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Research Article

Comparison of AODV, OLSR and DSDV Routing Protocol for MANETs

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Abstract-A MANET is a type of ad hoc network that can change locations and configure itself on the fly. The absence of fixed infrastructure in a MANET poses several types of challenges. The biggest challenge among them is routing. Routing is the process of selecting paths in a network along which to send data packets. An ad hoc routing protocol is a convention, or standard, that controls how nodes decide which way to route packets between computing devices in a mobile ad-hoc network. In this paper, we evaluate the performance of reactive routing protocols, Ad hoc On demand Distance Vector (AODV) and proactive routing protocol, Optimized Link State Routing protocol (OLSR) and Destination Sequenced Distance Vector (DSDV). The performances of the above protocols are determined by Packet Delivery Fraction (PDF), End to end delay and Throughput.

Keywords: MANETs, Routing Protocols, OLSR, DSDV, AODV.

1. Introduction:

A MANET is an autonomous collection of mobile users that communicate over relatively bandwidth constrained wireless links. [1] Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network is decentralized, where all network activity including discovering the topology and delivering messages must be executed by the nodes themselves, i.e., routing functionality will be incorporated into mobile nodes.

Fig 1: Mobile Adhoc Network (MANET)

The set of applications for MANETs is diverse, ranging from small, static networks that are constrained by power sources, to large-scale, mobile, highly dynamic networks. The design of network protocols for these networks is a complex issue. Regardless of the application, MANETs need efficient distributed algorithms to determine network organization, link scheduling, and routing. However, determining viable routing paths and delivering messages in a decentralized environment where network topology fluctuates is not a well-defined problem. While the shortest path (based on a given cost function) from a source to a destination in a static network is usually the optimal route, this idea is not easily extended to MANETs. Factors such as variable wireless link quality, propagation path loss, fading, multiuser interference, power expended, and topological changes, become relevant issues. The network should be able to adaptively alter the routing paths to alleviate any of these effects. Moreover, in a military environment, preservation of security, latency, reliability, intentional jamming, and recovery from failure are significant concerns. Military networks are designed to maintain a low probability of intercept and/or a low probability of detection. Hence, nodes prefer to radiate as little power as necessary and transmit as infrequently as possible, thus decreasing the probability of detection or interception. A lapse in any of these requirements may degrade the performance and dependability of the network.

Routing Protocol

Routing is the act of moving information from a source to a destination in an internetwork.

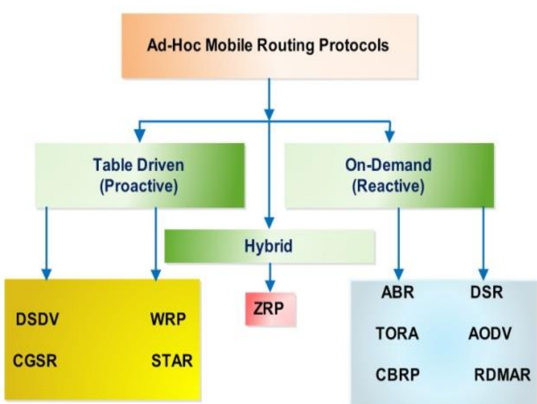

Fig 2: Classification of Routing Protocol

During this process, at least one intermediate node within the internetwork is encountered. This concept is not new to computer science since routing was used in the networks in early 1970's. But this concept has achieved popularity from the mid-1980's. The major reason for this is because the earlier networks were very simple and homogeneous environments; but, now high end and large scale internetworking has become popular with the latest advancements in the networks and telecommunication technology.

The routing concept basically involves, two activities: firstly, determining optimal routing paths and secondly, transferring the information groups (called packets) through an internetwork. The later concept is called as packet switching which is straight forward, and the path determination could be very complex.

Proactive Protocol

Pro active protocol should maintain accurate information in their routing tables [1]. The routing table will continuously evaluate all routes within a network. So this protocol maintains fresh lists of destinations and their routes by periodically distributing routing tables throughout the network. Therefore when a packet needs to be forwarded, a route is already known and can be used immediately. Once the routing tables are setup, then data (packets) transmissions will be easy and as fast as in the wired networks. Unfortunately, it is a big overhead to maintain routing tables in the mobile ad hoc network environment. The types of proactive protocols are Destination Sequenced Distance Vector (DSDV), Wireless routing Protocol (WRP), Cluster ahead Gateway Switch Routing Protocol (CGSR), Source Tree Adaptive Routing Protocol (STAR). Therefore, the proactive routing protocols have the following common disadvantages:

1. Respective amount of data for maintaining routing information.
2. Slow reaction on restructuring network and failures of individual nodes.

Reactive Protocol

Reactive protocol usually finds a route on demand by flooding the network with Route request packets [2].The types of reactive protocol are Associative Based Routing (ABR), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA), Optimized Link State Routing (OLSR), Cluster Based Routing (CBRP), Adhoc On-demand Distance Vector Routing (AODV).

2. Literature Survey

DSDV:

Destination Sequenced Distance Vector (DSDV) Protocol is designed to solve routing loop problems. Every entry in the routing table has a sequence number which is generated by the destination. The emitter sends out the next update with this number. Consider a node which is very far from base station. Here multi-hop path is established by the control messages from node. Using routing tables the packets are exchanged between the nodes [3]. When network topology changes are detected, each mobile node advertises routing information using broadcasting or multicasting a routing table update packet. The update packet starts out with a metric of one to direct connected nodes. This indicates that each receiving neighbor is one metric (hop) away from the node. It is different from that of the conventional routing algorithms. After receiving the update packet, the neighbors update their routing table with incrementing the metric by one and retransmit the update packet to the corresponding neighbors of each of them. The process will be repeated until all the nodes in the ad hoc network have received a copy of the update packet with a corresponding metric. If the update packets have the same sequence number with the same node, the update packet with the smallest metric will be used and the existing route will be discarded or stored as a less preferable route. In this case, the update packet will be propagated with the sequence number to all mobile nodes in the ad hoc network. The advertisements of routes that are about to change may be delayed until the best routes have been found. Delaying the advertisement of possibly unstable route can damp the fluctuations of the routing table and reduce the number of rebroadcasts of possible route entries that arrive with the same sequence number.

OLSR:

In [4], the network nodes exchange the topology information periodically with each other, thus, the optimal route between any two-network nodes is always present. Here MPR concept is introduced. This protocol recognizes its neighbors and records their network addresses, measures delays or cost towards its neighbors, and exchanges information by forming a package that represents the whole of the information. It sends these packages to all of the routers and calculates the shortest route to every other router. The OLSR routing protocol has the following features: (1) resends only the MPR control messages, (2) reduces the size of the control messages, (3) reduces the network overload, (4) is one stable protocol, (5) is one proactive protocol, (6) doesn't depend on any central entity, (7) supports the nodes mobility and dynamism, (8) is appropriate for dense networks and (9) OLSR protocol involves several steps: generation of the control packages, sending the packages to other nodes, making the shortest path tree (by using the Dijkstra's algorithm) and generation of the routing table. In OLSR, the MPR (Multipoint Relays) points are firstly identified, these points are the only points in the network, that are allowed to broadcast data packages to reduce the network overload and the amount of control packages transmissions.

AODV:

The Ad hoc On-Demand Distance Vector (AODV) routing protocol provides unicast, broadcast, and multicast communication in ad hoc mobile networks. AODV nodes maintain a route table in which next hop routing information for destination nodes is stored. Route discovery in AODV follows a route request/route reply query cycle. A source node in need of a route broadcasts a Route Request (RREQ) packet (Fig. 3) across the network. Any node with a current route to the destination, including the destination itself, can respond to the RREQ by unicasting a Route Reply (RREP) to the source node. Once the source node receives the RREP, it can begin sending data packets along this route to the destination. Fig. 4 illustrates the propagation of RREP messages back to the source node, and the subsequent route selected by the source node to the destination. Because nodes are moving, link breaks are likely to occur. When a link break in an active route occurs, the node upstream of the break broadcasts a Route Error (RERR) message containing a list of all the destinations which are now unreachable due to the loss of the link. The RERR is propagated back to the source node. Once the source node receives this message, it may reinitiate route discovery if it still needs the route. [6]

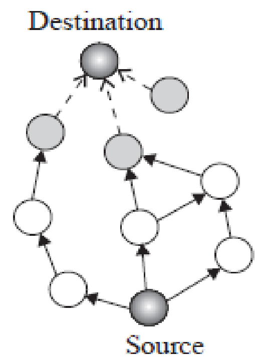

Fig 3: RREQ Broadcast

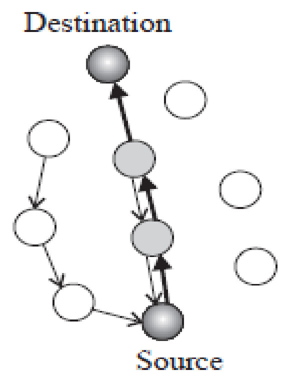

Fig 4: RREP Propagation and Subsequent Route.

3. Performance Metrics:

Throughput:

It is the rate of successfully transmitted data packets per second in the network during the simulation.

Average end-to-end delay:

It is defined as the average time taken by the data packets to propagate from source to destination across a MANET. This includes all possible delays caused by buffering during routing discovery latency, queuing at the interface queue, and retransmission delays at the MAC, propagation and transfer times.

Packet Delivery Ratio:

It is the ratio of the number of packets received by the destination to the number of data packets generated by the source.

Simulation Results

Throughput:

Compared to DSDV & OLSR routing protocols the throughput of AODV is much greater as shown in fig 4.

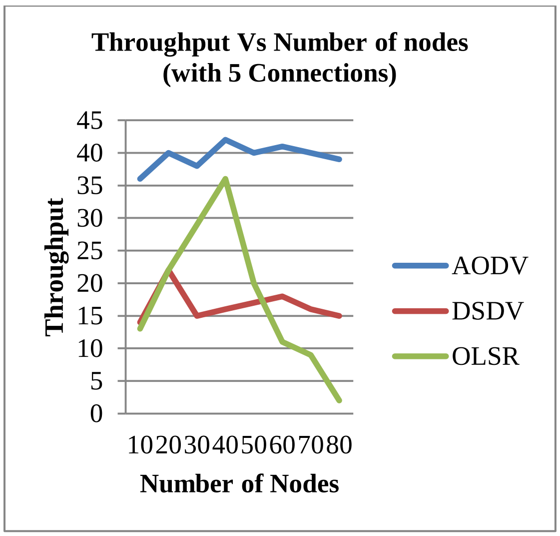

Fig.4 Throughput

Average end to end delay

The average end to end delay of AODV is less than both DSDV & OLSR routing protocols as shown in fig.5

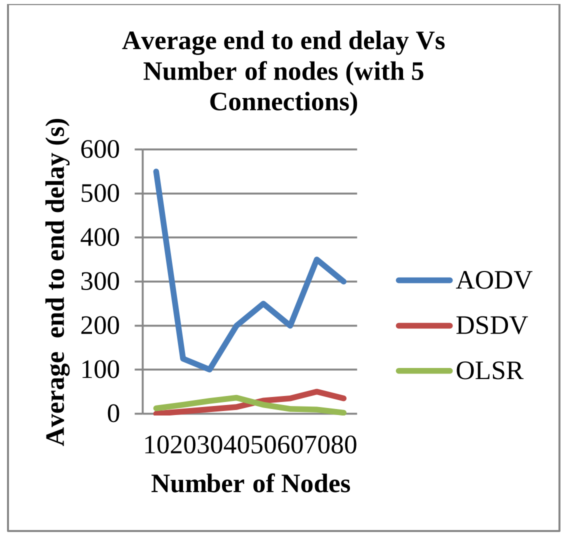

Fig. 5 Average end to end delay

Packet Delivery Ratio

The performance of AODV is better than OLSR & DSDV protocol as shown in fig.6.

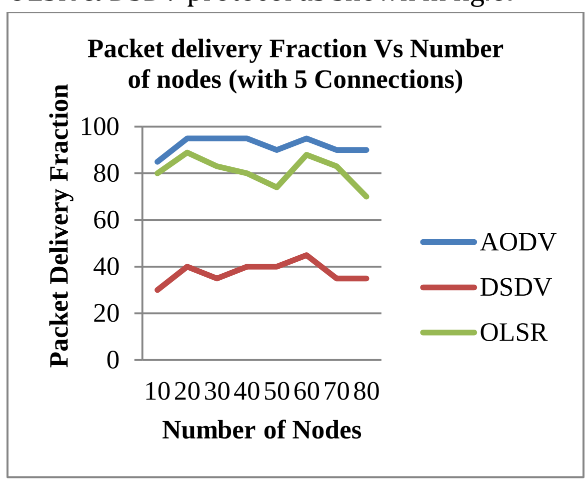

Fig. 6 Packet Delivery Ratio

4. Conclusion and Future Work

In this paper, we performed the comparison between four protocols AODV, DSDV and OLSR with traffic loads database in terms of Delay, Packet Delivery Fraction and Throughput. The results are taken in graphical form by using OPNET Simulator 14.5. The results show that AODV protocol performance is better than other two protocols.

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