



# multimedia communications

**Applications, Networks, Protocols and Standards**

**fred halsall**

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ISBN 978-81-317-0994-8

First Impression : 2007

Fifth Impression : 2011

Sixth Impression :

**Srinivas Institute of Technology**

Acc No. - 21095

Call No. ....

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Published by Dorling Kindersley (India) Pvt. Ltd., licensees of Pearson Education in South Asia.

Head Office: 7th Floor, Knowledge Boulevard, A-8(A), Sector-62, Noida – 201309, U.P, India.

Registered Office: 11 Community Centre, Panchsheel Park, New Delhi 110 017, India.

Printed in India by Saurbh Printers Pvt Ltd

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# **preface**

## **Objectives**

Multimedia communications embraces a range of applications and networking infrastructures. The term multimedia is used to indicate that the information/data relating to an application may be composed of a number of different types of media which are integrated together in some way. The different media types are text, images, speech, audio and video and some example applications are video telephony (speech and video), multimedia electronic mail (text, images and audio for example), interactive television (text, audio and video), electronic commerce (text, images, audio and video), Web TV (text, audio and video) and many others.

In practice, there are a number of different types of network that are used to provide the networking infrastructure. These include not only networks that were designed from the outset to provide multimedia communication services – normally referred to as broadband multiservice networks – but also networks that were designed initially to provide just a single type of service and it is as a result of advances in various technologies that these can now support a range of other (multimedia) services. For example, public (and private) switched telephone networks (PSTNs) were designed initially to provide a basic telephony service but they are now used to support a range of more advanced multimedia applications involving all of the different media types. Similarly, computer networks such as the Internet, which were designed initially to provide general data communication services such as electronic mail and file transfers, can now support a much richer set of multimedia applications.

In terms of the different types of media, text and images are generated and represented in a digital form. Speech, audio and video, however, are generated in the form of continuously varying – normally referred to as analog - signals. Hence in order to integrate all of the different media types together, it is necessary to first convert the various analog signals into a digital form. The integrated digital information stream can then be stored within a computer and transmitted over a network in a unified way. In addition, unlike text and images which are created in the form of a single block of digital information, since speech, audio and video are continuously varying signals, the digitization process can produce large volumes of information which carries on increasing with time. Hence in most multimedia applications, in

order to reduce the volume of information to be transferred, a range of compression algorithms are applied to the different media types prior to integrating them together.

In addition to the compression algorithms that have been used for many years with text and images, there is now available a wide range of algorithms for the compression of speech, audio and video. Until recently, however, because of the relatively low levels of compression that could be achieved, multimedia applications involving speech, audio and video – video telephony and video conferencing for example – required a high-capacity transmission channel to transmit the integrated source information. The rapid advances that have taken place in the field of compression over the past few years, however, mean that the capacity of the transmission channel required has reduced to the point that most types of communication network can now support a range of multimedia applications.

In addition, it is as a result of the same advances in compression algorithms, coupled with the development of the associated integrated circuits, that most television broadcasts are now in a digital form. A major issue in relation to analog television has always been the high level of transmission capacity that is required to broadcast the composite television signal containing the integrated audio and video signals. The move to (compressed) digital means that a transmission channel that was once used to broadcast a single (analog) television program can now be used to broadcast multiple (digital) programs. Moreover, the use of digital transmission means that other digital services can use the same channels so enabling multimedia applications such as interactive television and electronic commerce to be supported.

As we can conclude from this brief overview, the subject of multimedia communications involves a wide range of different subject areas. These include how the different media types are represented in their digital form, the range of compression algorithms that are used with these media types, the communication requirements of the different types of multimedia applications, the operation of the different types of communication networks that are used, the communication protocols associated with these networks and how they have been extended to meet the more demanding requirements of multimedia applications.

In addition, as with all applications that involve the use of a communication network, it is imperative that the two (or more) items of equipment that are attached to the network to provide the service, operate and interpret the transmitted information in the same way. This can only be achieved by the adoption of international standards for all applications and for all of the different types of network. Also their adoption by all the manufacturers of the related equipment. Hence an understanding of the range of standards that have been developed for use with all aspects of multimedia communications is also an important subject area. This book addresses all of these subject areas to a depth that enables the reader to build up a thorough understanding of the technical issues associated with multimedia communications.



## Intended readership

The book has been written primarily as a course textbook for both university and college students studying courses relating to the technical issues associated with multimedia communications. Typically, the students will be studying in a computer science, computer systems, computer engineering or electronic engineering department/school. In addition, it is suitable for computer professionals and engineers who wish to build up a working knowledge of this rapidly evolving subject. At one extreme this requires the reader to understand the techniques that are used to transmit a digital bitstream over the different types of transmission media such as copper wire, coaxial cable, radio and optical fiber. At the other extreme it requires an understanding of the software that is used in the different types of equipment – multimedia PCs and workstations, set-top boxes etc. – that are used to support multimedia applications. The first is the domain of the electronics engineer and the second the computer scientist. The book, however, is suitable for use with courses for both types of student since care has been taken to ensure that the level of detail required in each subject area is understandable by both categories of reader.

In order to achieve this goal, a chapter has been included which describes how the different types of media are represented and, associated with this, how analog signals are converted into a digital form. Also the principle of operation of television broadcasting and computer displays. In addition, a chapter that covers the basic techniques that are used to achieve the reliable transfer of a block/stream of digital information over a transmission channel. These include the essential theory that determines the rate at which data can be transmitted over a channel. Also, the different methods that are used to detect the presence of transmission errors – bit corruptions – in a received block/stream of information and the procedures that are followed when this occurs. The latter form what is called a communications protocol. Hence this chapter also includes an introduction to the subject of protocols to give the reader who has no previous knowledge of this subject the necessary foundation for the later chapters that describe the operation of the different types of network that support multimedia applications.

## 9.1 Intended usage

### To the instructor

As we can see from the list of contents of the book, the book covers a wide range of subject areas each of which is to a depth that makes it interesting and academically challenging. As a result, the book can be used with many different courses relating to multimedia applications and networks. Ideally, in order to obtain a comprehensive understanding of the subject, a set of

courses should be involved which collectively cover the total contents of the book from principles through to details of compression algorithms, applications, networks and protocols. Alternatively, one or two courses could be involved covering a subset of these subject areas. For example, a course may cover the subject areas of multimedia applications, multimedia information representation and the different types of compression algorithms that are used. Another may cover the basics of digital communications and an overview of the operation of the different types of network that are used. Alternatively, a pair of courses covering the detail operation of the Internet and its protocols and the World Wide Web.

As indicated earlier, all of the subject areas are covered to a depth that enables the reader to build up an in-depth technical understanding of the subject of multimedia communications. Hence because of the technical nature of the subject, to help the reader to understand each topic within an area, either a worked example or a relatively detailed diagram is used to illustrate the concepts involved. This is considered to be one of the main advantages of the book owing to the technical detail associated with many of the topics covered. Also, both the examples and diagrams are seen as being particularly useful for instructors as they can be used directly for lectures. To facilitate this, therefore, both the worked examples and all the diagrams are available to instructors in their electronic form so reducing considerably the time required to prepare a set of lectures for a course. These can be downloaded from [www.booksites.net/halsall](http://www.booksites.net/halsall). In addition, each chapter has a comprehensive set of exercises which have been structured to help the student to revise the topics covered in each chapter in a systematic way. Any errors that are found in the text or figures can be reported to me using the email address [halsall@pearsoned-ema.com](mailto:halsall@pearsoned-ema.com).

### **To the student**

The book has been structured to be used for self-study. Worked examples are included in most chapters and, to aid understanding of all the topics that are covered, associated with each topic is a relatively detailed diagram which illustrates the concepts involved. These you should find particularly useful since they facilitate understanding the many technical details associated with many of the techniques that are used. In addition, the comprehensive set of exercises at the end of each chapter have been structured to help you to test your knowledge and understanding of each of the topics covered in a chapter in a systematic way.

# acknowledgments

I should like to take this opportunity to thank various people for their help during the period I was preparing the manuscript. Firstly my postgraduate students and research assistants for their help with obtaining numerous papers and documents relating to multimedia and, in particular, Dr Jurek Wechta for guiding the group and generally keeping the ship afloat in my absence. Also my secretary Irene Dendle for her help in preparing the manuscript and fielding the day-to-day queries relating to my taught masters program. Finally my wife Rhiannon for her unwavering support, patience, and understanding while I was writing the book. It is to her that I dedicate the book.

Fred Halsall  
September 2000

A Companion Web Site accompanies  
**MULTIMEDIA COMMUNICATIONS**



by Fred Halsall

Visit the *Multimedia Communications* Companion Web Site at  
[www.booksites.net/halsall](http://www.booksites.net/halsall)  
to find valuable teaching and learning material including:

**For Students:**

- Study material designed to help you improve student results
- Chapter-by-chapter summaries
- Web links for key multimedia and data communications web sites organised by chapter
- Recommended key readings

**For Lecturers:**

- A secure, password protected site with teaching material
- Downloadable worked examples and diagrams for use in lectures and seminars
- Chapter summaries
- Case notes, points to stress, and teaching tips highlighted for each chapter

Also: This is a regularly maintained and updated site.