Preface

We are witnessing an explosive growth in use of multiple media forms (voice, data, images and video etc.) in varied application areas including entertainment, communication, collaborative work, electronic commerce and university courses. The increasing computing power, integrated with multimedia and telecommunication technologies, is bringing into reality our dream of real time, virtually face-to-face interaction with collaborators sitting far away from us.

In the process of realizing our technological ambitions, we need to address a number of technology, management and design issues. We need to be familiar with exciting current applications. It is impossible to track the magnitude and breadth of changes that the multimedia and communication technology is bringing daily to us in many different ways throughout the world. Consequently this book presents an overview of the expanding technology beginning with application techniques that lead to management and design issues. Our goal is to highlight major multimedia networking issues, understanding and solution approaches, and networked multimedia applications design. Because we wanted to include diverse ideas from various locations, chapters from professionals and researchers from about thirteen countries working in the forefront of this technology are included.

This book has nineteen chapters, which include the following major multimedia networking areas.

- Development and management of real time distributed multimedia applications
- Audio/video applications and streaming issues
- Protocols and technologies for building Internet multimedia applications
- QOS frameworks and implementation
- Collaborative applications
- Multimedia synchronization in distributed environment
- Multicasting technology and applications
- Use of mobile multimedia over wireless network.

The chapters in this book address the dynamic and efficient usage of the resources, which are the fundamental aspects of multimedia networks and applications. This book also details some current research, applications and future research directions. The following paragraphs are intended to put together the abstracts from each chapter in a manner to provide an overview of the topics covered.

Development and management of real time distributed multimedia applications

Management of distributed multimedia networking along with streaming issues are focused in the first three chapters. Real-time distributed multimedia environments, characterized by timing constraints and end-to-end quality of service (QoS) requirements, have set forth new challenges for the efficient management mechanisms to respond to transient changes in the load or the availability of the resources. Chapter one presents a real-time distributed multimedia framework, based on the Common Object Request Broker Architecture (CORBA), that provides resource management and Quality of Service (QoS) for CORBA

applications. Chapter two presents 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. 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. Chapter three focuses on another important topic in ORB end system research: the design and performance of the CORBA audio/video streaming service specification.

Protocols and technologies for building Internet multimedia applications

Next several chapters focus on the protocols and technological aspects for building networked multimedia applications. Chapter four aims to introduce the potential contribution of the emerging MPEG-4 audio-visual representation standard for future multimedia systems. This is attempted by the 'case study' of a particular example of such a system - 'LipTelephone' - which is a special videoconferencing system. The objective of 'LipTelephone' is to serve as a videophone that will enable lip readers to communicate over a standard telephone connection, or even over the Internet. The main objective of the chapter is to introduce students to these methods for the processing of multimedia material, provide to researchers a reference to the state-of-the-art in this area and urge engineers to use the present research methodologies in future consumer applications.

Recently scientists have been focusing on a new class of application that promises on-demand access to multimedia information such as radio and broadcast news. Chapter five describes how the synergy of speech, language and image processing has enabled a new class of information on demand news systems. In this chapter the ability to automatically process broadcast video 7x24 and serve this to the general public in individually tailored personal casts has also been discussed and some remaining challenging research areas identified. The next chapter presents another application covering open telecooperation architecture for medical telecosultation with modern high power workstations implemented using distributed computing system. The resulting medical Computer Supported Cooperative Work (CSCW) tool is evaluated experimentally. This tool has also the potential to be used in distance education environment. Chapter seven describes a 5 layer multimedia database management system (MDBMS) with storage sharing and object reuse support with application to an instruction on demand system that is used in the realization of several computer science related courses at Tamkang university.

More focus on QOS frameworks and implementation

In multimedia applications, media data such as audio and video are transmitted from server to clients via network according to some transmission schedules. Different from the conventional data streams, end-to-end quality-of-service (QoS) is necessary for media transmission to provide jitter-free playback. The subsequent chapters while dealing with the

protocol and technology aspects also have focus on the QoS frameworks and implementation issues.

Because of wide range of application areas the delivery of high quality video content to customers is now is a driving force for the evolution of the Internet. Chapter eight presents an originally developed video retrieval application with its unique features including a flexible user interface based on HTTP browser for content querying and browsing, support for both unicast and multicast addressing and a user oriented control of QoS of video streaming in Integrated Services IP networks. A part of the chapter is devoted to some selected methods of modelling information systems, the prediction of a system performance, and on influence of different control mechanisms on quality of service perceived by end users.

Chapter nine discusses various issues related to the shaping of Motion Picture Experts Group (MPEG) video for generating constrained or controlled variable bit rate (VBR) data streams. The results presented in this chapter can be utilized not only for network and nodal (buffer) capacity engineering but also for delivering the user-defined quality of service (QoS) to the customers. The next chapter presents a novel traffic shaping approach to optimize both the resource allocation and utilization for VBR media transmission. This idea is then extended to online transmission problems.

The emergence of high-speed networked multimedia systems provides opportunities to handle collection of real-time continuous media (CM) applications. Admission control in CM servers or video-on-demand systems restricts the number of applications supported on the resources. It is necessary to develop more intelligent mechanisms for efficient admission control, negotiation, resource allocation, and resource scheduling with an aim to optimize the total system utilization. In particular, there has been increased interest in I/O issues for multimedia or continuous media. Chapter eleven presents a dynamic and adaptive admission control strategy for providing a fair disk bandwidth scheduling and better performance for video streaming. It also presents a comparison of the simulation result on the behavior of conventional greedy admission control mechanisms with that of the proposed admission control and scheduling algorithm.

The traffic generated by multimedia applications presents a great amount of burstiness, which can hardly be described by a static set of traffic parameters. For dynamic and efficient usage of the resources the traffic specification should reflect the real traffic demand and at the same time optimize the resources requested. To achieve this goal chapter twelve presents a model for dynamically renegotiating the traffic specification (RVBR) and shows how this can be integrated with the traffic reservation mechanism RSVP demonstrating through an example of application that is able to accommodate its traffic to manage QoS dynamically. The remaining of this chapter is focused on the technique used to implement RVBR taking into account the problems deriving from delay during the renegotiation phase and on the performance of the application with MPEG4 traffic.

Audio is frequently perceived as one of the most important component of multimedia communications. Very high transmission delay and transmission delay variance (known as jitter) experienced in the current architecture of the Internet impair real-time human conversations. One way to cope with this problem is to use adaptive control mechanisms. These mechanisms are based on the idea to use a voice reconstruction buffer at the receiver in order to add artificial delay to the audio stream to smooth out the jitter. Chapter thirteen describes three different control mechanisms that are able to dynamically adapt the audio application to the network conditions so as to minimize the impact of delay jitter (and packet loss). A set of performance results is reported from extensive experimentation with an Internet audio tool designed by the authors.

Collaborative applications

The next two chapters have major focus on collaborative applications and their design issues. Rapid Prototyping within a virtual environment offers new possibilities of working. But tools to reduce the time to design a product and to examine different design alternatives are missing. The state of art shows that the current solutions offer a limited collaboration. Within the context of an extended team, the solutions do not address how to move easily from one style of working to another one. They do not define how to manage the rapid design of a complex product. Moreover, the different propositions suffer mainly from the client-server approach that is inefficient in many ways and limits the openness of the system. Chapter fourteen presents a global methodology enabling different styles of work. It proposes new collaboration services that can be used to distribute a virtual scene between the designers. The solution, called the Distributed Building Site Metaphor, enables project management, meeting management, parallel working, disconnected work and meeting work, real time validation, real time modification, real time conciliation, real time awareness, easy motion between these styles of work, consistency, security and persistency.

Much work has been devoted on the development of distributed multimedia systems in various aspects: storage, retrieval, transmission, integration and synchronization of different types of data (text, images, video and audio). However, such efforts have concentrated mostly on passive multimedia material, which had been generated or captured in advance. Yet, many applications require active data, especially 3D graphics, images and animation that are generated by interactively executing programs during an ongoing session, especially of a collaborative multimedia application. These applications demand extensive computational and communication costs that cannot be supported by current bandwidth. Thus, suitable techniques have to be devised to allow flexible sharing of dynamic visual data and activities in real time especially for collaborative applications. Chapter fifteen discusses different types of collaborative modes and addresses major issues for collaborative applications, which involve dynamic visual data from four perspectives: functionality, data, communication and scalability. In this chapter current approaches for dealing with these problems are also discussed, and pertinent issues for future research are identified.

Multimedia synchronization in distributed environment

Synchronization between various kinds of media data is the key issues for multimedia presentation. Chapter sixteen discusses temporal relationship and multimedia synchronization mechanism to ensure a temporal ordering of events in a multimedia system.

Multicasting technology and applications

Chapter seventeen and eighteen has major focus on multicasting technologies. Multicasting increases the user's ability to communicate and collaborate, leveraging more value from the network investment. Typical multicasting 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. Multimedia multicasting would demand huge resources if not properly optimized. Although IP Multicast is considered a good solution for internetworking multimedia in many-to-many communications, there are issues that have not

been completely solved. Protocols are still evolving and new protocols are constantly coming up to solve these issues because that is the only way for making multicast to become a true Internet service. The multimedia transport on the Internet, and the IP multicasting technology including the routing and transport protocols is described in chapter seventeen. It also includes discussions on the popular Multicast Backbone (MBone) and presents different aspects of the policy of the multicast applications detailing the main multicast application design principles, including the lightweight sessions, the tightly coupled sessions and the virtual communication architectures on the Internet. Chapter eighteen continues to describe the evolution of IP multicast from the obsolete MBone (Multicast Backbone) and intra-domain multicast routing to the actual inter-domain multicast routing scheme. Special attention is given to the challenges and problems that need to be solved, the problems that have been solved and the way they were solved. The readers can get a complete picture of the state of the art explaining the idea behind each protocol and how all those protocols work together. Some of the topics discussed are broadly related to address allocation, security and authentication, scope control and so on. Results and recommendations are also included in this chapter.

Mobile multimedia over wireless network

In recent years increasing use of multimedia over the Internet are being experienced in most application areas. The next step in the information age is the mobile access to multimedia applications: everything everywhere any time! The last chapter of this book is a tutorial chapter that addresses a key point of this development: Data transmission for mobile multimedia applications in wireless cellular networks. The main concern of this chapter is the cooperation between multimedia services and wireless cellular global networks. For network developers, the question is what constraints impose multimedia transmission on wireless networks? For multimedia experts, the question is rather which constraints impose the existing or foreseen wireless network standards on multimedia applications? This chapter follows the multimedia expert's view of the problem. Having studied this chapter, the reader should be able to answer several questions like:

Which network will be capable to transmit real-time video?
Does a rainfall interrupt my mobile satellite Internet connection?
When will high bandwidth, wireless networks be operational?
How to tune existing multimedia applications to be efficient in wireless networks?

Audiences

As is evident from the above discussions many different audiences can make use of this book. Students and teachers can use the book in their courses related to multimedia networking. Professionals involved in the management and design of multimedia network and applications will find many solutions to their questions and technological conundrums. Provocative ideas from the applications, case questions and research solutions included in this book will be useful for professionals, teachers and students in their search for design and development projects and ideas. It will also benefit even casual readers by providing them a broader understanding of this technology.

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