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Parametric comparison between various routing protocols in MANET

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Abstract *– MANET is a distributed system that can dynamically organize itself into the network topology. Now a days people mostly use and aware about the wireless technology and easily transfer the data or resources to each other. In MANET the nodes are self-organized so that nodes can easily join or leave the network at any time. But, some issues related to the wireless technology are the security, data transmission, more battery consumption. This paper basically focus on the various routing protocols such as proactive, reactive and hybrid routing protocols. In that various routing protocols used for the secure routing during the data transmission in a network. This paper provide the comparison between the routing protocols using the various parameters like latency, overhead, periodic updates, loop freeness.*

Keywords *– MANETs: Security; AODV; DSR; DSDV; TORA; ZRP; WRP; OLSR; RREQ; RREP; RERR.*

I. INTRODUCTION

In recent year, the use of wireless technology has become more popular than the other traditional wired technology in the world of communication. Now a days the use of wireless technology is more rapidly expanding because people mostly connected with the each other and transfer the data at any different places with the help of wireless network [1]. In that wireless networks are classified as: infrastructure network and Mobile Ad-Hoc Network (MANET). Infrastructure network consisting of the base station or access point able to manage all the communication between other nodes. In that the base station determine and optimize the route of the communication in the network. Whereas in MANET all the communication is done by every other node in the network so it does not depends on any existing infrastructure that contain base station [2] (For that reason it is called Ad-Hoc). MANET is self-organizing network in that node adjust itself in the network at any time. It is highly dynamic network so nodes are free to move at any direction. MANET is dynamic changing network topology that move freely in the network. It does not have fixed infrastructure so nodes freely move in any direction.

Below Figure. 1 shows general flow of MANET in which how node can transfer the data from one node to other nodes. In that node placement in Network Simulator (NS-2) is define and also this nodes moves freely and it is dynamic in nature. MANET provide multi-hop data transfer because it has limited transmission range so it transfer the data from one node to another node [3].In Ad-Hoc network nodes act as a router as well as hosts because the node forward the packet as well as the route data to the another node of the network. In NS-2 the node position, mobility, energy level, than number of nodes are set in this simulator.

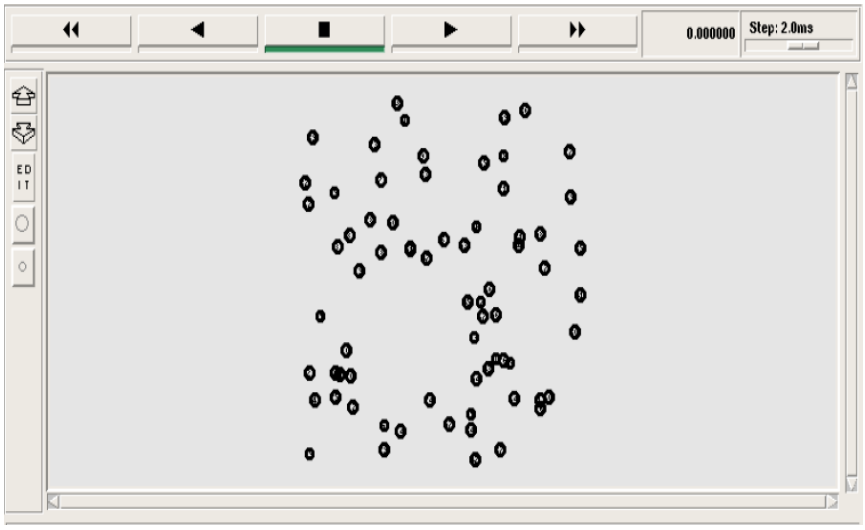

Figure 1. General flow of MANET

II. CLASSIFICATION OF ROUTING PROTOCOLS

Routing protocols mainly used for transfer the data or packet from source to destination in network [3]. Based on the routing the protocols are classified in three types: Table-driven, On-demand and hybrid routing protocol.

1. Proactive routing protocols
2. Reactive routing protocols
3. Hybrid routing protocols

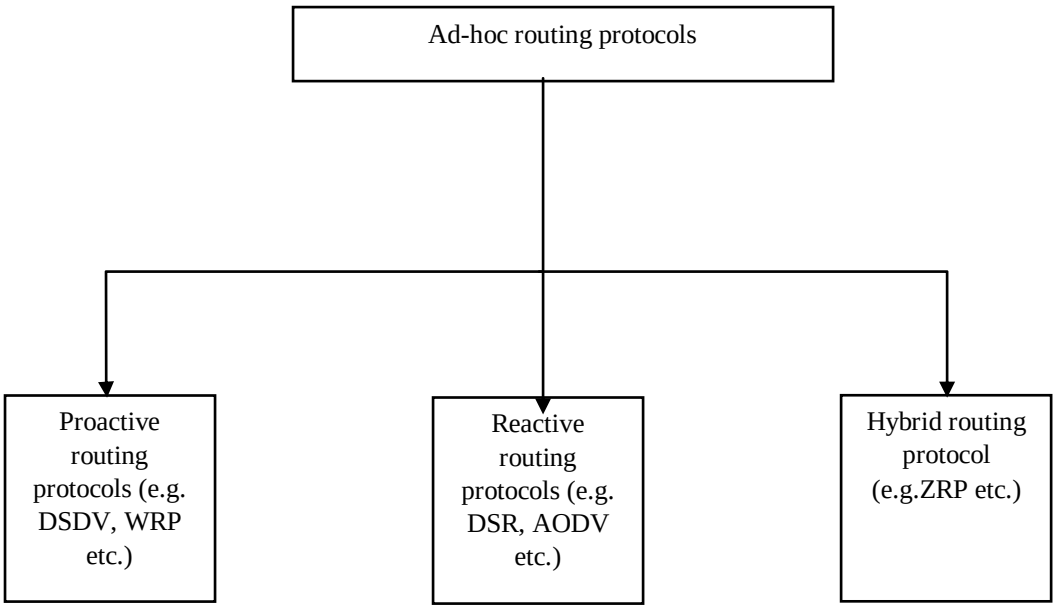

Figure. 2. Classification of routing protocols

Above Figure.2 shows the classification of the various routing protocols with their related examples and then briefly explain the routing protocols.

3.1. Proactive routing protocols

In proactive routing protocols [12] the route from source to destination is predefined and no need to find the route. Each node store the information on routing table to every other node in the network, for that reason it is also called table-driven routing protocol. In this protocol all the node maintain the routing table and updated regularly. The main advantage of this protocol is that it provide low latency in data delivery [2]. The drawback is due to the wastage of bandwidth in sending routing updates periodically even if they are not necessary. This protocols does not preferable for highly dynamic network. Examples: DSDV, OLSR, WRP.

3.1.1. Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV)

DSDV [3] is a proactive routing protocol. It is developed based on the distributed Bellman-Ford routing algorithm with the modification in that each node construct a one-dimensional array that containing the costs (distances) to the list of all available nodes and distribute this array (Vector) to its immediate neighbors. This information of array is stored in the routing table and all node contain the list of other node. In initial phase of distance-vector routing each node knows the cost of its directly connected neighbors and those neighbors do not directly connected to the link and that cost is assigned an infinite cost. Routing table is updated periodically based on two types of update packets [2]: One is called "Incremental dump" and another is "Full dump". In case of incremental dump only carry the information that has changed since last full dump, whereas in case of full dump it broadcasting the whole routing information [1]. The main drawback of this protocol is that it more uses the battery Power and network bandwidth because routing updates are exchanged even if the network is idle. It is not used for highly dynamic network.

3.1.2. Optimized Link State Routing Protocol (OLSR)

This protocol is mainly design for distributed manner. OLSR [4] is table-driven routing protocol because routes are available when needed. First it reduces the control packet size in all the links and it declare a link of subset with its neighbors it's called multi-point relay selectors. Multi-point relay is called a set of selected neighbor nodes that retransmit the packet to its neighborhood. In that the link of all the available neighbor nodes are constructed and flooded in the entire network. It minimizes the flooding of the control packets using the multi-point relays of the selected nodes. Only the multi-point relays of a node retransmit the broadcast message so that it reduces the retransmission procedure. This protocol mainly suitable for large network.

3.1.3. Wireless Routing Protocol (WRP)

Wireless Routing Protocol (WRP) is mainly used for determining the route. This algorithm calculate the shortest path using the information regarding the distance (length) and last hop to reach the destination. In this algorithm, each node maintain a distance table, routing table, link-cost table and Message Retransmission List (MRL). In MRL is basically formed using the update message. If there is a change from the last update MRL update on the basis of the acknowledgement. A node update its routing table after receiving an update message from a neighbor node and it select the better path using the new information. If a node gets better path, the information is send back to the original node so that they can update their tables [6]. In this the consistency of the routing protocol is checked by every node so that it eliminate the routing loop overhead.

3.2. Reactive routing protocols

Reactive routing protocols [4] are on-demand routing protocol because when route from source to destination is needed than this protocol establish the route. Each node store information of its immediate neighbors. This routing protocols does not support the periodic routing updates during the route discovery, so that it does not waste the energy and network bandwidth. The advantage of this protocol is to reduce the routing table maintenance overhead. The drawback is every time the path has to be determined so time increased to send message. This protocols mainly used for highly dynamic network [10]. This protocol works for mainly two phases: Route discovery and Route maintenance.

In route discovery phase source node initiate the route discovery for sending the data to the destination and it broadcast the RREQ to its neighbors and after receive the RREQ from the destination it send the RREP to the originator node and for that it select the shortest route and then data is transmitted. In Route maintenance phase it check that any link is break between two nodes and if link is broken than using this phase it locally repair the broken link. Example: AODV, DSR, TORA.

3.2.1. Ad-Hoc On-Demand Distance Vector Routing (AODV)

Ad Hoc On-Demand Distance Vector Routing (AODV) [6] protocol is a reactive type of protocol. The basic message set of AODV is: RREQ, RREP, RERR and HELLO message. It is on-demand routing protocol so route discovery is establish to select a shortest route. First source node wants to communicate with destination it initiate the route discovery for that source node broadcast the RREQ to its neighbors and neighbor nodes receive this RREQ and check in its routing table to see if it has valid route to destination if yes than it forward the RREQ to destination and if not than it set reverse route towards the source node and rebroadcast the RREQ to its neighbors [5]. After receiving RREQ by the destination, the destination node is unicasting a RREP back to the source node.

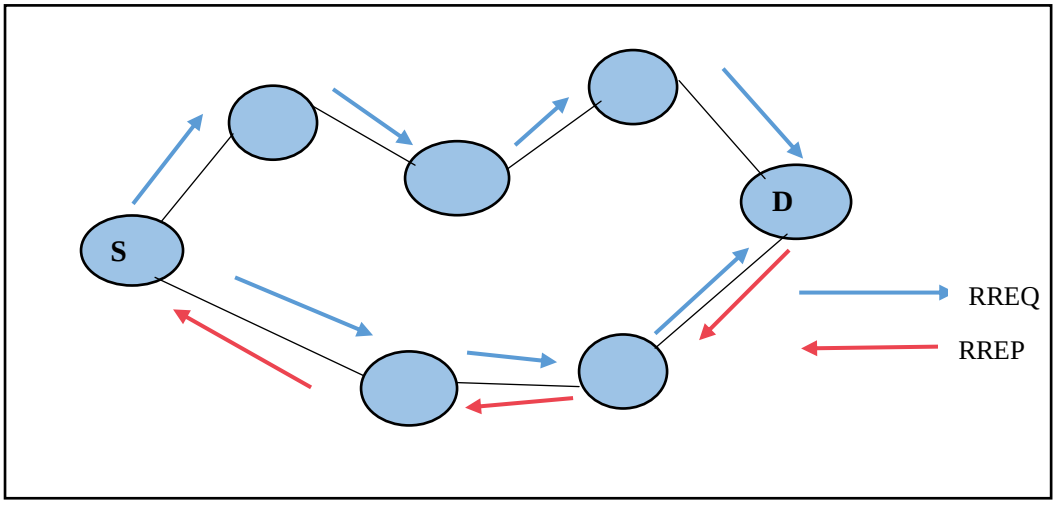

Figure. 3. Routing in AODV protocol

In RERR message is for the broken link during the routing and it generate the alarm message that broadcast in all the network. In HELLO message is mainly used for broadcasting the connectivity information. If a neighbor node does not receive any packets the node will assume that the link to this node is currently lost and this node is not participate in the network operation. Below figure. 3 shows the general working of AODV routing protocol in MANET. In that source and destination are shown and another is the intermediate node in the network. In Blue line is basically RREQ broadcast to its neighbors and in Red line RREP back to the shortest route to the source node and after route discovery is established the data is sent to the path of shortest route and in route maintenance if any one link is break into the network this mechanism is flood the message that this link is break in the network so not to transfer the data across to this link and locally repair the broken link using the Hello message exchange messages.

3.2.2. Dynamic Source Routing (DSR)

DSR developed at CMU in 1996 and it is based on the link state algorithm that mainly utilizes the source routing [9]. It uses source routing in which a data packet itself included in the path. The source node determine the path from source to destination and include the entire route information as a packet header. DSR uses the cache memory to store the entire route. In that one node can cache multiple route for the same destination, so it reduce the route discovery overhead. The route maintenance mechanism does not locally repair the broken link [8]. In DSR the network bandwidth is not fully used because all time the most of the bandwidth is used to send the path across the network. This protocol is not suitable for large network.

3.2.3. Temporarily Ordered Routing Algorithm (TORA)

Temporarily Ordered Routing Algorithm [7] (TORA) is a reactive routing protocol. It created a Directed Acyclic Graph of the route where the link between nodes is established from source to destination. Using the "link reversal" the route discovery is established. Route discovery is mainly for selecting the shortest route for transfer the data. The main parameter of TORA is height. Height is a measure of the distance of the node. As the response back each intermediate node update its TORA table. In TORA table mainly contain the route and height information. Here TORA table update with the route and height to the destination node. The main purpose of the height is to select the best route towards the destination. It provide the loop freeness during the routing. It locally repair the broken link in the routing. This protocol minimize the routing overhead [8].

3.3. Hybrid routing protocols

Hybrid routing protocols are the composition of proactive and reactive routing protocols. It combine the feature of both so it maintain routes to its nearby nodes even if they are not needed and it maintains routes to far away nodes only when needed. In that the network is divided in region [3]. Data distribution within a region is proactive and when source node wants to send data to another node of region is reactive routing protocol. Example: ZRP.

3.3.1. Zone Routing Protocol (ZRP)

ZRP [1] is a hybrid type of protocol, so the functionality of proactive and reactive both are in ZRP. It has wide and scalable. In that routing zone is maintain within a local region in a proactive manner. Here route establish based on the query-reply mechanism. ZRP create different zone based on their neighbors. A neighbor is particularly define as that one node directly connected to the other node in its range. In that neighbor information is used for within a region it can transfer the data and it is called Intra-zone routing. If one region node is communicate with other region node than and transfer the data to it is in a reactive manner. Query-reply mechanism reduces the routing overhead. Using that query packet is send by the source node towards the destination and after receiving the query destination node reply to the source node and effective path is established. In this protocol the latency is reduced because of reactive routing protocol.

III. PARAMETER COMPARISON OF VARIOUS ROUTING PROTOCOLS IN MANET

In this survey various comparison between routing protocols are explained in brief. This comparison mainly used for to know about the various parameter works in different situations for different routing protocols. In this table 1 shows the various comparison of parameter are shown and how they affect the routing protocols are categorized. In that the comparison of routing scheme, latency of the protocol, overhead of the system, network bandwidth is utilized effectively or not that is shown in table. Scalability of the protocol in various situations are define. The protocols provides the loop freeness or not is define in table for various routing protocols and also shows the protocol exchange the update information periodically send to the entire network in the table.

Table 1. Parameter comparison of various routing protocols

Protocol	Routing scheme	Latency	Overhead	Network bandwidth	Scalability of the routing protocol	Loop free	Periodic updates
DSDV	Table-driven	Low latency caused be route discovery	High because most routing information is never used	Wastage of bandwidth because routing updates are exchanged even if the network is idle	Not more scalable	Yes	Yes, whenever topology of the network changes
OLSR	Table-driven	Low	High	Wastage of bandwidth because of sending the periodical updates	This protocol works in dense network so it is scalable	Yes because sequence no. is used to avoid loops of the message	Yes
WRP	Table-driven	Low latency in discovering new routes	High	Bandwidth utilization is high	It suffers from limited scalability	Yes, It reduces the routing loop	Yes, Nodes exchange routing table with their neighbors via update message
AODV	On-demand	Low latency due to the flooding of the message	Heavy control overhead	Consumption of bandwidth because of periodic beaconing	More scalable	Yes	Not needed because route establish on demand
DSR	On-demand	High	Route caching can reduce the route discovery overhead	Network bandwidth not utilize fully because most of the bandwidth is used to send path across the nodes	Scalable	Yes	Not needed
TORA	On-demand	High	It aggregate TORA and control messages into a single packet to reduce overhead	It minimize the bandwidth utilization	Not scalable	Loop free routing	Not needed
ZRP	Hybrid	Latency is reduced because of reactive routing	Overhead is reduced	Not fully utilize the bandwidth	Scalable	Avoid temporary loop	Yes needed

IV. CONCLUSION

MANET is now become more popular and more rapidly expanding than the other wireless technology. In this paper various routing protocols are classified and summarized. Various protocols are classified based on their characteristics such as on-demand, table-driven and hybrid routing protocols. In this paper the advantages and disadvantages of various routing protocols are define and using this we can compare the various parameter for different type of routing protocols. There is not specific one protocol for all kind of communication in MANET. So based on the situation we can choose the protocol that fulfill the requirement of routing. In a future work, during the routing the security and energy are the major issue in MANET so to secure the routing the efficient technique to be developed in a future.

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