Performance Evaluation of DSR, AODV, DSDV, Multipath AOMDV Routing Protocols in MANETS

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Abstract— **A Mobile ad hoc network is a collection of various number of mobile nodes connected through wireless links forming a temporary network without any type of fixed topology, centralized access point and infrastructure. In such a network, each node acts as a router and host simultaneously, it can move out or join in the network freely as and when required. Various routing protocols have been discussed so far but in this paper a brief comparison of two reactive protocols DSR, AOMDV and AODV along with proactive protocol DSDV is done. AOMDV was designed primarily for highly dynamic ad hoc networks where link failures and route breaks occur frequently. It maintains routes for destinations in active communication and uses sequence numbers to determine the freshness of routing information to prevent routing loops. It is a timer-based protocol and provides a way for mobile nodes to respond to link breaks and topology changes. As the node performance gets affected due to mobility and position error, the variation in performance are analyzed by use of varying simulation time and it is carried out using NS-2 simulator. The results presented specify the importance in evaluation and implementation of routing protocols in an ad hoc environment.**

Keywords— MANET, AOMDV, AODV, DSR, DSDV.

I. Introduction

A mobile ad hoc network is a collection of digital data terminals equipped with wireless transceivers that can communicate with one another without using any fixed networking infrastructure. Communication is maintained by the transmission of data packets over a common wireless Channel. The absence of any fixed infrastructure, such as an array of base stations, makes ad hoc networks radically different from other wireless LANs. Communication from a mobile terminal in an infrastructure network, such as a cellular network, is always maintained with a fixed base station, a mobile terminal (node) in an ad hoc network can communicate directly with another node that is located within its radio transmission range. In order to transmit to a node that is located outside its radio range, data packets are relayed over a sequence of intermediate nodes using a store-and-forward ―multi hop‖ transmission principle. All nodes in an ad hoc network are required to relay packets on behalf of other nodes. Hence, a mobile ad hoc network is sometimes also called a multi hop wireless network. The design of adhoc network faces many challenges. The first is that all nodes in an ad hoc network, including the source nodes, the corresponding destinations, as well as the routing nodes forwarding traffic between them, may be mobile. As the wireless transmission range is limited, the wireless link between a pair of neighbouring nodes breaks as soon as they move out of range.
A second reason that makes the design of ad hoc networks complicated is the absence of centralized control. All networking functions, such as determining the network topology, multiple accesses, and routing of data over the most appropriate multi hop paths, must be performed in a distributed way. These tasks are particularly challenging due to the limited communication bandwidth available in the wireless channel. These challenges are resolved by different layers. The physical layer must tackle the path loss, fading, and multi-user interference to maintain stable communication links between peers. The data link layer (DLL) must make the physical link reliable and resolve contention among unsynchronized users transmitting packets on a shared channel. The latter task is performed by the medium access control (MAC) sub layer in the DLL. The network layer must track changes in the network topology and appropriately determine the best route to any desired destination. The transport layer must match the delay and packet loss characteristics specific to such a dynamic wireless network.

II. Mobile ad-hoc networks

A Mobile Ad-hoc Network (MANET) is a temporary wireless network consisting of mobile nodes which does not require any base infrastructure. MANETS have the advantage of rapid deployment, low cost, flexibility, inherent support and robustness for mobility. With such features MANETS can find its applications in areas like military, search and rescue, vehicle-to-vehicle communication in intelligent transportation, temporary networks, Personal Area Networks. Ad hoc networks require no fixed network infrastructure such as base stations and can be quickly and inexpensively set up as and when needed. The properties that are desirable in Ad-Hoc Routing protocols are as follows:

- The protocol should be distributed and should not be dependent on a centralized controlling node.
- Routes provided by routing protocol must be loop free as this will improve the overall performance, avoid wastage of bandwidth and consumption of CPU.
- Must have unidirectional link support.
- For demand based operation the protocol must be reactive.
- Power conservation.
- Multiple routes can be used to reduce congestion.
- Security.

III. Routing Protocols

Numerous protocols have been developed for ad hoc mobile networks to deal with the typical limitations of these networks, which include high power consumption, low bandwidth, and high error rates. The reactive and proactive protocols described in this paper may be used as reference protocols when a new protocol evaluation has to be done. As shown in Figure below, these routing protocols may generally be categorized as:

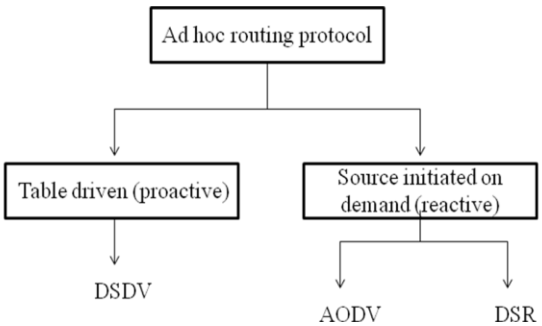

Fig 1: Routing Protocol Classification

A. DSDV

The DSDV algorithm [1] [11] is a modification of DBF which guarantees loop free routes. It provides a single path to a destination, which is selected using the distance vector shortest path routing algorithm. In order to reduce the amount of overhead transmitted through the network, two types of update packets are used. These are referred to as ‘‘full dump’’ and ‘‘incremental’’ packets. The full dump packet carries all the available routing information and the incremental packet carries only the information changed since the last full dump. The incremental update messages are sent more frequently than the full dump packets. However, DSDV still introduces large amounts of overhead to the network due to the requirement of the periodic update messages. Therefore the protocol will not scale in large network since a large portion of the network bandwidth is used in the updating procedures.

Packets Sent = 5715 packets
Packets Received = 3767 packets
Routing Overhead = 19034 packets
Packet Delivery Fraction = 65.914261 %
Average End-to-end delay = 0.083129 s

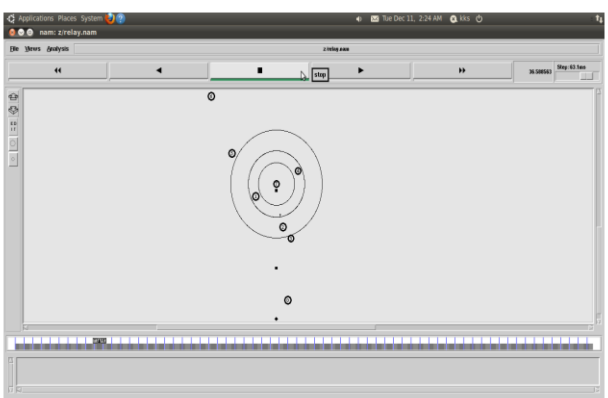

Figure 2: DSDV simulation using 8 mobile nodes

B. DSR

DSR [5][8][11] is a reactive source routing protocol designed for ad hoc networks up to two hundred mobile nodes. Unlike other unicast routing protocols, DSR does not maintain the routing table, because it utilizes the source routing option in data packets. It uses Route Cache instead, which store the complete list of IP addresses of the nodes along the path towards the destination. So as long as there is a route to the sink present in the cache, there is no need to perform route discovery, but if there is no route to the sink in the cache a route discovery has to be performed by broadcasting a route request message. When the route request reaches the desired target a route reply is returned to the source. If the links are bi-directional then the reply is sent back over the same route where the request travelled, otherwise it is returned via a route cached in the destination. When a used link is broken a route error message is sent back to the source and the path is invalidated.

Packets Sent = 5715 packets
Packets Received = 5714 packets
Routing Overhead = 24531 packets
Packet Delivery Fraction = 99.982502 %
Average End-to-end delay = 0.042002 s

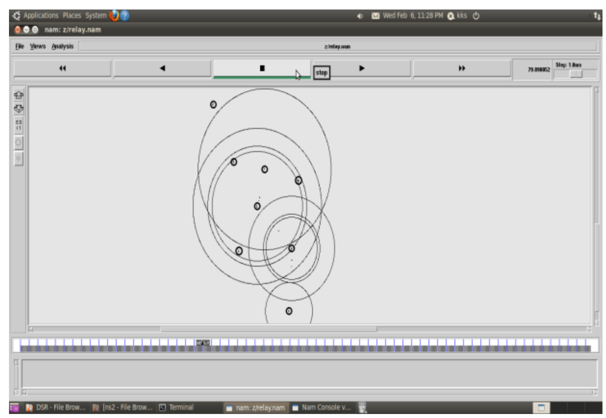

Figure 3: DSR simulation using 8 mobile nodes

C. AODV

The AODV [7] [10-11] routing protocol is based on DSDV and DSR algorithm. It uses the periodic beaconing and sequence numbering procedure of DSDV and a similar route discovery procedure as in DSR. However, there are two major differences between DSR and AODV. The most distinguishing difference is that in DSR each packet carries full routing information, whereas in AODV the packets carry the destination address. This means that AODV has potentially less routing overheads than DSR. The other difference is that the route replies in DSR carry the address of every node along the route, whereas in AODV the route replies only carry the destination IP address and the sequence number. The advantage of AODV is that it is adaptable to highly dynamic networks. However, node may experience large delays during route construction, and link failure may initiate another route discovery, which introduces extra delays and consumes more bandwidth as the network size increases.

Packets Sent = 5715 packets
Packets Received = 5706 packets
Routing Overhead = 31258 packets
Packet Delivery Fraction = 99.842520 %
Average End-to-end delay = 0.061881 s

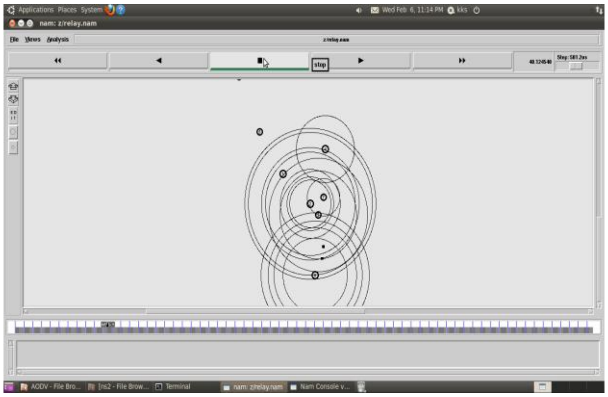

Figure 4: AODV simulation using 8 mobile nodes

D. AOMDV

Ad-hoc On-demand Multipath Distance Vector Routing (AOMDV) [14] protocol is an extension to the AODV protocol for computing multiple loop-free and link disjoint paths [16]. The routing entries for each destination contain a list of the next-hops along with the corresponding hop counts. All the next hops have the same sequence number. This helps in keeping track of a route. For each destination, a node maintains the advertised hop count, which is defined as the maximum hop count for all the paths, which is used for sending route advertisements of the destination. Each duplicate route advertisement received by a node defines an alternate path to the destination. Loop freedom is assured for a node by accepting alternate paths to destination if it has a less hop count than the advertised hop count for that destination. Because the maximum hop count is used, the advertised hop count therefore does not change for the same sequence number [16]. When a route advertisement is received for a destination with a greater sequence number, the next-hop list and the advertised hop count are reinitialized. AOMDV can be used to find node-disjoint or link-disjoint routes. The advantage of using AOMDV is that it allows intermediate nodes to reply to RREQs, while still selecting disjoint paths. But, AOMDV has more message overheads during route discovery due to increased flooding and since it is a multipath routing protocol, the destination replies to the multiple RREQs those results are in longer overhead.

Packets Sent = 5715 packets
Packets Received = 5222 packets
Routing Overhead = 25226 packets
Packet Delivery Fraction = 98.022 %
Average End-to-end delay = 0.189115 s

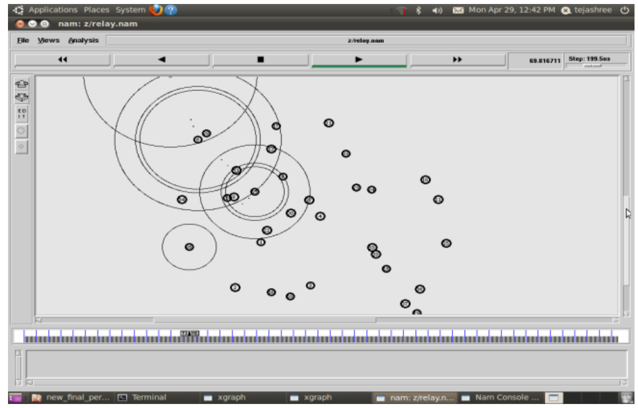

Figure 5: AOMDV simulation

IV. Simulation Result and Comparison

A Packet Loss

The degree of mobility is represented by pause time. The packet loss in DSDV is more than AODV, DSR, and AOMDV when the pause time is less but packet loss in DSR increases with increase in pause time. The route discovery process in AODV causes delays as large amount of control packets are transmitted causing then to wait in queue and the packets in queue drop which causes higher amount of packet loss. AOMDV has the lowest loss and has better performance than AODV.

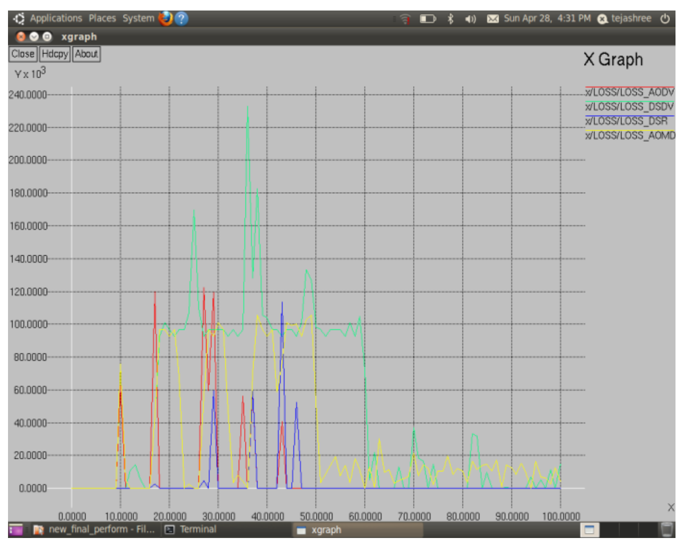

Figure 6: Packet Loss Vs Pause Time

V. CONCLUSION

A detailed performance comparison of important routing protocols AODV, AOMDV, DSR, and DSDV for mobile ad hoc wireless networks is presented. It can be concluded that in the static network, AOMDV gives better performance as compared to AODV, DSDV and DSR in terms of end-to end delay. Loss is less in AOMDV as compared to DSR, DSDV, and AODV and hence its throughput is highest as loss is inversely proportional to throughput. The lesser the loss more is the throughput.

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