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An Introduction to Broadband[1]

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Both market and technological factors should be taken into account in examing the development of broadband systems and networks. In technical terms, the major advance which broadband enjoys as compared to narrowband ISDN (Integrated Services Digital Network) is the ability to efficiently integrate full motion video alongside voice, data, text and still pictures in a single network, as well as the ability to process huge amounts of data in real time. This ability stems from technical and price/performance progress in fiber optics, high-speed large-scale integrated circuits and digital signal processing.

The market justifications for broadband development stem from both business and residential applications, with the former driving initial broadband investment. Among professional applications, high-speed data communications will generate the strongest demand. Applications include globe-spanning interconnections of local area networks (LANs) as well as high-speed data links among terminals, work stations and host computers. In addition, the multimedia terminals currently under development in many places will require broadband for the video component. Broadband networks are expected to provide the bandwidth necessary for broadcast-quality video conference services. They will also be used as backbone networks for other data communications, including frame relay and circuit emulation services.

Residential applications represent a huge potential market for broadband services, although it is important to note that private customers are not willing to spend as much for telecommunications as business customers. Distribution of TV and radio programmes will be among the applications. Video-on-demand services, which will become more important than simple programme distribution, could become a key driver for broadband. Video information distribution can go beyond movies to include educational services and video shopping.

Two basic technologies are being implemented to develop broadband networks: Asynchronous Transfer Mode (ATM), which provides the means to package and distribute information, and Synchronous Digital Hierarchy (SDH), which provides the means to transmit the information.

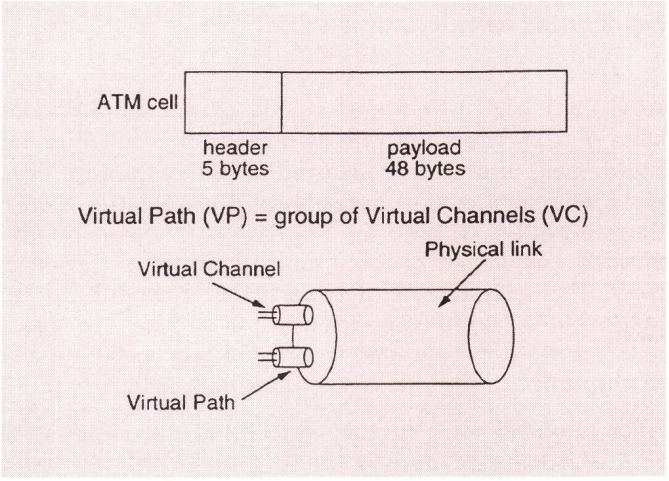

Fig. 1 ATM terminology

ATM involves dividing information — voice, data, text, still pictures, video — into fixed-length segments, known as ATM cells *(Fig. 1)*, which are then transmitted through a network at high speeds. The packaging approach is similar to that used for packet switching, with the notable difference that packet-switched cells are of variable length. The ATM cell contains 53 bytes of information, consisting of a 5-byte header plus a 48-byte payload. The way in which ATM cells are switched is very similar to the technique currently used for Metropolitan Area Networks (MANs).

In contrast to Synchronous Transfer Mode and Packet Transfer Mode, ATM techniques involve the slotting of

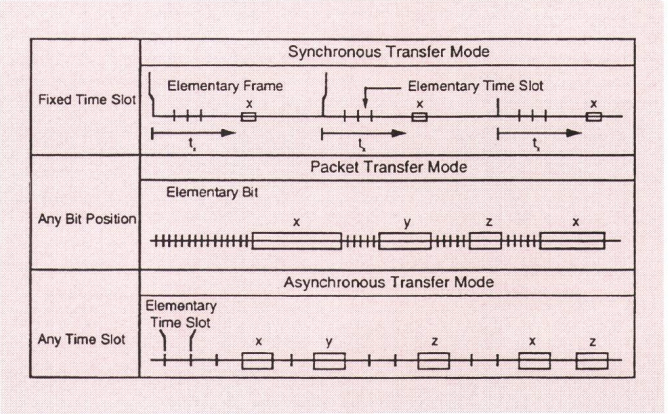

Fig. 2 Comparison of different transfer modes

[1] Lecture held at the Alcatel Press Seminar 1993 in Brussels.

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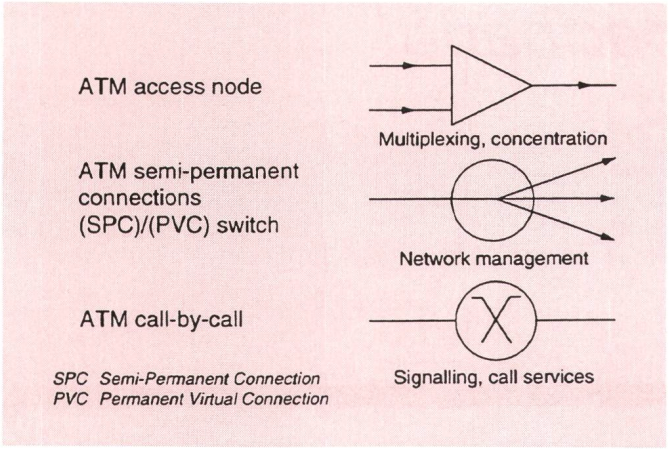

Fig. 3 ATM network elements

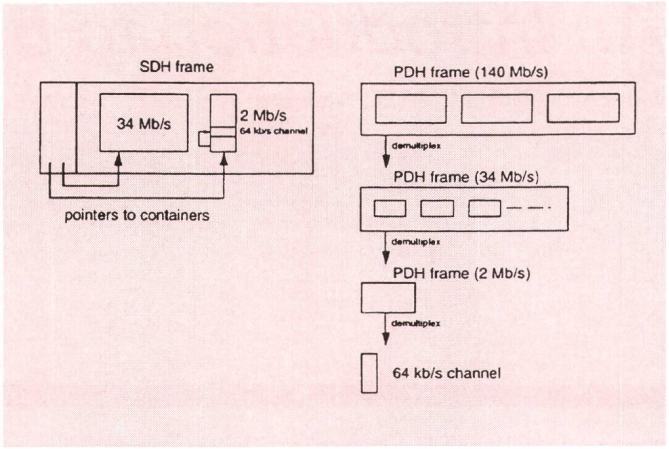

Fig. 5 SDH, direct access to tributaries

ATM cells into a continuous flow of elementary time slots *(Fig. 2)*. There is no frame into which a cell must be fitted; cells are simply inserted into the flow of time slots whenever a slot is available. The result is a very flexible system with no rigid structure. It makes no difference how much or what kind of traffic is travelling through the system at any particular moment, which means ATM can handle virtually any service. For these reasons, ATM can be said to provide bandwidth on demand.

ATM networks are built around three main elements *(Fig. 3)*. The lowest-level element, the ATM access node, provides the multiplexing and concentration functions for information entering (or leaving) the system. Connections are established or released by the network operator in a semipermanent connection switch (SPC), also known as a permanent virtual connection (PVC) switch or a cross-connect switch. Finally, a call-by-call switch handles broadband signalling as well as various call services.

Synchronous Digital Hierarchy is the technique behind a whole new generation of telecommunications transmission systems. It is an internationally standardized technique, of which SONET (Synchronous Optical Network), originally developed in the USA by Bellcore, is a totally compatible subset. Although SDH transmission is, as the name indicates, synchronous, SDH can carry both synchronous and asynchronous information.

Information transmitted via SDH is loaded into 2-Mbit/s or 34-Mbit/s containers. The containers are assembled into the payload of the basic SDH frame *(Fig. 4)*. The total payload, for the slowest standardized version of SDH, comes to about 150 Mbit/s. The payload constitutes the bulk of the basic SDH frame, but the frame also contains about 5 Mbit/s of overhead. This capacity is reserved for SDH management. While 155 Mbit/s is the basic SDH transmission speed, multiples of 2.4 Gbit/s and beyond are envisaged.

Easier and simpler access to low-speed information is one of the key advantages of SDH over traditional PDH (Plesiochronous Digital Hierarchy) transmission *(Fig. 5)*. For example, a 140 Mbit/s PDH frame must be demultiplexed four times to gain access to any particular 64-kbit/s channel. But SDH uses a simple access mechanism based on pointers.

SDH transmission systems are built around three main elements *(Fig. 6)*. The basic SDH multiplexer packages both high-speed and low-speed information flows for SDH transmission. The SDH add/drop multiplexer picks up ('adds') information at its destination. The SDH cross-connect element redirects lower-speed information in various directions.

The built-in flexibility and network management features render SDH particularly suited to ATM information. ATM cells are fitted into the largest possible SDH containers,

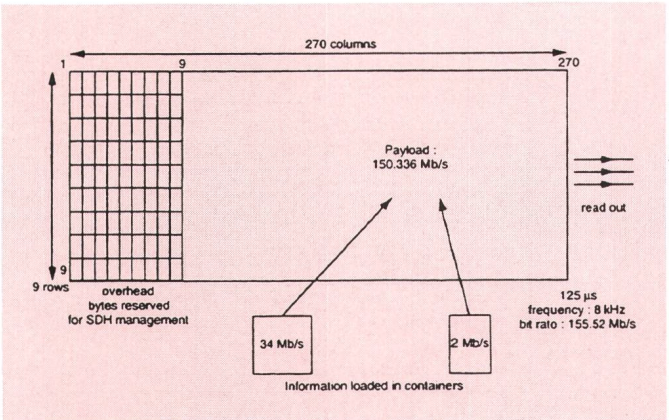

Fig. 4 Basic SDH frame

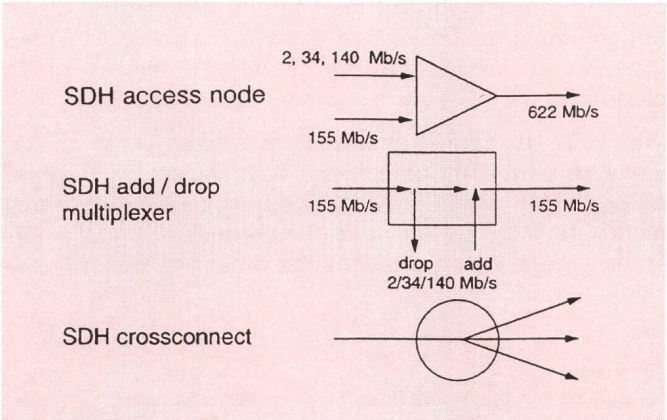

Fig. 6 SDH network elements

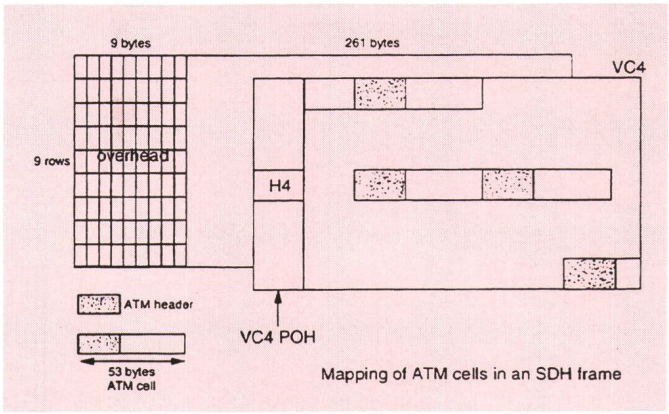

Fig. 7 Transport of ATM by means of SDH

which are transmitted within the payload section of the SDH frame *(Fig. 7)*.

ATM and SDH are complementary. ATM provides bandwidth on demand, i.e. the capability to handle virtually any type of service. SDH provides the means to transport ATM information network-wide, regardless of the type of traffic.

Zusammenfassung

Einführung in die Breitbandtechnik

Sowohl Geschäfts- als auch Heimanwendungen werden vermehrt den Einsatz von Breitbandnetzen erfordern. Der Autor gibt eine Übersicht der Markt- und Technologiefaktoren, die die Einführung von Breitbandsystemen und -netzen beeinflussen. Er erklärt die beiden grundlegenden Techniken, die bei der Entwicklung eingesetzt werden: der Asynchrone Transfer-Modus ATM, der das Paketieren der Information ermöglicht, und die Synchrone Digitale Hierarchie SDH, die das Mittel zum Transport der Information liefert.

Résumé

Introduction à la technique à large bande

Tant pour des applications commerciales que privées, le recours à des réseaux à large bande devient de plus en plus nécessaire. L'auteur examine les facteurs propres au marché et aux technologies susceptibles d'influencer l'introduction de systèmes à large bande. Il explique les deux technologies de base utilisées pour développer les réseaux à large bande: le mode de transfert asynchrone (ATM) qui permer de grouper les informations en paquets, et la hiérarchie numérique synchrone (SDH), le support de l'information proprement dit.

Riassunto

Introduzione nella tecnica a larga banda

Sia le applicazioni effettuate sul lavoro che quelle effettuate a domicilio richiedono sempre più l'impiego di reti a larga banda. L'autore illustra brevemente i fattori di mercato e quelli tecnologici che influiscono sull'introduzione di reti e sistemi a larga banda. Egli spiega le due tecniche di base impiegate nello sviluppo: la tecnica ATM (Asynchronous Transfer Mode) che consente l'impacchettamento dell'informazione e la tecnica SDH (Synchronous Digital Hierarchy) che fornisce il mezzo per il trasporto dell'informazione.

Summary

An Introduction to Broadband

Both business and residential applications will call for a wider use of broadband networks. The author reviews the market and technological factors which will influence the introduction of broadband systems and networks. He explains the two basic technologies which are used to develop broadband networks: Asynchronous Transfer Mode (ATM), which provides the means to package information, and Synchronous Digital Hierarchy (SDH), which provides the means to transmit the information.