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Chapter II

Building Internet Multimedia Applications: The Integrated Service Architecture and Media Frameworks

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The Internet has become a ubiquitous service environment. This development provides tremendous opportunities for building real-time multimedia applications over the Internet. In this chapter, we present a state-of-the art coverage of the Internet integrated service architecture and two multimedia frameworks that support the development of real-time multimedia applications. The Internet integrated service architecture supports a variety of service models beyond the current best-effort model. A set of new real-time protocols that constitute the integrated service architecture are described in some detail. The new protocols covered are those for real-time media transport, media session setup and control, and those for resource reservation in order to offer the guaranteed service. We then describe two emerging media frameworks that provide a high-level abstraction for developing real-time media applications over Internet: CORBA Media Streaming Framework (MSF) and Java Media Framework (JMF), both of which provide an object-oriented multimedia middleware. The future trends are also discussed.

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INTRODUCTION

The Internet has gone from near-invisibility to near-ubiquity and penetrated into every aspect of society in the past few years (Deptartment of Commerce, 1998). The application scenarios have also changed dramatically and now demand a more sophisticated service model from the network. A *service model* consists of a set of service commitments, in other words, in response to a service request the network commits to deliver some service. Despite its tremendous growth, the Internet is still largely based on a very simple service model, *best effort*, providing no guarantee on the correct and timely delivery of data packets. Each request to send is honored by the network as *best* it can. This is the worst possible service: packets are forwarded by routers solely on the basis that there is any known route, irrespective of traffic conditions along that route. Routers that are overloaded are allowed to discard packets. This simplicity has probably been one of the main reasons for the success of IP technology. The best-effort service model, combined with an efficient transport layer protocol (TCP), is perfectly suited for a large class of applications, which tolerate variable delivery rates and delays. This class of applications is called *elastic* applications. The interactive burst communication (telnet), interactive bulk transfers (FTP) and asynchronous bulk transfers (electronic mail, Fax) are all examples of such elastic applications. The elastic applications are insensitive to delay since the receiver can always wait for data that is late, and the sender can usually re-transmit any data that is lost or corrupted. However, for a real-time application, there are two problems with using this service model: if the sender and/or receiver are humans, they simply cannot tolerate arbitrary delays; on the other hand, if the rate at which video and audio arrive is too low, the signal becomes incomprehensible. To support real-time Internet applications, the service model must address those services that relate most directly to the *time-of-delivery* of data. Real-time applications like video and audio conferencing typically require stricter guarantees on throughput and delay. The essence of real-time service is the requirement for some service guarantees in terms of timing.

There has been a great deal of effort since 1990 by Internet Engineering Task Force (IETF) to add a broad range of services to the Internet service model, resulting in the Internet Integrated Service model (Braden, Clark and Shenker, 1994; Crowcroft, Handley and Wakeman, 1999). The Internet Integrated Services Model defines five classes of service which should satisfy the requirements of the vast majority of future applications:

1. *Best Effort*: As described above, this is the traditional service model of the Internet.
2. *Fair*: This is an enhancement of the traditional model, where there are no extra requests from the users, but the routers attempt to partition up network resources in *some fair manner*. This is typically implemented by adopting a random drop policy when encountering overload, possibly combined with some simple round robin serving of different sources.
3. *Controlled load*: This is an attempt to provide a degree of service guarantee so that a network appears to the user as if there is little other traffic, and it makes no other guarantees. The *admission control* is usually imposed so that the performance perceived is as if the network were over-engineered for those that are admitted.
4. *Predictive service*: This service is to give a delay bound which is as low as possible, and at the same time, is stable enough that the receiver can estimate it.
5. *Guaranteed service*: This is where the delay perceived by a particular source or to a group is bounded within some absolute limit. This service model implies that *resource reservation* and *admission control* are key building blocks of the service.

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