Chapter 3

Research Design and Methodology

3.1 Introduction

The discussion in this chapter centers on the experimental methodology used in simulation. The chapter begins with problem statement, objectives of the study including the limitations and scope of the study. Finally the chapter ends with the necessary details of research design used in the study.

3.2 Statement of Problem

Up till now researchers have concentrated either on designing new routing protocols or improving existing MANET routing protocols. Different routing protocols have been used in research using different simulators. Finding of these studies shows some inconsistency in the results. Most of the previous studies have been conducted for the less number of nodes, with slow speed and with small terrain size showing inconsistency in results. Therefore, the findings of these studies cannot be generalized. Furthermore, it is difficult for one to choose an appropriate routing protocol for a given MANET. The present study is a step forward to find an appropriate routing protocol for a given MANET by testing the different routing protocols for prominent scenarios.

In MANET, node mobility and collision (due to interference), are two major factors leading to route/link errors Lenders et al. (2006). In the present study, the researcher is trying to analyze the impact of node mobility in MANET for which two main problems are to be addressed:
i) Impact of node mobility on the performance of routing protocols in MANETs.

ii) Effect of mobility models on the performance of routing protocols in MANETs.

To find the solution of above problems, various MANET routing protocols have been investigated with varying number of nodes, mobility rates, and traffic patterns using various mobility models.

3.3 Objectives of Research Work

The objective of this study is to investigate the impact of node mobility on MANET routing protocols. The following sub objectives serve the main objective:

i) To analyze the effect of various existing mobility models on performance of routing protocols in MANET using simulation study.

ii) To evaluate the performance of existing routing protocols in MANET.

3.4. Scope of the Work

In wireless communication, the MANET has been a challenging field for the researchers. Due to the demand of modern age there is rapid growth in mobile communication technology, and so the mobile Ad-hoc network has become a more vibrant area of communication systems. In this study, the behavior analysis and comparison of the routing protocols under different mobility scenarios has been evaluated using QualNet 5.0.2 simulator and results of the simulations have been presented.

Focus of the study is on the performance evaluation of the routing protocols under different mobility models. To conduct performance analysis of routing
protocols, researcher has used various metrics like average throughput (bits/s), average end-to-end delay (s) and average jitter (s). The study also includes the CBR, and FTP traffic patterns.

3.5. Limitations

Following are not under the purview of the study:

i) Algorithm implementation and design issues of routing protocols have not been studied.

ii) Energy consumption of routing protocols has not been studied.

iii) The Pedestrian mobility model was not considered in the study because of technical limitations in their implementation in simulation.

iv) The security issues have not been considered under the study.

v) The Variable Bit Rate (VBR) traffic generator was not used in the study.

3.6 Research Design

It has been assumed that the mobility affects the performance of routing protocols in MANETs. This unique assumption needs to be verified by conducting simulations over the MANETs reactive and proactive routing protocols in same tune to meet research objectives framed above.

The QualNet5.0.2 is a network simulator which has been used for performance evaluation of routing protocols. The following simulation parameters have been considered:

i) Varying node density: The different numbers of nodes have been deployed randomly over the deployment region.
ii) Different mobility models have been used like Random Waypoint mobility model, Group mobility model, and File mobility model.

iii) Varying node speed.

iv) Different traffic patterns like Constant Bit Rate (CBR) and File Transfer Protocol (FTP) have been applied between different source-destination pairs.

v) The simulation results have been analyzed on the basis of performance metrics and conclusions have been drawn from these studies.

3.7 Tools and Techniques

Routing protocols in MANETs play a vital role in effective communication. The number of network simulators are available to evaluate the performance of routing protocols namely QualNet, NS-2, OPNET, P2PSim, PeerSim, OSA, GTNETs, simscript, Traffic, etc. The researcher has used the following simulator and operating system:

i) **Simulator:** Scalable Network Technologies Inc. developed QualNet as a commercial version of GloMoSim network simulator which is mainly used for wireless networks, Qabajeh et al. (2012)\(^6\). One can predict the behavior and performance of the networks to improve the design, operation and management using the QualNet5.0.2 simulator. QualNet is a commercial simulator which is widely tested and accepted for MANET's research.

ii) **Operating System:** UBUNTU operating system has been used to conduct the simulation study using QualNet simulator.

iii) **Application Software:** The QualNet5.0.2 has also been used for metrics preparation and plotting graphs. The results received in the form of .stat
files from simulator of different network performance metrics have been analyzed. The Microsoft Office Excel 2007 is used for data analysis and plotting graphs.