

System Planning, Design and Analysis

WiMAX

As an Inexpensive Source of Effective

Communication for Islamabad:

A Research Paper

By

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Executive Summary:

This paper is completed to explore the WiMAX (Worldwide Interoperability for Microwave Access) technology and its application in the developing regions like Islamabad, Pakistan. I am strongly convinced that Information Communication Technologies play an important role in the regional and human development¹ like use of Global Emerging Infectious Systems mentioned in the Voxiva case.

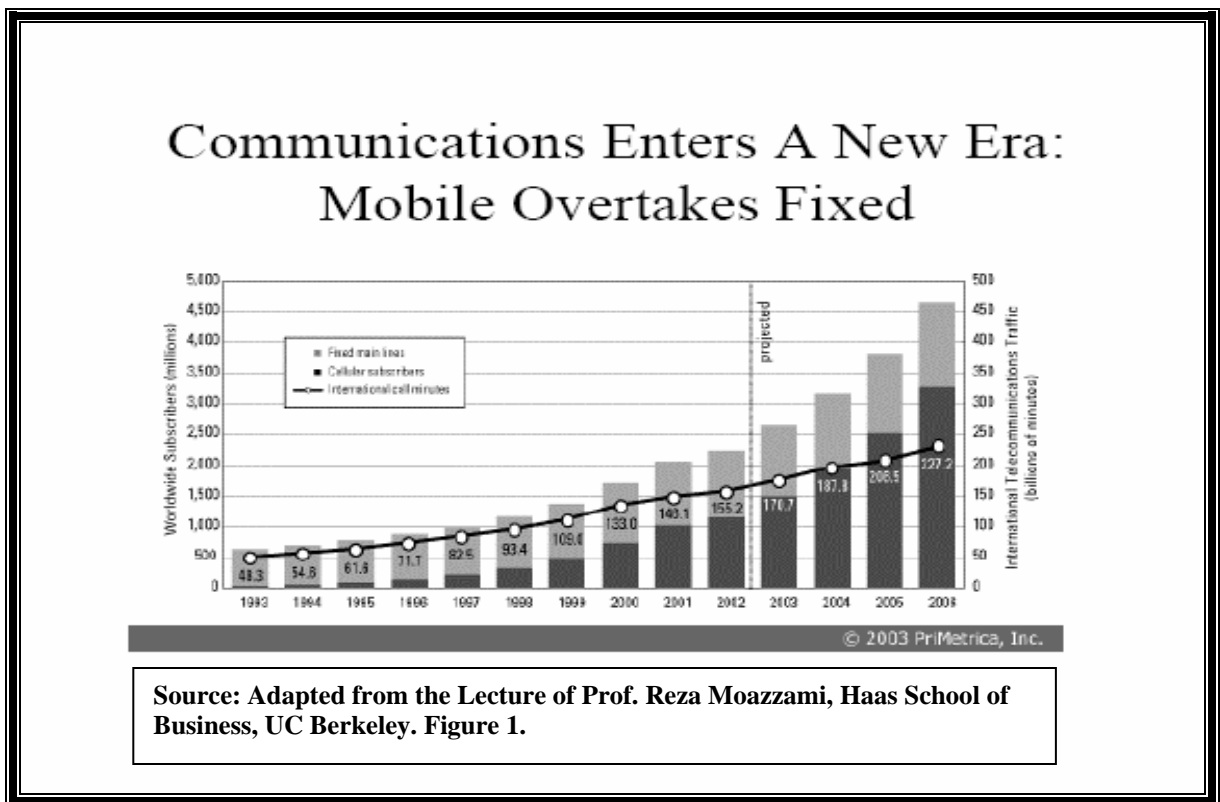
To better understand, this paper has been divided into three parts.

1. Global Telecommunication Environment; PriMetrica Inc. research (fig.1) shows that the Mobile communication has taken over the fixed. Morgan Stanley research in figure two shows that from 2003 onward there are more subscribers in the developing world than the developed world. Allied Business Research in figure three shows there is going to be 260 millions broad band lines by 2008.
2. Pakistan's Telecommunication Environment; because of the liberal approach by the government revolutionary policies has been adopted to enhance the Pakistan telecommunication sector. In 2003, call party billing was introduced in the country and the subscriptions jump from 225,000 in 2001 to 3.56 millions in 2003. At the same time government decided to open the market for new entrants.
3. The WiMAX Technology and Islamabad; because of the unique location, highest literacy rate in the country, and all jobs related to service sector it offers a great opportunity for emerging technologies like WiMAX.

After studying the research material by Tony Salvador; Research paper on use of technologies in developing nations, Prahalad and Hammond; Serving the Poor, Profitably as well as Amartya Sen and Jean Dreze comparison of India and China, I am convinced that the information communication technologies play an important role in the regional and human development.

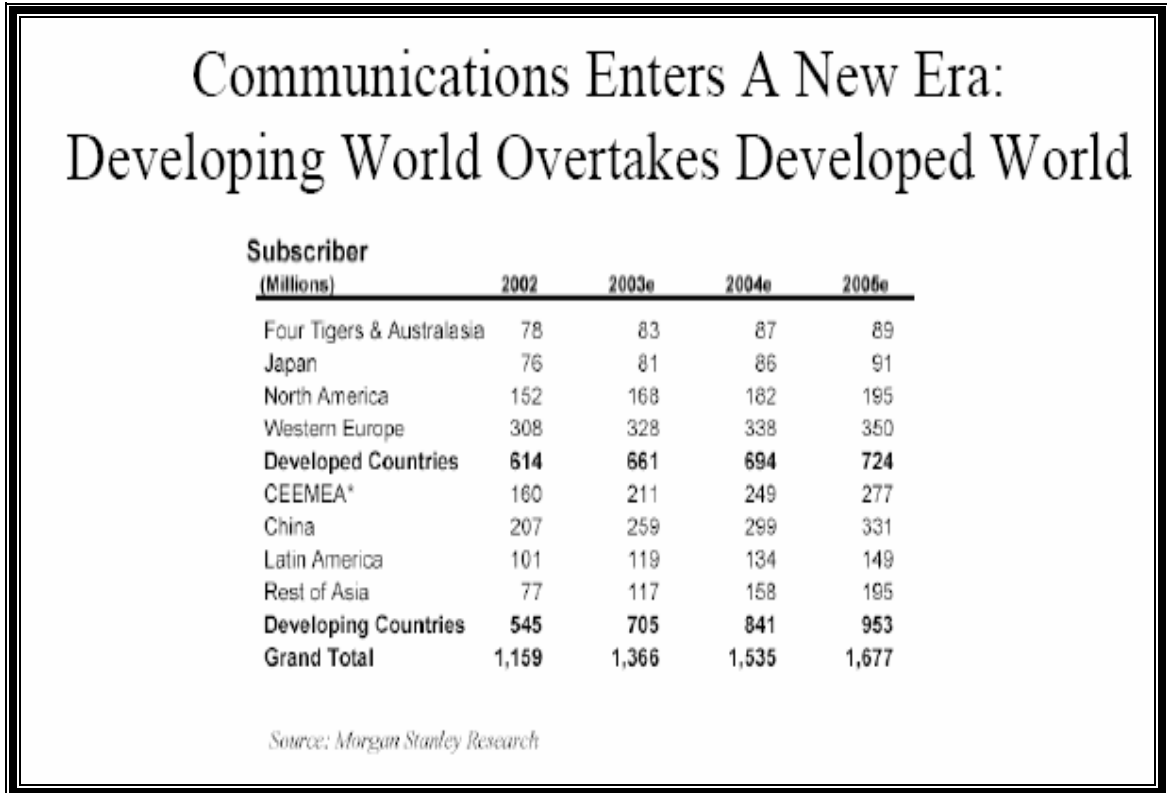
¹ Michigan Business School, Voxiva Case Study, GEIS, Released December 12, 2003, Page # 5.

The worldwide telecommunication market has been changing due to the advancement in technologies and special focus by the governments in the developing regions to enhance the telecommunication sector. Mobile communication has taken the lead in the developing regions due to economics and convenience. Fixed main lines, Cellular Subscribers and International Call minutes, has been displayed in the following figure to show how rapidly the mobile communication is advancing in the developing regions.



Worldwide Market for Telecommunication:

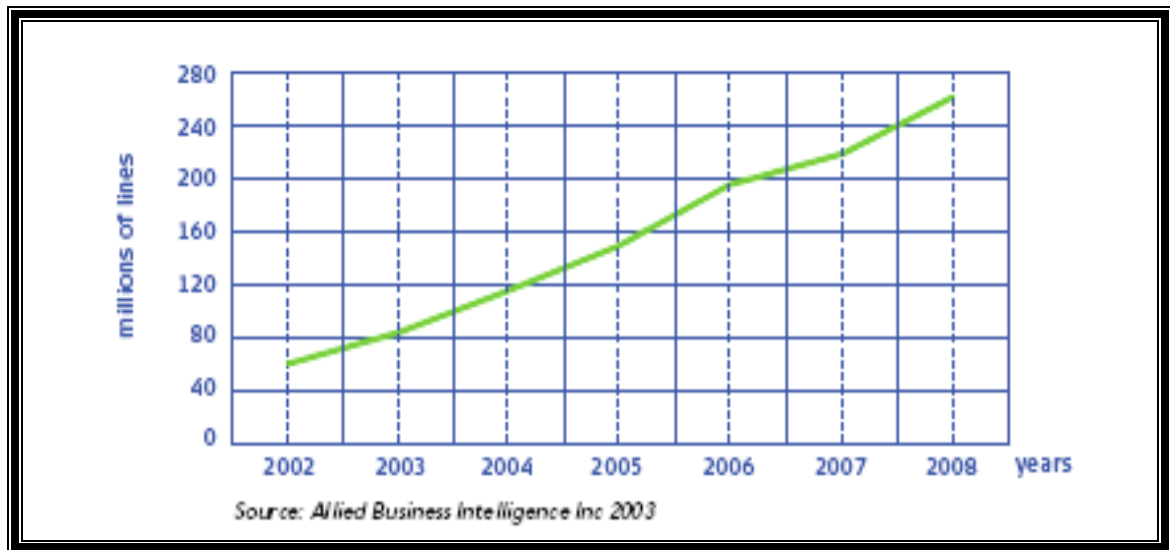
The following figure title; Communication Enters a New Era: Developing World Overtakes Developed World shows that the developing world would have more subscribers for the mobile communication than the developed world. The estimated data for the year 2003 to 2006 represent the highest growth in subscribers in the developing regions. This is the start of a new era as less expensive mobile technologies like WiMAX are just to be introducing in the developing nations.



**Source: Adapted from the Lecture of Prof. Reza Moazzami at Haas School Of Business,
UC Berkeley. Figure 2.**

This following research is completed by Allied Business Intelligence Inc² in 2003. This healthy growth curve shows that the demand would continue to grow in the next few years. In 2002 there were installed base of 57 millions broadband lines and that increased to 80 millions in 2003.

Worldwide Broadband Market Growth



(Source; Adapted from Alvarion Inc. a white paper on WiMAX technology Figure 3.)³.

This healthy growth curve would continue once less expensive laptops like the one promised by MIT's Media Lab⁴ for dollar one hundred or less is available in the market. Once these inexpensive computers are available in the market the demand for broadband would go-up dramatically in the developing nations⁵. At the moment the big barrier for the developing nations is the lack of affordable computers and extremely expensive broadband services.

After viewing the global telecommunication I would explore the Pakistan telecom environment.

² http://www.infomine.com/index/suppliers/Allied_Business_Intelligence,_Inc..html

³ http://www.alvarion.com/RunTime/Materials/pdffiles/Wimax_wp.pdf Page # 2

⁴ <http://www.cnn.com/2005/TECH/ptech/04/04/hundred.dollar.laptops.ap/index.html>

⁵ USTDA South Asia Communications Infrastructure Conference, New Delhi, India – April 21-23, 2004 page # 6.

Pakistan map:



Source: CIA World Fact Book 2003, Figure 4.

*The Unique Location,
economic advancement and highest
literacy rate in the country makes
Islamabad an ideal place for
WiMAX.*

The Telecom Policy environment in Pakistan⁶:

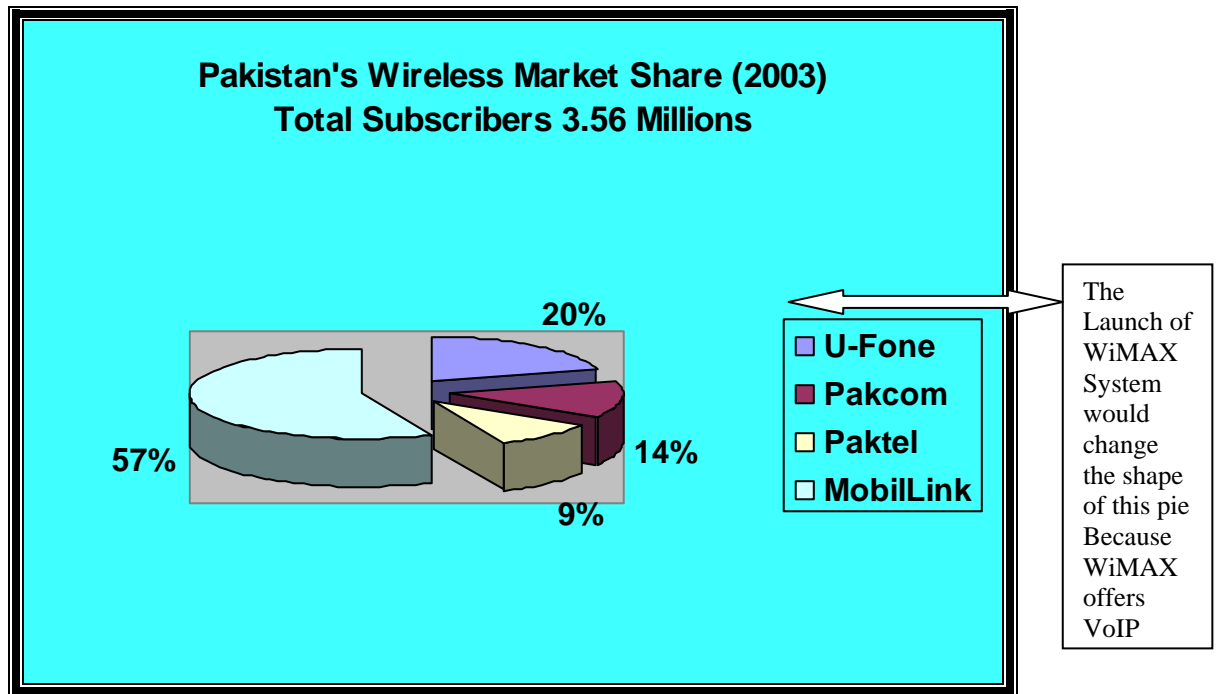
Pakistan has adopted a traditionalist approach to the telecommunication sector in the past. The state owned Pakistan Telecommunication services served as a cash cow. Pakistan Telecom in the past adopted a business model just to maintain and secure its monopoly. Pakistan Telecom through bureaucratic channels succeeded in imposing new tariffs, high taxes on devices and carriers that slowed the market demand, it directed the investment to rural areas disproportionately for the pleasure of political lords.

Pakistan has recently taken three steps on extreme priority basis to reform the Telecom industry.

- Opening the market for competition through minimal licensing requirement
- Restructuring and privatizing the PTCL
- Updating mobile sector policy and introducing new operators

⁶ USTDA South Asia Communications Infrastructure Conference, New Delhi, India – April 21-23, 2004

The following data is adapted from South Asia Association of Regional Co-Operation (SAARC) conference that took place in New Delhi⁷.



Source: PriMetrica Globalcomm, Figure 5.

In January 2001 there were only 2, 25, 000 mobile phone subscribers. The same year call party pay billing was introduced in the country and it caused rapid penetration in the mobile phone market. By the end of 2003 there were 3.56 million subscribers and industry experts estimate that the market may be 15 to 17 million subscriber by year 2006- 2007⁸. Once the market is open for new entrants and new services like WiMAX are available in the market the existing market share would change.

⁷ USTDA South Asia Communications Infrastructure Conference, New Delhi, India – April 21-23, 2004 page # 6.

⁸ USTDA South Asia Communications Infrastructure Conference, New Delhi, India – April 21-23, 2004 page # 10,

Pakistan Internet and Mobile Phone Data: Table 1.

(Source; CIA World Fact Book 2003)

Internet Hosts	15, 124
Internet Users	1.5 Millions
Telephone Mainlines in use	3, 982, 800
Mobile Phones in use	2, 624, 800

This data about telecommunication was published in the CIA World Fact Book 2003. The most interesting thing in the table is the row four that shows the mobile phones in use in the year 2003 in the country 2, 624, 800. Mobile phone operations were just started less than a decade ago whereas the conventional telephone lines have always been in operation. The convenience, affordability and the reliability of service are the factors in the growth of wireless industry. If better and inexpensive hand held devices like Palm Pilot are available in the market or laptops under one hundred dollars promised by the MIT's Media Lab then there would be a dramatic jump because affordability would not be a serious issue like we have seen in the table 1.

Pakistan Telecommunication Data: Table 2.

Source: Adapted from Euromonitor Database.

	1999	2000	2001	2002	2003	2004
Personal computers (PCs) in use ⁹ ('000)	580	590	600	687.61	784.92	892.97
Online households ¹⁰ (mn)	-	0.02	0.03	0.04	0.05	0.06
PC households online ¹¹ (% of PC households)	-	23.72	31.45	42.45	53.88	57.88
Internet users ¹² ('000)	80	300	500	1500	2494.76	4355.91
ISDN subscribers ¹³ ('000)	2	3.03	4.03	4.9	5.81	6.73
Availability of digital main lines ¹⁴ (% of telephone main lines)	94	94	94	96	95.34	95
Capital investment in telecommunications ¹⁵ (PKR mn)	11212	13458	8657	10104	8827.25	8947.03
Telephone lines in use ¹⁶ ('000)	2986	3053	3252	3655	3888.17	4121.34
National telephone calls ¹⁷ (mn minutes)	14897.67	16308.67	18178.53	20712.91	23104.31	25731.62
International outgoing telephone calls ¹⁸ (mn minutes)	87	99	110	128	134.5	141
Mobile telecommunication revenues ¹⁹ (% of telecom revenue)	-	15.18	19.48	22.3	-	-

⁹ Personal computers (PCs) in use : Euromonitor from International Telecommunications Union/national statistics

¹⁰ Online households : Jupiter Research

¹¹ PC households online : Jupiter Research

¹² Internet users : International Telecommunications Union/World Bank/Trade Sources/Euromonitor

¹³ ISDN subscribers : Euromonitor from International Telecommunications Union/national statistics

¹⁴ Availability of digital main lines : Euromonitor from International Telecommunications Union/national statistics

¹⁵ Capital investment in telecommunications : Euromonitor from International Telecommunications Union/national statistics

¹⁶ Telephone lines in use : Euromonitor from International Telecommunications Union/national statistics

¹⁷ National telephone calls : Euromonitor from International Telecommunications Union/national statistics

¹⁸ International outgoing telephone calls : Euromonitor from International Telecommunications Union/national statistics

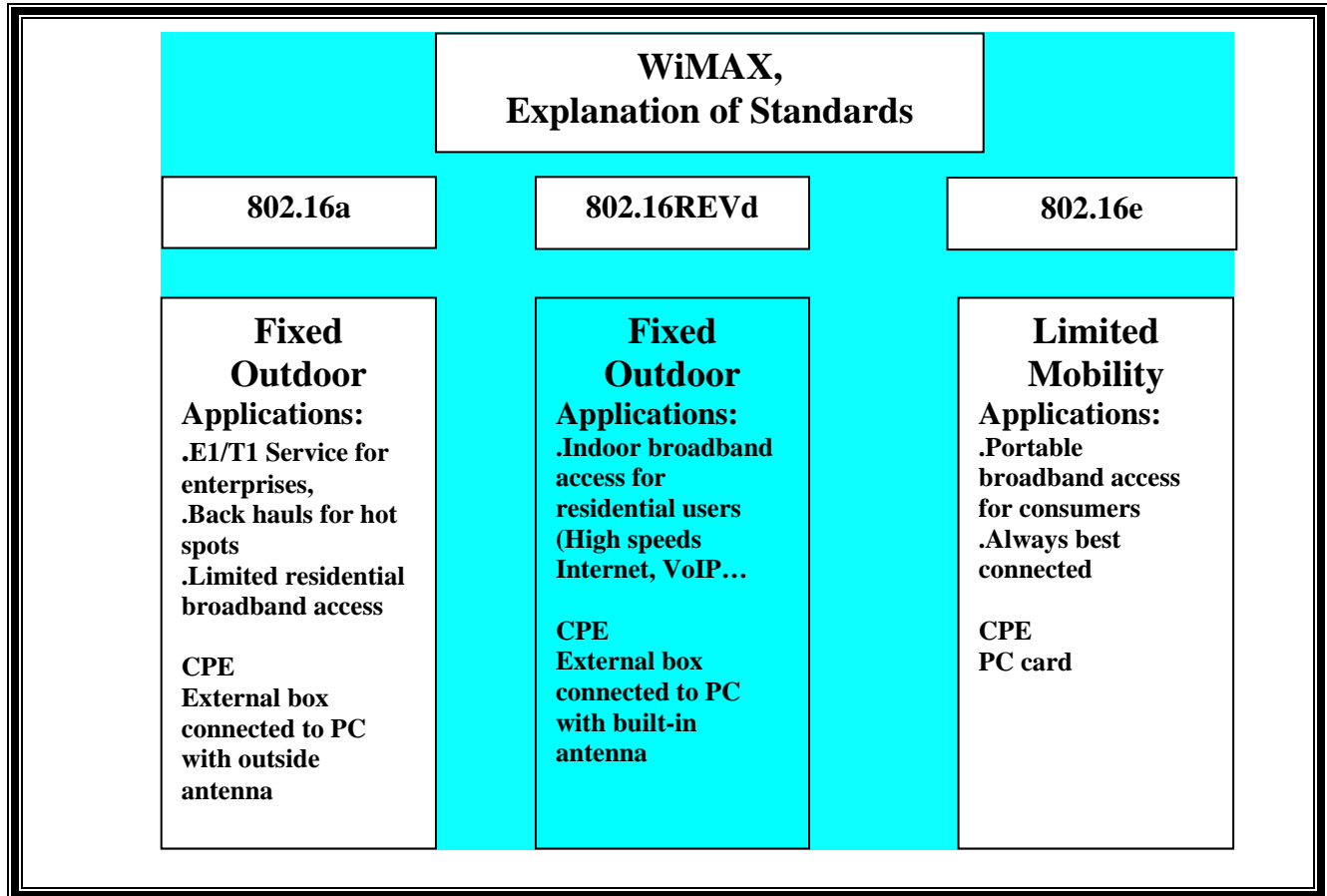
¹⁹ Mobile telecommunication revenues : ITU

Internet Projected Data:	2004	2005	2006	2007	2008	2009
Personal computers (PCs) in use ^{S1} ('000)	892.97	1012.91	1145.9	1292.99	1455.3	1634.09
Online households ^{S2} (mn)	0.06	0.07	0.09	0.1	-	-
PC households online ^{S3} (% of PC households)	57.88	68.98	71.49	73.43	-	-
Internet users ^{S4} ('000)	4355.91	8836.28	14638.53	19764.05	23152.92	25178.93
ISDN subscribers ^{S5} ('000)	6.73	-	-	-	-	-
Availability of digital main lines ^{S6} (% of telephone main lines)	95	-	-	-	-	-
Capital investment in telecommunications ^{S7} (PKR mn)	8947.03	-	-	-	-	-
Telephone lines in use ^{S8} ('000)	4121.34	-	-	-	-	-
National telephone calls ^{S9} (mn minutes)	25731.62	-	-	-	-	-
International outgoing telephone calls ^{S10} (mn minutes)	141	-	-	-	-	-
Mobile telecommunication revenues ^{S11} (% of telecom revenue)	-	-	-	-	-	-

Please see sources at the end of paper and page 5 for footnotes.

What is WiMAX?

Worldwide Interoperability for Microwave Access (WiMAX)²⁰ is the common name associated to the IEEE 802.16a/REVD/e standards.



Source: Adapted from Alcatel white paper, Figure 6.

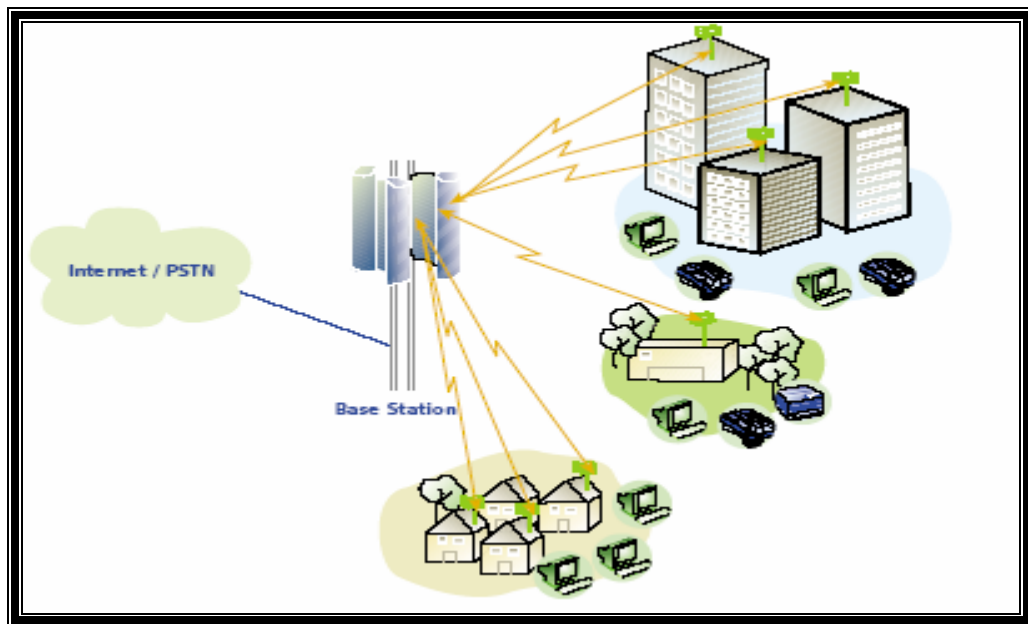
WiMAX²¹ –compliant systems will provide a cost-effective fixed wireless alternative to conventional wire-line DSL and cable is something promised by the WiMAX manufacturers. More importantly the WiMAX technology would provide cost-effective broadband access solution in the areas beyond the reach of DSL and cable in the Islamabad and other northern areas in Pakistan where spreading the copper wired network is difficult due to due to barren hills.

²⁰ WiMAX, making ubiquitous high-speed data services a reality, White paper by ALCATEL page # 1

²¹ The business case for fixed broadband wireless access based on WiMAX Technology and the IEEE 802.16 Standard, by WiMAX Forum.

In the information age the PC owners would likely demand for broadband because of convenience and economics. In a city like Islamabad it is almost impossible to take the traditional cable or copper infrastructure to the last mile due to hillside location of the city. Broadband Wireless Access (WBA) fills this gap by providing highly efficient and cost effective services for millions of subscribers who would otherwise be left out of loop²².

The WiMAX Model by Alvarion Inc.



(Source; Adapted from Alvarion Inc. a white paper on WiMAX technology)²³ Figure 7.

This Point to Multipoint Broadband Wireless Access system design is prepared by Alvarion Inc. Mountain View, California based wireless equipment manufacturers. This system has two elements: 1) Base Station and 2) the subscriber equipments. In this system design the

²² http://www.alvarion.com/RunTime/Materials/pdffiles/Wimax_wp.pdf Page # 9

²³ http://www.alvarion.com/RunTime/Materials/pdffiles/Wimax_wp.pdf Page # 3

base station connects to the network back bone and uses an out door antenna to send and receive data and voice to the subscriber equipments.

In this WiMAX model 208.16 two different explanations have been given. The first is the fixed wireless access. The Antennas at the roof top of the building gets the wireless connection and it is then transferred through the base station to the subscriber equipments like Wi-Fi devices to PC or laptops. The second explanation is related to embedded situation. It is scenario which is also known as 802.16e. In this case all the connectivity devices are ready to go online as the built in chip catches the signal directly from the WiMAX base station.

Islamabad Basic Information: Table 3.

(Source; CDA, Capital Development Authority, Islamabad, Pakistan)

Total Area	906.50	Sqr. Kms.
Islamabad Proper	220.15	Sqr. Kms.
Islamabad Park	220.15	Sqr. Kms.
Islamabad Rural area	466.00	Sqr. Kms.
Specified area	3626.00	Sqr. Kms.
Seasons	Maximum Average	Minimum Average
Winter (Oct-Mar)	16.6 C	3.4 C
Summer (Apr - Sept)	34.2 C	24.4 C
Annual average	28.9 C	14.4 C
	Population: (Source; CDA, Capital Development Authority)	
2004	1.2 Million	Approximate
1998	9,01,137	Approximate
1992	3,80,000	Approximate
1982	2,10,000	Approximate
1978	1,65,000	Approximate
1972	76,000	Approximate

With the dramatic growth in the population, there is a need for inexpensive and affordable wireless communication network. The existing internet cafés are expensive and not conveniently located in each neighbor hood. Although government of Pakistan is working to have broadband service available to public in each post office, but still the demand would not be accommodated in the coming years once the borders are open with India a technologically very advance nation.

Islamabad Internet Data: Table 4.

(Source: Mr. Siraj us Wahaj, CEO of a local telecom firm in Islamabad)

Approximate Population Per Square Mile	75,000
Monthly Subscription Rates of Cable or DSL per household	Rs. 999/256 kbps, 1Gb upload/download data in one month
Existing trend towards online resources (how much time people spend online everyday.	On average, people who are connected, spend 30 to 60 minutes every day on Internet
Security Of Online Resources, do the data companies use 64 bit or 128 bit for cryptography	Both
Data lines damaged by harsh weather conditions or blown up by unknown factors	Outside plant copper network of PTCL in Islamabad is relatively in good shape as compared to other cities. This entire network is underground.
The labor cost per hour or per day for telecom engineers and other people involve.	Salary of a telecom engineer with 1 – 2 years experience in data networking is around Rs. 25 - 35 K per month.

The 75,000 people per mile the capital is a great market for WiMAX. These people are spending some time every day by going online to check their emails. If the inexpensive source of communication is available, these people would spend more time online.

Islamabad Internet Data: Table 5.

(Source; National University of Science and Technology, Rawalpindi, Pakistan)

Literacy Rate	80 Percent
Average Income per month	Pak Rs. 60, 000 (This figure represents all the

	people working in the capital i.e. Expatriates, Foreign Diplomats as well as local communities).
Internet Cafes, Per Hour Rate	15 to 20 Rs. P/H go up during rush hours
Waiting time in the Queue in the Internet Cafes	20 to 45 minutes (most places used dialup 56k)
Why People go Online	Email, Chat
Restrictions on Import of WiMAX Systems	No Restrictions, but License is required from Ministry of Communication

With a literacy rate of 80% (people can read, write and communicate in national language) and average income of Pak Rs. 60, 0000 (this wages include all the expatriates, foreign diplomats and local community) there is a great market for WiMAX.

The Cost to Setup a WiMAX System in Islamabad: Table 6.

(Source: Phone conversation with WiMAX Systems Manufacturers in the USA and Singapore)

Base Station Range For Voice and Data, NLOS / OFDM (Like cell phones)	5 to 8 Miles
Frequency: 5 GHz	This frequency is unlicensed in the US but License is required in many other countries including the Pakistan.
Number Of Subscribers	2000 to 3000 Average
Price for the Base Station for Voice and Data CPE (Customer Premise Equipments)	US \$ 700 (Market Price on April 14, 2005) <ul style="list-style-type: none"> • LAN in the Building (Small business) • Wi-Fi (Residential)

	<ul style="list-style-type: none"> Everybody has its own CPE (Medium size businesses)
Base Station (Point to Multipoint, equivalent to Fig 4 on page 8 of this paper)	US \$ 35, 000 to 40, 000
SLA (System Level Agreements; Phone calls, Round the Clock Service, Updates)	Prices vary from Minimum few hundreds for only Updates to more than 15, 000 dollars a month.
Internet / PSTN backbone, Routers, and other devices by vendors like Siemens	Prices start from 10, 000 dollars and go up to 100, 000 dollars.

Comparison of Cost to Setup a Hybrid Fibre Coaxial Network: (In US Dollars) Table 7.

Source: Phone Conversation with CEO of a Local firm in Lahore: Internal Financial Information

Description / Cities ⇓ ⇓	Lahore (Actual data)	Islamabad (Estimated data)
Per Square Mile Cost for HFC Network	1, 94,176.00	2, 91, 264.00
Per subscriber cost	65.00	98.00
Cost for WiMAX System based on current market prices;	1, 35, 000	1, 35, 000
Cost Per Subscriber	45.00	45.00

This table shows that the cost to setup a copper wired network in one square mile is 291,264.00 where as the cost to setup a WiMAX base station is 135,000 dollars. With WiMAX systems a subscriber pays 45 dollars where as with the copper wired network the cost is 98 dollars per subscriber. So, it simply makes sense to have a WiMAX system not just because it is an inexpensive source of communication but it's the mobility part that makes it very unique.

Conclusion:

Islamabad is better off by implementing this state of the art WiMAX technology for its future broadband needs. It is not only very inexpensive source of communication but a system that can be implemented easily with relatively low cost and in a very short time. WiMAX has low maintenance compare to underground wired networks.

This emerging technology would help Islamabad become a new Bangalore (my vision) in the Subcontinent because of its highest literacy rate and strong communication infrastructure that WiMAX promise to offer.

Once the enabling environment is there many models would emerge that would help to improve the economic life of people in the region as we have seen in the Bangalore and other Indian cities.

The WiMAX is the system that has the flexibility to expand, enhance and update in a shortest possible time so in a developing region like Islamabad it is the best solution for broadband in the near future. With the last mile connectivity, accommodating WiFi, existing LAN infrastructure and offering VoIP and rich media application in the 64 – 128 bit cryptography secure environment for voice and data, in my opinion this is the best alternate for future broadband needs.

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3. PC households online : Jupiter Research
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5. ISDN subscribers : Euromonitor from International Telecommunications Union/national statistics
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