

Realising the WiMAX Opportunity in the Middle East

This paper describes the technical and business planning that is required for an effective commercial WiMAX deployment. It is based on our experience of winning the license to build and operate a national WiMAX network in the Kingdom of Bahrain.

Although specific to WiMAX technology, the major part of the work described here was not technical; the small size of Bahrain made the radio planning requirements relatively straightforward. Instead, the focus is on the development of the network operator's business plan through the modelling of demand and the definition of marketable services that can be supported over the WiMAX based infrastructure

In addition to specific observations from our experience in Bahrain, we also discuss the more general opportunities for WiMAX as a technical option for building sustainable business.

Presented by Intercai Consultants

Mark Norris & Adrian Golds

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1. Making the Business Case

At the end of 2006, the TRA decided to license spectrum in the 3.5GHz range, specifically for use by an operator deploying a fixed wireless services network. Although technology neutral, the license's available spectrum and its segmentation implied the use of WiMAX technology. The clear intent of the TRA was to stimulate competition in the fixed telephony market, and this is reflected in the terms of the license which was limited to fixed service provision, mandated the provision of voice service and required almost universal coverage of the population of the island.

The licenses, two of which were on offer, were to be awarded by an auction preceded by a pre-qualification beauty contest. Ten bidders were expected to bid, including the incumbent operator, the 2nd mobile operator, several established Telcos from neighbouring countries and recent entrants in the Bahrain market. Intercai was engaged to lead a bid on behalf of one of the latter.

The first issue that we had to face was whether the license would support a viable business, as analysis from several sources has portrayed WiMAX as a weak contender in a competitive market. Our client was an established operator offering telephony by carrier pre-selection and pre-paid cards and a broadband service delivered over VSAT. Their ambition was to become a full service operator as soon as a viable opportunity arose and then to take advantage of ongoing liberalisation

Given the current position and ambitions of our client, it was clear that any plan based on competing only for fixed telephony revenues was not going to be acceptable. Quite apart from the limited revenue from this option, it did not fit with the long term aspirations of our client.

To answer the question of viability (and to give some idea of what to bid in the license auction), it was first necessary to build a quantitative model of the market for a WiMAX service. There was expectation that the terms of the license would be eased to offer mobile services in the future but the initial business case had to be based only on what the license permitted.

The first step in defining the market was to decide on the range of services that would be offered. To tackle this, we drew up a number of user scenarios, based on our knowledge of the currently available business and residential services and their future needs. The drivers for these future needs ranged from wanting lower costs to a desire for higher quality and greater speed broadband access.

After analysis, the following service-set was put forward:

- Broadband internet at speeds from a minimum of 512kbps through to 2Mbps, with the capability for higher speeds. This would be a symmetric service, offering consumers significantly more uplink capability than is possible with current DSL technology. This service is likely to be of particular value to corporate customers.

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- Carrier grade voice, in the form of voice over IP, engineered to ensure a high quality of service and minimal call blocking. This service is likely to appeal to business customers.
- Data connectivity, supplied on demand in response to customer network and virtual private networking requirements, and
- Leased lines, again supplied in response to customer demand and point to point connectivity requirements.

At the same time as defining a putative set of services, it was necessary to determine where the consumers of these services were located and in what numbers. This required a considerable amount of modelling work with inputs from the national census and other sources feeding into a spreadsheet model of potential consumers, their service profile and likely usage. From this model, a forecast of demand was constructed to show the potential, over time, for a WiMAX deployment offering the service set defined above.

2. Network Design

Having built a picture of potential service demand, the next step was to design a network that would satisfy that demand. In many ways this was the easiest part of the exercise – the topography and demographics of Bahrain are forgiving and detailed bandwidth coverage and performance requirements could be extracted from the demand model.

In order to meet the license coverage requirements, the network was designed as a core to which access nodes could be added. This allows the progressive coverage requirements (40% of population within 2 years, up to 95% within 5 years) to be met with a consistent approach.

Core network

This is configured as a ring from the initial deployment in order to maximise network resilience. If any one link is lost, traffic can readily be backhauled to the central office via the remaining links. With this configuration, the availability of the core network is in excess of 99.99%.

Extra resilience is built in to the network by meshing of the base stations in each of the main areas. This minimises the likelihood of a base station being isolated from the core and can be implemented in this network without introducing an excessive number of hops. Hence network resilience is assured right down to the level of the access nodes without excessive redundancy and without the introduction of potentially service affecting re-routing.

The presence of a core that connects the access nodes allows complementary access for high-speed connections: it is possible to provide direct connections to corporate or government users with wholesale leased lines, microwave links or free-space optical links from these nodes direct to the customer.

Each node on the core network is implemented as a secure unit with battery back-up and generator facilities ensuring no interruption to services even during prolonged power outages.

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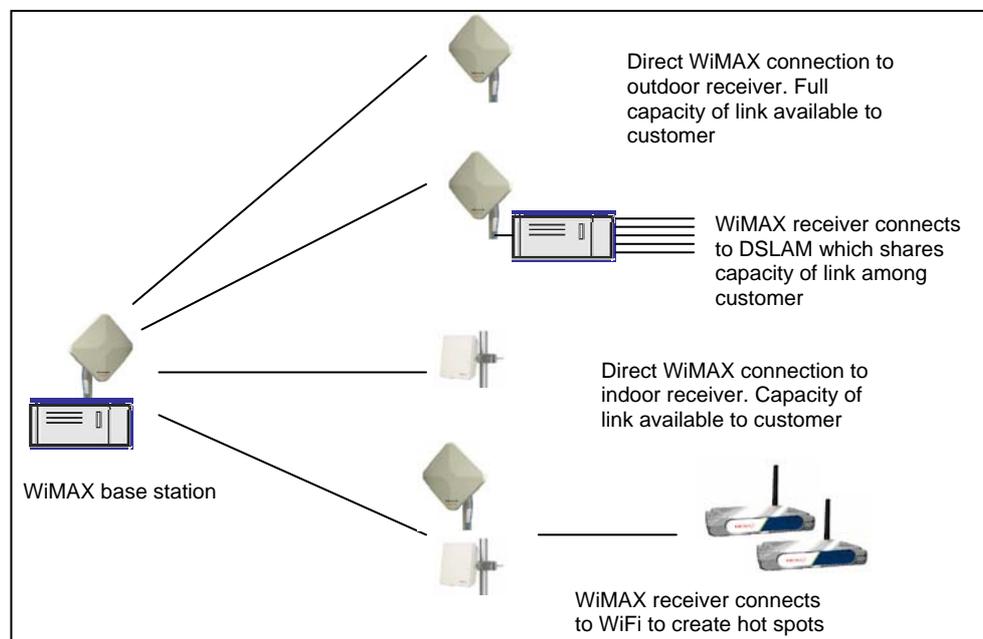
Access Network

Services will be delivered to the end customer over an access network that comprises a number of strategically placed WiMAX base stations.

Theoretically, each of the base stations is capable of providing several hundred Mbps of capacity over a radial distance of several kilometres. However, the design of the access network is such that the operational range of each base station is deliberately limited. A serving distance of no more than 1.5km has been taken as a plan guide to ensure that the adaptive modulation scheme used by WiMAX normally operates at the most efficient level. With this constrained range, the base station rollout was planned on the basis of proving a high bandwidth density over the served area, so as to maximise the range of services that can be offered to potential customers, with a variety of indoor and outdoor CPE solutions.

The configuration of each base station was adjusted to its environment. In a semi-urban location, the range assumption was that it will cover the maximum area and that the bandwidth density will be adequate for the customers served. In a more densely populated area, the maximum service range is reduced to as little as 1km and, if required, extra wireless channels are added at the base station to provide more bandwidth. One of the attractive features of WiMAX is that the number of channels can readily be increased to cater for high demand in a specific location without interference between radio channels.

A number of options were planned for the final delivery of service to the consumer, as illustrated below.



This variety allows considerable flexibility in the way that services are delivered to the end user and the design of the distribution network was based around the user scenarios that were developed during the demand modelling phase.

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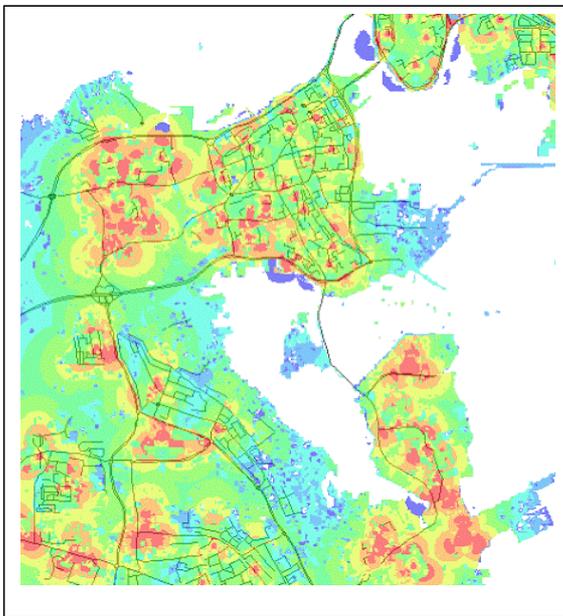
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Practical Issues

The credibility of the business case for our client rested on the accuracy of input data and sustainability of approach. In this section we highlight some of the practical issues that had to be addressed in ensuring a sound basis for investment.

Network dimensioning

From a technical perspective, the design of a WiMAX based network has proved to be much the same as any other wireless network. The required levels of coverage, capacity and resilience had to be engineered, as did all of the background issues of operational support systems, interconnect, application servers and session control.



With a clear notion of the location of potential customers and their likely bandwidth requirements, the radio planning needed to derive the number of base stations that would be required as the network grew was reasonably straightforward. The plot here shows the initial coverage over Manama, the capital of Bahrain. The only real issue that arose at this stage was the accuracy of information used in the planning tools: several of the suppliers we approached were reticent to provide information on the field performance of their equipment.

Given this lack of input, and prior to reaching agreement with a preferred equipment supplier, we used planning

guidelines produced by the WiMAX forum¹ (with a suitable safety factor) to derive indicative equipment costs for the business case. The specific design assumptions from our supplier required some modifications to the cost model but these did not have significant impact on the business case.

Network Evolution

Although time consuming, accurate and credible technical planning data was eventually captured. A more difficult issue to resolve was the most appropriate equipment strategy for our client. The planned deployment of access infrastructure in Bahrain was initially based on the

¹ “Business Case Models for Fixed Broadband Wireless Access based on WiMAX Technology and the 802.16 Standard” and WiMAX: “The Business Case for Fixed Wireless Access in Emerging Markets” both from www.wimaxforum.org

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WiMAX 802.16-2004 standard (also known as 802.16d or Fixed WiMAX). Equipment conforming to this standard, available from a number of manufacturers, has been successfully deployed in many operational networks throughout the world and is adequate for a network that operated within the terms of the license granted by the TRA.

However, the use of fixed WiMAX equipment would limit the long term aspirations of Intercai's client.

Within the industry, there has been considerable interest in the Mobile WiMAX standard, 802.16e-2005. This standard enhances the capabilities of 802.16d by improving the link budget through mechanisms such as Multiple Input Multiple Output (MIMO) antenna arrays and supports mobility functions such as handover. It seems likely that mobile WiMAX will be adopted by Intel, and according to company statements, will be incorporated into all Intel based PCs under its Centrino strategy. It is also anticipated that other devices, such as PDAs, will also include this technology within the next few years. Unfortunately, Mobile WiMAX equipment is not compatible with Fixed WiMAX equipment, so there is no natural upgrade path.

However, potential suppliers of mobile WiMAX equipment are aware that restrictions on mobility within the radio network exist in a number of markets, so propose to supply equipment with the mobility functions disabled. This would enable operators to deploy the technology, and therefore address a future market of expected nomadic devices, without compromising their current licence conditions.

Given this situation, an evolution path built into the business plan was to overlay this technology, with the mobility elements removed, on the 802.16d network subject to TRA agreement and approval at a later date.

Positioning of Services

In line with the regulator's aim of bringing competition to the fixed line market was the license constrain to provide voice service to all users who want it. One thing that was clear from the business case was that the cost of installing a national WiMAX network could not be supported on telephony alone. Hence, a deliberate part of the pricing strategy was to make voice only service unattractive.

The service strategy embedded in the business case was based around a wireless broadband offering with voice as an incremental service (as VoIP) and a higher quality of data services than established operators. To differentiate from the established market offerings, the service design incorporated a web based interface that can be used for a range of customer service applications, such as provisioning, status reports and service requests.

The longer term service opportunity, as mentioned above, was to ensure that our client is in a position to offer "4G" services as soon as restrictions on the current license are lifted (or an alternative license is available)

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3. Discussion

The business case and strategy for WiMAX, as presented here, is in the specific context of the Bahrain market and a particular operator. Of course, the approach of different operators will vary depending on their background and aspirations as well as the regulatory and market environment.

In the case study described here, the strategy was to become an established fixed network operator as a precursor to entering the mobile data market. In other markets, it may be that an established fixed network operator sees mobile WiMAX as good way of entering the mobile data market. With many mobile operators focused on maximising their established revenues (e.g. from text messaging), the high bandwidth and rapid deployment of WiMAX is attractive to new players. The table below summarises some of the likely operator strategies and motivations.

Established Operator	Market Entrant
<ul style="list-style-type: none">• Provision of Nomadic Services, particularly once WiMAX embedded in PCs• An option for backhaul for WiFi hotspots (giving immediate access to nomadic PC services)• Diversification of investment in technology (e.g. minimising risk in 3G rollout)	<ul style="list-style-type: none">• Provision of Fixed services:<ul style="list-style-type: none">○ Broadband access comparable to DSL (particularly in developing or high priced markets)○ Voice services (through high quality VoIP)• Provision of mobile service , effectively leapfrogging established mobile operators to deliver 4G service• Rapid deployment as an alternative service provider in newly liberalised markets

The abiding message from this case study is that generalities such as those given in the table are just that – generalities. It is only when the specific circumstance of an operator, their competition and the market in which they plan to operate are considered that a true picture can be drawn. Our initial expectation in Bahrain was that there would not be a viable business for a national fixed wireless operator. But careful analysis of likely demand and of the cost of deploying a network that met both the license conditions and supported the planned service set resulted in a positive business case. It also gave a sound basis for our client's bid in the license auction - so sound that they pitched an ideal amount to just win their license.

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4. Conclusion

There are a number of aspects to realising the promise of WiMAX and careful business planning is likely to be required in reconciling short and long term objectives. In this paper, we have explained how we built a sustainable business case for the deployment of a network that would be constrained, at least in the short term, to offering fixed services.

At the same time as determining the likely demand for fixed services as a basis for network design and hence cost, there was a subtler agenda in play. The real "behind the scenes" idea was to ensure that the WiMAX network was deployed so that it could support nomadic, and ultimately mobile services - but the initial business plan could not rely on this.

The key point in the paper is that, for all the generalities of WiMAX, its suitability can only really be assessed in relation to a specific market. On the face of it, well developed competition in Bahrain makes it an unlikely host for a new WiMAX network. However, the specific demographics, topography and market state proved amenable and there is every expectation that an enduring business can be built.