Towards Unified Services in Heterogeneous Wireless Networks Based on Soft-Switch Platform

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INTRODUCTION

The last two decades, after the telecommunication and computer technology convergence, the world of telecommunication applications has changed dramatically. The traffic needs of the customers have moved from circuit switched applications towards packet switched applications (Cox, 1995). Data traffic, with the characteristics of information transmission in the form of packets and the bursty flow characteristics rather than constant rate, nowadays accounts for slightly more than 60% of the traffic that is transmitted over the backbone telecommunication networks (Esmailzadeh, Nakagawa, & Jones, 2003). In addition to data traffic, multimedia applications like video calls, IP TV, and multimedia messaging traffic (variable rate with real time constraints) was made possible by low cost video digitizing equipment (Houssos, Alonistioti, Merakos, Mohyeldin, Dillinger, Fahrmair, & Schoenmakers, 2003).

Different *Radio Access Technology* (RAT) networks offer different services to their subscribers. This is a big problem for the multimedia industry since it poses certain constraints to the subscribers regarding specific technology handsets. The ideal solution might be a unified handset with a unified service *subscriber identity module* (SIM) card (Louvros & Iossifides, 2004). This handset should be able to access the service by any radio access network, like *Global System Mobile* (GSM) (Siegmund, Redl, Weber, & Oliphant, 1995), *General Packet Radio System* (GPRS), *Universal Mobile Telecommunications System* (UMTS), and *IEEE802.11 standard* (WiFi or WLAN) towards a common core platform. In order to achieve such a unification, the service request should be seamless to the radio access technology network and the core platform should support certain protocols to provide again seamless to the user access to the requested service. Such a platform is already designed and is known as the soft-switch solution. The idea behind the soft-switch solution is the layering of the core network management procedures (mobility management, call control, session management, charging) in such a way that the operator can support all requests as a unified routing process. Moreover the operator can deploy its core switch and transmission network based on a common backbone, designed according to the 3GPP standards on IP or ATM infrastructure, and also to be able to accommodate in the future any new radio access technology network simply and without any serious rearrangement of the existing backbone, thus eliminating cost implementation.

Asynchronous Transfer Mode (ATM) technology is proposed by the telecommunication industry to accommodate multiple traffic types (packet and voice) in a high speed wire-line backbone network. Briefly, ATM is based on very fast (on the order of 2.5 Gbits/sec or higher (Q.2931 ATM Network Signaling Specification, ITU)) packet switching technology with 53 byte long packets called cells being transmitted through wireline networks running usually on fiber optical equipment (Louvros, Karaboulas, Iossifides, & Kotsopoulos, 2003).

This chapter consists of three sections. In the first section there is a quick technical introduction regarding the existing radio access technologies and also the ATM technology. In the second section there is a presentation of the service accessibility regarding the vertical and horizontal integration. Finally in the third section the reader is introduced into the soft-switch solution of the common core platform and the general transport architecture.

TECHNICAL BACKGROUND

Introduction to Radio Access Technologies

In 1991 *European Telecommunication and Standardization Institute* (ETSI) accepted the standards for a new upcoming mobile, fully digital and cellular communication network, GSM. (Louvros et al., 2003). In order for GSM network to follow the evolution towards data transmission, the GPRS and *Enhanced Data for GSM Evolution* (EDGE) network (usually referred as 2.5G) with rates of up to 115Kb/s and 384Kb/s, respectively, were introduced. UMTS is an advanced network evolution of GSM/GPRS, realizing a new generation of telecommunications technology, following the demands posed by moving subscribers of upgrading the existing mobile cellular networks (GSM, GPRS) in nonhomogeneous environments. Moreover to this evolution and based on the more increasing demands of user for faster multimedia applications and demands of industry to boost the existing services into a more unified-multimedia approach, 3.5G and 4G systems (Esmailzadeh et al., 2003) are already under investigation with promising rates of up to 10Mb/s (3GPP Release 5), while with the use of greater bandwidth these rates may raise even more in 4G (Esmailzadeh et al., 2003). On the other hand, during the last five years a standardization effort has started for the evolution of WLANs (WiFi IEEE standard) in order to support higher bit rates in hotspots or business and factory environments with cell radius of the order of 100m. Regarding the different IEEE versions and the cell coverage (microcells or picocells), the WLAN can support data rates of up to 11Mb/s (802.11b) or 54Mb/s (802.11a/g), while rates in excess of 100Mb/s have already been referred (Simoens, Pellati, Gosteau, Gosse, & Ware, 2003).

ATM Technology Overview

ATM technology (ATM Forum, 1996) is proposed by the telecommunications industry to accommodate multiple traffic types (packets, multimedia, voice) in a high speed wireline network. The basic idea behind ATM is to transmit all information in small, fixed size packets called *ATM cells* over all transmission channels (wired or wireless). Formatting fixed size packets of information can emulate the circuit switching techniques of traditional telephony networks (thus performing time sensitive applications even for packets) and on the same time take advantage of the best utilization of transmission lines bandwidth. Moreover in order for ATM to accommodate TCP/IP or UDP/IP traffic (bursty packet traffic with specific constraints in *bit error rate* (BER), maximum bit rates, time sensitivity, and information representation) special *ATM adaptation layers* (AAL) are specified in ETSI standards. ATM technology operates in asynchronous mode and it can switch continuously information from/to different networks (voice, video, data) with variable bit rates. The nodes responsible for asynchronous operation are called ATM switches. They consist of interfaces in order to communicate with various heterogeneous networks as LANs, WANs, Ethernet, and so forth. All these networks transmit information in different bit rates and the ATM switches divide this heterogeneous information (using special AAL) into fixed size packets of 48 bytes to accommodate them into the ATM cells (Louvros et al., 2003).

ACCESSIBILITY OF SERVICES

Vertically Integrated Networks

All existent telecommunication and wireless cellular networks can be described as "vertically integrated." This means that these networks are optimized for a particular service category and typically offer a single service or set of closely related services solely to their users. The PSTN and PLMN are examples of vertically integrated networks. The operator offers everything from subscriber access to service creation and service delivery across a wholly owned network infrastructure. Each vertically integrated network incorporates its own protocols, nodes, switches, transmission backbone technology, and user handset. Traditional Telephony (*Public Switched Telephone Network,* PSTN) and packet data networks, in the vertical approach are still kept more or less separate. The advantage of a vertically integrated network is that, since it supports only a limited range of closely related services, it is relatively easy to ensure reliability, to meet customer expectations in terms of service quality, to provide specific approaches to operation and maintenance network management and to guaranteed service accessibility. However its main disadvantage in our case is the inability to provide a

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