Comparison and Analysis between Reactive Routing Protocols in MANET using Opnet17.5v

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Abstract- In the modern era, use of mobile wireless devices is increasing enormously which leads probers to frequently work over the new improvements in mobile ad hoc network i.e. MANET and routing protocols in MANET. The main aim behind this project is to compare the existing Reactive MANET routing protocols by using Opnet17.5 software. The focus of this paper is on reactive routing protocols (AODV and DSR) under the scenarios using file transfer protocol (ftp).In MANET, it is not an easy task to predict the performance of routing protocol. During this research, we analyzed the performance of reactive MANET routing protocols ,for example: Ad-hoc on demand distance vector routing (AODV) and Dynamic source routing (DSR) on the basis of different parameters such as delay, throughput, number of hops per route, routing traffic send and received.

Keywords – MANET, AODV, Delay, DSR, No. of hops per rote, route traffic received, route traffic send.

I. INTRODUCTION TO MANET

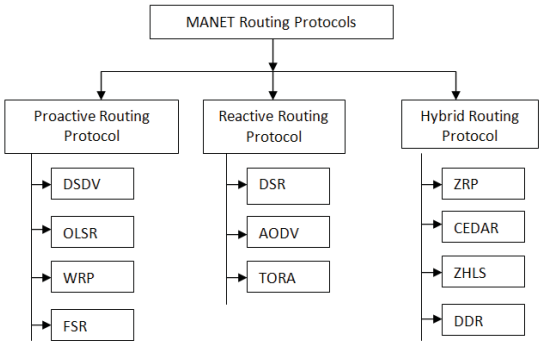
MANET stands for Mobile Ad hoc Network .The concept of MANET is nothing but the group of wireless mobile nodes without using any cables, infrastructures, architecture. Every mobile node in this network acts as peer or routing which does both the tasks- packets sending (forwarding) and packets receiving. MANET does not require centralized administration or fixed network infrastructure such as base stations or access points. Network topology may vary rapidly and unpredictably over time, because the nodes are mobile. A MANET consists of mobile nodes, a router with multiple hosts and wireless communication devices.

II. CLASSIFICATION OF MANET ROUTING PROTOCOLS

Routing protocols in MANETs are basically categorized, based on their routing approaches, into proactive, reactive and hybrid protocols.

1. *Proactive Routing Protocols*- This type of protocols maintains fresh lists of destinations and their routes by periodically distributing routing tables throughout the network. The main drawbacks of such algorithms include respective amount of data for maintenance, and slow reaction on reconstructing and failures.
   For Example: Destination-Sequenced Distance Vector (DSDV) Routing Protocol
2. *Reactive Routing Protocols*- This type of protocol finds a route on demand by flooding the network with route request packets. The main drawbacks of such algorithms are high latency time in route finding and network clogging due to excessive flooding.
   For Example: Dynamic Source Routing (DSR) protocol and Ad hoc On Demand Distance Vector (AODV) routing protocol.

3. *Hybrid Routing Protocols*- This type of protocols combines the advantages of proactive and reactive routing. The routing is initially established with some proactively prospected routes and then serves the demand additionally activated nodes through reactive flooding. The advantage depends on the amount of nodes activated and reaction to traffic on gradient of traffic volume.
For Example: Zone Routing Protocol



III. REACTIVE MANET ROUTING PROTOCOL

Reactive routing protocols are intended to maintain routing information about 'active' routes only. Routes are created when desired by the source node hence the protocols are known as on demand routing protocol. That means that there is no unnecessary routing information maintained. The route calculation process is divided to a route discovery and a route maintenance phase. The route discovery process is initiated when a source needs a route to a destination. The route maintenance process deletes failed routes and re-initiates route discovery in the case of topology change.
For example-DSR and AODV

3.1 Route discovery-

In this phase source node initiates route discovery on demand basis. Source nodes consults its route cache for the available route from source to destination otherwise if the route is not present it initiates route discovery. The source node, in the packet, includes the destination address of the node as well address of the intermediate nodes to the destination.

3.2 Route maintenance-

Due to dynamic topology of the network cases of the route failure between the nodes arises due to link breakage etc, so route maintenance is done. The route maintenance uses two kind of messages i.e. route error (RERR) and acknowledgement (ACK). The messages successfully received by the destination nodes send an acknowledgement ACK to the sender. Such as the packets transmitted successfully to the next neighbors nodes gets acknowledgement. If there is some problem in the communication network a route error message denoted by RERR is transmitted to the sender, that there is some problem in the transmission. In other words the source didn't get the ACK packet due to some problem. So the source gets the RERR packet in order to re initiate a new route discovery.

IV. DYNAMIC SOURCE ROUTING PROTOCOL (DSR)

DSR is also a reactive routing protocol. It uses the concept of source routing. In source routing the sender knows all hops by- hop routes to the destination. All the routes are stored in the route cache. When a node attempts to send a data packet to a destination it does not know the route. In DSR each node maintains a route cache with route entries which are continuously updated. It is used to updates its route caches by finding new routes. DSR has also the capability to handle unidirectional links. If any link of a source route is detected (detected by the MAC layer of the transmitting node) to be broken, the Dynamic Source Routing protocol uses two types of packets called Route Error packet and Acknowledgements to maintain the error. A node generates a Route Error packet if it encounters a fatal transmission problem at its data link layer. The route error is unicasted back to the source using the part of the route traversed so far, erasing all entries of the link in error from the route caches along the way. The correct operations of the links are verified by acknowledgement packets. AODV performs three operations: (1) route discovery and (2) route maintenance (3) Route Caching.

V. AD-HOC ON DEMAND DISTANCE VECTOR (AODV)

AODV is reactive routing protocol. In this route is discovered or maintain according to node request. For loop freedom and freshness of route, AODV uses destination sequence number. It is capable for both unicast and

multicast routing. Mobile nodes respond to the any change in network topology and link failures in necessary times. In case of the link failures the respective defective nodes are notified with the message, and then the affected nodes will revoke the routes using the lost link. AODV uses the message types Route Request (RREQ), Route Replies (RREP) and Route Error (RERR) in finding the route from source to destination. AODV performs two operations: (1) route discovery and (2) route maintenance.

Advantages-

1. Maintenance of the discovered /established route is necessary for two main advantages:
   (i) Achieve stability in the network.
   (ii) To reduce the excessive overhead required in discovering new route.
2. Because of its reactive nature, AODV can handle highly dynamic behavior of Vehicle Ad-hoc networks.
3. Used for both unicasts and multicasts using the 'J' (Join multicast group) flag in the packets.
4. In case of AODV packets carry the destination address this implies that AODV has a relatively less overhead than DSR.

Disadvantages-

1. Overhead on bandwidth will be occurred compared to DSR, when an RREQ travels from node to node in the process of discovering the route info on demand, it sets up the reverse path in itself with the addresses of all the nodes through which it is passing and it carries all this info all its way.
2. AODV is adaptable in very dynamic networks, but there may be large delay during route construction and while initiating another route discovery.
3. AODV lacks support for high throughput routing metrics: AODV is designed to support the shortest hop count metric. This metric favors long, low bandwidth links over short, high-bandwidth links.

VI. COMPARISON BETWEEN DSR AND AODV

1. Throughput in case of AODV is better or higher than that of DSR.
2. In AODV, Number of Hops per route is less than from DSR.
3. DSR is better in case of delay performance means delay is less in DSR, in AODV delay is higher.
4. In AODV Table driven routing with destination sequence numbers and DSR source routing is there.
5. Amount of routing information in case of DSR is greater than AODV.
6. DSR replies to all requests reaching a destination from a single request cycle.
7. In AODV, on the other hand, the destination replies only ones to the request arriving first and ignores the rest.
8. Used for unicast and multicast in AODV, but in DSR only Unicast.

VII. PERFORMANCE PARAMETER

7.1 Throughput-

Throughput is defined as the average rate of successful message delivery in a network. We can also say that it is the ratio of the total data reaches a receiver from the sender. The time it takes by the receiver to receive the last message is called as throughput. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec). Some factors affect the throughput as; if there are many topology changes in the network, unreliable communication between nodes, limited bandwidth available and limited energy. A high throughput is absolute choice in every network. Throughput can be represented mathematically as in equation:

$$\text{Throughput} = \frac{\text{number of delivered packet x packet size}}{\text{Total duration of simulation}}$$

7.2 Delay-

Since nodes in ad hoc networks have limited range of transmission, therefore they are multi hop networks. This implies establishing a route before forwarding the packets. This is one of the major reasons for delay in the network .End to end delay accounts for all the delays along the route from source node to the destination node .This includes transmission delay, prorogation delay and queuing delay experience at every node on the active path in the network.Mathematically,it can be expressed as:

$$D_{\text{end to end}} = N\,(D_{\text{trans}} + D_{\text{prop}} + D_{\text{proc}} + D_{\text{queuing}})$$

Where $D_{\text{end to end}}$ end to end delay, D_{trans} is transmission delay, D_{prop} is propagation delay, D_{proc} is processing delay and $D_{\text{queuing}}$is queuing delay.

7.3 Numbers of hops per route-

This statistic represents the number of hops in each route to every destination in the route cache of all nodes in the network. A major limitation of the nodes in ad hoc network is that they are batter limited and have short transmission ranges. As a result, for reaching a destination which has no direct link to source requires intermediate nodes to build a path for transmission of packets. As a result ad hoc network is a multi hop network that is they involve multiple hops from one node to another to forward a packet from source to destination. The measure of hop count illustrates how many hops would a protocol require for given node density in the network to transmit the packet .An optimal protocol would minimize the hop count.

VIII. ANALYZING RESULT

8.1 Simulation of first scenario (DSR_20nodes)-

Here in the first scenario we used 20 mobile stations, application configuration, profile configuration and Wlan server. The network size is of 5X5 km.

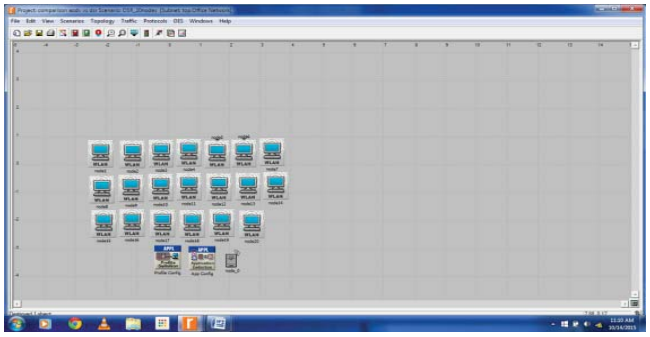


Figure 8.1 DSR_scenario_20 nodes

Table 1: Network parameter of DSR

Statistics	Value
Simulator	Opnet 17.5
Routing protocol	DSR
802.11 data rate	5.5Mbps
Scenario size	5x5 km
Application	FTP
Simulation time	600sec
Channel type	Wireless channel
Physical characteristics	Direct spread sequence
Performance parameter	Throughput, delay, No. of hops per route,

8.2 DSR Performance-

The first scenario is stimulated and it gives the required results as shown below in figure2 .In this 20 mobile nodes were stimulated. The Dynamic source routing protocol was checked by the four parameter such as routing traffic received, routing traffic sent, delay and throughput.

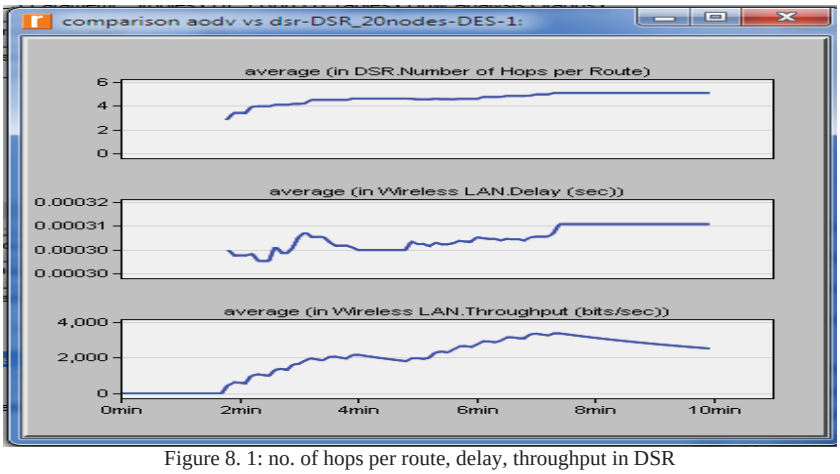


Figure 8. 1: no. of hops per route, delay, throughput in DSR

8.3 Simulation of Second scenario (AODV_20nodes)-

Here in the first scenario we used 20 mobile stations and Wlan server .The network size is of 5X5 km.

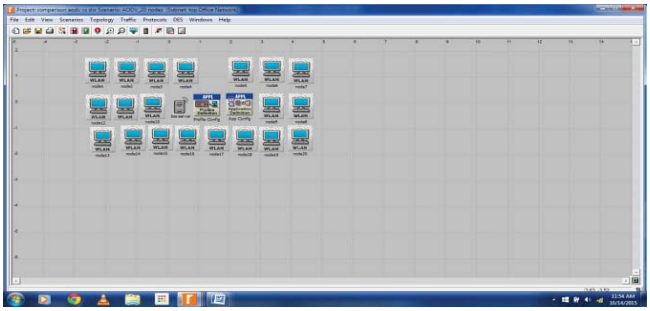


Figure 8.2: AODV_scenario_20nodes

Table 2 Network parameters in AODV

Statistics	Value
Simulator	Opnet 17.5
Routing protocol	DSR
802.11 data rate	5.5Mbps
Scenario size	5x5 km
Application	FTP
Simulation time	600sec
Channel type	Wireless channel
Physical characteristics	Direct spread sequence
Performance parameter	Throughput, delay, No. of hops per route,

8.4 AODV Performance-

The second scenario is stimulated and it gives the required results as shown in figure 4 .In this 20 mobile nodes were stimulated. The Ad hoc on demand vector protocol was checked by the three parameter such as No. of hopes per route, delay and throughput.

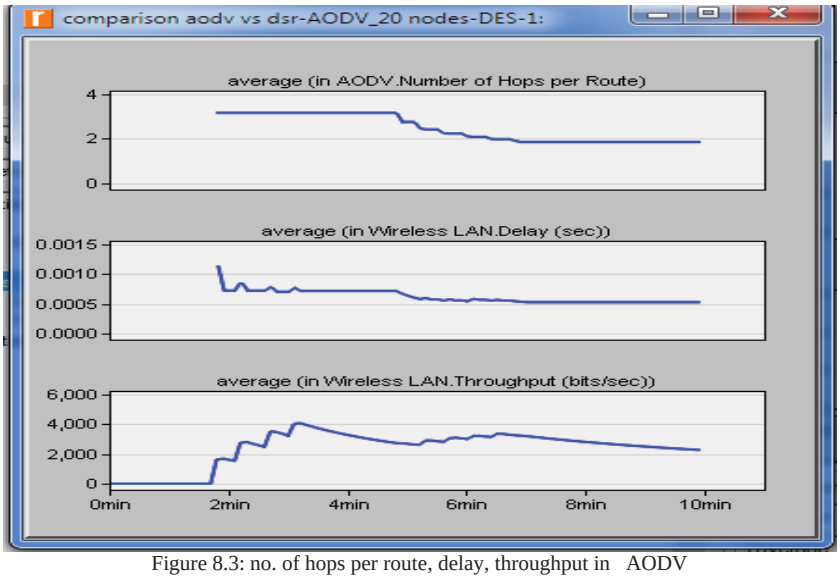


Figure 8.3: no. of hops per route, delay, throughput in AODV

8.5 Comparison between AODV and DSR

This section focuses on comparing the two protocols AODV and DSR on the basis of delay, throughput, routing traffic received and routing traffic sent. The idea is to identify which routing protocol is the best one for mobile ad hoc networks. The first discussion will be on delay, the second will be on throughput, then on number of hops per route .The results show difference in performance between these two routing protocols.

8.5.1 Delay-

The delays of two scenarios is shown in figure 5 in which AODV and DSR routing protocol are used respectively

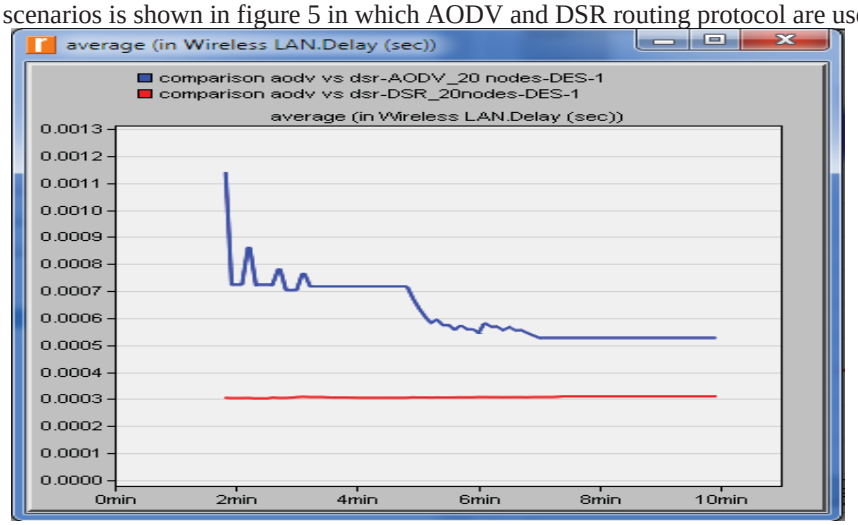


Figure8.4.1: Comparison of delay in DSR and AODV

8.5.2 Throughput-

Throughput of the two scenarios is shown in figure 6.It is observed that:

- Throughput is defined as the average successful data received from the sender .It is the ratio of number of data packets transmitted to the time required for transmission.
- Peak value of throughput for AODV is 4,061.0909 bps at 3min and for DSR is 3,318.596491 bps at 7 min.
- Thus we conclude that throughput of AODV is better than throughput of DSR.

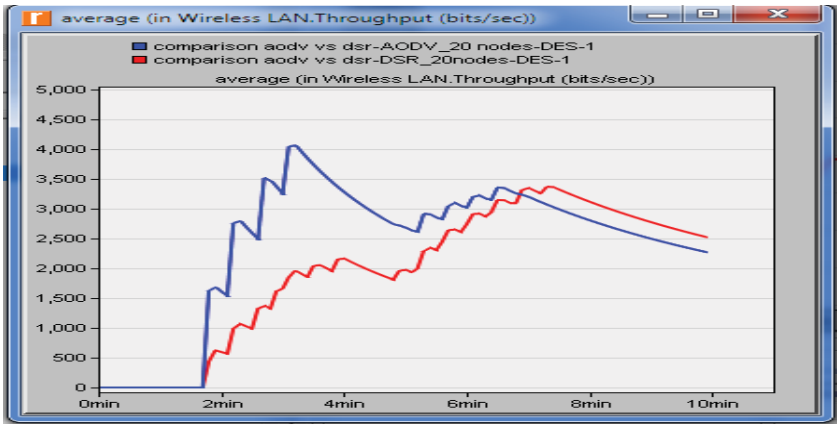


Figure 8.5.2 Comparison of Throughput in AODV

8.5.3 Number of hops per route-

The number of hops per route means that to transfer the packet from source to destination in MANET we require multiple hops per route to build the path. As shown in fig 7.It is observed that:

- Number of hops per route in AODV is less than DSR.As the hop count will be less in AODV than DSR
- Thus ,we conclude that AODV is better than the DSR

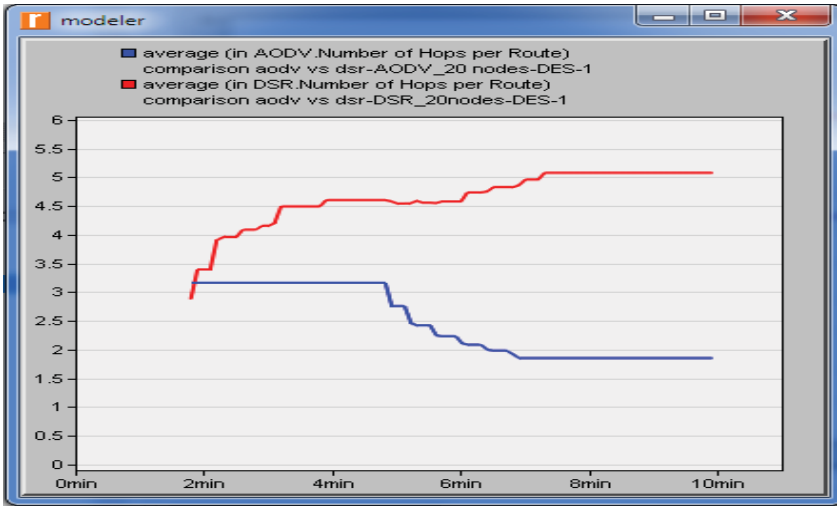


Figure 8.5.3: Comparison of no. of hops per count

8.6 Summary of results-

To compare the performance of two protocols under the study that is AODV and DSR, the following tables have been constructed for different performance parameters. The values listed are peak value and value at the end of simulation interval.

Table 3 Performance parameters

PARAMETERS	VALUES	DSR	AODV
Throughput (bits/sec)	**Peak**	**3,362.8444**	**4,061.0909**
	At end of simulation	**2,522.1333**	**2,269.9733**
Delay (sec)	**Peak**	**0.00030865**	**0.001141**
	At end of simulation	**0.00031036**	**0.000527**

No. of hops per route	**Peak**	**5.079773**	**3.166667**
	At end of simulation	**5.079773**	**1.854656**

IX. CONCLUSION

This is concluded that several authors tried to get result about which protocol among AODV and DSR is better but they find difficult and provide each protocol's different features w.r.t different parameters. We found that delay in AODV is less as compared to DSR but throughput of AODV is more than DSR.Also in addition routing traffic received and routing traffic send of AODV is more than DSR.At the end we can say that DSR is better in small networks as its delay is very less as compared to AODV.But in the case of large networks mobile node increases which result to the congestion so, we avoid using DSR.

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