



# WipAir

## **Installation and Operation Instructions**

February 2012

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## Notices

### Radio Frequency Statement

WipAir has been tested and found to comply with part 15 of the FCC rules and EN 301 489-1 rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment notwithstanding use in commercial, business and industrial environments. 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.

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**IMPORTANT!**

It is the responsibility of the installer to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), only those antennas certified with the product are used. The use of any antenna other than those certified with the product is expressly forbidden in accordance to FCC rules CFR47 part 15.204.

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**IMPORTANT!**

Outdoor units and antennas should be installed ONLY by experienced installation professionals who are familiar with local building and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities. Failure to do so may void the product warranty and may expose the end user or the service provider to legal and financial liabilities. WaveIP and its resellers or distributors of this equipment are not liable for injury, damage or violation of regulations associated with the installation of outdoor units or antennas.

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### R&TTE Declaration on Conformity



Hereby, WaveIP Ltd, declares that WipAir is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted through WaveIP Ltd., Teradion Industrial Park, Misgav 20179, Israel.

### Compliance with European Union WEEE Directives

In January 2003, the European Union adopted an important environmental directive - the Directive on Waste Electrical and Electronic Equipment (WEEE). It represents an important milestone in providing a safer environment for future generations.

The WEEE label and instructions for disposal are as follows:

**Instructions for Disposal of Waste Equipment by Users in the European Union**

This symbol on the product or its packaging indicates that this product must not be disposed of with other waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact WaveIP.

**Warranty**

WaveIP warrants that this product shall be free from defects in workmanship and materials for a period of one year from the date of original purchase. If the product should fail to operate correctly in normal use during the warranty period, WaveIP will replace or repair it free of charge. No liability can be accepted for damage due to misuse or circumstances outside WaveIP's control. WaveIP will not be responsible for any loss, damage or injury arising directly or indirectly from the use of this product. WaveIP's total liability under the terms of this warranty shall in all circumstances be limited to the replacement value of this product.

If any difficulty is experienced in the installation or use of this product that you are unable to resolve, please contact WaveIP.

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# 1. Introduction

Thank you for purchasing WipAir solution. WaveIP's WipAir series is a carrier-grade point-to-point and Point-to-multipoint broadband wireless solution that sets a benchmark of unrivaled performance, reliability, capacity, latency and RF robustness, making it the ultimate choice for future-proof wireless system.

## 1.1 WipAir applications

### Point-to-Point (PTP):

The basic subsystem is composed of a Master Unit (MU) and a Slave Unit (SU).

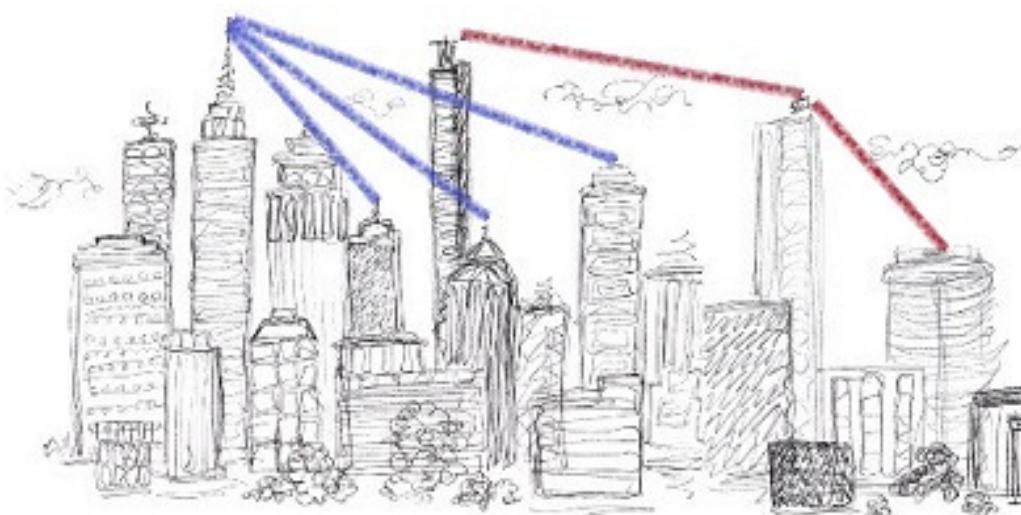
Typical applications:

- IP data backhaul of:
  - WiMAX/LTE operators
  - Metro WiFi Networks
  - Cellular and 3G
- Video surveillance networks
- Multi-hop solutions

### Point-to-Multipoint (PTMP):

The basic subsystem is composed of one Master Unit (MU) and multiple Slave Units (SUs). Typical applications:

- Multiple backhauls solutions
- IP video surveillance and security networks
- Business grade wireless access
- Backbone for Metro WiFi Networks
- High bandwidth campus solutions



**Figure 1-1: WipAir PTMP (blue) and PTP (red)**

## 2. Installation

### 2.1 Packing list

When you first open the package, verify that the unit is complete with the following components:

1. Outdoor Unit – WipAir MU or SU.
2. Indoor PoE power supply (indoor outlet).
3. Pole mounting kit (will not be added if advanced mounting kit is provided).



**Figure 2-1: General System View**

### 2.2 Additional part list – required for installation

- Outdoor Unit grounding cable
- Outdoor-to-Indoor shielded CAT5 cable (up to 100 meters).
- Indoor CAT5 cable.
- RJ-45 - Installation KIT.
- RJ-45 - Crimping tool.
- Adjustable wrench + screwdriver.

## 2.3 Installation overview

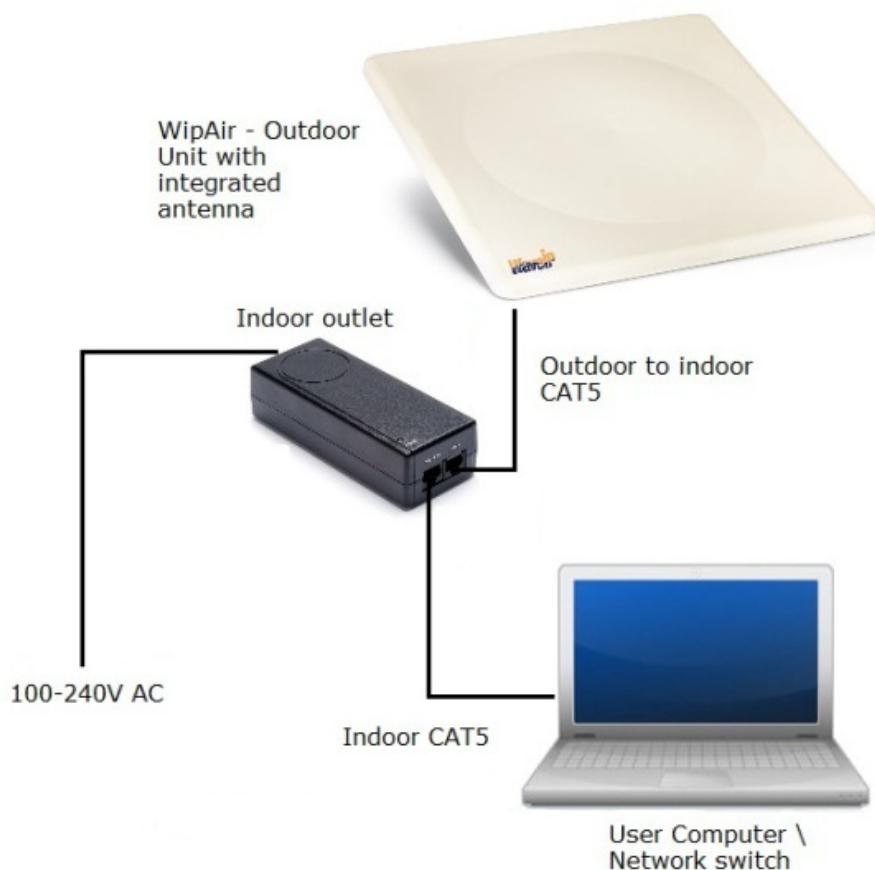
This section provides installation information for WipAir system.

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**Note:** Outdoor units and antennas should be installed ONLY by experienced installation professionals who are familiar with local building and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities. Failure to do so may void the product warranty and may expose the end user or the service provider to legal and financial liabilities. WaveIP and its resellers or distributors of this equipment are not liable for injury, damage or violation of regulations associated with the installation of outdoor units or antennas.

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Typical installation scheme:



**Figure 2-2: WipAir - General Installation Scheme**

Installation process summary:

- 1) Select the appropriate location for the Outdoor unit and the indoor PoE Outlet.
- 2) Mount the Outdoor unit (RJ-45 ports facing down). When using external antenna, mount the antenna and connect it to the Outdoor unit.

- 3) Connect a ground cable between the Outdoor unit and an appropriate grounding point.
- 4) Connect the Outdoor-to-Indoor shielded CAT5 cable to the Outdoor unit and route it to the selected location of the PoE Outlet. Assemble the enclosed connector on the cable.
- 5) Mount the Indoor Outlet and connect:
  - Outdoor-to-Indoor cable to the 'PWR LAN-OUT' port.
  - CAT5 Ethernet cable (from network) to the 'LAN-IN' port.
  - AC Input to the power (100-240VAC).
- 6) Align the antenna and secure the unit by fastening the mounting screws.

### **2.3.1 Select the best location**

Select the best location for the outdoor unit using the following guidelines:

- The outdoor unit can be pole or wall mounted.
- The location should allow easy access to the unit for installation.
- When using an external antenna, the unit should be installed as near as possible to the antenna.
- Make sure clear Line of Sight between the sites.

#### ***Path of clearest propagation***

A propagation path is the path that signals traverse between the antennas of any two bridges. The "line" between two antenna sites is an imaginary straight line, which may be drawn between the two antennas. Any obstacles in the path of the "line" degrade the propagation path. The best propagation path is, therefore, a clear line of sight with good clearance between the "line" and any physical obstacle.

#### ***Physical obstacles***

Any physical object in the path between MU and SU may cause signal attenuation. Common obstructions are buildings, trees and hills located in the path between the two sites. Install outdoor antennas high enough to avoid any obstacles, which may block the signal.

#### ***Minimal path loss***

Path loss is determined by several factors:

- **Distance between sites** – Path loss is lower when distance between sites is shorter.
- **Clearance** – Path loss is minimized when there is a clear line of sight. The number, location, and size of obstacles determine their contribution to path loss.
- **Antenna height** – Path loss is lower when antennas are positioned higher. Antenna height is the distance from the imaginary line connecting the antennas at the two sites to "ground" level. "Ground" level in an open area is the actual ground. In dense urban areas, "ground" level is the average height of the buildings between the antenna sites.

Minimizing path loss maximizes link's signal strength, throughput and availability.

### 2.3.2 Mounting

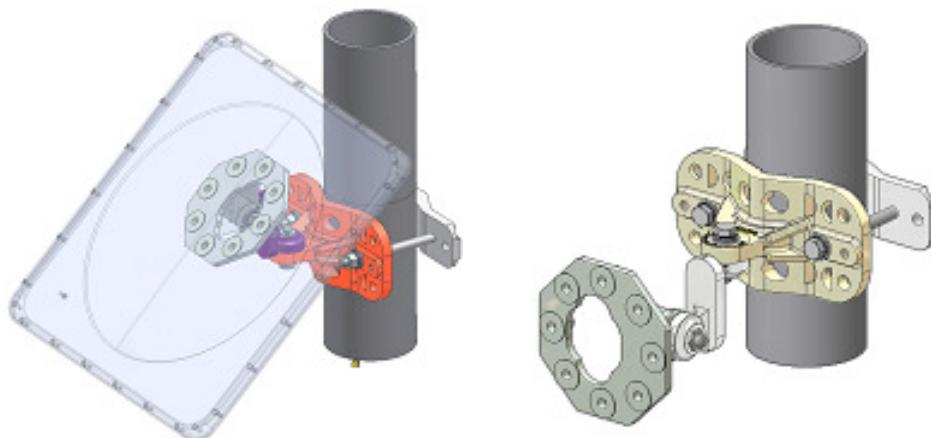
The outdoor unit can be mounted on a pole or on a wall. A general description of wall mount is given in Figure 2-3.



**Figure 2-3: Wall mount**

WipAir advanced mounting kit features:

- Azimuth and Elevation Adjustable Mount
- Suitable for pole or wall mounting
- Made of Die Cast Aluminum
- Heavy duty



**Figure 2-4: WipAir advanced mounting kit**

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**Note:** all outdoor units must be installed with a separation distance of at least **2.5 meters** from all persons during normal operation.

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### 2.3.3 Antennas

#### 2.3.3.1 General

WipAir system supports two types of antennas:

- Integrated antenna
- External antenna

Selecting the antenna model is according to the required range and performance.

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**Note:** To comply with the regulation EIRP limits, the outdoor unit-transmit power needs to be adjusted according to the installed antenna gain. Therefore a professional installation of the transmitter is required. The outdoor unit must be configured at the time of installation by qualified personal. Fail to comply with regulation rules may expose the installer to legal liabilities.

---

#### 2.3.3.2 Tx power

The outdoor unit transmit power is configurable. The unit limits the max transmit power according to the antenna gain, the regulation and the frequency band. The installer, if needed, can select a lower power.

Regulation of the unit defines the frequency band supported by the units:

- FCC: 5.8 GHz.
- ETSI: 3.x GHz, 5.4 GHz and 5.8 GHz.
- Mexico: 4.95-4.99 GHz, 5.15-5.35 GHz and 5.8 GHz.
- Non-regulated.

The unit supports two levels of privilege password: regular user and administrator user. Since Tx power level affect compliance of the unit with regulation rules, precautions are built into the system to keep the end user from adjusting the Tx power level above the regulation limits. Therefore, the following parameters are Configurable only by administrator user:

- Antenna gain and cable loss.
- Tx Power.

Please refer to WipAir\_x000\_configuration\_manual.pdf for more information.

#### FCC - 5.8 GHz

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**IMPORTANT!**

Antennas must be selected from a list of WaveIP approved antennas. Please refer to [Appendix C - FCC Approved Antennas](#).

It is the responsibility of the installer to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), only those antennas certified with the product are used. The use of any antenna other than those certified with the product is expressly forbidden in accordance to FCC rules CFR47 part 15.204.

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According to FCC part 15.247(b):

(1) *The maximum peak output power of intentional radiator shall not exceed 1 Watt (+30 dBm).*

(3) *If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the maximum peak power (of +30 dBm) as appropriate, by the amount in dB that the directional gain of antenna exceeds 6 dBi.*

That is to say that the maximum EIRP (Effective Isotropic Radiated Power) shall not exceed +36 dBm.

(ii) *Systems operating in 5.8 GHz exclusively for fixed, **point-to-point** operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.*

That is to say that the maximum EIRP can exceed +36 dBm in point-to-point applications.

Dynamic range of Tx power in WipAir is 40 dB.

In Point-to-Multipoint mode, the unit will automatically reduce the Tx power according to the antenna gain and regulatory. For example:

- For integrated antenna of 23 dBi, the max allowed Tx power is 13 dBm (10 dBm in WipAir 8000/6000) to meet the EIRP limitation of 36 dBm.
- For integrated antenna of 28.5 dBi, the max allowed Tx power is 7 dBm (4 dBm in WipAir 8000/6000) to meet the EIRP limitation of 36 dBm.

## **FCC – 4.9 GHz**

According to FCC part 90.1215:

(a)(1) *The maximum conducted output power should not exceed:*

<i>Channel bandwidth (MHz)</i>	<i>High power maximum conducted output power (dBm)</i>
5	27
10	30
20	33

(2) *High power point-to-point and point-to-multipoint operations (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the maximum conducted output power or spectral density. Corresponding reduction in the maximum conducted output power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.*

### 2.3.3.3 Antenna polarization

WipAir transmission is polarized according to the antenna:

- WipAir 3000/2000/1000 (SISO):
  - Vertical
  - Horizontal
- WipAir 8000/6000 (MIMO):
  - Dual polarization (Vertical + Horizontal)
  - Dual slant (+/- 45 degrees)

The MU and its SUs must be on the same polarization.

To verify antenna polarization, please refer to the assembly instructions supplied with the antenna set.

The polarization of integrated antenna is marked on the backside:

- Vertical polarization - marked with arrow pointing up or down.
- Horizontal polarization - marked with arrow pointing left or right.

### 2.3.4 Alignment

#### Power up the unit:

1. Plug the Power Supply into a wall outlet or other standard AC power source. This is only for use prior to permanent mounting, so any available wall outlet in close proximity to your mounting location is suitable.
2. Connect the Outdoor-to-Indoor cable to the PoE 'PWR LAN-OUT' port (this port supplies 48 VDC in addition to the Ethernet data).

WipAir is aligned using 2 methods:

#### 2.3.4.1 Using the Link Manager

1. Connect a CAT5 Ethernet cable from a PC to the PoE Outlet 'LAN-IN' port.

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**Note:** Do not attach standard CAT5 cable from the Outdoor Unit directly to the PC. Connecting the PC directly to the Outdoor Unit may cause damage to the PC Ethernet NIC.

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2. Start Link Manager application.
3. Press the "Start Session" button ("S" symbol) and select the unit from the popup address window.
4. Select "Installation" at the left menu tree.
5. Rotate the antenna for maximum RSSI with zero PER on the installation window of the Link Manager. To avoid saturation, make sure the RSSI level does not exceed -25 dBm.

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**Note:** Do not stand in front of transmitting antenna. Rotate the antenna from the rear side.

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6. Mount and secure the unit by fastening the mounting screws.

#### 2.3.4.2 Using the built in RSSI buzzer

WipAir units have a built in RSSI buzzer that indicates the best mounting location.

The buzzer is beeping at four tone levels:

- Fast – highest signal obtained so far.
- Medium – the current RSSI is lower than the highest signal obtained so far.
- Slow – the current RSSI is much lower than the highest signal obtained so far.
- No sound – no reception of the base station at all (or the buzzer is off).

To align the unit using the RSSI buzzer, please perform the following steps.

1. When the unit is first connected to power, the buzzer will be automatically activated in one of the following modes:
  - No sound – there is no reception.
  - Fast beep – there is a reception (which is currently the maximum signal obtained).
2. Set the MU at fixed modulation of BPSK 1/2 in both uplink and downlink.

3. Take the unit to the selected location and align the antenna in the link's direction. Listen to the buzzer tone level. Any sound (fast, medium or slow) indicates a reception.
4. Change and rotate the antenna to the left, right, up and down, scanning for the maximum reception point.
5. After the scan is complete, align the antenna to the location where the buzzer beeps at the fast rate, indicating the maximum reception.
6. Mount and secure the unit by fastening the mounting screws.
7. Set the MU back to adaptive modulation (AUTO) for both uplink and downlink.
8. Disable the RSSI buzzer.

To activate/deactivate the buzzer manually, use the Link Manager advanced window.

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**Note:** During this procedure, do not disconnect the unit from power.

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### **2.3.5 Sealing**

The outdoor unit must be sealed against rain with the rubber grommets. RJ-45 ports of the outdoor unit must be facing down.

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**Note:** All Units are factory sealed, seal needed only on Ethernet ports. Opening the unit will void WipAir product warranty.

RJ-45 ports must be facing down. If installed to the side, the bending of the CAT5 cable damages WipAir sealing and voids product warranty.

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### 2.3.6 Cables

The outdoor unit is connected to straight CAT5 Gauge 24-shielded outdoor rated cable. The cable should be UV resistant, flame retardant, **UL listed** and contain at least 4 twisted pairs.

The outdoor cables scheme is indicated in [Appendix A – Outdoor Cables Scheme](#).

The Indoor PoE Outlet side and Outdoor Unit side are crimped using RJ-45 tool.

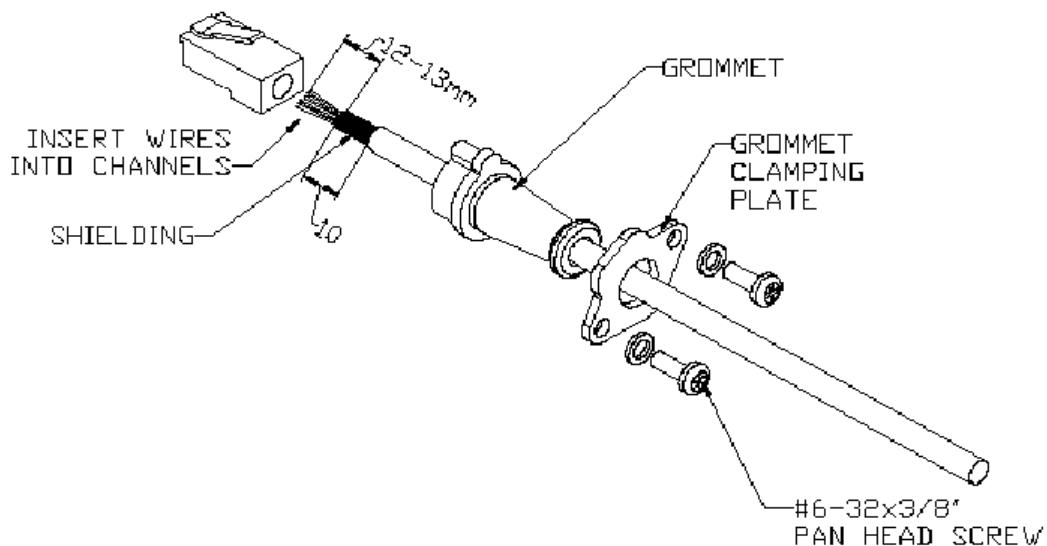
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Total length of the CAT5 cables must not exceed 100 meters

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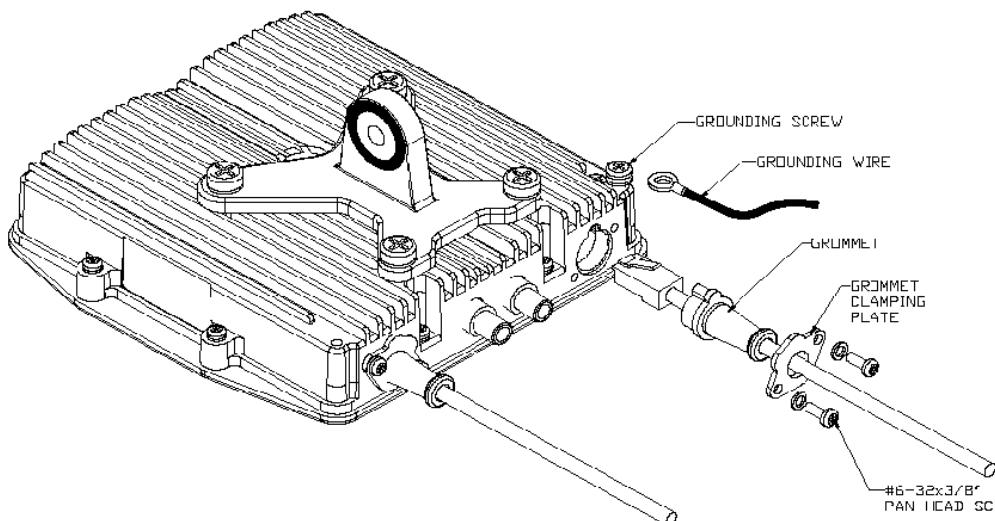
The Outdoor Unit side is assembled according to the following steps (Figure 2-5):

- Insert seal bracket (grommet clamping plate) on the cable.
- Insert rubber seal (grommet) on the cable.
- Crimp the RJ-45 Plug.



**Figure 2-5: Cable preparation for Outdoor Unit**

- Insert the RJ-45 to the Outdoor Unit (Figure 2-6).
- Insert *NC-6* screws with spring washer to the seal bracket.



**Figure 2-6: Cable assembly to Outdoor Unit**



**Figure 2-7: Cable insertion to Outdoor Unit.**

- Fasten the seal bracket (Figure 2-8).
- The unused port should be left sealed.



**Figure 2-8: Cable connection to Outdoor Unit**

### 2.3.7 Indoor outlet installation

The indoor PoE outlet is assembled as follows:

1. Crimp the RJ-45 Plugs on cable ends to form the Outdoor Unit cable.
2. Plug the Outdoor Unit cable to the RJ-45 Jack marked "*PWR LAN-OUT*".
3. Plug standard CAT5 cable from the PC to the RJ-45 Jack marked "*LAN-IN*".
4. Plug the AC Input to the power (100-240VAC).

**Note:** Do not attach standard CAT5 cable from the PC (or other network device) to the Indoor Unit RJ-45 jack marked "*PWR LAN-OUT*". It may damage the PC's Ethernet interface.



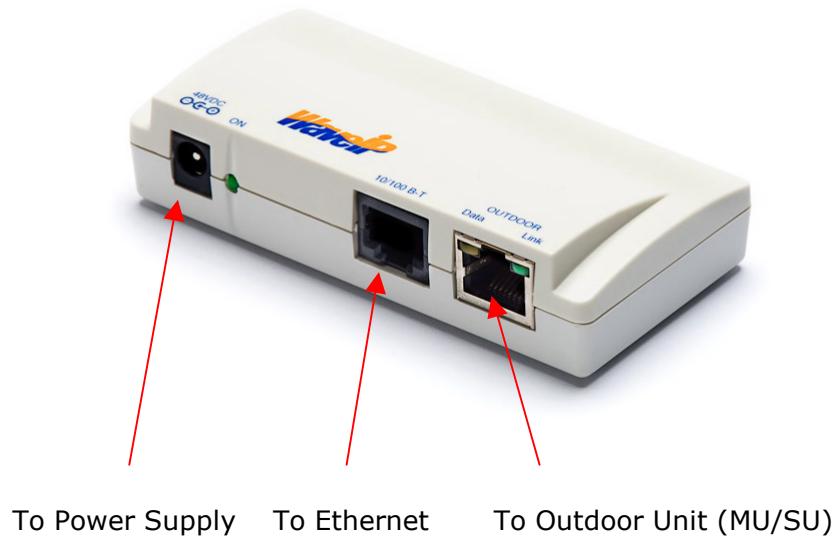
**Figure 2-9: WipAir 8000 PoE**

### WipAir 6000/3000 V1 PoE

WipAir 6000/3000 V1 PoE Outlet is assembled as follows:

1. Crimp the RJ-45 Plugs on cable ends to form the Outdoor Unit cable.
2. Plug the Outdoor Unit cable to the RJ-45 Jack marked "*OUTDOOR*".
3. Plug standard CAT5 cable from the PC to the RJ-45 Jack marked "*10/100 B-T*".
4. Plug the DC plug from the AC/DC power supply to the DC jack marked "*48VDC*".

**Note:** Do not attach standard CAT5 cable from the PC (or other network device) to the Indoor Unit RJ-45 jack marked "*OUTDOOR*". It may damage the PC's Ethernet interface.



**Figure 2-10: WipAir 6000/3000 V1 PoE**

WipAir 6000/3000 V1 PoE Outlet indicates the air and Ethernet link status via LEDs:

1. Air link (green LED) – indicates air connectivity of the SU to the MU.
2. Ethernet link (orange LED) – indicates Ethernet connectivity to the unit.

## 2.3.8 Grounding

### 2.3.8.1 Grounding the outdoor unit (MU /SU)

The outdoor unit shall be connected to a protective earth with not less than 10 AWG conductors having green-yellow insulation. The following figure shows the grounding cable from outdoor unit external screw to adjacent grounding rod. The cable should be long enough to reach from the mounting pole to the grounding rod with 3 to 6 feet extra to allow for strain relief.

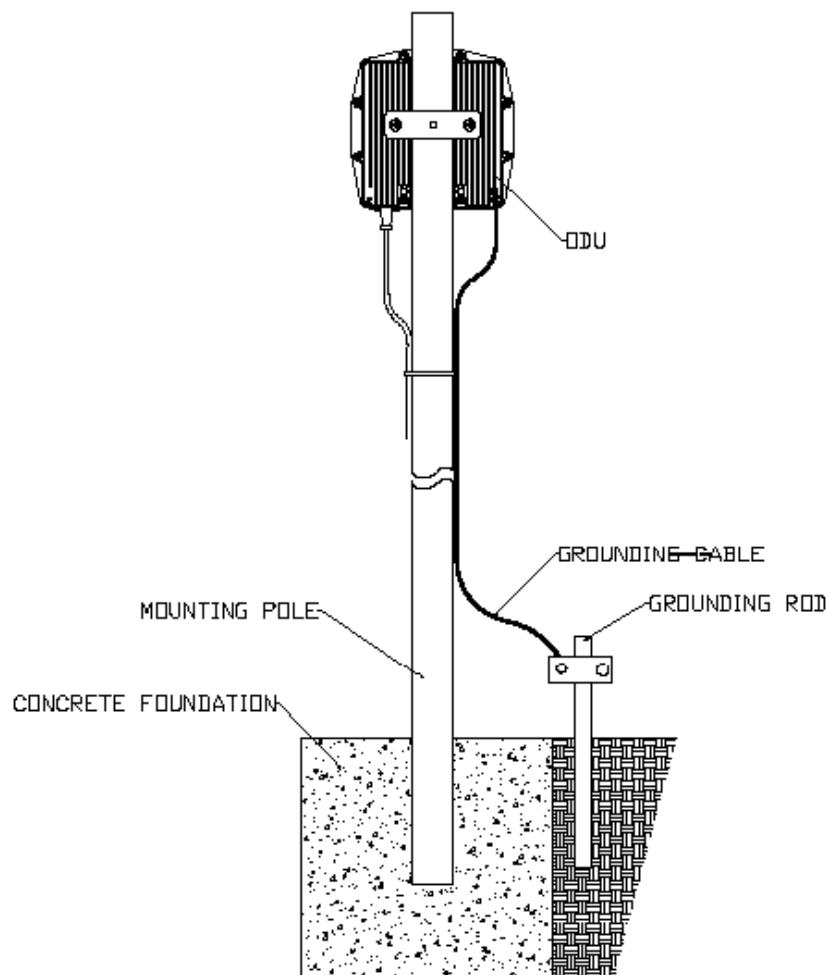


Figure 2-11: Ground Connection to Outdoor Unit

### Protection from lightning

US National Electric Department of Energy Handbook 1996 specifies that radio and television lead-in cables must have adequate surge protection at or near the point of entry to the building. The code specifies that any shielded cable from a detached antenna must have the shield directly connected to a 10 AWG wire that connects to the building ground electrode.

The ground wire shall be terminated with **UL listed** lug with a diameter of 0.2 inch (5.2 mm).

The ground lug will need to be suitable for terminating on aluminum materials, such as the use of an aluminum connector and aluminum ground conductor.

**FCC Notice**

This equipment has been tested and found to comply with the limits for 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 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 or more of the following measures:

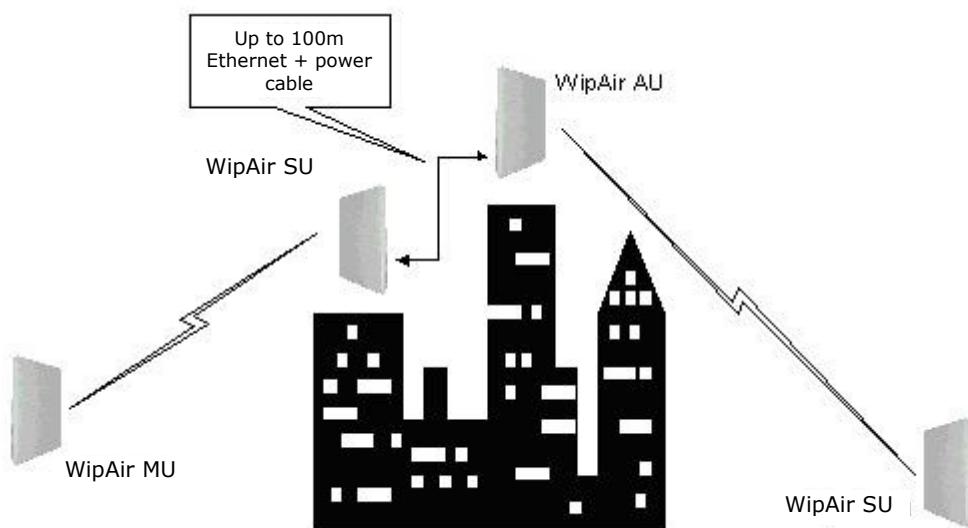
- Reorient or relocate-receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device must accept any interference received including interference that may cause undesired operation. Any unauthorized modification or changes to this device without the express approval of WaveIP may void the user's authority to operate this device. Furthermore, this device intended to be used only when installed in accordance with the instructions outlined in this manual. Failure to comply with these instructions may also void the user's authority to operate this device and/or the manufacturer's warranty

## 2.4 Consecutive AP connection

Consecutive connection is done by plugging CAT5 cable between SU and consecutive MU. This cable also provides power redundancy to the units.

Total length of all wires should not exceed 100 meters.



**Figure 2-12: Consecutive link principle**

## 2.5 Synchronization

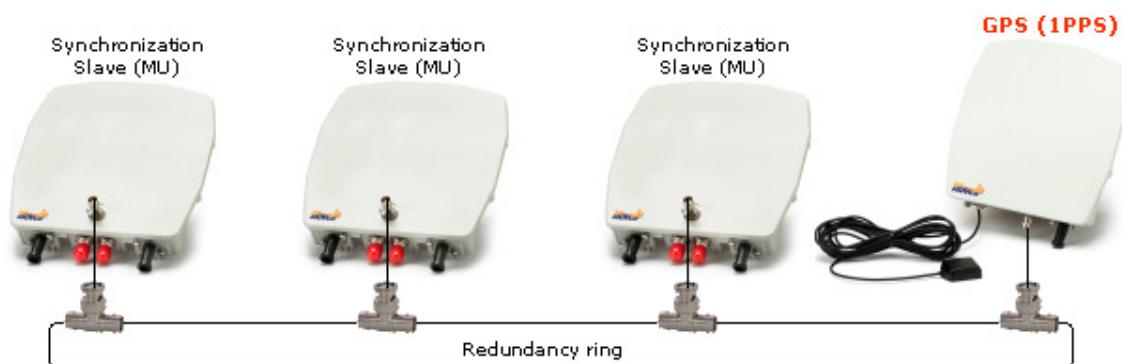
WipAir is designed to work with co-located radios. This means that two or more units can be mounted close to each other.

Time synchronization allows reusing frequencies between co-located links and configured with the Link Manager advanced window.

The synchronization signal is generated by an external GPS (1 PPS) when synchronizing multiple towers, or by a master MU when synchronizing units on the same tower.

### External synchronization:

Synchronize multiple towers with one GPS unit per tower.



**Figure 2-13: External time synchronization**

### Internal synchronization:

Synchronize multiple MUs on one tower without any external device.



**Figure 2-14: Internal time synchronization**

Please refer to WipAir\_x000\_configuration\_manual.pdf for more information.

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**Note:** The distance between any two antennas should be at least 50 cm.

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## 3. WipAir 8000 Technical Specifications

### 3.1 Radio

Radio Frequency	2.3-2.7 GHz, 4.4-4.7 GHz, 4.9 GHz, 5.x GHz, 6.0-7.0 GHz							
Net Throughput	Up to 270 Mbps (dynamic asymmetric, up to 250 Mbps one way)							
PPS	>100,000 Packets Per Second							
Range	More than 130 Km							
Channel Size	Configurable – 5 / 10 / 20 / 40 MHz							
Waveform	Advanced OFDM 2x2 dual polarization MIMO							
Output Power	Configurable up to 26 dBm, 40 dB dynamic range							
Handling Interference	AIS – Automatic Interference Sensibility Hitless ACM – Adaptive Coding & Modulation ACS – Automatic Channel Selection FEC – Forward Error Correction, k = 1/2, 2/3, 3/4, 5/6 Fast ARO – Automatic Retransmit reQuest							
Encryption & Security	256 & 128-bit AES & MAC level authentication							
Modulation	BPSK	QPSK		16QAM		64QAM		
FEC	1/2	1/2	3/4	1/2	3/4	2/3	3/4	5/6*
Data Rate @ 5 MHz (Mbps)	3.25	6.5	9.75	13	19.5	26	29.25	32.5
Data Rate @ 10 MHz (Mbps)	6.5	13	19.5	26	39	52	58.5	65
Data Rate @ 20 MHz (Mbps)	13	26	39	52	78	104	117	130
Data Rate @ 40 MHz (Mbps)	30	60	90	120	180	240	270	300
Sensitivity @ 20 MHz (dBm)	-87	-85	-83	-80	-78	-72	-70	-67

\* Not supported in all frequency bands

### 3.2 Networking and Management

Topology	Point-to-Point (PTP), Point-to-Multipoint (PTMP)							
Access Technology	Time Division Duplex (TDD) – Dynamic or Symmetric							
Data Latency	1ms typical							
Network modes	Layer 2 Bridge, VLAN, VLAN / broadcast / IP filters							
VLAN	Transparent, VLAN filter, tagging/stripping							
QoS	8 priority queues based on 802.1q & 802.1p							
Traffic shaping	SLA (Service Level Agreement) provisioning for uplink and downlink independently							
Management	WEB, EMS, SNMP, Telnet, Built in throughput test and RF Analyzer tools							

### 3.3 Physical and Environmental

Physical Interface	2x 10/100/1000 Base-T (ODU)							
Connector Type	RJ-45							
Mechanical	19 x 19 x 4 cm (external antenna port)							
Mounting	Wall or pole							
Power	100-240 VAC, 47-63 Hz to 48 VDC, Power over Ethernet (PoE)							
Power Consumption	<7Watt							
Operating Temperature	-30°C to 55°C							
Operating Humidity	100% non condensing (Rainproof)							

## 4. WipAir 6000 Technical Specifications

### 4.1 Radio

Radio Frequency	700MHz, 900 MHz, 2.0-2.3 GHz, 2.3-2.7 GHz, 3.3-3.8 GHz, 4.9 GHz, 5.x GHz							
Net Throughput	Up to 200 Mbps (100 Mbps Full Duplex)							
PPS	>100,000 Packets Per Second							
Range	More than 130 Km							
Channel Size	Configurable – 5 / 10 / 20 / 40 MHz							
Waveform	Advanced OFDM 2x2 dual polarization MIMO							
Output Power	Configurable up to 26 dBm, 40 dB dynamic range							
Handling Interference	AIS – Automatic Interference Sensibility Hitless ACM – Adaptive Coding & Modulation ACS – Automatic Channel Selection FEC – Forward Error Correction, k = 1/2, 2/3, 3/4, 5/6 Fast ARQ – Automatic Retransmit reQuest							
Encryption & Security	128-bit AES & MAC level authentication							
Modulation	BPSK	QPSK		16QAM		64QAM		
FEC	1/2	1/2	3/4	1/2	3/4	2/3	3/4	5/6
Data Rate @ 5 MHz (Mbps)	3.25	6.5	9.75	13	19.5	26	29.25	32.5
Data Rate @ 10 MHz (Mbps)	6.5	13	19.5	26	39	52	58.5	65
Data Rate @ 20 MHz (Mbps)	13	26	39	52	78	104	117	130
Data Rate @ 40 MHz (Mbps)	30	60	90	120	180	240	270	300
Sensitivity @ 20 MHz (dBm)	-87	-85	-83	-80	-78	-72	-70	-67

\* Not supported in all frequency bands

### 4.2 Networking and Management

Topology	Point-to-Point (PTP), Point-to-Multipoint (PTMP)
Access Technology	Time Division Duplex (TDD) – Dynamic or Symmetric
Data Latency	
Network modes	Layer 2 Bridge, VLAN, VLAN / broadcast / IP filters
VLAN	Transparent, VLAN filter, tagging/stripping
QoS	8 priority queues based on 802.1q & 802.1p
Traffic shaping	SLA (Service Level Agreement) provisioning for uplink and downlink independently
Management	WEB, EMS, SNMP, Telnet, Built in throughput test and RF Analyzer tools

### 4.3 Physical and Environmental

Physical Interface	2x 10/100 Base-T (ODU)
Connector Type	RJ-45
Mechanical	19 x 19 x 4 cm (external antenna port)
Mounting	Wall or pole
Power	100-240 VAC, 47-63 Hz to 48 VDC, Power over Ethernet (PoE)
Power Consumption	<6Watt
Operating Temperature	-30°C to 55°C
Operating Humidity	100% non condensing (Rainproof)

## 5. WipAir Series Technical Specifications

### 5.1 Radio

Radio Frequency	700MHz, 900 MHz, 2.0-2.3 GHz, 2.3-2.7 GHz, 3.3-3.8 GHz, 4.9 GHz, 5.x GHz							
Net Throughput	20, 40, 135 Mbps							
PPS	>100,000 Packets Per Second							
Range	More than 130 Km							
Channel Size	Configurable – 5 / 10 / 20 / 40 MHz							
Waveform	Advanced OFDM							
Output Power	Configurable up to 26 dBm, 40 dB dynamic range							
Handling Interference	AIS – Automatic Interference Sensibility Hitless ACM – Adaptive Coding & Modulation ACS – Automatic Channel Selection FEC – Forward Error Correction, k = 1/2, 2/3, 3/4, 5/6 Fast ARQ – Automatic Retransmit reQuest							
Encryption & Security	128-bit AES & MAC level authentication							
Modulation	BPSK	QPSK		16QAM		64QAM		
FEC	1/2	1/2	3/4	1/2	3/4	2/3	3/4	5/6
Data Rate @ 5 MHz (Mbps)	1.625	3.25	4.875	6.5	9.75	13	14.625	16.25
Data Rate @ 10 MHz (Mbps)	3.25	6.5	9.75	13	19.5	26	29.25	32.5
Data Rate @ 20 MHz (Mbps)	6.5	13	19.5	26	39	52	58.5	65
Data Rate @ 40 MHz (Mbps)	15	30	45	60	90	120	135	150
Sensitivity @ 20 MHz (dBm)	-87	-85	-83	-80	-78	-72	-70	-67

### 5.2 Networking and Management

Topology	Point-to-Point (PTP), Point-to-Multipoint (PTMP)							
Access Technology	Time Division Duplex (TDD) – Dynamic or Symmetric							
Data Latency	1ms typical							
Network modes	Layer 2 Bridge, VLAN, VLAN / broadcast / IP filters							
VLAN	Transparent, VLAN filter, tagging/stripping							
QoS	8 priority queues based on 802.1q & 802.1p							
Traffic shaping	SLA (Service Level Agreement) provisioning for uplink and downlink independently							
Management	WEB, EMS, SNMP, Telnet, Built in throughput test and RF Analyzer tools							

### 5.3 Physical and Environmental

Physical Interface	2x 10/100 Base-T (ODU)							
Connector Type	RJ-45							
Mechanical	19 x 19 x 4 cm (external antenna port)							
Mounting	Wall or pole							
Power	100-240 VAC, 47-63 Hz to 48 VDC, Power over Ethernet (PoE)							
Power Consumption	<6Watt							
Operating Temperature	-30°C to 55°C							
Operating Humidity	100% non condensing (Rainproof)							

## 6. Appendix A – outdoor cables scheme

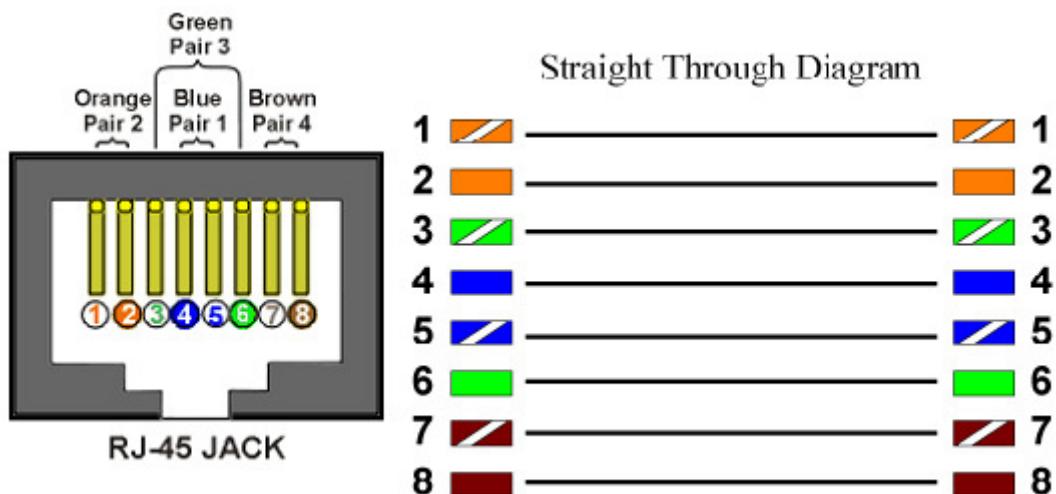


Figure 6-1: Outdoor Cables Scheme

**Note:** In order to comply with 100 meter CAT5 cable

- Pins 1,2 must be a twisted pair wire.
- Pins 3,6 must be a twisted pair wire.
- Pins 4,5 must be a twisted pair wire.
- Pins 7,8 must be a twisted pair wire.

## 7. Appendix B – RF channel lists

### 7.1 FCC operating Band: 5725 MHz - 5850 MHz

Channel No.	5 MHz Channel Frequency [MHz]	10 MHz Channel Frequency [MHz]	20 MHz Channel Frequency [MHz]	40 MHz Channel Frequency [MHz]
1	5730			
2	5735	5735	5735	
3	5740	5740	5740	
4	5745	5745	5745	5745
5	5750	5750	5750	5750
6	5755	5755	5755	5755
7	5760	5760	5760	5760
8	5765	5765	5765	5765
9	5770	5770	5770	5770
10	5775	5775	5775	5775
11	5780	5780	5780	5780
12	5785	5785	5785	5785
13	5790	5790	5790	5790
14	5795	5795	5795	5795
15	5800	5800	5800	5800
16	5805	5805	5805	5805
17	5810	5810	5810	5810
18	5815	5815	5815	5815
19	5820	5820	5820	5820
20	5825	5825	5825	5825
21	5830	5830	5830	5830
22	5835	5835	5835	
23	5840	5840	5840	
24	5845			

Figure 7-1: FCC 5 GHz RF channel List

### 7.2 FCC operating Band: 4940 MHz - 4990 MHz

- 5MHz channel – 4942.5 – 4987.5 MHz.
- 10MHz channel – 4945 – 4985 MHz.
- 20MHz channel – 4950 – 4980 MHz.

### 7.3 Operating Bands in Mexico

- 5150 MHz – 5350 MHz
- 5725 MHz – 5850 MHz
- 4.95 GHz - 4.99 GHz (Public Safety bands)

## 8. Appendix C – FCC approved antennas

Antenna Type	Model	Gain [dBi]	Beam Width	Dimension [mm]
Flat panel	SPDB-5159-23V12D	23	10° x 10°	305x305x15
	MT-485025/NVH	23	10° x 10°	371x371x40
	MT-485025/CVH	23	10° x 10°	371x371x40
Dish	DP-5X-285D-005	28.5	5° x 5°	2ft

**Figure 8-1: WipAir 5 GHz integrated/external antennas**

Antenna Type	Model	Gain 4.9 GHz [dBi]	Beam Width	Dimension [mm]
Flat panel	DP-5X-230D-010	22	10° x 10°	305x305x15
Dish	DP-5X-285D-005	27	5° x 5°	2ft

**Figure 8-2: WipAir 4.9 GHz integrated/external antennas**