

A Comprehensive WiMAX™ Operator Business Case Process

White Paper

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Abstract

Developing a WiMAX business case could be a complex and time-consuming process. Yet the need to determine the CapEx, OpEx and ROI is critical to any deployment. Promptly analyzing over 250 input variables, easily modifying these variables, testing key assumptions, and instantly visualizing their impact on a WiMAX business plan are invaluable capabilities. This white paper provides a step-by-step guide to a comprehensive WiMAX operator business case process and describes WiMAX 20/20's WiROI™ Business Case Analysis Tool, which offers a range of capabilities to simplify and accelerate the process of building WiMAX business cases.



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Introduction

The WiMAX Industry has seen much enthusiasm in the last two years, as measured by the number of field trials taking place on a global basis. The industry claims well over 300 trials worldwide. High profile trials and a few early deployments have dominated the media. These include WiMAX networks by Sprint and Clearwire in the USA and WiBro service in South Korea. Full commercial deployments, however, have been lagging the number of trials. This has been the source of major frustration to equipment vendors who have been planting seeds for many years and are waiting for their fruition.

The WiMAX industry cannot sustain itself on trials. Full deployments are critical for the success of WiMAX as an industry. Many licensees and operators need an objective WiMAX business modeling process to develop, evaluate and optimize their business cases in order to get funding for full deployment. A comprehensive business planning process will allow an operator to understand its capital needs, outline its service offerings, create its revenue profile, and recognize the critical success factors. Prospective WiMAX operators must clearly and confidently articulate their ROI proposition to their investors before full commercial deployments are funded.

A comprehensive WiMAX operator business planning process comprises of three main parts as follows:

Part 1 – Gathering the Input Parameters for a WiMAX Business Case

Part 2 – Service and Market Planning for a WiMAX Business Case

Part 3 – Optimization and Sensitivity Analysis of a WiMAX Business Case

Part 1 – Gathering the Input Parameters for a WiMAX business case

The first step in this process is to gather all the relevant input to a business case. As inputs may vary significantly from country to country, each WiMAX network deployment will undoubtedly manifest itself as a unique set of financial, technical and business parameters that need to be modeled and analyzed. We will outline a step by step process for gathering these input parameters.

Step 1 – Gather the Target Market statistics.

This includes a definition of the geographic area where service will be offered. Typically, this is measured by square kilometers of coverage for urban, suburban and rural geographies. For each of these geographic areas, specify the total population by individuals, number of households and the number of small and medium businesses (SMEs). Finally, a determination of the terrain type must be made. For signal propagation purposes, typical classification of terrain types is flat, moderately hilly or hilly. These are the terrain definitions specified in the Erceg-Greenstein channel models used by the IEEE to evaluate WiMAX technology options.

Step 2 – Determine the Spectrum & Bandwidth to Be Used.

Since we are concentrating on a WiMAX business case for licensed spectrum, the frequency spectrum is unquestionably the prime asset of an operator. In some cases an operator may be putting together a business case in order to determine how much to bid for a license and what bandwidth would be necessary to support a long term network operation. In either case, a comprehensive business case exercise is critical. How would the use of 2.3GHz, 2.5GHz or 3.5GHz spectrum or even 1.7GHz or 700MHz range affect the business case results? Determining not only the available spectrum, but also the total bandwidth available are critical inputs to the business case. With this information, we can decide whether to use a channel bandwidth of 5MHz, 10MHz or 20MHz. For those operators who already own spectrum, the cost of the licensed spectrum and whether a lump sum or a lease need to be specified.

Step 3 – Determine the Technological Parameters to Calculate Range and Capacity.

When contemplating a WiMAX deployment, the first technological selection is between 802.16d or the 802.16e standard. This, together with other technical parameters such as link budget, spectral efficiency and antenna configuration (SISO, MIMO & AAS), will be used to calculate the range and capacity of cell sites. These parameters, along with the frequency used, will predominantly control the coverage area per cell site and thus the total number of cell sites to cover the desired geography.

Step 4 – Customize Financial Assumptions.

For each operator deployment, the financial assumptions and parameters need to be customized. The interest rates on borrowing and return on cash capital need to be determined. The tax rate on corporate profit as well as taxes on revenue, if any, is specified as a part of the financial assumptions. Finally, depreciation and amortization period are specified.

Step 5 – Determine CapEx Assumptions.

Capital expenditures consist of the cost to acquire or lease sites. These may be existing sites through collocation agreements or Greenfield sites. There may be fixed costs as well as monthly recurring costs associated with site acquisition. The Access Network assumptions are next. These include not only the cost of the base stations, but also the cost to install and connect every component in the access network, from cabling to antennae to power and backhaul. The costs for backhaul provisioning, installation and operation also need to be considered. In developed regions, T1 or fiber may be readily available. Wireless backhaul links may also be considered. In this case, more capital will be invested in equipment, but operational costs will be eliminated. Figure 1 shows a diagram of a WiMAX network.

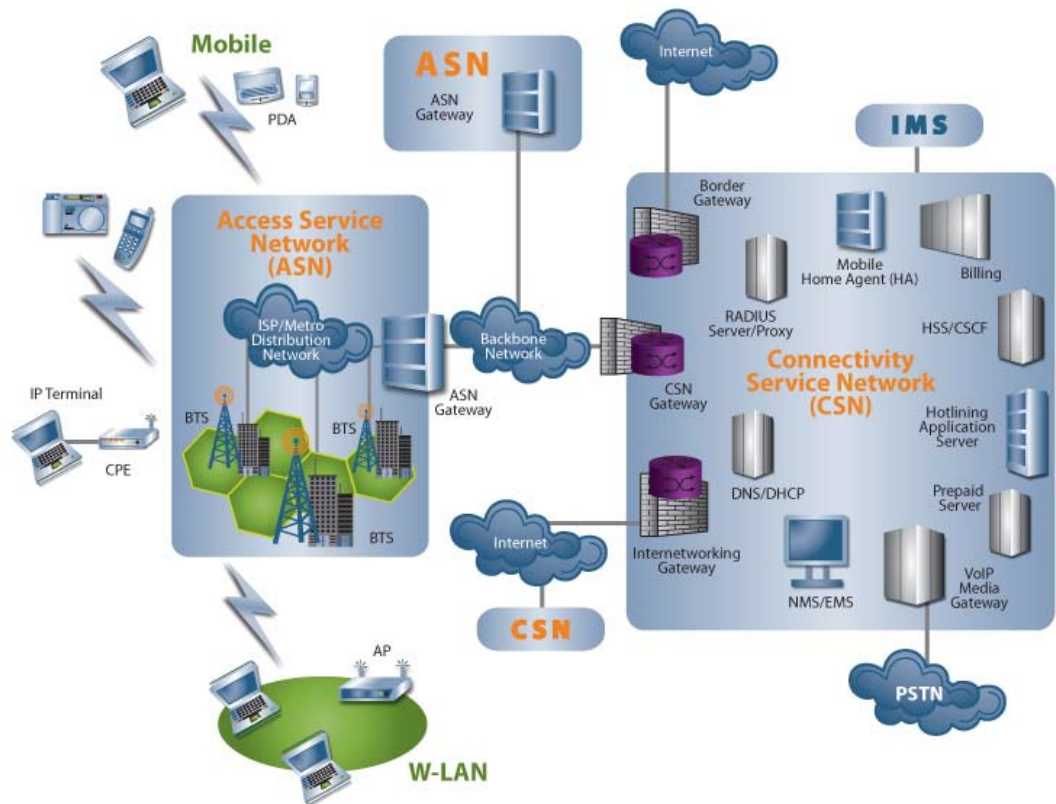


Figure 1. Block Diagram of a WiMAX Access and Core Networks

Once the access network parameters are specified, the cell sites are connected through the backhaul links to aggregators and then to the Access Services Network (ASN) gateway. These gateways in turn connect to the rest of the servers in a core network. Table 1 shows the elements of a core network. The features, capacity and performance parameters, as well as the cost of each component in the access network, the backhaul and the core network, need to be accurately specified in order to get a realistic determination of the CapEx requirements in the business case. Finally, an annual maintenance fee should be specified to sustain the network. This is typically a percentage of the total cumulative CapEx on an annual basis.

Core Network Elements
<i>IP Core Router</i>
<i>IP Aggregate Router</i>
<i>ASN Gateway</i>
<i>HA – Home Agent</i>
<i>Firewall</i>
<i>DHCP Server</i>
<i>AAA Server</i>
<i>Billing Server</i>
<i>NMS/EMS Server</i>
<i>VOIP Servers</i>

Table 1. WiMAX Core Network Components

Part 1 Conclusion

In this first part of the WiMAX operator business case development process, the goal has been to adequately define all of the necessary input parameters. This forms the cornerstone of the investment structure for bringing the network into service. Once the cornerstone has been laid, an operator can move on to the definition of the services that will be offered and sketch the plan for bringing those services to customers.

Part 2 – Service and Market Planning for a WiMAX Operator Business Case

Despite the enormous pent up demand for broadband wireless services worldwide, the broadband wireless market is still in its infancy, with relatively few operators realizing significant services revenue. This market is expected to expand significantly in the coming years due to the availability of a variety of fixed, portable and mobile WiMAX devices coming to the market, and to the anticipation that many of the WiMAX operators conducting trials will be able to construct convincing and bankable business cases in order to move from the trial stages to full network deployment. One of the most critical aspects of building these bankable business cases is the process of meticulously constructing the marketing model that will create the revenue profile needed to fuel a business case.

Business cases for these emerging services will be based on revenues from competitive, traditional broadband services to residential and business customers, and new mobility-based services enabled by new applications and devices. The broadband wireless services, as well as service pricing offered by WiMAX operators around the world, will vary significantly from region to region. An operator must understand the market conditions in its local markets which will drive its pricing, service packages, network coverage, roll out plans, and penetration estimates which in turn will drive its business case. For example, a 1 Mbps wireless broadband service in a particular city will be priced according to the supply and demand dynamics of that particular geographic area. Socioeconomic, regulatory and competitive elements are unique to each particular region and will greatly impact the supply and demand dynamics for broadband access. In this paper, we will outline a systematic approach to building a market model for an operator's market and defining the types of potential services a WiMAX network operator can use to build the layers of revenue that drive a WiMAX business case.

Building a Broadband Market Model - There are several steps to follow in order to build an accurate model for market penetration of broadband wireless services into an operator's market.

Market Planning

Competitive Analysis

While many markets have some level of broadband services available, penetration and pricing levels vary greatly. An operator must understand both current providers of wire-line broadband and future competitors offering wireless broadband services. These could include DSL and cable providers on the wire-line side. Wireless providers could include 3G service providers, metro WiFi providers, unlicensed wireless ISPs, or other holders of broadband licenses. Further consideration should be given to the licenses held by the operator and competitors. An operator that holds a 3.5 GHz license will likely need to focus on fixed services and will need to deploy more base stations to cover a given area as compared to a holder of

2.5GHz license, leading to a higher cost base. A complete understanding of the competitive environment for broadband services in an operator's market is the first step in developing a market plan.

Coverage Roll Out Plan

An operator must develop a plan for rolling out coverage by addressing such questions as: Whom do you want to serve? Do you want or need ubiquitous coverage? Is it best to roll out coverage quickly or take a slow roll out approach? Who are your most valued customers and where are they? A detailed study is necessary to set the geographic boundaries of what typically is a multi-stage roll out. This is an area where a comprehensive business case analysis tool such as WiROI will allow you to do the scenario planning necessary to evaluate the many options for a network roll out strategy.

Penetration

When building a WiMAX business case, one of the most challenging tasks is to forecast the number of subscribers that an operator can expect to sign over the life of the network. The plot of number of subscribers over a 10 year time frame is often called the S curve. This is because the shape of the curve looks like an S with relatively few subscribers in the first couple of years, as the operator is deploying the network, expanding coverage, and establishing brand recognition. Once the network is fully deployed, there will be a rapid increase in subscribers until a level of saturation is reached. The following table shows a typical S curve:

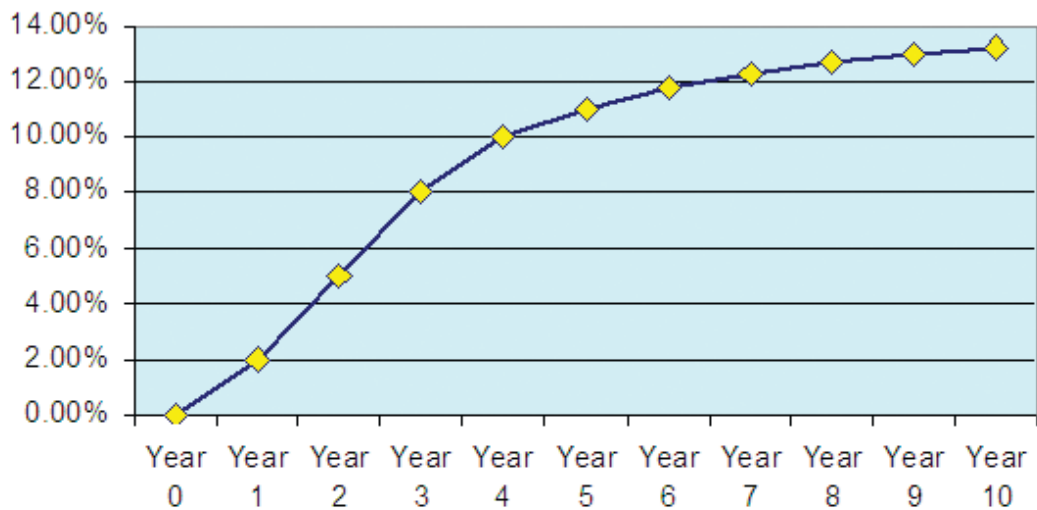


Figure 2. Penetration Curve

These types of service will contribute to lowering the monthly churn for WiMAX operators.

Determining the S curve for a particular WiMAX deployment is often the outcome of extensive market research and competitive analysis that includes an assessment of the existing broadband, PSTN, Cellular and VoIP competitive dynamics.

Service Planning

Next, an operator should define what services they would like to offer. We define several types of services that a WiMAX operator can consider offering. These include Broadband Access, VoIP, Value Added Wireless Service and Advertising.

Broadband Wireless Access

WiMAX promises a dramatic decrease in the price per megabit of broadband wireless access (BWA). This, along with the ability to rapidly deploy WiMAX networks and offer plug-and-play portable and mobile wireless services, will give new WiMAX operators a competitive advantage. BWA will constitute the bulk of most WiMAX operators' revenue in the early years of a business case. The two main categories of BWA service are Residential BWA and Business BWA. These are essentially high speed, "dumb-pipe" connections to the Internet. An operator will need to determine how many residential service level agreements (SLA) to offer. An SLA is a negotiated agreement between a service provider and a consumer. It is a subscription choice which typically defines the service level offered (i.e. a bit rate) for a given monthly fee. For example, a typical entry level residential SLA could be offered at 384 Kbps for \$29.95 per month. The following table illustrates an example set of residential SLAs a WiMAX Operator may choose to offer:

	Bit Rate	Monthly Fee
<i>Residential SLA 1</i>	<i>384 kbps</i>	<i>\$29.95</i>
<i>Residential SLA 2</i>	<i>768 kbps</i>	<i>\$39.95</i>
<i>Residential SLA 3</i>	<i>1,500 kbps</i>	<i>\$59.95</i>

Table 2. Example Set of Residential SLAs

Most operators will likely offer a couple of residential SLAs to give their consumers a choice of service and price while positioning their offering according to the competitive landscape in their particular market. For instance, in a market where wired broadband access using DSL or Cable networks have limited coverage, a WiMAX operator will price its service based on the pent-up demand for BWA. In most developing countries where wired broadband access is limited and where PC penetration is growing, these PCs use dial-up service at 56 kbps. Here, a 384 kbps service will look attractive. In other countries where DSL & Cable service is ubiquitous and the competitive environment has put pressures on prices, an operator has to carefully analyze the market prior to determining what would constitute a winning offer for a given market.

A similar set of SLAs are developed for the business market. In most cases, business SLAs should be able to

command higher prices and will require a higher guarantee of availability and throughput. The following table illustrates an example set of business SLAs a WiMAX Operator may choose to offer:

	Bit Rate	Monthly Fee
Business SLA 1	768 kbps	\$59.95
Business SLA 2	1,500 kbps	\$89.95
Business SLA 3	2,000 kbps	\$99.95

Table 3. Example Set of Business SLAs

Oversubscription – WiMAX operators will have to determine the extent to which they should oversubscribe their networks. The term oversubscription is used to mean assigning a total committed information rate to a given base station that is greater than that base station's maximum capacity. This number is used to calculate "busy hour" traffic in order to determine the traffic capacity of the network needed to support the anticipated number of users. As the number of users increases, a calculation using the oversubscription rate will tell an operator when to add cells for capacity. Again, a good business planning tool will provide this information to a network planner. Typical oversubscription rates are 25-40 for residential service and 10-15 for business service.

Unlimited vs. Usage Based Rates – In the USA, and Western Europe, WiMAX SLAs will often be offered with unlimited usage for data. In some cases, however, there will be a need to establish the maximum amount of data usage per month. As a result, most ISPs and international WiMAX operators will be faced with the fees for International Internet Connection. These fees are usage based fees that a WiMAX operator will incur. Therefore, an operator must include this not only in the OpEx analysis but also when pricing the SLAs. A comprehensive business case tool would provide cost per bit metrics in order to enable the operator to make informed pricing decisions.

Ad Hoc Services

Another way for an operator to build layers of revenue is to offer ad hoc WiMAX services for users who happen to roam into a coverage area. This model is very similar to the Wi-Fi hotspot model, where a user would pay \$9.95 for one day's Wi-Fi access at a hotel.

VoIP

VoIP over WiMAX is expected to become one of the most popular value added service that a WiMAX operator would offer in order to derive another "layer of revenue." The decisions for a WiMAX Business Case include the recurring cost for offering VoIP service, PSTN termination charges, CPE types and costs, as well as

utilizing the flat rate vs. the fee based approach for pricing VoIP service. VoIP service will typically be offered in conjunction with one of the residential or business SLAs discussed above.

Value Added Services

There is a list of additional value added services that a WiMAX operator should consider offering. Below are a few examples:

Wi-Fi Backhaul	<i>WiMAX can be used as wireless backhaul to a Wi-Fi hotspot. Hotels, vacation resorts, schools and retail businesses are prime targets for Wi-Fi hotspots with WiMAX backhaul. This allows an operator to attract ad-hoc users of portable computers with built in Wi-Fi, without requiring a WiMAX CPE.</i>
Music and Video Download	<i>WiMAX operators should consider building value added SLAs that combine broadband access with a certain number of music and video downloads per month. These types of services will provide the consumer flexibility of choice while offering a chance to experiment with value added service. At the same time, the operator would establish relationships with content providers where it would purchase content wholesale and provide it to its users.</i>
Pre-Paid Service	<i>Digital cameras with a pre-paid WiMAX service for uploading up to 500 photos to a photo sharing web site would be a great example of how WiMAX operators can enable and promote the broadband wireless experience.</i>
Mobile Advertising	<i>Selling advertising real estate has always been a way to fund subscriptions. WiMAX operators will undoubtedly have the opportunity to innovate with service that can partially or fully fund subscriptions.</i>

Table 4. Example Set of Value Added Services

These types of service will contribute to lowering the monthly churn for WiMAX operators.

Determining the S curve for a particular WiMAX deployment is often the outcome of extensive market research and competitive analysis that includes an assessment of the existing broadband, PSTN, Cellular and VoIP competitive dynamics.

CPE Assumptions

Another important element of an operator business case process is to establish the various types of subscriber stations or WiMAX terminals used with the various SLAs. The following list illustrates some of the options:

- Fixed CPEs (indoor and outdoor)
- Portable CPEs'
- Mobile CPEs
- WiMAX PC Cards
- WiMAX cards Integrated in laptops
- WiMAX Embedded in consumer electronic (CE) devices such as Portable Media Players (PMPs), digital cameras, gaming, and other CE devices.

Lastly, with each CPE, the business case should include the price of the CPE, whether it is being subsidized by the operator, the price erosion per year for the 10 year forecast period, the installation cost, along with whether the installation is being subsidized by the operator or paid by the consumer. Operators planning to offer WiMAX smart phones may also wish to consider the need and impact of the "refresh cycle." This is when an operator provides significant incentives for subscribers who have completed their contract term and would like to receive a new device.

Part 2 Conclusion

In the first part of the WiMAX operator business case development process, we outlined all of the necessary input parameters for a WiMAX operator business plan.

In this second part of the WiMAX operator business case development process, the goal has been to outline how to build layers of revenue by defining a number of service level agreements and value added services that will generate the top line revenue for the business. This forms the cornerstone of the revenue structure for the business case. Once the cornerstone has been laid, an operator can move on to optimizing the business case.

Part 3 – Optimization and Sensitivity Analysis of a WiMAX Business Case

In order to examine a WiMAX business case and perform sensitivity analysis as well as optimization, a mathematical model of a WiMAX network has to be developed. This model has to take into account all of the input parameters we discussed in Part 1 and Part 2 of the WiMAX Operator Business Case Process in order to generate all the necessary financial outputs needed to evaluate an investment and the return on investment (ROI). WiMAX 20/20 has developed such a model called WiROI™.

Introduction to WiROI

WiROI, short for WiMAX ROI, is a comprehensive business case model of a WiMAX network that takes into account more than 250 input variables that affect a WiMAX operator business case. The tool models every aspect of a WiMAX network: from CPE devices to the air interface, to the antenna technology used, to the cost of installation and the price of base station and core network equipment. Coverage and capacity calculations are driven for the geographical target area and take into account the addition and subtraction of subscribers over a 10 year period. Additions in the access network and backhaul are made due to the penetration assumptions and traffic usage patterns over time. The tool also models the WiMAX Core Network as outlined in Part 1. In addition to modeling the hardware and software elements of a WiMAX network, WiROI includes a financial model of a WiMAX network that takes into account the CapEx and OpEx assumptions.

As outlined in Part 2, the tool takes into account the operator service assumptions, which include SLA pricing for residential and business customers, as well as VoIP, Mobility and value-added services. For each of the proposed service, the tool accepts a set of penetration assumptions over time. The figure below represents a high-level block diagram of the WiROI model inputs and outputs.

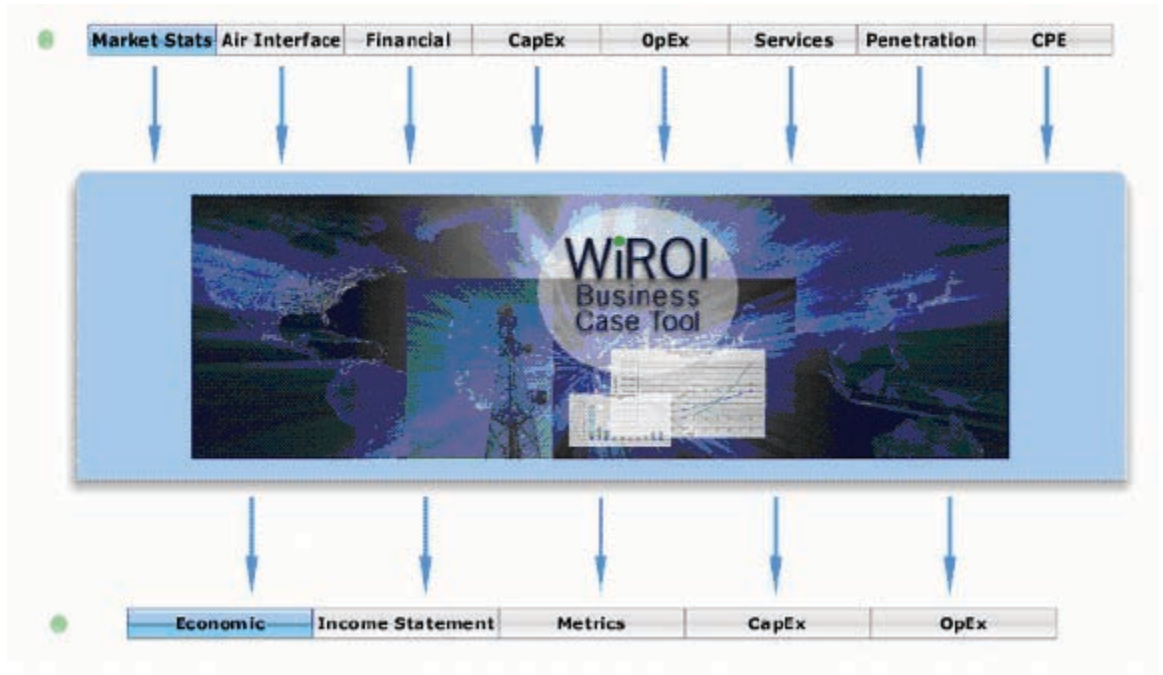


Figure 3. Block Diagram of the WiROI Inputs and Outputs

Once all the inputs of a WiMAX business case have been specified and entered into the WiROI model, a series of standard financial documents are generated. The financial output includes a complete 10 year income statement showing revenue, network operating expenses, marketing expenses and SG&A.

In addition, the following output is generated:

Financial Summary	<i>CapEx</i> <i>Revenue, OpEx, EBITDA and Net Income</i> <i>Cash Flow and Discounted Cash Flow</i>
Valuation Summary	<i>Present Value of Free Cash Flows</i> <i>Terminal Value</i> <i>NPV</i> <i>IRR</i>

Table 5.

Once an initial business plan output has been generated that includes a complete set of financial and investment parameters, WiROI can now generate a rich set of performance data that allows an operator to analyze the various coverage, traffic and financial metrics. The following is a list of the key performance indicators (KPI's) generated by WiROI.

Coverage Metrics	<i>Covered POPs</i>
	<i>Covered Households</i>
	<i>Covered Businesses</i>
	<i>Area of Coverage</i>
	<i>Covered POPs per Cell</i>
	<i>Covered Households per Cell</i>
	<i>Covered Businesses per Cell</i>
Traffic Metrics	<i>Total Traffic at Busy Hour</i>
	<i>Total Capacity</i>
	<i>Traffic/Capacity</i>
	<i>Traffic/KM2</i>
	<i>Capacity/KM2</i>
	<i>Total Daily Traffic</i>
	<i>Daily Traffic per subscriber</i>
Financial Metrics	<i>Revenue Metrics</i>
	<i>Expense Metrics</i>
	<i>Subscriber Metrics</i>
	<i>Cost per Bit Metrics</i>
	<i>Cost per Gross Add</i>

Table 6. Key Performance Indicators (KPIs)

The WiROI GUI

The WiROI GUI has a dashboard style user interface that allows the user to easily visualize a list of the critical inputs and output of a WiMAX business case. It incorporates animated selectors, sliders and buttons that allow the user to vary key input parameters and visualize the output immediately. Answers can be seen instantly to questions like:

- What would the effect of a link budget be on my overall WiMAX business plan be?
- How will the cost of backhaul affect my OpEx?
- How would the core network affect my CapEx and what might the impact on my 10 year business plan?
- How would using a 2.5 GHz spectrum vs. a 3.5 GHz spectrum impact my business plan?
- How do the costs of base stations and CPEs affect my business plan?
- How can the service agreements be optimized for my business plan?

These and many other critical questions can be answered instantly, interactively and easily by using WiROI.

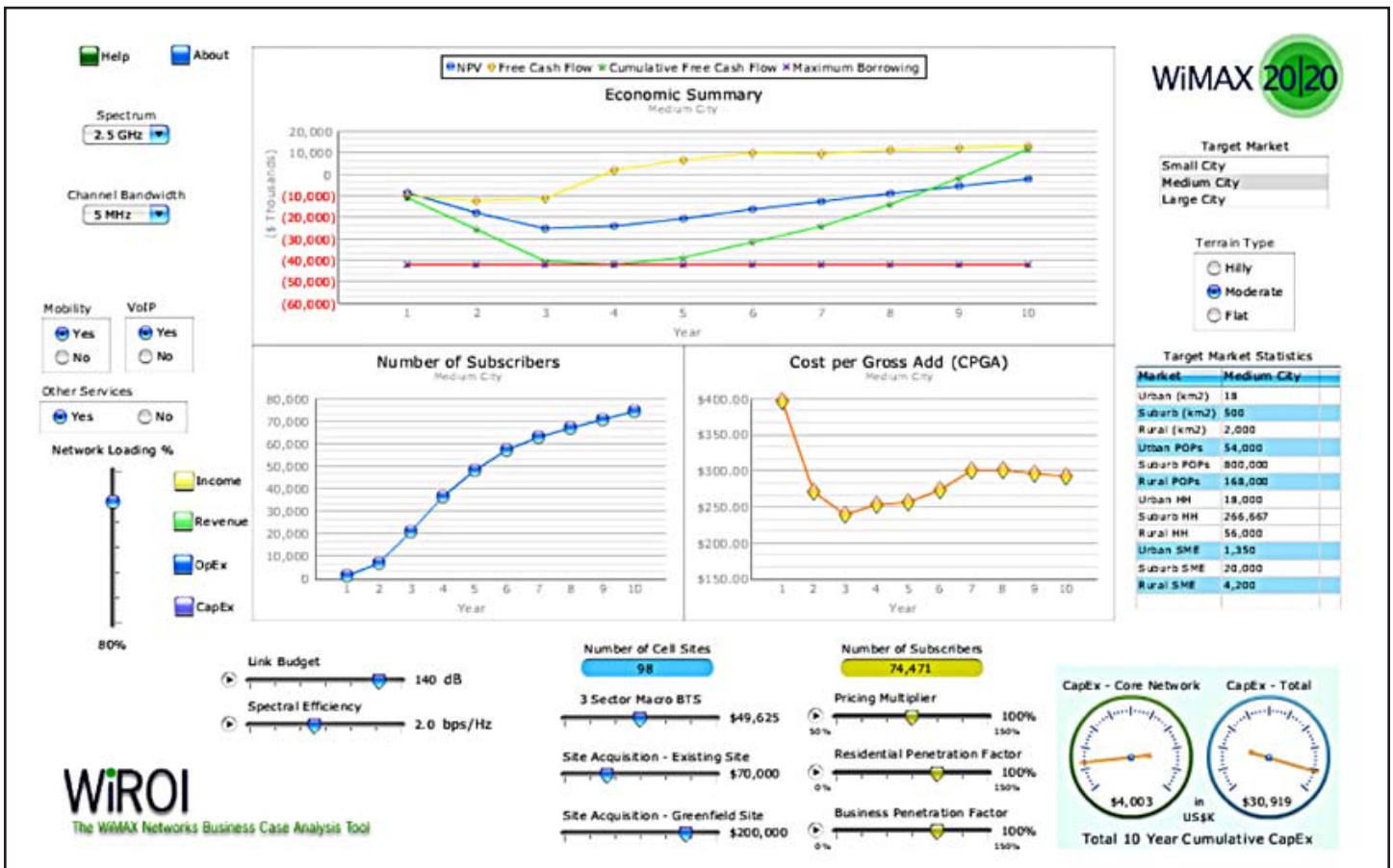


Figure 4. The WiROI Dashboard GUI. (For the interactive version of WiROI Tool, kindly visit <http://www.wimax2020.com/wiroi.html>)

Sensitivity Analysis of a WiMAX Business Case

Because of the dashboard-style GUI, WiROI can produce sensitivity analyses based on certain input parameters for a particular deployment. As a result, operators can quickly and easily visualize and understand the critical issues that affect their deployment plan. In addition to estimating the number of cell sites, the tool includes various options for selecting the WiMAX network infrastructure required to support specific coverage and capacity requirements. The user can select from a variety of core networks, access networks, base stations, and backhaul options. WiROI provides answers to a variety of “what if” scenarios in order to help identify the most important variables influencing the specific WiMAX business plan.

Target Market The Target Market selector allows the user to choose one of many pre-programmed target markets. The trial version incorporates three markets labeled Small, Medium and Large. This can be customized in the full version of WiROI to a given operator’s geographic market. It can also include an aggregation of numerous cities to constitute a nationwide deployment.

Spectrum	<i>The Spectrum selector is a pull down menu that allows the user to select between 2.5GHz and 3.5GHz deployment. The full version of WiROI will include 2.3GHz, 3.3GHz and other frequencies.</i>
Terrain Type	<i>The Terrain type selector allows the user to designate the geographic area as Hilly, Moderate, or Flat terrain. Based on the terrain type designation, WiROI will calculate the cell radius for each cell site at the selected frequency. Coverage parameters are subsequently calculated.</i>
Link Budget	<i>The link budget parameter is highly dependant on the equipment selected and the technology used. There are numerous factors that influence the link budget, such as the antenna technology used (MIMO and AAS), the transmit and receive characteristics of the base station and the CPEs.</i>
Spectral Efficiency	<i>Spectral Efficiency is a measure of the number of bits per second per Hertz. This parameter is dependent on the technology selection (i.e. 802.16d vs. 802.16e) and the equipment specifications. Smart antenna technology can also increase your spectral efficiency.</i>
Site Acquisition	<i>There are two separate site acquisition sliders: one for “existing sites” and one for “Greenfield sites.” These values vary greatly from country to country. In some developed countries, site acquisition costs for Greenfield operators could exceed the cost of base station equipment and thus have a significant impact on the business case.</i>
Base Station	<i>The trial version includes a slider for the cost of a 3 sector macro base station. Other sliders can be added for the cost of the Core Network, the price of CPEs and the cost of backhaul.</i>

Pricing Multiplier

This slider allows the user to implement a multiplier on the monthly SLA price. The default setting is at 100% of the assumed price. By moving the slider up to 150% or down to 50%, the user can analyze the sensitivity of the business plan to increases and decreases of the SLA pricing.

Penetration Factor

There are two separate penetration factor slides: one for residential services and one for business services. The slides move down to 0% of the default assumption in order to allow the user to simulate a network deployment based on residential only service or based on business only service. By moving these sliders up or down, the user can analyze the impact of worst-case and best-case penetration scenarios on the overall business case.

Table 7. Target Market Selectors

Conclusion

Developing a WiMAX Business Plan

Developing a WiMAX business case could be a complex and time-consuming process. Quickly choosing among over 250 different input variables and assumptions, the ability to instantaneously modify these variables, test key assumptions and instantly visualize their impact on a WiMAX business plan are invaluable capabilities. Without using a comprehensive WiMAX business planning tool, the task of performing sensitivity analysis and optimization becomes a tedious exercise of running various scenarios one by one and reviewing a multitude of output reports. Because of the iterative nature of the process, many business managers tend to either avoid optimizing their WiMAX business cases or are unable to confidently answer “what if” questions to their investors. This may very well be one of the primary reasons why many prospective WiMAX operators have not been able to obtain the necessary funding to move from trials to full commercial deployments. WiMAX 20|20's WiROI Business Case Analysis Tool offers a range of capabilities that simplify and accelerate the process of building bankable WiMAX business cases. For a complementary trial of the WiROI tool, please visit www.wimax.com/wiroi.html.

