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Comparative Performance Analysis of Ad-Hoc Routing Protocol using NS-2 Simulator

Prashant Rewagad
G.H. Raisoni Institute of Engineering & Managment, Jalgaon, Prashant_R@gmail.com

Nisha A. Lodha
G.H. Raisoni Institute of Engineering & Managment, Jalgaon, NishaALodha@gmail.com

Comparative Performance Analysis of Ad-Hoc Routing Protocol using NS-2 Simulator

Prashant Rewagad & Nisha A Lodha

G.H. Raisoni Institute of Engineering & Managment, Jalgaon

Abstract - Mobile Ad hoc Network is a collection of mobile nodes in which the wireless links are frequently broken down due to mobility and dynamic infrastructure. Routing is a significant issue and challenge in ad hoc networks. In Mobile ad hoc network, due to mobility of nodes network topology change frequently and thus, routing become challenging task to transfer the data from source to destination. A variety of routing protocols with varying network conditions are analyzed to find an optimized route from a source to some destination. This paper is based on performance comparison of two popular mobile ad-hoc network routing protocols using simulator i.e. DSR, ADOV. On the network simulation platform, a systematically simulation and research has been carried out on the performance of two routing protocols, and how the network environments impact on the performance of routing protocol.

Keywords - Ad-Hoc-Network, Ad-routing Protocol, Protocol Evaluation.

I. INTRODUCTION

A mobile ad hoc network is a collection of wireless nodes that can dynamically be set up anywhere and anytime without using any pre-existing network infrastructure. 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 traffic types in ad hoc networks are quite different from those in an infrastructure wireless network, including:[1]

1) ***Peer-to-Peer -*** Communication between two nodes which are within one hop. Network traffic (Bps) is usually consistent.

2) ***Remote-to-Remote***- Communication between two nodes beyond a single hop but which maintain a stable route between them. This may be the result of several nodes staying within communication range of each other in a single area or possibly moving as a group. The traffic is similar to standard network traffic.

3) ***Dynamic Traffic -*** This occurs when nodes are dynamic and moving around. Routes must be reconstructed. This results in a poor connectivity and network activity in short bursts.

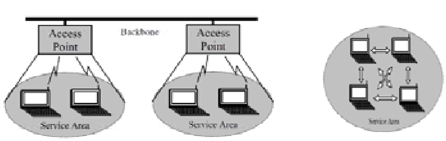

Fig. 1: Infrastructured and infrastructureless wireless Networks.

II. DESTINATION-SEQUENCED DISTANCE-VECTOR (DSDV)

This protocol is based on classical Bellman-Ford routing algorithm designed for MANETS. [3] Each node maintains a list of all destinations and number of hops to each destination. Each entry is marked with a sequence number. It uses full dump or incremental update to reduce network traffic generated by rout updates. The broadcast of route updates is delayed by settling time. The only improvement made here is avoidance of routing loops in a mobile network of routers. With this improvement, routing information can always be readily available, regardless of whether the source node requires the information or not. DSDV solve the problem of routing loops and count to infinity by associating each route entry with a sequence number indicating its freshness. In DSDV, a sequence number is linked to a destination node, and usually is originated by that node (the owner).[3]

III. Ad Hoc ON-DEMAND DISTANCE VECTOR ROUTING (AODV)

AODV discovers routes on an as needed basis via a similar route discovery process. However, AODV adopts a very different mechanism to maintain routing information. It uses traditional routing tables, one entry per destination.[3] This is in contrast to DSR, which can maintain multiple route cache entries for each destination. Without source routing, AODV relies on routing table entries to propagate an RREP back to the source and, subsequently, to route data packets to the destination. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops. All routing packets carry these sequence numbers. An important feature of AODV is the maintenance of timer-based states in each node, regarding utilization of individual routing table entries. A routing table entry is expired if not used recently. A set of predecessor nodes is maintained for each routing table entry, indicating the set of neighboring nodes which use that entry to route data packets. These nodes are notified with RERR packets when the next-hop link breaks. Each predecessor node, in turn, forwards the RERR to its own set of predecessors, thus effectively erasing all routes using the broken link. In contrast to DSR, RERR packets in AODV are intended to inform all sources using a link when a failure occurs. Route error propagation in AODV can be visualized conceptually as a tree whose root is the node at the point of failure and all sources using the failed link as the leaves. [1]

IV. DYNAMIC SOURCE ROUTING (DSR)

The Dynamic Source Routing (DSR) is a reactive unicast routing protocol that utilizes source routing algorithm. In source routing algorithm, each data packet contains complete routing information to reach its dissemination.[3]Additionally, in DSR each node uses caching technology to maintain route information that it has learnt. DSR (Dynamic Source Routing) is an on-demand routing protocol based on source routing algorithm, and its routing process is also carried out on demand. Firstly, the source node will flood a broadcast Routing Request packet with a TTL filed limited. Then the nodes received RREQ will add their own identifications to the RREQ and forwarding it. When the RREQ reaches to the destination node or any intermediate nodes which have cached with the route to the destination, this node will back to the source with a Routing Reply packet (RREP), which contents the whole routing order from the source to the destination, and rollbacks the routing order for the RREP. The routing process will complete while the RREP arrive the source node.[1]

V. PERFORMANCE ANALYSIS

a. Simulation Environment

The simulation experiment is carried out in LINUX (FEDORA 6). The detailed simulation model is based on network simulator-2, is used in the evaluation. The NS instructions can be used to define the topology structure of the network and the motion mode of the nodes, to configure the service source and the receiver, to create the statistical data track file and so on.[2]

b. Traffic Model

Continuous bit rate (CBR) traffic sources are used. The source-destination pairs are spread randomly over the network. Only 512-byte data packets are used. The number of source-destination pairs and the packet sending rate in each pair is varied to change the offered load in the network.[1]

c. Mobility Model

The mobility model uses the random waypoint model in a rectangular field. The field configurations used is: 500 m × 500 m field with 50 nodes. Here, each packet starts its journey from a random location to a random destination with a randomly chosen speed (uniformly distributed between 0–20 m/s). Once the destination is reached, another random destination is targeted after a pause. The pause time, which affects the relative speeds of the mobiles, is varied. Simulations are run for 100 simulated seconds. Identical mobility and traffic scenarios are used across protocols to gather fair results. Mobility models were created for the simulations using 50 nodes, with pause times of 0, 10, 20, 40, 100 seconds, maximum speed of 20 m/s, topology boundary of 500 × 500 and simulation time of 100 secs. [2]

VI. NS2-PERFORMANCE METRICS

a. Packet Delivery Fraction

The ratio of the data packets delivered to the destinations to those generated by the CBR sources is known as packet delivery fraction.[5]

b. Average End-to-End Delay

Average end to end delay includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times of data packets.[8]

c. Normalized Routing Load

The number of routing packets transmitted per data packet delivered at the destination. Each hop -wise transmission of a routing packet is counted as one transmission. The first two metrics are the most important for best-effort traffic. The routing load metric evaluates the efficiency of the routing protocol. Note, however, that these metrics are not completely independent. [2] For example, lower packet delivery fraction means that the delay metric is evaluated with fewer samples. In the conventional wisdom, the longer the path lengths, the higher the probability of a packet drops. Thus, with a lower delivery fraction, samples are usually biased in favor of smaller path lengths and thus have less delay.[8]

VII. PERFORMANCE RESULTS

For all the simulations, the same movement models were sed, the number of traffic sources was fixed at 20, the maximum speed of the nodes was set to 20 m/s and the pause time was varied as 0s, 10 s, 20 s and 30s.

a. Packet Delivery Fraction

The On-demand protocols, DSR and AODV performed particularly well, delivering over 85% of the data packets regardless of mobility rate.[8]

b. Average End-End Packet Delivery

The average end-to-end delay of packet delivery was higher in DSDV as compared to both DSR and AODV. In summary, both the On-demand routing protocols, AODV and DSR outperformed the Table-driven routing protocol. DSDV and the reasons are discussed later. Figures 1 and 2 highlight the relative performance of the three routing protocols. All of the protocols deliver a greater percentage of the originated data packets when there is little node mobility (i.e., at large pause time), converging to 100% delivery when there is no node motion. Next, since both AODV and DSR did better, an attempt was made to evaluate the performance difference between the two by varying the Mobility pattern and Number of traffic sources.[3]

Packet Deliver Fraction

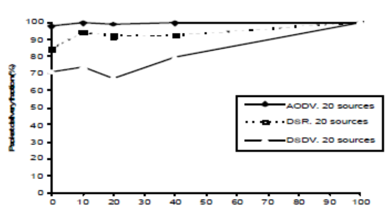

Fig 2: Packet Delivery Fraction Vs Pasuse time

Average End-End Delay

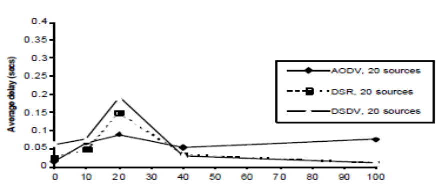

Fig 3 :Average Delay Vs Pasuse Time

VIII. PACKET DELIVERY FRACTION COMPARISON

The packet delivery fractions for DSR and AODV are similar with 10 sources (Fig. 1) , 20 source (fig-2),30 source(Fig-3)AODV outperforms DSR by about 15 percent at lower pause times (higher mobility).

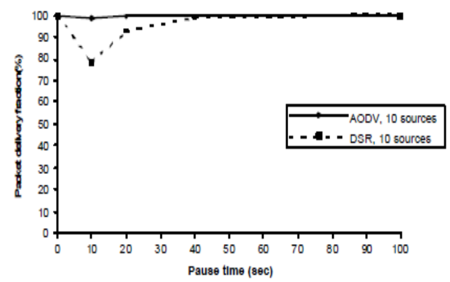

Fig 4: For 10 Sources

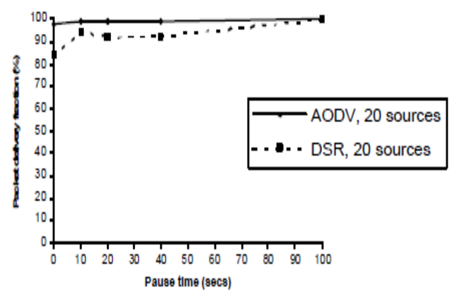

Fig 5: For 20 Sources

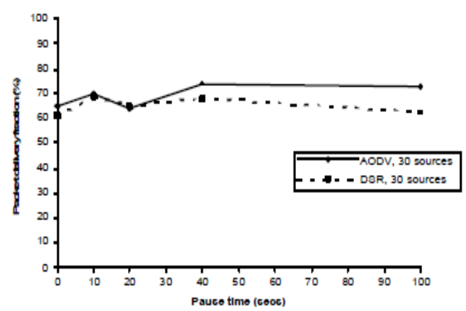

Fig 6: For 30 Sources

IX. NORMALIZED ROUTING LOAD COMPARISON

The number of routing packets transmitted per data packet delivers at destination. Each hop-wise transmission of a routing packet is counted as one transmission. In all case if we observe that AODV demonstrates significant higher routing load than DSR, with the factor increasing with a growing number of sources. The major contribution to AODV's routing over-head is from route requests, while route replies constitute a large fraction of DSR's routing overhead. Furthermore, AODV has more route requests than DSR, and the converse is true for route replies.

Normalized Routing Load

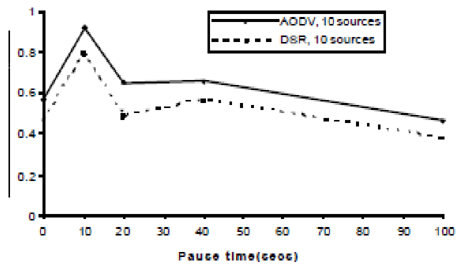

Fig 7: Routing load for 10 source

Normalized Routing Load

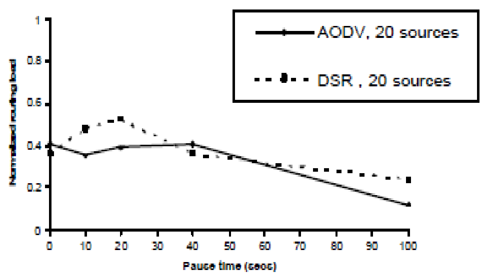

Fig. 8 - Routing load for 20 source

Normalized Routing Load

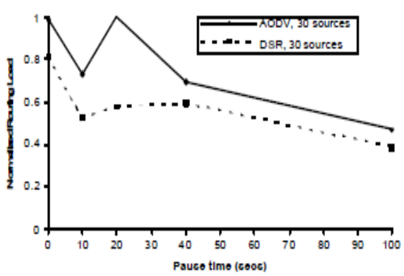

Fig 9 - Routing load for 30 source

X. PERFORMANCE ANALYSIS

Performance comparison of DSR, AODV and DSDV routing protocol at variant time interval between packet sending by CBR at application layer.[5]

Packet Deliver Ratio= ∑ CBR PK + Rcvd by CBR sinks/∑ CBR PKt Send by CBR source

Routing Overhead it is the number of packet generated by Routing protocol during the simulation. It is defined as:

Overhead =$\sum_t^n Overheadi$

There are number of factor are reflect the delays caused by buffering during route discovery latency, propagation ,transfer time ,retransmission delays at MAC.[2]The following metric describes the packet delivery time :lower the end-to-end delay the better the application performance .[4]

Avg E2E delay =$\sum_1^n CB\ ResentTime$ – CBR$RecTime$ /

$\sum_1^n CBRrec$

XI. CONCLUSION

In this paper the analysis of ad-hoc routing protocol is done the mentioned traffic pattern & mobility on different pause time. Results show that routing protocols with different algorithms have their own advantages and disadvantages respectively. The routing protocol can achieve its optimal performance only if matched to the given scene and network environment. Furthermore, network load and topology change have the greater impact on the performance of routing protocol. Routing protocol parameters should be considered to adapt to changes of network environment.

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