



Aperto **PacketMAX™** Wireless Broadband Family

The WiMAX Era Starts Now



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WiMAX—Setting the Industry Standard



The WiMAX Era Starts Now

Wired and wireless local area networks have Ethernet and Wi-Fi. Broadband wired networks have DSL and T1/E1. Now the broadband wireless industry has its own open standard: WiMAX.

No one questions the benefits of industry standards. They ensure interoperability, give customers more freedom of choice, drive innovation on a broad front, and help fuel industry growth. WiMAX enables all these benefits, plus additional advantages for everyone in the broadband wireless arena.

- **For service providers and integrators.** . WiMAX offers a wider choice of equipment vendors, lower costs based on economies of scale, and higher performance levels.
- **For customers and users.** . WiMAX delivers higher bandwidth than DSL or cable, lower costs than leased lines, and many more service options.
- **For equipment vendors.** . WiMAX provides a roadmap for innovation, straightforward compatibility testing and certification, and a fertile growth opportunity.

Availability of broadband wireless products based on WiMAX starts now with fixed and portable devices, to be followed soon by mobile solutions. The long-anticipated WiMAX era has finally arrived.

WiMAX Forum Certified

WiMAX broadband wireless communications are based on the IEEE 802.16 and ETSI HiperMAN standards and endorsed by the WiMAX Forum, an industry-wide consortium of service providers, equipment manufacturers, semiconductor vendors, software developers, and systems integrators. The culmination of this effort is a standard that meets performance and cost requirements, satisfies the needs of users, and can sustain profitable business models.

WiMAX Forum members have committed to supporting the IEEE and ETSI standards and ensuring compliance by submitting products for testing by an approved certification body. Only when a product has passed a compliance test does it receive the WiMAX Forum Certified™ designation.

Aperto Networks: A WiMAX Pioneer

In 2000 Aperto Networks established its position as a broadband wireless leader by introducing the PacketWave® line of carrier-class multiservices products. Since then, Aperto has delivered carrier- and enterprise-level infrastructure products to tens of thousands of users in more than 60 countries.

Anticipating that a comprehensive broadband wireless standard would bind the industry together and open more avenues for innovation and opportunity, Aperto helped found the WiMAX Forum. In addition, Aperto has served on the WiMAX Forum Board—the only private company to do so—and also chairs the WiMAX Service Provider Working Group.

Aperto has been a leading contributor to the IEEE 802.16 standard, making sure that key features such as Quality of Service (QoS), link adaptation, and Media Access Control (MAC) enhancements were adequately supported. Aperto was the first company to deliver IEEE 802.16-class systems as part of the popular PacketWave product line.



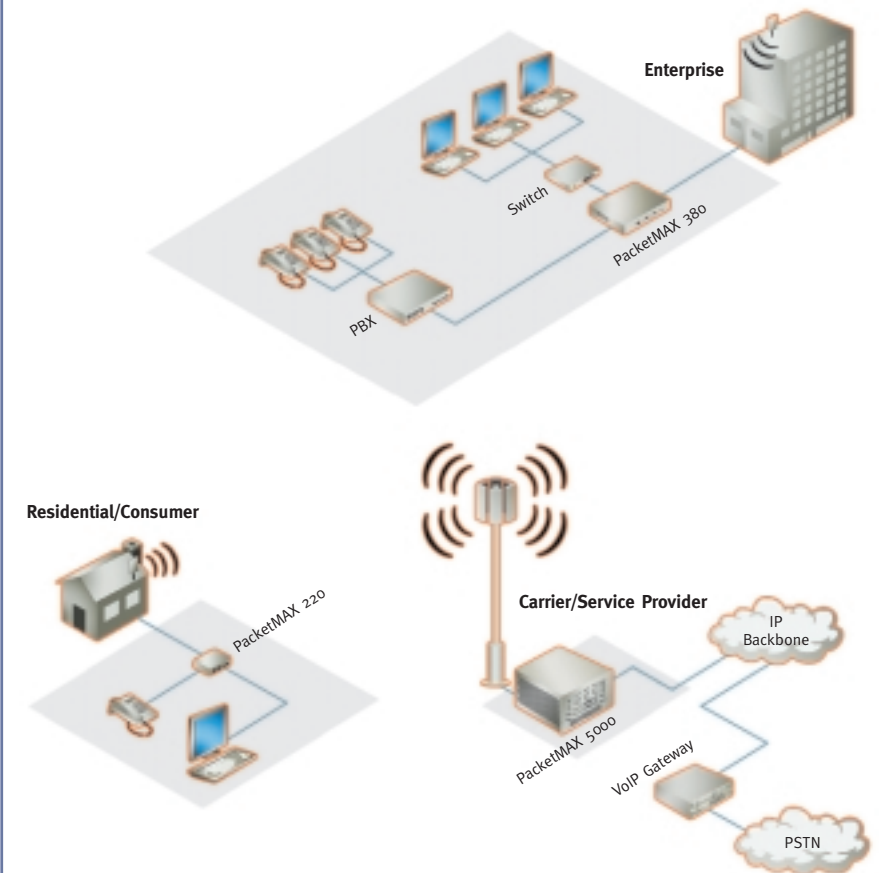
Aperto's PacketMAX Family: The New Generation

Aperto is well-positioned to take the next step in the evolution of wireless broadband. Building on the company's extensive participation in the WiMAX Forum, the IEEE 802.16 standards-setting initiative, and the development of WiMAX-class products, Aperto is introducing the new PacketMAX family of wireless broadband solutions to the marketplace.

All the advanced technologies and features originally designed into the PacketWave solution are now integrated into the PacketMAX product family. What's more, Aperto has leveraged its standards participation to ease the transition from pre-standard technologies to the fully WiMAX-compliant PacketMAX product line. The Aperto PacketWave and PacketMAX systems seamlessly coexist in the same sector, creating a smooth upgrade path and providing investment protection for service providers.

The result: a new generation of wireless broadband solutions powered by extensively field-proven technologies, enriched with forward-looking enhancements, and firmly based on the latest standards.

Building a Multiservices Infrastructure with PacketMAX



Aperto PacketMAX is designed with a service-intelligent IP architecture that takes full advantage of IEEE 802.16 standards to extend highly differentiated, tiered services to subscribers ranging from large enterprises to residential customers. Industry-leading spectral efficiency, sophisticated traffic classification, performance-enhancing technologies, and carrier-level reliability and management tools give PacketMAX the versatility to satisfy current subscriber demand while adapting economically to new market segments and future business models.

Bringing Broadband Within Easy Reach

PacketMAX — Key Business Benefits

Accelerated ROI for Network Operators

A fast return on investment (ROI) and the ability to drive profitable services across the customer base are critical to the success of networking providers everywhere. Aperto's PacketMAX broadband wireless solution gives operators a standards-based platform for addressing numerous and varied market segments, while also establishing a network footprint that minimizes capital and operating expenses.

- WiMAX-driven economies.** PacketMAX products take advantage of manufacturing economies of scale, including mass-produced silicon components, as well as the superior scalability made possible by the WiMAX standard. These cost savings are passed on to network service providers. PacketMAX also helps reduce providers' total cost of ownership by interoperating with tiers of subscriber equipment from a number of vendors.
- Pay as you grow.** PacketMAX offers operators several types of base station elements aimed at diverse market segments, applications, and subscriber densities. A flexible pay-as-you-grow capital expenditure model scales cost-effectively using subscriber-based license activations.
- Painless Upgrades.** PacketMAX gives operators a future-proof platform designed to support both the IEEE 802.16-2004 and IEEE 802.16e standards. This forward-looking strategy enables PacketMAX products to support fixed and mobile devices, allowing providers to deliver a variety of services and applications now and in the future without having to make large investments in additional equipment.
- Multiple Services, One Infrastructure.** Using ServiceQ® technology that has already proven itself in PacketWave products deployed around the world, PacketMAX provides comprehensive QoS capabilities that include thousands of service flows per sector and up to 16 service flows per subscriber unit. Intelligent packet classification software lets each client efficiently manage traffic by using any layer 2 or layer 3 packet header information—or even layer 4 port information such as IP address or application type—to assign packets to the proper service flows.
- Carrier-level Reliability.** PacketMAX products are designed to deliver the levels of redundancy and fault-tolerant operation that providers must have to ensure uninterrupted service and to meet stringent service level agreements (SLAs).
- Maximum Coverage and Capacity.** Aperto has integrated several technologies such as OptimalLink® into PacketMAX aimed at increasing overall system-link budget and enlarging cell range at higher modulations. These enhancements produce higher capacities over more expansive coverage areas, reducing the number of cells required and lowering infrastructure costs.

Aperto-powered networks already serve thousands of demanding end users, including small and midsize enterprises, multiple tenant buildings, and public-sector organizations ranging from universities to government agencies. With PacketMAX, network providers can offer their customers an even more compelling value proposition.

Aperto's Track Record of "Firsts"

In just a few short years, Aperto Networks has established a continuing tradition of excellence in carrier-class broadband wireless technology. The company has achieved an impressive number of industry firsts:

- First** to deploy IEEE 802.16-class solutions in 2001
- First** to implement carrier-class QoS profiles (up to 16 service flows) to support simultaneous voice and tiered data services
- First** to enable up to six different adaptive link parameters per subscriber for high throughput, peak performance, and interference resilience
- First** to support a media access control (MAC) scheme using burst mode time-division multiple access (TDMA) that can scale from a few users to hundreds per sector
- First** to offer a single base station that can support the major frequency bands used in broadband wireless: 2.5 GHz, 3.3 GHz, 3.5 GHz, and 5.8 GHz
- First** in the industry to offer enhanced IP networking functionality, such as virtual LAN (VLAN) support, IP routing, and Dynamic Host Configuration Protocol (DHCP) server

All these capabilities are integrated into the new Aperto PacketMAX product family, together with additional features and functions that broaden the advantages offered by industry standards.



Welcome to the Family

The Aperto PacketMAX product family includes:

- PacketMAX 5000 modular base station
- PacketMAX 3000 stackable base station
- PacketMAX 2000 micro base station
- PacketMAX 300 Series subscriber stations
- PacketMAX 200 Series subscriber stations
- WaveMAX Element Management System

Base Stations	
PacketMAX 5000 Modular Base Station	Chassis: 5-slot ATCA; fully nonblocking backplane; 2.56 Gbps capacity; fault-tolerant, field-replaceable fans; accommodates outdoor base station radios connected to indoor controller modules; supports multiple frequencies.
PacketMAX 3000 Stackable Base Station	Stackable, single-sector platform; multiple units may be co-located at a single site.
PacketMAX 2000 Micro Base Station	Economical single-sector platform; all-outdoor unit consisting of digital/radio and separate antenna with power-over-Ethernet connection to switch or router.
Subscriber Stations (Customer Premise Equipment)	
PacketMAX 200 Subscriber Station	Data-only unit for consumers provides bridging and VLANs with support for up to 5 hosts.
PacketMAX 220 Subscriber Station	Adds 2 analog POTS telephony lines to the PacketMAX 200, with a rich set of VoIP features.
PacketMAX 290 Subscriber Station	Adds a Wi-Fi (802.11a/b/g) access point to the PacketMAX 200.
PacketMAX 300 Subscriber Station	Data-only unit for businesses provides advanced IP networking: bridging, VLANs, PPPoE, NAT, and IP Routing with support for up to 250 hosts and built-in DHCP functionality.
PacketMAX 320 Subscriber Station	Adds 2 analog POTS telephony lines to the PacketMAX 300, with a rich set of VoIP features.
PacketMAX 380 Subscriber Station	Supports complete data and voice services to enterprises with 8 ports of analog POTS and T1/E1 connection to PBXs and key systems.
Antenna Options	Equipment comes standard with integral antenna, or as an option can be ordered with connectors for use with an external antenna.
Network Management and Provisioning	
WaveMAX Element Management System	Provides centralized facilities for monitoring and control of all Aperto products; can manage up to 10,000 elements; full suite of management functions; open management protocol support; pre-provisioning support; bandwidth conservation monitoring.



Well-Differentiated Data Services



Multi-tiered Data and Voice Services

Distinctions That Capture Subscribers

Aperto's PacketMAX system continues and augments the industry-leading differentiated data services provided by the PacketWave line. Several new WiMAX techniques combine with existing Aperto technologies to strengthen the system's ability to distinguish and handle packet streams, so network providers can optimize capacity and provide better wireless services to more users.

- **Maximizing Capacity.** The Weighted Fair Queuing (WFQ) capability offered in PacketWave systems is also a feature of the PacketMAX products. WFQ enables the system to provide minimum bandwidth guarantees to specific flows. This helps maximize capacity by allowing unused bandwidth to be allocated to other flows.
- **WiMAX-level Flow Handling.** Service flows per subscriber unit enable the systems to prioritize traffic within Constant Bit Rate (CBR), Committed Information Rate (CIR), and Best Effort data flows, enabling better service differentiation and SLA compliance. The PacketMAX classifiers that specify and determine which IP packets relate to specific flows comply with and exceed the entire set of classifiers specified in the IEEE 802.16-2004 standard.
- **Comprehensive Filtering.** Like the PacketWave systems, Aperto's PacketMAX products provide extensive packet filtering at layer 2 and layer 3. This filtering capability makes it possible to impose security or data transmission limitations on the data at any wireless or LAN interface.
- **Integrated router.** The PacketMAX system provides an integrated router feature that leads the industry when it comes to tightly coupling routing with WiMAX. Integrated routing capabilities enable the service provider to build layer 3 access networks that are more efficient than layer 2 only solutions. Competing systems rely on the WiMAX chipsets exclusively to implement packet priorities, which does not deliver as much routing functionality or integration with system-wide QoS.
- **Time Division Duplexing.** TDD is a leading trend in broadband wireless technologies and has been supported by Aperto since 2000. TDD uses just one single channel for operation and allows for configuration of the most appropriate upstream and downstream ratio depending on usage requirements. This provides operators the most flexibility in radio channel planning and spectral efficiency. Planned implementations of the IEEE 802.16e standard use TDD for portable and mobile applications. So for operators with plans to deploy IEEE 802.16e, PacketMAX offers a smooth migration path.



Well-Integrated Voice Handling

Wireless VoIP with a Difference

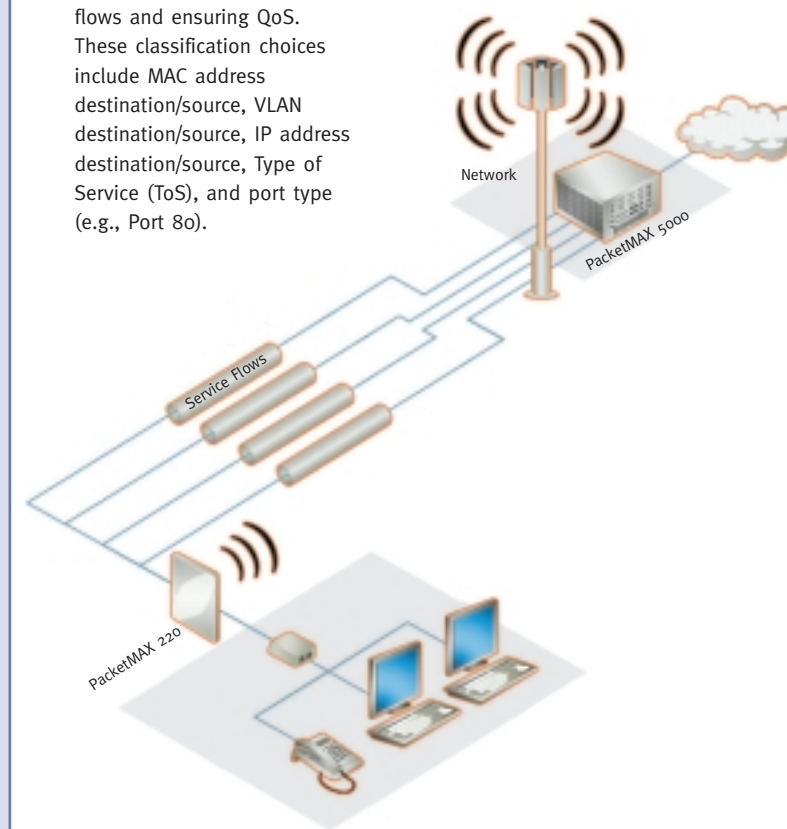
WiMAX gives network providers the opportunity to provide a wealth of services that they can use to differentiate their offerings and attract a tiered range of subscribers. A variety of flow types optimize performance for voice, data, and video.

Voice/data/video convergence makes sense for enterprises and network providers alike. Effective voice over IP (VoIP) communications require QoS features that can quickly identify voice traffic and prioritize it to assure high-quality audio and service level adherence. Aperto has extended the flexible VoIP classifier systems first offered in the PacketWave products to the PacketMAX line, while adding new business-critical features and functionality.

- **Intelligent Overbooking.** Aperto's earlier-generation products have fully supported Constant Bit Rate (CBR) services specifically designed to handle VoIP, Time Division Multiplexing over IP (TDMoIP), and other delay-sensitive traffic by maximizing capacity on the channels. The 802.16 Unsolicited Grant Service feature implemented in PacketMAX reinforces the benefits of CBR, allowing network providers to overbook bandwidth to make better use of resources.
- **Flexible Packet Classifiers.** Aperto extends the flexible classifier systems first offered in PacketWave products to the PacketMAX family. Any field in layers 2, 3, or 4 of packet headers can be used to identify VoIP packets for QoS treatment. Plus, the system can use DiffServ Type of Service (ToS) bits and VLAN 802.1p protocols to establish priorities.
- **IP Address Conservation.** Aperto's products integrate Network Address Translation (NAT) and Port Address Translation (PAT) protocols with VLAN and bridging technologies to conserve IP addresses for non-VoIP devices, and to provide direct IP addressing for incoming VoIP calls. This means that only two IP addresses are needed for as many as 254 hosts, while incoming calls get a direct IP address without special devices or services.
- **Fast Activation/Deactivation.** PacketMAX systems feature the ability to activate and deactivate VoIP sessions very rapidly, another aid to bandwidth overbooking.
- **Payload Header Suppression.** Also new to PacketMAX is a feature called Payload Header Suppression (PHS) that helps optimize bandwidth usage by tightly integrating VoIP protocols in order to boost efficiency.
- **Powerful Processing.** The PacketMAX product line increases the processing power available to the system, making it possible to transmit wireless VoIP traffic at full line rates for better performance. PacketMAX 5000 processing capabilities support a total of up to 10,000 simultaneous VoIP calls.
- **Simplified Configuration.** Telephony setup and configuration is easy to accomplish with PacketMAX: the administrator just selects the encoding standard and number of calls to be processed. The system is designed to gracefully accommodate new standards in the future.

Differentiating Service Flows with Diverse Classifiers

The PacketMAX system enables service providers to select from a variety of criteria for classifying service flows and ensuring QoS. These classification choices include MAC address destination/source, VLAN destination/source, IP address destination/source, Type of Service (ToS), and port type (e.g., Port 80).



PacketMAX—Powerful Enabling Technologies



A Potent Mix of WiMAX-Level Capabilities

From the beginning, Aperto's experts have applied their system-level understanding of broadband wireless applications, carrier services, signaling, and protocols to the tasks of defining architecture and developing products. Breakthrough technologies such as OptimaLink dynamic link parameter control, ServiceQ quality of service and bandwidth management, and RapidBurst® transmission control have made Aperto platforms a top choice of service providers concerned with frequency contention, interference resilience, and service quality.

With the introduction of the PacketMAX product line, Aperto has put the full weight of its technical expertise behind the move to WiMAX operability by integrating several key enabling technologies into the PacketMAX solution.

ServiceQ Technology

Aperto's ServiceQ has been delivering advanced QoS for wireless broadband products for over four years. Once the PacketMAX system has identified a packet with any of several specified classifiers, the packet is transmitted over one of up to 16 unique service flows according to its priority and transmission characteristics. These flows may be employed by a network provider to create revenue-enhancing service offerings for individual or multiple customers.

Advanced Scheduling Algorithm. Many years of experience in providing multiple priority services over broadband wireless give Aperto the edge in offering best-in-industry scheduling capabilities. PacketMAX systems maximize the overall real-time capacity of the network through advanced scheduling, accommodating easily to ever-changing conditions and the requirements of individual subscriber units. All this means greater profitability for the service provider.

Payload Header Suppression. PHS not only expands the number of active VoIP calls that can be accommodated on a base station or subscriber unit, it also helps resolve the problem of limited wireless bandwidth. PHS "snoops" call setups for information that can be used to compact VoIP data and minimize protocol overhead. As a result, more calls can be processed by the PacketMAX system than by any previous system using the same amount of bandwidth. With overbooking based on fast connect/disconnect, PacketMAX is the most efficient broadband wireless offering available for WiMAX-compliant VoIP processing.

OptimaLink Technology

Aperto's patented OptimaLink technology, first introduced with PacketWave, provides several important benefits by performing dynamic control of link parameters to optimize each subscriber's connection in a multiuser, cellular network. The OptimaLink adaptive algorithm dynamically selects and adjusts several physical layer and MAC layer parameters, including antenna diversity, modulation, coding, transmit power, frame size, and retransmission policy. The benefit to network operators is increased capacity, broader coverage, and interference mitigation.

Automatic Repeat-Request. Aperto has been delivering systems with ARQ for four years, longer than any other vendor. PacketMAX integrates this error-remediation technology to provide quick retransmissions, reduce overhead, and optimize parameters using a comprehensive model.

Automatic Frequency Selection. Aperto developed AFS to allow delivery of business-quality services in the license-exempt wireless spectrum. Using AFS, a service provider can adjust the level of interference that triggers a switch to another frequency, and can determine the time allowed to mitigate the problem before the frequency switch is made. In addition, AFS may be used to move from one licensed or unlicensed frequency to balance the load within a cell. Subscriber units do not have to be reset, and inactive subscriber units will automatically start using the new frequency upon activation.

Dynamic Frequency Selection. DFS is similar in operation to AFS. However, with DFS the detection of interference and the time allowed for switching between frequencies is more stringent. Transmission stops immediately when interference occurs, the system searches for a clear channel, and the new frequency is broadcast from the base unit to all subscriber units within the sector.

Leading-Edge IP Packet Processing

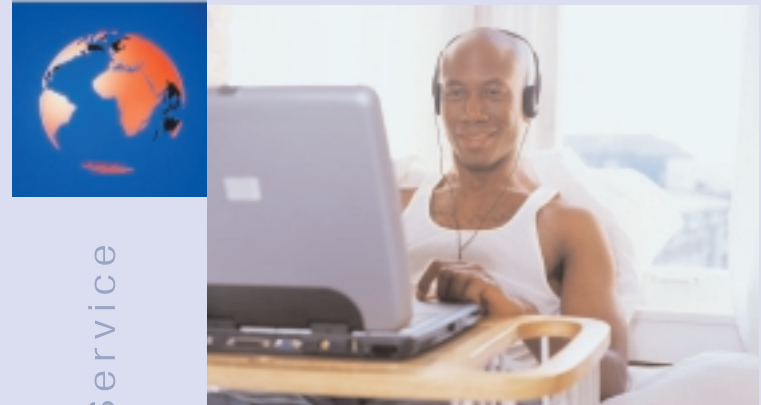
Aperto's IP packet processing technology leads the industry providing a rich set of capabilities and delivering unparalleled flexibility. This IP technology includes advanced implementations of NAT, PAT, PPPoE and VLANs. Moreover, Aperto's tightly integrated IP routing and bridging functionality rivals that of wireline-base products.

Virtual LANs. To contain traffic within workgroups for management purposes and to prioritize particular flows, the PacketMAX system provides multiple VLANs per subscriber unit. IP traffic at the LAN port may be tagged with up to 16 different VLAN IDs. Double-tagging of pass-through traffic allows for over 16 million unique VLANs. PacketMAX VLANs support IP addressing with NAT, NAT/PAT, and NAT/PPPoE. Special technology for bridging IP traffic outside NAT enables up to 256 hosts to use a single IP address, and can also provide one public address for incoming VoIP calls.

Point-to-Point Protocol over Ethernet. PPPoE offers network operators greater flexibility and is an important technique for conserving IPv4 addresses. With this protocol, approximately 125,000 IP addresses can be used to support 500,000 residential users in a typical configuration. To help build a profitable platform for network operators to differentiate SLAs, Aperto's implementation of PPPoE supports a variety of accounting systems that base fees on access times per subscriber. PPPoE may also be used in conjunction with new-generation broadband remote access server (BRAS) equipment to provide additional security and resolve payment issues.

Packet Filtering. Taking full advantage of layer 2, layer 3, and port layer 4 packet identifiers individually or in combination, Aperto PacketMAX offers full-featured packet filtering that gives service providers a number of benefits. For example, the provider can have subscribers pay one price for services such as Web access and another price for FTP hosting. Filtering is so specific that a host with a virus can be disabled without denying access to the subscriber's other devices. Advanced packet filtering in PacketMAX systems also helps impose security measures, enforce access lists, set limitations based on protocol types, and enable other SLA differentiators.

IP Routing . Routing at the base station provides additional network security within a link because packets are only delivered to the specific subscriber station. Routing capabilities also permit broadcast of packets to subscriber stations within the same subnet only, resulting in further wireless efficiencies.



Comprehensive Quality of Service

Security. PacketMAX integrates strong mechanisms that secure the wireless network against theft of service, intrusion, traffic sniffing, alteration, and replay attacks. Before subscriber terminals can join the network, they must secure permission using X.509 CA authentication and authorization certificates. Plus, all encryption keys are derived using a large 20-byte authentication key, which is encrypted and sent using the subscriber station's 1,024-bit RSA public keys. PacketMAX distributes the derived traffic encryption keys using 3 DES, AES, or 1,024-bit RSA cryptography. Additionally, the system encrypts all the connections between base stations and subscriber stations using DES or AES-CCM block ciphers with randomly generated traffic encryption keys. These keys are refreshed periodically to safeguard against brute-force attacks.

Aperto's Low-Risk Solution

Aperto's PacketMAX system helps to dramatically reduce business risks for service providers in several important ways.

PacketMAX...

- Leverages the proven performance, service level provisions, features, and flexibility of the PacketWave product line
- Provides a seamless migration to the open WiMAX standard, including service-level compatibility and overlay expansion
- Offers compatibility with Advanced Telecom Computing Architecture (ATCA) components for greater reliability, flexibility, and future-proofing
- Opens a path to higher throughput and capacity—base stations will support RF channels up to 20 MHz and speeds up to 55 Mbps per wireless channel.
- Supports all major frequency bands for maximum market flexibility
- Stands ready to support IEEE 802.16e capabilities in the future



PacketMAX — Base Station Equipment



Carrier-Class WiMAX Networks

The PacketMAX 5000

The PacketMAX 5000 is Aperto's modular base station for delivering WiMAX-compliant broadband wireless services. The major elements of the PacketMAX 5000 base station unit are described below.

PacketMAX 5000 Chassis and Enclosure

The enclosure is a full-featured, five-slot modular ATCA chassis. ATCA architecture ensures carrier-class quality. The fully nonblocking backplane with a 2.56 Gbps capacity provides complete fault-tolerance and scalability to higher processing speeds and bandwidth capacities in the future. The PacketMAX 5000 chassis contains dual temperature-controlled, fault-tolerant fans that can be replaced in the field.

PacketMAX 5000 Modules

The PacketMAX 5000 supports indoor and outdoor modules. Outdoor modules include spectrum-specific radios and antennas. Each of these carrier-class modules are manufactured according to strict quality specifications and designed for environmental extremes in deployments ranging from Siberia to the equator.

Outdoor base station radios connect to indoor controller modules using a single coax cable that carries power, timing reference, and control signals, using a standardized 70 MHz intermediate frequency. Network providers can use multiple frequency bands simultaneously on a single PacketMAX 5000 platform. This standardized indoor architecture for multiple frequencies increases system stability and reduces the need to stock spares.

Indoor switching and interface modules link the PacketMAX chassis system to the outdoor modules. The interface to the outdoor modules is a single-slot module called the Quad Wireless Carrier (QWC) that provides the interconnection between interface sub-modules and the backplane. The QWC supports four Wireless System Controller (WSC) sub-modules.

All WSC sub-modules connect through the backplane to the Main System Controller (MSC) on an independent, redundant bus. The MSC delivers switching and system management at full Ethernet line rate with

either 1000 Base-T copper or optical interfaces. The MSC also has an integrated ATCA shelf controller.

PacketMAX 5000 Main System Controller

The MSC comes in 1000 Base-T copper or optical versions, each offering maximum switched Ethernet data rates. This module is designed to provide capacity and scalability for generations of WiMAX solutions well into the future.

ATCA architecture requires a shelf manager for monitoring and coordination of all system elements. The shelf manager integrated into the MSC monitors environmental factors and also provides a reporting mechanism. Temperature and airflow are monitored by the shelf manager and reported through LEDs, alarms, and contact closures.

One or two MSC modules may be installed in the PacketMAX 5000 base station unit to provide full one-to-one redundancy for the system and shelf manager, with no additional setup required. PacketMAX provides hardware support that enables each MSC to have its own unchanging Ethernet MAC address. This allows for hot-swapping of the MSC with no need to make changes in the connecting routers.

PacketMAX 5000 Quad Wireless Controller

The QWC provides ATCA-compatible connections between the WSC sub-modules and the PacketMAX system, along with shelf manager support, connection to the redundant backplane buses, and power support for the WSC sub-modules. The PacketMAX 5000 can accommodate three QWC modules on a redundant bus.

PacketMAX 5000 Wireless System Controller

The WSC packs high-speed processing and exceptional WiMAX performance into a compact design. The PacketMAX 5000 may contain up to 12 of these sub-modules, each performing at full wireless bandwidth rates. The WSCs may be deployed in arrays of one-to-one or one-to-N redundancy.



The PacketMAX 3000

The PacketMAX 3000 is a stackable, single-sector platform for delivering WiMAX-class services. Multiple single-sector PacketMAX 3000 may be co-located at a single site, providing an economical and modular multisector solution for less-dense applications.

PacketMAX 3000 outdoor units consist of a spectrum-specific radio and an antenna. The outdoor radio connects to the indoor unit using a single RG-6 cable that carries power, timing reference, and control signals over a standardized 70 MHz intermediate frequency.

The indoor unit combines IP switching with the interface to the outdoor unit. The indoor interfaces include a 10/100 Base-T Ethernet port, a serial port, a synchronization port, and a radio interface port. The Ethernet port handles data and management, while the serial port supports local and/or remote management. The synchronization port allows synchronization with other PacketMAX 3000, PacketMAX 5000, and/or PacketWave 600, 700, and 1000 series systems. Synchronization also allows multiple units to be co-located at a single cell without frequency separation.

The indoor unit is suitable for mounting in a standard 19-inch rack in a 1 RU format. It is available in AC or DC versions. LEDs are provided for Ethernet and wireless interface status, as well as alarm and system status.



The PacketMAX 2000

The PacketMAX 2000 is an economical, single-sector micro base station. Apart from an indoor compact power injection unit, all the elements of the PacketMAX 2000 are outdoors. A single power-over-Ethernet cable connects switch/routers to the outdoor units.

The outdoor elements consist of a digital/radio unit and a separate antenna. The digital/radio unit contains both a high-speed switch/router and a spectrum specific radio. This compact unit offers the most inexpensive solution for medium-capacity sectors. LEDs give Ethernet, wireless, and other status indications. The PacketMAX 2000 supports AC power only.



Bringing Broadband Within Easy Reach



PacketMAX—Subscriber Stations

Solutions to Suit Any Subscriber Environment

Aperto offers a complete range of subscriber stations designed to meet a variety of subscriber needs and network requirements for both consumers and businesses.



Rapid ROI



The PacketMAX 200 Series Consumer Subscriber Station

The PacketMAX 200 Series Consumer Subscriber Station is a cost-effective, data-only unit for consumers providing bridging and VLAN data capabilities, with support for up to five hosts.

The PacketMAX 220 Subscriber Station adds two analog POTS telephony lines to the PacketMAX 200, with lifeline support and a rich set of VoIP features.

The PacketMAX 290 Subscriber Station incorporates an 802.11a/b/g Wi-Fi indoor access point that can be mounted on a wall power socket or sit on a desktop, providing a complete end-to-end wireless experience for the user.

The PacketMAX 300 Series Business Subscriber Stations

The PacketMAX 300 Series Business Subscriber Station is a cost effective, data-only unit for small businesses and telecommuters providing advanced IP networking: bridging, VLANs, PPPoE, NAT, and IP Routing with support for up to 250 hosts and built-in DHCP functionality.

The PacketMAX 320 Subscriber Station adds two analog POTS telephony lines to the PacketMAX 300, with lifeline support and a rich set of VoIP features.

The PacketMAX 380 Subscriber Station provides exceptional throughput. In addition to the Ethernet port, it also supports two full and fractional T1/E1 connections and eight RJ-11 analog POTS ports for linking to enterprise PBX and key systems. This provides complete data and voice services for corporate enterprises.

Subscriber Station Options

As options, outdoor units are available that can connect to outdoor power sources, or come with battery backup to protect against power outages.

Indoor units provide a power connector, an Ethernet RJ-45 connector for data services to a PC or a LAN, and telephony ports (with the number depending on the model). The POTS port offers a “fallback” connection to the public telephone system in case of an unavailable wireless link or malfunction to support lifeline requirements. The PacketMAX 200, 220, 290, 300, and 320 can all be mounted vertically or horizontally on the wall, or can be used as a desktop unit. The PacketMAX 380 is a 1U rack-mountable unit.

All subscriber equipment can be ordered with standard integral antenna, or can be ordered with connectors for use with an external higher gain.

Extending WiMAX to the Subscriber Site

Aperto's PacketMAX subscriber stations deliver high-speed data and voice access for small to midsize businesses, small office/home offices (SOHO), and residential users. With a PacketMAX subscriber unit installed at the subscriber's site, users can browse Web pages, handle voice calls, view streaming video, and download files—all at multimegabit data rates downstream and upstream. In addition, PacketMAX subscriber stations can automatically detect multiple base stations within range, and connect to the base station that provides the best signal.

PacketMAX 300 Series Business Subscriber Stations can be configured as a bridge supporting 2,000 hosts, or a router that supports up to 250 hosts.

Simple Installation, Easy Operation

Designed from the outset to take advantage of the latest advances in mechanical design, PacketMAX subscriber stations feature lightweight designs that greatly ease outdoor installation. Antenna diversity is supported, and flexible up and down tilt allows the unit to be set up for best reception. PacketMAX subscriber stations are equipped with an audible signal indicator for easy installation. For additional precision, software tools aid in installing the equipment by displaying the signal strengths at each position, allowing the installer to precisely mount the PacketMAX subscriber stations for optimal signal reception.

Value-Added Telephony Capabilities

PacketMAX offers a number of value-added telephony services through an array of indoor subscriber models. All telephony-capable models include an additional “lifeline” fallback POTS port. This port makes it possible to connect to the public phone network and keep telephony services in operation even if the wireless link is not available or the unit malfunctions.

The PacketMAX telephony product line supports SIP v2, MGCP, and H.323 VoIP protocols. In addition, all ports support multiple encoding and compression techniques, including G.711 (64 Kbps), G.729a (8 Kbps), G.723.1 (6.4 Kbps and 5.3 Kbps), and T.38 for faxes. Echo cancellation using G.165 and G.131 is also provided.

PacketMAX leverages Aperto's industry-proven QoS technology with support for CBR and highly flexible QoS classifiers to meet the most stringent requirements for VoIP, and allows virtually any field in the layer 2 or 3 and port layer 4 IP packet header to be used to identify IP packets. Adding to IP packet header identification the system can also identify and utilize various routing protocols. All this allows PacketMAX to offer integrated voice solutions as well as easy integration with third-party subscriber units.

A Spectrum of Applications

PacketMAX gives network operators a powerful, flexible infrastructure for delivering wireless applications to a broad array of customer segments, including small to midsize enterprises (SMEs), Wi-Fi hotspot providers, and consumers.

Today's SME market is underserved in many areas. PacketMAX can cost-effectively meet the requirements of these businesses in both low-density environments and urban areas, competing on a level playing field with leased-line and DSL services. The PacketMAX 380 subscriber stations provides an interface that supports full or fractional T1/E1 connectivity to enterprise PBXs or key systems. Alternatively, it also offers eight analog ports for interfacing with smaller analog PBXs. The



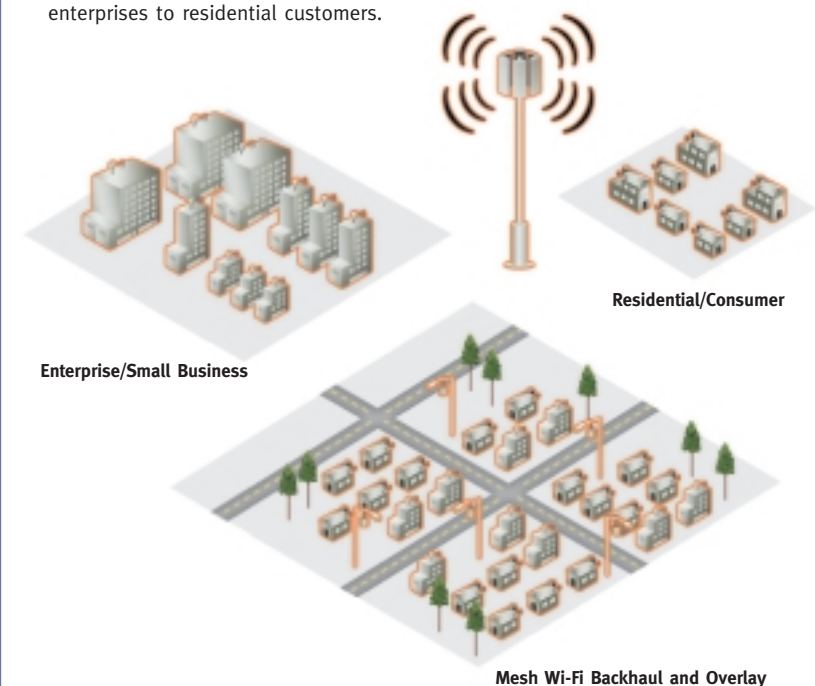
1U rack-mountable form factor is ideal for telephony or network equipment closets.

Wi-Fi hotspots are proliferating around the world, but growth in this market is hindered by the lack of high-capacity, cost-effective backhaul/overlay solutions. PacketMAX combines the benefits of WiMAX with the ubiquity of Wi-Fi to support backhaul for Wi-Fi mesh networks.

The consumer broadband market is largely dependent on cable and DSL, but offerings in many areas come up short when it comes to performance and reliability, or are too costly to attract mainstream customers. In developing countries, there are many regions with no means of Internet access at all. To address this consumer segment, the Aperto PacketMAX 200 and 300 Subscriber Stations provide a solution that integrates an Ethernet connection to a router or PC, providing Internet access in a small and attractive unit with its own power supply. As an alternative, the PacketMAX 220 and 320 models add two voice ports to provide integrated voice and data services in a wall-mountable unit.

A Service-Intelligent IP Architecture

The PacketMAX system offers network operators a broadband wireless infrastructure that can service the range of subscribers, from large enterprises to residential customers.



WaveMAX Element Management System



Carrier-Class WiMAX Networks

A Complete, Client-Oriented Network View

Aperto's WaveMAX Element Management System provides a centralized tool for the monitoring and control of all Aperto products. A single WaveMAX server can manage up to 10,000 network elements. In addition, the WaveMAX server provides a centralized application for obtaining system information and reconfiguring the network.

The WaveMAX Element Management System gives network operators a full suite of FCAPS (fault, configuration, accounting, performance, and security) functionality, making network information easy to view and analyze. The information is displayed in a simple and straightforward manner, drawing from an underlying information base that is both complete and comprehensive. WaveMAX clients provide timely information to up to 25 network operators simultaneously, so issues can be resolved before users experience a problem.

The alarm/event structure promotes the alarm that occurs at a subscriber unit so that it appears at the wireless interface of the base station, the base station itself, and the cell of which the subscriber unit is a member. This means that an operator can monitor multiple cells and immediately detect problems within the entire viewable network.

WaveMAX also provides administrators with performance information on virtually every device interface and service flow. The ability to track performance on a per-service-flow basis allows providers to accurately measure SLA compliance.

Open Technology

WaveMAX is based on open protocols including SNMP (Simple Network Management Protocol). SNMP MIBs (Management Information Bases) provide information to the centralized WaveMAX server by means of a standard SQL database server, which may be queried for current and historical information.

A CORBA object interface is provided for Northbound Operational Support System (OSS) management systems that enables system-wide coordination. The WaveMAX open interface and published APIs enable connection with open or private management systems.

Pre-Provisioning for Easy and Self Installation

WaveMAX server allows subscriber units to be pre-provisioned. Service classes may be applied to specific units, enabling both easy-install and self-install.

A pre-provisioning technique unique to the Aperto system provides a generic service class that allows the user to connect only to the service provider's billing/provisioning Web server. The user installs the PacketMAX system and then chooses the service class. When the system completes billing verification, PacketMAX will automatically provision to the service type requested by the user without intervention by the service provider. The user may reconnect to the provisioning system to change the service class at any time.



Bandwidth Conservation Monitoring

Wireless bandwidth is a limited resource. PacketMAX ensures that most of the management information that concerns the IP flows and radio signal quality is available at the base station for each connected subscriber station. The WaveMAX management system conserves wireless bandwidth by obtaining information from the subscriber unit only when that information is not already available at the base station. The bandwidth that would normally be used for management monitoring may be sold to more end users, increasing profitability.



Enter the WiMAX Era with Aperto PacketMAX
The WiMAX era is at hand. Building on proven technologies and incorporating the latest WiMAX innovations, Aperto's PacketMAX system gives network operators the platform they need to take full advantage of the business opportunities that wireless bandwidth offers now and in the years to come.



Comprehensive QoS

Key WaveMAX Management Features

- Automatic network discovery
- Single application provisioning and pre-provisioning using user-defined SLA templates
- Client-server architecture for network scalability with multiple concurrent network operators; up to 25 connected management servers can handle up to 10,000 network elements each
- Security using user/password logins; the administrator has full control of user access and privileges
- Complete, at-a-glance inventory
- Presentation of logical and physical network hierarchy
- Alarm propagation to higher-level network elements, allowing views of all network alarms and isolation of most server issues
- Alarm assignment and transfer to specific administrators
- Alarm acknowledgement and manual closing available
- Connection to embedded management system (cut-through to Web server and telnet CLI)
- Current and historical performance presentation in both graphical and tabular format



PacketMAX Base Station Specifications

Feature	PacketMAX 5000	PacketMAX 3000	PacketMAX 3000
Interfaces PacketMAX 5000			
Quad Wireless Controller (QWC) Wireless System Card (WSC) 1 IF Port per WSC Up to 4 WSC per QWC	(up to 3 per chassis) F Connector, 75 Ohm (up to IF 12 ports per chassis)		
Main System Card (MSC)	(up to 2 per chassis) 100/1000		
Backhaul Management	Mbps Full Duplex 10/100 Base-T, RS-232		
Shelf Management	10 Base-T, RS-232		
External Clock Input	2 BNC		
Synchronization Ports	2 BNC		
Interfaces PacketMAX 3000			
IF Port		F Connector 75 ohm	
Backhaul		10/100 Mbps Full Duplex	10/100 Mbps Full Duplex
Synchronization Ports		2 BNC	
Power Requirements			
AC Option	85-265 VAC 47-63 Hz	85-265 VAC 47-63 Hz	85-265 VAC 47-63 Hz
DC Option	40-60 VDC	40-60 VDC	40-60 VDC
Power Consumption	380 watts maximum	40 watts maximum	40 watts maximum
Dimensions			
Width	439 mm (17.3")	420 mm (16.6")	
Height	222 mm (8.75") - 5U	44 mm (1.75") - 1U	
Depth	381 mm (15")	216 mm (15")	
Mounting	19" rack	19" rack	
Weight	18.1 kg (40 lbs)	2.2 kg (4.4 lbs)	
Redundancy			
Power	Redundant feeds		
Main System Board	2 cards per system (future)		
Wireless IF	IF port redundancy (future)		
Environmental			
Operating Temperature (Indoor Unit)	0° to 40° C (32° - 104°F)	0° to 40° C (32° - 104°F)	0° to 40° C (32° - 104°F)
Humidity (Outdoor Unit)	10-90% non condensing	10-90% non condensing	10-90% non condensing
Operating Temperature (Outdoor Unit)	-45° to 60°C (-49° to 140° F)	-45° to 60°C (-49° to 140° F)	-45° to 60°C (-49° to 140° F)
Humidity (Outdoor Unit)	0-100% non condensing	0-100% non condensing	0-100% non condensing

PacketMAX Base Stations - Common Specifications

Feature	Specification
Operation	
PHY	OFDM 256 FFT
Frequency Bands Supported	3.3-3.6 GHz 3.6-3.8 GHz 2.5-2.7 GHz 5.425-5.725 GHz 5.725-5.925 GHz
Channel Bandwidths	
3.3-3.6 and 3.6-3.8 GHz	1.75, 3.5, 7, 14 MHz (future), 2-7 in 1 MHz steps
2.5-2.7 GHz	2-10 MHz in 1 MHz steps, 5.5 GHz
5.425-5.725 and 5.725-5.925 GHz	2-10 MHz in 1 MHz steps, 20 MHz
RF Power Output	Option 1: 20 dBm Option 2: 28 dBm (Q1 2006)
Receiver Sensitivity	-100 dBm
Modulation Rates	BPSK, QPSK, 16QAM, 64QAM
Duplexing Mode	TDD
Error Correction	Convolution coding 1/2, 2/3, 3/4
Automatic Frequency Selection (AFS)	Yes
Dynamic Frequency Selection(DFS)	Yes
Networking	
Protocols	IP Routing, OSPF, RIPv2, VLSM, CIDR DHCP (client and relay agent), VLAN, Bridging, and PPPoE
VLAN	16 management VLANs per network. Support for 4,096 VLAN's either tagged or double tagged.
QoS	
Service Classes	CG – Continuous Grant RT – Real Time NRT – Non Real Time BE – Best Effort
Flows per Base Station (Flows are Bi-directional)	16 flows per subscriber
Security	
Encryption	3DES AES CCM, 128 and 1024
Management	
Provisioning	Centralized using WaveCenter
Agent	Embedded WaveCenter agent supporting SNMP
SNMP	MIB II (RFC 1213), WiMAX MIB, Aperto Enterprise MIB
Antenna Options	
Full Frequency Reuse	90° and 60°
Other options	120° and 360° (omni)

PacketMAX Subscriber Equipment – Features by Model

Feature	380	320	300	290	220	200
Physical Interfaces						
LAN (RJ-45) 10/100Ethernet	1	1	1	1	1	1
Analog POTS (RJ-11)	8	2	0	0	2	0
Digital Telephony	T1 / E1	0	0	0	0	0
Diagnostics/Mgmt Port (RJ-11)	Yes	Yes	No	Yes	Yes	No
Wireless LAN 802.11a/b/g	No	No	No	Yes	No	No
Telephony Features						
Voice over IP	Yes	Yes	No	No	Yes	No
VoIP Protocols						
SIP v2, H.323, MGCP	Yes	Yes	No	No	Yes	No
FAX Support via T.38	Yes	Yes	No	No	Yes	No
Calling Number ID						
DTMF, FSK	Yes	Yes	No	No	Yes	No
Speech Codecs						
G.711 (64 kbps)						
G.729a (8 kbps)	Yes	Yes	No		Yes	No
G.723.1 (6.4 kbps)				Yes		
G.723.1 (5.3 kbps)						
Echo Cancellation						
G.165, G.131	Yes	Yes	No	No	Yes	No
Class 5 Services						
Ring Generation & Detection						
DTMF Tone Generation & Detection (RFC 2833)						
Conference Calling	Yes	Yes	No	No	Yes	No
Call Waiting						
Differentiated Ring Tones						
Announcement Generation						
IP Networking						
IP Routing	Yes	Yes	Yes	No	No	No
NAT	Yes	Yes	Yes	Yes	No	No
Bridging	Yes	Yes	Yes	Yes	Yes	Yes
PPPoE	Yes	Yes	Yes	Yes	No	No
802.1Q VLAN	Yes	Yes	Yes	Yes	Yes	Yes
DHCP Server & Client	Yes	Yes	Yes	Yes	No	No
OSPF	Yes	Yes	Yes	No	No	No
Max Number of Hosts	250	250	250	5	5	5
DHCP Clients with built-in DHCP server	100	100	100	0	0	0
QoS Service Flows						
	Service Classes CG – Continuous Grant RT – Real Time NRT – Non Real Time BE – Best Effort					
Bidirectional Services Flows Subscriber	16	16	16	4	4	4
Security						
Encryption	3DES					
	AES CCM, 128, & 1024					
VLAN						
	Management VLAN separate from data VLAN Double tag pass-through Add tag as double tag Tagging of up to 16 independent tags Pass-through in 16 ranges					

PacketMAX Subscriber Equipment – Common Specifications

Feature	Specification
Radio & Physical Layer	
PHY	OFDM 256 FFT
Frequency Bands Supported	3.3–3.6 GHz 3.6–3.8 GHz 2.5–2.7 GHz 5.425–5.725 GHz 5.725–5.925 GHz
Channel Bandwidths	1.75, 3.5, 7, 14 MHz (Future), 20 MHz (Future) 2-7 in 1 MHz Steps 2-10 MHz in 1 MHz steps, 5.5 GHz 2-10 MHz in 1 MHz steps, 20 MHz
Antenna Gain	18 dBi
Radio Output Power	20 dBm all frequencies
Receiver Sensitivity	-100 dBm
Modulation	BPSK, QPSK, 16QAM, 64QAM
Duplexing Mode	TDD
Forward Error Correction	Convolution coding 1/2, 2/3, 3/4
Management	
Provisioning	Centralized using WaveMAX
Agent	Embedded WaveMAX agent supporting SNMP
SNMP	MIB II (RFC 1213), WiMAX MIB, Aperto Enterprise MIB; IEEE 802.16f MIB planned
Installation Manager	Antenna alignment, throughput test
Environmental	
Operating Temperature (Outdoor Unit)	-40°C ~ 55°C (-40°F ~ 131°F)
Humidity (Outdoor Unit)	0~100% non condensing