

# InfiNet Wireless R5000

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*Quick start guide*

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# I. Getting Started

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This document is designed to help engineers/technicians in rapid configuring of InfiNet Wireless R5000 system. The document includes detailed instructions for first configuration steps and configuration scenarios for typical network topologies.

## 1. Scope of document

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This document consists of the following chapters:

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### *Getting started*

This chapter includes the information about this document purpose and structure.

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### *Getting access to the router*

The chapter describes how to get access to the router via Console Port and to configure Ethernet port.

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### *Point-to-point configuration*

This chapter includes a comprehensive list of instructions for point-to-point link configuration including providing LAN connectivity.

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### *Other topologies*

The chapter briefly describes the difference between configuring PTP links and networks with other topologies.

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### *Performing outdoor testing*

The chapter contains a list of requirements for outdoor testing. Also a basic steps for link improvement and antenna alignment is presented.

## 2. Abbreviations

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The following abbreviations are used in this document:

- BS – Base Station
- CPE – Customer Premises Equipment (also called **subscriber** or **subscriber unit**)
- ODU – Outdoor Unit
- IDU – Indoor power supply Unit
- RF cable – Radio Frequency cable to connect ODU and antenna
- LOS – Line-of-Sight
- STP cable – Shielded Twisted Pair cable to connect ODU and IDU (relevant for 5000-O and 5000-M modifications). FTP (Foiled Twisted Pair) CAT5e also can be used
- PTP – Point-to-Point topology
- PTM – Point-to-Multipoint topology
- MINT – Mesh Interconnection Networking Technology

### 3. Document marks

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*All warnings are marked with a special warning sign. One should pay a great deal of attention to what is written in the Warning sections.*

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*All notes are marked with a special note sign. Notes usually contain useful comments or hints to the described section of the document.*

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### 4. Additional information

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Additional information which is not included in this Manual can be found in the following sources:

- Device passport located in the box with the device
- InfiNet Wireless R5000. Technical User Manual
- WANFlE X OS User Guide
- Our web-site: [www.infinetwireless.com](http://www.infinetwireless.com)

## II. Getting access to the unit

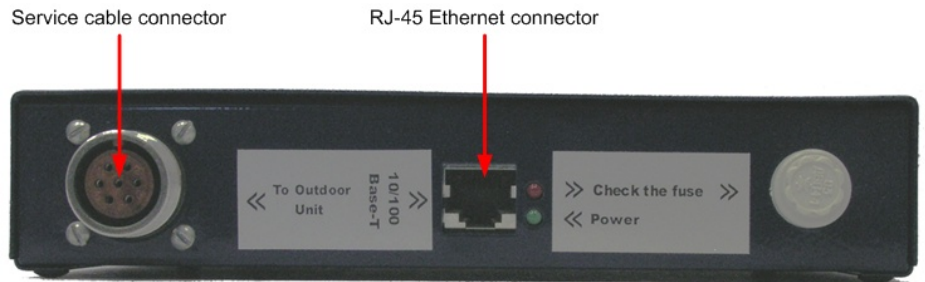
### 1. PC/Laptop/LAN connection

#### *Cabling (lab)*

The sequence of actions to be performed in order to connect the unit to the PC/Laptop is the following:

1. Unpack the equipment
2. If you do not have a service cable soldered, please do it using special connectors included into the package according to the soldering scheme located in the "Supplementary information" section. STP cable cat 5 or cat 5E should be used.
3. Locate IDU (blue case) and ODU (white case). Using STP Service cable connect ODU and IDU. Service cable sockets are marked on the diagrams below

#### IDU-5000-SCR



#### IDU-5000-CPE

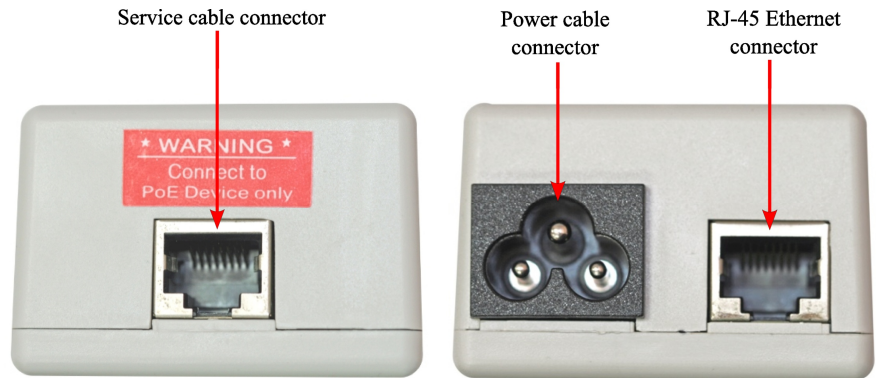


Figure 1. IDUs Fronts

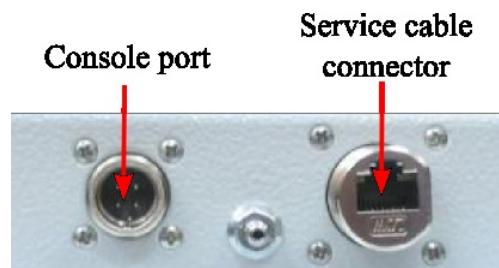


Figure 2. RJ-45 ODU Front (fragment)



Figure 3. Screw Lock ODU Front (fragment)

### *Accessing the unit via Console*

If you cannot get access to the unit using procedure described in “Accessing the unit via Ethernet” section please follow the steps described in this section.

1. Using InfiNet Console Cable please connect the unit’s console port (see Fig. 2) to the COM-port of your PC/Laptop



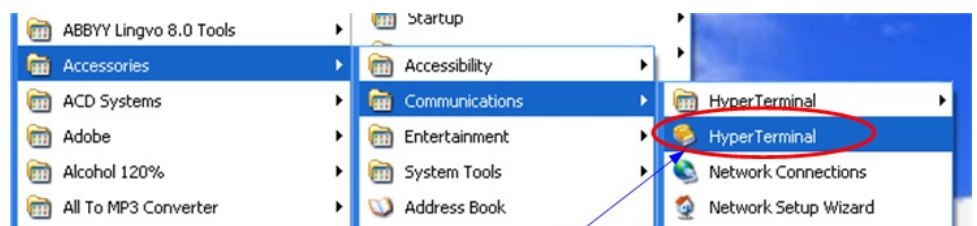
*In order to accomplish the steps described in this section your PC/Laptop must be equipped with a COM-port*

2. Locate the power cord in the package
3. Plug the power cord into the IDU power supply connector and to the power supply socket (220V 50 Hz or 110V 60 Hz depending on the country of residence)
4. Green power indicator on the IDU must light up
5. Power your PC/Laptop on



*Following step's screenshots are taken from Microsoft Windows XP. You can also perform this procedure in Microsoft Windows 98/NT/2003*

6. Run Hyperterminal. See Figure 4



Locate and run Hyperterminal

Figure 4. Locate Hyperterminal

7. Indicate connection name (e.g. “IWR Lab Test”) and specify the COM-port name to which the unit is connected. See Figure 5



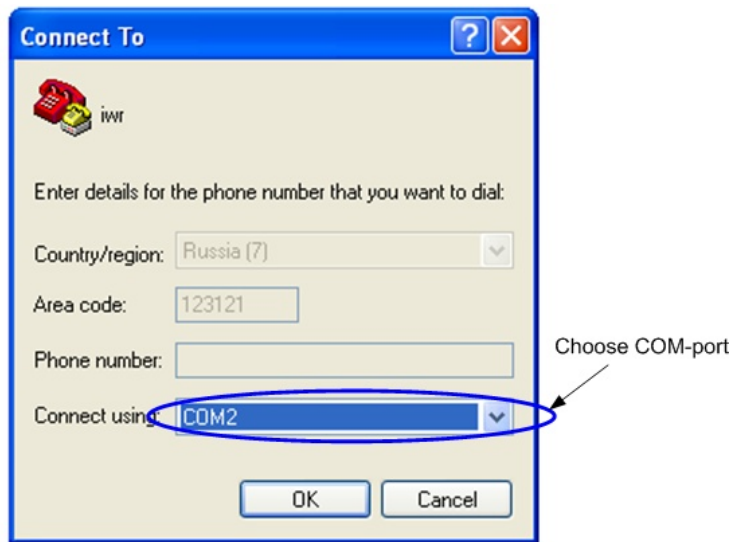
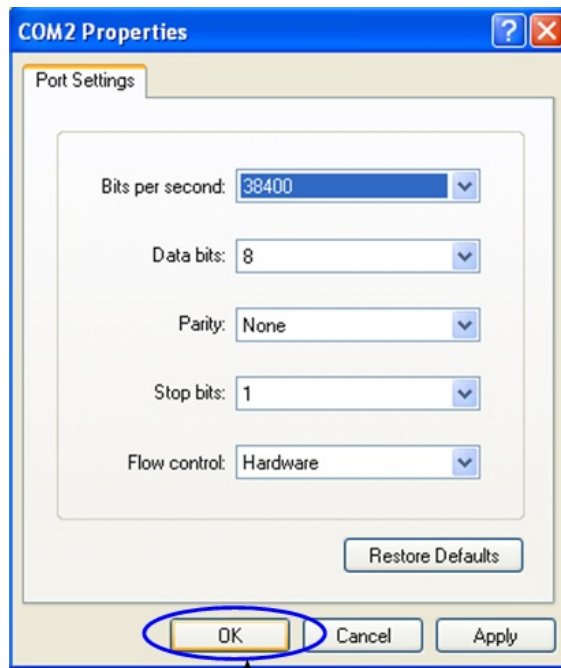


Figure 5. Select the port

8. Specify port parameters exactly as shown on Figure 6



After configuring, press OK

Figure 6. Port parameters

9. If you connected everything properly, selected the right port and made its configuration right, after pressing enter on the white blank screen (after step 8) you should see WANFlex OS prompt as shown on Figure 7

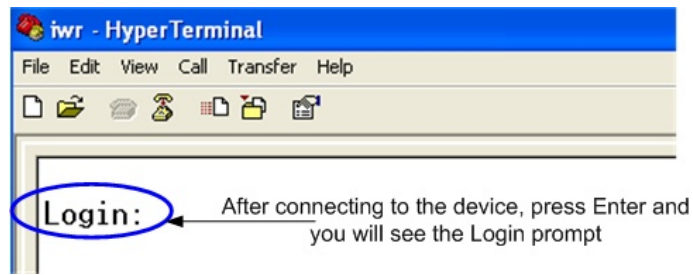


Figure 7. WANFlex OS prompt

- Your device has a factory configuration. That means that you can enter ANY non-zero length login and password. Once this is done, you will see WANFlex CLI (Command Line Interface). See Figure 8

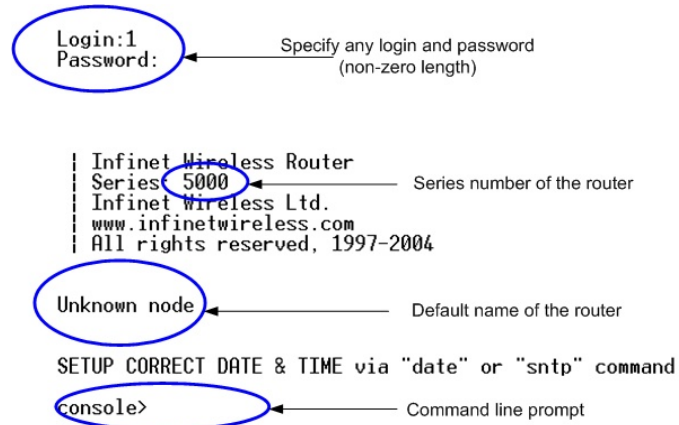


Figure 8. "After login" screen

- In order for your unit to be accessible from your LAN/PC/Laptop via Ethernet, you should configure `eth0` interface IP-address so the unit would allocate in the desired LAN (or accessible from your PC/Laptop Ethernet adapter). You can change this IP-address via "`ifc eth0`" command as shown on figure 9. After changing the IP-address, save the configuration using "`co sa`" command. In the example given the IP-address being assigned to `eth0` interface is `9.1.8.1` with mask length 24 (`255.255.255.0`). In order to check whether your changes were correct, use "`co sh ifc`" command which shows configuration for all interfaces of the unit. Do not forget to save your configuration using "`co sa`" (`config save`) command.

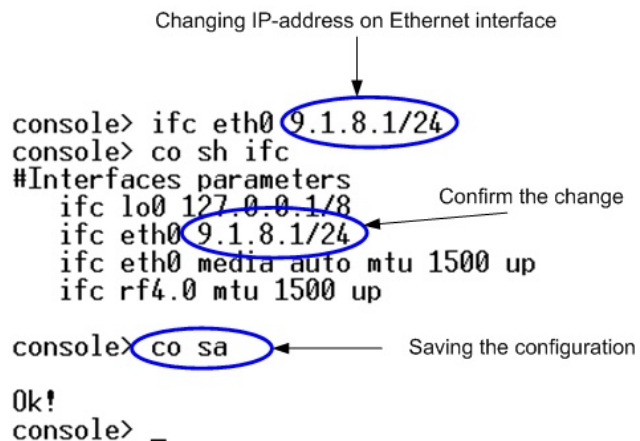


Figure 9. Changing IP-address on `eth0` interface

- If all your settings are correct you can connect the unit to your LAN using UTP cable with RJ-45 connectors (Ethernet port of the unit is located on IDU).

## *Accessing the unit via Ethernet*

If your PC/Laptop does not have a COM-port or you want to plug the unit to the LAN switch you can configure it using Telnet protocol.

The default IP-address assigned to the eth0 interface of the unit is 10.10.10.1 with 255.255.255.0 mask.

If you connect the unit directly to the LAN/PC/Laptop you should either change the IP-address on the Ethernet adaptor or create an alias IP-address which would be located in 10.10.10.0/24 network.

Connect the unit to LAN/PC/Laptop using UTP cable with RJ-45 connectors.

The procedure is the following:

1. Open the Control Panel in Windows. See Figure 10

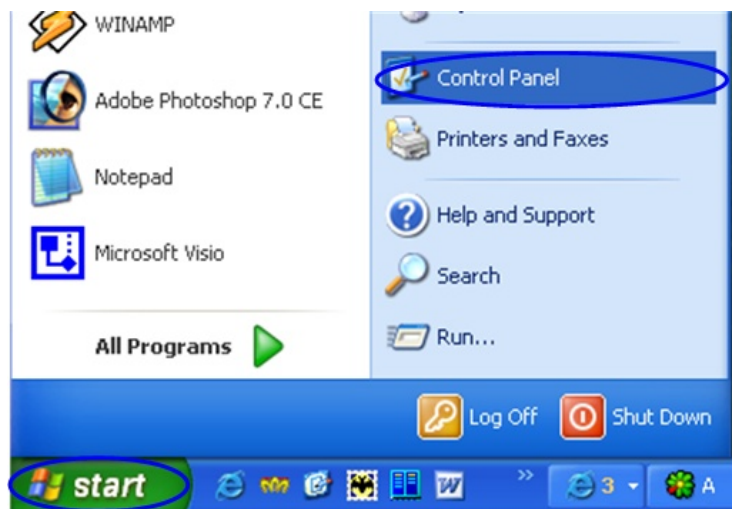


Figure 10. Open Control Panel

2. Open "Network connections" icon. See Figure 11



Figure 11. "Network connections"

3. In "Network connections" folder right mouse button click on the LAN connection and click "Properties". See Figure 12

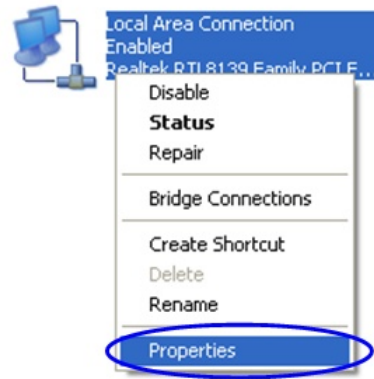


Figure 12. LAN Connection properties

4. Choose "Internet protocol (TCP/IP)" and click "Properties". See Figure 13.

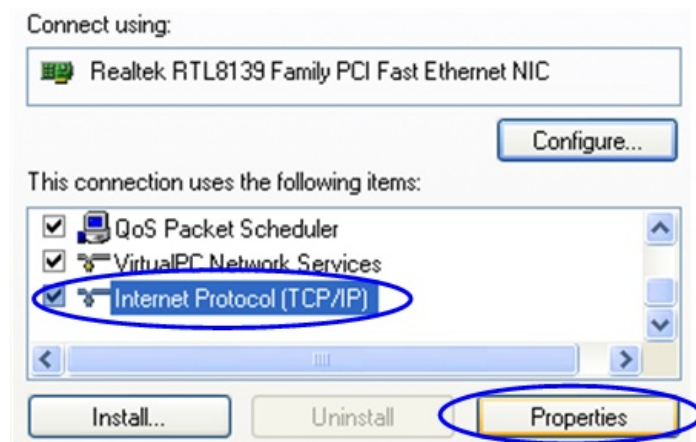


Figure 13. Internet Protocol Properties

5. If you want to connect to the unit using PC/Laptop you can just change an IP-address on the Ethernet adaptor to some address from 10.10.10.0/24 network (e.g. change "IP-address" field to "10.10.10.2" and "Subnet mask" to "255.255.255.0"). After that click OK and move to step 7. See Figure 14

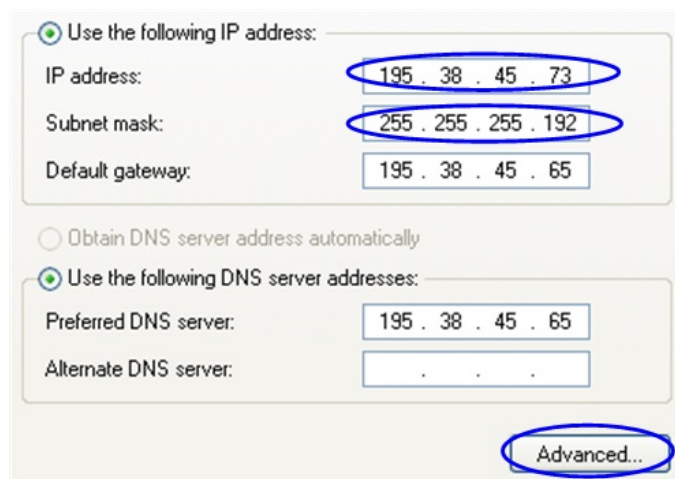


Figure 14. Change IP-address

6. If you are in a LAN and you do not want to change your primary IP-address so you could keep LAN connectivity, you can assign an alias. In order to do that, press "Advanced..." button (Figure 14). In "Advanced TCP/IP Settings" click "Add" and put alias IP-address and mask (e.g. "10.10.10.2" and "255.255.255.0" correspondingly). See Figure 15. Click OK in all windows opened in the described procedure.

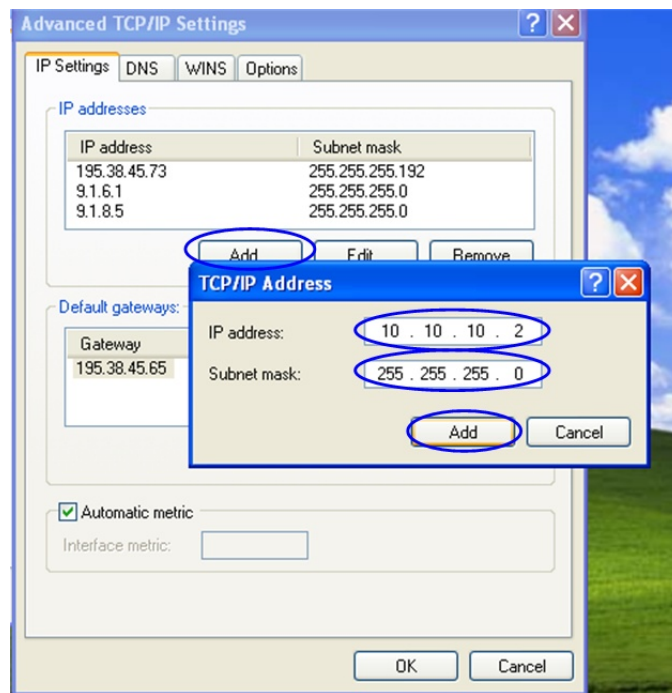


Figure 15. Create alias

7. Run "Telnet" utility using "Start->Run" and type "telnet IP-address" where IP-address is the unit's IP-address (by default: 10.10.10.1).
8. Follow Steps 9 to 11 of "Accessing the unit via Console" section in order to change the IP-address on the eth0 interface of the unit to the desired one.

## 2. Initial setup

Once you have got the access to the unit via Telnet, you can perform initial unit setup. Run telnet application (Start->Run) using IP-address that was assigned on the eth0 interface of the unit (for example, 9.1.8.1)

First of all, let us list some useful commands that should be remembered.

- "help" – lists all available commands in the unit
- "config show" (or "co sh" for short) – shows unit's current configuration
- "config save" (or "co sa" for short) – saves unit's current configuration
- "restart y" – immediate unit reboot. Reboot lasts for 20-30 seconds (approximately) and during this time you will not be able to control it over Telnet. "restart XX" can be used for a postponed reboot so the unit will be rebooted in XX seconds (this is very helpful when there is a risk of losing a remote unit while performing risky manipulations with configuration). "restart 0" cancels postponed reboot.
- "quit" – closes current telnet session



*The maximum number of concurrent Telnet sessions per one unit is five.*

## System parameters

Once you've got access to the unit, the most common thing to be done in the first turn is to set up some basic system parameters:

- System name. System name is specified by the following command:  
**system name [system\_name]**
- System user. This parameter will be used as a login:  
**system user [user\_name]**
- System password. System password is used as a password while login:  
**system password [password]**
- System prompt. This command will change current command line interface prompt:  
**system prompt [any\_word]**

Also, it may be useful to know firmware version that is currently available in the unit and unit's serial number. "Sys ver" command can be used for this purpose (Figure 16):

```

Firmware version      Firmware compilation time      Device Serial Number
iwr_test#1> sys ver
R5000 WANFlex 3.33-MINI <type 0> * Oct 11 2004 10:33:48 * SN:459?
iwr_test#1>
    
```

Figure 16. System version

## Learning unit's capabilities

1. In order to learn current interfaces configuration, execute "co sh ifc" command
2. In order to learn all configured interfaces, their states and statistics, execute "ifc -a" command. See Figure 17.

```

Loopback interface
Ethernet interface
Radio interface
Logical interface      MAC-address for rf4.0 radio
iwr_test#1> ifc -a
lo0: flags=8009<UP,LOOPBACK,MULTICAST> mtu 1500
    inet 127.0.0.1 netmask 0xff000000
eth0: flags=8003<UP,BROADCAST,MULTICAST> mtu 1500
    inet 9.1.8.1 netmask 0xffffffff broadcast
    ether 00:04:35:00:11:f1
eth0 is up, line protocol is up
full-duplex, 100Mb/s
Received 2161 packets, 273824 bytes
 0 pause packets, 0 bad packets, 0 overrun
 0 short packets, 0 alignment errors, 0 CR
 0 long packets, 0 out of range errors, 0
Transmitted 103 packets, 6538 bytes
64 CRC errors, 0 carrier loss, 0 excessiv
 0 excessive collisions, 0 late collisions
 0 multiple collisions, 0 single collision
 0 underruns, 0 SQE tests failed
rf4.0: flags=8003<UP,BROADCAST,MULTICAST> mtu 150
    inet 0.0.0.0 netmask 0x0
    ether 00:02:8a:e1:dd:13
null0: flags=8802<BROADCAST, NULL, MULTICAST> mtu 1
    
```

Figure 17. Interfaces information

Note that radio interface name may differ from "rf4.0" depending on the model's frequency range (2.4GHz or 5GHz) and number of radio modules in

the device (one or two). Anyway, radio interface name always starts with "rf".

Information on the specific interface can be obtained using "ifc <IF-NAME>" command. For example, "ifc rf4.0" will give you information on "rf4.0" interface.

3. In order to get unit's capabilities including available frequency list, transmit power levels, bitrates for the specific radio interface, "rf <IF-NAME> cap" command is used. For example, "rf rf4.0 cap". See Figure 18.

```
Atheros AR5212 radio capabilities:
MAC silicon revision:      5.6
PHY silicon revision:     4.1
5GHz analog silicon revision: 1.7
Power levels (mW):       6, 8, 16, 32, 63
MAC address:             00028ae1daa8
Frequency list:         5260, 5280, 5300, 5320, 5340.
Bitrate list:           6000, 9000, 12000, 18000,
                       24000, 36000, 48000, 54000
```

Figure 18. Unit's capabilities

### ***Radio module parameters configuration***

1. Power level changing is accomplished using "rf <IF-NAME> pwr <power-level>" command. For example, "rf rf4.0 pwr 32" sets transmitting power level to 32 mW. Power level specified in the command should be the one from the list of available power levels.
2. Frequency changing is accomplished using "rf <IF-NAME> freq <frequency>" command. For example, "rf rf4.0 freq 5340" sets current working frequency to 5340 MHz. At the same time one radio module can work only on ONE frequency.
3. Bitrate can be changed using "rf rf4.0 bitr <bitrate>" command. For example, "rf rf4.0 bitr 24000" sets current bitrate to 24 Mbps.

### III.Point-to-Point configuration

In our point-to-point configuration example we will built a simple network as shown in Figure 19a.

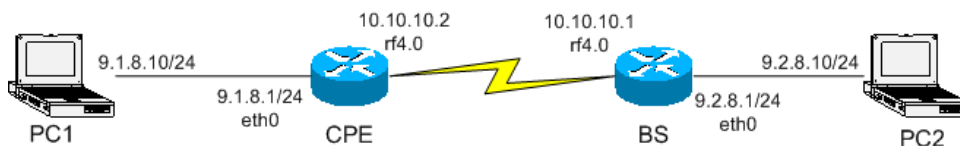


Figure 19a. Sample network (PtP connection)

Please note that InfiNet Wireless unit is able to work both in routing and switching modes. This particular example explains how to configure a PTP link in a **router** mode.

Here we will set up a connection between two PC/Laptops.



*All configuration samples and notes will use IP-addresses and names as specified in Figure 19a.*

#### 1. Units' configuration

1. Choose one of the units to be CPE and the other one to be BS. In PTP link it makes no difference which unit will take what role.

2. Provide connectivity from PC1 to CPE and PC2 to BS following the procedure described in "Getting access to the unit". As a result you should make sure that you can ping/telnet CPE from PC1 and ping/telnet from PC2

3. Now we will proceed to units' configuration. From PC1 enter CPE unit using Telnet (Start->Run: "telnet 9.1.8.1") and from PC2 enter BS unit ("telnet 9.2.8.1")

4. Next step is configuring radio parameters of the radios. As the purpose of this document is to show the basic settings we only will cover essential parameters of the radio so that the connection could be established. In fact, radio has many more other settings not mentioned below:

- Units should be configured for the same frequency. Example:  
`rf rf4.0 freq 5200`
- Set up output power. For lab testing purposes the power can be configured at the minimal value. Example:  
`rf rf4.0 pwr 4`
- Units should have same SID. SID can be chosen as any 8-digit HEX number. Example:  
`rf rf4.0 sid 11223344`
- Set up desired working bitrate. Example:  
`rf rf4.0 bitr 24000`

Please note that the list of allowed bitrates can be viewed using "rf rf4.0 cap" command and may depend on the unit's modification and selected channel width (these settings are not within the scope of this document).

5. After radio configurations are done, we need to run MINT protocol which is a core of InfiNet Wireless unit's architecture. On both units the following command should be executed:

`mint rf4.0 start`



If radio settings are done properly and units can physically “hear” each other, the units will exchange a series of service packets and establish a connection. In order to check it, one should use a command “mint map”.

Also, the following configurations may be made in our particular PTP scenario:

- Set up a name for a network node (from MINT standpoint). Example:  
`mint rf4.0 –name “Test_Node_1”`
- Set up node id (nodes in “mint map” will sorted according to this numerical parameter):  
`mint rf4.0 –nodeid 1234`

In order to see current MINT protocol configuration, use “co show mint” command.

## 2. Learning connection status

Once all configuration steps are correctly performed you should make sure that the connection is established.

Please keep in mind that once MINT protocol is working on MAC-layer (2<sup>nd</sup> layer of OSI) IP-connectivity needs to be configured after link connectivity is established.

Actually, it makes no sense to connect antennas to the devices while lab testing but still you need to make them “hear” each other. Also you may try inserting some kind of steel paper-clip in the connector – this might help in signal improvement.

In order to learn current connection status, “mint map” command should be used.

Example of “mint map” command output:

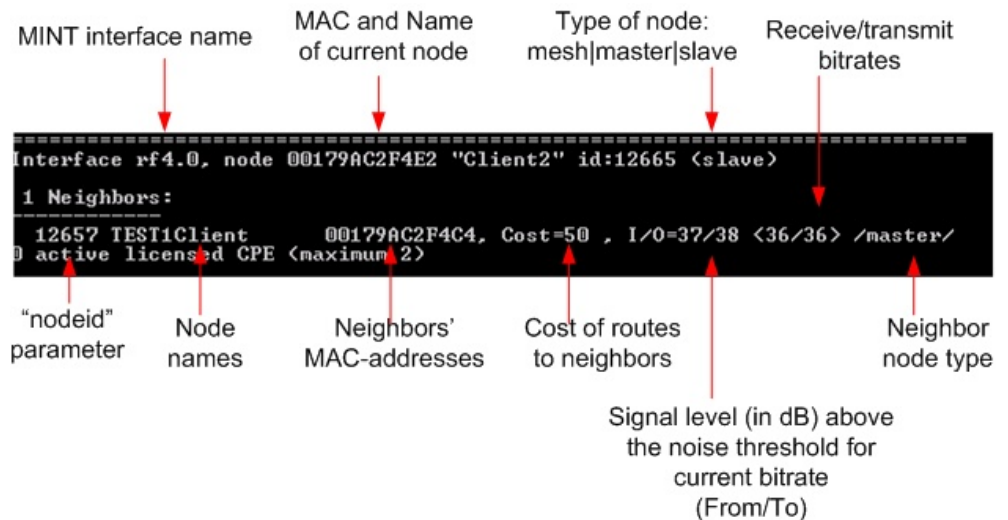


Figure 20. “mint map” command

In our Point-to-Point scenario, we will be having only one neighbor (in MINT protocol terminology) from either side of the link.

What important information do we learn from “mint map” output:

1. The list of current unit’s neighbors for one or more radio interfaces (here in our simple scenario we have one rf4.0 interface and one neighbor as the link is point-to-point)
2. Cost parameter is one the most important parameters in MINT architecture as it defines the base upon which all the routes in MINT network are calculated. But in point-to-point scenario this parameter is of a less

importance as MINT does not have to look for other alternative routes to send a packet to

3. Input / Output signal levels. Here, the parameters are displayed in dB above current noise thresholds which are defined by current bitrates (displayed on the right from signal levels). What is a good signal level (for current bitrate)? For lower bitrates (equal or less than 24 Mbps) signal levels higher than 12-14 dB can be considered acceptable. For higher bitrates it is recommended to have higher signal levels (>20 dB) in order to have a stable connection on this bitrate and less retries and errors.
4. Type of node: master, mesh or slave. Without going deep into details (as this is not the purpose of this document), the following must be mentioned:
  - a. In order to create PTP link, units should be configured either in "mesh" mode (both units) or one should be "master" and another one "slave". In the second case a non-collision polling protocol can be enabled on the "master" unit.
  - b. In Point-to-Multipoint link, Base Station should be configured as "master" and CPEs as "slaves".

### 3. Providing IP connectivity

---

Once we have connected our two units in a Point-to-Point link, the next step is to configure IP-connectivity.

Units can be configured in either router or switch mode or even in hybrid mode combining router and switch functionality.

In this manual we will review two most simple cases of link configuration in router and switch mode.

#### *Routed link*

---

In the simplest case, the following should be done to create routed link (see Figure 19, pg 13 for IP-addresses configuration):

1. Configure two units' eth0 (physical Ethernet) interface to a different network subnets. In our example the addresses are 9.2.8.10/24 (9.2.8.0/24 network) and 9.1.8.10/24 (9.1.8.0/24 network). Command example:

```
ifc eth0 9.1.8.1/24
```

Please note that after executing this command you will lose the connection to your current telnet session (as you have logged on using different IP-address) and you will need to re-log to the unit and save the configuration with a new IP-address ("co save" command saves the configuration).

2. Next step is to configure a subnet between two radio interfaces. In our example we use 10.10.10.0/30 network. One unit's radio interface gets 10.10.10.1 address and another one gets 10.10.10.2 address. Example:

```
ifc rf4.0 10.10.10.1/30
```

3. After configuring IP-addresses you can ping the opposite side of the link using addresses assigned to radio interfaces.
4. Next, we need to configure routing between our two subnets which are 9.2.8.0/24 and 9.1.8.0/24. One can use static or dynamic routing (RIP or OSPF). You can, for example, just enable RIP protocol on both units ("rip start" command) or use static routing. E.g. on the first unit which has 9.1.8.1/24 address on eth0 (Ethernet) and 10.10.10.2/30 on the radio interface (rf4.0) the command will look as follows:

```
route add 9.2.8.0/24 10.10.10.2
```

which will mean that the network 9.2.8.0/24 is accessible via 10.10.10.2 address.

At this point, you can reach (e.g. ping) remote's eth0 interface both from one unit to another.

```
Base#3> ping 9.1.8.1
ping (9.1.8.1): 56 data bytes
64 bytes from 9.1.8.1: icmp_seq=0 ttl=255 time=1 ms
64 bytes from 9.1.8.1: icmp_seq=1 ttl=255 time=<1 ms
64 bytes from 9.1.8.1: icmp_seq=2 ttl=255 time=1 ms
64 bytes from 9.1.8.1: icmp_seq=3 ttl=255 time=<1 ms
64 bytes from 9.1.8.1: icmp_seq=4 ttl=255 time=1 ms
--- 9.1.8.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
```

Figure 21. Pinging remote's Ethernet

The next step is to make you Laptops/PC/LAN "see" each other.

If you connect two PC/Laptops (for example, Windows-basic) two options are available in this case:

1. Write a route to the corresponding Ethernet network at the opposite side of the link. In order to do this, go "Start->Run" and run "cmd" – Command Line. At the BS computer you should write the following:

```
route add 9.1.8.0 mask 255.255.255.0 9.2.8.1
```

This means that when an IP-packet goes from the computer connected to your BS device to the computer at the CPE side, it will go to the BS Ethernet interface. In the unit, according to the routing tables formed using RIP protocol, the packet will be sent via radio to the CPE unit. After that, CPE unit will look up in its routing tables and send the packet through its Ethernet interface to the remote computer.

At the CPE computer you should perform similar actions. Go "Start->Run" and run "cmd" command. Type the following:

```
route add 9.2.8.0 mask 255.255.255.0 9.1.8.1
```

Now we provided connectivity between two computers.



*All routes in Windows that are specified using route command have power until next reboot of the computer (special parameter "-p" should be used to make a route permanent). To see the routing table in Windows "route print" command should be used.*

2. The second option is to specify a default gateway for the PC/Laptop which is going to be an Ethernet interface of the connected unit. You can specify default gateway parameter in the window shown on Figure 14. Please refer. For the BS side it will be 9.2.8.1, for CPE – 9.1.8.1

In order to make sure that your PC/Laptops are connected, you can ping one side from the other one. For example, from one PC/laptop (located at one side of the link) we are pinging remote computer at the opposite side (Figure 28)

```
Pinging 9.1.8.1 with 32 bytes of data:
Reply from 9.1.8.1: bytes=32 time<1ms TTL=255
Reply from 9.1.8.1: bytes=32 time<1ms TTL=255
Reply from 9.1.8.1: bytes=32 time<1ms TTL=255
Reply from 9.1.8.1: bytes=32 time<1ms TTL=255
Ping statistics for 9.1.8.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Figure 22. Pinging remote computer

**IMPORTANT HINT!**

IP-packets originated from the unit itself (e.g. ping, telnet, FTP, SNMP) are assigned an IP-address (primary) of the interface through which they leave the unit. In order for all IP-packets have one defined IP source address the following command can be used:

**sys OfficialAddress IP**

Here, "IP" is the Official Address of the unit should be specified which will act as a source IP address for all the packets originated from the unit.

Sample Point-to-Point router configuration:

## First device

```
# R5000 WANFlex 1.24.2-MINI-MESH (type 2) * Jul 24 2007 15:37:17 * SN:6345
#System parameters
  sys name Unknown node
  sys user root
  setpass

#QoS manager
  qm option voice -dot1p -tos strict

#Radio module parameters
  rf rf4.0 mod OFDM
  rf rf4.0 chntime 5000
  rf rf4.0 freq 5160 bitr 18000 sid 10101010 burst
  rf rf4.0 pwr 8 ant LEFT rts 2048 ptp distance 1

#Interfaces parameters
  ifc lo0 127.0.0.1/8
  ifc eth0 media auto mtu 1500 up
  ifc eth0 192.168.100.32/24
  ifc rf4.0 mtu 1500 up
  ifc rf4.0 10.1.2.1/30

#MINT configuration
  mint rf4.0 -nodeid 6345
  mint rf4.0 -type mesh
  mint rf4.0 -mode nomadic
  mint rf4.0 -name "Node_1"
  mint rf4.0 -authmode public
  mint rf4.0 -autobitrate
  mint rf4.0 -minbitrate 6000
  mint rf4.0 -hiamp 14 -loamp 7
  mint rf4.0 -log
  mint rf4.0 -airupdate passive normal
  mint rf4.0 -roaming disable
  mint rf4.0 start

#Add-on devices control
  ctl heater -8

#ARDA configuration
  arda interface eth0
  arda interface lo0
  arda interface null0
  arda interface rf4.0
  arda end

#ARDA RIP configuration
  arip start
  arip router
  arip network rf4.0
  arip network eth0
  arip end

#1>
```

## Second device

```
# R5000 WANFlex 1.23.1-MINI-MESH (type 2) * Jun 30 2007 17:15:36 * SN:6101
#System parameters
  sys name Unknown node
  sys user root
  setpass

#QoS manager
  qm option voice dot1p -tos strict

#Radio module parameters
  rf rf4.0 mod OFDM
  rf rf4.0 freq 5160 bitr 18000 sid 10101010 burst
  rf rf4.0 pwr 8 ant LEFT rts 2048 distance 1

#Interfaces parameters
  ifc lo0 127.0.0.1/8
  ifc eth0 media auto mtu 1500 up
  ifc eth0 1.2.3.2/24
  ifc rf4.0 mtu 1500 up
  ifc rf4.0 10.1.2.2/30

#MINT configuration
  mint rf4.0 -nodeid 6101
  mint rf4.0 -type mesh
  mint rf4.0 -mode nomadic
  mint rf4.0 -name "Node_2"
  mint rf4.0 -authmode public
  mint rf4.0 -autobitrate
  mint rf4.0 -minbitrate 6000
  mint rf4.0 -hiamp 14 -loamp 7
  mint rf4.0 -airupdate passive normal
  mint rf4.0 -roaming disable
  mint rf4.0 start

#Add-on devices control
  ctl heater -8

#ARDA configuration
  arda interface eth0
  arda interface lo0
  arda interface null0
  arda interface rf4.0
  arda end

#ARDA RIP configuration
  arip start
  arip router
  arip network rf4.0
  arip network eth0
  arip end

#1>
```

## ***Switched link***

---

MINT architecture has an ability of using switching capabilities along with routing. Thus, if required by your network, the link can be used to connect two parts of one Ethernet segment. Switch, realized in InfiNet Wireless units, is a very powerful tool that can be used in many different scenarios but in this particular example we will be using it for one simple purpose – create a simple switched link. The following steps should be taken:

1. Configure IP-addresses (e.g. on eth0 interface) from the same subnet. Say, 9.1.8.1/24 for the first unit and 9.1.8.2/24 for the second one.
2. On both units the switch needs to be configured. Although, switch realized in InfiNet Wireless units is a powerful tool and can be used for many different purposes, here in our example, we will use the simplest configuration which turns the unit to a full switch mode. The following set of commands should be executed on both units in the link:

```
switch group 1 add eth0 rf4.0
```

```
switch group 1 start
```

```
switch admin-group 1
```

```
switch start
```

Sample Point-to-point switch configuration:

## First device

```
# R5000 WANFlex 1.24.2-MINI-MESH (type 2) * Jul 24 2007 15:37:17 * SN:6345
#System parameters
sys name Unknown node
sys user root
setpass

#QoS manager
qm option voice -dot1p -tos strict

#Radio module parameters
rf rf4.0 mod OFDM
rf rf4.0 chntime 5000
rf rf4.0 freq 5160 bitr 18000 sid 10101010 burst
rf rf4.0 pwr 8 ant LEFT rts 2048 ptp distance 1

#Interfaces parameters
ifc lo0 127.0.0.1/8
ifc eth0 media auto mtu 1500 up
ifc eth0 192.168.100.32/24
ifc rf4.0 mtu 1500 up

##MINT configuration
mint rf4.0 -nodeid 6345
mint rf4.0 -type mesh
mint rf4.0 -mode nomadic
mint rf4.0 -name "Node_1"
mint rf4.0 -authmode public
mint rf4.0 -autobitrate
mint rf4.0 -minbitrate 6000
mint rf4.0 -hiamp 14 -loamp 7
mint rf4.0 -log
mint rf4.0 -airupdate passive normal
mint rf4.0 -roaming disable
mint rf4.0 start

#MAC Switch config
switch group 1 add eth0 rf4.0
switch group 1 start

switch admin-group 1
switch start

#Add-on devices control
ctl heater -8

#ARDA configuration
arda interface eth0
arda interface lo0
arda interface null0
arda interface rf4.0
arda end

#1>
```

## Second device

```
# R5000 WANFlex 1.23.1-MINI-MESH (type 2) * Jun 30 2007 17:15:36 * SN:6101
#System parameters
sys name Unknown node
sys user root
setpass

#QoS manager
qm option voice dot1p -tos strict

#Radio module parameters
rf rf4.0 mod OFDM
rf rf4.0 chntime 5000
rf rf4.0 freq 5160 bitr 18000 sid 10101010 burst
rf rf4.0 pwr 8 ant LEFT rts 2048 ptp distance 1

#Interfaces parameters
ifc lo0 127.0.0.1/8
ifc eth0 media auto mtu 1500 up
ifc eth0 192.168.100.34/24
ifc rf4.0 mtu 1500 up

##MINT configuration
mint rf4.0 -nodeid 6101
mint rf4.0 -type mesh
mint rf4.0 -mode nomadic
mint rf4.0 -name "Node_2"
mint rf4.0 -authmode public
mint rf4.0 -autobitrate
mint rf4.0 -minbitrate 6000
mint rf4.0 -hiamp 14 -loamp 7
mint rf4.0 -airupdate passive normal
mint rf4.0 -roaming disable
mint rf4.0 start

#MAC Switch config
switch group 1 add eth0 rf4.0
switch group 1 start

switch admin-group 1
switch start

#Add-on devices control
ctl heater -8

#ARDA configuration
arda interface eth0
arda interface lo0
arda interface null0
arda interface rf4.0
arda end

#1>
```

## 4. Link throughput test

The most evident way to test link throughput is to install FTP server on either first or second computer. For example, we set it up on the CPE computer.

During link throughput test using PC or Laptop with MS Windows please note the following:

1. Hard disk drive speed or Ethernet adaptor speed may become a bottleneck of the system at either side.
2. In MS Windows you need to run several (3 or more) TCP or UDP streams to load up the radio link. In this case you will obtain a correct result.

Log on to FTP server on the remote computer. To do that go "Start->Run" and execute "ftp 9.1.8.10". IP-address 9.1.8.10 is the address of the remote computer. Enter login and password for the FTP-server.

Run several FTP streams from the remote computer. In order to do that create several FTP sessions according to the procedure described in the previous paragraph and start downloading files from the remote computer (files should be relatively big).

Once the streams are run you can check the throughput using Load Meter utility built into the unit. You can run it on either side. Run it for the eth0 interface. The command is the following:

**loadm -l eth0**

"-l" parameter means line-by-line output.

The example is shown on the Figure 29.

```
Base#3> loadm -l eth0
Load Meter 1.2           All results in Kbits per second
Name  cur  avg  max  packets  cur  avg  max  packets  SUM  PACKETS
eth0  339  339  339   689    15245 15231 15245  1291    15584  1980
eth0  329  334  339   668    14859 15045 15245  1261    15188  1929
eth0  332  333  339   674    14974 15021 15245  1268    15306  1942
eth0  327  332  339   666    14878 14985 15245  1262    15205  1928
eth0  336  333  339   681    15186 15025 15245  1288    15522  1969
eth0  338  333  339   672    14802 14988 15245  1255    15140  1927
eth0  334  333  339   669    14838 14967 15245  1257    15172  1926
eth0  334  334  339   677    14991 14970 15245  1271    15325  1948
eth0  331  333  339   670    14902 14962 15245  1263    15233  1933
eth0  328  333  339   667    14886 14955 15245  1261    15214  1928
eth0  331  332  339   670    14873 14947 15245  1262    15204  1932
```

Figure 23. Load meter utility

In the second column from the right you can see the total throughput in both sides. In our example it is approximately 15.2 Mbps.

## 5. Simple configuration for establishing E1 radio link

*E1 radio link can be established only having InfiNet Wireless devices with IDU-5000-E1SCR, IDU-5000-E1RJ indoor units.*

In our E1 radio link point-to-point simple configuration example we will establish e1 radio link as shown in figure 19b.



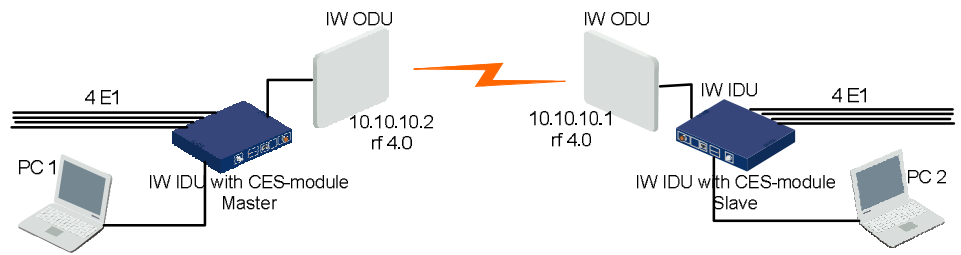


Figure 19b. E1 radio link

Follow the steps below to establish E1 radio link:

1. Provide initial Units' configuration and start MINT following the procedure described in "Units' configuration" part of chapter III.
2. Choose one of the units to be Master and the other one to be Slave.
3. On Master device configure list of E1 ports to transmit data and start CES-over-WLAN mode. Example:

```
ces ports 0 2
```

```
ces start
```

4. On slave device set mode and synchronization. In this example we will set **e1** mode with **recovery** synchronization mode (frequency is restored from CES-over-WLAN packet flow). Other settings (except **ces adjust**) will be received from Master device. Start CES-over-WLAN mode. Example:

```
ces mode e1 recovery
```

```
ces start
```

5. Now E1 radio link is established.
6. To view it's status and statistics you can use the following command:

```
ces stat
```

```

MG-5000#3> ces stat
unit status: master, active
time: 171:48:40 since started
mode: e1 loopback
peer: 00028AE1DAC1

physical interface: 0 tx fifo underruns, 0 rx fifo overruns
~~~~~
link status
port 0: up NoAlarm      octets in/out      frames in/out
port 1: up NoAlarm      2922883808/3582274368 2775694679/3467389274
port 2: up NoAlarm      0/3580824416        0/3467343963
port 3: up NoAlarm      3671158592/3580824544 651594618/3467343967
                                0/3580824416        0/3467343963

packet interface:
~~~~~
port 0:
tx: on restarts: 1
rx: on restarts: 1
jitter buffer: 40.992 cur (0.992 dev.), 34.097 min, 41.304 max
packets: total 65387, 500 per second, 99% valid
          0 R bit, 45 L bit, 0 late, 1 lost,
          0 out of order, 0 underrun, 0 overrun,
          0 invalid sequence, 0 duplicate, 0 malformed

port 1: disabled
port 2:
tx: on restarts: 1
rx: on restarts: 1
jitter buffer: 41.722 cur (1.722 dev.), 35.332 min, 41.996 max
packets: total 65238, 500 per second, 101% valid
          0 R bit, 0 L bit, 0 late, 0 lost,
          0 out of order, 0 underrun, 0 overrun,
          0 invalid sequence, 0 duplicate, 0 malformed

port 3: disabled
MG-5000#3>
    
```

Annotations:

- packages speed**: points to the '500 per second' value in the packet statistics.
- bytes received/sent**: points to the 'octets in/out' column in the physical interface table.
- TDM frames received/sent**: points to the 'frames in/out' column in the physical interface table.
- CES-module status**: points to the 'unit status: master, active' line.
- CES mode**: points to the 'mode: e1 loopback' line.
- Mac-address of neighboring device**: points to the 'peer: 00028AE1DAC1' line.
- shows E1 ports state**: points to the 'physical interface: 0 tx fifo underruns, 0 rx fifo overruns' line.
- CES-over-WLAN packet flows state**: points to the 'packet interface:' section.
- Total packets processed**: points to the 'total 65387' value.
- 99% of all packets are without mistakes**: points to the '99% valid' value.

## IV. Other topologies configuration

---

The configuration in Point-to-Multipoint node is very much similar to the one in Point-to-Point mode. Same parameters (RF, MINT) should be configured (in the simplest case). For the Base Station unit, the type of the node (in MINT command) should be specified as "master". For CPEs type "slave" should be used.

For MESH network configuration, type "mesh" should be used. Many other parameters can be configured to fine-tune mesh network (node "mode", costs parameters etc).

## V. Performing outdoor testing

---

Before carrying out outdoor testing make sure that the equipment is properly configured and tested in the lab. If you use outdoor equipment please prepare service cables to connect IDU and ODU and check them in the lab. Also the following accessories may be very useful while outdoor testing:

1. InfiNet Console cable to perform configuration on the rooftops/masts, etc
2. Binoculars to locate the opposite side (within reasonable range)
3. Mobile phones at either side to coordinate each others actions
4. Screwdrivers set
5. Soldering iron in case if you have to fix some problems with connectors.
6. Voltage analyzer to reveal cable problems if any

When planning your outdoor testing it is **strongly recommended** to perform calculations using:

- Speed/Range Calculator
- Fade Margin Calculator

Both of this calculators are located on InfiNet Wireless web-site [www.infinetwireless.com](http://www.infinetwireless.com) in the "Support" section.

How-to-use instructions are located in the Technical User Manual on the CD delivered with the equipment.

### 1. Distance setting

---

For outdoor testing/deployment it is vitally important to set up distance parameter correctly. The recommended procedure is the following:

1. If you have a PTP topology, on the BS you set up the distance to the CPE in kilometers. **It is required to set up a bit bigger distance. Setting up a smaller distance may cause errors on the link.** At the CPE set up distance as **auto** or a bit bigger distance than to the Base Station
2. In case of PTM topology on BS set up the distance to the **remotest** CPE. On every CPE set up distance as **auto**
3. If the distance is bigger than 22 km in Point-to-Point link, use "**long**" parameter of "**rfconfig**" command on both sides of the link (for example, "**rf rf4.0 long**")
4. If the distance to at least one CPE in Point-to-Multipoint is bigger than 22 km it is recommended to have "**long**" mode enabled on **all** CPEs and the Base Station.

Distance parameter is set up using **rf** command:

```
rf rf4.0 distance <VALUE>
```

### 2. Learning link status/antenna alignment procedure

---

In order to install the equipment, please do the following:

1. Install ODU and antenna at the roof top/mast etc. Connect ODU and antenna using RF cable. If the link is just for testing usage make sure that it is not going to rain or snow (because in this case you do not have to seal the connectors).
2. Even in test link it is highly recommended to provide all grounding. Ground the ODU to the mast/building grounding contour

3. Usually when installing ODU at the top, the ODU-IDU service cable is already connected to the ODU.
4. Connect ODU-IDU cable to IDU indoors
5. Provide IDU grounding to the LAN grounding contour
6. Connect power cable to IDU and plug this cable into the power socket

Once the power is switched on, you can access the unit via Telnet (all necessary configuration steps were already taken in the lab).

It will take several seconds for units to establish the connection. After this period of time you can check the link status by using "mint map" command.

If it turns out that during some significant period of time (1 minute) there is no link, several reasons may be the cause:

- Link fade margin is not sufficient to handle the connection
- Antenna alignment procedure is required in order to establish the connection
- Units are not configured properly
- Installation is made not according to the manual

Even if registration has occurred but signal levels are not enough antenna alignment procedure is strongly recommended.

In both cases (whether there is a link or not) antenna alignment procedure is recommended.

### *Antenna alignment with MINT Monitor*



*It is recommended to use "Antenna alignment with Link test" procedure instead of "Antenna alignment with MINT Monitor" procedure.*

1. Either on BS device or CPE run **mint IFNAME monitor**. Run it only from ONE side. The command looks as follows (example):

**mint rf4.0 monitor**

Also, the following options of this command can be used:

"-s" option keeps the output on one screen

"-i SEC" option defines the periodicity of command's output (1 second by default)

"MAC" option is a MAC-address (or several MAC-addresses) which should be monitored (MAC-addresses can be viewed in "mint map" command)

2. Antenna alignment should be done only from one side at one time. Align one side, than other side. Use mobile phones to check current signal levels. The output of **mint monitor** command is demonstrated on the Figure 24.

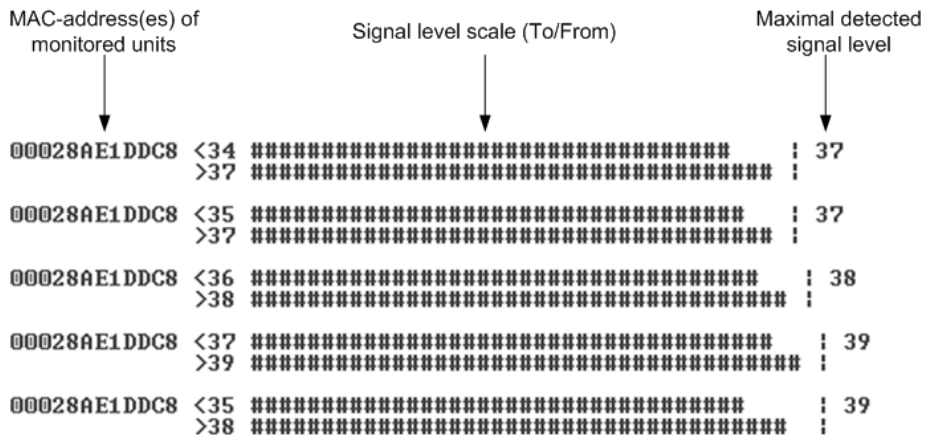


Figure 24. "mint monitor" output

3. The link can be claimed to be working when the following requirements are met:
  - Good signal levels. For low bitrates (<=18 Mbps) signal levels of 10-12 dB and higher are appropriate. For higher bitrates (24 and 36 Mbps) signal levels of higher than 18-20 dB should be achieved. For QAM64 bitrates (48 and 54 Mbps) signal levels of 30 dB and higher should be achieved for a reliable link
  - Low or zero repeats and errors. Please use "muf stat" command to see statistics on errors. "muf stat clear" command clears the statistics.

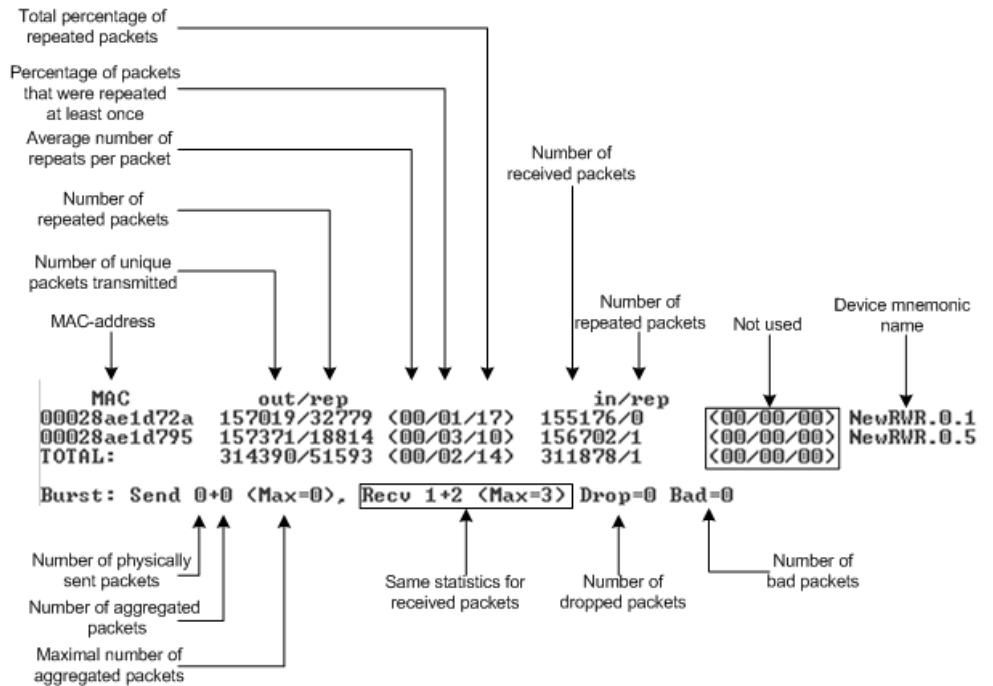


Figure 25. "muf stat" command output

- Link stability. Please check system log ("sys log show") if remote sides of the link are permanently connected

Keep in mind that the antenna alignment should be performed slowly and with pauses.

Also, important to remember that "mint monitor" command is a passive command and does not generate any traffic. Thus, it is recommended to put some load on the link while using "mint monitor"

4. Interference can be a possible reason for the link quality degradation (number of repeats increases, lower signal levels due to higher noise levels or other equipment working in the same area).

### ***Antenna alignment with Link test***

It is recommended to use "Antenna alignment with Link test" procedure instead of "Antenna alignment with MINT Monitor" procedure because Link test is much better radio link testing tool than Mint Monitor. This is so because of the following reasons:

- With Link test tool you are getting much more testing statistics using only one command.

- ü Link test tool perform “active testing”, i.e. it generates special testing traffic itself and then analyze radio link quality according to it. MINT Monitor doesn't do that.
- ü For Link test no MINT configuration needed.

**Procedure:**

1. Either on BS device or CPE run Link test. The command looks as follows:

**lttest IFNAME MAC**

Also, the following options of this command can be used:

“IFNAME” radio interface name which will be used in a test

“MAC” option is a MAC-address of the remote device on the opposite side of the radio link

**Example:**

```
lt rf4.0 00179AC2F3E6
```

This command illustrates the simplest way to start link test. «lt» command with all parameters undefined (default parameters) starts test of a local device with a remote device which have “00179AC2F3E6” MAC-address.

2. Antenna alignment should be done only from one side at one time. Align one side, than other side. Use mobile phones to check current signal levels. The output of lttest command is demonstrated on the Figure 26.

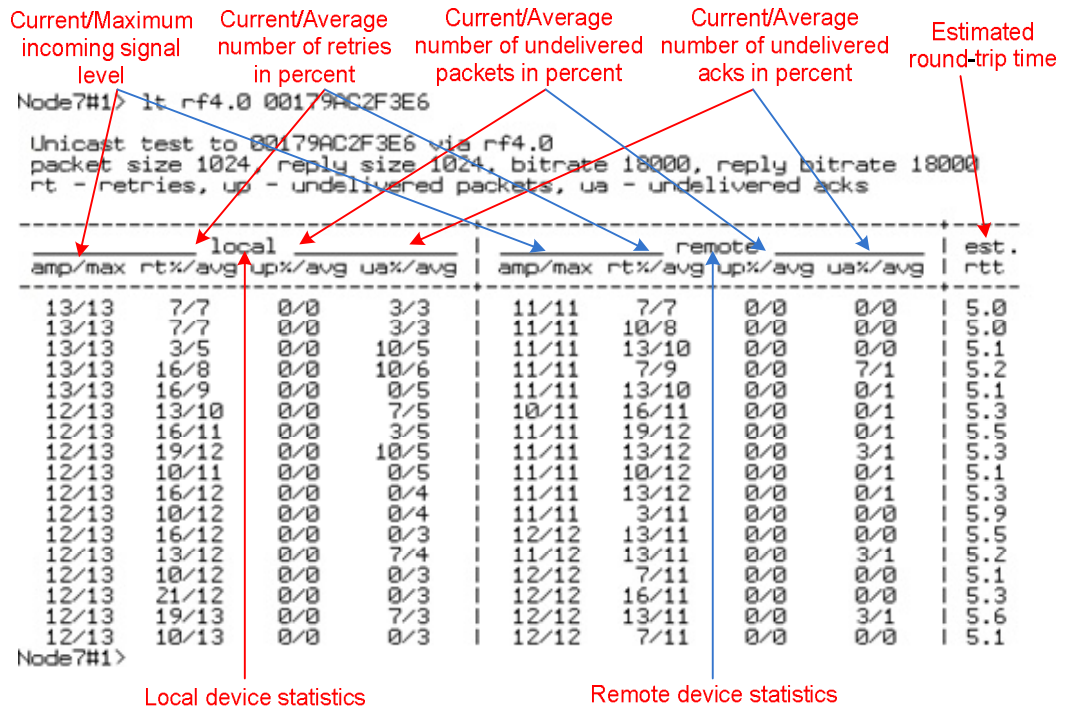


Figure 26. “lttest” output

3. The link can be claimed to be working when the following requirements are met on both sides of a radio link (local and remote):
  - Good current incoming signal levels (“amp” columns). For low bitrates (<=18 Mbps) signal levels of 10-12 dB and higher are appropriate. For higher bitrates (24 and 36 Mbps) signal levels of higher than 18-20 dB should be achieved. For QAM64 bitrates (48 and 54 Mbps) signal levels of 30 dB and higher should be achieved for a reliable link

- Low or zero number of retries, undelivered packets and acks ("rt%", "up%", "ua%" columns).
- Link stability. Please check the continuity of all the values in the statistics output of "ltest" command.

Keep in mind that the antenna alignment should be performed slowly and with pauses.

5. Interference can be a possible reason for the link quality degradation (number of repeats increases, lower signal levels due to higher noise levels or other equipment working in the same area).