Chapter 1

Introduction and Statement of the Problem

1.1 Introduction

Due to the tremendous growth of users and increasing demand of sophisticated applications, wired network is not sufficient to full fill the demand of the users. In this situation wireless networks are presented. Wireless network [1] can be categorized as infrastructure networks, Adhoc networks and hybrid networks which combine infrastructure and Adhoc aspects.

An infrastructure network consists of wireless mobile nodes (workstations) and one or more bridges are used to connect the wireless network to the wired network as shown in Figure 1.1. These bridges are called base stations. A mobile node within the network searches for the nearest base station (e.g. one with the best signal strength), connects to it and communicates with it. The important fact is that all communication is taking place between the wireless client and the base station but not between different wireless nodes.

In contrary to infrastructure networks, an Adhoc networks lacks any infrastructure as shown in Figure 1.2. In the Adhoc networks each node has the capability to form a temporary network such as wireless LAN/MANET. All nodes move randomly and able to join or leave any network, nodes in Adhoc networks are functioning as routers and workstation. Nodes are capable to learn and maintain routes to every other node in the network and to propagate packets accordingly.

A hybrid network combines both aspects of infrastructure and infrastructure less networks as shown in Figure 1.3. It makes use of any available base stations as well as it supports infrastructure less communication.
The MANET is a future technology and various challenges are superimposed by this technology. MANET inherited the challenges [2] from fixed wireless cell architecture like lack of bandwidth, power consumption. In addition highly dynamic topology and battery backup problem are introduced. The MANET is used where no infrastructure is available for communication such as monitoring of terrain sites where human being is unable to reach.
oceanography, mission to mars and other planets, disaster area where all infrastructure is destroyed, military tactical application, evolving sub category of the sensor network, war and defence [3] [4] [5]. Some of the primary Issues [6] of Adhoc networks are discussed as follows:

i. IP address configuration issues in address allocation in mobile Adhoc networks
ii. Highly dynamic topology
iii. Routing in mobile Adhoc networks
iv. Mobility
v. Bandwidth usage
vi. Security in mobile Adhoc networks
vii. Battery backup problem

Due to regular movements of mobile nodes some challenges like partitioning and merging in Adhoc networks are introduced. Individual subnet can combine to build a single network or single network may split into multiple subnets.

![Figure 1.4: Initial topology](image)

![Figure 1.5: Topology changes due to movements of node](image)

![Figure 1.6: Another form of topology changes](image)

This creates the problem with the assignment of IP addresses. Duplicity and scarcity of IP addresses are introduced while joining and leaving the network [7]. Nodes are dynamic in the mobile Adhoc networks due to a high degree of mobility topology changes frequently. In the Figure 1.4, Figure 1.5 and Figure 1.6 several nodes such as node A, B, C, D, E and F are forming different topology due to mobility in MANET.
Due to the mobile nature of nodes in MANET, the traditional routing technique does not work efficiently and not supported because parameters changes accordingly. So routing in MANET is a complex task. Routing protocols in MANET are categorized as reactive and proactive routing protocol. Routing protocols [8] are based on reactive or proactive functionality. One of the primary approaches to routing is to decide whether the calculation of routes is a proactive one or a demand based operation. The former, called proactive routing protocols continuously evaluate routes. When a node wants to transmit, a route is known and immediately available. On the other hand, reactive routing protocols do not maintain routes between all nodes at all times instead they maintain routes on demand or on the basis of need.

The study introduces each of these protocols and proceeds to do a comparative analysis [9].

Proactive routing protocols: Some proactive routing protocols are such as DSDV [10], CGSR [11] and Wireless routing protocol [12]. These are table-driven protocols. The DSDV protocol is based on the Bellman-Ford routing algorithm [13] and relies on routes weighed by hop numbers, prioritized using sequence numbers, and periodic broadcasting to maintain relevance of routes. CGSR differs in that it manages to address based on a hierarchy of cluster head; the internal non-head nodes transmit only to the cluster heads. WRP is a path finding algorithm [14] that performs consistency checks on neighbour information, thus providing faster recovery in case of link failures.

Some examples of reactive protocols are AODV [15] and DSR [16]. AODV is built on DSDV, but calculates routes only when the source needs to transmit. This minimizes the number of broadcasts as opposed to DSDV, thus utilizing lesser bandwidth. But, the flip side to demand based route calculations are having a greater percentage of broken source-to-destination links. However, AODV avoids such additional delays by using distance vector routing. Nodes that are not on a particular path neither maintain routing information, nor participate in routing table updates. The DSR uses source routing, which means that the sender uses the hop-by-hop route to the destination.

In this case the node maintains route caches containing the source routes it is aware of, and source route in the packet headers are carried by the data packets. This excessive route data caching introduces delay and throughput penalties, but keeps the routing load low, thus saving valuable bandwidth. Energy aware routing protocols for MANETs differ from wireless infrastructure networks in that they have the structure and characteristics of a low-power radio network [17]. Thus a novel approach to routing in MANETs determines routes based on the energy profiles of nodes rather than distance (number of hops).
Mobility of nodes can be defined in terms of speed [18]. The study concerns mobility scenarios like Random Waypoint, Group Mobility, Freeway and Manhattan models [19]. Furthermore, it is easier to launch attacks on MANETs than on infrastructure based wireless networks because there is no central base controlling identity of participating nodes. A battery is a big hazard to the environment and Adhoc networks are deployed where there is no infrastructure then in this case battery has an important role. Whatever the application we are going to design, constraint of battery must be considered.

1.2 Statement of the problem

The objective of the work is to propose a framework for IP address in the MANET and to design the algorithm for auto IP address configuration in case of joining and merging of the Adhoc networks. This main objective may be subcategorized as

- To design an algorithm for auto address configuration.
- To analyze the performance of the network in case of merging and partition.
- To analyze the performance of the network in case of merging and partition with mobility and scalability.
- To observe the performance comparison and validation of the approach.

1.3 Organization of Thesis

The structure of this thesis is described in chapter-wise.

In Chapter 2, there is a discussion over literature review of the previous work done by the researchers. Next, issues regarding IP address configuration in Adhoc environment and discussion over how to solve the problem of IP address configuration are discussed. And then on the basis of literature review research gaps are identified.

In Chapter 3, framework for address auto configuration of Adhoc environment is proposed to communicate with public network. Algorithm for network partition and joining of individual subnet is proposed for Adhoc environment. All the possible cases are investigated for network partitioning and merging of network with authentication.

In Chapter 4, Algorithm is deployed and simulation is carried out to find out the possible outcomes of the simulation and results for merging of the network are measured. In this chapter different scenarios are taken and varying network density of mobile nodes is considered to evaluate the performance of the proposed algorithm. For the verification of the results we compare the results with conventional models available for IP addressing.

In Chapter-5, the proposed algorithm is used to evaluate the performance of the network in the case of graceless leaving. Graceful leaving is not considered for performance evaluation.
because in this case the IP address of leaving node is restored and it has not much impact on the performance of the network. Simulation in the case of partition is done with the help of various scenarios and for the varying density of the network. The verification of the results and the outcome of the simulations are compared with previously available models for IP addressing.

In Chapter 6, performance of the proposed algorithm for merging and partition is checked when independent networks are merged with mobility and when a MANET is partitioned into different sub MANETs. This chapter also measures the effect on the network performance where the speed of the mobile nodes is the main concern. The results shown in this chapter prove that the performance degrades when mobile nodes moves with high speed.

Chapter 7 concluded the thesis by presenting the summary of the work and describing the key contribution. In this chapter we also identify and describe the scopes of possible future work for IP address configuration in Adhoc networks.