Performance Comparison of Two MANET Routing Protocols (AODV and DSDV)

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Abstract – Wireless networks can be classified in two types: infrastructure wireless networks and infrastructure less (ad hoc) wireless networks. Ad hoc networks are characterized by the need for efficiency routing protocols. As per past research, the Destination Sequenced Distance Vector (DSDV) routing protocol and the Ad hoc On Demand Distance Vector (AODV) routing protocol are two good representations for each routing protocol category, Table-driven category and On Demand category respectively.

This paper gives a short summary of these routing protocols as well as the feature and functions of these routing protocols and makes their relative analysis in order to measure the performance of the network.

Our objectives is objective to implement two MANET routing protocol using network simulator and run it for different number to nodes and shows result through graphs of different performance Metrics.

Such as: Throughput, Packet delivery ratio, Routing overhead.

Index Terms – MANET, AODV (Ad hoc On Demand Vector), DSDV (Destination Sequenced Distance Vector).

1. INTRODUCTION

A mobile ad hoc network (MANET) is a self-gestalt. Infrastructure-less network of mobile devices connected cordless. Ad hoc is Latin word which means "for specific purpose".MANETs circa 2001-2014 communicate in customary manner at radio frequencies (40 MHz - 5 GHz).

Each device in a MANET is independently moved in different direction, and each device will change links to other devices oftentimes. Each device must forward traffic which is not for its own use, and therefore will change itself to router. In MANET, primary challenge is each device to maintain the information required to properly route traffic without any pause. MANET usually has a routable networking environment on top of a Link Layer.

This paper focuses on two AODV and DSDV from many routing protocols for comparisons of performance because of its closeness amidst all other routing protocols.

Comparison between two routing protocols are based on the important metrical a i.e. control overhead, throughput, packet delivery ratio and average end-to-end delay.

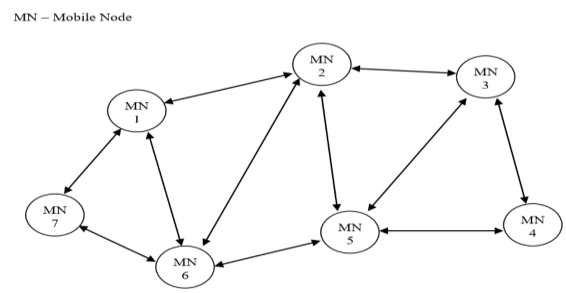

Figure 1: an example of MANET

2. RELATED TECHNOLOGIES AND WORK

2.1 Vehicular ad hoc networks (VANETs)

Vehicular uses the principles of the mobile ad hoc network (MANET). VANET is also called by more generic term Inter-Vehicle Communication. Spontaneous networking is main focus of VANET and less use of infrastructure like Road Side Unit (RSUs) and cellular network.

As their basis VANET can use any wireless network technology like WLAN (Standard Wi-Fi and ZigBee).

Applications of VANETs are:

- Electronic brake lights**,** which allow a driver to react to vehicles braking even though they might be unclear.
- Platooning,Leading vehicle by wirelessly sending acceleration and steering information to other vehicles, thus forming electronically coupled "road trains".

- Traffic information systems,give up-to-the minute obstacle reports to a vehicle's satellite navigation system using VANET communication.

2.2 Smart phone Ad hoc networks (SPANs)

To create peer-to-peer networks without relying on cellular carrier networks or wireless access points, Smart Phone Ad hoc Networks (SPANs) get strategic advantage of the existing hardware (primarily Bluetooth and Wi-Fi) in commercially available Smartphone.

SPANs differ from traditional hub and spoke networks, such as Wi-Fi Directand no notion of group leader so peers can easily join and leave the network at their will without destroy the network.

2.3 Data mining

It is very interesting and useful trend in computer. Data mining is depends on effective data collection, warehousing and computer processing. Data miners are experts which use software to find pattern in large data set.

2.4 Intrusion Detection System (IDS)

MANET can utilize Data mining based Architecture. An intrusion is characterizes as the set of actions which expose the integrity confidentiality or in other words sterling confidentiality data and using emails for spam.

Detection is defines as a process of detecting or monitoring activities in network or computer.

Intrusion detection system with instrumentation of a computer network for data collection pattern-based software ‘sensors’ monitor the network traffic and raise, alarms’ when the traffic matches a saved pattern.

Types of IDS: Host based and network based.

2.4 Manet mining

It is capable strategy for getting information from data go beyond the limits of conventional insights, machine learning and data base querying to be applied in the field of MANET.

2.5 Joint Tactical Radio System

Joint Tactical Radio System (JTRS) was a family of software-defined radios (SDR) that were to work with many existing military and civilian radios. It included Wideband Networking Software to create mobile ad hoc networks (MANETs) and encryption.

2.6 Internet-based mobile ad-hoc networks(iMANET)

iMANETs are ad hoc network which connect mobile node and internet-gateway nodes which is fixed. In this type of network we cannot apply MANET routing protocols directly.

Example: Persistent System's CloudRelay.

2.7 CloudRelay

It works with persistent systems wave relay by allowing long range remote access to video, voice and data to and from all MANETs.

3. PROPOSED MODELLING

3.1 Wireless Routing Protocols

Table-Driven and On-Demand are Routing protocol of Mobile Ad hoc Networks where Table Driven protocols are proactive and maintain a routing table and Source initiated On-Demand are reactive and do not maintain a routing table.

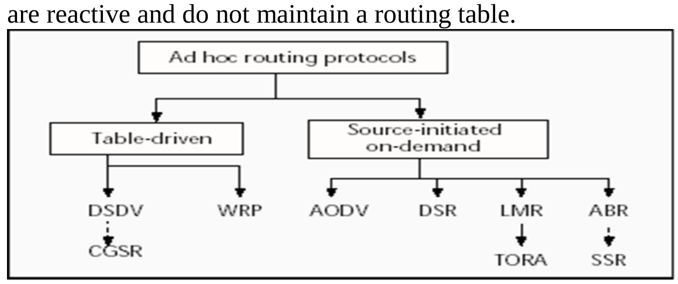

Figure2: Categorization of Ad hoc routing protocol

On the basis of Routing algorithms, Proactive routing protocols and Reactive Routing protocols are classification of routing protocols.

- Proactive Routing: Destination Sequence Distance Vector Routing (DSDV)
- Reactive Routing: Ad-hoc on-demand distance vector routing protocol (AODV), Dynamic source routing (DSR)

3.2 DSDV (Destination Sequenced Distance Vector)

The DSDV (Destination-Sequenced Distance- Vector) routing protocol is an algorithm that is based on routing tables and on the typical routing mechanism of Bellman-Ford. DSDV algorithm represents Table- Driven protocols because it maintains a loop-free, fewest-hop (resulting to the creation of fewer forwarded packets) path to every destination in the network.

Due to sequence number in routing table DSDV prevents loops in network, which gives the ability to the network to distinguish stale routes from new ones. So this protocol carries out low routing overhead and low packet delay. Routing information is exchanged when significant new information is available, for instance, when the neighborhood of a node changes. The main contribution of the algorithm was to solve the routing loop problem

Destination	Next Hop(Via)	Distance	Sequence number	Install Time

Figure3: Routing table in DSDV

3.2.1 Managing Routing of Packets and Routing Table

In DSDV, a directing or routing table is manage by each mobile node of a wireless network, which records every accessible destination, the metric and next hops to each destination and a sequence number created by the destination node. Directing table of every mobile node, the packets are transmitted between the nodes of a wireless Ad hoc network. Every node of the ad hoc network updates the directing table with advertisement recurrently or when important new data is available to manage the reliability of the routing table with constantly changing topology of the ad hoc network. When the network topology changes are detected, each mobile node advertises the routing information using broadcasting or multicasting a routing table to update a packet. The update packet begins with a metric of one to direct connected nodes. This shows that each receiving neighbor is one hop away from the node. It is not the same as 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 every nodes in the ad hoc network have received a duplicate of the update packet with a corresponding metric. The update data is also kept for a while to wait for the arrival of the best route for each particular destination node in each node before updating its routing table and retransmitting the update packet. If a node gets various update packets for a same destination during the waiting time period, the routes with latersequence numbers are constantly favored as the reason for packet forwarding decisions; however the routing data is not necessarily promoted immediately, if just the sequence numbers have been changed. If the update packets have a similar sequence number with the similar node, the update packet with the smallest metric will be utilized and the current route will be discarded or stored as a less preferable route. For this situation, the update packet will be propagated with the sequence numberto every single mobile nodes in the ad hoc network. The ads of routes that are going to change might be delayed until the best routes have been found. Deferring the ad 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. The components in the routing table of every mobile node continually change to keep consistency with dynamically changing topology of an ad hoc network. To achieve this consistency, the routing information notice must be successive or sufficiently speedy to guarantee that every mobile node can almost always locate all the other mobile nodes in the dynamic ad hoc network. Upon the updated routing information, every node needs to transfer data packet to different nodes upon request in the dynamically generated ad hoc network.

Example:

- At some the routing table is :

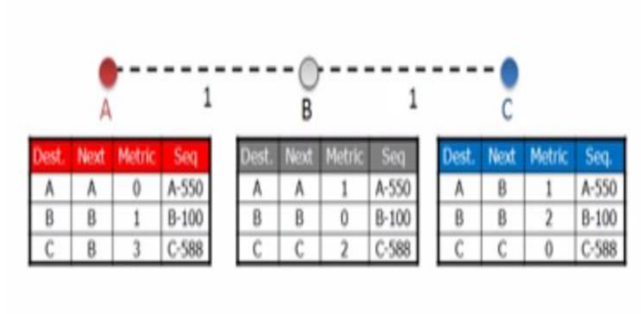

Figure3: Routing table of each node in network

- Now B broadcast its routing table to A and C then B increase its sequence number by 2 (B-100 to B-102). Updating of routing table of a node is done when :
- Sequence number of the incoming routing information >Sequence number of the routing table entry.
- Sequence number of the incoming routing information = Sequence number of the routing table entryand Value of metric that is the number of hop of the incoming routing information < Value of metric in the corresponding routing table entry.

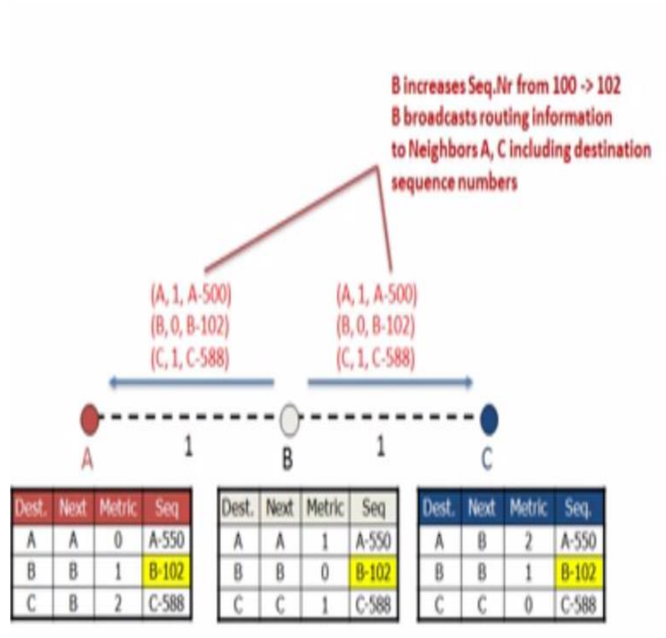

Figure4: Updating Routing table of each node in network

*3.2.2*Responding to Topology Change

Links can be rupture when the mobile nodes move from one place to another or has been shut down etc. The rupture link may be discovered by the communication hardware or be implied if no broadcasts have been received for a while from a previous neighbor. The metric of a rupture link is assigned to infinity. When a link to next hop has ruptured, any route through that next hop is instantly assigned infinity metric and an updated sequence number. Because link rupture qualifies as an important route change, the detecting node will instantly broadcast an update packet and open up the modified routes.

To describe the rupture links, any mobile node other than the destination node generates a sequence number, which is greater than the last sequence number received from the destination. This recently created sequence number and a metric of infinity will be packed in an update message and flushed over the network. To avoid conflicting sequence numbers, nodes and their neighbor nodes generating incompatible sequence numbers for themselves, and neighbors only generate odd sequence numbers for the nodes responding to the link changes.

Example:

- New node D is added to network, D broadcast for first time and send update packet to C, C insert entry for D with sequence number D-000 then immediately broadcast own table to B and B broadcast own table to A.

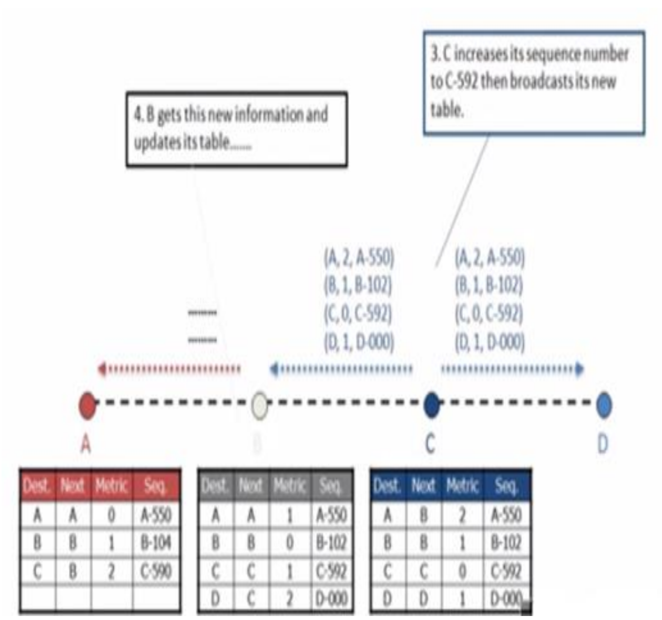

Figure5: Node D is added to network

- Now Node D is removes from network, C detects broken link and increase the sequence number of D. B does its broadcast to C but C knows that B has stale information because C has higher sequence number for destination D.

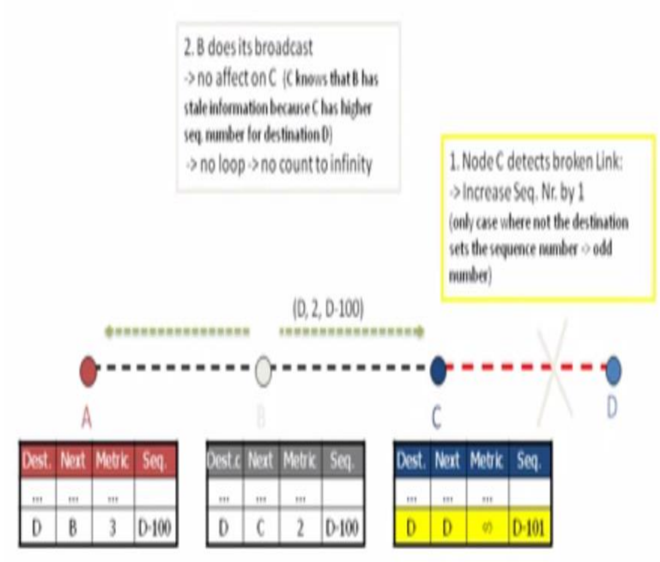

Figure6: Node D is removes from network

Advantages

- DSDV was one of the early algorithms available. When numbers of nodes are small in network then DSDV is suitable for that network.
- DSDV is enhanced version of DSR, so it removes count to infinity problem of DSR.
- Count to infinity is less.

Disadvantages

- DSDV uses up battery power and a small amount of bandwidth even when the network is idle to regularly update of its routing tables.
- Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not suitable for highly dynamic networks

3.3 AODV (Ad hoc On Demand Distance Vector)

AODV is one of the different protocols of on-demand or reactive protocol of MANET. Some important properties of DSR and DSDV are used to plot the AODV protocol. The route from a source node to a destination node is found only when a communication is needed between them. AODV protocol is also loop-free like DSDV. And it also does not face the count-to-infinity problem and this is attained by the using sequence numbers just like DSDV.

AODV is extension of DSR (Dynamic source routing).

3.3.1 Reactive routing

- Pure On-Demand route acquisition system

- The routes are created when needed, so called “On-Demand”.

3.3.2 A broadcast route discovery mechanism

- RREQ: This is the route request message which is transmitted by a node when it has to communicate with a particular destination and it does not have route information about that destination.

<source_addr, source_sequence#, broadcast_id, dest_addr, dest_sequence#, hop_cnt>

Figure7: RREQ packet

- RREP: This is the route reply message which is transmitted by a node that recently received an RREQ. RREP contains the route information about the destination which is mention in RREQ. And it is transmitted to the sender of the RREQ whenever if the node receiving RREQ has route information about the particular destination for which the RREQ was generated or if the node receiving RREQ is the destination itself.

<source_addr, dest_addr, dest_sequence#, hop_cnt, lifetime>

Figure8: RREP packet

- RERR: If a link break causes one or more destinations to become unreachable the RERR message is sent.

- RREP-ACK: RREP-ACK is used to acknowledge the received of RREP.

- Hello Message: Hello message is broadcasted periodically among the nodes in order to detect link break.

3.3.3 Dynamic Establishment of route table entries

AODV maintains the entire routes in the form of tables, where DSR does not use table for route information.

3.3.4Maintenance of timer based states

Any entry made in table timer also associated with that table, the timer will specify at what time the entry should be removed from the table.

3.3.5 Destination sequence number

Destination sequence number is consider like a timestamp, so at what time we have received this path information from the destination, sequence number is use to check whether coming information is stale or not. It also avoids routing loop.

Example:

- The network contains four nodes and objective is A wants to send data to E. Now A will send its RREQ packet to its entire neighbor.

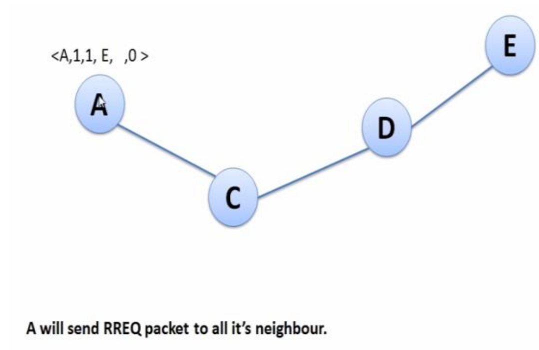

Figure9: AODV network

- A will send packet to C, C not having any information about E, so C will broadcast this packet to its entire neighbor, before broadcasting C will update hop count from 0 to 1.And C adds an entry for reverse path to source

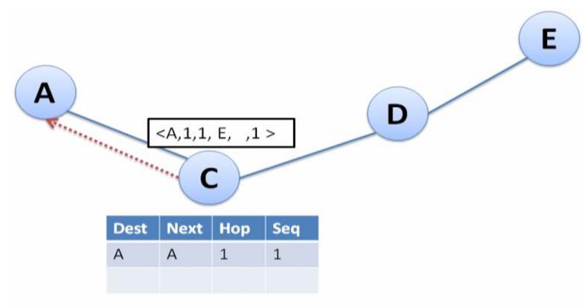

Figure10: A broadcast list

- Now C will send packet to D, D update its routing table and increase hop count from 1 to 2. Then D Will send packet to E, E update its routing table and increase hop count from 2 to 3. And Packet will reach destination and E will prepare RREP packet with destination sequence number.

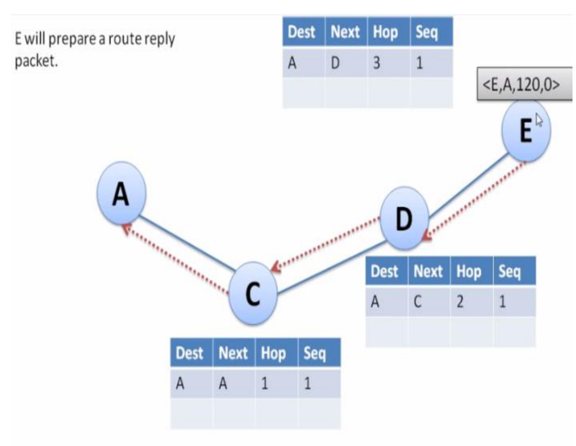

Figure11: E prepare RREP packet

- Now E will send RREP packet to D, D will create a entry for node E in routing table and D send this packet to C and so on till A. And our objective will complete A will send data to E by using routing tables.

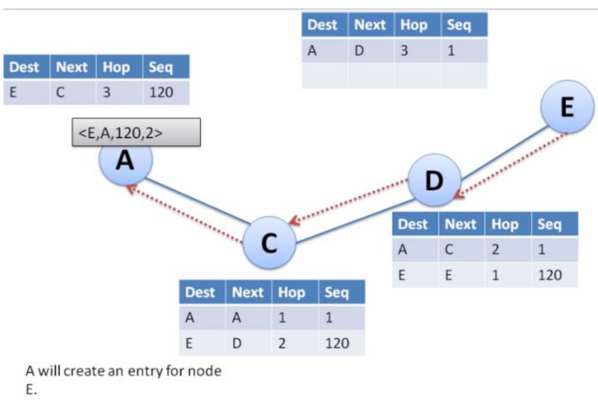

Figure12: Objective complete

Advantages

- The main advantage of this protocol is that routes are established on demand and destination sequence numbers are used to find the latest route to the destination.
- The connection setup delay is lower

Disadvantages

- Intermediate nodes can lead to inconsistent routes if the source sequence number is extremely old and the intermediate nodes have a higher but not the most recent destination sequence number, thereby having stale entries.
- Multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead.
- The periodic beaconing leads to unnecessary bandwidth consumption.

4. RESULTS AND DISCUSSIONS

In this paper we are doing performance comparison of two routing protocol one Table-Driven (proactive) that is Destination Sequenced Distance Vector (DSDV) and another On-demand that is Ad hoc On Demand Distance Vector routing protocol (AODV) based on different performance metrics.

4.1 Performance metrics

Packet Delivery Ratio: It is the ratio of the total amount data delivered to the destinations to those generated by the source. The performance is better when packet delivery ratio is high.

$$\text{Packet Delivery Ratio} = \frac{\text{Total Received Packets}}{\text{Total Sent Packets}} \times 100\%$$

Routing Overhead: It is number of routing packets transmitted per data packet delivered at the destination. The performance is better when routing overhead is low.

$$\text{Routing Overhead} = \frac{\text{Total Routing Signaling Packets}}{\text{Total Transmitted Packets}}$$

Throughput: The ratio of the total amount that reaches a receiver from a sender to the time it takes receiver to get the last packet is called throughput. It is measure packet per second or bits per second. Throughput is increase when connectivity is better. A high throughput network is desirable.

$$Throughput = \frac{Amount\ of\ Data\ Transfferd}{Total\ Simulation\ Time}(Kbps)$$

4.2 Packet Delivery Ratio

The packet delivery ratio is always above 90% for both protocols. When number of nodes are less than packet delivery fraction for both protocols are approximately same. As number of nodes is increasing packet delivery fraction of AODV and DSDV decreases. The packet delivery fraction for less in AODV whereas DSDV performs better than AODV. AODV must be preferred over DSDV for the Packet delivery ratio as it is out performed well due its ability to search for alternate routes when the current links breaks down.

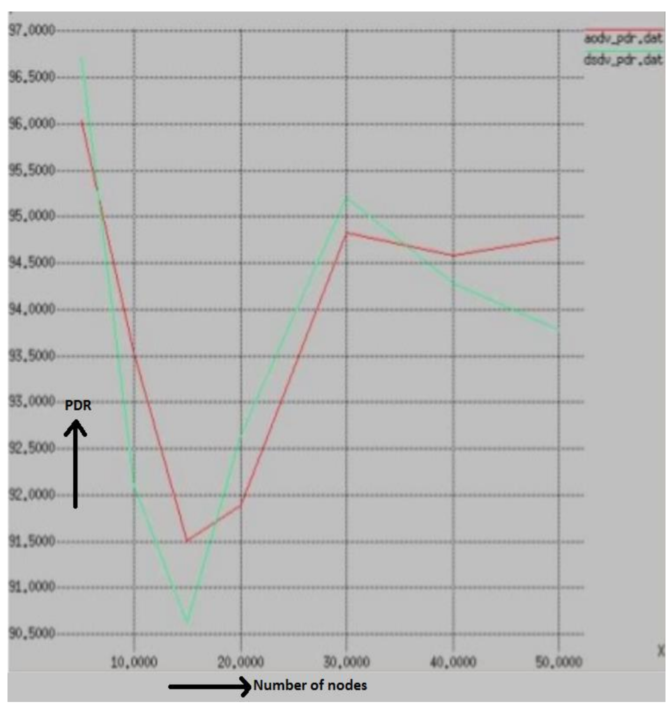

Figure13: Packet Delivery Ratio graph

4.3 Routing Overhead

The routing overhead is increasing when number of nodes in network is increasing for AODV. The routing overhead is less for DSDV. AODV finds multiple paths it requires more number of route discovery requests, hence it has more routing overhead. We can conclude that DSDV is better than AODV.

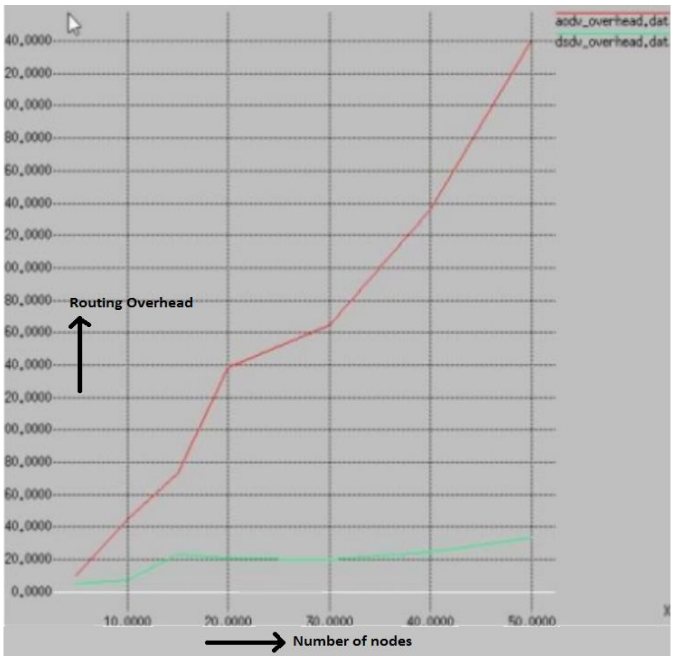

Figure14: Routing overhead graph

4.4 Throughput

When the number of nodes in network is high than DSDV has higher average throughput compared to AODV. From this we can conclude that DSDV connectivity is higher.

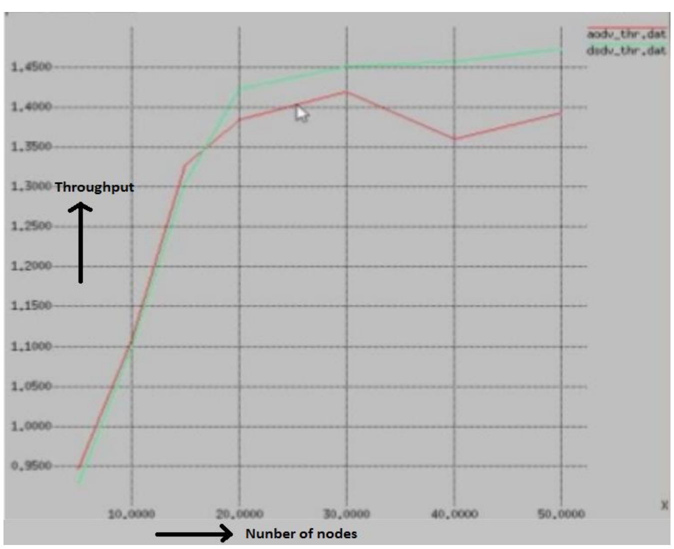

Figure15: Throughput graph

5 CONCLUSION

We have simulated and compared one reactive protocols AODV and one proactive protocol i.e. DSDV in different simulation scenarios and observing their performance in terms of four significant parameters i.e. Throughput, Packet delivery ratio and Routing Overhead in order to find out which one should be preferred when the mobile ad-hoc network has to be set up for the particular duration. We can check protocols performance at different number of nodes. The parameters Throughput, Packet delivery ratio, End-to-End delay and Routing Overhead can understand with the help of generated Graphs. By studying and analyzing the outputs appeared in Graphs we come to this conclusion that:

AODV must be preferred over DSDV for the Packet delivery ratio as it is out performed well due its ability to search for alternate routes when the current links breaks down.

In terms of Throughput all the two protocols have almost the same performance for different number of nodes but if the nodes are increased throughput of DSDV is increasing compare to AODV.

In terms of Routing Overhead DSDV must be preferred over AODV. We can grade that DSDV performs better than AODV routing protocol in the aspect of routing overhead.

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