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Scenario based Performance comparison of DSDV, DSR, AODV

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Abstract: There are various performance metrics to compare Ad hoc routing protocols. A Mobile Ad-Hoc Network (MANET) is a set of wireless mobile nodes which forms instant temporary network without using any central administration or network infrastructure. All the nodes in MANET's change their position frequently. The protocols have to maintain efficiency for low transmission power and dynamic links of networks, along with timely delivery of message.
The main classes of routing protocols are Proactive, Reactive and Hybrid. A reactive also known as On-Demand routing class is usually used with wireless adhoc routing. In this paper, an attempt has been made to compare the performance of three important on-demand reactive routing protocols for mobile ad hoc networks: DSR and AODV, along with the conventional proactive DSDV protocol.

Keywords: Wireless Mesh Network, AODV, DSDV, DSR.

I. INTRODUCTION

A mobile ad hoc network [1] is a collection of digital data terminals equipped with wireless Transceivers that can communicate with one another without using any fixed networking infrastructure. Communication is maintained by the transmission of data packets over a common wireless Channel.
The absence of any fixed infrastructure, such as an array of base stations, makes ad hoc networks radically different from other wireless LANs. Whereas Communication from a mobile terminal in an infrastructure network, such as a cellular network, is always maintained with a fixed base station, a mobile terminal (node) in an ad hoc network can communicate directly with another node that is located within its radio transmission or communication range. In order to transmit to a node that is located outside its radio range, data packets are relayed over a sequence of intermediate nodes using a store-and-forward ―multi hop transmission principle. Every node in an ad hoc network is required to relay packets on behalf of other nodes. A mobile ad hoc network is sometimes also known as multi hop wireless network. The design of adhoc network faces many challenges. The first is that all nodes in an ad hoc network, including the source nodes, the corresponding destinations, as well as the routing nodes forwarding traffic between them, may be mobile. As the range of wireless transmission is limited, the (wireless) link between a pair of neighboring nodes disconnects as soon as they move out of range.
A second reason that makes the design of ad hoc networks complicated is the absence of centralized control. All networking functions, such as determining the network topology, multiple accesses, and routing of data over the most appropriate multi hop paths, must be performed in a distributed way. These tasks are immense challenging due to the limited communication bandwidth available in the wireless channel. These challenges are resolved by different layers. The physical layer must tackle the fading, the path loss, and multi-user interference to maintain stable communication links between peers. The data link layer (DLL) must make the physical link reliable and resolve contention among unsynchronized users transmitting packets on a shared channel. The next operation is performed by the medium access control (MAC) sub layer in the DLL. The network layer needs to detect changes in the network topology and appropriately determine the best route to any desired destination. The transport layer must match the delay and packet loss characteristics specific to such a dynamic wireless network.

1.1 *ADVANTAGES OF MANETs [3] [4] [5]:*

1) They provide access to information and services regardless of geographic position.
2) These networks can be set up at any place and time.

1.4 *DISADVANTAGES OF MANETs [3] [4] [5]:*

1) Limited resources and physical security.
2) Volatile network topology makes it hard to detect malicious nodes.

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3) Security protocols for wired networks cannot work for ad hoc networks.

II. CLASSIFICATION OF ROUTING PROTOCOLS

Classification of routing protocols in mobile ad hoc network can be done in many ways; the routing protocols can be categorized as Proactive (Table Driven), Reactive (on demand) and Hybrid depending on the network structure.

A. Proactive routing protocols

Proactive protocols perform routing operations between all source destination pairs periodically, irrespective of the need of such routes. These protocols attempt to maintain shortest path routes by using periodically updated views of the network topology. These are usually maintained in routing tables in each node and updated with the acquisition of new information. Proactive protocols have the advantage of providing lower latency in data delivery and the possibility of supporting applications that have quality-of-service constraints. Their main disadvantage is due to the wastage of bandwidth in sending update packets periodically even when they are not necessary, in addition to such as when there are no link breakages or when only a few routes are needed Examples of Proactive MANET Protocols include: Optimized Link State Routing (OLSR), Fish-eye State Routing (FSR), Destination Sequenced Distance Vector (DSDV) etc.

B. Reactive routing protocols

Reactive protocols are designed to minimize routing overhead. Instead of tracking the changes in the network topology to continuously maintain shortest path routes to all destinations, so these protocols determine routes only when necessary. Generally, these protocols perform a route discovery operation between the source and the desired destination when the source needs to send a data packet and the route to the destination is not known. If a route is live, reactive routing protocols only perform route maintenance operations and resort to a new route discovery only when the existing one breaks. The advantage of this on demand operation is that it usually has a much lower average routing overhead in comparison to proactive protocols.

However, it has the disadvantage that a route discovery may involve flooding the entire network with query packets. Flooding is wasteful, which can be required quite frequently in case of high mobility or when there are a large number of active source-destination pairs. Moreover, route discovery adds to the latency in packet delivery as the source has to wait till the route is determined before it can transmit. Despite these drawbacks, on-demand protocols receive comparatively more attention than proactive routing protocols, because the bandwidth advantage makes them more scalable

C. On-demand (reactive) routing protocols

It presents an interesting and significant departure from the traditional proactive approach. Main idea in on-demand routing is to find and maintain only needed routes. Where as in proactive routing protocols maintain all routes without regard to their ultimate use. The confirms and best advantage with discovering routes on-demand is to avoid incurring the cost of maintaining routes that are not used. This approach is most suitable when the network traffic is sporadic, burst and directed mostly toward a small subset of nodes.

However, since routes are created when the need arises, data packets experience queuing delays at the source while the route is being found at session initiation and when route is being repaired later on after a failure. Another, not so obvious consequence of on-demand routing is that routes may become suboptimal, as time progresses since with a pure on-demand protocol a route is used until it fails. The different types of On Demand driven protocols are Ad hoc On Demand Distance Vector (AODV), Dynamic Source routing protocol (DSR), temporally ordered routing algorithm (TORA), Ad-hoc On demand Multipath Distance Vector Routing (AOMDV).

Hybrid protocols seek to combine the Proactive and Reactive approaches. For example Zone Routing Protocol (ZRP).Our discussion is limited to three on-demand ad-hoc routing protocols AODV, AOMDV and DSR as below:.

D. Ad Hoc on Demand Distance Vector (AODV)

The ad hoc on-demand distance-vector (AODV) routing protocol is an on-demand routing protocol; all routes are discovered only when needed, and are maintained only as long as they are being used. Routes are discovered through a route discovery cycle, in which the network nodes are queried in search of a route to the destination node. When a node with a route to the destination is discovered, that route is reported back to the source node that requested the route the following sections describe the features of AODV that allow it to discover and maintain loop free route.

III. SIMULATION TOOL

All simulations have been carried out using the NS simulator program version 2.34 under Linux platform. NS2 is an open source simulator software and used by a lot of institutes and researchers. The main goal of the NS2 simulator is to provide support to education and research in networking. It is one of the best programmed in terms of comparing different routing protocols and designing new ones. NS2 has been written in two languages: Object oriented variant of

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Tool Command Language (OTCL) and object oriented language C++ [2].

In this paper we analyze the three most common MANET protocols AODV, DSDV, DSR by varying the number of nodes and by varying speed of nodes.

We use following quantitative metrics to compare the performance [6].

• **Packet Delivery Ratio:** The fraction of packets sent by the application that are received by the receivers.

• **Average Jitter: Jitter** is the variation in the time between packets arriving, caused by network congestion, timing drift, or route changes.

• **Average End-to-end delay:** End-to-end delay indicates how long it took for a packet to travel from the source to the application layer of the destination.

• **Throughput:** The throughput is defined as the total amount of data a receiver R receives from the sender divided by the times it takes for R to get the last packet.

The following tables show the result we got and the same has been depicted in the graphs.

A) By considering varying number of nodes we got following graphs.

1) Packet delivery Ratio:-

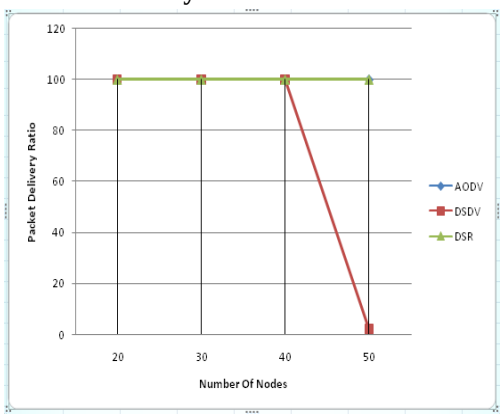

Fig:-Number of Nodes Vs Packet Delivery Ratio

AS observed iin the graph the number of nodes increases the packet delivery ratio of DSDV decreases. While the in this scenario the AODV and DSR are almost same.

2) End to End Delay:-

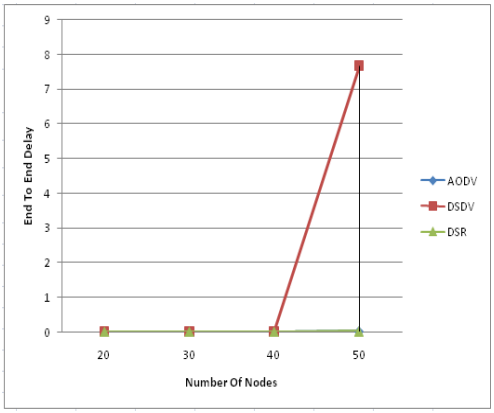

Fig: Number of Nodes Vs End to End Delay

The end to end delay is increases as number of nodes increases for DSDV. The AODV and DSR are almost same.

3) Throughput

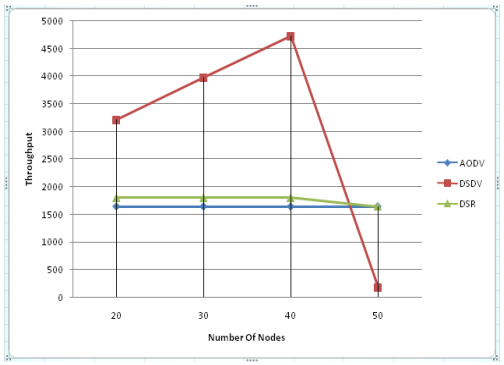

Fig: Number of Nodes Vs Throughput

The throughput of DSDV is high in the beginning but as the number of nodes increases the throughput of DSDV decreases. While the DSR is better than DSDV and perform good up to 40 nodes, as number of nodes increases it also decreases. The AODV is best among other two in this case.

B) By considering varying speed of nodes we got following graphs.

1) Packet delivery ratio

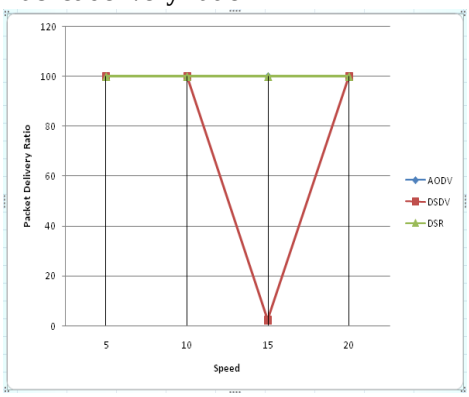

Fig: Varying Speed Vs Packet Delivery Ratio

In this case the variations are observed for the DSDV protocol as the speed varies.

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2) End to End Delay

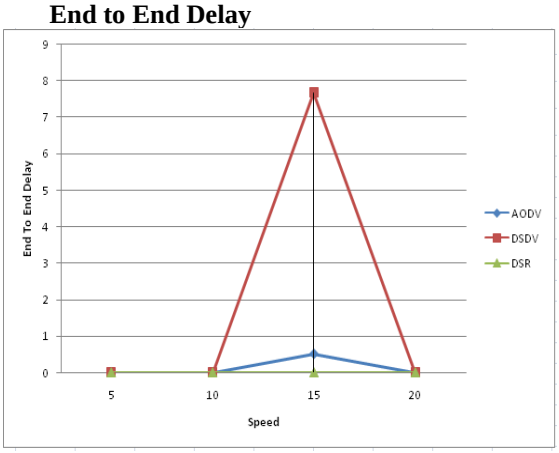

Fig: Varying Speed Vs End To End Delay

There is high end to end delay for DSDV where as there is no delay for DSR.

3) Throughput

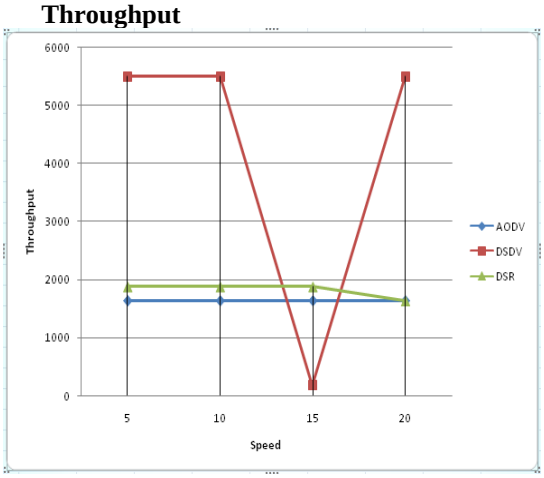

Fig: Varying Speed Vs Throughput

Throughput varies as the speed changes for DSDV. AODV is alomost consistant in this case. And DSR is better than AODV but its throughput also decreases as speed of nodes increases.

C) Sample scenario

This is sample scenario with 50 mobile nodes along with speed of 20. Dynamic State Routing (DSR) the DSR protocol [7, 8, 9] requires each packet to carry the full address (every hop in the route), from source to the destination. Which means that the protocol will not be very effective in large networks as the amount of overhead carried in the packet will continue to increase as the network diameter increases. In highly dynamic and large networks the overhead may consume most of the bandwidth. Anyway, this protocol has a number of advantages over other routing protocols and in small to moderately size networks (perhaps up to a few hundred nodes) the performance of this protocol is better. An advantage of DSR is that nodes can store multiple routes in their route cache which means that the source node can check its route cache for a valid route before initiating route discovery and if a valid route is found there is no need for route discovery. This is very useful in network with low mobility, as the routes stored in the route cache will be valid for a longer period of time. One more advantage of DSR is that it does not require any periodic beaconing (or *hello* message exchanges) therefore nodes can enter sleep node to conserve their power. This saves a considerable amount of bandwidth in the network. 2.2. Ad hoc On-demand Distance Vector Routing (AODV) The AODV routing protocol [6] is based on DSDV and DSR algorithm. It uses the periodic beaconing and sequence numbering procedure of DSDV and a similar route discovery procedure as in DSR. Apart from this, there are two major differences between DSR and AODV. The main important distinguishing difference is that in DSR each packet carries full routing information, but in AODV the packets carry the destination address. This means AODV has potentially less routing overheads than DSR. The another difference is that the route replies in DSR carry the address of every node along the route, but in case of AODV the route replies only carry the destination IP address and the sequence number. The important advantage of AODV is that it is adaptable to highly dynamic networks. But node may experience large delays during route construction and the link failure may initiate another route discovery which introduces extra delays and consumes more bandwidth as the size of the network increases.

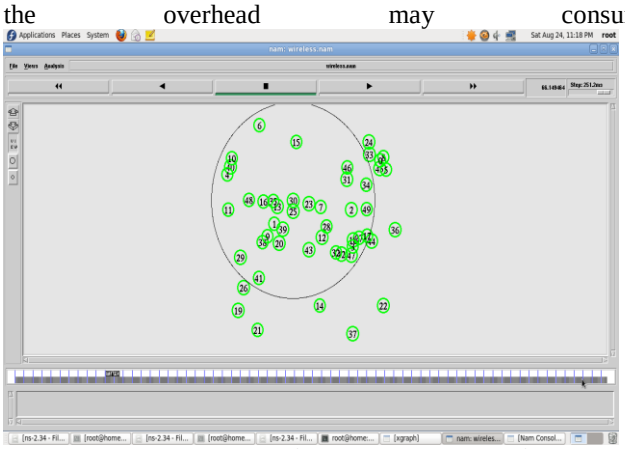

Fig: Sample scenario for 50 Nodes with Speed of 20

IV. CONCLUSION

AODV depicts the best performance with its competence to maintain connection by periodic exchange of information required for TCP network. The performance of AODV is

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best in case of packet delivery ratio and DSDV outperform others in case of throughput. Varying number of nodes with consistent speed and in case of varying speed of nodes and constant number of nodes, DSDV outperform others in case of packet loss and throughput, but as compare to other overall AODV outperforms DSDV and DSR as in high mobility environment topology change rapidly and AODV can adapt to the changes, but by considering all into account DSDV is better than others. For higher node mobility, AODV is worst in case of packet loss and throughput but performs best for packet delivery ratio. For higher node mobility, throughput and in case of end-to-end DSDV performs better than AODV but DSR performs best in case of packet loss. Hence, usually for real time traffic DSDV is preferred over DSR and AODV. From the above research work performance of AODV is considered best for Real-time and TCP network.

V. FUTURE SCOPE

This area will perform apart from comparison between AODV, DSDV and DSR routing protocols in grid but more on the vast areas. As we aware, routing protocol in grid environment is increasing day-by-day in the computer communications. Probably for the future we would be able to focus more on security issue. As the routing protocols are principal targets for impersonation attacks. Due to the mobile grid environment is does not have centralized control; so the security must be handled in a distributed fashion. This lead towards to the IPSec authentication headers should be deployed, as well as the necessary key management to distribute keys to the members of the mobile grid.

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BIOGRAPHY

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