Teleconferencing

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Summary The use of teleconferencing is becoming increasingly widespread as a means of overcoming the problems of distance and difficulties of travel when involved in face-to-face meetings. The use of terrestrial or satellite links is dependent on available services and both modes are considered, together with the advantages and disadvantages of teleconferencing systems.

The basic elements of a video-conferencing system are considered, including the microwave link and the interface with the terrestrial network. The hardware system for a studio is shown in detail, and the facilities needed to provide a modern video-conferencing set-up on either a permanent basis or just as a temporary facility are described.

Future development required for improved systems is discussed.

Introduction

Teleconferencing is increasingly being used by organizations of all kinds as a means of reducing costs, improving working practices and speeding up decision making. Audio or video teleconferencing is, of course, not new, it has been in use for many years, though with a slower growth than expected. In the early days, the video conference tended to be a special event, with equipment brought together temporarily. Fixed studio systems did not find favour because of inflexibility which tended to remove the advantages of the system. Since those times, technology has moved on, bringing low-cost solutions to the problems involved.

The evolution of teleconferencing has been determined by technology. Due to financial considerations, the early video conferencing arrangements employed one-way links which did not allow for interaction, but in the last few years two-way video conferencing with all its advantages has been brought to the forefront, giving rise to a new term 'business television'. In the field of audioconferencing, the highly sophisticated telephones now available allow a number of people to participate in business discussions. This form of conference is very simple to set up, cheap to run, and is capable of providing some of the advantages of teleconferencing. What it does not have is the ability to provide the detail and immediacy of a videoconferencing system with full motion video.

Advantages and disadvantages

The history of teleconferencing is one of a good idea that appears to have very positive advantages for the business community and institutions but which to date has been taken up by only a few hundred organizations throughout the world. The first reason for this is that the early users of video conferencing did not appreciate the nature of human communication, assuming that it was just a matter of speaking over a video link. In practice we operate with both verbal and body language and physically provide cues that allow the conversation to move to and fro between participants. It is therefore necessary that the users of videoconferencing be trained properly in the use of such techniques.

Another problem is the flexibility of the facilities. It is essential that studio and communication links are not only easily available but are, if possible, on the operator's premises. If participants have to travel very far to the studio then one of the advantages of videoconferencing is lost.

Indeed, the value of teleconferencing relates to the savings obtained by reducing the need to travel to attend meetings, which are usually much shorter than the travelling time, the better use of human resources giving a greater efficiency of operation. In addition to this the necessity to train people results in the meetings themselves being better structured, agendas are properly produced and in general are shorter. The transfer of information is not just verbal; in the engineering industry, for example, detailed technical data can be sent and design activity can actually take place between engineers. Project management can be speeded up with a consequent saving on design, development and production. A practical example of this is the Ford Motor Co. which transfers design data, etc, between its operating plants in Detroit, Dagenham and Cologne. There are many activities, other than technical, which can benefit from videoconferencing such as educational links, legal proceedings and health care for remote locations.

The cost element has been a barrier to the rapid growth of teleconferencing both in terms of equipment and in the cost of transmission, which requires considerable bandwidth to transmit the full video signal. How this problem has been solved by the application of digital processing techniques is described below.

Videoconferencing system

The basic system needed for a videoconferencing system is shown in figure 1. There are essentially three basic elements to any system:

a) studio facilities,
b) video codecs,
c) communication links.

Studio

A typical studio facility is shown in

Fig. 1. Basic video conferencing system

figure 2. The equipment may be housed in a specially designed external facility or on a user's premises. It can be seen that apart from a face-to-face video system it is possible to add in a variety of other elements to assist in communication. One novel realization of this is the GEC Video Systems Rollabout console, shown in figure 3, which brings together all the equipment needed for narrow band digital videoconferencing, such as colour monitors, two cameras, split screen facilities and various audio processing circuits. The options include graphic displays that allow simple examination of hard copy documents without the need for special slide projection, and electronic blackboards that produce immediate transfer of information written on them to the other studio and facsimile equipment.

Video codecs

To provide full motion video a video signal bandwidth greater than 7.0MHz must be preserved. The transmission system to provide such a considerable bandwidth would be expensive but with the development of digital processing techniques it has become possible to reduce the bandwidth of the television signal for teleconferencing purposes by a factor which can be as great as 40:1 when only a 180 kHz bandwidth is required. The trade-off in this case is that picture quality is reduced.

The GEC Video Codec is shown in figure 4 and is based on a British Telecom Research design, which was carried out as part of a European joint project on picture coding to provide a common European standard. This does not, however, ignore the needs of the US market with its different line and transmission standards. The design will thus allow videoconferencing between almost any countries in the world.

There are a number of ways in which bandwidth compression can be achieved but the GEC codec operates on the principle that there is no need to transmit all of the picture information but only that which has changed during a set sampling time, which is usually a frame period. This type of system is known as inter-frame coding or conditional replenishment, in which the picture information is sampled for changes, the non-moving elements of the signal being held in store and the changes transmitted.

The codec will operate in three modes:

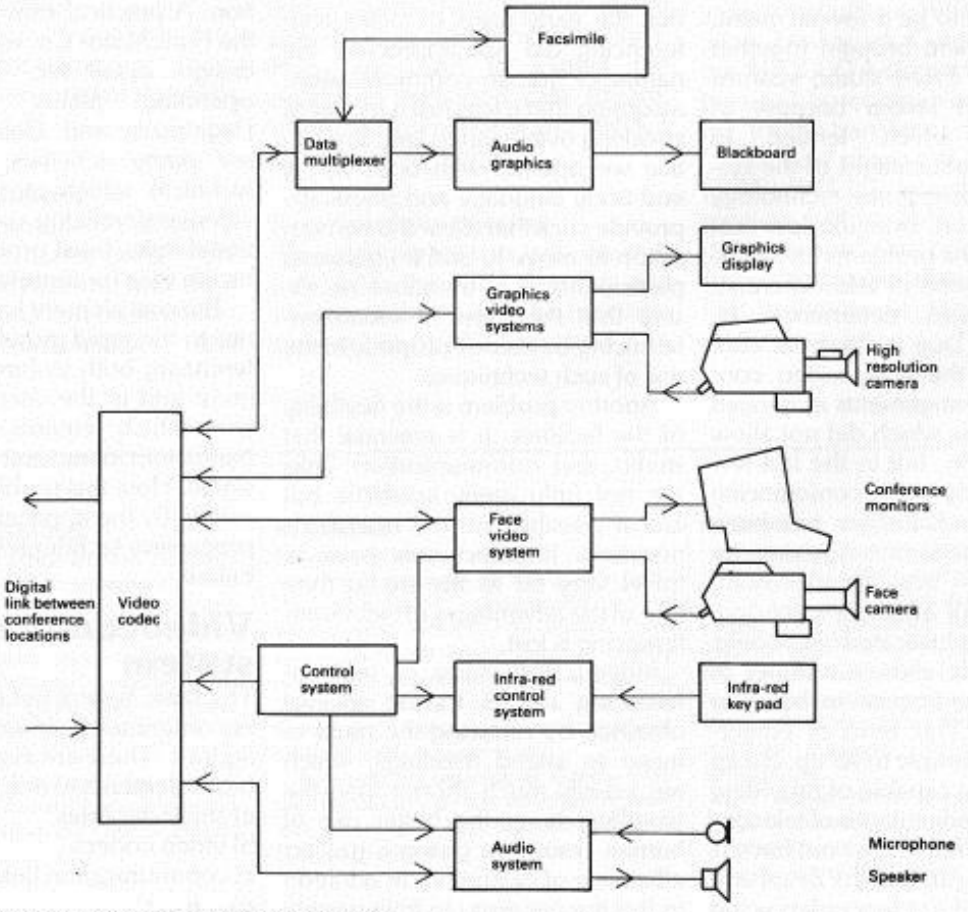

Fig. 2. Block diagram of a typical studio facility

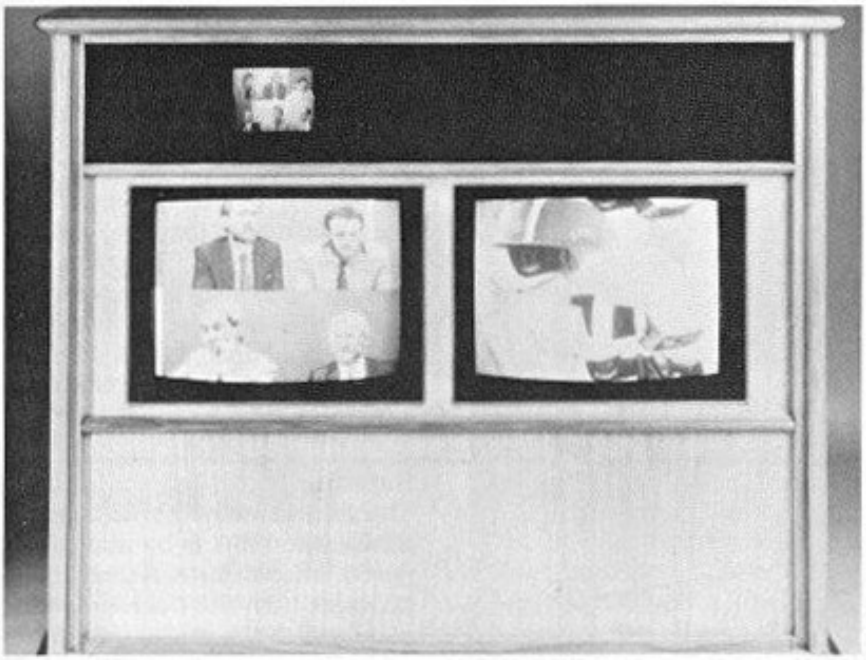

Fig. 3. The GEC Video Systems' Rollabout console

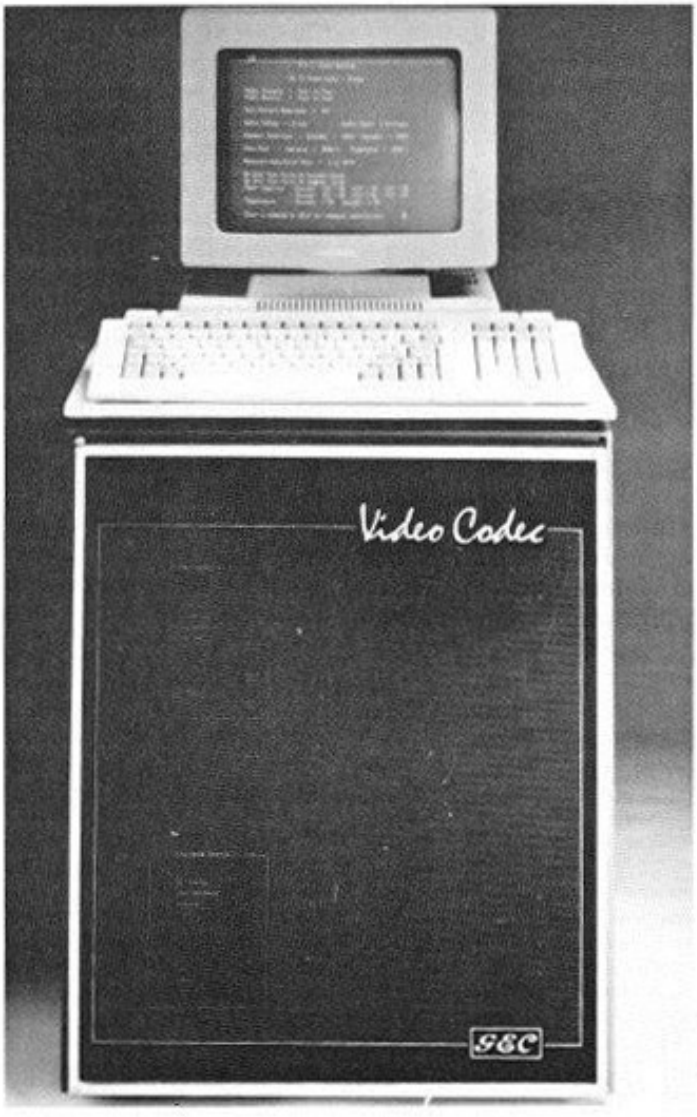

Fig. 4. The GEC Video Systems' codec

a) a real time mode using conditional replenishment and having an effective bandwidth of 2.5 MHz,
b) a high-resolution graphics mode where better definition is obtained by raising the sampling rate, which allows documents to be displayed and the electronic blackboard to operate. In this mode the effective bandwidth is near to the full video bandwidth requirement.
c) a graphic self-view mode which displays the encoded and decoded image.

The digital nature of the system allows it to be used with encryption for secure conferencing. The video, audio and signalling are multiplexed together to a standard G732 structure before transmission over the network. The codec overcomes the problem of different standards by including a standards converter in the codec itself. The transmission data rate can be varied in six steps between 384 kbit/s and 2048 kbit/s including the T1 rate as used in the USA. What has been achieved is a flexible system giving the wide variety of options needed for an efficient videoconferencing facility.

Communication link

An obvious requirement of modern videoconferencing is the availability of digital transmission circuits and with modern developments this can be in three forms, terrestrial, satellite of digital microwave.

Terrestrial

The terrestrial system requires a digital highway able to carry up to 2048kbit/s of data. In the UK, British Telecom (BT) provides a complete teleconferencing service using its MegaStream 2048kbit/s channels to carry the data. The service, Videostream, operates both within the UK and to overseas, especially North America and West Germany, with planned expansion into other European countries. It is both studio-based, at various set locations, and supplied as an in-house facility with all the necessary equipment sited in the user's premises.

The essentials of any system must be reliability and flexibility and in the BT network these needs are met by the use of ACE switches. ACE is a switch which automatically cross connects the Mega-

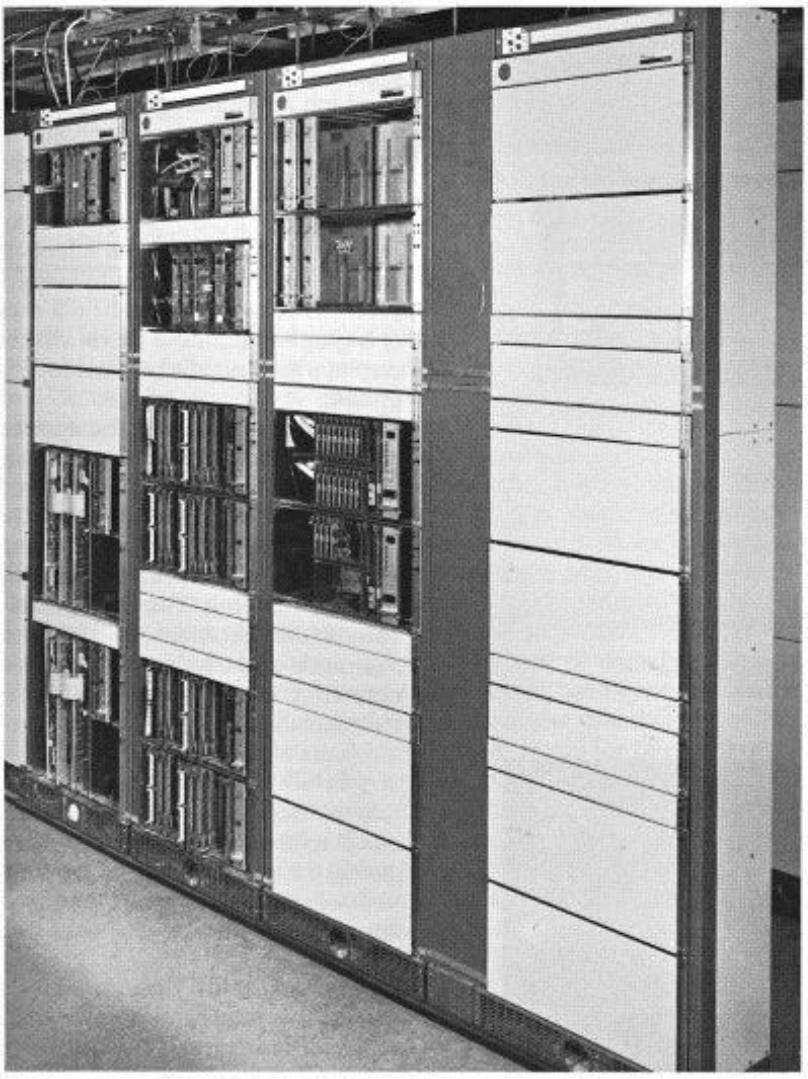

Fig. 5. Marconi Automatic Cross-connect Equipment (ACE)

Stream service to any required route. The equipment, shown in figure 5, allows any MegaStream connection to be set up for the purposes of videoconferencing. It is, therefore, inherently much more reliable than the early manual system where the 2048kbit/s stream had to be de-multiplexed into individual 64kbit/s timeslots before being connected manually, in a digital distribution frame, to the required destination. The setting up of a link is now simply a matter of changing the route using remote control equipment (RCE). Thus a total network management system is provided which allows automatic cross connection, alarm monitoring and maintenance facilities. ACE is particularly suitable in that it can not only provide point-to-point and point-to-multipoint connections at 2048 kbit/s but also allows switching at nx64kbit/s and is thus capable of meeting the different bit rates at which the codec may operate. At these lower bit rates, ACE can switch the block of 64kbit/s timeslots whilst retaining full bit-sequence integrity. The cost reduction accruing from increased compression is not lost by using the nx64kbit/s capability as ACE has the ability to aggregate traffic up to a 2048kbit/s rate.

Satellite

The second method of setting up a transmission link is by using satellite communications. A satellite link provides both the necessary reliability and the flexibility for the videoconferencing network. Fixed or mobile terminals are used to give two-way connections, thus allowing interactivity. The overall system requirement is shown in figure 6. The main uplinking station and hub would need to be larger than the remote terminals and could be similar to those installed by Marconi for BT at the London teleport. These stations operate at Ku band and can utilize both EUTELSAT and INTELSAT systems. The earth station is configured as shown in figure 7 and, by means of redundancy of all main equipment except the antenna, it can provide a very reliable service both in the UK, using BT's SatStream service, or internationally using the appropriate Ku band satellite. Theoretically the antennas have to be 13m in diameter though in practice this could be reduced to 8m. They are fully steerable so can be pointed to another satellite should the operational one fail.

The connection to the hub station can be either a short terrestrial link or line-of-sight. The earth sta-

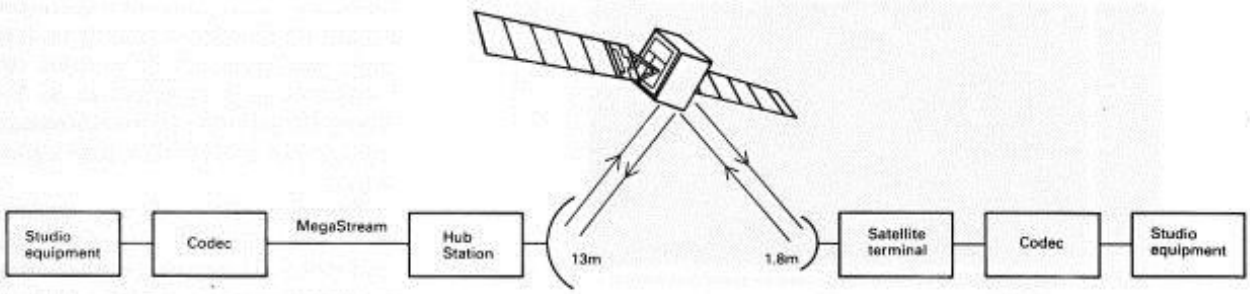

Fig. 6. Block diagram of a satellite teleconferencing system

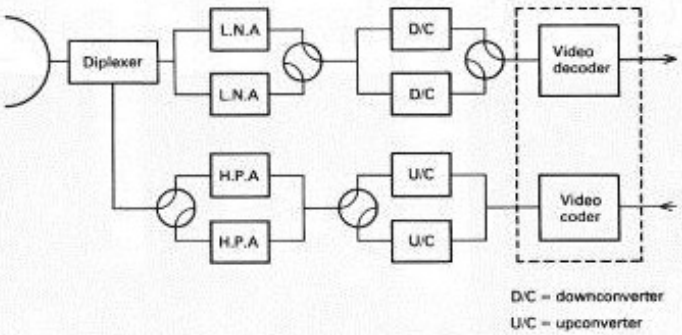

Fig. 7. Configuration of an earth station for teleconferencing

tion modem required can be variable in rate to cater for codec changes and can be one of the Marconi P3800 series of modems depending on whether the SMS/IBS or IDR satellite service is used.

The remote terminal can be fixed or mobile, depending on the amount of use that is to be made of the facility. The earth station will most likely operate to a satellite on an uplink of 14GHz and a downlink of 12.5 GHz using a service that has a single-channel-per-carrier (s.c.p.c), frequency division multiple access (f.d.m.a) accessing technique and could therefore be sub-equipped with a single down chain. The actual size of antenna required for the remote terminal is set by the G/T figure and the bit rate to be handled. A terminal with a 2.4m diameter antenna and a 200W high-power amplifier (h.p.a) will be able to handle a 2048 kbit/s data signal if the G/T is >24 dB/K, which also assumes a low-noise amplifier (l.n.a) having a noise temperature of 120K.

Digital microwave

The third method of transmission is line-of-sight, but this would be too inflexible in most cases.

Future

The development of teleconferencing, especially two-way interactive video, requires that the video signal be compressed still further to allow a much lower bit rate than is currently possible. This problem is already being addressed and it is likely that, in the near future, products will become available that will allow the video signal to be compressed into a single 64kbit/s timeslot. This will be a major breakthrough in that it will allow users of the KiloStream service to have a videoconferencing capability. This will not only reduce the transmission cost of conferencing but will also open it up to a much larger group. One remaining obstacle will be studio equipment costs which will constitute the major element of the capital cost.

The transmission system will still be the same, though the terrestrial method will be more flexible. The satellite terminal will reduce in size in terms of h.p.a, down to 10W to 20W at Ku band, with the antenna diameter at 2.4m and a corresponding reduction in the hub station size. In addition, it is expected that VSLI techniques will be applied to the modem and codec designs, bringing greater reliability and lower cost.

In the terrestrial area, the use of versatile multiplexers such as the Marconi U3500 will allow private networks to set up videoconferencing facilities throughout a network, with central control of routeing and network management.

ZUSAMMENFASSUNG

Telekonferenzen werden weitgehend angewandt, um die Probleme großer Entfernungen und Reiseschwierigkeiten bei Sitzungen im vis-a-vis zu überwinden. Land- bzw. Satellitenstrecken hängen von den verfügbaren Diensten ab und beide Betriebsarten werden betrachtet sowie auch die Vorteile und Nachteile der Telekonferenzsysteme.

Die grundlegenden Elemente eines Video-Konferenzsystems, einschließlich Mikrowellenstrecke und die Schnittstelle mit dem erdgebundenen Netz werden erörtert. Das Hardwaresystem für ein Studio wird im einzelnen beschrieben sowie auch die Einrichtungen, die erforderlich sind, um eine moderne Video-Konferenzanlage entweder auf Dauerbasis oder provisorisch vorzusehen.

Weitere, für ein verbessertes System erforderliche Entwicklungen werden untersucht.

RÉSUMÉ

L'utilisation de la téléconférence est un moyen de plus en plus répandu de surmonter les problèmes de la distance et des déplacements nécessaires aux réunions. L'utilisation des liaisons terrestres ou par satellite dépend des services disponibles et les deux modes sont envisagés, ainsi que les avantages et les inconvénients des systèmes de téléconférence.

Les éléments de base d'un système de vidéo-conférence sont envisagés, y compris les liaisons par micro-ondes et l'interface avec le réseau terrestre. Le matériel d'un studio fait l'objet d'une description détaillée, ainsi que les installations nécesaires à une salle de vidéo-conférence soit sur une base permanente, soit sous forme d'installation provisoire.

Les développements nécessaires à l'amélioration future des systèmes font l'objet d'une disucssion.

RESUMEN

El empleo de las teleconferencias se está extendiendo considerablemente como un medio de vencer los problemas de la distancia y las dificultades de viajar cuando se trata de reuniones cara a cara. La utilización de enlaces terrestres o por satélites depende de los servicios disponibles y se consideran ambos modos, junto con las ventajas y desventajas de los sistemas de teleconferencias.

Se consideran los elementos básicos de videoconferencias, con inclusión del enlace por microondas y la interconexión con la red terrestre. Se muestra detalladamente el sistema de equipamiento para un estudio, y se describen las necesidades necesarias para proporcionar un sistema moderno de videoconferencias establecido permanentemente o simplemente como instalación temporal.

Se discute el desarrollo futuro que se requiere para perfeccionar los sistemas.