RELIABILITY MEASURES AND EVALUATION OF MOBILE AD-HOC NETWORKS

ABSTRACT

Over the last few decades, wireless communication devices like mobile phones, PDAs, mobile computers *etc*., have ventured into the personal lives of people living around the globe. In reality all these devices are equipped with one or more wireless networking interfaces like Wi-Fi and/or Bluetooth using which one can communicate with the other through wireless media. These devices can connect with each other either directly (single-hop) or through intermediate users (multi-hop) in a decentralized fashion giving rise to an arbitrary/dynamic topology called self-organising networks "The Ad-hoc networks".

A mobile ad hoc network is a network with a set of mobile users (homogenous/heterogeneous) that are capable of communicating with the mobile users that lie within the vicinity of each other without relying on any predefined infrastructure. The mobile ad hoc network has wide range of applications mainly used for sensing, military purposes, environmental monitoring, medical monitoring, entertainment, advertising, peer-to-peer applications, risk management *etc*. This is currently an interesting research area and its demand to have reliable communication has attracted the researchers to work on the reliability aspects of such networks.

In this thesis, we deal with determining the reliability of MANET by modelling it using Geometric Random Graph and evaluating these networks using simulation approach. The theoretical approaches available for the wired networks are inadequate at modelling of the MANET because of its inherent properties like changing topology, mobility, flexibility and many more features. Moreover, these networks are highly complex and hence computing reliability of MANET is #NP hard, therefore estimation using simulation often becomes a favourable choice.

In our work, the MANET is represented using Geometric Random Graph *i.e*., $G(V, L, \tau)$ at a particular time instant. The MN move according to random waypoint mobility model with their time-to-failure to follow any statistical distribution while the link creation (deletion) is a function of distance and nodes transmission range. Algorithms have been developed using Monte-Carlo simulation approach to evaluate the MANET reliability under

different scenarios *viz*., with no link capacity constraints; the effect of propagation models on reliability and finally considering link capacities; with and without mobility conditions. An attempt has been made to address all the issues by applying the developed algorithm on a mobile ad hoc network of 18 nodes moving with a velocity between 3 mph to 6 mph and communicating with a transmission range of 3 miles. All the reliability metrics have been evaluated and our results help in deciding the optimum number of nodes needed to communicate with a desired transmission range operating and covering large geographical area under any specified environmental scenarios.

Keywords: Ad-hoc network, Mobility Models, Geometric Random Graphs, Propagation Models, Monte-Carlo Simulation, Network Reliability.