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A Review on Routing Protocols in MANET based on Routing Information Update Mechanism

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Abstract* — Mobile ad hoc networks (MANET's) are autonomously self-organized networks without infrastructure support. In a mobile ad hoc network, nodes move arbitrarily; therefore the network may experience rapid and unpredictable topology changes. Because nodes in a MANET normally have limited transmission ranges, some nodes cannot communicate directly with each other. Hence, routing paths in mobile ad hoc networks potentially contain multiple hops, and every node in mobile ad hoc networks has the responsibility to act as a router. In recent years, several routing protocols have been proposed for mobile ad hoc networks such as proactive routing protocols, reactive routing protocols and hybrid routing protocols. This survey paper provides an overview of routing protocols in MANET based on their routing information update mechanism by presenting their characteristics, functionality, benefits and limitations. The objective is to make observations about how the performance of these protocols can be improved.

***Index Terms* — MANET, Proactive, Reactive and Hybrid Routing Protocols.**

I. INTRODUCTION

Wireless networks are an emerging new technology that will allow users to access information and services electronically, regardless of their geographic position. Wireless networks can be classified in two types:- infrastructured network and infrastructure-less (ad-hoc) networks. Infrastructured network consists of a network with fixed and wired gateways. A mobile host communicates with a bridge in the network (called base station) within its communication radius. The mobile unit can move geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it. This is called handoff. In this approach the base stations are fixed. In contrast to infrastructure based networks, in ad hoc networks all nodes are mobile and can be connected dynamically in an arbitrary manner. Mobile ad hoc network (MANET) is an infrastructure-less multi-hop network where each node communicates with other nodes directly or indirectly through intermediate nodes. Thus, all nodes in a MANET basically function as mobile routers participating in some routing protocol required for deciding and maintaining the routes. Since MANETs are infrastructure-less, self-organizing, rapidly deployable wireless networks, they are highly suitable for applications involving special outdoor events, communications in regions with no wireless infrastructure, emergencies and natural disasters, and military operations. Routing is one of the key issues in MANETs due to their highly dynamic and distributed nature. A routing protocol is needed whenever a packet needs to be transmitted to a destination via number of nodes and numerous routing protocols have been proposed for such kind of ad hoc networks. All nodes of these networks behave as routers and take part in discovery and maintenance of routes to other nodes in the network. Ad hoc networks are very useful in emergency search-and-rescue operations, meetings or conventions in which persons wish to quickly share information, and data acquisition operations in inhospitable terrain.

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II. CLASSIFICATION OF ROUTING PROTOCOLS IN MANET

Routing Protocol is used to find valid routes between communicating nodes. They do not use any access points to connect to other nodes .It must be able to handle high mobility of the nodes. MANET routing protocols could be broadly classified into three major categories: Proactive, Reactive and Hybrid routing protocols.

A. Proactive (Table – Driven) Routing Protocols

Proactive protocols continuously learn the topology of the network by exchanging topological information among the network nodes. In this family of protocols, nodes maintain one or more routing tables about nodes in the network. These routing protocols update the routing table information either periodically or in response to change in the network topology. The advantage of these protocols is that a source node does not need route-discovery procedures to find a route to a destination node. On the other hand the drawback of these protocols is that maintaining a consistent and up-to-date routing table requires substantial messaging overhead, which consumes bandwidth and power, and decreases throughput, especially in the case of a large number of high node mobility. There are various types of Table

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Driven Protocols: Cluster-Head Gateway Switch Routing protocol (CGSR), Wireless Routing Protocol (WRP), Fisheye State Routing Protocol (FSR), Hierarchical State Routing (HSR) [1].

B. Reactive (On – Demand) Routing Protocols

For protocols in this category there is an initialization of a route discovery mechanism by the source node to find the route to the destination node when the source node has data packets to send. When a route is found, the route maintenance is initiated to maintain this route until it is no longer required or the destination is not reachable. The advantage of these protocols is that overhead messaging is reduced. One of the drawbacks of these protocols is the delay in discovering a new route. The different types of reactive routing protocols are: Dynamic Source Routing (DSR), Ad-hoc On-Demand Distance Vector Routing (AODV), Associativity - Based Routing (ABR), Signal Stability Based Adaptive Routing Algorithm (SSA), Flow Oriented Routing Protocol (FORP) [1] [2].

C. Hybrid Routing Protocols

The hybrid routing protocols employ both reactive and proactive properties by maintaining intra-zone information proactively and inter-zone information reactively. Often reactive or proactive feature of a particular routing protocol might not be enough; instead a mixture might yield better solution. Hence, in the recent days, several hybrid protocols are also proposed. The different types of hybrid routing protocols are: Core Extraction Distributed Ad - Hoc Routing Protocol (CEDAR), Zone Routing Protocol (ZRP), Zone - Based Hierarchical Link State Routing Protocol (ZHLS).

Figure.1 shows the classification of routing protocols in MANET based on the routing information update.

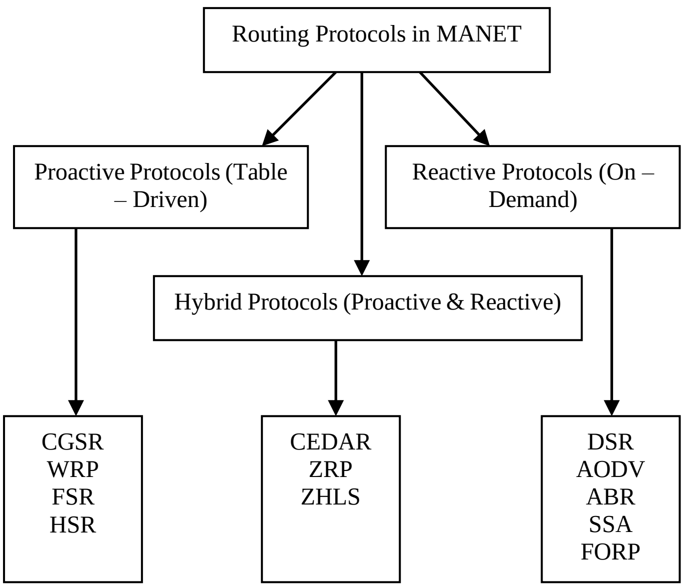

Figure.1 Classification of Routing Protocols

III. PROACTIVE ROUTING PROTOCOLS (TABLE – DRIVEN) / HIERARCHICAL ROUTING

A. Clusterhead Gateway Switch Routing (CGSR)

Clusterhead Gateway Switch Routing (CGSR) [3], uses as basis the DSDV Routing algorithm CGSR considers a clustered mobile wireless network instead of a ‘‘flat’’ network. Nodes are grouped into clusters. For each cluster a node acts as a cluster head. This cluster head is elected using the Least Cluster Change (LLC) algorithm [4]. The cluster head node provides some level of coordination among the nodes in the cluster. At the same time, the nodes located in the intersection areas between two clusters, can act as gateways between the two clusters. All the routing traffic goes through the cluster head and the gateways.

The mobile nodes are aggregated into clusters and a cluster-head is elected. All nodes that are in the communication range of the cluster-head belong to its cluster. A gateway node is a node that is in the communication range of two or more cluster-heads. In a dynamic network cluster head scheme can cause performance degradation due to frequent cluster-head elections, so CGSR uses a Least Cluster Change (LCC) algorithm. In LCC, cluster-head change occurs only if a change in network causes two cluster-heads to come into one cluster or one of the nodes moves out of the range of all the cluster-heads.

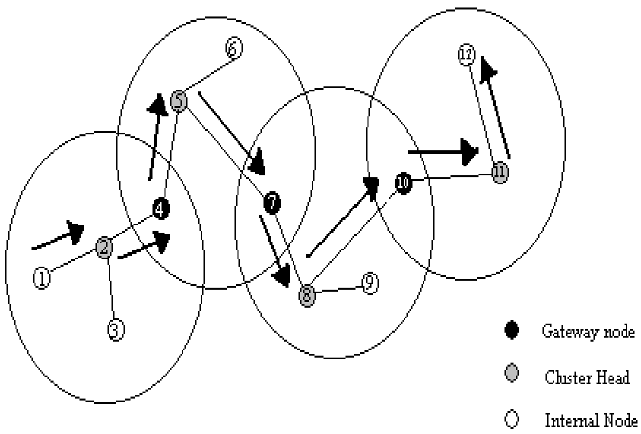

Figure.2 Route Establishment in CGSR

B. Wireless routing Protocol (WRP)

The Wireless Routing Protocol (WRP) [5], [6] is a table-based distance-vector routing protocol that eliminates the count-to-infinity problems. WRP is designed to adopt with the unreliability of the wireless links and provides faster convergence in case of link breaks than the case in DSDV. These two features of WRP are the result of the way the nodes exchange routing information updates, the way they maintain routing information in their tables, and the scheme WRP uses for route maintenance after link breaks. Particularly, the above two key features of WRP can be explained by applying the following two mechanisms. The first one is the acknowledged routing information update messages with the retransmission option for unacknowledged messages. This explains how WRP adopts with the unreliable nature of the wireless links. The second is storing the routes used by the neighbor nodes to all nodes in the network along with knowing the predecessor node to each destination node reachable by each neighbor. And this is the key piece of information which is used by WRP for fast convergence after link breaks. However, in WRP, each node in a network maintains the following four tables:

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1) Link Cost Table

Each node contains cost and other information like identifier to the directly connected nodes. The cost of a broken link is identified by infinity.

2) Distance Table

In this table, each node contains information to the nodes that are not directly connected.

3) Routing Table

It contains the shortest distance and the up-to-date information of all destinations.

4) Message Retransmission List (MRL)

Each node in a network sends a hello message to its neighbors and informs them that he is alive and waits for the acknowledgement (ACK) from its neighbors. If it does get any ACK from any neighbors within a certain time, then keeps this information to MRL list. Next time it will send update message to nodes only that did not reply to the hello message.

***Advantages**:*

- Same as DSDV
- Has faster convergence and fewer table updates

***Disadvantages**:*

- Need large memory and greater computing power because of the multiple tables.
- At high mobility, the control overhead for updating table entries is almost the same as DSDV.

C. Fisheye State Routing (FSR)

FSR is an implicit hierarchical routing protocol. It uses the "fisheye" technique proposed by Kleinrock and Stevens [7], where the technique was used to reduce the size of information required to represent graphical data. The eye of a fish captures with high detail the pixels near the focal point. The detail decreases as the distance from the focal point increases. In routing, the fisheye approach translates to maintaining accurate distance and path quality information about the immediate neighborhood of a node, with progressively less detail as the distance increases. FSR is functionally similar to LS Routing in that it maintains a topology map at each node. The key difference is the way in which routing information is disseminated. In LS, link state packets are generated and flooded into the network whenever a node detects a topology change. In FSR, link state packets are not flooded. Instead, nodes maintain a link state table based on the up-to-date information received from neighboring nodes, and periodically exchange it with their local neighbors only (no flooding). Through this exchange process, the table entries with larger sequence numbers replace the ones with smaller sequence numbers.

The FSR periodic table exchange resembles the vector exchange in Distributed Bellman-Ford (DBF) (or more precisely, DSDV [8]) where the distances are updated according to the time stamp or sequence number assigned by the node originating the update. However, in FSR link states rather than distance vectors are propagated. Moreover, like in LS, a full topology map is kept at each node and shortest paths are computed using this map. When network size grows large, the update message could consume considerable amount of bandwidth, which depends on the update period. In order to reduce the size of update messages without seriously affecting routing accuracy, FSR uses the Fisheye technique. Figure.3 illustrates the application of fisheye in a mobile, wireless network. The circles with different shades of grey define the fisheye scopes with respect to the center node (node 11). The scope is defined as the set of nodes that can be reached within a given number of hops. In our case, three scopes are shown for 1, 2 and > 2 hops respectively. Nodes are color coded as black, grey and white accordingly. The number of levels and the radius of each scope will depend on the size of the network.

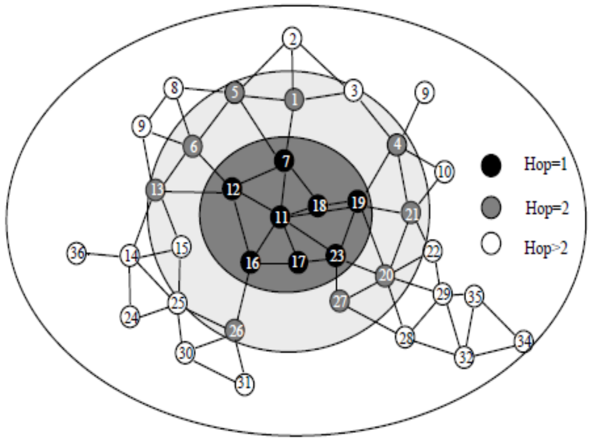

Figure.3 Scope of Fisheye

D. Hierarchical State Routing (HSR)

The Hierarchical State Routing (HSR) protocol [5], [17] is a distributed multi-level hierarchical routing protocol which provides nodes' clustering in multiple levels. HSR employs clustering in different levels. Here, every cluster has its leader which is elected through the election algorithm. The clustering is organized in levels and can be physical or logical. The first level of physical clustering is done between nodes that have physical wireless one-hop links between them. At this level, each cluster has its cluster leader. The second level of physical clustering is done between the leaders of the first level clusters. Once again, every cluster elects its leader. However, besides physical clustering, HSR defines also the concept of logical clustering. Here the links between the nodes are not physical. The links are based on certain relations.

In HSR protocol, every node maintains information about its peers' topology and the status of links to them. This information is broadcast to all the members of the cluster periodically. Just as all the other nodes, cluster leaders exchange similar information with their peers, which are also cluster leaders of the same level. Based on this information, higher-level clusters are built. After receiving topology information from its peers, each cluster leader broadcast the information to the lower level informing all the nodes about the hierarchical topology of the network.

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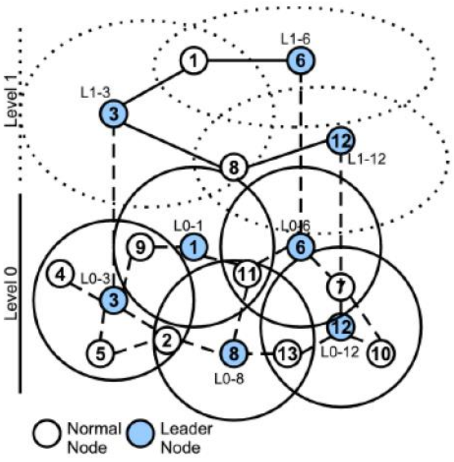

Figure.4 HSR Multi – Level Clustering

Figure.4 illustrates an example of HSR multi-level clustering. The lowest level defines five clusters with five different cluster leaders 1, 3, 6, 8 and 12. A cluster leader node is always responsible for exchange of routing information and handling of link breaks. Node 8 for example is described as L0-8 which means that its ID is 8 and it leads a cluster at zero level. Nodes that are located in more than one cluster are called cluster gateway nodes. The second level (level 1) of clustering is done among the cluster leaders of the first level. At this level we have three clusters with cluster leaders in each of them: L1-3, L1-6 and L1-12.

The path between two cluster leaders is called virtual (logical) link. This link consists of many physical wireless links between low level nodes. The status of this link is characterized by the status of the physical links that comprise it. The path between L1-3 and L1-12 in Figure 1 consists of the physical wireless links 3 – 2 – 8 – 13 – 12. Addressing in HSR is achieved by combining the hierarchical ID(HID) and the node ID. HID of a node is the sequence of all its cluster leaders starting from the higher level to its lower level. Node ID is its unique network ID usually referred to its MAC address. So the hierarchical address of node 10 in Figure 4 is <HID – nodeID> = <12, 12 - 10>. Every node's hierarchical address is stored in an HSR table and indicates its location in the hierarchy. HSR table is updated by the routing update packets. Every time a packet needs to be delivered from one node to another, it is forwarded to the highest node in the hierarchy of the source and then is sent to the highest node in the hierarchy of the destination. After, the packet is forwarded from this node to the destination node.

The advantage of HSR over other hierarchical routing protocols is the separation of mobility management from the physical hierarchy. This is done via Home Agents. This protocol also has far less control overhead when compared to GSR and FSR. However, this protocol (similar to any other cluster based protocol) introduces extra overheads to the network from cluster formation and maintenance.

IV. REACTIVE ROUTING (ON – DEMAND) / FLAT ROUTING

A. Dynamic Source Routing (DSR)

Dynamic Source Routing DSR is a reactive protocol. This protocol is one of the example of an on-demand routing protocol that is based on the concept of source routing. It is designed for use in multi hop ad hoc networks of mobile nodes. It allows the network to be completely self-organizing and self-configuring and does not need any existing network infrastructure or administration. DSR uses no periodic routing messages like AODV, thereby reduces network bandwidth overhead, conserves battery power and avoids large routing updates. However, it needs support from the MAC layer to identify link failure. The DSR routing protocol discovers routes and maintains information regarding the routes from one node to other by using two main mechanisms: (i) Route discovery – Finds the route between a source and destination and (ii) Route maintenance –In case of route failure, it invokes another route to the destination. DSR has a unique advantage by virtue of source routing. As the route is part of the packet itself, routing loops, either short – lived or long – lived, cannot be formed as they can be immediately detected and eliminated. This property of DSR opens up the protocol to a variety of useful optimizations**.** If the destination alone can respond to route requests and the source node is always the initiator of the route request, the initial route may the shortest. This routing protocol apply the concept of source routing, which means that the source determines the complete path from the source node to the destination node, that the packets have to traverse, and hence ensures routing to be trivially loop-free in the network. The packet in DSR carries all information pertaining to route in its preamble (header) thus permitting the intermediate nodes to cache the routing information in their route tables for their future use [9].

Benefits of DSR:

This protocol uses a reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table-driven approach. In a reactive (on-demand) approach such as this, a route is established only when it is required and hence the need to find routes to all other nodes in the network as required by the table-driven approach is eliminated. The intermediate nodes also utilize the route cache information efficiently to reduce the control overhead.

Limitations of DSR:

- Scalability, since the source need to add the IDs of all nodes along the path to the destination which increase the overhead in every data packet sent.
- When a link is broken RouteError packets need to go all the way to the source to inform it about the problem.
- Intermediate node can use outdated routes stored in their cache.
- As mobility increases more links are broken hence more route reconstructions is needed.

B. Ad hoc On-Demand Distance Vector (AODV)

AODV [10], [11] routing algorithm is a reactive routing protocol designed for ad hoc mobile networks. AODV builds routes using a route request / route reply query cycle. When a source node desires a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the network. Nodes receiving this packet update their information for the source node and set up backwards pointers to the source node in the route tables.

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In addition to the source node's IP address, current sequence number, and broadcast ID, the RREQ also contains the most recent sequence number for the destination of which the source node is aware. A node receiving the RREQ may send a route reply (RREP) if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ. If this is the case, it unicasts a RREP back to the source.

Otherwise, it rebroadcasts the RREQ. Nodes keep track of the RREQ's source IP address and broadcast ID. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it. As the RREP propagates back to the source nodes set up forward pointers to the destination. Once the source node receives the RREP, it may begin to forward data packets to the destination. If the source later receives a RREP containing a greater sequence number or contains the same sequence number with a smaller hopcount, it may update its routing information for that destination and begin using the better route.

When a link is broken due to movement of nodes or any other reason, the node that discover the failure link will send RouteError to the Source. When the source gets the RouteError Packet it will delete the path from the cache and will find another route in its cache, if it didn't find any route it will run RouteRequest again.

Benefits of AODV:

- In AODV routes are established on demand and destination sequence numbers are used to find the latest route to the destination.
- The connection setup delay is lower.

Limitations of AODV:

- In AODV the intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number, thereby having stale entries.
- Multiple RouteReply packets in response to a single RouteRequest packet can lead to heavy control overhead.
- Periodic beaconing leads to unnecessary bandwidth consumption.

C. Associativity – Based Routing (ABR)

In Associativity - Based Routing (ABR) [12], protocol uses a different metrics than shortest path. It also uses the same mechanism as DSR which is aggregating the node IDs along the path to the final destination. The objective is to select a longer lived route which will help in reducing the cost of reconstructing routes. The metric used instead of the shortest hop count is the Location Stability or the Associatvity between nodes. Moving nodes tend to break the associativity with their neighbors and hence they are not a good candidates to carry routes. Nodes periodically broadcast beacons to signify their existence with their neighbors. Location Stability is determined by counting the periodic beacons that a node receives from its neighbors. Links between nodes are classified into Stable and Unstable links based on the count of beacons. Source Node broadcast RouteRequest packets. Each neighbor will check if it received this request before or if its ID is in the list. If yes it will drop the packet. If not it will append its ID and the status of the link weather it is stable or not to the packet and rebroadcast the packet again. Furthermore, the selected route tends to be more long-lived due to the property of associativity, which is described below.

1) Rule of Associativity

This rule states that a MH's association with its neighbour changes as it is migrating and its transiting period can be identified by the associativity "ticks". The migration is such that after this unstable period, there exists a period of stability, where the MH will spend some dormant time within a wireless cell before it starts to move again.

2) Property of Associativity

A MH is said to exhibit a high state of mobility when it has low associativity ticks with its neighbours. On the other hand, if high associativity ticks are observed, the MH is in the stable state and this is the ideal point to select the MH to perform *ad-hoc* routing.

Benefits of ABR:

- Stable routes have a higher preference compared to shorter routes.
- Fewer paths will break which reduces flooding.
- A broken link is repaired locally, so the source node won't start a new path-finding-process when a broken link appears.

Limitations of ABR:

- Sometimes the chosen path may be longer than the shortest path, because of the preference given to stable paths.
- Stability informations are only used during the route selection process.
- Local query broadcasts may result in high delays during the route repair.

D. Signal stability adaptive (SSA)

The SSA [13] routing protocol is a derivative of the ABR routing protocol. It selects routes based on the signal strength between nodes. Signal strength of the link with a neighboring node is determined using the periodic beacons received from that node. If the signal strength is beyond a threshold, the link is considered stable; otherwise, the link is designated to be weak. Preference is given to paths on the stronger stable channels, SSA fits under the stability category. Route discovery in SSA is through source-initiated broadcast request messages. A node forwards the request message to the next hop only if it is received over a stronger channel and has not been previously processed. The destination chooses the first arriving route-search packet and sends back a route-reply in the reverse direction of the selected route. In addition to choosing the path of strongest signal stability, it is most likely that first arriving route-search packet traversed over the shortest and/or the least congested path. If no route-reply message is received within a specific timeout period, the source initiates another route-search and also indicates its acceptability of weak channels in the search packet header.

The main advantage of SSA is that this protocol finds more stable routes to a destination the shortest path aren't necessary the best. With the beacons between the nodes, SSA classifies the link as stable or unstable to find the strongest path.

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The limitation of SSA is that there is more bandwidth consumption because it send Route Request many times. Also the selected path may not be the shortest as the shortest path may have unstable link.

E. Flow Oriented Routing Protocol (FORP)

The Flow Oriented Routing Protocol (FORP) [2] is an on-demand routing scheme that uses mobility prediction. Only active routes are maintained and permanent route tables are not needed. When the source has a flow to send, it constructs a route to the destination on demand and injects the flow. The destination predicts the change in topology ahead of time and determines when the flow needs to be rerouted or “handoffed” based on the mobility information contained in data packets. We make the assumption that a given node is able to predict the link disconnection time of its one-hop neighbors. The basic concept is that if we can predict the LET along each hop on the route, we are able to predict the route expiration time (RET). RET is the minimum of the LETs along the route.

Figure.5 shows an example of flow setup process. In Figure.5(a), the source node A sends a FLOW-REQ message to destination node F. Nodes B, C, D and E forward the FLOW-REQ message and append information of their node IDs and the link expiration time (LET) of the link that the message was received from. Therefore, two FLOW-REQ messages arrive at node F. One contains a path <A,B,C,E,F> with LETs = <4,4,3,6>, and the other contains a path <A,B,D,E,F> with LETs = <4,5,4,6>. Since RET is the minimum of the set of LETs for the route, node F obtains the RET for both routes. Path <A,B,D,E,F> is more stable since it has a larger RET value of four compared with three of path <A,B,C,E,F>and is chosen as the route to set up the flow. As shown in Figure 5(b), node F then sends a FLOW-SETUP message and intermediate nodes set up the flow states.

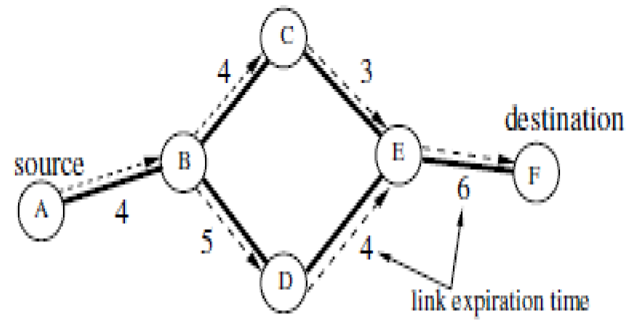

Figure 5(a). Flow Request Process

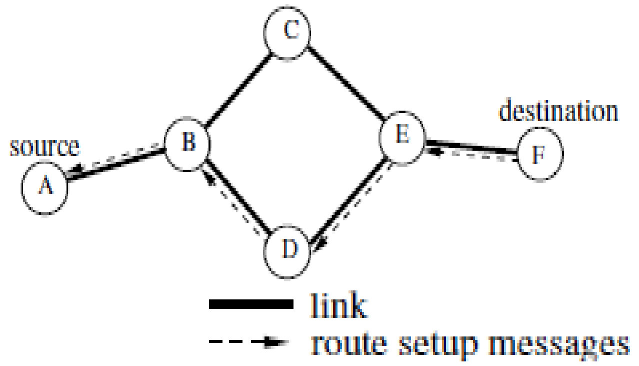

Figure 5(b). Flow Setup Process

V. Hybrid Routing Protocols

A. Core Extraction Distributed Ad - Hoc Routing Protocol (CEDAR)

The core-extraction distributed ad hoc routing algorithm (CEDAR) is a partitioning protocol which dynamically establishes a core of the network and then incrementally propagates the link state of stable high bandwidth links to the nodes of the core. Route computation is on demand and is performed by core nodes using only local state. We propose CEDAR as a QoS routing algorithm for small to medium size ad hoc networks consisting of tens to hundreds of nodes. The following is a brief description of the three key components of CEDAR.

1) Core extraction

A set of nodes is distributedly and dynamically elected to form the core of the network by approximating a minimum dominating set of the ad hoc network using only local computation and local state. Each core node maintains the local topology of the nodes in its domain and also performs route computation on behalf of these nodes.

2) Link state propagation

QoS routing in CEDAR is achieved by propagating the bandwidth availability information of stable high bandwidth links to core nodes far away in the network, while information about dynamic links or low bandwidth links is kept local. Slow-moving increase waves and fast-moving decrease waves, which denote corresponding changes in available bandwidths on links, are used to propagate nonlocal information over core nodes.

3) Route computation

Route computation first establishes a core path from the dominator of the source to the dominator of the destination. The core path provides the directionality of the route from the source to the destination. Using this directional information, CEDAR iteratively tries to find a partial route from the source to the domain of the furthest possible node in the core path (which then becomes the source for the next iteration) that satisfies the requested bandwidth, using only local information. Effectively, the computed route is a shortest-widest-furthest path using the core path as the guideline.

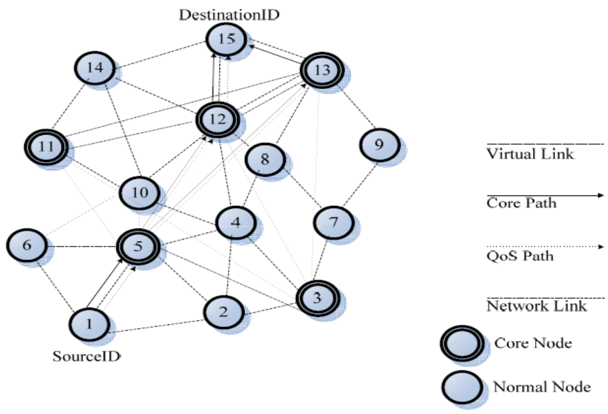

Figure.6 Route Establishment in CEDAR

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B. Zone Routing Protocol (ZRP)

ZRP [14] is suitable for wide variety of MANETs, especially for the networks with large span and diverse mobility patterns. In this protocol, each node proactively maintains routes within a local region, which is termed as routing zone. Route creation is done using a query-reply mechanism. For creating different zones in the network, a node first has to know who its neighbors are. A neighbor is defined as a node with whom direct communication can be established, and that is, within one hop transmission range of a node. Neighbor discovery information is used as a basis for Intra-zone Routing Protocol (IARP), which is described in detail in [15]. Rather than blind broadcasting, ZRP uses a query control mechanism to reduce route query traffic by directing query messages outward from the query source and away from covered routing zones. A covered node is a node which belongs to the routing zone of a node that has received a route query. During the forwarding of the query packet, a node identifies whether it is coming from its neighbor or not. If yes, then it marks all of its known neighboring nodes in its same zone as covered. The query is thus relayed till it reaches the destination. The destination in turn sends back a reply message via the reverse path and creates the route.

Advantages:

- It reduces the control traffic produced by periodic flooding of routing information packets (proactive scheme).
- It reduces the wastage of bandwidth and control overhead compared to reactive schemes.

Disadvantages:

- The large overlapping of routing zones.

C. Zone - Based Hierarchical Link State Routing Protocol (ZHLS)

In Zone-based Hierarchical Link State Routing Protocol (ZHLS) [16] protocol, the network is divided into non-overlapping zones as in cellular networks. Unlike other hierarchical protocols, there is no zone-head. ZHLS defines two levels of topologies - node level and zone level. A node level topology tells how nodes of a zone are connected to each other physically. A virtual link between two zones exists if at least one node of a zone is physically connected to some node of the other zone. Zone level topology tells how zones are connected together. There are two types of Link State Packets (LSP) as well - node LSP and zone LSP. A node LSP of a node contains its neighbor node information and is propagated with the zone where as a zone LSP contains the zone information and is propagated globally. Each node knows the node connectivity within its own zone and the zone connectivity information of the entire network. So given the zone id and the node id of a destination, the packet is routed based on the zone id till it reaches the correct zone. Then in that zone, it is routed based on node id.

Advantages:

- No overlapping zones.
- The zone-level topology information is distributed to all nodes reduces the traffic and avoids single point of failure.

Disadvantages:

- Additional traffic produced by the creation and maintaining of the zone - level topology.

VI. CONCLUSION

This paper presents a various routing protocols for MANET, which are broadly categorized as proactive reactive and hybrid. Proactive routing protocols tend to provide lower latency than that of the on-demand protocols, because they try to maintain routes to all the nodes in the network all the time. On the other hand, though reactive protocols discover routes only when they are needed, they may still generate a huge amount of traffic when the network changes frequently. Often reactive or proactive feature of a particular routing protocol might not be enough; instead a mixture might yield better solution called the hybrid protocols. When the network is relatively static, proactive routing protocols can be used, as storing the topology information in such case is more efficient. On the other hand, as the mobility of nodes in the network increases, reactive protocols perform better. Also it is clear that all the above mentioned protocols have certain advantages and some sort of limitations depending on the situation of the network in which these protocol works. This survey paper present an overview of the routing protocols in MANET based on the routing information update for the students or researchers to have an idea about these protocols so that they can be able to enhance the features of these protocols.

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