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TMN APPLICATIONS IN THE SWITCHED NETWORK OF SWISS TELECOM PTT

IN WHAT WAY CAN AN EFFICIENT TELECOMMUNICATIONS MANAGEMENT BE INTRODUCED?

Not only since yesterday the Public Network Operators (PNO) have introduced a more or less big collection of management solutions into their networks, which were operated more or less independent from each other. Nowadays, where an increased efficiency with higher turnover at lower profit margins is strongly required, cost-effective management solutions for the operation and maintenance of networks and services are requested. The TMN (Telecommunications Management Network) architecture is a possible candidate for the development of standardized management solutions for the networks and services of today and tomorrow. This article describes the Swiss Telecom PTT network and its management of today. Then a description of TMN-based solutions at Swiss Telecom PTT is given. The article closes with an outlook on possible developments in the field of Network Management.

In the past, telecommunications were said to be based mainly on switching and transmission. Nowadays, efficiency and reliability are strongly required to ensure a high quality of service.

KURT WABER UND RÜDIGER SELLIN, BERN

From a technical point of view, management forms the third field of activity in telecommunications besides switching and transmission.

Introduction

Today, telecommunications management is a very important task which becomes more and more complex. Management is important because it is one key for the reliable and efficient operation of telecommunication networks and services. Management becomes complex because today telecommunications is realized by the intensive use of microprocessing power, both for the network infrastructure and for its management. As one consequence, computer and telecommunications technology are merging together. On the one hand, not only the network infrastructure is distributed, but the management application itself, too. The management information is gathered from different places in the network and processed at other (central or distributed) places. On the other hand, stability and reliability is strongly required for efficient telecommunications management. It should be noted that the more a management process is distributed, the more sensitive it becomes against occurring errors, which may not be easy to find in every case.

So the question is in what way an efficient telecommunications management can be introduced into an already existing telecommunication network and what management architecture may be used as a target architecture. Swiss Telecom PTT as a typical PNO of the nineties has a real multivendor situation in its network and has chosen TMN as its target architecture. When introducing TMN concepts into network management, it is important to have a strategy of how to move from today to tomorrow. Swiss Telecom PTT has chosen a kind of step-by-step strategy when introducing TMN-based solutions. Firstly, existing proprietary management applications are harmonized e.g. through the use of common interfaces which follow standards as much as possible. By this approach the exchange of management information is already possible between systems who participate at management processes. Secondly, the proprietary parts in the harmonized management applications are substituted through standardized parts as soon as the appropiate standards are available.

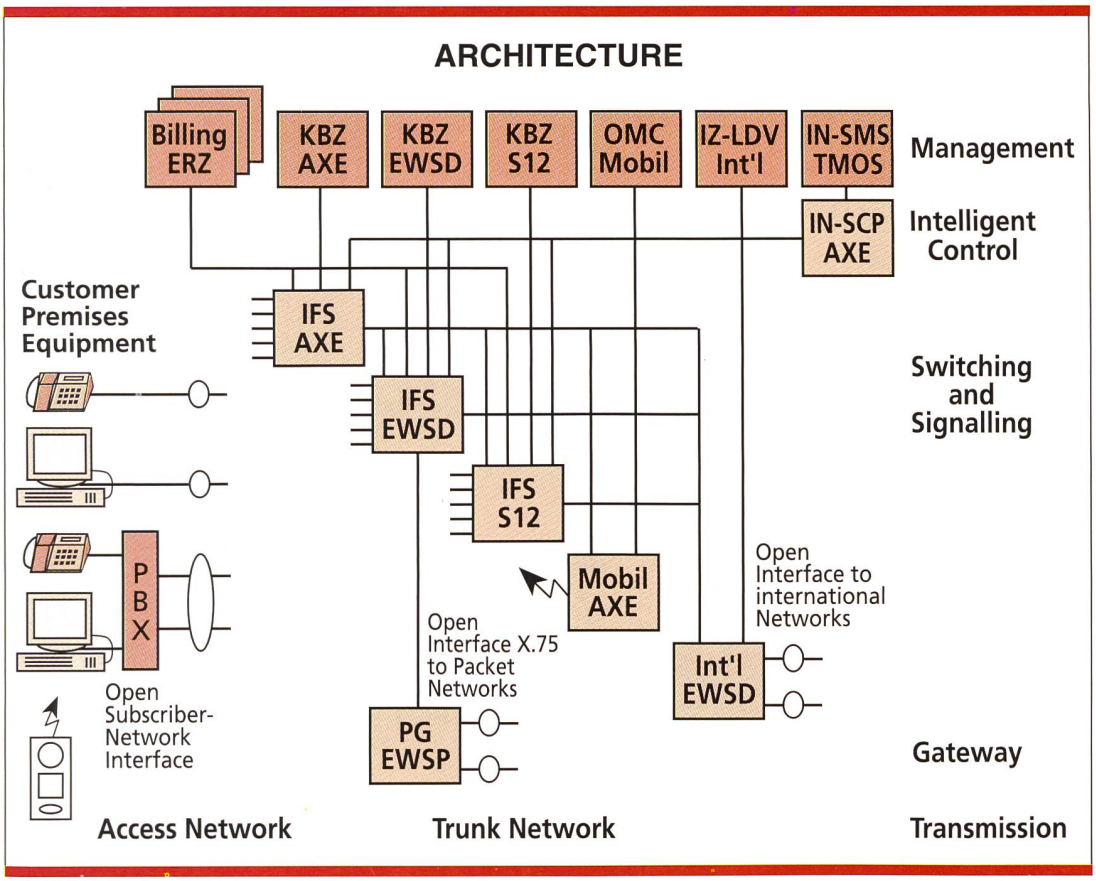

Fig. 1. Global Network Architecture.

The Swiss Telecom PTT network

The public Swiss Telecom PTT switched network, known as 'Integriertes Fernmeldesystem' (IFS), is based on:

- the Network Elements (NE) AXE™ (supplier Ascom), EWSD™ (supplier Siemens), S12™ (supplier Alcatel), performing the functions of local and transit exchanges, including proprietary Management Systems (called KBZ, 'Kreisbetriebszentrum', see chapter 'The Swiss Telecom PTT Network Management')
- the Network Elements (NE) EWSD™ (supplier Siemens), performing the functions of international exchanges, including proprietary Management Systems such as IZ-LDV ('Internationale Zentrale – Leitungsdatenverwaltung')
- the Intelligent Network (IN) with a Service Control Point (SCP) based on AXE™ technology and a Service Management System (SMS) based on Ericsson's Telecommunication Management and Operation Support (TMOS™) and Service Management Application System (SMAS™)
- a Packet Gateway (PG) function based on Siemens EWSP™ technology for access to dedicated Packet Networks across X.75 interfaces

Some harmonized Operations Systems (OS) for Network Management are also in operation. One is in use for billing and another for customer configuration and service management.
This network offers Plain Old Telephony Services (POTS) as well as ISDN services. The name for the ISDN offered and operated by Swiss Telecom PTT is SwissNet. SwissNet is based on Euro-ISDN concepts, offers services and supports protocols at the User-Network Interfaces in accordance with relevant ETSs. SwissNet is a narrowband ISDN which allows different types of calls such as speech, 3.1 kHz audio, 64 kbit/s unrestricted digital information, and also includes Packet Mode Bearer Services (PMBS). The Swiss Telecom PTT network supports ISDN and PSTN in an integrated network, i.e., ISDN is not an overlay network. Currently there is SwissNet2 in operation, and it is intended to launch SwissNet3 in 1996. Compared to SwissNet2, SwissNet3 offers new network technology such as Intelligent Network, CENTREX, V5.1 interface, Packet Gateway for access to dedicated Packet Networks across X.75 interface, and some new telecommunication services.
The Mobile Network is based on AXE™ technology (supplier Ascom). There is an analog network in operation called NATEL C, which is NMT technology, and the GSM, called NATEL D.
Figure 1 provides an overview. In this figure, network functionality is related to management, intelligent control, switching and signalling, gateway, and transmission in a functional layer approach. Open interfaces are defined, such as user-network interfaces offering ISDN services, access to dedicated packet networks, interface to international networks.

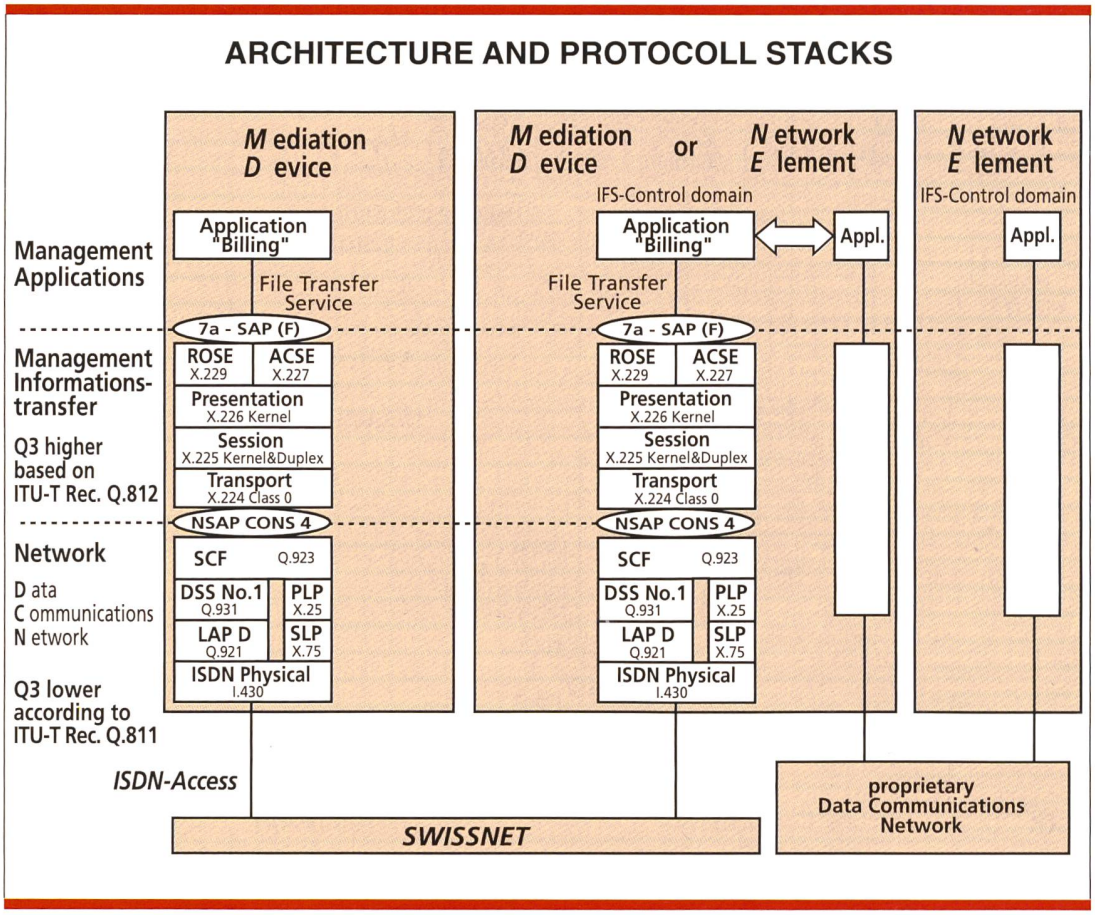

Fig. 2. NORA Network Management – architecture, protocol stacks for file transfer, application billing.

The Swiss Telecom PTT Network Management

Network Management is still dominated by proprietary concepts, architectures and protocols. SwissNet and PSTN are using Operation and Maintenance Centers called KBZ ('Kreisbetriebszentrum') dedicated to the different switching systems AXE™, EWSD™ and S12™. The management of the Intelligent Network is based on Ericsson's Service Management Application System (SMAS™) running on Ericsson's Telecommunication Management and Operation Support (TMOS™) platform. Mobile Communication performs Network Management based on Ericsson's TMOS™ platform as well.

Swiss Telecom PTT endeavours to adopt as much as possible the international approach for a harmonized Network Management, which is the so-called Telecommunications Management Network (TMN). Swiss Telecom PTT succeeded in harmonizing Network Management for billing. An architecture called NORA ('Normierter Rechneranschluss') was defined with the aim to include as much as possible TMN architecture and concepts. The management application 'billing' is making use of a file transfer capability between a Network Element (the switch) and the Operation System (Swiss National Computing Center, ERZ) in order to convey charging records created by the switch for processing in the computing center. The protocol stack in the Data Communication Network (DCN) is fully consistent with ITU-T Recommendation Q.811. The DCN function is provided by SwissNet, making use of the unre-

FUTURE DEVELOPMENTS

As already mentioned, the NORA family is divided into two parts, one for File Transfer applications and one for Dialog (or Transaction-Oriented Information Transfer) applications. In the NORA specifications at Swiss Telecom PTT, these two parts are further divided into application-specific parts.

At the present, NORA applications are defined for the following fields :

- Tax Data, Traffic Measurement Data, MCID Data and SS#7 Traffic Measurement Data as File Transfer applications
- Management of SS#7 networks and management of customer configuration and services (UNICURU, as defined in the text) as Dialog applications

It can be foreseen that further, already existing or planned management applications are introduced into the NORA family. Because many useful TMN-based management applications are defined in ETSI and ITU-T, this will have an impact on NORA, too.

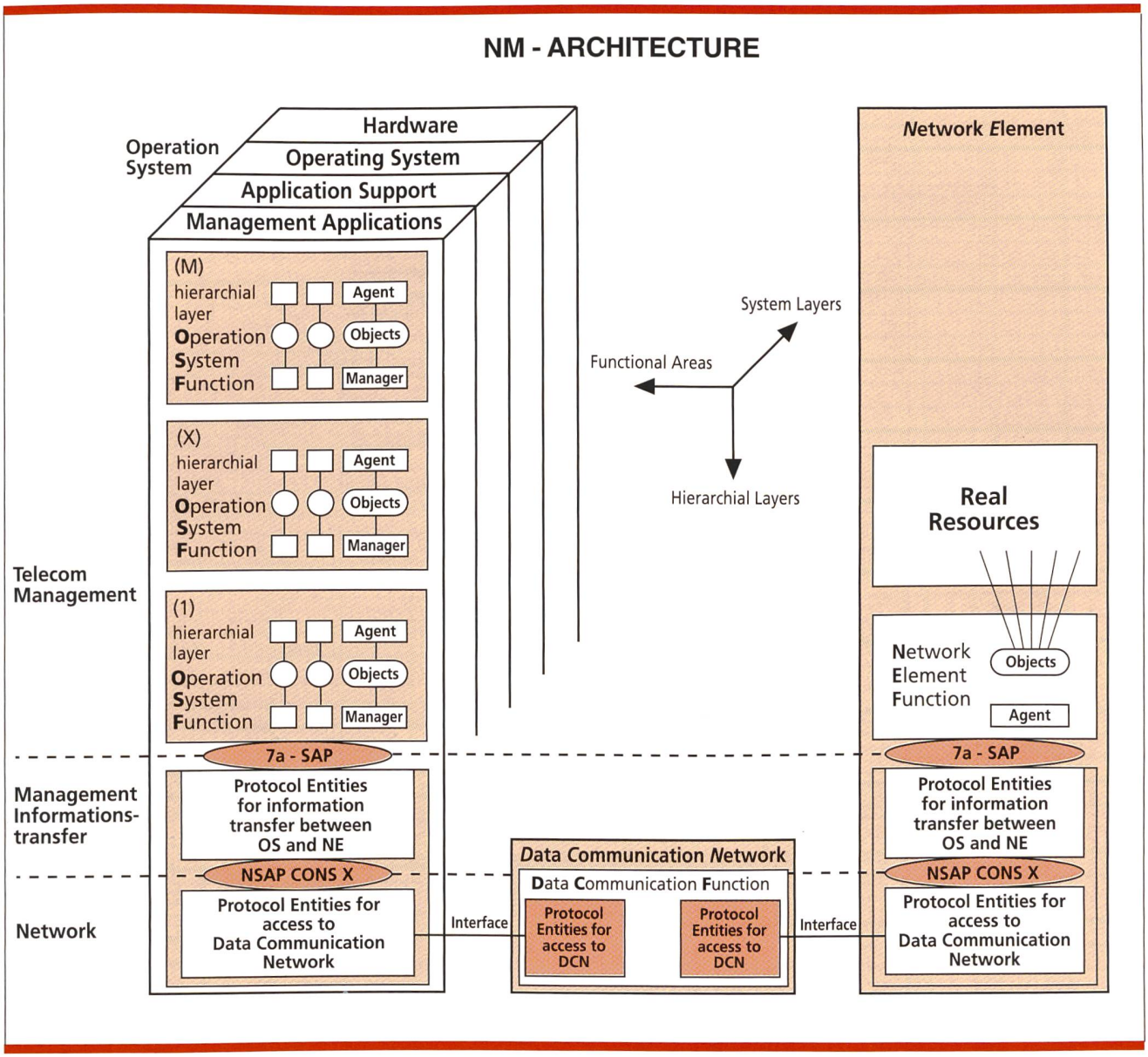

Fig. 3. NM Architecture – functions, system layers, protocol stacks and NM hierarchical layers.

stricted digital information transfer bearer service of the ISDN. The upper protocols for support of information transfer share many aspects with ITU-T Recommendation Q.812. The management application is proprietary; however, it is harmonized for the three IFS systems. In order to achieve this, the switching system may include a Mediation Device (MD). *Figure 2* illustrates the NORA approach for billing.

It was possible to use this application after a slight modification in the charging record also for mobile communication. In the meantime, different billing mechanisms have been introduced into the GSM network to meet the requirements for billing on demand.

The NORA architecture is intended to be developed further to cover beside file transfer a transaction-oriented capability, involving packet-switching facilities. The consolidated NORA architecture is depicted in *Figure 3*. This architecture is intended to support various Network Management applications.

The first application making use of the Transaction-Oriented Information Transfer service is the management of customer configuration and services. This management application, called UNICURU (Unified 'Computerunterstützte Ruf- und Lagenummerumwertung'), is harmonized for the three IFS systems. The information model is based on ETSI ETS 300 291. UNICURU will be launched with SwissNet3 and allows

- to access a Network Element (Local Exchange)
- to create a customer
- to establish an association between this customer, a directory number and an access port, which is analog access, ISDN basic rate access or ISDN primary rate access
- to select a customer profile, analog subscriber or ISDN subscriber
- to customize the bearer and supplementary services provided to this customer

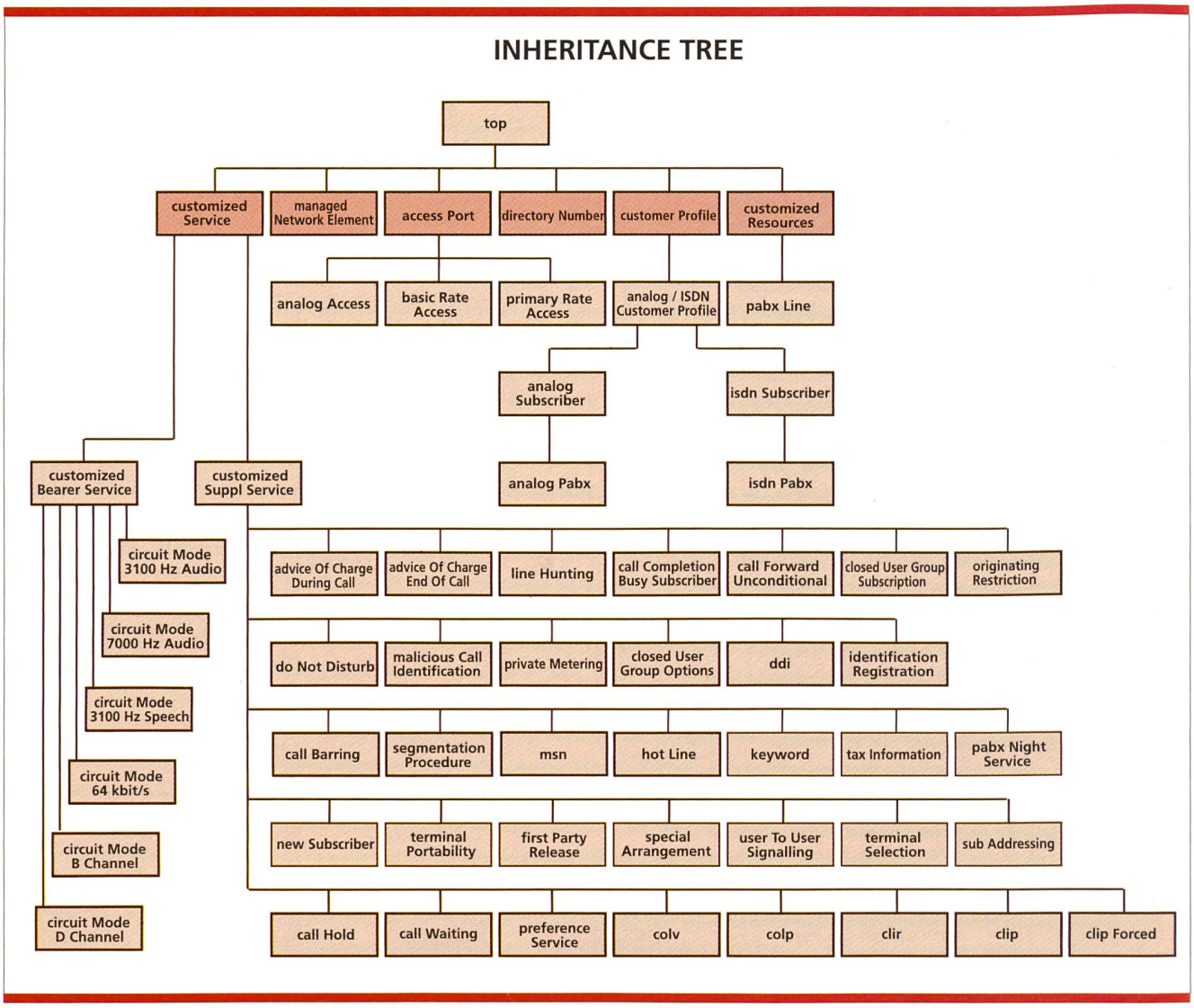

Fig. 4. Inheritance tree of Customer Management application (based on ETSI ETS 300 291).

All these parameters appear as manageable objects. *Figure 4* illustrates this management capability.
In addition, UNICURU also manages data of the Main Distribution Frame (MDF) in connection to the subscribers. UNICURU has knowledge of the geometry and geography of the MDF. At creation time of a subscriber, the physical ressources of the interface, e.g. Line Interface Circuit and Line Contact, are assigned to the subscriber always targeting optimized cross-connections on the MDF.

Evolution of Network Management

In the field of Network Management, there are three different evolutionary steps:

- evolution of the DCN
- evolution of NORA applications
- studies of new Network Management technology, i.e. TMN

As part of NORA activities it is the objective to upgrade the DCN in order to cover X.31 case b/CONS3 for use by transaction-oriented information transfer. In the medium term, new protocol stacks are to be defined in order to use ATM environment for DCN purposes. It is the objective to base these stacks on B-ISDN Protocol Architecture.
Another objective is to evaluate the applicability of information models to the management of Signalling System No. 7 and to mature the modelling of objects, with the aim to use NORA for this management application.

In the course of studies of new Network Management technology a TMN architecture has been established in ITU-T and ETSI, and Swiss Telecom PTT tried hard to adopt TMN concepts as much as possible (see NORA).
The problem which remains unresolved in ITU-T's TMN concept is the existence of 'three worlds', the physical architecture, the functional architecture, and the information architecture. Current ITU-T publications do not clarify how each of these three architectures is related to the others; moreover, aspects related to platform technology are not addressed at all.
In general a system for realizing telecommunications management could consist of four system layers:

- the hardware
- the basic OS software (operation

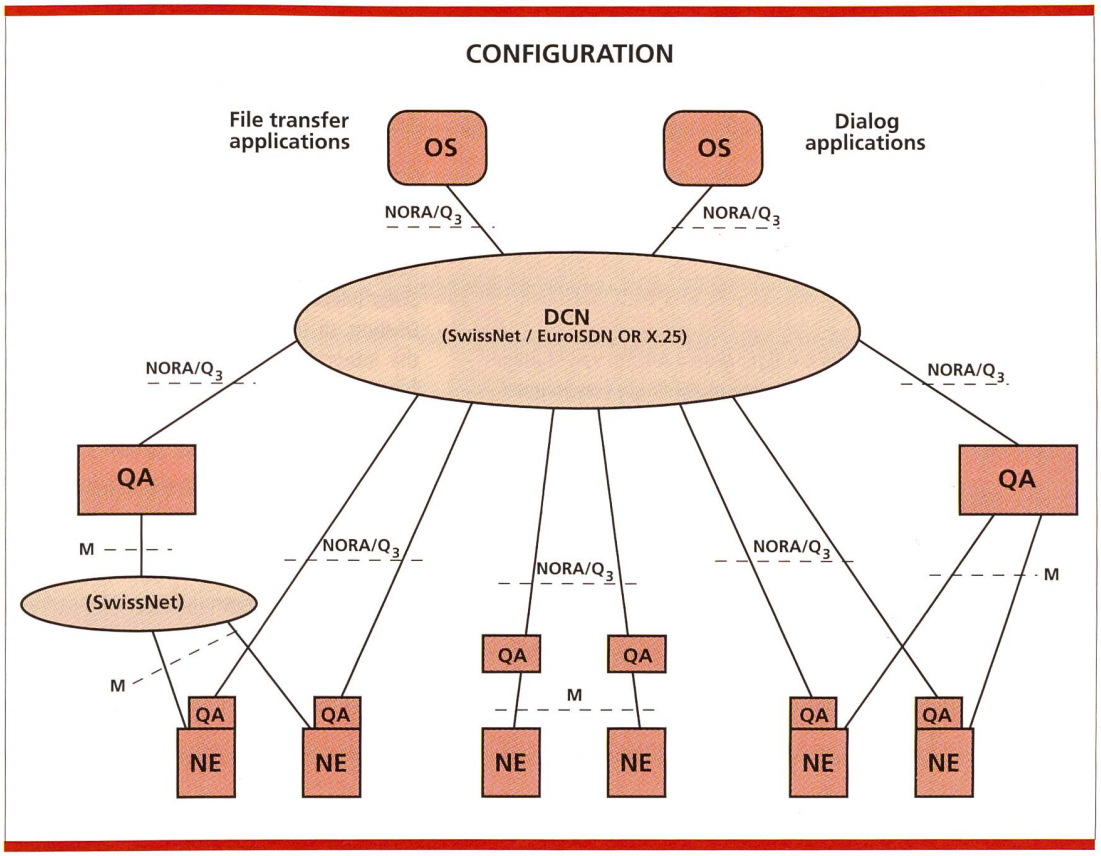

Fig. 5. Short-term target configuration.

systems like UNIX plus software for the local management of the computer environment, like printers, etc.)
- the basic management software (software which can be used for all kinds of management applications)
- the management application software itself (which depends on the specific management task, e.g. one for traffic management, one for the management of IN-based services, etc.).

From Swiss Telecom PTT's point of view, a management platform consists of the system layers one to three. The interpretation of the term 'platform' varies on a very broad range, often depending on vendor-specific views. But as all ITU-T standards do not deal with any implementation aspects, it is essential to come up with a common definition of a platform for telecommunications management. The EURESCOM project P 208 (TMN Operations System Platform) gives a useful platform definition.
It is our objective to elaborate a generic Network Management architecture which merges the three architectures into one and also covers OS platform technology aspects. 9.4

GLOSSAR AND SOURCES

ANSI	American National Standards Institute
ATM	Asynchronous Transfer Mode
DCN	Data Communication Network
ERZ	Elektronisches Rechenzentrum
ETS	ETSI Technical Standard
ETSI	European Telecommunication Standards Institute
GSM	Global System For Mobile Communications (in Switzerland called 'NATEL D')
IFS	Integriertes Fernmeldesystem
IN	Intelligent Network
ITU-T	International Telecommunication Union, Telecommunication Standardization Sector
IZ-LDV	Internationale Zentrale – Leitungsdatenverwaltung
KBZ	Kreisbetriebszentrum
MCID	Malicious Call Identification
MD	Mediation Device
MDF	Main Distribution Frame
NE	Network Elements
NORA	Normierter Rechneranschluss
OS	Operations System
PG	Packet Gateway
PMBS	Packet Mode Bearer Services
SCP	Service Control Point
SMS	Service Management System
TMN	Telecommunications Management Network
UNICURU	Unified 'Computerunterstützte Ruf- und Lagenummerumwertung'

ZUSAMMENFASSUNG

TMN-Anwendungen im Vermittlungsnetz der schweizerischen Telecom PTT

Nicht erst seit gestern haben die PNO eine mehr oder weniger grosse Anzahl von Managementlösungen in ihre Netze eingeführt, die mehr oder weniger unabhängig voneinander betrieben werden. Heutzutage, wo bei höherem Umsatz und niedrigeren Gewinnmargen ein starkes Bedürfnis nach grösserer Leistungsfähigkeit besteht, werden kostenwirksame Managementlösungen für Betrieb und Unterhalt der Netze und Dienste verlangt. Die TMN-Architektur ist ein möglicher Kandidat für die Entwicklung von standardisierten Managementlösungen für die heutigen und zukünftigen Netze und Dienste. TMN wurde vom ITU-T (International Telecommunication Union, Standardization Sector, ehemals CCITT) entwickelt und durch ETSI (European Telecommunication Standards Institute) und ANSI (American National Standards Institute) weiter ausgearbeitet und vervollständigt.

Der Artikel beschreibt das Netz der schweizerischen Telecom PTT und dessen heutiges Management. Es folgt eine Beschreibung der auf TMN basierenden Lösungen bei der schweizerischen Telecom PTT. Der Artikel schliesst mit einem Blick auf mögliche Entwicklungen im Bereich Netzmanagement.

Rüdiger Sellin, B.S. in Engineering, is engaged in R&D of the General Directorate PTT since 1992. After completion of his studies in communications engineering at the Technical College Düsseldorf, he worked two years for German Telecom and subsequently in the private industry as systems engineer in OSI development as well as product manager in marketing for network support systems. In his current position he is the leader of a group which is responsible for management aspects in various telecommunications projects. He also participates actively in European and international standardization committees.

Kurt Waber joined Swiss Telecom PTT in 1971 as a research engineer after having received a B.S. degree in electrical engineering at the Engineering College of the State of Berne at Burgdorf. He worked as researcher in the area of digital switching and signalling and is now head of the Switching Systems Section in the Swiss Telecom PTT Research and Development Division. In this capacity he is responsible for the integration and testing of new network functionality and technology in a test plant network prior to their launching into the real Swiss Telecom PTT network as well as for consulting to assist the network division in the specification of new network technology and functionality. He was involved in the first steps towards harmonized network management according to Telecommunication Management Network (TMN) principles in the Swiss Telecom PTT network, where a billing system at the lower protocol layers adopted a Q3 TMN protocol stack. Furthermore, he was active in the specification of the Swiss narrow-band Integrated Services Digital Network (ISDN), the SwissNet. As part of this work he also contributed to standardization bodies, the Telecommunication Standardization Sector of the International Telecommunication Union (ITU-T) and the European Telecommunications Standards Institute (ETSI). His current main activity is in the field of architectures of systems, networks and protocols for broad-band Integrated Services Digital Network (B-ISDN), Intelligent Network (IN) and TMN. He is expert in B-ISDN protocols, in particular protocols below the user part layers. He is currently chairing ITU-T Working Party 3 'Common Protocols' of Study Group 11. His main concern is a smooth integration of B-ISDN, Intelligent Network and TMN as well as clear architectures and specifications of communication protocols in order to have increasing complexity under control and to assist network management.

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