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A COMPARATIVE STUDY OF AODV AND DSR ROUTING PROTOCOLS IN MANET

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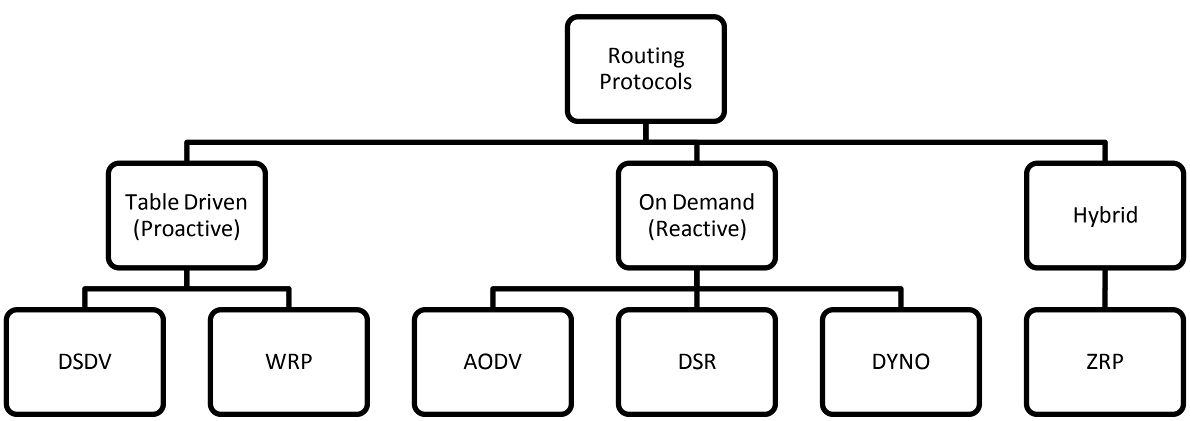
Abstract- Mobile Ad-hoc network(MANET) is a collection of mobile nodes sharing a wireless channel without any centralized control or established communication backbone. The network topology is in general dynamic, because the connectivity among the nodes may vary with time due to node mobility, node departures and new node arrivals. Hence, there is a need for efficient routing protocols to allow the nodes to communicate. A number of routing protocols have been developed and proposed in MANET. This paper deals with the study of two prominent algorithms namely, Dynamic Source Routing (DSR) and Ad Hoc On- demand distance Vector Routing (AODV) and evaluation of their performances.
Keywords – AODV, DSR, MANET, Routing protocols.

1. INTRODUCTION

A Mobile Ad hoc network is a collection of independent mobile nodes that communicate with each other using radio waves in an infrastructure-less environment. In an ad hoc network, a node can communicate directly with another node in point-to-point mode when the two nodes are located in the same transmission zone, while communication with a node in another zone is carried out via several intermediary nodes in multi-hop mode [1]. Each node in the network acts as both host and router. It discovers and maintains routes to other nodes in the network. Such networks are useful in military, disaster recovery and in other environments calamities, where no infrastructure exists or existing infrastructure has been destroyed.Since the nodes are mobile, the network topology may change rapidly and unpredictably and the connectivity among the terminals may vary over time. The time-varying nature of the ad hoc network topology renders the traditional fixed network routing techniques, such as the shortest-path and link-state protocols, obsolete for Ad hoc networks. An efficient routing protocol is required to cope with such dynamic network condition and must find the path quickly and efficiently. Such protocols must also deal with typical limitations of these networks which include low bandwidth, highpower consumption, and high error rates.

2. TYPES OF ROUTING IN AD HOC NETWORK

Over the past few years, number of routing protocols and algorithms have been proposed and closely studied. One of the most popular methods to distinguish mobile Ad hoc network routing protocols is based on how routing information acquired and maintained by mobile nodes. In this approach a mobile node uses its knowledge about recent connectivity of the network including the state of network links [2]. Based on the time at which the routes are discovered and updated, routing protocol are classified into three categories.



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2.1 Proactive Routing Protocols -

Proactive protocols also known as "table driven" approach because routing information is maintained in tables. In this approach nodes in the network regularly discover path to all nodes which are reachable and tries to keep consistent and up-to-date routing information in the routing table. This makes it easier for a source node to get a routing path immediately when required[1]. Routing information is generally flooded in the whole network. These routing tables are periodically exchanged between nodes in network at set time interval. No matter whatever may be the mobility and traffic characteristics of network, the routing updates occur at specified time intervals.

2.2 Reactive Routing Protocol -

In this approach a node does not continuously maintain a route between all pairs of network nodes. Here, routes are discovered only when they are actually needed. Whenever a node has data to send to some destination, first it checks its route table to know whether it has a route. If the route doesn't exist in table, then it will find a path to the destination this procedure is called as route discovery procedure. Hence, route discovery becomes on-demand. This approach is therefore also called as on-demand routing.

2.3 Hybrid Routing Protocols -

These protocols are the combination the proactive and reactive approaches that's why theyare known as hybrid routing protocol. Nodes within a certain distance from the node concerned, or within a particular geographical region, are said to be within the routing zone of the given node. For routing within this zone, a table-driven approach is used. For nodes that are located beyond this zone, an on-demand approach is used.

2.4 Ad Hoc On-Demand Distance Vector Routing (AODV) -

The AODV[3] routing protocol is a reactive routing protocol that discovers the route only on demand.Route discovery process begins by the source node broadcasting route request (RREQ) packet to the neighbors. The neighbors in turn re-broadcast the packet to their neighbors. This process is continued until either; it reaches an intermediate node that has recent route information about the destination or until it reaches the destination. Sequence numbers are used in route request packet to avoid the loop and to ensure that only most recent requests are replied by the intermediate nodes. Route table at each node contains the routing information for destination nodes along with an associated lifetime value. If a route is note utilized within the lifetime period, it gets expired. Premature expiry of route is prevented by updating its lifetime whenever it is used. Route request (RREQ) packet contains destination node's IP address, the last known sequence number for that destination and the source's IP address and current sequence number. The RREQ also contains a hop count, initialized to zero and RREQ ID. Packet format of RREQ is shown in figure 1.0

Type	J	R	G	D	U	Reserved	Hop Count
RREQ ID							
Destination IP Address							
Destination Sequence Number							
Originator IP Address							
Originator Sequence Number							

Figure 1.0: RREQ packet format in AODV

When a neighboring node receives a RREQ, it first creates a reverse route to the source node and increments the hop count in the RREQ by one to get the hop distance from the source. It checks for an unexpired route to the destination in its route table. If it does not have a valid route to the destination, it simply broadcasts the RREQ, with the incremented hop count value, to its neighbors. However, if a node has an unexpired route to the destination and route table entry for the destination, has a sequence number equal to or greater than the destination sequence number in the route request, it will return the route reply(RREP) message, containing the source node's IP address, the destination node's IP address and the destination's sequence number as given in the node's route table entry for the destination. In addition, the hop count field in the RREP is set equal to the node's distance from the destination. If the destination itself is creating the RREP, the hop count is set equal to Zero. After creating the reply, the node unicasts the message to its next hop toward the source node.

When the next hop receives the RREP, it first creates a forward route entry for the destination node. The hop count for that route is the hop count in the RREP, incremented by one. This forward route entry for the destination will be utilized if the source selects this path for data packet transmissions to the destination. The RREP is thus forwarded hop by hop to the source node. Once the source receives the RREP, it can utilize the path for the transmission of data packets. If the source receives more than one RREP, it selects the route with the greatest sequence number and smallest hop count.

2.5 Dynamic Source Routing (DSR) -

The Dynamic Source Routing (DSR) protocol [4]is a reactive routing protocol. It is a source routing protocol, wherein the data packets contain strict source routes that specify each node along the path to the destination. The source node broadcasts RREQ packets containing destination IP address, as well as its own IP address to its neighbors. On receiving RREQ message, the neighboring nodes update their route to the source and then append their own IP addresses to the RREQ. Thus, as the RREQ is forwarded throughput the network, the traversed path is accumulated in the message. When intermediate nodes receive the RREQ, they can create or update routing table entries for each of the nodes listed in the source route, not just the source node. When the destination node receives RREQ, it places the accumulated source route from the RREQ into the RREP. However, if intermediate node having route to destination receives RREQ, it concatenates its source route to the destination to the accumulated route in the RREQ, and places this new route into the RREP. Hence, in either scenario the message contains the full route between the source and the destination. The source route in the RREP is reversed and the RREP is unicast to the source.

Instead of maintaining a route table for tracking routing information, DSR utilizes a route cache that allows multiple route entries to be maintained per destination, there by accommodating multipath routing.If a route to a destination breaks alternate route can be utilized from the route cache, this prevents costly route discovery process. In the same way, if a link break in a route occurs, the node upstream of the break can perform route salvaging, whereby it utilizes a different route from its route cache and repairs the route. Once the route salvaging is performed, a RERR message is sent to the source to inform it of the break. DSR's route cache entries need not have lifetimes. Once a route is placed in the route cache, it can remain there until it breaks. Additionally, DSR nodes have the option of promiscuous listening, whereby nodes can receive and process data and control packets that are not addressed, at the MAC layer, to themselves. Through promiscuous listening, nodes can utilize the source routes carried in both DSR control messages and data packets to gratuitously learn routing information for other network destinations.

3. PERFORMANCE METRICS

The routing algorithms were evaluated using following four performance metrics[5].

3.1 Packet Delivery Ratio (PDR) **-**

It is the ratio of difference between the total number of generated packets and total number of received packets divided by the total number of generated packets. It measures the loss rate as seen by transport protocols and as specific to both the correctness and efficiency of ad hoc routing protocols. The performance is better when packet delivery ratio is high. PLR is calculated as:

PDR = (Generated packets - Received Packets)/ Generated packets

3.2 End-to-end delay (EED) **-**

The end-to-end delay is the total delay that a data packet experiences as it is traveling from the source node to the destination node. To find out the end-to-end delay the difference of packet sent and received time was stored and then dividing the total time difference over the total number of packet received gave the average end-to-end delay for the received packets. The performance is better when packet end-to-end delay is low.

EED= (Time packet received - Time packet sent) / Total number of packets received

This delay is built up by several smaller delays in the network such as, time spent in packet queues, forwarding delays, propagation delay (the time it takes for the packet to travel through the medium) and time needed to make retransmissions if a packet got lost etc.

3.3 Throughput **-**

Throughput is defined as the average number of message successfully delivered per unit time i.e. average number of bits delivered per second. It is measured as, Total number of delivered data packets divided by the total duration of simulation time. We can analyse the throughput of the protocol in terms of number of messages delivered per one second. Throughput is calculated as the ratio of the total number of packets that reach their destination, to the total number of packets sent by the source.

Throughput = Packets Received / Packets Sent

3.4 Control Overhead –

It is ratio of the control information sent to the actual data received at each node.

4. SIMULATION ENVIRONMENT

Network simulator (NS) is an open source, discrete event network simulator. It is used in the simulation of routing and multicast protocols, in particular for ad-hoc network research. NS supports an array of popular network protocols, offering simulation results for wired and wireless networks alike. It can be also used as limited functionality network emulator. Network Simulator (NS2) version 2 is the second major iteration of a discrete-event network simulation platform. The core of ns-2 is written in C++, but the C++ simulation objects are also linked to shadow objects in OTcl. Simulation scripts are written in the OTcl language (Object-oriented Tool Command Language) which is an extension of the Tcl scripting language. This structure permits simulations to be written and modified in an interpreted environment without having to resort to recompiling the simulator each time a structural change is made.

4.1 Simulation set up -

The simulations were performed using Network Simulator2 (NS2). The traffic sources are CBR (continuous bit – rate). The source-destination pairs are spread randomly over the network. The detailed description of simulation environment is presented below in table1.

Parameter	Value
Simulator	NS-2.34
Radio-propagation model	Propagation/Two ray round wave
Channel type	Channel/Wireless channel
MAC Type	Mac /802.11
Network interface type	Phy/WirelessPhy
Interface queue Type	Queue/Drop Tail
Link Layer Type	LL
Antenna	Antenna/Omni Antenna
Maximum packet in ifq	50
Area (M*M)	1000*1000
Source Type	CBR(constant bit rate)
Simulation Time	150 s
Routing Protocols	DSDV, AODV and DSR
Number of connection	20
Data rate	20 packet/second
Pause time	30 second
Packet size	512 bytes
Mobility Model	Random Way point model
Transmission Range	250 m
Mobility speed	0-20 m/s

Table 1: NS2 Simulation setup

5. RESULTS OF SIMULATION

5.1 Control Overhead -

From the Simulation it is evident that DSR has less control overhead as compared to AODV. This can be verified in the Graph figure 2. It is clear that the overhead of AODV increases with the increase in number of nodes. However, DSR does show a steady overhead with increase in number of nodes.

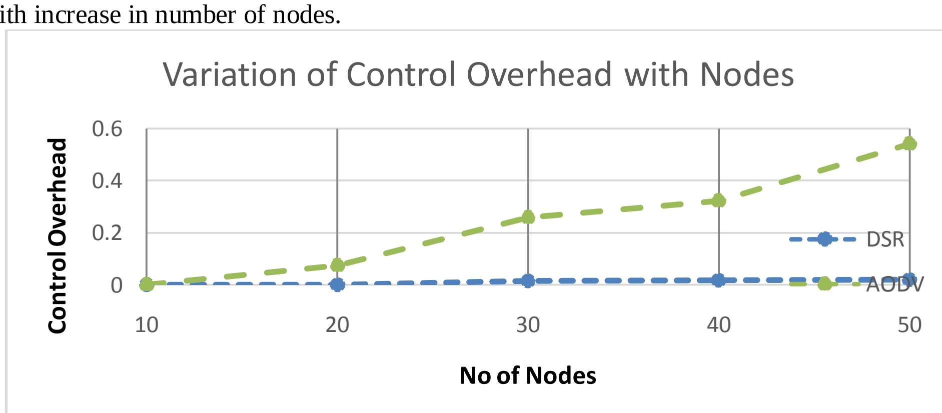

Figure 2. Control Overhead

5.2 End-to-End Delay -

As compared to AODV, DSR shows a steady end-to-end delay, which is lower than AODV. This is as shown in the figure 3.

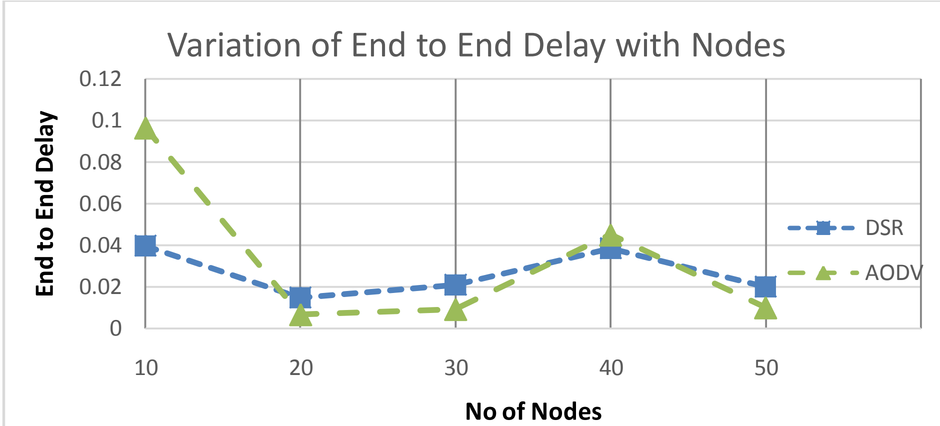

Figure 3. End to End Delay

5.3 Packet Delivery Ratio –
Packet delivery ratio of both AODV and DSR are fairly same in all the case. This is evident from the figure 4.

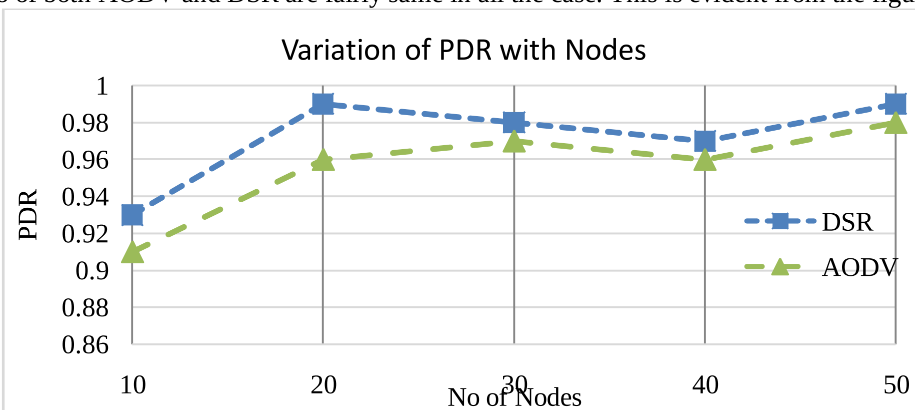

Figure 4.Packet Delivery Ratio

5.4 Throughput –
From the simulation it is found that AODV has less throughput than DSR, which is as shown in the figure 5.

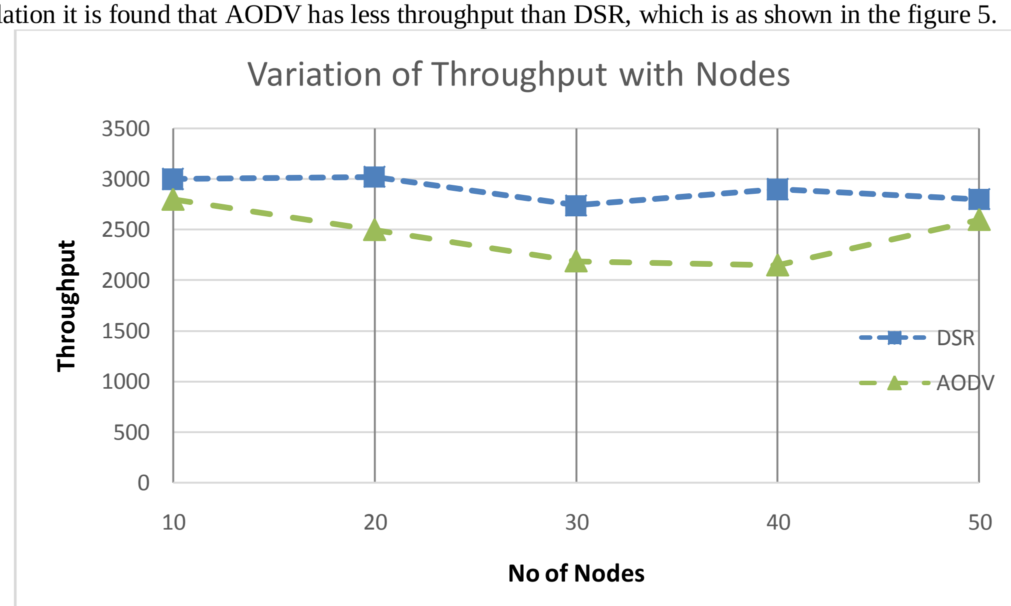

Figure 5.Throughput

6. CONCLUSION

In this paper, the performance of the two MANET Routing protocols such as AODV and DSR was analyzed using NS-2 Simulator.The simulated result shows that DSR outperforms AODV. We have done comprehensive simulation results of Average End-to-End delay, throughput, and packet delivery ratio over the routing protocols DSR and AODV by varying number of nodes. Comparing DSR with AODV protocol, byte overhead in each packet will increase whenever network topology changes since DSR protocol uses source routing and route cache. Hence, DSR is preferable for moderate traffic with moderate mobility. As AODV routing protocol needs to find route by on demand, End-to-End delay will be higher than other protocols. When the network load is low, AODV performs better in case of packet delivery ratio but it performs badly in terms of average End-to-End delay and throughput. Overall, DSR outperforms AODV because it has less routing overhead when nodes have high mobility considering the above said three metrics.

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