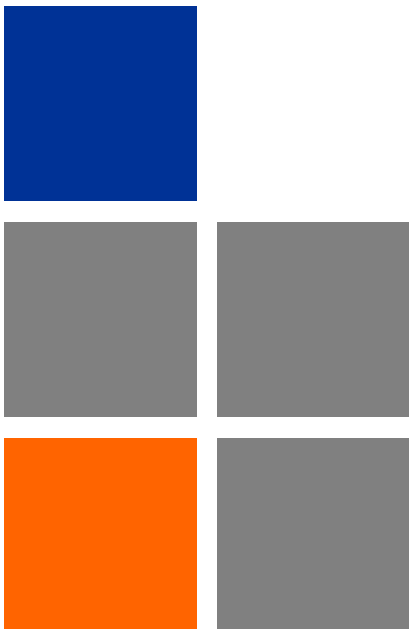




Voice and Multimedia Services with End-to-End QoS over WiMAX™

Alvarion® and Veraz leverage WiMAX™ and IMS to deliver an advanced solution for multimedia-centric services



Introduction

WiMAX™ technology provides reliable, cost effective, high speed, broadband services to both fixed and mobile networks. IMS is an excellent architectural framework for rapid delivery of new value-added services and seamless communication between fixed and mobile networks and devices with carrier grade QoS. Consequently, the interoperability between these two technologies is important, particularly as carriers look to leverage both WiMAX and IMS to offer advanced multimedia-centric services across fixed-nomadic environments.

One of the most critical factors for a successful deployment is the Quality of Service (QoS). This paper demonstrates the interoperability and end-to-end QoS afforded by the integration of Alvarion's BreezeMAX® WiMAX platform and Veraz's ControlSwitch User Services Core, ControlSwitch Interconnect, and its I-Gate family of media gateways. The joint Alvarion-Veraz offering to operators is substantiated, and the paper illustrates how to rapidly deploy reliable, value-added multimedia services and high bandwidth transport and broadband access networks without the cost of laying additional wires; and the opportunity to penetrate regions without wireline access and reliably expand their IMS services portfolio.

About the Companies

With more than 3 million units deployed in 150 countries, **Alvarion** is the world's leading provider of WiMAX and wireless broadband network solutions enabling Personal Broadband to improve lifestyles and productivity. Leading the market to OPEN™ WiMAX architecture, Alvarion offers the most proven product portfolio covering the full range of frequency bands with fixed-mobile solutions. As a wireless broadband pioneer, Alvarion has been driving and delivering innovations for over 10 years. Leveraging its key roles in the IEEE and HiperMAN standards committees and experience in deploying OFDMA-based systems, the company's prominent work in the WiMAX Forum® is focused on increasing adoption of standard-based wireless broadband products and leading the industry to OPEN WiMAX solutions.

Veraz Networks, Inc. is a leading global provider of IP soft switches, media gateways and digital compression products that enable voice, video and other multimedia services. Wireline, broadband and wireless service providers in over 50 countries have deployed Veraz's IP product suite to transport, convert and manage voice and multimedia traffic over both legacy and IP networks. Veraz products allow service providers to quickly and efficiently migrate from traditional voice networks to all-IP, fixed-mobile and multimedia networks consistent with emerging IMS standards.

Guaranteeing Quality of Service

Guaranteeing QoS is critical for success. There are two main methods of operation available which guarantee WiMAX RAN (radio access network) QoS for VoIP calls. The first method utilizes Alvarion's Dynamic Resource Allocation Protocol (DRAP) mechanism in WiMAX base stations and CPEs. This protocol dynamically allocates WiMAX access network resources for each voice call based on negotiation between Alvarion's CPEs and base stations.

The second method, which requires use of the Alvarion Voice Gateway together with any standard SIP end device, utilizes BreezeAPP Voice, a network-based SIP back-to-back user agent (B2BUA) solution located in the core or aggregation layer of the network, between the base stations and soft switch. When a SIP call is initiated, BreezeAPP Voice negotiates with the relevant base station and allocates the required RAN resources for the call duration, providing call admission control and ensuring subscriber Quality of Experience (QoE).

The protocol used for negotiation between BreezeAPP Voice and the base station is the standard WiMAX Forum NWG R3 interface, thereby enabling operation in a standard 802.16e environment according to Alvarion's OPEN WiMAX approach.

IMS Voice over WiMAX

WiMAX access infrastructure allows operators to provide service without the burden of digging and laying down wires. Additionally, operators with access to wired networks can deploy WiMAX in order to distribute advanced services enabled by IMS solutions. A key factor to the introduction of IMS frameworks has been the migration of service providers from legacy TDM voice services to IP based next generation.

Today, operators are increasingly looking at service bundles and fixed-mobile convergence (FMC) strategies, because of increased competition and high subscriber expectations. Subscribers, on the other hand, are demanding mobility and personalization, as well as innovative, rich, multimedia services that include high quality voice, video and data.

The combination of Alvarion's WiMAX infrastructure and Veraz's IMS core platform provides operators with an ideal solution which:

- Meets the demand for new, value-added services.
- Offers the advantages of fast time-to-market and addresses the convergence of wireline and wireless networks.
- Delivers an end-to-end solution, providing operators with the ability to offer flexible multimedia services to their users, based on WiMAX broadband wireless access.
- Enables operators to easily deploy, scale and offer broadband wireless services via point-to-point and point-to-multipoint networks, thus increasing revenue streams while also expanding operations into new markets.

At the network core, the Veraz IMS-compliant ControlSwitch User Services Core (CS-USC), a soft switch service delivery platform and media gateway product family, enable the coexistence of both WiMAX and traditional access technology for an NGN/IMS-compliant with ubiquitous coverage.

At the media transport level, the Veraz I-Gate 4000 media gateways provide high quality transmission of voice and fax traffic between the packet network and the PSTN. At the access level, Alvarion offers a WiMAX VoIP integrated access device (IAD), or third-party access media gateways and soft client products together with its BreezeAPP Voice QoS application.

At the access network, Alvarion's BreezeMAX – the RAN of Alvarion's 4Motion® solution – offers a reliable, proven and open standard WiMAX access platform. Additionally, Alvarion's BreezeAPP Voice delivers a unique adaptive QoS mechanism for enabling reliable transmission of SIP-based multimedia sessions on the WiMAX link.

The flexibility of the IMS together with the easy convergence enabled by the combined technologies of Alvarion and Veraz allows fixed and mobile access, presenting an investment-proof path for operators seeking solutions as part of an overall planned FMC rollout. This complete solution makes possible the deployment of flexible subscriber services and the lowering of network investment and operating costs.

Solution Architecture

Figure 1 provides a typical solution architecture.

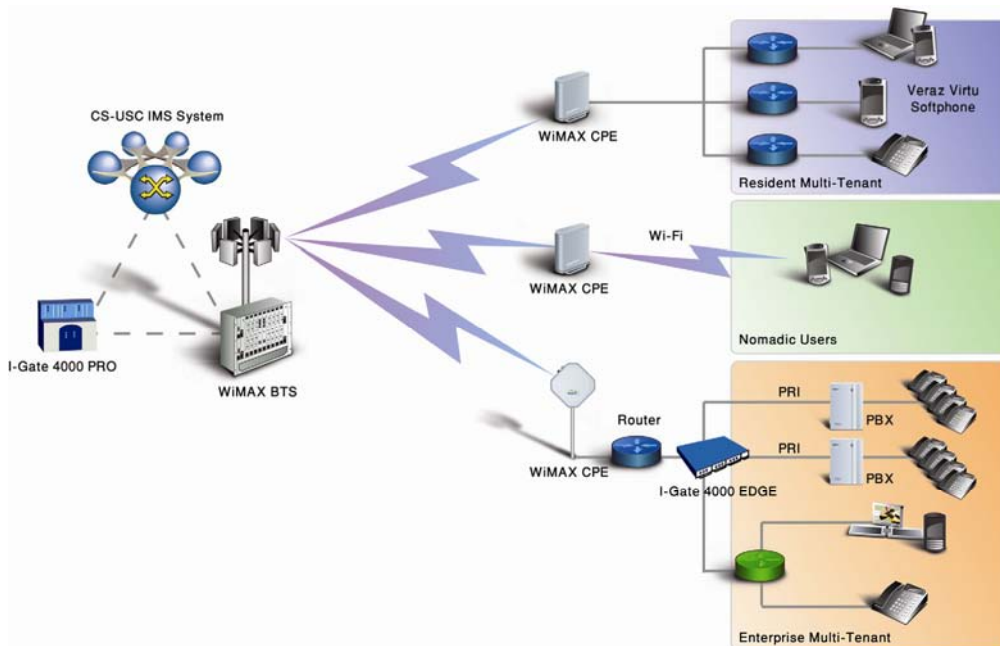


Figure 1: Solution Architecture

Important features of this architecture include:

- Fine session control and QoS for enhanced multimedia experience
- Voice enhancement techniques maintain high quality voice
- Multi-device support for IMS devices and non-IMS user equipment
- Space/power efficient IMS solution
- Nomadic and mobile multi-access with common control
- Advanced multimedia service delivery
- User device management

About Alvarion's OPEN WiMAX Approach

As the worldwide standard for wireless broadband access and personal mobile broadband applications, WiMAX technology offers solutions that enable fixed-line, cable, and mobile operators and new challengers to discover and capitalize on new opportunities in the anticipated market for higher average revenue per user (ARPU) services. This is because WiMAX has the capacity to deliver sufficient bandwidth to enable value-added applications, including live video broadcasting, high-speed data, toll-quality voice and multimedia content. Most importantly, the WiMAX (IEEE 802.16e-2005) standard was developed based on the concept of an all-IP network - a complete set of IP-based functions and interfaces allowing for high quality service delivery, while maintaining end-to-end QoS and minimizing investment and operating costs for operators.

WiMAX offers operators two fundamental technological advantages: a superior radio technology and an open IP-based access network infrastructure. WiMAX benefits from advanced Non-Line-of-Sight (NLOS) radio and antenna technologies which can be used in fixed, portable, and Mobile WiMAX™ networks to facilitate high spectral efficiency and obstacle penetration. This results in low latency and enhanced network coverage, capacity and user experience, and the opportunity for lower infrastructure costs and reduced cost per subscriber in comparison to other wireless technology. Furthermore, utilizing its built-in QoS mechanisms, WiMAX technology has the capacity to deliver maximal service quality under subscriber Service Level Agreements (SLAs) and enable rich, value-added applications including high-speed data and Internet, live video multicasting, toll-quality voice and multimedia content in both download and streaming formats. These capabilities enable toll-quality delivery of differentiated services coupled with enhanced subscriber Quality of Experience (QoE).

Alvarion's all-IP OPEN WiMAX architecture is the foundation of the company's operator-centric best-of-breed 4Motion solution. Whether providing a complete Alvarion-based solution, or combining the company's BreezeMAX superior radio technology with network elements from its world-class ecosystem of partners, Alvarion delivers end-to-end solutions that are tailored to the specific requirements of each operator.

Veraz User Services Core (USC-CS)

The USC platform is a distributed software system that executes on a number of SUN server (typically carrier-grade SUN Netra servers interconnected over an underlying IP data network) platforms, offering open, distributed, modular and scalable architecture which maps consistently into the IP Multimedia Subsystem architecture.

Consequently, providers can choose to start with a small system, and grow to large networks spanning multiple geographic centers by adding components as traffic and end-user volumes increase. The USC can be described as a distributed IP network-based system providing traditional switch functions of call control, call routing, signaling gateway, and media device control in addition to back office functions in support of provisioning, billing, and network operations.

Veraz's next generation VoIP USC solution is based on a field-proven and industry renowned Transit Switch solution, which extends existing Transit Switch components with the addition of new software modules, including the Subscriber Manager (SM), and several additional IMS modules. Furthermore, the scalability and robustness of the USC is extended through the aggregation of call processing resources into clusters (server farms) for maximum server efficiency. The combination of Transit and USC Switch elements provides a seamless interworking of IMS access devices with all traditional signalling (SS7, PRI, SIP, H.323, CAS), as well as serving as the basis for a multitude of diverse customer applications.

Typical Configurations

A main issue when deploying VoIP services over WiMAX RANs is the assurance of end-to-end QoS, particular at the RAN. The goal is to dynamically allocate the required resources to a VoIP session, ensuring quality and allowing re-use by other applications once the session ends. This is achieved by a protocol running at the CPEs and base station (in the basic configuration), and between the base station and a dedicated network element (BreezeAPP Voice) in the advanced configuration.

Basic Configuration

The basic solution configuration includes Alvarion CPEs that support the Dynamic Resource Allocation Protocol, which manages the negotiation between the VoIP-enabled WiMAX CPEs and the base station during any SIP session. When a session is initiated, the CPE requests appropriate resource allocation from the base station. Once this allocation is successfully achieved, the session is initiated with the Veraz Class 5 ControlSwitch. If there are insufficient resources available, the call is rejected (the user gets a busy/network busy signal) and the session is not initiated with the soft switch. This configuration is shown in Figure 2.

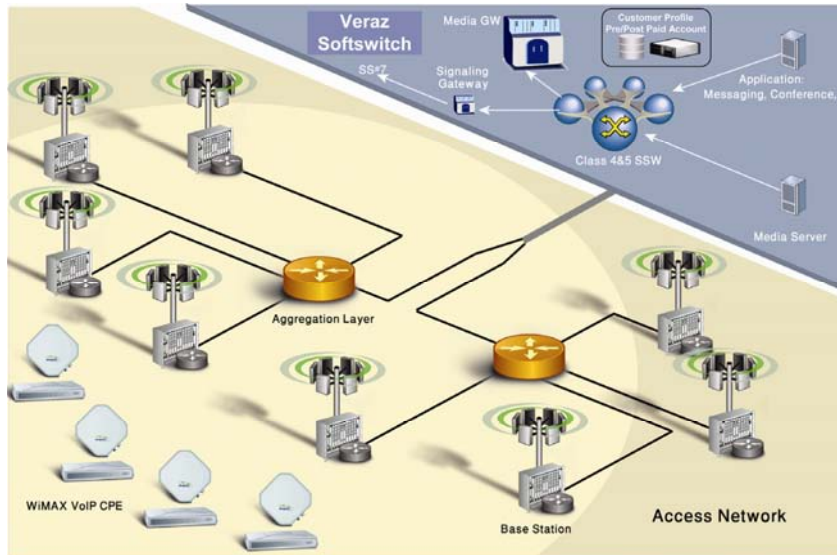


Figure 2: Basic Configuration

BreezeAPP Voice Advanced Configuration

In the advanced configuration, any standard SIP CPE can be used at the customer premises with a dedicated network element that is introduced in order to ensure QoS. BreezeAPP Voice acts as a SIP back-to-back User Agent to which the CPEs are registered. When a session is initiated, the CPE initiates the call with BreezeAPP Voice, which then requests the base station for appropriate resource allocation. Once this allocation is successfully achieved, the session is reinitiated from the BreezeAPP Voice to the Veraz Class 5 ControlSwitch. If there are insufficient resources available, the call is rejected (the user gets a busy/network busy signal) and the session is not forwarded to the soft switch. This configuration is shown in Figure 3.

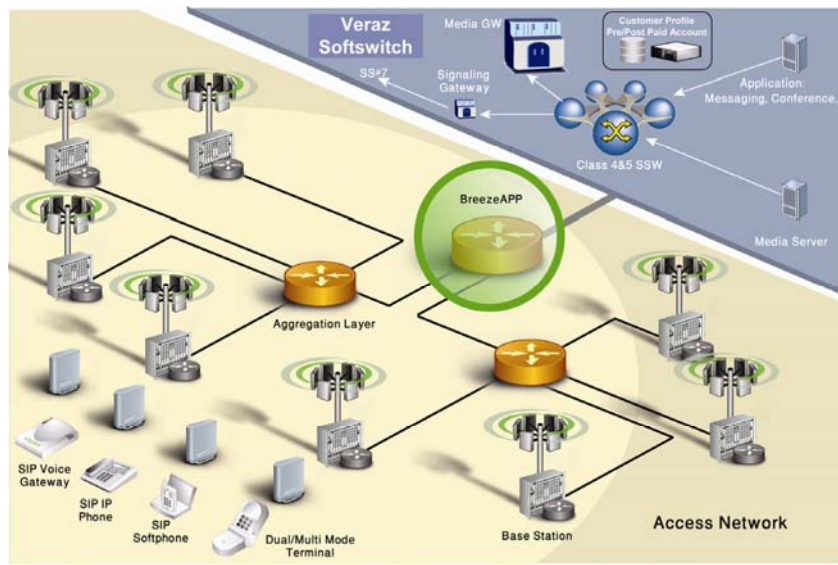


Figure 3: BreezeAPP Voice Advanced Configuration

Interoperability Lab Test Results

This section describes the tests performed in order to validate the interoperability of the Alvarion-Veraz solution.

Equipment Used for Tests

The following equipment was used:

Alvarion Equipment BreezeMAX μ TDD Base Station
 BreezeMAX μ AU
 4 BreezeMAX SUs
 BreezeMAX Type 1 VGs
 BreezeMAX Type 2 VGs
 BreezeAPP Voice AF/PF

Veraz Equipment User Services Core - ControlSwitch

A single service profile was defined for the BreezeMAX base station and used for BreezeAPP Voice-enabled services, as well as for the services that did not use the BreezeAPP Voice solution.

Tests Performed

The following tests were performed:

- **CODEC Support Functionality:** To check the performance of the system when a CODEC negotiation is carried out.
- **DTMF Digit Transmission:** To verify the successful bidirectional transmission of DTMF digits between two clients. Three different methods for DTMF digit generation were tested: RFC 2833, SIP INFO and Inband.
- **BreezeAPP Voice Tests:** To verify compatibility between BreezeAPP Voice and the USC-CS.

Test Results

Codec Support Functionality

Call Type	Originating CODEC List Configuration	Termination CODEC List Configuration	Successful Pass Results Obtained
Type 1 VGs to Type 1 VGs	1. G.729 2. G.711U 3. G.711A	1. G.711A 2. G.729 3. G.711U	G.729 codec selected by terminating UE and call successfully established with G.729 codec G.711A codec selected by terminating UE and call successfully established with G.711A codec
	G.729, VAD=on, Frame duration=20	G.729, VAD=on, Frame duration=20	Comfort noise packets transmitted when there is no voice activity
	G.729, VAD=off, Frame duration=20	G.729, VAD=off, Frame duration=20	Regular RTP packets transmitted even when there is no voice activity
Type 1 VGs to Type 2 VGs	1. G.729 2. G.711U 3. G.711A	1. G.711A 2. G.729 3. G.711U	G.729 codec selected by terminating UE and call successfully established with G.729 codec
	G.729, VAD=on, Frame duration=20	G.729, VAD=on, Frame duration=20	Comfort noise packets transmitted when there is no voice activity
	G.729, VAD=off, Frame duration=20	G.729, VAD=off, Frame duration=20	Regular RTP packets transmitted even when there is no voice activity
Type 2 VGs to Type 2 VGs	G.729, VAD=on, Frame duration=20	G.729, VAD=on, Frame duration=20	Comfort noise packets transmitted when there is no voice activity
	G.729, VAD=off, Frame duration=20	G.729, VAD=off, Frame duration=20	Regular RTP packets transmitted even when there is no voice activity
Type 2 VGs to PSTN	1. G.729 2. G.711U 3. G.711A	1. G.711U 2. G.711A	G.711U codec selected by terminating UE and call successfully established with G.711U codec

Call Type	Originating CODEC List Configuration	Termination CODEC List Configuration	Successful Pass Results Obtained
	G.711U, VAD=on, Frame duration=20	G.711U, VAD=on, Frame duration=20	Comfort noise packets transmitted when there is no voice activity
	G.711U, VAD=off, Frame duration=20	G.711U, VAD=off, Frame duration=20	Regular RTP packets transmitted even when there is no voice activity
	1. G.729	1. G.711U 2. G.711A	Call rejected because of codec negotiation failure
Type 1 VGs to Veraz SoftClient	1. G.711A 2. G.711U	1. G.711A 2. G.729 3. G.711U	G.711A codec selected by terminating UE and call successfully established with G.711A codec
Type 2 VGs to Veraz SoftClient	G.711A, VAD=on, Frame duration=20	G.711A, VAD=on, Frame duration=20	Comfort noise packets transmitted when there is no voice activity
	G.711A, VAD=off, Frame duration=20	G.711A, VAD=off, Frame duration=20	Regular RTP packets transmitted even when there is no voice activity

DTMF Digit Transmission Tests

Test Description	Successful Pass Results Obtained	Comments
DTMF digits transmitted from/to both UEs involved using SIP INFO method	DTMF digits heard at both sides of the call. SIP INFO packets seen in the traffic traces.	SIP INFO packets transmitted.
DTMF digits transmitted from/to both UEs involved using RFC2833 method	DTMF digits heard at both sides of the call. RTP EVENT packets seen in the traffic traces.	RTP-EVENT packets are transmitted.

BreezeAPP Voice Tests

The following tests were performed successfully:

- Call from/to Type 2 VGs from/to PSTN, G711u, VAD=on, frame duration 20ms. No codec negotiation.
- Call from/to Type 2 VGs from/to PSTN, G711u, VAD=off, frame duration 20ms. No codec negotiation.
- DTMF RFC2833. Type 2 VGs with PSTN.
- DTMF inband. Type 2 VGs with PSTN.
- T38 from Type 2 VGs to Type 2 VGs.

Benefits of the Alvarion-Veraz Solution

By leveraging WiMAX and IMS to deliver advanced, multimedia-centric services, Alvarion and Veraz deliver an IMS core solution for multimedia services with end-to-end QoS over WiMAX. This offers a series of important benefits:

- Enables carriers to leverage WiMAX and IMS to offer advanced multimedia-centric services across fixed-nomadic environments.
- Enables the easy and rapid deployment of reliable, value-added multimedia services and high bandwidth transport and broadband access networks without the cost of laying additional wires.
- Facilitates penetration in regions without wireline access and reliably expands IMS service portfolios.
- Delivers an end-to-end solution with QoS and QoE for VoIP and flexible multimedia services.
- Enables providers to offer service bundles, value-added services and fixed-mobile convergence (FMC) strategies.
- Meets subscriber demands for mobility and control over their communications needs, as well as innovative, rich, multimedia services that include high quality voice, video and data.
- Offers the advantages of fast time-to-market and addresses the convergence of wireline and wireless networks.
- Enables operators to offer broadband wireless services via point-to-point and point-to-multipoint networks, thus increasing revenue streams while also expanding operations into new markets.

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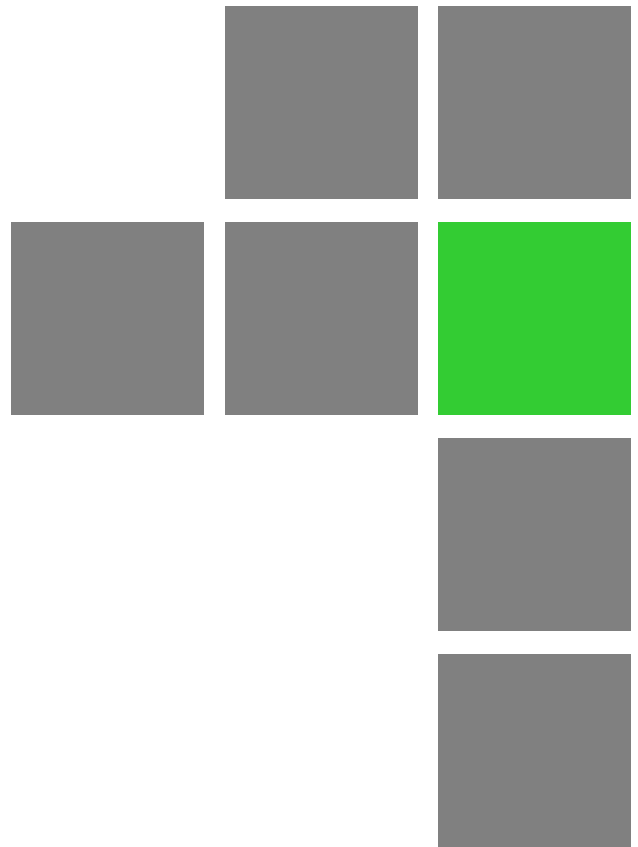
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About Alvarion

Alvarion is the largest WiMAX pure player, ensuring customer long-term success with fixed and mobile solutions for the full range of frequency bands. Based on its OPEN™ WiMAX strategy, the company offers superior wireless broadband infrastructure and an all-IP best-of-breed ecosystem in cooperation with its strategic partners. Alvarion boasts over 200 commercial WiMAX deployments worldwide.

