Chapter 12
Modeling and Simulation of Traffic with Integrated Services at Media Getaway Nodes in Next Generation Networks

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ABSTRACT
This paper is devoted to modeling and simulation of traffic with integrated services at media gateway nodes in the next generation networks, based on Markov reward models (MRM). The bandwidth sharing policy with the partial overlapped transmission link is considered. Calls arriving to the link that belong to VBR and ABR traffic classes, are presented as independent Poisson processes and Markov processes with constant intensity and/or random input stream, and exponential service delay time that is defined according to MRM. Traffic compression is calculated using clustering and learning vector quantification (e.g., self-organizing neural map). Numerical examples and simulation results are provided for communication networks of various sizes. Compared with the other methods for traffic compression calculations, the suggested approach shows substantial reduction in numerical complexity.

INTRODUCTION
The next generation networks (NGNs) are expected to be packet-based networks that provide various services including traditional telecommunications. The NGNs use broadband transport technologies that enable quality of service (QoS) management, and in which service-related functions are independent from underlying transport-related technologies. Additionally, the next generation networks offer unrestricted access to different service providers and support generalized mobility that allows consistent and ubiquitous provision of services to users. The NGNs that we consider in this paper can be defined with the following fundamental characteristics, including:
Modeling and Simulation of Traffic with Integrated Services at Media Getaway Nodes

• Packet-based transfer;
• Control functions that are separate for bearer capabilities, call/session, and application/service;
• Service provision that is largely independent from the network;
• Support for a wide range of services, applications and mechanisms, based on service building blocks that include real-time/streaming/non-real-time services, and multi-media;
• Open interfaces;
• Broadband capabilities that provide end-to-end QoS, and transparency;
• Ability to interconnect with legacy networks;
• Generalized mobility support;
• Converged services between Fixed/Mobile;
• Backward compatibility and support for IP based addressing schemes, including for a variety of IP address recognition schemes designed for routing in IP networks; and
• Unrestricted access to different service providers.

Furthermore, the next generation networks, considered in this paper, have to support unified service characteristics as well as convergence of broadcast and telecommunications. The NGNs architecture is layered, including the transport layer and the service layer, with the boundaries that are strictly defined, and with the following interfaces that have to be available:

• User-to-Network Interface (UNI);
• Network-to-Network Interface (NNI);
• Application-to-Network Interface (ANI).

The transport layer provides a connection between the outer NGN elements (such as, for example, the user terminals), and the elements located at the NGN servers (such as, for example, the databases and media gateways), with access that fully depends on the applied technology. For example, fixed access can be provided through the DSL and wired LAN, and wireless access can be provided through the WiFi, WiMAX, and CDMA.

The service layer provides session and other related services and delivery methods, as soon as the media gateway nodes (MGW) represent the above interfaces between the NGNs and other networks. This paper is devoted to modeling and simulation of traffic with integrated services at the media gateway nodes, based on Markov reward models (MRM), using clustering and learning vector quantification, e.g., self-organizing neural map (SOM). Compared with the other methods for traffic compression calculations, this approach provides substantial reduction in numerical complexity.

NEXT GENERATION NETWORKS AND MEDIA GATEWAY NODES

There are various views on next generation networks, which have been introduced by operators, manufacturers and providers, and that have been subject of research (Cochennec, 2002; Fazekas et al., 2002; Radev & Lokshina, 2008; Lokshina & Bartolacci, 2008). The foremost NGN concept is based on integration of currently divided voice and data networks into a simpler and more flexible IP-based network, where the transport, control and service layers are independent and interact via open interfaces. At the same time, all IP networks allow different access options seamlessly integrated with an IP network layer.

Particularly, the next generation networks contain both wired and wireless access networks. The most important NGN requirements include simplicity to provide new services, portability and accessibility through different networks, and support for Quality of Service. A most popular access to the NGNs is based on the media gateways with changing transfer and switching.
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