

Sun Unified Network Platform (SUN-P) Reference Architecture for WiMAX

Creating competitive advantage through radical consolidation



The buildout of today's 4G networks such as WiMAX requires a dramatic increase in computational resources to adequately deliver flexible telecommunications services to mobile subscribers. Yet business conditions also necessitate that new markets are approached incrementally. The challenge for telecom carriers is to reduce the cost of serving the first subscriber in small or cost-sensitive markets.

The Sun Unified Network Platform (SUN-P) Reference Architecture for WiMAX offers a radically consolidated, scalable core network architecture based on a new generation of multicore/multithreaded processors. It provides a new approach to building the core network infrastructure, enabling telecom carriers to significantly reduce the cost to serve the first subscriber while providing massive scalability for network expansion. Telecom carriers can benefit from greater business flexibility as well as increased return on investment (ROI).

WiMAX for agility and scalability

The proliferation of wireless LANs, mobile IP, and broadband Internet is driving the demand for new services using the World-wide Interoperability for Microwave Access (WiMAX) standard. WiMAX provides a robust, scalable, and cost-effective approach for bringing these services to mobile subscribers.

WiMAX enables carriers to deliver mobile broadband connectivity at high data rates and offers built-in support for high-speed handoffs as mobile users cross over from one section of the network to another. The WiMAX core network typically consists of the ASN (Access Service Network) as well as the CSN (Connectivity Services Network) as shown in Figure 1.

Agility is important in today's fast-changing markets. Unlike in the previous era of telecommunications, when large national networks were being built out, today's

telecom carriers are often looking to drive revenue growth by addressing unique market opportunities such as municipal government applications that may operate under new business models.

Rethinking scalability

The primary challenge in serving small WiMAX subscriber bases is that traditional core network architectures require high capital expenditures just to serve the first subscriber. Networks, whether entry-level or full-scale, have traditionally been built using separate network elements for each of several different functions. And most network elements have been deployed with a pair of carrier-grade servers to achieve redundancy with an active and a standby configuration.

Thus, a new network with 10 network elements requires 20 servers just to provide service to the first subscriber. Furthermore, because the network is designed to

Highlights

- Breakthrough economics based on virtualization technologies and chip multithreading (CMT) using next-generation UltraSPARC® T2 processors
- Dramatic reduction in the cost to serve the first subscriber by consolidating both the Control Plane and Data Plane functions onto a single rackmount server or ATCA blade
- Faster time to market due to greatly simplified application development in an open architecture with standardized interfaces and commercial-off-the-shelf (COTS) solutions
- Massive scalability by simply adding more processor threads or servers to increase throughput to levels that can exceed the capacity of proprietary-based solutions

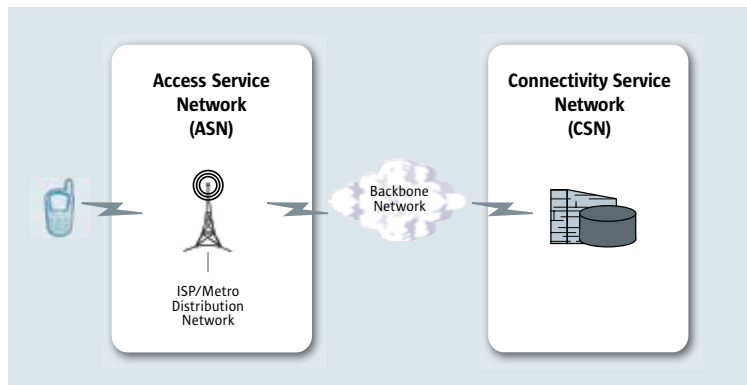


Figure 1. Traditional WiMAX Core Network Architecture

eventually support a large population of subscribers, the servers would remain underutilized until the subscriber base grows to the expected population. The ROI for small and emerging markets has therefore been limited by these high capital outlays. High operating costs for maintaining the servers and providing datacenter floor space, power, and cooling have also hindered new service opportunities.

SUN-P reference architecture for WiMAX

Sun has an answer for this challenge: The SUN-P Reference Architecture for WiMAX provides a completely new approach for building a WiMAX network. It offers a unified architecture based on open standards and can enable radical consolidation. Telecom carriers can benefit from:

- Radical cost savings by eliminating the need for physically separate servers for every network element
- Faster time to market due to greatly simplified application development versus proprietary platforms and technologies
- Ability to start small and grow to millions of subscribers on the same hardware and software architecture
- Investment protection through a scalable open architecture solution

These benefits are made possible by recent technology advances from Sun in the areas of chip multithreading (CMT), machine virtualization, and high-performance Data Plane software.

Architecture design

Unlike traditional network architectures that rely on specialized network processors (NPs) to execute Data Plane functions, the SUN-P Reference Architecture for WiMAX offers a holistic solution based on a single open architecture. Both Control Plane and Data Plane functions are executed on the same platform architecture, providing a simplified development and deployment environment.

The SUN-P Reference Architecture for WiMAX also takes advantage of the massive throughput offered by UltraSPARC T2 processors to deliver 10G line-rate packet-processing performance. The UltraSPARC T2 processor is the industry's first "system on a chip," packing the most cores and threads of any general-purpose processor available. It integrates all the key functions of a server on

a single chip: computing, networking, security, and input/output (I/O). With up to eight multithreaded cores and 64 simultaneous threads, the UltraSPARC T2 processor improves throughput while using less power and dissipating less heat than conventional processor designs. It provides massive scalability by executing eight threads per clock cycle, enabling carriers to execute all types of workloads at very low power. It also includes dual integrated 10 Gigabit Ethernet support as well as integrated floating-point and cryptographic processing in each CPU core to enable extreme throughput.

The SUN-P Reference Architecture for WiMAX further leverages Logical Domains (LDMs) technology to virtualize the server environment and isolate Control Plane and Data Plane functions. LDMs technology allows for a lower cost structure for initial subscriber offerings by enabling each LDM to start small and then get resized whenever throughput and capacity requirements change. Each network element runs in its own virtual server with its own operating system instance and its own memory, I/O, and computing resources. The network elements can interact over high-speed IP-based interfaces using shared memory. Figure 2 shows a logical view of the architecture, with separate domains for each of the different elements of the network.

The Data Plane region executes in a lightweight operating environment based on the Sun Netra Data Plane Suite. All other domains utilize the Solaris™ 10 Operating System (OS) for Control Plane processing,

platform and domain management, and high-availability services. The computing capacity of each of the LDMs can be easily scaled as processing needs change and grow through in-service provisioning. When additional CPU threads and memory are assigned to a domain, there is no need to modify the applications, making scalability much easier and more flexible than with traditional proprietary architectures. Additional LDMs can be added if desired. For example, separate LDMs could be used to provision both an active and a standby configuration of the Control Plane.

The network elements defined in the reference architecture include:

- LDom1 — This service and OAM processing domain is also the HA master server and acts as a management server for the complete WiMAX network architecture. It includes Web NMS software from AdventNet to provide network management services, and the SelfReliant Advanced Suite (SR-AS) from GoAhead to provide high-availability services running on top of the Netra HA Suite. In the event of a failure in the Control Plane, the SR-AS software executes a seamless failover transition from the active server to the standby server. Multiple Control Plane domains could also be implemented, demonstrating high availability for virtual servers
- LDom2 — This domain provides WiMAX Control Plane processing using ASN Lite, an ASN Gateway solution from Aricent. It is integrated with the market-leading carrier-grade OS, the Solaris 10 OS

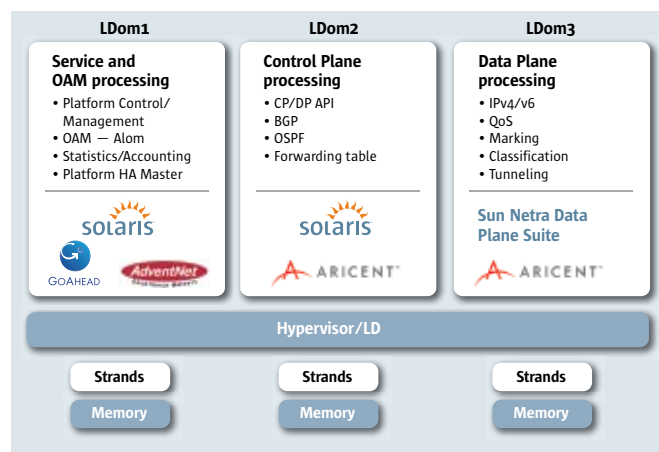


Figure 2. Sun Unified Network Platform (SUN-P) Reference Architecture for WiMAX.

- LDom3 — Data Plane processing is accomplished using the Sun Netra Data Plane Suite integrated with Aricent ASNLite WiMAX Data Plane features

Complete functionality

All services are delivered using the Sun Unified Network Platform in a common, general-purpose, computing architecture. The integrated solution combines Aricent ASNLite WiMAX software with the Solaris 10 OS and the Sun Netra Data Plane Suite. The following services are provided by the integrated solution:

Control Plane:

- Routing
- Authentication and security
- Mobility management
- Radio resource management
- Connection management

Data Plane and exception path processing:

- Packet forwarding
- Header compression
- Traffic aggregation
- Policy enforcement
- Accounting and statistics

System architecture

Because the entire architecture is based on the concept of Logical Domains that can be easily resized to achieve the required throughput, deployment options are virtually unlimited. The recommended approach is to deploy LDomS across a pair of carrier-grade Sun Netra™ rackmount or ATCA blade servers. A pair of servers or blades adds redundancy at the hardware-systems level to further protect against downtime.

Figure 3 shows a typical ATCA blade configuration with an ASN access layer, a CSN layer, and an OAM layer in the network. Connectivity between blades is provided via a network switch that utilizes 10 Gigabit Ethernet interfaces on Sun's ATCA blades and the built-in support for 10 Gigabit Ethernet in the UltraSPARC T2 processor.

Sun Netra T5220 server

Optimized for carrier-grade networks, the Sun Netra T5220 server is the first NEBS Level 3-certified rackmount server to integrate 10 Gigabit Ethernet technology directly from the system processor. It also features the industry's most ruggedized

enclosure, which provides a high level of system reliability and availability. The server supports large workloads, with up to 64 GB of memory. It also provides hardware RAID 0 and RAID 1 support for the pair of internal hard drives.

Sun Netra CP3260 ATCA blade server

An important part of Sun's continuing commitment to CMT-based computing for telecom, the Sun Netra CP3260 ATCA blade server is a second-generation CMT-based telecom blade that meets ATCA standards. The server has industry-leading memory capacity, with eight memory sockets, and offers a disruptive leap forward in ATCA blade performance over 10 Gigabit Ethernet, resulting in much greater compute density per shelf. It has a balanced I/O architecture through the use of new, advanced rear transition technology, which provides high-speed Zone 3 connectivity solutions.

SUN-P Reference Architecture for WiMAX — software components

The SUN-P Reference Architecture for WiMAX comprises the following key software components from Sun and its partners:

Aricent – ASNLite Gateway solution

ASNLite is a proven and comprehensive ASN Gateway framework from Aricent. It delivers broad functionality for both Control Plane and Data Plane requirements and provides the WiMAX ASN Gateway functionality within the SUN-P Reference Architecture for WiMAX. Control Plane software is provided through Aricent's SigASN signaling module, a component of ASNLite that delivers ASN Gateway features in an off-the-shelf software

solution. SigASN is WiMAX Forum standards-compliant and provides features such as:

- Mobility
- Handover support
- Bi-cast control
- Tunnel management — toward both the BS and the HA
- Authentication mediation
- IP address allocation
- Accounting

ASNLite also includes a Data Plane IP stack that is integrated with the Control Plane functionality of SigASN. The Data Plane IP stack implementation supports layer 3 routing as well as data classification and security features. It also includes a CLI-based element manager and is designed to take advantage of multithreaded platforms such as the Sun Netra CP3260 ATCA blade server, Sun Netra T2000 server, and future UltraSPARC T2 processor-based servers.

You can utilize ASNLite to implement the complete Data Plane and Control Plane functionality required in your ASN Gateway, enabling you to achieve significant time-to-market and cost benefits. Aricent also offers comprehensive customization and integration services for the development and creation of perfect-fit ASN Gateway solutions.

Sun Netra Data Plane Suite

The Sun Netra Data Plane Suite offers a complete carrier-grade packet processing solution comprising a unified development environment and lightweight runtime environment.

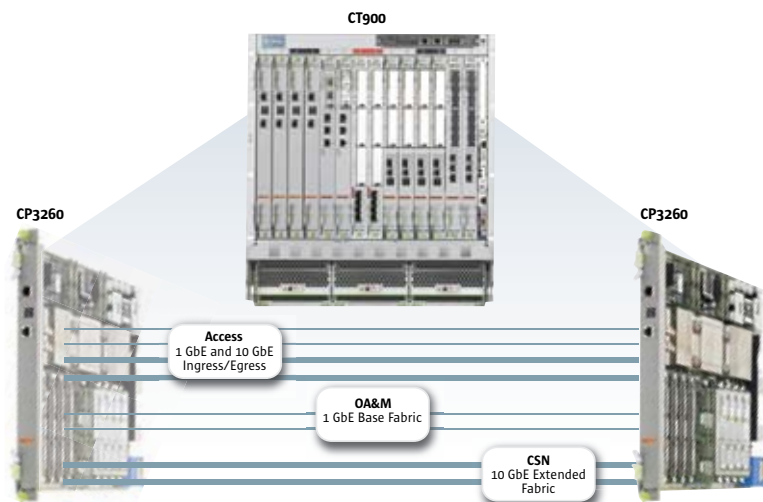


Figure 3. Reference architecture deployment options.

The unified development environment can help accelerate development of Data Plane packet-processing applications. It also helps reduce R&D and sustaining costs by leveraging mainstream development tools and high-level language development. It offers a complete and open ANSI C programming environment that includes a compiler, optimizer, debugger, profiler, and reference applications. This environment can dramatically reduce program risk and costs as compared to offerings from niche NPUs that use exotic microcoding or ad hoc development tools commonly provided by chip-only suppliers.

The lightweight runtime environment has no scheduler or interrupt handler and performs no context switching. Every thread runs to completion without time-slicing, making parallel execution extremely scalable. This enables 10G line-rate performance and linear scaling with the CMT architecture of the UltraSPARC T2 processor.

GoAhead — SelfReliant Advanced Suite (SR-AS)

SelfReliant Advanced Suite (SR-AS) is a full suite of standards-based, platform-independent high-availability (HA) middleware that delivers a preintegrated, carrier-grade platform for managing application availability.

SR-AS provides a broad array of services including messaging services, platform services, systems management services, and an extensive library of APIs. It provides millisecond failover with preservation of application state. Simple HA APIs enable start, stop, restart, and switchover for pairs of applications and/or nodes in active/standby and active/active configurations.

SR-AS also includes a Distributed Messaging Service (DMS), which provides the underlying inter- and intra-node communications framework for distributed applications. DMS supports heartbeating, congestion detection, message prioritization, checkpointing, transparent network failover, and resource discovery.

Using SR-AS, developers can reduce development costs and shorten the time required to build HA solutions. The tools can also help reduce project risk through the use of

pretested and preintegrated solutions. The SR-AS offering is implemented on top of the Netra HA Suite, which provides foundation platform HA services using OpenHPI interfaces.

AdventNet — Web NMS carrier-grade network management solution

AdventNet Web NMS is the industry-leading network management model/framework for building custom OEM software such as element, network, and systems management (EMS/NMS) applications.

Web NMS makes it possible to deliver superior management solutions in a cost-effective, low-risk, and high-productivity model. Most element management system (EMS) functions are supported out-of-the-box by AdventNet Web NMS, enabling developers to focus on delivering end-user application value instead of reinventing the underlying infrastructure.

AdventNet Web NMS also provides a lightweight Distributed Mediation Server that can provide distributed mediation functionality for remote management of devices across the network.

Business justification made easy

WiMAX carriers must consider the financial implications of their WiMAX network buildout to make sure they can create a sustainable business model that will generate a positive ROI. To illustrate the benefits of a consolidated core network based on SUN-P technologies, Sun created a Web-based ROI tool called the WiROI Business Case Tool. Developed in conjunction with WiMAX 20/20 Consulting, the underlying model contains over 250 parameters that impact the WiMAX business plan. The data used for the model is based on actual RFPs from carriers and on equipment technical specifications from NEPs, to ensure an accurate basis for evaluating the viability of a WiMAX investment.

The WiROI Business Case Tool provides an interactive graphical environment designed to help WiMAX service providers easily assess the costs and benefits of their deployments. It enables the user to fine-tune the variables of a network to optimize the key financial parameters of a WiMAX business case. The

Learn More

For more information about the Sun Unified Network Platform (SUN-P) Reference Architecture for WiMAX and Sun technologies for telecom, go to:

sun.com/wimax
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tool provides a dynamic dashboard-style interface that enables the user to easily control key input parameters and instantly visualize the results.

In summary, the WiROI Business Case Tool demonstrates how SUN-P technologies form the basis for a cost-effective WiMAX network — especially in smaller cities, villages, or communities, where the next wave of wireless growth is occurring.

The core network represents the largest capital expenditure required by the new WiMAX carrier and creates a heavy burden in the first year of operation. Because the SUN-P Reference Architecture for WiMAX can enable radical consolidation of the WiMAX core network, it can significantly reduce this first-year capital challenge.

Gain competitive advantage with Sun

A properly designed WiMAX network can provide a highly effective and low-cost method of delivering new 4G services to subscribers. You can avoid the high cost and inflexibility of traditional network architectures by consolidating your core network using the SUN-P Reference Architecture for WiMAX. The architecture offers a radically simple approach to building out your network, enabling faster time to market and dramatic reductions in cost. By bringing together leading third-party software solutions with innovative Sun technologies in a complete WiMAX solution, Sun offers you a chance to create a competitive advantage in today's fast-changing wireless markets.