



Optimizing Your WiMAX Device Investment

How WiMAX Device Selection Contributes to a Winning Business Case



Selecting Optimal WiMAX Devices

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Introduction

When investing in a commercial WiMAX installation, operators must carefully consider a number of equipment, system and operational components to ensure that they fully profit from their WiMAX service. WiMAX operators need to compare vendor offerings for infrastructure, devices, IP core, service delivery platforms, backhaul solutions and back office systems for billing, management and customer care. Each of these individual components supports the operator's business case in an important way. One of the most critical components contributing to the operator's WiMAX business case is the selected portfolio of WiMAX devices.

The operator's WiMAX device selection not only significantly impacts the efficiency of the overall WiMAX system and influences the dimensioning and site density of the radio access network, it is also the key interface point for the end users' WiMAX experience. A highly capable WiMAX network, delivering powerful wireless connections, should be transparent to the end user. Ultimately, the end user will judge the operator's WiMAX service based on their satisfaction with their WiMAX device and the applications running on it.

WiMAX has already established a strong, global growth trajectory. The WiMAX Forum projects 133 million WiMAX subscribers globally by 2012 and over 1000 WiMAX certified products available to serve them. As WiMAX networks continue to be deployed in greater scale and new networks emerge over the next year, we will also witness a boom in WiMAX devices supplied from a wide variety of manufacturers.

Operators must take great care in selecting WiMAX devices that excel in performance, convenience, control and reliability to ensure that they optimize the capability of the WiMAX network, optimize the cost of operating the system, and perhaps most importantly - optimize their customers' broadband experience.

WiMAX Device Selection Criteria

Operators evaluating WiMAX devices should form selection criteria across four key attributes:

Performance
Convenience
Control
Reliability

Each of these attributes plays a significant role in delivering important operator and end-user benefits.

Most WiMAX operators will employ a range of WiMAX devices with varying features, functionality and price points to attract targeted customer segments. Whether the operator is looking at top-tier devices for advanced users or value-based devices for more basic application – it is critical that the operator selects devices that acceptably deliver these four attributes.

While the cost of an individual WiMAX device is an important concern during the operator's investment decision, the operator should not be too quick to compromise cost for capability. The operator must avoid the risk of introducing a device that is by its own measure inexpensive but contributes to a cost of network ownership that is much higher due to the device's limitations.

While devices optimized to address these four attributes will deliver a strong business case for the operator and a positive experience for the end-user – devices that compromise on these attributes can quickly compromise the health of the overall WiMAX system, increase the cost of ownership for the operator, and lead to an unsatisfactory end-user experience.

WiMAX Device Selection Criteria Across Four Key Attributes

Performance	Attributes	<ul style="list-style-type: none">▪ High device receive sensitivity▪ Strong isolation between Wi-Fi and WiMAX▪ Flexibility in device placement and orientation
	Operator Benefits	<ul style="list-style-type: none">▪ Fewer sites required to serve the network▪ Higher order modulation throughout the cell▪ Higher effective capacity to share across subscribers
	End User Benefits	<ul style="list-style-type: none">▪ High speed, consistent service to user devices▪ Flexibility in device placement
Convenience	Attributes	<ul style="list-style-type: none">▪ True Plug-and-Play capability▪ Elimination of the need to load drivers
	Operator Benefits	<ul style="list-style-type: none">▪ Over-the-air activation▪ Reduced operator involvement in activating user
	End User Benefits	<ul style="list-style-type: none">▪ Quick and easy service activation▪ Speedy authentication each time they log on
Control	Attributes	<ul style="list-style-type: none">▪ Robust, standardized device management▪ Strict security provisions▪ High Quality of Service management
	Operator Benefits	<ul style="list-style-type: none">▪ Over-the-air software upgrades▪ Standardized management platform across in-home devices▪ Remote provisioning
	End User Benefits	<ul style="list-style-type: none">▪ Confidence in security of connections▪ Reliable service quality for voice and high priority services
Reliability	Attributes	<ul style="list-style-type: none">▪ High quality manufacturing processes▪ Rigorous testing and acceptance criteria
	Operator Benefits	<ul style="list-style-type: none">▪ Extended life for deployed devices▪ Reduced inventory requirements▪ Reduced repair and replacement costs
	End User Benefits	<ul style="list-style-type: none">▪ Dependable, quality devices▪ Reduced service outages

Performance

High performing WiMAX devices not only improve the connections that individual end-user receives, but also improve the utilization of system resources, improve the overall system capacity, and reduce the number of supporting sites in a coverage area. Well designed devices provide significant benefit to both the end-user experience and the operator's economics.

Key performance parameters to evaluate when considering WiMAX devices include receiver sensitivity, antenna gain, diversity gain, and orientation loss.

Devices in the market have demonstrated up to 18dB of variance across these performance parameters. Operators should evaluate the device performance balanced with the device cost and, most importantly, the impact to the total cost of ownership of the WiMAX network.

Device Receiver Sensitivity

A key specification for any radio is the receiver sensitivity. Receiver sensitivity for a WiMAX device is a measurement of how faint the radio signal from the base station may go while still being successfully received by the device.

Higher receive sensitivity offers the following system wide advantages:

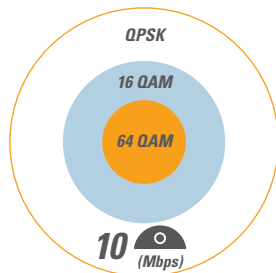
- » Larger coverage radius for a cell site
- » Larger area served by higher order modulation within cell radius
- » Fewer base sites required within the service perimeter
- » Higher end-user effective throughput
- » Greater tolerance for deep indoor penetration

The WiMAX Forum specifies the receiver sensitivity requirements for each certification profile at each of the varying modulation schemes. While this offers a minimum, baseline target for manufacturers to design to; well designed RF components within the WiMAX devices should be able to deliver as much as 5 dB higher receiver sensitivity than the WiMAX Forum requirements or more than three times higher. With this improved sensitivity, an operator can effectively double the area covered by the higher order modulation schemes, increasing throughput and optimizing system resources as well as reducing the number of sites by almost 50% in the coverage area.

Given the tremendous advantage improved receiver sensitivity can offer, WiMAX operators would be well advised to consider this measurement as a key selection criteria for their devices.

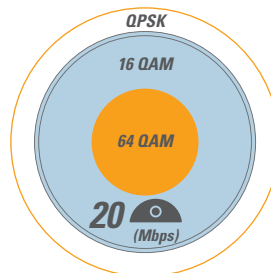
TYPICAL WiMAX DEVICES

High order modulation coverage built to WiMAX Forum specifications



MOTOROLA WiMAX DEVICES

Doubling effective area covered by higher order modulation



Approximate sector throughput (10 MHz channel)

64 QAM	35 Mbps
16 QAM	20 Mbps
QPSK	10 Mbps

Device Isolation for Wi-Fi & WiMAX

Many full-featured WiMAX devices are looking to integrate Wi-Fi capability into the device. WiMAX can be used to provide the broadband backhaul to the premises and the integrated Wi-Fi can be used to additionally support local area distribution of the broadband signal and connect to a broader array of Wi-Fi enabled devices.

A large percentage of global WiMAX installations are focused on employing the 2.5 GHz band. Recognizing that Wi-Fi operates largely in the nearby 2.4 GHz band, operators seeking to deploy WiMAX at 2.5 GHz must ensure that their devices provide ample isolation between the WiMAX and Wi-Fi radios. Merely integrating the two radios into a device can result in significant interference, increasing the number of WiMAX re-transmissions due to packet loss, requiring greater system resources to support the connection, and ultimately degrading the end-user throughput – despite receiving a strong WiMAX signal strength at the receiver.

Operators should ensure that selected WiMAX devices with integrated Wi-Fi capability employ innovative RF design considering techniques such as switched, diversity antennas and high-performing RF components which will offer high WiMAX and Wi-Fi isolation. Such devices increase the effective throughput for the end-user and minimize impact to overall system capacity by reducing resource intensive error correction and scheduler processing.

Antenna Gain, Diversity Gain, & Orientation Loss

High performing WiMAX devices should demonstrate strong antenna gains employing the full benefit of the diversity techniques allowed with multi-antenna designs. While certified WiMAX devices must support MIMO capabilities as specified in the certification profiles, better devices will also incorporate additional techniques such as Maximal-Ratio Combining (MRC) to combine the multiple signals for more robust reception. This represents a basic capability of sound RF design and a fundamental measurement for device comparison.

Additionally, the devices should offer minimal orientation loss, offering the end-user greater freedom for where in the premise the device is positioned and in what orientation. WiMAX devices will find their place in such likely environments as the living room or media center. Stylish design may find its value diminished if the end-user has to investigate and discover optimal placement for acceptable signal reception.

Convenience

The end user's WiMAX experience begins at the point where they carefully select and purchase their WiMAX device and bring it home. Stylish designs will help motivate their selection; however, the greater test of the experience takes place once the user plugs in the device and attempts to activate their service. When an end-user activates his device for the first time, he should seamlessly achieve an easy, broadband connection. Just as important, every following time he logs on to the service he should experience a reliable, speedy authentication. This type of satisfying end-user experience will contribute to customer loyalty over the long-term.

Speed Entry to WiMAX Service

Preferred WiMAX device solutions should be paired with support for seamless system integration of these devices into the operator's provisioning and service delivery platforms to eliminate the degree of intervention required from the end-user and speed their entry onto the WiMAX service.

Many WiMAX operators' device distribution processes allow for an inventory of pre-provisioned devices to be sold through retail channels as well as approved devices that may be optionally added to the provisioning system after service activation.

Pre-Provisioned Devices "Plug and Play"

With a pre-provisioned device, once the end-user is approved and the device is brought home, the device can be merely powered up and connected to a computer to have the WiMAX service engaged. This represents a true Plug and Play experience. As more computer accessories and peripherals move to Plug and Play interfacing, this is becoming an expectation of the end-user and anything otherwise will fall short.

The time it takes to activate service upon first power-up can vary depending on the capability of the device and its integration into the provisioning system. The industry's best solutions have demonstrated less than 40 seconds to service activation in comparison to alternative solutions that may take many times longer.

Approved, but Not Pre-Provisioned

For approved devices that have not been pre-provisioned, the end-user should also be supported with a speedy process for service activation. Leading device vendors have demonstrated systems and operational support to engage a straightforward process for such activations. Once the device is powered up, the end-user has to only select from a menu of available WiMAX service providers, provide personal and billing information, and offer the unique device ID printed on the package. The operator's role in activating the service should be fully automated and supported through over-the-air provisioning significantly reducing the operational cost of activating a subscriber.

Steps for Activating an Approved WiMAX Device onto a WiMAX Network

1. End user purchases an approved, non-provisioned device from a retail channel
2. Upon powering for the first time, the device will perform a band scan across all available RF channels to determine what WiMAX service providers are available.
3. Similar to enabling a Wi-Fi device, a list of available WiMAX service providers will be announced and the end-user has the opportunity to select the provider of choice.
4. The connection is immediately re-directed to the operator's service provisioning landing page where key vitals of the end-user are collected including profile information, billing details, and subscription preferences.
5. The operator will request the end-user to enter their unique device ID printed conveniently within the package and on the device. The device ID is typically a combination of the MAC address and the serial number of the device.
6. The operator will validate the information and upon election to grant service, the system will provision the user device onto the AAA and Home Agent (HA).
7. The end-user is authenticated, security keys are exchanged, and the broadband connection is enabled.

Eliminate the Need to Load Drivers

The need to install drivers and configure the computer to acknowledge the WiMAX device can be a burdensome process, especially when the end user is eager to engage in the WiMAX experience. Selecting a WiMAX device that has all necessary software drivers pre-loaded, utilizes standard Ethernet interfacing to connect to the computer, and places no requirement on the computer's operating system can substantially ease the end-user's path to connectivity.

Operators will benefit by selecting device vendors who are capable of extending their solution to consider how the device integrates into the broader WiMAX system. Such an integrated solution will offer great advantage to the convenience of the service – both for the operator and the end-user.

Control

Operators must have full control and management over their network, the established base of devices operating on that network, and the service delivered to the end user. Centralized device management supporting remote management and administration and health monitoring is a critical capability for enabling such control. Additionally, it is important that operators consider devices supporting standardized management protocols to allow their WiMAX devices to fit into a common platform managing the entirety of their devices portfolio irrespective of device type or technology.

Centralized Device Management

The Device Management Platform should provide a single, centralized control point for managing the entire base of subscriber devices including remote management and administration and health monitoring. The platform will integrate into the operator's Customer Relationship Management (CRM) system and play a key role throughout the service lifecycle from activation, routine maintenance, trouble ticket issuance, incident resolution, and service termination. Additionally, the platform will support administration and enforcement of the business rules associated with the various service types.

Key device management features

- » Over-the-air, remote management and software updates to subscriber devices
- » Policy-based auto-configuration, monitoring and debugging of devices
- » Fault management and status queries from the device
- » Enforcement of varying service tiers and service priorities
- » Administration of subscription models such as pre-pay or wholesale arrangements
- » Extended configuration and management capability for devices bridged by the WiMAX device and resident in the downstream local network

Remote Management & Administration

As subscribership grows on the WiMAX network, the need for highly capable remote management and administration capabilities becomes paramount for the operator. The operator's WiMAX system connecting from the central management to the device must support no-touch, over-the-air provisioning, configuration, and software upgrades. This capability will offer the operator the assurance of full management control over the system, the ability to reduce operational costs associated with system upgrades or configuration changes – and more importantly, the opportunity to rapidly grow their subscriber base without operational overhead.

Health Monitoring

Operators will want to ensure that the devices they select integrate with the management systems to deliver as much real-time information as possible regarding the health and performance of their devices deployed throughout the network. The more information that is available the greater intelligence the operator will have regarding how the network is being utilized, what opportunities exist to optimize the service, and resolving issues immediately as they arise.

Should an end-user have an issue with their service or their device, having such real-time data empowers the customer care professionals to conduct more detailed troubleshooting, increase the resolution rate, and decrease the number of service visits. Ultimately, this will improve the customer's satisfaction with their service and save the operator significant operating costs.

Standards-Based Device Management

WiMAX is blending the environments of traditional cellular service and traditional wireline broadband by offering wireless, mobile broadband connections. With the marriage of these environments we are seeing whole new families of end-user devices emerge that integrate the capabilities found in both cellular and wired broadband devices. An operator's WiMAX device portfolio is likely to include desktop modems, mobile Internet devices, PC adaptors, ultra-mobile computers, and an assortment of consumer electronics.

Additionally, a WiMAX operator may already have existing cellular or wireline assets with a large base of associated, established devices including mobile devices, set top boxes, broadband modems, and media gateways.

Operators will want the efficiencies of managing the entirety of their devices portfolio irrespective of device type or technology. This requires utilizing standards based device management protocols that can be integrated into a common device management platform.

WiMAX device manufacturers will need to support industry leading device management standards to offer all operators the opportunity to effectively control their device population without adding unnecessary systems complexity and cost overhead.

Two principal standardized device management protocols are administered in the industry today:

- » OMA-DM - Open Mobile Alliance Device Management
- » TR-069 - DSL Forum Technical Report 069

Deploying WiMAX devices that are conformant to both OMA-DM and TR-069 will offer operators the greatest flexibility in managing a broad array of subscriber devices. With such devices, operators will benefit from

- » Standard interfaces allowing the device to be deployed easily on any manufacturer's WiMAX network
- » A single management platform addressing all manner of devices from mobile devices to desktop modems
- » Interoperability with a wide variety of commercial, off-the-shelf management platforms

Industry standard device management protocols

OMA-DM

Wireless Devices

The OMA-SM device management protocol has been specified through the Open Mobile Alliance and was developed to support the management of such devices as mobile phones and PDAs. The specification is tailored to smaller devices where memory or storage may be limited.

TR-069

Wireline Devices

The TR-069 device management protocol has been specified through the DSL Forum and provides support to modems, routers, gateways, set top boxes, and VoIP phones and adapters.

Advanced Security Features

The WiMAX technology standard specified by IEEE maintains powerful standards-based security controls. These controls include the PKMv2 EAP-based standard between the device and the radio access network, over-the-air AES-based (Advanced Encryption Standard) encryption for subscriber traffic and AAA protocols for device authentication.

However, security planning for an operator's WiMAX network must extend beyond the security protocols inherent in the technology. Operators need to ensure that deployment efforts address and prioritize WiMAX security initiatives and that their design and integration adds a number of key security best practices into existing operational processes and policies. Managing security from the onset of deployment is an important step in managing the ongoing operational expense of running a healthy WiMAX service.

WiMAX devices play a key role in securing the WiMAX service. Leading WiMAX device vendors go beyond the IEEE security specifications to further secure the network through capabilities such as built in firewalls – inspecting and regulating network traffic as it travels over the WiMAX connection and denying or permitting the passage based on prescribed business rules.

Quality of Service (QoS)

WiMAX systems must be capable of administering an end-to-end QoS framework to meet the needs of true carrier-class deployments.

Leading WiMAX solutions should be capable of provisioning each end-user with a set of service flows mapping to the various services offered by the operator. For example, VoIP and data services may be defined as two distinct service flows for an end-user. Both service flows could be associated with appropriate QoS related parameters.

These parameters must be monitored and managed at multiple points across the network including the device to provide proper handling of the end-to-end service. Leading WiMAX devices should support the five classes of QoS (UGS, rtPS, ertPS, nrtPS, and BE) as defined by the IEEE 802.16e specification. The broad support of the varied scheduling classes enables a range of services including robust voice and data management and service level assurance.

Reliability

Device reliability can have a profound impact on both the end-user's experience as well as on the operator's financials. Device reliability has been demonstrated to have direct correlation to the degree of inventory required for device replacement, the load on customer care and resolution resources, customer satisfaction ratings, and customer churn. Operators must be certain that their selected WiMAX devices are supported by high quality manufacturing processes and rigorous testing and acceptance criteria

High Quality Manufacturing Processes

WiMAX devices must adhere to recognized and established quality processes during manufacturing to ensure the highest reliability devices with limited defects and failure rates.

Different countries may have specific requirements for validation of manufacturing processes. ISO (International Organization for Standardization) certification is typically an important validation criterion. ISO is an international standard-setting body composed of representatives from various national standards organizations. The organization specifies conformance testing standards for WiMAX devices required in many regions.

Leading WiMAX device vendors will employ best in class quality processes including Six Sigma and Capability Maturity Model Integration (CMMI). Six Sigma is a set of quality practices originally developed by Motorola to systematically improve the business processes for predictable, defect-free performance. CMMI is a process improvement methodology that can optimize the product development and supply chain management processes.

Rigorous Testing and Acceptance Criteria

Leading WiMAX vendors must conduct rigorous testing of its device population to ensure expected performance once the device enters the field. WiMAX Forum® certification is an important way for vendors to build confidence in device interoperability and conformance to key performance specifications. Certification offers operators a greater level of assurance that their investments can deliver reliable and flexible solutions.

However, certification, as important as it is, cannot be considered the final step in interoperable WiMAX solutions. To design and deploy a successful WiMAX network, each operator must choose vendor partners who are prepared to continue testing, proving and integrating certified equipment in real-world, multi-vendor environments.

To be successful in its respective market, each WiMAX network deployment will require customized features that go beyond the scope of certification. Each requires additional testing and verification in controlled environments, as well as further proving in a First Office Application (FOA) where devices, base stations and other elements unique to the particular network are methodically integrated and verified. Operators should select WiMAX devices from vendors that have undergone such rigorous testing with proof points from the laboratory as well as from the field.

Conclusion

WiMAX has tremendous global traction with an expanding footprint in all regions of the world. WiMAX is growing at an accelerating pace and offering real-world commercial services today. As the networks expand we will see an explosion of devices spanning all categories of application from a wide variety of suppliers. It is critical that operators take great care in selecting from this growing roster of devices as the selection of devices within an operator's portfolio may be the single greatest contributor to determining the success of their WiMAX service – dictating the end-user experience and the operator's cost of operations.

It is well advised that operators establish a careful selection process that considers:

- Performance**
- Convenience**
- Control**
- Reliability**

Selecting devices that excel in these areas will go a long way to optimizing the capability of the WiMAX network, optimizing the cost of operating the system, and optimizing their customers' broadband experience.



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