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Evolution of Communication Technologies and Systems

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New technologies closely related to informatics represent the driving force today for new developments in telecommunications. Their impact on the design of switching and transmission systems as well as the architecture of networks are briefly outlined.

Neue, eng mit der Informationstechnik verwandte Technologien stellen heute die treibende Kraft für die weiteren Entwicklungen in der Telekommunikation dar. Ihr Einfluss auf die Konstruktion von Vermittlungs- und Übertragungssystemen sowie die Architektur der betreffenden Netzwerke sind Gegenstand dieses Aufsatzes.

De nouvelles techniques en informatique contribuent à de nouveaux développements en télécommunication. L'article donne quelques indications au sujet de leur influence sur la conception de systèmes de commutation et de transmission, ainsi que sur l'architecture des réseaux.

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1. Introduction

This contribution gives a sequence of snapshots on the evolving communication technologies and systems. Three main subjects are briefly discussed:

1. market projections for information technology applications,
2. evolving communication network architectures and technologies,
3. communication and information services offered by public networks.

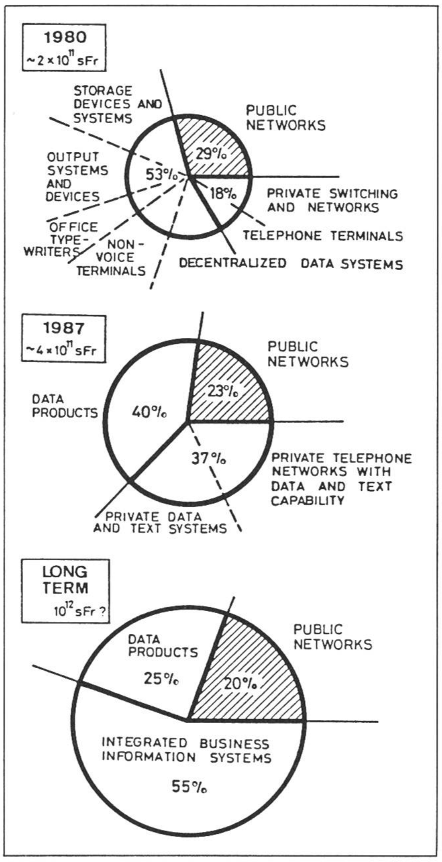

Fig. 1 Annual world market shares per main applications and products

ISDN Integrated Services Digital Network
LAN Local Area Network
PABX Private Automatic Branch Exchange

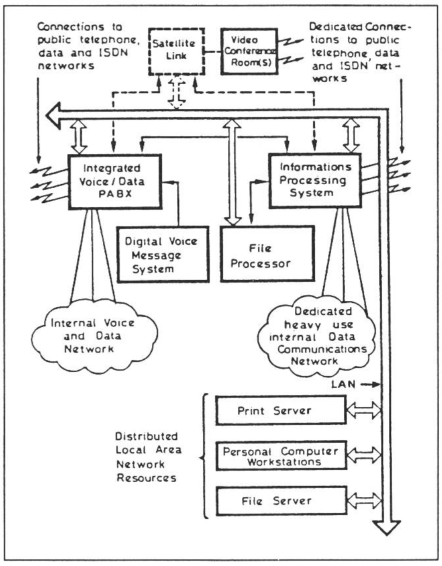

Fig. 2 Integrated office information system
late 1980s

2. Market Projections for Information Technology

Figure 1 shows the annual world market shares per main applications and products in the field of communication and processing for voice and data applications. The projection is for a progressive reduction of the public network market in favour of a large increase of the integrated information systems market for business applications.

The figures 2 and 3 are devoted to some reference scenarios for the evolving business and residential user applications. In particular, figure 2 gives the layout of the office of the future. PABX and LAN are integrated parts of this scheme. Their topological and functional arrangement is oriented toward the optimum use of different terminal applications with different performance and cost requirements.

The figures 3a, b, c show the evolution of the home information and con-

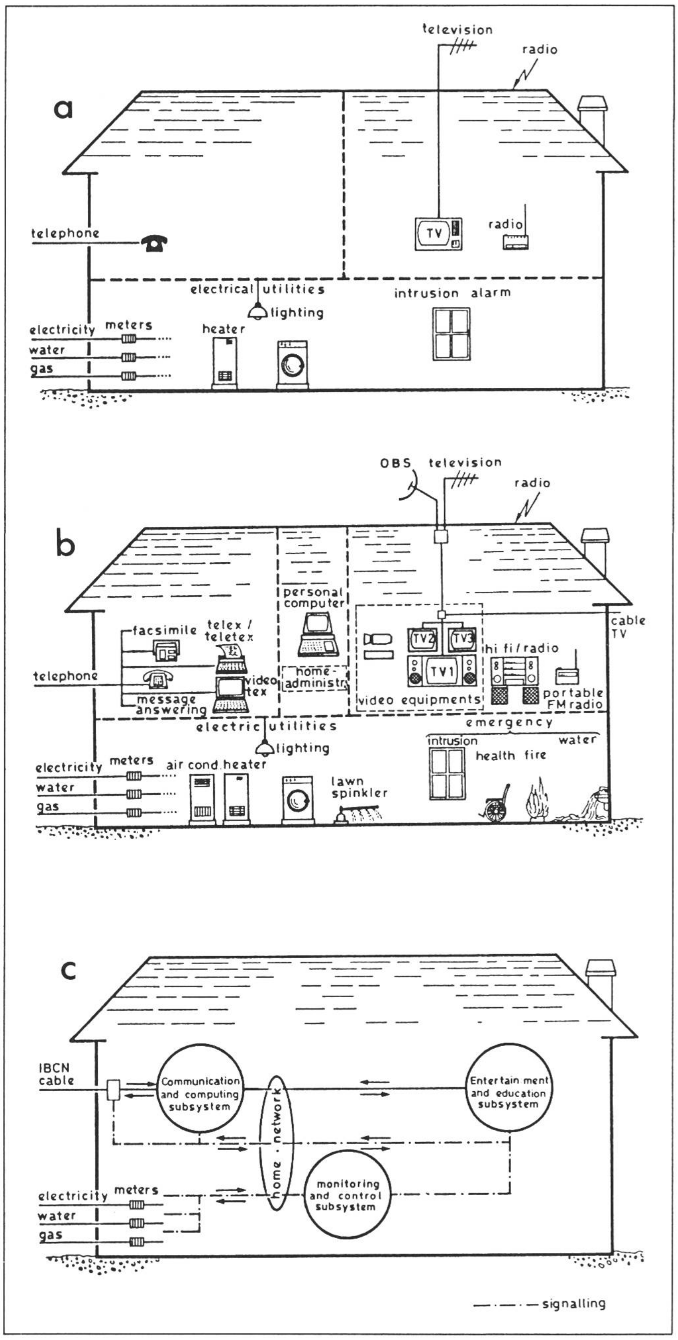

Fig. 3
Home information and control systems

a in the recent past
b today
c in the future

IBCN Integrated Broadband Communication Network
OBS Orbital Broadcast Satellite

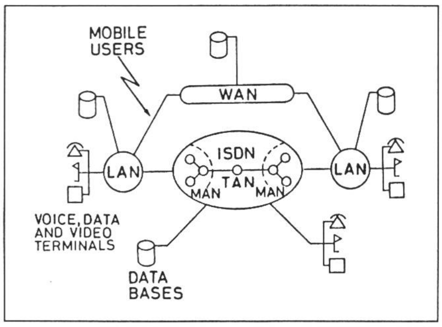

Fig. 4 Communication networks scenario
private versus public communication providers
LAN Local Area Network
MAN Metropolitan Area Network
WAN Wide Area Network
TAN Toll Area Network

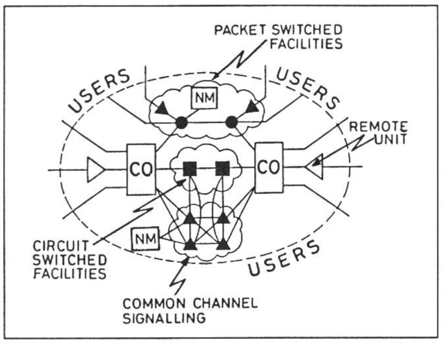

Fig. 5 ISDN scenario for voice and data services
late 1980s
CO Central ISDN Office
NM Network Maintenance Center

trol systems from the past to the future. Entertainment by full motion video applications is a key factor in investigating the market and technology for the home information services of the future.

3. Communication Systems Evolution

Figure 4 describes a communication network scenario where both private and public network providers play important roles. Private network providers are oriented to the implementation of LAN (including PABX) and WAN networks with local and long distance areas coverage. On the other hand, public network providers push development of the ISDN in both metropolitan and toll areas. Both private and public system developments are characterized by high speed digital technology and multiservice (voice, data, video) applications.

Figure 5 focuses on the early ISDN architecture and gives some details on the integrated access via a local ISDN central office to a toll arrangement composed by current service dedicated facilities. These are: circuit switched 64 kbits/s channels and switches, common channel signalling arrangement and switches; packet switched data channels and switches. Public communication networks are today experiencing a strong growth of land mobile business and personal applications. Multiservice capabilities are of increasing attractiveness in mobile user communications too.

While voice and data services will be dominant in the first stages of the ISDN evolution during the second half of the 1980s, in the early 90s broadband video services will be deployed mainly to cater for entertainment applications. Figure 6 deals with a broadband ISDN scenario in metropolitan areas. The double star distribution network is centered around a metropolitan office and a number of remote units. Fibers are used for both trunks and subscriber lines, while video switching and voice/data switching are performed by separate matrices under common control and signalling procedures. In this scenario very high quality video on demand

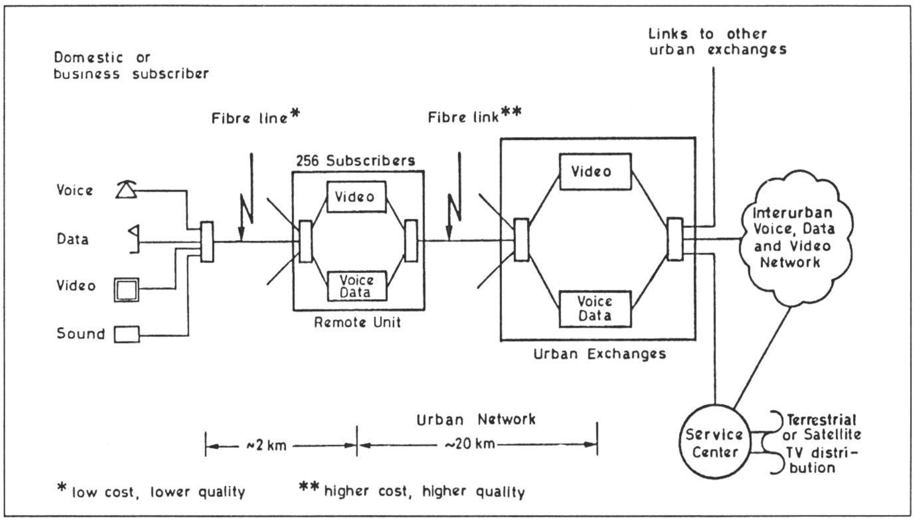

Fig. 6 Wideband ISDN scenario for voice, data and video services
after 1990

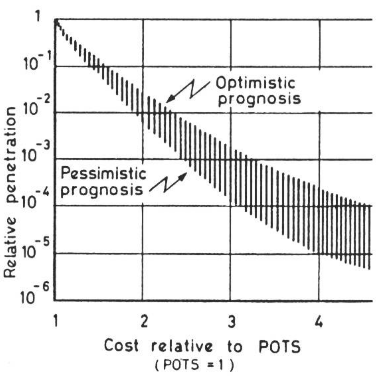

Fig. 7 Relative penetration of new services as a function of relative installation cost

Plain Old Telephone Service (POTS) main installation cost is equal to 1. Penetration is relative to the POTS subscribers population.

and two-way video services are offered to subscribers in addition to broadcast video services.

In investigating the potential penetration of the new ISDN services (voice, data and video), a key role ist played by the first installation cost per subscriber. This cost is ultimately dominant in establishing the monthly subscriber fee. Figure 7 shows trends for this penetration in comparison to the basic telephone service cost and penetration. The diagram of figure 7 clearly indicates that relatively high installation costs are strongly discouraging new services subscriptions.

Moreover, when projecting ISDN network scenarios, it is worth considering that advances in VLSI and signal processing may stimulate emergence of more advanced network architectures. An enhanced integrated transport capability for voice and data is targeted in the scenario of figure 8. The local network portion presents a structure similar to that of fig. 5, while the communication facilities in the toll portion are integrated in a single packet switched facility. High speed links and high capacity packet switches handle dynamically packetized voice, signalling and data information. This solution may result to be cost-effective when the toll area section of the network assumes large dimensions (e.g. a few thousand kilometers).

Voice packetization aims at reducing the effective throughput needed for a call (from 64 kbit/s to 16 or 8 kbit/s) in order to squeeze more voice calls on a digital bearer (e.g. on a 2048 kbit/s link, from 30 channels up to 150 channels using 32 kbit/s ADPCM speech coding). This objective is achievable by using VLSI digital signal processing. On the other hand, this trend is in contrast (or in synergy?) with the development of very high capacity fiber transmission systems. Figure 9 summarizes prices and fields of application of optoelectronic devices for digital transmission systems over fibers. Prices refer to an optical transceiver point. Capacities in the order of Gbit/s with 100km repeater spacings can be obtained by using the single mode lasers in development today and suitable signal demodulation techniques at the receiver.

4. Services offered by Public Networks

The last topic of this brief overview is concerned with the types of services that can be supported by a common

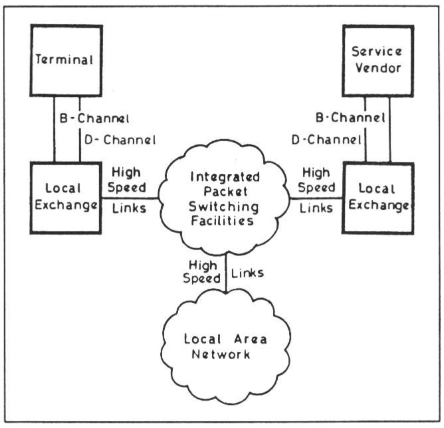

Fig. 8 Advanced ISDN scenario for voice and data services

B-channel	64 kbit/s circuit switched channel
D-channel	16/64 kbit/s packet switched channel
High-Speed Links	at least 2048 kbit/s

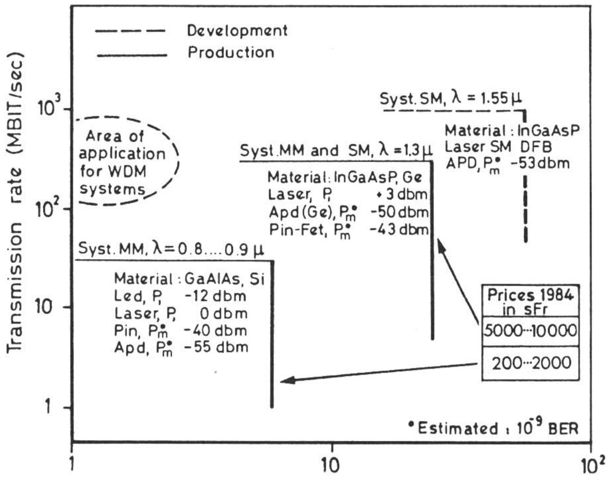

Fig. 9
Optoelectronic devices for digital fiber transmission systems

MM	Monomode Systems
SM	Single Mode Systems
WDM	Wave Division Multiplex

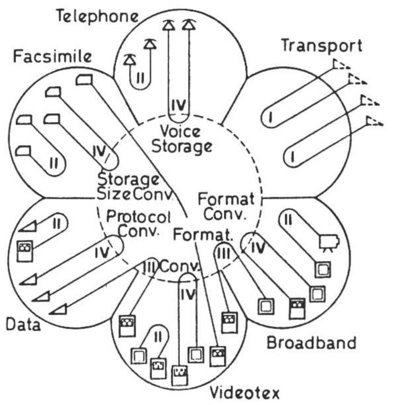

Fig. 10 Services in the Japanese Information Network System (INS)

I Basic Service (Bearer)
II Basic Service (Telecommunication)
III Supplementary Service (Interworking)
IV Supplementary Service (Convenience)

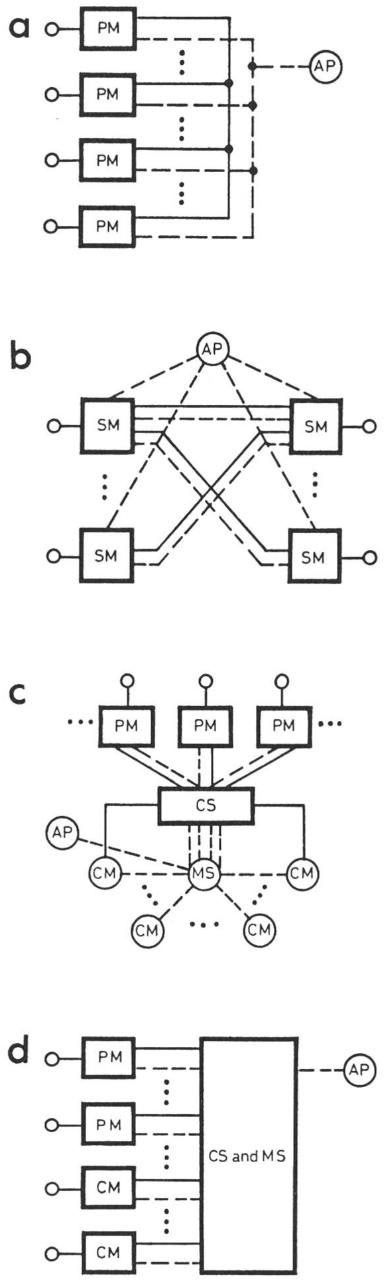

Fig. 11 Some distributed switching office architectures

CS Circuit Switching
MS Message Switching
PM Peripheral Modules
CM Centralized Modules
AP Administrative Processor
SM Standard Modules
—— CS links
----- MS links

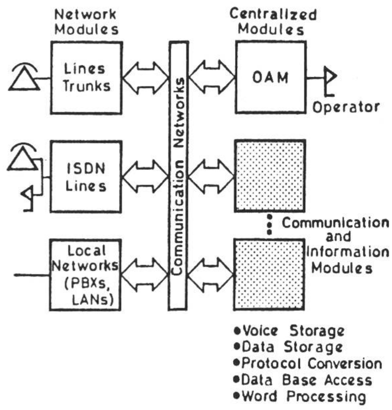

Fig. 12 European ISDN exchange layout

carrier network. The dichotomy between "basic" and "enhanced" services established five years ago in the North American environment could lead to the belief that public networks should provide a "transparent" transport service, while "processing" services should be performed outside the network by user facilities only. This is clearly in contrast with the spreading of digital techniques that imply "data storage and processing" even to provide just information transport applications, e.g. reduced bit rate voice with packetization for toll applications. In Europe and Japan today the above dichotomy does not apply and there is a strong tendency in permitting storage and processing within the network also for information processing services. Figure 10 sketches the types of services envisaged in the Japanese INS including storage and protocol conversion capabilities.

Distributed control architectures for communications switching equipment are favourable catalysts in permitting flexible addition of new communication and information services. Fig. 11 lists some typical distributed switching office architectures. These layouts are similar to those for multiprocessor interconnection. Each module is indeed controlled by a reliable computer complex and the architecture is conceived to obtain a suitable interconnection mechanism among them. Peripheral modules connect network lines and trunks; administrative modules provide man-machine interfaces to operators for administration and maintenance; centralized modules provide common resources to the whole office (e.g. voice storage modules). The interconnecting structure provides for circuit and message switching in a variety or topological and functional configurations (star, bus, full mesh, cross-bar switch). Figure 12 shows the resulting conceptual exchange layout for European applications. Centralized modules are devoted to a variety of a value-added services.

5. Summary

This overview has briefly listed several important aspects of the evolving comunication systems. This evolution is largely stimulated by technologies closely related to information systems development. Communication and information functions are indeed going to merge progressively in "inseparable" hardware and software implementations.