



NSR White Paper Series

Technological Leapfrogging via WiMAX

February 2007



Introduction

It is a widely known fact that an inextricable link exists between telecom modernization and economic growth. Similar to the role of railroads and trains in the age of the industrial revolution, modernization of the IT/telecom sector in today's information age promotes economic growth and helps sustain the wealth of nations.

Cutting edge technologies have given rise to new industries that were unforeseen and unanticipated at the time of discovery or introduction to the marketplace. The creation of the Internet continues to provide a profound effect on the global economy, which today is quickly moving towards mobile and wireless platforms. E-commerce that has begun to account for growing shares of national wealth measured in GDP and GNP is here to stay and is currently evolving towards m-commerce as individuals and companies become increasingly mobile in personal and professional activities.

...technical features of WiMAX represent the potential to leapfrog existing telecom platforms

WiMAX is a relatively new technology that addresses both fixed broadband services and broadband wireless access (BWA) services. In looking at the mobile web where the next evolutionary step in competition will take place, the technical features of WiMAX represent the potential to leapfrog existing telecommunications platforms and place nations on par with each other as countries engage in competition for the world's investments, trade and business. This idea benefits developing countries that have less in terms of infrastructure invested and infrastructure in place, both in terms of the fixed Internet, but more importantly on the emergence of the mobile web. Technological leapfrogging to be on par with the First World will invite global investments such as outsourcing First World business activities to Third World call centers, promote internal economic growth through increased consumption and spending on telecom services, and enhance a nation's overall competitiveness in the realm of globalization.

Developed countries have to adopt leapfrogging strategies as well

But technological leapfrogging is not only a developing nation strategy. Developed countries have to adopt leapfrogging strategies as well since the digital divide exists within continents, sub-regions and within countries. In the United States for instance, the Federal Communications Commission (FCC) has tried to address and support digital divide implementations since the role of the Internet has become more paramount in everyday life. The European Commission has likewise provided funds and laws for digital divide programs in efforts to bridge the widening digital gap among its members. And of course, when less competitive nations do manage to achieve parity with the First World, technological leapfrogging as a competitive strategy has to be implemented by First World members to maintain economic leadership.

Value Proposition for the Developed World

Apart from the obvious value proposition of WiMAX for digital divide implementations, developed country markets leapfrog or promote cutting edge technology development to remain economically strong. Simply put, a modern society remains modern because it continues to modernize.

WiMAX is a new technology based on an all-IP platform that promises higher throughput levels via MIMO technology and greater range, and is able to cover entire metropolitan areas. As such, traditional applications including voice and short messaging, as well as high bandwidth applications such as Internet access and video, can easily be accommodated via a WiMAX network.

WiMAX is based on an all-IP format that enables or opens up new avenues for future application suites

But why use WiMAX when there are other mobile computing technologies available and have been around for some time, specifically 3G? The answer lies in the all-IP format that enables or opens up new avenues for future application suites. Everything is converging to IP, and this area is where the future of communications is expected to be centered. Even the U.S. Military is looking at IP-centric warfare for its future strategic architecture, a move away from proprietary solutions that have been favored by military establishments for decades. And as an indicator for where long-term developments are headed, once again IP-centricity is a safe strategic move to take as the globe becomes more digitized.

South Korea Leads the Way

In short, developed country leapfrogging to advanced or state-of-the-art networks ensures continued economic growth prospects. This is so since, as stated earlier, modern networks ensure sustainability and growth of modern economies. It is no surprise then that South Korea has taken the lead in WiMAX and has moved ahead of the U.S.-based WiMAX Forum. Its WiBro is a version of WiMAX, but the big difference is not the technology aspects and features, but the speed by which WiBro is being developed and implemented compared to other countries of the globe.

Government support largely led or highly influenced the rapid uptake of broadband services

It is worth reviewing South Korea's overall broadband strategy in the late-1990s to make sense of why it wants to surge ahead of the field in WiMAX. South Korea has ranked the highest in terms of broadband penetration in the globe. Internet access has been enabled largely via broadband technologies as early as the late-1990s, and dial-up or slower speed solutions were and continue to be a minority in the country. Government support largely led or highly influenced the rapid uptake of broadband services in the country through policy initiatives, tax incentives and government usage of broadband platforms in its own internal communications requirements. But the most amazing and most noteworthy fact is that the high broadband penetration levels were achieved through a coordinated strategy during the Asian financial crisis. When other countries were giving less priority and cutting back on broadband or telecom investments, South Korea increased their efforts. The gamble paid off as IT/telecom investments helped in bailing out South Korea or insulated it from the financial crisis as IT/telecom accounted for a growing share of GDP. IT/telecom spending became an economic growth driver rather than a risky proposition that could have created a bubble, which if it burst, would have added to the country's economic woes.

Since then, South Korea continues to be at the forefront of telecom technology including its big gamble on digital multimedia broadcasting (DMB) services, which one year after introduction looks to be paying off handsomely. WiBro is another technology South Korea is betting will keep it on the cutting-edge. The development of the WiBro ecosystem is

moving rapidly, and if or when WiBro succeeds in South Korea, it should once again contribute to GDP growth as well as enhance South Korea's position as one of the key technology hubs of the Asia Pacific region.



Source: Samsung

Part of the manifestation of the WiBro strategy is that new capabilities have led to next-generation form factors, such as the new device by Samsung that features a large screen and larger keyboard. For developed country markets where mobile computing is becoming an everyday reality, WiMAX offers technology to enable users to easily accomplish such tasks. For developed country markets, new technology implementations should lead to consumer benefits in terms of productivity gains, ease-of-use and price advantages for using value-added services. From an economic standpoint, supporting the development of the WiMAX ecosystem will lead to consumption and investment activity that provide gains in GNP. And as competition intensifies within the ecosystem, further development of form factors could drastically change not only developments within the WiMAX industry, but entire industries as well, as exemplified by the impact of Apple's iPod in the music industry.

To remain the dominant economy in the globe, industrial or economic sectors have to be the most modern to open up opportunities for future growth.

The U.S. Experience

Another developed country market that has embraced WiMAX is the United States. The U.S. economy could have stopped at 2G or 2.5G implementations since the application suites were enough to satisfy the customer base at the time such networks were prevalent. But moving on to advanced networks such as 3G and WiMAX at the risk of making other high-value network implementations obsolete is sound economic policy. As the saying goes, "one has to run faster to stay at the same place." To remain the dominant economy in the globe, industrial or economic sectors have to be the most modern to open up opportunities for future growth. And here, U.S. policymakers and regulators (specifically the FCC) supported WiMAX via spectrum allocations.

The result is that companies such as Sprint/Nextel and Clearwire began making bets on WiMAX, and the ecosystem is beginning to be developed

as well. Sprint/Nextel specifically has made investments in network implementations and is now developing a monthly service fee plan that creates a new model where a single subscription could cover multiple devices. This is revolutionary as it has not been tried in the U.S. market, and if the company does follow with its plan to cover multiple devices in a single subscription package, the benefits to consumers will be tremendous.

A Golden Opportunity for the Developing World

India is a giant awakening

Nations such as India have embraced and embarked on technology investments as a major sector targeted to promote national growth. India is a giant awakening, known in part for its competitiveness in drawing call center investments, software development, and advances in the space industry via its national entity, the India Space Research Organization (ISRO).

As home to the 2nd largest population in the world, India's broadband subscriber numbers are not within the Top 15 Markets of the world in absolute terms. In relative terms where penetration levels are measured, India fares worse from a global perspective. Tiny Belgium statistically is more competitive in terms of both the absolute number of broadband subscribers and in penetration levels.

China, a giant that has already awakened, has fared far better and is currently at the second position globally. China's broadband ambitions aim to increase the number of broadband subscribers from 36 million in 2005 to more than 120 million by the end of 2010.

Top 15 Countries in Broadband Subscribers

Year-end 2005:	Broadband Subscribers (#M)	Share %
1. USA	46.9	21.6
2. China	35.9	16.5
3. Japan	26.4	12.2
4. South Korea	13.1	6.04
5. France	9.6	4.42
6. Germany	9.5	4.40
7. UK	8.9	4.35
8. Canada	6.7	4.09
9. Italy	6.6	3.05
10. Spain	4.6	2.12
11. Netherlands	4.4	2.00
12. Taiwan	4.3	1.97
13. Brazil	3.0	1.39
14. Australia	2.6	1.21
15. Belgium	2.1	0.97
Top 15 Countries	185.2	85.25
Worldwide Total	217.2	100

Source: Computer Industry Association

Both of these nations realize that broadband penetration levels have to be increased at a fast pace as part of their drive to achieve superpower status. For other developing countries, increasing broadband penetration levels, as shown by China, could lead to very high economic growth. In

the information age, infrastructure to be able to engage in the information economy is vital. As commerce is increasingly conducted across board rooms and meeting rooms, strategies to address the mobile web and broadband capabilities in a mobile platform become more paramount.

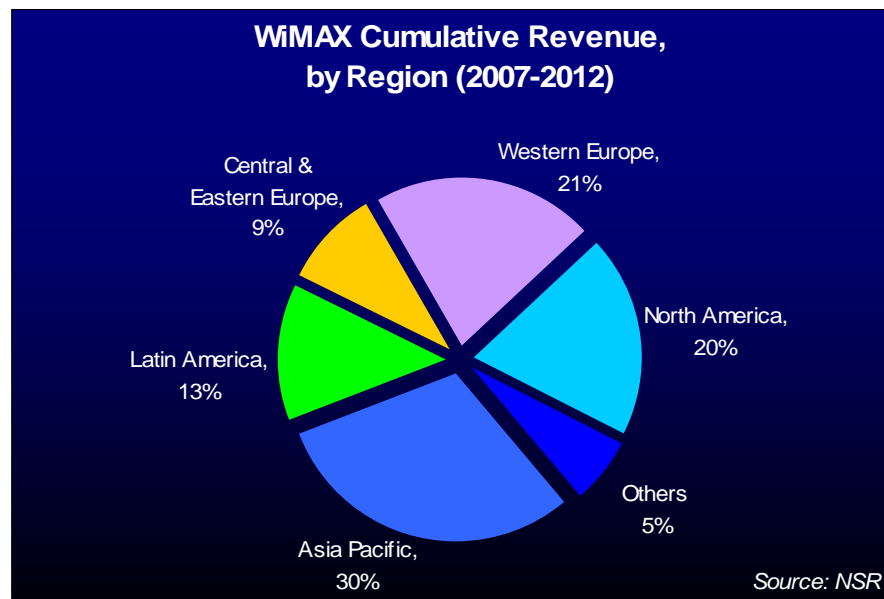
The deployment of a network in a metro zone or a super-metro zone is no longer prohibitive in terms of cost, time and effort.

Here is where WiMAX holds the greatest potential as an equalizer. The deployment of a network in a metro zone or a super-metro zone is no longer prohibitive in terms of cost, time and effort. A city, a state, a province, and even an entire country that plans to upgrade to a state-of-the-art broadband communications network can use WiMAX as part of the network architecture to achieve this goal. Install a WiMAX base station, and a robust BWA service is up and running within a 30-kilometer radius for a cost of less than \$20,000 today, which is estimated to decline to less than \$10,000 by 2012. As users double within the metro zone, a provider can install another base station to double the capacity, and install another when usage or traffic triples, and so forth.

In more challenging rural areas that have lower population densities, hybrid implementations such as a WiMAX/satellite network can do the job. The cost is a bit higher due to the satellite link, but compared to wireline implementations that are virtually impossible given terrain conditions, hybrid wireless networks are tremendous bargains in implementing digital divide programs efficiently, cost-effectively and quickly.

Asia-Pacific...is expected to account for the largest share of WiMAX revenues

In determining the value proposition of WiMAX, rich countries within the North American and Western European regions are expected to account for large shares of the market. But the Asia Pacific, driven by both "rich Asia" that includes Australia, Hong Kong SAR, Japan, South Korea, Singapore and Taiwan (among others), as well as "developing Asia," which includes giants China, India and Indonesia, the region as a whole is expected to account for the largest share of WiMAX revenues over NSR's 2007-2012 forecast period.



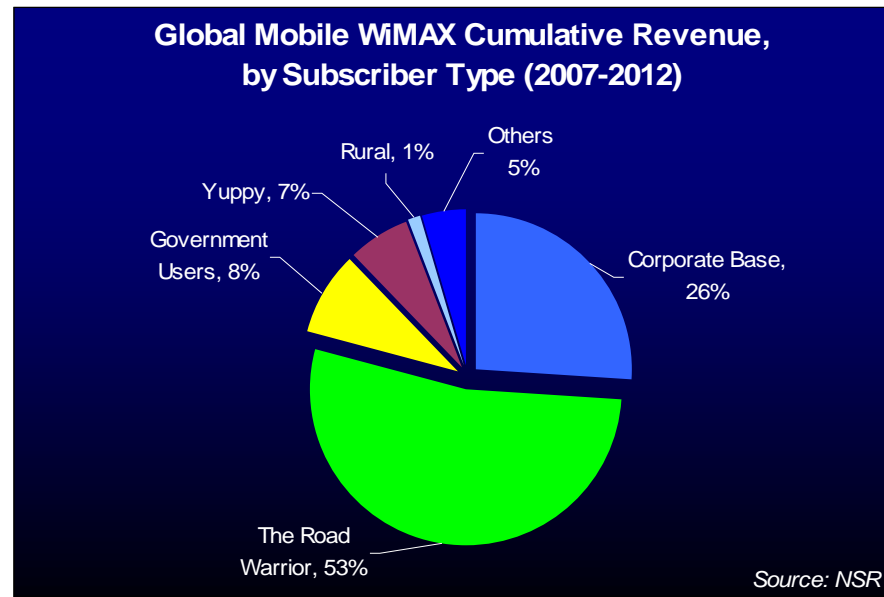
The argument and the economic conditions are ripe, specifically for awakened and awakening giants, to be at par and thus be competitive with First World counterparts in the telecommunications arena. As China and India continue to modernize and incorporate technology, specifically developments in the web and the mobile web, WiMAX provides the tool by which to achieve these goals.

Other countries such as Malaysia, the Philippines, Thailand and Vietnam cannot afford to be left behind by the Asian economic giants, dragons and tigers. In Central & Eastern Europe, parity needs to be achieved with Western Europe as the European Union continues to expand its membership. Latin America needs parity with North America, while the African/Middle East countries need parity both with other regions of the world as well as internally with countries such as the UAE, Saudi Arabia, Kuwait and South Africa.

Market Projections

The bulk of WiMAX end users are expected to come from the “Road Warrior” and the Corporate Base

The bulk of WiMAX end users are expected to come from the “Road Warrior” and the Corporate Base, accounting for nearly 80% of revenues globally. The value proposition or the so-called “sweet spot” of demand for WiMAX rests with these types of end users, and here, the value proposition for WiMAX clearly rests with enterprise-based applications. Once again, the finding is consistent with the argument for technology leapfrogging.



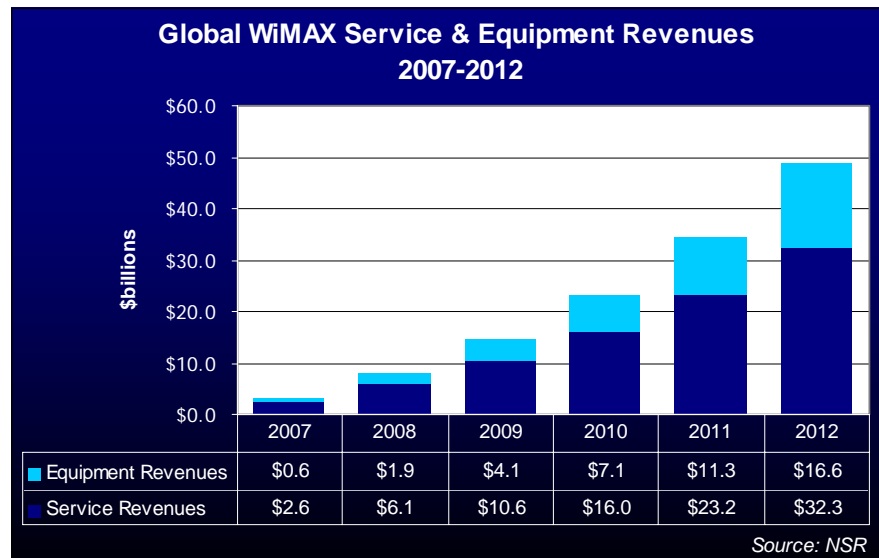
Unlike other state-of-the-art technologies such as WiFi, which primarily targets consumer sectors, WiMAX will initially be a more appropriate fit for enterprise use. The point for technological leapfrogging in pursuit of global competitiveness is therefore to primarily empower industry, while consumer benefits for entertainment-type or leisure applications come in a distant second. Trains and railroads in the industrial revolution carried goods, while the transport of passengers was but a secondary goal or benefit to the marketplace. The same goes with a WiMAX leapfrogging

...market should reach close to \$49 billion by end-2012

strategy. Its main purpose and justification is to improve the economic performance and competitiveness of an economic area rather than empower users to be able to conduct mobile entertainment activities.

NSR predicts a healthy market for equipment and service globally. From a combined revenue base of \$3.2 billion in 2007, the market should reach close to \$49 billion by end-2012. The overall market translates to a healthy subscriber base as well as a fully developed ecosystem where form factors and technical capabilities deliver promised quality that will prove to be compelling for business and consumer sectors.

However, although WiMAX does provide a compelling argument for leapfrogging current capabilities, the market projections outlined by NSR are nowhere near the investments made in other communications technology areas including DSL deployments, fiber deployments and 3G (to name a few).



There are a number of reasons why NSR believes the WiMAX market will be comparatively small despite the value proposition for leapfrogging and achieving parity:

- First, modernization areas will compete for attention and investment funds. For instance, it was reported that “China is betting that their growing investment in nanoscience will help them capture a large share of what shortly will become a \$3 trillion global market in nanotech manufactured goods, and that breakthroughs in nanotechnology research and commercialization will confer economic superpower status on the country that attains first mover advantage in this cutting-edge technology,” stated Richard P. Appelbaum, professor at the University of California at Santa Barbara. “The Chinese Government clearly understands that enhanced nanotechnology research capacity and marketable innovation go hand-in-hand. Both are key to their strategy for future

... investments in advanced telecom technologies have yet to show reasonable ROI

commercial success, economic competitiveness, and continued economic growth.”¹

- Second, investments in advanced telecommunications technologies have yet to show reasonable ROI, which will continue to prolong their life cycle. A leapfrogging strategy from both the private sector and the government in charge of regulations will take place but be delayed. In telecommunications, this specifically applies to 3G and WiMAX.
- Finally, the concept of technological leapfrogging itself as a strategic policy thrust is not widely accepted in government circles as of yet. The private sector that will be in charge of implementing the strategy through direct government support or purely through free market initiatives has risks to consider in terms of justifying an ROI model.

... technological leapfrogging as a strategic policy thrust is not widely accepted in government circles as of yet

Conclusion

Due to cost considerations, developing and under-developed countries could not achieve competitiveness or parity in the telecom sector during the first phase of the web under the fixed access regime. As the Internet evolves to the mobile web, these same nations can now attempt to be now on equal footing with their First World counterparts. WiMAX presents the perfect platform to conduct a leapfrogging strategy for the emerging mobile web that inherently arms a city, a state, a province or even an entire nation to tap the opportunities and reap the benefits of mobile commerce. Its technical features and more importantly, its relatively low investment cost, provide compelling arguments for network implementation as nations seek to address development goals, economic growth and poverty reduction initiatives.

¹ Dr. Appelbaum made his remarks during an event co-sponsored by the Project on Emerging Nanotechnologies, the Asia Program, the China Environment Forum, and the Program on Science, Technology, America and the Global Economy, at the Woodrow Wilson International Center for Scholars in Washington, D.C.

WiMAX, 2nd Edition

ANALYZING END USER DEMAND TRENDS

As regulatory issues, technical challenges and certification processes begin to be addressed, WiMAX ecosystems are steadily being built, leading to deployments that are slowly but surely being realized in both developed and developing country markets. For the majority of 2006, WiMAX equipment has been shipped and installed mainly for backhaul purposes and network building efforts. This trend will certainly continue until 2007 and gather momentum throughout succeeding years.

However, beyond system deployments that have largely been the dominant business model in recent years, service provider strategies and investment funds spent will begin to be manifested more concretely through the buildup of a WiMAX subscriber base. Many see 2007 as the tipping point or inflection point in time for "real" WiMAX growth, and 2007 will be the real test on whether WiMAX does in fact succeed given the market positioning or hype that has taken place thus far.

As such, efforts on the supply side via the establishment of the ecosystem will have to be translated to a sustainable business model on the demand side. Key elements such as form factors of devices ranging from laptop PCs, highly functional cellular phones, Blackberry-sized devices with a host of features that include data, video and voice, as well as the inherent feature of mobility need to be considered in analyzing their effects on end user penetration levels.

Other elements required to analyze and forecast distinct end user markets include:

- Urban Versus Rural Usage
- Corporate Usage
- Fixed, Nomadic and Mobile Usage Levels
- Developed Economy Versus Developing Country Use
- Financial Considerations
- Application Suite Requirements

End User Groups Analyzed in this Report

Corporate User	Government User	College Student	Young Professional	Urban Professional
Rural User	Younger Set-Male	Younger Set-Female	The Older Set	"The Road Warrior"

This NSR report provides an in-depth overview of the global WiMAX industry by tracking customer demand trends and competitive platforms, as well as economic, technological and other factors that affect the addressable market.

Primary Elements of the Report Include:

- Review of Current Trends in Each Market Sector and Region
- Analysis of Expected Trends Over the Next 1-5 Years
- Complete Market Forecasts by End User Category
- Complete Market Forecasts of Equipment Sales
- Complete Market Forecasts for Multiple Segments in Six Global Regions

WiMAX, 2ND EDITION

ANALYZING END USER DEMAND TRENDS

Publication Date: November 2006

Price: \$2,995 Additional Copy: \$550

A COMPLETE ANALYTICAL PERSPECTIVE

Elements of this extensive study include:

- **Complete report document** segmented by analysis on all regions, end user categories, equipment and demand trends
- An **Excel file** containing extensive data and charts so the client can easily use this work as a basis for their own internal market projections

In addition, all clients of *WiMAX, 2nd Edition: Analyzing End User Demand Trends* are entitled to a **FREE half-day** of consulting time with an NSR analyst. This time can be used to review report findings, interpret market forecasts and determine how the report information applies to your company's business model.

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ABOUT NSR

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Analyzing End User Demand Trends

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