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COMPARATIVE ANALYSIS OF ROUTING PROTOCOLS BASED ON SOME QoS FACTORS IN WIRELESS ADHOC NETWORKS

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ABSTRACT

In the last few years we have be observed a tremoundously increasing popularity of wireless networks because of its various advantages over wired netwok. And mobile adhoc networks ,one of the wireless networks has become research interest.A mobile ad hoc network consists of mobile self configuring wireless nodes and there is no centralized management for communication between these nodes. The dynamic characteristics of MANET demands better connectivity and guaranteed QoS.There are various factors that affect quality of service of network. It is an issue for mobile ad hoc networks to provide effective QoS. In this paper we have compared various routing protocols on some QoS factors.

***Keywords:** AODV, DSR, MANET, OLSR, QOS, ZRP*

I. INTRODUCTION

1.1 Mobile Ad-Hoc Network

A mobile ad-hoc network (MANET) is non-centralized infrastructure less collection of peer nodes, which discover their route themselves for communication. MANET is a self-creating, self-organizing and self-administrative network.

Ad hoc wireless networks (AWNs) are zero configuration, self-organizing, and highly dynamic networks formed by a set of mobile hosts connected through wireless links. These networks can be formed on the fly, without requiring any fixed infrastructure. As these are infrastructure less networks, each node should act also as a router. [1]

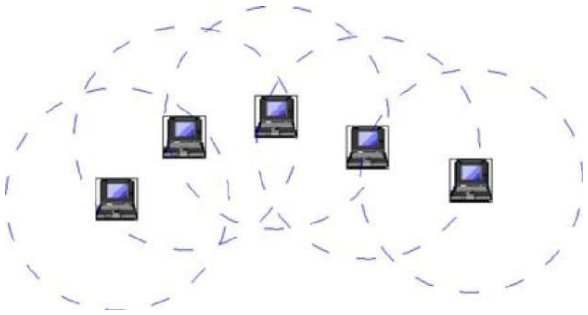

Fig-1 ad hoc network

1.2 Infrastructure Network

n Infrastructure wireless network, the nodes search for its nearest base station within their communication range and they communicate with other nodes via their base station . Nodes in infrastructure network are also mobile as like the nodes of ad hoc network but there is no direct communication between them.

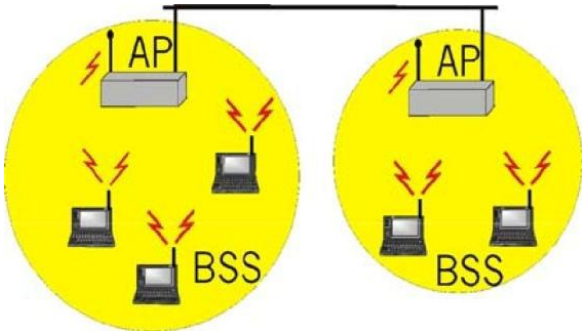

Fig-2 Infrastructure network

1.3 Quality of Service (QoS)

QoS has defined as a set of service requirements that needs to be meet by the network while transporting a packet stream from a source to its destination. The network has expected to guarantee a set of measurable pre-specified service attributes to the users in terms of end-to-end performance, such as time, bandwidth requirement, throughput, probability of packet loss, the variation in latency (jitter), Route acquisition Delay, Communication Overhead, Scalability etc. It is the capability to control the traffic mechanism so that network provides the services to the users.[8] Quality of service for a network is measured in terms of guaranteed amount of data which a network transfers from one place to another in a given time slot. The size of the ad-hoc network is directly related to the quality of service (QoS) of the network. If the size of the mobile ad-hoc network is large, it might make the problem of network control extremely difficult. Quality of service (QoS) is the performance level of a service offered by the network to the user. The goal of QoS provisioning is to achieve a more deterministic network behavior, so that information carried by the network can be delivered better and network resources can be utilized better.

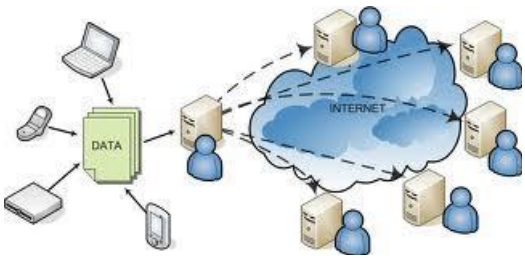

Fig-3 Quality of Service

1.3.1 QoS parameters in MANETs

As different applications have different requirements, the services required by them and the associated QoS parameters differ from application to application.

For example, in case of multimedia applications time, bandwidth requirement, power requirement, probability of packet loss, the variation in latency (jitter), Route acquisition Delay, Communication Overhead, Scalability are the key QoS parameters, whereas military applications have strict security requirements.

For applications such as emergency search and rescue operations, availability of network is the key QoS parameter.

In WSNs the QoS requirements are more influenced by the resource constraints of the nodes. Some of the resource constraints are battery charge, processing power, and buffer space.

Time complexity is defined as the largest time that can elapse between the moment T1 when the last topology change occurs and the moment T2 at which all the routers have final shortest path and distance to all other routers.

Delay is the time elapsed from the departure of a data packet from the source node to the arrival at the destination node, including queuing delay, switching delay, propagation delay, etc.

Jitter is generally referred as variations in delay, despite many other definitions. It is often caused by the difference in queuing delays experienced by consecutive packets.

Scalability is the ability of a computer application or product (hardware or software) to continue to function well when it (or its context) is changed in size or volume in order to meet a user need.

Packet loss rate is the percentage of data packets that are lost during the process of transmission.

Routing is an essential component of communication protocols in mobile ad hoc networks. The design of the protocols are driven by specific goals and requirements based on respective assumptions about the network properties or application area. Therefore, it is extremely important that these networks should be able to provide efficient quality of service (QoS) that can meet the vendor requirements. To provide efficient QoS in mobile ad-hoc networks, there is a strict need to establish new architectures and services for routine network controls. QoS support is essential for supporting time critical traffic sessions.

II. CHALLENGES IN MOBILE AD HOC NETWORK

There are various issues in ad hoc networks that make them very complicated to integrate with the existing global internet. Some of the problems discussed below:

2.1 Routing

Routing is one of the most complicated problems to solve as ad hoc networks have a seamless connectivity to other device in its neighborhood. No default route is available because of multi hop routing. Each node in the network acts as routers and transmits the data packet to its neighbor in the route to share the information between mobile nodes.

2.2 Security

The security of MANET is depends on its nodes. The wireless network is more vulnerable than the wired network. If we want to transmit the data over wireless channel then there is a possibility to lose or modify the information by any malicious node in the network. The attacker can modify the traffic and it may tries to be the

node of that network so that it can get the required information .so it is very important to solve various security issue to make the ad hoc network into a good solution

2.3 Quality of service

Quality of service (QoS) is the performance level of a service offered by the network to the user. Because of mobility of nodes in ad hoc wireless network it is very difficult to provide quality of service in the network .in the dynamic nature of MANET .made it fairly demanding to uphold connectivity and guaranteed QoS.There are various factors needs to be consider to provide better quality over the network as well as over the nodes.

2.4 Self Configuration

The mobile ad hoc network is an infrastructure less network. For communication within the network, it needs to organize the network, to discover the neighbor of the nodes and if the most important is to maintain the topology that is established. The route is discovered and maintained by the nodes itself and because of mobility of nodes and dynamic nature of the wireless network it is very important to properly organize the network .

III. ROUTING TECHNIQUES IN MANET

3.1 Proactive Routing

In proactive routing, each node has one or more tables that contain the latest information of the routes to any node in the network.

Each node in the network has routing table for the broadcast of the data packets and want to establish connection to other nodes in the network. These nodes record for all the presented destinations, number of hops required to arrive at each destination in the routing table. The routing entry is tagged with a sequence number that is created by the destination node. To retain the stability, each station broadcasts and modifies its routing table from time to time. How many hops are required to arrive that particular node and which stations are accessible is the result of broadcasting of packets between nodes. Each row has the next hop for reaching to a node/subnet and the cost of this route. as the number of nodes in the MANET increases, the size of the table will increase; this can become a problem in itself.

Destination Sequence Distance Vector (DSDV) Optimized Link State Routing (OLSR) are examples of Proactive routing protocols.

3.2 Reactive Routing

It employs flooding (global search) concept. When a source node wants to transmit a message, it floods a query into the network to discover the route to the destination. Reactive protocol searches for the route in an on-demand manner and sets the link in order to send and accept the packet from a source node to destination node. Route discovery process is used in on demand routing by flooding the route request (RREQ) packets throughout the network. The discovered route is maintained until the destination node becomes inaccessible or until the route is no longer desired. Although the network topology changes dynamically, the network traffic caused by the route discovery step is low compared to the total communication bandwidth.

E.g. Ad hoc on-demand distance vector routing (AODV), Dynamic Source Routing (DSR)

3.3 Hybrid routing

Hybrid protocols attempt to assimilate the advantages of purely proactive and reactive protocols. The key idea is to use a reactive routing procedure at the global network level while employing a proactive routing procedure in a node's local neighborhood. Initially the routing established with some proactively prospected routes and then serves the demand from additionally activated nodes through reactive flooding. The choice of one or the other method requires predetermination for typical cases. The main disadvantage of such algorithms is: Reaction to traffic demand depends on gradient of traffic volume.

E.g. Zone routing protocol (ZRP)

IV. CLASSIFICATION OF ROUTING PROTOCOLS IN MANET

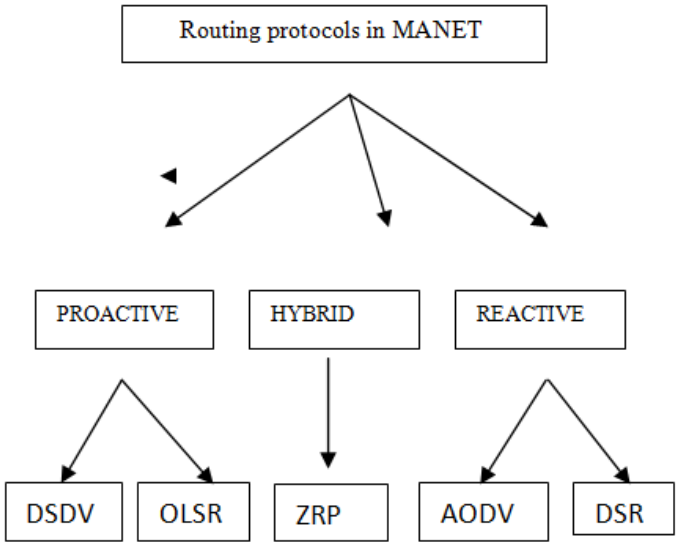

Fig-4 Routing Protocol in MANET

4.1 Destination Sequence Distance Vector (DSDV)

DSDV is a table-driven routing scheme for ad hoc wireless network based on the Bellman–Ford algorithm. C. Perkins and P.Bhagwat developed it in 1994. The main contribution of the algorithm was to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently.

If a router receives new information, then it uses the latest sequence number. If the sequence number is the same as the one already in the table, the route with the better metric is used. Stale entries are those entries that have not been updated for a while. Such entries as well as the routes using those nodes, as next hops, deleted. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle.

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

4.2 Optimized Link State Routing (OLSR)

OLSR (Optimized Link State Routing) routing protocol is a table-driven or proactive protocol based on the traditional link state algorithm. The point to point OLSR routing protocol is a non-uniform proactive protocol. It is important to understand that OLSR does not route traffic. It is not responsible for the process of routing traffic. It could be described as a route maintenance protocol and responsible for maintaining the routing table used for routing packages. OLSR protocol includes four steps for finding the route from source to destination: neighbor sensing, MPR selection, MPR Information Declaration, routing table calculation. OLSR protocol is the enhanced version of pure link state routing protocol that chooses the optimal path during a flooding process for route setup and route maintenance. Under the OLSR routing protocol strategy, nodes in the network exchange periodical topology information with each other and select a set of neighboring nodes called Multipoint Relays (MPRS) to retransmit their packets. OLSR uses MPR technique as an optimization for control traffic flooding and minimizes the size of control messages and the number of rebroadcast node during a route update. All the nodes are informed about the subset of all the available links and the link between MPR and MPR selectors. In OLSR, link state information is generated by nodes which are chosen by MPR's.

4.3 Ad Hoc on-Demand Distance Vector Routing (AODV)

AODV allows mobile nodes to obtain routes quickly for new destinations and does not require nodes to maintain routes to destinations that are not in active communication. AODV allows mobile nodes to respond to link breakages and changes in network topology in a timely manner. When links break, AODV causes the affected set of nodes to be notified so that they are able to invalidate the routes using the lost link. One distinguishing feature of AODV is its use of a destination sequence number for each route entry. The destination sequence number is created by the destination to be included along with any route information it sends to requesting nodes.

4.4 Dynamic Source Routing(DSR)

Dynamic Source Routing (DSR) is a routing protocol for wireless mesh networks. It is similar to AODV in that it forms a route on-demand when a transmitting computer requests one. However, it uses source routing instead of relying on the routing table at each intermediate device. Determining source routes requires accumulating the address of each device between the source and destination during route discovery. This protocol is truly based on source routing whereby all the routing information is maintained (continually updated) at mobile nodes. It has only two major phases, which are Route Discovery and Route Maintenance. Route Reply would only be generated if the message has reached the intended destination node. To return the Route Reply, the destination node must have a route to the source node. If the route is in the Destination Node's route cache, the route would be used. Otherwise, the node will reverse the route based on the route record in the Route Request message header. In the event of fatal transmission, the Route Maintenance Phase is initiated whereby the Route Error packets are generated at a node. The erroneous hop will be removed from the node's route cache; all routes containing the hop are truncated at that point. Again, the Route Discovery Phase is initiated to determine the most viable route.

4.5 Zone Routing Protocol(ZRP)

Zone Routing Protocol is a Hybrid network protocol that uses the advantages of proactive and reactive routing protocols. A node along with its neighboring nodes forms a Zone. Within the zone, this protocol uses table driven protocol for the local communication and for the communication outside the zone, it uses on demand approach. For example if the destination nodes lies within the zone then it uses the routing information stored by each need in that zone as like proactive routing technique but if the destination node lies outside the zone then it check for the zone having the destination node an in this way it reduces the overhead for route finding. After a finding the zone, the message will be send to it and with in that zone, have the destination node, it again uses proactive protocol.

V. PERFORMANCE OF ROUTING PROTOCOLS

5.1 Packet Routing Overhead

In case of OLSR, as it consistently floods the message for table updatation, it increases its network overhead. Hence, it provides higher routing traffic .In case of DSR as it does not send unnecessary routing traffic hence the routing overhead is less as compared to OLSR but AODV has less overhead as compared to DSR because it maintains no sequence of the packet to be deliver. In case of ZRP when the destination node lies within the zone it uses proactive protocol inside the zone the routing overhead will increase as it needs to maintain the updated information.

5.2 Delay

In OLSR it always updates its routing hence the network is available for data transmission. Hence the delay provided by the OLSR is relatively low while DSR performs better than AODV and ZRP.AODV works better if the number of nodes are less, Increase in nodes of network result in higher delay. Because of the varying nature of mobile network, ZRP provides maximum delay.

5.3 Throughput

The throughput of a network defined as the capability to transmit maximum number of data packets over the channel In case of higher number of nodes and mobility of nodes AODV transmits the maximum data from source to destination. The throughput provided by DSR is very low because of higher overhead. As number of node increases in the network, their performance degrades. In every case, the throughput provided by the OLSR is high. The ZRP provides the least throughput in case of varying nodes.

5.4 Jitter

Jitter defined as the variance in the delay timing. AODV provides high jitter but as no. of nodes increases its performance increases. In case of DSR protocol it is relatively low than AODV.As the route is updated in OLSR, it provides better performance. ZRP gives highest jitter: as the number of nodes increases, the delay in receiving the packets increases.

Table – Comparison of Protocols

Protocol\ QoS factors	OLSR	DSR	AODV	ZRP
Jitter	Lowest	More	High(but it decreases with increase in number of nodes)	Highest
Throughput	Good	Highest	Better	lowest
Delay	Least	Highest	Moderate	High
Overhead	Highest	Low	More	Lowest

VI. CONCLUSION

This paper provides the comparative analysis of various routing protocols. Performance varies according to the nature of the network. In case of throughput, DSR provides better performance than OLSR and ZRP but OLSR give you least end-to-end delay. Moreover, in case of ZRP it gives higher jitter where OLSR provide lowest jitter. However, if we talk about routing overhead then ZRP gives better performance than other routing protocols. Overall, we find that DSR is better. There are various aspects for further research based on some other QoS factors.

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