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Autor: Bajenesco, Titu I.

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CORPORATE TELECOMMUNICATION NETWORKS

SOLUTION FOR EACH PARTICULAR USER'S REQUIREMENTS

First of all, a Customer Premises Network (CPN) must secure the communication of speech, text, images and data within a company or authority *(Fig. 1)*. It is arguable whether systems such as site and building surveillance, systems controlling access to computer or control rooms and sound systems are to be regarded as components of a CPN. In future, these systems would presumably be more tightly integrated into joint in-house transmission networks. The central component of CPNs is the speech communication, increasingly implemented on digital telecommunications with ISDN interfaces (S_o, S_{2M}). These installations no longer have to be organized centrally; they can be distributed over the entire site in a decentralized fashion as free-standing systems or as peripheral modules.

A condition for this networking and the related company-wide utilization of all services typically provided by a telecommunication system are communication protocols. At present such protocols are available as manufacturer-specific or quasi standards

TITU I. BAJENESCO, LA CONVERSION

such as Digital Private Network Signalling System (DPNSS), but they are to be replaced by a worldwide standard (Q Interface Signalling Protocol, Q-SIG). This creates an individual in-house network of telecommunication installations which can be configured, supervised and controlled with the help of a management system. This management system can, in addition, also offer other functions, such as subscriber administration (telephone directory) or charge accounting.

Customer premises networks

Besides speech, additional services already exist and are provided via these telecommunication installations: paging, voice box, data transmission and cordless telephony (DECT). True: data transmission over ISDN installations is no alternative to dedicated data networks, but it can form an economic solution which complements LANs in certain applications (terminal connection and printer connection, back-up services).

As a result of the integration of data applications in a telecommunication installation and through applications such as computer-supported telephony (Computer Telephone Integration/Computer Supported Telephony Applications, CTI/CSTA), future speech and data networks will grow ever closer. Management areas such as the computer center and general office services, which up to now have been separate, will be forced to work more tightly together in order to fulfil their new tasks.

Through the integration of speech and data networks in the technical as well as administrative areas, if these networks are to be installed and operated economically, it will also be necessary to consider more urgently a joint strategy for cabling systems, control rooms, switchers and network management systems. Individual networks and/or systems for text (telex, teletext) and facsimile transmission that are ubiquitous today will – in the long term – become obsolescent by the introduction of ISDN installations and ISDN PC cards.

The first pillar of Corporate Networks (CN) is data communication; a changeover to new architectures and transmission methods is apparent in data communication, even more than in telecommunication installations. Current LANs are mainly characterized by topologies such as star, ring or bus and access methods as defined in

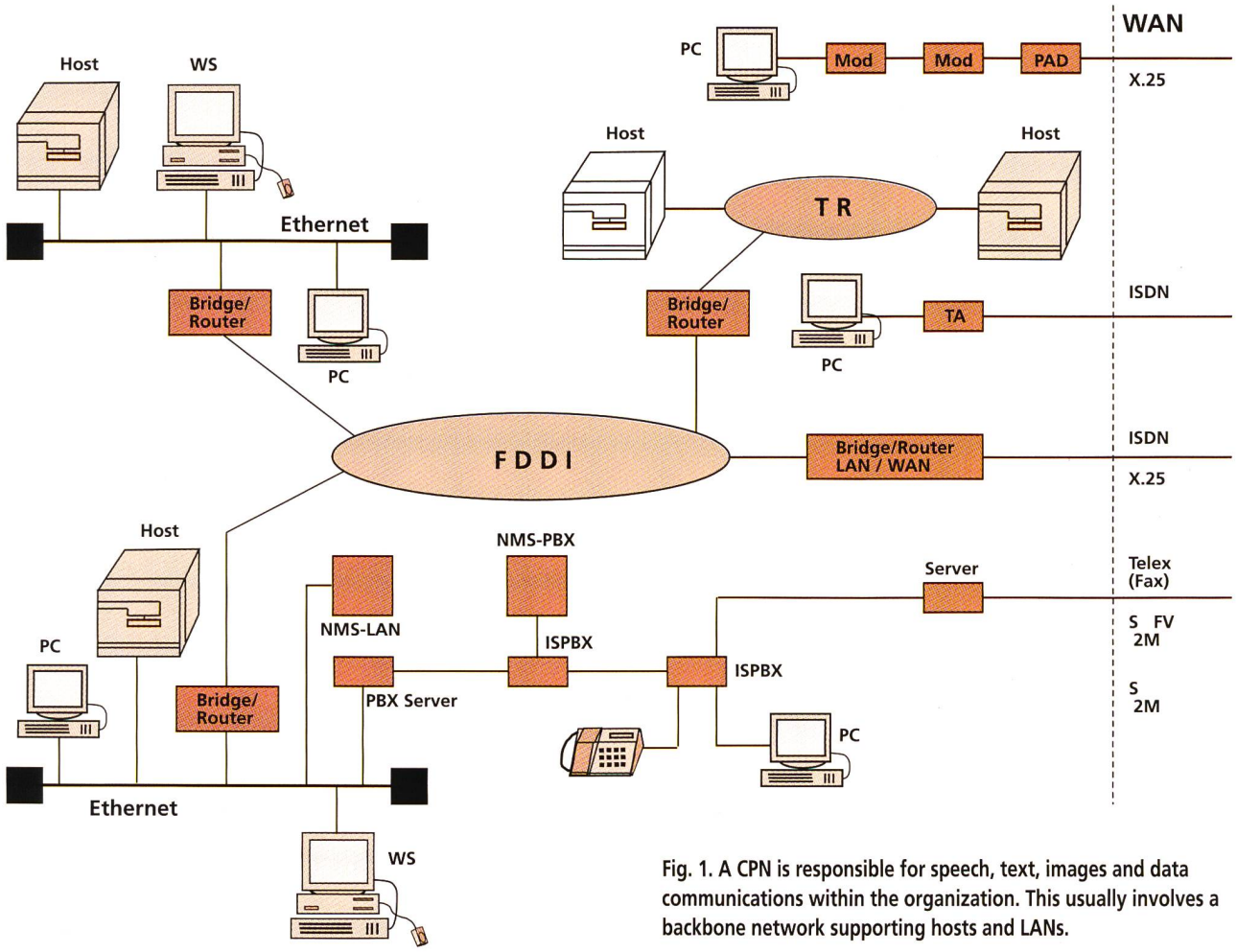

Fig. 1. A CPN is responsible for speech, text, images and data communications within the organization. This usually involves a backbone network supporting hosts and LANs.

IEEE 802: CSMA/CD, Token Ring, token passing. These network technologies permit transmission speeds of 4 to 16 Mbit/s (Token Ring), 10 Mbit/s (Ethernet) and 100 Mbit/s (FDDI).

Users may attempt to overcome limitations such as the area covered, the number of stations, traffic load or manufacturer-specific protocols by installing network building blocks such as bridges[1], routers[2] or gateways[3].

Convenient network management systems based on Simple Network Management Protocol (SNMP) are already offered by all major manufacturers. They supervise and control these network elements. The most important components of Internet standard SNMP are SNMP Protocol, the Structure of Management Information and the Management Information Base (MIB) standard. Version 1 of SNMP is now complemented by version 2, which, in comparison, exhibits among other things improvements regarding security and allows the extension to additional protocol stacks and the implementation of hierarchical management systems.

Besides these activities in the area of network management systems, LANs also exhibit other possible modifications:

- Due to the increased desktop performance of work stations (WS) and PCs, a rejection of centralized processing by mainframes in favour of decentralized processing – often called downsizing – is evident. On the other hand, efforts are being made to interconnect isolated PCs and WSs into useful unions (upsizing).
- Powerful Enterprise Hubs offer the option of 'collapsed backbone' networks as an alternative to the conventional backbone networks based on FDDI with linked bridges

[1] Bridges allow subnetworks on OSI layer 2 to interconnect, thereby helping to overcome restrictions on segment length and the number of stations. They also perform other tasks, such as testing check sums and frame length, rejection of erroneous frames and load separation. Modern bridges possess heuristic filtering functions, are protocol-transparent and allow redundant network structures through loop detection.

[2] Routers, in contrast to bridges, make possible the connection of subnetworks on OSI layer 3, giving traffic a choice of route. They allow construction of hierarchic and redundant network structures with alternative routes and are particularly well-suited to LAN couplings over public networks (WANs).

[3] Gateways are a prerequisite for internetworking computers with different manufacturer protocols such as SNA, DECnet and TCP/IP. They also possess performance characteristics such as protocol conversion up to OSI layer 7, conversion of addresses and formats, code conversion, packet buffering and flow control.

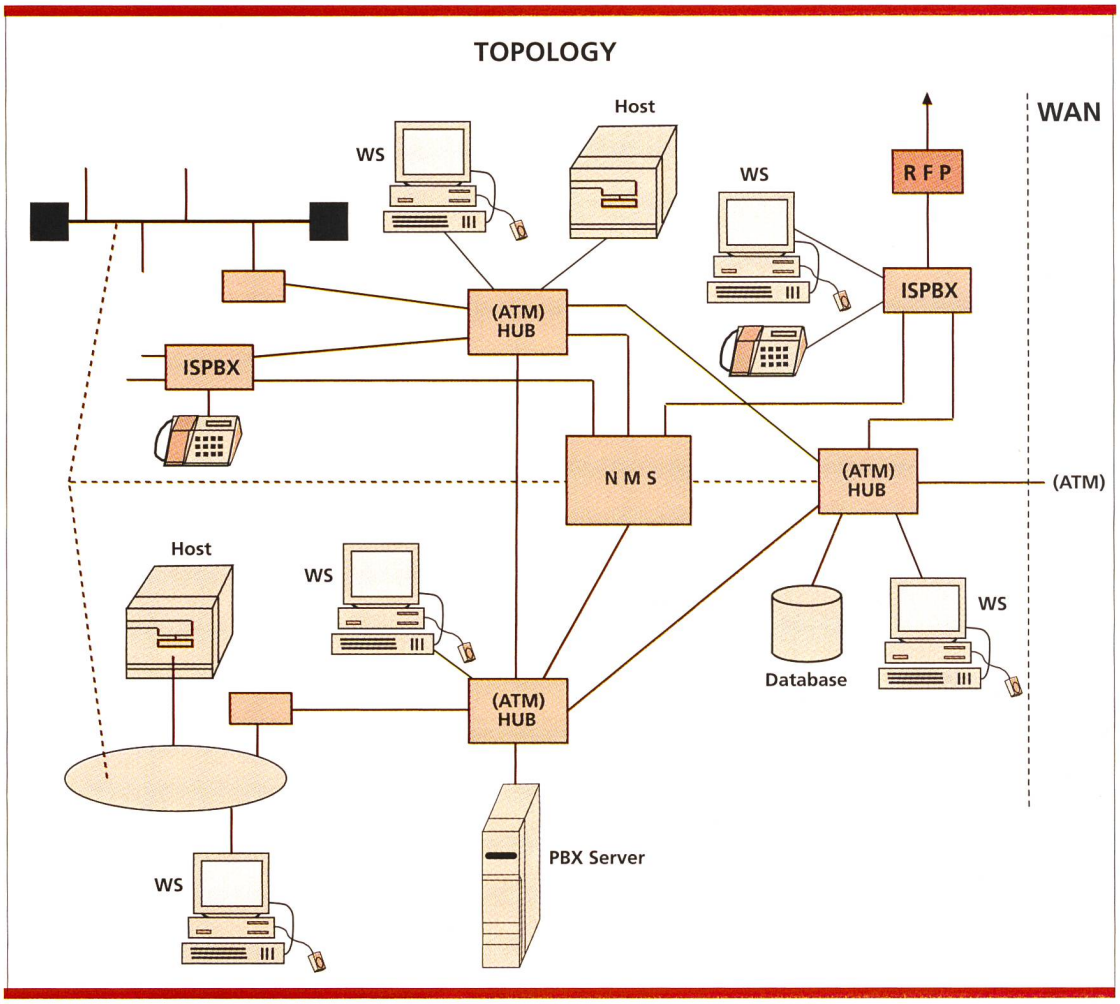

Fig. 2.
The 'collapsed backbone' topology is an increasingly popular alternative to conventional backbone networks.

or routers *(Fig. 2)*. Here, the buses of the hub, joined-up in the 'backplane', act as a backbone network for all linked departmental networks or terminals. Additional functions, which otherwise would have had to be implemented by the deployment of dedicated bridges or routers, are made possible by inserting additional plug-in cards. This brings advantages in better overall performance and smoothes the transition to and from different forms of networks and from LANs to WANs. It helps to simplify network management and maintenance, increases security and reliability and helps maintain investment security.

In the case of Ethernet, several firms (3Com, HP, AT&T, SynOptics and others) are making efforts to increase transmission rates to 100 Mbit/s (sometimes called Fast Ethernet). This allows the estimated 20 million Ethernet users to substantially improve their network performance[4] while retaining the present installed cabling[5]. Wireless LANs (offered by, among others, Motorola, NCR and Cylink) probably do not represent a short- or medium-term alternative, but rather complement conventional LANs. Their possible markets are not in simply replacing cables but are to be found – in the long term – in specialized niches where the construction of temporary and flexible LANs is needed (disaster recovery, short-term projects) or where the connection of individual LANs presents problems[6].

Besides pure LANs there are other forms of in-house data communication not considered here, such as X.25 networks, broadband networks based on CATV techniques, and transmission by modem or terminal adapter.

Through the introduction of ATM in the 'backbone' regime and also in the area of work stations, new options arise regarding transmission speeds (155 or 622 Mbit/s), the utilization of isochronous services (speech, video), WAN access (deploying the same technology in LAN and WAN), and the utilization of new services in the WAN such as LAN internetworking with the help of connectionless servers.

[4] National Semiconductor is planning a chip set which would permit the introduction of an isochronous Ethernet. If this happens, real-time applications for multimedia terminals and video conference terminals could also be implemented over Ethernet in competition with ATM.

[5] Companies are also currently rethinking their cabling philosophy; a universal or integral cabling system is supposed to bring order into the existing chaos of possible cabling approaches (FO coaxial, thick-wire Ethernet, thin-wire Ethernet, shielded twisted-pair STP, unshielded twisted-pair UTP). The division into primary sector (the linking of buildings), secondary sector (connecting floors within a building), and tertiary sector (star-shaped connection of users via twisted cable pairs) and the installation of appropriate distribution frames and multifunctional connecting sockets should guarantee the creation of a flexible infrastructure with comprehensive coverage suitable for data and speech communication.

[6] Other possible applications can be summarized under the heading mobile LAN for data collection, on-campus mobile workers, low-power personal area networks and wireless network interfaces.

Wide area networks

Only after suspension of the monopoly in transmission channels will it also be possible for private CN operators to lay down their own transmission pathways in the form of glass- or copper-based lines. With these fixed links, the networking of telecommunication installations is possible and so, also, the simultaneous transmission of speech and data in a PABX link-up *(Fig. 3)*. Analogue cross-links are increasingly losing importance, as digital ISDN installations are deployed.

Routers and bridges already allow LAN networking via ISDN[7]. To be able to do effectively in the future with ever more stringent requirements affecting high transmission rates, short delivery times and new services, it is important to introduce the frame relay packet switching and the Metropolitan Area Network (MAN) based on Distributed Queue Dual Bus (DQDB). The network's flexibility can be increased through the installation of flexible multiplexers, cross-connects and the appropriate network management[8] system; at the same time, operational reaction times (first installation, modifications, repairs) and operational costs are to be decreased.

Further it is meant to support the formation of virtual networks, allowing customers via access to network management to call up data over their virtual network and exchange electronic mail with the network operator. Technically it is also possible to give customers themselves control of the virtual network, but this would give rise to additional security problems affecting the overall network. The right moment to introduce this technical capability has, presumably, not yet arrived.

In the monopoly sector's transmission network, plesiochronous digital hierarchy (PDH) is – in the long term – being replaced by multiplexers and cross-connects of the internationally standardized synchronous digital hierarchy (SDH). SDH supports transmission rates up to the gigabit/second range and fulfils the precondition of a powerful installed management system based on international standards for operating the network.

SDH meets the provisions needed to operate a network with high levels of availability and – at the same time – to be able to react quickly and reliably to customer requirements while satisfying economic considerations.

ATM deploys technology which finds applications both in transmission methods (cross-connects, multiplexers) and in switching methods (switches, connectionless servers) and can be implemented both for in-

[7] The ISDN is used here both for the primary coupling of the LANs, for back-up circuitry and for controlling peak loads. Besides networking via ISDN there exist well-known alternatives using data direct-call links, connections to the X.25 network and satellite (VSAT), or one may rent transmission channels directly from the monopoly telecom sector.

[8] Network management is of particular significance in the context of implementing the network and the services based on it. It permits, among others, the configuration of network elements, the localization of errors and the deployment of back-up circuitry in case of network disruptions.

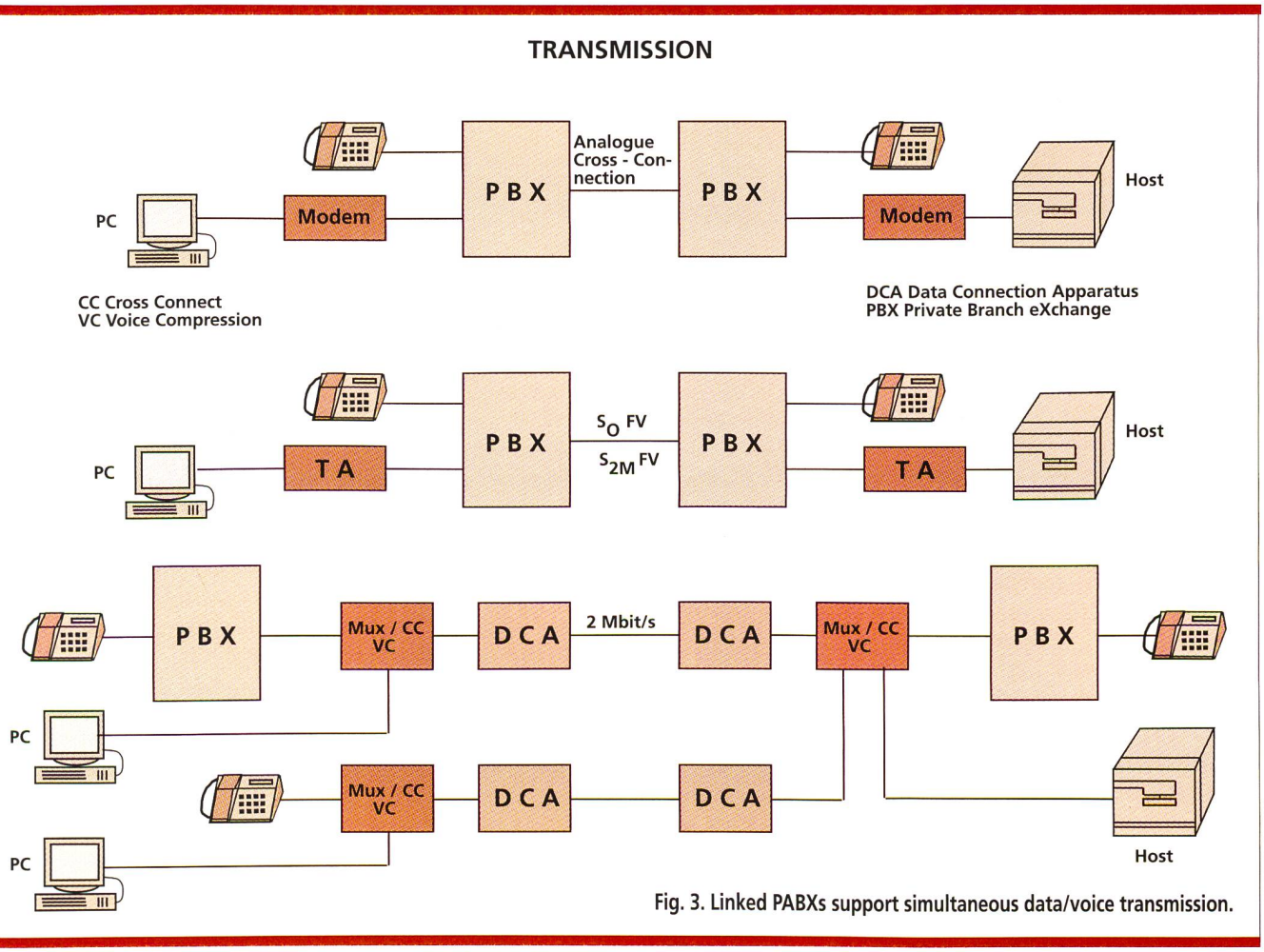

Fig. 3. Linked PABXs support simultaneous data/voice transmission.

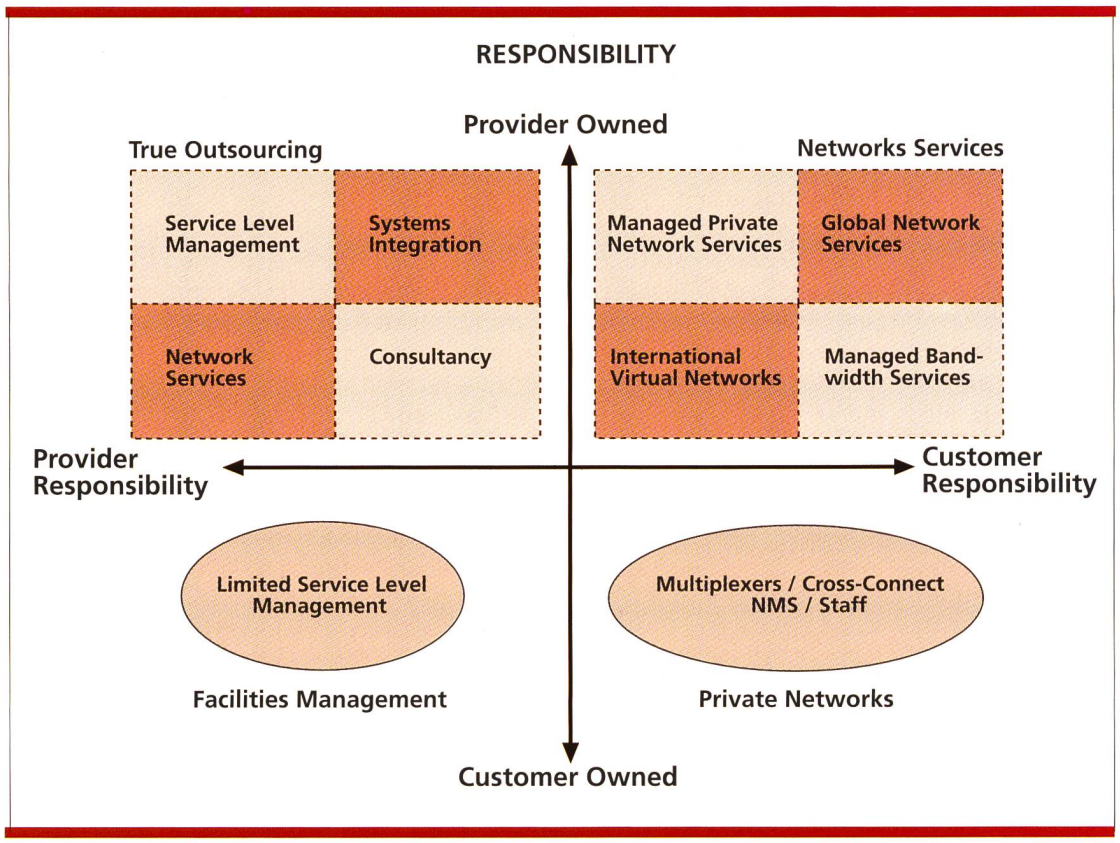

Fig. 4.
The division of responsibility between user and service provider.

house (via an ATM hub) and public networks. ATM allows the user to utilize high transmission rates with flexible bandwidth (bandwidth on demand) and – simultaneously – to transmit data, speech and video. It would be understandable to expect initial large-scale installation, if ATM would be found in-house, for implementing backbone networks and for local networking of fast work stations with integrated ATM interfaces. When large-scale ATM is implemented in the public network, a further advantage of ATM can be realized: a common transmission interface between in-house and public networks. All the innovations and improvements in the public network outlined above serve to meet the customers' growing needs and to underpin the telecommunication service provider's position in the ever tougher and more competitive telecommunication market. This applies both to those areas where competition already exists, such as data and value-added services, and to those for which 1998 may be considered the likely date for its introduction, notably public speech transmission and transmission channels.

BACKGROUND

Definition

Corporate Telecommunication Network (CN) is defined by an ETSI report (the Strategic Review Committee on Corporate Telecommunication Networks) as comprising 'sets of equipment (Customer Premises Equipment, CPE, and/or Customer Premises Network, CPN) which are installed at geographically dispersed locations and are interconnected to provide network services to a defined group of users'. CNs therefore serve to express this, albeit rather informally, for the cost-optimized transmission of speech, data, text and images between communicating groups. They represent a made-to-measure solution for each particular user's requirements at that time. In the ideal case, they allow fast, secure and reliable access to internal and external information relevant to the organization*.

Today CNs are installed not only by companies, but also by official bodies, local authorities, scientific organizations and banks. They may be restricted to one country, but they may stretch across the globe, as in the case of international corporations; therefore, they may need support from numerous service providers or network operators.

CNs may be subdivided into two in-house sections: CPNs defined by the company's site boundaries, and a public section (WANs) which allows interlinking of individual CPNs.

* In doing so – as far as possible – they should not overburden the internal cornmunication budget. A CN operates optimally when it goes unnoticed by both the users and the financial director.

Deregulation

The expansion and utilization of CNs will be influenced decisively by telecommunication deregulations. Today, telecommunication monopoly is limited to the transmission routes network, to public speech transmission and to the monopoly on broadcasting installations. In contrast, it is now permissible to transmit speech and data over a common line.

Outsourcing

The option of leasing computer time and computer services to free a company from the need to provide such capacity and overhead has existed in data processing for many years. In contrast, outsourcing is still a relatively new concept in the communication sector.

There are different ways of splitting the responsibility for a CN between a user and a service provider *(Fig. 4)*. In a situation involving a 'private network', the potential client himself is responsible for operating the network, relying on in-house personnel, and is also the actual owner of the network: the hardware, the software and Network Management System (NMS).

Pure outsourcing means clients have neither their own staff involved in network management nor do they own the network. In such a case, the contract must specify precisely which services the provider is to supply to the client, so as to ensure friction-free operation of the communications network. Between such extremes exist two further 'compromise' solutions: Facilities Management enables a client to continue owning the network, but the service provider takes responsibility for network management and so for operating the network. Only a limited service contract is needed compared with pure outsourcing[9].

Outsourcing is usually a long-term business – the contract may be in force for three to five years – and the path back to a private network is extremely difficult. The possible advantages and disadvantages to the client arising from outsourcing include:

ZUSAMMENFASSUNG

Ein CPN muss grundsätzlich die Sprach-, Text-, Bild- und Datenkommunikationsfunktionen innerhalb eines Unternehmens oder einer Behörde erfüllen. Es lässt sich darüber streiten, ob auch Areal- und Gebäudeüberwachungssysteme, Zutrittskontrollsysteme für Computer- und Kontrollräume und Audiosysteme als Teil eines CPN betrachtet werden sollen. In Zukunft werden solche Systeme wohl enger in das gemeinsame betriebseigene Übertragungsnetz integriert werden.

Die zentrale Funktion des CPN ist die Sprachübertragung, welche zunehmend durch digitale Telekommunikation mit ISDN-Schnittstellen realisiert wird. Diese brauchen nicht mehr zentral installiert zu werden; sie können dezentral als selbständige Systeme oder als periphere Module aufgebaut werden.

Eine Vorbedingung für diese Vernetzung und die entsprechende unternehmensweite Nutzung aller von einem Telekommunikationssystem normalerweise zur Verfügung gestellten Dienste ist das Vorhandensein geeigneter Kommunikationsprotokolle. Solche Protokolle sind als herstellerspezifische Produkte oder Quasi-Normen verfügbar, wie Digital Private Network Signalling System DPNSS, müssen jedoch durch eine weltweite Norm (Q interface SIGnalling protocol, Q-SIG) abgelöst werden.

Advantages to the client

- The service provider has to ensure that useful technical innovations are integrated into the network as quickly as possible and that the CN's performance is therefore always of a high standard.
- The service provider is responsible for the network's operational performance and must monitor it continuously with the help of the NMS.
- Clients have no need to provide the training of their own personnel to operate the network.
- The client does not have to be involved with the procurement of hardware and software and so has no need to negotiate with prospective suppliers.
- For worldwide networks, negotiations with the respective postal and Technical Committee (TC) authorities are carried out by the service provider.
- Clients only receive final invoicing for their CNs, listing all services and fees relating to the CN.

Disadvantages to the client

- Should private network have already been in existence, the organization gives up the know-how obtained laboriously. This can only be obtained afresh with great difficulty.
- The organization can no longer directly influence the security and confidentiality of their data and must rely completely on the measures taken by the service provider.
- Network availability becomes even more significant. A network breakdown can have disastrous financial consequences for a bank, for example, and must as far as possible be compensated for by appropriate liability arrangements (laid down in a service contract).

Prof. Eng. Titu I. Bajenesco, M.Sc., Member of the New York Academy of Scienes, Senior Member IEEE, international consultant, La Conversion.

[9] If clients only contract for certain 'network services' which, for example, permit them to connect their CPNs more effectively over a service provider's global network (MDNS), then clients themselves are responsible for their total network, while the service provider owns at least part of the network. Should an organization decide to put their entire CN or parts of it in the care of a service provider, then it is advisable to examine carefully in advance all technical and, in particular, all economic aspects. The decisive factor in the relationship between client and service provider is the service contract. In this document, all the service provider's responsibilities and services are to be precisely determined, including its response to any disruptions in the network. This will prevent, as far as possible, any later disagreement.