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Performance analysis of Mobile Ad-Hoc Network using Different Routing Protocol (AODV, DSR)

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Abstract - *In MANET each node acts as a host and router. As nodes, communicate with each other, routing used as a core function. In this paper, two protocols (AODV & DSR) have been evaluated using Riverbed Modeler Academic Edition 17.5. These protocols use different routing mechanism, which is supported by Riverbed Modeler Academic Edition. Some scenarios have been carried out to measure the performance of these protocols. Throughput, Delay, and Load are used as performance metrics.*

***Key Words*: Ad Hoc on-demand distance vector (AODV), Dynamic Source Routing (DSR), Optimized Link State Routing (OLSR), Mobile Ad-Hoc Network (MANET)**

I. INTRODUCTION

A Mobile Ad hoc Network (MANET) consists of mobile nodes such as computing devices like laptops and personal digital assistants (PDAs),that use wireless connections to link up to each other for the purpose of communication [1]. These networks are generally dynamic collections of self-organizing mobile nodes with links that are characterized by dynamic topology changes and no fixed infrastructure. In MANET, nodes are ready to free to move for that there is no such infrastructure exists and the network topology changes in an unpredictable manner. The main communication medium is broadcast.

II. ROUTING IN MANET

As there is no fixed infrastructure in MANETs , it requires distributive & cooperative actions from all nodes. Mechanisms of wired routing are not suitable for mobile ad-hoc networks as they are conceptually designed for infrequent topology changes, and they have relatively longer converge times. MANRTs routing would typically require the necessity of finding a route of optimal from a source node to a destination node with minimum overhead, minimum bandwidth consumption & minimized delay in data transfer. Protocols routing can be distinguished by the creation of routing tables. There are various routing strategies. Such as Proactive, reactive, Hybrid or Hierarchical routing. [2]

A. Proactive routing protocols

Proactive routing protocols maintain a routing table for entire nodes using the information present in the routing table of each individual node.

Two scenarios can be used in:

(i) Where mobility of node is small
(ii) Small network size with few nodes.

List of Proactive protocols are:-

i) Destination-Sequenced Distance Vector routing protocol (DSDV)
ii) Wireless routing protocol (WRP)
iii) Global State Routing protocol (GSR)
iv) Source Tree Adaptive Routing Protocol (STAR)
v) Topology Broadcast Reverse Path Forwarding routing protocol (TBRPF)
vi)Optimized Link State Routing Protocol (OLSR)
vii) Landmark routing protocol (LANMAR

Advantages of Proactive protocols are:-

(i) Lower route of determination latency.
(ii) The quality of Service related to connection setup or other real-time requirements.

Disadvantages of Proactive protocols are:-

(i) Frequent routing updates cause for high overhead on routing tables
(ii) Periodic updates is the reason for consumption of bandwidth.
(iii) Maintaining of unused routes

B. Reactive routing protocols

Reactive routing protocols are based upon the On-Demand Route Request approach in which nodes are used to find routes to destination nodes if there is a packet need to be sent and that time route is completely unknown. With the help of Route Request (RREQ) packets for computing a route to the destination node the nodes using these protocols flood its neighbors.

These protocols can be used in scenarios with:-

(i) Node of high mobility networks

List of Reactive protocols are:-

i) Ad-hoc On-Demand Distance Vector Routing protocol (AODV)
ii) Dynamic Source Routing protocol (DSR)
iii)Temporally Ordered Routing algorithm (TORA)
iv)Associativity Based Routing protocol (ABR)
v)Signal Stability based Adaptive Routing protocol (SSR)

Advantages of Proactive protocols are:-

(i) There is no overhead as because of routing information is obtained only when needed.
(ii) Scalability is possible for low mobility and less traffic.

Disadvantages of Proactive protocols are:-

(i) High route determination latency.
(ii) Congestion can be created for flooding of RREQ.

C. Hybrid Routing Protocols

Proactive & Reactive protocol advantage are combined in Hybrid routing protocol approach. In this approach initially, the routes tend to nearby nodes and maintained through some Proactive protocols and after that Reactive protocols can be used to discover the routes.

Zone Routing Protocol (ZRP) is a hybrid routing protocol.

Disadvantages of Hybrid routing are:-

(i) Requires the knowledge of nodes activated at any time.
(ii)Traffic demand reaction depends upon the gradient of traffic volume.

D. Hierarchical Routing protocols

Proactive & Reactive protocols scalability is limited due to their inherent designs. [2]

Clustering protocols places the node into groups and this called Clusters and perform hierarchical routing.

List of Reactive protocols are:-

(i) Fisheye State Routing (FSR)
(ii) Cluster Based Routing Protocol (CBRP)
(iii)Adaptive Routing using Clusters protocols. (ARC)
(iv)Distributed Clustering Algorithm protocols (DAC)
(v)Distributed & Mobility-Adaptive Clustering algorithm (DMAC)

Advantages of Hierarchical Routing protocols are:-

(i) During mobility of nodes it remain stable.
(ii) Control messages Flooding of across the network are reduced greatly

Hierarchical routing protocols disadvantages are:-

(i) The depth of nesting of clusters & addressing scheme.

III. DSR ROUTING PROTOCOL

Dynamic Source Routing (DSR) is a simple yet efficient reactive routing protocol designed for multi-hop mobile ad-hoc networks. DSR protocol operates in two phases:-

(i) Route Discovery Phase
(ii) Route Maintenance Phase

DSR uses Source Routing mechanism.In this mechanism collects & stores, the addresses of each intermediate node traversed between the source node & the destination node.

A. Route Discovery Phase

In this below [fig:1], a node S wants to send a data packet to a destination node D, at first, it checks its route cache for a possible path from node S to node D . If there is no such path exists then source node S may initiate a route discovery request otherwise the existence of any such path (un-expired) it is used for packet forwarding. [2]

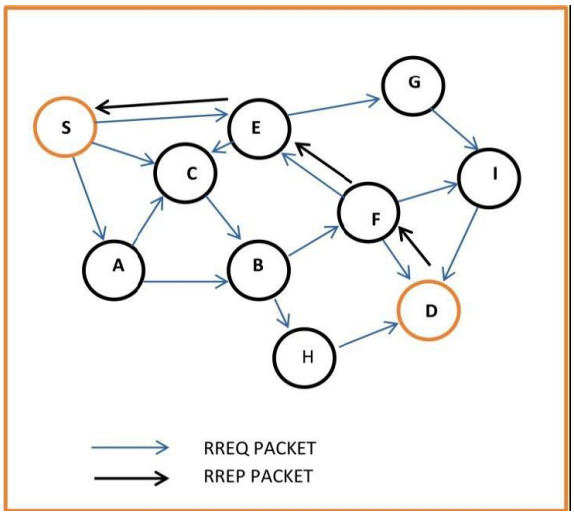

Figure 1:Route Discovery in adhoc network using DSR [2]

This request is intend by source node by broadcasting a single, local RREQ packet by all the neighboring nodes within the wireless vicinity of it. The RREQ packet contains information for identification of source node, destination

node, set of intermediate nodes through which it has been forwarded (initially it is empty on creation) and a unique id set by source node. [2]

B. Route Maintenance phase

Each node transmitting a data packet and it also carries the confirmation that the packet has been received at the next hop along the forward route [3].

C. Advantages of DSR

(i) DSR is a reactive routing protocol it does not require flooding the network with route update messages.

(ii) Intermediate nodes (hops) can be used as route cache information efficiently to further reduce route discovery overheads.

(iii) Multiple routes is the target node may get reported as intermediate nodes uses their local route cache for route discovery.

D. **Disadvantages of DSR**

(i) The packet header grows in size as the route length increases.

(ii) Route Reply Storm problem originates

(iii) Collisions creats between route requests packets.

IV. AODV ROUTING PROTOCOL

AODV (Adhoc On-demand Distance Vector) is another on-demand reactive routing protocol widely used in mobile adhoc networks.

This protocol operates in two phases:-

(i) Route Discovery Phase
(ii) Route Maintenance Phase

AODV and DSR are both reactive routing protocols though they differ in their conceptual method of route discovery mechanism. DSR uses source routing and AODV uses hop-by-hop routing.

A. Route Discovery Phase

If a source node S wants to send a data packet to a destination node D, first it checks it local routing table entries for a possible path to the mentioned destination node.

The RREQ packet has source node identification, destination node identification, destination sequence number assigned by the source node, broadcast identification, time to live. Destination sequence number is used to determine the newness of the route. An intermediate node updates its route only if the destination sequence number of a current packet is greater than or equal to the destination sequence number stored at the node with smaller hop count.

Upon receiving a RREQ packet a node can return a RREP (route reply) packet back to the source node S if it is requested destination node D or if it knows a more recent up-to-date route to the destination (although the probability for such is low as compared to DSR protocol). RREP packet contains a copy of the route traversed by the RREQ packet.

Other tanh, if the node does not contain an entry for the requested route, it rebroadcasts the RREQ packet The node also updates its routing table by recording the address of the intermediate node from which it first received this RREQ packet. [2]

B. Route Maintenance Phase

Nodes using AODV routing protocol periodically exchange data.

If a broken link is detected by any node when attempting to forward a data packet, it generates a route error RERR packet which is transmitted to all other nodes that might be using the broken link in their routing table entries. Then RERR packet deletes all routing entries which are using the broken link.

C. Advantages of AODV

(i) Connection setup requires less delay.
(ii)Destination sequence number discovered using the Latest and up-to-date routes

D. Disadvantages Of Aodv

(i) After a certain period of time even if any or some of the links is valid. Routing table entries are deleted.
(ii)Detecting broken links consumes bandwidth.due to periodic exchange of beacons

V. SIMULATION OF MANET

Some commercial (paid) network simulators are Qualnet, OPNET and some non-commercial (free) network simulators are ns2, ns3, Omnet++ [5].

A. Simulation Setup

In this paper for a detailed analysis of DSR and AODV RiverBed Modeler Academic Edition 17.5.A is used [6].

B. Simulation Environment Parameters

.The common parameters are:-

Table 1: Common Parameter Used in Simulation

Parameter	Value
Area	1000 x 1000 sq meter
Network size	15 nodes
Data Rate	24 Mbps
Mobility Model	Random Waypoint
Network Interface Type	Wireless Physical Layer
Link Layer Type	Data Link layer
Large packet processing	Drop
Wireless LAN	IEEE 802.11e capable
Data type	FTP
Simulation Time	7200 Seconds
Mobility speed	50 m/s

C. Simulation environment setup

In this paper Simulation environment consists of 15 wireless mobile nodes. It has been simulated against AODV protocol and then DSR protocol for High Load FTP application session simulation time is &7200s.

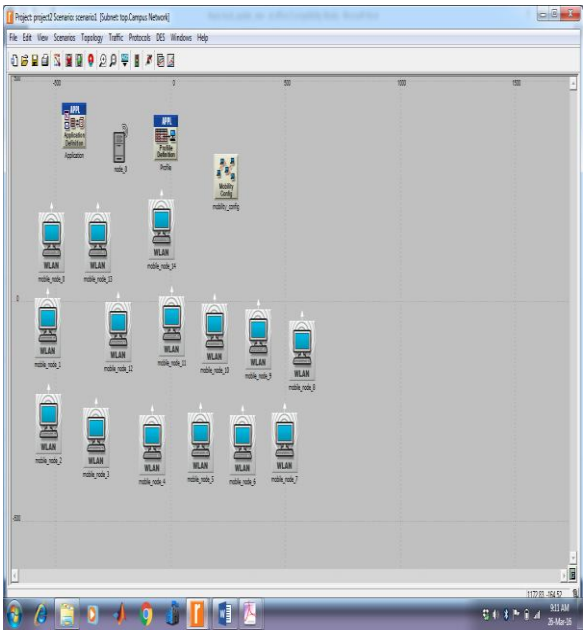

Figure 2: Simulation Model with 15 nodes in Riverbed Modeler

D. AODV RESULTS

In this paper three results has been collected:

a) Throughput:

Throughput determines the average rate of packets arrived over a transmission channel and the unit of measured is bit per second (bits/second). It also measures the efficiency and effectiveness of the routing protocol performance and determines the network performance from one node to destination. It also analyzed the quality of route and the capacity of the routing algorithm over network load.

b) Network Load:

Network load is the routing loads which can be defined as the number of routing traffic is being transmitted over the number of data packet transmitted from a source to its destination. It also determines the numbers of overhead packet are being transmitted through the network. In other words the traffic overhead is the number of control message transmitted to destination. Network load is measured with bits/sec unit.

c) Delay:

The delay can be measured in different ways; firstly the duration a packet spends at the queue during transmission. It also determines the buffer time and propagation time delay. Delay can be categorized as the network efficiency while using maximum resources by a network protocol.

In the figure 3 the Y axis is stands for delay (sec), load (bits/sec) and throughput (bits/sec) rates and the X axis represents duration (minutes) of the simulation.

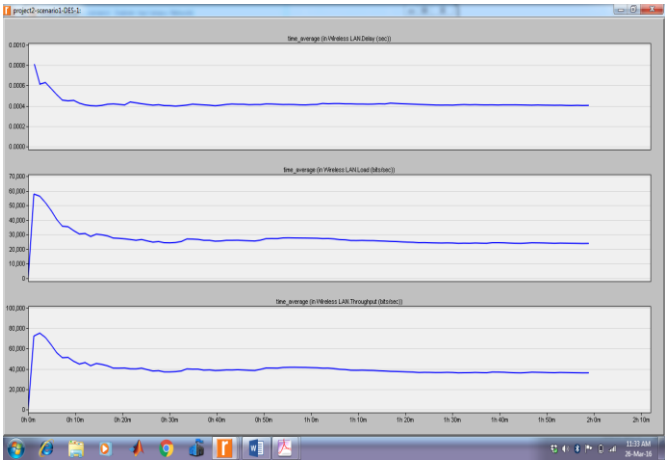

Figure 3: AODV (15 node) results (Average Delay, Load, and Throughput)

As shown in the above graph [Fig 3] the AODV protocol get good results as the delay started from just below 0.00085 seconds decrease gradually and till the end of the simulation, the average delay is just 0.000408 seconds. On the other hand network Load started from 50,000 bits/sec but decline steadily to a rate of 30,317 which is the average Load AODV protocol. And the throughput starts from high at over 74,000 and finished at near 41,058.7 bits/sec which can be said as constant 36,139.7 in average. Detail data were presented in the table below,

Table 2: **AODV, Node = 15 and ST = 7200 seconds**

Performance Metrics	Start at	Finish at	Results (Average)
Throughput(bits/sec)	74,000	41,058.7	36,139.7
Delay(sec)	0.00085	0.000489	0.000408
Load (bits/sec)	50,000	30,317	23,914.7

E. DSR RESULT

The next graph [Fig: 4] shows the results of DSR protocols throughput, Load and Delay in figure consisting of three different graphs. Table 03 involving DSR protocol with 15 nodes in the network, the Simulation Time is set to be 7200 sec with high load traffic.

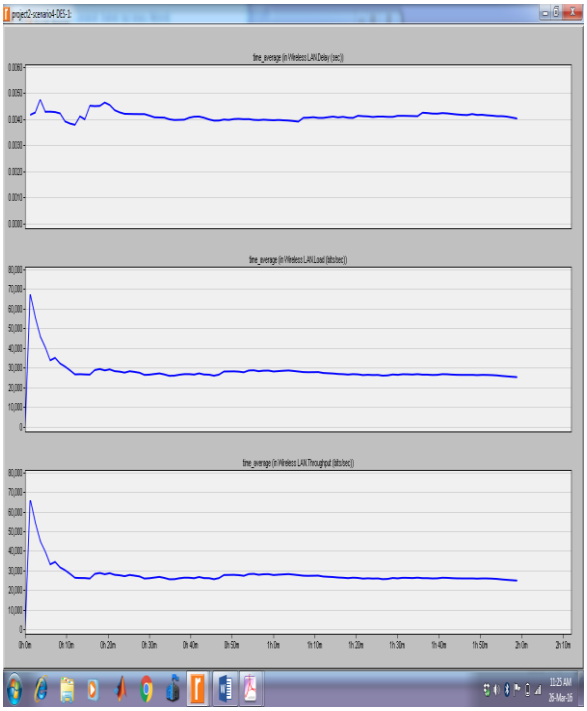

Figure 4: DSR (15 node) results (Average Delay, Load and Throughput)

In the graph [Fig: 4] above its can be found for when using DSR in the network results indicate high rate of throughput about 64,000 bits/sec at the start of the simulation. Network load is 25,288.4 bits/sec at the end of the simulation. The Delay is at 0.0045 sec but get average about 0.004 sec at the end of the simulation.

Table 3: DSR, Node = 15 and ST=7200 seconds

Performance Metrics	Start at	Finish at	Results (Average)
Throughput(bits/sec)	64,000	30,000	25,288.4
Delay(sec)	0.0045	0.000628	0.004
Load (bits/sec)	64,000	30,000	25,288.4

F. Throughput Comparison of AODV & DSR

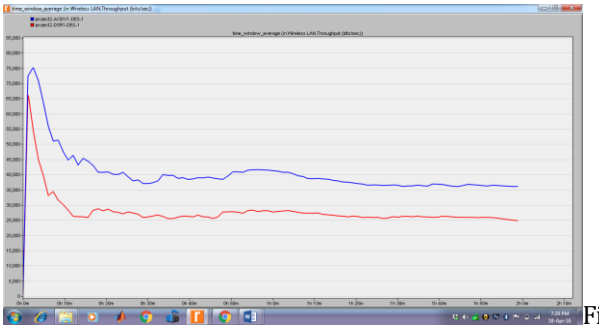

Figure 5: Throughput Analysis of AODV & DSR

Above Fig. 5 shown the comparison of AODV & DSR in comparison of Throughput. Here blue color stands for AODV & red color stands for DSR. The average throughput of AODV founds better than that of DSR.

G. Network Load Comparison of AODV & DSR

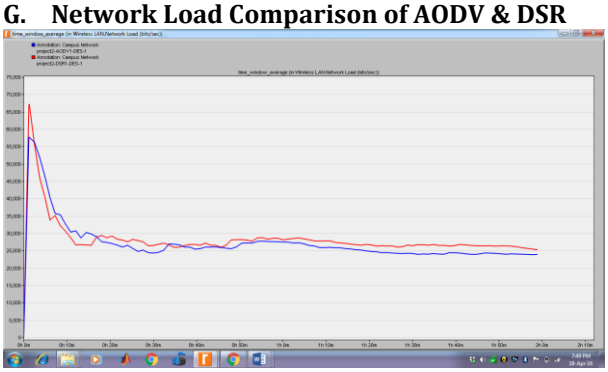

Figure 6: Network Load Analysis of AODV & DSR

Network Load founds better for AODV. From above [Fig.6] graph it can be found that AODV's network load is less than that of DSR protocol.

H. Delay Comparison of AODV & DSR

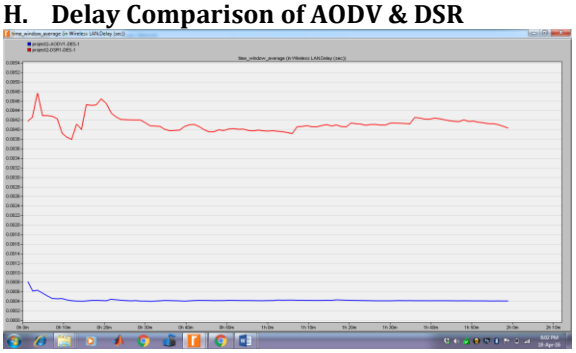

Figure 6: Delay Analysis of AODV & DSR

Delay result is also better for AODV protocol. From Fig. 6 it have been found that AODV protocol delay rate is .0008s where DSR protocol delay rate starts from .004s.

VI. CONCLUSION

Both protocols (AODV, DSR) have been analyzed against some specific parameters and it found that AODV routing protocol is efficient & better than DSR which is more effective in small sized adhoc networks. So, it can be concluded that using AODV routing protocol in MANET will enhance the performance.

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