InfiNet Wireless R5000

Technical User Manual

Creation date: 16 August 2005

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Regulatory Notice

A following notice is applicable to models R5000-L and R5000-O which are configured to work in 4.9 GHz band (4.940-4.990 GHz)

Federal Communications Commission (FCC) statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. InfiNet is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment is being certified by various national authorities under different model numbers including R5000-O as R5000-O-49 and R5000-L as R5000-L-49.

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I. Getting Started

This Technical User Manual is a description of InfiNet Wireless Routers and contains installation and configuration guidelines, recommendations and troubleshooting sections, and supplementary materials. The document is intended to be used by Qualified RF engineers/technicians and IT professionals. Qualified personnel should have skills and experience in the following areas:

• Outdoor/indoor radio equipment installation

• Outdoor wireless networks

• TCP/IP networking protocols

• Safety procedures and instructions for installing antenna equipment

• Professional command of electrical equipment and accessories

• Safety procedures and instructions for working on towers and heights

1. Scope of document

This document consists of the following chapters:

Getting started

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

Hardware description

This chapter shows the devices appearance and all plugs and connectors.

Installation procedure

The chapter describes the steps to be taken when installing the equipment at the installation sites and installation site requirements.

Device configuration procedure

This chapter includes basic recommendations for primary link configuration, including interfaces configuration and RMA protocol usage. Also there is a description of how to perform basic manipulations with device's configuration including its updating, importing and exporting.

Link configuring

The chapter contains basic recommendations for making preliminary choices and decisions while planning and deploying a wireless network based on InfiNet Wireless Routers. It also describes a set of tools that can help while improving the link quality and statistics gathering.

Services, features and tools

This chapter describes router's built-in services, features and tools which were not described in previous parts of the document

Recommendations

The chapter contains different recommendations for some particular cases of InfiNet Wireless Routers usage including building high-speed autonomous links and multi-sectored base station design.

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Supplementary information

Contains supplementary information (specifications, connectors soldering schemes and InfiNet Wireless Routers product matrix).

2. General products description

InfiNet Wireless FBWA products offer scalable, robust, flexible and cost-effective fixed broadband wireless access solutions for carrier-class networks. Wireless routing equipment from InfiNet Wireless is designed to implement and expand carrier-class networks for high-speed Internet access, enterprise campus networks, primary links for the Last Mile and backhauling traffic between cell towers and multiple access points.

InfiNet Wireless Routers are especially applicable to regions with complex wired infrastructures where infrastructure upgrades require costly or time-consuming activities. Many deployments have been accomplished in regions with a dearth of wired infrastructure where wireless solution is the only viable option for both voice and data networks. The deployment of InfiNet Wireless Routers minimizes both capital and operational investments for the creation of network infrastructure.

Key product features:

- Support 2.4 GHz and 4.9-6 GHz bands, based on DSSS and OFDM technologies
- Intelligent deterministic non-collision protocol using the radio spectrum
- Powerful QoS capabilities
- Security, tunneling, NAT and firewall
- Flexible network management
- VoIP functionality
- Powerful integrated diagnostic tools

InfiNet Wireless routers are generally used to create geographically spread FBWA transport networks. In its most basic form, a wireless network built with InfiNet Wireless routers consists of a base station and multiple subscriber units deployed one at each end of the wireless links. The radio link operates on a single frequency channel using Time Division Duplex (TDD) and dynamic adaptive polling MAC protocol. The difference between a base station unit and subscriber unit is a matter of configuration and CPU performance. Both devices have the same common software feature set and the same common hardware platform. The InfiNet Wireless software is not logically limited to the number of wired hosts on the subscriber LAN.

The InfiNet Wireless routers have been developed to operate within license exempt frequency bands which are either 2.412-2.484 GHz or 4.920 – 6.010 GHz. Different products series supports different frequency bands.

The InfiNet Wireless routers can support flexible topologies including point-to-point links, point-to-multipoint links, high-speed transport connections (backbones) and relay-points building. They have been designed to prevent internal and external interference using such product features as software selectable transmit power control, static frequency selection, asymmetrical bit-rate/transmit power rates selection for base and subscriber units. In order to maintain link availability, solve the "hidden node" problem and reduce the collision rate, the product employs dynamic adaptive non-collision polling MAC protocol that dynamically redistributes data streams between active and inactive subscribers. Autobitrate mechanism is an optional powerful feature that provides link reliability in case of changing conditions on the path of the link.

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The data network built on InfiNet Wireless products is implemented as a routed IP network which reduces flooding and broadcast messages specific to bridged networks and to implementation of Quality-of-Service (QoS) features set. QoS definitions per subscriber's data flows are effectively mapped on MAC level flow attributes.

Each device in the network can be configured using serial console port, Telnet protocol or HTTP (web-based).

RAPS (Remote Access Permission Service) provides a whole network with a flexible mechanism of a centralized management, configuration and monitoring.

The software/firmware is fully upgradeable for all InfiNet Wireless routers. New firmware images can be downloaded from the InfiNet Wireless web-site http://www.infinetwireless.com for its further uploading on the device.

3. Abbreviations

The following abbreviations are used in this document:

- BS – Base Station
- CPE – Customer Premises Equipment (also called subscriber or subscriber unit)
- ODU – Outdoor Unit (relevant for 5000-O and 5000-M modifications)
- IDU – Indoor power supply Unit (relevant for 5000-O and 5000-M modifications)
- RF cable – Radio Frequency cable to connect ODU and antenna/Router and antenna for 5000-O and 5000-I modifications correspondingly
- LOS – Line-of-Sight
- STP cable – Shielded Twisted Pair cable to connect ODU and IDU (relevant for 5000-O and 5000-M modifications)
- PTP – Point-to-Point topology
- PTM – Point-to-Multipoint topology
- RMA – Routed Multiple Access Protocol

4. Document marks

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.

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

5. Warranty terms

The manufacturer guarantees a reliable work of the product during 12 month from the date of product installation but no later than 15 months from the date of delivery of equipment to distributor. The warranty is not spread for the devices which stopped working properly due to improper usage, careless treatment, incorrect deployment or exploitation. The warranty voids in the following cases:

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- The device was opened and/or repaired by the owner on his own
- Improper exploitation conditions (including improper grounding)
- Electrical damaging of the print circuit board due to electric disruption caused by improper grounding
- Mechanical defects of the case

6. Additional information

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

- Package list located in the box with the device
- WANFlex OS User Guide
- Our web-site: www.infinetwireless.com

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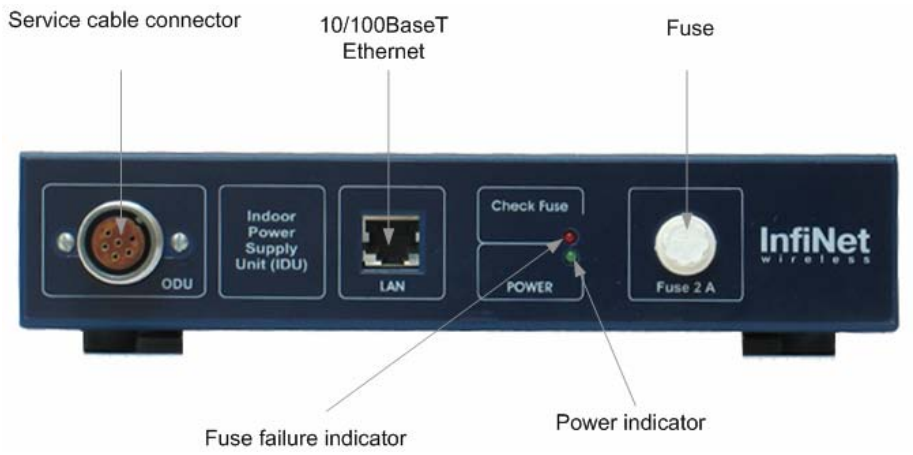
II.Hardware description

1. Power supply units (IDU)

All outdoor equipment is equipped with indoor power supply units. Exact type of IDU which is used with each router model is specified in different models description (see below).

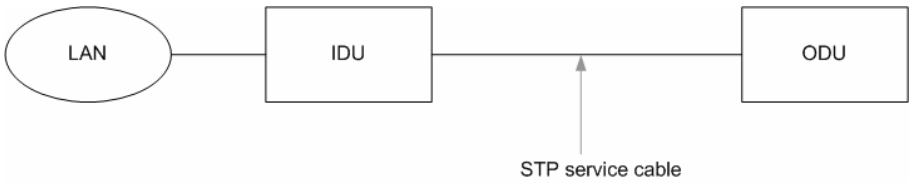
IDU-5000-SL

Front panel



Rear panel

Connection scheme for IDU-5000-SL



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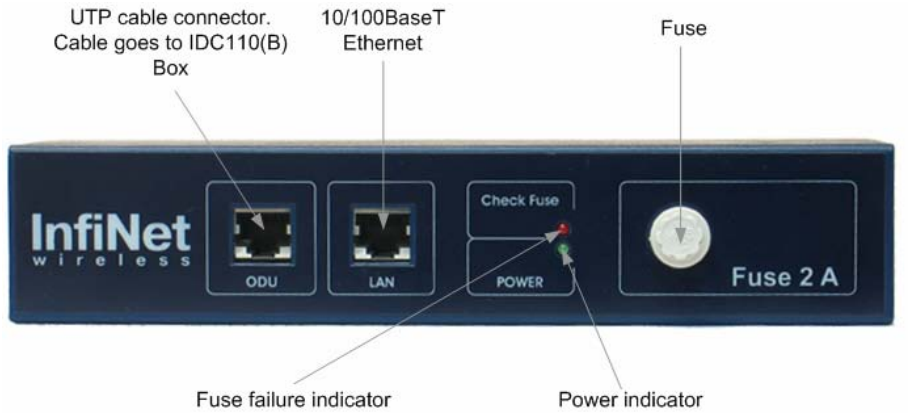
IDU-5000-RJ

Front panel



Rear panel

Top view

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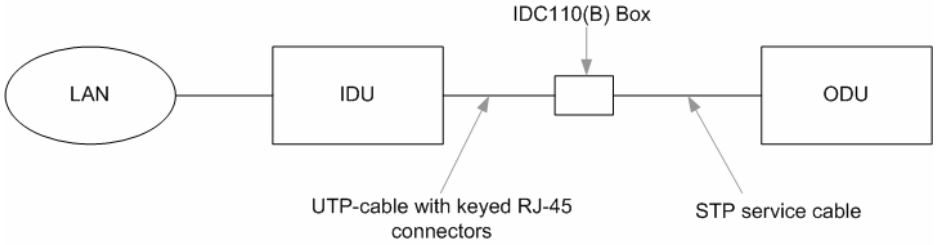
IDC110(B) Distribution Box

Distribution box is required to transfer the signal from STP service cable going from ODU into UTP RJ-45 keyed cable going to IDU. The inside of the box is shown on the picture below.

Connection scheme for IDU-5000-RJ



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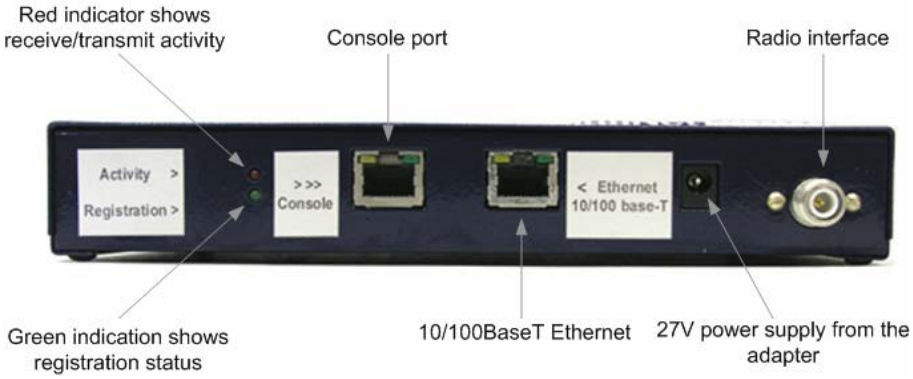
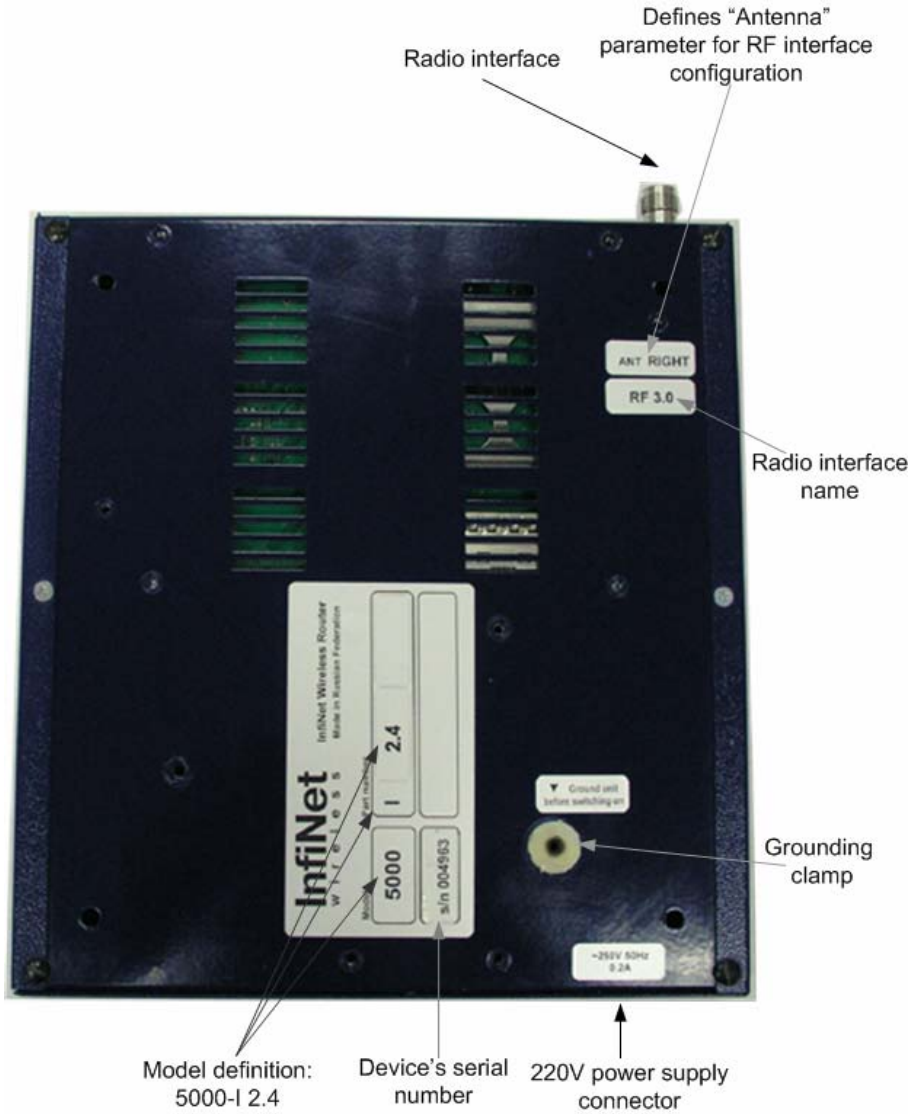
2. Routers

InfiNet Wireless R5000-I

Front panel

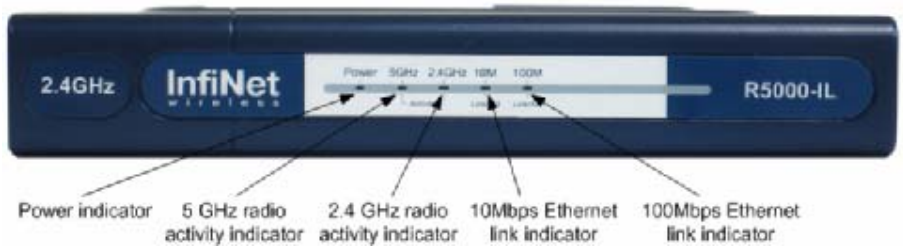


Top view



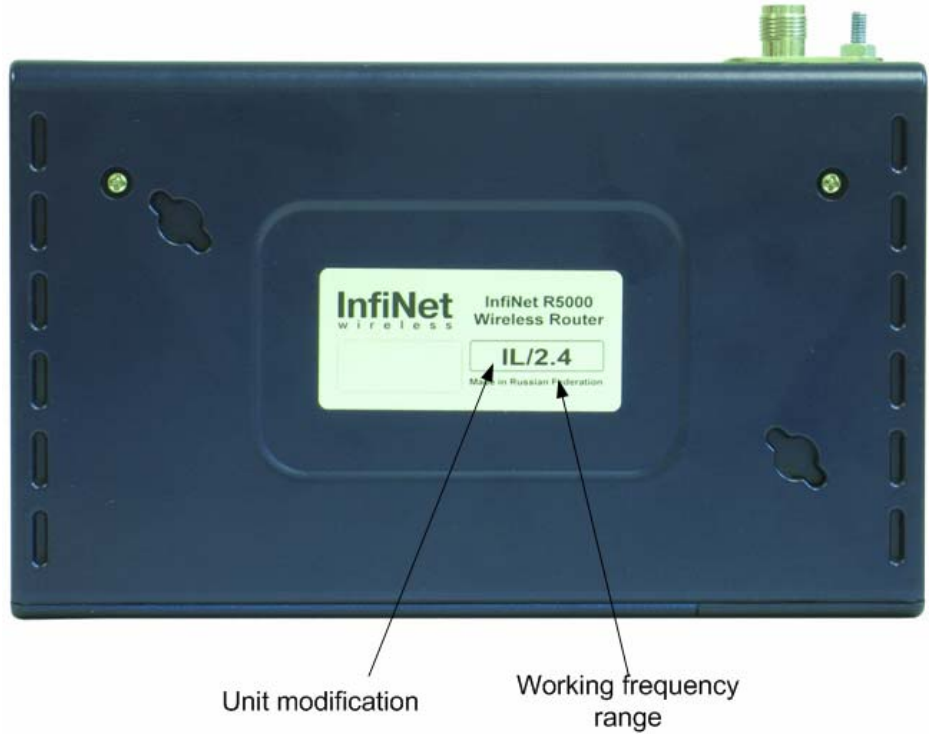
InfiNet Wireless R5000-IL

Front panel



Rear panel

Top view



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InfiNet Wireless R5000-O

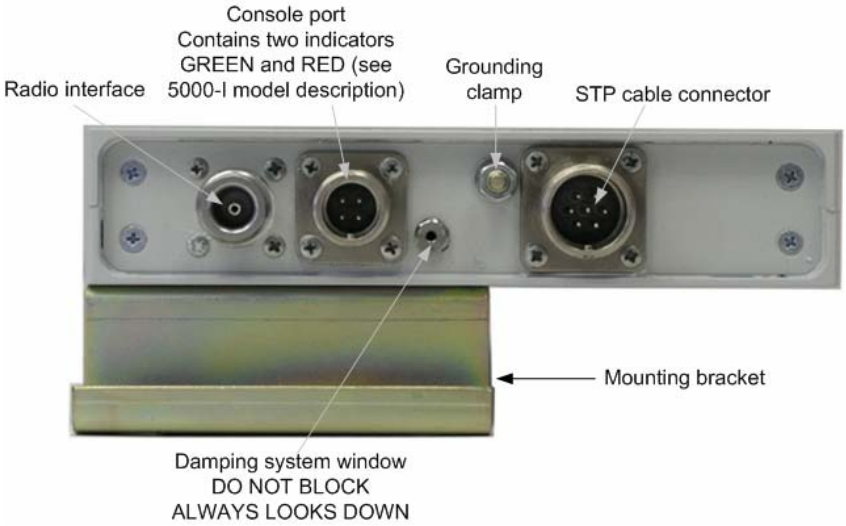
IDU

Default factory option: IDU-5000-SL.

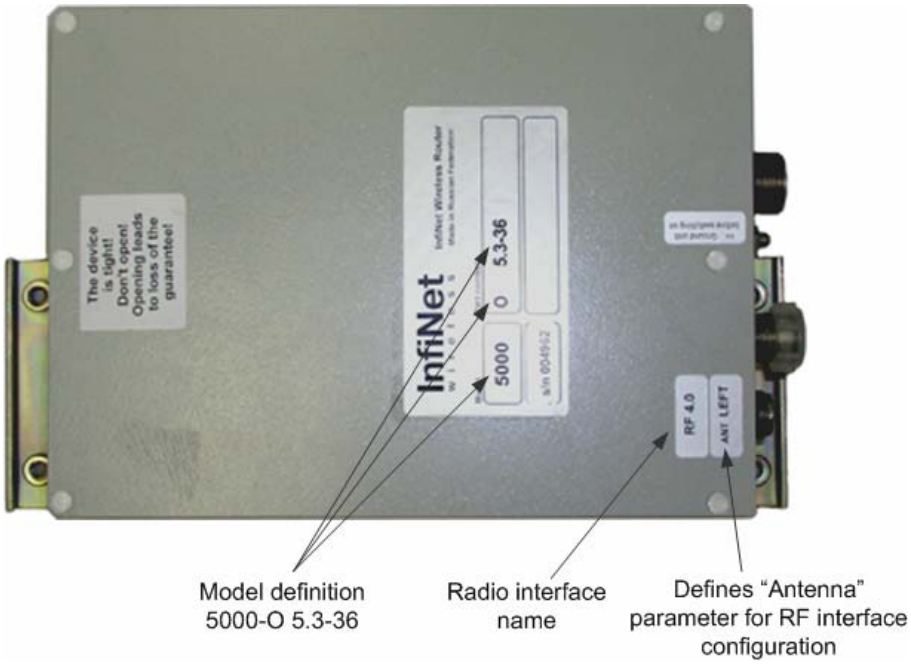
ODU

Can be both in the housing below and in the housing identical to R5000-L

Front panel



Top view



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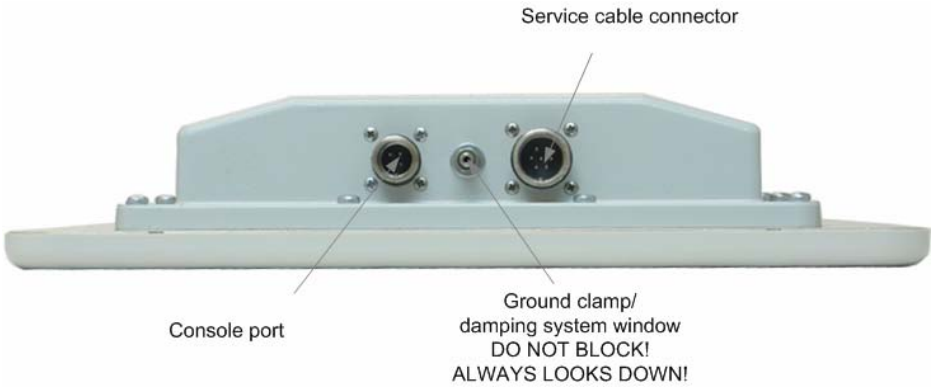
InfiNet Wireless R5000-M/ R5000-S

IDU

Default factory option: IDU-5000-RJ

ODU

Front panel



Top view

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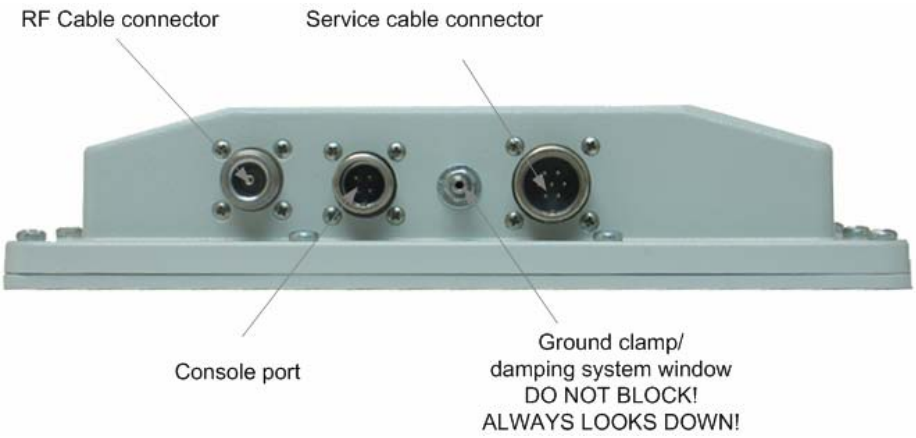
InfiNet Wireless R5000-L

IDU

Default factory option: IDU-5000-RJ

ODU

Front panel



Top view

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III. Installation procedure

1. Installation preparations

Required components and accessories

Before the installation, please make sure you have all necessary parts and accessories:

- InfiNet Wireless Router
- Antenna
- Low loss antenna cable for the required frequency range
- Antenna pole (if necessary)
- Required grounding system
- Accessories and tools

Antenna placement

When planning an antenna placement for PTP link, in order to obtain the maximal coverage range and best performance for the Router, one need to consider that LOS requirements must be fulfilled for the path between two antennas. Moreover, it is of vital importance that the certain zone that surrounds the signal propagation path must be free from obstructions. One should understand that the radio beam is not as thin as, for example, laser beam. Radio beam, also called as a 1st Fresnel zone, has a profile of a rugby ball. Its exact form and size depend upon the frequency and the signal propagation path length.

If most of the 1st Fresnel zone is obstructed, a major part of a electromagnetic energy will be lost which leads to a severe signal quality degradation and, as a result, to coverage range decreasing.

Below is an incomplete list of possible obstructions on the signal propagation path:

- Neighboring buildings
- Trees
- Bridges
- Power lines

To obtain the best results, it is necessary to perform a precise analysis of a signal propagation path zone and possible obstructions that may cover a part of the 1st Fresnel zone (usually the analysis is performed at the highest points of the signal propagation path).

When planning the antenna placement for Point-to-Multipoint connections, one must consider the necessity of a circular or sector coverage areas. In this respect, it is not recommended to use omni-directional antennas when sector antennas can be used.

While planning, it is strongly recommended to consult high-qualified and experienced technicians

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General recommendation for antennas placement are the following:

- Install antennas as high as possible over specific level. In case of flat surface - it will be ground level, in case of vegetation and forest – it will be tree heights, in urban environment – it will be the highest building in the observed area (specific level definition).
- Avoid tree and vegetation along with wave propagation path, influence of trees can increase depending on seasons (ice, dew, leaves);
- Proximity of other antennas should be avoided (at least 2 meters);
- Reflecting surfaces should be considered (building with reflective windows, water surfaces or wet grounds);
- When installing antenna over water surface, one should tune height bracket within 1-3 meter range variation, because it can yield signal level variation from minimum to maximum.
- If seasonal changes influence on the signal quality, so then the most probable reasons would be either the connectors are not protected enough from humidity, summer vegetation or ice covered cabling and connectors during winter.

Antenna poles usage

Antenna installation is performed on a special facility called antenna pole. The pole is used for strong antenna tightening at the installation site. Poles might have different modifications depending on the installation requirements.

Poles with Stretching

Usually this kind of poles are used when installing antenna on a flat surface and permits one to raise it to a significant height for providing optimal conditions for signal propagation.

Wall Mounted Pole

Usually these kinds of poles are used when there is no need to elevate antenna to the rooftop and there is the possibility to mounting it on a wall. This installation is significantly simpler than that implementation with poles. Mostly it is used for subscriber side deployments.

Antenna Poles Requirements

Ease of antenna mounting and sufficient mechanical durability should provide reliable fastening in conditions of high windy loads. Poles should have round profile for ease of azimuth adjustment. Typical pole diameter is 30 to 50 mm.

Grounding

Antenna should be placed on the mast on the level that is at least 1 meter lower than a mast's top. In this case it is of big probability that the lightning strikes the mast and not the antenna. The mast is to be grounded on the grounding contour according to your local standards. When the lightning strikes the antenna, the current goes through the coaxial cable which grounds ODU clamp with the mast – the mast is grounded via the grounding contour. The direct lightning strike to the STP service cable (ODU-IDU) is partially terminated on the grounded IDU case. Partial termination means that the direct lightning strike will probably destroy an STP cable. The service cable pickups from the electromagnetic

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impulses are terminated on the IDU case by the winding shield, and further – on the grounding contour. The data & power wires pickups on the top are terminated via ODU protection scheme; on the bottom – via IDU protection scheme (discharger and additional air gap). ODU and IDU grounding contours are connected with 100 kOhm resistor, and that provides no static charge accumulation on the ODU case if there are some problems with its connection to the grounding contour.

Antenna pole, tower, ODU and lightning arrestor should be connected to the first common grounding contour. Cable thickness should be no less than 10AWG using corrosion-steady connectors. It is highly recommended to entrust grounding contour development to the skilled personnel. IDU should be grounded to the same contour as customer LAN, having the second common grounding contour. Antenna should be grounded

Antenna alignment

To obtain maximal system performance antennas must be precisely aligned one towards another according to LOS requirements. General recommendations for antenna alignment are the following:

- Align antennas using optical equipment (binoculars, spyglass) accompanied by mobile phone actions coordination
- Use GPS receiver and area map
- Use build-in InfiNet Wireless Router features. These features allow evaluating current channel/signal quality and perform precise antenna alignment

Omni-directional and sector antennas have a wide radiation diagram width, thus usually they either do not require a very precise alignment or it is just not necessary due to radio link requirements.

Antenna polarization must be taken into consideration while installation. In most cases omni-directional and sector antennas have a vertical polarization. Directional antennas can be installed either with vertical or horizontal polarization. Please check a corresponding labeling on the antenna and address to the antenna technical documentation.

Sound indication usage

Sound indication is performed in channel testing mode (RMA command with Autotest option). The device is intended to be used while preliminary link establishing and antenna alignment procedure in order to obtain the maximum signal level from the remote side.

When having AudioMonitor plugged into the console port of the device with headphones plugged in, the sound signals will be sent to the headphones. The AudioMonitor or the console cable must be plugged in when the device is powered off.

No return packets state on the testing device input (no link) with described testing mode turned on is indicated by seldom tones in the headphones.

If there is a link established, the signal level is indicated by the set of clicks. The higher the signal level, the higher is the frequency of the clicks and their number in the set. The durability of the set and the interval between the sets is always the same and has a value of 2 and 0.5 seconds correspondingly. The indication cycle always corresponds with a PREVIOUS measurement cycle. That means that the sound indication has a delay of 2.5 seconds.

The maximum signal level (16) is indicated by a permanent tone.

Steps to be taken in WANFlex OS:

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- type: "rma <interface_name> autotest <MAC address> mcast
- config save
- restart the device
- plug the monitor to the console and listen

Usage algorithm:

- Fix the antenna
- Skip one indication cycle
- Listen to the sound indication
- Align the antenna and then fix the antenna again
- Skip the indication cycle
- Listen to the sound indication
- … etc

Precaution measures

Before you start the installation please read this section very carefully.

Antennas are installed on the roof tops or on the building walls. This work must be accomplished only by personnel having special skills and experience in this area.

Antennas and cables are electric conductors. Incidental electrostatic strikes may occur during the system installation. This can lead to equipment damaging or may hurt the personnel. While installing or changing the elements of the antenna-fider system one should make sure that open metal parts are temporarily grounded.

Do not install the antenna close to the electric power lines. Antenna and antenna pole have to be installed in such a way that while their assembling, disassembling and repairing they did not have any contact with power lines.

Basic precaution measures that must be fulfilled during the installation are the following:

- Do not stay on the roof top in windy or rainy weather, during the thunderstorm or when the working zone is covered with snow or ice
- Do not touch the antennas, antenna poles, cables and lighting arrestors during the thunderstorm
- Antenna placement should not be close to electric or telephone lines. Safe distance is a distance that is a sum of the two antenna poles heights and antenna height
- Antenna cable must be grounded at all times (not relevant for 5000-M modifications)

Connectors hermetic sealing

A big number of problems with link signal quality in case of outdoor installations result from RF cable and connectors corrosion. In order to avoid these problems it is necessary to isolate all the connections that are situated outdoors. One needs to use either thermal shrinkage with gel stuff or special waterproof tape.

Once the antenna alignment is not complete it is not recommended to perform isolating. This method prevents you to remove the isolation when there is a need to reallocate the antenna or the cable. The isolation with thermal shrinkage usage is performed with a special fan.

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Obey all precaution measures while using the fan as it is written in its manual

The isolation using the waterproof tape is performed by its winding with intersection around the connection.

Please keep in mind the following recommendations:

- Clean all the surfaces to be isolated and keep them free from the dust and water
- Isolating material must cover the whole connector and the cable with a gap of at least 2-3 cm from the connection place
- Isolating material must cover the surfaces as tight as possible

To protect the isolation material from the sun rays, it is recommended to cover it with vinyl isolation tape.

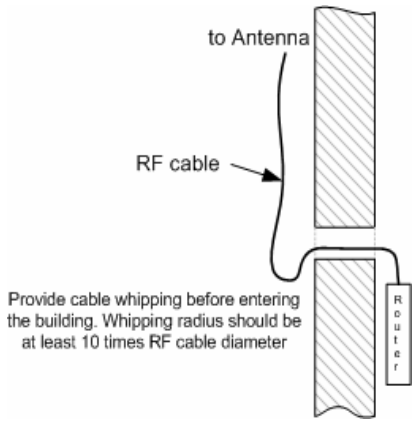
Tools to be available at the installation site

1. Screwdrivers set
2. Pliers
3. Soldering iron 40 W
4. Spanners set
5. Connectors isolating set
    - Raw rubber
    - Thermal shrinkage tube
    - Scissors
    - Fan
    - Mantling gun
6. Additional equipment
    - GPS receiver or area map (with compass and alidade)
    - Big zoom binoculars

2. InfiNet Wireless R5000-I / InfiNet Wireless R5000-IL

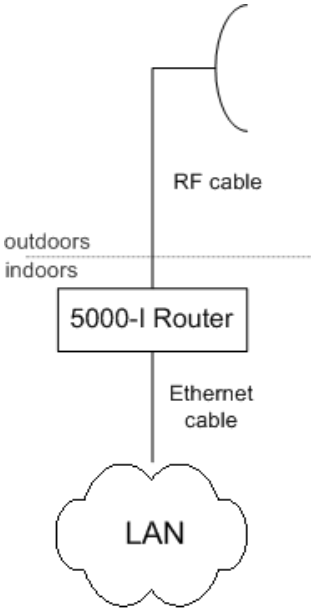
Installation guidelines

1. Unpack the equipment
2. Check items integrity
3. Prepare RF cable of the required length
4. Install and isolate the connectors on the RF cable
5. Install the Router on the mounting bracket (if any) and tighten it
6. Once the antenna and antenna pole (if any) are installed, metallic parts of antenna that touch RF cable must be isolated from the antenna pole and building's grounding contour. Antenna's position must be lower than the highest antenna pole point at least by 2 antenna heights. If antenna is NOT DC-shorted (see antenna technical documentation), the



additional lightning arrestor must be used which is placed between the Router and antenna and is grounded to the Router grounding contour. It is preferable that lightning arrestor is installed indoors right before the RF cable connects to the Router.

7. Connect RF cable to the antenna. Twist the connector tightly
8. Connect RF cable to the Router previously having touched RF cable connector case with connector case
9. Isolate RF connectors from both sides (the Router and the antenna)
10. Provide grounding for the Router
11. Connect Ethernet cable to the Router
12. Provide power supply for the Router
13. Connect to the Router using Telnet protocol



Slides installation

Slides are included in the package. The device can be installed on special slides as shown on the picture below.

Rack mounting

Rack mounting bracket is an optional accessory and must be ordered separately. Two InfiNet Wireless Routers 5000-I can be mounted into a standard 19” rack using special rack mounting bracket.

Legs mounting

Legs are included in the package. The device can be equipped with four legs as it is shown on the picture below.

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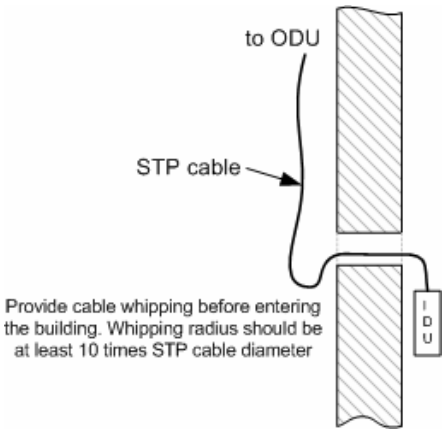
3. InfiNet Wireless R5000-O

Installation guidelines

1. Unpack the equipment
2. Check items integrity
3. Prepare RF-cables of the required length. For 5GHz devices the recommended maximal RF cable length is 1 meter.
4. Install and isolate the connectors on the RF cable
5. Determine the STP cable length that is used to connect IDU and ODU. The total cable length between LAN (behind IDU) and ODU should not be longer than 100 meters.
6. Install (solder) connector for ODU on the STP cable and isolate it
7. If it is possible to lay STP cable with a connector on the IDU side, install (solder) connector for IDU on the STP cable and isolate it



8. Lay the STP cable "from top to bottom" – from ODU to IDU
9. If step 7 is not accomplished, after the STP cable has been laid, install (solder) connector for IDU
10. Install ODU on the mounting bracket connectors down and tighten it
11. Connect the ODU-IDU cable to the ODU

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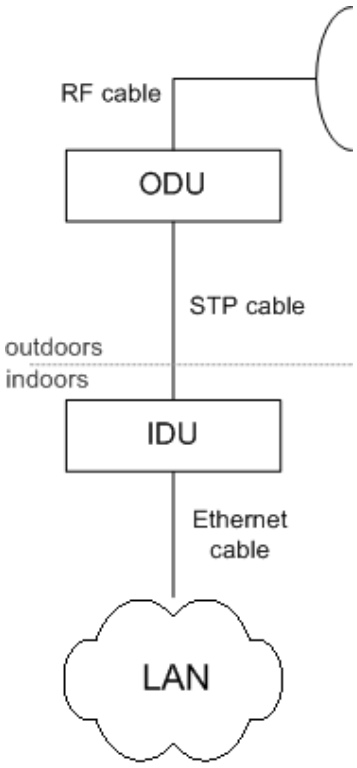
12. Isolate the ODU connector joint place
13. Once the antenna and antenna pole are installed they must be grounded via lightning protection grounding contour. Antenna's position must be lower than the highest antenna pole point at least by 2 antenna heights. If antenna is NOT DC-shorted (see antenna technical documentation), the additional lightning arrestor must be used which is placed between ODU and antenna and is grounded to the antenna pole grounding contour.
14. Connect RF cable to the antenna. Twist the connector tightly
15. Connect RF cable to the ODU previously having touched RF cable connector case with ODU connector case
16. Isolate RF connectors from both sides (ODU and antenna)
17. Connect the STP cable to IDU previously having touched IDU connector case with STP cable connector case
18. Provide grounding for IDU
19. Connect Ethernet cable to IDU
20. Provide power supply for IDU
21. Connect to the Router using Telnet protocol



It is extremely important to install ODU connectors down!

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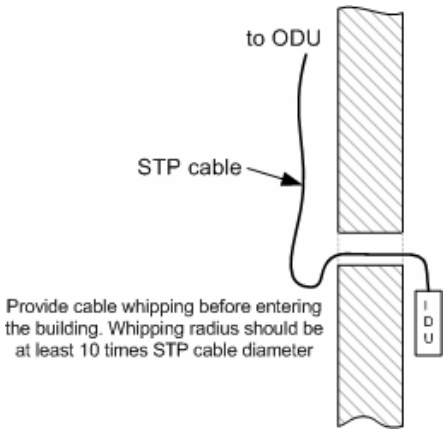
Tube mounting for ODU

4. InfiNet Wireless R5000-L

Installation guidelines

1. Unpack the equipment
2. Check items integrity
3. Prepare RF-cables of the required length. For 5GHz devices the recommended maximal RF cable length is 1 meter.
4. Install and isolate the connectors on the RF cable
5. Determine the STP cable length that is used to connect IDU and ODU. The total cable length between LAN (behind IDU) and ODU should not be longer than 100 meters.



6. Install (solder) connector for ODU side on the STP cable and isolate it

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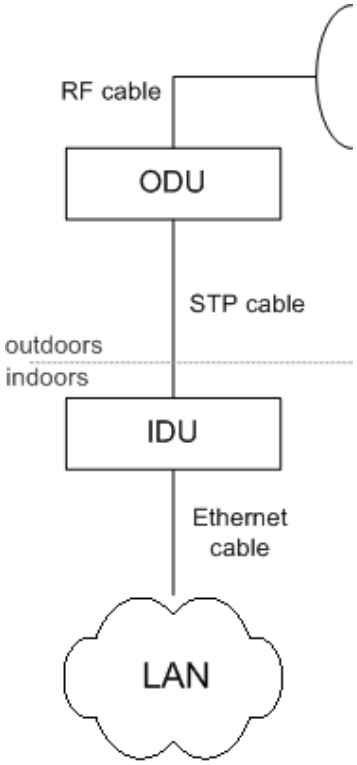
7. Lay the STP cable "from top to bottom" – from ODU to IDU
8. After the STP cable has been laid, use distribution box to switch from STP cable to UTP cable with RJ-45 connectors.
9. Install ODU on the mounting bracket connectors down and tighten it
10. Connect the ODU-IDU cable to the ODU
11. Isolate the ODU connector joint place
12. Once the antenna and antenna pole are installed they must be grounded via lightning protection grounding contour. Antenna's position must be lower than the highest antenna pole point at least by 2 antenna heights. If antenna is NOT DC-shorted (see antenna technical documentation), the additional lightning arrestor must be used which is placed between ODU and antenna and is grounded to the antenna pole grounding contour.
13. Connect RF cable to the antenna. Twist the connector tightly
14. Connect RF cable to the ODU previously having touched RF cable connector case with ODU connector case
15. Isolate RF connectors from both sides (ODU and antenna)
16. Connect the UTP cable to IDU
17. Provide grounding for IDU
18. Connect Ethernet cable to IDU
19. Provide power supply for IDU
20. Connect to the Router using Telnet protocol



It is extremely important to install ODU connectors down!

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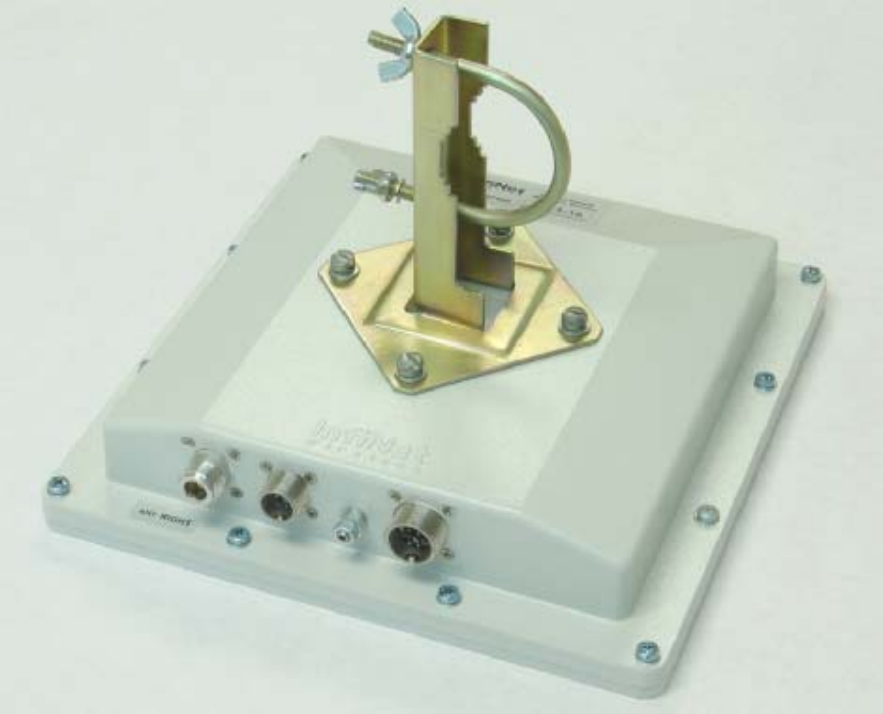
Wall mounting

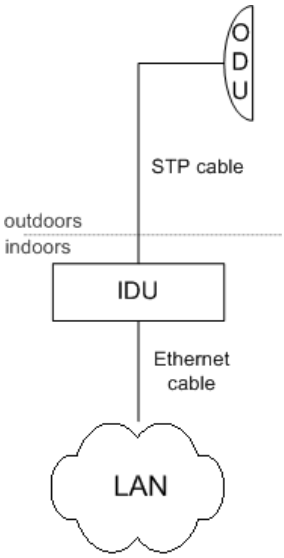
Assembled mounting kit is shown on the picture below.



5. InfiNet Wireless R5000-M/R5000-S

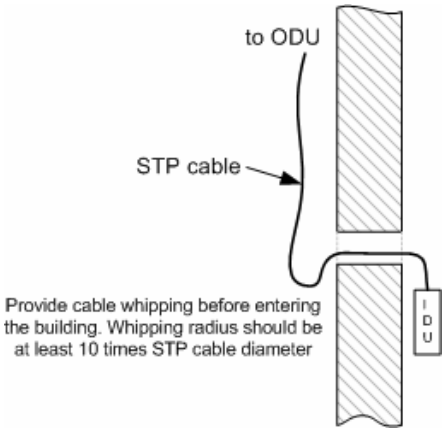
Installation guidelines

1. Unpack the equipment
2. Check items integrity
3. Determine the STP cable length that is used to connect IDU and ODU. The total cable length between LAN (behind IDU) and ODU should not be longer than 100 meters.
4. Install (solder) connector for ODU on the STP cable and isolate it
5. Lay the STP cable "from top to bottom" – from ODU to IDU
6. After the STP cable has been laid, use distribution box to switch from STP cable to UTP cable with RJ-45 connectors.
7. Install ODU on the mounting bracket according to the direction required for the link. Do not tight it too hard unless the antenna alignment is not complete. Install ODU connectors down.
8. Connect the ODU-IDU cable to the ODU
9. Isolate the ODU connector joint place
10. Once the ODU and antenna pole are installed they must be grounded via lightning protection grounding contour. ODU



position must be lower than the highest antenna pole point at least by 2 ODU heights

11. Connect the UTP cable to IDU
12. Provide grounding for IDU
13. Connect Ethernet cable to IDU
14. Provide power supply for IDU
15. Connect to the Router using Telnet protocol



It is extremely important to install ODU connectors down!

Wall mounting kit assembling

Attention! By default, the mounting kit for R5000-S/M does NOT contain a plate for wall mounting – it should be ordered separately.

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Pole mounting kit assembling

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IV. Device configuration instructions

1. Initial settings configuration procedure

Before starting new device, one should perform initial configuration. The configuration can be performed either using serial console port or using Telnet protocol. In order to configure the device using Console port, follow the instructions below:

- Device should be connected with host serial interface, using InfiNet Console cable
- Start any terminal emulation software (e.g. Hyper Terminal)
- Set serial interface properties to 38400 baud rate, 8 bit, 1 stop bit, parity off, flow control disabled
- Enable emulation mode ANSI or VT100, keyboard VT100

To connect using Telnet protocol from the wired LAN run Telnet with 10.10.10.1 IP-address that is configured for the Ethernet interface of the device by default.

If all above procedures are completed correctly, you will see the WanFlex OS prompt:

```
Login:
```

Every new device has no initial login and password settings, so you can use any non-zero length login and password to enter the device:

```
Login: root
Password: 1234
```

After default authorization there will be standard console prompt:

```
console>
```

Now the device is ready for the initial configuration procedure. The most relevant thing to be done at this phase is to define device name/user/password.

```
system name Test Base Station
system user root
system password qwerty
```

*Part of commands in **bold** must be typed in CLI (Command Line Interface). The rest of the command name is optional and can be skipped while typing.*

Since this is made ONLY specified username and password can be used to access the device. DO NOT FORGET THESE PARAMETERS.

2. Router interfaces

The Router has several physical and logical interfaces:

- lo0 - loopback interface, used for system interaction needs
- null0 – logical interface, can be used for auxiliary addresses assignation (for NAT module, for example); for routes aggregation for RIP protocol. Addresses (subnet) are announced to the network but every packet transmitted through this interface is destroyed
- eth0 - Ethernet 10/100 Mbit interface

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- rf3.0, rf4.0 - radio interface. See device's labeling it learn your radio interface name
- pppX – point-to-point interfaces
- tunX - interfaces used for IPIP tunnels building
- vlanX – interfaces supporting VLAN 802.1q tagging

All configures interfaces of the router can be reviewed using the following command:

```
ifconfig -a
```

3. Command line interface (CLI)

For device's management and configuration a Unix-like command line language is used. Every command starts having the power right after Enter key is pressed. However, each command lifetime duration is limited within one configuration session. In order to save a current configuration "config save" command is used.

Several commands can be grouped in one line using ";" character. If a wrong-syntax line is met in the group, the rest of the string is checked anyway and the wrong command is ignored. Command name can be shortened unless the ambiguity occurs.

If your terminal supports VT100 or ANSI standard you can move around the list of recently executed commands using cursor keys. Numbered list of these commands can be reviewed by "!h" command. Any command from this list can be available using "!<NUMBER>" command. TAB key performs substring search of recently executed commands.

Ctrl/R combination refreshes the command string if its content was disturbed by system messages.

The command executed with no arguments prints a short hint about its keys, parameters and syntax.

Context help can be obtained by printing "?" in any position of the line.

4. Lost password recovery

Starting from WANFlex OS 3.32 firmware version, the password can be recovered remotely. The procedure is the following:

1. Locate your device's serial number
2. Send this SN to the InfiNet Wireless Technical Support
3. You will be given a special key
4. Enter the device and use SN as a login and received key as a password
5. Reconfigure the username and password

5. Configuration manipulations

Printing and saving your configuration

You can easily review your current device's configuration by executing "config show" command. The output of the command is sorted by the configuration sections (e.g. "System parameters", "Interfaces configuration" etc).

You can review some particular parts of the configuration specifying the part of the configuration you want to see.

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Example:

```
config show ifc
```

This command will print the interfaces configuration. You can specify several parts of the configuration separating them with a space bar.

Example:

```
config show rip nat
```

In order to save your configuration "config save" command is used. It saves the current system configuration in the router's flash memory for subsequent permanent use. All modifications to the system parameters, if not saved by this command, are valid only during the current session (until the system reset occurs).

Import/export

Export/import of the device's configuration is performed using "config export" and "config import" commands correspondingly. "Config export" saves the router configuration on a remote server and "config import" reloads it from a remote server. The information is transferred using FTP.

Example:

```
config export user:secret@192.168.1.1/var/conf/test.cfg
```

"Config import" command writes the uploaded file directly into the Flash memory without changing the active configuration in RAM. In order to make a new configuration active, right after "config import" command implementation finishes the device should be rebooted. If "config save" command is run before rebooting, Flash memory is overwritten by the copy of the active configuration. This action will erase the uploaded configuration file.

New firmware uploading

The latest firmware version can be downloaded from www.infinetwireless.com web-site "Support/Downloads" section.

Command "flashnet" uploads specified firmware version to the Router. Download is performed using FTP and FTP server should be installed somewhere in the network or on a local host from where download being performed.

File name is a full path including IP address of FTP server:

```
flashnet get upgrade@192.168.1.1/conf/infinet/infinet_new.bin
```

Where 192.168.1.1 is IP-address of FTP server and .../conf/infinet/infinet_new.bin is a full path to firmware version.

The download process has two phases:

- File uploading into RAM of InfiNet device.
- Programming InfiNet device flash memory from RAM firmware image. This phase is indicated by "O.O.O.O.O.O..." sequence.

Do not interrupt this process, otherwise device will be brought into invalid state and it recovery will be possible only at manufacturer premises.

During installation process all system events should be observed in the system journal (command "sys log").

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6. IP address formats

Many commands of the operating system require specification of IP addresses.

In OS WANFleX, the IP-addressees may be specified in traditional numeric format. Optionally, the mask may be specified either by its bit length (the specified number of leading bits in the mask are set to 1, the remaining bits are reset to 0) or numeric value. The IP address 0/0 denotes all possible IP addresses.

Therefore, the possible formats to specify IP-addresses are:

nn.nn.nn.nn (no mask is used)

nn.nn.nn.nn/N (N is the bit length of the mask)

nn.nn.nn.nn:xxx.xxx.xxx.xxx (xxx.xxx.xxx.xxx is the numerical value of the mask)

Example:

The 192.168.9.0/24 address describes the network address 192.168.9.0 and the mask with leading 24 bits on.

The same set of addresses may be denoted as 192.168.9.0:255.255.255.0.

7. Ethernet interface configuration

In the most basic form Ethernet interface can be configured as follows:

```
ifconfig eth0 1.1.1.1/24 up
```

UP flag means than the interface is turned to UP state.

Also you can specify the following parameters for the Ethernet interface:

- Media type. By default media type is selected automatically (media auto parameter).
- Assign aliases to the Ethernet interface (alias key word)

Full information about interfaces configuration can be reviewed in OS WanFlex User Guide – ifconfig command.

8. Radio interface configuration

Radio interface configuration is performed using "rfconfig" command. In its most basic form one need to configure the following parameters of the radio interface:

- Frequency (freq parameter) in MHz. For example, 5260.
- Bit-rate (bitr parameter). Bit transfer rate in kBits/sec.
- System identifier (SID parameter). A hexadecimal number in the range of 1H to FFFFFFH. All routers that are supposed to see each other on the same radio link must have the same identifier.

*Radio interface state is not saved in the configuration. That means that if you put radio interface to the **down** state after rebooting it will be in the **up** state.*

To learn your device's radio module capabilities type the command:

```
rfconfig <IF-NAME> capabilitites
```

<IF-NAME> - radio interface name. Can be read on the device's labeling located on the case.

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This command outputs the following information:

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:	00028AE1D787
Frequency list:	5260, 5280, 5300, 5320, 5340.
Bitrate list:	6000, 9000, 12000, 18000, 24000, 36000, 48000, 54000

Radio interface configuration is performed using "rfconfig" command.

Example:

```
rfconfig rf4.0 freq 5260 bitr 24000 sid 01010101
```

Additional important parameters and settings for the radio interface:

- rf4.0 – radio interface name in this case. In order to obtain radiointerface name either see the ODU/Router labeling or execute "ifc -a" command.
- pwr – transmitting power selection. Available power levels can be obtained using "capabilities" parameter as shown above
- burst – enables burst mode. BURST protocol means grouping several short packets with the same destination address on a radio link into larger packets, thus cardinally decreasing the response time for applications generating streams of short packets. Burst enabling relates to a radio interface as a whole, and means only that you want to use this mode in this device; but the BURST protocol can only work for destinations where it is also enabled at the other end, and only if the RMA protocol is used at both sides.

  Burst enabling does not induce any changes in the work of other devices in the network. To disable "burst" mode use "-burst" parameter in "rfconfig" command.
- distance: this parameter is used to set the exact distance value between two devices (in kilometers). This parameter changes time values for some delays and time-outs of 802.11a/b/g protocol thus making possible to work on longer distances with smooth adjustment.

  There are several ways to manage this parameter:

  - if you set an exact value, this value is used no matter what the connection method is used
  - If the CPE has auto value instead of a number (by default), the CPE will configure its parameters using Base Station commands. It is enough to set a numeric value on a Base Station (the distance to the remotest CPE); all other CPEs will automatically adjust their work. While configuration showing, there might be the current distance value after auto parameter: auto (XX)
  - when knowing exact device's geographical coordinates (e.g. using GPS) you can specify their values in "sys gpsxy" command and distance parameter set as auto on all devices including the Base Station. In this case devices will automatically adjust their settings selecting an optimal value for the distance parameter. Base Station will calculate a distance to the remotest

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subscriber, and subscriber will calculate a distance to the base station. If the CPE has a link coordinates information it will use this information, otherwise it will use the distance parameter value got from the base station.

- If distance parameter is set to 0 radio module will use default settings.
- pwrctl – automatic transmitting power control mode. In this mode the output power is set up automatically within the values available for the radio module. Used for CPE only.

Example:

```
rfconfig rf4.0 freq 5260 bitr 36000 sid 10203040 burst
rfconfig rf4.0 pwr 63 ant RIGHT distance 0
```

ANT parameter is specified on the label on the device's case. The default setting corresponds with a labeled value.

9. Routed Multiple Access protocol configuration

Every InfiNet Wireless Router can be configured as a subscriber unit or as a base station. Each link between a base station and a subscriber unit is described as a PTP connection (or a subnetwork consisting of two units).

From external networks each subscriber unit will be seen as a subnetwork with the mask length of 30, and the information on attainability of this subnetwork and of all subnetworks connected to the subscriber unit will be spread by all base stations, where this subscriber unit is described.

The RMA protocol provides a mechanism enabling to direct routing information relating to a subscriber unit in such a way that at any moment of time it comes out only from that particular base station, to which this subscriber unit is actually connected.

It is HIGHLY recommended to use this protocol at all times even in PTP topology. RMA protocol does NOT differentiate between PTP and PTM topologies in both configuration ways and algorithms it uses.

The routing information can be processed using any available routing protocol.

Basic mechanisms

- RAPS database (Remote Access Permission Service) is common for all subscribers. For detailed description please address to our web-site www.infinetwireless.com "Support" section.
- Link testing protocol
- Subscribers' registration on the Base Station with a permanent link quality testing
- Roaming mechanism (subscriber's movement from one station to another) is based on the dynamic IP-routing
- Adaptive polling
- Adaptive transmit power control
- Adaptive Modulation & OFDM signaling scheme

When having RMA mode turned on, one should not configure radio interface IP-addresses manually. See below description.

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Base Station configuration

BS is configured by specifying all of its CPEs using "rma ab" command. The command format looks as follows:

```
rma ab <IFNAME> MAC ip=MYIP [name=NAME] [options]
```

"Rma ab" parameters:

- IFNAME – name of the radio interface
- MAC – MAC-address of the CPE. In order to obtain this address please use one of the following commands on the CPE:
  - ifconfig –a
  - rfconfig <IFNAME> capabilities
- MYIP – IP address of the connection as seen from the base station (mask length equals 30). IP-address for the CPE radio interface is assigned automatically
- NAME - subscriber's mnemonic name (up to 20 symbols without spaces)
- Options can be the following:
  - –disable|-enable - disables and enables the RMA mechanism for the CPE correspondingly
  - -del : removes the specified parameters from the BS configuration table

To review current BS tables containing all its subscribers use "rma ab" command.

rma ab command shows the status of all subscriber units registered on the base station and current connection quality, as shown on the following example:

1	2	3	4	5	6	7
ab1	00028ae1d72a	NewRWR.0.1	9.9.0.1->2	11/8	A/B/P	<18/36>
ab2	00028ae1d795	NewRWR.0.5	9.9.0.5			

Fields description:

Field#	Description
1	System assigned device's name. Can be used instead of a MAC-address while configuring
2	Subscriber unit MAC address.
3	Unit mnemonic name.
4	IP-addresses: (base station)>(subscriber unit). The address of a subscriber unit is included into the table after successful registration of the unit.
5	Current connection quality measured in relative units from 0 to 16. 0 indicates the weakest signal quality, 16 – the strongest. <signal level from CPE>/<signal level from BS>
6	Status field. A – active

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	B – burst mode on P – polling mode on
7	<transmitting speed>/<receiving speed>

CPE configuration

CPE configuration is performed using "rma bs" command. For each subscriber one can specify several base stations at which the CPE can be registered (see Roaming section). The command syntax looks as follows:

```
rma bs <IF-NAME> sid/speed[/minspeed] freq [,freq…] [-del]
```

When executed without parameters, the RMA BS command displays the status of the base station selected and the current connection quality.

The command has the following parameters:

- IF-NAME - the name of a radio interface
- sid - a network identifier
- speed - requested connection speed (bitrate) in KBit/s (if autobitrate mode is turned on, this parameter sets the highest possible speed). The list of available speeds can be displayed by "rfconfig <IF-NAME> bitr" command and depends on radio module type.
- Minspeed – optional parameter used in autobitrate mode. Sets the minimal value for the speed.
- freq - the base station operating frequencies; any number of frequencies may be specified, as a list of individual frequencies and/or of frequency ranges f1-f2, separated by commas.

The -DEL option is used to remove the specified parameters from the subscriber unit's configuration table.

Example of BS configuration on the CPE:

```
rma bs rf4.0 01010101/24000 5260, 5280
```

If you want this CPE to attempt to connect to another Base Station, you should specify it in a separate line with different frequencies and/or bitrate.

"rma bs" command executed without parameters shows current registration of the CPE on the BS.

Example:

```
rf4.0: bs (10101011/24000,5280) 00028aeb54d4   Q=155  7/6  IP=1.1.1.1
Links 13, reps 13, Q=155 Rx=18 Tx=24  burst
```

Here:

- rf4.0 – name of the interface
- 101010011 – SID
- 24000 – configured maximum speed (upstream to BS)
- 5280 – working frequency
- 00028aeb54d4 – MAC-address of the BS at which the registration was performed
- Q (1st entry)– base signal quality level
- Q (2nd entry) – current signal quality level

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- 7/6 – "signal level from the subscriber"/"signal level from the BS". Measured according to the relative InfiNet scale from 0 to 16 (0 – min, 16 – max)
- IP – IP-address for the radio interface from the BS side
- Links – number of testing packets sent
- Reps – number of testing packets acknowledgments received
- Rx – data rate on receiving in Mbit/sec
- Tx – data rate on transmitting in Mbit/sec
- Burst – Burst mode is turned on

Bitrate control

Traditional ways of InfiNet router's usage imply a fixed connection speed between a base station and a subscriber. A subscriber while searching and registering on a base station chooses an optimal mode which is available in the configuration and afterwards does not change connection parameters even if radio channel characteristics (signal levels, noise level) are changing. The speed in both directions is set as it is configured on the subscriber's side. If the conditions worsen so much that further work is impossible the connection breaks and a new base station search runs or new work parameters are being chosen. This way of configuration is logical when one needs to get a reliable channel with previously known characteristics and when all radio channel parameters are thoroughly designed.

However in some cases when there is a need in fast channel making (if it has non-critical parameters) it is more convenient to switch to an automatic mode. The automatic speed control mode solves this problem. In this mode every device controls the connection parameters independently (amplitude of the received signal, SNR on the opposite side etc) and chooses such transmitting speed which provides necessary conditions for a reliable work with minimum number of ARQs and losses. Speed values can be different for each direction but it will be optimal.

If this mode is turned on at the subscriber's side the base station will turn it on also for this particular subscriber. In this case the base station search is performed on the minimal for the subscriber speed and then the speed is increased to its maximum value (it can be limited by the speed specified in `rma bs` command or by limitations for the specific device model). If autobitrate mode is turned on at the base station all subscriber devices that work with it will automatically switch to this mode.

The speed ranges for the autobitrate algorithm are specified in CPE configuration by specifying `speed` and `minspeed` parameters.

In order to turn this mode on (either on BS or CPE), type:

```
rma <IF-NAME> autobitrate
```

In order to turn this mode off (either on BS or CPE), type:

```
rma <IF-NAME> -autobitrate
```

Roaming

Roaming means that for each CPE several base stations with which it can potentially interact can be specified. If there are several BS configured for the CPE, it will measure signal quality level with each of those BS and choose the BS with the best integral characteristic. In order for the CPE to have a roaming feature one should:

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- Specify using "rma bs" command all BS that CPE can potentially work with
- On each BS that is specified in CPE's configuration one need to configure the CPE

Subscriber's LAN switching from one base station to another takes place with no LAN Ethernet interface IP-addresses changing.

Router's configuration rebuilding takes not more than 15 seconds when the base station changing is performed.

IP-routing is used as a roaming mechanism and this feature allows subscriber's relocation within the whole network and switching between different base stations.

Polling

The WMA/CD (polling) regime is a method of accessing common radio channel under base station control, which means a centralized distribution of transmission authorization markers by a base station to subscriber units. This regime greatly improves operational stability and throughput of base stations under conditions of heavy load and signal level misbalance between different subscriber units. It is particularly useful when subscriber units are at long range from a base station and not in the direct visibility of each other, so that they cannot avoid mutual collisions in the radio channel by listening each other's transmission. The polling regime makes it possible to establish reliable communication between subscribers when the ordinary CSMA/CA wireless access method does not work at all.

Despite a slight decrease in the maximum transmission speed, the polling regime substantially increases the total throughput of a base station and provides for its fair distribution between subscriber units.

Among the drawbacks of wireless polling method one can mention comparatively greater initial delay and greater response delay variations for series of short packets, which is adversely affecting such applications as telemetry and on-line games.

The polling regime is enabled on the base station only. Configuration of subscriber units needs not to be modified. All those units, however, shall have RMA protocol enabled.

A base station with polling regime enabled may simultaneously serve both polling and non-polling subscriber units; presence of non-polling units (`dumb` units, `relay-points` which combine both BS and CPE configuration), however, substantially reduces the whole system's effectiveness.

To turn polling regime on the BS, type:

```
rma <IF-NAME> poll
```

To turn polling regime off, type:

```
rma <IF-NAME> -poll
```

Polling mode is recommended to be used with RMA protocol as it determines the radio environment and makes it predictable. The competitive results of CSMA/CA and polling protocols are presented on our web-site

Polling mode can significantly increase a ping round trip time. In this case this time is not a measure of a link quality.

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Link Test & Control

A Base Station performs a permanent link testing with a subscriber. Each testing is accompanied by subscriber's information update in the Base Station's tables. This mechanism provides a system operator with comprehensive data concerning registered subscribers and links quality without any additional tests launching.

RMA usage

The following procedure is recommended for RMA protocol configuration:

- Define which of the network components act as a BS and which are CPEs
- Configure all CPEs on the BS using "rma ab" command
- Configure BS on each CPE using "rma bs" command
- Run RMA on each device using "rma start" command. RMA mode can be disabled using "rma stop" command
- Enable polling mode on the BS
- Define which links are not stable at the configured speeds and try using autobitrate mode either for some specific CPEs or for the whole cell

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V.Link Configuring

1. Preliminary decisions

Speed selection

Basic recommendations for the device's speed selection are the following:

- The overall performance of the channel built using 54 Mbps devices is just a little bit higher than for 48 Mbps devices. However, the noise immunity for 54 Mbps is less than for 48 Mbps. So, the recommendation is to configure your devices for 48 Mbps speed instead of 54 Mbps
- BS downstream speed to CPE can be configured as high as it is possible. Upstream speed from CPE to BS should not exceed 24 Mbps. This kind of asymmetry leads to less expenses to create a required attenuation between BS sectors – subscriber's equipment costs less and the optimal price/performance parameter value is obtained
- By effective antenna selection for the subscriber units, one should set up equal speeds for all subscribers regardless their individual performance requirements
- In order to obtain a stable work mode for the whole network set up Autobitrate mode with optimal range of available speeds provided

Examples of typical network equipment selection:

1. Network with upstream traffic prevailing (e.g. video surveillance systems)
    - Base Station: 5000-O 5.8 24P200. Sector antenna gain: 17 dB
    - Nearest subscribers (e.g. 3 km coverage area): 5000-O 5.8 24 with 19 dB directional antenna
    - Remote subscribers (e.g. 9 km coverage area): 5000-O 5.8 24P200 with 29 dB directional antenna
    - Bottom value for the speed: 12 Mbps
    - This solution provides with the performance of not less than 8 Mbps real throughput
2. Network with downstream traffic prevailing (e.g. ISP networks)
    - Base Station: 5000-O 5.8 36P300. Sector antenna gain: 17 dB
    - Nearest subscribers (e.g. 6 km coverage area): 5000-O 5.8 18 with 19 dB directional antenna
    - Remote subscribers (e.g. 12 km coverage area): 5000-O 5.8 18 with 29 dB directional antenna
    - Bottom value for the speed: 6 Mbps
    - This solution provides with the performance of not less than 4 Mbps of real throughput for upstream traffic and 8 Mbps for downstream traffic with maximal coverage area
3. Network with downstream traffic prevailing (e.g. ISP with different services)
    - Base Station: 5000-O 5.8 36P3000. Sector antenna gain 17 dB
    - Nearest subscribers (e.g. 2.5 km coverage area): 5000-O 5.8 19 dB directional antenna
    - Remote subscribes (e.g. 5 km coverage area): 5000-O 18 with 29 dB directional antenna

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- Bottom value for the speed: 12 Mbps
- This solution provides with the performance of not less than 8 Mbps of real throughput for upstream traffic and 14 Mbps for downstream traffic with maximal coverage area

Frequency planning for multi-sectored Base Stations

Base Stations with six sectors deliver the maximal performance by providing with sector reciprocal reservation and best price/performance parameter value. When having an optimal frequency gap of 40 MHz between adjacent sectors of the BS, the following schemes are recommended to be configured (e.g. having 5 available in configuration frequencies F1, F2 … F5):

- F1, F3, F5, F1, F3, F5
- F1, F3, F1, F3, F1, F3

Transmitting power selection

High output power provides with a maximal connection performance. Power decreasing is logical when the maximal speed is already reached and there are no repeats. In this case an excessive output power can decrease the system parameters. When having no built-in or external amplifiers one can try to install the automatic power control for the subscriber.

Fade margin calculator

Fade Margin Calculator is used for estimating the link energetic parameters and for upstream/downstream speeds prognosis. The calculator is available at www.infinetwireless.com web-site in the Support section.

The procedure for the Calculator usage is the following:

1. Specify "Distance" and "Frequency" parameters of the link
2. Specify "Antenna Gain" for Unit №1 and for Unit №2
3. Specify "Cable Attenuation" per 1 meter cable length. For example, for 2.4 GHz devices - 0.24 dB, for 5 GHz – 0.4 dB. Depends upon used cables.
4. Specify "Output power" in milliwatts
5. Specify "Receiver sensitivity". In order to do that, please think of the desired/predicted speed on the link and refer to the tables below the Calculator. For Unit №1 – predict UPSTREAM speed. For Unit №2 – predict DOWNSTREAM speed
6. If you use external amplifiers, fill out "Amplifier" section(s)
7. Press "Recalculate" button
8. Perform the following actions:
    - For UPSTREAM speed prognosis use "Signal level by InfiNet scale" parameter for Unit №1. Subtract "Sinking Offset" parameter provided below. Search the calculated value in "Minimal InfiNet scale level required for maximal throughput" in the tables below. If the value matches with the predicted speed, the link works with selected parameters. If not, please select another speed and go back to Step 6
    - For DOWNSTREAM speed prognosis use "Signal level by InfiNet scale" parameter for Unit №2. Subtract "Sinking Offset" parameter provided below. Search the calculated value in "Minimal InfiNet scale level required for maximal throughput" in the tables below. If the value matches with the predicted speed, the link works with selected

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parameters. If not, please select another speed and go back to Step 6

In order to obtain speed range calculation for the link (for 5GHz devices only), please refer to "Speed range calculator".

Landscape details and signal propagation path obstructions are not taken into account in the calculator.

Speed range calculator

Speed range calculator is used for Speed/Coverage parameters calculation for the link. The Calculator is available at the www.infinetwireless.com web-site in the Support section.

The Calculator works for 5GHz devices only

The procedure for the Calculator usage is the following:

1. Specify "Distance" and "Frequency" parameters of the link
2. Specify "Antenna Gain" for "Base Station" and "CPE"
3. Specify "Cable Attenuation" per 1 meter cable length
4. Specify "Output power" in milliwatts
5. If you use external amplifiers, fill out "Amplifier" section(s)
6. Press "Calculate" button

The results are presented at the right side of the table. "Best" and "worst" values for bitrates both for BS and CPE act as recommendations only when planning the network. The worst value implies lower energetic parameters for the clients that are located on the sides of the BS sector antenna radiation diagram or on the limit of the fade margin.

Landscape details and signal propagation path obstructions are not taken into account in the calculator. Please refer to the "Remarks" section.

2. Link diagnostic tools

Muffer

The muffer module makes it possible to rapidly test the electromagnetic environment, visually estimate the efficiency of the utilization of the air links, reveal sources of interference, and estimate their power.

Several operating regimes of the muffer module provide for different levels of details in test results

Review mode

This regime is enabled by the review option. It makes possible to have a general estimation of emissions and interference within specified frequency range.

Normal operation of the radio is not possible in this mode.

This regime can be useful on the first steps of link configuration. One can observe the activity on the selected list of frequencies and make decisions of

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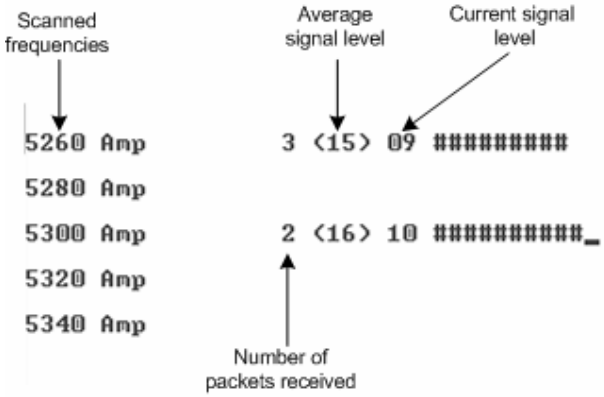
what frequencies can be used for the link so that the link did not interfere with other sources of signals.

The scan is performed only for the packets corresponding with the standard of the radio module (802.11a for 5GHz devices and 802.11b for 2.4 GHz devices. Other sources of signals on the scanned frequencies stay unseen.



The picture above shows the output of `review` mode.

To run the `review` mode please type the following command:

```
muffer <IF-NAME> review
```

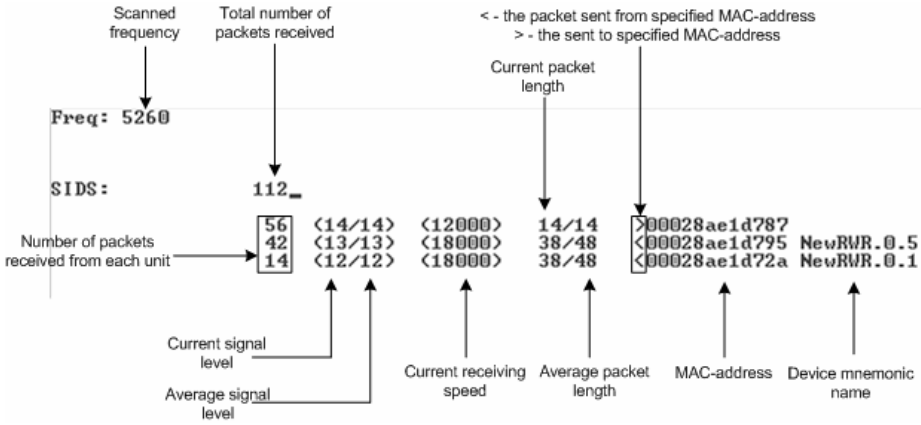
Once the link is established you can use this mode to review the activity on the configured for frequency for the link. If no activity is observed that means that the signal from the remote side is being broken by the interference sources or by the obstacles on the signal propagation path.

MAC2 mode

This regime performs MAC-addresses analysis to estimate the number of clients with different MAC addresses and the efficiency of their utilization of the air link. The analysis is carried out for all MAC addresses at the frequency previously specified by **rfconfig** command. The `mac2` regime checks both data packets and the link-level ACK messages sent by protocol supported devices.

Normal operation of the radio is not possible in this mode.

The picture below shows the output `mac2` regime.



Like in review mode this regime provides with the information about a current activity but on the configured frequency.

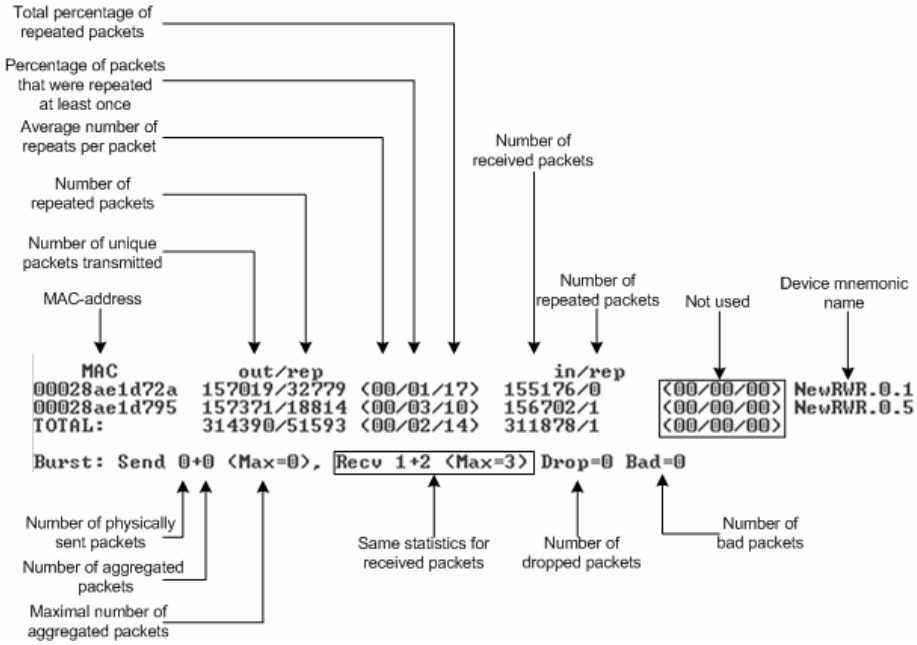
To run the review mode please type the following command:

```
muffer <IF-NAME> mac2
```

Statistics

The statistics gathering is used for estimating link load intensity and per client. The amount of packets sent and received, and the number of retransmissions is shown for each MAC address participating in the data exchange.

The statistics output is presented in the picture below.



The following decisions can be made by analyzing the outputted parameters:

- If the number of repeated packets is comparable with total number of packets that means that you might have an interference source on the selected frequency. For normally operating link the percentage of repeated packets should not exceed 10%. It is extremely important to obtain a permanent zero value for the average number of repeats per packet. If the value is not zero that means that the link is NOT working properly and requires further improvement
- If total percentage of repeated packets and the percentage of packets that were repeated at least once are close to each other that might mean that you have got a permanent source of interference. Otherwise, it means that a strong interference source appears from time to time breaking your signal
- Concerning the fact that statistics module outputs the information for each MAC-address separately, you can reveal the problem for some specific unit on the wireless network

The "muffer stat" command shows the statistics only from registered devices.

To view statistics type the following command:

```
muffer stat
```

To reset all counters please type

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muffer stat clear

Other modes of muffer

The muffer also has the following modes:

- mac mode. Compared to the mac2 mode this mode does not take link-level ACK messages sent by protocol support devices into account
- mynet mode performs the radio testing without disturbing radio module's normal operation, but taking into account only packets from within the given network
- sid mode. The sid regime allows estimating the number of currently operating subscriber groups having different identifiers (SID), and the efficiency of air links utilization. The analysis is carried out for all network identifiers at the frequency previously specified for the radio module by rfconfig command.

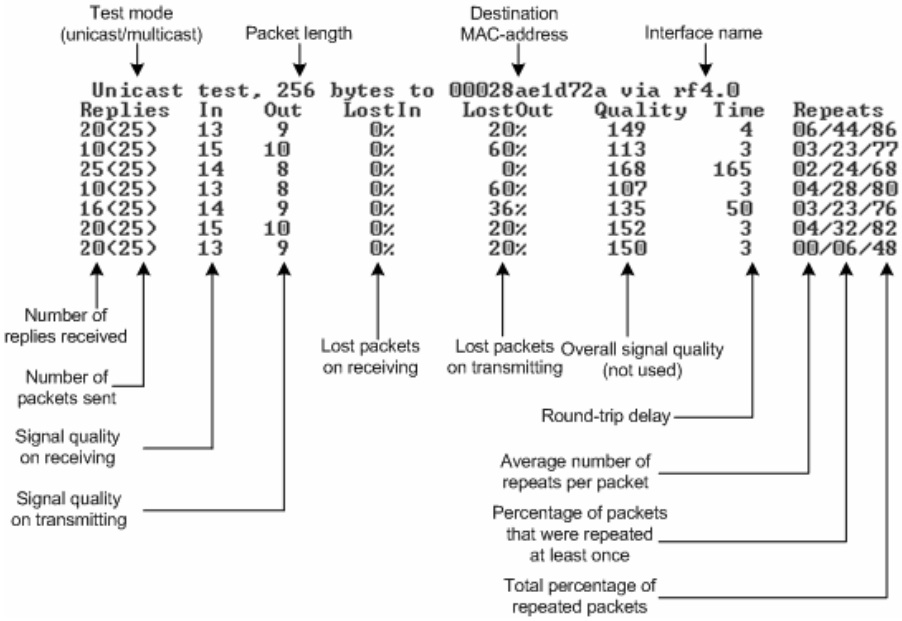
RMA Test

RMA test modes are used for estimating the quality of the established link. Compared to the muffer mode these modes are not passive and involve transmitting packets to the radio media.

Manual testing

Manual test of a link to a subscriber unit or base station with specified MAC-address. Any device can be tested in this mode, and testing results can be seen on the console and on the front panel LED indicators.

The output in this mode in presented in the picture below.



This mode can be very useful when run of one of the ends of a wireless link whereas the antenna alignment procedure and/or configuration manipulations are carried out on the other end of the link. Thus, having mobile phone handy or other communicating devices you can set up the link for the best performance. Varying the packet length and the test mode (unicast/multicast) you can obtain the required link quality for the specific subscriber unit. In unicast mode (default mode) one should obtain zero values for LostIn and LostOut parameters even when the packet length is long (e.g. 1400 bytes). For multicast mode the threshold value below which the link can be defined as satisfactory is approximately 20% of lost packets.

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Example of rma test mode usage for manual mode:

```
rma rf4.0 test ab1 1400 mcast
```

Here:

- Test key word means that the test is performed in the manual mode
- Ab1 – system assigned name for the subscriber (do not mix with a mnemonic subscriber name, see rma ab section). You can use subscriber MAC-address instead
- 1400 – testing packet length
- mcast – multicast mode. If not specified the unicast packets are sent

Automatic RMA test modes

Two automatic test modes are available: using MAC-address (no registration) and with registration on the BS. In the second case the subscriber searches for the BS specified in its configuration and afterwards the testing starts using MAC-address of the found BS.

Example (deferred test using MAC-address):

```
rma rf4.0 auto 00:00:0e:12:13:ac 2048 mcast
config save
```

Example (Base Station search test):

```
rma rf4.0 autobs 2048 mcast
config save
```

To disable automatic test modes, please type:

```
rma rf4.0 -autotest
config save
```

Load Meter

Load meter is a powerful tool that allows estimating the load of a system interface specified by interface parameter. By default, the information is displayed on one line and updated every second; the load is measured in kilobytes.

Below picture shows the load meter output for the radio interface outputted in line-by-line mode with one second interval.

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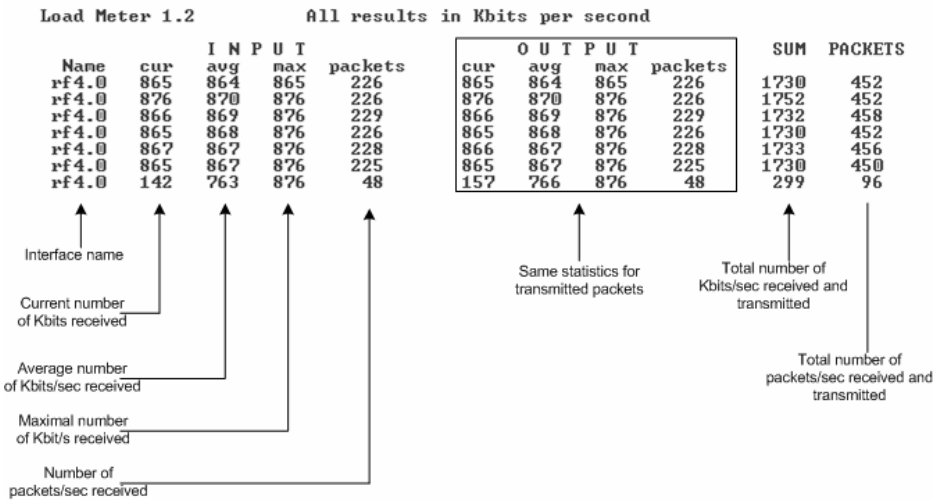


To run load meter like it is shown above, please type:

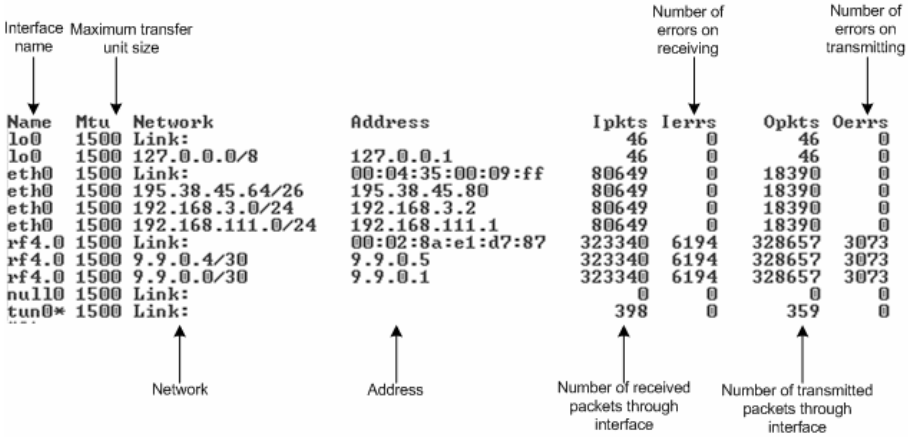
```
loadm –I <IF-NAME>
```

Acquiring interfaces statistics

Interface statistics can be acquired using `netstat` module which includes two modes:

- Routing tables output (using "-r" parameter with the command)
- Interfaces statistics output (using "-I" parameter with the command)

Below picture shows the example of interfaces statistics output.



If the interface has several aliases the statistics is still measured for physical interface in a whole. For example, see rf4.0 or eth0 interfaces above. The numbers shown in 4 right columns correspond in physical interface.

VI. Services, features and tools

This chapter describes router's built-in services, features and tools which were not described in previous parts of the document. Descriptions provided in this chapter are shortened. Full description is available in the OS WANFlex User Guide.

1. Network services

MAC filter

The MAC filter (macf command) performs static mapping of IP-addresses to MAC addresses in an Ethernet network. It may be useful for service providers when they connect to their network a group of clients (such as individual users in an apartment block) via one common access unit. In this case, clients may be tempted to change their IP address to that of a neighbor, thus deceiving provider's accounting system. Although it is almost impossible to definitely resolve this issue, you can make however your life easier by directly mapping the client's assigned IP-address to his/her MAC-address, because surreptitiously modifying a MAC address is much more difficult for an average user.

NAT

NAT - network address translation according to rfc1631

NAT (nat command) allows solving to the certain extent the problem IPv4 address space exhausting. It means that several computers in the given LAN may connect to Internet via the same public IP address. NAT-module receives outgoing IP-packets, modifies sender's IP address to the public IP address and forwards it to Internet. Sender's IP address is modified in such a way that it is possible to identify the sender when IP packet received on the LAN incoming interface and to forward the IP packet to the initial sender. NAT-module is similar to natd and libalias from FreeBSD. Original manuals can help understand the subject better.

Full support of H.323 protocol.

IP firewall

IP Firewall (ipfw command) is a mechanism of filtering packets crossing an IP network node, according to different criteria. System administrator may define a set of incoming filters (addincoming) and a set of outgoing filters (addoutgoing). The incoming filters determine which packets may be accepted by the node. The outgoing filters determine which packets may be forwarded by the node as a result of routing.

Each filter describes a class of packets and defines how these packets should be processed (reject and log, accept, accept and log).

Packets can be filtered based on the following properties:

- Protocol (IP, TCP, UDP, ICMP);
- Source address and/or destination address (and port numbers for TCP and UDP);
- The network interface it arrived on;
- Whether the packet is a TCP/IP connection request (a packet attempting to initiate a TCP/IP session) or not;
- Whether the packet is a head, tail or intermediate IP fragment;
- Whether the packet has certain IP options defined or not;

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- The MAC address of the destination station or of the source station.

QoS

QoS manager (qm command) is a convenient and flexible mechanism to manipulate data streams going through the router. The user can create up to 64 logical channels characterized by different properties (such as priority levels and data transfer rates), and then assign data streams to these logical channels according to special rules of assignment. Packets going through different channels are thus modifying their own properties as well as properties of their respective data flows.

QoS application:

- Traffic shaping
- Traffic prioritization
- Traffic redirection

Tunneling

There are several approaches for tunnels building. One of them is IP into IP Encapsulation (described in RFC 2003). It is implemented in OS WANFleX (tun command). This technology is used, for example, in Cisco Systems routers, and is a subset of the IPSEC protocol supported by several operating systems.

Within this approach, tunnels are implemented as point-to-point (P2P) links between two endpoint routers. The whole data stream through such a link is encapsulated into IP packets at one end of a link and is delivered to its opposite end through the existing transport network.

Routing core

InfiNet Wireless Router supports the standard TCP/IP (IPv4) protocols stack.

2. Utilities and services

Telnet

Telnet system protocol support.

Telnet command sets up a connection with a remote host specified by the IP-address in the terminal emulation mode. The telnet command uses transparent symbols stream without any intermediate interpretation; therefore, the terminal type is defined by the terminal from which the command has been executed

Ping

Ping command sends test packets (ICMP_ECHO_REQUEST) to the given IP-address. Enables to estimate attainability of a host and the destination response time.

Access control lists

While network planning you may often need to group similar parameters in lists which can be used for different filters. Access control lists (acl command) can effectively solve this problem.

The ACL command creates an access list the specified name and type.

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3. Routing protocols

Static

The router has a feature of creating static routing tables

The route command provides with manual management of system routing tables. In the normal mode, when a routing daemon is active, this command is not needed. However, in some cases it allows to achieve more precise, non-standard configuration.

All routes that are described using route add command are "pseudostatic". It means that this information will be immediately placed into the configuration and will be active until it is deleted using route delete command. However, actually described routes will be put into the system tables only when there is an interface with an address and a mask within the boundaries of the gateway address set. When this address is absent routes set will be automatically deleted from system tables but still will be present in the configuration

RIP

The routing module supports two versions of the Routing Information Protocol: RIP-1 and RIP-2. The rip command is used to set up the module for using these routing protocols.

OSPF

An OSPFv2 module daemon is now also available in OS WANFlex.

4. Management features

HTTP

The HTTP protocol support module (httpd command) makes it possible to configure the router using any Web browser. A mini-server built into the router provides for executing any WANFleX command, and also some predefined scripts.

RSH

RSH (remote shell) protocol support module.

The built-in RSH server makes it possible remote command execution using the rsh command. Identification is based on using privileged TCP ports and a list of authorized hosts.

SNMP

Simple Network Management Protocol version 3 support.

SNMP support (snmp command) is an important feature supported by the router as it provides the network administrator with a control over the whole system and any of its components.

Console

The router has a feature of its configuration management via console. By specifying the correct parameters of the RS-232 interface and connecting the device via console cable one can get an access to the WanFlex OS command prompt in order to configure the device.

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VII.GUI "InfiNet Wireless Router Manager"

1. Overall functionality overview

"InfiNet Wireless Router Manager" ("IWR Manager" for short") is used for the following purposes:

- View and change system parameters of the router
- View and change interfaces parameters of the router
- Obtain ARP table and routing table
- View interfaces statistics and interfaces current load statistics
- Setting up the router as a BS or/and CPE
- View CPEs parameters if the router acts as a BS
- View BS registration parameters if the router acts as a CPE
- Separate Telnet session for console management

The application is designed for OS Windows.

2. Application requirements

In order to run and properly use the application, the following requirements must be met:

- InfiNet Wireless R5000, single-radio
- OS WANFleX version 3.36 or higher
- SNMP agent is running (`snmp enable` command)
- Before starting the application, not more than 3 session of Telnet should be opened for this particular router
- Automatic screen messaging must be turned off (`sys log off` command)

3. User guide

In the authorization window please enter login, password, SNMP community name, IP-address of the router. In case if one of the listed parameters is incorrect, the user gets one of the following error messages:

- `SNMP test failed`. The message states that the application is unable to work with the router using SNMP protocol. Amongst the reasons for this error messages one can state the following:
    - SNMP Community name is incorrect
    - SNMP agent is not run on the router
- `Client socket error`. The error message means that the application cannot establish the connection with the router using Telnet protocol. The reasons may be the following:
    - Login is incorrect
    - Password is incorrect
    - IP-address is incorrect or the router is not attainable via IP

If authorization went well, the user will be able to see "IWR Manager" window after all parameters had been downloaded from the router.

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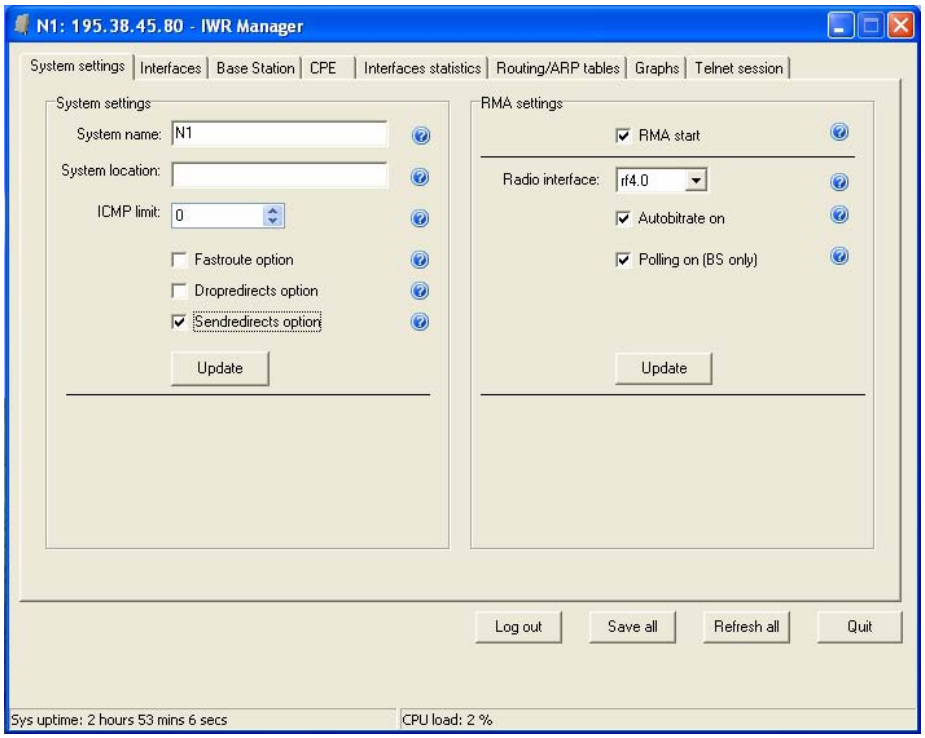
In system panel at the bottom of the window the following parameters are permanently updated:

- Sys uptime. A time since last device's reboot.
- CPU load. Current CPU load.

Also, a set of buttons is also available at the bottom of the window:

- Save all. Saves all changes. Equivalent to "config save" command.
- Refresh all. Updates all information is all tabsheets.
- Quit. Closes the application.

System settings



The following system parameters can be changed/viewed in this sheet:

- System name
- Optional parameter setting a geographical location of the router

RMA protocol manipulations:

- Starting/stopping the protocol
- Turning on/off the autobitrate mechanism
- Turning on/off the polling mechaism

Parameters are usually united in groups with one common "Update" button at the bottom of the group (e.g. "RMA settings"). Unless the button is not pressed all changes in the group does not have power.

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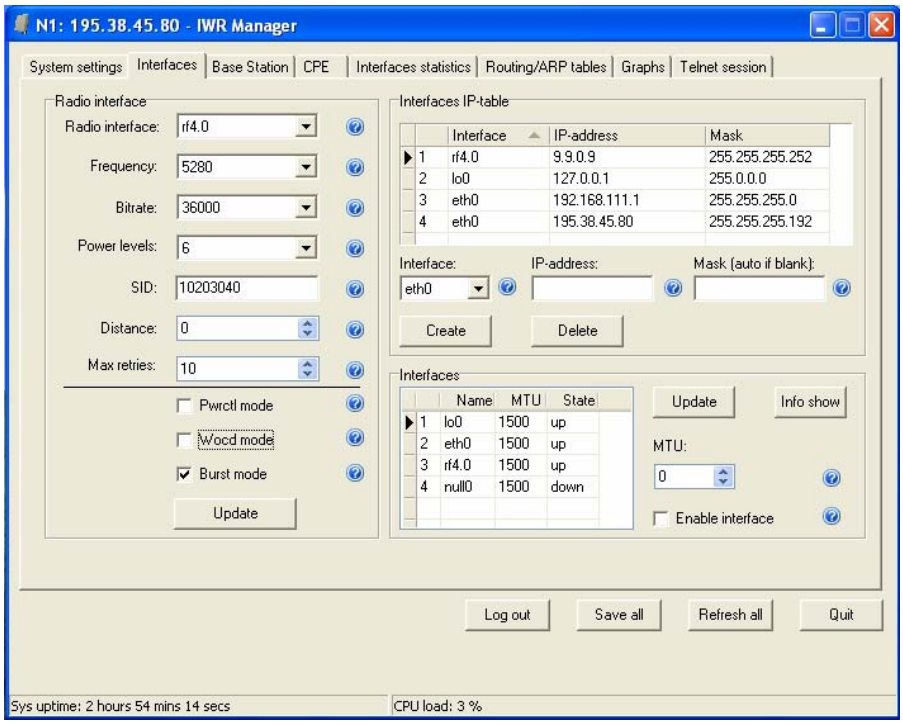
Interfaces



Among all interfaces parameters that can be adjusted in this tabsheet, the most important are radiointerface parameters:

- Working frequency. Usually this parameter is relevant only for BS. For the CPE the frequency (or a list of frequencies) is set in RMA protocol configuration and determines the list of frequencies where the BS should be searched.
- The bit transfer rate (in Kbit/s) of the radio link.
- Power of a transmitter (in milliwatts). The values of acceptable trasmit power levels can vary depending on the type of radio module installed. The full list of acceptable trasmit power levels is available by using "`rf if-name` capabilitites" command. If the value entered is invalid the system will automatically set a minimal adjacent value.
- System identifier of the router, a hexadecimal number in the range of 1H to FFFFFFH. All routers that are supposed to see each other on the same radio link must have the same identifier. To be compatible with ARLAN 655 network adapters, the identifier must be an even number. For 11 Mbit/s radio modules (PC4800, Lucent ORINOCO etc) the identifier must be entered as a string of 6 hexadecimal digits (using digits 0 to 9 and CAPITAL letters A to F), with leading zero's when necessary, e.g. 00A2CD.
- Distance. this parameter is used as an alternative method of link range configuring in order to set the exact distance value between two devices (in kilometers). This parameter changes time values for some delays and time-outs of 802.11a/b/g protocol thus making possible to work on longer distances with smooth adjustment.

  There are several ways to manage this parameter:

  - if you set an exact value, this value is used no matter what the connection method is used

- If the CPE has auto value instead of a number (by default), the CPE will configure its parameters using Base Station commands. It is enough to set a numeric value on a Base Station (the distance to the remotest CPE); all other CPEs will automatically adjust their work. While configuration showing, there might be the current distance value after auto parameter: auto (XX)
- when knowing exact device's geographical coordinates (e.g. using GPS) you can specify their values in sys gpsxy command and distance parameter set as auto on all devices including the Base Station. In this case devices will automatically adjust their settings selecting an optimal value for the distance parameter. Base Station will calculate a distance to the remotest subscriber, and subscriber will calculate a distance to the base station. If the CPE has a link coordinates information it will use this information, otherwise it will use the distance parameter value got from the base station.

Using several checkboxes you can manage different regimes for the radio:

- wocd mode. Disables carrier sense on the radio interface when sending data packets. May only be used on a base station working in WMA (Wireless Marker Access) mode. Reduces the number of retransmitted packets, thus increasing effective throughput of a multipoint radio link. "-vocd" re-enables the standard mechanism of permanent carrier sense. Initial setting is "-wocd" (carrier sense enabled).
- burst mode consists in grouping several short packets with the same destination address on a radio link into larger packets, thus cardinally decreasing the response time for applications generating streams of short packets..
- pwrctl enables automatic management of transmitter's emitting power.

Along with radiointerface parameters, the user can view/change other interfaces parameters::

- eth0 – Ethernet interfaces
- lo0 – Loopback interface
- null0 – auxiliary interface

The application has the following functionality to manage the interfaces:

- Add/delete/change primary and secondary (alias) IP-address on each interface
- Change the state of the interfaces (up/down).
- Change MTU (Maximum Transfer Unit) parameter for each of the interfaces

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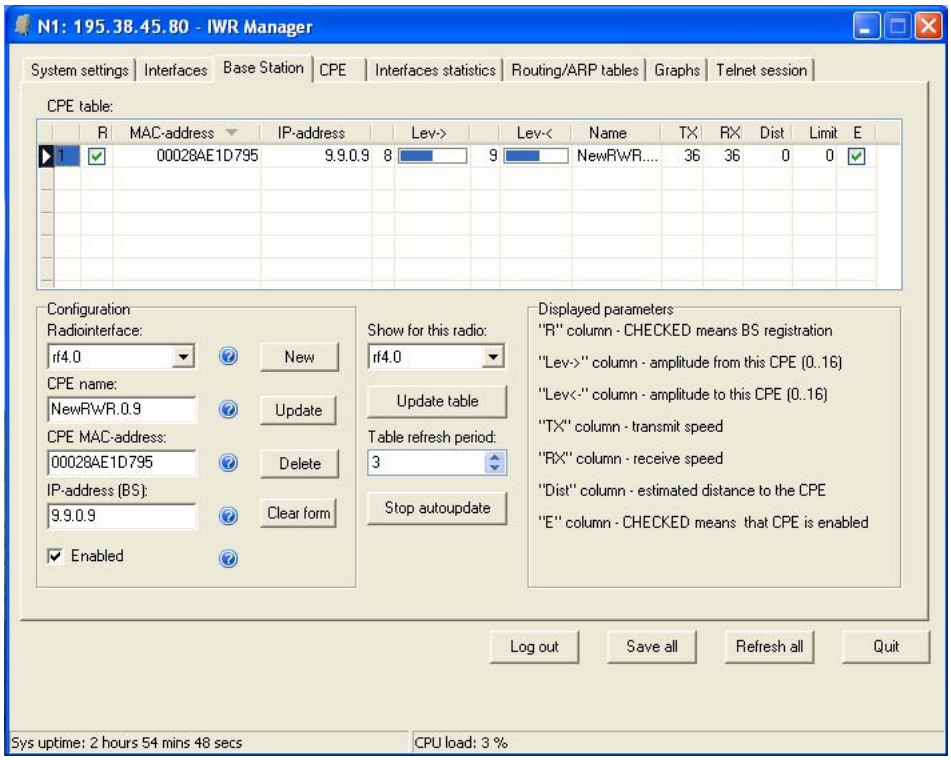
Base Station



In this Tabsheet the user can edit the following parameters:

- Create/delete/edit records for the CPEs that can register on this Base Station. Each record corresponds with "rma ab" string in RMA protocol configuration
- Manual CPEs switching on/off

The application is capable of periodic update of the CPE current information which includes:

- BS registration status
- Signal levels from BS to CPE and from CPE to BS. Signal levels are measured from 1 to 16
- Upstream and downstream speeds
- Distance to the Base Station
- Mnemonic name of the CPE

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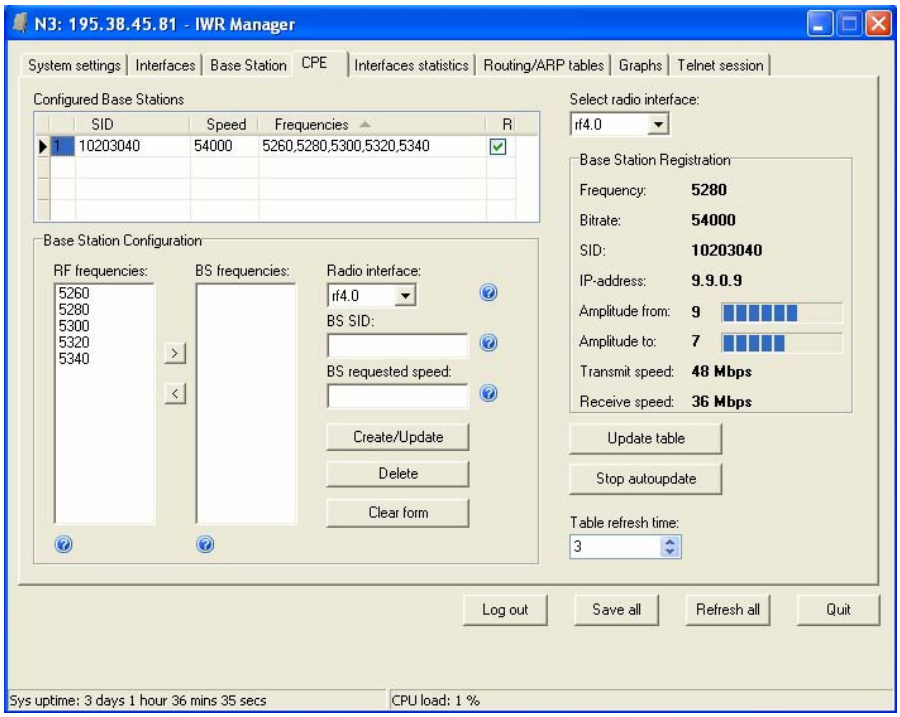
CPE – Customer Premises Equipment)



For each CPE there can be several configured BS. Surely, CPE at the moment can be registered only at one BS. Each BS is represented by three parameters: SID of the searched BS, requested transmitting speed and list of frequencies where the BS should be searched at. Each time RMA is run or CPE looses registration at the BS, it starts searching for a new BS scanning through the list of configured BS.

If CPE is registered at the BS, the application will show all the registration parameters and, if required, update them periodically:

- BS working frequency
- Requested speed from the BS
- System identifier (SID)
- IP-address for the radiointerface from the side of the BS. For CPE, the address for the radiointerface will be assigned automatically.
- Signal levels from BS and to BS
- Current upstream and downstream speeds

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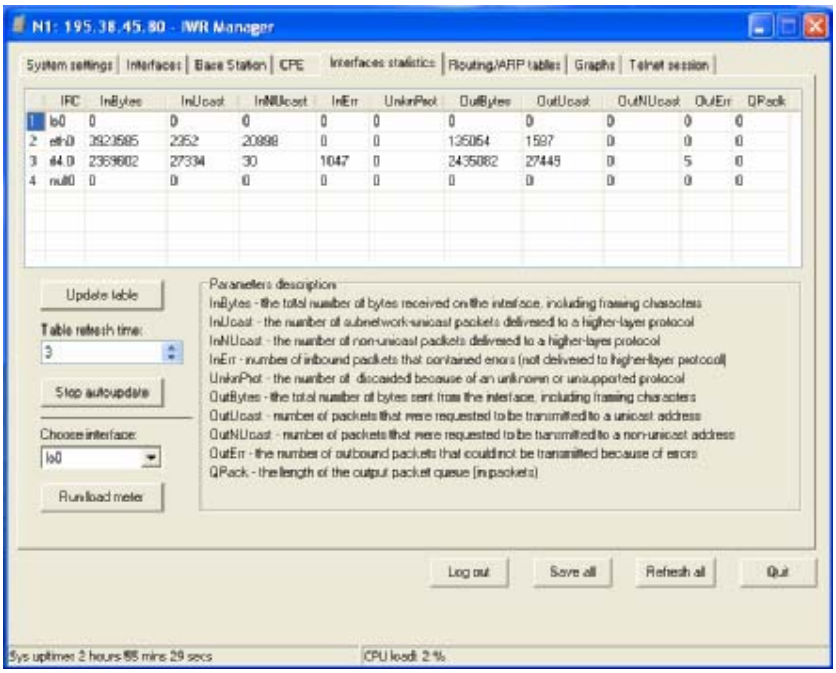
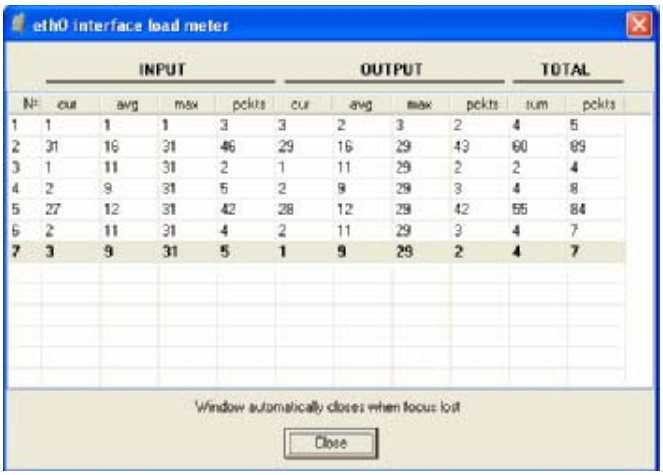
Interfaces statistics



Prompts and hint available in this tabsheet provide the user with all necessary information on all displayed parameters.

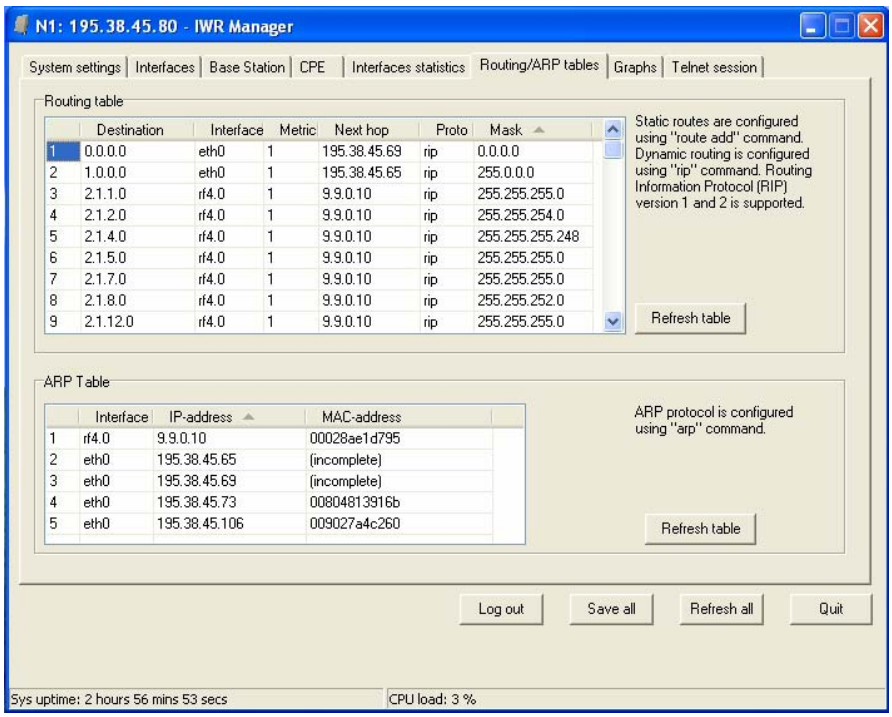
Also, the page has a feature of running a load meter which provides with a detailed information on interfaces load dynamics. The parameters which are shown by load meter are the following:

- INPUT/OUTPUT: cur – number of received/sent kilobits/sec through the interface
- INPUT/OUTPUT: avg – the average number of received/sent kilobits/sec through the interface normalized by the time of observation
- INPUT/OUTPUT: max – the maximal number of received/send kilobits/sec through the interface normalized by the time of observation
- INPUT/OUTPUT: pckts – total number of incoming/outgoing pps through the interface
- TOTAL: sum – total number of kbps that went through the interface
- TOTAL: pckts – total number of pps went through the interface



Вкладка "Таблица маршрутизации/таблица ARP" (Routing/ARP tables)

This Tabsheet lets the user to view routing table and ARP-table..



Graphs

This Tabsheet contain three subsheets:

- CPU Load. Builds a graph, showing CPU load changing in time
- CPE signal levels. Shows how levels from different CPEs change in time
- Interfaces Graphs. Displays current load on all interfaces.

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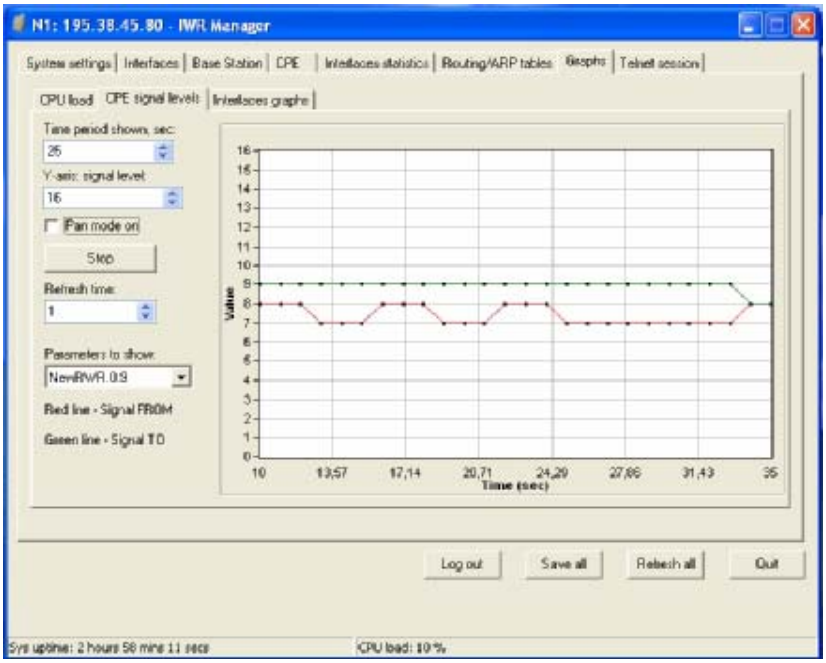
N1: 195.38.45.80 - IWR Manager
System settings
Interfaces
Base Station
CPE
Interfaces statistics
Routing/ARP tables
Graphs
Telnet session
CPU load
CPE signal level
Interfaces graphs
Time period shown, sec:
25
Y-axis: signal level:
16
Pan mode on
Stop
Refresh time:
1
Parameters to show:
NewIRWR 0.9
Red line - Signal FROM
Green line - Signal TO
Value
Time (sec)
Log out
Save all
Refresh all
Quit
Sys uptime: 2 hours 58 mins 11 secs
CPU load: 10 %

VIII.Recommendations

1. Using InfiNet Devices for High Speeds (48, 54 Mbps)

Using InfiNet devices on greater speeds 48 and 54 Mbps can specific limitations and requirements because of low noise immunity of high-order modulation techniques (64 QAM).

One should take all possible precautions to prevent exceeding of parasite signals over receiver sensitivity threshold. The problem is aggravated by the presence of this parasite signal in entire spectrum. This practically is not impossible to achieve when there are other active devices in neighborhood and therefore such high speed devices can be used only in autonomous links.

2. Design of Multi-sectored Base Stations

Based on the above, we can resume that it is possible to build only single-sectored base station for high speeds and building multi-sectored base stations is possible only for speeds less than 36 Mbps. More than that, there is trade-off between coverage and speed. The more powerful base station we have (amplifiers, greater range), the less speeds can be defined for this base station. So we have ultimate choice: either optimizing base station for more speed/less range (without amplifiers) or optimize base station for more range/less speed (with amplifiers).

Compromise is achieved by using amplifiers and directional antennas at remote subscribers, but this approach essentially is more costly.

Remote subscribers can be configured for significantly lower than average speeds providing more stable operating modes but those subscribers can decrease overall cell performance; so try to avoid mix solutions when the BS-CPE has a big difference for different subscribers.

3. Asymmetrical System Design

Following conclusions regarding using base station can be made:

- Downstream speed (base to CPE) is usually higher than upstream;
- Beam width of base station sectored antenna is 10 times wider than beam width of subscriber antenna;
- Trying to deploy base stations on area heights leads to raising overall noise level and reducing noise immunity;
- Subscriber SNR measured at a base station is significantly worse than that of subscriber side.
- Increasing transmit speed does not influence the overall working conditions and network performance;
- Increasing receive speed does worsen noise immunity and network performance.

Every step in speed increasing requires 3 dB step improvements SNR. Asymmetry in 8 times corresponds to 9 dB. It means that without link quality losses we can have 2 times speed difference between upstream and downstream. In order to maintain energetic parameters, we have to increase base station output power by 9 dB by means of built-in amplifier. Other option is to install external amplifier at subscriber side, because it has more gain for receiving than for transmitting.

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IX. Supplementary information

1. InfiNet Wireless R5000. Technical hardware specifications

R5000-I

Radio Interface

• Frequency band supported, software selectable:

— 2,412-2,483 GHz

• Modulation types: CCK with BPSK, QPSK

• Spectrum spreading method: IEEE 802.11b DSSS

• 20 MHz channel width

• Net throughput: 4 Mbps @ 11 Mbps speed

• Media access method: non-collision, adaptive, proprietary polling with dynamic and adaptive bandwidth, permanent link quality monitoring

• Antenna connection: RP-TNC

• Spectral efficiency: 0.5 bs/Hz

• Transmitting power automatic control mode

• Transmitter power:

— 14...20 dBm

— up to 23 dBm for P200 modification

• Receiver sensitivity:

-90…-83 dBm

Environment

• Operating temperature range: 0… +40 C

Interfaces

• Wire LAN interface Ethernet 10/100BaseT

• Serial interface System Console Port

Wire network connection

• Ethernet 10/100BaseT

• Wire network protocol: IEEE 802.3 CSMA/CD and Ethernet Blue Book

Power

• 220-240 VAC @ 50 Hz, 0.2 A or 90-120 VAC @ 60 Hz, 0.5 A

• Power consumption: 30 W

Form factor and dimensions

• Unit dimensions: 206 x 206 x 28mm

• Weight: 1.2 kg

Dual-radio options

• Two RF front-ends in one case – two independent radio interfaces:

Dual 2.4 GHz radio (tmp. range -50..+60C)

• Optimal solution for repeater stations building

• Ideally suits for multisectoral Base Station building

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Radio Interface

• Modulation types: OFDM with BPSK, QPSK, 16 QAM, 64 QAM

• Operating rated frequencies (in MHz):

For 2.4 GHz radio:

— 2412 – 2483 MHz

For 5-6 GHz radio:

— 4940 – 4990 MHz

— 5150 – 5350 MHz

— 5470 – 5725 MHz

— 5725 – 5875 MHz

— 5920 – 6060 MHz

• Antenna connection: N-type female

• Net throughput:

25-26 Mbps @ 54 Mbps speed for 5 GHz radio

4 Mbps @ 11 Mbps speed for 2.4 GHz radio

• 20 MHz channel width

• Media access method: non-collision, adaptive, polling with dynamic and adaptive bandwidth, permanent link quality monitoring

• Transmitting power automatic control mode

• Transmitter power:

— 14…17dBm (for 5-6 GHz)

— up to 21dBm for 18P200 and 24P200 modifications (for 5-6 GHz)

— up to 23dBm for 18P300 and 24P300 modifications (for 5-6 GHz)

— up to 25dBm for 36P300 modification (for 5-6 GHz)

— up to 23dBm for P200 modification (for 2.4 GHz)

• Receiver sensitivity:

-90...-69 dBm for 5-6 GHz

-90…-83 dBm for 2.4 GHz

Environment

• Outdoor router unit temperature range:

— -35… +50ºC, Humidity: 100%, condensing

— -50… +60ºC, Humidity: 100%, condensing for "OT" modification and for 2.4 GHz radios

• Power supply temperature ranges: 0… +40ºC

• Built-in lightning protection for outdoor router unit and power supply

Interfaces

• Wireless interface

• Wire LAN interface Ethernet 10/100BaseT

• Serial interface System Console Port

Wire network connection

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• Ethernet 10/100BaseT

• Wire network protocol: IEEE 802.3 CSMA/CD and Ethernet Blue Book

Power

• 110-240 VAC @ 50/60 Hz, 0.5 A

• Power consumption: 30 W

Form factor and dimensions

Outdoor router unit: Milled waterproof case 220 x 160 x 35, weight: 1.3 kg

power supply: 217x200x50, weight: 1 kg

Dual-radio options

• Two RF front-ends in one case – two independent radio interfaces:

Dual 5 GHz radio (tmp. range -35..+60C)

Dual 5 GHz and 2.4 GHz radio (tmp. ranges -35..+60C and -50..+60C for OT)

Dual 2.4 GHz radio (tmp. range -50..+60C)

• Optimal solution for repeater stations building

• Ideally suits for multisectoral Base Station building

Accessories

• AudioMonitor for antenna alignment procedure

• InfiNet Console cable for outdoor unit

• Outdoor connectors wrench

Power supply unit options

• with screw lock connector for ODU connection

• with RJ-45 connector from IDU side for ODU connection

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R5000-M

Radio Interface

• Modulation types: OFDM with BPSK, QPSK, 16 QAM, 64 QAM

• Operating rated frequencies (in MHz):

— 5150 – 5350 MHz

— 5470 – 5725 MHz

— 5725 – 5875 MHz

— 5920 – 6060 MHz

• Net Throughput: 20 Mbps actual throughput, maximum up to 150 subscribers per single base station device (for minimal 128 Kbps subscriber throughput) with recommended cell coverage 4-5, max 12 kilometers

• 20 MHz channel width

• Media access method: non-collision, adaptive, polling with dynamic and adaptive bandwidth, permanent link quality monitoring

• Antenna connection: N-type female

• Spectral efficiency: 2.5 bs/Hz

• Transmitting power automatic control mode

• Integrated antenna:

— 22 dB gain

— vertical polarization (optional horizontal)

— radiation pattern width: 9 degrees vertical, 9 degrees horizontal

— F/B ratio: -35 dB (max)

— Cross polar discrimination: -28 dB (max)

• Transmitter power:

— 14…17dBm

— up to 21dBm for 18P200 and 24P200 modifications

• Receiver sensitivity:

– 90...– 69 dBm

Environment

• Outdoor router unit temperature range:

-40… +50 C, Humidity: 100%, condensing

• Power supply temperature ranges: 0… +40 C

• Built-in lightning protection for outdoor router unit and power supply

Interfaces

• Wireless interface

• Wire LAN interface Ethernet 10/100BaseT

• Serial interface System Console Port

Wire network connection

• Ethernet 10/100BaseT

• Wire network protocol: IEEE 802.3 CSMA/CD and Ethernet Blue Book

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Power

• 110-240 VAC @ 50/60 Hz, 0.5 A

• Power consumption: 25 W

Form factor and dimensions

• Outdoor router unit: casted waterproof case 305x305x65, weight: 2.6 kg

• Power supply unit: 217x200x50; weight: 1 kg

Accessories

• AudioMonitor for antenna alignment procedure

• InfiNet Console cable for outdoor unit

• Outdoor connectors wrench

Power supply unit options

• with screw lock connector for ODU connection

• with RJ-45 connector from IDU side for ODU connection

R5000-S

Radio Interface

• Modulation types: OFDM with BPSK, QPSK, 16 QAM, 64 QAM,

• Operating rated frequencies (in MHz):

— 5150 – 5350 MHz

— 5470 – 5725 MHz

— 5725 – 5875 MHz

— 5920 – 6060 MHz

• Net Throughput: 20 Mbps actual throughput, maximum up to 150 subscribers per single base station device (for minimal 128 Kbps subscriber throughput) with recommended cell coverage 4-5, max 12 kilometers

• 20 MHz channel width

• Media access method: non-collision, adaptive, polling with dynamic and adaptive bandwidth, permanent link quality monitoring

• Antenna connection: N-type female

• Transmitting power automatic control mode

• Integrated antenna:

— 22 dB gain

— vertical polarization (optional horizontal)

— radiation pattern width: 9 degrees vertical, 9 degrees horizontal

— F/B ratio: -35 dB (max)

— Cross polar discrimination: -28 dB (max)

• Transmitter power:

— 14…17dBm

— up to 21dBm for 18P200 and 24P200 modifications

• Receiver sensitivity:

– 87...– 71 dBm

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Environment

• Outdoor router unit temperature range:

-40… +50 C, Humidity: 100%, condensing

• Power supply temperature ranges: 0… +40 C

• Built-in lightning protection for outdoor router unit and power supply

Interfaces

• Wireless interface

• Wire LAN interface Ethernet 10/100BaseT

• Serial interface System Console Port

Wire network connection

• Ethernet 10/100BaseT

• Wire network protocol: IEEE 802.3 CSMA/CD and Ethernet Blue Book

Power

• 110-240 VAC @ 50/60 Hz, 0.5 A

• Power consumption: 15 W

Form factor and dimensions

• Outdoor router unit: casted waterproof case 305x305x65, weight: 3.8 kg

• Power supply unit: 217x200x50; weight: 1 kg

Accessories

• AudioMonitor for antenna alignment procedure

• InfiNet Console cable for outdoor unit

• Outdoor connectors wrench

Power supply unit options

• with screw lock connector for ODU connection

• with RJ-45 connector from IDU side for ODU connection

R5000-L

Radio Interface

• Modulation types: OFDM with BPSK, QPSK, 16 QAM, 64 QAM

• Operating rated frequencies (in MHz):

— 4940 – 4990 MHz

— 5150 – 5350 MHz

— 5470 – 5725 MHz

— 5725 – 5875 MHz

— 5920 – 6060 MHz

• Net Throughput: 20 Mbps actual throughput, maximum up to 150 subscribers per single base station device (for minimal 128 Kbps subscriber throughput) with recommended cell coverage 4-5, max 12 kilometers

• 20 MHz channel width

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• Media access method: non-collision, adaptive, polling with dynamic and adaptive bandwidth, permanent link quality monitoring

• Antenna connection: N-type female

• Transmitting power automatic control mode

• Transmitter power:

— 14…17dBm

• Receiver sensitivity:

– 87...– 71 dBm

Environment

• Outdoor router unit temperature range:

— -40… +50 C, Humidity: 100%, condensing

• Power supply temperature ranges: 0… +40 C

• Built-in lightning protection for outdoor router unit and power supply

Interfaces

• Wireless interface

• Wire LAN interface Ethernet 10/100BaseT

• Serial interface System Console Port

Wire network connection

• Ethernet 10/100BaseT

• Wire network protocol: IEEE 802.3 CSMA/CD and Ethernet Blue Book

Power

• 110-240 VAC @ 50/60 Hz, 0.5 A

• Power consumption: 15 W

Form factor and dimensions

• Outdoor router unit: Casted waterproof case: 240x240x51; weight: 2.6 kg

• Power supply unit: 217x200x50; weight: 1 kg

Accessories

• AudioMonitor for antenna alignment procedure

• InfiNet Console cable for outdoor unit

• Outdoor connectors wrench

Power supply unit options

• with screw lock connector for ODU connection

• with RJ-45 connector from IDU side for ODU connection

R5000-IL

Radio Interface

● Frequency band supported, software selectable:

— 2,412…2,472 GHz

● Modulation types: CCK with BPSK, QPSK

● Spectrum spreading method: IEEE 802.11b DSSS

● 20 MHz channel width

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● Net throughput: 5-6 Mbps @ 11 Mbps speed

● Media access method: collision-free, adaptive proprietary polling with dynamic bandwidth allocation, permanent link quality monitoring and minimized packets number

● Antenna connection: RP-TNC

● Spectral efficiency: 0.5 bs/Hz

● Automatic transmit power control mode

● Transmitter power:

- up to +18 dBm

● Receiver sensitivity:

– 92…– 83 dBm

Environment

● Operating temperature range: 0… + 55 C

Interfaces

● Wire LAN interface Ethernet 10/100BaseT

● Serial interface System Console Port

Wire network connection

● Wireless interface

● Wire Wired LAN interface: Ethernet 10/100BaseT

Power

● 100-120 VAC 60 Hz 0.5A / 200-240 VAC @ 50 Hz, 0.2A

● Power consumption: 10 W

Form factor and dimensions

● Unit dimensions: 109 x 142 x 31mm

● Weight: 0.2 kg

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2. InfiNet Wireless R5000. Common software platform features

MAC Protocol

• Proprietary poling with dynamic and adaptive bandwidth allocation, especially optimized for minimal control messages overhead

• Proprietary scrambling

• Dynamic roaming

• Polling modes and features:

— centralized marker grant mode

— dynamically taking into account low activity of the subscribers

— permanent channel testing

— autobitrate adjustment and distance learning

Networking and Security Features

• IP-based Quality-of-Service (QoS) Manager, Traffic Shaping, 64 priority queues with 256 priorities. Service classes: MIR, BER

• Guaranteed unconditional high priority bandwidth allocation for voice traffic.

• Layer 3 and Routing: RIP1, RIP2, static

• Layer 2: ARP, VLAN, small packets aggregation (burst)

• Firewall, NAT, access lists, IP-tunneling, authentication, password protection

• Telnet password encryption

Management and Billing Support

• Support for standard management protocols, billing applications, registration servers (SNMP — MIB I, II, proprietary, HTTP, and telnet)

• Serial local console

• Remote firmware upgrades (using wireless or wired links)

• Graphical User Interface for initial router configuration

• System log

• Third party billing applications support: CDR (call data records), IP accounting, remote shell

VoIP Gatekeeper

• Besides OS WANFleX, InfiNet Wireless Router also has Unify SoftSwitch software which is a high-efficient VoIP H.323 Gatekeeper:

- o acts as a core element of an IP-telephony provider's system
- o implies all major functionality connected with both network's own subscribers (IP-phones and their gateways) and other provider's equipment including authentication, flexible routing and calls accounting
- o offers a wide range of possibilities including addresses translation and IP-telephony operators numeration plans coordination

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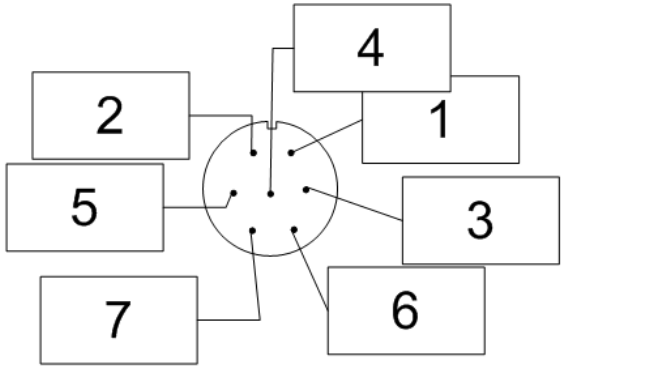
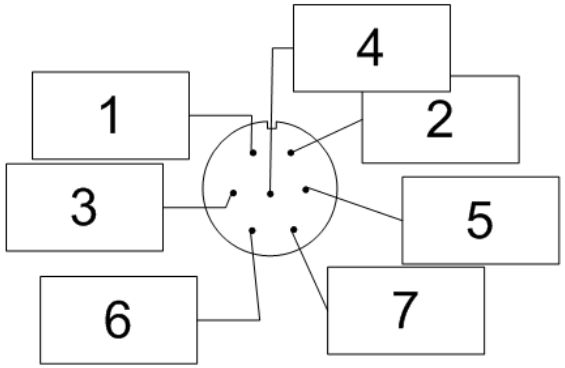
3. Connectors soldering schemes

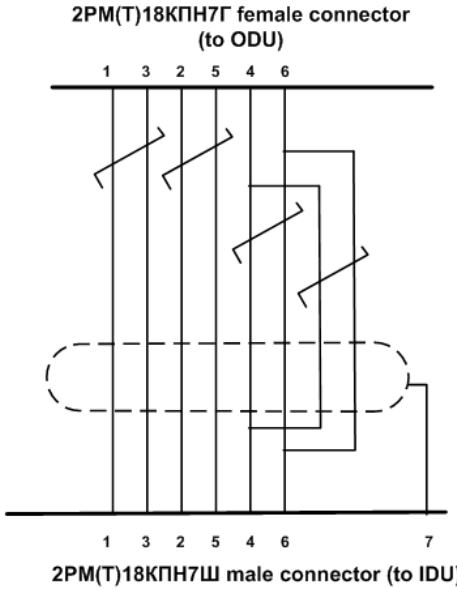
Service cable connector soldering scheme



Female connector soldering side view



Male connector soldering side view



5000-I 5000-M service cable			
	Outdoor IWR cable	1.07.03	List 1 from 1

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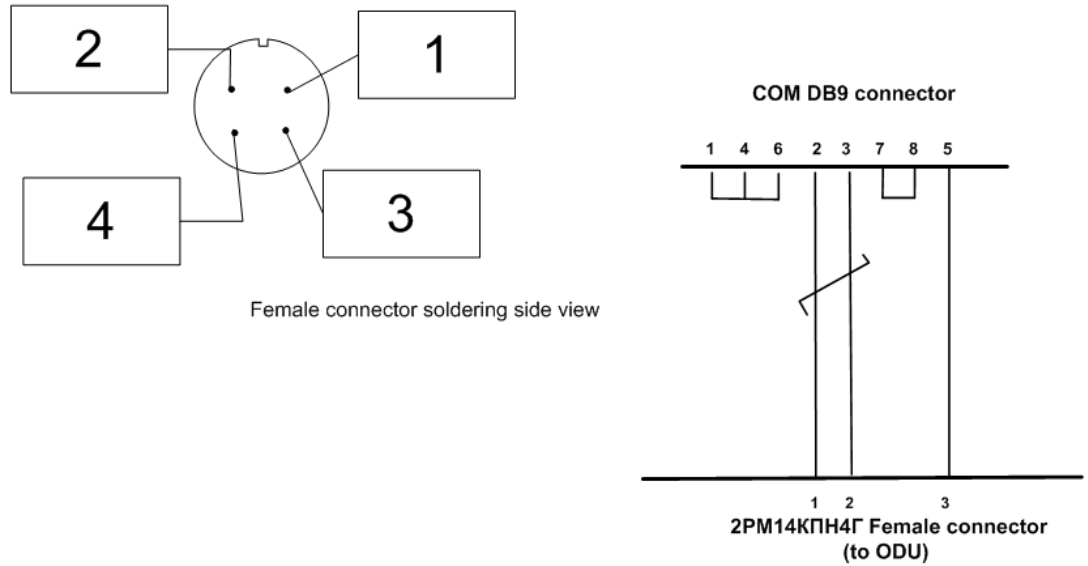
Console cable connector for 5000-M and 5000-O soldering scheme



5000-O 5000-M Console Cable			
	Outdoor IWR cable	1.07.03	List 1 from 1

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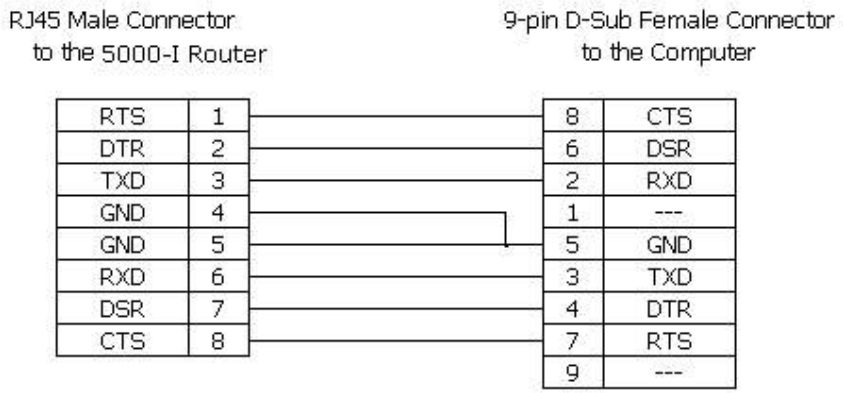
Console cable connector for 5000-I soldering scheme



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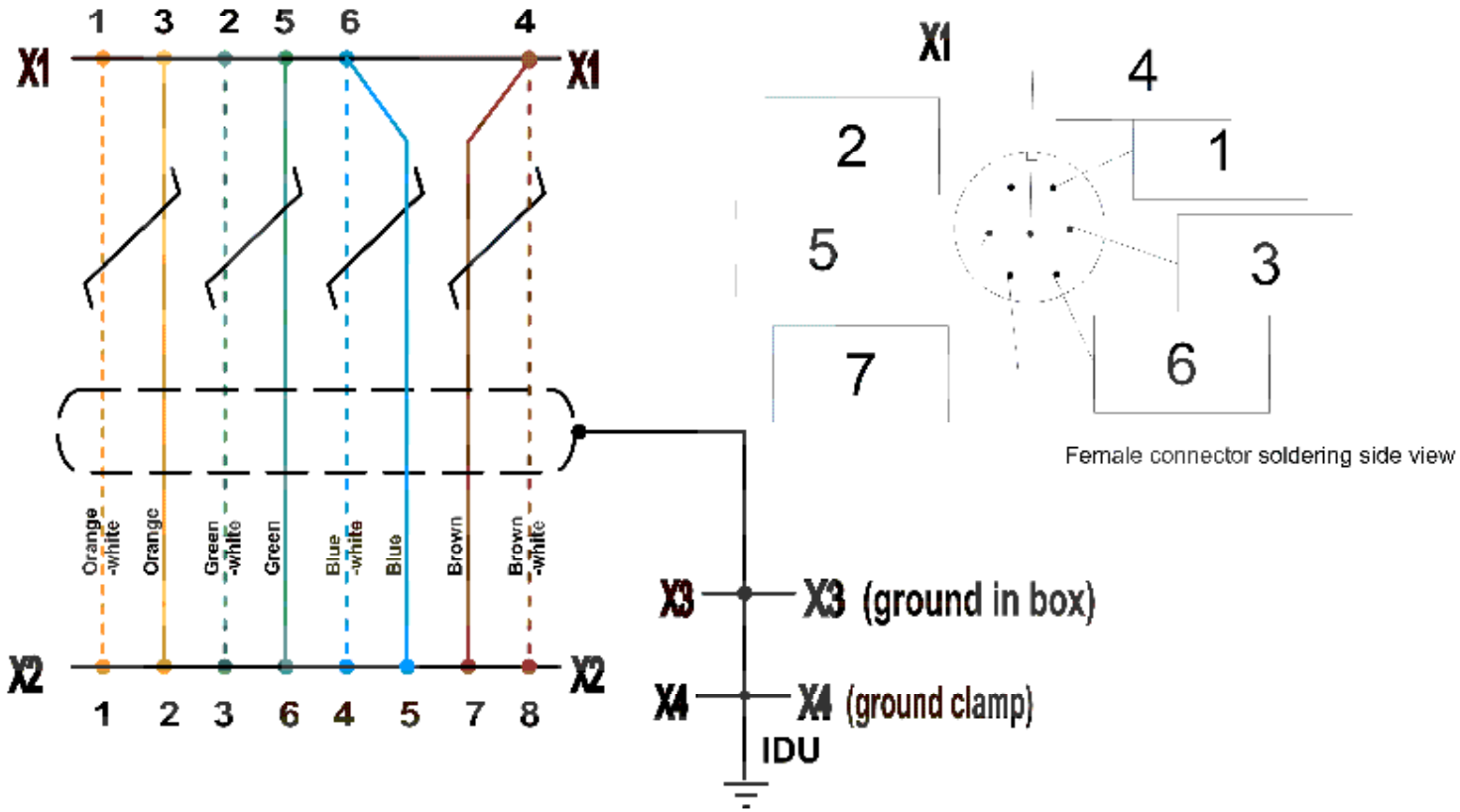
Cable cutting scheme for IDC110(B) distribution box



X2 RJ-45 Connector or IDC110(B) Box

Service cable for CPE

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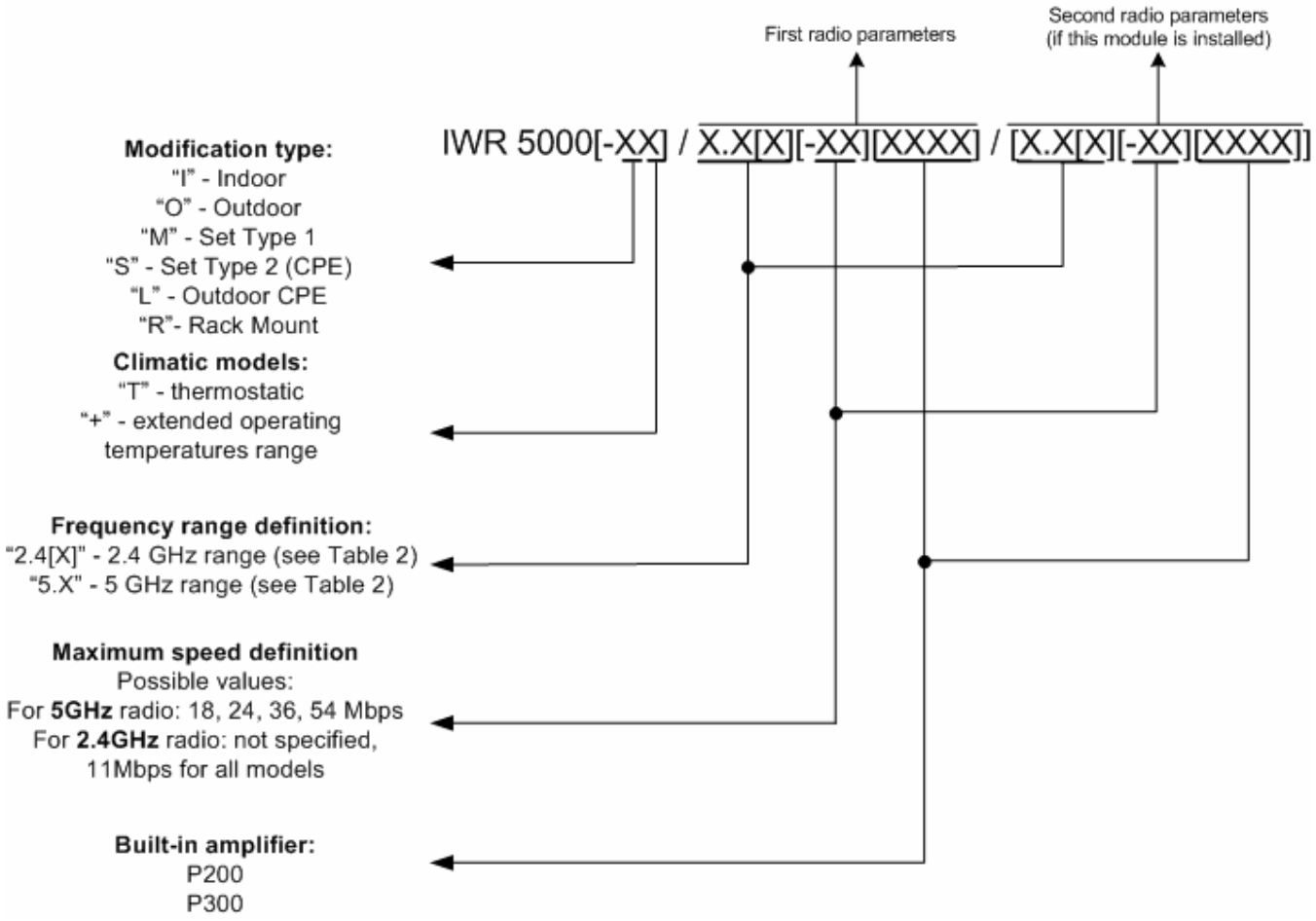
4. Devices notation description



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