ISSN 2229-5518

Empirical Speech Analysis of Wireless LAN over Wired LAN

Raihana Zannat[1], Sakib Ahmod[2], Shahab Uddin[3], Shamsuzzaman Miah[4], Ahmed Nur A Jalal[5], Ohidujjaman[6]

[1]Department of Software Engineering,

[2,3,4,5,6]Department of Computer Science and Engineering,

Daffodil International University, Dhaka-1207

Abstract— Earth is becoming a global rural community. As a result communication is gaining increased importance. The wireless LANs are becoming more and more popular because they can gratify the requirement like mobility, relocation of user, ad-hoc networking and coverage of locations which are difficult to wire. Earlier the wireless LANs were costly, could support only low data rates, a license was required. Hence there were limitations on the practical utility of wireless LANS. However all these problems are being addressed now which is increasing the popularity of wireless LANs day by day. This study is concerned with establishing audio calls using wireless and wired LAN. There is utilized adhoc network for achieving this purpose. Establishing wireless LAN is easier, cost effective and less time consuming than establishing wired LAN. This study analyzes the performance of voice data packet for both cases such as wireless and wired LAN. This research also shows Real-time Transport Protocol (RTP) stream analysis and RTP graph analysis.

Index Terms— H.323, IEEE 802.11 standard, jitter, RTP, wireless LAN, wireshark

1 Introduction

VOICE over Wireless LAN (VoWLAN) is a technique of transfer voice information in digital form over a wireless broadband network. VoWLAN is a VoIP delivered through wireless technology. The technology is sometimes called VoWi-Fi or Wi-Fi VoIP since it uses the IEEE 802.11 set of specifications for transporting data over wireless local area networks and the Internet. Each IEEE standard is called protocol individually. VoWLAN entails a voice enabled wireless device, most commonly a PDA or a Wi-Fi handset which looks and functions like a cell phone, but sends voice as discrete data packets rather than an analogue voice stream. Callers can also use a software-based phone, known as a soft phone that resides on devices including laptop and desktop computers. A voice over Wireless LAN system proposes tremendous benefits to the organizations like warehouses, campuses and hospitals. The major benefits are mobility of user and saving cost, like within a campus teachers and administration persons can maintain voice communications at any time at less cost compared to Wired LAN and cellular service. The IT manager is generally visiting with technicians distributed in various parts of the facility, making sure that projects, such as PC hardware upgrades, are going smoothly. The problem is that when issues arise, the technicians have no way of contacting the IT manager immediately. The technicians use a phone in the office where they are working to call the manager's office, and 90 percent of the time must leave a voice message. In most cases, hours would pass before the manager would receive the message [15]. The solution to this problem is for this company to make use of a wireless LAN and deploy VoWLAN phones to the managers. This solution enables just about anyone to reach an appropriate manager within seconds, without experiencing the delays of voice mail. VoWLAN contributes to cost efficiency because calls can be routed over the data network internally or over the Internet externally, mobile telephony costs can be eliminated or decreased significantly. Major obstructions to VoWLAN include incompatible voice performance and the need for quality of service (QoS); slow and unreliable encryption and authentication; and the proprietary nature of current products [2]. The IEEE and the WiFi alliance have been developing standards improvements to mitigate VoWLAN limitations. The recent 802.11i standard implemented intelligent security to speed up authentication while roaming [3].

1.1 Major Structure of Different LAN

There are three basic core systems to establish wireless LAN such as Basic Service Set (BSS), Extended Services Set (ESS) and Distributed System (DS). Every BSS has an identification (ID) called the BSSID, which is the MAC address of the access point servicing the BSS. Each ESS has an ID called the SSID which is a 32-byte character string. The concept of a Distributed System (DS) can be used to increase network coverage through travelling between cells. Distributed system mainly two types such as wired and wireless distributed system. In this research wireless LAN is set up by creating an SSID (Service Set ID) in the server PC (Personal Computer). The major wireless LAN physical structures are classified into three categories such as Peer-to-Peer (P2P), Bridge, Wireless Distributed System (WDS). Peer to peer (P2P) network is an ad-hoc network, also called Wi-Fi Direct network. A peer-to-peer (P2P) network allows wireless devices to directly communicate with each other. Wireless devices within range of each other can discover and communicate directly without involving central access points. This method is typically used by two computers so that they can connect to each other to form a network. In this study Peer-to-Peer (P2P) wireless LAN and wired LAN are configured to examine the primary data. The figures 1 and 2 show the ad-hoc wireless LAN and Ad-hoc wireless LAN features.

IJSER © 2021
http://www.ijser.org

Fig. 1. Peer-to-Peer or adhoc wireless LAN

Fig. 2. Adhoc wireless LAN features

A wired LAN is constructed by using UTP cable for peer-to-peer networks. Alternatively maximum number of PCs connected through third party device such as router, switch and hub etc. For the study there uses switch for connecting maximum number of computers. Figures 3 and 4 show Peer-to-Peer or adhoc wired LAN and adhoc wired LAN features.

Fig. 3. Peer-to-Peer or adhoc wired LAN

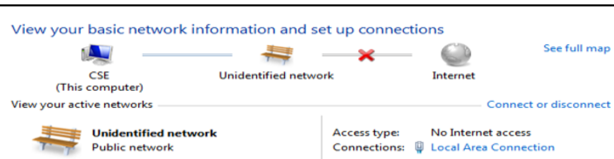

Fig (a) Adhoc wired LAN for CSE computer

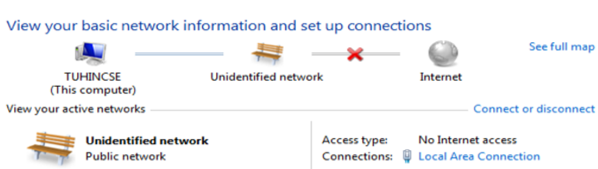

Fig (b) Adhoc wired LAN for TUHINCSE computer

Fig. 4. Adhoc wired LAN features

1.2 IEEE Specification

Several IEEE set of standards are deploying to provide wireless broadband access in local area network (LAN) such as campuses, offices. Voice over wireless LAN system utilizes the IEEE standards such as IEEE 802.11, IEEE 802.11g (Wi-Fi), IEEE 802.11b (Wi-Fi), IEEE802.11a (Wi-Fi), IEEE 802.16 (Wi-MAX), IEEE802.16a (Wi-MAX).The most popular are the 802.11b and 802.11g protocols, which are modification to the original standard. 802.11-1997 was the first wireless networking standard, but 802.11a was the first widely accepted one, followed by 802.11b and 802.11g. IEEE 802.11n is a new multi-streaming modulation technique. Data rate of the two popular IEEE standards 802.11b and 802.11g are respectively up to 11Mbps and 54Mbps in the 2.4GHz band. These two standards also included Pre Shared-Key (PSK) encryption mechanisms: Wired Equivalent Privacy (WEP) and Wi-Fi Protected Access (WPA). There are two versions of WPA2: WPA2-Personal, and WPA2-Enterprise. WPA2-Personal protects unauthorized network access by utilizing a set-up password. WPA2-enterprise verifies network users through a server. In this study WAP2 pre shared key encryption mechanism is used as a primary experiment. To encrypt a network with WPA2-PSK one provides the router not with an encryption key, but rather with a plain English passphrase between 8 and 63 characters long using a technology called TKIP. The table 1 shows the IEEE specifications.

IJSER

TABLE 1
IEEE SPECIFICATION [13]

Standard	Data Rate	Security
IEEE802.11	Up to 2 Mbps in the 2.4GHz band	WEP and WPA
IEEE802.11a (Wi-Fi)	Up to 54 Mbps in the 5GHz band	WEP and WPA
IEEE802.11b (Wi-Fi)	Up to 11Mbps in the 2.4GHz band	WEP and WPA
IEEE802.11g (Wi-Fi)	Up to 54Mbps in the 2.4GHz band	WEP and WPA
IEEE 802.16 (WiMAX)	Specifies WiMAX in the 10 to 66 GHz range	DES3 and AES
IEEE 802.16a (WiMAX)	Added support for the 2 to 11 GHz range.	DES3 and AES

1.3 Problem Statements

- ✓ No mobility
- ✓ Cost consuming
- ✓ Maximum haphazard
- ✓ Difficult to construct the networks
- ✓ Wired maintenance problem
- ✓ Space consuming
- ✓ Time intense

ISSN 2229-5518

2 Methodology

- ✓ Construct wireless LAN (ad-hoc P2P network)
- ✓ Construct wired LAN (P2P and switch to PCs)
- ✓ Voice conversation between two ends by H.323 phone for wireless LAN
- ✓ Voice conversation between two ends by H.323 phone for wired LAN
- ✓ Voice capture using Wireshark (packet analyser) by RTP protocol for wireless LAN
- ✓ Voice capture using Wireshark (packet analyser) by RTP protocol for wired LAN
- ✓ Analysis voice packet for both cases such as wireless LAN and wired LAN
- ✓ RTP graph analysis from jitter for both cases such as wireless LAN and wired LAN

3 Background

3.1 OSI layer for LAN architecture

LAN protocol utilizes only OSI layers 1 and 2, the physical and data link layers, respectively. The data link layer is split into two sub layers: Logical Link Control (LLC) and Medium Access Control (MAC).These relationships are shown in figure 5. The functions of OSI Layers 1 and 2 are incorporated in LAN architecture. Layer 3, the network layer in LAN architecture is concerned with routing involved with LANs. There is a direct link involved between any two points. The other functions carried out by OSI layer 3-addressing, sequencing and flow control are carried out by layer 2 in LANs. The difference is that the layer 2 performs these functions across a single link. OSI layer 3 carries out these functions across a sequencing of links required to traverse a network. It is obligatory; only one link required traversing a LAN. However, only two layers are implemented in LAN [20].

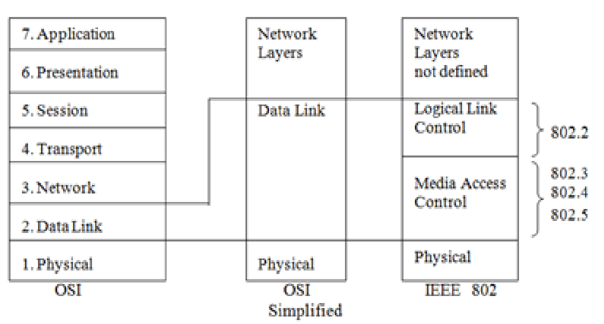

Fig. 5. LAN 802 architecture related to OSI

3.2 Real-time Transport Protocol (RTP)

RTP is the Internet-standard protocol for the transport of real-time data, including audio and video. It can be used for media on demand as well as interactive services such as Internet telephony. RTP consists of a data and a control part. The latter is called RTCP (RTP Control Protocol). The data part of RTP is a thin protocol providing support for applications with real-time properties such as continuous media (e.g., audio and video), including timing reconstruction, loss detection, security and content identification. RTCP provides support for real-time conferencing of groups of any size within an internet. It offers quality-of-service feedback from receivers to the multicast group as well as support for the synchronization of different media streams. The RTP Control Protocol (RTCP) is a sister protocol of the Real-time Transport Protocol (RTP) [16]. Typically RTP will be sent on an even-numbered UDP port, with RTCP messages being sent over the next higher odd-numbered port [17]. The primary function of RTCP is to provide feedback on the quality (QoS) in media distribution by periodically sending statistics information to participants in a streaming multimedia session.

3.3 H.323 Phone

H.323 is a recommendation from the ITU Telecommunication Standardization Sector (ITU-T) that defines the protocols to provide audio-visual communication sessions on any packet network. The H.323 standard addresses call signaling and control, multimedia transport and control, and bandwidth control for point-to-point and multi-point conferences [10]. There are two standard protocols: Session Initiation Protocol (SIP) and H.323, (Skype [2] and some others use proprietary signaling and messaging protocols). H.323 [1] is ITU (International Telecommunication Union) standard based on Real-time Protocol (RP) and Real-Time Control Protocol (RTCP); H.323 is a set of protocols for sending voice, video and data over IP network to provide real-time multimedia communications. H.323 is reliable and easy to maintain technology and also is the recommendation standard by ITU for multimedia communications over LANs [3], [4].

3.4 Delay Variation Jitter

Delay variation also called Jitter. Jitter is the difference value between the delays of two queuing packets. Root causes of jitter including network conditions and packet loss; it is very difficult to deliver voice traffic at a constant rate. In order to minimize jitter a jitter buffer (also known as play out buffers) is needed. Jitter value is considered acceptable between 0ms and 50 ms and above this is considered as unacceptable [6]. Jitter is a typical problem of the connectionless networks or packet switched networks. Due to the information is divided into packets each packet can travel by a different path from the emitter to the receiver. Jitter is technically the measure of the variability over time of the latency across a network. Jitter between the starting and final point of the communication should be less than 100ms. However, jitter value is smaller than 100 ms it can be solved otherwise not must be reduced. The best solution is to use jitter buffers. A jitter buffer is basically to assign a small buffer to receive the packets and give it to the receiver with a small delay. If jitter buffer is increased turns out in less packet loss but more delay. A reduction turns out in less delay but more packet loss [9].

3.5 Wiresahrk (Packet Analyser)

Wireshark is a free and open source packet analyser. It is used for network troubleshooting, analysis, software and communications protocol development, and education. Originally named Ethereal, in May 2006 the project was renamed Wireshark due to trademark issues [11]. Wireshark is crossplatform, using the GTK+ widget toolkit to implement its user interface, and using pcap to capture packets; it runs on various Unix-like operating systems including Linux, OS X, BSD, and Solaris, and on Microsoft Windows. There is also a terminal-based (non-GUI) version called T-Shark. Wireshark, and the other programs distributed with it such as T-Shark, are free software, released under the terms of the GNU General Public License. Wireshark is very similar to TCP dump, but has a graphical front-end, plus some integrated sorting and filtering options.

4 Applications [12][20]

- ✓ It will be useful for small mall scale industries for giving instructions to employees by making audio calls without using internet bandwidth.
- ✓ It will be helpful for educational institutions since it is very easy to establish an audio conferencing using which departments can be connected faster and communicated.
- ✓ Small organizations which are looking for cost cutting and time saving means for communication can use this.
- ✓ Peer-to-peer wireless LAN is set up temporarily to meet some immediate need
- ✓ Network for duration of meeting
- ✓ No fixed infrastructure, so space is saved.
- ✓ Flexible mobility

5 Experimental Result

5.1 Speech Diagram at RTP Player for Wireless LAN

In forward case the speech quality is clear, neat and noiseless, but in case of reverse direction the output is ignorable, trace-less and noisy. This conclude that the input voice never be traced in reverse direction from other end while in forward direction processing. The speech diagram in forward and reverse direction is shown in figure 6 and 7.

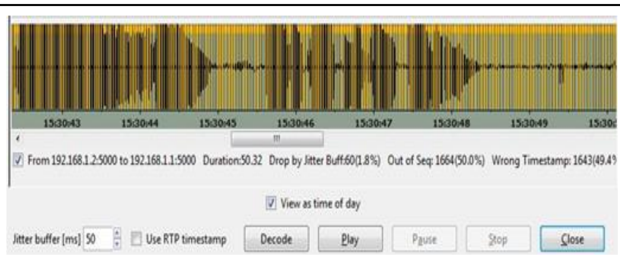

Fig. 6. Speech diagram at RTP player (forward direction)

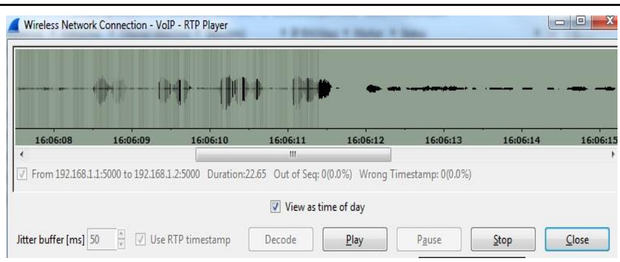

Fig. 7. Speech diagram at RTP player (reverse direction)

5.2 Speech Diagram at RTP Player for Wired LAN

In forward case the speech quality is clear, neat and noiseless, but in case of reverse direction the output is ignorable, trace-less and noisy. This conclude that the input voice never be traced in reverse direction from other end while in forward direction processing. The speech diagram in forward and reverse direction is shown in figure 8 and 9. Speech quality is not enough good comparing with the wireless LAN for both forward and reverse cases.

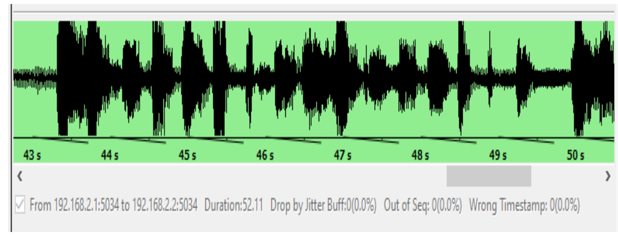

Fig. 8. Speech diagram at RTP player (forward direction)

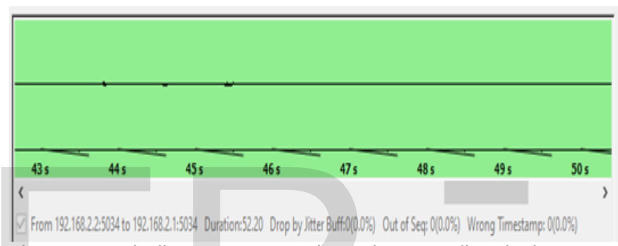

Fig. 9. Speech diagram at RTP player (reverse direction)

5.3 RTP Stream Analysis for Wireless LAN

Total RTP packets are 1664 and retrieve same amount in case of forward direction but two packets are lost in reverse direction. The error rate is 0.36% in reverse direction. Also mention that, from two figures jitter and mean jitter time are raised in reverse direction. The RTP stream analysis in forward and reverse direction is shown in figure 10 and 11.

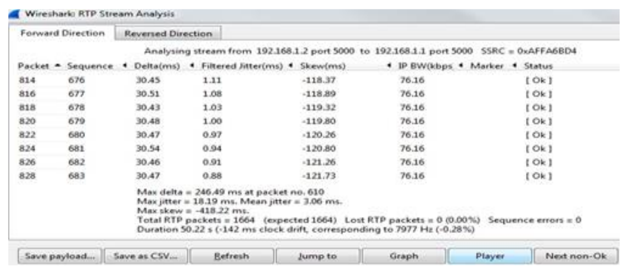

Fig. 10. RTP stream analysis chart (forward direction)

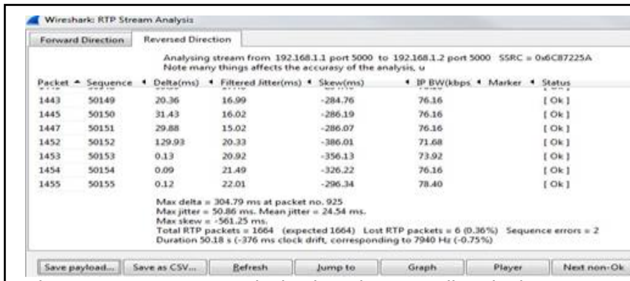

Fig. 11. RTP stream analysis chart (reverse direction)

5.4 RTP Stream Analysis for Wired LAN

Total RTP packets are 1737 and 1740 in case of forward and reverse directions and, retrieve same amount packet in both cases. The error rate is 0.00% in both directions. Also mention that, from two figures jitter and mean jitter time are reduced in reverse direction. The RTP stream analysis in forward and reverse direction is shown in figure 12 and 13.

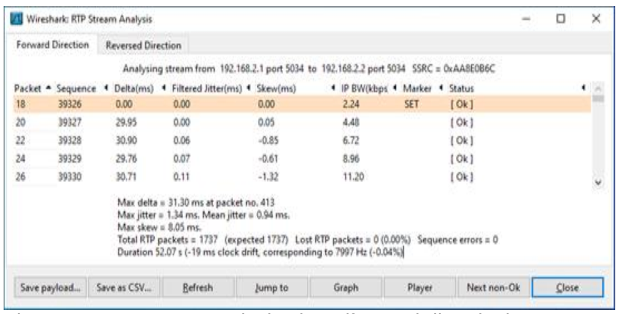

Fig. 12. RTP stream analysis chart (forward direction)

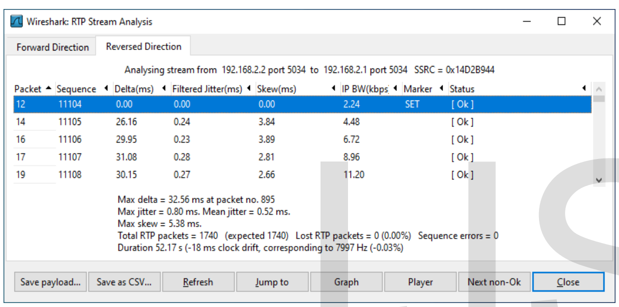

Fig. 13. RTP stream analysis chart (reverse direction)

5.5 RTP graph analysis for Wireless LAN

The RTP graph shows the speech frame in peak and down status and some are missing. From 2.0s to 3.0s the peak frame size is rare. Moreover after 5.0s the some frames are over-lapped.

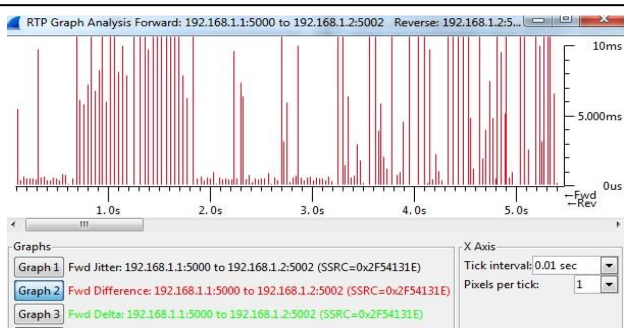

Fig. 14. RTP graph analysis chart

5.6 RTP graph analysis for Wired LAN

The RTP graph shows the speech frame in almost same status and some are noisy which represent in red color. From the figure it is shown that before 51.0s and near to 51.50s two frame are noisy. Moreover after 52.0s one more frame is noisy.

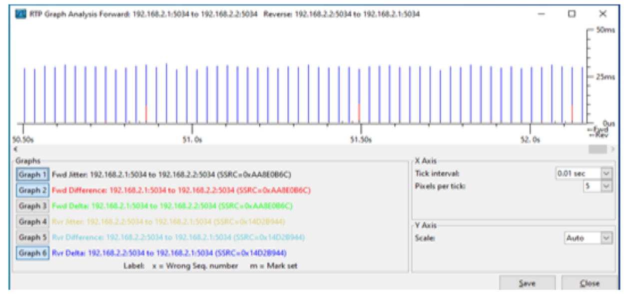

Fig. 15. RTP graph analysis chart

5.7 UDP Stream for RTP in case of Wireless LAN

The UDP stream contents are in two color pattern representing in hexadecimal data packet and some dotted symbols. These different patterns of data packets ensure the security issues comparing wired LAN. The user datagram protocol (UDP) in case of wireless LAN is shown in figure 16.

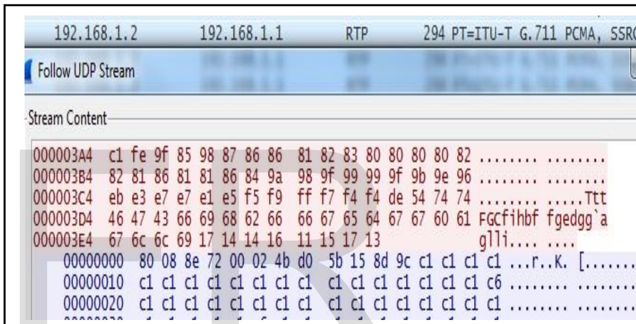

Fig. 16. UDP stream for wireless LAN

5.8 UDP Stream for RTP in case of Wired LAN

The UDP stream contents are in two color pattern representing in hexadecimal data packet and some dotted symbols. These different patterns of data packets ensure the security issues comparing wireless LAN. The user datagram protocol (UDP) in case of wired LAN is shown in figure 17.

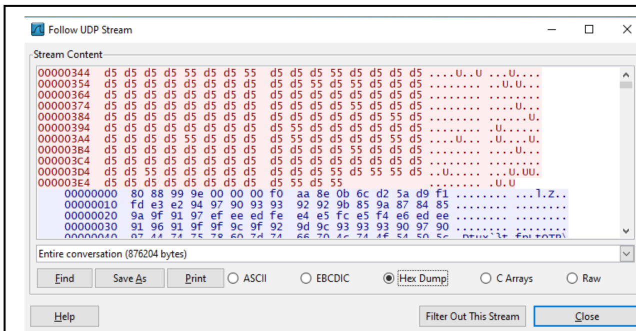

Fig. 17. UDP stream for wired LAN

6 RESULT DISCUSSION

Performance of voice quality for wireless LAN and wired LAN is not identical. Typically voice quality of wired LAN is better than wireless LAN. Capturing voice at RTP player for wireless LAN is better in forward direction compared to reverse direction in perspective of same voice which is shown in the fig.6 and Fig.7. Similar result is shown in case of wired LAN in fig. 8 and fig. 9. By observing the experimental results it is conclude that wireless LAN provides comparatively less noise rather than wired LAN. For RTP stream analysis in the forward case there is no RTP packets loss, but at the reverse direction there are 2 packets loss but it may vary. In the both directions expected packets were 1664.Total duration in forward case is 50.22s and reverse is 50.18 seconds. In case of wired LAN there is no packets loss and the total expected packets of forward direction is 1737 where 1740 packets are in reverse direction. RTP graph analysis in fig.14 and fig. 15 shows the difference (packet queuing time) between the delays of two queuing packets. It is predicted by using jitter which is called delay variation. UDP stream for wired LAN represents complex type hexadecimal data packet and also more of dotted symbol, but in case of wireless LAN UDP stream for real time protocol shows two types combination of hexadecimal data packets and dotted symbol. However examining every cases of wireless LAN and wired LAN, it is very lucid that both voice and packet data wireless LAN performs relatively enhanced performance rather than wired LAN.

IJSER

7 CONCLUSION

Wireless LANs are used when the computers that need to be linked together are in different distances. However wired LANs need third party network devices such as router, switch and so more to operate the network, but users connect up to the network using modems, usually connected to the telephone system. Wireless technology such as microwaves or satellite can also be used. While wireless (WIFI) networks are just like fixed LANs but instead of using cables, devices are linked by radio waves. Each computer in a wireless network requires a wireless network interface card (MC). These allow each component in the network to communicate with a wireless access point (AP) to create a wireless local area network. Comparing different parameters wireless LAN provides better result in performance rather than wired LAN. In future we will consider more parameters for finding the effectiveness of network.

REFERENCES

[1] ITU-R Rec. H.323 (1999).Packet-Based Multimedia Communications Systems.

[2] Skype official website: http://about.skype.com/

[3] S. K. Das, E. Lee, K. Basu, & S. K. Sen , "Performance Optimization of VoIP Calls over Wireless Links Using H.323 Protocol", Computers. IEEE Transactions, Vol. 52, No. 6 Page(s):742 – 752, 2003.

[4] G. A. Thom, "H.323: the multimedia communications standard for local area networks", Communications Magazine, IEEE, Volume 34, Issue 12, page(s): 52-56, 1996.

[5] L. Hong, & P. Mouchtaris, "Voice over IP signaling: H.323 and beyond", Communications Magazine, IEEE, Volume 38, Issue 10, Page(s):142 – 148, 2000.

[6] L. Milandinovic, & J. Stadler, " Multiparty Conference Signaling using SIP", International Network Conference, 2002

[7] J. Rosenberg, H. Schulzrinne, G. Camarillo, A.Johnston, J. Peterson, R. Sparks, M. Handley, & E. Schooler, "SIP: Session Initiation Protocol", RFC 3261, IETF, 2002.

[8] B. Goode , "Voice Over Internet Protocol (VOIP)", Proceedings of three IEEE, Volume 90, Issue 9, Page(s): 1495 – 1517, 2002

[9] http://www.en.voipforo.com/QoS/QoS_Jitter.php(Delay variation Jitter)

[10] Davidson, Jonathan; James Peters, Jim Peters, Brian Gracely. "H.323". Voice over IP fundamentals. Cisco Press. pp. 229–230. ISBN 978-1-57870-168-1.

[11] "Wireshark FAQ". Retrieved 31 December 2011. (Sniff Tool)

[12] Ravindra L. Pardhi, Vishwas T. Gaikwad, "Voice and Video over Wireless LAN", ISSN: 0975-3397 NCICT 2010 Special Issue.

[13] http://www.webopedia.com/quick_ref/WLANStandards.asp

[14] Wireless Distribution System Linked Router Network DD-WRT Wiki. Retrieved December 31, 2006.

[15] http://searchitchannel.techtarget.com/feature/Voice-over-Wireless-LAN-in-the-enterprise.

[16] H. Schulzrinne, S. Casner, R. Frederick, V. Jacobson, "RTP: A Transport Protocol for Real-Time Applications" , The Internet Society (July 2003)

[17] C. Huitema, "Real Time Control Protocol (RTCP) attribute in Session Description Protocol (SDP)" , Microsoft (October 2003)

[18] Di Wu, "Performance Studies of VoIP over Ethernet LANs", A dissertation submitted to Auckland University of Technology, 2008

[19] Ravindra L. Pardhi, Vishwas T. Gaikwad, "Voice and Video over Wireless LAN", (IJCSE)

[20] Book, Roger L. Freeman, Telecommunication System Engineering (Third Edition)

[21] Kashif Nisar, Nurul I. Sarkar, Suhaidi B Hassan, Di Wu4, "Performance Studies of VoIP over Ethernet LANs", International Journal of the Computer, the Internet and Management Vol. 19. No.3 (September-December, 2011) pp 1 -7