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Communications Planning Directives and Data Communications Concept of the PTT for 1980s

Albert KUENDIG, Bern

1 Introduction

At the beginning of the 1970s it became evident that the technical development will exercise an increasing influence on the communications system. Not only existing equipment and networks are affected but also a great range of new services becomes possible, and therefore most industrialized nations are thinking of an orderly development. The situation and possible development are analyzed in several studies especially in the report of the Commission for technical Communications (KtK Report [1]) prepared by the Federal Republic of Germany. The Swiss PTT also recognized the importance of guidelines for future business in the area of communications. The PTT presented its communications planning directives as overall guidelines at a seminar at the end of April 1982 [2]. The important principles of these directives are shown in *Table 1*. The main technical decisions in the area of teleinformatics have also been drawn up within the framework of a concept for data communications. The important principles of this concept are summarized and briefly described in this paper as an elucidation of the communications planning directives for the area of teleinformatics.

Table 1. The 10 basic principles of the PTT's Communications Planning Directives

- 1 The PTT is pledged to public welfare
- 2 The PTT ensures satisfactory coverage of the whole country with Postal and Telecommunications services at similar conditions of quality and cost
- 3 The PTT provides its services on the basis of its legal mandate
- 4 The PTT preserves its organizational and financial unity
- 5 The PTT is concerned with the transmission of information and not with its contents in the telecommunications area
- 6 The PTT maintains responsibility of the public networks for the transmission of information
- 7 The PTT ensures open access to all of its offered communications services
- 8 The PTT guarantees the protection of privacy in all its areas of responsibility
- 9 The PTT pursues a progressive and social personnel policy
- 10 The PTT is aware that not all technically and economically feasible projects are socially desirable and therefore the PTT judges developments within the communications area holistically

2 The status of development of the telecommunications services in Switzerland at the end of the 1970s

The status of the development of the telecommunications services is summarized in *Figure 1*. It shows some characteristics that are also known in other countries:

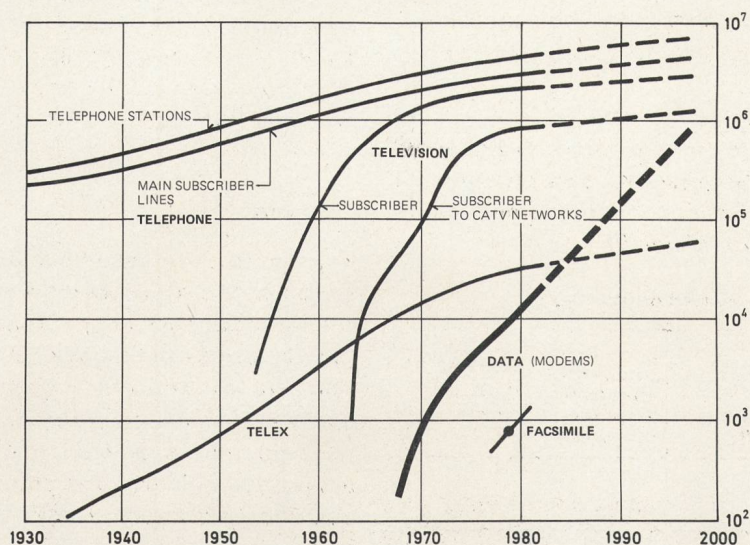


Fig. 1
The development of the most important telecommunications services in Switzerland

- the telephone will probably still dominate within two-way communications for a minimum of one or two decades
- the high growth rate of data transmission and—considering the technological development—the possible merging of data transmission, telex and picture transmission into a new teleinformatics service

The almost explosive expansion of teleinformatics can continue only for some time if new areas of application are opened beyond the specialized business data communications, new simple forms of office communications and data transmission to private households.

Unlike many other countries the PTT is already confronted with a largely saturated market for telephone service. Therefore, it is more difficult to introduce new services simply «piggyback» style in the course of extension of the telephone network. Economical considerations lead to a replacement rate that will provide a nationwide digital telephone network in the 1990s.

The demographic situation also poses special problems to the telecommunications administrations. *Figure 2* shows as illustration the geographical distribution of potential business teleinformatics customers in Switzerland. On one side, the distribution makes it possible to serve a large number of customers in the agglomerations with a few network nodes. On the other side, the PTT as a government agency must observe the rule that all participants have to be served under most similar conditions (compare [2], paragraph 211). At least modern technology helps to find solutions to these problems: multiplexers and concentrators in association with cost advantageous transmission systems allow to serve distant customers.

3 Basic ideas on future technical planning

The ideas are summarized in a special form as follows:

- A special situation or a problem area is outlined briefly by several *theses*
- Afterwards, appropriate guidelines and working hypotheses are set up for the corresponding *postulates*
- *Commentaries* attempt to substantiate the postulates.

Thesis 1

The user requirements stretch over a broad area of very different demand. A rough division of users on the one hand and the ways of utilization on the other hand shows the following situation (*Table II*):

Table II. Categories of Users Way and Art of Utilization

Ways of utilization user	1 Transaction oriented, intermittent data traffic	2 Data traffic characteristics similar to telephone	3 Special requirements
H Private			
HA small household	HA-1	HA-2	HA-3
HB big household	HB-1	HB-2	HB-3
P Business			
PA small and medium sized business	PA-1	PA-2	PA-3
PB large business	PB-1	PB-2	PB-3

The given user categories can be outlined as follows:

- HA Private household (families)
- HB Private user in big households, as in hospitals, schools, etc. as well as in publicly accessible buildings and traffic areas
- PA Industries, trust companies, architects' and engineers' offices, small factories, small community administrations
- PB Large enterprises in industry and commerce, banks, insurance companies, large state-owned administrations, utility and service companies in favour of the user categories PA and H

The different ways of utilization have been better differentiated in *Table III*.

Table III. Explanatory data for the ways of utilization (Typical values and examples)

	1	2	3
Duration of connection (minutes)	1...60	0.5...5	30...∞
Amount of real data transmitted per connection (kbit)	10...500	100...10,000	either < 10 or 10,000
activity factor	0.01...0.1	0.1...1	either ≪ 0.1 or ≈ 1
examples	<ul style="list-style-type: none"> – data bank inquiry – reservation system – realtime banking 	<ul style="list-style-type: none"> – facsimile – transmission of long texts – transfer of small and medium files 	either telemetry and remote control or transmission of large files

Postulate 1

In the area of data transmission different types of user groups have to be respected with their partly specific requirements. This fact must be considered for the construction of the technical infrastructure and must allow the various corresponding services. It is urgent to better cover the cases in PA-1 and PB-1, second priority should be given to HA-1 as well as to PA-2 and PB-2.

Commentary 1

The conventional telephone network with its nationwide coverage and trunk branches represents the ideal carrier for data communications. The disadvantages of the telephone network are long construction time for line, partly deficient transmission quality, limited transmission speeds. Due to these reasons the private leased networks greatly expanded in the last years. These are naturally used only by large enterprises. This development does not really serve the PTT's interest nor that of the entire group of customers:

- Prevention of the formation of open networks (open in the sense of the possibility of connections as well as in the sense of equipment procurement)
- Disadvantage to small and medium users
- The PTT is deprived of traffic

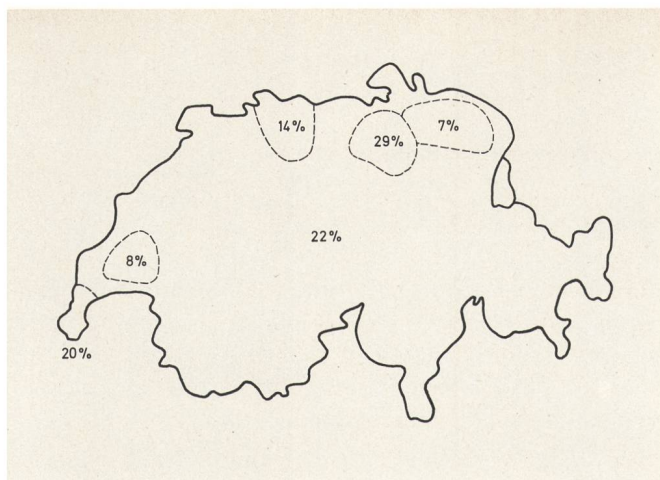


Fig. 2
Geographical distribution of data terminals at present

At this time the cases PA-1 and PA-2 are of special importance from the application point of view. With the progressive development of terminals the cases HA-1 (videotex!) as well as PA-2 and PB-2 (facsimile) are getting increasingly important.

Thesis 2

The PTT is expected to offer its services to the extent possible at a uniform tariff, although, 80 pc of the potential users of data communications are to be found in only 5 agglomerations (Fig. 2).

Postulate 2

The extension of the digital transmission network is to be stressed such that it rapidly connects and reaches all important node centres and offers cost advantageous access to user groups that are located far from new data switching equipment (with front-end multiplexers and concentrators). The inter-office connections shall be secured with the same network and the dedicated circuits shall permit leasing for special requirements.

Commentary 2

The service obligation of the PTT is the natural outcome of the decreed monopoly.

The digital transmission technique is very flexible in setting up several applications and it permits the most cost advantageous transmission of groups of channels.

Thesis 3

The transborder data flow is becoming of great importance. The Swiss telecommunications system becomes a part of a worldwide network with the intermixture of different national networks.

Similarly, the manifold user requirements can only be completely covered if the *data terminals* can be selected on an international market, additionally opened in Europe through the harmonization. But the standard interfaces to the public networks (i.e. to the *data circuit terminating equipment*) have to be respected.

Postulate 3

The data concept is based on the internationally agreed standards of the CCITT, the ISO and the CEPT. The stepwise realization of the concept has to follow the plans and priorities of the CEPT. The data terminals are not exclusively offered through the PTT but only in cases with a large distribution of the same equipment (i.e. user groups HA, HB and PA).

Commentary 3

A clear statement is made in the communications planning directives that the PTT strives for a proper separation between the networks and the customer equipment. In particular, the PTT likes to see a clear interface in the teleinformatics between the *real terminals* and the *PTT's data circuit terminating equipment* (Fig. 3). The interfaces shall allow without hindrance, to the extent possible, the development of the terminal side. The data circuit terminating equipment protects the PTT's transportation network from uncontrolled outside influences.

The PTT wants to treat the equipment monopoly as follows:

- the PTT decides which telephone or telex sets it can supply or which ones can be procured privately. Whereby, the PTT's assortment of sets can be enlarged as far as financially justifiable

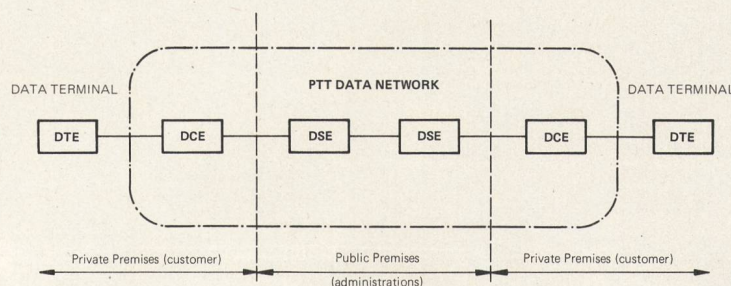


Fig. 3
Definition of the most important parts of a data network

- type-tested additional equipment that supplements functionally the PTT sets, such as automatic selection-aid, automatic answering equipment may be bought on the market. However, the equipment for speech transmission from set to set as well as for transmission and evaluation of call and charging signals are excluded from the monopoly if they are not going to be built into the PTT equipment
- type-tested terminals for other services, e.g. facsimile, teletex, videotex can be privately procured
- subscriber exchanges shall be supplied by the PTT. If the customer requirements are not met in the area of teleinformatics with the PTT equipment then private procurement of type-tested sets and equipment can be allowed
- private procurement is allowed for type-tested additional equipment to subscriber exchanges that do not exercise any immediate switching function such as alarm-call sets if they are not built into the PTT supplied equipment
- modems and data circuit terminating equipment are part of the data channel. In principle, they will be supplied by the PTT. Exceptionally, private modems can be permitted or allowed for installation into private terminals in the case of special subscriber requirements

Thesis 4

From the point of view of data transmission the public network still has some missing capabilities and often operates at an inadequate transmission quality. This led to a considerable increase in private leased circuit networks for large user groups (closed networks for users of type PB or partially open networks of an operator of type PB for customers of the type PA and PB).

This development is critical for different reasons:

- The PTT becomes merely a lessor of circuits, its existing public network loses more and more traffic
- The division in various closed networks is only attractive to large customers, it hurts the small and medium sized business
- Closed networks hinder an open, worldwide data exchange. They do not economically solve the problem of an appropriately high availability and service quality and they hinder an open market for terminals.

Postulate 4

The priority lies with the procurement of appropriate public switched networks with uniform standardized subscriber interfaces during the extension of the technical means for the data transmission. The construction and operation of this network by the PTT is a national policy and an economic necessity. Besides, this allows the PTT to gather technical and operational experience in view of the development and later introduction of the integrated services digital network.

Commentary 4

Switched networks are truly open networks. The attractiveness of such a network increases with the number of reachable subscribers.

Because the customers can themselves restructure anew faulty connections the availability to the customers can be improved with the corresponding systems configuration.

Please, compare also commentary 1.

Thesis 5

The introduction and the further extension of the digital switching system for the telephone (Integrated Telecommunications System — IFS [4]) is linked to its investment cycle (slow growth of the subscriber number, long life time of the exchanges). Although, it is agreed internationally that the digital telephone network will gradually change to a multipurpose network for telephone and teleinformatics services (ISDN — Integrated Services Digital Network [10]) it cannot be counted before 1995 on an operational nationwide digital circuit switched network for application to teleinformatics. Beyond, special applications require always special equipment. This may be central additional equipment for IFS and if necessary special additional networks for teleinformatics as well as special terminals.

Postulate 5

The period of about 15 years must be rapidly covered with the construction of a special network for data transmission till the introduction of a nationwide digital circuit switched network for the telephone and the appropriate teleinformatics services. In the long time this network must be able to offer, if necessary, also those services that may not be purposefully covered by the IFS.

In the long term, the coverage of the telecommunications services is to be strived for with an integrated services digital network (ISDN).

Commentary 5

Figure 4 illustrates the introduction cycle of the IFS. Only by the mid-90s all telecommunications districts will have access to the basic IFS equipment. Then all condi-

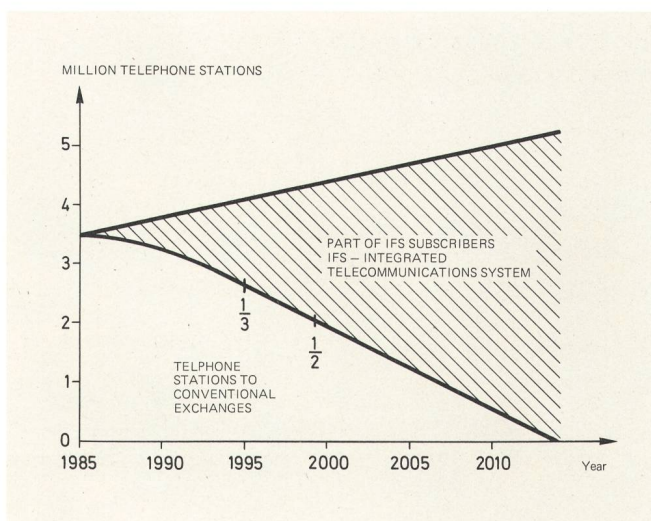


Fig. 4
Gradual introduction of the digital integrated telecommunications system for the telephone

tions will be met for offering nationwide switched 64 kbit/s channels.

Thesis 6

The satisfaction of very special customers' requirements through the public network is uneconomical and in many cases practically impossible. This concerns mainly:

- customer specified functions on the application-oriented levels of the data transmission protocols
- application specified terminals

But such great diversification conceals the danger of fragmentation of technical and operational means and of an unprofitable business.

Postulate 6

The PTT services have to be concentrated to a few established basic transportation networks. A few standardized interfaces have to be defined for the terminals. The realization of application specified functions is foremost the concern of the subscribers as are the special encryption measures. If economical and in public interest the PTT can, however

- construct and operate message switching systems and other similar additional equipment to the basic networks
- support the definition and realization of a public key cryptosystem

Commentary 6

This postulate is of prime importance. The aim is to apply as consistently as possible the ISO/CCITT model for structuring of data transmission protocols in accordance with Figure 5 [5] to the formation of the telecommunications networks: Extensive uniformity on the lower functional layers (with the all connecting digital transmission network on the lowest layer), diversification

through spreading of possibilities on the higher levels (terminals, centralized special equipment, such as message switching).

The limitation to only a few basic transportation networks is important also from the point of view of operations and economics, as correspondingly few different operational and maintenance organizations have to be set up.

The ISO/CCITT model can also serve as basis to the solution of the monopoly questions: The PTT will keep control of the services and equipment of the lower layers while it will endorse a more liberal attitude on the higher levels so as to counteract a fragmentation of own forces, the more application specified the telecommunications function is the more liberal the attitude of the PTT.

Thesis 7

A hierarchical construction of a transmission network based on an internationally standardized model for the structuring of communications protocols and systems leads to economical solutions. Whereby, the basic functions can be simplified to the extent possible to meet the diverse user requirements thanks to various peripheral and central auxiliary equipment.

Postulate 7

7.1 The standardized digital transmission networks reinforced by the hierarchy of PCM multiplexers and still supplemented by the analogue circuits (modems) will serve for a long time as basis to all new transmission systems in the area of teleinformatics. The PCM hierarchy is extended downwards between the stages of 64 kbit/s and 2.4 kbit/s. The digital network is transparent and is furnished with monitoring and switch-over devices. A few switching networks are erected on this basis. The construction of the corresponding technical system is described in the following concrete plan:

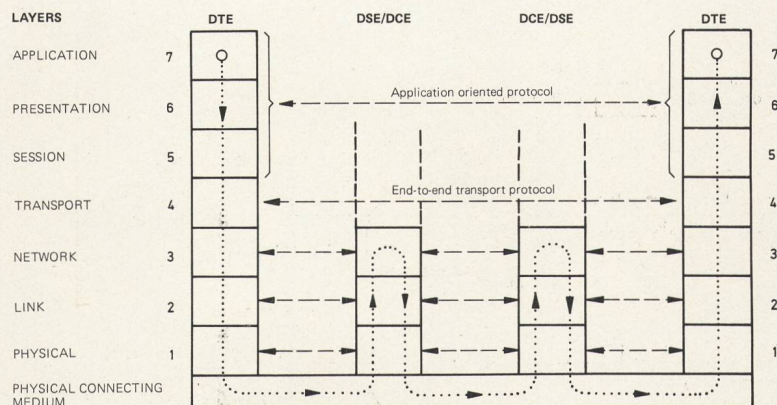


Fig. 5
Layer structure ISO/OSI (International Standards Organisation/Open System Interconnection), for CCITT data network of Fig. 3
..... data flow
--- protocols

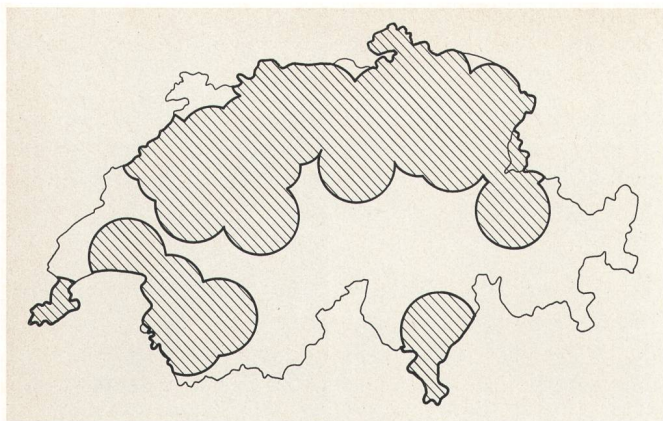


Fig. 6
Coverage of Switzerland with 2.4 kbits baseband direct connection if the existing digital trunk network is provided with access ports (multiplexers) to 31 important locations

7.2 The switching systems are for the switching of transparent channels and for all necessary operational functions of error detection, location and clearance as well as for network administration. Connection set-up either through a PTT station or automatic on request by subscriber or channel signalling, with or without selection information:

- Conventional telephone exchange, step by step cut-off through IFS
- Modernization of the telex network with extension up to user class 300 bit/s
- Possibly synchronous circuit switching for data at higher bit rates, so far not covered through IFS

7.3 Switching systems for virtual connections, for conversion functions, for message processing and switching, etc. (e.g. packet switching system with PAD functions).

7.4 Particular application specified equipment e.g. data banks, mass memory devices, videotex exchanges.

Commentary 7

Different figures illustrate here the stepwise realization of this postulate. *Figure 6* shows that not only areas with high subscriber density are reached at the end of 1982

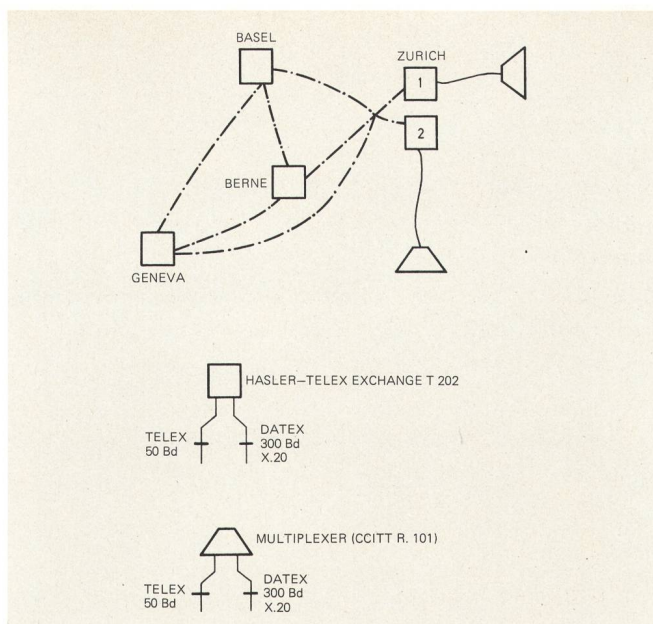


Fig. 7
Modernization of telex network and introduction of Datex service with 300 Bd

- digital trunk network
- 2400 bit/s transmission via digital network or modems

with the status of the existing digital transmission network but also those areas of lower priority. The technique and the conditions of connection of this network are stated in [6].

Figure 7 shows the present modernization of the telex network through the introduction of 5 stored program control (SPC) exchanges and the correspondingly extended transmission speed [7]. In accordance with postulate 2 some of the telex subscribers will be connected to the new exchanges by multiplexers up to a distance of 150 km. The telex subscribers are offered a special service namely the *message switching* (SAM — system for automatic message switching) which is made possible at Zurich through a connected node to the telex network.

The *packet switching service* will be introduced in two stages. The transitional solutions according to *Figure 8* are already in operation. They secure access to the Eu-

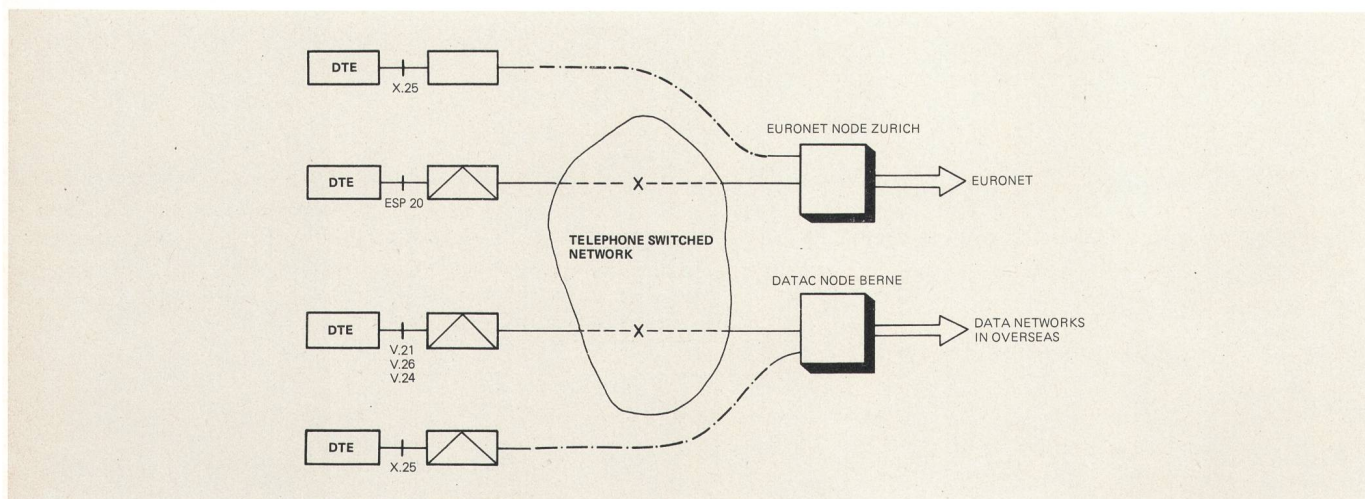


Fig. 8
Temporary solution for data packet exchange (Euronet: PTT, Datac: Radio Suisse Ltd)

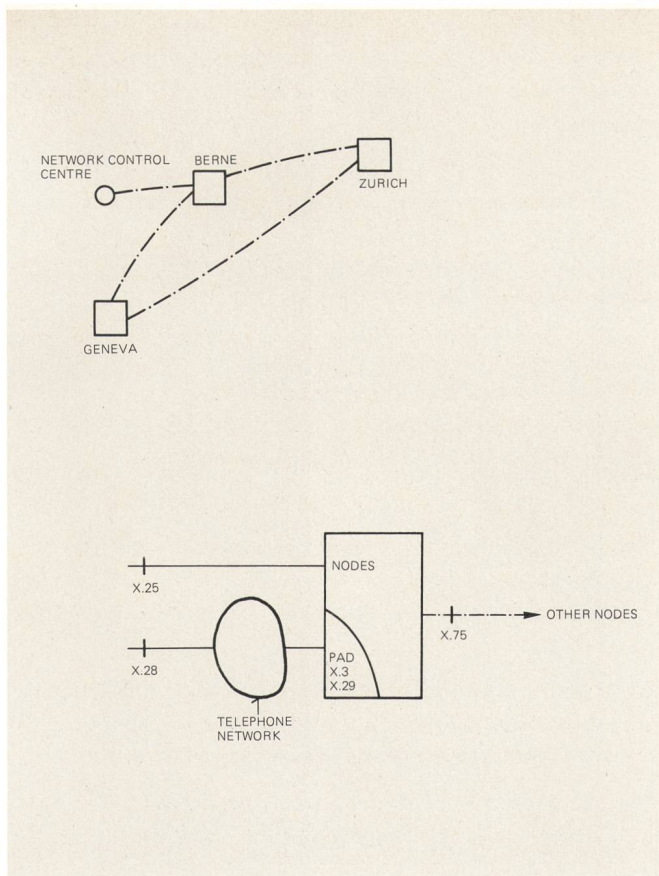


Fig. 9
Telepac network with interfaces

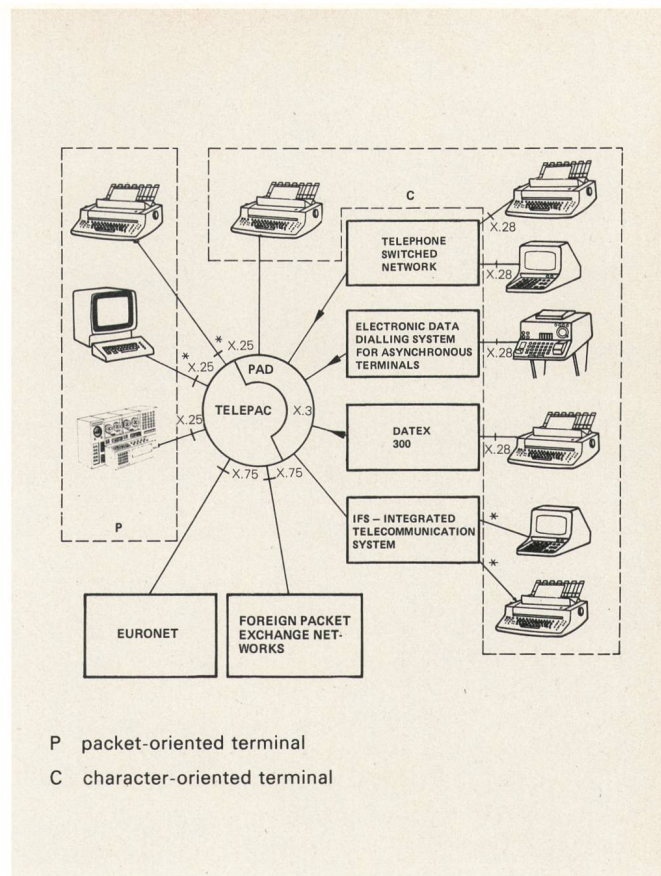


Fig. 10
Combined representation of Swiss PTT's concept for data services

ropean and North American data banks. The national packet switching network *Telepac* in accordance with Figure 9 is now on operational trial. It will be connected later with other national networks in foreign countries as planned in CEPT [8].

Since 1980 a *videotex* pilot equipment has been in operation to clarify the user requirements, especially on the side of the information providers. But this does not yet correspond to the data concept [9]. (Commentary 9 will specially point to the long term technical development).

Further information can be found in [11].

Thesis 8

Above all, the satellite systems are suited to offer already within a short time those services that can only be realized much later by the integrated services digital network (ISDN). The satellite system is further applied to special coverage particularly for wideband and/or temporary requirements, for example:

- Combined speech and data transmission
- Video conferences
- Data broadcasting
- Transmission of large files between pre-fixed stations (e.g. nuclear research centres)

In the long term, satellite systems are specially predestined for intercontinental connections.

Postulate 8

If possible, satellite systems should be introduced from the beginning such that they can be offered to the subscribers at the ISDN interfaces. Beyond, they can be used for special requirements that are not well met with terrestrial means such as the video conference service.

Commentary 8

The Swiss PTT is participating in both European Satellite Communications Systems ECS (telephone and teleinformatics application — SMS (Satellite Multiple Services), as well as in the French *Telecom-1*.

Thesis 9

The required wide range of offered services in the area of teleinformatics can only be realized if the characteristics of the technical means are sufficiently and properly tuned to the demand. *Several services can only be offered through the combined use of different technical means or networks.*

Postulate 9

The harmonization has to be clearly regulated between the various technical systems and the various networks. The connection possibilities have to be planned according to Figure 10.

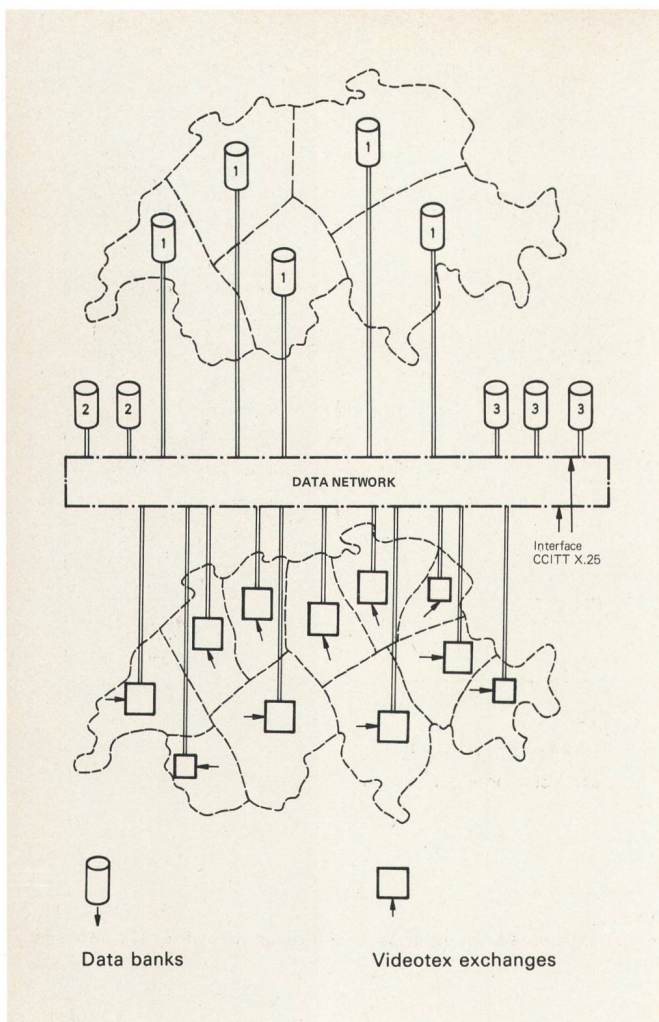


Fig. 11
Long range solution for the realization of the Videotex service

Commentary 9

Naturally, Figure 10 must be complemented with more precise data on the various connection possibilities as well as with corresponding functional and technical specifications. Figure 11 shows a specially instructive example of the basic principles that were put forward in thesis 9 and in the preceding postulates. The combined effort of the packet switching network (as a basic network for teleinformatics) with the videotex exchanges (as special auxiliary equipment) allows to reach any data banks independent of their location by any subscriber at almost equal conditions. This is a very good example of the interrelation of technical and political questions!

Thesis 10

Today, the data transmission has become an essential factor of many branches of business, public utilities and administrations. The failure of one or more data channels is very disturbing to these customers. This may even lead to a breakdown of all business. Therefore, it is necessary to secure a very high availability of all relevant equipment included in an allocated customer data network. Today's personnel situation forces the PTT also to rationalize as far as possible the operational procedures.

Postulate 10

A satisfactory availability for the customer can only be reached by a balanced cooperation of the following components:

1. Supervision of the transmission quality as well as functional sequences in the equipment and exchanges
2. Adequate availability of each equipment
3. Measures of network topological lay-out, such as readily available standby circuits, more levels of operation, etc.
4. Efficient means of fault isolation
5. Organizational measures to minimize the interval between the fault report and fault clearance

The following principles have to be applied:

- The PTT undertakes all necessary steps to monitor the transportation system
- The subscriber has to supervise the end-to-end data processing

The PTT intends to offer the customer a 24 hours maintenance service for the data transportation system. This maintenance service comprises the following points:

- Acceptance of all fault reports concerning the transportation system through a central fault reporting office
- Isolation of faults and initiation of the reconfiguration measures
- Fault clearance and control of the functions that had been reported faulty
- Acknowledge the fault report

In the long term network monitoring offices shall be procured that will allow fault isolation and control of faultless transmission to the separation position, terminal—data circuit terminating equipment. This will be in view of offering similar maintenance possibilities for digital leased circuits as are usual for the connections to public switched networks.

Commentary 10

The introduction of remote control loops in the base band data circuit terminating equipment GMB 9600 is a first step. The installation of individual test and maintenance centres is still being studied.

4 Conclusions

The PTT, from its point of view, is taking full responsibility as network carrier for private and for commercial applications, for individual and for mass communications, within the communications planning directives and the herewith published extracts of the concept for data transmission. It makes an effort to further extend the telecommunications services and networks so as to find a reasonable balance between the public interest and its service obligation on one side and the smooth development of the technically advantageous services for the customers on the other side. For this reason, the PTT will keep control of the basic transportation networks and the services connected to them.

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