

# RouterOS and Wireless Systems

## Quick Setup Guide and Warranty Information



*The picture may not represent the actual product you have purchased, however the information below is valid for all MikroTik routers*

### MikroTik Wireless Package Installation

A MikroTik Wireless package includes a router, coaxial cable with connectors installed, and antenna(s). To deploy your newly received Wireless package, you should proceed as follows:

1. Place and align your antenna. Antenna positioning is very individual for each site, so it will not be described here, except for some general suggestions:
  - Maintain clear line of sight between the antenna and all the points that will connect to it (unless used indoors, where radio waves are reflected extensively). Note that most antennas do not cover a complete sphere around them, and do not radiate equally in all directions – they only roughly cover a spherical cone (directional and flat-panel antennas) or an elliptic torus (omnidirectional antennas).
  - Having obstacles in the signal path even if clear line of sight is maintained, may influence and reduce signal quality due to Fresnel effect. Note that even when clear line of sight is not secured, a connection with [a significantly weaker] signal level still might be possible due to reflection and diffraction effects.
  - Beware of large open surfaces reflecting radio waves (like ground and rivers) – they might affect signal quality greatly (up to neutralizing it completely) if appear in the area of coverage of both antennas because of direct and reflected received signal phase difference. This is also caused by Fresnel effect.
  - Keep in mind that the antennas at both sides of the link must have the same polarization. Having one antenna vertically polarized, and the other one horizontally, will effectively neutralize the signal. Note that indoors this effect may not be considered because of many reflections. Also note that vertical antenna polarization is considered to be better for longer links as the radio wave is less reflected by ground, but horizontal – for links across water or marsh lands.
2. Install the router at the desired location. Consider placing the router as much close to the antenna as possible. Long cables between the router and antenna weaken signal strength due to significant attenuation in cable (having 10-15 meter long cable on each side of the wireless link means reducing the maximal distance between the endpoints two times). Consider using outdoor package if you have problems placing the router close to the antenna.
3. Attach supplied coaxial cable to appropriate connectors on the router and the antenna. When tying the coaxial cable, make sure no water can get into it and/or into the equipment it is attached to. It is very important to seal the connection properly with a good rubber tape made particularly for this purpose (note that many general purpose tapes will not prevent moisture to leak into connector, or will fail after some time).

### Connecting to the router

If you have received a factory-configured router, it is preset to have all factory-installed interfaces enabled, and IP addresses assigned. There is the 192.168.0.1 address on the first Ethernet interface and DHCP client on the second. Other interfaces have addresses 192.168.1.1, 192.168.2.1, and so on (wireless interfaces are enumerated after the Ethernet ones). Newly installed interfaces will not be enabled and configured automatically. **CAUTION:** it is possible to reset the configuration, in which case all the configuration, including IP addresses will be permanently erased and it will only be possible to connect to this router using serial console, the **MAC-telnet** tool, as well as Winbox. It is also possible to restore the initial factory configuration (including all IP addresses) with the command `/system backup load=factory-default`.

Not factory-configured routers do **not** have any IP configuration preset, but only have Ethernet ports enabled, so you can only connect to the router using serial console, the **MAC-telnet** tool, as well as Winbox.

Normally you connect to the router by IP addresses with any telnet or SSH client software (a simple text-mode telnet client is usually called **telnet** and is distributed together with almost any OS). You can also use graphical configuration tool for Windows (also can be run in Linux using **Wine**) called **Winbox**. To get **Winbox**, connect to the router's IP address with a

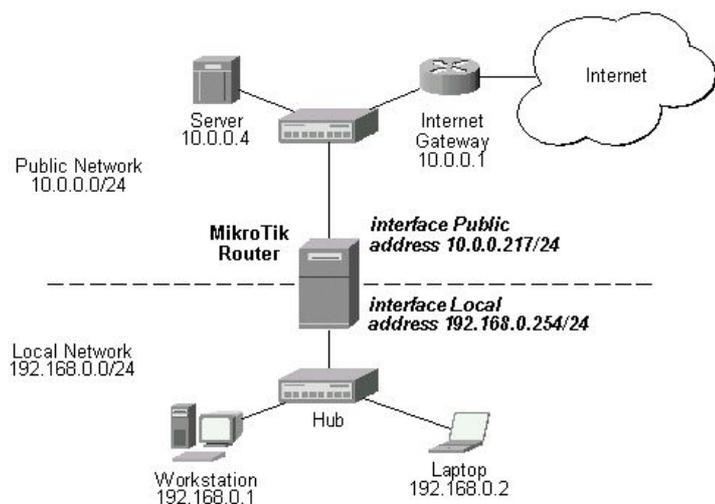
web browser, and follow the link to download **winbox.exe** from the router. After connecting to the router, use "admin" (without quotation marks) as username and blank password (just press **[Enter]** key instead of it) to log in.

MAC-telnet is used to connect to a router when there is no other way to connect to it remotely – if the router has no IP address or in case of misconfigured firewall. **MAC-telnet** can only be used from the same broadcast domain (so there should be no routers in between) as any of the router's enabled interfaces (you can not connect to a disabled interface). **MAC-telnet** program is a part of the **Neighbor Viewer**. Download it from [www.mikrotik.com](http://www.mikrotik.com), unpack both files contained in the archive to the same directory, and run **NeighborViewer.exe**. A list of MikroTik routers working in the same broadcast domain will be showed – double-click the one you need to connect to. Note that Winbox is also able to connect to routers by their MAC addresses, and has the discovery tool built-in.

You can also connect to the router using a standard DB9 serial null-modem cable from any PC. Default settings of the router's serial port are 9600 bits/s (for RouterBOARD 500 series – 115200 bits/s), 8 data bits, 1 stop bit, no parity, hardware (RTS/CTS) flow control. Use terminal emulation program (like **HyperTerminal** or **SecureCRT** in Windows, or **minicom** in UNIX/Linux) to connect to the router. The router will beep twice when booted up, and you should see the login prompt shortly before that (check cabling and serial port settings if you do not see anything in the terminal window).

## Basic Software Setup

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 has 10.0.0.217 address in this network and it's gateway is 10.0.0.1

## Enabling Interfaces

Interface must be enabled in order to use it. To enable the interfaces we are using in this example:

```
/interface enable Public, Local
```

Here the interface names **Public** and **Local** are generic. Use **ether1**, **ether2**, **wlan1**, etc. according to your actual configuration. If you are using wireless interfaces in this setup, please consult the next chapter "**Wireless Configuration Examples**" on how to configure wireless interfaces as it is not enough just to enable them as shown here.

## Adding Addresses

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

```
/ip address add address=10.0.0.217/24 interface=Public
/ip address add address=192.168.0.254/24 interface=Local
```

The resulting configuration can be viewed using the **/ip address print** command:

```
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
```

Here, the network mask has been specified together with the IP address in the **address** field. Alternatively, the **netmask** argument could have been used with the value of either **24** or **255.255.255.0** with the same effect. Please **note** that you must specify network mask for each address. 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.

## Adding Routes

To configure the default route for the traffic from your network to get to the Internet through your ISP's gateway (10.0.0.1), which can be reached through the interface **Public** :

See [www.mikrotik.com](http://www.mikrotik.com) for more information. Contact [support@mikrotik.com](mailto:support@mikrotik.com) for support questions.

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```
/ip route add gateway=10.0.0.1
```

Now to check that we have set up the default route correctly, issue the `/ip route print` command. Let's analyze the output

```
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
```

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.

If you have added an unwanted static route accidentally, use the `remove` command to delete it (so if you need to delete route #1, issue the `/ip route remove 1` command). You will not be able to delete dynamic (DC) routes. They are added automatically and represent routes to the networks the router connected directly.

If you do not have at least one dynamic (DC) route for each interface you have configured, it may mean that some interface is either disabled or not configured.

### 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.

This is how the `ping` command works:

```
[admin@MikroTik] > /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
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 1/1.0/1 ms
[admin@MikroTik] >
```

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
```

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

### Why I cannot access anything beyond the router?

You cannot access anything beyond the router (network 10.0.0.0/24 and the Internet), unless you do 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 also required that you have some knowledge of TCP/IP networks. There is a comprehensive list of IP resources compiled by Uri Raz at [http://www.private.org.il/tcpip\\_rl.html](http://www.private.org.il/tcpip_rl.html). We strongly recommend that you obtain more networking knowledge, if you have difficulties configuring your network setups.

If you want to 'hide' the private 192.168.0.0/24 LAN 'behind' the 10.0.0.217 address given to you by the ISP, you should use 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, so that all requests appear to be coming from the 10.0.0.217 host of the ISP's network. The masquerading will change the source IP address and port of the packets originated from the 192.168.0.0/24 network 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:

```
/ip firewall nat add chain=srcnat action=masquerade out-interface=Public
```

### Further Information

Please consult the online RouterOS documentation (<http://www.mikrotik.com/documentation.html>) for more information on different kinds of configuration. You can also find many configuration examples there. If, after reading the manual, you still have some questions, you can contact [support@mikrotik.com](mailto:support@mikrotik.com).

## Wireless Configuration Examples

These basic examples show some introductory configuration tasks done from text-mode interface, not from Winbox (but they still can be done with Winbox). Note that the examples given assume that you are configuring the first wireless interface (**wlan1**) and/or the first Ethernet interface (**ether1**) of the router.

### Wireless Client

Choose frequency band (one of: **2.4ghz-b**, **2.4ghz-b/g**, **2.4ghz-g-turbo**, **2.4ghz-only-g**, **5ghz**, **5ghz-turbo**), SSID (a text identifier of the wireless network, must be the same as on the AP the client is connecting to) and mode (**station**):

```
/interface wireless set wlan1 ssid="test" band=5ghz mode=station disabled=no
```

### Wireless Base Station (Access Point)

Choose frequency band (one of: **2.4ghz-b**, **2.4ghz-b/g**, **2.4ghz-g-turbo**, **2.4ghz-only-g**, **5ghz**, **5ghz-turbo**), actual frequency (in MHz), SSID (a text identifier of the wireless network, should be different from the APs of other wireless networks) and mode (**ap-bridge**):

```
/interface wireless set wlan1 ssid="test" frequency=5805 band=5ghz mode=ap-bridge disabled=no
```

### Wireless Bridge

Configuration is the same as for **Wireless Base Station**, but in addition if you want to bridge the wireless network together with the wired Ethernet, connected to the **ether1** port of the router, do the following:

```
/interface bridge add name=wirebridge disabled=no  
/interface bridge port set ether1,wlan1 bridge=wirebridge
```

**Note** that cards in **station** mode can not be bridged – this example is only for access points.

### Wireless WDS Repeater or Point-to-Point Link

You can define static Point-to-Point (WDS) connections between wireless access points (**note**: you do not need wireless AP **Level 5** license to do this – **Level 4** license will be sufficient). Choose frequency band (one of: **2.4ghz-b**, **2.4ghz-b/g**, **2.4ghz-g-turbo**, **2.4ghz-only-g**, **5ghz**, **5ghz-turbo**), actual frequency (in MHz), SSID (a text identifier of the wireless network, should be different from the APs of other wireless networks and the same between the APs you want to connect with WDS to) and mode (either **bridge** or **ap-bridge**). You can put multiple WDS connections on one physical radio card.

If you do not plan to use the **wlan1** card as a regular access point (i.e. to connect wireless clients), but only to create a single Point-to-Point link to the **00:0B:6B:31:AE:AF** remote wireless card, simply create one WDS interface:

```
/interface wireless set wlan1 ssid="test" frequency=5805 band=5ghz mode=bridge wds-mode=static  
default-authentication=no disabled=no  
/interface wireless wds add name=AF master-interface=wlan1 wds-address=00:0B:6B:31:AE:AF disabled=no
```

You may also want to bridge the newly created WDS interface with the Ethernet port, just like in the previous example.

To create an additional wireless WDS link to the **00:0B:6B:31:02:4B** cards, and bridge the connections together (thus creating a wireless repeater between the two mentioned remote sites), add the following to the configuration:

```
/interface wireless wds add name=4B master-interface=wlan1 wds-address=00:0B:6B:31:02:4B disabled=no  
/interface bridge add name=repeater disabled=no  
/interface bridge port set AF,4B bridge=repeater
```

**Note** that on the remote sites there should be the same configuration of wireless card (band, frequency, SSID and WDS mode), and WDS interface created to the wireless card of the given location.

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