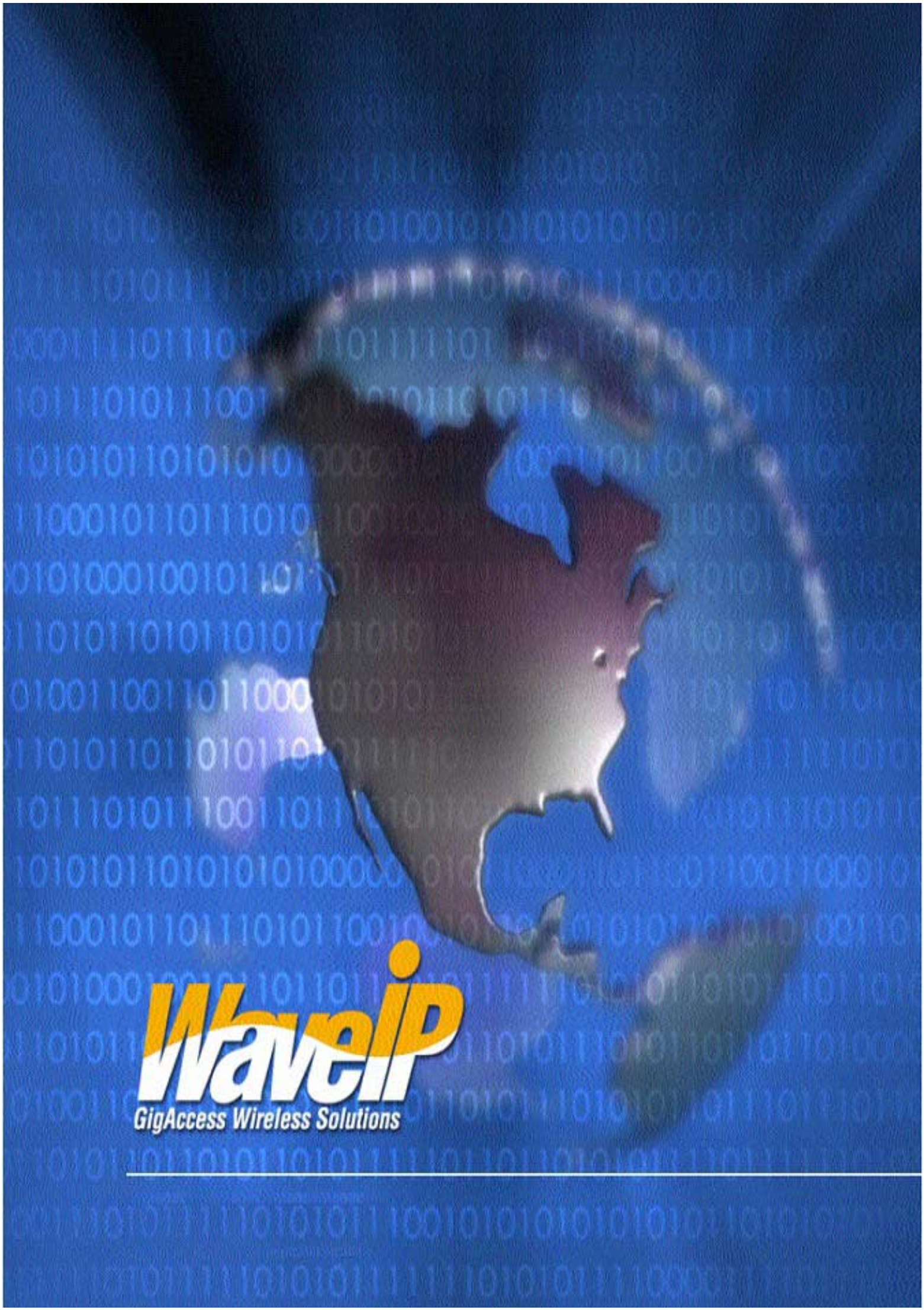
WaveIP
GigAccess Wireless Solutions

GigAccess™ OFDM 700

Installation and Operation Instructions

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WaveIP Ltd.
P.O. Box 336
Yokneam 20692, Israel
Tel: 972-4-9937333
Fax: 972-4-9592614
Info@waveip.com

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1. Introduction

1.1 General

The information contained in this manual provides GigAccess™ OFDM 700 system overview and instructions for Planning, Installation, Configuration, and Operation of both the Access Units, the Subscriber Units including antennas and accessories.

1.2 GigAccess™ OFDM System Overview

GigAccess™ OFDM is a wireless point-to-point and point-to-multipoint broadband communication system. The basic subsystem is composed of a single sector, which consists of an Access Unit (AU) and up to 250 Subscriber Units (SU). Each sector is a stand-alone communication network operating on a star topology with a gateway to the WAN, which allows two-way communication between the SUs and the WAN via the AU. A Sector may be extended by sub sectors, which are consecutive to the SUs within the sector.

GigAccess™ include a Base Controller (BC). The BC is a PC running GigAccess™ Network Management System (NMS) application that monitors and controls the AUs and their corresponding SUs. The NMS provides SNMP integration, thus connecting with already existing NMS that service providers might have. Its main purpose is to configure the AUs and SUs with SLA (Service Level Agreement). Once the AU is configured, the configuration is stored in the AU and the sector can run autonomously without the need of a BC (stand alone configuration).

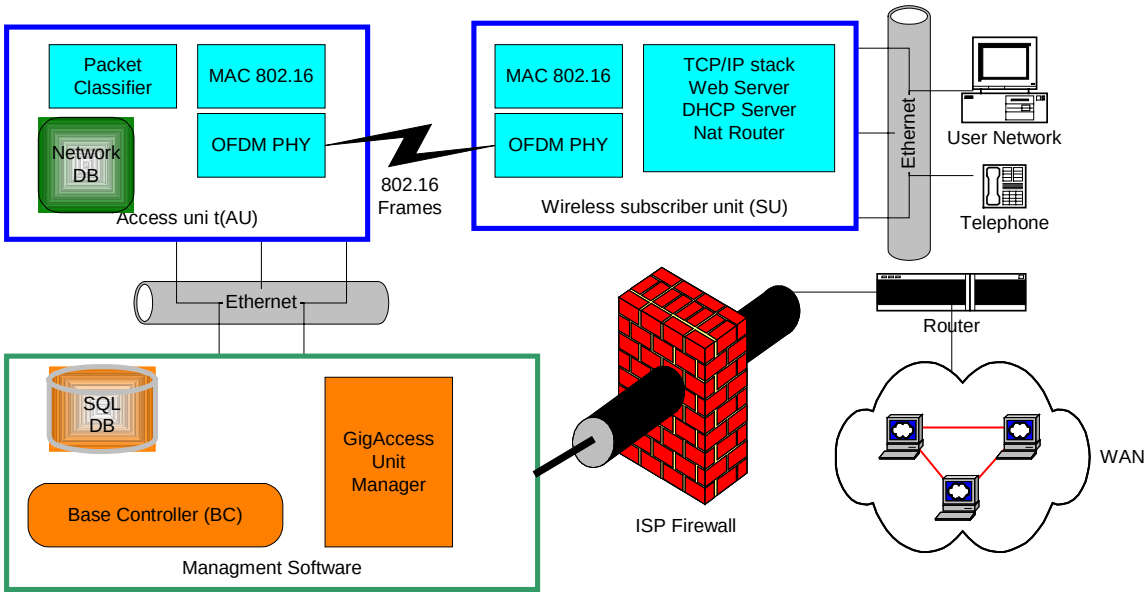

Figure 1-1: GigAccess™ OFDM functional blocks

The following figure depicts a general description of a typical sector in the GigAccess™ OFDM system.

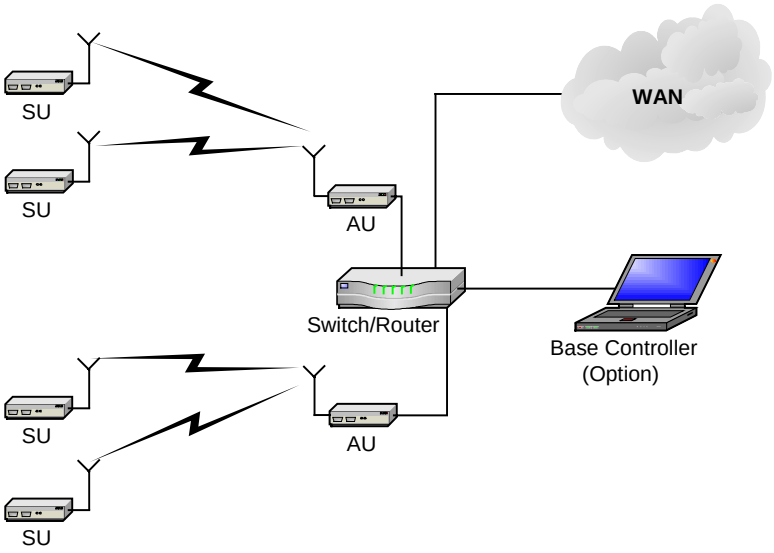

Figure 1-2: Typical sector in GigAccess™ OFDM System

The sector uses a single radio channel frequency with a 5 MHz bandwidth, which carries up to 9 Mbps data throughput. The system is a frame-based system, meaning the time dimension is divided into small periods called frames. Each frame is divided into two parts: downstream part (traffic passing from the AU to the SUs) and upstream part (traffic passing from the SUs to the AU). The Time Domain Duplex (TDD) technique is utilized to divide the bandwidth periodically based on the frame size. The portion of the frame, which is allocated to the upstream traffic, is divided between the SUs in the time domain using TDMA (Time Division Multiplex Access) technique.

All the divisions are done dynamically thus allowing the SUs to share the channel capacity in a very efficient way.

Figure 1-3: GigAccess™ OFDM 700 Outdoor Unit

GigAccess™ OFDM MAC layer is based on IEEE 802.16 MAC standard with additional proprietary attributes, which allow for special features such as Consecutive AP™.

GigAccess™ OFDM network layer enables routing and QoS queuing of traffic based on classification of packets using information in layers 2, 3 & 4-7. In certain instances, QoS queuing can be done using packet information (priority defined by the management).

GigAccess™ OFDM leverages Orthogonal Frequency Division Multiplexing (OFDM) technology to deliver high data rates, high spectral efficiency in addition to immunity to interference and line of site boundaries via patent pending Consecutive AP™ technology, delivering data burst rates of up to 9 Mbps. GigAccess™ OFDM ensures always-on connectivity to full range of IP-based services, including fast Internet, High Quality VoIP and Video.

GigAccess™ provides an instant and independent infrastructure, which is immediately deployable (self installed) with low infrastructure construction and operating costs.

In case of Non-Line-Of-Sight (NLOS) between the AU and the SU due to obstacles such as tall buildings or mountains, a consecutive sector may be used. In this scenario, the SU Ethernet output feeds a consecutive AU, which is used as a router and transmits the input data over the obstacle as shown in figure below.

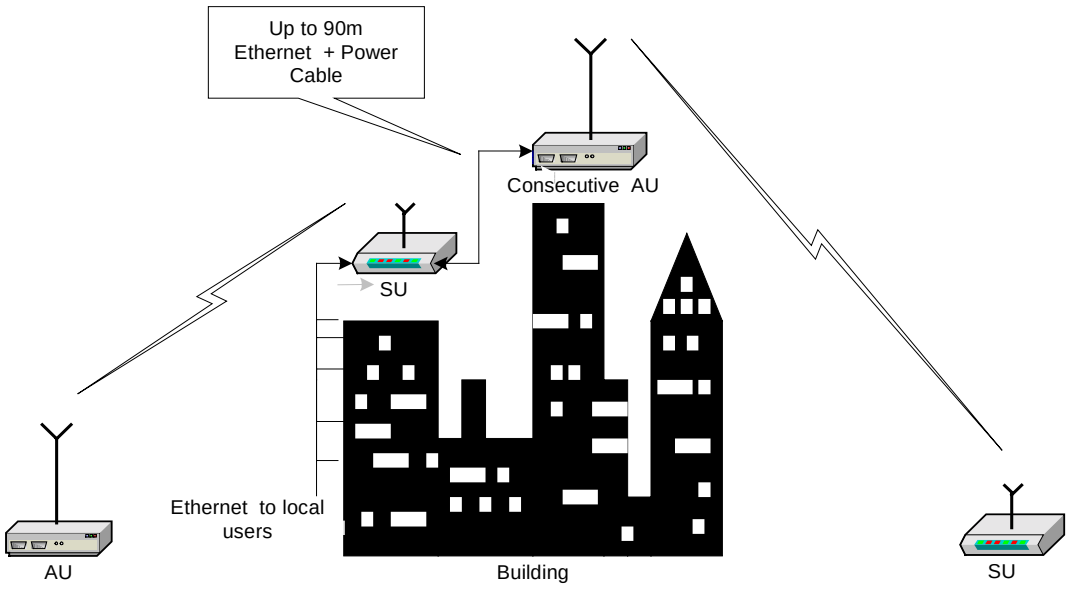

Figure 1-4: Consecutive Sector principle

2. Installation

2.1 Packing List

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

1. AU or SU Outdoor Unit
2. Indoor Outlet.
3. Indoor Power Supply (AC input).
4. Pole mounting kit.
5. Sealing grommet, cap and clamping plates.

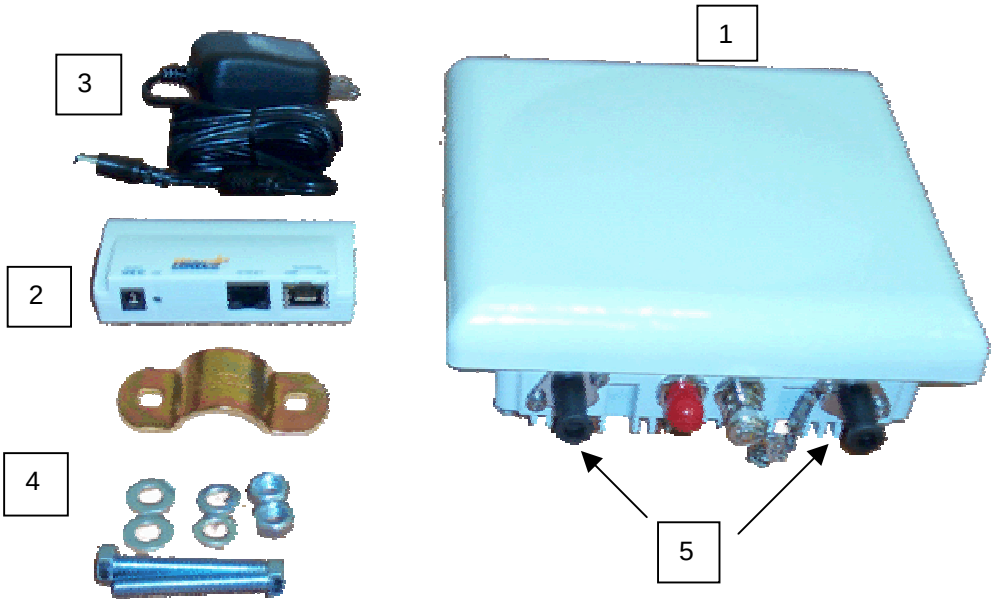

Figure 2-1: General System View

2.2 Additional Part List – Required for Installation

- Outdoor Unit grounding cable
- Outdoor-to-Indoor CAT5 shielded cable (Up to 90 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 GigAccess™ OFDM 700 system.

This device can be expected to comply with Part 15 of the FCC Rules provided it is assembled in accordance with the instructions provided in this document.

***Note*:** ONLY professional installers who are familiar with local building and safety codes, wherever applicable, and are licensed by the appropriate government regulatory authorities should install outdoor units and antennas. Failure to do so may void the GigAccess™ OFDM 700 product warranty and may expose the end user or the service provider to legal and financial liabilities. WaveIP and its resellers or distributors are not liable for injury, damage or violation of regulations associated with the installation of outdoor units or antennas.

A typical installation scheme is depicted in Figure 2-2.

The installation process should follow the following steps:

1) Select the appropriate location for the Outdoor unit and the indoor Outlet.
2) Mount the Outdoor unit. If you are using detached antenna mount the antenna and connect it to the Outdoor unit.

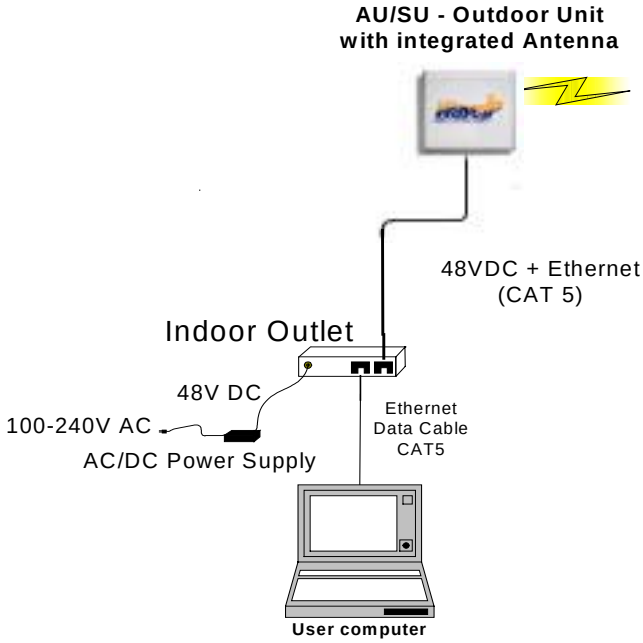

Figure 2-2: GigAccess™ OFDM 700 - General Installation Scheme

WARNING: It is the responsibility of the installer to insure 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.

3) Connect a ground cable between the Outdoor unit and an appropriate grounding point.
4) Connect the Outdoor-to-Indoor CAT5 shielded cable to the Outdoor unit and route it to the location selected for the Indoor Outlet. Assemble the enclosed connector on the cable.
5) Mount the Indoor Outlet.
6) Connect the Outdoor-to-Indoor cable to the Indoor Outlet Radio port. (This port supplies 48 VDC in addition to the Ethernet data).
7) Connect the CAT5 Ethernet cable from the user's network/PC to the Indoor Outlet data port.
8) Connect the power supply to the Indoor Outlet power port.
9) Align the antenna and verify connectivity of the Outdoor as follows:
    - For SU - check connectivity to the base controller.
    - For AU - check connectivity to the SU management IP address.

   Connectivity check can be done by ping instruction.

2.4 AU/SU Outdoor Installation

2.4.1 Site Selection

2.4.1.1 Guidelines for Selecting Outdoor Location

Select the appropriate locations for the outdoor unit using the following guidelines:

- The outdoor unit can be pole or wall mounted. Its location should allow easy access to the unit for installation and testing.
- The AU should be installed where it provides coverage of all SUs in the area it is intended to serve. The higher the AU or its detached antenna, the better coverage it can provide.
- When using a detached antenna, the AU should be installed as near as possible to its antenna.

2.4.1.2 Access Unit (AU)

Location of the Access Unit is on the Service Provider sole discretion considering local topology and the desired cover. One (in case of Omni antenna) or several AUs (in case of directional antenna) forms the BS (Base-Station) – the central of a cell. The placement of AUs should be such that cells overlap slightly, to guarantee seamless wireless connectivity everywhere. Neighboring AUs should preferably send and receive on different channels or different polarization for maximum throughput (minimum interference).

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.

2.4.1.3 Subscriber Unit (SU)

Location of the Subscriber Unit must take into consideration the following guidelines:

- Clear line of site to the AU.
- Height above the ground.
- Distance between 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 AU and SU can cause signal attenuation. Common obstructions are buildings and trees. Any buildings or other physical structure such as trees, mountains or other natural geographic features higher than the antenna and situated in the path between the two sites can constitute obstructions. 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 distances between sites are shorter.
- **Clearance** – Path loss is minimized when there exists a clear line of sight. The number, location, size, and makeup 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.

2.4.2 Mounting and Wiring

Outdoor Unit mounting and installation will be performed only by personal licensed to install rooftop antenna equipment where such license required by the regulation authorities. On any installation case, only professional antenna installers will perform Outdoor Unit mounting and installation**.**

Outdoor Unit can be mount on a pole or on a wall.

A general description of wall mount is given in Figure 2-3.

Figure 2-3: Wall mount description

WARNING! All outdoor units must be installed with a separation distance of at least **2 meters** from all persons during normal operation.

2.4.3 Antennas

2.4.3.1 General

Two types of antennas are available for the GigAccess™ system:

- Integrated antenna
- Detached antenna

The necessary antenna gain depends on the required range and performance.

IMPORTANT! Antennas must be selected from a list of WaveIP approved antennas. Please refer to Appendix A – WaveIP Approved Antennas.

2.4.3.2 Tx power

The outdoor unit transmit power configuration is done by the Unit Manager Tool. The tool consists of dedicated software running on a PC. This PC communicates with the outdoors unit via the Ethernet and is used to burn the configuration parameters (including the transmit power) into the outdoor unit. The tool limits the max transmit power according to the selected antenna, the selected regulation (FCC) and the selected link type (point-to-multi-point/point-to-point). The installer, if needed, can select a lower power.

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

- Antenna type (detached or integrated)
- Antenna gain
- Tx Power
- Link Type (point-to-multi-point or point-to-point)

The above configuration is done with the advanced window of the Unit Manager Tool – (paragraph **10.5.1**).

For open outdoor areas with clear line of sight between the SU and the AU the suggested maximum distance is given in Appendix C – RF Power and Distance versus Antenna Gain. For detailed calculations please refer to Appendix B – RF Link Budget Calculation.

2.4.3.3 Co-located antennas

GigAccess™ OFDM was designed to work with co-located antennas. That means that two or more units can be mounted close to each other. The minimum distance between the two antennas should be 50 cm. The two antennas should be of the same type (Directional Flat Panel Antenna or Base Station Antenna). The main idea is to utilize polarizations: one antenna in vertical polarization and the other in horizontal polarization.

Omni antennas are not relevant for co-location.

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

2.4.3.4 SU Antenna Alignment

Antenna alignment can be done with GigAccess™ Unit Manager software tool. The tool runs on PC with Windows operating system. In general, low gain antenna (such as omni antennas) do not required alignment due to their very wide radiation pattern. High gain antennas have a narrow beam width and therefore require alignment procedure in order to optimize the link.

Instruction hereunder can be done after completion the connection of the AU and SU outdoor units to their indoor Outlet.

Please perform the following steps in order to align the antenna:

1. Attach data cable from the PC to the SU Indoor Outlet data port. It is possible to attach special provided cable marked **"data only"** to a vacant Outdoor Unit port.

WARNING! Do not attach standard CAT 5 cable from the Outdoor Unit directly to the PC. Connecting the PC directly to the Outdoor Unit may cause damaged to the PC Ethernet NIC.

2. Start "GigAccess™ Unit Manager" application.
3. Press on the "Start Session" button ("S" symbol).
4. Select the SU from the popup address window.
5. Select "Installation" at the left menu tree.
6. Rotate the antenna until you get maximum RSSI with minimal PER shown on the right bars see the installation window in the Unit Manager Tool (Figure 10-5).

WARNING! Do not stand in front of transmitting antenna. Rotate the antenna from the rear side.

7. Secure the antenna by fastening the mounting screws.

2.4.3.5 Antenna Polarization

The SU antenna polarization must be the same as in the AU antenna. In most applications, the preferred orientation is vertical polarization. Above ground propagation of the signal is better when it is polarized vertically. To verify antenna polarization, refer to the assembly instructions supplied with the antenna set. (The polarization of integrated antenna is marked on the backside).

2.4.4 Sealing

The outdoor unit must be sealed against rain with the rubber grommets.

WARNING! All Units are factory sealed, seal needed only on Ethernet ports. Opening the unit will void the GigAccess™ OFDM 700 product warranty.

2.4.5 Cables

Straight CAT5 Gauge 24-shielded outdoor rated cable must be installed between Outdoor Unit and Indoor Outlet. It should be UV resistant and flame retardant. The cable should be **UL listed** and contain at least 4 twisted pairs.

The outdoor cables scheme is given in Appendix E – Outdoor Cable Scheme.

The Indoor Outlet side and Outdoor Unit side will crimped with RJ-45 tool.

CAT5 cable must not exceed 300 feet (91 meters).

Use a suitable primary protector in accordance with article 800 in the NEC, if the exposed part of the CAT5 cable exceeds 140 feet (42 meters). Requirements of NEC articles 725 and 800 for the appropriate wiring methods during cable installation, shall be satisfied.

The Outdoor Unit side will be assembled by the following list (Figure 2-4):

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

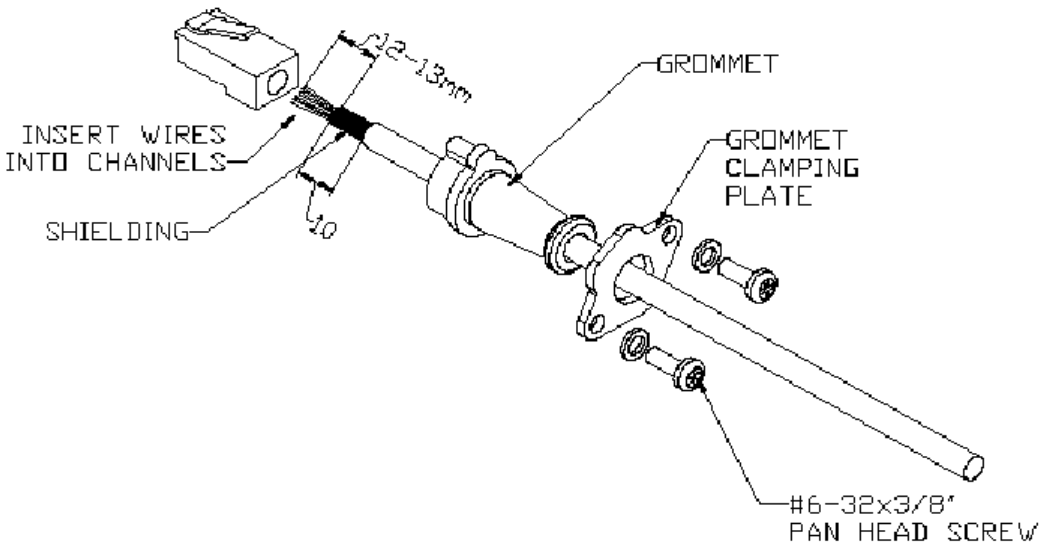

Figure 2-4: Cable preparation for Outdoor Unit

- Insert the RJ-45 to the Outdoor Unit (Figure 2-5).
- Insert *NC-6* screws with spring washer to the seal bracket.

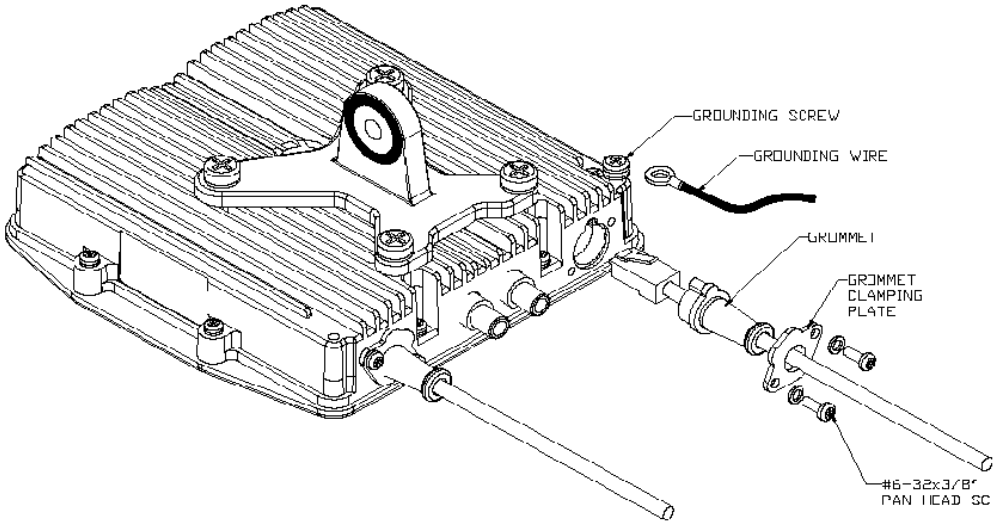

Figure 2-5: Cable assembly to Outdoor Unit

Figure 2-6: Cable insertion to Outdoor Unit.

- Fasten the seal bracket (Figure 2-7).
- The unused port should be left sealed.

Figure 2-7: Cable connection to Outdoor Unit

2.4.6 Indoor Outlet Installation

Indoor Outlet is wall mounted.

The Indoor Outlet side cables 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 *"AU/SU"*.
3. Plug standard CAT5 cable from the PC to the RJ-45 Jack marked *"10/100 BT"*.
4. Plug the DC plug from the AC/DC power supply to the DC jack marked *"48VDC"*.

Warning: Do not attach standard CAT5 cable from the PC to the Indoor Unit RJ-45 jack marked *"AU-SU"*. Connecting the PC directly to the Outdoor Unit may cause damaged to the Ethernet NIC in the PC.

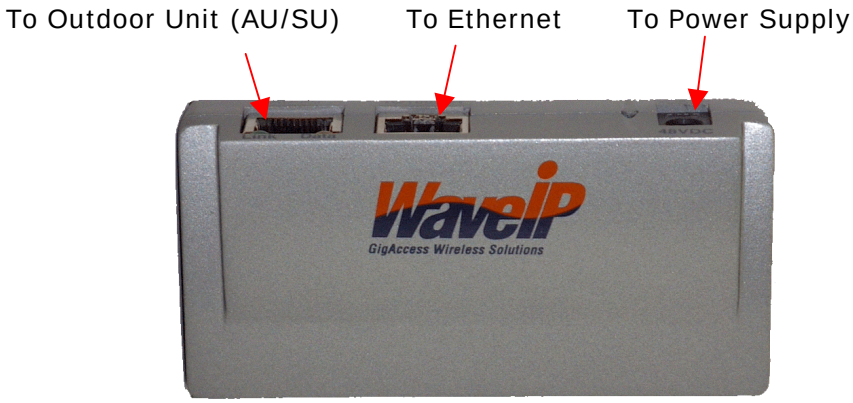

Figure 2-8: Indoor Outlet

2.4.7 Indoor HUB

Figure 2-9: The HUB

The HUB has 2 groups of 16 RJ-45 ports; each group has 8 ports for AUs connection and 8 ports for Ethernet connection. One of the groups is for the stable work and the other group is used for redundancy. The 2 groups can also use to connect 16 AUs to the HUB.

2.4.8 Grounding

2.4.8.1 Grounding the Outdoor Unit (AU /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.

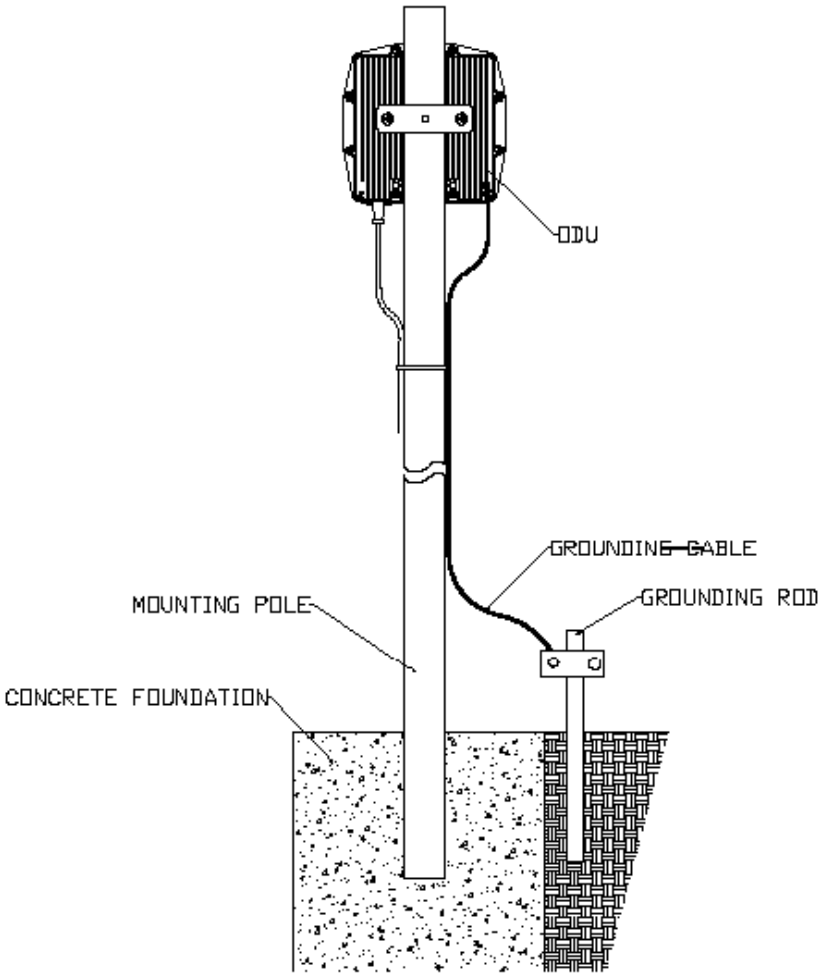

Figure 2-10: Ground Connection to Outdoor Unit

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 the 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

2.5 Consecutive Connection

The SU Indoor Outlet provides power and data connection to the SU Outdoor unit. Connection done by plugging **data crossover** CAT5 cable between SU and consecutive AU. Total length of all wires should not exceed 300 feet each (91 meters).

To achieve DC power redundancy an additional indoor Outlet + power supply can be connected to the AU's second RJ-45 port.

2.6 Synchronization

GigAccess™ OFDM was designed to work with co-located antennas. That means that two or more units can be mounted close to each other.

When such scheme is used it is mandatory to use synchronization. Configuration is done with the advanced window of the Unit Manager Tool (See paragraph **10.5.1**). Only one AU Master is needed or input from external GPS (1 PPS). When GPS is used, all AU's must be configured to synchronization Enable and Slave mode.

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

2.7 Subscriber PC Setup

In Case of specific IP setup - Configure the PC NIC to the same specific IP address as configured in the Base Controller. For this configuration follow the following steps:

- Press right click on the Network Neighborhood Icon.
- Select the Protocol reed and press properties.
- Choose the Specify an IP address and fill in the required specific IP address.

In Case of DHCP/NAT setup - Configure the PC NIC obtain an IP address from DHCP server. For this configuration follow the following steps:

- Press right click on the Network Neighborhood Icon.
- Select the Protocol reed and press properties.
- Choose Obtain an IP address from DHCP server.

3. GigAccess™ OFDM 700 Technical Specifications

3.1 General Specification

Access technology	TDMA (Time division multiple access)
Duplex schemes	TDD (Time division duplex)
Wireless MAC Interface	Proprietary based on IEEE 802.16
Applications	Access, Campus, Consecutive

3.2 Base Station - Access Unit (outdoor)

Sectors (degrees)	Sectors from 30^0 to 360^0
SUs per sector (AU)	Up to 250
Physical Interface	2 x 10/100 Base-T (ODU)
Connector Type	RJ-45
Protocol Supported	IP, ICMP, TCP, UDP, RTP, ARP, FTP, TFTP, DNS, HTTP, SNMP, MIB II, NAT, DHCP, PPPoE, RADIUS AAA, VLAN 802.1q.
Packet classification	Wire-speed based to information in layers 2, 3 and 4-7: MAC, IP, Protocol, Ports, TOS and VLAN, payload
Output Power (at antenna port)	up to +26 dBm
Antenna:	
• Integrated	Refer to Table 4-1
Software Update	Remote Download via TFTP
Operating Temperature	-20°C - +55°C
Operating Humidity	5% - 95% non condensing (Rainproof)
Power (via indoor Outlet)	48 VDC, <10 Watt
Mechanical	7” x 7” x 2” (detached antenna)
Indoor outlet:	
• Interface: to AU	RJ-45 + Led indication
• Interface to WAN	RJ-45
• Mechanical	4” x 2” x 1”
• AC Input Voltage	100 – 240 VAC, 47 – 63 Hz
Outdoor to Indoor Outlet	CAT5 shielded cable (Up to 90 meters)

3.3 Outdoor Subscriber Unit (HSU/OSU)

Physical Interface	2 x 10/100 Base-T (ODU)
Connector Type	RJ-45
Protocol Supported	IP, ICMP, TCP, UDP, RTP, ARP, FTP, TFTP, DNS, HTTP, SNMP, MIB II, NAT, DHCP, PPPoE, RADIUS AAA, VLAN 802.1q.
Packet classification	Wire-speed based to information in layers 2, 3 and 4-7: MAC, IP, Protocol, Ports, TOS and VLAN, payload
Output Power: (at antenna port)	up to +26 dBm
Antenna:	
• Integrated	Refer to Table 4-1
Software Update	Over the Air Download via TFTP
Operating Temperature	-20°C - +55°C
Operating Humidity	5% - 95% non condensing (Rainproof)
Power (via indoor Outlet)	48 VDC, <10 Watt
Mechanical	7.5” x 7.5” x 2” (with 11 dBi integrated antenna).
Indoor outlet:	
• Interface: to AU	RJ-45 + Led indication
• Interface to WAN	RJ-45
• Mechanical	4” x 2” x 1”
• AC Input Voltage	100 – 240 VAC, 47 – 63 Hz
Outdoor to Indoor Outlet	CAT5 shielded cable (Up to 90 meters).

3.4 Radio Specifications

Operating Frequency	700L: 710 - 716 MHz 700H: 740 - 746 MHz
RF Waveform	Orthogonal Frequency Division Multiplexing (OFDM).
Modulation	BPSK, QPSK, 16QAM
Antenna Polarization	Vertical or Horizontal
Data Rates	up to 9 Mbps

3.5 Management NMS

Management Architecture	Distributed management located at multiple base controllers with automatic load balancing and fault tolerance. - Self Discovery - Alarms and status Indications - Remote SW downloads to outdoors units.
Physical Interface	10/100 Base-T
Connector Type	RJ-45
Compliant with	Ethernet/IEEE 802.3
Protocol Supported	GigAccess™ Internal Protocol (GIP), SNMP
QoS Services (SLAs)	Constant Bit Rate (CBR), Best Effort (BE), Committed Information Rate (CIR), Activity Detect (CBR AD), Voice, Multicast.
QoS Support Criteria	Latency, jitter and bandwidth for each direction (uplink and downlink) independently

4. Appendix A – WaveIP Approved Antennas

Antenna Type	Model	Gain [dBi]	Beam Width	Dimension [mm]	Ideal for
Flat Panel	MA-WA74LXWI	8.5	60°x60°	305x305x25	Medium Range, Multipoint links.
	MT223003/N	11	45°x55°	450x450x30	Long Range, Multipoint links.

Table 4-1: Integrated (or external) Antennas for GigAccess™ OFDM 700

5. Appendix B – RF Link Budget Calculation

Proper RF link planning ensures that the AU/SU receives sufficient signal power to maintain the desired Bit Error Rate (BER). The following section gives a brief description of the basic RF terms and describes the calculation of the maximum safe distance versus the antenna gain.

A typical radio system is given hereunder:

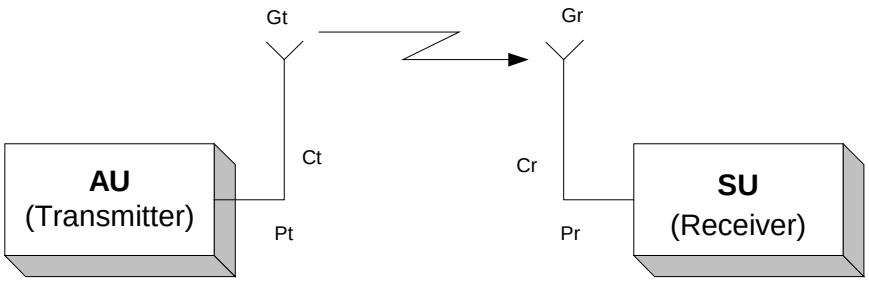

Figure 5-1: Radio Link – General description

The following variables are used to calculate the link budget:

P_t - Transmitted Power in dBm.

C_t – Transmitter Cable Attenuation in dB.

G_t - Transmitting antenna Gain in dBi.

EIRP – Effective Isotropic Radiated Power in dBm. This is the power radiating from the antenna, taking into account the output power from the transmitter, connector losses, cable losses and antenna gain.

PL - Path Loss in dB. This is the signal loss as it travels through the air.

G_r - Receiving antenna Gain in dBi.

C_r – Receiver cable attenuation in dB.

P_r – Receiving Power Level at Receiver in dBm.

S_r – Receiver Sensitivity in dBm (The minimum RF signal power level required at the input of the receiver for certain performance: E^-5 BER).

F.M. – Fade margin in dB. The fade margin is the amount by which the system gain plus total gain exceeds the path loss or in other words this is the number of dB that the received signal strength exceeds the minimum receiver sensitivity. Any wireless system requires some level of fade margin to compensate for RF path fading due to weather conditions or multi-path interference. (The transmitted signal arrives at the receiver from different directions, with different path length, attenuation and delays. The summed signal at the receiver may result an attenuated signal). GigAccess™ recommended fade margin at 700 MHz is minimum of 6-10 dB.

Example of Link Parameters:

P_t = 26 dBm

$C_t = C_r$ = 0 dB

$G_t = G_r$ = 8.5 dBi

S_r (4.5 Mbps) = -80 dBm

F.M. = 7 dB

(1) $EIRP = P_t - C_t + G_t$

(2) $P_r = S_r = EIRP - PL - F.M. + G_r - C_r$

(3) $PL = EIRP + G_r - C_r - S_r - F.M.$

(4) $PL = 32.4 + 20 \times \log(F_{MHz}) + 20 \times \log(R_{Km})$

(5) $PL_{700\ MHz} = 90 + 20 \times \log(R_{Km})$

(6) $R_{Km} = 10^{\frac{PL-90}{20}}$

	8.5 dBi Antenna
	Rate=4.5 Mbps
P_t	26
C_t	0
G_t	8.5
EIRP	34.5
G_r	8.5
C_r	0
S_r	-80
F.M.	7
PL	116
R_{Km}	**20**

6. Appendix C – RF Power and Distance versus Antenna Gain

Antenna Type	Antenna Gain [dBi]	Max RF Power [dBm]	EIRP [dBm]	Distance at 4.5 Mbps [Km]
Integrated or Detached	8.5	26	34.5	20 (7 dB F.M.)
Integrated or Detached	11	26	37	26.6 (7 dB F.M.)

Table 6-1: RF power and distance versus antenna gain

*** All calculations are for 8.5-dBi antenna at the SU.

7. Appendix D – RF Hazard Distance Calculation

The Power density is given by:

(1) $S = \frac{P \times G}{4 \times \pi \times R^2}$

Therefore:

(2) $R = \sqrt{\frac{P \times G}{4 \times \pi \times S}}$

Where:

S = Power Density = 0.466 [mW/cm^2] - power density limit for general population / uncontrolled exposure at 700 MHz.

P = Power input to the antenna [mW].

G = Antenna Gain in the direction of interest [In numeric format].

R = Distance to the center of radiation antenna [cm].

(3) $P_{dBm} = 10 \times \log P_{mW}$

Therefore:

(4) $P_{mW} = 10^{\frac{P_{dBm}}{10}}$

The hazard distances versus antenna gain are listed in the following table:

Antenna Gain		TX power		EIRP		Safe Distance
[dBi]	[Numeric]	[dBm]	[mW]	[dBm]	[mW]	[cm]
8.5	7	30.5	1122	39	7943	**36.8**
11	12.6	30.5	1122	41.5	14125	**49.1**

Table 7-1: Hazard Distance

All outdoor units must be installed with a separation distance of at least **2 meters** from all persons during normal operation.

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8. Appendix E – RF Channel List

Operating Band: 710 - 716 MHz & 740 - 746 MHz.

Channel No.	700 Frequency [MHz]
1	N/A
2	N/A
3	713 (L)
4	N/A
5	N/A
6	N/A
7	N/A
8	743 (H)

Table 8-1: RF channel List

9. Appendix F – Outdoor Cables Scheme

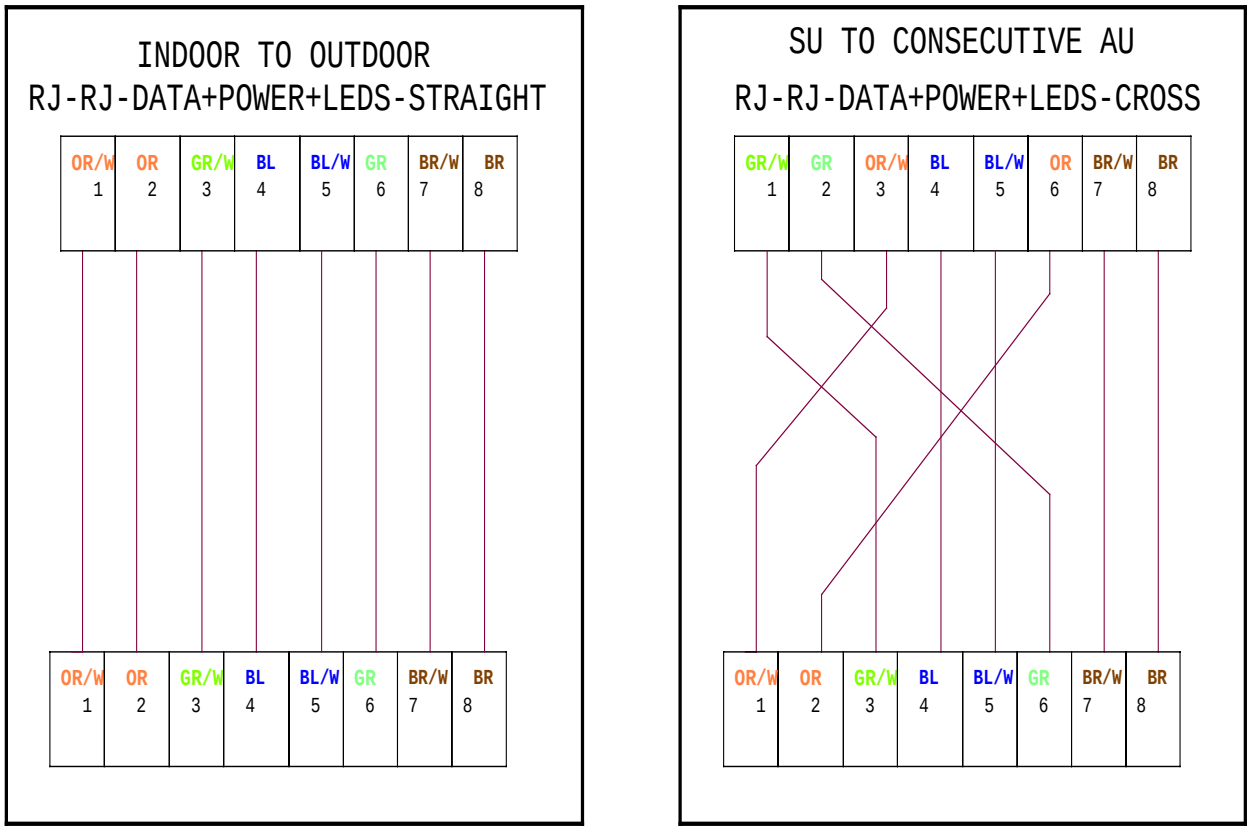

Figure 9-1: Outdoor Cables Scheme

Note: In order to comply with CAT5 91 meters cable
Pins 1,2 must be on a twisted pair wire!
Pins 3,6 must be on a twisted pair wire!

10. Appendix G - Using the Unit Manager Tool

10.1 General

The Unit Manager is a technician tool that is used for installation and configuration of the Units (AU or SU).

The tool is divided logically into two levels, standard and advanced. At startup, the tool automatically direct the technician into a simple installation page that includes all the information needed to install the unit. When the need arises, the technician can select another pages and operations in order to perform more complex infrequent operations (like burning a new firmware etc.).

The tool has the ability to discover GigAccess Units connected to the network and allows configuration of one unit at a time.

10.2 Activating the tool

Activate the tool by clicking the SW icon. (Normally called: GigAccessUnitManager.exe).
When you first activate the tool the following windows appears:

Figure 10-1: Unit Manager Tool – First Window

10.3 Menu Commands

10.3.1 Selecting adapter

If the PC consists more than one Ethernet adapter (NIC), select the default adapter used by the GigAccess™ Unit Manager tool. The selection is done by pressing **Tools→Select Adapter**. A list of the available adapters is shown. Select the appropriate adapter and press ok. The adapter selected is saved in the application configuration file.

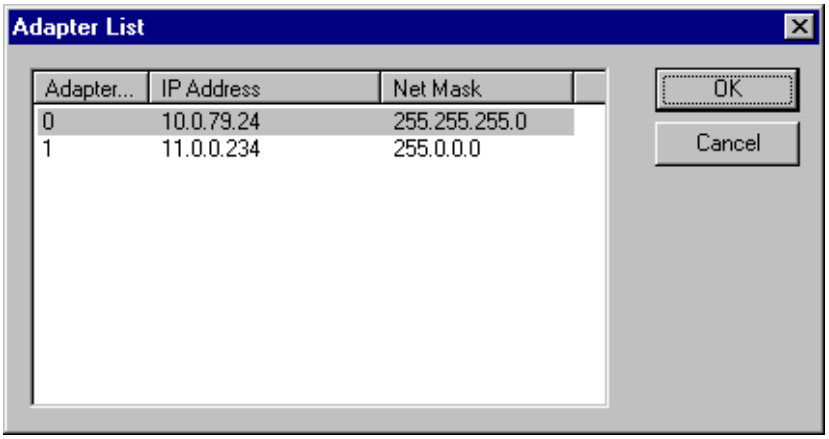

Figure 10-2: Adapter Selection Window

10.4 Toolbar Commands

10.4.1 Start Session (S)

Basically the user has two options to login into a unit (AU/SU):

- If the IP address of the unit is unknown, press the icon “S” to start a new session. This command discovers (with a broadcast command) the units on the network. The application waits (discover time) for replies and display a list of the units replied (see Figure 10-3).

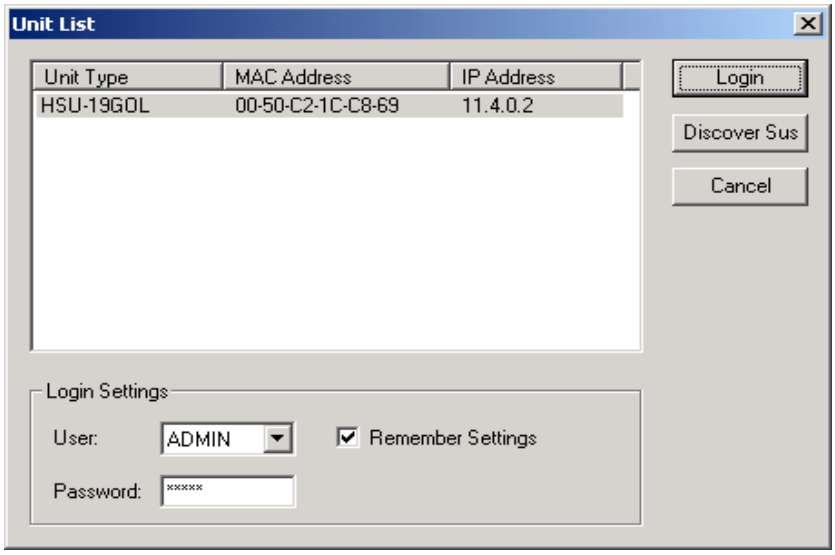

Figure 10-3: Discover Window

The discover time interval can be configured in the application configuration file. Select one the units from the list, select a Login User privilege (USER or ADMIN) and type the corresponding password. (The default passwords are user / admin). Finally, press the Login Button. The application starts a session with the selected unit. The unit configuration is retrieved and displayed. As long as the session is active, the unit type, MAC and IP address are displayed on the title of the application window. The Login settings can be saved in the application configuration file by checking the **Remember Setting** Checkbox.

- Another way to login into the unit consider that the user already know the IP address of the unit. In this case, just insert the unit IP address in the appropriate edit box of the First Window select a User privilege and password and then press Login.

Figure 10-4: Direct login

10.4.2 End Session (E)

This command ends the session with the unit and the title of the application window is changed.

10.4.3 Refresh Unit Parameters (!)

This command refreshes the displayed unit configuration by getting it again from the unit.

10.4.4 Auto Reconnect ({})

When the Auto-Reconnect button is pressed and a session with a unit ends the application tries to reconnect to the unit until a session is started. If the Logger was active before the session ended, the Logger is started again.

10.4.5 Start Logger (EL)

Enables the output of log messages from the unit and printing to the log window and log file (**Admin only**).

10.4.6 Stop Logger (DL)

Disables the output of log messages (**Admin only**).

10.4.7 Clear Log (X)

Clears the log window.

10.4.8 Log to File

When pressing the Log to File button, the “GigAccessUnitManager.log“ is cleared and all log printed to the log window are also printed to the log file. The log file is placed in the application directory and can be opened only when the Log to File button is released.

10.4.9 View Log

Opens the "GigAccessUnitManager.log" in Notepad. Can be done only if the Log to File button is released.

10.4.10 Reset Text (RT)

Gets the Last reset reason and prints to the log window and log file.

10.4.11 Reset Unit (RU)

Send SW reset command to the unit.

10.5 Installation Window

The Installation Window provides a simple to use installation and configuration of the general parameters of the unit. The window contains both AU and SU fields. Only the relevant fields are enabled.

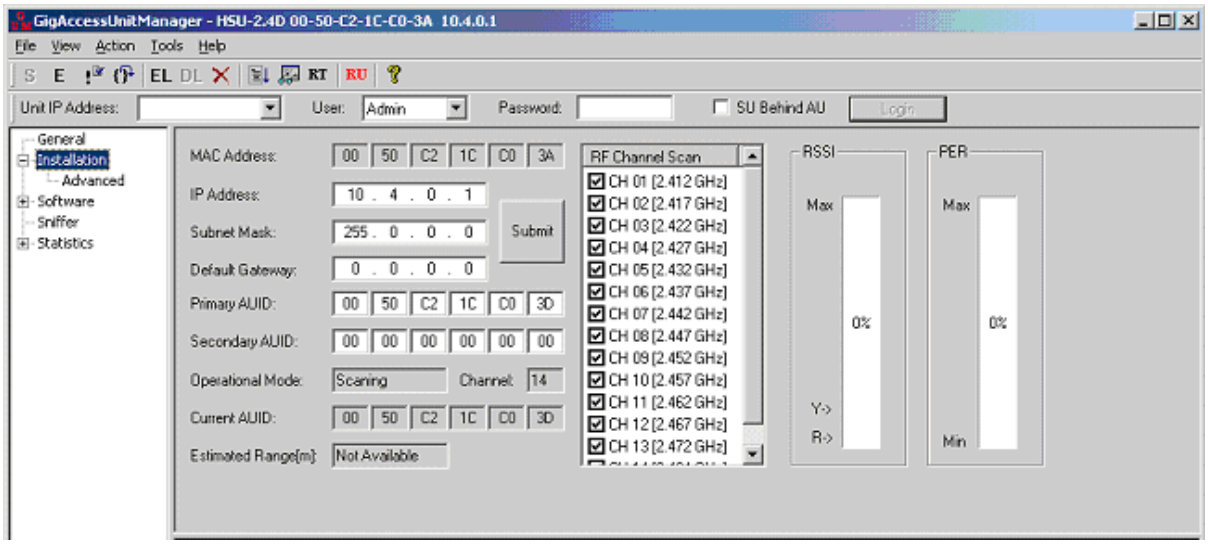

Figure 10-5: Installation Window

The Installation window contains the following fields:

- MAC Address – the Unit's unique MAC Address.
- IP Address – the Agent's IP Address. This field can be configured.
- Subnet Mask – the Agent's Subnet Mask. This field can be configured.
- Default Gateway – the default gateway the Agent needs to use for transfer packets out of its subnet. This field can be configured.
- Primary AUID – the Primary AU MAC Address the SU needs to connect to. This field can be configured for **SU only**.
- Secondary AUID – the Secondary AU MAC Address the SU needs to connect to. This field can be configured for **SU only**.
- Estimated Range status window – the estimated range in meters between the AU and the SU. This field is updated when the SU is online (Operation Mode) and relevant for **SU only**.

- Operation Mode status window – this field shows the status of the Unit. The status is different between AU and SU:
  - AU Operation Modes:
    - BC Negotiation – the AU tries to negotiate with the Base Controller in order to get configuration file.
    - Online – the AU has the configuration file (Local Configuration File or the one it received from the Base controller) and RF channel is online.
  - SU Operation Modes:
    - Scanning – the SU scans the RF channels marked in the RF channel list and search for the Primary/Secondary AUID.
    - Online – the SU is connected to the AU if the SU exists in the AU configuration file.
- Channel – the actual RF channels of the AU or SU.
- RF Channel Scan– the RF Channels the SU should scan. This field can be configured and is relevant for **SU only**.
- RSSI – this field is used to adjust the position of the SU during installation. The SU should be position in the direction where the RSSI value is the highest (Green color). This field is relevant for **SU only**.
- PER – Packet Error Rate, this field shows the quality of the RF channel for periodic interference. This field is relevant for **SU only**.

When the configuration is updated, it can be burned to the unit by pressing Submit. The Unit performs reset and reconnect to it should be done in order to verify the changes.

10.5.1 Advanced Window

The Advanced Window provides the ability to change more parameters of the unit.

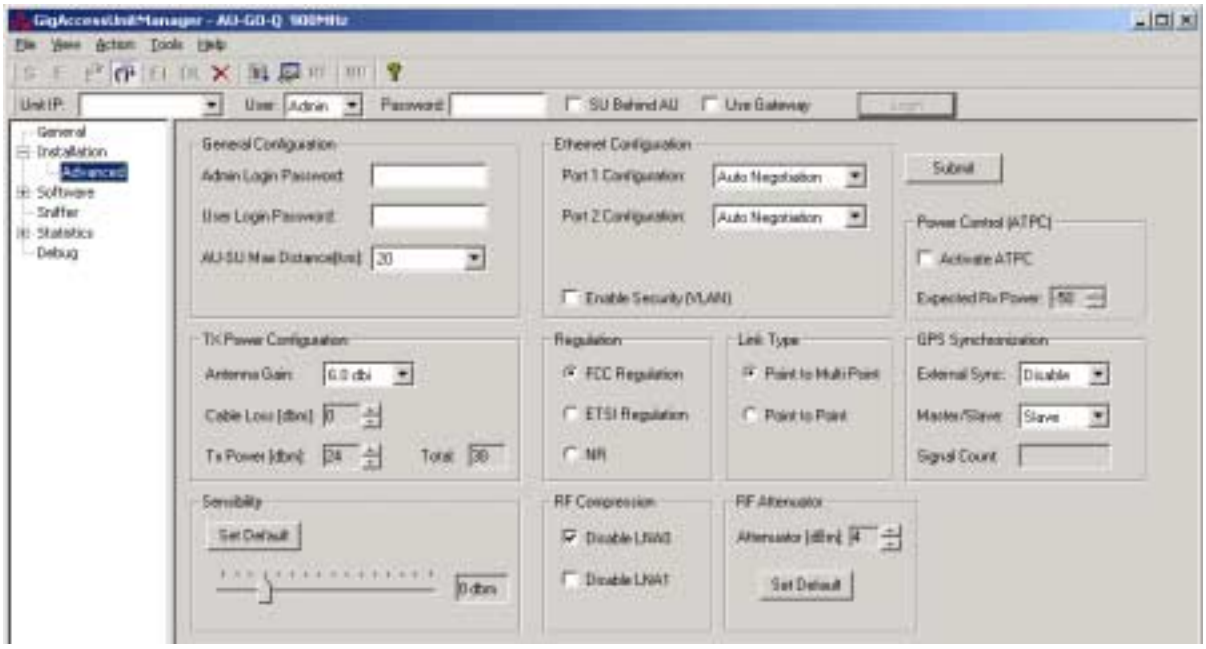

Figure 10-6: Advanced Window

The Advanced window contains the following fields:

General Configuration:

- Admin Login Password – Set the "Administrator" password for **Admin** login.
- User Login Password – Set the "User" password for **User** login.
- AU-SU Max Distance – Set the distance of the farthest SU.

Ethernet Configuration:

- Ethernet Switch Port 1 Configuration – set the speed and duplex of port 1. Available values are: 10M Full Duplex, 100M Full Duplex and Auto-Negotiation.
- Ethernet Switch Port 2 Configuration – set the speed and duplex of port 2. Available values are: 10M Full Duplex, 100M Full Duplex and Auto-Negotiation.
- Enable Ethernet Switch Security – when this flag is set, traffic between Port 1 to Port 2 is blocked (VLAN).

NOTE: GigAccess unit Ethernet port and the other end Ethernet port (Router, PC etc.) need to be set to same speed (both sides AUTO, 100 Full or 10 Full). Fail to do so may cause Ethernet packet lost.

Power Control – ATPC (AU only):

- Activate ATPC – Check this box to activate ATPC.
- Expected Rx power – Set the desired Rx power (expected RSSI at the AU).

Tx Power Configuration:

- Antenna Gain – select the antenna gain.
- Cable Loss - Insert cable attenuation for the specific frequency used.
- TX Power – Select the output power at the antenna connector (**Admin user only**). Changes of the Tx Power **must** be done by an **Expert Technician**. This TX Power value is limited by the Tool set according to the type of the antenna used in order to ensure that the power at the output of the antenna **stands** in the selected **regulation restrictions**.

Regulation:

- Select the appropriate regulation (FCC, ETSI, no regulation).

Link Type:

- Set the link type (p2p, p2mp). This field is not relevant for 900 MHz.

GPS Synchronization:

- AU Synchronization / External Sync – Available values are: Enable or Disable. If an external clock (from GPS or AU) is used to synchronize the AU select Enable, otherwise select Disable.
- AU Synchronization / Master/Slave – This field is relevant only if External Sync is Enabled. Select Master when the AU acts as the master unit, which produces the synchronization clock to all other AUs (Slaves). At any time only one master exists. The slave unit are synchronize to the Master clock.
- Signal Count – Shows running number for synchronization input pulses. Running counter indicates synchronization is active.

Sensibility:

- Set the default value (threshold to cut RF noise level).

RF compression:

- For WaveIP technicians only. Do not mark the checkboxes.

RF attenuator:

- Add attenuation in the Rx path (reception). Good for increasing IIP3. Default value is recommended.

When the configuration is updated, it can be burned to the unit by pressing Submit. The Unit performs reset and reconnect to it should be done in order to verify the changes.

10.6 Software window

The Software Window provides information of the burned software in the unit.

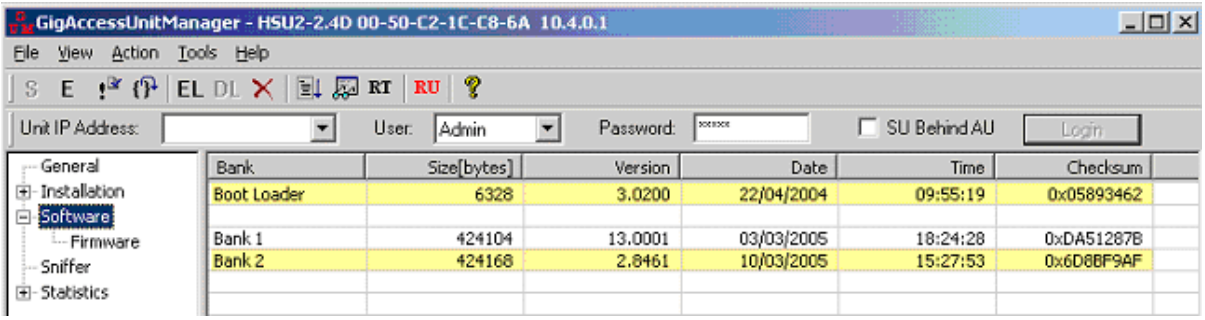

Figure 10-7: Software Window

The information contains the following fields:

- Bank – the bank number.
- Size – the size in bytes of the image burned in the bank.
- Version – the image version.
- Date – the image date.
- Time – the image time
- Checksum – the image checksum.

Note: The active boot banks are marked in yellow.

Note: value of 'N/A' in the bank's field means that there is no software burned in this bank.

10.6.1 Firmware Window

The Firmware Window provides the ability to burn a new firmware to one of the banks (**Admin user only**). The new software can only be burned to the alternate boot Bank. The browser button is used to choose software for burning. When submitting the burn operation, a progress window that shows the burning process appears. When the burn process is done, the user is asked if switching banks is needed and whether to reset the unit after the switch. After the reset, reconnect to the unit and check that the software was burned (View the Software Window).

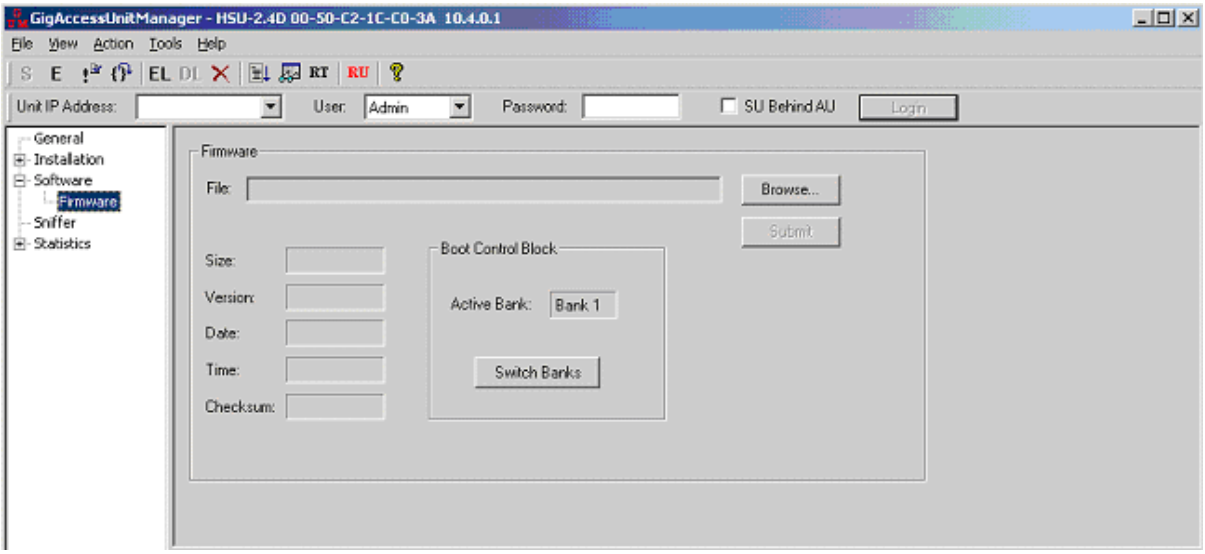

Figure 10-8: Firmware Window

10.7 Sniffer

The sniffer is used to make a site survey before deploying units in a site. To start the sniffer, press the “Start” button. The “Clear” button is used to clear the display and energy readings. In order to end the sniffing press the ”Stop (Reset)” button, and answer yes when prompted to reset the unit. If you want to sniff a specific channel, you can choose it from the list on the right.

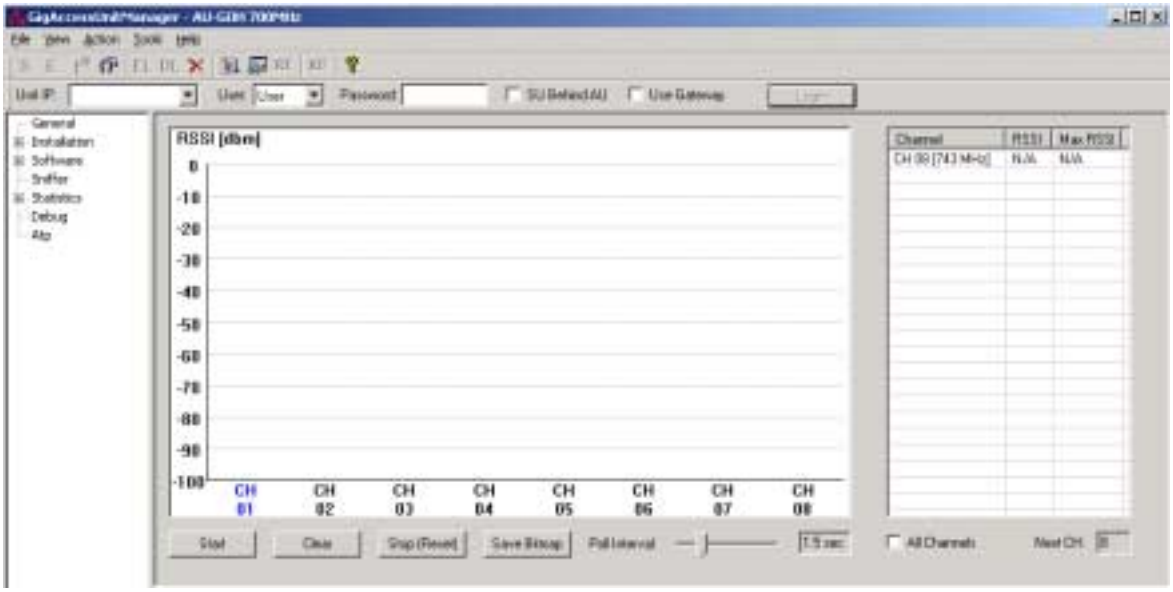

Figure 10-9: Sniffer Window