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Analysis of MANET Routing Protocols Based on Traffic Type

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***Abstract*—Mobile Ad-hoc Network is an infrastructure less, which is the collection of wireless nodes that can exchange information dynamically among them without pre existing fixed infrastructure and is a decentralized network which need a robust dynamic routing protocol. Because of highly dynamic in nature, performance of routing protocols is an important issue. Many routing protocols for such networks have been proposed so far. Amongst the most popular ones are Dynamic Source Routing (DSR), Ad-hoc On-demand Distance Vector (AODV) and Destination-Sequenced Distance Vector (DSDV) routing protocol. This paper presents simulation based performance analysis of AODV and DSR routing protocol for UDP and TCP Connections.**

***Index Terms*— Ad-hoc Networks, Routing Protocols, AODV, DSR, DSDV, Performance, Simulation**.

I. Introduction

MOBILE Ad-hoc Network (MANET) is a collection of wireless nodes that can dynamically be set up anywhere and anytime without using any pre-existing network infrastructure [1]. It is an autonomous system in which mobile hosts connected by wireless links are free to move randomly and often act as routers at the same time. The topology of such networks is likely highly dynamic because each network node can freely move and no pre-installed base stations exist. Due to the limited wireless transmission range of each node, data packets then may be forwarded along multi-hops. Route construction should be done with a minimum of overhead and bandwidth consumption. Routing protocols are challenging to design as performance degrades with the growth of number of nodes in the environment and a large ad hoc network is difficult to manage.

This paper has been organized as follows: In the following section, AODV and DSR Protocols are briefly reviewed. Then the performance metrics like Packet Delivery fraction and Packet Loss Ratio are described on the basis of which the protocols are compared. A simulation model has been explained on which basis results are obtained and graphs are generated to compare and analyze the results with the help of performance metrics using NS2.34 simulation tool [2][3]. The simulation based comparative performance analysis of routing protocols DSR and AODV are done and finally concluded which protocol is better under certain traffic conditions and scenarios.

II. Ad hoc On-demand Distance Vector Routing Protocol [AODV]

AODV is a purely reactive routing protocol. In AODV, the source node and the intermediate nodes store the next hop information corresponding to each flow for data packet transmission. The source node floods the Route Request Packet in the network when a route is not available for the desired destination. It may obtain multiple routes to different destinations from a single Route Request. It uses a destination sequence number (DestSeqNum) to determine an up-to-date path to the destination. A node updates its path information only if the DestSeqNum of the current packet received is greater than the last DestSeqNum stored at the node [4] [5].

A. Route Request

A Route Request carries the source identifier (SrcID), the destination identifier (DestID), the source number (SrcSeqNum), the destination sequence number (DestseqNum), the broadcast identifier (BcastID) and the time to live (TTL) field. DestseqNum indicates the freshness of the route that is accepted by the source [10]. When an intermediate node receives a Route Request, it either forwards it or prepares a Route Reply if it has a valid route to the destination. The validity of the route at the intermediate node is determined by comparing the sequence number at the intermediate node with the destination sequence number in the Route Request Packet.

B. Route Reply

If a Route Request is received multiple times, which is indicated by the BcastID-SrcID pair, the duplicate copies are discarded. All intermediate nodes having valid route to the destination; or the destination node itself, are allowed to send Route Reply Packets to the source. Every intermediate node, while forwarding a Route Request, enters the previous node address and it's BcastID. A timer is used to delete this entry in case a Route Reply is not received before the timer expires.

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C. Route Repair

AODV does not repair a broken path locally. When a link breaks, which is determined by observing the periodical beacons or through link-level acknowledgements, the end nodes (source and destination nodes) are identified. When a source node learns about the path break, it reestablishes the route to the destination if required by the higher layers. If a path break is detected at an intermediate node, the node informs the end nodes by sending an unsolicited RouteReply with the hop count set as infinity.[6]

D. Advantages:

1) Routes are established on demand and destination sequence numbers are used to find the latest route to the destination.
2) The connection set up delay is less.

E. Disadvantages:

1) 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.
2) Multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead.
3) The periodic beaconing leads to unnecessary bandwidth consumption.

III. DYNAMIC SOURCE ROUTING [DSR]

DSR is an on-demand protocol designed to restrict the bandwidth consumed by control packets by eliminating the periodic table updates messages.[7][8]

A. Route Establishment

The route is established by flooding Route Request packets in the network. The destination nodes, on receiving a Route Reply packet, responds by sending a Route Reply packet back to the source, which carries the route traversed by the Route Request packet received.

Each Route Request carries a sequence number generated by the source node and the path it has traversed. A node upon receiving a Route Request packet, checks the sequence number on the packet before forwarding it. The packet is forwarded only if it is not a duplicate Route Request.

The sequence number on the packet is used to prevent loop information and to avoid multiple transmissions of the same Route Request by an intermediate node that receives it through multiple paths. Thus, all nodes except the destination forward a Route Request packet during the route construction phase.

A destination node, after received the first Route Request packet, replies to the source node through the reverse path the Route Request had traversed. If an intermediate node receiving a Route Request has route to the destination node in its route cache, then it replies to the source node by sending Route Reply with the entire route information from the source node to the destination node.

B. Route Maintenance

When an intermediate node in the path moves away, causing a wireless link to break, a Route Error message is generated from the node adjacent to the broken link to inform the source node. The source node reinitiates the route establishment procedure. The cached entries at the intermediate nodes and the source node are removed when a Route Error packet is received. If a link breaks due to the movement of edge nodes, the source node again initiates the route discovery process.[9]

C. Advantages

1) The route is established only when it is required.
2) The intermediate nodes also utilize the route cache information efficiently to reduce the control overhead.

D. Disadvantages:

1) The route maintenance mechanism does not locally repair a broken link.
2) Stale route cache information could also result in inconsistencies during the route construction phase.
3) The connection set up delay is higher.
4) The performance degrades rapidly with increasing mobility.
5) Routing overhead is involved due to the source-routing mechanism. The routing overhead is directly proportional to the path length.

IV. PERFORMANCE METRICS

A. Packet Delivery Fraction: [PDF]

Packet delivery ratio is defined as the ratio of data packets received by the destinations to those generated by the sources.

PDF=NPD/TPS

Where,

TABLE I
SIMULATION PARAMETERS

Parameter	Attributes
Simulator	ns-2.34
Protocols	AODV, DSR
Simulation duration	200 seconds
Simulation area	1000 m x 1000 m
Number of nodes	06, 25, 50, 150
Transmission range	250 m
Movement model	Random Waypoint
Antenna Type	Omni Antenna
Radio Propagation	Two Ray Propagation
MAC Layer Protocol	IEEE 802.11
Maximum speed	20 m/s
Packet rate Data	4 packets/sec
Traffic type	CBR
payload	512 bytes/packet
Pause Time	100 sec

NPD=No. of Packets received by the destination
TPS=Total no. of Packets transmitted by the source.

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B. Packet Loss Ratio: [PLR]

The ratio of the data packets originated by the sources failure to deliver to the destination

V. SIMULATION RESULTS

A. Simulation Parameters

B. AODV Performance for TCP Connection

The simulated chart shows the Packet Delivery Fraction and Packet Loss Ratio at 2ms, 4ms, 6ms and 8ms for AODV protocol under TCP traffic as the number of nodes increases to 6, 25, 50 and 100 nodes. The graph is plotted against Time in ms Vs Number of Packets in Bytes/Sec. PDF and PLR increases as pause time increases.

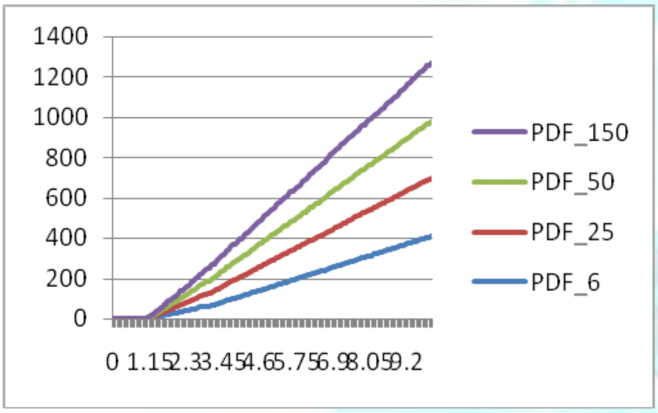

Fig.1. Packet Delivery Fraction for TCP Connection

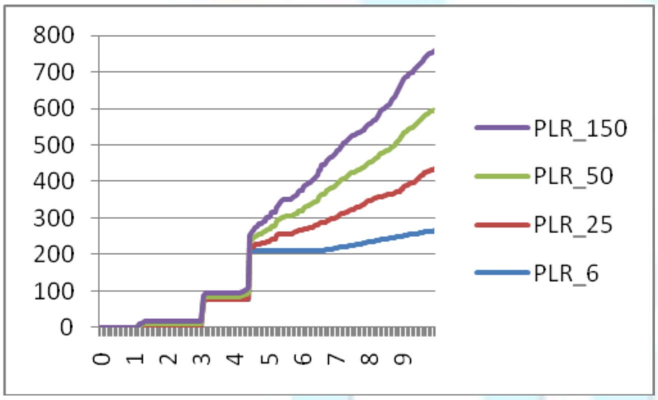

Fig.2. Packet Loss Ratio for TCP Connection

C. AODV Performance for UDP Connection

The simulated chart shows the Packet Delivery Fraction and Packet Loss Ratio at 2ms, 4ms, 6ms and 8ms for AODV protocol under UDP traffic as the number of nodes increases to 6, 25, 50 and 100 nodes. The graph is plotted against Time in ms Vs Number of Packets in Bytes/Sec. PDF and PLR increases as pause time increases. But performance of AODV under TCP traffic is best compared to performance of AODV under UDP traffic.

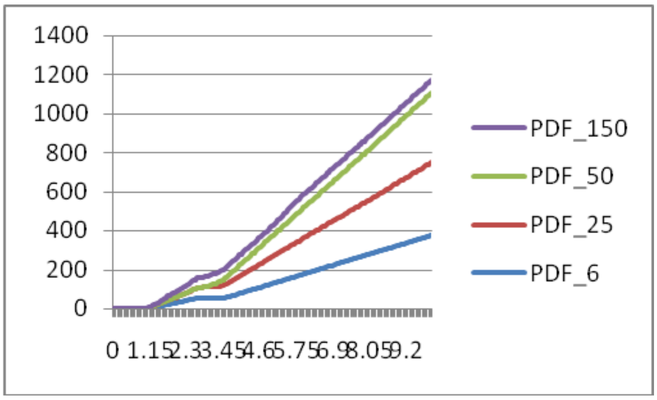

Fig.3. Packet Delivery Fraction for UDP Connection

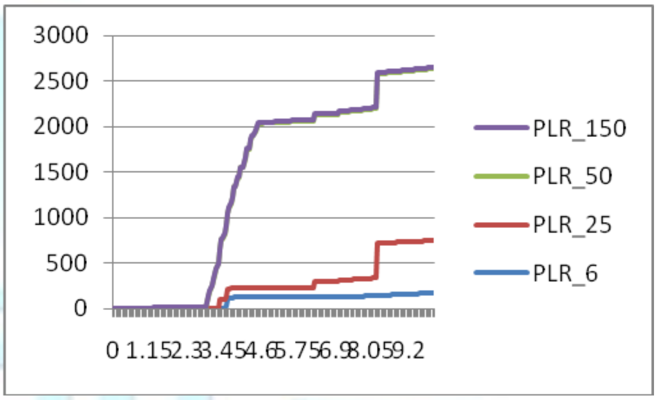

Fig.4. Packet Loss Ratio for UDP Connection

D. DSR Performance for TCP Connection

The simulated chart shows the Packet Delivery Fraction and Packet Loss Ratio at 2ms, 4ms, 6ms and 8ms for DSR protocol under TCP traffic as the number of nodes increases to 6, 25, 50 and 100 nodes. The graph is plotted against Time in ms Vs Number of Packets in Bytes/Sec. PDF increases as time pause increases.PLR is poor when pause time increases.

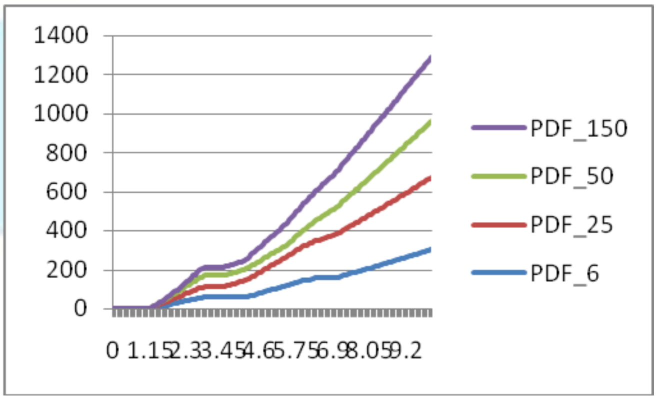

Fig.5. Packet Delivery Fraction for TCP Connection

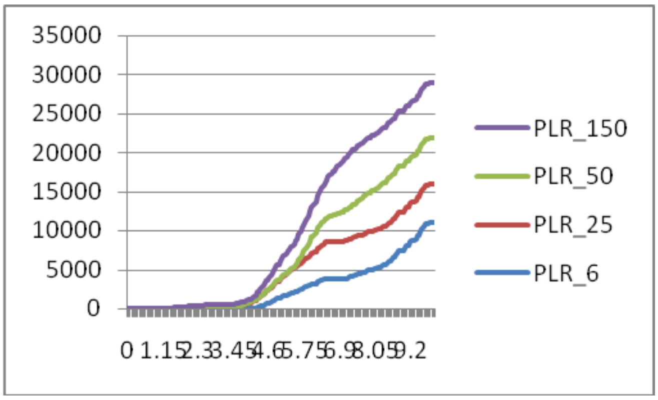

Fig.6. Packet Loss Ratio for TCP Connection

E. DSR Performance for UDP Connection

The simulated chart shows the Packet Delivery Fraction and Packet Loss Ratio at 2ms, 4ms, 6ms and 8ms for DSR protocol under UDP traffic as the number of nodes increases to 6, 25, 50 and 100 nodes. The graph is plotted against Time in ms Vs Number of Packets in Bytes/Sec. But PDF under TCP traffic is best compared to UDP traffic.PLR is not poor when compared to TCP traffic as pause time increases.

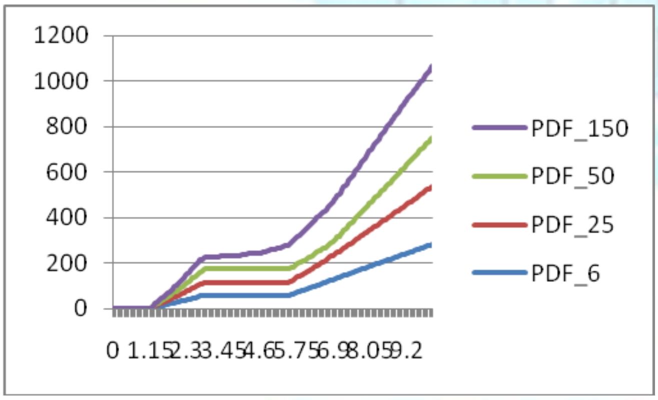

Fig.7. Packet Delivery Fraction for UDP Connection

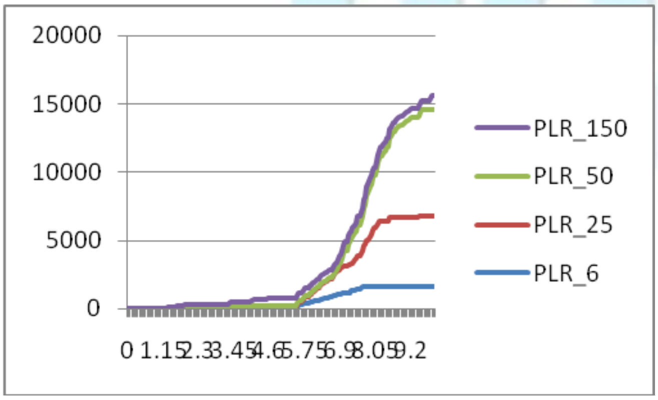

Fig.8. Packet Loss Ratio for UDP Connection

VI. CONCLUSION

In simulation work, the AODV and DSR routing protocol is evaluated for the application oriented performance metrics such as packet delivery fraction, Packet Loss Ratio for Mobile Ad hoc networks and have comparison with UDP and TCP traffic Connections. From the simulation results, it is concluded that testing a protocol using UDP traffic is not a good indicator for the AODV and DSR protocol performance when subject to TCP traffic. Finally the TCP is better than UDP Traffic.

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