; default: **0s**) - total uptime limit for user (pre-paid time)

- **0s** - no limit

mac-address (*MAC address*; default: **00:00:00:00:00:00**) - static MAC address. If not 00:00:00:00:00:00, client is allowed to login only from that MAC address

name (*name*) - user name

packets-in (*read-only: integer*) - total amount of packets received from user

packets-out (*read-only: integer*) - total amount of packets sent to user

password (*text*) - user password

profile (*name*; default: **default**) - user profile

routes (*text*) - routes that are to be registered on the HotSpot gateway when the client is connected. The route format is: "dst-address gateway metric" (for example, "10.1.0.0/24 10.0.0.1 1"). Several routes may be specified separated with commas

uptime (*read-only: time*) - total time user has been logged in

Notes

If **auth-mac** property is enabled, clients' MAC addresses (written with CAPITAL letters) can be used as usernames. If **auth-mac-password** is set to **no**, there should be no password for that users. Otherwise, the password should be equal to the username. When a client is connecting, his/her MAC address is checked first. If there is a user with that MAC address, the client is authenticated as this user. If there is no match, client is asked for username and password.

The **address** property is used only for **dhcp-pool** login method to tell it DHCP server. If a user already has a permanent IP address (as it is happening when **enabled-address** method is used), this property will just be ignored.

The byte limits are total limits for each user (not for each session as at **/ip hotspot active**). So, if a user has already downloaded something, then session limit will show the total limit - (minus) already downloaded. For example, if download limit for a user is 100MB and the user has already downloaded 30MB, then session download limit after login at **/ip hotspot active** will be 100MB - 30MB = 70MB.

Should a user reach his/her limits (bytes-in >= limit-bytes-in or bytes-out >= limit-bytes-out), he/she will not be able to log in anymore.

The statistics is updated if a user is authenticated via local user database each time he/she logs out. It means, that if a user is currently logged in, then the statistics will not show current total values. Use **/ip hotspot active** submenu to view the statistics on the current user sessions.

Example

To add user Ex with password Ex that is allowed to log in only with 01:23:45:67:89:AB MAC address and is limited to 1 hour of work:

```
[admin@MikroTik] ip hotspot user> add name=Ex password=Ex \
\... mac-address=01:23:45:67:89:AB limit-uptime=1h
[admin@MikroTik] ip hotspot user> print
Flags: X - disabled
  #   NAME        ADDRESS         MAC-ADDRESS       PROFILE     UPTIME
  0   Ex          0.0.0.0         01:23:45:67:89:AB default     0s
[admin@MikroTik] ip hotspot user> print detail
Flags: X - disabled
  0   name="Ex" password="Ex" address=0.0.0.0 mac-address=01:23:45:67:89:AB
      profile=default routes="" limit-uptime=1h limit-bytes-in=0
      limit-bytes-out=0 uptime=0s bytes-in=0 bytes-out=0 packets-in=0
      packets-out=0

[admin@MikroTik] ip hotspot user>
```

HotSpot Active Users

Home menu level: ***/ip hotspot active***

Description

The active user list shows the list of currently logged in users. Nothing can be changed here, except user can be logged out with the **remove** command

Property Description

address (*read-only: IP address*) - IP address of the user

bytes-in (*read-only: integer*) - how many bytes did the router receive from the client

bytes-out (*read-only: integer*) - how many bytes did the router send to the client

domain (*read-only: text*) - domain of the user (if split from username)

idle-timeout (*read-only: time*) - how much idle time it is left for the user until he/she will be automatically logged out

keepalive-lost (*read-only: time*) - how much time past since last packed from the client has been received

packets-in (*read-only: integer*) - how many packets did the router receive from the client

packets-out (*read-only: integer*) - how many packets did the router send to the client

session-timeout (*read-only: time*) - how much time is left for the user until he/she will be automatically logged out

uptime (*read-only: time*) - current session time (logged in time) of the user

user (*read-only: name*) - name of the user

Example

To get the list of active users:

```
[admin@MikroTik] ip hotspot active> print
Flags: R - radius, H - DHCP
  #    USER         ADDRESS         UPTIME          SESSION-TIMEOUT IDLE-TIMEOUT
  0    Ex           10.0.0.144      4m17s           55m43s
[admin@MikroTik] ip hotspot active>
```

HotSpot Remote AAA

Home menu level: ***/ip hotspot aaa***

Property Description

accounting (yes | no; default: **yes**) - whether RADIUS accounting should be used (have no effect if RADIUS is not used)

interim-update (*time*; default: **0s**) - Interim-Update time interval

- **0s** - do not send accounting updates

use-radius (yes | no; default: **no**) - whether user database in a RADIUS server should be consulted

Notes

RADIUS user database is consulted only if the required username is not found in local user database

The value set in **interim-update** is overridden by the value sent by a RADIUS server (if any)

Example

To enable RADIUS AAA:

```
[admin@MikroTik] ip hotspot aaa> set use-radius=yes
[admin@MikroTik] ip hotspot aaa> print
        use-radius: yes
        accounting: yes
    interim-update: 0s
[admin@MikroTik] ip hotspot aaa>
```

HotSpot Server Settings

Home menu level: ***/ip hotspot server***

Description

HotSpot Server configuration is used to modify DHCP leases for logged-in users in order them to get non-temporary addresses. When a user has successfully authenticated, the HotSpot Server communicates with the DHCP server to change the lease information the user will receive next time he/she will request the DHCP lease (that is why the lease of temporary address should be as short as possible). The new lease should not be for a long time either for users to be able to switch fast on one machine as well as to reuse the IP addresses of this pool (users are logged out just as they click the log out button, but their addresses stay allocated to the machines they have been using, making it impossible for another users to log in from these machines)

Property Description

address-pool (*name*) - IP pool name, from which a HotSpot client will get an IP address if it is not given a static IP address

dhcp-server (*name*) - DHCP server with which to use this profile

lease-time (*time*; default: **1m**) - DHCP lease time for logged in user

login-delay (*time*; default: **10s**) - Time required to log user in. The after-login page is displayed for this time. This time should be approximately the same as the lease-time for the temporary address lease

name (*name*) - server profile name

Notes

This configuration is ignored by **enabled-address** method.

There can be added one HotSpot Server for each DHCP server. Which server profile to apply will depend on DHCP server which gave DHCP lease to that client. Actually it means that if user will log in from different interfaces, then different server profiles will be used. It allows assigning different IP addresses on different Ethernet interfaces.

Network mask, gateway and some other setting are set up in **/ip dhcp network** submenu

Example

To add a HotSpot server named **dhcp1** to the DHCP server **hotspot-dhcp** giving IP addresses from the **hotspot** address pool:

```
[admin@MikroTik] ip hotspot server> add name=dhcp1 dhcp-server=hotspot-dhcp \
\... address-pool=hotspot
[admin@MikroTik] ip hotspot server> print
  # NAME                 DHCP-SERVER    ADDRESS-POOL LOGIN-DELAY  LEASE-TIME
  0 dhcp1                hotspot-dhcp   hotspot      10s          1m
```

```
[admin@MikroTik] ip hotspot server>
```

HotSpot Cookies

Home menu level: ***/ip hotspot cookie***

Description

Cookies can be used for authentication in the Hotspot service

Property Description

domain (*read-only: text*) - domain name (if split from username)

expires-in (*read-only: time*) - how long the cookie is valid

mac-address (*read-only: MAC address*) - user's MAC address

user (*read-only: name*) - username

Notes

There can be multiple cookies with the same MAC address. For example, there will be a separate cookie for each web browser on the same computer.

Cookies can expire - that's the way how it is supposed to be. Default validity time for cookies is **1** day (24 hours), but it can be changed:

```
/ip hotspot set http-cookie-lifetime=3d
```

Example

To get the list of valid cookies:

```
[admin@MikroTik] ip hotspot cookie> print
  # USER               DOMAIN            MAC-ADDRESS       EXPIRES-IN
  0 Ex                                   01:23:45:67:89:AB 23h54m16s
[admin@MikroTik] ip hotspot cookie>
```

Walled Garden

Home menu level: ***/ip hotspot walled-garden***

Description

Walled garden is a system which allows unauthorized use of some resources, but requires authorization to access other resources. This is useful, for example, to give access to some general information about HotSpot service provider or billing options.

Property Description

action (*allow* | *deny*; default: **allow**) - action to undertake if a packet matches the rule:

- **allow** - allow the access to the page without prior authorization
- **deny** - the authorization is required to access this page

dst-host (*text*; default: "") - domain name of the destination web server (this is regular expression)

dst-port (*integer*; default: "") - the TCP port a client has send the request to

path (*text*; default: "") - the path of the request (this is regular expression)

Notes

Currently you can not place HTTPS servers inside the Walled Garden. However, there is a workaround on this. You can add a mangle rule that allows you to pass traffic to an IP address of secure web server, *exempli gratia*:

```
/ip firewall mangle add dst-address=159.148.108.1/32 mark-flow=hs-auth
```

Example

To allow unauthorized requests to the **www.example.com** domain's **/paynow.html** page:

```
[admin@MikroTik] ip hotspot walled-garden> add path="^/paynow\\.html$" \
\... dst-host="^www\\.example\\.com$"
[admin@MikroTik] ip hotspot walled-garden> print
Flags: X - disabled
 #   DST-HOST                      DST-PORT PATH                         ACTION
 0   ^www\.example\.com$                    ^/paynow\.html$              allow
[admin@MikroTik] ip hotspot walled-garden>
```

Notes:

- \\ symbol sequence is used to enter \ character
- **\.** pattern means **.** only (in regular expressions single dot in pattern means any symbol)
- to show that no symbols are allowed before the given pattern, we use **^** symbol at the beginning of the pattern
- to specify that no symbols are allowed after the given pattern, we use **$** symbol at the end of the pattern

Customizing HotSpot Servlet

Description

Servlet Pages

The HotSpot servlet recognizes 5 different request types:

1. request for a remote host
    - if user is logged in, the requested page is served

    - if user is not logged in, but the destination host is allowed by walled garden, then the request is also served
    - if user is not logged in, and the destination host is disallowed by walled garden, **rlogin.html** is displayed; if **rlogin.html** is not found, **redirect.html** is used to redirect to the login page

2. request for '/' on the HotSpot host
    - if user is logged in, **rstatus.html** is displayed; if **rstatus.html** is not found, **redirect.html** is used to redirect to the status page
    - if user is not logged in, **rlogin.html** is displayed; if **rlogin.html** is not found, **redirect.html** is used to redirect to the login page

3. request for '/login' page
    - if user has successfully logged in (or is already logged in), **alogin.html** is displayed; if **alogin.html** is not found, **redirect.html** is used to redirect to the originally requested page or the status page (in case, original destination page was not given)
    - if user is not logged in (username was not supplied, no error message appeared), **login.html** is showed
    - if login procedure has failed (error message is supplied), **flogin.html** is displayed; if **flogin.html** is not found, **login.html** is used
    - in case of fatal errors, **error.html** is showed

4. request for '/status' page
    - if user is logged in, **status.html** is displayed
    - if user is not logged in, **fstatus.html** is displayed; if **fstatus.html** is not found, **redirect.html** is used to redirect to the login page

5. request for '/logout' page
    - if user is logged in, **logout.html** is displayed
    - if user is not logged in, **flogout.html** is displayed; if **flogout.html** is not found, **redirect.html** is used to redirect to the login page

Note that if it is not possible to meet a request using the pages stored on the router's FTP server, the default pages are used.

There are many possibilities to customize what the HotSpot authentication pages look like:

- The pages are easily modifiable. They are stored on the router's FTP server in **hotspot** directory.
- By changing the variables, which client sends to the HotSpot servlet, it is possible to reduce keyword count to one (username or password; for example, the client's MAC address may be used as the other value) or even to zero (License Agreement; some predefined values general for all users or client's MAC address may be used as username and password)
- Registration may occur on a different server (for example, on a server that is able to charge Credit Cards). Client's MAC address may be passed to it, so that this information need not be written in manually. After the registration, the server may change RADIUS database enabling

client to log in for some amount of time.

To insert variable in some place in HTML file, variable name surrounded by % symbols is used. This construction may be used in any HotSpot HTML file accessed as '/', '/login', '/status' or '/logout'. For example, to show a link to the login page, following construction can be used:

```
<a href="%link-login%">login</a>
```

Variables

All of the Servlet HTML pages use variables to show user specific values. Variable names appear only in the source - they are automatically replaced with the respective values by the HotSpot Servlet. For each variable there is an example included in brackets.

- Common variables (available in all pages):
  - **hostname** - DNS name or IP address (if DNS name is not given) of the HotSpot Servlet ("hotspot.example.net")
  - **identity** - RouterOS identity name ("MikroTik")
  - **ip** - IP address of the client ("10.5.50.2")
  - **link-logout** - link to logout page ("http://10.5.50.1/logout")
  - **link-login** - link to login page including original URL requested ("http://10.5.50.1/login?dst=http://www.example.com/")
  - **link-status** - link to status page ("http://10.5.50.1/status")
  - **link-orig** - original URL requested ("http://www.example.com/")
  - **session-id** - value of 'session-id' parameter in the last request
  - **var** - value of 'var' parameter in the last request

- redirect.html, rlogin.html, rstatus.html, fstatus.html, flogout.html:
  - **link-redirect** - page to which redirect has to be done (for example, "http://www.example.com/")

- login.html, flogin.html:
  - **mac** - MAC address ("01:23:45:67:89:AB"; if unknown, then contains "---")
  - **error** - error message, if previous login failed ("invalid username or password")
  - **input-user** - name and value of username input field ("name=user value=john")
  - **input-password** - name of password input field ("name=password")
  - **input-popup** - name and value of pop-up input field ("name=popup checked")
  - **form-input** - name of input form and login JavaScript for password encoding ("name=login onSubmit=...")
  - **main** - MD5 encryption JavaScript and form for encrypted password
  - **user** - value of username input field ("john")
  - **domain** - value of domain ("example")
  - **popup** - whether to pop-up checkbox ("true" or "false")
  - **chap-id** - value of chap ID ("\371")
  - **chap-challenge** - value of chap challenge

("\357\015\330\013\021\234\145\245\303\253\142\246\133\175\375\316")

- alogin.html:
  - **link-redirect** - page to which redirect has to be done ("http://www.example.com/")
  - **login-time** - time in seconds after which redirect has to be done ("9")
  - **popup** - if alogin.html should pop-up status page in new window ("true" or "false")

- logout.html:
  - **username** - name ("john")
  - **ip** - IP address ("192.168.0.222")
  - **mac** - MAC address ("01:23:45:67:89:AB")
  - **uptime** - session uptime ("10h2m33s")
  - **session-timeout** - session timeout left for the user ("5h" or "---" if none)
  - **session-valid-till** - date and time when session will expire ("Sep/21/2003 16:12:33" or "---" if there is no session-timeout)
  - **idle-timeout** - idle timeout ("20m" or "---" if none)
  - **bytes-in** - number of bytes received from the user ("15423")
  - **bytes-out** - number of bytes sent to the user ("11352")
  - **packets-in** - number of packets received from the user ("251")
  - **packets-out** - number of packets sent to the user ("211")
  - **uptime-secs** - uptime in seconds ("125")
  - **session-timeout-secs** - session timeout in seconds ("3475" or "" if there is such timeout)
  - **idle-timeout-secs** - idle timeout in seconds ("88" or "" if there is such timeout)
  - **limit-bytes-in** - byte limit for send ("1000000" or "---" if there is no limit)
  - **limit-bytes-out** - byte limit for receive ("1000000" or "---" if there is no limit)
  - **remain-bytes-in** - remaining bytes until limit-bytes-in will be reached ("337465" or "---" if there is no limit)
  - **remain-bytes-out** - remaining bytes until limit-bytes-out will be reached ("124455" or "---" if there is no limit)

- status.html:
  - **username** - name ("john")
  - **ip** - IP address ("192.168.0.222")
  - **mac** - MAC address ("01:23:45:67:89:AB")
  - **uptime** - session uptime ("10h2m33s")
  - **session-timeout** - session timeout left for the user ("5h" or "---" if none)
  - **session-valid-till** - date and time when session will expire ("Sep/21/2003 16:12:33" or "---" if there is no session-timeout)
  - **idle-timeout** - idle timeout ("20m" or "---" if none)
  - **bytes-in** - number of bytes received from the user ("15423")
  - **bytes-out** - number of bytes sent to the user ("11352")

- **packets-in** - number of packets received from the user ("251")
- **packets-out** - number of packets sent to the user ("211")
- **refresh-time** - time in seconds after which to automatically refresh status page ("90s")
- **refresh-time-str** - more friendly representation of refresh-time ("1m30s")
- **uptime-secs** - uptime in seconds ("125")
- **session-timeout-secs** - session timeout in seconds ("3475" or "" if there is such timeout)
- **idle-timeout-secs** - idle timeout in seconds ("88" or "" if there is such timeout)
- **limit-bytes-in** - byte limit for send ("1000000" or "---" if there is no limit)
- **limit-bytes-out** - byte limit for receive ("1000000" or "---" if there is no limit)
- **remain-bytes-in** - remaining bytes until limit-bytes-in will be reached ("337465" or "---" if there is no limit)
- **remain-bytes-out** - remaining bytes until limit-bytes-out will be reached ("124455" or "---" if there is no limit)

- error.html:
  - **error** - error message ("DHCP lease not found")

Notes

To insert % symbol as a text (not as a part of variable construction), "%%" has to be used (if there is only one % symbol on a page or string between it and next % symbol is not a valid variable name, % may be used with the same result).

In most cases it is required login page to use **main** variable. And it is strongly suggested to place it BEFORE **form-input** input form. Otherwise situation can happen, that user already has entered his username/password, but MD5 encryption JavaScript is not yet loaded. It may result in password being sent over network in plain text. And of course, that login will fail in this case, too (if **allow-unencrypted-password** property is not set to **yes**).

The resulting password to be sent to the HotSpot gateway is formed MD5-hashing the concatenation of the following: chap-id, the password of the user and chap-challenge (in the given order)

The gateway uses CHAP authentication in case client's browser is hashing his/her pasword (in other words, if the **main** variable has been initialized successfully before the form is being submitted). In case plain-text password has been sent, PAP authentication algorithm is used. So if you want to force PAP-only authentication, you must remove the **main** variable from the servlet (of course, you must also allow the gateway to accept unencrypted passwords, or otherwise no one would be able to login at all).

In case if variables are to be used in link directly, then they must be escaped accordingly. For example, in login page??<a href="https://login.example.com/login?mac=%mac%&user=%user%">link</a> will not work as intended, if username will be "123&456=1 2". In this case instead of %user%, its escaped version must be used: %user-esc%: <a href="https://login.server.serv/login?mac=%mac-esc%&user=%user-esc%">link</a>. Now the same username will be converted to "123%26456%3D1+2", which is the valid representation of "123&456=1 2" in URL. This trick may be used with any variables, not only with %user%.

Example

With basic HTML language knowledge and the examples below it should be easy to implement the ideas described above.

- To provide predefined value as username, in login.html change:

```
<input type="text" %input-user%>
```

  to this line:

```
<input type="hidden" name="user" value="hsuser">
```

  (where **hsuser** is the username you are providing)

- To provide predefined value as password, in login.html change:

```
<input type="password" %input-password%>
```

  to this line:

```
<input type="hidden" name="password" value="hspass">
```

  (where **hspass** is the password you are providing)

- To send client's MAC address to a registration server in form of:

```
https://www.server.serv/register.html?mac=XX:XX:XX:XX:XX:XX
```

  change the Login button link in login.html to:

```
https://www.server.serv/register.html?mac=%mac%
```

  (you should correct the link to point to your server)

- To show a banner after user login, in alogin.html after

```
if ('%popup%' == 'true') newWindow();
```

  add the following line:

```
open('http://your.web.server/your-banner-page.html', 'my-banner-name','');
```

  (you should correct the link to point to the page you want to show)

- To choose different page shown after login, in login.html change:

```
<input type="hidden" name="dst" value="%link-orig%">
```

  to this line:

```
<input type="hidden" name="dst" value="http://your.web.server">
```

  (you should correct the link to point to your server)

An another example is making HotSpot to authenticate on a remote server (which may, for example, perform creditcard charging):

- Allow direct access to the external server in dst-nat and hotspot-temp firewall chain or, alternatively, either in mangle, or in walled-garden. Note: walled-garden is not compatible with HTTPS.
- Modify login page of the HotSpot servlet to redirect to the external authentication server. The external server should modify RADIUS database as needed
  Here is an example of such a login page to put on the HotSpot router (it is redirecting to https://auth.example.com/login.php, replace with the actual address of an external authentication server):

```
<html> <title>...</title> <body> <form name="redirect"
action="https://auth.example.com/login.php" method="post"> <input type="hidden"
name="mac" value="%mac%"> <input type="hidden" name="ip" value="%ip%"> <input
type="hidden" name="user" value="%user%"> <input type="hidden" name="link-login"
value="%link-login%"> <input type="hidden" name="link-orig" value="%link-orig%">
<input type="hidden" name="error" value="%error%"> </form> <script
language="JavaScript"> <!-- document.redirect.submit(); //--> </script> </body>
</html>
```

- The external server can log in a HotSpot client by redirecting it back to the original HotSpot servlet login page, specifying the correct username and password
  Here is an example of such a page (it is redirecting to https://hotspot.example.com/login, replace with the actual address of a HotSpot router; also, it is displaying www.mikrotik.com after successful login, replace with what needed):

```
<html> <title>Hotspot login page</title> <body> <form name="login"
action="https://hotspot.example.com/login" method="post"> <input type="text"
name="user" value="demo"> <input type="password" name="password" value="none">
<input type="hidden" name="domain" value=""> <input type="hidden" name="dst"
value="http://www.mikrotik.com/"> <input type="submit" name="login" value="log in">
</form> </body> </html>
```

- Hotspot will ask RADIUS server whether to allow the login or not. If not allowed, alogin.html page will be displayed (it can be modified to do anything!). If not allowed, flogin.html (or login.html) page will be displayed, which will redirect client back to the external authentication server.
- Note: as shown in these examples, HTTPS protocol and POST method can be used to secure communications.

Possible Error Messages

Description

There are two kinds of errors: fatal non-fatal. Fatal errors are shown on a separate HTML page called error.html. Non-fatal errors are basically indicating incorrect user actions and are shown on the login form.

General non-fatal errors:

- **You are not logged in** - trying to access the status page or log off while not logged in. Solution: log in
- **IP <your_ip_address> is already logged in** - trying to log in while somebody from this IP address has already been logged in. Solution: you should not log in twice
- **no chap** - trying to log in using MD5 hash, but HotSpot server does not know the challenge used for the hash (this is may happen if you use BACK buttons in browser). Solution: instruct browsers to reload (refresh) the login page
- **invalid username: this MAC address is not yours** - trying to log in using a MAC address username different from the actual user's MAC address. Solution: no - users with usernames that look like a MAC address may only log in from the MAC address specified as their user name

- **current license allows only <num> sessions** - Solution: try to log in later when there will be less concurrent user sessions, or buy an another license that allows more simultaneous sessions
- **hotspot service is shutting down** - RouterOS is currently being restarted or shut down. Solution: wait until the service will be available again

General fatal errors:

- **unknown MAC address for <your_ip_address>** - trying to log in from a remote MAC network (i.e. there is a router between the client and the HotSpot gateway). Cause: if auth-requires-mac parameter is enabled, users can only log in from the same MAC network the HotSpot router belongs to. Solution: disable the auth-requires-mac parameter
- **can't get IP: no IP pool** - DHCP-pool login method is chosen for this user, but no IP pool is specified. Solution: make sure that an IP pool is specified in /ip hotspot server submenu
- **no address from ip pool** - unable to get an IP address from an IP pool. Solution: make sure there is a sufficient amount of free IP addresses in IP pool
- **IP <your_ip_address> from pool is already logged in** - somebody is already logged in using the address should be given by DHCP server (in DHCP-pool login method) to the current user. Solution: do not specify static IP addresses from the range that belongs to an IP pool that HotSpot is using to dynamically give out IP addresses
- **unable to determine IP address of the client** - The client's IP address is the same the HotSpot router has. Cause: this happen if a user is using a local SOCKS proxy server to access the HotSpot gateway. Solution: do not use local SOCKS proxy to access the HotSpot page. You may use a local HTTP proxy server without any troubles
- **invalid license** - report this error to MikroTik
- **unencrypted passwords are not accepted** - received an unencrypted password. Solution: either use a browser that supports JavaScript (all modern browsers) or set allow-unencrypted-passwords parameter to yes

Local HotSpot user database non-fatal errors:

- **invalid username or password** - self-explanatory
- **invalid mac address** - trying to log in from a MAC address different from specified in user database. Solution: log in from the correct MAC address or take out the limitation
- **your uptime limit is reached** - self-explanatory
- **your traffic limit is reached** - either limit-bytes-in or limit-bytes-out limit is reached
- **no more sessions are allowed for user** - the shared-users limit for the user's profile is reached. Solution: wait until someone with this username logs out, use different login name or extend the shared-users limit

RADIUS client non-fatal errors:

- **invalid username or password** - RADIUS server has rejected the username and password sent to it without specifying a reason. Cause: either wrong username and/or password, or other error. Solution: should be clarified in RADIUS server's log files
- **<error_message_sent_by_radius_server>** - this may be any message (any text string) sent back by RADIUS server. Consult with your RADIUS server's documentation for further information

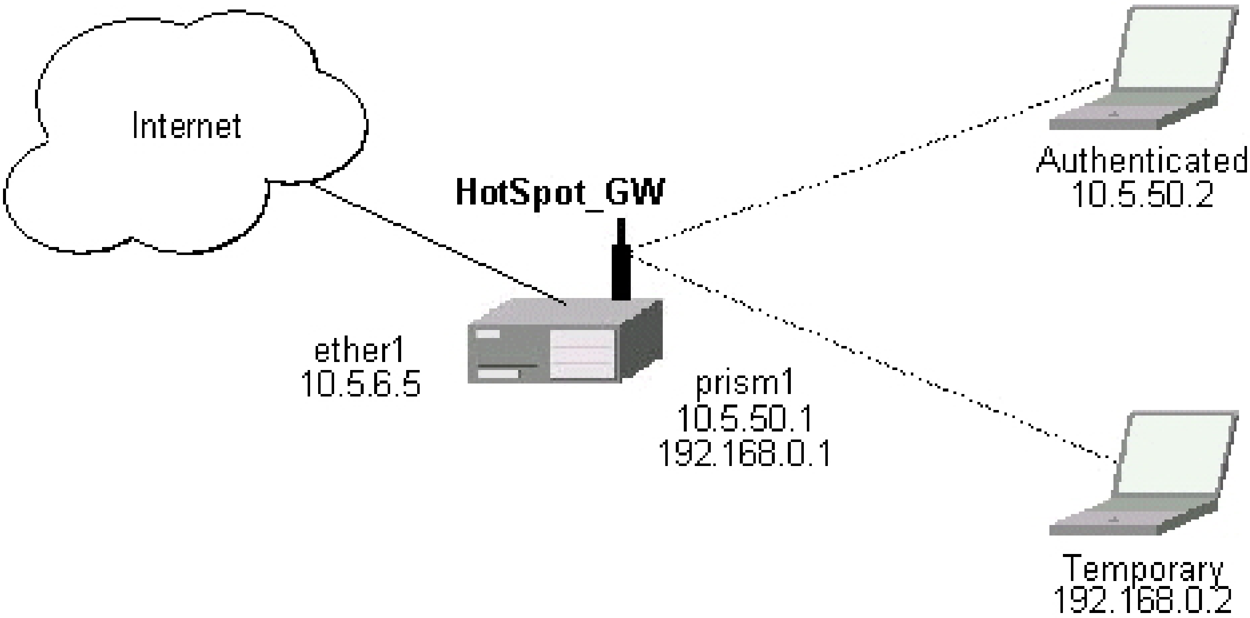
RADIUS client fatal errors:

- **RADIUS server is not responding** - self-explanatory. Solution: check whether the RADIUS server is running and is reachable from the HotSpot router
- **invalid response from RADIUS server** - the RADIUS server has sent incorrect response (neither accept nor reject). Solution: make sure the RADIUS server sends only accept or reject responses to authentication requests

HotSpot Step-by-Step User Guide for dhcp-pool Method

Description

Let us consider following example HotSpot setup:



There will be 2 HotSpot IP address ranges used for clients on **prism1** interface. You are free to choose the address ranges, just make sure you use masquerading for not routed ones. In this example, we are using:

- temporary addresses which must be masqueraded:
  - network: 192.168.0.0/24
  - gateway: 192.168.0.1
  - pool: 192.168.0.2-192.168.0.254
- real addresses which require routing:
  - network: 10.5.50.0/24
  - gateway: 10.5.50.1
  - pool: 10.5.50.2-10.5.50.254

For HotSpot client accounting, HotSpot will add dynamic firewall rules in firewall HotSpot chain. This chain has to be created manually. And all network packets (to/from HotSpot clients) have to pass this chain.

Example

1. The **ether1** interface is configured with IP address 10.5.6.5/24 and the default route pointing to the 10.5.6.1 gateway.
2. The **prism1** interface is configured for AP mode and is able register IEEE 802.11b wireless clients. See the Prism Interface Manual for more details.
3. ARP should be set to **reply-only** mode on the **prism1** interface, so no dynamic entries are added to the ARP table. DHCP server will add entries only for clients which have obtained DHCP leases:

```
/interface prism set prism1 arp=reply-only
```

4. Add two IP addresses to the **prism1** interface:

```
/ip address add address=192.168.0.1/24 interface=prism1 \
    comment="hotspot temporary network"
/ip address add address=10.5.50.1/24 interface=prism1 \
    comment="hotspot real network"
```

5. add 2 IP address pools:

```
/ip pool add name=hs-pool-temp ranges=192.168.0.2-192.168.0.254
/ip pool add name=hs-pool-real ranges=10.5.50.2-10.5.50.254
```

6. add masquerading rule for temporary IP pool, which is not routed:

```
/ip firewall src-nat add src-address=192.168.0.0/24 action=masquerade \
    comment="masquerade hotspot temporary network"
```

Make sure you have routing for authenticated address space. Try to ping 10.5.50.1 from your Internet gateway 10.5.6.1, for example. See the Basic Setup Guide on how to set up routing.

7. Add dhcp server (for temporary IP addresses):

```
/ip dhcp-server add name="hs-dhcp-server" interface=prism1 lease-time=14s \
    address-pool=hs-pool-temp add-arp=yes disabled=no
/ip dhcp-server network add address=192.168.0.0/24 gateway=192.168.0.1 \
    dns-server=159.148.60.2,159.148.108.1 domain="example.com"
```

8. Add hotspot server setup (for real IP addresses):

```
/ip hotspot server add name=hs-server dhcp-server=hs-dhcp-server \
    address-pool=hs-pool-real
/ip dhcp-server network add address=10.5.50.0/24 gateway=10.5.50.1 \
    dns-server=159.148.60.2,159.148.108.1 domain="example.com"
```

9. Add local hotspot user:

```
/ip hotspot user add name=Ex password=Ex
```

10. Setup hotspot service to run on port 80 (www service has to be assigned another port, e.g., 8081):

```
/ip service set www port=8081
/ip service set hotspot port=80
```

    Note! Changing www service to other port than 80 requires that you specify the new port when connecting to MikroTik router using WinBox, e.g., use 10.5.50.1:8081 in this case.

11. Redirect all TCP requests from temporary IP addresses to hotspot service:

```
/ip firewall dst-nat add src-address=192.168.0.0/24 dst-port=443 protocol=tcp \
    action=redirect to-dst-port=443\
    comment="redirect unauthorized hotspot clients to hotspot service"
/ip firewall dst-nat add src-address=192.168.0.0/24 protocol=tcp \
    action=redirect to-dst-port=80 \
    comment="redirect unauthorized hotspot clients to hotspot service"
```

12. Allow DNS requests and ICMP ping from temporary addresses and reject everything else:

```
/ip firewall add name=hotspot-temp comment="limit unauthorized hotspot clients"

/ip firewall rule forward add src-address=192.168.0.0/24 action=jump \
jump-target=hotspot-temp comment="limit access for unauthorized hotspot clients"

/ip firewall rule input add src-address=192.168.0.0/24 dst-port=80 \
protocol=tcp action=accept comment="accept requests for hotspot servlet"
/ip firewall rule input add src-address=192.168.0.0/24 dst-port=443 \
protocol=tcp action=accept comment="accept request for hotspot servlet"
/ip firewall rule input add src-address=192.168.0.0/24 dst-port=67 \
protocol=udp action=accept comment="accept requests for local DHCP server"
/ip firewall rule input add src-address=192.168.0.0/24 action=jump \
jump-target=hotspot-temp comment="limit access for unauthorized hotspot clients"

/ip firewall rule hotspot-temp add protocol=icmp action=return \
    comment="allow ping requests"
/ip firewall rule hotspot-temp add protocol=udp dst-port=53 action=return \
    comment="allow dns requests"
/ip firewall rule hotspot-temp add action=reject \
    comment="reject access for unauthorized hotspot clients"
```

13. Add hotspot chain:

```
/ip firewall add name=hotspot comment="account authorized hotspot clients"
```

14. Pass all through-going traffic to the hotspot chain:

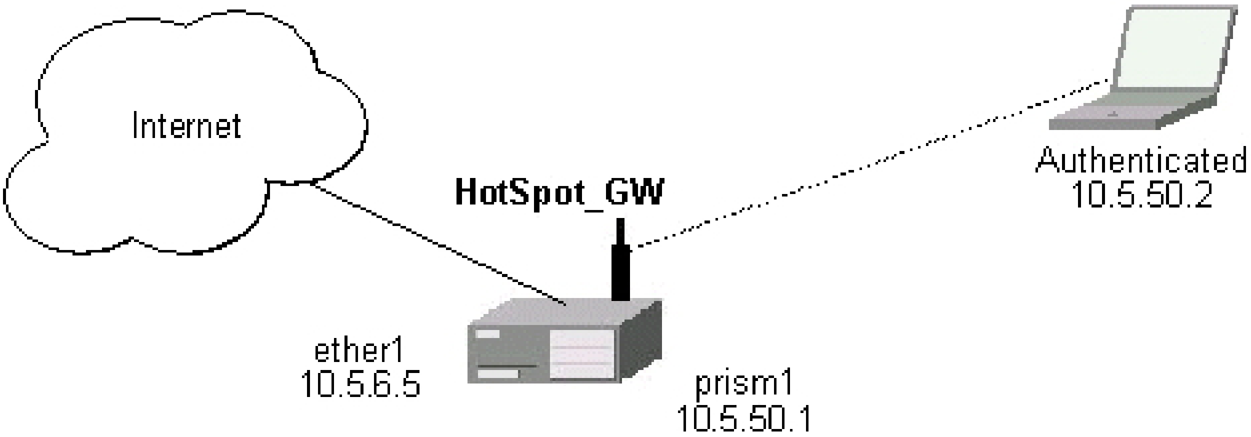
```
/ip firewall rule forward add action=jump jump-target=hotspot \
    comment="account traffic for authorized hotspot clients"
```

Note that in order to use SSL authentication, you should install an SSL certificate. This topic is not covered by this manual section. Please see the respective manual section on how to install certificates in MikroTik RouterOS

HotSpot Step-by-Step User Guide for enabled-address Method

Description

Let us consider following example HotSpot setup:



There are clients at **prism1** interface, which are able to use Internet already. You want all these clients to authenticate before they are able to use Internet.

For hotspot client accounting, hotspot will add dynamic firewall rules in firewall hotspot chain. This chain has to be created manually. And all network packets (to/from hotspot clients) have to pass this chain.

Example

1. Setup hotspot service to run on port 80 (www service has to be assigned another port, e.g., 8081):

```
/ip service set www port=8081
/ip service set hotspot port=80
```

   Note! Changing www service to other port than 80 requires that you specify the new port when connecting to MikroTik router using WinBox, e.g., use 10.5.50.1:8081 in this case.

2. Setup hotspot profile to mark authenticated users with flow name "hs-auth":

```
/ip hotspot profile set default mark-flow="hs-auth" login-method=enabled-address
```

3. Add local hotspot user:

```
/ip hotspot user add name=Ex password=Ex
```

4. Redirect all TCP requests from unauthorized clients to the hotspot service:

```
/ip firewall dst-nat add in-interface="prism1" flow="!hs-auth" protocol=tcp \
    dst-port=443 action=redirect to-dst-port=443 \
    comment="redirect unauthorized hotspot clients to hotspot service"
/ip firewall dst-nat add in-interface="prism1" flow="!hs-auth" protocol=tcp \
    action=redirect to-dst-port=80 \
    comment="redirect unauthorized clients to hotspot service"
```

5. Allow DNS requests and ICMP ping from temporary addresses and reject everything else:

```
/ip firewall add name=hotspot-temp comment="limit unauthorized hotspot clients"

/ip firewall rule forward add in-interface=prism1 action=jump \
jump-target=hotspot-temp comment="limit access for unauthorized hotspot clients"

/ip firewall rule input add in-interface=prism1 dst-port=80 protocol=tcp \
action=accept comment="accept requests for hotspot servlet"
/ip firewall rule input add in-interface=prism1 dst-port=443 protocol=tcp \
action=accept comment="accept request for hotspot servlet"
/ip firewall rule input add in-interface=prism1 dst-port=67 protocol=udp \
protocol=udp action=accept comment="accept requests for local DHCP server"
/ip firewall rule input add in-interface=prism1 action=jump \
jump-target=hotspot-temp comment="limit access for unauthorized hotspot clients"

/ip firewall rule hotspot-temp add flow="hs-auth" action=return \
    comment="return if connection is authorized"
/ip firewall rule hotspot-temp add protocol=icmp action=return \
    comment="allow ping requests"
/ip firewall rule hotspot-temp add protocol=udp dst-port=53 action=return \
    comment="allow dns requests"
/ip firewall rule hotspot-temp add action=reject \
    comment="reject access for unauthorized clients"
```

6. Create a hotspot chain for authorized hotspot clients:

```
/ip firewall add name=hotspot comment="account authorized hotspot clients"
```

7. Pass all through-going traffic to the hotspot chain:

```
/ip firewall rule forward add action=jump jump-target=hotspot \
    comment="account traffic for authorized hotspot clients"
```

Note that in order to use SSL authentication, you should install an SSL certificate. This topic is not covered by this manual section. Please see the respective manual section on how to install certificates in MikroTik RouterOS

As we see from example, only hotspot interface is used - we don't care what IP addresses are there.

It is possible to add hotspot authentication for one more interface (**prism2**) by adding only 4 additional firewall rules:

- Setup dst-nat to redirect unauthorized clients to the hotspot service:

```
/ip firewall dst-nat add in-interface="prism2" flow="!hs-auth" protocol=tcp \
    dst-potr=443 action=redirect to-dst-port=443 \
    comment="redirect unauthorized prism2 clients to hotspot service"
/ip firewall dst-nat add in-interface="prism2" flow="!hs-auth" protocol=tcp \
    action=redirect to-dst-port=80 \
    comment="redirect unauthorized prism2 clients to hotspot service"
```

- Limit access for unauthorized **prism2** interface clients:

```
/ip firewall rule forward add in-interface=prism2 action=jump \
jump-target=hotspot-temp comment="limit access for unauthorized prism2 clients"
/ip firewall rule input add in-interface=prism2 action=jump \
jump-target=hotspot-temp comment="limit access for unauthorized prism2 clients"
```

Optional Settings

- You may want to use same address space for both your LAN and HotSpot networks. Please consult the IP Address and ARP Manual for **proxy-arp** feature.
- You may want to translate the destination addresses of all TCP port 25 connections (SMTP) from HotSpot users to your local mail sever for mail relaying. Thus, users can retain their mail client setup and use your mail server for outgoing mail without reconfiguring their mail clients. If **10.5.6.100** is your mail server accepting connections from network **10.5.50.0/24**, then the required destination NAT rule would be:

```
/ip firewall dst-nat add src-address=10.5.50.0/24 dst-port=25 protocol=tcp \
    to-dst-address=10.5.6.100 action=nat \
    comment="Translate SMTP TCP 25 port to our mail server"
```

- One more option is to allow access certain pages without authentication (walled garden). For example, if **http://hotspot.example.com** is your web server's name:

```
[admin@MikroTik] ip hotspot walled-garden> add \
\... dst-host="^hotspot\\.example\\.com$"
[admin@MikroTik] ip hotspot walled-garden> print
Flags: X - disabled
 #   DST-HOST                          DST-PORT PATH                        ACTION
 0   ^hotspot\.example\.com$                                                allow
[admin@MikroTik] ip hotspot walled-garden>
```

- For HotSpot clients to use transparent web-proxy on the same router, following configuration can be used:
  1. make sure, **web-proxy** software package is installed and DNS client is configured
  2. it is assumed, that HotSpot is set up and successfully running on port 8088. Hotspot clients are connected to the interface named **prism1**
  3. set up HotSpot to use one of the router's local IP addresses (10.5.50.1):

```
/ip hotspot set hotspot-address=10.5.50.1
```

4. set up web-proxy to run on the same IP address on the port 3128:

```
/ip web-proxy set enabled=yes src-address=10.5.50.1:3128 transparent-proxy=yes
```

5. configure hotspot service to use this web proxy as its parent proxy:

```
/ip hotspot set parent-proxy=10.5.50.1:3128
```

6. redirect all requests from hotspot interface to port 80 (except to 10.5.50.1), to the web-proxy:

```
/ip firewall dst-nat add in-interface=prism1 dst-address=!10.5.50.1/32 \
    dst-port=80 protocol=tcp action=redirect
    to-dst-port=8088 comment="transparent proxy"
```

7. Now, everything should be working fine. Only traffic of the redirected requests to the web-proxy will not be accounted. It's because this traffic will not pass through the forward chain.
   to enable accounting for the HotSpot user traffic to/from transparent web-proxy, additional firewall rules should be added:

```
/ip firewall rule input add in-interface=prism1 dst-port=3128 \
    protocol=tcp action=jump jump-target=hotspot \
    comment="account traffic from hotspot client to local web-proxy"
/ip firewall rule output add src-port=3128 protocol=tcp \
    out-interface=prism1 action=jump jump-target=hotspot \
    comment="account traffic from local web-proxy to hotspot client"
```

- You may want to allow multiple logins using the same username/password. Set the argument value of **shared-users** to the number of simultaneous user sessions using the same username in HotSpot profile. For example, to allow 10 clients to use the same username simultaneously:

```
/ip hotspot profile set default shared-users=10
```

- If you want the router to resolve DNS requests, enable DNS cache, and redirect all the DNS requests to the router itself (**159.148.60.2** is this example mean the external DNS server the router will work with):

```
/ip dns set primary-dns=159.148.60.2
/ip dns set allow-remote-requests=yes
/ip firewall dst-nat add protocol=udp dst-port=53 action=redirect \
comment="intercept all DNS requests"
```

DHCP Client and Server

Document revision 2.5 (Mon Jul 19 07:06:08 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The DHCP (Dynamic Host Configuration Protocol) is needed for easy distribution of IP addresses in a network. The MikroTik RouterOS implementation includes both - server and client parts and is compliant with RFC2131.

General usage of DHCP:

- IP assignment in LAN, cable-modem, and wireless systems
- Obtaining IP settings on cable-modem systems

IP addresses can be bound to MAC addresses using static lease feature.

DHCP server can be used with MikroTik RouterOS HotSpot feature to authenticate and account DHCP clients. See the ***HotSpot Manual*** for more information.

Quick Setup Guide

This example will show you how to setup DHCP-Server and DHCP-Client on MikroTik RouterOS.

- Setup of a DHCP-Server.
    1. Create an IP address pool

```
/ip pool add name=dhcp-pool1 ranges=172.16.0.10-172.16.0.20
```

2. Add a DHCP network which will concern to the network **172.16.0.0/12** and will distribute a gateway with IP address **172.16.0.1** to DHCP clients:

```
/ip dhcp-server network add address=172.16.0.0/12 gateway=172.16.0.1
```

3. Finally, add a DHCP server:

```
/ip dhcp-server add interface=wlan1 address-pool=dhcp-pool
```

- Setup of the DHCP-Client (which will get a lease from the DHCP server, configured above).
    1. Add the DHCP client:

```
/ip dhcp-client set interface=wlan1 enabled=yes
```

2. Check whether you have obtained a lease:

```
[admin@DHCP-Client] ip dhcp-client lease> print
         status: bound
        address: 172.16.0.20/12
        gateway: 172.16.0.1
    dhcp-server: 192.168.0.1
    primary-dns: 159.148.147.194
        expires: jun/24/2004 19:11:12
[admin@DHCP-Client] ip dhcp-client lease>
```

Specifications

Packages required: ***dhcp***
License required: ***level1***
Home menu level: ***/ip dhcp-client, /ip dhcp-server, /ip dhcp-relay***

Standards and Technologies: ***DHCP***

Description

The DHCP protocol gives and allocates IP addresses to IP clients. DHCP is basically insecure and should only be used in trusted networks. DHCP server always listens on UDP 67 port, DHCP client - on UDP 68 port. The initial negotiation involves communication between broadcast addresses (on some phases sender will use source address of **0.0.0.0** and/or destination address of **255.255.255.255**). You should be aware of this when building firewall.

Additional Documents

- ***ISC Dynamic Host Configuration Protocol (DHCP)***
- ***DHCP mini-HOWTO***
- ***ISC DHCP FAQ***

DHCP Client Setup

Home menu level: ***/ip dhcp-client***

Description

The MikroTik RouterOS DHCP client may be enabled on one Ethernet-like interface at a time. The client will accept an address, netmask, default gateway, and two dns server addresses. The received IP address will be added to the interface with the respective netmask. The default gateway will be added to the routing table as a dynamic entry. Should the DHCP client be disabled or not renew an address, the dynamic default route will be removed. If there is already a default route installed prior the DHCP client obtains one, the route obtained by the DHCP client would be shown as invalid.

Property Description

add-default-route (yes | no; default: **yes**) - whether to add the default route to the gateway specified by the DHCP server

client-id (*text*) - corresponds to the settings suggested by the network administrator or ISP. Commonly it is set to the client's MAC address, but it may as well be any test string

enabled (yes | no; default: **no**) - whether the DHCP client is enabled

host-name (*text*) - the host name of the client

interface (*name*; default: **(unknown)**) - any Ethernet-like interface (this includes wireless and EoIP tunnels)

use-peer-dns (yes | no; default: **yes**) - whether to accept the DNS settings advertized by DHCP server (they will appear in /ip dns submenu)

Command Description

renew - renew current leases. If the renew operation was not successful, client tries to reinitialize lease (i.e. it starts lease request procedure (rebind) as if it had not received an IP address yet)

Notes

If **host-name** property is not specified, client's system identity will be sent in the respective field of DHCP request.

If **client-id** property is not specified, client's MAC address will be sent in the respective field of DHCP request.

If **use-peer-dns** property is enabled, the DHCP client will uncoditionally rewrite the settings in **/ip dns** submenu. In case two or more DNS servers were received, first two of them are set as primary and secondary servers respectively. In case one DNS server was received, it is put as primary server, and the secondary server is left intact.

Example

To enable DHCP client on **ether1** interface:

```
[admin@MikroTik] ip dhcp-client> set enabled=yes interface=ether1
[admin@MikroTik] ip dhcp-client> print
              enabled: yes
            interface: ether1
            host-name: ""
            client-id: ""
    add-default-route: yes
         use-peer-dns: yes
[admin@MikroTik] ip dhcp-client>
```

DHCP Client Lease

Home menu level: ***/ip dhcp-client lease***

Description

This submenu shows the actual IP address lease received by the client

Property Description

address (*read-only: IP address/mask*) - the address received

dhcp-server (*read-only: IP address*) - IP address of the DHCP server that have given out the current lease

expires (*read-only: text*) - expiration time of the lease

gateway (*read-only: IP address*) - the gateway address received

primary-dns (*read-only: IP address*) - the address of the primary DNS server received

secondary-dns (*read-only: IP address*) - the address of the secondary DNS server received

status (*read-only: "" | searching... | requesting... | bound | renewing... | rebinding...*) - the current state of DHCP client:

- **""** - DHCP client is not enabled
- **searching...** - the DHCP client is searching for DHCP server, but has not yet received an offer

- **requesting...** - the DHCP client has received an offer from a DHCP server, and requesting an IP address now
- **bound** - the DHCP client has received an IP address (status bound should also appear on the DHCP server)
- **renewing...** - the DHCP client is trying to renew the lease
- **rebinding...** - the renew operation has failed, and lease time is over, so the DHCP client is trying to request an IP address once again

Example

To check the obtained lease:

```
[admin@MikroTik] ip dhcp-client lease> print
         status: bounded
        address: 80.232.241.15/21
    dhcp-server: 10.1.0.172
        expires: oct/20/2002 09:43:50
        gateway: 80.232.240.1
    primary-dns: 195.13.160.52
  secondary-dns: 195.122.1.59
[admin@MikroTik] ip dhcp-client lease>
```

DHCP Server Setup

Home menu level: ***/ip dhcp-server***

Description

The router supports an individual server for each Ethernet-like interface. The MikroTik RouterOS DHCP server supports the basic functions of giving each requesting client an IP address/netmask lease, default gateway, domain name, DNS-server(s) and WINS-server(s) (for Windows clients) information (set up in the DHCP networks submenu)

In order DHCP server to work, you must set up also IP pools (do not inlude the DHCP server's IP address into the pool range) and DHCP networks.

Property Description

add-arp (yes | no; default: **no**) - whether to add dynamic ARP entry:

- **no** - either ARP mode should be enabled on that interface or static ARP entries should be administratively defined in /ip arp submenu

address-pool (*name* | *static-only*; default: **static-only**) - IP pool, from which to take IP addresses for clients

- **static-only** - allow only the clients that have a static lease (i.e. no dynamic addresses will be given to clients, only the ones added in lease submenu)

authoritative (yes | no; default: **no**) - whether the DHCP server is the only one DHCP server for that network

interface (*name*) - Ethernet-like interface name

lease-time (*time*; default: **72h**) - the time that a client may use an address. The client will try to renew this address after a half of this time and will request a new address after time limit expires

name (*name*) - reference name

relay (*IP address*; default: **0.0.0.0**) - the IP address of the relay this DHCP server should process requests from:

- **0.0.0.0** - the DHCP server will be used only for direct requests from clients (no DHCP really allowed)
- **255.255.255.255** - the DHCP server should be used for any incomming request from a DHCP relay except for those, which are processed by another DHCP server that exists in the /ip dhcp-server submenu

src-address (*IP address*; default: **0.0.0.0**) - the address which the DHCP client must send requests to in order to renew an IP address lease. If there is only one static address on the DHCP server interface and the source-address is left as 0.0.0.0, then the static address will be used. If there are multiple addresses on the interface, an address in the same subnet as the range of given addresses should be used

Notes

If using both - Universal Client and DHCP Server on the same interface, client will only receive a DHCP lease in case it is directly reachable by its MAC address through that interface (some wireless bridges may change client's MAC address).

If **authoritative** property is set to **yes**, the DHCP server is sending rejects for the leases it cannot bind or renew. It also may (although not always) help to prevent the users of the network to run illicitly their own DHCP servers disturbing the proper way this network should be functioning.

If **relay** property of a DHCP server is not set to **0.0.0.0** the DHCP server will not respond to the direct requests from clients.

Example

To add a DHCP server to the **ether1** interface, lending IP addresses from **dhcp-clients** IP pool for 2 hours:

```
[admin@MikroTik] ip dhcp-server> add name=dhcp-office disabled=no \
\... address-pool=dhcp-clients interface=ether1 lease-time=2h
[admin@MikroTik] ip dhcp-server> print
Flags: X - disabled, I - invalid
  #   NAME         INTERFACE    RELAY           ADDRESS-POOL LEASE-TIME ADD-ARP
  0   dhcp-office  ether1                       dhcp-clients 2h         no

[admin@MikroTik] ip dhcp-server>
```

DHCP Networks

Home menu level: ***/ip dhcp-server network***

Property Description

address (*IP address/mask*) - the network DHCP server(s) will lend addresses from

boot-file-name (*text*) - Boot file name

dns-server (*text*) - the DHCP client will use these as the default DNS servers. Two comma-separated DNS servers can be specified to be used by DHCP client as primary and secondary DNS servers

domain (*text*) - the DHCP client will use this as the 'DNS domain' setting for the network adapter

gateway (*IP address*; default: **0.0.0.0**) - the default gateway to be used by DHCP clients

netmask (*integer*: 0..32; default: **0**) - the actual network mask to be used by DHCP client

- **0** - netmask from network address is to be used

next-server (*IP address*) - IP address of next server to use in bootstrap

wins-server (*text*) - the Windows DHCP client will use these as the default WINS servers. Two comma-separated WINS servers can be specified to be used by DHCP client as primary and secondary WINS servers

Notes

The **address** field uses netmask to specify the range of addresses the given entry is valid for. The actual netmask clients will be using is specified in **netmask** property.

DHCP Leases

Home menu level: ***/ip dhcp-server lease***

Description

DHCP server lease submenu is used to monitor and manage server's leases. The issued leases is showed here as dynamic entries. You can also add static leases to issue the definite client (determined by MAC address) the specified IP address.

Generally, the DHCP lease it allocated as follows:

1. an unused lease is in **waiting** state
2. if a client asks for an IP address, the server chooses one
3. if the client will receive statically assigned address, the lease becomes **offered**, and then **bound** with the respective lease time
4. if the client will receive a dynamic address (taken from an IP address pool), the router sends a ping packet and waits for answer for 0.5 seconds. During this time, the lease is marked **testing**
5. in case, the address does not respond, the lease becomes **offered**, and then **bound** with the respective lease time
6. in other case, the lease becomes **busy** for the lease time (there is a command to retest all busy addresses), and the client's request remains unanswered (the client will try again shortly)

Then a client may free the leased address. Then the dynamic lease is removed, and the allocated address is returned to the address pool. But the static lease becomes **busy** until the client will reacquire the address.

Note that the IP addresses assigned statically are not probed.

Property Description

address (*IP address*; default: **0.0.0.0**) - lended IP address for the client

expires-after (*read-only: time*) - time until lease expires

lease-time (*time*; default: **0s**) - time that the client may use an address

- **0s** - lease will never expire

mac-address (*MAC address*; default: **00:00:00:00:00:00**) - MAC address of the client. It is the base for static lease assignment

rx-rate (*integer*; default: **0**) - maximal receive bitrate to the client (for users it is upload bitrate))

- **0** - no limitation

server (*read-only: name*) - server name which serves this client

status (*read-only: waiting | testing | busy | offered | bound*) - lease status:

- **waiting** - not used static lease
- **testing** - testing whether this address is used or not (only for dynamic leases) by pinging it with timeout of 0.5s
- **busy** - this address is assigned statically to a client or already exists in the network, so it can not be leased
- **offered** - server has offered this lease to a client, but did not receive confirmation from the client
- **bound** - server has received client's confirmation that it accepts offered address, it is using it now and will free the address not later, than the lease time will be over

tx-rate (*integer*; default: **0**) - maximal transmit bitrate to the client (for users it is download bitrate))

- **0** - no limitation

Command Description

check-status - Check status of a given busy dynamic lease, and free it in case of no response

Notes

Even though client address may be changed (with adding a new item) in **lease print** list, it will not change for the client. It is true for any changes in the DHCP server configuration because of the nature of the DHCP protocol. Client tries to renew assigned IP address only when half a lease time is past (it tries to renew several times). Only when full lease time is past and IP address was not renewed, new lease is asked (rebind operation).

the deault **mac-address** value will never work! You should specify a correct MAC address there.

Example

To assign 10.5.2.100 static IP address for the existing DHCP client (shown in the lease table as item #0):

```
[admin@MikroTik] ip dhcp-server lease> print
Flags: X - disabled, H - hotspot, D - dynamic
  #   ADDRESS         MAC-ADDRESS       EXPIRES-AFTER SERVER         STATUS
  0 D 10.5.2.90       00:04:EA:C6:0E:40 1h48m59s      switch         bound
  1 D 10.5.2.91       00:04:EA:99:63:C0 1h42m51s      switch         bound
[admin@MikroTik] ip dhcp-server lease> add copy-from=0 address=10.5.2.100
```

```
[admin@MikroTik] ip dhcp-server lease> print
Flags: X - disabled, H - hotspot, D - dynamic
  #   ADDRESS          MAC-ADDRESS       EXPIRES-AFTER SERVER         STATUS
  1 D 10.5.2.91        00:04:EA:99:63:C0 1h42m18s      switch         bound
  2   10.5.2.100       00:04:EA:C6:0E:40 1h48m26s      switch         bound
[admin@MikroTik] ip dhcp-server lease>
```

DHCP Relay

Home menu level: ***/ip dhcp-relay***

Description

DHCP Relay is just a proxy that is able to receive a DHCP request and resend it to the real DHCP server

Property Description

dhcp-server (*text*) - list of DHCP servers' IP addresses which should be the DHCP requests forwarded to

interface (*name*) - interface name the DHCP relay will be working on

local-address (*IP address*; default: **0.0.0.0**) - the unique IP address of this DHCP relay needed for DHCP server to distinguish relays:

- **0.0.0.0** - the IP address will be chosen automatically

name (*name*) - descriptive name for relay

Notes

DHCP relay does not choose the particular DHCP server in the dhcp-server list, it just sent to all the listed servers.

Example

To add a DHCP relay named **relay** on **ether1** interface resending all received requests to the **10.0.0.1** DHCP server:

```
[admin@MikroTik] ip dhcp-relay> add name=relay interface=ether1 \
\... dhcp-server=10.0.0.1 disabled=no
[admin@MikroTik] ip dhcp-relay> print
Flags: X - disabled, I - invalid
  #   NAME                         INTERFACE DHCP-SERVER     LOCAL-ADDRESS
  0   relay                        ether1    10.0.0.1        0.0.0.0

[admin@MikroTik] ip dhcp-relay>
```

Question&Answer-Based Setup

Command name: ***/ip dhcp-server setup***

Command Description

dhcp server interface (*name*) - interface to run DHCP server on

dhcp address space (*IP address/mask*; default: **192.168.0.0/24**) - network the DHCP server will lease to the clients

gateway (*IP address*; default: **0.0.0.0**) - the default gateway of the leased network

dhcp relay (*IP address*; default: **0.0.0.0**) - the IP address of the DHCP relay between the DHCP server and the DHCP clients

addresses to give out (*text*) - the pool of IP addresses DHCP server should lease to the clients

dns servers (*IP address*) - IP address of the appropriate DNS server to be propagated to the DHCP clients

lease time (*time*; default: **3d**) - the time the lease will be valid

Notes

Depending on current settings and answers to the previous questions, default values of following questions may be different. Some questions may disappear if they become redundant (for example, there is no use of asking for 'relay' when the server will lend the directly connected network)

Example

To configure DHCP server on **ether1** interface to lend addresses from 10.0.0.2 to 10.0.0.254 which belong to the **10.0.0.0/24** network with **10.0.0.1** gateway and **159.148.60.2** DNS server for the time of 3 days:

```
[admin@MikroTik] ip dhcp-server> setup
Select interface to run DHCP server on

dhcp server interface: ether1
Select network for DHCP addresses

dhcp address space: 10.0.0.0/24
Select gateway for given network

gateway for dhcp network: 10.0.0.1
Select pool of ip addresses given out by DHCP server

addresses to give out: 10.0.0.2-10.0.0.254
Select DNS servers

dns servers: 159.148.60.2
Select lease time

lease time: 3d
[admin@MikroTik] ip dhcp-server>
```

The wizard has made the following configuration based on the answers above:

```
[admin@MikroTik] ip dhcp-server> print
Flags: X - disabled, I - invalid
  #   NAME            INTERFACE RELAY           ADDRESS-POOL LEASE-TIME ADD-ARP
  0   dhcp1           ether1    0.0.0.0         dhcp_pool1   3d         no

[admin@MikroTik] ip dhcp-server> network print
  # ADDRESS            GATEWAY         DNS-SERVER      WINS-SERVER     DOMAIN
  0 10.0.0.0/24        10.0.0.1        159.148.60.2

[admin@MikroTik] ip dhcp-server> /ip pool print
```

```
  # NAME                                        RANGES
  0 dhcp_pool1                                  10.0.0.2-10.0.0.254

[admin@MikroTik] ip dhcp-server>
```

Universal Client Interface

Document revision 2.2 (Fri Mar 05 08:39:12 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Universal Client Interface allows to work with clients regardless of their IP addresses, translating these addresses to the ones the router is able to work with. It gives a possibility to provide a network access (for example, Internet access) to mobile clients that are not willing to change their networking settings. The feature is intended to use with HotSpot, but may be useful even without HotSpot.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/ip hotspot universal***
Hardware usage: ***Not significant***

Description

Universal client accepts any incoming address from a connected network interface and does one to one network address translation so that data may be routed through standard IP networks. Clients may use any preconfigured addresses. If the Universal client feature is set to translate a client's address to a public IP address, then the client may even run a server or any other service that requires a public IP address. It is possible to add static entries, so that some clients will get the specified addresses.

Universal client is changing source address of each packet just after it is received by the router (even mangle 'sees' the translated address).

Note also that **arp** mode must be **enabled** on the interface you set Universal Client Interface on.

Universal Client Interface Setup

Home menu level: ***/ip hotspot universal***

Property Description

interface (*name*) - interface to run universal client on

address-pool (*name*) - IP address pool name

arp (*all-arp* | *no-arp*; default: **all-arp**) - ARP handling mode:

- **all-arp** - respond to all ARP requests
- **no-arp** - respond to ARP requests normally

use-dhcp (yes | no; default: **yes**) - do not translate the addresses assigned by DHCP server

idle-timeout (*time*; default: **5m**) - idle timeout (maximal period of inactivity) for client added dynamically

addresses-per-mac (*integer*; default: **2**) - maximal amount of IP addresses assigned to one MAC address

Notes

Setting **arp** in **all-arp** is generally a good idea because in most cases you cannot know what is the gateway's IP address configured on the clients, but it can potentially disturb some network protocols.

Example

To enable Universal Client Interface on **ether1** interface that will take the addresses to translate to from the **exp** pool:

```
[admin@MikroTik] ip hotspot universal> add address-pool=exp interface=ether1
[admin@MikroTik] ip hotspot universal> print
Flags: X - disabled, I - invalid
  #   INTERFACE    ADDRESS-POOL ADDRESSES-PER-MAC ARP     USE-DHCP IDLE-TIMEOUT
  0 X ether1       exp          2                 all-arp yes      5m

[admin@MikroTik] ip hotspot universal> enable 0
[admin@MikroTik] ip hotspot universal> print
Flags: X - disabled, I - invalid
  #   INTERFACE    ADDRESS-POOL ADDRESSES-PER-MAC ARP     USE-DHCP IDLE-TIMEOUT
  0   ether1       exp          2                 all-arp yes      5m

[admin@MikroTik] ip hotspot universal>
```

Universal Host List

Home menu level: ***/ip hotspot universal host***

Description

The list shows the current translation table. There are three ways a client may be added to the table:

- Each time router receives a packet from an unknown client (determined by three properties: **mac-address**, **address** and **interface**), it adds the client to the list
- Client may be added by DHCP server

Property Description

mac-address (*read-only: MAC address*) - client's MAC address

address (*read-only: IP address*) - client's IP address

to-address (*read-only: IP address*) - IP address to translate the address to

interface (*read-only: name*) - interface name the client is connected to

idle-time (*read-only: time*) - inactivity time

uptime (*read-only: time*) - how long the client is active

bytes-in (*read-only: integer*) - the amount of bytes received from the client

bytes-out (*read-only: integer*) - the amount of bytes sent to the client

packets-in (*read-only: integer*) - the amount of packets received from the client

packets-out (*read-only: integer*) - the amount of packets sent to the client

Example

To check the current translation table:

```
[admin@MikroTik] ip hotspot universal host> print
Flags: I - invalid, H - DHCP, D - dynamic
  #   MAC-ADDRESS       ADDRESS         TO-ADDRESS      INTERFACE
  0 D 00:05:5D:5F:4E:34 10.1.0.144      192.168.0.254   int

[admin@MikroTik] ip hotspot universal host>
```

Universal Access List

Home menu level: ***/ip hotspot universal access***

Description

You can specify manually what IP address will a given IP and/or MAC addresses get.

Property Description

mac-address (*MAC address*) - client's MAC address

address (*IP address*) - client's IP address

to-address (*IP address*) - IP address to translate the address to

interface (*name | empty*) - interface name the client is connected to

Example

To add an entry specifying that IP address **10.20.30.40** should be translated to **10.0.0.20** for packets coming from **ether1** interface:

```
[admin@MikroTik] ip hotspot universal access> add address=10.20.30.40 \
\... interface=ether1 to-address=10.0.0.20
[admin@MikroTik] ip hotspot universal access> print
Flags: X - disabled, I - invalid, H - DHCP, D - dynamic
  #   MAC-ADDRESS       ADDRESS         TO-ADDRESS      INTERFACE IDLE-TIME
  0                     10.20.30.40     10.0.0.20       ether1    1s
[admin@MikroTik] ip hotspot universal access>
```

Service Port

Home menu level: ***/ip hotspot universal service-port***

Description

Just like for classic NAT, the Universal Client Interface 'breaks' some protocols that are incompatible with address translation. To leave these protocols consistent, helper modules must be used. For the Universal Client Interface the only such a module is for FTP protocol.

Property Description

name (*read-only: name*) - protocol name

ports (*read-only: integer*) - list of the ports on which the protocol is working

Example

To set the FTP protocol uses bot 20 and 21 TCP port:

```
[admin@MikroTik] ip hotspot universal service-port> print
Flags: X - disabled
  #   NAME                                                                PORTS
  0   ftp                                                                 21
[admin@MikroTik] ip hotspot universal service-port> set ftp ports=20,21
[admin@MikroTik] ip hotspot universal service-port> print
Flags: X - disabled
  #   NAME                                                                PORTS
  0   ftp                                                                 20
                                                                          21
[admin@MikroTik] ip hotspot universal service-port>
```

IP Telephony

Document revision 2.2 (Mon Apr 26 12:53:19 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

The MikroTik RouterOS IP Telephony feature enables Voice over IP (VoIP) communications using routers equipped with the following voice port hardware:

- Quicknet LineJACK or PhoneJACK analog telephony cards
- ISDN cards
- Voicetronix OpenLine4 (was V4PCI) - 4 analog telephone lines cards
- Zaptel Wildcard X100P IP telephony card - 1 analog telephone line

Specifications

Packages required: ***telephony***
License required: ***level1***
Home menu level: ***/ip telephony***
Standards and Technologies: ***RTP***
Hardware usage: *Pentium MMX level processor recommended*

Related Documents

- ***Package Management***
- ***ISDN***
- ***AAA***

Description

IP telephony, known as Voice over IP (VoIP), is the transmission of telephone calls over a data network like one of the many networks that make up the Internet. There are four ways that you might talk to someone using VoIP:

- Computer-to-computer - This is certainly the easiest way to use VoIP, and you don't have to pay for long-distance calls.
- Computer-to-telephone - This method allows you to call anyone (who has a phone) from your computer. Like computer-to-computer calling, it requires a software client. The software is typically free, but the calls may have a small per-minute charge.
- Telephone-to-computer - Allows a standard telephone user to initiate a call to a computer user.
- Telephone-to-telephone - Through the use of gateways, you can connect directly with any other standard telephone in the world.

Suppoted hardware:

- ***Quicknet Technologies*** cards:
  - Internet PhoneJACK (ISA or PCI) for connecting an analog telephone (FXS port)
  - Internet LineJACK (ISA) for connecting an analog telephone line (FXO port) or a telephone (FXS port)
- ISDN client cards (PCI) for connecting an ISDN line. See ***Device Driver List*** for the list of supported PCI ISDN cards
- ***Voicetronix*** OpenLine4 card for connecting four (4) analog telephone lines (FXO ports)
- Zaptel Wildcard X100P IP telephony card (from ***Linux Support Services***) for connecting one analog telephone line (FXO port)

Supported standards:

- MikroTik RouterOS supports IP Telephony in compliance with the International Telecommunications Union - Telecommunications (ITU-T) specification H.323v4. H.323 is a specification for transmitting multimedia (voice, video, and data) across an IP network. H.323v4 includes: H.245, H.225, Q.931, H.450.1, RTP(real-time protocol)
- The followong audio codecs are supported: **G.711** (the 64 kbps Pulse code modulation (PCM) voice coding), **G.723.1** (the 6.3 kbps compression technique that can be used for compressing audio signal at very low bit rate), **GSM-06.10** (the 13.2 kbps coding), **LPC-10** (the 2.5 kbps coding), **G.729** and **G.729a** (the 8 kbps CS-ACELP software coding), **G.728** (16 kbps coding technique, supported only on Quicknet LineJACK cards)

In PSTN lines there is a known delay of the signal caused by switching and signal compressing devices of the telephone network (so, it depends on the distance between the peers), which is generally rather low. The delay is also present in IP networks. The main difference between a PSTN and an IP network is that in IP networks that delay is more random. The actual packet delay may vary in order of magnutude in congested networks (if a network becomes congested, some packets may even be lost). Also packet reordering may take place. To prevent signal loss, caused by rendom jitter of IP networks and packet reordering, to corrupt audio signal, a jitter buffer is present in IP telephony devices. The jitter buffer is delaying the actual playback of a received packet forming

The larger the jitter buffer, the larger the total delay, but fewer packets get lost due to timeout.

The total delay from the moment of recording the voice signal till its playback is the sum of following three delay times:

- delay time at the recording point (approx. 38ms)
- delay time of the IP network (1..5ms and up)
- delay time at the playback point (the jitter delay)

Notes

Each installed Quicknet card requires IO memory range in the following sequence: the first card occupies addresses 0x300-0x31f, the second card 0x320-0x33f, the third 0x340-0x35f, and so on. Make sure there is no conflict in these ranges with other devices, e.g., network interface cards, etc.

Use the telephony logging feature to debug your setup.

Additional Documents

General Voice port settings

Home menu level: ***/ip telephony voice-port***

Description

This submenu is used for managing all IP telephony voice ports (linejack, phonejack, isdn, voip, voicetronix, zaptel)

Property Description

name (*name*) - assigned name of the voice port

type (*read-only: phonejack* | *linejack* | *phonejack-lite* | *phonejack-pci* | *voip* | *isdn* | *voicetronix* | *zaptel*) - type of the installed telephony voice port:

- **phonejack** - Quicknet PhoneJACK (ISA)
- **linejack** - Quicknet LineJACK (ISA)
- **phonejack-lite** - Quicknet PhoneJACK Lite Linux Edition (ISA)
- **phonejack-pci** - Quicknet PhoneJACK (PCI)
- **voip** - generic Voice over IP port
- **isdn** - ISDN cards
- **voicetronix** - Voicetronix OpenLine4
- **zaptel** - Zaptel Wildcard X100P

autodial (*integer*; default: "") - number to be dialed automatically, if call is coming in from this voice port

Notes

If **autodial** does not exactly match an item in **/ip telephony numbers**, there can be two possibilities:

- if **autodial** is incomplete, rest of the number is asked (local voice port) or incoming call is denied (VoIP)
- if **autodial** is invalid, line is hung up (PSTN line), busy tone is played (POTS) or incoming call is denied (VoIP)

Voicetronix Voice Ports

Home menu level: ***/ip telephony voice-port voicetronix***

Property Description

name (*name*) - name given by the user or the default one

autodial (*integer*; default: **""**) - phone number which will be dialed immediately after the handset has been lifted. If this number is incomplete, then the remaining part has to be dialed on the dial-pad. If the number is incorrect, the line is hung up. If the number is correct, then the appropriate number is dialed (the direct-call mode is used - the line is picked up only after the remote party answers the call)

playback-volume (*integer*: -48..48; default: **0**) - playback volume in dB

- **0** - 0dB meand no change to signal level

record-volume (*integer*: -48..48; default: **0**) - record volume in dB

- **0** - 0dB meand no change to signal level

region (*name*; default: **us**) - regional setting for the voice port. This setting is used for setting the parameters of PSTN line, as well as for detecting and generating the tones

agc-on-playback (yes | no; default: **no**) - automatic gain control on playback (can not be used together with hardware voice codecs)

agc-on-record (yes | no; default: **no**) - automatic gain control on record (can not be used together with hardware voice codecs)

detect-cpt (yes | no; default: **no**) - automatically detect call progress tones

balance-registers (*integer*: 0..255; default: **199**) - registers which depend on telephone line impedance. Can be adjusted to get best echo cancellation. Should be changed only if echo cancellation on voicetronix card does not work good enough. Echo cancellation problems can imply DTMF and busy-tone detection failures. The value has to be in format bal1[,bal3[,bal2]], where bal1, bal2, bal3 - balance registers. bal1 has to be in interval 192..248 (0xC0..0xF8). The others should be in interval 0..255 (0x00..0xFF)

balance-status (*read-only: integer*; default: **unknown**) - shows quality of hardware echo cancellation in dB

loop-drop-detection (yes | no; default: **yes**) - automatically clear call when loop drop is detected

Command Description

test-balance - current balance-registers value is tested once. Result is placed in balance-status parameter. Balance can be tested only when line is off-hook. It won't work if line is on-hook or there is an established connection (*name*) - port name to test balance of

find-best-balance - series of test-balance is executed with different balance-registers values. During the tests balance-registers are updated to the best values found (*name*) - port name to find best balance of

clear-call - terminate a current call established with the specified voice port (*name*) - port name to clear call with

show-stats - show voice port statistics (*name*) - port name show statistics of (*time*) - maximal time of packet round trip (*integer*) - number of packets sent by this card (these packets are digitalized input of the voice port) (*integer*) - number of bytes sent by this card (these packets are digitalized input of the voice port) (*text*) - minimal/average/maximal intervals between packets sent (*integer*) - number of packets received by this card (these packets form analog output of the voice port) (*integer*) - number of bytes received by this card (these packets form analog output of the voice port) (*text*) - minimal/average/maximal intervals between packets received (*time*) - approximate delay time from the moment of receiving an audio packet from the IP network till it is played back over the telephony voice port. The value shown is never less than 30ms, although the actual delay time could be less. If the shown value is >40ms, then it is close (+/-1ms) to the actual delay time.

monitor - monitor status of the voice port (*name*) - port name to monitor (*on-hook* | *off-hook* | *ring* | *connection* | *busy*) - current state of the port:

- **on-hook** - the handset is on-hook, no activity
- **off-hook** - the handset is off-hook, the number is being dialed
- **ring** - call in progress, direction of the call is shown by the direction property
- **connection** - the connection has been established
- **busy** - the connection has been terminated, the handset is still off-hook

(*ip-to-port* | *port-to-ip*) - direction of the call

- **ip-to-port** - call from the IP network to the voice card
- **port-to-ip** - call from the voice card to an IP address

(*integer*) - the phone number being dialed (*text*) - name and IP address of the remote party (*name*) - CODEC used for the audio connection (*time*) - duration of the phone call

Notes

As some Voicetronix cards fail to detect loop drop correctly, with **loop-drop-detection** you can manage whether loop drop detection feature is enabled. The effect of not working loop-drop detection is call terminated at once when connection is established.

Some tips for testing balance registers:

- test is sensitive to noise from the phone, so it's recommended to cover mouth piece during it;
- **find-best-balance** can be interrupted by **clear-call** command;
- once best **balance-registers** value is known, it can be set manually to this best value for all voicetronix voice ports, which will use the same telephone line.

LineJack Voice Ports

Home menu level: ***/ip telephony voice-port linejack***

Property Description

name (*name*) - name given by the user or the default one

autodial (*integer*; default: **""**) - phone number which will be dialed immediately after the handset has been lifted. If this number is incomplete, then the remaining part has to be dialed on the dial-pad. If the number is incorrect, the line is hung up (FXO "line" port) or busy tone is played (FXS "phone" port). If the number is correct, then the appropriate number is dialed. If it is an incomming call from the PSTN line, then the direct-call mode is used - the line is picked up only after the remote party answers the call

playback-volume (*integer*: -48..48; default: **0**) - playback volume in dB

- **0** - 0dB meand no change to signal level

record-volume (*integer*: -48..48; default: **0**) - record volume in dB

- **0** - 0dB meand no change to signal level

ring-cadence (*text*) - a 16-symbol ring cadence for the phone, each symbol lasts 0.5 seconds, + means ringing, - means no ringing

region (*name*; default: **us**) - regional setting for the voice port. This setting is used for setting the parameters of PSTN line, as well as for detecting and generating the tones

aec (yes | no) - whether echo detection and cancellation is enabled

aec-tail-length (*short* | *medium* | *long*; default: **short**) - size of the buffer of echo detection

aec-nlp-threshold (*off* | *low* | *medium* | *high*; default: **low**) - level of cancellation of silent sounds

aec-attenuation-scaling (*integer*: 0..10; default: **4**) - factor of additional echo attenuation

aec-attenuation-boost (*integer*: 0..90; default: **0**) - level of additional echo attenuation

software-aec (yes | no) - software echo canceller (experimental, for most of the cards)

agc-on-playback (yes | no; default: **no**) - automatic gain control on playback (can not be used together with hardware voice codecs)

agc-on-record (yes | no; default: **no**) - automatic gain control on record (can not be used together with hardware voice codecs)

detect-cpt (yes | no; default: **no**) - automatically detect call progress tones

Command Description

blink - blink the LEDs of the specified voice port for five seconds after it is invoked. This command can be used to locate the respective card from several linejack cards (*name*) - card name to blink the LED of

clear-call - terminate a current call established with the specified voice port (*name*) - port name to clear call with

show-stats - show voice port statistics (*name*) - port name show statistics of (*time*) - maximal time of packet round trip (*integer*) - number of packets sent by this card (these packets are digitalized input of the voice port) (*integer*) - number of bytes sent by this card (these packets are digitalized input of the voice port) (*text*) - minimal/average/maximal intervals between packets sent (*integer*) - number of packets received by this card (these packets form analog output of the voice port) (*integer*) - number of bytes received by this card (these packets form analog output of the voice port) (*text*) - minimal/average/maximal intervals between packets received (*time*) - approximate delay time from the moment of receiving an audio packet from the IP network till it is played back over the telephony voice port. The value shown is never less than 30ms, although the actual delay time could be less. If the shown value is >40ms, then it is close (+/-1ms) to the actual delay time.

monitor - monitor status of the voice port (*name*) - port name to monitor (*on-hook* | *off-hook* | *ring* | *connection* | *busy*) - current state of the port:

- **on-hook** - the handset is on-hook, no activity
- **off-hook** - the handset is off-hook, the number is being dialed
- **ring** - call in progress, direction of the call is shown by the direction property
- **connection** - the connection has been established
- **busy** - the connection has been terminated, the handset is still off-hook

(*phone* | *line*) - the active port of the card

- **phone** - telephone connected to the card (POTS FXS port)
- **line** - line connected to the card (PSTN FXO port)

(*ip-to-port* | *port-to-ip*) - direction of the call

- **ip-to-port** - call from the IP network to the voice card
- **port-to-ip** - call from the voice card to an IP address

(*plugged* | *unplugged*) - state of the PSTN line

- **plugged** - the telephone line is connected to the PSTN port of the card
- **unplugged** - there is no working line connected to the PSTN port of the card

(*integer*) - the phone number being dialed (*text*) - name and IP address of the remote party (*name*) - CODEC used for the audio connection (*time*) - duration of the phone call

Notes

When telephone line is connected to the 'line' port, green LED next to the port should be lit in some seconds. If telephone line disappear, the LED next to the 'line' port will change its state to red in an hour or when the line is activated (i.e. when somebody calls to/from it). When telephone line is plugged in the 'phone' port before the router is turned on, red LED next to the port will be lit. WARNING: do not plug telephone line into the 'phone' port when the router is running and green LED next to the port is lit - this might damage the card. The status of the 'phone' port is only detected on system startup.

PhoneJack Voice Ports

Home menu level: ***/ip telephony voice-port phonejack***

Property Description

name (*name*) - name given by the user or the default one

type (*read-only: phonejack* | *phonejack-lite* | *phonejack-pci*) - type of the card

autodial (*integer*; default: **""**) - phone number which will be dialed immediately after the handset has been lifted. If this number is incomplete, then the remaining part has to be dialed on the dial-pad. If the number is incorrect, busy tone is played. If the number is correct, then the appropriate number is dialed

playback-volume (*integer*: -48..48; default: **0**) - playback volume in dB

- **0** - 0dB meand no change to signal level

record-volume (*integer*: -48..48; default: **0**) - record volume in dB

- **0** - 0dB meand no change to signal level

ring-cadence (*text*) - a 16-symbol ring cadence for the phone, each symbol lasts 0.5 seconds, + means ringing, - means no ringing

region (*name*; default: **us**) - regional setting for the voice port. This setting is used for generating the dial tones

aec (yes | no) - wheteher echo detection and cancellation is enabled

aec-tail-length (*short* | *medium* | *long*; default: **short**) - size of the buffer of echo detection

aec-nlp-threshold (*off* | *low* | *medium* | *high*; default: **low**) - level of cancellation of silent sounds

aec-attenuation-scaling (*integer*: 0..10; default: **4**) - factor of additional echo attenuation

aec-attenuation-boost (*integer*: 0..90; default: **0**) - level of additional echo attenuation

software-aec (yes | no) - software echo canceller (experimental, for most of the cards)

agc-on-playback (yes | no; default: **no**) - automatic gain control on playback (can not be used together with hardware voice codecs)

agc-on-record (yes | no; default: **no**) - automatic gain control on record (can not be used together with hardware voice codecs)

detect-cpt (yes | no; default: **no**) - automatically detect call progress tones

Command Description

clear-call - terminate a current call established with the specified voice port (*name*) - port name to clear call with

show-stats - show voice port statistics (*name*) - port name show statistics of (*time*) - maximal time of packet round trip (*integer*) - number of packets sent by this card (these packets are digitalized input of the voice port) (*integer*) - number of bytes sent by this card (these packets are digitalized input of the voice port) (*text*) - minimal/average/maximal intervals between packets sent (*integer*) - number of packets received by this card (these packets form analog output of the voice port) (*integer*) - number of bytes received by this card (these packets form analog output of the voice port) (*text*) - minimal/average/maximal intervals between packets received (*time*) - approximate delay time from the moment of receiving an audio packet from the IP network till it is played back over the telephony voice port. The value shown is never less than 30ms, although the actual delay time could be less. If the shown value is >40ms, then it is close (+/-1ms) to the actual delay time.

monitor - monitor status of the voice port (*name*) - port name to monitor (*on-hook* | *off-hook* | *ring* | *connection* | *busy*) - current state of the port:

- **on-hook** - the handset is on-hook, no activity
- **off-hook** - the handset is off-hook, the number is being dialed
- **ring** - call in progress, direction of the call is shown by the direction property
- **connection** - the connection has been established
- **busy** - the connection has been terminated, the handset is still off-hook

(*phone* | *line*) - the active port of the card

- **phone** - telephone connected to the card (POTS FXS port)
- **line** - line connected to the card (PSTN FXO port)

(*ip-to-port* | *port-to-ip*) - direction of the call

- **ip-to-port** - call from the IP network to the voice card
- **port-to-ip** - call from the voice card to an IP address

(*plugged* | *unplugged*) - state of the PSTN line

- **plugged** - the telephone line is connected to the PSTN port of the card
- **unplugged** - there is no working line connected to the PSTN port of the card

(*integer*) - the phone number being dialed (*text*) - name and IP address of the remote party (*name*) - CODEC used for the audio connection (*time*) - duration of the phone call

Zaptel Voice Ports

Home menu level: ***/ip telephony voice-port zaptel***

Property Description

name (*name*) - name given by the user or the default one

autodial (*integer*; default: **""**) - phone number which will be dialed immediately after the handset has been lifted. If this number is incomplete, then the remaining part has to be dialed on the dial-pad. If the number is incorrect, the line is hung up. If the number is correct, then the appropriate number is dialed (the direct-call mode is used - the line is picked up only after the remote party answers the call)

playback-volume (*integer*: -48..48; default: **0**) - playback volume in dB

- **0** - 0dB meand no change to signal level

record-volume (*integer*: -48..48; default: **0**) - record volume in dB

- **0** - 0dB meand no change to signal level

region (*name*; default: **us**) - regional setting for the voice port. This setting is used for setting the parameters of PSTN line, as well as for detecting and generating the tones

aec (yes | no) - wheteher echo detection and cancellation is enabled

aec-tail-length (*short* | *medium* | *long*; default: **short**) - size of the buffer of echo detection

aec-nlp-threshold (*off* | *low* | *medium* | *high*; default: **low**) - level of cancellation of silent sounds

aec-attenuation-scaling (*integer*: 0..10; default: **4**) - factor of additional echo attenuation

aec-attenuation-boost (*integer*: 0..90; default: **0**) - level of additional echo attenuation

software-aec (yes | no) - software echo canceller (experimental, for most of the cards)

agc-on-playback (yes | no; default: **no**) - automatic gain control on playback (can not be used together with hardware voice codecs)

agc-on-record (yes | no; default: **no**) - automatic gain control on record (can not be used together with hardware voice codecs)

detect-cpt (yes | no; default: **no**) - automatically detect call progress tones

Command Description

clear-call - terminate a current call established with the specified voice port (*name*) - port name to clear call with

show-stats - show voice port statistics (*name*) - port name show statistics of (*time*) - maximal time of packet round trip (*integer*) - number of packets sent by this card (these packets are digitalized input of the voice port) (*integer*) - number of bytes sent by this card (these packets are digitalized input of the voice port) (*text*) - minimal/average/maximal intervals between packets sent (*integer*) -

number of packets received by this card (these packets form analog output of the voice port) (*integer*) - number of bytes received by this card (these packets form analog output of the voice port) (*text*) - minimal/average/maximal intervals between packets received (*time*) - approximate delay time from the moment of receiving an audio packet from the IP network till it is played back over the telephony voice port. The value shown is never less than 30ms, although the actual delay time could be less. If the shown value is >40ms, then it is close (+/-1ms) to the actual delay time.

monitor - monitor status of the voice port (*name*) - port name to monitor (*on-hook* | *off-hook* | *ring* | *connection* | *busy*) - current state of the port:

- **on-hook** - the handset is on-hook, no activity
- **off-hook** - the handset is off-hook, the number is being dialed
- **ring** - call in progress, direction of the call is shown by the direction property
- **connection** - the connection has been established
- **busy** - the connection has been terminated, the handset is still off-hook

(*ip-to-port* | *port-to-ip*) - direction of the call

- **ip-to-port** - call from the IP network to the voice card
- **port-to-ip** - call from the voice card to an IP address

(*plugged* | *unplugged*) - state of the PSTN line

- **plugged** - the telephone line is connected to the PSTN port of the card
- **unplugged** - there is no working line connected to the PSTN port of the card

(*integer*) - the phone number being dialed (*text*) - name and IP address of the remote party (*name*) - CODEC used for the audio connection (*time*) - duration of the phone call

ISDN Voice Ports

Home menu level: ***/ip telephony voice-port isdn***

Property Description

name (*name*) - name given by the user or the default one

msn (*integer*) - telephone number of the ISDN voice port (ISDN MSN number)

lmsn (*text*) - msn pattern to listen on. It determines which calls from the ISDN line this voice port should answer. If left empty, msn is used

autodial (*integer*; default: **""**) - phone number which will be dialed immediately on each incoming ISDN call. If this number contains 'm', then it will be replaced by originally called (ISDN) telephone number. If this number is incomplete, then the remaining part has to be dialed by the caller. If the number is incorrect, call is refused. If the number is correct, then the appropriate number is dialed. For that direct-call mode is used - the line is picked up only after the remote party answers the call

playback-volume (*integer*: -48..48; default: **0**) - playback volume in dB

- **0** - 0dB meand no change to signal level

record-volume (*integer*: -48..48; default: **0**) - record volume in dB

- **0** - 0dB meand no change to signal level

region (*name*; default: **us**) - regional setting for the voice port. This setting is used for setting the parameters of PSTN line, as well as for detecting and generating the tones

aec (yes | no) - wheteher echo detection and cancellation is enabled

aec-tail-length (*short* | *medium* | *long*; default: **short**) - size of the buffer of echo detection

software-aec (yes | no) - software echo canceller (experimental, for most of the cards)

agc-on-playback (yes | no; default: **no**) - automatic gain control on playback (can not be used together with hardware voice codecs)

agc-on-record (yes | no; default: **no**) - automatic gain control on record (can not be used together with hardware voice codecs)

Command Description

clear-call - terminate a current call established with the specified voice port (*name*) - port name to clear call with

show-stats - show voice port statistics (*name*) - port name show statistics of (*time*) - maximal time of packet round trip (*integer*) - number of packets sent by this card (these packets are input of the voice port) (*integer*) - number of bytes sent by this card (these packets are input of the voice port) (*text*) - minimal/average/maximal intervals between packets sent (*integer*) - number of packets received by this card (these packets form output of the voice port) (*integer*) - number of bytes received by this card (these packets form output of the voice port) (*text*) - minimal/average/maximal intervals between packets received (*time*) - approximate delay time from the moment of receiving an audio packet from the IP network till it is played back over the telephony voice port. The value shown is never less than 30ms, although the actual delay time could be less. If the shown value is >40ms, then it is close (+/-1ms) to the actual delay time.

monitor - monitor status of the voice port (*name*) - port name to monitor (*on-hook* | *off-hook* | *ring* | *connection* | *busy*) - current state of the port:

- **on-hook** - the handset is on-hook, no activity
- **off-hook** - the handset is off-hook, the number is being dialed
- **ring** - call in progress, direction of the call is shown by the direction property
- **connection** - the connection has been established
- **busy** - the connection has been terminated, the handset is still off-hook

(*ip-to-port* | *port-to-ip*) - direction of the call

- **ip-to-port** - call from the IP network to the voice card
- **port-to-ip** - call from the voice card to an IP address

(*integer*) - the phone number being dialed (*text*) - name and IP address of the remote party (*name*) - CODEC used for the audio connection (*time*) - duration of the phone call

Notes

In contrary to analog voice ports phonejack, linejack, voicetronix, zaptel), which are as many as the number of cards installed, the isdn ports can be added as many as desired.

- **;** - separates pattern entries (more than one pattern can be specified this way)
- **?** - matches one character
- ***** - matches zero or more characters
- **[ ]** - matches any single character from the set in brackets
- **[^]** - matches any single character not from the set in brackets

There is a possibility to enter some special symbols in **lmsn** property. Meaning of the special symbols:

Voice Port for Voice over IP (voip)

Home menu level: ***/ip telephony voice-port voip***

Description

The voip voice ports are virtual ports, which designate a voip channel to another host over the IP network. You must have at least one voip voice port to be able to make calls to other H.323 devices over IP network.

Property Description

name (*name*) - name given by the user or the default one

remote-address (*IP address*; default: **0.0.0.0**) - IP address of the remote party (IP telephone or gateway) associated with this voice port. If the call has to be performed through this voice port, then the specified IP address is called. If there is an incoming call from the specified IP address, then the parameters of this voice port are used. If there is an incoming call from an IP address, which is not specified in any of the voip voice port records, then the default record is used. If there is no default record, then default values are used

- **0.0.0.0** - the record with this IP address will specify the default values for an incomming call

autodial (*integer*) - phone number which will be added in front of the telephone number received over the IP network. In most cases it should be blank

jitter-buffer (*time*: 0..1000ms; default: **100ms**) - size of the jitter buffer

- **0** - the size of it is adjusted automatically during the conversation, to keep amount of lost packets under 1%

silence-detection (yes | no; default: **no**) - whether silence is detected and no audio data is sent over the IP network during the silence period

prefered-codec (*name*; default: **none**) - the preferred codec to be used for this voip voice port. If possible, the specified codec will be used

- **none** - there is no preferred codec defined for this port, so whichever codec advised by the remote peer will be used (if it is supported)

fast-start (yes | no; default: **yes**) - allow or disallow the fast start. The fast start allows establishing the audio connection in a shorter time. However, not all H.323 endpoints support this feature. Therefore, it should be turned off, if there are problems to establish telephony connection using the fast start mode

Numbers

Description

This is the so-called "routing table" for voice calls. This table assigns numbers to the voice ports.The main function of the numbers routing table is to determine:

- to which voice port route the call
- what number to send over to the remote party

Property Description

dst-pattern (*integer*) - pattern of the telephone number. Symbol '.' designate any digit, symbol '_' (only as the last one) designate any symbols (i.e. any number of characters can follow, ended with '#' button)

voice-port (*name*) - voice port to be used when calling the specified telephone number

prefix (*integer*) - prefix, which will be used to substitute the known part of the dst-pattern, i.e., the part containing digits. The dst-pattern argument is used to determine which voice port to be used, whereas the prefix argument designates the number to dial over the voice port (be sent over to the remote party). If the remote party is an IP telephony gateway, then the number will be used for making the call

Notes

More than one entry can be added with exactly the same **dst-pattern**. If first one of them is already busy, next one with the same **dst-pattern** is used. Telephony number entries can be moved, to select desired order.

Example

Let us consider the following example for the number table:

```
[admin@MikroTik] ip telephony numbers> print
Flags: I - invalid, X - disabled, D - dynamic, R - registered
  #     DST-PATTERN                        VOICE-PORT PREFIX
  0     12345                              XX
  1     1111.                              YY
  2     22...                              ZZ         333
  3     ...                                QQ         55

[admin@MikroTik] ip telephony numbers>
```

We will analyze the Number Received (nr) - number dialed at the telephone, or received over the line, the Voice Port (vp) - voice port to be used for the call, and the Number to Call (nc) - number to be called over the Voice Port.

- If nr=55555, it does not match any of the destination patterns, therefore it is rejected
- If nr=123456, it does not match any of the destination patterns, therefore it is rejected
- If nr=1234, it does not match any of the destination patterns (incomplete for record #0), therefore it is rejected
- If nr=12345, it matches the record #0, therefore number "" is dialed over the voice port XX
- If nr=11111, it matches the record #1, therefore number "1" is dialed over the voice port YY
- If nr=22987, it matches the record #2, therefore number "333987" is dialed over the voice port ZZ
- If nr=22000, it matches the record #2, therefore number "333000" is dialed over the voice port

ZZ

- If nr=444, it matches the record #3, therefore number "55444" is dialed over the voice port QQ

Let us add a few more records:

```
[admin@MikroTik] ip telephony numbers> print
Flags: I - invalid, X - disabled, D - dynamic, R - registered
  #     DST-PATTERN                    VOICE-PORT PREFIX
  0     12345                          XX
  1     1111.                          YY
  2     22...                          ZZ         333
  3     ...                            QQ         55
  4     222                            KK         44444
  5     3..                            LL         553

[admin@MikroTik] ip telephony numbers>
```

- If nr=222 => the best match is the record #4 => nc=44444, vp=KK (note: the 'best match' means that it has the most coinciding digits between the nr and destination pattern).
- If nr=221 => incomplete record #2 => call is rejected
- If nr=321 => the best match is the record #5 => nc=55321, vp=LL
- If nr=421 => matches the record #3 => nc=55421, vp=QQ
- If nr=335 => the best match is the record #5 => nc=55321, vp=LL

Let us add a few more records:

```
[admin@MikroTik] ip telephony numbers> print
Flags: I - invalid, X - disabled, D - dynamic, R - registered
Flags: I - invalid, X - disabled, D - dynamic, R - registered
  #     DST-PATTERN                    VOICE-PORT PREFIX
  0     12345                          XX
  1     1111.                          YY
  2     22...                          ZZ         333
  3     ...                            QQ         55
  4     222                            KK         44444
  5     3..                            LL         553
  6     33...                          MM         33
  7     11.                            NN         7711

[admin@MikroTik] ip telephony numbers>
```

- If nr=335 => incomplete record #6 => the call is rejected. The nr=335 fits perfectly both the record #3 and #5. The #5 is chosen as the 'best match' candidate at the moment. Furthermore, there is record #6, which has two matching digits (more than for #3 or #5). Therefore the #6 is chosen as the 'best match'. However, the record #6 requires five digits, but the nr has only three. Two digits are missing, therefore the number is incomplete. Two additional digits would be needed to be entered on the dialpad. If the number is sent over from the network, it is rejected.
- If nr=325 => matches the record #5 => nc=55325, vp=LL
- If nr=33123 => matches the record #6 => nc=33123, vp=MM
- If nr=123 => incomplete record #0 => call is rejected
- If nr=111 => incomplete record #1 => call is rejected

- If nr=112 => matches the record #7 => nc=77112, vp=NN
- If nr=121 => matches the record #3 => nc=55121, vp=QQ

It is impossible to add the following records:

```
#     DST-PATTERN                    VOICE-PORT PREFIX
                                                            reason:
      11                             DD                conflict with record # 1
                                                       and # 7
      11..                           DD                conflict with record # 7
      111                            DD                conflict with record # 1
      22.                            DD                conflict with record # 2
      .....                          DD                conflict with record # 3
```

Regional Settings

Home menu level: ***/ip telephony region***

Description

Regional settings are used to adjust the voice port properties to the PSTN system or the PBX. For example, to detect hang-up from line, there has to be correct regional setting (correct busy-tone-frequency and busy-tone-cadence). Without that, detect-cpt parameter the voice port has to be enabled.

Property Description

name (*name*) - name of the regional setting

busy-tone-cadence (*integer*: 0..30000; default: **500,500**) - busy tone cadence in ms

- **0** - end of cadence

busy-tone-frequency (*integer*: 20..2000 | *integer*: -24..6; default: **440x0**) - frequency and volume gain of busy tone, Hz x dB

data-access-arrangement (*australia* | *france* | *germany* | *japan* | *uk* | *us*; default: **us**) - ring voltage, impedance setting for line-jack card

dial-tone-frequency (*integer*: 20..2000 | *integer*: -24..6; default: **440x0**) - frequency and volume gain of dial tone, Hz x dB

dtmf-tone-cadence (*integer*: 0..30000; default: **180,60**) - Dual Tone Multi Frequency tone cadence in ms

- **0** - end of cadence

dtmf-tone-volume (*integer*: -24..6; default: **-3,-3**) - Dual Tone Multi Frequency tone volume in dB

ring-tone-cadence (*integer*: 0..30000; default: **1000,2000**) - Ring tone cadence in ms

- **0** - end of cadence

ring-tone-frequency (*integer*: 20..2000 | *integer*: -24..6; default: **440x0**) - frequency and volume gain of busy tone, Hz x dB

Notes

To generate a tone, frequency and cadence arguments are used. The dialtone always is continuous signal, therefore it does not have the cadence argument. In order to detect dialtone, it should be at least 100ms long.

There are 10 pre-defined regions, which can not be deleted (but may be changed)

Audio CODECs

Home menu level: ***/ip telephony codec***

Description

CODECs are listed according to their priority of use. The highest priority is at the top. CODECs can be enabled, disabled and moved within the list. When connecting with other H.323 systems, the protocol will negotiate the CODEC which both of them support according to the priority order.

The hardware codecs (/hw) are built-in CODECs supported by some cards.

The choice of the CODEC type is based on the throughput and speed of the network. Better audio quality can be achieved by using CODEC requiring higher network throughput. The highest audio quality can be achieved by using the G.711-uLaw CODEC requiring 64kb/s throughput for each direction of the call. It is used mostly within a LAN. The G.723.1 CODEC is the most popular one to be used for audio connections over the Internet. It requires only 6.3kb/s throughput for each direction of the call.

Example

```
[admin@MikroTik] ip telephony codec> print
Flags: X - disabled
  #   NAME
  0   G.723.1-6.3k/sw
  1   G.728-16k/hw
  2   G.711-ALaw-64k/hw
  3   G.711-uLaw-64k/hw
  4   G.711-uLaw-64k/sw
  5   G.711-ALaw-64k/sw
  6   G.729A-8k/sw
  7   GSM-06.10-13.2k/sw
  8   LPC-10-2.5k/sw
  9   G.723.1-6.3k/hw
 10   G.729-8k/sw
[admin@MikroTik] ip telephony codec>
```

AAA

Home menu level: ***/ip telephony aaa***

Description

AAA (Authentication Authorization Accounting) can be used to configure the RADIUS accounting feature.

- **NAS-Identifier** - router name (from /system identity print)
- **NAS-IP-Address** - router's local IP address which the connection was established to (if exist)

- **NAS-Port-Type** - always Async
- **Event-Timestamp** - data and time of the event
- **Acct-Session-Time** - current connection duration (only in INTERIM-UPDATE and STOP records)
- **Acct-Output-Packets** - sent RTP (Real-Time Transport Protocol) packet count (only in INTERIM-UPDATE and STOP records)
- **Acct-Output-Packets** - sent RTP (Real-Time Transport Protocol) packet count (only in INTERIM-UPDATE and STOP records)
- **Acct-Input-Packets** - received RTP (Real-Time Transport Protocol) packet count (only in INTERIM-UPDATE and STOP records)
- **Acct-Output-Octets** - sent byte count (only in INTERIM-UPDATE and STOP records)
- **Acct-Input-Octets** - received byte count (only in INTERIM-UPDATE and STOP records)
- **Acct-Session-Id** - unique session participient ID
- **h323-disconnect-cause** - session disconnect reason (only in STOP records):
- **h323-disconnect-time** - session disconnect time (only in INTERIM-UPDATE and STOP records)
- **h323-connect-time** - session establish time (only in INTERIM-UPDATE and STOP records)
- **h323-gw-id** - name of gateway emitting message (should be equal to NAS-Identifier)
- **h323-call-type** - call leg type (should be VoIP)
- **h323-call-origin** - indicates origin of call relatively to the gateway (answer for calls from IP network, originate - to IP network)
- **h323-setup-time** - call setup time
- **h323-conf-id** - unique session ID
- **h323-remote-address** - the remote address of the session
- **NAS-Port-Id** - voice port ID
- **Acct-Status-Type** - record type (START when session is established; STOP when session is closed; INTERIM-UPDATE (ALIVE)session is alive). The time between the interim-update messages is defined by the interim-update-interval parameter (if it is set to 0s, there will be no such messages)

The contents of the CDR (Call Detail Record) are as follows:

- - **0** - Local endpoint application cleared call
  - **1** - Local endpoint did not accept call
  - **2** - Local endpoint declined to answer call
  - **3** - Remote endpoint application cleared call
  - **4** - Remote endpoint refused call
  - **5** - Remote endpoint did not answer in required time
  - **6** - Remote endpoint stopped calling
  - **7** - Transport error cleared call
  - **8** - Transport connection failed to establish call
  - **9** - Gatekeeper has cleared call

- **10** - Call failed as could not find user (in GK)
- **11** - Call failed as could not get enough bandwidth
- **12** - Could not find common capabilities
- **13** - Call was forwarded using FACILITY message
- **14** - Call failed a security check and was ended
- **15** - Local endpoint busy
- **16** - Local endpoint congested
- **17** - Remote endpoint busy
- **18** - Remote endpoint congested
- **19** - Could not reach the remote party
- **20** - The remote party is not running an endpoint
- **21** - The remote party host off line
- **22** - The remote failed temporarily app may retry

Property Description

use-radius-accounting (yes | no; default: **no**) - whether to use radius accounting or not

interim-update (*integer*; default: **0**) - defines time interval between communications with the router. If this time will exceed, RADIUS server will assume that this connection is down. This value is suggested not to be less than 3 minutes

- **0** - no interim-update messages are sent at all

Notes

All the parameters, which names begin with **h323**, are CISCO vendor specific Radius attributes

Gatekeeper

Home menu level: ***/ip telephony gatekeeper***

Description

For each H.323 endpoint gatekeeper stores its telephone numbers. So, gatekeeper knows all telephone numbers for all registered endpoints. And it knows which telephone number is handled by which endpoint. Mapping between endpoints and their telephone numbers is the main functionality of gatekeepers.

If endpoint is registered to endpoint, it does not have to know every single endpoint and every single telephone number, which can be called. Instead, every time some number is dialed, endpoint asks gatekeeper for destination endpoint to call by providing called telephone number to it.

MikroTik IP telephony package includes a very simple gatekeeper. This gatekeeper can be activated by setting **gatekeeper** parameter to **local**. In this case the local endpoint automatically is registered to the local gatekeeper. And any other endpoint can register to this gatekeeper too.

Registered endpoints are added to the **/ip telephony voice-port voip** table. Those entries are marked as dynamic and can not be removed or changed. If there already was an voip entry with the same IP address, it is marked as registred. Remote-address can not be changed for these entries too, but registered voip voice ports can be removed - they will stay as dynamic ones. If there already is a dynamic voip voice port and a static one with the same IP address is added, then instead of dynamic entry, registered will appear.

Dynamic entries disappear when corresponding endpoint unregisters itself from the gatekeeper. Registered entries are static and will stay even after that endpoint will be unregistered from this gatekeeper.

Registered telephone numbers are added to **/ip telephony numbers** table. Here is exactly the same idea behind dynamic and registered telephone numbers as it is with voip voice ports.

When an endpoint registers to the gatekeeper, it sends its own telephone numbers (aliases and prefixes) within this registration request. **/ip telephony numbers** entry is registered to the endpoint only if voice-port for that entry is local (not voip). If **dst-pattern** contains '.' or '_', it is sent as prefix, otherwise - as alias. The known part of the **dst-pattern** is sent as prefix. If there is no known part (**dst-pattern** is "_" or "...", for example), then this entry is not sent at all.

Property Description

gatekeeper (*none* | *local* | *remote*; default: **none**) - Gatekeeper type to use

- **none** - don't use any gatekeeper at all
- **local** - start and use local gatekeeper
- **remote** - use some other gatekeeper

remote-address (*IP address*; default: **0.0.0.0**) - IP address of remote gatekeeper to use. If set to 0.0.0.0, broadcast gatekeeper discovery is used

remote-id (*name*) - name of remote gatekeeper to use. If left empty, first available gatekeeper will be used. Name of locally started gatekeeper is the same as system identity

registered (*read-only:* yes | no) - shows whether local H.323 endpoint is registered to any gatekeeper

registered-with (*read-only: name*) - name of gatekeeper to which local H.323 endpoint is registered

Example

In most simple case with one phonejack card and some remote gatekeeper, configuration can be as follows:

```
[admin@MikroTik] ip telephony voice-port> print
Flags: X - disabled
  #   NAME                          TYPE            AUTODIAL
  0   phonejack1                phonejack
  1   voip1                         voip

[admin@MikroTik] ip telephony voice-port voip> print
Flags: X - disabled, D - dynamic, R - registered
  #    NAME      AUTODIAL REMOTE-ADDRESS  JITTER-BUFFER PREFERED-CODEC  SIL FAS
  0    voip1              0.0.0.0         0s            none            no  yes

[admin@MikroTik] ip telephony numbers> print
Flags: I - invalid, X - disabled, D - dynamic, R - registered
  #     DST-PATTERN             VOICE-PORT              PREFIX
  0     11                      phonejack1
  1     _                       voip1

[admin@MikroTik] ip telephony gatekeeper> print
         gatekeeper: remote
          remote-id: ""
     remote-address: 10.0.0.98
         registered: yes
    registered-with: "MikroTik@10.0.0.98"
```

In this case this endpoint will register to gatkeeper with the IP address of 10.0.0.98 and telephone number 11. Every call to telephone number 11 will be transfered from gatekeeper to this endpoint. And this endpoint will route this call to phonejack1 voice port. On any other telephone number gatekeeper will be asked for real destination. From this endpoint it will be possible to call all the endpoints, which are registered to the same gatekeeper. If that gatekeeper has static entries about endpoints, which are not registered to gatekeeper, it still will be possible to call those endpoints by those statically defined telephone numbers at gatekeeper.

Example

For example, if numbers table is like this:

```
[admin@MikroTik] ip telephony numbers> print
Flags: I - invalid, X - disabled, D - dynamic, R - registered
  #     DST-PATTERN             VOICE-PORT              PREFIX
  0     1.                      phonejack1
  1     128                     voip1                   128
  2     78                      voip2                   78
  3     77                      phonejack1
  4     76                      phonejack1              55
  5     _                       voip1
```

then entries 0, 3 and 4 will be sent to the gatekeeper, others are voip voice ports and are ignored. Entry 0 will be sent as prefix 1, entry 3 - as alias 77, and entry 4 - as alias 76.

If IP address of local endpoint is 10.0.0.100, then gatekeeper voip and numbers tables will look as follows:

```
      [admin@MikroTik] ip telephony voice-port voip> print
Flags: X - disabled, D - dynamic, R - registered
  #    NAME      AUTODIAL REMOTE-ADDRESS  JITTER-BUFFER PREFERED-CODEC  SIL FAS
  0    tst-2.5            10.0.0.101      0s            none            no  yes
  1  D local              127.0.0.1       100ms         none            no  yes
  2  D 10.0.0...          10.0.0.100      100ms         none            no  yes

[admin@MikroTik] ip telephony numbers> print
Flags: I - invalid, X - disabled, D - dynamic, R - registered
  #     DST-PATTERN             VOICE-PORT              PREFIX
  0     78                      linejack1
  1     3...                    vctx1
  2     33_                     voip1
  3     5..                     voip1
  4  XD 78                      local                   78
  5  XD 3_                      local                   3
  6   D 76                      10.0.0.100              76
  7   D 77                      10.0.0.100              77
  8   D 1_                      10.0.0.100              1
```

Here we can see how aliases and prefixes are added to numbers table. Entries 0..3 are static. Entries 4 and 5 are added by registering the local endpoint to the local gatekeeper. Entries 6..8 are added by registering endpoint (with IP address 10.0.0.100) to the local gatekeeper.

For prefixes, '_' is added at the end of dst-pattern to allow any additional digits to be added at the end.

Local endpoint is registered to the local gatekeeper too. So, local aliases and prefixes are added as dynamic numbers too. Only, as they are local and corresponding number entries already exist in the number table, then these dynamically added entries are disabled by default.

If any registered telephone number will conflict with some existing telephone numbers entry, it will be added as disabled and dynamic.

If in gatekeeper's numbers table there already exists exactly the same dst-pattern as some other endpoint is trying to register, this gatekeeper registration for that endpoint will fail.

Troubleshooting

Description

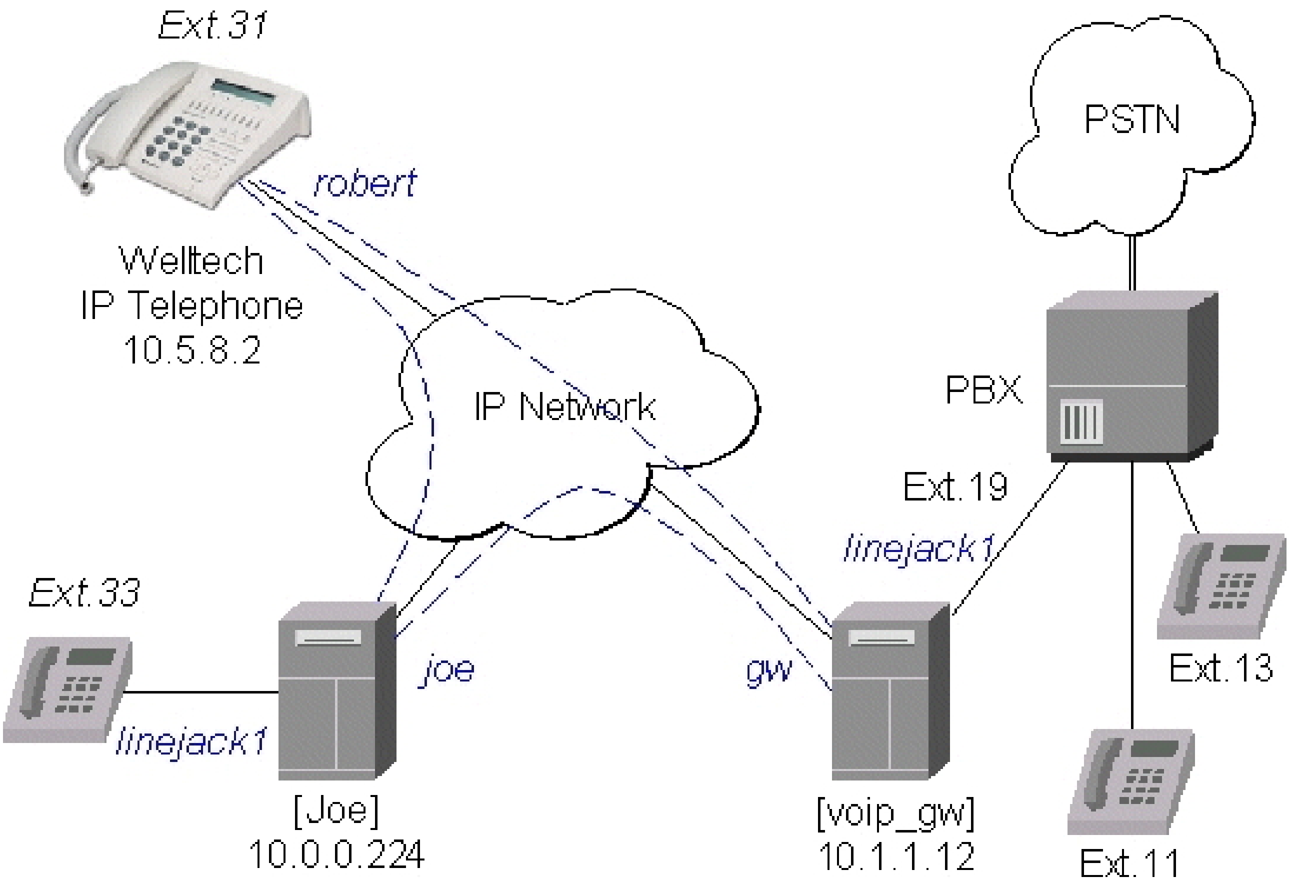
- **The IP Telephony does not work after upgrading from 2.5.x version** - You need to completely reinstall the router using any installation procedure. You may keep the configuration using either the installation program option or the backup file.
- **The IP Telephony gateway does not detect the drop of the line when connected to some PBXs** - Different regional setting should be used to match the parameters of the PBX. For example, try using uk for Meridian PBX.
- **The IP Telephone does not call the gateway, but gives busy signal** - Enable the logging of IP telephony events under /system logging facility. Use the monitoring function for voice ports to debug your setup while making calls.
- **The IP telephony is working without NAT, but sound goes only in one direction** - Disable H323 service port in firewall: /ip firewall service-port set h323 disabled=yes
- **The IP Telephony does not work through NAT** - Enable H323 service port in firewall: /ip firewall service-port set h323 disabled=no

A simple example

Description

The following describes examples of some useful IP telephony applications using MikroTik RouterOS.

Let us consider the following example of IP telephony gateway, one MikroTik IP telephone, and one Welltech LAN Phone 101 setup:



Setting up the MikroTik IP Telephone

If you pick up the handset, a dialtone should be heard.

The basic telephony configuration should be as follows:

- Add a voip voice port to the **/ip telephony voice-port voip** for each of the devices you want to call, or want to receive calls from, i.e., (the IP telephony gateway 10.1.1.12 and the Welltech IP telephone 10.5.8.2):

```
[admin@Joe] ip telephony voice-port voip> add name=gw remote-address=10.1.1.12
[admin@Joe] ip telephony voice-port voip> add name=rob remote-address=10.5.8.2
[admin@Joe] ip telephony voice-port voip> print Flags: X - disabled, D - dynamic, R
- registered # NAME AUTODIAL REMOTE-ADDRESS JITTER-BUFFER PREFERED-CODEC SIL FAS 0
gw 10.1.1.12 100ms none no yes 1 rob 10.5.8.2 100ms none no yes [admin@Joe] ip
telephony voice-port voip>
```

  You should have three vioce ports now:

```
[admin@Joe] ip telephony voice-port> print Flags: X - disabled # NAME TYPE AUTODIAL
0 linejack1 linejack 1 gw voip 2 rob voip [admin@Joe] ip telephony voice-port>
```

- Add at least one unique number to the **/ip telephony numbers** for each voice port. This number will be used to call that port:

```
[admin@Joe] ip telephony numbers> add dst-pattern=31 voice-port=rob [admin@Joe] ip
telephony numbers> add dst-pattern=33 voice-port=linejack1 [admin@Joe] ip telephony
numbers> add dst-pattern=1. voice-port=gw prefix=1 [admin@Joe] ip telephony numbers>
print Flags: I - invalid, X - disabled, D - dynamic, R - registered # DST-PATTERN
```

```
VOICE-PORT PREFIX 0 31 rob 31 1 33 linejack1 2 1. gw 1 [admin@Joe] ip telephony
numbers>
```

Here, the **dst-pattern=31** is to call the Welltech IP Telephone, if the number 31 is dialed on the dialpad. The **dst-pattern=33** is to ring the local telephone, if a call for number 33 is received over the network. Anything starting with digit '1' would be sent over to the IP Telephony gateway.

Making calls from the IP telephone 10.0.0.224:

- To call the IP telephone 10.5.8.2, it is enough to lift the handset and dial the number 31
- To call the PBX extension 13, it is enough to lift the handset and dial the number 13 After establishing the connection with 13, the voice port monitor shows:

```
[admin@Joe] ip telephony voice-port linejack> monitor linejack status: connection
port: phone direction: port-to-ip line-status: unplugged phone-number: 13
remote-party-name: PBX_Line [10.1.1.12] codec: G.723.1-6.3k/hw duration: 16s
[admin@Joe] ip telephony voice-port linejack>
```

Setting up the IP Telephony Gateway

The IP telephony gateway [voip_gw] requires the following configuration:

- Set the regional setting to match our PBX. The **mikrotik** region will be used in thisn example:

```
[admin@voip_gw] ip telephony voice-port linejack> set linejack1 region=mikrotik
[admin@voip_gw] ip telephony voice-port linejack> print
Flags: X - disabled
  0   name="linejack1" autodial="" region=mikrotik playback-volume=0
      record-volume=0 ring-cadence="++-++--- ++-++---" agc-on-playback=no
      agc-on-record=no aec=yes aec-tail-length=short aec-nlp-threshold=low
      aec-attenuation-scaling=4 aec-attenuation-boost=0 software-aec=no
      detect-cpt=yes

[admin@voip_gw] ip telephony voice-port linejack>
```

- Add a voip voice port to the **/ip telephony voice-port voip** for each of the devices you want to call, or want to receive calls from, i.e., (the IP telephone 10.0.0.224 and the Welltech IP telephone 10.5.8.2):

```
[admin@voip_gw] ip telephony voice-port voip> add name=joe \
\... remote-address=10.0.0.224
[admin@voip_gw] ip telephony voice-port voip> add name=rob \
\... remote-address=10.5.8.2 prefered-codec=G.723.1-6.3k/hw
[admin@voip_gw] ip telephony voice-port voip> print
Flags: X - disabled, D - dynamic, R - registered
  #    NAME      AUTODIAL REMOTE-ADDRESS  JITTER-BUFFER PREFERED-CODEC  SIL FAS
  0    joe                10.0.0.224      100ms         none            no yes
  1    rob                10.5.8.2        100ms         G.723.1-6.3k/hw no yes
[admin@voip_gw] ip telephony voice-port voip>
```

- Add number records to the **/ip telephony numbers**, so you are able to make calls:

```
[admin@voip_gw] ip telephony numbers> add dst-pattern=31 voice-port=rob prefix=31
[admin@voip_gw] ip telephony numbers> add dst-pattern=33 voice-port=joe prefix=33
[admin@voip_gw] ip telephony numbers> add dst-pattern=1. voice-port=linejack1 \
\... prefix=1
[admin@voip_gw] ip telephony numbers> print
Flags: I - invalid, X - disabled, D - dynamic, R - registered
```

```
  #     DST-PATTERN             VOICE-PORT              PREFIX
  0     31                          rob                 31
  1     33                          joe                 33
  2     1.                          linejack1           1
[admin@voip_gw] ip telephony numbers>
```

Making calls through the IP telephony gateway:

- To dial the IP telephone 10.0.0.224 from the office PBX line, the extension number 19 should be dialed, and, after the dial tone has been received, the number 33 should be entered. Thus, the telephone [Joe] is ringed.
  After establishing the voice connection with '33' (the call has been answered), the voice port monitor shows:

  ```
  [admin@voip_gw] ip telephony voice-port linejack> monitor linejack1 status:
  connection port: line direction: port-to-ip line-status: plugged phone-number: 33
  remote-party-name: linejack1 [10.0.0.224] codec: G.723.1-6.3k/hw duration: 1m46s
  [admin@voip_gw] ip telephony voice-port linejack>
  ```
- To dial the IP telephone 10.5.8.2 from the office PBX line, the extension number 19 should be dialed, and, after the dial tone has been received, the number 31 should be entered.

Setting up the Welltech IP Telephone

Please follow the documentation from ***www.welltech.com.tw*** on how to set up the Welltech LAN Phone 101. Here we give just brief recommendations:

1. We recommend to upgrade the Welltech LAN Phone 101 with the latest application software. Telnet to the phone and check what you have, for example:

```
usr/config$ rom -print

Download Method  :  TFTP
 Server Address  :  10.5.8.1

   Hardware Ver. :  4.0
       Boot Rom  :  nblp-boot.102a
Application Rom  :  wtlp.108h
        DSP App  :  48302ce3.127
     DSP Kernel  :  48302ck.127
  DSP Test Code  :  483cbit.bin
  Ringback Tone  :  wg-ringbacktone.100
      Hold Tone  :  wg-holdtone10s.100
  Ringing Tone1  :  ringlow.bin
  Ringing Tone2  :  ringmid.bin
  Ringing Tone3  :  ringhi.bin

usr/config$
```

2. Check if you have the codecs arranged in the desired order:

```
usr/config$ voice -print
Voice codec setting relate information
    Sending packet size  :
            G.723.1      : 30 ms
            G.711A       : 20 ms
            G.711U       : 20 ms
            G.729A       : 20 ms
            G.729        : 20 ms
    Priority order codec :
            g7231 g711a g711u g729a g729
```

```
    Volume levels        :
            voice volume : 54
            input gain   : 26
             dtmf volume : 23
Silence suppression & CNG:
            G.723.1      : Off
    Echo canceller       : On
 JitterBuffer Min Delay  : 90
 JitterBuffer Max Delay  : 150
usr/config$
```

3. Make sure you have set the H.323 operation mode to phone to phone (P2P), not gatekeeper (GK):

```
usr/config$ h323 -print
H.323 stack relate information
    RAS mode               : Non-GK mode
    Registered e164        : 31
    Registered H323 ID     : Rob
    RTP port               : 16384
    H.245 port             : 16640
    Allocated port range   :
              start port   : 1024
              end port     : 65535
    Response timeOut       : 5
    Connect  timeOut       : 5000
usr/config$
```

4. Add the gateway's address to the phonebook:

```
usr/config$ pbook -add name gw ip 10.1.1.12
usr/config$
This may take a few seconds, please wait....

Commit to flash memory ok!

usr/config$ pbook -print
index   Name                 IP                    E164
======================================================================
1       gw                   10.1.1.12
----------------------------------------------------------------------
usr/config$
```

Making calls from the IP telephone 10.5.8.2:

- Just lift the handset and dial '11', or '13' fo the PBX extensions.
- Dial '33' for [Joe]. The call request will be sent to the gateway 10.1.1.12, where it will be forwarded to [Joe]. If you want to call [Joe] directly, add a phonebook record for it:

  ```
  usr/config$ pbook -add name Joe ip 10.0.0.224 e164 33
  ```

Use the telephony logging feature on the gateway to debug your setup.

Setting up MikroTik Router and CISCO Router

Let's try a different example.

Here are some hints on how to get working configuration for telephony calls between CISCO and MikroTik router.

Configuration on the MikroTik side

- G.729a codec MUST be disabled (otherwise connections are not possible at all!!!)
  ```
  /ip telephony codec disable G.729A-8k/sw
  ```
- G.711-ALaw codec should not be used (in some cases there is no sound)
  ```
  /ip telephony codec disable "G.711-ALaw-64k/sw G.711-ALaw-64k/hw"
  ```
- Fast start has to be used (otherwise no ring-back tone and problems with codec negotiation)
  ```
  /ip telephony voice-port set cisco fast-start=yes
  ```
- Telephone number we want to call to must be sent to Cisco, for example
  ```
  /ip telephony numbers add destination-pattern=101 voice-port=cisco prefix=101
  ```
- Telephone number, cisco will call us, must be assigned to some voice port, for example,
  ```
  /ip telephony numbers add destination-pattern=098 voice-port=linejack
  ```

Configuration on the CISCO side:

- IP routing has to be enabled
  ```
  ip routing
  ```
- Default values for fast start can be used:
  ```
  voice service pots default h323 call start exit voice service voip default h323 call start exit
  ```
- Enable opening of RTP streams:
  ```
  voice rtp send-recv
  ```
- Assign some E.164 number for local telephone, for example, 101 to port 0/0
  ```
  dial-peer voice 1 pots destination-pattern 101 port 0/0 exit
  ```
- create preferred codec listing:
  ```
  voice class codec codec_class_number codec preference 1 g711ulaw codec preference 2 g723r63 exit
  ```
  NOTE: g723r53 codec can be used, too
- Tell, that some foreign E.164 telephone number can be reached by calling to some IP address, for example, 098 by calling to 10.0.0.98
  ```
  dial-peer voice 11 voip destination-pattern 098 session target ipv4:10.0.0.98 voice-class codec codec_class_number exit
  ```
  NOTE: instead of codec class, one specified codec could be specified:
  ```
  codec g711ulaw
  ```

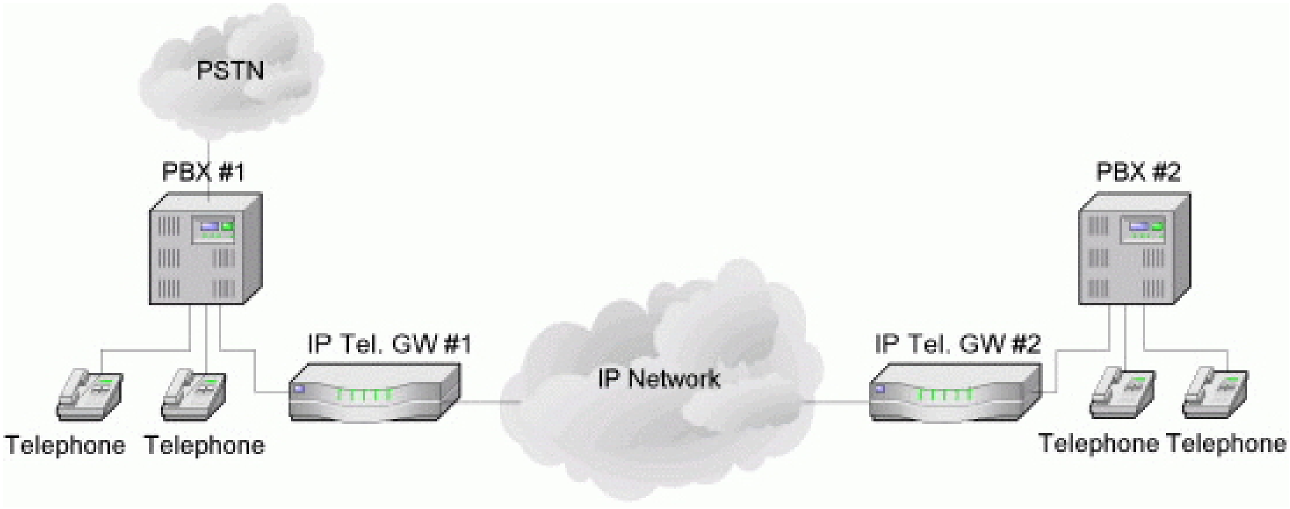
For reference, following is an exported CISCO configuration, that works:

```
!
version 12.1
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router
!
logging rate-limit console 10 except errors
enable secret 5 $1$bTMC$nDGl9/n/pc3OMbtWxADMg1
enable password 123
!
memory-size iomem 25
ip subnet-zero
no ip finger
!
```

```
call rsvp-sync
voice rtp send-recv
!
voice class codec 1
 codec preference 1 g711ulaw
 codec preference 2 g723r63
!
interface FastEthernet0
 ip address 10.0.0.101 255.255.255.0
 no ip mroute-cache
 speed auto
 half-duplex
!
ip classless
ip route 0.0.0.0 0.0.0.0 10.0.0.1
no ip http server
!
dialer-list 1 protocol ip permit
dialer-list 1 protocol ipx permit
!
voice-port 0/0
!
voice-port 0/1
!
voice-port 2/0
!
voice-port 2/1
!
dial-peer voice 1 pots
 destination-pattern 101
 port 0/0
!
dial-peer voice 97 voip
 destination-pattern 097
 session target ipv4:10.0.0.97
 codec g711ulaw
!
dial-peer voice 98 voip
 destination-pattern 098
 voice-class codec 1
 session target ipv4:10.0.0.98
!
!
line con 0
 transport input none
line aux 0
line vty 0 4
 password 123
 login
!
end
```

Setting up PBX to PBX Connection over an IP Network

To interconnect two telephone switchboards (PBX) over an IP network, two IP telephony gateways should be configured. The setup is shown in the following diagram:



We want to be able to use make calls from local telephones of one PBX to local telephones or external lines of the other PBX.

Assume that:

- The IP telephony gateway #1 has IP address 10.0.0.182, and the name of the Voicetronix first line is 'vctx1'.
- The IP telephony gateway #2 has IP address 10.0.0.183, and the name of the Voicetronix first line is 'vctx1'.

The IP telephony configuration should be as follows:

- IP telephony gateway #1 should have:
  ```
  /ip telephony voice-port voip add name=gw2 remote-address=10.0.0.183 /ip telephony
  numbers add dst-pattern=1.. voice-port=gw2 prefix=2 add dst-pattern=2..
  voice-port=vctx1 prefix=1
  ```
- IP telephony gateway #2 should have
  ```
  /ip telephony voice-port voip add name=gw1 remote-address=10.0.0.182 /ip telephony
  numbers add dst-pattern=2.. voice-port=vctx1 prefix=1 add dst-pattern=1..
  voice-port=gw1 prefix=2
  ```

The system works as follows:

To dial from the main office PBX#1 any extension of the remote office PBX#2, the extension with the connected gateway at PBX#1 should be dialed first. Then, after the dial tone of the gateway#1 is received, the remote extension number should be dialed.

To dial from the main office PBX#2 any extension of the remote office PBX#1, the actions are the same as in first situation.

OSPF

Document revision 1.3 (Mon Sep 06 04:56:42 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

MikroTik RouterOS implements OSPF Version 2 (RFC 2328). The OSPF protocol is the link-state protocol that takes care of the routes in the dynamic network structure that can employ different paths to its subnetworks. It always chooses shortest path to the subnetwork first.

Specifications

Packages required: ***routing***
License required: ***level3***
Home menu level: ***/routing ospf***
Standards and Technologies: ***OSPF***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***Routes, Equal Cost Multipath Routing, Policy Routing***
- ***Log Management***

Description

Open Shortest Path First protocol is a link-state routing protocol. It's uses a link-state algorithm to build and calculate the shortest path to all known destinations. The shortest path is calculated using the Dijkstra algorithm. OSPF distributes routing information between the routers belonging to a single autonomous system (AS). An AS is a group of routers exchanging routing information via a common routing protocol.

In order to deploy the OSPF all routers it will be running on should be configured in a coordinated manner (note that it also means that the routers should have the same MTU for all the networks advertized by OSPF protocol).

The OSPF protocol is started after you will add a record to the OSPF network list. The routes learned by the OSPF protocol are installed in the routes table list with the distance of 110.

General Setup

Home menu level: ***/routing ospf***

Description

In this section you will learn how to configure basic **OSPF** settings.

Property Description

distribute-default (*never* | *if-installed-as-type-1* | *if-installed-as-type-2* | *always-as-type-1* | *always-as-type-2*; default: **never**) - specifies how to distribute default route. Should be used for ABR (Area Border router) or ASBR (Autonomous System boundary router) settings

- **never** - do not send own default route to other routers

- **if-installed-as-type-1** - send the default route with type 1 metric only if it has been installed (a static default route, or route added by DHCP, PPP, etc.)
- **if-installed-as-type-2** - send the default route with type 2 metric only if it has been installed (a static default route, or route added by DHCP, PPP, etc.)
- **always-as-type-1** - always send the default route with type 1 metric
- **always-as-type-2** - always send the default route with type 2 metric

metric-bgp (*integer*; default: **20**) - specifies the cost of the routes learned from BGP protocol

metric-connected (*integer*; default: **20**) - specifies the cost of the routes to directly connected networks

metric-default (*integer*; default: **1**) - specifies the cost of the default route

metric-rip (*integer*; default: **20**) - specifies the cost of the routes learned from RIP protocol

metric-static (*integer*; default: **20**) - specifies the cost of the static routes

redistribute-bgp (*as-type-1* | *as-type-2* | *no*; default: **no**) - with this setting enabled the router will redistribute the information about all routes learned by the BGP protocol

redistribute-connected (*as-type-1* | *as-type-2* | *no*; default: **no**) - if set, the router will redistribute the information about all connected routes, i.e., routes to directly reachable networks

redistribute-rip (*as-type-1* | *as-type-2* | *no*; default: **no**) - with this setting enabled the router will redistribute the information about all routes learned by the RIP protocol

redistribute-static (*as-type-1* | *as-type-2* | *no*; default: **no**) - if set, the router will redistribute the information about all static routes added to its routing database, i.e., routes that have been created using the /ip route add command

router-id (*IP address*; default: **0.0.0.0**) - OSPF Router ID. If not specified, OSPF uses the largest IP address configured on the interfaces as its router ID

Notes

Within one area, only the router that is connected to another area (i.e. Area border router) or to another AS (i.e. Autonomous System boundary router) should have the propagation of the default route enabled.

OSPF protocol will try to use the shortest path (path with the smallest total cost) if available.

OSPF protocol supports two types of metrics:

- **type1** - external metrics are expressed in the same units as OSPF interface cost. In other words the router expects the cost of a link to a network which is external to AS to be the same order of magnitude as the cost of the internal links.
- **type2** - external metrics are an order of magnitude larger; any type2 metric is considered greater than the cost of any path internal to the AS. Use of type2 external metric assumes that routing between AS is the major cost of routing a packet, and climinates the need conversion of external costs to internal link state metrics.

Both Type 1 and Type 2 external metrics can be used in the AS at the same time. In that event, Type 1 external metrics always take precedence.

In **/ip route** you can see routes with **Io** status. Because router receives routers from itself.

The metric cost can be calculated from line speed by using the formula 10e+8/line speed. The table contains some examples:

network type	cost
ethernet	**10**
T1	**64**
64kb/s	**1562**

Example

To enable the OSPF protocol redisrtibute routes to the connected networks as **type1** metrics with the cost of **1**, you need do the following:

```
[admin@MikroTik] routing ospf> set redistribute-connected=as-type-1 \
\... metric-connected=1
[admin@MikroTik] routing ospf> print
                 router-id: 0.0.0.0
        distribute-default: never
    redistribute-connected: as-type-1
       redistribute-static: no
          redistribute-rip: no
          redistribute-bgp: no
            metric-default: 1
          metric-connected: 1
             metric-static: 20
                metric-rip: 20
                metric-bgp: 20
[admin@MikroTik] routing ospf>
```

Areas

Home menu level: ***/routing ospf area***

Description

OSPF allows collections of routers to be grouped together. Such group is called an area. Each area runs a separate copy of the basic link-state routing algorithm. This means that each area has its own link-state database and corresponding graph

The structure of an area is invisible from the outside of the area. This isolation of knowledge enables the protocol to effect a marked reduction in routing traffic as compared to treating the entire Autonomous System as a single link-state domain

60-80 routers have to be the maximum in one area

Property Description

area-id (*IP address*; default: **0.0.0.0**) - OSPF area identifier. Default area-id=0.0.0.0 is the backbone area. The OSPF backbone always contains all area border routers. The backbone is responsible for distributing routing information between non-backbone areas. The backbone must be contiguous. However, areas do not need to be physical connected to backbone. It can be done with virtual link. The name and area-id for this area can not be changed

authetication (*none* | *simple* | *md5*; default: **none**) - specifies authentication method for OSPF protocol messages

- **none** - do not use authentication
- **simple** - plain text authentication
- **md5** - keyed Message Digest 5 authentication

default-cost (*integer*; default: **1**) - specifies the default cost used for stub areas. Applicable only to area boundary routers

name (*name*; default: **""**) - OSPF area's name

stub (yes | no; default: **no**) - a stub area is an area which is out from part with no routers or areas beyond it. A stub area is configured to avoid AS External Link Advertisements being flooded into the Stub area. One of the reason to configure a Stub area is that the size of the link state database is reduced along with the routing table and less CPU cycles are used to process. Any router which is trying access to a network outside the area sends the packets to the default route

Example

To define additional OSPF area named **local_10** with **area-id=0.0.10.5**, do the following:

```
[admin@WiFi] routing ospf area> add area-id=0.0.10.5 name=local_10
[admin@WiFi] routing ospf area> print
Flags: X - disabled, I - invalid
 #   NAME                      AREA-ID         STUB DEFAULT-COST AUTHENTICATION
 0   backbone                  0.0.0.0                           none
 1   local_10                  0.0.10.5        no   1            none
[admin@WiFi] routing ospf area>
```

Networks

Home menu level: ***/routing ospf network***

Description

There can be Point-to-Point networks or Multi-Access networks. Multi-Access network can be a broadcast network (a single message can be sent to all routers)

To start the OSPF protocol, you have to define the networks on which it will run and the area ID for each of those networks

Property Description

area (*name*; default: **backbone**) - the OSPF area to be associated with the specified address range

network (*IP address/mask*; default: **20**) - the network associated with the area. The network argument allows defining one or multiple interfaces to be associated with a specific OSPF area. Only directly connected networks of the router may be specified

Notes

You should set the network address exactly the same as the remote point IP address for point-to-point links. The right netmask in this case is **/32**.

Example

To enable the OSPF protocol on the 10.10.1.0/24 network, and include it into the backbone area, do the following:

```
[admin@MikroTik] routing ospf network> add area=backbone network=10.10.1.0/24
[admin@MikroTik] routing ospf network> print
Flags: X - disabled
  #   NETWORK            AREA
  0   10.10.1.0/24       backbone
[admin@MikroTik] routing ospf>
```

Interfaces

Home menu level: ***/routing ospf interface***

Description

This facility provides tools for additional in-depth configuration of OSPF interface specific parameters. You do not have to configure interfaces in order to run OSPF

Property Description

authentication-key (*text*; default: **""**) - authentication key have to be used by neighboring routers that are using OSPF's simple password authentication

cost (*integer*: 1..65535; default: **1**) - interface cost expressed as link state metric

dead-interval (*time*; default: **40s**) - specifies the interval after which a neighbor is declared as dead. The interval is advertised in the router's hello packets. This value must be the same for all routers and access servers on a specific network

hello-interval (*time*; default: **10s**) - the interval between hello packets that the router sends on the interface. The smaller the hello-interval, the faster topological changes will be detected, but more routing traffic will ensue. This value must be the same on each end of the adjancency otherwise the adjacency will not form

interface (*name*; default: **all**) - interface on which OSPF will run

- **all** - is used for the interfaces not having any specific settings

priority (*integer*: 0..255; default: **1**) - router's priority. It helps to determine the designated router for the network. When two routers attached to a network both attempt to become the designated router, the one with the higher router's priority takes precedence

retransmit-interval (*time*; default: **5s**) - time between retransmitting lost link state advertisements. When a router sends a link state advertisement (LSA) to its neighbor, it keeps the LSA until it receives back the acknowledgment. If it receives no acknowledgment in time, it will retransmit the LSA. The following settings are recommended: for Broadcast network are 5 seconds and for Point-to-Point network are 10 seconds

transmit-delay (*time*; default: **1s**) - link state transmit delay is the estimated time it takes to transmit a link state update packet on the interface

Example

To add an entry that specifies that **ether2** interface should send Hello packets every 5 seconds, do the following:

```
[admin@MikroTik] routing ospf> interface add interface=ether2 hello-interval=5s
[admin@MikroTik] routing ospf> interface print
  0 interface=ether2 cost=1 priority=1 authentication-key=""
    retransmit-interval=5s transmit-delay=1s hello-interval=5s
    dead-interval=40s


[admin@MikroTik] routing ospf>
```

Virtual Links

Home menu level: ***/routing ospf virtual-link***

Description

As stated in OSPF RFC, the backbone area must be contiguous. However, it is possible to define areas in such a way that the backbone is no longer contiguous. In this case the system administrator must restore backbone connectivity by configuring virtual links. Virtual link can be configured between two routers through common area called transit area, one of them should have to be connected with backbone. Virtual links belong to the backbone. The protocol treats two routers joined by a virtual link as if they were connected by an unnumbered point-to-point network

Property Description

neighbor-id (*IP address*; default: **0.0.0.0**) - specifies router-id of the neighbour

transit-area (*name*; default: **(unknown)**) - a non-backbone area the two routers have in common

Notes

Virtual links can not be estabilished through stub areas

Example

To add a virtual link with the 10.0.0.201 router through the ex area, do the following:

```
[admin@MikroTik] routing ospf virtual-link> add neighbor-id=10.0.0.201 \
\... transit-area=ex
[admin@MikroTik] routing ospf virtual-link> print
Flags: X - disabled, I - invalid
  #   NEIGHBOR-ID     TRANSIT-AREA
  0   10.0.0.201      ex
[admin@MikroTik] routing ospf virtual-link>
```

Virtual link should be configured on both routers

Neighbours

Home menu level: ***/routing ospf neigbor***

Description

The submenu provides an access to the list of OSPF neighbors, *id est* the routers adjacent to the current router, and supplies brief statistics

Property Description

address (*read-only: IP address*) - appropriate IP address of the neighbour

backup-dr-id (*read-only: IP address*) - backup designated router's router id for this neighbor

db-summaries (*read-only: integer*) - number of records in link-state database advertised by the neighbour

dr-id (*read-only: IP address*) - designated router's router id for this neighbor

ls-requests (*read-only: integer*) - number of link-state requests

ls-retransmits (*read-only: integer*) - number of link-state retransmits

priority (*read-only: integer*) - the priority of the neigbour which is used in designated router elections via Hello protocol on this network

router-id (*read-only: IP address*) - the router-id parameter of the neighbour

state (*read-only: Down | Attempt | Init | 2-Way | ExStart | Exchange | Loading | Full*) - the state of the connection:

- **Down** - the connection is down
- **Attempt** - the router is sending Hello protocol packets
- **Init** - Hello packets are exchanged between routers to create a Neighbour Relationship
- **2-Way** - the routers add each other to their Neighbour database and they become neighbours
- **ExStart** - the DR (Designated Router) and BDR (Backup Designated Router) create an adjancency with each other and they begin creating their link-state databases using Database Description Packets
- **Exchange** - is the process of discovering routes by exchanging Database Description Packets
- **Loading** - receiving information from the neighbour
- **Full** - the link-state databases are completely synchronized. The routers are routing traffic and continue sending each other hello packets to maintain the adjacency and the routing information

state-changes (*read-only: integer*) - number of connection state changes

Notes

The neighbour's list also displays the router itself with 2-Way state

Example

The following text can be observed just after adding an OSPF network:

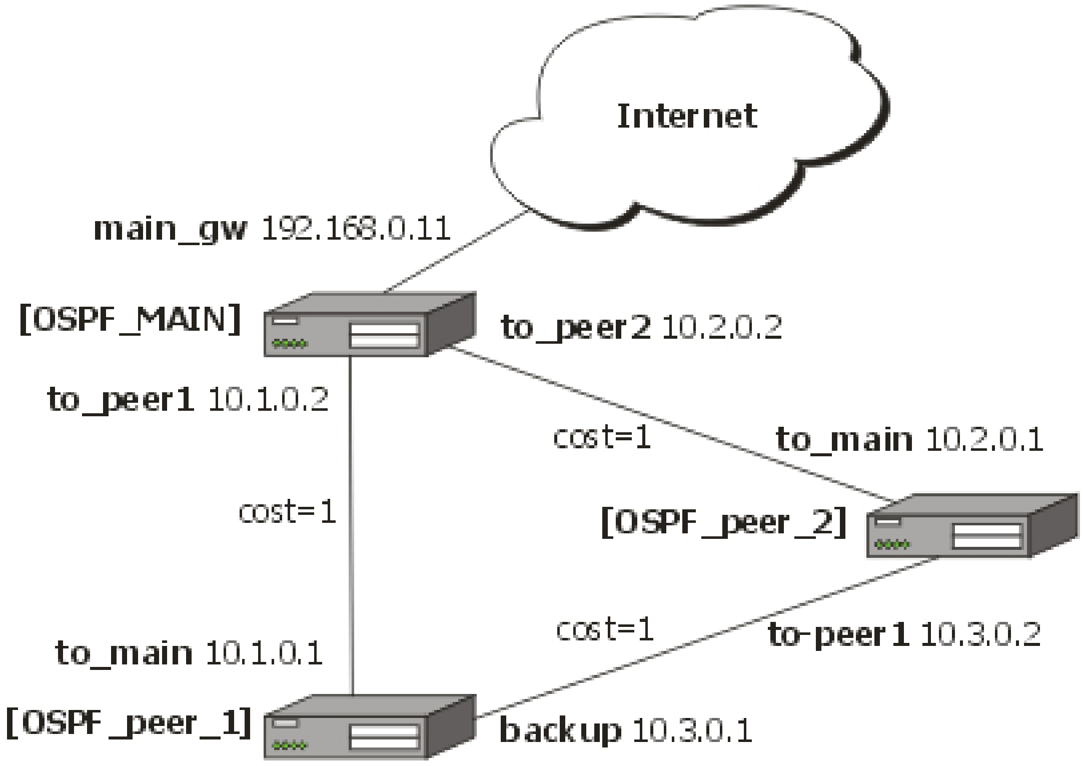
```
admin@MikroTik] routing ospf> neighbor print
 router-id=10.0.0.204 address=10.0.0.204 priority=1 state="2-Way"
    state-changes=0 ls-retransmits=0 ls-requests=0 db-summaries=0
    dr-id=0.0.0.0 backup-dr-id=0.0.0.0

[admin@MikroTik] routing ospf>
```

General Information

OSPF backup without using a tunnel

Let us assume that the link between the routers OSPF-Main and OSPF-peer-1 is the main one. If it goes down, we want the traffic switch over to the link going through the router OSPF-peer-2.

This example shows how to use OSPF for backup purposes, if you are controlling all the involved routers, and you can run OSPF on them



For this:

1. We introduce an OSPF area with area ID=0.0.0.1, which includes all three routers shown on the diagram
2. Only the OSPF-Main router will have the default route configured. Its interfaces peer1 and peer2 will be configured for the OSPF protocol. The interface main_gw will not be used for distributing the OSPF routing information
3. The routers OSPF-peer-1 and OSPF-peer-2 will distribute their connected route information, and receive the default route using the OSPF protocol

Now let's setup the **OSPF_MAIN** router.

The router should have 3 NICs:

```
[admin@OSPF_MAIN] interface> print
Flags: X - disabled, D - dynamic, R - running
  #      NAME                                      TYPE                   RX-RATE
TX-RATE      MTU
  0   R main_gw                                    ether                    0
0          1500
  1   R to_peer_1                                  ether                    0
0          1500
```

```
  2   R to_peer_2                                 ether                    0
0          1500
```

Add all needed ip addresses to interfaces as it is shown here:

```
[admin@OSPF_MAIN] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #    ADDRESS                 NETWORK            BROADCAST          INTERFACE
  0    192.168.0.11/24       192.168.0.0        192.168.0.255      main_gw
  1    10.1.0.2/24           10.1.0.0           10.1.0.255         to_peer_1
  2    10.2.0.2/24           10.2.0.0           10.2.0.255         to_peer_2
```

You should set distribute-default as if-installed-as-type-2, redistribute-connected as as-type-1 and redistribute-static as as-type-2. Metric-connected, metric-static, metric-rip, metric-bgp should be zero

```
[admin@OSPF_MAIN] routing ospf> print
                        router-id: 0.0.0.0
               distribute-default: if-installed-as-type-2
           redistribute-connected: as-type-1
              redistribute-static: as-type-2
                 redistribute-rip: no
                 redistribute-bgp: no
                   metric-default: 1
                 metric-connected: 0
                    metric-static: 0
                       metric-rip: 0
                       metric-bgp: 0
```

Define new OSPF area named local_10 with area-id 0.0.0.1:

```
[admin@OSPF_MAIN] routing ospf area> print
Flags: X - disabled, I - invalid
  #    NAME                             AREA-ID            STUB DEFAULT-COST
AUTHENTICATION
  0    backbone                         0.0.0.0
none
  1    local_10                         0.0.0.1             no         1
none
```

Add connected networks with area local_10 in ospf network:

```
[admin@OSPF_MAIN] routing ospf network> print
Flags: X - disabled, I - invalid
  #    NETWORK                 AREA
  0    10.1.0.0/24           local_10
  1    10.2.0.0/24           local_10
```

For main router the configuration is done. Next, you should configure **OSPF_peer_1** router

Enable followong interfaces on **OSPF_peer_1**:

```
[admin@OSPF_peer_1] interface> print
Flags: X - disabled, D - dynamic, R - running
  #      NAME                                     TYPE                   RX-RATE
TX-RATE      MTU
  0   R backup                                    ether                    0
0         1500
  1   R to_main                                   ether                    0
0         1500
```

Assign IP addresses to these interfaces:

```
[admin@OSPF_peer_1] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #    ADDRESS                 NETWORK            BROADCAST          INTERFACE
  0    10.1.0.1/24             10.1.0.0           10.1.0.255         to_main
  1    10.3.0.1/24             10.3.0.0           10.3.0.255         backup
```

Set redistribute-connected as as-type-1. Metric-connected, metric-static, metric-rip, metric-bgp should be zero.

```
[admin@OSPF_peer_1] routing ospf> print
                          router-id: 0.0.0.0
                 distribute-default: never
             redistribute-connected: as-type-1
                redistribute-static: no
                   redistribute-rip: no
                   redistribute-bgp: no
                     metric-default: 1
                   metric-connected: 0
                      metric-static: 0
                         metric-rip: 0
                         metric-bgp: 0
```

Add the same area as in main router:

```
[admin@OSPF_peer_1] routing ospf area> print
Flags: X - disabled, I - invalid
  #    NAME                                 AREA-ID             STUB DEFAULT-COST
AUTHENTICATION
  0    backbone                             0.0.0.0
none
  1    local_10                             0.0.0.1              no         1
none
```

Add connected networks with area local_10:

```
[admin@OSPF_peer_1] routing ospf network> print
Flags: X - disabled, I - invalid
  #    NETWORK                  AREA
  0    10.3.0.0/24            local_10
  1    10.1.0.0/24            local_10
```

Finally, set up the **OSPF_peer_2** router. Enable the following interfaces:

```
[admin@OSPF_peer_2] interface> print
Flags: X - disabled, D - dynamic, R - running
  #      NAME                                     TYPE                   RX-RATE
TX-RATE      MTU
  0   R to_main                                   ether                    0
0         1500
  1   R to_peer_1                                 ether                    0
0         1500
```

Add the needed IP addresses:

```
[admin@OSPF_peer_2] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
  #    ADDRESS                  NETWORK             BROADCAST          INTERFACE
  0    10.2.0.1/24              10.2.0.0            10.2.0.255         to_main
  1    10.3.0.2/24              10.3.0.0            10.3.0.255         to_peer_1
```

Add the same area as in previous routers:

```
[admin@OSPF_peer_2] routing ospf area> print
Flags: X - disabled, I - invalid
  #    NAME                                 AREA-ID             STUB DEFAULT-COST
AUTHENTICATION
  0    backbone                             0.0.0.0
none
  1    local_10                             0.0.0.1              no         1
none
```

Add connected networks with the same area:

```
[admin@OSPF_peer_2] routing ospf network> print
Flags: X - disabled, I - invalid
```

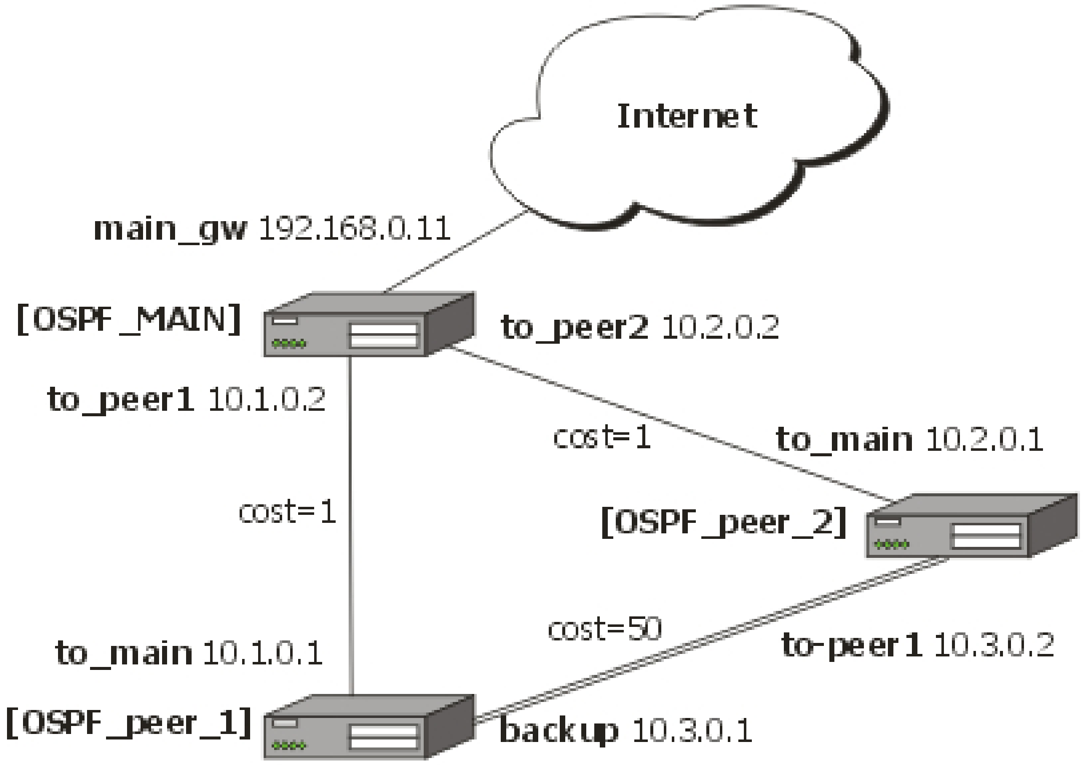
```
  #    NETWORK                  AREA
  0    10.2.0.0/24            local_10
  1    10.3.0.0/24            local_10
```

After all routers have been set up as described above, and the links between them are operational, the routing tables of the three routers look as follows:

```
[admin@OSPF_MAIN] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
  #      DST-ADDRESS            G GATEWAY             DISTANCE INTERFACE
  0 Io 192.168.0.0/24                                110
  1 DC 192.168.0.0/24         r 0.0.0.0                0        main_gw
  2 Do 10.3.0.0/24            r 10.2.0.1               110      to_peer_2
                              r 10.1.0.1                        to_peer_1
  3 Io 10.2.0.0/24                                110
  4 DC 10.2.0.0/24            r 0.0.0.0                0        to_peer_2
  5 Io 10.1.0.0/24                                110
  6 DC 10.1.0.0/24            r 0.0.0.0                0        to_peer_1

[admin@OSPF_peer_1] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
  #      DST-ADDRESS            G GATEWAY             DISTANCE INTERFACE
  0 Do 192.168.0.0/24         r 10.1.0.2               110      to_main
  1 Io 10.3.0.0/24                                110
  2 DC 10.3.0.0/24            r 0.0.0.0                0        backup
  3 Do 10.2.0.0/24            r 10.1.0.2               110      to_main
                              r 10.3.0.2                        backup
  4 Io 10.1.0.0/24                                110
  5 DC 10.1.0.0/24            r 0.0.0.0                0        to_main

[admin@OSPF_peer_2] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
  #      DST-ADDRESS            G GATEWAY             DISTANCE INTERFACE
  0 Do 192.168.0.0/24         r 10.2.0.2                110     to_main
  1 Io 10.3.0.0/24                                          110
  2 DC 10.3.0.0/24            r 0.0.0.0                 0       to_peer_1
  3 Io 10.2.0.0/24                                 110
  4 DC 10.2.0.0/24            r 0.0.0.0                 0       to_main
  5 Do 10.1.0.0/24            r 10.3.0.1                110     to_peer_1
                              r 10.2.0.2                        to_main
```

Routing tables with Revised Link Cost

This example shows how to set up link cost. Let us assume, that the link between the routers **OSPF_peer_1** and **OSPF_peer_2** has a higher cost (might be slower, we have to pay more for the traffic through it, etc.).



We should change cost value in both routers: **OSPF_peer_1** and **OSPF_peer_2** to 50. To do this, we need to add a following interface:

```
[admin@OSPF_peer_1] routing ospf interface> add interface=backup cost=50
[admin@OSPF_peer_1] routing ospf interface> print
  0 interface=backup cost=50 priority=1 authentication-key=""
 retransmit-interval=5s transmit-delay=1s hello-interval=10s
dead-interval=40s

[admin@OSPF_peer_2] routing ospf interface> add interface=to_peer_1 cost=50
[admin@OSPF_peer_2] routing ospf interface> print
  0 interface=to_peer_1 cost=50 priority=1 authentication-key=""
 retransmit-interval=5s transmit-delay=1s hello-interval=10s
     dead-interval=40s
```

After changing the cost settings, we have only one equal cost multipath route left - to the network 10.3.0.0/24 from **OSPF_MAIN** router.

Routes on **OSPF_MAIN** router:

```
[admin@OSPF_MAIN] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
  #      DST-ADDRESS            G GATEWAY             DISTANCE INTERFACE
  0 Io 192.168.0.0/24                                 110
  1 DC 192.168.0.0/24         r 0.0.0.0                 0       main_gw
  2 Do 10.3.0.0/24            r 10.2.0.1                110     to_peer_2
                              r 10.1.0.1                        to_peer_1
  3 Io 10.2.0.0/24                                 110
  4 DC 10.2.0.0/24            r 0.0.0.0                 0       to_peer_2
  5 Io 10.1.0.0/24                                 110
  6 DC 10.1.0.0/24            r 0.0.0.0                 0       to_peer_1
```

On **OSPF_peer_1**:

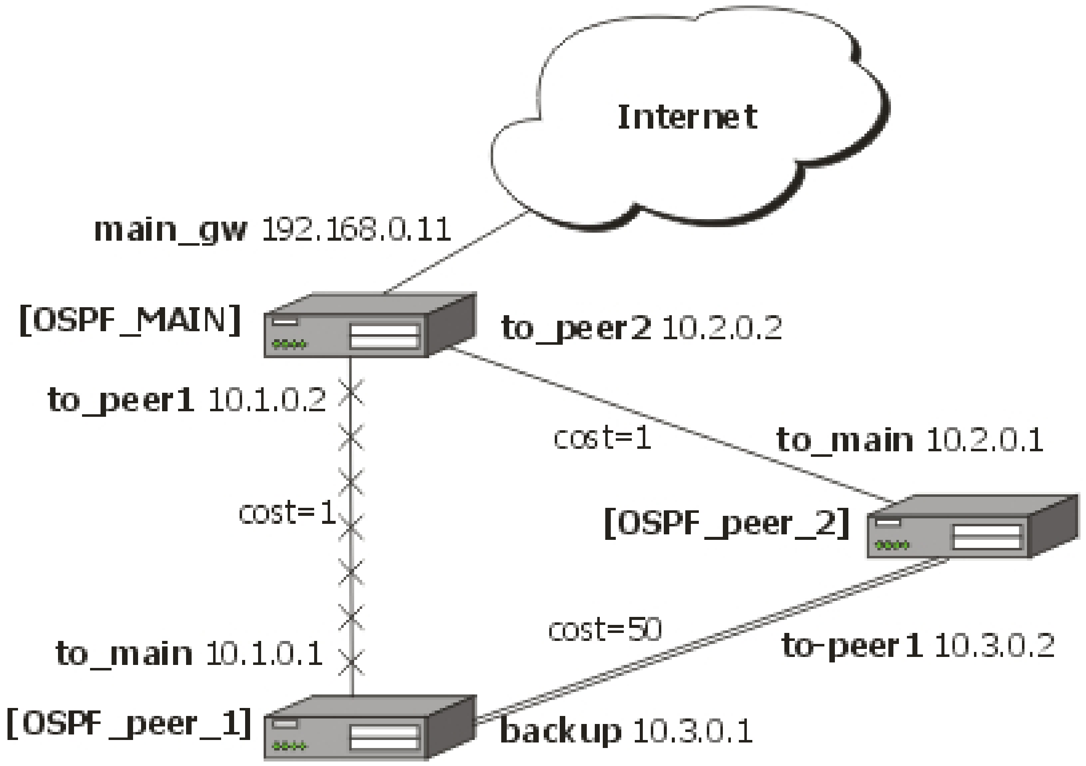
```
[admin@OSPF_peer_1] > ip route pr
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
  #      DST-ADDRESS            G GATEWAY             DISTANCE INTERFACE
  0 Do 192.168.0.0/24         r 10.1.0.2               110       to_main
  1 Io 10.3.0.0/24                                110
  2 DC 10.3.0.0/24            r 0.0.0.0                0         backup

  3 Do 10.2.0.0/24            r 10.1.0.2               110       to_main
  4 Io 10.1.0.0/24                                110
  5 DC 10.1.0.0/24            r 0.0.0.0                0         to_main
```

On **OSPF_peer_2**:

```
[admin@OSPF_peer_2] > ip route print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
  #      DST-ADDRESS            G GATEWAY             DISTANCE INTERFACE
  0 Do 192.168.0.0/24         r 10.2.0.2               110       to_main
  1 Io 10.3.0.0/24                                110
  2 DC 10.3.0.0/24            r 0.0.0.0                0         to_peer_1
  3 Io 10.2.0.0/24                                110
  4 DC 10.2.0.0/24            r 0.0.0.0                0         to_main
  5 Do 10.1.0.0/24            r 10.2.0.2               110       to_main
```

Functioning of the Backup

If the link between routers **OSPF_MAIN** and **OSPF_peer_1** goes down, we have the following situation:



The OSPF routing changes as follows:

Routes on **OSPF_MAIN** router:

```
[admin@OSPF_MAIN] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
  #      DST-ADDRESS            G GATEWAY             DISTANCE INTERFACE
  0 Io 192.168.0.0/24                                 110
  1 DC 192.168.0.0/24         r 0.0.0.0                 0         main_gw
  2 Do 10.3.0.0/24            r 10.2.0.1                110       to_peer_2
  3 Io 10.2.0.0/24                                 110
  4 DC 10.2.0.0/24            r 0.0.0.0                 0         to_peer_2
  5 Io 10.1.0.0/24                                 110
  6 DC 10.1.0.0/24            r 0.0.0.0                 0         to_peer_1
```

On **OSPF_peer_1**:

```
[admin@OSPF_peer_1] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
  #      DST-ADDRESS            G GATEWAY             DISTANCE INTERFACE
  0 Do 192.168.0.0/24         r 10.3.0.2                110       backup
  1 Io 192.168.0.0/24                                 110
  2 DC 10.3.0.0/24            r 0.0.0.0                 0         backup
  3 Do 10.2.0.0/24            r 10.3.0.2                110       backup
  4 Io 10.1.0.0/24                                 110
  5 DC 10.1.0.0/24            r 0.0.0.0                 0         to_main
```

On **OSPF_peer_2**:

```
[admin@OSPF_peer_2] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
  #      DST-ADDRESS            G GATEWAY             DISTANCE INTERFACE
  0 Do 192.168.0.0/24         r 10.2.0.2                110       to_main
  1 Io 10.3.0.0/24                                 110
  2 DC 10.3.0.0/24            r 0.0.0.0                 0         to_peer_1
  3 Io 10.2.0.0/24                                 110
  4 DC 10.2.0.0/24            r 0.0.0.0                 0         to_main
  5 Do 10.1.0.0/24            r 10.2.0.2                110       to_main
```

The change of the routing takes approximately 40 seconds (the hello-interval setting). If required, this setting can be adjusted, but it should be done on all routers within the OSPF area!

RIP

Document revision 1 (Wed Mar 24 12:32:12 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

MikroTik RouterOS implements RIP Version 1 (RFC1058) and Version 2 (RFC 2453). RIP enables routers in an autonomous system to exchange routing information. It always uses the best path (the path with the fewest number of hops (i.e. routers)) available.

Specifications

Packages required: ***routing***
License required: ***level3***
Home menu level: ***/routing rip***
Standards and Technologies: ***RIPv1***, ***RIPv2***
Hardware usage: ***Not significant***

Related Documents

- *Package Management*
- *IP Addresses and ARP*
- *Routes, Equal Cost Multipath Routing, Policy Routing*

Description

Routing Information Protocol (RIP) is one protocol in a series of routing protocols based on Bellman-Ford (or distance vector) algorithm. This Interior Gateway Protocol (IGP) lets routers exchange routing information across a single autonomous system in the way of periodic RIP updates. Routers transmit their own RIP updates to neighboring networks and listen to the RIP updates from the routers on those neighboring networks to ensure their routing table reflects the current state of the network and all the best paths are available. Best path considered to be a path with the fewest hop count (*id est* that include fewer routers).

The routes learned by RIP protocol are installed in the route list (**/ip route print**) with the distance of 120.

Additional Documents

- *RIPv1 Protocol*
- *RIPv2 Protocol*
- *Cisco Systems RIP protocol overview*

General Setup

Property Description

redistribute-static (yes | no; default: **no**) - specifies whether to redistribute static routes to neighbour routers or not

redistribute-connected (yes | no; default: **no**) - specifies whether to redistribute connected routes to neighbour routers or not

redistribute-ospf (yes | no; default: **no**) - specifies whether to redistribute routes learned via OSPF protocol to neighbour routers or not

redistribute-bgp (yes | no; default: **no**) - specifies whether to redistribute routes learned via bgp protocol to neighbour routers or not

metric-static (*integer*; default: **1**) - specifies metric (the number of hops) for the static routes

metric-connected (*integer*; default: **1**) - specifies metric (the number of hops) for the connected routes

metric-ospf (*integer*; default: **1**) - specifies metric (the number of hops) for the routes learned via OSPF protocol

metric-bgp (*integer*; default: **1**) - specifies metric (the number of hops) for the routes learned via BGP protocol

update-timer (*time*; default: **30s**) - specifies frequency of RIP updates

timeout-timer (*time*; default: **3m**) - specifies time interval after which the route is considered invalid

garbage-timer (*time*; default: **2m**) - specifies time interval after which the invalid route will be dropped from neighbor router table

Notes

The maximum metric of RIP route is **15**. Metric higher than **15** is considered 'infinity' and routes with such metric are considered unreachable. Thus RIP cannot be used on networks with more than 15 hops between any two routers, and using **redistribute** metrics larger that **1** further reduces this maximum hop count.

Example

To enable RIP protocol to redistribute the routes to the connected networks:

```
[admin@MikroTik] routing rip> set redistribute-connected=yes
[admin@MikroTik] routing rip> print
       redistribute-static: no
    redistribute-connected: yes
         redistribute-ospf: no
          redistribute-bgp: no
             metric-static: 1
          metric-connected: 1
               metric-ospf: 1
                metric-bgp: 1
              update-timer: 30s
             timeout-timer: 3m
             garbage-timer: 2m
[admin@MikroTik] routing rip>
```

Interfaces

Home menu level: ***/routing rip interface***

Description

In general you do not have to configure interfaces in order to run RIP. This command level is provided only for additional configuration of specific RIP interface parameters.

Property Description

interface (*name*; default: **all**) - interface on which RIP runs

- **all** - sets defaults for interfaces not having any specific settings

send (*v1* | *v1-2* | *v2*; default: **v2**) - specifies RIP protocol update versions to distribute

receive (*v1* | *v1-2* | *v2*; default: **v2**) - specifies RIP protocol update versions the router will be able to receive

authentication (*none* | *simple* | *md5*; default: **none**) - specifies authentication method to use for RIP messages

- **none** - no authentication performed
- **simple** - plain text authentication
- **md5** - Keyed Message Digest 5 authentication

authentication-key (*text*; default: **""**) - specifies authentication key for RIP messages

prefix-list-in (*name*; default: **""**) - name of the filtering prefix list for received routes

prefix-list-out (*name*; default: **""**) - name of the filtering prefix list for advertised routes

Notes

It is recommended not to use RIP version 1 wherever it is possible due to security issues

Example

To add an entry that specifies that when advertising routes through the **ether1** interface, prefix list **plout** should be applied:

```
[admin@MikroTik] routing rip> interface add interface=ether1 \
\... prefix-list-out=plout
[admin@MikroTik] routing rip> interface print
Flags: I - inactive
  0   interface=ether1 receive=v2 send=v2 authentication=none
      authentication-key="" prefix-list-in=plout prefix-list-out=none


[admin@MikroTik] routing rip>
```

Networks

Home menu level: ***/routing rip network***

Description

To start the RIP protocol, you have to define the networks on which RIP will run.

Property Description

address (*IP address/mask*; default: **0.0.0.0/0**) - specifies the network on which RIP will run. Only directly connected networks of the router may be specified

netmask (*IP address*; default: **0.0.0.0**) - specifies the network part of the address (if it is not specified in the address argument)

Notes

For point-to-point links you should specify the remote endpoint IP address as the network IP address. For this case the correct **netmask** will be **/32**.

Example

To enable RIP protocol on **10.10.1.0/24** network:

```
[admin@MikroTik] routing rip network> add address=10.10.1.0/24
[admin@MikroTik] routing rip network> print
  # ADDRESS
  0 10.10.1.0/24
[admin@MikroTik] routing rip>
```

Neighbors

Description

This submenu is used to define a neighboring routers to exchange routing information with. Normally there is no need to add the neighbors, if multicasting is working properly within the network. If there are problems with exchanging routing information, neighbor routers can be added to the list. It will force the router to exchange the routing information with the neighbor using regular unicast packets.

Property Description

address (*IP address*; default: **0.0.0.0**) - IP address of neighboring router

Example

To force RIP protocol to exchange routing information with the **10.0.0.1** router:

```
[admin@MikroTik] routing rip> neighbor add address=10.0.0.1
[admin@MikroTik] routing rip> neighbor print
Flags: I - inactive
  #   ADDRESS
  0   10.0.0.1
[admin@MikroTik] routing rip>
```

Routes

Home menu level: ***/routing rip route***

Property Description

dst-address (*read-only: IP address/mask*) - network address and netmask of destination

gateway (*read-only: IP address*) - last gateway on the route to destination

metric (*read-only: integer*) - distance vector length to the destination network

from (*IP address*) - specifies the IP address of the router from which the route was received

Notes

This list shows routes learned by all dynamic routing protocols (RIP, OSPF and BGP)

Example

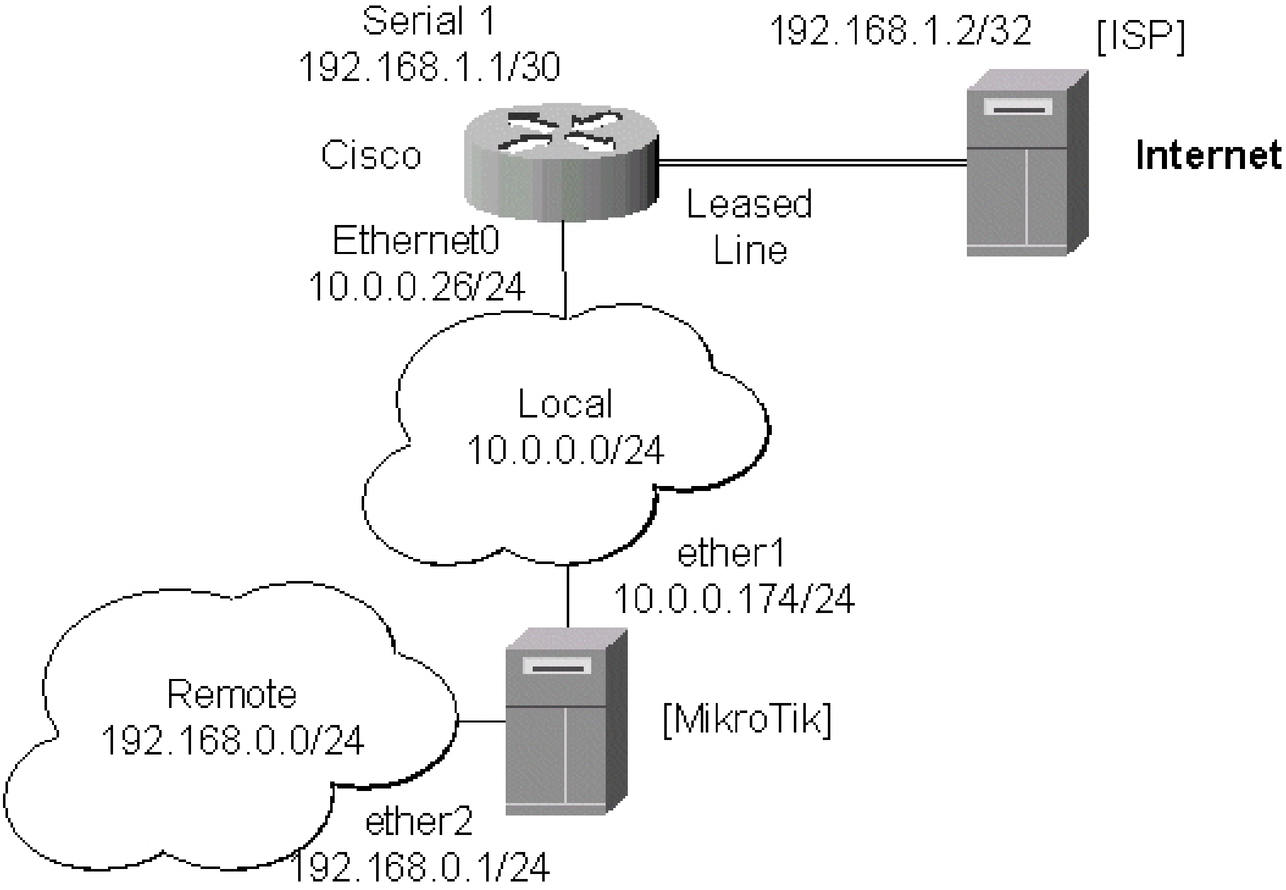
To view the list of the routes:

```
[admin@MikroTik] routing rip route> print
Flags: S - static, R - rip, O - ospf, C - connect, B - bgp
  0 O dst-address=0.0.0.0/32 gateway=10.7.1.254 metric=1 from=0.0.0.0

...

 33 R dst-address=159.148.10.104/29 gateway=10.6.1.1 metric=2 from=10.6.1.1

 34 R dst-address=159.148.10.112/28 gateway=10.6.1.1 metric=2 from=10.6.1.1

[admin@MikroTik] routing rip route>
```

General Information

Example

Let us consider an example of routing information exchange between MikroTik router, a Cisco router and the ISP (also MikroTik) routers:



- MikroTik Router Configuration

```
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                 TYPE             MTU
  0  R ether1               ether            1500
  1  R ether2               ether            1500
[admin@MikroTik] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
  #   ADDRESS            NETWORK         BROADCAST       INTERFACE
  0   10.0.0.174/24      10.0.0.174      10.0.0.255      ether1
  1   192.168.0.1/24     192.168.0.0     192.168.0.255   ether2
[admin@MikroTik] > ip route print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0 DC 192.168.0.0/24     r 0.0.0.0         0        ether2
    1 DC 10.0.0.0/24        r 0.0.0.0         0        ether1
[admin@MikroTik] >
```

Note, that no default route has been configured. The route will be obtained using the RIP. The necessary configuration of the RIP general settings is as follows:

```
[admin@MikroTik] routing rip> set redistribute-connected=yes
[admin@MikroTik] routing rip> print
      redistribute-static: no
    redistribute-connected: yes
         redistribute-ospf: no
          redistribute-bgp: no
             metric-static: 1
          metric-connected: 1
               metric-ospf: 1
                metric-bgp: 1
              update-timer: 30s
             timeout-timer: 3m
             garbage-timer: 2m

[admin@MikroTik] routing rip>
```

The minimum required configuration of RIP interface is just enabling the network associated with the ether1 interface:

```
[admin@MikroTik] routing rip network> add address=10.0.0.0/2
[admin@MikroTik] routing rip network> print
  # ADDRESS
  0 10.0.0.0/24

[admin@MikroTik] routing rip network>
```

Note, that there is no need to run RIP on the ether2, as no propagation of RIP information is required into the Remote network in this example. The routes obtained by RIP can be viewed in the /routing rip route menu:

```
[admin@MikroTik] routing rip> route print
Flags: S - static, R - rip, O - ospf, C - connect, B - bgp
  0 R dst-address=0.0.0.0/0 gateway=10.0.0.26 metric=2 from=10.0.0.26

  1 C dst-address=10.0.0.0/24 gateway=0.0.0.0 metric=1 from=0.0.0.0

  2 C dst-address=192.168.0.0/24 gateway=0.0.0.0 metric=1 from=0.0.0.0

  3 R dst-address=192.168.1.0/24 gateway=10.0.0.26 metric=1 from=10.0.0.26

  4 R dst-address=192.168.3.0/24 gateway=10.0.0.26 metric=1 from=10.0.0.26

[admin@MikroTik] routing rip>
```

The regular routing table is:

```
[MikroTik] routing rip> /ip route print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, R - rip, O - ospf, B - bgp
    #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
    0  R 0.0.0.0/0          r 10.0.0.26       120      ether1
    1  R 192.168.3.0/24     r 10.0.0.26       120      ether1
    2  R 192.168.1.0/24     r 10.0.0.26       120      ether1
    3 DC 192.168.0.0/24     r 0.0.0.0         0        ether2
    4 DC 10.0.0.0/24        r 0.0.0.0         0        ether1
```

```
[admin@MikroTik] routing rip>
```

- Cisco Router Configuration

```
Cisco#show running-config
...
interface Ethernet0
 ip address 10.0.0.26 255.255.255.0
 no ip directed-broadcast
!
interface Serial1
 ip address 192.168.1.1 255.255.255.252
 ip directed-broadcast
!
router rip
 version 2
 redistribute connected
 redistribute static
 network 10.0.0.0
 network 192.168.1.0
!
ip classless
!
...
```

The routing table of the Cisco router is:

```
Cisco#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
       U - per-user static route, o - ODR

Gateway of last resort is 192.168.1.2 to network 0.0.0.0

     10.0.0.0/24 is subnetted, 1 subnets
C       10.0.0.0 is directly connected, Ethernet0
R    192.168.0.0/24 [120/1] via 10.0.0.174, 00:00:19, Ethernet0
     192.168.1.0/30 is subnetted, 1 subnets
C       192.168.1.0 is directly connected, Serial1
R    192.168.3.0/24 [120/1] via 192.168.1.2, 00:00:05, Serial1
R*   0.0.0.0/0 [120/1] via 192.168.1.2, 00:00:05, Serial1
Cisco#
```

As we can see, the Cisco router has learned RIP routes both from the MikroTik router (192.168.0.0/24), and from the ISP router (0.0.0.0/0 and 192.168.3.0/24).

BGP (Border Gateway Protocol)

Document revision 1.2 (Thu Mar 04 19:34:34 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The Border Gateway Protocol (BGP) allows setting up an interdomain dynamic routing system that automatically generates the routing table for routing between autonomous systems (AS).

MikroTik RouterOS supports BGP Version 4, as defined in RFC1771.

The MikroTik RouterOS implementation of the BGP has filtering (using prefix lists) feature

Specifications

Packages required: ***routing***
License required: ***level3***
Home menu level: ***/routing bgp***
Standards and Technologies: ***RFC1771***
Hardware usage: *requires additional RAM for storing routing information (128MB recommended)*

Related Documents

- *Package Management*
- *IP Addresses and ARP*
- *Routes, Equal Cost Multipath Routing, Policy Routing*
- *Prefix Lists*

Description

The Border Gateway Protocol (BGP) is an Exterior Gateway Protocol (EGP). It allows setting up an interdomain routing system that automatically guarantees the loop-free exchange of routing information between autonomous systems (AS). It is widely used in companies assigned with a definite IP address ranges and connected to a nubmer of ISPs simultaneously so that if one of the links is down, the IP address ranges are still reachable via an another ISP.

The MikroTik RouterOS implementation of the BGP supports filtering with prefix lists, that is used for filtering received and sent routing information.

The routes learned by BGP protocol are installed in the route list with the distance of **200** for iBGP (Internal BGP) routes and of 20 for eBGP (External BGP) routes.

Additional Documents

- ***http://www.ietf.org/rfc/rfc1771.txt***
- ***http://www.cisco.com/univercd/cc/td/doc/cisintwk/ics/icsbgp4.htm***
- ***http://www.cisco.com/univercd/cc/td/doc/cisintwk/idg4/nd2003.htm***

BGP Setup

Home menu level: ***/routing bgp***

Property Description

enabled (*yes* | *no*; default: **no**) - enable or disable BGP

as (*integer*; default: **1**) - autonomous system number

router-id (*IP address*; default: **0.0.0.0**) - the Router identification in form of an IP address

redistribute-connected (*yes* | *no*) - if enabled, the router will redistribute the information about all connected routes, i.e., routes to the networks that can be directly reached

redistribute-static (*yes* | *no*; default: **no**) - if enabled, the router will redistribute the information about all static routes added to its routing database, i.e., routes that have been created using the /ip route add command on the router

redistribute-rip (*yes* | *no*; default: **no**) - if enabled, the router will redistribute the information about all routes learned by RIP protocol

redistribute-ospf (*yes* | *no*; default: **no**) - if enabled, the router will redistribute the information about all routes learned by the OSPF protocol

state (*read-only: disabled* | *running* | *terminating*) - status of the BGP

- **disabled** - not working, has been disabled
- **running** - working
- **terminating** - shutting down, flushing all route information

Notes

Usually, you want to redistribute connected and static routes, if any. Therefore change the settings for these arguments and proceed to the BGP networks.

Example

To enable BGP protocol specifying that router **192.168.0.206**, that belongs to the **65002** AS, should redistribute the connected routes

```
[admin@MikroTik] routing bgp>
[admin@MikroTik] routing bgp> print
                   enabled: yes
                        as: 65002
                 router-id: 192.168.0.206
       redistribute-static: no
    redistribute-connected: yes
          redistribute-rip: no
         redistribute-ospf: no
                     state: running
[admin@MikroTik] routing bgp>
```

BGP Network

Home menu level: ***/routing bgp network***

Description

BGP Networks is a list of the networks to be advertised.

Property Description

network (*IP address/mask*; default: **0.0.0.0/0**) - network to advertise

Notes

You can add to the list as many networks as required.

The router is not checking whether the network is in the routing table, it always advertises all the routes that are specified here.

Note the difference with OSPF, that use network list for different purpose - to determine where to send updates.

Example

To advertise the network **159.148.150.192/27**:

```
[admin@modux] routing bgp network> add network=159.148.150.192/27
[admin@modux] routing bgp network> print
 # NETWORK
 0 159.148.150.192/27
[admin@modux] routing bgp network>
```

BGP Peers

Home menu level: ***/routing bgp peer***

Description

You need to specify the BGP peer with whom you want to exchange the routing information. The BGP exchanges routing information only if it can establish a TCP connection to its peer. You can add as many peers as required.

Property Description

remote-address (*IP address*; default: **0.0.0.0**) - address of the remote peer

remote-as (*integer*; default: **0**) - AS number of the remote peer

multihop (*yes* | *no*; default: **no**) - if enabled, allows BGP sessions, even when the neighbour is not on a directly connected segment. The multihop session is not established if the only route to the multi-hop peer's address is the default route (0.0.0.0/0)

route-reflect (*yes* | *no*; default: **no**) - defines whether to redistribute further the routes learned from router of the same AS or not. If enabled, can significantly reduce traffic between routers in the same AS

prefix-list-in (*name*; default: **""**) - name of the filtering prefix list for receiving routes

prefix-list-out (*name*; default: **""**) - name of the filtering prefix list for advertising routes

state (*read-only: connected* | *not-connected*) - the status of the BGP connection to the peer

routes-received - the number of received routes from this peer

Example

To enable routing information exchange with the neighbour (non-multihop) **192.168.0.254** that belongs to **65002** AS:

```
[admin@MikroTik] routing bgp peer> add remote-address=192.168.0.254 remote-as=65002
[admin@MikroTik] routing bgp peer> print
  # REMOTE-ADDRESS  REMOTE-AS MULTIHOP ROUTE-REFLECT PREFIX-LIS... PREFIX-LI...
  0 192.168.0.254   65002     no       no            none          none
[admin@MikroTik] routing bgp> peer print status
  # REMOTE-ADDRESS  REMOTE-AS STATE          ROUTES-RECEIVED
  0 192.168.0.254   65002     connected      1
[admin@MikroTik] routing bgp>
```

Troubleshooting

Description

- *The BGP does not learn routes from its peer*

Try to see if the peer is directly attached, or you should use the **multihop** flag when defining the peer and static routing to get the connection between the peers.

- *I can ping from one peer to the other one, but no routing exchange takes place*
  Check the status of the peer using **/routing bgp peer print detail** command. See if you do not have firewall that blocks TCP port 179.

Prefix Lists

Document revision 1.2 (Wed Mar 24 12:31:52 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Prefix lists are used to filter routes received from or sent to other routers.

Specifications

Packages required: ***routing***
License required: ***level1***
Home menu level: ***/routing prefix-list***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***Routes, Equal Cost Multipath Routing, Policy Routing***
- ***RIP***
- ***BGP***

Description

Filtering by prefix list involves matching the prefixes of routes with those listed in the prefix list.

When there is a match, the route is used. The prefix lists are used when specifying the BGP peers under **/routing bgp peer** or RIP interfaces under **/routing rip interface**.

To match a prefix-list entry, a route should have its prefix (i.e. destination address) matching **prefix** property of the entry, and it should have the length of its prefix (i.e. mask of destination address) matching **prefix-length** property of the entry.

Setup

Home menu level: ***/routing prefix-list***

Property Description

name (*name*; default: **""**) - a name for the prefix list

default-action (*accept* | *reject*; default: **accept**) - default action for all members of the list

Notes

An empty prefix list matches all prefixes

Example

To add a **cybernet** list that rejects the routes by default:

```
[admin@MikroTik] routing prefix-list> add name=cybernet default-action=reject
[admin@MikroTik] routing prefix-list> print
  # NAME                                                 DEFAULT-ACTION
  0 cybernet                                             reject
[admin@MikroTik] routing prefix-list>
```

Prefix List Rules

Home menu level: ***/routing prefix-list list <listname>***

Property Description

prefix (*IP address/mask*; default: **0.0.0.0/0**) - network prefix to match

prefix-length (*integer*; default: **0-32**) - length (range) of the network prefix in bits

action (*accept* | *reject*; default: **accept**) - action to perform on list member

Notes

There are two different values to match - prefix (i.e. destination address of the route applying the network mask) and prefix length. Prefix length matches network mask of the received route.

For example, if **prefix=172.16.0.0/16** and **prefix-length=16-24**, then received route for **172.16.24.0/24** will match, but route for **172.16.24.0/25** will not.

Example

To accept the routes to the **172.16.0.0/16** network and any of it's subnetworks that has their network mask between **16** and **24**:

```
[admin@MikroTik] routing prefix-list> list cybernet
[admin@MikroTik] routing prefix-list list cybernet> add prefix=172.16.0.0/16 \
\... prefix-length=16-24
[admin@MikroTik] routing prefix-list list cybernet> print
  # PREFIX             PREFIX-LENGTH ACTION
  0 172.16.0.0/16      16-24         accept
[admin@MikroTik] routing prefix-list list cybernet>
```

AAA

Document revision 2.1 (Fri Dec 17 18:28:01 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

Authentication, Authorization and Accounting feature provides a possibility of local and/or remote (on RADIUS server) Point-to-Point and HotSpot user management and traffic accounting (all IP traffic passing the router is accounted).

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/user, /ppp, /ip accounting, /radius***
Standards and Technologies: ***RADIUS***
Hardware usage: *Local traffic accounting requires additional memory*

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***HotSpot Gateway***
- ***PPP and Asynchronous Interfaces***
- ***PPPoE***
- ***PPTP***

- *L2TP*
- *ISDN*

Description

The MikroTik RouterOS provides scalable Authentication, Athorization and Accounting (AAA) functionality.

Local authentication is performed consulting User Database and Profile Database. The configuration is collected from the respective item in User Database (determined by the username), from the item in Profile Database, that is associated with this item and from the item in Profile Database, that is set as default for the service the user is authenticating to. Settings received from the default profile for the service is overriden by the respective settings from the user's profile, and the resulting settings are overriden by the respective settings taken from the User Database (the only exception is that particular IP addresses take precedence over IP pools in the **local-address** and **remote-address** settings, as described later on).

RADIUS authentication gives the ISP or network administrator the ability to manage PPP user access and accounting from one server throughout a large network. The MikroTik RouterOS has a RADIUS client which can authenticate for PPP, PPPoE, PPTP, L2TP and ISDN connections. The attributes received from RADIUS server override the ones set in the default profile, but if some parameters are not received they are taken from the respective default profile.

Traffic is accounted locally with Cisco **IP pairs** and snapshot image can be gathered using Syslog utilities. If RADIUS accounting is enabled, accounting information is also sent to the RADIUS server default for that service.

Router User Groups

Home menu level: ***/user group***

Property Description

name (*name*) - the name of the user group

policy (*multiple choice: local* | *telnet* | *ssh* | *ftp* | *reboot* | *read* | *write* | *policy* | *test* | *web*; default: **!local,!telnet,!ssh,!ftp,!reboot,!read,!write,!policy,!test,!web**) - group rights set

- **local** - user can log on locally via console
- **telnet** - user can log on remotely via telnet
- **ssh** - user can log on remotely via secure shell
- **ftp** - user can log on remotely via ftp and send and retrieve files from the router
- **reboot** - user can reboot the router
- **read** - user can retrieve the configuration
- **write** - user can retrieve and change the configuration
- **policy** - user can manage user policies and add and remove users
- **test** - user can run ping, traceroute, bandwidth test
- **web** - user can log on remotely via winbox

Notes

There are three system groups which cannot be deleted:

```
[admin@MikroTik] user group> print
  0 ;;; users with read only permission
    name="read"
    policy=local,telnet,ssh,!ftp,reboot,read,!write,!policy,test,web

  1 ;;; users with write permission
    name="write"
    policy=local,telnet,ssh,!ftp,reboot,read,write,!policy,test,web

  2 ;;; users with complete access
    name="full" policy=local,telnet,ssh,ftp,reboot,read,write,policy,test,web

[admin@MikroTik] user group>
```

Exclamation sign '**!**' just before policy name means **NOT**.

Example

To add **reboot** group that is allowed to reboot the router locally or using telnet, as well as read the router's configuration:

```
[admin@MikroTik] user group> add name=reboot policy=telnet,reboot,read
[admin@MikroTik] user group> print
  0 ;;; users with read only permission
    name="read"
    policy=local,telnet,ssh,!ftp,reboot,read,!write,!policy,test,web

  1 ;;; users with write permission
    name="write"
    policy=local,telnet,ssh,!ftp,reboot,read,write,!policy,test,web

  2 ;;; users with complete access
    name="full" policy=local,telnet,ssh,ftp,reboot,read,write,policy,test,web

  3 name="reboot"
    policy=!local,telnet,!ssh,!ftp,reboot,read,!write,!policy,!test,!web

[admin@MikroTik] user group>
```

Router Users

Home menu level: ***/user***

Property Description

address (*IP address/mask*; default: **0.0.0.0/0**) - IP address from which the user is allowed to log in

group (*name*) - name of the group the user belongs to

name (*name*) - user name. Although it must start with an alphanumeric character, it may "*", "_", ".", "@" symbols

password (*text*; default: **""**) - user password. If not specified, it is left blank (hit [Enter] when logging in). It conforms to standard Unix characteristics of passwords and can contain letters, digits, "*" and "_" symbols

Notes

There is one predefined user that cannot be deleted:

```
[admin@MikroTik] user> print
Flags: X - disabled
  #   NAME                                             GROUP ADDRESS
  0   ;;; system default user
      admin                                            full  0.0.0.0/0

[admin@MikroTik] user>
```

When the user has logged in he can change his password using the **/password** command. The user is required to enter his/her current password before entering the new password. When the user logs out and logs in for the next time, the new password must be entered.

Example

To add user **joe** with password **j1o2e3** belonging to **write** group:

```
[admin@MikroTik] user> add name=joe password=j1o2e3 group=write
[admin@MikroTik] user> print
Flags: X - disabled
  0   ;;; system default user
      name="admin" group=full address=0.0.0.0/0

  1   name="joe" group=write address=0.0.0.0/0


[admin@MikroTik] user>
```

Monitoring Active Router Users

Home menu level: ***/user active print***

Property Description

address (*read-only: IP address*) - IP address from which the user is accessing the router

- **0.0.0.0** - the user is logged in locally

name (*read-only: name*) - user name

via (*read-only: console* | *telnet* | *ssh* | *web*) - user's access method

when (*read-only: date*) - log-in time

Example

```
[admin@MikroTik] user> active print
Flags: R - radius
  #   WHEN                 NAME                        ADDRESS         VIA
  0   feb/21/2003 17:48:21 admin                       0.0.0.0         console
  1   feb/24/2003 22:14:48 admin                       10.0.0.144      ssh
  2   mar/02/2003 23:36:34 admin                       10.0.0.144      web

[admin@MikroTik] user>
```

Router User Remote AAA

Home menu level: ***/user aaa***

Property Description

accounting (yes | no; default: **yes**) - specifies whether to use RADIUS accounting

default-group (*name*; default: **read**) - user group used by default for users authenticated via RADIUS server

interim-update (*time*; default: **0s**) - Interim-Update interval

use-radius (yes | no; default: **no**) - specifies whether a user database on a RADIUS server should be consulted

Notes

The RADIUS user database is consulted only if the required username is not found in local user database

Example

To enable RADIUS AAA:

```
[admin@MikroTik] user aaa> set use-radius=yes
[admin@MikroTik] user aaa> print
        use-radius: yes
        accounting: yes
    interim-update: 0s
     default-group: read
[admin@MikroTik] user aaa>
```

Local Point-to-Point AAA

Local PPP User Profiles

Home menu level: ***/ppp profile***

Description

PPP profiles are used to define default values to users managed in **/ppp secret** submenu. Settings in **/ppp secret** override corresponding **/ppp profile** settings except in the case when **local-address** or **remote-address** are configured in both **/ppp secret** and **/ppp profile**, but in one of them ip pool is referred, concrete IP addresses always take precedence.

Property Description

idle-timeout (*time*; default: **0s**) - specifies the amount of time after which the link will be terminated if there was no activity present

- **0s** - no link timeout is set

incoming-filter (*name*; default: **""**) - firewall chain name for incoming packets. If set, then for each packet coming from the client, this firewall chain will get control. You have to manually add chain ppp and jumps to this chain from other chains in order this feature to work

local-address (*IP address* | *name*; default: **0.0.0.0**) - either address or pool name of the PPP server

name (*name*) - profile name

only-one (yes | no; default: **no**) - if enabled, allows the user only one connection at a time

outgoing-filter (*name*; default: **""**) - firewall chain name for outgoing packets. If set, then for each packet coming to the client, this firewall chain will get control. You have to manually add chain ppp and jumps to this chain from other chains in order this feature to work

remote-address (*IP address* | *name*; default: **0.0.0.0**) - either address or pool name of the PPP client

require-encryption (yes | no; default: **no**) - defines whether to require encryption from the client or simply prefer it

rx-bit-rate (*integer*; default: **0**) - receive bitrate in bits/s

session-timeout (*time*; default: **0s**) - maximum time the connection can stay up

- **0s** - no connection timeout

tx-bit-rate (*integer*; default: **0**) - transmit bitrate in bits/s

use-compression (yes | no; default: **no**) - defines whether to compress traffic or not

use-encryption (yes | no; default: **no**) - defines whether to encrypt traffic or not

use-vj-compression (yes | no; default: **no**) - specifies whether to use Van Jacobson header compression

wins-server (*text*) - the Windows DHCP client will use this as the default WINS server. Two comma-separated WINS servers can be specified to be used by PPP user as primary and secondary WINS servers

Notes

One default profile is created:

```
[admin@MikroTik] ppp profile> print
Flags: * - default
  0 * name="default" local-address=0.0.0.0 remote-address=0.0.0.0
      session-timeout=0s idle-timeout=0s use-compression=no
      use-vj-compression=no use-encryption=yes require-encryption=no
      only-one=no tx-bit-rate=0 rx-bit-rate=0 incoming-filter=""
      outgoing-filter="" wins-server=""

[admin@MikroTik] ppp profile>
```

Use VJ compression only if you have to because it may slow down the communications on bad or congested channels.

incoming-filter and **outgoing-filter** arguments add dynamic **jump** rules to chain **ppp**, where the **jump-target** argument will be equal to **incoming-filter** or **outgoing-filter** argument in **/ppp profile**. Therefore, chain **ppp** should be manually added before changing these arguments.

only-one parameter is ignored if RADIUS authentication is used

Example

To add the profile **ex** that will assign the router itself the **10.0.0.1** address, and the addresses from the **ex** pool to the clients:

```
[admin@MikroTik] ppp profile> add name=ex local-address=10.0.0.1 remote-address=ex
[admin@MikroTik] ppp profile> print
Flags: * - default
  0 * name="default" local-address=0.0.0.0 remote-address=0.0.0.0
      session-timeout=0s idle-timeout=0s use-compression=no
      use-vj-compression=no use-encryption=yes require-encryption=no
      only-one=no tx-bit-rate=0 rx-bit-rate=0 incoming-filter=""
      outgoing-filter="" wins-server=""

  1   name="ex" local-address=10.0.0.1 remote-address=ex session-timeout=0s
      idle-timeout=0s use-compression=no use-vj-compression=no
      use-encryption=no require-encryption=no only-one=no tx-bit-rate=0
      rx-bit-rate=0 incoming-filter="" outgoing-filter="" wins-server=""


[admin@MikroTik] ppp profile>
```

Local PPP User Database

Home menu level: ***/ppp secret***

Description

PPP User Database stores PPP users and defines owner and profile for each of them.

Property Description

caller-id (*text*; default: **""**) - for PPTP and L2TP it is the IP address a client must connect from. For PPPoE it is the MAC address (written in CAPITAL letters) a client must connect from. For ISDN it is the caller's number (that may or may not be provided by the operator) the client may dial-in from

- **""** - no restrictions on where clients may connect from

limit-bytes-in (*integer*; default: **0**) - maximal volume of client upload, in bytes, for a session

limit-bytes-out (*integer*; default: **0**) - maximal volume of client download, in bytes, for a session

local-address (*IP address* | *name*; default: **0.0.0.0**) - either address or pool name of the PPP server

name (*name*) - user name

password (*text*; default: **""**) - user's password

profile (*name*; default: **default**) - profile name for the user

remote-address (*IP address* | *name*; default: **0.0.0.0**) - either address or pool name of the PPP client

routes (*text*) - routes that appear on the server when the client is connected. The route format is: dst-address gateway metric (for example, 10.1.0.0/ 24 10.0.0.1 1). Several routes may be specified separated with commas

service (*any* | *async* | *isdn* | *l2tp* | *pppoe* | *pptp*; default: **any**) - specifies the services available to a particular user

Example

To add the user **ex** with **lkjrht** password for PPTP service only and with **ex** profile:

```
[admin@MikroTik] ppp secret> add name=ex password=lkjrht service=pptp profile=ex
[admin@MikroTik] ppp secret> print
Flags: X - disabled
  #   NAME              SERVICE CALLER-ID       PASSWORD        PROFILE
  0   ex                pptp                    lkjrht          ex
[admin@MikroTik] ppp secret> print detail
Flags: X - disabled
  0   name="ex" service=pptp caller-id="" password="lkjrht" profile=ex
      local-address=0.0.0.0 remote-address=0.0.0.0 routes=""


[admin@MikroTik] ppp secret>
```

Monitoring Active PPP Users

Home menu level: ***/ppp active print***

Property Description

address (*read-only: IP address*) - an Ip address the client got from the server

caller-id (*read-only: text*) - shows unique client identifier

encoding (*read-only: text*) - shows encryption and encoding (separated with '/' if asymmetric) being used in this connection

name (*read-only: name*) - user name

service (*read-only: async | isdn | l2tp | pppoe | pptp*) - shows the kind of service the user is using

uptime (*read-only: time*) - user's uptime

Example

```
[admin@MikroTik] ppp profile> .. active print
Flags: R - radius
  #   NAME         SERVICE CALLER-ID         ADDRESS         UPTIME   ENCODING
  0   ex           pptp    10.0.0.148        10.1.0.148      1d15h... MPPE12...

[admin@MikroTik] ppp profile> .. active print detail
Flags: R - radius
  0   name="ex" service=pptp caller-id="10.0.0.148" address=10.1.0.148
      uptime=1d15h4m41s encoding="MPPE128 stateless"

[admin@MikroTik] ppp profile>
```

PPP User Remote AAA

Home menu level: ***/ppp aaa***

Property Description

accounting (yes | no; default: **yes**) - specifies whether to use RADIUS accounting

interim-update (*time*; default: **0s**) - Interim-Update time interval

use-radius (yes | no; default: **no**) - specifies whether to consult user database on a RADIUS server

Notes

RADIUS user database is consulted only if the required username is not found in local user database.

Example

To enable RADIUS AAA:

```
[admin@MikroTik] ppp aaa> set use-radius=yes
[admin@MikroTik] ppp aaa> print
        use-radius: yes
        accounting: yes
    interim-update: 0s
[admin@MikroTik] ppp aaa>
```

Local IP Traffic Accounting

Home menu level: ***/ip accounting***

Description

As each packet passes through the router, the packet source and destination addresses are matched against an IP pair in the accounting table and the traffic for that pair is increased. The traffic of PPP, PPTP, PPPoE, ISDN and HotSpot clients can be accounted on per-user basis too. Both the number of packets and the number of bytes are accounted.

If no matching IP or user pair exists, a new entry will be added to the table

Only the packets that enter and leave the router are accounted. Packets that are dropped in the router are not counted as well as ones that are sent from the router itself. Packets that are NATted on the router will be accounted for with the actual IP addresses on each side. Packets that are going through bridged interfaces (i.e. inside the bridge interface) are also accounted correctly.

Property Description

enabled (yes | no; default: **no**) - whether local IP traffic accounting is enabled

threshold (*integer*; default: **256**) - maximum number of IP pairs in the accounting table (maximal value is 8192)

Notes

For bidirectional connections two entries will be created.

Each IP pair uses approximately 100 bytes

When the threshold limit is reached, no new IP pairs will be added to the accounting table. Each packet that is not accounted in the accounting table will then be added to the **uncounted** counter!

Example

Enable IP accounting:

```
[admin@MikroTik] ip accounting> set enabled=yes
[admin@MikroTik] ip accounting> print
```

```
       enabled: yes
     threshold: 256
 [admin@MikroTik] ip accounting>
```

Example

See the uncounted packets:

```
 [admin@MikroTik] ip accounting uncounted> print
     packets: 0
       bytes: 0
 [admin@MikroTik] ip accounting uncounted>
```

Local IP Traffic Accounting Table

Home menu level: ***/ip accounting snapshot***

Description

When a snapshot is made for data collection, the accounting table is cleared and new IP pairs and traffic data are added. The more frequently traffic data is collected, the less likelihood that the IP pairs thereshold limit will be reached.

Property Description

bytes (*read-only: integer*) - total number of bytes, matched by this entry

dst-address (*read-only: IP address*) - destination IP address

dst-user (*read-only: text*) - recipient's name (if aplicable)

packets (*read-only: integer*) - total number of packets, matched by this entry

src-address (*read-only: IP address*) - source IP address

src-user (*read-only: text*) - sender's name (if aplicable)

Notes

Usernames are shown only if the users are connected to the router via a PPP tunnel or are authenticated by HotSpot.

Before the first snapshot is taken, the table is empty.

Example

To take a new snapshot:

```
 [admin@MikroTik] ip accounting snapshot> take
 [admin@MikroTik] ip accounting snapshot> print
  # SRC-ADDRESS     DST-ADDRESS     PACKETS    BYTES      SRC-USER    DST-USER
  0 192.168.0.2     159.148.172.197 474        19130
  1 192.168.0.2     10.0.0.4        3          120
  2 192.168.0.2     192.150.20.254  32         3142
  3 192.150.20.254  192.168.0.2     26         2857
  4 10.0.0.4        192.168.0.2     2          117
  5 159.148.147.196 192.168.0.2     2          136
  6 192.168.0.2     159.148.147.196 1          40
  7 159.148.172.197 192.168.0.2     835        1192962
 [admin@MikroTik] ip accounting snapshot>
```

Web Access to the Local IP Traffic Accounting Table

Home menu level: ***/ip accounting web-access***

Description

The web page report make it possible to use the standard Unix/Linux tool wget to collect the traffic data and save it to a file or to use MikroTik shareware Traffic Counter to display the table. If the web report is enabled and the web page is viewed, the **snapshot** will be made when connection is initiated to the web page. The **snapshot** will be displayed on the web page. TCP protocol, used by http connections with the wget tool guarantees that none of the traffic data will be lost. The **snapshot** image will be made when the connection from wget is initiated. Web browsers or wget should connect to URL: **http://routerIP/accounting/ip.cgi**

Property Description

accessible-via-web (yes | no; default: **no**) - wheather the snapshot is available via web

address (*IP address/mask*; default: **0.0.0.0**) - IP address range that is allowed to access the snapshot

Example

To enable web access from **10.0.0.1** server only:

```
[admin@MikroTik] ip accounting web-access> set accessible-via-web=yes \
\... address=10.0.0.1/32
[admin@MikroTik] ip accounting web-access> print
    accessible-via-web: yes
               address: 10.0.0.1/32
[admin@MikroTik] ip accounting web-access>
```

RADIUS Client Setup

Home menu level: ***/radius***

Description

This facility allows you to set RADIUS servers the router will use to authenticate users.

Property Description

accounting-backup (yes | no; default: **no**) - specifies whether this entry should serve as RADIUS accounting backup

accounting-port (*integer*; default: **1813**) - specifies the server's port used for accounting

address (*IP address*; default: **0.0.0.0**) - IP address of the RADIUS server

authentication-port (*integer*; default: **1812**) - specifies the server's port used for authentication

called-id (*text*; default: **""**) - this setting depends on Point-to-Point protocol:

- **ISDN** - phone number dialled (MSN)

- **PPPoE** - service name
- **PPTP** - server's IP address
- **L2TP** - server's IP address

domain (*text*; default: **""**) - Microsoft Windows domain of client

realm (*text*) - explicitly stated realm (user domain), so the users do not have to provide proper ISP domain name in user name

secret (*text*; default: **""**) - shared secret used to access the server

service (*multiple choice: hotspot | login | ppp | telephony | wireless*; default: **""**) - specifies services that will use this RADIUS server

- **hotspot** - HotSpot authentication service
- **login** - router's local user authentication
- **ppp** - Point-to-Point clients authentication
- **telephony** - IP telephony accounting
- **wireless** - wireless client authentication(client's MAC address is sent as User-Name)

timeout (*time*; default: **100ms**) - specifies timeout after which the request should be resend

Notes

The order of the items in this list is significant.

Microsoft Windows clients send their usernames in form **domain\username**

When RADIUS server is authenticating user with CHAP, MS-CHAPv1, MS-CHAPv2, it is not using shared secret, secret is used only in authentication reply, and router is verifying it. So if you have wrong shared secret, RADIUS server will accept request, but router won't accept reply. You can see that with **/radius monitor** command, "bad-replies" number should increase whenever somebody tries to connect.

Example

To set a RADIUS server for **HotSpot** and **PPP** services that has **10.0.0.3** IP address and **ex** shared secret, you need to do the following:

```
[admin@MikroTik] radius> add service=hotspot,ppp address=10.0.0.3 secret=ex
[admin@MikroTik] radius> print
Flags: X - disabled
  #   SERVICE         CALLED-ID     DOMAIN        ADDRESS         SECRET
  0   ppp,hotspot                                 10.0.0.3        ex

[admin@MikroTik] radius>

AAA for the respective services should be enabled too:

[admin@MikroTik] radius> /ppp aaa set use-radius=yes
[admin@MikroTik] radius> /ip hotspot aaa set use-radius=yes

To view some statistics for a client:

[admin@MikroTik] radius> monitor 0
             pending: 0
            requests: 10
             accepts: 4
             rejects: 1
             resends: 15
            timeouts: 5
         bad-replies: 0
    last-request-rtt: 0s

[admin@MikroTik] radius>
```

Suggested RADIUS Servers

Description

MikroTik RouterOS RADIUS Client should work well with all RFC compliant servers. It has been tested with:

- ***FreeRADIUS***
- ***XTRadius*** (does not currently support MS-CHAP)
- ***Steel-Belted Radius***

Supported RADIUS Attributes

Description

MikroTik RADIUS Dictionaries

Here you can download ***MikroTik reference dictionary***, which incorporates all the needed RADIUS attributes. This dictionary is the minimal dictionary, which is enough to support all features of MikroTik RouterOS. It is designed for FreeRADIUS, but may also be used with many other UNIX RADIUS servers (eg. XTRadius).

Note that it may conflict with the default configuration files of RADIUS server, which have references to the Attributes, absent in this dictionary. Please correct the configuration files, not the dictionary, as no other Attributes are supported by MikroTik RouterOS.

There is also ***dictionary.mikrotik*** that can be included in an existing dictionary to support MikroTik vendor-specific Attributes.

Definitions

- **PPPs** - PPP, PPTP, PPPoE and ISDN
- **default configuration** - settings in default profile (for PPPs) or HotSpot server settings (for HotSpot)

Access-Request

- **Service-Type** - always is "Framed" (only for PPPs)
- **Framed-Protocol** - always is "PPP" (only for PPPs)
- **NAS-Identifier** - router identity
- **NAS-IP-Address** - IP address of the router itself

- **NAS-Port** - unique session ID
- **NAS-Port-Type** - async PPP - "Async"; PPTP and L2TP - "Virtual"; PPPoE and HotSpot - "Ethernet"; ISDN - "ISDN Sync"
- **Calling-Station-Id** - PPPoE - client MAC address with capital letters; PPTP and L2TP - client public IP address; HotSpot - MAC address of the client if it is known, or IP address of the client if MAC address is unknown; ISDN - client MSN
- **Called-Station-Id** - PPPoE - service name; PPTP and L2TP - server IP address; ISDN - interface MSN; HotSpot - MAC of the hotspot interface (if known), else IP of hotspot interface specified in hotspot menu (if set), else attribute not present
- **NAS-Port-Id** - async PPP - serial port name; PPPoE - ethernet interface name on which server is running; HotSpot - name of the hotspot interface (if known), otherwise - not present; not present for ISDN, PPTP and L2TP
- **Framed-IP-Address** - IP address of HotSpot client (for HotSpot enabled-address login method only)
- **User-Name** - client login name
- **MS-CHAP-Domain** - User domain, if present
- **Realm** - If it is set in /radius menu, it is included in every RADIUS request as Mikrotik-Realm attribute. If it is not set, the same value is sent as in MS-CHAP-Domain attribute (if MS-CHAP-Domain is missing, Realm is not included neither)
- **User-Password** - encrypted password (used with PAP authentication)
- **CHAP-Password, CHAP-Challenge** - encrypted password and challenge (used with CHAP authentication)
- **MS-CHAP-Response, MS-CHAP-Challenge** - encrypted password and challenge (used with MS-CHAPv1 authentication)
- **MS-CHAP2-Response, MS-CHAP-Challenge** - encrypted password and challenge (used with MS-CHAPv2 authentication)

Depending on authentication methods (NOTE: HotSpot uses CHAP by default and may use also PAP if unencrypted passwords are enabled, it can not use MSCHAP):

Access-Accept

- **Framed-IP-Address** - IP address given to client. PPPs - if address belongs to 127.0.0.0/8 or 224.0.0.0/3 networks, IP pool is used from the default profile to allocate client IP address. HotSpot - used only for dhcp-pool login method (ignored for enabled-address method), if address is 255.255.255.254, IP pool is used from HotSpot settings; if Framed-IP-Address is specified, Framed-Pool is ignored
- **Framed-IP-Netmask** - client netmask. PPPs - if specified, a route will be created to the network Framed-IP-Address belongs to via the Framed-IP-Address gateway; HotSpot - ignored by HotSpot
- **Framed-Pool** - IP pool name (on the router) from which to get IP address for the client. If specified, overrides Framed-IP-Address

NOTE: if Framed-IP-Address or Framed-Pool is specified it overrides remote-address in default configuration

- **Idle-Timeout** - overrides idle-timeout in the default configuration

- **Session-Timeout** - overrides session-timeout in the default configuration
- **Class** - cookie, will be included in Accounting-Request unchanged
- **Framed-Route** - routes to add on the server. Format is specified in RFC2865 (Ch. 5.22), can be specified as many times as needed
- **Filter-Id** - firewall filter chain name. It is used to make a dynamic firewall rule. Firewall chain name can have suffix .in or .out, that will install rule only for incoming or outgoing traffic. Multiple Filter-id can be provided, but only last ones for incoming and outgoing is used. For PPPs - filter rules in ppp chain that will jump to the specified chain, if a packet has come to/from the client (that means that you should first create a ppp chain and make jump rules that would put actual traffic to this chain). The same applies for HotSpot, but the rules will be created in hotspot chain
- **Acct-Interim-Interval** - interim-update for RADIUS client, if 0 uses the one specified in RADIUS client
- **MS-MPPE-Encryption-Policy** - require-encryption property (PPPs only)
- **MS-MPPE-Encryption-Types** - use-encryption property, non-zero value means to use encryption (PPPs only)
- **Ascend-Data-Rate** - tx/rx data rate limitation if multiple attributes are provided, first limits tx data rate, second - rx data rate. If used together with Ascend-Xmit-Rate, specifies rx rate. 0 if unlimited
- **Ascend-Xmit-Rate** - tx data rate limitation. It may be used to specify tx limit only instead of sending two sequental Ascend-Data-Rate attributes (in that case Ascend-Data-Rate will specify the receive rate). 0 if unlimited
- **MS-CHAP2-Success** - auth. response if MS-CHAPv2 was used (for PPPs only)
- **MS-MPPE-Send-Key, MS-MPPE-Recv-Key** - encryption keys for encrypted PPPs provided by RADIUS server only is MS-CHAPv2 was used as authentication (for PPPs only)
- **Ascend-Client-Gateway** - client gateway for DHCP-pool HotSpot login method (HotSpot only)
- **Recv-Limit** - total receive limit in bytes for the client
- **Xmit-Limit** - total transmit limit in bytes for the client
- **Wireless-Forward** - not forward the client's frames back to the wireless infrastructure if this attribute is set to "0" (Wireless only)
- **Wireless-Skip-Dot1x** - disable 802.1x authentication for the particulat wireless client if set to non-zero value (Wireless only)
- **Wireless-Enc-Algo** - WEP encryption algorithm: 0 - no encryption, 1 - 40-bit WEP, 2 - 104-bit WEP (Wireless only)
- **Wireless-Enc-Key** - WEP encruption key for the client (Wireless only)
- **Rate-Limit** - Datarate limitation for clients (PPPs only). Format is: rx-rate[/tx-rate] [rx-burst-rate[/tx-burst-rate] [rx-burst-threshold[/tx-burst-threshold] [rx-burst-time[/tx-burst-time]]]]. All rates should be numbers with optional 'k' (1,000s) or 'M' (1,000,000s). If tx-rate is not specified, rx-rate is as tx-rate too. Same goes for tx-burst-rate and tx-burst-threshold and tx-burst-time. If both rx-burst-threshold and tx-burst-threshold are not specified (but burst-rate is specified), rx-rate and tx-rate is used as burst thresholds. If both rx-burst-time and tx-burst-time are not specified, 1s is used as default.
- **Group** - Router local user group name (defimes in /user group; only for local users)

Note that the received attributes override the default ones (set in the default profile), but if an attribute is not received from RADIUS server, the default one is to be used.

Here are some Rate-Limit examples:

- **128k** - rx-rate=128000, tx-rate=128000 (no bursts)
- **64k/128M** - rx-rate=64000, tx-rate=128000000
- **64k 256k** - rx/tx-rate=64000, rx/tx-burst-rate=256000, rx/tx-burst-threshold=64000, rx/tx-burst-time=1s
- **64k/64k 256k/256k 128k/128k 10/10** - rx/tx-rate=64000, rx/tx-burst-rate=256000, rx/tx-burst-threshold=128000, rx/tx-burst-time=10s

Accounting-Request

- **Acct-Status-Type** - Start, Stop, or Interim-Update
- **Acct-Session-Id** - accounting session ID
- **Service-Type** - same as in request (PPPs only)
- **Framed-Protocol** - same as in request (PPPs only)
- **NAS-Identifier** - same as in request
- **NAS-IP-Address** - same as in request
- **User-Name** - same as in request
- **MS-CHAP-Domain** - same as in request (only for PPPs)
- **NAS-Port-Type** - same as in request
- **NAS-Port** - same as in request
- **NAS-Port-Id** - same as in request
- **Calling-Station-Id** - same as in request
- **Called-Station-Id** - same as in request
- **Acct-Authentic** - either authenticated by the RADIUS or Local authority (PPPs only)
- **Framed-IP-Address** - IP address given to the user
- **Framed-IP-Netmask** - same as in RADIUS reply
- **Class** - RADIUS server cookie (PPPs only)
- **Acct-Delay-Time** - how long does the router try to send this Accounting-Request packet

Stop and Interim-Update Accounting-Request

- **Acct-Session-Time** - connection uptime in seconds
- **Acct-Input-Octets** - bytes received from the client
- **Acct-Input-Gigawords** - 4G (2^32) bytes received from the client (bits 32..63, when bits 0..31 are delivered in Acct-Input-Octets) (HotSpot only)
- **Acct-Input-Packets** - nubmer of packets received from the client
- **Acct-Output-Octets** - bytes sent to the client
- **Acct-Output-Gigawords** - 4G (2^32) bytes sent to the client (bits 32..63, when bits 0..31 are delivered in Acct-Output-Octets) (HotSpot only)

- **Acct-Output-Packets** - number of packets sent to the client

Stop Accounting-Request

These packets can additionally have:

- **Acct-Terminate-Cause** - session termination cause (see RFC2866 ch. 5.10)

Attribute Numeric Values

Name	VendorID	Value	RFC where it is defined
Acct-Authentic		45	RFC2866
Acct-Delay-Time		41	RFC2866
Acct-Input-Gigawords		52	RFC2869
Acct-Input-Octets		42	RFC2866
Acct-Input-Packets		47	RFC2866
Acct-Interim-Interval		85	RFC2869
Acct-Output-Gigawords		53	RFC2869
Acct-Output-Octets		43	RFC2866
Acct-Output-Packets		48	RFC2866
Acct-Session-Id		44	RFC2866
Acct-Session-Time		46	RFC2866
Acct-Status-Type		40	RFC2866
Acct-Terminate-Cause		49	RFC2866
Ascend-Client-Gateway	529	132	
Ascend-Data-Rate	529	197	
Ascend-Xmit-Rate	529	255	
Called-Station-Id		30	RFC2865
Calling-Station-Id		31	RFC2865
CHAP-Challenge		60	RFC2866
CHAP-Password		3	RFC2865
Class		25	RFC2865
Filter-Id		11	RFC2865
Framed-IP-Address		8	RFC2865
Framed-IP-Netmask		9	RFC2865
Framed-Pool		88	RFC2869

Framed-Protocol		**7**	**RFC2865**
Framed-Route		**22**	**RFC2865**
Group	**14988**	**3**	
Idle-Timeout		**28**	**RFC2865**
MS-CHAP-Challenge	**311**	**11**	**RFC2548**
MS-CHAP-Domain	**311**	**10**	**RFC2548**
MS-CHAP-Response	**311**	**1**	**RFC2548**
MS-CHAP2-Response	**311**	**25**	**RFC2548**
MS-CHAP2-Success	**311**	**26**	**RFC2548**
MS-MPPE-Encryption-Policy	**311**	**7**	**RFC2548**
MS-MPPE-Encryption-Types	**311**	**8**	**RFC2548**
MS-MPPE-Recv-Key	**311**	**17**	**RFC2548**
MS-MPPE-Send-Key	**311**	**16**	**RFC2548**
NAS-Identifier		**32**	**RFC2865**
NAS-Port		**5**	**RFC2865**
NAS-Port-Id		**87**	**RFC2869**
NAS-Port-Type		**61**	**RFC2865**
Rate-Limit	**14988**	**8**	
Realm	**14988**	**9**	
Recv-Limit	**14988**	**1**	
Service-Type		**6**	**RFC2865**
Session-Timeout		**27**	**RFC2865**
User-Name		**1**	**RFC2865**
User-Password		**2**	**RFC2865**
Wireless-Enc-Algo	**14988**	**6**	
Wireless-Enc-Key	**14988**	**7**	
Wireless-Forward	**14988**	**4**	
Wireless-Skip-Dot1x	**14988**	**5**	
Xmit-Limit	**14988**	**2**	

Troubleshooting

Description

- **My radius server accepts authentication request from the client with "Auth: Login**

OK:...", but the user cannot log on. The bad replies counter is incrementing under radius monitor

This situation can occur, if the radius client and server have high delay link between them. Try to increase the radius client's timeout to 600ms or more instead of the default 300ms! Also, double check, if the secrets match on client and server!

Certificate Management

Document revision 2.3 (Fri Mar 05 13:58:17 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

SSL (Secure Socket Layer) is a security technology to ensure encrypted transactions over a public network. To protect the data, an encryption key should be negotiated. SSL protocol is using Certificates to negotiate a key for data encryption.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/certificate***
Standards and Technologies: ***SSLv2***, ***SSLv3***, ***TLS***
Hardware usage: *high CPU usage*

Description

SSL technology was first introduced by Netscape to ensure secure transactions between browsers and web servers. When a browser requests a secure web page (usually on TCP port 443), a web server first sends a Certificate, which contains a public key for the encryption key negotiation to take place. After the encryption key is negotiated, the web server will send the requested page encrypted using this key to the browser (and also the browser will be able to submit its data securely to the server)

SSL Certificate confirms the web server identity. The Certificate contains information about its holder (like DNS name and Country), issuer (the entity has signed the Certificate) and also the public key used to negotiate the encryption key. In order a Certificate to play its role, it should be signed by a third party (Certificate Authority) which both parties trust. Modern browsers that support SSL protocol have a list of the Certificate Authorities they trust (the most known and trusted CA is VeriSign, but that is not the only one)

To use a Certificate (which contain a public key), server needs a private key. One of the keys is used for encryption, and the other - for decryption. It is important to understand, that both keys can encrypt and decrypt, but what is encrypted by one of them can be decrypted **only** by the another. Private key must be kept securely, so that nobody else can get it and use this certificate. Usually private key is encrypted with a passphrase.

Most trusted Certificate Authorities sell the service of signing Certificates (Certificates also have a finite validity term, so you will have to pay regularly). It is also possible to create a self-signed Certificate (you can create one on most UNIX/Linux boxes using openssl toolkit; all Root Certificate Authorities have self-signed Certificates), but if it is not present in a browser's database, the browser will pop up a security warning, saying that the Certificate is not trusted (note also that most browsers support importing custom Certificates to their databases).

Certificates

Home menu level: ***/certificate***

Description

MikroTik RouterOS can import Certificates for the SSL services it provides (only HotSpot for now). This submenu is used to manage Certificates for this services.

Property Description

name (*name*) - reference name

subject (*read-only: text*) - holder (subject) of the certificate

issuer (*read-only: text*) - issuer of the certificate

serial-number (*read-only: text*) - serial number of the certificate

invalid-before (*read-only: date*) - date the certificate is valid from

invalid-after (*read-only: date*) - date the certificate is valid until

ca (yes | no; default: **yes**) - whether the certificate is used for building or verifying certificate chains (as Certificate Authority)

Command Description

import - install new certificates

- **file-name** - import only this file (all files are searched for certificates by default)
- **passphrase** - passphrase for the found encrypted private key
- **certificates-imported** - how many new certificates were successfully imported
- **private-keys-imported** - how many private keys for existing certificates were successfully imported
- **files-imported** - how many files contained at least one item that was successfully imported
- **decryption-failures** - how many files could not be decrypted
- **keys-with-no-certificate** - how many public keys were successfully decrypted, but did not have matching certificate already installed

reset-certificate-cache - delete all cached decrypted public keys and rebuild the certificate cache

decrypt - decrypt and cache public keys

- **passphrase** - passphrase for the found encrypted private key
- **keys-decrypted** - how many keys were successfully decrypted and cached

create-certificate-request - creates an RSA certificate request to be signed by a Certificate Authority. After this, download both private key and certificate request files from the router. When you receive your signed certificate from the CA, upload it and the private key (that is made by this command) to a router and use /certificate import command to install it

- **certificate request file name** - name for the certificate request file (if it already exists, it will be overwritten). This is the original certificate that will be signed by the Certificate Authority
- **file name** - name of private key file. If such file does not exist, it will be created during the next step. Private key is used to encrypt the certificate
- **passphrase** - the passphrase that will be used to encrypt generated private key file. You must enter it twice to be sure you have not made any typing errors
- **rsa key bits** - number of bits for RSA (encryption) key. Longer keys take more time to generate. 4096 bit key takes about 30 seconds on Celeron 800 system to generate
- **country name** - (C) ISO two-character country code (e.g., LV for Latvia)
- **state or province name** - (ST) full name of state or province
- **locality name** - (L) locality (e.g. city) name
- **organization name** - (O) name of the organization or company
- **organization unit name** - (OU) organization unit name
- **common name** - (CN) the server's common name. For SSL web servers this must be the fully qualified domain name (FQDN) of the server that will use this certificate (like www.example.com). This is checked by web browsers
- **email address** - (Email) e-mail address of the person responsible for the certificate
- **challenge password** - the challenge password. It's use depends on your CA. It may be used to revoke this certificate
- **unstructured address** - unstructured address (like street address). Enter only if your CA accepts or requires it

Notes

Server certificates may have **ca** property set to **no**, but Certificate Authority certificates must have it set to **yes**

Certificates and encrypted private keys are imported from and exported to the router's FTP server. Public keys are not stored on a router in unencrypted form. Cached decrypted private keys are stored in encrypted form, using key that is derived from the router ID. Passphrases are not stored on router.

Configuration backup does not include cached decrypted private keys. After restoring backup all certificates with private keys must be decrypted again, using **decrypt** command with the correct passphrase.

No other certificate operations are possible while generating a key.

When making a certificate request, you may leave some of the fields empty. CA may reject your certificate request if some of these values are incorrect or missing, so please check what are the requirements of your CA

Example

To import a certificate and the respective private key already uploaded on the router:

```
[admin@MikroTik] certificate> import
passphrase: xxxx
       certificates-imported: 1
       private-keys-imported: 1
              files-imported: 2
         decryption-failures: 0
    keys-with-no-certificate: 1
[admin@MikroTik] certificate> print
Flags: K - decrypted-private-key, Q - private-key, R - rsa, D - dsa
  0 QR name="cert1" subject=C=LV,ST=.,O=.,CN=cert.test.mt.lv
       issuer=C=LV,ST=.,O=.,CN=third serial-number="01"
       invalid-before=sep/17/2003 11:56:19 invalid-after=sep/16/2004 11:56:19
       ca=yes

[admin@MikroTik] certificate> decrypt
passphrase: xxxx
    keys-decrypted: 1
[admin@MikroTik] certificate> print
Flags: K - decrypted-private-key, Q - private-key, R - rsa, D - dsa
  0 KR name="cert1" subject=C=LV,ST=.,O=.,CN=cert.test.mt.lv
       issuer=C=LV,ST=.,O=.,CN=third serial-number="01"
       invalid-before=sep/17/2003 11:56:19 invalid-after=sep/16/2004 11:56:19
       ca=yes

[admin@MikroTik] certificate>
```

Now the certificate may be used by HotSpot servlet:

```
[admin@MikroTik] ip service> print
Flags: X - disabled, I - invalid
  #   NAME                                 PORT  ADDRESS            CERTIFICATE
  0   telnet                               23    0.0.0.0/0
  1   ftp                                  21    0.0.0.0/0
  2   www                                  8081  0.0.0.0/0
  3   hotspot                              80    0.0.0.0/0
  4   ssh                                  22    0.0.0.0/0
  5   hotspot-ssl                          443   0.0.0.0/0          none

[admin@MikroTik] ip service> set hotspot-ssl certificate=
cert1  none
[admin@MikroTik] ip service> set hotspot-ssl certificate=cert1
[admin@MikroTik] ip service> print
Flags: X - disabled, I - invalid
  #   NAME                                 PORT  ADDRESS            CERTIFICATE
  0   telnet                               23    0.0.0.0/0
  1   ftp                                  21    0.0.0.0/0
  2   www                                  8081  0.0.0.0/0
  3   hotspot                              80    0.0.0.0/0
  4   ssh                                  22    0.0.0.0/0
  5   hotspot-ssl                          443   0.0.0.0/0          cert1

[admin@MikroTik] ip service>
```

FTP (File Transfer Protocol) Server

Document revision 2.2 (Tue Apr 06 13:25:13 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

MikroTik RouterOS implements File Transfer Protocol (FTP) server feature. It is intended to use for software packages uploading as well as configuration script exporting and importing procedures.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/file***
Standards and Technologies: ***FTP (RFC 959)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Configuration Export and Import***
- ***Configuration Backup and Restore***

File Transfer Protocol Server

Home menu level: ***/file***

Description

MikroTik RouterOS has an industry standard FTP server feature. It uses ports 20 and 21 for communication with other hosts on the network. Do not disable these ports on your router!

Uploaded files as well as exported configuration or backup files can be accessed under /file menu.

There you can delete unnecessary files from your router.

Authorization via ftp uses router's system user account names and passwords.

Property Description

name (*read-only: name*) - item name
type (*read-only: file* | *directory* | *unknown* | *script* | *package* | *backup*) - item type
size (*read-only: integer*) - package size in bytes
creation-time (*read-only: time*) - item creation date and time

Command Description

print - shows a list of files stored - shows contents of files less that 4kb long - offers to edit file's contents with editor - sets the file's contents to 'content'

Ping

Document revision 1 (Mon Jul 19 09:36:24 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Ping uses Internet Control Message Protocol (ICMP) Echo messages to determine if a remote host is active or inactive and to determine the round-trip delay when communicating with it.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/, /tool mac-server ping***
Standards and Technologies: ***ICMP***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

Description

Ping sends ICMP echo (ICMP type 8) message to the host and waits for the ICMP echo-reply (ICMP type 0) from that host. The interval between these events is called round trip. If the response (that is called pong) has not come until the end of the interval, we assume it has timed out. The second significant parameter reported is ttl (Time to Live). Is is decremented at each machine in which the packet is processed. The packet will reach its destination only when the ttl is greater than the number of routers between the source and the destination.

The Ping Command

Command name: ***/ping***

Property Description

(*IP address* | *MAC address*) - IP or MAC address for destination host

count (*integer*; default: **0**) - how many times ICMP packets will be sent

- **0** - Ping continues till [Ctrl]+[C] is pressed

do-not-fragment - if added, packets will not be fragmented

interval (*time*: 10ms..5s; default: **1s**) - delay between messages

size (*integer*: 28..65535; default: **64**) - size of the IP packet (in bytes, including the IP and ICMP headers)

ttl (*integer*: 1..255; default: **255**) - time To Live (TTL) value of the ICMP packet

Notes

If DNS service is configured, it is possible to ping by DNS address. To do it from **Winbox**, you should resolve DNS address first, pressing right mouse button over it address and choosing **Lookup Address**.

You can not ping with packets larger that the MTU of that interface, so the packet **size** should always be equal or less than MTU. If 'pinging' by MAC address, minimal packet size iz 50.

Only neighbour MikroTik RouterOS routers with MAC-ping feature enabled can be 'pinged' by MAC address.

Example

An example of Ping command:

```
[admin@MikroTik] > ping 159.148.60.2 count=5 interval=40ms size=64
159.148.60.2 64 byte pong: ttl=247 time=32 ms
159.148.60.2 64 byte pong: ttl=247 time=30 ms
159.148.60.2 64 byte pong: ttl=247 time=40 ms
159.148.60.2 pong timeout
159.148.60.2 64 byte pong: ttl=247 time=28 ms
5 packets transmitted, 4 packets received, 20% packet loss
round-trip min/avg/max = 28/32.5/40 ms
[admin@MikroTik] >
```

MAC Ping Server

Home menu level: ***/tool mac-server ping***

Property Description

enabled (yes | no; default: **yes**) - whether MAC pings to this router are allowed

Example

To disable MAC pings:

```
[admin@MikroTik] tool mac-server ping> set enabled=no
[admin@MikroTik] tool mac-server ping> print
    enabled: no
[admin@MikroTik] tool mac-server ping>
```

Bandwidth Control

Document revision 1.6 (Wed Dec 08 12:40:17 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Queuing is a mechanism that controls data rate allocation, delay variability, timely delivery, and delivery reliability. The MikroTik RouterOS supports the following queuing mechanisms:

- **PFIFO** - Packets First-In First-Out
- **BFIFO** - Bytes First-In First-Out

- **SFQ** - Stochastic Fair Queuing
- **RED** - Random Early Detection
- **HTB** - Hierarchical Token Bucket
- **PCQ** - Per Connection Queue

The queuing can be used for limiting the data rate for certain IP addresses, protocols or ports. The queuing is performed for packets leaving the router through a real interface. It means that the queues should always be configured on the outgoing interface regarding the traffic flow. There are two additional virtual interfaces in queue tree which are used to limit all the traffic coming to (**global-in**) or leaving (**global-out**) the router regardless of physical interface.

Specifications

Packages required: ***system***
License required: ***level1 (limited to 1 queue), level3***
Home menu level: ***/queue***
Standards and Technologies: ***None***
Hardware usage: *significant*

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***Firewall Filters***

Description

Clasless Queues

There are four types of simple queues implemented in RouterOS: PFIFO, BFIFO, SFQ and RED. With Bytes First-In First-Out (BFIFO) and Packets First-In First-Out (PFIFO) packets are served in the same order as they are received. The only difference between BFIFO and PFIFO is that PFIFO has a length measured in packets, BFIFO in bytes. Generally, you do not want to use BFIFO or PFIFO as traffic shapers. It's better to use them just for statistics as they are pretty fast. The only exception is when you are running out of resources with RED and/or with complicated queue tree.

Stochastic Fair Queuing (SFQ) cannot limit traffic at all. Its main idea is to equalize sessions (not computer traffic, but session traffic, it is sometimes mentioned as SFQ drawback) when your link is completely full. It works in round-robin fashion, giving each session a chance to send **sfq-allot** bytes. Its algorithm can distinguish only 1024 sessions, and that is why several sessions can be treated as one. Each **sfq-perturb** seconds it drops internal table mixing all the connections and creates a new table. As it is very fast, you may want to use it as a child queue.

To address the imperfectness of SFQ, PCQ was created. PCQ is an advanced SFQ implementation without its stochastic nature - it is more precise, lets you choose classifiers and put a limit (it is called pcq-rate) on each subqueue it has (limits are applied on each subqueue simultaneously, you can not make different limits on particular subqueues). It degrades into a precise version of SFQ if you put no limit and choose all classifiers at once. PCQ type is used for limiting data rate for each connection. These connections can be classified by the **pcq-classifier**:

- **src-address** - source address
- **dst-address** - destination address
- **src-port** - source port
- **dst-port** - destination port

You can use multiple parameters in the **pcq-classifier**. The **pcq-limit** is number of packets which can hold a single PCQ queue. Data rate for each connection is limited by the **pcq-rate** parameter(in bytes per second).

The combination of src-address, src-port, dst-address, dst-port (also known as tuple) uniquely identifies a connection (i.e., there can not be two different connections with the same tuple).

Note: for using PCQ you have to use queue tree.

Note: to equalize not each particular user (by IP address), but each particular connection, specify all pcq-classifiers at once.

The normal behavior of queues is called tail-drop. Tail-drop works by queuing up to a certain amount, then dropping all traffic that 'spills over'. Random Early Detection (RED is also known as Random Early Drop because it actually works that way) statistically drops packets from flows before it reaches its hard limit. This causes a congested backbone link to slow more gracefully. It starts dropping packets when threshold reaches **red-min-threshold** mark randomly with increasing probability as threshold rising. Maximum probability is used when traffic reaches **red-max-threshold** mark. Then packets are simply thrown away. burst parameter is the number of packets allowed to burst through the interface when the link is empty (generally value of (**red-min-threshold+red-min-threshold+red-max-threshold**)/3 works fine). The minimum value that can be used here is equal to the value of **red-min-threshold**.

Classful Queues

Classful queues are very useful if you have different kinds of traffic which should have different treatment. Generally, we can set only one queue on the interface, but in RouterOS even simple queues (known as classless queues) are attached to the main (attached to the root, which represent real interface) Hierarchical Token Bucket (HTB) and thus have some properties derived from that parent queue. With classful queues it is possible to deploy hierarchical queue trees. For example, we can set a maximum data rate for a workgroup and then distribute that amount of traffic between the members of that group as we can do with simple queues attached to the main HTB, but with upper limit.

Each queue represents a virtual interface with the allowed data rate. It can be borrowed from sibling queues (queues that are children of one queue) when **max-limit** is greater than **limit-at**. If so, the queue would use over the allocated data rate whenever possible. Only when other queues are getting too long and a connection is not to be satisfied, then the borrowing queues would be limited at their allocated data rate.

When a parent is allowed to send some amount of traffic, it asks its inner queues in order of **priority** (priorities are processed one after another, from 1 to 8, where **1** means the highest priority). When a queue reaches its **limit-at** value, its priority is not to be taken in account, such a queue will be less-prioritative than the ones not reached this limit.

Information Rates and Contention Ratios

Quality of Service (QoS) means that router should prioritize and shape network traffic. QoS is not so much about limiting, it is more about providing quality. The main terms used to describe the level of QoS for network applications are:

- **CIR (Committed Information Rate)** - the guaranteed data rate. It means that traffic not exceeding this rate should always be delivered
- **MIR (Maximal Information Rate)** - the maximal data rate router will provide
- **Contention Ratio** - the ratio to which the defined data rate is shared between users (i.e., data rate is allocated to a number of subscribers). For example, the contention ratio of 1:4 means that the allocated data rate may be shared between no more than 4 users
- **Priority** - the order of importance in what traffic will be processed. You can give priority to some traffic in order it to be handeled before some other traffic.

MikroTik RouterOS may be used to provide CIR and MIR with some contention level and priority. Here we will talk in terms of queues (which represent either real or virtual interface) and classes (children of a queue; each class has an another queue attached to it):

- **limit-at** property is used to specify CIR. If the queue will be able to provide that data rate, it will (i.e, the parent queue (and the link the router is connected to) should be able to provide the total data rate equal or greater that the sum of all CIRs the queue should satisfy in order to quarantee these CIRs). CIRs will be satisfied in order of their **priority**.
- **max-limit** property is used to specify MIR. If the queue has satisfied all the CIRs and it is able to provide some additional data rate, it will try to distribute that additional data rate between all its classes regardless of their priorities and not exceeding their MIRs.
- Filters in RouterOS are very powerful and flexible. Providing Contention Ratio is only one application of what they can do. Using firewall mangle you can mark some a number of hosts with a flow-mark, so the data rate allocated for that mark will be shared between these hosts.

Virtual Interfaces

In addition to real interfaces, there are two vitrual interfaces you can attach tree queues to:

- **global-out** - represents all the output interfaces in general. Queues attached to it applies before the ones attached to a specific interface.
- **global-in** - represents all the input interfaces in general (INGRESS queue). Please **note** that queues attached to **global-in** applies to incomming traffic, not outgoing. **global-in** queueing is taking place just after mangle and **dst-nat**.

Queue burst

A queue burst is a way to 'overcome' the queue limit for a certain amount of time and packets. A queue with burst allows peaks of data rate up to **burst-limit** value, but if average data rate is higher than **burst-threshold** for **burst-time** (in seconds) time, the queue is collapsed to the **limit-at** value. The queue size is expanded back to **burst-limit** value when average data rate becomes lesser than

burst-threshold.

This type of behaviour can be extremely useful for prioritizing small rapid packet sequences like these coming from http www sessions.

For queues that limit traffic flow in both directions, **total-burst-time**, **total-burst-limit** and **total-burst-treshold** properties can be used to apply bidirectional bursts.

Additional Documents

- *Home of Hierarchical Token Bucket (HTB)*
- *Paper on Random Early Detection (RED)*
- *More complete information on Traffic Cotrol*

Queue Types

Home menu level: ***/queue type***

Description

The queue types are used to specify some common argument values for queues. There are four default built-in queue types: **default**, **ethernet-default**, **wireless-default** and **synchronous-default**. The built-in queue types cannot be removed.

Property Description

bfifo-limit (*integer*; default: **15000**) - BFIFO queue limit. Maximum byte count that queue can hold

kind (*pfifo* | *bfifo* | *red* | *sfq* | *pcq*; default: **pfifo**) - kind of the queuing algorithm used:

- **pfifo** - Packets First-In First-Out
- **bfifo** - Bytes First-In First-Out
- **red** - Random Early Detection
- **sfq** - Stohastic Fair Queuing
- **pcq** - Per Connection Queuing

name (*name*) - name for the queue type

pcq-classifier (*multiple choice: dst-address*, *dst-port*, *src-address*, *src-port*; default: **""**) - the classifier of grouping traffic flow

pcq-limit (*integer*; default: **50**) - how many packets to hold in a PCQ

pcq-rate (*integer*; default: **0**) - maximal data rate (in bits per second) assigned to one group

- **0** - do not limit data rate

pfifo-limit (*integer*; default: **10**) - PFIFO queue limit. Maximum packet count that queue can hold

red-burst (*integer*; default: **20**) - RED burst

red-limit (*integer*; default: **60**) - RED queue limit

red-max-threshold (*integer*; default: **50**) - RED maximum threshold

red-min-threshold (*integer*; default: **10**) - RED minimum threshold

sfq-allot (*integer*; default: **1514**) - amount of data in bytes that can be sent in one round-robin round

sfq-perturb (*integer*; default: **5**) - how often to change hash function

Notes

For small limitations (64kbps, 128kbps) RED is more preferable. For larger speeds PFIFO will be as good as RED. RED consumes much more memory and CPU than PFIFO & BFIFO.

Example

To add **red** queue type with minimum threshold of **0**, without any burst and named **CUSTOMER-def**:

```
[admin@MikroTik] queue type> add name=CUSTOMER-def kind=red \
\... red-min-threshold=0 red-burst=0
[admin@MikroTik] queue type> print
  0 name="default" kind=pfifo bfifo-limit=15000 pfifo-limit=50 red-limit=60
    red-min-threshold=10 red-max-threshold=50 red-burst=20 sfq-perturb=5
    sfq-allot=1514 pcq-rate=0 pcq-limit=50 pcq-classifier=""

  1 name="ethernet-default" kind=pfifo bfifo-limit=15000 pfifo-limit=50
    red-limit=60 red-min-threshold=10 red-max-threshold=50 red-burst=20
    sfq-perturb=5 sfq-allot=1514 pcq-rate=0 pcq-limit=50 pcq-classifier=""

  2 name="wireless-default" kind=sfq bfifo-limit=15000 pfifo-limit=50
    red-limit=60 red-min-threshold=10 red-max-threshold=50 red-burst=20
    sfq-perturb=5 sfq-allot=1514 pcq-rate=0 pcq-limit=50 pcq-classifier=""

  3 name="synchronous-default" kind=red bfifo-limit=15000 pfifo-limit=50
    red-limit=60 red-min-threshold=10 red-max-threshold=50 red-burst=20
    sfq-perturb=5 sfq-allot=1514 pcq-rate=0 pcq-limit=50 pcq-classifier=""

  4 name="CUSTOMER-def" kind=red bfifo-limit=15000 pfifo-limit=50
    red-limit=60 red-min-threshold=0 red-max-threshold=50 red-burst=0
    sfq-perturb=5 sfq-allot=1514 pcq-rate=0 pcq-limit=50 pcq-classifier=""

[admin@MikroTik] queue type>
```

Interface Default Queues

Home menu level: ***/queue interface***

Property Description

interface (*name*) - interface name

queue (*name*; default: **default**) - default queue for the interface

Example

To change the default queue type to **wireless-default** for the **wlan1** interface:

```
[admin@MikroTik] queue interface> print
  # INTERFACE                             QUEUE
  0 ether1                                default
  1 wlan1                                default
[admin@MikroTik] queue interface> set wlan1 queue=wireless-default
[admin@MikroTik] queue interface> print
  # INTERFACE                             QUEUE
  0 ether1                                default
  1 wlan1                                wireless-default
```

```
 [admin@MikroTik] queue interface>
```

Configuring Simple Queues

Home menu level: ***/queue simple***

Description

Simple queues can be used to set up data rate management for the whole traffic leaving an interface or for certain target (source) and/or destination addresses. For more sophisticated queue setup use the queue trees described further on.

Property Description

burst-limit (*text*; default: **0/0**) - maximal allowed burst of data rate in form of in/out

burst-threshold (*text*; default: **0/0**) - average burst threshold in form of in/out

burst-time (*text*; default: **0/0**) - burst time in form of in/out

dst-address (*IP address/mask*) - destination IP address

interface (*name*) - outgoing interface of the traffic flow

limit-at (*text*; default: **0/0**) - allocated stream data rate (bits/s) in form of in/out, where in is the flow that matches the rule precisely, and out is the flow that matches the reverse rule (i.e. going from the specified interface with source and destination addresses swapped)

max-limit (*text*; default: **0/0**) - maximal stream data rate (bits/s) in form of in/out, where in is the flow that matches the rule precisely, and out is the flow that matches the reverse rule (i.e. going from the specified interface with source and destination addresses swapped)

name (*name*; default: **queue1**) - name of the queue

priority - flow priority, 1 is the highest priority

queue (*name*; default: **default**) - queue type. If you specify the queue type other than default, then it overrides the default queue type set for the interface under /queue interface

target-address (*IP address/mask*) - limitation target IP address (source address)

total-burst-limit (*text*; default: **0**) - maximal allowed total (bidirectional) burst of data rate (bits/s)

total-burst-threshold (*text*; default: **0**) - Total (bidirectional) average burst threshold (bits/s)

total-burst-time (*text*; default: **0**) - total (bidirectional) burst time

total-limit-at (*integer*; default: **0**) - allocated total (bidirectional) stream data rate (bits/s)

total-max-limit (*integer*; default: **0**) - maximal total (bidirectional) stream data rate (bits/s)

Notes

max-limit must be equal or greater than **limit-at**.

Queue rules are processed in the order they appear in the list. If some packet matches the queue rule, then the queuing mechanism specified in that rule is applied to it, and no more rules are processed for that packet.

The value **0** means that these settings will be ignored.

Example

To add a simple queue that will limit download traffic from **192.168.0.0/24** network to **128000** bits per second, and upload traffic to **192.168.0.0/24** network to **64000** bits per second on **ether1** interface:

```
[admin@MikroTik] queue simple> add dst-address=192.168.0.0/24 interface=ether1\
\... max-limit=64000/128000
[admin@MikroTik] queue simple> print
Flags: X - disabled, I - invalid, D - dynamic
 0    name="queue1" target-address=0.0.0.0/0 dst-address=192.168.0.0/24
      interface=ether1 queue=default priority=8 limit-at=0/0
      max-limit=64000/128000
[admin@MikroTik] queue simple>
```

Configuring Queue Trees

Home menu level: ***/queue tree***

Description

The queue trees should be used when you want to use sophisticated data rate allocation based on protocols, ports, groups of IP addresses, etc.

Property Description

burst-limit (*text*; default: **0**) - maximal allowed burst of data rate

burst-threshold (*text*; default: **0**) - average burst threshold

burst-time (*text*; default: **0**) - for how long the burst is allowed

flow (*name*; default: **""**) - flow mark of the packets to be queued. Flow marks can be assigned to the packets under '/ip firewall mangle' when the packets enter the router through the incoming interface

limit-at (*integer*; default: **0**) - maximum stream data rate (bits/s)

max-limit (*integer*; default: **0**) - maximum stream data rate (bits/s)

name (*name*; default: **queueN**) - descriptive name for the queue

parent (*name*) - name of the parent queue. The top-level parents are the available interfaces (actually, main HTB). Lower level parents can be other queues

- **global-in** - match all incomming traffic
- **global-out** - match all outgoing traffic

priority - flow priority, 1 is the highest

queue (*name*; default: **default**) - queue type

Notes

max-limit must be equal or greater than **limit-at**.

To apply queues on flows, the mangle feature should be used first to mark incomming packets.

The router tries to apply queue trees before simple queues.

Example

To mark all the traffic going from web-servers (**TCP** port **80**) with **abc-http** mark:

```
[admin@MikroTik] ip firewall mangle> add action=passthrough mark-flow=abc-http \
\... protocol=tcp target-port=80
[admin@MikroTik] ip firewall mangle> print
Flags: X - disabled, I - invalid, D - dynamic
 0   target-address=:80 protocol=tcp action=passthrough mark-flow=abc-http
[admin@MikroTik] ip firewall mangle>
```

You can add queue using the **/queue tree add** command:

```
[admin@MikroTik] queue tree> add name=HTTP parent=ether1 flow=abc-http \
max-limit=128000
[admin@MikroTik] queue tree> print
Flags: X - disabled, I - invalid, D - dynamic
 0    name="HTTP" parent=ether1 flow=abc-http limit-at=0 queue=default
      priority=8 max-limit=128000 burst-limit=0 burst-threshold=0
      burst-time=0
[admin@MikroTik] queue tree>
```

Troubleshooting

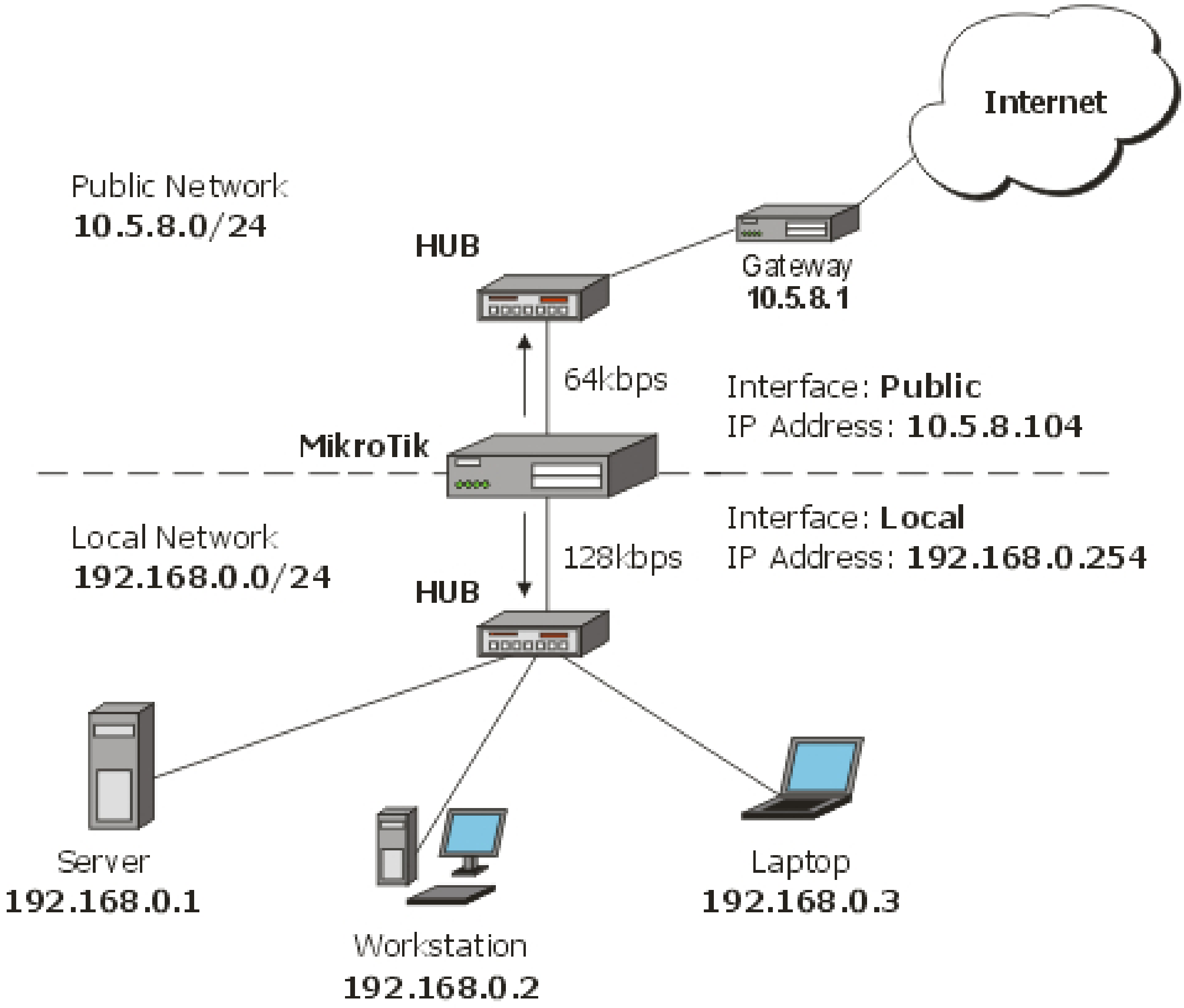
Description

- **The queue is not added for the correct interface**
  Add the queue to the interface through which the traffic is leaving the router. Queuing works only for packets leaving the router!
- **The source/destination addresses of the packets do not match the values specified in the queue setting**
  Make sure the source and destination addresses, as well as network masks are specified correctly! The most common mistake is wrong address/netmask, e.g., 10.0.0.217/24 (wrong), 10.0.0.217/32 (right), or 10.0.0.0/24 (right)
- **The priority setting does not work!**
  In order to take the priority setting in account, you have to specify **limit-at** parameter. Otherwise This setting will be ignored or will not work correctly

General Information

Example of Emulating a 128kbps/64kbps Line

Assume we want to emulate a 128k download and 64k upload line connecting IP network 192.168.0.0/24. The network is served through the Local interface of customer's router. The basic network setup is in the following diagram:



IP addresses on MikroTik:

```
[admin@MikroTik] ip address> print
Flags: X - disabled, I - invalid, D - dynamic
 #   ADDRESS            NETWORK         BROADCAST       INTERFACE
 0   192.168.0.254/24   192.168.0.0     192.168.0.255   Local
 1   10.5.8.104/24      10.5.8.0        10.5.8.255      Public
[admin@MikroTik] ip address>
```

And routes:

```
[admin@MikroTik] ip route> print
Flags: X - disabled, I - invalid, D - dynamic, J - rejected,
C - connect, S - static, r - rip, o - ospf, b - bgp
 #    DST-ADDRESS        G GATEWAY         DISTANCE INTERFACE
 0  S 0.0.0.0/0          r 10.5.8.1        1        Public
 1 DC 192.168.0.0/24     r 0.0.0.0         0        Local
 2 DC 10.5.8.0/24        r 0.0.0.0         0        Public
[admin@MikroTik] ip route>
```

Add a simple queue rule which will limit download traffic to 128kbps and upload traffic to 64kbps for clients on local network (**192.168.0.0/24**):

```
/queue simple add name=Limit-Local target-address=192.168.0.0/24 \
interface=Local max-limit=65536/131072
```

```
[admin@MikroTik] queue simple> print
Flags: X - disabled, I - invalid, D - dynamic
 0    name="Limit-Local" target-address=192.168.0.0/24 dst-address=0.0.0.0/0
      interface=Local queue=default priority=8 limit-at=0/0
      max-limit=65536/131072
```

The **max-limit** parameter defines maximum allowed bandwidth in form of upload/download (for clients, connected to interface **Local**). **target-address** is an additional matcher that specifies our local network. If you will not specify **target-address** and will attach a new network to interface **Local** it will also be limited.

You can also monitor the traffic flow through an interface while doing file transfer, using the **/interface monitor-traffic** command:

```
[admin@MikroTik] interface> monitor-traffic Local
    received-packets-per-second: 7
       received-bits-per-second: 68kbps
        sent-packets-per-second: 13
           sent-bits-per-second: 135kbps
```

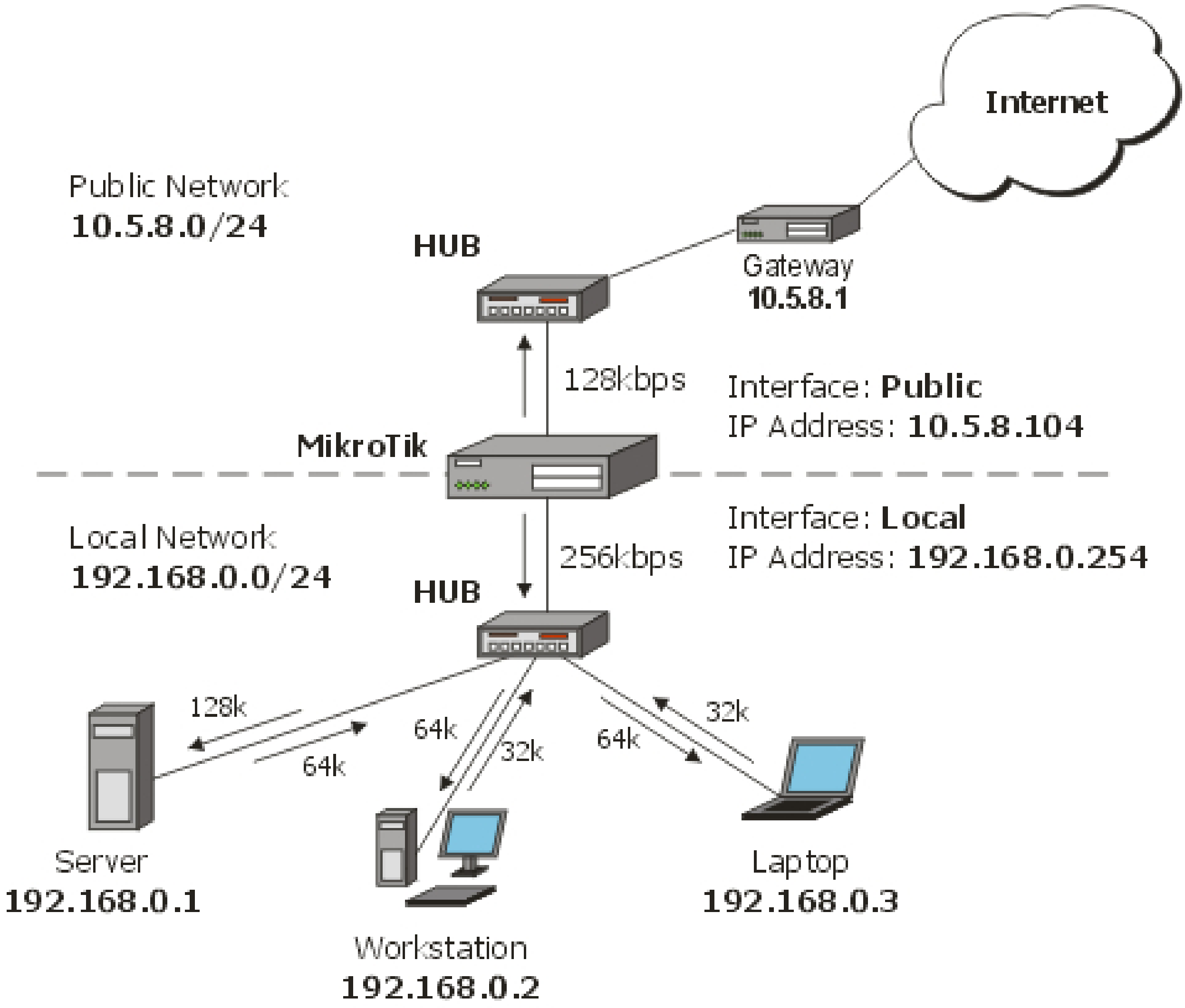
If you want to exclude the server from being limited, add a queue for it without limitation (**max-limit=0/0** which means no limitation) and move it to the top:

```
/queue simple add name=Exclude-Server interface=Local \
   target-address=192.168.0.1/32
/queue simple move 1 0
[admin@MikroTik] queue simple> print
Flags: X - disabled, I - invalid, D - dynamic
 0    name="Exclude-Server" target-address=192.168.0.1/32 dst-address=0.0.0.0/0
      interface=Local queue=default priority=8 limit-at=0/0 max-limit=0/0

 1    name="Limit-Local" target-address=192.168.0.0/24 dst-address=0.0.0.0/0
      interface=Local queue=default priority=8 limit-at=0/0
      max-limit=65536/131072
[admin@MikroTik] queue simple>
```

Queue tree example with masquerading

In previous example we dedicated 128kbps download and 64kbps upload to local network. In this example we will show you how to guarantee 256kbps download (128kbps for server, 64kbps for Workstation and Laptop) and 128kbps for upload (64kbps for server, 32kbps for workstation and laptop) for local network devices. Additionally, if there is bandwidth that is currently free, share it among users. For example, if we turn off the laptop (or it does not use nework resources), share its 64k download and 32k upload to Server and workstation.

When using masquerading, you have to mark the outgoing connection with **mark-connection** parameter and then mark all packets belonging to this connection with the **mark-flow** parameter.



1. Mark server's download and upload traffic. At first we will mark the outgoing connection and then all packets which belong to this connection.

```
/ip firewall mangle
    add src-address=192.168.0.1/32 action=passthrough mark-connection=server-con
    add connection=server-con action=accept mark-flow=server
```

2. The same for laptop and workstation:

```
/ip firewall mangle
    add src-address=192.168.0.2/32 action=passthrough \
        mark-connection=lap_work-con
    add src-address=192.168.0.3/32 action=passthrouth \
        mark-connection=lap_work-con
    add connection=lap_work-con action=accept mark-flow=lap_work
```

   As you can see, we marked connections that belong for laptop and workstation with the same flow.

3. Now add rules in **/queue tree**. The first rule will limit server's download and the second - upload traffic:

```
/queue tree
   add name=Server-Down parent=Local flow=server limit-at=131072 \
       max-limit=262144
   add name=Server-Up parent=Public flow=server limit-at=65536 \
        max-limit=131072
```

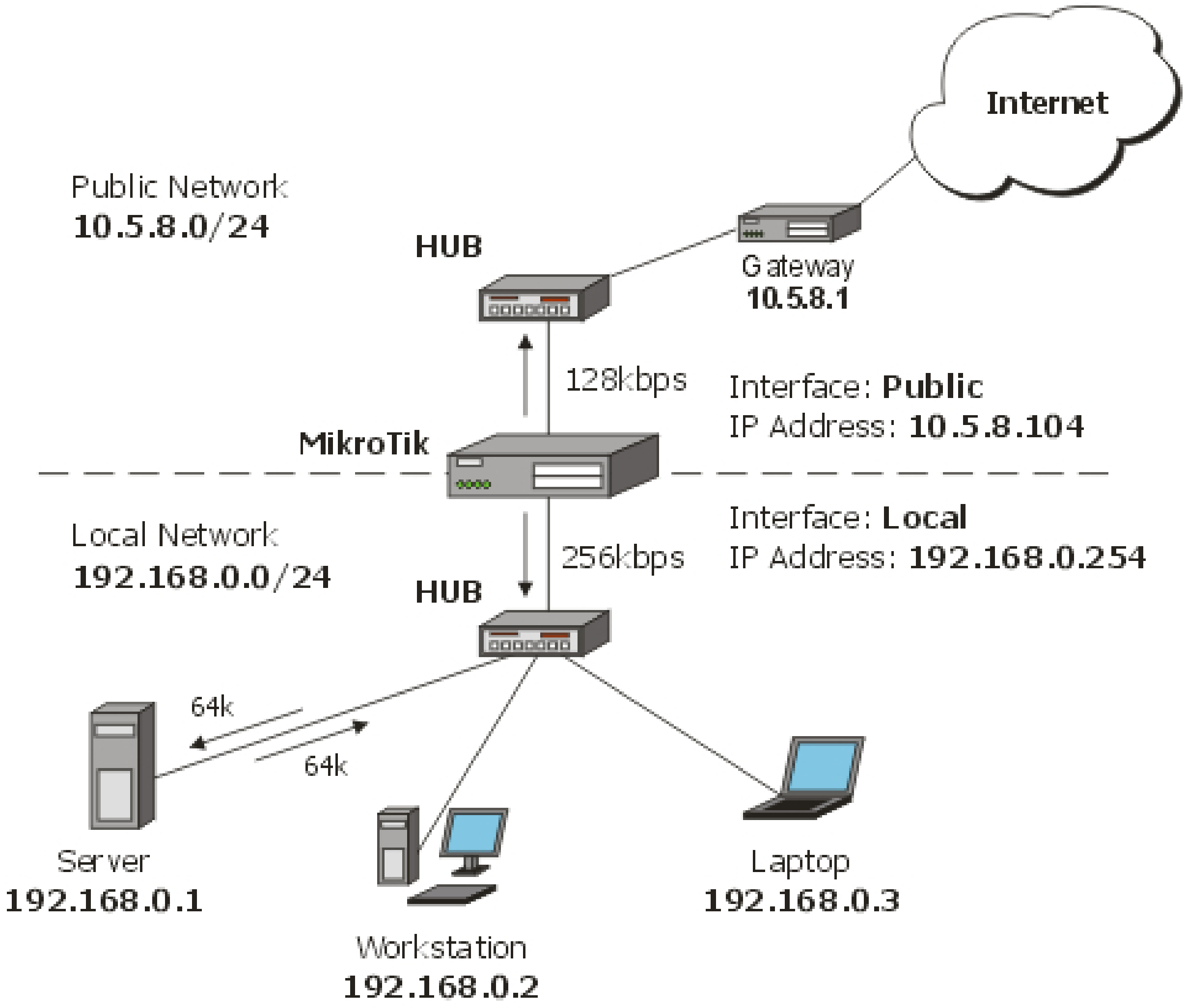
And the same for Laptop and Workstation:

```
/queue tree
    add name=Laptop-WorkStation-Down parent=Local flow=lap_work \
        limit-at=65536 max-limit=262144
    add name=Laptop-WorkStation-Up parent=Public flow=lap_work \
        limit-at=32768 max-limit=131072
```

Example of Guaranteed Quality of Service

This example shows how to limit data rate on a channel and guarantee minimum speed to the FTP server allowing other clients to use the rest of the traffic.

Assume we want to emulate a 256kbps download and 128kbps upload line connecting IP network **192.168.0.0/24** as in the previous examples. But if these speeds are the best that you can get from your Internet connection, you may want to guarantee certain speeds to the **FTP** server (192.168.0.1) so that your customers could download from and upload to this server with the speeds not dependent on the other traffic using the same channel (for example, we will guarantee this server the minimum data rate of 64kbps for each flow direction).



1. Limit the overall download (256k) and upload (128k) traffic:

```
/queue tree
    add parent=Local max-limit=262144 name=Download
    add parent=Public max-limit=131072 name=Upload
```

2. Mark FTP connection, initiated by FTP server (will not work for FTP passive mode!):

```
/ip firewall mangle add src-address=192.168.0.1/32 src-port=20-21 \
    mark-connection=ftp-con protocol=tcp action=passthrough
```

   Mark all packets belonging to this connection with a mark **ftp**:

```
/ip firewall mangle add connection=ftp-con mark-flow=FTP_Server action=accept
```

   Mark other traffic:

```
/ip firewall mangle add action=accept mark-flow=other
```

3. Add queues for FTP Server download and upload:

```
/queue tree add name=Server_Upload parent=Upload limit-at=65536 \
   flow=FTP_Server max-limit=131072 priority=7
/queue tree add name=Server_Download parent=Download limit-at=32768 \
   flow=FTP_Server max-limit=262144 priority=7
```

   Add queues for other's download and upload:

```
/queue tree add name=Other_Upload parent=Upload flow=other
/queue tree add name=Other_Download parent=Download flow=other
```

Now, the FTP traffic destined to and coming from FTP Server will have a guaranteed bandwidth of 64kbps, and a higher priority than other traffic (**priority=7**).

Example of using global-in and global-out queues

Let us consider a situation when you are using a Web-Proxy on your MikroTik router and you want to use bandwidth limitation to/from Internet and allow the maximum speed available if the clients use proxy-data (or do uploads to the router). In this situation you can use **global-in** and **global-out** virtual interfaces. Remember that data from Web-Proxy is sent to clients from Local Process. See ***this*** diagram for a better understanding of packet flow through the router.

1. Assume that you already have configured your web-proxy:

```
[admin@MikroTik] ip web-proxy> print
                enabled: yes
            src-address: 10.5.8.104
                   port: 8080
               hostname: proxy
      transparent-proxy: no
           parent-proxy: 0.0.0.0:0
    cache-administrator: webmaster
        max-object-size: 4096 kB
            cache-drive: system
         max-cache-size: none
                 status: running
     reserved-for-cache: 100 MB
```

2. Add a mangle rule for marking all packets coming from interface **Public**:

```
/ip firewall mangle add in-interface=Public mark-flow=all-down action=accept
```

   Add a mangle rule for marking all packets coming from interface **Local**:

```
/ip firewall mangle add in-interface=Local mark-flow=all-up action=accept
```

3. Add a queue tree rule that will limit all traffic coming from interface **Public** (flow=all-down) to 512kbps:

```
/queue tree add parent=global-in max-limit=524288 flow=all-down
```

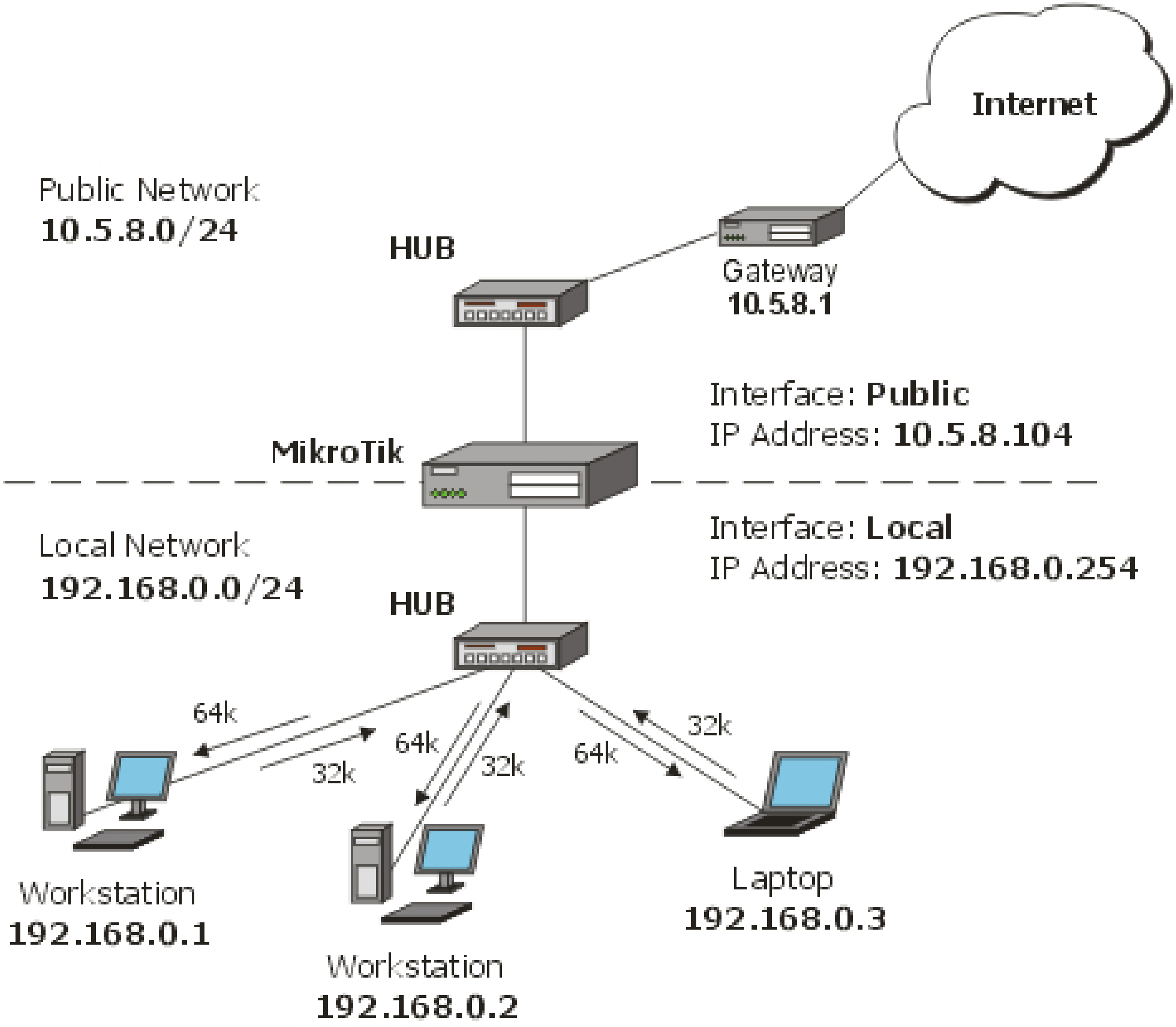
Add a queue tree rule that will limit all traffic coming from interface **Local** (flow=all-up) to 256kbps:

```
/queue tree add parent=global-out max-limit=262144 flow=all-up
```

Now the client downloads from the router (proxy) will be unlimited, but downloads from the Internet will be limited to 512K! The same goes for uploads - no limitation if you are uploading to router, but limit all uploads to Internet to 256K.

PCQ Example

In situations when you want to limit users in your network to a specific bandwidth, you can use PCQ. In this example we will show you how to configure the router so that all users have 64kbps download and 32kbps upload:



1. Mark all packets with flow **all**:

```
/ip firewall mangle add action=accept mark-flow=all
```

2. Create two PCQ queue types - one for download and one for upload. For download traffic queues will be classified by **dst-address** and for upload - by **src-address**:

```
/queue type add name=PCQ-Download kind=pcq pcq-rate=65536 \
   pcq-classifier=dst-address
/queue type add name=PCQ-Upload kind=pcq pcq-rate=32768 \
   pcq-classifier=src-address
```

3. Add two queue rules - one for download and one for upload:

```
/queue tree add parent=Local queue=PCQ-Download flow=all
/queue tree add parent=Public queue=PCQ-Upload flow=all
```

Configuration Export and Import

Document revision 2.1 (Fri Mar 05 08:51:02 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Configuration export feature is used to dump the part or whole RouterOS configuration. Then it can be edited and imported to the same or to an another router.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/***
Standards and Technologies: ***None***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***Configuration Backup and Restore***

Description

The configuration export can be used for dumping out MikroTik RouterOS configuration to the console screen or to a text (script) file, which can be downloaded from the router using ftp. The configuration import can be used to import the router configuration script from a text file.

The **export** command prints a script that can be used to restore configuration. The command can be invoked at any menu level, and it acts for that menu level and all menu levels below it. If the argument **from** is used, then it is possible to export only specified items. In this case **export** does not descend recursively through the command hierarchy. **export** also has the argument **file**, which allows you to save the script in a file on the router to retrieve it later via ftp.

The root level command **/import file_name** restores the exported information from the specified file. This is used to restore configuration or part of it after a **/system reset** event or anything that causes configuration data loss.

Note that it is impossible to import the whole router configuration using this feature. It can only be used to import a part of configuration (for example, firewall rules) in order to spare you some typing.

For backing up configuration to a binary file and restoring it without alterations, please refer to the configuration backup and restore section of the MikroTik RouterOS Manual.

The Export Command

Command name: ***export***

Example

```
[admin@MikroTik] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
 #   ADDRESS            NETWORK         BROADCAST       INTERFACE
 0   10.1.0.172/24      10.1.0.0        10.1.0.255      bridge1
 1   10.5.1.1/24        10.5.1.0        10.5.1.255      ether1
[admin@MikroTik] >
```

To make an export file:

```
[admin@MikroTik] ip address> export file=address
[admin@MikroTik] ip address>
```

To make an export file form olny one item:

```
[admin@MikroTik] ip address> export file=address1 from=1
[admin@MikroTik] ip address>
```

To see the files stored on the router:

```
[admin@MikroTik] > file print
 # NAME                             TYPE         SIZE        CREATION-TIME
0  address.rsc                      script       315         dec/23/2003 13:21:48
1  address1.rsc                     script       201         dec/23/2003 13:22:57
[admin@MikroTik] >
```

To export the setting on the display use the same command without the **file** argument:

```
[admin@MikroTik] ip address> export from=0,1
# dec/23/2003 13:25:30 by RouterOS 2.8beta12
# software id = MGJ4-MAN
#
/ ip address
add address=10.1.0.172/24 network=10.1.0.0 broadcast=10.1.0.255 \
    interface=bridge1 comment="" disabled=no
add address=10.5.1.1/24 network=10.5.1.0 broadcast=10.5.1.255 \
    interface=ether1 comment="" disabled=no
[admin@MikroTik] ip address>
```

The Import Command

Home menu level: ***/import***

Description

The **import** command is used to load a saved configuration script.

Example

To load the saved export file use the following command:

```
[admin@MikroTik] > import address.rsc
Opening script file address.rsc
Script file loaded successfully
[admin@MikroTik] >
```

SNMP Service

Document revision 1.7 (Wen Sep 15 11:00:38 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

SNMP is an application layer protocol. It is called simple because it works that way - the management station makes a request, and the managed device (SNMP agent) replies to this request. In SNMPv1 there are three main actions - Get, Set, and Trap. RouterOS supports only Get, which means that you can use this implementation only for network monitoring.

Hosts receive SNMP generated messages on UDP port 161 (except the trap messages, which are received on UDP port 162).

The MikroTik RouterOS supports:

- SNMPv1 only
- Read-only access is provided to the NMS (network management system)
- User defined communities are supported
- Get and GetNext actions

- No Set support
- No Trap support

Specifications

Packages required: ***system, ppp (optional)***
License required: ***level1***
Home menu level: ***/snmp***
Standards and Technologies: ***SNMP (RFC 1157)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***

Additional Documents

- ***http://www.ietf.org/rfc/rfc1157.txt***
- ***http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/snmp.htm***
- ***http://www.david-guerrero.com/papers/snmp/***

SNMP Setup

Home menu level: ***/snmp***

Description

This section shows you how to enable the SNMP agent on MikroTik RouterOS.

Property Description

enabled (*yes* | *no*) - whether the SNMP service is enabled

contact (*text*; default: "") - contact information for the NMS

location (*text*; default: "") - location information for the NMS

Example

To enable the service, specifying some info:

```
[admin@MikroTik] snmp> set contact="admin@riga-2" location="3rd floor" enabled="yes"
[admin@MikroTik] snmp> print
     enabled: yes
     contact: admin@riga-2
    location: 3rd floor
[admin@MikroTik] snmp>
```

SNMP Communities

Home menu level: ***/snmp community***

Description

The community name is a value in SNMPv1 header. It is like a 'username' for connecting to the SNMP agent. The default community for SNMP is **public**.

Property Description

name (*name*) - community name

address (*IP address/mask*; default: **0.0.0.0/0**) - allow requests only from these addresses

- **0.0.0.0/0** - allow access for any address

read-access (*yes* | *no*; default: **yes**) - whether the read access is enabled for the community

Example

To view existing communities:

```
[admin@MikroTik] snmp community> print
 # NAME                                            ADDRESS            READ-ACCESS
 0 public                                          0.0.0.0/0          yes
[admin@MikroTik] snmp community>
```

You can disable read access for the community **public**:

```
[admin@MikroTik] snmp community> set 0 read-access=no
[admin@MikroTik] snmp community> print
 # NAME                                            ADDRESS            READ-ACCESS
 0 public                                          0.0.0.0/0          no
[admin@MikroTik] snmp community>
```

To add the community called **communa**, that is only accessible from the **159.148.116.0/24** network:

Available OIDs

Description

You can use the SNMP protocol to get statistics from the router in these submenus:

- /interface
- /interface pc
- /interface wavelan
- /interface wireless
- /interface wireless registration-table
- /queue simple
- /queue tree
- /system identity

- /system resource

Example

To see available OID values, just type **print oid**. For example, to see available OIDs in **/system resource**:

```
[admin@motors] system resource> print oid
             uptime: .1.3.6.1.2.1.1.3.0
    total-hdd-space: .1.3.6.1.2.1.25.2.3.1.5.1
     used-hdd-space: .1.3.6.1.2.1.25.2.3.1.6.1
       total-memory: .1.3.6.1.2.1.25.2.3.1.5.2
        used-memory: .1.3.6.1.2.1.25.2.3.1.6.2
           cpu-load: .1.3.6.1.2.1.25.3.3.1.2.1
[admin@motors] system resource>
```

Available MIBs

Description

You can download ***MikroTik MIB file***

MikroTik RouterOS OID: enterprises.14988.1

RFC1493

dot1dBridge.dot1dBase.dot1dBaseBridgeAddress

dot1dBridge.dot1dStp.dot1dStpProtocolSpecification

dot1dBridge.dot1dStp.dot1dStpPriority

dot1dBridge.dot1dTp.dot1dTpFdbTable.dot1dTpFdbEntry.dot1dTpFdbAddress

dot1dBridge.dot1dTp.dot1dTpFdbTable.dot1dTpFdbEntry.dot1dTpFdbPort

dot1dBridge.dot1dTp.dot1dTpFdbTable.dot1dTpFdbEntry.dot1dTpFdbStatus

RFC2863

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifName

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCInOctets

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCInUcastPkts

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCOutOctets

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCOutUcastPkts

RFC1213

interfaces.ifNumber

interfaces.ifTable.ifEntry.ifIndex

interfaces.ifTable.ifEntry.ifDescr

interfaces.ifTable.ifEntry.ifType

interfaces.ifTable.ifEntry.ifMtu

interfaces.ifTable.ifEntry.ifSpeed

interfaces.ifTable.ifEntry.ifPhysAddress

interfaces.ifTable.ifEntry.ifAdminStatus

interfaces.ifTable.ifEntry.ifOperStatus

interfaces.ifTable.ifEntry.ifLastChange

interfaces.ifTable.ifEntry.ifInOctets

interfaces.ifTable.ifEntry.ifInUcastPkts

interfaces.ifTable.ifEntry.ifInNUcastPkts

interfaces.ifTable.ifEntry.ifInDiscards

interfaces.ifTable.ifEntry.ifInErrors

interfaces.ifTable.ifEntry.ifInUnknownProtos

interfaces.ifTable.ifEntry.ifOutOctets

interfaces.ifTable.ifEntry.ifOutUcastPkts

interfaces.ifTable.ifEntry.ifOutNUcastPkts

interfaces.ifTable.ifEntry.ifOutDiscards

interfaces.ifTable.ifEntry.ifOutErrors

interfaces.ifTable.ifEntry.ifOutQLen

RFC2011

ip.ipForwarding

ip.ipDefaultTTL

ip.ipAddrTable.ipAddrEntry.ipAdEntAddr

ip.ipAddrTable.ipAddrEntry.ipAdEntIfIndex

ip.ipAddrTable.ipAddrEntry.ipAdEntNetMask

ip.ipAddrTable.ipAddrEntry.ipAdEntBcastAddr

ip.ipAddrTable.ipAddrEntry.ipAdEntReasmMaxSize

ip.ipNetToMediaTable.ipNetToMediaEntry.ipNetToMediaIfIndex

ip.ipNetToMediaTable.ipNetToMediaEntry.ipNetToMediaPhysAddress

ip.ipNetToMediaTable.ipNetToMediaEntry.ipNetToMediaNetAddress ip.ipNetToMediaTable.ipNetToMediaEntry.ipNetToMediaType

RFC2096

ip.ipForward.ipCidrRouteNumber

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteDest

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteMask

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteTos

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteNextHop

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteIfIndex

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteType

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteProto

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteAge

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteInfo

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteNextHopAS

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteMetric1

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteMetric2

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteMetric3

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteMetric4

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteMetric5

ip.ipForward.ipCidrRouteTable.ipCidrRouteEntry.ipCidrRouteStatus

Note that obsolete ip.ipRouteTable is also supported

RFC1213

system.sysDescr

system.sysObjectID

system.sysUpTime

system.sysContact

system.sysName

system.sysLocation

system.sysServices

RFC2790

host.hrSystem.hrSystemUptime

host.hrSystem.hrSystemDate

host.hrStorage.hrMemorySize

host.hrStorage.hrStorageTable.hrStorageEntry.hrStorageIndex

host.hrStorage.hrStorageTable.hrStorageEntry.hrStorageType

host.hrStorage.hrStorageTable.hrStorageEntry.hrStorageDescr

host.hrStorage.hrStorageTable.hrStorageEntry.hrStorageAllocationUnits

host.hrStorage.hrStorageTable.hrStorageEntry.hrStorageSize

host.hrStorage.hrStorageTable.hrStorageEntry.hrStorageUsed

CISCO-AAA-SESSION-MIB

Note that this MIB is supported only when **ppp** package is installed. It reports both **ppp** and **hotspot** active users

enterprises.cisco.ciscoMgmt.ciscoAAASessionMIB.casnMIBObjects.casnActive.casnActiveTableEntries

enterprises.cisco.ciscoMgmt.ciscoAAASessionMIB.casnMIBObjects.casnActive.casnActiveTable.casnActiveEntry

enterprises.cisco.ciscoMgmt.ciscoAAASessionMIB.casnMIBObjects.casnActive.casnActiveTable.casnActiveEntry

enterprises.cisco.ciscoMgmt.ciscoAAASessionMIB.casnMIBObjects.casnActive.casnActiveTable.casnActiveEntry

RFC2863

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifInMulticastPkts

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifInBroadcastPkts

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifOutMulticastPkts

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifOutBroadcastPkts

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCInMulticastPkts

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCInBroadcastPkts

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCOutMulticastPkts

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCOutBroadcastPkts

ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHighSpeed

RFC2790

host.hrStorage.hrStorageTable.hrStorageEntry.hrStorageAllocationFailures

Tools for SNMP Data Collection and Analysis

Description

MRTG (Multi Router Traffic Grapher) is the most commonly used SNMP monitor. For further information, see this link: ***http://people.ee.ethz.ch/~oetiker/webtools/mrtg/***

An example of using MRTG with MikroTik SNMP

Here is a example configuration file for MRTG to monitor a network interface traffic on Mikrotik RouterOS. This is only an example file.

```
######################################################################
# Multi Router Traffic Grapher -- Sample Configuration File
######################################################################
# This file is for use with mrtg-2.5.4c

# Global configuration
WorkDir: /var/www/mrtg
WriteExpires: Yes

RunAsDaemon: Yes
Interval: 6
Refresh: 300

######################################################################
# System: RouterBOARD
# Description: RouterOS v2.8
# Contact: support@mikrotik.com
# Location: Mikrotik main office
######################################################################


### Interface 'RemOffice'

Target[RouterBOARD]: 1.3.6.1.2.1.2.2.1.10.8&1.3.6.1.2.1.2.2.1.16.8:public@1.1.1.3
#SetEnv[RouterBOARD]: MRTG_INT_IP="1.1.1.3" MRTG_INT_DESCR="ether1"
MaxBytes[RouterBOARD]: 1250000
Title[RouterBOARD]: Traffic Analysis for RouterBOARD(1)
PageTop[RouterBOARD]: <H1>Traffic Analysis for RouterBOARD(1)</H1>

  <TABLE>
    <TR>
      <TD>System:</TD> <TD>RouterBOARD</TD>
          </TR>
    <TR>
            <TD>Maintainer:</TD> <TD>MicroTik Support</TD>
          </TR>
    <TR>
            <TD>Description:</TD><TD>An Embedded Board</TD>
          </TR>
          <TR>
            <TD>ifType:</TD>     <TD>ethernetCSMACD(6)</TD>
          </TR>
          <TR>
            <TD>ifName:</TD>     <TD>RemOffice</TD>
          </TR>
          <TR>
            <TD>Max Speed:</TD>  <TD>1250.0 kBytes/s</TD>
          </TR>
          <TR>
            <TD>IP:</TD>         <TD>10.10.2.1</TD>
    </TR>
  </TABLE>

### Queue 'queue1'

Target[RouterBOARD_queue]:
1.3.6.1.4.1.14988.1.1.2.1.1.8.1&1.3.6.1.4.1.14988.1.1.2.1.1.9.1:public@1.1.1.3
#SetEnv[RouterBOARD_queue]: MRTG_INT_IP="1.1.1.3" MRTG_INT_DESCR="ether1"
MaxBytes[RouterBOARD_queue]: 100000
```

```
Title[RouterBOARD_queue]: Traffic Analysis for RouterBOARD(1_1)
PageTop[RouterBOARD_queue]: <H1>Traffic Analysis for RouterBOARD(1_1)</H1>

  <TABLE>
    <TR>
      <TD>System:</TD> <TD>RouterBOARD</TD>
          </TR>
    <TR>
            <TD>Maintainer:</TD> <TD>MicroTik Support</TD>
          </TR>
    <TR>
            <TD>Description:</TD><TD>An Embedded Board</TD>
          </TR>
          <TR>
            <TD>ifType:</TD>     <TD>ethernetCSMACD(6)</TD>
          </TR>
          <TR>
            <TD>ifName:</TD>     <TD>RemOffice</TD>
          </TR>
                <TR>
            <TD>queueName:</TD>     <TD>queue1</TD>
          </TR>
          <TR>
            <TD>Max Speed:</TD>  <TD>64.0 kBytes/s</TD>
          </TR>
          <TR>
            <TD>IP:</TD>         <TD>10.10.2.1</TD>
    </TR>
  </TABLE>
```

The output page of MRTG (interface part) should look like this: ***Example MRTG Output***

For more information read the MRTG documentation: ***Configuration Reference***

MAC Telnet Server and Client

Document revision 2.0 (Fri Mar 05 09:01:27 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

MAC telnet is used to provide access to a router that has no IP address set. It works just like IP telnet. MAC telnet is possible between two MikroTik RouterOS routers only.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/tool, /tool mac-server***
Standards and Technologies: ***MAC Telnet***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Ping***
- ***MNDP***

MAC Telnet Server

Home menu level: ***/tool mac-server***

Property Description

interface (*name* | *all*; default: **all**) - interface name to which the mac-server clients will connect

- **all** - all interfaces

Notes

There is an interface list in configured in the submenu level. If you add some interfaces to this list, you allow MAC telnet to that interface. Disabled (**disabled=yes**) item means that interface in not in the list rather than that MAC telnet is disabled on that interface.

Example

To enable MAC telnet server on **ether1** interface only:

```
[admin@MikroTik] tool mac-server> print
Flags: X - disabled
 #   INTERFACE
 0   all
[admin@MikroTik] tool mac-server> remove 0
[admin@MikroTik] tool mac-server> add interface=ether1 disabled=no
[admin@MikroTik] tool mac-server> print
Flags: X - disabled
 #   INTERFACE
 0   ether1
[admin@MikroTik] tool mac-server>
```

Monitoring Active Session List

Home menu level: ***/tool mac-server sessions***

Property Description

interface (*read-only: name*) - interface the client is connected to

src-address (*read-only: MAC address*) - client's MAC address

uptime (*read-only: time*) - how long the client is connected to the server

MAC Telnet Client

Command name: ***/tool mac-telnet***

Example

```
[admin@MikroTik] tool> mac-telnet "00:40:63:C1:23:C4"
Login: admin
Password:
Trying 00:40:63:C1:23:C4...
Connected to 00:40:63:C1:23:C4

  MMM      MMM       KKK                          TTTTTTTTTTT      KKK
  MMMM    MMMM       KKK                          TTTTTTTTTTT      KKK
  MMM MMMM MMM  III  KKK  KKK  RRRRRR     OOOOOO      TTT     III  KKK  KKK
  MMM  MM  MMM  III  KKKKK     RRR  RRR  OOO  OOO     TTT     III  KKKKK
  MMM      MMM  III  KKK KKK   RRRRRR    OOO  OOO     TTT     III  KKK KKK
  MMM      MMM  III  KKK  KKK  RRR  RRR   OOOOOO      TTT     III  KKK  KKK

  MikroTik RouterOS v2.7 (c) 1999-2003       http://www.mikrotik.com/

Terminal linux detected, using multiline input mode
[admin@10.5.7.1] >
```

Ping

Document revision 08-Jun-2004 (1.11)
This document applies to V

Table of Contents

General Information

Summary

Ping uses Internet Control Message Protocol (ICMP) Echo messages to determine if a remote host is active or inactive and to determine the round-trip delay when communicating with it.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/, /tool mac-server ping***
Standards and Technologies: ***ICMP***
Hardware usage: ***Not significant***

Related Documents

-

Description

Ping sends ICMP echo (ICMP type 8) message to the host and waits for the ICMP echo-reply (ICMP type 0) from that host. The interval between these events is called round trip. If the response (that is called pong) has not come until the end of the interval, we assume it has timed out. The second significant parameter reported is ttl (Time to Live). It is decremented at each machine in which the packet is processed. The packet will reach its destination only when the ttl is greater than the number of routers between the source and the destination.

The Ping Command

Command name: ***/ping***

Property Description

(*IP address* | *MAC address*) - IP or MAC address for destination host

size (*integer*: 28..1500; default: **64**) - size of the IP packet (in bytes, including the IP and ICMP headers)

do-not-fragment - if added, packets will not be fragmented

interval (*time*: 10ms..5s; default: **1s**) - delay between messages

count (*integer*; default: **0**) - how many times ICMP packets will be sent

- **0** - Ping continues till [Ctrl]+[C] is pressed

ttl (*integer*: 1..255; default: **255**) - Time To Live (TTL) value of the ICMP packet

src-address (*IP address*) - change the source address of the packet

Notes

You can not ping with packets larger that the MTU of that interface, so size should always be equal or less than MTU

If DNS service is configured, it is possible to ping by DNS address. To do it from **Winbox**, you should resolve DNS address first, pressing right mouse button over it address and choosing **Lookup Address**.

Packet size may not be greater than the interface's mtu. If 'pinging' by MAC address, minimal packet size is 50.

Only neighbour MikroTik RouterOS routers with MAC-ping feature enabled can be 'pinged' by MAC address.

An example of Ping command

```
[admin@MikroTik] > ping 10.1.1
10.1.0.1 64 byte ping: ttl=64 time=1 ms
10.1.0.1 64 byte ping: ttl=64 time=1 ms
10.1.0.1 64 byte ping: ttl=64 time=1 ms
10.1.0.1 64 byte ping: ttl=64 time=1 ms
10.1.0.1 64 byte ping: ttl=64 time=1 ms
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 1/1.0/1 ms
[admin@MikroTik] >
```

MAC Ping Server

Home menu level: ***/tool mac-server ping***

Property Description

enabled (yes | no; default: **yes**) - whether MAC pings to this router are allowed

Example

To disable MAC pings:

```
[admin@MikroTik] tool mac-server ping> set enabled=no
[admin@MikroTik] tool mac-server ping> print
    enabled: no
[admin@MikroTik] tool mac-server ping>
```

DDNS Update Tool

Document revision 1.2 (Fri Mar 05 09:33:48 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Dynamic DNS Update Tool gives a way to keep domain name pointing to dynamic IP address. It works by sending domain name system update request to name server, which has a zone to be updated. Secure DNS updates are also supported.

The DNS update tool supports only one algorithm - **hmac-md5**. It's the only proposed algorithm for signing DNS messages.

Specifications

Packages required: ***advanced-tools***
License required: ***level1***
Command name: ***/tool dns-update***
Standards and Technologies: ***Dynamic Updates in the DNS (RFC 2136)***, ***Secure DNS Dynamic Update (RFC 3007)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

Description

Dynamic DNS Update is a tool that should be manually run to update dynamic DNS server.

Note that you have to have a DNS server that supports DNS updates properly configured.

Additional Documents

- ***DNS related RFCs***

Dynamic DNS Update

Command name: ***/tool dns-update***

Property Description

address (*IP address*) - defines IP address associated with the domain name

dns-server (*IP address*) - DNS server to send update to

key (*text*; default: **""**) - authorization key (password of a kind) to access the server

key-name (*text*; default: **""**) - authorization key name (username of a kind) to access the server

name (*text*) - name to attach with the IP address

ttl (*integer*; default: **0**) - time to live for the item (in seconds)

zone (*text*) - DNS zone where to update the domain name in

Notes

Example

To tell **23.34.45.56** DNS server to (re)associate **mydomain** name in the **myzone.com** zone with **68.42.14.4** IP address specifying that the name of the key is **dns-update-key** and the actual key is **update**:

```
[admin@MikroTik] tool> dns-update dns-server=23.34.45.56 name=mydomain \
\... zone=myzone.com address=68.42.14.4 key-name=dns-update-key key=update
```

Torch (Realtime Traffic Monitor)

Document revision 1.2 (Fri Mar 05 09:45:04 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Realtime traffic monitor may be used to monitor the traffic flow through an interface.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/tool***
Standards and Technologies: ***none***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

Description

Realtime Traffic Monitor called also torch is used for monitoring traffic that is going through an interface. You can monitor traffic classified by protocol name, source address, destination address, port. Torch shows the protocols you have chosen and mean transmitted and received data rate for each of them.

The Torch Command

Command name: ***/tool torch***

Property Description

interface (*name*) - the name of the interface to monitor

protocol (*any* | *any-ip* | *icmp* | *igmp* | *ipip* | *ospf* | *pup* | *tcp* | *udp* | *integer*) - the name or number of the protocol

- **any** - any ethernet or IP protocol
- **any-ip** - any IP protocol

port (*name* | *integer*) - the name or number of the port

source-address (*IP address/mask*) - source address and network mask to filter the traffic only with such an address, any source address: 0.0.0.0/0

destination-address (*IP address/mask*) - destination address and network mask to filter the traffic only with such an address, any destination address: 0.0.0.0/0

Notes

If there will be specific port given, then only **tcp** and **udp** protocols will be filtered, i.e., the name of the **protocol** can be **any**, **any-ip**, **tcp**, **udp**.

Except TX and RX, there will be only the field you've specified in command line in the command's output (e.g., you will get **PROTOCOL** column only in case if **protocol** property is explicitly specified).

Example

The following example monitors the traffic that goes through the **ether1** interface generated by **telnet** protocol:

```
[admin@MikroTik] tool> torch ether1 port=telnet
 SRC-PORT                     DST-PORT                     TX         RX
 1439                         23 (telnet)                  1.7kbps    368bps

[admin@MikroTik] tool>
```

To see what IP protocols are going through the **ether1** interface:

```
[admin@MikroTik] tool> torch ether1 protocol=any-ip
 PRO.. TX         RX
 tcp   1.06kbps   608bps
 udp   896bps     3.7kbps
 icmp  480bps     480bps
 ospf  0bps       192bps

[admin@MikroTik] tool>
```

To see what IP protocols are interacting with **10.0.0.144/32** host connected to the **ether1** interface:

```
[admin@MikroTik] tool> torch ether1 src-address=10.0.0.144/32 protocol=any
 PRO.. SRC-ADDRESS     TX         RX
 tcp   10.0.0.144      1.01kbps   608bps
 icmp  10.0.0.144      480bps     480bps

[admin@MikroTik] tool>
```

To see what tcp/udp protocols are going through the **ether1** interface:

```
[admin@MikroTik] tool> torch ether1 protocol=any-ip port=any
 PRO.. SRC-PORT                  DST-PORT                  TX         RX
 tcp   3430                      22 (ssh)                  1.06kbps   608bps
 udp   2812                      1813 (radius-acct)        512bps     2.11kbps
 tcp   1059                      139 (netbios-ssn)         248bps     360bps
```

```
[admin@MikroTik] tool>
```

Bandwidth Test

Document revision 1.7 (Wed Jul 21 11:37:29 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The Bandwidth Tester can be used to monitor the throughput only to a remote MikroTik router (either wired or wireless) and thereby help to discover network "bottlenecks".

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/tool***
Standards and Technologies: ***TCP (RFC 793)***, ***UDP (RFC768)***
Hardware usage: *significant*

Related Documents

- ***Package Management***

Description

Protocol Description

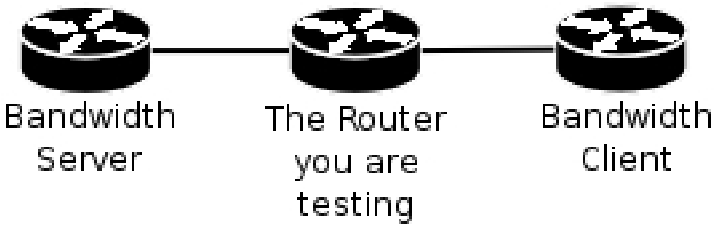
The TCP test uses the standard TCP protocol with acknowledgments and follows the TCP algorithm on how many packets to send according to latency, dropped packets, and other features in the TCP algorithm. Please review the TCP protocol for details on its internal speed settings and how to analyze its behavior. Statistics for throughput are calculated using the entire size of the TCP packet. As acknowledgments are an internal working of TCP, their size and usage of the link are not included in the throughput statistics. Therefore this statistic is not as reliable as the UDP statistic when estimating throughput.

The UDP tester sends 110% or more packets than currently reported as received on the other side of the link. To see the maximum throughput of a link, the packet size should be set for the maximum MTU allowed by the links which is usually 1500 bytes. There is no acknowledgment required by UDP; this implementation means that the closest approximation of the throughput can be seen.

Usage Notes

Caution! Bandwidth Test uses all available bandwidth (by default) and may impact network usability.

Bandwidth Test uses much resources. If you want to test real throughput of a router, you should run bandwidth test through it not from or to it. To do this you need at least 3 routers connected in chain: the Bandwidth Server, the given router and the Bandwidth Client:



Note that if you use UDP protocol then Bandwidth Test counts IP header+UDP header+UDP data. In case if you use TCP then Bandwidth Test counts only TCP data (TCP header and IP header are not included).

Server Configuration

Home menu level: ***/tool bandwidth-server***

Property Description

allocate-udp-ports-from - allocate UDP ports from

authenticate (*yes* | *no*; default: **yes**) - communicate only with authenticated (by valid username and password) clients

enable (*yes* | *no*; default: **no**) - enable client connections for bandwidth test

max-sessions - maximal number of bandwidth-test clients

Notes

The list of current connections can be obtained in **session** submenu

Example

Bandwidth Server:

```
[admin@MikroTik] tool bandwidth-server> print
                    enabled: no
               authenticate: yes
    allocate-udp-ports-from: 2000
               max-sessions: 10
[admin@MikroTik] tool>
```

Active sessions:

```
[admin@MikroTik] tool> bandwidth-server session print
  # CLIENT          PROTOCOL DIRECTION USER
  0 35.35.35.1      udp      send      admin
  1 25.25.25.1      udp      send      admin
  2 36.36.36.1      udp      send      admin

[admin@MikroTik] tool>
```

To enable **bandwidth-test** server without client authentication:

```
[admin@MikroTik] tool bandwidth-server> set enabled=yes authenticate=no
[admin@MikroTik] tool bandwidth-server> print
                    enabled: yes
               authenticate: no
    allocate-udp-ports-from: 2000
               max-sessions: 10
[admin@MikroTik] tool>
```

Client Configuration

Command name: ***/tool bandwidth-test***

Property Description

address (*IP address*) - IP address of destination host

assume-lost-time (*time*; default: **0s**) - assume that connection is lost if Bandwidth Server is not responding for that time

direction (*receive*/*transmit*/*both*; default: **receive**) - the direction of the test

do (*name* | *string*; default: "") - script source

duration (*time*; default: **0s**) - duration of the test

- **0s** - test duration is not limited

interval (*time*: 20ms..5s; default: **1s**) - delay between reports (in seconds)

local-tx-speed (*integer*; default: **0**) - transfer test maximum speed (bits per second)

- **0** - no speed limitations

password (*text*; default: "") - password for the remote user

protocol (*udp* | *tcp*; default: **udp**) - protocol to use

random-data (*yes* | *no*; default: **no**) - if random-data is set to yes, the payload of the bandwidth test packets will have incompressible random data so that links that use data compression will not distort the results (this is CPU intensive and random-data should be set to no for low speed CPUs)

remote-tx-speed (*integer*; default: **0**) - receive test maximum speed (bits per second)

- **0** - no speed limitations

size - packet size in bytes (only for UDP protocol)

user (*name*; default: "") - remote user

Example

To run 15-second long bandwidth-test to the **10.0.0.211** host sending and receiving **1000**-byte UDP packets and using username **admin** to connect

```
[admin@MikroTik] tool> bandwidth-test 10.0.0.211 duration=15s direction=both \
\... size=1000 protocol=udp user=admin
                status: done testing
              duration: 15s
            tx-current: 3.62Mbps
  tx-10-second-average: 3.87Mbps
      tx-total-average: 3.53Mbps
            rx-current: 3.33Mbps
  rx-10-second-average: 3.68Mbps
      rx-total-average: 3.49Mbps

[admin@MikroTik] tool>
```

Packet Sniffer

Document revision 1.5 (Thu May 20 14:56:46 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Packet sniffer is a feature that catches all the data travelling over the network, that it is able to get (when using switched network, a computer may catch only the data addressed to it or is forwarded through it).

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/tool sniffer***
Standards and Technologies: ***none***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

Description

It allows you to "sniff" packets going through the router (and any other traffic that gets to the router, when there is no switching in the network) and view them using specific software.

Packet Sniffer Configuration

Home menu level: ***/tool sniffer***

Property Description

interface (*name* | *all*; default: **all**) - the name of the interface that receives the packets

only-headers (*yes* | *no*; default: **no**) - whether to save in the memory packets' headers only (not the whole packet)

memory-limit (*integer*; default: **10**) - maximum amount of memory to use. Sniffer will stop after this limit is reached

file-name (*text*; default: **""**) - the name of the file where the sniffed packets will be saved to

file-limit (*integer*; default: **10**) - the limit of the file in KB. Sniffer will stop after this limit is reached

streaming-enabled (*yes* | *no*; default: **no**) - whether to send sniffed packets to a remote server

streaming-server (*IP address*; default: **0.0.0.0**) - Tazmen Sniffer Protocol (TZSP) stream receiver

filter-stream (*yes* | *no*; default: **yes**) - whether to ignore sniffed packets that are destined to the stream server

filter-protocol (*all-frames* | *ip-only* | *mac-only-no-ip*; default: **ip-only**) - specific protocol group to filter

- **all-frames** - sniff all packets
- **ip-only** - sniff IP packets only
- **mac-only-no-ip** - sniff non-IP packets only

filter-address1 (*IP address/mask:port*; default: **0.0.0.0/0:0-65535**) - criterion of choosing the packets to process

filter-address2 (*IP address/mask:port*; default: **0.0.0.0/0:0-65535**) - criterion of choosing the packets to process

running (*yes* | *no*; default: **no**) - if the sniffer is started then the value is yes otherwise no

Notes

filter-address1 and **filter-address2** are used to specify the two participients in communication (i.e. they will match only in the case if one of them matches the source address and the other one matches the destination address of a packet). These properties are taken in account only if **filter-protocol** is **ip-only**.

Not only **Ethernal** (***http://www.ethereal.com***) and **Packetyzer** (***http://www.packetyzer.com***) can receive the sniffer's stream but also MikroTik's program **trafr** (***http://www.mikrotik.com/download.html***) that runs on any IA32 Linux computer and saves received packets **libpcap** file format.

Example

In the following example **streaming-server** will be added, streaming will be enabled, **file-name** will be set to *test* and packet sniffer will be started and stopped after some time:

```
[admin@MikroTik] tool sniffer>set streaming-server=10.0.0.241 \
\... streaming-enabled=yes file-name=test
[admin@MikroTik] tool sniffer> prin
            interface: all
         only-headers: no
         memory-limit: 10
            file-name: "test"
           file-limit: 10
    streaming-enabled: yes
     streaming-server: 10.0.0.241
        filter-stream: yes
      filter-protocol: ip-only
      filter-address1: 0.0.0.0/0:0-65535
      filter-address2: 0.0.0.0/0:0-65535
              running: no
[admin@MikroTik] tool sniffer>start
[admin@MikroTik] tool sniffer>stop
```

Running Packet Sniffer

Command name: ***/tool sniffer start, /tool sniffer stop, /tool sniffer save***

Description

The commands are used to control runtime operation of the packet sniffer. The **start** command is used to start/reset sniffering, **stop** - stops sniffering. To save currently sniffed packets in a specific file **save** command is used.

Example

In the following example the packet sniffer will be started and after some time - stopped:

```
[admin@MikroTik] tool sniffer> start
[admin@MikroTik] tool sniffer> stop
```

Below the sniffed packets will be saved in the file named *test*:

```
[admin@MikroTik] tool sniffer> save file-name=test
[admin@MikroTik] tool sniffer> /file print
  # NAME                          TYPE         SIZE       CREATION-TIME
  0 test                          unknown      1350       apr/07/2003 16:01:52

[admin@MikroTik] tool sniffer>
```

Sniffed Packets

Home menu level: ***/tool sniffer packet***

Description

The submenu allows to see the list of sniffed packets.

Property Description

data (*read-only: text*) - specified data inclusion in packets

dst-address (*read-only: IP address*) - IP destination address

fragment-offset (*read-only: integer*) - IP fragment offset

identification (*read-only: integer*) - IP identification

ip-header-size (*read-only: integer*) - the size of IP header

ip-packet-size (*read-only: integer*) - the size of IP packet

ip-protocol (*ip* | *icmp* | *igmp* | *ggp* | *ipencap* | *st* | *tcp* | *egp* | *pup* | *udp* | *hmp* | *xns-idp* | *rdp* | *iso-tp4* | *xtp* | *ddp* | *idrp-cmtp* | *gre* | *esp* | *ah* | *rspf* | *vmtp* | *ospf* | *ipip* | *encap*) - the name/number of IP protocol

- **ip** - Internet Protocol
- **icmp** - Internet Control Message Protocol
- **igmp** - Internet Group Management Protocol
- **ggp** - Gateway-Gateway Protocol
- **ipencap** - IP Encapsulated in IP
- **st** - st datagram mode
- **tcp** - Transmission Control Protocol
- **egp** - Exterior Gateway Protocol
- **pup** - Parc Universal packet Protocol
- **udp** - User Datagram Protocol
- **hmp** - Host Monitoring Protocol
- **xns-idp** - Xerox ns idp
- **rdp** - Reliable Datagram Protocol
- **iso-tp4** - ISO Transport Protocol class 4
- **xtp** - Xpress Transfer Protocol
- **ddp** - Datagram Delivery Protocol
- **idpr-cmtp** - idpr Control Message Transport
- **gre** - General Routing Encapsulation
- **esp** - IPsec ESP protocol
- **ah** - IPsec AH protocol
- **rspf** - Radio Shortest Path First
- **vmtp** - Versatile Message Transport Protocol

- **ospf** - Open Shortest Path First
- **ipip** - IP encapsulation (protocol 4)
- **encap** - IP encapsulation (protocol 98)

protocol (*read-only: ip | arp | rarp | ipx | ipv6*) - the name/number of ethernet protocol

- **ip** - Internet Protocol
- **arp** - Address Resolution Protocol
- **rarp** - Reverse Address Resolution Protocol
- **ipx** - Internet Packet exchange protocol
- **ipv6** - Internet Protocol next generation

size (*read-only: integer*) - size of packet

src-address (*IP address*) - source address

time (*read-only: time*) - time when packet arrived

tos (*read-only: integer*) - IP Type Of Service

ttl (*read-only: integer*) - IP Time To Live

Example

In the example below it's seen, how to get the list of sniffed packets:

```
[admin@MikroTik] tool sniffer packet> pr
  # TIME    INTERFACE SRC-ADDRESS             DST-ADDRESS             IP-.. SIZE
  0 0.12    ether1    10.0.0.241:1839         10.0.0.181:23 (telnet) tcp   46
  1 0.12    ether1    10.0.0.241:1839         10.0.0.181:23 (telnet) tcp   40
  2 0.12    ether1    10.0.0.181:23 (telnet)  10.0.0.241:1839        tcp   78
  3 0.292   ether1    10.0.0.181              10.0.0.4               gre   88
  4 0.32    ether1    10.0.0.241:1839         10.0.0.181:23 (telnet) tcp   40
  5 0.744   ether1    10.0.0.144:2265         10.0.0.181:22 (ssh)    tcp   76
  6 0.744   ether1    10.0.0.144:2265         10.0.0.181:22 (ssh)    tcp   76
  7 0.744   ether1    10.0.0.181:22 (ssh)     10.0.0.144:2265        tcp   40
  8 0.744   ether1    10.0.0.181:22 (ssh)     10.0.0.144:2265        tcp   76
-- more
```

Packet Sniffer Protocols

Home menu level: ***/tool sniffer protocol***

Description

In this submenu you can see all kind of protocols that have been sniffed.

Property Description

bytes (*integer*) - total number of data bytes

protocol (*read-only: ip | arp | rarp | ipx | ipv6*) - the name/number of ethernet protocol

- **ip** - Internet Protocol
- **arp** - Address Resolution Protocol
- **rarp** - Reverse Address Resolution Protocol
- **ipx** - Internet Packet exchange protocol

- **ipv6** - Internet Protocol next generation

ip-protocol (*ip* | *icmp* | *igmp* | *ggp* | *ipencap* | *st* | *tcp* | *egp* | *pup* | *udp* | *hmp* | *xns-idp* | *rdp* | *iso-tp4* | *xtp* | *ddp* | *idrp-cmtp* | *gre* | *esp* | *ah* | *rspf* | *vmtp* | *ospf* | *ipip* | *encap*) - the name/number of IP protocol

- **ip** - Internet Protocol
- **icmp** - Internet Control Message Protocol
- **igmp** - Internet Group Management Protocol
- **ggp** - Gateway-Gateway Protocol
- **ipencap** - IP Encapsulated in IP
- **st** - st datagram mode
- **tcp** - Transmission Control Protocol
- **egp** - Exterior Gateway Protocol
- **pup** - Parc Universal packet Protocol
- **udp** - User Datagram Protocol
- **hmp** - Host Monitoring Protocol
- **xns-idp** - Xerox ns idp
- **rdp** - Reliable Datagram Protocol
- **iso-tp4** - ISO Transport Protocol class 4
- **xtp** - Xpress Transfer Protocol
- **ddp** - Datagram Delivery Protocol
- **idpr-cmtp** - idpr Control Message Transport
- **gre** - General Routing Encapsulation
- **esp** - IPsec ESP protocol
- **ah** - IPsec AH protocol
- **rspf** - Radio Shortest Path First
- **vmtp** - Versatile Message Transport Protocol
- **ospf** - Open Shortest Path First
- **ipip** - IP encapsulation
- **encap** - IP encapsulation

packets (*integer*) - the number of packets

port (*name*) - the port of TCP/UDP protocol

share (*integer*) - specific type of traffic compared to all traffic in bytes

Example

```
[admin@MikroTik] tool sniffer protocol> print
  # PROTOCOL IP-PR... PORT          PACKETS   BYTES   SHARE
  0 ip                              77        4592    100 %
  1 ip       tcp                    74        4328    94.25 %
  2 ip       gre                    3         264     5.74 %
  3 ip       tcp      22 (ssh)      49        3220    70.12 %
  4 ip       tcp      23 (telnet)   25        1108    24.12 %

[admin@MikroTik] tool sniffer protocol>
```

Packet Sniffer Host

Home menu level: ***/tool sniffer host***

Description

The submenu shows the list of hosts that were participating in data excange you've sniffed.

Property Description

address (*read-only: IP address*) - IP address of the host

peek-rate (*read-only: integer/integer*) - the maximum data-rate received/transmitted

rate (*read-only: integer/integer*) - current data-rate received/transmitted

total (*read-only: integer/integer*) - total packets received/transmitted

Example

In the following example we'll see the list of hosts:

```
[admin@MikroTik] tool sniffer host> print
  # ADDRESS        RATE          PEEK-RATE           TOTAL
  0 10.0.0.4       0bps/0bps     704bps/0bps         264/0
  1 10.0.0.144     0bps/0bps     6.24kbps/12.2kbps   1092/2128
  2 10.0.0.181     0bps/0bps     12.2kbps/6.24kbps   2994/1598
  3 10.0.0.241     0bps/0bps     1.31kbps/4.85kbps   242/866

[admin@MikroTik] tool sniffer host>
```

Packet Sniffer Connections

Home menu level: ***/tool sniffer connection***

Description

Here you can get a list of the connections that have been watched during the sniffing time.

Property Description

active (*read-only: yes* | *no*) - if yes the find active connections

bytes (*read-only: integer*) - bytes in the current connection

dst-address (*read-only: IP address*) - destination address

mss (*read-only: integer*) - Maximum Segment Size

resends (*read-only: integer*) - the number of packets resends in the current connection

src-address (*read-only: IP address*) - source address

Example

The example shows how to get the list of connections:

```
[admin@MikroTik] tool sniffer connection> print
Flags: A - active
  #   SRC-ADDRESS       DST-ADDRESS             BYTES     RESENDS   MSS
  0 A 10.0.0.241:1839   10.0.0.181:23 (telnet)  6/42      60/0      0/0
  1 A 10.0.0.144:2265   10.0.0.181:22 (ssh)     504/252   504/0     0/0

[admin@MikroTik] tool sniffer connection>
```

Sniff MAC Address

You can also see the source and destination MAC Addresses. To do so, at first stop the sniffer if it is running, and select a specific interface:

```
[admin@MikroTik] tool sniffer> stop
[admin@MikroTik] tool sniffer> set interface=bridge1
[admin@MikroTik] tool sniffer> start
[admin@MikroTik] tool sniffer> print
            interface: bridge1
         only-headers: no
         memory-limit: 10
            file-name:
           file-limit: 10
    streaming-enabled: no
     streaming-server: 0.0.0.0
        filter-stream: yes
      filter-protocol: ip-only
      filter-address1: 0.0.0.0/0:0-65535
      filter-address2: 0.0.0.0/0:0-65535
              running: yes
[admin@MikroTik] tool sniffer>
```

Now you have the source and destination MAC Addresses:

```
[admin@MikroTik] tool sniffer packet> print detail
 0 time=0 src-mac-address=00:0C:42:03:02:C7 dst-mac-address=00:30:4F:08:3A:E7
   interface=bridge1 src-address=10.5.8.104:1125
   dst-address=10.1.0.172:3987 (winbox-tls) protocol=ip ip-protocol=tcp
   size=146 ip-packet-size=146 ip-header-size=20 tos=0 identification=5088
   fragment-offset=0 ttl=126

 1 time=0 src-mac-address=00:30:4F:08:3A:E7 dst-mac-address=00:0C:42:03:02:C7
   interface=bridge1 src-address=10.1.0.172:3987 (winbox-tls)
   dst-address=10.5.8.104:1125 protocol=ip ip-protocol=tcp size=253
   ip-packet-size=253 ip-header-size=20 tos=0 identification=41744
   fragment-offset=0 ttl=64

 2 time=0.071 src-mac-address=00:0C:42:03:02:C7
   dst-mac-address=00:30:4F:08:3A:E7 interface=bridge1
   src-address=10.5.8.104:1125 dst-address=10.1.0.172:3987 (winbox-tls)
   protocol=ip ip-protocol=tcp size=40 ip-packet-size=40 ip-header-size=20
   tos=0 identification=5089 fragment-offset=0 ttl=126

 3 time=0.071 src-mac-address=00:30:4F:08:3A:E7
   dst-mac-address=00:0C:42:03:02:C7 interface=bridge1
   src-address=10.1.0.172:3987 (winbox-tls) dst-address=10.5.8.104:1125
   protocol=ip ip-protocol=tcp size=213 ip-packet-size=213 ip-header-size=20
   tos=0 identification=41745 fragment-offset=0 ttl=64

-- [Q quit|D dump|down]
```

Traceroute

Document revision 1.2 (Fri Mar 05 09:48:20 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Traceroute determines how packets are being routed to a particular host.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/tool***
Standards and Technologies: ***ICMP***, ***UDP***, ***Traceroute***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***Firewall Filters***
- ***Ping***

Description

Traceroute is a TCP/IP protocol-based utility, which allows user to determine how packets are being routed to a particular host. Traceroute works by increasing the time-to-live value of packets and seeing how far they get until they reach the given destination; thus, a lengthening trail of hosts passed through is built up.

Traceroute shows the number of hops to the given host address of every passed gateway. Traceroute utility sends packets three times to each passed gateway so it shows three timeout values for each gateway in ms.

The Traceroute Command

Command name: ***/tool traceroute***

Property Description

(*IP address*) - IP address of the host you are tracing route to

port (*integer*: 0..65535) - UDP port number

protocol (*UDP* | *ICMP*) - type of protocol to use. If one fails (for example, it is blocked by a firewall), try the other

size (*integer*: 28..1500; default: **64**) - packet size in bytes

timeout (*time*: 1s..8s; default: **1s**) - response waiting timeout, i.e. delay between messages

tos (*integer*: 0..255; default: **0**) - Type Of Service - parameter of IP packet

use-dns (*yes* | *no*; default: **no**) - specifies whether to use DNS server, which can be set in /ip dns menu

src-address (*IP address*) - change the source address of the packet

Notes

Traceroute session may be stopped by pressing [Ctrl]+[C].

Example

To trace the route to 216.239.39.101 host using ICMP protocol with packet size of 64 bytes, setting ToS field to 8 and extending the timeout to 4 seconds:

```
 [admin@MikroTik] tool> traceroute 216.239.39.101 protocol=icmp size=64 tos=8 timeout=4s
      ADDRESS                                       STATUS
    1 159.148.60.227   3ms    3ms     3ms
    2 195.13.173.221  80ms  169ms    14ms
    3 195.13.173.28   6ms    4ms     4ms
    4 195.158.240.21 111ms  110ms   110ms
    5 213.174.71.49 124ms  120ms   129ms
    6 213.174.71.134 139ms  146ms   135ms
    7 213.174.70.245 132ms  131ms   136ms
    8 213.174.70.58 211ms  215ms   215ms
    9 195.158.229.130 225ms  239ms      0s
   10 216.32.223.114 283ms  269ms   281ms
   11 216.32.132.14 267ms  260ms   266ms
   12 209.185.9.102 296ms  296ms   290ms
   13 216.109.66.1 288ms  297ms   294ms
   14 216.109.66.90 297ms  317ms   319ms
   15 216.239.47.66 137ms  136ms   134ms
   16 216.239.47.46 135ms  134ms   134ms
   17 216.239.39.101 134ms  134ms   135ms
 [admin@MikroTik] tool>
```

ICMP Bandwidth Test

Document revision 1.2 (Fri Mar 05 09:36:41 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The ICMP Bandwidth Tester (Ping Speed) can be used to approximately evaluate the throughput to **any** remote computer and thereby help to discover network 'bottlenecks'.

Specifications

Packages required: ***advanced-tools***
License required: ***level1***
Home menu level: ***/tool***
Standards and Technologies: ***ICMP (RFC792)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***
- ***Log Management***

ICMP Bandwidth Test

Description

The ICMP test uses two standard echo-requests per second. The time between these pings can be changed. Ping packet size variation makes it possible to approximately evaluate connection parameters and speed with different packet sizes. Statistics for throughput is calculated using the size of the ICMP packet, the interval between ICMP echo-request and echo-reply and the differences between parameters of the first and the second packet.

Property Description

do (*name*) - assigned name of the script to start

first-ping-size (*integer*: 32..64000; default: **32**) - first ICMP packet size

second-ping-size (*integer*: 32..64000; default: **1500**) - second ICMP packet size

time-between-pings (*integer*) - the time between the first and the second ICMP echo-requests in seconds. A new ICMP-packet pair will never be sent before the previous pair is completely sent and the algorithm itself will never send more than two requests in one second

once - specifies that the ping will be performed only once

interval (*time*: 20ms..5s) - time interval between two ping repetitions

Example

In the following example we will test the bandwidth to a host with IP address **159.148.60.2**. The interval between repetitions will be **1** second.

```
[admin@MikroTik] tool> ping-speed 159.148.60.2 interval=1s
    current: 2.23Mbps
    average: 2.61Mbps

[admin@MikroTik] tool>
```

System Resource Management

Document revision 2.0 (Fri Mar 05 09:11:42 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

MikroTik RouterOS offers several features for monitoring and managing the system resources.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/system***
Standards and Technologies: ***None***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***NTP (Network Time Protocol)***

System Resource

Home menu level: ***/system resource***

Notes

In **monitor** command priotout the values for cpu usage and free memory are in percentage and kilobytes, respectively.

Example

To view the basic system resource status:

```
[admin@MikroTik] > system resource print
                   uptime: 1d3h2m39s
              free-memory: 26420 kB
             total-memory: 62700 kB
                      cpu: "Celeron"
            cpu-frequency: 626 MHz
                 cpu-load: 0
           free-hdd-space: 148524 kB
          total-hdd-space: 3123332 kB
  write-sect-since-reboot: 645208
         write-sect-total: 645208
[admin@MikroTik] >
```

To view the current system CPU usage and free memory:

```
[admin@MikroTik] > system resource monitor
      cpu-used: 0
   free-memory: 115676

[admin@MikroTik] >
```

IRQ Usage Monitor

Command name: ***/system resource irq print***

Description

IRQ usage shows which IRQ (Interrupt requests) are currently used by hardware.

Example

```
[admin@MikroTik] > system resource irq print
Flags: U - unused
   IRQ OWNER
   1   keyboard
   2   APIC
 U 3
   4   serial port
   5   [Ricoh Co Ltd RL5c476 II (#2)]
 U 6
 U 7
 U 8
 U 9
 U 10
   11  ether1
   12  [Ricoh Co Ltd RL5c476 II]
 U 13
   14  IDE 1
[admin@MikroTik] >
```

IO Port Usage Monitor

Command name: ***/system resource io print***

Description

IO usage shows which IO (Input/Output) ports are currently used by hardware.

Example

```
[admin@MikroTik] > system resource io print
 PORT-RANGE        OWNER
 0x20-0x3F         APIC
 0x40-0x5F         timer
 0x60-0x6F         keyboard
 0x80-0x8F         DMA
 0xA0-0xBF         APIC
 0xC0-0xDF         DMA
 0xF0-0xFF         FPU
 0x1F0-0x1F7       IDE 1
 0x2F8-0x2FF       serial port
 0x3C0-0x3DF       VGA
 0x3F6-0x3F6       IDE 1
 0x3F8-0x3FF       serial port
 0xCF8-0xCFF       [PCI conf1]
 0x4000-0x40FF     [PCI CardBus #03]
 0x4400-0x44FF     [PCI CardBus #03]
 0x4800-0x48FF     [PCI CardBus #04]
 0x4C00-0x4CFF     [PCI CardBus #04]
 0x5000-0x500F     [Intel Corp. 82801BA/BAM SMBus]
 0xC000-0xC0FF     [Realtek Semiconductor Co., Ltd. RTL-8139/8139C/8139C+]
 0xC000-0xC0FF     [8139too]
 0xC400-0xC407     [Cologne Chip Designs GmbH ISDN network controller [HFC-PCI]
```

```
  0xC800-0xC87F     [Cyclades Corporation PC300/TE (1 port)]
  0xF000-0xF00F     [Intel Corp. 82801BA IDE U100]

 [admin@MikroTik] >
```

USB Port Information

Command name: ***/system resource usb print***

Description

Shows all USB ports available for the router.

Property Description

device (*read-only: text*) - number of device

vendor (*read-only: text*) - vendor name of the USB device

name (*read-only: text*) - name of the USB port

speed (*read-only: integer*) - bandwidth speed at which the port works

Example

To list all available USB ports:

```
 [admin@MikroTik] system resource usb> print
  # DEVICE VENDOR                  NAME                   SPEED
  0 1:1                            USB OHCI Root Hub      12 Mbps
 [admin@MikroTik] system resource usb>
```

PCI Information

Command name: ***/system resource pci print***

Property Description

device (*read-only: text*) - number of device

vendor (*read-only: text*) - vendor name of the USB device

name (*read-only: text*) - name of the USB port

irq (*read-only: integer*) - IRQ number which this device uses

Example

To see PCI slot details:

```
 [admin@MikroTik] system resource pci> print
  # DEVICE   VENDOR                        NAME                        IRQ
  0 00:13.0  Compaq                        ZFMicro Chipset USB (rev... 12
  1 00:12.5  National Semi                 SC1100 XBus (rev: 0)
  2 00:12.4  National Semi                 SC1100 Video (rev: 1)
  3 00:12.3  National Semi                 SCx200 Audio (rev: 0)
  4 00:12.2  National Semi                 SCx200 IDE (rev: 1)
  5 00:12.1  National Semi                 SC1100 SMI (rev: 0)
  6 00:12.0  National Semi                 SC1100 Bridge (rev: 0)
  7 00:0e.0  Atheros Communications       AR5212 (rev: 1)             10
  8 00:0d.1  Texas Instruments            PCI1250 PC card Cardbus ... 11
  9 00:0d.0  Texas Instruments            PCI1250 PC card Cardbus ... 11
 10 00:0c.0  National Semi                DP83815 (MacPhyter) Ethe... 10
 11 00:0b.0  National Semi                DP83815 (MacPhyter) Ethe... 9
 12 00:00.0  Cyrix Corporation            PCI Master (rev: 0)
 [admin@MikroTik] system resource pci>
```

Reboot

Command name: ***/system reboot***

Description

The system reboot is required when upgrading or installing new software packages. The packages are installed during the system shutdown.

The reboot process sends termination signal to all running processes, unmounts the file systems, and reboots the router.

Notes

Only users, which are members of groups with reboot privileges are permitted to reboot the router.

Reboot can be called from scripts, in which case it does not prompt for confirmation.

Example

```
[admin@MikroTik] > system reboot
Reboot, yes? [y/N]: y
system will reboot shortly
[admin@MikroTik] >
```

Shutdown

Command name: ***/system shutdown***

Description

Before turning the power off for the router, the system should be brought to halt. The shutdown process sends termination signal to all running processes, unmounts the file systems, and halts the router.

For most systems, it is necessary to wait approximately 30 seconds for a safe power down.

Notes

Only users, which are members of groups with reboot privileges are permitted to shutdown the router.

Shutdown can be called from scripts, in which case it does not prompt for confirmation.

Example

```
[admin@MikroTik] > system shutdown
Shutdown, yes? [y/N]: y
system will shutdown promptly
[admin@MikroTik] >
```

Router Identity

Home menu level: ***/system identity***

Description

The router identity is displayed before the command prompt. It is also used for DHCP client as 'host name' parameter when reporting it to the DHCP server.

Example

To view the router identity:

```
[admin@MikroTik] > system identity print
    name: "MikroTik"
[admin@MikroTik] >
```

To set the router identity:

```
[admin@MikroTik] > system identity set name=Gateway
[admin@Gateway] >
```

Date and Time

Home menu level: ***/system clock***

Property Description

time (*time*) - date and time in format "mm/DD/YYY HH:MM:SS"

time-zone (*text*) - UTC timezone in format "+HH:MM" or "-HH:MM"

Notes

It is recommended that you reboot the router after time change to obviate the possible errors in time measurments and logging.

Date and time settings become permanent and effect BIOS settings.

Example

To view the current date and time settings:

```
[admin@Gateway] system clock> print
         time: dec/24/2003 15:53:05
    time-zone: +02:00
[admin@Gateway] system clock>
```

To set the system date and time:

```
[admin@Gateway] system clock> set date=dec/31/2022 time=12:11:32 time-zone=+0
```

```
[admin@Gateway] system clock> print
         time: dec/31/2022 12:11:33
    time-zone: +00:00
[admin@Gateway] system clock>
```

Configuration Change History

Home menu level: Command name: ***/system history, /undo, /redo***

Description

The history of system configuration changes is held until the next router shutdown. The invoked commands can be 'undone' (in reverse order they have been invoked). The 'undone' commands may be 'redone' (in reverse order they have been 'undone').

Command Description

/undo - undoes previous configuration changing command (except another '/undo' command)

/redo - undoes previous '/undo' command

/system history print - print a list of last configuration changes, specifying whether the action can be undone or redone

Notes

Floating-undo actions are created within the current SAFE mode session. They are automatically converted to undoable and redoable when SAFE mode terminated successfully, and are all undone irreverively when SAFE mode terminated insuccessfully.

Undo command cannot undo commands past start of the SAFE mode.

Example

To show the list of configuration changes:

```
[admin@MikroTik] system history> print
Flags: U - undoable, R - redoable, F - floating-undo
   ACTION                                   BY                 POLICY
 U system time zone changed                 admin              write
 U system time zone changed                 admin              write
 U system time zone changed                 admin              write
 U system identity changed                  admin              write
[admin@MikroTik] system clock>
```

What the **/undo** command does:

```
[admin@MikroTik] system history> print
Flags: U - undoable, R - redoable, F - floating-undo
   ACTION                                   BY                 POLICY
 R system time zone changed                 admin              write
 U system time zone changed                 admin              write
 U system time zone changed                 admin              write
 U system identity changed                  admin              write
[admin@MikroTik] system clock>
```

LCD Management

Document revision 2.1 (Tue Apr 06 17:26:47 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

LCDs are used to display system information.

The MikroTik RouterOS supports the following LCD hardware:

- Crystalfontz (***http://www.crystalfontz.com***) Intelligent Serial LCD Module 632 (16x2 characters)
- Powertip (***http://www.powertip.com.tw***) PC2404 (24x4 characters)

Specifications

Packages required: ***lcd***
License required: ***level1***
Home menu level: ***/system lcd***
Standards and Technologies: ***None***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

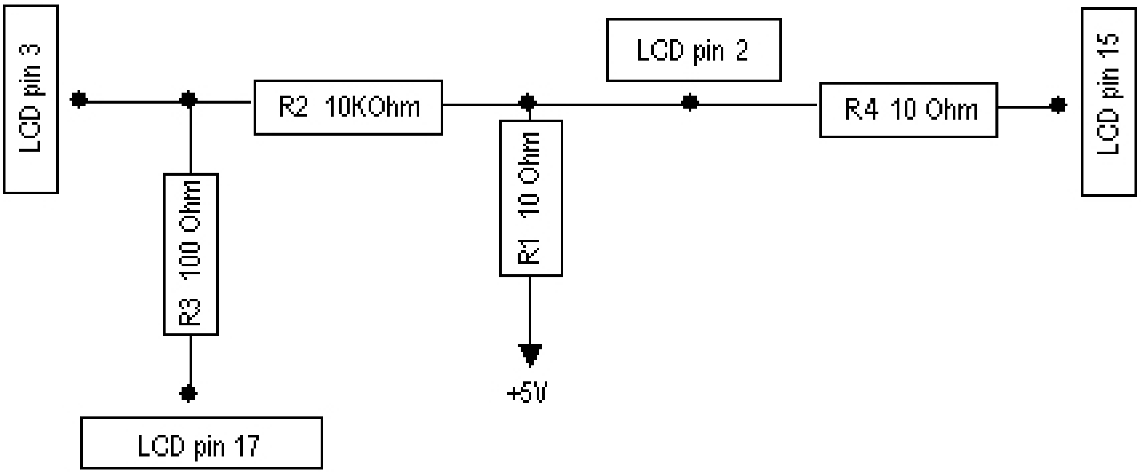
Description

How to Connect PowerTip LCD to a Parallel Port

Data signals are connected that way:

DB25m	Signal	LCD Panel
1	Enable (Strobe)	6
2	Data 0	7
3	Data 1	8
4	Data 2	9
5	Data 3	10
6	Data 4	11
7	Data 5	12
8	Data 6	13
9	Data 7	14
14	Register Select	4
18-25, GND	Ground	1, 5, 16

Powering:



As there are only 16 pins for the PC1602 modules, you need not connect power to the 17th pin.

GND and +5V can be taken from computer's internal power supply (use black wire for GND and red wire for +5V)

WARNING! Be very careful connecting power supply. We do not recommend using external power supplies. In no event shall MikroTik liable for any hardware damages.

Note that there are some PowerTip PC2404A modules that have different pin-out. Compare:

- ***From www.powertip.com.tw (probably newer one)***
- ***From www.actron.de (probably older one)***

Some LCDs may be connected without resistors:

DB25m	Signal	LCD Panel
18-25, GND	Ground	1, 3, 4, 16
+5V	Power	2, 15

Crystalfontz LCD Installation Notes

Before connecting the LCD, please check the availability of ports, their configuration, and free the desired port resource, if required:

```
[admin@MikroTik] port> print
  # NAME                        USED-BY                        BAUD-RATE
  0 serial0                        Serial Console                 9600
  1 serial1                                                           9600
[admin@MikroTik] port>
```

Configuring the LCD's Settings

Home menu level: ***/system lcd***

Property Description

enabled (*yes* | *no*; default: **no**) - turns the LCD on or off

type (*powertip* | *crystalfontz*; default: **powertip**) - sets the type of the LCD

serial-port (*name*) - name of the port where the LCD is connected (not shown when type type=powertip)

Example

Printout:

```
[admin@MikroTik] system lcd> print
    enabled: no
       type: powertip
[admin@MikroTik] system lcd>
```

To enable Powertip parallel port LCD:

```
[admin@MikroTik] system lcd> print
        enabled: no
           type: powertip
[admin@MikroTik] system lcd> set enabled=yes
[admin@MikroTik] system lcd> print
        enabled: yes
           type: powertip
[admin@MikroTik] system lcd>
```

To enable Crystalfontz serial LCD on **serial1**:

```
[admin@MikroTik] system lcd> set type=crystalfontz
ERROR: can't acquire requested port - already used
[admin@MikroTik] system lcd> set type=crystalfontz serial-port=serial1
[admin@MikroTik] system lcd> /port print
  # NAME                        USED-BY                        BAUD-RATE
  0 serial0                        Serial Console                 9600
  1 serial1                        LCD Panel                         9600
```

```
[admin@MikroTik] system lcd> print
        enabled: yes
           type: crystalfontz
    serial-port: serial1
[admin@MikroTik] system lcd>
```

As You see, the first try to set LCD **type** failed because it wanted to use **serial0** (that is commonly used for **Serial Console**) by default.

LCD Information Display Configuration

Home menu level: ***/system lcd page***

Description

The submenu is used for configuring LCD information display: what pages and how long will be shown.

Property Description

display-time (*time*; default: **5s**) - how long to display the page

description (*text*) - page description

Notes

You cannot neither add your own pages (they are created dynamically depending on the configuration) nor change pages' description.

Example

To enable displaying all the pages:

```
[admin@MikroTik] system lcd page> print
Flags: X - disabled
  #   DISPLAY-TIME    DESCRIPTION
  0 X 5s            System date and time
  1 X 5s            System resources - cpu and memory load
  2 X 5s            System uptime
  3 X 5s            Aggregate traffic in packets/sec
  4 X 5s            Aggregate traffic in bits/sec
  5 X 5s            Software version and build info
  6 X 5s            ether1
  7 X 5s            prism1
[admin@MikroTik] system lcd page> enable [find]
[admin@MikroTik] system lcd page> print
Flags: X - disabled
  #   DISPLAY-TIME    DESCRIPTION
  0   5s            System date and time
  1   5s            System resources - cpu and memory load
  2   5s            System uptime
  3   5s            Aggregate traffic in packets/sec
  4   5s            Aggregate traffic in bits/sec
  5   5s            Software version and build info
  6   5s            ether1
  7   5s            prism1
[admin@MikroTik] system lcd page>
```

To set "System date and time" page to be displayed for 10 seconds:

```
[admin@MikroTik] system lcd page> set 0 display-time=10s
[admin@MikroTik] system lcd page> print
Flags: X - disabled
  #   DISPLAY-TIME    DESCRIPTION
  0   10s            System date and time
  1   5s            System resources - cpu and memory load
  2   5s            System uptime
  3   5s            Aggregate traffic in packets/sec
  4   5s            Aggregate traffic in bits/sec
  5   5s            Software version and build info
  6   5s            ether1
  7   5s            prism1
[admin@MikroTik] system lcd page>
```

LCD Troubleshooting

Description

LCD doesn't work, cannot be enabled by the '/system lcd set enabled=yes' command.

Probably the selected serial port is used by PPP client or server, or by the serial console. Check the availability and use of the ports by examining the output of the **/port print** command. Alternatively, select another port for connecting the LCD, or free up the desired port by disabling the related resource

LCD doesn't work, does not show any information.

Probably none of the information display items have been enabled. Use the */system lcd page set* command to enable the display.

Support Output File

Document revision 2.1.0 (Wed Mar 03 16:11:16 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The support file is used for debugging MikroTik RouterOS and to solve the support questions faster. All MikroTik Router information is saved in a binary file, which is stored on the router and can be downloaded from the router using ftp.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/system***
Hardware usage: ***Not significant***

Generating Support Output File

Command name: ***/system sup-output***

Example

To make a Support Output File:

```
[admin@MikroTik] > system sup-output
creating supout.rif file, might take a while
...................
Done!
[admin@MikroTik] >
```

To see the files stored on the router:

```
[admin@MikroTik] > file print
 # NAME                            TYPE         SIZE       CREATION-TIME
 0 supout.rif                      unknown      108787     dec/24/2003 10:12:38
[admin@MikroTik] >
```

Connect to the router using FTP and download the supout.rif file using BINARY file transfer mode. Send the supout.rif file to MikroTik Support ***support@mikrotik.com*** with detailed description of the problem.

SSH (Secure Shell) Server and Client

Document revision 2.0 (Fri Mar 05 09:09:40 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

SSH Client authenticates server and encrypts traffic between the client and server. You can use SSH just the same way as telnet - you run the client, tell it where you want to connect to, give your username and password, and everything is the same after that. After that you won't be able to tell that you're using SSH. The SSH feature can be used with various SSH Telnet clients to securely connect to and administrate the router.

The MikroTik RouterOS supports:

- SSH 1.3, 1.5, and 2.0 protocol standards
- server functions for secure administration of the router
- telnet session termination with 40 bit RSA SSH encryption is supported
- secure ftp is not supported
- Winbox connection encryption (TSL)

The MikroTik RouterOS has been tested with the following SSH telnet terminals:

- PuTTY
- Secure CRT
- Most SSH compatible telnet clients

Specifications

Packages required: ***security***
License required: ***level1***

Home menu level: ***/system ssh***
Standards and Technologies: ***SSH***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

Additional Documents

- ***http://www.zip.com.au/~roca/ttssh.html***
- ***http://www.chiark.greenend.org.uk/~sgtatham/putty.htmll***
- ***http://pgpdist.mit.edu/FiSSH/index.html***
- ***http://akson.sgh.waw.pl/~chopin/ssh/index_en.html***
- ***http://cs.mscd.edu/MSSH/index.html***
- ***http://www.networksimplicity.com/openssh/***
- ***http://www.openssh.com/***
- ***http://www.freessh.org/***

SSH Server

Home menu level: ***/ip service***

Description

SSH Server is already up and running after MikroTik router installation. The default port of the service is 22. You can set a different port number.

Property Description

name (*name*) - service name

port (*integer*: 1..65535) - port the service listens to

address (*IP address/mask*; default: **0.0.0.0/0**) - IP address from which the service is accessible

Example

```
[admin@MikroTik] ip service> set ssh port=65
[admin@MikroTik] ip service> print
Flags: X - disabled, I - invalid
 #   NAME                                  PORT  ADDRESS            CERTIFICATE
 0   telnet                                23    0.0.0.0/0
 1   ftp                                   21    0.0.0.0/0
 2   www                                   80    0.0.0.0/0
 3   hotspot                               8088  0.0.0.0/0
 4   ssh                                   65    0.0.0.0/0
 5 X hotspot-ssl                           443   0.0.0.0/0          none
[admin@MikroTik] ip service>
```

SSH Client

Command name: ***/system ssh***

Example

```
[admin@MikroTik] ip service> /system ssh
address:
[admin@MikroTik] ip service> /
[admin@MikroTik] > system ssh 10.1.0.1 user=admin port=22

  MMM      MMM       KKK                          TTTTTTTTTTT      KKK
  MMMM    MMMM       KKK                          TTTTTTTTTTT      KKK
  MMM MMMM MMM  III  KKK  KKK  RRRRRR     OOOOOO      TTT     III  KKK  KKK
  MMM  MM  MMM  III  KKKKK     RRR  RRR  OOO  OOO     TTT     III  KKKKK
  MMM      MMM  III  KKK KKK   RRRRRR    OOO  OOO     TTT     III  KKK KKK
  MMM      MMM  III  KKK  KKK  RRR  RRR   OOOOOO      TTT     III  KKK  KKK

  MikroTik RouterOS 2.8beta12 (c) 1999-2003       http://www.mikrotik.com/


Terminal ansi detected, using single line input mode
[admin@10.1.0.1] >
```

Configuration Backup and Restore

Document revision 2.0 (Fri Mar 05 08:53:40 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The configuration backup can be used for backing up MikroTik RouterOS configuration to a binary file, which can be stored on the router or downloaded from it using ftp. The configuration restore can be used for restoring the router's configuration from a backup file. For exporting configuration or part of it to a text (script) file and importing it, please refer to the configuration export and import section of the MikroTik RouterOS Manual.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/system backup***
Standards and Technologies: ***None***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***Configuration Export and Import***

Description

The **save** command is used to store the entire router configuration in a backup file. The file is shown in the **/file** submenu. It can be downloaded via ftp to keep it as a backup for your configuration.

To restore the system configuration, for example, after a **/system reset**, it is possible to upload that file via ftp and load that backup file using **load** command in **/system backup** submenu.

General Information

Command name: ***/system backup save***

Example

To save the router configuration to file **test**:

```
[admin@MikroTik] system backup> save name=test
Configuration backup saved
[admin@MikroTik] system backup>
```

To see the files stored on the router:

```
[admin@MikroTik] > file print
  # NAME                           TYPE         SIZE       CREATION-TIME
  0 test.backup                    backup       12567      aug/12/2002 21:07:50
[admin@MikroTik] >
```

Configuration Load Command

Command name: ***/system backup load***

Example

To load the saved backup file **test**:

```
[admin@MikroTik] system backup> load name=test
Restore and reboot? [y/N]: N
```

Serial Console and Terminal

Document revision 2.0 (Wed Mar 03 16:12:49 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The Serial Console and Terminal are tools, used to communicate with devices and other systems that are interconnected via serial port. The serial terminal may be used to monitor and configure many devices - including modems, network devices (including MikroTik routers), and any device that can be connected to a serial (asynchronous) port.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/system***
Standards and Technologies: ***RS-232***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

Additional Documents

- ***http://www.camiresearch.com/Data_Com_Basics/RS232_standard.html***

- *http://www.ctsystems.org/rs.htm*

Description

The Serial Console (managed side) feature allows configuring one serial port of the MikroTik router for access to the router's Terminal Console over the serial port. A special null-modem cable is required to connect the router's serial port with the workstation's or laptop's serial (COM) port. A terminal emulation program, e.g., HyperTerminal, should be run on the workstation. You can also use MikroTik RouterOS to connect to an another Serial Console (for example, on a Cisco router).

Several customers have described situations where the Serial Terminal (managing side) feature would be useful:

- in a mountaintop where a MikroTik wireless installation sits next to equipment (including switches and Cisco routers) that can not be managed in-band (by telnet through an IP network)
- monitoring weather-reporting equipment through a serial-console
- connection to a high-speed microwave modem that needed to be monitored and managed by a serial-console connection

With the serial-terminal feature of the MikroTik, up to 132 (and, maybe, even more) devices can be monitored and controlled

Serial Console Configuration

Description

A special null-modem cable should be used for connecting to the serial console. The Serial Console cabling diagram for DB9 connectors is as follows:

Router Side (DB9f)	Signal	Direction	Side (DB9f)
1, 6	CD, DSR	IN	4
2	RxD	IN	3
3	TxD	OUT	2
4	DTR	OUT	1, 6
5	GND	-	5
7	RTS	OUT	8
8	CTS	IN	7

Setting Serial Console

Home menu level: ***/system serial-console***

Property Description

enabled (*yes* | *no*; default: **no**) - whether serial console is enabled or not

port (*name*; default: **serial0**) - which port should the serial terminal listen to

Example

To enable Serial Console:

```
[admin@MikroTik] system serial-console> set enabled=yes
[admin@MikroTik] system serial-console> print
    enabled: yes
       port: serial0
[admin@MikroTik] system serial-console>
```

To check if the port is available or used:

```
[admin@MikroTik] system serial-console> /port print detail
  0 name=serial0 used-by=Serial Console baud-rate=9600 data-bits=8 parity=none
    stop-bits=1 flow-control=none

  1 name=serial1 used-by="" baud-rate=9600 data-bits=8 parity=none stop-bits=1
    flow-control=none

[admin@MikroTik] system serial-console>
```

Using Serial Terminal

Command name: ***/system serial-terminal***

Description

The command is used to communicate with devices and other systems that are connected to router via serial port.

All keyboard input is forwarded to the serial port and all data from the port is output to the connected device. After exiting with [Ctrl]+[Q], the control signals of the port are lowered. The speed and other parameters of serial port may be configured in the **/port** directory of router console. No terminal translation on printed data is performed. It is possible to get the terminal in an unusable state by outputting sequences of inappropriate control characters or random data. Do not connect to devices at an incorrect speed and avoid dumping binary data.

Property Description

port (*name*) - port name to use

Notes

[Ctrl]+[Q] and [Ctrl]+[X] have special meaning and are used to provide a possibility of exitting from nested serial-terminal sessions:

To send [Ctrl]+[X] to to serial port, press [Ctrl]+[X] [Ctrl]+[X]

To send [Ctrl]+[Q] to to serial port, press [Ctrl]+[X] [Ctrl]+[Q]

Example

To connect to a device connected to the **serial1** port:

```
[admin@MikroTik] system> serial-terminal serial1

[Type Ctrl-Q to return to console]
[Ctrl-X is the prefix key]
```

GPS Synchronization

Document revision 2.0 (Fri Mar 05 08:56:37 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Global Positioning System (GPS) receiver can be used by MikroTik RouterOS to get the precise location and time (which may be used as NTP time source)

Specifications

Packages required: ***gps***
License required: ***level1***
Home menu level: ***/system gps***
Standards and Technologies: ***GPS, NMEA 0183, Simple Text Output Protocol***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***NTP (Network Time Protocol)***

Description

Global Positioning System (GPS) is used for determining precise location of a GPS receiver. There are two types of GPS service:

- Precise Positioning Service (PPS) that is used only by U. S. and Allied military, certain U. S. Government agencies, and selected civil users specifically approved by the U. S. Government. Its accuracy is 22m horizontally, 27.7m vertically and 200ns of time
- Standard Positioning Service (SPS) can be used by civil users worldwide without charge or restrictions except that SPS accuracy is intentionally degradated to 100m horizontally, 156m vertically and 340ns of time

GPS system is based on 24 satellites rotating on 6 different orbital planes with 12h orbital period. It makes that at least 5, but usually 6 or more satellites are visible at any time anywhere on the Earth. GPS receiver calculates more or less precise position (latitude, longitude and altitude) and time based on signals received from 4 satellites (three are used to determine position and fourth is used to correct time), which are broadcasting their current positions and UTC time.

MikroTik RouterOS can communicate with many GPS receivers which are able to send the positioning and time via asynchronous serial line using NMEA 0183, NMEA/RTCM or Simple Text Output Protocol.

Precise time is mainly intended to be used by built-in NTP server, which can use it as a time source without any additional configuration if GPS is configured to set system time.

Additional Documents

- ***Global Positioning System - How it Works***

Synchronizing with a GPS Receiver

Home menu level: ***/system gps***

Property Description

enabled (*yes* | *no*) - whether the router will communicate with a GPS receiver or not

port (*name*) - the port that will be used to communicate with a GPS receiver

set-system-time (*time*) - whether to set the system time to the value received from a GPS receiver or not

Notes

If you are synchronizing system time with a GPS device, you should correctly choose time zone if it is different from GMT as satellites are broadcasting GMT (a.k.a. UTC) time.

Example

To enable GPS communication through serial0 port:

```
[admin@MikroTik] system gps> print
            enabled: no
               port: (unknown)
    set-system-time: yes
[admin@MikroTik] system gps> set enabled=yes port=serial0
[admin@MikroTik] system gps> print
            enabled: yes
               port: serial0
    set-system-time: yes
[admin@MikroTik] system gps>
```

GPS Monitoring

Home menu level: ***/system gps monitor***

Description

This command is used for monitoring the data received from a GPS receiver.

Property Description

date-and-time (*read-only: text*) - date and time received from GPS server

longitude (*read-only: text*) - longitude of the current location

latitude (*read-only: text*) - latitude of the current location

altitude (*read-only: text*) - altitude of the current location

speed (*read-only: text*) - mean velocity

valid (*read-only: yes* | *no*) - whether the received information is valid or not (e.g. you can set a GPS receiver to the demo mode to test the connection, in which case you will receive information, but it will not be valid)

Example

```
[admin@MikroTik] system gps> monitor
    date-and-time: jul/23/2003 12:25:00
        longitude: "E 24 8' 17''"
         latitude: "N 56 59' 22''"
         altitude: "-127.406400m"
            speed: "0.001600 km/h"
            valid: yes

[admin@MikroTik] system gps>
```

Scripting Host and Complementary Tools

Document revision 2.6 (Wed Nov 24 12:48:55 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

This manual describes the usage of internal console expressions as well as techniques to combine them in scripts.

Scripting host provides a way to automate some router maintenance tasks by means of executing user-defined scripts if some event occurs. The script consists of configuration commands and console expressions. The configuration commands are described in the relevant documentation.

The events can be used to invoke a script include the System Scheduler, the Traffic Monitoring Tool, and for the Netwatch Tool generated events.

Specifications

Packages required: ***system***

License required: ***level1***
Home menu level: ***/system script***
Standards and Technologies: ***None***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

Console Command Syntax

Description

Console commands are made of following parts:

- **prefix** - optional parts which indicates whether that the command is an ICE, like **:put** or that the **path** starts from the root menu level, like **/ping 10.0.0.1**
- **path** - a relative path to the desired menu level
- **path_args** - this part is required to select some menu levels, where the actual path can vary across different user inputs, like **/ip firewall rule <name>**
- **action** - one of the *actions* available at the specified menu level
- **action_args** - these are required by some actions and should come in fixed order after the action name, like in **/ping <ip address>**
- **params[=values]** - a sequence of parameter names followed respective values, if required

Notes

Variable substitution, command substitution and expressions are allowed only for **path_args** and **action_args** values. **prefix**, **path**, **action** and **params** can only be given directly, as a word. So, `:put (1 + 2)` is valid and `":pu" . "t") 3` is not.

Example

The internal console commands' parts are futher explained in the following examples:

```
/ping 10.0.0.1 count=5
```

prefix	**/**
action	**ping**
action_args	**10.0.0.1**
params[=values]	**count=5**

```
.. ip firewall rule input
```

path	**.. ip firewall rule**

path_args	**input**

```
:for i from=1 to=10 do={:put $i}
```

prefix	**:**
action	**for**
action_args	**i**
params[=values]	**from=1 to=10 do={:put $i}**

```
/interface monitor-traffic ether1,ether2,ipip1
```

prefix	**/**
path	**interface**
action	**monitor-traffic**
action_args	**ether1,ether2,ipip1**

Expression Grouping

Description

This feature provides the easy way to execute commands from within one command level, by enclosing them in braces '{ }' or square brackets '[ ]'. Square brackets can be used only in a single line and give the ability for command auto-completion, by pressing the [Tab] key twice.

Notes

You should not change current command level in scripts by typing just it's path, without any command, like you when working with console interactively. Such changes have no effect in scripts. Consider the following:

```
admin@MikroTik] ip address> /user {
{... /ip route
{... print
{... }
Flags: X - disabled
  0   ;;; system default user
      name="admin" group=full address=0.0.0.0/0

  1   name="x" group=write address=0.0.0.0/0

  2   name="y" group=read address=0.0.0.0/0


[admin@MikroTik] ip route>
```

Although the current command level is changed to **/ip route**, it has effect only on next command entered from prompt, **print** command is still considered to be **/user print**.

Example

We will add two users to the **user** menu in the example below:

```
[admin@MikroTik] ip address> /user {
{... add name=x password=y group=write
{... add name=y password=z group=read
{... print
{... }
Flags: X - disabled
  0   ;;; system default user
      name="admin" group=full address=0.0.0.0/0

  1   name="x" group=write address=0.0.0.0/0

  2   name="y" group=read address=0.0.0.0/0


[admin@MikroTik] ip address>
```

Variables

Description

Console allows you to create and use global (system wide) and local (only usable within the current script) variables. Variables can be accessed by writing '$' followed by a name of variable. Variable names can contain letters, digits and '-' character. A variable must be declared prior to using it in scripts. There are three types of declaration available:

- **global** - defined by action global, global variables can be accessed by all scripts and console logins on the same router. Variables are not kept across reboots.
- **local** - defined by action local, local variables are not shared with any other script, other instance of the same script or other console logins. Its value is lost when script finishes.
- **loop index variables** - defined within for and foreach statements, these variables are used only in do block of commands and are removed after command completes.
- **monitor action** - some monitor commands that have do part can also introduce variables.

You can assign a new value to a variable using **set** action. It has two arguments: the name of the variable and the new value of the variable. After variable is no longer needed, it's name can be freed by :unset command. If you free local variable, it's value is lost. If you free global variable, it's value is still kept in router, it just becomes inaccessible from current script.

Notes

Loop variables "shadows" already introduced local variables with the same name.

Example

```
[admin@MikroTik] ip route> /
[admin@MikroTik] > :global g1
[admin@MikroTik] > :set g1 "this is global variable"
[admin@MikroTik] > :put $g1
this is global variable
[admin@MikroTik] >
```

Command Substitution and Return Values

Description

Some console commands are most useful if their output can be used as an argument value in other commands. In console, this is done by "returning" value from commands. Return value is not displayed on the screen. When you type such a command between square brackets '[' ']', this command is executed and it's return value is used as the value of these brackets. This is called command substitution.

The commands that return usefull values are, but not limited to: **find**, **/ping** - returns the number of sucessful pings, **time** - returns the measured time value, **incr** and **decr** return the new value of a variable, **add** - return the internal number of newly created item.

Example

Consider the usage of **find** command:

```
[admin@MikroTik] > /interface
[admin@MikroTik] interface> find type=ether
[admin@MikroTik] interface>
[admin@MikroTik] interface> :put [find type=ether]
*1,*2
[admin@MikroTik] interface>
```

This way you can see console internal numbers of items. Naturally, you can use them in other commands:

```
[admin@MikroTik] interface> enable [find type=ether]
[admin@MikroTik] interface>
```

Operators

Description

Console can do simple calculations with numbers, time values, ip addresses, strings and lists. It is achieved by writing expressions and putting them in parentheses '(' and ')'. The result of the expression serves as a return value for the parentheses.

Command Description

- - unary minus. Inverts given number value.

- - binary minus. Substracts two numbers, two time values, two IP addresses or an IP address and a number

! - logical NOT. Unary operator, which inverts given boolean value

/ - division. Binary operator. Divides one number by another (gives number) or a time value by a number (gives time value).

. - concatenation. Binary operator, concatenates two string or append one list to another or appends an element to a list.

^ - bitwise XOR. The argumens and the result are both IP addresses

~ - bit inversion. Unary operator, which inverts bits in IP address

* - multiplication. Binary operator, which can multiply two numbers or a time value by a number.

& - bitwise AND The argumens and the result are both IP addresses

&& - logical AND. Binary operator. The argumens and the result are both logical values

+ - binary plus. Adds two numbers, two time values or a number and an IP address.

< - less. Binary operator which compares two numbers, two time values or two IP addresses. Returns boolean value

<< - left shift. Binary operator, which shifts IP address by a given amount of bits. The first argument is an IP address, the second is an integer and the result is an IP address.

<= - less or equal. Binary operator which compares two numbers, two time values or two IP addresses. Returns boolean value

> - greater. Binary operator which compares two numbers, two time values or two IP addresses. Returns boolean value

>= - greater or equal. Binary operator which compares two numbers, two time values or two IP addresses. Returns boolean value

>> - right shift. Binary operator, which shifts IP address by a given amount of bits. The first argument is an IP address, the second is an integer and the result is an IP address.

| - bitwise OR. The argumens and the result are both IP addresses

|| - logical OR. Binary operator. The argumens and the result are both logical values

Notes

When comparing two arrays note, that two arrays are equal if their respective elements are equal.

Example

Operator priority and evaluation order

```
[admin@MikroTik] ip firewall rule forward> :put (10+1-6*2=11-12=2+(-3)=-1)
false
[admin@MikroTik] ip firewall rule forward> :put (10+1-6*2=11-12=(2+(-3)=-1))
true
[admin@MikroTik] ip firewall rule forward
```

logical NOT

```
[admin@MikroTik] interface> :put (!true)
false
[admin@MikroTik] interface> :put (!(2>3))
true
[admin@MikroTik] interface>
```

unary minus

```
[admin@MikroTik] interface> :put (-1<0)
true
[admin@MikroTik] > :put (--1)
1
```

bit inversion

```
[admin@MikroTik] interface> :put (~255.255.0.0)
0.0.255.255
[admin@MikroTik] interface>
```

sum

```
[admin@MikroTik] interface> :put (3s + 5s)
8s
[admin@MikroTik] interface> :put (10.0.0.15 + 0.0.10.0)
ERROR: cannot add ip address to ip address
[admin@MikroTik] interface> :put (10.0.0.15 + 10)
10.0.0.25
[admin@MikroTik] interface>
```

subtraction

```
[admin@MikroTik] interface> :put (15 - 10)
5
[admin@MikroTik] interface> :put (10.0.0.15 - 10.0.0.3)
12
[admin@MikroTik] interface> :put (10.0.0.15 - 12)
10.0.0.3
[admin@MikroTik] interface> :put (15h - 2s)
14h59m58s
[admin@MikroTik] interface>
```

multiplication

```
[admin@MikroTik] interface> :put (12s * 4)
48s
[admin@MikroTik] interface> :put (-5 * -2)
10
[admin@MikroTik] interface>
```

division

```
[admin@MikroTik] interface> :put (10s / 3)
3s333.333ms
[admin@MikroTik] interface> :put (5 / 2)
2
[admin@MikroTik] interface>
```

comparison

```
[admin@MikroTik] interface> :put (10.0.2.3<=2.0.3.10)
false
[admin@MikroTik] interface> :put (100000s>27h)
true
[admin@MikroTik] interface> :put (60s,1d!=1m,3600s)
false
[admin@MikroTik] interface> :put (bridge=routing)
false
[admin@MikroTik] interface> :put (yes=false)
false
[admin@MikroTik] interface> :put (true=aye)
ERROR: cannot compare if truth value is equal to string
[admin@MikroTik] interface>
```

logical AND, logical OR

```
[admin@MikroTik] interface> :put ((yes && yes) || (yes && no))
true
[admin@MikroTik] interface> :put ((no || no) && (no || yes))
false
[admin@MikroTik] interface>
```

bitwise AND, bitwise OR, bitwise XOR

```
[admin@MikroTik] interface> :put (10.16.0.134 & ~255.255.255.0)
0.0.0.134
[admin@MikroTik] interface>
```

shift operators

```
[admin@MikroTik] interface> :put (~((0.0.0.1 << 7) - 1))
255.255.255.128
[admin@MikroTik] interface>
```

Concatenation

```
[admin@MikroTik] interface> :put (1 . 3)
13
[admin@MikroTik] interface> :put (1,2 . 3)
1,2,3
[admin@MikroTik] interface> :put (1 . 3,4)
13,4
[admin@MikroTik] interface> :put (1,2 . 3,4)
1,2,3,4
[admin@MikroTik] interface> :put ((1 . 3) + 1)
ERROR: cannot add string to integer number
[admin@MikroTik] interface>
```

Data types

Description

The console can work with several data types. Currently it distinguishes between strings, boolean values, numbers, time intervals, IP addresses, internal numbers and lists. Currently console tries to convert any value to the most specific type first, backing up if it fails. This is the order in which console attempts to convert a value:

- list
- internal number
- number
- IP address
- time
- boolean
- string

There is no way to explicitly control this type conversion.

In console integers are internally represented as 64 bit signed numbers, so the range of variable values can be from -9223372036854775808 to 9223372036854775807. It is possible to input them as hexadecimal numbers, by prefixing with **0x**.

Lists are written as comma separated sequence of values. Putting whitespaces around commas is not recommended, because it might confuse console about word boundaries.

Boolean values are written as either **true** or **false**. Console also accepts **yes** for **true**, and **no** for **false**.

Internal numbers begin with *****.

Time intervals are written as sequence of numbers, that can be followed by letters specifying the units of time measure. The default is a second. Numbers may have decimal point. It is also possible to use the HH:MM:SS notation. Accepted time units:

- **d, day, days** - one day, id est 24 hours

- **h, hour, hours** - one hour
- **m, min** - one minute
- **s** - one second
- **ms** - one millisecond, id est 0.001 second

Internal Console Expressions (ICE)

Description

Within this document, ICE refers to console's built-in commands and expressions those do not depend on the current menu level.

These commands do not change configuration directly, but they are useful for automating various maintenance tasks. The full ICE list can be accessed by typing '?' after the ':' prefix.

Command Description

beep - this action forces the built-in beeper to beep a signal for length seconds at frequency Hz.

```
[admin@MikroTik]          >          :beep          length=2s          frequency=10000

[admin@MikroTik] >
```

delay - this action does nothing for a given amount of time. It takes one argument, an amount of time to wait, which defaults to one second.

do - this action takes one argument, which holds the console commands that must be executed. It is similar to the do statement of other commands. It has also two parameters, while and if. If no parameters are given, do just executes its payload once, which does not make much use. However if you specify a condition as a value for the while argument, it will be evaluated after executing commands, and if it will return true, do statement is executed again and again until false. If you specify a condition for the if argument, it is evaluated only once before doing anything else, and if it is false, nothing is done.

```
[admin@MikroTik]   >   {:global   i;   :set   i   10;   :do{:put   $i;   :decr   i;}   \
\...     while     (($i     <     10)     &&     ($i     >     0));     :unset     i;}
10
9
8
7
6
5
4
3
2
1
[admin@MikroTik] >
```

environment print - this action prints information about variables. All global variables in the system are listed under the heading Global Variables. All variables that are introduced in this script (local variables introduced by :local or created by :for or :foreach statements, global variables introduced by :global, in short, all variables that can be used within the current script) are listed under the heading Local Variables.

```
[admin@MikroTik]                  >                  :environment                  print
Global                                                                              Variables
g1=this                     is                     global                      variable
```

```
Local Variables
g1=this is global variable
l1=this is local variable
counter=2
[admin@MikroTik] >
```

for - this action takes one argument, the name of the loop variable. It has also four parameters, from, to, step and do. First two parameters indicate the borders for the loop counter. The interval includes these two values as well. The third one specifies the step of decrement (or increment). And, finally, the do statement holds console commands to repeat.

```
[admin@MikroTik] > :for i from=1 to=100 step=37 do={:put ($i . " - " . 1000/$i)}
1 - 1000
38 - 26
75 - 13
[admin@MikroTik] >
```

foreach - this action takes one argument, the name of the loop variable. It has also two parameters, in and do. The in argument is treated as a list with each value assigned to the loop variable, and do statement executed for this value. If in value is not a list then do statement is executed only once. in case in value is empty, do statement is not executed at all. This way it is optimized to work with find command, which returns lists of internal numbers, and may return an empty list or just one internal number. This example prints all ethernet interfaces, each followed by all addresses that are assigned to it:

```
[admin@MikroTik] > :foreach i in=[/interface find type=ether ] do={
{... :put [/interface get $i name]
{... :foreach j in=[/ip address find interface=$i] do={
{{... :put [/ip address get $j address]
{{... }
{... }
ether1
ether2
10.0.0.65/24
[admin@MikroTik] >
```

if - this action takes one argument, a logical condition, id est an expression which must return a boolean value. It has also two parameters, do and else. If the logical condition is evaluated to true then the part after the do parameter is executed, otherwise the else part takes place. Note, that else part is optional.

```
[admin@MikroTik] > :if (yes) do={:put yes} else={:put no}
true
[admin@MikroTik] > :if ([/ping 10.0.0.1 count=1] = 0) do {:put "gw unreachable"}
10.0.0.1 pong timeout
1 packets transmitted, 0 packets received, 100% packet loss
gw unreachable
[admin@MikroTik] >
```

log - this action adds an entry to the system logs. It has two parameters, message which contains the string needed to be added and facility which, in turn, specifies by which logging facility the message should be logged. The facility parameter defaults to System-Info

```
[admin@MikroTik] > :log facility=Firewall-Log message="Very Good \
\... Thing happened. We have received our first packet!"
[admin@MikroTik] >
```

put - this action takes one argument, which it echoes to console.

resolve - this action takes one argument, a DNS name and resolves it to the IP address of the host. You have to configure DNS settings on the router (/ip dns submenu) prior to using this action.

```
[admin@MikroTik] ip route> /ip dns set primary-dns=159.148.60.2
[admin@MikroTik] ip route> :put [:resolve www.example.com]
192.0.34.166
```

time - this action calculates the amount of time needed to execute given console commands. It takes one argument, which holds console commands the time action should be applied to. The commands are executed once and the total amount of time taken is returned.

```
[admin@MikroTik]            >            :put            [:time            {:delay}]
1s34.31ms
[admin@MikroTik] >
```

while - this action takes one argument, a logical condition, id est an expression which must return a boolean value. It has also one parameter, do. The logical condition is evaluated every time before executing do statement.

```
[admin@MikroTik]   >   {:global   i;   :set   i   0;   :while   ($i   <   10)   \
\...        do={:put        $i;        :incr        i;};        :unset        i;}
0
1
2
3
4
5
6
7
8
9
[admin@MikroTik] >
```

Special Actions

Description

Monitor

It is possible to access values that are shown by most **monitor** actions from scripts. If **monitor** action has **do** argument, it can be supplied either script name (see **/system scripts**), or console commands.

Get

It is also possible to access from scripts values that are shown by most **print** actions. Most command levels that have **print** action, also have **get** action. It has one or two arguments. If this command level's **get** action deals with a list of items, the first argument is a name or an internal number of an item. The second argument is a name of item's property which should be returned.

Notes

Monitor action with **do** argument can also be called directly from scripts. It will not print anything then, just execute the given script.

Names of properties that can be accessed by **get** are the same as shown by **print** action, plus names of item flags (like the disabled in the example below). You can use [tab] key completions to see what properties any particular **get** action can return.

Example

In the example below **monitor** action will execute given script each time it prints stats on the screen, and it will assign all printed values to local variables with the same name:

```
[admin@MikroTik] interface> monitor-traffic ether2 once do={:environment print}
    received-packets-per-second: 0
       received-bits-per-second: 0bps
        sent-packets-per-second: 0
           sent-bits-per-second: 0bps

Global Variables
i=1
Local Variables
sent-bits-per-second=0
received-packets-per-second=0
received-bits-per-second=0
sent-packets-per-second=0
[admin@MikroTik] interface>
```

Additional Features

Description

It is possible to include comments in console scripts. If script line starts with '#', all characters until new line are ignored.

It is possible to put multiple commands on a single line, separating them by ';'. Console treats ';' as end of line when separating script text into commands.

If you want to use any of {}[]"\$ characters in a string, you have to prefix them with '\' character. Console takes any character following '\' literally, without assigning any special meaning to it, except for such cases:

```
\a     bell (alarm), character code 7
\b     backspace, character code 8
\f     form feed, character code 12
\n     newline, character code 10
\r     carriage return, character code 13
\t     tabulation, character code 9
\v     vertical tabulation, character code 11
\_     space, character code 32
```

Note that '\', followed by any amount of whitespace characters (spaces, newlines, carriage returns, tabulations), followed by newline is treated as a single whitespace, except inside quotes, where it is treated as nothing. This is used by console to break up long lines in scripts generated by export commands.

Scripts

Home menu level: ***/system script***

Description

In RouterOS, a script may be started in three different ways:

- according to a specific time or an interval of time
- on an event - for example, if the netwatch tool sees that an address does not respond to pings
- by another script

Property Description

last-started (*time*) - date and time when the script has been last invoked. The argument is shown only if the run-count!=0.

owner (*name*; default: **admin**) - the name of the user who created the script

policy (*multiple choice: ftp* | *local* | *policy* | *read* | *reboot* | *ssh* | *telnet* | *test* | *web* | *write*; default: **reboot,read,write,policy,test**) - the list of the policies applicable:

- **ftp** - user can log on remotely via ftp and send and retrieve files from the router
- **local** - user can log on locally via console
- **policy** - manage user policies, add and remove user
- **read** - user can retrieve the configuration
- **reboot** - user can reboot the router
- **ssh** - user can log on remotely via secure shell
- **telnet** - user can log on remotely via telnet
- **test** - user can run ping, traceroute, bandwidth test
- **web** - user can log on remotely via http
- **write** - user can retrieve and change the configuration

run-count (*integer*; default: **0**) - script usage counter. This counter is incremented each time the script is executed. The counter will reset after reboot.

source (*text*; default: **""**) - the script source code itself

Command Description

run (*name*) - executes a given script

Notes

You cannot do more in scripts than you are allowed to do by your current user rights, that is, you cannot use disabled policies. For example, if there is a policy group in **/user group** which allows you **ssh,local,telnet,read,write,policy,test,web** and this group is assigned to your user name, then you cannot make a script that reboots the router.

Example

The following example is a script for writing message "Hello World!" to the system log:

```
[admin@MikroTik] system script> add name=log-test source={:log \
\... message="Hello World!"}
[admin@MikroTik] system script> print
  0 name="log-test" source=":log message="Hello World!"" owner="admin"
    policy=reboot,read,write,policy,test last-started=dec/06/1999 20:07:37
    run-count=1

[admin@MikroTik] system script>
```

Task Management

Home menu level: ***/system script job***

Description

This facility is used to manage the active or scheduled tasks.

Property Description

name (*read-only: name*) - the name of the script to be referenced when invoking it
owner (*text*) - the name of the user who created the script
source (*read-only: text*) - the script source code itself

Example

```
[admin@MikroTik] system script> job print
  # SCRIPT  OWNER                   STARTED
  0 DelayeD admin                   dec/27/2003 11:17:33

[admin@MikroTik] system script>
```

You can cancel execution of a script by removing it from the job list

```
[admin@MikroTik] system script> job remove 0
[admin@MikroTik] system script> job print

[admin@MikroTik] system script>
```

Script Editor

Command name: ***/system script edit***

Description

RouterOS console has a simple full-screen editor for scripts with support for multiline script writing.

Keyboard Shortcuts

- **Delete** - deletes character at cursor position
- **Ctrl+h, backspase** - deletes character before cursor. Unindents line
- **Tab** - indents line
- **Ctrl+b, LeftArrow** - moves cursor left
- **Ctrl+f, RightArrow** - moves cursor right
- **Ctrl+p, UpArrow** - moves cursor up
- **Ctrl+n, DownArrow** - moves cursor down
- **Ctrl+a, Home** - moves cursor to the beginning of line or script
- **Ctrl+e, End** - moves cursor to the end of line or script
- **Ctrl+y** - inserts contents of buffer at cursor position
- **Ctrl+k** - deletes characters from cursor position to the end of line

- **Ctrl+u** - undoes last action
- **Ctrl+o** - exits editor accepting changes
- **Ctrl+x** - exits editor discarding changes

Command Description

edit (*name*) - opens the script specified by the name argument in full-screen editor

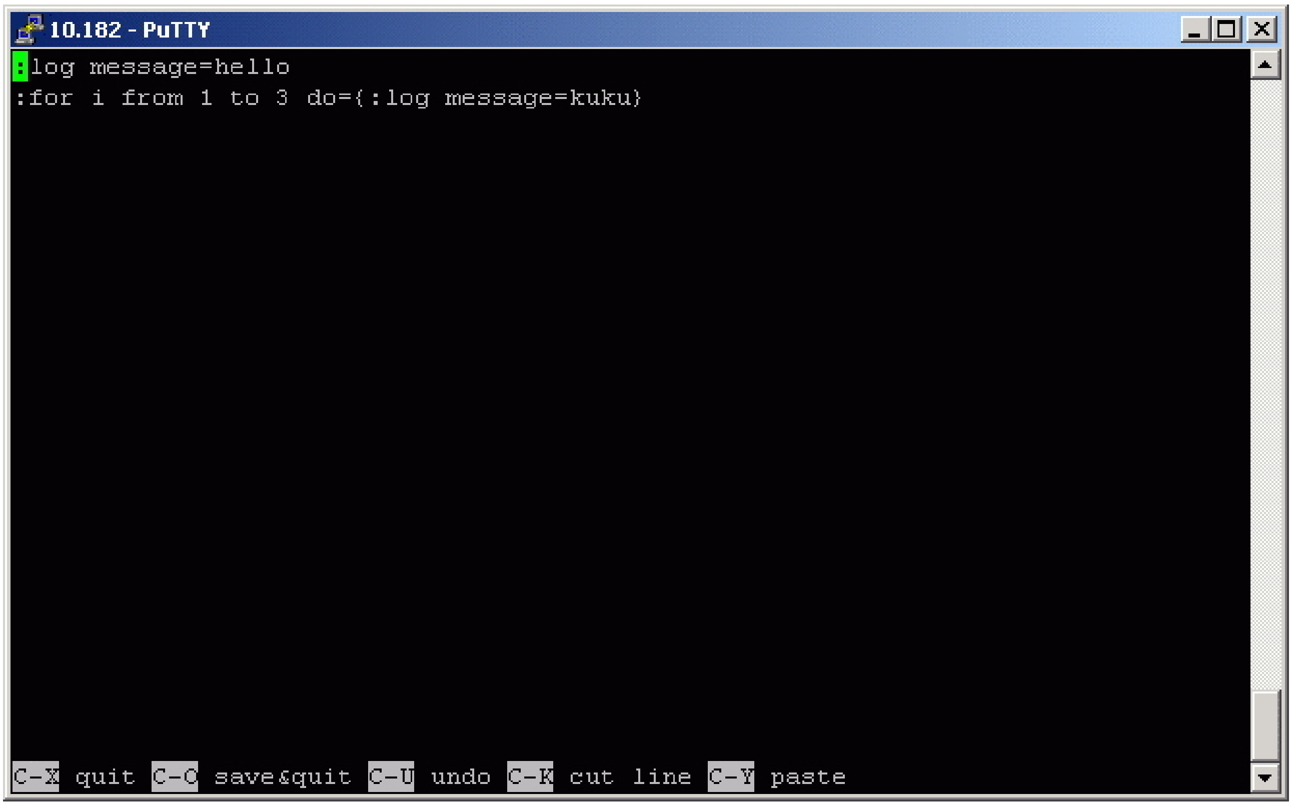
Notes

All characters that are deleted by **backspace, delete** or **Ctrl+k** keys are accumulated in the buffer. Pressing any other key finishes adding to this buffer (**Ctrl+y** can paste it's contents), and the next delete operation will replace it's contents. Undo doesn't change contents of cut buffer.

Script editor works only on VT102 compatible terminals (terminal names "vt102", "linux", "xterm", "rxvt" are recognized as VT102 at the moment). Delete, backspace and cursor keys might not work with all terminal programs, use 'Ctrl' alternatives in such cases.

Example

The following example shows the script editor window with a sample script open:



```
:log message=hello
:for i from 1 to 3 do={:log message=kuku}
```

```
C-X quit C-O save&quit C-U undo C-K cut line C-Y paste
```

This script is used for writing message "hello" and 3 messages "kuku" to the system log.

System Scheduler

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/system scheduler***
Standards and Technologies: ***none***
Hardware usage: ***Not significant***

Description

System scheduler provides a way to execute scripts at designated time.

Property Description

interval (*time*; default: **0s**) - interval between two script executions, if time interval is set to zero, the script is only executed at its start time, otherwise it is executed repeatedly at the time interval is specified

name (*name*) - name of the task

on-event (*name*) - name of the script to execute. It must be presented at /system script

run-count (*read-only: integer*) - to monitor script usage, this counter is incremented each time the script is executed

start-date (*date*) - date of the first script execution

start-time (*time*) - time of the first script execution

Notes

Rebooting the router will reset **run-count** counter.

If more than one script has to be executed simultaneously, they are executed in the order they appear in the scheduler configuration. This can be important if one scheduled script is used to disable another one. The order of scripts can be changed with the **move** command.

If a more complex execution pattern is needed, it can usually be done by scheduling several scripts, and making them enable and disable each other.

Example

We will add a task that executes the script **log-test** every hour:

```
[admin@MikroTik] system script> add name=log-test source=:log message=test
[admin@MikroTik] system script> print
    0 name="log-test" source=":log messgae=test" owner=admin run-count=0
[admin@MikroTik] system script> .. scheduler
[admin@MikroTik] system scheduler> add name=run-1h interval=1h
on-event=log-test
[admin@MikroTik] system scheduler> print

Flags: X - disabled
 #   NAME      ON-EVENT  START-DATE  START-TIME INTERVAL     RUN-COUNT
 0   run-1h    log-test  mar/30/2004 06:11:35   1h           0
[admin@MikroTik] system scheduler>
```

In another example there will be two scripts added that will change the bandwidth setting of a queue rule "Cust0". Every day at 9AM the queue will be set to 64Kb/s and at 5PM the queue will be set to 128Kb/s. The queue rule, the scripts, and the scheduler tasks are below:

```
[admin@MikroTik] queue simple> add name=Cust0 interface=ether1 \
\... dst-address=192.168.0.0/24 limit-at=64000
[admin@MikroTik] queue simple> print
Flags: X - disabled, I - invalid
  0   name="Cust0" target-address=0.0.0.0/0 dst-address=192.168.0.0/24
      interface=ether1 limit-at=64000 queue=default priority=8 bounded=yes

[admin@MikroTik] queue simple> /system script
[admin@MikroTik] system script> add name=start_limit source={/queue simple set \
\... Cust0 limit-at=64000}
[admin@MikroTik] system script> add name=stop_limit source={/queue simple set \
\... Cust0 limit-at=128000}
[admin@MikroTik] system script> print
  0 name="start_limit" source="/queue simple set Cust0 limit-at=64000"
    owner=admin run-count=0

  1 name="stop_limit" source="/queue simple set Cust0 limit-at=128000"
    owner=admin run-count=0

[admin@MikroTik] system script> .. scheduler
[admin@MikroTik] system scheduler> add interval=24h name="set-64k" \
\... start-time=9:00:00 on-event=start_limit
[admin@MikroTik] system scheduler> add interval=24h name="set-128k" \
\... start-time=17:00:00 on-event=stop_limit
[admin@MikroTik] system scheduler> print
Flags: X - disabled
  #   NAME      ON-EVENT START-DATE  START-TIME INTERVAL             RUN-COUNT
  0   set-64k   start... oct/30/2008 09:00:00   1d                   0
  1   set-128k  stop_... oct/30/2008 17:00:00   1d                   0
[admin@MikroTik] system scheduler>
```

The following example schedules a script that sends each week a backup of router configuration by e-mail.

```
[admin@MikroTik] system script> add name=e-backup source={/system backup
{... save name=email; /tool e-mail send to="root@host.com" subject=([/system
{... identity get name] . " Backup") file=email.backup}
[admin@MikroTik] system script> print
  0 name="e-backup" source="/system backup save name=ema... owner=admin
    run-count=0

[admin@MikroTik] system script> .. scheduler
[admin@MikroTik] system scheduler> add interval=7d name="email-backup" \
\... on-event=e-backup
[admin@MikroTik] system scheduler> print
Flags: X - disabled
  #   NAME      ON-EVENT START-DATE  START-TIME INTERVAL             RUN-COUNT
  0   email-... e-backup oct/30/2008 15:19:28   7d                   1
[admin@MikroTik] system scheduler>
```

Do not forget to set the e-mail settings, i.e., the SMTP server and From: address under **/tool e-mail**. For example:

```
[admin@MikroTik] tool e-mail> set server=159.148.147.198 from=SysAdmin@host.com
[admin@MikroTik] tool e-mail> print
    server: 159.148.147.198
      from: SysAdmin@host.com
[admin@MikroTik] tool e-mail>
```

Example below will put 'x' in logs each hour from midnight till noon:

```
[admin@MikroTik] system script> add name=enable-x source={/system scheduler
{... enable x}
[admin@MikroTik] system script> add name=disable-x source={/system scheduler
{... disable x}
[admin@MikroTik] system script> add name=log-x source={:log message=x}
```

```
[admin@MikroTik] system script> .. scheduler
[admin@MikroTik] system scheduler> add name=x-up start-time=00:00:00 \
\... interval=24h on-event=enable-x
[admin@MikroTik] system scheduler> add name=x-down start-time=12:00:00
\... interval=24h on-event=disable-x
[admin@MikroTik] system scheduler> add name=x start-time=00:00:00 interval=1h \
\... on-event=log-x
[admin@MikroTik] system scheduler> print
Flags: X - disabled
  #   NAME      ON-EVENT START-DATE  START-TIME INTERVAL             RUN-COUNT
  0   x-up      enable-x oct/30/2008 00:00:00   1d                   0
  1   x-down    disab... oct/30/2008 12:00:00   1d                   0
  2   x         log-x    oct/30/2008 00:00:00   1h                   0
[admin@MikroTik] system scheduler>
```

Network Watching Tool

Specifications

Packages required: ***advanced-tools***
License required: ***level1***
Home menu level: ***/tool netwatch***
Standards and Technologies: ***none***
Hardware usage: ***Not significant***

Description

Netwatch monitors state of hosts on the network. It does so by sending ICMP pings to the list of specified IP addresses. For each entry in netwatch table you can specify IP address, ping interval and console scripts. The main advantage of netwatch is it's ability to issue arbitrary console commands on host state changes.

Property Description

down-script (*name*) - a console script that is executed once when state of a host changes from unknown or up to down

host (*IP address*; default: **0.0.0.0**) - IP address of host that should be monitored

interval (*time*; default: **1s**) - the time between pings. Lowering this will make state changes more responsive, but can create unnecessary traffic and consume system resources

since (*read-only: time*) - indicates when state of the host changed last time

status (*read-only: up* | *down* | *unknown*) - shows the current status of the host

- **up** - the host is up
- **down** - the host is down
- **unknown** - after any properties of this list entry were changed, or the item is enabled or disabled

timeout (*time*; default: **1s**) - timeout for each ping. If no reply from a host is received during this time, the host is considered unreachable (down)

up-script (*name*) - a console script that is executed once when state of a host changes from unknown or down to up

Example

This example will run the scripts gw_1 or gw_2 which change the default gateway depending on the status of one of the gateways:

```
[admin@MikroTik] system script> add name=gw_1 source={/ip route set
{... [/ip route find dst 0.0.0.0] gateway 10.0.0.1}
[admin@MikroTik] system script> add name=gw_2 source={/ip route set
{.. [/ip route find dst 0.0.0.0] gateway 10.0.0.217}
[admin@MikroTik] system script> /tool netwatch
[admin@MikroTik] tool netwatch> add host=10.0.0.217 interval=10s timeout=998ms \
\... up-script=gw_2 down-script=gw_1
[admin@MikroTik] tool netwatch> print
Flags: X - disabled
  #   HOST       TIMEOUT            INTERVAL         STATUS
  0   10.0.0.217      997ms            10s                 up
[admin@MikroTik] tool netwatch> print detail
Flags: X - disabled
  0   host=10.0.0.217 timeout=997ms interval=10s since=feb/27/2003 14:01:03
      status=up up-script=gw_2 down-script=gw_1

[admin@MikroTik] tool netwatch>
```

Without scripts, netwatch can be used just as an information tool to see which links are up, or which specific hosts are running at the moment.

Let's look at the example above - it changes default route if gateway becomes unreachable. How it's done? There are two scripts. The script "gw_2" is executed once when status of host changes to **up**. In our case, it's equivalent to entering this console command:

```
[admin@MikroTik] > /ip route set [/ip route find dst 0.0.0.0] gateway 10.0.0.217
```

The **/ip route find dst 0.0.0.0** command returns list of all routes whose **dst-address** value is **0.0.0.0**. Usually, that is the default route. It is substituted as first argument to **/ip route set** command, which changes gateway of this route to 10.0.0.217

The script "gw_1" is executed once when status of host becomes **down**. It does the following:

```
[admin@MikroTik] > /ip route set [/ip route find dst 0.0.0.0] gateway 10.0.0.1
```

It changes the default gateway if 10.0.0.217 address has become unreachable.

Here is another example, that sends e-mail notification whenever the 10.0.0.215 host goes down:

```
[admin@MikroTik] system script> add name=e-down source={/tool e-mail send
{... from="rieks@mt.lv" server="159.148.147.198" body="Router down"
{... subject="Router at second floor is down" to="rieks@latnet.lv"}
[admin@MikroTik] system script> add name=e-up source={/tool e-mail send
{... from="rieks@mt.lv" server="159.148.147.198" body="Router up"
{.. subject="Router at second floor is up" to="rieks@latnet.lv"}
[admin@MikroTik] system script>
[admin@MikroTik] system script> /tool netwatch
[admin@MikroTik] system netwatch> add host=10.0.0.215 timeout=999ms \
\... interval=20s up-script=e-up down-script=e-down
[admin@MikroTik] tool netwatch> print detail
Flags: X - disabled
  0   host=10.0.0.215 timeout=998ms interval=20s since=feb/27/2003 14:15:36
      status=up up-script=e-up down-script=e-down

[admin@MikroTik] tool netwatch>
```

Traffic Monitor

Specifications

Packages required: ***advanced-tools***
License required: ***level1***
Home menu level: ***/tool traffic-monitor***
Standards and Technologies: ***none***
Hardware usage: ***Not significant***

Description

The traffic monitor tool is used to execute console scripts when interface traffic crosses a given threshold. Each item in traffic monitor list consists of its name (which is useful if you want to disable or change properties of this item from another script), some parameters, specifying traffic condition, and the pointer to a script or scheduled event to execute when this condition is met.

Property Description

interface (*name*) - interface to monitor

name (*name*) - name of the traffic monitor item

on-event (*name*) - script source. Must be present under /system script

threshold (*integer*; default: **0**) - traffic threshold

traffic (*transmitted* | *received*; default: **transmitted**) - type of traffic to monitor

- **transmitted** - transmitted traffic
- **received** - received traffic

trigger (*above* | *always* | *below*; default: **above**) - condition on which to execute the script

- **above** - the script will be run each time the traffic exceeds the threshold
- **always** - triggers scripts on both - above and below condition
- **below** - triggers script in the opposite condition, when traffic reaches a value that is lower than the threshold

Example

In this example the traffic monitor enables the interface ether2, if the received treffic exceeds 15kbps on ether1, and disables the interface ether2, if the received traffic falls below 12kbps on ether1.

```
[admin@MikroTik] system script> add name=eth-up source={/interface enable ether2}
[admin@MikroTik] system script> add name=eth-down source={/interface disable
{... ether2}
[admin@MikroTik] system script> /tool traffic-monitor
[admin@MikroTik] tool traffic-monitor> add name=turn_on interface=ether1 \
\... on-event=eth-up threshold=15000 trigger=above traffic=received
[admin@MikroTik] tool traffic-monitor> add name=turn_off interface=ether1 \
\... on-event=eth-down threshold=12000 trigger=below traffic=received
[admin@MikroTik] tool traffic-monitor> print
Flags: X - disabled, I - invalid
  #   NAME           INTERFACE     TRAFFIC     TRIGGER THRESHOLD  ON-EVENT
  0   turn_on        ether1        received    above   15000      eth-up
  1   turn_off       ether1        received    below   12000      eth-down
[admin@MikroTik] tool traffic-monitor>
```

Sigwatch

Specifications

Packages required: ***advanced-tools***
License required: ***level1***
Home menu level: ***/tool sigwatch***
Standards and Technologies: ***none***
Hardware usage: ***Not significant***

Description

Sigwatch can be used to monitor the state of serial port pins.

Property Description

count (*read-only: integer*) - how many times the event for this item was triggered. Count is reset on reboot and on most item configuration changes

log (*yes* | *no*; default: **no**) - whether to add a message in form of name-of-sigwatch-item: signal changed [to high | to low] to System-Info facility whenever this sigwatch item is triggered

name (*name*) - name of the sigwatch item

on-condition (*on* | *off* | *change*; default: **on**) - on what condition to trigger action of this item

- **on** - trigger when state of pin changes to high
- **off** - trigger when state of pin changes to low
- **change** - trigger whenever state of pin changes. If state of pin changes rapidly, there might be triggered only one action for several state changes

port (*name*) - serial port name to monitor

script (*name*) - script to execute when this item is trigered

signal (*dtr* | *rts* | *cts* | *dcd* | *ri* | *dsr*; default: **rts**) - name of signal of number of pin (for standard 9-pin connector) to monitor

- **dtr** - Data Terminal Ready (pin #4)
- **rts** - Request To Send (pin #7)
- **cts** - Clear To Send (pin #8)
- **dcd** - Data Carrier Detect (pin #1)
- **ri** - Ring Indicator (pin #9)
- **dsr** - Data Set Ready (pin #6)

state (*read-only: text*) - last remembered state of monitored signal

Notes

You can type actual script source instead of the script name from **/system script** list.

Example

In the following example we will add a new sigwatch item that monitors whether the port **serial1** has cts signal.

```
[admin@10.179] tool sigwatch> pr
Flags: X - disabled
  #   NAME                                  PORT    SIGNAL     ON-CONDITION LOG
  0   test                                  serial1 cts        change       no
[admin@MikroTik] tool sigwatch>
```

By typing a command **print detail interval=1s**, we can check whether a cable is connected or it is not. See the **state** argument - if the cable is connected to the serial port, it shows **on**, otherwise it will be **off**.

```
[admin@MikroTik] tool sigwatch> print detail
Flags: X - disabled
  0   name="test" port=serial1 signal=cts on-condition=change log=no script=""
      count=1 state=on

[admin@MikroTik] tool sigwatch> print detail
Flags: X - disabled
  0   name="test" port=serial1 signal=cts on-condition=change log=no script=""
      count=1 state=on

[admin@MikroTik] tool sigwatch> print detail
Flags: X - disabled
  0   name="test" port=serial1 signal=cts on-condition=change log=no script=""
      count=2 state=off

[admin@MikroTik] tool sigwatch> print detail
Flags: X - disabled
  0   name="test" port=serial1 signal=cts on-condition=change log=no script=""
      count=2 state=off

[admin@MikroTik] tool sigwatch>
```

In the **port** menu you can see what **signal** is used by serial cable. For example, without any cables it looks like this:

```
[admin@MikroTik] port> print stats
  0 name="serial0" line-state=dtr,rts

  1 name="serial1" line-state=dtr,rts
[admin@MikroTik] port>
```

But after adding a serial cable to the serial port:

```
[admin@MikroTik] port> print stats
  0 name="serial0" line-state=dtr,rts

  1 name="serial1" line-state=dtr,rts,cts
[admin@MikroTik] port>
```

This means that the line-state besides the **dtr** and **rts** signals has also **cts** when a serial cable is connected.

The example below will execute a script whenever **on-condition** changes to **off**:

```
[admin@10.MikroTik] tool sigwatch> pr detail
Flags: X - disabled
  0   name="cts_rest" port=serial1 signal=cts on-condition=off log=no
      script=/system shutdown count=0 state=on
[admin@10.MikroTik] tool sigwatch>
```

It means that if a serial cable is connected to the serial port, all works fine, but as soon as it is disconnected, the router shuts down. It will continue all the time until the serial cable will not be connected again.

UPS Monitor

Document revision 2.1 (Mon Jul 19 07:33:14 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

The UPS monitor feature works with APC UPS units that support “smart” signaling. This feature enables the network administrator to monitor the UPS and set the router to ‘gracefully’ handle any power outage with no corruption or damage to the router. The basic purpose of this feature is to ensure that the router will come back online after an extended power failure. To do this, the router will monitor the UPS and set itself to hibernate mode when the ‘utility’ power is down and the UPS battery is has less than 10% of its battery power left. The router will then continue to monitor the UPS (while in hibernate mode) and then restart itself after when the ‘utility’ power returns. If the UPS battery is drained and the router loses all power, the router will power back to full operation when the ‘utility’ power returns.

The UPS monitor feature on the MikroTik RouterOS supports

- hibernate and safe reboot on power and battery failure
- UPS battery test and run time calibration test
- monitoring of all "smart" mode status information supported by UPS
- logging of power changes

Specifications

Packages required: ***ups***
License required: ***level1***
Home menu level: ***/system ups***
Standards and Technologies: ***APC's smart protocol***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

Description

Cabling

The APC UPS (BackUPS Pro or SmartUPS) requires a special serial cable. If no cable came with the UPS, a cable may be ordered from APC or one can be made "in-house". Use the following diagram:

Router Side (DB9f)	Signal	Direction	UPS Side (DB9m)
2	**Receive**	**IN**	**2**
3	**Send**	**OUT**	**1**
5	**Ground**		**4**
7	**CTS**	**IN**	**6**

UPS Monitor Setup

Home menu level: ***/system ups***

Property Description

alarm-setting (*delayed* | *immediate* | *low-battery* | *none*; default: **immediate**) - UPS sound alarm setting:

- **delayed** - alarm is delayed to the on-battery event
- **immediate** - alarm immediately after the on-battery event
- **low-battery** - alarm only when the battery is low
- **none** - do not alarm

enabled (*yes* | *no*; default: **no**) - status of the monitoring is disabled by default

manufacture-date (*read-only: text*) - the UPS's date of manufacture in the format "mm/dd/yy" (month, day, year)

min-run-time (*time*; default: **5m**) - minimal run time remaining. After a 'utility' failure, the router will monitor the run-time-left value. When the value reaches the min-run-time value, the router will go to hibernate mode

- **0** - the router will go to hibernate mode when the "battery low" signal is sent indicating that the battery power is below 10%

model (*read-only: text*) - less than 32 ASCII character string consisting of the UPS model name (the words on the front of the UPS itself)

nominal-battery-voltage (*read-only: integer*) - the UPS's nominal battery voltage rating (this is not the UPS's actual battery voltage)

off-line-time (*time*; default: **5m**) - how long to work on batteries. The router waits that amount of time and then goes into hibernate mode until the UPS reports that the 'utility' power is back

- **0** - the router will go into hibernate mode according the min-run-time setting and 10% of battery power event. In this case, the router will wait until the UPS reports that the battery power is below 10%

port (*name*) - communication port of the router

rtc-alarm-setting (*delayed* | *immediate* | *low-battery* | *none*; default: **none**) - UPS sound alarm setting during run time calibration:

- **delayed** - alarm is delayed to the on-battery event
- **immediate** - alarm immediately after the on-battery event
- **low-battery** - alarm only when the battery is low
- **none** - do not alarm

serial (*read-only: text*) - a string of at least 8 characters directly representing the UPS's serial number as set at the factory. Newer SmartUPS models have 12-character serial numbers

version (*read-only: text*) - UPS version, consists of three fields: SKU number, firmware revision, country code. The county code may be one of the following:

- **I** - 220/230/240 Vac
- **D** - 115/120 Vac
- **A** - 100 Vac
- **M** - 208 Vac
- **J** - 200 Vac

Notes

In order to enable UPS monitor, the serial port should be available.

Example

To enable the UPS monitor for port **serial1**:

```
[admin@MikroTik] system ups> set port=serial1 enabled=yes
[admin@MikroTik] system ups> print
                    enabled: yes
                       port: serial1
              off-line-time: 5m
               min-run-time: 5m
              alarm-setting: immediate
          rtc-alarm-setting: immediate
                      model: "Back-UPS Pro 420"
                    version: "11.4.I"
              serial-number: "NB9941252992"
           manufacture-date: "10/08/99"
    nominal-battery-voltage: 12
[admin@MikroTik] system ups>
```

Runtime Calibration

Command name: ***/system ups run-time-calibration***

Description

The **run-time-calibration** command causes the UPS to start a run time calibration until less than 25% of full battery capacity is reached. This command calibrates the returned run time value.

Notes

The test begins only if the battery capacity is 100%.

Example

```
[MikroTik] system ups> run-time-calibration
```

UPS Monitoring

Command name: ***/system ups monitor***

Property Description

battery-charge (*percentage*) - the UPS's remaining battery capacity as a percent of the fully charged condition

battery-voltage - the UPS's present battery voltage. The typical accuracy of this measurement is ±5% of the maximum value (depending on the UPS's nominal battery voltage)

frequency (*percentage*) - when operating on-line, the UPS's internal operating frequency is synchronized to the line within variations within 3 Hz of the nominal 50 or 60 Hz. The typical accuracy of this measurement is ±1% of the full scale value of 63 Hz

line-voltage - the in-line utility power voltage

load (*percentage*) - the UPS's output load as a percentage of full rated load in Watts. The typical accuracy of this measurement is ±3% of the maximum of 105%

low-battery - only shown when the UPS reports this status

on-battery (*yes* | *no*) - Whether UPS battery is supplying power

on-line (*yes* | *no*) - whether power is being provided by the external utility (power company)

output-voltage - the UPS's output voltage

overloaded-output - only shown when the UPS reports this status

replace-battery - only shown when the UPS reports this status

run-time-calibration-running - only shown when the UPS reports this status

run-time-left (*time*) - the UPS's estimated remaining run time in minutes. You can query the UPS when it is operating in the on-line, bypass, or on-battery modes of operation. The UPS's remaining run time reply is based on available battery capacity and output load

smart-boost-mode - only shown when the UPS reports this status

smart-ssdd-mode - only shown when the UPS reports this status

transfer-cause (*text*) - the reason for the most recent transfer to on-battery operation (only shown when the unit is on-battery)

Example

When running on utility power:

```
[admin@MikroTik] system ups> monitor
                         on-line: yes
                      on-battery: no
                   run-time-left: 11m
                  battery-charge: 100
                 battery-voltage: 13
                    line-voltage: 221
                  output-voltage: 221
                            load: 57
                        fequency: 50

[admin@MikroTik] system ups>
```

When running on battery:

```
[admin@MikroTik] system ups> monitor
                         on-line: no
                      on-battery: yes
                  transfer-cause: "utility voltage notch or spike detected"
                   run-time-left: 9m
                  battery-charge: 95
                 battery-voltage: 11
                    line-voltage: 0
                  output-voltage: 233
                            load: 66
                        fequency: 50

[admin@MikroTik] system ups>
```

NTP (Network Time Protocol)

Document revision NaN (Mon Jul 19 07:25:46 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

NTP protocol allows synchronizing time among computers in network. It is good if there is an internet connection available and local NTP server is synchronized to correct time source. List of public NTP servers is available at ***http://ntp.isc.org/bin/view/Servers/WebHome#Browsing_the_Lists***

Specifications

Packages required: ***ntp***
License required: ***level1***
Home menu level: ***/system ntp***
Standards and Technologies: ***NTP version 3 (RFC 1305)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***IP Addresses and ARP***

Description

Network Time Protocol (NTP) is used to synchronize time with some NTP servers in a network. MikroTik RouterOS provides both - NTP client and NTP server.

NTP server listens on UDP port 123

NTP client synchronizes local clock with some other time source (NTP server). There are 4 modes in which NTP client can operate at:

- **unicast** (Client/Server) mode - NTP client connects to specified NTP server. IP address of NTP server must be set in ntp-server and/or second-ntp-server parameters. At first client synchronizes to NTP server. Afterwards client periodically (64..1024s) sends time requests to NTP server. Unicast mode is the only one which uses ntp-server and second-ntp-server parameters.
- **broadcast** mode - NTP client listens for broadcast messages sent by NTP server. After receiving first broadcast message, client synchronizes local clock using unicast mode, and afterwards does not send any packets to that NTP server. It uses received broadcast messages to adjust local clock.
- **multicast** mode - acts the same as broadcast mode, only instead of broadcast messages (IP address 255.255.255.255) multicast messages are received (IP address 224.0.1.1).
- **manycast** mode - actually is unicast mode only with unknown IP address of NTP server. To discover NTP server, client sends multicast message (IP 239.192.1.1). If NTP server is configured to listen for these multicast messages (manycast mode is enabled), it replies. After client receives reply, it enters unicast mode and synchronizes to that NTP server. But in parallel client continues to look for more NTP servers by sending multicast messages periodically.

Client

Home menu level: ***/system ntp client***

Property Description

enabled (*yes* | *no*; default: **no**) - whether the NTP client is enabled or not

mode (*unicast* | *broadcast* | *multicast* | *manycast*; default: **unicast**) - NTP client mode

primary-ntp (*IP address*; default: **0.0.0.0**) - specifies IP address of the primary NTP server

secondary-ntp (*IP address*; default: **0.0.0.0**) - specifies IP address of the secondary NTP server

status (*read-only: text*) - status of the NTP client:

- **stopped** - NTP is not running (NTP is disabled)
- **error** - there was some internal error starting NTP service (please, try to restart (disable and enable) NTP service)
- **started** - NTP client service is started, but NTP server is not found, yet
- **failed** - NTP server sent invalid response to our NTP client (NTP server is not synchronized to some other time source)
- **reached** - NTP server contacted. Comparing local clock to NTP server's clock (duration of this phase is approximately 30s)
- **timeset** - local time changed to NTP server's time (duration of this phase is approximately 30s)

- **synchronized** - local clock is synchronized to NTP server's clock. NTP server is activated
- **using-local-clock** - using local clock as time source (server enabled while client disabled)

Example

To enable the NTP client to synchronize with the **159.148.60.2** server:

```
[admin@MikroTik] system ntp client> set enabled=yes primary-ntp=159.148.60.2
[admin@MikroTik] system ntp client> print
          enabled: yes
             mode: unicast
      primary-ntp: 159.148.60.2
    secondary-ntp: 0.0.0.0
           status: synchronized
[admin@MikroTik] system ntp client>
```

Server

Home menu level: ***/system ntp server***

Property Description

broadcast (*yes* | *no*; default: **no**) - whether NTP broadcast message is sent to 255.255.255.255 every 64s

enabled (*yes* | *no*; default: **no**) - whether the NTP server is enabled

manycast (*yes* | *no*; default: **yes**) - whether NTP server listens for multicast messages sent to 239.192.1.1 and responds to them

multicast (*yes* | *no*; default: **no**) - whether NTP multicast message is sent to 224.0.1.1 every 64s

Notes

NTP server activities only when local NTP client is in **synchronized** or **using-local-clock** mode.

If NTP server is disabled, all NTP requests are ignored.

If NTP server is enabled, all individual time requests are answered.

CAUTION! Using **broadcast**, **multicast** and **manycast** modes is dangerous! Intruder (or simple user) can set up his own NTP server. If this new server will be chosen as time source for your server, it will be possible for this user to change tome on your server at his will.

Example

To enable NTP server to answer unicast requests only:

```
[admin@MikroTik] system ntp server> set manycast=no enabled=yes
[admin@MikroTik] system ntp server> print
      enabled: yes
    broadcast: no
    multicast: no
     manycast: no
[admin@MikroTik] system ntp server>
```

Time Zone

Home menu level: ***/system clock***

Notes

NTP changes local clock to UTC (GMT) time by default.

Example

Time zone is specified as a difference between local time and GMT time. For example, if GMT time is 10:24:40, but correct local time is 12:24:40, then time-zone has to be set to +2 hour:

```
[admin@MikroTik] system clock> print
         time: dec/24/2003 10:24:40
    time-zone: +00:00
[admin@MikroTik] system clock> set time-zone=+02:00
[admin@MikroTik] system clock> print
         time: dec/24/2003 12:24:42
    time-zone: +02:00
[admin@MikroTik] system clock>
```

If local time is before GMT time, time-zone value will be negative. For example, if GMT is 18:00:00, but correct local time is 15:00:00, time-zone has to be set to -3 hours:

```
[admin@MikroTik] system clock> set time-zone=-3
[admin@MikroTik] system clock> print
         time: dec/24/2003 07:29:33
    time-zone: -03:00
[admin@MikroTik] system clock>
```

RouterBoard-specific functions

Document revision 2.5 (Mon Oct 11 09:03:20 GMT 2004)

This document applies to V

Table of Contents

General Information

Summary

There are some features used to configure specific functions exist only in RouterBOARD 200 series:

- BIOS upgrading
- BIOS configuration
- Health monitoring
- LED control (may be used in scripting)

- Fan voltage control (on/off)
- Console reset jumper

Specifications

Packages required: ***routerboard***
License required: ***level1***
Home menu level: ***/system routerboard***
Hardware usage: *works only on RouterBOARD platform*

BIOS upgrading

Home menu level: ***/system routerboard***

Description

The BIOS is needed to recognize all the hardware and boot the system up. Newer BIOS versions might have support for more hardware, so it's generally a good idea to upgrade the BIOS once a newer version is available.

The newest versions of BIOS firmware is included in the newest **routerboard** software package. BIOS firmware may also be uploaded to router's FTP server (the file is called **wlb-bios.rom**). This way, for example, BIOS firmware may be transferred from one router to an another.

Property Description

current-firmware (*read-only: text*) - the version and build date of the BIOS already flashed

routerboard (*read-only:* yes | no) - whether the motherboard has been detected as a RouterBOARD

upgrade-firmware (*read-only: text*) - the version and build date of the BIOS that is available for flashing

Command Description

upgrade - write the uploaded firmware to the BIOS (asks confirmation, and then reboots the router)

Example

To check the current and available firmware version numbers:

```
[admin@MikroTik] > system routerboard print
         routerboard: yes
    current-firmware: "1.0.8 (Oct/03/2003 08:50:48)"
    upgrade-firmware: "1.0.8 (Oct/17/2003 19:06:26)"
[admin@MikroTik] >
```

To upgrade the BIOS version:

```
[admin@MikroTik] > system routerboard upgrade
Firmware upgrade requires reboot of the router. Continue? [y/n] y
Firmware upgrade can take up to 20s. Do NOT turn off the power!
```

BIOS Configuration

Home menu level: ***/system routerboard bios***

Description

In addition to BIOS own setup possibilities, it is possible to configure BIOS parameters in RouterOS condole

Property Description

baud-rate (*1200* | *2400* | *4800* | *9600* | *19200* | *38400* | *57600* | *115200*; default: **9600**) - initian bitrate of the onboard serial port

beep-on-boot (yes | no; default: **yes**) - whether to beep during boot procedure (to indicate that it has succeeded)

boot-delay (*time*: 0s..10s; default: **1s**) - how much time to wait for a key storke while booting

debug-level (*none* | *low* | *high*) - BIOS output debug level

- **none** - no debugging output
- **low** - show only some debugging information
- **high** - show all debugging information about the boot process

memory-settings (*optimal* | *fail-safe*; default: **optimal**) - specifies how the RouterBoard will use the memory

memory-test (yes | no; default: **no**) - whether to testall the RAM during boot procedure. Regardless of the choice, hte first megabyte of the RAM will be tested anyway. Enabling this option may cause longer boot process

vga-to-serial (yes | no; default: **yes**) - whether to map VGA output to the serial console. Should be enabled if working via serial terminal (gives much more output)

Example

To set high debug level with RAM test:

```
[admin@MikroTik] > system routerboard bios print
        baud-rate: 9600
      debug-level: low
       boot-delay: 1s
     beep-on-boot: yes
    vga-to-serial: yes
      memory-test: no
[admin@MikroTik] > system routerboard bios set debug-level=high ram-test=yes
[admin@MikroTik] > system routerboard bios print
        baud-rate: 9600
      debug-level: high
       boot-delay: 1s
     beep-on-boot: yes
    vga-to-serial: yes
      memory-test: yes
[admin@MikroTik] >
```

System Health Monitoring

Home menu level: ***/system routerboard health***

Description

LM87 health controller chip provides some measurments of temperature and voltage. Information becomes available not sooner than 2 minutes after boot up. It is not available if LM87 chip is not detected successfully. All values are 10 second averages, with short peak values ignored as likely read errors

Property Description

12v - +12V power line voltage

3.3v - +3.3V power line voltage

5v - +5V power line voltage

board-temp - temperature of the PCI area

core - CPU core voltage

cpu-temp - temperature of the CPU area

lm87-temp - temperature of the LM87 chip

state (*read-only: enabled* | *disabled*; default: **disabled**) - the current state of health monitoring (whether it is enabled or not)

state-after-reboot (*enabled* | *disabled*; default: **disabled**) - the state of the health monitor after the reboot

Notes

You cannot change state on the fly, just control, whether the health control will be enabled after reboot

All themperature values are in Celsius degrees

Example

To check system health:

```
[admin@MikroTik] > /system routerboard health print
                  core: 1.8
                  3.3v: 3.3
                    5v: 5.02
                   12v: 12.25
             lm87-temp: 33
              cpu-temp: 33
            board-temp: 26
                 state: enabled
    state-after-reboot: enabled
[admin@MikroTik] >
```

LED Managment

Command name: ***:led***

Description

The four user LEDs of the RouterBOARD can be controlled from user-space scripts.

Property Description

led1 (yes | no; default: **no**) - whether the LED1 is on

led2 (yes | no; default: **no**) - whether the LED2 is on

led3 (yes | no; default: **no**) - whether the LED3 is on

led4 (yes | no; default: **no**) - whether the LED3 is on

length (*time*; default: **0s**) - how long to hold the given combination

- **0s** - no limit

Notes

The command does not imply a pause in execution. It works asynchronously, allowing execution to continue just after the command was entered, not waiting for LEDs to switch off.

After the given time (**length** property) the LEDs will return to the default (off) condition.

Any new **:led** command overrides the the previous state and resets the LED state after the **length** time interval.

Example

To turn LED1 on for a minute:

```
[admin@MikroTik] > :led led1=yes length=1m
[admin@MikroTik] >
```

Fan voltage control

Command name: ***/system routerboard fan-control***

Description

Starting with version 2.8.18 you can control, whether the J11 fan 5V voltage output is enabled. This feature will only work with newest BIOS versions. This is useful in scripts to control some devices attached to the J11 connector.

Property Description

length (*time*; default: **0**) - how long to hold the set state value, and then return to the prevoius state

- **0** - leave the state in the set mode until restart

state (yes | no) - whether to enable the 5V output on pins 1-2 of the J11 header

Console Reset Jumper

Description

The J16 jumper on the RouterBOARD may be used as serial console reset pin. If it held short for at least 10 seconds, then:

- Serial console configuration is reset
- Serial port that serial console will pick by default (usually serial0) is set to 9600 baud 8 bit 1 stop bit no parity (default settings after installation)
- Special flag that prevents any other program except serial console to acquire this port is set
- Router is rebooted

License Management

Document revision 3 (Tue Jul 13 13:04:07 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

MikroTik RouterOS software has a licensing system with Software License (Software Key) issued for each individual installation of the RouterOS. RouterOS version 2.8 introduces a new licensing scheme with different key system. You should upgrade your key when updating to 2.8 version from 2.5, 2.6 or 2.7 versions.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/system license***
Hardware usage: ***Not significant***

Description

The Software License can be obtained through the Account Server at **www.mikrotik.com** after the MikroTik RouterOS has been installed. The Software ID of the installation is required when obtaining the Software License. Please read the MikroTik RouterOS Basic Setup Guide for detailed explanation of the installation and licensing process.

RouterOS allows you to use all its features without registration for about 24 hours from the first run. Note that if you shut the router down, the countdown is paused, and it is resumed only when the router is started again. During this period you must get a key, otherwise you will need to reinstall the system. A purchased license key allows you to use RouterOS features according to the chosen license level for unlimited time, and gives you rights to freely upgrade and downgrade its versions for the term of one year since the key was purchased. A free registred license key (referred as a SOHO key further on) allows you to use a restricted set of functions for unlimited period of time, but does not allows upgrading and downgrading versions.

There are 6 licensing levels, each providing some additional features. Level 0 means that there is no key and all the features are enabled for one day. Level 2 is a transitional license level, that allows to use all the features were allowed by your original license key for a previus version.

Level number	1 (SOHO)	3 (ISP)	4 (WISP)	5 (WISP AP)	6 (Controller)
Wireless Client and Bridge	**-**	**-**	**yes**	**yes**	**yes**
Wireless AP	**-**	**-**	**-**	**yes**	**yes**
Synchronous interfaces	**-**	**-**	**yes**	**yes**	**yes**
EoIP tunnels	**1**	**unlimited**	**unlimited**	**unlimited**	**unlimited**
PPPoE tunnels	**1**	**200**	**200**	**500**	**unlimited**
PPTP tunnels	**1**	**200**	**200**	**unlimited**	**unlimited**
L2TP tunnels	**1**	**200**	**200**	**unlimited**	**unlimited**
VLAN interfaces	**1**	**unlimited**	**unlimited**	**unlimited**	**unlimited**
P2P firewall rules	**1**	**unlimited**	**unlimited**	**unlimited**	**unlimited**
NAT rules	**1**	**unlimited**	**unlimited**	**unlimited**	**unlimited**
HotSpot active users	**1**	**1**	**200**	**500**	**unlimited**
RADIUS client	**-**	**yes**	**yes**	**yes**	**yes**
Queues	**1**	**unlimited**	**unlimited**	**unlimited**	**unlimited**
Web proxy	**-**	**yes**	**yes**	**yes**	**yes**
RIP, OSPF, BGP protocols	**-**	**yes**	**yes**	**yes**	**yes**
Upgrade	**configuration erased on upgrade**	**yes**	**yes**	**yes**	**yes**

Note that **Wireless Client and Bridge** means that wireless cards can be used in **station** and **bridge** modes. **Bridge** mode allows one wireless station to connect it.

When upgrading to 2.8, you can update your existing key for version 2.5, 2.6 or 2.7 for free, if the existing key upgrade term is not over, during the three-day demonstration period either manually on our accounting server or with a console or WinBox command. This three-day term allows you to use all the existing key features present in the previous version. There is also a possibility in 2.8 version to upgrade your key (i.e. to extend licensing term) from the console or WinBox.

Note that the license is kept on hard drive. You can move the hard drive to another system, but you can not move license on another hard drive. License transfer to another drive is a paid service (unless your hard drive has crashed). Please contact support@mikrotik.com to arrange this. Also note that you must not use MS-DOS format or fdisk utilities or you may loose the license.

Important: the abovementioned limits depict the limits enforced by the license. The actual number of concurrent tunnels, rules, queues, users, etc. will vary depending the combination of features used and the load they place on the MikroTik RouterOS.

License Management

Home menu level: ***/system license***

Description

There are three methods of entering a key to the system console:

- import a file that should be sent to you after you will require a key (you should upload this file to the router's FTP server)
- simply copy the received key as a text and paste (or type) in to the router's console (no matter in which submenu)

These methods also apply to WinBox, with the difference that key importing and exporting is happening through the Windows host PC itself. The options available:

- **Paste Key** - get a new license from the Windows Clipboard
- **Import Key** - get a new license from a file stored locally on the Windows PC
- **Export Key** - save the existing license as a file on the Windows PC
- **Upgrade/Get New Key** - the same as new-upgrade-key command in system console
- **Update Key** - the same as update-key command in system console

Property Description

key (*read-only: text*) - software license key that unlocks the installation

level (*read-only: integer*: 0..6) - license level of the installation

software-id (*read-only: text*) - ID number of the installation

upgradable-until (*read-only: text*) - the date until which the software version can be upgraded or downgraded

Command Description

import - import a key file (*name*) - file name to use as a key

new-upgrade-key - request a new key (*IP address*) - key server's IP address (*text*) - username to log into the key server (*text*) - password to log into the key server (*integer*: 2..6) - license level to request (*credit-card* | *credit-keys* | *credit-money* | *debit-keys* | *debit-money*) - Payment method to use (*text*; default: **""**) - script to execute while the command is running (*time*; default: **1s**) - how frequently to execute the given script - if specified, executes the sctipt once, and then terminates the command - command's execution status

- **Resolving www.mikrotik.com** - resolving DNS name

- **Failed to resolve www.mikrotik.com, check your dns settings** - check whether DNS client is set up on the router, and that it is allowed to resolve a DNS name on the DNS server set
- **Failed to connect, probably no IP address** - self-explanatory
- **Failed to connect, is your router public?** - check whether the router has a default route and is able to reack the key server
- **Connecion failed** - connection has timed out
- **Bad response from server** - try again
- **ERROR: You don't have appropriate debit key!** - no existing debit keys on your account matches the requested one
- **ERROR: You don't have enought debit money!** - self-explanatory
- **ERROR: Credit key limit exceeded!** - self-explanatory
- **ERROR: Your credit limit is exceeded!** - self-explanatory
- **ERROR: This payment method is not more allowed! Go to www.mikrotik.com, log on and purchase key there or use other payment methods.** - you can not use the selected payment method from the router anymore due to system changes (for credit cards now)
- **ERROR: You must enable this feature in account server (change user information section)!** - you should enable Allow to use my account in netinstall feature on the accout server (in change user information section
- **ERROR: Incorrect username or password!** - self-explanatory
- **ERROR: You are not allowed to use this service!** - please contact sales@mikrotik.com for further assistance
- **Key upgraded successfully** - the upgrade procedure has been completed successfully

output - exports the current key to a key file

update-key - request a free update of your existing key to the version's 2.8 one (this can be done during your existing key upgrade term) (*IP address*) - key server's IP address (*text*) - username to log into the key server (*text*) - password to log into the key server (*text*; default: **""**) - script to execute while the command is running (*time*; default: **1s**) - how frequently to execute the given script - if specified, executes the sctipt once, and then terminates the command - command's execution status

- **Resolving www.mikrotik.com** - resolving DNS name
- **Failed to resolve www.mikrotik.com, check your dns settings** - check whether DNS client is set up on the router, and that it is allowed to resolve a DNS name on the DNS server set
- **Failed to connect, probably no IP address** - self-explanatory
- **Failed to connect, is your router public?** - check whether the router has a default route and is able to reack the key server
- **Connecion failed** - connection has timed out
- **Bad response from server** - try again
- **ERROR: You must enable this feature in account server (change user information section)!** - you should enable Allow to use my account in netinstall feature on the accout server (in change user information section
- **ERROR: Incorrect username or password!** - self-explanatory
- **ERROR: Someone has already converted this key!** - the requested software ID has already been converted to 2.8 version

- **ERROR: Key for specified software ID is expired. You can purchase new key at www.mikrotik.com website!** - you may not update an expired key to the version 2.8, you must purchase a new one
- **ERROR: You are not allowed to use this service!** - please contact sales@mikrotik.com for further assistance
- **Key upgraded successfully** - the upgrade procedure has been completed successfully

Telnet Server and Client

Document revision 2.1 (Mon Jul 19 07:31:04 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

MikroTik RouterOS has a build-in Telnet server and client features. These two are used to communicate with other systems over a network.

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/system, /ip service***
Standards and Technologies: ***Telnet (RFC 854)***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***
- ***System Resource Management***

Telnet Server

Home menu level: ***/ip service***

Description

Telnet protocol is intended to provide a fairly general, bi-directional, eight-bit byte oriented communications facility. The main goal is to allow a standard method of interfacing terminal devices to each other.

MikroTik RouterOS implements industry standard Telnet server. It uses port 23, which must not be disabled on the router in order to use the feature.

You can enable/disable this service or allow the use of the service to certain IP addresses.

Example

```
[admin@MikroTik] ip service> print detail
Flags: X - disabled, I - invalid
 0   name="telnet" port=23 address=0.0.0.0/0

 1   name="ftp" port=21 address=0.0.0.0/0

 2   name="www" port=80 address=0.0.0.0/0

 3   name="hotspot" port=8088 address=0.0.0.0/0

 4   name="ssh" port=65 address=0.0.0.0/0

 5 X name="hotspot-ssl" port=443 address=0.0.0.0/0 certificate=none
[admin@MikroTik] ip service>
```

Telnet Client

Command name: ***/system telnet [IP address] [port]***

Description

MikroTik RouterOS telnet client is used to connect to other hosts in the network via Telnet protocol.

Example

An example of Telnet connection:

```
[admin@MikroTik] > system telnet 10.1.0.1
Trying 10.1.0.1...
Connected to 10.1.0.1.
Escape character is '^]'.

MikroTik v2.8beta12
Login: admin
Password:

  MMM      MMM       KKK                          TTTTTTTTTTT      KKK
  MMMM    MMMM       KKK                          TTTTTTTTTTT      KKK
  MMM MMMM MMM  III  KKK  KKK  RRRRRR     OOOOOO      TTT     III  KKK  KKK
  MMM  MM  MMM  III  KKKKK     RRR  RRR  OOO  OOO     TTT     III  KKKKK
  MMM      MMM  III  KKK KKK   RRRRRR    OOO  OOO     TTT     III  KKK KKK
  MMM      MMM  III  KKK  KKK  RRR  RRR   OOOOOO      TTT     III  KKK  KKK

  MikroTik RouterOS 2.8beta12 (c) 1999-2003       http://www.mikrotik.com/


Terminal unknown detected, using single line input mode
[admin@10.1.0.1] >
```

Log Management

Document revision 2.3 (Mon Jul 19 07:23:35 GMT 2004)
This document applies to V

Table of Contents

General Information

Summary

Various system events and status information can be logged. Logs can be saved in a file on the router, or sent to a remote server running a syslog daemon. MikroTik provides a shareware Windows Syslog daemon, which can be downloaded from ***www.mikrotik.com***

Specifications

Packages required: ***system***
License required: ***level1***
Home menu level: ***/system logging, /log***
Standards and Technologies: ***Syslog***
Hardware usage: ***Not significant***

Related Documents

- ***Package Management***

Description

The logging feature sends all of your actions on the router to a log file or to a logging daemon.

Router has several global configuration settings that are applied to logging. Logs have different facilities. Logs from each facility can be configured to be discarded, logged locally or remotely. Log files can be stored in memory (default; logs are lost on reboot) or on hard drive (not enabled by default as is harmful for flash disks).

General Settings

Home menu level: ***/system logging***

Property Description

default-remote-address (*IP address*; default: **0.0.0.0**) - remote log server IP address. Used when remote logging is enabled but no IP address of the remote server is specified

default-remote-port (*integer*; default: **0**) - remote log server UDP port. Used when remote logging is enabled but no UDP port of the remote server is specified

disk-buffer-lines (*integer*; default: **100**) - number of lines kept on hard drive

memory-buffer-lines (*integer*; default: **100**) - number of lines kept in memory

Example

To use the **10.5.13.11** host, listening on **514** port, as the default remote system-log server:

```
[admin@MikroTik] system logging> set default-remote-address=10.5.13.11
default-remote-port=514
[admin@MikroTik] system logging> print
    default-remote-address: 10.5.13.11
       default-remote-port: 514
         disk-buffer-lines: 100
       memory-buffer-lines: 100
[admin@MikroTik] system logging>
```

Log Classification

Home menu level: ***/system logging facility***

Property Description

echo (*yes* | *no*; default: **no**) - whether to echo the message of this type to the active (logged-in) consoles

facility (*name*) - name of the log group, message type

local (*disk* | *memory* | *none*; default: **memory**) - how to treat local logs

- **disk** - logs are saved to hard drive
- **memory** - logs are saved to local buffer. They can be viewed using the '/log print' command
- **none** - logs from this source are discarded

prefix (*text*; default: **""**) - local log prefix

remote (*none* | *syslog*; default: **none**) - how to treat logs that are sent to remote host

- **none** - do not send logs to a remote host
- **syslog** - send logs to remote syslog daemon

remote-address (*IP address*; default: `""`) - remote log server's IP address. Used when logging type is remote. If not set, default log server's IP address is used

remote-port (*integer*; default: **0**) - remote log server UDP port. Used when logging type is remote. If not set, default log server UDP port is used

Notes

You cannot add, delete or rename the facilities: they are added and removed with the packages they are associated with.

System-Echo facility has its default **echo** property set to **yes**.

Example

To force the router to send **Firewall-Log** to the 10.5.13.11 server:

```
[admin@MikroTik] system logging facility> set Firewall-Log remote=syslog \
\... remote-address=10.5.13.11  remote-port=514
[admin@MikroTik] system logging facility> print
 # FACILITY       LOCAL  REMOTE PREFIX         REMOTE-ADDRESS  REMOTE-PORT ECHO
 0 Firewall-Log   memory syslog                10.5.13.11      514         no
 1 PPP-Account    memory none                  0.0.0.0         0           no
 2 PPP-Info       memory none                  0.0.0.0         0           no
 3 PPP-Error      memory none                  0.0.0.0         0           no
 4 System-Info    memory none                  0.0.0.0         0           no
 5 System-Error   memory none                  0.0.0.0         0           no
 6 System-Warning memory none                  0.0.0.0         0           no
 7 Telephony-Info memory none                  0.0.0.0         0           no
 8 Telephony-E... memory none                  0.0.0.0         0           no
 9 Prism-Info     memory none                  0.0.0.0         0           no
10 Web-Proxy-A... memory none                  0.0.0.0         0           no
11 ISDN-Info      memory none                  0.0.0.0         0           no
12 Hotspot-Acc... memory none                  0.0.0.0         0           no
13 Hotspot-Info   memory none                  0.0.0.0         0           no
14 Hotspot-Error  memory none                  0.0.0.0         0           no
15 IPsec-Event    memory none                  0.0.0.0         0           no
16 IKE-Event      memory none                  0.0.0.0         0           no
17 IPsec-Warning  memory none                  0.0.0.0         0           no
18 System-Echo    memory none                  0.0.0.0         0           yes
[admin@MikroTik] system logging facility>
```

Log Messages

Home menu level: ***/log***

Description

Some log entries, like those containing information about user logout event, contain additional information about connection. These entries have the following format: `<time> <user> logged out, <connection-time-in-seconds> <bytes-in> <bytes-out> <packets-in> <packets-out>`

Property Description

message (*text*) - message text

time (*text*) - date and time of the event

Notes

print command has the following arguments:

- **follow** - monitor system logs
- **without-paging** - print the log without paging
- **file** - saves the log information to ftp with a specified file name

Example

To view the local logs:

```
[admin@MikroTik] > log print
 TIME                 MESSAGE
 dec/24/2003 08:20:36 log configuration changed by admin
 dec/24/2003 08:20:36 log configuration changed by admin
 dec/24/2003 08:20:36 log configuration changed by admin
 dec/24/2003 08:20:36 log configuration changed by admin
 dec/24/2003 08:20:36 log configuration changed by admin
 dec/24/2003 08:20:36 log configuration changed by admin
-- [Q quit|D dump]
```

To monitor the system log:

```
[admin@MikroTik] > log print follow
 TIME                 MESSAGE
 dec/24/2003 08:20:36 log configuration changed by admin
 dec/24/2003 08:24:34 log configuration changed by admin
 dec/24/2003 08:24:51 log configuration changed by admin
 dec/24/2003 08:25:59 log configuration changed by admin
 dec/24/2003 08:25:59 log configuration changed by admin
 dec/24/2003 08:30:05 log configuration changed by admin
 dec/24/2003 08:30:05 log configuration changed by admin
 dec/24/2003 08:35:56 system started
 dec/24/2003 08:35:57 isdn-out1: initializing...
 dec/24/2003 08:35:57 isdn-out1: dialing...
 dec/24/2003 08:35:58 Prism firmware loading: OK
 dec/24/2003 08:37:48 user admin logged in from 10.1.0.60 via telnet
-- Ctrl-C to quit. New entries will appear at bottom.
```