Journal of Basic and Applied Engineering Research
Print ISSN: 2350-0077; Online ISSN: 2350-0255; Volume 2, Number 14; April-June, 2015 pp. 1201-1207

http://www.krishisanskriti.org/jbaer.html

Performance Evaluation of VoIP Packet in MANET under the different Audio Codec G.711, G.722 and GSM using OPNET

Atul Sharma[1] and Naveen Bilandi[2]

[1,2]Dept. of Computer Science &Engineering DAV University Jalandhar, India
E-mail: [1]atulsharma334@yahoo.in, [2]naveen.bilandi@davuniversity.org

Abstract—*A mobile ad hoc network (MANET) involves of moveable nodes in wireless medium that are communicated to each other without any third party or base station. The message data is transfer between these mobile nodes that is sanctioned out without any centralized control. MANET is a self-prearranged and self-configurable network where the mobile nodes move capriciously. With the growing of the Internet application, multimedia and Voice over IP (VoIP) has been playing a key role in wireless network. This paper presents a performance analysis of three Mobile Ad Hoc Network (MANET) routing protocols – AODV, OLSR and TORA under the audio codecs such as G.711, G.722, and Global Systems for Mobile Communications (GSM) in voice application. Performance of the voice applications depends on the quality of service requirements like throughput, delay, network load by GSM traffic and retransmission. Simulation results by the OPNET 14.5 is also showed that AODV reactive routing protocol is the best suited for MANET networks in with voice codecs data in real time application.*

Keywords: *MANET, AODV, OLSR, TORA, GSM, G.71, G.72, OPNET.*

1. INTRODUCTION

In MANET every node finds the route by route request. Routing protocol plays a crucial role to send the data from source to destination that discovers the optimal path between the two communication nodes. Each protocol has its own rules (algorithm) to finds the route or maintenance the route. There are various routing protocol proposed by researchers. MANETs [1] are facing various challenges for e.g. No central controlling authority, Mobility models, limited power ability, continuously maintains the information required to properly route traffic. Mobility models are also a factor that puts a deep impact over the performance of a MANET and need to be concerned.

MANET is wide network so different node may communicate over the same limited bandwidth. So there may be the problem of congestion, so to cover such problem appropriate routing is required to be done. Good routing can be done by different routing protocols which find out the path between two nodes. There are many type of routing nodes in MANET are shows in the Fig. 1.

MANET routing protocols are traditionally divided into three categories which are Proactive Routing Protocols, Reactive Routing Protocols, Hybrid.

The most popular routing protocols [2] [3] in MANET are AODV (reactive) [4] [5], DSR (reactive) [6], OLSR [7] [8] (proactive) and TORA (hybrid) [9]. Reactive protocols find the routes when they are desired. Proactive protocols are table driven protocols and discovery best routes before they need it. And finally hybrid routing protocols offer an efficient framework that can concurrently draw on the strengths of proactive [2] and reactive routing protocols [3]. Proactive Routing protocol, a node is closely able to route (or drop) a packet. Examples of proactive protocols include the Optimized Link State Routing Protocol OLSR. Reactive Routing protocols are characterized by node gain and maintain routes on demand. i.e., a route to a destination is not acquired by anode until packet is not received by a destination node. Examples of reactive protocols are Ad-Hoc on Demand Distance Vector Routing Protocol (AODV) [10]. In this paper, we focus on two MANET routing protocols AODV, OLSR and TORA. We consider four parameters to evaluate the performance of these routing protocols: Throughput, Delay, Retransmission and Network Load by GSM traffic and Retransmission.

The rest of this paper is planned as follows. In section 2 we briefly describe the routing protocols in MANET. In Section 3 presents related work. In section 4 the Simulation environment and research Methodology used for evaluation of the said protocols and traffic. In Section 5 we analysis our simulation results and observations. Finally, section 6 concludes the paper.

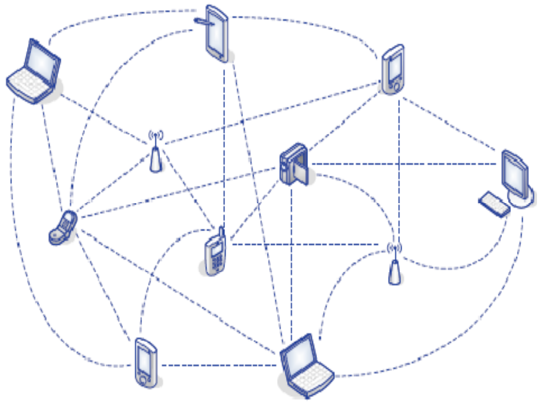

Fig. 1: Mobile Ad-hoc Network

2. ROUTING PROTOCOLS IN MANETS

2.1 Ad-hoc on demand distance vector (AODV)

AODV [4] is based upon on-demand routing protocol. Its provides on-demand route discovery in MANET. When the nodes need to send data to the destination, if the source node doesn't have routing information in its table, route discovery process begins to find the routes from source to destination. Route discovery begins with broadcasting a route request (RREQ) [12] packet by the source node to its neighbours. RREQ packet comprises broadcast ID, two sequence numbers, and the addresses of source and destination and hop count. The intermediary nodes which receive the RREQ packet could do two steps: If it isn't the destination node then it'll rebroadcast the RREQ packet to its neighbours. Otherwise it'll be the destination node and then it will send a unicast replay message, route replay (RREP), directly to the source from which it was received the RREQ packet.

2.2 Optimized Link State Routing Protocol (OLSR)

The OLSR [5] is a table driven protocol. It usually stores and updates its routes so when a route is needed, it present the route immediately without any initial delay. In OLSR, some candidate nodes called multipoint relays (MPRs). Multipoint Relay (MPR) nodes broadcast route packets. These MPR nodes can be selected in the neighbor of source node. Each node in the network keeps a list of MPR nodes.

Multi-Point Relays (MPR) [14] are used to avoid unnecessary broadcast of packet retransmissions, moreover only partial link state is flooded to provide the shortest path route.

2.3 Temporally Ordered Routing Algorithm

TORA [6] is a routing algorithm. It is mainly used in MANETs to enhance scalability. TORA is an adaptive routing protocol. It is therefore used in multi-hop networks. A destination node and a source node are set. TORA establishes scaled routes between the source and the destination using the Directed Acyclic Graph (DAG) built in the destination node. This algorithm does not use 'shortest path' theory, it is considered secondary.

3. RELATED WORK

We also studied performance evaluation of AODV, OLSR and TORA protocols, in that study various QoS parameters used were throughputs, end-to-end delay and network load. But a real evaluation of performance of protocols must also describe the degree of variability in packet arrivals, which can be caused by network congestion (bursts of data traffic), timing drift or because of route changes. Eric Thibodeau et.al. [7] represent node mobility and node density have a limited influence on the performance of the protocol. However, the route length and the network load seem to be the critical factors deteriorating the performance of the routing protocol. We finally suggest solutions in order to reduce MAC layer misbehaviour and to improve future MANET routing protocols for mobility support of VoIP. Suhaib A. Obeidat et. al. [8] describe an adaptation scheme that maintain acceptable quality while minimizes bandwidth consumption is proposed, it combines compression and modulation in a way to increase the chance of a connection survival throughout the lifetime of a call as opposed to focusing on short time quality and also gives system model for generating voice traffic. The packet drops are due to link break, collision and congestion in the ad hoc network. Dimitri Perrin et. al. [9] there are several reasons for packet drops such as network congestion, link break and collision. In the given situation as we have increased work load by increasing the number of connections, heavy packet drops occur. DSDV drops more packets than AODV. Congestion is the possible reason for higher delay at high traffic load. Delay variation is less in DSR. Among AODV and DSDV protocol, end-to- end delay is high for DSR. 2.

During literature review, it was observed that in most of the studies, the performance was qualitatively described (indicating whether the experience is a good or bad one). But, there is also a numerical method called Mean Opinion Score (MOS) that gives a numerical indication of the perceived quality of the media received after being transmitted and eventually compressed. In most of the studies, the major drawback is that the performance evaluation is done on the basis of traffic patterns such as CBR, FTP ,Telnet and but for the use of real time data application(VoIP) voice over internet protocol GSM based provides a better and more efficient way of optimum resource utilization.

DSR has performed well compared to AODV and DSDV in the situation of heavy traffic load.

4. SIMULATION ENVIRONMENT AND RESEARCH METHODOLOGY

We carried out simulations on Opnet 14.5 [10] [11] simulator [21]. The simulation parameters are summarized in table 1. Modeller is commercial network simulation environment for network modeling and simulation. IP networks are on a steep slope of innovation that will make them the long-term carrier of all types of traffic, including voice. However, such networks are not designed to support real-time voice communication because their variable characteristics (e.g. due to delay, delay variation and packet loss) lead to a deterioration in voice quality. A major [12] challenge in such networks is how to measure or predict voice quality accurately and efficiently for QoS monitoring and/or control purposes to ensure that technical and commercial requirements are met. They can be used to translate between IP addresses and telephone numbers, perform registration and authentication functions, and manage bandwidth [16]. In the VoIP MANET (VoMANET) System. Fig. 2 shows the components of the dhcp amd mobile ip. The VOIP system metrics delay, throughput, load, MOS, packet loss are shows the QoS.

(a) Ad Hoc Nodes- Each node [18] in the ad hoc network functions as both a client and a server. As clients, the nodes complete two tasks - send requests to the network and receive information from the network. As servers, the nodes process information received from the network and determines whether packets require forwarding.

(b) MAC Layer Protocol - IEEE 802.11g. A MAC [19] layer protocol provides coordinated access to the network. The MAC layer is responsible for the transport of frames at the data link layer.

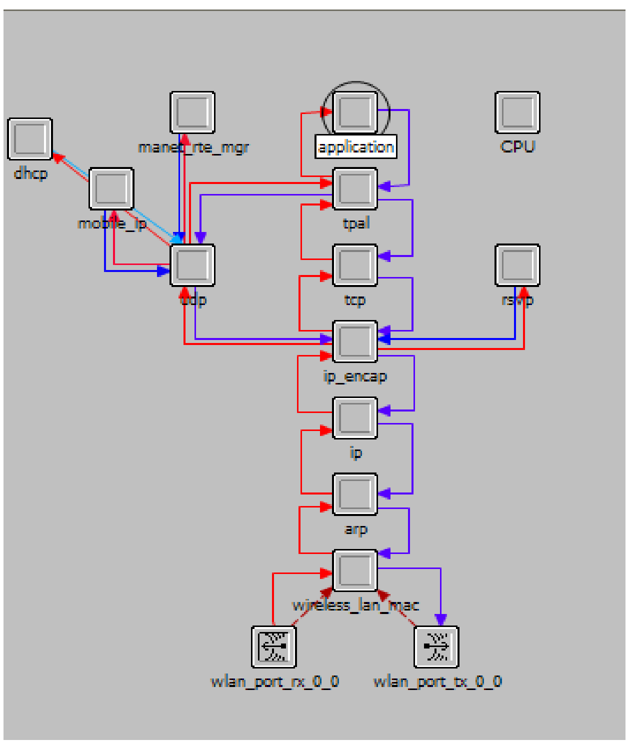

Fig. 2: VoIP MANET system

(c) Throughput of Ad Hoc Network-Throughput is defined as; the ratio of the total data reaches a receiver from the sender. The time it takes by the receiver to receive the last message is called as throughput. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec).

(d) Retransmission- The number of retransmission defines as the number of data packet transmitted divided by the number of data delivered. The number of data packet transmitted takes in to consideration each data packet transmission for each node. It include packet that are leaved and retransmitted by intermediary node.

(e) Packet End-to-End Delay-The packet End-to-End delay is the average time that packets take to traverse the network. This is the time from the generation of the packet by the sender up to their reception at the destination's application layer and is expressed in seconds.

(f) Network Load- When there is more traffic coming on the network, and it is difficult for the network to handle all this traffic so it is called the network load.

Table 1: Simulation Parameters

Statistic	Value
Simulator	OPNET 14.5
Application Traffic	GSM audio codecs such as G.711, G.722
Data rate	11 Mbps for 802.11
MANET Nodes	Scenario one- 15 nodes Scenario two- 30 nodes
Scenario Size	3*3km
Channel Type	IEEE 802.11 Wireless channel
Simulation Time	15 minutes
Transmit Power	0.005
Routing Protocols	AODV,OLSR and TORA
Performance Parameter	Throughput, Retransmission Delay, Network Load

(g) Routing Protocol – AODV, OLSR and TORA. When there are no direct links between the sender and receiver, packets must pass through other nodes in the network to reach their destination. This multi-hop routing is implemented using routing protocols. Determines routes from each node to every other node in the network.

It allows the users to design and study communication networks, devices, protocols, and applications with flexibility and scalability. It simulates the network graphically and its graphical editors mirror the structure of actual networks and network components. The simulation voice application parameters are summarized in table 2.

Table 2: Voice Application Attributes

Attribute	Value
Silenced Length(sec)	Default
Talk spurt length(sec)	Default
Symbolic Destination Name	Voice destination
Encoder scheme	GSM FR
Voice frames per packets	1

Types of services	Best effort
Traffic mix(%)	All Discrete
Compression Delay(sec)	0.02
Decompression Delay(sec)	0.02

Fig. 3, Shows a sample network created with 30 Nodes, one GSM based server, application configuration and profile configuration with audio codecs G.711, G.722 for the network.

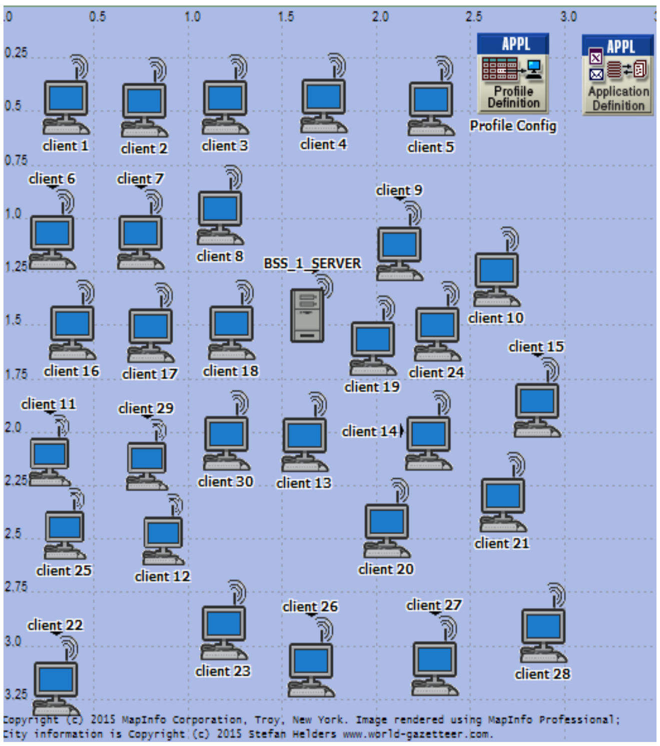

Fig. 3: Simulation Network with 30 nodes with GSM codecs

OPNET modeler 14.5 is used to investigate the performance of routing protocols AODV, OLSR and TORA with varying network sizes, data rates, and network load. We evaluate three routing protocol with four parameters and show of these applications is estimated beside the quality of service requirements using the voice and wireless LAN metrics and based on the results it is clear that GSM quality speech has shown the maximum QoS standards when compared to the other scenarios.

5. SIMULATION RESULT AND OBSERVATIONS

We carried out simulations on OPNET simulator [20]14.5. The results show differences in performance between considered routing protocols, which are the consequence of various mechanisms on which protocols are based. We carried out our simulations with 15 and 30 nodes [21].

Fig. s 4,5,6 and 7 depicts the throughput, delay, retransmission and network load of this network with respect to total simulation time which is taken as 15 minutes for which the simulation was run. In this simulation, the networks is set to 15 and 30 nodes, the voice traffic with G.711, G.722, the data transmission rate is 11 Mbps, IEEE 802.11 Wireless channel and the simulation time is 15 minutes

A.Throughput:

In this Fig. 4 show that throughput in TORA is the higher than OLSR and AODV. The network throughput of AODV and OLSR becomes low with the increase of the node number. The reason is that OLSR and AODV have different strengths and weaknesses when it comes to node mobility in MANETs. Unlike wired networks, the topology in wireless ad hoc networks may be highly dynamic, causing frequent path breaks to on-going sessions. When a path break occurs, new routes need to be found.

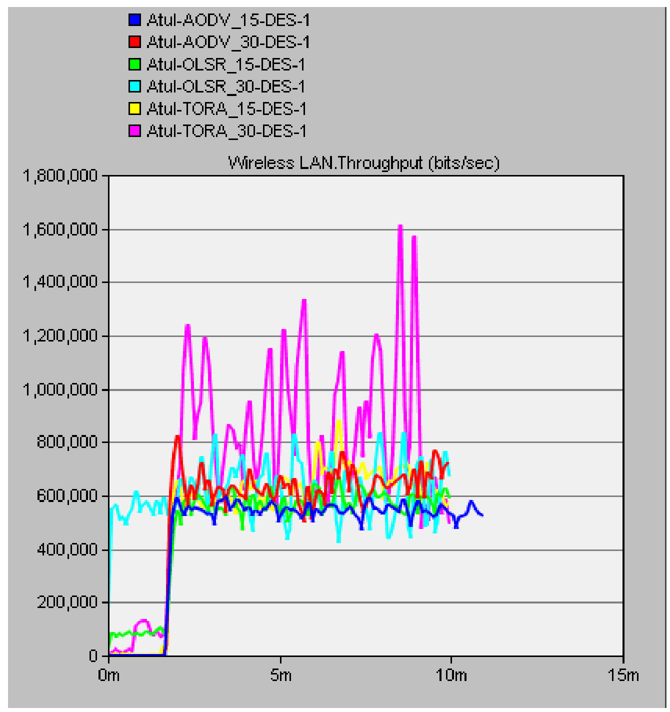

Fig. 4: Throughput comparison in routing protocols with 15 and 30 nodes

Throughout of TORA is consistent till Pause time reaches 10 secs, and then it shows the drop in the PDR till pause time of 15 secs. Again it shows the great improvement till the pause time reach 20 secs, and then it shows a big drop in performance till the pause time of 30 secs. PDR of TORA is increased as it reaches the pause time of 35 secs and it performs consistently till the pause time of 40 secs. It is observed, that Loss Packet Ratio in TORA is always greater as compared to AODV from the pause time of 10 secs to 35 secs, even though it can be observed that performance of TORA is drastically improved as the pause time exceeds 35 secs., while OLSR starts to perform poorly at the same point. TORA performs better on bigger pause time with given scenario while, OLSR is performs better on lesser pause time with the same scenario.

B. Delay:

Again TORA outperforms both in Fig. 5 AODV and OLSR in terms of end to end delay experienced in the network.

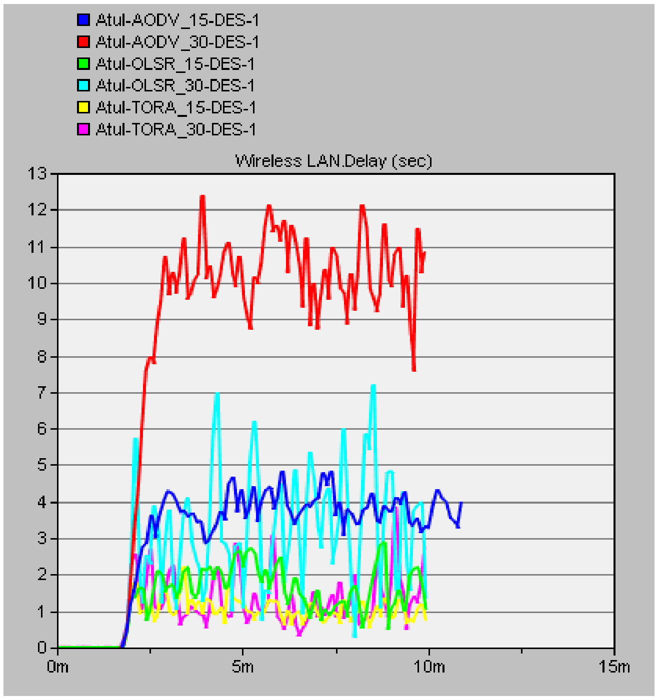

Fig. 5: Delay comparison in routing protocols with 15 and 30 nodes

Because TORA, being a hybrid protocol, typically shows values of network load which lie in between the reactive and proactive protocols because of its initial on-demand nature. In reactive protocols, if there is no route to a destination, packets to that destination will be stored in a buffer while a route discovery is conducted (forwarded hop by hop). In other words, a route discovery process has to be activated, because AODV is a routing protocol that has no available route when needed. Because of inefficient route maintenance, delay is the largest for AODV. Accordingly as the network size is increased AODV have more delay.

C. Network Load

According to Fig. 6 TORA network load [7] is highest, OLSR data dropped is low after end of simulation time.

AODV shows the least network delay regardless of the network size because AODV maintains routes for as long as the route is active. This includes maintaining a multicast tree for the life of the multicast group. The efficient network can easily cope with large traffic coming in, and to make a best network, many techniques have been introduced. High network load affects the MANET routing packets and slow down the delivery of packets for reaching to the channel, and it results in increasing the collisions of these control packets. Thus, routing packets may be slow to stabilize.

TORA experiences the maximum network load of 2,400,000 bits with nodes density of 30 this may be due to the reason that TORA requires a reasonably large amount of bandwidth and CPU power to compute optimal paths in the network.

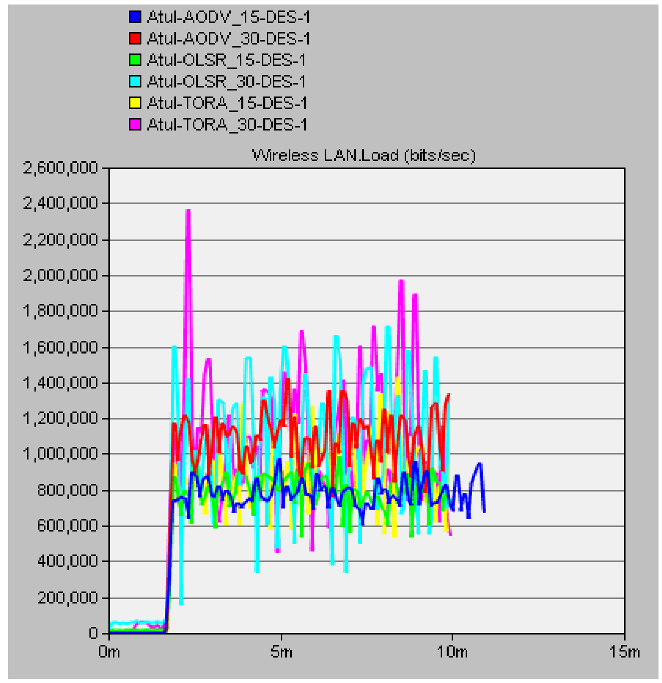

Fig. 6: Network load comparison in routing protocols with 15 and 30 nodes

D. Retransmission

Total number of retransmission attempts by all WLAN MACs in the network until either packet is successfully transmitted or it is discarded as a result of reaching short or long retry limit.

For 802.11e-capable MACs, the retransmission attempt counts recorded under this statistic also include retry count increments due to internal collisions. Additionally, if any 11e-capable MACs use Block-ACK mechanism, this statistic will furthermore record retransmitted Block-ACK Requests, delayed Block-ACKs and block MPDUs, which are not acknowledged in received Block-ACKs. According to Fig. 7 AODV retransmission attempt is highest and TORA retransmission attempt is low after end of simulation time.

As the number of nodes is increased the performance becomes more or less constant but if density is too large, more and more of nodes try to access the common medium, thus number of collisions increase thereby increasing packet loss and decreasing the retransmission attempt .

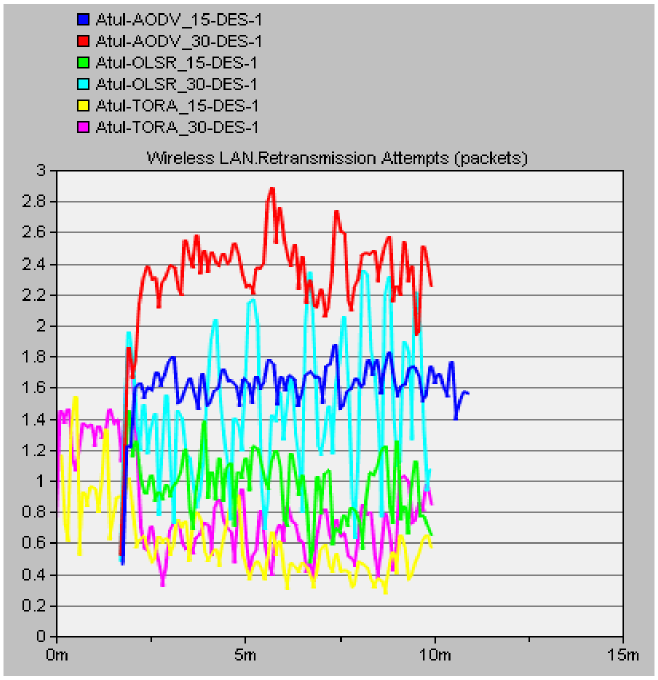

Fig. 7: Retransmission comparison in routing protocols with 15 and 30 nodes

TORA performs better than OLSR and AODV because of its adaptive nature. Overall, the protocols experience a drop in packet delivery ratio as network loading increases. TORA has less overhead as compared to AODV. Hybrid protocol has a high-normalized MAC load when compared to AODV. AODV has lowest network latency in the RPGM model when network loading increases compared to TORA. The overall results observations are summarized in table 3.

Table 3: Comparison Table

Nodes	Parameter	AODV	OLSR	TORA
15	Throughput (bits/sec)	600,000	700	900
15	Delay (sec)	5	7	2
15	Network Load (bits/sec)	1,000,000	9,000,000	1,400,000
15	Retransmission (packets)	1.9	1.5	1.4
30	Throughput (bits/sec)	800,000	850,000	1,600,000
30	Delay (sec)	12.5	7	3
30	Network Load (bits/sec)	1,400,000	1,600,000	2,400,000
30	Retransmission (packets)	2.9	2.4	1.5

6. CONCLUSION

In this paper, according to simulation study of this work has been done for three routing protocols AODV, OLSR and TORA deployed over MANET using Voice traffic. we modeled MANET scenarios with varying traffic loads and mobility scenarios and evaluated the performance of AODV (Ad Hoc On-demand Distance Vector), TORA (Temporally Ordered Routing Algorithms) and OLSR (Optimized Link State Routing) with respect to throughput, end-to-end delay, network load, and retransmission. In this research no single routing protocol among AODV, OLSR and TORA is clearly superior to the others in terms of overall network performance. One protocol may be superior in terms of average end-to-end delay and throughput while another may perform better in terms of network load and retransmission.

REFERENCES

[1] V.Ramesh, Dr.P.Subbaiah, N. Koteswar Rao and M.Janardhana Raju, “Performance Comparison and Analysis of DSDV and AODV for MANET “ in (IJCSE) International Journal on Computer Science and Engineering Vol. 02, No. 02, 2010, 183-188. optimization ad-hoc on-demand muitipath distance vector routing for mobile ad-hoc networks, WICOM'09, 2894-2899.

[2] C. Tschudin, P. Gunningberg, H. Lundgren, and E. Nordstrom, "Lessons from Experimental MANET Research," Elsevier Ad Hoc Networks Journal, Vol. 3,Issue 3, March 2005.

[3] S. Rajeswari and Dr. Y. Venkataramani, “Traffic performance analysis of MANET Routing Protocol”, International Journal of Distributed and Parallel Systems (IJDPS) Vol.2, No.3, May 2011.

[4] R. Preston, J. Doane, and D. Kiwior, "Modeling Antenna Blockage in Airborne Networks", OPNETWORK 2005.

[5] Suhaib A. Obeidat and Sandeep K.S.Gupta “Towards Voice over Ad Hoc Networks: An Adaptive Scheme for Packet Voice Communications Over Wireless Links” IEEE International Conference on Wireless and Mobile Computing, Networking And Communications, WiMob. 2005, Montreal, Canada, , pp.419-425 August, 2005.

[6] Perkins, C., Belding, E., Das, S., Ad hoc On- Demand Distance Vector (AODV) Routing - RFC 3561, 2003.

[7] Eric Thibodeau el at. “Investigating MANET Performance in a VOIP Context” IEEE CCECE/CCGEI, Ottawa, pp 920-923, May 2006.

[8] Suhaib A. Obeidat and Sandeep K.S.Gupta “Towards Voice over Ad Hoc Networks: An Adaptive Scheme for Packet Voice Communications Over Wireless Links” IEEE International Conference on Wireless and Mobile Computing, Networking And Communications, WiMob. 2005, Montreal, Canada, August, , pp.419-425, 2005.

[9] Dimitri Perrin, Hiroyuki Ohsaki, “Impact of Mobility and Topology on Information Diffusion in MANETs” IEEE (2012).

[10] Magazine, April 2007.

[11] Thomas Staub,' "Performance Comparison of MANET Routing Protocols in Ad-hoc and Hybrid Network", Computer Science Project, University of Berne, Switzerland, February 2004.

[12] J. Broch et al., "A Performance Comparison of Multihop Wireless Ad Hoc Network Routing Protocols", Proc. IEEE/ACM MOBICOM '98,Oct.1998, pp. 85–97.

[13] Perkins, C. E., Bhagwat, P.: Highly Dynamic Destination-sequenced Distance-Vector Routing (DSDV) for Mobile Computers, October 1994,Computer Communications, pp. 234-244.

[14] M. S. Corson, V. Park, "An Internet MANET Encapsulation Protocol (IMEP) Specification", draftietf-manet-imep-spec-00.txt, November 1997.

[15] Jerome Haerri, Fethi Filali, Christian Bonnet, "Performance Comparison of AODV and OLSR in VANETs Urban Environments under Realistic Mobility Patterns" Institute Eurecomz Department of Mobile Communications, 2006.

[16] Ravi Shankar Ramakrishnan & P. Vinod kumar, "Performance Analysis of Different Codec in VoIP Using SIP", National Conference on Mobile and Pervasive Computing CoMPC., pp 142-145,2008.

[17] V. Ayatollahi Tafti and A. Gandomi, "Performance of QoS Parameters in MANET Application Traffics in Large Scale Scenarios, "World Academy of Science, Engineering and Technology", 72 pp 857-860,2010.

[18] Vishal Sharma, Harsukhpreet Singh, Mandip Kaur and Vijay Banga, "Performance evaluation of reactive routing protocols in MANET networks using GSM based voice traffic applications" Optik - Int. J. Light Electron Opt., Elsevier pp 201-204.JUNE 2012.

[19] M. Keshtgary and V. Babaiyan, "Performance Evaluation of Reactive, Proactive and Hybrid Routing Protocols in MANET", International Journal on Computer Science and Engineering (IJCSE), Vol. 4 No, pp 248-254, 2012.

[20] P. Garg and A. Tuteja, "Comparative Performance Analysis of Two Ad Hoc Routing Protocols" 2011 International Conference on Network and Electronics Engineering IPCSIT vol.11, IACSIT Press, Singapore, pp 248-254,2011.

[21] A. Boukerche et.al. "Routing protocols in ad hoc networks: A survey "ELSEVIER /Computer Networks 55, pp 3032-3080, 2011.

[22] http://www.opnet.com/products/modeler/home-1 html.

[23] A. Quintero, S. Pierre, and B. Macabéo, "A Routing Protocol based on Node Density for Ad hoc Networks," Ad Hoc Networks, vol. 2, no. 3, pp. 335-349, 2004.

[24] S. Gupta. Performance Evaluation of Ad hoc Routing Protocols Using ns2 Simulations. Retrieved July 23, 2008, from http://www.cs.utk.edu/~gupta/Adhoc.doc.

[25] M. Abolhasan, T. Wysocki, and E. Dutkiewicz, "A review of Routing Protocols for Mobile Ad hoc Networks," Ad Hoc Networks, vol. 2, no. 1, pp. 1-22, 2004.

[26] S. R. Chaudhry, A. Al-Khwildi, Y. Casey, H. Aldelou, and H. S. Al-Raweshidy, "A Performance Comparison of Multi On demand Routing in Wireless Ad hoc Networks," Presented at the IEEE International Conference on Wireless And Mobile Computing, Networking And Communications (WiMob'05), 2005, pp. 1-8.

[27] Stephanie Demers and Latha Kant, ''MANETs: Performance Analysis and Management'' Telcordia Technologies Inc. One Telcordia Drive, Piscataway, NJ 08854.