QoS Issues in MANET: A Comparative Study over Different Routing Protocols

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Abstract – MANETs are composed of autonomous nodes that are self-managed without any existing of infrastructure and centralized administration. Therefore, each node operates not only as an end system but also as a router to forward packets for other nodes. For these reasons, the network has a dynamic topology, so nodes can easily join or leave the network at any time. Routing information differentiates these networks from other ad-hoc networks. The study of QoS issues in Mobile Ad-hoc Network is done by simulation in MATLAB that can help in better understanding of the behavior of various routing protocols. This paper is intended to compare QoS parameters of various routing protocols.

Keywords- *QOS, MANET, MATLAB, DSR, OLSR, AODV*

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I. INTRODUCTION

Wireless Communication is one of the emerging technology, which allows users to access information and services electronically, despite their geographical position. Wireless communication can be classified as infrastructure network and infrastructure less network.

Mobile Ad hoc network is a special kind of infrastructure less network. It is a collection of mobile nodes that move randomly and dynamically. [1]

Due to the mobile nature of the nodes, the network topology keeps on changing. Each node acts as a host and a router, forwarding and receiving packets from the other nodes in the network, that may not be in the transmission range of the network. The nodes in MANETs discover other nodes dynamically. Routing in such networks is a challenging task due to the highly dynamic network topology. The aim of deploying these networks is to provide communication in areas where limited or no connectivity or any communication infrastructure exists. These networks are flexible and can be employed in military rescue operations, interactive lectures, business sharing information and emergency situations. [3]

Fig.1. Mobile Ad hoc Network

The field of wireless communication is becoming more popular than ever before due to the rapid advancement of wireless technologies and the widespread of mobile devices. After a natural disaster, such as a fire, flood, or earthquake, Mobile Ad hoc Networks (MANET) are among the limited available options for wireless networks, since such a network can be easily configured in a short period of time, without the need for a fixed infrastructure network. [2]

The objective of the work is to compare theperformance of routing protocols namely OLSR, DSR, and AODV against the Quality of Service (QoS) parameters.

II. AD HOC NETWORK

An Ad-hoc network is a decentralized type of Network. Decentralized means it doesn't rely on pre-existing infrastructure, each and every node in the network participate in forwarding data for other nodes. Each node in a mobile Ad-hoc network is free to move independently and therefore will change its links to other devices frequently.

Ad hoc is Latin word which means "for this" [15]

The wireless hosts in an ad-hoc network communicate with each other without the exiting of a fixed infrastructure and without a central control. Setting up of fixed access points and backbone infrastructure is not always viable as infrastructure may not be practical short radio (Bluetooth range ~10m). Also, there may be lack of infrastructure in the war zone. It is self-organizing and adaptive therefore allows spontaneous formation and deformation of a mobile network. Supports peer-to-peer communication, Supports pear-to-remote communication, useful when infrastructure is absent, destroyed or impractical.

III. QUALITY OF SERVICE (QOS)

Quality of Service which means the degree of user satisfaction is characterized by a number of important parameters like bandwidth, throughput, availability, delay, jitter, packet delivery ratio, end to end delay and packet drop. It is especially important to provide QoS because of the resource limitations and dynamic nature of MANET networks. A QoS enabled network ensures that its applications and users have their parameters fulfilled, besides also ensuring an efficient resource usage, also the most important traffic still has its parameters fulfilled during network overload. [7]

IV. ROUTING PROTOCOLS IN MANET

An ad-hoc routing protocol is a standard through which nodes decide which way to route packets between source and destination. Nodes in the ad-hoc network are not familiar with the topology of the network. They have to discover it. Each node must announce its presence and must listen to announcements made by other nodes through broadcasting.There are many ways to classify the MANET routing protocols. Depends on how the protocols handle the packet to deliver from source to destination, most of the protocol classifications are made -

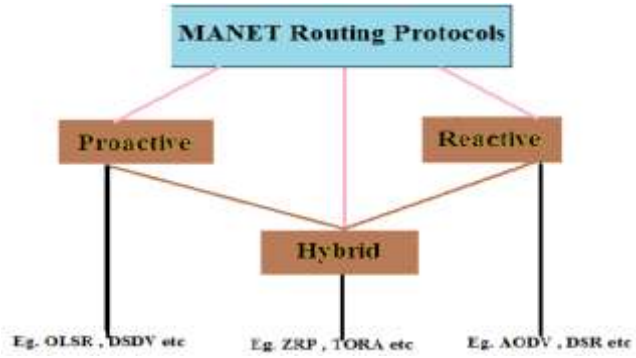

Fig.2. Routing Protocols in MANET

The routing protocol is a standard or set of rules through which nodes decide which way to route packets between source and destination. Routers are used for selecting the best possible route for sending packets from source to destination.

The routing protocols in a MANET may be proactive, reactive or hybrid depending on how the protocols handle the packet to deliver from source to destination.

A proactive protocol is also known as a table driven protocol, it is consistent and up to date routing information to all nodes is maintained at each node and maintains fresh lists of destinations and their routes by periodically distributing routing tables throughout the network. eg DSDV, OLSR etc. [4]

A reactive protocol is also known as the on-demand routing protocol, it looks for the routes and is created as and when required. When a source wants to send to a destination, it invokes the route discovery mechanisms to find the path to the destination. It does not need to search for and maintain the routes on which there is no route request. Reactive routing protocols are very pleasing in the resource-limited environment. However, the source node should wait until a route to the destination is discovered. This approach is the best suitable when the network is static and traffic is very light. eg, DSR, AODV etc. [5]

A hybrid protocol is generated by using the best features of both the on-demand and table driven routing protocols. The Ad Hoc network can use the hybrid routing protocols that have the advantage of both proactive and reactive routing protocols to balance the delay and control overhead is the combination of proactive and reactive protocols and have the characteristics of both eg, ZRP, TORA etc. [6]

The current paper intends to evaluate the three routing protocols AODV, OLSR and DSR while considering many performance parameters (throughput, packet drop, delay, packet delivery ratio, etc.)

DSR (Dynamic Source Routing)

It is a reactive protocol i.e. it doesn't use periodic advertisements. It computes the routes when necessary and then maintains them. Source routing is a routing technique inwhich the sender of a packet determines the complete sequence of nodes through which the packet has to pass ; the sender explicitly lists this route in the packet's header, identifying each forwarding "hop" by the address of the nextnode to which to transmit the packet on its way to the destination host. There are two significant stages in working of DSR: Route Discovery and Route Maintenance. A host initiating a route discovery broadcasts a route request packetwhich may be received by those hosts within wireless transmission range of it. The route request packet identifies the host, referred to as the target of the route discovery, for which the route is requested. If the route discovery is successful the initiating host receives a route reply packet listing a sequence of network hops through which it may reach the target. In addition to the address of the original initiator of the request and the target of the request, each route request packet contains a route record, in which is accumulated a record of the sequence of hops taken by the route request packet as it is propagated through the network during thisroute discovery. DSR uses no periodic routing advertisement messages, thereby reducing network bandwidth overhead, particularly during periods when little or no significant hostmovement is taking place. DSR has a unique advantage by virtue of source routing. As the route is part of the packetitself, routing loops, either short-lived or long-lived, cannot be formed as they can be immediately detected and eliminated. [9]

AODV(Ad Hoc On-demand Distance-Vector Protocol)

This is a protocol which comes under the category of a reactive unicast routing protocol. It is a descendant of Destination Sequenced Distance Vector Protocol (DSDV). [16]

AODV offers low network utilization and uses destination sequence number to ensure loop freedom. It is a reactive protocol implying that it requests a route when needed and itdoes not maintain routes for those nodes that do not actively participate in a communication. An important feature of AODV is that it uses a destination sequence number, whichcorresponds to a destination node that was requested by a routing sender node. The destination itself provides the number along with the route it has to take to reach from therequest sender node up to the destination. If there are multiple routes from a request sender to a destination, the sender takes the route with a higher sequence number. This ensures that thead hoc network protocol remains loop-free. [10]

Optimized Link State Routing Protocol (OLSR)

This protocol works in collaboration with other nodes through the exchange of topology information. This exchange of information is done periodically. To avoid the broadcast of unnecessary packet re-transmissions, this protocol uses multipoint relays. In a network, a node broadcasts a message periodically to its neighboring nodes. This is done to compute the multipoint relay set as well as the exchange of information about the neighborhoods. From the information about the neighborhood, this node calculates the minimum set of one-hop relay point that is needed to reach the two hop neighbors and this set is called the Multipoint relay set. OLSR differsfrom link state protocols in two factors based on the dissemination of routing information. First is by construction i.e. only the multipoint relay nodes of a node A need to forward updates about link state that are issued by A.Secondly, the size of the link state update of a node A is reduced because it only consists of those neighbors that selected node A as their multipoint relay node. Thus we can conclude that OLSR reduces the Link state protocol. It is used in a network where nodes are densely deployed; the OLSR calculates the shortest path in such networks to an arbitrarydestination. [11]

V. QOS PARAMETERS

1. Packet Delivery Ratio

It can be defined as the total number of packets delivered to the destination nodes per the total number of packets transmitted from sender nodes. It illustrates the level of delivery to the destination nodes. [8]

$$\text{PDR} = \frac{\textbf{total no of packets delivered}}{\textbf{total no of packets sent}}$$

The DSR is performing better in packet delivery and speed than the other two. [12]

The higher the value, better are the results.

2. Packet Drop

It is the ratio of the-the no of dropped packets to the no of sent packets.

$$\boldsymbol{PD = \frac{total\ no\ of\ droped\ packets}{total\ no\ of\ sent\ packets}\ X\ 100}$$

Lower the packet drop rate, better the performance. [13]

3. Throughput

It is defined as the-the total simulation time taken to deliver all the packets

$$\boldsymbol{TP = \frac{Total\ number\ of\ delivered\ packets}{total\ simulation\ time}}$$

AODV and OLSR experienced higher throughput compared to DSR and it shows that the OLSR protocol performs better than the other two. The reason could be that the OLSR maintains the cluster of nodes in the topology by dividing them into different node sets. Dividing the sets into one hop and two-hop neighbors make OLSR more efficient in link process without having all nodes taking part in this.[14]

4. End-to-End Delay

It is defined as the time taken for a datapacket to be transmitted across a MANET from source to destination.

D = (Tr-Ts)

Where Tr is receiving Time and Ts is sent Time. Average end to end delay is defined as

$$\boldsymbol{AD = \frac{total\ end\ to\ end\ delay}{total\ no\ of\ packets} = \frac{[\sum_{i=0}^{n} D(i)]}{n}}$$

Where D(i) = end to end delay of i^{th}packet

AODV and OLSR have lower delay compared to DSR.OLSR has even lower delay than AODV. For AODV this is due to, frequent broadcasting of RREQ and route re-initialization messages to find an optimal freshet path. End-to-End delay of DSR is very high, this was due to DSR algorithm that uses cached routes, sending of traffic onto stale routes, causes retransmissions and leads to excessive delays. .Lower the delay, better the performance.

VI. CONCLUSION

In this paper, we discussed the comparative study of AODV, OLSR and DSR protocols for different QoS parameters packet delivery ratio, end to end delay, packet drop, throughput etc.

AODV and OLSR have lower delay compared to DSR. OLSR has even lower delay than AODV. Lower the delay, better the performance.

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AODV and OLSR experienced higher throughput compared to DSR and it shows that the OLSR protocol performs better than the other two.

In future, we shall analyze the performance of OLSR, DSR and AODV protocols by their simulation in MATLAB.We shall discuss Simulation of these QoS parameters and their results with the help of graphs.

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