Can WiMAX Address Your Applications?

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on behalf of the
WiMAX Forum

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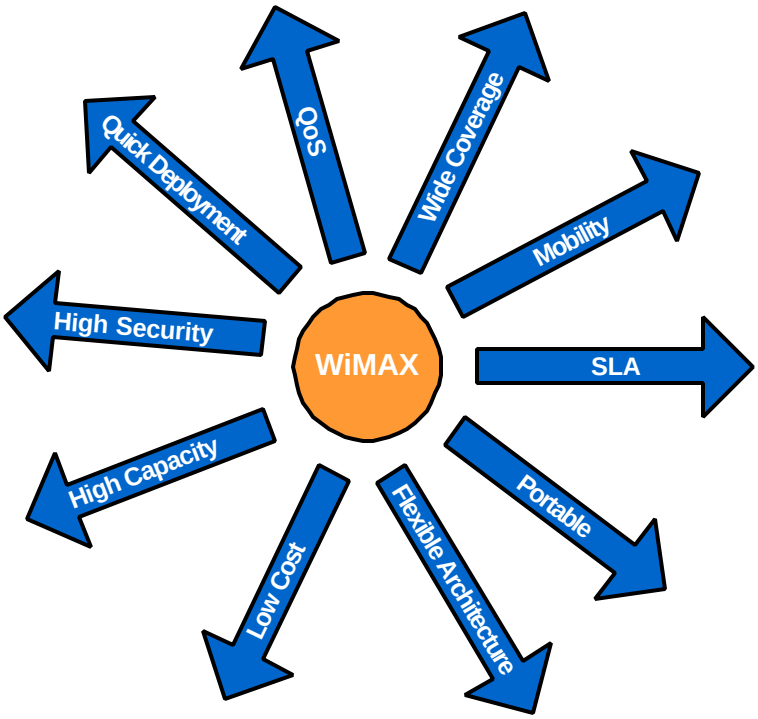
1 Introduction

WiMAX is a broadband wireless standard that enjoys widespread support from both the computer and telecom industries worldwide, making this technology particularly cost-effective. It is engineered to deliver significant business benefits to operators and users in diverse environments (enterprise, consumer, emerging, public service), geographies and demographies (urban, suburban, rural), both over the short and long terms. This paper attempts to present the key technical features and applications of WiMAX, and illustrate them by providing examples of usage scenarios in which WiMAX would be the preferred solution.

There are many usage scenarios that can be addressed by WiMAX; however, the limited length of this paper means that we cannot address all of them. For this reason, the paper is primarily focused on fixed and portable usage; however, some examples of mobility usage have also been included.

2 WiMAX Technology

The WiMAX standard has been developed with many objectives in mind. These are summarized below:



- **Flexible Architecture:** WiMAX supports several system architectures, including Point-to-Point, Point-to-Multipoint, and ubiquitous coverage. The WiMAX MAC (Media Access Control) supports Point-to-Multipoint and ubiquitous service by scheduling a time slot for each Subscriber Station (SS). If there is only one SS in the network, the WiMAX Base Station (BS) will communicate with the SS on a Point-to-Point basis. A BS in a Point-to-Point configuration may use a narrower beam antenna to cover longer distances.
- **High Security:** WiMAX supports AES (Advanced Encryption Standard) and 3DES (Triple DES, where DES is the Data Encryption Standard). By encrypting the links between the BS and the SS, WiMAX provides subscribers with privacy (against eavesdropping) and security across the broadband wireless interface. Security also provides operators with strong protection against theft of service. WiMAX also has built-in VLAN support, which provides protection for data that is being transmitted by different users on the same BS.
- **WiMAX QoS:** WiMAX can be dynamically optimized for the mix of traffic that is being carried. Four types of service are supported:

Table 1 WiMAX Service Types

Service Type	Description
Unsolicited Grant Service (UGS)	UGS is designed to support real-time data streams consisting of fixed-size data packets issued at periodic intervals, such as T1/E1 and Voice over IP.
Real-Time Polling Service (rtPS)	rtPS is designed to support real-time data streams consisting of variable-sized data packets that are issued at periodic intervals, such as MPEG video.
Non-Real-Time Polling Service (nrtPS)	nrtPS is designed to support delay-tolerant data streams consisting of variable-sized data packets for which a minimum data rate is required, such as FTP.
Best Effort (BE)	BE service is designed to support data streams for which no minimum service level is required and which can be handled on a space-available basis.

- **Quick Deployment:** Compared with the deployment of wired solutions, WiMAX requires little or no external plant construction. For example, excavation to support the trenching of cables is not required. Operators that have obtained licenses to use one of the licensed bands, or that plan to use one of the unlicensed bands, do not need to submit further applications to the Government. Once the antenna and equipment are installed and powered, WiMAX is ready for service. In most cases, deployment of WiMAX can be completed in a matter of hours, compared with months for other solutions.

- **Multi-Level Service:** The manner in which QoS is delivered is generally based on the Service Level Agreement (SLA) between the service provider and the end-user. Further, one service provider can offer different SLAs to different subscribers, or even to different users on the same SS.
- **Interoperability:** WiMAX is based on international, vendor-neutral standards, which make it easier for end-users to transport and use their SS at different locations, or with different service providers. Interoperability protects the early investment of an operator since it can select equipment from different equipment vendors, and it will continue to drive the costs of equipment down as a result of mass adoption.
- **Portability:** As with current cellular systems, once the WiMAX SS is powered up, it identifies itself, determines the characteristics of the link with the BS, as long as the SS is registered in the system database, and then negotiates its transmission characteristics accordingly.
- **Mobility:** The IEEE 802.16e amendment has added key features in support of mobility. Improvements have been made to the OFDM and OFDMA physical layers to support devices and services in a mobile environment. These improvements, which include Scaleable OFDMA, MIMO, and support for idle/sleep mode and hand-off, will allow full mobility at speeds up to 160 km/hr. The WiMAX Forum-supported standard has inherited OFDM's superior NLOS (Non-Line Of Sight) performance and multipath-resistant operation, making it highly suitable for the mobile environment.
- **Cost-effective:** WiMAX is based on an open, international standard. Mass adoption of the standard, and the use of low-cost, mass-produced chipsets, will drive costs down dramatically, and the resultant competitive pricing will provide considerable cost savings for service providers and end-users.
- **Wider Coverage:** WiMAX dynamically supports multiple modulation levels, including BPSK, QPSK, 16-QAM, and 64-QAM. When equipped with a high-power amplifier and operating with a low-level modulation (BPSK or QPSK, for example), WiMAX systems are able to cover a large geographic area when the path between the BS and the SS is unobstructed.
- **Non-Line-of-Sight Operation:** NLOS usually refers to a radio path with its first Fresnel zone completely blocked. WiMAX is based on OFDM technology, which has the inherent capability of handling NLOS environments. This capability helps WiMAX products deliver broad bandwidth in a NLOS environment, which other wireless product cannot do.
- **High Capacity:** Using higher modulation (64-QAM) and channel bandwidth (currently 7 MHz, with planned evolution towards the full bandwidth specified in the associated IEEE and ETSI standards), WiMAX systems can provide significant bandwidth to end-users.

3 WiMAX Applications

The WiMAX standard has been developed to address a wide range of applications, as summarized in the following table:

Table 2 WiMAX Service Classes

Class Description	Real Time?	Application Type	Bandwidth
Interactive Gaming	Yes	Interactive Gaming	50 - 85 kbps
VoIP, Video Conference	Yes	VoIP	4 - 64 kbps
		Video Phone	32 - 384 kbps
Streaming Media	Yes	Music/Speech	5 - 128 kbps
		Video Clips	20 - 384 kbps
		Movies Streaming	> 2 Mbps
Information Technology	No	Instant Messaging	< 250 byte messages
		Web Browsing	> 500 kbps
		Email (with attachments)	> 500 kbps
Media Content Download (Store and Forward)	No	Bulk Data, Movie Download	> 1 Mbps
		Peer-to-Peer	> 500 kbps

Based on its technical attributes and service classes, WiMAX is suited to supporting a large number of usage scenarios. Some of these scenarios are outlined in the following table, which indicates the WiMAX technical attributes that are critical for the successful operation of these scenarios:

Table 3 WiMAX Usage Scenarios

	Flexible Architecture	High Security	WiMAX QoS	Quick Deployment	Multi-Level Service	Interoperability	Portability	Mobility	Cost-Effective	Wider Coverage	NLOS	High Capacity
Cellular Backhaul				x					x			x
WSP Backhaul				x					x			x
Banking Networks	x	x	x						x		x	
Education Networks	x		x						x	x		
Public Safety	x	x	x	x			x	x			x	
Offshore Communications	x		x				x	x		x	x	
Campus Connectivity	x	x	x									x
Temporary Construction			x	x			x				x	
Theme Parks	x		x				x	x			x	
WSP Access Network		x	x		x	x			x		x	x
Rural Connectivity			x			x			x	x		
Military Battlefield	x	x		x			x	x				

Many of the above usage scenarios are discussed, in more detail, in *Usage Scenarios*.

4 Usage Scenarios

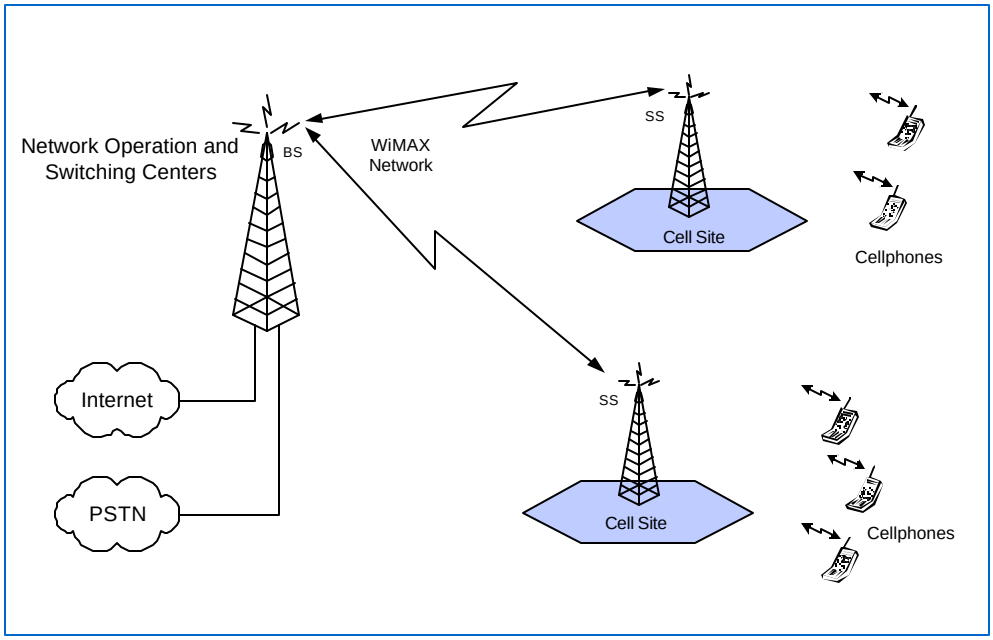
WiMAX technology will revolutionize the way we communicate. It will provide total freedom to people who are highly mobile, allowing them to stay connected with voice, data and video services. WiMAX will allow people to go from their homes to their cars, and then travel to their offices or anywhere in the world, all seamlessly. To illustrate the ability of WiMAX to address the applications outlined in the preceding section, several representative usage scenarios, grouped into two broad categories – private and public networks – are outlined in the following sections.

4.1 Private Networks

Private networks, used exclusively by a single organization, institution or business, offer dedicated communication links for the secure and reliable transfer of voice, data and video. Quick and easy deployment is generally a high priority, and configurations are typically Point-to-Point or Point-to-Multipoint.

4.1.1 Cellular Backhaul

The market for cellular services is becoming more and more competitive. To stay in the business, cellular operators are constantly looking for ways to reduce operating costs. Backhaul costs for cellular operators represent a significant portion of their recurring costs. WiMAX can provide Point-to-Point links of up to 30 miles (50 km), with data rates capable of supporting multiple E1/T1s Cellular operators can therefore use WiMAX equipment to backhaul Base Station traffic to their Network Operation and Switching Centers, as shown below:

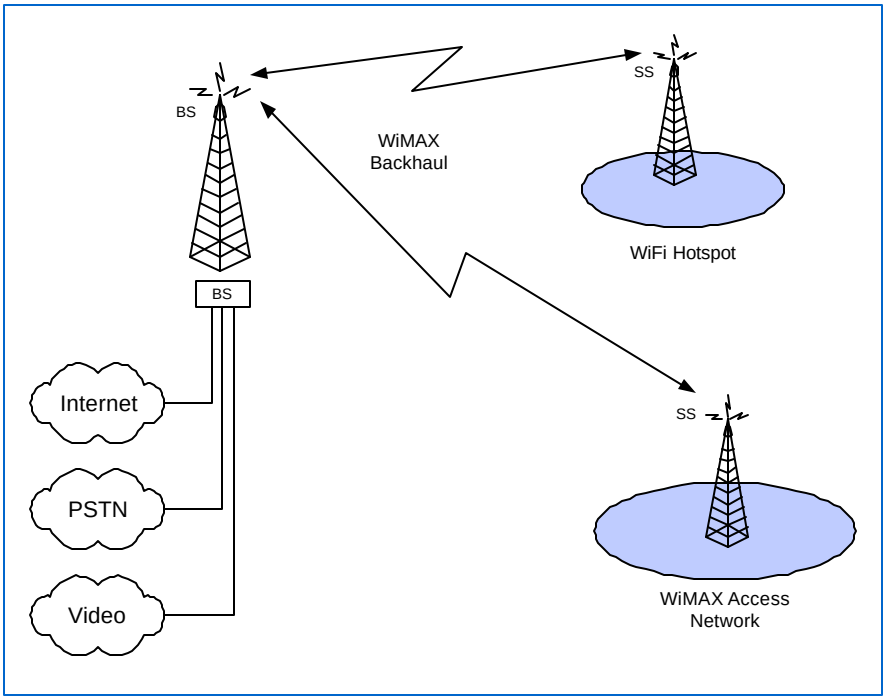


Note: Based on the availability of spectrum for WiMAX in different countries, the cellular backhaul application may or may not be able to handle nationwide networks.

Cellular traffic is a mix of voice and data, for which the built-in QoS feature of WiMAX is highly suited. Leasing backhaul facilities from local telephone companies can be cost-prohibitive, and deploying a fiber solution, which is both costly and time consuming, could negatively impact rollout of service. Wired solutions for providing cellular backhaul are seldom cost-effective in rural or suburban areas, and most versions of DSL and cable technology cannot offer the required bandwidth, especially for backhauling upcoming 3G networks.

4.1.2 Wireless Service Provider Backhaul

Wireless Service Providers (WSPs) use WiMAX equipment to backhaul traffic from Base Stations in their access networks, as shown below:

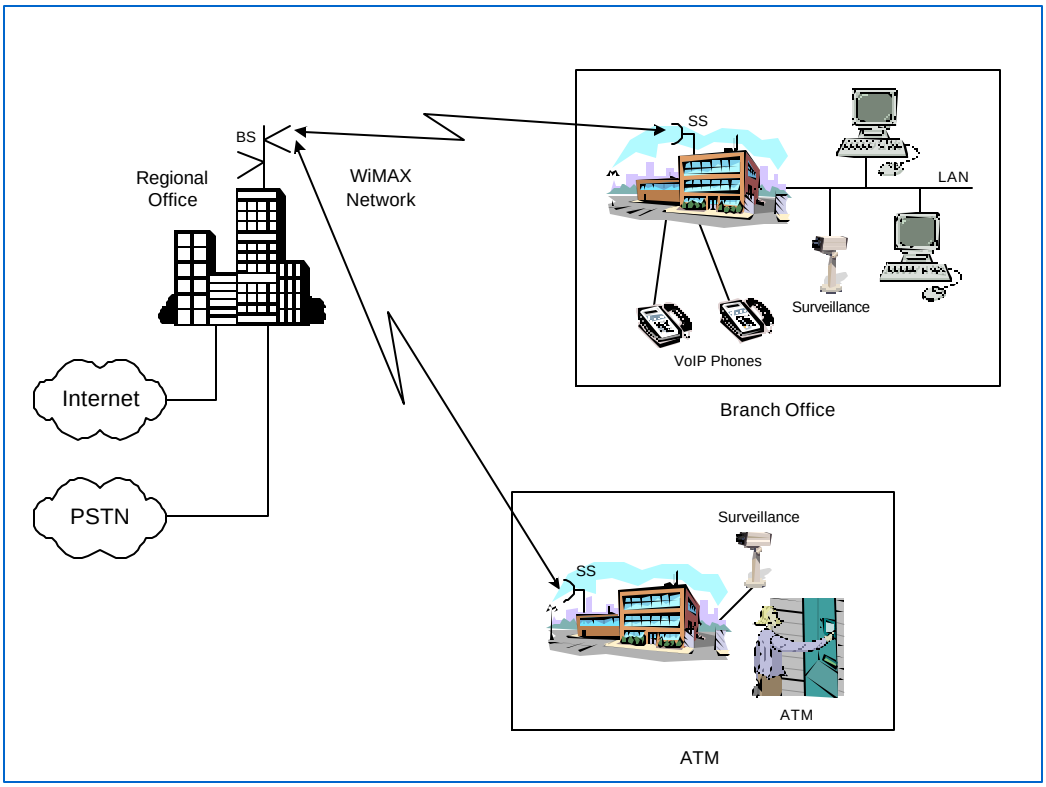


Access networks may be based on WiFi, WiMAX or any proprietary wireless access technology. If the access network uses WiFi equipment, the overall WSP network is referred to as a Hot Zone. Since WSPs typically offer voice, data and video, the built-in QoS feature of WiMAX will help prioritize and optimize the backhauled traffic. WiMAX equipment can be deployed quickly, facilitating a rapid rollout of the WSP network. As already illustrated, leasing backhaul facilities from the local telephone company will increase operating costs, and deployment of a fiber solution can be very costly and requires significant lead times, negatively impacting rollout. Furthermore, fiber, DSL and

cable are not cost-effective in rural and suburban areas, and most versions of DSL and cable technology will not provide the capacity required for these networks.

4.1.3 Banking Networks

Large banks can connect branches and ATM sites to their regional office through a private WiMAX network carrying voice, data and video traffic, as shown below. These banks are normally spread over a large area and need high security and bandwidth to handle the traffic:

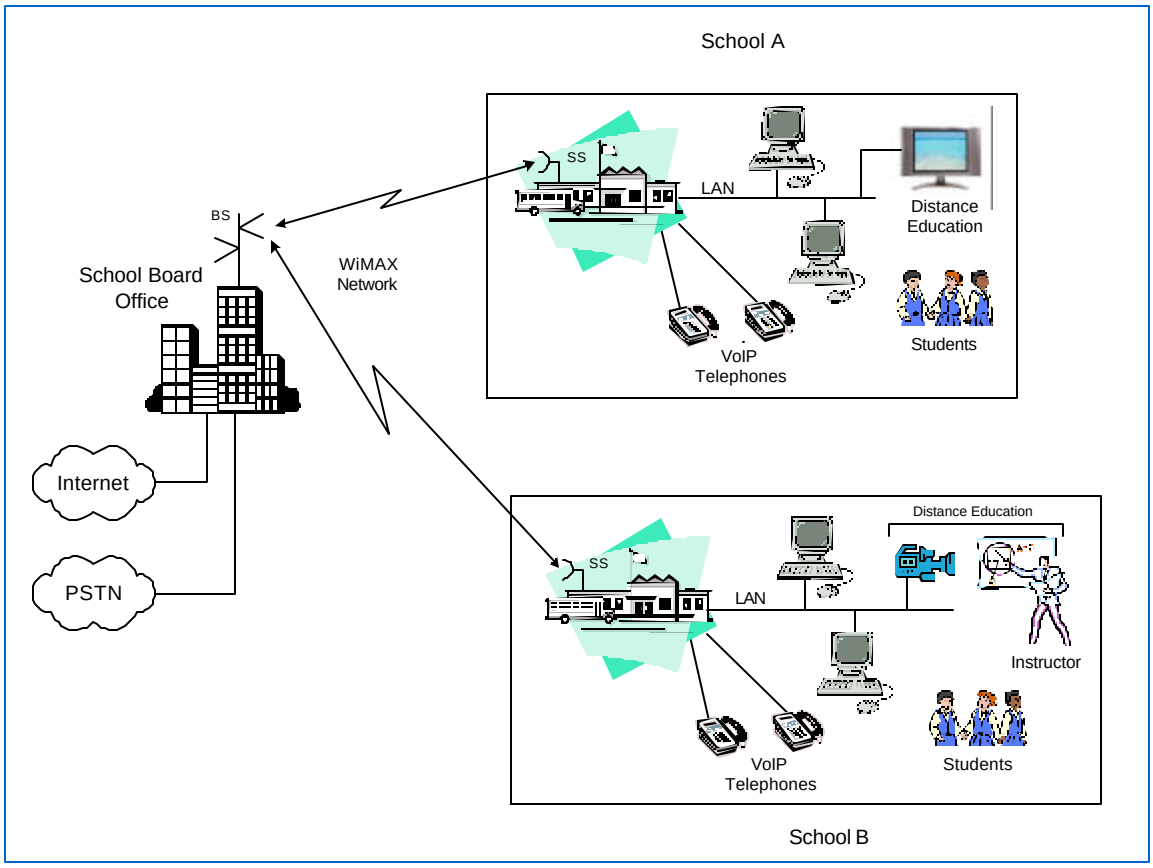


WiMAX data encryption offers excellent link security, however, banks will most likely also need end-to-end security, such as that provided by SSL, to protect against undesired interception and manipulation of sensitive banking traffic. The broad coverage and high capacity allows the bank's regional office to be connected to a large number of diversely located brand offices and ATM sites. WiMAX networks also offer a high degree of scalability, so that low-data-rate traffic between the regional office and ATM machines can co-exist with the high levels of traffic needed to support branch-to-regional office communications. This is made possible by the WiMAX QoS, which is used to prioritize voice (telephony among branches), data (financial transactions, email, Internet, and intranet) and video (surveillance, CCTV) traffic.

It is desirable for banks to own their own networks, for a number of reasons. Besides eliminating the repeat costs charged by telephone companies, this will provide banks the ability to quickly redeploy their network if an ATM or branch is temporarily or permanently relocated. In addition to their inability to be quickly deployed, most versions of DSL and cable technology will not provide the bandwidth required to support and sustain branch-to-regional office communications.

4.1.4 Education Networks

School boards can use WiMAX networks to connect schools and school board offices within a district, as shown below. Some of the key requirements for a school system are NLOS, high bandwidth (>15 Mbps), Point-to-Point and Point-to-Multipoint capability, and a large coverage footprint.



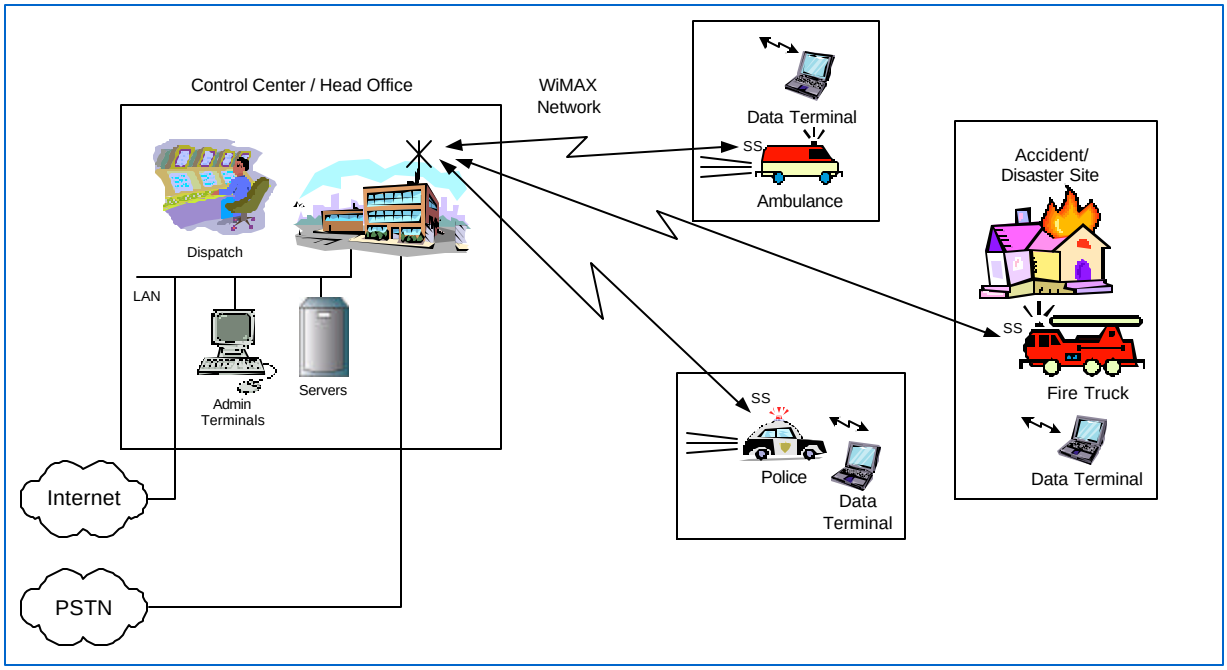
WiMAX-based education networks, using QoS, can deliver the full range of communication requirements, including telephony voice, operating data (such as student records), email, Internet and intranet access (data), and distance education (video) between the school board office and all of the schools in the school district, and between the schools themselves.

In the above scenario, the camera at School B delivers real-time classroom instruction to School A, allowing the schools to simultaneously deliver instruction from a recognized subject-matter expert to a large number of students, eliminating the need for additional instructors.

The WiMAX solution provides broad coverage, making it very cost-effective, particularly for rural schools, which may have little or no communications infrastructure, and which are widely dispersed. When school boards own and operate their own network, they can be responsive to changes in the location and layout of their facilities. This will significantly reduce the annual operating cost of leased lines. Wired solutions cannot offer a quickly deployable, low-cost solution, and most versions of DSL and cable technology do not have the throughput required by these education networks.

4.1.5 Public Safety

Government public safety agencies, such as police, fire, and search and rescue, can use WiMAX networks to support response to medical and other emergency situations, as illustrated below:



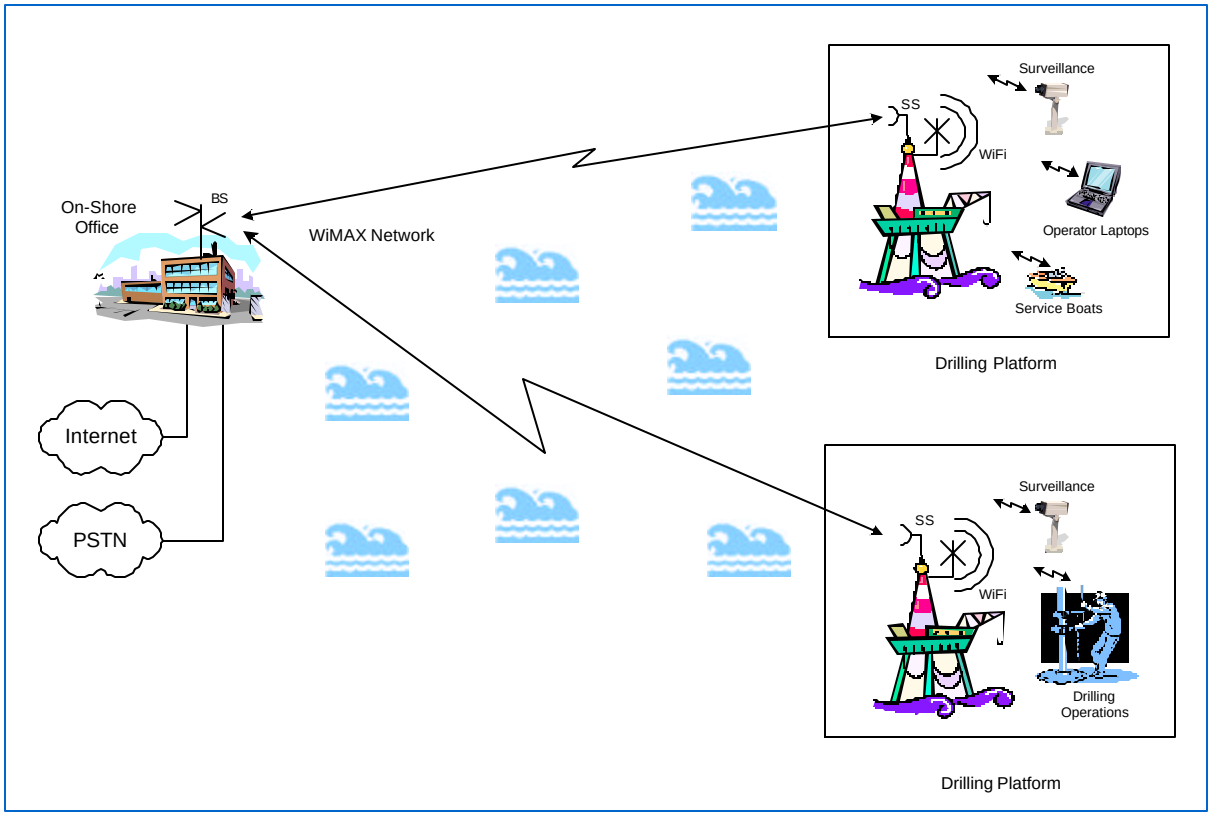
In addition to providing two-way voice communications between the dispatch center and on-site emergency response teams, the network relays video images and data from the site of the accident or disaster to the control center. This data can be relayed to expert teams of medical or emergency staff, who can analyze the situation in real-time, as if they were on site. WiMAX QoS allows the network to handle these diverse types of traffic.

WiMAX solutions are highly deployable, so the initial response team can set up a temporary wireless network at the site of the accident, event, or natural disaster, in a matter of minutes. They can also relay traffic from this network back to a control or dispatch center, over an existing WiMAX network. Wired solutions are not appropriate situations like these, due to unpredictability and instability of accidents and disasters.

As well, there may be a requirement for mobility, such as, for example, a policeman having to access a database from a moving vehicle, or a fireman having to download information about the best route to a fire scene or the architecture of the building on fire. A video camera in the ambulance can offer advance information about the condition of a patient, before the ambulance reaches the hospital. In all of these cases, WiMAX provides support for mobility and high bandwidth, which narrowband systems cannot deliver.

4.1.6 Offshore Communications

Oil and gas producers can use WiMAX equipment to provide communication links from land-based facilities to oilrigs and platforms, to support remote operations, security, and basic communications, as shown below:



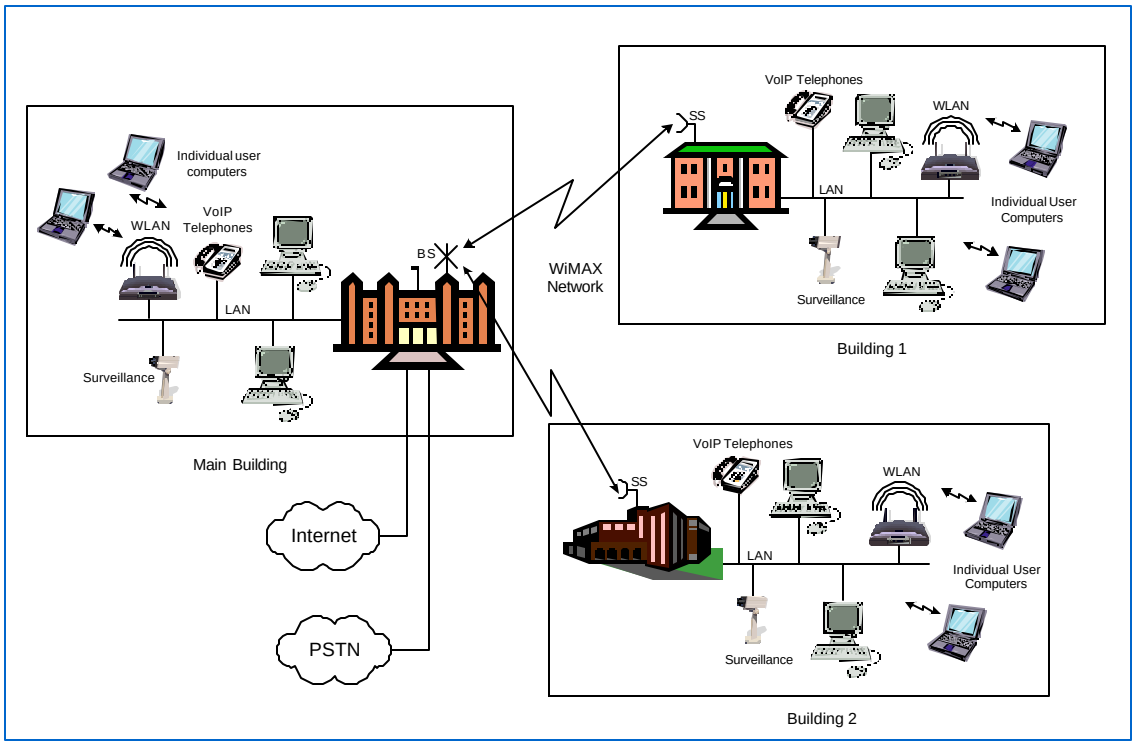
Remote operations include remote troubleshooting of complex equipment problems, site monitoring, and database access. For example, video clips of malfunctioning components or subassemblies can be transmitted to a land-based team of experts for analysis. Security includes alarm monitoring and video surveillance. Basic communications includes voice telephony, email, Internet access, and video conferencing.

WiMAX networks are quickly and easily deployed. The network can be set up or redeployed in a matter of hours, if not minutes, even when oilrigs and platforms are moved to other locations. Wired solutions are not appropriate for this scenario, because the facilities are offshore, and since oilrigs are temporarily located and moved regularly within the oil or gas field.

In the event of having to temporarily abandon an offshore facility, communications for monitoring the status of the asset can continue to be maintained, using battery-backed WiMAX terminals.

4.1.7 Campus Connectivity

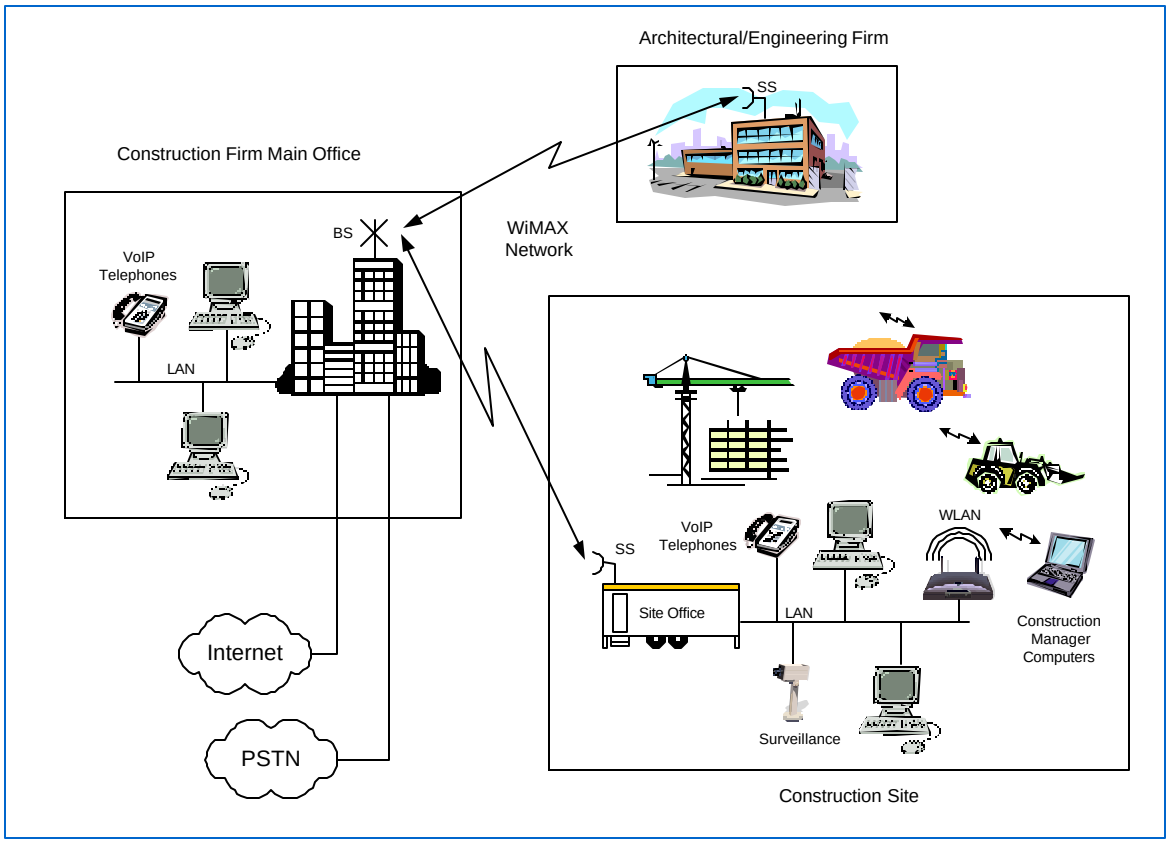
Government agencies, large enterprises, industrial campuses, transportation hubs, universities, and colleges, can use WiMAX networks to connect multiple locations, sites and offices within their campus, as shown below. Campus systems require high data capacity, low latency, a large coverage footprint, and high security:



Like other usage scenarios, campus networks carry a mix of voice, data, and video, which the WiMAX QoS helps prioritize and optimize. It takes less time and resources to interconnect a campus through a WiMAX network, since excavation and external construction are not required. Some campuses have been around for a long time, and digging trenches for cable may not be permitted. In such cases, WiMAX solutions may be one of the most effective ways to interconnect campus buildings. Even if wired installations are permitted, the lead-time to deploy a wired solution is much longer than the lead-time to deploy a WiMAX solution, without offering any accompanying benefits.

4.1.8 Temporary Construction Communications

Construction companies can use WiMAX networks to establish communication links between the company head office, construction sites, offices of other project participants, such as architectural and engineering firms, and storage facilities, as shown below:



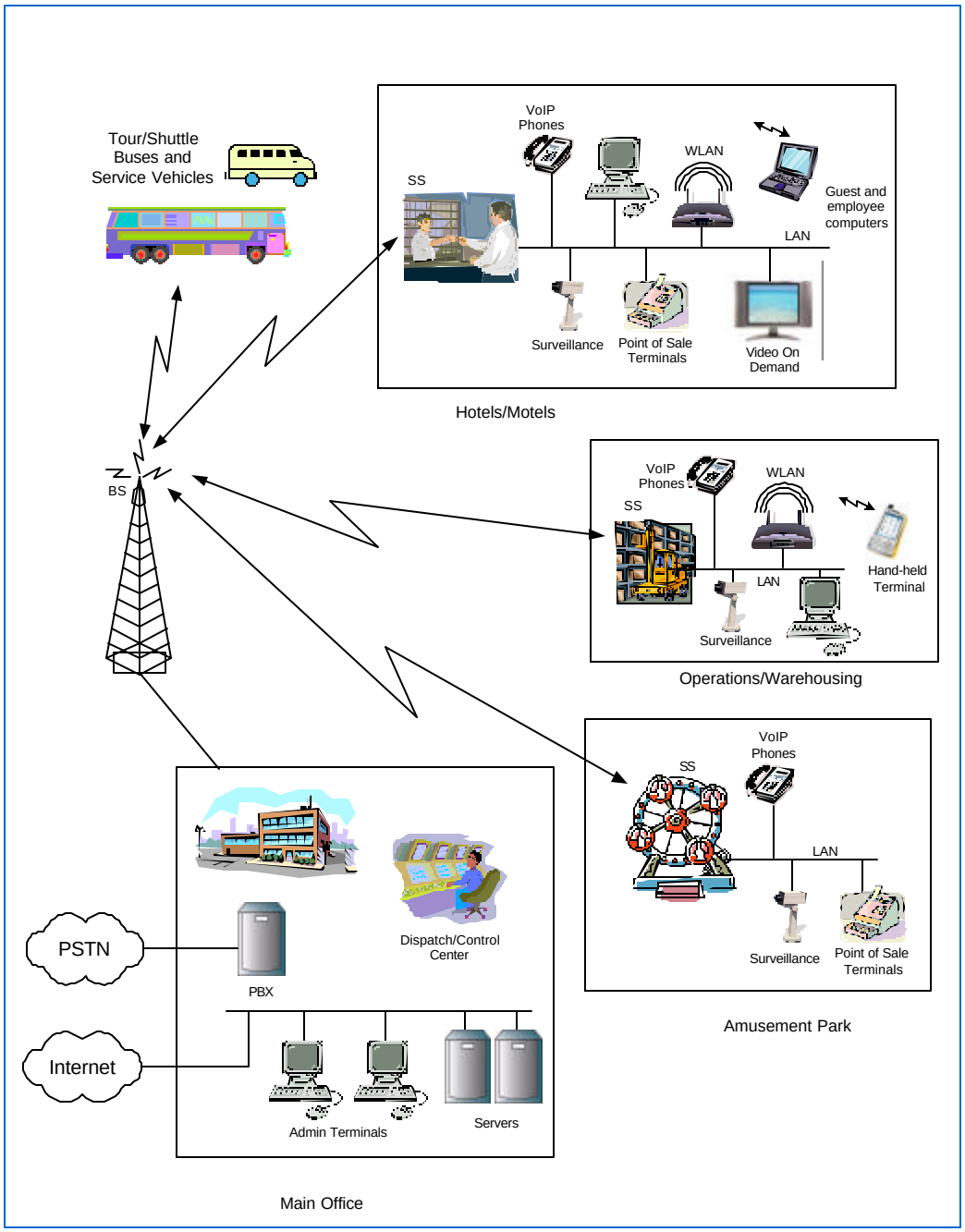
The fast deployability of WiMAX networks is also important in this scenario, since it allows for quick provision of communications to the construction site, including voice (telephony) and data (emails, engineering drawings, and Internet access). Surveillance video can also be carried over the network, to support monitoring of the site or areas of the site that are otherwise difficult to access. A local Hotspot can also be set up at the

construction site, allowing personnel at the site to communicate and exchange data and schedule information.

Like the other usage scenarios, the WiMAX built-in QoS will prioritize network traffic and optimize the communications channel. Construction sites include, but are not limited to, office buildings, residential land development, and oil and gas facilities. Since construction activity at these sites is temporary, wired solutions are usually not appropriate. WiMAX equipment, being highly portable, can be redeployed and reused at other construction sites.

4.1.9 Theme Parks

Theme park operators can use WiMAX to deliver a broad range of communication services for their amusement parks, expositions, hospitality and operation centers, and buses and service vehicles, as shown below:



The above network can support a wide range of communications traffic, including two-way dispatch from a control center, video surveillance throughout the park, reservation data, inventory database access and update, site status monitoring, video on demand, and voice telephony. Some of the key requirements for a system like this are support for fixed and mobile operations, high security, scalable architecture and low latency. The broad coverage range of WiMAX means an entire park can be covered from only ll number of Base Stations, scalable upwards as capacity requirements increase. The WiMAX QoS MAC will prioritize and optimize the communications channel, based on the operator's requirements. Re-deployment of the network, in response to changes in theme park facilities, is straightforward and simple, unlike the changes that would be required had the park been served by wired facilities, such as DSL or cable.

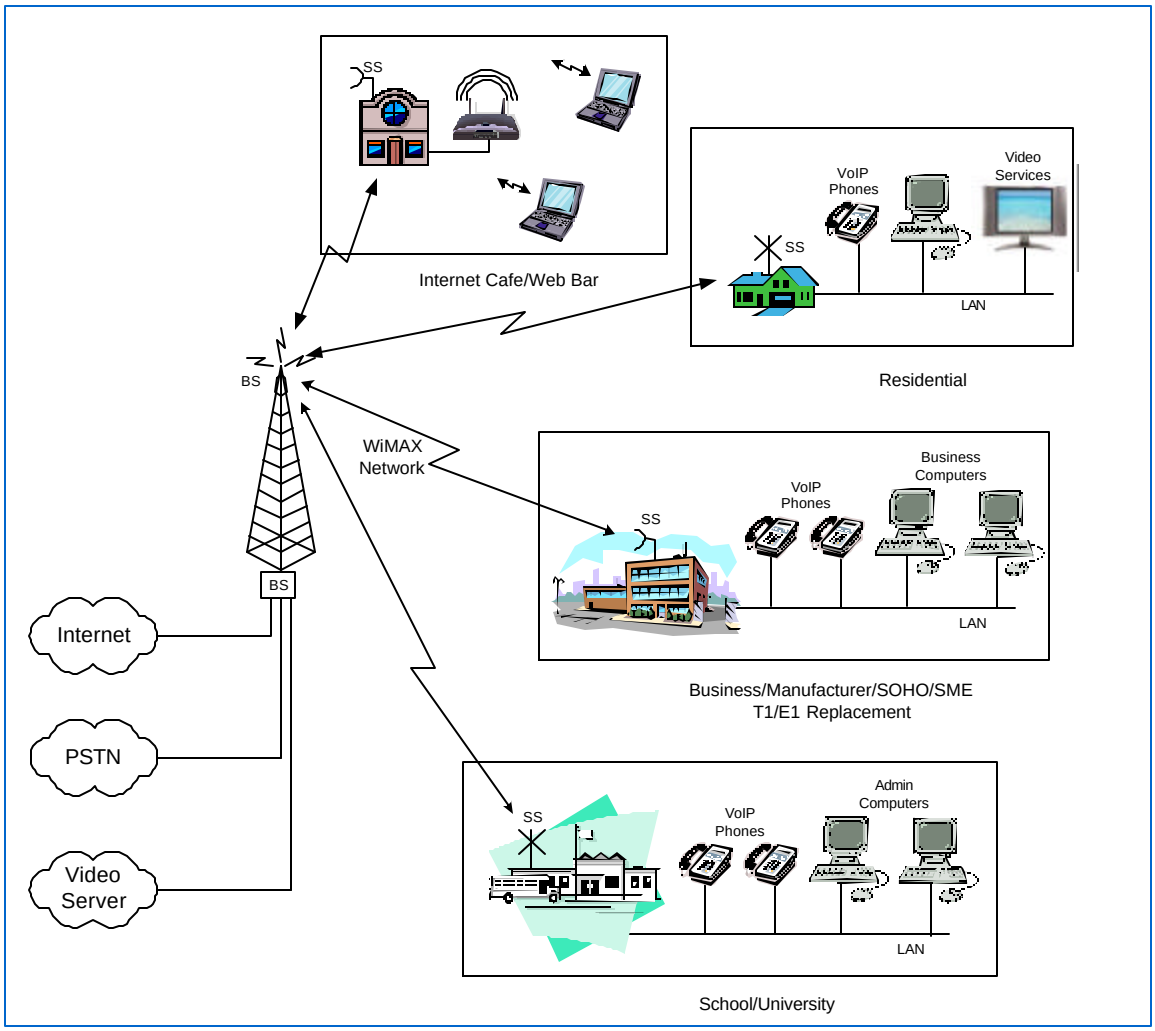
WiMAX mobility capability will support two-way voice and data communications to the theme park's tour buses and service vehicles. Real-time video can be broadcast to tour buses, providing tourist information, promotions, and weather to passengers.

4.2 Public Networks

In public network, resources are accessed and shared by different users, including both businesses and private individuals. Public networks generally require a cost-effective means of providing ubiquitous coverage, since the location of the users is neither predictable nor fixed. The main applications of public networks are voice and data communication, although video communication is becoming increasingly popular. Security is a critical requirement, since many users share the network. Built-in VLAN support and data encryption address these concerns. Several usage scenarios involving public networks are shown below.

4.2.1 Wireless Service Provider Access Network

Wireless Service Providers (WSPs) use WiMAX networks to provide connectivity to both residential (voice, data and video) and business (primarily voice and Internet) customers, illustrated as follows:



The WSP could be a CLEC (Competitive Local Exchange Carriers) that is starting its business with little or no installed infrastructure. Since WiMAX is easy to deploy, the CLEC can quickly install its network and be in position to compete with the ILEC (Incumbent Local Exchange Carrier). The WiMAX built-in QoS mechanism is highly suited for the mix of traffic carried by the CLEC. The QoS MAC also offers multi-level service to address the variety of customer service needs. A common network platform, offering voice, data and video, is highly attractive to end customers, because it presents a one-stop shop and a single monthly bill. Support for multiple service types allows for

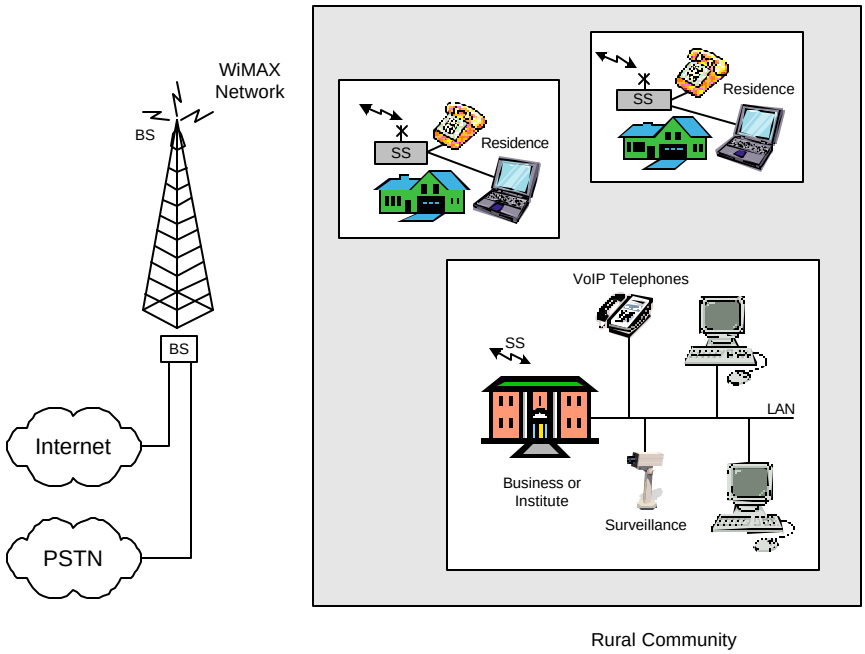
different revenue streams, yet it reduces customer acquisition cost, and increases ARPU (Average Revenue Per User). The WSP needs only one billing system and one customer database.

Cellular operators may also be interested in applying WiMAX in their networks. These operators already have towers, billing infrastructure and a customer base in place, but the deployment of a WiMAX solution will expand their market presence in their service area.

All of the wired solutions, including fiber, DSL, and cable, require substantial up-front costs for implementing the wired infrastructure. In particular, wired solutions are not suited for markets in developing countries, where there is very little infrastructure, or in the less-populated areas of developed countries, such as rural areas, small towns or the suburban edges of major centers.

4.2.2 Rural Connectivity

Service providers use WiMAX networks to deliver service to underserved markets in rural areas and the suburban outskirts of cities, as shown below:



The delivery of rural connectivity is critical in many developing countries and underserved areas of developed countries, where little or no infrastructure is available. Rural connectivity delivers much-needed voice telephony and Internet service. Since the WiMAX solution provides extended coverage, it is a much more cost-effective solution

than wired technology in areas with lower population densities. WiMAX solutions can be deployed quickly, providing communication links to these underserved areas, providing a more secure environment, and helping to improve their local economies.

5 Conclusions

As shown in the preceding sections, WiMAX technology and products are poised to address a wide range of applications and usage scenarios, over a broad range of markets and geographies. The above usage scenarios should be considered representative, not comprehensive. As noted in the *Introduction*, the length of this paper precludes a discussion of all possible usage scenarios, and our focus has, by necessity, been limited to fixed and portable usage scenarios.

Contact the WiMAX Forum at http://www.wimaxforum.org/home to learn more.

Acronyms and Abbreviations

The following abbreviations and acronyms have been used in this white paper:

3DES	Triple DES (Data Encryption Standard), one of two encryption standards used in WiMAX networks to provide subscriber privacy and security.
AES	Advanced Encryption Standard, one of two encryption standards used in WiMAX networks to provide subscriber privacy and security.
ARPU	Average Revenue Per User, the average monthly services revenue received from a company's wireless customers.
BE	Best Effort service, WiMAX service type designed to support data streams for which no minimum service level is required and which can be handled on a space-available basis.
BPSK	Binary Phase Shift Keying, a type of digital transmission used in WiMAX, where two phases of the transmitted signal are used to double the bandwidth.
BS	Base Station, term used to describe the WiMAX equipment installed at the system operator's central facility.
CLEC	Competitive Local Exchange Carrier, a long distance carrier, cable company, or small startup local exchange carrier that competes for business in the local telephone market.
DES	Data Encryption Standard, an unclassified crypto-algorithm available for public use, in systems such as WiMAX.
DSL	Digital Subscriber Line or Digital Subscriber Loop, refers to several technologies used to provide high-speed, two-way data connection over ordinary telephone lines.

E1	European standard for the high-speed digital network, originally developed to support long-haul voice traffic, but now commonly used to carry digital traffic of all kinds. E1 has a capacity of 2.088 Mbps, with 32 carriers.
ETSI	European Telecommunications Standards Institute, which is the European standardization body for telecommunications
FTP	File Transfer Protocol, the protocol used to exchange files over the Internet.
HIPERMAN II	High Performance Radio Metropolitan Area Network, a standard created by the European Telecommunications Standards Institute (ETSI) Broadband Radio Access Networks (BRAN) group to provide broadband wireless communication in the 2 - 11 GHz bands across Europe and other countries that follow the ETSI standard.
IEEE	Institute of Electrical and Electronics Engineers, organization that, among other things, develops LAN standards, such as IEEE 802.16, to ensure devices produced by different companies can interoperate.
IEEE 802.16 – 2004	The IEEE 802.16 – 2004 standard supports the development and deployment of broadband wireless Metropolitan Area Networks (MAN). The standard's OFDM profile, also used in ETSI HIPERMAN II (High Performance Radio Metropolitan Area Network), is the foundation of the WiMAX technology. The standard supports very high bit rate transmission between a base station and subscriber stations, up to distances of 30 miles, and services such as VoIP, Internet connectivity, and TDM voice and data.
IEEE 802.16e	IEEE standard that defines a new air interface for broadband mobile applications, in the 2 to 6 GHz licensed bands.
ILEC	Incumbent Local Exchange Carrier, the local telephone company that existed before CLECs were able to compete in these markets.
MAC	Media Access Control, the protocol that controls access to a physical transmission medium, such as the WiMAX radio channel.

MIMO	Multiple Input - Multiple Output, referring to the use of multiple transmitters and receivers (multiple antennas) on wireless devices for improved performance.
MPEG	Moving Picture Experts Group, the industry group tasked with the development of video and audio encoding standards.
NLOS	Non-Line-Of-Sight, where the radio path between the Base Station and the Subscriber Station is partially or completely obstructed.
nrtPS	Non-real-time Polling Service, WiMAX service type designed to support delay-tolerant data streams consisting of variable-sized packets for which a minimum data rate is required, such as FTP.
OFDM	Orthogonal Frequency Division Multiplexing, a modulation technique used in WiMAX for transmitting high-speed data over wireless links. OFDM works by splitting the radio signal into sub-signals that are then transmitted simultaneously at different frequencies.
QAM	Quadrature Amplitude Modulation, a modulation technique used in WiMAX, whereby two out-of-phase carriers are amplitude modulated by separate base-band signals.
QoS	Quality of Service, the ability of a network to sustain a given service at, or above, its required minimum performance level.
QPSK	Quadrature Phase Shift Keying, a modulation technique used in WiMAX, which uses four different phase angles to increase the bandwidth.
rtPS	Real-time Polling Service, WiMAX service type designed to support real-time data streams consisting of variable-sized data packets that are issued at periodic intervals, such as MPEG video.
SLA	Service Level Agreement, a formal written agreement made between the service provider and the service recipient.

sOFDMA	Scalable Orthogonal Frequency Division Multiplexing Access, the flexible channelization scheme used in the IEEE 802.16e standard, to support mobility applications.
SS	Subscriber Station, term used to describe the WiMAX equipment installed at the subscriber's facility.
T1	North America standard high-speed digital network, originally developed to support long-haul voice traffic, but now commonly used to carry digital traffic of all kinds. T1 has a capacity of 1.544 Mbps, with 24 carriers.
UGS	Unsolicited Grant Service, WiMAX service type designed to support real-time data streams consisting of fixed-size data packets issued at periodic intervals, such as T1/E1 and Voice over IP.
VoIP	Voice over IP (Internet Protocol), a technology for transmitting ordinary telephone calls over the Internet. Also referred to as IP telephony
WiFi	Wireless Fidelity, trademark of the Wi-Fi Alliance, a nonprofit organization formed in 1999 to certify interoperability of IEEE 802.11 wireless LAN products, and to promote them as the global, wireless LAN standard across all market segments.
WiMAX Forum	Worldwide Interoperability for Microwave Access, a non-profit organization formed to help promote and certify the compatibility and interoperability of broadband wireless access equipment adhering to the IEEE 802.16 standard.
WSP	Wireless Service Provider, a company providing access to a digital network, such as the Internet, over wireless facilities.