Chapter 13
A Comparative Study of Evolutionary Algorithms for Maximizing Reliability of a Flow in Cellular IP Network

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ABSTRACT

The rapid development in technology, witnessed in daily communication, especially in wireless communication, is a good motivation for performance improvement in this field. Cellular IP access network is a suitable environment where a micro mobility of mobile users is implemented and managed. The reliability of Cellular IP network during the communication is an important characteristic measure and must be considered while designing a new model. Evolutionary Algorithms are powerful tools for optimization and problem solving, which require extracting the best solution from a big search space. This chapter explores the reliability issue in Cellular IP of a flow of packets passing through the route from a source to a destination. The main aim of the chapter is to maximize the reliability of the flow passing through a route having number of routers. Two Evolutionary Algorithms (EAs), Genetic Algorithm (GA) and Particle Swarm Optimization (PSO), have been used for this purpose, and a comparative study between the two is performed. Experimental studies of the proposed work have also been performed.

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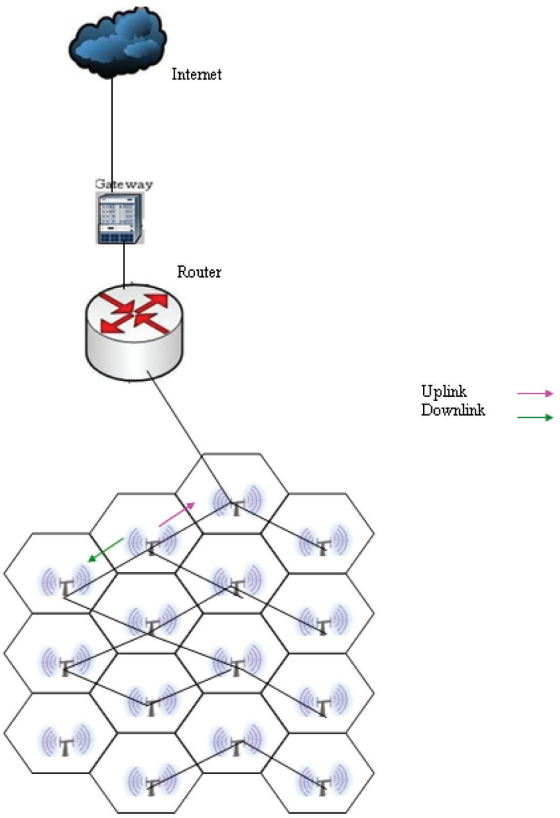
INTRODUCTION

Different operations such as handoff, paging and routing are performed by the Mobile Hosts (MHs) in Cellular IP network, which consists of many cells controlled by the base stations (BSs). Routing, in Cellular IP network, is done on hop-by-hop basis. The structure of Cellular IP network, depicted in Figure 1, explains the reason for hop-by-hop routing. Each base station in the network is configured with a downlink and an uplink and when a packet destined to a MH encounters a BS it simply forwards it to the next hop as per the routing information available in the routing cache (RC) with each BS (Campbell, & Gomez, 2000). Routing is an important operation as a good deal of processing time is involved here that desires the components to be available during this period to make the routing reliable.

Technically, base stations in Cellular IP networks serve as routers for a flow of packets intended to be sent to a MH under the control of BS till it reaches the final destination. During the routing operation, each BS checks it's RC to find the route through which the flow is to be directed. Working as a router, BS's CPU is involved in packet processing operation. Some amount of time is involved to process a packet at CPU router. This time period is important for a flow as the routers should not fail during this period for reliable transmission. Router CPU is a scarce resource (Tanenbaum, 2004) and the reliability of the flow should be maximized in Cellular IP network.

It is important in Cellular IP networks how the data packets are transmitted and processed through a route. Doing so is an important job to be done in this type of wireless networks, which manage the micro mobility of the users and the time is an important parameter in it. Reliability is the probability that the network, consisting of various components, performs its intended function for a given time period when operated under normal (or stated) environmental conditions. The

Figure 1. Structure of cellular IP network



unreliability of a connection is the probability that the experienced outage probability for the connection is larger than a predefined maximum tolerable value. The connection reliability is related to the traffic parameters (Zhao, Shen, & Mark, 2006). Base stations in a wireless cellular IP network environment are prone to failure (Prakash, Shivaratri, & Singhal, 1999). Due to the failure of a base station, all the connections in the failed cell area get terminated and all the services are interrupted until the failed base station is restored. Base station failure significantly degrades the performance and bandwidth utilization of the Cellular IP networks. Specifically, services for high priority ongoing calls such as real-time traffic could be interrupted, which is usually not acceptable.