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Strategies for Next Generation Networks Architectures

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INTRODUCTION

As the technological scene of the 21st century changes rapidly, new facts for telecom and networks are coming to the front. Users' growing demands for enhanced multimedia services on one hand and expanding infrastructure on the other lead to the realization of innovative networks, able to serve more subscribers more efficiently. Past technologies have failed to meet the present and immediate needs for integrated services and applications of real time traffic and high data volumes, high speed Internet, video on demand, and mobile communications everywhere and all the time (Chochliouros & Spiliopoulou, 2003). Globalization and deregulation of the market stimulate increased competition and call for integration of existing switching, optical, satellite, and wireless technologies (Commission of the European Communities, 2006).

In the telecom industry new commercial opportunities are introduced. Internet and data services growth, in combination with increased maturity of packet-based technologies, results in the redrawing of traditional telecommunications architectures (Barnes, & Jackson, 2002). High quality, distributed, multiservice networks, with advanced features of flexibility and reliability, are now feasible, accommodating both circuit-switched voice and packet-switched data (Chochliouros & Spiliopoulou, 2005).

This key architectural evolution in telecommunication core and access networks is described under the broad term "*next generation networking (NGN)*." Next generation networks, which are expected to be deployed in the markets over the next years, base their operation on packet transport of all information and services, voice, data, or multimedia. Encapsulation into packets is commonly implemented via the Internet protocol (IP), whereas services become independent of transport details, thus enabling improved functionality at the edge of the network, extreme scalability, and higher availability (European Commission, 2005).

Nevertheless, the industry shift from centralized switches to "next generation" distributed, enhanced service platforms arises very important issues. Interoperability with existing networks is implicit, while great challenges appear in the conversion strategies towards implementing and exploiting the new architecture. Conventional communication systems need to evolve smoothly to NGN, through well-defined and carefully-planned transition procedures, in order for true convergence to take place.

BACKGROUND

According to the International Telecommunication Union (ITU) Study Group 13 Recommendation Y.2001 (ITU-T, 2004a), a NGN is defined as a packet-based network able to provide telecommunication services and make use of multiple broadband, quality-of-service (QoS)-enabled transport technologies. Consequently, such a "network" possesses various service-related functions that are all independent from any underlying transport-related technologies. Therefore, it enables unfettered access of users to competing providers and services of their choice. In addition, it can support generalized mobility which allows consistent and ubiquitous provision of a great portfolio of services to users.

The first provision of next generation networks was specified by the 3rd Generation Partnership Project (3GPP) with the IP multimedia subsystem (IMS) architecture (Grida Ben Yahia, Bertin, & Crespi, 2006a; Grida Ben Yahia, Bertin, Deschrevel, & Crespi, 2006b), which can be adapted to implement common services over various types of networks such as wireless local area networks (WLANs). The European Telecommunications Standards Institute (ETSI) Group of Telecommunication and Internet Converged Services and Protocols for Advanced Networking (TISPAN) also specified the interfaces and adaptations to control digital subscriber line (xDSL) access networks with IMS. In addition, TISPAN defined gradual public switched telephone network (PSTN) replacement by NGN technology. Oncoming NGN services need to be configured for coherent interaction with Internet service elements in order to provide a complete and integrated session-based service (European Commission, 2006).

NGN BASIC FEATURES

Architecture

In general, the main difference between traditional telecommunications services and services of the next generation (Knightson, Morita, & Towle, 2005) lies in the shift from many separate vertically integrated application-specific networks to one single network capable of carrying all potential applications. This "horizontal" approach, where each layer provides reusable elements to the other layers implies the separation between transport, control, and application procedures (Grida Ben Yahia et al., 2006a, 2006b). Indeed, the new connectivity network can carry the required information from source to destination, while access, transport, control, and service layer functions remain clearly separated. Moreover, the presence of open interfaces guarantees interoperability between layers and seamless control of multiple transport technologies, such as asynchronous transfer mode (ATM), IP, time division multiplexing (TDM), frame relay (FR), wavelength division multiplexing (WDM), and so forth. With the realization of NGN, users are capable of communicating data, voice, and multimedia over a common infrastructure, with customized QoS (Bar; 2003; Tzounakis, 2003).

The basic architectural building blocks of a next generation network include a media gateway, a call server, a media server, and an application server (Wen Yao, Fang, Jian Xue, & Zhi Guang, 2004). Their specific roles are very briefly discussed in the following sections:

- The media gateway operates as a "translator" between media formats of the access networks and the packet NGN. It collects call records and is responsible for alarm reports of abnormal events to the call server, internal switching, and media stream policy. It supports the main routing protocols and procedures for operation and management of the entire network.
- The call server has important control functionalities over the media gateway. It supports standard protocols for authentication, authorization, and accounting (AAA), call routing and signalling, performance management, and administration. It provides interfaces with other call servers, media gateways, and media servers, with standard application programming interface (API) for ease of deployment.
- The media server is the entity that actually allows applications to interact with each other. It is responsible for media resource functions such as compression and transcoding and has appropriate interfaces to network main protocols in the NGN.
- Finally, the application server is dedicated to the support of routing services and the control of network elements performing AAA applications. Moreover, it provides registration mechanism support and encryption procedures to ensure secure access.

A great variety of technologies is currently feasible through NGN architecture, including xDSL, synchronous digital hierarchy (SDH/SONET), dense WDM (DWDM), gigabit Ethernet, local multipoint distribution service (LMDS), point-to-multipoint radio (PMP Radio), ATM and, of course, IP.