Chapter 5
An Analysis of Traffic and Throughput for UMTS Packet Core Networks

Ye Ouyang
Stevens Institute of Technology, USA

M. Hosein Fallah
Stevens Institute of Technology, USA

ABSTRACT

Mobile packet services are penetrating mobile markets rapidly. The mobile industry relies heavily on data services to replace traditional voice services. Designing a reliable packet service network is critical to the mobile operators' ability to maintain their core competence in a data service market. The current literature provides many practical tools and theoretical methods to design, plan and dimension Global System for Mobile Communications (GSM) and Universal Mobile Telecommunications System (UMTS) radio networks but overlooks the algorithms of network plan and dimensioning for the core networks. This paper introduces the algorithms to dimension the throughput for packet switched domain of a UMTS network. The analysis is based on the traffic and data throughput generated and absorbed in the interfaces of network entities in UMTS PS network. A case study is provided to verify the algorithms created for UMTS PS network. This paper provides UMTS PS network operators an optimum network size and network structure to deliver an optimum quality of service for users.

INTRODUCTION

Packet switched domain of third generation (3G) UMTS network serves all data related services for the mobile subscribers. People have a certain expectation for their experience of mobile data services that the mobile wireless environment has not fully met, since the speed at which they can access their packet switched (PS) services has been limited. Mobile operators realize that if they are to succeed in today's wireless com-

DOI: 10.4018/978-1-4666-0050-8.ch005

munications landscape, they must address the quality of service for their packet service users. Simply adding more bandwidth to accommodate increased packet switched traffic is an expensive alternative. Hence, the mobile operators are faced with the issue of how to do more with less? The answer is to ensure a reasonable dimensioning for UMTS packet switched (PS) network while maintain the network quality of service.

Radio access solutions are a primary concern of the UMTS deployment strategy, as it impacts the mobile operators' most valuable asset: spectrum. As an equally important part of this formula, the core network will play an essential role in enhancing mobility, service control, efficient use of network resources and a seamless migration from 2G/3G to 4G. Hence the network evolution calls for a transition to a "flat," all-IP core network with a simplified architecture and open interfaces.

UMTS Packet Switched (PS) network is a typical data network in which data traffic, particularly with streaming media services, is live, extremely time sensitive to delay, latency, jitter, and non-tolerant of congestion. For example, a small minority of packet service subscribers running File Transfer Protocol (FTP), streaming video or peer-to-peer (P2P) file sharing applications can generate enough traffic to congest UMTS PS networks and impact the majority of subscribers using interactive Web browsing and E-mail applications. As a result, mobile operators must find algorithms and rules that will dimension their emerging 3G PS networks, while addressing their potential 4G deployment requirements and that will not require a "forklift" upgrade.

In order to accurately plan, design, and dimension the UMTS PS network, this paper will develop the algorithms of traffic and throughput for the UMTS PS network entities (NEs). The analysis will be based on the live traffic and throughput generated or absorbed in the interfaces of PS NEs. A case study is provided to verify the algorithms created for UMTS PS domain. This paper is aimed at helping UMTS PS network operators dimension an optimum network size and build an optimum network structure to deliver an optimum quality of service for users.

In addition, the network optimization and expansion is the further effort for the mobile operator after the rolling out of mobile networks. To minimize the CAPEX/OPEX and maintain the QoS of mobile core networks, we propose that the impact of cell cite re-homing on the mobile core should be studied. It is believed that the appropriate cell site re-homing in radio domain, via correct algorithms applied, not only optimizes the radio network but also helps improve the QoS of the core network and minimize the mobile operator's CAPEX/OPEX investment in their core networks.

The rest of the article is organized as follows: the literature in the related area and the challenges in dimensioning mobile packet core networks are summarized. The architecture of the UMTS packet core network and in particular the key network entities in UMTS packet domain is then introduced. The paper also discusses the algorithms for traffic and throughput in those interfaces of UMTS packet core networks such as Iu-PS, Gn, Gp, Gr, and Gi interface and provides a case study to illustrate application of the algorithms.

LITERATURE REVIEW

The current literature provides many practical tools and theoretical methods to design, plan and dimension GSM and UMTS radio networks but overlooks the algorithms of network plan and dimensioning for GPRS (General Packet Radio Service) network, packet switched domain of UMTS network, and IP Multimedia Sub-system (IMS). Also no previous literature provides a unified approach to calculate the throughput or traffic for UMTS packet switched network. Very few studies have been made on the wireless core network planning and dimensioning topics. This can be explained by two facts that both packet switched domain and circuit switched domain in