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Broadcasting in the New Millennium: A Prediction

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Broadcasting in the New Millennium : A Prediction

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The paper is an attempt to predict the Broadcasting in the new millennium keeping in view it's new role, the technological development, convergence, the impact of multimedia, computer, Internet on Radio and TV. The paper predicts that the prospect of digital and new delivery systems does not imply the 'death of traditional broadcasting'. Broadcast transmissions will, of course, eventually become digital, but analogue services will continue for another 20 years, with "Plain Old Radio" continuing to be the heart of broadcasting. It further suggests that broadcasting will be a part of Global Information Infrastructure (GII) and National Information Infrastructure (NII) and will not exist in isolation. The broadcast organizations have to completely reorganize to be globally competitive and also to cater to its new role.

"Prediction is difficult - especially of the future".

Storm Petersen, Danish humorist.

PREDICTION about the future is a risky business. Many predictions made in the past have proved to be dramatically wrong even when made by experts with impeccable credentials. The eminent scientist Lord Kelvin stated in 1895 that "Heavier-than-air-flying machines are impossible" and in 1897 compounded this error by further predicting that "Radio has no future". H. M. Warner said in 1927 "Who the hell wants to hear actors talk?" President Franklin Roosevelt addressed the 1938 New York World's Fair over which he categorized Television as "an interesting curiosity of little commercial value". In case of broadcasting the prediction is much more difficult on two counts viz its changing role in the society and rapid technological developments in the field of computer and communications[1]. However, certain parameters are available with us, which show us the road, albeit dimly lit.

The consumers of 2005 will be familiar with computers and accustomed to interactivity and navigating through 3D environments. Their television receivers will probably contain a computer with rendering power exceeding that of today's high-end workstations. Broadcasters already have some of the tools needed to originate such material. These are in the form of virtual studio technology, Hypervideo, Video-to-video linking, MPI (Multiple Perspective Interactive) Video Architecture, CORBA (Common Object Request Broker Architecture), ORB, JAVA, Server Push technology, Virtual Human Agent, Video Parsing, Scene Detection, View Processor, MHEG, TCP/IP over Internet etc. Services like DAB (Digital Audio Broadcasting, DVB (Digital Video Broadcasting), DMB (Digital Multimedia Broadcasting) and Internet broadcasting are already in the offing. Given this, will today's two-dimensional images and one-dimensional sound be an unattractive product by 2005? Will the existing receivers and type of content vanish by 2010? In this paper, an attempt is being made to predict the broadcasting scenario say after 15-20 years.

ROLE OF BROADCASTING

Traditionally broadcasting being point to multipoint communication system, it's role was defined as "a medium for information, education and entertainment" to masses using sound or /and vision. However, 1990s witnessed rapid development of digital broadcasting, computer, and communication systems. The development of digital compression techniques threw open the prospects of multimedia broadcasting and data broadcasting. The broadcast of sound/video/text /data all into one stream became a reality. The transmission system changed from analog transmitters to a host of delivery media viz Satellite, cable, Internet, ATM /SDH networks. Several types of services could be provided over a common link. Therefore broadcaster became an information provider. The concept of Global Information Infrastructure (GII) and National Information Infrastructure (NII) were evolved with broadcast becoming a component of the overall scheme.

Information is the key to all activities, and knowledge is the core of strength. Information can be used for production as well as for destruction, for good as well as bad purposes. A Global Information

Infrastructure will offer easy access to limitless information. This creates new threat of culture invasion, programming of the mind, and changing the way we behave. Defense personnel, all over the world have realized the potential of Information War and Anti-War. The well-known three-dimensional space domain (land, sea, air and the space above) is supplemented by the fourth domain - the logic domain (human minds and will). Besides the conventional 'hard kill' threat, the new emerging threat is 'soft kill', characterized by unspecified and unquantified vulnerabilities of mind of people in a conflict. A hostile country can use this vulnerability to his advantage. Even in India, the foreign channel programmes, the Delhi FM programmes and certain Doordarshan programmes have led to change in the ethos and thinking process in the minds of people.

This leads to very changed role of broadcasting in the new "Information Era" of GII /NII. The Nations have to play their distinct, well-defined role of preventing its people from the "soft kill". The private channels may provide the programmes, which may be commercially viable, but a national public broadcasting system will have to play a vital role. Market forces can not be allowed to chalk out the road. Thus the role of broadcasting will be very distinct in future. Governments shall have to play a larger role and decide the roadmap of broadcasting of nations.

BROADCAST SCENARIO

Technological development trend

Figure 1 shows the approximate dates of introduction of various technologies in broadcasting and related sectors. It is clear that the pace of technology had been very slow in the early years of the century when technologies have lasted a very long time. However in 1990s, the pace has been accelerating. Rapid changes in technology mean that there is little prospect of such stability in the next millennium. As broadcasters need to assess the risk of their favoured new technology becoming obsolete within a few years, we need to address the question "Is technology truly unpredictable?"

Success in the consumer market is not determined by technology, but by other factors viz the range of features, ease of use, cost of equipment (Receiver), cost of use, and content (quantity and quality). Attractive content is the most important factor in the success of any broadcast service. It is tempting for engineers to believe that the 'best' technology will always succeed in the market place. In practice, there have been numerous occasions where the 'best' has been soundly defeated by inferior technologies. Success or failure is determined primarily by timing and by marketing tactics - not solely by technical superiority. The problem with developing countries is that if they opt for readily available, proven and inexpensive technologies, these become obsolete very quickly since the manufactures (foreign) stop producing the same or supplying the spares. This forces them to buy products or equipment with many features which they rarely use. They also have to go in for immature technologies. These again become obsolete before consumers have had a chance to buy products or services based on that standard. Sometimes the decision-makers are lured by new upcoming technology and become too ambitious. The result is the same. This is the penalty that the countries have to pay for non-self-reliance. However if the nations have to go with the developed world, the key is to be neither too early nor too late.

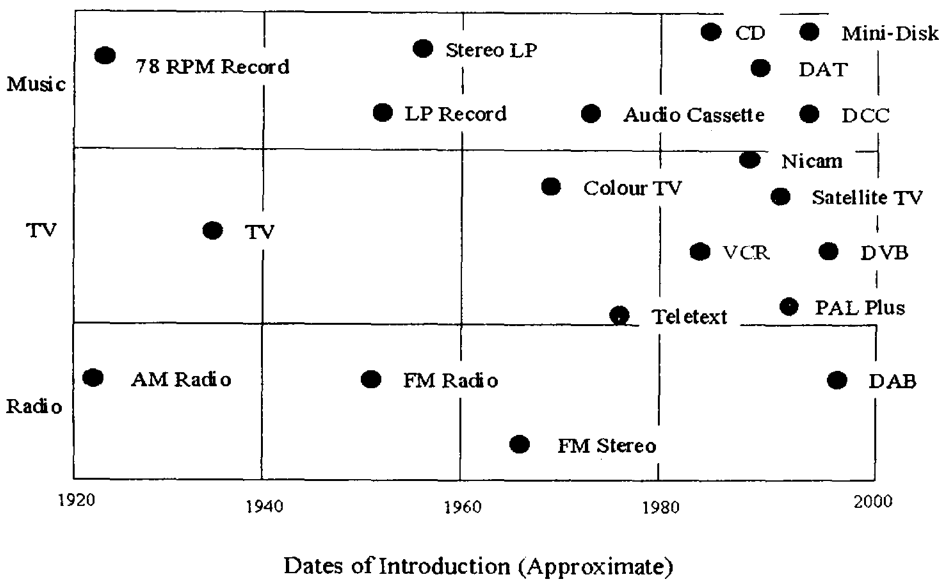


Fig 1 Introduction of broadcast technology

New Services

Many new forms of multimedia services become possible with the introduction of digital delivery. A number of new interactive services will be offered to the consumers. Few of these will be:

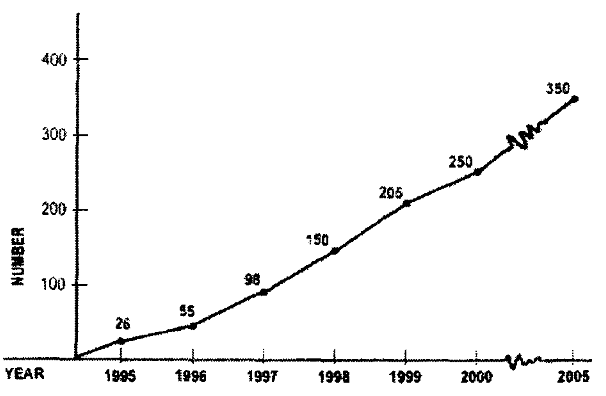
- Video-on-demand: Movies, sports events, concerts using interactive demand.
- Educational and distance learning: Courses, interactive link with the teacher.
- Interactive Entertainment: Games, statistics of players in a sport, news-on-demand, detailed reports on desired stories.
- Interactive personalized navigation facility: More choices will be available to the viewers to get the desired programme. A computerized agent would seek the individual's favourite programmes and offer an index or catalogue of productions available.
- Civic networking: This would serve as a town hall where debates, ventures, education and issues concerning the community are discussed.

Internet

In a very short span of time, the world of information, collection, collation, dissemination and 3rd person retrieval for an estimated 240 million by the year 2000, has taken a quantum leap in accessibility (Fig 2). With its fast growth, Internet is promising to be the next TV industry[2]. Internet marshaling, streaming, and compression provide a cross-product method of sending and receiving data through standard Internet protocols (TCP/IP, http, and so on) for compressing and decompressing the data, and for asynchronously streaming and caching the data.

The lack of interactivity inherent in broadcast delivery systems is a serious shortcoming. Another problem is that of limited content available on broadcast systems. As more and more users get exposed to the Internet, they will be reluctant to accept this lack of interactivity. Many broadcasters already use the World Wide Web to offer programme-related information, audio services and limited video services. The Internet will become very imported for broadcasters as a new delivery mechanism for broadcast services, for on-demand services and, especially, for delivery of services to international audiences. The present limitation of Internet as low quality delivery system will definitely be solved. The Internet will undoubtedly develop to offer a wide range of enhanced services, including good quality video and audio. However, unlike broadcasting, the Internet is not well suited to simultaneous delivery of programme material to large audiences. It cannot offer services to mobiles and portables (without consuming huge amounts of the radio spectrum).

How Many Online Worldwide



Note: Numbers given in Millions; *Source*: Nua Internet Surveys[3]

Fig 2 Prediction of internet users by 2005

The ability to browse the Internet through the TV opens new opportunities. Various commercial services allow consumers to display world web pages on standard TV sets. Special set-top boxes connected by a modem to a normal telephone line are used. A key feature of such services is that they are easier to use than computer-based access to the Internet. For example, WebTV Networks, California in association with Microsoft, allows the customers to browse the Internet through their TV sets. The service is primarily targeted at the many potential consumers who are totally perplexed by computers. There may be a significant market for such services. Enhanced TV is designed to display e-mail and WWW content on TV set. It uses a hand-held remote to navigate web pages and a wireless keyboard to type e-mail. Channel Hyperlinking allows TV viewers to click on an icon while watching TV. The icon quickly sends the viewer (2-3 seconds) directly to a Web site for more information. Interactive Multimedia Network allows subscribers to peruse a long list of movies that can be played, stopped and rewound anytime. Used initially for VOD, the broadband scheme places the actions of a videocassette recorder in the network in the same way that voice mail simulates an answering machine. Dallas-based uniView Technologies is drawing consumers into set-top box technology with its in-home health monitor. Patients can gauge their heart rate, blood pressure, temperature, blood sugar levels and breathing levels, and send their readings on-line to health care providers. When taking heart rates, for instance, the patient places a clip on a finger to collect data that is then transmitted from the set-top-box.

Set-Top Boxes (STB)

Digital set-top boxes promise greater graphical support for interactive and Internet applications, in addition to greater number of channels with potentially better audio and voice quality. Advanced analog set top boxes also include a digitally encoded stream for accommodating Internet and e-mail applications. Downstream bit rates for digital and advanced analog set-top boxes are respectively, 1.5 Mb/s and 76 kb/s. The services offered are - Basic Video, Addressable messaging, Expanded Channels, Parental control, Near VOD, Internet access /E-mail, Enhanced broadcasting, Impulse pay-per-view, Interactive programme guides, VCR programming, virtual channels, Home banking, Home shopping, Networked games, Travel services, VOD etc.

DTH for India

The Indian Space Research Organization (ISRO) will start work on a direct-to-home satellite later this year for TV broadcasting. The Satellite will be launched after 2002. The satellite has been conceptualized as a high-power spacecraft with about 20 transponders operating in 14 GHz to 17 GHz (Ku-band) channel, to provide reception to TV signals by small roof dish antennas[4].

Color radio

An American company, GEODE Electronics, LLC, has introduced COLOR RADIO for RDS (Radio Data Service) audiences. The company's proprietary radio technology provides listeners with text information on a color-graphics display. It has been estimated that out of 93 million radio receivers sold in the US each year, 60 million are RDS COLOR RADIO candidates. COLOR RADIO is designed to allow a choice of colors and to display text in different font types and styles, and with a variety of lines and borders. The color radio provides listeners with a series of screens displaying station and advertising information. GEODE claims that there are about 550 stations in the US transmitting RDS signals at present. In addition to the receiver, GEODE has introduced what it calls RDS II to add features to the transmission end in the hope that more stations will be attracted to radio data service[5].

Digital Music

The proliferation of the Internet and growing consumer demand for home computers has made the direct digital downloading of music a realistic commercial option. Several companies have already begun selling music directly to the consumer. Technology allowing the secure downloading of music files direct to consumer PCs have already been developed. The explosion of a music file format called MP3 that compresses sound files for sending over the Internet has led to this explosion and while some are legitimate, the vast majority are unlicensed and illegal. The popularity of MP3 files is not in doubt: behind 'sex' it is the second most commonly used key term processed by search engines. Some legitimacy has been bestowed on MP3, with Lycos establishing a special MP3 search page, and the development of portable MP3 music players such as Diamond Multimedia's Rio player, which can be loaded with more than an hour's worth of MP3 files from a PC. Until recently five major record companies - BMG, EMI, Sony, Universal and Warner, which account for 80 per cent of the world's music, have been reluctant to make their products available due to piracy fears, and the lack of security of copyright[6].

Secure Digital Music Initiative (SDMI)

The Secure Digital Music Initiative (SDMI), announced in December 1998, is the industry's definitive response to the growing popularity and acceptance of direct downloading as a realistic delivery method. It is also a riposte to digital pirates. This forum comprises both music and technology companies, and has the aim of developing an open interoperable architecture and specification for digital music security. SDMI's mission statement describes its objective as one which will "enable consumers to conveniently access music in all forms, artists and recording companies to build successful businesses in their chosen areas". Final technical specifications are planned for completion by the end of this year. SDMI has the backing of the five major record companies and key technology players in the Internet, electronics, software, and telecoms.

Broadcasting to Computers

Some computers are already fitted with TV cards that permit reception of analogue TV broadcasts. This feature will probably become more common with the advent of digital broadcasting. Microsoft has predicted that "50% of PCs sold in the USA in the year 2000 will be capable of receiving digital TV broadcasts". This obviously represents a new and expanding market for normal broadcast TV services. It could also permit important new forms of broadcast multimedia services, using the processing power and storage capability of computers.

Tools and Techniques

A variety of tools and techniques are available to cater to the above needs, albeit few in infancy. For example CORBA is language-independent and platform independent architecture by OMG (Object Management Group) that provides a standard mechanism for defining interfaces between components as well as some tools to facilitate the implementation of those interfaces using the developer's choice of languages[7]. This means that a client written in C++ can communicate with a server written in Java, which in turn can communicate with server written in COBOL and so on. A single user interface can query all servers. ORB is a software component whose purpose is to facilitate communication between objects. The JAVA applets in the users set-top-box maintains user's profile which helps the transmitting sites to push the hypermedia programmes as per the user taste[8]. Server push allows delivery of multimedia content without requiring the customer to request or "pull" the information. With this mechanism the server sends down a chunk of data. The browser displays them leaving the connection open to receive more data for a fixed time or until the client interrupts the connection. Virtual Human Agent is a "multi-modal interactive interface" - a Graphical User Interface (GUI) system that uses human modes of communication such as sight, hearing, talking, facial expression and gestures[9].

Video parsing is done by temporal segmentation and content abstraction [10]. Key frames (First frame of every shot) extraction by properties of color, texture, shape, edge features etc are used as indices to access the desired scene/video clip.

- key frame to key frame
- match /search the content from key frame
- query by visual templates - pre-defined templates (sky, sea, beach, forest) to formulate query

Color has excellent discrimination power in image retrieval since it is very rare that two images of totally different objects have similar color. Color can be represented by a histogram of the distribution of color components. Average brightness, color moments (including mean), dominant color etc are used for shot detection. In most images, a small number of color ranges capture the majority of pixels. These colors are used to construct an approximate representation of color distribution. These dominant colors can be easily identified from the color histograms of key frames.

Motion is the major indicator of content change. Dominant motion components resulting from camera operations and large moving objects are important source of information for video parsing e.g. zoom shot is abstracted by first, last and the middle frame.

Key frame retrieval using texture is done through Tamura features & Simultaneous Autoregressive model (SAR). Tamura feature includes coarseness (Granualarity - moving average over window), contrast (distribution of pixel intensities) and directionality (direction of gradients at all pixels). SAR model provides a description (mean and variance) of each pixel in term of it's neighboring pixel. Edges (derived by Sobel filter) provide good cue for content. Shapes are derived by spatial segmentation algorithms[11].

Multiple camera are used to capture view from different angles. The view processor allows the user to select its viewing angle like a virtual camera[12].

MPEG-2 has become the standard for distribution for today's linear broadcasting media. In the MPEG-4[13], the content will be more than linear 2D images and 2D sound. MPEG-4 will provide support for animated face and body models, as well as more general 3D models. It can also represent arbitrary-shaped video objects, which may be texture-mapped onto 3D geometry. Work on a "new" MPEG initiative for very low bit-rate coding was approved by ISO (International Standards Organization)/ International Electro-technical Commission / Joint Technical Committee 1. When completed, the much-discussed Version 2 of MPEG-4 will support a spectrum of applications, including interactive mobile multimedia communication. Similarly, an increase in the volume of content available and the pressure to re-use rather than re-manufacture creates the need for the cataloguing, searching, and trading engines under development in MPEG-7[14].

MHEG (hypermedia information coding expert group) is an ISO standard designed to meet the requirements of multimedia applications and services, running on heterogeneous workstations, that interchange information in real-time: computer supported multimedia cooperative work, multimedia message systems, audiovisual telematic systems for training and education, simulation and games, video on demand services, interactive TV-guides and other systems. MHEG seeks to fulfill these interchange requirements by defining the representation and encoding of final-form multimedia and hypermedia information objects[15].

HyTime defines an extensive meta-language for hypermedia documents, including general representations for links and anchors, a framework for positioning and projecting arbitrary objects in time and space, and a structured document query language. The purpose of HyTime is to standardize some of the facilities for all of the applications. In particular, it standardizes those facilities having to do with the addressing of portions of hypermedia documents and their component multimedia information objects including the linking, alignment and synchronization that standardized addressing makes possible.

The HyTime coordinate addressing is a generalization of the time model originally developed for another standards project, ISO/IEC 10743, the standard music description language (SDML). SDML, which is now an application of HyTime, is intended to foster the growth of applications that bring music into the information processing world, and that apply information processing technology to the musical domain (e.g. music publishing using modern text processing technology, including the integration of music with text and graphics).

Actor motion capture

The motion and facial expression of actors is required to be captured in real time. Current systems based on reflective markers or magnetic trackers interfere with the freedom of movement of actors, and with the normal process of TV production. An ideal system will work with multiple actors over a large space, will be completely non-invasive, and will work in real time without operator intervention. An actor motion capture system that works without any special markers or trackers will allow the simultaneous production of both conventional TV programmes and 3D/interactive programme content. For conventional TV, images of real actors in the studio set will be used, as in present-day Virtual Production. For 3D content that retained the appearance of the 2D production, 3D models of the actors will be created by texture-mapping the studio camera images onto 3D models. This may require additional cameras in the studio, or other specialized 3D capture devices, but these could co-exist with the conventional TV studio equipment. Relatively crude models may suffice for some applications, particularly those where the possible viewpoints in 3D space are restricted. At simplest, each actor could be texture-mapping onto a flat plane normal to the camera's direction of view, at a depth corresponding to the depth of the actor. This would allow a "2½D" scene to be formed, and would enable virtual foreground objects to obscure real objects without the need for separate mask signals and mixers[16]. For 3D content with virtual actors, information relating specifically to a 3D face and body model may be derived. This may be used to animate a virtual human, or other virtual character. With the 3D information expressed in terms of body model parameters, it becomes easier to edit the movements in post-production, or to control the motion of the character by other means, for example under software control in an interactive programme.

Authoring tools

Much software already exists for editing motion capture data and creating 3D programmes. Development of such software will be needed that support open standards for data, such as MPEG-4 and MPEG-7. Authoring tools must also allow the creation of content in multiple forms, including both conventional 2D, and 3D, with degrees of user interaction ranging from none, through viewpoint selection, to fully interactive or immersive. A further development would be to support the creation of shared virtual environments to allow multiple users to experience and inhabit a shared virtual world. An example of work on shared collaborative environments may be found in[17]. It may be possible to extend the use of MPEG-4 to such environments[18].

FUTURISTIC HYPERMEDIA SYSTEM : A PREDICTION

Broadcast Delivery Systems

It is inevitable that the future of broadcasting will be digital. Digital technology is the source of convergence. A bit is a bit-whether it represents an element of text, software, graphics, audio or video. Does this mean that delivery systems will converge into a single broadband 'pipe' into people's homes? Will the Internet or its successors supplant broadcasting?

The transition from analogue to digital will not inaugurate the 'digital super-highway'. In practice, digital transmission will not, by itself, change the essential nature of broadcasting. Over-air broadcasting will remain, inherently, a 'passive', 'one-to-many', 'one-way' communication system. Figure 3 shows several alternative means for delivering real-time multimedia 'content', in addition to the usual broadcast delivery systems (i.e. terrestrial, satellite and cable). However, traditional broadcasting will become interactive. Digital

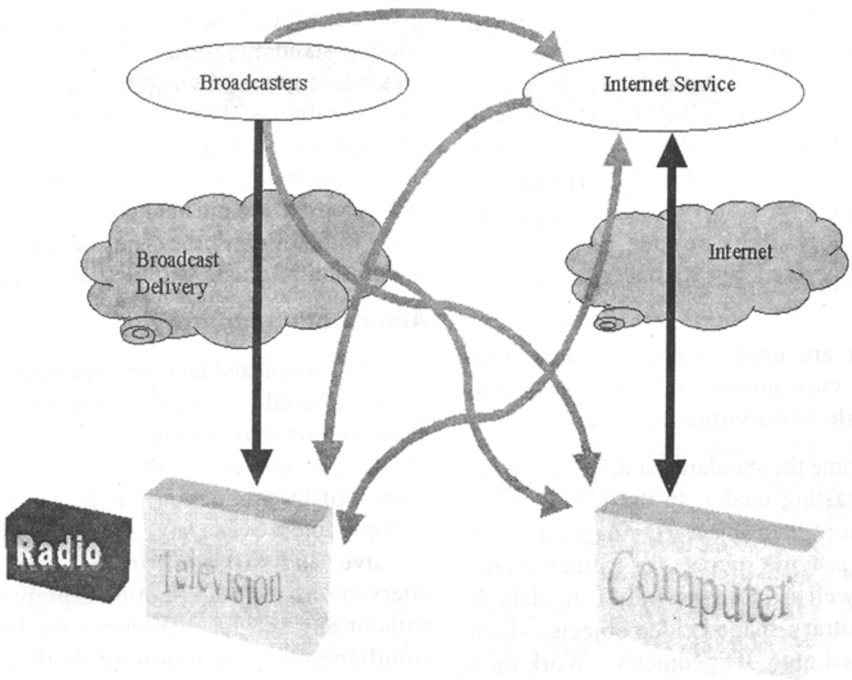


Fig 3 Broadcast delivery channels

technology will multiply the number of available broadcast services, including:

- free-to-air services;
- subscription services;
- near-video-on-demand services; and
- Pay-per-view services.

The delivery system will be a mix of conventional broadcast transmitters, Internet, HFC, and satellite. Each delivery system has its own particular strengths and weaknesses. It is clear that there will be no universal solution. Individual broadcasters will need to choose the most appropriate delivery mechanism for their customers. However, as consumers are certain to demand increased portability and mobility, delivery of services from terrestrial radio transmitters will remain an essential element of broadcasting. Another certainty is that we will not 'converge' on a single delivery mechanism. There will be many competing technologies for delivery of multimedia services.

Production System

Pressure to produce content for markets beyond that of traditional 2D television, and to cut the costs of programme-making, will force broadcasters to consider radical new approaches to programme production. The production system will be independent of the delivery system. Audio / Video professionals will be creating format-independent content that will be distributed via the Internet, CD- and DVD-ROM, cable, DBS (Direct Broadcasting Satellite) and data broadcasts, to a new generation of digital media appliances, using emerging standards such as MPEG-4, MPEG-7 and MHEG. The content will have to be created in a very different but standard formats to cater to the following needs.

Hypervideo

Hypervideo is digital video and hypertext, offering to its user and author the richness of multiple narratives, even multiple means of structuring narrative (or non-narrative), combining digital video with a polyvocal, linked text.

Hypermedia

Multimedia is an amalgamation of audio, video, data and text. Hypermedia is the union of two information processing technologies: hypertext and multimedia. Hypermedia is based on objects and time. Within a Camera scene there are multiple objects. The scene 00.01.16.12 (Fig 4), which is one camera shot has got multiple objects viz the actor riding the horse, horse, the background scene etc. All these objects can be directly linked to their meta-data. The meta-data is the detailed information about each object. This meta-data can be accessed by clicking on the specific object. The link may also lead to more objects. Time-based, scenario-oriented hypermedia has been demonstrated in VideoBook[19, 20]. Here multimedia content is specified within a nodal structure and timer driven links are automatically activated to present the content, based on the time attributes. Hardman *et al*[21] have utilized timing to explicitly state the source and destination contexts when links are followed. This technology is being addressed by MPEG-4 and MHEG groups. Hypermedia affords immense potential for limitless information and education.

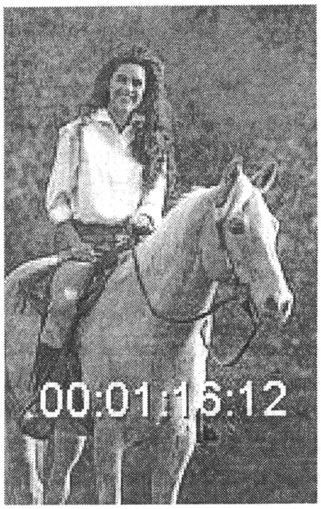


Fig 4 Object based scene

Video-to-video linking

Video-to-video linking was earlier demonstrated in the hypermedia journal Elastic Charles[22], developed at the Interactive Cinema Group (MIT Media Lab). Digital video permits newer design and aesthetic solutions, such as considered in the design of the Interactive Kon-Tiki Museum[23]. Rhythmic and temporal aspects achieve continuous integration in linking from video to text and video to video, by exchanging basic qualities between the media types. Time dependence is added to text and spatial simultaneity to video. Narrative sequence is a path through a set of linked video scenes, dynamically assembled based on user interaction. Temporal links are the time-based reference between different video scenes, where a specific time in the source video triggers the playback of the destination video scene. Spatio-temporal links provide reference between different video scenes, where a specified spatial location in the source video triggers a different destination video at a specific point in time.

MPI Video Architecture

Video provides a comprehensive visual record of environment activity over time. Multiple Perspective Interactive Video (MPI-Video) architecture provides the infrastructure for the processing and analysis of multiple streams of video data[24]. A variety of mechanisms can be employed to acquire data about the "real world", which is then used to construct a model of this world for use in a "virtual" representation. Blending of "real" aspects in a virtual world is of great importance in applications such as telepresence systems, 3-D digital television and augmented reality scenarios[25]. MPI video provides content based interactivity, multiple perspectives, virtual cameras immersion and scalable interactivity.

Immersive Video

Immersive Video (IV) uses multiple live videos of an event captured from different perspectives, to generate live videos of that event from any interactively specified viewpoint, thus creating a virtual camera. This new concept is an extension of Multiple Perspective Interactive (MPI) Video[26,27], which explores applications of visual information management techniques in interactive television.

Let us assume that a scene is being recorded by multiple strategically located cameras. This scene may be a dance performance on a small stage, a football game in a large stadium, or a stage play that takes place in a theater. In Immersive Video, a remote viewer is able to walk through and observe this monitored environment from anywhere in the scene using virtual reality devices such as a Head-Mounted Displays or a Boom (Fig 5). In addition, the view position may be tethered to a moving object in the scene, picked by the interactive viewer. Motion images which are sent to the viewer's display are created synthetically using computer vision and computer graphics techniques. To generate these images, Immersive Video uses a spatio-temporally realistic, 3-dimensional model of the entire environment. This Environment Model is built and continually updated by assimilating dynamic scene information extracted from each video stream. Special visualization techniques are then applied to create photo-realistic views of this model from the current position of the interactive viewer[28].

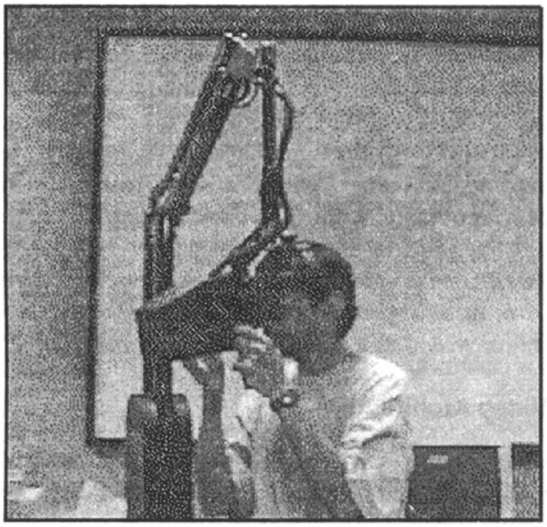


Fig 5 In Immersive Video, a remote viewer is able to walk through and observe a scene from anywhere using virtual reality devices such as a head-mounted display of a boom

A Possible Production System

A possible future production system is shown in Fig 6. "Action capture" may be in the form of a number of consumer HD cameras stuck at varying heights to the walls and ceiling and connected by wireless link to a small box in the corner of the room. The cast's movements, voices and facial expressions are captured and automatically catalogued against the production script using voice analysis and intelligent interpretation to allow the producer and cast to make changes for best dramatic effect. The action capture information was distributed to the post-production team along with a library of virtual environments. The post production process was controlled using a production planning tool which contained a 3D story board together with intelligent progress-monitoring routines. Virtual sets were assembled largely from customised libraries of standard object descriptions. Each scene was lit and animated as a joint effort using the action captured in the rehearsal as a starting point. Shot compositions were optimised both for 2D and 2½D presentations but fundamental limitations on viewing point for 3D immersive viewing were imposed by an intelligent sub-system. Changes were made frequently to actor movements, facial expressions and dialogue, now that the producer had more time to get the best performance out of the virtual actors. A measure of interactivity was to be offered later using a script which has decision points at which the direction of the plot can be altered by consumer choice. The complexity of the script is contained by writing it in such a way that all possible decisions lead back to a limited number of future decision points. This form has the added value that it can be viewed several times with different plot options, without further input from the content creator and the animation script brings further income for little incremental cost and can be packaged as a CD-ROM. The fully developed version uses voice analysis, for instructions from the consumer(s) and context, psychology and plot sensitive dialogue and action construction. This mode will be

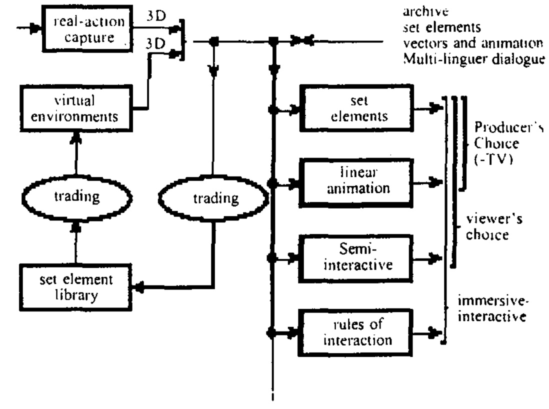


Fig 6 A possible future production system

enhanced by offering more than the normal audible and visible sensory inputs e.g. smell, taste, touch orientation and tactile feedback depending on the consumer's home installation[29].

Organization

A Possible futuristic Hypermedia system is shown in Fig 7. Data/object bases will be maintained by independent and specialized agencies. These databases will be linked to production houses. Production houses will be creating multi-media-hypermedia contents. They will be paying royalty for the uses. The delivery system will be under separate organizations. The entire system will be highly computerized.

Data Broadcasting

Data broadcasting started with the Teletext services on analogue TV transmissions where data was inserted in the vertical blanking pulses. However, Teletext services have been hampered by the fact that a complete rotation of the carousel (i.e. transmission of all data) typically take 20 seconds and, hence, the average waiting time is ten seconds. This was due to the fact that until recently, most TV sets had only enough memory to store a single Teletext page. Other data broadcast services viz RDS (Radio Data Service), DARC etc are based on the concept of a data carousel in which the entire contents of the data service are repeated frequently. With the cost of memory chips falling, it is possible to have local storage in TV sets. Local storage in the TV receivers would avoid the need for repeated retransmission of data. Furthermore, local storage would result in better utilization of the digital multiplex and, hence, give better spectrum efficiency.

Combining local storage with other forms of broadcast data services would also offer considerable benefits. Whereas data received over the Internet is rarely transferred at the nominal data rate of, say, 28.8 kb/s, broadcast data channels can offer a sustained continuous data rate. This means that, for example, a 64 kb/s broadcast data channel can deliver 30 MB in just over one hour. Special broadcast data services on DAB (Digital Audio Broadcasting) could be targeted at receivers with, say, 16 MB or 32 MB of local storage. Special DAB receivers or laptop computer fitted with DAB cards could offer sophisticated multimedia information services, which would be continuously up-dated and instantly available to consumers.

Few satellite operators have devoted an entire digital satellite transponder to data broadcasting, offering full interactive high-speed access to the Internet. A normal telephone line is used to request data from the Internet, but the content from the Internet is delivered by high-speed data broadcasts from the satellite. A data rate of 0.5 Mb/s or more is possible by this service. However, as the digital multiplex delivers a total of 30-40 Mb/s, a

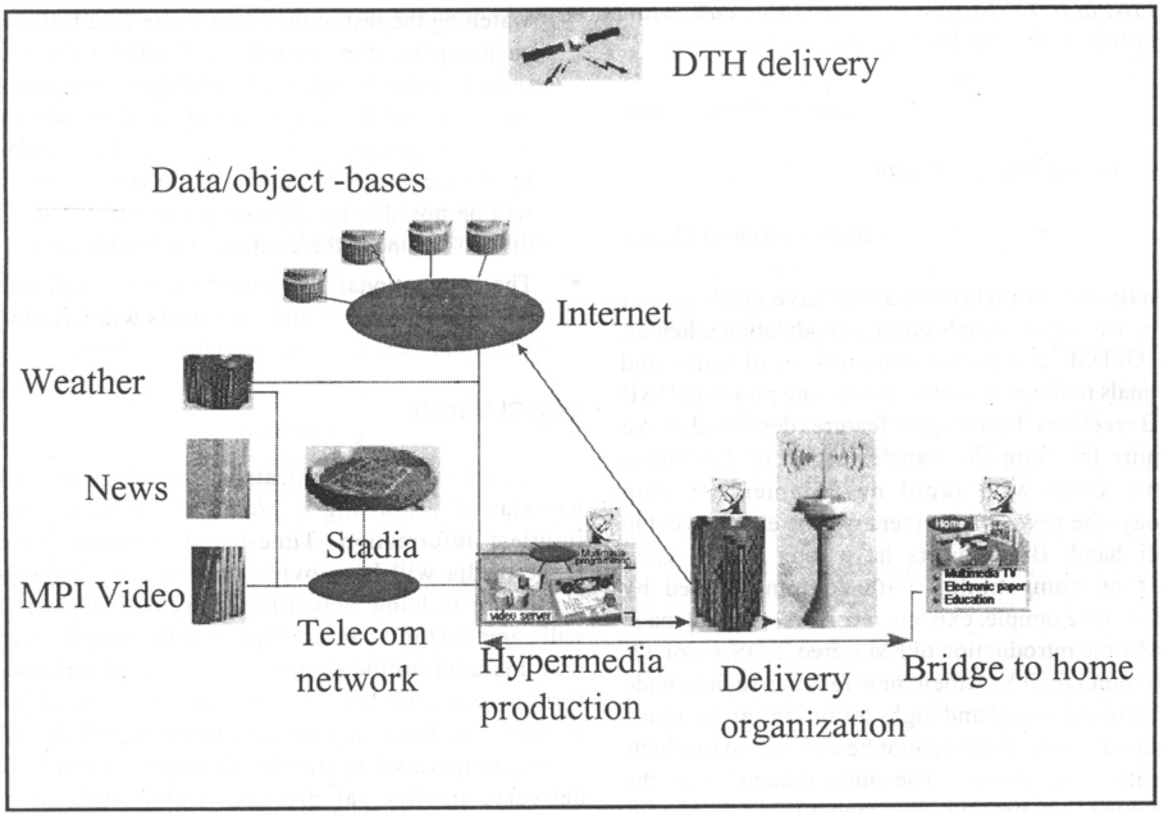


Fig 7 Hypermedia delivery system

moment's reflection reveals that a continuous data rate of 0.5 Mbit/s can be sustained only if there are less than 80 simultaneous users across the entire footprint of the satellite service.

Receipt System

POR (Plain Old Radio)

Let me borrow this term from POT (Plain Old Telephone). In this connection, let me predict that the POR, as it is today, will remain for many more years. The demise of POR, if it happens, will be poor planning on the part of broadcasters in the developing country. After all everybody is not going to become rich with a magic wand.

No technology change has challenged its (radio's) existence. Not even Television because radio has unique advantages. It is the only portable medium. It is a broadcast medium whose costs are sufficiently low that it can afford to support local communities. It can cater to niche interests of audiences. We are saluting radio-the broadcast medium of convenience, specialization and localization.

Brian Jones, MD Australian Broadcasting Corporation at the occasion of 75 years of Radio broadcasting[30].

TV Receiver

If you can figure out a way to make [the TV] a little bit more interactive, billions of people can start participating in this technology revolution.

- Laurie Mann, Oracle

"We need dialog lines, not scan lines."

- Bran Ferren of Disney

Manufactures of televisions will have much greater problems. The use of complex digital modulation schemes, such as OFDM, and digital compression of video and audio signals requires immense processing power in DAB and DVB receivers. Further new features described above will require the complete transformation of Television receivers. Even with rapid development of chip technology, the new TV receivers will be expensive. On the other hand, Broadcasters have long placed great emphasis on compatibility with equipment used by consumers: for example, existing receivers were not made obsolete by the introduction of FM stereo, RDS, color TV or stereo sound for TV. Albeit, new features such as wide screen, surround sound and high-definition can be added to ordinary TV sets, these cannot be evolved to products with greater functionality. The other dimension of the problem is that consumers expect their TV sets to 'last for ever'.

Many observers expect that the TV set and the personal computer will merge into a single consumer appliance. Many people don't subscribe to this theory because of differences in the viewing conditions. TV sets are viewed from a considerable distance, typically six-ten times picture height, whereas computer users are much closer to the screen, typically less than two times picture height. This difference means that text and graphics for TV viewing must be much larger than the ideal size for computer applications. Secondly, TVs are often viewed passively by several people simultaneously, whereas computer usage is generally a solitary and heavily interactive activity. The reality is that interactivity and communal viewing do not mix-except if you are the one with the remote control. Although TVs are unsuited to interactivity, computers will undoubtedly be increasingly used to display TV programmes. All these developments lead to certain conclusion:

- TV reception will become a standard feature of computers
- TV set will double as TV and computer if not with all the features then atleast with the provisions of channel surfing, hard disk storage and memory system. Use of hard disks promises to offer several advantages, such as automatic self-indexing of recordings (using metadata transmitted by broadcasters); random-access capability offering rapid access to all recorded material; and replay whilst recording. The last property offers pseudo-video-on-demand facilities. This means, viewers may pause a programme to have their dinner and then resume watching the rest of the programme with full control such as play, stop, rewind, etc. Further, local storage would enable broadcasters (and their consumers) to 'break free of the constraints of linear broadcasting' allowing viewing /listening in the order determined by the user rather by the programme presenter. This will be possible by allocating a portion of the hard disk to be under the control of a broadcaster.
- The conventional TV /sound receivers will remain what they are today and consumers will have to buy additional sets for new service.

CONCLUSION

A new mass communication technology revolution has started promising a potential global access of limitless information. Time-based, scenario-oriented Hypermedia will be provided to users on high-speed bridge for in-home networks. Many delivery methods will compete for the future Hypermedia system. Internet with matured protocols and wide array of servers will form an essential lane for the super-highway delivery system. The future hypermedia delivery will demand a critical reappraisal of traditional means of production, delivery, intellectual property rights and charging system.

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