Comparison of Mobile Ad-hoc Routing Protocols (DSDV, DSR, AODV) in Network

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Abstract:
Mobile Ad-hoc Network (MANET) is a network which is capable of autonomous operations and operates without base stations and without centralized administration. Nodes cooperate to provide services. In the mobile ad hoc network every node is router as well as host. They support dynamic topology and have limited energy and computed resources. Ad hoc routing protocols like as Dynamic source routing (DSR), Distance sequence vector (DSDV) , and Ad hoc on demand distance vector (AODV) routing which solve the multi hop routing problem in Ad hoc network. In this survey paper we concentrate on the routing protocols which are DSDV, DSR and AODV . Routing protocol are evaluated according many performance parameters Packet Delivery Ratio (PDR), Average end-to-end delay, Routing overhead, Packet Loss Percentage and Throughput. The performance of these protocols is application specific and shows different performance under different application. It is not clear that any particular algorithm or class of algorithm is the best for all scenarios.

Keywords: MANET, Routing protocol, Vector, DSDV

INTRODUCTION

Ad hoc networks consist of hosts interconnected by routers without a fixed infrastructure and can be arranged dynamically. Considerable work has been done in the development of routing protocols in different types of ad hoc networks like MANETS, WMNs, WSNs, and VANETS etc[11]. Mobile Ad Hoc Network (MANET) is an autonomous, infrastructure less, self-healing and self-configurable network of mobile nodes with wireless links providing connections among them. Node mobility is an inherent characteristic of MANETs. The nodes move about randomly and may join or leave the network in a random manner[9]. In MANET, each mobile node acts as a router as well as an end node which is either source or destination. AODV is perhaps the most well-known routing protocol for MANET[4]. Routing is the act of moving information from a source to a destination in an internetwork. During this process, at least one intermediate node within the internetwork is encountered[6].Routing is a fundamental engineering task on the internet. It consists of finding a path from source to destination host. Routing is complex in large networks because of many potential intermediate destinations a packet might traverse before reaching its destination [3]. In this paper discusses the performance evaluation and comparison of typical routing protocols, AODV, DSDV, DSR.

RELATED WORK

Anju Gill, 2012 [1] discussed classification of routing protocols on the basis of routing information update mechanism, highlighting their characteristics and done comparative analysis for wireless ad hoc networks routing protocols viz. DSDV, CGSR, DSR, AODV and TORA etc. As there are still many challenges facing wireless ad hoc networks, it is not clear that any particular algorithm or class of algorithm is the best for all scenarios, each protocol has their own merits and demerits and is well suited for certain situations. Dilpreet Kaur , 2013[2] AODV has maximum throughput under low traffic and DSDV has maximum throughput under high traffic. As network becomes dense OLSR, DSR and DSDV perform well in terms of Throughput than AODV and TORA. DSDV has least Normalized Routing load in both low and high traffic. OLSR and DSDV give the least Jitter and Average Delay in both networks. Geetam singh Tomar, 2011 [3] three routing protocols AODV, DSR and DSDV under various network conditions. DSDV shows the best performance under security attack while AODV shows the worst performance under security attacks. Thus the performance of these routing protocols is application specific and shows the different performance under different network conditions. Jaya Jacob , 2012 [4] evaluated the performance of different routing protocols such as, AOMDV, AODV, DSDV, TORA and DSR in MANET in different network environments. AOMDV is analyzed as the best protocol compared to AODV, DSR, DSDV and DSDV. Then the result will be compared with performance of modified AOMDV. Results will be obtained as modified AOMDV providing better performance compared to AOMDV, AODV, TORA, DSR and DSDV protocols. . Natarajan,2013 [5] seven routing protocols have different values for the routing parasite. Generally, one can say that DSR has the lowest parasite while TORA has the highest parasite. Md. Monzur Morshed Franz I. S. Ko Dongwook Lim, 2010 [7] Simulation result analyze the performance of TCP and UDP packets with respect to delay, throughput, jitter, round trip time. Based on the result for real time applications AODV performs better than DSDV routing protocol. M. Shobana,2013[8] AODV are being compared with the geographic-based routing such as POR and RGR. From the analysis, the geographic based routing performs better when compared to other traditional routing protocols.
KPragya Gupta, 2013[12] evaluated the performance of AODV, DSDV, DSR and OLSR in the presence of Random Waypoint Mobility Model. We observe that an increase in the node density has a similar impact on all network routing protocols i.e degradation in performance. A similar trend is observed with an increase in speed of the nodes. AODV outperforms all other routing protocols Mina Vajed Khiavi1, 2012[10] attempt to evaluation performance of four commonly used mobile ad hoc routing protocols namely AODV, DSDV, DSR and TORA. Performance evaluation did in NS-2 simulator by doing many simulations. Comparison was based on Packet Delivery Ratio, Network Life Time, System Life Time, End-to-End Delay and Routing Overhead. Simulation results are shown by many figures. By using simulation results we can understand that DSDV gives better performance in wide range of simulation conditions. Yudhvir Singh,2010[17] performance analysis of On Demand Multicasting Routing protocols (ODMRP) has been done by comparing it with AODV and FSR routing protocol on the basis of three different performance metrics i.e. Average throughput, packet delivery ratio and end-to-end delay. The simulation results shows that Average throughput of ODMRP is better than AODV and FSR with the varying number of nodes and also with the increase in mobility. Packet delivery ratio for AODV is better than that of ODMRP and FSR with the changing number of nodes as well as with changing mobility. Finally from the above comparison it is concluded that multicasting protocol ODMRP for adhoc networks perform well as compared to AODV and FSR in terms of throughput and end to end delay.

**ROUTING PROTOCOLS**

This section provides the review of different routing protocols which will be evaluated.

### 2.1 Table Driven Protocol

Proactive Protocol is a table driven approach where each node maintains a routing table and any changes to the network topology should be updated in each routing table and it is stored reliably. During transmission, each and every node maintains a routing information table that communicates all the other nodes in the network to update the changes in network topology and this information should be reflected to all other nodes within the network. Though it establishes the routes quickly with a small delay, it requires larger resources and the major disadvantage is that, there is a tendency of creating loops within the network [6].

#### 1) **Distance – Sequenced Distance vector (DSDV)**

DSDV is based on Routing Information Protocol. It is characterized that each host maintains a table consisting of the next-hop neighbour and the distance to the destination in terms of number of hops. It uses sequence numbers for the destination nodes to determine “freshness” of a particular route. DSDV guarantees loop free routes to each destination and find the optimal path based on an average settling delay which is a delay before advertising a route [1]. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. So, the update is both time-driven and event-driven. The routing table update can be sent in two ways: - a "full dump" or an incremental update. A full dump sends the full routing table to the neighbours and could span many packets whereas in an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet. If there is space in the incremental update packet then those entries may be included whose sequence number has changed. When the network is relatively stable, incremental update are sent to avoid extra traffic and full dump are relatively infrequent. In a fast changing network, incremental packets can grow big. So, full dumps will be more frequent [4].

### 2.2 On-demand protocol

Reactive (or on-demand) Routing Protocols employ a lazy approach whereby nodes only discover routes to destinations on-demand. In other words, a route is discovered only when needed. They consume much less bandwidth but the delay in determining a route can be substantially large [9]. For protocols in this category there is an initialization of a route discovery mechanism by the source node to find the route to the destination node when the source node has data packets to send. When a route is found, the route maintenance is initiated to maintain this route until it is no longer required or the destination is not reachable. The advantage of these protocols is that overhead messaging is reduced. One of the drawbacks of these protocols is the delay in discovering a new route [15].

#### 1) **Dynamic Source Routing Protocol (DSR):**

DSR is an efficient routing protocol proposed specially to be used in multi-hop mobile Ad hoc networks [7]. The key feature of this protocol is that it is a pure on demand protocol, i.e. it does not employ any periodic exchange of packets. DSR does even employ beacon packets like some other on demand protocols. Consequently, DSR applies on demand schemes for both route discovery and route maintenance. This makes the routing overhead traffic scales to the actual needed size automatically, which is considered as the main advantage of DSR. On the other hand, DSR employs source routing, so that each data packet contains the full path it should traverse to its destination. Source routing is some time considered as a disadvantage of DSR [5]. Each data packet sent then carries in its header the complete ordered list of nodes through which the packet must pass, allowing packet routing to be a trivially
loop free and avoiding the need for up-to-date routing information in the intermediate nodes through which the packet is forwarded [11].

II) Adhoc on-Demand Distance Vector Routing (AODV)

AODV is an on-demand routing protocol where the route is discovered when the packet has to be transmitted to the destination. Destination sequence number is used to find the up-to-date path to the destination node. The source node floods the Route request to find the route to destination node. The Route request contains the source identifier, destination identifier, broadcast identifier and time to live (TTL). The destination sequence number is used in identifying the freshness of the path. Thus using this sequence number we can verify the validity of the route. The intermediate node which has the valid route to the destination sends its path to the source node through Route reply message [5]. The connection setup delay is less in this protocol [6]. AODV does not provide any type of security [2]. The AODV protocol is loop-free and avoids the count-to-infinity problem by the use of sequence numbers. AODV protocol uses a simple request-reply mechanism for route discovery [4]. The connection setup delay is less in this protocol [6].

PERFORMANCE METRICS

These are the performance metrics:

Packet delivery ratio
It is the ratio of the total number of packets received at the destination node to the total number of packets sent by the UDP agent at source node. It can be expressed as:

\[
\text{Packet delivery ratio} = \frac{\text{Total Packets received at the destination}}{\text{Total Packets sent by the source}}
\]

Average end-to-end delay
Delay is the total time taken by the packets to reach from the source to destination. It can be expressed as:

\[
\text{Average end-to-end delay} = \frac{\text{Total Time duration evolved by the packets to reach destination}}{\text{Total number of received packets}}
\]

Throughput
It is measured as the total number of bits transmitted per unit time. Throughput improves if there is less traffic, less node density, channel is free and, source and destination nodes are close.

\[
\text{Throughput} = \frac{\text{number of received packets} \times \text{packet size} \times 8}{\text{Total simulation Time}}
\]

Packet loss percentage
It is the percentage of the total number of lost packets to the total number of sent packets in a network.

Packet loss percentage is expressed as:

\[
\text{Packet loss percentage} = \frac{\text{Total number of lost packets}}{\text{Total number of sent packets}}
\]

Routing Overhead: The number of extra routing packets “transmitted” per data packet “delivered” at the destination.

NRL = no of routing packet sent/no of routing packet received

SIMULATION ENVIRONMENT

<table>
<thead>
<tr>
<th>Network simulation model parameters</th>
<th>Value of parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Type</td>
<td>Wireless</td>
</tr>
<tr>
<td>Radio propagation model</td>
<td>Two ray ground propagation</td>
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<tr>
<td>Antenna</td>
<td>Omni directional</td>
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<tr>
<td>MAC</td>
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<tr>
<td>Queue length</td>
<td>100</td>
</tr>
<tr>
<td>Number of nodes</td>
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<tr>
<td>Traffic Type (Application/Agent)</td>
<td>CBR/UDP</td>
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<tr>
<td>Simulation time</td>
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<td>Simulation areas</td>
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<tr>
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<tr>
<td>Packet size</td>
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<tr>
<td>Maximum number of packets</td>
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</tr>
</tbody>
</table>
RESULTS

The graphical analysis i.e. comparison of various protocols is shown from figure 1 to 8.

Fig. 1: End to End Delay versus Number of Nodes

Fig. 2: Routing Overhead versus Number of Nodes

Fig. 3: Packet Delivery Ratio versus Number of Nodes

Fig. 4: Throughput versus Number of Nodes
Figure 1 represents the effect of number of nodes with respect to End to End Delay. AODV has worst performance in End to End Delay. Figure 2 represents the effect of number of nodes with respect to Routing Overhead. AODV has the maximum routing overhead. Figure 3 represents the effect of number of nodes with respect to Packet Delivery Ratio. DSR has the maximum Packet Delivery Ratio. Figure 4 represents the effect of number of nodes with respect to throughput, DSR has the maximum Throughput. Figures 5, 6, 7, 8 represents the effect of the simulation area on network performance parameters- throughput, routing overhead, packet delivery ratio, average end-to-end delay, that are computed for DSDV, AODV and DSR protocols in MANET where number of nodes in the network is fixed at 30 nodes. The given figure 5 represents that there is an average decrease in performance of all the three protocols in larger network size. In contrast, AODV shows better throughput in 800 sq meters. However, DSR shows best performance. The figure 6 represents the routing overhead that all the three protocols increases the value of routing overhead in large network size. Here, DSDV shows the worst result, while average behaviour of AODV shows slightly better performance than DSR. Figure 7 represents that all the three protocols lower the value of packet delivery ratio with large network size. This result shows that the increase in distance between source and destination node or between intermediate nodes along the routing path may occur with an increase in network size and this lowers the value of packet delivery ratio for all the three protocols. Here, average behaviour of AODV shows slightly better performance than DSR and DSDV shows the worst performance in the given scenario.
Packet loss percentage is inversely related to packet delivery fraction. Hence, the figure 8 shows that all the three protocols increase the value of packet loss percentage in large network size. The outcome is that DSR outperforms and DSDV shows the worst behavior

**CONCLUSION AND FUTURE SCOPE**

This paper has discussed the three main routing protocols - DSDV, AODV and DSR in MANET followed by a qualitative comparison among them. On the basis of simulation results and discussion in Ns2.35 for 20,40,60,80 and 100 nodes, it is observed that DSR performs slightly better than AODV in terms of the packet delivery ratio. In the routing overhead DSDV has the best performance versus number of nodes. In the end to end delay DSDV has best performance versus number of nodes. AODV has best throughput performance versus number of nodes. The result analysis of a simulation scenario with 200, 400, 600, 800 and 1000 square meters network size confines that all the four performance parameters - packet delivery ratio, average end-to-end, throughput and packet loss percentage. Packet delivery ratio degrades with increase simulation area. Packet loss increases with an increase in simulation area. Routing overhead increases with an increase in simulation area. Throughput degrades as increase simulation area. Hence, it is observed that none of the protocol among DSDV, AODV, and DSR supersedes the other for all network scenarios. These protocols are application specific. In future, some more parameters - jitter, bandwidth and other network factors – packet size, maximum number of packets, connection type, data rate, and queue size can be used in the analysis. Also, some more protocols can be analyzed in VANET - OLSR, ZRP, and DYMO. Besides, network performance of these protocols can also be analyzed for VANET environment.

**REFERENCES**


