Chapter 1

Introduction

1.1 Introduction

A network distribute some valuable information among the users. It is an interconnected system through wire or wireless devices which have the capabilities to transmit or receive information. An ad hoc system established communication path among different users without base station.

Currently, wireless Ad-Hoc networks have been found to be widely used due to the vast potential for use in different fields. These networks are the special classes of wireless networks that make use of an multi-hop radio relaying and can operate with out any variable infrastructure [35]. The term “Ad-Hoc” represents that a network constructed for a special or customized service and is set up for a limited period of time.

An extension of wireless networks is Mobile Ad-Hoc Networks (MANETs). In wireless network when nodes are movable, that network is named as MANET. As a result, the ad hoc protocols of MANETs should be self-configured to accumulate to environment and traffic changes. Bluetooth and third generation cellular networks have led to rapid increase in usage of mobile devices. In the near future, the proliferation of mobile devices might increase the mobile users to more than a billion.

Mobile Ad hoc Network (MANET) perform communication through radio broadcasting. There exists a group of communication devices which communicate to each other through air (Wireless) without infrastructure. A devices are acting as both sender (source) or destination (receiver). The logical configuration of such communication system can be changed due to the movement of users in different direction. Such movements creates routing problem such as packet delay, packet loss and connection failure or instability of the connection path. In this context, It is important to design a routing protocol which reduce packet loss and packet delivery times which enhance the throughput and goodput of the routing strategies.

There are various problem that MANETs faces such as media access, routing, energy constraints, security issues. Among all of these problem, most important is congestion is major ones. Congestion is meaning to “excessive crowding” when there is a high demand of resources that exceeds the capacity causes the congestion. The congestion are happening due to the growing/increasing of networks. The packet loss, delay indicate that congestion has occured. For the wired networking, congestion very effectively deals by the Transport Control Protocol (TCP). That wired networking mechanism is not compatible for MANETs. One can use the following frameworks for congestion reduction and regulation : (a) An effective mobility model. (b) An effective Routing protocol. (c) TCP Variant as per the requirement and (d) Cross layered congestion control technique.

Wireless transmission meets many challenges such as delay, packet loss, mobility, energy of node etc. The wireless systems are categorized into two (2) types: Infrastructure where base station is essential and Infrastructure less where no base station is required. The nodes communicate to each other with out any base station.

There are various factor to select the best routing technique for MANETs.

- Multi-casting: Packets are forwarded through broadcasting mechanism to reduce time to reach.
- loop-free: Packets are transmitted only once from sender to intermediate point.
- Multiple Router:Packets are transmitted to alternate route in case of route failure.
- Distributed: The information should be distributed to all the nodes in the network.
- Reactive: The packets may transmit when source points wishes to communicate.
- Power preservation: The computing devices needs a power supply through battery.

1.1.1 Routing Methods

Routing techniques are normally classified into following components which helps to determine the better path from origin to the final destination. In MANET routing the Figure 1.1 is classified into those categories:

- Proactive Routing Protocols
- Reactive Routing Protocols
- Hybrid Routing Protocols

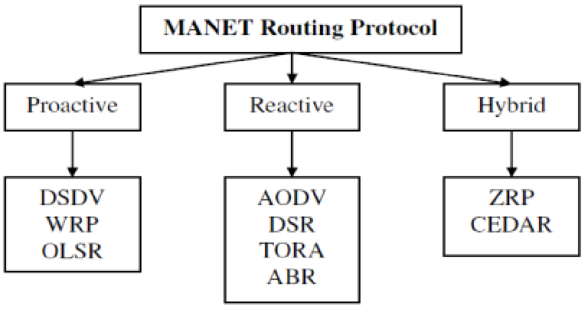

Figure 1.1: *Types of routing protocol for MANET*

1.1.2 Proactive Routing Protocols

Proactive routing mechanism introduces the routing strategies focused on the distance vector dependent or connexion state which keeps the updated routing information clear to each and every another node in network. This protocols normally need tables to store routing information of each node. This is one of the greatest advantages of proactive protocols which excel with low latency in data transmission. When the topology of the network changes, the protocol responds by propagating updates throughout the network.

1.1.2.1 Destination Sequenced Distance Vector Routing (DSDV)

The DSDV [45] is an effective routing protocol which guarantees loop free routing. DSDV routing protocol extends the Distributed Bellman-Ford (DBF) routing mechanism [17] where the entry is attached by a successor number that originate from the target node. This makes it possible for nodes to discern stale routes easily. In DSDV, packets are routed among ad hoc network nodes using routing tables. Each routing table comprises, a set of addresses for each and every former node in the network. The table includes the next hop address for a packet to be taken along with the address of each node.

Routing is done in DSDV by using routing tables established by each node. Regardless of network traffic, DSDV is ineffective due to the demand of periodical update transmissions. These upgrade packets are spread all over the network, because every network node need to know how to access every other node. This overhead is the biggest DSDV constraint. Furthermore, DSDV is unstable until upgrade packets spread across the network as the topology varies. In a highly dynamic network, incremental updates will grow in size and will have adverse effect on the performance. DSDV is unreliable, regardless of the network traffic, because of the requirement for frequent communication changes. These modification messages are spread across the entire network, so every sensor network learns how and when to meet every device.

1.1.2.2 Wireless Routing Protocol (WRP)

WRP [36] uses distributed shortest path algorithms that use distance from second hop to last hop of minimal route to reduce the issue of counting to infinity. In table repair and upgrade operations, this protocol varies from DSDV. In WRP, each node needs four routing tables to be maintained, including the Distance Table (DT), the Routing Table (RT), the Connection Cost Table (LCT) as well as the Message Retransmission List (MRL). The DT includes the network view of all node's neighbors. The RT includes the network's update view of all recognised targets. The LCT involves expense of relaying messages across each connexion (for example, the number of hops to reach the destination). It also includes the number of update cycles elapsed after the last effective update has been obtained from that link (intervals between two consecutive periodic updates). These are designed to check breaks in ties. For any upgrade message to be retransmitted, the MRL includes an entry and retains a counter by each entry. Until an update message is received and evaluate its best path routes, a node alters the distance graph. To both eradicate loops and accelerate integration, it also performs a continuity quest for its neighbours.

WRP will have the same benefit as DSDV does. Moreover, it has quicker integration and needs fewer table updates. But the difficulty of storing several tables requires greater capacity and higher computing capacity from ad hoc wireless network nodes. The overhead regulation associated for updating table entries same as that of DSDV for high mobility and thus it's not appropriate in for extremely complex wireless networks and very large ad hoc wireless networks. In managing its tables, WRP requires comprehensive memory capacity and services. Since it suffers from minimal scalability, the protocol is not ideal for major mobile ad hoc networks.

1.1.2.3 Optimized Link State Routing (OLSR)

OLSR is a constructive protocol [7] which is applied to make use of an optimization mechanism called Multipoint Relaying (MPR) of flood traffic management. OLSR includes a heuristic designed technique to optimize the shared wireless media environment. OLSR,is also an abstraction over the classical connection state protocol. It can be used to optimize mobile Ad-Hoc networks. OLSR minimizes the overhead from the flooding of control traffic. This approach greatly decreases the extended of retransmissions that required for sending excessive number of message to all network nodes. Secondly , in order to include shortest path routes, OLSR needs only partial connexion status to be flooded.

In summary, proactive routing protocols keep unicast routes among all pairs of nodes irrespective of the usage of paths. When a need arises, the source has easily available route to the destination and it does not suffer any further delay in finding/discovering routes. The main disadvantage of this concept is that when the topology of the network varies regularly, the management of unused paths will take a large part of the available bandwidth.

1.1.3 Reactive Routing Protocols

The Reactive Routing Techniques produces routes only once by the source node. It attempts a route determination activity when the routes from the node leads to the destination. Once a valid route is located between a source and the destination, this phase is completed. Once a route has been developed, a path preservation protocol preserves it until the path is no longer needed.

The example reactive Ad-Hoc routing protocols are-
(i)Ad-Hoc On-demand Distance Vector (AODV) [43],
(ii) Dynamic Source Routing (DSR) [27],
(iii) Temporally Ordered Routing Algorithm (TORA) [41].
and (iv) Associativity-Based Routing (ABR) [58]

1.1.3.1 Ad hoc On-demand Distance Vector (AODV)

When a comparison is made between DSDV algorithm and AODV algorithm with respect to keep a full list of all routes, Then AODV is the DSDV enhancement of the necessary broadcast in minimum number by generating routes on demand. However, AODV does not include route information in every data or control packet. Instead, the data packet transfer flow helps to store the respective next data in the origin node as well as at the intermediate node. AODV employs sequence number for destination numbers in most recent path. One unique feature in AODV is that nodes use “Hello” messages in a particular interval to probe their neighbours in order to validate routes. If a node is not getting a “Hello” letter from a specific neighbour, the route passing through that neighbour node is marked as invalid. Even though this feature is very effective, it will lead to unnecessary bandwidth consumption. AODV provides an instant loop free route from a source to a destination. It differs from DSR in maintaining routing information by using traditional routing tables. This routing table contains the list of all nodes and their corresponding next hop neighbours.

1.1.3.2 Dynamic Source Routing Protocol (DSRP)

The function of Dynamic Source Routing Protocol(DSRP) is to make it possible for nodes to end point dynamically.The routing of each packet is carried out with full order list of intermediate nodes in its travel through. Since a packets carry this routing information, intermediate nodes are free from additional overhead of maintaining it. The nodes in the network are caches the main path which expected to be confirmed for the destination. When new routes are available, the entries in the route cache are dynamically got updated. DSR basically comprised of two crucial stages (1) Route identification and (2) management of routes.

The path discovery process is started during the transfer of data from source node to target node. During that stage, it floods the Routing Request (RREQ) to its one-hop neighbours to set up a path. The RREQ incorporates the target address to the source address-broadcast id pair. When a node receives RREQ data packet , the source address makes a pair of checks and includes the specific address to the list of RREQ route log. Then RREQ is forwarded to its neighbours provided it does not previously received an identical RREQ and is not the destination.

Route maintenance is an important operation in DSR since the dynamic nature of mobile nodes can affect existing routes which disrupt the existing communication link. For example, when a node included in a source route moves out of a transmission range or it is turned off, the corresponding route becomes unusable. The route maintenance procedure monitors and notifies the source about the errors. There are two ways by which route maintenance can be carried out.It depends on whether the data link layer supports acknowledgement or not. The first method utilizes the hop-by-hop acknowledgements at the data link level to detect lost or corrupted packets and perform retransmissions. A node transmitting the packet will be able to assess whether the next hop to which it transmitted the packet is still functioning. To notify the source node, route error packets are created at a node adjacent to a broken connexion. The error hop is deleted from the route cache of the node whenever a route error packet is received, and all routes including the hops are truncated at that point. The root node re-initiates the protocol for path exploration.

1.1.3.3 Temporally-Ordered Routing Algorithm (TORA)

The TORA [41] is a Mobile Ad-Hoc Network algorithm for routing data, it is a distributed protocol which provides routing combined of demand based and proactive. TORA associates a ’height” with each node in the network which is unique for every node. Using a “flat ”, non-hierarchical routing algorithm, the TORA aims to attain high-degree scalability. The algorithm attempts to prevent the creation of far-reaching control message propagation in its application, to the greatest extent possible. The TORA does not use a shortest path solution. To do this, a method that is uncommon for routing algorithms. The Guided Acyclic Graph (GAG) rooted in a destination is constructed and maintained by TORA. No two nodes necessarily have to be same height. Information can flow from higher-height nodes to lower-height nodes. Therefore, knowledge can flow downhill same as like fluid. TORA achieves loop-free multi-path routing by preserving a series of fully-ordered heights.

1.1.3.4 Associativity Based Routing (ABR)

The ABR [58] method is free of loop, deadlock and packet duplicates and it defines a new routing parameter named the organisation's equilibrium degree. Based on degree of node mobility affiliation cohesion, a route is selected in ABR. Each intermediate node emits a beacon signal. Upon the reception of the beacon signal by the neighbouring nodes, the associated tables are updated. For each beacon received, there is an increment in the associativity tick of the current node. Association stability is characterised over time and space by the relation stability of one node with regard to another node. Associativity indicator gets reset when a node's neighbours shift out of proximity or the node itself. Longer-lived routes for ad-hoc mobile networks are a central goal of ABR.

1.1.4 Hybrid Routing Protocols

Proactive schemes result in lower delay, but use considerable bandwidth capacity to update routes and in some cases the determined routes may not be used at all. On the contrary, reactive routing protocols find and maintain only needed routes, thus the elimination of the overhead if only a limited number of routes are in service at any point on the network. This technique is most compatible when the traffic of that network is irregular and control towards set of nodes. Nevertheless, the routes are generated best of the specifications, the data packets experience queuing pause at the origin as the route is being built. Considering these factors, a combination of proactive and reactive approaches may provide better routing in an ad hoc environment. One such hybrid routing protocol is Zone Routing Protocol (ZRP) [22]. In order to reach a greater degree of functionality and usability, local proactive routing and national reactive routing are combined. One major deficiency of ZRP, however, is that its architecture assumes a uniform allocation of traffic and thus optimises the total overhead, which is impractical in a MANET environment. Core-Extraction Distributed Ad Hoc Routing (CEDAR) is another hybrid routing which uses core nodes (dominating set) of that network while deciding the path.

TCP uses connexions for virtual circuit flipping. MAC, data link layer and transport layer can arise from congestion-related issues. TCP addresses latency in the following ways: (i) Combined acknowledgements are used. (ii) TCP utilises the method of Additive Rise / Multiplicative Decrease. (iii) Based on measured RTT, it uses timeout. (iv) The slow start process is used after the timeout. (v) The control system for TCP congestion is not ideal for path failures. (vi) The retransmission timeout increases too soon.

The latest research area is congestion control in MANET. In controlling congestion, TCP plays an important role. In congestion-free networking, operating the header section and uses the TCP variants has been demonstrated. In MANETs, however, congestion still exists. TCP resides on the transport layer, so it is important to conform to unique MANET properties. To escape congestion, the TCP version should be used efficiently.

The main aim of the proposed research work is to change and update the current RED algorithm in order to improve the performance of the new models developed for MANNET. A difficult problem is the design of suitable and reliable routing protocols in a network like this. In specific, on-demand routing protocols are commonly researched since they use fewer bandwidth than proactive protocols.

The goal of the AQM based routing protocol is to maintain the rate of packet reaching at the waiting line, that is some proportion of the capability of the link. It regulates queue length circuitously [6]. A queue-based AQM adjusts on the (fast or average) dimension of the waiting line [29] and its activity is to maintain the size of the queue at a level of objective measure [55], [23], [34].

In this research work, we explore and solve the problem for AQM based ad hoc mobile networks protocol to provide quality of service. The current work focuses on providing approaches through non-immediate layer connections, which contributes to decreased connection failures and increased packet delivery. In addition, it attempts to use routing protocol link prediction to prevent network layer link breaks and to use regulated power to relay control and data packets to increase its value on the MAC layer.