SAF FreeMile™

38GHz

25GHz

23GHz

FreeMile 5.8GHz MIMO TDD

Technical Description and Configuration Guide

20GHz

19GHz

Produced by SAF Tehnika

Produced in Europe

FCC Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:
Reorient or relocate the receiving antenna.
Increase the separation between the equipment and receiver.
Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
Consult the dealer or an experienced radio/TV technician for help.
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.

FCC Caution

To assure continued compliance, any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

FCC Radiation Exposure Statement

To comply with FCC RF exposure requirements in section 1.1307, a minimum separation distance of 5.8 feet is required between the antenna and all occupational persons, and a minimum separation distance of 13.1 feet is required between the antenna and all public persons.

CE Mark Warning

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

R&TTE Compliance Statement

This equipment complies with all the requirements of the Directive 1999/5/EC of the European Parliament and the Council of 9 March 1999 on Radio Equipment and Telecommunication Terminal Equipment and the Mutual Recognition of their Conformity (R&TTE). The R&TTE Directive repeals and replaces in the directive 98/13/EEC (Telecommunications Terminal Equipment and Satellite Earth Station Equipment) As of April 8, 2000.

Safety

This equipment is designed with the utmost care for the safety of those who install and use it. However, special attention must be paid to the dangers of electric shock and static electricity when working with electrical equipment. All guidelines of this manual and of the computer manufacturer must therefore be allowed at all times to ensure the safe use of the equipment.

EU Countries Intended for Use

The ETSI version of this device is intended for home and office use in Austria, Belgium, Denmark, Finland, France (with Frequency channel restrictions), Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and United Kingdom. The ETSI version of this device is also authorized for use in EFTA member states Iceland, Liechtenstein, Norway and Switzerland.

EU Countries Not Intended for Use

None.

IC Notice

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter IC ID: 8855A-Freemile5 has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

- Dual-polarized integrated directional panel antenna (385x375x40mm) with 23dBi gain
- External dual-polarized HDDA5W-29-DP dish antenna (648mm diameter) with 29dBi gain
- External dual-polarized HDDA5W-32-DP dish antenna (927mm diameter) with 32dBi gain

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage adioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio IC ID: 8855A-Freemile5 a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

- Double polarisation antenne intégrée panneau directionnel (385x375x40mm) avec 23dBi de gain
- Externe à double polarisation HDDA5W-29-DP antenne parabolique (648mm de diamètre) avec un gain 29dBi
- Externe à double polarisation HDDA5W-32-DP antenne parabolique (927mm de diamètre) avec un gain 32dBi

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Table of Contents

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The specifications or information contained in this document are subject to change without notice due to continuing introduction of design improvements. If there is any conflict between this document and compliance statements, the latter will supersede this document.

SAF Tehnika, JSC has no liability for typing errors in this document or damages of any kind that result from the use of this document.

To get up to date information about accessories and their availability, please contact sales representative.

Note: FODU/ODU does not contain serviceable parts. Warranty will not be applicable in the event FODU/ODU has been hermetically unsealed.

Note: SAF Tehnika, JSC is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

Copyright Notice

About This Guide

Purpose

This document provides information and procedures on installation, setup, configuration, and management of the FreeMile 5.8GHz MIMO.

Definitions, Acronyms and Abbreviations

The following typographic conventions and symbols are used throughout this document:

Additional information that may be helpful but which is not required.

Important information that should be observed.

bold Menu commands, buttons, input fields, links, and configuration keys are displayed in bold

italic References to sections inside the document are displayed in italic.

code File names, directory names, form names, system-generated output, and user typed entries are displayed in constant-width type

Introduction

The FreeMile 5.8GHz MIMO link consists of two units, one on each end: Master and Slave. Master unit operates as an access point; therefore the Slave connects to the Master and operates as a client.

Figure 1 – Point-to-Point Link Elements

From the point of view of the administrator the **Local unit** is the one with the direct connection to the Web management interface and the **Remote unit** is the one which is connected to the Local unit in FreeMile 5.8GHz MIMO link. The concept of the Local unit and the Remote unit is not related to the operating mode (Master or Slave). This terminology will be used throughout the manual, particularly in the description of statistics.

Application Examples

Building to Building Connectivity

Use the FreeMile FODU 5.8GHz for building to building connectivity in the private networks such as campus building connections, corporate building connections, universities and schools that wish to own and manage their own networks and eliminate the costly recurring charges from service providers. The same connectivity is perfect to build backup/failover connections.

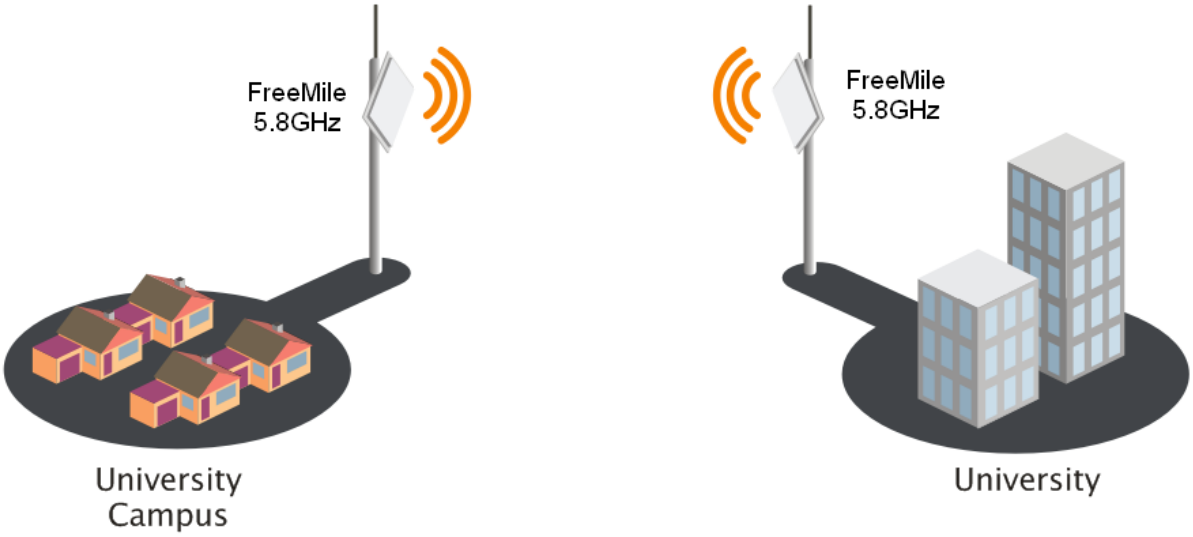


Figure 2 – Building to Building Connectivity

Backhaul

The FreeMile FODU 5.8GHz offers a cost effective solution made for WISPs, Cellular Carrier, Telco, ISPs, enabling operators to quickly and efficiently expand their networks.

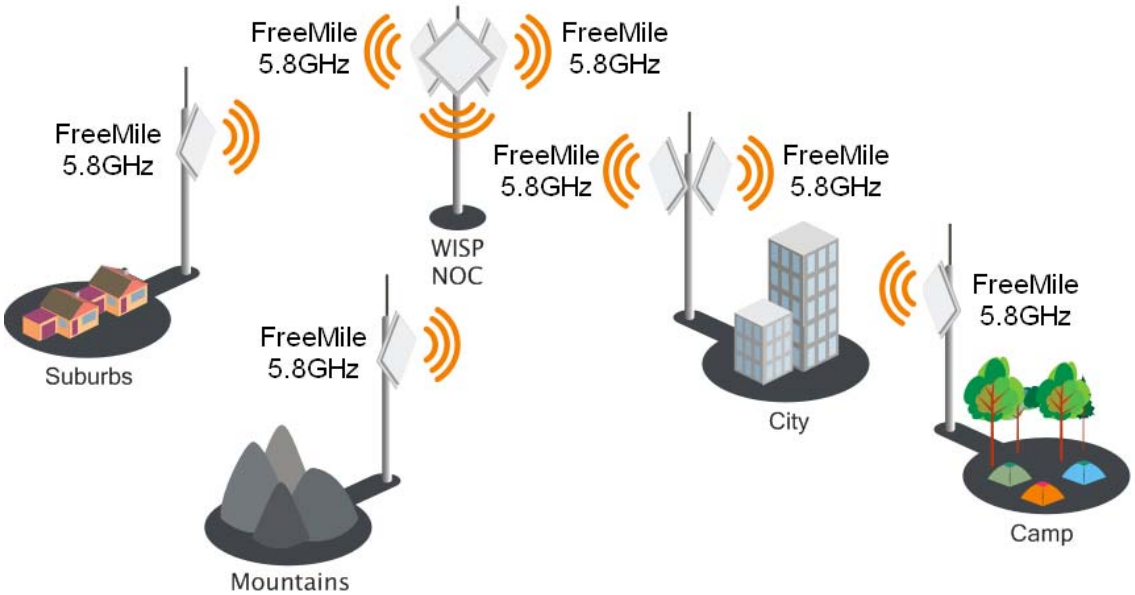


Figure 3 – FreeMile FODU 5.8GHz MIMO Backhaul

FreeMile FODU 5.8GHz MIMO Features

Technical Features

High throughput;
Default frequency range 5180-5825MHz (4920-5915MHz upon request)
Flexible Channel Sizes (20MHz and 40MHz);
Flexible center frequency selection (allows selecting center frequency in 5MHz step);
Robust MAC layer:

- Selective repeat ARQ with block ACK
- Only lost packets are retransmitted
- Highly efficient in noisy environments
- Low throughput loss over long distance
- Forward error correction (recovers packets with errors without retransmit)
- Dynamic TDD (see the *Figure 4 – Point to Point Protocol* W-jet MIMO)
- Allocates bandwidth in the direction needed in real-time
- Highly reliable and efficient over long distances
- Packet aggregation (smaller frames are collected into larger frames to increase efficiency and throughput)

High PPS (Packet Per Seconds) performance
High TX power and RX Sensitivity
PoE built-in for single cable installation

Figure 4 – Point to Point Protocol W-jet MIMO

Management

Flex based fast GUI
Command line management via SSH
SNMP V1/2/3 with traps supporting MIBs: 802.1, 802.1x, MIBII
Syslog support
Reset over Ethernet on boot

Reliability

Lightening protection
Solid metal construction
IP67 rated
Proven software platform
Extensive production testing

FreeMile FODU 5.8GHz MIMO Installation

This chapter provides installation instructions for the hardware and software components of the FreeMile FODU 5.8GHz MIMO unit.

Package Contents

- SAF FreeMile 5.8GHz MIMO with integrated antenna, 2 pcs.
- Sealing for RJ45 connectors, 1 pcs.;
- Documentation and software DVD (optional);
- RJ-45 connectors for SAF FreeMile, 2 pcs. (upon order);
- Grounding screw, 2 pcs.;
- Installation instruction, 1 pcs.

The following table lists all the included packages and their weight and dimensions.

Package type	Weight of empty package [g]	Dimensions [mm]
Commercial package for SAF FreeMile 5.8GHZ MIMO	486	532x365x75
Transporting package for SAF FreeMile 5.8GHZ MIMOs	700	562x385x283

Hardware Introduction

The FreeMile 5.8GHz MIMO unit comes with integrated antenna (23dBi gain). The FreeMile unit itself is compact, **230x230x85mm**, **2.0 kg**

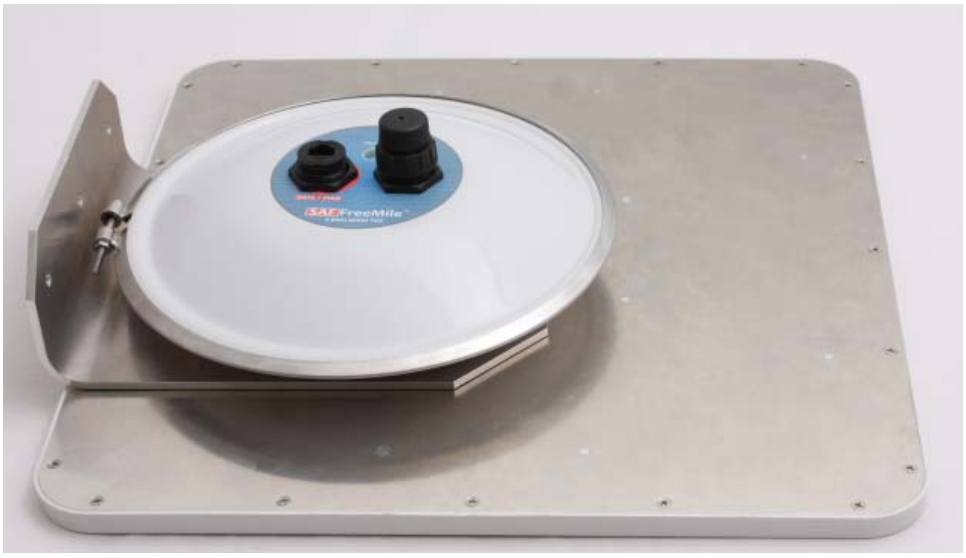


Figure 5 – FreeMile 5.8GHz MIMO with integrated antenna

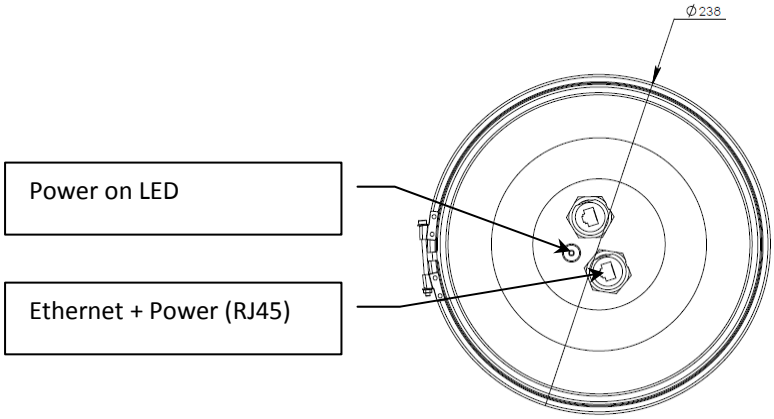


Figure 6 – FreeMile 5.8GHz MIMO front panel

Accessing the FreeMile 5.8GHz MIMO Unit's Web Management

In order to access the FreeMile 5.8GHz MIMO unit and to perform initial configuration you will need a laptop with LAN card, 2 Category 5e Ethernet cables and a Power over Ethernet injector.

- Your connected laptop should be in the same subnet with manageable SAF FreeMile, so you can "see" them; that is why, the laptop Ethernet port settings should be set as follows: (in 'Microsoft Windows' go to *Control panel* → *Network Connections* → *Local Area Connection* → *Properties* → *Internet Protocol (TCP/IP)* → *Properties*):
  - IP address 192.168.2.1;
  - Net mask 255.255.255.0;
  - everything else is blank.
- You must have PoE (Power over Ethernet) injector with 48V DC power supply to connect the laptop to the SAF FreeMile FODU. Power over Ethernet injector can be purchased from SAF Tehnika JSC as optional accessory.
- Connect to SAF FreeMile 5.8GHz MIMO by entering IP address in the browser address line - by default the IP address is 192.168.2.66
- Enter the default administrator login settings to access the Web management page. The default administrator login settings for FreeMile 5.8GHz MIMO unit are:

  Login: **admin**
  Password: **admin01**

- After successful administrator log on you will see the main page of the FreeMile 5.8GHz MIMO unit Web management interface. The FreeMile 5.8GHz MIMO unit now is ready for configuration. For further instructions on configuration refer to the respective chapter *Web Management.*

Quick Setup Guide

Step 1. **Login in to the FreeMile 5.8GHz MIMO unit web management.** To access the FreeMile 5.8GHz MIMO unit Web management interface, configure your PC with a static IP address on the 192.168.2.0 subnet with mask 255.255.255.0. Connect the FreeMile 5.8GHz MIMO unit in to the same physical network as your PC. Open the Web browser and type the default IP address of the unit https://192.168.2.66/ and the login page will be loaded. Enter default administrator login settings:

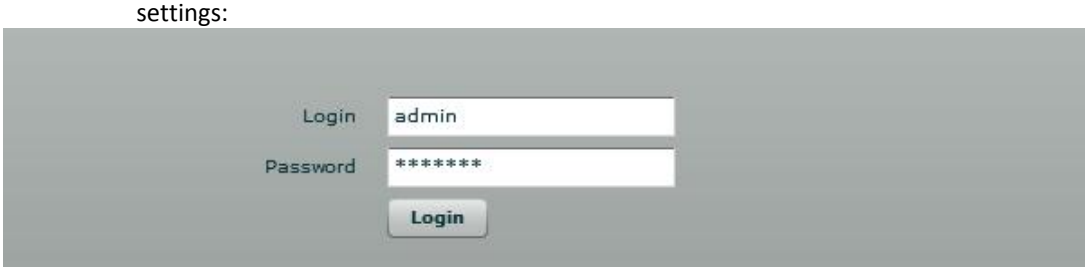


Figure 7 – Login Page

The default administrator login settings for FreeMile 5.8GHz MIMO unit are:
Login: **admin**
Password: **admin01**

After successful administrator login you will see the main page of the FreeMile 5.8GHz MIMO unit Web management interface. The FreeMile 5.8GHz MIMO unit now is ready for configuration.

Step 2. **Specify the operation mode: Master or Slave.** The difference in configuration of Master and Slave is that the frequency does not need to be specified for the Slave. The Slave scans the air and chooses the frequency automatically after finding the Master.

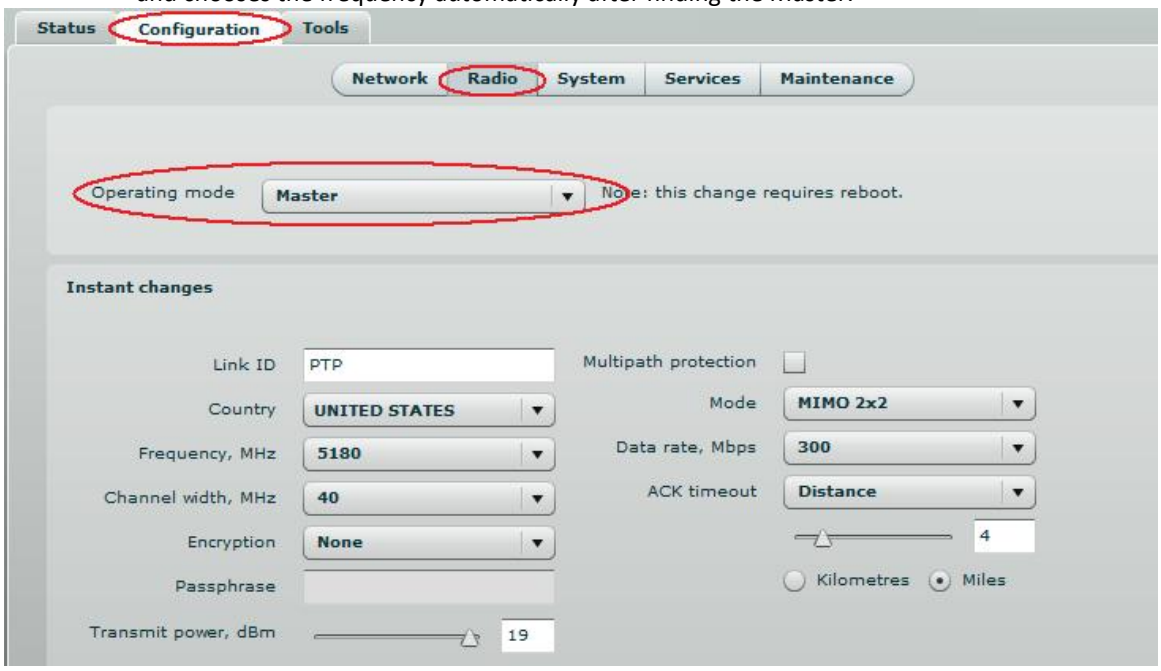


Figure 8 – Specify Unit's Operating Mode

Step 3. **Specify a Link ID.** Link ID must be identical for each unit of the same link. For instructions on changing this setting refer to the *Radio* section in the Web management chapter.

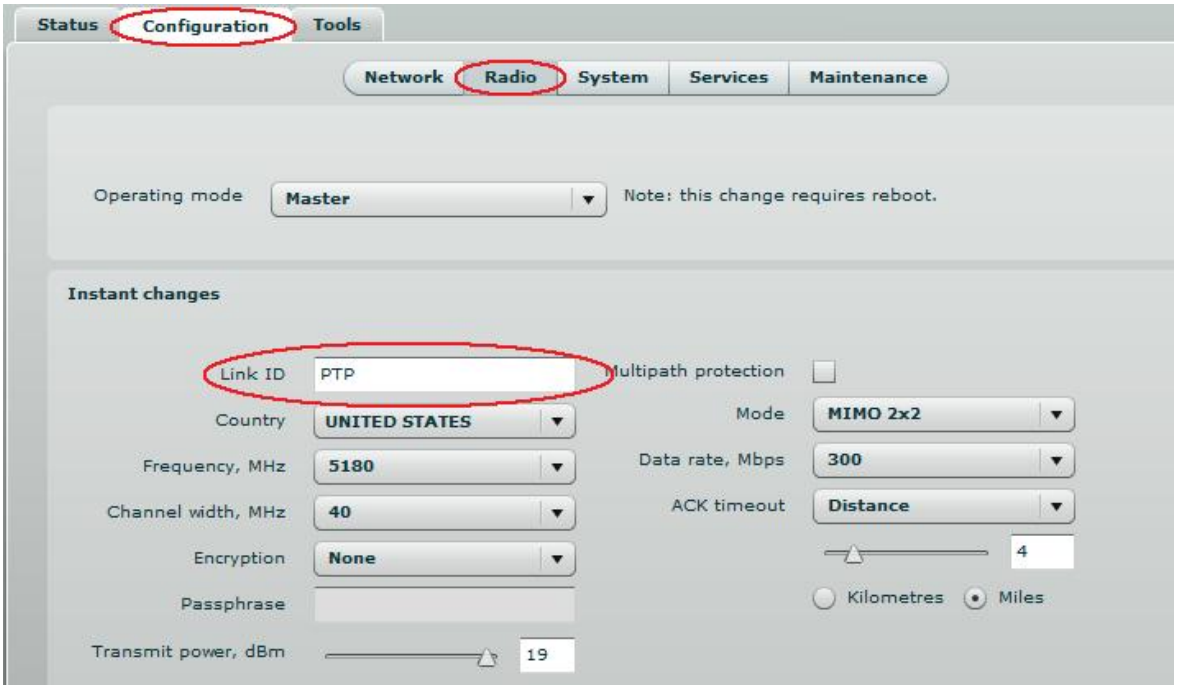


Figure 9 – Specify FreeMile 5.8GHz MIMO Link ID

Step 4. **Choose the Country** in which the link will operate. FreeMile 5.8GHz MIMO unit will automatically adjust Radio settings to meet country/region specific regulations.

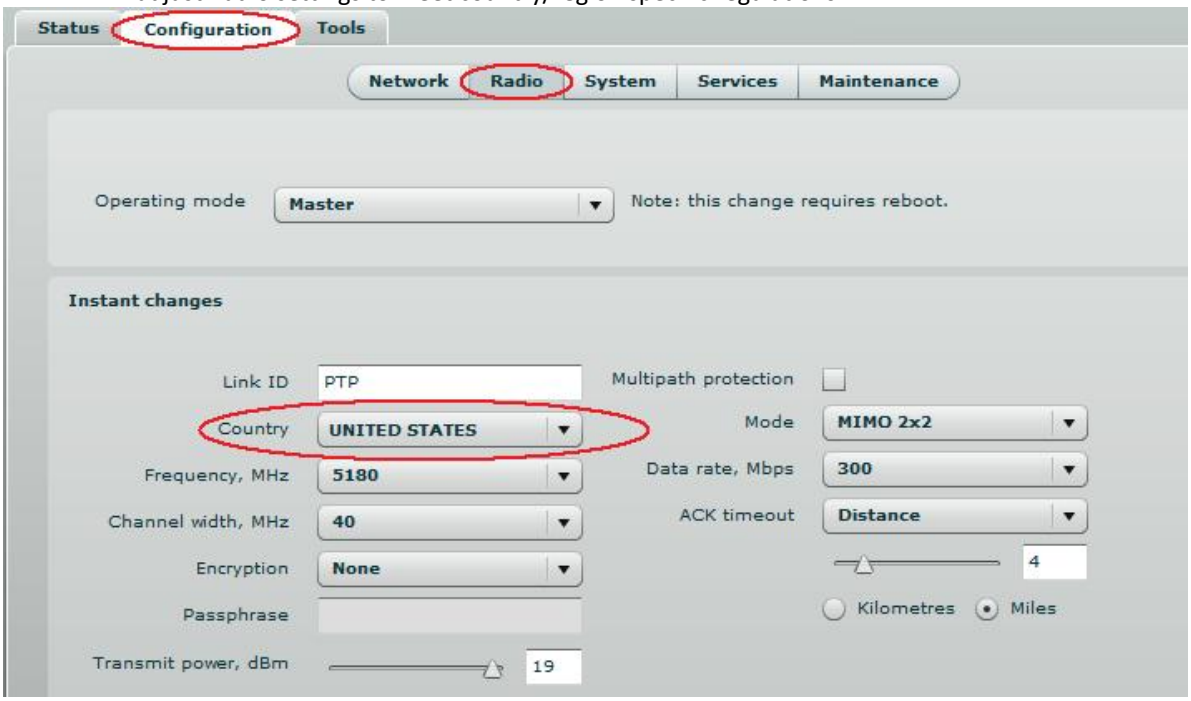


Figure 10 – Specify Country

Step 5. **Set Frequency at which link will operate on Master unit.** Change Frequency applies only for Master units. The Slave unit will choose the frequency automatically after the Master unit will be found. For instructions on changing this setting refer to the *Radio* section in the Web management chapter.

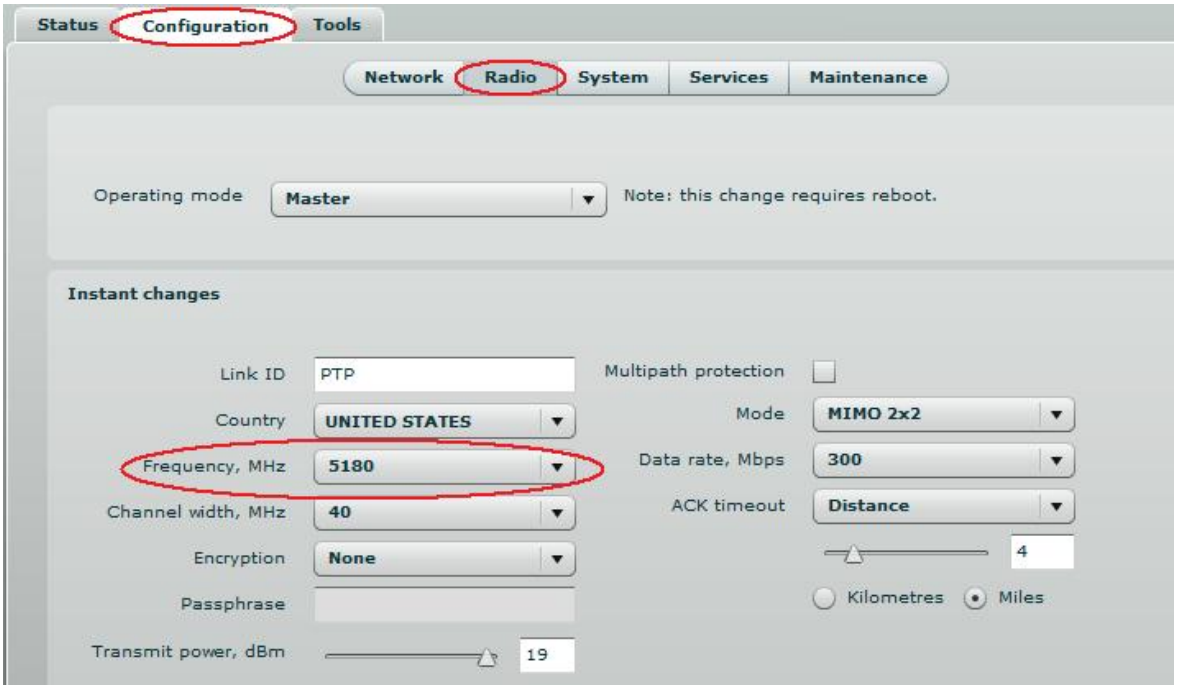


Figure 11 – Specify Frequency

Step 6. **Set Channel width at which link will operate.** For instructions on changing this setting refer to the **Error! Reference source not found.** section in the Web management chapter.

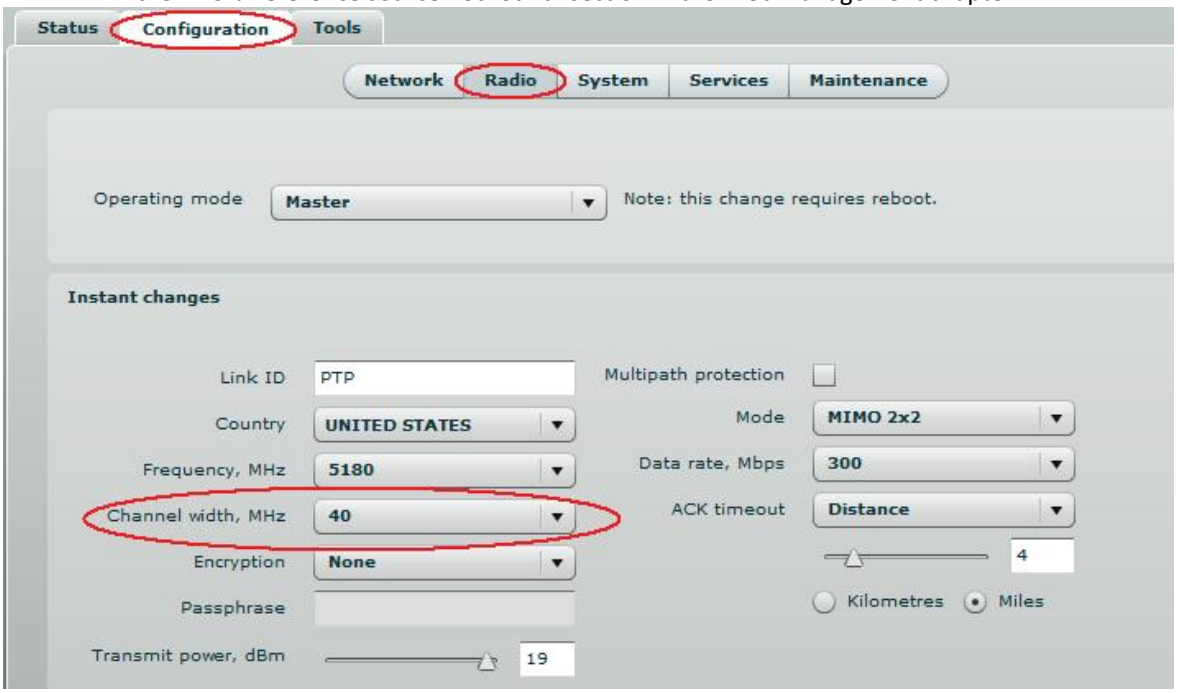


Figure 12 – Specify Channel Width

Step 7. **Set link encryption for secure data transfer between FreeMile 5.8GHz MIMO units.** The security settings (encryption and passphrase) must be the same on each side of the link otherwise the link will not establish. For instructions on changing this setting refer to the *Radio* section in the Web management chapter.

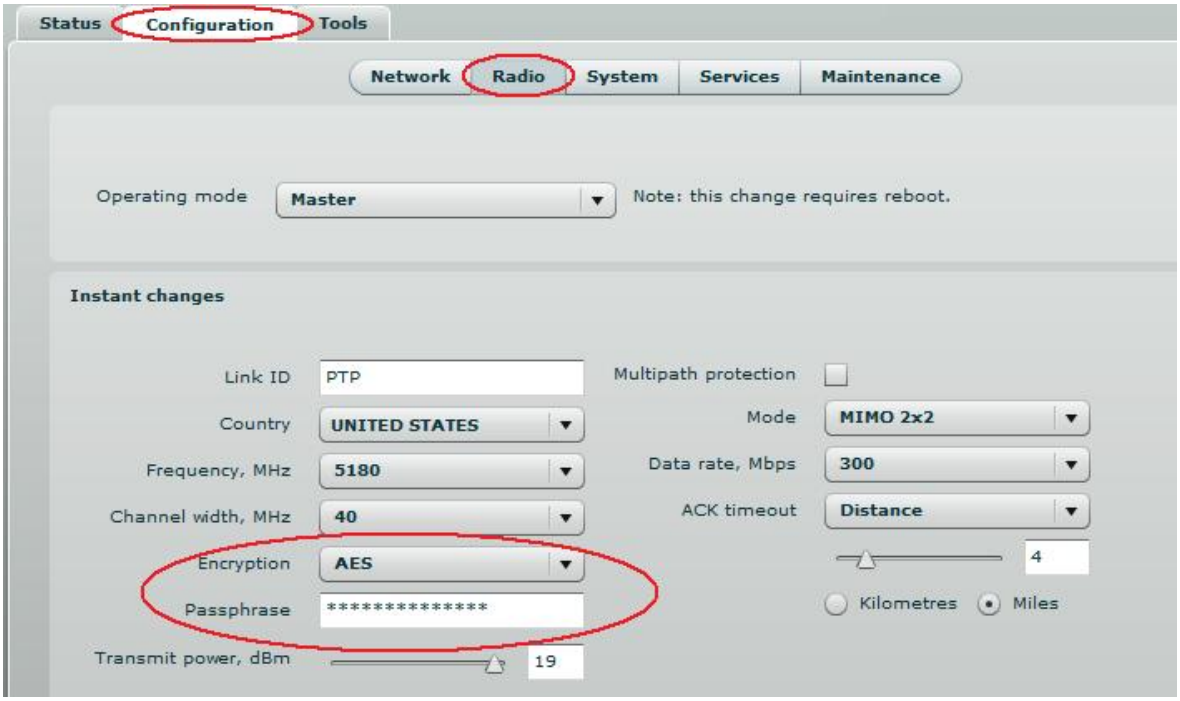


Figure 13 – Set the Encryption

Step 8. **Reduce Transmit Power** before testing the units placed on a table. FreeMile 5.8GHz MIMO units placed in short distance with high transmit power may not work or even damage the peer's radio's receiver.

Step 9. **Change web management login password.** This is strongly recommended for security reasons. For instructions on changing the administrator's password refer to the corresponding section *Administrative Account*.

Figure 14 – Change Administrator's Password

Step 10. **Save** and **Apply** the configuration**.**

Step 11. **Setup the second unit of the link** in the same way and check if configured units established a Link.

Verify FreeMile 5.8GHz MIMO Link Connection

After the both units of the Link are configured, verify the link quality:

Step 1. Connect to the unit's web management interface.

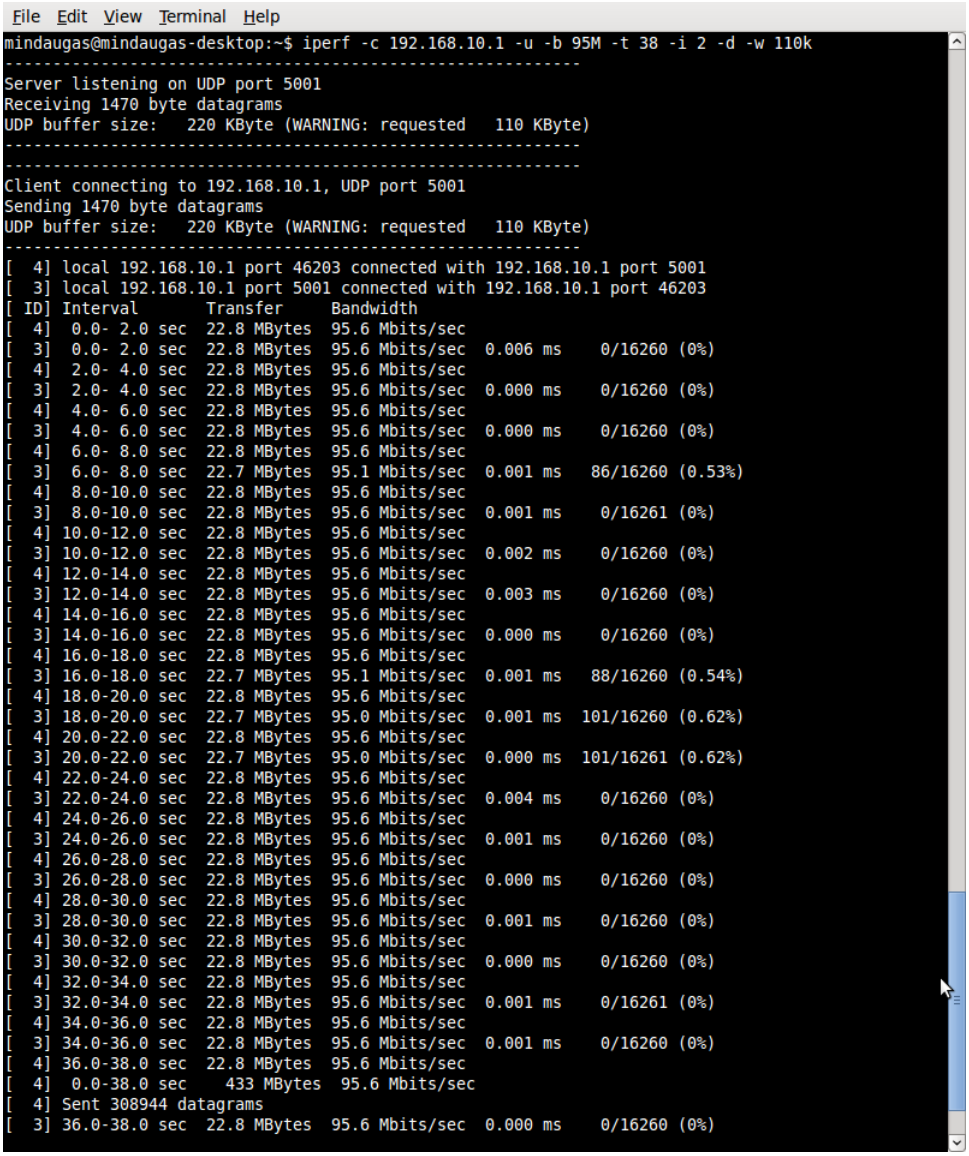
Step 2. Check the ***Signal Indicator*** bar located at the bottom of the web management interface:

Figure 15 – Signal Indicator Bar

Step 3. Run the **iperf** tool (or use the *Link Test*) on server and client sides to verify the point-to-point connection:

```
File  Edit  View  Terminal  Help
mindaugas@mindaugas-desktop:~$ iperf -c 192.168.10.124 -w 85K -M 1.0K -l 2.0M -t 102 -i 2
WARNING: attempt to set TCP maximum segment size to 1024, but got 536
------------------------------------------------------------
Client connecting to 192.168.10.124, TCP port 5001
TCP window size:   170 KByte (WARNING: requested 85.0 KByte)
------------------------------------------------------------
[  3] local 192.168.10.1 port 43074 connected with 192.168.10.124 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 2.0 sec  14.0 MBytes  58.7 Mbits/sec
[  3]  2.0- 4.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3]  4.0- 6.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3]  6.0- 8.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3]  8.0-10.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 10.0-12.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 12.0-14.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 14.0-16.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 16.0-18.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 18.0-20.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 20.0-22.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 22.0-24.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 24.0-26.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 26.0-28.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 28.0-30.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 30.0-32.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 32.0-34.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 34.0-36.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 36.0-38.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 38.0-40.0 sec  16.0 MBytes  67.1 Mbits/sec
[  3] 40.0-42.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 42.0-44.0 sec  18.0 MBytes  75.5 Mbits/sec
[  3] 44.0-46.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 46.0-48.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 48.0-50.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 50.0-52.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 52.0-54.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 54.0-56.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 56.0-58.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 58.0-60.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 60.0-62.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 62.0-64.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 64.0-66.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 66.0-68.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 68.0-70.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 70.0-72.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 72.0-74.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 74.0-76.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 76.0-78.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 78.0-80.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 80.0-82.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 82.0-84.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 84.0-86.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 86.0-88.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 88.0-90.0 sec  22.0 MBytes  92.3 Mbits/sec
[  3] 90.0-92.0 sec  20.0 MBytes  83.9 Mbits/sec
[  3] 92.0-94.0 sec  22.0 MBytes  92.3 Mbits/sec
```

Figure 16 – iperf Results (TCP)



```
File  Edit  View  Terminal  Help
mindaugas@mindaugas-desktop:~$ iperf -c 192.168.10.1 -u -b 95M -t 38 -i 2 -d -w 110k
------------------------------------------------------------
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size:   220 KByte (WARNING: requested   110 KByte)
------------------------------------------------------------
------------------------------------------------------------
Client connecting to 192.168.10.1, UDP port 5001
Sending 1470 byte datagrams
UDP buffer size:   220 KByte (WARNING: requested   110 KByte)
------------------------------------------------------------
[  4] local 192.168.10.1 port 46203 connected with 192.168.10.1 port 5001
[  3] local 192.168.10.1 port 5001 connected with 192.168.10.1 port 46203
[ ID] Interval       Transfer     Bandwidth
[  4]  0.0- 2.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3]  0.0- 2.0 sec  22.8 MBytes  95.6 Mbits/sec  0.006 ms    0/16260 (0%)
[  4]  2.0- 4.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3]  2.0- 4.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
[  4]  4.0- 6.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3]  4.0- 6.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
[  4]  6.0- 8.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3]  6.0- 8.0 sec  22.7 MBytes  95.1 Mbits/sec  0.001 ms   86/16260 (0.53%)
[  4]  8.0-10.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3]  8.0-10.0 sec  22.8 MBytes  95.6 Mbits/sec  0.001 ms    0/16261 (0%)
[  4] 10.0-12.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 10.0-12.0 sec  22.8 MBytes  95.6 Mbits/sec  0.002 ms    0/16260 (0%)
[  4] 12.0-14.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 12.0-14.0 sec  22.8 MBytes  95.6 Mbits/sec  0.003 ms    0/16260 (0%)
[  4] 14.0-16.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 14.0-16.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
[  4] 16.0-18.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 16.0-18.0 sec  22.7 MBytes  95.1 Mbits/sec  0.001 ms   88/16260 (0.54%)
[  4] 18.0-20.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 18.0-20.0 sec  22.7 MBytes  95.0 Mbits/sec  0.001 ms  101/16260 (0.62%)
[  4] 20.0-22.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 20.0-22.0 sec  22.7 MBytes  95.0 Mbits/sec  0.000 ms  101/16261 (0.62%)
[  4] 22.0-24.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 22.0-24.0 sec  22.8 MBytes  95.6 Mbits/sec  0.004 ms    0/16260 (0%)
[  4] 24.0-26.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 24.0-26.0 sec  22.8 MBytes  95.6 Mbits/sec  0.001 ms    0/16260 (0%)
[  4] 26.0-28.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 26.0-28.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
[  4] 28.0-30.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 28.0-30.0 sec  22.8 MBytes  95.6 Mbits/sec  0.001 ms    0/16260 (0%)
[  4] 30.0-32.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 30.0-32.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
[  4] 32.0-34.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 32.0-34.0 sec  22.8 MBytes  95.6 Mbits/sec  0.001 ms    0/16261 (0%)
[  4] 34.0-36.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 34.0-36.0 sec  22.8 MBytes  95.6 Mbits/sec  0.001 ms    0/16260 (0%)
[  4] 36.0-38.0 sec  22.8 MBytes  95.6 Mbits/sec
[  4]  0.0-38.0 sec   433 MBytes  95.6 Mbits/sec
[  4] Sent 308944 datagrams
[  3] 36.0-38.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
```

Figure 17 – iperf Results (UDP)

Step 4. If test results are meeting the requirement and are no configuration will be done Transmit power should be increased, before mounting FreeMile 5.8GHz MIMO units outside. Note that if the distance between the units is short, do not set Transmit Power to the maximum value. Observe the *Signal Indicator* bar – if it is red, decrease the Transmit Power.

FreeMile 5.8GHz MIMO Link Establishment

This chapter provides instructions how to install a Point to Point link. A Point to Point link operates in pairs of two units with the same configuration. Both units must be installed, and the antennas aligned for maximum throughput.

Mounting the FreeMile 5.8GHz MIMO Unit

The FreeMile 5.8GHz MIMO unit's mounting bracket is designed to make installation on a pipe easy. The unit is attached and it's position is fixed with bolts.

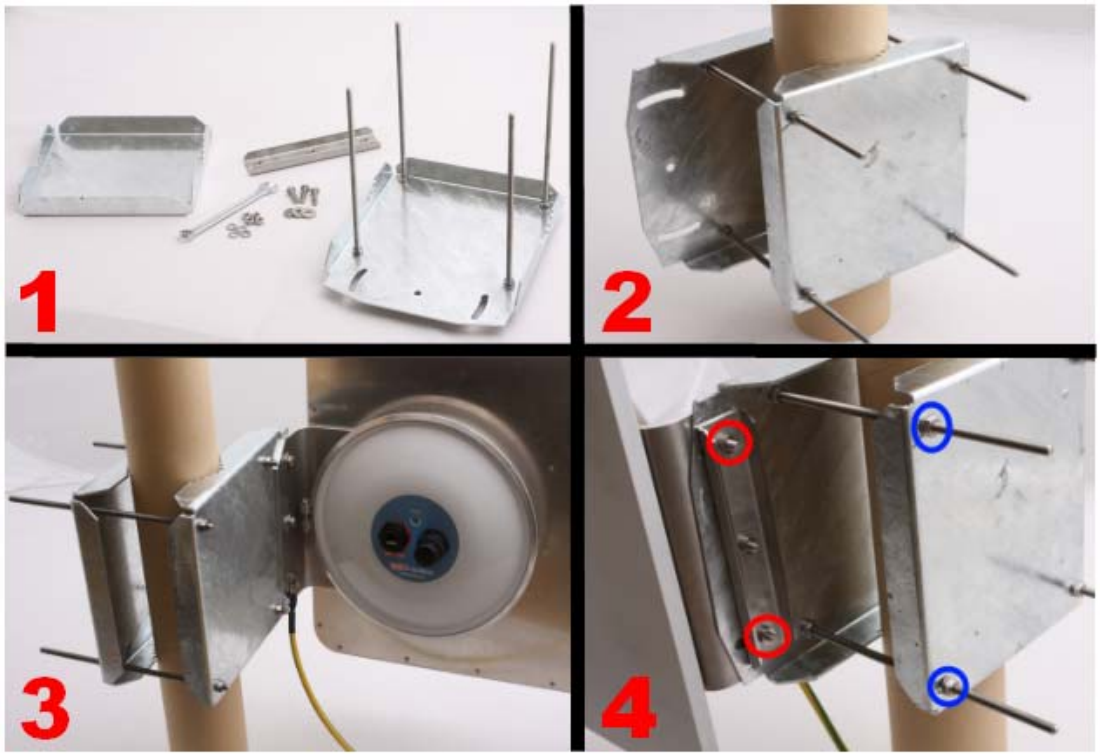


Figure 18 – Attaching SAF FreeMile 5.8GHz MIMO with integrated antenna to the mast

Fig. 4(1). Prepare the mounting bracket and necessary tools: wrench (10mm), nuts, screws and clamps as shown in the figure.
Fig. 4(2). Adjust the mounting bracket to the pole as shown in the figure. The smallest part of the mounting bracket should not be attached in this stage.

Note that the mounting bracket supports pole diameter in the range 32-130mm.

Fig. 4(3). Attach the FreeMile 5.8GHz MIMO unit with integrated antenna to the mounting bracket. The grounding cable should also be attached at this stage. The smallest part of the bracket should be attached at this moment from the back side of the mounting bracket.
Fig. 4(4). The antenna can be aligned by loosening the screws marked in red circles (elevation direction) and in blue circles (azimuth direction). After the signal values during the alignment have peaked secure the screws using 10mm wrench.

Assembling FreeMile 5.8GHz MIMO Ethernet cable connector

Figure 19 – Assembling Ethernet weatherproof connector

Fig. 19(1). Put rubber sealing inside the connector as shown. Fastening screw should be placed on the front part of connector.
Fig. 19(2). Put connector parts on the cable.
Fig. 19(3). Stick the rubber gasket on the connector.
Fig. 19(4). Plug RJ45 connector into the Ethernet socket.
Fig. 19(5). Fix the connector to the socket with screw.
Note that cable sealing screw is still not fixed at this moment.
Fig. 19(6). Push the RJ45 connector into the socket by pushing the cable and at the same time seal and fix the cable using cable sealing screw.
Fig. 19(7). Assembled cable. Fix the cable to the mast as close as possible to FreeMile unit. Do not bend it! The radius of bending should not be less than 10cm.
Fig. 19(8). Example of correct positioning of RJ45 connector during weatherproof connector assembly.
Fig. 19(9). Example of incorrect position of connector – improper alignment.
Note, that it is too deep in the connector.

Antenna Alignment

Avoid standing directly in front of an operating antenna while aligning.

The antenna alignment procedure can be made easier by placing one person at each antenna location during alignment process. However, alignment should be performed on one antenna at a time, each person alternatively turns antenna until the RSL is optimized.
The following steps are required to properly align the antennas:

1. Start at one end of the link; Run the **Antenna Alignment** tool on the selected interface:

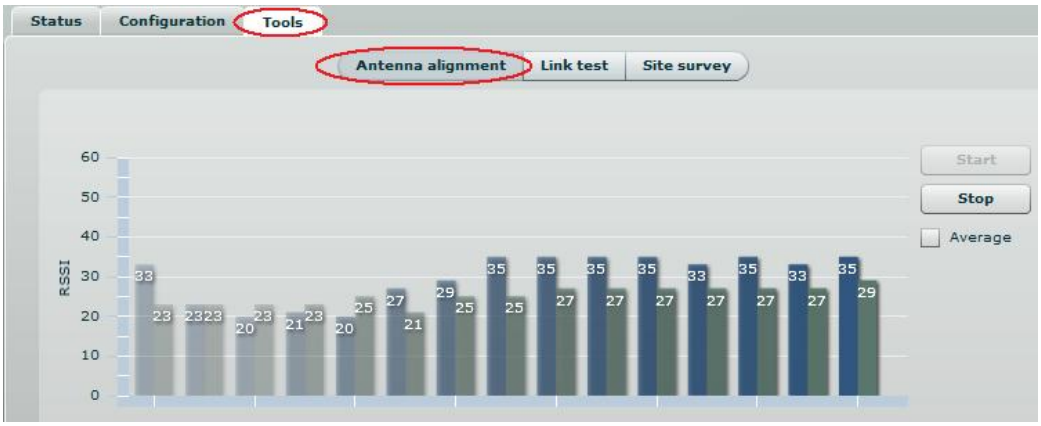


Figure 20 – Antenna Alignment Tool on Web Management Interface

The antenna alignment test measures signal quality between the Master and Slave units. For best results during the antenna alignment test, turn off all wireless networking devices within range of the device except the device(s) with which you are trying to align the antenna. Watch the constantly updated display in the antenna alignment test window as you adjust the antenna.

2. Loosen the antenna hardware that is used for securing the antenna movement in the azimuth directions.
3. Roughly aim the antenna directing the main lobe of the far-end antenna.
4. Slowly sweep the antenna while observing the readings of RSSI. The higher is the RSSI, the higher is the RSL.
5. Secure the azimuth adjustment hardware once main lobe is found and the highest signal level is achieved.
6. Loosen the antenna hardware that is used for securing the antenna movement in the elevation direction. Slowly sweep the antenna while observing the RSSI reading. Once the signal is peaked, the elevation adjustment hardware can be secured.
7. Perform steps 1 through 6 on the opposite end of the link until the signal level is peaked for both azimuth and elevation.

After the "RSSI" values have been peaked on both ends of the link, observe the RSL indicated in Web management window. Ensure that the RSL is within +/- 2dB of calculated RSL.

For detailed instructions on Antenna Alignment tool, refer to the respective sections:
Web management – *Antenna Alignment*

Web Management

FreeMile 5.8GHz MIMO products are designed to provide superior performance at long range distances. With a proprietary wireless driver that was written for the sole purpose of optimizing wireless point to point links, one can achieve much higher throughput, especially at longer links, than standards based products.

General Operation

This section provides information about concepts used in FreeMile 5.8GHz MIMO unit's Web management interface.

Instant Changes

Some of the FreeMile 5.8GHz MIMO radio parameters do not require to reboot the device. These parameters are named as **instant** changes.
Instant changes are useful for best performance parameters tuning. These parameters will take effect as soon as the Apply button is clicked. When best configuration is founded press **Save** button and reboot the device to make changes permanent. Otherwise all instant parameter changes will be lost during FreeMile 5.8GHz MIMO unit reboot.
Instant changes are on the *Radio* section.

System Warnings and Errors

There are 3 types of system messages that must be noted: notifications, warnings and error messages. These messages appear at the bottom of the page and can be closed by clicking the sign ×.

For example notification messages are displayed in brown color and contain information about configuration changes:

Figure 21 – Notification Message (1)

This message has an implemented Reboot button. Simply click this button and the PTP unit will be rebooted at once – there is no need to navigate into the *Maintenance* page for additional action to reboot the unit.
Notification messages also are on Wireless page Instant changes. This message informs you about instant changes that were made:

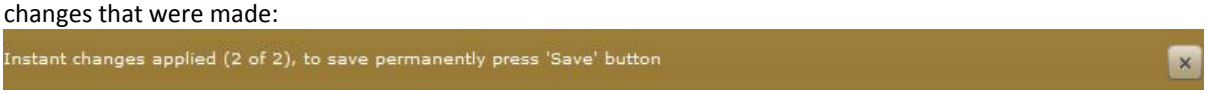


Figure 22 – Notification Message (2)

Warning messages are displayed in red and contain FreeMile 5.8GHz MIMO unit's system cautions:

Figure 23 – Warning Message

The FreeMile 5.8GHz MIMO unit contains built in validation for configuration settings in the web management interface. If a user sets an incorrect value in the entry field, its frame turns red, and if the user tries to save such incorrect configuration, an error message appears at the end of the page:

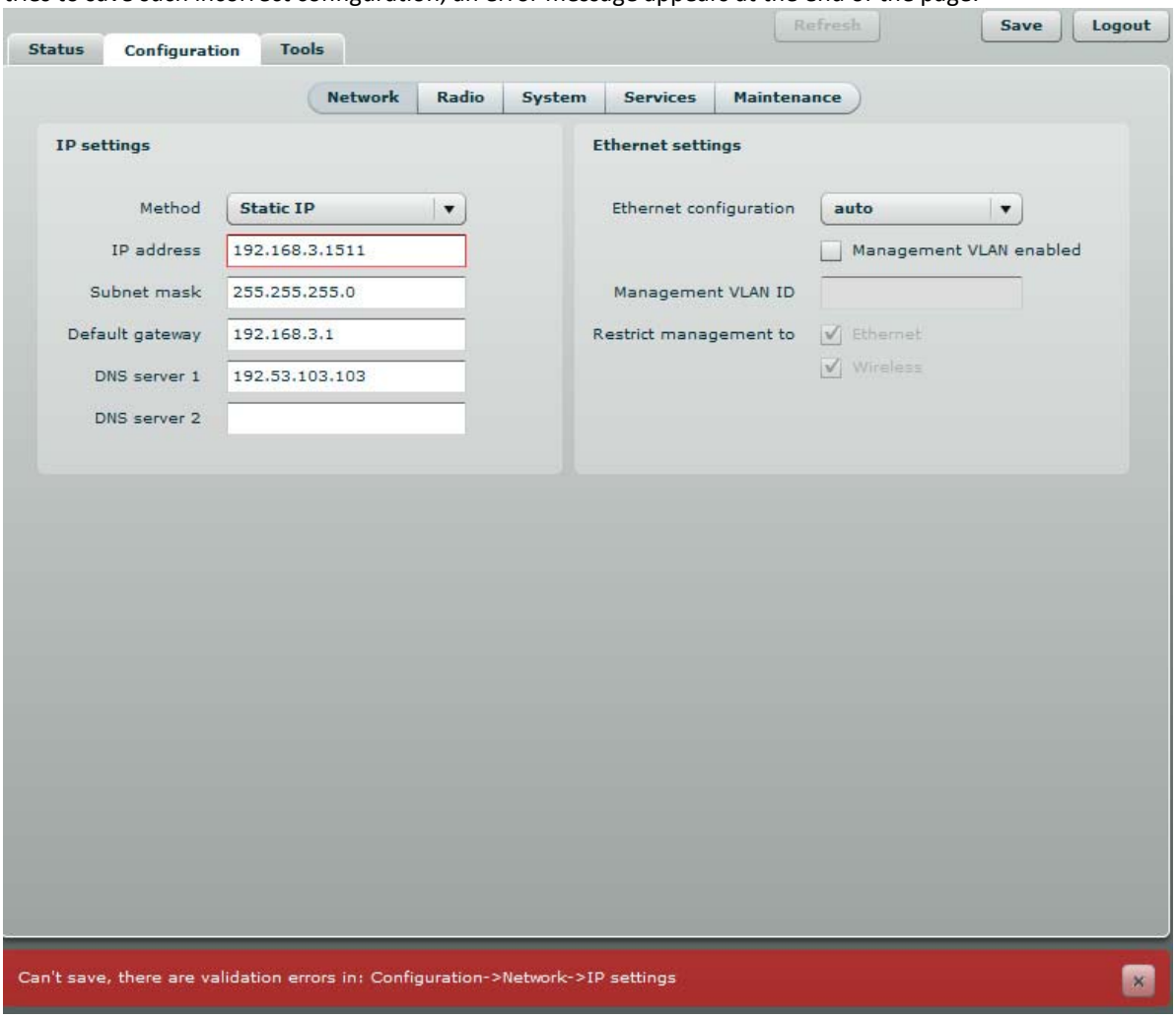


Figure 24 – Error Message

Signal Indicator

The FreeMile 5.8GHz MIMO web management interface has a link signal indicator. This indicator displays real-time signal level in dBm of the Local and Remote units.

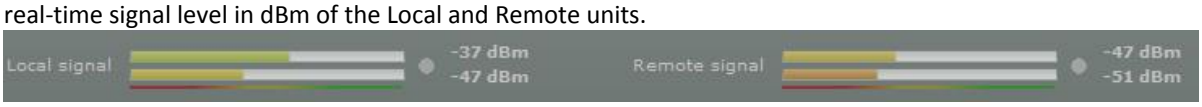


Figure 25 – Signal Indicator

The color of the Signal indicator will change according to the signal level quality of the unit. The green color means excellent link quality while the red color of the indicator means that link quality is poor.
The red circle beside full filled red indicator switches on immediately when the signal level becomes too high and overload is detected.

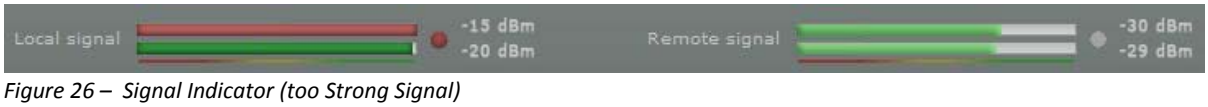


Figure 26 – Signal Indicator (too Strong Signal)

This may happen on an incorrect link layout, for example, in the case when the TX power parameter in the FreeMile 5.8GHz MIMO units is set to maximum but physically the units are too close to each other (e.g. testing units are placed on a table).
The screenshot below displays Signal indicator if there is no link established between FreeMile 5.8GHz MIMO units:

Figure 27 – Signal Indicator (no Link Established)

Status

Use the Status menu to check the current status of the FreeMile 5.8GHz MIMO unit and established link (this is the default page when accessing the device's web management interface). The Information page displays generic information and status of the FreeMile 5.8GHz MIMO unit. The page is divided into three main categories: System, Network and Wireless. The System section displays the identification information of the FreeMile 5.8GHz MIMO unit. The Wireless section presents main wireless settings. The Ethernet section describes the FreeMile 5.8GHz MIMO unit's network identity and connectivity.
The information in the page can be updated using **Refresh** button.

Figure 28 – Status Page

System

System section displays general information of the FreeMile 5.8GHz MIMO unit.
Product name – displays the product name.
Link name – displays the link name which is used to identify the FreeMile 5.8GHz MIMO unit on the network.
Link location – displays the link location, which is used to identify the FreeMile 5.8GHz MIMO unit on the network.
Latitude – displays the latitude coordinates of the device.
Longitude – displays the longitude coordinates of the device.
Firmware version – displays the device hardware and software version.
Uptime – displays the time, expressed in days, hours and minutes since the system was last rebooted.
Average load – displays the average load of the device processor in the period of the last 1minute, 5 minutes and 15 minutes (a larger value means a larger average load on the processor).
<1.0 – System is idle
=1.0 – Normal load
>1.0 – Processor is busy.
Total memory, kB – displays total system memory.
Free memory, kB – displays free system memory.
System time – displays current system time.

Network

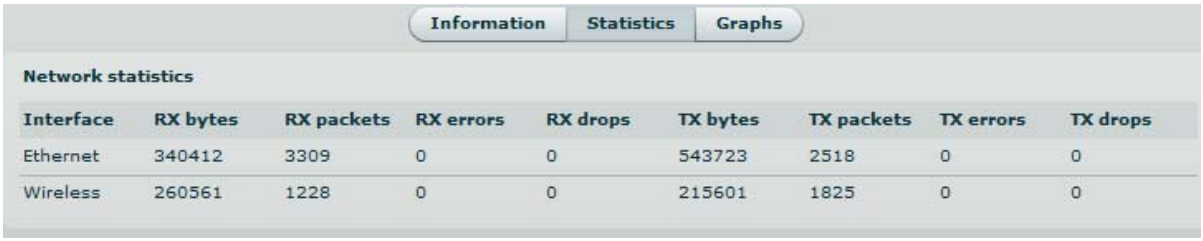
Ethernet link status – displays the status of the Ethernet link. A State **UP** indicates that the Ethernet link is established. A state **DOWN** indicates that the Ethernet link is not established.
Ethernet speed/duplex – displays the negotiated speed and duplex of the Ethernet interface specified in Mbps. The N/A will be displayed if the Ethernet status is down. Full duplex means that data can be transmitted in both directions on a signal carrier at the same time. Half duplex means that data can be transmitted in both directions on a signal carrier, but not at the same time. Auto means that the system will detect link speed and duplex mode automatically.
MAC address – displays MAC address of the device.
Local IP – displays IP address of the local unit.
Remote IP – displays IP address of the remote unit. The N/A will be displayed if there is no FreeMile 5.8GHz MIMO link established.

Wireless

Wireless link status – displays the status of the Wireless link. A State **UP** indicates that the Wireless link between local and remote units is established. A state **DOWN** indicates that the Wireless link between local and remote units is not established.
Operating mode – displays the operating mode of the device. The operating mode can be Master or Slave.
Link ID – displays FreeMile 5.8GHz MIMO link ID, specified by the user.
Encryption – displays encryption method: none or AES.
Peer MAC – displays MAC address of the remote unit.
Frequency, MHz – displays frequency in MHz at which the FreeMile 5.8GHz MIMO link communicates.
Channel width, MHz – displays the channel width (5/10/20/40) at which the FreeMile 5.8GHz MIMO link communicates.
Data rate, Mbps – displays the data rate at which the FreeMile 5.8GHz MIMO link communicates.
Transmit power, dBm – displays TX power value of the local FreeMile 5.8GHz MIMO unit.
Remote transmit power, dBm – displays TX power value of the remote FreeMile 5.8GHz MIMO unit.

Statistics

The statistics page displays detailed statistics of the FreeMile 5.8GHz MIMO link performance. The Statistics page is divided into the two sections: Networks statistics and W-Jet statistics.
Network statistics contains detailed statistics of Ethernet and Wireless interfaces:



Interface	RX bytes	RX packets	RX errors	RX drops	TX bytes	TX packets	TX errors	TX drops
Ethernet	340412	3309	0	0	543723	2518	0	0
Wireless	260561	1228	0	0	215601	1825	0	0

Figure 29 – Statistics Page

RX bytes - displays the total number of received bytes by the Ethernet or Wireless interface of the FreeMile 5.8GHz MIMO link.
RX packets - displays the total number of received packets by the Ethernet or Wireless interface of the FreeMile 5.8GHz MIMO link.
RX errors - displays the total number of received corrupted packets by the Ethernet or Wireless interface of the FreeMile 5.8GHz MIMO link.
RX drops - displays the total number of dropped packets by the Ethernet or Wireless interface of the FreeMile 5.8GHz MIMO link.
TX bytes - displays the total number of sent bytes by the Ethernet or Wireless interface of the FreeMile 5.8GHz MIMO link.
TX packets - displays the total number of sent packets by the Ethernet or Wireless interface of the FreeMile 5.8GHz MIMO link.
TX errors - displays the total number of sent corrupted packets by the Ethernet or Wireless interface of the FreeMile 5.8GHz MIMO link.
TX drops - displays the total number of dropped packets by the Ethernet or Wireless interface of the FreeMile 5.8GHz MIMO link.

W-Jet statistics displays detailed statistics of FreeMile 5.8GHz MIMO link communication protocol.

W-Jet statistics

Local name	Local value	Remote name	Remote value
Rx bytes	56920623 (+10159670)	Tx bytes	13507210 (0)
Tx bytes	178475 (0)	Rx bytes	28624065 (0)
Rx packets	348678 (+63369)	Tx packets	16763 (0)
Tx packets	777 (0)	Rx packets	698078 (0)
Tx packets fail	0 (0)	Tx packets fail	4 (0)
Tx packets retry	0 (0)	Tx packets retry	7411 (0)
Rx duplicated packets	21 (+5)	Rx duplicated packets	0 (0)
CRC errors	0 (0)	CRC errors	0 (0)

Figure 30 – W-Jet Statistics

Local – statistics of the Local unit.
Remote – statistics of the Remote unit.
Rx bytes – number of transmitted bytes. The number in brackets (+xx) displays the data change since the last page refresh.
Tx bytes – number of the received bytes. The number in brackets (+xx) displays the data change since the last page refresh.
Rx packets – number of received data packets The number in brackets (+xx) displays the data change since the last page refresh.
Tx packets – number of transmitted data packets. The number in brackets (+xx) displays the data change since the last page refresh.
Tx packets fail – number of failed to transmit packets. The number in brackets (+xx) displays the data change since the last page refresh.
Tx packets retry – total number of attempts to retransmit data packets. The number in brackets (+xx) displays the data change since the last page refresh.
RX duplicated packets – the number of received duplicated packets. The number in brackets (+xx) displays the data change since the last page refresh.

CRC errors – the total number of CRC errors. The number in brackets (+xx) displays the data change since the last page refresh.

Graphs

The Graphs page contains device statistics in graphic diagrams and is used for device monitoring. Select the required statistics (RSSI, Traffic, RX/TX errors, Memory, CPU load or Frequency change) and the corresponding graphic diagrams will be displayed. The statistics in diagrams are displayed on hourly, daily, weekly, monthly or yearly basis; hourly is chosen by default. The option **Display current time set on the system** gives possibility to convert the time stamps on the diagrams in current date, set on the administrator's PC.

To update statistics data click **Refresh** button.

Point the mouse cursor on the diagram line and you will get the numeric expression of the particular statistic.

RSSI diagram displays RSSI change of the Local and Remote FreeMile 5.8GHz MIMO units at the chosen period:

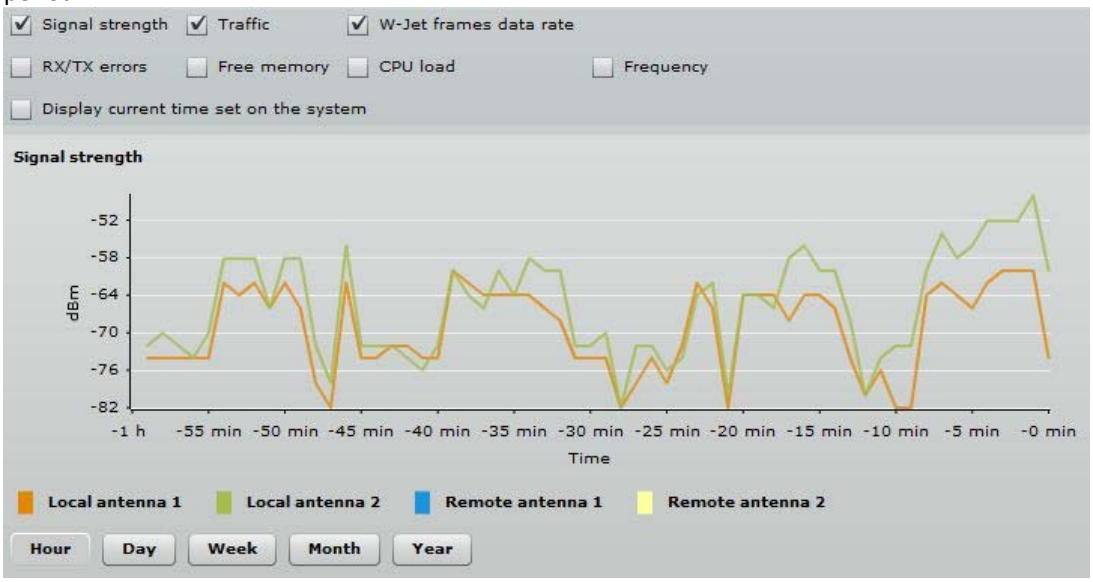


Figure 31 – Signal Strength Graph

Traffic diagram displays Incoming and Outcoming traffic statistical data:

Figure 32 – Traffic Statistics Graph

W-Jet data rates diagram displays the count of data frames send on chosen data rates. This gives possibility to choose the most effective data rates for the FreeMile 5.8GHz MIMO. The data on diagram must be observed carefully: the correctly chosen data rates must generate diagram with one distinguished data rate

column (300 Mbps data rate column in first picture below), thus meaning that a little or no data frame were sent on lower data rates. The second picture shows that a lot of retries were on 270 Mbps data rate (this means that administrator needs to lower the data rate).

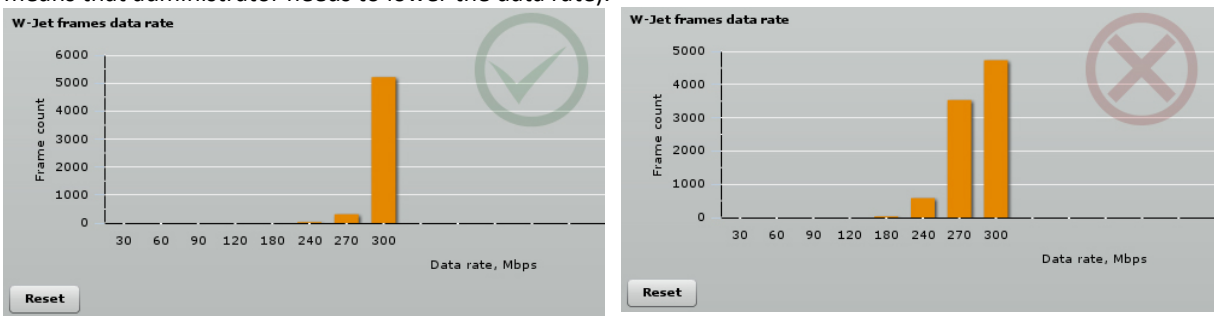


Figure 33 – W-Jet frames data rate graph

RX/TX errors diagram displays statistical data of RX drop of the Local and Remote units, TX try of the Local and Remote units:

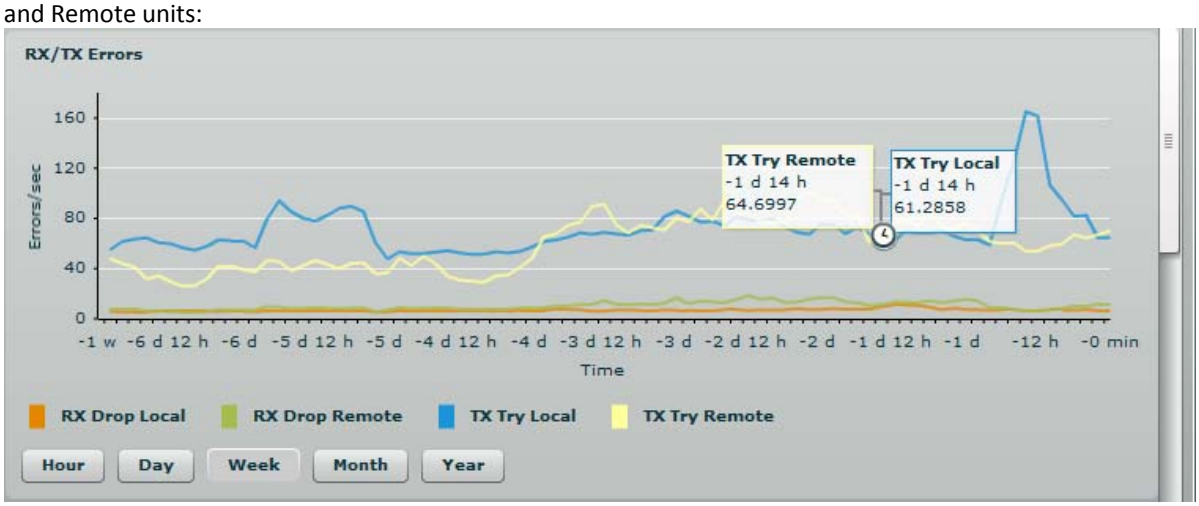


Figure 34 – RX/TX Errors Statistics Graph

Memory diagram displays memory usage data:

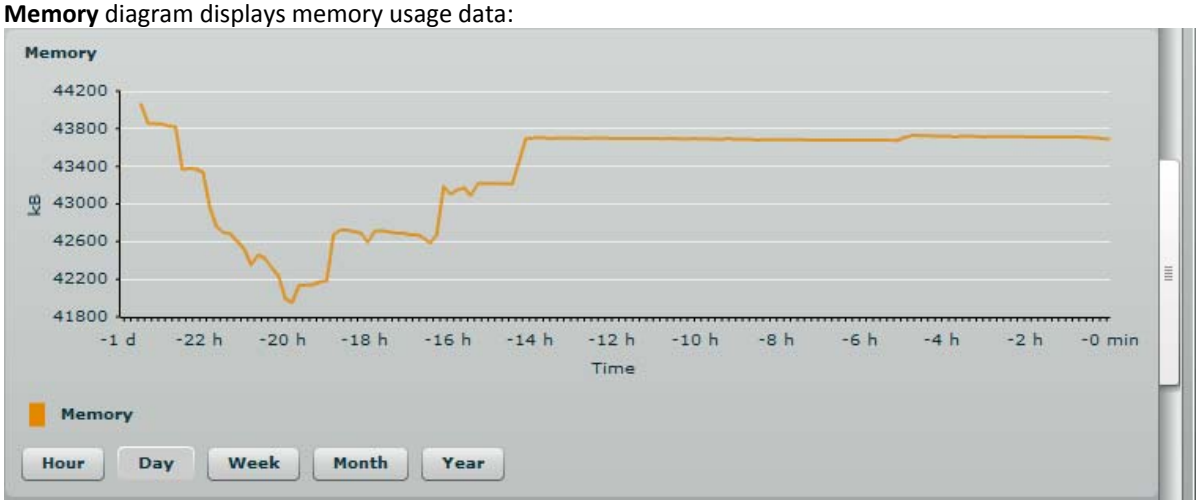


Figure 35 – Memory Status Graph

CPU load diagram displays device CPU load in appropriate time basis:

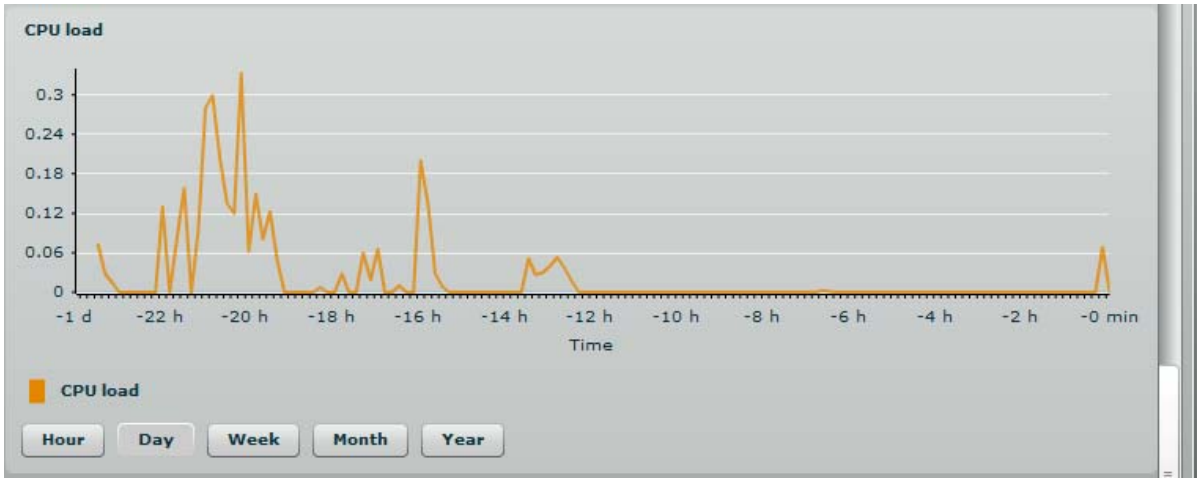


Figure 36 – CPU Load Graph

Frequency diagram displays device operating frequency in GHz:

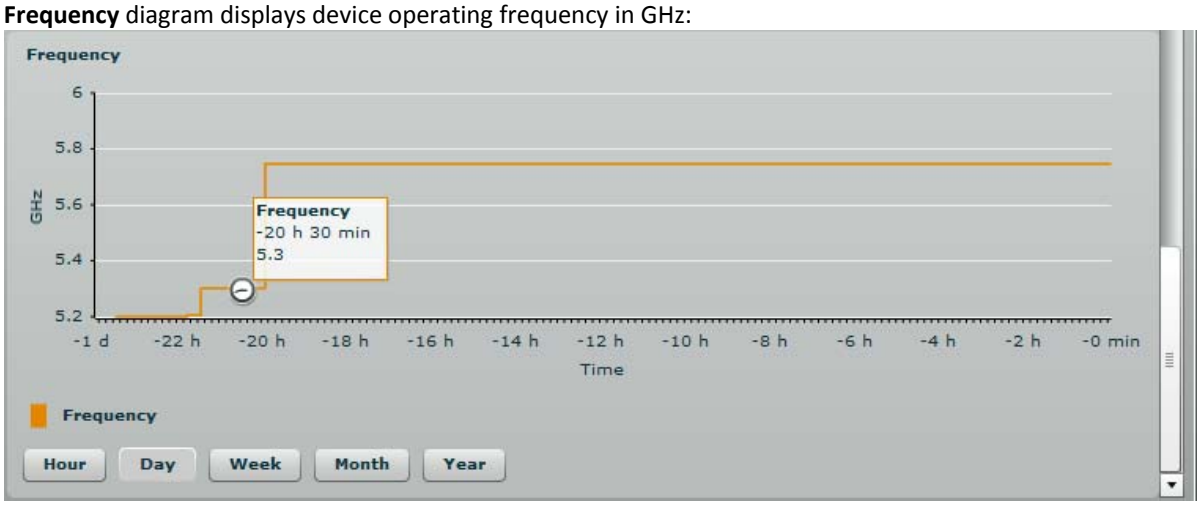


Figure 37 – Frequency Graph at which FreeMile 5.8GHz MIMO Link is Operating

Configuration

The Configuration page is subdivided into following pages:
Network – to set main network configuration for FreeMile 5.8GHz MIMO device.
Radio – to setup radio settings of the FreeMile 5.8GHz MIMO link.
System – to setup system date, administrator's access settings, configure system log feature.
Services – to setup SNMP, RCMS settings and configure device alerts.
Maintenance – for device firmware update, reboot, reset device to factory defaults, troubleshooting file download and to view system log messages.

Network

The network configuration as described below is required for FreeMile 5.8GHz MIMO management purposes. Use the **Network** menu to setup the network settings of the FreeMile 5.8GHz MIMO unit:

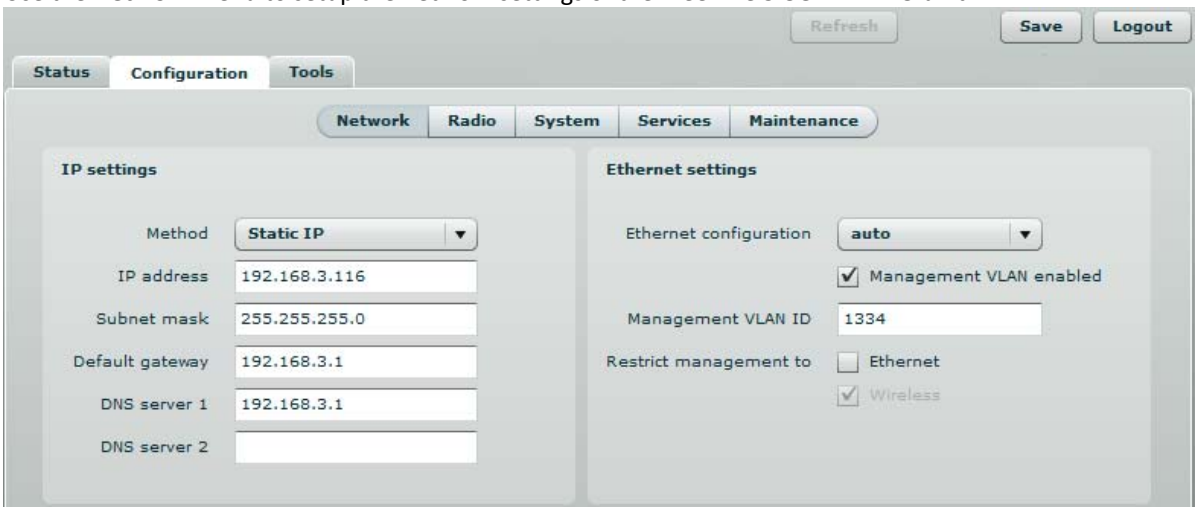


Figure 38 – Network Settings

Method – specify IP configuration mode:
Static IP – choose to specify static IP of the device.
Dynamic IP – choose to use dynamic IP given by the DHCP server (running DHCP server is required).
IP address – specify the device IP address [digit and dots]. When shipped from the factory or reset to factory settings, device defaults to a static IP address of 192.168.2.66.
Subnet mask – specify the device subnet mask [digit and dots]. When shipped from the factory or reset to factory settings, the device defaults to a subnet mask of 255.255.255.0.
Default gateway – specify the IP address of the device gateway [digit and dots]. When shipped from the factory or reset to factory settings, the device defaults to a gateway IP address of 192.168.2.1.
DNS server 1 – specify the IP address of the primary DNS server [digit and dots]. The DNS (Domain Name Service) service translates Internet host names into their IP addresses.
DNS server 2 – specify the IP address of the secondary DNS server.
Ethernet configuration - configures the Ethernet link speed and the duplex mode of the Ethernet port. Choose "auto" for automatic detection of link speed and duplex mode.
Management VLAN ID – specify the management VLAN ID [2-4094].If a management VLAN is enabled, all traffic received by the device must by tagged with the management VLAN ID to access the network. All non-tagged traffic will be dropped, thus reducing the risk of unauthorized access.
Restrict management to – select interfaces on which management access will be restricted.

Radio

Use the **Configuration | Radio** menu to set up radio settings for the FreeMile 5.8GHz MIMO link:

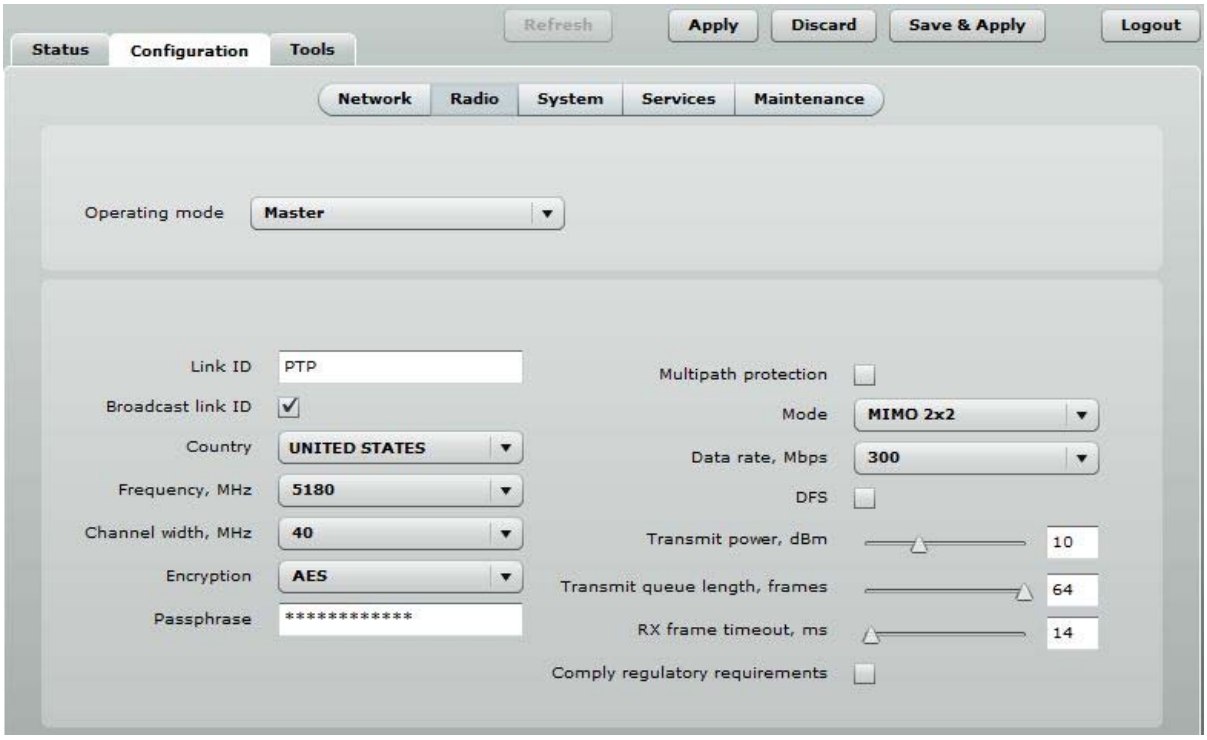


Figure 39 – Radio Settings

Operating mode – specify the operating mode of the local device to create FreeMile 5.8GHz MIMO link [Master/Slave]. The device mode depends on the network topology.
Master – in this mode local device is the controlling FreeMile 5.8GHz MIMO link unit.
Slave – in this mode local device connects to the Master unit.

Instant Changes

Applying parameters in the **Instant changes** section does not require device reboot, therefore making easy parameters adjustment for best performance.
Link ID – specify known network name of the remote device to establish a FreeMile 5.8GHz MIMO link.

Both sides (Master and Slave units) of the link must have the same **Link ID** name.

Country – from drop-down list choose country in which the devices will operate. According to the chosen country the regulatory domain settings may differ. You are not allowed to select radio channels and RF output power values other the permitted values for your country and regulatory domain.
Frequency – specify frequency at which the FreeMile 5.8GHz MIMO link will be operating. If the device is operating in Slave mode, it will not have the possibility to choose a frequency. The Slave scans the air and connects to the Master automatically.

The available Frequencies list varies depending on the selected **Country** and **Channel width**.

Channel width – choose the channel width in MHz [20/40].

Both sides (Master and Slave) of a link must have the same Link ID, Channel width and Encryption specified.

Encryption – select the security level for the FreeMile 5.8GHz MIMO link:
None – means no security on link.
AES – means encryption with passphrase.
Passphrase – specify passphrase of the AES security [8-63 characters]. This parameter appears and is mandatory when AES security is chosen.

Multipath protection – if checked the signal will became more robust to signal interference caused by signal echos or reflections. However as the drawback the enabled multipath protection will lead to reduced link capacity.
Mode – choose the FreeMile 5.8GHz MIMO antenna operating mode:
SISO – single input single output. The device will use only one antenna for data transfer. The antenna will be chosen automatically.
MIMO – multiple input multiple output. The device will use two antennas for data transfer (two simultaneous streams). In this mode the *link capacity doubles *if compared to SISO mode.
Data rate – select the device data transmission rates in Mbps from the drop-down list.
DFS - select to enable a radar detection. With enabled DFS, FreeMile 5.8GHz MIMO monitors the operating frequency for radar signals. If radar signals are detected on the channel, the unit randomly selects a different channel.
Transmit power – set the radio transmit power at which the device will transmit data. The larger the distance, the higher transmit power is required. To set transmit power level use the slider or enter the value manually. The transmit power level that is actually used is limited to the maximum value allowed by your country's regulatory agency.
Transmit queue length, frames - specify the length in frames of the transmit queue.
RX frame timeout, ms - specifies number in milliseconds to wait for a RX frames.
Comply regulatory requirements - if selected, the FreeMile 5.8GHz MIMO's radio settings (frequency range, maximal channel width and maximal EIRP) will comply with IEEE regulations.

System

The System page is subdivided into 4 sections:
Link settings – to specify FreeMile 5.8GHz MIMO link settings.
System date – to setup system date and time of the FreeMile 5.8GHz MIMO unit.
Administrative account – to change administrator's password.
System log – to configure logging of the system messages.

Link Settings

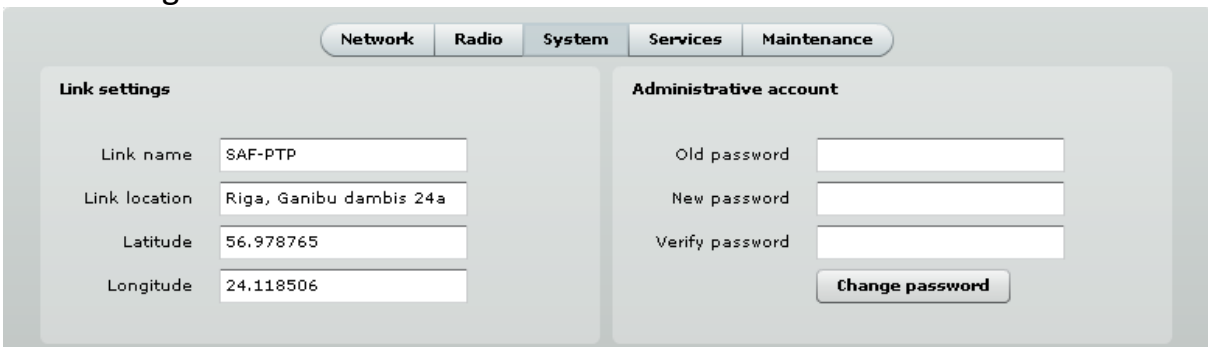


Figure 40 – Link Settings

Link name – specify name of the FreeMile 5.8GHz MIMO link that is used to identify the unit on the network [maximum 255 ASCII characters].
Link location – describe the location of the FreeMile 5.8GHz MIMO unit [maximum 255 ASCII characters].
Longitude – specify the longitude coordinates of the FreeMile 5.8GHz MIMO unit [specific decimal format, e.q. 54.869446].
Latitude – specify the latitude coordinates of the FreeMile 5.8GHz MIMO unit [specific decimal format, e.q. 23.891058]. Both coordinates helps indicate accurate location of the FreeMile 5.8GHz MIMO unit's.

System Date

Use this section to manage the system time and date on the device automatically, using the Network Time Protocol (NTP), or manually, by setting the time and date on the FreeMile 5.8GHz MIMO unit.
The NTP (Network Time Protocol) client synchronizes the clock of the device with the defined time server. Choose NTP from the configuration menu, select your location timezone and enter NTP server in order to use the NTP service:

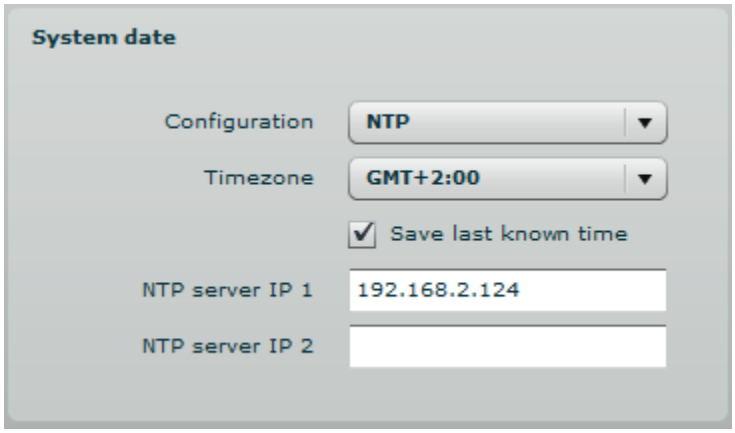


Figure 41 – System Date: NTP Configuration

Configuration – choose the system clock configuration mode [NTP/Manual].
Timezone – select the timezone. Time zone should be specified as a difference between local time and GMT time.
Save last known time – select to recall the timestamp that was saved on last reboot. When NTP is enabled, this option will set system clock to last reboot time if no NTP servers are available.
NTP server – specify the trusted NTP server IP or hostname for synchronizing time with [IP address].

To adjust the clock settings manually, choose the configuration mode as **Manual** and specify the following settings:

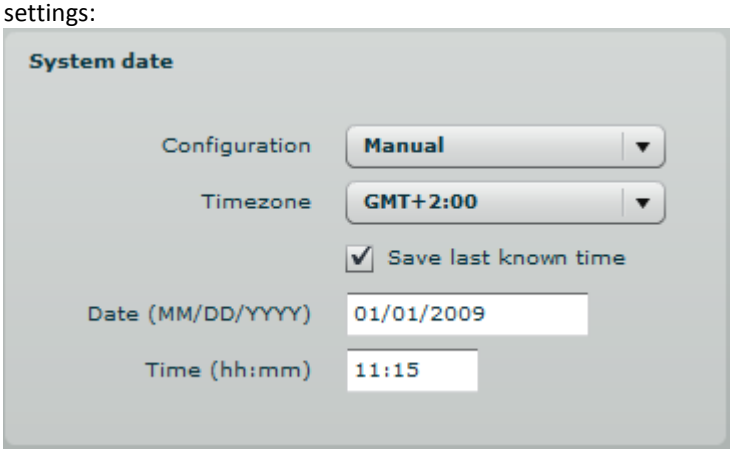


Figure 42 – System date: Manual Clock Configuration

Configuration – choose the system clock configuration mode [NTP/Manual].
Timezone – select the timezone. Time zone should be specified as a difference between local time and GMT time.
Save last known time – select to recall the timestamp that was saved on last reboot.
Date – specify the new date value in format MM/DD/YYYY.
Time – specify the time in format hh:mm.

If the device hardware has no internal clock, the configured manual time will be reset to the specified date and time after each device reboot.

Administrative Account

We recommend changing the default administrator password as soon as possible.

The Administrative Account menu is for changing the administrator's password.

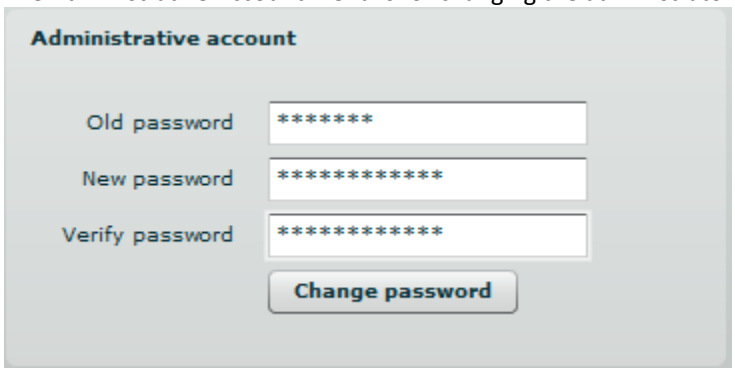


Figure 43 – Changing the Administrator's Password

Old password – enter the old administrator password.
New password – enter the new administrator password for user authentication.
Verify password – re-enter the new password to verify its accuracy.

The only way to gain access to the web management if you forget the administrator password is to reset the device to factory default settings.

Default administrator login settings are:
User Name: **admin**
Password: **admin01**

System Log

Use the Configuration | System menu to configure device to save log messages to the local or remote server using standard syslog facility:

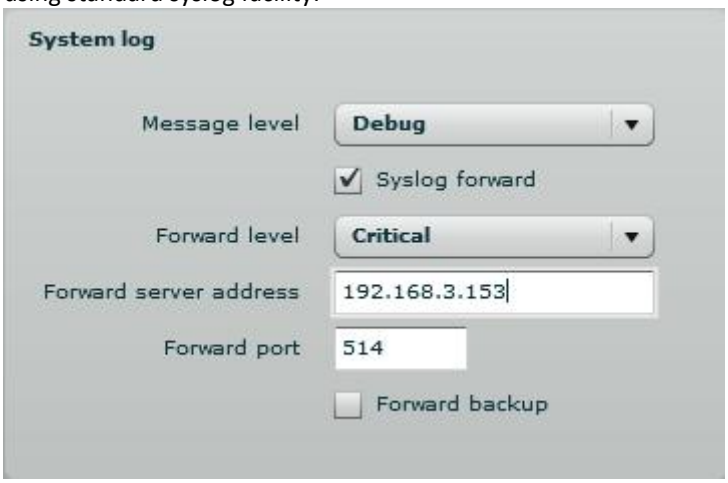


Figure 44 – System Log Configuration

Message level – specify system's message tracing level. The level determines the importance of the message and the volume of messages generated by the FreeMile 5.8GHz MIMO unitThe levels are in increased importance order [emergency, alert, critical, error, warning, notice, information, debug]. Default: info.
The FreeMile 5.8GHz MIMO unit can be configured to send system log messages to a remote server:
Syslog forward – select to enable remote system logging.
Forward server – specify the remote host IP address or hostname where syslog messages will be sent.
Forward port – specify the port to which syslog messages will be forwarded [0-65535]. Default: 514.
Forward message level – specify the message level that will be send to the remote syslog server. The level determines the importance of the message and the volume of messages generated by the FreeMile 5.8GHz MIMO unit. The levels are in order of increasing importance [emergency/alert/critical/error/warning/notice/information/debug]. Default: information.
Forward backup – select to enable remote syslog logging backup.
Backup server – specify the backup host IP address or hostname where syslog messages will be send to.
Backup port – specify the port to which syslog messages will be forwarded [0-65535]. Default: 514.

To view logged system messages locally, navigate to the menu *Maintenance*

Services

The Services page is divided into 3 sections:
SNMP configuration – To enable SNMP and setup SNMP on the FreeMile 5.8GHz MIMO unit.
Alerts – to enable and setup system alerts.

SNMP Configuration

SNMP is the standard protocol that is widely used for remote network management over the Internet. With the SNMP service enabled, the FreeMile 5.8GHz MIMO unit can act as SNMP agent.

To communicate with SNMP manager you must configure SNMP communities and identifiers on both ends (manager and agent).

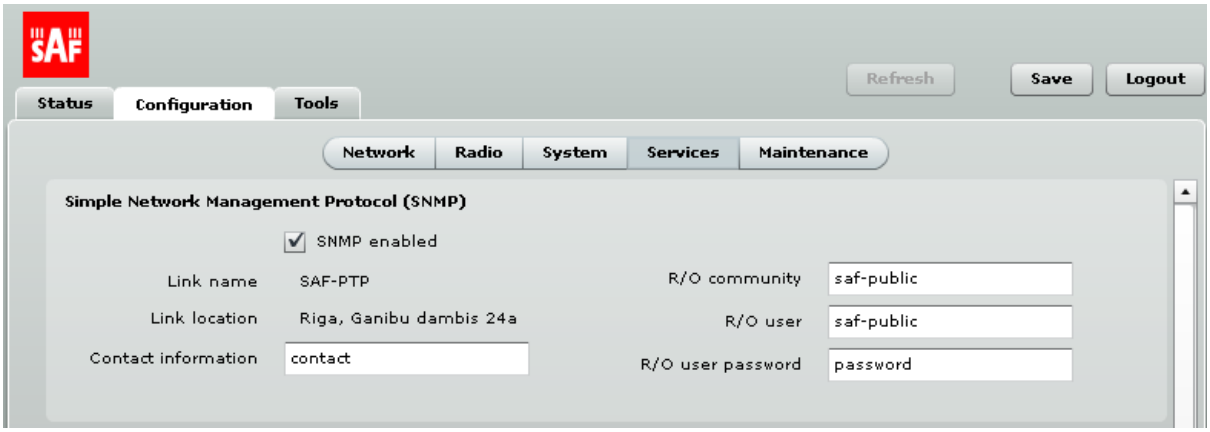


Figure 45 – SNMP Settings Configuration

Enable SNMP – specify the SNMP service status.
Name – displays an administratively assigned name.
System location – displays the physical location of the FreeMile 5.8GHz MIMO unit [string].
R/O community – specify the read-only community name for SNMP version 1 and version 2c [string]. The read-only community allows a manager to read values, but denies any attempt to change values.
R/O user – specify the user name for read-only SNMPv3 access [string]. The read-only community allows a manager to read values, but denies any attempt to change values.
R/O user password– specify the password for read-only SNMPv3 access [string].

System Alerts

The FreeMile 5.8GHz MIMO unit is able to send external alerts when there are system errors. The alerts can be sent via SNMP Traps or/and SMTP notifications.

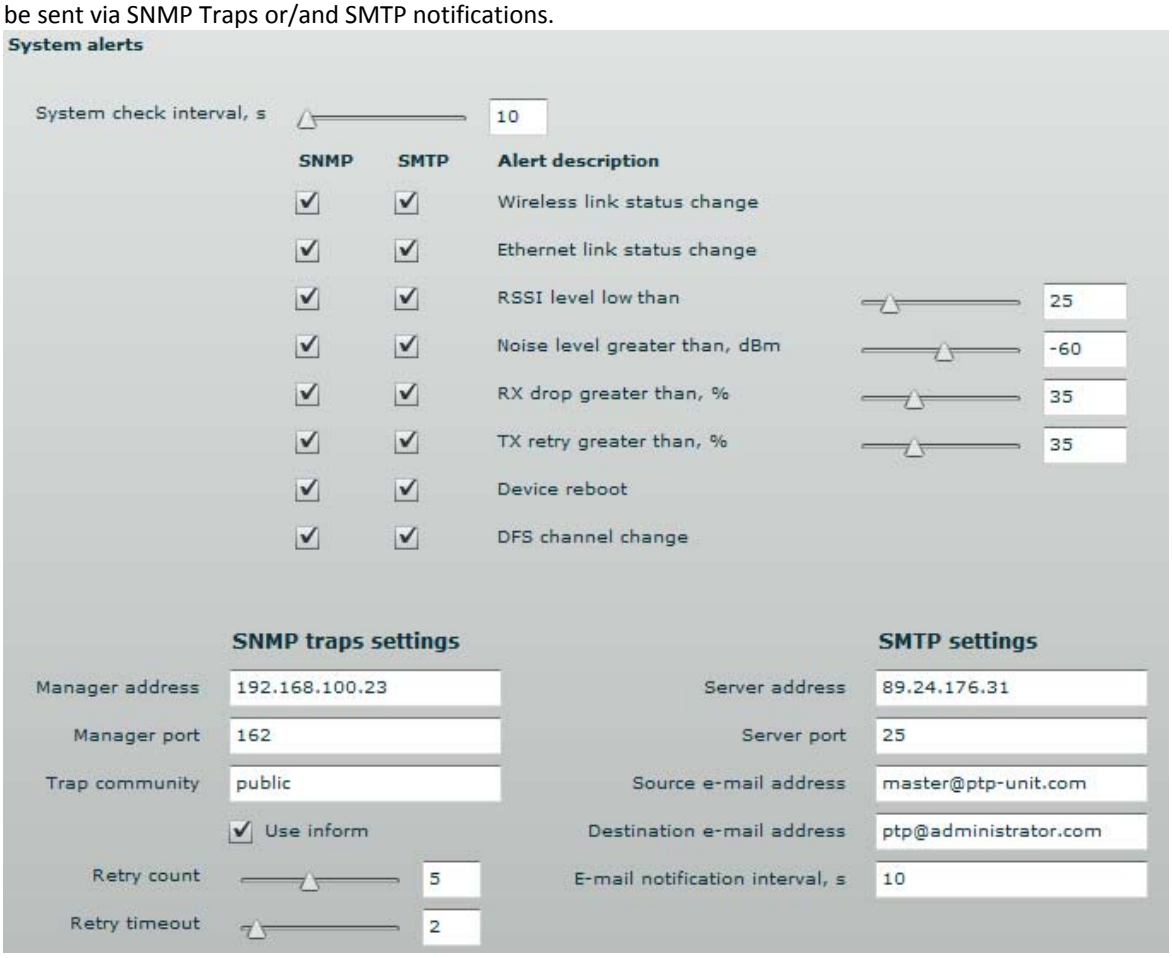


Figure 46 – System Alerts Configuration

Enable alerts – select to enable alert notifications on the system.

System check interval, s – specify interval in seconds at which the device will send notifications of unexpected system behavior.
System alerts:
Wireless link status change – system will send notification on Wireless link status change.
Ethernet link status change – system will send notification on Ethernet link status change.
RSSI level lower than – system will send notification when RSSI reach value lower than specified. Default: 25.
Noise level greater than – system will send notification when signal noise will reach value greater than specified. Default: -60 dBm.
RX drop greater than – system will send notification when the specified percent of RX dropped packets becomes higher than specified value.
TX retry greater than – system will send notification when the specified percent of TX retries becomes higher than specified value.
Device reboot – system will send notification about unexpected or administrator initiated device reboot.
DFS channel change – system will send notification on DFS channel change.

SNMP Traps Settings
Manager address – specify the IP address or hostname of Trap receiver.
Manager port – specify the port number of the Trap receiver. Default port number is 162.
Trap community – specify the SNMP community string. This community string acts as password between SNMP manager and FreeMile 5.8GHz MIMO unit. by default Trap community string is "public".
Use inform – select to wait for an acknowledgment from SNMP manager that trap was received.
Retry count – specifies maximum number of times to resend an inform request [1-10]. Default: 5.
Retry timeout – specifies number in seconds to wait for an acknowledgment before resending request [1-10]. Default: 1.

SMTP Settings
Server address – specify the IP address or hostname of the networked SMTP server.
Server port – specify the SMTP Port Number is the port number used by the networked SMTP server. By default the port number is 25.
Source e-mail – specify the e-mail address that will be used by the FreeMile 5.8GHz MIMO unit.
Destination e-mail – specify the e-mail address where the FreeMile 5.8GHz MIMO unit will send the alert messages.
E-mail notification interval – specify interval in seconds at which the e-mail notification will be sent from the FreeMile 5.8GHz MIMO unit [0-86400]. If 0 specified, then device will send an e-mail notification immediately after unexpected system behavior.

Maintenance

Use Maintenance menu for device firmware update, reboot, reset device to factory defaults, troubleshooting file download, view system log messages and control OLED.

System Functions

Figure 47 – Main System Functions

Reboot device – reboot device with the last saved configuration.
Reset device to factory defaults – click to restore unit's factory configuration values.

Resetting the device is an irreversible process. Current configuration and the administrator password will be set back to the factory default.

Download troubleshooting file – click to download the troubleshooting file. The troubleshooting file contains valuable information about device configuration, routes, log files, command outputs, etc. When using the **troubleshooting file,** the device quickly gathers troubleshooting information automatically, rather than requiring you to gather each piece of information manually.. This is helpful for submitting problems to the support team.
Backup configuration file - click to save the current configuration file. The saved configuration file is useful to restore a configuration in case of a device misconfiguration or to upload a standard configuration to multiple devices without the need to manually configure each device through the web interface..
Restore configuration from file - click to upload an existing configuration file to the device.
View system log - click to view current trace messages. The Syslog viewer utility provides debug information about the system services and protocols. If the device's malfunction occurs recorded messages can help operators to locate misconfiguration and system errors. The syslog capability can help operators to locate misconfiguration and system errors.

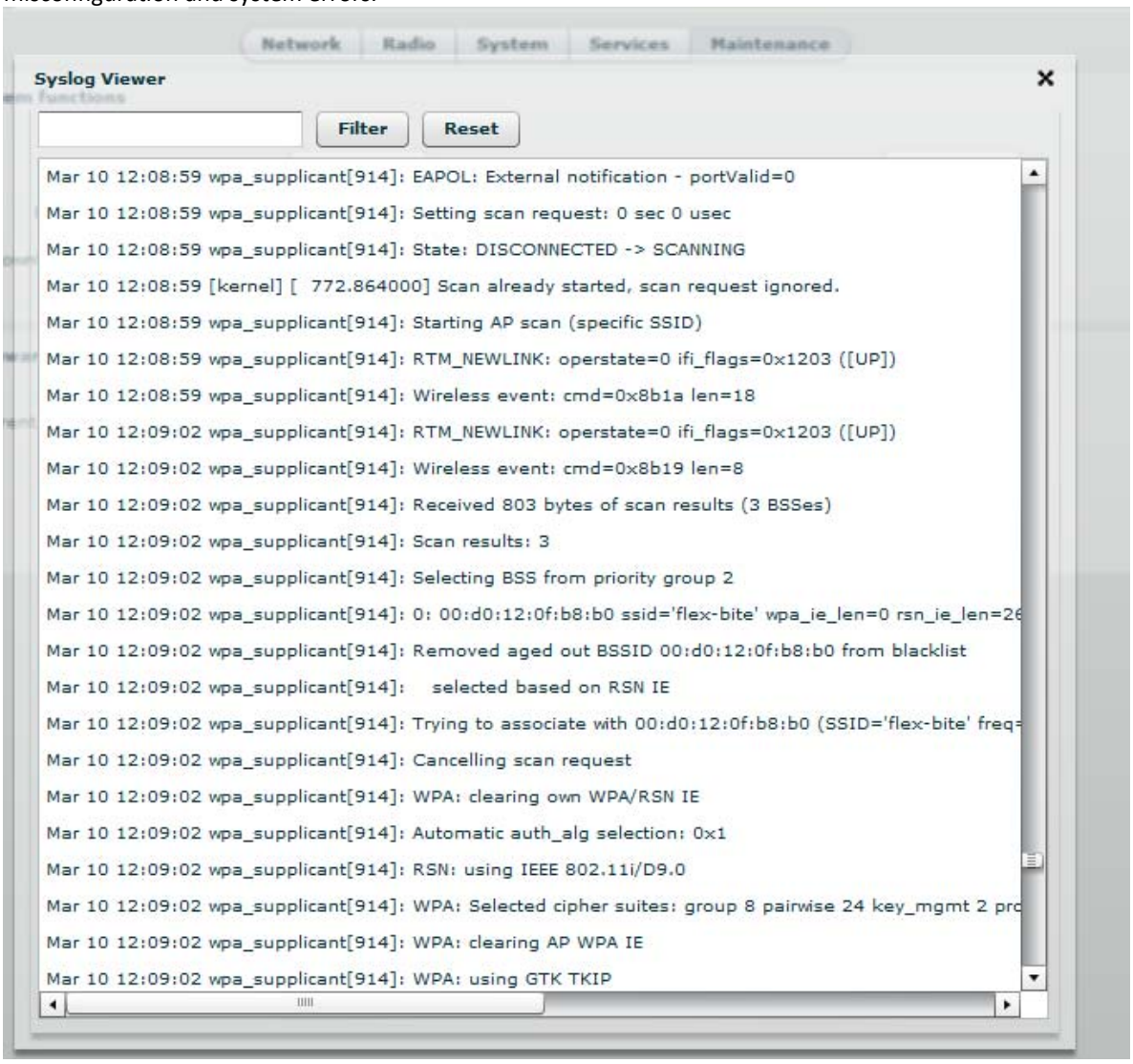


Figure 48 – System Log Viewer

Filter – filter content of the system messages by entering required words or symbols.

To change level of the system messages displayed in the Syslog viewer use menu *System Log.*

Firmware Upgrade

To update your device firmware use the **Firmware upgrade** section under the **Maintenance** menu, select the firmware file and click the **Upload** button:

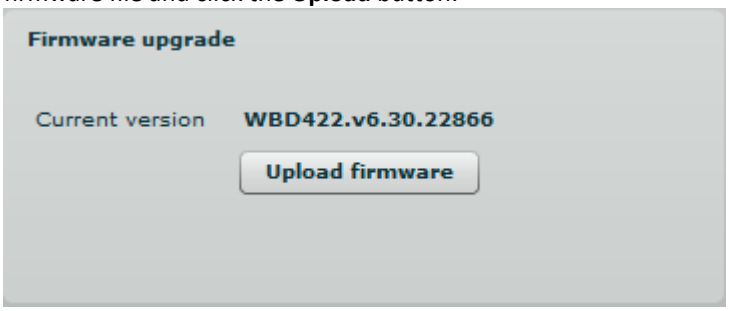


Figure 49 – Firmware Upload on the System

Current version – displays version of the current firmware.
Upload firmware – click the button to select the new firmware image for uploading it to the device..
The device system firmware upgrade is compatible with all configuration settings. When the device is upgraded with a newer version or the same version builds, all the system's configuration will be preserved after the upgrade.
The new firmware image is uploaded to the controller's temporary memory. It is necessary to save the firmware into the device permanent memory. Click the **Upgrade** button:

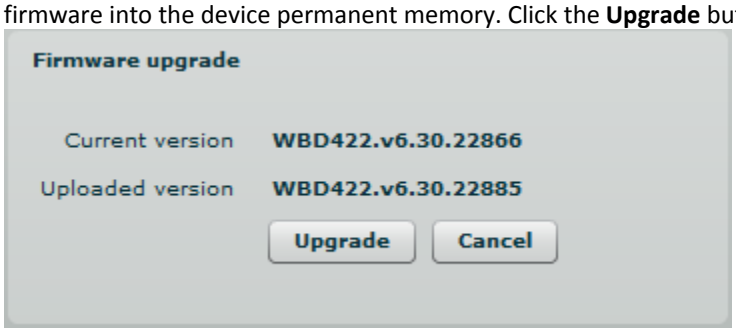


Figure 50 – Firmware Upgrade

Upgrade – upgrade device with the uploaded image and reboot the system.

Do not switch off and do not disconnect the device from the power supply during the firmware update process as the device could be damaged.

Tools

Use the Tools menu to use the following device applications:
Site survey – to view the list of wireless networks in the surrounding area.
Antenna alignment – to align device antenna.
Link test – to check quality of the established FreeMile 5.8GHz MIMO link.

Antenna Alignment

The antenna alignment test measures signal quality between the Master and Slave units. For best results during the antenna alignment test, turn off all wireless networking devices within range of the device except the device(s) with which you are trying to align the antenna. Watch the constantly updated display in the antenna alignment test window as you adjust the antenna.
The Antenna Alignment test results appear when you click the **Start** button and finishes when you click the **Stop** button.

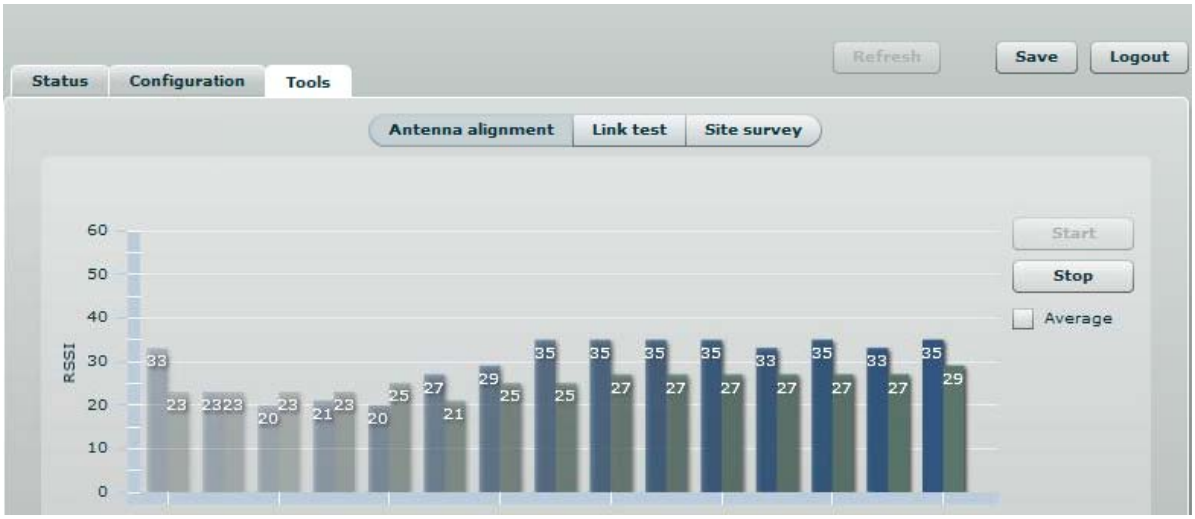


Figure 51 – Antenna Alignment Tool

Average – if this option selected, the graph will display the average RSSI of both antennas.

Site Survey

The **Site Survey** test shows overview information for wireless networks in a local geographic area. Using this test, an administrator can scan for working access points, check their operating frequency, encryption, see signal/noise levels and view whether device has enabled W-Jet or not. This feature may be used by the administrator find unused wireless channel so that FreeMile 5.8GHz MIMO unit would not interference with adjacent working devices thus getting best possible performance.

Note that Site Survey function can take several minutes to perform.

To perform the Site Survey test, click the **Start scan** button:

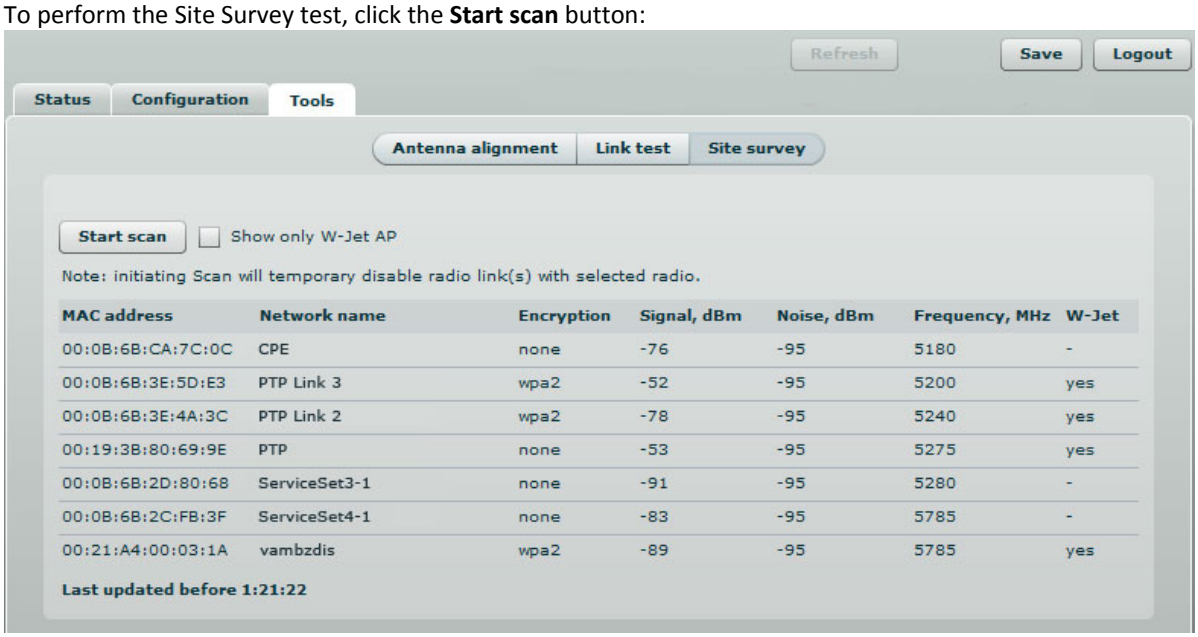


Figure 52 – Site Survey Tool

Start scan – click to perform the Site Survey test.

Show only W-Jet AP – select this option to sort Site Survey results.

Link Test

We recommend to ensure that there is no traffic on the link before running the Link Test as results may not be completely accurate.

Use the Link test tool to check the quality of the established FreeMile 5.8GHz MIMO link. This tool tests the throughput at selected packet sizes and iterations. Link test can be run from either the Remote unit or Local unit. Results represent the maximum, minimum and average value of the performed test.

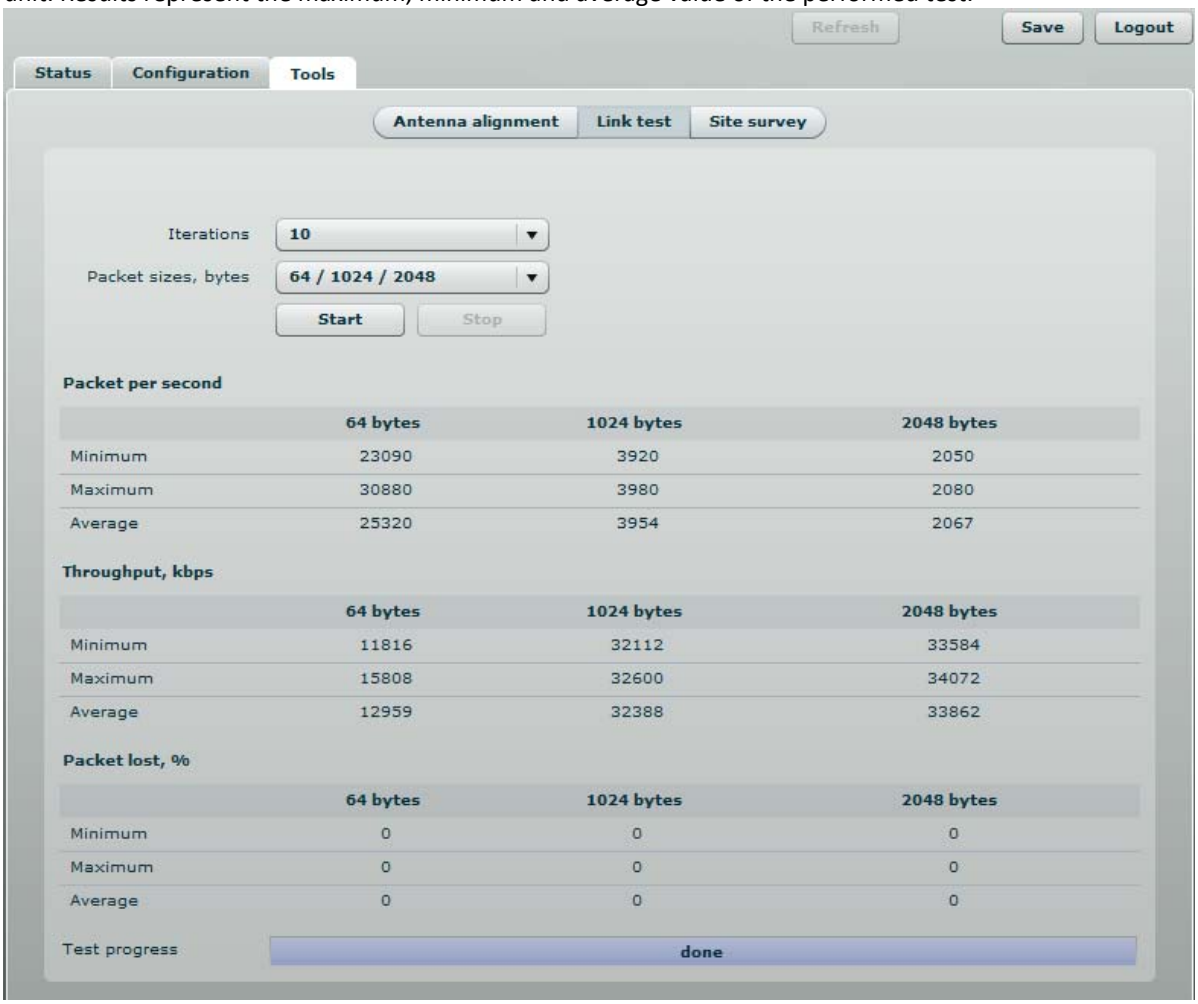


Figure 53 – Link Test Tool

Iterations – specify number of test iterations.
Packet sizes – specify packet sizes in bytes at which the test will be performed.
Start – click to start the throughput test.
Stop – click to stop the throughput test.

Spectrum Analyzer

The Spectrum analyzer is available from firmware version 6.71 and later.

The Spectrum analyzer test displays detailed information about signal level of each FreeMile 5.8GHz MIMO's antenna on each frequency. This enables administrator choose the best available frequency/channel for the particular unit operation. The frequency list depends on the Country at which the unit is operating, and chosen channel width.

Do not use the Spectrum analyzer on the remote unit of the link, as the connection to the device will be lost during the test.

Click **Start** button to perform the test:

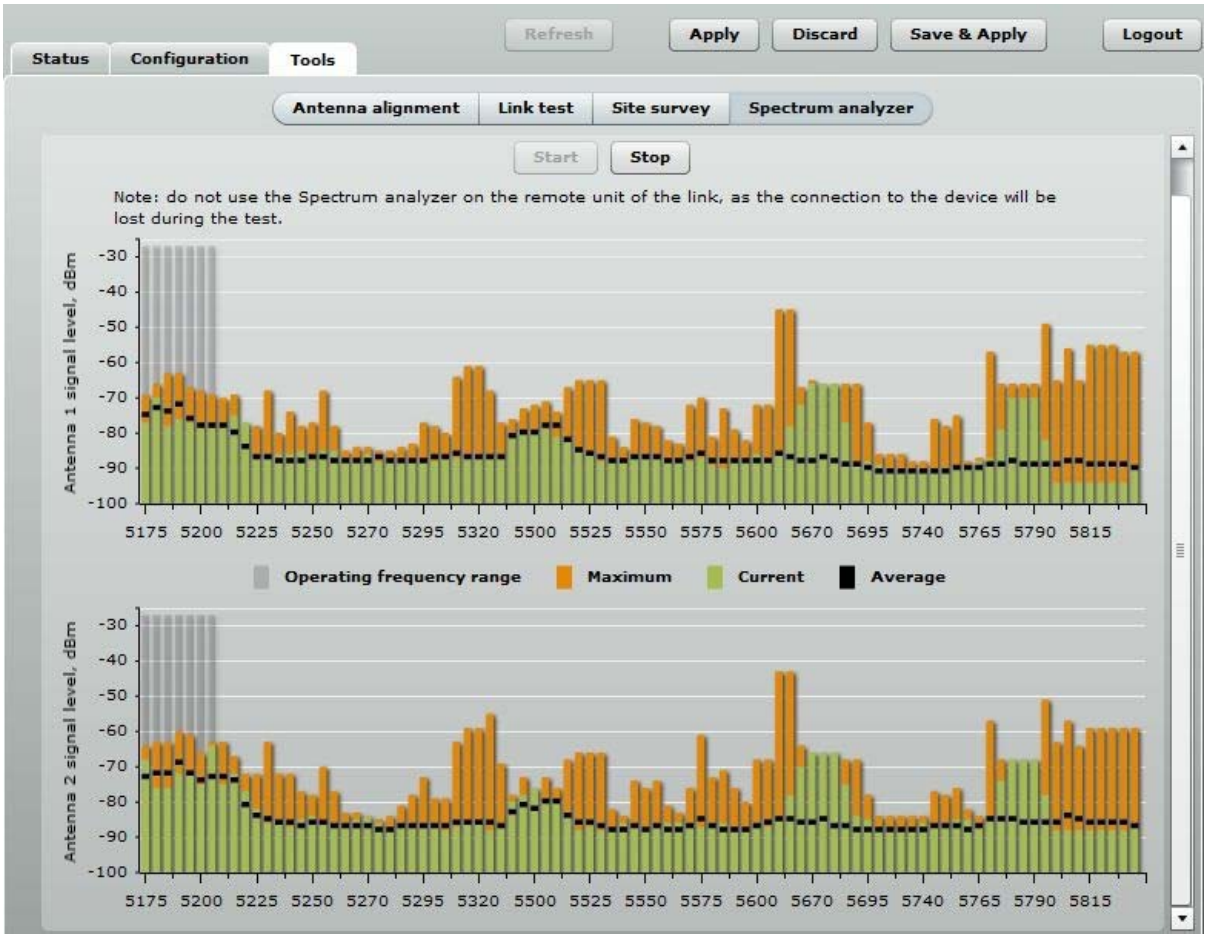


Figure 54 – Spectrum Analyzer

Operating frequency range – displays the channel frequency range at which the particular FreeMile 5.8GHz MIMO is operating currently.
Maximum – the maximum achieved signal level on the appropriate frequency.
Current – current signal level on the appropriate frequency.
Average – displays average of the signal level on the appropriate frequency.

Logout

Click the **Logout** link on the top right corner of the main menu to leave the Web management interface:

Figure 55 – Logout Page

Logout – click to leave the FreeMile 5.8GHz MIMO unit Web management.

When the **Logout** button is clicked, the administrator is redirected to the login page of the FreeMile 5.8GHz MIMO unit.

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Appendix

A) Run FreeMile 5.8GHz MIMO Link in Small Distance

Follow up the steps to run the link for testing it in small distances (e.g. testing on a table) and achieve throughput up to 70 Mbps.

Step 1. Power-up both units: Master and Slave.

Step 2. FreeMile 5.8GHz MIMO units must be placed at least a distance of 2 meters from each other.

Step 3. Change major **Radio** parameters for both units (Master and Slave):

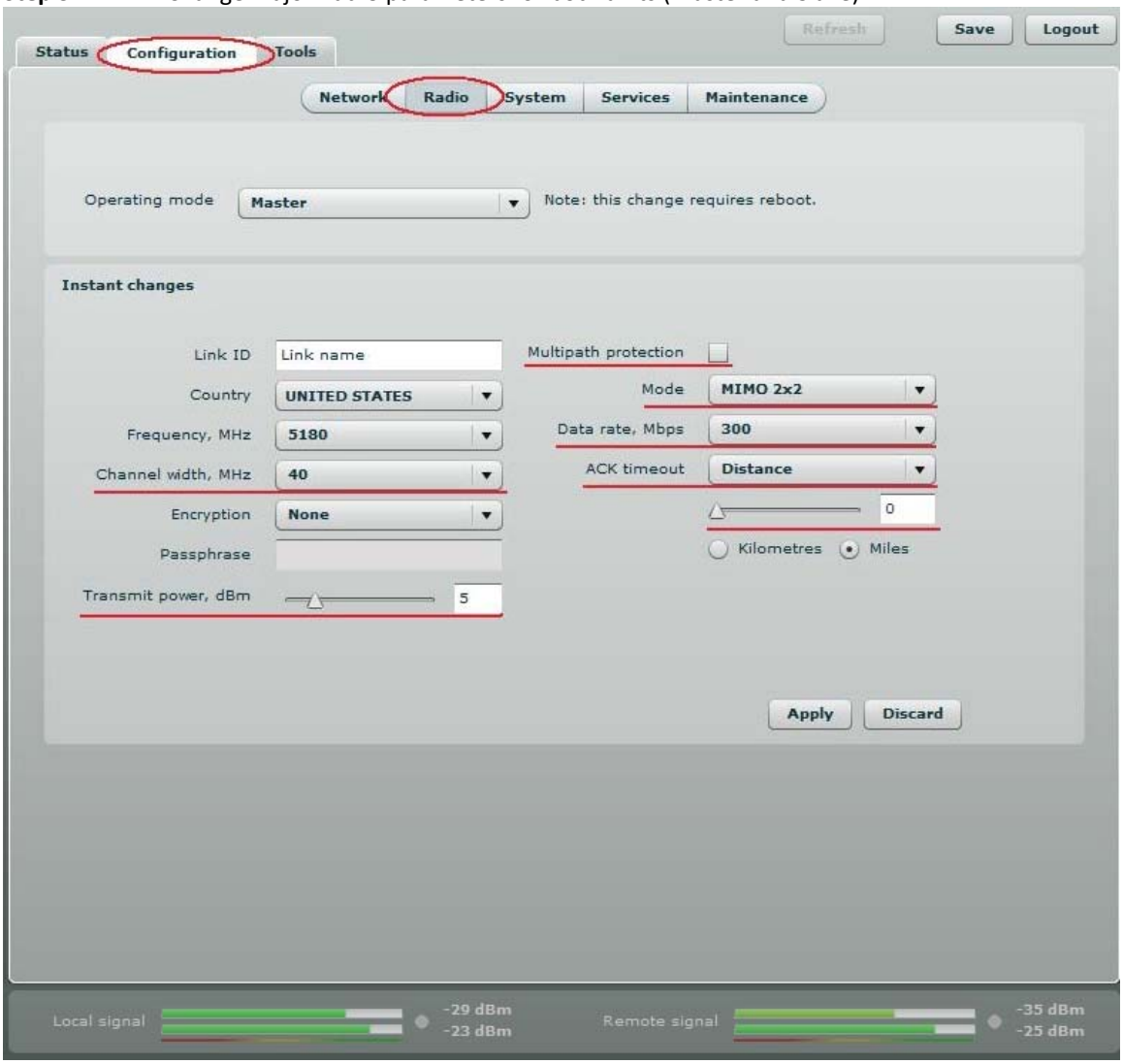


Figure 56 – Radio Settings

Channel width: 40 MHz
Transmit power: 5 dBm
Multipath protection: off
Mode: MIMO 2x2
Data rate: 300 Mbps
ACK timeout: Distance 0 km/miles

Click **Apply** button for configuration to take effect.

Step 4. Observe the *Signal Indicator* bar at the bottom of the screen. If it is green the quality of the link is excellent whereas the red color indicates a poor quality of the link. If results do not meet the requirements increase or decrease the Transmit Power on Radio page depending on the status of the Signal Indicator bar. The Signal must be approximately 25-30dBm.

Step 5. Start the testing: start the iperf server , then iperf client:

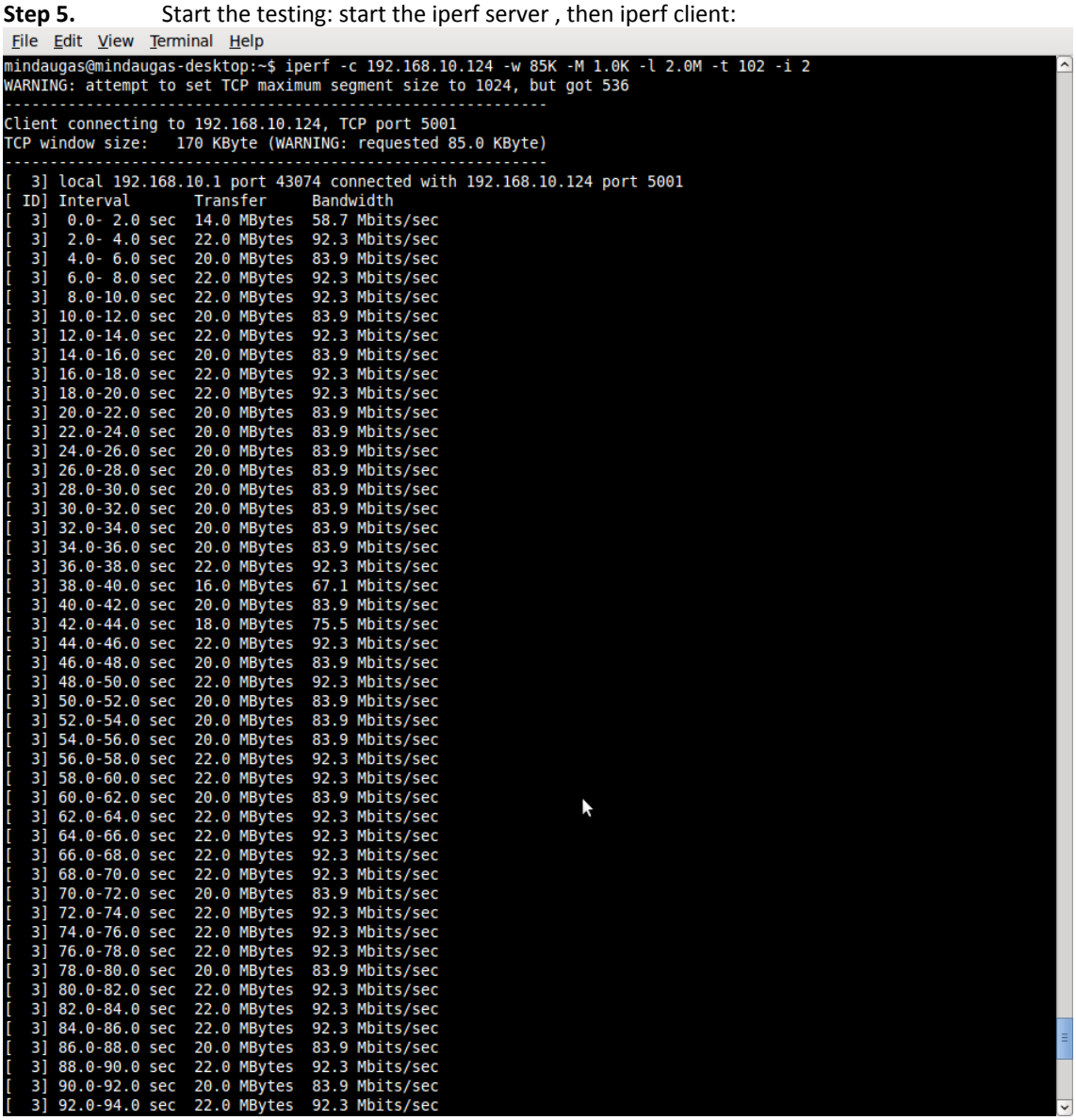
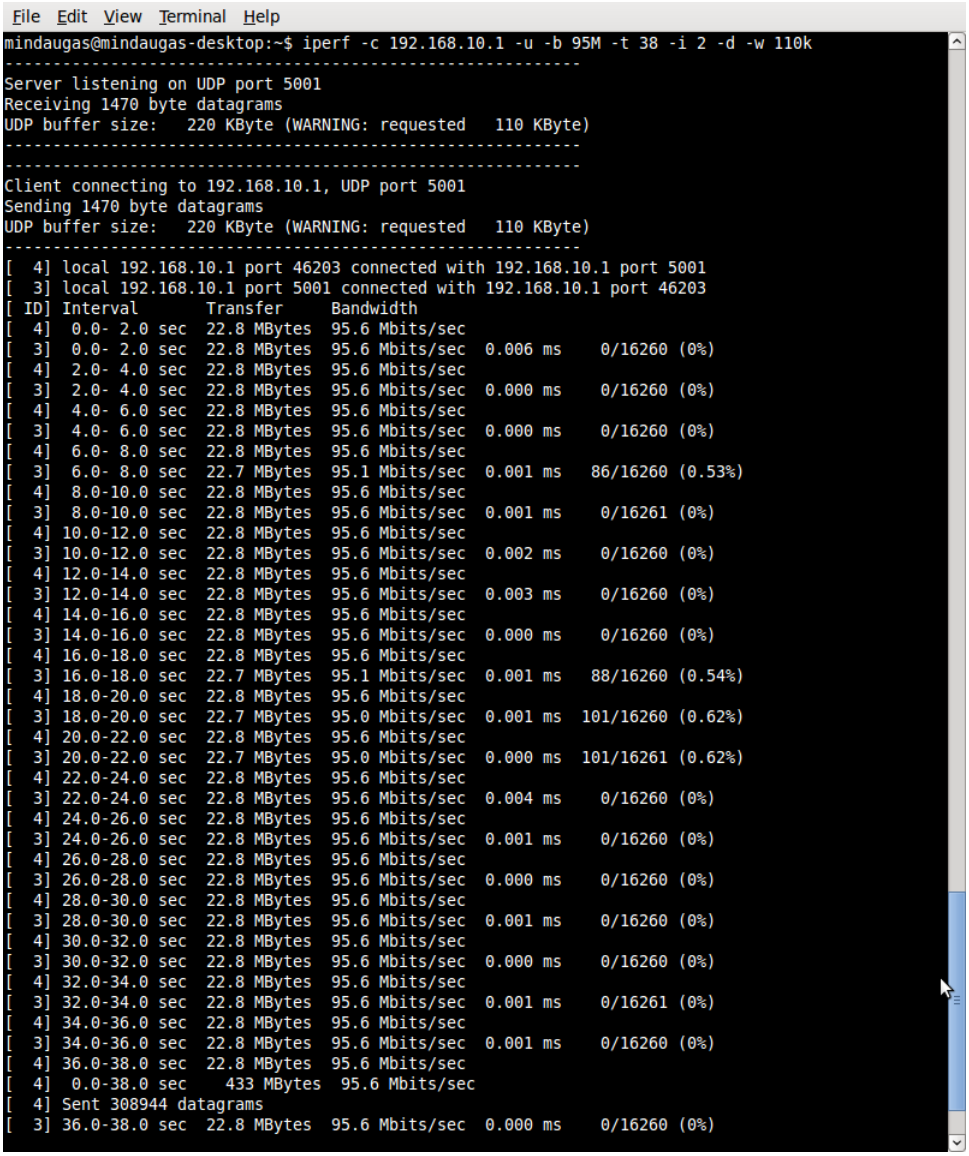


Figure 57 – iperf Results (TCP)



```
File  Edit  View  Terminal  Help
mindaugas@mindaugas-desktop:~$ iperf -c 192.168.10.1 -u -b 95M -t 38 -i 2 -d -w 110k
------------------------------------------------------------
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size:   220 KByte (WARNING: requested   110 KByte)
------------------------------------------------------------
------------------------------------------------------------
Client connecting to 192.168.10.1, UDP port 5001
Sending 1470 byte datagrams
UDP buffer size:   220 KByte (WARNING: requested   110 KByte)
------------------------------------------------------------
[  4] local 192.168.10.1 port 46203 connected with 192.168.10.1 port 5001
[  3] local 192.168.10.1 port 5001 connected with 192.168.10.1 port 46203
[ ID] Interval       Transfer     Bandwidth
[  4]  0.0- 2.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3]  0.0- 2.0 sec  22.8 MBytes  95.6 Mbits/sec  0.006 ms    0/16260 (0%)
[  4]  2.0- 4.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3]  2.0- 4.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
[  4]  4.0- 6.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3]  4.0- 6.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
[  4]  6.0- 8.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3]  6.0- 8.0 sec  22.7 MBytes  95.1 Mbits/sec  0.001 ms   86/16260 (0.53%)
[  4]  8.0-10.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3]  8.0-10.0 sec  22.8 MBytes  95.6 Mbits/sec  0.001 ms    0/16261 (0%)
[  4] 10.0-12.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 10.0-12.0 sec  22.8 MBytes  95.6 Mbits/sec  0.002 ms    0/16260 (0%)
[  4] 12.0-14.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 12.0-14.0 sec  22.8 MBytes  95.6 Mbits/sec  0.003 ms    0/16260 (0%)
[  4] 14.0-16.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 14.0-16.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
[  4] 16.0-18.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 16.0-18.0 sec  22.7 MBytes  95.1 Mbits/sec  0.001 ms   88/16260 (0.54%)
[  4] 18.0-20.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 18.0-20.0 sec  22.7 MBytes  95.0 Mbits/sec  0.001 ms  101/16260 (0.62%)
[  4] 20.0-22.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 20.0-22.0 sec  22.7 MBytes  95.0 Mbits/sec  0.000 ms  101/16261 (0.62%)
[  4] 22.0-24.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 22.0-24.0 sec  22.8 MBytes  95.6 Mbits/sec  0.004 ms    0/16260 (0%)
[  4] 24.0-26.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 24.0-26.0 sec  22.8 MBytes  95.6 Mbits/sec  0.001 ms    0/16260 (0%)
[  4] 26.0-28.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 26.0-28.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
[  4] 28.0-30.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 28.0-30.0 sec  22.8 MBytes  95.6 Mbits/sec  0.001 ms    0/16260 (0%)
[  4] 30.0-32.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 30.0-32.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
[  4] 32.0-34.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 32.0-34.0 sec  22.8 MBytes  95.6 Mbits/sec  0.001 ms    0/16261 (0%)
[  4] 34.0-36.0 sec  22.8 MBytes  95.6 Mbits/sec
[  3] 34.0-36.0 sec  22.8 MBytes  95.6 Mbits/sec  0.001 ms    0/16260 (0%)
[  4] 36.0-38.0 sec  22.8 MBytes  95.6 Mbits/sec
[  4]  0.0-38.0 sec   433 MBytes  95.6 Mbits/sec
[  4] Sent 308944 datagrams
[  3] 36.0-38.0 sec  22.8 MBytes  95.6 Mbits/sec  0.000 ms    0/16260 (0%)
```

Figure 58 – iperf Results (UDP)

Step 6. If the result meets the requirements, before mounting FreeMile 5.8GHz MIMO units outside, increase the Transmit Power.

B) Resetting Unit to Factory Defaults

FreeMile 5.8GHz MIMO units have the capability of being reset to defaults by pinging the device with a certain packet size when the radio is booting. During the startup of the device, when the drivers of the ethernet interfaces are loaded, the discovery daemon is started. The daemon suspends startup process for 3 seconds and waits for ICMP "echo request" packet of length 369 bytes. If the packet received, the discoveryd resets the device to default configuration.

It is recommended to connect PC to the device via switch, as depending on PC OS settings, the ARP table might be flushed during wired link status change (connecting the device that will be reset).

Steps to reset to default settings:

Step 1. Power off the device.

Step 2. Obtain the device MAC address.

Step 3. Connect a PC to the same physical subnet as the device.

Step 4. Execute 'arp -s' command to assign the IP address (IP address should be from the same subnet as PC) to the device MAC address:

arp -s <IP address to assign> <device MAC address>

Note that syntax of MAC address differs depending on OS:
Linux OS: AA:BB:CC:DD:EE:FF
Windows OS: AA-BB-CC-DD-EE-FF

Step 5. Start pinging the device:

For Linux users: ping <IP address> -s 369

For Windows users: ping <IP address> -l 369 -t -w 0.2

Step 6. Power up device and wait about 30sec or more (depending on device hardware).

Step 7. Stop pinging the device, and let the device boot as usual. The device should start up with factory default settings.

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