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Comparative Analysis of AODV and SSA Protocol Based on Routing Parameters

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Abstract: In Mobile Ad-hoc Network (MANET) packet transmission is very important. The performance of MANET is related to the efficiency of the routing protocols in adapting to frequently changing network topology and link status. An ad-hoc network is often described as a collection of mobile platforms or nodes where each node can move freely and arbitrarily without the benefit of any fixed infrastructure except for the nodes themselves. In this paper we provide comparison between two routing protocols AODV and SSA based on some of routing parameters like Average delay, throughput, packet drop and packet delivery ratio.
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Keywords: MANET; Routing Parameters; NS2; Proactive; Reactive

I. INTRODUCTION

A mobile ad-hoc network (MANET) is an autonomous system of mobile nodes connected by wireless links. In MANET as 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. Hence routing functionality will have to be incorporated into the mobile nodes.

II. ROUTING PROTOCOLS IN AD HOC NETWORK

A. *Table-Driven (or Proactive):*

The nodes maintain a table of routes to every destination in the network, for this reason they periodically exchange messages. At all times the routes to all destinations are ready to use and as a consequence initial delays before sending data are small. Keeping routes to all destinations up-to-date, even if they are not used, is a disadvantage with regard to the usage of bandwidth and of network resources [4].

B. *On-Demand (or Reactive):*

These protocols were designed to overcome the wasted effort in maintaining unused routes. Routing information is acquired only when there is a need for it. The needed routes are calculated on demand. This saves the overhead of maintaining unused routes at each node, but on the other hand the latency for sending data packets will considerably increase [4].

In on-demand trend, routing information is only created to requested destination. Link is also monitored by periodical Hello messages. If a link in the path is broken, the source needs to rediscovery the path. On-demand strategy causes less overhead and easier to scalability. However, there is more delay because the path is not always ready.

The following part will present AODV as characteristic protocols of on-demand trend [8].

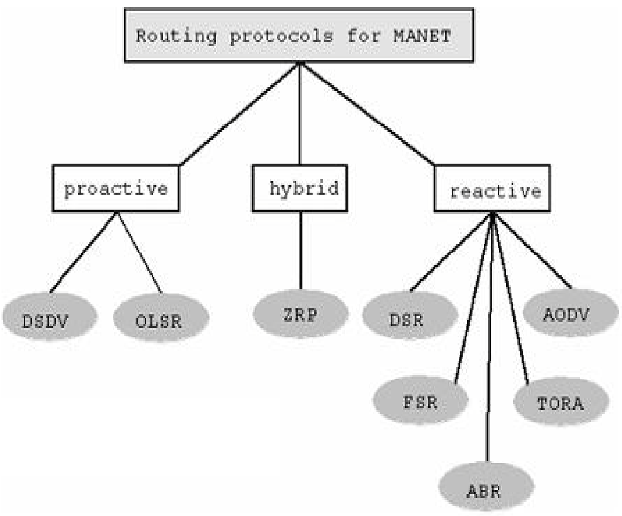

Fig.1 Breif overview of routing protocols

C. *AODV Routing:*

Ad hoc on demand distance vector routing (AODV) [3] is the combination of DSDV [4] and DSR [4]. In AODV, each node maintains one routing table. Each routing table entry contains:

a. Active neighbor list: a list of neighbor nodes that are actively using this route entry. Once the link in the entry is broken, neighbor nodes in this list will be informed.
b. Next-hop address toward that destination
c. Number of hops to destination
d. Sequence number: for choosing route and prevent loop
e. Lifetime: time when that entry expires

Routing in AODV consists of two phases: Route Discovery and Route Maintenance. When a node wants to communicate with a destination, it looks up in the routing table. If the destination is found, node transmits data in the same way as in DSDV. If not, it start Route Discovery mechanism: Source node broadcast the Route Request packet to its neighbor nodes, which in turns rebroadcast this request to their neighbor nodes until finding possible way to the destination. When intermediate node receives a RREQ, it updates the route to previous node and checks whether it satisfies the two conditions: (i) there is an available entry which has the same destination with RREQ (ii) its sequence number is greater or equal to sequence number of RREQ. If no, it rebroadcast RREQ. If yes, it generates a RREP message to the source node. When RREP is routed back, node in the reverse path updates their routing table with the added next hop information. If a node receives a RREQ that it has seen before (checked by the sequence number), it discards the RREQ for preventing loop. If source node receives more than one RREP, the one with greater sequence number will be chosen. For two RREPs with the same sequence number, the one will less number of hops to destination will be chosen. When a route is found, it is maintained by Route Maintenance mechanism: Each node periodically send Hello packet to its neighbors for proving its availability. When Hello packet is not received from a node in a time, link to that node is considered to be broken. The node which does not receive Hello message will invalidate all of its related routes to the failed node and inform other neighbor using this node by Route Error packet. The source if still want to transmit data to the destination should restart Route Discovery to get a new path. AODV has advantages of decreasing the overhead control messages, low processing, quick adapt to network topology change, more scalable up to 10000 mobile nodes.

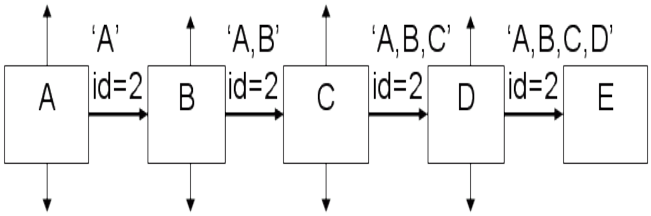

Figure.2 Route Discovery process

If node A has in his Route Cache a route to the destination E, this route is immediately used. If not, the Route Discovery protocol is started:

a. Node A (initiator) sends a RREQ packet by flooding the network
b. If node B has recently seen another Route Request from the same target or if the address of node B is already listed in the Route record, then node B discards the request!
c. If node B is the target of the Route Discovery, it returns a Route Reply to the initiator. The Route Reply contains a list of the "best" path from the initiator to the target. When the initiator receives this Route Reply, it caches this route in its Route Cache for use in sending subsequent packets to this destination.
d. Otherwise node B isn't the target and it forwards the Route Request to his neighbors (except to the initiator).

D. Signal Stability–Based Adaptive Routing Protocol (SSA):

SSA [13] protocol focuses on obtaining the most stable routes through an ad hoc network. The protocol performs on demand route discovery based on signal strength and location stability. Based on the signal strength, SSA detects weak and strong channels in the network. SSA can be divided into two cooperative protocols: the Dynamic Routing Protocol (DRP) [13] and the Static Routing Protocol (SRP) [13]. DRP uses two tables: Signal Stability Table (SST) and Routing Table (RT). SST stores the signal strengths of the neighboring nodes obtained by periodic beacons from the link layer of each neighboring node. These signal strengths are recorded as weak or strong. DRP receives all the transmissions and, after processing, it passes those to the SRP. SRP passes the packet to the node's upper layer stack if it is the destination. Otherwise, it looks for the destination in routing table and forwards the packet. If there is no entry in the routing table for that destination, it initiates the route-finding process. Route-request packets are forwarded to the neighbors using the strong channels. The destination, after getting the request, chooses the first arriving request packet and sends back the reply. The DRP reverses the selected route and sends a route-reply message back to the initiator of route request. The DRPs of the nodes along the path update their routing tables accordingly. In case of a link failure, the intermediate nodes send an error message to the source indicating which channel has failed. The source in turn sends an erase message to inform all nodes about the broken link and initiates a new route-search process to find a new path to the destination. SSA Adds Signal Strength as a prime metric, In addition to beacon count, each node keeps record of the signal strength of other neighbors. Links are classified as Strong/Stable links vs Weak/unstable links

SSA– Route Discovery In SSA Route Requests are forwarded through strong/stable links only Route Request received through weak/unstable links are dropped. The Failed Route Request → flood route discovery without Signal strength metric Destination node, once get the first Route Request over stable links, it sends Route Reply

III. SIMULATION RESULTS

A. Routing Parameters [15]:

a. Packet Delivery Fraction (PDF):

The PDF states number of packets delivered successfully at the receiver which is transmitted from the sender

$$\mathrm{PDF} = \frac{\text{Number of recived packets}}{\text{Number of sent packets}} \qquad (1)$$

This estimate gives us an idea of how successful the protocol is in delivering packets. A high value of Packet Delivery Fraction indicates that most of the packets are being delivered to the higher layers and is a good indicator of the algorithm performance.

b. Average End-to-End Delay (AED):

This is defined as the average time taken by the data packets to reach the intended destinations. This include delay occurred due to different reasons like queuing delay, propagation delay, processing delay etc.

$$\mathrm{AED} = \frac{\sum(\text{time recived} - \text{time sent})}{\text{Total data packets recived}} \qquad (2)$$

c. Throughput:

This metric represents the total number of bits forwarded to higher layers per second. It is measured in bps. It can also be defined as the total amount of data a receiver actually receives from sender divided by the time taken by the receiver to obtain the last packet.

$$Throughput = \frac{\sum_i^n CBRrece}{simulation\ time} \qquad (3)$$

d. Packet Drop:

This is the number of data packets that are not successfully sent to the destination during the transmission. In this the time versus number of packets dropped can been calculated.

We have used the above mentioned parameters to analyze performance of AODV and SSA routing protocol using Simulation. we have used NS2 for our Simulation. Ns is a discrete event simulator targeted at networking research. Ns provide substantial support for simulation of routing, and multicast protocols over wired and wireless networks.

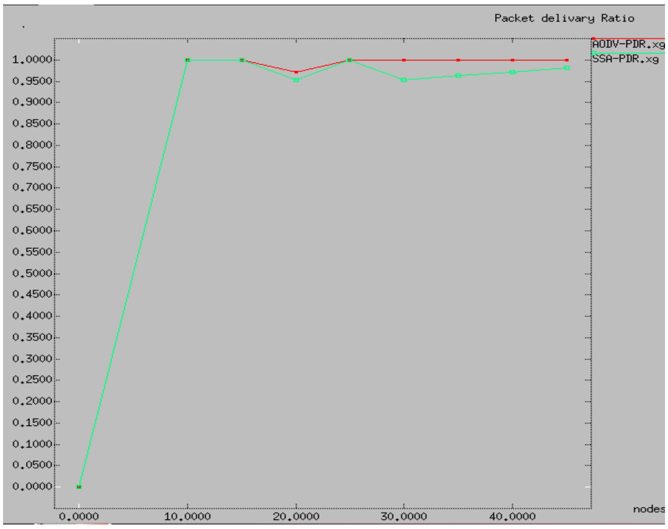

Figure.3 Packet Delivery Ratio vs Nodes

Above fig.3 shows the result of packet delivery ratio vs number of nodes. The green line show graph for SSA protocol and red line show the graph for AODV protocol. It is clear from graph that packet delivery ratio is almost same for SSA and AODV, but slightly better in case of AODV protocol, it is seen that as number of nodes increases AODV outperforms SSA. As update mechanism is better in AODV as compared to SSA.

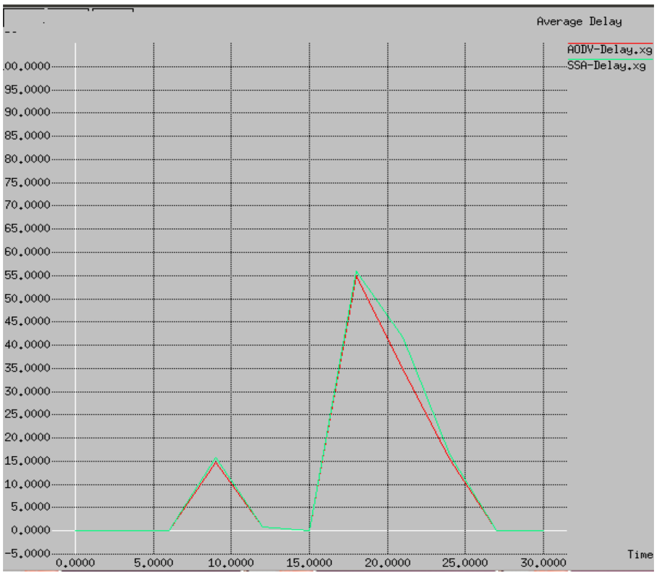

Figure.4 Average Delay vs Time

Above fig. 4 shows the result for average delay the green line show graph for SSA protocol and red line show the graph for AODV protocol. Delay in both the cases is almost similar in nature.

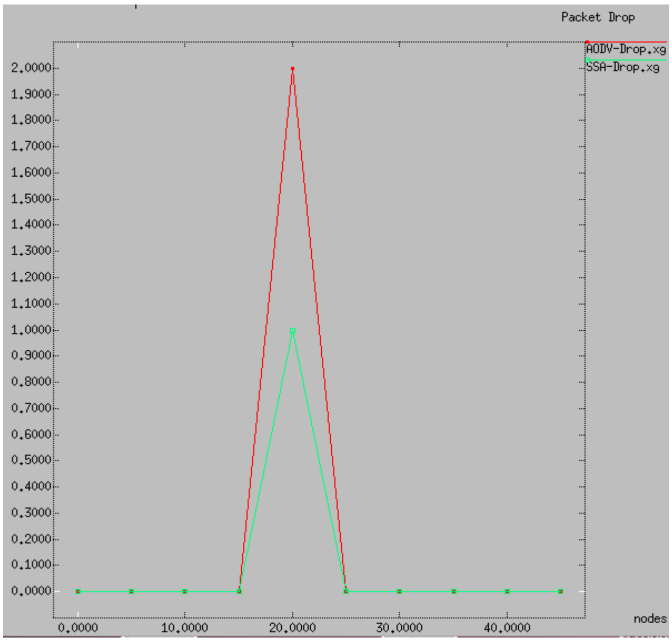

Figure.5 Packet Drop vs Nodes

Above fig. 5 shows the result for average delay the green line show graph for SSA protocol and red line show the graph for AODV protocol.as seen in figure packet drop for the SSA protocol is very less as it takes optimal path and chances of packets getting dropped is very less. Here SSA protocol outperforms AODV.

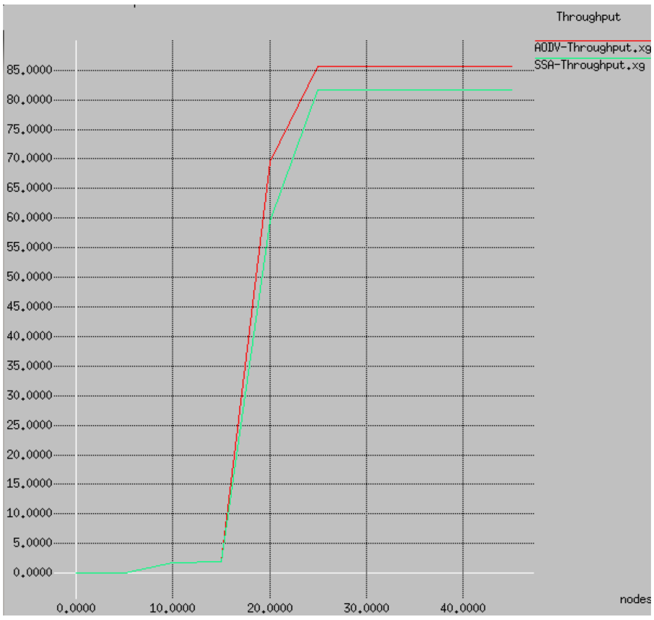

Figure.6 Throughput vs Nodes

Above fig.6 shows the result for throughput the green line show graph for SSA protocol and red line show the graph for AODV protocol. As there is increase in number of nodes, it affects the throughput and AODV is slightly better as compared to SSA protocol.

IV. CONCLUSION AND FUTURE SCOPE

This work mainly consists of two studies, one is analytical study and other is simulation study. From analytical study it is concluded that routing protocols in new modern arena of telecommunications, internet systems and in seamless communication play prominent role to develop better communication between end users. The selection of suitable protocol according to the network definitely increases the reliability of that network.

The simulation study consisted of two routing protocols AODV and SSA, analyzing their behavior with respect to parameters like Packet delivery fraction/ ratio, Average delay, packet drop and throughput. The motive was to check the performance of these three routing protocols in MANET in the above mentioned parameters. From result's it can be seen that AODV has the best all round performance. SSA may be suitable in smaller network as it takes more setup time. Whereas AODV is more suitable in larger network where there is dense network with more number of nodes.

The next step for the future work would be to implement the protocol in a real time environment which consists of nodes running different routing protocols and check the performance of the protocol under different scenarios and can be extended to various other protocols like TORA and also analyze performance of such protocols on the performance parameter like path optimality, delay overload and energy consumption, etc.

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