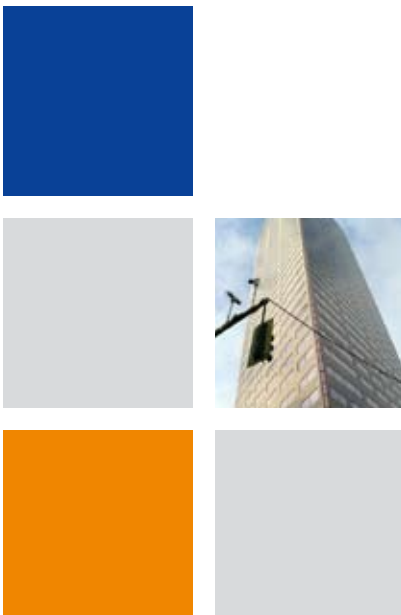




# Muni-Wireless and the Safe City

Municipal Wireless Networks for Safety, Security and Prosperity

White Paper





## Muni-wireless and the Safe City

## Introduction

Large-scale metro area networks are becoming an increasingly important tool in providing public services and ensuring public safety and security. Ubiquitous broadband networks have not only proven to be an effective way to support the growing data, voice and video communications needs throughout an entire metropolitan area; they have become a critical element enabling the prevention of crime and rapid first response.

Responsible government agencies and municipalities are leveraging the power of broadband connectivity to embrace the safe city approach, with centralized emergency response and management in the face of threats, attack, natural disasters, crime or industrial-scale accidents. Simply put, effective communications is the cornerstone of effective municipal management and crucial in saving lives and mitigating damage.

Safe city projects are municipal-level network deployments whose specific goal is to enhance civilian safety. Once this network is deployed, the municipality can enjoy the added value of utilizing it to drive economic development, increase educational excellence, attract business investment, provide municipal services and ultimately improve quality of life for residents. Moreover, the same muni-wireless networks that are ideal for safe city deployments, offer compelling revenue-generating opportunities, such as traffic control, transportation security, automatic meter reading, e-services for citizens and more.

Broadband wireless networking facilitates the deployment of municipal wireless networks and enables them to work more effectively. Wireless networking technologies are more scalable and flexible, overcoming the limitations of wired broadband in large areas.

This white paper will review the challenges and advances of muni-wireless networks, provide an overview of the technological needs, and demonstrate how they can be leveraged to build safe cities.



## Municipal and Safe City Network Requirements and Challenges

Wireless broadband networks can complement existing wired infrastructure, or they can be utilized as the core access infrastructure for a safe city. Wireless network infrastructure helps municipalities overcome many challenges, such as:

**Support for High-quality Video Transmission.** Video surveillance, a core function of any safe city and municipal network deployment, requires reliable and high quality video streaming. Sometimes existing infrastructure is limited in supporting high-quality video. This can be due to overtaxed shared infrastructure, limited bandwidth, or simply obsolete infrastructure that lacks the required Quality of Service (QoS).

**Limited or Unavailable Wired Reach.** Many desired, or required locations for cameras and other sensitive surveillance devices are simply not equipped with the wired infrastructure to link them to the network. This can be due to high costs, limited physical feasibility, vulnerability to vandalism or any number of reasons.

**Support for Multiple Applications and Integration.** A municipal safe city project usually consists of multiple applications, such as video surveillance, traffic management and more. Applications need to be added to the network at different project phases, according to priority, available budgets, complexity and other considerations. The municipal network must support smooth integration and the flexibility to add new applications at any phase.

**High Deployment Costs (CAPEX).** Safe city and municipal networks require very reliable high-bandwidth infrastructure. The cost to lay copper or fiber for such bandwidth intensive, high-quality infrastructure is significant, especially where no wired infrastructure existed before, such as rural areas and developing countries. Trenching is a very expensive, time-consuming endeavor, with the inherent inconvenience and costly disruption of business and daily routine. Aerial cable solutions may require less investment and cause less physical havoc, but are an eyesore on the local skyline, and are still more costly than wireless solutions.

**High Operating Costs (OPEX).** Leased E1/T1 lines are very costly; whereas self-ownership keeps network operating expenses down. Moreover, no safe city can be entirely safe if dependent on, and subject to, local operators' frameworks it has no control over.

**Time Consuming Deployment.** When a municipality wants to deploy a network that will ensure personal safety and security to its citizens, it does not want to wait years as natural disasters, emergencies or terrorist attacks come unexpectedly and deploying extensive wired networks takes time.

**Bureaucratic, Cable Route and Regulatory Delays.** Getting approval and licenses for trenching or aerial cable takes time and may delay project deployment.

**Limited Flexibility for Changes and Rerouting.** Once cables are in place, relocation, additions, revisions or rerouting are formidable challenges, due to cost factors, regulatory issues, new trenching issues and more. Wireless network infrastructure offers the flexibility for change.

**Scalability.** Wired networks do not inherently support pay-as-you-grow models. The entire infrastructure must be deployed at once when supporting one camera for video surveillance or ten in the same location. Adding devices or other bandwidth intensive applications means even more investment of time and resources. The right wireless infrastructure can be scalable from day one, depending on the equipment and proper RF planning.

## Added Value and Revenue-generating Municipal Applications

Rolling out a private safe city network creates opportunities to deploy a myriad of applications and services that can generate actual revenues for municipalities, enhance services to residents, reduce municipal expenditures and ensure a compelling return on investment.

Some of these applications include:

- Managed video surveillance services for commercial customers
- Municipal access and broadband for the council providing inter-building connectivity and mobile workers support, while eliminating the need to lease or maintain costly public networks
- Intelligent remote traffic management to balance traffic loads, reduce accidents rates, and provide driver alerts on road conditions
- e-Education services providing interactive remote education via shared or dedicated networks, enabling remote school connectivity
- Residential Internet access offering a lower cost alternative to residents versus costly commercial services, or an Internet access solution when other alternatives are not available
- Automatic meter reading to efficiently collect the information and save on costs
- Digital signage for electronic advertisements

In short, the municipal administration can leverage the same network to protect residents, enhance municipal services and generate revenue. These application opportunities require robust and reliable broadband wireless networks that support side-by-side wireless infrastructure as well as full separation between the two, in terms of security, prioritization and bandwidth allocation.



## Welcome to the 21<sup>st</sup> Century Wireless Safe City

Deploying safe city-related wireless applications requires reliable network infrastructure with high capacity and low latency to ensure quality of video, data and voice applications. Existing wired networks, in many cases, were not designed to serve safe city bandwidth savvy applications, multiple new connections of wide-scale deployment or deliver reliable mobility.

Municipalities deploying safe city projects can address a very broad range of applications that leverage the same infrastructure for the overall benefit of residents and offer revenue-generating municipal services on the same network. The necessary applications to deploy a safe city approach include public safety alarm and alert systems, video surveillance, intelligent traffic control, transportation security and access. Other applications that enhance the quality of service a municipality provides, can also be provided over the same self-owned network, and include automatic meter reading, municipal access, mobile management of the city workforce, e-services (e-Health, e-Education) and residential access.

### Wireless Technology and Infrastructure

Making a safe city work means spinning a delicate and vast web of independently mandated departments, from law enforcement agencies and first responder units to firefighters, Emergency Medical Services (EMS), hospitals, government agencies and civilian interfaces – with an even vaster array of devices, needs and security considerations.

New wireless technologies, such as WiMAX™ and mesh Wi-Fi networks, address many of the requirements for safe city network deployments and applications. Wireless networks can be deployed quickly and are very flexible. Once a base station is operational, services can be provided in a coverage area of up to several dozen kilometers. Services are provided using CPE (Customer Premises Equipment) and all that is required is a power source. Peripheral equipment, such as video cameras, sensors, and computers are connected to CPEs and the data between them is easily transferred. Wireless technologies make deployment changes and expansion very easy, such as installing new CPEs or changing CPE locations.

The technology choice is just one piece of the puzzle and system integrators need end-to-end solutions that address all application requirements, and of course, the seamless integration between them. Successful safe city network infrastructure will be provided best by a single, end-to-end and cost-effective solution portfolio.

While broadband wireless solutions are becoming more increasingly popular for customer-made safe city connectivity, municipalities must consider several key factors when evaluating wireless safe city infrastructure options. These include breadth and depth of the solution portfolio, including both licensed and license-exempt products, the degree to which solutions are optimized for safe city and municipal wireless connectivity specifically, and the ability to support and enable creative revenue streams with the addition of commercial applications and services for a compelling ROI.

#### Wireless Advantages

- Ubiquitous metro connectivity
- High bandwidth support
- QoS
- Reliable in harsh outdoor conditions
- Agile and non-disruptive
- Affordable
- Portable and scalable
- Mobile connectivity
- Secure and standard-based for interoperability
- Centralized management

## Safe City Requirements

Leveraging the full business potential of a safe city project requires a network infrastructure that meets diverse application requirements while controlling CAPEX and OPEX. It must provide ubiquitous metro connectivity with standard IP interface to end-point devices, and support mobility and coverage that reaches the most remote locations. Reliable connectivity in harsh outdoor conditions is critical, as is the need for 100% uptime that operates 24x7 365 days of the year and does not disrupt the city's daily routine. Today's infrastructure must be ready for tomorrow, and be scalable to support additional devices, mobile connectivity, new bandwidth requirements and real-time application deployments. Support for mobile connectivity is critical in today's mobile world, for connecting key elements, such as public transportation, first responders, police forces and residents wherever they may be.

A safe city project incorporates multiple applications, some of which are time critical, such as traffic management. Others may require very high bandwidth, such as video surveillance. The safe city wireless infrastructure must include QoS networking elements to set appropriate priorities for different applications and users. These will minimize data latency and guarantee a certain level of performance by reserving bandwidth for more important applications, while others get bandwidth on a best effort basis. Furthermore, safe city applications require the highest level of security and so does the network infrastructure that supports it. The security mechanisms within the network must not impact on performance which could negatively impact revenue-generating applications.

Safe city network infrastructure must provide seamless interoperability between disparate applications to communicate critical incident information and to ensure collaboration between agencies and jurisdictions. Moreover, the network infrastructure should be able to leverage future investments in surveillance equipment and revenue generating applications, as well as adhering to open standards that enable integration of emerging devices, applications and technologies. Providing IP-based network infrastructure solutions ensures a future-proof implementation, lowering total cost of ownership while enabling adoption of new services and devices as they develop and mature.

Finally, proactive network management is paramount to maintaining the availability and performance of the network and the applications it supports. The majority of safe city applications involve outdoor network devices that are subject to vandalism or damage as a result of harsh weather conditions. The ability to detect changes in performance, identify intrusions and other network impacts will significantly contribute to the value of the safe city as a whole, while maintaining public confidence and respect for individual rights and privacy, and therefore centralized network management is essential.

## Benefits of Private Networks over Public Networks

Safe city applications, must be reliable and available at all times and private networks can be designed and operated to provide this required level of reliability, availability, and security. Public networks, on the other hand, are designed to deliver acceptable performance to as many commercial end-users as possible and are inherently built to address the commercial market. As a result, they are limited, by design, to meet rigorous and mission-critical requirements.

It has become increasingly common to physically separate emergency application networks from carrier networks – both cellular and landline. When emergencies arise, carrier and operator networks fast become overloaded and mission-critical emergency applications can cease operating. In a privately-owned and operated safe city network, the city can control traffic, define priorities and make sure that the network is always available for the critical applications when they are needed. Finally, private networks cost less to operate than leased networks.

## The Wireless Advantage

Wireless broadband networks create a new and more efficient paradigm for public safety agencies to work together, save costs and optimize utilization of existing manpower. Wireless systems link disparate devices and systems of the safe city in a network that is independent of landline infrastructure. This enables real-time, mobile broadband access to critical databases, seamless voice services, live video feeds from geographically-spread surveillance cameras and a host of other services in a single, reliable network, while easily supporting mobile broadband for officials on-the-move.

Deploying networks cost-effectively and in a relatively short period of time that support these issues poses many formidable challenges. These, and more, can all be addressed by choosing the right broadband wireless network technology and infrastructure. Wireless broadband overcomes the physical obstacles of trenching cable, as well as the expense. Wireless networks are easy to install, relocate to new locations, and involve relatively small initial investments and maintenance costs. With 100% privately-owned connectivity, city finance planners can avoid the recurring and uncontrollable expenditures of leased E1/T1/xDSL links.

The following demonstrates the potential savings for a 10-line network over a period of 36 months:



Carrier-class, standards-based wireless broadband technologies, such as WiMAX, support complex video surveillance deployments within safe city networks. Wireless technologies make it possible to add and place cameras in locations previously inaccessible, and offer the QoS, high-capacity, high-availability, built-in data encryption mechanisms and low latency connectivity essential for real-time high-resolution video streaming over large geographic areas.

In terms of time, a 15 km wireless link can be installed and fully operational in a matter of hours. Moreover, regulatory delays are avoided when using license-exempt frequencies. In cases when a licensed frequency is used, only one time approval is needed to cover an entire region rather than individual approval for each link in the city, which would be the case if using wired solutions.

Wireless broadband offers the flexibility to provide quadruple play, mobile voice, video and data coverage as well as always be ready for the unexpected, such as accidents, fires, crime scenes, attacks, and the expected such as special sporting events, rallies, municipal celebrations, social happenings and more.

The scalability of wireless broadband makes it the ideal choice, in terms of bandwidth capacity, geographic expansion and adding new sites. For example, pay-as-you-grow software licensed upgradeable models are part and parcel of advanced WiMAX network infrastructure.

## Wireless Topology Defined

Wireless communications networks use radio modems mounted on public or private buildings, water towers, poles or any other elevated structure in order to optimize transmissions. To attain coverage, the choice is between point-to-point (PTP) and point-to-multipoint (PtMP) architectures, depending on the applications and services that need to be provided.

### Point-to-Point (PTP) Topology

PTP topology permits communications between two points. Coverage can reach tens of kilometers supporting a high capacity PTP link. PTP topology is suitable for both public and private networks.

Common municipal PTP applications are:

Building to building connectivity



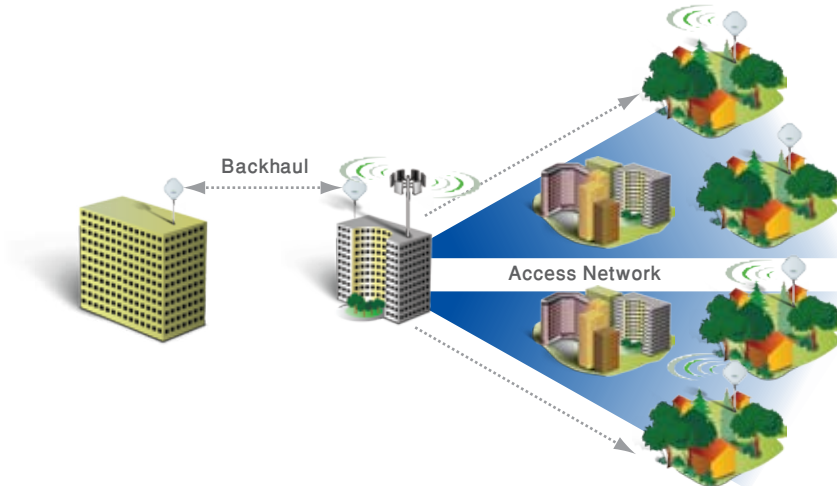
Video surveillance applications



Leased line replacement (E1 / T1 lines)



Backhauling for access networks



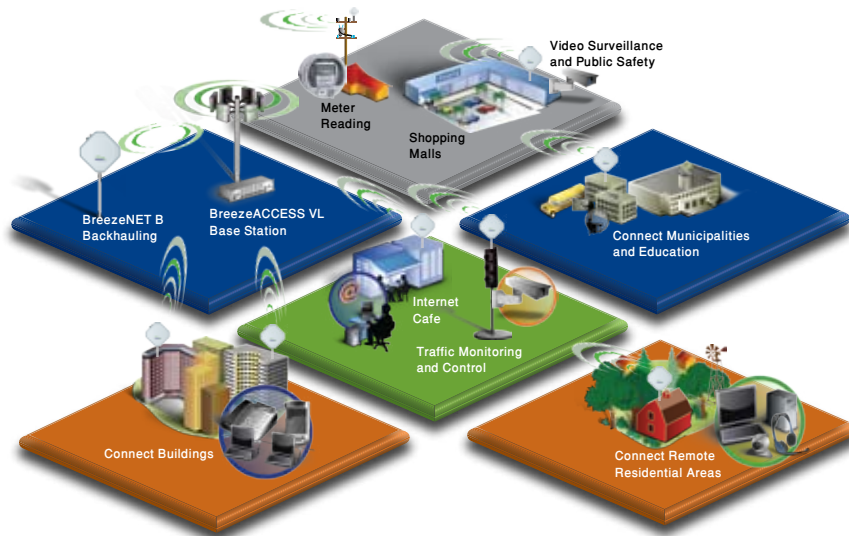
## Point-to-Multipoint (PtMP) and Mesh Topology

PtMP topology, also known as Star topology, consists of a central base station which concentrates the flow of multiple CPEs. Each CPE can be connected to single or multiple cameras, a variety of sensors and controllers, or even to a PC when providing Internet/intranet access. Usually, the base station is installed in a high location so that all the sites communicate directly with the base station regardless of their location. This is a modular infrastructure, which can evolve according to needs, in terms of capacity and coverage. Remote points can be added as required and the base station can easily perform effective QoS, since it senses the entire network and can easily set the bandwidth for each site.

In a mesh topology data is routed between nodes, hopping from node to node until the destination is reached. A mesh network whose nodes are all connected to each other is a fully connected network. Mesh networks differ from other networks in that the component parts can all connect to each other via multiple hops. Mesh networks may support self-healing as the network can still operate even when a node breaks down or a connection fails. While pure mesh topology has inherent advantages, it introduces a degree of limitation in terms of throughput, efficiency, coverage and latency. Mesh topology also involves very complex network routing, while PtMP offers simplified radio planning. In general, the preferred primary solution is PtMP topology with mesh, possibly used as a supplementary solution only at the network edges.



Alvarion leverages the advantages of each topology as its solutions use a combination of PtMP and Mesh. Whenever direct communication to the base station is available, PtMP is used. If PtMP topology is not supported, Mesh topology takes over as an ideal complement. Common municipal PtMP applications include video surveillance, mobile broadband, education, meter reading and rural Internet access.



## Building a Wireless Safe City and Muni-wireless Networks with Alvarion

Alvarion offers comprehensive and optimized broadband wireless infrastructure solutions that address the widest range of topologies (PTP, PtMP, Mesh), technologies (WiMAX, Wi-Fi), frequencies, and deployment types (fixed, nomadic, mobile). In addition, Alvarion solutions comply with industry standards, are secure and enable control over operating costs. Flexible and scalable, these solutions support multi-layer configurations and expandability for pay-as-you-go growth and the rollout of revenue-generating applications to help achieve a compelling ROI on infrastructure investments.

The Alvarion BreezeMAX®, BreezeACCESS® and BreezeNET® B families make up a complete portfolio of solutions that are optimized for safe city and municipal networks.

Safe City Requirement	Alvarion Product Features
<b>Ubiquitous</b>	<ul style="list-style-type: none"> <li>• WiMAX and Wi-Fi access points</li> <li>• Fixed, nomadic and mobile</li> <li>• OFDM technology supporting Non-Line-of-Sight (NLOS) coverage</li> <li>• 2<sup>nd</sup> and 4<sup>th</sup> order diversity for enhanced coverage and performance</li> <li>• High range PtMP coverage                             <ul style="list-style-type: none"> <li>up to 15 km ETSI standard</li> <li>up to 30 km FCC standard</li> </ul> </li> </ul>
<b>Reliable</b>	<ul style="list-style-type: none"> <li>• Proven carrier class solution</li> <li>• RF assessment and planning expertise</li> <li>• All outdoor solution (IP65)</li> </ul>
<b>Agile</b>	<ul style="list-style-type: none"> <li>• Easy to install</li> <li>• Automatic self configuration</li> <li>• Rapid deployment</li> </ul>
<b>Affordable</b>	<ul style="list-style-type: none"> <li>• Pay-as-you-grow model for base station and CPE</li> <li>• Efficient coverage (NLOS, high capacity and coverage) enables reduced CAPEX</li> <li>• Low maintenance enables reduced OPEX</li> </ul>
<b>Scalable</b>	<ul style="list-style-type: none"> <li>• Scalable star topology</li> <li>• SW upgradeable bandwidth options</li> <li>• Capacity of up to 33 Mbps per PtMP sector</li> <li>• Up to 6 sectors per chassis</li> <li>• Bandwidth management (uplink, downlink)</li> <li>• Wide range of frequencies</li> </ul>
<b>Mobile</b>	<ul style="list-style-type: none"> <li>• Mobile WiMAX™ 802.16e</li> <li>• Fast 802.11 handover between Wi-Fi APs</li> </ul>
<b>Secured</b>	<ul style="list-style-type: none"> <li>• Encryption (hardware based AES 128, FIPS-197, FIPS 140-2)</li> <li>• Allow/Deny unauthorized CPEs</li> </ul>
<b>Quality of Service (QoS)</b>	<ul style="list-style-type: none"> <li>• Priority per application</li> <li>• Bandwidth allocation per application</li> <li>• Configurable MIR/CIR per CPE per direction</li> </ul>
<b>Standard compliance</b>	<ul style="list-style-type: none"> <li>• All-IP based solutions (Wi-Fi 802.11 and WiMAX 802.16)</li> <li>• Alvarion is a founding member of the WiMAX Forum®</li> <li>• Product roadmap aligned with industry standards</li> </ul>
<b>Management</b>	<ul style="list-style-type: none"> <li>• Centralized network management with standard NMS interfaces</li> <li>• Proactively identify network issues</li> </ul>

## Alvarion Solution Highlights

Alvarion is a market leader in both fixed and Mobile WiMAX with a comprehensive portfolio of wireless broadband infrastructure solutions that is shaping the new wireless broadband experience. Alvarion is a preferred WiMAX partner, and a premier contributor to open standards development.



## Alvarion Product Offering Highlights

### BreezeACCESS VL

Alvarion's broadband wireless platform in the 5 GHz frequency is part of the BreezeACCESS product family, the world's most deployed wireless broadband platform. Superior features, such as NLOS, extended reach, high capacity in all packet sizes, encryption, and end-to-end QoS for time critical applications, work together in a pay-as-you-grow model to meet demanding muni-wireless needs.



### BreezeMAX

BreezeMAX is the industry's most advanced and robust WiMAX IEEE 802.16e platform. BreezeMAX delivers efficient wireless broadband connectivity over mobile, fixed and nomadic networks, using a variety of end-user devices. Designed for a wide range of frequencies, BreezeMAX provides greater flexibility, operating in both FDD and TDD duplex modes.



### BreezeNET B

BreezeNET B is a family of outdoor wireless point-to-point bridging solutions that operate in the 2.4 and 4.9-5.9 GHz band and provide an efficient and highly secure solution for connectivity and backhaul services between two remote locations.

### BreezeMAX \ BreezeACCESS Wi<sup>2</sup>

Answering the need for outdoor Wi-Fi connectivity, Wi<sup>2</sup> offers localized mesh networks with a Wi-Fi AP-rich feature set. The Wi<sup>2</sup> enables immediate connection with WiMAX Star backhauling networks for a high performance, low complexity, easy-to-deploy network which can be easily tailored to specific operational and budget demands.

For a more detailed feature list see Appendix A or visit [www.alvarion.com](http://www.alvarion.com)



## Conclusion

Broadband wireless solutions are fast becoming more commonly used and a de-facto standard for safe city connectivity. They provide a range of benefits that answer municipalities' technical, application and business demands. With the myriad of broadband wireless solutions available today and significant variation among them, municipalities must carefully consider several key factors:

- The breadth and depth of a vendor solution portfolio in both licensed and license-exempt products
- Optimization of the products for safe city and municipal wireless connectivity
- Flexibility and agility to support rollout of revenue-generating applications to achieve a compelling ROI
- Expertise in radio RF planning

Municipalities should seek core competency in superior WiMAX and broadband wireless solutions designed for private and alternative networks. Secure carrier-class, standards-based solutions that uniquely support complex video surveillance deployments within safe city networks are ideal, and must offer the QoS, high-capacity, high availability and low latency connectivity essential for real-time high-resolution video streaming over large geographic areas. Easy to install solutions that provide quadruple play mobile voice, video and data coverage are vital to handle the unexpected, as well as revenue-generating opportunities for astute operators. Finally, scalability to support pay-as-you-grow models should be inherent in the wireless broadband infrastructure selected, to offer the flexibility to support the dynamic nature of these networks and applications.

Alvarion offers a complete wireless portfolio that offers end-to-end solutions for advanced safe city applications. With a large customer base and complete high-quality, high-speed broadband wireless solutions portfolio, Alvarion is the municipality's preferred partner – fully committed to tailoring solutions for safe city and other municipal applications.

## Appendix A: Alvarion Product Offering - Key Features

### BreezeACCESS VL

- Point-to-Multipoint wireless outdoor robust solution
- Wide range of bands: 900 MHz, 5.x GHz
- Based on TDD OFDM NLOS technology
- Coverage of up to 30 km (FCC)
- Net capacity of up to 33 Mbps per sector
- Standalone or 1 to 6 sectors per chassis (up to a total of 200 Mbps)
- Hardware based encryption: AES, FIPS-197
- Mixing and matching of different bands within the chassis
- Configurable MIR/CIR per CPE per direction
- WLP: over-the-air traffic prioritization
- Full outdoor BST enclosure option available
- Carrier-grade 19" chassis with optional redundant power supply
- Flexible scalability support for IT friendly deployments
- Centralized network management system

### BreezeNET B

- Point-to-point wireless outdoor solution
- Frequencies: 2.4 GHz; 4.9 - 5.9 GHz
- OFDM Non-Line-Of-Site (NLOS) technology
- Long reach, up to 50 km (30 km in ETSI)
- Aggregated throughput: 10 Mbps – 250 Mbps
- High level security: AES (FIPS-197 available)
- Channel size: 10 MHz; 20 MHz and 40 MHz (B100 only)
- 4 rate options: B10, B14, B28, B100, and B300 reaching up to 250 Mbps
- QoS for voice and video applications
- Fast and simple to deploy
- Centralized network management

### BreezeMAX

- Complete spectrum: 2.3 GHz, 2.5 GHz, 3.3 GHz - 3.8 GHz, 3.65 GHz
- Channel width: 3.5 MHz and 5 MHz
- Based on TDD or FDD OFDM/OFDMA NLOS technology
- Coverage of up to 30 km
- Capacity of up to 15 Mbps per sector
- Support of 3 sectors with 2 carriers or 6 sectors with 1 carrier
- AAS support of 2<sup>nd</sup>/4<sup>th</sup> order diversity and MIMO
- Carrier-class platform with hot swappable functionality
- Full outdoor BST enclosure option available
- Centralized network management

### BreezeMAX / BreezeACCESS Wi<sup>2</sup>

- Wi-Fi connectivity in hot zones for Wi-Fi enabled devices
- Frequency: 2.4 GHz
- Level 2 and 3 mobility, client service transparency
- Supports up to 16 virtual networks each with unique SSID, authentication and QoS
- Mesh (DWDS), self-healing, self-optimizing
- Integrated HTML login/captive portal and RADIUS authentication
- Plug & play AP configuration, upgrade and control
- Configurable min/max connect speed
- Centralized system monitor for thousands of APs

## Headquarters

International Corporate HQ  
corporate-sales@alvarion.com

North America HQ  
n.america-sales@alvarion.com

## Sales Contacts

Australia:  
anz-sales@alvarion.com

Asia Pacific:  
ap-sales@alvarion.com

Brazil:  
brazil-sales@alvarion.com

Canada:  
canada-sales@alvarion.com

Caribbean:  
caribbean-sales@alvarion.com

China:  
cn-sales@alvarion.com

Czech Republic:  
czech-sales@alvarion.com

France:  
france-sales@alvarion.com

Germany:  
germany-sales@alvarion.com

Italy:  
italy-sales@alvarion.com

Ireland:  
uk-sales@alvarion.com

Japan:  
jp-sales@alvarion.com

Latin America:  
lasales@alvarion.com

Mexico:  
mexico-sales@alvarion.com

Nigeria:  
nigeria-sales@alvarion.com

Philippines:  
ph-sales@alvarion.com

Poland:  
poland-sales@alvarion.com

Portugal:  
sales-portugal@alvarion.com

Romania:  
romania-sales@alvarion.com

Russia:  
info@alvarion.ru

Singapore:  
asean-sales@alvarion.com

South Africa:  
africa-sales@alvarion.com

Spain:  
spain-sales@alvarion.com

U.K.:  
uk-sales@alvarion.com

Uruguay:  
uruguay-sales@alvarion.com

For the latest contact information  
in your area, please visit:  
[www.alvarion.com/company/locations](http://www.alvarion.com/company/locations)



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## About Alvarion

Alvarion (NASDAQ: ALVR) is the largest WiMAX pure-player with the most extensive WiMAX customer base and over 250 commercial deployments around the globe. Committed to growing the WiMAX market, the company offers solutions for a wide range of frequency bands supporting a variety of business cases. Through its OPEN WiMAX strategy, superior IP and OFDMA know-how, and proven ability to deploy end-to-end turnkey WiMAX projects, Alvarion is shaping the new wireless broadband experience.

