Chapter XLIX
High-Speed Multimedia Networks:
Critical Issues and Trends

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ABSTRACT

This chapter presents high-speed networking technologies and standards such as Asynchronous Transfer Mode (ATM), Fast Ethernet, 10 Gigabit Ethernet, Synchronous Optical Network (SONET), Resilient Packet Ring (RPR), Provider Backbone Transport (PBT), Provider Backbone Bridges (PBB), Transport - Multi Protocol Label Switching (T-MPLS) and Optical Transport Network (OTN). It considers the requirements imposed to high-speed networks by multimedia applications and analyses crucial issues of high-speed networking such as bandwidth problems, discarding policies and fast broadcast. Finally, the chapter discusses future trends in high-speed multimedia networking.

INTRODUCTION

High-speed networks are speeding up computer communications and are designed to transmit continuous-media traffic such as audio and video (Mammeri and Lorenz, 2004). Continuous media and data can be integrated in a multimedia service. In the past decade, an integrated communication fabric and spectacular increases in bandwidth have been achieved in order to support multimedia applications. For example, Chen et al. (1999) developed a high-speed network environment to satisfy the special requirements of multiparty multimedia applications such as real-time communication, multicast transmission and media synchronization. High-speed multimedia networks carry continuous-media traffic and pose many design challenges not faced in other sorts of telecommunication systems. Nowadays, it is possible to carry efficiently multimedia over high-speed networks because these networks support the quality of service (QoS) requirements imposed by multimedia applications (Gibson, 2000). These QoS requirements are specified by the following

four closely related parameters: 1) bandwidth on demand, 2) low end-to-end delay, 3) low delay variation (or delay jitter) and 4) acceptable error or loss rate without retransmission as the delay would be unacceptable with retransmission. These parameters may all be required in a multimedia application.

This chapter will present high-speed networking technologies and will analyze crucial issues of high-speed networking such as bandwidth problems, discarding policies and fast broadcast. In addition, it will present various categories of multimedia applications and will discuss future trends in high-speed multimedia networking.

BACKGROUND

In the 1990s, many multimedia services were developed on a single network infrastructure, while many QoS mechanisms emerged in order to support real-time and interactive applications (Aurrecoechea et al., 1998). Giordano et al. (2003) describe the current evolution of QoS architectures, mechanisms and protocols in the Internet, as it is ongoing in the framework of the European Union funded research projects (AQUILA, CADENUS, TEQUILA) on premium Internet Protocol (IP) networks. Recently, an IP based global information infrastructure (GII) was established, which was increasingly based on fast packet switching technology interconnected by fibber optic cable. The IP joined previously disjoint networks, while the World Wide Web (Web) became the killer application that drove bandwidth demand. Today, customers access not only data in Web pages but images and streaming multimedia content using Web browsers.

High-speed networking research moved up the protocol stack to be more concerned with multimedia applications. In the late 1990s, we had the practical application of fast packet switching technology to IP routers, which became IP switches. This was caused by the failure of Asynchronous Transfer Mode (ATM) and the decreasing cost in hardware. This divergence of high-speed networking research into the application layer and switch design had the effect of fragmenting the discipline into other sub-disciplines of communications such as router/switch design and multimedia applications. Two forces resisted the global deployment of a connection-oriented network layer such as ATM.

- In the mid 1990s, the explosion of the Internet and Web entrenched TCP as the end-to-end protocol and IP as the single global network layer.
- The limitations of shared medium link protocols such as Ethernet and token ring were overcome by the evolution of Ethernet to a switched point-to-point link protocol with order-of-magnitude increases in data rate. This evolution additionally reduced the motivation for adoption of ATM using scalable Synchronous Optical Network (SONET) links to increase the bandwidth on network links.

The important characteristics of fast packet switching technologies began to be incorporated into the Internet. For example, IP switches based on the fast switch fabrics and protocol optimisations such as Multi Protocol Label Switching (MPLS) began to be established (Armitage, 2000).

HIGH SPEED NETWORKS

Pillalamarri and Ghosh (2005) write… *"A high-speed network is one where its link bandwidth, the source traffic controls that guarantee QoS for all traffic sources, and the total processing times within the nodes are such that the transmission time of a characteristic frame's transportation across its characteristic distance, is always less than the physical propagation delay of electromagnetic transmission for that distance in that*