INNOVATIONS

A SERIES OF ARTICLES WHICH EXPLORES SOME OF THE COMPLEXITIES OF EMERGING TECHNOLOGIES

DELIVERY OF CABLE VIDEO SERVICES

BY MURRAY DELAHOY, COMMUNICATIONS LABORATORY, DEPARTMENT OF COMMUNICATIONS AND THE ARTS, AND
REJI MATHEW, TECHNOLOGY ASSESSMENT, PLANNING BRANCH, ABA.

INTRODUCTION

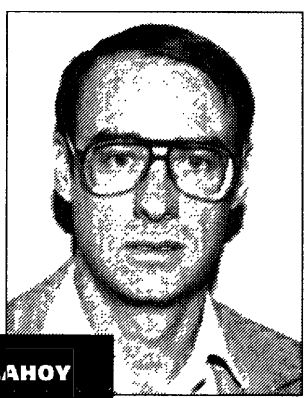
Pay TV, home shopping and interactive television are all possibilities with the advent of a 'broadband' cable network. This paper briefly discusses the delivery of video services using optic fibre, coaxial cable and copper pair cable technology.

Possible methods of bringing video services to the home are examined and an overview of current Australian initiatives in implementing a cable video network is presented.

TELEPHONE NETWORK

Telecommunication carriers in Australia such as Telecom and, more recently, Optus have built an intricate cable network. It is this far reaching network that allows telephone conversations to take place between individuals who may be thousands of kilometres apart.

Simple copper wire pairs connect telephones from private residences and business premises to a local telephone exchange. In the past these local exchanges were connected together with cables composed of a large number of copper wire pairs, but nowadays it is normal practice to connect local exchanges with optic fibre cables. For long distance routes or trunk routes (e.g. Sydney to Melbourne) coaxial cables or microwave radio links have traditionally been used. In more recent times these transmission media have been augmented for heavy traffic routes by high capacity optic fibre links.



MURRAY DELAHOY

Coaxial cables can carry more information than copper wire pairs. A copper wire pair can carry the voice information for one telephone call, while a coaxial cable can carry hundreds of calls at any one time.

Optic fibre has even greater information carrying capacity than coaxial cable. It is this greater information carrying capacity or greater 'bandwidth' that is contributing to the popularity of optic fibre.

OPTIC FIBRE

Optic fibre is carefully manufactured silicon glass fibre with special characteristics that allow it to transmit light with very low loss. Light waves used for optic fibre communications are from the near-infrared part of the spectrum. These light waves carry information from the transmitter through the fibre to the receiver.

Delivery of video services requires the transmission of large amounts of information. Optic fibre is well suited to such intensive transmission requirements. An optic fibre can easily carry a number of video services such as pay TV channels, video on demand and interactive television.

OPTIC FIBRE IN THE NETWORK

Optic fibre is being deployed into the telephone network in progressive stages. The move to an all fibre network has already commenced with optic fibre replacing coaxial cables on heavy traffic routes. Initially however, customers are likely to see a hybrid optic fibre/coaxial cable network rather than a full fibre network.

Optic fibre can be used in two possible ways to deliver video services: Fibre to the Home (FTTH) where the connection from the local exchange to the home terminal equipment is entirely optic fibre. Fibre to the Curb (FTTC) where optic fibre cables extend to a junction point where signal conversion takes place and the final distance to the home terminal equipment is traversed by coaxial cable. FTTC systems are really a hybrid between a fully optic fibre connection and a fully coaxial cable connection.

FIBRE TO THE HOME

FTTH proposes to replace all existing copper wire pairs with optic fibre. Every home will have its own optic fibre connection, making it theoretically possible for residents to get access to a large number of video services. An optic fibre network can be used to provide High Definition Television or HDTV as it is commonly known. Inter-

REJI MATHEW

active television is another service that can be introduced with a broadband fibre network.

In a FTTH scheme, the electronics required at the receiver to interface with the fibre and process the incoming signals currently remains expensive. FTTH therefore is not currently considered a cost effective solution for the present but it remains a long term goal for telecommunications carriers who are interested in delivering a range of video communications services to the home.

Hybrid Networks

Hybrid networks using both optic fibre and coaxial cable are seen as a more viable alternative for introducing cable delivery of video services.

Coaxial cable, although providing less bandwidth than optic fibre, is well suited for video distribution. Established cable television services in the USA and Europe have primarily relied on coaxial cable networks for distributing television programs to individual homes.

One possible hybrid architecture involves using optic fibre to provide video services to telephone exchanges and using coaxial cables to distribute the video services from the exchange to individual homes. Such a hybrid network could provide 50 to 100 video channels of conventional television picture quality if analog television signals are used. If digitally compressed signals are used a greater number of channels might be possible.

A natural extension of the proposed hybrid scheme is to bring the fibre from the exchange to a point closer to the homes being served. The FTTC hybrid scheme proposes to install fibre to each street corner or to another convenient location. Coaxial cables will then be used to connect each house in the street to the fibre at the street corner. It is expected that a FTTC scheme will be able deliver to the home approximately 500 video services of conventional television picture quality. A comparison of network architectures for FTTH and FTTC is shown in Figure 1.

In an FTTC situation, multiple video services will be delivered to the curb. The resident can choose which video service he or she wants to watch from all that is available from the fibre termination at the street corner. Once a decision is made an electronic switch at the street corner will connect the appropriate service to the coaxial cable leading to the resident's house.

The receive equipment or decoder required to process the signals from a coaxial cable connection is far less expensive than that required for a FTTH connection.

Although when compared to FTTH the number of channels that can be delivered by a hybrid network is less, the relatively low cost of implementation makes a hybrid network a viable alternative for bringing 'broadband' services to the home.

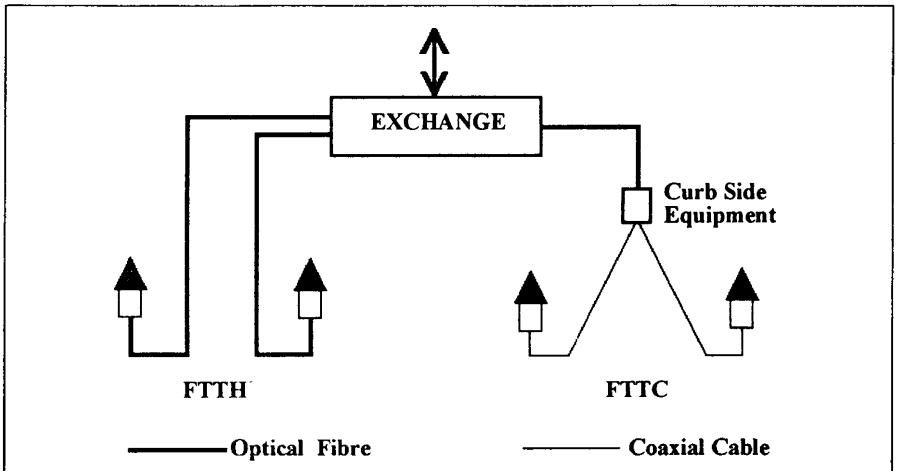


Figure 1. Example of FTTH and FTTC cable network.

It is important to note that the number of video channels made available to the home depends not only on the transmission medium (e.g. coaxial cable or optic fibre) but also on the network architecture and switching technology used.

Australian Developments in Optic Fibre Technology

Telecom in Australia is progressively deploying optic fibre in the telephone network. Optic fibre has now been deployed in most trunk and inter-exchange routes. The next stage of deployment is to bring fibre closer to the home.

Telecom is conducting trials in delivering video services to the home using optic fibre technology. These trials are being conducted at Cordeaux Heights in Wollongong and at Centennial Park in Sydney. In Cordeaux Heights, FTTH and a hybrid network architecture (FTTC) are being trialed while Centennial Park is solely a hybrid network project. [*See April Update for further discussion of the Telecom project.*]

Telecom recently announced the formation of a subsidiary called Visionstream to coordinate work on implementing a broadband network. The network will be a hybrid system using both optic fibre and coaxial cable. Under Telecom's current plans the network is to pass 1.1 million homes within three years. Deployment of the network will initially be restricted to the 'high density' areas of Sydney, Melbourne, Brisbane and the Gold Coast.

Cable pay TV licensees will be the first service providers to use the hybrid network. Telecom earlier this year reached an agreement with Cable Television Services (CTS) for a 10 channel pay TV service to be provided using Telecom's new network[1]. According to Telecom, it will be possible initially to provide 67 channels of cable television, with other facilities such as home shopping and interactive games to be introduced at a later stage[2].

Telecom is investing $710 million to implement the fibre/coaxial cable network and has recently announced Philips as a major contractor to work with Visionstream in providing broadband services to the home[3].

continued on p.16

continued from p.15

ADSL

Due to developments in digital compression and advanced digital electronics, technologies have now emerged that can deliver video over existing simple copper wire pairs.

Asymmetric Digital Subscriber Line (ADSL) is a technology that can deliver video services from a local telephone exchange to the home using existing copper wire pairs. Using ADSL, three communication channels are opened up for use at any one time. The first channel is a narrowband channel used for voice communications. The second channel is another narrowband channel used to send control signals back to the exchange. The third channel is a wideband channel used for transmitting video services to the home.

This implementation of three independent communications channels allows a normal telephone conversation to be conducted even when a video service is being received over the same copper wire pairs. A simple illustration of an ADSL system is shown in Figure 2.

With ADSL, only one television channel will fit into the existing copper wire pairs. This complicates switching from channel to channel but is overcome by placing an electronic switch at the telephone exchange. The local exchange will have available a number of television channels or video services. Using the control channel the viewer communicates to the local exchange which television service he or she prefers to watch. The electronic switch at the exchange then connects the appropriate television service to the copper wire pair leading to the viewer's house.

The great attraction of ADSL is that it does not require the extensive investment in new cabling (optic fibre or coaxial cable) that FTTH and FTTC solutions require. However ADSL does suffer from certain disadvantages. ADSL receivers will need to employ advanced digital processing techniques which could raise the cost of an ADSL system for the home. Secondly, unlike optic fibre, ADSL does not support high data rate two-way video interaction such as video conferencing.

The adequacy of picture quality offered by ADSL depends on the amount of information that can be successfully transmitted over copper wire pairs. For digital services the rate of information flow is measured in bits per second. One of the proposed ADSL systems is claimed to make available a rate of two million bits per second. This rate of data transfer will in most cases produce picture quality that is somewhat below that of today's conventional television picture quality. When operating at this rate noticeable picture quality degradation will occur for more complex scenes.

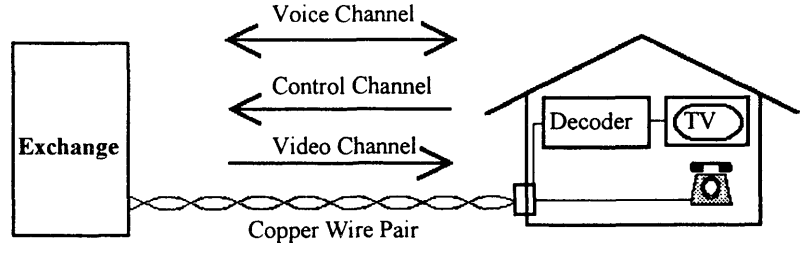


Figure 2. Proposed ADSL scheme.

Many viewers may however find this acceptable if the cost of equipment and the programme offerings are attractive enough. Currently an ADSL system offering a transmission rate of six million bits per second is being examined. This higher bit rate is more suitable for video transmission and would be comparable to that offered by satellite delivered pay TV.

An electrical signal becomes progressively attenuated as it travels through a wire or cable and hence less distinguishable from noise. Due to the large attenuation introduced by copper wire pairs, the bit rate that can be achieved by an ADSL system depends on the total length of copper wire that a signal must travel through before it gets to the home. It is expected that ADSL will be able to deliver video services over copper wire pairs that are not more than approximately three km in length. For shorter cable run lengths higher data rates are possible.

Recent advances in ADSL has meant that it may now be possible to deliver two television services instead of one over an existing copper wire pair.

ADSL is viewed by some as an interim technology that can be employed while fibre is being introduced. The provision of video services over copper wire pairs may accelerate the market demand for cable video services and hence lead to a faster take up of fibre.

Australian Developments in ADSL Technology

Telecom is considering ADSL technology for providing video services to the home for medium and low density areas.

In March this year Telecom released details of an ADSL trial project to be conducted in Melbourne. The trial will involve about three hundred households and is proposed to commence early 1995. The trial will provide Telecom a unique opportunity to access viewer perceptions of picture quality offered by ADSL.

At present there are two main competing ADSL standards, these are referred to as the Carrierless Amplitude Phase standard and the Discrete Multitone standard. Both standards are to be tested in the Melbourne trials.

In implementing the initial ADSL trials, a major contract has been awarded by Telecom to NEC[4]. Telecom now joins other international telecommunications carriers in assessing ADSL.

continued on p.19

signments for low power information services where a television service is operating on VHF channel 3, or there are FM radio services operating on frequencies below 88.4 MHz (there are about 26 areas where this is the case).

Initially, applications for low power information services in these areas will be processed only where the proposed location for the low power information service transmitter is outside the radius indicated for the locations listed in Table 1 or Table 2, because they could interfere with mainstream broadcasting services.

In areas where an alternative sub-band was previously dropped through per s.34 of the *Broadcasting Services Act 1992*, applications for low power information services will be treated the same as those in areas which would use 87.6 - 88.0 MHz. That is, the upper frequency will be assigned first and the lower frequency (400 kHz away) will be assigned next. Once two frequencies have been assigned from the alternative FM sub-band for an area, no additional frequencies within the alternative sub-band will be assigned for low power information services until planning for that area has been completed. No new alternative sub-bands will be authorised under s.34, until planning has been completed in each area.

TABLE 2

OPERATING FM BROADCASTING SERVICES ON 88.1 AND 88.3 MHz

(areas where FM broadcasts are on 88.1 or 88.3 MHz - gives radius around each town to be protected)
(no low power information open narrowcast services are to be licensed to operate within the radii indicated in this table)

FREQUENCY	EXISTING FM RADIO TRANSMITTER SITE	AREA SERVED	ERP	PROTECTION RADIUS
88.1MHz	2ABCFM - Khancoban	Khancoban	18 W	30 km
	2ABCFM - Talbingo	Talbingo	2 W	10 km
	2RDJ - Burwood	Burwood	50 W	50 km
	2RVR/T15.5km ENE of Hay	Hay	3 kW	100 km
	3ABCFM1.5km N of Bright	Bright	10 W	30 km
	3ABCFM - Mt Clay	Portland	2 kW	80 km
	3MFM - Mt Misery	Leongatha	1 kW	80 km
	4HI - Blair Athol Mine	Blair Athol	100 W	50 km
	8ABCRN - South Alligator	South Alligator	2 W	10 km
88.3MHz*	3SCB - Moorabbin	Southern Subs Melb.	200 W	30 km

** = 87.6 MHz only, may be assigned initially, within this area.*

IMPLEMENTATION

The revised licensing arrangements are being implemented immediately. Each application held by the ABA will be assessed strictly in accordance with the date of receipt of the application by the ABA. Applications which do not comply with the published guidelines will be rejected and the applicant advised of the reason for the rejection; those which cannot be assigned a frequency immediately will be retained for reassessment. Once planning for the area is completed, the applicant will receive appropriate advice regarding their application.

A copy of the guidelines is available from the Director Planning, ABA; the reference is ABA News Release No. 13/1992.

DELIVERY OF CABLE VIDEO SERVICES

continued from p.16

CONCLUSION

Optic fibre can deliver to the home a variety of video services, however bringing fibre to the home remains an expensive exercise. Hybrid optic fibre and coaxial cable networks provide a viable alternative in implementing a broadband network.

ADSL, currently under going field trials, promises video delivery over existing telephone wires. In Australia, ADSL may be used to introduce cable video services to regions not served by either an optic fibre or hybrid network.

Footnotes

1 *Exchange*, Volume 6, Number 8, 4 March 1994, p.3.

2 *Exchange*, Volume 6, Number 14, 15 April 1994, p.4.

3 *Exchange*, Volume 6, Number 14, 15 April 1994, p.4.

4 *Exchange*, Volume 6, Number 10, 18 March 1994, p.4.

Further reading:

T. Russell Hsing, Cheng-Tie Chen and Jules A. Bellisio 'Video Communications and Services in the Copper Loop' *IEEE Communications Magazine*, p.62, January 1993.

Joe Sutherland and Larry Litteral, 'Residential Video Services' *IEEE Communications Magazine*, p.36, July 1992

D. Waring, J Lechleider and T Hsing, 'Digital Subscriber Line Technology Facilitates a Graceful Transition from Copper to Fiber, *IEEE Communications Magazine*, p.96, March 1991

R White, 'ADSL Bridging the Superhighway Gap' *Australian Communications*, p.81, May 1994

Bureau of Transport and Communications Economics, Communications Futures Project, *Delivery Technologies in the New Communications World* Module 5, March 1994