**Zeitschrift:** Technische Mitteilungen / Schweizerische Post-, Telefon- und Telegrafenbetriebe = Bulletin technique / Entreprise des postes, téléphones et télégraphes suisses = Bollettino tecnico / Azienda delle poste, dei telefoni e dei telegrafi svizzeri

**Herausgeber:** Schweizerische Post-, Telefon- und Telegrafenbetriebe

**Band:** 73 (1995)

**Heft:** [1]: Spezial Edition ATM

**Artikel:** An innovative value-for-money total solution

**Autor:** Loosli, Andreas

**DOI:** https://doi.org/10.5169/seals-876025

THE RANGE OF SWISSWAN SERVICES

# AN INNOVATIVE VALUE-FOR-MONEY TOTAL SOLUTION

With the European ATM pilot network, the foundations for the new product family 'SwissWAN services' were laid within the course of one year. Customer demand and market studies show that there is already a great need for new ATM-based services, as long as price and performance are well balanced. The two important characteristics, 'economy of scale' and 'economy of integration', were therefore given due consideration in the pricing of SwissWAN services. With the early introduction of new broadband services, Telecom PTT aims at offering to the Swiss telecommunications market new and interesting total solutions at an early date, hoping to be one of the most competent, innovative suppliers of services.

Europe-wide surveys amongst users have shown that new ATM technology services are expected from service providers in the next two years. Full functionality as regards

ANDREAS LOOSLI, BERN

new features made possible by ATM technology is expected within five years.
With the launch of the data superhighway and the SwissWAN services on it, Telecom PTT is closing a critical gap in the Telecom portfolio. As the capacity of PCs and workstations increases, so do the customers' needs to eliminate the bottleneck in connecting LANs and to install so-called native speed solutions.

## Market introduction

### First phase: Pre-Launch of services based on individual customer projects

This phase is planned from 1 August 1995 to 30 June 1996, with emphasis on the launch of a new family of products made up of the following SwissWAN services:
- SwissWAN SMDS (Switched Multimegabit Data Service)
- SwissWAN FR (Frame Relay)
- SwissWAN CE (Circuit Emulation)
- SwissWAN LIS (LAN Interconnect Service)
- SwissWAN CNS (Corporate Network Service)
- SwissWAN ATM (native ATM)

Tariffs have been structured in such a way that the first phase targets a very specific customer segment, namely customer networks which, in their geographical location, roughly correspond to those of Telecom PTT's SwissWAN nodes. In this phase mainly the cities of Basel, Bern, Geneva, Lausanne, Lugano and Zurich will be covered. A further requirement is that there are a number of ports at the customer site, so that the connection charge is spread over several ports. Under these two conditions, a nationwide network can be realized at less cost than previously. The national WAN will then be expanded on the basis of sufficient customer requirement, that is to say, in accordance with economic principles.
Other services such as special Citynet offers will probably follow already at the beginning of 1996.

### Second phase: official launch of SwissWAN services

This is planned from 1 July 1996 to 31 December 1997, and the emphasis is on improvement of services already introduced.
This phase provides for new functions, such as improved quality of service, management functions for users, detailed billing, performance statistics, etc. It is also planned to offer the ATM-UNI bearer service as a regulated service.
In this phase the necessary adjustments in the SwissWAN range of services will also be made. In this space of time, standardization will be largely completed and new functions realized. Thus, services tailored to customers' requirements, for instance with the available bit rate function, can be developed, and a comprehensive SwissWAN range can be offered by Telecom PTT.

### Third phase: liberalized telecom market

Beginning 1 January 1998, SwissWAN services will be offered in the liberalized telecom market. The national range from Telecom PTT and the international services from Unisource and/or Uniworld are completely coordinated and are available in all economically important centers.

## Range of services

*Figure 1* gives an overview of the SwissWAN range of services.

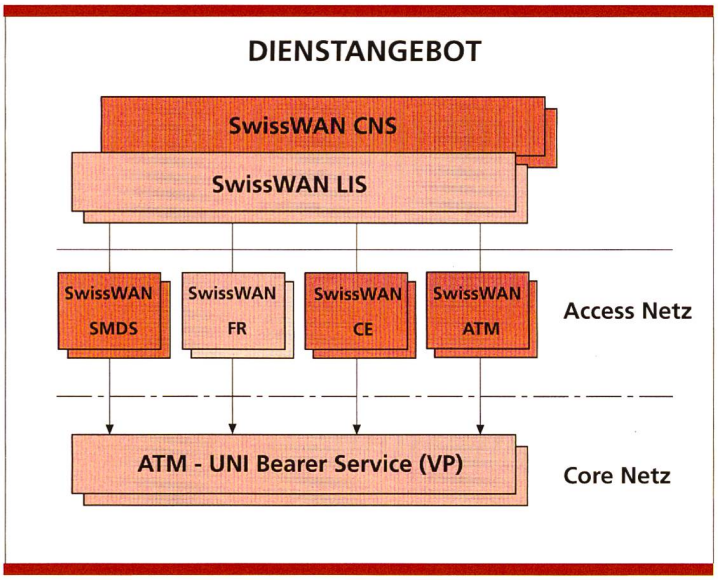


**Fig. 1.**
**The SwissWAN range of services.**

### ATM-UNI bearer service

The ATM-UNI bearer service is the basis for the product family of SwissWAN services. It is expected to be available in mid-1996.
The ATM-UNI bearer service permits two users to communicate in both directions and in a point-to-point configuration. Only the physical layer and the ATM layer are defined, so the service is still restricted to the transmission of ATM cells. The upper layers enable end-to-end links and can be selected according to the requirements of the application.
Provision of the ATM-UNI bearer service is based on virtual path (VP) links in the Telecom PTT core network. Several multiplexed VPs can be led to a particular user interface. In accordance with CCITT recommendation I.361, up to 256 VPs can be switched by the user interface in an ATM network. The cell format corresponds to CCITT recommendation I.361 for the user interface (UI). Users have the possibility of transmitting information with constant binary data rates (constant bit rates, CBR) or variable binary data rates (variable bit rates, VBR).
The peak cell rate parameter is assigned to each VP. This bit rate is defined as the maximum bit rate with which the user can feed information into the network. It is determined by the network operator and the user. The network resources are allocated on the basis of the required maximum cell rate.
The data source can supply a constant (CBR) or a variable (VBR) bit rate. The cell sequence produced in this manner may, however, have only the maximum cell rate of the VP link. Cells which lead to exceeding of the maximum cell rate are rejected by the network.
For the connection of ATM users, the following interfaces are available at the user network interface (UNI):

*Optical 155 Mbit/s ATM interface (STM-1)*

The STM-1 interface meets ITU-T I.432 and G.709 specifications. ATM cells are transported in C4 containers (4th-stage PDH). If the module is installed at the UNI, a usage parameter control function (UPC) ensures that the flow of ATM cells into SwissWAN is restricted to the preset maximum cell rate. Control of this paramater (peak rate cell policing) is based on a leaky-bucket algorithm on the basis of individual VPI/VCI. Cell delineation is performed by header error control (HEC) mechanism. The optical signal corresponds to ITU-T recommendations G.957 and G.652, respectively.

*Electrical 155-Mbit/s ATM interface (STM1)*

As distinguished from the the optical STM1 interface, transmission and reception characteristics are realized in accordance with G.703. The code mark inversion (CMI) procedure is applied.

*Electrical 34-Mbit/s ATM interface (E3)*

The installed E3 interface either maps ATM cells in the 34-Mbit/s-circuit bit stream as set out in ITU-T recommendations G.804 and G.832 or uses the physcial layer convergence protocol (PLCP) in accordance with E3/G.751. If installed at the UNI, this module also controls the flow of ATM cells into SwissWAN by means of the UPC function. The electrical interface signal corresponds to ITU-T recommendation G.703.

*Provision of links*

Until the introduction of the switched virtual circuit (SVC) ATM-specific signalling technique in SwissWAN, links are being set up and released by the SwissWAN network operator. Users inform Telecom PTT that they require a link, whereupon the SwissWAN operator arranges the desired through-connection via the management system.
The enhanced services are extensions of the ATM-UNI bearer service, so the features described below also apply to the enhanced services.
VP links may be provided in three ways as follows:

- permanent mode *(Fig. 2)*
- occasional mode *(Fig. 3)*
- periodic mode *(Fig. 4)*

*Link granularity*

There are the following granularities for a desired link:

- time granularity (A link can be switched on or off at any minute.)
- capacity granularity (Allocation of network capacity can be in stages of 1 kbit/s.)
- VC switching (From the end of 1996, SwissWAN will support SVC in accordance with ITU-T recommendation Q.2931. From their own terminal, subscribers can then set up the desired paths in the requisite bandwidth through SwissWAN and disconnect, once communication has been completed. The SwissWAN accounting management ensures that the user is debited with the correct communication costs according to use.)

### SwissWAN SMDS

The Switched Multimegabit Data Service (SMDS) is a data service originally developed for LAN-WAN links. ETSI has standardized the specifications under the name of Connectionless Broadband Data Service (CBDS). With the use of the connectionless server (CLS), a connectionless data transmission service is also possible in the ATM core network. Complex networks can thus be realized more simply and at less cost, as in each case only one permanent link has to be set up from the user to the CLS. The CLS also enables the use of different bit rates between the DSU and the CLS (speed conversion in the CLS).

The service is available over a standardized interface (subscriber network interface, SNI) at various connection speeds. In the first phase the service is available over a 34-Mbit/s interface.

*Examples of applications*

SMDS affords the SwissWAN user, for instance, faster access from his LAN to remote router networks. In a typical application customers are connected to SwissWAN by a router in their LAN via a high-speed serial interface (HSSI). In accordance with the digital exchange interface (DXI), the router transmits datagrams of up to 9232 octet which contain the full destination address in E.164 format. The datagrams are segmented according to the AAL3/4 ATM adaptation layer. The ATM cells thus produced are handed over to the ATM network via certain virtual links. Either they are led over a predefined path to the connectionless server CLS in the ATM core network, which handles distribution of messages to the appropriate recipients, or the individual cells are transmitted over the virtual links assigned to the E.164 addresses. Thus, connectionless communication is acheived in the connection-oriented ATM network, when required, and the multicast or broadcast features are found in shared-media networks.

### SwissWAN FR (Frame Relay)

SwissWAN offers customers a FR Interconnect Service. If transmission is over the ATM network, the FR datagrams reach the service multiplexer (Newbridge 36150) via a preswitched intelligent multiplexer system (SIMUX) with accompanying FRATM, an FR/ATM converter module. The link to the ATM network is over a 34-Mbit/s ATM circuit from the FRATM to the multiplexer service.

The FR Service is an evolution of the X.25 packet-switching technology and, unlike SMDS, is connection-oriented. The service uses only OSI layer 2 and has been defined by CCITT and other bodies as a 'slimmed down' version of X.25. FR offers restricted dynamic bandwidth regulation. Transmission is determined by the data rate and the effective data rate block size. The virtual links are led over permanent virtual circuits (PVCs) with data throughput up to the committed information rate (CIR) in the range of 64 kbit/s to 2 Mbit/s. Should a subscriber's data stream be larger, it will be transmitted, provided there is still spare capacity in the network. If there is a bottleneck in the network, the frames are rejected. With FR there is no active error correction at network level. FR transmits data in so-called frames, which can be of varying lengths. Voice and video applications are not supported. In accordance with Definition I.122, the FR Service enables acknowledgement-free transmission of frames between subscriber interfaces.
The service guarantees that the frames reach their destination in the original frame sequence. The network itself does not administer any frame sequence numbers.
In the event of errors or network overload, the frames are rejected and lost. End-to-end control is still up to the user.

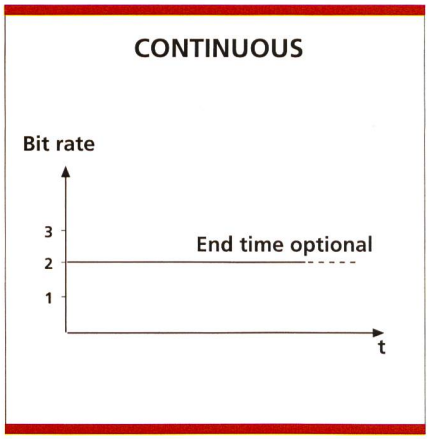


Fig. 2. Permanent mode.

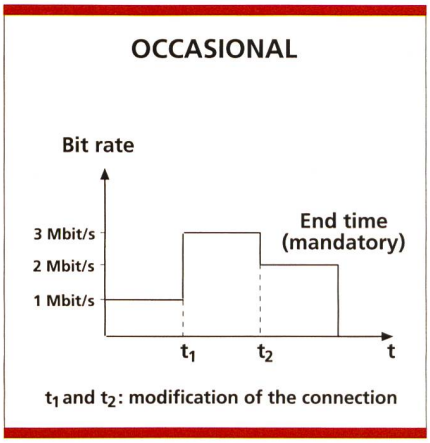


Fig. 3. Occasional mode.

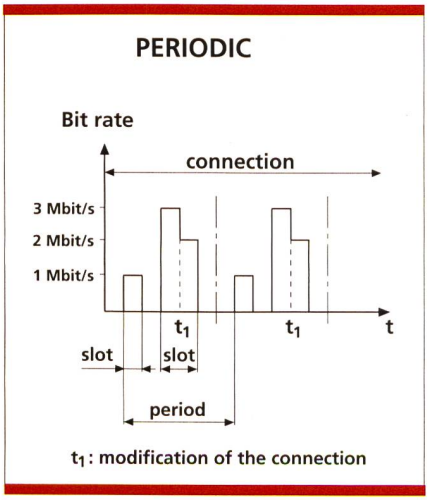


Fig. 4. Periodic mode.

*Protocol*

The address field *(Fig. 5)* is called the data link channel identifier (DLCI). It assigns a logical connection to each circuit over which a particular data

item is to be relayed. The connectivity between incoming and outgoing DLCIs is set out in tables in the FR nodes.

*Frame Forwarding Service*

Frame forwarding (FF) permits a customer to transmit data transparently over SwissWAN using a certain frame format. SwissWAN offers the following variations for FF over the ATM network:

- FF by means of 2-Mbit/s Circuit Emulation Service over a G.703 interface
- FF up to a bit rate of 2 Mbit/s over various data interfaces, facilitated by a SIMUX 3645/3600 intelligent multiplexer system preswitched to the service multiplexer (Newbridge 36150). In this case, too, a virtual 2-Mbit/s link is switched by the ATM network. The FF Service enables certain customer requirements regarding frame relay to be met immediately.

**SwissWAN CE (Circuit Emulation) Service**

With the Circuit Emulation Service (CES), a bidirectional link with constant bit rate (CBR) and transparent timing is transported by SwissWAN. SwissWAN CE is an emulated, unstructured leased circuit on Telecom PTT's ATM WAN. For example, PABX can thus be connected over the ATM network. Adaptation of the CBR signal is in accordance with ATM adaptation layer AAL1.
The circuit emulation interface has an electrical 2048-kbit/s interface, as laid out in ITU-T recommendation G.703. The interface timing at the receiving end is regained in plesiochronous clock operation using the adaptive method:

## BACKGROUND

**In 1993 Telecom PTT specified and realized a national ATM network and invited potential tenders. In the same period of time 16 other European network operators have realized their national networks and interlinked them Europe-wide. Then, within the framework of the Memorandum of Understanding, the European ATM pilot network was opened on 1 July 1994. The aim was to examine the technical characteristics of ATM equipment for interworking and to confirm or substantiate standards as well as work out the foundations for the commercial launch of new services. These goals were reached with the ATM pilot network.**

- interface: unstructured G.703
- applications: connection of private telecommunications exchanges and multiplexers as well as 2-Mbit/s video transmission

Together with other SwissWAN services, the SwissWAN CE Service is offered for customer networks. Leased circuits are to be preferred as single point-to-point connections.

**SwissWAN ATM**

This native ATM service has the same functionality as the ATM-UNI bearer service and permits two users to communicate in both directions and in a point-to-point configuration; however, the physical layer and the ATM layer are defined, so the service remains limited to the transmission of ATM cells. The upper layers facilitate end-to-end connections and can be selected according to the requirements of the application.
Provision of the SwissWAN ATM service is based on VP links in the core and access network. Already in the introductory phase, SwissWAN ATM is being offered as part of the two services, SwissWAN LIS and SwissWAN CNS. In the consolidation phase it will also be available as an autonomous service in the SwissWAN portfolio.
The following application interfaces are possible for SwissWAN ATM:

- STM-1, 155 Mbit/s optical, as per I.432
- E3, 34 Mbit/s electrical, as per G.804 and G.832
- E3, 34 Mbit/s electrical, as per G.751/PLCP
- E1, 2 Mbit/s electrical, as per G.703

The user pays only for the bandwidth used or the data volume bandwidth, respectively. Accounting and billing data are registered in the service multiplexer.

**SwissWAN LIS**

LAN Interconnection Services (LIS) connect locally distributed LANs via SwissWAN. A virtual connection with the desired bandwith is set up over the ATM network from one local segment to any remote LAN segment. SwissWAN LIS can use SwissWAN FR, SwissWAN SMDS or SwissWAN ATM as transmission services. Unlike conventional LAN interconnection services, SwissWAN LIS offers the possiblity to connect LANs with native speed. Another very important feature is that routers are tied into the service. Telecom PTT assumes users' investments for routers as well as management of the network. Customers may either buy or subscribe to CPE (routers or bridges). Configuration, management and maintenance of the equipment is done by Telecom PTT *(Fig. 6)*.

**Other possibilities with SwissWAN LIS**

The following possibilities for LAN-LAN connections concern bridging functions:

## DEFINITION

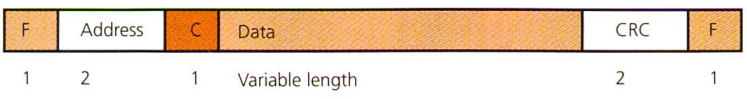


**Fig. 5. Definition of a FR frame per CCITTI.44.**

*Ethernet Interconnection Service*

The Ethernet Interconnection Service connects Ethernet IEEE-802.3 LAN segments. The segments are coupled at the media access control (MAC) level, and the interface modules behave as self-instructing bridges. The spanning-tree procedure is supported. The MAC frames are encapsulated according to Internet RFC1483 and segmented by means of an ATM adaptation layer. There is a choice of Ethernet modules with either one of four attachment unit interface (AUI) ports. The modules contain a so-called filtering data base which performs the assignment of Ethernet MAC addresses to ATM virtual-channel numbers. The cell rate can be individually set for each channel. The flow of data into SwissWAN can thus be limited.

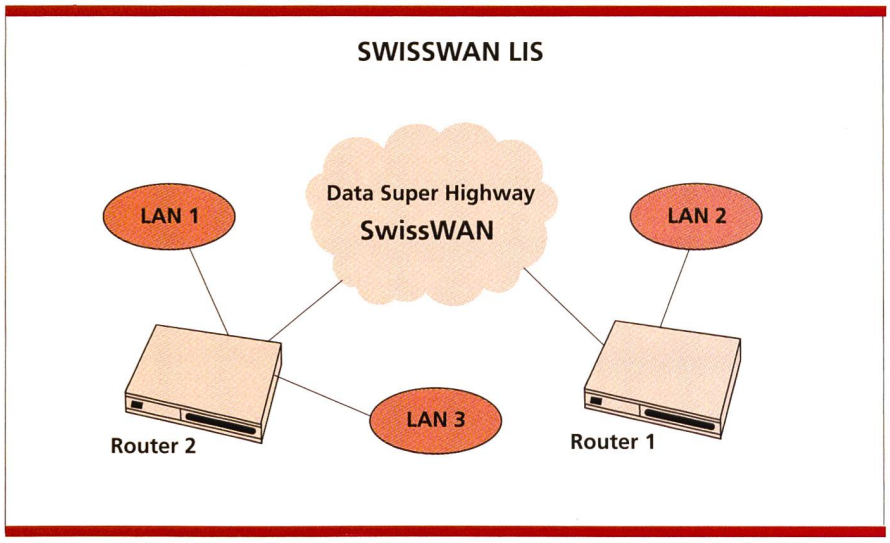


**Fig. 6. LAN Interconnect Service: SwissWAN LIS.**

*Token ring Interconnection Service*

The token ring connection module facilitates the Interconnection Service for IEEE 802.5 LAN rings. Connection of the rings is at the MAC level, and the interface modules behave as self-instructing bridges. The source route bridging- and spanning-tree procedures are supported. The MAC frames are encapsulated and segmented by means of ATM adaptation layer AAL5. Token ring modules with three token ring ports are available. The cell rate can be individually set for each channel. The flow of data into SwissWAN can thus be limited.

*FDDI Interconnection Service*

The fiber-distributed data interface (FDDI) module in the service multiplexer offers a transparent bridging function for FDDI frames over SwissWAN. The spanning tree is supported. The FDDI frames are encapsulated in accordance with Internet RFC1483 and segmented by means of ATM adaptation layer AAL5.
The FDDI connection module has an FDDI port in accordance with ANSI standard X3T 9.5. Connection to a single FDDI ring (single attached station) or to an FDDI double ring (dual attached station) is possible. The cell rate can be set, and the flow of data into SwissWAN is thus limited. The FDDI interface is laid out for optical multimode fibres in accordance with ANSI standard X3.166 or for single-mode fibers in accordance with ANSI X3.184.

**SwissWAN CNS**

The Corporate Network Service (CNS) is a fringe service which makes it possible to offer customized services.
SwissWAN CNS comprises advice on as well as operation and maintenance of customer premises equipment in conjunction with other Telecom PTT services.
Telecom PTT can assume the role of investor in the corporate network sphere. Equipment such as ATM switches, routers, bridges, video equipment, etc., are in this case made available to the user under subscription.
SwissWAN CNS can comprise the following services:

- engineering for the corporate network
- subscriptions to equipment in the corporate network sphere
- management in the corporate network sphere
- maintenance of equipment in the corporate network sphere
- SwissWAN LIS
- SwissWAN SMDS, SwissWAN FR, SwissWAN ATM and SwissWAN CE transmission services
- other services in the Telecom PTT portfolio

Important possible features and facilities of the SwissWAN CNS package:

- Telecom PTT manages and executes the entire project for a corporate network, starting with advice through planning right up to realization, and afterwards assumes management and maintenance.
- Video and audio interfaces (point-to-point or point-to-multipoint) can be offered.
- Special customer requirements are met with the best possible solutions.

SwissWAN CNS enables users to link their networks over SwissWAN and, thanks to the joint use of resources such as management, support and maintenance which are provided by Telecom PTT, to operate these networks more efficiently and economically *(Fig. 7)*.

## Pricing structure

What are the important factors in SwissWAN services for customer networks?

- Economy of scale: The joint use of WAN by a large number of users leads to lower prices per transmitted bit. Customers who produce large traffic flows per network connection (in the order of gigabytes per month) can profit; this is also known as economy of scale.
- Economy of integration: ATM service multiplexers facilitate the inte-

gration of various services. The more SwissWAN services a customer uses per network connection, the cheaper are the individual services.
- Bandwidth on demand: The cell structure of ATM permits variable bit rates. So-called overbooking can thus be dealt with. Transmission routes can be better utilized, and the benefits are passed to the customer by taking economy of scale into consideration in the pricing structure.

**Comments on the pricing of SwissWAN services**

The prices of SwissWAN services are made up of the following elements:

*Point of presence (POP) connection charge*

The connection charge depends on the sum of the peak cell rates of the different, VP used by the customer at a certain POP. It is graded according to the bit rates of 155, 34 and 8 Mbit/s. The customer thus profits from the economy of integration rendered possible by ATM technology.

*Port charges*

There is a port charge for every connection of customer site to the POP. This port charge depends on the type of port and its speed. There are different charges for the access link to the customer, namely:

- Connection to a POP **within** the leased circuit charge zone: the link is included in the port price.
- Connection **outside** the leased circuit charge zone: the link to the customer is not included in the port price and must be paid separately.

*Basic traffic charge per POP*

A traffic class is determined on the basis of the totalized peak cell rates (PCRs) of the respective customer's incoming virtual paths (VPs) at the same POP. Depending on the traffic class, there is a corresponding basic charge, which also includes a set amount of free traffic.

*Traffic charge for additional traffic per POP*

The real traffic which exceeds the free traffic defined per traffic class is billed to the customer; however, the traffic charge (Fr./GByte) for the actual amount of traffic really decreases, as the price per gigabyte comes down with each higher traffic class. Here again, the customer profits from economy of scale.
In the initial phase of a service, the actual amount of traffic is not measured and billed on-line but is based on an agreement between Telecom PTT and the customer.

*A simple example (Fig. 8)*

User A has to pay the following charges:
- 1 POP connection charge, 34 Mbit/s (it is, though, already spread over three ports)
- 2 port charges, 2 Mbit/s
- 1 port charge, 34 Mbit/s

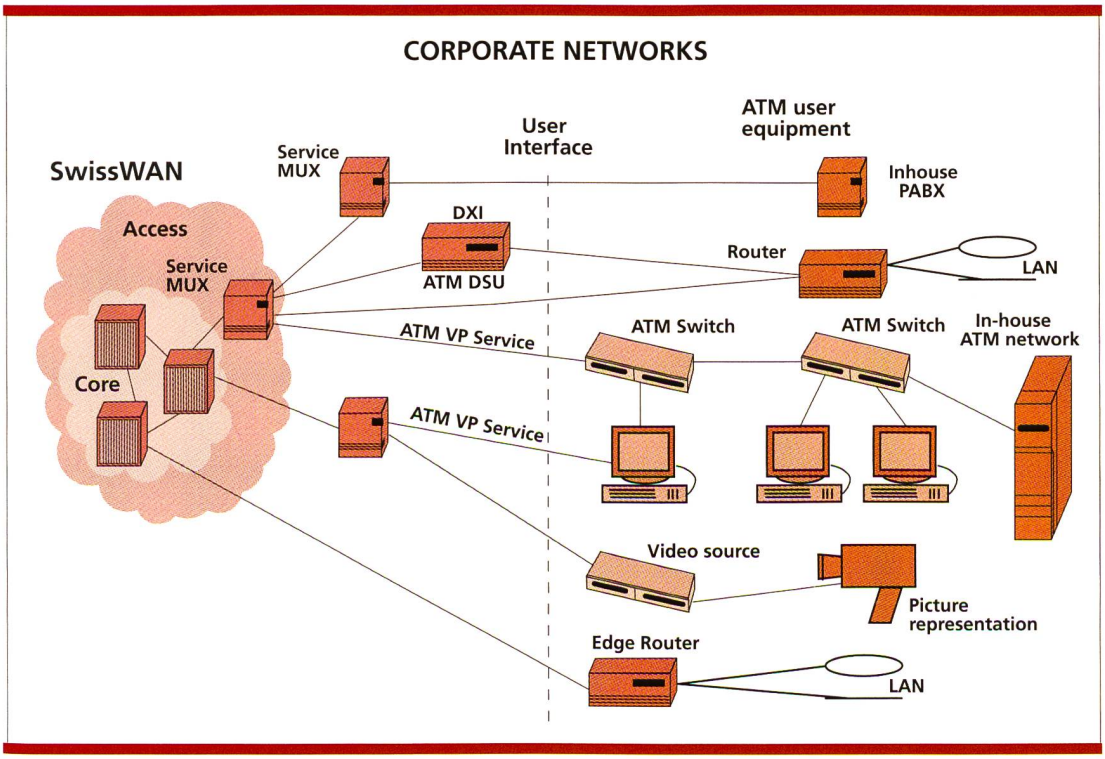


Fig. 7.
A corporate network.

- 1 link (2 Mbit/s, leased circuit) for users outside the leased circuit charge zone (less the lump sum already calculated in the port price)
- traffic charge (sum of the ATM cells during one month on all user A ports at the POP)

*Project-related charges*

For the SwissWAN CNS and SwissWAN LIS, the prices of the individual services used plus any possible subscription charges, the costs for management and maintenance as well as engineering are totalled and sold as a 'SwissWAN CNS total package'.

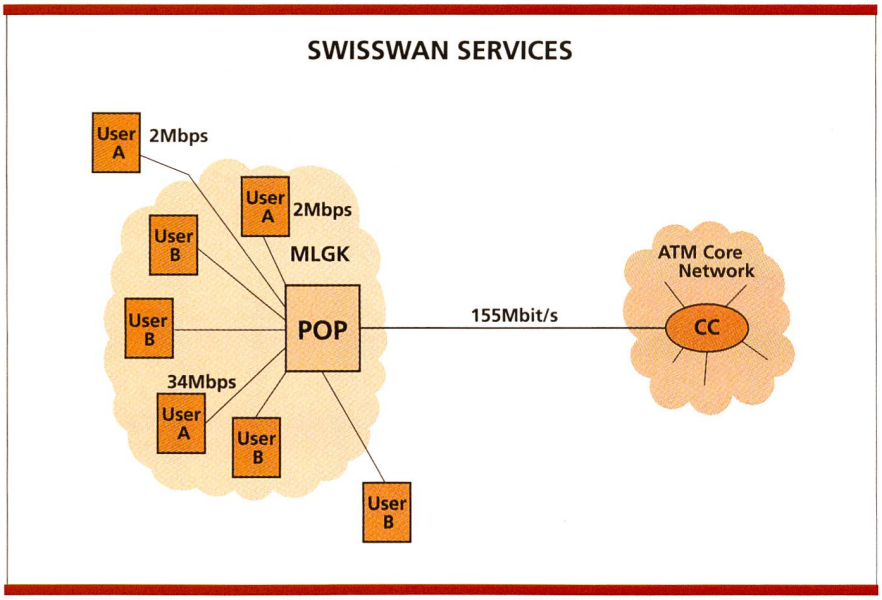


Fig. 8. Simple example for the pricing components of SwissWAN services.

## Positioning of SwissWAN services

The new SwissWAN services are positioned for applications with bandwidths of 2 Mbit/s and higher, on condition that they are for networks. The tariff structure implies that individual point-to-point connections are of little interest to users because the connection charge cannot be spread over various ports. New services will close this gap, too, at a later date. *Figure 9* shows the position of SwissWAN services in relation to other services.

SwissMAN (DQDB-MAN) from the Zurich Telecom Directorate which went into commercial operation already in 1994 meets the same customer requirements with regard to bandwidth as do the SwissWAN services. The MAN can therefore also serve as infrastructure for access to SwissWAN, which will be expanded to cover the whole of Switzerland and linked with worldwide networks as soon as these become available. Interworking between SwissMAN and SwissWAN has already been realized. At the 1995 TeleNetCom trade fair in Zurich (TNC 95) it was demonstrated that interworking is functioning: An application for the Porsche Company, which runs on the computer at Stuttgart University, was switched via MAN in Stuttgart over the Interworking Unit (IWU) in Germany onto the Euro-

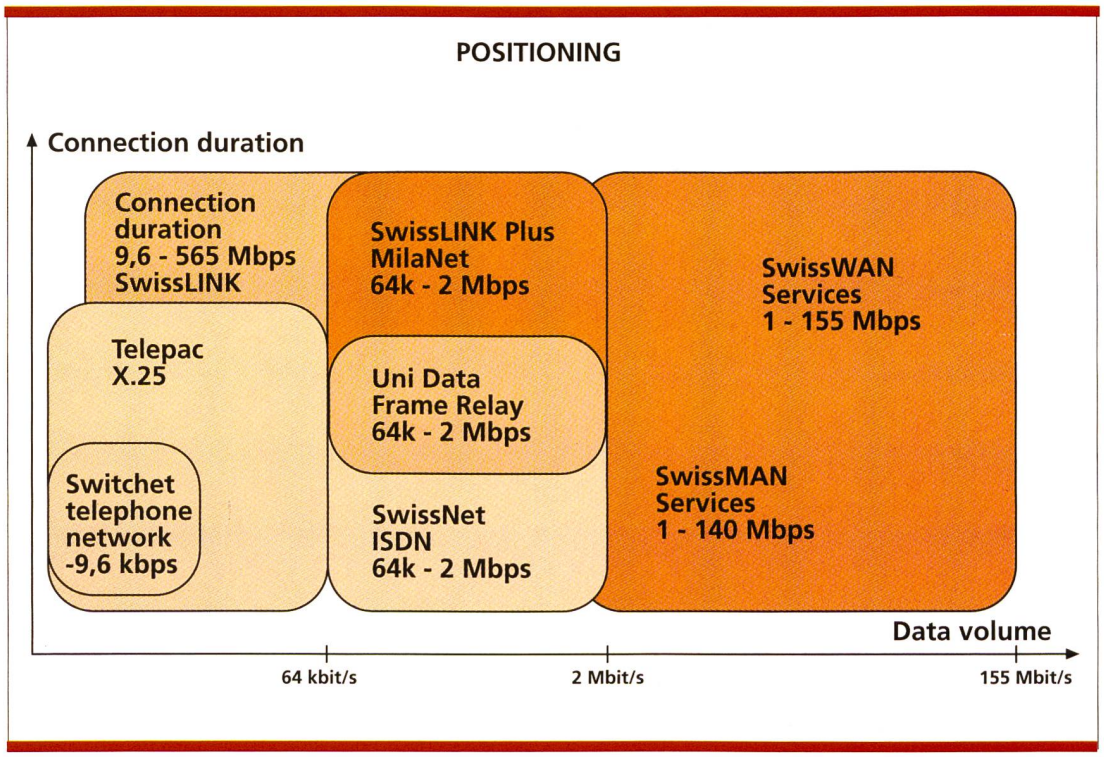


Fig. 9.
Position of the most important Telecom and Unisource services.

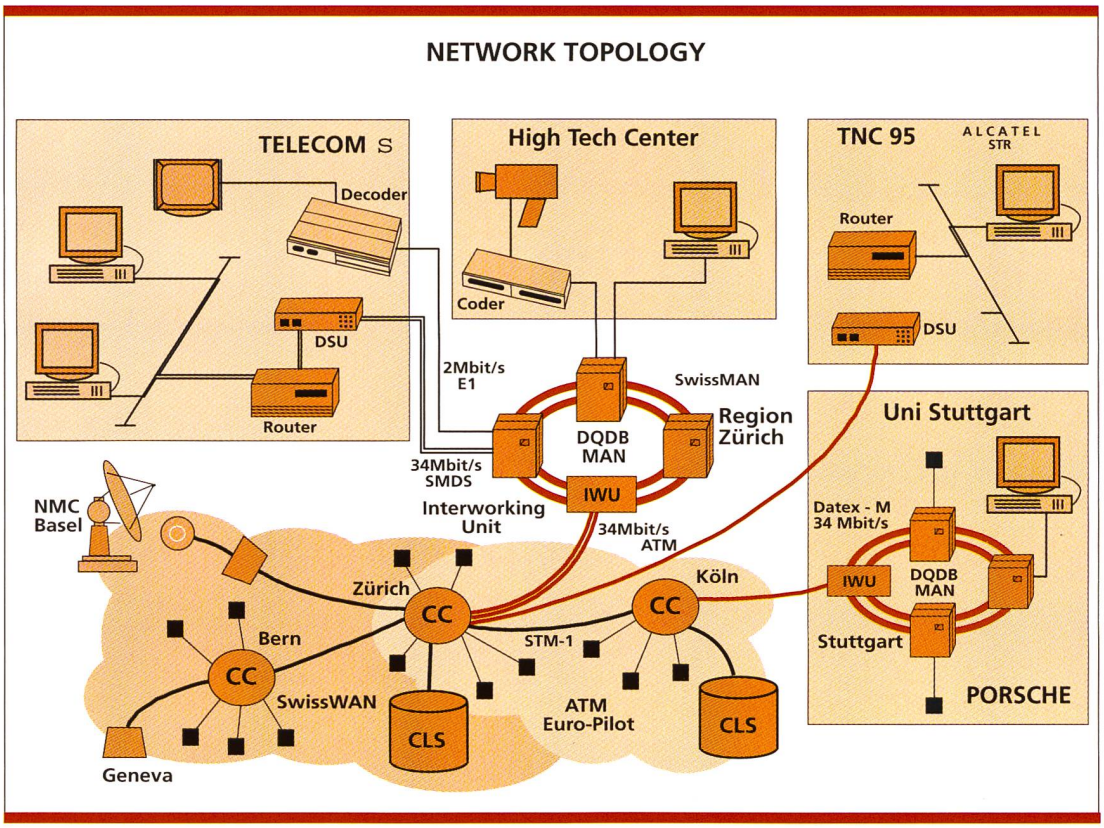


Fig. 10.
The TNC 95 network topology.

## Tailored to customers' requirements

**Considerable know-how was gained from the ATM pilot network. This enabled Telecom PTT to introduce on 1 August 1995 a family of new services in the ATM network which has been expanded for commercial applications. In the first phase, there is controlled introduction of services, i.e., suitable customer networks are being treated as projects and migrated to Telecom PTT's ATM WAN. This guarantees that, particularly in the initial phase, the services can be further developed in accordance with customers' wishes and requirements.**
**The new family of products is being marketed under the name of SwissWAN. SwissWAN services are competitive services and are offered on economic and market principles. Telecom PTT is endeavouring to expand an attractive range of services tailored to customers' requirements. Some of these services are completely new, while others, such as Frame Relay or LAN Interconnect, are already known. Customers can thus migrate already existing applications onto the data superhighway and protect their investments.**

pean ATM pilot network; in Zürich it was connected by ATM Crossconnect, again over the IWU back to the MAN, and finally switched onto an ATM switch at the TeleNetCom. Simulation of the oscillatory behaviour of a Porsche axle could be demonstrated problem-free. *Figure 10* shows the application.

## Typical applications

The following applications can be efficiently realized on Telecom PTT's WAN:
- LAN-WAN links with no diminishment of performance (native speed)
- computer network, for example distributed billing centers
- collaborative work (developments are being made at Airbus Industries in various countries; the new data superhighways are particularly suited for such applications)
- multimedia applications, e.g. teleteaching, as in joint lectures for various colleges and universities
- telemedicine: remote diagnosis, transmission of high-resolution pictures
- electronic publishing (thanks to the periodic provision of links, this application can be provided inexpensively)
- CAD/CAM applications

**Andreas Loosli** graduated in 1978 with an HTL diploma in electrical engineering from the School of Engineering in Berne and obtained in 1985 a post-graduate diploma in business engineering. He is Group Head in the Leased Circuits Marketing Section at Telecom PTT in charge of SwissWAN service development and product management.