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COMPARISON OF EFFECTIVENESS OF AODV, DSDV AND DSR ROUTING PROTOCOLS IN MOBILE AD HOC NETWORKS

Sapna S. Kaushik[1] & P.R.Deshmukh[2]

Mobile ad hoc networks (MANET) represent complex distributed systems that comprise wireless mobile nodes that can freely and dynamically self organize into arbitrary and temporary ad hoc network topologies. A mobile ad hoc network is a collection of nodes that is connected through a wireless medium forming rapidly changing topologies. The widely accepted existing routing protocols designed to accommodate the needs of such self-organized networks do not address possible threats aiming at the disruption of the protocol itself. Simulation is the research tool of choice for a majority of the mobile ad hoc network (MANET) community. Manets are infrastructure less and can be set up anytime, anywhere. We have conducted survey of simulation results of various Manet routing algorithms and analyzed them. The routing algorithms considered are classified into two categories proactive and reactive. The algorithms considered are AODV, DSR, DSDV. The performance measurements are based on the various parameters such as packet delivery fraction, average end to end delay and number of packets dropped. Future work in this area includes development of efficient routing protocols so as to improve the performance of the parameter in which the particular routing protocol is lagging.

Keywords: Mobile Ad hoc Network, Simulation, AODV, DSR, DSDV, Packet Delivery Fraction, Average End to End Delay, Number of Packets Dropped.

1. Introduction

Mobile Ad Hoc Network (MANET) is a collection of communication devices or nodes that wish to communicate without any fixed infrastructure and pre-determined organization of available links. The nodes in MANET themselves are responsible for dynamically discovering other nodes to communicate. It is a self-configuring network of mobile nodes connected by wireless links the union of which forms an arbitrary topology. The nodes are free to move randomly and organize themselves arbitrarily thus, the network's wireless topology may change rapidly and unpredictably. Routing is a core problem in networks for sending data from one node to another. Such networks are aimed to provide communication capabilities to areas where limited or no communication infrastructures exist. MANET's can also be deployed to allow the communication devices to form a dynamic and temporary network among them. A mobile Ad Hoc network (MANET) is receiving attention due to many potential military and civilian applications. MANETs have several salient characteristics: 1) Dynamic topologies 2) Bandwidth-constrained links 3) Energy constrained operation 4) limited physical security. Therefore the routing protocols for wired networks cannot be directly used for wireless networks. Some examples of the possible uses of ad hoc networking include students using laptop computers to participate in an interactive lecture, business associates sharing information during a meeting, soldiers relaying information for situational awareness on the battlefield and emergency disaster relief personnel coordinating efforts after a hurricane or earthquake. A MANET uses multi-hop routing instead of a static network infrastructure to provide network connectivity. Several routing protocols have been proposed for mobile Ad Hoc networks.

2. MANET Routing Protocol

There are different criteria for designing and classifying routing protocols for wireless ad hoc networks. For example, what routing information is exchanged; when and how the routing information is exchanged, when and how routes are computed etc?

2.1. Proactive (Table Driven) and Reactive (On-Demand)

2.1.1. Proactive (Table-Driven) Routing Protocols

These routing protocols are similar to and come as a natural extension of those for the wired networks. In proactive routing, each node has one or more tables that contain the latest information of the routes to any node in the network. Each row has the next hop for reaching a node/subnet and the cost of this route. Various table-driven protocols differ

[1]M.E. II Semester,Computer Science and Engg., Sipna College of Engg. Amravati, INDIA.

[2]Professor and Head, CSE and IT, Sipna College of Engg. Amravati,INDIA

Email: sapnakaushik123@gmail.com, sapna_408@yahoo.com, pr_deshmukh@yahoo.com

in the way the information about a change in topology is propagated through all nodes in the network. There exist some differences between the protocols that come under this category depending on the routing information being updated in each routing table. Furthermore, these routing protocols maintain different number of tables. The proactive protocols are not suitable for larger networks, as they need to maintain node entries for each and every node in the routing table of every node. This causes more overhead in the routing table leading to consumption of more bandwidth. Examples of such schemes are the conventional routing schemes, Destination Sequenced Distance Vector (DSDV).

2.1.2. Reactive (On-Demand) Protocols

Reactive routing is also known as on-demand routing protocol since they don't maintain routing information or routing activity at the network nodes if there is no communication. These protocols take a lazy approach to routing. They do not maintain or constantly update their route tables with the latest route topology. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet. The route discovery usually occurs by flooding the route request packets throughout the network. Examples of reactive routing protocols are the dynamic source Routing (DSR) , ad hoc on-demand distance vector routing (AODV).

3. DESTINATION-SEQUENCED DISTANCE-VECTORS ROUTING (DSDV)

DSDV is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. The main contribution of the algorithm was to solve the Routing Loop problem which is present in Bellman-Ford algorithm. To do so, DSDV makes use of sequence numbers. Each entry in the routing table contains a sequence number; the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently.

4. AD HOC ON DEMAND DISTANCE VECTOR (AODV)

AODV is another routing algorithm used in ad hoc networks. In AODV, each node maintains a routing table which is used to store destination and next hop IP addresses as well as destination sequence numbers. Each entry in the routing table has a destination address, next hop, precursor nodes list, lifetime, and distance to destination. To initiate a route discovery process a node creates a route request (RREQ) packet. The packet contains the source node's IP address as well as the destination's IP address. The RREQ contains a broadcast ID, which is incremented each time the source node initiates a RREQ. The broadcast ID and the IP address of the source node form a unique identifier for the RREQ. The source node then broadcasts the packet and waits for a reply. When an intermediate node receives a RREQ, it checks to see if it has seen it before using the source and broadcast ID's of the packet. If it has seen the packet previously, it discards it. Otherwise it processes the RREQ packet. To process the packet the node sets up a reverse route entry for the source node in its route table which contains the ID of the neighbor through which it received the RREQ packet. In this way, the node knows how to forward a route reply packet (RREP) to the source if it receives one later. When a node receives the RREQ, it determines if indeed it is the indicated destination and, if not, if it has a route to respond to the RREQ. If either of those conditions is true, then it unicasts a route reply (RREP) message back to the source. If both conditions are false, i.e. if it does not have a route and it is not the indicated destination, it then broadcasts the packet to its neighbors. Ultimately, the destination node will always be able to respond to the RREQ message. When an intermediate node receives the RREP, it sets up a forward path entry to the destination in its routing table. This entry contains the IP address of the destination, the IP address of the neighbor from which the RREP arrived, and the hop count or distance to the destination. After processing the RREP packet, the node forwards it toward the source. The node can later update its routing information if it discovers a better route.

5. DYNAMIC SOURCE ROUTING (DSR)

It is one of the most well known routing algorithms for ad hoc wireless networks. It was originally developed by Johnson, Maltz, and Broch. DSR is on demand, which reduces the bandwidth use especially in situations where the mobility is low. It is a simple and efficient routing protocol for use in ad hoc networks. It has two important phases, route discovery and route maintenance. The main algorithm works in the following manner. A node that desires communication with another node first searches its route cache to see if it already has a route to the destination. If it does not, it then initiates a route discovery mechanism.This is done by sending a Route Request message. When the node gets this route request message, it searches its own cache to see if it has a route to the destination. If it does not, it then appends its id to the packet and forwards the packet to the next node; this continuous until either a node with a route to the destination is encountered (i.e. has a route in its own cache) or the destination receives the packet. In that case, the node sends a route reply packet which has a list of all of the nodes that forwarded the packet to reach the destination. This constitutes the routing information needed by the source, which can then send its data packets to the destination using this newly discovered route. DSR can support relatively rapid rates of mobility.

6. COMPARISONS

In order to evaluate the performance of ad hoc network routing protocols, the following metrics were considered:

6.1. Packet Delivery Fraction (PDF) Result

PDF is the ratio between the numbers of packets originated by the application layer sources and the number of packets received by the sinks at the final destination. It will describe the loss rate that will be seen by the transport protocols, which in turn affects the maximum throughput that the network can support. In terms of packet delivery ratio, DSR performs well when the number of nodes is less as the load will be less. However its performance declines with increased number of nodes due to more traffic in the network. The performance of DSDV is better with more number of nodes than in comparison with the other two protocols. The performance of AODV is better at the beginning and decreases slightly with increase in number of nodes.

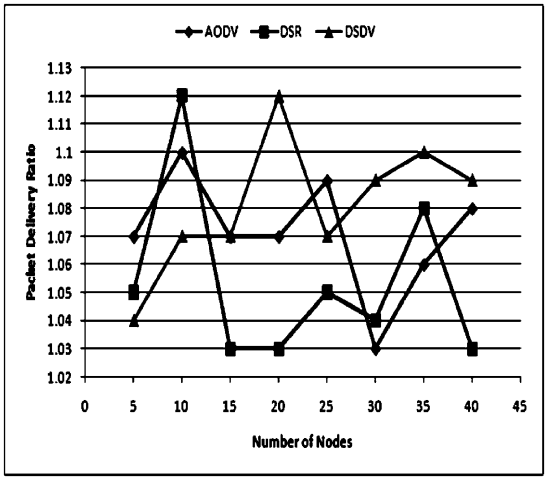

Fig. 6.1: Packet Delivery Ratio for AODV, DSR, DSDV

6.2. Average End to End Delay Result

The delay is affected by high rate of CBR packets as well. The buffers become full much quicker, so the packets have to stay in the buffers a much longer period of time before they are sent. This can be seen at the DSR routing protocol when it was reach around 2300 packets at the 0 mobility. For average end-to-end delay, the performance of DSR decreases and varies with the number of nodes. However, the performance of DSDV is degrading due to increase in the number of nodes the load of exchange of routing tables becomes high and the frequency of exchange also increases due to the mobility of nodes.The performance of

AODV decreases and remains constant as the number of nodes increases.

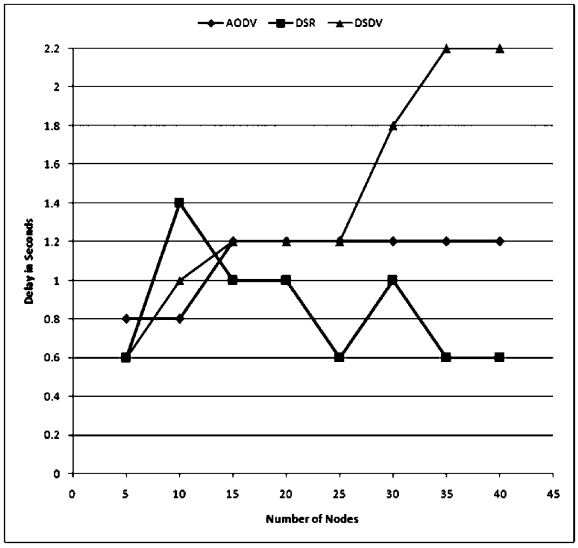

Fig. 6.2: Average End-to-End Delay for AODV, DSR, DSDV

6.3. Number of Packets Dropped

The number of data packets that are not successfully sent to the destination. In terms of dropped packets, AODV's performance is the worst. The performance degrades with the increase in the number of nodes. As the number of nodes increases the number of packets dropped increases which means that number of packets not successfully reaching the destination has also increased. DSDV performs consistently well with increase in the number of nodes.The number of packets dropped is negligible which means that almost all packets reach the destination successfully. DSR performs well when number of nodes is less but fails slightly to perform with increase in the number of nodes. The packes dropped is much less compared to performance of AODV.

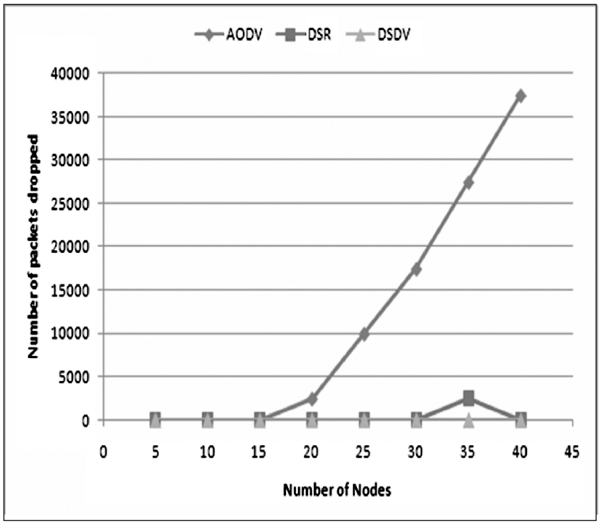

Fig. 6.3: Dropped Packets for AODV, DSR, DSDV

7. CONCLUSION

It is difficult for the quantitative comparison of the most of the ad hoc routing protocols due to the fact that simulations have been done independent of one another using different metrics and using different simulators. This paper does the realistic comparison of three routing protocols DSDV, AODV and DSR. The significant observation is, simulation results agree with expected results based on theoretical analysis. As expected, reactive routing protocol AODV performance is the best considering its ability to maintain connection by periodic exchange of information, which is required for TCP, based traffic. AODV performs predictably. It delivered virtually all packets at low node mobility, and failing to converge as node mobility increases. Meanwhile DSR was very good at all mobility rates and movement speeds and DSDV performs almost as well as DSR, but still requires the transmission of many routing overhead packets. At higher rates of node mobility it's actually more expensive than DSR. Compared the On-Demand (DSR and AODV) and Table-Driven (DSDV) routing protocols by varying the number of nodes and measured the metrics like end-end delay, dropped packets, As far as packet delay and dropped packets ratio are concerned, DSR/AODV performs better than DSDV with large number of nodes. Hence for real time traffic AODV is preferred over DSR and DSDV. For less number of nodes and less mobility, DSDV's performance is superior.

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