Effect of Pause Time and Nodes Mobility Speed on AODV and DSR in MANET

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***Abstract*: An ad hoc network is a collection of mobile nodes that dynamically form a temporary network. It operates without the use of existing infrastructure. As mobile ad hoc network applications are deployed, Routing is one of the central requirements. This paper analyses the performance of AODV and DSR routing protocols using network simulator NS2.34 on Ubuntu 10.04 by varying the pause time and speed of node's mobility using constant bit rate. In a real world scenario, the pause time and nodes mobility speed frequently changed. In this paper assumed different pause time and nodes movement speed. The metrics for evaluation has been considered as Packet Delivery Ratio and throughput. This would be a great help for the people conducting research on real world problems in MANET Routing and other solutions.**

***Index Terms*- AODV, DSR, Routing Protocol, Pause Time**

I. INTRODUCTION

The wireless network can be classified into two types: Infrastructured or Infrastructure less. In Infrastructured wireless networks, the mobile node can move while communicating, the base stations are fixed and as the node goes out of the range of a base station, it gets into the range of another base station. In Infrastructureless or Ad Hoc wireless network, the mobile node can move while communicating, there are no fixed base stations and all the nodes in the network act as routers. The mobile nodes in the Ad Hoc network dynamically establish routing among themselves to form their own network 'on the fly'. A Mobile Ad Hoc Network is a collection of wireless mobile nodes forming a temporary/short-lived network without any fixed infrastructure where all nodes are free to move about arbitrarily and where all the nodes configure themselves. In this network, each node acts both as a router and as a host & even the topology of network may also change rapidly. In this paper AODV and DSR are considered for evaluation using varying the pause time and nodes movement speed in MANET.

In section II routing protocols is discussed, section III proposed analyses and section IV conclusion.

II. ROUTING PROTOCOLS

A routing protocol is needed whenever a packet needs to be transmitted to a destination via number of nodes and numerous routing protocols have been proposed for such kind of ad hoc networks. These protocols find a route for packet delivery and deliver the packet to the correct destination. The studies on various aspects of routing protocols have been an active area of research for many years. Many protocols have been suggested keeping applications and type of network in view. Basically, routing protocols can be broadly classified into two types as: Table Driven Protocols or Proactive Protocols and On-Demand Protocols or Reactive Protocols. In Table Driven routing protocols each node maintains one or more tables containing routing information to every other node in the network. All nodes keep on updating these tables to maintain latest view of the network. Some of the existing table driven protocols are DSDV [5, 10], DBF [6], GSR [12], WRP [11] and ZRP [15, 9]. In on-demand routing protocols, routes are created as and when required. When a transmission occurs from source destination, it invokes the route discovery procedure. The route remains valid till destination is achieved or until the route is no longer needed. Some of the existing on demand routing protocols are: DSR [7, 8], AODV [3, 4] and TORA [13, 14]. The emphasis in this research paper is concentrated on the performance analysis of two prominent on-demand routing Protocols i.e. DSR and AODV.

Dynamic state routing (DSR) [7, 8]

DSR is an Ad Hoc routing protocol which is based on the theory of source-based routing rather than table-based. This protocol is source-initiated rather than hop by-hop. This is particularly designed for use in multi hop wireless ad hoc networks of mobile nodes. Basically, DSR protocol does not need any existing network infrastructure or administration and this allows the Network to be completely self-organizing and self-configuring. This Protocol is composed of two essential parts of route discovery and route maintenance. Every node maintains a cache to store recently discovered paths. When a node desires to send a packet to some node, it first checks its entry in the cache. If it is there, then it uses that path to transmit the packet and also attach its source address on the packet. If it is not there in the cache or the entry in cache is expired (because of long time idle), the sender broadcasts a route request packet to all of its neighbors asking for a path to the destination. The sender will be waiting till the route is discovered. During waiting time, the sender can perform other tasks such as sending/forwarding other packets. As the route request packet arrives to any of the nodes, they check from their neighbor or from their caches whether the destination asked is known or unknown. If route information is known, they send back a route reply packet to the destination otherwise they broadcast the same route request packet. When the route is discovered, the required packets will be transmitted by the sender on the discovered route. Also an entry in the cache will be inserted for the future use. The node will also maintain the age information of the entry so as to know whether the cache is fresh or not. When a data packet is received by any intermediate node, it first checks whether the packet is meant for itself or not. If it is meant for itself (i.e. the intermediate node is the destination), the packet is received otherwise the same will be forwarded using the path attached on the data packet. Since in Ad hoc network, any link might fail anytime. Therefore, route maintenance process will constantly monitors and will also notify the nodes if there is any failure in the path. Consequently, the nodes will change the entries of their route cache.

Benefits and Limitations:

The benefits of DSR protocol are:

a. DSR uses no periodic routing messages (e.g. no router advertisements and no link-level neighbor status messages), thereby reducing network bandwidth overhead, conserving battery power, and avoiding the propagation of potentially large routing updates throughout the ad hoc network.
b. It is able to adapt quickly to changes such as host movement, yet requires no routing protocol overhead during periods in which no such changes occur.
c. There is no need to keep routing table so as to route a given data packet as the entire route is contained in the packet header.
d. The routes are maintained only between nodes that need to communicate. This reduces overhead of route maintenance.
e. Route caching can further reduce route discovery overhead. A single route discovery may yield many routes to the destination, due to intermediate nodes replying from local caches
f. The DSR protocol guarantees loop-free routing and very rapid recovery when routes in the network change.
g. In addition, DSR has been designed to compute correct routes in the presence of asymmetric (uni-directional) links. In wireless networks, links may at times operate asymmetrically due to sources of interference, differing radio or antenna capabilities, or the intentional use of asymmetric communication technology such as satellites. Due to the existence of asymmetric links, traditional link-state or distance vector protocols may compute routes that do not work. DSR, however, will find a correct route even in the presence of asymmetric links.

The limitations of this protocol can be summarized as:

a. The DSR protocol is mainly efficient for mobile ad hoc networks with less than two hundred nodes. This is not scalable to large networks.
b. DSR requires significantly more processing resources than most other protocols. In order to obtain the routing information, each node must spend lot of time to process any control data it receives, even if it is not the intended recipient.
c. The Route Maintenance protocol does not locally repair a broken link. The broken link is only communicated to the initiator.
d. Packet header size grows with route length due to source routing.
e. Flood of route requests may potentially reach all nodes in the network.

Care must be taken to avoid collisions between route requests propagated by neighboring nodes.

a. The contention is increased if too many route replies come back due to nodes replying using their local cache. The Route Reply Storm problem is there.
b. An intermediate node may send Route Reply using a stale cached route, thus polluting other caches. This problem can be eased if some mechanism to purge (potentially) invalid cached routes is incorporated.

Ad hoc on demand distance vector routing (ADOV) [3, 4]

AODV is a variation of Destination-Sequenced Distance-Vector (DSDV) routing protocol which is collectively based on DSDV and DSR. It aims to minimize the requirement of system-wide broadcasts to its extreme. It does not maintain routes from every node to every other node in the network rather they are discovered as and when needed & are maintained only as long as they are required. The key steps of algorithm used by AODV for establishment of unicast routes are explained below.

Route Discovery:

When a node wants to send a data packet to a destination node, the entries in route table are checked to ensure whether there is a current route to that destination node or not. If it is there, the data packet is forwarded to the appropriate next hop toward the destination. If it is not there, the route discovery process is initiated. AODV initiates a route discovery process using Route Request (RREQ) and Route Reply (RREP). The source node will create a RREQ packet containing its IP address, its current sequence number, the destination's IP address, the destination's last sequence number and broadcast ID. The broadcast ID is incremented each time the source node initiates RREQ. Basically, the sequence numbers are used to determine the timeliness of each data packet and the broadcast ID & the IP address together form a unique identifier for RREQ so as to uniquely identify each request. The requests are sent using RREQ message and the information in connection with creation of a route is sent back in RREP message. The source node broadcasts the RREQ packet to its neighbours and then sets a timer to wait for a reply. To process the RREQ, the node sets up a reverse route entry for the source node in its route table. This helps to know how to forward a RREP to the source. Basically a lifetime is associated with the reverse route entry and if this entry is not used within this lifetime, the route information is deleted. If the RREQ is lost during transmission, the source node is allowed to broadcast again using route discovery mechanism.

Setting up of Forward Path:

When the destination node or an intermediate node with a route to the destination receives the RREQ, it creates the RREP and unicast the same towards the source node using the node from which it received the RREQ as the next hop. When RREP is routed back along the reverse path and received by an intermediate node, it sets up a forward path entry to the destination in its routing table. When the RREP reaches the source node, it means a route from source to the destination has been established and the source node can begin the data transmission.

Route Maintenance:

A route discovered between a source node and destination node is maintained as long as needed by the source node. Since there is movement of nodes in mobile ad hoc network and if the source node moves during an active session, it can reinitiate route discovery mechanism to establish a new route to destination. Conversely, if the destination node or some intermediate node moves, the node upstream of the break initiates Route Error (RERR) message to the affected active upstream neighbors/nodes. Consequently, these nodes propagate the RERR to their predecessor nodes. This process continues until the source node is reached. When RERR is received by the source node, it can either stop sending the data or reinitiate the route discovery mechanism by sending a new RREQ message if the route is still required.

Benefits and Limitations:

The benefits of AODV protocol are as under:

a. The routes are established on demand and destination sequence numbers are used to find the latest route to the destination. The connection setup delay is lower.
b. It favors the least congested route instead of the shortest route and it also supports both unicast and multicast packet transmissions even for nodes in constant movement.
c. It also responds very quickly to the topological changes that affects the active routes.
d. It does not put any additional overheads on data packets as it does not make use of source routing.

The limitations of AODV protocol are summarized below:

a. The intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number, thereby having stale entries.
b. The multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead. The periodic beaconing leads to unnecessary bandwidth consumption.
c. It expects/requires that the nodes in the broadcast medium can detect each others' broadcasts. It is also possible that a valid route is expired and the determination of a reasonable expiry time is difficult. The reason behind this is that the nodes are mobile and their sending rates may differ widely and can change dynamically from node to node.
d. The various performance metrics begin decreasing as the network size grows.
e. It is vulnerable to various kinds of attacks as it based on the assumption that all nodes must cooperate and without their cooperation no route can be established.

III. PROPOSED ANALYSIS

The working of routing largely depends upon successful transmission of packets to the destination. This requires proper selection of Routing path and algorithm. AODV and DSR have been used in this paper for routing solutions. All the simulations have been performed using Network Simulator NS-2.34 [2] on the platform Ubuntu 10.04. The traffic sources are CBR (continuous bit–rate). The source-destination pairs are spread randomly over the network. The mobility model uses 'random waypoint model' [9] in area 750m × 1000m. During the simulation, each node starts its journey from a random spot to a random chosen destination. Once the destination is reached, the node takes a rest period of time in second and another random destination is chosen after that pause time. This process repeats throughout the simulation, causing continuous changes in the topology of the underlying network. Different network scenario for different number of nodes and different node transmission range are generated. The model parameters that have been used in the following experiments are summarized in Table 1.

Parameter	**Value**
Simulator	NS-2.34
Simulation Area	750m×1000m,
Routing Protocols	AODV & DSR
Mobile Nodes	15, 25
Pause Time	0,50,100,150,200,250,300
Speed	0,5,10,15,20 m/sec
Packet Size	512
Traffic Sources	CBR(UDP)
Simulation Time	500 Sec.

TABLE 1: *SIMULATION PARAMETERS*

Performance Metrics

There are number of qualitative and quantitative metrics that can be used to compare reactive routing protocols. Most of the existing routing protocols ensure the qualitative metrics. Therefore we have used the following metrics. These performance metrics determines the completeness and correctness of the routing protocol.

Packet Delivery Ratio: PDR is defined as a percentage of data packets delivered at receiver end compared to that of number of data packets sent for that node. It is used to measure the reliability, effectiveness and efficiency of routing protocols. Generally the reliability, effectiveness and efficiency of routing protocols can be improved by improving the PDR.

Throughput: It is one of the dimensional parameters of the network which gives the fraction of the channel capacity used for useful transmission selects a destination at the beginning of the simulation i.e., information whether or not data packets correctly delivered to the destinations.

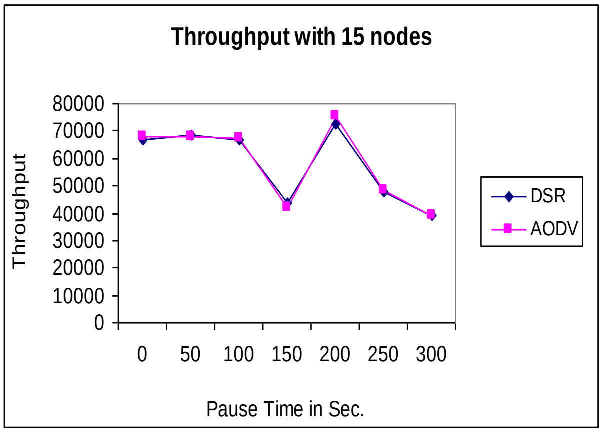

Figure 1: *Throughput*

Figure 1 shows that throughput of AODV and DSR almost same in all scenarios. In this figure throughput cover data packets as well as control packets in both routing protocols.

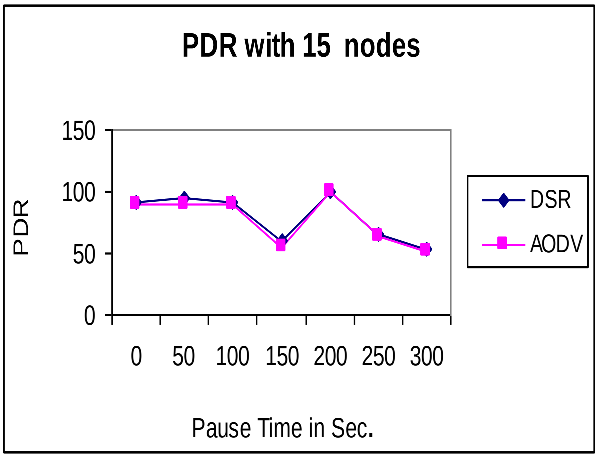

Figure 2: *Packet delivery Ratio*

Figure 2 shows that in DSRs Packet delivery ratio is little bit high compare to AODV.

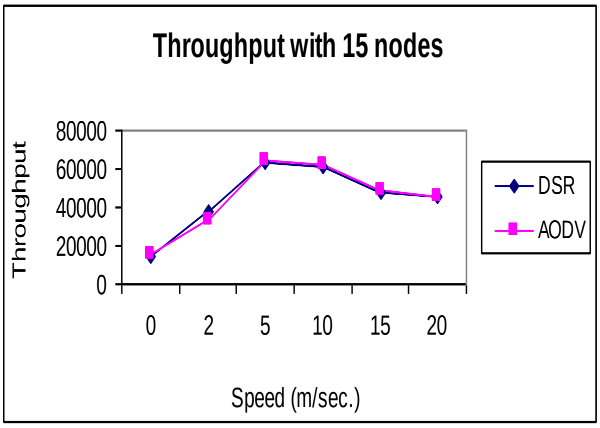

Figure 3: *Throughput*

Figure 3 shows that throughput of AODV and DSR almost same in all scenarios. But after the speed 5 m/sec. is high in both protocols.

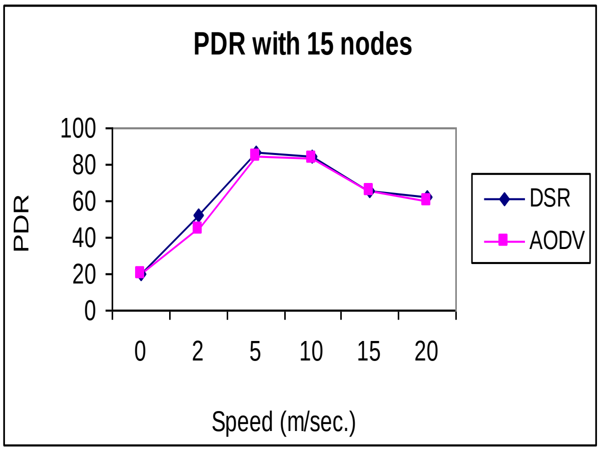

***Figure 4:** Packet delivery Ratio*

Figure 4 shows that in DSRs Packet delivery ratio is little bit high compare to AODV in all scenarios.

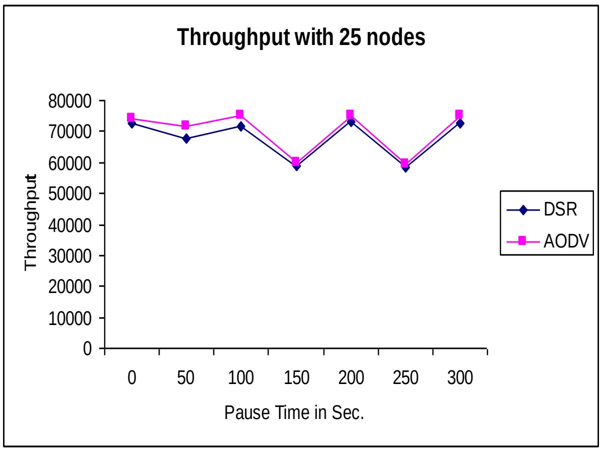

***Figure 5:** Throughput*

Figure 5 shows that throughput of AODV is better compare to DSR in all scenarios.

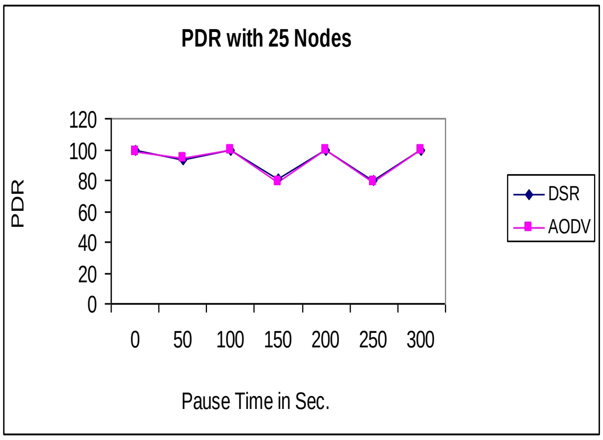

***Figure 6:** Packet delivery Ratio*

Figure 6 shows that in AODVs Packet delivery ratio is little bit high compare to DSR in all scenarios.

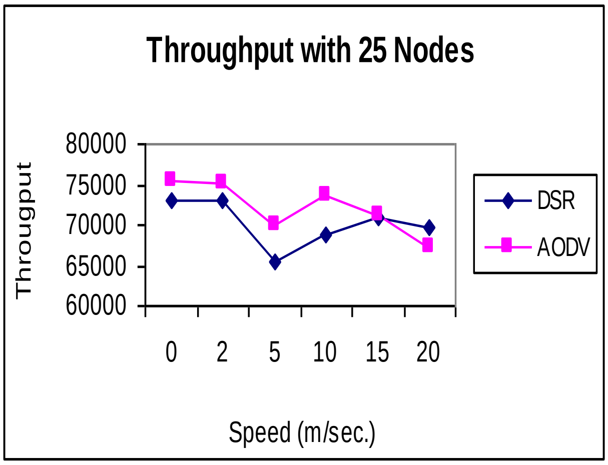

***Figure 7:** Throughput*

Figure 7 shows that throughput of AODV is very high compare to DSR in all scenarios.

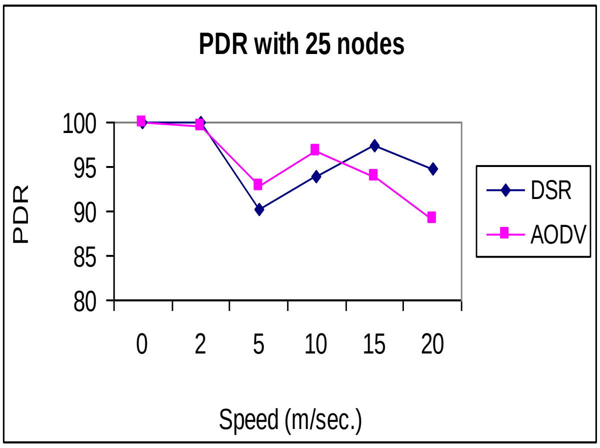

***Figure 8:** Packet delivery Ratio*

Figure 8 shows that in AODVs Packet delivery ratio is better upto speed 10 but after that DSRs PDR is good.

IV. CONCLUSION

In this research paper, an effort has been made to concentrate on the comparative study and performance analysis of two prominent on demand routing protocols i.e. DSR and AODV on the basis of packet delivery ratio and Throughput. The results are presented with the help of graphs. The results show that the DSR protocol has outperformed the AODV protocol with the number of nodes 15 but when the number of nodes increases i.e. 25 AODV protocol outperformed the DSR. The parameters selected are most suited to check the performance of routing protocols.

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