CHAPTER 1

INTRODUCTION

1.1 GENERAL

Communication is sharing of thoughts or information from one subject to another subject. The subject may be a human being, animal or bird, even it can be a tree. The recent research studied by Gagliano (2012) says that trees are communicating one another. Very long ago human beings communicated very first through drawing an image or picture on a rock. They used some kind of sounds like birds and animals. Later sounds got evolved into a natural language when they were capable of writing a symbol or script for a particular sound. The people, at a hand stretch distance, communicate directly. Various forms of communication were used to convey the information to a remote location. The Marathon was one of the examples of remote communication as stated by Professor Theodore (2001). Ancient kings used pigeons to carry the message from one region to any other region, which was far away from where they used to live. Day by day, human culture, tradition and civilization had changed. Postal service, telegram, radio and television are used for communication. In this information age, the way information shared among people, is a wonder. The most appreciated invention is computer and one of its major applications is the Internet. Because of the Internet the world is called global village where people are very close to one another. The Internet is defined as the network of networks in which all computers can be connected to each other. The communication

through computer network can be done by two media namely wired communication and wireless communication.

1.2 WIRED COMMUNICATION

Wired communication is a very first method that uses electronic devices in which communication signal is transmitted from source to destination through some media like coaxial cable, fiber optics. The media are also multiplexed mostly to enhance the bandwidth of the transmission line. The possibility of signal loss in wired communication is lesser than that of wireless communication. Cable communication, telephonic communication and fiber optics are some of the examples of wired communication.

1.3 WIRELESS COMMUNICATION

The developments in electronic communication evolved into a big status, which resulted in the signals in the form of electromagnetic waves transmitted from source to destination without a wire. Leiner et al (1987) introduced Defense Advanced Research Project Agency (DARPA) radio packet networks, which were first the deployed wireless network. Wireless communication is carried out based on the principles of broadcast and reception of electromagnetic waves. Like wired media, wireless communication is also carried out through several multiplexing techniques. The low frequency band consisting of radio, microwave and infrared is widely used in wireless communication. Satellite communication, mobile communication, VANET, wireless sensor and MANET are a few examples of wireless communication.

1.3.1 Signal Propagation

Electromagnetic waves are easy to generate and widely used for both indoor and outdoor communication. They are capable of passing through the building and the ability to travel long distance. Signals are transmitted omnidirectional. It is meant that they are spread out from the transmitting antenna in all directions. Signals in wired networks, travel along the wire and they exhibit almost the same behavior and characteristics at each point. For wireless transmission the behavior and characteristics are different at each point between the source and destination. The Figure 1.1 drawn below depicts the transmission behavior of wireless media.

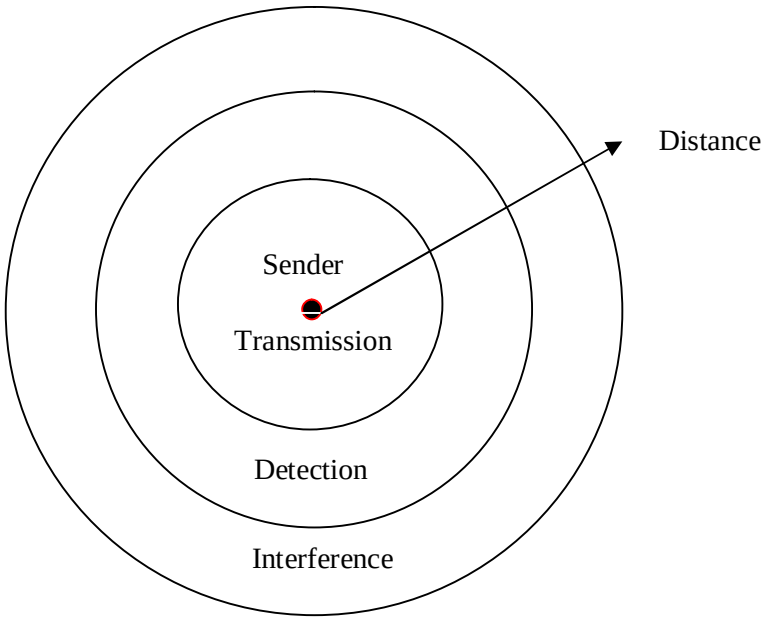

Figure 1.1 Signal propagation range

Transmission rang is the undisturbed area with a certain range of the radius, a sender is very much capable of sending signals and a receiver is very much capable of receiving signals with a negligible error rate. In this range signal can be free from external noise .Detection range is the partially

disturbed area with a second range of radius. In this distributed area signals can be differentiated from background noise, but the error rate is too high to make effective communication. Interference rang is the fully disturbed area with a third range of the radius. In this interference range the transmitted signals are mingled with background noise and a receiver cannot detect the signals.

1.3.2 Path Loss of Radio Signals

When electromagnetic signals travel in its wireless path, it has to suffer from various kinds of path loss. The properties of electromagnetic waves are as similar as the properties of light. In free space electromagnetic waves propagate at a speed as light waves do. They travel in a straight line. If such a straight line appears between a sender and receiver then it is called line-of-sight. Even if it travels in free space, the signals suffer from free space loss. MacDonald (1979) studied that the power of transmitted signal loosens its strength with respect to distance. The received power P_r is proportional to $1/d^2$ where d refers to the distance between sender and receiver. This is what called the inverse square law. The P_r also depends on the wavelength and gain of receiver and transmitter antennas and expressed in Equation (1.1) below

$$\mathrm{Pr} = Pt\ Gt\ Gr\left(\frac{\lambda}{4\pi d}\right)^2 \tag{1.1}$$

where G_t is the transmitter antenna gains

G_r is the receiver antenna gains

P_t is the transmitter antenna power

and λ is the wavelength of the signal

Mostly radio transmission occurs through the atmosphere, when signals travel through air, snow, mist, fog, rain and dust particle where path loss or attenuation is prevalent. The frequency of the radio wave also determines the fact that how much it can penetrate the objects across the travel. The lower frequency penetrates more than the higher frequency.

1.3.3 Propagation Behavior of Radio Waves

Boithias (1983) told that the way electromagnetic waves travel in wireless medium is classified into three types, namely ground wave, sky wave and line of sight. The waves with less than 2MHz of frequency can follow the earth's surface and travel long distances. These waves are said to be ground wave. They are used in submarine communication and AM radio. The wave with the frequency range between 2 to 30 MHz can travel back and forth between the ionosphere and earth's surface is said to be sky wave. The sky wave is capable of travelling around the world as they are reflected at the ionosphere. International broadcasts and entertainment radios use these short wave length waves. The wave with the frequency range greater than 30 MHz travels almost in straight line. It is said to be line of sight. It is mostly used in satellite and mobile phone systems. It can be reflected at the ionosphere. It is used for direct communication between satellites and microwave links on the ground.

1.4 DISTURBANCES TO SIGNAL PROPAGATION

Rappaport (2001) analyzed that though signal follow line of sight, In reality when it travels across the city the signal has to come across big building, mountains, multistoried architecture and many obstacles. Because of this the strength of the signal gets weakened.

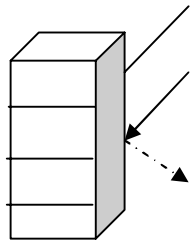

Figure 1.2 Shadowing

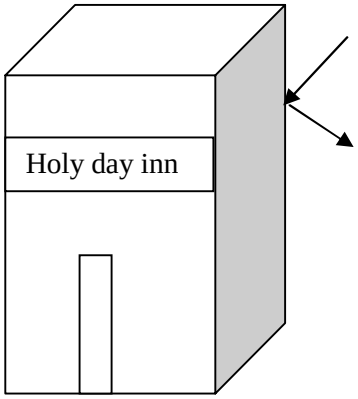

Figure 1.3 Reflection

Blocking or shadowing, reflection, refraction, scattering and diffraction are some of the disturbances to weaken the signals when they travel in space. Blocking or shadowing is one of the disturbances to signal propagation in which the signal gets attenuated when it hits obstacles like large building, simple wall, truck on the street and tress in a passage. The Figure 1.2 depicts the problem of shadowing.

Reflection is another kind of disturbances to signal propagation in which the signal is reflected if an object is larger than the wavelength of the signal, like mountains, huge building, Thereby some of the signal's power is absorbed by the objects. The Figure 1.3 shows reflection. When an electromagnetic wave travels in a vacuum, then its velocity is equal to the speed of light, otherwise velocity depends on the density of the medium through which it travels. The signal travels through denser medium, it bends towards the medium and this effect is called refraction. The Figure 1.4 depicts the phenomenon of refraction.

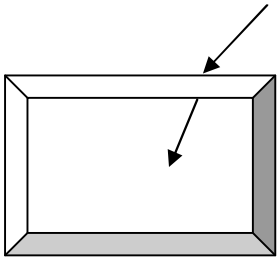

Figure 1.4 Refraction

The objects like sign board can cause scattering. If the size of an object is lesser than the wavelength, then incoming signal can be scattered into several weaker outgoing signals. The Figure 1.5 shows the problem of scattering.

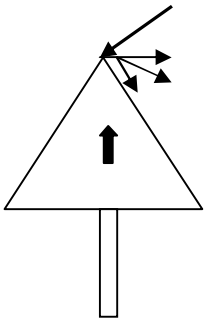

Figure 1.5 Scattering

Diffraction is very much like scattering in which the radio waves get diffracted and propagate in different direction when it hits edge of an object. The Figure 1.6 shows the problem of diffraction.

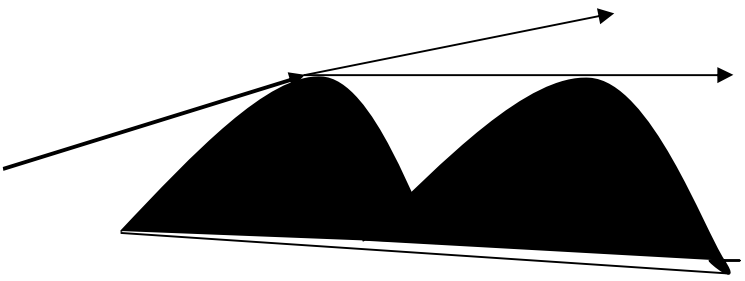

Figure 1.6 Diffraction

1.5 TRANSMISSION RATE CONSTRAINTS

The transmission rate is a very important constraint that has to meet various requirements of electromagnetic waves. The maximum rate of transmission on a wireless channel can be determined by Nyquist's theorem and Shannon's theorem. Nyquist's theorem states that the signaling speed of a transmitted signal refers to the number of times per second the signal changes its value or voltage. The number of changes per second is calculated in terms of baud rate. If B refers to the bandwidth of the channel and L denotes the number of discrete signal levels, then the maximum channel capacity C is given by Nyquist theorem as described in Equation (1.2).

$$C = 2 \times B \times \log_2 \times L \; bits/s \tag{1.2}$$

Shannon's theorem states that noise level in the channel is represented by the signal to noise ratio (SNR). SNR is the ratio of signal power(S) to noise power (N) and measured in decibels that is, SNR is equal to10 log10(S/N). If B is the bandwidth of the channel in hertz, then maximum channel capacity given by shannon theorem is

$$C = B \times \log_2 (1 + (S/N) \; bits/s \tag{1.3}$$

1.6 MOBILE AD HOC NETWORK - MANET

The MANET is one of the examples of wireless communication. The basic principle behind this MANET is multi –hop relaying. The MANET is a self organizing set of nodes in which nodes act both as a router and workstation. The messages between mobile nodes are sent without an aid of centralized access point. If receiving node is not within transmission range, the message is delivered to destination node through some intermediate

nodes. Due to absence of centralized coordinator, the routing is a very complex task.

The MANET has become a very important communication system in certain scenario where a network with an infrastructure can't be deployed. Nodes in MANET can be connected to a fixed infrastructure through mobile Internet Protocol (IP) and the Dynamic Host Configuration Protocol (DHCP). Basagni et al (2001) said that some subset of nodes in ad hoc networks form a backbone network in order to increase the network reliability.

The Internet Engineering Task Force (IETF) takes the responsibility to standardize the protocol and their functionality for ad hoc networks. The major difference between cellular networks and ad hoc networks can be understood by looking at the Figure (1.7) and (1.8). In cellular network a message from mobile node A to the other mobile node B is sent via a base station. Here base station acts as switching center and gateway. The base station is also called as an access point. The cellular network works on a circuit switched network concept. The Figure 1.7 denotes the typical cellular network.

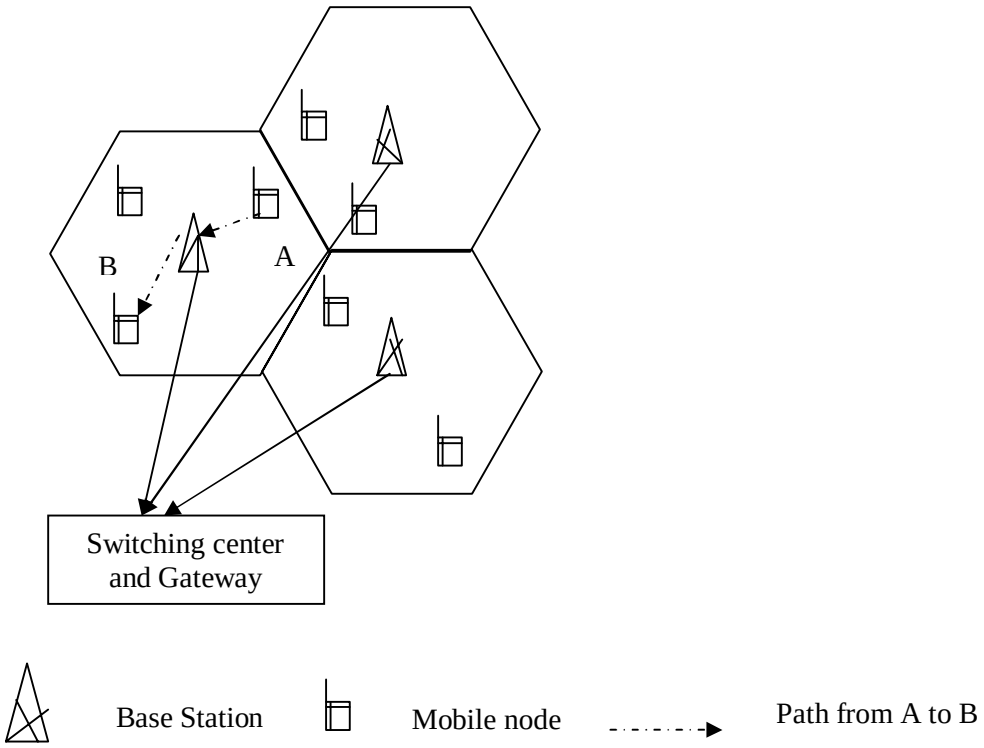

Figure 1.7 Cellular network structure

The Figure 1.8 shows the ad hoc networks in which the message from a mobile node A to B is sent via some intermediate nodes. This network does not have an access point, so the MANET is an infrastructure-less networks. The message is sent through multi-hop wireless links. The node in MANET is subject to dynamic topology, node in motion often leads to link breakage. This ad hoc network works on packet switched concept.

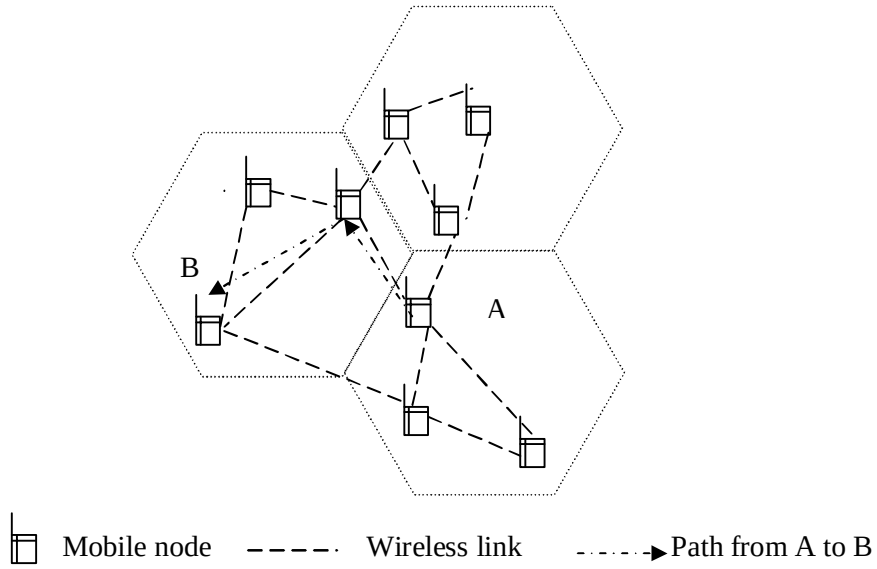

Figure 1.8 Ad hoc network structure

1.6.1 Characteristics of MANET

The node in a MANET has some specific characteristics. The behavior of MANET is autonomous, nodes act as both host and router. When a node acts a router, it forwards the message to the neighbor node. The MANET works on multi-hop relaying. When indented destination is not within the transmission range, the message travels along various intermediate nodes. There is no centralized control over routing; security and host configuration, all of these are carried out in a distributed manner. A node can join or leave the network anytime and move across the network. The network subsequently leads to dynamic topology configuration. The nodes in MANET are equipped with less memory, low battery backup. Due to mobility, paths between nodes often get broken. The deployment environment is very easy and cost effective compared to a fixed infrastructure network.

1.7 APPLICATION OF MANET

As ad hoc wireless network can be deployed easily and economically, it paves way to various application areas such as military applications, collaborative and distributed computing, emergency operations, wireless mesh networks and hybrid network architectures.

1.7.1 Military Applications

Communication among soldiers is very essential in the battlefield. The soldiers can't rely on a fixed infrastructure network at the battlefield. In such environments ad hoc networks are able to coordinate military objects moving at tremendous speed such as airplanes or warships. Such applications need fast and reliable communication. The commander in chief may give an order to all the soldiers or to a set of selected personnel engaged in the operation. Hence reliable multicast communication has to be ensured in real time traffic. The military vehicle can be equipped with mobile nodes having assisted by Global Positioning System (GPS) or other satellite services for effective coordination

1.7.2 Collaborative and Distributed Computing

To establish a temporary communication with minimal available configuration among a group of people in a conference or seminar, ad hoc networks are used. For instance a group of researchers who like to share their important research findings or documentation during a conference, the purpose of ad hoc wireless network with reliable multicast routing is very essential.

1.7.3 Emergency Operations

The MANET is very useful in emergency operation such as mob control, search and rescue and commando operations. The MANET has the privilege that it does not require fixed infrastructure and has the ability of quick deployment. In the environments where traditional wired networks are destroyed due to war or natural disaster such as earthquake, landslide, tsunami , sudden deployment of ad hoc networks would become the excellent solution to perform the rescue operation. Ad hoc networks employed in such a scenario must be distributed and scalable to dense nodes and capable of providing robustness in communication paths.

1.7.4 Wireless Mesh Networks

Wireless mesh networks are ad hoc wireless networks which provide an alternate way for fixed nodes. This mesh topology of wireless mesh networks offers more alternate path between source and destination for a data transmission, which result in a quick reconfiguration of the path when the existing one get failed due to node failures. These kinds of networks are deployed in the scenarios like residential area, national and state highways, business area and big university campuses. They should be capable of organizing and maintain themselves. The merits of wireless networks are high data rate, low deployment cost, improved services, high scalability and high availability.

1.7.5 Hybrid wireless Networks

The Multi-hop Cellular Network (MCN) and integrated cellular ad hoc relay (iCAR) are some of the examples of hybrid wireless networks. In

this kind of architecture nodes within the same cell want to communicate with each other and can be connected directly through multiple wireless hops over few intermediate nodes without intervention of the base station. The role of the base station is to maintain the topological information for effective routing. The base station may or may not involve in multi-hop path

1.8 ISSUES IN MANET

There are a lot of issues and challenges that need to be taken into account when an ad hoc wireless system is being devised. The authors Sivarammurthy & Manoj (2011) stated that the major issues that affect the design and performance of protocols designed for ad hoc networks are medium access, routing , multicasting, transport layer protocol, pricing scheme, quality of service provisioning, self-organization, security, energy management, addressing and service discovery, scalability and deployment considerations. Out of these twelve issues, this thesis report mainly focuses on the medium access, routing, multicasting, scalability and self-organizing.

1.8.1 Medium Access Scheme

The main objective of a medium access control protocol in ad hoc networks is to provide the distributed decision making for the shared channel for sending of packets. The various issues to be noticed in devising a Medium Access Control (MAC) protocol for ad hoc wireless networks are distributed operation, hidden terminals, exposed terminal problems, throughput and access delay

1.8.1.1 Distributed operation

The main property of ad hoc wireless networks is to arbitrary operation of individual nodes in environments where no centralized coordination is required. The MAC protocol design should be free from centralized coordination and fully support of distributed coordination involving minimum control overhead.

1.8.1.2 Hidden terminals

The hidden terminal problem is very unique to wireless networks. This problem causes the collision of packets at a receiving node because the sender is not aware of nodes that are not within direct transmission range of the sender but nodes are within the direct transmission of the receiver. Collusion happens when both nodes transmit packets simultaneously without knowing about the transmission of each other. This hidden terminal problem can considerably reduce the throughput of a MAC protocol employed in ad hoc wireless networks.

1.8.1.3 Exposed terminal problem

It is also a special problem occurring in wireless networks. The nodes that are within transmission range of the sender of an ongoing session are forbidden from making a transmission to its receiver. These nodes are called exposed terminal. To improve the performance of the MAC protocol, exposed terminals should be allowed to transmit packets in such a way that collision does not occur with ongoing data transfer.

1.8.1.4 Throughput

An attempt should be made in order to improve the throughput of the MAC protocol designed for ad hoc wireless networks. The increased throughput can be obtained by minimizing the occurrence of collisions,

exercising minimum control overhead and maximizing the channel utilization. Lin et al (2011) proposed a mechanism to avoid the congestion and subsequently increases the bandwidth utilization.

1.8.1.5 Access delay

End to end delay should be minimized, access delay refers to the average delay that any packet experiences when it is transmitted to the intended receiver.

1.8.2 Routing

It is well known that the MANET lacks the centralized coordination. Nodes are self organizing. They act as both host and router. The responsibilities of routing protocol include how the route information is exchanged and how feasible path between source and destination is identified based on the criteria of hop length, minimum power required, the lifetime of the wireless link. The MANET collects information for path breaking and how to repair the broken path ensuring the minimum utilization of bandwidth. The major challenges that routing protocol encounter in wireless ad hoc networks are mobility, bandwidth, error - prone and shared channel and location dependent contention. Mobility is a very important property of ad hoc wireless networks. It is the freedom of movement of nodes within the networks. The mobility of nodes causes frequent path failure, collisions of the packet, stale routing information, scarcity of resource reservation and transient loops.

The protocol designed for routing must be able to solve all the above issues. In bandwidth constraint, nodes share the wireless channel in the broadcast region. Bandwidth availability depends on the number of nodes and the amount of traffic handled by them. The only division of the total

bandwidth is available for every node. In error –prone and shared channel the probability of bit error rate is very high in a wireless channel. It is in the order of 10^{-5} to 10^{-3} and it seems very high compared to wired channel. Routing protocol designed for ad hoc networks should consider this bit error rate. The efficiency of the routing protocol can be improved while considering the state of the wireless link, signal-to-noise ratio and path loss. In location dependent contention the load on wireless channel differs with the density of nodes present in a given geographical region. The contention of channel increases when the number of nodes increases. The high contention causes a huge number of collisions and leads to bandwidth wastage. A good routing protocol should ensure the uniformity network load across the network system so that collisions can be avoided.

1.8.3 Multicasting

Multicast communication is the group communication between one source to many receivers or many source to many receiver. Multicasting plays very important role in the distinctive applications of ad hoc networks, applications like emergency search and rescue operation, battle field, conferencing and so on. In such an application, nodes that form groups to perform certain tasks require point-to multipoint and multipoint-to multipoint data and voice communication. The mobility of nodes in the multicast group makes dynamic topology and that result in unpredictable link failure. The multicast routing is very challenging in designing a protocol for ad hoc networks.

The major challenges that are to be faced in designing multicast routing protocols are robustness, efficiency, control overhead and efficient group management. In robustness the multicast routing protocol designed for

mobile ad hoc networks must be capable of recovering from link failure and reconfiguring quickly from potential path breaks, enable the protocol more suitable for use in the highly acrobat environment. An efficient multicast routing protocol should make a minimum number of hops to transmit a data packet to all the group members. If number of hops increases the possibility of link failure increases. Control overhead in wireless channel is shared by all the nodes. It causes the scarcity of bandwidth availability. The number of control packets used for multicast session must be minimum for effective performance. Efficient group management is group membership management and is very important in designing the multicast routing protocol for ad hoc networks. Accepting multicast session members and maintaining the connectivity among the group members are carried out by exchange of control messages. Group management should be carried out with minimal exchange of control messages.

1.8.4 Scalability

Though the number of nodes in an ad hoc wireless network does not expand in the same level as in Internet, the operation of a huge number of nodes in ad hoc network is prevalent in some application scenario. Some conventional applications such as military, emergency operations and mob control do not lead to a bigger ad hoc wireless network. A commercial application that includes wireless mesh networks needs a widespread of nodes for effective streaming. When nodes density increases, the path discovery failure will also be unacceptably high in on demand routing protocol. The periodic routing update will cause an overhead in table driven routing protocol due to limited bandwidth constraint. A large ad hoc wireless network cannot be a homogeneous, which consists of nodes developed by different

manufacturers. An ad hoc protocol should be designed in a manner that it can support varying density of nodes to yield effective performance.

1.8.5 Self-organizing

One of the important characteristics is that an ad hoc network should organize and maintain the nodes by itself. In order to achieve the efficient self-organizing, neighbor discovery is the major activities of ad hoc networks. In the process of neighbor discovery phase every node in the network collects information about its neighbors and stores and updates this information in a suitable data structures. This operation needs a periodic transmission of beacon packets for identifying activities of neighbors. In the topology organization phase, every node in the network collects information about the whole network or a portion of the network to preserve the topological information. The topological information changes due to mobility of node, failure of nodes are incorporated during the topology reorganization phase. The reorganization phase consists of two major activities. One is a periodic or aperiodic exchange of topological information and the other one is adaptability. The adaptability refers to recovery from topological changes in the network. Ad hoc networks should be capable of performing rapid self organization in order to achieve very good performance.

1.9 RESEARCH OVERVIEW

In wireless communication, the application of MANET has become more inevitable in areas where the wired communication cannot be established immediately. Multicast communication is one of the important communication mechanisms that require some specific attention when it is devised in MANET. Many routing protocols have been invented to address

the issues related to multicast routing. The group management, robustness and scalability are the important issues that still to be addressed more effectively in order to achieve the best performance of multicast routing. As far as multicast routing is concerned group construction, group leader selection, group management through minimum control messages and the ability to adopt a new group membership with existing group determines the performance of multicast routing.

In this thesis a new multicast routing protocol Mutual Sharing Range Detection Multicast Protocol (MSRDMP) is proposed. The MSRDMP is a location aware table driven, proactive routing protocol. As its name implies the sharing of work between group leader and leadership track node is made in the MSRDMP. Each node deployed using MSRDMP is equipped with global positioning system. In MSRDMP multicast group is constructed based on the transmission range with respect the virtual reference point (VRP). The VRP acts as a reference point to identify distance of the group leader from the VRP.

Every multicast group has one group leader and some group members. One of the group members acts as leadership track node for that group. Effective group management can be done while monitoring the group leader of the multicast group. Every time the group leader transmits the multicast packet to its group members, the multicast packet is padded with the location information of the group leader. The leadership track node generates the alert message using the location information of the group leader and Signal to Noise Ratio (SNR). The alert message is used mutually so that the leadership track node makes its move either forward or backward and the leadership track node alerts the group leader when the group leader moves away from the group for which it acts.

Multicast routing protocol should ensure that multicast packet is reached to all of its members and collision is avoided. If any of the group members does not receive the packet, the lost packet has to be sent once again by the group leader. If the group leader sends the lost packet, it would take additional time and resulting in an end to end delay. To overcome these problems, the group leader is assisted by the leadership track node so that robustness can be achieved.

The proposed MSRDMP introduces the Interim Clear To Send (ICTS) request to recover the lost packet by the group member. In order to avoid the collision the optimum Contention Waiting Time (CWT) is calculated by counting the number of collision. The contention waiting time tells that how long the group leader has to defer transmitting the packet once collision occurs. If group member has not received the multicast packet within stipulated Packet Delivery Time (PDT), then the group member invokes the Interim CTS request to the leadership track node.

The leadership track node takes additional responsibilities to send the lost packet to the group member which has not received the packet within the PDT. Thus reliability in multicast routing can be achieved using the interim CTS request.

The groups in multicast communication should allow as much as group members to join the group as and when required and new group should be allowed to join the existing group. The node which has not been deployed during the group construction should not be allowed to join the group, but trusted node should be allowed to join the group. The proposed MSRDMP maintains a transit table which holds the information about the virtual reference point.

The nodes or group members which migrate from one group to another send the transit hello packet using transit table maintained by them. The information about the new group construction is made known to existing groups using the Appendix Packet (AP). The appendix packet has information about the new the virtual reference point for new group along with existing values. The appendix packet is passed to the leadership track node that has been adjacent to the group leader so that the ambiguity of passing the appendix packet is avoided. After the appendix packet received by the leadership track node, the appendix packet is promulgated to all group members of the group through its own group leader.

The Global Mobile Simulation (GloMoSim) information system tool is used to implement the proposed MSRDMP and the result is analyzed considering the packet delivery ratio, control overhead, average path length and average joining delay. The comparison is made with existing multicast routing protocol On-Demand Multicast Routing Protocol (ODMRP), Robust Scalable Geographic Multicast (RSGM) and Scalable Position Based Multicast routing (SPBM).

1.10 ORGANIZATION OF THE THESIS

The Chapter one gives detailed explanation about signal propagation, transmission Constraints, problems occurring in electromagnetic waves, constructive information about mobile ad-hoc networks. The characteristics of MANET are briefed. The application of MANET is narrated clearly. The issues related to MANET are explained carefully. Finally research overview is narrated.

The Chapter two narrates the detailed literature review of multicast routing protocols for MANET. The chapter includes the main topics on routing protocols for MANET. Characteristics of routing protocols, taxonomy of multicast routing protocols, and detailed literature survey of typical multicast routing protocols for MANET are explained with keen attention and brief introduction about proposed protocol MSRDMP is highlighted.

The Chapter three explains the design overview of proposed multicast routing protocol MSRDMP. This chapter includes topics on the objectives of the proposed protocol, design on construction of group in MSRDMP and a table maintained by each node that exercises the MSRDMP protocol is narrated and how IPv4 protocol format is used in the MSRDMP is explained.

The Chapter four of this thesis explains in detail about the implementation of MSRDMP. How alert message is created and helpful to manage the group leader is explained. It includes distributive group leader selection algorithm. The explanation about contention waiting time for collision avoidance and the introduction of the Interim CTS request for recovery of the lost data from the group member is explained. The results of MSRDMP are analyzed and compared with existing protocols like ODMRP, RSGM.

The Chapter five narrates the scalability in MSRDMP. This chapter of thesis includes the need for scalability, the migration of group members between the groups. The topic explains the process of informing the existing group about new group construction using appendix packet and leadership declination is narrated .Finally the results of MSRDMP are analyzed and compared with existing protocols like SPBM and RSGM.

The Chapter six explains the overall conclusion of the thesis report and the importance of research work. Contributions of the thesis are explained. The way MSRDMP would be molded to enhance the features is narrated.

1.11 SUMMARY

This chapter of the thesis explains in detail about basics of wired and wireless communication and clearly tells the disturbances likely to be happening to electromagnetic waves in wireless communication and how the signal is propagated in wireless medium. How cellular network differs from mobile ad hoc network is given. The characteristics and specific application of MANET are narrated in detail. The issues in MANET are discussed and the research over view is narrated at the end of the chapter.