Technical Seminar Topic on

WIMAX

The next frontier broadband wireless......

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CONTENTS:

- Abstract
- Introduction
- What is WiMax?
- Architecture of WiMax
- Fundamental Technologies in WiMax
- WiMax access devices
- Features of WiMax
- Applications of WiMax
- WiMax Radio
- Future of WiMax
- Disadvantages of WiMax
- Conclusions
ABSTRACT

Imagine a single wireless technology that can make portable Internet a reality by extending public WLAN hotspots to metropolitan area coverage for mobile data-centric service delivery, connect enterprises and residential users in urban and suburban environments where access to copper plant is difficult, bridge the digital divide by delivering broadband in low-density areas. Thanks to the innovative technology, WiMax which offers broadband wireless access at data rates of multiple M bits/s to end-user and within a range of several Kilometers. The same technology will also offer high-speed data services to all nomadic terminals (Laptops, PDAs, etc) with optimized tradeoff between throughput and coverage.

WiMax is a much touted advanced technology can deliver big, complicated files to handsets as fast as desktops.WiMax will also be as painless as WiFi, turning your computer on will automatically connect you to the closest available WiMax antenna.
INTRODUCTION:
The wireless revolution is underway and devices based on radio technologies are expected to become a significant market in the next several years. Mobile phones, cordless phones, walkie-talkies, car door openers, garage door openers are just a few examples of radio devices that have already achieved widespread adoption in the marketplace. Out of the past several years, innovations in wireless radio technology such as Bluetooth, Wi-Fi(ieee-802.11b) and WiMax(ieee-802.16e) have captured our attention. Some pitfalls in has led to the advent of WiMax technology.

WiMax offers some advantages over WiFi, a similar wireless technology, in that it offers a greater range and is more bandwidth efficient. Ultimately, WiMax may be used to provide connectivity to entire cities, and incorporated into laptops to give users an added measure of mobility.

WiMax requires a tower, similar to a cell phone tower, which is connected to the Internet using a standard wired high-speed connection, such as a T3 line. But as opposed to a traditional Internet Service Provider (ISP), which divides that bandwidth among customers via wire, it uses a microwave link to establish a connection.

Because WiMax does not depend on cables to connect each endpoint, deploying WiMax to an entire high-rise, community or campus can be done in a matter of a couple days, saving significant amounts of manpower.

WHAT IS WIMAX?
WiMax is defined as World wide Interoperability for Microwave Access by the WiMAX Forum, formed in April 2001 to promote conformance and interoperability of the IEEE 802.16 standard, officially known as Wireless MAN. The Forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL".

WiMax is the real wireless architecture by which the wireless access range can be extended to 49.6Kms compared with Wi-Fi 91mts and Bluetooth’s 9mts. WiMax 802.16 has a single carrier modulation scheme that operates between 10GHz and 66GHz radio frequency and
requires line of sight towers for connection to work. The new ratified 802.16 extension uses a lower frequency range of 2GHz to 11GHz, and does not require line of sight towers. It also boasts 70Mbps data transfer rate that can support thousands of users.

ARCHITECTURE OF WiMax

The core components of a WiMax system are the subscriber station (SS) and the base station (BS). A BS and one or more SS’s can form a cell with point to multipoint (P2MP) structure. An 802.16 based system often uses fixed antenna at the subscriber station site. The antenna is mounted on a roof. Provisions such as adaptive antenna systems and sub channel stations are also supported by this system.

A BS typically uses either directional or omni directional antennas. A fixed SS typically uses directional antenna while mobile or portable SS uses an omni directional antenna. Multiple BS’s can be configured to form a cellular wireless network. The 802.16 standard also can be used in a point to point topology with pairs of directional antennas. This increases the effective range of the system compared to what can be achieved in P2MP mode.

FUNDAMENTAL TECHNOLOGIES IN WiMax:

OFDM (Orthogonal Frequency Division Multiplexing):

It is fundamental technology in digital TV. It transmits multiple signals simultaneously across the wireless transmission paths within separate frequencies to avoid interference. It is also supported in WLAN standard OFDM will almost certainly become dominant in all wireless technologies.

ADAPTIVE MODULATION

Many systems in the past decade have involved in the fixed modulation, offering a trade off between higher order modulation for high data rates. But requiring links or more robust lower order that will only operate at low data rates. But 802.16 supports adaptive modulation, balancing different data rates and link quality, making most efficient use of bandwidth.
FDD AND TDD

The standard also supports both frequency and time division multiplexing to enable interoperability with cellular and other Wireless system. FDD has been widely deployed in cellular telephony. It requires two channel pairs. One for transmission and other for reception, with some frequency separation between them to migrate self-interference.

TDD uses a single channel for both upstream and downstream transmissions, dynamically allocating bandwidth depending on traffic requirements.

WiMax ACCESS DEVICES

This figure shows some of the different types of WiMax access devices. This diagram shows that

FEATURES OF WIMAX:

The main feature of WiMax that make this technology popular are summarized below:

1) Flexible Architecture: WiMax supports several system architectures, including Point-to-Point, Point-to-Multipoint and ubiquitous coverage, which make WiMax a flexible Technology.

2) High Security: WiMax supports Advanced Encryption Standard (AES) and Triple Data Encryption Standard (3DES). By encrypting the links between the BS and the SS, WiMax provides subscribers with privacy and security across the broadband wireless interface.
3) **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.

4) **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.

5) **Mobility:** The IEEE 802.16e has improved OFDM and OFDMA physical layers to support devices and services in a mobile environment.

6) **Cost effective:** Mass adoption of the international standard of WiMax and the use of low cost mass-produced chipsets will drive the cost of SS and BS down.

7) **Wider Coverage:** WiMax dynamically supports modulation levels including BPSK, QPSK, 16-QAM and 64-QAM. Thus, WiMax systems cover a large geographic area when the path between the BS and SS is unobstructed.

8) **High capacity:** Using higher modulation (64-QAM) and channel bandwidth (currently 7 MHz), WiMax systems can provide significant bandwidth to end-users.

9) **Non-Line-of-Sight Operation:** WiMax is based on OFMD technology, which has

**APPLICATIONS OF WiMAX**

There are many usage scenarios that can be addressed by WiMax. The following are mobility usage applications of WiMax.

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.
2. 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 with high security and bandwidth to handle the traffic.

3. Educational Networks:
School boards can use WiMax networks to connect schools and school board offices within a district. Some 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.

4. 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 emergencies.

5. 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. Campus systems require high data capacity, low latency, a large coverage footprint, and high security.

WIMAX RADIO
This figure shows the components of a WiMax system, which include subscriber station, a base station and interconnection gateways. An antenna and receiver (subscriber station) in the home converts the microwave radio signals into broadband data signals for distribution in the home. In this example, a WiMax system is being used to provide television and broadband data communication services. The head-end system connects the WiMax system to a satellite connection for video on demand. When this broadband data signal is distributed in the home, it is converted into standard television signals (NTSC or PAL) via a set top box. The digital signal from the WiMax system also connects the Internet through a gateway to a computer in the home to provide...
broadband Internet through a gateway to a computer in the home to provide broadband Internet access. This example also shows that the 2-11 GHz lower frequency portion of the WiMax system (802.16A) can reach distances of 50 Km while the higher 10-66 GHz frequency portion of WiMax may be limited to approximately 5 to 10 Km.

FUTURE OF WiMAX
WiMax backers are working to sort out problems with service providers who want low-cost systems that support portable devices and roaming. In the development cycle, WiMax is expected to support Mobile wireless technology, which is a wireless transmission directly to mobile users. This will be similar in function to the General Packet Radio Services (GPRS).

• Mobile WiMax will win more than 80 million subscribers globally by 2013 according to a report by Juniper Research.
• Intel and Comstar are working to develop the first mobile WiMax in Russia.
• Videsh Sanchar Nigam Ltd (VSNL), a Tata Group company, plans to launch wireless broadband service on the wimax platform.

• Nokia is expect to see WiMAX capable mobile devices from Nokia sometime during 2008.

DISADVANTAGES OF WiMax
1) Line of site is needed for longer connections
2) Weather conditions like rain could interrupt the signal.
3) Other wireless equipment could cause interference.
4) Bandwidth is shared between users in a given radio sector. If there are many users in one sector, they will have lower speed. Users could have 2, 4, 6, 8, or 10 Mbps of the shared bandwidth. If users are moving, speed can drop significantly.
5) WiMAX is very power intensive technology and requires strong electrical support.
6) Big installation and operational coast.
CONCLUSION
WiMAX is a much touted advanced technology can deliver big, complicated files to handsets as fast as desktops. Despite of some of its limitations, WiMax is expected to be the dominant technology for wireless networking within five years.

By the time it will be fully mobile, as well as providing low cost, fixed broadband access that will open up regions where internet Access has so far not been practical. WiMax will be most significant technology in making wireless access ubiquitous and, as the free spectrum is opened up, in creating a major shake-up of the traditional shape of the wireless and mobile communication sectors.

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