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Multimedia and Data Transfer Technology: The Challenges and Delivery

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Abstract

This article deals with multimedia data, which combines basic functions with high quality graphics, sound, video and animation and definitions of multimedia. Also deals with multimedia characteristics, network technology – Ethernet, Provisioning and ATM, bandwidth needs and multimedia networking along with data transfers protocols. Right issues for multimedia content like ownership, general right issues, use of photographs, film clips, music works have been discussed. Also multimedia delivery has been discussed with applications of multimedia. Several implications of bandwidth for large transmission have been explained. Multimedia applications are also highlighted in this article along with the patent issues for multimedia products.

1. INTRODUCTION

In every area of information technology computing, communications and content, there has been tremendous development over the last decade. In the area of content, the society is witnessing the growth both in size and in number of massive public and private databases – bibliographic first, then numeric and now multimedia. This boom is principally technology driven, which arises from the development of optical disc technology, the availability of high quality graphics and imaging, developments in networking and the falling cost of computing power and storage capacity. In the area of communications, there has been enormous development in electronic digital communications via which multimedia information can be transmitted worldwide at an incredible speed. Also seen the convergence of all new information technologies with conventional media.

Information seekers are no longer satisfied with only print based information. One desires to have the information in any form viz. text, data, still image, motion picture and sound. Multimedia systems are applied to a broad range of applications from education to entertainment and specialized systems for military, research and other purposes. This article deals with the data transfer technology and the bandwidth requisites and the challenges for LIS professionals.

2. DEFINITIONS

Multimedia systems combine the digital form of images, graphics, audio, electronic signals or video and hypertext with traditional text data.

Multimedia is more than the text and simple graphics of a regular computer. It combines basic functions with high-quality graphics, sound, video, and animation all in one computer. Multimedia is ideal for things like presentations. Instead of making black-and-white printouts, for example, one can present information on-screen using colour video and graphics accompanied by sound.

The working definition of multimedia is as follows:

'Hypermedia extends the hypertext concept to non-linear and non-sequential links of textual material to all forms of material that may be digitally encoded for storage and retrieval through computer-based systems, including images, sound, graphics and animation. Thus, multimedia refers to a synthesis of text, data, graphics, animation, optical storage, image processing and sound. Clearly, multimedia technology is not a single technology and there is no single product or definable market. It emphasizes technology integration. (Chen, June 1989a; Nov 1989a).

3. CHARACTERISTICS OF MULTIMEDIA

Multimedia can be as simple as a few images with some accompanying text to a multimedia presentation using video clips, sound, images, animation and text. Multimedia files use a lot of data when in a digital format. Video is the most demanding. A PAL signal when digitised can require a data rate of 170 Mbps. Audio is less demanding but still requires 1.3 Mbytes for a 1 minute clip using a Sound Blaster Pro system at 22 kHz sampling rate. Still images require and use more space proportional to their size. Synchronisation of sound and video are important. Sound is likely to brake up if parts of it are lost or delayed in storage or transmission. To accommodate these characteristics, techniques used by the telecommunication networks include compression of data and methods of timing the transmission and replay of multimedia. Data networks and computers have been built in a different way (they are asynchronous) to telephone and TV networks (which are isochronous).

4. NETWORK TECHNOLOGY

Multimedia computers common features include CD-ROM playback, audio processing, front-panel access for most audio connections and a set of loudspeakers. It should be assumed that many peripherals are required for multimedia data and its transfer. The first step to optimized input/output performance is choosing the right networking technology for the application. Some applications need raw available bandwidth, while others need dedicated bandwidth. When the network becomes congested, packets can be dropped. Servers are forced to retransmit data to clients, further congesting the network and degrading performance. Having the right amount of networking bandwidth and being able to allocate it as needs dictate is crucial. The appropriate configuration is critical to meeting the needs of the application, whether it is transmitting small or large packets.

Ethernet - With a wide range of capabilities, such as ease of connectivity and a stable installed base, ethernet is ubiquitous, inexpensive and easy to deploy. Available in 10Mbps, 100Mbps (Fast Ethernet) and 1Gbps (Gigabit Ethernet), with future trends promising 10Gbps, Ethernet provides a scalable platform on which many environments can succeed.

Provisioning - Sometimes a source of strength can also be a failing. While ethernet's single fat pipe approach enables high performance for single applications, it prohibits multiple applications from sharing bandwidth simultaneously. As a result, applications may have to get in line to send data. This dilemma can be solved by provisioning - allocating bandwidth, setting priorities and bounding delays. Ethernet supports this capability only with additional software, while ATM supports it natively. Understand the alternatives and associated overhead and make appropriate trade-offs.

ATM - A network technology based on cell switching, ATM uses small, fixed-sized cells and high-bandwidth, low-latency switches. ATM can deliver approximately the same performance as Gigabit Ethernet for many data centre applications. This technology offers a deterministic quality of service and the mixture of multimedia data. ATM enables the network to be tailored to the application. ATM LAN interfaces are available at 155Mbps and 622Mbps.

4.1 Bandwidth Needs

Simply selecting a networking technology and topology is not enough. Maximizing the effective bandwidth is essential to ensure that servers can adequately supply the organization with information and resources. Most networks transfer information using TCP/IP, a protocol that supplies a logical client/server communications structure that transparently handles inter-process communication details. The protocol of choice for the internet and intranet, TCP/IP consists of a network layer (IP) and a transport layer (TCP). These layers have unique characteristics and limitations that need to be considered when maximizing bandwidth. The transport layer limits the TCP packet size to the maximum network interface frame size to avoid fragmentation.

There are many techniques that one can use to reduce the problem, in case of limited bandwidth, which are as follows:

Compression is one easy solution for the limited bandwidth. One can apply even data-specific compression eg. Still pictures can be compressed with JPEG, Wavelet compression or GIF. Moving pictures can be compressed with MPEG, Motion JPEG, Cinepak or one of the other QuickTime codecs. Audio can be compressed with dictionary-based compression algorithms.

Different users require different compression methods. Video conferencing must be done in real time so fast encoding and decoding is needed. Video film distribution via cable networks, radio or CD is essentially a playback process, so encoding is not time critical and decoding should be easy to implement to reduce consumer costs. The MPEG standards address these applications.

Another way to cope with limited bandwidth is to write programs that take care not to waste bandwidth. To reduce packet size, wherever possible Bolo uses bytes instead of 16-bit or 32-bit words.

A third way to cope with limited bandwidth is simply to send less data. One can use lower resolution also.

Regardless of the network, higher data speed may encourage greater take-up of wireless application protocol (WAP) services and other forms of mobile content delivery. Version 2.0 of WAP will include push capabilities, enabling organisations to use it to send short message service - style alerts or other time-sensitive data. It also provides support for colour and greater use of multimedia, as well as a wider range of user interface elements. Use of the Extended Hypertext Markup Language (XHTML) rather than the Wireless Markup Language (WML) for content brings WAP applications closer to their conventional HTML-based equivalents. The use of WAP may begin to deliver more usable applications, both for business and consumer use, helping some of the original expectations of WAP.

Use of ISDN is another way of controlling the limited bandwidth as

- ISDN is scalable, flexible; voice, data & video traffic are easily accommodated.
- ISDN is not a point-to-point circuit but a switchable, dial-up circuit via PBX or router.
- ISDN can be folded into current and future LAN/ WAN technologies.

Also, there are economies of scale due to the ability to combine voice, data, and video traffic over the same facilities.

5. MULTIMEDIA NETWORKING

Computer networks were designed to connect computers on different locations so that they can share data and communicate. Animation, voice and video clips become more and more popular on the Internet. Multimedia networking products like Internet telephony, Internet TV, video conferencing have appeared on the market. Now people are using multimedia products in distance learning, distributed simulation, distributed work groups and other areas.

For multimedia networking one has to build the hardware and software infrastructure and application tools to support multimedia transport on networks so that users can communicate in multimedia. Multimedia networking will greatly boost the use of

computer as a communication tool and dramatically change our life in future.

5.1 Real-Time Challenge

In multimedia networking, one can expect at least three difficulties, which are as follows:

(a) Compared with traditional textual applications, multimedia applications usually require much higher bandwidth. A typical piece of 25-second 320x240 QuickTime movie could take 2.3MB, which is equivalent to about 1000 screens of textual data.

(b) Most multimedia applications require the real-time traffic. Audio and video data must be played back continuously at the rate they are sampled. If the data does not arrive in time, the playing back process will stop and human ears and eyes can easily pick up the artifact. In addition to the delay, network congestion also has more serious effects on real-time traffic.

(c) Multimedia data stream is usually bursty. Just increasing the bandwidth will not solve the burstiness problem. For most multimedia applications, the receiver has a limited buffer. If no measure is taken to smooth the data stream, it may overflow or underflow the application buffer. When data arrives too fast, the buffer will overflow and some data packets will be lost, resulting in poor quality. When data arrives too slow, the buffer will underflow and the application will starve.

5.2 Multimedia over internet

There are other ways to transmit multimedia data, like dedicated links, cables and ATM. ATM was said to be the ultimate solution for multimedia because it supports very high bandwidth. It is connection-oriented and can tailor different level of quality of service to different type of applications.

The well-established LAN and WAN technologies based on IP protocol suite connect bigger and bigger networks all over the world to the internet. Another benefit of running multimedia over IP is that users can have integrated data and multimedia service over one single network, without investing on another network hardware and building the interface between two networks.

Presently, IP and Ethernet seem to be more favoured in the desktops and LANs, with ATM in wide area networks.

Multimedia means extremely dense data and heavy traffic. The hardware has to provide enough bandwidth.

Multimedia applications are usually related to multicast, i.e., the same data stream, not multiple copies, is sent to a group of receivers. For example, in video conference, the video data need to be sent to all participants at the same time. Live video can be sent to thousands of recipients.

The price tag attached shared network resources is unpredictable availability. But real-time applications require guaranteed bandwidth when the transmission takes place. So there must be some mechanisms for real-time applications to reserve resources along the transmission path.

Internet is a packet-switching data network where packets are routed independently across shared networks. The current technologies cannot guarantee that real-time data will reach the destination without being jumbled and jerky. Some new transport protocols must be used to take care of the timing issues so that audio and video data can be played back continuously with correct timing and synchronization.

There should be some standard operations for applications to manage the delivery and present the multimedia data.

6. RIGHTS ISSUES IN MULTIMEDIA CONTENT

(a) 'Ownership' may not be enough

Even the outright purchase of a portfolio of works, such as motion pictures, may not provide the right of unrestricted use of the contents of such works in multimedia products. An assignment of all right, title and interest in a copyrighted work, i.e., a transfer of ownership, may leave residual rights to be dealt with such as:

- Moral rights such as the right to prevent changes to a work that could harm the author's reputation or honour
- Payments may be required for reuse rights under production agreements or group contracts
- Music sound track rights are a property separate from a movie itself

(b) General rights issues

The general legal rule in copyright licensing is to assume that the owner reserves any right not expressly granted in the license language. If the right is needed it should be expressly included in the license language. The commercial rights needed for multimedia content may include copying, in whole or part; performance rights; public display rights; the preparation of derivative works (modifications); and publication and distribution by any variety of methods on all media whether now known or invented hereafter.

Content providers known as 'stock houses' and media libraries are an alternative to obtaining the rights to specific works through rights clearance agencies. The 'stock houses' maintain libraries of video clips, photographs, illustrations, music and sound effects that can be licensed for use in a multimedia product.

(c) Use of literary and other written works

The Copyright Clearance Centre, Inc. ('CCC') was established primarily to protect the rights of owners of printed materials against unauthorized photocopying. The CCC collects and distributes royalties to publishers. The CCC has also begun to address the electronic use of printed works protected by copyright. Thus, the CCC could be a candidate for the administrator of the multimedia clearinghouse.

(d) Use of photographs

A book may also contain photographs of interest to the developer of a multimedia product. A publisher of a work that contains a photograph may have only a one-time use right rather than outright ownership of the photograph. The publication agreement may also impose additional restrictions on use of the photograph: minimum size, resolution, number of copies, time period, etc. Thus, a developer of a multimedia product may need to negotiate with the photographer to obtain rights to the photograph.

(e) Use of film clips

Films and related works are loosely divided into motion pictures and other films. Film libraries other than commercial motion pictures often have fee schedules for traditional uses of content. Thus, special negotiations may be required to cover the exact usage in the multimedia product.

(f) Use of music works

Music encompasses a number of different licensing rights. The good news is that procedures and policies for obtaining rights to use a musical composition are well established. It is also usually clear who owns the rights being sought. The bad news is that one normally has to negotiate with several different parties to obtain all needed rights for use as multimedia content.

- A mechanical license is needed for the right to make and distribute material objects in which a recording of a musical composition is embodied such as a record, tape or CD.
- A synchronization license is needed to authorize the synchronization of a musical composition with visual images of a multimedia work. No compulsory license is available for this right. Rights must be obtained through a clearing agency.
- Another exclusive right of the owner of a musical composition is to control public performances. A multimedia product may need a public performance license.

7. MULTIMEDIA DELIVERY AND APPLICATIONS

The main problem with multimedia data is just delivering it where needed. Because of its bulkiness, multimedia is often best archived at a few sites and retrieved from there. That can entail logistical problems in delivering all those bits efficiently since networks are generally optimized for text data. Multimedia delivery systems are being explored for digital

multimedia libraries, video meetings, video medicine, distance learning, multimedia mail and interactive television.

Multimedia delivery is typically intensive in input/output and communications resources as opposed to processor resources. Network architectures and software need to be optimized for large transmission 'bandwidth' (bits per second). This has several implications:

- System architectures should be chosen for fast input/output. Parallel ports are desirable (although not currently common).
- Star and fully connected topologies are desirable. That may only be feasible with local-area networks for many applications.
- Switches should be preferred to routers on network connections since the routers have lower bandwidth and higher delays.
- Experimentation with the packet size for multimedia data may improve performance since the best size is hard to predict.
- Data-compression techniques should be used where possible to minimize the necessary bandwidth; typical compression ratios range from 2:1 for audio to 20:1 for images and 50:1 for video.
- Caching of frequently used data can help efficiency, but not all multimedia applications so benefit. A simple and popular alternative to caching is a CD-ROM optical disk at the end-user site containing commonly needed media data.

7.1 Real-time multimedia delivery

Many multimedia applications have real-time constraints, such as those delivering audio and video and those supporting real-time simulations. But bandwidth over networks is a problem. A single MPEG-1 compressed video of current television-picture quality needs around 2 megabits per second (though video conferencing and video interviews can be adequate with less); compact-disk music audio requires 1.4 megabits/second. Standard (ISDN) telephone lines provide 0.064 megabits/second, nowhere near adequate for either (though several lines can be used in parallel, what is called 'bonding'). Without careful design there can be serious problems in quality of service in real-time multimedia delivery, problems suggesting negotiation both beforehand and in real time.

7.2 Multimedia Applications

Networked multimedia applications will give users the possibility to interact all kind of media like text, graphics, images, audio, video and animation. When adding network to connect users it has the capabilities to new merging applications. When added to the networked multimedia environment where telephone, computer, television, publishing, education, movie and consumer electronics industries are converging to the new digital information industry and provide new ways to use telephones, computers, televisions and all kind of home electronics. It offers new possibilities to interact and cooperate.

Using together the internet and the world wide web, mobile phones, high resolution TV, high quality VCR and DVD, one can draw a light glimpse what the future can offer when converging of different media will continue and the network speed and bandwidth will increase. Also when one interacts with the large screen, it gives the natural three-dimensional space, the virtual reality.

The multimedia applications provide to interact the proper media and to be connected to other people so that one can share ideas, thoughts and create new ones. Collaboration and sharing ideas is ideal for developing new products and services and rearranging processes to create better new flexible and virtual environments. Interaction will increase our pleasure. Different kinds of entertainment, edutainment, infotainment and sociotainment applications and products are coming.

The interactive networked multimedia (e.g. internet/intranets/extranets) is a good expedient to come closer to customers and to penetrate deeply into customer's processes, so that people can make productive co-operation. These products and services bring added value to customers, which creates totally new services to new media

business. The deregulation of telecommunication and digitalisation will burst new operators and end-user customers. Networked multimedia offers us interaction by sending and receiving multimedia e-mails.

Multimedia products demand is for educating students and training employees in classrooms those are remote from teachers. There is also demand for accessing a wide variety of movies, sports, news, and other video programming at times that users select, along with the demand for business video conferences. Customers will use and pay for multimedia only if it provides better solutions at lower costs than available alternatives. Relatively few multimedia solutions now have higher quality and lower cost than alternative solutions.

From a user's point of view, an application is everything that user sees of both the software and the hardware, including the delivery network and any other support services. Programs should be build-in to help a user navigate through the author's media (besides tables of contents and indexes that merely assist page flipping).

A successful multimedia application must be both economical and easy to use.

9. PATENT ISSUES

Patents are also important intellectual property in multimedia products even when the primary element is copyrighted content. There are many patent issues and potential disputes involving compression technology. In addition, while MPEG is an open compression standard, it is still proprietary and it remains to be seen if there will be adequate cooperation to achieve licensing at reasonable royalty rates. There may also be patented processes for presentation or retrieval that must be embedded in the content itself. Even if clearances are obtained for copyrighted content, the process of presenting that content as part of a multimedia product could infringe a patent. Content developers will have to deal with this issue.

CONCLUSION

Digitized multimedia data such as images, video, and audio is rapidly becoming commonplace and will soon replace conventional alphanumeric data as the primary data format. New techniques are needed to access, manage and search these new multimedia data types. This article has given an overall idea of the multimedia; data types and data transfer methods available with the rights for multimedia content. Library and information professionals should take these as a challenge and act upon to the latest developments on multimedia data transfer. The expectations of the current technology of integrated multimedia information system inevitably greatly expand the traditional system and functions and have increased sharply information access for its users.

A comprehensive information system of tomorrow will be one of that is evolving far beyond a text and/or data base system. It will definitely be multimedia with capabilities for non-sequential linking of not only related, but also non-related information sources.

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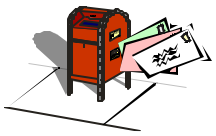

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