Chapter XVII

Introduction to Multicast Technology

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The multimedia communication over the Internet needs the multicasting delivery scheme. In this chapter the sophisticated group management and routing protocols required for multicasting are presented. The different kinds of transport protocols for satisfying the special requirements of the multimedia applications are also included. Finally the current design principles of the multicast-based multimedia applications are discussed.

INTRODUCTION

Most of the widely used traditional Internet applications, such as Web browsers and e-mail, operate between one sender and one receiver. However, in a lot of new software, one sender transmits to a group of receivers at the same time. These programs increase the user's ability to communicate and collaborate, leveraging more value from the network investment. Such typical applications are video and audio conferencing for remote meetings, updates on the latest election results, replicating databases and Web site information, collaborative computing activities, transmission over networks of live TV news or live transmission of multimedia training, etc.

The Internet Multicast Service (McCanne, 1997) is a network technology which extends the traditional, best-effort unicast delivery model of the Internet Protocol (IP) with efficient multi-point packet transmission. With Internet multicast, a single packet is sent to an arbitrary number of receivers by replicating the packet within the network at fan-out points along a distribution tree rooted at the packet's source. This extension to IP, called IP multicast, is an efficient, standard-based solution that is supported in the local networks by the majority of the standard operating systems. With IP multicast, applications send one copy of the information to a group address, reaching all recipients who want to receive it. Without multicasting, the same information must be either carried over the network multiple times, one time for each recipient, or broadcast to everyone on the network, consuming unnecessary

bandwidth and processing resources and limiting the number of participants. IP multicast technologies address the needed mechanisms at different levels in the network and internetworking infrastructure to efficiently handle group communications. Under development since the early 1990s, IP multicast is an important advance in IP networking (Johnson, 1997c).

In order to reach the necessary level of reliability of the multicast delivery, controlling of the packet transmission process is needed by so-called transport protocols. To solve the problem that the multicasting technology does not completely cover the whole Internet, sophisticated applications are also needed to produce real-time multimedia services.

In this chapter the multimedia transport on the Internet, and the IP multicasting technology including the routing and transport protocols, will be described. After them the popular Multicast Backbone (MBone) is discussed. Lastly the different aspects of the policy of the multicast applications are presented detailing the main multicast application design principles, including the light weight sessions, the tightly coupled sessions and the virtual communication architectures on the Internet.

MULTIMEDIA TRANSPORT ON THE INTERNET

The Problem of the Reliable or Real-Time Transport

Due to the advantages in the multimedia and network technologies, multimedia has become an indispensable feature on the Internet. *Multimedia networking* means to build the hardware and software infrastructure and application tools to support multimedia transport on networks in such a way that users can communicate in multimedia (Liu, 1998).

There are other ways to transmit multimedia data, like dedicated links and cables, but they are not practical because they require special installation and new software. Without an existing technology, like Local Area Network (LAN) and Wide Area Network (WAN), the software development may be very expensive.

In the Internet the developed LAN and WAN technologies based on IP protocol stack connect large networks all over the world together. In fact, the Internet has become the platform of most networking activities. This is the primary reason to develop the multimedia supporting protocols over Internet. Another advantage of running multimedia over IP is that users can have integrated data and multimedia service over one single network, without investing in another network's hardware and building up the interface between two networks.

The technology, like live audio and video transmissions in teleconferencing or live broadcasting are called real-time streaming, enables the transmission of digitized audio/video information-in the following referred to as multimedia data-from one user to another via the Internet (Kretschmer, 1998). To avoid the same multimedia stream transmitted separately to each user, in case of a large number of these multicast, capable protocol has to be used. To run real-time traffic or multimedia over the Internet as a shared datagram network, a number of issues must be solved:

- *High bandwidth* is required. Since multimedia means extremely dense data and heavy traffic, the hardware has to provide sufficient bandwidth.
- Multimedia applications are usually related to *multicast*, i.e., the same data stream, not multiple copies, is sent to the thousands of receivers. At a videoconference, for instance, the video data need to be sent to all participants at the same time.

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