1. Introduction

1.2. GigAccess^{TM} System Overview

GigAccess^{TM} 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 100 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 as well as having the ability to integrate with service providers NMS using an SNMP interface. 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.
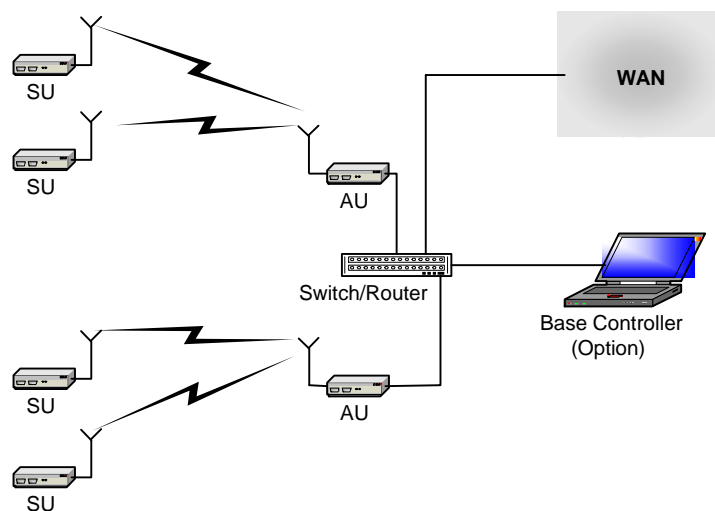

Figure 1-1: General Description of typical sector in GigAccess System

The sector uses a single radio channel frequency with certain amount of bandwidth, which in the unlicensed 2.4 GHz spectrums band carries up to 11 MBPS of data. The bandwidth is divided between the traffic from the AU to SUs (downstream) and the traffic from the SUs to AU

(upstream). The Time Domain Duplex (TDD) technique is utilized to divide the bandwidth periodically based on 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 divisions are done dynamically and allow the SUs to share the channel capacity in a very efficient way. 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^{TM} MAC layer is based on IEEE 802.16 MAC standard with additional proprietary attributes, which allow for special features such as Consecutive AP^{TM}.

GigAccess^{TM} network layer enables routing and QoS queuing of traffic based on classification of packets using 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^{TM} 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 technology. Delivering data burst rates of up to 11 MPBS, GigAccess^{TM} 2.4 ensures always-on connectivity to full range of IP-based services, including fast Internet. GigAccess^{TM} 2.4 provides an instant and independent infrastructure, which is easy to deploy with low operating costs.

In case of 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 is used as a repeater and transmit the input data over the obstacle as shown in Figure 1-3.
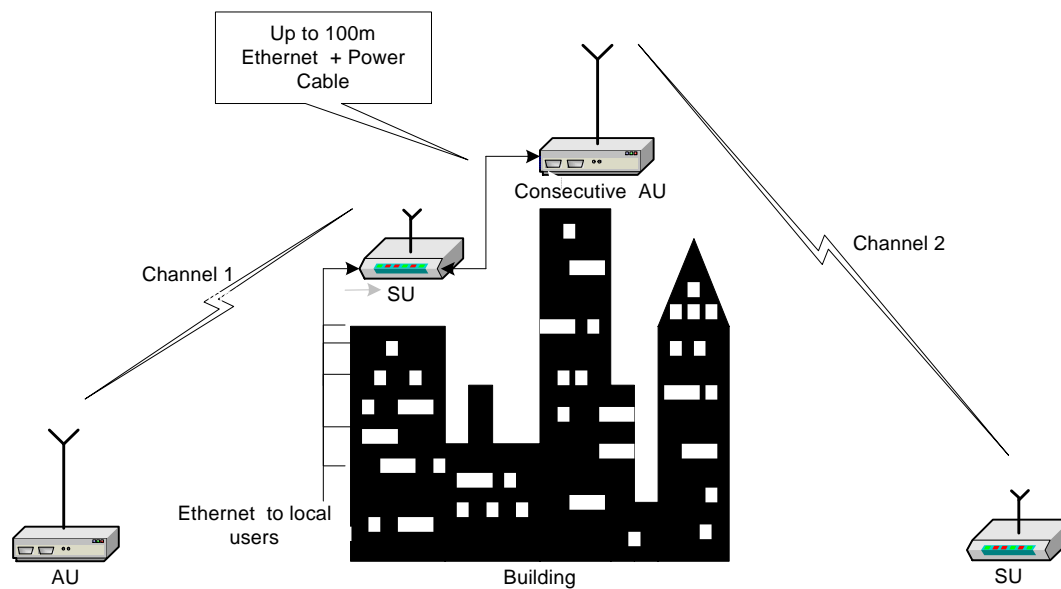

Figure 1-3: Consecutive Sector principle

1.3. Outdoor Unit General Description

SDRAM

132Mhz

power and
data port1

power and
data port2

data

data

Ethernet
Block

Digital
Block

PHY
Block

IF
Block

Filter
374Mhz

RF
Block

25Mhz
Crystal

44Mhz
Oscilator

Synthesizer
(741 - 755 Mhz)
Operate Fixed :
748Mhz

Synthesizer
(2035- 2125 Mhz)
Operating Range :
2038 - 2110 Mhz

Frequency Control

RF OUTPUT
CH00 = 2.412Ghz
CH01 = 2.417Ghz
CH02 = 2.422Ghz
CH03 = 2.427Ghz
CH04 = 2.432Ghz
CH05 = 2.437Ghz
CH06 = 2.442Ghz
CH07 = 2.447Ghz
CH08 = 2.452Ghz
CH09 = 2.457Ghz
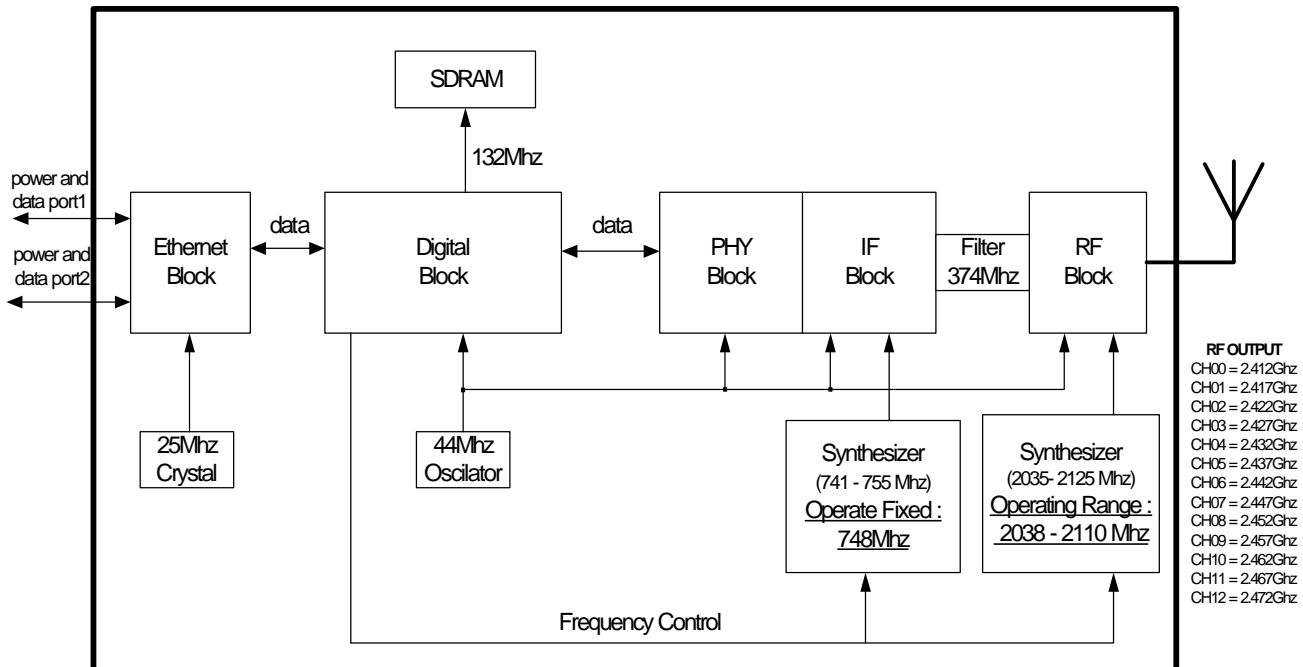CH10 = 2.462Ghz
CH11 = 2.467Ghz
CH12 = 2.472Ghz

Figure 1-4: Outdoor Unit Block Diagram

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

- **Ethernet interface** – 2 Ethernet interfaces compliant with Ethernet/IEEE 802.3. Via those connectors the 48 VDC in also injected to the system. 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** – consist 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.

2.4.3. Antennas

2.4.3.1. General

Two types of antennas are available for the GigAccess system:
- Integrated antennas
- Detached antennas

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 28 for list.

According to FCC part 15:

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

(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 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.

According to ETSI:

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

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 or +20 dBm EIRP for Europe with the attached detached antenna.

¾¾

When detached antenna installation required, the Outdoor Unit must be configured in advance by qualified personal. Configuration must comply with the FCC requirements. Fail to comply with FCC rules may expose the installer to legal liabilities.

¾¾

The outdoor unit configuration is done with the Unit Manager Tool. For detailed description of how to use the Unit Manager tool See Appendix F - Using the Unit Manager Tool, on page 34.

The antennas gain selection done with the advanced window of the Unit Manager Tool. (See paragraph 9.4.1.

The regulation (FCC or ETSI) can be select by **Admin user only**.
Once the antenna gain is selected, the max-transmitted power is auto set by the tool so that the max EIRP will not exceed the regulation limitation.

For example: if the selected antenna gain is 24dBi and the regulation is FCC the tool will set the max transmitted power (before the antenna) to +12 dBm (max EIRP = +36dBm).

¾¼

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. 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 required an alignment procedure in order to optimize the link.

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

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.

¾¼

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 9-3).

¾¼

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

¾¼

7. Secure the antenna by fastening the mounting screws.

3. GigAccess^{TM} 2.4 Technical Specifications

3.1. General Specification

Number of sectors (degrees):	Up to 18 sectors 20^0 to 360^0
SUs per sector (AU)	100
Regulatory:	FCC Part 15 compliance, UL 1950
Applications:	Access, Campus, Consecutive, 1+1

3.2. Wired LAN Interface

Compliant with:	Ethernet/IEEE 802.3 CSMA/CD
Physical Interface:	2 x 10/100 Base-T
Connector Type:	RJ-45
Protocol Supported:	IP, ICMP, ARP, TCP, UDP, SNMP, TELNET, DiffServ (TOS), FTP, TFTP, TELNET, DHCP, and HTTP
Packet classification:	Wire-speed layer 2,3, and 4

3.3. Power Supply Specifications

AC Input Voltage Range (via Indoor Unit):	100 – 240 VAC (Universal Input)
AC Input Frequency Range:	47 – 63 Hz
DC Output (from Indoor unit to Outdoor unit):	48 VDC
Power Consumption:	15 Watt

3.4. Wireless Interface

Wireless PHY Interface:	Proprietary based on IEEE 802.11b
Wireless MAC Interface:	Proprietary based on IEEE 802.16

3.5. Radio Specifications

Frequency Range:	2.400 -2.483 GHz ISM Band
RF Waveform:	Direct Sequence Spread spectrum (DSSS)
Modulation modes:	Adaptive: DQPSK, 16CCK[1], 256 CCK
Processing Gain:	10.4 dB
Forward Error Correction:	Dynamic convolution FEC
Access technology:	TDMA (Time division multiple access)
Duplexing schemes:	TDD (Time division duplex)

Transmit Power (Before the Antenna): -6÷18.5 dBm

EIRP: USA/FCC: +36 dBm (max)

                                   Europe/ETSI: +20 dBm (max)

Range(depended on antenna gain): USA/FCC: 30 Km (max) in the highest bit rate.

                                   Europe/ETSI: 7 Km (max) in the highest bit rate.

Frequency Range:	2.400 -2.483 GHz ISM Band
Number of Channels:	US: 13
	Europe: 11
Data Rates:	11 Mbps, 5.5 Mbps, 2 Mbps
Radio Sensitivity:	@2 Mbps with FEC (1.5 Mbps): -90 dBm, IE-2 PER[2]
	@2 Mbps: -88 dBm, IE-2 PER
	@5.5 Mbps with FEC (4.125 Mbps): -89 dBm, IE-2 PER
	@5.5 Mbps: -87 dBm, IE-2 PER
	@11 Mbps with FEC (8.25 Mbps): -86 dBm, IE-2 PER
	@11 Mbps: -84 dBm, IE-2 PER

3.6. Envinromental

Operating ambient Temperature	-20^{0}C to 55^{0}C
Storage Temperature	-40^{0}C to 70^{0}C
Humidity	Up to 100%
Wind Loading	110 mph
Dimensions and Weight	7" x 7" x 3"; 3lb without antenna

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[1] CCK stands for Complementary code Keying (see INTERSIL Application Note AN9850.1)
[2] PER - Packet Error Rate

4. Appendix A – WaveIP Approved Antennas

Antenna Type	Model	Gain [dBi]	Beam Width	Dimension [mm]	Ideal for:
Directional	MTI-1004/C/A	13.5	33^0	190x190x30.5	Medium Range, Multipoint links (AU)
Directional	MTI-30081/C/A	15.5	20^0	305x305x25	Medium Range, Multipoint links (AU, SU)
Directional	MARS: MA-WA24-1X	15.5	20^0	305x305x30	Medium Range, Multipoint links (AU, SU)
Directional	MTI-364023/N	16	20^0	305x305x25	Medium Range, Multipoint links(AU, SU)
Directional	MTI-345010/C/A	18	17^0	450x450x36	Long Range, Multipoint links(AU, SU)

Table 4-1: Integrated Antennas for GigAccess

Antenna Type	Model	Gain [dBi]	Beam Width	Dimension	Ideal for:
Omni Directional	Hyperlink Tech-HG2409U	8	360^0x15^0	50 cm	Short Range, Multipoint links, 360^0 coverage (AU)
Omni Directional	Hyperlink Tech-HG2410U	10	360^0x8^0	100 cm	Short /Medium Range, Multipoint links, 360^0 coverage (AU)
Omni Directional	Hyperlink Tech-HG2412U	12	360^0x8^0	120 cm	Medium Range, Multipoint links, 360^0 coverage (AU)
Omni Directional	NCG GP-24	12	360^0x5^0	5 ft + 10 inch	Medium Range, Multipoint links, 360^0 coverage (AU)
Omni Directional	NCG GP-24-3 (3 deg down-tilt)	12	360^0x5^0	5 ft + 10 inch	Medium Range, Multipoint links, 360^0 coverage (AU)
Base Station Antenn	MT-36010/HN /NV	13	90^0 – AZ 16^0 - EL	510x330x30 mm	Multipoint link (AU)
Base Station Antenn	MT-36428/HN /NV	17	90^0 – AZ 8^0 - EL	1000x330x30 mm	Multipoint link (AU)
Base Station Antenn	MARS: MA-WC24-5X	14	60^0 – AZ 12^0 - EL	600x140x30 mm	Multipoint link (AU)
Base Station Antenn	MARS: MA-WC24-6X	17	60^0 – AZ 6.7^0 - EL	1200x140x30 mm	Multipoint link (AU)
Directional	Hyperlink Tech-HG2424G	24	8^0	100.3x59.7cm	Long Range, **Point-to-point** link (AU, SU)
Directional	Andrew-26T-2400-1	23	7.5^0	99.7x60x38cm	Long Range, **Point-to-point** link (AU, SU)

Table 4-2: Detached Antennas for GigAccess