White Paper:

Pre-WiMAX Wireless Broadband Solutions for Service Providers

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Introduction

This paper provides guidelines for network providers on how best to take advantage of the IEEE 802.16-2004 standard for wireless broadband equipment, which will be certified by the WiMAX Forum, to grow their business while managing risks. We begin by identifying the key challenges currently facing service providers, and providing a brief introduction to WiMAX technology. We go on to describe some of the ways in which WiMAX can help service providers meet those challenges and the main risks involved in making the move to WiMAX. We then provide detailed recommendations on how and when service providers should transition to WiMAX so as to further their business goals while minimizing the risks.

Key Challenges:

- Reverse declining or stagnating revenue flows from traditional sources
- Need to take advantage of emerging technologies like WiMAX
- Need a strategy for adopting WiMAX technology that minimizes risks while taking full advantage of the opportunities WiMAX can bring to the bottom line
- Need to move more quickly than competitors to maximize share of new markets

What Network Service Providers Need Most

Network service providers currently face a situation in which revenues from traditional sources are either declining or stagnating. The market for services delivered via wired infrastructure is saturated, and opportunities for growth in that market are extremely limited. By contrast, demand for services beyond the reach of wired infrastructures is potentially huge, but the wireless technology required to support the delivery of broadband to those market sectors has until now been largely proprietary and marked by either poor performance (at the low end) or prohibitive cost (at the high end).

Network service providers need a cost-effective solution that would allow them to satisfy the demand for broadband-based services beyond the reach of wired infrastructures. They need a solution with a rapid ROI and the promise of steadily increasing revenues. They need to move more quickly than their competitors in order to achieve a dominant position in these new markets. And they need to minimize the risks associated with timely deployment of new wireless technologies.

The Promise of WiMAX

Enter IEEE 802.16, or “WiMAX”—the emerging wireless standard that promises to substantially reduce the costs required to further expand the reach of broadband delivery systems while delivering performance that exceeds that of most wired technologies. WiMAX technology will offer several key benefits to network service providers. It will:

- Allow service providers to profitably deliver high-throughput, broadband-based services like VoIP, high-speed Internet access and video to business and residential users who previously could not be economically served
- Facilitate equipment compatibility, allowing all of the components of WiMAX-based broadband systems to form a cohesive network, further reducing deployment and maintenance costs
- Facilitate equipment interoperability, allowing service providers to avoid having to commit to single vendors, diversifying vendor-dependent deployment risks
- Reduce the initial and incremental capital expenditures required for network expansion

- Provide vastly improved performance and extended range compared to existing wireless technologies
- Overcome many technical limitations of current wireless technology—for example, it will support service to customers that could not be economically served by legacy "line of sight" wireless technologies
- Allow service providers to achieve rapid ROI and maximize revenues

The potential for providers to achieve a faster ROI by deploying emerging wireless technologies than they could by deploying wired networks has been widely recognized. For example, a recent Gartner Research study describes the business advantage of emerging wireless succinctly:

> Looking at the basic pricing mode, a leased T1 line can cost $7,200 per year ($600 per month). Basic wireless point-to-point metropolitan-area network equipment ranges from $1,000 to $10,000 per unit (not including towers, additional routers, shelters, cables or installation, which can add less than $5,000 to the project), depending on speed needed. An enterprise can get a return on investment in less than a year on many systems, and in less than 18 months for most systems.
>
> *Source: P. Redman, Research Note, Gartner Research Inc., July 2003*

Factors to Consider Before Transitioning to WiMAX

The changes posed by WiMAX will no doubt have a profound impact on the industry and individual service providers. While much of this impact is expected to be positive, not every service provider will be able to manage the transition to WiMAX successfully to become a winner in the WiMAX world. While the WiMAX standard promises increased performance, significantly extended coverage, and a reduced cost of deployment when compared to currently prevailing technologies, as with any new technology it comes with significant risks. Service providers must therefore embrace the changes in an intelligent way, based on a careful analysis of both the opportunities and risks. Service providers need to carefully consider the following factors when planning a transition to WiMAX.

Timing

Timing is critical, but exactly when a service provider should make the move to WiMAX may not be obvious. Should service providers wait for WiMAX-compliant equipment or should they consider deploying a WiMAX precursor now? On the one hand, because WiMAX-certified equipment is not yet available, committing dollars to any existing technology would appear to risk purchasing hardware that could turn out to be incompatible with WiMAX equipment when it arrives on the scene. On the other hand, waiting too long—for example, until after WiMAX-certified equipment is available—could give competitors an edge at a time when no one knows who the successful players will be. Service providers must move more quickly than the competition while also managing the risk of embracing a technology that is not WiMAX compliant.

Recommendation 1: Get Ready Now

While it may be tempting to err on the side of caution when dealing with an emerging wireless standard, there are powerful technical, marketing, and financial reasons to deploy a WiMAX-ready system now.

The Technical Case

By acting now rather than delaying deployment of a WiMAX-ready network, service providers can gain experience with both the technology and the new markets to which the technology allows access. Early deployment can provide a foundation for migration to a pure WiMAX network when it becomes available, and allow service providers to tackle technical hurdles early. With a foundation in place, the move to WiMAX can become a matter of integrating new WiMAX components into existing networks rather than building an entirely new system from the ground up.

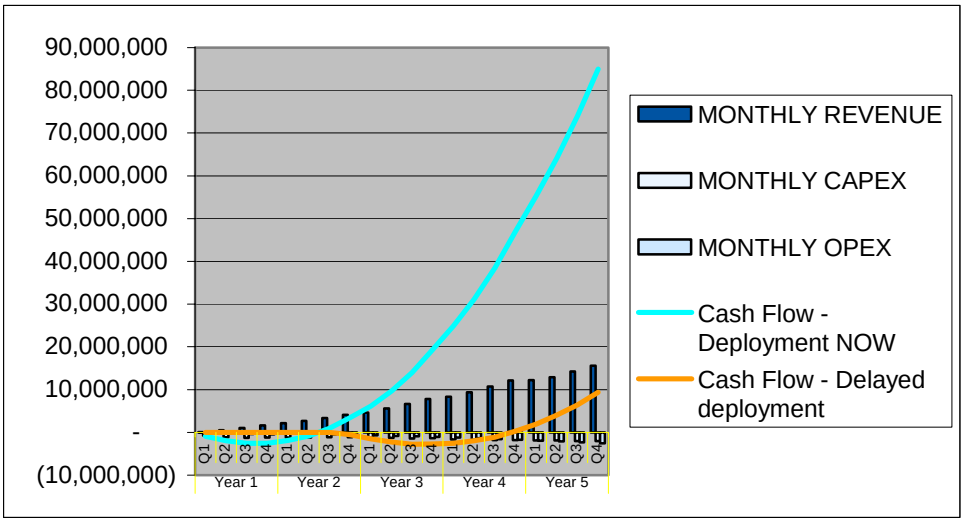
The Marketing Case

Acting now allows for earlier market penetration, identification and adjustment of market focus, and can help service providers maximize market share. The fact is, by the time WiMAX-compliant equipment is available, many service providers will have already made the move to some sort of WiMAX precursor system. While delaying deployment may seem prudent from a technical point of view, waiting virtually ensures that a service provider will be among the last to move into the "last mile" market—hardly a sound basis for establishing a leading position in a new market.

The Financial Case

Most importantly, a careful financial analysis based on plausible (even conservative) assumptions makes a convincing "bottom-line" case for acting now. As we show in Figure 1, deploying a WiMAX-ready system now can result in a much faster ROI, and rapidly growing returns. In fact, our comparative analysis of projected cash flows over the next five years in the "wait for WiMAX" scenario versus the immediate deployment of our own WiMAX-ready solution shows that cash flows obtained by deploying now can exceed those obtained by delaying deployment by a large margin.

Figure 1: Comparison of Cumulative Cash Flow in "Delayed Deployment" versus "Deployment Now" Scenarios over Five-year Period



Note: Monetary figures are in U.S. dollars. See Appendix A for the business assumptions underlying this analysis.

Equipment Compatibility

As outlined above, one of the key benefits of WiMAX will be that of *equipment compatibility*. But service providers must be careful here to make sure that the "WiMAX" precursor solutions they purchase really will fulfill the promise of compatibility. For example, several vendors are currently offering "pre-WiMAX"products. These products are generally construed as precursors to, or even equivalent to, WiMAX and to offer much of the promised performance of the WiMAX standard. However, one problem that service providers encounter when assessing possible entrance strategies is that many vendors in the WiMAX arena cannot guarantee that their current pre-WiMAX products will be compatible with WiMAX compliant equipment when it arrives. Without this assurance, the service provider assumes the risk of committing funds to the deployment of infrastructure hardware that may turn out to be a stranded investment—which undermines much of the business case for moving to WiMAX in the first place. Service providers must therefore find a way to avoid the risk that the technology they select today may turn out to be incompatible with WiMAX compliant equipment.

Recommendation 2: Remove Precursor-system Risk

Service providers should seek a solution that removes the risk of being left with a system that is not compliant with the WiMAX standard and hence includes components that are not compatible with WiMAX-compliant technology. This could come in the form of a planned migration path from the pre-WiMAX system to a full-fledged WiMAX network when it becomes available. Service providers should seek a migration path that entails minimal risk in pursuing the upgrade. Making the upgrade should also require little or no interruption in the services that are delivered by the precursor system.

Vendor's Expertise and Role in Defining WiMAX

Selecting the right wireless technology vendor is critical. To reduce risk, service providers should select a vendor with as much expertise as possible with WiMAX technology. Service providers should also consider the degree to which the technology currently offered by the vendor is incorporated into the WiMAX standard. Finally, the amount of participation and input that a vendor has had and currently has in defining the WiMAX standard and protocol is a strong indicator of the degree of compatibility that the vendor's current pre-WiMAX equipment will have with future WiMAX compliant equipment.

"Enterprises looking for cost-effective and reliable options to a wired T1 (and higher) connection should consider newer high-speed wireless point-to-point systems. Be wary of startups; vendor viability is an issue."

–P. Redman, Research Note, Gartner Research Inc., July 2003

Recommendation 3: Find a Vendor that has Made Significant Input into the WiMAX Standard

To minimize risk, the vendor should:

- Have as much WiMAX experience as possible
- Hold relevant patents
- Have had as much input into developing the WiMAX standard and protocol as possible
- Have a long-standing and active record of participation in the WiMAX forum

Which Market to Serve?

Network service providers must decide on which part of the market to target using pre-WiMAX technology today and WiMAX technology tomorrow. Should they deploy the new wireless network with a focus on business users, residential customers or some combination of both as part of their entrance strategy? Should they focus first on one sector, then on the other?

Recommendation 4: Focus on Businesses First

While many service providers are attracted to the residential market, there is a sound business case for expanding into the business market first, establishing a reliable revenue source there, and then expanding to the residential market later. Serving businesses involves setting up fewer subscriber stations (which lowers initial costs) while revenue on a per-unit basis is much higher in the business market. Figure 2 and Figure 3 compare cash flow projections over a five-year period for a service provider business model that targets residences only, versus a business model that targets businesses first and then residences gradually over time.

Figure 2: Five-Year Projected Cumulative Cash Flows from Residential Market

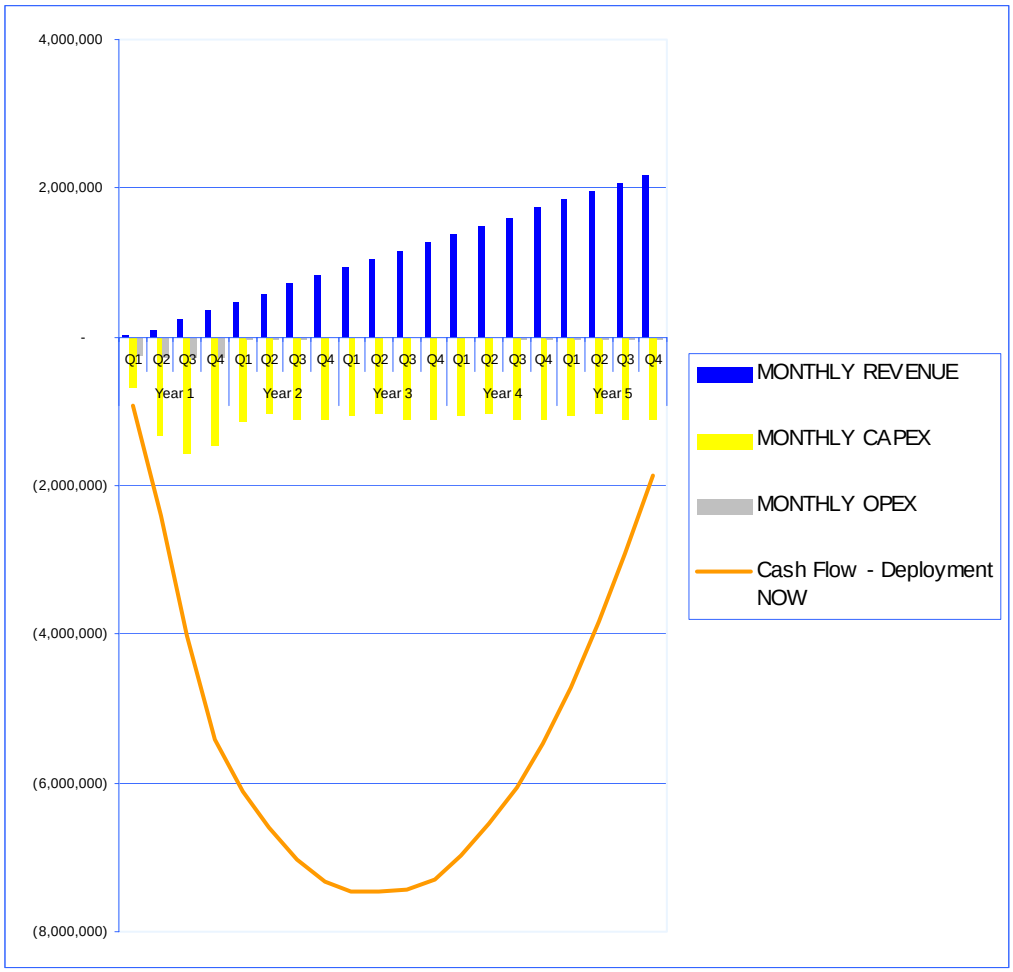
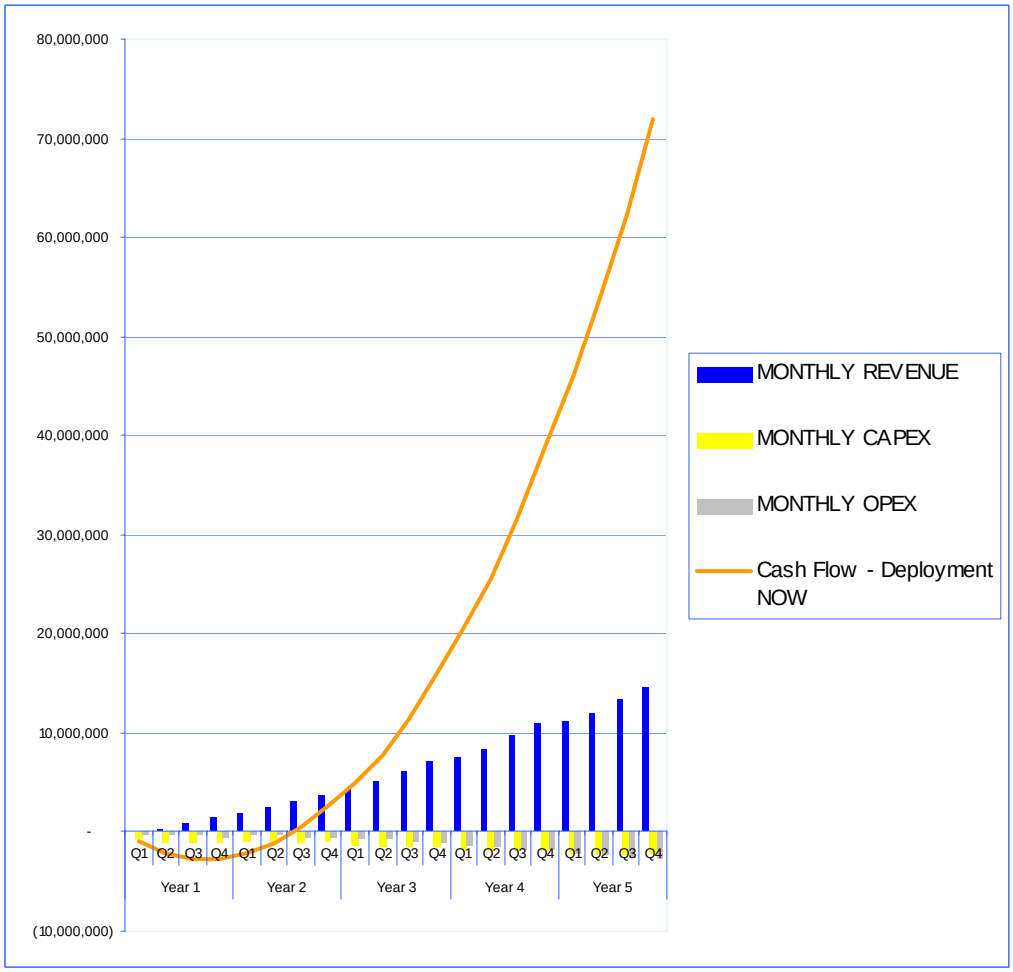


Figure 3: Five-year Projected Cumulative Cash Flows from Targeting Businesses First and then Residences over Time



Introducing Libra MX™

Network service providers have been waiting for a solution that can quickly help them achieve the business benefits of WiMAX. They know they have to move quickly. But they have been reluctant to begin laying the foundation for WiMAX because, with WiMAX-compliant equipment as yet unavailable, such deployments would mean assuming the risk of developing networks that are incompatible with certified equipment when it arrives. Now there is a solution that removes this risk and offers all of the benefits of WiMAX—Libra MX™ from Wi-LAN. With Libra MX, service providers can act now to begin realizing the benefits of the entrance strategy recommended in this paper.

Libra MX Solution:

- Delivers the performance and range of WiMAX, supporting provision of advanced broadband-based services including VoIP and video
- Enables cost-effective expansion of networks to areas beyond the reach of fixed network infrastructures
- Supports rapid ROI and increasing revenues over time
- Innovative Continuity Program™ eliminates risks associated with purchasing WiMAX precursor systems
- Supports seamless transition to WiMAX-certified technology when it becomes available
- Allows service providers to dominate new markets by expanding now instead of waiting

Continuity Program™ Enables Risk-free Transition to WiMAX

Wi-LAN's innovative Continuity Program™ enables a seamless transition to a WiMAX Forum-certified system.

Libra MX is a true pre-WiMAX system that allows network service providers to quickly take advantage of new opportunities for substantial growth in the new markets created by WiMAX, to achieve rapid ROI and revenue growth—with absolutely **no risk** of being left with a system that is incompatible with the ultimate WiMAX standard.

By removing the risk involved in transitioning to WiMAX before certified equipment becomes available, Libra MX allows service providers to quickly penetrate the "last mile" market to offer subscribers broadband-based services and gain market share.

The Libra MX Base Station supports both proprietary Wi-LAN and standard WiMAX protocols. When the service provider is ready to add WiMAX compliant sectors to their network, they simply add WiMAX sector cards to the existing Libra MX base station. There is no need to replace the base station or the proprietary Wi-LAN subscriber stations already deployed. And no interruption in service is required to perform the upgrade.

Libra MX Allows Service Providers to Offer WiMAX-based Services Now

With Libra MX, service providers can realize the technical, marketing and financial benefits of deploying a WiMAX-ready system now. They can:

- Gain immediate experience with the technology, and tackle any technical hurdles much sooner than they would with a delayed deployment
- Have the infrastructure in place for a speedy and trouble-free transition to a fully WiMAX-compliant system and rapid penetration of the residential broadband market when WiMAX equipment becomes available

- Gain immediate experience with the “last mile” market—allowing them to quickly enter and establish a leading position
- Achieve rapid ROI and revenue growth

Libra MX Key Features

The following table lists the key features of Libra MX and explains the benefit of each one.

Feature	Benefits
Supports both proprietary Wi-LAN and WiMAX equipment in the same system	Allows addition of WiMAX equipment to network with no stranded cost
Continuity Program	Provides a guaranteed path to WiMAX, investment protection, and risk-free deployment, allowing service providers to move as quickly as possible to establish a leading position in new markets
Flexible form factors—1U, 4U and 8U	Allows service providers to choose the right equipment to optimize their network. Base stations are scalable to projected customer loads.
High capacity—up to 288 Mbps and 12,000 users	Allows cost-effective delivery of advanced services to more customers
Field-proven NLOS performance	Increases the number of accessible customers—reducing overall network costs
Newly redesigned high-powered W-OFDM processor	Permits delivery of WiMAX triple-play services. Supports four times as many voice calls as its predecessors and other products on the market.
Quality of Service (QOS)	Permits delivery of WiMAX triple-play services

Libra MX Opportunities

Libra MX can be used to replace wired E1/T1 networks, provide connectivity to Multiple Dwelling Units or Multiple Tenant Units, power urban hotzones and provide backhaul for cellular networks. It supports wireless delivery of advanced broadband-based value-added services like high-speed Internet, VoIP, and video applications. Libra MX allows service providers to profitably deliver these services to more subscribers by incrementally expanding their network coverage without having to invest in expensive new infrastructure.

Hotzones

Driven by the widespread adoption of WiFi hotspots, hotzones can provide Internet access across large outdoor areas of urban geography, and address demanding business requirements such as virtual private networks. Hotzones are creating substantial business opportunities for service providers. Cities, towns and

villages are looking to provide high-speed Internet community networks, bringing ubiquitous access to citizens and businesses, particularly where high-speed access was not possible before. Hotzone opportunities are there for the innovative service provider. Wi-LAN's Libra MX delivers the WiMAX-level performance and coverage required for robust hotzone backhaul—breaking down barriers to entry and delivering fast business results.

Wireless MDUs/MTUs

The provision of wireless broadband services to Multiple Dwelling Units or Multiple Tenant Units represents another significant opportunity for service providers. Until now, the business model has not been compelling enough to make these projects highly profitable. The case for selling services into the MDU/MTU market is now strong: with Libra MX, service providers can sell more services to more people, using fewer base stations and subscriber stations than required by competitive offerings.

Cellular Backhaul

The capacity and coverage of Libra MX also make it the ideal backhaul product for cellular service providers who need to meet the demands of today's voice networks and an easy and less expensive alternative to E1/T1 lines, which translates to cost savings for enterprise customers.

Libra MX was Developed by Wi-LAN, the leader in WiMAX Technology

Wi-LAN is the only active founding member of the WiMAX Forum, a non-profit organization made up of key industry players. Wi-LAN was instrumental in creating WiMAX from its inception. In fact, Wi-LAN's patented W-OFDM technology lies at the core of the WiMAX standard, and Wi-LAN was the first company to build commercial equipment based on 256-FFT OFDM, which is the flavor of OFDM that was chosen by WiMAX for certification of vendor equipment. Wi-LAN thus has had significant input into the creation and development of the WiMAX standard right from the start.

And the future? Two members of the WiMAX Forum Board of Directors are from Wi-LAN—including the chair of the Forum's technical committee. Their efforts are helping to ensure that Wi-LAN's W-OFDM based broadband wireless technology will continue to serve as the basis of the WiMAX standard.

The following table compares Wi-LAN and Libra MX with the competition, highlighting Wi-LAN's lengthy record of experience with OFDM and the superior performance of Libra MX.

	OFDM Technology Experience	Throughput	Deploying OFDM Systems Since	WiMAX Upgradeable	WiMAX Board Member
Wi-LAN	12+ years W-OFDM patent	Up to 288 Mbps	1998	802.16-2004 and 802.16e	Yes
Competitor A	5 years	Up to 76 Mbps	2002	802.16-2004 via software only	Yes
Competitor B	5 years	Up to 70 Mbps	2000	N/A	No
Competitor C	NA	Up to 18 Mbps	NA	Limited, 802.16e only	No

Libra MX: The Solution for Service Providers

WiMAX is coming, and it is presenting both great opportunities and risks for network service providers. Network service providers need a way to leverage the opportunities that WiMAX makes achievable as quickly as possible in order to penetrate and dominate the new markets in areas beyond the range of existing wireless networks. They need to gain experience with the new technologies, and the markets themselves, to stake out this new territory and get an edge on the competition. And they must do so while managing the risks involved in committing resources to new technology.

Libra MX provides the leverage service providers can use to seize the WiMAX opportunity now to achieve rapid ROI and revenue growth. Wi-LAN's innovative Continuity Program removes the risks associated with adopting WiMAX precursor technology too early. With Libra MX there is no risk of being left with network components that turn out to be incompatible with WiMAX-certified equipment. Libra MX delivers all of the performance of WiMAX with guaranteed migration to a certified WiMAX system for minimal cost and with no disruption in service. With Libra MX, service provides can begin building a WiMAX-ready wireless network now, and be the first to deliver the high bandwidth-dependent services their customers will expect in the WiMAX world.

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Appendix A: Business Assumptions for Delayed Deployment vs. Deployment Now Comparison

Deployment starting NOW	Deployment End 2005
• 1M population • 2.5% market penetration • $1M license fee **Year 1** • 60% MDU/SOHO/Residential • 30% SME • 10% Corporate **Year 5** • 77.5% MDU/SOHO/Residential • 30% SME • 2.5% Corporate **Data and Voice Services** • 128-2048 Mbps • Voice 1%GOS • 0.1E per subscriber • G729 • 512 byte packet average size **4 sector FDX network** **Backhaul Costs** • DS3 $250 per MB per month **Project Costs** • Project Management • $150k pa • Site Survey - $60k • Training $20k pa • Marketing $1.2M pa • Yr5 $0 **Installation costs** • Base Station $9000 • Subscriber Station Yr1 $100	• 1M population • 1.5% market penetration • $1M license fee **Year 1** • 85% Res/MDU/SOHO • 10% SME • 5% Corp **Year 5** • 90% Res/MDU/SOHO • 9% SME • 1% Corp **Data and Voice Services** • 128-2048 Mbps • Voice 1%GOS • 0.1E per subscriber • G729 • 512 byte packet average size **4 sector FDX network** **Backhaul Costs** • DS3 $250 per MB per month **Project Costs** • Project Management: $150k pa • Site Survey - $60k • Training $20k pa • Marketing $1.8M pa **Installation costs** • Base Station $9000 • Subscriber Station Yr1 $100 • Yr5 $0