

# **Mobile WiMAX**

## **The next generation broadband wireless network**

**A paper presented by:**

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### **Abstract**

Most hand held electronic devices, forming part of a Personal Area Network (PAN) strive to improve their value, by the inclusion of multimedia and wireless functions. A good add-on in a PAN can turn sour if the medium of transport (especially a wireless channel) performs below expectation. Cellular networks, originally designed for outdoor use have a hard time delivering quality indoor voice service, let alone multimedia. A more efficient outdoor/indoor network is required to meet up this growing challenge. WiMAX, the product of the IEEE 802.16e committee is designed to meet the challenge of better wireless network efficiency. By using adaptive beam formation and Multiple Input Multiple Output (MIMO), a better service delivery is achieved. This paper looks at the WiMAX promise and its preference over older generation networks.

## **Introduction**

In an attempt to improve the efficiency of wireless networks, engineers have come up with six network types based on different technologies- 3G LTE, UMTS, HSPA, EV-DO, MBMS, and WiMAX. Of the six network technologies, EV-DO and WiMAX have gained more popularity among broadband solution providers in Nigeria. This paper would be focusing on WiMAX networks and its relative advantage as one of the six new generation networks.

World wide Interoperability for Microwave Access (WiMAX) is a near Non-Line of Sight (NLOS) network technology, designed to deliver high speed broadband solutions (voice and multimedia) over wireless networks. WiMAX is the product of the IEEE 802.16e committee. This committee consists of electronic design professionals, with representatives from large companies, involved in the design and production of broadband wireless devices. This committee is responsible for setting international standards for the wireless broadband technology known as WiMAX.

## **WiMAX Operation**

### **Smart Beam Forming**

WiMAX base stations use an antenna array that has an adaptive beam formation technology (see figure 1 below). This type of antenna has multiple directional

antennas built into the array. When a mobile WiMAX device enters network's cell, the base station detects it and connects to it.

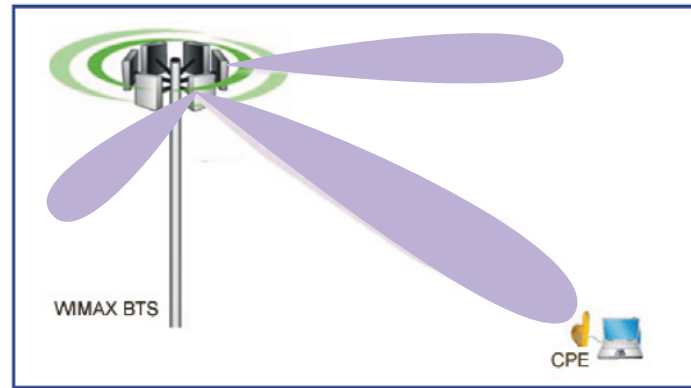


Figure 1: A WiMAX Base Transmitted Station's (BTS) adaptive beam formation

This search is done entirely by the base station and all other mobile WiMAX units remain dormant. Unlike cellular networks whose mobile device keeps scanning for base stations at intervals, the mobile unit saves power by remaining “silent” until a base station (BS) connects to it. The WiMAX device only acknowledges connection received from a base station when requested. The base station would then select an antenna in its array that has the shortest echo time. Echo time is the time it takes an echo signal to travel from a transmitter to the receiver and back. The base station can adjust the beam width of each antenna, by varying its frequency, modulation, power and a few other properties. By varying the beam width of an antenna, the base station can set a minimum signal power that the mobile device receives, as long as the device remains in its cell. With this

adjustment, the base station ensures that the mobile device does not disconnect frequently.

Once a base station has “found” the mobile device and located its direction, the base station directs its transmission to that area. This is more effective than transmitting in all directions. By adjusting the frequencies, transmission power and carrier signal, the base station can slightly alter the beam of its antennas. Such beam width adjustments helps to accommodate mobile units whose receiving power levels are below minimum.

### **Multiple Input Multiple Output (MIMO)**

WiMAX technology also makes use of Multiple Input Multiple Output (MIMO). MIMO is a system where the base station sends signals through multiple carrier frequencies. These carriers behave differently to obstacles. On getting to the receiver, only one copy is taken. If the signal stream coming from one carrier is cut off, another carrier is selected to make up for the packet loss. Thus a better Quality of Service (QoS) is achieved. With this, you get a continuous stream of uninterrupted data (it would be difficult for all the carriers not to get to the receiver, unless the receiver is outside the base station coverage area).

<b>Feature</b>	<b>802.11 (WLAN)</b>	<b>802.16e (WiMAX)</b>
Range	<ul style="list-style-type: none"> <li>• Optimized for users within a 100m radius.</li> <li>• Add high gain antenna for greater coverage</li> </ul>	<ul style="list-style-type: none"> <li>• Typical cell size 7-10Km</li> <li>• Up to 50Km range</li> </ul>
Coverage	<ul style="list-style-type: none"> <li>• Optimized for line-of-sight environments.</li> </ul>	<ul style="list-style-type: none"> <li>• Adapts to obstacles (Trees, buildings etc)</li> <li>• Uses objects such as buildings to act as reflectors.</li> </ul>
Scalability	<ul style="list-style-type: none"> <li>• Fixed Bandwidth, 20Mhz</li> </ul>	<ul style="list-style-type: none"> <li>• Flexible bandwidth- 1.5 MHz to 20 MHz.</li> <li>• Frequencies re-use.</li> </ul>
Band	<ul style="list-style-type: none"> <li>• Operated on unlicensed 2.4 GHz frequency bandwidth.</li> <li>• Noise from other devices emitting 2.4 GHz cause interference.</li> </ul>	<ul style="list-style-type: none"> <li>• Operates on both licensed and unlicensed frequency range (2GHz to 11GHz) and is immune to noise where it exists.</li> </ul>

**Figure 2:** Comparing WLAN and WiMAX

## **Conclusion**

WiMAX is a technology that promises to deliver better quality of service. It's ideal for service providers that want to offer mobile broadband high speed internet connectivity. Being based on IP network, WiMAX is built for future scalability, which means that as deployment and performance increases, the cost per bit decreases. WiMAX offers a cheaper and more reliable solution for wireless broadband networks.