GigAccess™ - User Guide

Installation and Operation Instructions

PRELIMINARY

February 2003

Rev A

Table of Contents

Table of Figures

Table of Tables

1. Introduction

1.1. General

The information contained in this manual provides GigAccess™ 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™ System Overview

GigAccess™ is WaveIP's wireless point-to-point and point-to-multipoint broadband communication system. The basic subsystem is composed of a single sector, which consists of an AU (Access Unit) and up to 64 SUs (Subscriber Units). 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 divided into sub sectors, which are consecutive to the SUs within the sector.

A sector may include a BC (Base Controller) as an option. The BC is based on a PC and is connecting to the AUs via the Ethernet. The interface to the BC is a 10/100 BASE-T, Ethernet port, which provide an NMS (Network Management System) that can be integrated through an SNMP interface to high level NMS of the service provider . Its main purpose is to configure the AUs and SUs with SLA (Service Level Agreement). Once the AU was configured, the configuration file is burned into an internal FLASH memory and the AU can run autonomic without the need of a BC (stand alone configuration).

Figure 1-1 depicts a general description of a typical sector in the GigAccess™ system.

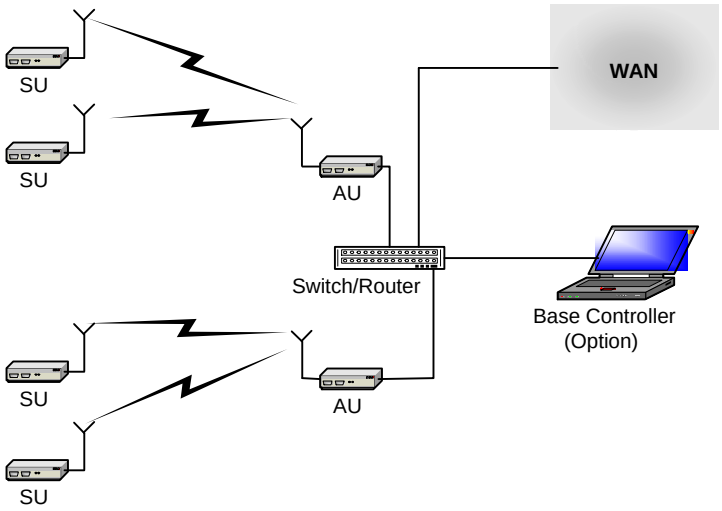

Figure 1-1: General Description of typical sector in GigAccess™ System

The sector uses a single radio channel frequency that carries up to 11 MBPS of data throughput. The data bandwidth is divided between the traffic from the AU to SUs (downstream) and the traffic from the SUs to AU (upstream). GigAccess™ utilizes Time Domain Duplex (TDD) technique in

order to divide the bandwidth periodically, based on FRAME SIZE. The portion of the frame, which is allocated to the upstream traffic between the SUs, is TDMA (Time Division Multiplex Access) time domain technique.

It is controlled dynamically and allows a very efficient way of channel capacity utilization. A small portion of the capacity is allocated for new SU registration. The registration slot is allocated to the SU based on slotted aloha algorithm.

Figure 1-2: GigAccess™ Outdoor Unit

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

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

Operating in the unlicensed 2.4 GHz frequency band, GigAccess™ 2.4 leverages Direct Sequence Spread Spectrum (DSSS) 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. GigAccess™ 2.4 ensures always-on connectivity to full range of IP-based services, including fast Internet streaming video and VOIP. GigAccess™ 2.4 provides an independent infrastructure, which is easy to deploy with very low operating costs.

In case of NLOS (Non Line of Sight) between the AU and the SU due to obstacles such as tall buildings or mountains, a consecutive sector can be used. In this case the SU Ethernet output feed a consecutive AU, which acts as a repeater to bypass the obstacle as shown in Figure 1-3.

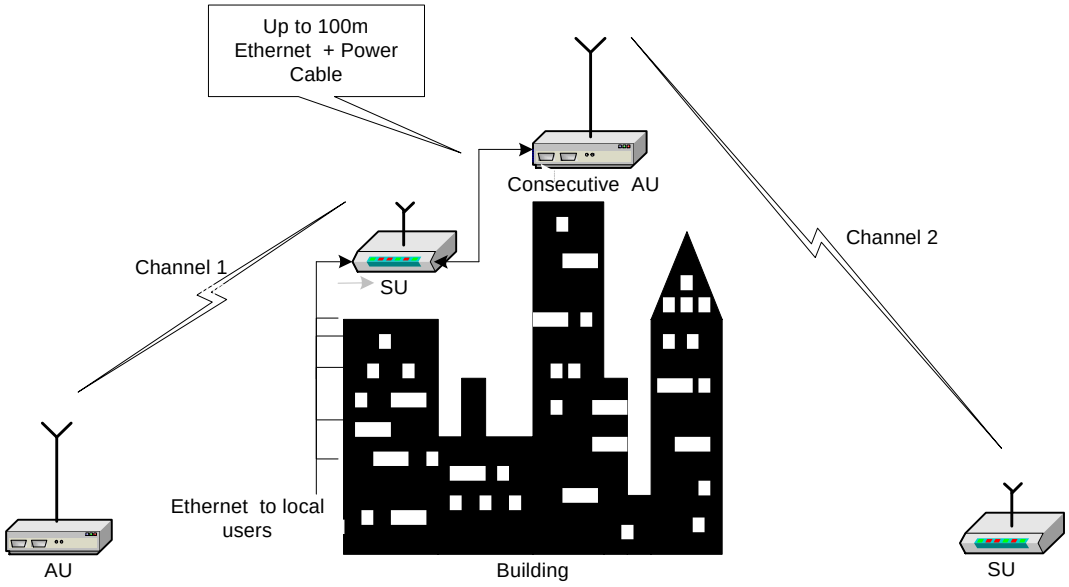

Figure 1-3: Consecutive Sector principle

1.3. The AU/SU Outdoor Unit General Description

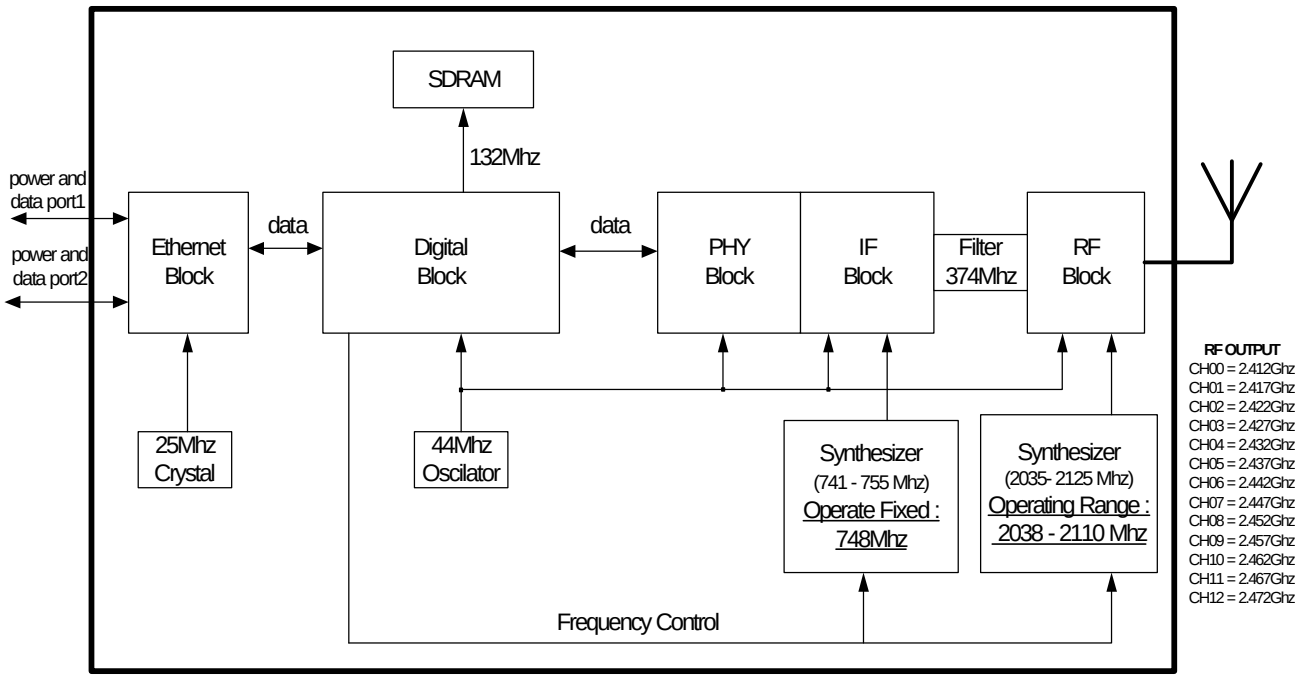

Figure 1-4: Outdoor Unit Block Diagram

The outdoor unit (AU/SU) is composed from the following blocks:

- **Ethernet interface** – 2 RJ 45 connectors for Ethernet interfaces compliant with Ethernet/IEEE 802.3 and the power (48 VDC). This block consists of an Ethernet PHY, Ethernet switch and Ethernet MAC.
- **Digital Block** – consists of the main HW control logic, the CPU and it peripherals like memories (RAM, DDR, Flash), Timers, Interrupt controller, UART etc.
- **PHY Block** – consists of a PHY11B based around INTERSIL Direct Sequence Spread Spectrum Base-band processor.
- **RF/IF Block** - Consists of the Modulator/Demodulator and Synthesizer + RF IF converter and synthesizer based on INTERSIL Prism2 chipset.

2. Installation

2.1. Packing List

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

- AU or SU Outdoor Unit
-
- Indoor Outlet.
- Indoor Power Supply (AC input).
- Pole mounting kit.
- Sealing grommet and cap and clamping plates.

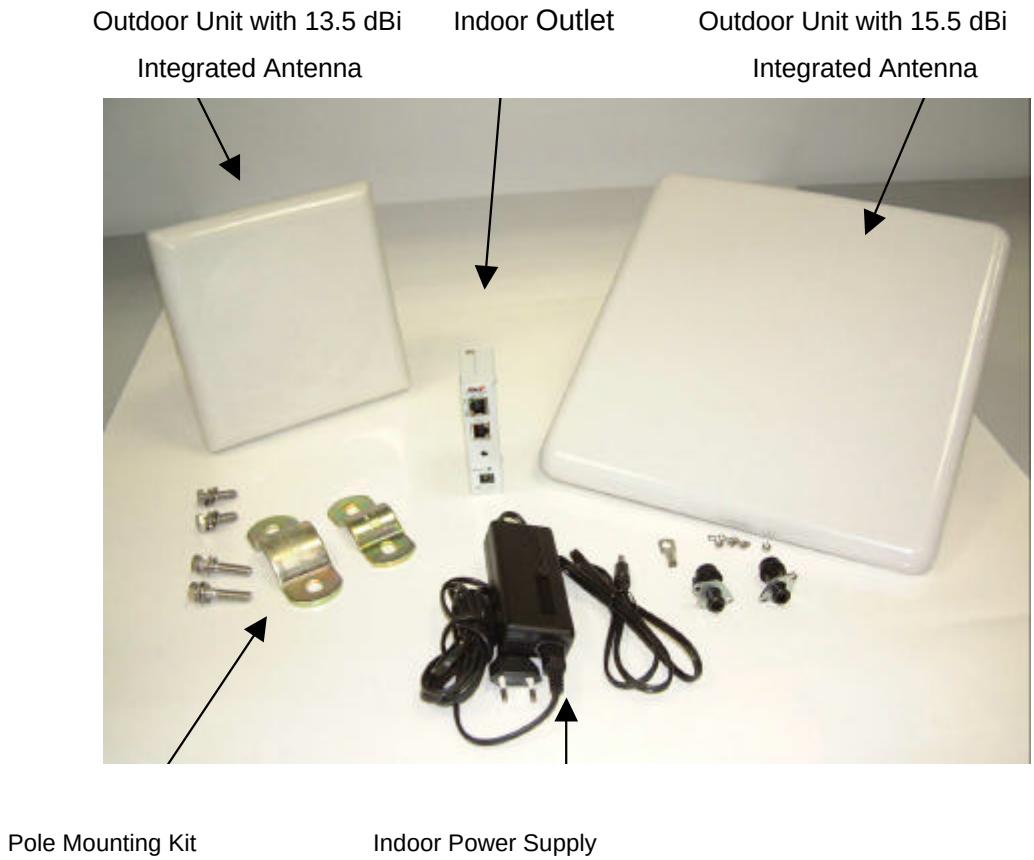

Figure 2-1: General System View

2.2. Additional Part List – Required for Installation

- Outdoor Unit grounding cable
- Indoor Outlet grounding cable (for metal Indoor Outlet only!).
- Outdoor-to-Indoor CAT5 shielded cable (Up to 90 meters).
- Indoor CAT5 cable.
- RJ45 - Installation KIT.
- RJ45 - Crimping tool.
- Adjustable wrench + screwdriver.

2.3. Installation Overview

This section provides installation information for GigAccess™ 2.4 system.

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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.
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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 GigAccess™ 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.

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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.

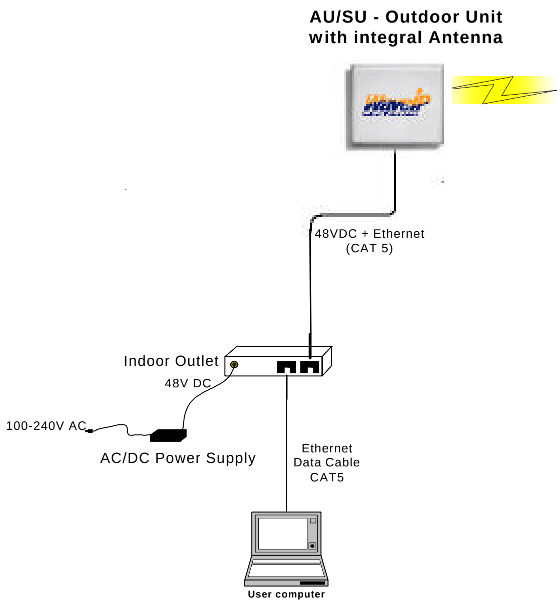

Figure 2-2: GigAccess™ - General Installation Scheme

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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. The use of any antenna other than those certified with the product is expressly forbidden in accordance to FCC rules part 15.247 The installer should configure the output power level of antennas, according to country regulations and per antenna type.

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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.

   The connectivity can be checked by using the ping instruction.

2.4. AU/SU Outdoor Installation

2.4.1. Site Selection

2.4.1.1. 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). The radio channels depend on the regulations in your area. Table 2-1 provides the specifications for main regulatory domains:

Region	Regulatory Domain	Relevant Radio Channels
USA	FCC	0 – 12
Canada	DOC	0 – 12
Europe (Except Spain and France)	ETSI	0 - 12
Spain	SPAIN	10
France	FRANCE	10

Table 2-1: Regulatory Domain Specification

For channel frequency list see Table 8-1 in Appendix E – RF Channel List

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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.
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2.4.1.2. 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 mainly by several factors:

- **Distance between sites** – Path loss is lower and system performance better 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

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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**.**

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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

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WARNING! When using the system for point-to-multi-point all outdoor units must be installed with a separation distance of at least **20 cm**. For a base station or any installation consisting of more than one outdoor unit (AU or SU) the safety distance for all persons should be at least **2 meters**.

When using the system for point to point (p2p) applications all outdoor units must be installed with a separation distance of at least **2 meters** from all persons during normal operation

For detailed calculation see: Appendix D: RF Hazard Distance Calculation on page 36

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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. See Appendix A – WaveIP Approved Antennas, page 31 for list.

According to FCC part 15.247(b):

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

(2) "*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.

(3) "*Systems operating in the 2400-2483.5 Mhz band that are used exclusively for fixed,* ***point-to-point*** *operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi*".

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WARNING! To comply with the FCC 15.247(b)(4)(iii), the equipment should be professionally installed. The installer is responsible for ensuring that the system is used exclusively for fixed, **point-to-point** operation!

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WARNING! It is the installer responsibility that when using approved parabolic dish antennas in **point-to-point** operations, that they may not be co-located with other intentional radiators transmitting the same information.

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According to ETSI:

(1) The maximum EIRP shall not exceed +20 dBm (100 mWatt).

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IMPORTANT! To comply with the FCC/ETSI EIRP limits, the outdoor unit-transmit power need to be adjusting 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 FCC rules may expose the installer to legal liabilities.

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For open outdoor areas with clear line of sight between the SU and the AU the suggested maximum distance is given in Appendix C – Max RF Power and Distance versus Antenna Gain.

2.4.3.2. Detached Antenna

Operating with detached antenna allowed only after outdoor unit power setup is confirmed not to exceed +36 dBm EIRP for USA for point-to-multi-point operation or +20 dBm EIRP for Europe for any antenna used. For point-to-point operation the EIRP can exceeds +36dBm and therefore it must be configured by a professional installer. The configuration is only allowed by password of administrator privilege.

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 internal FLASH. The tool limits the max transmit power according to the selected antenna, the selected regulation (FCC/ETSI) and the selected link type (point-to-multi-point/point-to-point). Of course the installer, if needed can select a lower power.

For example: if the selected antenna gain is 24 dBi, the regulation is FCC and the link type is point-to-multi-point, the tool will set the maximum transmitted power (before the antenna) to +12 dBm (so that EIRP will not exceeds +36dBm).

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 / ETSI rules, precautions are built into the system to keep the end user from adjusting the power output level above the regulation limits. Therefore:

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

Configuration is only allowed by password of administrator privilege.

The above configuration is done with the advanced window of the Unit Manager Tool - see paragraph 10.4.1. For detailed description of how to use the Unit Manager tool See Appendix G - Using the Unit Manager Tool, on page 40.

The GigAccess™ was designed to work with co-located antennas. That means that two antennas can be connected. The minimum distance between the two antennas should be 20 cm. The two antennas should be of the same type (Directional Flat Panel Antenna, or Base Station Antenna or Parabolic Dish). The main idea is to utilize two polarizations: one antenna in vertical polarization and the other in horizontal polarization. The user will select the antenna in need. Omni antennas are not relevant for co-location. Only the selected antenna is operational. Configuration is done with the advanced window of the Unit Manager Tool (See paragraph 10.4.1). If the "External Antenna Select" check box is selected the detached antenna is selected, otherwise the integrated antenna is selected.

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Note: The FCC 15.203 requirement prohibits the connection of detached antennas with standard N-type connectors. In order to meet this requirement, the detached antenna connectors provided on GigAccess™ models (with no integral antenna) are non-standard, TNC connector. Only professional technician will perform the installation.

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2.4.3.3. 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.

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

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Warning! For a base station or any installation consisting of more than one outdoor unit (AU or SU) the safety distance for all persons should be at least **2 meters**.

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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.

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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 Ethernet NIC in the PC.

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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 10-3).

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

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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.

2.5. 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 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.

2.6. Indoor Outlet Installation

2.6.1. Indoor Outlet

Indoor Outlet is wall mounted. In case of multiple Indoor Units needed at the same location it is possible to attach the units to each other to form a stack unit.

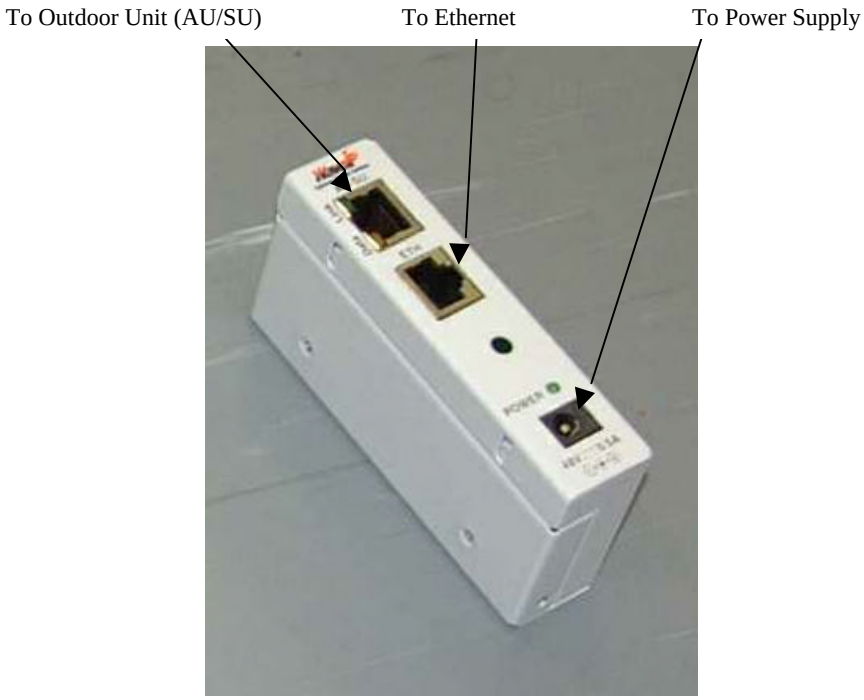

Figure 2-4: Indoor Outlet – Metal Model

Figure 2-5: Power Supply for Indoor Outlet (This picture is for illustration only!)

2.6.2. 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 F – Outdoor Cables Scheme.

The Indoor Outlet side and Outdoor Unit side will crimped with RJ45 tool.

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CAT5 cable must not exceed 300 feet (91 meters).
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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.
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The Outdoor Unit side will be assembled by the following list (See Figure 2-6):

- Insert seal bracket (grommet clamping plate) on the cable.
- Insert rubber seal (grommet) on the cable.
- Crimp the RJ45 Plug.

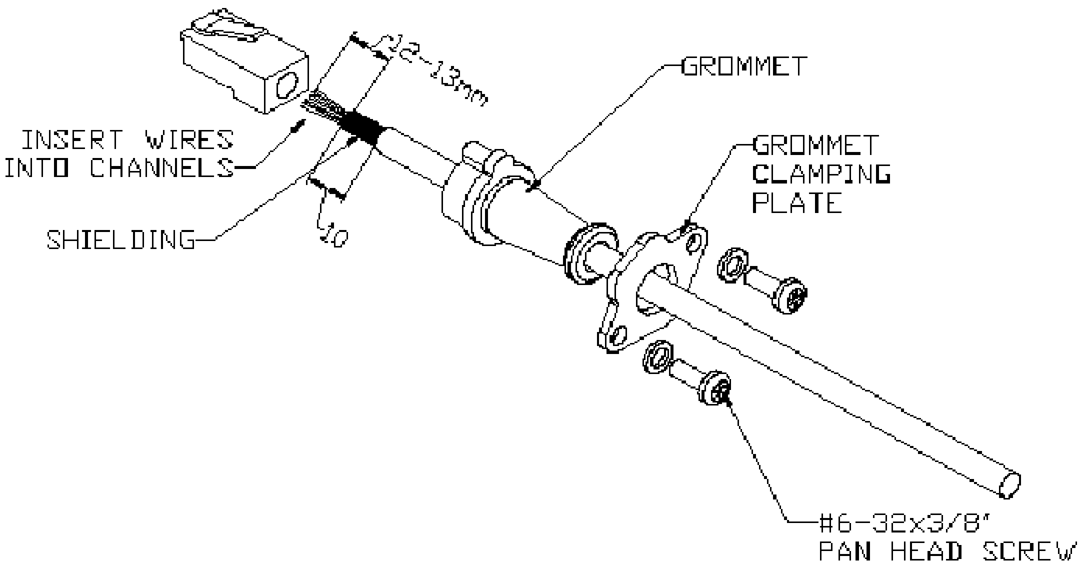

Figure 2-6: Cable preparation for Outdoor Unit

- Insert the RJ45 to the Outdoor Unit. See Figure 2-7 and Figure 2-8.
- Insert *NC -6* screws with spring washer to the seal bracket.

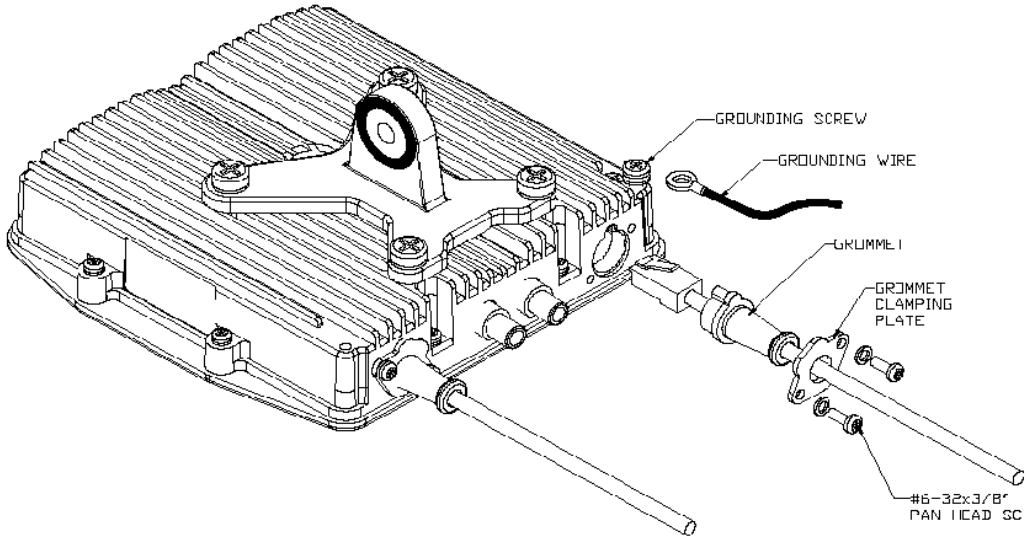

Figure 2-7: Cable assembly to Outdoor Unit

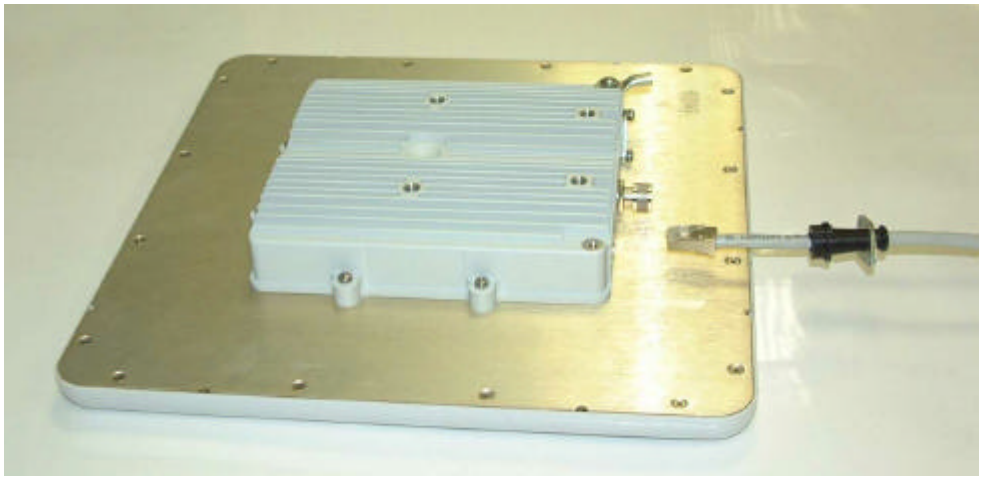

Figure 2-8: Cable insertion to Outdoor Unit.

- Fasten the seal bracket. See Figure 2-9.
- The unused port should be left sealed.

Figure 2-9: Cable connection to Outdoor Unit

The Indoor Outlet side cables assembled as follows:

1. Crimp the RJ45 Plugs on cable ends to form the Outdoor Unit cable.

2. Plug the Outdoor Unit cable to the RJ45 Jack marked *"AU/SU"*.

3. Plug standard CAT5 cable from the PC to the RJ45 Jack marked *"10/100 BT"*

4. Plug the DC plug from the AC/DC power supply to the DC jack marked *"48VDC"*

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Warning: Do not attach standard CAT 5 cable from the PC to the Indoor Unit RJ45 jack marked *"AU-SU"*. Connecting the PC directly to the Outdoor Unit may cause damaged to the Ethernet NIC in the PC.

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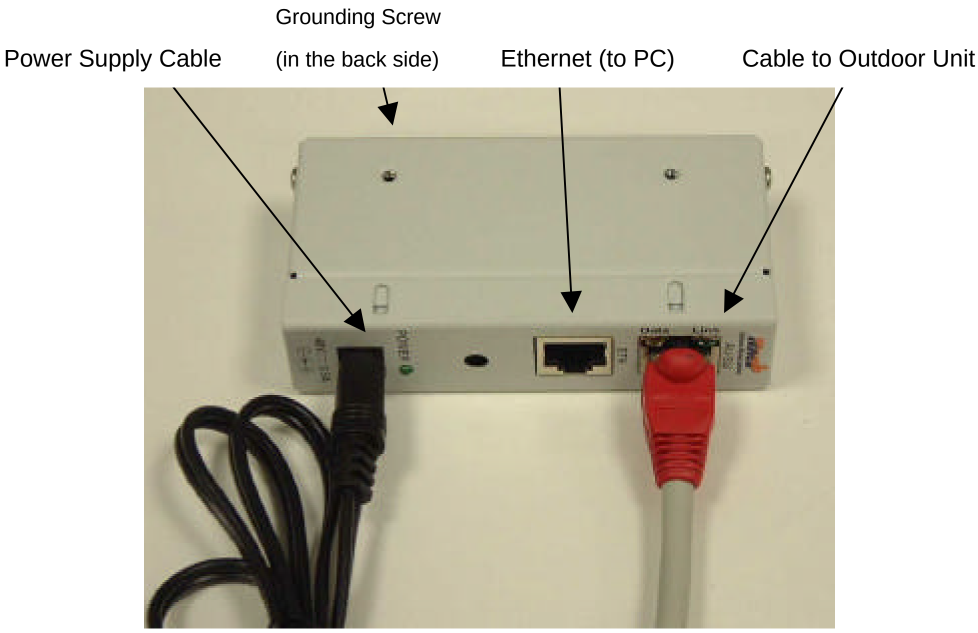

Figure 2-10: Cable connection to Indoor Outlet

2.6.3. Grounding

2.6.3.1. 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. Figure 2-11 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.

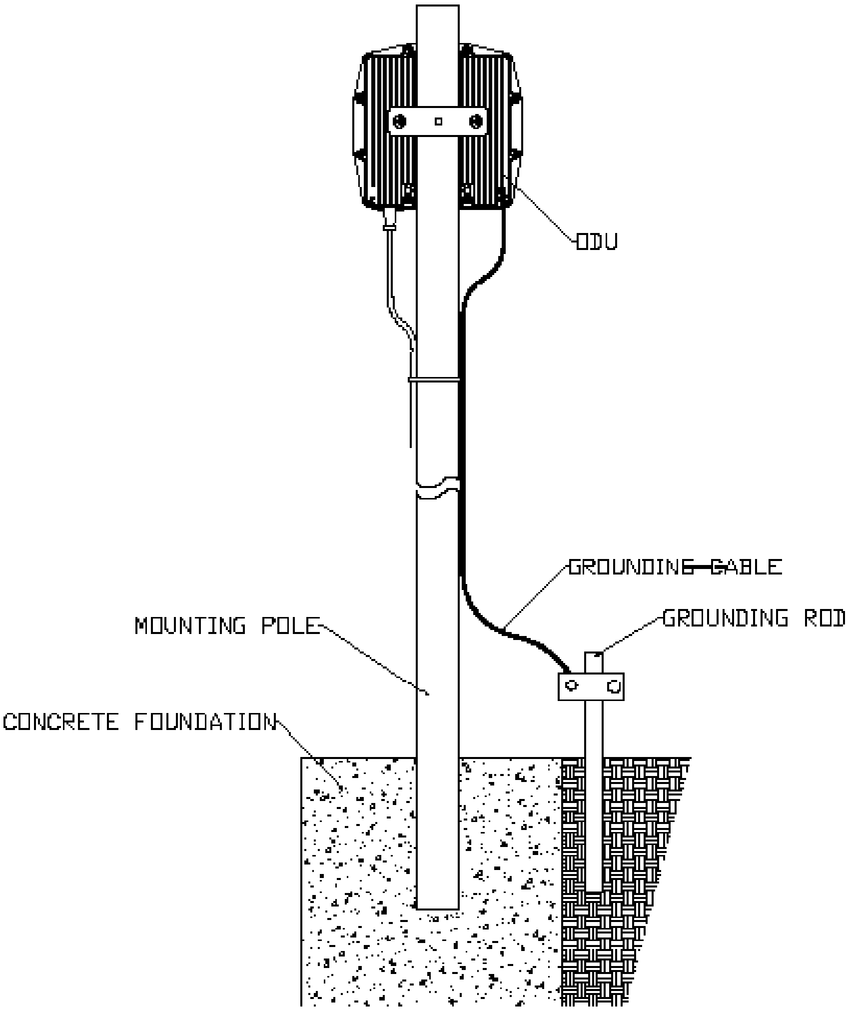

Figure 2-11: Ground Connection to Outdoor Unit

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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).

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2.6.3.2. Grounding the Indoor Outlet (Metal Version Only!)

The indoor Outlet shall be connected to a protective earth with 18 AWG conductors having green-yellow insulation. The grounding cable shall be connected to the indoor external screw locating at its backside. 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

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NOTE! Only metal version of indoor Outlet should be grounded.

There is no need to ground Plastic version of Indoor Outlet.

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FCC Notice, USA

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

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2.6.4. Consecutive Connection

The SU Indoor Outlet provides power and data connection to the SU Outdoor unit. The connection is done by plugging **data crossover** CAT5 cable between SU and consecutive AU. In this case the **total** length of all wires from Indoor Outlet to the far Outdoor Unit should not exceed 600 feet (182 meters).

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

3. GigAccess™ 2.4 Technical Specifications

3.1. General Specification

Access technology	TDMA (Time division multiple access)
Duplexing schemes	TDD (Time division duplex)
Wireless PHY Interface	Proprietary based on IEEE 802.11b
Wireless MAC Interface	Proprietary based on IEEE 802.16
Forward Error Correction	Dynamic convolution FEC
Regulatory	FCC Part 15, UL 1950
Applications	Access, Campus, Consecutive

3.2. Base Station - Access Unit (outdoor)

Sectors (degrees)	Sectors from 20^0 to 360^0
SUs per sector (AU)	64
Physical Interface	2 x 10/100 Base-T (ODU)
Connector Type	RJ-45
Protocol Supported	IP, ICMP, ARP, TCP, UDP and HTTP
Packet classification	Wire-speed layer 3
Output Power (at antenna port)	-6 dBm up to +18 dBm (1 dB step)
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. High performance Subscriber Unit (outdoor)

Physical Interface	2 x 10/100 Base-T (ODU)
Connector Type	RJ-45
Protocol Supported	IP, ICMP, ARP, TCP, UDP, DHCP, and HTTP
Packet classification	Wire-speed layer 3
Output Power: (at antenna port)	-6 dBm up to +18 dBm (1 dB step)
Antenna:	
• Integrated	13.5 dBi or 15.5 dBi
• Detached	See Table 4-2
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” (13.5 dBi antenna) 12” X 12” X 2” (15.5 dBi 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	2.400 – 2.483 GHz ISM band
RF Waveform	Direct Sequence Spread spectrum (DSSS)
Modulation	DQPSK, 16CCK[1], 256 CCK
Processing Gain	10.4 dB
EIRP	USA/FCC: +36 dBm (max)
	Europe/ETSI: +20 dBm (max)
Antenna Polarization	Vertical or Horizontal
Number of Channels	US: 13
	Europe: 13
Data Rates	11 Mbps, 5.5 Mbps, 2 Mbps
Radio Sensitivity	@11 Mbps: -82 dBm, IE-2 PER[2]
	@5.5 Mbps: -87 dBm, IE-2 PER
	@2 Mbps: -89 dBm, IE-2 PER

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)
QoS Support Criteria	Bandwidth, Latency.

[1] CCK - Complementary Code Keying (See INTERSIL AN9850.2)
[2] PER - Packet Error Rate

4. Appendix A – WaveIP Approved Antennas

Antenna Type	Model	Gain [dBi]	Beam Width	Dimension [mm]	Ideal for:
Directional- Flat Panel	MTI-1004/C/A	13.5	33^0	190x190x30.5	Medium Range, Multipoint links.
	MTI-30081/C/A	15.5	20^0	305x305x25	Medium Range, Multipoint links.
	MARS: MA-WA24-1X	15.5	20^0	305x305x30	Medium Range, Multipoint links.

Table 4-1: Integrated Antennas for GigAccess™

Antenna Type	Model	Gain [dBi]	Beam Width	Dimension	Ideal for:
Directional- Flat Panel	MTI-345010/C/A	18	17^0	450x450x36	Long Range, Multipoint links.
Omni Directional	Hyperlink Tech-HG2409U	8	360^0x15^0	50 cm	Short Range, Multipoint links, 360^0 coverage (AU only)
	Hyperlink Tech-HG2410U	10	360^0x8^0	100 cm	Short Range, Multipoint links, 360^0 coverage (AU only)
	Hyperlink Tech-HG2412U	12	360^0x8^0	120 cm	Medium Range, Multipoint links, 360^0 coverage (AU only)
	NCG GP-24	12	360^0x5^0	5 ft + 10 inch	Medium Range, Multipoint links, 360^0 coverage (AU only)
	NCG GP-24-3 (3 deg down-tilt)	12	360^0x5^0	5 ft + 10 inch	Medium Range, Multipoint links, 360^0 coverage (AU only)
Base Station Antenna	MT-363010/HN /NV	13	90^0 – AZ 16^0 - EL	510x330x30 mm	Multipoint link (AU only)
	MT-364028 /NV	17	90^0 – AZ 8^0 - EL	1000x330x30 mm	Multipoint link (AU only)
	MARS: MA-WC24-5X	14	60^0 – AZ 12^0 - EL	600x140x30 mm	Multipoint link (AU only)
	MARS: MA-WC24-6X	17	60^0 – AZ 6.7^0 - EL	1200x140x30 mm	Multipoint link (AU only)
Parabolic Dish	Hyperlink Tech-HG2424G	24	8^0	100.3x59.7cm	Long Range Multipoint links and Point-to-point link
	Andrew-26T-2400-1	23	7.5^0	99.7x60x38cm	Long Range Multipoint links and Point-to-point link

Table 4-2: Detached Antennas for GigAccess™

5. Appendix B: Calculation RF Link Budget

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:

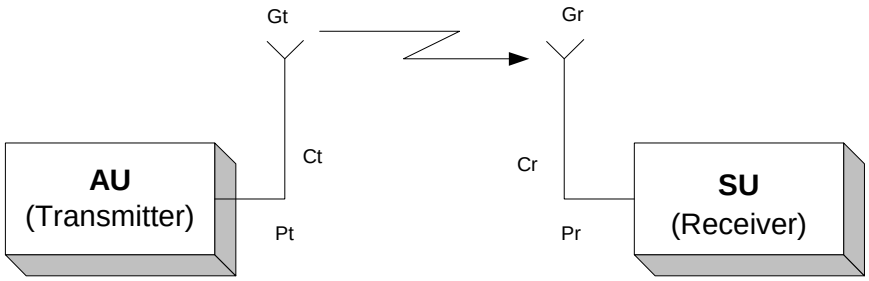

Figure 5-1: Radio Link – General description

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 IE-5 BER)

GM – Gain (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 multipath 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). The GigAccess™ recommended fade margin at 2.4 GHz is 10 dB minimum.

Example of Link Parameters:

P_t = 18 dBm

$C_t = C_r$ = 0 dB

$G_t = G_r$ = 13.5 / 15.5 dBm

S_r (11 Mbps) = 85 dBm, S_r (5.5 Mbps) = 87 dBm, S_r (2 Mbps) = 88 dBm

GM = 10 dB

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

(2) $P_r = S_r = EIRP - PL - GM + G_r - C_r$

(3) $PL = EIRP + G_r - C_r - S_r - GM$

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

(5) $PL_{2.4GHz} = 100 + 20 \times \log(R_{Km})$

(6) $R_{Km} = 10^{\frac{PL-100}{20}}$

	13.5 dBi Antenna	15.5 dBi Antenna
	Rate=11 Mbps	Rate=11 Mbps
P_t	18	18
C_t	0	0
G_t	13.5	15.5
EIRP	31.5	33.5
G_r	13.5	15.5
C_r	0	0
S_r	-82	-82
PI	117	121
R_{Km}	**7**	**11**

Detailed results for RF calculation is given in Appendix C – Max RF Power and Distance versus Antenna Gain

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

FCC (point-to-multi-point operation)

Antenna Type	Antenna Gain [dBi]	Max RF Power [dBm]	EIRP [dBm]	Distance at Highest Rate [Km]	Sector Type
Detached	8	18.5	26.5	2	p2mp Sector
Detached	10	18.5	28.5	3	p2mp[3] Sector
Detached	12	18.5	30.5	5	p2mp Sector
Detached	13	18.5	31.5	6	p2mp Sector
Integrated	13.5	18.5	32	7	p2mp Sector
Detached	14	18.5	32.5	8	p2mp Sector
Integrated	15.5	18.5	34	11	p2mp Sector
Detached	17	18.5	35.5	16	p2mp Sector
Detached	18	18	36	20	p2mp Sector
Detached	23	11	36	25	p2mp Sector
Detached	24	12	36	30	p2mp Sector

Table 6-1: Max RF Power and Distance for FCC in point-to-multi-point

¾ ¾

Note! For point-to-multi-point the output EIRP should never exceed +36dBm for any antenna combination used.

¾ ¾

[3] p2mp = Point To Multi Point

FCC – (point-to-point operation)

Antenna Type	Antenna Gain [dBi]	Max RF Power [dBm]	EIRP [dBm]	Distance at Highest Rate [Km]	Sector Type
Detached	24	18.5	42.5	50	p2p[4]

Table 6-2: Max RF Power and Distance for FCC in point-to-point

¾ ¾

Note! When the system is used exclusively for fixed point-to-point operation, the output EIRP can exceed +36dBm for the 24 dBi antenna according to FCC 15.247(b)(4)(i). Therefore this option is only allowed by password of administrator privilege and should be done by a professional installer only!

¾ ¾

ETSI

Antenna Type	Antenna Gain [dBi]	Max RF Power [dBm]	EIRP [dBm]	Distance at Highest Rate [Km]	Sector Type
Detached	8	12	20	1	p2mp Sector
Detached	10	10	20	1.3	p2mp Sector
Detached	12	8	20	1.6	p2mp Sector
Detached	13	7	20	1.8	p2mp Sector
Integrated	13.5	6.5	20	1.9	p2mp Sector
Detached	14	6	20	2	p2mp Sector
Integrated	15.5	4.5	20	3	p2mp Sector
Detached	17	3	20	3.5	p2mp Sector
Detached	18	2	20	4	p2mp Sector
Detached	23	-4	20	5.6	p2mp, p2mp
Detached	24	-4	20	7	p2mp, p2mp

Table 6-3: Max RF Power and Distance for ETSI

[4] p2p = Point To Point

7. Appendix D: RF Hazard Distance Calculation

The Power density is given by:

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

Therefore:

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

where:

S = Power Density = 1 [mW/cm^2]

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 Table 7-1.

¾ ¾

Note! GigAccess™ was designed for fixed and mobile applications.

¾ ¾

point-to-multi-point operation

Antenna	Gain	Tx	Power	Safe Distance	Sector Type
[dBi]	[Numeric]	[dBm]	[mW]	[cm]	
8	6.3	18.5	70.8	**5.96**	p2mp
10	10.0	18.5	70.8	**7.51**	p2mp
12	15.8	18.5	70.8	**9.45**	p2mp
13	20	18.5	70.8	**10.6**	p2mp
13.5	22.4	18.5	70.8	**11.23**	p2mp
14	25.1	18.5	70.8	**11.9**	p2mp
15.5	35.5	18.5	70.8	**14.14**	p2mp
17	50.1	18.5	70.8	**16.81**	p2mp
18	63.1	18	63.1	**17.8**	p2mp
23	199.5	13	20	**17.8**	p2mp
24	251	12	15.8	**17.8**	p2mp

Table 7-1: Hazard Distance versus Antenna Gain for Point to Multi Point

¾ ¾

When using the system for point to multi point (p2mp) applications all outdoor units must be installed with a separation distance of at least **20 cm** from all persons during normal operation.

For a base station or any installation consisting of more than one outdoor unit (AU or SU) the safety distance for all persons should be at least **2 meters**.

¾ ¾

point-to-point operation

Antenna	Gain	Tx	Power	Safe Distance	Sector Type
[dBi]	[Numeric]	[dBm]	[mW]	[cm]	
24	251	18.5	70.8	**37.63**	p2p

Table 7-2: Hazard Distance versus Antenna Gain for Point to Point

¾ ¾

When using the system for point to point (p2p) applications all outdoor units must be installed with a separation distance of at least **2 meters** from all persons during normal operation

¾ ¾

8. Appendix E – RF Channel List

Operating Band: 2400 MHz - 2483.5 MHz

Channel No	Frequency
0	2412 MHz
1	2417 MHz
2	2422 MHz
3	2427 MHz
4	2432 MHz
5	2437 MHz
6	2442 MHz
7	2447 MHz
8	2452 MHz
9	2457 MHz
10	2462 MHz
11	2467 MHz
12	2472 MHz

Table 8-1: RF channel List

9. Appendix F – Outdoor Cables Scheme

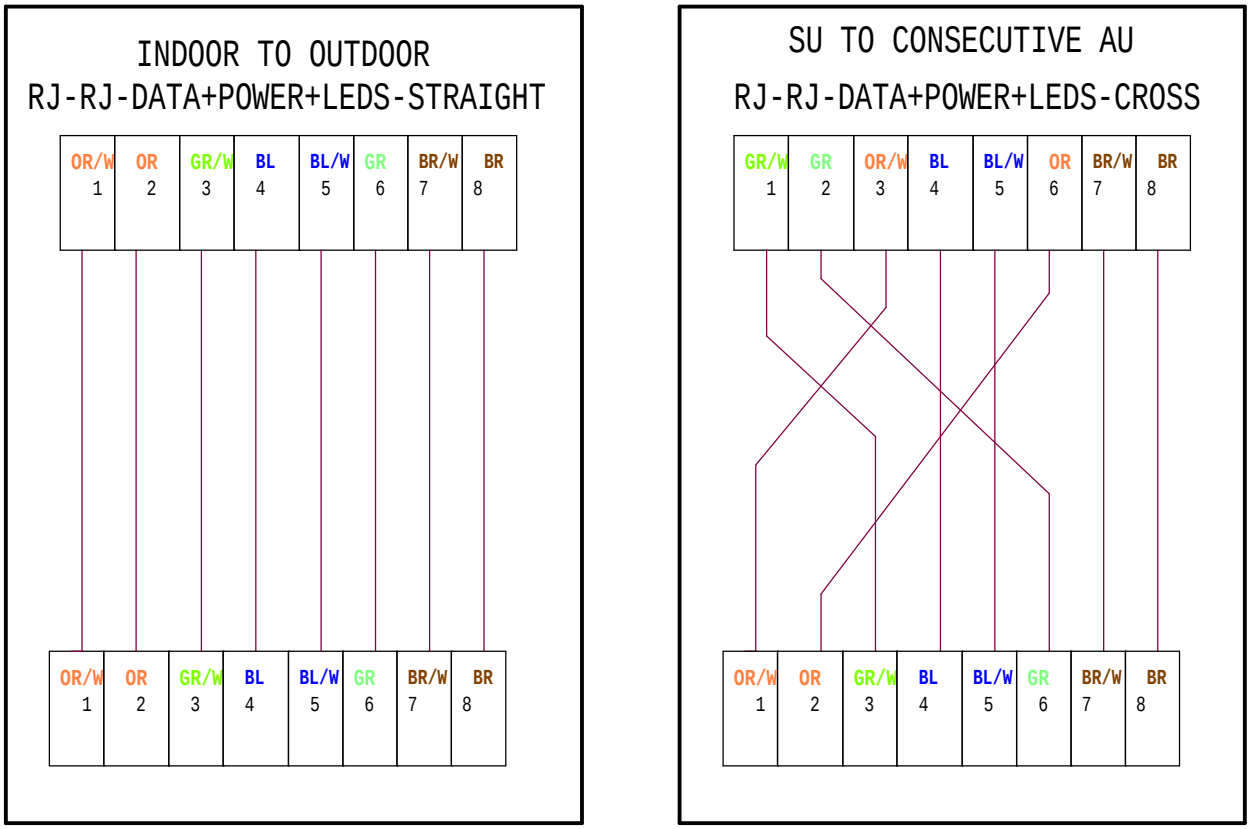

Figure 9-1: Outdoor Cables Scheme

10. Appendix G - Using the Unit Manager Tool

10.1. General

The Unit Manager Tool is used for installation and configuring the Unit (AU or SU).

A technician that installs and maintain an AU or an SU should use this tool.

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.

This manual gives a short description of the features available and is using terms from the GigAccess™ system. A more complete and detailed manual will be available shortly.

10.2. Menu Commands

10.2.1. Selecting adapter

The adapter used by the GigAccess™ Unit Manager can be selected in the **Menu→Tools→Select Adapter**. A list of the adapter list installed in the computer is shown. Select the appropriate adapter and press ok. The adapter selected is saved in the application configuration file.

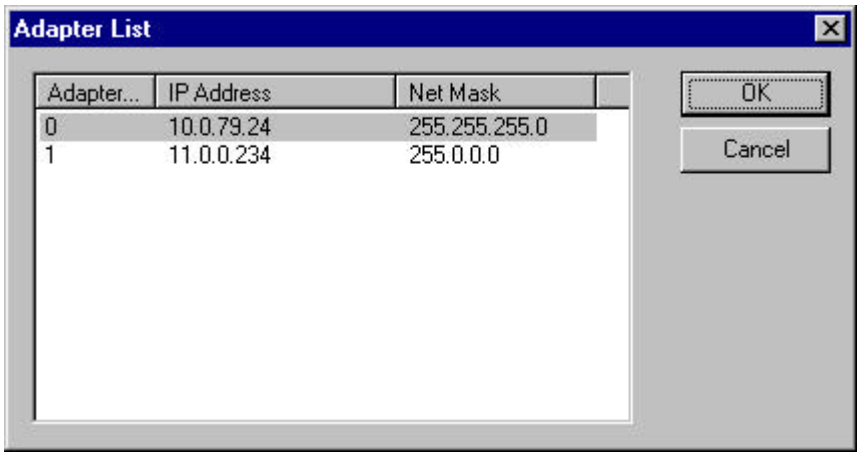

Figure 10-1: Adapter Selection Window in Unit Manager Tool

10.3. Toolbar Commands

10.3.1. Start Session

This command discovers (broadcast) the units on the network. The application waits (discover time) for replies from the units (AUs and SUs) and display a list of the units replied. The discover time interval can be configured in the application configuration file.

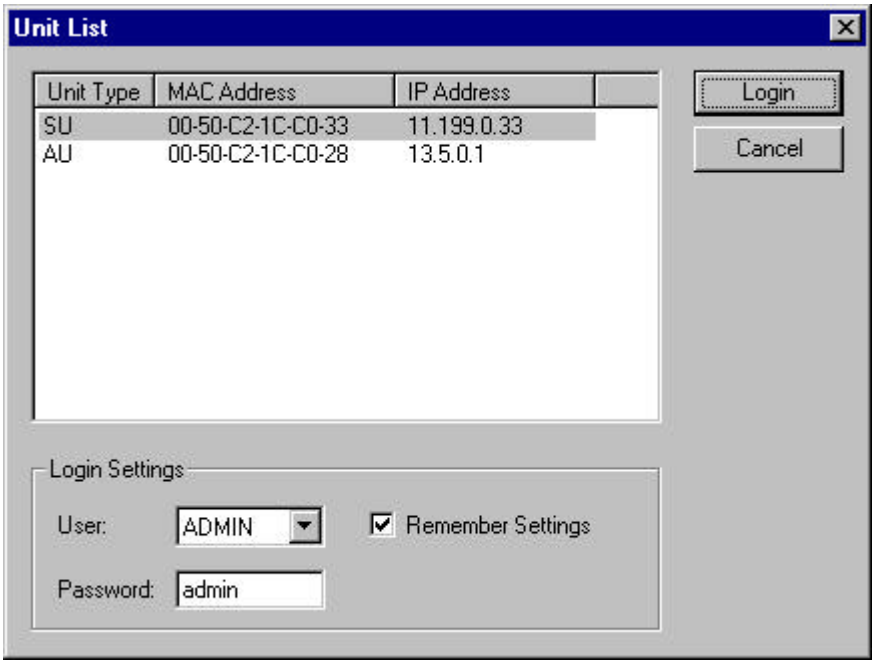

Figure 10-2: Discover Window in Unit Manager Tool

Select one the units from the list, select a Login User and type the password. Finally press the Login Button. The application starts a session with the selected unit and the unit configuration is retrieved and displayed. As long as the session is active, the unit type, MAC address 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.

10.3.2. End Session

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

10.3.3. Refresh Unit Parameters

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

10.3.4. 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.

10.3.5. Start Logger

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

10.3.6. Stop Logger

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

10.3.7. Clear Log

Clears the log window.

10.3.8. 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.

10.3.9. View Log

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

10.3.10. Reset Text

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

10.4. 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. The appropriate fields are disabled when connecting to an AU or SU unit.

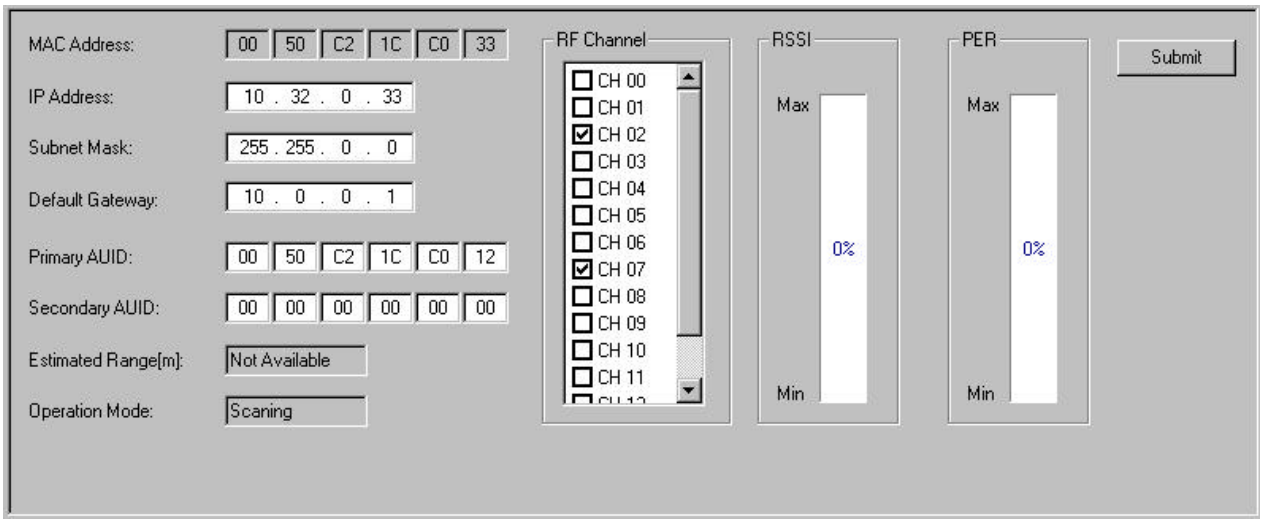

Figure 10-3: Installation Window in Unit Manager Tool

The Installation window contains the following fields:

- MAC Address – the Unit unique MAC Address.
- IP Address – the Agent IP Address. This field can be configured.
- Subnet Mask – the Agent 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 – 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 – 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.
- RF Channel – the RF Channels the SU should scan. There should be at least to channels between two successive channels that the SU should scan (RF channel band). This field can be configured 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. A RSSI value must be greater the “0x40”. 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.

10.4.1. Advanced Window

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

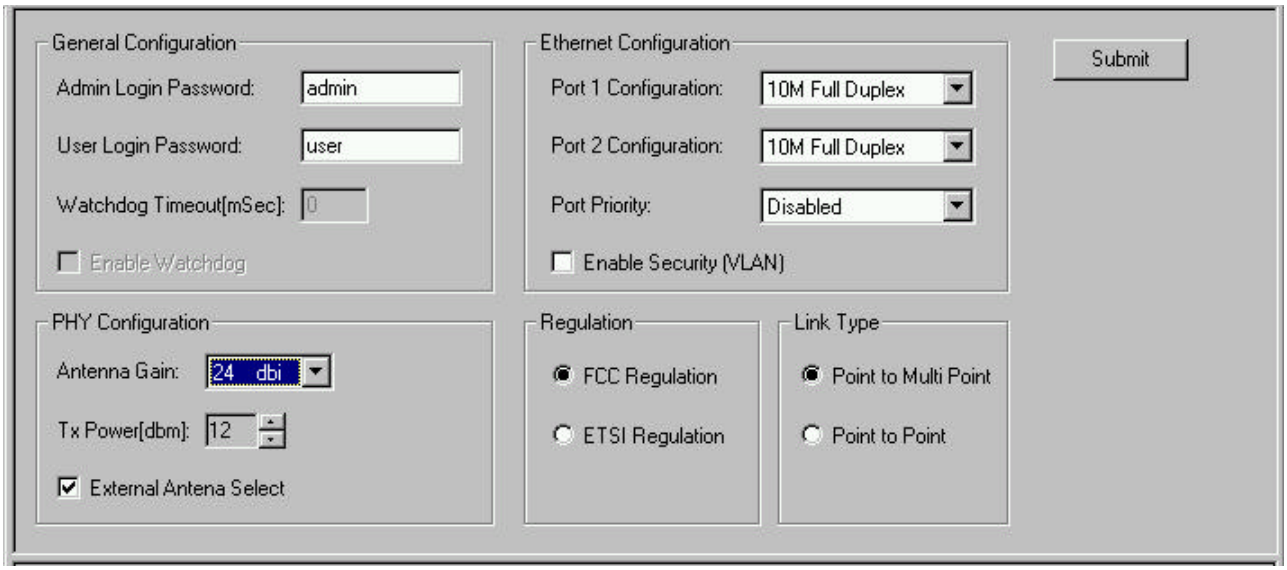

Figure 10-4: Advanced Window in Unit Manager Tool

The Advanced window contains the following fields:

- Admin Login Password – the Administrator password that should be entered when trying to login as an **Admin** user (**Admin user only**).
- User Login Password – the User password that should be entered when trying to login as a **User** user.
- Antenna Gain – select the antenna used (**Admin user only**).
- 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 only**. This TX Power value **must** be set according to the type of the antenna used in order to insure that the power at the output of the antenna **stands** in the selected **regulation restrictions**.
- Detached Antenna Select – this field is used to select Internal or Detached antenna (**Admin user only**). For now, when the **flag is set so the Internal antenna is selected**. The **default** for this flag is to use internal antenna. Detached antenna should be selected only when the unit has and **detached antenna connector**.
- 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.
- Ethernet Switch Priority – set the priority between the two Ethernet ports. Available values are: Disabled, Port 1 High Priority and Port 2 High Priority.
- Enable Ethernet Switch Security – when this flag is set, traffic between Port 1 to Port 2 is blocked (VLAN).
- Regulation – select the appropriate regulation: FCC or ETSI. (**Admin user only**).

- Link Type – select the appropriate link type: point-to-multi-point or point-to-point. (**Admin user only**). In point-to-multi-point the output power (EIRP) will never exceeds +36dBm for any antenna combination.

  In point-to-point only EIRP can exceed +36dBm according to FCC 15.247(b)(4)(i). For the 24dBi antenna gain there is no limit of the output power and it can reach the max of +18.5dBm.

  This option is only allowed by password of administrator privilege and should be done by a professional installer 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. Boot Window

The Boot Window displays the Boot Banks and the Active Boot Banks. Changes to the boot banks can be done only by an **Admin user**.

The Boot Banks are used by the Boot Loader to decide which Firmware/PLD/PHY software should be loaded. The Actual Boot Banks that show which Firmware/PLD/PHY software the Boot Loader actually loaded.

After the software was burned and verified (Software Window), the boot bank should be changed and burned by pressing Submit.

It is necessary to reconnect to the unit and verify that the burned software was loaded - the Actual Boot Bank matches the Boot Bank. If the Boot Bank and the Actual Boot Bank does not match, the image burned is corrupted and should be burned again.

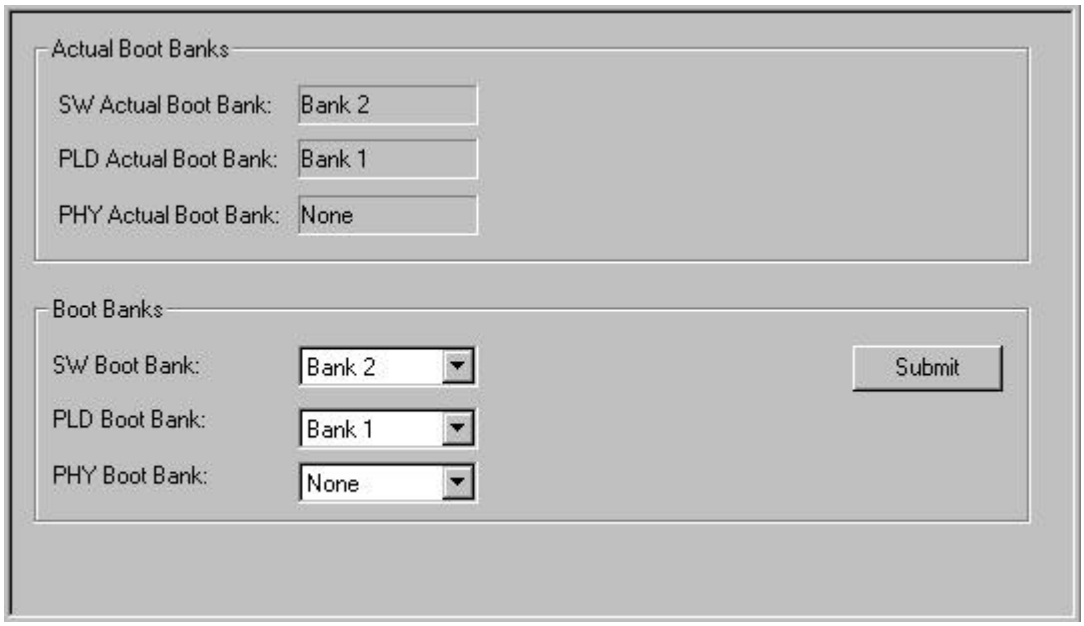

Figure 10-5: Boot Window in Unit Manager Tool

10.6. Software window

10.6.1. General

The Software Window provides information of the burned Firmware, PLD and PHY SW in the unit.

Bank Type	Size[bytes]	Version	Date	Time	Checksum
Firmware Bank 1	433008	2.01902	22/12/2002	17:12:48	0x52AABD26
Firmware Bank 2	439676	3.00000	09/01/2003	18:12:15	0x0E088F69
PLD Bank 1	491724	2.00000	08/12/2002	15:50:54	0x162353A9
PLD Bank 2	491724	2.00000	08/12/2002	15:50:54	0x162353A9
PHY Bank 1A	-1	FFFF.0FFFF	FF/FF/FFFF	FF:FF:FF	0xFFFFFFFF
PHY Bank 1B	-1	FFFF.0FFFF	FF/FF/FFFF	FF:FF:FF	0xFFFFFFFF
PHY Bank 2A	-1	FFFF.0FFFF	FF/FF/FFFF	FF:FF:FF	0xFFFFFFFF
PHY Bank 2B	-1	FFFF.0FFFF	FF/FF/FFFF	FF:FF:FF	0xFFFFFFFF

Figure 10-6: Software Window in Unit Manager Tool

The information contains the following fields:

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

Note: value of “FF” in the bank field’s means there is no software is burned in this bank.

10.6.2. Firmware Window

The Firmware Window provides the ability to burn a new firmware to one of the banks (**Admin user only**). The new software should not be burned to the actual boot Bank. The actual boot bank is displayed in the Boot Window. An alert message box is displayed if trying to burn the new software to the actual boot bank. When submitting the burn operation, log prints are printed to the log window and log file. When the burn is done the units resets and it is required to reconnect to it and check that the software was burned (View the Software Window). Finally the boot bank should be changed in the Boot Window.

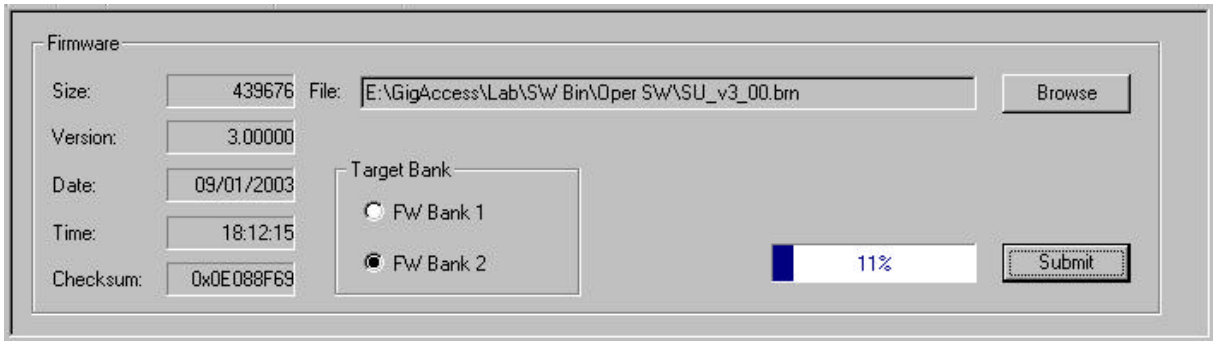

Figure 10-7: Firmware Window in Unit Manager Tool

10.6.3. PLD Window

The PLD Window provides the ability to burn a new firmware to one of the banks (**Admin user only**). The new software should not be burned to the actual boot Bank. The actual boot bank is displayed in the Boot Window. An alert message box is displayed if trying to burn the new software to the actual boot bank. When submitting the burn operation, log prints are printed to the log window and log file. When the burn is done the units resets and it is required to reconnect to it and check that the software was burned (View the Software Window). Finally the boot bank should be changed in the Boot Window.

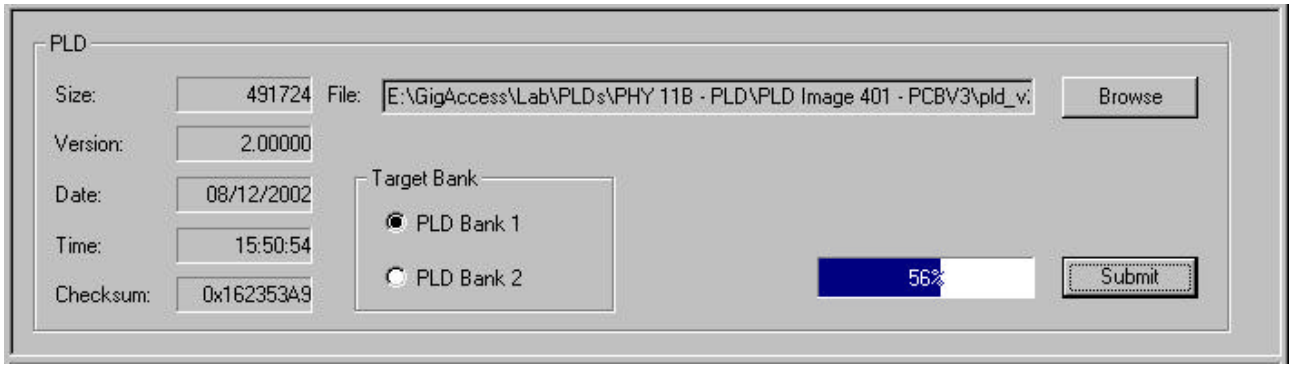

Figure 10-8: PLD Window in Unit Manager Tool

10.6.4. PHY Window

The PHY Window provides the ability to burn a new firmware to one of the banks (**Admin user only**). The new software should not be burned to the actual boot Bank. The actual boot bank is displayed in the Boot Window. An alert message box is displayed if trying to burn the new software to the actual boot bank. When submitting the burn operation, log prints are printed to the log window and log file. When the burn is done the units resets and it is required to reconnect to it and check that the software was burned (View the Software Window). Finally the boot bank should be changed in the Boot Window.

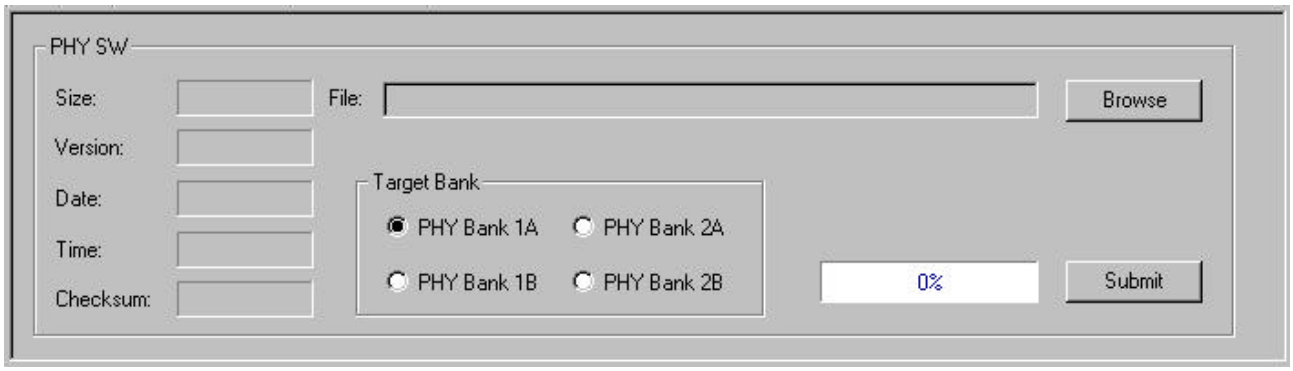

Figure 10-9: PHY Window in Unit Manager Tool