Wi-Fi, WiMAX and 802.20 – The Disruptive Potential of Wireless Broadband

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Emerging wireless broadband technologies

The rapid growth of Wi-Fi in the home, enterprise and public hotspot market has given users and service providers alike a new glimpse into what wireless connectivity can deliver, through a single interface, in multiple locations. Wi-Fi realizes the vision of untethered broadband connectivity within the LAN (Local Area Network) and has paved the way for new wireless technologies that can deliver the same experience in the MAN (Metropolitan Area Network) and in the WAN (Wide Area Network).

Gone are the days when wireless access conjured up the image of a point-to-point connection to an expensive antenna mounted on top of the roof or to a satellite dish that has to be installed by expert technicians. New BWA (Broadband Wireless Access) technologies offer, and increasingly already deliver, data connections that do not require a line-of-sight link to the base station, can be self-installed by the user and can be used at different locations. Data connectivity becomes increasingly linked to the individual subscriber, like a mobile phone, and less dependent on a specific location.

Compared to the previous generation of technologies, 802-based BWA offers several advantages:

- Standard-based solutions, which means that service providers do not have to rely on a single vendor and that economies of scale are possible
- Improved coverage due to NLOS capabilities

- Lower costs as CPE (Customer Premises Equipment) can be self-installed
- Ability to use both licensed and license-free spectrum
- Support for portable and mobile use.

802-based BWA technology has the opportunity to redefine the entire BWA market and the performance it promises is impressive. The major concerns voiced by service providers are not about the ability of the technology to deliver, but about the cost effectiveness of the solution and its ability to compete with fixed alternatives.

Disruptive potential of wireless broadband

If expectations from WiMAX and 802.20 are met, the combination of Wi-Fi, WiMAX and 802.20 may have a huge impact on the fixed and mobile provisioning of broadband services and on the overall business model of service providers.

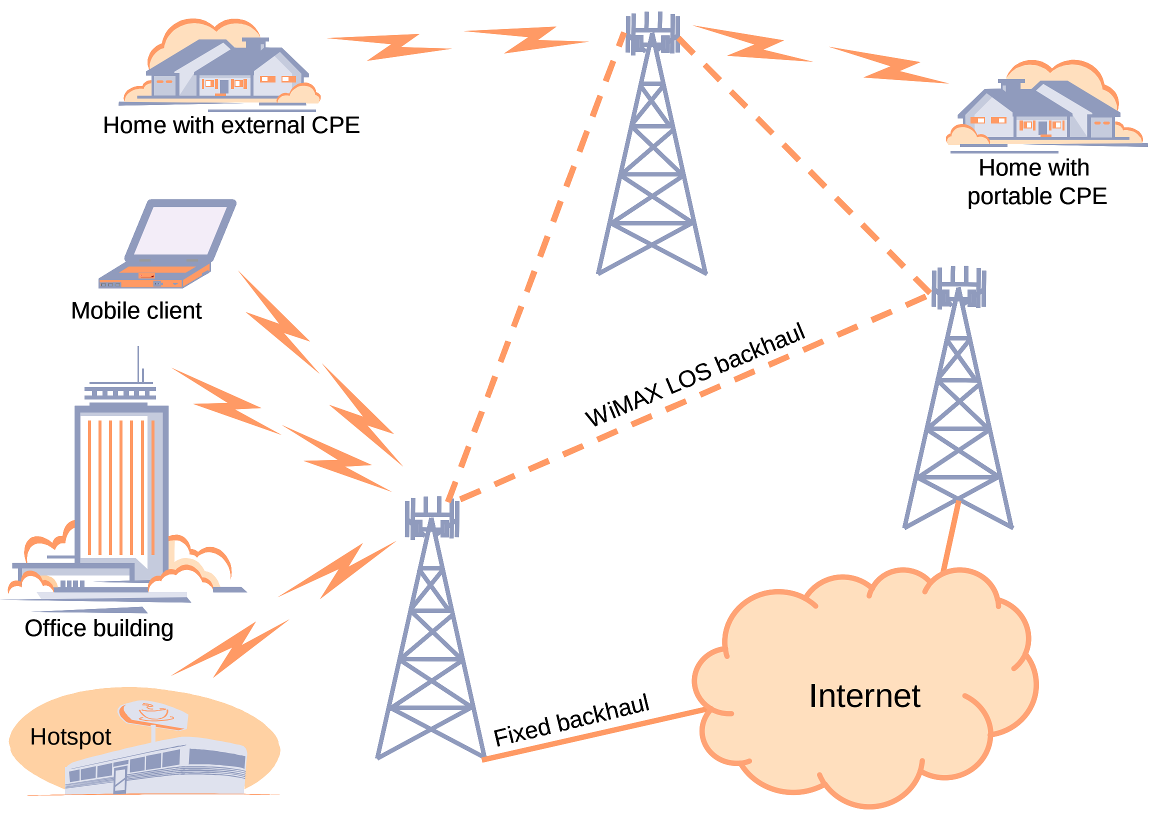
The main impact is likely to be seen in three areas:

- **Fixed broadband services.** 802-based BWA will be able to offer a cost-competitive, facilities-based alternative to both wireless and wired technologies, including cable modem, DSL and, in some environments, fibre. Although initially aimed at the underserved market, BWA may eventually compete head-on with current DSL and cable service providers, both on price and quality of service. In addition, BWA competitiveness is strengthened by the ability of WiMAX and 802.20 to support IP-based voice services. BWA may allow new entrants to offer broadband connectivity through a network independent of the incumbent telco or cable operators. Alternatively, incumbents may choose to deploy BWA to reach underserved areas.
- **Mobile data services.** The ability to support mobile, or at least portable, data connectivity makes BWA a competitor to cellular data services. Mobile operators may adopt 802-based BWA to add capacity for data services, but this may cannibalize revenues from their existing GPRS, EDGE, or UMTS networks. If they don’t, other service providers may, especially if they have already built out the infrastructure for fixed access.
- **Bundled fixed and mobile services.** The next logical step is to provide a business or residential service that combines fixed and mobile data connectivity. While in the office or at home, the subscriber can get online using the local Wi-Fi network, which is in turn connected to a WiMAX link, or through a WiMAX modem

(external or built into the laptop). While travelling, the subscriber can still connect to a WiMAX or 802.20 network, either directly or through a Wi-Fi local network, wherever coverage is offered by the service provider or by a roaming partner. Figure 1 illustrates how Wi-Fi and WiMAX can combine to provide users with connectivity wherever they are.

Successful and wide BWA deployments will not only increase the competition in the fixed broadband and cellular data market, but will also have a deep and long lasting effect on how broadband services are used (and marketed), on the overall broadband value chain and on the business models of the network operators and service providers.

Figure 1 Examples of how Wi-Fi and WiMAX complement each other



WiMAX

Of the emerging 802-based BWA technologies, WiMAX has so far attracted the most attention and will be the first to become available. Work on the 802.16 standard started in 1999, but it was only during 2003 that the standard received wide attention when the IEEE 802.16a standard was ratified in January and the WiMAX Forum added to its membership companies like Intel and Nokia (Nokia has since let its membership elapse at the Forum). Thanks to the efforts of the WiMAX Forum and to a large PR campaign by Intel, WiMAX reached prominence before any product was commercially available and, therefore, before the technology has proved that it can fulfill its promises.

WiMAX and Wi-Fi are designed to complement and strengthen each other. This has provided increased impetus for Wi-Fi and, at the same time, has established immediate credibility for WiMAX and helped to set it apart from other previous fixed wireless technologies like LMDS, MMDS, satellite, or Metricom's Ricochet, which have met only limited acceptance in the market.

Standards overview

The IEEE 802.16 working group was established initially to expand the capabilities of 802.11 to the MAN and to add QoS, but it later amended the standard to include NLOS capabilities. The group is currently working on a standard that supports pedestrian mobility.

The key standards in the IEEE 802.16 working group are the following:

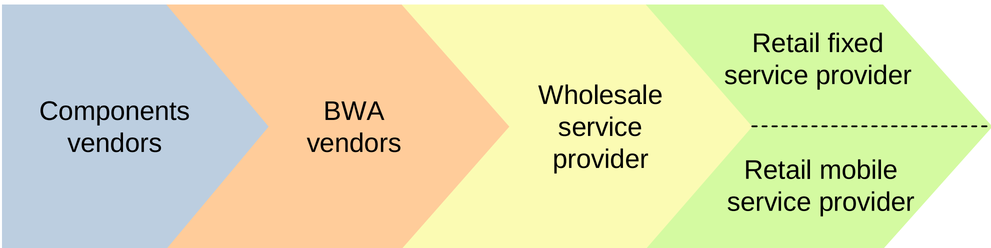
- **802.16.** The first standard to be ratified, 802.16 required a LOS link and can operate anywhere in the 10-66 GHz band. It is well suited for fixed wireless connections for business subscribers and, in particular, for backhaul.
- **802.16a/RevD.** Ratified in January 2003, 802.16a uses lower frequencies (2-11GHz) to allow NLOS transmission, while retaining a good spectral efficiency. RevD will provide a revised standard that will supersede 802.16a, adding new functionality (e.g. system profiles), but without altering the key specifications of 802.16a. While 802.16a/RevD does not allow mobile use, it does allow portable use (access from multiple locations, while the client is stationary) if the CPE is not fixed. 802.16a will be mostly used for small businesses, residential users and for backhaul to hotspots.
- **802.16e.** The last addition to the 802.16 family, 802.16e has proved to be the most controversial standard, as it overlaps with the mandate of the IEEE 802.20 group, which was established before work started on 802.16e. 802.16e is targeted at mobile users, who will be able to keep their connection while moving or driving (but not too fast: the maximum speed that 802.16e will support is 150km, but a reliable connection may only be maintained at a lower speed). It is still unclear whether full compatibility between 802.16e and 802.16 will be maintained or not (despite backward compatibility being one of the core targets of the 802.16e working group) and

whether the changes that will be required will be limited to changes to the MAC layer or will include changes to the PHY layer as well.

Wireless broadband value chain

The ability of 802-based BWA technologies to support both fixed and mobile services will have a deep impact on the value chain (Figure 2). Some service providers will be interested in offering both fixed and mobile services, either as a bundle or as stand-alone products. In other cases, a service provider may be interested in offering only one product.

Figure 2 BWA value chain



In both cases, infrastructure sharing by multiple service providers may help to reduce costs and improve coverage. A service provider may find it cost effective not to build its own network in a region either to contain costs or simply because it lacks spectrum licences. Instead it may establish a roaming agreement with a service provider that has coverage in the target area to provide service to its customers.

This type of arrangement may be attractive to different service providers for different reasons:

- A mobile service provider may lack the funding to build a national footprint (or may find it impossible to build it in regions where it owns no spectrum). Instead, the service provider may prefer to build its own network in its core markets (possibly acting as a wholesale provider in them) and establish roaming relationships with wholesale service providers to increase its coverage.
- A wholesale service provider, such as Covad in the US, may be interested in building a network in new markets or in markets where it does not have sufficient capacity or the ability to reach potential costumers. BWA deployments would complement the existing wired network and, in the case of CLECs, they would enable them to develop their own facilities-based networks[1] and to have more

[1] This particularly relevant in the US, where recent FCC rulings have made the future availability of local loop unbundling uncertain.

control over the reliability of the service provided. The wholesale provider would then resell the service to both fixed and mobile retail service providers.

- A WISP or an incumbent operating a local network in an underserved area and offering fixed and portable access within the area to residents, may provide access to mobile users from a national mobile service provider that does not have coverage in the area. The WISP gets additional revenues, the mobile operator a larger coverage area.

The infrastructure sharing that BWA enables is different from that used by MVNO in cellular networks or by CLECs in the local loop: in these cases, the virtual provider offers the same service that the facilities-based provider does and conflicts of interest are often inevitable. The ability to use the same infrastructure for both fixed and mobile services, which in several instances will not be directly competing, is a great asset of new BWA technologies, because they enable a more efficient use of spectrum and deployed networks which may lead to substantial cost savings.