WiMAX™ Applications for Utilities

A case study of how WiMAX can enable vertical enterprise applications

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This white paper was prepared by Senza Fili Consulting on behalf of the WiMAX Forum®

Executive Summary

Vertical applications present a huge new market opportunity for WiMAX operators. WiMAX is not the only wireless technology that can support vertical applications, but it is particularly well suited to delivering them because of its high capacity, low per-bit cost, and Quality of Service (QoS), and security capabilities.

The value proposition of vertical applications such as asset tracking, fleet management, remote monitoring and control, smart metering, and mobile workforce support is compelling. WiMAX operators stand to gain a steady revenue flow generated by low-churn enterprise customers. To the enterprise, wireless connectivity delivers cost savings and increased operational efficiency. Vendors benefit from increased sales of wireless modules and devices, as well as from increased infrastructure sales.

To successfully market and deliver vertical applications, operators either have to develop expertise specific to the industries they want to serve, or they have to work with other WiMAX ecosystem players that have that expertise. A number of business models can—and will—be adopted, but they will be effective only if operators, their partners and their enterprise customers will listen to one another to devise what works best in each situation.

This paper explores the potential role of WiMAX in supporting vertical applications in the utilities sector, which is a good model of how operators and the enterprise can mutually benefit from the wide adoption of vertical applications. Utilities are quickly adopting wireless connectivity for their new smart metering devices, to monitor and control remote assets and to support their field staff. Accustomed to owning and controlling their telecom infrastructure, utilities are gradually becoming more comfortable about using public networks, whose performance, security, and network management capabilities have improved, and the costs of which are decreasing.

Enterprise vertical applications rely on a fundamentally different operator business model than retail connections for individual (consumer or business) subscribers. Low churn, lack of device subsidies, and lower customer acquisition costs create a high-margin revenue stream generated by applications ranging from smart metering (with a high number of connections, but relatively lower service revenues per connection) to wireless support for remote employees (with higher service revenues, but a smaller number of connections).

Utilities are demanding customers that insist on strong Service Level Agreements (SLAs) and guarantees of reliable network access during emergencies. Operators have to carefully assess the applications they want to support directly and whether they have the in-depth expertise to gain credibility in the marketplace—or if they should partner with someone who has already acquired vertical-specific knowledge.

1. Introduction: the vertical market opportunity

Vertical applications for the enterprise are a major growth opportunity for WiMAX operators to widen their market beyond consumer and business subscribers, and to reach vehicles, sensors, meters and other machines. Adoption of vertical applications brings advantages to all ecosystem players, as it will:

- Create a steady and substantial revenue stream for WiMAX operators associated to lower customer acquisition costs and lower churn.
- Generate operational benefits and cost savings for the enterprise.
- Increase sales volume for chipset, device, and infrastructure vendors.

Cellular operators have not been able to address in a cost-effective way the demand for vertical applications in the enterprise. Adoption of vertical applications in Second Generation (2G) networks is growing rapidly, but capacity limitations of 2G cellular networks restrict the opportunity and raise the costs to the enterprise.

WiMAX technology has the bandwidth and advanced network traffic management tools to support cost-effective applications that require a true broadband connection, high capacity, or prioritized access. Addressing the specific requirements of vertical markets can be challenging, especially for greenfield operators, as new sales channels and market-specific expertise are typically needed. But the rewards can be substantial. A recent report[1] from Senza Fili Consulting estimates that by 2014 there will be over 20 million vertical connections worldwide, and they will equal 24% of WiMAX retail connections (Figure 2). The revenue stream generated by vertical applications will accelerate the path to profitability for WiMAX operators.

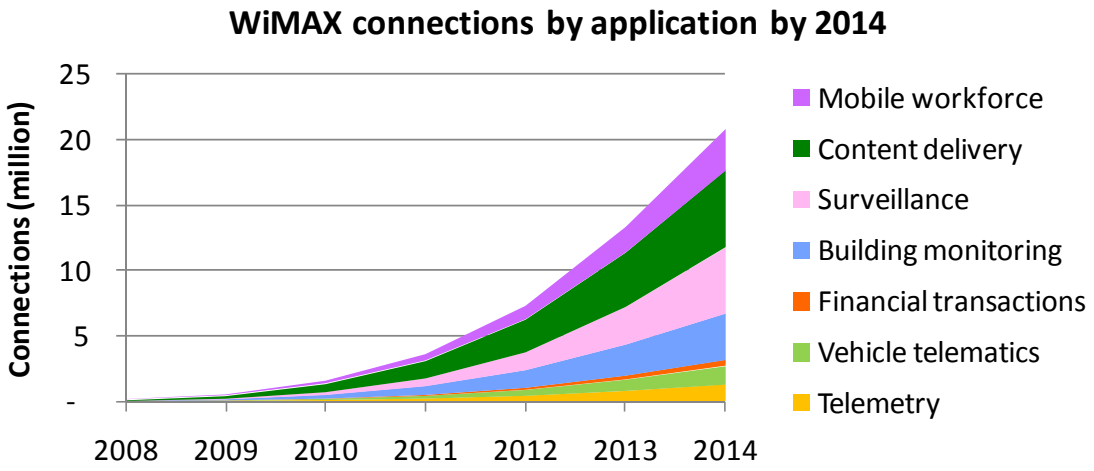

Figure 1. WiMAX connections by application by 2014 (Source: Senza Fili Consulting, 2008)

[1] "Bringing Wireless Broadband to Vertical Markets", Senza Fili Consulting, 2008.

This paper discusses the opportunity that vertical applications targeted at utilities represent for both WiMAX operators and utilities, and how the ecosystem will be instrumental in promoting growth. Vertical applications encompass an extremely varied landscape of traffic requirements, devices, and functionality to be supported. Within this context, utilities offer a good illustration of the opportunities and challenges of vertical segments. The range of applications many utilities have adopted or plan to adopt cover most of the requirements, business model issues, and value chain models that can be found across different market segments, such as transportation, healthcare, or security.

Utilities have been blazing the path towards the adoption of wireless applications, either using proprietary networks managed by the utilities companies themselves or, increasingly, relying on public wireless networks that, in some cases, are purpose-built for utilities. Applications used by utilities include:

- Meter reading, a low-bandwidth Machine-To-Machine (M2M) application, with low Average Revenues Per Connection (ARPC), but a huge number of potential connections.
- Smart metering to improve the management of power consumption, with slightly higher bandwidth requirements and the need for a two-way (uplink and downlink) connection.
- Asset management to remotely monitor fixed assets and vehicle location and status, and to act on them as needed (e.g., to power on/off a remote device).
- Closed Circuit TV (CCTV) remote monitoring of facilities for security and safety, with high bandwidth requirements but regular traffic flow.
- Support for staff working at remote locations or on board vehicles.
- Temporary networks-on-wheels established during emergencies.

2. Addressing vertical application requirements

The availability of WiMAX equipment in the market lines up well with the recent growth in the interest and need for wireless connectivity in the enterprise, no longer limited to supporting their mobile and telecommuting staff, but extended to support highly customized applications and devices that are crucial to the core operations of the enterprise (Table 1).

WiMAX operators have a unique opportunity to address vertical enterprise applications. WiMAX technology gives them the ability to meet the traffic and SLA requirements cost effectively and to support a high number of connections. Furthermore, WiMAX operators are deploying networks at the same time demand from the enterprise is growing. So far, they have little competition from cellular operators, which still have not shown much interest. In most cases, 2G and Third Generation (3G) cellular operators address vertical markets through MVNOs, device vendors, or system integrators that manage the relationship with the customer, but the overall percentage of vertical connections is still

below 1–2% of overall cellular connections in most markets.

The need to preserve the high profitability of voice services and limited network capacity are the main reasons for cellular operators' limited interest in vertical applications. This is changing rapidly, however, because Average Revenues Per User (ARPUs) are stagnant or in decline, and penetration is reaching saturation levels in most developed markets, at a time when capacity is growing with 3G networks. As a result, vertical applications represent an increasingly appealing new revenue stream for cellular operators as well.

The enterprise vertical market is still in the early development phases, and growth is still limited by infrastructure availability and the lack of established, well-proven business models. However, enterprises increasingly find that the business case for the initial capex cost and the recurring opex is easily justified by enterprise-wide cost savings, improved service, and additional revenues. As WiMAX operators roll out their networks worldwide, the increased availability of coverage will accelerate adoption of vertical services.

Why now? Why WiMAX?	
Technology	▪ WiMAX technology brings true broadband connectivity to vertical applications. ▪ QoS allows operators to offer prioritized access and SLAs. ▪ A single wireless interface supports voice and data services. ▪ WiMAX's end-to-end Internet Protocol (IP) core network facilitates integration with enterprise internal networks.
Applications	▪ M2M applications include telemetry or remote monitoring, with increased functionality (e.g., remote control of assets, video feedback, and secure data transmission). ▪ Mobile workforce applications require full voice and video support and will increase productivity of employees on the ground. ▪ In-vehicle applications enable the enterprise to track vehicles, stream content to them, and coordinate workflow with the driver and passengers.
Devices	▪ Wider choice of devices at a lower cost is expected as volumes of sale for WiMAX modules grow. ▪ Devices with multiple wireless interfaces provide increased flexibility and coverage.
Enterprise	▪ Wireless connectivity increases operational efficiency and brings cost savings. ▪ Enterprises have become more comfortable with wireless applications in general, and specifically with access through public networks. ▪ Where used, private proprietary networks often prove to be too expensive to build and operate, and their capacity is typically limited. WiMAX access through public networks avoids this cost burden.

Operators	▪ WiMAX's increased network capacity enables operators to address vertical applications. ▪ Vertical applications are a new market that is currently underserved, but it is an attractive one because of its long contracts (commonly 10 years or more), low churn, low customer acquisition and support costs, and limited need for device subsidies. ▪ Enterprises are demanding, but less price sensitive than retail subscribers because many applications are critical to their operations. ▪ Most applications have very limited traffic requirements (e.g., remote metering) and/or predictable traffic levels (e.g., CCTV monitoring).

Table 1. Why now? Why WiMAX?

3. Wireless applications for utilities

From a wireless operator perspective, utility companies are the ideal customer. They are virtually everywhere, and everywhere they are, they have something to track, monitor, or control remotely, or information that needs to be retrieved or sent. Wireline connectivity is and will continue to be used in some environments, but the appeal of wireless connectivity is growing as the costs of devices and services come down, performance and coverage improve, and flexibility in managing the wireless connection increases. Furthermore, utilities operate in well-defined geographical areas that keep their radio coverage requirements bounded.

Electricity, natural gas, water, and sewage companies have a very similar business model and communications needs, as they are involved in similar functions (generation or collection, transmission, distribution, service, operations, and emergency) that are specifically relevant to the type of vertical applications that they require. Table 2 shows the infrastructure, locations, applications, and requirements involved in electric utilities. A table for water utilities would look very similar, even though some applications (e.g., monitoring of water quality, stream gauging, or leak detection) would be specific to it.

Requirements for different applications vary substantially. Monitoring a power plant requires good coverage in a limited area, good throughput, and a strong SLA. For Automatic Vehicle Locating (AVL) and navigation, on the other hand, the key requirement is wide-area connectivity. Automatic Meter Reading (AMR) and Automatic Meter Infrastructure (AMI) generate little traffic (and low ARPCs), but require a very high number of connections[2]. Each household and business site typically has meters in

[2] In the largest smart meter deployment to date, Enel installed over 27 million smart meters in Italian households. In Sweden and Finland, M2M connections account for approximately 10% of cellular connections, and most of them are used for smart meters.

Function	Infrastructure	Applications	Requirements
Generation	Generation station (e.g., power plant)	Supervisory Control And Data Acquisition (SCADA) systems and Distributed Control Systems (DCS) to monitor, coordinate, and control processes and assets in real time. Security monitoring (including CCTV)	Reliable coverage at target locations Bidirectional connectivity to control processes and assets remotely High uplink-traffic requirements where CCTV cameras are used
Transmission	Transmission lines, transmission center		
Distribution	Distribution lines, transformer station, local distribution center		
Service	Direct customers (e.g., households, business sites)	AMR, AMI (or smart metering)	Low (but growing with AMI) traffic requirements, initially using uplink connections only, but increasingly bidirectional Wide coverage needed, but may be provided with multiple technologies Ability to support a very high number of connections
Operations	Headquarters and local offices Mobile workforce and vehicles	Facilities broadband coverage Mobile connectivity to employees, including Virtual Private Network (VPN), Voice over IP (VoIP), and Geographic Information System (GIS) based applications for logistics or asset management In-vehicle applications and fleet telematics, including Location-Based Services (LBS) with Global Positioning System (GPS) tracking and navigation, and Automatic Vehicle Locating (AVL)	Depending on the application, traffic requirements may be high. SLAs/QoS are required. Wide coverage and mobility support are typically required
Emergency	Mobile (base stations on wheels)	Provide voice and data services, and support for applications listed above in areas affected by an emergency where the public network is temporarily unavailable	Fast and flexible deployments Ability to carry high levels of traffic and to secure good coverage within the affected area

Table 2. Electric utility requirements for wireless applications

covered areas, although in many cases these connections are mediated by a concentrator that collects data from individual meters and transfers all the information to a wireless network with Wide Area Network (WAN) coverage. To support these services, the operator has to be able to cost-effectively manage a higher number of connections than planned for retail subscribers.

Utilities show a convincing case of why there is such growth in adoption of wireless vertical applications: the business case for them is very easy to make. Costs, especially labor costs, can be reduced and operational efficiency improved.

AMR, for instance, removes the need to send staff to take meter readings and allows for more frequent measurements, which make it easier to detect tampering, reduce fraud, and improve distribution efficiency. It also allows more accurate and timely billing, which leads to higher customer satisfaction. Initially, remote meters collected data from users only sporadically, typically using Short Messaging Service messages (SMSs) or circuit-switched connections. Now, continuous data collection over a packet-based network enables a much more powerful use of the data for applications such as load shedding, demand response, and variable pricing to reduce overall and peak consumption.

Smart metering goes one step further: it allows customers to monitor their own consumption and the costs associated with it, and to change their usage profiles accordingly. Customers are glad to save on their bills, but an even bigger benefit goes to the electric company. Like telecommunications networks, electricity networks are planned on the basis of expected peak usage; demand above capacity can have disastrous rippling effects across the grid, so electric utilities have to manage distribution very carefully, even though peak usage is limited to very small periods, on the order of 1% of time. Some of the demand during peak hours is non-elastic: regardless of the price of electricity, a manufacturing plant has to operate during work hours. However, some of the demand, especially from residential users, is elastic, and usage profiles can be adjusted—provided that customers have the necessary information and the appropriate incentives.

Smart metering provides that information about consumption and allows the utilities to offer incentives that reduce average or peak consumption. For instance, some residential users may decide to run the laundry in the evening rather than in the morning, if that cuts the cost in half. While not everybody is willing to heed the advice of their smart meter, even a small percentage of customers modifying their behavior will significantly reduce energy demand. According to a report[3] from the Brattle Group, smart metering combined with dynamic prices that change based on real-time estimates of usage and congestion may produce a 5% decrease in peak demand for electricity, which may save $35 billion in the US alone. This reduces the need for investment to increase

[3] "The Power of Five Percent", The Brattle Group, 2007.

production and distribution network capacity to meet peak demand.

Cost savings due to reduction in usage, however, are not even necessary to justify the adoption of smart metering. The key justifications are the labor cost savings and efficiencies. Alone, they can provide a quick return on investment. PG&E in California estimates that 89% of the initial investment in smart meters will be paid off by operational benefits alone within a few years.

Applications such as monitoring, remote control, and security applications at the utilities generation, collection and transmission facilities can improve the overall performance of the network, reduce labor costs, or make staff more efficient because many routine, repetitive tasks are entirely avoided, left to purpose-designed devices.

Similarly, broadband connectivity of the mobile workforce, through either in-vehicle or mobile devices, is increasingly perceived as a requirement. With a broadband connection, engineers in the field get full access to all information available in their enterprise internal system, including technical references, drawings, and maps. Video sessions can be used to troubleshoot problems remotely and to assist staff on the ground. This is particularly important because a day's assignments for a technician are often not known in advance—they are driven by network failures or problems that have to be addressed right away. Without a broadband connection, the technician may have to go back to the office to get the documentation needed or may have to spend more time figuring out a solution. Currently, utilities have access to private networks—which tend to be expensive to build and maintain—or they use the cellular infrastructure for voice and basic data communication. But increasingly, utilities realize that wireless broadband networks can provide a level of performance that cannot be achieved in private networks (because of spectrum limitations) or in 2G networks (because of throughput limitations).

4. Why are utilities looking at WiMAX?

As they get a better understanding of the applications they need and their requirements, utilities are carefully looking at the wireless technologies that will best support their requirements. It is increasingly clear that there will not be a single technology—wireless or wireline—that will be able to satisfy utilities' requirements. Different technologies may offer the best solution in terms of performance and cost, depending on location, application, device type, and other constraints, such as regulation, existing and planned infrastructure, coverage, throughput, and SLA requirements. In most cases, however, WiMAX features prominently as a key technology that presents compelling advantages:

- High throughput, needed for a variety of applications—for instance, GIS-based applications that require transmission of large files.
- Low latency and advanced multimedia capabilities, enabling the operator to support

applications such as those targeted at the mobile workforce.

- QoS and advanced traffic management capabilities, such as deep packet inspection, which enable the operator to assign a higher priority level to critical utilities applications when needed. A WiMAX operator may also set up a virtual network for the enterprise that allocates an uncontended, secure channel that the enterprise can use as needed.
- Secure access to protect the utilities' communications, and, by extension, the safety of their staff and customers.
- IP-based connectivity to facilitate integration of applications with the core IT functions within the utility. For some applications, IP connectivity lowers the cost of the terminal device as it does not have to be provisioned with a Subscriber Identity Module (SIM) card, as it would to work within a Global System for Mobile Communications (GSM) or a High Speed Packet Access (HSPA) network.
- Handoffs to support mobility access, mostly for in-vehicle and mobile workforce applications.

Exclusive control over the infrastructure is what some utilities will miss most when moving to a public network, especially if they are used to owning their own infrastructure and using it as they see fit. But that complete control comes with a high price tag and a more limited performance, so utilities are trying to address the issue of guaranteed network access along with WiMAX operators.

Because WiMAX operators are still in the early deployment stages, wide area coverage is another issue that can initially have a substantial impact as utilities assess their options. In applications like smart metering and AMR, operators may have to resort to using multiple technologies. They will use WiMAX preferentially where available, and alternative technologies—cellular, Wi-Fi, or licensed or license-exempt proprietary solutions—elsewhere. In dense urban and suburban environments, WiMAX will also compete with—or work alongside—wireline technologies, including Power Line Communications (PLC).

5. The business proposition for WiMAX operators

WiMAX operators enjoy unprecedented flexibility in deciding which market segments to target. They can offer fixed or mobile access, target residential or business users, and deploy their infrastructure in dense urban areas or focus on underserved areas—and they may decide to address all these market segments.

In addition, they can also choose whether to address vertical enterprise applications—and if so, which applications (e.g., telemetry, remote monitoring, financial transactions) and which types of enterprises (e.g., utilities, transportation, healthcare, safety). In many instances, vertical applications may prove very attractive, but the choice will depend on domestic market conditions, the internal and external resources and expertise available,

coverage, capacity, and overall business strategy.

The rest of this section assesses the benefits and challenges of targeting the utilities market for the applications we have identified, by trying to answer some of the key questions WiMAX operators have.

What are the differences between the consumer retail model and the vertical applications model?

The business model for vertical applications is profoundly different from the consumer and business retail services in many dimensions. The differences stem mostly from the fact that, in the retail market, the operator has to address consumer users, who are notoriously difficult to sign up, but easy to lose to the competition, while in vertical markets the operator deals with enterprises, which prize reliability, performance, and continuity.

Vertical applications attract longer contracts (10 years is common), because enterprises want to make sure their investment in the applications and devices will continue to be supported through time. The cost of churn to the enterprise is high, so the resulting churn rate is substantially lower than for retail users. Customer acquisition costs can be lower for vertical applications, because each contract includes a large number of connections and brand-based marketing is not as important.

The creation of a sales organization with expertise in the chosen vertical market will, however, require an upfront investment and focus—resources that some operators may not have as they commercially launch their service. Operators need to adjust to a different sales model, in which enterprise connections cannot be treated—and charged—as expensive retail business connections. Furthermore, enterprises—especially large ones—want to keep full control of the applications and are not willing to pay additional fees to have an operator process the application data on their behalf.

Because enterprise users tend to be more sophisticated, their requirements are going to be stricter, and SLAs will have to be in place. Subscriber management (e.g., provisioning or billing) may need to be adapted to the applications where the number of subscribers is high and bills aggregate fees across a large number of connections.

On the other hand, customer care and management are likely to require fewer resources, as enterprises take an active role in managing (and troubleshooting) applications. Furthermore, because connections are used for very specific applications, the operator does not typically subsidize the devices, and the enterprise usually purchases the devices directly from the manufacturer or system integrator.

The major downside of vertical applications is that the ARPC can be substantially lower than retail ARPU. This is especially true for low-traffic applications that are not mission-critical. A utility may want to have a meter at each household, but it will pay only a few

dollars a month. Alternatively—and this is the dominant practice now—utilities send the meters' data to a concentrator that in turn transfers the data from a large number of meters to a public wireless network from a single location, further reducing the overall revenues to operators. The low-ARPC vertical applications, however, are the ones that can be hosted on 2G cellular networks, as well, and they need only very low-cost devices (e.g., meters with a wireless modem) that are not yet available for WiMAX. As the cost of the devices reaches the right point, these applications can be as profitable as high-ARPC applications for WiMAX operators because the per-bit service revenues can be high.

In the next few years, the vertical applications prevalent in WiMAX networks are likely to be those that will take advantage of the broadband and QoS capabilities of the technology (e.g., CCTV monitoring or in-vehicle applications), and the lower per-bit transport costs. These applications typically generate high ARPCs—in some cases, higher than the ARPUs for retail users.

What is the cost of supporting vertical enterprise applications?

One advantage of vertical applications is that the marginal cost of supporting them initially, and often in the long term, is very low. WiMAX operators need to build wide networks to ensure good coverage, but at commercial launch they will have unused capacity, because it takes time to build a customer base. Vertical applications also will share the same core network that retail users use. Hosting vertical applications at this crucial stage does not require additional funding outlays, yet it provides a steady revenue stream. As the number of subscribers and vertical connections grows, the operator will need to increase the network capacity and coverage, but it will be able to do so directly in response to growth in demand—and in revenues.

What are the requirements and revenue opportunities associated with different applications? Does it make sense to support all utilities applications?

Table 3 compares the requirements, features, and revenue opportunities for the applications for electric utilities listed in Table 2. Requirements and revenue opportunities vary significantly, and each operator has to carefully evaluate which applications should have priority and which, if any, should not be supported at all.

Operators that provide fixed services will support applications that target fixed locations. Operators targeting mobile subscribers may prefer—but are not required to—to focus on mobile applications and stay away from fixed applications like CCTV monitoring that may add a heavy burden on their network infrastructure.

Revenues are listed on a per-connection basis, but operators should also consider the per-bit revenues, which factor in the traffic requirements: an application like smart metering may generate a low ARPC, but have higher per-bit revenues than a high ARPC one like CCTV monitoring.

Application	Location	Wide coverage	High throughput	Voice and video services	QoS required	High traffic levels	Predictable traffic	High number of devices	High ARPC	Low price sensitivity
SCADA/DCS	Fixed	◉	○	○	●	○	●	○	◉	●
CCTV monitoring	Fixed	◉	●	○	●	●	●	○	●	●
AMR	Fixed	●	○	○	○	○	●	●	○	○
Smart metering	Fixed	●	○	○	○	○	●	●	○	○
Office/facilities coverage	Fixed	◉	●	●	◉	●	○	○	●	◉
Workforce connectivity	Mobile	●	●	●	◉	●	○	○	●	●
In-vehicle LBS	Mobile	●	◉	◉	◉	◉	○	◉	●	◉
AVL	Mobile	●	○	○	○	○	●	◉	●	●
Emergency connectivity	Mobile	○	◉	◉	◉	◉	○	○	●	●

● = yes; ○= no; ◉= in some cases

Table 3. Comparison among applications in the utilities market

6. The business case for metering and mobile workforce applications for utilities

The business case for applications to support utilities can be easily justified. Here we look at an example that illustrates the different impact of customer acquisition costs on retail connections and in two applications for utilities—metering and mobile workforce.

The capex and opex costs associated with retail and vertical services are comparable, as they both rely on the same infrastructure. The main differences between them are in customer acquisition costs and revenues; these are summarized in Table 4. If revenues are kept constant across segments, the number of subscribers varies from 1,000 in retail to 20,000 for AMR, due to the differences in ARPC. Churn estimates are in line with cellular operator figures for retail subscribers, but conservative (that is, high) for vertical applications, as churn is likely to be lower than 1% if contracts are set for 10-year periods. The example involves only a small number of subscribers, representing a limited area within a large-scale network.

Assumptions	Retail	Utilities: mobile workforce	Utilities: AMR
Revenues in year 5	US$480,000 (equal across segments)		
Subscribers or connections in year 5	1,000	1,333	20,000
Revenues per subscriber or connection	US$40	US$30	US$2
Monthly churn	2%	1%	1%
Acquisition costs per subscriber or connection	US$300	US$113	US$5
Device subsidy	US$100	NA	NA

Table 4. Comparison of retail versus mobile workforce and AMR applications for a utility

Customer acquisition costs, device subsidies, and service revenues are based on current operator data. For retail subscribers, customer acquisition costs are incurred during the year the customer is signed up, but for utilities applications, most of the costs are incurred in the first two years. In this example, it is expected that the operator faces most customer acquisition costs when signing the contract with the utility, but that not all the connections included in the contract will be activated during the first year. As a result, the customer acquisition costs during the first year are comparable for retail and vertical services, but then decline sharply for vertical applications. By keeping revenues constant, the example shows that customer acquisition costs are substantially lower for mobile workforce and AMR applications (Figure 3) even when the effect of more-limited service revenues from vertical applications is taken into account.

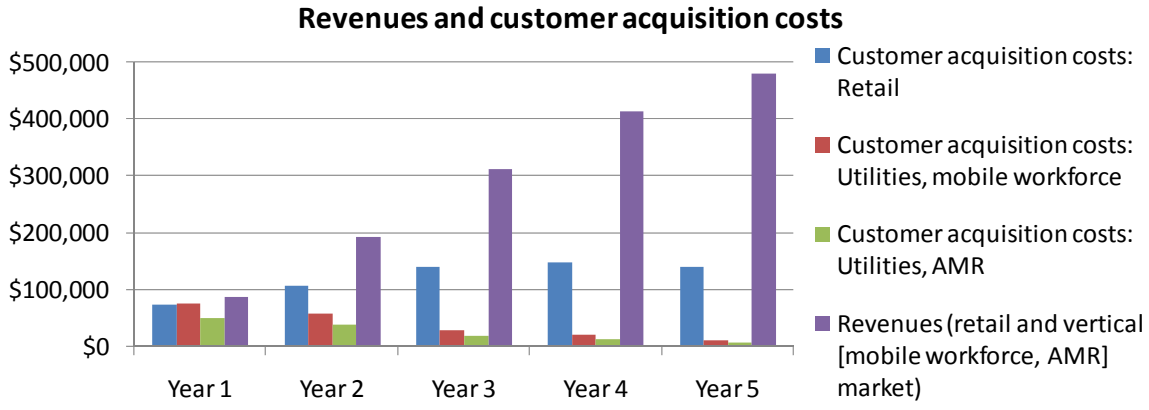

Figure 2. The business case for mobile workforce and metering applications for utilities

7. The WiMAX ecosystem for applications for utilities

A strong ecosystem is necessary to address the needs of utilities. The range of applications they plan to adopt and the strict performance levels expected require more in-depth expertise than operators and utilities have. Chipset, module, and device vendors occupy a crucial role in ensuring that the devices are available at the right price point and support the key capabilities that applications demand. Application developers and system integrators have the task of getting devices, network infrastructure, and utilities' internal networks to work together and perform the expected tasks. In some cases, an MVNO may mediate the relationship between the utility and the operator and host the application.

There are multiple business models currently in use in the marketplace, and it is not clear yet which one—if any—will prevail, as the market is still in its early phases and it is still heavily fragmented. In a direct model (Figure 4), the operator controls the relationship with the utility, even though the utility is likely to deal separately with device vendors, application developers, and system integrators to customize the applications and integrate them within its internal system.

Other models requiring a less direct involvement of the operator are also widely used. If the device plays a crucial role in a given application, the device vendor may be the one responsible for the end-to-end performance of the application and will have a deal with the operator to get network access on behalf of the utility. This type of model may work with in-vehicle devices, where the vehicle manufacturer establishes MVNO relationships with one or more operators that cover a wide range of potential customers, including but not limited to utilities. Similar arrangements can be made by application developers or system integrators, which may strike a deal with one or more operators to effectively resell network access to their utilities customers. Finally, a separate MVNO entity may coordinate the ecosystem players and be the main contact point for the utilities.

In a direct model, the WiMAX operator stands to gain higher revenues and benefit from a closer relationship with the utility, but it also needs to develop segment- and application-specific expertise and support a sales team dedicated to utilities. Some WiMAX operators, especially greenfield operators, may lack the resources to do so; for them, an indirect business model may be better suited to addressing the utilities market. Alternatively, an operator may decide to focus on other vertical markets and work with partners to gain market share in the utilities market. The fragmented nature of the overall market for vertical applications is likely to dictate that, at least initially, operators as well as utilities will work with multiple business models at the same time, depending on the application, while trying to reduce the complexity and focus on a more streamlined relationship between the operator and the utility.

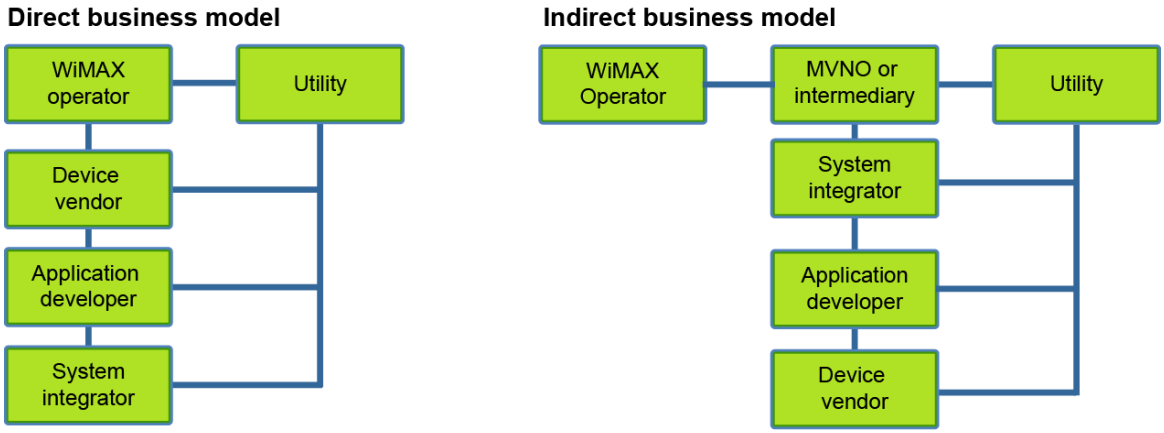

Figure 3. Business models for WiMAX operators

8. Conclusions

Widespread presence and the provisioning of crucial services make utilities one of the segments with the strongest and most varied demand for vertical applications. Because utilities reach each home and business in their coverage area, applications like AMR and AMI will require a large number of connections. As more bandwidth and real-time measurements are needed to allow customers to adjust their consumption on the basis of fluctuating energy costs, WiMAX is well positioned to meet the demand in this market, especially as modules reach the right price point.

Remote metering is only one of the applications that utilities are adopting. Monitoring and managing facilities and the transmission and distribution infrastructure, as well as support for utilities' mobile workforce and for emergencies, are also key, because they provide cost savings and improved operations.

Utilities are, however, demanding customers: they operate in an environment where service disruption has to be kept to a minimum. WiMAX technology gives operators the technical tools to meet the utilities' requirements, but operators will also need to develop either the expertise that will gain their perspective customers' trust or partnerships with ecosystem players that have industry-specific experience.

WiMAX operators have the right technology at the right time to address the connectivity demands of utilities. And they are deploying their networks at a time when utilities are becoming increasingly convinced of the soundness of a business model that uses public networks to host their applications. It is an exciting opportunity for WiMAX operators, opening an entirely new market that is still in the early phases of growth but has a huge long-term potential.

Acronyms

2G	Second Generation [Mobile Services]
3G	Third Generation [Mobile Services]
AMI	Automatic Meter Infrastructure
AMR	Automatic Meter Reading
ARPC	Average Revenues Per Connection
ARPU	Average Revenues Per User
AVL	Automatic Vehicle Locating
CCTV	Closed Circuit TV
DCS	Distributed Control Systems
GIS	Geographic Information System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HSPA	High Speed Packet Access
IP	Internet Protocol
LBS	Location-Based Services
LTE	Long Term Evolution
M2M	Machine to Machine
MVNO	Mobile Virtual Network Operator
PLC	Power Line Communications
QoS	Quality of Service
SCADA	Supervisory Control And Data Acquisition
SIM	Subscriber Identity Module
SLA	Service Level Agreement
SMS	Short Messaging Service
VoIP	Voice over IP
VPN	Virtual Private Network
WAN	Wide Area Network
WiMAX	Worldwide Interoperability for Microwave Access

About the WiMAX Forum®

The WiMAX Forum® is an industry-led, not-for-profit organization formed to certify and promote the compatibility and interoperability of broadband wireless products based upon the harmonized IEEE 802.16/ETSI HiperMAN standard. A WiMAX Forum goal is to accelerate the introduction of these systems into the marketplace. WiMAX Forum Certified™ products are interoperable and support broadband fixed, nomadic, portable and mobile services. Along these lines, the WiMAX Forum works closely with service providers and regulators to ensure that WiMAX Forum Certified systems meet customer and government requirements. Through the WiMAX Forum Congress Events Series of global trade shows and events, the WiMAX Forum is committed to furthering education, training and collaboration to expand the reach of the WiMAX ecosystem. For more information, visit the trade show link at www.wimaxforum.org.