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Study of Different Types of Routing Protocols in MANET

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Abstract **-** Routing protocol performs better in wireless Ad Hoc environment if they are designed to keep in mind the error prone environment and resource constraint of mobile nodes. To achieve the packet transition goal we have need of effective and reliable routing algorithm. Most of the exiting routing algorithm is work fine when network is small but when the network is large then there is problem of link break in multipath routing algorithm specially on demand routing algorithm fail when network size is large .So we studied the different types of routing protocols and find the all shortcoming of the existing algorithms. In this paper we analysis the existing protocols on various network parameters like delay, throughput, energy, control overhead etc.

I. INTRODUCTION

The wireless network has gained popularity today and is at its height [1, 2]. Wireless networks to allow the users to communicate with each other and transfer data without the need for a wired medium. The growing popularity of wireless network is due to emergence of wireless devices. Components and wireless devices so primarily focus on wireless local area networks (WLAN). Generally, they have two modes of operation which are as followed: one, the presence of control modules that is known as the base station (BS) and the second, has no control module [1]. Ad-Hoc network has infrastructure independent operations. Here, the systems can show the same common problems with radio communications, such as limited battery power, the limited bandwidth, poor transmission quality, and coverage problems. Wireless networks, such as traditional wired networks, also made up of router and host. The function of the router is forwarding data or packets to a network and can function as the source or host synchronization. Besides varying between a wired network and a wired network, the wire is not used; there is a fundamental difference between the two and the method of using that network to communicate with each other within the network. As the wireless network is not dependent on the physical wireless connection, this allows the freedom to move to a wireless network for both hosts to the router and turns out to be a benefit to a wireless network. The signal strength when travelling outside the specific area is weakened. The word "range radio signal" is used to travel a distance when it reaches this point. Most people assume that when the receiver is within range of the

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radio, the radio signal becomes stronger so that the receiver receives the signal. Otherwise, the receiver does not receive the message. To manage wireless communication several access control protocols are used. In wireless network, the elements (nodes) are mobile and change network topology randomly [2].

Wireless ad hoc networks can be classified on the basis of topology and deployment [2]:

(a) Homogeneous wireless network: In this nodes have similar characteristics in terms of their buffer size, CPU capacity, battery life etc. such as a network formed by laptops.

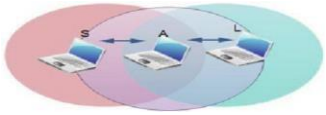

Fig.1 Homogeneous wireless network

(b) Heterogeneous wireless network: In these nodes consists of different characteristics in terms of their buffer size, CPU capacity, battery life etc. Such as a network formed by the PC, Smartphone and laptops.

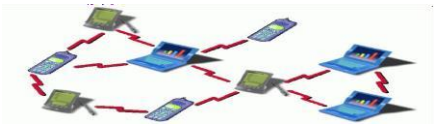

Fig.2 Heterogeneous wireless network

The evolution of wireless Ad hoc networks after, packet switching technology inspired Defense Advanced Research Projects Agency (DARPA) to sponsor Packet Radio Network (PRNET) project to explore its possible application in wireless infrastructure less and hostile environment [2] evolved in 1972. In 1983, Survivable Adaptive Radio Network (SURAN) was developed to address issues like network scalability, security, processing capability and energy management in PRNET [2].

Advancements in microelectronics technology with time, made possible to integrate nodes and network devices into a single unit called Ad hoc node and the wireless interconnection of such nodes is referred as Ad hoc Network.

The wireless ad hoc is multi hop network and nodes communicate to each other using single hop

wireless technology like Bluetooth, ZigBee and IEEE 802.11(ad hoc mode).

IEEE standard for wireless network

Table 1.1: Comparisons of Various 802.11 Measures

IEEE Standards	Speed	Frequency	Interface
802.11	Up to 2 Mbps	2.4 GHz	IR / FHSS / DSSS
802.11a	Up to 54 Mbps	5 GHz	OFDM
802.11b	Up to 11 Mbps	2.4 GHz	HR-DSSS
802.11g	Up to 54 Mbps	2.4 GHz	OFDM

The most common variable value of 802.11 IEEE standards is the 802.11b. This works in the 2.4 GHz spectrum, and the nominal transmission data rate is about 11 Mbps. The rate of actual data transmission, which is achieved by the 802.11b standard, is about 4 to 7 Mbps.

Difference between the ad-hoc network and cellular network

There are some differences between the ad hoc network, and cellular network are shown in Table 1.2[1]

Table 1.2: Characteristics Wireless Ad-Hoc and Cellular Networks

S. No.	Parameter	Cellular Networks	Wireless Ad hoc Networks
1	Infrastructural support	Required	Not required
2	Number of hops	Single	Multi
3	Bandwidth	Guaranteed	Shared radio channel
4	Routing	Centralized	Distributed
5	Switching	Circuit	Packet
6	Connectivity	Seamless	Frequent path breaks
7	Deployment Cost	High	Cost effective
8	Deployment Time	Large	Quick deployment

9	Time synchronization	Easier to achieve	Difficult and consumes bandwidth
10	Bandwidth reservation	Easier to employ	Requires complex Medium access control protocols
11	Maintenance cost	High	Self organization
12	Node circuitry	Less complex	More complex
13	Application Domain	Civilian and Commercial sector	Battlefield, medical, environment monitoring etc.

Wireless communication faces challenges like bandwidth constrains, link stability, mobility, node energy, MAC layer designing and so on.

II. Routing Protocol in MANET

Routing in wireless Ad hoc networks is a two step process: First find the route between Source and Destination and second is data packet transmission. Routing protocols for traditional wired networks cannot be directly applied to MANETs because of their limitations and characteristics such as dynamic topology, limited bandwidth, unpredictable link capacity and energy constrained. Numerous routing protocols for MANETs have been proposed in the recent past for discovering and maintaining routes [3]. Routing finds suitable paths between source and destination nodes pairs, possibly consisting of a number of intermediate nodes. Depending on the underlying communication model, routing protocol can be distinguished as unicast, multicast, and broadcast routing. All the above types have one sender, but different number of destination nodes and the destination nodes are determined in a different methodology in each of the above type. In unicast routing, there is exactly one specific destination node while in unicast routing, packets are delivered to exactly one destination among several possible destinations. Multicast routing is to establish paths for the delivery of data packets to multiple destinations that are aggregated in a group. Broadcast routing aims at delivering data packets to all nodes in the network [1, 3].

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Characteristics of routing protocols

Traditional routing protocols for fixed wired networks such as Routing Information Protocol (RIP) [63] and Open Shortest Path First (OSPF) [4] are not adequate for MANETs, due to their in-built characteristics, and they perform poorly. A routing protocol for MANET should demonstrate following characteristics:

- It should be fully distributed and should not depend on centralized controlling node; centralized routing involves high control overhead and is not scalable.
- In MANET nodes may enter or leave the network at any time and because of their mobility the network may get partitioned. Hence the routing protocol must adapt to frequent topology changes.
- To improve the overall performance the routing protocol should be loop-free and free from stale routes to avoid wastage of bandwidth.
- It should also utilize both the unidirectional links, and bi-directional links.
- It should be localized and should involve minimum number of nodes in route computation and maintenance.
- It should minimize the number of packet collisions to reduce loss of information.
- It should converge to optimal routes quickly, once the network gets stable.
- It should use scarce resources such as bandwidth, processing power, memory and battery power efficiently.
- It should incorporate quality of service (QoS) as per application demand.

Routing protocol classification

In a MANET, due to their limited range of wireless transmission, one or more intermediate nodes are often required to forward packets between source and destination mobile nodes. Therefore each node in the network expected to have the routing capability. Due to variations of wireless channels and moving of mobile nodes, MANET has highly dynamic topology. Considering the various application requirements and performance issues, several techniques of establishing and maintaining routes for reliable data transfer from source to destination are reported in the literature [3] which may be classified in many different ways and the classifications are important

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Reactive routing protocols

Reactive routing protocols determine routes only when a source node has data to send to a destination node. If the route from the source to required destination is not already available, the source node initiates a route discovery operation to find the needed routes [3]. In route discovery operation, a route request message (RREQ) is flooded to the entire network and a route reply messages (RREP) from a subset of nodes are send back to the source node. The most optimum route from all available routes is used for connection establishment and data transmission and the chosen path is being used till it becomes invalid or gets unavailable or broken [7]. DSR and AODV are the most widely used routing protocols based on On-Demand strategy. The main advantage of reactive routing approaches is their ability to provide route immediately, when needed. Reactive routing protocols eliminate any extra overheads in maintaining static routing tables. Protocols belonging to this category discover the routes when required or needed, hence they also called as on-demand routing protocols. Reactive routing protocols do not consume bandwidth when node is not sending data packet, which means, bandwidth is only consumed when the node has some data to transmit to a destination. Reactive routing protocol reduce network bandwidth overhead and battery power, because there are no routing update messages are exchanged periodically in the network.

Proactive routing protocols

In proactive routing protocols, a route is always available between every two nodes in the network. Periodic route update messages are propagated in the network for the purpose of route creation and maintenance [3]. Periodic updates are exchanged between nodes at specific intervals irrespective of traffic state and mobility of nodes. On the other hand, event triggered updates occurs only when some specific event like link breakage takes place. Since node mobility has a direct impact on link changes, hence frequency of event triggered updates also increases. In this category of routing protocols, routing information is maintained in number of routing tables. These tables are updated periodically; therefore they also called as Table-driven routing protocols.

The primary advantage of proactive routing protocols is the availability of consistent and up-to-

date routes in routing tables between all nodes at all times in the network. However, a major disadvantage is incurrence of large overheads in terms of creation, updation and maintenance of this routing table. The routing table updation can become quite frequent in case of high node mobility. Destination-Sequenced Distance Vector (DSDV) and Optimized Link State Routing (OLSR) are important protocols for MANET.

Hybrid routing protocols

A routing scheme that is purely proactive is not suitable for MANET environment due to large overheads associated with routing tables. In the same way, a pure reactive protocol cannot be completely successful in MANETs due to its associated disadvantages. Hence, certain characteristics of both these approaches can be integrated to form an enhanced class of mobile ad-hoc routing protocols, called as Hybrid protocols [3]. These protocols demonstrate reactive behavior in some instances and proactive behavior in other set of circumstances. Hybrid routing protocols allow flexibility and scalability in the MANET environment by assuming the entire network as being partitioned into zones [8]. The ZRP and ZHLS are the examples of hybrid class.

Proactive versus Reactive Routing

In proactive or table driven routing protocols nodes periodically exchange routing information, stored and maintained in the form of one or more routing tables, with every other node in the network in order to compute the routes in advance so that the routes are readily available whenever needed. These protocols consume bandwidth in order to maintain consistent and up-to-date routing information about the entire network. Proactive routing assures higher quality routes in static topology, but it does not perform well to large and dynamic networks. Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP) and Cluster Gateway Switch Routing Protocol (CGSR) are the typical examples of proactive routing protocols [5].

In reactive or on-demand routing, routes are determined as and when are needed. The reactive routing protocols have smaller route discovery overheads and larger route set up delay as compared to proactive routing protocols. In proactive routing paths are discover only when the

node want to send data .Dynamic Source Routing (DSR), Ad-Hoc On Demand Distance Vector Routing (AODV) and Cluster Based Routing Protocol (CBRP) are the examples of this class.

Some proposals combine the best features of both proactive and reactive routing which may be termed as hybrid routing protocols. Zone Routing Protocol (ZRP) [4] is a common hybrid routing protocol.

Source routing versus hop by hop routing

Source routing based protocols are not suitable for big size networks, because the complete route information is combined with data packet so large amount of overhead is created. So in source based routing of large network chances of network failure increased. CBRP and DSR are the mostly used protocols of this class.

Hop by hop routing protocols are suitable the MANET in which topology of network changes very frequently due to mobility of nodes. In this class type protocols data packet do not carry the complete the path information, it only contain the information of next hop with the address of destination node, so overhead is reduced and more bandwidth is available for data transmission. Data packets are forward in the network with the help of routing table information. Routing tables are updated periodically or when there are some changes in the topology occurred due to nodes move away, nodes power failure etc. AODV is the example of this category protocol.

Flat versus Hierarchical Structure routing

In a flat structure, all nodes in a network are at the same level and have the same capability and responsibility [6]. Flat structure routing is simple and efficient for small networks. In a large network, the volume of routing information or routing overhead is expected to be large and may take a long time for routing information to arrive at remote nodes. For such networks, hierarchical (cluster-based) routing may be used to solve the above problems. In hierarchical routing the nodes in the network are dynamically organized into partitions called clusters and then the clusters are aggregated again into larger partitions called super clusters and so on. Partitioning a network into different clusters maintains a relatively stable network topology. The high dynamics of membership and network topology is limited within clusters. Only stable and high level information such as the cluster level or the super cluster level is to be propagated

across a long distance. Thus the control traffic gets largely reduced. Within a cluster structure, nodes have complete topology information about their cluster and proactive routing may be used. If the destination is in a different cluster from the source, intercluster routing must be used. Intercluster routing is generally reactive or a combination of proactive and reactive routing.

DSR, AODV and DSDV are some of the routing protocols based on flat structure and ZRP, CGSR and CBRP are typical hierarchical structure based protocols

III. CONCLUSION

Different classes of routing algorithms were studied. The process of route finding is different in each algorithm. Proactive routing algorithm maintains the route information to the other nodes in its routing table so minimum delay to transmit data packets on the other hand reactive routing protocol finds the route on demand so it reduces the control overhead. Hybrid routing protocol is the mixture of proactive and reactive routing protocol which combines the advantages of both. It is not easy to say that which type of protocol performs better to another. The use of protocol depends the type of applications and required QoS parameters, such as energy, PDR, throughput and synchronization. This routing phase has been included as an efficient routing protocol, which has proved to be demonstrated with it. Improved QoS algorithms are compatible with the changes in network conditions and provide better performance. In future the combined type of algorithms will be design to increase the quality of service parameters such as throughput, delay, power, and packet delivery ratio.

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