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Performance Evaluation of AODV, TORA and DSR in MANET Multimedia Applications using OPNET

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Abstract— A mobile ad-hoc network (MANET) is an infrastructure-less network in which the mobile nodes are free to move and communicate without any fixed manner. Recently, the multimedia applications are very popular in MANET, so it is necessary to compare the performance of different routing protocols of MANET in multimedia applications so that a protocol with better performance will be selected. This paper presents performance comparison of AODV, TORA and DSR in voice transmission and video-conferencing over mobile ad-hoc network using OPNET modeler 14.5.

Keywords— MANET, AODV, TORA, DSR, voice transmission, video-conferencing, OPNET.

I. INTRODUCTION

A mobile ad-hoc network (MANET) is a collection of wireless mobile devices. These devices act as nodes in the network. The nodes are dynamic so they are free to move in the network[1]. There are different routing protocols in MANET for the packet transmission. These routing protocols are divided into three categories[2].

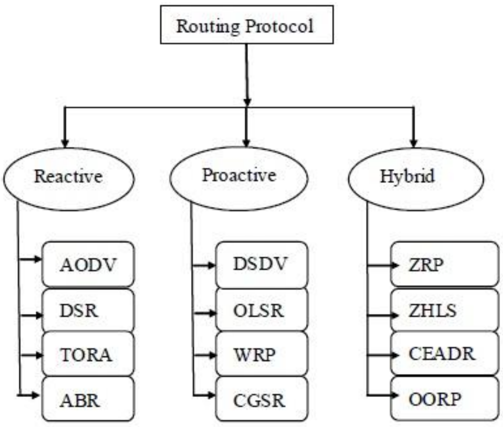

Fig. 1. Routing protocols[2]

Recently, multimedia applications are very popular in MANET, so it is necessary to compare the different routing protocols of MANET in multimedia applications. The packets are transferred through wireless medium between the mobile nodes. Due to the dynamic nature of the nodes, the topology of MANET changes frequently[3][1].

In this paper, we evaluate the performance of AODV, DSR and TORA in MANET multimedia applications. Using the OPNET simulator, we compare the quality of service parameters of these three routing protocols. This research will help us in selecting the routing protocol with high performance for voice transmission and video-conferencing in MANET.

II. AD HOC ROUTING PROTOCOLS

A. Ad hoc On Demand Distance Vector (AODV)

As the name of AODV indicates, it operates only when it is requested. The packets are transferred through the active route within the past active timeout period. AODV broadcasts a route request (RREQ) in the network, when there does not exist an active route between source and destination. The RREQ is received by all the nodes in the network. All the nodes receiving the RREQ, send a route reply(RREP) to the source so as to generate the route for packet transmission[4].

When all the RREPs are received by the source, the source has to select the best route for the transmission. A route is active only for the transmission period, when the transmission is completed or the source stops sending the packets the route discards. Due to the mobile nodes, the routes between the nodes break with the movement of the nodes, so the topology changes in the network. AODV alternates the routes in respond to the route breakages and does not stop the transmission[5].

B. Dynamic Source Routing (DSR)

Dynamic Source Routing is specially designed for the networks having mobile nodes. In DSR, two mechanisms work together for the packet transmission, i.e., Route Discovery and Route Maintenance. Route Discovery is used when a source wants to send a packet to the destination but does not have a route, Route Discovery finds a route for the packet transmission[6]. Due to the mobile nodes in MANET, the positions of the nodes changes frequently that results in route breakage, in that case, Route Maintenance is used, it detects other routes that leads the packet to the destination[6]. DSR works well even with high mobility rates and also responds good in large networks of 100 nodes[7].

C. Temporally Ordered Routing Algorithm (TORA)

The temporally ordered routing algorithm is a reactive routing protocol, it inhibits the following attributes[8]:

- Multipath routing,
- Loop-free routes,
- Distributed execution,
- Localization of algorithmic reaction to topological changes,
- Route establishment and maintenance.

In TORA, it is necessary for each node to maintain the adjacent routers information so that whenever a packet is to be transferred, source just search in the adjacent routers information table for a route which leads the packet to the destination. In the manner a route is established from source to the destination to transfer a packet in TORA. TORA supports both reactive and proactive routing[2].

III. NETWORK MODEL AND SIMULATION PARAMETERS

In this research, we are using OPNET Modeler 14.5 simulator for the performance evaluation. OPNET offers easy graphical interface, highly reliable, robust and efficient. It supports large number of built-in industry standard network protocols, devices and applications[9]. We are using 75 nodes for the voice transmission and video-conferencing. Every node in the network is configured to execute AODV, DSR and TORA respectively. The nodes are distributed over the office network of 100*100 meters.

Fig. 2: Network Scenario of 75 nodes

Table I
Simulation Parameters

Simulation time	180 seconds
Simulation area	100*100 meters
Number of nodes	75
Data rate(bps)	11mbps
Routing protocols	AODV, DSR , TORA
Network layout	Hierarchical
Applications	Voice transmission, Video-conferencing
Performance parameters	Voice- Jitter, MOS value, packet end-to-end delay, traffic sent, traffic received. Video-conferencing- Packet end-to-end delay, traffic sent, traffic received.

Table III Voice Parameters

Attribute	Value
Silence length(sec.)	Default
Talk spurt length (sec.)	Default
Symbolic destination name	Voice destination
Encoder scheme	GSM FR
Voice frames per packet	1
Type of service	Best effort(0)
Traffic mix(%)	All discrete
Compression delay(sec.)	0.02
Decompression delay(sec.)	0.02

Table IIIII Video-conferencing Parameters

Attribute	Value
Frame interarrival time information	30 frames/sec
Frame size information (bytes)	352*240 pixels
Symbolic destination name	Video destination
Type of service	Best effort(0)
Traffic mix (%)	All discrete

IV. ROUTING PROTOCOL PARAMETERS

TABLE IVV TORA PARAMETERS

Mode of operation	On-demand
OPT Transmit Interval(sec.)	300
IP Packet Discard Timeout(sec.)	10

Table V AODV Parameters

Route request retries	5
Route request rate limit(pkts/sec)	11
Active route timeout(sec)	3
Hello interval(sec)	uniform(1,1.1)
Allowed hello loss	2
Net diameter	35
Node traversal time(sec)	0.04
Route error rate limit (pkts/sec.)	10
Timeout buffer	2
Addressing mode	IPv4

Table VI DSR Parameters

Route expiry timer(sec)	300
Max cached routes	Infinity

Route Discovery Parameters	
Request table size(nodes)	64
Maximum request table identifiers	16
Maximum request retransmissions	16
Maximum request period(sec)	10
Initial request period(sec)	0.5
Route Maintenance Parameters	
Maximum buffer size(packets)	50
Maintenance holdoff time(sec)	0.25
Maximum maintenance retransmissions	2

V. SIMULATION AND RESULTS

The performance of routing protocols is evaluated b using the OPNET Modeler 14.5. The network consists of 75 nodes randomly distributed over the network of area 100*100 meters.

A. Voice transmission results

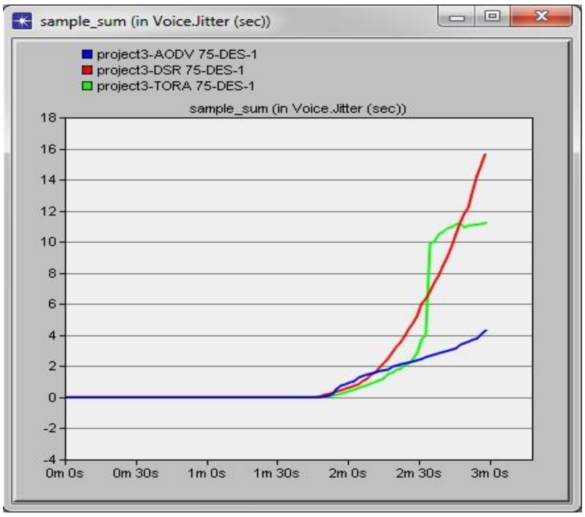

Fig. 3: Voice Jitter(sec.)

Jitter is the variation in the time between packets arriving, caused by network congestion, time drift or route changes. Jitter should be less for the better performance[4]. In Figure 3, the result shows the comparison of AODV, DSR and TORA in jitter for the voice transmission between 75 nodes in 3 minutes. As AODV shows least jitter of around 4 seconds, so AODV is better than DSR and TORA in the jitter calculation.

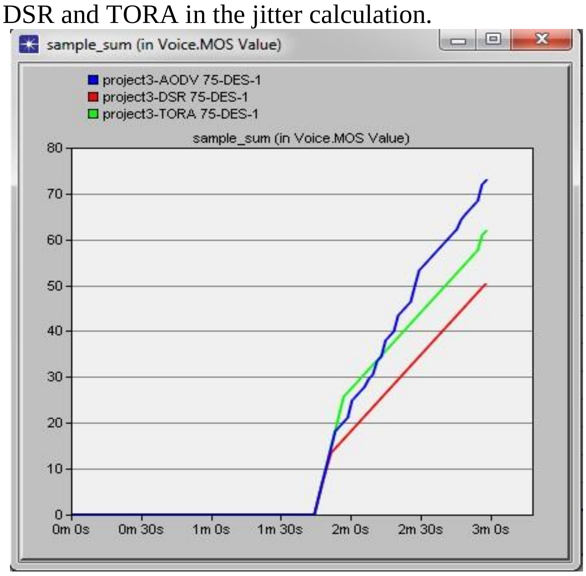

Fig 4: Voice MOS Value

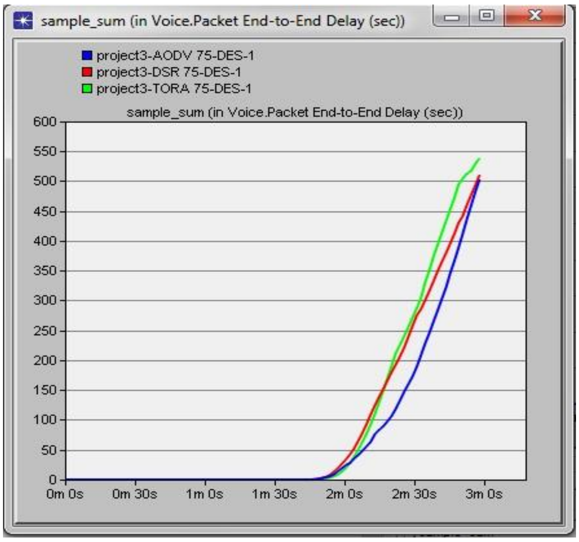

Fig. 5: Voice Packet end-to-end delay

Figure 4 shows the MOS factor variation in voice transmission that varies between 50 to 75 in 3 seconds. DSR has least MOS value whereas AODV as the highest MOS value. Another important parameter for the performance evaluation is packet end-to-end delay. Figure 5 shows the comparison of these three protocols for 75 nodes. AODV has least delay of 500 seconds whereas TORA has the highest delay of 545 seconds approximately.

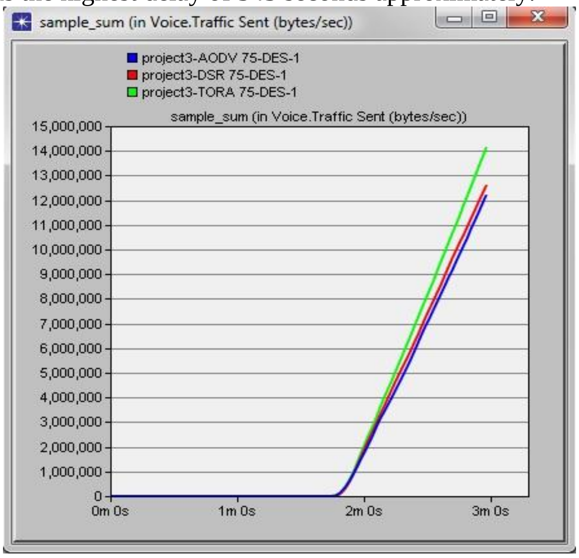

Fig 6: Traffic sent in Voice

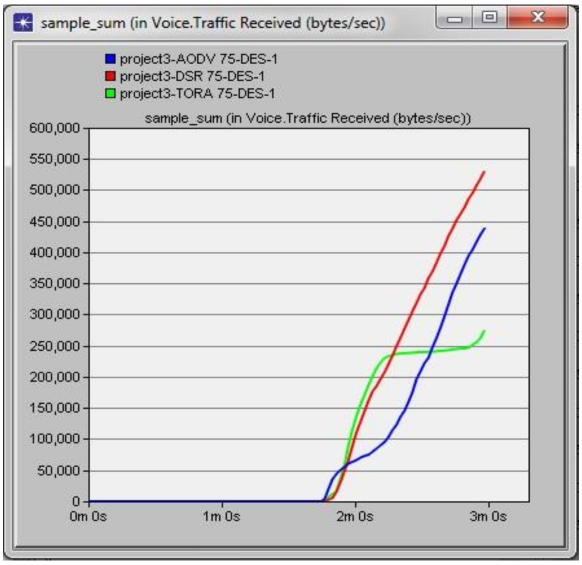

Fig. 7: Traffic received in Voice

Figure 5 and 6 shows the comparison for the traffic send and traffic received in voice transmission. DSR receives approx. 545,000 bytes per second whereas TORA receives least traffic approx. 275,000 bytes per second.

B. Video-Conferencing Results

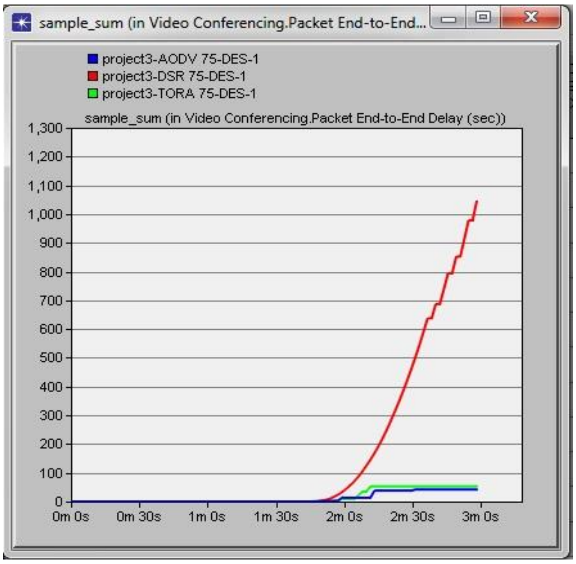

Fig 8: Packet end-to-end delay in video-conferencing

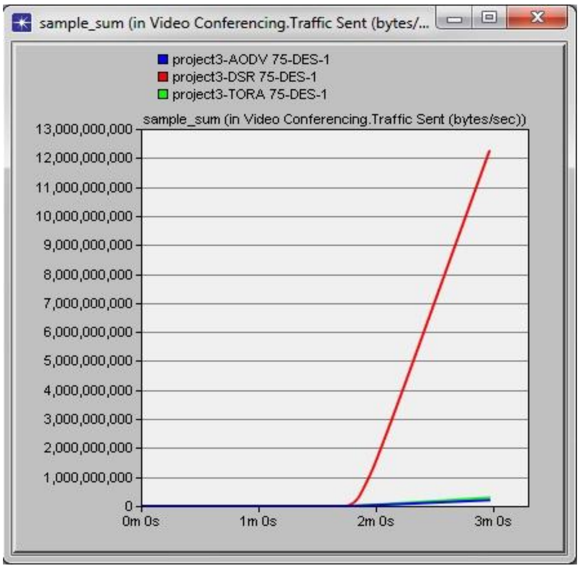

Fig 9: Traffic sent in video-conferencing

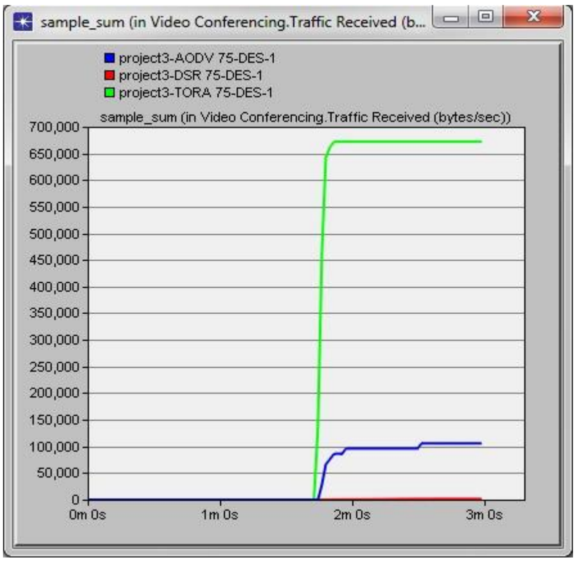

Fig 10: Traffic received in video-conferencing

Figure 8 shows that DSR has the highest packet end-to-end delay of more than 1000 seconds whereas AODV and TORA has the same rate of approx. 50 seconds in video-conferencing. But in terms of the traffic sent, DSR sent approx. 12,000,000,000 bytes per second, which is almost 11 times than the traffic sent in AODV and TORA, as shown the figure 9.

Figure 10 shows that the traffic received in video-conferencing is highest in TORA as compare to AODV which is approx. 100,000 bytes per second. DSR has the least traffic received so it is a video-conferencing compatible protocol.

VI. CONCLUSION

In this paper, performance of AODV, DSR and TORA was analyzed using the OPNET simulator. To compare the performance of these three routing protocols, these protocols were tested for the different parameters in voice transmission and video-conferencing. From the results, we analyzed that TORA is the best suited protocol for video-conferencing as it has the highest traffic received (throughput) whereas DSR shows the least throughput. The packet end-to-end delay was approximately same for these three routing protocols in video-conferencing. Whereas in voice transmission, the traffic received in DSR was highest among three and TORA received least traffic. Packet end-to-end delay was almost same for these three in voice transmission.

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