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REVIEW ON MOBILE AD HOC NETWORK

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Abstract: A Mobile Ad Hoc Network (MANET) is a wireless network in which mobile nodes are connected in wireless medium without any base station or centralized control. MANETs used in business environment, commercial application, military application, disaster recovery. Routing in MANET is the serious challenge because network topology is dynamic that means node can change their position again and again. Routing protocol is used to determine the route from source to destination with minimum battery and minimum cost and minimum distance. In this paper define the different routing protocol and the comparisons between the routing protocols and also discuss the How Link failure occurred between the nodes and how it is detected.

Keywords- Mobile Ad Hoc Network, Routing Protocol, Comparison between Routing Protocol, Link Failure Problem.

INTRODUCTION

A Mobile Ad Hoc Network (MANET) is an autonomous system of mobile nodes with routing capabilities connected by wireless link, the union of which forms a communication network. For ad-hoc networks every node communicates with other nodes directly or indirectly through intermediate nodes that relay its. It support dynamic topology because in MANET nodes can move from one place to another. There are many application of Mobile Ad Hoc network include the battlefield applications, rescue work, disaster relief operation as well as applications like an outdoor meeting, or an ad-hoc classroom and Law enforcement. There are some disadvantages also in Mobile Ad Hoc network like reliability and bandwidth problem in wireless communication and limited resources (memory and Battery Power) and mobility problem. An ad hoc network is of two types: Infrastructure based network and Without Infrastructure network as shown in Fig 1(a) and (b). An Infrastructure Based network is an interconnected group of computer linked by the routers, cables, wireless access points, hubs etc as shown in fig1 (b). Infrastructure based network can be open or closed. The open infrastructure based network such as the internet and the closed infrastructure network such as the private intranet.
Infrastructure based network

Figure 1 (a) Infrastructure Based Network

Infrastructure Less network no fixed base station or access point are included in this network, all the nodes in infrastructure less network can act as routers means one node is connected to another node without any base station as shown in Fig 1(b).

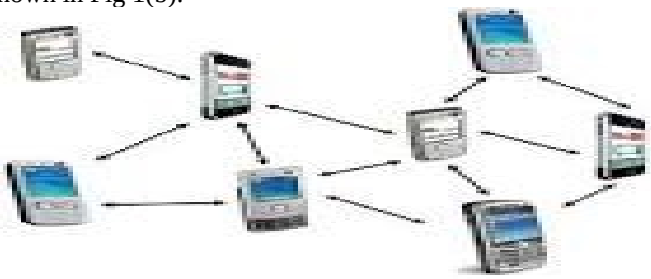

Figure 1(b) Infrastructure less network

History of Mobile Ad Hoc Etwork: Mobile Ad-hoc network is basically consists of Ad-hoc and network in which the word 'Ad-hoc' means 'for this only' and the word network means a set of mobile nodes connected via wired or wireless link. We can classify this type of network on the behalf of generation as follows: -

First Generation (1970s): The first ad-hoc network system was Packet radio networks that were used for military purpose in 1970 and next development is carrier sense medium access (CSMA). It uses radio technology for transmit and receive data.

Second Generation (1980s to the mid 1990s): development focused on the further advancement of the previously build Ad-hoc network structure like global mobile information systems, near term digital radio (NTDR). It provide packet switching networking to the mobile battlefield and beneficial for improving scalability.

Third Generation (1990s to the 2000s): are commonly known for commercial Ad-hoc network systems with notebook computers and other communications equipment. At research conferences the idea of an arranging of JTRS (joint tactical radio system) in 1996, IEEE workshop on mobile ad hoc networking was established in 2000.
Fourth Generation (2000s onwards): These fourth generation developments are use of mobile Ad-hoc routers to provide

internet connectivity to mobile users, distributed sensing networks, disaster recovery networks.

Application of Manet: The Mobile Ad Hoc Network can be used in many areas such as Disaster Recovery, military application, Hospital, Tactical Network, Sensor Network, Education, Entertainment etc.

a. **Disaster Recovery:-** MANET can be used in Disaster Recovery when the complete communication infrastructure is destroyed and communication quickly is necessary.

b. ***Military Application:-*** MANET can be used in military application because military operations are spontaneous means it does not contain fixed infrastructure. In this operation the soldiers in military should create the ad hoc network when it is necessary.

c. ***Hospital:-*** MANET can be used in Hospital for developing some theoretical model.

d. ***Tactical Network:-*** MANET can be used for battlefield, disaster recovery areas. It create temporary network for communication when it is needed without any infrastructure or control administration.

e. ***Sensor Network:-*** MANET can be used in sensor network to detect and gain information about explosion, enemy movement and to detect and monitor changes in forests, oceans etc and provide security in parking garages.

f. ***Education:-*** MANET can be used in education for communication during lectures or meetings and is used in virtual classroom.

g. ***Entertainment:-*** MANET can be used for entertainment like multiuser games, outdoors internet access, Theme parks, wireless point to point networking.

Features of Mobile ad HOC Network:

MANET support various features that are shown in Table 1.

Table 1(Features of MANET)

Properties	Description
1) Self Healing	Nodes can join or leave the network quickly without affecting other nodes.
2) No Infrastructure	MANET create their own temporary network without any infrastructure. Each node in the MANET can act as router that transmit and receive the packet.
3) Dynamic Topology	Mobile nodes in MANET are in continuous movement, its network topologies are constantly changing.
4) Self Forming	Mobile nodes that cover the range of other node can create the own network without using pre configuration association.
5) Autonomous	Each node in MANET can act as both router and Host, so it is autonomous.

Routing Protocol:

Routing protocol is used to find and maintain the routes between nodes in the dynamic topology with possibly unit-directional links, by using minimum resources. Whenever a packet needs to be transmitted via number of nodes to a destination a routing protocol is needed. Routing protocols deliver the packet to the correct destination after finding path for packet [19][20][21]. For efficient routing a routing protocol has to follows various qualities such as:

a. Routing Protocol must be Aware of Power.
b. Quality of Service should maintain in routing protocol.
c. Routing Protocol should be insecure to security attacks.
d. Routing Protocol should be less proactive than reactive to avoid overhead.

***Analysis of Routing Protocol*:** The Routing protocols are analyzed in three ways. **Proactive routing protocol** is that in which all node maintain consistent, up–to-date information via exchange of routing information from each node to every other node like DSDV and OLSR and it never communicate to other node. The benefit of this protocol is that fast delivery of packet with existing path, and drawback is scalability problem due to routing overhead, the nodes may be maintaining topological information about nodes with which it may never communicate. And **Reactive Routing Protocol** is that in which paths are discovered with data delivery requests with less routing overhead and longer path setup delay. AODV, DSR etc are reactive routing protocol. **Hybrid routing protocol** is that in which both routing protocol are used (Proactive and Reactive protocol). Fig-2 represents the classification of routing protocol:

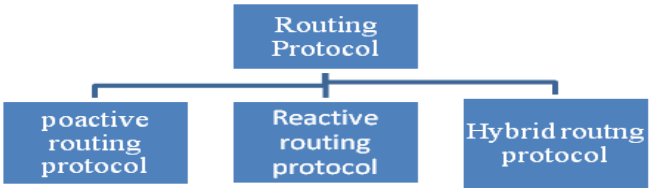

Figure 2 (Analysis of Routing Protocol)

The **Table driven** Routing Protocol are classified into various routing protocol. These are Destination Sequence Distance Vector (DSDV), Optimized Link State Routing (OLSR), and Fish eye State Routing (FSR) protocol. Some other routing protocols are Cluster head Gateway switching Routing (CGSR), and Wireless Routing Protocol (WRP) as shown in Fig 3:

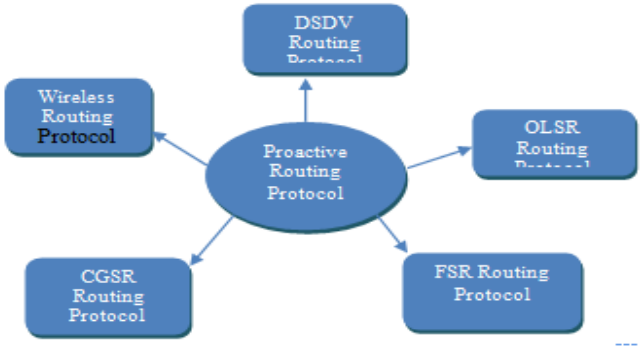

Figure 3 (Table Driven Routing Protocol)

OLSR (Optimized Link State Routing) Protocol– is a routing

protocol that is optimized for mobile ad-hoc network, which can also be used on other ad-hoc networks. OLSR is a Table-Driven link-state routing protocol, which uses hello interval and topology control (TC) messages to discover and then broadcast link state information through the mobile ad-hoc network. Individual nodes use this dynamic topology information to compute next hop destinations for all nodes in the network using shortest hop forwarding paths[1].

DSDV (Destination Sequenced distance vector) routing protocol [2] – is also Table-Driven routing protocol for ad hoc network based on bellman ford scheme. The aim of this protocol is to resolve the loop problem. In DSDV every mobile node maintains a routing table in which all of the possible destination and number of hops to each destination are stored. Each entry is marked with a sequence number assigned by the destination node. The sequence number enables the mobile nodes to distinguish repeated routes from new roots. DSDV protocol is suitable for ad hoc network of small size only. The disadvantages of this protocol is that it provides only single path for routing from the starting node to ending node and DSDV uses a proper updating routing table which uses battery power and bandwidth when the ad hoc network is down.

FSR (Fisheye State Routing) – is that in which node maintain the routing table based on updated information received from nearer nodes more frequently and exchange with the local neighbor nodes. Hence each node can have accurate information about its nearer node. The Advantage of this protocol is control traffic is manageable and perform in large network also it reduces the amount of traffic for transmitting the updated message. The drawback is routing table sizes grow with network size and it is less accurate[3].

CGSR (Clustered Gateway Switch coordination between nodes in the cluster. For every cluster the cluster head is selected, by having a cluster head it controlled the group of ad hoc network for separating the code, access the Routing) - This CGSR protocol is different from other protocol from the addressing and network structure. This CGSR is the clustered multichip wireless network with analytic routing scheme. The main aim of this protocol is provide channel and allocate the bandwidth. To select the cluster head the LLC (Least Cluster Change) algorithm was used. When there is the link break with cluster head node the LLC algorithm chooses the next one. The drawback of this protocol is that cluster head changes affect the performance of routing protocol since nodes are engaged in cluster head selection other than packet transmitted[4].

WRP (Wireless Routing Protocol**) –** WRP is a Table based routing protocol with the aim of maintaining or controlling the routing table information in the mobile ad hoc network. It also used the Bellman's Ford algorithm to calculate path. Each node in the network contains four types of table like node to node Distance table, Routing information table, Link Cost table and Message Retransmission List. The advantage of this protocol is that it avoid "count-to-infinity" problem means each node perform consistency check of predecessor node information than reported to all its neighbors and it has faster convergence and updation of table is fewer. The drawback of this protocol is the maintenance of multiple table need large memory and greater processing power in mobile ad hoc network. It suffers from limited scalability [5].

The **Reactive or On Demand routing Protocol** are shown in fig 4. The On Demand Routing Protocol are Ad Hoc On Demand Distance Vector (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm(TORA) Routing Protocol.

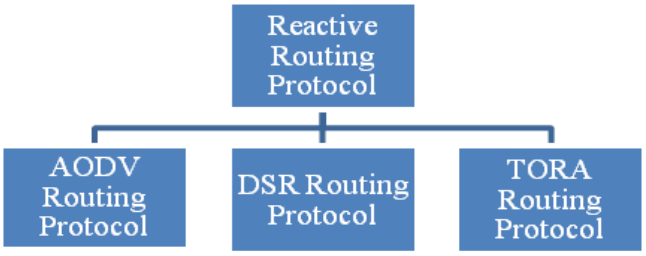

Figure 4 (Reactive Routing Protocol)

AODV (Ad-Hoc On Demand Distance Vector) Routing Protocol is the reactive routing protocol in which information is transmitted by nodes on-demand. AODV defines three types of control messages. **RREQ-** A route request message is transmitted by a node requiring a route to a node. Every RREQ carries a time to live (TTL) value that states for how many hops this message should be transmitted. This value is set to a defined value at the first forwarding packet and increased at retransmission. Retransmit the packet if replies are not received. **RREP-** A route reply message is send back to the originator of a RREQ if the receiver is either the node using the requested address or it has a valid route to the requested address. **RERR -** Nodes monitor the link status of next hops in active path. When the link break in an active path is detected, a RERR message is used to signify other nodes that the link was break. The **advantage** of this protocol is that it is simple and more efficient protocol than the other protocol [7] and it has higher reliability of data delivery and **drawback** of this protocol is very high routing overhead and hard to implement reliable delivery[6]

DSR (Dynamic Source Routing) protocol is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks. DSR make the network to be completely self-organizing and self-configuring, without any existing network infrastructure or base station[6]. The use of source routing allows packet routing to be loop-free, ignore the need for up-to-date routing information in the intermediate nodes through which packets are transmitted, and allows nodes transmitted or overhearing the packets to cache the routing information in them for their own use. All of the protocol that operate on-demand, allowing the packet of DSR to scale automatically to only that needed to react to changes in the routes that is used currently. The **advantage** of this protocol is that it utilizes the cache information to reduce the control

overhead and **drawback** is that route maintenance mechanism does not repair the broken path[7]

TORA (Temporally Ordered Routing Algorithm) protocol[8] – It is efficient and adaptive algorithm and it is the On-Demand Routing Protocol to find several path between source to destination. This protocol performs three function. (1) Create the route (2) Maintain the route (3) Erase the route. TORA create and maintain the DAG(Directed Acyclic Graph). The directed acyclic graph directs the flow of packet and ensures reachability of all nodes. The main aim of TORA is to limit control messages in the dynamic computing. The **advantage** of this protocol is it is good in complicated network and create a DAG only when it is necessary and **drawback** is that it is not scalable and not used much since AODV and DSR outperform TORA[8]

The **Hybrid Routing protocols** are used to reduce the control overhead of proactive routing protocols and decrease the initial route discovery delay in reactive routing protocols. The hybrid Routing protocol is also classified into ZRP and HARP.

ZRP(Zone Routing Protocol) – It is the hybrid routing protocol that is locally proactive and globally reactive with the aim of minimize the control overhead of proactive or reactive protocol. It uses the proactive protocol for discovery of node's local neighborhood and uses the reactive protocol for maintain the communication between nodes. Each node would maintain their routing tables for the route to the destination if the destination were to be within a maximum hop count (zone radius) from the source node. If the destination were found to the outside the hop count (zone radius), the source node would call an on demand like AODV search mechanism called border casting. The **advantage** of this protocol is used less Bandwidth, maintain up-to-date network information, less time period uses for transmitting the message between nodes and the **drawback** is latency is too short for finding new routes and if the person is not found in zone's area then the person can't receive any information, Hacking process can took place in ZRP[9][10].

HARP (Hybrid Ad Hoc Routing Protocol): This routing protocol is performed on two levels – intra-zone and inter-zone depending on the destination belongs to same zone as the forwarding node. Its goal is to establish the stable route from the starting end to ending end to improve delay. It uses both protocol in inter-zone and intra-zone routing and it is not applicable in high mobility environment. This protocol reduce the delay stem from a route failure during data forwarding[11].

COMPARISON BETWEEN ROUTING PROTOCOL

***Table driven and On–Demand Routing protocol*:** Table driven routing protocol only maintain up to date routing table to each node to every other node and never communicate to the nearer node. It is similar to the method of without connection for transmitting the data without knowing the routes for transmission. In the Table driven routing protocol the route is always available. On the other hand On Demand routing protocol computes the routes when needed so periodic update is not required in this protocol and it support higher nodes than table driven routing protocol. The comparison between the protocols is shown in table 2

Table 2(Comparison between Table driven and On-Demand Routing Protocol)

Parameters	**Table – Driven Routing Protocol**	**On – Demand Routing Protocol**
Path Availability	Always available	Determined when needed
Delay	Small, Because paths are predetermined.	Large, because paths are determined when necessary.
Scalability	Up to 100 nodes	Higher than Table – Driven Routing Protocol.
Updates	Always required	Not required

***DSDV and AODV Routing protocol*:** These two different routing protocol are compared by the following points. Some of the property of both protocol (DSDV and AODV) are same like:

a. Both routing protocol have flat routing structure.
b. Both are loop free protocol.
c. Both protocol utilizes the sequence number.

But some properties of both protocol (DSDV and AODV) are different like:

a) DSDV does not include the capability of multicasting but AODV include the capability of multicasting.
b) Time complexities are different, In DSDV time complexity O (D) but in AODV time complexity is O (2D where D is the diameter of the network.
c) Communication complexity is also different, In DSDV communication complexity is O(N) but in AODV communication complexity is O(2N) where N is the number of nodes in the network.

LINK FAILURE PROBLEM

MANET supports multi hop routing where the nodes other than the source and the destination nodes also take part in packet forwarding from one end to the other end. This results in the energy consumption of the intermediate nodes even though they are not the actual sender or receiver of the data. The available battery power of the nodes decides the life time of the node as well as the whole network. In the Mobile Ad Hoc Network when data can be transmitted from source to destination in wireless network then most of the time there was the Link Failure problem occurred because of Range, Congestion, Delay and Battery Backup Problem. There are no of routing problem include in mobile ad hoc network but most efficient and useful routing protocol is Reactive or On Demand (AODV) Routing Protocol. These On Demand routing protocol need to determine the link break in ad hoc network.

Mobile ad hoc networking is a challenging task due to the frequent changes in network topology as well as the lack of

wireless resources. As a result, routing in such networks experiences link failure more often. Hence, it is essential that a routing protocol for an ad hoc network considers the reasons for link failure to improve the routing performance. Link failure stems from node mobility and lack of network resources both resides in wireless medium and in nodes. Therefore it is essential to capture the characteristics to identify the quality of nodes and hence the quality of links. To identify the quality of nodes and quality of network, various levels are power level, Buffer level, stability level[12].

Power Level **-** The power level represents the battery life time. It represents a node's internal state. It is translated into a two-bit code that indicates the QoS state of a node in terms of battery life time. We classify the QoS state in terms of battery life time into high, medium, low and selfish states corresponding to each of the four two-bit codes.

Buffer Level **–** which stands for the available buffer that is unallocated. if the buffer level of a particular node is low, then this implies that a large number of packets are queued up for forwarding, which in turn implies that a packet routed through this node would have to experience high delays. This metric is converted into a two-bit code which indicates the QoS state of a node in terms of available buffer.

Stability Level**-** we define the connectivity variance of a node with respect to its neighboring nodes over time as the stability of that node. This metric is used to avoid unstable nodes to relay packets.

Detection of Link Break in Mobile Ad Hoc Network:

The link break can be detected by using Hello interval messages, MAC Layer Feedback and passive acknowledgement [13].

a. AODV usually transmit the Hello Interval messages at regular interval with default rate like once per second. These Hello messages determine the link availability between the source and destination. This Procedure works on the wired network which suffers from loss of packets and change of topology.
b. AODV uses the MAC Layer Feedback to find out Link break to neighboring nodes. This method is used for find the broken link quickly. MAC layer feedback method are performed on the network layer declaring the transmission error if the packets are not transmitting to the next neighbor node.
c. DSR uses the passive acknowledgement method if the MAC layer feedback method is not available. In this method a node after the transmission of packet to the next node to hear the channel that the next node further transmit the packet to the next neighbor node or not. If it is not transmit the packet to next node that means there is the link break in the network. This process needs the WLAN network card that is energy expensive. So this approach is not applicable in wireless ad hoc network only hello messages and MAC layer feedback methods are applicable for detection of link break in mobile ad hoc network.

RELATED WORK

In mobile ad hoc network there exist various methods to resolve the problem of link failure based on routing protocol. In recent technologies one is the dynamic link failure and power aware routing mechanism (LPAR)[14] can be used in which instead of establishing multiple path, we develop a new reliable single paths routing protocol based on node's link failure frequency and battery drain used to forward packet. It can significantly reduce the path maintenance overhead and control message due to the most stable single route instead of multiple routes. With this method a load balancing routing can be achieved in limited manner. And 2nd method that was proposed is the AODV-BR protocol[15], AODV-BR establishes the hybrid and multiple-paths to destination. The starting route and alternate routes together establish a hybrid structure that looks similar to a fish bone when stating route breaks, alternate routes can be ready to carry out data transmission. AODV-BR increases Packet delivery rate, but end-to-end delay is large since AODV-BR transmitted more packets, and those packets are transmitted in AODV-BR but not in AODV, taking alternate longer hop routes. When the starting route breaks, there still exist some problems,

a. There will be a time interval used to select the alternate routes, it must lead to data packet loss and delay increase, etc.
b. If the alternate node is more than one, then it must be considered which node is to be selected.
c. AODV-BR has no action to repair link, but simply uses information of alternate routing table, and it cannot be adopted by MANET.

In order to resolve these problem the 3rd method a link failure prediction mechanism AODV-RD[16] was proposed in order to reduce or even cancel the required time interval after primary routes breaks, set up an effective metric of alternate nodes based on improved AODV-BR, select alternate node whose communicating power is better by comparing metric to participate in transmitting. AODV-RD gave the higher packet delivery rate and optimizes the network performance and also guarantees the communication quality. Another or 4th algorithm was RAODV algorithm [17], find out links break by predicting signal strength and link expired time in the network, delay and throughput which result in improvement of QoS. This approach to prediction of link break is based on the Received Signal Strength (RSS) Algorithm and Link Expired Time (LET) which is used to find out received signal strength of node. This results in minimizes loss of packet, improved average throughput, which results in QOS improvement. In recent years The energy Saving Ad hoc Routing Algorithm was proposed [18], in which the distance from source to destination and minimum battery power of a node in the path is used to find the best route for packet transmitting. In Large scale Ad Hoc networks the terminal mobility may cause radio links to be broken frequently. With AODV reactive protocol, This leads to increase in end – to

- end delay, packet dropping rate and can reduce the packet delivery rate. In view of such problems then proposed a new Algorithm which introduces a mechanism of link failure prediction and accordingly perform a rapid local route repair algorithm[14] LRAODV_LP(Local Repair AODV Based On Link Prediction)in which each node maintains two tables NPL (Neighbor Power List) and PDT(Power Difference Table) Link Failure Threshold(LFTHRSH), Link Failure Flag(LFF). This algorithm proposes the local repair scheme based on link failure prediction for Mobile Ad Hoc Network and perform a local route repair to reduce end to end delays and packet dropping rate and increase packet delivery rate.

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