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RESEARCH ARTICLE

Performance Evaluation of AODV and DSR Routing Protocols with PCM and GSM Voice Encoding Schemes

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Abstract— A mobile ad hoc network (MANET) is one of the narrowest and most specific of research topics in the field of telecommunications. The growth of this type of network, and the large number of applications with mobility requirements, has led to a wider study and research in the analysis and enhancement of the work in this area. In such networks, nodes are communicating with each other without the need of a centralized administration. In this topology, the communication between the nodes is done by pair to pair within the coverage area. The routing is managed and organized by a number of routing protocols. A limited coverage area, collision and power consumption for mobile nodes are the main problems occurring in such networks.

In this paper, two important MANET routing protocols were used, Ad- Hoc on-Demand Distance Vector (AODV) and Dynamic Source Routing (DSR) to analyse their behaviour with two different voice encoding schemes, Pulse Code Modulation (PCM) and Global System Mobile (GSM).

Keywords— AODV; DSR; PCM; GSM; OPNET17.1

I. INTRODUCTION

Mobile ad hoc network is a new form of independent network. It is a set of wireless mobile nodes and works without centralized administration. MANET is suitable for applications that require mobility. However, there are also a number of problems in these networks. Restriction of coverage area and nodes mobility sometimes causes problems in communications. Moreover, it is necessary to increase the security and authentication programs installed on these nodes. Quality of Service (QoS) is a very important point that should be considered in the evaluation of the performance of these networks. In this paper, two important MANET protocols were analyzed: AODV and DSR. In addition, these routing protocols were used on mobile node with two encoding schemes PCM and GSM. The behaviour of the AODV and DSR with these voice encoding schemes with a different numbers of nodes and one client and server was studied. OPNET 17.1 was used for modeling a mobile ad hoc network. The OPNET modeler is one of the best simulation programs. It provides very accurate and reliable results.

II. RELATED WORK

In [2] a simulation with a MANET network is done. AODV and DSR ad hoc mobile routing protocols with simulation time 900sec and data rate 11Mpbs settings are used. The GSM voice application was set for 20, 40 random waypoint mobility nodes movement with 500m random waypoint mobile area. The simulation area was

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set 5Km ×5Km. Network load, route discovery time, packet end-to-end delay and number of hops per route performance metrics were used to evaluate the MANET work. According to the results AODV protocol is better compared with DSR protocol.

In [3] AODV, DSR, GRP, OLSR and TORA protocols were used with simulation time 300 sec and 600 sec for 25, 85 number of mobile nodes. PCM and GSM voice encoding schemes used with random way point speed 5 and 10 m/sec for simulation area 800m×800m and 1600 m×160m. Performance metrics used are jitter, throughput, end -to-end delay variation, WLAN delay variation and packet delay variation. From the results it is observed that, AODV is better than other MANET routing protocols.

In [4] performance metrics like throughput and delay are analyzed for 50, 70 and 100 mobile nodes for DSR MANET routing protocol. It is observed that throughput is more in 100 nodes than 50 and 70. Also the delay is less for 70 nodes than 50 nodes.

In [5] it is shown that the link breakage is more in large node density. In the case of DSR, when the route breakage in a network with a large density node occurs, packets are cached and a route repair takes place. This improves the overall throughput of the system.

In [6] OLSR and AODV and DSR protocols were used. It is shown that when the number of nodes increases to 50, the DSR performance is better.

In [7] the performance of AODV, OLSR, GRP and DSR are evaluated. It is shown that, DSR does not perform well for media access delay and WLAN throughput and network load with 60 minutes simulation time for 20 nodes. The mobility node speed is 7m/sec. PCM voice encoding schemes were used. AODV is better than the others routing protocols. In addition, AODV and OLSR perform better compared with DSR.

In [8] there is a simulation work for MANET with AODV, DSDV, TORA and DSR routing protocols with simulation time 900sec and number of nodes 21.TheVoice application scheme is (G.729). The simulation area is 340m × 340m with random waypoint mobility mode. Mobility speeds are (1, 5, 10, 15, 20) meters/sec. Voice packet delay and Packet delivery fraction are evaluated in MANET. DSR is worse compared with other MANET routing protocols.

In [9] the performance of AODV and DSR are evaluated. Performance matrices throughput, delay, normalized routing protocols and packet delivery ratio are studied for 10, 20, 30, 40 and 50 number of nodes. It is observed that, the end-to-end delay is very high in DSR; however, it decreases in the case that, the number of node increases. This is due to the increase in finding destination when the number of node is increased.

III. DESCRIPTION OF ROUTING PROTOCOL

A.Ad Hoc on-Demand Distance Vector Routing (AODV)

AODV uses an on demand algorithm; it builds a route between nodes only when it is required by source nodes. Furthermore, AODV builds trees which connect multicast group members. Trees consist of the group members, and the nodes needed to connect the members. To ensure that freshness routes are used, sequence numbers are used. It is a loop-free, self-starting, and can be scaled to a large number of mobile nodes. When a source node requires a route to a destination, it broadcasts a route request (RREQ) packet through the network. RREQ packet contains hop count, source and destination address and Destination sequence number (DSN). Nodes receiving this packet update their information for the source node and set up backwards pointers to the source node in the route tables. If the node has a sequence number greater than or equal to that contained in the RREQ it will send a route reply packet. A node receiving the RREQ may send a route reply (RREP) if it is either the destination, or if it has a route to the destination with a corresponding sequence number greater than or equal to that contained in the RREQ. If this is the case, it is unicasts a RREP back to the source. Otherwise, it rebroadcasts the RREQ if there was link failure. It will rebroadcast the RREQ [18-19]. When the source node receives the RREP, it starts to forward data packets to the destination. If the source receives an RREP with a greater sequence number with the least hop count, it considers this route as the best and begins to forward data packets through it. If there is a route which has data transmission from the source to the destination, this route is considered active, as long as there are data packets periodically travelling from the source to the destination along that route. If the source stops transmission the data packets, the link will be timeout and be deleted from the source routing table. If a link break occurs while the route is active, the node that detected the link failure will propagates a route error (RERR) message to the source node. If the sources node receiving the RERR, still demands the route, sources will initiate a route discovery again. Hello messages in AODV are used locally for route maintenance. If two

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nodes are no longer neighbours then the first node invalidates all routes through second node. The first node may also send an RERR messages to all nodes that used this unveiled route. AODV is using table-driven which means each node has only one hop routing information.

B. Dynamic Source Routing (DSR)

This routing protocol is a simple and efficient routing protocol designed specifically for use in the multi-hop wireless ad hoc networks of mobile nodes. Here the network is completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. DSR was the same as AODV in broadcasting RREQ packets by the source to find the destination with unicasting RREP packet. Each ROUTE REQUEST message identifies the initiator and target of the Route Discovery, and also contains a unique id-request. DSR protocol has two stages of routing "Route Discovery" and "Route Maintenance" which allow for the discovery and the repairing of the routes path between the source and destination through the network. The protocol is on-demand which means that no route occurs until there is a need for the transmission of a data packet through the network. DSR used a route cache or a route record to save the routes in the source node. DSR doesn't need to consistently update its routing table like AODV. It also uses a cache memory which decreases the control overhead. DSR works very well in high node density low mobility networks.

IV. SIMULATION ENVIRONMENT

A. Simulation model.

OPNET is commercial software that provides performance analysis of computer networks and applications. It stands for Optimized Network Engineering Tools. OPNET is one of the best and most powerful networks modeling software. Most of the tools that a designer needs are in the OPNET library. For example, the time to begin work for the application in the server or the profile with the client can be easily specified using OPNET. In addition, it provides mobility elements: speed, area of movement, start time movement, the pause time of the mobile node and their corresponding probability type (e.g. uniform, exponential, etc.). The number of the performance metrics provided in OPNET library is enormous. It is classified in a very convenient and intelligent way for all network types.

B. Simulation parameters.

The evaluation of voice application using two different routing protocols AODV and DSR were done with different scenarios. We have two voice schemes PCM and GSM with one client and one server. And we have used a different number of the nodes (25, 50, 75 and 100).

TABLE 1: SIMULATION SCENARIOS

AODV								**DSR**							
PCM with 1client &1 server				**GSM with 1clients & 1 server**				**PCM with 1clients & 1 server**				**GSM with 1clients & 1 server**			
25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100

TABLE 2: SIMULATION PARAMETRIES

Parameter	**Value**
Simulator	OPNET 17.1
Area(Km × Km)	5× 5
Simulation time	1000 sec
Mobility model	Random waypoint
Speed of Mobility	1 m/sec
802.11 data rate	11Mbps
Application Traffic	VoIP
Voice encoding schemes	PCM, GSM
Voice coding ratio for PCM and GSM Kbps	64,12
Performance Parameter	Route discovery time, Jitter ,packet end-to-end delay

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V. PERFORMANCE METRICS

A. Route Discovery Time

This performance metric represents the time required to discover destination among the intermediate nodes.

B. Jitter

If two packets leave the source node with time stamps t1 & t2 and are played back at the destination node at time t3 & t4, then:

Jitter = (t4 - t3) - (t2 - t1)

C. Packet end-to-end delay

It is the total delay time starting from the analog form of the voice at the source until conversion of the analog form at the destination. It includes network delay, encoding and decoding delay, compression and decompression delays

VI. SIMULATION RESULT

The simulation results are shown in the following section in the form of line graphs. Graphs show comparison between the two protocols (AODV, DSR) by varying different numbers of nodes with PCM and GSM voice encoding schemes on the basis of different performance metrics.

A. Route Discovery Time

The route discovery time for DSR is larger than AODV in PCM and GSM because the route discovery takes a longer time at every intermediate node since DSR tries to extract information before forwarding to the next node. The same thing happens when a data packet is forwarded hop by hop. While the AODV routing protocol makes a route discovery more efficient, and using refreshable and the newest route to the destination. As the number of node increases, the route discovery time for DSR is decreases. This is due to the large number of alternative multiple routes to the destination node which is cached in its memory during the route discovery time. In additional, the route discovery time for AODV is decreases. This is due to the large number of route request messages forwarded to the destination node with routing information for the newest routes to it. But, AODV still have a less route discovery time compared with DSR protocol. This is because of AODV uses a sequence number to find the newest routes to the destination during the route discovery time [1].

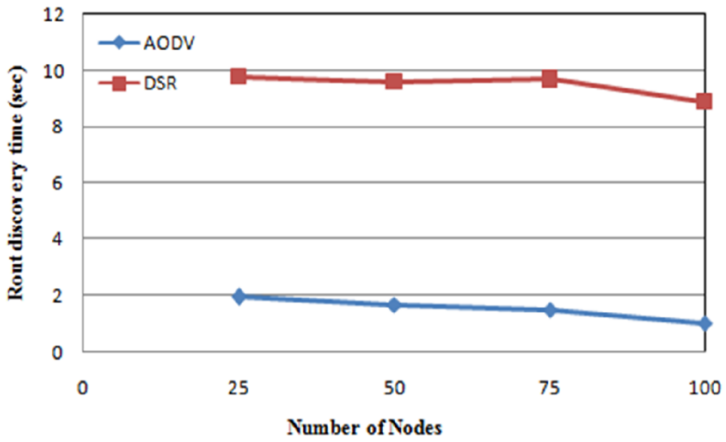

Figure1. Route Discovery Time versus Number of Nodes for AODV and DSR with PCM

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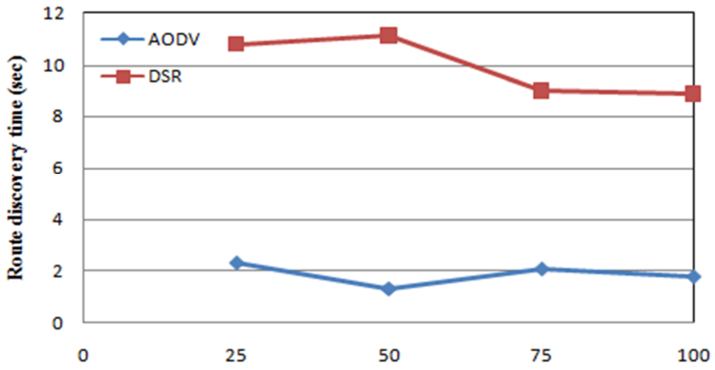

Figure2. Route Discovery Time versus Number of Nodes for AODV and DSR with GSM

B. Jitter

Jitter values for DSR are larger than the jitter value in the AODV MANET routing protocol. DSR is visit and route through all the possible intermediate nodes to the destination. This increases the jitter. AODV uses the most refreshable and the newest route to the destination. GSM is includes more compression for the voice packet. This affects the quality of voice. GSM has a high jitter compared to PCM. In DSR, there is more probability for jitter as a node broadcasting a route request packet to its entire neighbour nodes in the network. For DSR, increasing the number of nodes causes a decrease in jitter. It is because DSR has multiple routes, during its route discovering process. DSR identifies the multiple routes to the target node which is an increase in high density and low mobility nodes.

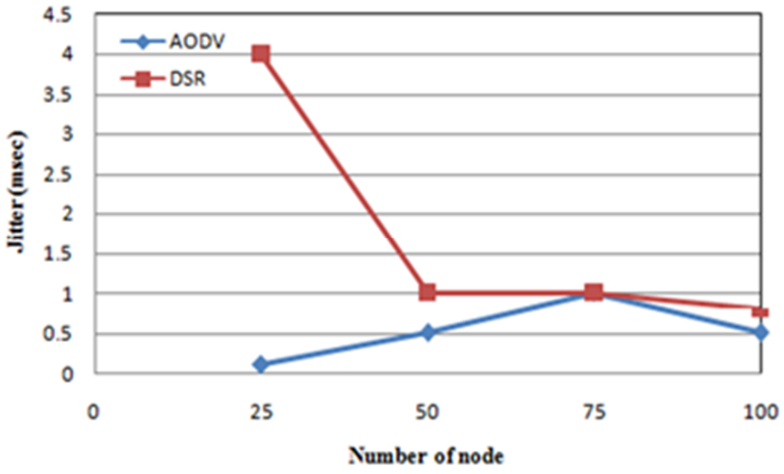

Figure3. Jitter versus Number of Nodes for AODV and DSR with PCM

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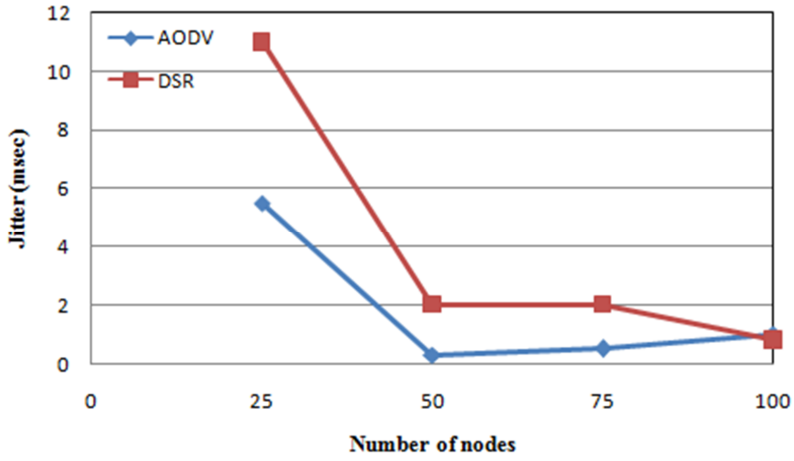

Figure 4.Jitter versus Number of Nodes for AODV and DSR with PCM

C. Packet end-to-end delay

Packet end-to-end delay for DSR is larger than AODV. This is due to the fact that in the case of congestion or routing overhead, control messages get lost and so decreasing its advantage of fast establishing new routes with DSR routing. Under such conditions, DSR has a relatively high delay. GSM has more delay over PCM. This is because of the high compression of GSM, we experience more delay. In additional GSM has coding ration 12 Kbps compared to PCM 64 Kbps. In DSR, there is a high voice packet end-to-end delay because of an aggressive route caching. Increasing the number of nodes leads to a decreased the delay in DSR. Clearly, large multiple routes to the destination node are increased in high density and low mobility nodes and also it causes a decreasing route discovery time to the destination.[2],[3]. In additional, the route discovery time for AODV is decreases. This is due to the large number route request messages forwarded to the destination node with routing information for newest routes to it, during its route discovering process. However, AODV still has a better performance compared with DSR. This is because AODV used the freshness routes to the destination.

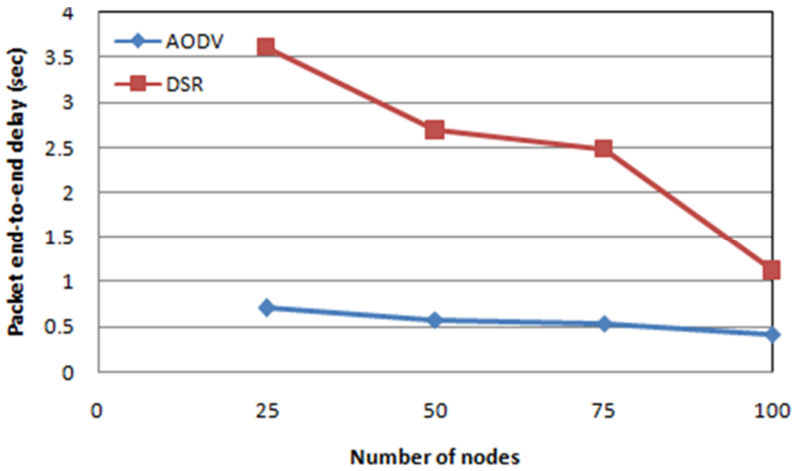

Figure 6.9 Packet End -to-End Delay versus Number of Nodes for AODV and DSR with PCM

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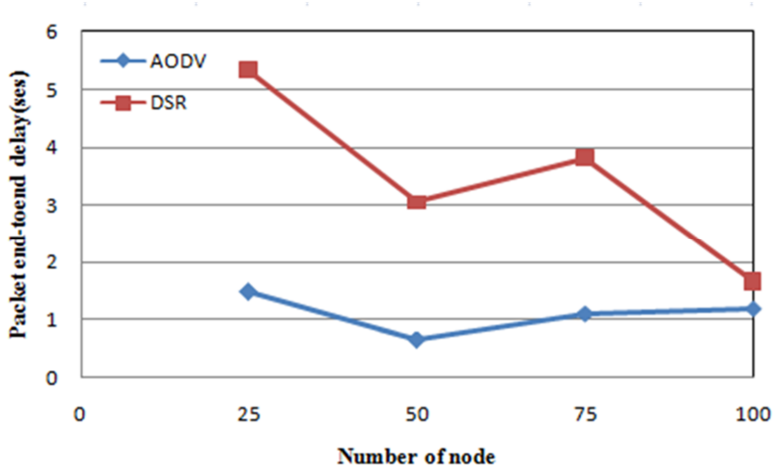

Figure 6.9 Packet End -to-End Delay versus Number of Nodes for AODV and DSR with GSM

VII. CONCLUSIONS

In this paper, a study was conducted for an ad hoc wireless network environment with voice applications. OPNET 17.1 was used in the simulation of the paper to model an ad hoc with voice application. AODV and DSR ad hoc routing protocols were used with PCM and GSM encoding schemes. AODV and DSR routing protocols were analyzed with PCM and GSM voice schemes using one client and one server in varying number of nodes (25, 50, 75 and 100) in the MANET.

Two classes of performance metrics were used in the evaluation of the system. The first class of performance metrics was for MANET routing (route discovery time). The second class was for voice application jitter, packet end-to-end delay. We can conclude that AODV performance is better than DSR. AODV maintains only one entry per destination in the routing table. The destination replies only to the first arrived request and ignores the rest. While DSR uses route caching aggressively and replies to all requests reaching a destination from a single request cycle.

Simulation results also showed that AODV reactive routing protocol is the best suited for MANET networks with GSM and PCM voice encoding scheme compared with DSR.[5], [6]. But, DSR has multiple routes, during its route discovering process increasing the number of nodes make DSR identifies many routes to the destination node in which these routes are increased in high density and low mobility nodes. It causes a decrease in route discovery time for the destination and makes DSR better. But, AODV is a slightly better compared with DSR. This is because AODV uses the newest route to the destination compared with DSR [7], [8].

Finally, PCM has a good quality and low end-to-end delay, but it requires a high bandwidth. GSM has fair quality and high delay but doesn't consume bandwidth. In addition, it was determined that AODV is best to use with both voice schemes PCM and GSM with a different number of clients and one server. AODV and DSR have almost the same behaviour in a large node density e.g. 100 nodes. But still AODV has better performance than DSR.

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