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Throughput Enhancement in Scalable MANETs using Proactive and Reactive Routing Protocols

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***Abstract*- In MANET routing is an essential activity that connects a call from source to destination in telecommunication networks and also need to be essential in architecture, design and operation of networks. Routing with Scalable performance is one of the key challenges in deploying large scale Mobile Ad hoc Networks. In order to operate the ad hoc networks as efficiently as possible, appropriate on-demand routing protocols have to be incorporated, to find effective routes between source and destination, taking node mobility into consideration. This paper mainly concentrates to study the various performance metrics like latency, throughput for better understanding of functionalities of the routing protocols. In this paper, we experimentally tested and compared the performance of various proactive and reactive routing protocols over their throughput and latency using NS-2 simulator and results were graphically depicted.**

***Index Terms*- scalable performance, proactive protocol, reactive protocol.**

I.INTRODUCTION

A mobile ad hoc network (MANET) is a collection of mobile nodes that dynamically self organize in a wireless network without using any pre-existing infrastructure [4]. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router.

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The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet. MANETs are a kind of wireless ad hoc networks that usually has a routable networking environment on top of a Link Layer ad hoc network [8].

For MANET, various routing protocols are available each has its own characteristics and some of them have derived characteristics. Depending upon the nature of application, appropriate routing protocol is implemented. Proactive and reactive protocols are the two classes of MANET routing protocols and each constitute a set of protocols as described below.

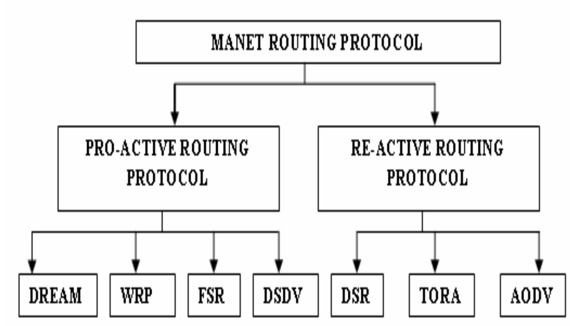

Fig 1.Classification of various Routing Protocols

II. ROUTING PROTOCOLS

Among various routing protocols available for MANETs, we worked with three protocols AODV, DSR, and DSDV, and each protocol is described with a figure as follows.

Destination-Sequenced Distance Vector (DSDV)

DSDV is a hop-by-hop distance vector routing protocol. It is proactive and each node has to periodically broadcast routing updates. The key advantage of DSDV over traditional distance vector protocols is that it guarantees loop-freedom by using the concept of sequence numbers [4]. Fig. 2 shows the DSDV routing protocol workflow and its mechanism is described below.

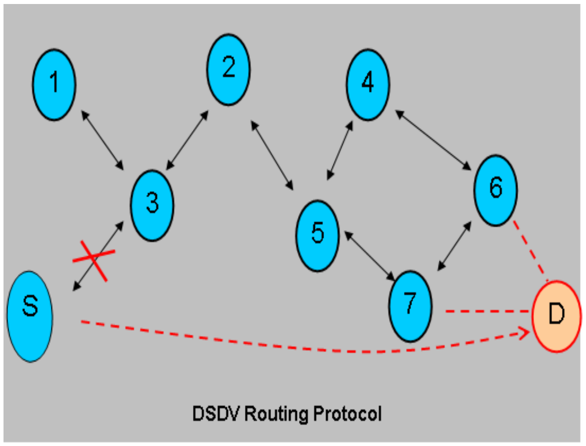

Fig 2.DSDV Workflow

Each DSDV node maintains a routing table listing the "next hop" for each reachable destination. DSDV tags each route with a sequence number and considers a route R more favorable than R if R has a greater sequence number, or if the two routes have equal sequence number but R has a lower metric. Each node in the network advertises an increasing even sequence number for itself. When a node decides its route to a destination is broken, it advertises the route to destination with an infinite metric and a sequence number one greater than its sequence number for the route that has broken (Making an odd sequence number) [6]. This causes any node routing packets through S to incorporate the infinite-metric route into its routing table until the origin node hears a route to destination D with a higher sequence number. DSDV uses triggered route updates when the topology changes. The transmission of updates is delayed to introduce a softening effect when the topology is changing quickly. This gives an additional adaptation of DSDV to ad-hoc networks.

B. Dynamic Source Routing (DSR)

DSR [4] is a reactive protocol that uses source routing rather than hop-by-hop routing, with each packet to be routed carrying in its header the complete, ordered list of nodes through which the packet must pass. The key advantage of source routing is that intermediate nodes do not need to maintain up-to-date routing information in order to route the packets they forward, since the packets themselves already contain all the routing decisions. For better understanding Fig. 3 shows the DSR routing protocol workflow and its mechanism is described below.

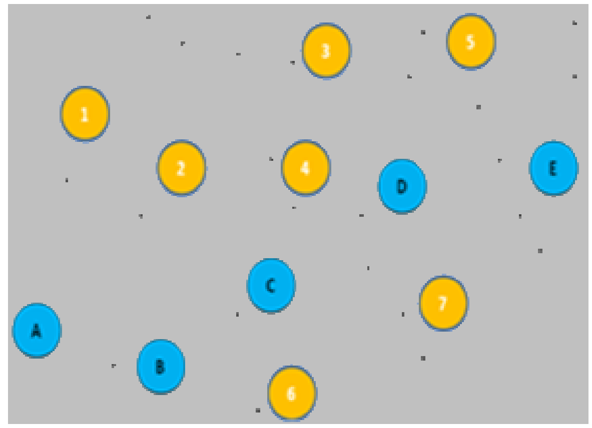

Fig 3.DSR Workflow

The DSR protocol consists of two mechanisms: Route Discovery and Route Maintenance. Route Discovery is the mechanism by which a node A wanting to send a packet to a destination E obtains a path. To perform a Route Discovery, the source node A broadcasts a Route Request packet that is flooded through the network in a controlled manner and is answered by a Route Reply packet from either the destination node or another node that knows a route to the destination [12]. To reduce the cost of Route Discovery, each node maintains and actively uses a cache of source routes it has learned or overheard. That way, the frequency and propagation of Route Requests is limited.

Route Maintenance is the mechanism by which a packet's sender A detects if the network topology has changed such that it can no longer use its route to the destination E because two nodes listed in the route have moved out of range of each other. When Route Maintenance indicates a source route is broken, A is notified with a Route Error packet [2]. The sender A can attempt to use any other route to destination node E already in its cache or can invoke Route Discovery again to find a new path. The nodes 1, 2, 3...7 in the network is away from the task i.e., not processing the packet after looking into the destination address and next possible neighbor node. A DSR node is able to learn routes by overhearing packets not addressed to it. How ever this feature requires an active receiver in the nodes, which maybe rather power consuming and apparently does not improve performance.

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C. Ad Hoc On-Demand Distance Vector (AODV)

The Ad Hoc On-Demand Distance Vector routing protocol (AODV) is an improvement of the Destination-Sequenced Distance Vector routing protocol (DSDV) [7]. It creates the routes on an on-demand basis, as opposed to maintain a complete list of routes for each destination. Therefore, the literature on AODV, classifies it as a pure on-demand route acquisition system [7]. The usage of the AODV protocol for mobile ad hoc networking applications provided consistent results for large scale scenarios.

For better understanding Fig. 4 shows the DSR routing protocol workflow and its mechanism is described below.

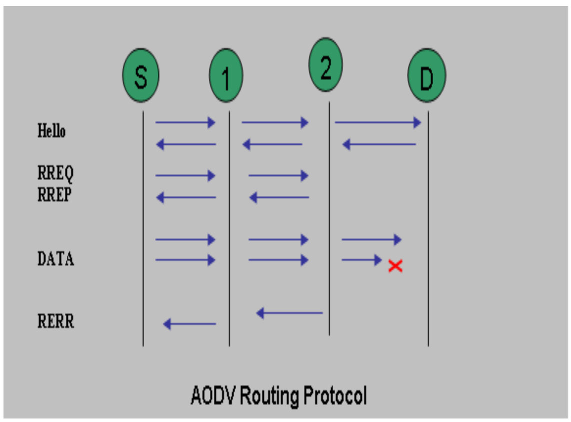

Fig 4.AODV Workflow

AODV is essentially a combination of both DSR and DSDV [4]. It borrows the basic on-demand mechanism of Route Discovery and Route Maintenance from DSR, plus the use of hop-by-hop routing, sequence numbers, and periodic beacons from DSDV. When a node S needs a route to some destination D, it broadcasts a Route Request message to its neighbors, including the last known sequence number for that destination. The Route request is flooded until it reaches a node that knows a route to the destination D. Each node that forwards the Route Request creates a reverse route for itself back to node S. When the Route Request reaches a node with a route to D, that node generates a Route Reply that contains the number of hops necessary to reach D and the sequence number for D most recently seen by the node generating the Route Reply. Every node that participates in forwarding this Route Reply towards the originator of the Route Request (node S), will create a route to D. The state created in each node along the path from S to D is hop-by-hop state; that is, each node remembers only the next hop and not the entire route, as would be done in source routing [8].

In order to maintain routes, AODV normally requires that each node periodically transmit a HELLO message, with a default rate of once per second. Failure to receive three consecutive HELLO messages from a neighbor is taken as an indication that the link to the neighbor is down [7]. Alternatively, the AODV specification briefly suggests that a node may use physical layer or link layer methods to detect link breakages to nodes that it considers neighbors. When a link goes down, any upstream node that has recently forwarded packets to a destination using that link is notified via an Unsolicited Route Reply containing an infinite metric for that destination [6]. Upon receipt of such a Route Reply, a node must acquire a new route to the destination using Route Discovery as described above.

III. METHODOLOGY

1. Mobility: The random way-point mobility pattern is used. In this model, nodes select random way-points within the roaming area, and travel there with a constant speed randomly chosen from a uniform distribution, *U[0, Vmax]*. When reaches its destination, the node waits for some pause time then moves to the next waypoint. This scenario is applicable to networks such as conferences, and emergency situations with people walking as nodes [12]. In a high mobility system the data transmission energy may be negligible compared to the energy used for the mobility [2].

2. Traffic Pattern: Using constant bit rate traffic was generated. The network size kept constant while varying the number of nodes and the number of source- destination pairs within the network [12]. In effect, this model attempts to observe the relationship between latency and system performance [10].

3. MAC Layer: The MAC layer implements the IEEE802.11 interface available with the Distributed Coordination Function (DCF), so as to involve link layer functionalities over data request and reply between source and destination.

IV. SIMULATION ENVIRONMENT

Table 1: Simulation Parameters

Parameter	Value
Simulator	ns-2
Studied protocols	DSDV, DSR and AODV
Simulation time	100 seconds
Simulation area	500 m x 500 m
Traffic type	CBR (UDP)
Data payload	512 bytes/packet
Channel type	Wireless Channel
MAC type	802.11
Mobility	Random way point
Antenna model	Omni

When running an experiment, the first step is to create the traffic and movement patterns. The TCL script is used to write a file which specifies the number of connections, number of nodes that actually required. The traffic sources of these connections can be either of TCP type or Constant Bit Rate (CBR) over UDP. In all our experiments we used CBR traffic sources, the same as [6]. To generate the movement patterns, we used a modified version of the program *setdest*, developed by the Monarch Project from CMU [1]. In a movement pattern, the initial position of all nodes is randomly determined. Changes are stored at the end of the generated file. The TCL scripts for AODV, DSR, and DSDV are created, then for each protocol, traffic pattern, and movement pattern are fixed.

- Those settings are fixed for all experiments and their default value is shown in table.
- Then, the user can choose the options what they need, and can be modified in the configuration file.
- Finally, the NS2 simulator is command to execute the given scenario file, as a result trace files are generated and is used to generate graph using Xgraph.

Table2**:** Constants and Terminologies used in Simulating Environment

Terminologies in DSDV simulations	**Terminologies in DSR simulations**	**Terminologies in AODV simulations**
Time for which a route is active : 4ms	Time between retransmitted Route Requests (exponentially backed off) : 5ms	Time for which a route is considered active : 3ms
Size of source route header carrying n addresses : 4n + 4bytes	Size of source route header carrying n addresses : 4n + 4bytes	Lifetime on a Route Reply sent by destination node : 6ms
Route updates :when topology changes	Timeout for non propagating search : 3ms	Time before a Route Request is retried : 6ms
Sequence no. check S(R1)>S(R3)	Time to hold packets awaiting routes : 15ms	Time for which the broadcast id for a forwarded Route Request is kept : 3ms

Fig 5. Sample NS2 NAM window

V. SIMULATION RESULTS

Throughput: One of the dimensional parameters of the network which gives the fraction of the channel capacity used for useful transmission selects a destination at the beginning of the simulation i.e., information whether data packets correctly delivered or not , to the destinations[6]. The maximum number of packets made, by using each protocol in a finite simulation time is analyzed.

Latency: The delay at every node may be of processing, investigating the data units (packets) from the network [11]. When the number of nodes is small, the latency experienced with the DSR routing protocol is minimum and while increasing the number of nodes, the latency increases [3].

Table 3: Latency comparison of various protocols

Latency when No. of nodes:	10	26
DSDV	0.05ms	0.06ms
AODV	0.04ms	0.03ms
DSR	0.02ms	0.05ms

Case 1:

In this scenario we consider the Number of nodes is 10 and the given Simulation time is: 100ms. The routing protocols AODV, DSDV, DSR were compared based on their throughput for a given number of nodes with the same simulation parameters. The comparisons are represented graphically in fig. 6

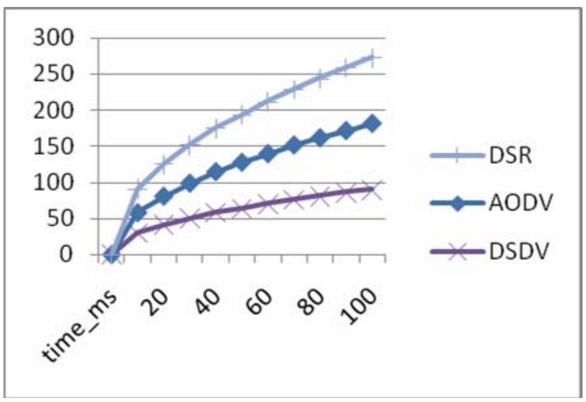

Fig. 6. No. of Nodes: 10

Graph shows the performance of DSR routing protocol, which is better than both AODV and DSDV routing protocols. Comparatively AODV holds good with throughput than DSDV.

Case2:

In this scenario we consider the Number of nodes is 26 and the given Simulation time is: 100ms.With the above mentioned parameters, the three different routing protocols were compared with increase in the number of nodes. The comparisons are represented graphically in fig. 7

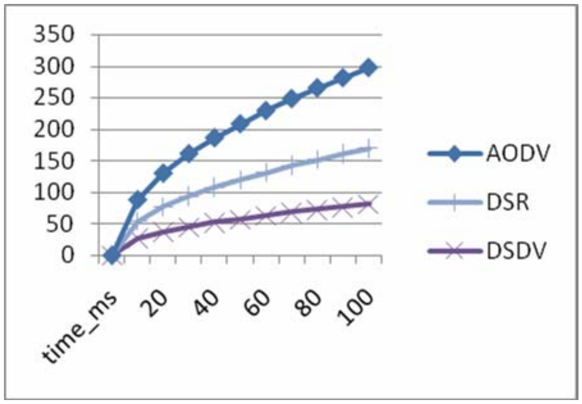

Fig. 7. No. of Nodes: 26

Graph shows the performance of AODV routing protocol that is better than both DSR and DSDV routing protocols. Comparatively DSR holds good with throughput than DSDV.

VI. CONCLUSION

Comparison of both proactive and reactive routing protocols based on significant parameter like throughput is done. The implementation of routing protocols shows the results based on the some network parameters like latency, various simulation times for unique scenario conditions. We also tested other metrics such as packet loss for higher node densities .AODV routing protocol produces a very consistent throughput with minimal latency even with increasing number of nodes while comparing DSR protocol which varies with the difference in number of nodes. The deployment of proactive and reactive protocol selection and their suitability of application in real time scenario analysis in scalable performance of mobile ad hoc networks are made and the experimental results are discussed. For future improvement we planned to identify some more additional network parameters to enhance the throughput of scalable MANETs performance.

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