Available online at www.sciencedirect.com
SCIENCE DIRECT
Computer Communications 28 (2005) 393–404
computer communications
www.elsevier.com/locate/comcom

Quality of service and performance issues in multiservice networks subject to voice and video traffics

Fabien Houéto, Samuel Pierre*

Department of Computer Engineering, École Polytechnique de Montréal, P.O. Box 6079, Station Centre-ville, Montreal, Que., Canada H3C 3A7

Received 8 April 2004; revised 9 September 2004; accepted 14 September 2004
Available online 18 October 2004

Abstract

Third generation networks tend to integrate an ever increasing number of services. Thus, standards and protocols such as the UMTS and Wireless Access Protocol (WAP) should allow any mobile user, in addition to telephony, to navigate the Web, have a videoconference call, etc. However, the integration of services raises a certain number of problems. For example, the advent of new services (such as the Internet) has questioned the traditional traffic models used in the telecommunications world. New models have then been proposed to take into account bursty and self-similar traffic. But in third generation networks, even if several studies have been dedicated to the analysis of the performance of radio technologies, few have been done on the analysis of these networks from an application perspective, when various types of traffic are aggregated. In this paper, the focus is on the performance issues arising in UMTS third-generation wireless networks, subject to voice and video traffics. For that purpose, we adapt existing traffic models or propose new ones, which are based on the UMTS forum specifications and real traffic observations. The models obtained are calibrated and validated by comparison with real traces and used to simulate a UMTS network aggregating various types of traffic. This defines a reference model whose performance was evaluated according to certain metrics of quality of service (QoS). The performance achieved by the implementation is average because the throughputs suggested by the UMTS forum are a little restrictive. It is thus necessary in the design process to carefully define the QoS profiles associated with each class or application. For the streaming class, it would be necessary to install adequate buffers to ensure the quality of service, particularly end-to-end delay. Also, the addition of another QoS management layer has shown to improve the performance.
© 2004 Elsevier B.V. All rights reserved.

Keywords: Quality of service; Multiservice networks; UMTS; Traffic models; Voice and video traffics; Third-generation wireless networks

1. Introduction

The revolution in networking, which started with broadband technologies, made possible a wide variety of services and applications. With the market liberalization, new possibilities lead to new requirements and applications. High-speed networks allow the creation of new applications, which can lead to new problems and new challenges. Wireless networks are commonly used, but user mobility, network management, and current network protocols raise important issues, which must be taken into account in the next-generation telecommunications networks.

Multiservice wireless networks can carry multimedia, voice, data, and video traffic [3,13]. Their architecture integrates broadband and wireless access networks in order to suit multimedia and mobile applications with bursty traffic [7,34]. In high-speed multimedia networks with mobile applications, bursty traffic poses new challenges [29]. In fact, multimedia, voice, data and video network services combined with the challenges in wireless and high-speed networks require new solutions to the problems of synchronization in multimedia systems, dynamic channel assignment in cellular mobile networks, access technologies, quality of service and performance requirements related to the services and applications envisioned [12,13,23].

This paper focuses on the performance issues arising in UMTS third-generation wireless networks considered as integrated multiservice networks. Section 2 sets

* Corresponding author. Tel.: +1 514 340 4711x4685; fax: +1 514 340 3240.
E-mail address: samuel.pierre@polymtl.ca (S. Pierre).

0140-3664/$ - see front matter © 2004 Elsevier B.V. All rights reserved.
doi:10.1016/j.comcom.2004.09.008

Nomenclature[1]

3G	third generation
ATM	Asynchronous Transfer Mode
CBR	Constant Bit Rate
cdf	cumulative distribution function
CDMA	Code Division Multiple Access
DCH	Data Channel
FDD	Frequency Division Duplex
GGSN	Gateway GPRS Serving/Support Node
GPRS	General Packet Radio Service
HIMM	High Interactive Multimedia
HMM	High Multimedia
HTTP	Hypertext Transfer Protocol
IP	Internet Protocol
ITU	International Telecommunications Union
KB	kilobyte
KBps	kilobit per second
MAC	Medium Access Control
MB	megabyte
MBps	megabit per second
MMM	Medium Multimedia
MPEG	Moving Picture Experts Group
nrt-VBR	non-real time Variable Bit Rate
pdf	probability density function
QoS	Quality of Service
s	second
SGSN	Serving GPRS Support Node
TCP	Transmission Control Protocol
TDD	Time Division Duplex
TTI	Transmission Time Interval
UBR	Unspecified Bit Rate
UDD	Unconstrained Delay Data
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
UTRA	Universal Terrestrial Radio Access
UTRAN	Universal Terrestrial Radio Access Network
VBR	Variable Bit Rate
VoD	Video on Demand
WCDMA	Wideband Code Division Multiple Access

the background and characterizes the traffic and network models. Section 3 presents the model implementation. Section 4 analyzes the results obtained in terms of calibration, validation and experimentation on the model. Finally, Section 5 gives some concluding remarks.

2. Background and motivation

The concept of multiservice cellular network implies an integrated infrastructure intended to support various applications and services generating voice and data traffic in a mobile environment. An example of multiservice cellular network is the UMTS system (Universal Mobile System Telecommunications) which is a third-generation (3G) mobile communication system introduced by the International Telecommunications Union (ITU) [33]. In fact, in the context of third generation systems, the ITU introduced six radio access technologies including the UMTS. UMTS is composed of Universal Terrestrial Radio Access/Frequency Division Duplex (UTRA/FDD) and Universal Terrestrial Radio Access/Time Division Duplex (UTRA/TDD) technologies. The majority of 3G technologies including UMTS are based on a Code Division Access Multiplexing (CDMA) access method [32].

The UMTS coverage is organized in a hierarchical way, with picocells inside buildings, microcells in dense urban environment, macrocells in suburban or rural environment, and global cells served by satellites. As illustrated in Fig. 1, a UMTS network consists of three domains: the user equipment domain, the access network domain, and the core network domain.

The traffic in multiservice cellular networks has unique characteristics that raise new challenges [29]. The exponential growth of bursty traffic applications changes the dynamics of the networks and requires a good evaluation of the various service classes, when designing access loops. Moreover, the combination of voice, data, video and multimedia on a single network requires new approaches for the performance evaluation of the services and applications [13,25].

During decades, the traffic of public switched networks was well modeled using various combination of the Poisson process. In 1992, Habibet al. [16] have proposed a voice source model which was primarily an ON–OFF model with exponentially distributed interarrivals. Even if this model remains valid for voice traffic on packet switched networks [4], the advent of new applications, the integration of new

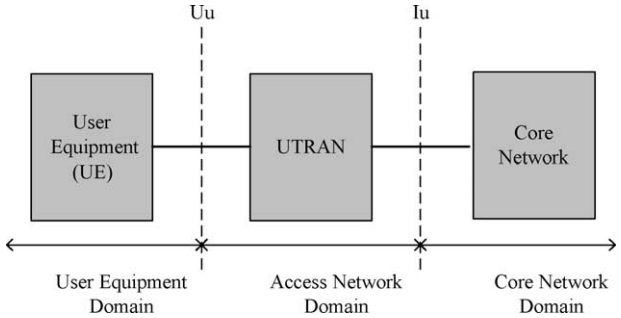

Fig. 1. UMTS domain architecture.

[1] The singular and plural of an acronym are always spelled the same.

Download English Version:

https://daneshyari.com/en/article/10338368

Download Persian Version:

https://daneshyari.com/article/10338368

Daneshyari.com