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Voice and Video over the WiMAX

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ABSTRACT : The IEEE 802.16 standard, which is called Worldwide Interoperability for Microwave Access (WiMAX) is a low cost solution for Internet access in metropolitan and rural areas; it provides both high throughput and large coverage broadband wireless access. In this paper, we give the introduction about the voice and video streaming over a WiMax network.

Keywords –WiMAX, VoIP, WI-Fi, Video, PUMA

I. INTRODUCTION:

WiMAX (Worldwide Interoperability for Microwave Access) technology based on IEEE 802.16 standard and it is a telecommunication protocol offering full access to mobile internet across cities and countries with a wide range of devices, and is also called as a WMAN (Wireless MAN). It is a great invention in wireless technology providing 30 miles broadband access and with a maximum data transfer rate of up to 70 Mbps. It also supports a wide range of applications, which may include such as web browsing, file transferring, voice conferencing, VoIP, also real-time multimedia applications (e.g., video streaming and video conferencing), the applications requiring better quality of services may suffer due to reasons that the wireless channels are error prone, band-limited, etc. WiMAX is an up-coming technology for broadband wireless access and for providing wireless last mile connectivity, and provides both mobile and fixed broadband wireless Internet access. In WiMAX, the application of multimedia and communication had gathered a great importance in recent years. The name "WiMAX" was created by the WiMAX Forum, which was formed in June 2001 to promote conformity and interoperability of the standard. 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".

Fig.1 Wi-Fi Signal Logo

II. Worldwide Interoperability of Microwave Access

WiMAX is an IP based, wireless broadband access technology that provides performance similar to 802.11/Wi-Fi networks with the coverage and QOS (quality of service) of cellular networks. It is said to be the second generation broadband wireless access (BWA) standard and will most likely be used along with Wi-Fi, rather than replace it. Since WiMAX has such as large signal range, it will potentially be used to provide wireless Internet access to entire cities and other large areas. WiMAX can provide broadband wireless access (BWA) up to 30 miles (50 km) for fixed stations, and 3 - 10 miles (5 - 15 km) for mobile stations. In contrast, the Wifi/802.11 wireless local area network standard is limited in most cases to

only 100 - 300 feet (30 - 100m). WiMAX could replace cable and DSL services, providing universal Internet access just about anywhere you go. WiMAX will also be as painless as WiFi -- turning your computer on will automatically connect you to the closest available WiMAX antenna.

III. HOW WIMAX WORKS

It is offering an internet access to point to point/multipoint path. Wimax make possible the broadband access to conservative cable or DSL lines. The working method of Wimax is little different from Wifi networks, because Wifi computer can be connected via router, hotspot, or LAN card, while the connectivity of Wimax network constitutes of two parts in which one is Wimax Tower also known as Wimax base station and connects to the Wimax networks. These devices are usually stand alone Antenna or PCMCIA slot card for laptops or computers. This tower works exactly like GSM network phones towers standing high up in the air to broadcast radio signals. Wimax tower base station can cover up 10km radius. In theory it suggests to cover a lot more distance than just 10km, it can reach some where about 50km (30 miles), but in fact due to certain geographical limitations it goes as far as 10km approx. 6miles. Any wireless connecting device Wimax will connect to Wimax network if fallen in to range. Connecting to Wimax base stations works as similar as connection to Wifi to access point works, the only difference is that Wimax covers much wider area.

The Wimax network is just like a cell phone. When a user send data from a subscriber device to a base station then that base station broadcast the wireless signal into channel which is called Uplink and Base station transmit the same to the another user is called Downlink.

When signal transmit from user to Wimax base stationed base to user (Wimax receiver) the wireless channel faces many attenuation such as noise, reflection, refraction, wall obstruction etc. These all attenuation may cause of distorted, and split toward multi path. The main purpose of Wimax receiver is to rebuild again the transmitted data perfectly to make the possible reliable data transmission. The orthogonal frequency division multiplexed access (OFDMA) in Wimax technology, is a great technique used for transmitting large amounts of digital data over a radio wave. The OFDMA technology works by splitting the radio signal into multiple smaller sub-signals that are then transmitted simultaneously at different frequencies to the receiver. OFDMA reduces the amount of crosstalk in signal transmissions.

The independency of data is a great feature of OFDMA that prohibit interfering and be multiplexed. Enter scalability, because channels differ in size in different countries, the 802.16 standard supports all of the various channel sizes, ranging from 1.25Mhz to 20Mhz Wimax is providing quality of service (Wimax Qos) which enables high quality of data like VoIP or TV broadcasts, or for Video also.

IV. Types of WiMAX

The WiMAX family (802.16) mainly concentrates on two types of models: a fixed WiMAX and mobile WiMAX. The basic element that differentiates these systems is the ground speed at which the systems are designed to manage. Based on mobility, wireless access systems are designed to operate on the move without any disruption of service; wireless access can be divided into three classes; stationary, pedestrian and vehicular.

This raises a question about the Nomadic wireless access system, which is referred to

as a system that works as a fixed WiMAX network access system but can change its location.

1. *F*ixed Wimax

802.16 – 2004 is often called 802.16d, since that was the working party that developed the standard. It is also frequently referred to as "fixed WiMAX" since it has no support for mobility. Because communications takes place via wireless links from WiMAX Customer Premise Equipment (WiMAX CPE) to a remote Non Line-of-sight (NLOS) WiMAX base station. The fixed WiMAX serves the stationary and pedestrian classes. Another challenge for the Fixed WiMAX access air interface is the need to set up high performance radio links capable of data rates comparable to wired broadband service, using equipment that can be self installed indoors by users, as is the case for Digital Subscriber Line (DSL) and cable modems.

2. *M*obile Wimax

The 802.16a extension, refined in January 2003, uses a lower frequency of 2 to 11 GHz, enabling NLOS connections. These clients will be able to hand off between WiMAX base stations, enabling users to roam between service areas.

WiMAX Technology supports various protocols such as VLAN, IPv4 Ethernet etc.

Advantages of WiMAX Technology

- Coverage: The single station of WiMAX can operates and provide coverage for more than hundred of users at a time and also manage sending and receiving of data at very high speed with the full of network security.
- High Speed: The High speed of connectivity over a long distance and high speed voice makes it more demanded in hardly populated areas plus congested areas.
- Multi-functionality: WiMAX perform a variety of task at a time such as offering high speed internet, providing telephone service, transformation of data, video streaming, voice application etc.

WiMAX Limitations

- Low bit rate over Long distance: WiMAX technology offering long distance data range which is 70 kilometers and high bit rate of 70Mbit/s but both features does not work together when we will increase distance range the bit rate will decreased and if we want to increase bit rate then we should reduce the distance range.
- Speed of connectivity: The WiMAX other drawback is that any user closer to the tower can get high speed up to 30Mbit/s but if a user exists at the cell edge from the tower can obtain only 14Mbit/s speed.

V. Threats in WiMAX

Some of the attacks conducted at the various layers of WiMax are –

1. *P*hysical Layer Threats

1.1. Jamming

Jamming is the process of introducing a strong source of noise powerful enough to significantly reduce the signal to noise ratio [5].

1.2. Scrambling

Scrambling is another form of jamming, but for short intervals and is used to disorder targeted frames (mostly management messages) [7].

2. *M*ac Layer Threats

2.1. Eavesdropping

During basic and primary connection, MAC management messages are sent in plaintext and are not properly authenticated which can be used by an attacker to launch an attack [2].

2.2. Denial of Service (DoS)

An attacker can force a BS to digest a large amount of handoffs and then launch a denial of service attack [2]. In an 802.16 mesh network deployment routers or gateways that reside between base station and client

are susceptible to attacks in the application layer [2].

3. Network Layer Threat

3.1. Blackhole Attack

An attacker creates fake packets to target a valid node. A low cost route is advertized by the attacker. Subsequently the packets forwarded to it are dropped [2] as shown in Fig.5.

S – Source
N1-Node1
N2 - Node2
BH – Black hole
D – Destination

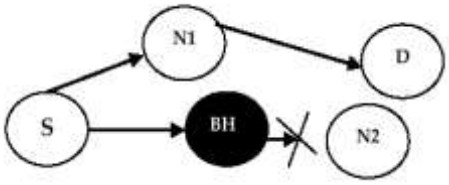

Fig.1 Blackhole Attack

3.2. Greyhole Attack

Grey Hole is a node that can alter from behaving correctly to behaving like a black hole where packets are dropped. This is done to avoid detection [2].

3.3. Wormhole Attack

In a wormhole attack, an attacker creates a high quality out-of-band link and forwards packets and replays those packets at another location in the network through that out-of-band link [2].

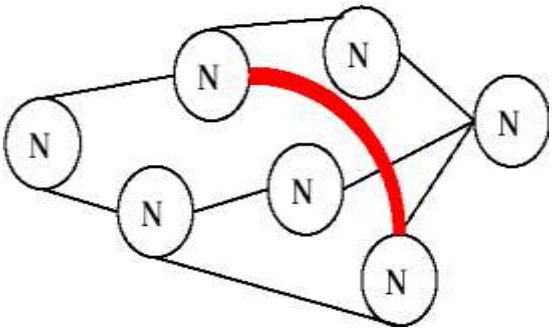

Fig.2 Wormhole Attack

The attacks may be present as there is a "Adhoc feature" in the current WiMax technology (even though this is not the case during its initial plan - a direct transmission from sender to base station).

VI. What is VoIP?

VoIP uses Internet Protocol for transmission of voice as packets over IP networks. Digitized voice will be carried in IP data packets over a LAN and/or WAN network. The legacy telephone network has provided reliable and high-quality voice communications for many years. It delivers voice and speech over a standardized 64 Kbps channel. The 64 Kbps bandwidth is guaranteed for each call and the speech path carries the voice as a continuous digital stream. In a VoIP network, there is a signaling protocol and a speech transmission protocol. Both protocols require all information be carried in IP packets. Several standards-based choices are available for signaling protocols, including H.323, SIP, MGCP and H.248. RTP is the standard speech transmission protocol used with VoIP networks. The speech is digitized, placed in packets, and transmitted through the IP network. Multiple packets are required to carry a single spoken word. The process involves digitization of voice, the isolation of unwanted noise signals and then the compression of the voice signal using compression algorithms/codes. After the compression the voice is packetized to send over an IP network, each packet needs a destination address and sequence number and data for error checking. The signaling protocols are added at this stage to achieve these requirements along with the other call management requirements. When a voice packet arrives at the destination, the sequence number enables the packets to be place in order and then the decompression algorithms are applied to recover the data

from the packets. Here the synchronization and delay management needs to be taken care of to make sure that there is proper spacing. Jitter buffer is used to store the packets arriving out of order through different routes, to wait for the packets arriving late.

Why use IP for voice?

One or more of the following may justify the move to VoIP:

• Reducing long distance charges, especially international long distance

• Reducing staff by combining voice-network and data-network management and eliminating redundant functions

There are two forms of a VoIP call:-

You can set up a PC-to-PC call without working with a call server. This is typically how the early users of VoIP made calls. However, the enterprises for a VoIP solution requires a call server (the standards community calls this a "gatekeeper") to be part of the network configuration. Although it is called a "server", the server does not operate like a traditional server.

-Call Server: In VoIP, the call server controls all the services offered, provides control over the call, supports the telephone features, authenticates and authorizes the caller and implements security. The call server is NOT the telephone switch. Once the call server sets up a phone (peer-to-peer) call, the server becomes in standby during the speech transmission unless the phones contact the server to indicate a change in status or the call server wants to change the call configuration, such as indicating there is a call waiting. The server is there to process the signaling, but does not switch the speech. The speech packets are passed directly from phone to phone.

-IP Phone: There are two major categories of IP phone implementations, hard phone and soft phone.

The hard phone contains all the hardware and software to implement VoIP. It is not a PC, but is specifically designed as a phone. Hard phones can be simple in their functions, but can also have color displays with touch sensitive screens and may even support web browsing. There is no typical hard phone on the market now-a-days.

The second category, the soft phone, is a headset connected to a PC with all the telephone features implemented by the sound card and software resident in the PC.

VII. Implementing VoIP over WiMAX

"I give a unique Identification name to this new technology as VoIP over WiMAX and named in future as ""VoMAX"".

Voice over Internet Protocol (VoIP) provides an alternative to the telephone service offered by the traditional Public Switched Telephone Network (PSTN) by using an IP network to carry digitized voice. Packet switched air interfaces that support flat IP architectures have now made it possible to run VoIP applications over wireless technology.

Compression/Decompression (CODEC) techniques for VoIP transform audio signals into digital bit streams. While preserving voice quality, speech samples are further compressed to produce bit streams of 8–12 kbps that are carried over the IP network. The compressed speech sample is then transmitted using the Real-time Transport Protocol (RTP) over the User Datagram Protocol (UDP) over the Internet Protocol (IP).

VoIP over wireless networks is affected by the choice of CODEC and packet loss, delay and jitter. Fluctuating channel conditions typically cause packet loss and increased latency. In order to keep mouth-to-ear round trip latencies to reasonable levels of 250–300 ms, the delay budget for transmission over the air interface is 50–80 ms. Channel

aware scheduling with Quality of Service (QoS) differentiation, Hybrid Automatic Repeat Request (HARQ) and dynamic link adaptation are used to keep delays within acceptable limits. Jitter buffers are used to compensate for delay jitter experienced by packets due to network congestion, timing drift or route changes.

VIII. Video

Video streaming is a multimedia service that gains significant development in recent years. The main problem that arises within that service is bandwidth fluctuation utilization on wireless channel network. In this paper, we propose combined methods of scalability as an attractive solution for the aforementioned problem. Scalable method on wireless communication must be suited to processed input/video sequence. To create combined scalable video coding (CSVC) method that match the QoS (Quality of Service) of video streaming service on wireless channel

IX. PUMA in WiMAX

Protocol for Unified Multicasting through Announcements (PUMA) [6] is used to multicast the scalable video streams over WiMAX networks. It aims to support the transportation of information from a sender to multiple receivers in a group while trying to use the available bandwidth efficiently. In PUMA, any source can send multicast data to a multicast group without having to knowing the constituent members of the group. Moreover source does not require joining the group to dispatch the data. PUMA is a receiver initiative approach where receivers join the multicast group using the address of a special core node. Every receiver connects to the elected core along all shortest paths between the receiver and the core. All nodes on the shortest paths between any receiver and the core collectively form the mesh. A sender sends a data packet to the group along any of the shortest paths between the sender and the core. When the data packet reaches a mesh member, it is flooded within the mesh, and nodes maintain a packet ID cache to drop duplicate data packets. PUMA uses a single control message for all its functions, the multicast announcement. Multicast announcements are used to: - elect cores dynamically - determine the routes for sources outside a multicast group to unicast multicast data packets towards the group - join and leave the mesh of a group - maintain the mesh of the group Each multicast announcement specifies a sequence number, the address of the group (group ID), the address of the core (core ID), the distance to the core, a mesh member flag that is set when the sending node belongs to the mesh, and a parent that states the preferred neighbor to reach the core.

Mesh Membership code	Distance to core
Group ID	
Core ID	
Sequence Number	
Parent ID	

Table1: Multicast Announcement Packet format

Successive multicast announcements have a higher sequence number than previous multicast announcements sent by the same core. With the information contained in such announcements, nodes elect cores, determine the routes for sources outside a multicast group to unicast multicast data packets towards the group, notify others about joining or leaving the mesh of a group, and maintain the mesh of the group.

X. Overview about the video and voice over IP

1. End to end Delay

End to end Delay is the total transit time for packets in a data stream to arrive at the endpoint and it is inevitable in communication system. Delay time is one of the most important factors in determining the quality of a call. Echoing has been a major problem that is caused by end to end delay. Typically, for optimum VoIP call quality, end to end delay must be less than 150ms.

2. Jitter

Jitter is one the most common VoIP problems. Jitter is the undesired time delay from the packets sending end to receiving end in VoIP or other video communication network. The jitter can be affected by computer usage, the length and quality of the Ethernet cables and some other issues. This will result in severe distortion in call quality or large increases in delay. Therefore in our case, we want to minimize the jitter as possible as we can.

-Jitter Buffer

Jitter buffers are used to adjust the delays. The delays are different from delivering the packets asynchronously. In order to play the audio stream we received, the receiving point will require constant delays other than variable delays. We need to adjust the jitter buffer by the size of the current jitter to avoid buffer overflow or underflow. If the buffer is overflow, we will lose part of the packets received. Also if the buffer is underflow, the buffer will be empty if we want to play the frame.

3. Packet Loss

Failure or one of more packets to reach their destination across the network is recognized as packet loss. The occurrence of lost and dropped packets are extremely noticeable with real time streaming technology such as Skype and online gaming. On another hand, there is always a degree of packet loss allowance in almost every network. There are possible causes that lead to packet loss, such as channel congestion, corrupted

XI. My Contribution towards this paper:

In this paper we are talking about the VoIP technology through WiMax. Though the higher speed and bandwidth we also work on different aspects of technology and with addition to this we obtain a better services like video conferencing over IP,4D Television with 4Generation WiMAX Network.

-Video Conferencing

In this we want to state a technology with aspects to video conferencing like that in voice there are more than two or more people get connected through a single network like wise I would talking about a need of conferencing with the different person at a one instance of time, by using this technology more than two person can see and share their thoughts across a network and play games, share their knowledge with different people and this technology will also help us in medi-claim aspects.

-4D Television with 4th Generation WiMAX

In this aspect we are talking about a 4D Television broadcasting will be possible with having a higher bandwith and a speed.

XII. Conclusion

In this paper, we discussed the transmission of VoIP and Video over WiMAX, the changes required in the existing protocols. The possible challenges encountered and their solutions. The effects of the advent of WiMAX on the existing telecom and Cable TV industry. Lastly we looked into the new aspects for the future generation in the WiMAX around the world.

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