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Installation of WiMAX: Worldwide Interoperability for Microwave Access Broadband Network For GUS/Palestine/Gaza Strip and West Bank

Financial Proposal

Case Study

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1. Introduction

This document provides an overview of a draft proposal for the installation of WiMAX Broadband Network for Global University System (GUS) Gaza/West Bank at different educational institutions in various campuses in Gaza Strip.

This proposal explains the functional parts of a WiMAX system and its basic operation. You will learn how WiMAX can use base stations to provide high speed data connections that can be used for voice, data and video services to distances of over 30 km.

This document includes a technical description of WiMAX technology, WiMAX standards, a description of the WiMAX deployment options, and licensed and license-exempt WiMAX technologies for fixed access.

The rest of the proposal is organized as follows: Section 2 presents technical description of WiMAX, section 3 presents the WiMAX standards, section 4 presents WIMAX DEPLOYMENT options including fixed access and portable access, section 5 presents licensed and license-exempt WIMAX technologies for fixed access, and finally, section 5 presents design and budget.

2. TECHNICAL DESCRIPTION

WiMAX technology is a worldwide wireless networking standard that addresses interoperability across IEEE 802.16* standard-based products. WiMAX technology offers greater range and bandwidth than the wireless fidelity (Wi-Fi) family of standards and provides a wireless alternative to wired backhaul and last mile deployments that use Data Over Cable Service Interface Specification (DOCSIS) cable modems, Digital Subscriber Line technologies (xDSL), T-carrier and E-carrier (T-x/E-x) systems, and Optical Carrier Level (OC-x) technologies.

WiMAX technology can reach a theoretical 30-mile coverage radius and achieve data rates up to 75 Mbps, although at extremely long range, throughput is closer to the 1.5 Mbps performance of typical broadband services (equivalent to a T-1 line), so service providers are likely to provision rates based on a tiered pricing approach, similar to that used for wired broadband services.

The original WiMAX system was designed to operate at 10-66 GHz and it had to change to offer broadband wireless access (BWA) in the 2-11 GHz frequency range. To do this, the WiMAX standard includes variants (profiles) that use different combinations of radio channel types (single carrier –vs- multicarrier), modulation types, channel coding types to provide fixed, nomadic or portable services.

WiMAX can provide multiple types of services to the same user with different QoS levels. For example, it is possible to install a single WiMAX transceiver in an office building and provide real time telephone services and best effort Internet browsing services on the same WiMAX connection. To do this, WiMAX was designed to mix contention based (competitive access) and contention free (polled access) to provide services which have different quality of service (QoS) levels.

WiMAX protocols are designed to allow for point to point (PTP), point to multipoint (PMP) and mesh networks. Operators can use the mesh configuration to allow it to link base stations without the need to install or lease interconnecting communication lines. Some of the services WiMAX operators can provide include leased line, residential broadband, commercial broadband and digital television (IPTV) services.

WiMAX can use radio channel bandwidths that can vary from 1.25 MHz to 28 MHz and data transmission rates can exceed 155 Mbps. The types of data connections on WiMAX radio channels include basic (physical connection), primary (device control), secondary (configuration) and, transport (user data).

WIMAX systems extend the range of WIMAX systems through the use of directional antennas.

3. WIMAX STANDARDS AND DEPLOYMENT OPTIONS

It is often thought that WiMAX is one homogenous technology when in fact it is a trade name for a group of IEEE wireless standards. In that respect, WiMAX and Wi-Fi are analogous. Wi-Fi is not a standard, but a trade name that can be applied to a series of 802.11 IEEE standards, including 802.11b, 802.11a, and 802.11g.

WiMAX is a worldwide certification addressing interoperability across IEEE 802.16 Working Group standards-based products. The IEEE 802.16 standard with specific revisions addresses two usage models:

• Fixed (IEEE 802.16-2004)
• Portable (802.16 REV E).

3.1 Fixed (IEEE 802.16-2004)

IEEE 802.16-2004 is a fixed wireless access technology, meaning that it is designed to serve as a wireless DSL replacement technology, to compete with the incumbent DSL or broadband cable providers or to provide basic voice and broadband access in underserved areas where no other access technology exists; examples include developing countries and rural areas in developed countries where running copper wire or cable does not make economic sense. 802.16-2004 is also a viable solution for wireless backhaul for WiFi access points or potentially for cellular networks, in particular if licensed spectrum is used. Finally, in certain configurations, WiMAX fixed can be used to provide much higher data rates and therefore be used as a T-1 replacement option for high-value corporate subscribers.

Typically, the CPE (consumer premise equipment) consists of an outdoor unit (antenna, etc.) and an indoor modem, meaning that a technician is required to get a commercial or residential subscriber connected to the network. In certain instances, a self-installable indoor unit can be used, in particular when the subscriber is in relatively close proximity to the transmitting base station. As it does, the fixed wireless technology would introduce a degree of nomadic capability since the subscriber could travel with the CPE and use it in other fixed locations - office, hotel and coffee shop, etc. Additionally, self-installable CPEs should make 802.16-2004 more economically viable as a large part of the customer acquisition cost (installation, CPE) is dramatically reduced. Although it is technically feasible to design an 802.16-2004 data card, handheld devices with an embedded 802.16-2004 solution do not appear to be a top priority within the industry at this time.

The fixed version of the WiMAX standard was approved in June 2004. Further, base station and CPE chipsets from the major vendors are just reaching the point where potential customers are sampling them with the Intel Rosedale chipset sampling since September 2004 and Fujitsu having announced its first WiMAX chipset.

The IEEE 802.16-2004 standard (which revises and replaces IEEE 802.16a and 802.16REVd versions) is designed for fixed-access usage models. This standard may be referred to as “fixed wireless” because it uses a mounted antenna at the subscriber’s site. The antenna is mounted to a roof or mast, similar to a satellite television dish. IEEE 802.16-2004 also addresses indoor installations, in which case it may not be as robust as in outdoor installations.

The 802.16-2004 standard is a wireless solution for fixed broadband Internet access that provides an interoperable, carrier-class solution for the last mile. The Intel WiMAX solution for fixed access operates in the licensed 2.5-GHz, 3.5-GHz and license-exempt 5.8-GHz bands. This technology provides a wireless alternative to the cable modem, digital subscriber lines of any type (xDSL), transmit/exchange (Tx/Ex) circuits and optical carrier level (OC-x) circuits.
The 802.16-2004 standard allows for near line of sight operation (NLOS) and better resiliency to multipath interference than the 802.11* standard and revisions. This enables operators to deploy base stations further away from subscriber stations and within areas that have obstructed views to the subscriber, such as within a forest or among buildings in a densely populated area. The ability of a solution based on the 802.16-2004 standard to cope with multipath interference allows it to operate in various locations under extreme conditions, although deploying the solution in more favorable conditions can improve performance.

Figure 1 and Figure 2 show the WiMAX network topology for the fixed access usage model.

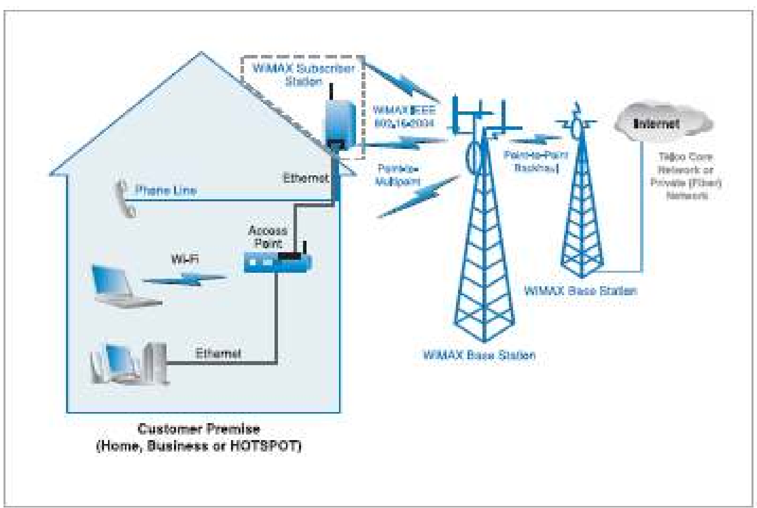

Figure 1: WiMAX Network Topology for Fixed Access Usage Model

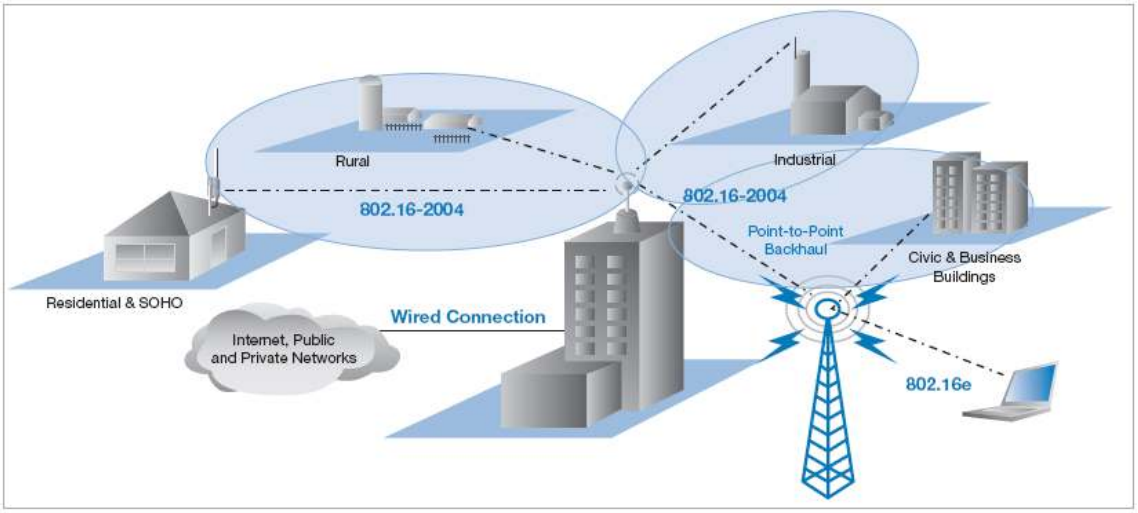

Figure 2: Fixed WiMAX deployment and usage models.

A typical WiMAX Scenario to be used in the **GUS/Palestine/Gaza Strip and West Bank** project is shown in Figure 3.

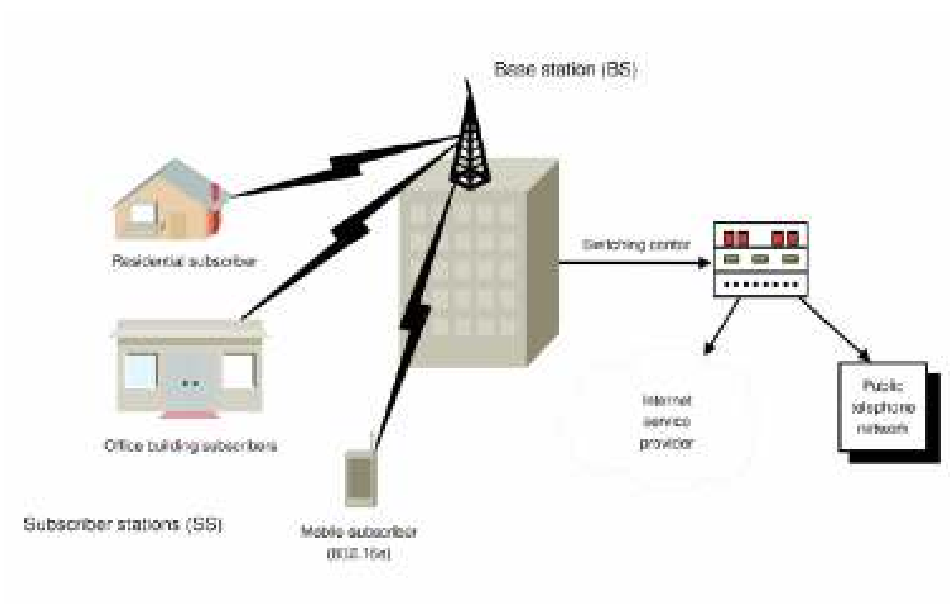

Figure 3: A typical WiMAX Scenario to be used in the GUS/Palestine/Gaza Strip and West Bank project.

Benefits of Adopting a WiMAX Fixed Solution

The ability to operate a standardized solution in both a licensed and a license-exempt band (see section 4) is one of the benefits of WiMAX solutions for deployments around the world. Both licensed and license-exempt WiMAX solutions provide significant advantages over wired solutions. The adoption of license-exempt and licensed WiMAX solutions is being driven by the following additional benefits:

1. **Scalability:** The 802.16-2004 standard supports flexible radio frequency (RF) channel bandwidths and reuse of these frequency channels as a way to increase network capacity. The standard also specifies support for Transmit Power Control (TPC) and channel quality measurements as additional tools to support efficient spectrum use. The standard has been designed to scale up to hundreds or even thousands of users within one RF channel. Operators can re-allocate spectrum through sectoring as the number of subscribers grows. Support for multiple channels enables equipment makers to provide a means to address the range of spectrum use and allocation regulations faced by operators in diverse international markets.

2. **Cost effectiveness:** The wireless medium used by WiMAX enables service providers to circumvent costs Associated with deploying wires, such as time and labor.

3. **Flexibility:** A wireless medium enables deployment of an access solution over long distances across a variety of terrains in different countries.

4. **Standard-based:** The WiMAX Forum helps support interoperability and coordination between vendors developing 802.16-2004 compliant products by testing and certifying the compliance of products.

Antennas for Fixed Wireless Applications

Directional antennas increase the fade margin by adding more gain. This increases the link availability as shown by K-factor comparisons between directional and omni-directional antennas. Delay spread is further reduced by directional antennas at both the Base Station and CPE. The antenna pattern suppresses any multi-path signals that arrive in the sidelobes and backlobes. The effectiveness of these methods has been proven and demonstrated in successful deployments, in which the service operates under significant NLOS fading.

Adaptive antenna systems (AAS) are an optional part of the 802.16 standard. These have beamforming properties that can steer their focus to a particular direction or directions. This means that while transmitting, the signal can be limited to the required direction of the receiver; like a spotlight. Conversely when receiving, the AAS can be made to focus only in the direction from where the desired signal is coming from. They also have the property of suppressing cochannel interference from other locations. AASs are considered to be future developments that could eventually improve the spectrum re-use and capacity of a WiMAX network.

3.2 Portable (802.16 REV E)

The IEEE 802.16e standard is an amendment to the 802.16- 2004 base specification and targets the mobile market by adding portability and the ability for mobile clients with IEEE 802.16e adapters to connect directly to the WiMAX network to the standard.

The 802.16e standard uses Orthogonal Frequency Division Multiple Access (OFDMA), which is similar to OFDM in that it divides the carriers into multiple subcarriers. OFDMA, however, goes a step further by then grouping multiple subcarriers into sub-channels. A single client or subscriber station might transmit using all of the sub-channels within the carrier space, or multiple clients might transmit with each using a portion of the total number of sub-channels simultaneously.

4. LICENSED AND LICENSE-EXEMPT WIMAX TECHNOLOGIES FOR FIXED ACCESS

Governments around the world recognize the value of innovations associated with open standards and license-exempt solutions and have established frequency bands available for use by licensed and license-exempt WiMAX technologies. However, to impose some control over license-exempt solutions to mitigate the potential for interference, some governments stipulate power requirements for highpower and low-power operations.

Each geographical region defines and regulates its own set of licensed and license-exempt bands, as shown in Table 1. To meet global regulatory requirements and allow providers to use all available spectrums within these bands, the 802.16-2004 standard supports channel sizes between 1.5 MHz and 20 MHz.

Table 1: Bands and frequencies available for WiMAX.

Band	Frequencies	License Required?	Availability
2.5 GHz	2.5 to 2.69 GHz	Yes	Allocated in Brazil, Mexico, some Southeast Asian countries and the U.S. (The WiMAX Forum* also includes 2.3 GHz in this band category because it "expects to cover [2.3 GHz] with the 2.5 GHz radio.") Ownership varies by country.
3.5 GHz	3.3 to 3.8 GHz, but primarily 3.4 to 3.6 GHz	Yes, in some countries	In most countries, the 3.4-GHz to 3.6-GHz band is allocated for broadband wireless.
5 GHz	5.25 to 5.85 GHz	No	In the 5.725-GHz to 5.85-GHz portion, many countries allow higher power output (4 watts), which can improve coverage.

Source: WiMax Forum*

4.1 LICENSED BANDS: 2.5 GHZ AND 3.5 GHZ

The 2.5 GHz band has been allocated in much of the world, including North America, Latin America, Western and Eastern Europe and parts of Asia-Pacific as a licensed band. Each country allocates the band differently, so the spectrum allocated across regions can range from 2.6 GHz to 4.2 GHz. A system operating in the licensed band has an advantage over a system operating in an unlicensed band in that it has a more generous downlink power budget and can better support indoor antennas.

In the US, the Federal Communications Commission (FCC) has created the Broadband Radio Service (BRS), previously called the multi-channel multipoint distribution system (MMDS), for wireless broadband access. The restructuring that followed has allowed for the opening of the 2.495 GHz to 2.690 GHz bands for licensed solutions such as 2.5GHz in WiMAX.

In Europe, the European Telecommunications Standards Institute (ETSI) has allotted the 3.5 GHz band, originally used for wireless local loop (WPLL), for licensed WiMAX solutions.

4.2 LICENSE-EXEMPT BAND: 5 GHZ

The majority of countries around the world have embraced the 5 GHz spectrum for license-exempt communications. The 5.15 GHz and 5.85 GHz bands have been designated as license exempt in much of the world.

Approximately 300 MHz of spectrum is available in many markets globally, and an additional 255 MHz of license-exempt 5 GHz spectrum is available in highly populated markets like the United States. Some governments and service providers are concerned that interference resulting from the availability of too many license-exempt bands could affect critical public and government communication networks, such as radar systems.

These countries and entities have become active in establishing limited control requirements for 5 GHz spectrums. For example, the United Kingdom is currently introducing restrictions on certain 5 GHz channels and considering enforcement of the use of the DFS (Dynamic Frequency Select) function. In Mexico, regulations requiring the use of spectrum “to benefit the people” have influenced the government to take a protectionist and revenue generating approach toward licensing. The Mexican government is moving toward licensing at least one of the 5 GHz bands, with 5.8 GHz currently a primary candidate.

4.3 CHALLENGES OF DEPLOYING A LICENSE-EXEMPT WIMAX SOLUTION

Licensed and license-exempt WiMAX solutions face common challenges related to government regulations, infrastructure placement, and interference. However, license-exempt solutions have more to prove in environments where licensed solutions are seen as more stable and reliable.

The benefits of a license-exempt WiMAX solution, including cost-effectiveness and easier entrance for new providers, can lead to additional hurdles. Easier entrance and lower costs allow more operators to deploy solutions. More deployments mean increased RF usage, a higher possibility of interference, and more competition for prime real estate for deployment. RF interference and the physical placement of the infrastructure are the primary challenges associated with deploying a license-exempt solution.

Two major challenges to overcome in deploying a WiMAX solution are:

1. **RF interference** – An interfering RF source disrupts a transmission and decreases performance by making it difficult for a receiving station to interpret a signal. Forms of RF interference frequently encountered are multipath

interference and attenuation. Multipath interference is caused by signals reflected off objects resulting in reception distortion.

Attenuation occurs when an RF signal passes through a solid object, such as a tree, reducing the strength of the signal and subsequently its range. Overlapping interference from an adjacent base station can generate random noise.

License-exempt solutions have to contend with more interference then licensed solutions, including intra-network interference caused by the service provider's own equipment operating in close proximity, and external network interference. Licensed solutions must only contend with inter-network interference. For license-exempt solutions, RF interference is a more serious issue in networks with centralized control than in a shared network because the base station coordinates all traffic and bandwidth allocation.

2. **Infrastructure placement** – Infrastructure location refers to the physical location of infrastructure elements. Infrastructure placement can be an issue for both licensed and license-exempt solutions. However, infrastructure placement presents some special considerations for license-exempt solutions. Service providers are quickly deploying solutions in specific areas to stake out territory with high subscriber density and spectrum efficiency. Such areas include higher ground, densely populated or population growth areas, and areas with a less crowded RF spectrum. In addition, the physical structure that houses or supports the base station must be RF compatible, A metal farm silo, for example, may distort signals, or a tree swaying in the wind may change signal strength.

4.4 SOLVING THE CHALLENGES OF DEPLOYING A LICENSE-EXEMPT WIMAX SOLUTION

In a license-exempt network, proper network design and infrastructure placement are critical. Interference mitigation through planning can greatly reduce interference and improve the quality of a service as shown in Figure 4 and described below:

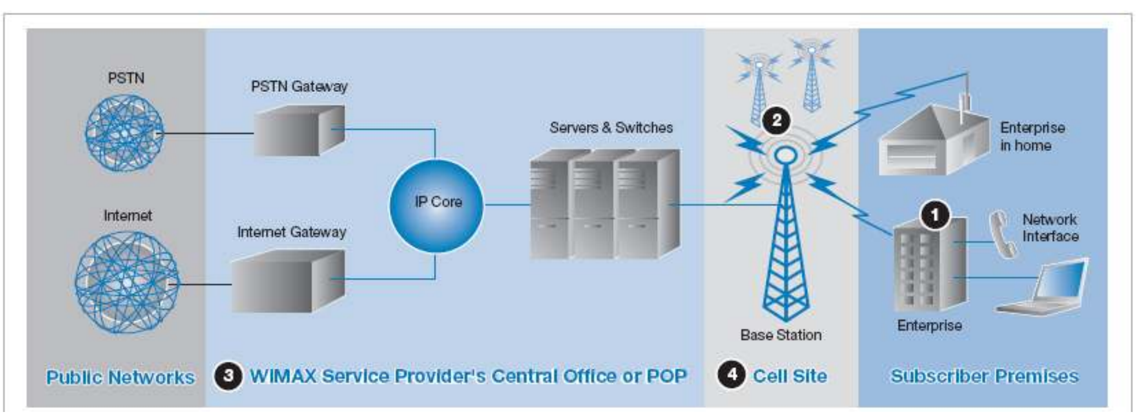

Figure 4: a properly deployed license-exempt WiMAX solution

• **Subscriber site (1)** – Professional installation of a subscriber station should include site surveys to gather information, such as RF activity within the area, and determine antenna types and tilt angles required for optimum RF reception.

• **Antennas (2)** – In addition to redundant links and proper antenna tilt angles, array gain and diversity gain can help optimize RF reception.

– Array Gain – The gain achieved by using multiple antennas so that the signal adds coherently.

– Diversity Gain – The gain achieved by using multiple paths, so that if a signal is compromised in one of the paths, overall performance is still maintained. Effectively, diversity gain refers to techniques used at the transmitter or receiver to achieve multiple “looks” at a fading channel. These schemes improve performance by increasing the stability of the received signal strength in the presence of wireless signal fading. Diversity may be exploited in the spatial (antenna), temporal (time), or spectral (frequency) dimensions.

• **Central office (CO) or point-of-presence (POP) (3)** –
The CO or POP is the provider’s network operation center. The proper design and deployment of the network operation center includes:

– Identifying user requirements
– Professional installation of base stations and antennas with appropriate tilt angles
– Providing a broadband service with typically at least 1Mbps per subscriber
– Connecting properly to the backbone
– Connecting to voice services, such as public switched telephone networks (PSTNs), and media gateways
– Implementing traffic management, routers, and firewalls
– Establishing a means to collect network statistics

• **Forward deployed base station or cells (4)** –
Providing 24/7 access, a sturdy RF-friendly structure, and shielding from weather elements can help reduce interference and improve quality of service.

4.5 IMPROVING LICENSE-EXEMPT WIMAX DEPLOYMENTS USING ANTENNA TECHNIQUES

Several solutions of license-exempt WiMAX deployments are described below and illustrated in Figure 5.

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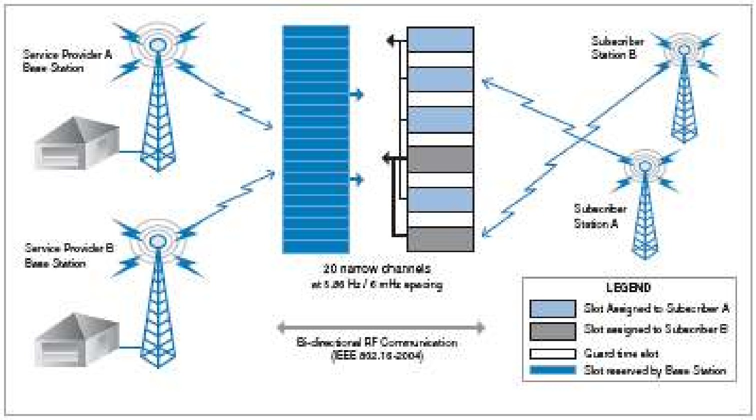

Figure 5: Improving resiliency using channelization and smart antenna technology

Antenna technology can by used to improve transmissions in two ways—through using diversity techniques and through using advanced antenna systems and switching techniques. These techniques can improve resiliency and signal-to-noise ratio but do not guarantee the transmission will not be affected by interference.

Diversity Techniques – Diversity techniques, such as multiple antennas, receivers, or transmitters, reduce multipath fading by providing alternate paths for the signal. The system selects the appropriate receiver or transmitter depending on the implemented technique. Appropriate space-time codes are applied to determine the best path. The availability of alternate paths enables improved network resiliency.

Advance Antenna Systems and Switching – This approach uses a beam forming and steering technique in which the angle, path and width of the beam is altered. By focusing the beam at a given point through power and RF coding, the quality of a signal can be improved.

5. WIMAX EQUIPMENT SPECIFICATIONS

This section describes the WiMAX equipment technical specification.

Two likely types of base stations include:

1. A standard base station:
   - Basic WiMAX implementation (mandatory capabilities only).
   - Standard RF output power for a lower cost base station (vendor specific).

2. A full featured base station
   - Higher RF output power than standard base station (vendor specific).
   - Tx/Rx diversity combined with space-time coding and MRC reception.
   - Sub-channeling.
   - ARQ.

Both the standard and full-featured base stations can be WiMAX compliant, however the performance that can be achieved by each is quite different. Table 2 shows the amount of differentiation between the two different types, for a reference system configuration. It is important to understand that there are a number of options within WiMAX that give operators and vendors the ability to build networks that best fit their application and business case. *The uplink maximum throughput in Table 2 assumes that a single subchannel is used to extend the cell edge as far as possible.

Table 2: Full featured base station versus Standard base station comparison

Assumptions	Frequency: 3.5 GHz Bandwidth: 3.5 MHz Per 60^{o} sector	Full featured		Standard	
		From	To	From	To
Cell radius (km)	LOS	30	50	10	16
	NLOS (Erceg-Flat)	4	9	1	2
	Indoor self-install CPE	1	2	0.3	0.5
Maximum throughput per sector (Mbps)	Downlink	11.3	8	11.3	8
	Uplink	11.3	8	11.3	8
Maximum throughput per CPE at cell edge (Mbps)	Downlink	11.3	2.8	11.3	2.8
	Uplink	0.7	0.175	11.3	2.8
Maximum number of subscribers		More		Less	

6. GUS/GAZA STRIP AND WEST BANK WIMAX NETWORK DESIGN AND BUDGET

6.1 Gaza Strip Map

This section describes the required equipment for deploying WIMAX network for **GUS/Palestine/Gaza Strip and West Bank** project. The project will connect Gaza strip universities and schools with WiMAX network.

The Gaza Strip area is approximately 365 Km^2. It has a geographic location with Latitude/Longitude: 31/34. Also it has a long beach about 41 Km. the weather is maritime temperature over sea. The land is a seaboard means doesn't contain mountains, rivers and density forests. Gaza Strip geographical map is shown in Figure 6.

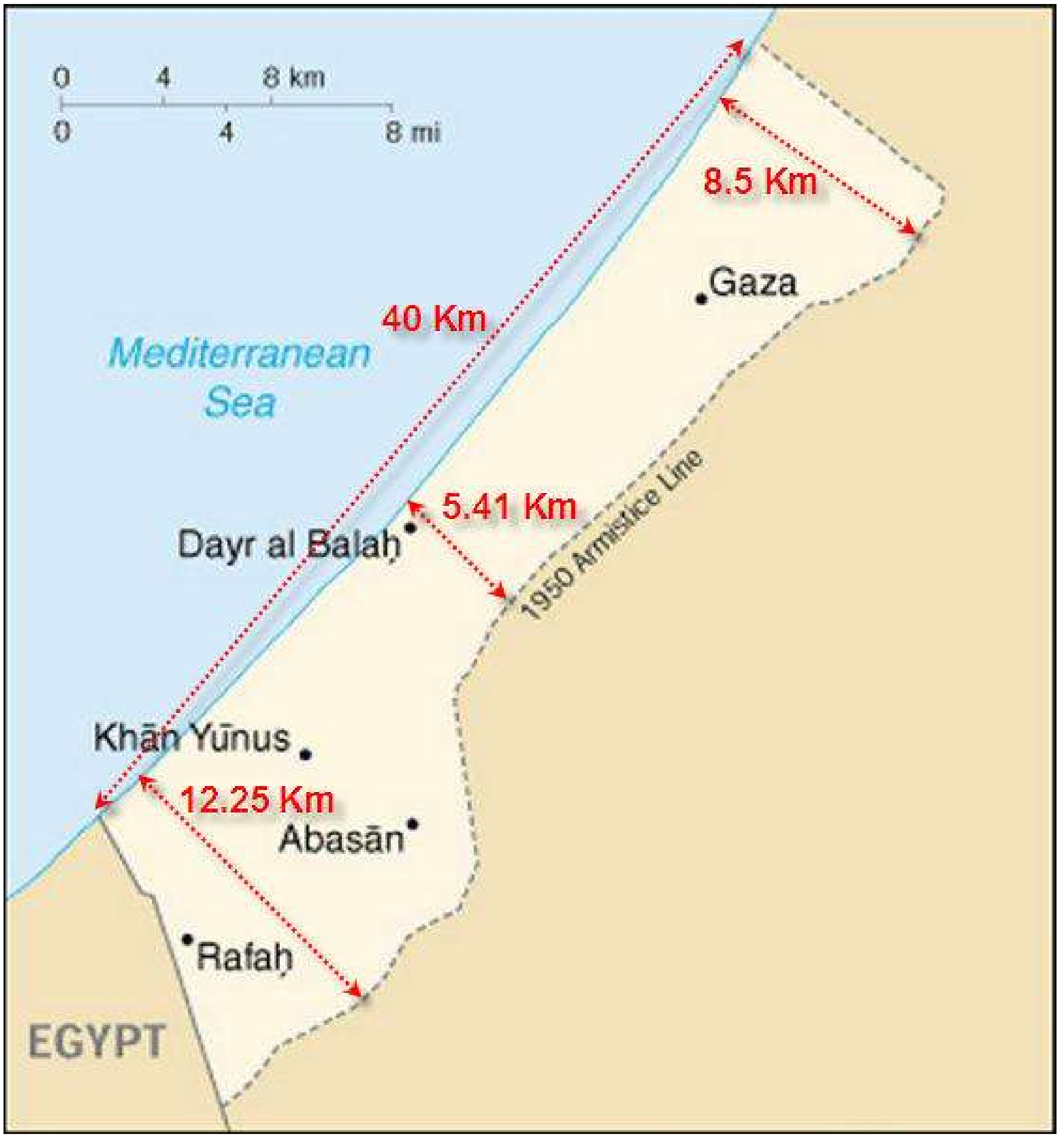

Figure 6: Gaza Strip Map

The land property of Gaza Strip is divided into three levels as shown in Table 3.

Table 3: Levels of land property of Gaza Strip

region	Height above the sea
The South	70 meter
The Middle	30 meter
The North	50 meter

Figure 7 shows these Levels of land property of Gaza Strip geographically.

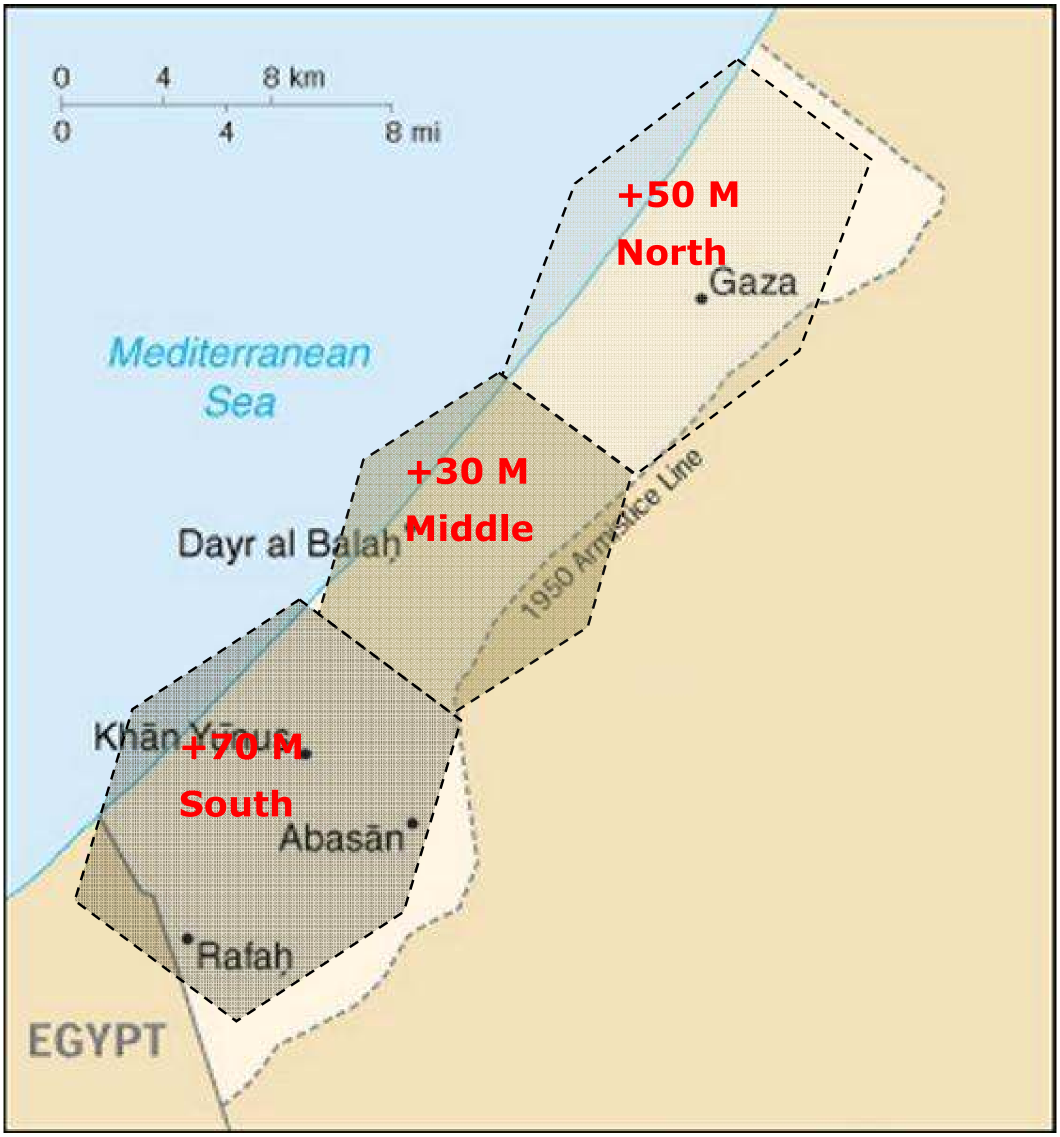

Figure 7: Levels of land property of Gaza Strip

6.2 Gaza Strip Universities and Schools Distribution

Table 4 shows the Distribution of students at K-12 Schools in Gaza Strip

Table 4: Distribution of students at K-12 Schools in Gaza Strip

Number of Students	*Number of K-12 schools*	*Region*
18614	45	Gaza
9133	19	North Gaza
10527	23	Khan Younos
7141	15	Rafah
8450	19	Middle of Gaza
53865		

Table 5 shows the Distribution of students at Higher Education Institution in Gaza Strip (H.E.I) 2005/2006

Table 5: Distribution of students at Higher Education Institution in Gaza Strip (H.E.I) 2005/2006

Higher Education Institution	*Number of Students*
Traditional Universities	25472
Open Universities	19957
University Colleges	2622
Community Colleges	6887
Total	54934

Table 6 shows the list of universities and colleges in Gaza strip based on their categories.

Table 6: list of universities and colleges in Gaza strip based on their categories

	Traditional Universities	Open Universities	University Colleges	Community Colleges
1	Al-Azhar University	Al-Quds Open University	Palestine Technical Deir Al-Balah	Intermediate Studies - Al-Azhar
2	The Islamic University		Science and Technology College	Applied Science & Tech – Al-Islamiyah
3	Al-Aqsa University		Palestine Nursing	Gaza Community
4			Al-Dawa College	Gaza Comm. For Tourist Studies

6.3 Equipment Cost

Figure 8 shows the key components of a basic WiMAX radio system. This diagram shows that the major components of a WiMAX system include subscriber station (SS), a base station (BS) and interconnection gateways to datacom (e.g. Internet) and telecom (e.g. PSTN). An antenna and receiver (subscriber station) in the home or business converts the microwave radio signals into broadband data signals for distribution in the home. In this example, a WiMAX system is being used to provide telephone and broadband data communication services. When used for telephone services, the WiMAX system converts broadcast signals to an audio format (such as VoIP) for distribution to IP telephones or analog telephone adapter (ATA) boxes. When WiMAX is used for broadband data, the WiMAX system also connects the Internet through a gateway to the Internet. This example also shows that the WiMAX system can reach distances of up to 50 km when operating at lower frequencies (2-11 GHz).

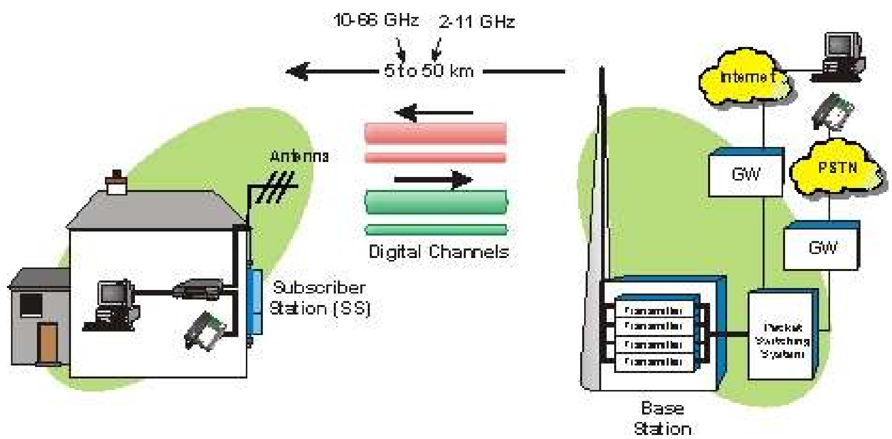

Figure 8: A typical WiMAX Scenario to be used in the GUS (Gaza/West Bank) project.

Table 7 shows the Frequency Allocation in Gaza Strip.

Institution/ Company	Used Frequency
Palestinian Cellular Communications Company (Jawwal)	806-880 MHz.
Palestinian Communications Company (PALTEL)	13, 18, 21 GHz and upper 6 GHz
Fusion Internet Company (ISP)	4.2, 2.4 GHz ISM
UNRWA	3.2 GHz

Figure 9 shows the WiMAX network design for Gaza Strip.

Figure 9: WiMAX network design for Gaza Strip

Our design is depend on dividing the area into cells, as shown in Figure 9 above.

Each cell covers approximately area of 5 Km radius, and can serve 120 users at least, with bandwidth of 512 Kbps in the worst case. Each cell contains one base station, with the following specifications:

Each cell will be bridged with the others by backhaul system that can support 70Mbps data rate, and can cover distance of 20 mile at least. Table 8 shows the WiMAX equipment required for the **GUS/Palestine/Gaza Strip and West Bank** project and Budget.

Table 8: WiMAX equipment required for the **GUS/Palestine/Gaza Strip and West Bank** project and Budget

#	Item	Quantity	Price US$	T Price US$
1.	WiMAX Base Station with 6 sectors, 60 degrees sectorial antennas and cables, total capacity - 72Mbps Net FD per BS	5	123,500	617,500
2.	- Complete Subscriber Unit, Indoor Network Interface Unit and Power supply + Outdoor radio unit, Integrated antenna, Indoor to Outdoor Cat5 20 Meter cable included. , Full Data Bridge, 6Mbps data rate	140	2080	291,200
3.	Full Point to Point link, 54Mbps Gross, including IDU + ODU + Antennas + cables	4	12350	49,400
4.	Steel Tower for Clients	140	156	21,840
5.	Cisco 1700 router	140	1040	145,600
6.	Cisco 3600 router	5	2765	13,825
Total				**US $ 1,139,365**

NOTE:

The above cost includes only the basic local design for **Gaza Strip**, but in case we want to extend the network to connect to West Bank and other countries, the cost may vary depending on frequency licensing governmental rules in the area.

6.4 Personnel Cost

Assistance in the detailed Network design includes:

1. Specify equipment
2. Consideration of space requirements for facilities to house the electronic equipment and the required environment to meet the equipment's specifications
3. Assist in the development of selected user locations, interface equipment, and networking platform for the delivery of high-speed data transmission services.
4. Recommendations on the operating platform gear and network monitoring system
5. Recommend network and systems integration
6. Provide equipment estimates

The project period is 3 years. This period is to install the WiMAX in Gaza Strip.

The project team consists of qualified and experienced personnel. The project team utilizes a matrix organization system in which a designated Project Manager is assigned the responsibility for the administrative activities of the project team. The technical manager is assigned the technical activities of the project team. Table 9 shows the personnel needed to implement the project and their cost.

Table 9: personnel needed to implement the project and their cost

Personnel title	Number of Personnel	Monthly Salary	Months	Total cost US$	Responsibilities
Project Coordinator	1	3000	36	108,000	Project Principal and Manager
Technical Manager	1	2000	36	72,000	Project technical management
Technical Engineer	4	1000	36	144,000	Logical network design of the project, supervision of implementation
Technician	10	500	36	180,000	Physical network work and installation of equipment
Secretary	1	700	36	25,200	Secretarial work
Technical Consultant	2	1500	36	108,000	Providing technical consultation services to project coordinator and technical manager
Grand Total of Personnel cost				**US$ 637,200**	

6.4.1 Project Management Services

1. Providing overall project direction
2. Assist with bid document preparation
3. Coordinate all external and internal communications
4. Coordinate all work associated with contractors
5. Distribute all necessary project related documentation.

6.4.2 Project Consultation Services

1. Provide consultation services during construction, answer questions, etc…
2. Meet periodically with the sponsors of the project to provide general project management assistance.

Travel Cost

Table 10 shows the travel cost.

Table 10: Travel cost

Travel	Unit	Number of units	Unit rate	Total cost
International Travel	Per journey	1 per month (36 months)	2000	36,000
Local Transportation	Per month	1 per month (36 months)	500	18,000
Total Travel				**US$ 54,000**

Local Office/Project Cost

Table 11 shows the **Local Office/Project** cost.

Table 11: **Local Office/Project** cost

Local Office/Project Costs		Number of units	Unit rate	
Office Running Costs (tel, phone, electricity etc)	Total provision	1	100,000	100,000
total Local Office/Project Costs				**100,000**

Telecommunication Costs

Table 12 shows the **Telecommunication** cost.

Table 12: **Telecommunication** cost

Telecommunication Costs	Per annum	3	35,000	105,000
Subtotal Other				**105,000**

Total Project Cost

Table 13 shows the **Total Project** cost.

Table 13: **Total Project** cost

Equipment (Table 8)	1,139,365
Personnel Salaries • Administrative cost • Management cost • Consultation cost • Implementation cost	637,200
travel	54,000
Local Office/Project Costs	100,000
Telecommunication Costs	105,000
Total Project Cost	**US $ 2,035,565**

7. Project Sustainability

At its completion date (the end of the 3 year financing period), the GUS (Gaza/West Bank) project aims to be operating independently and self-sufficiently, offering broadband network services (video conferencing, audio conferencing, Telephony, video on demand, etc.) to the Gaza Strip area. GUS (Gaza/West Bank) aims to offer a large number of high-quality eLearning and eHealthcare services across Gaza Strip through the participating institutions and schools. All partners are highly reputable universities and schools that already have the expertise and know-how in delivering classroom courses. The international partners will help to provide the training required to transform online teaching and learning methodologies. The services offered through the project will be charged based on its quality and duration. An NGO will be established at the end of the project to supervise and manage the project and convert it into a business model.

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