Experimental and Operational East-West Computer Connections:

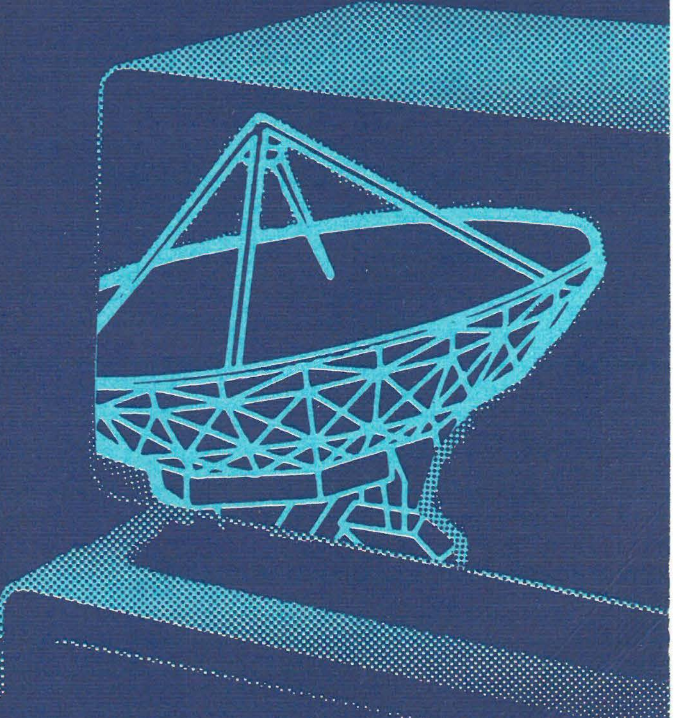
THE TELECOMMUNICATION HARDWARE AND SOFTWARE, DATACOMMUNICATION SERVICES AND RELEVANT ADMINISTRATIVE PROCEDURES

ISTVÁN SEBESTYÉN

FINAL REPORT

Supported by
Control Data Corporation
Austrian Federal Ministry for Science and Research

February 1983



International Institute
for Applied Systems Analysis

EXPERIMENTAL AND OPERATIONAL EAST-WEST COMPUTER CONNECTIONS: THE TELECOMMUNICATION HARDWARE AND SOFTWARE, DATA COMMUNICATION SERVICES, AND RELEVANT ADMINISTRATIVE PROCEDURES

István Sebestyén

International Institute for Applied Systems Analysis
Laxenburg, Austria

TABLE OF CONTENTS

PREFACE

Every study has its own history and this one is no exception. Discussions concerning this study started during the Summer of 1980 between the Control Data Corporation (CDC) and the International Institute for Applied Systems Analysis (IIASA). At that time IIASA had already developed its first computer connections to both West and East and preparations were under way to provide further links to the different emerging data services in more and more countries. All computer links used by IIASA primarily served the scientific research purposes of this international research institute, but in broader terms there was also the desire to promote the international exchange of computerized data in the fields of science and technology. From this point of view a study, which would take stock of the datacommunication infrastructure and relevant administrative procedures around the IIASA networking activities,

seemed to be of utmost interest to the Institute.

The Control Data Corporation has always been one of the strongest supporters of IIASA's computer related activities and -- as strange as it may sound -- they donated to the Institute a Hungarian made TPA-70 minicomputer that controlled a Hungarian made graphical display. It is perhaps of interest that this computer -- now more than ten years old -- after being upgraded and extended by numerous telecommunication adapters and storage memories -- became one of the cores of the present packet-switched based networking nodes at IIASA.

It is well-known that CDC operates one of the world's largest data services to many countries in the world; their CYBERNET network is one of the largest international time sharing networks used primarily for engineering and business purposes. Furthermore, and independent from CYBERNET, CDC operates separate data services in many countries of the world built on CDC mainframes and the datacommunication infrastructure of the country in question. In light of this, it is not surprising that CDC is also interested in the datacommunication infrastructure, relevant administrative procedures and emerging policy issues regarding transborder data flows in all parts of the world. As a logical consequence CDC expressed its interest in the planned IIASA study and was willing to contribute to the funding of the project. Other organizations soon became interested and also joined the planned study.

One of the strongest promoters of computer networking activities in Austria is the Austrian Federal Ministry for Science and Research. For a small open economy such as Austria, international computer communications were from the outset of high interest, and IIASA's relation with the

Austrian Ministry for Science and Research has always been particularly strong and fruitful. For example, in 1977 IIASA completed for the Ministry a study of the "Feasibility of Austrian Participation in International Computer Networks", which looked at the current state of the art of computer networking and made recommendations on how Austria could be involved in international networking. Four years after this study was completed the Ministry expressed their interest in conducting a follow-up study. At that time IIASA was still negotiating with CDC concerning their study and with the extra support of the Ministry the opportunity arose to extend the original scope of the CDC study to new dimensions. As a result of this support all the chapters in this study regarding the existing transborder data flow applications between East and West were made possible.

Needless to say we are extremely grateful for the generous support of the Control Data Corporation and the Austrian Ministry for Science and Research in our work. Special thanks also go to Frau Minister Firnberg who has always strongly supported our activities, to Dr. N. Rozsenich who helped us in elaborating the scope of the study and for his prompt help and advice whenever it was needed, and to Dr. Becker who helped us over the administrative hurdles. I am also particlarly grateful to Mr. Robert D. Schmidt, Vice Chairman of the Control Data Corporation who has proven to be one of the main promoters of the work, to Mr. Hugh P. Donaghue, Vice President and "transborder data flow guru" at Control Data for the many valuable discussions, to Mr. Robert E. Wesslund, Mr. Günter Rockenbauer and Mr. James E. Rein all at the Control Data Corporation in Minneapolis and Vienna who greatly helped to promote the (more or less) smooth implementation of the project and gave useful advice.

Throughout the preparation of the study we discovered many institutions who became interested in our work and then actively contributed to by providing invaluable information, useful hints and suggestions on the scope of the work and on many individual details. The list of institutions and people who supported us is far too long to be given here and I do not want to fall into the unforgivable mistake of giving the reader a long list to read and possibly offending someone who I have missed. Nevertheless, a few names are mentioned in order to present the type of organizations that have helped us.

First of all there were the many different PTTs from the countries involved in the study; many thanks especially to our colleagues at the Austrian PTT, Radio Austria, the Hungarian PTT, the Federation of the Yugoslavian PTTs and the Croation PTT.

I am also most grateful to those organizations who provided invaluable information on the different transborder data flow applications: including the Austrian Press Agency (APA) in Vienna, the World Meteorological Organization (WMO) in Geneva, the SITA regional office in Zurich, the European Centre for Medium Term Weather Forecasting (ECMTWF) in Reading, the Hungarian Meteorological Service in Budapest, the Central Institute for Meteorology and Geodynamics in Vienna, the Central Institute for Scientific and Technical Information (CINTI) in Sofia, the University Computing Center (SRCE) in Zagreb, the Institute for Scientific Research in Telecommunications in Sofia, the Institute for Computation and Automation of the Hungarian Academy of Sciences (SZTAKI), the Elektronska Industrija in Nis, the Austrian Federal Ministry for Transport, and last but not least the Hungarian State Committee for Technical

Development.

One last thought on the scope of the study. When it became possible through the generosity of the Austrian Ministry of Science and Research to include in the study the present state of the art of transborder data flow applications between East and West, the first rather incidental idea of setting up a study outline, which could be regarded as a forerunner to the so-called country case studies of the United Nations Center for Transnational Corporations (UNCTC) in New York, became concrete. This idea became even more real as IIASA and the UNCTC, as one of the distinguished centers where problems of transborder data flows are studied, were already in close contact.

In its 1982-1983 work program the UNCTC defined that country-case studies on the impact of transborder data flows, with special emphasis on the role of transnational corporations in them, should be undertaken. The present IIASA study, which is basically a regional study, can, in our view, be regarded as a forerunner to some future UNCTC country case studies. There are differences in the nature of the studies, the IIASA study being more technically oriented with the main emphasis on taking stock of the present hardware, software, service, regulations and application aspects of transborder data flows, whereas the work done under UNTCT's guidance is more country oriented focusing on the economy and information policies. For these reasons we believe that our work for the Middle and East European regions prepares the ground well for follow-up country studies.

We also hope that our work will prove beneficial to the UNESCO/UNDP South-East European regional project (RER/79/006/C/01/13) on "Crossborder Computerized Data Exchange in Science and Technology", which aims at the development of a dedicated pilot computer network in this area to promote the exchange of data in the field of science and technology.

I am most indebted to those who helped to write this report including K. Arabadjian from ELCODATA in Vienna, A. Berisa from the University Computing Centre in Zagreb, P. Brakalova from the Institute for Scientific Research in Telecommunications in Sofia, A. Butrimenko from the Institute for Systems Studies in Moscow, A. Labadi from IIASA, J. Puzmann from the Federal Ministry of Technology and Investment in Prague, E. Tasheva at NIIS in Sofia, and to T.K. Todorov from the Central Institute for Scientific and Technical Information in Sofia.

Last but not least I would like to thank the dedicated work of my colleagues at IIASA in the preparation of this report. I am most grateful to Dr. Paul Makin for his editorial support and many useful suggestions, to Ms. Nora Avedisians, Ms. Susie Riley, and Ms. Miyoko Yamada for the not at all easy wordprocessing job, and to the PDP 11/70 computer at IIASA that did not put us down too often.

EXPERIMENTAL AND OPERATIONAL EAST-WEST COMPUTER CONNECTIONS: THE TELECOMMUNICATION HARDWARE AND SOFTWARE, DATACOMMUNICATION SERVICES, AND RELEVANT ADMINISTRATIVE PROCEDURES

by

István Sebestyén

INTRODUCTION

The task of studying experimental and operational computer connections between East and West is considerably more complex and interdisciplinary than would be expected. First, telecommunicatons, and in particular the data communication infrastructure of all the countries involved, has to be dealt with; however, this includes not only the technical parameters and traffic capabilities of these networks but also the whole range of services they can provide and the full set of relevant administrative procedures that regulate under what conditions and how those services are actually to be used.

The next field of study is the examination of the teleprocessing hardware and software "infrastructures" of the countries involved. In other words, it is not enough to look at the telecommunication services provided by the post and telegraphy administrations (PTTs) and the rules and regulations on how these services are to be used. In addition, the computer hardware (terminals, modems, multiplexers, host computers, etc.) that can be connected to those services and the telecommunication software needed to make this all run has to be examined. When all this is completed, a precise technical answer can then be given on how one particular computer or terminal in a given country can communicate with a particular computer or terminal in another country. As the necessary administrative and bureaucratic procedures are reviewed, it also becomes clear which administrative "battles" with which bureaucratic body have to be "fought" in order to finally send over the first byte from a terminal in country A to a computer in country B.

When all these hurdles have been jumped in practice, and one succeeds in sending the first byte over the data communication set-up across a border, one is soon faced with a number of tricky questions such as:

What is it good for and should it be done? Is it necessary to access a timesharing computer abroad in order to carry out these types of calculations that could be done within a country? Should a database computer be accessed abroad and if so under what conditions? Which type of foreign databases should be imported in tape form and mounted onto domestic mainframes and which should still be accessed abroad? Should databases or computational services be exported and if so, to what degree does it allow the unwanted transfer of any anxiously protected technology? Should such services be prohibited and if so, to what degree does this go against the widely accepted principle of the free flow of information? What sort of economic impacts does the cost of providing such services have in the sending and receiving countries? Are jobs lost in the country consuming the service and if so, how many? Are new jobs created in the country providing the service? Should information on individuals be stored on computers in other countries, and if so, under what conditions? Do transborder data flow applications increase the vulnerability of any country and if so, in what form and to what degree?

It is at this point that experts actually start to talk about transborder data follow applications and all the issues and problems that are known to accompany this somewhat clouded term. These types of basic questions are numerous and are regarded as the cornerstones of the transborder data flow debate.

In order to enable us to try and answer some of the more important questions above, the next step in the study is to analyze in a more descriptive and "stock-taking" way all major transborder data flow applications between East and West that primarily use datalines as a transmission medium. The main aim of this study therefore is to provide a first stock of information with only a limited amount of analysis. Implicitly, our task is to fill those gaps in the information, which, as mentioned in the Preface, will be required for any later indepth analysis of the situation for detailed country case studies.

We started the study by dividing the work into three main steps: 1, gathering the available information; 2, structuring and presenting the information; and 3, analyzing the information. Great effort was made to do all three as well as possible. We started by designing questionnaires in such a way that the structure of the questions enabled us to better organize the information received. Even so, problems arose. First of all, there has been very little written on this subject in the literature and certainly not in the integrated way that we desired. All the data we collected were openly available and to a certain extent had even been published, if only in a very fragmented way and in different forms. One of the first major problems we faced was that not all the information we needed was available in every country. There were many reasons for this: either the data were not publicly available, they simply did not exist, or we were not lucky enough to find them. In other cases, however, we sometimes found information that we thought would, if included, broaden the horizons of the study even though they were not directly related.

The information we acquired, therefore, varied in quantity and quality; for example, we would obtain information from one country on telecommunication networks, terminals, and computer statistics but nothing on public databases. The opposite would be true of another country and for this reason a common in-depth structuring of the data proved to be very difficult. It was decided therefore to present all materials in a common basic structure in independent country chapters, each chapter a unit within itself. We believe that through this approach the peculiarities of each country would be more easily understood. One disadvantage with this method, of course, is that the aggregation of data, which would be so necessary for a regional study, was not done adequately in all fields. However, we did, and we hope well, disaggregate the data in the field of datacommunication hardware and software systems for the countries involved but not for the telecommunication infrastructure.

The countries included in the study were also not chosen arbitrarily. Primarily those countries to which IIASA had computer connections, or would soon have in the future, were chosen. The GDR and Poland, for example, were not covered by this simple concept and thus left out, except for telecommunication hardware and software and the special networks. Nonetheless, we hope that we have managed to produce a general picture of the state of the art and the possibilities of transborder data flows to and from Central and East European countries, although this could probably be refined by further studies.

We now turn to the actual structure of the study, which was divided into two major parts. The *first part* deals with the actual datacommunication infrastructure of the countries involved and describes all those components, i.e, technical, economical, political, and legal, which are involved in moving data from one country to another. *Chapter 1* gives a short introduction to the basic telecommunication hardware and software "jargon" needed to read the study and may be passed over by those already conversant with such language. *Chapters 2- 7* describe the datacommunication infrastructures of the individual countries, including the relevant administrative procedures that govern their use. We tried, as far as was possible, to present a broad background picture to give the reader a view of the whole scene in which the actual datacommunication is embedded. As a basis for pointing out the possible future directions of each country, and the speed with which they may be achieved, an attempt was also made to provide a history of each country's past and present advances in this field. I strongly believe that the history of industry is a most important, if somewhat neglected, subject. Especially now, when we are trying to predict the potential role and impacts of new information and telecommunication technologies, it is worthwhile looking back at the history of each of the "elements" involved (e.g., telecommunication and computer technology) and their applications in such areas as meteorology, banking, documentation, industry etc. For example, it is most characteristic that, except when the world was at war, the structural changes in telecommunication services and their market penetration was very slow, sometimes taking years and even decades to produce changes. Following the history of the industry and a description of the state of the art in the telecommunication and datacommunication fields, administrative procedures, such as how to connect to the system, how to subscribe to a given service, the tariffs, contact points, and who is responsible, are detailed.

The last part of each country chapter concerns the most typical transborder data flow applications relevant to each country. In fact, these data would actually fit better in Part 2 of the study under the heading "Transborder data flow applications", but since they are very much country specific we decided to include them in the country chapters. Therefore, only the common applications, such as meteorological data networks, airline reservation and data networks, etc., are handled separately in Part 2. Once again, however, the scope of Part 1 differs from country to country. In the case of Bulgaria, for example, we have included a rather detailed description of the Bulgarian data base industry and services, which in a way is also related with the separate chapter on Hungarian public database services in Part 2.

The *last chapter* of Part 1 deals with the telecommunication hardware and software systems produced in the CMEA countries and Yugoslavia. We discuss here the Ryad (ES) and SM computer system families -- the unified computer systems of the CMEA countries -- and some of the dedicated networks built on them. This aspect is dealt with in a separate chapter because we wanted to handle the subject independently from the countries in which they were produced.

In *Part 2* all the applications describe regional transborder data flow uses with the exception of the chapter on Hungarian Public Database services, which was included to give an example of how this important aspect works. Incidentally, the availability of very good detailed data and statistics on this topic made a lengthly analysis possible.

The other chapters in Part 2 deal with the different dedicated computer networks and thus transborder data flow applications in this region. The IIASA TPA/70-X.25 gateway network is used solely for the exchange of scientific and technical information; the meteorological networks of the WMO and the ECMWF are used for the transmission of meteorological observation and processed data, the SITA network to carry data needed by airlines and the data networks of major news agencies to exchange the latest news among themselves. There are two important categories of dedicated networks which were not included in our study: the interbanking network SWIFT and the computer networks of transnational corporations such as UNILEVER and CYBERNET, because they are not yet connected to any Eastern European country. The only transnational corporation network included in the study, however, is the news agency network of Reuters, but this is handled within the chapter describing new agency networks in general.

In the final summarizing chapter I have tried to provide a picture of the general aspects of the present tele- and datacommunication infrastructure of the countries involved in the study and their most important transborder data flow applications.

PART 1:

DATA COMMUNICATION INFRASTRUCTURE AND SERVICES, HARDWARE AND SOFTWARE COMPONENTS, ADMINISTRATIVE PROCEDURES

Chapter 1:

CLASSIFICATION OF TELECOMMUNICATION HARDWARE AND SOFTWARE SYSEMS

I. Sebestyen

CLASSIFICATION OF TELECOMMUNICATION HARDWARE AND SOFTWARE SYSTEMS

0. INTRODUCTION

This chapter is aimed at readers less familiar with data communication and computer networking terms or who are in doubt about how these terms are applied in this study. In the first part of the chapter an introduction is given to the basic elements of data communication, followed by a description of the basic computer network functions and finally the roles of the PTTs and the manufacturers in this process.

1. BASIC DATA COMMUNICATION FUNCTIONS

Computers and their peripherals were linked together over telecommunication circuits practically from the first days of computers in the early 1940s. The functional components of a data-communication system are shown in Figure 1 and Table 1. Data input and output devices, which in almost all cases are provided by the users and not the telecommunication authorities, are connected to some kind of communication control units which perform several important functions of the data communication subsystem (Table 2).

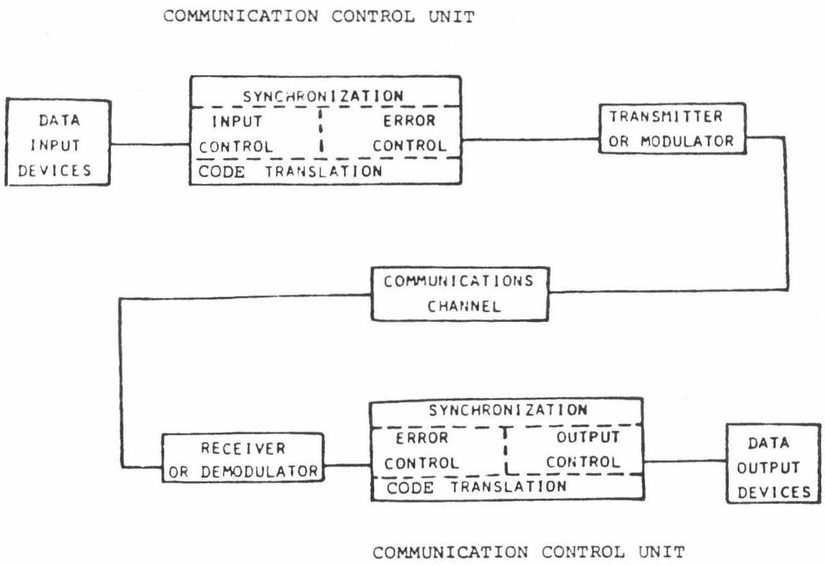


Figure 1. The data communications subsystem, often called the data link, consists of the indicated functional components which are required in every data communications system [1]

These functions may be performed entirely by hardware devices (such as concentrators, multiplexors) in a hard wired manner, or they may be performed entirely by software devices (such as programs in mini and microcomputer systems). They can also be performed by a combination of hardware and software devices (such as communication processors, front-end processors). In the majority of cases these functions are

Table 1. System components of a data communications subsystem [1].

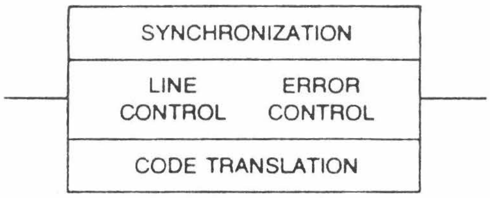
Data input or output devices	Communication control units
Keyboard	Memory or buffer storage
P/T reader (paper tape)	Magnetic core
C/R (card reader)	Magnetic drum
M/T unit (magnetic tape)	Shift registers
Facsimile	Delay lines
Badge reader	
Microfilm reader	
CRT/VDT (cathode-ray tube/visual display tube)	
MICR (magnetic ink character recognition)	
CCR (optical character reader)	
Transducers	
Sensors	
A/D equipment (analog to digital)	
Computer processors	

Transmitters or receivers	Communication links	Data output devices
Modulators/demodulators	Telegraph lines	P/T punch
Modems	Telephone plant	Card punch
Datasets	Radio	Line printer
Acoustic couplers	Microwave	Teleprinter
Dataphone	Coaxial cable	Teletypewriter
Line adaptors	Wire pairs	M/T unit
		CRT/VDT
		Plotter
		Recorder
		Dials and gauges
		Computer processors
		COM (Computer output microfilm)

performed by systems which are installed and operated by the users.

The two communication control units to be linked are interconnected by telecommunication channels. The technically appropriate link between the telecommunication channel and the communication control units is provided through so-called modems. In analogue, voice

Table 2. The functions of the communications-control unit and some example [1].



Synchronization (timing considerations)
- Bit
- Character
- Message

Line control (line protocol, line discipline, "handshaking")
- BISYNC (binary synchronous communications)
- ASCII (American Standard Code for Information Interchange)
- SDLC (synchronous data link control)
- DDCMP (digital data communications message protocol)
- HLDC (high-level datalink control)

Error control (detection/correction)
- Parity—LRC, VRC (longitudinal, vertical redundancy check)
- Polynomial—CRC (cyclic redundancy check)
- ARQ vs. FEC sys. ns (ARQ = automatic request for retransmission
FEC = forward error correcting)

Code translation (communications codes)
- ASCII
- EBCDIC (extend binary coded decimal interchange code)
- Baudot

telecommunication networks, the main task of the modem, is to transform the databits to be transmitted into a suitable signal format which can then easily be transmitted over a telephone network. This was not designed for digital data transmission but for the transmission of analogue signals in voice frequencies (Figure 2). For digital data network, other types of modulation methods are required (Table 3).

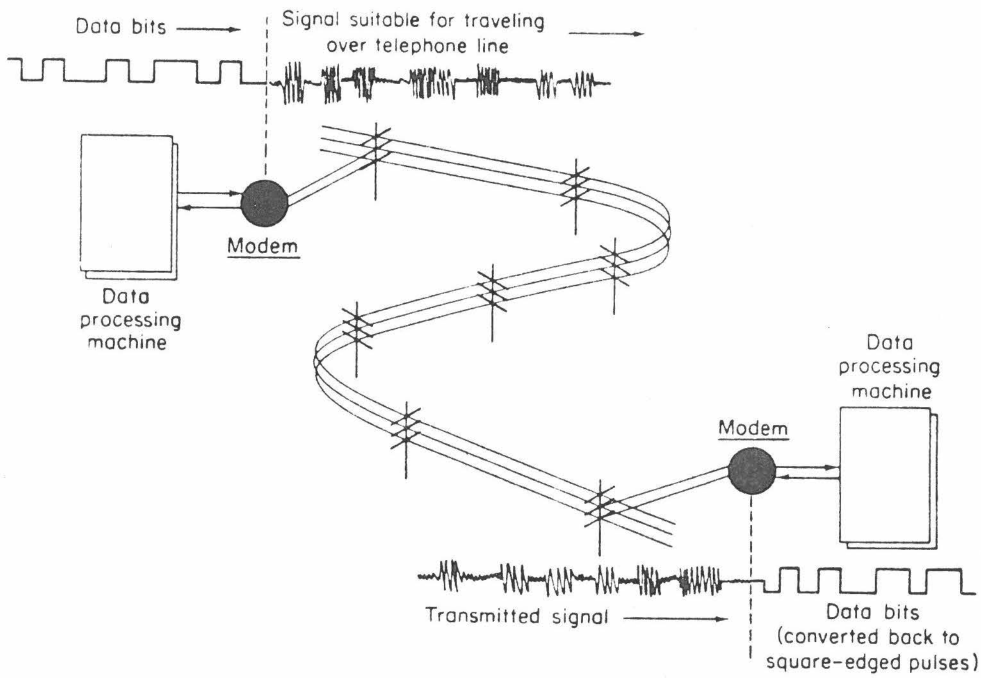
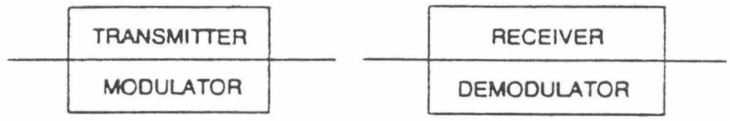


Figure 2. Use of modems [2].

Depending on the type of PTT service, modems are provided by the PTTs or by the users. Modems provided by the PTTs are usually in digital data services--such as for the Austrian Datex or the Hungarian Nedix--whereas modems for data communication over analogue voice and telegraphic lines are usually provided by the users. However, to make sure that user modems are compatible with the telecommunication hardware

Table 3. Modem functions and terminology [1].



Terminology	Modulation method
Transmitter/receiver	Analog
Modulator/demodulator	Amplitude modulation (AM)
Modem	Frequency modulation (FM)
Dataset	Phase modulation (ϕM)
Dataphone	Digital
Acoustic coupler	Pulse (PAM, PDM, PFM, PPM)
Line adapter—erroneous usage	Pulse code modulation (PCM)

(lines, amplifiers, multipliers, switches, etc.) of the telephone network, they have to be approved by the national PTTs. The national PTTs usually provide a list of approved modems in order to simplify the administrative procedure of the connection. Generally, it can be said that if the modems fulfill the appropriate recommendations of the CCITT of the International Telecommunication Union (ITU), they are in practice approved.

The modems and the telecommunication link together provide for actual data transmission. Some main characteristics of the telecommunication channel are given in Table 4, and Table 5 lists the major categories of communication lines. Advantages and disadvantages of the various transmission modes are then summarized in Table 6. The actual telecommunication channels are always provided by the different PTTs or common carriers. They lease circuits to private users or provide data transmission services over public switched or dedicated telephone or data networks. Parameters of public PTT networks are also defined by appropriate CCITT recommendations.

Table 4. Communication channel characterizations [1].

COMMUNICATIONS CHANNEL

Channel modes	Facilities organization type
Simplex	Point-to-point
Half-duplex (HDX)	Multidrop
Full-duplex (FDX)	Switched
Transmission speeds	Network
Bits per second (bps)	Channel type
Characters per second (char/s)	Baseband
Words per minute (wpm) (note: one word contains six characters)	Narrowband
Baud (note: Baud is the plural)	Voiceband
Transmission method	Wideband
Serial-by-bit } Asynchronous or	Multiplexed (FDM/TDM)
Parallel-by-bit } synchronous	Carrier service
Facilities types	Transmission link
Wholly owned private system	
Private leased (PL)	
Public system (DDD)	

A summary of the data communication subsystem with its components as discussed in this chapter is given in Figure 3.

There are several distinct ways in which a communications facility (or data-communications system) may be arranged according to topologi-

Table 5. Categories of communication line based on [2].

Types of Links		Comments
	Digital link	Designed for digital transmission. No modem required. Are code-sensitive in some cases.
	Analog link	Transmits a continuous range of frequencies like a voice line. Modem required.
	Switched public	Cheaper if usage is low. Switched telephone and data lines are universally available.
	Leased (sometimes called "private")	Cheaper than the public lines if usage is high. May have lower error rate. Higher speeds possible on leased telephone lines than switched ones.
	Leased with private switching	May give the lowest cost. Combines the advantages of leased lines with the flexibility of switching. Public switched wideband lines may not be available.
	Private (noncommon-carrier)	Usually only permitted within a subscriber's premises. See next item.
Private (noncommon-carrier) links:		
	In-plant	Very high bit-rates achievable.
	Microwave radio	Permissible in special cases for point-to-point links.
	Sho wave or VHF radio	Used for transmission to and moving vehicles or people.
	Optical or infrared	Used for short links - e.g., intercity - at high bit rates (250,000 bps, typical). No license required. Put out of action by fog or very intense rain.
Speeds		
	Baseband	Originating frequencies, for links up to 600 m signals over wire pair do not require modulation.
	Subvoice grade	Usually refers to speeds below 600 bits per second.
	Voice grade (Narrowband)	Usually refers to analog voice lines using modems of speeds from 600 to 10,500 bits per second.
	Wideband	Speeds above those of voice voice lines, most commonly 19,200, 40,800, 50,000, and 240,000.
Multiplexing		
	FDM	In frequency-division multiplexing (FDM), a channel carries the signals of several lower speed subchannels. Each of the subchannels is allocated to a specific frequency range.
	TDM	Time-division multiplexing (TDM) is a technique where each subchannel is allocated a portion of the transmission time.

Table 6. Modes of transmission [2]

DISADVANTAGES OF THE VARIOUS TRANSMISSION MODES

MODE OF TRANSMISSION			ADVANTAGES AND DISADVANTAGES
	Four-wire		Permits full-duplex transmission.
	Two-wire		Full-duplex transmission still possible with separate frequency bands for the two directions.
	Simplex		Rarely used for data transmission, as there is no return path for control, or error signals.
	Half duplex		Commonly used for data transmission, though a full-duplex line may cost little more.
	Full duplex	Data in both directions at once	System sometimes cannot take advantage of this, as data cannot be made available for transmitting in both directions simultaneously. Can substantially reduce the response time, however, on a conversational multidrop line. Often requires a more expensive terminal. Commonly used on a link between concentrator and computer.
		Data in one direction; control information in the other	A common arrangement, though, as data are still only being sent in one direction at a time, half-duplex transmission may give better value for money at low character rates. With high character rates the line turnaround time may be long compared to the character time and full-duplex operation may eliminate most turnaround delay.
Serial-by-character Parallel-by-bit		Separate wires	Low transmitter cost, but high line cost. Economical for in-plant use. Line costs too expensive for long distances.
		Separate frequencies	Used on voice lines to give a slow but inexpensive terminal. For efficient line utilization, however, data set costs are high, and receiver cost can be high.
Serial-by-character Serial-by-bit			The most common system, especially on long lines.
		Start-stop transmission	Inexpensive terminal, e.g., telegraph machines. Only one character lost if synchronization fails. Not too resilient to distortion at high speeds.
		Synchronous transmission	More expensive terminal. Block lost if synchronization fails. Efficient line utilization. High ratio of data to control bits. More resilient to noise and jitter than start-stop transmission, especially at high transmission speeds. The most common system on lines of 600 bits per second and faster.
		High-speed pulse train	In-plant or private wiring only at present. Low wiring cost with low terminal cost. High accuracy.

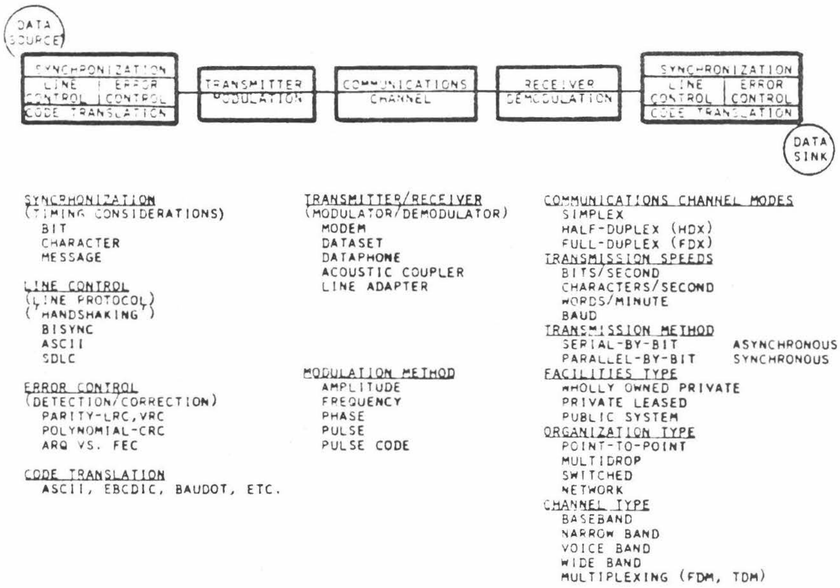


Figure 3. The data communications subsystem with its components as discussed in this chapter [1]

cal and utilization considerations. Topologically an organization may be either point-to-point, multipoint, or a network. In terms of utilization a system may be either switched, nonswitched, or a message-switched network. Each of these is discussed in the following paragraphs.

The simplest arrangement is *point-to-point*, which defines the existence of a channel between two stations. Point-to-point service, is indicative only of the kind of connection between two stations, and not what kinds of links make up that connection.

Another type of arrangement is known as *multipoint* or *multidrop* and is comparable to a telephone party line service. In a multidrop system, any station can communicate with all other stations. Therefore, each station must have the capability of recognizing its own address so that it can respond to messages addressed to it and ignore all other messages.

The third type of arrangement is the *network* where many point-to-point connections exist among three or more stations. In a network arrangement, each station usually has the capability of relaying messages on to other stations, in addition to transmitting and receiving its own message traffic. These kinds of networks are called *message- switching networks* (or systems).

Networks may topologically be categorized as centralized (or star) networks, decentralized (or distributed) networks, and loop networks. Typically, where an installation consists of one large computer system with connections to a number of data terminals, we see the *centralized network* as the organization type. Systems containing several large computers with a large number of terminals may be arranged as *decentralized networks*. The term *distributed computing* describes an organization consisting of a (mini-) computer-driven message-switching network connected to several large computers (called host computers). Many data terminals provide the capacity for concurrent execution of jobs on more than one host computer. A type of arrangement known as a *packet-switched network* is an implementation of a computer message-switched system, which will be explained in some length later.

The communications system may be either *switched* or *nonswitched* in its utilization. Switched means that station calling capability exists (usually by dialing). A switched system implies that the communications channel exists only for the duration of the call, or message transfer, and does not exist at other times. This differs from systems described as point-to-point or multidrop nonswitched where the communications channel exists even though there is no message transfer taking place.

2. BASIC NETWORK FUNCTIONS

(The following part of this chapter has mainly been adopted from J. Martin's work on computer networks and distributed processing [3]).

In this study we are basically concerned with networks for communication between intelligent machines--some more intelligent than others. We use the word *session* for machines in communication. There are three main phases to communication: establishing the session, conducting the session, and terminating the session.

As with a telephone call, establishing the session involves two separate operations. The first is the process of establishing the telecommunications path so that information can be interchanged. The second is the process of identifying the parties and having them agree to communicate, using specified procedures and facilities.

There are thus five processes:

1. Connecting the transmission path.(physical process)
2. Establishing the session.

3. Conducting the session.(logical process)

4. Terminating the session.

5. Disconnecting the transmission path.(physical process)

Connecting and using the transmission path is an operation entirely separate from that of setting up the session once the path is connected. On the telephone system the former involves the transmission and switching equipment. In computer networks the transmission links and their operation can be regarded separately from the session services and applications which employ them. We will refer to a *transport subsystem* in computer networks which passes messages between the communicating machines. External to this are the *session services*.

We will refer to the collection of services of functions which exist *external to the transport subsystem* as the *termination subsystem* (see Figure 4).

The termination subsystem consists of software (and possibly some hardware or microcode) in any of the following five places:

1. A host computer

2. A front-end communications controller.

3. A terminal concentrator.

4. A terminal controller.

5. An intelligent terminal.

Session services fall into two types: those used when setting up the session and those used when the session is in progress. Networks for distributed processing and computer resource sharing can employ many

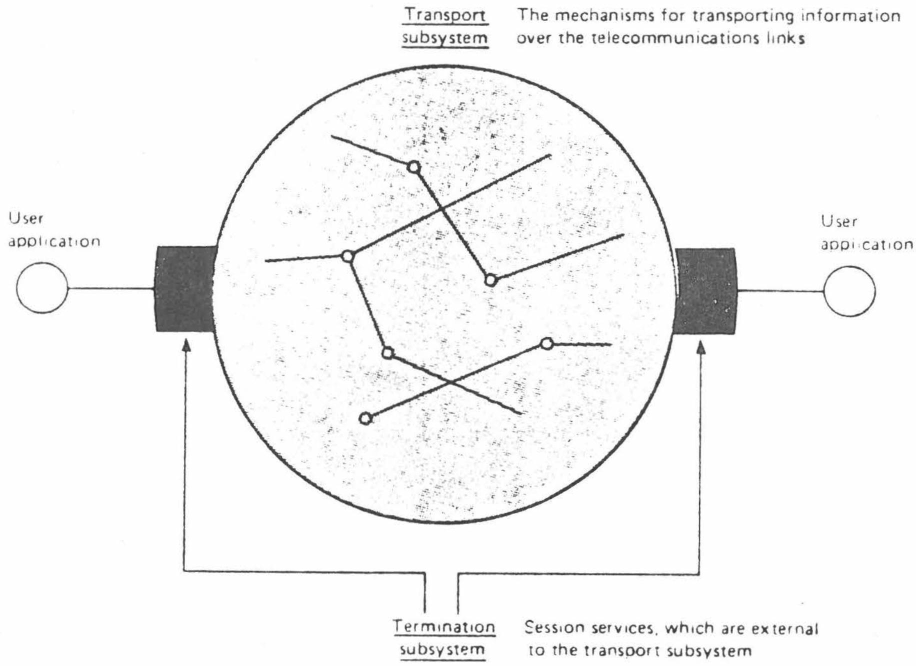


Figure 4.

types of services external to the transport subsystem. They include the editing of data, code conversion, data base services, cryptography, or other techniques for achieving security.

Session services are used prior to the interchange of data to ensure that the communicating parties

- are authorized to communicate,
- have the facilities they need to communicate, and
- agree upon the manner in which they shall communicate.

2.1. Layers of Control

For distributed processing, in which distant machines are interconnected, certain layers of software (or hardware or microcode) are needed around the telecommunications links to make these more useful, to hide the complexity from the network users, and to separate the functions into more manageable slices.

Figure 5 illustrates four types of layers which are fundamental to advanced teleprocessing systems.

The innermost layer is the *physical (electrical) connection* between the data machine and the telecommunications circuit.

The next layer is the *link control* which relates to how data are transmitted over a physical line. Throughout the history of teleprocessing there have been many different forms of link control. Some were character-oriented--telex line control, start-stop line control with an ASCII character set. Some were oriented to blocks of characters--binary synchronous line control, line control for specific terminals, line control for specific applications such as airline reservations. More recently the bit-oriented line control procedures have emerged--HDLC, SDLC, etc.

The third layer, *transmission control*, in conjunction with inner layers, provides the transmission network--the transmission subsystem. The transmission network can be regarded as an entity which the higher

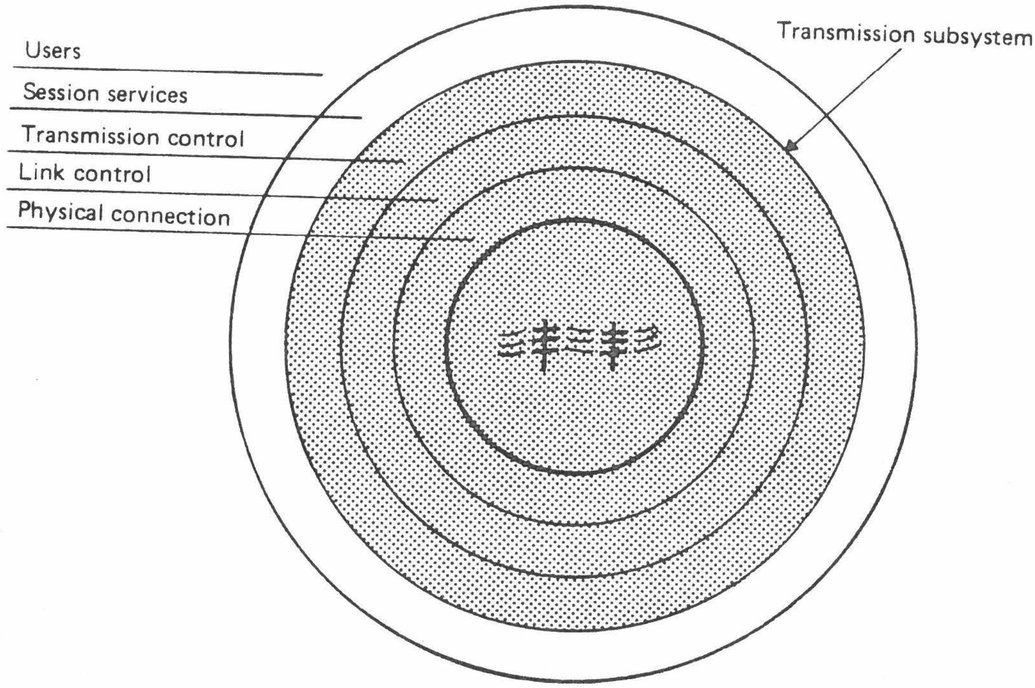


Figure 5. The layers of control for communications are intended to make the physical communications links more capable and more useful.

levels employ for moving data from one user machine to another through multiple intermediate nodes such as concentrators, packet switches, line controllers, etc.

The layer external to the transmission subsystem in Figure 5 provides a variety of services which are used to establish and operate sessions between the using machines.

These four layers are fundamental to data networking and distributed systems. They are found in all of the computer manufacturers' architectures for distributed processing. Their detail differs somewhat from one manufacturer to another especially in the outermost layer.

Given the immense proliferation of machines that is now occurring, one of the activities most important at present and to the future of data processing is the setting of standards to enable machines of different manufacturers and different countries to communicate. As a start in the setting of such standards ISO, the International Standards Organization, has defined seven layers, further subdividing the four layers of Figure 5. These are shown in Figure 6.

Their functions are as follows:

Layer 1: Physical Control

The innermost layer relates to setting up a physical circuit so that bits can be moved over it. It is concerned with *the physical, electrical, functional, and procedural characteristics to establish, maintain, and disconnect the physical link*. If the user machine employs an analog circuit like a conventional telephone line, it will be connected to a modem. Its inteface with the modem is a generally accepted standard, e.g., EIA RS 232-C and CCITT Recommendation V.24. If a digital circuit is used, a newer Recommendation for the physical interface, CCITT Recommendation X.21 can be used, or support for a V.24 interface can be achieved

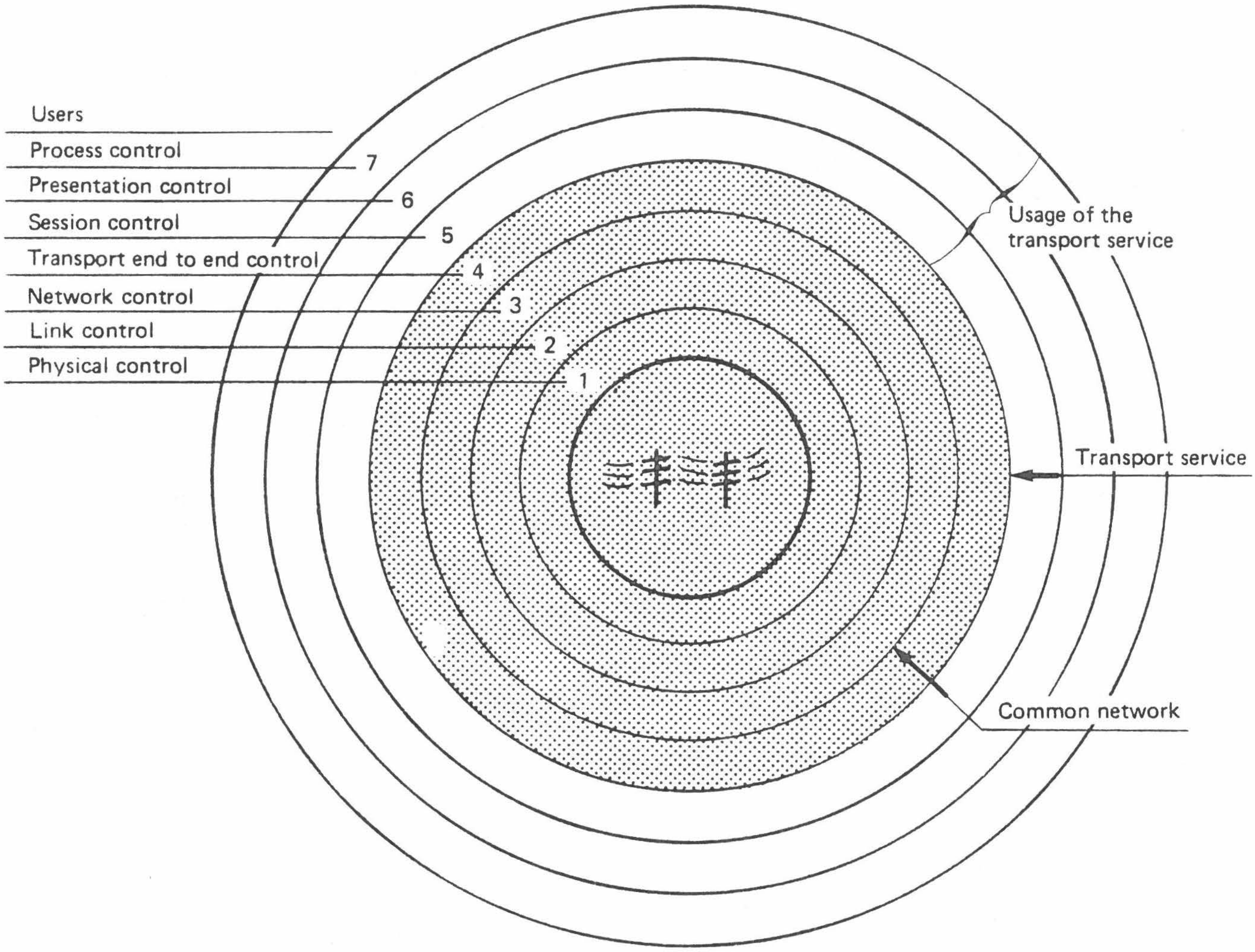


Figure 6. The International Standards Organization's seven layers of control for distributed processing.

through the use of X.21 *bis*.

Layer 2: Link Control

This layer relates to the sending of blocks of data over a physical link. It is concerned with issues such as:

- How does a machine know where a transmitted block starts and end?
- How can transmission errors be detected?
- How can recovery from transmission errors be accomplished so as to give the appearance or an error-free link?
- When several machines share one physical circuit how can they be controlled so that their transmissions do not overlap and become jumbled?
- How is a message addressed to one of several machines?

The transmission of physical blocks of data requires a ***physical link control*** procedure which specifies the headers and trailers of blocks which are sent, and defines a protocol for the interchange of these blocks. Such procedures have been used since the earliest days of data communications. For distributed processing a more efficient line control procedure than start-stop or binary synchronous is desirable, which permits continuous transmission in both directions, of data which can contain any bit pattern. The ISO has specified such a line control procedure, HDLC (Higher-level Data Link Control). The CCITT, and various computer manufacturers, each have their own variants of this which differ slightly in subtle details.

Layer 3: Network Control

Prior to 1975, Layers 1 and 2 were all that were specified. These were adequate for communication between machines connected to the same physical line. The world of distributed processing and computer networks requires more layers, and these are substantially more complex.

Layer 3 relates to *virtual circuits*, sometimes called *logical circuits* or *logical links*. These are make-believe circuits. They do not exist in physical reality but Layer 3 pretends to the higher levels that they do exist.

The path between computers may at one instant be via a number of physical lines as shown in Figure 7. Each physical line spans two network machines which must .se the Layer 1 and Layer 2 procedures to exchange data. The users do not wish to know what route the data travels or how many physical lines it travels over. The user machines want a simple interface to a virtual circuit. The Layer 3 of control creates the virtual circuit and provides the higher levels with an interface to it.

On some systems, the route on which data travels between two user machines varies from one instant to another. The network machines may reqire that users' messages be divided into slices, called packets, no greater than a certain length. The packets become out of sequence during transmission. The packets must be reassembled into messages after transmission. On some networks the packets become out of sequence during transmission. The rules for Layer 3 state that the network must deliver the packets to the user machine in the same sequence as that in

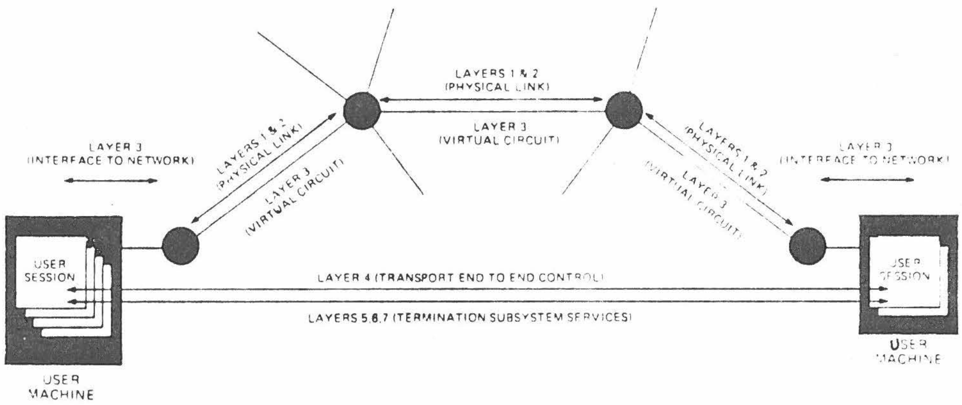


Figure 7.

which they were sent by a user machine.

There are many such complications in the operation of a virtual circuit. Layer 3 provides a standard interface to the virtual circuit, and as far as possible hides the complex mechanisms of its operation from the higher layers of software.

Layer 4: Transport End-to-End Control

The inner three layers of Figure 6 represent a common network which many machines may share, independently of one another. It is possible that a service might occasionally lose a "message". To ensure that this has not happened, two users might apply their own end-to-end controls, such as numbering their "messages". Layer 4 is concerned with similar end-to-end controls of the transmission between two users having a session.

Figure 7 illustrates that whereas Layer 3 is concerned with the interface between the user machine and the network, Layer 4 (and the higher layers) is concerned with the end-to-end integrity controls to prevent loss or double processing of transactions, flow of transactions, and addressing of end user machines or processes.

The lower four layers--as mentioned above--provide a *transport* service. They are concerned with the transport of blocks of bits from one user to another, but not with the manipulation of those bits in any way. Some of the higher layei manipulate the bits.

The transport service takes many different forms. Sometimes it is a packet-switching network using the international standards from Layer 3 and below (CCITT Recommendation X.25, discussed later). Sometmes it is quite different--wideband point-to-point circuits, satellite circuits, and so on. The interface from higher layers or from user machines to Layer 4 is intended to provide a *standard interface to users of the transport service independent of what network type is used.*

Layer 5: Session Control

The task of setting up a session between user processes can be complex because there are so many different ways in which machines can cooperate.

Layer 5 standardizes this process of setting a session and of terminating it. If something goes wrong in mid-session Layer 5 must restore the session without loss of data, or if this is not possible terminate the session in an orderly fashion. Checking and recovery are thus functions of Layer 5.

In some types of sessions a dialogue takes place between machines and a protocol must regulate who speaks when and for how long. In some cases the two machines speak alternately. In others one machine may send many messages before the other replies. In some sessions one machine may interrupt the other; in other cases not. The rules for how the dialogue is conducted need to be agreed upon when the session is set up.

Layer 6: Presentation Control

Layer 6 contains functions relating to the character set and data code which is used, and to the way data is displayed on a screen or printer. A stream of characters reaching a terminal will result in certain actions to give an attractive display or print out.

There are many possible functions concerned with the presentation of data. These are carried out by Layer 6. Many of them relate to the character stream, its codes, and the ways they are used. In some cases application programmers perceive a *virtual terminal* or *virtual display space*. Input/output statements relate to this make-believe facility, and the Layer 6 software must do the conversion between virtual facility and the real terminal.

It is desirable that devices with different character sets should be able to communicate. Conversion of character streams may therefore be a concern of Layer 6. The character stream may be compacted into a smaller bit stream to save transmission costs. This may be a Layer 6 function.

Encryption and decryption for security reasons may also be a Layer 6 function.

Layer 7: Process Control

Layer 7 is concerned with higher level functions which provide support to the application or system activities, for example, operator support, the use of remote data, file transfer control, distributed data base activities, higher level dialogue functions, and so on. The extent to which these are supported in the network architecture and in the software external to the network architecture, such as data base software, will differ from one manufacturer to another.

When distributed files and data bases are used various controls are needed to prevent integrity problems or deadlocks. Some types of controls for this are strongly related to networking, for example, the timestamping of transactions and delivery of transaction in timestamp sequence (sometimes called pipelining).

Pacing is necessary with some processes so that the transmitting machine can send records continuously without flooding the receiving machine, or so that an application can keep a distant printer going at maximum speed.

2.2 Computer Manufacturers' and PTTs' Network Architecture

The architectures for distributed processing from the various computer and minicomputer manufacturers and the various PTT data services, contain all or part of the seven layers we have described. Layers 1, 2, and 3 are usually clearly distinguished, but the functions of Layers 4, 5, 6, and 7 may be intermixed and not broken into those layers recommended by the ISO. Increasingly, as distributed processing technology evolves, the clean separation of the layers is becoming a necessity.

At present there are two trends. According to one trend there is a strong tendency to set up international standards starting from the simplest and most basic Layer 1 to higher layers. International standards exist along these lines at present and are widely accepted for Layers 1, 2, and 3. They are employed not only by the computer industry but by the telecommunications industry in creating public data networks.

Partly because of the telecommunications industry use of Layers 1, 2, and 3, the computer industry is building hardware and software which employs these layers. Some computer vendors, however, have created their own incompatible versions of Layer 3. Old incompatible versions of Layer 2 are still in use and likely to remain so because old protocols take a long time to die.

At the higher layers different manufacturers are going their own way, and creating their own in-house standards. These are perceived by individual manufacturers as being extremely important because they make the many different machines in the product line interconnectable. But although machines of one manufacturer are interconnectable, those of different manufacturers cannot be interconnected at the higher layers. They can be interconnected only at Layers 1 and 2, and sometimes Layer 3.

Developments to further specify higher level protocols are proceeding well. The Institute for Computer Sciences and Technology of the U.S. National Bureau of Standards, for example, has recently specified Layer 4 (Transport) [4] and Layer 5 (Session) [5], which, after passing through the complicated and time consuming standardization procedure of the ISO and CCITT, might one day be widely accepted.

In a distributed processing network the layers may be spread across a variety of different machines. Figure 8 shows several types of machines. A central processing unit may be designed to contain all seven layers like the computer on the left in Figure 8, or, probably better, some of the layers may be removed to a separate *front- end* processor. A front-end processor may handle the lower three layers or it may handle Layer 4 functions also.

Terminals containing microprocessors may have enough power to handle all the layers like the intelligent terminal in Figure 8. This is less complex than the networking software at a computer site because the terminal supports only one session at a time, uses only one logical channel, and contains few management functions. In many cases the terminals are simpler machines connected to a terminal cluster controller, and it is this controller which contains the networking software, as shown at the bottom of Figure 8. The terminals may be in the immediate vicinity of the controller, or they may be far away, connected by telecommunications, in which case the controller may be regarded as a concentrator.

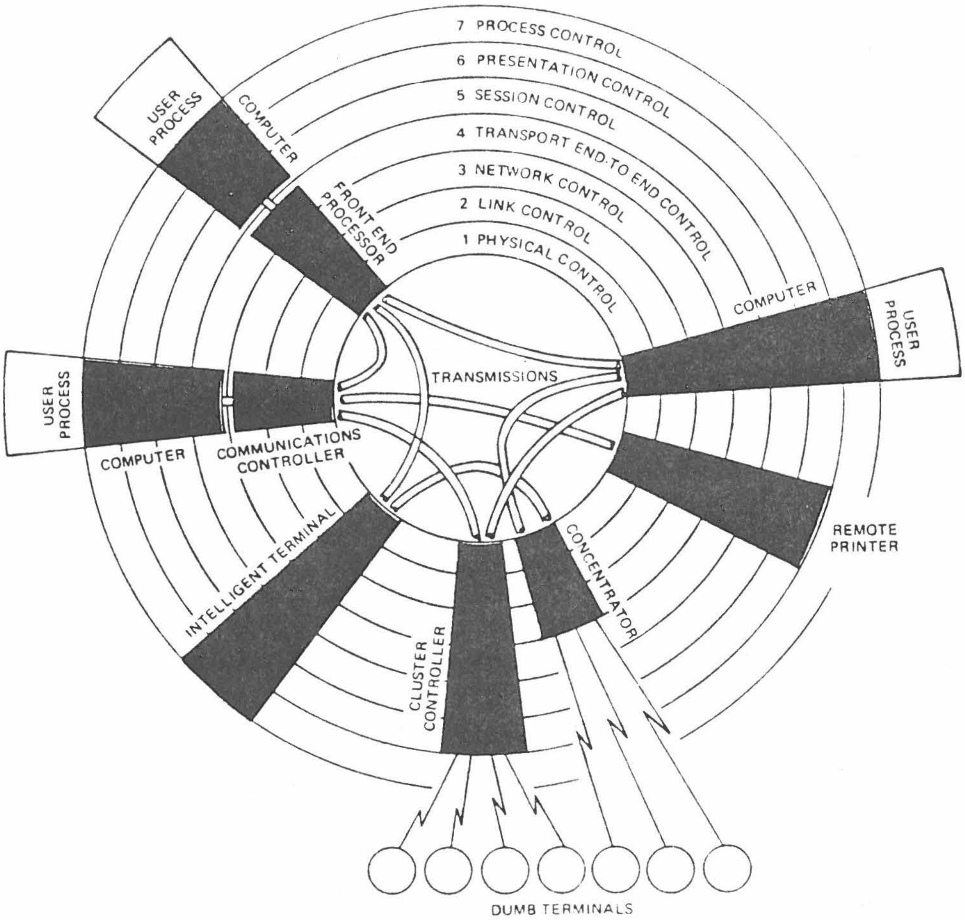


Figure 8. The layers of control are allocated between machines in different ways

A concentrator may contain only the lower three layers.

Figure 8 does not show mid-network nodes such as packet-switching machines or concentrators. These may be part of the transport subsystem, with no Layer 5, 6, 7 or even Layer 4 functions.

The logical and physical Layers 1, 2, and 3 are found in almost all architectures. They are fundamental: the existence of an electrical interface to the transmission circuit (Layer 1), the existence of a link control procedure (Layer 2), and the separate existence of a common network to which many different machines can be connected (Layer 3).

The common network may be a public network or may be private. Layers 1, 2, and 3 are vital to public networks. Private networks may use the same standards and then they can be interconnected to public networks also.

End-to-end control of the movement of data in a particular session is often (but not always) important. This is done by Layer 4. Where one module of Layer 3 is needed in a machine which is connected to a network, one module of Lay-r 4 is needed *for each session* in that machine.

Session services are also needed for each session. The concept of a session services subsystem is fundamental. However in software architectures it is not always broken into Layers 5, 6, and 7. The architecture may have one layer for providing session services.

The second trend which can presently be observed is the definition and standardization of the services and functions of the higher layers (at the application and presentation levels). All other underlying layers have to ensure that those functions defined at higher layers can actually be fulfilled. Often a certain higher level function can be satisfied by quite different lower layer functions based on pragmatic solutions.

Examples of this trend are the present standardization efforts of the new types of public services such as teletex--the super fast computer supported telex, and videotex--a combination of telephone, television set, and computer technology.

The standardization effort for teletex on the Application Layer 7 and the Presentation Layer 6 has led to the sensible compromise that such services, according to the CCITT Recommendation F.200, can be provided over structurally different types of telecommunication networks (e.g., circuit-switching data networks, packet-switching data networks, or simple telephone networks), by a unified speed of international interconnections of 2400 bit/sec (Figure 9).

This philosophy has enabled all PTTs interested in introducing teletex services to begin building up their national systems with no restrictions on the type or status of their own telecommunication network.

The standardization of videotex services is also being concentrated on the highest layers. On lower layers different types of services can again be taken into account. Briefly, according to [7], each layer is described in terms of teletext and videotex services:

> *Application Layer (Layer 7).* Protocols of this layer directly serve the end user by providing the distributed information service appropriate to each particular videotex application, i.e., the application layer defines the information service itself, e.g., Prestel, Bildschirmtext, Videotext.
>
> *Application* standards define the way in which a user will be served by the teletext or videotex system. They concern the functions or services available to the user. They incude the control functions (to clear an unwanted entry), the service functions (to select an application provided by a videotex service), the retrieval functions (e.g., to obtain direct access to a page, to progress from frame to frame, to retrace the progression of the user's action), and the display options (24 rows or 20 rows, 40 or fewer columns).
>
> *Presentation Layer (Layer 6).* The purpose of this layer is to provide the set of services that may be selected by the application layer to enable it to interpret the meaning of the data exchanged. These services are for the management of the entry, exchange, display, and

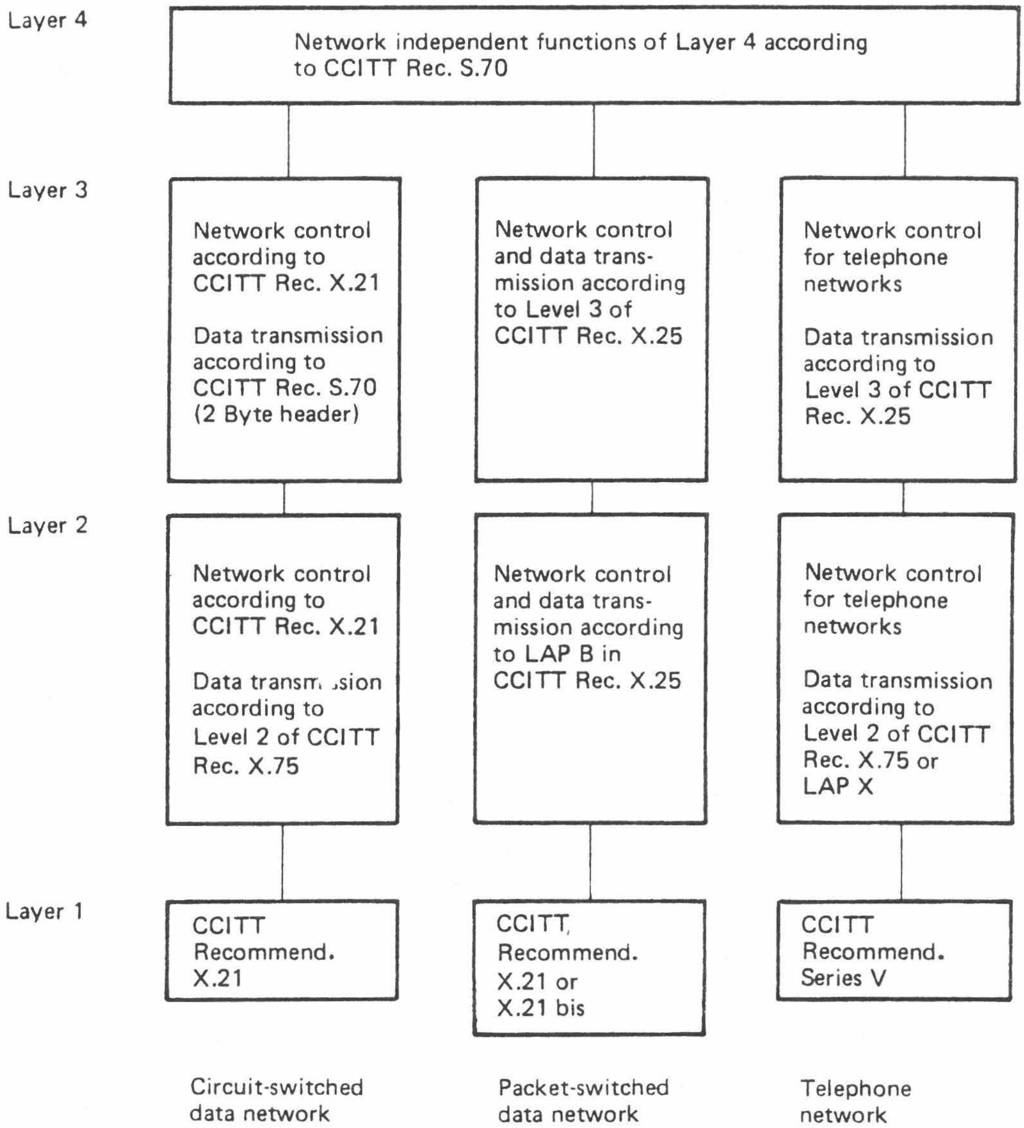


Figure 9. Protocol functions/interface definitons for teletex services over different types of networks (according to CCITT Rec. S.70)

control of structured data. For videotex systems, the presentation layer protocols define the character repertoire (sets of usable characters and their interpretation), text and graphics coding schemes (alphamosaic, alphageometric, alphaphotographic, and dynamically redefinable character sets), and attribute coding (coding/parallel attribute). Standard protocols at this layer allow applications in an Open Systems Interconnection environment to communicate without unacceptable costs in interface variability, transformation, or application modification.

Session Layer (Layer 5). The purpose of this layer is to assist in the support of the interactions between cooperating presentation entities, i.e., procedures for log-on, user identificaton, billing, and statistics gathering.

These two layers or levels, in particular the presentation level, are the most critical in the videotex debate as they relate to the protocols or procedures and are generally but not always invisible to the immediate user. They include graphics sophistication, serial/parallel attribute codes for graphics, bit-error rates, data transmission rates, and fixed or variable format transmissions.

The lowest four layers, also called Transmission Layers, are primarily the concern of the communications network provider. The transmission requirements for digital data over the three principal teletext/videotex communicaton media--telephone (two-way videotex), broadcast television, and cable television (one-way videotex or teletext)--differ, and therefore different standards are required for each. These standards would be transparent to the actual service provided.

Transport Layer (Layer 4). This layer provides transfer of data between two videotex systems or between a user's terminal and the videotex computer. Its task is to optimize the use of available communicatons services to provide the performance required for each intersystem connection at a minimum cost; e.g., if the communicatons network is a packet-switched network, the transport protocol defines the routing algorithm and the flow control procedures.

Network layer (layer 3). This layer provides functional and procedural means to exchange data between two videotex systems (or a terminal and the videotex computer) over a communication network connection; e.g., for packet-switched networks this protocol defines how data is assembled into packets (CCITT Recommendation X.25, level 3).

Data link layer (layer 2). The purpose of this layer is to provide the functional and procedural means to establish, maintain, and release data links in a communication network, e.g., SDLC (synchronous data link control), HDLC (high-level data link control).

Physical layer (Layer 1). This layer provides mechanical, electrical, functional, and procedural characteristics to establish, maintain, and release physical communications between two videotex systems (or a terminal and and videotex computer); e.g., CCITT V.24, lines 15 through 18 of the vertical blanking interval.

On international level at present two recommendations on videotex standards--S.100 ("International Information Exchange for International Videotex", which deals with the characteristics of coded information and display formats) and F.300 ("Videotex Service", which describes the standard parameters for a public videotex service)--they were both ratified by the CCITT in October and November 1980. In May 1981 the European Conference of Post and Telecommunications announced the definition and adoption of a verified European videotex standard (CEPT, 1981) a presentation level protocol, followed by AT&T's announcement of the North American Videotex standard.

The above outlined two main trends actually lead to the emergence of two interconnected OSI-layer pyramids (Figure 10), one in normal standing position and one upside down. By this, for example, the same national packet switching network provides the lower layer services for two way videotex, for teletex, for closed user group networks, etc., on the other hand, a specific high layer application--such as videotex or teletex--can be built on different low layer services. Between two high layer services (A and B in our example) "gateway"--services can be developed and provided, if desired, such as a possible gateway service between videotex and teletex for message sending applications.

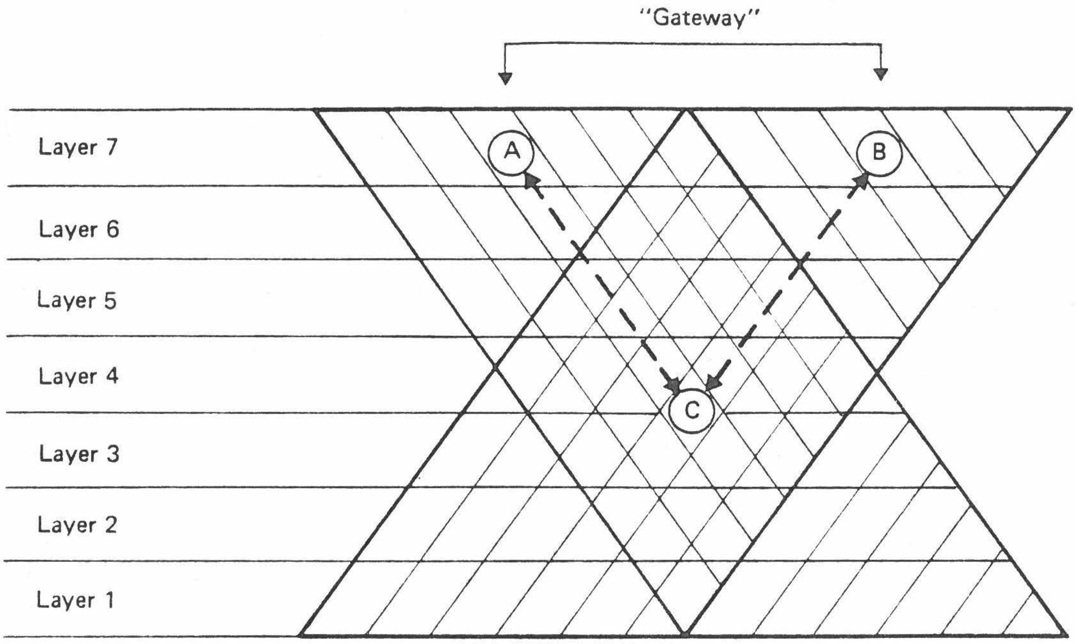


Figure 10. OSI-layer pyramids

2.3. Interfaces Between Layers

Particularly important in a layered architecture are the interfaces between the layers. These must be precisely defined and adhered to rigorously. As mentioned earlier they are all canditates for standardization, either in the international standards arena or in the architectural standards employed by a major common carrier or computer manufacturer.

Each layer in an architecture for distributed processing communicates with an equivalent layer at the other end of a link (Figure 11).

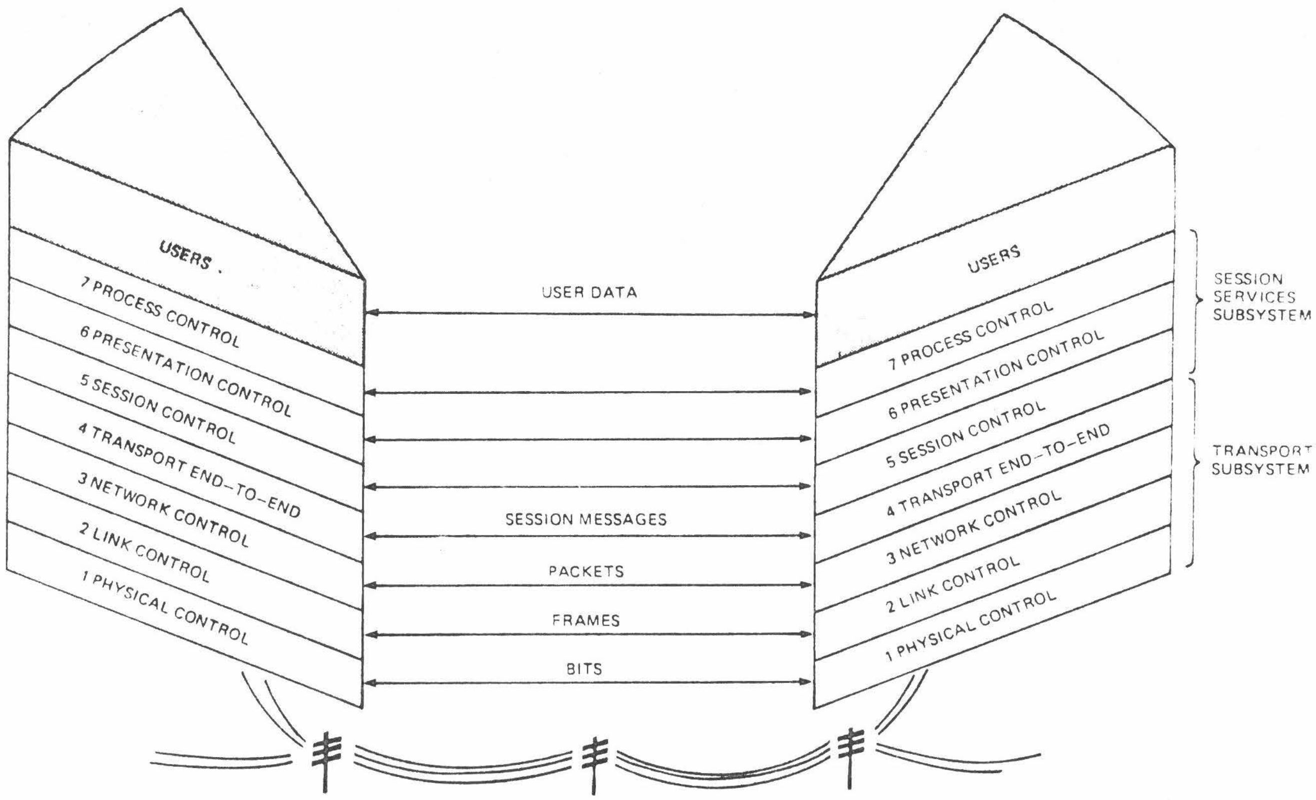


Figure 11. Each layer contains different functions. Each layer communicates with its peer in another machine.

Sessions take place between user processes. The higher layers (4, 5, 6, and 7) relate to these sessions. The lower layers are not concerned with the sessions, but with the movement of data through a network shared by many machines. Figure 12 illustrates this. Layers 4, 5, 6, and

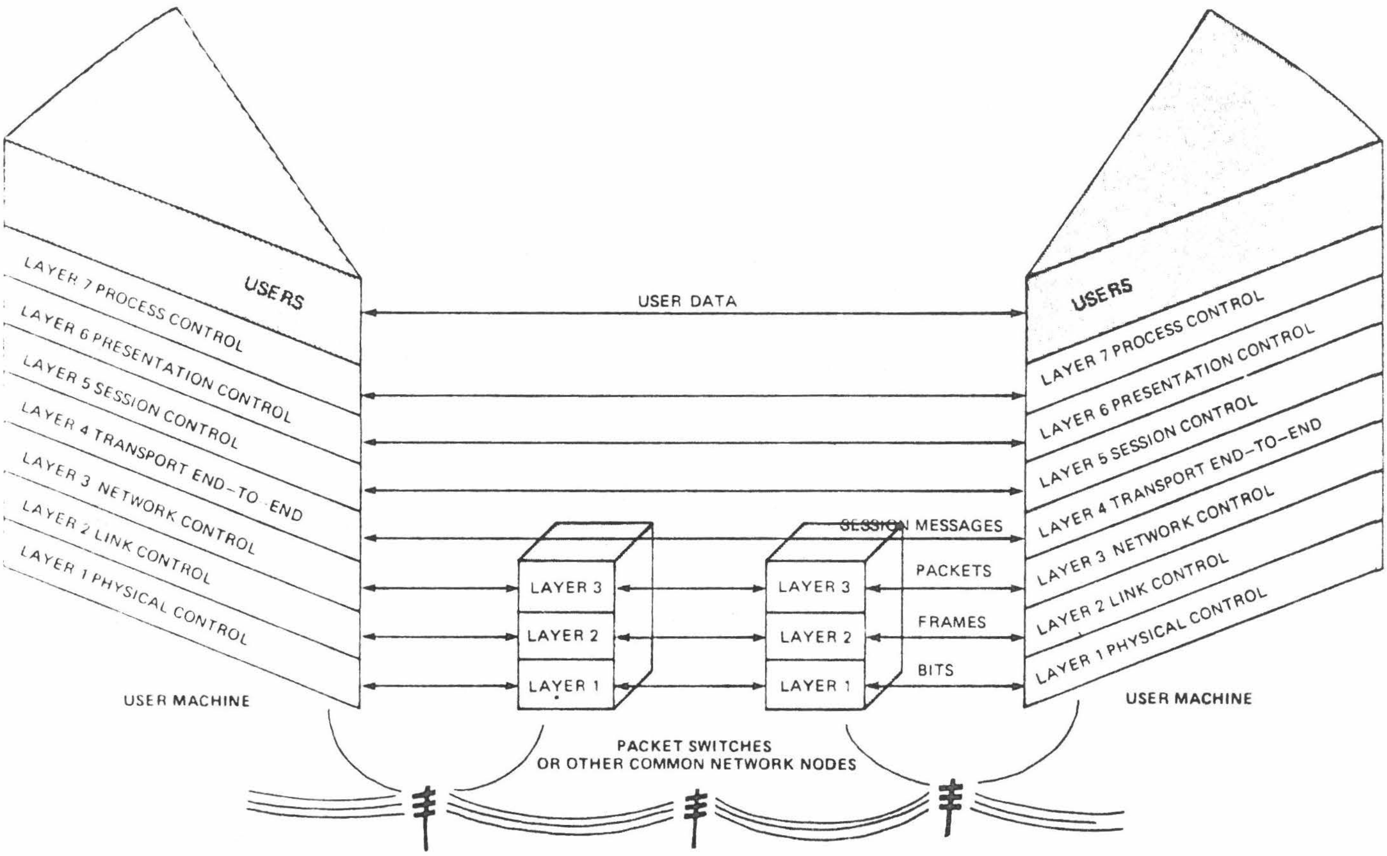


Figure 12. Layers 4 to 7 provide end-to-end communication between session software. Layers 1 to 3 provide an interface to a shared network

7 provide end-to-end communication between the sessions in user machines. Layers 1, 2, and 3 provide communication with the nodes of a shared network. These nodes may be packet switched, communications controllers, concentrators, or other machines designed to make a data network operate.

Each layer of a layered architecture (except Layer 1) may add a header to the messages sent. This header is interpreted by the equivalent layer at the other end of the link.

Layer 2 frames contain a header to be used by the Layer 2 mechanisms at the other end of a physical link. They also contain a trailer which is used to indicate the end of the frame and to check whether the frame contains any transmission errors.

Layer 3 packets contain a header which directs the packet to its destination and is used by Layer 3 at that destination. Layer 4 messages may contain a header intended for use by the distant and complementary Layer 4 and so on.

In general, the Layer N header is not inspected by Layer N - 1. It appears like any other data being transmitted. Layer N - 1 then adds its own header (shown in Figure 13).

The most commonly used two interfaces which are of importance for the PTT services are shortly mentioned in what follows:

Layer 1 Interface

The innermost interface, Layer 1, is usually the well-established 25-pin plug connection to a modem or other transmission equipment. Any data machine, with or without software can send bits over it. A simple terminal may use start-stop transmission. If this terminal is connected to a computer network it will be via a concentrator or gateway processor such as that in Figure 14, and this machine will use the higher software layers.

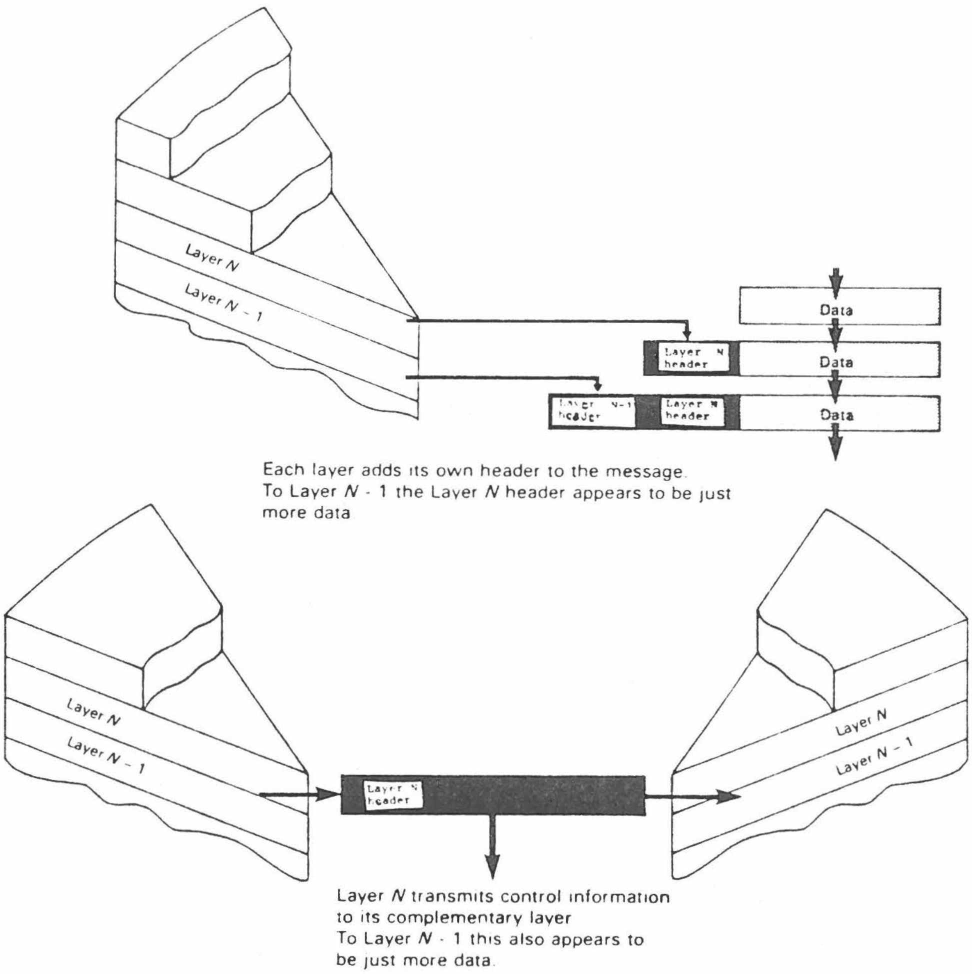


Figure 13. There are two firms of communication between equivalent layers: message headers for that layer, and control messages passed between the layers. These are, or will become, the basis of international standards

Layer 2 Interface

In some cases machines drop down to the Layer 2 interface, *physical* data link control, as shown in Figure 15, i.e., they have no Layer 3 or higher layer. Layer 2 control is often built into a terminal.

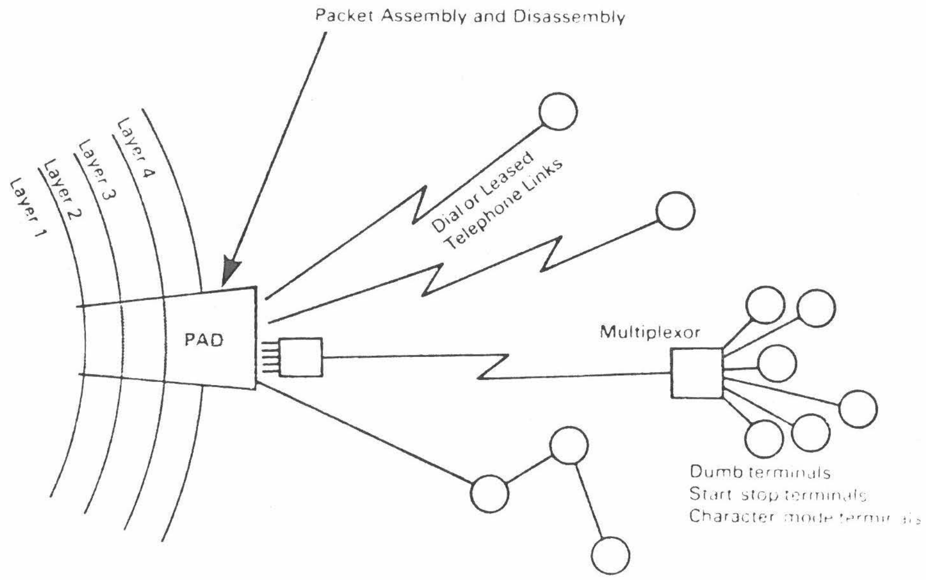


Figure 14. Dumb terminals connected to the network via a PAD (Packet Assembly and Disassembly) interface

Terminals are often connected to a computer via a network interface machine as shown in Figure 15. They may be remote from this network node; connected to it via a physical link such as a leased or dial telephone line. On this circuit Layer 2 link control is used. However, it might be different from the Layer 2 link control used by the network. Most networks employ an advanced data link control procedure (such as HDLC, SDLC,

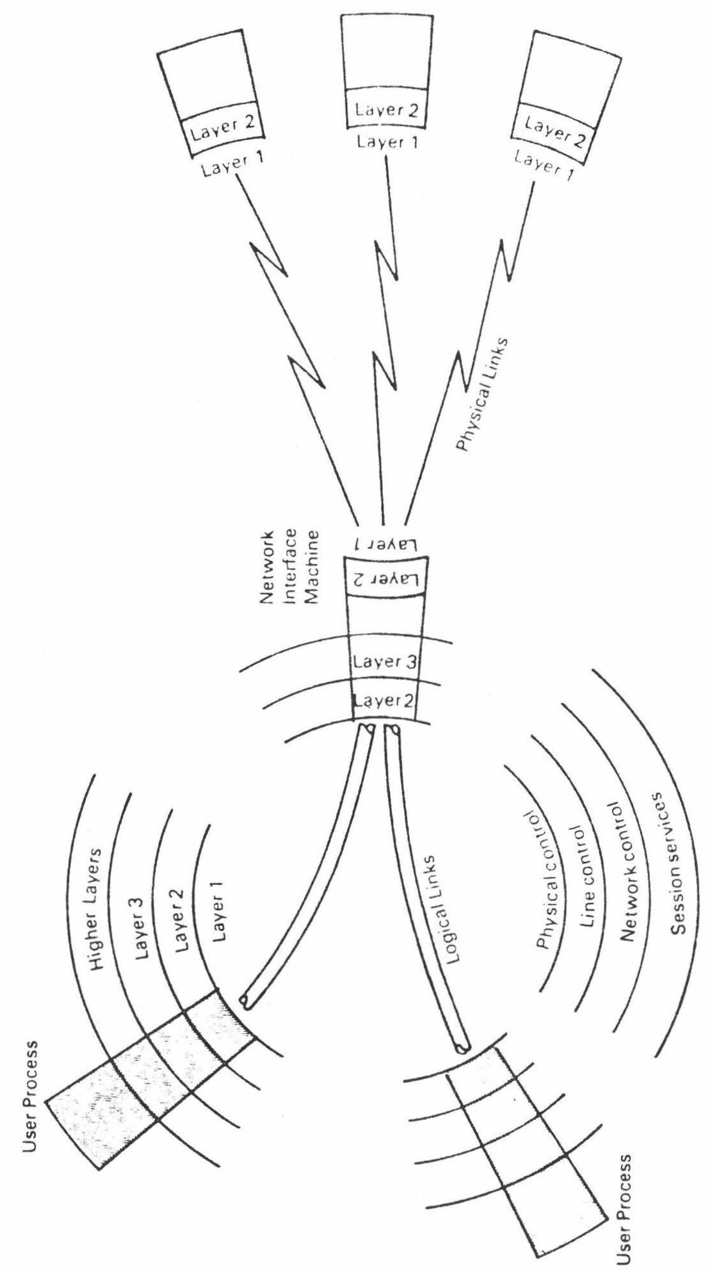


Figure 15. Terminals without Layer 3 software (or hardware) are connected to physical circuits going to a network interface machine

UDLC, etc.). Terminals may use simpler or older procedures. They may be *binary synchronous* or *start- stop* terminals.

Bypassing the Inner Layers

A channel of a distributed processing system may bypass all or some of the inner layers when components can be connected more directly. Two machines in the same building may be connected by a high capacity channel rather than a virtual circuit. Figure 16 shows user processes which employ the Session services layers but these modules are directly interconnected, bypassing the normal transmission subsystem layers. The session services subsystem uses the standard interface to Layer 4.

The transmission media used in Figure 16 might be a point-to-point connection, or circuit-switched connection which does not need messages to be sliced into packets and which avoids the complications of Layer 3. It might be a communication satellite channel, an office network like a local wideband network, cable television, or merely a conventional computer channel connecting machines in building. Some digital circuit-switched facilities use CCITT X.21 physical control. The interface to Layer 4 is intended to be a general-purpose transport service interface which can work with a wide variety of different types of networks.

To the user processes it may make no difference whether or not Layers 4, 3, 2, or 1 are used.

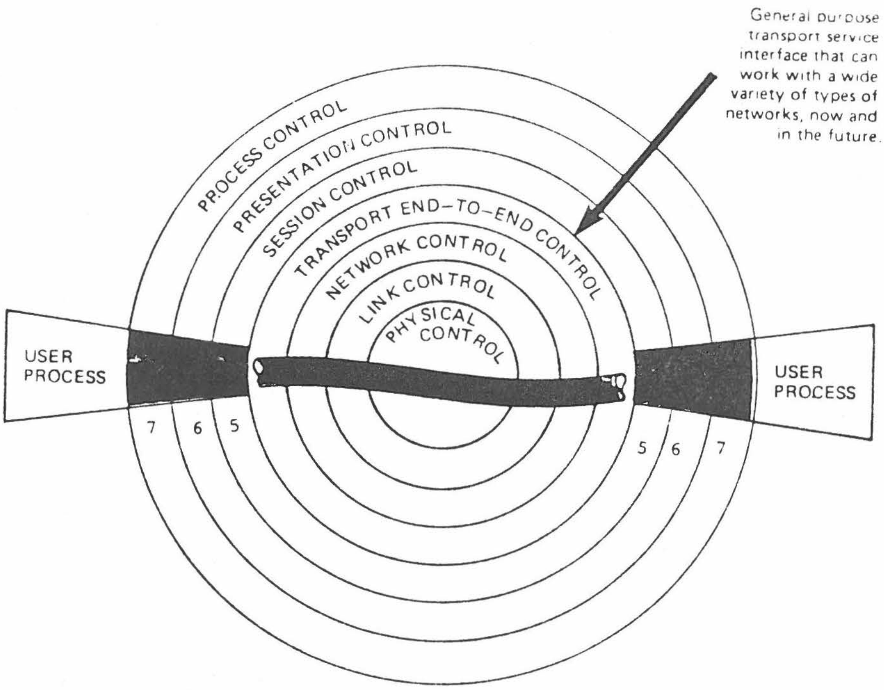


Figure 16. A system which uses the session services layers but not the transmission subsystem layers. It employs the ***standard interface to Layer 4***, but transmission does not use CCITT X.25 mechanisms or similar. It may be a wideband point-to-point channel, CATV, communication satellite network, office network, or merely a computer channel connecting machines in a building

3. THE ROLE OF THE PTTS AND OF THE COMPUTER SYSTEM MANUFACTURERS

The logical and physical functions of the OSI model layers can be with exception of Layer 1 (physical layer) performed in principle both by the PTTs and the computer system manufacturers. The physical layer is in all cases the "territory" of the PTTs. In which sense and to what extent this is actually done will be described in subsequent chapters dealing with the individual PTT administrations and their services.

The layers 2-7 can be performed to a certain extent by the PTT services as well. This depends on the type of service to be provided, but also on the general servicing policies of the respective PTT administrations.

As it will be shown in what follows there are PTT administrations, such as MINSVJAZ in the USSR, which has the policy to provide service only for layer 1 and leave the rest to the computer system manufacturers and above all to the users. The Hungarian and the Austrian PTT, on the other hand, adopted the policy to provide broad PTT services on certain higher layers as well. The Austrian Administration offers or plans to offer service (in addition to the physical layer service) for Layers 2 and 3 (public circuit and packet-switching networks), and application and presentation layer services, such as teletex and videotex. The Hungarian PTT, which offers much the same range of services, with the exception of Layer 3 services by means of a public packet-switching network. Because of policy and economical considerations, the Hungarian PTT administration leaves this service to the users and to the computer system manufacturers and only provides the required lowest layer on the physical level.

The provision of potential "gateway" services between high level PTT services (e.g., between teletex and videotex), does also depend on general policy of the PTT administrations.

4. PACKET SWITCING VERSUS CIRCUIT SWITCHING

Last but not least in this chapter a few words about packet and circuit switching services should be spent, because these two different network technologies are often mentioned in subsequent chapters.

4.1. Packet Switching

The CCITT definition of a *packet* is as follows: *A group of binary digits including data and call control signals which is switched as a composite whole. The data, call control signals, and possibly error control information are arranged in a specified format.*

The associated CCITT definition of *packet switching* is: *The transmission of data messages by means of addressed packets whereby a transmission channel is occupied for the duration of transmission of the packet only. The channel is then available for use by packets being transferred between different data terminal equipment. Note: the data message may be formatted into a packet or divided and then formatted into a number of packets for transmission and multiplexing purposes.*

The data split into packet is sent through the network in packets. There are two ways of doing it. Either first a so-called virtual channel is going to be established for the time of the process--a physical route between the two destination points in the network through which route packages are sent one after the other. It is possible through software multiplexing techniques to mix on the same physical network link between two network nodes packages belonging to different data messages. The other way is when no virtual channel is defined a priory, and each of the packages like separate lives, they may use different physical routes between the two destination points. At the final destination the packages are collected, put into right order and reassembled.

One of the most important standards for the computer industry is the CCITT Recommendation X.25. This defines the relationship between a transport subsystem, or common carrier packet-switching network, and user machines which employ it.

Figure 17 illustrates the concept of X.25 networks. Many user machines are interconnected by *virtual circuits* on which they communicate by means of packets. The virtual circuits are derived by sharing common communication facilities. The X.25 Recommendation says nothing about how the network shall be constructed, but it is oriented to conventional packet-switching on terrestrial lines on the types available in today's common carrier tariffs. It may need modification for satellites, packet radio, data broadcasting, or networks in advance of today's state of the art.

The PAD Interface

Many terminals transmit characters rather than blocks of data or packets. In some cases they use start-stop line control. Sometimes they are inexpensive devices. These terminals need to be connected to an interface machine which buffers the data they send and assembles and disassembles the packets needed for X.25 operation.

The interface machine could be a control unit controlling multiple terminals, which is part of a computer manufacturer's product line. It could be a concentrator to which remote character-oriented terminals are connected by either leased or dialed telephone lines.

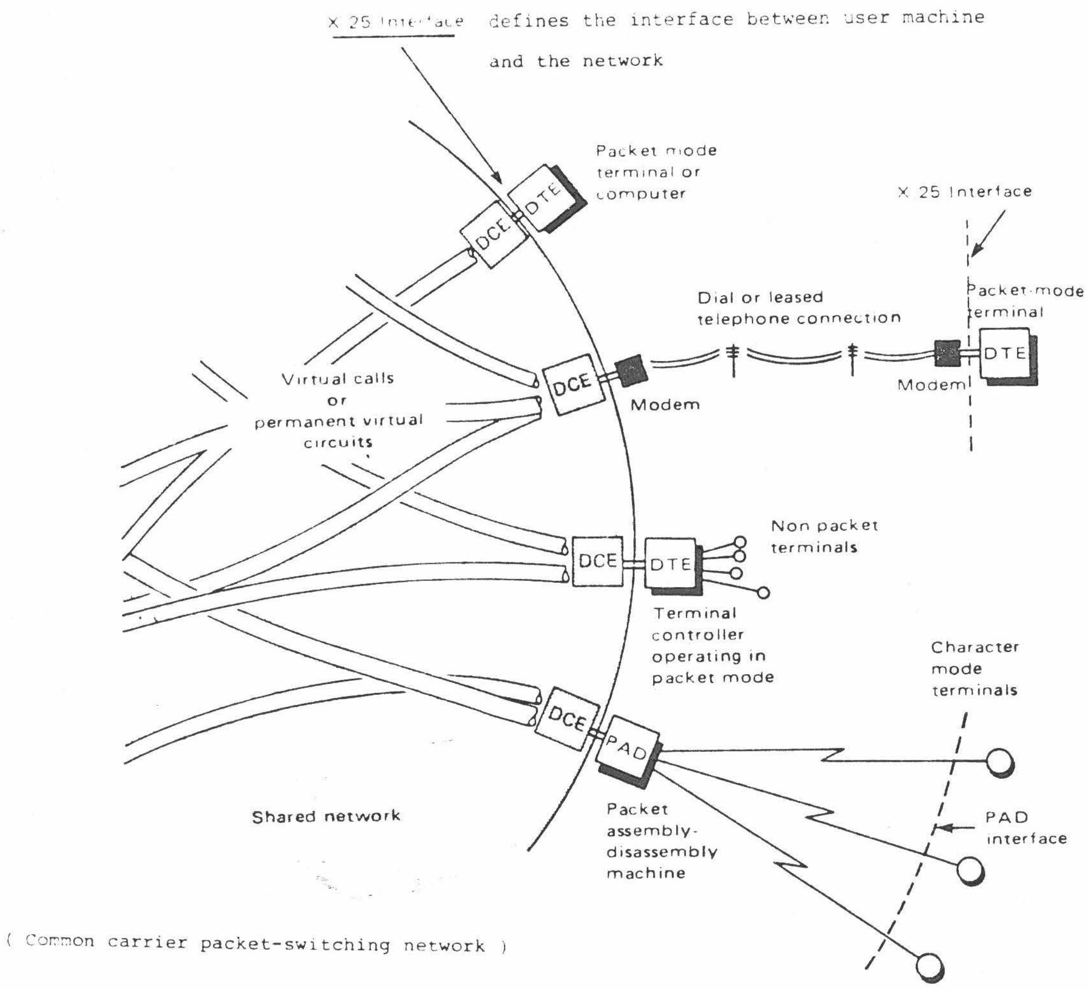


Figure 17. The user machine, DTE, can be computer, terminal, terminal controller, or interface to another form of teleprocessing. The PAD, packet assembly/disassembly machine, buffers characters to and from character-mode terminal (e.g., start-stop machines) and forms the requisite packets.

Most common carriers operating X.25 networks provide an interface machine for connecting character-oriented terminals to the network. A standard for such an interface has been proposed. It is an extension to (but not part of) the CCITT Recommendation X.25, and is called the PAD (Packet Assembly/Disassembly) interface. It is illustrated at the bottom of Figure 17. The PAD machine receives characters for network transmission and assembles them into a packet. Conversely it disassembles packets and sends the resulting characters to the terminal which needs them. A protocol is defined for communication between the PAD machine and the character-oriented terminal. This protocl defines how characters are used for indicating the start and end of messages, requesting and confirming connections, and dealing with errors.

There can thus be ***packet- mode*** user machines which execute the X.25 protocols, and ***character- mode*** user machines which communicate via a PAD interface. Different types of character-mode machines can be used including HDLC m^chines and start-stop machines which use delimiter characters from CCITT alphabets to indicate the start and end of messages.

Layers of Control

The user/network interface is concerned with control Layers 1, 2, and 3 (Figure 18).

4.2. Circuit Switching

Computer networks which use circuit switching are also widely in operation and have major advantage for certain type of applications. Through this technique similar to traditional telephone networks predefined path between two network destinations are set up at the beginning of a session for the whole duration of data traffic. Once the channel allocated to a certain session unlike packet-switching it cannot be shared

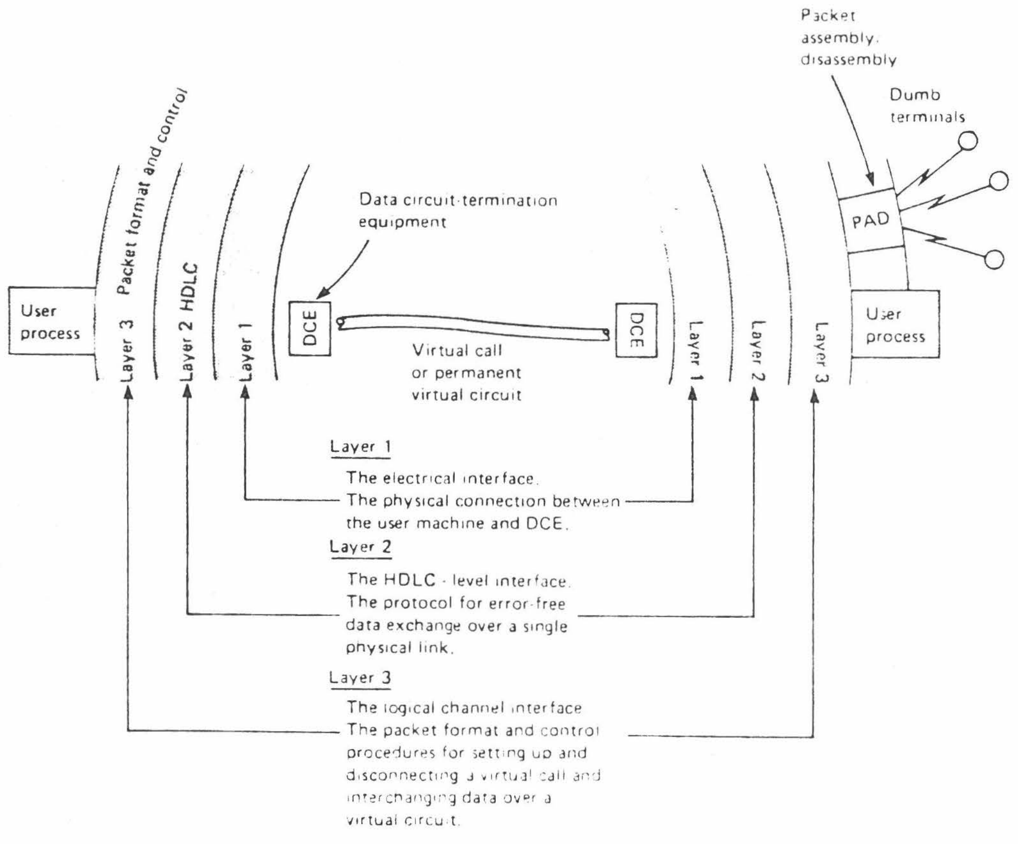


Figure 18. The CCITT X.25 user/network interface is subdivided into three level of interfaces

with other sessions.

Figure 19 shows a comparison of fast-connect circuit switching and packet switching over a route which employs four physical links.

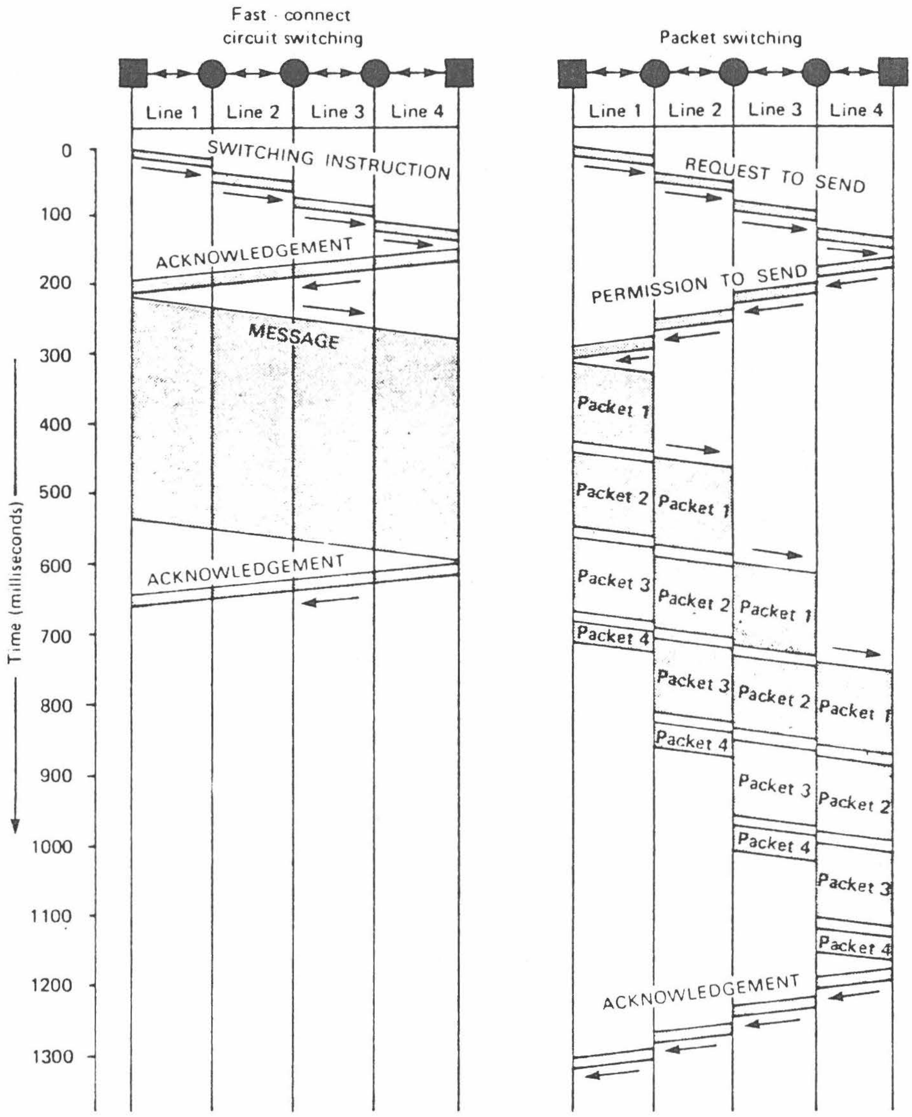


Figure 19. A comparison of the timing on packet switching and fast-connect circuit switching. In this illustration a 400-byte (3200-bit) message is sent on 9600 bps lines. The packet size is 1008 bits. No queuing delays are shown. If the lines were moderately highly utilized queuing delays would lengthen the end-to-end delay with packet switching more than with circuit switching.

With circuit switching a command must be sent through the network to set the switches. A signal returns indicating that they are set correctly and then the entire message is transmitted. When it has been received, and an acknowledgment is transmitted to the sender.

With packet switching the preliminary step of setting the switches is not needed. A packet could travel immediately to the first node, which would examine its address and route it onward. Usually however, the sender has to contact the recipient before transmission to reserve the buffering needed for message reassembly or to ensure that the recipient is ready to receive. Then the packets travel to the destination and an acknowledgment is returned to the sender.

A comparison of the main characteristics between circuit switching and packet switching is shown in Table 7.

Table 7. Comparison of the main characteristics of conventional telephone switching, and packet switching

Conventional Circuit Switching (e.g., telephone switching)	Circuit-Switching Data Networks	Packet Switching Data Networks
The equivalent of a wire circuit connects the communicating parties.	The equivalent of a wire circuit is connected between the end buffers for brief periods.	No direct electrical connection.
Real-time or conversational interaction between the parties is possible.	Real-time or conversational interaction between the parties is possible.	Fast enough for real-time or conversational interaction between data machines.
Messages are not stored.	Messages are not stored.	Messages are stored until delivered, but not filed.
Designed to handle long continuous transmissions.	Designed to handle short sporadic transmissions.	Designed to handle bursts of data.
The switched path is established for the entire conversation.	The switched path is repeatedly connected and disconnected during a lengthy interaction.	The route is established dynamically for each packet.
There is time delay in setting up a call and then negligible transmission delay.	A delay which ought to be less than one second, associated with setting up the call and delivering the message.	Negligible delay in setting up the call. Delay of usually less than one second in packet delivery.
Busy signal if called party is occupied.	Delay, or busy signal, if called party is occupied.	Packet returned to sender if undeliverable.
Effect of overload: Increased probability of blocking, causing a network busy signal. No effect on transmission once the connection is made.	*Effect of overload:* Increased delay and/or increased probability of a busy signal.	*Effect of overload:* Increased delivery delay (but delivery time is still short). Blocking when saturation is reached.
Any length of transmission is permitted.	Any length of transmission *may* be permitted.	Lengthy transmissions are chopped into short packets. Very long messages must be divided by the users.
Economical with low traffic volumes if the public telephone network is employed.	High traffic volumes needed for justification.	High traffic volumes needed for economic justification.
The network cannot perform speed or code conversion.	*May* provide speed or code conversion.	The network can perform speed or code conversion.
Does not permit delayed delivery.	*May* permit delayed delivery if the delay is short.	Does not permit delayed delivery (without a special network facility).
Fixed bandwidth transmission.	Users effectively employ small or large bandwidth according to need.	Users effectively employ small or large bandwidth according to need.

REFERENCES

[1] Techo, R., 1980. Data Communications: An Introduction to Concepts and Design, Plennum Press, New York.

[2] Martin, J., 1972. Introduction to Teleprocessing. Prentice-Hall Inc., Englewood Cliffs, New Jersey.

[3] Martin, J., 1981. Computer Networks and Distributed Processing-Software, Techniques, and Architecture. Prentice-Hall Inc., Englewood, New Jersey.

[4] Burruss, J., 1981. Specification of the Transport Protocol (Vol 1 - Vol 4), Bolt Beranek and Newman Inc., Report No. ICST/HLNP-81-(11-15). Report prepared for the US National Bureau of Standards, Washington, D.C.

[5] Burruss, J., 1981. Specification of the Session Protocol. Bolt Beranek and Newman Inc., Report No. ICST/HLNP-81-2. Report prepared for the US National Bureau of Standards, Washington D.C.

[6] Schenke, K., R. Rüggeberg, J. Otto, 1981. Teletex - ein neuer internationaler Fernmeldedienst für die Telekommunikation. Jahrbuch der Deutschen Bundespost 1981. Verlag für Wissenschaft und Leben Georg Heidecker, Bad Windsheim.

[7] Tydeman, J., et al, 1982. Teletext and Videotex in the United States - Market potential, Technology, Public Policy Issues. Mc Graw-Hill Publications Company, New York.

Chapter 2:

DATA COMMUNICATION IN AUSTRIA — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

I. Sebestyén

DATA COMMUNICATION IN AUSTRIA — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

I. Sebestyén

0. INTRODUCTION

Because of its geographical location and international functions, Austria plays a key role in the communication of data between East and West. To be able to fulfill this role, Austria had to develop both its own data communication infrastructure and also provide international links to various data communication services abroad. Not only did the necessary hardware infrastructure have to be built up but this had to be accompanied by necessary administrative procedures and managerial arrangements. Because the development process in this especially fast changing field had not been completed by the time of writing, this report describes the present status of this process. In this paper a detailed description of the various Austrian data services, their technical characteristics, availability, costs, and necessary administrative procedures is given with special emphasis on the international aspects of these services. Since technical characteristics, tariffs, and organizational arrangements change rapidly, this paper should only be used as a guide to provide general information and should not be considered as a reference.

1. GENERAL INFORMATION [11]

1.1. Legal Basis of the Telecommunications Administration

The telecommunications monopoly, i.e., the exclusive right of the Republic of Austria to install and operate telecommunications facilities, is based on the Telecommunications Act of 13 July, 1949, published in Federal Law Gazette Number 170, as amended. The decrees with respect to telecommunications matters issued under the Telecommunication Act have been raised to the level of laws by virtue of the Federal Act of 5 July, 1972, published in Federal Law Gazette Number 267.

1.2. PTT Organizational Structure

The senior management in the field of posts and telecommunications is provided in Austria by Division III of the Federal Ministry of Transport, the "Head- quarters of the Postal and Telegraph Administration" (Generaldirektion fuer die Post- und Telegraphenverwaltung--PTV) or in short Austrian PTT (Figure 1). Five Regional Directorates and one Inspectorate are controlled by the Headquarters and these regional units are shown on the map in Figure 2.

The regional directorates may authorize individuals and organizations to install and operate telecommunications facilities.

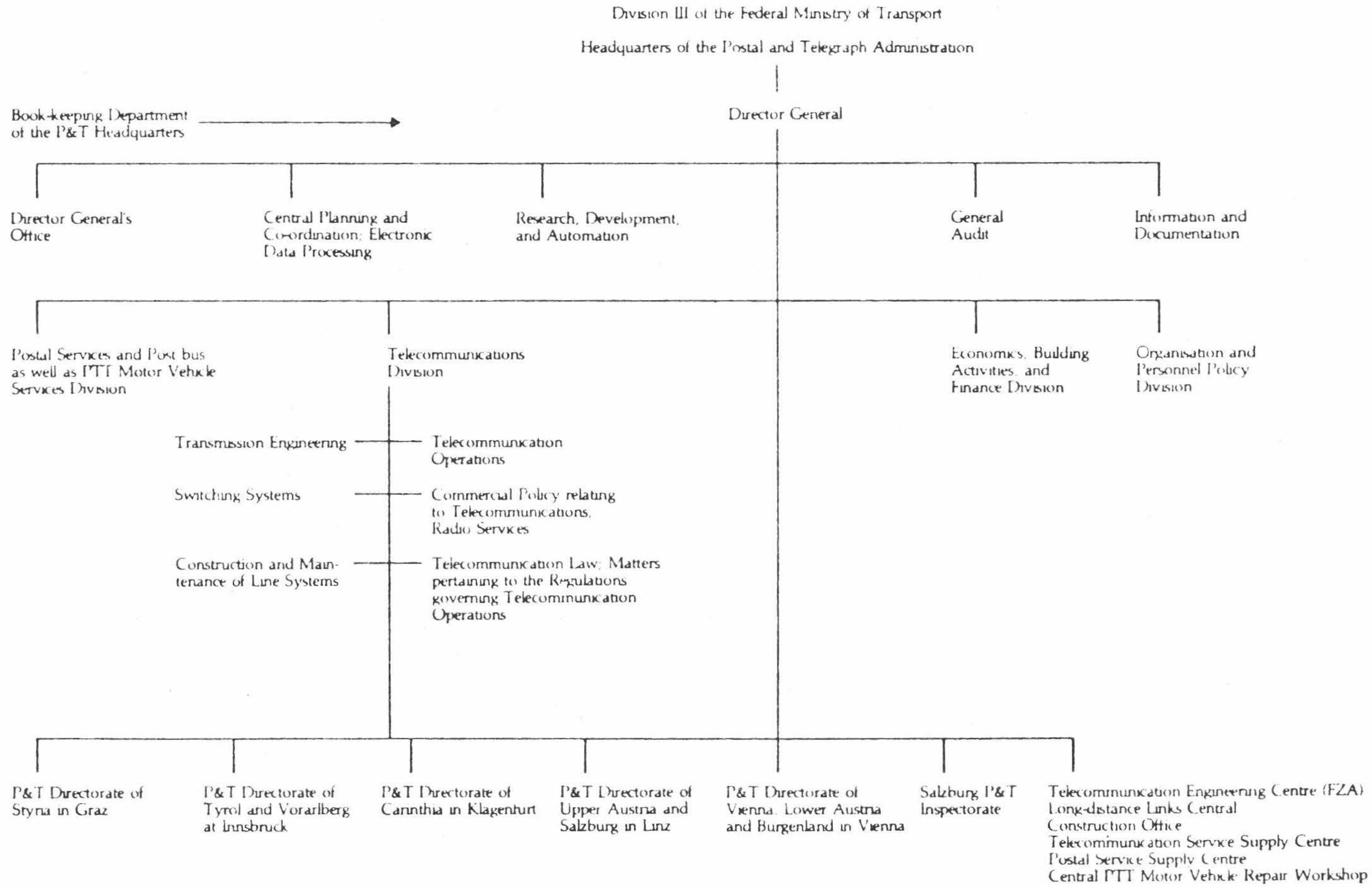


Figure 1. Structure of the Austrian Postal and Telegraph Administration

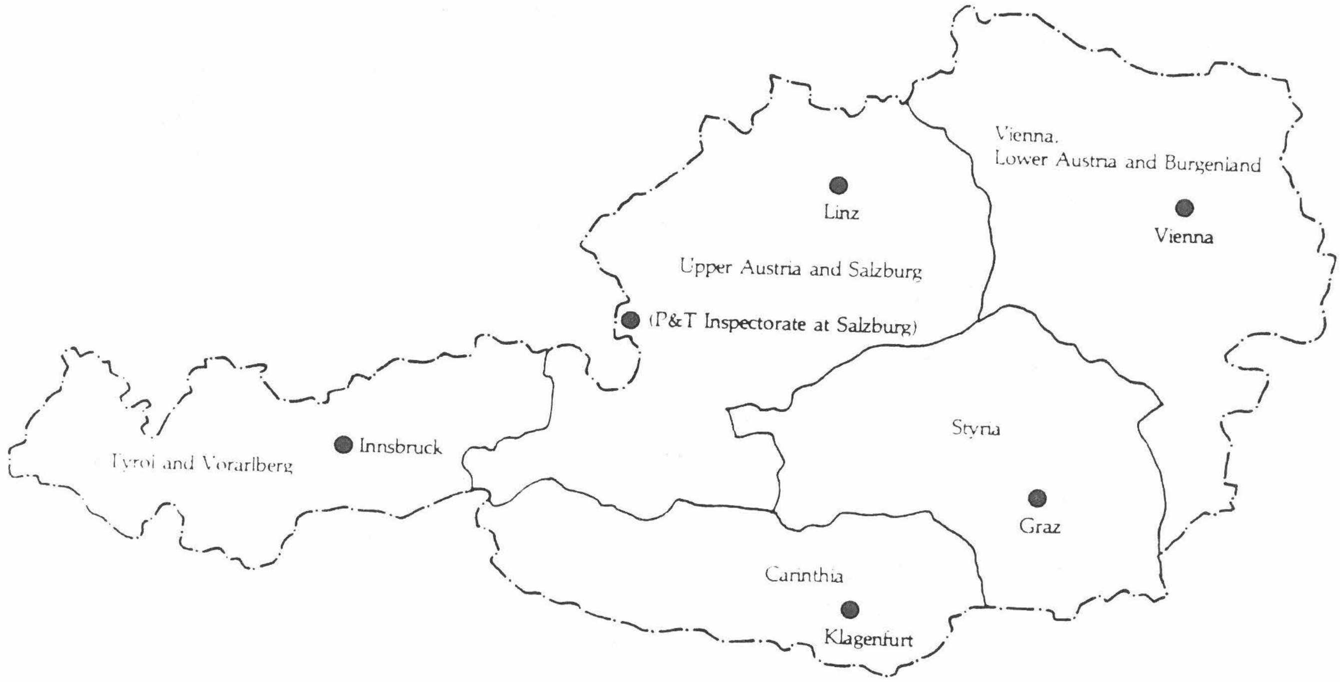


Figure 2. Regional Directorates and Inspectorates in Austria.

The regional directorates are in control of the establishments responsible for field operations, namely 2,281 post offices, 5 Broadcasting Service Administration Offices, 6 Telecommunication Operation Offices, and 12 Telecommunication Construction Offices. In addition, a Telephone Operation Office, an International Telephone Exchange, a Central Telegraph Office, a Cable Construction Office and a Telephone Accounting Office are established on the territory of the Vienna Directorate.

The administrative structure also includes the Telecommunication Engineering Center (Fernmeldetechnisches Zentralamt or FZA) which is responsible for the technical specifications of the network, for the granting of permission to connect private equipment to the network and for research.

Not all international services are performed by the Austrian PTT. Certain services are also provided on an exclusive basis by another government owned firm, namely, Radio Austria AG. Radio Austria AG, founded in 1922 as the successor to the Austrian Marconi Company, is a recognized private operating agency owned by the state and has, for example, the responsibility for providing intercontinental telegraph and telex services, including intercontinental private telegraph circuits.

1.3. General Policy in Respect of Data Transmission

Data communications facilities are provided by means of the Public Switched Telephone Network (PSTN), the telex network, private leased circuits, and last but not least on the new Public Data Networks.

Generally, the PSTN data service provided conforms to CCITT recommendations. It is possible, however, because of the technical characteristics of the telephone network, that full duplex transmission at speeds in excess of 200 bit/s may not be attainable on all connections. This difficulty is gradually being overcome and, depending on the circumstances, PTT will assist subscribers in overcoming any transmission speed limitations. The inland telephone service is fully automatic.

A fully automatic telex service is also available within Austria, to all countries in Western and Eastern Europe and a number of countries outside Europe including the USA, Canada, Japan, and Israel.

Private leased telegraph, telephone, and wideband circuits are available from the PTT.

The PTT does not supply modems (except for digital services) or data terminal equipment, the provision of which is the responsibility of the subscriber. Permission from PTT is required for connection of private equipment. There is currently a long list of modems which have been granted permission for attachment and further details can be provided by PTT. Although it does not supply modems, the satisfactory functioning of each modem to be connected must be tested by the PTT who carry out the installation. Subscribers must make their own arrangements for modem maintenance.

The Administration has introduced a public circuit switched data network (DATEX-L) based on the Siemens circuit-switched EDS exchange and a public packet switched data network (DATEX-P) based on Canadian Northern Telecom system. The first exchange of the circuit switched network was installed in Vienna at the end of 1978 and the second at Salzburg in early 1980. At the moment this network provides a 50 baud, 300 bit/s low-speed circuit switching services (DATEX-L) and higher speeds (2400, 4800, and 9600 bit/s) from the end of 1982. At the same time, a packet switched network (DATEX-P) was also introduced with PTT providing the data control units, but no terminals.

1.4. Permission to Attach Equipment

Before any private equipment can be connected, permission must be granted by the Fernmeldetechnisches Zentralamt (FZA) in Vienna. The address for application is:

Fernmeldetechnisches Zentralamt
Arsenal, Postfach 111
1030 WIEN

Telephone: (0222) 781511

The application procedure requires the submission of technical descriptions, full wiring diagrams, and a sample of the equipment for testing. Currently, the elapsed time for evaluation and testing is of the order of three months from the time of receipt of the equipment sample, although time required for the initial processing of the application prior to provision of a sample will increase this period.

Charges raised for evaluation and testing in connection with the application for permission to attach private equipment are time and materials based. Currently, the average staff cost is approximately 250 schillings per hour. In addition, the charge raised for the use of testing equipment is 320 schillings per hour and between four and 10 hours use is required during the process of a normal test. A list of the telecommunication equipment approved by the Austrian PTT is annexed.

2. TEXT COMMUNICATION

2.1. Telex and Telegraph

2.1.1. Basic service

The PTT provides only the basic two- or four-wire connection, including a plug-in telegraph modem. The teleprinter, without a plug-in telegraph modem, and all other subscriber equipment must be provided by the subscriber, including all switches and connection lines needed for data transmission. The PTT handle installation of the equipment and a maintenance service is available from the Administration.

Currently, only three manufacturers are allowed to supply teleprinters for connectioı to the network. These manufacturers are ITT, Olivetti, and Siemens. Also, it is PTT policy to allow connection of the most recent electronic teleprinter equipment. Thus for the establishment of a new telex station in Austria, it is necessary to install one of the following models:

ITT	SEL LO 2000
Olivetti	Model 431 (SES)
Siemens	Model T 1000

The teleprinters have to be provided by the users; it cannot be rented from the PTT.

Within Austria and Europe, service is provided by the PTT, but Radio Austria AG are responsible for intercontinental connections. Private leased telegraph circuits for transmission at a speed of 50, 100, and 200 bauds are available.

2.1.2. Telex Service

The present telex net in Austria serves about 20,000 domestic subscribers. The old telex system (TW39) is gradually being replaced by the new Siemens electronic EDS system, which integrates both telex and all circuit switched data services. The first part of the EDS system went into operation between 1978 and 1980 and is scheduled to be complete by 1986. In addition to the classical telex network functions, the systems offers a full range of new capabilities.

a) Technical characteristics:

- Transmission speed: 50 Baud
- Transmission mode: asynchronous, halfduplex
- Transmission code: international telegraphy alphabet No. 2 (ITA No. 2).

b) Special telex services available to users on subscription:

- closed user group
- concentrator connections
- short dialing mode
- direct dialing through separate buttons

c) Special telex services available to all users:

-- simultaneous telex transmission to more than one user

-- tariff request

d) Service applications:

Applications (form DS 44080) for new telex services have to be forwarded to the respective "Telegraphenbauamt" of the PTT.

2.1.3. Additional Facilities

Message switching facilities and private telegraph branch exchanges (PTBXs) are not supplied by PTT but can be privately supplied.

3. SERVICES USING PTT PROVIDED DATA COMMUNICATIONS EQUIPMENT

3.1. General

The PTT provides only DCEs for the public data networks and the direct data networks; it does not provide modems for other purposes. DTEs have, in all cases, to be provided by subscribers. Permission from the PTT is required before connection of private apparatus. There is currently a comprehensive list of modems available at the FZA which have been granted permission to attach, covering a large number of manufacturers, with a wide range of facilities and speeds.

The circuit switched public data network, the direct data network and the packet switched data network offer services at 300, 2400, 4800, and 9600 bit/s. Services at higher speeds will be offered later.

Table 1. Summary of PTT Services.

Service	Transmission media	Transmission speed	Operating mode	Mode of operation	Local and junction lines	Interface connection	Other remarks
Up to 50 bit/s	Public switched telex network	50 bit/s	Depends on equipment	Half duplex	2 wire	Depends on equipment	—
Up to 200 bit/s	Leased telegraph circuits	50, 100 200 bit/s	Depends on equipment	Half duplex Full duplex	2 wire 4 wire	Depends on equipment	—
300 bit/s	Public switched network	300 bit/s	Asynchronous	Duplex	2 wire	X.20 or X.20 bis	Also for PAD in DATEX-P
300 bit/s	Direct data network (circuit switched)	300 bit/s	Asynchronous	Duplex	2 wire	Mechanically the same as X.20	Also for PAD in DATEX-P
Up to 2400 bit/s	Public circuit switched telephone network	Up to 2400 bit/s	Depends on modem	Half duplex	2 wire	Depends on modem	Service up to 2400 bit/s may not be available on all connections. Also for PAD.
Up to 9600 bit/s	Leased telephone circuits	Up to 9600 bit/s	Depends on modem	Half duplex Full duplex	2 wire 4 wire	Depends on modem	For transmission in excess of 2400 bit/s CCITT M1020 quality may be required
48 KHz or 240 KHz	Wideband	48 Kbit/s or 240 Kbit/s	Depends on modem	—	—	Depends on modem	As available
2400 6800 9600 bit/s	Public circuit switched data network	2400 4800 9600 bit/s	Synchronous	Duplex	4 wire	X.21	Also used for teletex
2400 4800 9600 bit/s	Direct data network (circuit switched)	2400 4800 9600 bit/s	Synchronous	Duplex	4 wire	X.21	—
2400 4800 9600 48000 bit/s	Packet switched data network	2400 4800 9600 48000 bit/s	Synchronous	Duplex	4 wire	X.25 X.21	—
2400 4800 9600 48000 bit/s	Direct packet switched data network	2400 4800 9600 48000 bit/s	Synchronous	Duplex	4 wire	X.25 X.21	—
2400 bit/s	Teletex	2400 bit/s	Sychronous	Duplex	4 wire	X.21	—
1200/75 bit/s	Videotex	1200/75 bit/s	Asynchronous	Duplex	2 wire	PTT modem V.24	—

3.2. Transmission paths

Data transmission is available over the public data networks, the direct data networks, the telex network, the PSTN or private leased circuits (point-to- point and multipoint).

Private leased speech band circuits (two-wire and four-wire) of normal voice grade CCITT M 1040 and special CCITT M 1020 quality are available. Additionally, branching equipment for construction of multipoint circuits can be provided by the PTT. On a multipoint circuit, up to six remote stations can be connected to a central station.

Wideband circuits can be provided, depending on the exact location of the terminal sites, if required. Bandwidths of 48 kHz, 240 kHz, 4 MHz and 10 MHz are available. (See also Section 4: Leased Private Circuits.)

3.3. PTT Network Term. ıating Points (NTPs) and Line Statistics

According to the official Austrian PTT statistics, 14,166 NTPs were registered by the FZA [1] at the end of June 1982. Table 2a shows that at present the most frequently used line speed in Austria is 2400 bit/sec, but the number of higher speeds is growing. The majority of NTPs are still linked to the telephone network, both leased and switched telephone connections count for around 94% (!) of all NTPs. Digital services -- basically the low speed circuit switched DATEX network -- only accounted for less than 1% of all NTP connections. There is, however, no doubt that this proportion will change in the future; and this will be strongly supported by the introduced new digital data services and the general Austrian PTT policy.

Table 2a. Statistics of Network Terminating Points (NTPs) in Austria.

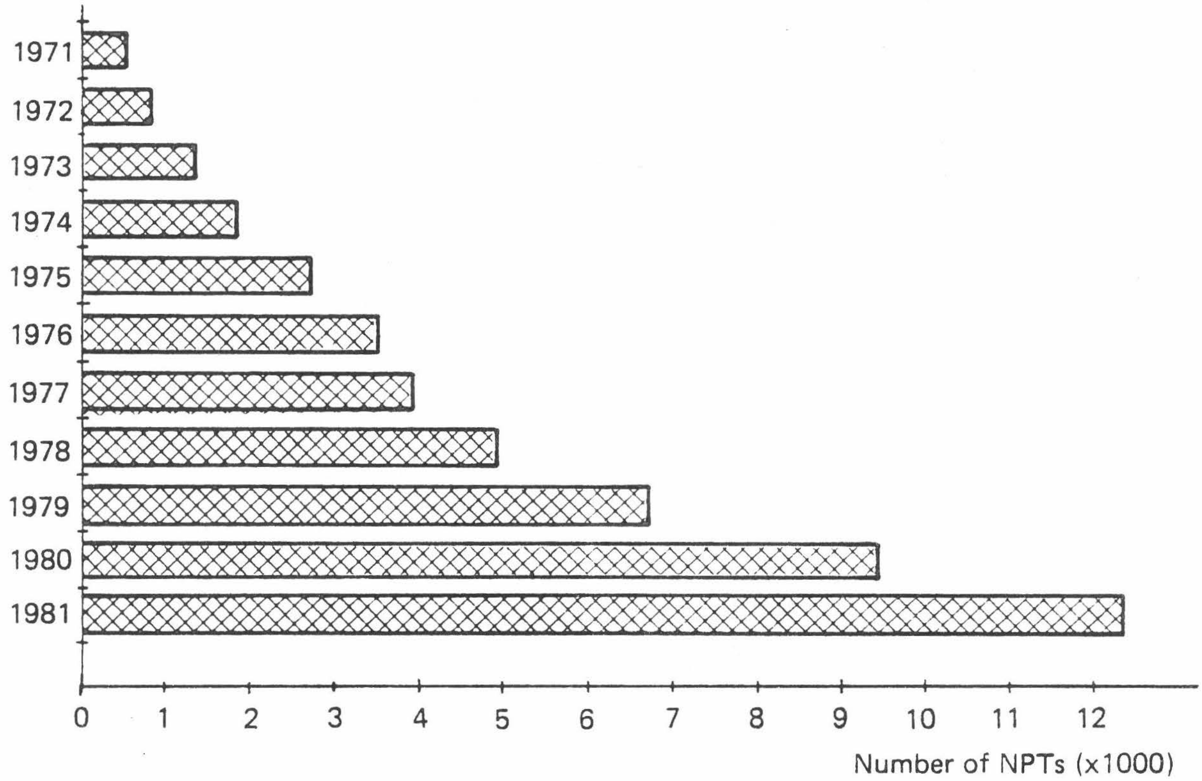
Speed	Switched data network (WDN-L) (DATEX-300L)	Direct data network (DDN-L) (DATEX-L)	PSTN (telephone)	Videotex (BTX)	Leased telephone lines	Leased telegraph lines	Radio link	Total (number)	Total (%)
Analog signal			12		—			12	0.08
20/40 char/s			539		4			534	3.83
up to 50 bit/s			—		—	492		492	3.47
up to 300 bit/s	48	78	811	4	212	217		1370	9.67
up to 1200 bit/s			1766	213	1329		3	3311	23.37
up to 2400 bit/s			1458		2962			4420	31.20
up to 4800 bit/s					1850			1850	13.06
up to 7200 bit/s					1			1	0.007
up to 9600 bit/s					2110			2110	14.89
up to 19200 bit/s					57			57	0.4
up to 48k bit/s								—	—
Total (number)	48	78	4586	217	8525	709	3	14166	100%
Total (%)	0.33	0.55	32.4	1.53	60.17	5.0	0.02	100	—

Source: Fernmeldetechnisches Zentralamt FZA, Vienna.

Similar to other countries the number of NTPs in Austria is growing fast (Table 2b). In general, the Austrian yearly growth is between 30 and 40%; higher than the average for Western European countries. Table 2c shows the changing pattern of line speeds used. As can be seen there was a shift from the lower speeds (300 bit/sec) towards the higher speeds (2400 bit/sec and above) during the 1970s. The growth in the number of very high speed lines (between 9,600 bit/sec and 48 kbit/sec) during the last couple of years has been remarkable.

Table 2d shows that the telex has actually been little used for data communication in Austria and although the telegraph network is still used, its role is declining. There is still some growth in the use of switched telephone networks for data transmission but the backbone of data communication in Austria at present is the use of leased telephone lines; the recently introduced digital network services have only a limited significance yet. The role of videotex in data communication is still moderate. Table 2e shows the distribution of NTPs by the major user groups with some interesting aspects. There are very few terminals used for educational purposes in Austria. Surprisingly, the use of data communication in the travel and transportation industry is also rather low, although the potential for this sector in Austria should be significant. The majority of NTPs, over 5000 (40%) are used in banking applications, while insurance companies playing a smaller role.

Table 2b. Statistics of Network Terminating Points (NTPs) in Austria as of 31 December 1981.



Source: Fernmeldetechnisches Zentralamt—Vienna

Table 2c. Statistics of Network Terminating Points (NTPs) in Austria according to line speeds used.

Year as at 31.12	20/40 bit/s	= 50 bit/s	< = 100 bit/s	< = 300 bit/s	< = 1200 bit/s	< = 2400 bit/s	< = 4800 bit/s	< = 9600 bit/s	< = 48k bit/s	Total
1971	5	264	0	137	84	16	0	0	0	506
1972	23	447	0	193	137	32	3	0	0	835
1973	58	641	0	263	223	79	10	2	0	1276
1974	94	673	2	465	368	170	40	3	0	1815
1975	129	762	4	590	673	410	108	19	0	2695
1976	190	781	15	665	1085	587	164	47	0	3534
1977*	—	—	—	—	—	—	—	—	—	3876
1978	262	551	10	663	1595	1178	420	250	0	4929
1979	310	527	139	741	2069	1754	745	441	12	6738
1980	383	499	178	871	2670	2677	1299	912	21	9448
1981	497	508	1138		3175	3732	1652	1596	25	12323
1982 up to 30.6	543	492	1382		3311	4420	1850	2111	57	14166

*Only total data available.

Source : Fernmeldetechnisches Zentralamt, Vienna.

Table 2d. Statistics of Network Terminating Points (NTPs) in Austria according to type of connection.

Year as at 31.12	Telex network	Leased telegraph lines	Switched telephone network (PSTN)	Leased telephone lines	DATEX 300-L	DDN-L (DATEX)	Videotex	Radio Link	Total
1971	0	264	109	133	0	0	0	0	506
1972	1	446	185	203	0	0	0	0	835
1973	1	640	321	314	0	0	0	0	1276
1974	1	674	623	500	0	0	0	17	1815
1975	4	762	1019	892	0	0	0	18	2695
1976	4	792	1471	1249	0	0	0	18	3534
1977*	—	—	—	—	—	—	—	—	3876
1978	0	561	2095	2270	0	0	0	0	4929
1979	0	666	2752	3317	0	0	0	0	6738
1980	0	685	3506	5245	0	8	0	4	9448
1981	0	697	4167	7238	23	26	169	3	12323
1982 up to 30.6	0	709	4586	8525	48	78	217	3	14166

*Only total data available

Source: Fernmeldetechnisches Zentralamt, Vienna.

Table 2e. Statistics of Network Terminating Points (NTPs) in Austria according to main classification of users in 1981.

Group	Number of NTPs	%
Government	1527	12.42
Public organizations (e.g., authorities, hospitals)	595	4.84
Research institutes and education	254	2.07
Medicine (doctors, pharmaceutical shops etc.)	632	5.14
Industry	1291	10.50
Business and sales	1088	8.85
Banks and insurances	5429	44.17
Travel and transportation	308	2.51
Computer service bureaus	165	1.34
Press	21	0.17
Others	979	7.97
TOTAL*	12290	100.0

*In 1981 total NTPs in Austria was 12323.

Source: Fernmeldetechnisches Zentralamt FZA, Vienna.

3.4. Description of PTT Data Services [5]

3.4.1. Asynchronous circuit switched data services

The low-speed asynchronous circuit switched data services DATEX-300L and DDL 300 are provided by the Austrian PTT through their integrated telex and data system EDS. The DATEX-300L service works with switching, while on the DDL 300 fixed asynchronous connections are provided.

a) Technical characteristics:

- Transmission speed: 300 bit/sec (according to the CCITT recommendation X.1 Class 1)
- Transmission mode: asynchronous, duplex
- Interface between DTE and network:
  - 15-pole connection according to IS 4903, or
  - 25-pole connection according to IS 2110
- Error rate: better than 3.10^{-6}.

b) Technical characteristics only for DATEX- 300L:

- Call establishment: manual or automatic, about 0.5 sec after dialing has made.
- Transmission code and protocols: for call establishment, code according to IA No. 5 (IS 646), pro character 1 startbit, 7 information bits, 2 stopbits with even parity, protocol according to CCITT X.20; for data transfer, code IA No. 5 also with even partity, transmission protocol, however, is free up to the user.

c) Technical characteristics only for DDL 300:

- Transmission code and protocols: free up to the users. Codeframe 11 bits pro character, with maximum 8 databits, 1 startbit and 2 stopbits.

d) Special services for DATEX- 300L network only:

- closed user group
- short dialing code
- direct dialing
- concentrator connection
- subscriber identificator

e) Application for service

Application should be made to the PTT Regional Unit responsible. Technical advice and help with problems is given by the "Abteilung T" of the "FernmeldetechnischesZentralamt" in Vienna.

f) International connections

First connection was introduced in April 1, 1982 to the Federal Republic of Germany, and Switzerland and it is planned to connect the Hungarian NEDIX network and all appropriate European PTT data networks.

3.4.2. Synchronous circuit switched data services

Medium and high speed synchronous circuit switching data services were introduced to the service during the second half of 1982. They are built on the above mentioned integrated telex and data communication system EDS. Two different synchronous services are provided: DATEX-L for switched synchronous services, and DDL synchronous for fixed medium and high speed connections.

a) Technical characteristics:

- Transmission speeds: 2400, 4800, 9600 bit/s (according to CCITT Recommendation X.1 Classes 4, 5, and 6)
- Transmission mode: synchronous (timing signal provided by the network), duplex
- Interface DTE to DCE:
  - 15-pole connection according to IS 4903, or
  - 25-pole connection according to IS 2110 (V.24) (only for the direct network)
- Error rate: better than 10^{-6}.

b) Technical characteristics for DATEX- L synchronous only:

- Call establishment: about 0.5 sec after completion of manual or automatic dialing
- Transmission code and protocol: during call establishment and call termination code according to IA No. 5 (ASCII) and protocol according to X.21 of CCITT. During data transmission phase

code and protocol are free up to the users.

c) Technical characteristics for DDL synchronous only:

-- Transmission code and protocol: free up to the users

-- Possible connectionss are point-to-point and multipoint

d) Special services for DATEX- L synchronous only:

-- direct dialling

-- closed user group

-- short dialing code

-- concentrator identificator

-- subscriber identificator

e) Application for service:

Application should be made to the next regional PTT unit responsible. Technical advice and help with problems is given by the "Abteilung T" of the "Fernmeldetechnisches Zentralamt" in Vienna.

f) International connections:

The first planned are to the Datex network of the Federal Republic of Germany, Switzerland, Scandinavia, and Italy. This will be followed by a connection in about two years to the Hungarian NEDIX network, whereby the X.50 - X.51 protocol conversion has to be performed. Since this service is one of the possible lower level layers for teletex services, it can be expected that interconnection of the DATEX-L synchron service to similar PTT data networks abroad will take place relatively soon. Actually, the synchronous circuit switching services between Austria and West Germany are already experimentally connected and used especially for telex.

3.4.3. Packet switched data services

The packed switched data services in Austria will become fully in operation at the end of 1982 (Figure 3). The packet switching data node of the PTT in Vienna has been available since the beginning of 1982 for experimental operation. The Austrian PTT provides two types of packet switched data services: DATEX-P for switched connections and DDP for fixed connections. The backbone of the packet switching service is a separate data network made by Northern Telecom in Canada. Major network nodes in Austria are interlinked with 64 kbit/sec high speed lines.

a) Technical characteristics for transmission speeds and modes:

- 2400, 4800, 9600, 48000 bit/sec for DTEs (according to X.1 user classes 8, 9, 10, 11) with packet switching capabilities according to CCITT X.25 for:
  - level 1: CCITT X.21, synchronous, duplex interface; 15 pole connection IS 4903
  - level 2: HDLC (ISO) and LAPB (CCITT)
  - level 3: virtual calls
- 300 bit/sec for asynchronous, character oriented DTEs with interfaces according to CCITT Rec. X.20 (X.20 bis) over direct links for the circuit switched data network to the PAD function of the packet switched network.

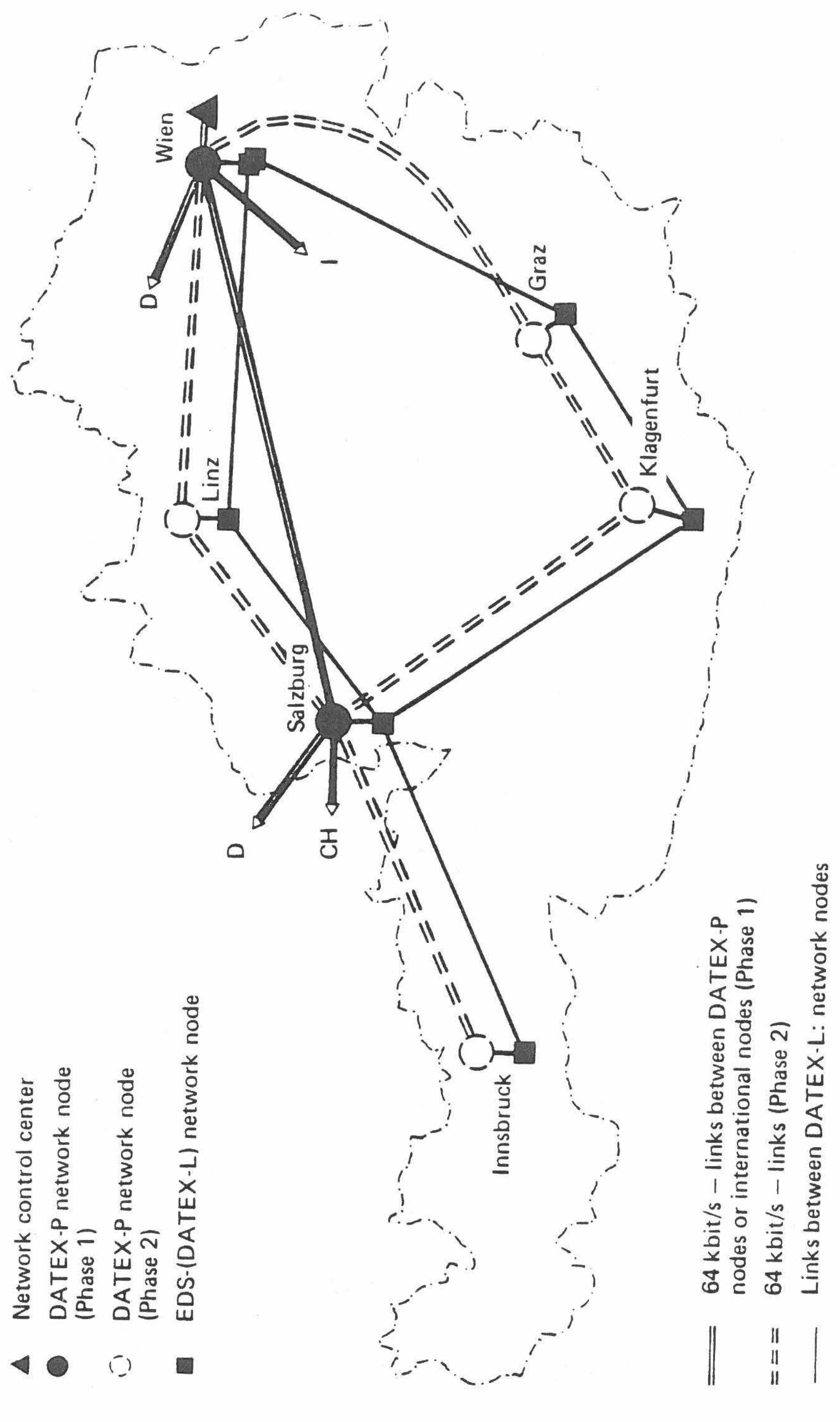


Figure 3. The Austrian PTT packet switched data network DATEX-P and its link to DATEX-L.

- 2400, 4800, 9600 bit/sec for synchronous, character oriented DTEs with interfaces according to CCITT Rec. X.21, also over direct links or the circuit switched data network. The necessary protocol transformation is also handled by the packed switched network.

b) Further characteristics:

- speed conversion
- address multiplex techniques
- protocol conversion
- gateways to other data networks
- call establishment in less than 400 msec
- data transfer delay of network less than 100 msec

c) Special services provided for limited periods:

- directed traffic (sent or received only)
- connection authorization
- closed user group options
- definition of maximum packet length
- concentrator connection
- direct dialing
- flow control options, etc.

d) Special services for all users during any session:

-- request for taking over payment

-- setting of flow control parameters

Interworking between DATEX- P and DATEX- L

Interworking of DTE's of DATEX-P and DATEX-L is in principle possible, according to the following scheme (Figure 4).

Figure 4. Connection possibilities between DATEX-L and DATEX-P

		DTE DATEX-P (X.25)				DTE (X.20)* asynchronous		DTE (X.21)* synchronous	
Called DTE	calling DTE	Direct terminal	Direct host	Direct host (64 KByte/s)	DATEX-L	Direct	DATEX-L	Direct	DATEX-L
DTE DATEX-P (X.25)	Direct terminal	●	●	●	●	●	●	●	●
	Direct host	●	●	●	●	●	●	●	●
	Direct host (64 KByte/s)	●	●	●	●	●	●	●	●
	DATEX-L (direct call)	○	○	○	X	○	X	○	X
DTE (X.20)* asynchronous	Direct	●	●	●	●	●	●	X	X
	DATEX-L (switched)	○	○	○	X	○	X	X	X
DTE (X.21)* synchronous	Direct	●	●	●	●	X	X	●	●
	DATEX-L (switched)	○	○	○	X	X	X	○	X

● possible

○ implementation may be at later point

X not planned

* realized through the PAD function of DATEX-P

Interconnections between DATEX-P network nodes and connections to international packet switched data are provided by 64 kbit/s links.

e) International connections from DATEX- P (country code Austria: 232)

At the end of 1982 the DATEX-P network is interlinked with the West German DATEX-P network (country code: 262) and for 1983 it is planned to make connection to the Swiss PTT packet switched data network (country code: 228). Through the West German network when agreement with the respective PTT is achieved it will be possible to reach the following PTT networks: The Netherlands (202), Belgium (206), France (208), Spain (214), Italy (222), United Kingdom (234), Denmark (238), Sweden (240), Luxembourg (270), Ireland (272), Canada (303), USA (310), Japan (440). Connection of the DATEX-P network to oversees will most likely be done through the node of RADAUS in Vienna.

f) Application to the service

Applications are sent in a letter to the responsible PTT Directorates:

PTD Vienna, Abt. 17, Bäckerstrasse 1, A-1010 Wien

PTD Linz, Abt. 5, Huemerstrasse 4, A-4020 Linz

PTD Innsbruck, Abt. 6, Maximilianstrasse 2, A-6010 Innsbruck

PTD Graz, Abt. 6, Neutorgasse 46, A-8011 Graz

PTD Klagenfurt, Abt. 4, Sterneckstrasse 19, A-9020 Klagenfurt

3.4.4. Telepost

A facsimile service (Telepost) with group 2 equipment has been offered since 1981. In the initial phase, equipment are located in 60 post offices, further 13 are to be connected soon. Compatible equipment for use in subscribers premises are approved so that a facsimile service (Telefax) may also be provided. The transmission time for an A4 page over the PSTN of analogue facsimile data is 3 minutes, and the telepost service guarantees that the recipient will receive the transmitted page in about 3 hours.

The cost of this service is Austrian Schillings 45 for the first page and 25 for any subsequent pages. Major advantage of the system is that telepost is faster than express mail and it is cheaper than telegrams, in addition also drawings can be transmitted.

3.4.5. Videotex (Bildschirmtext)

The Austrian videotex trial (called Bildschirmtext) with 300 participants started in 1981. The national videotex network is a starlike system with a central GEC computer located at the FZA in Vienna. As an experiment, the German version of the British Prestel system--with alphamosaic coding--was taken over. Telephone connection from all over Austria is provided for local call charges.

a) Technical characteristics of the trial system:

- Transmission speed: videotex computer to subscriber 1200 bit/sec, subscriber to videotex computer 75 bit/sec

- Transmission mode: asynchronous, duplex
- Transmission code and protocol: videotex code according to Prestel (10 bit/character; startbit, 7 databits, parity bit, stop-bit), higher level protocols also according to Prestel.

b) Applications supported in the:

- information retrieval
- message sending including gateway to traditional mail service (expected to start in 1983)
- transactions, ordering
- games
- teleprograms.

c) Terminals

All equipment, such as TV and editing computers have to be approved by the PTT. Among the terminals in use is MUPID, the first intelligent videotex decoder in the world developed by the Technical University of Graz at the request of the PTT, and with the support of the Federal Ministry for Science and Research, which allows a number of new original applications. MUPID is also used to provide the experimental gateway function to external service computers, such as to a bank computer [7,8].

Future Plans

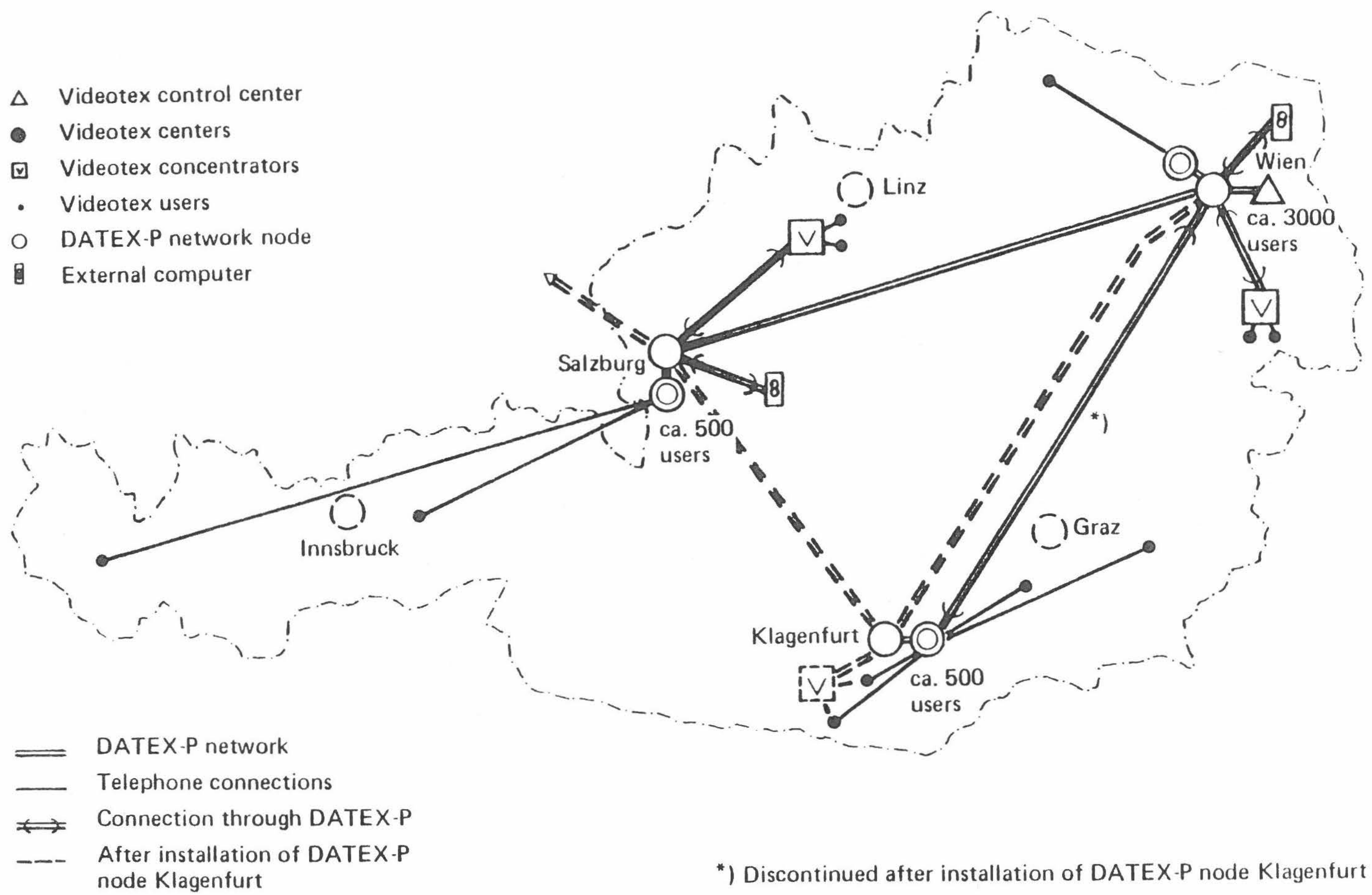
The first national videtotex system will be put into operation in 1984. Austria is taking over the new CEPT videotex standard for its new system. The data communication backbone of the service will be the national

DATEX-P packet switched network with speeds of 64 kbit/sec (Figure 5). Transmission speed between terminals and videotex center will be the classical 1200/70 bit/sec asynchronous full duplex, and 2400 bit/sec in asynchronous and duplex transmission mode. Connection through the DATEX-L and DATEX-P network and through the teletex service will be possible too. Links to videotex networks abroad will also be provided through the DATEX-P network. The PTT hopes that videotex in Austria will have 4000 subscribers in 1984 which would grow to 100,000 subscribers not before 1987. In the first version of videotex 100,000 frames of information will be stored and an additional 30,000 frames will be reserved for messages and transactions.

3.4.6. Teletex Services

Teletex in Austria i~ based on the DATEX-L 2400 synchronous service of the Austrian PTT. By this transmission, messages of A4 format take less than 10 seconds. Gateways to the national and international telex networks will be provided. First links to the FRG teletex service were established in August 1982. Connection to other national teletex networks are also envisaged, such as to Switzerland and Italy, and over Germany to Sweden. In countries such as the United Kingdom, the Netherlands and France, where teletex will be based on the national packet switching service, connection through X.71 is foreseen, as is a connection to the future Hungarian teletex system. The introduction of teletex took place in 1982, when the appropriate DATEX-L 2400 synchronous services were introduced.

a) Technical characteristics:



*) Discontinued after installation of DATEX-P node Klagenfurt

Figure 5. Phase 1 of the Austrian national videotex network in 1984.

-- Transmission speed: 2400 bit/sec (according to CCITT recommendation X.1 class 4)

-- Transmission mode: synchronous, duplex

-- Transmission code and protocol: teletex protocol with the following CCITT recommendations (Figure 6)

- X.21 -- interface between data terminal equipment and data circuit terminating equipment for synchronous operation on public data network
- S.70 -- network independent basic transport service for teletex (in connection with X.75)
- S.62 -- control procedures for teletex
- S.61 -- character repertoire and coded character sets for the international teletex service
- S.60 -- terminal equipment for use in the teletex service
- F.200 -- Teletex service.

4. LEASED PRIVATE CIRCUITS

4.1. General Information

Private leased telegraph, telephone, and wideband circuits are available from the PTT. All equipment operated in conjunction with private leased circuits is subject to a PTT license. Access of private leased circuits to the public networks may be authorized, in which case increased rental tariffs are payable.

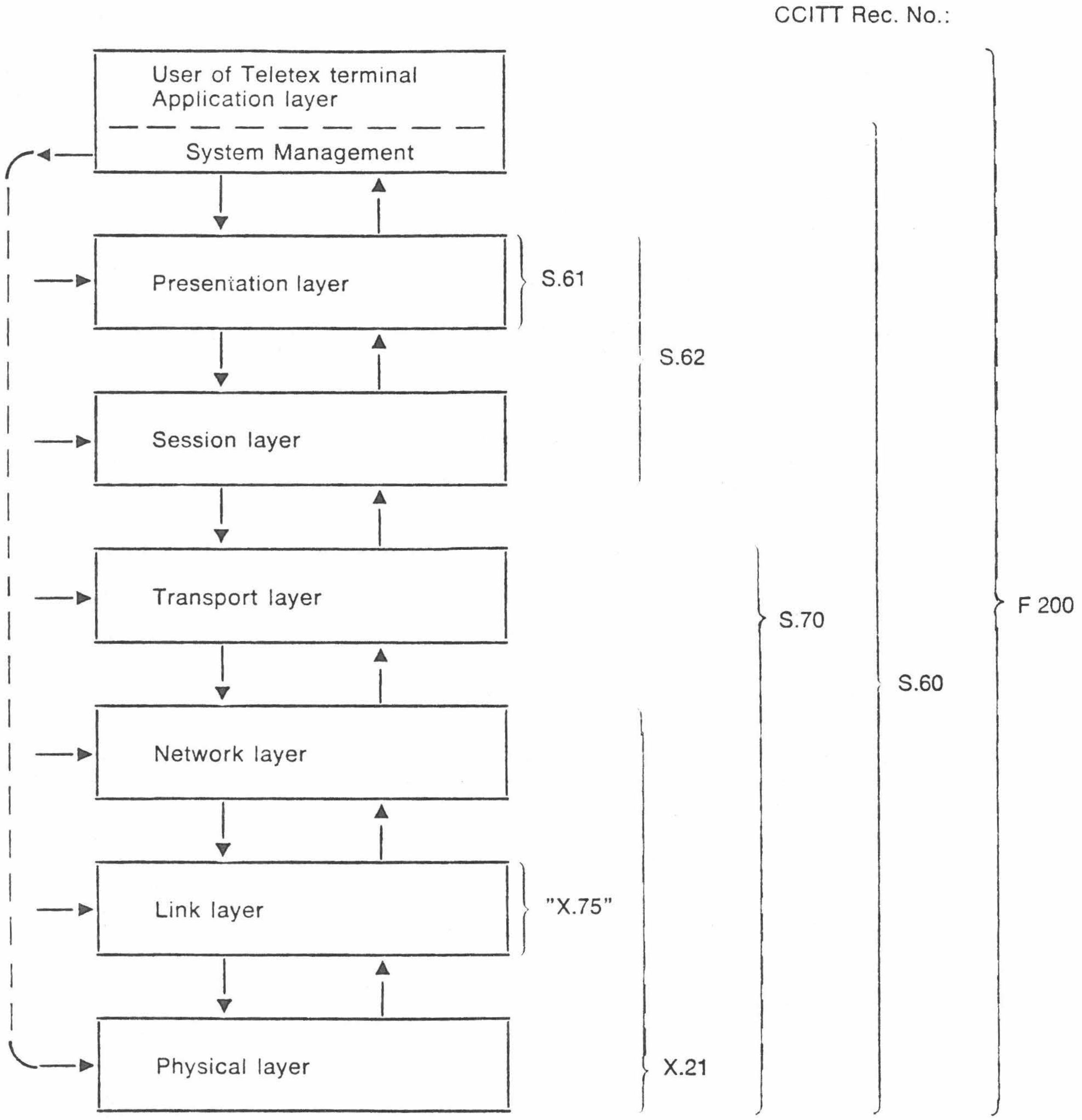


Figure 6. CCITT recommendations relevant to Teletex.

4.2. Telegraph Circuits

Telegraph circuits are available for serial and digital transmission up to 200 bauds. Two-wire and four-wire connections can be provided. All data terminal equipment for telegraph circuits has to be provided by the subscriber.

4.3. Speech Band Circuits

Private leased telephone circuits with two-wire or four-wire connections can be provided by the PTT. Normal and special quality (CCITT M1020) circuits are available, the latter normally being required for transmission in excess of 2400 bit/s up to 9600 bit/s.

Multipoint configuration circuits can be provided by the PTT using PTT branching equipment. Up to six remote stations can be connected to a central station.

4.4. Wideband Circuits

Depending on the exact location of the terminal sites, wideband circuits of bandwidths 48 kHz, 240 kHz, 5MHz, and 10 MHz can be provided.

5. INTERNATIONAL SERVICES

5.1 General Information

When discussing the different data and other telecommunication services earlier references were made to international connections. In this chapter we give a summary of those and describe the present status quo of international links and policy implementations with hints to future directions.

Data transmission is possible internationally via the telex network, the PSTN, the different data networks or international private leased circuits. Private leased circuits for international transmission can be provided to normal voice grade quality or the specially conditioned CCITT M-1020 quality.

5.2. Present and Proposed Public Data Network Interconnections

It is planned that the new Austrian Public Data Network, based on Siemens circuit-switched EDS exchange on the one hand (DATEX-L), and the Canadian made Northern Telecom public packet switched network on the other, will be increasingly interconnected to other national public data networks.

At the time of writing, the oldest domestic data network of the PTT in operation (DATEX-300L) is connected to similar data networks in the FRG and Switzerland. It can also be expected that the DATEX-L network will be interconnected with the Hungarian NEDIX network soon. The interconnection with the Hungarian asynchronous DATEX-300L network will not be particularly difficult. The higher speed synchronous connections (2400 bit/sec; 4800 bit/sec), however, will need a so-called "envelope conversion" with an envelope structure according to the CCITT X.50 recommendation on the Hungarian NEDIX network and an envelope structure according to the CCITT X.51 recommendation on the Austrian DATEX-L network. Because of relevant CCITT recommendations the conversion has to be performed by the Austrian PTT.

The DATEX-P PTV packet switching network is planned to be linked to other PTT packet switching networks, with links to the West German

DATEX-P network planned from the outset. Plans for a future connection to the EURONET network could not yet be realized because no agreement between Austria and the European Community in Brussels could be reached. Thus, the experimental node of the Austrian EURONET connection--run at the Technical University of Vienna--will not be able to provide public services for Austria. The experimental EURONET node of the University had a 9600 baud X.25 packet switching connections to the EURONET node in Frankfurt and ran on a PDP 11/34 computer. Early 1982 due to lack of agreement the line to Frankfurt and the pilot access project was cancelled. Plans for the interconnection of Western European PTT packet switched data networks, however, also exist and are shown in Figure 3.

The interconnection of these networks is proceeding well. According to [3]:

> DATEX-P, the German public packet switched data network, is already connected to Euronet as well as to TRANSPAC (France) and PSS, the British Packet Switched Service, and to Scandinavian (NORDIC network).
>
> This development is one further stage in the far-reaching plans of the European Postal and Telecommunications Administrations (PTTs) to improve international and, later, intercontinental telecommunications facilities, benefiting directly users of online information services.
>
> In Europe, France, the UK and the Federal Republic of Germany have installed international gateway systems which act as switches between their national networks and the rest of the world.

Interconnection of national packet switched data networks conforming to CCITT Recommendations
(including single node configurations providing full national coverage).*

	Austria	Belgium	Denmark	Finland	France	Germany, F.R.	Ireland	Italy	Luxembourg	Netherlands	Norway	Portugal	Spain	Sweden	Switzerland	UK	Euronet
Austria	82																
Belgium	83	81															
Denmark	84	84	83														
Finland	84	84	84	83													
France	83	82	84	84													
Germany, F.R.	83	82	84	84	81												
Ireland	84	84	84	84	84	84	83										
Italy	83	83	84	84	83	83	84	82									
Luxembourg	83	83	84	84	83	83	84	83	82								
Netherlands	83	82	84	84	82	82	84	83	83	81							
Norway	83	82	84	84	82	82	84	83	83	82							
Portugal	84	84	84	84	84	84	84	84	84	84	84	83					
Spain	83	82	84	84	81	81	84	83	83	82	82	84	81				
Sweden	83	82	84	84	81	81	84	83	83	82		84	82				
Switzerland	83	83	84	84	83	83	84	83	83	83	83	84	83	83	82		
UK	83	82	84	84	81	81	81	83	83	82	82	84	81	81	83		
Euronet	83*	82	84	84		81	84	83	83	82	82	84	82	81	83	81	

Operational

Initial service established mainly for I-and D-type traffic

Introduction of a national network is under consideration. However, packet switched services are available via Sweden.

Preliminary direcrt connection with UK from 1981. Possibility to access the same countries as UK and within the same timescale. Access from abroad to customers directly connected to the Dublin data centre.

Eurodata Foundation Yearbook 1981 £ 85.
Contact: Eurodata, Broad Street House, 55 Old Broad St., UK-London EC 2 M 1 RX.

Figure 7. Interconnection of West European national packet switched data networks.

world. The French International Transit Node (NTI) in Paris, for example, is already connected with the USA, all EEC countries and Switzerland through EURONET and by bilateral links to Spain, Portugal and the Antilles. Further connections include the Canadian networks DATAPAC and INFOSWITCH and the Japanese DDX-P.

British Telecom and the Deutsches Bundespost has similar plans and these three countries will probably constitute the main Western European switching sites for intercontinental traffic.

Naturally some countries may choose to operate their own international switching facilities, but others have already opted in the short-term to transit their international connections over Paris, London or Frankfurt.

The diagram (Figure 8) describes the probable shape of worldwide interconnections over the next few years, however it is by no means complete. This view is drawn with some modifications, from a comprehensive review of packet switched networks by Michael Casey [2].

The Austrian PTT network interconnection to DATEX-P would also be linked to this large mesh of emerging PTT networks.

Radio Austria--the second international carrier of Austria--established its data network node in 1978, and the first transmission service, called RADUSDATA, was between the USA and Austria [4]. During the first few years of its operation Radio Austria served as the Austrian node of the TYMNET network, which is one of the largest public networks in the US. The USA part of the TYMNET network has gradually been extended by

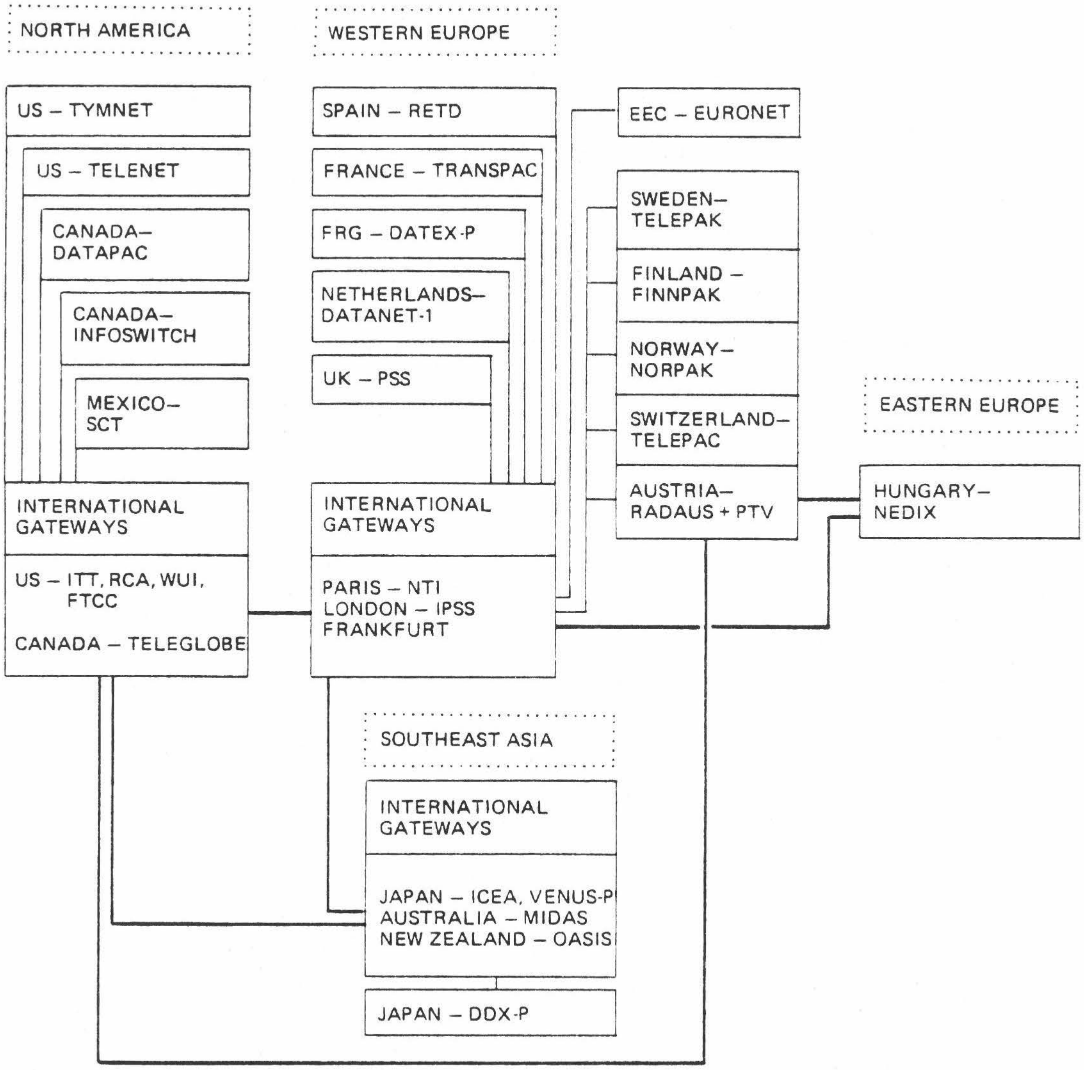


Figure 8. International network interconnections in Western Europe.

(probable shape)

leased lines between the USA and remote destinations outside the country, operated by US international carriers. The remote network nodes, usually operated by the national PTT or similar administrations, provide services to TYMNET and vice versa for domestic and US users respectively. This has been Radio Austria's main function in this field too: they have serviced a number of Austrian users seeking US databases and computational services, and have also provided the necessary technical means for foreign customers to obtain access to the Austrian TYMNET hosts, such as the International Atomic Energy Agency (IAEA) and their databases INIS and AGRIS; the International Patent Documentation Center (INPADOC) and their patent databases; and to IIASA's inhouse computers, to carry out joint research.

The increase in traffi on the TYMNET node of Radio Austria has been growing at a considerably high growth rate: over 150% per year (Figure 8). The data services of the Radio Austria node have been gradually extended according to an agreement between Radio Austria and the Austrian PTT. In 1981 a connection to the TYMNET node of Radio Swiss--the Swiss equivalent to Radio Austria in Bern--was established with the aim of increasing the reliability of the Vienna-New York cable connection by setting up a "reserve" route over the node in Bern. An interesting side effect of this link was that the first Swiss database host DATA-STAR (operated by Radio Swiss) could be accessed for the first time from Austria. This possibility urged for a special agreement between Radio Austria and the PTT and accordingly, under the present rules, Radio Austria may now establish and operate links to other data services in Europe on a temporary basis until such a time as the appropriate PTT data services are able to take over.

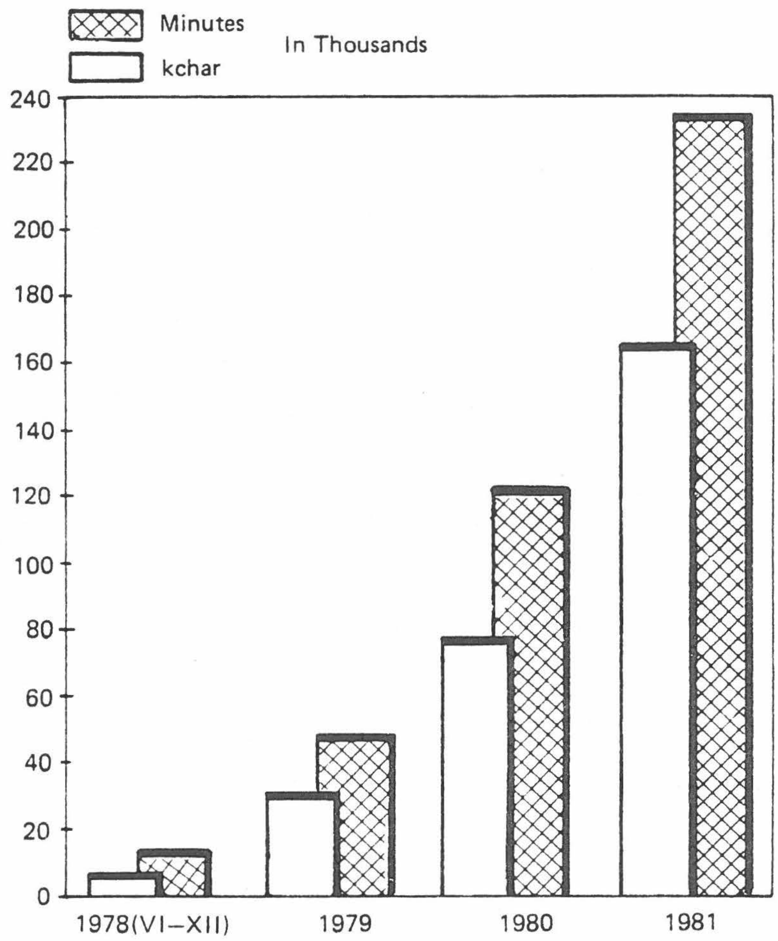


Figure 9 Data traffic of the TYMNET node of Radio Austria.

Along the same line , inter-European links have been established and are serviced by Radio Austria. The first link they took over was the direct IAEA-Europan Space Agency (ESA) link, which also became the first public data link between Austria and Italy. The protocol for data transmission corresponds with the packet switched protocol of the TYMNET network. This new connection was introduced at the beginning of 1982 and for the first time Austrian users were able to access some 40 bibliographical and statistical databases of the IRS service of ESA.

During the summer of 1982, further new links were put into operation. The connection between the Radio Austria node and the German DATEX-P network node in Frankfurt became available for the first time. Of course, this link to the West German PTT network also enabled the physical connection of all those networks to which the German PTT network was already connected, for example, to TRANSPACK in France, the PSS in the United Kingdom, and NORDIC, the Scandinavian network. In July 1982 the link with the Hungarian NEDIX-PTT network went fully into operation. About the same time, a separate cable link was opened between the TYMNET node and CTNE, the Spanish PTT administration, and through this link the Spanish packet switched PTT network hosts could be accessed and vice versa.

All in all, with the massive efforts of both Radio Austria and the Austrian PTT, Austria is gradually becoming integrated into the growing data communication infrastructure of the world.

6. AUSTRIAN TARIFFS

All tariffs are valid from the 1st January 1982 and are quoted in local currency (Austrian Schilling AS). All services are free of tax.

6.1 Inland Tariffs

Exchange line service

	Monthly rental AS
Exchange line	160.00
Extra charge for data transmission	180.00

Connection charges are especially assessed on time and materials basis.

Inland telephone call charges

Charge per minute	Local (Same Area)	Trunk 1	Trunk 2	Trunk 3	Trunk 4
Kilometers	< 5	5-25	25-50	50-100	> 100
Standard rate (Mon-Fri 0800-1800)	0.50	1.00	4.00	6.50	7.50
Reduced rate (Mon-Fri 18.00-08.00) (Fri 18.00-Mon 08.00)	0.50	0.50	3.00	4.00	5.00

Telex

Installation fee:	Includes actual costs but with a minimum of AS 1,750.--
	Monthly rental AS
Telex line	300.00
Maintenance charge (per telex machine)	550.00

Note: Telex machine maintenance is available from PTV and the rate sometimes varies, depending on the installation. The rate quoted is the normal rate for maintenance.

Inland telex call charges

Charge for each 3 minute period or part thereof	Local (same exchange) AS	Trunk 1 (same province) AS	Trunk 2 (adjacent province) AS	Trunk 3 (non-adjacent province) AS
Standard Rate (08.00-18.00)	0.85	5.10	10.20	12.75
Reduced Rate (18.00-08.00)	0.85	3.40	6.80	8.50

Note: Non-local telex call charges given in the above table are based on the division of Austria into nine autonomous Provinces (Bundeslaender), the Provinces of Vienna and Lower Austria counting as a single Province for charging purposes.

Datex-L 300 (DDL 300)

Installation fee:	actual costs but with a minimum of AS 1,750.--
	Monthly rental AS
Datex line (300 bit/s)	650.00

Datex call charges (300 bit/s)

Charge for each 3 minute period or part thereof	Local (same exchange) AS	Trunk 1 (same province) AS	Trunk 2 (adjacent province) AS	Trunk 3 (non-adjacent province) AS
Standard rate (08.00-18.00)	1.275	7.65	15.30	19.125
Reduced rate (18.00-08.00)	1.275	5.10	10.20	12.75

In 1983 a new DATEX-L tariff structure will be introduced and will consist of the following time charges:

Charge for each minute or part thereof	Local (same Datex exchange) AS	Trunk 2 (Austria wide) AS	International (FRG, Switzerland) AS
Standard rate (08.00-18.00)	-.90	4.20	6.06
Reduced rate (18.00-08.00)	-.60	2.82	6.06

Note: For every successful call an additional AS -.30 will be charged.

DDL-300

	AS
Installation fee:	Minimum 1,750.--
Monthly rental:	120
Monthly line charges per km:	
Less than 10 km	150
Between 10-50 km	75
Between 51-100 km	65
More than 101 km	30

Bildschirmtext (Videotex)

	AS
Installation fee:	750
Monthly modem rental:	200
Connection fee to videotex center:	local phone tariff
Access charge per frame:	defined by Information provider (between 0-50)
Monthly charge for Information providers:	100 (incl. 10 free frames)
Monthly frame reservation charges:	AS per frame
Between 11-100	7
Between 101-500	6
Between 501-1000	5
More than 1001	3
Closed user group:	500 per month
MUPID terminal rental:	90 per month

Telepost

First page (A4 format or smaller)	AS 45
Subsequent pages (A4 or smaller)	AS 25

Connection charges are specially assessed on time and materials basis.

Additional charges on the above tariffs are:

1. For data transmission usage 25% increase
2. For multi-user usage 50% increase

3. Provision of access to PSTN	AS 2,000 per month
4. Circuits to M1020 quality	AS 4,000 per month

Multipoint circuits

Multipoint configuration circuit tariffs are specially assessed. Reference to PTV should be made.

Wideband circuits

Monthly rental	48 KHz AS	240 KHz AS
First 10 km per 100 meters	150.00	650.00
Next 40 km per km	1,300.00	5,000.00
Next 50 km per km	1,000.00	4,000.00
Further kms per km	500.00	2,000.00

Wideband circuits are subject to a minimum lease period of one month. Connection charges are specially assessed on a time and materials basis. Additional charges on the above tariffs are:

1. For other type of communication (e.g., speech, facsimile) in addition to data transmission	25% increase
2. Multi-user usage	50% increase

Tariffs Planned for New Services

At the time of writing no revenues are collected for a number of the new services outlined above. It is planned to start charging users in the middle of 1983; thus exact tariffs will only be introduced at that time.

However, we provide a preliminary tariff structure for these services in the following.

DATEX-L Synchronous (2400, 4800, 9600 bit/sec)

1. Installation fee: Actual costs but with a minimum of AS 1,750.--

2. Monthly charges per station in AS:

	Transmission speed in bit/sec		
	2400	4800	9600
Monthly rental	1300	2200	4000
Special services --closed user group	200		

3. Connection charges in AS (between 1800 and 0800; night fares being reduced by one-third).

	Transmission speed in bit/sec		
	2400	4800	9600
Charges per minute - Regional (within the same DATEX exchange)	3.60	5.70	7.86
- National wide service	6.90	10.98	15.06

4. Gateway service from DATEX-L to DATEX-P AS 200 per month

DDL-Synchronous

1. Installation fee: Actual costs but with a minimum of AS 1,750.--

2. Monthly charges per station in AS:

	Transmission speed in bit/sec			
	2400	4800	9600	48000
Monthly rental	1300	2200	4400	6000
Line charges --regional --national		 2600 5800		

DATEX-P

1. Installation fee: Actual costs but with a minimum of AS 1,750.--

2. Monthly charges per station in AS:

	Transmission speed in bit/sec				
	300	2400	4800	9600	48000
Monthly rental	650	1300	2200	4000	6000
Additional charge per virtual channel	40				
Special services --closed user group --"toll-free" call service	 200 100				
Gateway between DATEX-L and DATEX-P	200	200	200	200	---

3. Connection charges in AS (reduced by 33.3% during the period 18.00 and 06.00)

	Transmission speed in bit/sec				
	300	2400	4800	9600	48000
Connection charge per minute --regional --national	 0.06 0.10	 0.08 0.14	 0.10 0.19	 0.14 0.26	 0.30 0.56
Volume charges per 1000 segments* --regional --national			 14.00 26.00		

*1 segment = 64 Octetts = 512 bits

DDP

1. Installation fee: Actual costs but with a minimum of AS 1,750.--

2. Monthly charges per station in AS:

	Transmission speed in bit/sec				
	300	2400	4800	9600	48000
Monthly rental*	650	1300	2200	4000	6000
Additional charge per virtual channel					
--regional	250	340	420	590	1260
--national	420	590	800	1100	2350

3. Usage charges in AS (reduced by 33.3% between 18.00 and 06.00)

	Transmission speed in bit/sec				
	300	2400	4800	9600	48000
Volume charges per 1000 segments**					
--regional			14.00		
--national			26.00		

*If DATEX-P channels are also rented there are no DDP charges.
**1 segment = 64 octetts - 512 bits.

Teletex

1. Telex charges are identical with those of DATEX-L 2400 synchronous.

2. Charges for gateway teletex/telex connections are according to the telex tariffs in both directions. This also holds for international connections.

Inland Private Leased Circuits

Telegraph circuits (2-wire)

Monthly rental	50 bauds AS	100 bauds AS	200 bauds AS
First 10 km per 100 meters	15.00	15.00	15.00
Next 40 km per km	50.00	60.00	75.00
Next 50 km per km	40.00	45.00	65.00
Further kms per km	20.00	25.00	30.00

Note: Telegraph circuits (4-wire) are charged at double the above tariffs and connection charges are specially assessed on time and materials basis. There is an extra charge for provision of access to the Public Telex Network of AS 2,000.-- per month.

Speech Band Circuits

Point-to-point Circuits

Monthly rental	Normal quality (2-wire) AS	Normal quality (4-wire) AS
First 10 km per 100 meters	15.00	30.00
Next 40 km per km	125.00	250.00
Next 50 km per km	100.00	200.00
Further kms per km	50.00	100.00

6.2 International Tariffs

Tax: All services are free of tax

Country	Telex call charges: No of secs for 0.85S	Telex call charges: Charge per minute S	Telephone call charges: Min charge 3 mins S	Telephone call charges: Automatic service zone	Operated connected service: Charge per minute S	Operated connected service: Min charge 3 mins S
Albania			86.40	—	25.—	75.—
Andorra	10.0	5.10		2	17.—	51.—
Balearic Islands	8.2	6.23		3	20.—	60.—
Belgium	10.0	5.10		2	17.—	51.—
Bulgaria	8.2	6.23		—	25.00	75.00
Canary Islands	8.2	6.23		3	20.—	60.—
Cyprus	6.7	7.65		3	20.—	60.—
Czechoslovakia	10.0	5.10		1	14.—	42.—
Denmark	10.0	5.10		2	17.—	51.—
Faroe Islands	10.0	5.10		2	17.—	51.—
Finland	8.2	6.23		3	20.—	60.—
France	10.0	5.10		2	17.—	51.—
German Democratic Republic	10.0	5.10		2	17.—	51.—
German Federal Republic — Band 1	10.0	5.10		1	14.—	42.—
— Band 2				2	17.—	51.—
Gibraltar	8.2	6.23		—	20.—	60.—
Greece	8.2	6.23		3	20.—	60.—
Hungary	10.0	5.10		1	14.—	42.—
Iceland	6.7	7.65		3	20.—	60.—
Ireland	8.2	6.23		3	20.—	60.—
Italy — Band 1	10.0	5.10		1	14.—	42.—
— Band 2				2	17.—	51.—
Liechtenstein	10.0	5.10		1	14.—	42.—
Luxembourg	10.0	5.10		2	17.—	51.—
Malta	6.7	7.65		3	20.—	60.—
Monaco	10.0	5.10		2	17.—	51.—
Netherlands	10.0	5.10		2	17.—	51.—
Norway	8.2	6.23		3	20.—	60.—
Poland	10.0	5.10		2	17.—	51.—
Portugal	8.2	6.23		3	20.—	60.—
Rumania	8.2	6.23		—	17.—	51.—
San Marino	10.0	5.10		2	17.—	51.—
Spain	8.2	6.23		3	20.—	60.—
Sweden	8.2	6.23		3	20.—	60.—
Switzerland	10.0	5.10		1	14.—	42.—
Tunisia	6.7	7.65		3	15.00	45.00
Turkey	6.7	7.65		3	15.00	45.00
United Kingdom	8.2	6.23		3	20.—	60.—
USSR	6.7	7.65		3	15.00	45.00
Vatican City	10.0	5.10		2	17 —	51.—
Yugoslavia — Band 1	10.0	5.10		1	14.—	42.—
— Band 2				2	17.—	51.—
Algeria	6.7	7.65		3	15.00	45.00
Argentina		72.00		5	56.00	168.00
Australia		72.00		5	56.00	168.00
Brazil		72.00		5	56.00	168.00
Canada		40.00		4	41.00	123.00
Colombia		72.—		5	56.—	168.—
Ecuador		72.—		5	56.—	168.—

International Tariffs continued

Country	Telex call charges: No of secs for 0.85S	Telex call charges: Charge per minute S	Telephone call charges: Min charge 3 mins S	Automatic service zone	Operated connected service: Charge per minute S	Operated connected service: Min charge 3 mins S
Egypt		54.—		4	41.—	123.—
Gabon		72.—		5	56.—	168.—
Indonesia		72.00		5	56.00	168.00
Iran		54.00		4	41.00	123.00
Iraq		54.00		4	41.00	123.00
Israel		40.00		4	41.00	123.00
Japan		72.00		5	56.00	168.00
Korea Republic of		72.—		5	56.—	168.—
Kuwait		54.00		4	41.00	123.00
Lebanon		40.00		4	41.00	123.00
Libya		7.65		3	15.—	45 —
Morocco		7.65		3	15.—	45.—
New Zealand		72.—		5	56.—	168.—
Nigeria		72.00		5	56.00	168.00
Philippines		72.—		5	56.—	168.—
Saudi Arabia		54.00		4	41.00	123.00
South Africa		72.00		5	56.00	168.00
Syria		40.—		4	41.—	123.—
United Arab Emirates		54.00		4	41.00	123.00
USA		40.00		4	41.00	123.00
Venezuela		72.00		5	56.00	168.00

Charge per minute (Automatic services)	S
Zone 1	9.00
Zone 2	11.50
Zone 3	14.00
Zone 4	40.50
Zone 5	55.50

International Leased Circuit Tariffs

The tariffs below represent only amounts payable to the Austrian Administration.

Short term rentals are possible for both national and international private leased circuits. The tariffs for temporary leases of international circuits are calculated on the basis of CCITT Recommendation D1 and are as follows:

1st & 2nd day	1/10 of normal monthly rental
For each of the next 8 days	1/20 of normal monthly rental
Thereafter	1/25 of normal monthly rental

International Leased Line Rates (AS/month)

Country	Speech band Coefficient 1	Speech band Coefficient 0.75	Speech band M1020 quality Additional rental	200 bauds	100 bauds	50 bauds
Belgium	38.304.00	28.728.00	1.425.00	15.321.60	11.491.20	9.576.00
Bulgaria	37,346.40	28,009.80	1,425.00	14,938.60	11,204.00	9,336.60
Cyprus	54.583.20	40,937.40	1,425.00	21,833.30	16,375.00	13,645.80
Czechoslovakia	28.728.00	21,546.00	1,425.00	11,491.20	8,618.40	7,182.00
Denmark	40,219.20	30,164.40	1,425.00	16,087.70	12,065.80	10,054.80
Finland	48,358.80	36,269.10	1,425.00	19,343.60	14,507.70	12,089.70
France	38,304.00	28,728.00	1,425.00	15,321.60	11,491.20	9,576.00
German Democratic Republic	31,122.00	23,341.50	1,425.00	12,448.80	9,336.60	7,780.50
German Federal Republic	32,558.40	24,418.80	1,425.00	13,023.40	9,767.60	8,139.60
Greece	45,007.20	33,755.40	1,425.00	18,002.90	13,502.20	11,251.80
Hungary	27,770.40	20,827.80	1,425.00	11,108.20	8,331.20	6,942.60
Italy	33,516.00	25,137.00	1,425.00	13,406.40	10,054.80	8,379.00
Luxembourg	37,346.40	28,009.80	1,425.00	14,938.60	11,204.00	9,336.60
Netherlands	38,782.80	29,087.10	1,425.00	15,513.20	11,634.90	9,695.70
Norway	45,964.80	34,473.60	1,425.00	18,386.00	13,789.50	11,491.20
Poland	32,079.60	24,059.70	1,425.00	12,831.90	9,623.90	8,019.90
Rumania	32,079.60	24,059.70	1,425.00	12,831.90	9,623.90	8,019.90
Spain	45,007.20	33,755.40	1,425.00	18,002.90	13,502.20	11,251.80
Sweden	40,698.00	30,523.50	1,425.00	16,279.20	12,209.40	10,174.50
Switzerland	36,388.80	27,291.60	1,425.00	14,555.60	10,916.70	9,097.20
Turkey	51,710.40	38,782.80	1,425.00	20,684.20	15,513.20	12,927.60
United Kingdom	44,049.60	33,037.20	1,425.00	17,619.90	13,214.90	11,012.40
USSR	36,388.80	27,291.60	1,425.00	14,555.60	10,916.70	9,097.20
Yugoslavia	30,643.20	22,982.40	1,425.00	12,257.30	9,193.00	7,660.80
USA and Canada	91,200.00	—	1,425.00	36,480.00	27,360.00	* 22,800.00

*75 baud: 25,080.00

International Tariffs

Tariffs for Data Services Provided by Radio Austria

Charges in AS	Country FRG (DATEX-P) & via it to France & UK	Switzerland (Radio Swiss-DATASTAR)	Italy (ESA, Frascati)	North-America (USA, Canada)
Traffic charges for every started minute through telex PSTN*, data network	1.80	1.80	3.00	6.00
Traffic charges for every started minute through dedicated line to Radio Austria	1.20	1.20	1.50	3.00
Volume charge for every started kilo-character of input or output	0.05	2.00	4.00	8.00

7. CONTACT POINTS

7.1 Fernmeldetechnisches Zentralamt (FZA)

FZA, the Telecommunications Engineering Centre, is the contact point for Permission to Attach Equipment, for Domestic and International Service information and can be contacted at:

Fernmeldetechnisches Zentralamt
Arsenal
1030 Wien

Telephone: 78 15 11 Extensions 280, 281, 284, 286
Telex: 133722

Both German and English languages are accepted for telexes and written communication.

7.2 Regional Directorates

For national service information for Vienna, Lower Austria, and Burgenland:

Post- und Telegraphendirektion fuer Wien,
Niederoesterreich und Burgenland
Baeckerstrasse 1
1010 WIEN

Telephone: 52 68 11
Telex: 112352

For Upper Austria and Salzburg:
Post- und Telegrahendirektion fuer Oberoesterreich
und Salzburg

Huemerstrasse 4
4020 LINZ

Telephone: 721
Telex: 21105

For Tirol and Vorarlberg:

Post- und Telegrahendirektion fuer Tirol
und Vorarlberg
Maximilianstrasse 2
6020 INNSBRUCK

Telephone: 26761
Telex: 53599

For the Steiermark:

Post- und Telegraphendirektion fuer Steiermark
Neutorgasse 46
8020 GRAZ

Telephone: 91 22 33
Telex: 31530

For Carinthia:

Post- und Telegraphendirektion fuer Kaernten
Sterneckstrasse 19
9020 KLAGENFURT

Telephone: 7951
Telex: 42338

8. THE AUSTRIAN DATA LAW

The first data protection law in Europe was introduced in 1969 in Hessen (FRG). In 1972 it was Sweden which followed this step. Later data laws were issued in France, Denmark, Laxenburg, Norway, the FRG. In the USA, Canada and new Zeeland there are data protection laws in force for certain application areas. From the socialist countries it was Hungary which first released a special data protection and security regulation in 1981. In international forums guidelines were issued by the OECD and the Council of Europe on the protection of privacy of computer readable information. There is a strong tendency to harmonize internationally the different data laws and regulations; this with special emphasis to the understanding of transborder data flow issues and the solutions of some of the problems involved.

Austria, a country with an open economy and open information flow, has issued its data protection law (Datenschutzgesetz or DSG for short) [8, 10] in 1978, and a novellation thereof is expected by 1984. The main emphasis of the data law lies on the protection of personal data, which includes in Austria also protection of data of so-called legal persons, such as of a company, a village, a country, etc.

Special emphasis is given to the transborder data flow of data, which according to the law has to be registered by the so-called Datenschutzregister, a registration instance belonging to the Central Statistical Bureau of Austria. Applications to such registration has to be submitted on special application form and for the registration entry charges have to be paid.

For the export of computer readable information including personal data with the intention of processing abroad according to § 32 - § 34 of DSG a permission from the Data Protection Commission (Datenschutzkomission) of the government (Vienna 1, Ballhauspl. 2) is needed. In the application for such permission the nature of the data to be exported has to be described, the aim of the export and the recipients of the data and it has to be explained how it is assured that the interests of the data subjects will be protected abroad.

The importing of computer data is free and is not subject of the data protection law.

The Federal Government and the so-called Data Protection Council of the National Assembly have to report to the National Assembly every two years on the issue of data protection. More on the Austrian DSG can be found in [12].

9. SUMMARY

Austrian data communication services are developing rapidly with a proliferation of different services being offered by the Austrian PTT and Radio Austria. According to the general policy of the administration in all seven layers of the ISO model for Open System Interconnection, different types of data services are provided by the PTT: the usual data services on the physical level, circuit and packet switching services up to layer 3, and finally teletex and videotex services up to the higher layers.

At the time of writing, the development phase of these new services were just completed, and it is hoped that they will provide sufficient infrastructure for future data communication both domestically and internationally. It is also expected that Austria will be able to successfully fulfill its special role in data communication between East and West.

ANNEX 1: LIST OF APPROVED MODEMS IN AUSTRIA

Coding of the So-called PTT-'Ordnungsnummer'

HHH	SSS	LLL	'PTV-ORDNUNGSNUMMER' (9-POSITION)
100	...	...	MAIN GROUP : DATA TRANSMISSION EQUIPMENT
...	SSS	...	CHARACTER GROUP
			1. POSITION: TRANSMISSON OVER 1. Public switched telephone network (PSTN) 2. Leased telephone lines 3. PSTN + leased lines 4. Radio link 5. Telex network 6. Leased telegraph network 7. Telex network + leased telegraph network 8. Special network 9. Others 2. POSITION: CONNECTION 1. Two wired 2. Four wired 3. Two or four wired (switchable) 4. Acoustic 3. POSITION: DATA TRANSMISSION SPEED 1. <= 50 BD 2. <= 75 BD 3. <= 100 BD 4. <= 300 BD 5. <= 1200 BD 6. <= 2400 BD 7. <= 4800 BD 8. <= 9600 BD 9. > 9600 BD
...	...	LLL	SEQUENTIAL NUMBERING IN THE MAIN GROUP

LIST OF APPROVED MODEMS BY THE AUSTRIAN PTT

As of 1982/11/12

Code-number	'Ordnungsnummer'	Type
		SAT / SCHRACK
0101	100 227 044	Codex 4800
0102	100 228 044	Codex 7200
0103	100 228 045	Codex 9600
0104	100 227 112	Codex LSI 48 I
0105	100 228 113	Codex LSI 96/V29
0106	100 228 114	Codex LSI 96/FP
0107	100 238 130	Codex SAT 8200
0108	100 228 128	Codex LSI 48FP
0109	100 115 140	Codex 5540, Codex 5544
0110	100 336 144	Codex 5510, Codex 5513
0111	100 238 150	19 K2 B J T
0112	100 225 151	5440
0113	100 336 153	M X 2400
0114	100 227 162	Modem CS 48 FP
0115	100 228 163	Modem Codex CS 96 FP
		IBM-AUSTRIA
0303	100 114 034	IBM 3976/2
0304	100 335 010	IBM 3976/3
0305	100 336 035	IBM 3977/1
0306	100 336 035	IBM 3977/2
0307	100 226 018	IBM 3978/2
0308	100 235 051	IBM MINI 12
0309	100 227 048	IBM 3878/14
0310	100 226 055	IBM 3872
0311	100 228 056	IBM 3875
0312	100 227 072	IBM 3874
0313	100 215 082	IBM MINI 6x6
0315	100 228 091	IBM 5979/L11 or L12
0316	100 611 004	IBM 3945
0317	100 227 142	IBM 3864 MOD.I
0318	100 226 141	IBM 3863 MOD.I
0319	100 228 143	IBM 3865 MOD.I and MOD.II
0320	100 116 146	IBM 3863 MOD.II
		TEKADE, NUERNBERG
0401	100 227 092	DTE 310
0402	100 228 093	DTE 320
0403	100 228 094	DTE 330
		ITT-Austria Datensysteme Ges.M.B.H.
*0501	100 314 005	GH 1101-H
*0502	100 335 003	GH 2002

*0503	100 335 025	GH 2002-H/J/N/K/L/Q
*0504	100 336 029	GH 2003-R
*0505	100 334 059	GH 1151 A,C
0506	100 335 058	GH 2052 A/B/C/F/G/K
0507	100 336 057	GH 2054 A/B/C/F/G/K
*0508	100 228 060	GH 2005
0509	100 238 079	DCB 9600
0510	100 237 099	4800-I
0511	100 315 106	GH 1161
0512	100 238 111	DCB 19200 H
0513	100 237 121	GH 2058
0514	100 228 120	GH 2082
0515	100 335 124	GH 2084
0516	100 336 123	GH 2084
0517	100 227 119	GH 2068
0518	100 238 137	DCB 19200 MK2
0519	S100 115 002	VT 1200 Bildschirmtextmodem (Videotex modem)
0520	100 228 159	Modem GH 2089

Datentechnik

*0601	100 236 012	4400/24 PB
0602	100 237 011	4400/48
0603	100 228 041	5500/96
0604	100 315 052	300
0605	100 236 053	24 LSI
*0606	100 227 054	COM-LINK II
0607	100 236 014	2200
0608	E100 224 003	Modem 300 - Four wire
0609	100 335 067	ARE MD6-12
0610	100 227 066	4500/48
*0611	100 238 084	COM-LINK II with SCRAMBLER
0612	100 237 096	27 LSI
0613	100 215 102	DM 600 D
*0614	100 237 098	4700/48
0615	100 113 100	PDM 20/40-A
0616	100 228 101	96 MULTI-Mode
0617	100 237 103	MPS 48
0618	100 336 104	26 LSI
0619	100 238 105	COM-LINK II with SCRAMBLER, VERS.A
0620	100 114 110	ARE MD 3
0621	100 238 115	COM-LINK IV
0622	100 228 118	MPS 9629
0623	100 111 127	ZPDM 10
0624	100 314 132	MPS 3021
0625	100 111 138	V20 ZPDM 20/40
0626	100 111 152	MODEM TV 19
0627	100 114 161	MD 300
0628	100 215 154	ZUE 300 (600)

NIXDORF, WIEN

0701	100 235 015	506

0702	100 335 030	506/09
0703	100 237 039	NGD 504
		AUSTRO-OLIVETTI
0801	100 334 008	TD 2330
0802	100 234 031	MD 200-M6
		PHILIPS-AUSTRIA
*0901	100 335 037	8 TR 652
*0902	100 336 043	8 TR 683
0903	100 235 049	DTE 201
*0904	100 314 065	SEMATRANS 202
*0905	100 237 070	SEMATRANS 1001
0906	100 335 075	SEMATRANS 1203
0907	100 336 089	SEMATRANS 2403
0908	100 227 117	SEMATRANS 4804
0909	100 228 116	SEMATRANS 9063
0910	100 314 125	SEMATRANS LSI 311/312
0911	100 238 129	SEMATRANS LSI 1012
0912	100 335 131	SEMATRANS LSI 1212
0913	100 238 136	SEMATRANS LSI 1011
0914	100 336 135	SEMATRANS 2405
0915	S100 115 001	D-BT02 BILDSCHIRMTEXTMODEM (Videotex Modem)
0916	100 314 024	D 200 E
0917	100 314 016	D 200 D
0918	100 23[illegible] 157	SEMATRANS LSI 1021
		SIEMANSDATA
1001	100 111 026	8340
1002	100 111 027	8341
1003	100 111 028	8342
1004	100 334 019	200-200 (8335)
1005	100 335 032	8331
*1006	100 336 042	8332
1007	100 235 050	GDN 4800
1008	100 335 087	8336 (600/1200)
1009	100 227 090	8333 (4800 A)
1010	100 238 107	N 10 (8353)
1011	100 314 109	8330 (300A)
1012	100 228 126	9600 TRANSDATA 8334
		HONEYWELL BULL AG.
1101	E100 114 001	TRADAN 1100
		THOMSON CSF, WIEN
*1202	100 314 020	TRC 598 B
*1203	100 335 036	TRC 585 B
*1204	100 335 036	TRC 586 B
		ING. MAYERHOFER, WIEN
1301	100 226 013	DATA PUMP 680 ADMD 0041

		NCR, WIEN
1401	100 235 069	C 752 100
1402	100 235 076	M 51-4-STD
1403	100 235 077	C 698 500
		CARDIAC-EKG COMPUTER SYSTEM
1501	100 111 134	EKD 4000 T, (AUSSENSTELLE)
1502	100 111 133	MUSE EKG, (ZENTRALSTELLE)
		GLOBOTRONIK
2401	100 238 147	IDS 6000 H
2402	100 238 148	IDS 6000 L
		ICA ING. FEGERL, WIEN
2601	100 111 139	ICAM 40P
2602	100 114 149	BUILT IN MODEM ICAM 300
		GEBRUEDER SCHOELLER
4001	100 238 155	BASE BAND MODEM SERIES 100
4002	100 238 156	BASE BAND MODEM SERIES 300
4003	100 228 158	PARADYNE T 96
4004	100 336 160	PARADYNE MODEM LSI 24B/V26

* Not for new connection.

ANNEX 2: PTT LEASED DATA COMMUNICATION EQUIPMENT

As of 1982/09/01

Code-Number	'ORDNUNGSSNUMMER'	Type
		Equipment of PTT
9901		DFG-300
9902		DAG-300V
9903		DAG-300X
9904		ED1-EDB
9905		ZM1-ZMB
9906		SES (B)
9987		DAG-1V with ADA
9988		DAG-1V
9989		DAG-1X

ANNEX 3: LIST AND CODING OF THE SO-CALLED PTT 'ORDNUNGSNUMMER' FOR THE DATEX NETWORK

HHH	SSS	LLL	'PTV-ORDNUNGSNUMMER' (9 POSITIONS)
104	...	...	MAIN GROUP: DATA TERMINATION EQUIPMENT (DTE)
...	SSS	...	CHARACTER GROUP
			1. POSITION: DATA TRANSMISSION OVER 1. Telex network 2. Leased telegraph lines 3. Telex network or leased telegram lines 4. Data network circuit switched (WDN-L) 5. Direct data network circuit switched (DDN-L) 6. (WDN-L) or (DDN-L) 7. Switched data network packet switched (WDN-P) 8. Direct data network packet switched (DDN-P) 9. (WDN-P) or (DDN-P) 0. Others 2. POSITION: TYPE OF INTERFACE BETWEEN DCE AND DTE 1. Two or four wired with ADOS 8 2. Multiwired Asymmetrical (V.28) with 25-pole connection (ISO 2210) 3. Multiwired Asymmetrical (V.10) with 15-pole connection (ISO 4903) 4. Multiwired symmetrical (V.11) with 15-pole connection (ISO 4903) 5. Integrated data transmission technique 0. Others 3. POSITION: DATA TRA. SPEED: ALPHABET: SYN-/ASYNCHRONOUS 1. 50 BIT/S; ITA Nr. 2; Asynchronous 2. <= 100 BIT/S; ITA Nr. 2; Asynchronous 3. <= 100 BIT/S; Other alphabet; Asynchronous 4. 300 BIT/S; ITA Nr. 5; Asynchronous 5. 2400 BIT/S; Synchronous 6. 4800 BIT/S; Synchronous 7. 9600 BIT/S; Synchronous 8. 48000 BIT/S; Synchronous 9. > 48000 BIT/S; Synchronous 0. Others
...	...	LLL	SEQUENTIAL NUMBERING OF THE MAIN GROUP

DTE CODE TABLE FOR DATEX DTES.

As of 1982/11/12

Code-number	'ORDNUNGSNUMMER'	Type
		IBM-Austria
03301	104 224 008	IBM 3101
03302	104 224 009	IBM 3705
03303	104 224 010	SYSTEM/7
		DATENTECHNIK
06301	104 224 023	HASSLER SP 300
		SIEMENSDATA
10301	104 224 013	IVR/CVR
10302	104 224 015	TD 967 X
10303	104 224 014	TD 966 X
10304	104 224 012	TD 968 X
10305	104 224 017	3974 X
10306	104 224 024	TD 9770
		THOMSON CSF, WIEN
12301	104 3[illegible] 011	TVT 6060
		SIEMENS-AUSTRIA
16301		PT80
		GENERAL ELECTRIC
31301	104 224 006	TN 200 KSR
31302	104 224 007	MC III
		I.P. SHARP
35301	104 224 020	ALPHA/LSI
		TU-WIEN
39301	E104 224 002	TR 100-S.NR. 55191
39302	E104 224 003	TR 100-S.NR. 37014
		GEBRUEDER SCHOELLER
40301	104 224 021	8318 ASR
		PHILIPSDATA
41301	104 224 016	P2000
41302	104 224 019	P5002
		VOEST
42301	104 224 026	LA 36
42302	104 224 027	VAX 11/780

		IIASA
43301	104 224 025	KFKI-TPA/70
		SPERRY-UNIVAC
44301	104 224 018	UTS10/T3510
		BUERO-MATIC
45301	104 224 022	ALPHATRONIC
		RM-ELEKTRONIC
58301	104 524 028	RME-TC

REFERENCES

[1] Fernmeldetechnisches Zentralamt (FZA), 1982. Official PTT Statistics.

[2] Casey, M., 1982. Packet Switched Data Networks. An International Review. To be published in Information Technology: Research and Development. Butterworths, London, United Kingdom.

[3] Anonymous, 1982. National Networks Interconnection, Euronet Diane News 26. Directorate General for Information Market and Innovation, CEC, Luxembourg.

[4] Annual Report, 1981. Radio Austria, AG.

[5] Austrian PTT, 1982. Allgemeines über: Telex, Datex-L, Datex-P, Teletex, Telepost, Pildschirmtext. Brochure DS 5080/1982 of the Austrian PTT, and the special brochures of the PTT about each individual data service. Brochures: DS 5081/1982, DS 5082/1982, DS 5083/1982, DS 5084/1982, DS 5085/1982, DS 5086/1982, and DS 5087/1982.

[6] Austrian PTT, 1982. Gebuehren fuer: Telex, Datex-L, Datex-P, Teletex, Telepost, Bildschrimtext. Brochure DS 5089/1982 of the Austrian PTT.

[7] Maurer, H.A., R. Posch, 1982. MUPID: An Austrian Contribution to the Development of Videotex. Report F88, TU Graz - IIG, Graz, Austria.

[8] Nationalrat, 1978. Bundesgesetz vom 18 Oktober 1978 über den Schutz personenbezogener Daten (Datenschutzgesetz - DSG). Bundesgestzblatt für die Republik Österreich, 1978/193, Vienna, Austria.

[10] Stadler, G., 1980. Die Bundesregierung informiert - Datenschutzgesetz. Bundeskanzleramt, Vienna, Austria.

[11] Eurodata Foundation, 1981, Eurodata Foundation Yearbook 1981. Eurodata, London, UK.

[12] Stadler, G., and T. Herzog, 1981. Data Protection: International Trends and the Austrian Example, IIASA CP-82-22, Laxenburg, Austria.

Chapter 3:

DATA COMMUNICATION IN BULGARIA — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

K. Arabadjian, P. Brakalova, I. Sebestyén, E. Tasheva and T. Todorov

DATA COMMUNICATION IN BULGARIA — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

K. Arabadjian, P. Brakalova, I. Sebestyén,
E. Tasheva and T. Todorov

0. INTRODUCTION

In a small country with an open economy such as Bulgaria the potential role of transborder data flows is enormous. In what follows the present and future data communication infrastructure of Bulgaria will be described and the relevant administrative procedures outlined. Special emphasis will be given to the present transborder data flow applications of the country, which are characterized, in addition to the "classical" flow of data for civil aviation, information, news agencies' data, and meteorological data networks, by an emerging data base production and service industry.

1. STATE OF THE TELE AND DATA COMMUNICATION NETWORK IN BULGARIA

1.1 The Telephone and Telegraph Network

At present the backbone of Bulgaria's data communication infrastructure is its telephone network. According to [1] in 1978 in Bulgaria there were 1,032,000 telephones in use, or in other terms the number of telephones per 100 inhabitants was 11.6; higher than in Hungary, Yugoslavia, or Turkey, but lower than in Czechoslovakia or Austria. The development of the telephone network has been especially rapid since World War II, and in particular during the last couple of years. Between 1970 and 1978 for example, the number of telephones more than doubled (from 473,000 to 1,032,000). The yearly development rate between 1977 and 1978 was 8.4%, a relatively high figure at international standards.

By the end of 1982, there was still no public data communication network in service in Bulgaria. As will be described in what follows, however, in 1984-1985 the introduction of the public packet switching data communication network —called BULPAC —is planned.

The present data communication users of the country use primarily switched or leased telephone lines. The characteristics of the lines are maintained according to the recommendations of CCITT. In Bulgaria, the Ministry of Telecommunications and the PTT guarantee — according to CCITT recommendations —the following speeds for data transmission:

- for data transmission on leased telephone lines up to 9600 bit/sec transmission speed;

- for data transmission on public switched telephone lines speeds up to 1200 bit/sec;
- for data transmission on leased and switched telegraph lines up to 50 bauds speed.

1.2 Basic Principles for Building up the National Data Communication Network BULPAC [3]

The Ministry of Telecommunications has been working on the project of a National Data Communication Network since 1975. Till the finalization and ratification of the relevant CCITT recommendations, the Ministry directed its main efforts towards extension of the existing telephone network so that it was able to carry low and medium speed data traffic.

First, new normatives and methodology documents were prepared. Then modems, channel measuring devices and other basic equipment for data communications were developed and implemented. In addition, systematic and complex measurements of the whole telecommunication network were carried out. As a result —as mentioned above —at present the telephone network ensures data transmission up to a speed of 9600 bits per second.

According to the new conception for the future Bulgarian public data communication network BULPAC, it is to be implemented according to the ISO model for open system architecture. It will be built up containing several levels, the first three forming the so-called transmission subnetwork, which will entirely correspond to the CCITT X.25 interface, namely:

- level 1: electrical and physical interface according to recommendation X.20 bis and X.21 bis (in a longer-term aspect according to X.20 and X.21);
- level 2: X.25 LAP-B and X.75 of CCITT;
- level 3: X.25/3 and X.75 of CCITT.

At the fourth, the so-called "transport" level of the network, the protocol must comply with the emerging international standards in this field.

1.2.1 Basic Requirements and Design of the Data Communication Network BULPAC

The BULPAC data communication network will be a public network accessible to both computer hosts and terminals, the latter operating in either synchronous or asynchronous mode. The switching nodes of the network have to support host and terminal access according to the CCITT "packet" protocol version issued in 1980 as well as user access according to the 3rd to 6th user classes of service (Recommendation X.1 of the CCITT) and operating in accordance with Recommendations X.3, X.28, and X.29 of the CCITT.

For international connections, a separate switching host, likely in Sofia, will provide for the interaction with other national packet switching networks according to Recommendations X.75, X.121, X.180, X.87, X.96, X.110, and X.150 of the CCITT.

Each of the seven switching node of BULPAC will be connected to three other nodes of the network in order to provide alternative routing (Figure 1). The system of packet routing will be adaptive, taking into account the criteria of shortest physical route, traffic load of the switching node to which the packets are being routed while setting up a given virtual connection, and length of the outgoing queues at this node.

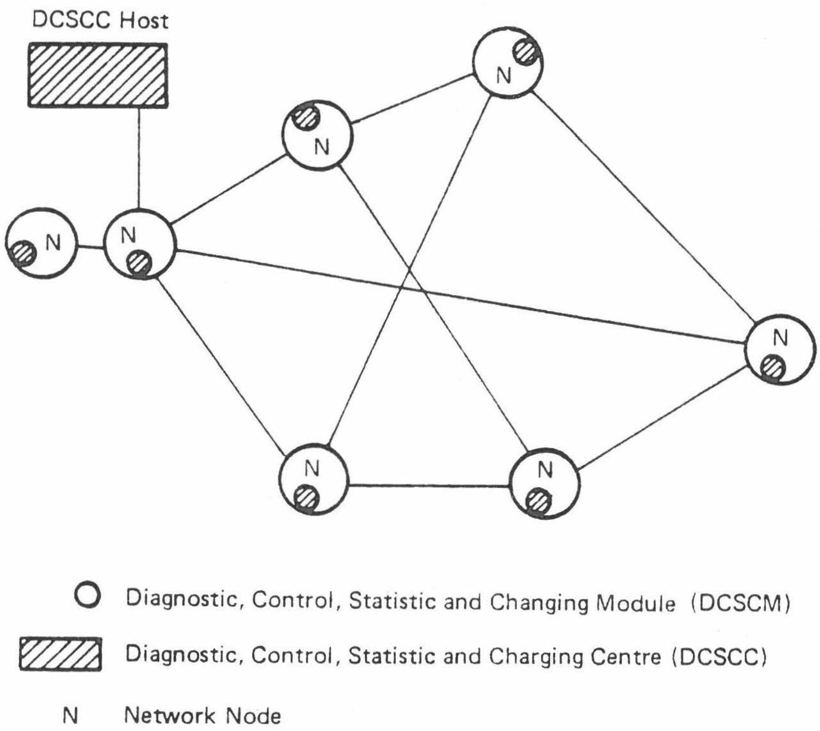


Figure 1. Functional structure of the diagnostic, control, statistic, and charging system of BULPAC network.

The incoming subscriber's line capacity will be from 24 to 70 subscriber lines per node. The subscriber lines of the node will enable information interchange between users and network at the maximum user speed of 9600 bits per second. If however baseband modems are to be used over physical lines up to a distance shorter than 35 km, even higher speeds are possible. The information interchange of 64000 bits per second between the network nodes will be carried out over wide-band telephone channels structured in so-called carrier primary groups of 60-108 kHz.

Each switching node will in addition perform the functions of a packet assembly/disassembly (PAD). The PAD module has to comply with Rec.X.28 and X.29; and its operational characteristics with the Rec.X.3 of the CCITT.

Each switching node will have a local module for control, diagnostics, statistics, and charging. This module, however, has to be part of the overall system of control, diagnostics, statistics, and changing, which must perform: diagnostics and statistics of its own node's traffic flows, as well as of those of the neighboring nodes; control and routing of incoming/outgoing user information flows; statistics of its users' requests for both established and unsuccessful connections; identification of both calling and called party; identification of the accessibility to the data communication network for a given user; permission for a given user to use optional facilities; billing of all established virtual connections; regular connection with the so-called Diagnostics, Control, Statistics, and Charging Center (DCSCC) for information interchange. The functions of the network have to comprise the logical levels 1 to 4 of the ISO model of open network architecture.

The DCSCC is to be connected to the other switching nodes of the network as a packet type remote host computer by means of dedicated permanent virtual channels (duplex operating at speed of 9600 bits per second). Functionally it must provide for:

- the control and routing of network information flows on the basis of data received from the different nodal modules of control, diagnostics, and charging;
- the centralized supervision and statistics of all the network parameters and grade of service, based on both data received from the nodal modules and its own;
- regular (once in every 30 seconds) supervision through the normal operation of all nodal modules of control;
- the function of a network databank containing data for: number of users registered as network subscribers; facilities offered to each of them; number and composition of closed user groups; number and duration of faults in the network; network trafficability and traffic statistics, etc.

1.2.2 Network Facilities

The BULPAC data communication network will provide for the following services according to Recommendation X.2 of the CCITT:

- switched virtual connection (VC);
- permanent virtual channel (PVC);
- closed user group;

- closed user group with incoming access;
- closed user group with outgoing access;
- possibility for a user to take part in up to three different closed user groups;
- both calling and called party identification;
- reverse charging;
- priority in servicing the users at three levels;
- circular transfer;
- possibility of operation with a length of the packet information field of 16-32-64 octets;
- possibility of requesting the network for a different window length at level 2 and level 3;
- possibility of choosing the class of efficiency for a given virtual connection.

With regard to the implementation of BULPAC, it is planned to put the network in operation by 1985-1986 [3].

2. THE RELEVANT ADMINISTRATIVE PROCEDURES AND TARIFFS FOR DATA COMMUNICATION

As mentioned earlier, the Ministry of Telecommunications laid down a number of so-called normative documents relating to data communication on subjects such as:

(a) the order of requesting and issuing licenses to Bulgarian and foreign data communication equipment manufacturers for delivery and connection of data transmission and teleprocessing equipment to the Bulgarian telecommunication network;

(b) techniques for carrying out basic, operational, and diagnostic measurements of telegraph and telephone circuits for data transmission and modems operating at speeds up to 9600 bit/sec;

(c) the order of how to connect new subscribers to the telecommunication network;

(d) tariffs for connection rights and utilization of data transmission communication circuits.

2.1 Normative Rules on Request for Permission for Connection of Subscriber Equipment to the Bulgarian Communication Network for Data Transmission

When a given piece of equipment has to be connected to a communication circuit for digital information transmission, the subscriber has to apply to the Data Transmission Laboratory of the Bulgarian Ministry of Telecommunications (Address: Sofia 1000, 6, Gourko str., Bulgaria). The order for submission of the application and the granting of permission for the subscriber is regulated by the document: "*Rules and Normatives for Connection of Data Transmission Equipment to the Domestic Telecommunication Network*," which was ratified as a second normative document by the Ministry of Telecommunications in 1973 and published (in Bulgarian) in the State Newspaper No. 31 from 17 April 1973.

According to the regulations, to get permission for connection of a given device (computer, subscriber station, terminal concentrator, modem or other equipment) the manufacturer or the user of the device is obliged to submit to the Data Transmission Laboratory at the Ministry of Telecommunications two pieces of the equipment accompanied by a complete set of technical documentation. The Laboratory checks, according to the approved techniques, whether the technical parameters are in line with the appropriate CCITT recommendations. If the test results are positive, the Laboratory issues permission to connect the type of equipment to the domestic telecommunication network for an unrestricted time period. The detailed description of the technical requirements for data transmission equipment and devices are contained in a document ratified in 1972, entitled "*Uniform Requirements for Data Transmission Equipment*" issued by the Ministry of Telecommunication. This document is based on the appropriate CCITT recommendations for data transmission and is periodically updated and supplemented according to changes or new CCITT recommenda. ons.

2.2 Testing Techniques of Data Transmission Equipment and Circuits

In 1974 the *Scientific Institute for Research in Telecommunications* in Sofia, Bulgaria developed a variety of relevant methodic normative documents:

- "Techniques for telegraph and telephone (permanent and switched) circuit measurement for data transmission";
- "Techniques for measurement of signal conversion equipment, operating at 9600 bit/sec speed";
- "Techniques for measurement of data transmission equipment".

These documents have been approved by the Ministry of Telecommunications as obligatory methodic guidelines, according to which operational measurements of the communication circuits and the "Type" and "Check" measurements of the user devices are to be made.

Regarding the results of the checked characteristics in the above document, the CCITT recommendations were fully taken into account. In determining the ways to connect the measuring sets to the HF multiplex equipment of the telephone lines (and their adjustment), the specific characteristics of the Bulgarian multiplexing systems were considered. Other specific peculiarities of the structure and equipment of the Bulgarian communication telephone network are also considered, these have to be taken into account when performing the measurements, but they do not effect the qualitative parameters of the objects measured.

According to these guidelines, a 3-year measurement of the domestic communication network was performed in order to check its ability for digital data transmission at different speeds. The following parameters were checked: reliability of transmission, telegraph distortion factor, pulse noise level, residual attenuation of the circuit, amplitude-frequency characteristics and characteristics of signal propagation group time, stability of the carrier frequency on the data transmission circuit, and the impact of the kind of the physical telephone route (cable, radio-relay and telephone) and the kind of HF multiplex system on the enumerated parameters. As a result of the tests, several measures have been adopted for improving the transmission quality in some sections of the Bulgarian telecommunication network.

2.3 Permission and Tariffs of Connection and Utilization of the Telegraph and Telephone Circuits for Data Transmission

The appropriate normative documents developed and applied by the Bulgarian Ministry of Telecommunications were ratified by the Council of Ministers (20 May 1972) and the Committee for Economic Coordination. These documents have been supplemented and corrected by an order of the Ministry of Telecommunications — Central Board on Prices, dated 26 June 1979.

According to these documents, the tariffs included in any data transmission equipment (computers, multiplexers, modems, terminals subscriber stations, terminal concentrators, etc.) are determined by the sum of several components. These components are given below:

1. Services for supply of technical devices for connection, installation, and contr l:

   These rates have to be considered during the phase of service initiation; they do not significantly influence the network charges in everyday operation.

   a) Item *II.64**: for the investigation of the technical possibilities to install new data transmission equipment (DTE) 14.00 lv. is to be paid.

   b) Item *II.65*: for installation of a permanent (or temporary) DTE, the subscriber must pay:

* The numbering of each tariff component here corresponds to the numbering of the normative documents: "Data transmission network: Tariffs."

- 20.00 leva for an installation within 40 m from a PABX or the communication station;
- 5.00 leva for every additional 10 m (or part of 10 m) above 40 m;
- 6.00 leva when a telephone circuit is available for the DTE.

c) *Item II.66*: 45.00 leva have to be paid for measurement of data transmission equipment or correction modules which the data transmission subscriber wants to connect to the transmission network with the purpose of getting permission for upgrading of that connection.

2. Monthly subscription rates for the use of the data transmission network:

a) *Item II.67*: subscription rate for the use of the communication line, depending on its speed (see Table 1)

b) *Item II.68*: Telex network subscribers who operate equipment provided by the Ministry of Telecommunications for increase of transmission reliability pay additionally every month —30.00 leva

c) *Item II.69*: For periodical utilization of the data transmission circuit the subscriber pays:

- for utilization up to 10 days —40% of the corresponding monthly charges;

Table 1. Subscription rate for the use of the communication line.

Operation speed of data transmission equipment in bit/sec	Monthly charges in leva
up to 50	40.00
up to 100	60.00
up to 200	120.00
up to 300	140.00
up to 600/1200	200.00
up to 2400	400.00
up to 4800	750.00
up to 7200	1,600.00
up to 48000	7,000.00

- for utilization within 11-20 days — 70% of the corresponding monthly tariff; and
- for utilization of more than 20 days monthly — the total mont` ly charge.

d) *Item II.70*: A monthly charge of 0.80 leva is envisaged for each 100 (or part of 100 m) for data transmission circuits beyond the "boundaries" of a given place, in order to implement the so-called operational diagnostics and to guarantee that the quality of data transmission be not worse than that recommended by the CCITT.

e) *Item II.71*: No additional charge is required for utilization of switched telephone communication circuits for data transmission

f) *Item II.72*: The minimal monthly tax for the right of data transmission on the switched or permanent communication network should not be less than 120.00 leva.

g) *Item II.74*: If a few more subscribers are connected to a leased circuit, the first subscriber (leasing the circuit) pays the total tariff and all the rest 1/12 of the total tariff.

3. Rates for data transmission (see Table 2) [4].

Table 2. Rates for data transmission.

Zone (according to Item II.71)	Line length	Switched Lines (Item II.71)		Leased Lines (Item II.73)		Price reduction for temporary use		
	km	leva/min		leva/month		%		
Zone		Time of operation 7-21 h	22-6 h	Telephone	Telex	10 days	20 days	30 days
I. II. III.	0- 60 60-160 above 160	0.20 0.40 0.50	0.15 0.30 0.40	1,300 1,730 2,160	325 430 540	60	30	0

4. Other charges

a) *Item II.75*: The subscriber will not pay the respective tariff sums during the period when he has handed over the line to the PTT for trouble shooting; provided the trouble lasts more than a day. In this case the monthly subscriber charge is reduced by 1/30 for each day.

b) *Item II.77*: For making test measurements of a piece of equipment (or device) for data transmission under laboratory conditions, and in agreement with the requirements of so-called state standards or specialized norms, the subscriber must pay 150.00 leva.

c) *Item II.79*: If the subscriber leases a modem owned by the Ministry of Telecommunications, for each day of the modem utilization the subscriber will pay:

- 3.00 lv for modem at 200/1200 bit/sec speed
- 5.00 lv for modem at 2400 bit/sec speed
- 6.00 lv for modem at 4800 bit/sec speed
- 8.00 lv for modem at 7200 bit/sec speed
- 12.00 lv for modem at 9600 bit/sec speed
- 25.00 lv for modem at 48000 bit/sec speed

Payment for temporary usage is not allowed.

There are also some other items of lesser importance included in the tariff document, but these are not listed here.

2.4 Administrative Organization of Operation of the Data Transmission Network

To serve subcribers and equipment for data transmission, the Ministry of Telecommunications introduced two types of Data Transmission Services (DTS); the so-called central DTS and the regional DTS.

The data communication system will be operated by the Central Data Transmission Laboratory in Sofia and by the Regional Groups for operational servicing of the data transmission circuits. Such regional groups have been formed since 1974 in each of the 27 regional communication administrations. They are obliged to make everyday and periodical to ensure the data transmission circuits are in good condition, and also to provide free circuits when new subscriber DTEs have to be connected to the network.

The competence of the Data Transmission Laboratory (towards 1984 it will move to the central DTS) includes: processing of applications for "type" or check tests of the equipment and communication circuits; development of new DTEs; building up of international routes for data transmission; permanent and periodical servicing of the communication circuits offered to the subscribers for data transmission (Communication circuit plus data transmission equipment on the part of the communication station). DTEs however are served by their manufacturers, only the communication part of DTEs being examined in the PTT Laboratory tests.

3. TRANSBORDER DATA FLOW APPLICATIONS — PUBLIC DATA BASES IN BULGARIA

There are a number of transborder data flow applications in daily use in Bulgaria, such as the dedicated computer network SITA to carry civil aviation information, the GTS network of the WMO to carry meteorological information, or the dedicated data network of the world leading news agencies. All these applications are discussed in other papers at length, e.g., in [5, 6, 7, and 8]; therefore, in what follows only the service and use of public databases in Bulgaria will be described in a more detailed way [9].

The central technical information and documentation body in Bulgaria, the Bulgarian National System for Scientific and Technical Information (NSSTI), was established during the 1960s. It was formed on three levels: with a central body — The Central Institute for Scientific and Technical Information (CISTI), in Sofia — on the first level; information branch offices on the second level; and local information groups or offices at the institutes, plants, agricultural and industrial complexes, etc. on the third. Until 1976, only traditional methods of information activities were used in the NSSTI and also CISTI. During 174-1976, a so-called National Computer Center was established within CISTI by the integrated efforts of the Bulgarian government — in particular CISTI — and UNESCO. Its basic goals were to satisfy, to the possible greatest extent, the users' requirements for scientific and technical information, to provide the necessary information for the advancement of science and technology in Bulgaria, to establish new ways and methods of providing and getting valuable and flexible information services.

It is well known that computerized information systems — basically databanks — are characterized by a great variety of their subject coverage, record structure, availability of information searching guides (languages) — such as Thesaury, controlled dictionaries and/or classification schemes, keywords, etc. — by the variety of working languages — English, French, German, Russian, etc. — and the hardware and software methods used in processing (i.e., availability of different apparatus and programming means).

To satisfy all requirements while taking into consideration the experience of the Information Centres abroad and the local conditions, the National Computer Centre was equipped with an IBM 370/135 computer working with the information retrieval program package STAIRS. The

system VIDEO is used for the data input and both systems work under the control of the IBM program package CICS under OS/VS. The computer has a main storage of 512K, external disk storage of 1074 MB and a virtual storage of 3.5 MB. The computer is also furnished with an integral communication adapter for connecting eight remote terminal lines. At present, there are ten local terminals and ten remote terminals linked to the IBM 370/135. Five of the local terminals are used for data input and the rest for information retrieval services. The local terminals are all placed in a central terminal room at CISTI, the remote terminals, at other acting branch information bodies (i.e., such as at the Bulgarian Academy of Sciences, at the National Agrarian-Industrial Union, at the Medical Academy, at the Institute for Computer Techniques, etc.).

With regard to computer equipment, both IBM and Bulgarian made hardware are used (Figure 2). To extend the external storage capacity of the system, 29 MByte Bulgarian ES 5061 disc drives were connected to the system. A Bulgarian ES 8401 multiplexer, running under the ESTEL 2.1 system with different ES terminals was connected for data communication purposes.

To satisfy the information needs of Bulgaria, and to foster the development of science and technology in the country, the National Computer Information Centre runs the following databases:

— INSPEC, subject scope: physics, electrical and electronics engineering, computer science and control engineering. Time span: 1976 to present. File update: approximately 180,000 documents per year. To assure a more effective information processing and user service, the database is split into three independent subsystems: INSPEC-A — physics, INSPEC-B — electrics and electronic engineering, and INSPEC-C — computer and control engineering. The above mentioned subsystems are

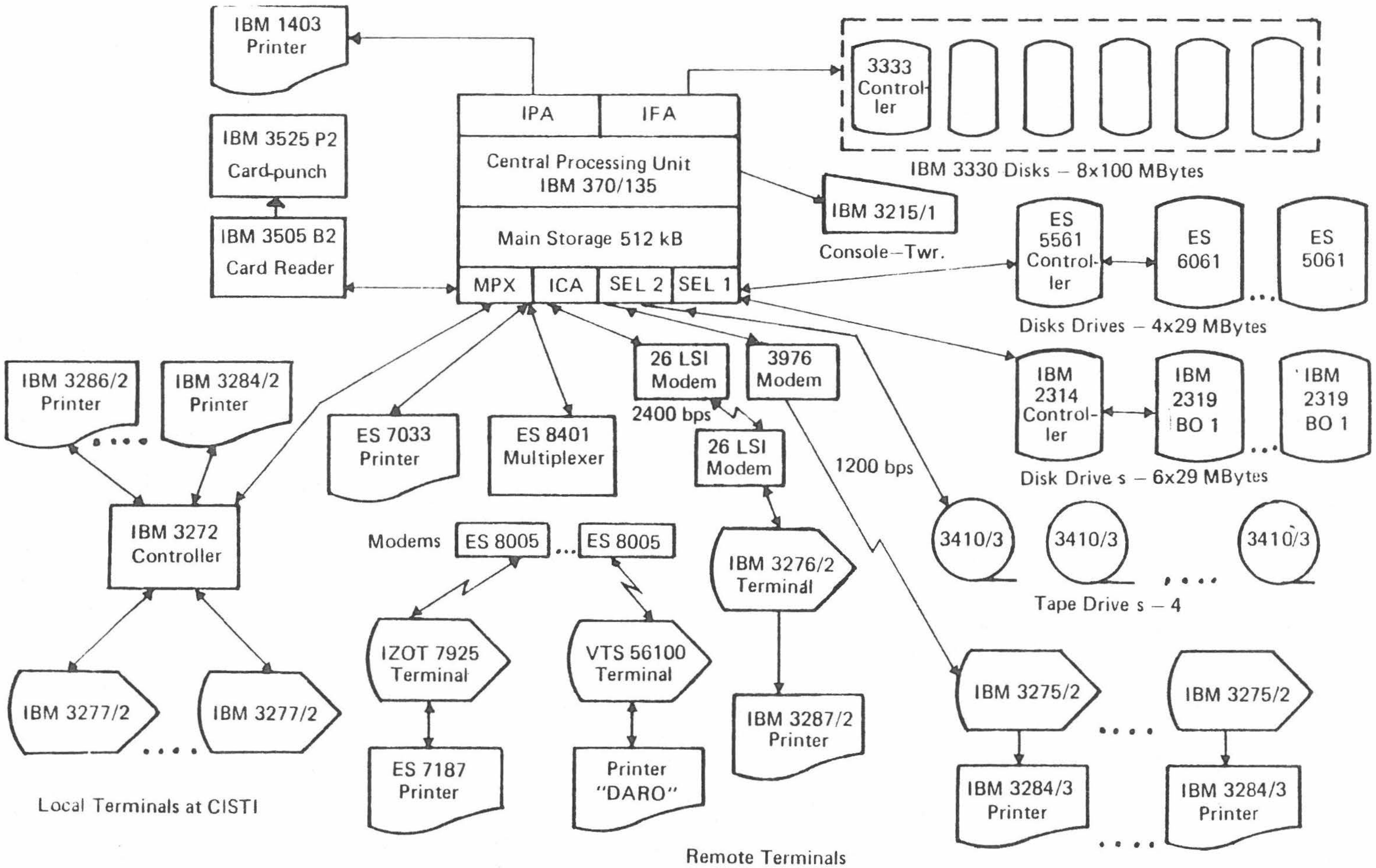


Figure 2. The CISTI Database Service Center in Sofia.

searched in both for Selective Dissemination of Information (SDI) and retrospective (on-line) mode.

- BIOSIS, subject coverage: biology and all related subjects such as botany, zoology, microbiology, pharmacology, plant-growing, and others. The magnetic tapes of BIOSIS have been processed in CISTI since 1978. File update: approximately 300,000 documents per year. The system is used in both SDI and retrospective (on-line) mode.
- COMPENDEX: engineering (multidisciplinary). The main subjects of interest are mechanical engineering, pollution, civil engineering, architecture, environmental engineering, pollution, etc. Time span: from 1977 to present. File update: 90,000-100,000 documents per year. Users are serviced in both SDI and retrospective (on-line) mode.
- AGRIS: international system relating to agriculture and food production. The magnetic tapes of AGRIS have been processed in CISTI since 1975. File update: approximately 100,000 documents per year. The system is searched in both SDI and retrospective (on-line) mode.
- INIS: international system for peaceful applications of nuclear energy. Time span: 1976 to present. File update: approximately 70,000 documents per year. The system is searched only in SDI mode, since retrospective searches are performed in an on-line regime by the International Atomic Energy Agency in Vienna. Through remote network connections it is possible to access this

service from CISTI.

- MSIS-NIR: international specialized information system for research projects and dissertations in the CMEA countries. Subject coverage: human sciences, basic sciences, applied sciences, aviation, medicine, economics, engineering, etc. Time span in CISTI: since 1976. File update: approximately 25,000-30,000 documents per year. The system is searched in both SDI and retrospective (on-line) mode. Source documents are available on microfilms. Language of database: Russian.
- VINITI: automation and electronics. A database provided by VINITI in Moscow is run under this service. Subject coverage of the database: automation control, computers, electronics, communications. Time span in CISTI: 1978 to present. Annual increase is about 35,000 documents per year, in total 200,000. The language of the database is Russian. The system is searched in both SDI and retrospective (on-line) mode.
- VINITI: information. This database is the machine readable version of the *"Referativny Journals"* of VINITI. Magnetic tape entry in CISTI contains information starting from 1981 and the system is searched in both SDI and retrospective mode. The annual increase in number of documents is 5,000.
- MEDIC (Medinform): international bibliographical database in medicine of the CMEA countries. It has been in operation since 1981. File update: 15,000-20,000 documents per year. The system is searched only in retrospective (on-line) mode.

Besides the above mentioned systems, some Bulgarian databases are in service as well, such as:

- HORIZONT: bibliographical-documental database with economic and industrial prognosis information. It is aimed for use by government agencies and indutrial managers. The yearly additions of HORIZONT are 7,000-8,000 documents. The system is searched in both SDI and retrospective (on-line) mode. The language of the database is Bulgarian.
- SYRENA: Bulgarian bibliographical database for Bulgarian and CMEA research projects and dissertations in all branches of science and technology. The yearly additions are 8,000 documents. It is searched only in retrospective (on-line) mode.
- LIDA: Subject coverage: information on public computer information systems available worldwide. It is searched only in retrospective (on-line) mode. The language of the system is English.

From these databases, HORIZONT, SYRENA, and also LIDA might be of international interest.

The philosophy behind the processing of the computerized information systems and service of the users at CISTI is to aim to service databases in retrospective (on-line) and SDI mode. Because of the limited external storage of the computer, depending on the annual increase of the database, however, there is a limit for the time span on retrospective (on-line) searching. For example, BIOSIS has one year retrospective search time span, COMPENDEX two years, AGRIS, INSPEC (A,B,C) three years, etc. For searching beyond these time limits, the off-line (batch) mode is used. The external storage capacity for simultaneous on-line search is about 300,000-400,000 documents, but the basic stock of all documents is well above 4,000,000. The service is performed according to a weekly timetable. In order to prevent the disc storage shortage problem, each system is available for on-line mode search half a day per week.

For the selective dissemination of information (SDI) the systems are searched only in off-line mode (batch) during the night.

In 1982, approximately 8,000 profiles (queries) in SDI mode were regularly searched. In on-line-retrospective mode, approximately 7,000 queries were requested.

The greatest number of profiles and retrospective queries have been performed for the Bulgarian Academy of Science, the Higher Education Institutes, the National Agrarian-Industrial Union, and the Ministry of Mechanical, Electrical and Electronics Engineering.

The National Computerized Information Centre gives an opportunity to satisfy the needs for computerized information service of thousands of scientific workers and specialists easily and quickly. Moreover, the difficulty of a centralized information service lies in the great variety of subjects and thousands of users that have to be served by one information center, far from users and of their problems. This is the reason why the different information branch offices also cooperate in the joint work on servicing scientific and technical information. They help to identify the information interests of every customer. They form subject profiles, submit their requests to the computerized information center, receive and disseminate the results, check for the completeness and relevancy of information, and provide copies of original sources to the users. In fact, they function as virtual connections between users and the computer center.

The increasing demand for information by a growing user community calls for increased performance and improved computerized information service. To satisfy this growing demand is not an easy task and it is worthwhile to list some of the present difficulties.

First, as is well known, the number of databases offered on the world market is increasing rapidly. As a result, some of them are seemingly formed incidentally, others are not complete enough and quite often the information in databases is duplicated. Besides, databases most often represent only the national original sources completely, although they also include those that are difficult to access in their source format. For this reason searches have to be made in different databases, which makes information retrieval more expensive.

Second, the central issue for usage of a computerized information systems is the language barrier. Many poliglot thezauri have appeared recently, for example, the TITUS system became popular, providing possibilities for four language services, but all this is not enough concerning the end user. The question for machine translation stands open.

Third, one of the greatest disadvantages of most databases is the difficulty of accessing their primary sources; this decreases the effectiveness of their use a great deal. There are few information systems that are ready to provide microcopies of their original documents together with the magnetic tapes.

Fourth, the databases, except those prepared by international organizations, are mostly commercial products, and countries with limited financial resources like Bulgaria find it difficult to pay more and more to buy them or to use them abroad on network hosts (through remote access). The reality is is that such countries lack the possibility to reach equivalent exchange with developed countries because of the smaller amount of their own information.

Fifth, the commercial and also political aspects of database supply force many countries to create their own databases. In the end, as a result of their twofold or threefold input, the preparation of the input for the databases created is at lease twice as expensive as it could be.

Sixth, the main purpose of the presently offered databases in Bulgaria is to satisfy the information needs of scientific workers and research scholars. There is, however, a great need for information by the industry. There is great interest especially in factographic information for the introduction of new products technologies and production. The existence of about 1,000 factographic databases is known worldwide, but only a few of them are of international interest and some of them are not accessible for all users.

Thus, in spite of the achievements in the development of computerized information services, there are still many daily problems to be solved.

In order to reply to the users' needs, as well as to speed up the processes of computerized information services, CISTI launched a number of activities in the following directions:

1. Expanding the range of the processed and serviced foreign databases in Bulgaria. This will be realized mainly in the near future through new databases received on magnetic tapes from VINITI, Moscow. There is an agreement between CISTI and VINITI for distributed processing and servicing of the VINITI databases in an on-line mode between the two organizations. In other words, part of the databases created in VINITI will be serviced on-line at CISTI in Sofia.

2. VINITI in Moscow and CISTI in Sofia are at present interlinked by a dedicated 600 bit/sec telecommunication line via the node of the line of the All Union Scientific and Research Institute for Applied Computerized Systems (VNIIPAS) in Moscow. At present this line between CISTI and VNIIPAS is being upgraded to higher speeds and more logical channels. In 1982, successful experiments were carried out for the realization of terminal connection between CISTI and VNIIPAS. Thus it was possible to access from CISTI through VNIIPAS

   - the International Atomic Energy Agency in Vienna,
   - the All Union Institute for Scientific and Technical Information (VINITI) in Moscow, and
   - the Central Institute for Scientific, Technical and Economic Information in Prague (Figure 3).

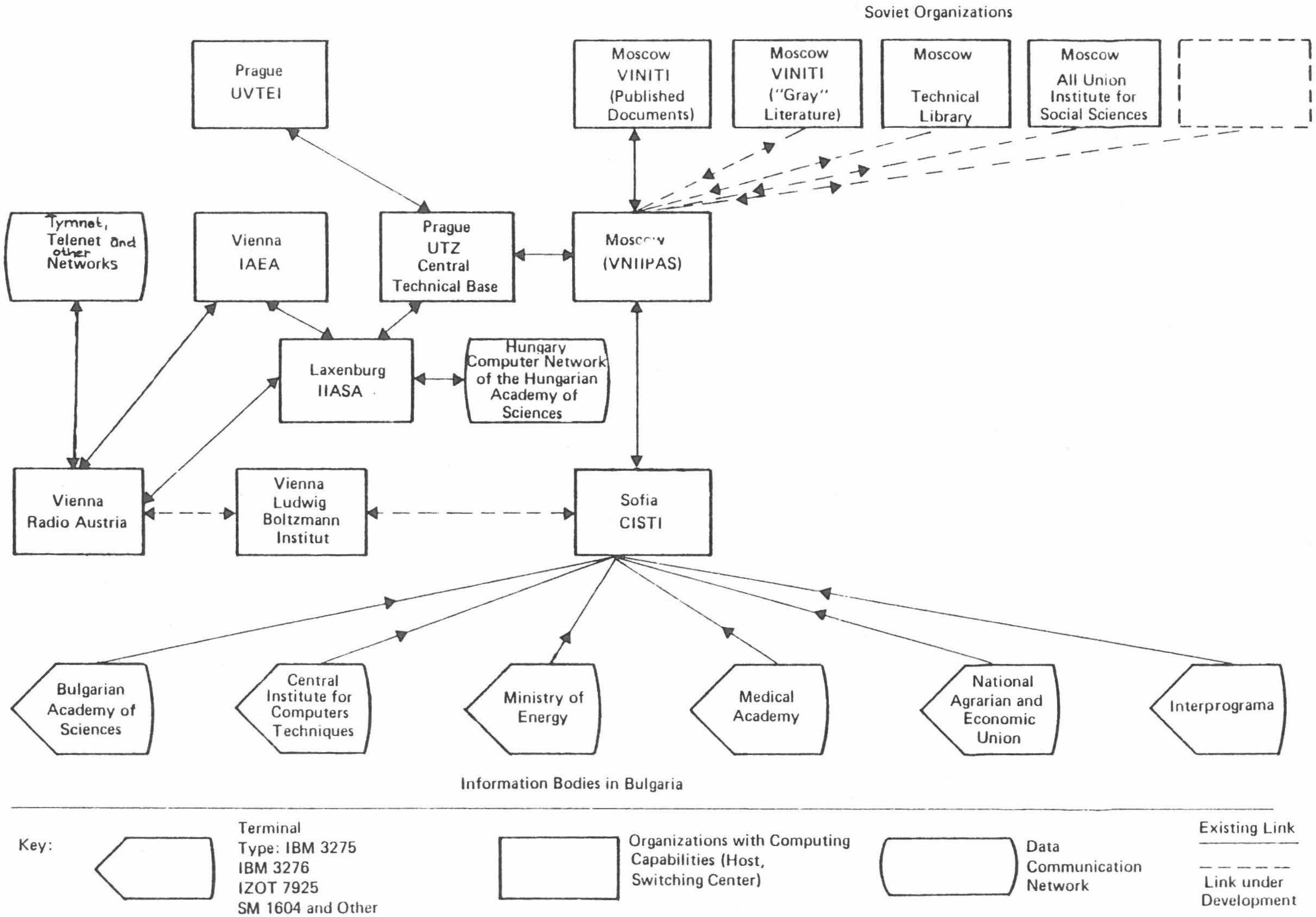


Figure 3. Scheme of the telecommunication links of CISTI (Bulgaria) [9].

At present the most frequently searched databases via the VNII-PAS node are INIS and AGRIS serviced by the International Atomic Energy Agency in Vienna. Next year, CISTI expects to launch regular service with the Central Institute for Scientific, Technical, and Economic Information in Prague and with VINITI in Moscow.

Some experiments are also being carried out for information retrieval by foreign users in CISTI databases via VNIIPAS. In 1982, mainly experimental access from VINITI and VNIIPAS was carried out. In 1983, it is also expected that through a new line between the Ludwig Boltzmann Institute in Vienna and CISTI, Austrian users would be served by CISTI.

Computer connection between CISTI and IIASA in Laxenburg, Austria, will also be feasible on a regular basis in 1983. There will be two routes available to do this, first through the VNIIPAS node in Moscow, and the UTZ node in Prague, second through the Ludwig Boltzmann Institute and the Radio Austria node in Vienna.

Experimental interconnection of CISTI and the computer network of the Hungarian Academy of Sciences will also be possible through the IIASA node.

3. Increasing the possibilities of CISTI's Computerized Information Centre by new and more powerful computer hardware.

4. Provision of conditions for mutual cooperation and integration of the efforts of the Peoples' Republic of Bulgaria and her neigh-

boring Balkan countries to expand and improve the information services. This effort will be greatly promoted by an ongoing UNESCO/UNDP supported regional project "Crossborder Computerized Data Exchange in Science and Technology." Within the framework of this project it is expected that information centers in Yugoslavia and perhaps from other Balkan countries will be linked to the CISTI computer center.

4. SUMMARY

Data communication in Bulgaria is at the beginning of its potential. At present, data transmission is carried out primarily through switched and leased telephone lines. At the end of 1982 no separate digital data communication service⁻ were provided by the PTT. However, preparations for the introduction of a nationwide public packet switched computer network (BULPAC) are being made. Introduction of this new PTT service is expected around the middle of the 1980s. It is also expected that at that time the present administrative procedures for data communication will change slightly. The present and future administrative procedures, however, are following the respective recommendations of the CCITT as closely as possible.

With regard to transborder data flow applications, besides the classical dedicated data networks such as SITA, WMO-GTS, and news agencies network, one of the strongest applications in Bulgaria is database services. The organizational structure for scientific-technical information in Bulgaria is centralized, the Central Institute for Scientific and Technical

Information (CISTI) in Sofia playing a key role in providing both domestic and foreign services to Bulgarian users. CISTI itself operates its own database center in both on-line (retrospective searches) and batch (SDI searches) mode. The databases installed at the CISTI center are partly of foreign origin, from both East and West, but CISTI also operate some Bulgarian databases. Experiments for on-line access abroad from Bulgaria and access to the CISTI center by foreign users were successfully completed and in the future the introduction of such services on a regular basis can be expected.

REFERENCES

[1] UN Department of International Economic and Social Affairs — Statistical Office. 1981. Statistical Yearbook 1979/80, New York: United Nations.

[2] Brakalova, P., Ch. Dimitrov, E. Tasheva. 1982. Basic Principles for Building-Up of the BULPAC National Data Communication Network. Report at the UNESCO/UNDP Project-Seminar on Software and Data Services in Bulgaria, December 1982, Sofia, Bulgaria.

[3] Kostadinova, A. et al. 1981. The Diagnostics, Control, Statistic, and Tariff System in the Public Packet-Switched Network of the PR of Bulgaria. Proceedings of the COMNET '81 Conference in Budapest, "Networks from tne Users' Point of View." Amsterdam: North-Holland Publishing Company.

[4] Galabov, K.R. 1981. An Approach to Tariff Control Policy in Bulgarian Computer Networks. Proceedings of the COMNET '81 Conference in Budapest, "Networks from the Users' Point of View." Amsterdam: North-Holland Publishing Company.

[5] Lábadi, A., and I. Sebestyén. 1982. The IIASA TPA/70-X.25 Gateway — Network Promotes International Flow of Scientific Information. WP-82-88. Laxenburg, Austria: International Institute for Applied Systems Analysis.(*)

[6] Sebestyén, I. 1982. Data Communication and New Information Technologies for Civil Aviation. WP-83-15. Laxenburg,

Austria: International Institute for Applied Systems Analysis.(*)

[7] Sebestyén, I. 1982. Flow on International News over Data Networks. WP-82-101. Laxenburg, Austria: International Institute for Applied Systems Analysis.(*)

[8] Sebestyén, I. 1982. Meteorological Networks —A Special Application of Transborder Data Flows. WP-82-119. Laxenburg, Austria: International Institute for Applied Systems Analysis.(*)

[9] Todorov, T.K. 1982. CISTI and National System for Scientific and Technical Information Activities in the Set Up and Maintenance of Databases for STI and Services to the Users in On-Line Mode. Report at the UNESCO/UNDP Project-Seminar on Software and Data Services in Bulgaria, December 1982, Sofia, Bulgaria.

Remark: Those references which are also chapters of this study are marked with (*).

Chapter 4:
DATA COMMUNICATION IN CZECHOSLOVAKIA — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

J. Puzman

DATA COMMUNICATION IN CZECHOSLOVAKIA — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

J. Puzman

0. INTRODUCTION

As in many other countries, data communication is becoming increasingly important in Czechoslovakia. In what follows we will describe first the general status quo of information processing, which sets the increasing demands for data communication. Then the general status of data communication in the country is discussed, followed by some governmental and PTT policy considerations. In Chapter 2 a picture of the Czechoslovak telecommunication network is given, followed by a description of data communication services provided by the Czechoslovak PTT. A separate chapter is devoted to tariffs and other administrative procedures. Special emphasis is given to international data communication throughout the paper. The last chapter deals with some of the present transborder data flow applications in Czechoslovakia.

1. GENERAL STATUS OF DATA COMMUNICATION AND INFORMATION PROCESSING

Data communication is not a service and technique *per se* but is closely connected with computer applications and utilization. Therefore, some space should be devoted to a brief explanation of the computer application situation in the CSSR.

According to [1], there were 1810 digital computers (excluding microcomputers) in operation in the CSSR at the end of 1978. In fact, 2005 computers (including 432 analog, 211 punched-card, 161 process-controlled) were in operation at that time. The growth of the computer population between 1972 and 1978 is shown in Figure 1.

Most of the computers are East European products (CMEA) with nearly 30 percent belonging to the Ryad Series. In this figure for 1978, 54 computers of the ES-1 10 series, 161 of the ES-1020 series, 107 of the ES-1030 series, and 41 of the ES-1040 series are hidden.

At the beginning of 1979, the total purchase price of CPUs (Central Processing Units) with necessary periphery equipment (but without data acquisition, collection, and transmission devices) was more than 13 billion crowns, whereas one year earlier it constituted 11 billion crowns; a growth rate of nearly 22 percent. At the same time, the purchase price of data communication equipment was 150 million crowns with a rate (index 1979/1978) of 36 percent.

Data communication in Czechoslovakia, strictly speaking the first steps of two point data transmission began in the late 1960s. Because second generation computers were installed and operated at that time, only off-line data transmission could be provided. Nevertheless, some

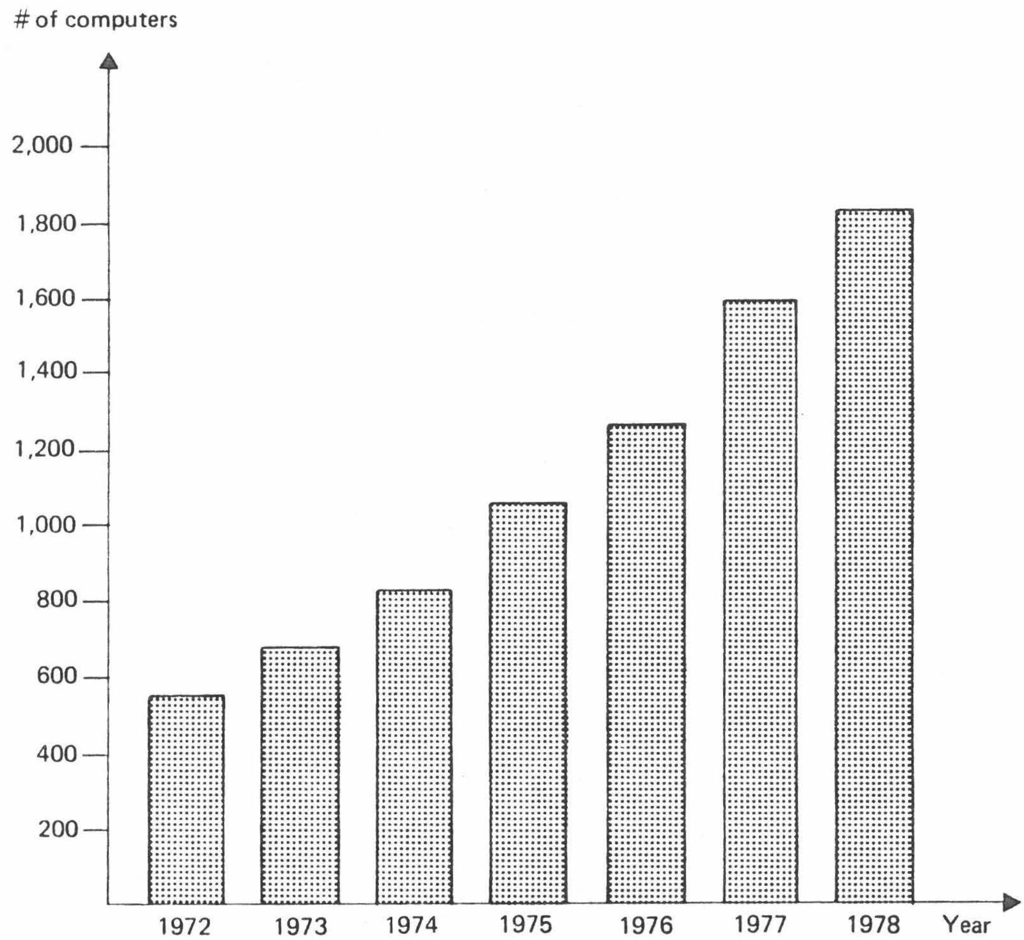

# of computers
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
1972
1973
1974
1975
1976
1977
1978
Year

Figure 1.

useful experiences have been gathered, in particular that Czechoslovak telex and telephone networks have proved feasible for data transmission at lower speeds.

Simultaneously with the above, the Czechoslovak industry with the support of the Research Institute of Post and Telecommunications developed a series of low-speed modems (up to 1200 bit/s, serial and parallel) and off-line batch terminals with paper tape readers and punchers, which were then manufactured by the Czechoslovak industry. After having checked the telecommunication network for use for data transmission, the Czechoslovak PTT prepared the first user guide for data communication purposes. This guide was issued in 1971 [2], accompanied by appropriate PTT regulations on how the Administration should collaborate with data transmission users.

Data transmission (and not just experimentally) started thus in the early 1970s and the number of terminals connected to the PTT telecommunication network has rapidly increased since then. For example, in 1980 there was a total of 1159 NTPs (Network Terminal Points), excluding telex devices used for data transmission, while in 1981 this figure had increased by more than 14 percent mainly due to the better utilization of switched telephone networks [3]. The population growth of NTPs during the last decade or so is shown in Figure 2.

The NTP population shows that the interest of data transmission users grew dynamically and that such a trend will continue. For example, while in 1973 only 4 NTPs were, on the average, installed in a month, this figure increased up to 18 NTPs in 1980 [3].

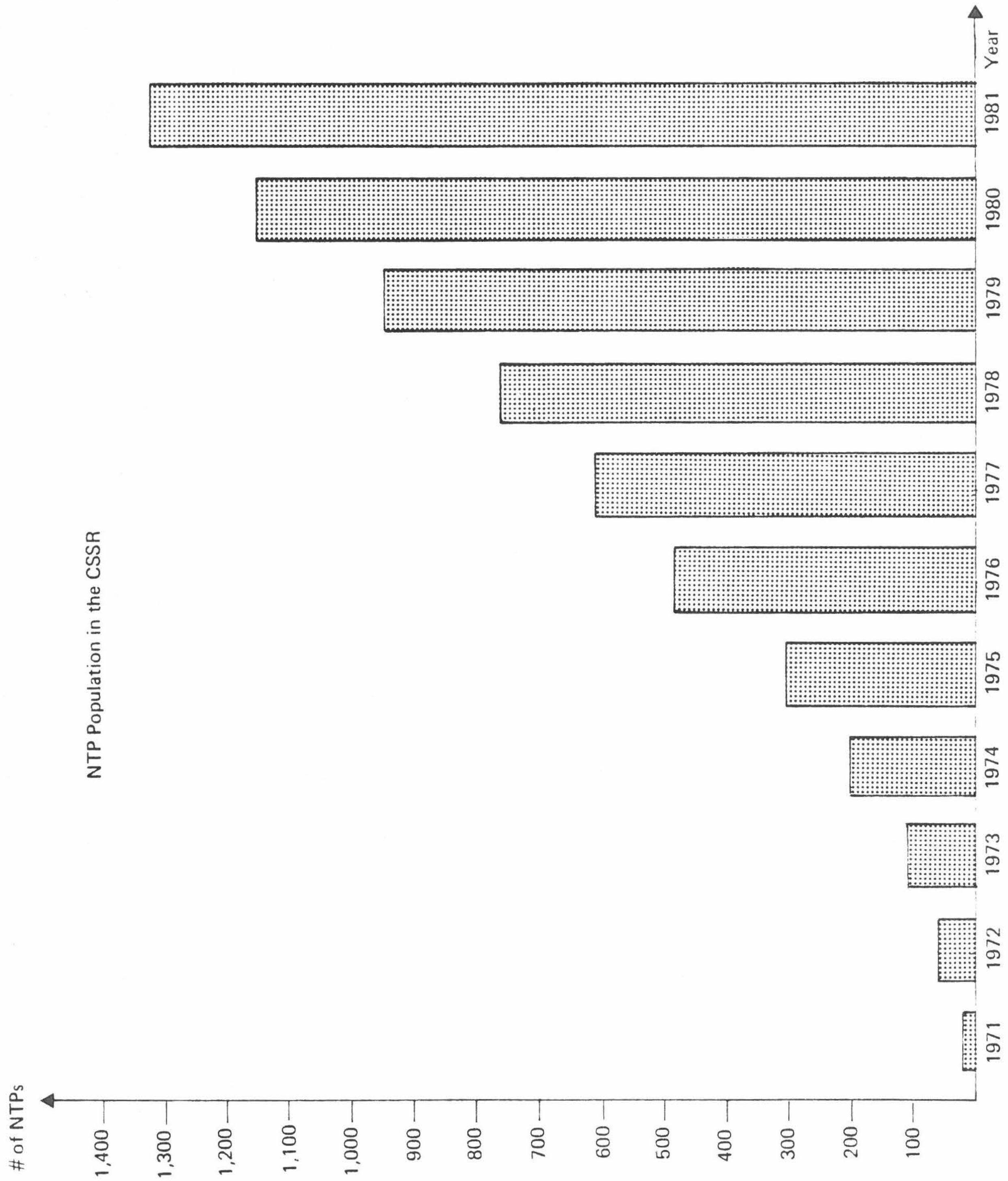

NTP Population in the CSSR
# of NTPs
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
Year
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981

Figure 2.

The overall figures, however, cannot express the trends of communication media and transmission rates usage for data transmission in detail. Figure 3 shows the the development of NTPs installed with different lines within a period of four years: switched vs. leased, and telegraph vs. telephone. Leased lines play the dominant role in data communication because of their higher performance over switched lines (the former are more reliable so their error rate is of several orders lower and they are less noisy. At present, due to higher transmission speed requirements the preference for leased lines still continues.

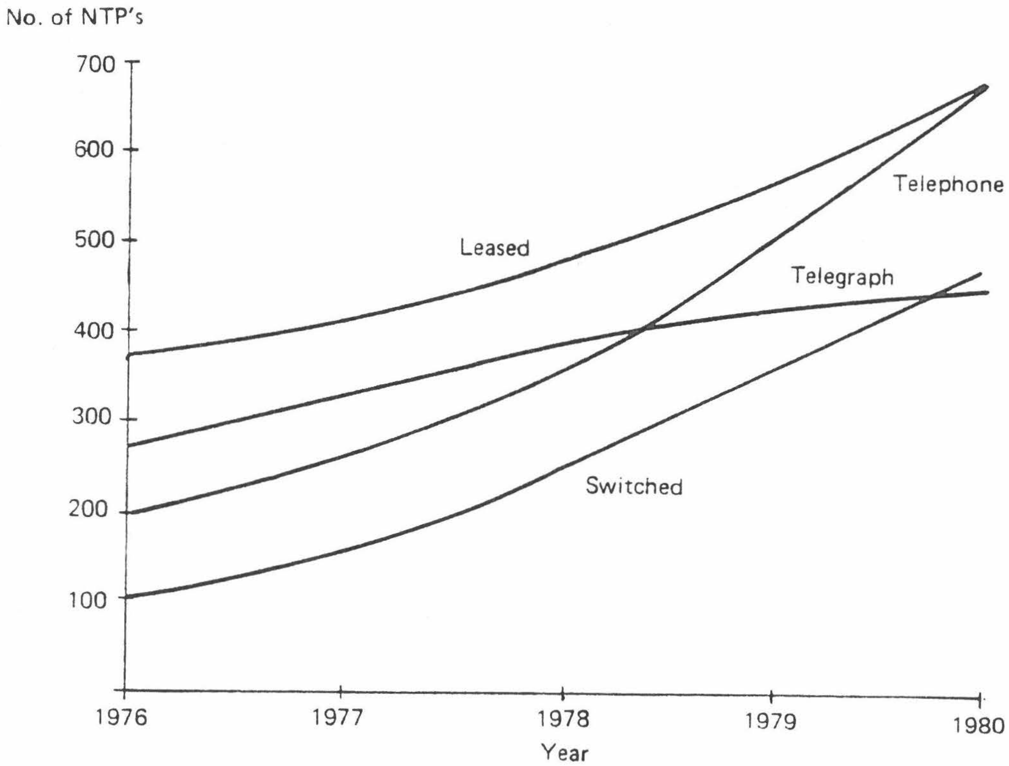


Figure 3. NTP population with respect to the types of connected lines

Table 1. NTP Statistics in Czechoslovakia (as of 30 December 1980)

Speed / Service type	up to 200 bit/s	up to 600/1200 bit/s	2400 bit/s	4800 bit/s	9600 bit/s	Total
Switched telegraph (excluding telex)	26					26
Leased telegraph	449					449
Switched telephone	219	223				442
Leased telephone	16	132	75	17	2	242
Total	710	355	75	17	2	1159

transmission manufacturers. There are a number of CMEA standards in force and most of them form the basis for the emerging national standards of CMEA countries. In spite of the fact that the Czechoslovak Office for Standardization and Measurements (UNM) up to now has only issued, standards concerning 7 and 8 bit coding (CSN 39 9100, 36 9102-9104), the manufacturers, as well as the PTT, already follow all CMEA standards.

2. CZECHOSLOVAK TELECOMMUNICATION NETWORK

All public services for information transfer, exchange, and distribution by means of electrical signals is provided by the Czechoslovak PTT (according to the Law No. 110/1964) within the framework of the so-called Unified Telecommunication Network (JTS). JTS includes the telephone network as the main means, supplemented by the telex and telegraph networks (at present the integrated telegraph network) and broadcasting and TV distribution networks.

The development of the telephone network is usually measured by the number of telephone stations per 100 population. In 1979 [4.] the Czechoslovak telephone network had a density of 20.1 percent, with more than 3,000,000 telephone stations in service, and held 19th place in the world (13th in Europe) with a growth index of approximately 1.04 (4 percent). In spite of this, the telephone network is not yet fully automated and a small part of trunk traffic is still connected manually.

The telephone network involves many different telecommunication facilities. Wire lines, as well as microwave radio-relay links for local and trunk connections, and satellite channels for long distance telephone calls, all service telephone signal transmissions. Line switching on a four-level arrangement serves to connect telephone calls. Telecommunication facilities are predominantly based on second generation technologies (analog transmission systems with frequency division multiplexing (FDM) techniques, cross-bar exchanges). However, because of the slow depreciation in telephony, some exchanges are still of the first generation type. All equipment has to be interconnectable, even with third and fourth generation exchanges, which are already being installed (such as digital transmission systems based on pulse code modulation (PCM) and time division multiplexing (TDM) techniques, semi-electronic exchanges with space switching, and fully electronic exchanges with time switching).

The telex network comprised more than 8,800 subscribers in 1979 [4], which represented 58 telex stations per 100,000 population and places the CSSR in 18th place in the world (13th in Europe), with a growth rate of about 5 percent. With the intention of extending services, in particular for those telex subscribers who want to utilize the telex network for data and electronic message transfer, the Czechoslovak telex service provides within the framework of the so-called integrated telegraph network transmission at rates of up to 200 bit/s in any code format (not only for the standard ITA 2 code).

The telegraph network is equipped with telegraph exchanges in a two-level arrangement, with telegraph converters extending 4-wire connections to subscribers, and with VFT (Voice Frequency Telegraphy) transmission systems created on telephone lines.

All data transmission traffic can be handled over either the two networks or over leased lines on the transmission facilities of the networks. In special cases the Czechoslovak PTT provides other media for transmission users: radio channels (radio frequencies) to connect moving objects (cars, persons), or microwave frequencies for those situations when line connection is difficult or unexecutable. The emerging CATV (cable-television) networks do not belong to JTS and thus the corresponding services are not provided by the PTT. From the technical point of view, they only serve for television and broadcasting and are, therefore, one-way and unsuitable for two-way data exchange.

In many countries, public data networks are at present created on either the classical line-switching or the packet-switching basis. Such networks prove to be economical if the volume of data flow traffic is sufficiently large that sufficient revenues based on a appropriate tariff policy are able to balance the capital and operational costs in a reasonably short time As can be seen from Figure 2, the terminal population, speed and volume of data traffic in Czechoslovakia does not yet justify the introduction of a new dedicated data network. Thus, for the time being, data transmission will use traditional telecommunication means as sketched out above and no special data network is being planned for the immediate future. However, to utilize better the present telecommunication means, namely the telephone network, multiplexers, multidrop lines, etc., will need to be applied as an extension of PTT services.

3. PTT SERVICES FOR DATA COMMUNICATION USERS

As has been mentioned, the PTT services offered to data communication users still follow the guidelines of document in [2] although Data Communication Regulations [5] are under preparation and should be approved soon. Such an act will elevate data communication services in Czechoslovakia to the level of telephone and telegraph services, for which such regulations have been in existence for a long time. This section, therefore, will be based upon [2] with reference to [5], whenever necessary.

3.1. General Services and Contact Points

The PTT services offered for data communications (hereafter called services), are understood to be a set of technical and organizational arrangements, which enable the utilization of JTS as a technical means of data communication. The services include:

- leasing of lines on a permanent or temporary basis for local, trunk, and inter-state data communication
- provision for subscribers with appropriate facilities and equipment (e.g., data sets) to enable user DTEs (data terminal equipment) to be connected to the JTS

-- licensing of the DTEs and DCEs (data circuit terminating equipment) to be connected to the JTS.

-- a consulting activity to aid with the problems of JTS utilization at the beginning and design stage of data communication systems

The highest level contact point in Czechoslovakia, which is also an addressee of requests for the international flow of data, is the Federal Ministry of Post and Telecommunications (Olsanska street 5, 13000 Prague 3, Tel.: 714 1111 (exch.)).

For Czechoslovak users the licenses are issued by the regional PTT Directorates throughout the country and by the International and Interurban Telephone and Telegraph Switching Center. The same authorities also provide a consultation activity free of charge.

3.2. Licensing Procedures

Every user-owned communication device to be directly connected to the JTS must be licensed by the Czechoslovak PTT. In general, the licensing procedure is initiated through a request from either the domestic manufacturer, or the distributor, or in special cases, by the user himself. The requests are accepted and processed by the Research Institute of Post and Telecommunications (Prague 5, Kobrova street 2) and appropriate fees are charged for the procedures involved.

There are two different types of licenses issued. The first, type of license is granted for manufactured devices freely available on the market. The second type are individual licenses, which can only be granted for predescribed and limited applications for a limited time, and applies in particular to "home-made" equipment, experimental operations, etc. Besides data sets manufactured in Czechoslovakia, however, several licenses have been granted for imported communication devices, such as modems for speeds above 1200 bit/s (Videoton, Racal Milgo, SAT, IBM) and baseband modems (Videoton, Racal Milgo, SAT, Siemens) (Table 1a).

Table 1a. List of data sets approved to be connected to the Czechoslovak PTT facilities.

Type of data set	Model	Manufacturer	No. of approval
modem FDX 1200	Telsat 640	SAT (France)	H-144 PD/81
modem 2400	26 LSI	RACAL MILGO (UK)	H078-2667/77
modem 2400	60300	Videoton (Hungary)	H087-5537/77
modem 2400	Telsat 730	SAT (France)	H101-4298/79
modem 2400	Telsat 740	SAT (France)	H-145 PD/81
modem 2400	386 /1	IBM (USA)	H-128 PD/81
modem 4800	MPS 48	RACAL MILGO (UK)	H076-2667/77
modem 4800	Telsat 830	SAT (France)	H102-4298/79
modem 4800	3864/1	IBM (USA)	H-129 PD/81
modem 9600	Telsat 1030	SAT (France)	H103-4298/79
baseband DS	COM-LINK II	RACAL MILGO (UK)	H077-2667/77
baseband DS	Telsat 930	SAT (France)	H105-4298/79
GDN data set	60000	Videoton (Hungary)	H079-524/77
GDN data set	N 10	Siemens (FRG)	H094-9163/78

Licenses for connecting a user DTE to a PTT DCE or user DCE to JTS are granted by the PTT on an individual basis upon receipt of a written request by the corresponding PTT authority. The user must fulfill the following conditions:

- his subscriber line must be equipped with the technical means for DTE and/or DCE connection

- the user DTE interface or the user DCE must already be licensed
- the user must assure the maintenance of his own equipment.

The same procedure applies for acoustic and electromagnetic couplers.

As precisely described in [2] and [5] the user has well-defined rights and duties. For example, if the user has the possibility of monitoring and measuring with his own equipment and locates a fault, a failure, or a decline in transmission quality, he can ask the PTT to repair it or to supply an appropriate hardware replacement as soon as possible. On the other hand, he is obviously obliged to pay for the service (see below), to allow access to his equipment by PTT staff, and has to obtain permission before making any changes in his hardware arrangements and operation.

3.3. Data Communications Services

Table 2 shows the data communication services presently provided by the Czechoslovak PTT [2, 6]. The services are divided into three groups according to the telecommunication facilities discussed in section 2:

- data communications over the telephone network
- data communications over the integrated telegraph network
- data communications over leased lines.

The data transmission quality is not specified in the service;, nevertheless, it follows the corresponding CCITT recommendations. Some figures of performance criteria (e.g., for the error rate) have been published [7 and 8] and help the users to plan and design their data communication system.

Table 2. Data communication services provided by the Czechoslovak PTT

Service	Transmission media	Tranimission rate (bit/s)	Transmission mode	Operating mode	Subscriber line	Interface
Public telephone network	Switched telephone lines	up to 300	asynchronous	FDX	2-wire	V.24
		up to 600/ 1200	asynchronous synchronous	HDX	2-wire	V.24
Inte-grated tele-graph network	switched telegraph lines	50 (ITA2)	start-stop	HDX	2-wire	telex
		50 (arbitrary 5 unit code)	start-stop/ synchronous	HDX	2-wire	as specified by PTT
		up to 200 (arbitrary code)	start-stop/ synchronous	HDX	2-wire	V.24
Leased lines	telegraph lines	up to 50 up to 100 up to 200	start-stop/ synchronous ibid ibid	HDX FDX ibid ibid	2-wire 4-wire ibid ibid	as specified by PTT
	telephone lines	up to 300 up to 600/ 1200	asynchronous asynchronous synchronous	FDX HDX FDX	2-wire 2-wire 4-wire	V.24 V.24
		above 1200	depends on modem	HDX FDX	2-wire 4-wire	as specified by PTT
	wideband lines	48,000-72,000	depends on modem	HDX FDX	2-wire 4-wire	as specified by PTT

An example of typical error rates of data lines is shown in Table 2a; however, the actual values vary to a large extent. The table proves the necessity of implementing an error control function in some layer protocols in order to achieve the residual error rate that satisfies user requirements.

Table 2a. Typical values of character error rate (CER)

Type of line	CER
telex	1.10^{-4}
switched telegraph	1.10^{-5}
leased telegraph	8.10^{-6}
switched telephone	2.10^{-2}
leased telephone	4.10^{-4}
leased metalic (short)	1.10^{-7}

3.4. Services Over the Telephone Network

Services over the public telephone network usually involve the connection of user DTE to the PTT DCE so that the interface is digital (it must also be licensed) and constructed for data transmission up to 300 bit/s and 600-1200 bit/s. If the user wants to exchange data over the public switched telephone network at higher speeds (2400, 1200+1200 bit/s), or by means of acoustic or electromechanical couplers from portable DTEs, the corresponding DCE is the property of the user and must be licensed (the interface is obviously analog). Parallel transmission at a rate of 20/40 char/s is also permitted and will soon be the standard service (by means of parallel data sets ES-8025).

The data connection set-up is provided either manually from the user site (the user dials by means of a telephone set connection to the addressee and, after connection has been established he switches on to the data transmission mode), or may be automatic. In the latter case, the user device must be equipped with an ACU (Automatic Calling Unit) and/or an AAU (Automatic Answering Unit).

3.4.1. Services over the Telegraph Network

There are three types of service offered over the integrated telegraph networks:

- data communications by means of the PTT teleprinter of 50 bit/s with the ITA 2 code (such a service does not require a special license)
- data communications by means of the user DTE (or of a supplementary PTT teleprinter) of 50 bit/s with an arbitrary 5 unit code
- data communications by means of the user DTE up to 200 bit/s with an arbitrary code

The last service comprises the termination of a telegraph circuit with the PTT telegraph data set (of type TMS 200 - ES 8032). The interface between the user DTE and the PTT DCE must fulfill the corresponding CCITT recommendations.

If teleprinters are used they serve not only to establish the connection but also as a means of data acquisition and buffering on paper tape. If the user DTE is used it can be equipped with the ACU and/or AAU.

3.4.2. Services over Leased Lines

The leased lines provided for data communications are of the following type:

- telegraph up to 50 bit/s
- telegraph up to 100 bit/s
- telegraph up to 200 bit/s
- data (telephone equipped with modems) up to 300 bit/s
- data (telephone equipped with modems) up to 600-1200 bit/s
- analog telephone for speeds above 1200 bit/s
- analog wideband (60-108 kHz) for speeds above 48 kbit/s.

The user may request either the 2-wire subscriber line for SX (simplex) and HDX (half duplex) operation (full duplex operation is only possible with FDX modems) or the 4-wire subscriber line. Leased lines terminate at the user site with digital interfaces according to the corresponding CCITT recommendations or with an analog interface. Both point-to-point and multi-point lines can be leased from the PTT. Leased lines shared among several users are offered on a special tariff rate.

3.5. Data Communications Tariffs

For tariffs of data transmission services as well as of telephone and telex services the corresponding PTT rate tables are provided, the most up-to-date rate table is outlined in [9].

3.5.1. Tariffs for Switched Telephone Calls

Tariffs for data transmission over the public telephone network are based on the same principles and have the same rates as for ordinary telephone calls. The inland speech band connections established manually are charged according to the distance, the duration and type of the call. The charges per 3-minute normal calls are listed in Table 3. For the zones between cities in Czechoslovakia see Table 4. "Urgent" and "Avia" telephone calls are possible options and in these cases the charges are multiplied by two and five; an additional charge of 2 crowns per call is added if data are transmitted over manually switched lines.

Table 3. Charges for inland normal telephone calls

Zone	1 (within the same group area)	2 (within the transit area and between adjacent transit areas)	3 inter-transit up to 250 km	4 intertransit above 250 km
Charges per 3 minutes (in crowns)	3.00	6.00	9.00	12.00

The international telephone call charges for automatically established telephone connections are shown in Table 5.

Installation and maintenance of telephone and data sets provided by the PTT and that of subscriber lines are billed monthly and the rental fee depends on the distance from the exchange and on the data transmission rate.

Table 4. Telephone tariff zones between transit areas

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Prague	1	2	2	3	2	3	2	2	2	2	2	3	3	4	4	3	4	4	4	4	4	4	4	4
Tabor	2	2	2	2	3	3	3	3	3	3	2	2	3	3	4	3	3	4	4	4	4	4	4	4
C. Budejovice	3	3	2	2	2	3	3	3	3	3	3	2	3	3	4	3	3	4	4	4	4	4	4	4
Plzen	4	2	3	2	2	2	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4
K. Vary	5	3	3	3	2	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
Most	6	2	3	3	3	2	2	2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
Usti n/L	7	2	3	3	3	3	2	2	2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4
Liberec	8	2	3	3	3	3	3	2	2	3	3	3	3	4	4	3	4	4	4	4	4	4	4	4
Hr. Kralove	9	2	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3	4	4	4	4	4	4
Pardubice	10	2	2	3	3	3	3	3	3	2	2	2	2	3	3	2	3	3	3	4	4	4	4	4
Jihlava	11	3	2	2	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3	4	4	3	4	4
Brno	12	3	3	3	3	4	4	3	3	3	2	2	2	2	3	2	2	3	3	3	3	4	4	4
Gottwaldov	13	4	4	3	4	4	4	4	4	3	3	3	2	2	2	2	2	2	3	3	3	4	3	4
Ostrava	14	4	4	4	4	4	4	4	4	3	3	3	3	2	2	2	3	3	3	3	3	3	3	3
Olomouc	15	3	3	3	4	4	4	4	3	3	2	3	2	2	2	2	3	3	3	3	3	4	3	4
Bratislava	16	4	4	3	4	4	4	4	4	3	3	3	2	2	3	3	2	2	2	3	3	4	4	4
Trencin	17	4	4	4	4	4	4	4	4	3	3	3	3	2	3	3	2	2	2	2	2	3	3	3
Nitra	18	4	4	4	4	4	4	4	4	3	3	3	3	2	3	3	2	2	2	2	2	3	3	3
Zilina	19	4	4	4	4	4	4	4	4	3	3	3	3	2	2	3	3	2	3	2	2	3	2	3
B. Bzstrica	20	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	2	2	2	2	3	2	2
Poprad	21	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	4	3	3	3	3	2	2	2
Presov	22	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	3	3	3	3	2	2	2
Kosice	23	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	3	3	2	2	2	2	2

Table 5. International telephone call charges

Country	No. of second for one crown	Charge per minute crowns
Austria	4	15.00
Belgium	3	20.00
Bulgaria (Sofia)	2	30.00
Denmark	3	20.00
Finland	2	30.00
France	3	20.00
Ireland	2	30.00
German Democratic Republic	4	15.00
German Federal Republic	3	20.00
Hungary	4	15.00
Italy	3	20.00
Liechtenstein	2.5	24.00
Luxembourg	3	20.00
Monaco	3	20.00
Netherlands	2.5	24.00
Norway	2	30.00
Poland - Warsaw	4	15.00
- others	2	30.00
Portugal	4	15.00
Rumania	3	20.00
Spain	2	30.00
Sweden	2.5	24.00
Switzerland	2.5	24.00
United Kingdom	2.5	24.00
USSR (Moscow)	2	30.00
Yugoslavia	3	20.00

3.5.2. Tariffs for Telegraph Calls

As the telegraph network in Czechoslovakia is fully automated the telegraph charges are concerned only with automatically established connections. The corresponding inland charges are shown in Table 6.

Installation and maintenance of teleprinters and telegraph subscriber lines are billed monthly. The rental depends on the distance from the nearest telegraph exchange and varies between 5,000 and 12,000

Table 6. Charges for inland telex calls

Zone	1 (within the local exchange area)	2 (within the transit exchange area)	3 (out of the transit exchange area)
Charges per 1 minute (in crowns)	1.00	2.00	4.00

crowns per year. If a telegraph data set is required it is leased for an additional monthly rental.

3.5.3. Tariffs for Leased Lines

The charges for leased lines depend on the type of circuit (telegraph, telephone), the transmission rate, and the distance. For telegraph connections only two zones are distinguished: within the area of a transit (remote) exchange, and otherwise (outside of the transit exchange area). Table 7 contains monthly rentals for the three transmission rates. Of course, these rentals do not include the rentals for subscriber (local) lines.

The scheme for the speech band charge policy is different. The rentals depend on the distance (there are 4 zones described in Table 3), and if the line is used for data transmission the charge increases by 25 percent regardless of the data transmission rate (unless the line is conditioned). Table 8 shows the monthly rentals for leased speech band lines. If the modem is provided by the PTT a marginal additional charge applies;

Table 7. Monthly rentals in crowns for inland leased telegraph circuits

Transmission rate (bit/s)	up to 50	up to 100	up to 200
Transit connection	6,000	7,200	9,600
Intertransit connection	12,000	14,400	19,200

installation charges depend on the actual costs. When paying for lines one has to pay always for 4-wire lines, regardless of whether 2-wire lines are used in the connection.

Table 8. Monthly rentals for inland speech band circuits

Zone	1	2	3	4
Monthly rental (in crowns)	7,500	15,000	22,500	30,000

If leased telephone lines are used for the multi-user scheme the monthly rental is increased by 37.5 percent. Multi-point and conditioned (e.g., according to the CCITT recommendation M. 1020) speech band lines are specially charged.

Charges for wideband circuits as well as international lines are subject to the PTT and are calculated on a case-by-case basis. Applications for international lines have to be submitted to the Federal Ministry of Post and Telecommunication.

4. SOME TRANSBORDER DATA FLOW APPLICATIONS

4.1. Transborder Activity of the Regional Telecommunication Center of the Czech Hydrometeorological Institute [10]

The Regional Telecommunication Center (RTC) of the Czech Hydrometeorological Institute was established in 1972 and is responsible for data transmission within the WMO-GTS (World Meteorological Organization) and the ICAO (International Civil Aviation Organization) networks. It provides connection among others with the World Meteorological Center in Moscow,with regional telecommunication centers in Vienna, Offenbach, and Sofia, and national meteorological centers in Potsdam, Warsaw, and Budapest. Within the ICAO network RTC is connected with centers in Budapest, Berlin, Moscow, Warsaw, and Vienna. For data communication,a wide range of transmission rates are used: 50-200 bit/s for national meteorological purposes, 100 bit/s for ICAO purposes, and 100-2400 bit/s for WMO purposes. Data are exchanged over FDX 4-wire leased telephone lines equipped with modems both in synchronous mode and asynchronous (start-stop) mode.

Subscribers of the telex network have access to the RTC via universal DTEs. The RTC provides many different services: message switching for WMO and ICAO, selecting, editing, and correcting of meteorological reports, subscriber dialogue with an average response time of 1 second, databases of original and selected messages, code conversion (ITA 2, IA 5), transmission rate conversion, error control, etc. Most of the RTC hardware is duplicated for higher reliability. The RTC is in operation for 24 hours a day, and daily receives about 10 million characters and transmits 40 million characters.

4.2. Remote Access to SITA [11]

The Czechoslovak Airlines (CSA) is connected to the SITA (Societe Internationale des Telecommunications Aeronautiques) network to the Seat Reservation System GABRIEL run on UNIVAC computers, in Atlanta (USA) via the SITA Main Communication Processor in Frankfurt and Satellite Processors both in Zurich and Munich. Data are exchanged over two HDX trunk lines at a transmission rate of 4800 bit/s and over remote national lines that are controlled by the cluster controller in Prague, which assures high reliability and data flow flexibility.

The Czechoslovak domestic sub-network involves more than 60 VDUs and 15 matrix printers, which are placed in two reservation control centers, two airports, and five town offices. The inquiry system provides identical services to SITA's, e.g., storing and updating flight timetables, booking, changing or cancelling air tickets, avoiding duplications of reservations, reporting statistical data, informing about vacancies and connecting lines. The response time, in spite of the long distance to Atlanta, is very short--on average, approximately 3 seconds.

4.3. International Connection for Scientific, Technical, and Economic Information Exchange [12]

Within the Czechoslovak Scientific, Technical, and Economic Information (STEI) system, a Central Technical Base (CTB) was established, which enables inter-alia the direct access to databases of STEI. For the purposes of information exchange with databases in Eastern and Western European countries, the experimental data connection VNIISI (Moscow)-CTB (Prague)-IIASA (Laxenburg-Austria) was established in 1981. The connection is based on a leased 4-wire telephone line equipped with modem

4800 bit/s. The data flow is routed at CTB by means of time division multiplexers.

The CTB provides among others:

- access to Czechoslovak databases for Soviet organizations,
- STEI exchange between scientific institutes in the CSSR and in the USSR
- access to Soviet and Eastern European databases for Czechoslovak organizations
- centralized control of the orders of primary records (documents) on the basis of on-line Western European database systems.

It can be expected that the exchange of STI (Scientific Technical Information) in the future will grow and new connections will be established to promote this.

5. SUMMARY

As in other countries, the demand for data communication is increasing in Czechoslovakia. However, according to the PTT its demand has not yet required the establishment of a dedicated digital PTT data communication service. Thus data communication services by the PTT are provided through the existing telecommunication networks, through telephone, telex, and telegraph lines, which fully satisfy the present data communication requirements both in speed, quality, and volume. As to the technical characteristics of such services the Czechoslovak PTT strictly follows the appropriate recommendations of the CCITT. Similarly the telecommunication equipment industry follows the standards of ISO and CMEA.

The importance of transborder data flows for Czechoslovakia--a small country with an open economy--is not to be overlooked. The country plays an important role, for example, in the WMO-GTS network, actively participates in the networking activities of ICAO, and in the exchange of scientific and technological information over computer networks. It can be expected that the scope and volume of this transborder data fow traffic will further increase in the future.

REFERENCES

[1] Barasek, A., 1979. Utilizing Computing Techniques in CSSR (in Czech). Vyber Informaci 5: 539-552.

[2] Data Communication Services (in Czech), 1971. Federal Ministry of Post and Telecommunications.

[3] Bek, Z., 1981. The Present Development of Data Transmission Services Provided by the PTT (in Czech). MAA 12 (21): 444-448.

[4] Yearbook of Common Carrier Telecommunication Statistics, 1982. ITU. Geneva.

[5] Data Communication Regulations (in preparation). Federal Ministry of Post and Telecommunications.

[6] Puzman, J., 1979. Data Communications in Czechoslovakia (in Russian). Vychislitelnaya Tekhnika Sotsialisticheskikh Stran 4, 20-25.

[7] Puzman, J., 1977. The Design of Data Transmission Systems in the Czechoslovak Conditions. In: Proc. COMNET '77 Computer Networks and Teleprocessing. NJSZT Budapest, 313-328.

[8] Puzman, J., 1977. The Telecommunication Network Constraints on Interactive Systems. In: Proc. Int. Seminar Experiences of Interactive System Use. Politechnik Wroclawska, Wroclaw, 189-197.

[9] Bulletin of the Federal Ministry of Post and Telecommunications, (in Czech), 179. No. 29/1979.

[10] Masl, J., 1981. The Regional Telecommunication Center of the Czech Hydrometeorological Institute (in Czech). MAA 12 (21): 456-475.

[11] Dusil, M., 1981. Booking System in Czechoslovak Airlines (in Czech). MA 12 (21): 472-475.

[12] Srb, M., 1981. International Interconnection for Information Exchange (in Czech). In: Proc. 5th Intl. Conf. on Data Transmission. DPD' 81. Karlovy Vary: I/50-I/51.

[13] Chovanec, J., P. Pronay, 1981. Packet-switched Network - A Communication Mean for the Experimental Computer Network. Vychislitelnaya Tekhnika Sotsialisticheskikh Stran 10: 120-126.

Chapter 5:
DATA COMMUNICATION IN HUNGARY — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

I. Sebestyén

DATA COMMUNICATION IN HUNGARY — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

I. Sebestyén

0. INTRODUCTION

In what follows, a description is provided of the data communication and telecommunication infrastructure in Hungary together with all the relevant administrative procedures. First, on a historical basis, the general status of telecommunication, information processing, and data communication is given. This is followed by a description of all the data communication services of the telegraph, telex, telephone, and dedicated data networks and the corresponding administrative procedures. Special emphasis is given to the public digital data network NEDIX, which is the first such service in Eastern Europe. Last but not least the legal basis for transborder data flows is outlined and a short overview of the present transborder data flow applications is described.

1. GENERAL STATUS OF INFORMATION PROCESSING AND DATA COMMUNICATION

The most frequently used physical carriers for data communication are the different telecommunication networks: the telegraph, the telex, the telephone, and the digital data networks. In order to understand the present status of data communication in Hungary it is impossible to ignore the history of these carriers, since their present state has evolved during the past decades, especially in the field of wired telecommunication. In addition, due to the complexity and "heaviness" of the system no rapid change can be expected. Thus, if one wants to predict where the Hungarian telecommunication service is moving, one should look back at its origins and compare with where it is now.

As to the telegraph network, which is also suitable for carrying low speed data traffic although its importance for this purpose is insignificant, the development in Hungary started well back in the last century. The first Hungarian cities were actually served by the Austrian telegraph network and it was only after 1867 when the Austro-Hungarian Monarchy came into life that the situation changed. One of the first steps of the new Hungarian government was to take over the telegraph network and to rebuild it within the frame of the new political borders of Hungary. First the center of the telegraph network, which was until 1867 in Vienna, was moved to Budapest and new lines were established between this new center and other major cities of the country. Due to the rapid industrial development in Europe, international connections had soon to be built also. On some heavily used lines starting from 1861 so-called Hughes-type of telegraph systems were introduced. These transmitted alphanumerical characters. The first Hughes-type of system was put into service in Hungary for the connection between Vienna and Budapest in 1867. These Hughes-type systems were generally generally introduced in the country later and were used widely in a mixed way together with the old morse-type systems. In 1887 the telegraph and postal services were united; an important steps towards the type of PTT we know today. In 1876 Graham Bell put his new invention, the telephone, on exhibition at the World Fair in Philadelphia. In 1877 a Hungarian engineer Tivadar Puskás, who worked in one of Thomas A. Edison's teams, suggested that switching exchanges should be introduced for the telephone service, which would allow flexible connections among all telephone subscribers. This idea was at that time revolutionary, since even Edison first thought that the telephone would not be more than a new type of point to point telegraph. The first telephone exchange on this basis was built in London. Puskás as a co-worker of Edison had the task to build telephone exchanges in a number of European countries. The first telephone exchange in Hungary was opened in Budapest on May 1, 1881, about five years after the telephone was introduced by Bell. On February 1, 1882 the first telephone directory of Budapest appeared, which reported about 240 telephone subscribers. Thus in Budapest there was considerable interest for this new service from the beginning. This was in slight contradiction to the general European view, which did not really believe in the viability of the telephone and did not recognize its economic importance. For example, the German Imperial PTT did not think at that time that the telephone was a useful invention, they only claimed that should it become so they wanted to have a monopoly on it.

After the inauguration of the Budapest telephone exchange, telephone exchanges were also built in the major cities of the country also - Temesvár, Bratislava, Zagreb, Arad, Pécs, Sopron, Györ, Debrecen, Nagyvárad, Miskolc, Rijeka. The first international line was opened, allowing three parallel connections at the same time in 1890, obviously between Vienna and Budapest. Until 1897 the Telephone company of Budapest was in private hands, when according to the governmental law No. XVI the telephone company was taken over by the Hungarian Royal PTT. The legal basis for the takeover was actually laid in 1888 when the law No. XXXI declared that only the government had the monopoly to build telegraph and telephone networks in the country. Already at the time of the introduction of these new services the first Hungarian companies supplying telecommunication equipment were founded, for example, the predecessor co.npany of the Telefongyár (TRT), which is today one of the main producers of Hungarian-made modems, multiplexers and terminals, was founded in 1876. As a recognition of the advancement of telecommunication in Hungary in 1896 the International Telecommunication Union (ITU) held, with the participation of 16 countries, its second conference on telegraphy in Budapest. Hungary's advance in the field of telecommunication shows that already in 1899 new experimental telegraph systems were introduced between Budapest-Temesvár and Budapest-Berlin with a speed of about 100 character/sec (!). The experimental service was later discontinued because at that time there was no need for such a high speed of communication.

In 1922, after World War I, when the telephone and telegraph service practically collapsed a ministerial decision was taken to build the first automatic telephone exchange in Hungary. The first such exchange was actually only installed in 1928 in Budapest. The first interurban connection without manual switching was introduced in Hungary in 1938.

At the turn of the century the telephone service of Budapest already had 5,300 subscribers. Since the telephone exchange operators could not keep all these numbers in their heads any more, in 1901 it became compulsory for the subscribers to give the name *and number* of the person they wished to call. It is interesting to note that at that time this step proved to be most unpopular within the subscriber community and was a major source of dissatisfaction with the service. Later on the introduction of dialling to select a subscriber by its telephone number became daily practice and was generally accepted by the public. Strangely enough we will now be in a position to return to the original stage. By putting more local intelligence into the telephone sets and the main exchanges, we could move back to the old principle of dialling in a more "forgiving" way: e.g., by names, or "the doctor in the High Street"; the computer either in the set or in the exchange could find out the exact number and could do the dialling automatically.

The first public telephone booth was installed in Budapest in 1901, at the Eastern Train station. By 1911 Budapest already had 18,000 telephone subscribers. After World War I the international link between Hungary and Austria was extended from 8 to 18 circuits in 1927. With this upgrade Austria also handled a considerable amount of transit traffic between Hungary and Western Europe. By this time all Hungarian exchanges could be reached from all Austrian exchanges and vice versa. In a similar way connections were opened between Czechoslovakia and Hungary in 1928 with the transit possibility of three circuits to Berlin. The link between Belgrade and Budapest was opened in 1924 and through this also in a rather limited way transit to Greece and Turkey. A limited link between Hungary and Rumania was only opened in 1929, due to political difficulties; the problem of international information flow is thus not a new issue at all.

The penetration of the telephone network between the two world wars was slow. In 1940 in Hungary the number of telephone stations per 100 of population was 1.76. At the same time the same indicator for the USA was already about 15, however, among the neighboring countries it was still a "remarkable" position (Greece 0.76, Yugoslavia 0.45, Rumania 0.51). As a result of the destruction of World War II, the pre war indicator of 1.76 could only be reached again in 1950. In the war, 40% of the capacity of the Budapest telephone exchanges was lost and the rest seriously damaged. 70% of the wires were destroyed from the network itself. Also, the telegraph and broadcasting network was completely demolished.

By the end of 1981, according to [2], the number of main stations telephone in the country was 636,600, from which only about one-third was installed in homes, the rest in business. The number of telephone stations per hundred of population grew from 1.76 in 1950 to 12.1 in 1981, impressive progress in itself, but in comparison with other countries it is only moderate; e.g., [3] USA 79.1, Austria 36.6, Greece 28.2. All in all Hungary's international position in telephone population corresponds to its GDP/capita indicator. It is a well known fact that there is a direct relationship between number of telephones in a given country and the GDP/capita. There is an interesting lesson for other countries here, in particular for the developing countries, since although Hungary was one of the first countries in the world to introduce this service and although it has been in the forefront of research and technological development in this field since then, the telephone infrastructure of the country due to its economic potential does not properly reflect its advanced knowhow in this field. There is certainly a positive feedback from a well developed telephone infrastructure to the economy, but first there must be an initial investment to build up the critical mass needed for such a feedback. Due to the present telephone infrastructure unlike other countries the telegraph network still plays an important role in the country. In Hungary one telegraph message/year/person is sent, which is worldwide an extremely high figure.

The telex network (partly used for data transmission - such is the case with meteorological data) was introduced in Hungary in 1942. This network had at that time only 26 subscribers and one center, operated manually. The number of subscribers grew relatively slowly, in 1944 it reached only 67 and, this value could only be reached again in 1948, after the telex network was restored. It was only in 1953 that the system became automated; at this time a Hungarian made telex network with one control exchange in Budapest and five exchanges in other major towns was put into operation.

International connection through telex became possible from the outset of this service back in the forties (this was actually one of the main reasons to introduce this service); from 1963 automatic international calling became available. In 1974 the number of subscribers reached 5,000 and there is still a very high demand for becoming telex subscribers in the country; the waiting list is still rather long. In 1976 the density of the telex network was 6 subscribers/10,000 population, a relatively low figure; in some countries the telex density is over 20/10,000.

The Hungarian PTT has made data transmission both technically and legally possible since 1967. The number of subscribers with data transmission needs was relatively low during the first decade of data transmission, but this was also the case with the telex network. During the first years of service data transmission was provided through the telegraph and the telephone network on both switched and leased lines. In 1971 the Hungarian PTT opened its first dedicated data network called DATEX, which is built on a separate, independent telegraph type of network with one central exchange in Budapest. This network allowed data transmission up to 200 bit/sec in an asynchronous mode. The DATEX network was superseded in 1981 by the NEDIX data network.

In 1960 in Hungary there were only five computers in the country. By 1965 there were already 21 and by 1979 646; this does not include mini and microcomputers [4] (Figure 1). For this computer population in 1979 the number of data communication hardware processors (multiplexers as a part of the computer configuration) was 82, the number of line interfaces to these 390, the number of linked on-line terminals 274. The total number of network terminating points in 1980 was about 600. This gives 0.12 NTPs per ten thousand working population, which is considerably lower than the West European average (between 1 and 5), but is about the same range as the neighboring countries in Eastern Europe.

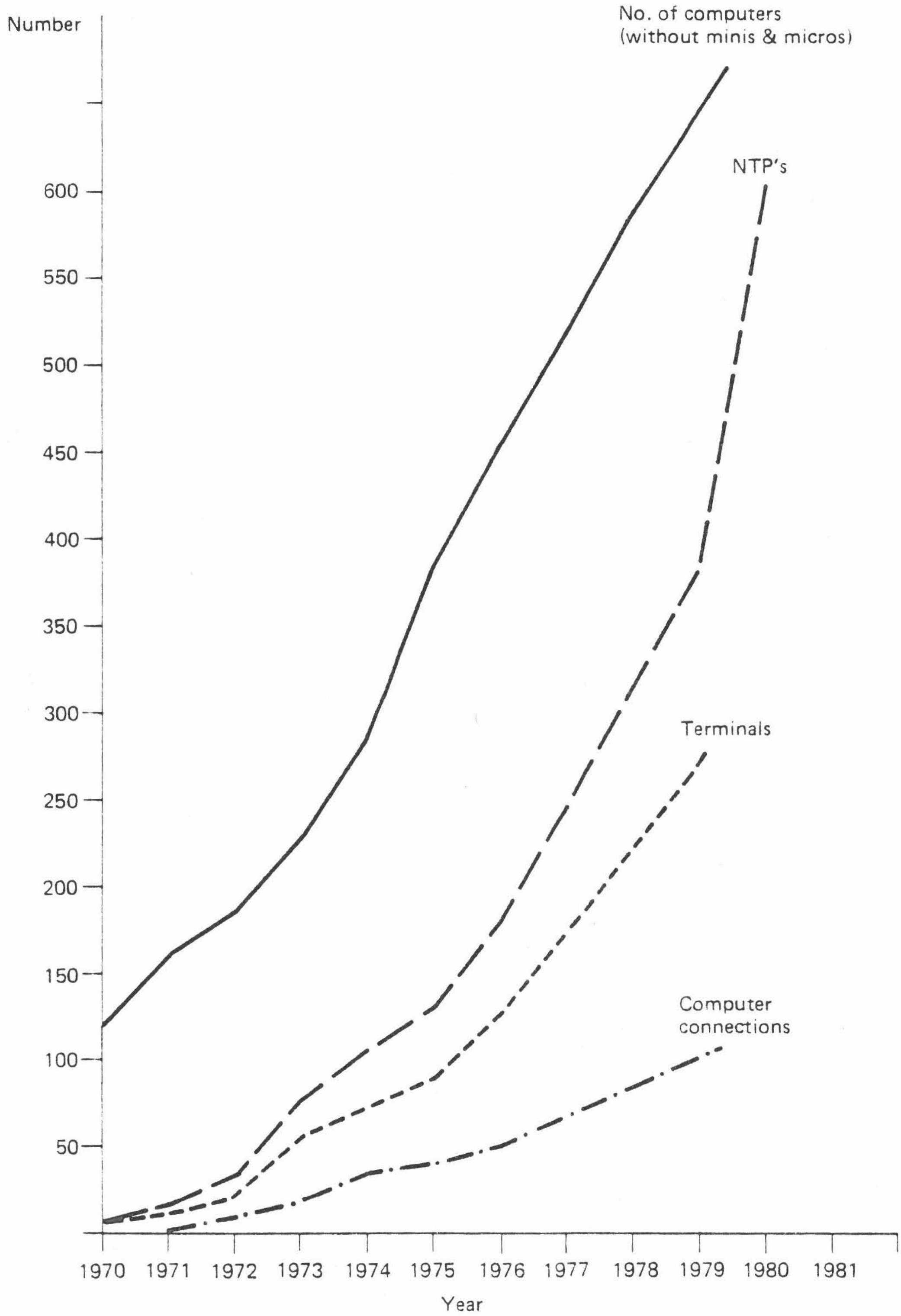


Figure 1. Number of subscribers for data services in Hungary [1, 4].

Figure 2 shows the distribution of NTPs by line use between 1970 and 1980.

It can be seen that the telephone network played the most important role for data communication in Hungary during the seventies; however the dedicated data network DATEX was also of major significance. The values in Figure 2 do not yet include data of the NEDIX network, which after a few months of its installation, i.e., at the beginning of 1982, had about thirty subscribers and a waiting list of over 60, due to the growing demand for data communication. More characteristic figures for the use of NEDIX can be expected in our view only around 1985, since each network needs a kind of introductory period.

Looking at the figures and demands for data communication it becomes evident, and this is also the expectation of the Hungarian PTT, that with the introduction of the new NEDIX network in 1981 basically all data communication needs for the first half of the eighties will be satisfied.

The relatively low use of data communication during the seventies can be explained because of the small number of computers with data communication facilities and the small volume of international data traffic, which during the seventies was confined practically to access to the SITA network. Other international network access projects were only in their experimental phase in the seventies.

With regard to computer hardware the seventies were dominated by mainframes of the RYAD I series, with limited or no data communication capabilities. This is one of the main reasons for the low figures in data

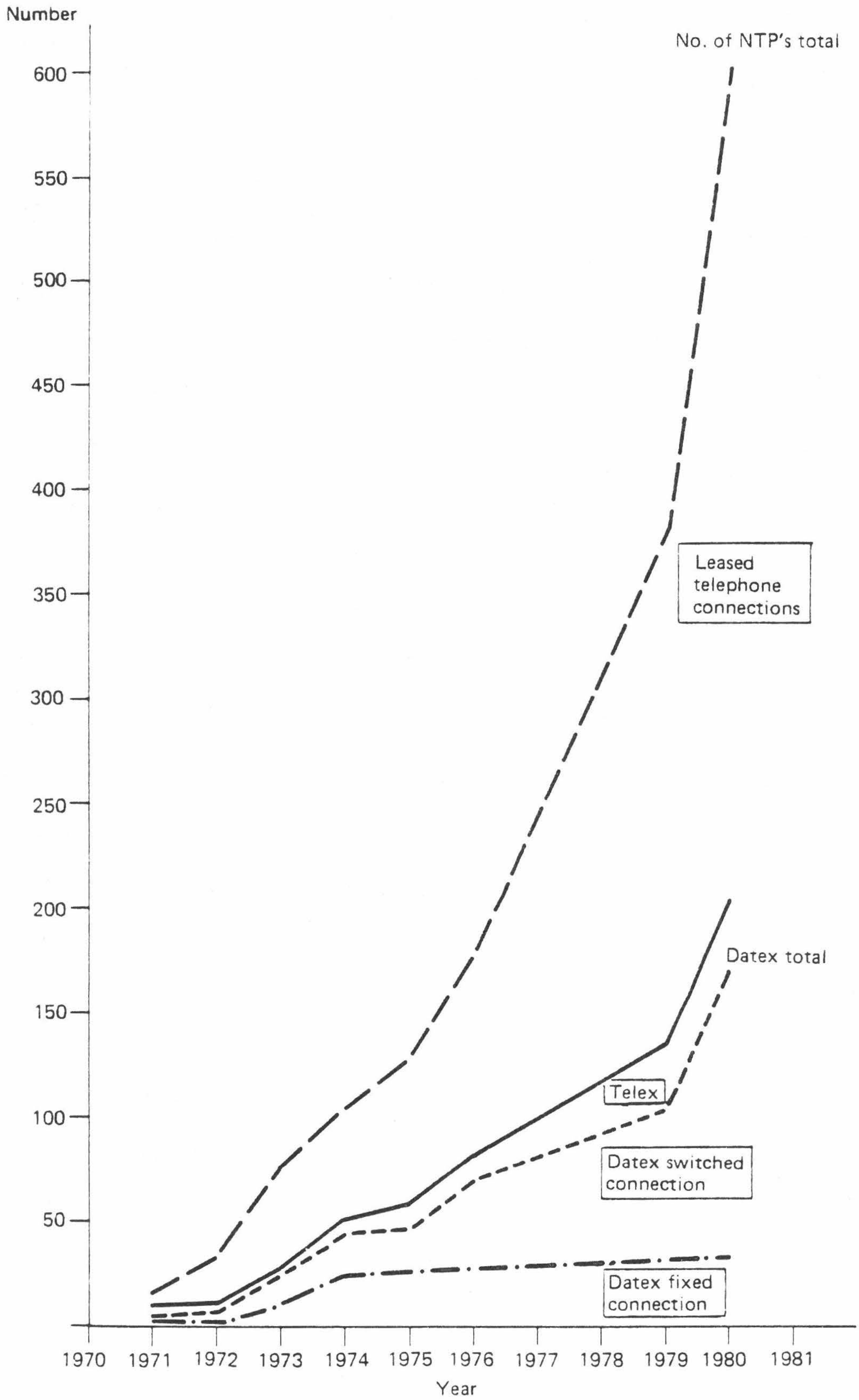


Figure 2. Distribution of NTPs by line use.

communication. The RYAD II series computers, which were introduced in 1979, however, do already support data communication and from the computer mainframe point of view it will certainly solve this problem. Another hardware difficulty lies in the interface of the present generation of RYAD terminals and data communication equipment that only support connections to analog carriers (CCITT V. interfaces), but not to digital circuits (CCITT X. interfaces). Along this line, e.g., no RYAD computer can be directly connected yet through a standard CCITT X. 25 interface to a packet switching network or the production of terminals with CCITT X. 20, X. 21 interfaces has only just started. For this reason the Hungarian PTT has also to support in its digital network NEDIX the V. interfaces by providing connection equipment according to CCITT X. 20 bis and X. 21 bis. On a research and experimental basis obviously various direct X. 20, X. 21, and X.25 interfaces for computer, telecommunication processors do exist, but not on a mass production basis yet.

Concerning the necessity of introducing the digital data network NEDIX for Hungary the average annual growth rate of data terminals in the last couple of years reached 40-50%. Not only the growth of data terminal equipment but also the rapid development of teleprocessing earmarked the end of the seventies and the beginning of the eighties in Hungary. On the one hand the equipment and software components needed for teleprocessing is considerably improving, and on the other hand the demand for such applications is growing. For more and more users teleprocessing is becoming a necessary tool in order to satisfy their data processing demands.

In this new situation the Hungarian PTT had to respond accordingly, which it did with the introduction of its new data network service NEDIX.

As mentioned above, the Hungarian PTT first started its data service more than a decade ago, and since then it has been providing data link facilities over direct links and switched connections of the telephone and telegraph network. According to the PTT--from the line quantity point of view--there is no bottleneck to using these analog networks for data communication purposes in the short run. However, both the telephone and the telegraph network were not originally designed to carry data traffic, i.e., on the one hand it often brought about the problem of inadequate transmission quality and limited data services to the users, and on the other hand the way these services were provided in the long run seemed to be unfavorable for the PTT itself. For these reasons it seemed advisable to speed up the development and installation of a PTT network that is solely designated to serve the data communication needs of the users. The design of this new network responds to the following new philosophy adopted by the PTT.

A hierarchy of networks should provide for high quality performance in services, such as data services, teletex, telex, and telegraph. On the first level of hierarchy, a common, integrated, basic network should provide for the principal transmission of signals. The different type of value-added services for data, telex, teletex, etc. are provided on the second level.

Since public PTT networks are designed to provide services for several decades, when making the planning the actual situation of a given country and the future trends in development have to be taken into consideration. In addition, international recommendations and standardization efforts, such as those of CCITT (within ITU) and ISO have to be taken into account. The Hungarian PTT, which is closely following all developments of CCITT and ISO, in addition follows the guidelines of the CMEA Permanent Commission on Postal and Telecommunication matters, and they are also actively participating in the work of that body. One of the present activities is to define the basic requirements for interlinking the present and future national data networks of the socialist countries. This work should aim to establish similar types of data networks and data service classes in the socialist countries. The technical specifications of the CMEA Permanent Commission fully harmonizes with the recommendations of CCITT, therefore in what follows only references to the original CCITT recommendations will be made.

After a specific tender for the new Hungarian telex and data network–after thorough technical and economic consideration--the offer from the Nippon Electronic Company (NEC) of Japan was finally accepted.

The new telex and data network (Type NEDIX 510 a) with one central switching center in Budapest and with multiplexers in major country towns was put into operation early in 1981. The use of the network is rapidly expanding, and in a couple of years the Hungarian PTT plan to upgrade their NEDIX network both in its capacity and in the scope of its services.

2. SERVICE STRATEGY OF THE HUNGARIAN PTT

The choice of whether to use the new NEDIX network or other PTT data communication services is left to the users. The Hungarian PTT itself, however, has a preference towards the new network, since the quality for data services can be easier fulfilled by NEDIX than by the analog telephone network. Nevertheless, the PTT does not plan to discontinue its earlier services; data communication over analog telephone and telegraph connections will still be provided in the future.

The technical parameters and the new tariff structure of the new system enable most data communications demand to be satisfied in an economical way. In some cases, however, it might happen that the technical parameters of the DTE or the software data processing system do not make the use of the NEDIX data network really economical. In such special cases it is best to rely on the traditional PTT data services.

The general policy of the PTT towards NEDIX is that through this data network all equipment needed for telecommunication are provided by the PTT on a lease basis. However for data communication over traditional telephone and telegraph lines, all telecommunication equipment, such as modes, and multiplexers, have to be made available by the user. Therefore the new policy--applied only for the NEDIX network--makes life both easier for the subscribers and for the PTT, which now can organize in an effective way the maintenance of all of the telecommunication equipment. The local connections to the NEDIX network or to its concentrators are provided in most cases through local analog telephone links. Only telecommunication equipment provided by the Hungarian PTT may be operated on these lines.

The NEDIX network and its services are such that they can be extended according to user demand. The extension can include, for example, new subscriber services, new special services, new subscriber interfaces, and new switching technologies. From this point of view it is of major importance that at a later date the Hungarian packet switching PTT network can be built on to NEDIX, because this network with its circuit switching capabilities takes fully into consideration those recommendations of the CCITT, which make provision for the introduction of packet switching services. The X.21 interface--used in synchronous services--represents also in the CCITT X.25 recommendation the lowest (the physical) level of the three levels defined. From the NEDIX's and PTT's point of view it is completely unimportant whether the synchronous channels of NEDIX are used by the subscribers for simple synchronous type of transmission or for a "user owned" packet switched subnetwork. For this reason the PTT does not object to the introduction of "user designed and serviced" private packet switched subnetworks, which the PTT itself does not yet support. According to PTT sources, for the next couple of years--at least until 1984/85--no PTT packet switched service is planned, mainly due to economic and technical considerations. The PTT seems to be confident that at this point practically all present and future user demands can be satisfied. As to the introduction of PTT packet switching services their standpoint is that the investment in hardware and software is not justified by the present and predicted user demand. If, however, users want to build their own packet switched subnetwork on NEDIX synchronous services, they may do it.

Data transmission over the analog telegraph and telephone network will be also possible in the future. The PTT, however, does not plan any major reconstruction of these networks in order to accommodate better data transmission services.

3. LICENSING PROCEDURE OF DATA COMMUNICATION EQUIPMENT BY THE HUNGARIAN PTT [5]

As outlined earlier, for the establishment of teleprocessing and remote computing systems there are at present three different telecommunication media available in Hungary:

- the telex/telegraph network
- the telephone network
- the circuit switched public data network NEDIX.

For the NEDIX network the Hungarian PTT provides all means and equipment for data communication between the telecommunication interfaces of the data terminal equipment. For the telephone network, the Hungarian PTT only provides the necessary transmission routes; therefore the users have to provide the data connection equipment, such as modems and multiplexers, needed for the remote data connection.

According to the present Hungarian Postal law (law No. 2 in 1964), the Hungarian PTT requires that only those types of equipment may be connected to any of the telecommunication networks of the Hungarian PTT that have been tested and approved by the PPT from the point of view of technical and safety requirements. On this same legal basis, all data connection equipment (modem, multiplexers, etc.) have to be licensed by the Hungarian PTT.

The licensing procedure can be initialized either by the manufacturer of the equipment in question, by the distributor or by the end-user himself. The application for licensing should be submitted to the Central Telegraph Office of the Hungarian PTT (Posta Központi Táviró Hivatal--PKTH, Budapest, V., Városház u. 18. Mailing address: 1365, Budapest, Pf. 1).

There are three different types of licenses granted by the PTT:

- individual licenses (so-called "egyedi engedély")
- temporary type-licenses ("ideiglenes tipusengedély")
- type licenses ("tipus engedély").

The *individual licenses* are granted only for the piece of equipment that has been actually tested and it can be applied only for a specific application. The so-called *temporary type- license* is issued by the Hungarian PTT as a result of the PTT test of a prototype telecommunication equipment in question. This temporary license is only valid for the piece of equipment that has been tested and the aim of the license is to inform the manufacturer about the standpoint of the PTT before launching mass production. Application for a *type- license* can only be submitted for equipment that can be mass produced through the same technology and where it is secured that all equipment coming from the production line is identical in their technical parameters and quality. Therefore the validity of the *type- license* is extended to all equipment that is identical in parameters and quality to the piece of equipment that was subject to the PTT test. Furthermore, it is a necessary precondition for any *type-*

license that the equipment to be licensed has to comply with the corresponding CCITT recommendations and with the general requirements and regulations for provision of healthy and safe working conditions.

The Hungarian PTT keeps at the PKTH an open register on the licensed equipment and provides information on them and on the range of permitted applications.

A full list of data connection equipment as of February 1982 is provided in Table 1. In principle both Hungarian and non-Hungarian equipment can be submitted for application.

It should be noted that Table 1 only contains information on licenses that include information about equipment presently in use. Thus, for example, equipment with early licensing dates, and that is technically obsolete and neither in use nor in continued usage, is not included in the table.

In addition to the up-to-date register maintained by the PKTH--where information can be provided any time upon request--the journal "Számitástechnika" is planning to publish the updated list of PTT licensed equipment once or twice annually.

Costs incurred for testing and licensing of any telecommunication equipment are to be met by the applicants according to the actual expenses.

Table 1. List of data connection equipment (modems) tested and approved by the Hungarian PTT.

Type	Manu-facturer	PTT licensce number	Data transmission speed (bit/sec)	Type of Application
VT-60200	VIDEOTON	VT-6-0040	600/1200	- for direct telephone connection with two and four wires, - for switched telephone network with or without. The license is also valid for modems which are built into the terminals VT-56191, VT-60291, VT-60292.
24 LSI	RACAL-MILGO (UK)	VT-6-0041	1200/2400	- for direct two and four wired telephone connection - for switched telephone network in connection with an LA III. Call handling device.
MPS 48	RACAL-MILGO (UK)	VT-6-0048	4800/3200	- for two and four wire direct telephone connection.
AM-1200	ORION (HUNGARY)	VT-6-0051	600/1200	- for two and four wire direct telephone connection. - for switched telephone connection. The modem family is produced in the following models: AM-1200/E - without supervisory channel and calling/answering capability AM-1200/F - with calling/answering capability but without supervisory channel AM-1200/G - with supervisory channel but without calling/answering capability AM-1200/H - with supervisory channel and calling/anwering capability.
AM-2400	ORION (HUNGARY)	VT-6-0057	1200/2400	- for direct two and four wire connection The validity of the license includes the models AM-2400/F and AM-2400/L as well, but the latter can only be applied for local telephone networks.
VT-60300	VIDEOTON (HUNGARY)	VT-6-0059	1200/2400	- for direct two and four wire connection - for switched telephone network but with manual calling initiation and manual call receipt. The license does not include the multipoint option provided by the modem.
VT-61400	VIDEOTON (HUNGARY)	VT-A-0060	600/1200/2400/4800/9600	- for galvanic two and four wire connections.
TAM-601	TERTA (HUNGARY)	VT-5-0061	600/1200	- for direct two wire telephone connection - for switched telephone connection Application valid for modems with TMM-600 monitoring device too.
SEMA-TRANS 48[illegible]2	TRT (FRANCE)	VT-6-0063	4800	- for four wire direct telephone connection, in duplex and half duplex, with manual balance without replay channel.
38[illegible]3/1	IBM (USA)	VT-6-0064	1200/2400	- for direct four wire telephone connection in point-to-point or multipoint mode. The device cannot work together with other type of V.26 type of modems.

TAM-201	TERTA (HUNGARY)	VT-2-0065	200/300	- for two wire direct telephone connection - on switched telephone network, also with TMM 200 type of monitoring device.
AM-[illegible]TD	ORION (HUNGARY)	VT-6-0066	600/1200	Modem built according to the V.22 recommendation of CCITT. In synchron or start-stop mode - for two wired, direct telephone connections - for switched telephone network.
3864/1	IBM (USA)	VT-6-0067	1200/2400	- for four wire direct telephone connection in point-to-point or multipoint mode. Because of the applied modulation the modem cannot work together with other type of v.27 type of modem.
2200/24	RACAL-MILGO (UK)	VT-6-009	1200/2400	- for four wire direct telephone connection
SZAM-32	MTA SZTAKI (HUNGARY)	VT-6-0022	Maximum 3200	- for two- and four wire direct telephone connection, - on switched public telephone network (with restrictions)
S 8351	SIEMENS (FRG)	VT-A-0025	1200/2400/4800	- for two- and four wire galvanic connection. In case of four wire connection up to 10 Km length it can be run also on 9600 bit/sec speed.
TAM-200	TERTA (HUNGARY)	VT-2-0026	200	- for two wire direct telephone connection, - over switched telephone network
TAM-600	TERTA (HUNGARY)	VT-2-0027	600/1200	- for two wire direct telephone connection, - over switched telephone network
GH-2052	ITT-SRT	VT-6-0028	600/1200	- for two and four wire direct telephone connection - for switched telephone network The modem does not comply exactly with the CCITT regulations, therefore for the switched telephone network it can be used only according to given conditions.
FM-200	VILATI (HUNGARY)	VT-2-0030	200	- for two wire direct telephone connection
5979	IBM	VT-A-0032	2400/4800/9600	- for four wire galvanic connection
3872	IBM	VT-6-0033	1200/2400	- for two and four wire direct telephone connection
SEMATRANS 1203	TRT (FRANCE)	VT-6-0049	600/1200	- for two and four wire direct telephone connection - for switched telephone network with manual calling/answering
SEMATRANS	TRT (FRANCE)	VT-6-0050	1200/2400/4800/9600/19200/38400	- for two and four wire galvanic connection
MK-600	MIKI (HUNGARY)	VT-6-0053	600/75	- for two and four wire direct telephone connection. In simplex mode, the data channel is 600 baud. The PTT permission is given for a modem card with the understanding, that it has to be applied in "telematics" equipment manufactured by MIKI. The mode of application has to be provided by the user before installation.
MK-75	MIKI (HUNGARY)	VT-6-0054	75/600	Simplex modem, 600 baud data channel, 75 baud reverse channel. Procedures for application similar to MK-600.
26 LSI	RACAL-MILGO (UK)	VT-6-0070	1200/2400	- for two and four wire direct telephone connection in point-to-point or multi-point mode with reverse channel, CCITT B type of communication. To the modem a voice adapter type RACAL-MILGO VA-100 can be connected.

page 2 of Table 1.

4. DATA COMMUNICATION OVER ANALOG TELECOMMUNICATION NETWORKS — TECHNICAL CHARACTERISTICS AND TARIFFS

4.1. Technical Characteristics

Data communication over analog telecommunication networks, i.e., the telegraph, the telex, and the telephone network will also remain in use for a long period in the future. The significance of the telegraph and the telex network, because of its low speed and limited character sets, will, however, be minimal. The analog telephone network,on the other hand, will keep its role in data communication for a long time.

From the technical point of view, as in other countries, for speed half duplex is generally possible for the public switched telephone network up to 2400 bit/sec; higher speeds are only possible in a limited way, depending on the actual technical status of the line used and of the telephone exchanges, which are in some regions hopelessly overloaded and outdated. Higher speeds are possible on the new generation exchanges and lines, which are gradually taking over the function of old equipment and lines.

Leased telephone lines with line quality according to CCITT M 1040 (and if needed M 1020) with speeds up to 9600 bit/sec are in use, but actually the quality of the leased lines basically corresponds to the average Western European standard. With regard to line quality and speeds it is the modem that is decisive. According to the CCITT recommendations each modem has a certain requirement towards line quality (e.g., CCITT M 1020; M 1025 or M 1040) and the PTT automatically - when it provides the permission to connect the modem to the line - measures the quality of the connection. The requirements for M 1040 (characteristics of ordinary quality international closed circuits) are no problem, since the network basically provides this quality. M 1020 - the special band with conditioned connection - however, cannot always be assured. The PTT nonetheless does not see the line quality as a bottleneck, since according to the general tendency adopted by the manufacturers of modern modems, more local intelligence is put into the modems itself, which allows them to work with higher speeds even on lower quality lines. In this way modems with speeds up to 14400 and 16000 bit/sec are already on the world market. The usual practice is that when the CCITT recognizes that such new equipment can be mass produced by a manufacturer in a reliable way, then it is ready to take over the specification of the modem as a CCITT recommendation.

4.2. Tariffs

Tariffs for data communication in Hungary are regulated by the Ministry for Transport and Post in accordance with the National Bureau of Materials and Prices. The legal basis for tariffs was laid down in the postal and telecommunication law of 1964 (II. law No. 6, phrase 1c) and in the 41/1979 (XI.1) regulation of the Council of Ministers (No. 2, phrase 1). The actual tariffs are then defined and modified according to needs on this basis by the Ministry for Transport and Post. The latest modifications of the telex and data communication tariffs for analog networks were issued by the Ministry on April 9, 1982 (Regulation No. 3/1982 (IV. 6) KPM, VI. 5/1982 (AT 15), and VI/4/1982 (AT 15) modified the previous regulation issued in early 1981: VI/4/1981 (AT2), and VI/2/1981 (AT2)).

4.2.1. Telex Tariffs

Although the role of telex is not too important for data communication, some basic figures are given below.

I) Installation Fee

In addition to the installation costs needed for a telex terminal and for becoming a subscriber of the telex service, for the licensing procedure of a telex data terminal 500 Ft per data station has to be paid.

For the actual installation of the telex data terminal the Hungarian PTT charges the customers according to the real costs of installation.

II) Monthly Charges

a). Monthly subscription fee to the telex network: 1200 Ft/telex station.

b). Rental fee for data communication equipment leased from PTT is 2% of the gross price of the apparatus.

c). Maintenance fee for data communication equipment leased from PTT is 1% of the gross price of the apparatus.

d). Maintenance fee for the telex network.

e). Message charges:

1). Direct telex data connection

a). Line fee: 50% of a corresponding telephone line fee between the locations of the telex stations.

2). Switched telex data connection

a). cost of messaging between telex stations belonging to the same telex exchange centers: 1.50 Ft for every three minutes.

b). cost of messaging between telex stations of different exchange centers

- between 8-19 o'clock 1.50 Ft/36 sec
- between 19-8 o'clock 1.50 Ft/54 sec

4.2.2. Tariffs for Data Communication through the Telephone Network

1). Connection fee both for direct and switched telephony.

A connection fee--in addition to the actual installation costs--for a telephone station is 6,000 Ft for residential users and 30,000 Ft for business users. This relatively high additional cost is aimed as a subsidy for the development investment of the telephone network. According to this, a fee of 30,000 Ft is charged for establishing data terminal equipment access to the public switched telephone network pro two wire access point.

Thus for direct point to point connection over a two wire link an installation fee of 60,000 Ft is opted for, and for a four line direct point to point connection 120,000 Ft.

2). Public Switched Telephone Network

I). Installation Changes

In addition to the connection costs for the licensing procedure of connecting data communication equipment to the telephone network, 500 Ft has to be paid. For the actual installation costs the PTT bills the applicants according to the real costs of installation.

II). Monthly Charges

a). The usual monthly subscription charges, as for any telephone station obviously apply.

b). For data communication equipment rented from the PTT 2% of its gross price has to be paid.

c). For the maintenance of these PTT owned data communication equipment 1% of its gross price is charged.

III). Service Charges

For data traffic on the PSTN the usual telephone charges apply, which is time and distance dependent. Basically the user has to pay for any telephone impulse consumed. The duration between two telephone impulses depends on the time of day, e.g., in cities it is 1.50 Ft for every 3 minutes between 6:00 and 18:00 and for every 6 minutes between 18:00 and 6:00.

Interurban charges vary according to the distance and time of day between 15 and 60 seconds telephone time for 1.50 Ft.

Charges of calls to other countries depend basically on time, distance, and technical possibilities. As an example, a 1-minute direct call from Hungary to Austria costs 13.20 Ft, to the FRG 19.50 Ft, to Italy 27.00 Ft, to the UK 31.80 Ft to Poland 17.40 Ft, to the GDR 19.40 Ft, and to the USSR 34.10 Ft.

3). Direct Data Communication Links

I). Installation Charges

In addition to the connection and telephone installation changes mentioned above 500 Ft is charged for the licensing procedure for the connection of data communication equipment to the telephone network. For the actual linkage of the data communication equipment to the telephone network, the PTT bills the applicants with the real costs of installation.

II). Monthly Traffic Charges

a). For local direct data connection the monthly charges for each subscriber and interexchange line per circuit are the following:

-- 2-wire connection 1200 Ft

-- 4-wire connection 2400 Ft

b). For long distance direct data communication links the monthly charges are the following:

1). For telegraph and telex types of connection

-- up to 50 baud 50%

-- up to 110 baud 60%

-- up to 200 baud 70%

of the costs of a direct telephone line between the two end points of the connection.

2). For telephone type of connection the monthly costs are equal to the monthly costs of a direct telephone line, unless time division multiplexing by the user is used, in this case it is increased by 30%, but no third party traffic is allowed on the line.

Cost of Long Distance Direct Telephone Connection:

in zone I

- up to 5 km 4,000 Ft/month
- up to 10 km 7,000 Ft/month
- up to 25 km 13,000 Ft/month

in zone II

- up to 100 km 26,000 Ft/month

in zone III

- over 100 km 39,000 Ft/month

5. THE DIGITAL DATA NETWORK NEDIX

5.1. The Main Functions of the NEDIX Network

The NEDIX network is built upon the recommendations of CCITT (of ITU) for public data networks. Its basic principle is *circuit switching*, but the applied technical solutions do not prevent the introduction of new services (such as *packet switching).* On the contrary they make provisions for extensions those.

The NEDIX data network of the Hungarian PTT supports data transmission services of different speeds and types. The first NEDIX electronic data exchange and switching center was installed at the Central Telegraph Office of the PTT in Budapest in early 1981. At this stage the system was a star-shaped network, but the services of this network could be utilized nationwide.

In five major rural towns of Hungary (Miskolc, Debrecen, Szeged, Pécs and Györ) multiplexers were installed in order to collect and distribute traffic from and to data terminal equipment.

It is planned--according to the traffic growth--to upgrade the NEDIX network by installing electronic switching centers--similar to the one in Budapest--in the above major rural towns of Hungary.

The data terminal equipment of the subscribers which can be a data terminal or a host computer, are connected by so-called *unified digital interfaces* to the data network. The physical connection between the network and the *data terminal equipment (DTE)*, is provided by a so-called *Data- circuit Terminating Equipment (DCE)*, which fulfills all functions of initiating, upkeeping, and terminating data communication calls. The DCE provides for all necessary coding and signal transformation. The *Data- circuit Terminating Equipment* of NEDIX is--on an exclusive basis--rented from the PTT, and users have to pay for their lease and maintenance.

The connection principle of DTEs to the network is based upon the CCITT recommendations X.20 and X.21. The primary aim of the NEDIX data network is to serve "X-type" of DTEs, which at present only represent the minority of the terminal population. For this reason the Hungarian PTT also supports the connection of CCITT "V-type" data terminal equipment, which was mainly designed for data transmission on analog telephone networks. For subscribers with "V-type" data terminals the PTT provides a special device that performs the necessary V/X conversion. This device will be installed at the user's site and will be connected to the above mentioned DCE, also provided by the PTT. Using this solution, the "X-type" of equipment can call or receive calls automatically while the "V-type" of DTEs can call the network only through manual operation--although incoming calls can be received either manually or automatically.

The data terminal equipment can be connected to NEDIX either directly through separate direct connection or through multiplexers, which are located, as mentioned before, in the main telephone exchanges.

The Data-circuit Terminating Equipment at the users' end can according to the physical parameters of the connection to the network be connected through a modem (if the carrier is voice frequency) or through so-called baseband transmitters (if the carrier of information is digital, without modulation).

All subscriber connections have to be 4-wire lines. The NEDIX network does not provide any speed and protocol conversion, therefore only those connections are technically feasible where data terminal equipments with the same protocols (synchronous or asynchronous) is to be interconnected.

Connections between DTEs are established on the basis of the *call number* of the DTE to be called. All stations of NEDIX are identified by a six digit call number. The numbering system is such that the same station can be addressed by all subscribers through the same identification number.

On NEDIX the following subscriber service classes (according to CCITT X.1) are supported:

- the asynchronous low-speed services class 1 and 2 and
- the synchronous medium speed services class 4 and 5.

All NEDIX services enable duplex type of data transmission. During establishment of calls in all CCITT X.1 type of service classes the CCITT No. 5 code set is used, and the character structure is identical with the one used during the data transmission phase.

Special NEDIX Services

The basic function of the network is to provide concurrent connections between data termination equipment belonging to the same service classes.

Apart from this basic service some special services are also at the disposal of the users. Along this line the NEDIX network offers the following special services according to the X.2 recommendation of CCITT:

1) *Direct Calling*

   This service enables the network to connect the calling stations--after having received the call request signal–directly to the predefined called station without dialing the number of the called station.

2) *Closed User Group*

Closed User Groups enable the subscribers of a predefined group of DTEs to make connections only among themselves. DTEs outside the Closed User Group may not call any member of the group. One DTE may be a member of a maximum of two groups.

3) *Closed User Group with the Right of Establishing Outgoing Calls*

Specified members of a Closed User Group may establish outside calls to DTEs belonging to the same service classes.

4) *Call Restrictions within a Closed User Group*

a) Specified members of Closed User Groups may not be called from even other members of their own groups.

b) Specified members of Closed User Groups may not call other members of their groups.

5) *Identification*

a) At the time of call initiation the network may send the number of the calling part to the called DTE.

b) At the time of call initiation the network may send the number of the called partner to the calling DTE.

In addition to the above CCITT recommended services the following value added services are available on NEDIX:

1) *Group-Switching*

The option of group-switching enables several DTEs of the same service class linked to the same center to be called by one common number; the network selects a free line and DTE according to a predefined chain of data terminals.

2) *Call/Receive- Only Stations*

Any data terminal of the network can be turned into "call" or "receive-only" types.

5.2. Technical Characteristics of the NEDIX Network and its Services [6]

At this point no attempt is made to describe the technical details of NEDIX fully, which has been done, for example, by [7, 8, 9, 10]; only some of important aspects for users are outlined here.

5.2.1. Subscriber Service Classes of the Data Network

Subscriber service classes of public data networks are defined by the X.1 recommendation of CCITT. According to this, circuit switching data networks support *start- stop* and *synchronous* type of Data Terminal Equipment (DTE).

a) Start-stop (asynchronous) services

From the service classes listed in the CCITT recommendation, the following are available on NEDIX:

Class 1: With bound address selection and data transmission speed (both 300 bauds) and predefined character structure (1 start-, 8 information-, 2 stop bits). During the phase of call establishment both DTE and network use the code set CCITT No. 5.

Class 2: Into this class belong all data stations working with 11 bit character structure and 200 baud speed. The same data transmission speed and character structure are used during both the phase of call establishment and data transmission.

The above *start- stop* type of subscriber categories are code- and speed-dependent. However, taking into account that at present there is a strong demand by several users to continue the speed- and code-independent service of the *old DATEX* network as well transmission up to 200 baud speed is provided within class 2 services of the new NEDIX network--in addition to the CCITT X.1 recommendations--as class 2' service code and speed-independent data. Subscribers of the class 2' use number dialing (10 impulses/sec)--according to CCITT U.1.B--and use single- or double-current telegraph interfaces.

b) Synchronous type of services

According to CCITT classes 3-7 are provided for synchronous data terminal equipment (Table 2). These classes utilize the CCITT No. 5 code during the call establishment phase. The NEDIX network supports only the synchronous classes 4 and 5 in its present configuration.

The network is provided for duplex transmission in all application classes.

In the first phase of interconnections to other national data networks it is planned to link NEDIX to Austrian data networks, i.e., to the DATEX circuit switching network of the Austrian PTT, and to the network

Table 2. Subscriber Service Classes of the Hungarian PTT Data Network NEDIX

Service class	call establishment			data transmission		Type of DTE
	Speed /bit/s/		Character-structure	speed /bit/s/	Character-structure	
1.	300	No.5	11 bit	300	11 bit	start-stop
2.	110	No.5	11 bit	110	11 bit	start-stop
	200	No.5	11 bit	200	11 bit	start-stop
2' / DATEX /	Number dialing, 10 imp/sec			max. 200	free	start-stop
4.	2400	No.5	-	2400	-	Synchronous
5.	4800	No.5	-	4800	-	Synchronous

node of Radio Austria in Vienna . The latter was actually put into operation in July 1982. As to the connection to the Austrian DATEX system, the asynchronous type of services in class 1 and 2 can be interconnected without any technical difficulties. The synchronous services for class 4 and 5 do differ for the two networks in the so-called envelope structure. The NEDIX has a 6+2 envelope structure according to CCITT recommendation X.50, the Austrian DATEX has a 8+2 envelope structure according to

CCITT recommendation X.51. Thus, in order to interlink the service classes 4 and 5 of the two systems, an X.51/50 converter has to be installed, which has to be provided according to CCITT recommendations by the Austrian PTT.

5.2.2. Numbering System of the Data Network

Data stations of NEDIX are identified by a six digit so-called network terminal number (NTN). The numbering system is closed, thus, any particular terminal can be reached by all other terminals belonging to the same service class by the same network terminal number. The numbering system will not be changed when the network gets upgraded and it also allows the introduction of new service classes.

Structure of the 6-digit Numbering System

```
|D...D| = |Z|     |Y|     |XXXX|
           |       |        |________ local number of DTEs belonging
           |       |                  to the same service class
           |       |
           |       |_________________ service class identifier code
           |
           |_________________________ exchange area code
```

International Calls

International calls from and to Hungary through the NEDIX network can be made according to the X. 121 recommendation of CCITT: according to this CCITT recommendation, Hungary, for example, has the country code "216", which would be used by the caller from abroad.

General Structure of International Calls

P CCC N D....D

- D....D — DTE number within a given country (it can be maximally 10 digits; for Hungary as mentioned above it is 6 digits)
- N — network identifier code (the different PTT networks of the country of the called DTE are identified by a separate digit)
- CCC — three digit country code
- P — Prefix, which signals that the call requests connection to a foreign DTE; for domestic DTE its value is 0.

Thus a call to Hungary:

$P\,2160\,D_1 \ldots D_6$

5.2.3. The Topology and Systems Technology of the NEDIX Network

The present NEDIX network incorporates in its present topology all elements needed for future upgraded network based upon many switching centers. The network supports even in its present star-like form the connection of DTEs country-wide. The network performs all digital switching and all network multiplexing functions on the basis of time division. The principle of time division enabled the optimization of the switching and data transmission functions of the system. At remote locations of the system in five major cities of Hungary time division multiplexers were installed, as their counterpart in the central data switching center in Budapest is a joint multiplexer, a so-called transmultiplexer. The synchronous data channels are collected according to CCITT X.50 by digital time multiplexer devices.

These digital multiplexer devices, which operate with a group carrier rate of 64 kbit/sec, are connected locally (within a given local network) either by baseband or by PCM transmission devices.

Subscribers may connect their DTEs through DCEs directly to the network switching center or to the multiplexers installed in the country towns. The signal transformer at the user side is built in the DCE. Up to a maximum of 20-30 km--provided physical connection is given--baseband transformer has to be used, beyond this limit a modem should be applied connected to analog telephone channels. Figure 3 lists all options for connections to the NEDIX network.

The multiplexers--at least at the beginning of the NEDIX service--are installed in PTT buildings. It is, however, quite clear that in certain cases it would be of major advantage (both for the subscribers and the PTT) if multiplexers could also be placed at the user's location. This opportunity has been looked at recently by CCITT and resulted in a recommendation for synchronous multiplexer-DCE specification. This new recommendation could not be taken into consideration in NEDIX, but the PTT is examining how it might be introduced.

The synchronous DTEs are connected to the network on the software principle of enveloping. Enveloping means that the bit stream coming from the DTE is divided into 6-bit groups, and each group has two additional bits to indicate the status of envelope synchronizing and control interface wires. As a result of the enveloping the actual transmission speed of the network is 33% higher than the speed available for sub-

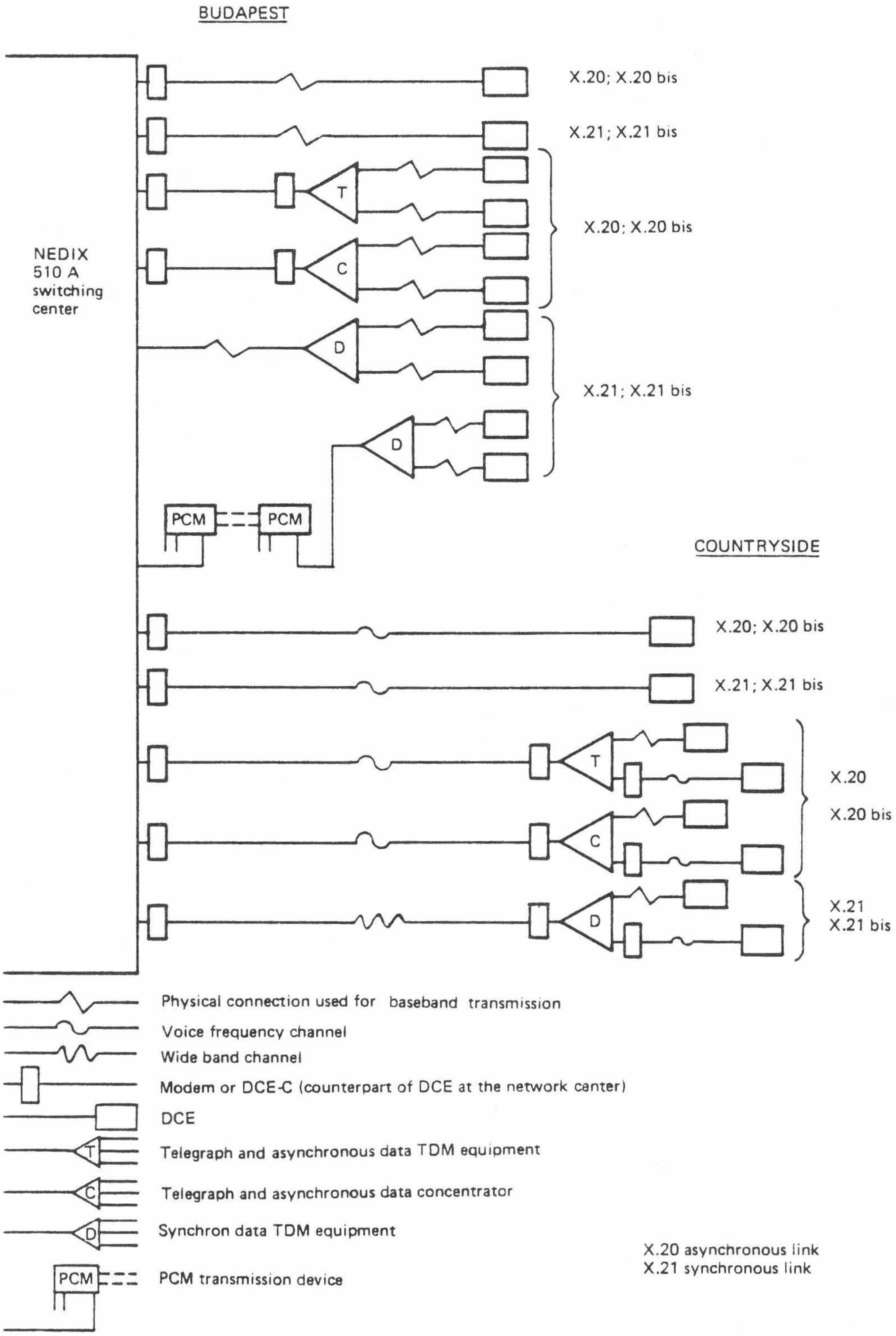


Figure 3. Connection options to the NEDIX network

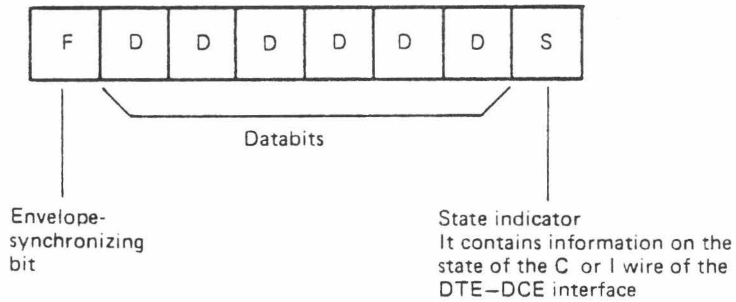
scriber services. As a result of the enveloping the carrier rate is 3200 and 6400 bit/sec, respectively, for class 4 (2400 bit/sec) and class 5 (4800 bit/sec) services (Figure 4).

5.2.4. Quality Parameters of Subscriber Services

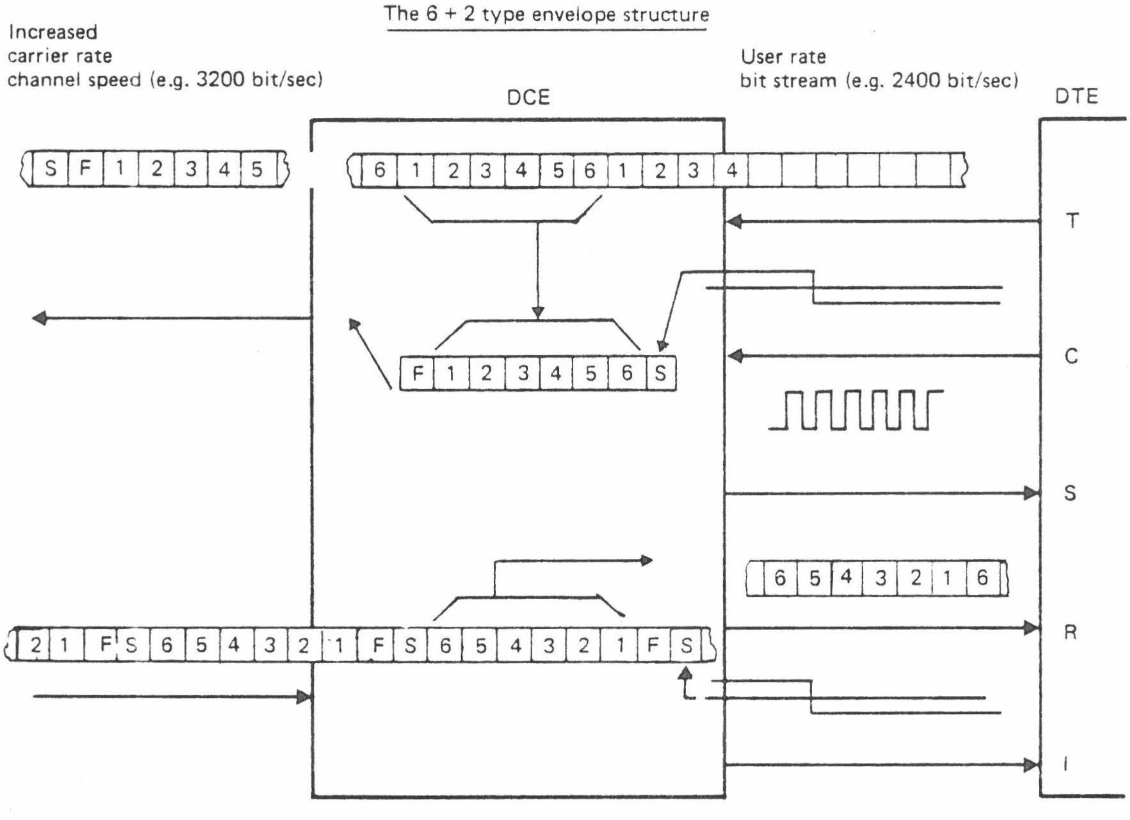
- The bit-error rate between two NEDIX DTEs of the same service class cannot be worse than 10^{-5}.
- The time limits for call establishment and call termination are the following (Table 2a).
- On the data network not more than one unsuccessful connection attempt is allowed for every thousand call requests. The reasons for this can be traffic congestion on the network, or disability of handling the call request, or hardware errors.
- On the basis of calculations it is expected that on average that only once in every 100 days will subscribers have to restart their data transmission due to network errors of NEDIX. In such cases the network center will not accept new call requests, but existing data connections will be still served. The restart process and the duration of such "disturbances" is expected to be in each case about 20 seconds. The disruption of existing connection is expected to happen even more rarely.

5.3. NEDIX Tariffs

All NEDIX tariffs for installation of DTEs and their operation are also governed by the Regulation of the Ministry for Transport and Telecommunication (Közlekedés és Postaügyi Minisztérium) on the Tariffs of Data



The 6 + 2 type envelope structure



Processing of envelopes in the DCE

Figure 4. Processing of envelopes by the DCE

Table 2a.

Time limits for NEDIX	Between call and call request	Between call termination request and actual termination
Asynchronous service classes	150 msec	490 msec
Synchronous service classes	50 msec	100 msec

Communication Services (No. VI/4/1981/AT 2). The tariffs fall basically into two major categories; cost of service initiation and costs of service use.

I. Tariffs for Service Initiation

These tariffs are to paid when users subscribe to NEDIX:

1) The connection fee is 500 Ft and has to be paid for the administration and licensing procedure before installation.

2) All costs in connection with the establishment of lines and installation of DTE. Subscribers have to pay for the installation according to the number of working hours and materials used. This usually does not exceed 2000-5000 Hungarian Forints. Higher costs, however, can be expected if the required 4-wire connection has to be provided through the installation of a separate line or by the provision of some special devices. In such cases the subscriber will be notified separately, and the PTT only starts installation upon acceptance of extra costs by the subscriber.

II. Monthly Payments

For the use and operation of the network, monthly payments have to be made. These payments are *fixed* and *traffic dependent*.

a) Fixed Charges

1) Monthly subscription fee

A monthly subscription fee--independent from the traffic--has to be paid for each DTE connected to the network:

class 1 (300 bit/s)	1200 Ft
class 2 (200 bit/s)	1200 Ft
class 4 (2400 bit/s)	3000 Ft
class 5 (4800 bit/s)	4000 Ft
class 6 (9600 bit/s)	4800 Ft

2) Equipment rental

(see Table 3).

Table 3. Monthly equipment rental

Equipment	Service Classes				
	1	2	4	5	6*
	Forint				
Data circuit terminating equipment (DCE)					
- for digital connection (X.20/X.21)	800	800	1200	1200	1200
- for analog connection (X.20 bis/X.21 bis)	800	800	5000	1100	13000
Network controller	700	700	700	700	700
Other equipment	2% of the gross price of equipment				

* This service is not offered yet on NEDIX, only prices are defined.

3) Equipment maintenance charges

(see Table 4).

Table 4. Monthly maintenance charges of equipment

Equipment	Service Classes				
	1	2	4	5	6*
	Forint				
Data Circuit terminating equipment (DCE)					
- for digital connection	400	400	600	600	600
- for analog connection	400	400	2500	5500	6500
Network controller	350	350	350	350	350
Other equipment	1% of the gross price of equipment				

* Service not offered yet on NEDIX

4) Line Maintenance Charges

If the DTE and the data switching center is connected to the same local telephone network, maintenance of lines is without charges. If the DTE is connected by long-distance line to the data switching center, then 2 Ft maintenance charges for every 100 m of the long-distance line have to be paid by the subscribers.

All monthly fixed charges have to be paid independent of the amount of traffic between the DTE and the NEDIX network.

b) Traffic Dependent Usage Charges

1) Local traffic

(between DTEs connected to the same data switching centers)

Day fares (between 8:00 - 19:00 hours)	Minute charges (Ft)
Class 1	1
Class 2	1
Class 4	2
Class 5	4
Class 6*	8

Night fares (between 19:00 - 8:00 hours)	Minute charges (Ft)
Class 1	0.75
Class 2	0.75
Class 4	1.50
Class 5	3
Class 6*	6

2) Long- distance Usage Charges

(between DTEs connected to different data switching centers)

Day fares (between 8:00 - 19:00 hours)	Minute charges (Ft)
Class 1	3
Class 2	3
Class 4	3
Class 5	6
Class 6*	12

Night fares (between 19:00 - 8:00 hours)	Minute charges (Ft)
Class 1	2.25
Class 2	2.25
Class 4	2.25
Class 5	4.50
Class 6*	9

At present there is only one data switching center in operation, i.e., in Budapest. As mentioned before multiplexers have been installed for

* This service is not provided yet on NEDIX.

collecting synchronous traffic in five major cities of Hungary (Miskolc, Debrecen, Szeged, Pécs and Györ). DTEs within the reach of these five multiplexers may use through this equipment the NEDIX network at local charges.

The duration of the actual traffic between DTEs is measured by the PTT with 0.1 minute accuracy.

A minimum charge for all successful calls both local and long-distance, has to be paid, even if the actual connection time was below the above minimum limits, i.e.:

- 60 sec for classes 1 and 2
- 30 sec for classes 4, 5 and 6.

The traffic dependent charges are billed monthly.

All above charges are valid for all DTEs connected to the data network. The charges for the DTEs of the old DATEX network (class 2'), which has been operational since the beginning of the seventies, are equal to the NEDIX class 2 charges.

III. International Charges

It was planned from the outset to connect the NEDIX network to public data networks of other countries. The first such connection was made in July 1982 to Radio Austria, which maintains in Austria international links to overseas on a permanent basis, such as to TYMNET, TELENET and DATAPACK in North America and on a temporary basis to some European PTT networks, such as DATEX-P in the FRG, TRANSPACK to France, CTNE the PTT network in Spain, PSS in the UK and NORDIC in Scandinavia.

Dedicated links to Italy (ESA) and Switzerland (Radio Swiss) are also available. The Radio Austria link, however, is only permitted by the Austrian PTT to transit to overseas and vice versa, transit to other European networks has to go through the Austrian DATEX networks. Traffic both from Hungary through NEDIX to international networks are provided, and vice versa: the Hungarian PTT aims for a balance between in and out calls to and from Hungary in order to outweigh the amount of convertible currency spent on foreign data links and that earned on calls to Hungary from foreign locations. Hungarian users pay--as for international telephone and telegraph services--for international data calls through NEDIX in Hungarian Forints, for connection to North America through the Radio Austria node Hungarian users pay 25 Ft per minute. No traffic charges are paid separately. The next step in international connection will be to the DATEX 300 L network of the Austrian PTT.

IV. Fees for Special Services

Some outlined special services are provided by the Hungarian PTT against separate charges. All charges for special services belong to the category of so-called free charges, which means that they do not have to be approved by the Hungarian Price and Material Office (Országos Anyag és Árhivatal).

For the administrative preparation of any of the chargeable special services 500 Ft have to be paid separately for each service as *service preparation fee*. For modification of any of these services 250 Forints are charged. In addition a *monthly fixed usage charge* has to be paid, which is independent of the frequency of usage.

Table 5. The charges for the special services per DTE

Special service	Charges (Ft) per DTE
Closed User Group	
- with 2 DTEs	2000
- with 3-5 DTEs	800
- with 6-10 DTEs	400
- with more than 10 DTEs	200
Direct calling	750
Identification of calling DTE	150
Identification of called DTE	150
Restriction in call initiation	500
Restriction in call acceptance	free

V. Charges for Temporary Data Stations

Temporary data stations can be established by the PTT on the request of the user, for a maximum of 2 months. For the installation and use of a temporary data station the same tariff structure is applicable as for permanent data stations. For temporary data stations in use for less than a month, charges for one month have to be paid.

5.4 Contact Points — How to Make an Application to Subscribe to NEDIX

Enquiries and information on data transmission services of the Hungarian PTT can be obtained from the Central Telegraph Office of the PTT (PKTH), and all requests for satisfying data transmission needs have to be directed to the same office (Address: Budapest, V. Városház utca 18. Mailing address: 1364 Budapest, Pf. 1. Telephone: 184-811).

All applications for services have also to be sent to the Central Telegraph Office of the Hungarian PTT. Applications can be made in letters, but separate printed forms are available as well.

Applications to NEDIX have to include:

-- Name of subscriber, address, bank account number,

-- Name of the responsible person at the subscriber's organization, telephone number,

-- Location of DTE, where the NEDIX port has to be installed,

-- Service category of the DTE (in class 2, also speed has to be given) in case of "V" type interface also the planned mode of service has to be described,

-- Is "V" or "X" type of interface available at the DTE? Make of DTE has to be provided,

-- Special services required,

-- Name and telephone number of responsible person at the subscriber's organization for technical questions.

For further information on the application and NEDIX services the Data Communication Division (Adatátviteli Csoport) of PKTH in Budapest can be contacted (Tel: 01/175-313). Forms for applications can be obtained from the same group.

Where to Report in Case of Trouble or Technical Defects?

Technical defects of DTEs and of NEDIX have to be reported twenty-four hours a day to the operating center of PKTH (PKTH Hibafelvevö Szolgálata, Tel: 01/175-415, 01/175-619 and Telex:22-1171) in Budapest.

6. TRANSBORDER DATA FLOW APPLICATIONS

6.1. The Legal Basis for Transborder Data Flow Communication

In Hungary there are several governmental and ministerial regulations in force, which on the whole regulate the generation, processing, storage and transfer of computer readable information both domestically and internationally. Some of the regulations deal with the handling and protection of so-called "state secrets" and "office secrets" such as the governmental regulation No. 14/1971 (IV. 15), the ministerial regulation No. 3/1971 (IX. 23) issued by the Minister for Internal Affairs and the Penal Code IV./1978 of the Hungarian Parliament. For more technical type of matters in connection with data processing the following regulations are in force: The ministerial regulation No. 2/1977 (VII. 30) issued by the Chairman of the Central Statistical Office (KSH) about data processing and storage of statistical data; technical guidelines and safety standards (M1 - 02102) issued by the National Fire Department for the fireprotection of computer centers; the construction standards 12/1980 (III. 14) issued by the Ministry for Building and Town planning for computer centers; the ministerial regulation No. 4/1800 (IX. 5) issued by the Minister for Internal Affairs on National Fireprotection Standards; the ministerial regulation No. 1/1981 (I. 27) issued by the Minister for Internal Affairs on the security, safety and fireprotection of computer systems, and in connection with it the guidelines issued by the Chairman of the Central Statistical Office on the implementation of the above regulations.

Concerning privacy of individuals--a frequently discussed issue lately in the literature and at many conferences--in Hungary the Civil Code (No. IV./1959 modified by IV./1977) is of guiding importance. This law is the basis for personal privacy, it regulates on how personal privacy should not be affected by computer supported data processing methods and what the consequences are if personal privacy is offended.

In the field of transborder data flow the first ministerial regulation No. 3/1974 issued by the Minister of Finance regulates the way official documents can be taken abroad or can brought into Hungary. Certainly the off-line and on-line transfer of machine-readable information is one category of official documents.

The most important step in regulating transborder data flow was within the framework of the new Hungarian Data Regulation N. 1/1981 (I. 27) signed by the Minister for Internal Affairs, which came into force on 1 July 1981.

The regulation was formulated at the request of the Council of Ministers in close cooperation with the Central Office of Statistics and other responsible ministries.

This new regulation, which is published in the official Hungarian Law Gazette (Magyar Közlöny, Issue 5/1981, pp 130-136), is a result of pioneering efforts in the very difficult and complex field of data legislation. Similar to the existing Western Data Protection Acts, the law is a "first generation" regulation, although the model it represents obviously reflects the philosophy and constitution of a socialist country.

The new regulation deals among other things with the handling and protection of computerized data; the regulation of fire and property security; the security aspects of data communications; and the regulation of international data transfer.

With regard to transborder data flow, the law does not restrict the free flow of "open data", unless it falls into the so-called "state secret" or "office secret" category. Information under the latter two categories can also be transmitted according to a well-defined procedure described in the law.

The protection of privacy, an issue of considerable interest to many countries, is described in paragraph 21 of the law: it begins by classifying all personnel information under the "office secret" category, with the exception of information intended primarily for public usage (e.g., the computerized "Who's Who?" database) or in the case where no link to the "owner" of the data can be established.

Data collection, data communication, data processing of information on persons having working or legal relations with a given entity (organization, firm, etc.) can only be carried out in accordance with the primary purpose and function of the organization, subject to the permission of the director. All other categories of collection, transmission, processing of personnel data can only be initiated by separate law, upon the instruction of the Council of Ministers or by the responsible Minister.

Although possible in principle, transborder data flow of personnel data nonetheless falls under the category of high security control since, as mentioned above, all personnel data is classified as "office secret".

This regulation, we believe, equips Hungary from a legal point of view to accept and participate in increasing international computerized data traffic.

There is also a special regulation that has also some connection to transborder data flow issues related to the service on remote sensing data--especially processing and responsibility for such services (Regulation 13/1980 (VI. 11) issued by the Ministers for Agriculture and Defense).

6.2. Some Transborder Data Flow Applications

Online transborder data flow applications have at present a relatively small share of the total flow of data crossing the borders of the country. With regard to databases the off-line exchange of machine-readable data still exceeds the online form of flow. Nonetheless the on-line access to databases and other host services from and to Hungary started at the beginning of the eighties. First it was experimental dedicated connections, such as various links between Hungarian research institutions and similar institutions both East and West. In 1982 after the introduction of the NEDIX public data network the first international link to Radio Austria was opened allowing international public on-line transborder data flow traffic for the first time.

Only references are made here to present individual transborder data flow applications, since they are described to a great extent in other papers and chapters: access to public databases as a special form of transborder data flows in [11], flow of meteorological data to and from Hungary in [12], data network of the international news agencies in [13], SITA the data network of airlines in [14], and the private data network of

IIASA and other Hungarian research institutions--used for exchange of scientific data for the promotion of IIASA's research in [15] and [11].

In addition to these present transborder data flow applications what can be expected for the future?

In the domain of public networks and services the number of international connections will continue to grow. During the eighties we will witness the emergence of public PTT data services in most European countries. As soon as these new services become available PTTs will interconnect them either directly or where this is not possible through gateways. The emergence of such networks in most Western European countries will be completed by 1985. It is expected depending on demand, that they will be interconnected and intermeshed with the Hungarian PTT data services in one way or another. With regard to Eastern European PTT networks the Hungarian NEDIX network is the first public digital data network in this region. In some other countries, such as Bulgaria and Yugoslavia, PTT data networks are expected to emerge before or around 1985, but on a global basis for Eastern Europe the emergence and interconnection of public digital data networks for this part of the continent is only expected for the second half of the eighties, when both demand for such services and technical capabilities, especially in computer hardware and data communication equipment, justify the creation of such a public international data network.

The situation with dedicated private network is different. Not only have they already been operational for a couple of years, they will also grow both in number and in their technical capabilities throughout the eighties.

From the presently known major networks it is expected that the interbank network SWIFT will be extended also to Hungary within the next few years.

In the field of science and technology there are plans for a dedicated computer network to interlink, with UN assistance, Hungarian research institutes already interlinked to similar institutions in Austria and the Soviet Union also to institutions in Yugoslavia, Bulgaria and perhaps Rumania, Turkey, and Greece.

All in all--although with the usual time delay of a few years--the role of transborder data flow in Hungary will be as significant as in any European countries with an open economy.

REFERENCES

[1] Vajda, E., et al, 1981. A Magyar Hiradástechnika Évszázada (The centernarium of Hungarian telecommunication). Hiradástechnikai Tudományos Egyesület, Budapest, Hungary.

[2] Central Statistical Office, 1982. Hungarian Statistical Yearbook 1981. Statistical Publishing House, Budapest, Hungary.

[3] AT & T Long Lines, 1981. The World's Telephones 1980. AT & T, Morris Plains, N.J. USA.

[4] KSH-OSZI, 1980. Számitástechnikai Statisztikai Évkönyv 1980. Statistical Publishing House, Budapest, Hungary.

[5] Anonymous, 1982. Adatátviteli berendezések postai engedélyezése I, (Licensing procedure of telecommunication equipment by the Hungarian PTT). Számitástechnika, Vol. 13, No. 2, p 6., issued February 1982, Statistical Publishing House, Budapest, Hungary.

[6] Central Telegraph Office of the Hungarian PTT, 1980. The Circuit-switching Data Network of the Hungarian PTT (PTT brochure in Hungarian). Headquarters of the Hungarian PTT (Postavezérigazgatóság, Vezetékes Távközlési Szakosztály), Budapest, Hungary.

[7] Matuka, L., 1981. A Magyar Posta Vonalkapcsolt Adathálózata (The circuit-switched data network of the Hungarian PTT). Hiradástechnika, Vol. 32/10. Budapest, Hungary.

[8] Srinka, G., 1982. A Magyar Posta nyilvános adathálózata - Az adathálózat rendszertechnikája (The public data network of the Hungarian PTT - The system technology of the network). Információ-

Elektronika, 1982/3. Budapest, Hungary.

[9] Uhrin, P., 1982. A Magyar Posta nyilvános adathálózata - Távbeszélö-hálózati adatátvitelre készült terminálok illesztése az adathálózathoz (The public data network of the Hungarian PTT - Connection of terminals with interfaces for data transmission over analog telephone networks to the digital data network). Informácio-Elektronika, 1982/4. Budapest, Hungary.

[10] Horváth, P., 1981. A Magyar Posta tároltprogram - vezérlésü távíró- és adatkapcsoló központja (The stored program controlled telegraph and data-switching center of the Hungarian PTT). Hiradástechnika, Vol. 32/10. Budapest, Hungary.

[11] Sebestyén, I., 1982. Public Database Services in Hungary. WP-82-111, IIASA, Laxenburg, Austria. (*)

[12] Sebestyén, I., 1982. Meteorological Networks - A Special Application of Transborder Data Flows. WP-82-119, IIASA, Laxenburg, Austria. (*)

[13] Sebestyén, I., 1982. Flow of International News Over Data Networks. WP-82-102, IIASA, Laxenburg, Austria. (*)

[14] Sebestyén, I., 1982. Data Communication for Aviation. WP-83-15 IIASA, Laxenburg, Austria. (*)

[15] Lábadi, A., I. Sebestyén, 1982. The TPA/70 - X.25 Gateway Network Promotes International Flow of Scientific Information. WP-82-88, IIASA, Laxenburg, Austria. (*)

[16] Central Statistical Office, 1982. A számitástechnikai rendszerek védelmének egyes szempontjai - Módszertani segédlet az 1/1981. (I.27) BM. számú rendelet, valamint a KSH elnökének a rendelet

végrehajtásához kiadott irányelvei alkalmazásához (Some aspects of the Protection of Computer Systems - a methodological guide to the regulation BM. 1/1981 (I. 27) and the guidelines issued by the Chairman of Central Statistical Office for the fulfillment of this regulation). Statistical Publishing House, Budapest, Hungary.

[17] Weiss, I., 1981. Mi a teendö a számitástechnikai rendszerek adatvédelme terén? (What to do in the field of data protection of computer systems), Számitástechnika, V. 1981/07-08. Statistical Publishing House. Budapest, Hungary.

[18] Gömbös, E., 1981. A számitástechnikai rendszerek titok - vagyon- és tüzvédelme (Security, Property and Fire protection of Computer Systems), Számitástechnika, V.1982/03. Statistical Publishing House, Budapest, Hungary.

* (Those referenced IIASA Working Papers which are included as chapters of this study are separately marked with an "*" at the end of the reference).

Chapter 6:

DATA COMMUNICATION IN THE USSR — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

A. Butrimenko and I. Sebestyén

DATA COMMUNICATION IN THE USSR — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

A. Butrimenko and I. Sebestyén

0. INTRODUCTION

Data communication in a large country such as the USSR is a very complex subject, which has to be approached from many different sides. Therefore in what follows we try to elaborate this topic first from the general status quo and of the telecommunication network of the USSR. The present status of the telephone network, which still represents the backbone of data communication, is a very important factor in determining what actually can be done in data transmission. We devote a separate chapter to the description of communication satellite systems, which already play an important part in telecommunication and data transmission in the USSR, and which are even more promising for future data transmission applications; their potential is truly tremendous.

In a subsequent chapter we describe the present PTT telecommunication services, its present administrative procedures, and some tariff questions. This chapter aims to provide a general overview of what is available for data communication users, special emphasis being paid to the international aspects of these services.

Finally, we describe briefly the state of computer networking in the USSR, showing present practices, applications and some future trends. In particular we point to some of the existing international computer communication systems already in use.

1. STATE OF THE TELECOMMUNICATION NETWORK

1.1. The Telephone

Data communication possibilities over leased lines or public switched telephone networks has been largely determined by the state of development of the national telephone network, which is influenced by many factors only referred to briefly in this study.

The first well known factor is that the development level-- measured, for example, as numbers of telephone stations per 100 population—is generally dependent on the economic capacity of a given country, often expressed as Gross National Product per capita. As shown in Ref. 1 and in a number of other publications, there is generally a linear correlation between GNP/capita and the number of telephone stations/population (Figure 1). There are obviously other factors that impact on this development level, such as the geographical characteristics of a given country, the usage pattern and social role of the telephone, and historical development trends.

Figure 1 shows also that countries with extremely large scarcely populated territories operate telephone network services that are actually less developed than one might expect according to their GNP/capita figures. This is obvious, since the difficulty of extending the telephone network infrastructure to remote parts of countries--often with climatic extremes, such as in Siberia--cannot be compared with the network expansion in densely populated and highly industrialized areas, such as the Netherlands.

Much has been said about the social role of the telephone, e.g., in Ref. 2. There are regions in the world, e.g., the USA, where the social role and impact of the telephone, both on the private and business life, is more determinant than for example in Europe. This obviously influences differently the needs of telephone users in various countries.

Another important factor is the development history of a given national network. Using the traditional wired technology, the development process of a national network is both extremely slow and resource consuming. Figure 1 shows that even in the United States, which had one of the most favorable conditions for building up a telephone network, this was a long and time consuming process. In [1] we showed that the full penetration (80%) of the telephone in US households took about 72 years, a progress that was about four times slower than for the radio or the television service. For other countries this relation is far worse. The trend might be changed to some degree with the introduction of new technologies, such as fiber optics, integrated high speed telephone networks, and satellite communication, but for the moment it remains slow.

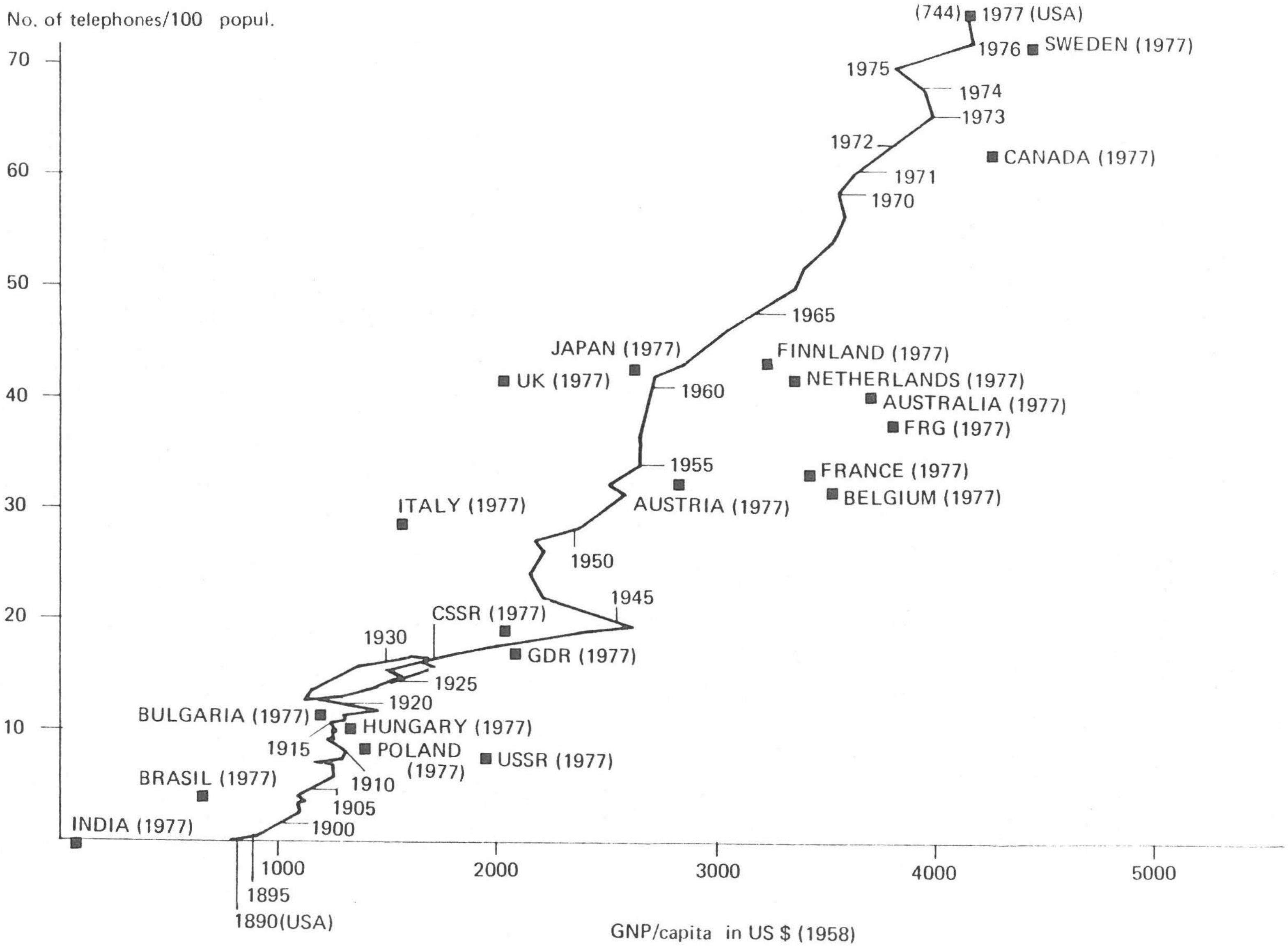


Figure 1. The linear relation between the number of telephones and GNP/capita in a given country. USA figures suggest that the historical development followed the same rule.

The present state of development of the USSR telephone network can be fully derived and understood from the above considerations.

Geographically the country, with its territory of 22.5 million km^2 occupying about 20% (!) of the whole earth, has a scarce population especially in remote rural areas. From this point of view the characteristics of the USSR are somewhat similar to those of Canada and Australia, although the population distribution pattern differs in some ways: in Canada the majority of the population lives in a 100-150 km wide "belt" along the US-Canadian border; a similar concentration can be observed in Australia, especially around Sidney and Melbourne. The population pattern of the USSR is, however, distributed.

Some comparative data are given in Table 1 for selected national PTT telephone networks. In 1980 the USSR had about 20.5 million telephones in service. However, the ratio of telephones per head of population is relatively low for a country that belongs to the industrialized world. There are many factors contributing to this low ratio: the GNP/capita figure, the unfavorable geographical and climatical conditions for building up the network, and the social role of the telephone in the USSR. The historical development of the network is also important. For a long period of time the industrialization policy of the country gave higher priorities to industries--such as the steel industry--that contributed directly to the production capacity of the country. Thus the general state of the telephone network is somewhat less developed. According to Table 1 the situation is improving, the growth rate figures are promising; the 7.3% increase between 1979-1980 in the number of telephones in service implies that the country is expanding its telephone network as fast as is

Table 1. Countries that have reported 500,000 or more telephones. Comparative data for the years 1980, 1979, and 1970. (Reported data are as of January 1, 1980. Source: AT&T Long Lines, 1981, The World's Telephone's - a Statistical Compilation as of January, 1980, AT&T Long Lines Overseas Administration, Morris Plains, USA).

	Total telephones in service					Ratio of telephones per 100 population		
Name	1980	1979	Percent increase 1979-1980	1970	Percent increase 1970-1980	1980	1979	1970
Argentina	2,759,736	2,659,949	3.8	1,668,426	65.4	10.3*	10.0*	6.9
Australia	7,396,212[558]	6,266,290	18.0	3,598,692[580]	105.5	52.0[406]	43.7	29.3
Austria	2,812,678	2,617,634	7.5	1,334,339	110.8	36.6	34.0	181.1
Belgium	3,447,697	3,270,882	5.4	1,936,814	78.0	35.0	33.2	20.1
Brazil	6,494,000	5,522,445	17.6	1,787,000	263.4	5.1	4.5	1.9
Canada	15,560,264[561]	15,059,428[576]	3.3	9,302,828	67.3	65.6[443]	63.5*	43.8
Chile	553,856	531,143	4.3	348,258	59.0	4.9	4.8	3.6
China-Taiwan	2,566,078	2,099,310	22.2	338,803	657.4	14.7	12.3	2.4
Colombia	1,524,000	1,444,972	5.5	545,851[573]	179.2	5.8	5.7	2.6
Czechoslovakia	3,072,829	2,981,197	3.1	1,895,229	69.5	20.1	19.7	13.1
Denmark	3,144,558[561]	2,935,124[582]	7.1	1,599,952	96.5	61.4[597]	56.5[597]	32.5
Finland	2,244,365	2,127,392	5.5	1,089,700	106.0	47.1	44.7	23.1
France	22,211,95.	19,870,006	11.8	8,114,041	173.7	41.4*	37.3	16.1
German Dem.Rep.	3,071,515	2,958,390	3.9	1,986,190	54.6	18.3	17.7	11.6
Germany, Fed.Rep.of	26,632,302	24,743,467	7.6	12,456,268	113.8	43.4[68]	40.3	20.4
Greece	2,664,050	2,487,495	7.1	881,003	202.4	28.2*	26.5*	10.0
Hong Kong	1,517,294	1,382,214	9.8	502,374	202.0	30.2*	29.2	12.5
Hungary	1,186,526	1,142,597	3.8	777,739	52.6	11.1	10.7	7.5
India	2,615,075[559]	2,423,762	7.9	1,159,519	227.9	0.4[423]	0.4[578]	0.2
Iran	730,000	n.r.	-	286,220	155.0	2.2	-	1.0
Ireland	586,000	554,000	5.8	287,108	104.1	17.3[325]	16.8*	9.8
Israel	1,081,480	1,028,087	5.2	457,721	136.3	28.2	27.5	16.0
Italy	18,084,996	17,080,870	5.9	8,528,354	112.1	31.8	30.1	16.0
Japan	55,421,515[490,564]	52,937,304[579]	4.7	23,131,688[581]	139.6	47.6[490]	45.8[579]	22.4
Korea, Rep.of	2,898,687	2,387,336	21.4	562,111	415.7	7.8	6.6	1.8
Mexico	4,532,557	4,140,271	9.5	1,327,702	241.8	6.4*	6.0*	2.7
Netherlands	6,852,776	4,140,271	8.1	3,120,766	119.6	48.6	45.4	24.1
New Zealand	1,729,916	1,762,130	-1.8	1,202,590[581]	43.8	55.0	56.1	42.6
Norway	1,725,678	1,636,491	5.4	1,090,662	58.2	42.3	40.2	28.2
Philippines	519,642	593,127	-12.4	293,543	77.0	1.2	1.2	0.8
Poland	3,243,693	3,095,303	4.8	1,756,248	84.7	9.1	8.9	5.4
Portugal	1,305,580	1,253,530	4.2	698,075	87.0	13.1	12.7*	7.3
Puerto Rico	651,388	604,271	7.8	302,214	115.5	18.5	19.3	10.9
Singapore	625,130	540,209	15.7	136,267	358.8	26.5	22.9	6.7
South Africa	2,662,399[551]	2,456,329[574]	8.4	1,482,299[581]	79.6	10.8*	10.0*	7.3
Soviet Union	22,464,000	20,943,000	7.3	n.a.	-	8.4	7.9	-
Spain	11,107,624	10,311,423	7.7	4,126,363	169.2	29.4	28.0	12.5
Sweden	6,407,031	6,160,359	4.0	4,306,905	48.8	77.1	74.4	53.7
Switzerland	4,446,005	4,292,205	3.6	2,846,535	56.2	70.4	59.8	45.4
Turkey	1,747,854	1,578,586	10.7	513,569	240.3	3.9	3.7*	1.5
United Kingdom	26,651,384[565]	24,934,670[577]	6.9	13,947,000[581]	91.1	47.7	44.6	25.0
United States	175,505,000[567]	168,994,000[575]	3.9	115,222,000	52.3	79.1	77.0	56.4
Venezuela	1,165,016	920,252	26.6	377,662	208.5	8.5	6.2	3.7
Yugoslavia	1,912,833	1,732,558	10.4	622,939	207.1	8.5	7.6	3.1

reasonably possible. The growth rate for the USSR compares favorably with the growth rates for other developed countries that are in a similar phase of development (e.g., Austria) and is obviously higher than for those countries that are about to get close to their saturation level, such as Sweden, Switzerland, or the USA.

1.2. Space Technology in Telecommunication

In the development of the PTT networks, recent technological advances such as satellite communication--in which the USSR is one of the leading countries--are of major importance. According to [11], for such purposes the USSR at present operates the MOLNIYA type of satellites in highly elliptical orbits that are quite suitable for high latitude service areas, together with a number of geostationary satellites (STATSIONAR, STATSIONAR-T) using the 4/6 GHz spectrum. Satellites of this type are used not only for the national needs of the USSR in telephony, TV, and radio broadcasting but also for the requirements of the INTERSPUTNIK International System and Organization of Space Communications.

Typically, the bandwidth of a satellite space channel is measured in tens or hundreds of Mbit/s. Typical inputs into this space channel are voice (tens of Kbit/s), data (from a few Kbit/s to Mbit/s), and image (up to several Mbit/s). It is therefore necessary to multiplex these inputs into and demultiplex them out of the space channel.

In the national satellite communication system of the USSR two types of multiple access (multiplexing techniques) are used: FDMA (frequency division multiplexing) and TDMA (time division multiplexing).

a) FDMA

The FDMA technique is used in the majority of telecommunication satellites, also in the USSR. It is used in links with low traffic such as the analog transmission of voice. In this case a certain part of the frequency spectrum within the transponder passband is assigned to each transmitting and receiving station in the network separately all the time and all the stations can operate simultaneously emitting carriers modulated by telephone messages or TV-radio broadcasts in the allocated frequency bands (Figure 2).

The advantage of FDMA is its simplicity and its adequacy for telephone transmission. Its disadvantage, however, is that it uses bandwidth in a somewhat inexpensive way and it lacks the flexibility required by data transmission, which can vary between low data rates of a few hundred to a few million bit/s.

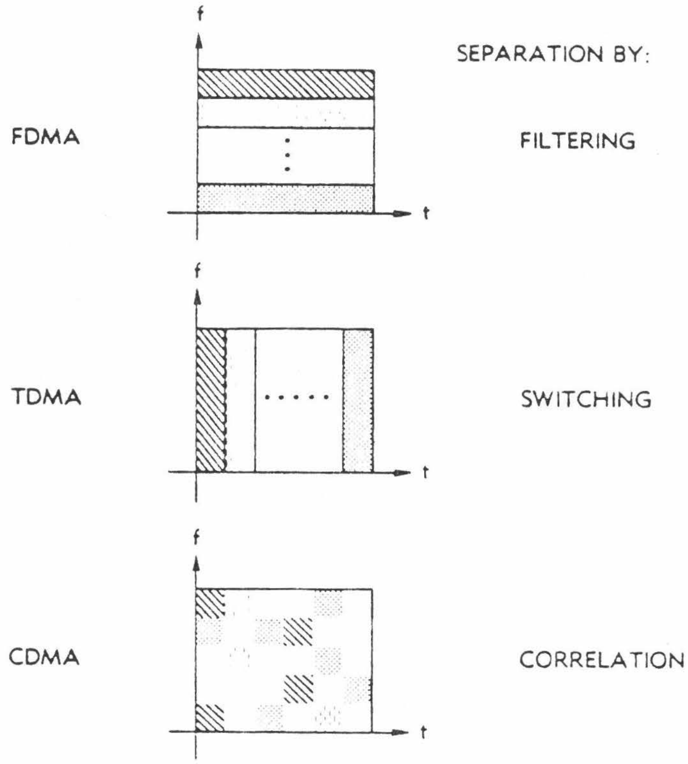
In the transmission of discrete analog data, the transponder capacity may be as high as in the transmission of digital data. Discrete data transmission offers certain advantages. First of all, discrete data available from a computer, control systems, etc., may be transmitted most efficiently. If for transmissions over the voice frequency channel, the rate of 9.6 kbit/s may be achieved, then by using the primary standard discrete channel, the binary data stream may be transmitted at 32-64 kbit/s. Apart from this, discrete data transmission allows forward error correction, new modulation techniques (e.g., a hybrid amplitude-phase modulation), and the use of source redundancy, which in the near future will make possible a several fold increase in the communication system capacity.

A number of links provided with digital data transmission equipment using FDMA have been operating in the USSR domestic satellite network for several years.

As a rule, in these communication links, a data signal from the trunk exchange goes via the connecting line to the earth station at the terminal ADC/DAC input for conversion of analogue data in digital form. The terminal equipment uses adaptive PCM (pulse code modulation) techniques and performs analysis of the signal block containing a fixed number of samples of the input signal function. If the values of all samples in a given block do not exceed specific threshold quantities, values of all samples increase 2,4 or 8 times. An output terminal signal, which is a binary data stream at 512 kbit/s, then goes to the FDMA equipment, where the assigned carrier frequency is phase modulated. With reliability at the receive side of the order of 10^{-6} per bit, simultaneous transmission of 12-14 carriers is possible in the transponder. This corresponds to a transponder capacity of 6-7 Mbit/s.

b) TDMA

According to the TDMA (Time Division Multiplexing) principle each user is allocated all of the space channel for some of the time. Thus each user gets allocated a certain time slot. User time slots are allocated in such a way that time slots for users transmitting from a given earth station are continuous. For a fixed duration of so-called TDMA frames, bursts and time slots are allocated for different earth stations (Figure 3).



TRADEOFFS IN SELECTION:

- COMMUNICATION CAPACITY
- NUMBER AND VARIETY OF ACCESSES
- POWER/BANDWIDTH
- SIGNAL QUALITY
- INTERCONNECTIVITY (PRESENT & FUTURE)
- PRIVACY
- TERRESTRIAL INTERFACES
- COST

Figure 2. Modes of multiple access [14].

The synchronization of a burst is a key problem for a TDMA communication satellite because it must ensure that bursts, sent by two different stations, never overlap when they reach the satellite. Synchronization can be assured by a master station, the so-called slave stations constantly monitoring the frame reference burst from the master station to extract their own bursts timing information. A major advantage of TDMA over FDMA is to be able to operate with dynamic allocation, i.e., to be able to allocate bursts and slots within a frame according to the instantaneous transmission need of the users. The capability is more often referred to as Demand Assignment (DA).

The communication links with TDMA are used to establish communication between large administrative-economic centers. The first link of this type for 120 duplex channels was put into operation in 1977. At each earth station of the link, signals for two 60-channel groups coming from the trunk exchange via the radio relay or cable link are converted to digital signals and form two streams of about 6 Mbit/s each. After time compression, 62.5 microsecond synchronous bursts are formed with a period of repetition of 125 microseconds. The bursts comprise specific code words for mutual synchronization of stations and a preamble necessary for synchronization of the coherent demodulator at the receiving side. The time required for initial acquisition of synchronization of the slave station does not exceed 125 microseconds.

As the satellite communication systems may be most efficiently used for one-way multidestination transmission, such systems are widely used in the USSR for TV and sound broadcasting, transmission of photoelectric signals of newspaper pages, etc.

Experiments on newspaper page transmission via communication satellites were first carried out in the USSR in 1968, and in the course of time the first satellite newspaper transmission system Moscow-Khabarovsk was put into operation.

The latest development along this line is a special ORBITA-RB satellite system developed for digital transmission of sound broadcasting and newspapers. Newspaper transmission in this system is provided via a 2.048 Mbit/s dedicated digital channel capable of high capacity (the time required to transmit one printed page is less than 1 minute) and high quality operation (the scanning is up to 26 lines per millimeter). For sound broadcasting this system provides about 30 high quality sound programs to ORBITA earth stations using approximately half of the standard

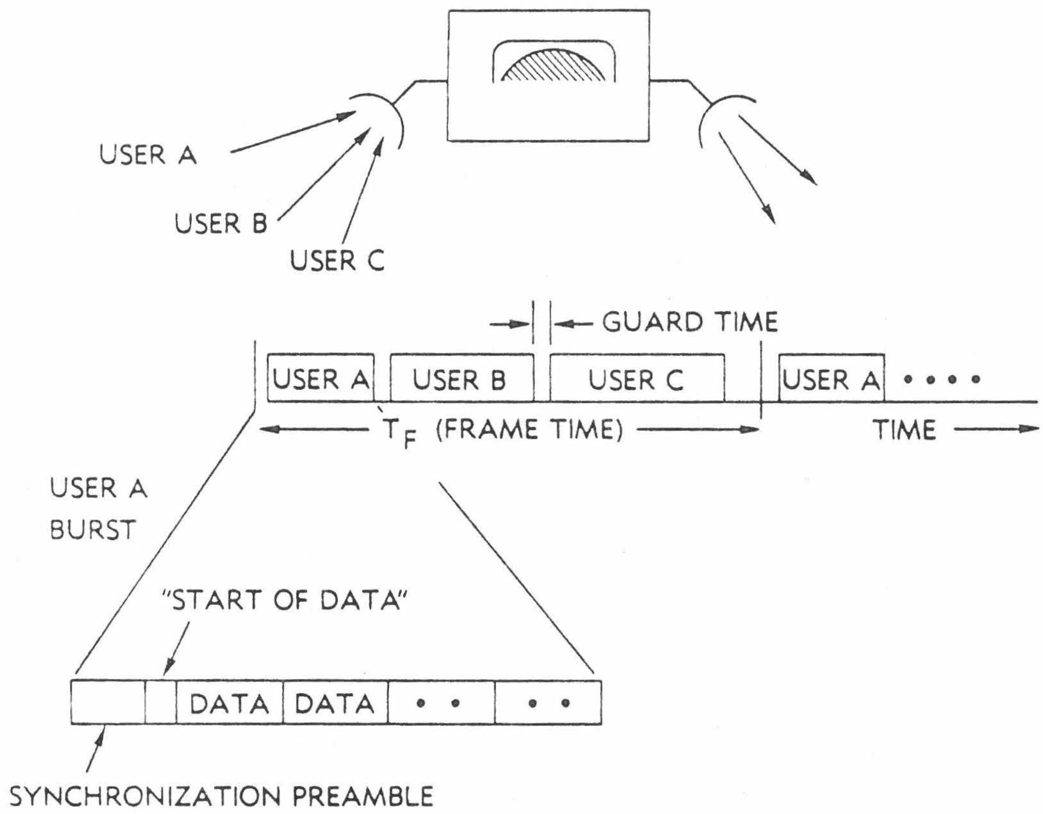


Figure 3. TDMA philosophy.

satellite transponder capacity. It also provides stereo program transmission. An important advantage of broadcasting satellite systems is that the channel cost and transmission quality of such systems do not depend on the distance to receiving stations.

It can be expected that satellite systems will be used increasingly for high speed data transmission in the future.

It is interesting to note that according to [13] the general trend worldwide is that satellite channels, originally viewed as a transmission path for wideband information such as TDMA and FM network quality television, are increasingly used for 56 kbit/s digital transmission. This can be appreciated by recognizing that the newer generation of computers, have protocols that allow direct computer interfacing with the satellite system, that accommodates the time delay. This makes possible more widespread interconnections by satellite of computer and data systems operating at the data rates of 2400, 4800, 9600, 56000 bits and up to so-called carrier rates (1.544 Mbit/s). For this type of application earth stations designed especially for this purpose have to be introduced with modems that can multiplex the traffic of the individual data circuits, which can be up to 56 kbit/s.

The advantages of digital communications by satellite at the 56 kbit/s rate can be listed as follows:

- Up to this time, practically all data communications have taken place over telephone networks that are designed for voice, not data.
- The telephone network generally restricts data transmission to 9600 bit/s and below.
- The telephone network generally serves a computer data system at a 10^{-5} bit error rate and lower; a satellite link can be served with a 10^{-7} bit error rate and a 0.9995 availability.
- Satellite transmission of digital data over medium to long distance and to multipoint locations is less costly than the use of terrestrial microwave.
- Satellite transmission of digital data can handle higher data rates than can be provided by wire lines.
- Higher speed satellite data systems to handle rapidly increasing volumes of data demanded by business involves less capital expenditure than the expansion of terrestrial microwave systems.
- Emerging low cost terminals make satellite distributed digital data links highly cost effective--even for short distances.

Thus, considering the present status of the terrestrial data communication infrastructure of the country, its geographical characteristics, and its technological advances in space technologies, it can be expected that the above outlined digital communication by satellite will attain much importance. According to [12] the role of satellite communication in international telephony of CMEA countries is also increasing. For the socialist countries this activity is based on the INTERCOSMOS program. INTERCOSMOS is a program of comprehensive cooperation among the socialist countries in the peaceful exploration and use of outer space--embracing also space communications activities--in which 10 countries take part: Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Rumania, the USSR and Viet Nam.

Work in the field of space communications has led to the creation of the INTERSPUTNIK international space communications system and organization, which broadcasts television programs, telephone messages, and other types of information.

Current members are Afghanistan, Bulgaria, Cuba, Czechoslovakia, Democratic Yemen, the German Democratic Republic, Hungary, Mongolia, Poland, Rumania, the USSR, and Viet Nam.

The INTERSPUTNIK communications system comprises a space segment and earth stations. The space segment, which includes communications satellites and control systems, is the property of the organization or is leased by it from its members. The earth stations are the property of the countries that build them or the organizations that operate them. INTERSPUTNIK currently operates using Soviet satellites on the basis of lease. The system employs two STATSIONAR satellites in geostationary orbit at longitudes of 14^0 west (Atlantic region) and 53^0 east (Indian region). Two relay units on board each satellite are used for telephone/telegraph links and for the exchange of radio and television programs.

Thirteen ground stations operate the INTERSPUTNIK system: seven in Europe (Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, and two in the USSR), four in Asia (Afghanistan, Laos, Mongolia and Viet Nam) and one each in Central America (Cuba) and North Africa (Algeria). There are plans to build earth stations in Syria, Democratic Yemen, Guinea, and a number of other countries. In addition to the members of the organization, other countries (France, Italy, Spain, Yugoslavia, etc.) also use the channels of the INTERSPUTNIK system.

The INTERSPUTNIK communications system is used mainly for exchanges of television programs with broadcasts lasting 4 to 8 hours daily, with more than 20 countries participating in the system. About the same number use its channels for international telephone and telegraph links. Plans for the development of the system in the next few years include bringing additional channels into use on board the STATSIONAR satellites and introducing new equipment in the earth stations, so as to increase the amount of information transmitted and improve the quality and reliability of the communication channels.

INTERSPUTNIK coordinates its activities with the International Telecommunication Union (ITU) and other international organizations in connection with the use of the frequency spectrum and the application of standards for communications channels, and in other areas as well. Relations between INTERSPUTNIK and the Pan-African Telecommunication

Network (PANAFTEL) are being expanded and consolidated.

It can be expected that in the long run INTERSPUTNIK capabilities will also be more and more utilized for high speed data transmission purposes, since the concept of the digital data earth terminal can also be extended to international systems.

In a similar way, in the USA [13] COMSAT now offers a new international digital service, DIGISAT, which uses INTELSAT satellites for communication between earth terminals. DIGISAT employs digital Time Division Multiplexers (TDMs) at earth stations, which accept multiple channels at the lower data transmission rates on the input side and combine them into a single 50 and 56 kbit/s SCPC (single channel per carrier) channel for transmission through a satellite. On a single 50 kbit/s channel, a multiplexer using input signal rates of 2.4, 4.8 and 9.6 kbit/s can handle the transmission and reception of up to twenty 2.4 kbit/s channels, ten 4.8 kbit/s channels, five 9.6 kbit/s channels, or combinations not exceeding a total of 48 kbit/s. Earth stations are equipped with individual multiplexers assigned to each international destination. The TDMs used in this service can also provide clocking and regeneration of digital signals.

In a similar way INMARSAT, the International Maritime Satellite Organization also offers through its satellites high speed data services up to 56 kbit/s.

2. PTT TELECOMMUNICATION SERVICES, PROCEDURES, TARIFFS

2.1. Line Ordering

Communication lines in the USSR for data transmission are leased from the PTT in accordance with the requirements of the customers.

International leased lines are provided by the PTT under the condition that two corresponding customers, who are to be connected by the line, supply separately their requests to their national telecommunication administrations. In the Soviet Union such requests should be addressed to the Department of Foreign Relations of the Ministry for Telecommunication in Moscow (MINSVJAS, 7 Gorky Street, Moscow, K375, Telegram address: MINSVJAS MOSKVA, Telex: 961).

The Ministry for Telecommunications is responsible for handling all technical matters with the corresponding PTT administrations of the "destination" countries as well as with the telecommunication administrations of the "transit" countries that are between the USSR and the "destination" country. The request to MINSVJAS for a leased line should include:

a) the exact address of the customer organizations to be connected and addresses of premises where the line should be terminated

b) specification of the required line quality in accordance with the recommendations of the CCITT

c) a clear statement of who is responsible for payment, i.e., is the whole line to be paid by one customer organization, or is every organization paying the line on the territory of its own country, or are there any other arrangements?

d) in case the domestic customer organization is paying for the line (or part of the line) the order should be signed by both the director (or his deputy) and the person responsible for budget (accountant). Account number and the bank should be specified in the order.

In case the organization is only confirming the acceptance of the line ordered by the other party abroad the "order" need only be signed by the director (or his deputy).

In practice, the preferred situation is that the two organizations cover costs incurred in their own countries (on the territory of the country where the organization is located). As a rule this procedure saves time when establishing the line.

Leased lines can also be ordered for domestic (or intercity) communication within the USSR. The above mentioned guidelines are also applied in this case, except that the line has always to be paid by only one of the organizations.

As to the duration of line lease, normally leased lines (or permanent connections) are ordered for not less than one month. This applies to all types of lines (i.e., international or domestic); however, it does not exclude the possibility of establishing the line for shorter periods in the case of special events (e.g., exhibition, experiment). It is advisable in these cases to lay out the background of the request for the PTT, e.g., an international agreement, governmental decision to fulfill a particular project, so that the request can be implemented in a timely manner. Usually the time scale for establishing a leased line is on the order of two months, which is about average for European standards.

2.2. Communication and Terminal Equipment to be Connected to Leased Lines

As a general rule all communication devices (modems, multiplexers) should be provided by the customer. The Telecommunication Administration of the USSR normally does not follow the policy of providing or renting any communication equipment and thus no tariffs for these exist.

The usual practice is that telecommunication equipment (such as modems, and multiplexers,) to be connected to the line should be agreed upon between communicating organizations and full technical documentation be submitted for approval by the Telecommunication Administration (MINSVJAS). For the equipment to gain acceptance by MINSVJAS it must correspond with the recommendations of the CCITT, which is practically always the case, since the majority of telecommunication equipment--such as the ones of the Ryad series-- used in the USSR follows the CCITT recommendations anyway. After the technical documentation is supplied together with the application to MINSVJAS, the Telecommunication Administration checks the documentation provided before granting approval. Usually no special physical checking of the equipment is needed. The time scale of the licensing procedure to allow the attachment of additional or new equipment for an operational leased line is about ten days.

2.3. Line Quality

Leased lines provid. d by the Telecommunication Administration are guaranteed to correspond to the recommendations of the CCITT M. 1040, up to 4800 bit/sec speed. In practice experience has shown that lines can be used on 9600 bit/sec speed, but this is not guaranteed by the PTT because intercity lines in the USSR do not have so-called frequency phase correction.

Testing of the line quality is usually carried out by the Telecommunication Administration, although the Administration allows testing of the line by a customer if he wishes to do so. Their only requirement is that the testing equipment and procedure should correspond to the usual CCITT recommendations. However, no testing equipment is provided for customers by the Telecommunication Administration on a lease basis.

2.4. Costs and Tariffs

In contrast to the PTT policies of many countries, no separate charges are usually required by MINSVJAS for installing lines and services. The usage tariffs, however, are the following:

a) Leased Lines

Cost calculations for national (or intercity) lines both (two and four wires) are based on the following principles:

a) Independent of the speed or multiplexing mode used the basic price is just for telephone channels ("wires"), because this is the actual resource that is used.

b) Costs are calculated on the basis of the standard tariffs for long distance calls on the assumption that the line is used continuously for 24 hours per day, i.e., (cost per day) = (price for one minute) X 1440 min.

c) Tariffs for standard telephone calls depend on distance zones. There are 10 zones starting from less than 100 km with a cost of 0.05 rubles/min and finishing with more than 8000 km with a cost of 0.6 rubles/min.

   In addition, the cost for dedicated lines can also include expenses for the part of the line between the premises of the organization and the nearest central exchange station.

   In the case of international leased lines the costs consist basically of two parts. The first part is the cost of the line on the territory of the USSR, namely, between two geographical points: the place where the ordering organization is located, and the imaginary crossing point of the country boundary with the direct line between the two destinations to be connected. The costs for this part of the line are calculated as they are for national lines. The second part, generally the cost of the line on the territory of the other country (or countries in case of transit through the territory of third countries), is basically negotiated and handled by the PTT in that country and is defined on a case by case basis.

b) Public Switched Telephone Network

Public switched telephone lines can also be used for data transmission, and their tariffs are based on the same scheme as for ordinary telephone calls.

According to the present practice, it is, however, not advisable to use speeds higher than 1200 bit/sec. "Urgent" telephone calls for the case of ordering the switched line from the operator is a possible option . In this case the costs for normal telephone calls are multiplied by two. These "urgent" calls can be served only by operators and are established as so-called higher priority calls.

According to practice, normal switched telephone channels can also be used for international data transmissions, but similarly with a speed not higher than 1200 bit/sec. Tariffs applied in this case are the same as those for normal telephone calls. Costs for one minute are between 1 and 7 rubles. Calls to European countries cost between 1.0 and 1.5 rubles per minute, to Asia 3 rubles, to the Middle East and North Africa 4 rubles, to America 4 rubles, and finally to Australia and some remote areas up to 7 rubles.

With some countries, reduced tariffs (60% of the normal tariff) are agreed on for communication from 7 p.m. till 6 a.m. local time.

2.5. Telegraph and Telex Lines

Telegraph and telex lines can also be used for data transmission. In this case the Telecommunication Administration can provide teletype and equipment for facsimile transmission.

Installation of the telex in the USSR costs 60 rubles with 33 rubles per month maintenance. Rental of the telex connection costs 65 rubles per month.

Costs for telegraph communication varies from 0.3 ruble/word up to 0.9 ruble/word under normal tariff and are doubled for urgent placing of messages.

3. COMPUTER NETWORKING IN THE USSR

In this expansive phase of development in the telecommunication infrastructure of the USSR, efforts have been concentrated on the expansion of the telephone and other telecommunication networks and lower priority has been given to provide "value added PTT services", such as the introduction of special public packet switched data network services. However, The PTT provides the basic infrastructure to various organized communication users for building up their own "interorganizational" communication systems and networks, which are, according to the networking terminology, "private networks". In this case the PTT provides for its customers sufficient physical lines with parameters fulfilling the appropriate recommendations of CCITT. The Administration in return expects that the customers building up their own networks use telecommunication equipment that fulfills the above CCITT recommendations in order that the basic physical service by the PTT can be secured. In this respect all the "value added", higher level services are usually built up and provided by the "private" network operators themselves.

A few private computer networks have already been implemented or are under development. A particular group of these private networks is the of the scientific institutions belonging to the Academy of Sciences in the USSR. There is a strong driving force among these institutions to build up and operate a set of high level data networks. According to Eduard Yakubaitis [3, 4], in the USSR, distributed systems are in operation in Moscow [5], Novosibirsk [6], and Riga [7], but also in several scientific centers of the country. According to [4], the Institute for Electronics and Computer Techniques for the Latvian Academy of Sciences is building up a dedicated computer network for the Academy. Up to the summer of 1981 all the major computers from Academic institutions dealing with energy, physics, forestry, chemistry, and computer technology were integrated into the network, and the final goal is to hook up all the computers of the Latvian Academy of Sciences into the network. The main purpose of this type of networking is joint research and better cooperation between the academic institutions. As mentioned above similar regional networking projects are being implemented in several parts of the USSR. The computer networking teams in Riga , Moscow, Kiev, Novosibirsk, and some other places are already at the stage of interlinking the regional academical networks, which would actually form the integrated computer network of the USSR Academy of Sciences.

Trends and plans to interlink the USSR Academic network to similar networks abroad are already on the horizon. For example, the leased line connections between the computer network of the Hungarian Academy of Sciences and in particular the Institute for Automation and Computerization should be mentioned. According to [8], on December 3, 1981 a leased computer line was put into operation between Budapest and Leningrad where large main frames such as a Soviet BESM 6 system can be accessed in an interactive regime. The use of this line enables among other things the joint writing and editing of papers in the jointly published journal of the USSR and Hungarian Academy of Sciences. In addition, access to databases and graphical software systems are typical uses of this link. Since the Computer Network of the Hungarian Academy of Sciences is also interlinked with the TPA 70 node computer of IIASA, on an experimental basis connections between the Leningrad data center and IIASA were made early in 1982. But this is not the only computer link between Academic Institutions in the USSR and Hungary. In [9] Géza Huba from the Central Physical Institute of the Hungarian Academy of Sciences (KFKI) reports about a 4 wire leased computer link between KFKI in Budapest and the Space Research Institute of the USSR Academy of Sciences. This permanent computer-computer connection was put into operation on January 26, 1981 and is mainly for high speed exchange of computerized data.

Dedicated lines were established between the Institutes for System Studies (ISS) in Moscow and the Central Institute for Scientific and Technical Information (CISTI, Sofia), as well as between the Institute for System

Studies and the Central Technical Base (UTZ) in Prague and through it to the International Institute for Applied Systems Analysis (IIASA) in Laxenburg (Austria), [15].

According to [16] in the autumn of 1982 the role of ISS node in Moscow was taken over by the newly created research institute VNIIPAS (All Union Scientific and Research Institute for Applied Computerized System) in Moscow. Through this node the All Union Institute for Scientific and technical Information (VINITI) started to provide online database services on the VINITI and CMEA databases to Bulgaria, Czechoslovakia, and IIASA. The link Moscow-Sofia is being upgraded, and will serve the increasing exchange of scientific and technical information between CISTI and Soviet institutions. The connection to Czechoslovakia [17] and IIASA [15] is being upgraded with packet switching nodes based on SM4 computers.

According to [8], these computer links will eventually lead to the establishment of an interlinked computer network of the Academy of Sciences of the Socialist countries. This international "private network" in the field of science and research will be a unique one in a sense that in Western Europe and North America similar types of organizations often use the national PTT data networks for their interconnections. For this reason, in order to facilitate cooperation between academic institutions of socialist and western countries, connection at some point between the PTT networks and this international "private" network is a logical consequence. IIASA might play an important role in achieving this level of cooperation.

Another typical example of an operational "private" network in the USSR is reported in [10], in which multilevel information processing networks built on the ES (Ryad) and MES basis are described. For example, the hierarchical network system GTSK-Moscow of the Moscow Savings Bank is given. This special network, tailored for the special needs of a large savings bank, serves more than 3000 terminals in an online regime distributed in branch offices of the bank. The number of personal saving accounts handled by the system exceeds 8 million. According to the special "savings bank" oriented tasks both online and batch type of services are basically supported by the network. On the highest level of the hierarchy an ES-1055 large mainframe performs the function of a central data processing center, which collects all data and reports coming from the next lower level, the so-called regional centers based on doubled SM4 machines. In the central system those data processing functions are performed that concern the banking system as a whole. Also, an archival database of the system is installed there. The regional centers, 32 in all, store local databases in a decentralized and distributed way; in addition they serve all local terminals belonging to the branch office. The basically SM4 based and supported telecommunication network supports online work and work with distributed databases in an efficient way. The regional centers are connected with the central office over leased lines rented from the PTTs, which operate with high speeds, the lowest speed applied in the system being 1200 baud.

It is clear that the networking requirements of the savings bank system and of the USSR Academy of Sciences networks are completely different. The savings bank network is a specialized, purpose-oriented system, which is best achieved if all the special requirements--such as transaction security, time availability, privacy, etc.,-- are taken into consideration as a whole. The academic network on the other hand has to be an open system in order to incorporate as many different types of computer system as possible. Here emphasis had to be given both to batch exchange of data and online access from terminal to computer. Also the security requirements of this network differ considerably from those of the savings bank system. For this and similar reasons it is not advisable to combine these two systems.

On the basis of examples such as those above, it can be said that the development of computer networks in the USSR follows a "sectoral" pattern. Instead of common services, "private" computer networks such as the savings bank network or the academic network have been built and more are being established in the near future.

However, this does not mean that at some point the PTT will not introduce its own data service. It will when it is recognized that such needs have also to be satisfied by centralized efforts, since there are also a number of applications in which PTT networks are more beneficial, e.g., access to public bibliographical databases.

REFERENCES

[1] Maurer, H.A., I. Sebestyén, 1982. One-Way Versus Two-Way Videotex. IIASA, WP-82-30, Laxenburg, Austria.

[2] Ithiel de Sola Pool, ed, 1977. The Social Impact of the Telephone. Cambridge, Mass. The MIT Press.

[3] Yakubaitis, E.A., 1981. Concept of Distributed Computer Networks, Conference Proceedings of the Conference COMNET '81 Networks from the User's Point of View. North-Holland Publishing Company, Amsterdam.

[4] APN, 1981. Számitógép - hálózatok létesuelnek (Computer networks are emerging), Számitástechnika, Issue July/August 1982. Statistical Publishing House, Budapest.

[5] Drozhinov, V.I., A.I. Ilyushing, A.N. Miamlin, V.S. Starkman, 1979. Principles of Building an Experimental Computer Problems of Information Exchange in Computer Networks, Moscow.

[6] Martchuk, G.I., I.P. Kuznietsov, O.V. Moskalev, I.V. Metliaev, 1978. Program of Works in Building a Computing Complex Center for Common Usage in the Scientific Center of Novosibirsk.

[7] Yakubaytis, E.A., 1979. Architecture of Computer Networks, Moscow. Reference Model of Open Systems Interconnection ISO/TC 97/SC 16 No. 227.

[8] Hencsey, G., 1982. Budapest - Leningrád: Állandó Kapcsolat, (Budapest - Leningrad: dedicated computer link) Számitástechnika Issue July/August 1982. Statistical Publishing House, Budapest.

[9] Huba, G., 1982. Pf. 146, Számitástechnika, Issue March 1982, Statistical Publishing House, Budapest.

[10] Anonymous, 1981. Toebb szintue információfeldolgozó rendszer ESZR es MSZR eszkoezbázison (Multilevel information processing system based on ES and MES basis), Számitástechnika, Issue November 1981. Statistical Publishing House, Budapest.

[11] Minachin, B.P., L. Ya. Kantur, Yu. M. Peyansky, 1981. Utilization of the USSR Satellites for Telephony, Television and Sound Broadcasting and Newspaper Page Transmission. Chapter VIII of USSR National Paper A/Conf. 101/NP/30 prepared for the UNISPACE '82 Conference in Vienna, August 1982.

[12] UNISPACE Secretariat, 1981. Multilateral Intergovernmental Cooperation in Sp ce Activities, UNISPACE '82 Conference Background Paper A/CONF. 101/BP/10.

[13] Louis Cuccia, C., 1982. Earth Station Development, in Innovations in Telecommunications - Part B (Ed. J.T. Manassah). Academic Press, New York.

[14] Bargellini, P.L., S.J. Campanella, 1982. An Overview of Satellite Transmission Techniques, in Innovation in Telecommunication - Part B (Ed. J.T. Manassah). Academic Press, New York.

[15] Lábadi, A., I. Sebestyén, 1982. The IIASA TPA/70-X.25 Gateway Network Promotes International Flow of Scientific Information. WP-82-88, IIASA, Laxenburg, Austria(*)

[16] Todorov, I.K., 1982. CISTI and National System for Scientific and technical Information Activities in the Set up and Maintenance of Databases for STI and Services to the Users in Online Mode. Bulgarian Presentation of the Third Meeting of the Steering Committee of the UNESCO/UNDP, Project No. RER/79/006 on "Crossborder Computerized Data Exchange in Science and Technology" in December 1982, Sofia, Bulgaria.

[17] Puzman, J., 1982. Data Communication in Czechoslovakia - The Telecommunication Infrastructure and relevant Administrative Procedures. WP-82-104, IIASA, Laxenburg, Austria.(*)

* (Those referenced IIASA Working Papers which are included as chapters of this study are separately marked with an "*" at the end of the reference).

Chapter 7

DATA COMMUNICATION IN YUGOSLAVIA — THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

I. Sebestyén

DATA COMMUNICATION IN YUGOSLAVIA – THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

I. Sebestyén

0. INTRODUCTION

In many countries, the increasing importance of new information technologies requires the development and use of an appropriate data communication infrastructure to enable remote use to and between computers. The development of this infrastructure in Yugoslavia is still in its infancy. In this paper an attempt is made to sum up the status quo of the Yugoslavian tele- and data- communication infrastructure, to give some illustrative statistical figures on the present data communication uses and future needs, and to describe the relevant administrative procedures linked to data communication. Finally some aspects of Yugoslavian transborder data flow applications will be outlined.

1. STATE OF THE TELECOMMUNICATION NETWORK

1.1. The Telephone

Telephony in Yugoslavia--as in other European countries--has a history of over one hundred years. In Zagreb, Croatia, for example, the first telephones were installed as early as 1881, about the same time as telephony in the other regions of the old Austro-Hungarian Monarchy started. In terms of telephones the Monarchy was one of the most advanced countries in the world, the first switched telephone exchanges of this federation being installed at about the same time as the first exchanges in the US, France, and the UK. At that time the Southern and Eastern parts of Yugoslavia were just about to finish the period of the Turkish occupation, which had lasted for about four hundred years and had certainly not been influenced too much by technology "hard-liners". Thus, when Yugoslavia, after long struggles, several wars and uprisings, finally became independent and unified after World War I, the country inherited a rather heterogeneous telephone infrastructure. Slovenia and Croatia, which were important parts of the old Austro-Hungarian Monarchy, were much better developed from the telephony point of view than the remote mountainous Monte Negro or Kosovo. Although the situation is now much better than in the past, there is still a difference in the level of development of the telecommunication infrastructure between West and East Yugoslavia.

In 1980 [1] Yugoslavia had about 1.9 million telephones in operation, out of which 46.7% were used in business and administration and 53.3% by residential users. The number of telephones per 100 population is 8.5, a figure similar to countries such as the USSR, Poland or Venezuela, and with respect to some of its neighbors it is somewhat lower than Hungary (11.1) and considerably lower than Austria (36.6), Greece (28.2) or Italy (31.8). The difference is even more significant in comparison with the most leading countries in the world like the USA (79.1) and Canada (65.6). It is interesting to note that residential usage (the "number" of telephones per household) in Yugoslavia is 0.17, which means that only every fifth family has a telephone; in the US the average number of telephones per household is 1.67, i.e., most households have more than one telephone.

The telephone density in the major cities of Yugoslavia is somewhat better: Belgrade, Ljubljana, Novi Sad, Rijeka, Sarajevo, Skopje, and Zagreb account for 42.8% of the total telephones. On the other hand these cities only account for 16.4% of the total population, which means that the rural areas still represent a major problem in telephone coverage. Belgrade has 21 telephones per 100 population; the other cities, with the exception of Ljubljana with its 41.8 telephone stations are at about the same level. All in all, these figures are below the European average, and thus it is evident that the primary goal of the different PTT Administrations in Yugoslavia is to improve these figures by extending the present telephone network. The development figures are according to this policy high: between 1979 and 1980 the number of telephones increased by 10.4%, the number of telephones per 100 population by 14.1%.

For international telephony all stations are connected to the worldwide telephone network, the most frequently called countries from Yugoslavia being (in descending order) the FRG, Austria, Italy, Switzerland, and

France. From Austria, Yugoslavia is the fourth most frequently called country, while no other countries have reported [1] Yugoslavia as one of the five most frequently called countries from their territories.

The administrative organization of the PTT in Yugoslavia differs from that of most other countries. First of all, Yugoslavia, which is a federation of six republics and two autonomous provinces, has separate PTT administrations in each of its republics. These regional PTTs are loosely linked together on a federal level at the headquarters of the so-called Communities of Yugoslavian PTTs in Belgrade, which represents the country to the outside world (their address is: ZAJEDNICA JUGOSLAVENSKIH PTT, Palmoticeva 2, 11000 BEOGRAD). It is also this body that represents the country on the international level, such as in CEPT (in which Yugoslavia is the only member from the Eastern European socialist countries) and in ITU. At the federal level the general planning, technical development, and coordination of the work between the individual PTTs takes place. However, the individual PTTs are responsible for the provision of services and development of the network at the republic level. Strangely enough, the definition of PTT tariffs are also done at the regional level, which means that each republic has a slightly different tariff structure and level. There are even some republics in which separate data communication tariffs are not yet specified. For this reason we did not make an attempt to collect all tariff structures for each republic of Yugoslavia; for information purposes we have enclosed the tariffs for Croatia only, which is one of the largest republics and represents and excellent example for the general Yugoslavian conditions. Figure 1 shows a general scheme of the Yugoslav Federal Telephony Network. The network is built up of seventeen main "transit" exchanges (TE's) of each to which are linked several "main" exchanges (69 in total). For example, eight main switching exchanges (e.g. Varazdin, Karlovac) are linked to the TE Zagreb in Croatia, which are major telephone centers in their region.

1.2. General Status of Data Communication

The present base of data communication in Yugoslavia is the standard telephone network. The quality of lines are in accordance with the CCITT recommendation M 1040; however, the line quality requirements for specially conditioned lines requested by the CCITT recommendation M 1020 cannot be fulfilled. For dedicated data lines, speeds up to 9600 baud are used; in baseband mode up to 19,200. For the public switched telephone network (PSTN), speeds up to 2400 baud can be used in a reliable way. Higher speeds are obviously allowed, between telephone exchanges in the network, usually up to 48,000 baud; between Belgrade and Zagreb, in the so-called basic group mode, this speed rises to 60,000 - 108,000 baud. The telephone network is still built basically on analog technology; in the process of digitalization, the main exchanges are being replaced first. The present main exchanges are mainly equipped with Ericsson-type crossbar exchanges, however, new, so-called fourth generation, switching centers will be produced in Yugoslavia by N. TESLA, based on Ericsson licenses. In the telephone network mechanical switching is still the dominant technology, systems based on time division multiplexing (TDM) not being in operation yet. An EDX digital system of Siemens has recently been installed in Belgrade for telex and telegraphy.

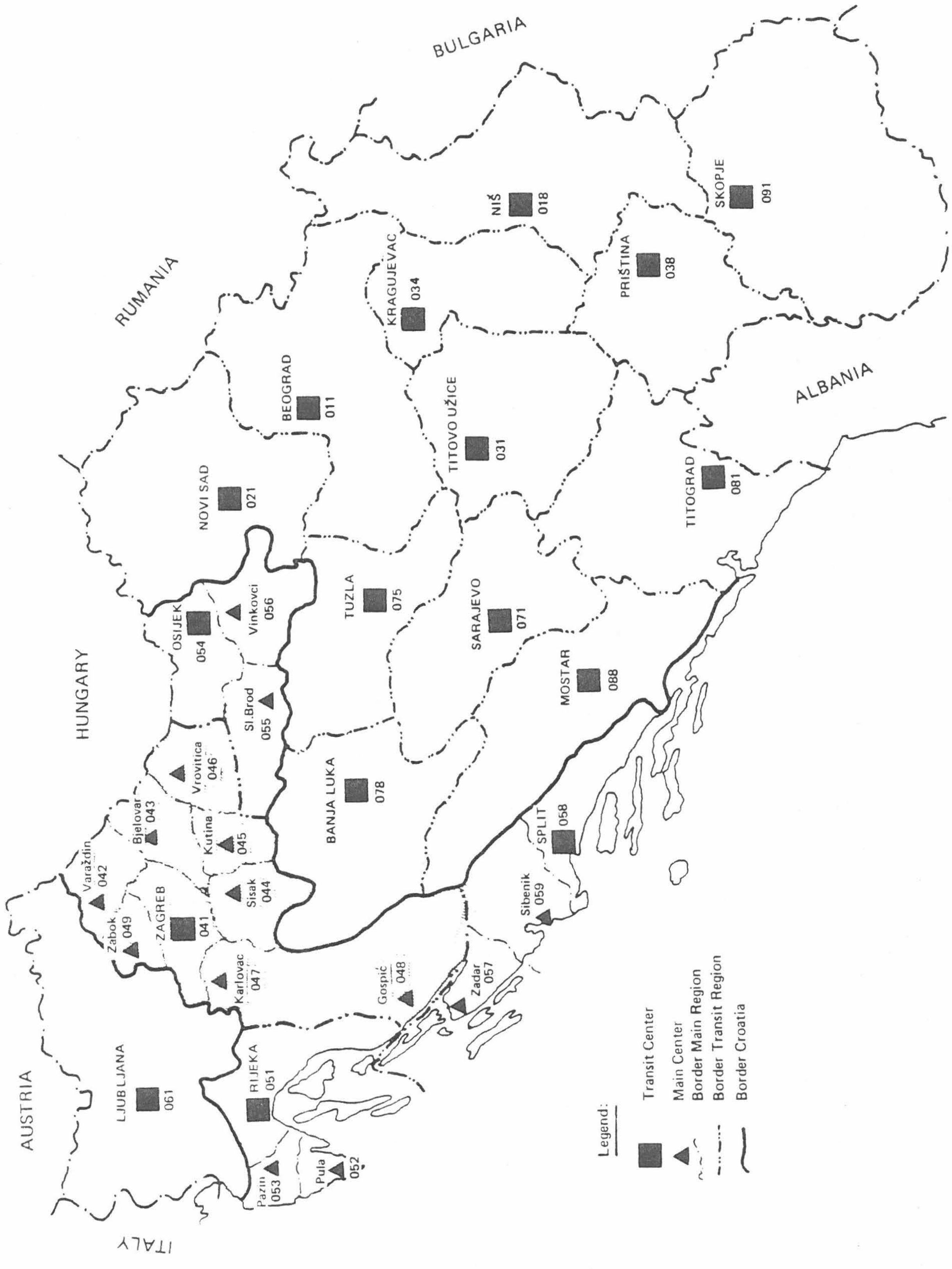


Figure 1. General scheme of the Yugoslav Federal Telephony Network

Separate digital data services are not yet offered by the PTTs in Yugoslavia, thus all data traffic is carried by the analog telephone network; to a lesser extent, the telex network is also used for data transmission.

For the long run the PTTs are planning to introduce digital data services, i.e., in the form of circuit and packet switching data networks. It seems as though the PTT packet switching network would be built first, with three initial network nodes at Ljubljana, Zagreb, and Belgrade. It is, however, not expected that this service would become available before 1985. Interconnection with other PTT networks is of utmost importance from the outset. The first connections are planned to the PTT networks of Austria, Italy, FRG, and Switzerland through X.75 protocols. As described in some length in the last part of this paper, there is a strong interest of some domestic users to locate nodes of dedicated data networks in Yugoslavia, for example, the banking network S.W.I.F.T. or a link to Euronet. The experimental connection to Euronet by Yugoslavia has already been decided: the University Computing Center in Zagreb will be responsible for establishing and operating an X.25 connection to the Euronet node in Rome.

The introduction of new data services, as in other countries, is not a question simply of technical capabilities. The analysis of present and future demands for data communication has to justify economically the introduction of such a service. Estimates are being made in Yugoslavia in order to predict this demand. The results of this activity--performed by all PTTs in Yugoslavia--are just about to take shape. At the time of writing this report, some preliminary results (for Croatia) were made available

[2] through the generosity of the Croatian PTT. The statistical figures for this republic--which, with an area of 56536 km^2 territory and a population of 4.25 million inhabitants, is the second largest in Yugoslavia--provide a typical example for a Yugoslavian republic.

The Yugoslavian PTTs, have made a major survey to map the present data communication situation in Yugoslavia, and as a part of it in Croatia, and to predict future demands. The Croatian PTT sent out a questionnaire to 25 major organizations in Zagreb asking for information on their data communication data usages and requirements. The Croatian PTT hope that through this survey they will actually cover 75-80% of all connections of the transit exchange Zagreb.

The cumulated results of the survey are given in Table 1. As can be seen the number of network terminating points (NTPs) and terminals will grow by a factor of approximately 2.5 over the three year period 1982 to 1985. It can also be seen that the trend is towards more distribution of computer traffic, going out from a more centralized type of status. In Table 2, the distribution of NTPs are given according to major application categories. It can be seen that in the region of TE Zagreb the most important application is banking, followed by data traffic of industrial enterprises and educational centers. The trend between 1982 and 1985 will not change significantly. Table 3 shows the line speeds used. At present, 2400 bit/sec is the most frequently used line speed. This is also expected to remain so for the future, at least until 1985, but in general a slight shift to higher line speeds can be observed. Table 4 gives an overview of the ratio between switched and direct telephone lines used for data communication. The change between 1982 and 1985 is negligible,

Table 1. Distribution of NTPs and terminals according to transit regions (for those 25 organizations based in Zagreb who sent answers to the survey on TE Zagreb).

Region	in 1982		in 1985	
	(NTP)	terminals	(NTP)	terminals
Zagreb	237	433	520	980
Rest of region of transit exchange Zagreb	58	93	169	316
Osijek	6	8	20	26
Rest of region of transit exchange Osijek	5	9	26	45
Rijeka	10	23	19	51
Rest of region of transit exchange Rijeka	4	4	9	31
Split	4	4	20	33
Rest of region of transit exchange Split	3	7	13	35
Other parts of Yugoslavia	6	18	44	89
Total	333	599	840	1516

roughly one-third of the NTPs using the public switched telephone network, while the rest using leased lines. Table 5 shows the present compositions of terminals according to terminal manufacturer.

Table 6 shows the number of terminals in 1982 and 1985 for the whole of Croatia. These data are based on information from 50 major organizations in Croatia (not only those that are based in Zagreb) and they expect to cover 75-80% of the total terminal population. As can be seen the number of terminals during this period is almost going to triple. The location of the majority of all terminals, which in 1982 was in the town

Table 2. Distribution of NTPs by application categories (Answers of 25 organizations based in Zagreb to the survey on TE Zagreb)

No.	Application category	in 1982 NTP (%)	in 1985 NTP (%)
1.	Banking	37.6	32.7
2.	Industrial	24.6	23.1
3.	Education	19.2	15.4
4.	Government	9.9	6.1
5.	Insurance	3.3	9.6
6.	Trade	1.8	2.5
7.	Mass media	1.5	3.5
8.	Communal services	1.5	2.0
9.	Health	0.6	5.1
	Total (%)	100%	100%
	Total (NTP)	333	840

Table 3. Distribution of speeds of lines of NTPs in % (for 25 major organizations based in Zagreb, who responded to the survey on TE Zagreb).

Line speeds (bit/sec)	in 1982 NTP (%)	in 1985 NTP (%)
300	3	1.8
1200	6.9	5.8
2400	79.9	70.6
4800	8.4	15.4
9600	1.2	3.8
19200	0.6	2.6
Total (NTP):	333	840

of Zagreb, will become more dispersed, and in general the share of terminals in rural areas will slowly increase.

It is interesting to observe that the number of terminals in the rest of Yugoslavia used for traffic to Croatia is relatively small, showing that the "transborder data flow" over data links even between republics of Yugoslavia is almost negligible at present.

Table 4. Distribution of NTPs according to type of lines used (for 25 major organizations based in Zagreb who responded to the survey on TE Zagreb).

Type of line	in 1982		in 1985	
	No. of lines	%	No. of lines	%
Switched	102	30.6	261	31.1
Direct	231	69.4	579	68.9
Total	333	100	840	100

Table 5. Distribution of terminals in 1982 by manufacturers (for 25 major organizations based in Zagreb who responded to the survey on TE Zagreb).

Terminals by manufacturer	Terminals	
	Number	%
UNIVAC	159	27
IBM	127	21
NCR	120	20
TRS 721	90	15
MDS	36	6
Honeywell	19	3
Others (Interscan, Videoton, Singer, HP, ICL, PDP, Delta, RIZ, ...)	48	8
Total	599	100

Finally, Table 7 shows a rough comparison between NTPs in some European countries. As can be seen values for the NTP per number of working population, which is one of the characteristic indicators for the development of data communications, is rather low for the Eastern European countries shown here. This explains the present policies of some of

Table 6. Distribution of terminals and NTPs linked to transit regions in Croatia (data based on response of 50 Croatian organizations to the survey of the Croatian PTT).

Region	in 1982		in 1985	
	Number	%	Number	%
Zagreb Rest or region of TE Zagreb	435 93	60.7 13	895 327	43.8 16
Osijek Rest of region of TE Osijek	36 27	5 3.7	137 171	6.7 8.37
Rijeka Rest of region of TE Rijeka	75 6	10.5 0.8	124 66	6 3.2
Split Rest of region of TE Split	12 7	1.7 0.97	157 65	7.68 3.18
Rest of Yugoslavia	23	3.2	101	4.94
Total terminals	714	100	2.043	100
Total NTPs	401	–	1.141	–

the Eastern European PTTs not to install at this point a separate data network.

2. PTT SERVICES FOR DATA COMMUNICATION USERS

As has been mentioned, the different PTT services of the republics provide data services rather independently of each other. The Community of Yugoslavian PTT in Belgrade, provides mainly a coordinating function between them.

The general policy of the PTTs towards data communication is--as in other countries--to follow as closely as possible all recommendations made by CCITT within the framework of ITU.

Table 7. Numbers and penetrations of NTPs in some European countries, 1979 [2], [6], [7], [8]

Countries	1979	
	Number of NTPs	NTPs per 1000 working population
United Kingdom	117000	5.20
German FR	61700	2.87
France	54100	3.03
Italy	45500	3.16
Spain	25000	2.80
Sweden	20000	5.66
Netherlands	16500	4.06
Denmark	12100	4.56
Switzerland	10900	4.81
Belgium	9050	3.04
Finland	7090	3.22
Norway	6640	3.56
Austria	4480	1.60
Ireland	966	1.33
Portugal	794	0.32
Luxembourg	649	5.15
Greece	639	0.42
Yugoslavia (data for Croatia only) (1982)	401	0.19
Czechoslovakia	940	0.13
Hungary	~ 600	0.12

For the purpose of data communication using the telephone network, the PTT only provides the communications channels required, guaranteeing M 1040 quality; however, the users must provide all the required telecommunication equipment, such as modems, multiplexers, and terminals.

Line ordering requests for leased telecommunication lines have to be sent to the respective republican PTTs. For example, the Croatian PTT is responsible for Croatia; its address is PTT Zagreb, Yu 41000 Zagreb, Jurisiceva 13, Telex 22-333. On average, lines are established by the PTTs within one or two months after the order has been placed.

The Community of Yugoslavian PTT, is responsible for international connections. The tariffs and procedure for international lines follow the appropriate recommendation D2 of CCITT. To all European countries, for example, the costs for the Yugoslavian part of an international four-wire leased line are at present 5535 "gold franks"--the imaginary currency of the PTTs. Other PTTs are responsible for the non-Yugoslavian part of the line. They collect the revenues for their services, also according to a special well-defined tariff. Thus, if a Yugoslavian customer wants to establish an international leased line, say to Austria, he first orders the connection from the Yugoslavian PTT, which contacts the Austrian PTT on the request, and asks the Austrian user partner about its willingness to accept the computer line. If the answer is positive the two PTTs establish the physical line, and on both ends the appropriate--(PTT approved)--telecommunication equipment will be connected, in order that the data traffic may start. Yugoslavian customer is responsible for payment which is to make in local currency, i.e., in dinars, to its PTT. In this case, the Yugoslavian PTT transfers the predefined amount in "gold franks" to the Austrian PTT for the use of the Austrian part of the line. Since there are also lines ordered by Austrian customers to locations in Yugoslavia the usual practice between the PTTs is to "clear" their accounts at the end of each year.

The telecommunication equipment linked to the telecommunication lines has to be approved by the PTT, as in other countries. This equipment has to fulfill the appropriate V. or X. recommendations of CCITT. Usually it is the case that either the domestic manufacturer or the importeur of the equipment requests the PTT to test and approve the equipment. The costs for such a procedure are billed to the domestic manufacturer, the importeur (or the end user, if the application was submitted by him). When specific telecommunication equipment has been approved by the PTT for use, all other similar types of equipment can be connected to the PTT network, without further complicated application procedures. The PTT maintains a list of approved telecommunication equipment, which is available publicly, and all equipment on this list can be connected to PTT lines without any delay after appropriate notification by the user to the PTT.

A list of the telecommunication equipment currently approved in Yugoslavia is provided in Table 8. Table 8 also shows that the domestic modem production of Yugoslavia covers, from the speed point of view, all categories that are of significance at present for data communication purposes. The factory of N. Tesla in Zagreb is manufacturing modems up to 9600 bit/sec under licenses from LM Ericsson in Sweden, and ISKRA in Kraj is producing modems under SRT licenses. From this point of view the domestic modem production is basically in a position to cover all domestic needs.

3. TARIFFS

3.1. International Tariffs

As mentioned in the previous chapter international data communication is done between Yugoslavia and the rest of the world almost completely through the telephone network. If the public switched telephone

Table 8. List of telecommunication equipment approved by the Communities of Yugoslavian PTTs.

Modem 200 Bd (300 Bd)

1.	GH 1101	–	SRT
2.	IBM 3976 Mod 102	–	IBM
3.	D 200 E	–	PYE TMC
4.	MD 200	–	EI - IRI
5.	ZAT 300	–	N. TESLA Lic. Ericsson
6.	SRT 1161	–	ISKRA Lic. SRT

Table 8a. Modem 600/1200 Bd

1.	8 TR 652	–	Philips
2.	GH 2002	–	SRT
3.	IBM 3976 Model 3	–	IBM
4.	GH 2052	–	SRT
5.	IBM mini 12	–	IBM
6.	GH 2052	–	ISKRA Lic. SRT
7.	ZAT 1200	–	N. TESLA Lic. Ericsson
8.	PP 1200	–	INST. M. PUPIN
9.	MD 6-12	–	RACAL-MILGO LTD
10.	IBM 38 LS	–	IBM
11.	ZAT 1200-5 LSI	–	N. TESLA Lic. Ericsson
12.	SRT - 2082	–	SRT

Table 8b. Modem 2400/1200 bit/s

1.	GH 2054	–	ISKRA Lic. SRT
2.	2200/24	–	RACAL MILGO LTD
3.	24 LSI	–	RACAL MILGO LTD
4.	IBM 3872	–	IBM
5.	IBM Mini 24	–	IBM
6.	GH 2054	–	ISKRA - License SRT
7.	ZAT 2400	–	N. TESLA - License Ericsson
8.	26 LSI	–	RACAL-MILGO LTD
9.	PP 2400	–	Institut Mihailo Pupin - Belgrade
10.	ZAT 2400-5 LSI	–	N. TESLA Lic. Ericsson
11.	IBM 3863 model 1 and 2	–	IBM
12.	SRT 2084	–	SRT

Table 8c. Modem 4800/2400 bit/s

1. MPS 48	–	RACAL-MILGO LTD
2. IBM 3874	–	IBM
3. ZAT 4800-5 microprocessor	–	N. TESLA Lic. Ericsson
4. IBM 3864 model 1 and 2	–	IBM
5. SRT - 2058	–	ISKRA Lic. SRT (4800 bit/s)

Table 8d. Modem 9600 bit/s

1. 96 MM/96	–	RACAL-MILGO LTD
2. MPS 9629	–	RACAL-MILGO LTD
3. IBM 3865	–	IBM
4. ZAT 9600 LSI microprocessor	–	N. TELSA Lic. Ericsson

Table 8e. Baseband modems

1. COM - LINK II 2,4 : 19,2 kbit/s	–	RACAL-MILGO LTD
2. COM - LINK IV 2,4 : 64 kbit/s	–	RACAL-MILGO LTD
3. ER BdB 19-12 2,4 : 19,2 kbit/s	–	CIT-ALCATEL
4. IBM 5979-L41 2,4 : 19,2 kbit/s	–	IBM
5. ZAT 12/96 2,4 : 9,6 kbit/s	–	N. TESLA Lic. Ericsson
6. DCB 19200 MK 2	–	ISKRA Lic. SRT

network is to be used for such connection, the usual telephone tariffs between Yugoslavia and the country in question applies. For neighboring countries, users of telephone lines have to pay for 1 IMPULSE every 2 seconds (1 IMPULSE = 1.08 dinars), and for other countries 1 IMPULSE every second. The quality and convenience for such types of data traffic is, however, somewhat limited, and although it is daily practice to use the PSTN for such purposes it is far from being ideal.

For leased telecommunication lines the line charges are defined by the PTT according to the rules and tariffs on a case-by-case basis, and customers in Yugoslavia have to pay their monthly telecommunication bills in local currency, i.e., in dinars.

3.2. Domestic Tariffs

As mentioned ear ier domestic tariffs do differ from republic to republic. Croatia, Serbia, and Slovenia, for example, have basically the same tariff structure with minor differences in the impulse costs, but other less developed republics do not even distinguish between voice and data traffic. As an example of a tariff structure in a Yugoslavian republic, the tariff scheme for Croatia is given in Table 9.

4. TRANSBORDER DATA FLOW APPLICATIONS

One of the most important applications of transborder data flow is the access it provides to bibliographical and numerical databases. According to [9] at present in Yugoslavia some 38 mainly bibliographical public databases are in operation. Fifteen of them are of foreign origin and are imported from all parts of the world on a subscription basis, such

Table 9. Telephone line rental tariffs for data transmission in Croatia

A. Leased lines*		Price
1. In-town network		(based on number of impulses) current impulse price = 1.08 Din.
1.1. Line crossing 1 telephone exchange		1.500 IMP = 1.620 Din/month
1.2. Line crossing 2 telephone exchanges		3.000 IMP = 3.240 Din/month
1.3. Line crossing more than 2 telephone exchanges		5.000 IMP = 5.400 Din/month
1.4. In-town lines which are extensions of inter-urban connections		
1.4.1. Line crossing 1 telephone exchange		400 IMP = 432 Din/month
1.4.2. Line crossing 2 telephone exchanges		1000 IMP = 1080 Din/month
1.4.3. Line crossing more than 2 telephone exchanges		1600 IMP = 1728 Din/month
2.1. Inter-urban lines		
2.1.1. Line between telephone exchanges of the same node region**		11.666 Din/month
2.1.2. Line between telephone exchanges of different node regions of the same transit exchange		14.580 Din/month
2.1.3. Line between different transit exchanges		
	Zone I (100 km)	17.496 Din/month
	Zone II (200 km)	21.870 Din/month
	Zone III (400 km)	29.160 Din/month
	Zone IV (more than 400 km)	34.992 Din/month

B. Switched lines (in-town network only)

Line usage:	24 hours a day	5000 IMP = 5400 Din/month
	from 7 am - 3 pm	3000 IMP = 3240 Din/month
	from 3 pm - 7 am	1500 IMP = 1620 Din/month

* The term line means a 2-wire connection; 4-wire = 2 lines

** The term node region covers either one main exchange, e.g., in rural areas, or more main exchanges, e.g., in major towns such as Zagreb.

Note that all NTP's have to be declared to the PTT if they are going to use the switched telephone network for data transmission. In this case the above charges apply regardless of the actual use of the line.

as INSPEC, COMPENDEX, ISMEC, METADEX, CAS, and VINITI. There are 3 international databases to which Yugoslavia provides its own contribution and benefits from the whole, but the majority of the databases (more than 20) are national ones.

Some smaller national databases are "manually" operated in the form of catalogs and registers, but the vast majority of database operations are provided through computers, in both SDI (Selective Dissemination of Information) and retrospective type of service. The online, interactive type of information retrieval is still in an experimental phase, but there are a few information centers in the country (e.g., in Belgrade, Zagreb, Ljubljana, Nis, Sub otica and so on), which have all the facilities to introduce such services in the near future.

Concerning the organizational framework for scientific/technical information activities in Yugoslavia, since the beginning of the seventies much effort has been made to organize and coordinate work at the federal level. In 1976, for example, a so-called Interrepublic Self-management Agreement was signed to foster computer processing of scientific and technical information. A so-called Project Council for Coordination of Database Performance, Purchase and Processing was also introduced.

Direct cooperation between specialized information centers and between powerful computer centers largely promoted the emergence of effective database services. Examples for such bilateral cooperation are, for example, between the Public Library of Serbia (Narodna Biblioteka Srbije) and the Institute for Informatics in Vinca (Institut za Informatiku); between the Reference Center in Zagreb (Referalni centar) and the

University Computing Center in Zagreb (Sveucilisni racunski centar); and between the Institute for Occupational Safety and Health Documentation "Edvard Kardelj" in Nis (Institut za dokumentaciju zastite na radu "Edvard Kardelj") and the EDP center of Electronic Industry in Nis (Electronski racunski centar Elektronske industrije).

The general policy for scientific/technical information services in Yugoslavia is to provide all domestic users with national and worldwide information and to provide foreign users with the possibility of access to Yugoslavian information sources. In order to achieve this broader goal, several projects and experiments were launched and are being conducted.

One of the first computer networking projects in which Yugoslavia participated was the so-called EC COST Project 11--or as it is better known--the European Informatics Network (EIN) [3]. This experimental packet switched computer network, which in a sense can be regarded as a forerunner of the present EURONET network, was initiated in 1971 by nine European Governments--including Yugoslavia--which signed together with Euroatom an international agreement for the creation of a European pilot informatics network. The main goals of the project were to create a model for future networks for commercial and other purposes, to promote the agreement of standards and networks, and to coordinate and exchange ideas for national networks.

As a result of this activity, in May 1976 the so-called EIN sub-network was completed and put into operation. In 1978, when the network had already been operational for two years, some signatories nominated so-called Associated Centers, not connected permanently to the network but capable of access through the public switched telephone network to one of the network nodes (Figure 2). From the Yugoslavian side, RSS-Raziskovalna Skupnost Slovenije--participated in the project with the status of an Associated Center. The EIN project finally phased out in 1979 after it had successfully fulfilled its mission. EURONET, originally the network of the European Communities, can to a certain degree be regarded as the successor to EIN.

Yugoslavia's plans for interconnection with EURONET are in a sense a logical consequence of Yugoslavia's special relation to the European Communities. EURONET, which became fully operational in February 1980, linked some 25 host computers to the network at its opening date, with some 150 databases and databanks. At the time of writing the number of EURONET hosts were above 40 and the number of databases more than 250. Also, other applications such as message sending and scientific computing are being supported on EURONET in an increased way. Originally the network used four packet-switched exchange nodes located in London, Paris, Frankfurt, and Rome. Remote access facilities were available in Amsterdam, Brussels, Copenhagen, Dublin, and Luxembourg. In 1980, Switzerland, the first non-Community country joined EURONET, setting up a fifth packet-switching exchange in Zurich. Sweden joint EURONET in 1982, and it is expected that Portugal and Yugoslavia will follow [4].

Yugoslavia's connection to EURONET is expected around the beginning of 1984, when EURONET becomes a public data network. The technical solution of the EURONET link will be similar to the original Austrian approach which was finally dropped in 1982 by Austria when still no agreement between the state of Austria and the European Communities could be

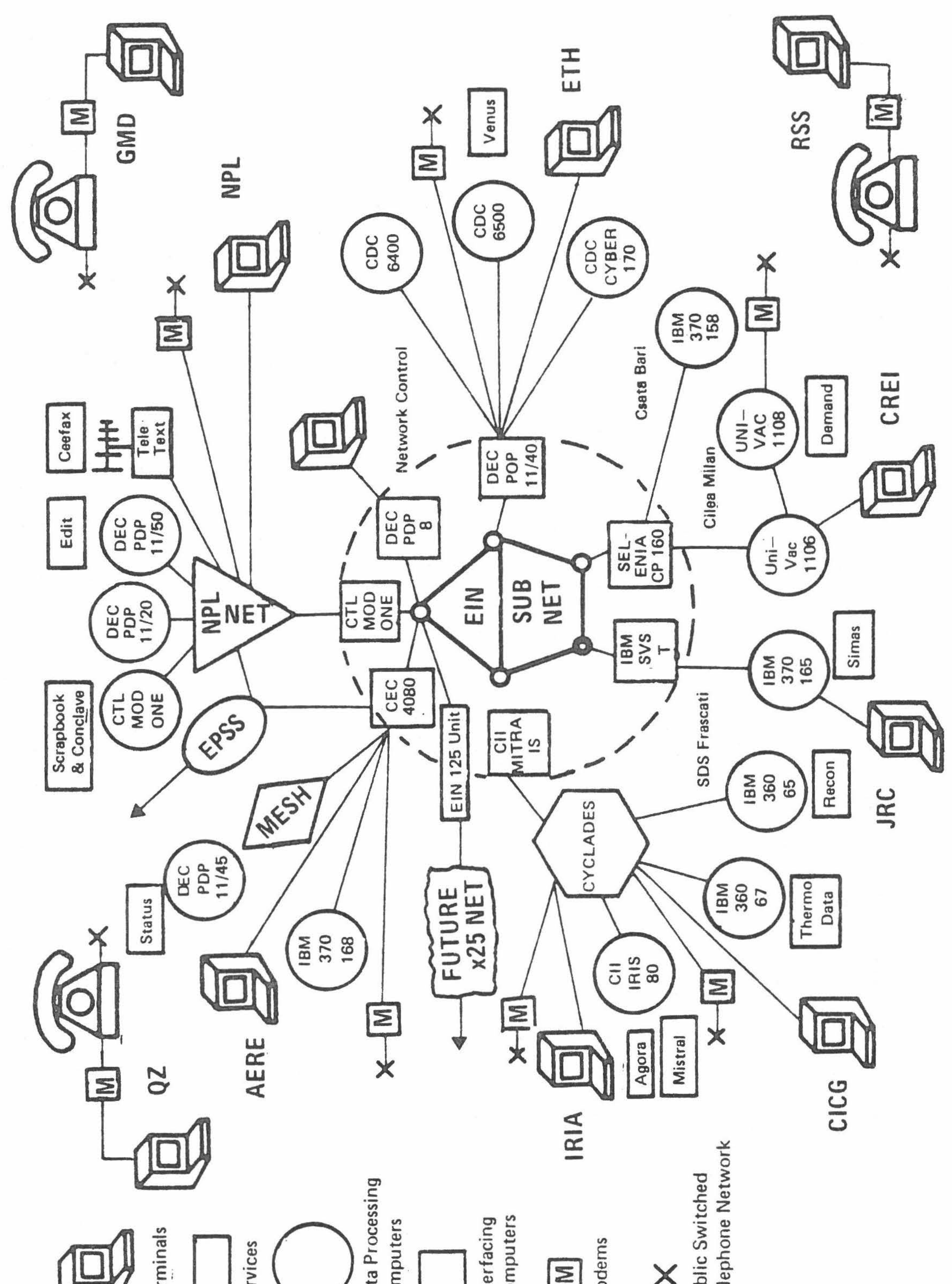


Figure 2. General scheme of the EIN network

reached. The Austrian PTT, which did not operate its own packet switching network in 1981 when the technical work started, subcontracted the Technical University of Vienna to interlink its PDP 11/34 to the Frankfurt node of EURONET through an X.25 high speed line. In the same way the University Computing Center of Zagreb will be responsible for the link to the EURONET node in Rome. In 1981 Yugoslavia joined the COST 11 BIS project and participated actively in the work of the file transfer protocol development group, together with Norway and Sweden. To realize that project, connection to EURONET is necessary. The University Computing Center will establish, for the experimental purposes, an X.25 high speed line by means of a 3705 IBM front-end processor of an IBM 4341 computer. This EURONET experimental connection is planned to become permanent, and to act as a EURONET node for all the present University Computing Center user community (which means all the Croatian university community: Split, Rijeka, Osijek, Varazdin) and even wider. Through the EURONET connection first of all a number of publicly available databases would be accessed easily by Yugoslavian users. At present access to foreign database hosts are made exclusively through the public switched telephone network, which is not only expensive, but also most inconvenient for such applications.

Plans also exist to link Yugoslavian computers into an international computer network with its neighbors. Within the framework of UNESCO project, supported by UNDP, a regional South-East European network would link together computers of scientific institutions in Hungary, Yugoslavia, Bulgaria, and perhaps Greece, Turkey, and Rumania. Through the current Hungarian Academic Network, or the CISTI node at the Central Institute of Scientific and Technical Information in Sofia links to Austrian scientific institutions are planned to promote exchange of scientific technical information and joint research.

With regard to the classical dedicated international networks, such as the WMO-GTS for meteorology, the SITA network for aviation information, and the news agencies networks, Yugoslavia is naturally linked through dedicated computer lines to these networks.

In the field of meteorological networks Yugoslavia is the only East European socialist country that is a member of the European Center of Medium Term Forecasts (ECMWF) in Reading, United Kingdom. Their own dedicated network called ECNET, which became operational in 1980, is linked or will be linked to all member countries with medium speed lines (2400 or 4800 bit/s) [5]. Through these links, medium range (4-10 days) forecast results produced on large CDC and Cray mainframes are transmitted to the member countries; approximately 8-16 million pieces of information per night. In addition, member countries use the super computers of the Reading Center in its free time for their own purposes by means of remote job entries.

S.W.I.F.T., the "Society for Worldwide Interbank Financial Telecommunication", founded in 1973 and fully operational since 1977, is presently operational throughout Western Europe and North America and the Far East and is being extended to Latin America and slowly, most probably, to some Eastern European countries. Along these lines Yugoslavia is one of the first candidates to be connected to this interbanking network.

5. SUMMARY

With regard to its tele- and data communication infrastructure Yugoslavia is at the beginning of its potential. At present, all datacommunication is carried out through the telephone network. Dedicated data PTT networks are not expected to be operational until the middle of this decade. Both domestic and international data communication applications have only recently started but their growth rates predict high prospects and importance in the future.

REFERENCES

[1] AT&T Long Lines, 1981. The World's Telephones as of January 1980. AT&T, Morris Plains, New Jersey, USA.

[2] Zuber, M., Z. Bralic, 1982. Personal Communication at the Croatian PTT Headquarters in Zagreb.

[3] Barber, D.L.A., 1979. The End is Nigh for EIN, in Proceedings of the IIASA Meeting "Evolution of Computer Networks: Theory and Experience". CP-81-27, IIASA, Laxenburg, Austria.

[4] Kelly, P.T.F., 1982. The Euronet Diane Network, Proceedings of the COMNET '81 Conference held in Budapest, May 1981. North-Holland Publishing, Amsterdam, The Netherlands.

[5] Haag, A., F. Königshofer, P. Quailin, 1982. Review and Re-assessment of ECNET - A Private Network with Open Architecture, ECMWF Technical Report No. 30, Reading, England.

[6] Savezin Zavod Za Statistiku, 1982. Statisticki Kalendar Yugoslavije 1982, Belgrade, Yugoslavia.

[7] Johnson, T., 1981. The Data Comms Market in Western Europe 1981-1987. Logica Ltd., UK. Online Publications Ltd., Northwood Hills, UK.

[8] Puzman, J., 1982. Data Communication in Czechoslovakia - The Telecommunication Infrastructure and Relevant Administrative Procedures. IIASA, WP-82-104, Laxenburg, Austria. (*)

[9] Korunovic, D., 1982. Scientific/Technical Informatics in Yugoslavia - Experiences and Possibilities in Computerized connecting into the International Information Exchange in the Field of Occupational

Safety and Health. Proceedings of the International Symposium on Occupational Safety and health held in Nis (Yugoslavia) in June 1982. Institute for Occupational Safety and Health Documentation "Edvard Kardelj".

* (Those referenced IIASA Working Papers which are included as chapters of this study are separately marked with an "*" at the end of the reference).

Chapter 8:
TELECOMMUNICATIONS HARDWARE AND SOFTWARE SYSTEMS MADE IN CMEA COUNTRIES AND YUGOSLAVIA

I. Sebestyén

TELECOMMUNICATIONS HARDWARE AND SOFTWARE SYSTEMS MADE IN CMEA COUNTRIES AND YUGOSLAVIA

I. Sebestyén

0. INTRODUCTION

The telecommunications hardware and software systems used in CMEA (Council of Mutual Economic Assistance) countries and Yugoslavia are a most complex field of investigation. For this reason in this study the following approach has been adopted: Rather than collecting and presenting all CMEA telecommunications hardware and software systems in a directory type of form, which would neither be complete nor fully up to date (even at the time of data collection), a general analysis is given, with sufficient detailed information to make it useful. During the analysis we will discuss in depth the different classes of telecommunications hardware and software systems, their past, present, and potential future.

In order to do this, as pointed out in [1], the analysis has to include all major levels of the International Standardization Organization's Open System Interconnection (ISO/OSI) Reference Model — and this is the way we handle the telecommunications hardware and software systems of the CMEA countries and of Yugoslavia.

1. ANALYSIS OF TELECOMMUNICATIONS HARDWARE AND SOFTWARE SYSTEMS ACCORDING TO THE OPEN SYSTEMS ARCHITECTURE MODEL

The architecture of an open system has to be built on well-defined standards. The CCITT of the ITU (International Telecommunication Union) are basically responsible for the definition of lower level communications standards, such as the user-to-network-interface connection standards for public data networks (but more recently also for some high level user-to-user procedures such as for teletex or videotex). In the field of high level user-to-user procedures — which is one central point of ISO's activities — the ISO working group ISO/TC97/SC16 had the responsibility for developing standards for open systems interconnection.

One of their first tasks was to define a reference model for open systems architecture in order to help define the areas in which standards are actually needed. One basic new concept was the definition of a so-called transport service, which is a mixture of hardware and software, embodying all the data transmission functions of the system and presenting an interface to the levels above it — an interface that is completely independent of the communications network (Figure 1). A major advantage of this concept is that application-oriented protocols and procedures at the higher levels need not be aware of any of the peculiarities of the

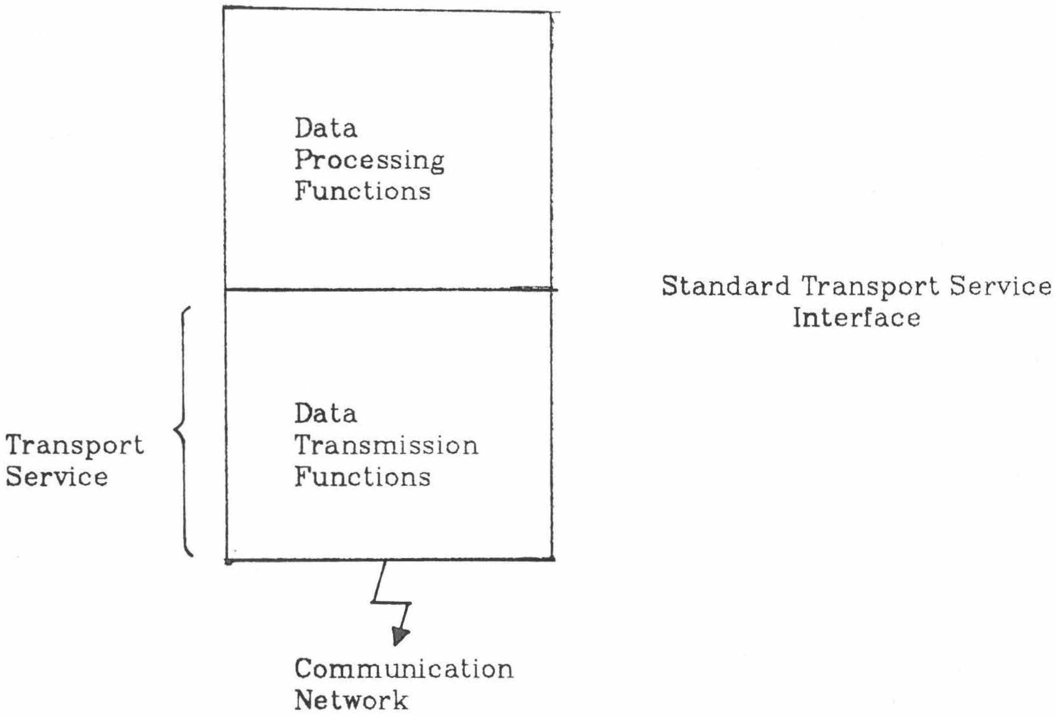


Figure 1. Basic functions of an open system interconnection.

different communications networks that may be used from time to time — all that is handled by the so-called transport service. As discussed in [1] there are basically four layers included in the transport service; the physical (layer 1), the link control (layer 2), the network control (layer 3), and the transport (layer 4). The present ISO model divides the higher levels — the actual data processing functions — into three layers — session (layer 5), presentation (layer 6), and application (layer 7). In what follows we will discuss the telecommunications hardware and software systems in the CMEA countries and Yugoslavia according to these major groupings.

1.1 Communication Network

With regard to the communication network much has been said in other chapters ([7] [14] [15] [6] [17] [18]) about the various basic data communications services provided by the different PTTs. At present in the CMEA countries data communication is carried primarily by the analog telephone network, through switched and leased lines, and to lesser extent by the telex and the telegraph network. Basic digital services are only offered by the Hungarian PTT through their NEDIX network, but plans for public digital networks of other PTTs (e.g., the BULPAC network in Bulgaria) are also under preparation.

1.2 Data Transmission Functions —Transport Services

PTT services are at present provided at the first ISO layer, on the physical level. For digital services this layer is defined by the CCITT Recommendation X.20, which defines the interface between Data Termination Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for start-stop (asynchronous) transmission services on public data networks, and by the CCITT Recommendation X.21, which defines the interface between DTE and DCE for synchronous operation on public data networks. As mentioned above these interfaces are only provided by the NEDIX network of the Hungarian PTT. The DCEs — owned by the PTT — are rented to the users who have to connect appropriate DTEs equipped with X.20 or X.21 interfaces. The number of such DTEs is still rather limited: only a few terminal manufacturers such as Videoton in Hungary are starting to offer real 'X' type terminal interfaces as yet. Thus for a 'bridging over' period, interface converters from the traditional 'V' standard to the 'X' standard are offered by the Hungarian PTT, also on a lease basis. According to the CCITT Rec.X.20 bis, a V.21-compatible interface with V.24 interchange circuits is provided between DTE and DCE for start-stop services on public data networks, and according to the CCITT Rec.X.21 bis, for the synchronous type of services (Rec.X.1) for the classes 3-7 (600 bit/sec-48 Kbit/sec) a 'V' type interface is provided that simulates connection to synchronous V-series modems. This solution actually reduces the 'X' type of interface problem to the classical 'V' type of interface problem, however, with some disadvantages, such as no automatic dialing by the DTE.

For connection of DTEs with analog networks (i.e., 'V' interfaces) in the CMEA countries and in Yugoslavia, all the basic problems have been solved, and as we will show, a full range of appropriate DCEs and DTEs exist and are in use in the CMEA countries. It has to be stressed that all relevant CCITT recommendations are fully taken into consideration both by the PTTs and the hardware manufacturers. Thus all telecommunications equipment manufactured within the framework of the CMEA Ryad and SM Series also follow the appropriate CCITT recommendations. A list and short description of the main characteristics of the modems and other telecommunication equipment manufactured in the CMEA countries and in Yugoslavia are given in Annex 1. Due to the proliferation of telecommunications hardware it should be noted that this list is neither fully complete nor fully up to date. Its main aim is to give a general overview about the availability of this type of telecommunications hardware in the countries involved. It can be seen that a full range of modems is in production, starting from a speed of 200 bit/sec up to 9600 bit/sec. The majority of the modems, however serve low and medium speeds up to

2,400 bit/sec.

The hardware technology used varies widely, mainly depending on when the modem was originally developed. New generation modems, for example, are usually LSI and microprocessor based developments.

The choice of line concentrators and remote multiplexers is at present somewhat limited to those suitable for medium speeds. For example, no statistical multiplexer is at present produced and marketed.

In Annex 2, the local multiplexers and data communication processors are listed that can be connected for teleprocessing purposes to various Ryad mainframes. Since the hardware and software architecture of the Ryad series is similar to those of the an IBM 360/370 series, as we discuss later, the functions of the local multiplexers and data communication processors are also similar —for example, the ES 8371 front end processor performs similar functions to IBM 3705. With regard to their functions, the line concentrators and communication controllers listed in the annexes basically perform up to the layer 3 (network control) of the ISO 7-layer model, the ES 8371 type of front end processor up to the layer 4 (transport end-to-end control). It should be noted here that the equipment listed in Annex 2 can only be used in connection with Ryad or IBM computers; it is preferable to use with other dedicated mini or microcomputers, which basically allow — provided appropriate telecommunication software is written for them —flexible connection to other types of mainframes and terminals. In Annex 3, we have listed a few small computers produced in different CMEA countries, which are used in such a way. This is by no means complete. Rather arbitrarily we have listed separately some of the SM CPU models which present the majority of the minicomputers produced and used in the CMEA countries, then separately those small computers configurations (i.e., CPU and peripherals) that are used for data communication purposes in Czechoslovakia. These show some basic configurations and the 'environment,' in which SM CPUs are applied. Finally, some non-SM based Hungarian CPUs are listed, which are relevant for this paper, since the IIASA and the VIDEOTON networks (examples follow) are built on these computers. Other important manufacturers of small computers (other than the SM series) in CMEA countries —e.g., the GDR, Poland or the USSR —are arbitrarily left out.

It should be noted that the use of these small computers for data communication is one of their broad possible applications. The appropriate telecommunication programs for them are most often written by the users themselves rather than by the computer manufacturers. The users often write these programs with their own special purpose and usually not with the intention of marketing their telecommunication systems after its completion. Therefore, to list these systems as telecommunication node computers might seem to be misleading to the readers. Some of these computers are, however, interesting in so far as they can be potentially used and are actually used as data communication- and computer-network nodes in some applications. Hungarian TPA 70 computers at IIASA in Laxenburg and SZTAKI in Budapest are the backbone of a private packet switched gateway network [2]. However, the packet switched computer network of the Hungarian Academy of Sciences which is linked to the IIASA-SZTAKI gateway network [2], is built on special purpose microprocessor hardware and thus does not fall into this category.

According to [3], [4], [5], and [6], the computer factory VIDEOTON in Hungary has built a private packet switched computer network for their own purposes, which interconnects through X.25 computer lines their main factory sites in Budapest and Székesfehérvár. The main purpose of the so-called Videoton Network System (VNS) is to provide a communication subsystem for distributed databases containing production control information on stock, orders, parts lists, inventory, etc. The network closely follows the ISO Model Recommendation for Open Systems Interconnection. Its services are: to provide packet switching services through virtual calls; a generalized terminal control through a so-called Virtual Terminal Protocol (VTP); packet assembly/disassembly (PAD) for terminals; interface to the application programs. The nodes of the network are VT 60 minicomputers, and the hosts with the database applications are R10 minicomputers. Besides the VNS network, the computer network of the Hungarian Academy of Sciences and the IIASA-SZTAKI gateway network, the KFKI TPA 11/40 computer is used in an increasing way as a data communication node in a great variety of ways in Hungary.

In Czechoslovakia [7], the USSR, Bulgaria [8], and other CMEA countries, SM computers are being used especially as telecommunication nodes of pilot packet switched computer networks. In Bulgaria for example, the Central Institute for ComputerTechniques implemented an SM4-based experimental four node X.25 packet switched computer network, with bisynchronous communication. Each node is connected in a ring to the others through SM-8507 synchronous adapters and 9,600 bit/sec modems. The network provides the basic transport network function with a throughput of approximately 100 packets/sec (256 octet/packet).

The proliferation of terminals — video displays, teletypes, printers, intelligent terminal installations, etc. — in the CMEA countries is broad. In Annex 4, some of the main characteristics of the terminals are listed. The list of terminals is by no means complete, their number and variety is growing constantly. The technology used in these terminals covers a very broad range. Early terminals are using the old electromechanical technology; this equipment is, for example, based on modified versions of telex terminals or traditional typewriters. Newer families, however, like the VDT, VDDS, or VSD terminal family of VIDEOTON in Hungary, are fully microprocessor controlled. A good description of all intelligent VIDEOTON terminal families is given in [9]. Terminals are produced in all CMEA countries, and we have made a list of the majority of terminals produced in the CMEA countries in Annex 4, based on different sales brochures and other published sources.

1.3 Data Processing Functions —Higher Level Services

The higher level functions — session (layer 5), presentation (layer 6), and application (layer 7) — are usually realized in host computers, to which access is made through the telecommunication transport services. The implementation of these layers depends on the actual host systems in question. CCITT defined and PTT serviced higher layered services — such as videotex or teletex — are at present not in operation in the CMEA countries on a permanent basis. Experiments — especially for videotex and teletex — are being carried out, but their introduction is not expected before the middle of the 1980s. From these services we exclude the one-way broadcast videotex systems — called teletext — which are at the time of writing at an experimental stage in some CMEA countries, and already introduced in Hungary since November 1982. Although teletext also is defined by ITU as low and higher level PTT 'data service,' we should exclude it from our discussion because of its broadcast nature.

Since the majority of mainframes in the CMEA countries are based on Ryad (ES) and SM computers, special consideration to these two families should be given.

1.3.1 Higher Level Layers on Ryad (ES) Computers

The hardware and software architecture of the Ryad I and II series is compatible with the IBM 360/370 family. For this reason the teleprocessing system programs and telecommunication access methods through the data management system are similar. As in the IBM series, Ryad also has a telecommunications access method BTAM (Basic Telecommunication Method), to provide the basic functions needed for controlling telecommunication lines; a QTAM (Queued Telecommunication Access Method), which provides for connection between terminals; a TCAM (Telecommunication Access Methods), which in addition to the functions of BTAM handles tasks like giving and timing a VTAM (Virtual Telecommunication Access Methods) for the newer generation computers. The very complex ES teleprocessing system, which occupies a relatively large part of the memory of the CPU, is being partly 'shifted out' to separate telecommunication processors, like the ES-8371s, to which users actually are connected. Teleprocessing has been enhanced during the past years through the introduction of more sophisticated ES system software at the mainframe, such as POWER-RJE, POWER/VS-RJE, MASP II, and RES. For the integration of autonomous systems into computer networks, IBM announced its ACF (Advanced Communication Function) products (such as ACF/NCP/VS, SSP, ACF/TCAM, VTAM, NOSP, NJE/JES release 1,2,3) first in 1976; similar products are now becoming available on Ryad systems (for example a short description of the teleprocessing system components of the Polish ES-8371.01 front end processor is given in [13]). Thus the distribution of intelligence from the mainframes to the teleprocessing front-ends and terminals has also been a strong tendency in the Ryad computer family. For further developments, it soon became obvious that a clear concept was needed as to how this should continue in the future. One line was — since Ryad is IBM compatible — to follow the IBM-SNA strategy, which has the disadvantage, however, that it is only partly compatible with the internationally widely accepted ISO 7 layered model for Open Systems Interconnection. SNA has six layers only; on the transport subsystem level it has three for which ISO has four, because the third level of SNA comprises the ISO layers three and four. The functions of the ISO layer 5 are provided by the SNA layers 3 and 4. The remaining layers are identical for both ISO and SNA.

In spite of the similarities of Ryad and IBM, according to [14] the Teleprocessing Concept III of ES is very similar to the ISO-OSI model.

In the Ryad concept there are also seven layers: *Layer 1* defines the logical (CCITT V.21), electrical, physical specifications of connections to modems and line adapters. *Layer 2* comprises the data link control procedure (Basic, BSC, CCITT V.41, etc.). *Layer 3* regulates message transmission between two neighboring nodes (e.g., in packet switching the virtual call). *Layer 4* is responsible for building up, maintaining, and terminating of the logical connection between end users. *Layer 5* provides for the building up, maintaining and terminating the logical connection between end users. *Layer 6* is responsible for the presentation of information (e.g., display formating, code conversion) to the user and finally *Layer 7* is the application level, the immediate link with the user.

The main aims of the Ryad concept are to create a code independent, bit-oriented, synchronous, error protected network with unified information format (packets or datagrams), which should provide full transparency through the network and the distribution of intelligence. The defined hardware elements are shown in Figure 2.

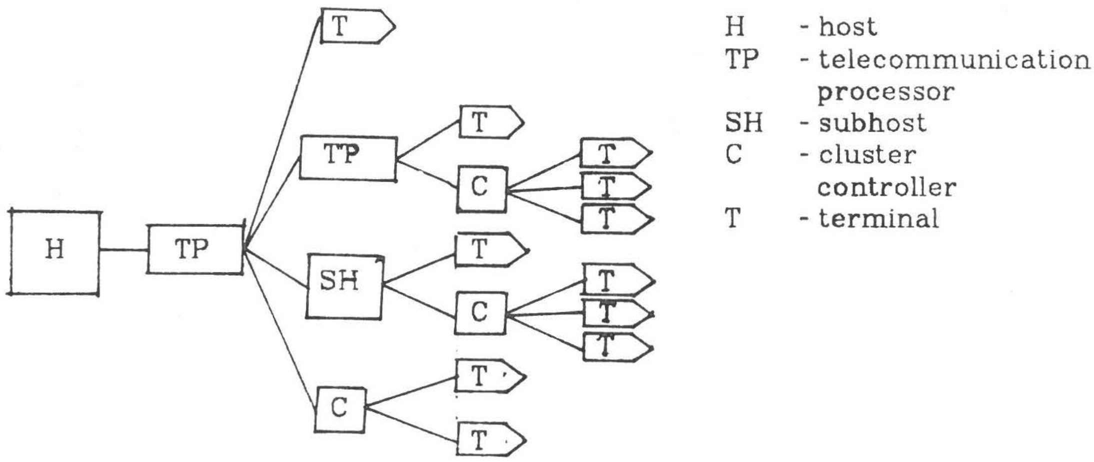


Figure 2. Hardware elements of the Ryad network concept.

It is expected that Ryad systems following the new ES teleprocessing concept will be widely introduced around the middle of the 1980s.

1.3.2 Higher Level Layers on SM Computers [12]

In this chapter we discuss the standard systems of SM computers to show how they support higher layer services of the ISO reference model. This should not be mixed up with the network node application of SM machines mentioned earlier, which are regarded as special purpose user programs.

SM computers can basically be controlled by the following three operating systems:

a) FOBOS: a single user operating system supporting fore and background program execution suitable for small configurations and fast real time applications. It supports batch processing.

b) DOS-RVR: a multi-user timesharing operating system with virtual storage suitable for interactive environment but also supporting batch processing. However, it does not support real time applications.

c) DOS-RV: a multi-user real-time operating system, suitable for program development and commercial applications on larger SM systems. The DOS-RV system has a special networking package, which can be regarded as an extension of the DOS-RV system to other computers of the network.

Main characteristics of the networking packages of the DOS-RV system

The structure of the networking package strictly follows the ISO layers mentioned earlier. It has four functional levels: application, logical connection control, physical connection control, and hardware level. The application level also includes the higher levels of ISO model.

The networking package of the DOS-RV system provides the following services:

- *Resource sharing* — it allows users access to user peripherals of other host computer systems of the network
- *File sharing* — it allows users to access in their programs files located on other hosts
- *Program sharing* — it allows users to send over jobs to other hosts for pro, ram execution
- *Intertask communication* — it allows two independent tasks, running on different host systems, send messages to each other.

2. SUMMARY

In this chapter we have discussed the telecommunications hardware and software systems produced in the CMEA countries and in Yugoslavia. We have seen that data communication in these countries are primarily carried by analog networks, such as telephone, telex, and telegraph. Digital services are not yet really available. For this reason, or perhaps vice versa, telecommunications equipment is primary suitable for connecting to the above analog networks. Although there is a broad proliferation of modems, what is perhaps missing is a variety of high speed modems, and simple cheap modems for mass usage. The range of cheap remote multiplexers is also somewhat limited; for example, we have not found statistical multiplexers or 'X.25 black boxes' on the market, which could be used in private networks, since no such service is offered yet by the PTTs. The range of mini and microcomputers that could be used for data communication purposes is great, and we have not covered the full range of such machines. The just emerging personal computer families were also left out, although they will certainly be suitable for a whole range of such applications. It is too early to include these system in our review. Finally we have looked at the teleprocessing system programs of Ryad and SM machines. For the Ryad series, which are compatible with the IBM 360/370 series, these programs are rather similar to those of the IBM system. It should be mentioned that the mainframe storage requirements of such teleprocessing system programs are relatively high. Time sharing operating systems only recently became available on Ryad machines, thus teleprocessing on Ryad computers is really only suitable for the second generation machines, which were introduced first at the end of the seventies. It is expected that teleprocessing applications of Ryad will be widely in use by the middle of the present decade. The new Ryad teleprocessing concept follows closely the ISO/OSI reference model definition.

The SM series can also be used as small host computers. A particularly important use for the SM will be their utilization as data communication node computers. Experimental packet switched network based on SM4s already exist, and their proliferation and operational usage is expected before the middle of the present decade.

ANNEX 1:

PART 1: MODEMS, LINECONCENTRATORS, REMOTE MULTIPLEXERS, AND OTHER TELECOMMUNICATION EQUIPMENT MADE IN CMEA COUNTRIES
(Based on [10], [11] and various sales brochures)

<table>
<tr><th>Type of equipment</th><th>Country</th><th>Technical characteristics</th></tr>
<tr><td>Modem
200 ES-8001</td><td>USSR
Bulgaria
Rumania</td><td>two and four wire duplex, synchronous,
asynchronous, data transfer up to
a speed 200 bit/sec. For switched telephone
networks.
frequences: 980 Hz - 1,180 Hz for the first channel,
1,650 Hz - 1,850 Hz for the second channel
CCITT Recommendations: V.21, V.24, V.25</td></tr>
<tr><td>Modem
200 ES-8002</td><td>DDR
Hungary
CSSR
Poland</td><td>duplex, speed ≤ 200 bit/sec,
synchronous and asynchronous
data transmission, duplex, according CCITT V.21
frequency: channel 1 = 1,080 Hz ± 100 Hz;
channel 2 = 1,750 Hz ± 100 Hz
for two and four wire line on switched telephone
network
Interface: CCITT V.24/V.28 (Ryad I-2)
Automatic answering: 2,100 Hz according CCITT V.25</td></tr>
<tr><td>Modem
200 ES-8004</td><td>Hungary</td><td>duplex, speed ≤ 200 bit/sec
asynchronous, according to CCITT V.21 on switched
telephone network, with accoustic coupler.
frequencies:
<table>
<tr><th></th><th>send</th><th>receive</th><th></th></tr>
<tr><td>request:</td><td>980 Hz
1,180 Hz</td><td>1,650 Hz
1,850 Hz</td><td>blank
signal</td></tr>
<tr><td>answer:</td><td>1,650 Hz
1,850 Hz</td><td>980 Hz
1,180 Hz</td><td></td></tr>
</table>
</td></tr>
</table>

Type of equipment	Country	Technical characteristics
Modem 1200 ES-8005	Bulgaria USSR Rumania	According to CCITT V.23 modem recommendation halfduplex, synchronous or asynchronous transmission on two wire line, speed 600 bit/sec or 1,200 bit/sec, secondary channel 75 bit/sec, frequencies: for 600 bit/sec: 1,300-1,700 Hz for 1,200 bit/sec: 1,300-2,100 Hz for 75 bit/sec: 390-450 Hz for automatic answer: 2,100 Hz according to CCITT V.25 other CCITT recommendations: V.23, V.24
Modem 1200 ES-8006	Hungary CSSR Poland	According to CCITT V.22 and V.23 modem recommendation half duplex (duplex is also possible on request), speeds 600 bit/sec (data channel: 1,500 Hz ± 200 Hz, reverse channel: 420 ± 30 Hz) or 1,200 bit/sec (data channel: 1,700 ± 400 Hz, reverse channel: 420 ± 30 Hz), synchronous or asynchronous, In some versions with secondary channel 75 bit/sec. Frequencies in accordance with CCITT recommendations for two and four wire (for duplex) lines. Interfaces: CCITT V.24/V.28 (Ryad I-2) Automatic answer: 2,100 Hz according CCITT V.25. Other CCITT recommendations taken into account: V1, V2.
Modem 1200 ES-8007	Hungary	Manufactured by ORION - complies with CCITT Rec. V.22 Alternatives "A" and "B", as well as Ryad ES-8007 - full duplex transmission over 2-wire switched telephone lines - synchronous or start-stop communication - automatic answering and calling - alternative voice transmission with voice adopter MOHA-96 - testing in local and remote loops Data Modem ORION AM-12TD provides a full duplex data transmission of synchronous data at a rate of 1200 bit/s, or that of start-stop characters at a rate of 1200 bit/s + 1%-2.5% over the 2-wire public switched telephone network. The AM-12TD fully complies with the CCITT Rec. V.22 approved in 1979 for a "1200 bit/s duplex modem standardized for use on the general switched telephone network and on leased circuits." CCITT Recommendations V.2, V.5, V.24, V.25, V.28 and V.54 are also met, as

Type of equipment	Country	Technical characteristics
		well as the technical requirements of "Modem 12" having a code number of ES-8007 in the Unified Range of Electronic Computers (Ryad). Carrier frequencies: 1200 Hz ± 0.01% low channel, 2400 Hz ± 0.01% high channel. Answering tone: 2100 Hz ± 10 Hz. Guard tone frequency: 1800 Hz ± 10 Hz. Interconnection with data terminals are according to CCITT recommendations V.24 and V.28 (i.e., Ryad interface standard I-2).
Modem 1200 ES-8009	Bulgaria	1200 bit/sec, modem for telephone connections.
Modem 2400 ES-8010 (IZOT 8010)	USSR Bulgaria	duplex, synchronous speeds 600, 1200 (two phase modulaton) or 2400 bit/sec (four phase modulation) with 75 bit/sec secondary channel, four wire connections, operation modes: data mode and telephone conversation mode, according to CCITT V.26 recommendation, synchronous modem with 1200/2400 bit/sec speed, full duplex on 4 wire, half duplex on 2 wire lines, CCITT V.26 and V.26 bis, Interfaces: CCITT V.24 and V.28 (Ryad I-2)
Modem 2400 ES-8011 (ORION AM-2400)	Hungary	two and four wire lines, speeds 1200 or 2400 bit/sec with 75 bit/sec secondary channel option (AM-2400F), synchronous, full duplex, according to CCITT recommendations V.2, V.22 bis, V.24, V.26 and V.28 (Ryad I-2 interface), can be used with voice adapter as well.
Modem 1200/2400 ES-8013	Poland	According to CCITT V.26 recommendation for modems, for speeds 1200 or 2400 bit/sec, synchronous, duplex, "A" and "B" type modulation, two and four wire lines can be used with built-in voice adapter for telephone, secondary channel 75 bit/sec
Modem 2400/4800 ES 8015	Bulgaria	Primarily 4800 bit/sec modem for use on leased telephone circuits, half duplex operation on 2-wire circuits, or full duplex on 4-wire lines, synchronous operation, with optional 75 baud reverse channel. The modem is designed primarily for use on high quality data circuits (CCITT Rec. M.1020). The

Type of equipment	Country	Technical characteristics
		modem is equipped with differential 8-phase modulation nominally adjustable equalizer (CCITT Rec. V.27) and also with automatic equalization possibility (CCITT Rec. V.27 bis). Fall-back to 2400 bit/sec as per Rec. CCITT V.26 Alternative "A".
Modem ES-8015	USSR	2400/4800 baud modem for 4 wire communication over leased telephone lines. Data transfer mode: duplex, synchronous, voice adapter connection optional, phase modulation
Modem 4800 ES-8017	Rumania	Four-wire leased telephone connection, duplex transmission, synchronous mode, speed: 2400 and 4800 bit/sec, phase modulation.
Modem 4800 ES-8018	Hungary	Four-wire telephone connection, serial duplex transmission, 4800 bit/sec transmission speed, phase modulation (1800 Hz).
Modem 48/72 ES-8020	Poland	Broadband connection with 4 wire termination; speeds: 48/56/64/72 bit/sec; modulation: frequency with one side band, carrier frequency: 100 KHz
Group of modems ES-8036	Hungary	Can contain the following modems: ES-8002, ES-8006, ES-8011, ES-8028; with automatic selection for 8 lines.
Modem ES-8027	Bulgaria	Base band modem up to 4800 bit/sec, two-wire physical connection, synchronous or asynchronous transmission in duplex mode. Transmission distances: for 600 bit/sec up to 18 km, for 4800 bit/sec up to 10 km
Modem TPR	CSSR	Wideband modem to to 9600 bit/sec on leased metalic 2 or 4-wire lines, Type of transmission: serial, asynchronous, full duplex transmission mode. Interfaces: CCITT V.24 and V.28 Manufacturer: Tesla-Strasnice
Modem base-band ES-8028 (TEM)	Hungary	for two or four wire lines (physical link) within 40 km distance, synchronous and asynchronous transmission, duplex, 2-wire 2400 bit/sec, max distance 16 km 4-wire 2400 bit/sec, max distance 28 km

Type of equipment	Country	Technical characteristics
		4-wire 4800 bit/sec, max distance 18 km 4 wire 9600 bit/sec, max distance 10 km Interfaces: CCITT V.24/V.28 (Ryad I-2), voice adapter connection TTH-4800 possible.
Digital-to telegraph signal converter ES-8030	USSR Hungary Bulgaria	Digital-to-telegraph signal converter. Duplex transmission over switched or dedicated 4-wire telegraph circuits. Data transfer rate in synchronous mode: 20, 50, 100 (bit/sec); in asynchronous mode up to 200 (bit/sec). CCITT Recommendations: V.24, V.28, U1, U2, V.10 and V.11.
Digital-to-telegraph signal converter ES-8032	Hungary CSSR	Equipment allowing connection to the telegraph network.
Digital-to-telegraph signal converter ES-8033	Bulgaria Hungary	Speeds: 50, 75, 100 bit/sec It can be used in combination with multiplexer ES-8410 and ES-8401 too.
Modem 200 SM-8101	Hungary	duplex, asynchronous dedicated and switched two-wire telephone lines, speed ≤ 300 bit/sec, modulation according to CCITT V.21 Recommendation, produced by VIDEOTON
Modem 1200 SM-8102	Hungary	two or four wire connection, synchronous, asynchronous, duplex, half duplex, speeds 600/1200 bit/sec, modulation according to CCITT V.23 Recommendation, produced by VIDEOTON
Modem 2400 SM-8103	Hungary	two or four wire telephone lines, synchronous, duplex or half duplex, speeds 2400 sec/bits, secondary channel 75 band, modulation according to CCITT Reccomendation V.26.
Modem ZERO-Modem SM-8105	CSSR	null modem, asynchronous, duplex, half duplex, up to 50,000 bit/sec
Modem 300 SM-8107	Bulgaria	on leased or switched telephone lines, half duplex and duplex transmission, up to 300 bit/sec

Type of equipment	Country	Technical characteristics
Modem 2400 SM-8108	Bulgaria	on leased or switched telephone lines, half duplex and duplex transmission, 2400/1200 bit/sec.
ES-8070 (MOHA-96)	Hungary	Voice adapter produced by ORION is designed to transmit and receive signaling and to establish telephone conversation over 2-wire or 4-wire leased telephone circuits. It can be connected to any modem and DTE meeting appropriate CCITT Recommendations (V.24, V.28 and I-1 (telephone line)).
TERTA TTH-4800	Hungary	Voice adapter TTM-4800 can be linked to the modems of TERTA: TAM-200, TAM-201 (ES-8002), TAM-600, TAM-601 (ES-8006); for two and four wired leased line connections
ORION DATEST-2A	Hungary	Testing equipment, generation of data between 50 - 19,200 bit/sec, and analysis of test results. Connections: CCITT V.28/V.28 (Ryad I-2) interface. Testing of modems, for synchronous and asynchronous systems
Telephone caller ES-8061	USSR	To provide automatic connection over switched telephone voice-grade communication lines to teleprocessing systems of ES computers
ES-8062	Hungary	Automatic calling device for switched telephone network, for establishing calls automatically, and maintaining the connection. Its operating algorithm is according to CCITT recommendation V.25. It can be connected to DTEs according to CCITT V.24 and V.28 (interface of the 100 and 200 series). The modem connected to the DTE can be any according to the CCITT V series (CCITT V.24 and V.28 series 100) dialing tone level 425 Hz ± 25 Hz received tone level 2100 Hz ± 25 Hz calling tone level 1300 Hz ± 10 Hz
Telegraph caller ES-8063	USSR	To provide automatic connection in four wire switched telegraph network to teleprocessing systems of ES computers
Remote Multiplexer ES-8421	Hungary	TMX-2400 time division synchron multiplexer. Up to 23 channels can be multiplexed into one medium speed telephone line. Synchronization

<table>
<tr><th>Type of equipment</th><th>Country</th><th>Technical characteristics</th></tr>
<tr><td></td><td></td><td>of high speed channel from low speed channels are independent. High speed side can be 600/1200 bit/sec duplex, synchronous. Interfaces on high and low speed side CCITT V.24, V.28. The low speed channels can be 50, 100, 200 bit/sec asynchronous and 200 bit/sec synchronous.
<table>
<tr><th colspan="9">Possible combinations:</th></tr>
<tr><th rowspan="2">low speed channels bit/sec</th><th colspan="8">high speed bit/sec</th></tr>
<tr><th>1200</th><th>1200</th><th>1200</th><th>1200</th><th>1200</th><th>1200</th><th>600</th><th>600</th></tr>
<tr><td>50 (5 or 7 databit)</td><td>23</td><td>-</td><td>-</td><td>10</td><td>-</td><td>2</td><td>10</td><td>1</td></tr>
<tr><td>100 (8 data bit code)</td><td>-</td><td>10</td><td>-</td><td>6</td><td>4</td><td>3</td><td>-</td><td>5</td></tr>
<tr><td>200 (8 data bit code)</td><td>-</td><td>-</td><td>5</td><td>-</td><td>5</td><td>3</td><td>-</td><td>-</td></tr>
</table></td></tr>
<tr><td>Line concentrator TERTA TETA-1210</td><td>Hungary</td><td>Line concentrator and error protection device. Allows up to 4 max 200 bit/sec leased and switched telegraph line connections to be linked to Ryad multiplexers (e.g., to ES-8410).
Error protection according to CCITT V.41.
The equipment includes:
ES-8033 telegraph line adapter and
ES-8121 error protection unit.
Interface: CCITT V.24/V.28</td></tr>
<tr><td>Line concentrator TERTA TETA-1220</td><td>Hungary</td><td>Line concentrator and error protection device. Allows up to 3 max 1200 bit/sec leased and switched telephone line connections to be linked to Ryad multiplexers (e.g., to ES-8410).
The equipment includes:
ES-8002 (TAM 201) or ES-8006 (TAM 601) – modems
ES-8062 (TBA-1) automatic calling device
ES-8122 error protection unit.
Interface: CCITT V.24/V.28</td></tr>
<tr><td>Error protection device ES-8122</td><td>Hungary</td><td>Speed: 600, 1200 bit/sec
reverse channel 75 Bd,
according to CCITT Rec. 41
(sending, receiving, sending-receiving)</td></tr>
<tr><td>Programmed asynchronous multiplexer SM-8503</td><td>Bulgaria</td><td>Up to 16 lines, with speeds up to 9600 bit/sec</td></tr>
</table>

Type of equipment	Country	Technical characteristics	
Multiplexer-concentrator SM-	GDR	Channels: Speeds:	telephone, telegraph, physical in asynchronous mode up to 9600 bit/sec in synchronous mode up to 48000 bit/sec
		Design based on single card microcomputer SM-50/40-2	
Asynchronous multiplexer for data transmission SM-	CSSR	Channels: Internal storage: Speed:	switched on leased telephone channels, physical link; 0.128 KByte up to 9600 bit/sec
Remote group control unit ES-7911	Poland	Channels: Mode: Speed: Number:	leased telephone lines synchronous, block 1200 - 4800 bit/sec up to 32 of ES-7919 and up to 32 of ES-7914 (part of the system ES-7910)
Remote group control unit ES-7921	USSR	Channels: Mode: Speed: Number:	leased telephon lines synchronous, block 600/2400, 4800 bit/sec; up to 32 of ES-7927 or up to 32 of ES-7934, ES-7936 (part of the sys tem ES-7920).

PART 2) MODEMS MADE IN YUGOSLAVIA

Main communication equipment manufacturers in Yugoslavia are N. Tesla from Zagreb and Iskra from Drany.

a) N. Tesla manufactures *modems* under licence of CM Ericsson, Sweden.

Type of modem	Technical characteristics
ZAT 300	- Switched/leased lines - Asynchronous, two wire, half & full duplex - Speed up to 600 bits/sec - Frequences 1080 Hz; 1750 Hz - Automatic answering unit included - CCITT Rec. V.21, V.24, V.28
ZAT 1200-5 LSI	- Switched/leased lines - Asynchronous/synchronous, 2/4 wire - Asynch: speed up to 1200 bits/sec - Synch: speed 1200 or 600 bits/sec - Frequencies: for speed $\le$ 1200 bit/sec, 1300-2100 Hz for speed $\le$ 600 bit/sec, 1300-1700 Hz - Automatic answering unit included - Optional-secondary channel: 75 bit/sec - CCITT Rec. V.23, V.28, V.25, V.24
ZAT 2400-5 LSI	- Switched/leased lines - Synchronous, 2/4 wire - speed 2400/1200 bit/sec - Carrier frequency 1800 Hz - Automatic answering unit included - Optional: asynchronous sec. channel 75 bit/sec - CCITT Rec. V.26, V.26 bis, V.28, V.24
ZAT 4800-5 Microprocessor	- Switched/leased lines - Synchronous, 2/4 wire - Speed 4800bit/sec - Carrier frequency 1800 Hz - Automatic answering unit included - Optional: - asynchronous sec. channel 75 bit/sec - multiplexer feature for 2 x 2400 bit/sec channel handling - CCITT Rec. V.27 bis, V.27 Ter, V.28, V24.
ZAT 9600 - LSI Microprocessor	- Leased lines - Synchronous, 2/4 wire - Speed 9600/7200/4800 bit/sec - Optional: 4 channel multiplexer - CCITT Rec. V29, V.24

Type of modem	Technical characteristics
ZAT 12/96 (Baseband)	- Leased lines - Synchronous, 2/4 wires - speed 9600/4800/2400/1200 bit/sec - CCITT Rec. V.28, V.24

b) *Iskra, Kray modems*:
production is based under licence from Standard Radio & Television.

Type of modem	Technical characteristics
GH 1161	- Switched/leased lines - Asynchronous, 2 wire, full duplex - Speed up to 300 bit/sec - Automatic answering unit included - CCITT Rec. V.21, V.24, V.28
GH 20521	- Switched/leased lines - Asynchronous, 2/4 wire, half/full duplex respectively - Speed up to 1200 bit/sec - Optional: - secondary channel 75 bit/sec - Synchronous transmission 1200/600 bit/sec - CCITT Rec. V.24, V.24, V.28
GH 2054	- Switched/leased lines - Synchronous, 2/4 wire - Speed 2400/1200 bit/sec - Optional: - secondary channel 75 bit/sec - automatic answering unit - CCITT Rec. V.26, V.26 bis, V.24, V.28
GH 2058	- Leased lines - Synchronous, 2/4 wires - Speed 4800 bit/sec - Optional: - Secondary channel 75 bit/sec - CCITT Rec. V.27, V.24, V.28
DCB 19200 (Baseband)	- Leased lines - Synchronous, 2/4 wire - Speed 19200/9600/4800/2400/1200/600 bit/sec - CCITT Rec. V.24, V.28

ISKRA's product line also covers some equipment for data communication control and measurement which is produced under licences of Standard Radio and Telephone and Dynatech Data Communication.

ANNEX 2: LIST OF DATA COMMUNICATION CONTROLLERS TO BE LINKED TO RYAD (ES) COMPUTERS

(Based on [10] and various sales brochures)

Type of equipment	Country	Main technical characteristics
Multiplexer ES-8400 (MPD 1A)	USSR	Connecton to all ES computer models and ES terminals (ES-8502, ES-8004, ES-8561, ES-8563, ES-8570, PTA-6). Maximum number of lines 16, combination of telegraph, switched and dedicated telephone lines, speeds ≤ 100 bit/sec on telegraph lines, ≤ 2400 bit/sec on telephone lines. Half duplex telecommunication, two channel switch option, error protection
Multiplexer ES-8401 (MPD 1)	Bulgaria	Number of the controlled lines; 63 (with the speed ≤ 600 bit/sec), 32 (with the speed ≤ 1200 bit/sec), Available speeds: 50, 75, 100, 200, 600, 1200, and 2400 bit/sec
Multiplexer ES-8402 (MPD 2)	USSR	Connection to all ES computers possible. Multiplexer for switched and dedicated telegraph and telephone lines. For bidirectional half duplex data exchange between ES computers and terminals or full duplex computer-computer data exchange. It is connected to the standard multiplexer channel of an ES computers. Data transfer rates per line (bit/sec): 50, 100, 200, 600, 1200, 2400, 4800 Configuration limits: 8 to 176 half duplex lines or 4 to 88 duplex lines

Type of equipment	Country	Main technical characteristics
Multiplexer ES-8403 (MPD 3)	USSR	Multiplexer for bi-directional computer-computer or computer-terminal links. To be used for multiplexer or selector channels of an ES type computer through the internal adapters (TA2, TA1, CA1, CA2) to various types of telephone and telegraph lines. Half duplex and full duplex transmission possible. Available speeds: 50, 100, 600, 1200, 2400 and 4800 bit/sec. Direct computer-computer link with 4800 bit/sec speed.
Multiplexer ES-8404 (MPD 4)	GDR	For connection of computer ES-1040 with max. 12 connection of telecommunication equipment, (terminals ES-8505, ES-8570, ES-8504, ES-8514, etc.). Speeds: 100, 200, 600, 1200 (2400) bit/sec through V.24 interface. Teletypewriter regime 50, 75, 100 bit/sec, Transmission mode: start-stop, Operating mode: half duplex, Storage capacity: 8K or 16K words.
Multiplexer ES 8405 (MPD 5)	Rumania	Up to 4 telephone connections with speeds of 600, 1200, 2400, and 4800 bit/sec.
Multiplexer (TMX 2410) ES-8410 (MPD 10)	Hungary	Maximum layout 32 channels (max. 2400 bit/sec each) at a data transmission speed of 50 - 19,200 bit/sec to be linked to the central computer (to the mux. channel) of Ryad and IBM machines. Type of terminals supported: Ryad and IBM *BSC* terminals (Teletype, TAP-70, AP-1, AP-74, ES-7910, VTS-56100, TAP-2, TAP-3, AP-61, AP-62, AP-63, AP-64, etc.). Data communication equipment to be connected are all ES modems, it can be connected to TMX-2400 (ES-8421) remote multiplexer. Interface to DCE: CCITT V.24/V.28 (I-2) and (I-3). Software support: works under all telecommunication control of ES OS and DOS operating system, e.g., BTAM, TCAM Code used: ISO-7, 5 bit telex, EBCDIC

Type of equipment	Country	Main technical characteristics
Multiplexer ES-8371 (ESTEL 4)	Bulgaria	Front-end processor, can support between 2 and max. 352 lines. Half duplex and duplex connection, 1200 bit/sec average speed in synchronous and asynchronous mode. Limits of line speeds: 50 bit/sec - 48000 bit/sec. High speed connection to the computer (Ryad and IBM machines) through byte-multiplex, block-multiplex or selector channels. It can serve up to two computers if the two channel adapter is chosen. Type of terminals supported: ES-8501, IZOT-7925, VTS 56100, IZOT-8500, IZOT-8531, ES-8531, ES-90037, etc. Type of modems to be connected: ES-8001, VLOT-8010, ES-8005-06, IZOT-8015, ES-8033, etc. Procedures: Software support: start-stop, BSC, SDLC, Works under ES DOS and OS systems Main storage: up to 512 Kbyte in 32 Kbyte modules 1982-1983: X.25 emulation will be possible.
Multiplexer ES-8371.01 (TELE JS)	Poland	Frond end processor, in its characteristics similar to IBM 3705. It can maximally support up to 352 lines with speeds between 50 - 48,000 bit/sec. Line protocols start/stop (SS), BSC/SDLC. ES-8371.01 especially suitable to support the larger mainframes of Ryad II (ES-1035, ES-1055) equipped with extensive terminal networks. Mainframe software support: ES OS; access methods TCAM, VTAM; TSO systems; telecommunication monitors (CICS, SHADOWS, etc.) Terminal supported: ES-7900 terminal family, ES-8575, IBM, BSC, etc. Storage capacity: 16 Kbyte - 256 Kbyte

ANNEX 3:

PART 1: BASIC CHARACTERISTICS OF THE SM COMPUTER FAMILY (CPU'S PRODUCED BY CMEA COUNTRIES) —A GENERAL PURPOSE MINI COMPUTER FAMILY ALSO TO BE USED FOR DATA COMMUNICATION PURPOSES [11]

1) *SM 3 Computer CPU (SM-2101)*

Manufacturer: USSR

- microprogrammed, (4K words) microprogram memory, 0.25 μ sec cycle time
- 4 work registers addressable by programs
- main storage: Max. 32K words (16 bit); 1.2 μ sec access time
- Max. number of addressable peripherals: 55
- various synchronous and asynchronous data communication adapters (SM 8501 ÷ SM 8507)

2) *SM 2P Computer CPU (SM-2101)*

Manufacturer: USSR

- microprogrammed, (4K words) microprogram memory, 0.25 μ sec cycles time
- number of work registers addressable by microprograms: 17
- number of work registers addressable by programs: 4
- main storage: 32K words - 128K words (16 bit)
- Max. addressable peripherals: 56
- various synchronous and asynchronous data communication adapters (SM 8501 ÷ SM 8507)

3) *SM-3P Computer CPU*

Manufacturers: Poland (SM-2302)
Cuba (SM-2303)/CID-300/
USSR (SM-2103)
CSSR (SM-2301)/SM-3-20/

- microprogrammed
- number of universal registers: 8 (16 bit)
- main storage: 32K words (16 bit)
- execution time of register-register operations:

for SM-2302	5 μ sec
for SM-2303	up to 5 μ sec
for SM-2103	5 μ sec
for SM-2301	3.3 μ sec.

— various synchronous and asynchronous data communication adapters (SM 8501 ÷ SM 8507).

4) *SM-4P Computer CPU*

Manufacturers: Rumania (SM-2402)/I-100/
USSR (SM-2401)
CSSR (SM-2401)

— microprogrammed
— number of universal registers: 8 (16 bit)
— main storage: 124K words (16 bits)
— virtual storage system, access less than 2.5 μ sec.
— execution time of register-register operations:
for SM-2402 0.8 μ sec
for SM-2104 1.2 μ sec
— various synchronous and asynchronous data communication adapters (SM 8501 ÷ SM 8507).

5) *SM-52 Computer CPU*

Manufacturers: Hungary

— microprogrammed 16 bit word processor
— 1 million operation per second (LOAD or STORE)
— 12 registers
— main storage: 64/128K words (16 bits)
— access time: 0.55 μ sec
— various synchronous and asynchronous data communication adapters (SM 8501 ÷ SM 8507).

6) *Data Communication Adapters for SM Computers*

a) *SM-8501 and SM-8502 Asynchronous Adapters*

Manufacturer: CSSR

— number of channels up to 8
— data transmission speeds: 50, 100, 200, 300, 600, 1200, 4800, 9600 bit/sec
— connection to telephone, telegraph, and physical lines
— asynchronous mode
— simplex, half duplex, duplex, transmission mode
— 5, 6, 7 or 8 bit code, no parity
— for SM 3P and SM 4P computers

b) *SM-8505*

Manufacturer: USSR

- adapter for data transmission
- speed up to 20000 bit/sec
- number of channels: 1

c) *SM-8506*

Manufacturer: CSSR

- synchronous adapter for data transmission for leased and switched telephone channels
- speed: up to 9600 bit/sec
- half duplex and duplex transmission mode

d) *SM-8507*

Manufacturer: Bulgaria

- synchronous adapter for data transmission, for leased and switched telephone channels
- speed: up to 9600 bit/sec
- half duplex and duplex transmission mode.

PART 2: LIST OF CZECHOSLOVAK MINICOMPUTER CONFIGURATIONS USED FOR DATA COMMUNICATIONS
(based on various sales brochures)

SM 3-20 SM-1 series, data collection and preprocessing, communication control in real-time regime.

Processor SM 2301: 16 bit words, 65,000 operat./s (of type LOAD or STORE), 76 instructions, 8 registers, main storage 32/64K, access time less than 500 rs.

Standard peripherals: cassette disk unit SM 5400, 5 MB; magnetic tape unit SM 5300, 10 MB; alphanumeric VDU (24 lines, 80 char/line) with a keyboard SM 7202, serial transmission up to 9600 bit/s; mosaic serial printer SM 6301 (178 char. per line, parallel transmission 100 char/s); paper tape reader an punch SM 6208 (300 and 55 char/s, resp.).

Optional peripherals: VDU SM 1601, KSR terminal with a matrix printer SM 7108, line printer SM 6313, card reader SM 6100, serial asynchronous adapter SM 6002, serial synchronous adapter SM 8606, null modem SM 8105.

Software: operating system FOBOS, LOS DOS-RV V2, PPPD-1, TMOS, DIAMS; compilers Macroassembler, Basic, Basic-Plus, FORTRAN IV, Fokal, COBOL.

Data communications: serial transmission via adapters SM 6002 and SM 8606, interface telegraph 40 mA, CCITT V.24/V.28, code KOI-7, transmission rate up to 9600 bit/s, communication control procedure HDLC, SDLC, DDCMP (MSC).

SM 4-20 SM-1 series, real-time systems, data entry and collection, communication control in terminal and computer networks.

Processor SM 2401: 16 bit words, 120,000 oper./s (of type LOAD or STORE), main storage 128/256K, virtual addressing.

Standard peripherals: cassette disk unit SM 5400, 5MB; magnetic tape unit SM 5300, 10MB; alphanumeric VDU (24 lines, 80 char/line) with a keyboard SM 7202, serial transmission up to 9600 bit/s; serial mosaic printer SM 6301, 178 char. per line, parallel transmission 100 char/s; paper tape reader and punch SM 6204 (500 and 100 char/s, respectively).

Operational peripherals: VDU SM 1601, KSR terminal SM 7108 with a mosaic printer, line printer SM 6313, card reader SM 6100, serial asynchronous adapter SM 6002, serial synchronous adapter SM 8606, null modem SM 8105.

Software: operating systems DOS RV V2, DOS RVR, DIAMS I., FOBOS II., TMOS, PPPD-2; compilers Macroassembler, FORTRAN IV, FORTRAN IV-Plus, Cobol, Basic, Focal; application software SYRPOS for communication control in terminal and computer networks.

Data communications: via SM 6002 serial transmission 50-9600 bit/s, 5-8 unit code with or without odd/even parity, interface telegraph 4 wire up to 500 m, CCITT V.24; via SM 8606 serial transmission up to 9600 bit/s, interface CCITT V.24/V.28, communication control procedures HDLC, SDLC, DDCMP (BSC).

SM 52/11 SM-2 series, SM-1 compatible, real-time and time sharing systems, batch and interactive processing, communication control in terminal and computer networks.

Processor: 16 bit words. 1 million operation per second (of type LOAD or STORE), main storage 128/256 K, access time less than 550 ns, 12 registers.

Peripherals standard: cassette disk unit SM 5400, 5 MB; magnetic tape unit SM 5300, 10 MB; alphanumeric VDU (24 lines, 80 char/line with a keyboard SM 7202, serial transmission up to 9600 bit/s; mosaic printer SM 6301, 178 char. per line, parallel transmission 100 char/s.

Optional peripherals: VDU SM 1601, KSR terminal with a mosaic printer SM 7108, line printer SM 6313, magnetic disk unit SM 5405 (29 MB), floppy disk unit SM 5605 (512K), card reader SM 100, serial asynchronous adapter SM 6002, serial synchronous adapter SM 8606, null modem 8105.

Software: operating systems DOS RV V2, DIAMS I., II., DOS RVR, FOBOS II., TMOS, PPPD-2; compilers macroassembler, FORTRAN IV, FORTRAN [illegible]-Plus, COBOL, Basic Plus; application software SYRPOS for communication control in terminal and computer networks.

Data communications: via SM 6002 serial transmission 50-9600 bit/s, 5-8 unit code with or without even/odd parity, telegraph interface 4 wire up to 500 m, CCITT V.24; via SM 8606 serial transmission control procedures (line protocols HDLC, SDLC, DDCMP (BSC).

ADT 4500 (SM 1) process control, communication control, real-time processing, compatible with M 6000, M 7000, SM 1-2, JSEP and SMEP compatible by means of a magnetic tape and a floppy disk.

Processor: 16 bit words, 128 instructions, 300 oper./s, 2 index registers, 12 scratch pad registers, main storage 8-32K, cycle 650 ns.

Standard peripherals: 8 unit paper tape reader FS 1503, 1500 char/s; 8 unit paper tape punch DT 105S, 110 char/s; alphanumeric VDU (24 lines, 80 char/line) with a keyboard SM 7202, parallel transmission up to 9600 bit/s; mosaic serial printer DZM 180, 132 char/line, 180 char/s; cassette disk unit ES 5069, capacity 3 MB.

Optional peripherals: card reader ES 6112, cassette magnetic tape unit KPP 800, floppy disk unit ES 51074, magnetic tape unit PT 305, SM 5400; line printer ES 7181.

Software: operating systems DOS III, RTS-1; compilers Assembler, FORTRAN, ALGOL, Basic; telecommunication access method DCAM.

Data communications: via communication controller TC 104: asynchronous (50-9600 bit/s) or synchronous (up to 19,200 bits/s) transmission, 5-8 unit code with or without odd/even parity, communication control procedure BSC, interface CCITT V.24/V.28; via communication controller TC 110: synchronous HDX/FDX transmission up to 19.2 kbit/s, communication control procedures (line protocols) BSC, SDLC/HDLC.

JPR 12 R Process control, data entry and collection, terminal communication control; compatible with SM-3 series.

Processor: 16 bit words, 16 registers, real-time clocks, four interrupt priority levels, 66 basic instructions, main storage 8-28K, cycle time 950 ns.

Standard peripherals: paper tape reader FS 1503 1500 char. per second; paper tape punch DT 105S, 110 char/s; alphanumeric keyboard ES 0101, serial printer ES 7181, 132 char. per line, 150 char/s.

Optional peripherals: floppy disk unit MOM 3300 (250K); cassette magnetic tape unit KPP 800 (2 x 200K); magnetic tape unit SM 5300, VDU (e.g., VT 340, SM 7202).

Software: paper tape or disk oriented operating system; compilers Macroassembler, Basic, Focal, FORTRAN.

Data communications: serial asynchronous FDX transmission, 50-9600 bit/s, 7-11 unit code with or without odd/even parity; telegraph interface 2 x 200 mA, CCITT V.24/V.28.

PART 3: LIST OF HUNGARIAN MICROCOMPUTERS USED FOR DATA COMMUNICATION, NOT MEMBERS OF THE SM COMPUTER FAMILY)
(based on various sales brochures)

KFKI TPA-70

- 16 bit processor with with 1 μ sec access time, 4 registers, DMA card
- Peripherals: disc, magnetic tapes, paper peripherals, alphanumerical, graphical displays, data acquisition and control modules, communication interfaces, etc.
- system softwares: DOS, MINORB,

  compilers: Assembler, Basic, FORTRAN, etc.
- Data communication:
  - serial synchronous, asynchronous interfaces
  - parallel BSI interface
- Network software (basic version developed at IIASA and SZTAKI): PSG (X.25, X.20, V.24), BSC, CDC 200 UT emulator

KFKI TPA-11-40

- small computer similar to PDP 11/40

VT60 (ES 1010M) Compu er

- VT 60 is a small computer compatible with ES 1010/ES 1012.
- storage capacity: 64 KByte program + 64 KByte data optional
- word length: 16 bit + parity
- suitable for real time applications, for front-end processors of large mainframes
- operating systems: Disc Batch Monitor (DMB),

  Real Time Disc Monitor (RTDM),

  Multitask Monitor (MTM).
- Telecommunication programs: PROGRESS-2000, which is the communication system of the so-called VNS (Videoton Network Systems).

ANNEX 4: LIST OF TEMINALS PRODUCED BY CMEA COUNTRIES

(Based on [10], [11], and various sales brochures)

Equipment classfication	Country	Purpose	Components and characteristics
ES-8501 (Remote group data station AP-1)	Bulgaria	For communication with computer, terminal to terminal, data preparation for duplex and half duplex, synchronous and asynchronous data transmission, (between 50-1200 bit/sec) through telephone or telegraph channels	typewriter ES-7177, paper tape reader/puncher ES-6191/ES-7191, e.g., modem ES-8002, Interfaces: CCITT V.24/V.28, Other CCITT recommendations: V.2, V.21, V.23
ES-8502 (Remote group data station AP-2)	USSR	Synchronous, half duplex data exchange with computer or terminal through 2 or 4-wire telephone or telegraph channels	typewriter ES-7172, paper tape reader/puncher ES-6199/ES-7191, modem ES-8001 and ES-8030, binary to telegraph converter if the ES-8502 is linked to telegraph channels.
ES-8502 (Remote group data station TAP-2)	Hungary	for batch and interactive usage, half duplex, 200 bit/sec, synchronous data transmission through telephone or telegraph circuits	CONSUL 260 typewriter, ES-7172 paper tape reader/puncher ES-6191/ES-7191 (ER 40/EP 35), modem ES-8002 for telephone or ES-8030 for telegraph connection. Error correction: CCITT V.41 Interfaces: CCITT V.24/V.28 Other CCITT recommendations: V.21, V.25

Equipment classfication	Country	Purpose	Components and characteristics
ES-8503 (Remote group data station AP-3)	Hungary (TAP-3) Bulgaria DDR	batch and integrative regime, for 600 or 1200 bit/sec synchronous 2/4 wire telephone connections, reverse channel: 75 bit/sec	Typewriter, paper reader/ puncher, (ES-6121/ES-7121), modem ES-8006 or ES-8028. CCITT recommendations: V.23, V.24, V.25, V.28, V.41
ES-8503 (Remote group data station AP-3)	Bulgaria	For 2-wire telephone connection, for 600 or 1200 bit/sec, synchronous data transmission	typewriter ES-7174, paper tape reader/puncher (ES-6121/ES7121), modem 1200 ES 8005
ES-8504 (Remote group data station AP-4)	USSR	Program-controlled multi-terminal system for data acquisition from peripheral devices, data exchange with remote computer. Both batch and interface communication mode, connection through multiplexers ES-840.. or ES-8400, for telegraph and telephone lines, data transfer 1200, 2400 bit/sec, synchronous transmission in half duplex mode	typewriter ES-7172, paper tape reader/puncher (ES-6121/ES-7123 (ES-7122)), AP-6100 card reader, AP-2100 central control unit, AP-7100 (7101) serial printer, alphanumeric display, AP-5080 magnetic tape unit, ES-8010 modem
ES-8505 (Remote group data station AP-5)	GDR	For synchronous, half duplex data transmission for 200, 600, or 1200 bit/sec on telephone lines.	typewriter, paper reader/puncher (up to 15 work stations), modems: ES-8002 or ES-8006
ES-8506 (Remote group data station AP-6)	GDR	For synchronous, half duplex data transmission for 600/1200 bit/sec.	up to 15 work stations
ES-8514 (Remote group data station AP-14)	Poland	Group data station, channels: switched or leased telephone lines, speed: 200, 600, 1200 bit/sec; code: KOI-7	consists of: paper tape reader/puncher; typewriter; display; line printer; cassette deck;

Equipment classfication	Country	Purpose	Components and characteristics
ES-8515 (Remote group data station AP-15)	Rumania	Channels: switched or leased telephone lines, speed: 600-4800 bit/sec code: KOI-7	consist of: paper tape reader/puncher; keyboard for input/output; card reader/puncher; cassette deck; disc;
ES-8531 (Remote group data station AP-31)	Bulgaria	For batch and interactive mode, point-to-point and multi-point connections, speeds 600, 1200, 2400, 4800 bit/sec, 2/4 wire telephone connections for duplex and half duplex data transmission. It can function in start-stop or synchronous transmission mode, also suitable for telegraph connection.	Programmed remote data station, display monitor, card reader (ES-6112), magnetic card identificator, magnetic disc (ES-5074), paper tape reader/puncher, cassette, printer (ES-7181), diskette, built-in modem
ES-8534 (AP-34)	Hungary	Programmed group data station for banking purposes, with exchangeable control block; speed: 200, 1200 bit/sec code: KOI-7	consists of: input/output on 4 or 8 special typewriters; normal typewriter; paper tape reader/puncher
ES-8540 (KA-10)	CSSR	Group remote data preparation system Channel: leased telephone line; transmission mode: synchronous; speed: 600-1200 bit/sec, code: KOI-7	consists of: processor; card puncher; smart card reader; numerical keyboard; line printer; control unit for peripherals; diskette; teletype
ES-8550 (Remote data station)	Hungary	For stand alone usage in data preparation as well as for connection to remote computer, point-to-point or multi point connection duplex and half duplex synchronous data transmission, speed 600-2400 bit/sec	based on ES-1010 computers typewriter WA-7172, display, paper tape reader/puncher (ES-6121/ES-7121), disc (ES-7048, ES-5060), matrix printer (ES-7183), card reader, modems (ES-8006 or or ES-8011).

Equipment classfication	Country	Purpose	Components and characteristics
ES-8561 (Remote data station AP-61)	USSR	Conversational terminal: data exchange with computer or terminal station, four wire telephone synchronous and asynchronous half duplex mode, data speeds 200, 1200, 2400 bit/sec	typewriter (ES-7172), display, modem (ES-8010 or ES 8001), connection through ES-8400 or ES-8402 multiplexer
ES-8562 (Remote data station AP-62)	Hungary	Stand alone station for data preparation or computer terminal for 4-wire telephone, telegraph connections, half duplex regime, speeds 1200-4800 bit/sec	data display, typewriter
ES-8563 (Remote data station AP-63)	USSR	Conversational group terminal for interactive usage, for providing simultaneous operation of a group of users with a remote computer. 4-wire telephone connection, half duplex mode, synchronous and asynchronous transmission mode, data transfer speed: 1200/2400 bit/sec	group control unit, display units (up to 24), 2 typewriters ES-7172, modem ES-8010, connection through ES-8400 or ES-8402 multiplexers
ES-8564 (Remote grop data station AP-64)	Hungary	For interactive usage through 4-wire telephone lines in half duplex mode, synchronous, 1200-4800 bit/sec	up to 16 VIDEOTON VT100 displays, CONSUL typewriter
ES-8570 (Remote data station TAP-70)	Hungary	2-wire telephone channels or 4-wire telegraph channels, simplex, half duplex, start-stop, max. 100 bit/sec.	typewriter CONSUL 260 (ES-7172), modem ES-8003 (TAM-200) (ES-8030 TTB-200)

Equipment classfication	Country	Purpose	Components and characteristics
ES-8570 (TAP-70AB)	Hungary	intelligent terminal for max. 300 bit/sec speed. For interactive usage, asynchronous, simplex or half duplex data transmission	periferals: VDU, line printer (optional), modem TAM-201 (ES-8002) for telephone connection, modem TTX-200 (ES-8032) for telegraph connection, CCITT recommendations: V.21, V.24, V.25, V.28
ES-8570 (TAP-70SB)	Hungary	intelligent terminal for max. 2400 bit/sec speed. For online batch usage, synchronous half duplex data transmission, in ES/IBM BSC mode, for data preparation, local connection and batch transmission to the central mainframe	peripherals: VDU, line printer (optional), modem: TAM-601 (ES-8006). CCITT recommendations: V.21, V.24, V.25, V.28
ES-8570	USSR	low speed 100 bit/sec terminal station, half duplex, asynchronous transmission for telephone or telegraph type of connection	typewriter (ES-7172), modem (ES-8001).
ES-8574	Hungary	portable terminal, in point-to-point or multipoint, for switched or dedicated telephone or telegraph channels, asynchronous, duplex trans-mission up to 200 bit/sec	Portable, with telephone accoustic coupler which can be connected to ES-8002 or ES-8006 modems
ES-8575 (Remote data station AP-75)	Poland	for half duplex asynchronous data transmission, for interactive processing, speeds: 100, 200, 600, 1200 bit/sec, for telephone or telegraph lines	workstation with alphanumerical keyboard, 132/158 character wide printer output, sprinting speed 180 char/sec, matrix printer ES-7186, modems ES-8002 or ES-8006, converter ES-8030 or ES-8027 for telegraph transmission

Equipment classfication	Country	Purpose	Components and characteristics
ES-8576 (Remote data station AP-76)	CSSR	For telephone connection, synchronous data transmission, speeds: 600, 1200, 2400, 4800 bit/sec, interactive and batch processing	work station with matrix printer ES-7184 and alphanumerical keyboard
ES-7920	USSR Hungary GDR Poland CSSR	Alphanumerical display group	consist of - remote group control unit (ES-7921) - local group control unit (ES-7922) - remote alphanumerical display with keyboard (ES-7925) - alphanumerical display with keyboard (ES-7927) - serial printer (ES-7934) - serial printer (ES-7936)
SM-7401 (Intelligent alpha-numerical video-terminal)	Hungary	data collection, data prepar tion, office terminal, interactive usage	80x24 char. display, magnetic cassete, diskette option, buffer memory, core memory up to 16 Kbyte. Adapters and connectors for communication lines, printers and other peripherals CCITT V.24 interface
SM-7402 (Intelligent alpha-numerical terminal)	GDR	As stand alone device or in connection with SM computers, for interactive usage and data collection, also in terminal networks with speeds 200, 600, 1200 bit/sec, half duplex	display, core memory up to 16 Kbyte, read only memory 4 Kbyte, buffer memory up to 0.75 KByte, interfaces for connection to communication lines and various other peripherals such as teletypes
ES-7920	GDR	Complex data collection system for interactive usage, half duplex data transmission, synchronous, speeds 600, 1200, 2400, 4800 bit/sec	Max. 32 displays, printers of ES-7922, ES-7927 ES-7934, or ES-7936, modem ES-8010 connection through mux. ES-8403

Equipment classfication	Country	Purpose	Components and characteristics
Robotron K-8922	GDR	For special applications such as travel and ticket booking systems	display, printer, communication controllers for connection to switched or dedicated channels
Alpha-numerical display group ES-7910	Poland	Display concentrator	Consists of - remote group control unit ES-7911 - local group control unit ES-7912, - serial printer ES-7914, - remote alphanumerical display with keyboard and serial printer ES-7915, - alphanumerical display and keyboard ES-7917
Remote group control unit ES-7911	Poland	Group control unit, for up to 32 displays, 32 printers; mode: synchronous, block; channel: telephone; speed: 1200-4800 bit/sec	(part of the system ES-7910)
ES-8591 teletype	CSSR	On switched or leased telegraph lines; speed: 50/100 Bd Code: ITA-2	teletype
ES-7168 (Video-terminal)	Hungary	Connection to modems through CCITT V.24 interface, speed: 75-1200 bit/sec Code: KOI-7	Videoterminal with V.24 or parallel interface; optional connection to ES-7184 line printer; Latin and Russian character set, display: 1280 characters
IZOT 7926/28	Bulgaria	Synchronous bit-oriented data transmission mode	terminal system based on the terminal controller IZOT 7926 and up to 7 video displays IZOT 7828 with modems, optional ES-7187 or ES-7186 printer

Equipment classfication	Country	Purpose	Components and characteristics
ES-9003	Bulgaria	Data transmission speed: 600/1200, 2400, 4800, 9600 bit/sec	Remote data entry station. Built on a minicomputer and its peripherals, a monitor controller of 16 data entry stations, modems: ES-8027 for base band data transmission, other modems for 600/1200, 2400, 4800 bit/sec
TPR (Tesla)	CSSR	Transmission rate: up to 9600 bit/sec. Type: serial, asynchronous. Mode of transmission: full duplex, 2 or 4 wire telephone line.	video terminal, connection to remote computers through modem according to CCITT: V.24, V.28. interface.
SM-1614 Video terminal (group)	USSR	Synchronous and asynchronous mode	video terminal with 1024/1920 character display, microcomputer SM 50/40-2 based, storage: 3KByte-9KByte
SM-1604 alpha-numerical video-terminal (group)	Bulgaria	Asynchronous transmission mode, speed: 2400 bit/sec	based on single card microcomputer SM 50/40-3, 1920 character display
SM-1605 Small terminal (group)	Bulgaria	Asynchronous transmisson mode; speed: 300 bit/sec.	based on single card microcomputer SM 50/40-3; numerical keyboard; card reader, magnetic card reader, modem
SM-Group terminal for inventory control	GDR	Synchronous transmission mode; speed: 600, 1200 bit/sec	Based on single card microcomputer SM 50/40-3; memory: 24 KByte; peripherals: keyboard, printer ES-7107, diskette ES-5077 (3 units)

Equipment classfication	Country	Purpose	Components and characteristics
SM-Universal programmed group terminal	GDR	Asynchronous, synchronous transmission mode; speed: 600, 1200, 2400, 4800, 9600 bit/sec	Based on single card microcomputer SM 50/40-2; memory: 4-6 KByte; peripherals: diskette or cassete deck, printer 30 or 200 char/sec, keyboard, display with 1024 or 1920 characters.
SM-Programmed cheap group videoterminal	GDR	Asynchronous, synchronous transmisson mode; speed: up to 9600 bit/sec	Based on single card microcomputer SM 50/40-2, memory: 4-36 KByte; peripherals: printer 30 char/sec or 200 char/sec, keyboard, diskette with 0.125 or 0.25 MByte or cassette deck
SM-Programmed cheap group video-terminal	GDR	Asynchronous, syncronous transmission mode; speed: up to 9600 bit/sec	Based on single card microcomputer SM 50/40-2, peripherals: keyboard; printer 30 or 200 char/sec; display with 1024 characters; diskette SM-5601; cassette 2.75 MByte; magnetic card; paper tape reader/puncher
SM-Programmed group terminal	CSSR	Synchronous transmission mode; half duplex; speed: 600-1200 bit/sec	microprocessor based, memory: 4-8 KByte; peripherals: keyboard SM-7601 diskette SM-5604
SM-Terminal station	Bulgaria	Asynchronous transmission mode	Based on single card microcomputer SM 50/40-3; memory: up to 48 KByte + 46 KByte optional; peripherals: keyboard; printer ES-7187; diskette ES-5074; modem ES-8005; 4 microprocessor based terminals

Equipment classfication	Country	Purpose	Components and characteristics
ES-7915 Remote display with keyboard and printer	Poland	Channels: leased telephone lines; transmission mode: synchronous, block; Code: DKOI speed: 1200, 4800 bit/sec	Display with keyboard, serial printer ES-7914 (part of the system ES-7910)
ES-7925 Remote display with keyboard	CSSR	Channel: telephone transmission mode, synchronous, block; Code: KOI-7	Display with keyboard with the option of line pinter ES-7934.02 with light pen (part of the system ES-7920)
SM-1610 Alpha-numerical group video terminal	Cuba	Speed: 75, 100, 200, 600 1200, 2400 bit/sec	Based on single card microcomputer SM 50/40-1, ROM: 2 KByte, No. of display characters: 1920

Equipment classification	Country	Purpose, components and characteristics
ES-7915	Poland	Videoterminal, batch processing, 1200/4800 bit/sec, synchronous transmission
IZOT-7925	Bulgaria	Videoterminal display format 80x24 characters start-stop regime, speed 1200/2400 bit/sec according to CCITT V.26, V.26 bis, V.24 and V.28 with printing options by ES-7187 or ES-7188 printers
MERA-7952	Poland	ASCII character code video terminal with 64 or 95 characters, display format: 1920 characters, (80x24 lines). Asynchronous transmission, CCITT V.24/V.26 modem interface, selectable transmission speeds: 110, 300, 600, 1200, 2400, 4800, 9600 baud, 100 K baud (without modem)
DZM-180	Poland	Matrix printer with 64 or 96 ASCII character set, printing speed: 180 char/sec.

Equipment classification	Country	Purpose, components and characteristics
DZM-180 KSR	Poland	Matrix printer DZM-180 with printing speed of 180 char/sec, ASCII character set with 64 or 96 characters, with 64 or 96 character ASCII keyboard, to CCITT V.24 interface, selectable transmissiion speeds: 110 or 150, 300, 600, 1200, 2400, 4800, bauds, 100 Kbaud (without modem), asynchronous transmission mode
SM-7401	Hungary	Intelligent videoterminal with alphanumerical character set, display format: 2000 characters (80x25). microprocessor controlled, with cassettes.
SM-1610	Cuba	Alphanumerical videoterminal, microcomputer 50/40-1 —2 KByte stoage, display format 1920 characters. Character transmission speed: 75, 100, 200, 600, 1200, 2400 bit/sec. (Nebo vice ner 1000 bit/s).
VDDS	Hungary	Intelligent terminal family, alphanumerical display with 1920/2000 characters (80x24/25 lines). Microprocessor controlled, special characters (Latin, Cirilic, Greek, mathematical symbols). Optional minicartridge storage or matrix printer. Optionally it can be provided with synchronous or asynchronous interface to connect to remote computer.
VT-20	Hungary	Intelligent terminal system built upon the VDDS family, with the addition of appropriate storage systems: 64 KByte memory address, 8 KByte ROM, 48 KByte RAM, INTEL 8080A processor, 5 MByte hard disc capacity or 2x250 KByte diskette, printer 180 char/sec or 300 line/min, synchronous or asynchronous interface for data communications
VTD (SM-7219)	Hungary	Microprogrammed video teminal family with telephone, telegraph, printer interface options, max. speed for data transmission 9600 bit/sec suitable. Display format: 1920 characters (80x24). The basic functions of the terminal is according to the specification of SM-7219. However different type of other versions exist also: a VT:340 compatible, an IBM 3275 compatible, a SIEMENS 6252 and a DEC compatible version.
VDS-47703	Hungary	Cheap alphanumerical video terminal designed for data input. Display format: 640 characters (40x16), display memory capacity: 1280 characters, through modem it can be used as teletype compatible video terminal.

REFERENCES

[1] Sebestyén, I. 1982. Classification of Telecommunication Hardware and Software systems. WP-82-115. Laxenburg, Austria: International Institute for Applied Systems Analysis. (*)

[2] Lábadi, A. and I. Sebestyén. 1982. The IIASA TPA/70-X.25 Gateway — Network Promotes International Flow of Scientific Information. WP-82-88. Laxenburg, Austria: International Institute for Applied Systems Analysis. (*)

[3] Rajki, P. and R. Szentes. 1981. Videoton Network System — General Overview. In Csaba, et al. ed., Proceedings of the COMNET '81 Conference in Budapest *Networks From the User's Point of View*. Amsterdam: North-Holland Publishing Company.

[4] Fenyves, L. et al. 1981. Session and Transport Control in the Videoton Mininet. In Csaba, et al. ed., Proceedings of the COMNET '81 Conference in Budapest *Networks From the User's Point of View*. Amsterdam: North-Holland Publishing Company.

[5] Ambrus Z., and T. Gerhardt. 1981. Principles and Implementation of the Network Control Layer in the V.N.S. In Csaba, et al. ed., Proceedings of the COMNET '81 Conference in Budapest *Networks From the User's Point of View*. Amsterdam: North-Holland Publishing Company.

[6] Rácz, Zs. and I. Simon. 1981. A PROCESS - 2000 operációs rendszer (The operation system PROCESS 2000), *Információ-Elektronika* Vol. 1981/6. Budapest: Statistical Publishing House.

[7] Puzman, J. 1982. Data Communication in Czechoslovakia — The Telecommunication Infrastructure and Relevant Administrative Procedures. WP-82-104. Laxenburg, Austria: International Institute for Applied Systems Analysis. (*)

[8] Bulgarian report at the Third Meeting of the Steering Committee of the UNSCO/UNDP Project No. RER/79/006/C/01/13 on "Crossborder Computerized Data Exchange in Science and Technology," December 14-15, Sofia, Bulgaria.

[9] Hadrévi, I. 1981. A VIDEOTON Gyár intelligens videoterminál családja (The Intelligent Terminal Families of VIDEOTON) *Hiradástechnika*, Vol. XXXII. 1981/10. Budapest.

[10] International Commission of Cooperating Socialist Countries in the Field of Computer Techniques. 1980. Catalog — ES EDP systems — Vol. 1. Technical Characteristics. Moscow: Moskva Stroyzdat.

[11] International Commission of Cooperating Socialist Countries in the Field of Computer Techniques. 1979. Catalog — SM EDP systems — Moscow: International Commission of Cooperating Socialist Countries in the Field of Computer Techniques.

[12] Gálfi, Z., K. Kovács, and S. Salamon. 1982. MSZR-Számitógépek programozási rendszerei (Programming systems of SM computers), Budapest: SZAMALK.

[13] Balogh, N. 1980. Távadatfeldolgozás, hálózatok — Egyesitési Kisérletek (Teleprocessing, computer networks — unification trials), Számitástechnika, May, 1980. Budapest: Statistical Publishing House.

[14] Sebestyén, I. 1983. Data Communication in Austria —The Telecommunication infrastructure and Relevant Administrative Procedures. WP-83-xxx (forthcoming). Laxenburg, Austria: International Institute for Applied Systems Analysis. (*)

[15] Sebestyén, I. 1983. Data Communication in Hungary —The Telecommunication infrastructure and Relevant Administrative Procedures. WP-83-xxx (forthcoming). Laxenburg, Austria: International Institute for Applied Systems Analysis. (*)

[16] Arabadijan, K., P. Brakalova, I. Sebestyén, E. Tasheva and T. Todorov. 1983. Data Communication in Bulgaria — The Telecommunication infrastructure and Relevant Administrative Procedures. WP-83-xxx (forthcoming). Laxenburg, Austria: International Institute for Applied Systems Analysis. (*)

[17] Butrimenko, A., and I. Sebestyén. 1983. Data Communication in the USSR —The Telecommunication infrastructure and Relevant Administrative Procedures. WP-82-102 , Laxenburg, Austria: International Institute for Applied Systems Analysis. (*)

[18] Sebestyén, I. 1983. Data Communication in Yugoslavia — The Telecommunication infrastructure and Relevant Administrative Procedures. WP-83-xxx (forthcoming). Laxenburg, Austria: International Institute for Applied Systems Analysis. (*)

* (Those referenced IIASA Working Papers which are included as chapters of this study are separately marked with an "*" at the end of the reference).

PART 2:

TRANSBORDER DATA FLOW APPLICATIONS

Chapter 9:

THE IIASA TPA/70 - X.25 GATEWAY-NETWORK PROMOTES INTERNATIONAL FLOW OF SCIENTIFIC INFORMATION*

A. Lábadi and I. Sebestyén

THE IIASA TPA/70 - X.25 GATEWAY-NETWORK PROMOTES INTERNATIONAL FLOW OF SCIENTIFIC INFORMATION*

A. Lábadi and I. Sebestyén

0. INTRODUCTION

There are many different categories of transborder data flow: the Electronic Fund Transfer of the SWIFT network; the air passenger reservation data of the SITA network; observed meteorological data on the network of national meteorological institutes; news on the network of news agencies such as Reuter's; corporate data on the private networks of multinationals such as IBM, Philips or Unilever; technical and economic data on private time-sharing networks such as CYBERNET or the IP Sharp Network; scientific, technical, economical, and legal information on Euronet, Tymnet, and Telenet. Through the international links of IIASA in Laxenburg, Austria, information relating primarily to the Institute and its

*This paper is an updated and extended version of the article "IIASA TPA-70 Gateway-network promotes international flow of scientific information" which appeared in Vol V No 1 (1982) of Transnational Data Report, North-Holland, 1982.

research activities are transmitted between collaborating parties. The major categories of IIASA's transborder data flow activities are shown in Table 1.

Table 1. Major Categories of IIASA's Transborder Data Flow Activities

Name of category	**Example**
Service of scientific time-sharing centers.	Computational services of, e.g., CNUCE (Italy) or SZTAKI (Hungary) for IIASA; or services of the IIASA VAX 11/780 and PDP 11/70 computers to external collaborators.
Service of data base centres (mainly in the field of science and technology).	Data Bank Services of, e.g. Data Star (Switzerland), ESA (Italy),IAEA (UN), SZTAKI (Hungary), VINITI (USSR), for IIASA; or usage of IIASA private data bases by external collaborators.
Electronic message sending and computerized teleconferencing.	For writing joint manuscripts, preparing joint conf -ences, management of joint projects on, e.g., the EIES system (US) or on the PDP 11/70 of IIASA by the TELECTR System.
Bulk (file) transfer of scientific data for remote handling.	e.g., IIASA's large global energy models were partly installed at the IBM computers of CNUCE (ITALY) and SZTAKI (Hungary), or scientific data files loaded from Moscow to IIASA for batch processing on the internal IIASA computers.

1. STATUS OF IIASA'S EXTERNAL COMPUTER COMMUNICATION LINKS

The Computer Services department of IIASA is responsible for providing the telecommunication infrastructure necessary for the above transborder data flow. The basic philosophy of the services provided by this department is described in length in earlier papers ([2] and [3]); the activities of the Institute with regard to the transborder dataflow category of electronic message sending and computerized teleconferencing are described in [4]. The present status of IIASA's external computer links through dedicated lines is shown in Figure 1. The rather complicated mesh of connections represent the links of some significance to IIASA, however it does neither mean that all these connections are owned and operated by the Institute nor that they represent all computer communication links, which physically could be used by the Institute, if desired. Compared with figures on the same subject as shown in papers [3] and [4], a major step forward has been the installation of the second TPA/70 node (based on the Hungarian made minicomputer TPA/70) at the Institute for Computerization and Automation of the Hungarian Academy of Sciences (SZTAKI) in Budapest. This node is also linked to the computer network of the Hungarian Academy of Sciences, and to the IBM 3031 computer of the Academy where work is being carried out, for example on the water quality models of IIASA's Resources and Environment Area. In addition, on this IBM 3031 computer, the on-line bibliographical data base being installed under STAIRS on "Mass Communication Research"--compiled by the Central European Mass Communication Research Documentation Center (CECOM) in Krakow, Poland might be of considerable interest to IIASA. Also our former Systems and Decision Sciences Area started to use for econometrical modeling the SZTAKI computer in an increased way. According to the latest statistics the monthly usage of this computer by IIASA staff is at present about 25 hours.

The next important step forward at the TPA/70 node in Budapest was the connection of the node to the Hungarian Circuit Switching PTT-network NEDIX, which was brought into operation early in 1981. Through

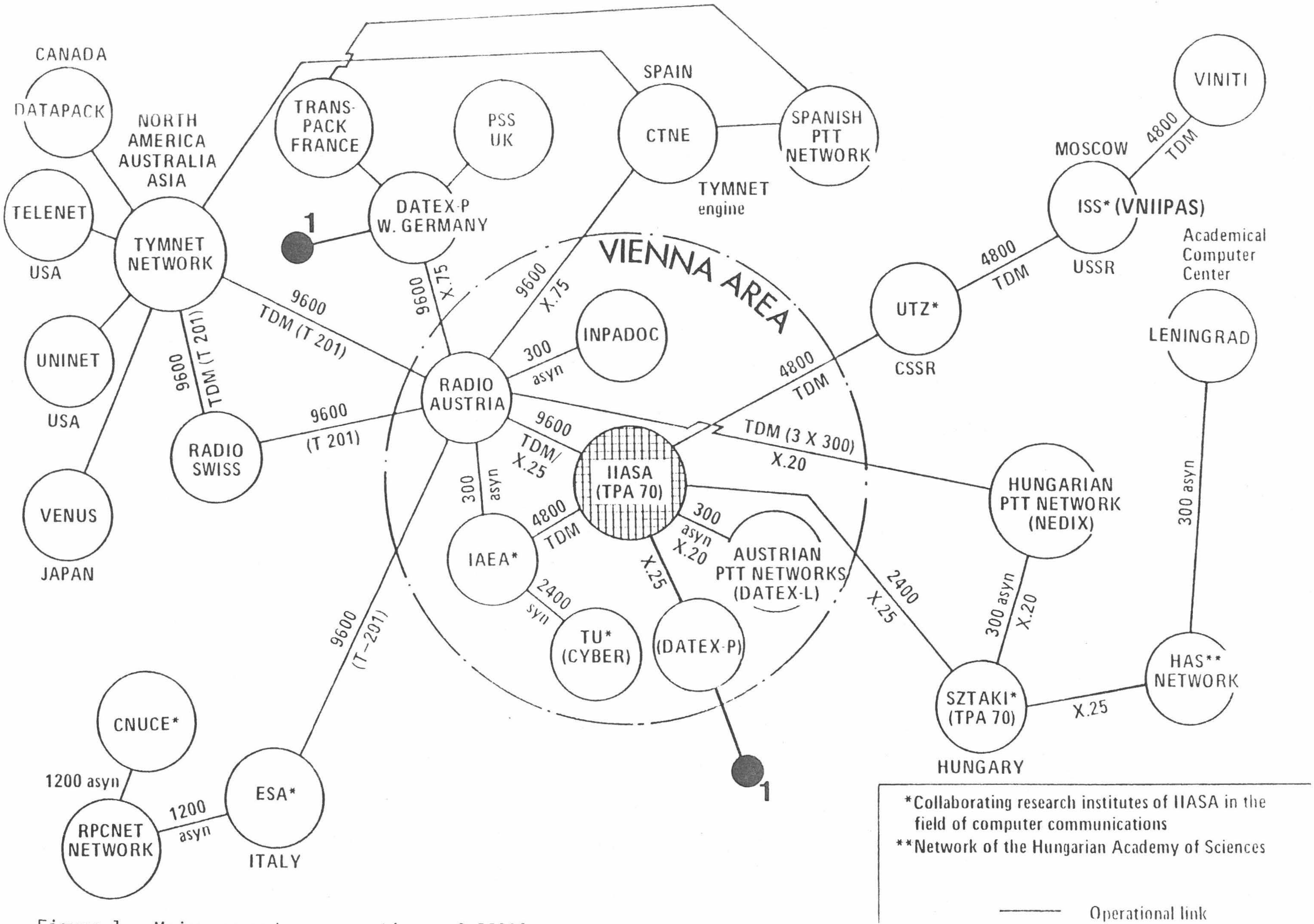


Figure 1. Major computer connections of IIASA.

NEDIX it is possible to establish direct computer connections with IIASA's cooperating scientific institutions in Hungary.

In addition all third party traffic from Hungary previously routed through IIASA from Academic Institutions in Hungary are now connected through this network, since NEDIX has been interconnected to the network node of Radio Austria since July 1982.

It should be mentioned that the HAS network is also linked to the Leningrad Research Computer Center of the USSR Academy of Sciences (CYBER and BESM6 systems) for collaborative research purposes and through this connection IIASA is also able to access that computer center in Leningrad, and actually during the past couple of months several connections were established. Also the direct connection to Czechoslovakia and the USSR was extended by new services. In Moscow the data base center of VNIITI with its multidisciplinary bibliographical databases became available to IIASA users through the VNIIPAS-node in Moscow. VNIIPAS--the All Union Scientific and research Institute for Applied Computerized Systems--and ISS--the All Union Institute for Systems and Studies--which also represent the Soviet National Member Organization of IIASA are one of our major partners in the Soviet Union for carrying out and coordination of joint research with our Institute. Negotiations with other Eastern European countries concerning computer link to IIASA (such as to Bulgaria, and the GDR) are in progress, and actually Bulgarian institutions may already access IIASA through the VNIIPAS node in Moscow [6]. The Western european computer links from Austria have been considerably improved during the last year or so although the connection through Euronet--allowing access to some specifically Western European data bases relevant to IIASA's research--could not be put into operation because of contractual difficulties between the Commission of European Communities and the State of Austria, and the Austrian pilot access project was actually cancelled in early 1982. The solution to this problem of IIASA is being gradually brought about; *i.e.*, the individual national PTT networks are being interconnected. In Austria itself we see two coordinated developments along this line. First Radio Austria--originally operator of oversees data communication services--has received from the PTT a temporary licence to provide Intereuropean connections as well--as long as the PTT does not make similar services available itself. By this decision much time was saved--all to the benefit of Austrian customers, who are now able to access most European national PTT networks, and *vice versa* Austrian hosts--such as IIASA--can now be accessed through Radio Austria not only from oversees but also from many countries in Europe. Through this service new connections are opened literally month by month and we expect that in the next two years or so our data communication infrastructure with Western Europe will be perfectly developed.

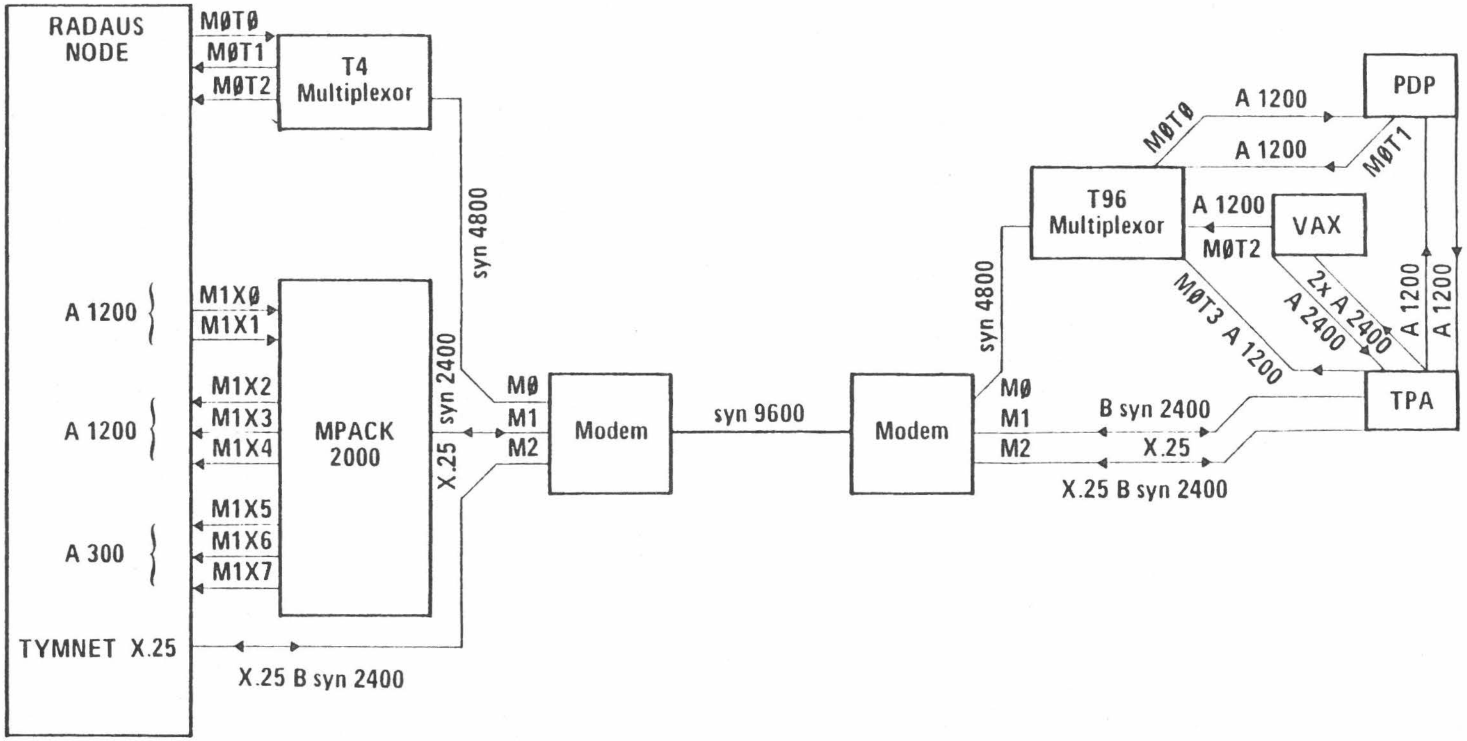
At the beginning of 1983 the Austrian DATEX-P packet switching network and the DATEX-L circuit switched network were already interlinked to some West European PTT data networks such as of those of the FRG.

Bye the end of 1982 a line from the TPA 70 to the new Austrian PTT packet switching network (DATEX-P) was established. The connection to the low-speed circuit switching network of the Austrian PTT (DATEX-L) which allowed incoming calls only has been replaced by a real X.20 connection to provide automatic outgoing calls also.

3. THE MAIN FUNCTIONS OF THE TPA/70-X.25 GATEWAY-NETWORK

The principal technical description of IIASA's computer communication infrastructure is described in more detail in [3] and [5].

It is basically a mixed system built on node computers performing the usual network functions (switching, routing, multplexing, flow control, code conversion, etc.) and on Time Division Multiplexers (TDMs). As an example of the present network on Figure 2 the present configuration between IIASA and Radio Austria is shown. The actual implementation is very much dependent on the technical and financial capability of our partners and of course of IIASA itself. Therefore, the original link to the International Atomic Energy Agency (IAEA) and European Space Agency (ESA) was practically conceived as the extension of the private network of the European space agency 'Esanet', built on TDMx; thus on this link IIASA had to adopt the same TDM-based technology. A similar case was that of the Radio Austria (Tymnet/Telenet) and the Prague-Moscow line. It is, however, planned to replace the TDM technology gradually; the connection to ESA and Radio Austria through packet-switching has been completed, and the control of the Prague-Moscow line will be taken over by a Czechoslovak-made minicomputer SM 4, which was donated to IIASA by its Czechoslovak NMO in 1980 and is already under preparation by all parties. The connection to Hungary was planned from the beginning to be built on Hungarian-made TPA/70 node computers. It is worth drawing attention to the interesting fact that the present model of the TPA/70 at IIASA was originally donated to the Institute by CDC and controlled a very early version of the Hungarian-made graphical display GD-71. In 1977 when the first plans were made to implement a gateway system for IIASA, it was



Multichannel modem (MØ – M3) set to:

MØ = 4800 bit/sec
M1 = 2400 bit/sec
M2 = 2400 bit/sec
M3 = –

Figure 2. Communication hardware between IIASA and Radio Austria VAX-PDP-TPA-RADAUS

decided, for reasons of economy, to upgrade the original TPA/70 hardware configuration. The enhancement of the system was started in 1978 and is still continuing in accordance with the needs of the growing gateway traffic. At present this rather old TPA/70 hardware--which was built almost a decade ago--performs all major network functions of IIASA with reliability of over 97%. From the software point of view, which will be discussed later at length, the first node version described in [5] was basically one-node oriented. However, after the installation of a second TPA/70 node computer in Budapest, circuit-switching network software was put into operation which has eventually been superseded by packet-switching network software supporting X.25 (Figure 3).

The main system functions of the TPA/70 nodes are listed in Table 2. It mainly performs the usual network control functions plus some specific "value-added" functions which were required to improve the quality of the gateway service. Thus, additional features for remote training and monitoring, for control of authorization (who may access what), and for direct exchange of short messages between users of the TPA/70 gateway-network, had to be built in. From the 'semantics' point of view a short overview of the kind of services the TPA/70 gateway-network is actually used for is given in Table 3. It can be seen that the Institute's connections are primarily used for supporting the research work of IIASA. In addition to this, they allow a form of third party traffic between other international organizations and partner organizations of the Institute, in cases where no other way of connection is possible. Thus, for example, the Czechoslovak Liaison Office of INIS/AGRIS to the International Atomic Energy Agency can be switched from their terminal in Prague through the

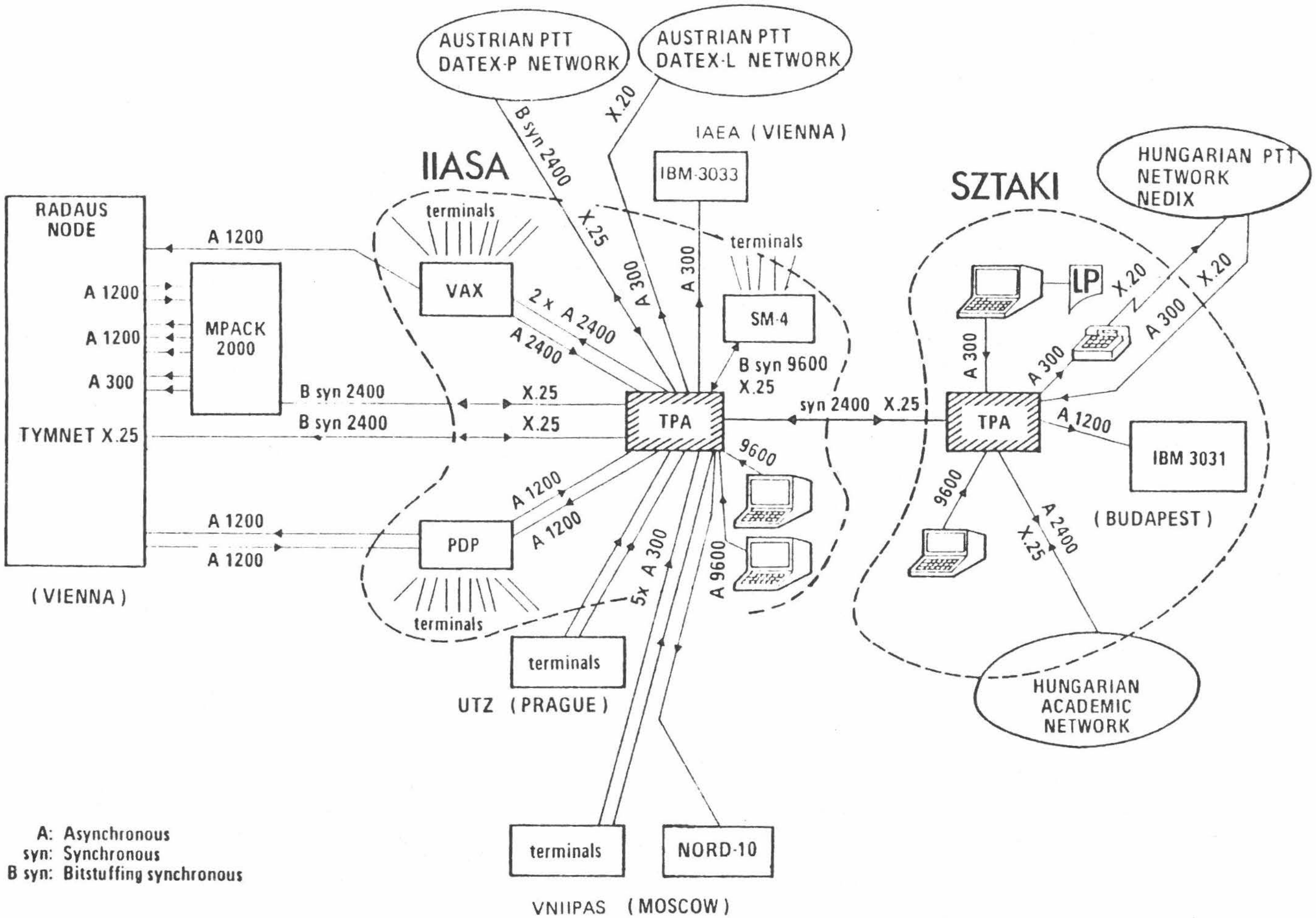


Figure 3. IIASA TPA/70 - X.25 Gateway Network

Table 2. The main functions of a TPA/70 node

- Provision of concurrent terminal-host communications
- User-user communication
- User-node-operator communication
- Monitoring
- Remote training
- Saving of the traffic of any terminal
- Authorization control
- Maintaining of a day-file (statistics)
- Status reports

gateway-network to the IAEA center in Vienna. This switching function will be discontinued as soon as the appropriate national PTT networks are interconnected, since it is not the function of IIASA to take over the role of national PTTs in international networking. This already happened in the case of third party access of Hungarian Academic Research Institutions through IIASA, whereby the Hungarian PTT insisted that all such kind of connections have to go through them, which is actually the case now. Another aspect of the provisional 'switching-through function' is its close user group nature. IIASA only grants switching facilities to those organizations, such as UN organizations, collaborating research institutes *etc.*, which are in close relation to the Institute. Thus it may be claimed that IIASA, and its partners were the first organizations which operate international computer links carrying transborder data traffic in the field of science and research between East and West, but it represents a closed user group; thus it will not and cannot compete with present and future interconnected national data networks, which carry transborder data traffic for a considerably broader audience.

Table 3. Switching function of the gateway-network according to major categories of scientific application between users and providers of information services

Source of service / Consumer of service	IIASA	International organizations	IIASA partner organization West	IIASA partner organization East	Scientific service centres (data bases, time-sharing)
IIASA	–	– access to data bases – scientific computing	– access to private data bases – scientific computing – message-sending	– scientific computing – access to private data bases (experimental)	– scientific computing – public data bases – message-sending
International organizations	– IIASA data bases – scientific computing – message-sending	–	–	–	–
IIASA partner organization West	– IIASA data bases – scientific computing – message-sending	–	–	– scientific computing – access to private data bases (experimental)	–
IIASA partner organization East	– access to IIASA data bases – scientific computing – message-sending	– access to data bases of international organizations	– scientific computing – access to private data bases – message-sending	–	– scientific computing – public data bases (experimental)
Liaison offices of international organizations	–	– access to data bases of international organizations (experimental)	–	–	–

3. SOME TECHNICAL AND OPERATIONAL ASPECTS

The TPA/70-X.25 gateway supports different types of lines. To make the interconnections easier a common language is used between those processes which are logical entities representing either physical lines or local gateway services. These processes can be called from any location in the network and in return they can establish calls to any location in the network. The processes using the common language are called "INTERFACE"s, the common language used is the third level of the X.25. Since the INTERFACEs are expected to work as "ideal" X.25 level 3 automats, time-outs and error recovery procedures are not included in the internal common language. Each data communication line is handled by an INTERFACE. Network callable functions (*e.g.*, "echo") are also implemented by an INTERFACE. A given connection between two INTERFACEs is labelled by an internal "association number" which is established at call-time and released at clear-time. The method of association numbering is similar to the channel numbering of the X.25. An INTERFACE process may be part of any number of associations at a given time.

All address-like information concerning requested destination is handled by the "LOGON" process. The LOGON is responsible for security check, association establishment and the selection of the destination INTERFACE. After having established a particular association, the data flow is maintained by the "ROUTE" which recognizes partner INTERFACEs by their association number.

The "X.25 INTERFACE" process is to connect network lines. It can work either as a DCE or a DTE. Essentially it follows the CCITT X.25 Recommendation (1980). Only virtual calls are supported. Any number of groups, any number of channels in each group and any range of (channel) numbering in each group can be defined. Two versions of LAPB can be used. One conforms to the CCITT recommendation, the other is slightly modified according to the standard used in the Hungarian Academic Network. On the physical level usually bit stuffing synchronous interface is used running with block input-output hardware. It is also possible to utilize conventional synchronous or asynchronous interfaces. In that case the framing is done by software and similar to the IBM BSC transparent format.

The "PAD INTERFACE" process is responsible for interfacing TTY like terminals to the packet switching network. It follows the CCITT X.3 and X.28 Recommendations (1978), all 12 PAD parameters are implemented. The speed of the lines can vary from 50 to 9600 baud. Upper case only terminals are also supported. Special, character filtering masks can be applied on input and output or both. Any kind of parity check or generation can be used. Since the PAD INTERFACE can be called by any other process, terminal to terminal communication is also allowed.

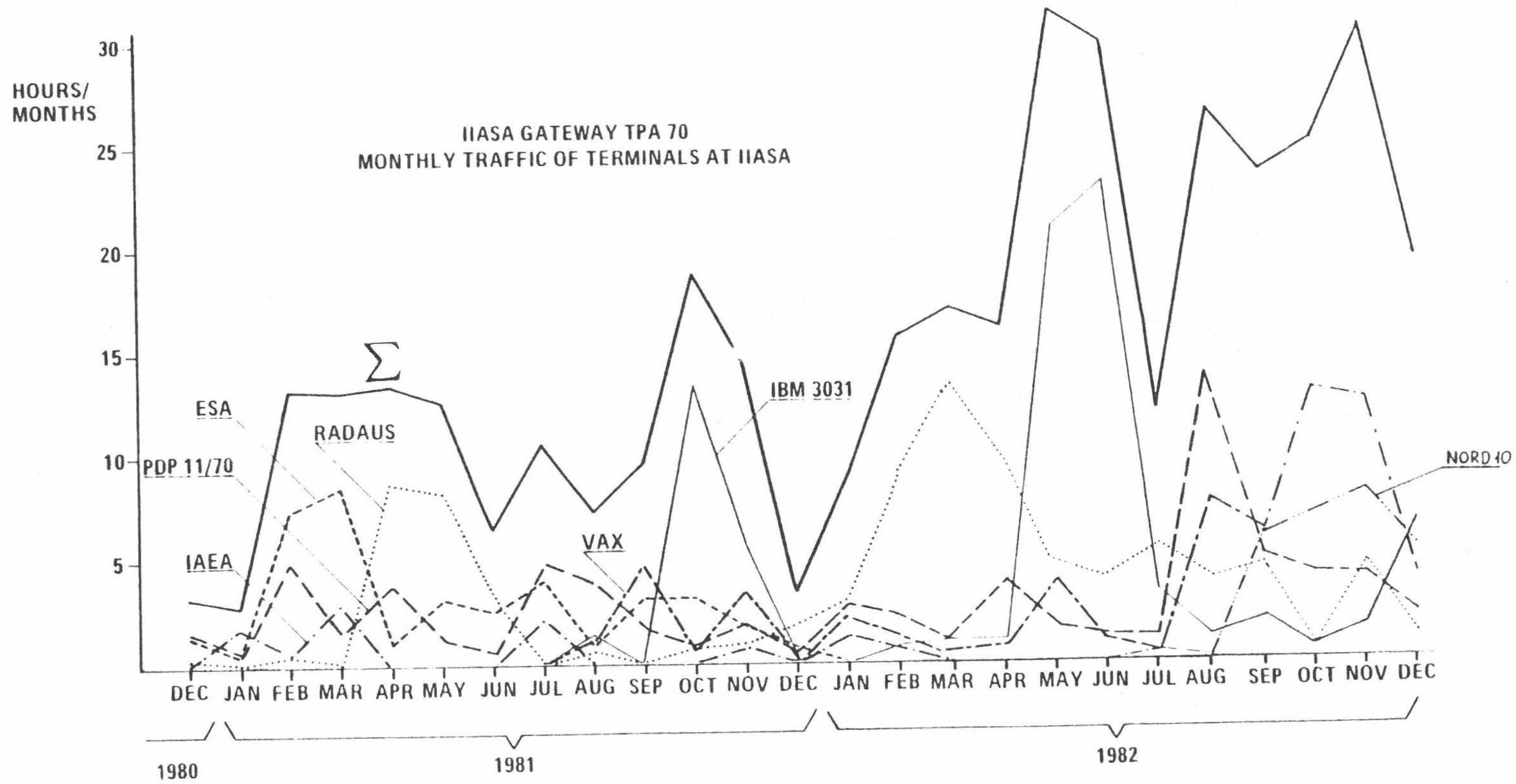
The "AHPAD INTERFACE" process is responsible for connecting computers using ASCII code set to the packet switching network through asynchronous channels. Speed may be up to 9600 baud. When several channels are used to connect a specific computer, then the channels are dynamically assigned to the incoming calls. Explicit channel selection can also be made by the so called CALL USER DATA FIELD. The handling of the physical lines (speed, conversion, parity, filtering) is similar to that mentioned in PAD. Input-output flow-control can be made by means of CTRL Q and CTRL S characters.

The network callable "MONITOR" process is to supervise the Gateway. It provides information such as connections going through the Gateway, status of the lines and so on. Certain operational parameters can be changed; INTERFACEs, can be stopped or started, short messages can be sent to terminals connected directly to the Gateway, independently of their possible existing connections. Any traffic going through the Gateway can be copied to any other terminal and to a disc file to help fault investigation as well as user training. The MONITOR-- with a limited command set--is available to the users to gain status-like information as well as to send messages to other terminals or to the Gateway operator.

A day-file is maintained in the Gateway containing information about each major event which has happened, such as changes in the status of the lines, messages to the operator, call establishment, accounting information, and so on.

5. STATISTICS

The upgraded configuration of the TPA/70 was installed at IIASA in December 1978. The development of the first version of the node (character switching for asynchronous lines only) was finished by May 1980. The regular experimental service of the TPA/70 node at IIASA started in July 1980 and since then the node has been in daily operation. With the other TPA/70 in Budapest the circuit switching version of the Gateway-network was put into operation in August 1981. The packet switching based Gateway-network was introduced in February 1982. The aggregated statistics of the IIASA TPA/70 Gateway from December 1980 (when the accounting system was installed) are given in Figures 4, 5 and 6.



TOTAL TRAFFIC (CONNECTION TIME)
OF 25 MONTH

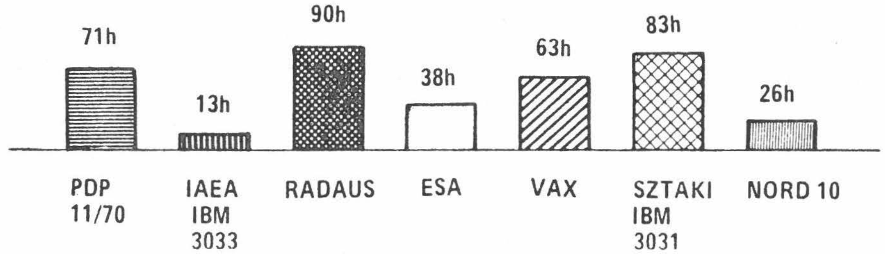
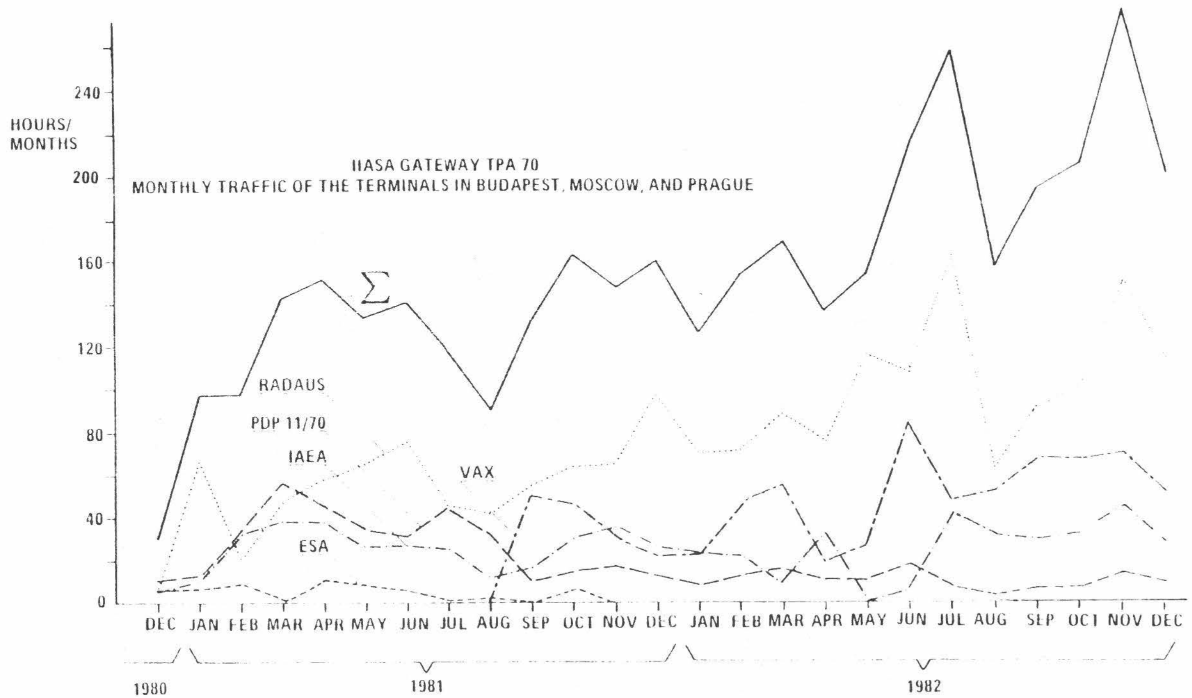
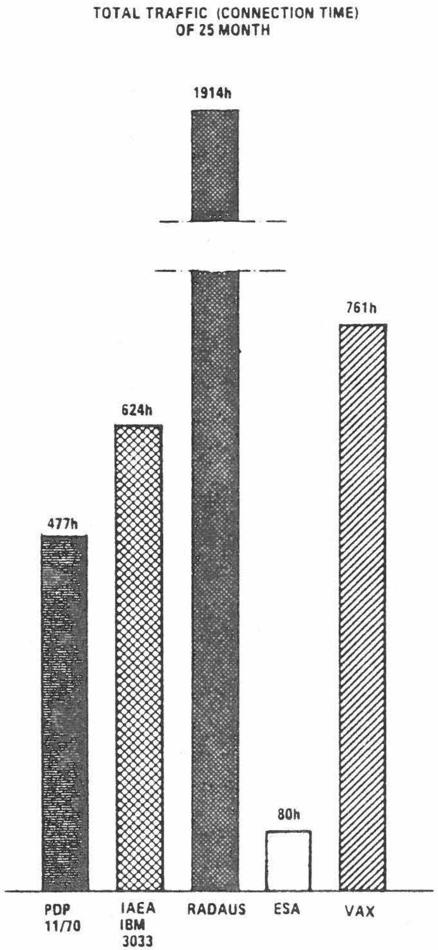


Figure 4.

Figure 5.


IIASA GATEWAY TPA 70
MONTHLY TRAFFIC OF THE TERMINALS IN BUDAPEST, MOSCOW, AND PRAGUE
HOURS/
MONTHS
240
200
160
120
80
40
0
Σ
RADAUS
PDP 11/70
IAEA
VAX
ESA
DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1980
1981
1982


TOTAL TRAFFIC (CONNECTION TIME)
OF 25 MONTH
1914h
761h
624h
477h
80h
PDP
11/70
IAEA
IBM
3033
RADAUS
ESA
VAX

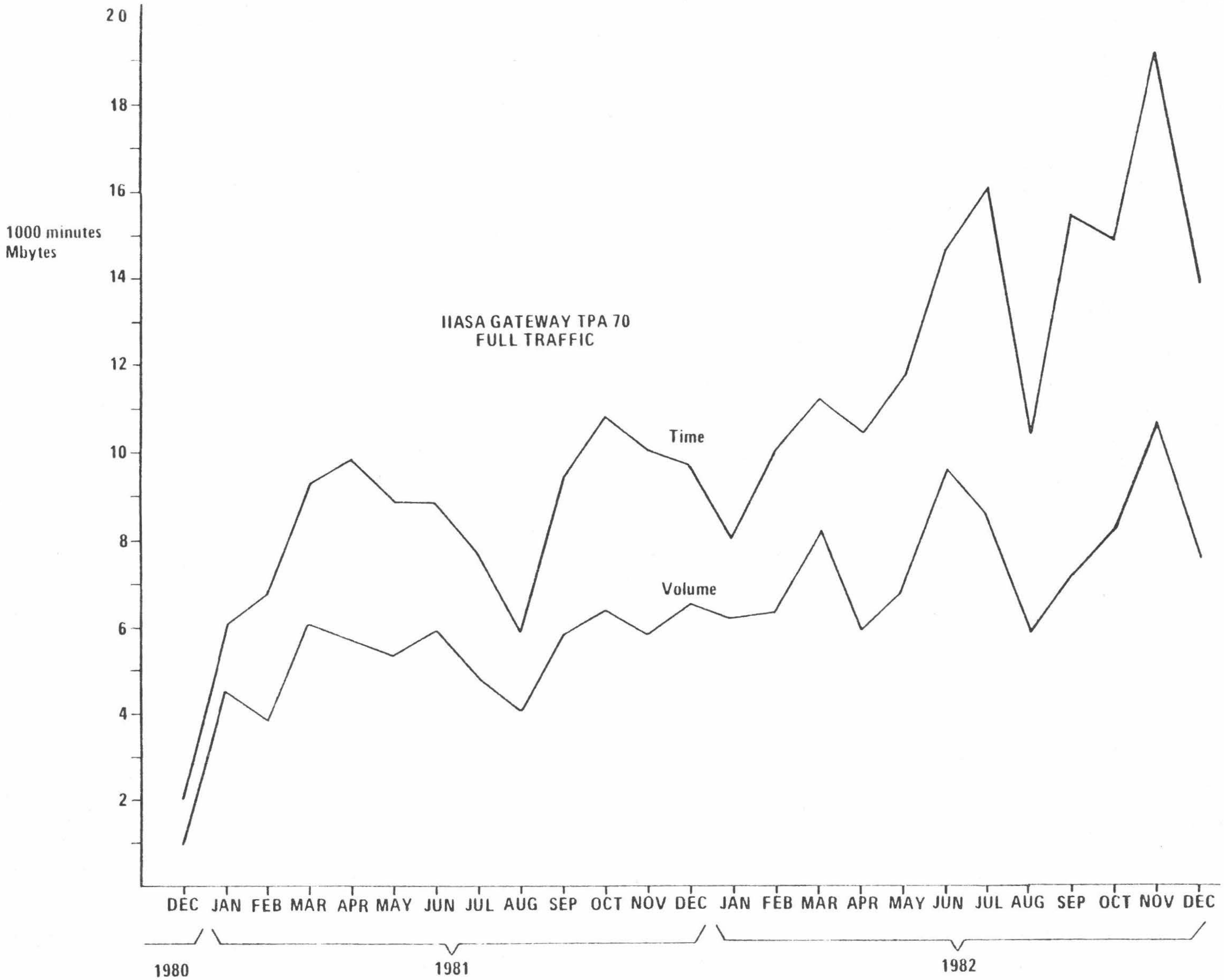

IIASA GATEWAY TPA 70
FULL TRAFFIC
1000 minutes
Mbytes
Time
Volume
20
18
16
14
12
10
8
6
4
2
DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1980
1981
1982

Figure 6.

REFERENCES

[1] IBI-SPIN 231 Documents on Policies for Information, Transborder Data Flow: Its Environment and Consequences, June 1980, Rome, Intergovernmental Bureau for Informatics.

[2] Butrimenko, A., 1979 Computer Communication for Scientific Cooperation--the IIASA case. pp 383-388 Proceedings of the EURO-IFIP Conference 1979, London, 25-28 September, Amsterdam: North-Holland.

[3] Bakonyi, P., Kiss, I., Petrenko, A., Sebestyén, I., 1981 Promotion of East-West Computer Communication in IIASA's International Environment and the Hungarian Case Study; Proceedings of COMNET '81 Conference, Budapest, 11-15 May, Amsterdam: North-Holland.

[4] Sebestyén, I., 1981 Computerized Message-sending and Teleconferencing in an International Environment--Present and Future, Proceedings of the First International Conference on Computer Messaging Ottawa, Canada, 6-8 April 1981, Amsterdam: North-Holland.

[5] Lábadi, A., 1981 IIASA Gateway System and Experiments in Daily Operation. Proceedings of COMNET '81 Conference, Budapest, 11-15 May, Amsterdam: North-Holland.

[6] Todorov, T.K., 1982. CISTI and National System for Scientific and Technical Information Activities in the Set Up and Maintenance of Databases for STI and Services to the Users in Online Mode. Presentation at the Third Steering Committee Meeting of the UNESCO/UNDP Project, No. RER/79/006 on "Crossborder Computerized Data

Exchange in Science and Technology" held in Dec. 1982., Sofia, Bulgaria.

Chapter 10:
PUBLIC DATABASE SERVICES IN HUNGARY

I. Sebestyén

PUBLIC DATABASE SERVICES IN HUNGARY

I. Sebestyén

0. INTRODUCTION

One of the most important categories of data flow applications is databases--especially public databases. Without going into depth concerning the philosophy of database classification, which is discussed in length, for example, in [1, 2], in what follows we are going to describe and analyze the state of public database production and services in Hungary. All data and statistics that are used were published by the Hungarian Central Statistical Office (Országas Statisztikai Hivatal) [3], the National Technical Library and Documentation Center (Országos Mueszaki Koenyvtár és Dokumentácios Koezpont - OMKDK) and by the Information Center for Construction and Building (Épitésuegyi Tájékoztatási Koezpont) [4] and in other printed publications. At this early point we would like to mention that OMKDK was recently reorganized and extended by new functions and now is called OMIK, but throughout the paper when mentioning this institution we refer to its old name, which was valid when the data for this study were collected.

In order to ensure that the terminology used in this paper will be unanimously understood, let us recall some of the known terminology used in connection with the database service industry:

(I) Classification of Databases

Databases in general contain numeric, textual, or a combination of numeric and textual, *information in a wide range of subject* areas that can be used to meet both general and specific information needs. According to [2], databases differ in a number of ways: in subject, scope, geographic and chronological coverage, periodicity of release of new information by the producer, and frequency of updating (the addition of newly released information to the database). In addition, they differ in the type of information or data that they contain. A classification scheme often used in the literature [2] is:

> **Reference Databases.** Refers or "points" users to another source (e.g., a document, an organization, or an individual) for additional details or for the complete text.
>
> **Bibliographic.** Contains citations and, sometimes, abstracts of the printed literature, e.g., journal articles, reports, patents, dissertations, conference proceedings, books, or newspaper items.

Referral. Contains references and, sometimes, abstracts or summaries of non-published information. Generally this will refer users to organizations, individuals, audiovisual materials and other non-print media, for further information.

Source Databases. Those that contain complete data or the full text of the original source information.

Numeric. Contains original survey data and/or statistically manipulated representations of data. These are generally in the form of a time series, which represent measurements (e.g., tons or dollars) over time for a given variable (e.g., production or shipment statistics for a given product or industry).

Textual-Numeric. These are generally databases of records that contain a number of data elements, or fields with a combination of textual information and numeric data.

Properties. Contains dictionary or handbook-type data, typically, chemical and physical properties.

Full Text. Contains records of the complete text of an item, e.g., a newspaper item, a specification, or a court decision.

(II) The Database Producers

Databases are developed by a group of suppliers referred to as "producers". In some cases, particularly for reference databases, producers are primarily publishers of printed index and abstract journals. These organizations--in both the public and private sectors--acquire, screen, select, index, and sometimes abstract or summarize the primary literature. To produce their printed publications, these organizations have adopted automated systems for phototypesetting and thereby generate a magnetic tape that can be used further for computerized processing, particularly in storage and retrieval systems.

Source databases, on the other hand, are produced by a number of different types of organizations. Some producers of these databases are also publishers of reports and other publications. Others have, as their main line of business, research, consulting, and advisory services in the areas covered by the database they produce. Still others are government agencies that, like their counterparts in agencies that produce bibliographic databases, have a responsibility for the dissemination of information collected or generated in their particular areas. Some producers process and package data into databases that were originally collected by some other source, often the federal government. In their packaging, these producers frequently bring together data from a number of different sources and sometimes increase the value of a collection by including additional data, such as forecasts, that they generate.

(III) The Database Services

Computer-based database services are provided by computer service organizations (often by the database producers themselves) equipped with appropriate computer hardware and software to mount the databases to be serviced on their computer and to retrieve the required information. In the process of retrieval there are basically two different categories--which we also use in some of the following tables.

(1) *selective dissemination of information* (for short SDI) where information is periodically filtered according to a certain category (often called profile) from the new increments of the database.

(2) During the so-called *retrospective search* of information where a browse on the full (cumulated) database is to be performed in order to find the requested information (profile) over a long period.

Other classifications of services we distinguish between are the so-called *offline* and *online* services:

(1) Both SDI and retrospective searches can be made in an offline regime, in this manner the request for information is processed in batch mode, i.e. not instantaneously after the request has been made. Offline regime, although generally wrongly regarded as "old fashioned", is still most useful in our opinion--especially for periodical SDI service subscriptions.

(2) *Online* regime is an elegant, rather new way of retrieving information from a database instantaneously. For this purpose usually a powerful timesharing computer equipped with an appropriate disc and terminal configuration is used. By this technique both SDI and retrospective searches can be performed; however, the interactive mode of this service is most suitable for finding on a trial and see basis the right search strategies and obtaining the desired result instantaneously. Thus, this type of regime is preferably used for retrospective searches and in factual databases. Online services are typical computer network applications. Time sharing data centers in this regime are linked as hosts to the computer network, users get access to these systems through the network by using

terminals. Larger public computer networks such as TYMNET or EURONET not only provide services for one single country, but allow the use of online services over many borders. Similar is the case for the increasing number of interlinked national PTT computer networks. By this fact online access to databases in foreign locations have become one of the most discussed information policy issues--under the umbrella of transborder data flow policies.

In this paper we discuss and analyze the present state of the Hungarian database industry and public database services, and predict future trends of this industry in Hungary. In the analysis special emphasis was placed on the history of the database industry in the country; the computer hardware and software systems used, the stage of the telecommunication service infrastructure, information policy issues, and potentials for international cooperation in this field. We will show that in Hungary--as in other countries-- this industry has reached extremely high growth figures, and will be an important participant in transborder data flows.

1. PUBLIC DATABASE SERVICES IN HUNGARY

The database industry, as with the computer industry--is relatively young. In 1954 the number of machine readable data files publicly available did not exceed more than some ten worldwide, and databases came into being only as some kind of "sideproduct" of referral journals and different kinds of bibliographies. By about the end of the sixties machine readable data files were found in almost all important disciplines of applied sciences and technologies. The introduction of online database and services at the end of the sixties and in the early seventies, were connected to the hardware and system software development of computer systems and telecommunication data networks. By the early seventies major manufacturers introduced time sharing mainframes to the market, and data networks through dial-up and leased telephone lines gradually became available to users. It was also about that time that new types of databases mainly linked to these services started to emerge namely, numeric databases.

The development of the database services and the database industry in Hungary generally followed the above trend, obviously influenced by some country--specific circumstances and factors, such as special requirements for information by the Hungarian industry and research, long traditions in the library and documentation services, the state of computer and telecommunication infrastructure and the general economic situation of the country.

In the following discussion of the Hungarian database industry we will provide a thorough "cross-section" of it based on official statistical data taken between late 1979 and early 1981. Taking these statistics as a basis, we will first look backwards to trace the development of the Hungarian database industry and then discuss its present situation in order to help predict its future path. As to the statistics, the latest data on the computer service industry originate from the end of 1979 and first half of 1980; the latest data on the database industry are dated end of 1980 and the first quarter of 1981. In such a rapidly evolving field as computer service-- and database--industry, a time difference of one year can bring significant changes and we have tried to take this into consideration when making the analysis. Furthermore, although all data are the latest available, the known fast development of the above fields (databases, computers, telecommunication infrastructure) have since brought about further significant changes, which could obviously not yet be reflected in the statistics. We have tried however to give consideration to this in a descriptive way.

As a last remark, before diving into the analysis of figures and tables, it should be mentioned that a large amount of statistical data offers the temptation of "shovelling" around numbers and figures in order to bring out just the type of results, proofs and lessons that the authors believe correct. We have tried not to fall into the above trap and have made all the present analysis as objective as possible. Nevertheless we recommend the present data not be used a as reference source, but only to be regarded as a tool for better orientation.

1.1 State of The Hungarian Database Service Industry

Table 1 represents a list of all public database services available in Hungary in the first quarter of 1981.

The term "publicly available" means that in principle--if fulfilling certain well defined conditions--all institutions in Hungary can become users of these services. These conditions differ from case to case; some databases can be used without any restriction and one is even free of charge, but for the majority of databases the completion of a standard agreement form is an adequate precondition of access. Finally, there are databases, such as the DERWENT ones, where, according to the agreement between DERWENT and the Hungarian service suppliers, "heavy and expensive" preconditions are to be fulfilled in order to become a user of these database services. But overall, as everywhere in the world these databases are classified as public database services, as opposed for example to those databases that serve only the internal needs of companies.

Table 1 shows that at the beginning of 1981, 25 databases were serviced in Hungary, and Table 2 indicates that there are 13 more that are under preparation for introduction by 1983. The first public database service was established as early as 1970, but the majority of databases were installed during the last three years. The subject category of the databases suggest that there is a strong interest in disciplines such as chemistry, pharmacology, agriculture and in scientific technical information in general. Since the above "statistical snapshot" was taken in early 1981, and especially with the growing use of remote foreign online services (which unfortunately with regards to our statistics were just about to start when the data were collected and therefore only access to the INIS databases in Vienna could be reflected in it) there is a growing interest for numeric databases, and especially for economical and patent information. Also the early interest of the pharmaceutical and chemical industries in databases are not surprising at all. First of all Hungary has long traditions and relative weight in Europe in those industries and these users have already learned how really important it is to be well informed if they want to keep pace with foreign competition. For this purpose their interest for information and documentation goes well back to before the existence of databases and it was relatively easy for their information centers to embrace these new tools of information retrieval in their standard practice. As can be seen from Table 1 most pharmaceutical- and chemistry- related information is processed in Hungary itself yet in an

Table 1. Public database services in Hungary (1980). (Source: [4] Dúzs J. et al. 1981.)

No.	Name of database	Coverage	Number of records (1980) (000s)	Number of new records in 1980 (000s)	Database producer
1.	AGDOC	Agricultural chemistry	100	5	Derwent Publ Limited (UK)
2.	AGRIS	Agriculture, plant growing, forestry, nutrition science, fishery, environmental control, etc.	600 (UN)	130	FAO
3.	AOBIPD	Multidisciplinary patents	4,500	900	COMECON (USSR)
4.	BIBDOSZ	Management science, management training	23	2	Országos Vezetőképző Központ
5.	CA SEARCH	Chemistry	3,500	360	Chemical Abstract Service (USA)
6.	CCDB (Cambridge Crystallographic Data Base)	Crystal structure and molecule geometry of organic & metalorganic compounds	28	2	Crystallographic Data Centre, Univ. Chem. Lab (UK)
7.	CIN	Marketing in the Chemical industry	340	50	Chemical Abstract Service (USA)
8.	^{13}C-NMR	^{13}C-MNR spectascopy data	16	35	MTA KKI (Hungary)
9.	COMPENDEX	Multidisciplinary, technology, science	970	100	Engineering Index, Inc. (USA)
10.	CRDS	organic chemical reactions ˜ processes	38	3	Derwent Public Limited (UK)
11.	FARMDOC	Pharmatology	140	10	Derwent Public Limited (UK)
12.	INIS	Use of atomic energy, atomic energy power station izotopes, nuclear biology, chemistry, nuclear control technology, nuclear medicine, radiation protection, etc.	572	80	International Atomic Energy Agency (UN)
13.	INSPEC	Physics, electronics, communications technology, automation, control technology, system science, informatique, computer technology	1.500	?	Institution of Electrical Engineers (UK)
14.	IRB	Architecture, construction industry	20	6	Frauenhofer Gesellschaft
15.	METADEX	Iron, metal, industry and science	450	38	Americal Soc for Metals (USA)
16.	MIX	Computer technology and science; reports, software, standards, etc.	32	6	SEKI (Hungary)
17.	NAIVR	Agrochemistry, plant protection	4	4	MEM-NAK (Hungary)
18.	PASCAL-GEODE	Geo-sciences	260	40	CNRS (France)
19.	PESTDOC	Insecticides, plant protection	90	8	Derwent Public Limited (UK)
20.	RINGDOC	Phamatology; chemistry and medicalbiology	600	53	Derwent Public Limited
21.	SCI	Multidisciplinary science index	6,600	518	Institute for Scientific Information (USA)
22.	STATINFORM	Sociology, demography, statistics, economy, etc.	20	9	KSH Könyvtár és Dokumentációs Szolgálat (Hungary)
23	SZAMOK-ISIS	Informatiques, computer technology and computer science	46	7	Nemzetközi Számítás-technikai Oktató és Tájékoztató Központ (Hungary)
24.	VETDOC	Veterarian medicine	54	4	Derwent Public Limited (UK)
25.	INFORMATION ON WORLD POLITICS	International politics, economies (news)	18	3	Országgyűlési Könyvtár (Hungary)

Language of database	Introduction of service in Hungary	Type of service SDI	retro-spective	Online service	Computer system	Service provider	Name of database
English	1971	+	+		R-22	Magyar Gyógyszeripari Egyesülés	AGDOC
English	1979	-	+		R-20	MÉM Információs Központja	AGRIS
English	1977	-	+	+	R-55	KG-INFORMATIK	AOBIPD
Hungarian	1976	-	+		ICL-1905/E	MüM-SZAMTI	BIBDOSZ
English	1971	-	-		R-40	Veszprémi Vegyipari Egyetem Központi Könyvtára	CA SEARCH
English	1979	+	+	+	IBM-3031	MTA Központi Kémiai Kutató Intézet	CCDB (Cambridge Crystallographic Data Base)
English	1980	-	+		R-22 R-40	Veszprémi Vegyipari Egyetem Központi Könyvtára	CIN
English	1977	-	+	+	Honeywell-Bull 66/20D	MTA Központi Kémiai Kutató Intézet	^{13}C-NMR
English	1979	-	-		R-20	Országos Müszaki Könyvtár és Dokumentációs Központ	COMPENDEX
English	1977	-	+		R-22	Magyar Gyógyszeripari Egyesülés	CRDS
English	1970	+	+		R-22	Magyar Gyógyszeripari Egyesülés	FARMDOC
English	1978	- -	- +	 -	R-20 +IBM 3033	Országos Müszaki Könyvtár és Dokumentációs Központ	INIS
English	1976	-	-		R-20	Országos Müszaki Könyvtár és Dokumentációs Központ	INSPEC
German	1980	+	+	-	Siemens 7755	Tervezésfejlesztési és Típustervező Intézet	IRB
English	1975	-	-		R-40	Nehézipari Müszaki Egyetem Központi Könyvtára	METADEX
Hungarian	1979	-	-	-	Siemens 7755	Számitástechnikai Koordinációs Intézet	MIX
Hungarian	1979	-	-	-	Siemens 7755	MÉM Növényvédelmi és Agrokémiai Központ	NAIVR
French, English	1979	-	+		R-20	Magyar Állami Földtani Intézet	PASCAL-GEODE
English	1977	-	+		R-22	Magyar Gyógyszeripari Egyesülés	PESTDOC
English	1974	+	+		R-22	Magyar Gyógyszeripari Egyesülés	RINGDOC
English	1980	-	+		IBM-3031	MTA Könyvtára	SCI
Hungarian	1978	-	-	-	IBM 370/188 IBM 370/155	KSH Könyvtár és Dokumentációs Szolgálat	STATINFORM
Hungarian	1977	-	+	+	IBM-370/145	Nemzetközi Számitástechnikai Oktató és Tájékoztató Központ	SZAMOK-ISIS
English	1979	-	+		R-22	Magyar Gyógyszeripari Egyesülés	VETDOC
Hungarian	1974	-	-		R-20	Országgyülési Könyvtár	INFORMATION ON WORLD POLITICS

Table 2 Public database — services under preparation in Hungary (1980)
(Source: [4] Dúzs, J. et al. 1981)

No	Database	Coverage	Number of records (1980 data) (000s)	New records in 1980
1.	AIS-MISON (Automated Information System of International)	Economics, political sciences, sociology, law, history, lingistics, literature critiques, orientalistics, etc.	?	?
2.	CAB	Agricultural economics and policy, entormology, animal breading, agricultural sciences and applied biology	1,200	60
3.	ETK-SZAKI	Architecture, construction, town planning, construction materials	7	7
4.	FRANCIS	Philosophy, history of science and technology, history and science of literature, linguistics, art, acheology, history and science of educations, sociology, ethnology, international bibliography of administrative science, energy, computer sciences, etc.	570	70
5.	IFIS	Nutrition science, food production and industry, technology	200	18
6.	INFORMECON	Economics	90	20
7.	IRL	Virology, microbiology, ecology, etc.	?	100
8.	IRRD (International Road Research Documentation)	Road transportation	100	12
9.	ISDS	International Serials Data Systems (all sciences)	140	25
10.	(VINITI) (International Information System of Published Papers)	All published papers of the world; according to the plans, in 1980; informatics, automation, biology, telecommunication, mining, metallurgy, etc.	700	?
11.	MNB	Hungarian National Bibliography	60	18
12.	IICST-SIISRS (Special Intl. Inf. System of Research Projects in Science)	Research reports, doctoral dissertations, thesis, reviews, computer program packages (coverage; general)	76	39
13.	WAA (World Aluminium Abstracts)	Aluminium industry and all related topics and areas	75	7

* Decision to be taken later

** Coverage for 1981 services

Database producer	Language of database	Planned date of service introduction in Hungary	Type of service SDI	Type of service retro-spective	Online service	Service provider	Database
INION-MISON (USSR)	Russian	1982-1983	-	+	?	MTA Könyvtára	AIS-MISON (Automated Information System of International)
Commonwealth Agricltural Bureau (UK)	English	1981	+	-		MÉM Információs Központja	CAB
ETK (Hungary)	Hungarian	1981	+	+	+	Epitésügyi Tájékoztatási Központ	ETK-SZAKI
Centre de Documentation Sciences Humanies du CNRS (France)	French	•	•	•	?	MTA Könyvtára	FRANCIS
International Food Information Service (FRG)	English	1981-1982	+	-		MÉM Információs Központja	IFIS
Economische Voorlichtingsdienst Ministrie von Economische Zaken (Netherlands)	English, Dutch, German, French	•	+	•		MTA Közgazdaság-tudományi Intézetének Közgazdasági Információs Csoportja	INFORMECON
Information Retrieval Limited (IRL) (UK)	English	1981	+	-	•	MÉM Információs Központja	IRL
OECD (international)	English (French German)	1981	+	+	-	Közuti Közlekedési Tudományos Kutató Intézet	IRRD (International Road Research Documentation)
ISDS (Paris) (International)	42 different languages	1981-1982 1981-1982	-	+		Országos Széchenyi Könyvtár	ISDS
VINITI (USSR)	Russian	1981	+	-	+	Országos Müszaki Könyvtar és Dokumentációs Központ	VINITI (International Information System of Published Papers)
Országos Széchenyi Könyvtár Szki (Hungary)	Hungarian	• Experimental service already	-	-	+	Országos Széchenyi Könyvtar	MNB
International Information Center on Science and Technology (IICST) (COMECON)	Russian	1982	+	+	+	Országos Müszaki Könyvtár és Dokumentációs Központ	IICST-SIISRS (Special Intl. Inf. System of Research Projects in Science)
American Society for Metals (USA)	English	1981	+	-		Nehézipari Müszaki Egyetem Központi Könyvtára	WAA (World Aluminium Abstracts)

offline regime. Thus it is of no surprise that it was this industry that became the earliest interested in online services. It is also not surprising that it was because of the information needs of these industries that some special databases were produced and serviced in Hungary, especially in fields such as the ^{13} C-NMR or the NAIVR databases. It is interesting to note that these database services were already implemented for online regimes well before the use of online series to foreign hosts started in Hungary.

Major databases in the field of chemistry and pharmacology in Hungary are imported in the form of magnetic tapes from the USA (such as Chemical Abstracts) and the UK (such as the DERWENT databases). These databases are basically international in their source coverage and also represent a type of "tı .nsactional record". For example, a new specific chemical structure is developed somewhere in the world, and the producer is rather interested in including his invention in, for example, Chemical Abstracts as soon as possible. A similar case is with patents and patent databases. In this sense these databases are built up to a certain degree as a result of international cooperation, they are de facto accepted by the relevant international industry and scientific communities as a common reference, an information and transaction forum that has best used widely. Up to now in many cases this development has been natural, source and even reference information is submitted from many countries into the central pool, to be collected, and widely distributed again. This philosophy is applied also in some of the major imported databases to Hungary. Through this approach not only convertible financial resources can be saved for the country, but also a type of interdependence between database producers and the Hungarian partners can be developed and maintained, on its one hand, as providers of source information to the database on the other hand as consumer of the "accumulated" product. Often--although this has not been the practice in Hungary yet--the national contribution to the source database becomes the national language version, e.g. the national (Hungarian) equivalent of a Chemical Abstract or DERWENT. The language of these large international databases are, for practical reasons, in the most frequently used languages in the scientific and technical literature. According to estimates 75% of the scientific and technical literature written at present worldwide is in English. This is also reflected in the language of the present major databases and is expected to remain so in the future. It is also remarkable to notice that databases produced in Hungary also follow the above philosophy: the data files that are intended exclusively, domestic use such as the bibliographical database of SZAMOK-ISIS, are in Hungarian, with Hungarian keywords, and Hungarian abstracts. This particular database contains references to literature sources *available in Hungary* in the field of computer science and information technology. It is actually one of the most popular databases in the country; however, because of its very nature it is less suitable for foreign users. Foreign users, if they want to find out the literature available worldwide, say, in the field of videotex, are better served by major English language databases covering this field, such as INSPEC, where they not only find the relevant information, but can also get help to order literature identified immediately from the source of primary information (e.g. journals, books).

At present the Hungarian contributions to major international databases are in two major languages, i.e., English and Russian; sources to CMEA databases such as IICST-SIISRB and AIS-MISON are in Russian, and contribution to UN databases such as INIS and AGRIS in English.

Contribution and distribution of information to the UN and international databases is provided for within the UN system or by some specific international organization (e.g. INPADOC). To give an example of Hungary's cooperation in collection and distribution of databases of international interest, the National Technical Library and Information Center (OMKDK) coordinates all the above activities [18] for INIS. In 1980 the new INIS input worldwide was between 70-80 thousand information items, out of which the Hungarian input was 1.2% of the total. Since 82.5% of all input was provided by only seven countries, it is not surprising that the Hungarian input was the 11th largest among all. In 1980 in Hungary, 200 different journals were watched, and in addition all research reports, conference papers, patents, dissertations, etc. were under observation as well. The number of Hungarian inputs grew from only 25 items in 1970 to 951 in 1980.

Information is collected by the Hungarian INIS center in a predefined and standardized machine readable format, which is sent to the INIS Section of the IAEA to Vienna for compilation of all new information coming from all parts of the world.

The national distribution of the information of the INIS databases is also coordinated through OMKDK, which fulfills the duties of the Hungarian liaison office.

Through this measure no separate marketing and direct user support is needed from the IAEA itself; all these functions are taken care of by the liaison office in Budapest.

There is no reason to assume that similar arrangements cannot be worked out with producers of other databases too, even if it is only on a purely commercial basis.

In many cases, however, collaboration between players of the database industry and market just happens in a spontaneous way. In a time of increasing trade protectionism (both for import and export of goods and also information!), and in a time when more and more governments discover that informatics is becoming a political and strategic issue, the spontaneous, basically commerce-built, cooperations and relations are affected in an increasing way by governmental policy decisions.

1.2 General Growth Figures of the Hungarian Database Industry

The database industry is worldwide one of the most dynamically growing sectors, it stands even the comparison with the rapidly expanding computer industry. In Hungary the number of public databases grew from 14 in 1979 to 25 in 1981 with a growth rate of almost 78% in this two year period. The number of service providers grew from 14 in 1979 to 20 in 1981, a rate of 43% for the same two year period. A list of Hungarian information service providers is given in Table 3. The relatively large number of service providers for a country with only 10 million inhabitants and moderately developed industry might be surprising at first glance. Among the 20 service centers that provide data services, most are major libraries and documentation centers with long traditions in these discip-

Table 3. Hungarian public database service providers and list of their database services (source: [4] Dúzs et al. 1981).

No.	Service provider: Name of the Institute	Service provider: Discipline of the Institute	Database
1.	Építésügyi Tájékoztatási Központ	Information center construction industry	ÉTK-SZAKI
2.	KG Informatik	Information center, metallurgy, machine industry	AOBIPD
3.	Központi Statisztikai Hivatal Könyvtár és Dokumentációs Szolgálat	Library and documentation service, Central Statistical Office	STATINFORM
4.	Közúti Közlekedési Tudományos Kutató Intézet	Research Institute, road transportation	IRRD
5.	Magyar Állami Földtani Intézet	Geology Institute	PASCAL-GEODE
6.	Magyar Gyógyszeripari Egyesülés	Hungarian Pharma-industry Association	AGDOC CRDS FARMDOC PESTDOC RINGDOC VETDOC
7.	Magyar Tudományos Akadémia Könyvtára	Library of the Hungarian Academy of Sciences	AIS-MISON SCI FRANCIS
8.	Magyar Tudományos Akadémia Közgazdasági Információs Szolgálata	Information Center on Economy, Hungarian Academy of Sciences	INFORMECON
9.	Magyar Tudományos Akadémia Központi Kémia Kutató Intézet	Central Chemical Research Institute, Hungarian Academy of Sciences	CCDB ^{13}C-NMR
10.	Mezögazdasági és Élelmezésügyi Minisztérium Információs Központja	Information Center, Ministry for Agriculture and Food	AGRIS SAB IFIS IRL
11.	Mezögazdasági és Élelmezésügyi Minisztérium Növényvédelmi es Agrokémiai Központ	Plant protection and Agrochemical Center, Ministry for Agriculture and Food	NAIVR
12.	Nehézipari Müszaki Egyetem Központi Könyvtára	Central Library, University for Heavy Industry, Miskolc	METADEX WAA
13.	Nemzetközi Számitástechnikai Oktató és Tájékoztató Központ	International Education and Information Center on Computing	SZAMOK-ISIS
14.	Országgyülési Könyvtar	Library of the Parliament	INFORMATION ON WORLD POLITICS
15.	Országos Müszaki Könyvtár es Dokumentácios Központ	National Technical Library and Documentation Center	COMPENDEX INIS INSPEC MISOD IICST-SIISRS
16.	Országos Széchenyi Könyvtár	National Library	ISDS MNB
17.	Országos Vezetöképzö Központ	National Management Training Center	BIBDOSZ
18.	Szamitástechnikai Koordinációs Intézet	Institute for Coordination of Computer Techniques	MIX
19.	Tervezésfejlesztési és Tipustervezö Intézet	Planning Bureau, Construction & Building	IRB
20.	Veszprémi Vegyipari Egyetem Központi Könyvtára	Central Library of the Chemical University of Veszprém	CA SEARCH CIN

lines. Some of them are relatively recently created specialized information centers, research institutes, educational centers, and industry associations. According to Table 3 most of the centers are only operating a few databases, the maximum number bring six. The reason for this is twofold. First of all the service centers in Hungary are rather specialized in their disciplines, which has obvious advantages and disadvantages. One advantage is that by concentrating on one or two disciplines they can satisfy special user requirements and, in addition, in many cases they are also the source of the primary document identified. SZÁMOK - the International Education and Information Center on Computing-- runs a moderately large bibliographic database containing references of its own extensive library. The often heard disadvantage of distributed service provider centers is the unnecessary multiplication of resources such as hardware, software and man-power. Nonetheless, in a Hungarian type of environment the distributed type of information and database centers seem to be better suited.

Only a few illustrative figures concerning the growth rates of database users will be given here.

Table 4 shows the number of users served for selected databases. In general--taking into account that Hungary is a small country--the number of customers for some of the databases is remarkably high. Very specialized databases, such as CCDB, ^{13}C-NMR or PASCAL-GEODE have only a few customers. The DERWENT databases are only used--due to their special arrangement with the database supplier--by a few companies of the pharmaceutical industry, but the usage of the classical bibliographic databases such as INIS, or INSPEC, etc., are not at all low. If one takes into

Table 4. Selected public databases serviced in Hungary (1980 data) according to their customer institutions served (Source:[4])

Name of database	Country of origin	Number of customer institutions served			Number of records (1980 data)	Cost of service in Hungary		Information retrieval software package used
		SDI	Retrospective	Total		SDI	Retrospective	
AGDOC	UK	6	7	7	100,000	AU[3]	AU	DERWENT -ROBINS
AGRIS	UN(FAO)	14	?	14	600,000	6000 Ft/yr	AU	BINAR
AOBIPD	USSR (COMECON)	5	5	5	4,500,000	AU	AU	PA(own)
CA SEARCH	USA	99	-	99	3,500,000	10000 Ft/yr + AU	-	BINAR
CCDB	UK	3	3	3	28,000	AU	AU	CCDB
CIN	USA	7	7	7	340,000	9000 Ft/yr + AU	9000 Ft/yr + AU	(own development)
^{13}C-NMP	HUNGARY	1	8	8	16,000	AU	AU	CMRSYS
COMPENDEX	USA	29	-	29	970,000	6000 Ft/yr +AU[1]	-	BINAR
CRDS	UK	6	7	7	38,000	AU	AU	DERWENT-ROBINS
FARMDOC	UK	6	7	7	140,000	AU	AU	DERWENT-ROBINS
INIS	UN (IAEA)	20	16[2]	34	572,000	6000 Ft/yr +AU[1]	AU	BINAR
INSPEC	UK	49	experimental	49	1,500,000	6000 Ft/yr + AU[1]	AU	BINAR
IRB	FRG	17	17	17	20,000	AU	AU	GOLEM
METADEX	UK	18	-	18	450,000	8000 Ft/yr	-	BINAR
PASCAL-GEODE	FRANCE	4	4	4	260,000	free	free	BINAR
PESTDOC	UK	6	7	7	90,000	AU	AU	DERWENT-ROBIS
RINGDOC	UK	6	7	7	600,000	AU	AU	DERWENT-ROBIS
STATINFORM	HUNGARY	17	2	19	20,150	3000 Ft/yr-5000 Ft/yr	5000 Ft/yr	TEX-PAC
SZAMOK-ISIS	HUNGARY	221	221	221	46,000	3000 Ft/yr-4000 Ft/yr	4000 Ft/yr-5000 Ft/yr	ISIS
VETDOC	UK	6	7	7	54,000	AU	AU	DERWENT-ROBINS
INFORMATION ON WORLD POLITICS	HUNGARY	250	30	250	18,000	7200 Ft/yr	AU	(own development)

1) over 1000 items/yr according to usage

2) online to the IAEA computer in Vienna

3) AU = according to usage

account that these statistics were assembled at a time when these databases were serviced in an offline regime, which has since changed, then the extent of the meaning of these figures is even better. The most "popular" foreign database is at present--as one could have expected--Chemical Abstracts with about hundred customer institutions. However, surprisingly (or perhaps not), of the two most widely used databases within the customer community are Hungarian: one being the bibliographical online database of SZÁMOK and the other a database on INFORMATION OF WORLD POLICY MATTERS--produced by the Library of the Parliament. Both databases had, at the time of sampling, more than 200 customers each.

The "customer growth" rates for the two years between 1979 and 1981 are shown in Table 5 for some selected databases.

Table 5. Growth rates of customer institutions (between 1979 and 1981) for some selected databases serviced in Hungary [4]

Name of the database	No. of customer institutions in 1979	No. of customer institutions in 1981	Growth rates for two years [%]
CA SEARCH	98	99	1
INIS	11	34	209
INSPEC	56	49	-14
METADEX	17	18	6
SZAMOK-ISIS	145	221	52
INFORMATION ON WORLD POLITICS	150	250	67

From these few figures the following can be deduced: as mentioned above at the time of sampling CA SEARCH, INSPEC and METADEX were retrieved in offline mode and only in SDI regime. All services started at the beginning and middle of the seventies, thus when the statistics were taken they were already well established and saturated. Online service to foreign database hosts was only introduced around the 1980 sampling, it is not yet known how many new customers were attracted by this type of service, how many old customers switched over from offline SDI to online, or how many took SDI online as a new form of service in addition to offline. INIS is actually the only database in the sample that became online during the sampling period 1979-1981. In the case of INIS this resulted in of 14 new customer organizations joining this service, and some old customer organizations also took the opportunity of getting online services. The customer growth figures of the most "popular" databases SZAMOK-ISIS and the one on World Politics also had very high rates.

1.3 Cost of Database Usage

There is no single pricing policy for database usage in Hungary--as anywhere else in the world. As an orientation for pricing policy and cost level, data were also collected in [4]. These data, however, should be used as general information; for the current prices it is best to contact the contact points and persons that are also listed in [4].

In general one may say that the pricing practices in Hungarian services are very similar to those of other countries.

The majority of services sampled in [4] were offline services, and in particular SDI. For the majority of such services, as shown in Table 4, a yearly subscription fee has to be paid, which is, for example, in the case of CA SEARCH, 10000 Ft/year (approximately AS 5000/year) or for INSPEC, INIS, METADEX, etc. 6000 Ft/year per profile. In addition to these costs customers have to pay for each found and printed item, which in the case of CA SEARCH is 28 Ft/item, and in the case of INSPEC, INIS, METADEX, etc. 10 Ft/item, however the first 1000 items/profile are always free of charge for this second group.

It has to be mentioned that although the database service organizations pay their subscription fees for foreign, non CMEA databases, in convertible currencies, such as US$, Hungarian users pay in Hungarian currency.

Hungarian databases are usually cheaper. SZÁMOK requires for its ISIS database between 3000 and 4000 Ft/year from its customers, the Library of the Parliament 7200 Ft/year. No separate charges for selected and printed items are requested.

A large number of database services are charged according to the measured resources used, especially in computer time.

Charges for online foreign services are not included in [4], since they basically became operational after the sampling point in early 1981. In principle one can say, however, that they follow the pricing practices used in North America and Western Europe quite closely. Users have to pay to foreign online database service centers in convertible currencies. As is well known, a part of that payment is in the form of royalties to the producer of the particular database used and the rest is kept by the data center operator as revenue for providing his services. In addition, users have to pay for the used telecommunication resources as well. If the connection was made through the public switched telephone network, the Hungarian PTT collects the revenue for the long distance call, if the Hungarian data network NEDIX is used for connection, again the Hungarian PTT collects all revenues, even for the foreign part of the data communication channel. A similar case is when a user decides to establish a leased line connection to a foreign data center. All these expenses are collected by the PTT in Hungarian currencies.

Thus, from the financial point of view, when establishing access to foreign database hosts the only "critical" part in the chain of administrative matters in Hungary is the agreement between host and customer. Since it is a foreign trade agreement, with obligations in foreign currencies, it necessitates special administrative, and contractual steps, even for the most simplest form of agreement, such as the establishment of a no-cost, open ended account number and user name on a foreign database computer.

For this, and obvious other known reasons for having so-called, intermediary services, a few companies in Hungary have already taken up the task of serving the database community with "information broker" services. These organizations help users to identify which database is best suited to their purposes and which data hosts to work with. They will also introduce users to online services in general, provide consultancy on the databases and the systems, or provide terminal equipment to the users. In addition to these services they can take over the burden of all--sometimes complicated and time-consuming-- administrative procedures, which they can cut down considerably. There are also intermediaries who require payment in local currency which is most convenient for users short of convertible currency. One advantage of these intermediaries is that they are better able to establish more favorable deals and conditions with the suppliers of database services, such as lower rates for the bulk use of data, or take over marketing, educational activities, etc., for them in Hungary. The variety of collaboration between foreign database supplier and Hungarian intermediaries can actually be very diverse and broad.

Nonetheless, foreign online services in Hungary are not the cheapest. In some applications, however, e.g. when specific information is promptly required, or information with high update frequency is sought foreign online services are essential.

One of the major uses of online services to foreign database service centers is when access to a database has to be made, that is not serviced in Hungary. There are in total some 1000 public databases around the world, some of which are of international interest and importance, but the majority of which serve only local needs. This is the case with the majority of the Hungarian databases. Among databases of international interest a certain number of them are of primary interest for a given country. There is a certain point in the "cost" and "benefit" analysis for each database where it is better to buy and install the database within the country rather than to access it on foreign database hosts. There are, for example, simple economic factors that decide when it is better to become a subscriber to a database, loading the magnetic tape of the database onto a data center in the country to serve domestic users as opposed to subscribing to foreign database services and paying for these services and the long distance data communication charges. There are also many databases however that need to be accessed only now and then or are expensive, very special services, let us say, requiring heavy hardware and software installments not residing in the county. To put these data files onto national systems is hardly justified. In some countries nowadays there is, after economical and technical applications, a trend to take political considerations into account as well. There are countries that prefer to install foreign databases of interest to their own data center rather than allow domestic users to access data centers abroad. The main argumentation is that dependence on foreign data services increases the vulnerability of the serviced country and is, in addition, negative for the balance of payments and for the domestic labor market.

In Hungary major considerations along these lines fall only into the category of technical and economical applications. Since both the purchase of a particular database, or the signing of a standard form agreement for online services, fall into the category of foreign trade, where governmental authorities are involved to grant import licenses, the implementation of a governmental information policy is also provided for through this channel. "Transactional" databases--such as patents, commodity and stock exchange market, and news agencies' databases--obviously should not be included in this category. They are by their nature often better accessed through a worldwide network.

1.4 Origin of Databases Serviced Publicly in Hungary

Tables 1, 2, and 6 show the origin of databases publicly serviced in Hungary together with their regional distribution. The first database publicly serviced--introduced in 1970--was the FARMDOC (DERWENT) database from the UK. The first public service of a Hungarian database (INFORMA-

TION on WORLD POLITICS) started four years later, in 1974. By 1979--when the first major sampling of the Hungarian databases was taken there were 14 databases serviced. According to the number of databases the majority originated in Western Europe, followed by Hungarian databases. The CMEA, the International Organizations and the USA being represented by one database each.

At the time of the second sample in early 1981, the share of West European databases was still the largest, followed by the increasing number of domestic databases (Table 6). The share of the US databases and of the international organizations has increased too. By 1983 it is expected that the weight of CMEA databases will also have increased.

In the long run it can be anticipated that first of all the share of the domestic and CMEA databases will grow. It can still be presumed that the share of West European databases will remain high. Many of these databases are international in their nature and importance and it can be expected that with some of the database procedures cooperative efforts in collecting input materials will be strengthened.

As to the size of databases, the general trend can be observed that the purely Hungarian databases are small to medium in size; some other specialized foreign databases are also proportionally small. Databases of international organizations such INIS or AGRIS--which came into being as a result of international cooperation--are between medium and large. The same is true for the bibliographical databases, such as COMPENDEX, METADEX, INSPEC, DERWENT and others. In this category of databases of international interest, arrangements are known in which national input is provided locally. The largest "mammoth" type of databases are foreign

Table 6. Databases publicly serviced in Hungary according to their origin (Source: [4] Duzs et al. 1981).

	DOMESTIC	CMEA	Inter-national	West-European	North-American
0/ Database services operation (1st half of 1979)	BIBDOSZ SZAMOK-ISIS INFORMATION ON WORLD POLITICS	AOBIPD	INIS	AGDOC CRDS RINGDOC PESTDOC VETDOC FARMDOC INSPEC METADEX	CA SEARCH
ad 0/Total: 14 (100%)	3 (22%)	1 (7%)	1 (7%)	8 (57%)	1 (7%)
1/ Database services in operation (1980 end)	BIBDOSZ ^{13}C-NMR MIX NA[illegible] STATINFORM SZAMOK-ISIS INFORMATION ON WORLD POLITICS	AOBIPD	AGRIS INIS	AGDOC CCDB CRDS FARMDOC INSPEC IRB METADEX PASCAL-GEODE PESTDOC RINGDOC VETDOC	CA SEARCH CIN COMPENDEX SCI
ad 1/Total: 25 (100%)	7 (28%)	1 (4%)	2 (8%)	11 (44%)	4 (16%)
2/ Database services under preparation (1980 end)	ETK-SZAKI MNB	AIS-MISON MISOD IICST-SIISRS	ISDS	CAB FRANCIS IFIS INFORMECON IRL IRRD	WAA
ad 2/Total: 13 (100%)	2 (15%)	3 (23%)	1 (8%)	6 (46%)	1 (8%)
Grand total: 38[1+2](100%)	9 (24%)	4 (10%)	3 (8%)	17 (45%)	5 (13%)

ones, and probably they will be that way for a long time. Two of them are North-American and one Eastern-European. All databases are, to a certain extent, of a "transactional" nature: SCI Science Citation Index--contains who cited whom, where and when; AOBIPD (on multidisciplinary patents) contains who patented what, when and where; Chemical Abstracts, to a certain extent, also belongs to this category. It would be an illusion to think that databases of this sort and kind should be generated solely by small countries such as Hungary.

1.5. Computer Hardware and Systems Software Used

Table 1 shows that when the "snapshot" of statistics was taken the majority of the database service centers used computer systems belonging to the Ryad series--computer systems produced in CMEA countries. Out of the computer systems employed, 16 belong to the category of the so-called Ryad I series, one already to the category of Ryad II. The rest of the computer systems applied originated from Western Europe and North America: the 5 IBM mainframes used are similar in their hardware and software architecture to the Ryad series; in addition, one Siemens, one ICL, and one Honeywell/Bull system were servicing databases.

The actual services that were provided at the time of sampling (end of 1980) were in close relation to the characteristics and performance categories of the computer mainframes used. The majority of the services--as we pointed out earlier--were SDI (each database had an SDI service), retrospective services being provided for 80% of the databases; the remaining 20% included just the largest ones, such as CA SEARCH, COMPENDEX, INSPEC and METADEX and had only SDI services. For INIS this type of service was not so critical, since online access from Hungary to the IBM 3033 data center of the International Atomic Energy Agency (IAEA) was already usual practice at the time of sampling. This service actually eliminated any need for a similar service on a Hungarian host. Online services--although growing in their numbers--were outweighted at the end of 1980 by offline services. In 1980 only 36% of the publicly serviced databases had an online service option. Looking at the computer systems applied it can be seen that all online services were provided on time sharing systems. Time sharing, however, could be provided only on major West European and North American systems and on the computers of the emerging Ryad II computer series. In 1980, however, the delivery of Ryad II had just started, and this is fairly reflected in the statistics of Table 1. Thus, the majority of database services were provided on computers working with batch oriented operation systems, such as the R-20 and R-22 computers, which were not only the most commonly used systems for database services, but also for other computer applications in general during the second half of the seventies.

The R-20 and R-22 computers (produced in the USSR and Bulgaria) have, in this respect, other unfavorable characteristics that do not allow them to become ideal database service computers. This first of all lies in their relatively low online disc storage and main memory capacity. All in all they are too small to be ideal for database services. The R-20 has a maximum core capacity of 250 KBytes (the R-22 of 500 KBytes), allowing on each their two selector channels the linkage of one disc- and one tape controller. The most suitable disc controller (ES-5561) allows the connection of maximum 8 (ES-5061) disc drives, each of 29 MByte capacity (in total 232 MByte).

The R-40 produced in the German Democratic Republic is larger and thus more suitable for database services. Its main memory is built in 256 KByte modules, with a maximum capacity of 1 MB. It offers a one byte-MUX channel for low speed peripherals such as discs. These channels can support up to 8 100 MByte disc drives (ES-5066)--produced by the USSR.

For the theoretically available maximum of 5 selector channels, if one selector is kept reserved for tape devices, 4 GByte secondary storage (disc) could be attached to the system--using 5 ES-5566 disc controllers with each 8 ES-5066 drives.

The 100 MByte discs, however, have only been in production since the end of the seventies--actually they already belong to the category of the Ryad II series--which had not yet reached its full market penetration when the database sample was taken in Hungary at the end of 1980, early 1981. Thus the R-40s in use for database services had much less disc capacity, using mainly 29 MByte disc drives.

As to the question why in 1980-1981 offline database services had such weight in Hungary, and why R-20 and R-22 computers were used for database services if they were only of limited use, one has to look at the development of the Hungarian computer population as a whole. Tables 7-9 show the development of the Hungarian computer population [3] without mini- and microcomputer systems. Table 7 shows that in 1979 only 4.3 percent of the computer population was, with regard to the size of the computer (medium-large, large), really suitable for providing database services of this kind. On the medium-size computers--which

Table 7. Time series of computer installations in Hungary according to their performance categories* (end of the year data). (Source: [3] 1981, Számitástechnikai Statisztikai Évkönyv 1980).

Computer performance category	1960	1965	1970	1975	1976	1977	1978	1979
				(pieces)				
Small computers	5	16	42	219	272	322	372	419
Small-medium	-	5	48	32	32	30	30	28
Medium	-	-	29	118	133	150	163	171
Medium-large	-	-	1	12	16	17	21	26
Large mainframes	-	-	-	1	1	2	2	2
Total	5	21	120	382	454	521	588	646
Index: year 1970=100.0	4.2	17.5	100.0	318.3	378.3	434.2	490.0	538.3
				(%)				
Small computers	100.0	76.2	35.0	57.3	59.9	61.8	63.3	64.9
Small-medium	-	23.8	40.0	8.4	7.1	5.7	5.1	4.3
Medium	-	-	24.2	30.9	29.3	28.8	27.7	26.5
Medium-large	-	-	0.8	3.1	3.5	3.3	3.6	4.0
Large mainframes	-	-	-	0.3	0.2	0.4	0.3	0.3
Total:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
				Value in Forints				
Value of all computer installations (Billion Ft)	..	.	2.1	7.5	9.4	11.4	12.6	13.8
Value of an average computer installation (Million Ft)	..	.	17.3	19.6	20.8	21.8	21.4	21.4

* without mini- and microcomputer systems

Table 8. Number of computers in Hungary (data end of 1979) according to the origin of computers and their performance categories. (Source: [3] 1981, Számitástechnikai Statisztikai Évkönyv 1980).

Computer performance category	Total:	Out of them originated in		
		Hungary	Other socialist countries	the rest of the world
	(pieces)			
Small computers	419	255	26	138
Small/medium	28	8	10	10
Medium	171	4	113	54
Medium/large	26	-	17	9
Large mainfames	2	-	-	2
Total:	646	267	166	213
	(%)			
Small computers	100.0	60.9	6.2	32.9
Small/medium	100.0	28.6	35.7	35.7
Medium	100.0	2.3	66.1	31.6
Medium/large	100.0	-	65.4	34.6
Large mainframes	100.0	-	-	100.0
Total:	100.0	41.3	25.7	33.0

comprise 26.5% of the whole computer population--database services could basically provide an SDI regime, also because of the software used. The remaining, approximately 70%, of the computer population is practically of no use for providing public database services. Table 9 shows that in 1979 the majority of the medium and large mainframes were Ryad I machines (actually R-20, R-22 and R-40s), which is accordingly expressed in Table 1. The average number of peripherals belonging to these com-

Table 9. Number of computers in Hungary (data end of 1979) according to their performance category and compatibility with the Ryad series. (Source: [3] 1981, Számitástechnikai Statisztikai Évkönyv 1980).

Computer performance category	Total:	Out of this Ryad (ES)	Ryad compatible	incompatible with Ryad
	(pieces)			
Small computers	419	82	4	333
Small/medium	28	-	-	28
Medium	171	100	27	44
Medium/large	26	19	5	2
Large mainfames	2	-	1	1
Total:	646	201	37	408
	(%)			
Small computers	100.0	19.6	1.0	79.4
Small/medium	100.0	-	-	100.0
Medium	100.0	58.5	15.8	25.7
Medium/large	100.0	73.1	19.2	7.7
Large mainframes	100.0	-	50.0	50.0
Total:	100.0	31.1	5.7	63.2

puter installations in Hungary is shown in Table 10, which proves that the average computer installation in Hungary around that time was basically a batch oriented system (the average number of terminals being extremely low!), with a moderate number of disc drives per installation. By looking at these figures one can almost guess the type of public database services they can offer. Table 11 underlines what is said above that out of the 25 registered information retrieval system installations of Hungary [3] most were running under Ryad or IBM batch systems.

Table 10. Average number of peripherals belonging to computer intstallation in Hungary (data: end of 1979). (Source: [3] 1981, Számitástechnikai Évkönyv 1980).

(pieces)

Device	Total	Small	Small/ medium	Medium	Medium/ large	Large
		mainframes				
Number of mainframes	646	419	28	171	26	2
Visual display unit	1.0	1.4	0.0	0.3	1.6	1.5
Lineprinter	1.1	0.9	0.9	1.7	2.2	3.0
Console	0.9	0.7	0.9	1.1	1.5	1.5
Papertape reader	0.8	0.8	1.4	0.9	1.0	-
Papertape puncher	0.6	0.7	0.8	0.5	0.5	-
Card reader	0.6	0.3	0.5	1.4	1.8	1.0
Card puncher	0.1	0.0	0.0	0.3	0.3	-
Card reader/puncher	0.1	0.0	0.2	0.1	-	-
Magnetic tape drive	2.2	0.9	1.1	4.7	6.8	7.0
Magnetic casette device	0.2	0.3	0.3	0.0	-	-
Magnetic disc drive	2.9	1.1	1.4	6.5	8.8	11.5
Disc/tape controller	0.3	0.0	-	0.9	1.7	-
Other peripherals	1.8	2.2	1.5	1.0	1.3	2.0
Total	12.7	9.3	9.0	19.3	27.5	27.5

The hardware and system software situation is, however, just about to change. With the introduction of the Ryad II series, which started around the end of the seventies, a new computer generation is gradually taking over the place of the old database service computer generation, the one which is shown in the above statistics.

Table 11. "Registered" computer application program packages according to application categories and type of computers (in 1979). (Source: [8] OSAK*, Számitástechnikai Statisztikai Évkönyv 1980)

Application packages	ES-IBM		R-10	Other CMEA systems	Other non-CMEA systems	Total:
	DOS	OS				
"Classical" data processing	198	3	4	5	177	387
Production control	80	2	8	1	53	144
Financial	61	2	15	1	46	125
Statistical	25	4	7	-	17	53
Operation research	19	2	3	2	4	30
Mathematical	30	5	8	3	16	62
Numerical control	-	1	-	-	-	1
Process control	2	-	1	-	-	3
Database management systems	22	-	2	-	8	32
Information retrieval systems	16	1	2	-	6	25
Scientific-technological	95	24	18	161	89	387
System programs, util..ies	11	2	2	-	5	20
Software development tools	21	10	8	-	5	44
Others	61	4	5	2	26	98
Total:	641	60	83	175	452	1411

* Országos Software Archivum és Követőszolgálat (National Software Archive and Register Service)

Already in 1979 two R-35s were delivered and installed in Hungary [3] and according to Table 1, one R-55 is taking over the servicing of the "mammoth" AOBIPD database. The Hungarian National Technical Library and Documentation Center (OMKDK), which services five major database services, put a new R-35 configuration into service, in 1981, which gradually took over the task of an old, less powerful R-20 [5]. The Ryad II series model R-35 with a configuration of 1 MByte CPU capacity, 640 MByte disc capacity and 16 terminals for remote working, delivered at the end of 1980 has already allowed for the upgrading (Figure 1) of OMKDKs domestic services considerably.

First OMKDK plan to provide offline services and then introduce online services. They foresee keeping the R-20 with the present DOS based batch services until 1984.

OMKDK is planning to use database handling systems available in Hungary and not to develop any systems themselves. They believe that the two most suitable packages for their purposes are DIALOG-KAMA from the Soviet Union and CDS/ISIS from the United Nations (ILO, UNESCO).

In general, the medium and larger models of the new Ryad II series are better suited to providing public database services (Table 12, compiled by CDC [6, 7] on the basis of information and sales brochures and personal discussions). A particularly interesting new version of the R-55 was presented along these lines by the GDR manufacturers Robotron at the Leipzig Fair in March 1982 [8]. A double processor EC-1055/EC-1055M configuration (Figure 2) linked together with direct channels KKA-ES 4065 is sufficiently large enough to host major database services. The double processor capability is particularly suitable for secure online database services.

As pointed out earlier, the availability of sufficiently large secondary storage capacity on magnetic discs or similar devices are of utmost importance for providing online database services. For a long period the

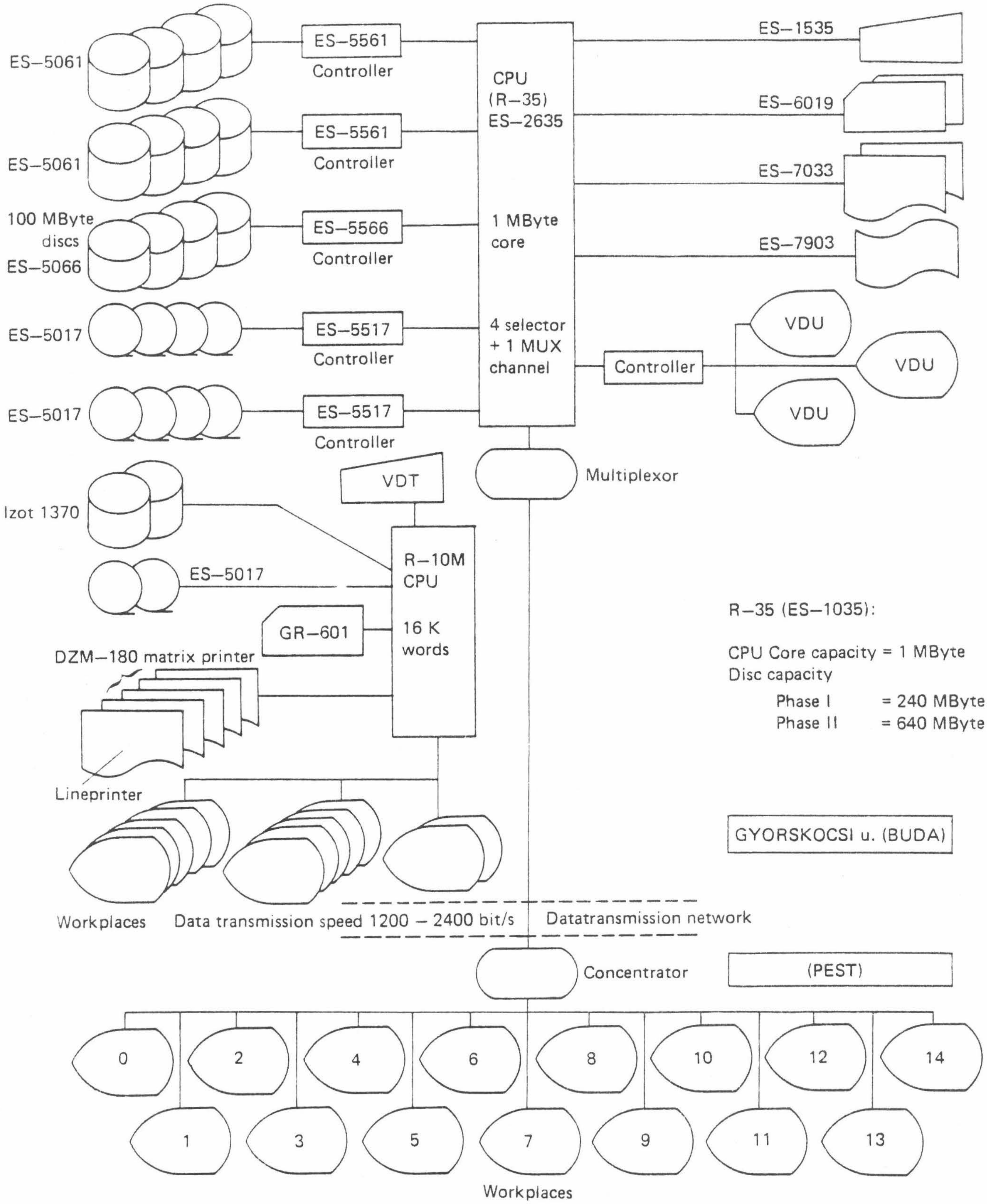


Figure 1. Example of a Hungarian data center configuration (OMKDK) based on an R-35 computer, supported by an R-10M processing system [5].

Table 12a. RYAD I Central Processor Profile. [6]

	Model						
Background	ES-1020	ES-1022	ES-1030	ES-1032	ES-1033	ES-1040	ES-1050
Country of origin	Bulgaria USSR	Bulgaria USSR	Poland USSR	Poland	USSR	GDR	USSR
Prototype date	1971	-	1972	1974	-	1972	1973
First delivery	1972	1977(?)	1973	1975	-	1973	–
Annual production rate	?	?	?	25	?	50	?
Installations	?	?	?	100	?	300	?
Characteristics							
Processor speeds*							
Fixed point (32 bit)							
Add/subtract	33.4	6.5	13.3	2.6	2.0	1.9	1.9
Multiply	349.0	57.6	14.1	9.3	11.0	7.6	2.2
Divide	398.0	65.0	112.0	17.7	15.2	11.4	8.5
Floating point (32 bit)							
Add/subtract	70.8	15.5	16.3	5.0	5.0	3.7	1.9
Multiply	413.0	36.3	37.5	13.2	9.0	6.4	2.4
Divide	399.0	52.4	58.7	14.5	13.2	8.4	5.9
Floating point (64 bit)							
Add/subtract	94.3	17.8	25.9	6.3	5.9	4.2	1.8
Multiply	1200.0	54.7	140.0	28.7	19.0	6.4	2.4
Divide	2150.0	128.0	218.0	48.2	29.3	16.1	10.8
Cache memory*	No	No	No	No	No	No	No
Average speed (MIPS)	0.025	0.080	0.10	0.29	0.20	0.38	0.5
Processing data rate	0.83	5.45	3.30	14.4	18.4	21.3	25.7
Main memory*							
Type	CORE	CORE	CORE	CORE	CORE	CORE	CORE
Max capacity	250	500	500	1,000	500	1,000	1,000
Cycle time	2.0	2.0	1.25	1.3	1.25	1.35	1.25
Access width (bytes)	1	4	4	4	4	8	8
Channels*							
Selector							
Number	2	2	3	3	3	6	6
Maximum rate /ch.	300.0	500.0	800.0	1030.0	800.0	1300.0	1250.0
Multiplexor							
Number	1	1	1	1	1	1	1
Burst rate	140.0	300.0	300.0	240.0	350.0	720.0	180.0

* Times are given in microseconds capacities in kilobytes (KB) and transfer rates in megabits/second instruction times assume data in memory.

Table 12b. RYAD II Profile.

	Model						
	ES-1025	ES-1035	ES-1045	ES-1055		ES-1060	ES-1065
Background				With Cache	Without Cache		
Country of origin	CSSR	Bulgaria USSR	Poland USSR	GDR		USSR	USSR
Prototype date	1979		1979	1978			
First delivery		1976		1979			
Installations				15		20	
Characteristics							
Processor speeds*							
Fixed point							
Add/subtract	5-13	4.5	0.7-0.85	0.3-0.6	0.6-2.7	0.25-0.3	0.12
Multiply	95-220	23	2.8-3.4	3.1	3.4-5.2	1.5-1.8	0.60
Divide	145-250	38	9.4-12.0	5.7	5.8-7.8	4.0-5.0	1.80
Floating point (32 bit)							
Add/subtract	50-55	9.7	1.9-2.3	1.3-3.6	1.6-3.6	0.8-1.0	0.24
Multiply	95-220	19.8	2.8-3.4	2.6	2.7-2.8	2.3-2.8	0.3
Divide	145-250	32.1	8.4-11	3.9	4.1-6	3.0-4.0	1.2
Floating point (64 bit)							
Add/subtract	65-70	15	2.6-3.2	2.2	2.2-4.2	0.8-1.0	
Multiply	125-600	91.4	8.6-11.0	7.0	7.2-9.1	3.6-4.5	
Divide	620-640	180	21.6-25	14	14.2-16.1		5.3-6.5
Cache memory*	No	No	Yes	Yes	No	Yes	Yes
Max capacity			8	8		16	
Cycle time				0.125		0.060	
Average speed (MIPS)	0.3-0.4	1-1.4	4-5	7.5-9	.45-.6	1.3-1.6	4.5
Processing data rate	1.70	8.43	43.8	61.2	28.2	96.7	350.3
Main memory*							
Type		CORE	CORE	IC	IC	CORE	IC
Max capacity	250	1,000	3,000	2,000	2,000	8,000	16,000
Cycle time	0.625			0.750	0.750		
Access width (bytes)	2	4		8	8	8	
Channels*							
Maximum number	2	5	6	6	6	7	
Total I/O capacity*		9.6	40.0	48.0	48.0	72.0	90.0

* Times are given in microseconds capacities in kilobytes (KB) and transfer rates in megabits/second instruction times assume data in memory.

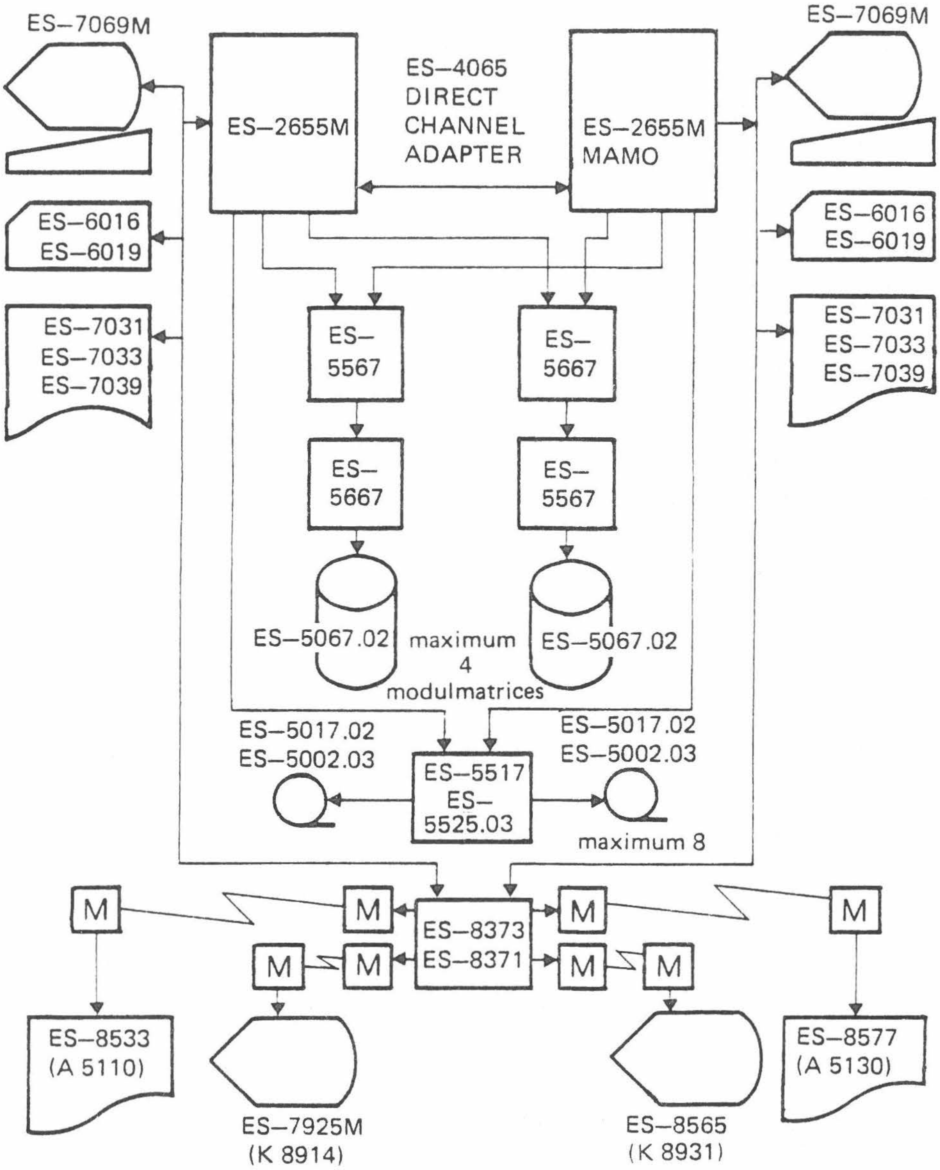


Figure 2. Double-processor EC-1055/EC-1055 M configuration [8]

disc storage capacity of Ryad disc drives actually presented a bottleneck for providing larger online database services.

Early Ryad models equipped with ES-5052 and ES-5056 disc drives with a storage capacity of only 7.25 MByte per unit were not really suitable for such types of applications. Nonetheless these were the only ones that could be delivered to the models R-20 and R-40 until the second half of the seventies when the Bulgarian made ES-5061 unit with 29 MByte storage capacity appeared on the market. Actually, when the sampling of Hungarian databases was taken in early 1981 these three types of disc units were the ones tend to be most commonly used in Hungarian Ryad installations. Since all Ryad disc controllers can accommodate up to 8 disc drives, an early model of an R-20 maximally 58 MByte disc storage could be . nked to--let us say-- a ES-5551 or ES-5552 controller. However, this is not really enough for online services. An ES-5566 disc controller, on the other hand, could accommodate 232 MByte secondary storage capacity, which easily allows the operation of medium size databases online. Since up to 5 such controllers can be linked (reserving the 6th channels for tapes), let us say an R-40 to as a maximum 1,160 MByte disc storage capacity could be accumulated, which is sufficient for online database services.

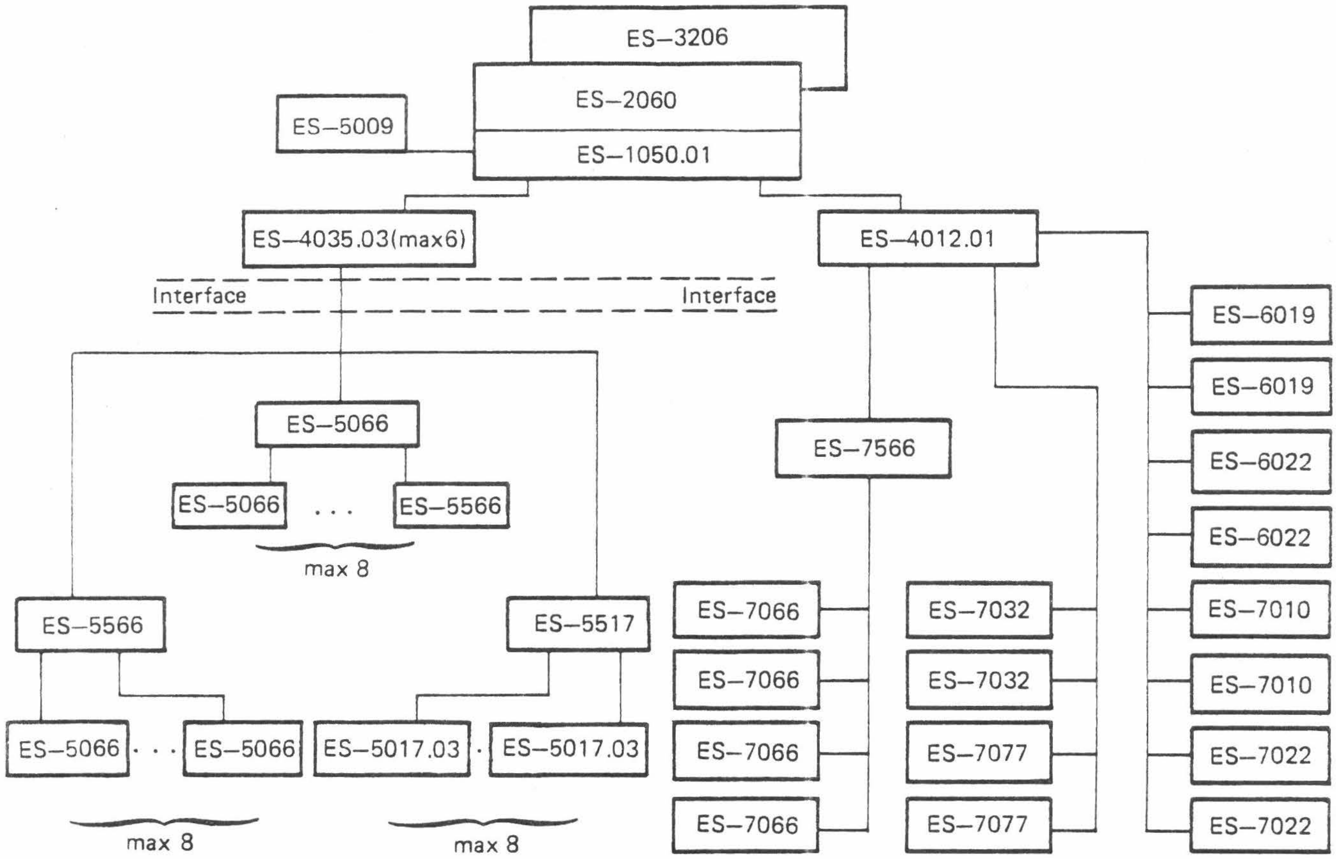
Obviously, with the new 100 MByte Ryad disc drives that became available around the end of the seventies, all secondary storage problems for database services can in principle be solved. Up to 96 ES-5060 disc drives with 9.28 GByte capacity could be connected to an R-60 in its maximum configuration (Figure 3). This capacity is more than enough for providing online data services. The ES-5566 disc controller and the ES-

5066 disc unit models are nowadays standard elements of Ryad II computer configurations, and this equipment has been in production in the USSR for the last couple of years. The Bulgarian equivalent of the 100 MByte disc devices have become also available, for example, the R-55 model shown at the Leipzig Fair was equipped with ES-5567 controllers and ES-5067-02 drives. 200 MByte disc drives (ES-5067), basically double density versions of the Bulgarian ES-5067-02 drive, have also been announced and were already on display at the CMEA computer exhibition held in Moscow in June and July 1979 [6, 7] (Table 3).

All in all, the disc storage capacity problem of Ryad models seems to be solved, and these days the large Ryad configurations under delivery are suitable for providing online database services from the point of view of computer hardware.

1.6 Information Retrieval Software Used

On the basis of [4], Table 4 shows the list of information retrieval software packages used in Hungary in 1980 for public database services. The basic trends are the following: In most cases--for the largest databases--the program package BINAR developed by the Central Physical Research Institute of the Hungarian Academy of Sciences (KFKI) was used. BINAR in its present version allows the sequential processing of data files, mainly used for SDI services. A more detailed description of the BINAR program is found in [9]. According to the authors of [9] the present version of the system can be run on Ryad and IBM machines both in DOS and OS environments, and because it is so flexible it can be adapted to databases with different record formats. The system can also



The ES–1060 configuration can be based on the following devices:

Processor	ES–2060	Card reader	ES–6019 (ES–6015)
Main storage	ES–3206	Paper tape reader	ES–6022
Multiplexor channel	ES–4012.01	Card punch	ES–7010
Selector channel rack	ES–4035.03	Paper tape punch	ES–7022
Control panel	ES–1501.01	Alphanumeric printer	ES–7032
Console magnetic tape unit	ES–5009		(ES–7033, ES–7037)
Power supply	ES–0824 and ES–0825	Typewriter with control	ES–7077
Power switching device	ES–0853.01	4 display group control	
Interchangeable magnetic		(ES–7566) with display	
Disc storage	ES–5066	terminals (ES–7066)	ES–7906
Disc storage control	ES–5566	Card read punch	ES–9011.01
Magnetic tape storage	ES–5017.03 (ES–5025)	Card verifier	ES–9013.01
Magnetic tape control	ES–5517 (ES–5525)	Paper tape data recorder	ES–9024

Figure 3. ES-1060 Specifications

Source: ELORG Brochure - USSR

Table 13. RYAD Disc Products [6]

	ES-5052	ES-5056	ES-5061	Model ES-5066	ES-5067-02	ES-5067
Country of origin	Bulgaria	USSR	Bulgaria	USSR	Bulgaria	Bulgaria
Unit capacity (MB)	7.25	7.25	29	100	100	200
Access time (MS)						
Minimum	20	25	20			
Maximum	95	150	80			
Average	45	66.7	40			
Transfer rate (KBS)	156	156	312	806	806	806
Disc controllers	ES-5551 ES-5552 ES-5555 ES-5558	ES-5558	ES-5561	ES-5566	ES-6667	

be extended to handle [10] so-called inverted files, which would allow for an appropriate online version of BINAR to be developed with relative ease.

Other SDI systems are often provided by the database supplier himself. This is the case, for example, with DERWENT Ltd. For other database services, the information retrieval software of the computer suppliers was used. For example, the online database services run on Siemens computers used the BS 2000 version of the GOLEM system, which was originally developed for the 1972 Olympic Games in Munich.

Some of the database services run on software developed by the service provider himself. Some of them even handle very large databases, for example, the program package PA developed by KG-INFORMATIK.

For its online database services SZÁMOK uses SZAMOK-ISIS, a system originally developed by the International Labour Organization (ILO) in Geneva, but developed further by SZÁMOK to a version allowing online retrieval. This system is called ISIS-BABILON and is run on SZÁMOK's IBM 370/145 computer. In an online regime ISIS-BABILON allows many users to access the system simultaneously--unlike the ILO online version of the system. ISIS-BABILON also allows the use of a greater variety of terminal types. A more detailed description of the ISIS-BABILON system can be found in [10]. There are also other database retrieval systems in use in Hungary, which are suitable for database services, such as the DIALOG-KAMA and STAIRS mentioned before. They could be used in providing public services.

All in all it appears that the information retrieval software for future database computer systems will not become a bottleneck in the next couple of years. They may not be the best possible systems available worldwide, but they will nonetheless allow for a respectable information retrieval system.

1.7 Telecommunication Needs of Database Services

As mentioned above the majority of database services in Hungary, when the last statistics were taken, were provided in an offline regime by medium size computers. The majority of these computers were not adequate for connection to telecommunication networks, however, and the offline regime and the relatively small size of the country did not really necessitate links to telecommunication networks. The data communication service options offered in different forms by the Hungarian PTT, in the early seventies were only of marginal interest for these systems. The few Hungarian online data services were accessed by remote users through telecommunication channels, but only in a moderate way. One of the reasons for this was that some Western European and North American computer installations only allowed access from remote users on dedicated, non-switched lines.

This obviously caused major costs for the users and some, who would certainly have been interested in dial-up connections through the public switched telephone network, were totally discouraged from using the system at all.

The low number of online connections is, however, changing. The above mentioned models and systems of the Ryad II series are much more time sharing and data communication oriented. Thus, not only the size of the CPUs and the amount of online disc storage capacity is increasing but also the basic software systems will be better suited for remote access.

Simultaneously with this development the Hungarian PTT has also upgraded its data communication services. In 1981 the national circuit switching PTT Network NEDIX became operational--supporting terminal to computer access in a flexible way. The national PTT network is gradually being connected to other national networks as well, the first link being established with the Austrian telecommunication authorities in July 1982. It is expected that links with other national networks will follow soon.

Through this arrangement, Hungarian terminals are able to reach Hungarian database hosts linked to the network, and hosts abroad.

In a similar way, Hungarian hosts are accessible from terminals in foreign countries, the first opportunity for Hungarian database hosts to supply a database service to customers abroad. Looking at the present list of database services, however, there are very few that could be of potential use to a foreign customer at present. Access to pure Hungarian keywords or Hungarian abstracts, such as SZAMOK-ISIS, is of limited use to them, since major databases of international interest such as CA SEARCH, INSPEC, etc., are also available in many other countries and from other online database hosts, such as LOCKHEED, ESA or SDC. A real interest and a real potential for database services from Hungary would be if major CMEA databases were serviced from Hungarian hosts or if very specialized database were offered. One of the unique and specialized databases available now is the ^{13}C-NMR database. Such a database can be developed without major hardware resources, since it is relatively small in size. One experiment along these lines is known to us [11]: The Hungarian Academy of Sciences is installing an online bibliographical database under STAIRS on "Mass Communication Research"--compiled in English and Russian by the Central European Mass Communication Research Documentation Center (CECOM) in Krakow, Poland on their IBM 3031 computer. This database, with its few thousand information records, is small, but is not available on any other online host in the world.

Because of the high investment costs the decision of setting up and installing new online databases has obviously to be preceded by detailed cost and benefit analysis and market research.

1.8 Online Access to Databases Abroad from Hungary

Experimental online access to foreign public database services from Hungary goes back according to [4] as early as 1977. Between 1977 and 1979 several online experiments were carried out with connections being established to SDC and Lockheed in California, the IAEA in Vienna, ESA-ESRIN in Frascati--to mention only a few.

The first experimental service to foreign public databases was promoted in May 1979, when a leased data communication line was installed between the Institute for Automation and Computerization of the Hungarian Academy of Sciences (SZTAKI) in Budapest and the International Institute for Applied Systems Analysis (IIASA) in Laxenburg. Using a TPA-70, a Hungarian made minicomputer-switching node was developed and brought into operation. The regular experimental service of the IIASA node started in July 1980 [12]. The main purpose of the IIASA node, and in particular the Budapest link, was its utilization for the joint research work between IIASA and Hungarian institutions. However, and practically as a side effect, it has also been used for experimental access to other data centers, such as the IAEA in Vienna for the databases INIS and AGRIS, and ESA in Frascati, etc. [13]. The IIASA-SZTAKI link was further developed in 1981 to a circuit switching gateway network with another TPA-70 node in Budapest [11]. Through this gateway network it became possible to access the CECOM experimental database on the SZTAKI computer in Budapest for the first time. A new packet switching system was implemented in early 1982, which allowed increased throughput of the system.

Until November 1981 several Hungarian institutions--such as OMKDK, the Library of the Hungarian Academy of Sciences, the Library of the Chemical University in Veszprem and the Institutes of the Hungarian Academy of Sciences--made experimental connections through the IIASA-SZTAKI link to foreign public database services [14].

In early 1982 the Hungarian PTT and Radio Austria GmbH in Vienna started experiments to interlink the NEDIX computer network to the network node of Radio Austria. By spring 1982 the two systems were successfully interconnected by 3 multiplexed 1200 baud, X.20 channels. The official service by Radio Austria to Hungarian hosts accessible over the Radio Austria node started in July 1982.

As soon as the above PTT service became operational all connections to foreign public data services from and to Hungary have in principle to use the data network services PTT. Obviously connections through the public switched telephone or telex network are also still possible.

Data connections to CMEA countries became operational almost at the same time as the IIASA-SZTAKI TPA-70 gateway started to take up its regular services.

According to [4] and [15] the National Technical Library and Documentation Center (OMKDK) provides online service in Hungary for access over public switched telephone networks to the bibliographic databases of the International Information Center on Science and Technology (MCNTI) in Moscow. The experiments with the MCNTI system actually started in 1979 before the CMEA computer exhibition held in Moscow [16], where it was presented. The system used there, and a similar one that is at present in operation at OMKDK (Figure 4) is built on an ES-1040 (R-40) database center at MCNTI under the system OS-ES 4.1. For telecommunication the Hungarian made Orion hardware and the telecommunication monitor software KAMA (similar to IBM CICS) is used. The three databases serviced by MCNTI run under the information retrieval system KAMA-DIALOG, which is similar in its characteristics to ISIS or STAIRS. The databases serviced by MCNTI include: INIS (from the IAEA in Vienna), the Soviet VINITI database and the CMEA database IICST-SIISRB (the last two databases are also included in Table 2 because installation of them on Hungarian hosts is planned as well).

For information concerning the costs of using foreign database see chapter 2.3 where this has been discussed in detail.

All in all, it can be said that online access to databases abroad from and to Hungary is increasing. This rapid development necessitated the recent establishment of Hungarian Association for Online Computer Services (SZIT - Számitógépes Információs Társaság) by leading Hungarian information and documentation service institutions such as (SZKI, SZTAKI, SZÁMALK, OMIK, KKI, MTA Library, etc.) with the goal of coordination major activities (such as training, contacts to online vendors and database suppliers, compensation business, etc.) in this field.

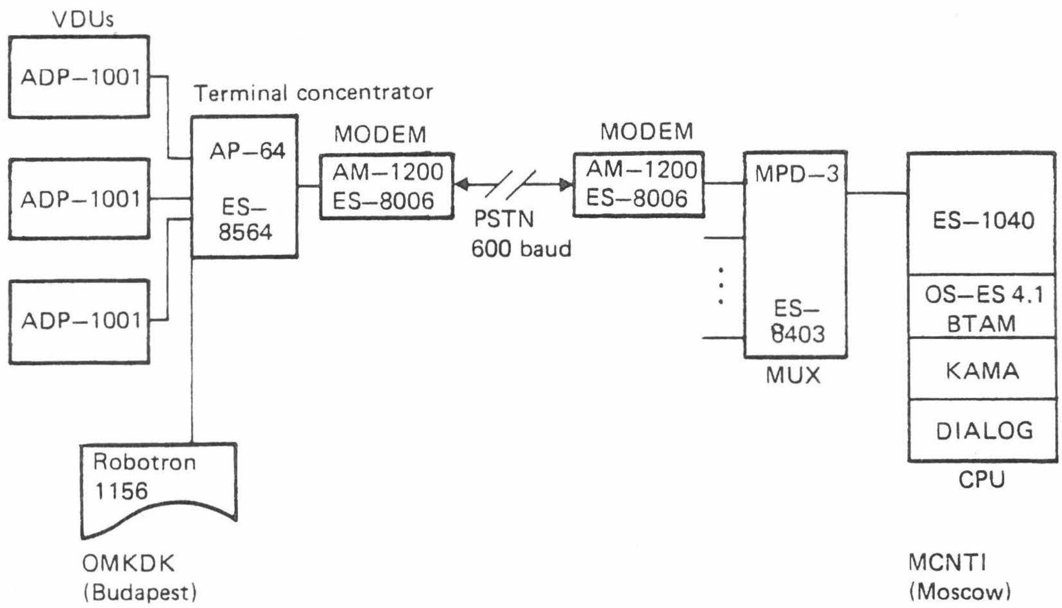


Figure 4. Hardware and system configuration for access from OMKDK in Budapest to the databases of MCNTI in Moscow [15].

2. CONCLUSIONS

(1) Public database services with bibliographic references and factual data have existed in Hungary for quite a long time, originating in the early seventies. In addition, the Hungarian public library and documentation services go back in history for about 150 years generating

experience and well established traditions. This meant that there was fertile ground ready to accept the new technology, which in essence was nothing more than another powerful and useful tool to perform their functions. Accordingly not only the providers of such services had relatively long experience with databases, but also the users of them, such as companies in the chemical and pharmaceutical industry or in the scientific community.

(2) The nature of public database services in Hungary is just about to change. Up until now offline database services--and in particular SDI have dominant, but with the introduction and penetration of the more powerful Ryad II series and the introduction of new national data services the trend towards increasing online services should not be overlooked. It can be expected that online services will be dominant in Hungary by about 1985.

(3) The necessary training, and provision and use of online services are some of the tasks that need to be solved. However, if one is aware what databases are all about, the change from offline to online is actually not a basic one. We do not expect that retraining and education will be a major barrier for the penetration of online services in Hungary, for the following reasons:

Because of the high degree of interaction between user and system in online services increased comfort of access allows users to educate themselves easily. Second, Hungarian educational institutions in the field of computing, such as SZÁMOK, are considering launching online education courses [17]. The fact that SZÁMOK runs one of the major Hungarian online database services in its own library will also be of help in educating the old and new generation of information professionals and users.

(4) In Hungary there are at present 25 databases in operation and 13 under immediate preparation. Although this is not small for a country like Hungary, the number could be much larger.

The high growth rate figures in terms of databases, number of service providers and number of users, suggest that the database industry in Hungary will become stronger in the next couple of years.

(5) International cooperation and transborder data flow in the field of databases will also be of utmost importance to the country. Similar to other small countries with limited financial, technical, informational and manpower resources, international cooperation in production, distribution, and the use of databases will be crucial. Signs of cooperation along these lines are already visible. There are a few examples of international cooperation known in the field of production, distribution, and use of databases--such as for INIS, AGRIS and some CMEA databases--but there is obviously plenty of room to broaden this collaboration. Hungary as a small country, is outstanding in some special disciplines, and has a good chance to produce and market smaller, specialized databases in different disciplines. However,the ways of cooperation to the collection and dissemination of database information have to be consciously sought, found, and followed.

(6) Access to foreign database hosts will, for a small country like Hungary, always be of importance. Probably only those foreign data-

bases that are economically justified or are of strategical importance to the country can be installed on Hungarian hosts, the rest have to be accessed on foreign hosts. Access to major, foreign "transactional" databases, such as stock market, commodity, latest patent news, etc., are also better accessed by large foreign networks. Access to databases abroad will be one of the important factors of the country's transborder data flow traffic, and all activities around it should be done in a way that promotes mutual interdependence for all participants and that has no negative effects on the balance of payment of the country.

REFERENCES

[1] Hall, J.L., 1981. Online Bibliographic Databases: An International Directory. Second Edition, Aslib, London, UK.

[2] Cuadra, R.N. et al, 1981. Directory of Online Databasis. Cuadra Associates Inc., Santa Monica, California, USA.

[3] KSH Országos Számitástechnika-Alkalmazási Iroda, 1980. Számitástechnikai Statisztikai Évkoenyv 1980 (Statistical yearbook on Computer Techniques 1980), (ISSN 0139-3286). Central Statistical Office, Statistical Publishing House, Budapest, Hungary.

[4] Dúzs, J., et al, 1981. Hazai Szakirodalmi Számitógépes Információkeresoe Szolgáltatások-Tájékoztató (Domestic Computerized Technical Information Retrieval Services - Review), OMKDK & ETK, OMKDK Publication (ISBN 963 5. 2 2191, ISSN 0230-290x), Budapest, Hungary.

[5] Szabó, I., et al, 1981. Számitógépes integrált információrendszer fejlesztési elképzelései az OMKDK-ban (Plans for an integrated computerized information system for OMKDK). Információ-Elektronika, 1981/5. Statistical Publishing House, Budapest, Hungary.

[6] Anonymous, 1980. State of the Art of Computer Technology in Eastern Europe. CDC Control Data Corporation Brochure.

[7] Schmidt, R.D., 1981. Soviets Catch-up Crusade, Datamation, March 1981.

[8] Dr. Sz. I., 1982. Robotron ujdonságok Lipcsében (Robotron news in Leipzig), Számitástechnika, Issue April 1982. Statistical Publishing House, Budapest, Hungary.

[9] József, E., et al, 1981. Számitógépes információ-feldolgozás a Koezponti Fizikai Kutató Intézet Koenyvtárában (Computerized information processing in the library of KFKI), Információ-Elektronika 1981/5. Statistical Publishing House, Budapest, Hungary.

[10] Huba, Z., 1981. Az ISIS-BABILON rendszer egy programozó szemével (The ISIS-BABILON system with the eye of a programmer), Információ-Elektronika 1981/5. Statistical Publishing House, Budapest, Hungary.

[11] Lábadi, A., I. Sebestyén, 1982. IIASA TPA-70 Gateway Network Promotes International Flows of Scientific Information. Transnational Data Report, Vol. v, No. 1, 1982. North-Holland Publishing, Netherlands.

[12] Lábadi, A., 1982. IIASA Gateway System and Experiments in Daily Operation: Proceedings of the COMNET '81 Conference on Computer Networks from the Users' point of view, May 1981, Budapest. North-Holland Publishing, Netherlands.

[13] Bakonyi, P., I. Kiss, A. Petrenko, I. Sebestyén, 1982. Promotion of East-West Computer Communication in IIASA's International Environment and the Hungarian Case Study: Proceedings of COMNET '81 Conference on Computer Networks from the Users' point of view, May 1981, Budapest. North-Holland Publishing, Netherlands.

[14] Kiss, I., 1981. A Nemzetkoezi on-line szolgáltatások hazai hozzáféréseroel (About the domestic access possibilities of international online services), Számitástechnika, November, 1981. Statistical Publishing House, Budapest, Hungary.

[15] Grotte, A., 1981. On-line adatbázis-lekérdezés Moszkva és Budapest koezoett (Online database retrieval between Moscow and Budapest), Számitástechnika, January 1981. Statistical Publishing House, Budapest, Hungary.

[16] Grotte, A., 1979. Orion terminálok Moszkvában (Orion terminals in Moscow), Számitástechnika, October 1979. Statistical Publishing House, Budapest. Hungary.

[17] Jacsó, P., 1981. Oktatás-tájékoztatás-online információs kultura (Education - Information - Online information culture), Számitástechnika November 1981. Statistical Publishing House, Budapest, Hungary.

[18] Haraszthy, E., 1982. Input-eloeállitás az INIS adatbázisba (Input preparation for th INIS database), Tudományos - Mueszaki Információ Szakkoenyvtára Vol. 5. OMKDK & ETK, ETK Press, Budapest, Hungary.

Chapter 11:

METEOROLOGICAL NETWORKS — A SPEICAL APPLICATION OF TRANSBORDER DATA FLOWS

I. Sebestyén

METEOROLOGICAL NETWORKS — A SPECIAL APPLICATION OF TRANBORDER DATA FLOWS

I. Sebestyén

0. INTRODUCTION

Meteorological networks are one of the oldest examples of transborder data flow, going back in an organized form for about two centuries. According to [1], [2], and [3], the weather has been a primary concern of mankind since before the dawn of civilization.

This fact is reflected in fragments of the earliest writings and in the existence of numerous ancient deities associated with various weather phenomena. The earliest known systematic treatises on meteorology are the famous *Meteorological* of Aristotle (384-322 B.C.) and the writings of his pupil Theophrastus on winds and on weather signs. During the next 2,000 years the science of meteorology did not progress substantially beyond the point to which it had been carried by Aristotle, in spite of a number of treatises on the subject. The development of the science, like that of the other physical sciences, was forced to await the invention of the instruments by which the primary physical elements could be measured.

The 17th and 18th centuries, in the history of physical science, constitute essentially a period of instrumentation and establishment of the elementary physical laws of gases, liquids, and solids. Especially significant for the development of meteorology were the inventions of the thermometer by Galileo in 1607 and of the barometer by Evangelista Toricelli in 1643, followed by the discovery of Boyle's law in 1659. An explanation of the trade winds, including for the first time the effect of the earth's rotation on atmospheric winds, was attempted by George Hadley in 1735. When the true nature of atmospheric air was determined by Antoine Lavoisier in 1783, and when John Dalton, in 1800 had explained the variations of water vapor in the atmosphere and the relation between the expansion of air and atmospheric condensation, the physical basis of modern meteorology was established.

The development of the science during the 19th century occurred primarily in the field of synoptic meteorology, i.e., in the organization of networks of weather observing stations, in the preparation of daily synoptic charts and in the initiation of modern weather forecasting. The first international compilation of weather observations was made by J.B. Lamarck (with P.S. Laplace, Lavoisier and others) from 1800 to 1815. The earliest weather charts were made well before 1835 by collecting synchronous weather reports by mail. The first telegraphic collection of synoptic reports and mapping thereof for forecasting was accomplished by Urbain J.J. Leverrier following the Crimean War.

Between 1850 and 1875 many nations established meteorological services based on synoptic observations from networks of weather stations. International conferences (Brussels, 1853; Vienna, 1873) established international coordination of these national weather services by arranging for standard observational techniques and for the international exchange of weather observations by telegraph and later by wireless. The practice of weather forecasting increased rapidly during the same period, but progress in the understanding of atmosphere behavior was not rapid before 1900.

From about 1870 the leading nations have published charts each day along with the official forecasts. The basic chart shows the synchronous observations at sea level or surface stations over a more or less extended area, generally at least a large part of a continent and often a whole hemisphere. For each weather station whose observations are taken at internationally standardized synoptic hours--one to four times a day--and received by radio or telegraph at the forecast offices, the values of or symbolic indications of a number of weather elements, are plotted in a model grouping around the circle representing the station on the map. For all stations at least the barometric pressure (usually converted to its value at sea level), the air temperature, the present weather, the wind direction and speed or force, and the sky cover will be reported.

Although meteorology is as old as the other branches of the physical sciences, weather forecasting as a public service is only about 100 years old. It was only after the invention of the electric telegraph (about 1840) that it became possible to establish a communication system suitable for the rapid collection of weather reports. The first systematic experiments in weather telegraphy and forecasting began about 1860 and were conducted by Robert Fitzroy in England, Urbain Jean Joseph Leverrier in France, and the Smithsonian Institution in the United States. A decade later forecasting services had been established in several other countries.

The next advance came from 1900 to 1920 after the invention and development of radiotelegrahpy. As radio became standard equipment on ships it became possible to collect weather reports also from ocean areas. At the same time, and particularly after World War I, aircraft equipped with instruments began to provide information on the state of the atmosphere at higher levels. A major advance was made about 1930. At this time development of the radiosonde permitted soundings of temperature, pressure, and humidity through the troposphere and lower stratosphere. During World War II, the radiosonde was improved to also allow observations of the winds to be made. At the same time radar was developed and used to provide information on clouds and precipitation. After the late 1950s it was much used in locating and tracking thunderstorms, tornadoes and tropical revolving storms.

A major advance of the postwar period was the development of meteorological satellites capable of monitoring the cloud cover and temperature distribution around the world. Another technological advance was the introduction of the electronic computer. Such machines, in a variety of types, have contributed greatly to improvement in the processing of meteorological data, and made it possible to solve many mathematical problems that could not readily be tackled by customary techniques.

The early experiments in weather telegraphy and forecasting were based upon reports from a few land stations observing once or twice a day. The number of observation stations and the frequency of reports grew slowly until about 1920. It was only after the end of World War II that worldwide networks of surface and upper air stations and meteorological telecommunication channels became established. The international network of observing stations and the telecommunication services continued to expand, particularly in the regions that were undergoing rapid technological development. By the late 1950s there were about 10,000 ordinary land stations that provided surface reports, and about 1,000 stations that made soundings of temperature, pressure, humidity, and wind through the troposphere and lower parts of the stratosphere. About 3,000 commercial ships and about 50 specially equipped weather-observing ships provided observations from ocean areas. Several squadrons of aircraft equipped with meteorological instruments and radar engaged in meteorological reconnaissance over ocean areas where ship observations were absent or sparse. Much of the improvement in the forecasting of tropical storms resulted from information provided by meteorological reconnaissance. Commercial aircraft provided much useful information on the cloud and wind systems aloft, and a steadily growing network of radar stations gave detailed reports on severe local weather.

To ensure uniformity in the observations and the reporting procedures throughout the world, sets of definitions, scales, standards and codes were adopted in the 1950s by international agreements under the auspices of the UN World Meteorological Organization (WMO).

Instrumental observations (e.g., pressure and temperature) are reported as numbers, and visual observations (e.g., types of clouds, rain and snow) are translated into numbers according to internationally adopted specifications. The observations are then composed into coded messages and transmitted through established communication networks to all forecasting centers, where the instrumental observations are decoded and plotted as numbers while visual observations are represented by symbols.

The history of East-West relations in the exchange of meteorological observations also goes back as far as the history of organized meteorological observation. In Hungary, for example, the first organized meteorological observation service was launched on November 1, 1781 at the observatory of the University of Buda, which was at this time a member of the so called "Societas Meteorological Palatina", a meteorological network with 36 member stations and its headquarters in Mannheim, Germany.

As mentioned earlier, considerable progress in the development of meteorological network was made around the 1870s, when the international telegraph networks became well established and were already able to provide the telecommunication backbone needed for the international exchange of meteorological data.

On the order of Emperor Franz Joseph II, the Central Meteorological Institute was founded in Hungary on April 8, 1870 and has since that time been in charge of coordinating and handling the traffic flow of transborder meteorological data. Later, after the beginning of the twentieth century, the radio transmission of morse coded meteorological data became the dominating telecommunication medium for the exchange of meteorological information.

With the growing weight of international telex networks after World War II, 50 baud leased point-to-point telegraph and telex circuits started to take on the daily traffic between national meteorological centers. The map of the European Meteorological Telex Network around the beginning of the 1970s is shown in Figure 1. According to [4], however, this manually switched European telex network, which operated without error detection and correction, became increasingly saturated and overloaded by the growing amount of information. For example, at the beginning of the 1970s the 50 baud Budapest-Moscow telegraph circuit worked for a full 23 hours a day, leading to a delay of 2-3 hours, for example, before the meteorological data of Ukrania were received in Budapest.

By the end of the 1960s it became increasingly obvious that the World Weather Watch program of the WMO had to be reorganized on a new and different basis. This function is now being fulfilled by the new dedicated computer communication network of the WMO, called the Global Telecommunication System (GTS). This system provides the backbone for the WMO Global Observing System (GOS) and the WMO Global Data-Processing System (GDPS).

In the following sections the nature of transborder data flow in the field of meteorology, its traditional trade pattern, and its change due to the emerging new information and telecommunication technologies in particular, within the framework of computer communication networks between East and West will be discussed. It will also be shown that, even in this special field of transborder data flow, which is regarded as rather unproblematic, some new worrying signals of growing difficulties are emerging.

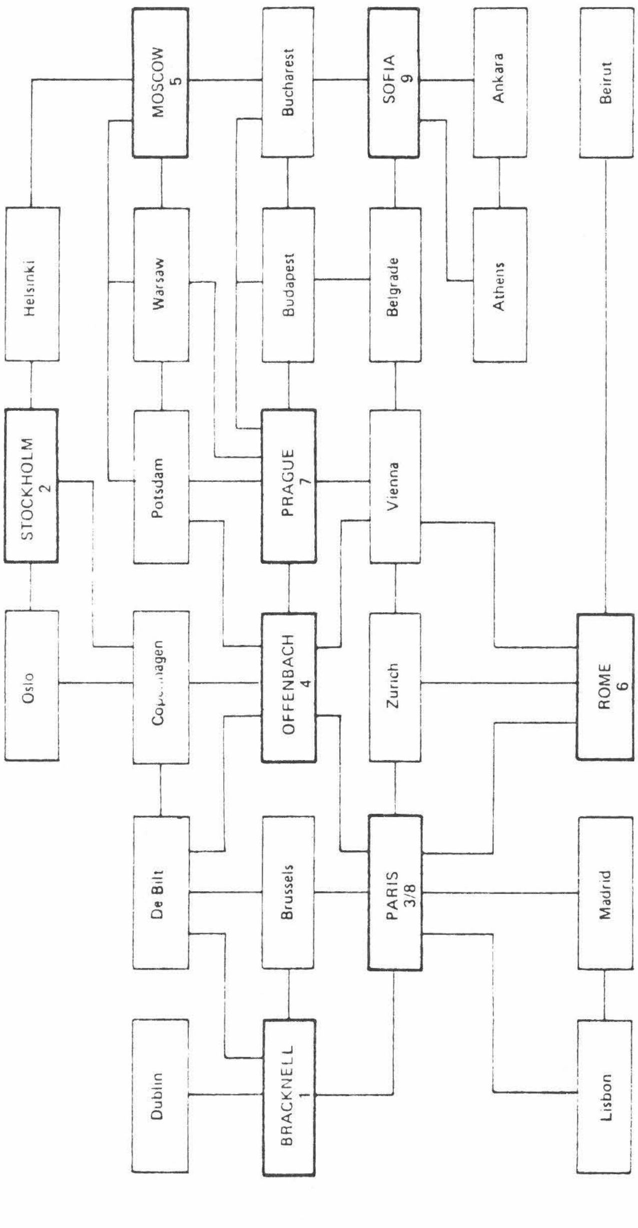


Figure 1. The defunct European meteorological telex network.

1. THE WORLD WEATHER WATCH PROGRAM AND THE GLOBAL TELECOMMUNICATION SYSTEM (GTS) OF THE WMO

1.1. General Description

As already mentioned the Global Telecommunication System (GTS) of the WMO [5], was designed at the end of the 1960s as part of the WMO World Weather Watch (WWW) Program. The GTS is one of the largest international information networks in existence that allows transmission in a store and forward mode of both digital and analogue meteorological information.

According to [13], the WWW is the basic program of the WMO. The WWW was first established by the Fifth World Meteorological Congress (Geneva, 1967).

While the basic approach of the WWW plan remained generally unaltered, important additions have been brought in since the launch of the program, mainly due to two developments. The first is the rapid technological changes and the second is the existing and expected new demand, from several applied fields and programs of other international organizations, on the facilities created under the WWW plan.

Technological change has been rapid in many fields, such as satellite meteorology, where remarkable progress has culminated in a plan for a global system of geostationary and near-polar-orbiting satellites. Continued advances are being made in data-processing techniques, too.

The primary purpose of the WWW is to make available to each of its members, within the limits of the agreed system, meteorological and other related environmental information required in order to enjoy the most efficient and effective meteorological and other related environmental service possible, as regards both applications and research.

The essential elements of the WWW are:

(a) The Global Observing System (GOS), consisting of facilities and arrangements for making observations at stations on land and at sea, from aircraft, meteorological satellites and other platforms;

(b) The Global Data-Processing System (GDPS), consisting of meteorological centers with arrangements for the processing of the required observational data (real-time uses), and for the storage and retrieval of data (non-real-time uses)*;

(c) The Global Telecommunication System (GTS), consisting of telecommunication facilities and arrangements necessary for the rapid and reliable collection and distribution of the required observational data and processed information.

Some of the actual and expected benefits of the WWW are:

(a) Improvements in short- and medium-range meteorological forecasting for general purposes and for many types of special activity, e.g., agriculture, aviation, shipping, fishing, transportation, hydrology, industry, recreation, etc;

(b) Improvements in extended-range meteorological forecasts for the benefit of long-term planning of agriculture, water management, etc.;

*Real-time uses in this sense, are operations in which the information must be received and used or processed within, at most, a few hours of being generated. Non-real-time uses are those operations that can be carried out over a more extended time period.

(c) Improvements in the timeliness and accuracy of wanings against natural disasters caused by meteorological phenomena, particularly tropical cyclones;

(d) Provision of observational data and processed information for several types of applications;

(e) Provision of meteorological and other related environmental information for understanding many aspects of environmental pollution and for taking remedial action;

(f) Easier access to stored data and information for all parts of the world for applied as well as basic atmospheric research or related environmental research projects.

1.1.1. The Global Observing System (GOS)

The GOS is the coordinated system of methods, techniques, and facilities for making observations on a world-wide scale within the framework of the WWW.

The GOS consists of two sub-systems, the surface-based sub-system and the space-based (satellite) sub-system. The former is composed of the regional basic synoptic networks, other observational networks of stations on land and at sea, and aircraft meteorological satellites.

The GOS provides observational information that falls broadly into two categories: quantitative information, derived from instrumental measurements, and qualitative (descriptive) information. Examples of quantitative information, which specifies the physical state of the atmosphere, are instrumental measurements of the atmospheric pressure and humidity, air temperature and wind velocity. Examples of qualitative (descriptive) information are observations of of the state of the sky, the forms of clouds, and the types of precipitation.

1.1.2. The Global Processing System (GDPS)

The purpose of the GDPS is to make available to all members processed information, which they require for both real-time and non-real-time applications, with a minimum of duplication, using the most modern computer methods. The GDPS is organized as a three-level system of World Meteorological Centers (WMCs) and Regional Meteorological Centers (RMCs) at the global and regional levels, respectively, and National Meteorological Centers (NMCs), which carry out GDPS functions at the national level. In general, the real-time functions of the system involve pre-processing of data analysis and prognosis, including derivation of appropriate meteorological parameters. The non-real-time functions include collection, quality control, storage and retrieval as well as cataloguing of data for use in research and special applications.

The WMCs, located in Melbourne, Moscow, and Washington provide products that can be used for general short-, medium-, and long-range forecasting of planetary or large-scale meteorological systems. Melbourne provides products for the southern hemisphere.

The RMCs are: Algiers/Oran, Bracknell, Brasilia, Buenos Aires, Cairo, Dakar, Darwin, Khabarovsk, Lagos, Melbourne, Miami, Montreal, Moscow, Nairobi, New Delhi, Norrkoeping, Novosibirsk, Offenbach, Peking, Rome, Tananarive, Tashkent, Tokyo, Tunis/Casablanca, Wellington. These centers provide regional products that can be used for short- and medium-range forecasting of small-, meso-, and large-scale meteorological systems by NMCs. Products of RMCs have to be presented in such a way that they can be used by members at the national level as input to data-processing procedures that must be performed to provide adequate assistance to users.

Taking into account the requirements for data and forecasting services, the general objectives of the GDPS during the period 1980-1983 are the following:

(a) To facilitate the functioning of short-range weather forecasting and storm-warning services, especially at the regional and national levels;

(b) To improve operational weather forecasts in all time ranges by development and incorporation into operational use of new methods for forecasting, such as models based on stochastic/dynamic techniques, other new modeling techniques and ways of parameterizing atmospheric processes;

(c) To develop and improve methods for presenting and, as necessary, modifying machine-made products for the user, so as to make these products more valuable and more easily applied to operational problems;

(d) To develop and improve methods for processing, storage and retrieval of data for basic meteorological, climatological and other purposes, as appropriate, to meet the needs of other WMO programs in accordance with the requirements stated by the appropriate WMO technical commission (s).

1.1.3. The Global Telecommunication Systems (GTS)

The main functions of the GTS are the following:

(a) To collect observational data provided by the GOS of the WMO;

(b) To distribute the data to so-called National, Regional, and World Meteorological Centers (NMCs, RMCs, and WMCs);

(c) To transmit the resulting processed information--provided by the GDPS of the WMO--to other WMCs, RMCs, and NMCs.

The network organization of the GTS is implemented on a three-level basis, namely:

(a) The so-called Main Trunk Circuit (MTC) and its branches, linking together the WMCs as well as designated so-called Regional Telecommunication Hubs (RTHs);

(b) The regional telecommunication networks; and

(c) The national telecommunication networks.

The basis for the organization of GTS is that it should accommodate the volume of meteorological information and its transmission within the required time limits to meet the needs of the World, Regional, and National Meteorological Centers.

The main concept of GTS is to ensure that every country in the world receives all needed meteorological information, partly in numerical, partly in graphical format. During the middle of the 1970s, the amount of information traveling on GTS per day was approximately 3.5 million characters and 50-70 weather charts. A guiding principle of GTS is that both contribution and consumption of information on the network is free of charge and based on mutual interdependency.

The backbone of the GTS system [5] is a medium-high speed ring network interlinking the main World Meteorological Centers (WMCs) in Washington, Moscow, and Melbourne, with the Regional Telecommunication Hubs (RTHs) in Bracknell, Paris, Offenbach, Prague, Cairo, New Delhi, Tokyo, Nairobi, Peking and Brasilia (Figure 2). All these centers are interlinked with the Main Trunk Circuits (MTCs) and their branches which operate in a segmented "store and forward" mode.

The functions of the Main Trunk Circuit and its branches are the following:

(a) Ensuring the rapid and reliable exchange of observational data required for making analyses and prognosis;
(b) Ensuring the exchange of processed information between the World Meteorological Centers, including data received from meteorological satellites;
(c) Transmitting additional processed information for the purpose of providing Regional Telecommunication Hubs, Regional Meteorological Centers and National Meteorological Centers with the information produced by the WMCs;
(d) Transmitting when feasible, other observational data and processed information required for interregional exchange.

With regard to telecommunications, the World Meteorological Centers and the Regional Telecommunication Hubs are responsible for:

(a) Collecting the observational data originating in their zone of responsibility and transmitting such data in the appropriate form and at the appropriate speed on the Main Trunk Circuit and its branches;
(b) Relaying as internationally agreed, on the Main Trunk Circuit and its branches, in the appropriate form and at the appropriate speed, the meteorological information that they receive from these circuits and/or from RTHs not situated on the Main Trunk circuits;

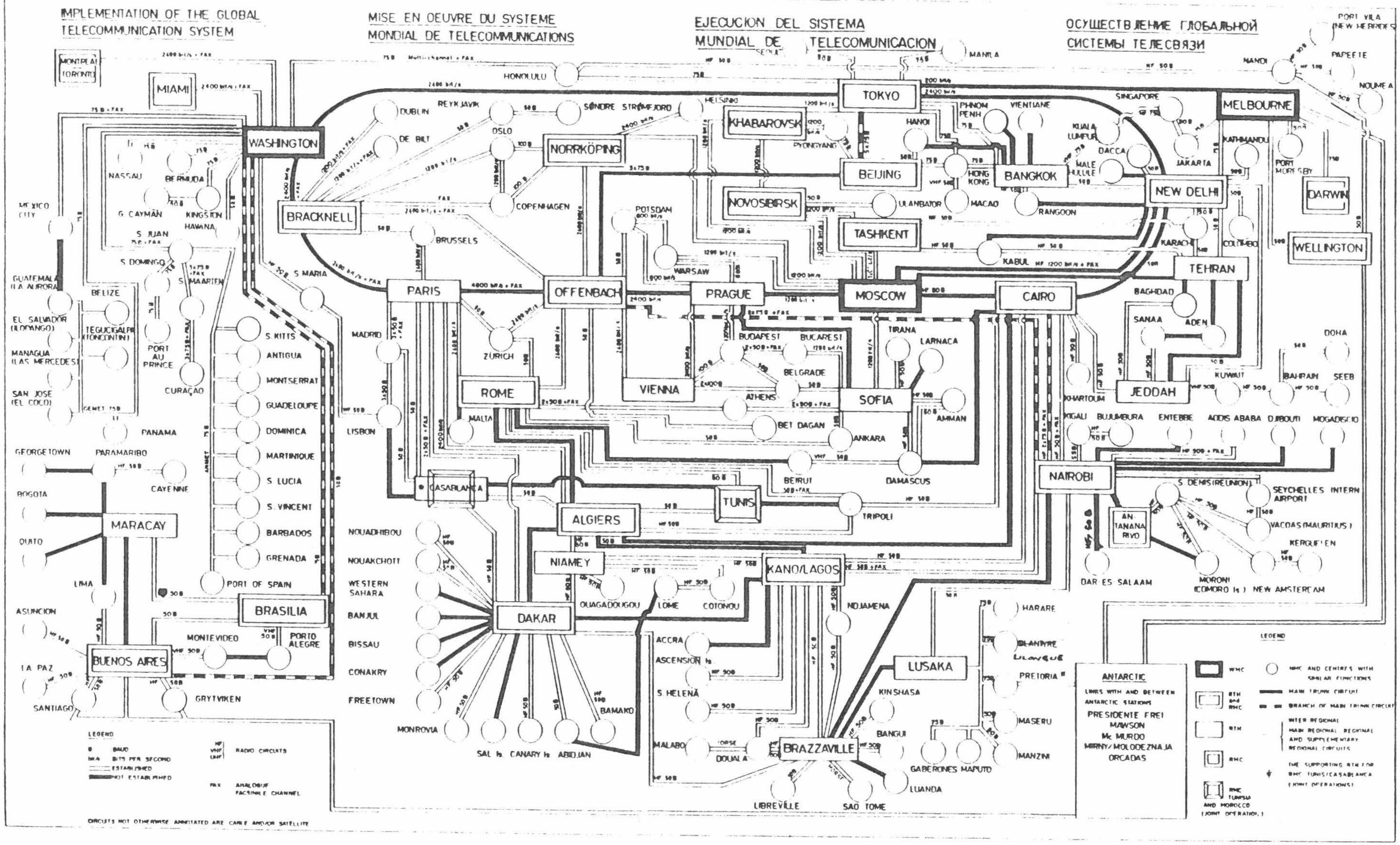


Figure 2. Routing of the main trunk circuit and its branches of the GTS-WMO.

(c) Ensuring, in the appropriate form and at the appropriate speed, the selective distribution of meteorological information to the NMCs and to the RTHs not situated on the Main Trunk Circuit that they serve;

(d) Checking and making corrections in order to maintain standard telecommunication procedures;

(e) Establishing radio broadcasts as required in accordance with regional plans;

(f) Carrying out the monitoring of the operation of the GTS of the WWW.

With regard to telecommunications, the National Meteorological Centers are responsible for:

(a) Collecting observational data from their own territory or that of one or more members according to bilateral agreements, as well as observational data from aircraft and ships received by centers located within the area of responsibility. This collection takes place as soon as possible and is completed within 15 minutes of the observing station's filing time;

(b) Transmitting such data to the associated Regional Telecommunication Hub and World Meteorological Center;

(c) Receiving and distributing for their benefit and that of members who request them, in accordance with bilateral agreements, observational data and processed meteorological information, to meet the requirements of the members concerned;

(d) Checking and making corrections in order to ensure that standard telecommunication procedures are applied;

(e) Carrying out the monitoring of the operation of the GTS of the WWW.

The main engineering principle of GTS is such that the system makes the fullest use of all available telecommunication means (including cable, radio, and satellite circuits) that are reliable and have suitable technical and operational characteristics. For medium- and high-speed data transmissions and for facsimile transmission in digital and analogue forms, standard circuits of the telephone type and radio circuits having similar technical characteristics are used whenever possible for operational and financial reasons.

The circuits provided and the techniques employed have to be adequate to accommodate the volume of meteorological information and its transmission within the required time limits to meet the needs of World, Regional, and National Meteorological Centers.

In the planning of the circuits and transmission schedules, the daily volume of traffic to be passed over any one channel should not exceed 80% of its ultimate capacity. The channels are engineered to ensure the highest possible reliability. The system is based mainly on the interconnection of a number of centers, namely, NMCs, RMCs, RTHs, and WMCs. The WMCs, RMCs, and RTHs are provided with suitable equipment for selection, switching and editing in order to provide NMCs with the data selected to meet their specified needs.

Provision is envisa~ed for alternative routings, where necessary, to ensure the reliability and efficiency of the system, particularly the reliability and efficiency of the Main Trunk Circuit. The GTS network functions according to a well predefined schedule for alternatively transmitting analogue facsimile weather charts and digital data. Switching between analogue and digital transmission is made automatic by adding special codes to the data to be transmitted. According to their size and resolution a facsimile weather chart takes on average between 9 and 25 minutes to be transmitted over the network, thus at a rather slow speed.

The WMO has defined special transmission protocols for GTS, and a data transmission error protection according to the CCITT V.41 recommendation has been adopted. Some of the WMO protocols are also applied to the upper levels, such as the application level.

1.2. The GTS Regional Telecommunication Network for Europe

The European part of the GTS network is shown in Figure 3 and the status of the individual links of the network and future plans as of June 1980 are shown in Table 1. From the telecommunication point of view, the actual speeds of the network are rather low to medium, but these are more or less adequate for the present traffic load. According to measurements on the 1200 bit/s Budapest-Prague line [4], the daily digital traffic is approximately 2 MByte per day, utilizing the link to about 70%.

Alternative systems for the switching hardware providing the "store and forward" function are used in the different network locations. For example, in the European section of GTS, which was completed between 1970 and 1975, the following computer systems are used:

- dual CDC 1700 in Vienna
- dual Telefunken TR86 in Offenbach
- dual IBM S/7 in Rome and Belgrade
- dual CDC 1700 in Prague
- CII 10070 in Paris
- dual Siemens 4004 in Zurich
- IBM S/7 in Budapest
- dual Marconi Myriad II in Bracknell.

In other European countries CDC and IBM computers are primarily used for switching purposes.

The Eastern and Western European systems are mixed in the sense that error protection is carried out by software in Western Europe and by

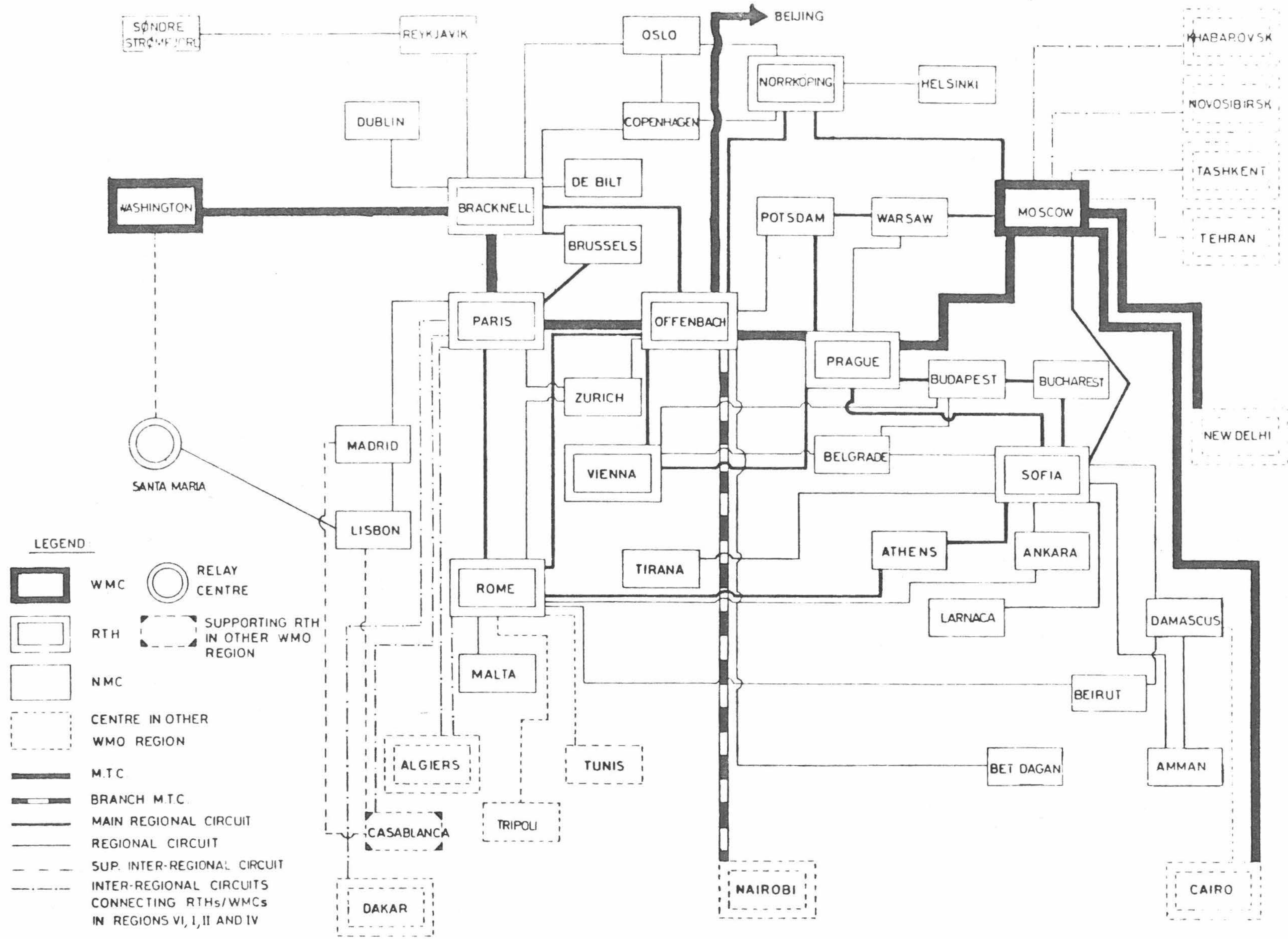


Figure 3. GTS regional telecommunication network for Europe.

Table 1. Present status and future plans for the implementation of the proposed GTS regional meteorological telecommunication network in Europe.

	Present operational status	*Future plans*
1. MTC and its branches		
Moscow–Prague	Cable, 1200 bit/s data, hardware EDC	2400 or 4800 bit/s data/FAX
Prague–Offenbach	Cable, 2400 bit/s data, software EDC	Cable, 2 × 4800 bit/s data + FAX, software EDC
Offenbach–Paris	Cable, 2 × 4800 bit/s data/FAX + FAX, software EDC (1980)	—
Paris–Bracknell	Cable, 2400 bit/s data/FAX, software EDC	Cable, 4800 bit/s data/FAX, software EDC
Bracknell–Washington	Satellite, 2400 bit/s data/FAX, software EDC	Satellite, 4800 bit/s data/FAX, software EDC
Moscow–New Delhi	HF/ISB, 1200 bit/s special EDC + 1 FAX	Satellite, 2400 bit/s (1980)
Moscow–Cairo	HF, 50 bauds ARQ	HF/ISB, 1200 bit/s special EDC + 1 FAX
Offenbach–Nairobi	Satellite, 2 × 50 bauds + 1 FAX	2 × 75 bauds + 1 FAX (to be considered)
2. Main regional circuits		
Bracknell–Offenbach	Cable, 2400 bit/s data/FAX, software EDC	—
Bracknell–Brussels	Cable, 50 bauds	Cable, 2400 bit/s, software EDC (1980)
Brussels–Paris	Cable, 2400 bit/s, software EDC	—
Paris–Rome	Cable, 2400 bit/s data/FAX, software EDC	—
Rome–Offenbach	Cable, 2400 bit/s data, software EDC	—
Offenbach–Vienna	Cable, 2400 bit/s data/FAX, software EDC	Cable, 2 × 4800 bit/s data + FAX, software EDC (1980)
Offenbach–Norrköping	Cable, 2400 bit/s data, software EDC	—
Vienna–Prague	Cable, 2400 bit/s, software EDC	Cable, 2 × 4800 bit/s data + FAX, software EDC
Prague–Budapest	Cable, 1200 bit/s data, hardware EDC	—
Sofia–Prague	—	Cable, 1200 bit/s data (1980)
Budapest–Bucharest	Cable, 2 × 50 bauds + 1 FAX	Cable, 1200 bit/s data/FAX, hardware EDC (1980)
Bucharest–Sofia	Cable, 1200 bit/s data/FAX, hardware EDC	—
Sofia–Moscow	Cable, 1200 bit/s data/FAX, hardware EDC	Cable, 2400 bit/s data/FAX
Prague–Potsdam	Cable, 600 bit/s	Cable, 1200 bit/s data, software EDC
Potsdam–Warsaw	Cable, 600 bit/s	Cable, 1200 bit/s data/FAX, hardware EDC
Warsaw–Moscow	Cable, 1200 bit/s data/FAX, hardware EDC	—

NOTES: (1) Data/FAX = transmission on a time-sharing basis on the same channel.
(2) Data + FAX = transmission on two separate channels used for data and FAX transmissions respectively.
(3) An entry of "FAX" in this table does not necessarily mean that FAX is transmitted in both directions.

Table 1 continued.

	Present operational status	*Future plans*
2. Main regional circuits (*continued*)		
Moscow–Norrköping	Cable, 1200 bit/s data, hardware EDC	Cable, 2400 bit/s (1980)
Rome–Athens	Cable, 2 × 50 bauds + 1 FAX	Cable, 2400 bit/s data/FAX, software EDC
Sofia–Athens	Cable, 2 × 50 bauds + 1 FAX	Cable, 1200 bit/s and, at a later date, updating to 2400 bit/s data/FAX, software EDC
3. Regional circuits		
Bracknell–Dublin	Cable, 1200 bit/s, software EDC + 1 FAX	—
Bracknell–De Bilt	Cable, 1200 bit/s, software EDC + 1 FAX	—
Bracknell–Reykjavik	Cable, 50 bauds/FAX	Cable, 1200 bit/s data/FAX, software EDC
Reykjavik–Søndre Strømfjord	UHF/cable, 50 bauds	—
Bracknell–Oslo	Cable, 1200 bit/s, software EDC	—
Bracknell–Copenhagen + Oslo	Cable, FAX	—
Oslo–Copenhagen	Cable, 1200 bit/s, software EDC	—
Paris–Madrid	Cable, 3 × 50 bauds + 1 FAX	Cable, 4800 bit/s data/FAX, software EDC (1980)
Madrid–Lisbon	Cable, 3 × 50 bauds	Cable, 2400 bit/s data/FAX, software EDC
Paris–Zurich	Cable, 50 bauds	—
Prague–Warsaw	Cable, 100 bauds	—
Offenbach–Bet Dagan	Cable, 50 bauds	Cable, 100 bauds
Offenbach–Potsdam	Cable, 50 bauds	Cable, 100 bauds
Rome–Zurich	Cable, 50 bauds	—
Vienna–Budapest	Cable, 100 bauds	—
Vienna–Belgrade	Cable, 2 × 100 bauds	Under consideration
Belgrade–Budapest	Cable, 50 bauds	—
Rome–Malta	Cable, 50 bauds (AFTN, unidirectional from Malta to Rome)	—
Rome–Beirut	Cable, 50 bauds (AFTN, unidirectional from Beirut to Rome)	HF/ISB, 75 bauds
Sofia–Larnaca	HF, 50 bauds (unidirectional from Sofia to Larnaca; AFTN, unidirectional from Larnaca to Sofia)	Cable, 100 bauds (1980)
Sofia–Belgrade	Cable, 50 bauds	Cable, 100 bauds
Sofia–Tirana	HF, 50 bauds	—
Sofia–Ankara	Cable, 50 bauds	Cable, 100 bauds (1981/1982)
Sofia–Damascus	HF, 50 bauds	HF, 100 bauds (1981/1982)
Sofia–Amman	HF, 50 bauds	Satellite, 100 bauds (1981/1982)

	Present operational status	*Future plans*
3. Regional circuits (*continued*)		
Damascus–Beirut	VHF, 50 bauds	Cable, 75 bauds
Oslo–Norrköping	Cable, 100 bauds	—
Norrköping–Copenhagen	Cable, 100 bauds	—
Norrköping–Helsinki	Cable, 2400 bit/s, software EDC	—
Offenbach–Zurich	Cable, 2400 bit/s data/FAX, software EDC	—
Rome–Ankara	Cable, 50 bauds	1200 bit/s (1982/1983)
Amman–Damascus	—	Cable, 50 bauds
4. Inter-regional circuits		
Damascus–Cairo	—	HF, 50 bauds
Paris–Algiers	2400 bit/s data/FAX, software EDC	—
Rome–Algiers	—	Not yet determined
Paris–Casablanca	Cable, 50 bauds	2400 bit/s data/FAX, software EDC
Madrid–Casablanca	Cable, 50 bauds	Not yet determined
Lisbon–Casablanca	—	HF, 50 bauds
Paris–Dakar	Satellite, 2 × 50 bauds + 1 FAX	—
Rome–Tunis	Cable, 50 bauds	Cable, 1200 bit/s data/FAX
Rome–Tripoli	—	Cable, 50 bauds (1980)
Moscow–Tehran	HF, 50 bauds	—
Moscow–Novosibirsk	Cable, 1200 bit/s data/FAX, hardware EDC	—
Moscow–Khabarovsk	Cable, 1200 bit/s data/FAX, hardware EDC	—
Moscow–Tashkent	Cable, 1200 bit/s data/FAX, hardware EDC	—
Lisbon–Washington	HF, 50 bauds ARQ	—
5. WMC/RTH radio broadcasts		
Bracknell	1 RTT and 1 FAX	—
Moscow	2 RTT and 2 FAX	—
Norrköping	1 FAX	—
Offenbach	1 FAX	Upgrading to 240 rpm
Paris	1 RTT and 1 FAX	—
Prague	1 FAX	—
Rome	1 RTT and 1 FAX	Combined ISB transmission (end 1980)
Sofia	1 RTT and 1 FAX	—

hardware according to the CCITT recommendation V.41 in Eastern Europe. In most installations in Eastern Europe the telecommunication equipment--modems and terminals--used are domestic made. For example, in Hungary, the Hungarian built modems TAM 600 (ES 8006) and terminals are used, and in the USSR domestic POTOK modems and AKKORD/PL 150 terminals are operated.

The major functions of the "store and forward" switching computers in each network node are the collection and local storage of meteorological data received from the national observation network, and the forwarding of the message package to the regional network node by providing date stamping. Functions such as polling and addressing, sequence checking, disabling/ enabling lines, and message broadcasting are also typical functions. The storage and retrieval of files transmitted from the regional center are most important functions too. Data are--depending on the storage capacity of the computer--usually kept for about one day before they are overwritten by new data. Other daily functions include system and housekeeping functions such as taking system statistics.

As an example of a system configuration, the IBM S/7 system of the Hungarian Meteorological Service has a core capacity of 500 kByte, two disc drives of 80 MByte and handles three 1200 bit/sec leased telephone lines, one each to Prague and Bucharest, and one to the central computer center of the Meteorological Service in Budapest. Connected to each of the two multiplex channels are 16, either local or remote, terminals linked by telegraph circuits. Connection to the national PTT telex network could not be realized because of export license restrictions on the side of the manufacturer. For the same reason, the switching software could also not be supplied. The telecommunication software was therefore written in two years by the inhouse programmers of the Meteorological Service. The system finally went into operation in 1978, and has since worked 24 hours a day with a reliability of over 99%.

The European GTS system allows for fast and reliable transmission of data on the network. Data given by [4] illustrate the use of the network: information from all Hungarian meteorological observation points are in Washington within one hour, and *vice versa* observation data from US ships in the Atlantic are in Budapest within 40 minutes.

As a backup the meteorological service in Budapest has kept their old, traditional, manually switched system. In the event of line failures, as in other centers of the region, they either use spare lines to other centers or receive radio broadcast messages, which are provided for both data and facsimile by some stations (see Table 1). Other meteorological centers also provide appropriate backup systems, according to the guidelines of the WMO, based on additional private data and telex lines, and broadcasting and receiving stations.

2. DATA NETWORK OF THE EUROPEAN CENTER FOR MEDIUM RANGE WEATHER FORECASTS (ECMWF)

The second largest meteorological network with computer links between East and West is the data network--called ECNET--of the European Center for Medium Range Weather Forecasts (ECMWF) (Figure 4) [6, 7]. The ECMWF actually represents a new and interesting trend in the field of meteorological networks and associated special services, which deserves special attention.

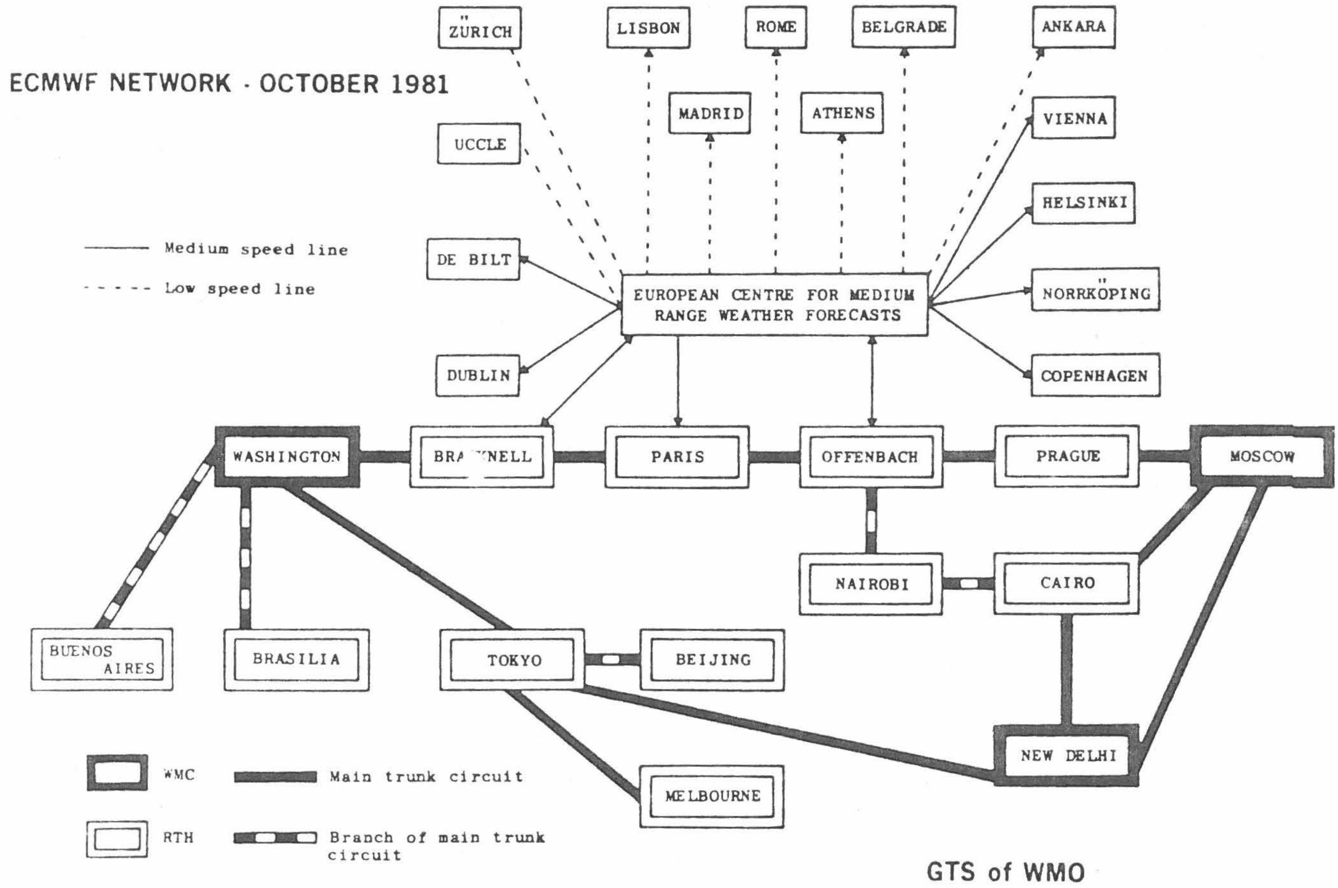


Figure 4. Topology of the ECMWF Network ECNET, October 1981.

In the field of meteorology in general, there are three major steps in handling meteorological data: generation of data by observation, transmission over meteorological networks, and processing for forecasting and statistical purposes, etc. The processed "value added" information can be distributed in many forms, such as printed publications or as data offered through telecommunication networks. According to the general philosophy of the WMO, such data should preferably be fed back into the GTS network and this is accomplished by a number of distinguished meteorological processing centers. These data--in most cases forecasting data--can be received by all meteorological centers within the regular GTS service free of charge. As an example, the Hungarian Meteorological Service uses, among others, the numerical forecasts prepared as a result of model runs on large mainframes of the major WMO centers in Washington, Offenbach, and Moscow for its short term-term forecasting. These forecasting services are at present, and according to meteorology tradition, also free of charge.

There is however a growing conflict in the generation and consumption of these new "value added" services. First of all they are very expensive to set up and run, and thus can only be established by major, more developed countries. The USA, for example, spends about US$50 million per year for the operation and maintenance of their meteorological satellites. The computer configurations used for meteorological forecasting are some of the largest in operation and are also very expensive. Therefore, a new tendency to change to more and more special services of this kind is becoming apparent. This of course, can bring major problems.

First, many meteorologists view with sorrow the gradual disappearance of the intact world of traditional meteorology in which information was exchanged solely on the basis of mutual interdependence. Second, with the introduction and use of new technologies such as meteorological and remote sensing satellites, the predominant role of domestic local observation is diminishing. More and more data can now be gathered from the sky with automated observation devices without having to rely on the data provided by other countries. In this sense, the more developed countries who can afford to operate these new technologies rely increasingly less on international cooperation. On the other hand, the less developed or smaller countries will continue to depend on data (raw and processed) originating from these large developed countries. As the primary reasons for this trend are technical and economical there are thus no good major reasons to halt the process, even though it may produce as a side effect negative impacts on mutual international cooperation which has always been regarded as a positive example in the world.

As mentioned earlier these new systems are very expensive and for this reason can only be built by either the richest countries, or by a group of countries as a result of international cooperation. However, since very large investments are required, some return will be necessary. Either fees will have to be charged for the consumption of services, or only those organizations that contributed financially to the development and operation of these services can benefit from them. There are already several systems in Europe that belong to this category. The system ARGOS, which provides data base information from sea buoys on the oceans, charges according to its use.

Another large system of this kind is the ECMWF system that charges its member countries subscription fees in proportion to their Gross National Product; a total of £7 million per year (1982)[14]. The center, with its headquarters in Shinfield Park near Reading in the UK, operates one of the world's largest computer installations used for meteorological medium-range forecasting [8] (Figure 5). The ECMWF with its huge CDC and Cray mainframes is a nice example of how a group of nations can cooperate and share expensive resources. However, it is also an example of how other countries that do not have sufficient resources to enable them to participate are unintentionally "excluded", although a fraction of the generated results is fed back into the GTS network of the WMO.

The main tasks of the Center are the following:

- Joint development of dynamical atmospheric models for medium-range weather forecasting by means of numerical methods.
- Regular generation of data suitable for medium-range forecasting.
- Cooperation in science and research to improve the quality of medium-range forecasting.
- Collection and storage of meteorological data.
- Dissemination of medium-range forecasts and research results to member states.

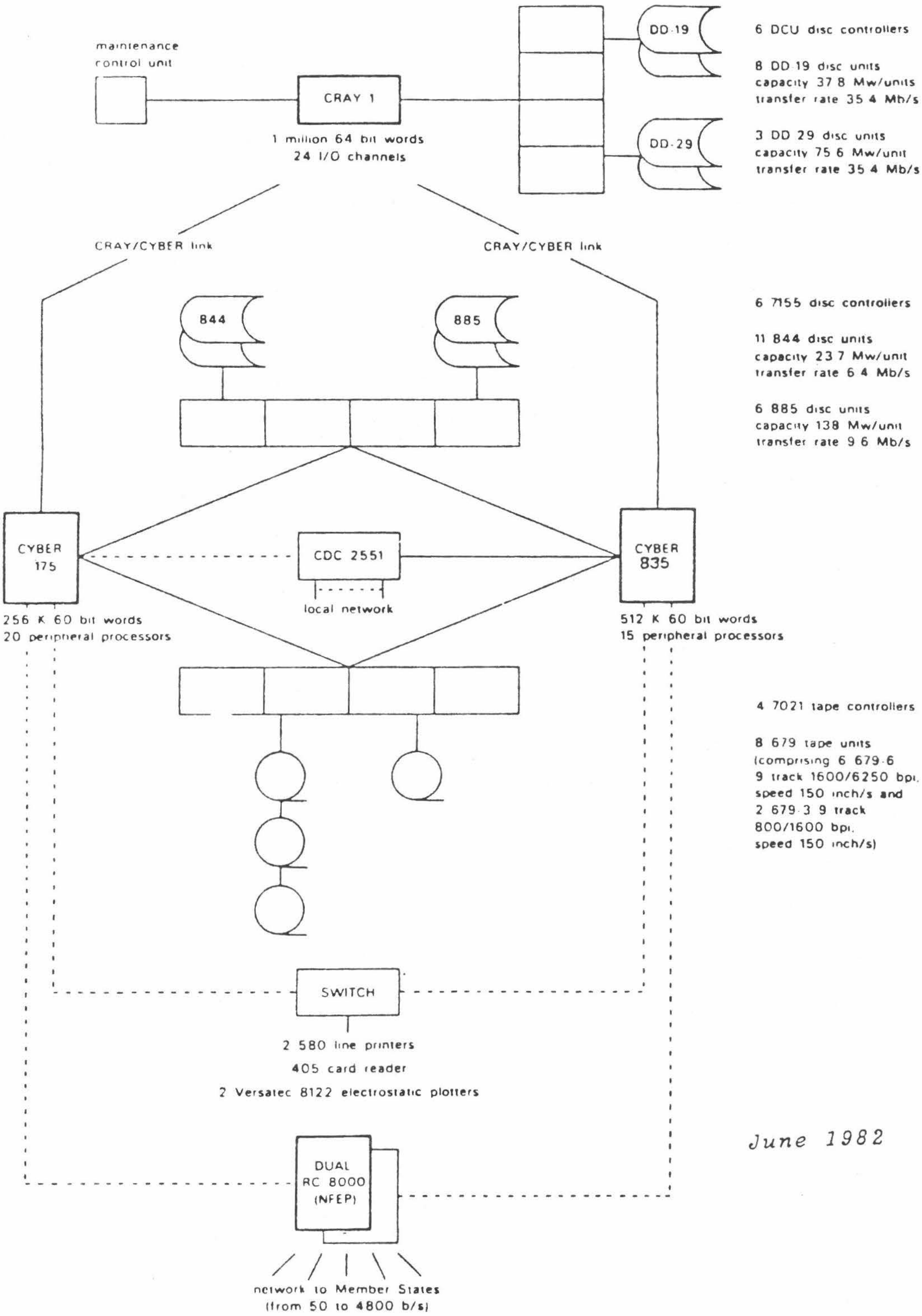


Figure 5 The European Center for Medium Range Weather Forecasts (ECMWF).

-- Collaboration with the WMO in fulfilling meteorological programs.

-- Training member countries in meteorological forecasting.

As can be seen in Figure 4, the ECMWF network is separate from the GTS network of the WMO, and its topology reflects the above main functions of the center. It is primarily used for the dissemination of medium-range forecasting data to the member countries and for remote working on the large mainframes of the Reading Computer Center. For example, the local CYBER 171 system of the Austrian Weather Service in Vienna is connected to the Reading center as a Remote Job Entry device, where models are run on the CRAY computer and output for dispatch is prepared on the CYBERS of the center. The line between Vienna and Reading is a point-to-point connection with 2400 bit/sec, using the X.25 protocol of CCITT on lower levels.

The main, regular service of the ECMWF network is to provide forecasts for up to 7-10 days in advance. Observational meteorological data are acquired through the Global Telecommunications System (GTS) of the World Meteorological Organization. Figure 4 shows that ECMWF has two links with the GTS, one via Bracknell, the other via Offenbach, each link acting as a back-up for the other. The 10-day forecast, taking about 3 1/2 hours elapsed time on the Cray computer, starts at 21.30 and is completed at around 01.00. As a measure of the reliability of the daily operation, a record is kept of the termination times of the forecasts on the Cray. Approximately 45% of the forecasts terminate within 15 minutes of the scheduled time of 01.00, while 90% terminate within one hour. Less than one forecast in 20 is delayed more than 2 hours, the usual reason for long delays being computer malfunction. Post-processing, including transforming the parameters from the mode coordinate system to one more suitable for users of the forecasts, is carried out as the operational run proceeds. Figure 4 also shows the ECMWF network for dissemination of its products; this will be considered further below. The major steps in ECMWF's daily forecasting routine are shown in Figure 6.

Since ECMWF has a global analysis system, all available observational data from the entire global domain are required, including surface observations from land and sea (SYNOP), radiosonde reports from instrumental balloons (TEMP), weather reports from commercial aircraft (AIREP), atmospheric temperature measurements from polar-orbiting satellites (SATEM), wind observations from geostationary satellites (SATOB), and reports from drifting buoys or oceanographic reports (SEA). Each day, around 35,000 separate weather reports are received at ECMWF. After reception, the reports are checked, some are corrected and the reports are stored in the ECMWF Reports Data Base.

3. METEOROLOGICAL DATA FROM SATELLITES

Information received from earth observation satellites represents a special category of transborder data flow. In this regime, a satellite owned by a given country can make observations of just its country of origin and/or other countries from an extraterritorial orbit and beam data back to earth. In this sense the transborder data flow takes place between neutral territory and one or more places in one or more countries. The data transmission path to earth may either be in a broadcast mode, allowing access to the data by any observation station on earth

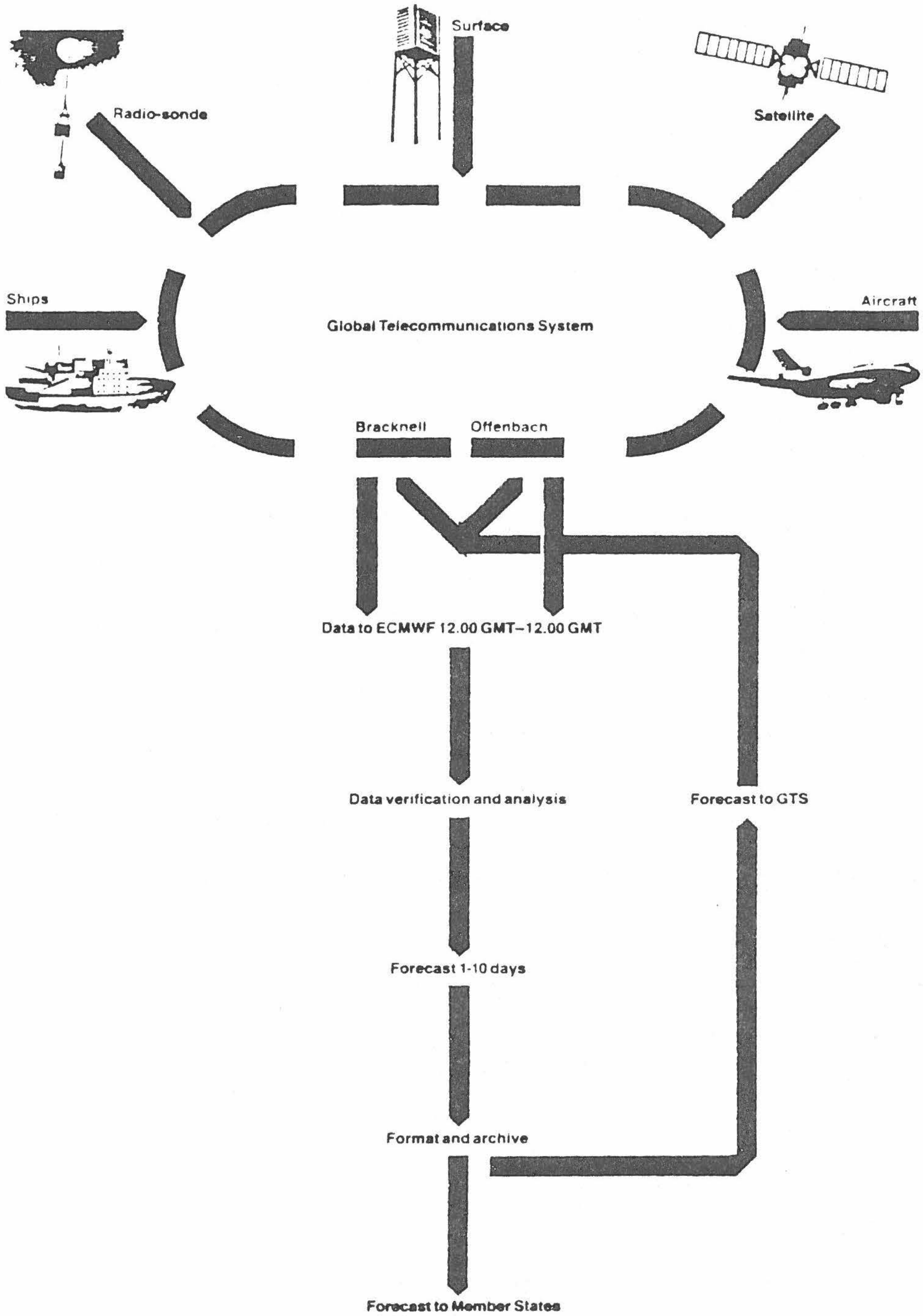


Figure 6. The steps in ECMWF's daily forecasting routine.

equipped with the appropriate dishes, receivers, and other instruments required, or in a point-to-point mode addressed to only one or a few recipients. Most meteorological satellites belong to the first category, i.e., their observation data is free to all stations; having the appropriate receiving equipment is the only criteria for receiving data.

In the second category of satellites, the majority belong to the so-called sensing satellites type, but there are also a few low orbit meteorological satellites. The information flow in these systems is triggered off by terrestrial command when the satellite is in the best position to transmit its high speed data to the earth. To share this type of data with other nations, a second step in transborder data flow cooperation-- now between national territories--has to be taken. For some meteorological satellites this is actually the case; data collected by a designated earth station is fed into the GTS network of the WMO for worldwide distribution. GTS, however, also carries image and numerical satellite data of the first category, enabling those countries and meteorological stations without their own earth stations or with smaller dishes and limited capability (e.g., for analogue weather facsimile data only) to receive the full spectrum of observations, such as digital data for high resolution in weather facsimiles. In the following we describe the two main categories of satellites, i.e., the meteorological satellites and the remote sensing satellites.

3.1. Weather Satellites

In the category of earth observation satellites, the first and still most frequently used are weather satellites. From far above the earth's surface, cameras and other sensors provide meteorologists with broader pictures of weather movements. Combined with the analysis from high-speed computers, meteorological satellites have made weather forecasting much less of a guessing game: today's 24-hour forecasts have the same accuracy--84%--as 12-hour forecasts did 15 years ago. With better prediction of severe storms, such as hurricanes and typhoons, evacuation warnings can be issued and lives saved. Since satellites began keeping track of hurricanes in the mid-sixties, no one has died because of deficient warning. Hurricane Camille, the worst storm of the century, caused minimal loss of life in 1969, whereas 1,500 people died in hurricanes in Mexico in 1959 and 5,000 in Texas in 1900. A cooperative typhoon-warning system being set up in East Asia should reduce the area's yearly storm damage of more than US$3 billion. The Philippines, annually hit by four or five typhoons boiling suddenly off the Pacific, will be a major beneficiary. Within 15 years, global satellite imagery should enable meteorologists to make five-day forecasts that are as accurate as 24-hour ones today, which would translate into US$5.5 billion of savings in agriculture and aviation in the United States alone [9].

Meteorological satellites are generally divided into two groups, according to their type of orbit, being described as either polar-orbiting or geostationary [10].

The polar orbiters are at an altitude typically between 800 km and 1,000 km and they pass near both North and South Poles in the course of a single orbit, that is to say their orbit is roughly at right angles to the equitorial plane of the earth. They take about 105 minutes to circle the earth and because of the earth's rotation, each orbit crosses the equator about 25° of longitude farther west than the previous one. With instruments that are able to scan from side to side, a particular location on the earth can be viewed at least twice every 24 hours; once when the satellite is traveling roughly from north to south and again when it is traveling from south to north. The possibility of viewing the specified location more than twice in 24 hours arises from the fact that many instruments view sufficiently far to the side of the satellite track for there to be an overlap on consecutive orbits. This occurs particularly at high latitudes, where consecutive orbits come much closer together than near the equator.

One item normally carried on polar-orbiting satellites is a tape recorder. The satellite is within view of its main ground station for only a short time during an orbit and may be out of view altogether for several orbits. If this station is to recover the global coverage of observations made during these periods, data must be recorded to await a suitable opportunity for transmission.

A geostationary satellite (sometimes called a geosynchronous satellite) remains stationary relative to the earth and so always views the same area of the earth's surface. This is achieved by putting it into orbit above the equator at a height such that it takes precisely 24 hours to complete one orbit and so matches exactly the rotation rate of the earth. The necessary height is very nearly 36,000 km (approximately 23,000 miles)--many times greater than the heights at which polar-orbiting satellites operate. From its high vantage point a single geostationary spacecraft can view a circular area representing more than one quarter of the earth's surface. The problem of being often out of sight of the controlling ground station does not arise in the case of geostationary satellites, so normal operations do not require a data-recording facility on board.

The characteristics of polar and geostationary orbits offer different advantages to the meteorologist so the two types of satellite complement each other. In particular, a polar-orbiting satellite can provide complete global coverage every 12 hours while a geostationary satellite, although never achieving global coverage, can monitor a substantial part of the earth's surface almost continuously.

3.1.1. Current Operational Polar-Orbiting Meteorological Satellites

There are two series of satellites in this category, the TIROS-N series and the METEOR-2 series, which are operated by the USA and the USSR, respectively.

TIROS-N is the third generation of operational polar-orbiting satellites from the USA. The first of the series was launched on 13 October, 1978; the program was declared fully operational on 16 July, 1979 (following the launch of the second satellite) and it is planned to be continued into the 1990s. There are normally two spacecraft operating together, traveling in orbits approximately at right angles to each other. In this way, they pass alternatively across any part of the earth's surface at intervals of between five and eight hours. Their heights are about 850 kms above the earth and each orbit takes about 101 minutes, so that in the course of 24 hours they complete over 14 orbits. The orbits are said to be "sun-synchronous", which means that they cross the equator at the same local time (solar time) on each orbit, thus ensuring consistent illumination for visible imagery from day to day. Every spacecraft is designed to have an operational life of at least two years and replacements are launched at suitable intervals to maintain the twin system.

Four primary instrument packages are carried: one provides visible and infra-red pictures of cloud cover (or, in the absence of clouds, the earth's surface); one is an atmospheric sounder; another monitors solar activity; and the fourth is for data collection and platform location. Picture resolution, i.e., the size of the distinct elements of which it is composed, is slightly more than 1 km. It is interesting to note that the TIROS-N series has a somewhat international character with part of the sounding package (the Stratospheric Sounding Unit), which provides data for levels high in the atmosphere, being provided by the United Kingdom and the package for data collection and platform location (named ARGOS--one of the charged services in Europe) being provided by France.

Data are relayed to ground stations via three separate direct broadcasts. One of them, the Automatic Picture Transmission (APT) service, transmits medium-resolution (4 kms) images continuously as they are acquired by the satellite. They appear as an ever-extending strip whose width represents a distance of about 2,600 kms, and the picture ends when the spacecraft disappears below the horizon of the receiving station. Equipment needed for reception of this particular broadcast is relatively simple and inexpensive, enabling many sections of the meteorological community with only modest resources to enjoy the benefits of direct reception of images of their own region.

The USSR METEOR-2 satellites, of the METEOR-2 improved operational meteorological satellite system, were first brought into operation in the mid-1970s. They followed an earlier METEOR series and will continue until at least 1985, with one or two satellites being launched each year throughout that time. Their primary task is the acquisition of visible and infra-red images, although world-wide temperature soundings are being made on an experimental basis. Like the TIROS-N series, they carry an APT facility that broadcasts reduced-resolution images. Orbital height is 900 kms and the time taken to complete one orbit is about 102 minutes. Images are obtained from three different instruments on each spacecraft: a radiometer is used for the infra-red; there is television-type scanning equipment for the high-resolution visible, and the APT service relays images from a device called a scanning telephotometer.

3.1.2. Current Operational Geostationary Meteorological Satellites

Geostationary meteorological satellites are operated by the USA, Japan, and the European Space Agency (ESA). They have much in common with each other and there is a good deal of collaboration between the operators. Working through an international group called the Co-ordination of Geostationary Meteorological Satellites (CGMS), the operators have achieved a compatibility between data-collection systems and, to a lesser extent, between data-dissemination services. The former ensures that transmission from a mobile DCP (for instance, one on board an aircraft), will be received without interruption as it passes from one spacecraft coverage area to another. The satellites all provide two direct broadcast services, one of which--WEFAX (Weather Facsimile)--has characteristics similar to the APT transmissions of polar-orbiting satellites. By adding just one or two extra pieces of equipment, an APT station can be modified to receive WEFAX as well.

The USA satellites are known as Geostationary Operation Environmental Satellites (GOES). The two main ones are located at 75°W and 135°W and are known simply as GOES-East and GOES-West, respectively. GOES-East monitors the weather over the eastern half of North America, all of Central and South America and much of the Atlantic, while GOES-West monitors western North America and a substantial part of the eastern Pacific. They both provide frequent visible and infra-red images of the whole of the areas (or discs) viewed. The normal interval between images is 30 minutes but this can be reduced to as little as three minutes if coverage is restricted to a small part of the disc. This operation mode is used to make detailed observations of a weather feature that is rapidly changing or developing. Environmental data can be collected from as many as 10,000 DCPs every six hours. The two most recently launched GOES spacecraft carry experimental instrumentation for making atmospheric soundings of both temperature and humidity and are the first geostationary satellites to have this capability. First results have been extremely encouraging but operational soundings are not expected to become available for some time, particularly since soundings and image cannot yet be obtained simultaneously. A Space Environment Monitor on each GOES includes sensors for measuring solar activity and magnetic field.

The European satellite is named METEOSAT. It is located above the equator on the prime meridian from where it can observe the whole continent of Africa, much of Europe and the Atlantic and part of South America. The first in the series, METEOSAT-1, was launched in November 1977 and METEOSAT-2 in June 1981. Primary missions are imaging, data collection and dissemination, and services broadly similar to those of GOES are provided. The imagery available includes, in addition to the usual visible and infra-red, what are called "water-vapor images". These depict the average humidity in the part of the atmosphere between about 5 kms and 10 kms above the earth's surface. Moist areas appear in the pictures as relatively light shades and dry areas as very dark. The tops of some of the highest clouds can also be seen, showing up as intense white patches. Water-vapor images often reveal quite dramatically the broad, sweeping character of major features of the global atmospheric circulation, which cannot be observed directly by any other technique.

Japan's Geostationary Meteorological Satellite (GMS) (also called Himawari) is located at 140° E and views a large part of eastern Asia, the whole of Australasia and a vast area of the western Pacific. The original spacecraft was launched in July 1977 and its replacement, GMS-2, in August 1981. The principal meteorological payload is again a radiometer for high-quality images and like GOES (but not METEOSAT), there is instrumentation for monitoring solar activity and the space environment. Routine full-disc images are produced every three hours but special observations may be made at intermediate times for research purposes or when, for example, a severe storm or typhoon is under surveillance.

Two more geostationary satellites are expected to complement the geostationary meteorological satellite network: GOMS (Geostationary Operational Meteorological Satellite) to be placed over the Indian Ocean by the USSR, and INSAT (the Indian National Satellite) to be placed over the same region.

In addition to these "meteorological service" satellites, there are worldwide some special research oriented programs using dedicated "research" satellites, such as the NIMBUS program of the USA or the METEOR program of the USSR. A recent research satellite, which represented an exciting step forward in the applications of satellites to environmental sciences, was the USA satellite SEASAT-A, or ocean dynamics satellite. Its particular significance was that its instrument payload was concerned primarily with measurements of the ocean surface using microwave techniques. SEASAT was launched into a polar orbit approximately 850 kms high, on 26 June 1978. Unfortunately, its life was not as long as had been hoped, for it suffered a major power failure on 10 October of the same year. However, during its time in orbit, more than 90 days of data were collected from its microwave instruments, giving the data-analysis teams plenty to work on to establish accuracies, capabilities, and limitations.

All the instrument sensors on SEASAT were evolved from predecessors that had been flown successfully on spacecraft or aircraft. They included a radar altimeter, to measure average wave height and sea-surface topography; a device called a scatterometer for determining wind speed and direction at the sea surface; radar to observe wave patterns and ice distribution; and a microwave radiometer to measure sea-surface temperature. SEASAT was described as a "proof-of-concept" mission. Evaluations of its achievements and the quality of its observations have clearly demonstrated the feasibility and potential usefulness of a satellite dedicated to ocean purposes.

3.2. Remote Sensing Satellites

Beyond weather satellites, a wide array of remote sensing satellites [9] stand poised to move from the research and development phase to routine daily use. Beginning in the early 1970s, the USA and the USSR put into orbit general purpose remote sensing satellites. France and Japan are expected to orbit civilian remote sensing systems within the next five years. Known as LANDSATS, these satellites have proved useful to farmers, foresters, shippers, highway builders, coastal zone managers, and mapmakers. LANDSATS work in a polar orbit and on each pass scan a 185 kms wide strip of the earth's surface, much less than the meteorological orbiters. The result is that 18 days are therefore required for complete global coverage, making it unsuitable for most meteorological applications.

Remote sensing of living systems--crops, forests, grasslands, plankton and fisheries--could provide solid trend information on a truly global scale as well as having many uses in day-to-day resource management. The US Department of Agriculture has used LANDSAT images of foodgrowing regions to improve crop harvests. It was estimated in 1979 that the direct economic benefits of satellite crop forecasting have been about

US$325 million a year, far exceeding the US$80 million cost of the program. In the United States, forest-products firms with large landholdings have found that satellite images provide not only broader coverage than ground-based assessments, but also a more accurate view of tree health than direct visual inspection. Thus far these systems are of value only over areas with large fields and low crop variety.

Mineral and petroleum explorers have also benefited from remote sensing. By studying satellite images of known mineral deposits and then looking for similar formations elsewhere, geologists have been able to locate commercially valuable deposits. Most notable thus far has been the discovery of copper deposits in a remote region of Pakistan. How widespread such discoveries are likely to be is a matter of controversy among geologists. The oil companies have made extensive use of LANDSAT data, but the impact this has had on oil discoveries is hard to assess because firms maintain a tight lid of proprietary secrecy on exploration techniques. Another useful application of remote sensing will be to monitor the reclamation of strip-mined land.

The prospects for greater routine use of LANDSAT-type satellites for resource management are today clouded by a series of institutional, political, and financial problems. Because the data obtained by remote sensing satellites have commercial use, developing countries fear that multinational corporations geared to use the information will gain greater leverage on their economies and enhanced control over their resources. Several Third World countries, led by Indonesia, believe that no remote sensing data of a country should be acquired or released without the observed country's explicit permission.

The United States, supported by most of the other OECD members, maintains a policy of "open access" by selling LANDSAT photographs to anyone willing to pay the price without even asking for the purchaser's identity. A compromise position advanced by the Soviet Union would require the sensed nation to give prior consent for dissemination of images with greater than 50 meters resolution. The current US LANDSAT satellites have a resolution of 80 meters, but a US experimental system has a 30 meter resolution and the new French commercial system (SPOT) will go down to 10 or 20 meters. Stopping at 50 meters would eliminate some potentially valuable applications, such as detecting specific pollution sources, but going to 10 or 20 meters would generate information of military significance.

According to [11], for example, forecasting of crop yields would require the best possible resolution. A resolution of 10 meters would be necessary in redefined categories of inventory and mapping of land use, and mapping of vegetation types. For most other types of applications a resolution below 50 meters would be ideal. From the technological point of view, a remote sensing satellite resolution of 10 meters or less will be feasible. As already mentioned, the French SPOT satellite to be launched in 1984, will provide images with 20 and 10 meters resolution, and limited stereo capability. The French system is an exception, however, since unfortunately these resolution areas are in the category of military applications, and thus access to these technologies by civilian scientists is limited.

According to [9], for example, maps of the moon are better than those of the earth because military authorities allow lunar orbiters to carry more advanced cameras than those on civilian spacecraft that orbit the earth. Much of the early earth-sensing technology was pioneered by the military and transferred to civilian uses later. But the military is less open about the use of key sensing technologies by civilian groups. Thus the US military advised the SEASAT system to carry radar systems considerably below the state of the art, much to the dismay of some scientists whose experiments could have benefited from the more advanced radars. Point-source pollution monitoring will also suffer without the use of high resolution sensors now primarily used by the military.

As already mentioned the dissemination of remote sensing data is done on a purely commercial basis, and this has become a source of many problems and conflicts between nations; should weather access to remote sensing data be free or not, and if not, who should pay for it and how much, and last but not least, how can these data be best utilized?

After examining the use of satellites for earth observation it becomes apparent at this point that although these new technologies have brought about many advances and benefits for mankind, they are, at the same time, a source of new conflicts.

4. PROBLEMS AND CONFLICTS IN TRANSBORDER FLOW OF METEOROLOGICAL DATA

As has been shown, the developments in meteorological observation, information exchange, and processing over the last hundred years, and in particular the last 20 years, has brought about dramatic technological changes and advances. However, the new, more powerful, but more expensive, systems have also resulted in some negative effects which were not experienced earlier when the "intact world" of traditional meteorology was still in order. In the "good old days" it was meteorology that was often cited as being a beautiful example of international cooperation based on mutual dependency. Now, this "world" is only just intact as a result of the efforts made by international organizations, such as the WMO, and some governments. However, the number of discouraging signs is growing, su :h as the increasing gap between the meteorological services of developed and developing countries, the increasing number of charged services, the decreasing dependency of the biggest countries on the rest of the world, and the increasing dependency of the rest of the world on them. Without exaggerating these signs (which can be compared to the tip of an iceberg), we will describe and analyze some of the problems that are disturbing to the present practice of meteorological services, and that may badly affect future cooperation.

4.1. The Increasing Overload of Meteorological Data and the High Costs of Processing

As a result of new observation, telecommunication, and processing technologies, the amount of meteorological data obtained per day is exploding. It is estimated that a single weather satellite generates 10^{12}

new data points each day, which have to be delivered to the user and these, of course, are expensive and difficult to handle. Although the cost of installation and operation of observation systems is extremely high, many of these systems still generate observational data--due to the generosity of the more developed countries--free of charge. The tragedy is that although the data are made available through massive international efforts and financial investment, many countries still lack the financial and intellectual resources to complete the chain. Thus, although the information is there and crosses borders to become available in other territories, some countries cannot take advantage of it.

This is often the case for GTS's services too. Although, for example, digital data of satellite images are regularly put on the network, less developed and poorer countries do not have the necessary computer systems or means to store and process these data for their own needs. Thus, for them, much of this valuable information is simply lost. The more developed countries, on the other hand, can cope much more easily with the increased demand for computer power. Even though it means major investments they are in a better situation to install powerful computers linked to their local GTS node. They are able to build up meteorological archives on these computers, run complicated forecasting models and utilize effectively the data available. Often, as a result of these model runs, they generously feed some of their results back into the GTS network. However, due to the high investment and operating costs only a part of this service is free of charge. The results of these--free or not--model runs would, in principle, be of great help to the meteorological centers in all countries. There is, unfortunately, still a number of countries that do not have the necessary means to utilize even those goods that are free.

Another problem is that poorer countries often do not have the means to even archive the observational data of their own country, observational information that they originally fed into the GTS network.

The richer countries, on the other hand, who have better means for absorbing and processing the vast amount of information on the network, can easily archive all data, including those from countries who do not have their national data archived in machine readable format. However, when the poorer countries need their own historical data at some later date, they have to buy it back, a situation that creates another area of conflict between the developed and developing countries. This new conflict is also brought about by the increased costs of meteorological technologies and new technological advances in this complex field. In the "good old days" the data would neither have been collected nor transmitted, and it definitely would not have been stored. It would simply have been lost and forgotten for ever. However, with present technology this data can be and is archived and retrieved; but someone has to pay for it.

As previously mentioned, the same is true whenever the observed information is processed, for example, for medium-term forecasting. The resources involved in such services are extremely high and again someone has to pay for them. For these reasons it appears that it will be very difficult to keep up the practice of mutual and free exchange of observations and the meteorological data derived from them. This classic principle was easy to keep in the "good old days" when observational tools and techniques were similar and data were mainly manually collected, and where all concerned were fully dependent on the effective exchange of such data.

4.2. Polarization of Dependencies

As already mentioned the mutual dependency between countries in the transborder flow of meteorological data is diminishing. Major developed countries who find it much easier to accumulate the necessary resources required for the provision of complicated observation stations, such as meteorological satellites, and for large data processing centers, are more and more in a better position to generate and transmit a larger share of all the data and to archive and process meteorological information and to rely less and less on the traditional meteorological observations that were the basis for exchange and interdependency between nations. Due to technological progress less developed countries are increasingly more dependent on the data and services provided by developed countries as the former are less likely to be able to afford the high costs associated with the introduction of these new technologies. However, with more concentrated regional cooperation among these countries, and maybe eventually external support, the situation might improve.

The growing tendency for the richest countries to build up and maintain global meteorological observational and forecasting systems by themselves is basically supported by the growing weight of military systems. It is a well known fact that in military operations the exclusive knowledge of an exact weather forecast can be decisive. For example, during World War II all major military operations were planned on meteorological advice, and the launchings were timed on the basis of weather forecasts. Of major importance were the highly specialized forecasts prepared for massive air operations in darkness, amphibious operations, etc. The largest of all operations, namely, the assault on the continent of Europe by the Allied forces in June 1944, was successfully postponed for 24 hours on the basis of weather forecasts, which had to satisfy a number of operational specifications. The importance of military weather forecasting has increased greatly with the increase in military technology, and forecasting services have become integral parts of the military establishments [8]. In the United States, for example, the U.S. Department of Defence operates separate so-called DMSP (Defence Meteorological Satellite Program) satellites for its exclusive use [12].

4.3. Polarization in Data Use

Technological developments in meteorology progress at a rapid rate and only developed countries and transnational corporations have any chance of keeping pace with this process and thus utilizing its advantages. It is certainly true, both in absolute and relative terms, that less developed countries also benefit greatly from these advances in general, and the development in each individual developing country is remarkable. However, the development pattern and especially pace of development in these countries is at considerably different stages. Differences in the quality of meteorological observation and in the exchange and use of data have always existed but with the technological advances made in the last 20 years these differences have, in absolute terms, grown. If the individual development stages in meteorology are regarded as "learning curves" then we believe that the last major learning curve--introduced by the new information, observation and telecommunication technologies--which occurred in most developed countries about 20 years ago, will only now start to take place in the less developed countries. This general pattern is shown in Figure 7, which we believe reflects the nature of the qualitative changes in the meteorological services that we are witnessing.

As a result of this technological explosion, a polarization can be observed in the use of meteorological data, which might be the source of future conflicts. Most developed countries and transnational corporations are in a better position to master the problem of information overflow of meteorological data. They will also be in a far better position to utilize these data to make decisions on problems that developing countries cannot react upon due to their lack of information. It is well known that many less developed countries feel uneasy because the more developed countries know more about their past, present, and future weather conditions and the impacts this could have on a given developing country, than the country themselves. A major point of conflict is that the generation of this information is tied to large investments, which only some countries can afford. In the case of a large transnational corporation this investment may bring returns, but this often results in the new generated data being handled as the property of the corporation. On the other hand, if these investments were not made no new information would be generated and a lot of observational data would probably be lost. How to find the solution to this problem is a complicated and difficult question, but it needs to be answered soon.

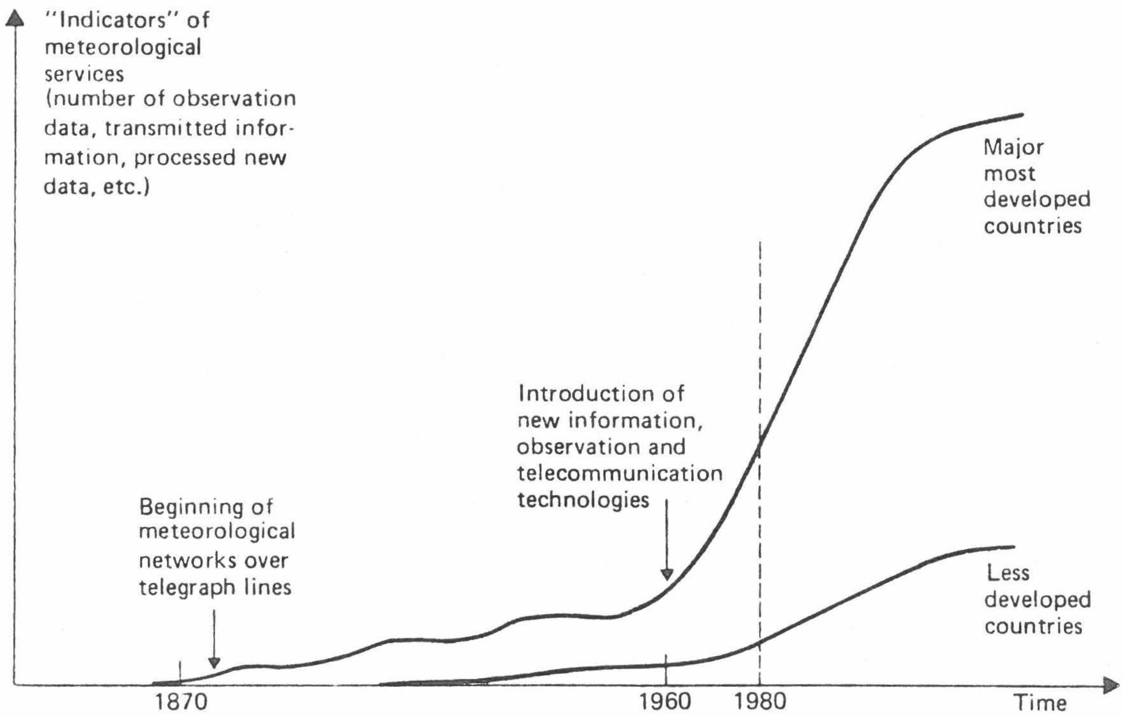

"Indicators" of meteorological services (number of observation data, transmitted information, processed new data, etc.)
Major most developed countries
Introduction of new information, observation and telecommunication technologies
Beginning of meteorological networks over telegraph lines
Less developed countries
1870
1960
1980
Time

Figure 7.

4.4. Export and Import Restrictions on Equipment

Last, but not least, the growing problem of export and import restrictions on equipment used for meteorological purposes should be mentioned. In an area where, traditionally, interdependency and cooperation were guiding principles, the growing "technologization" of meteorology raises the issue of export and import restrictions linked to the general trade of high technology. As more and more new technology moves into the field of meteorology it brings with it an increasing fear of the undesired transfer of this technology or export/import discrimination. It also raises again the problem that some components of meteorological systems (especially in observation technology) come close inside the "neighborhood" of military systems, and this cannot be overlooked.

A concrete example of an import restriction case was reported by [4]. When the Hungarian Meteorological Service wanted to import the IBM S/7 switching computer no export license was granted for the IBM "store and forward" software CCAP. In addition no permission was granted to provide the IBM S/7 with telex ports. As a result, an inhouse team of the Hungarian Meteorological Service had to independently develop an appropriate switching software. This meant that the computer was delayed for two-years before it could provide a regular service and higher costs were incurred due to the duplication of effort. It also, however, meant a loss of revenue for IBM because the deal did not go through as planned.

On a more general note, it would seem worthwhile to investigate the advantages and disadvantages of export/import restrictions, which until now have not been properly understood. The above example of not granting an export license did not serve for the good of IBM and forced the Hungarians to develop this system by themselves, which, in the long run, put them in a better position with regard to the level of knowledge for this particular application and thus makes them less dependent on foreign technology. The impact of export restrictions on the creation of new jobs in foreign countries is another interesting and most timely issue to look at.

5. SUMMARY AND CONCLUSIONS

Meteorological networks are one of the oldest and classic applications of transborder data flow, which existed well before the emergence of computer communication networks. During the last 20 years with the appearance of new observation, telecommunication, and information technologies, the amount and complexity of data crossing borders has increased dramatically. In East-West relations, the flow of meteorological data is one of the best established applications known that works without any major problems according to the standards developed and introduced by the WMO. The backbone of transborder meteorological data traffic between East and West is the GTS network of the WMO. In addition, data from Western meteorological satellites is received and processed in the Socialist countries and data from Soviet meteorological satellites by Western and Third World countries. As a backup system to the GTS network between East and West, meteorological data are broadcast across borders in a manner defined and coordinated by the WMO.

International cooperation in the exchange of meteorological data has traditionally been good. The exchange of observational and processed data was based on interdependency and no cost. With the introduction of new and expensive observation, telecommunication, and information technologies this favorable situation is about to change. Although the guiding principles of interdependency and the free exchange of information still dominate, there is a growing tendency to introduce certain cost recovery policies due to the high investment and operating costs of new systems.

The new technological developments have brought considerable advances and benefit to mankind, however, and probably inherently, it has also triggered off some negative impacts, such as

- an increase in the overload of meteorological data for less advanced meteorological services
- an increase in the cost of forecasting and processing data
- a growing dependency by others on a few major developed countries coupled with the growing independency of these major countries on the rest of the world
- a polarization of countries with regard to their capability to utilize meteorological data, and
- an increase in trade restrictions in this classical field of cooperation.

REFERENCES

[1] *Encyclopedia Britannica*, Vol. 15, p. 28. Encyclopedia Britannica, Inc., William Benton Publisher, London.

[2] *Encyclopedia Britannica*, Vol. 21, p. 567.

[3] *Encyclopedia Britannica*, Vol. 23, p. 333.

[4] Mezoesi, M., S. Olasz, T. Csikely, Hungarian Meteorological Service, Budapest. Personal discussion, 1982.

[5] World Meteorological Organization (1981) *Manual on the Global Telecommunication System.* WMO Publication No. 386. Geneva, Switzerland.

[6] Wihl, G., Zentralanstalt fuer Meteorologie und Geodynamik, Vienna. Personal discussioı 1982.

[7] European Center for Medium Range Weather Forecast (1981) *ECMWF Newsletter* No. 2, p. 2. Reading, United Kingdom.

[8] European Center for Medium Range Weather Forecast (1982) *ECMWF Newsletter* No. 15, p. 1. Reading, United Kingdom.

[9] Deudney, D. (1982) *Space: The High Frontier in Perspective.* Worldwatch Paper No. 50. Worldwatch Institute, Washington, D.C.

[10] World Meteorological Organization Secretariat (1982) *Satellites in Meteorology, Oceanography and Hydrology.* WMO-No. 585. Geneva, Switzerland.

[11] European Space Agency (1978) *Applications of Earth Resources Satellite Data to Development Aid Programmes.* ESA SP-1010. Remote Sensing Working Group Experts, European Space Agency,

Paris, France.

[12] Barrett, E.C. (1979) Crop Environment Monitoring: The Remote Sensing Systems. In the Proceedings of an International Training Course organized by the ESA and the FAO on *Satellite Remote Sensing Applications in Agroclimatology and Agrometeorology*, Rome, October 1978. ESA-SP-1020. European Space Agency, Paris France.

[13] Secretariat of the WMO (1979) *World Weather Watch, The Plan and Implementation Programme 1980- 1983.* WMO No. 535. WMO, Geneva, Switzerland.

[14] Knighting, E. (1982) The European Centre for Medium-Range Weaher Forecasts, ECMWF, Reading, United Kingdom.

Chapter 12:
DATA COMMUNICATION AND NEW INFORMATION TECHNOLOGIES FOR CIVIL AVIATION

I. Sebestyén

DATA COMMUNICATION AND NEW INFORMATION TECHNOLOGIES FOR CIVIL AVIATION

I. Sebestyén

0 INTRODUCTION

Civil aviation started in many countries after World War I. For a long time aviation services were of marginal importance in public transport. It was rather the privilege of an exclusive minority and remained so practically until the 1950s. After World War II, aviation became a mass public transport service in a surprisingly short period of about twenty years. There were many reasons for this sudden change: primarily, the technological developments that allowed the introduction of reliable, relatively cheap mass produced airplanes driven first by internal combustion and then later by jet engines. The military role and importance of air forces certainly helped civil aviation in so far that it allowed--although with some delay--the diffusion of military aviation technologies into civil aviation. Second, after World War II, the economy became truly global and national systems were more and more interrelated and interconnected. With growing economic ties, political, institutional, and cultural relations were also linked closer together and last but not least mass tourism emerged on a scale never seen before. Generally there was a feeling that the world was becoming smaller and smaller. All these developments could obviously have not taken place if oil and energy prices were as high as they are today. Oil and consequently kerosene were cheap and the trade-off of civil aviation-- which could link continents in only a few hours, instead of the days and weeks that ships used to take--outweighed its relatively high energy demand and cost per passenger or unit of freight. Now, at the beginning of the eighties, the situation has changed dramatically. The increasing costs of energy and the general economic recession have meant that this mammoth aviation industry is also facing serious economic difficulties. The main slogan nowadays is to keep the "status quo"--to make airlines as economical as possible despite increasing costs.

Aviation and information industry, in broad terms, have always had a particularly close association. On the one hand aviation has been one of the main consumers of data, such as on weather, navigation, passenger or freight. On the other hand it has itself been a carrier of information in both a narrow and broad sense: in addition to the usual airmail baggages, one can also regard passengers as performing "information carrier and transfer" functions. In what follows we do not deal with this latter category; we only look at the civil aviation industry as a consumer of information with particular emphasis on the international transfer of relevant data.

From the very beginning, the aviation industry has been largely dependent on a vast amount of precise and readily available information. To satisfy this demand, the emerging aviation industry had to develop and built up its information and telecommunication infrastructure. In the early days of aviation this infrastructure was rather rudimentary and remained so for a long time. It is well known that pilots used rivers, lakes, mountains and towns as navigation aids--in fact in the early days of aviation these were almost the only aids available. Navigation aid from the ground was also rather limited: landing on an airfield was tracked by some kind of sign such as fire. New communication technologies such as radio have been invaluable from their introduction. In fact for a very long time radio has been the only effective means of communication between ground and air. As the volume of air traffic grew and the need for communication among airports, other ground facilities and planes increased, communication between ground units also increased--such as between town booking offices and airline reservation computers, or between one airport and another, e.g., when baggage gets lost--and also communication between the airplanes themselves.

This increase in the amount of information is required to keep civil aviation safe and to keep the rise in operational costs (caused by increasing fuel prices and labor) as low as possible with better information and management technologies. Fortunately, as we will explain in what follows, new information and telecommunication technologies will greatly promote this process. Since the end of the forties much has already been done in this field. For example, since the beginning of the seventies a huge international worldwide information and telecommunication network called S.I.T.A. has been built up to become one of the first international packet switched computer networks. The development of the aviation information and telecommunication network has not ceased; it is being upgraded day by day, incorporating the latest technologies and satisfying the increasing demand for aviation related information.

Although the demand for such information is still rising, it seems that for many applications the present infrastructure for handling the growing amount of more sensitive type of data is just not sufficient any more. Over the North Atlantic route between New York and Europe the heavy traffic and thus the overburden on the air traffic controllers was so heavy during the summer of 1981, that the entire traffic controller community of the US East coast went on strike for about two weeks in order to improve their working conditions.

The present navigation methods currently in practice seem to be rather primitive if we consider the opportunities offered by new telecommunication and information technologies. The majority of the communication between ground and airplanes is still by radio. This is basically real-time voice communication, meaning that the utilization of bandwidth is rather low, in addition to other difficulties caused by the speakers' ability to speak and pronounce English--i.e., communication is different from speaker to speaker. Improvements, such as the possibility of "store and forward" type of communication (mailbox principle) for certain purposes seems to be advisable and useful too. Also different types of computer supported applications could be initiated if other ways of communication existed.

With the emergence of new information and telecommunication technologies this becomes more and more feasible and S.I.T.A. is planning to introduce such services in the future.

With regard to East-West computer communication the exchange of aviation data is one of the most natural of the present transborder data flow applications. Although it could have created some issues of concern for some countries, it did not, and in fact it provides same examples of how nations should work together when satisfying their special "transborder data flow needs".

1 A DESCRIPTION OF S.I.T.A.'S SERVICES

Most major airlines use reservation systems in which terminals over a wide geographic area are connected to a central computer. Several major airlines have worldwide tele and data communication networks of their own. Many booking requests, however, cannot be fulfilled completely by only one airline. The airline might have no seats available, or the journey may necessitate flights on more than one carrier. Booking messages therefore have to be passed from the computer of one airline to the computer of another, and often the response is passed back swiftly enough to inform the booking agent who initiated the request at his terminal. In order to achieve this linking of separate systems, all participating airlines had to agree to a rigorously defined format for the messages passing between them. This format was standardized internationally by an industry association, called IATA. To operate the interlinking information data network, the airlines set up in 1947 an independent non-profit organization, called SITA (Societe International de Telecommunications Aeronautique). Through the SITA network separate airlines send IATA-format messages using SITA protocols.

1.1 SITA in Brief [1]

SITA is a non-profit making cooperative organization created by the airline community to meet its needs for telecommunication services. It was founded in 1949 by eleven airlines: Air France; three British companies, which form the present-day British Airways; KLM; SABENA; three Scandinavian companies, which today are merged in SAS; Swissair, and TWA. They pooled their existing telecommunications resources, which in those days consisted of radio-telegraph circuits and networks, with messages transmitted by Morse code or teleprinters.

From very modest beginnings SITA has today grown into a truly international enterprise, serving 241 member airlines in 154 countries of the world, and operates the largest private telecommunications network in existence.

The SITA network permits the worldwide exchange of commercial, technical, and administrative information for air transport and associated activities. By providing the airlines with a specialized, dedicated network, SITA ensures the rapid transmission of information relating particularly to aircraft movements and flight security. In this context, SITA holds a prominent position as a public service. Without the availability of the SITA network, member airlines would be greatly handicapped in their ability to communicate satisfactorily.

As of the end of 1980, there were over 18000 teleprinters and computer terminals in some 12000 airline offices located in 800 cities connected to the SITA network. Included are approximately 7000 terminals for 45 different computer based seat reservation systems, utilized by 103 member airlines.

In addition to its telecommunication network, SITA operates a large reservation system, called GABRIEL, in Atlanta, USA, which is shared by 30 airlines.

In 1980 SITA's total turnover reached 114 million US dollars.

SITA's worldwide operations are performed by a staff of 1750, most of them natives of the countries in which they work.

SITA's operation is truly international, with its 241 member airlines being represented at the General Assembly and on the Board of Directors, and by the various nationalities at the Headquarters and in Regional Management.

Since its creation in 1949, SITA has developed into a unique tool for worldwide air transportation, which, although based on the leasing of transmission circuits from the PTT administrations and "common carrier" organizations, is a "private" entity dedicated and restricted to the specific requirements of its users.

Services provided by SITA fall into one of two broad categories:

- **Telecommunications services**, the mainstay of SITA activities since its creation.

- **Information handling and supplementary services**, which SITA has offered since 1973/1974, and will be becoming more and more important in SITA's future services.

1.2 SITA's Telecommunication Services

1.2.1 SITA Worldwide Telecommunications Network

The SITA worldwide network today consists essentially of switching centers and teletype and data circuits, the circuits being meshed so as to provide a "fail-safe" alternative in case of outages on a particular route. The 174 switching centers, which are maintained and operated by SITA, perform a message and data switching function under the store-and-forward transmission principle.

The backbone of t .e network is the packet-switched (actually the first international packet-switched network in operation), meshed "High Level Network" currently composed of ten large switching nodes in Amsterdam, Beirut, Frankfurt, Hong Kong, London, Madrid, New York, Paris, Rome and Tokyo, linked by medium speed circuits operated in most cases at 9600 bits per second (Figure 1). It controls a second level of computerized nodes consisting of "Medium Level" centers, located in Bangkok, Manila and Sydney, and of 50 "Satellite Processors" (programmed data concentrators) scattered over the world and serving as interface devices for the connection of data terminals and teleprinters. A third level of the network is formed by Time Division Multiplexers serving as circuit concentrators, and by other types of data concentrators and manual telegraph switching centers.

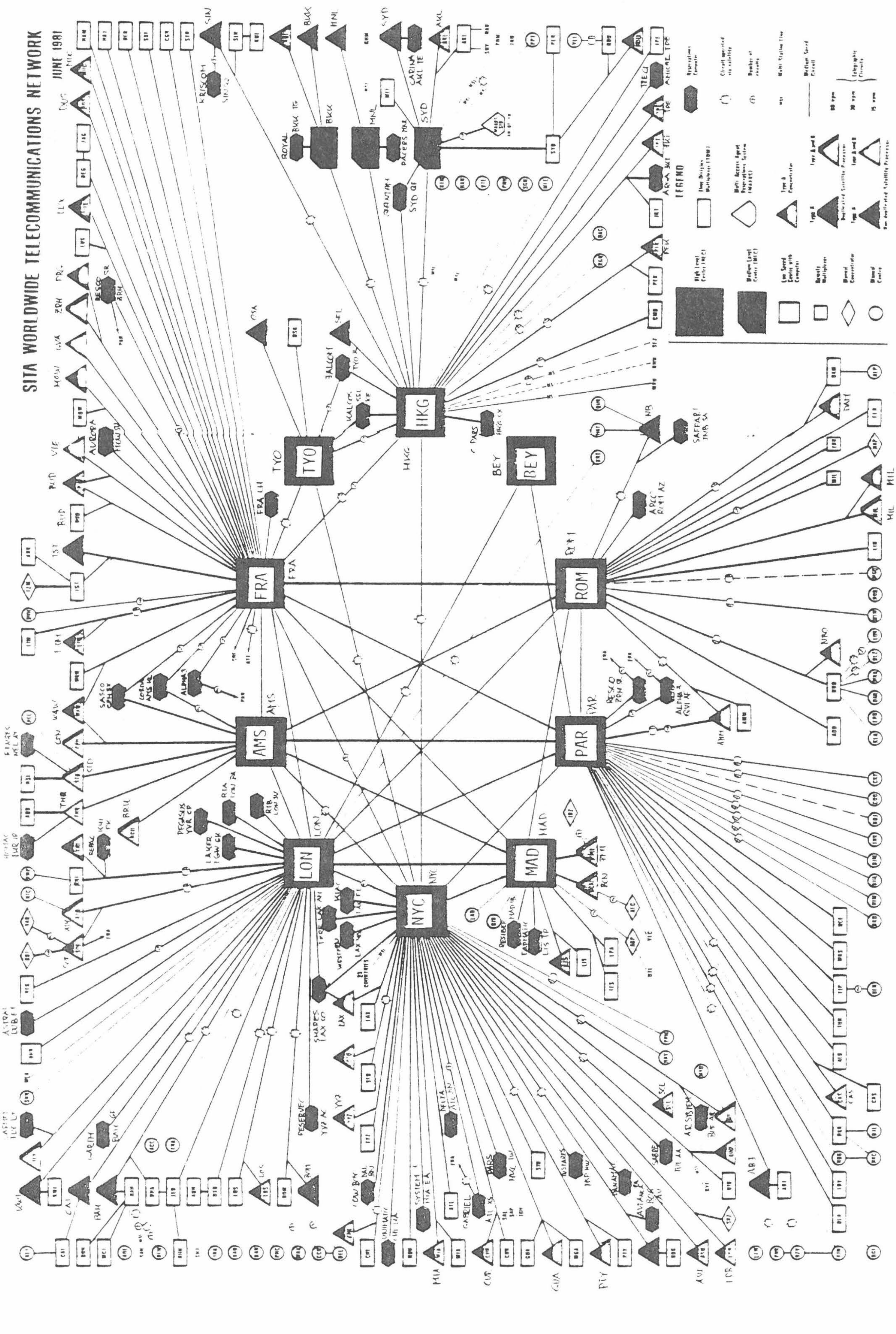


Figure 1. SITA worldwide telecommunications network.

In 1980 the SITA network included over 500 medium speed and 5000 low speed circuits.

The SITA network provides at present two types of communications services corresponding to two different types of traffic. Type "A" traffic refers to the conversational exchange of messages in real-time mode as used for instance for remote interrogation of airline seat reservation systems. For these relatively short (approximately 80 characters) enquiry/response type communication messages between usually a Visual Display Unit (VDU) terminal and a central computer, SITA offers a response time of about 3 seconds. Type "B" traffic refers to conventional telegraphic messages of about 200 characters whose functional information relates to flight operations and safety, aircraft movements, administrative matters such as lost luggage, flight services and status, and commercial activities such as sales and reservation. For this type of non-conversational traffic, SITA provides almost 100% security against message loss or mutilation.

In 1980, SITA transmitted approximately, 3.1 billion type "A" and 432 million type "B" messages.

The foreseen sustained increase in conversational type "A" traffic demand, together with the need to introduce new telecommunications services, have led SITA to study and define a new network architecture, the so-called **Advanced Network**, which is at present under development and implementation.

The *Advanced Network* intended to meet the airlines' future requirements in terms of evolving functional characteristics of communications services and of expanding traffic volumes, is recognized as being the largest civilian network project yet undertaken in view of the major development effort involved. There is a profound need to achieve a smooth transition from the current to the new architecture without disrupting the 24-hour-a-day service.

The definition of the **Advanced Network** architecture is the result of an in-depth analysis of the functions required for the provision of the present and future communications services. This analysis led to the identification of four major classes of functions, to which are associated four specific families of systems:

- **User Interface System (UIS)**

  for the support of user interface connections, concentration of data and translation of these data into internal network format.

- **Data Transport Network (DTN)**

  For the transport of data in transparent mode between two points.

- **Message Storage and Handling System (MSS)**

  For the storage and processing of messages requiring high protection (e.g., type "B" traffic).

- **Network Control System (NCS)**

  For the provision of control facilities required to operate the network.

1.2.2 Data Transmission Principles and Access Protocols

The present and future SITA automatic network may be accessed by its users through a variety of data transmission facilities and access protocols in line with the requirements expressed by the airlines.

Table 1 gives a summary of the transmission facilities and protocols presently available for accessing the SITA network.

Table 1. Access to the SITA network

Airline System	Data Transmission Facilities	Access protocol to SITA network	SITA service available
Teleprinter	Telegraph leased circuit	Point-to-point teleprinter procedure	Type B service
		Multi-station line procedure	Type B service
Telex procedure	Public Type B service	Teleprinter	Type B service
Reservation Agent Set (CRT)	Synchronous leased circuit	P1024 procedure	Type A service
		P1024 B procedures	Type A service
		P1024 C procedure	Type A service
Application Computer System	Synchronous leased circuit	P1024 (1) synchronous link control procedure	Type A service Type B service
		SIRCCO procedure	Type A service

(1) in compliance with ATA/IATA Synchronous Link Control Procedures

At present, SITA offers access through:

- Telegraph leased circuits of various types, according to local conditions in each country

- telex network, in which case the SITA connection complies with the regulations in force in each particular country
- voice grade circuits, of normal quality or complying with CCITT M1020 recommendations.

a) Interconnection Principles

For teletype traffic, airline offices are connected to the nearest SITA center via telegraph circuits leased by the airline from the local Post and Telecommunications administration (speeds of 50, 75 and 100 bauds).

If available, and for smaller volumes of traffic, the public telex service is quite convenient for delivering and receiving traffic to and from the network.

For conversational data traffic, modem-equipped medium-speed circuits operated at 2.4, 4.8, or 9.6 kbit/sec are leased by the airline between its offices and the nearest SITA center.

For this type of traffic, the SITA network can support different communications procedures and protocols as outlined in Table 1, according to the user's requirements. The access facility, as described, can connect either a terminal device in an airline office (teleprinter, VDU) or a more complex airline application system (Reservation, Check-in, etc.).

b) Access Protocols

Access protocols, such as the so-called SITA P1024 Synchronous Link Control Procedure, have been developed in compliance with ATA/IATA recommendations. The use of such standards permits the airlines to access the SITA network through the same protocol, irrespective of the computer equipment used at either end of the connection.

SITA has developed protocols for specific purposes to connect terminals or other equipment of a particular manufacturer, as for example, the P1024B procedure for terminal equipment responding to the IBM Airline Control Procedure known as IBM 1006 Line Control, the P1024C procedure for terminal equipment responding to the procedure defined in the UNIVAC document "UNISCOPE 100 Display Terminal Communication Control Procedure", and the IBM based SITA-IBM Reservation Computer Connection Protocol (SIRCCO).

Within the framework of the new Advanced Network development, SITA plans to support an even wider range of communications protocols, such as:

- The ATA-IATA based Airline Network Architecture (ANA) family of protocols
- the IBM based Synchronous Data Link Control protocol (SDLC).

1.3 SITA's Information Handling and Supplementary Services

SITA offers the following Information Handling and Supplementary Services on a cooperative, nonprofit making basis.

1.3.1 GABRIEL Reservation System

GABRIEL is a SITA owned and operated airlines reservation system based on a triple UNIVAC configuration located in Atlanta, Georgia; it provides a most comprehensive reservation and management information service to those airlines that for one reason or another, do not choose a privately owned or leased system.

The number of revenue passengers aboarded by the system in 1980 amounted to 17 million.

Currently more than 1700 terminals are connected to GABRIEL, which offers a system availability of 99.5% and an average response time of 3 seconds, worldwide.

There are currently thirty carriers using this system:

Aeroperu
Air Panama Internacional
Alia Royal Jordanian Airlines
Aviateca
Balkan Bulgarian Airlines
CAAC
Capitol International
Ceskoslovenske Aerolinie (CSA)
Cruzeiro do Sul
Ecuatoriana de Aviation
Ethiopian Airlines
Evergreen Int'l Airlines
Faucett
Flugleidir-Icelandair
Int'l Air Bahamas
Ladeco
Lan Chile
Lanica
Lineas Areas Paraguayas
Lloyd Aero Boliviano
LOT-Polish Airlines
Luxair
Malev Hungarian Airlines
Pakistan Int'l Airlines
SAHSA
Surinam Airways
Syrian Arab Airlines
TAN
Transamerica
Varig

As can be seen from the above list the carriers utilizing GABRIEL's services are smaller airlines, which would usually find it difficult to set up and operate their own computer reservation service linked to SITA. Other, bigger airlines operate usually their own reservation systems: thus, for example, AIR FRANCE operates its ALPHA III system located in

Valbonne (France) with 360 terminals, British Airways + Air India its BABS+RTB systems in London with 839 terminals, KLM its CORDA system in Amsterdam with 528 terminals. For tradition and resource sharing purposes it is also usual practice for some smaller airlines to join these systems rather than GABRIEL. For example, the British Airways system is also "host" for eight other small airlines. The same is true for the GDR airlines' INTERFLUG, which utilizes the AURORA system of Aeroflot located in Moscow, and serves 53 agent sets via SITA. It is interesting to note that the physical connection between East Berlin and Moscow goes through the Frankfurt/M node of SITA. Swissair and Austrian Airlines operate jointly the RESCO system in Zurich, JAT--the Yugoslavian airlines--has its reservation file under the KLM system in Amsterdam; Malev the Hungarian, CSA the Czechoslovak, LOT the Polish, and Balkan Bulgaria Airlines use GABRIEL in the USA.

Thus it can be seen that with this mixture of system usage there are no political fears in this category of transborder data flows-- not even because of vulnerability reasons. There is, however, some concern especially by some Western European countries about potential privacy problems [2]. Some French sources, for example, expressed their view with regard to SITA, that the most dangerous aspect of this network is the communication about the actual movement of people. For example, Air France puts on microfiche all its reservation transactions. It is feared that at some stage this information could be misused--although it would be against the French law.

GABRIEL is a shared real-time reservations and information processing system, a true multi-host system with participants sharing the central site hardware and programs, but with their data residing in each airline's discrete files. All airlines are treated by GABRIEL equally, with the same priority, and with full security.

The current GABRIEL system is based on 12 years of development, usage, and refinement by the user airlines and operating staff. It has been continuously updated and kept current in accordance with ATA/IATA standards.

The system also enhances service to the air traveler by providing immediate confirmation of interline space for both GABRIEL users and other airlines.

By utilizing the SITA high level data network, GABRIEL is available to all SITA members for online or interline services. SITA's offices throughout the world provide representation and liaison for all aspects regarding GABRIEL and associated telecommunications services.

The central site processors in Atlanta, purchased with the original system, consisted of two UNIVAC 494's. A third 494 was added to accommodate new users. More recently, UNIVAC 1100-83's were purchased to replace the 494's and to facilitate the addition of new applications and users.

Conversion of the programs from the current system (GABRIEL I) to GABRIEL II is underway. The first version of GABRIEL II is scheduled for early 1983.

GABRIEL II was developed from the basic UNIVAC Standard Airlines System (USAS), from selected features' from the original GABRIEL Services (GABRIEL I), and with new features emanating from GABRIEL user requirements.

Basically the current system provides:

- All the requirements of an airline reservations system.
- A hotel accommodation availability and inventory system.
- Interface with car rental systems for availability and direct sales.
- Interface with credit card systems for modifications and authorization.
- The IATA/SITA Baggage Tracing System (BAGTRAC).
- METEO - A worldwide weather data disseminating system.

Developments underway, or being considered at the request of SITA members, include centralized departure control, fare quotation, tour control and sales, and automated ticketing.

The New GABRIEL II Passenger Name Record Reservations System

The upcoming GABRIEL II Passenger Name Record (PNR) System provides state-of-the-art processing for all areas of reservations requirements. The following highlights some of the key features.

Reservations Sales

- Comprehensive displays of schedule and availability information.
- Logical transactions for creating, retrieving, modifying, and canceling PNR's.
- Provisions for up to five agents using a single CRT, or for one agent processing up to five transactions concurrently on a single CRT terminal.
- Control of transactions allowed for travel agencies equipped with user CRT's; e.g., one agency may not retrieve a PNR created by another agency, an important facility to secure privacy of passengers.

Reservations Control

- An extensive and sophisticated range of transactions and processing for parameters such as availability status (AVS) levels, group limits, combined classes of service, and payload control.
- Automated processing for waitlist confirmation. Confirmation priorities are ordered so as to realize maximum revenue while providing good passenger service.

Flight Schedules Management

- Provisions for loading and changing host flight schedules by CRT from each user's central reservations office. Processing is online and includes all necessary features such as passenger protection and advise-schedule-change notifications.
- Provisions for loading and changing other airline schedules by magnetic tape supplied by a third party. Content of the tape is dictated by user-supplied parameters.

Management Reports

- Reports containing data regarding reservations agent and office activity. For example, a report may be requested containing the following information for one or more agents: number of host seats booked, PNR's created, total transactions, and error responses.
- Reports containing data regarding inventory flight activity. Examples of these reports are: (1) load factor for the preceding day's flights; (2) seats booked, open, and waitlisted over a city pair for a specified date or date range; and (3) flights with less than a specified number of seats open for a date or date range.

Given the numerous report parameters contained in the system, the user controls the content and scope of each report.

1.3.2 BAGTRAC - The IATA/SITA Baggage Tracing System

BAGTRAC is a worldwide automated baggage tracing service, jointly developed by IATA and SITA and has been offered to the air transport industry since March 1980.

This service facilitates the speedy recovery of misrouted passenger baggage for all participating airlines. It allows information exchange both within a given airline as well as between airlines throughout the world.

IATA is responsible for the overall administration of the service, while SITA provides the technical support using its GABRIEL data processing center located in Atlanta. By the end of 1980, 54 airlines were connected to BAGTRAC.

This is how BAGTRAC works: Suppose a tourist is traveling from New York to Amsterdam, with a connecting flight *via* London. Arriving in Amsterdam, he cannot find his luggage, because in New York, through a conveyer belt mishap, the destination tag was ripped off and his bag ended up on another airline's baggage cart for a flight to Paris. He at once reports the loss. This is how "BAGTRAC" will work to return his bag:

- Amsterdam enters the missing baggage report in "BAGTRAC"
- Paris enters the unclaimed baggage information in "BAGTRAC"
- Amsterdam receives a computer match based on name, bag type and color.
- Amsterdam contacts Paris, verifies contents, etc., and determines that it is the tourist's bag
- Paris forwards the bag to Amsterdam on the next available flight--and Amsterdam delivers it to the tourist within 24 hours.

In a manual tracing environment, Amsterdam would receive negative replies from both New York and London, and would have no idea where to continue the search, resulting in interim passenger expenses and a lost claim processed after 5 days, another lost claim paid if the bag is not recovered in 21 days, plus a very dissatisfied customer!

BAGTRAC benefits are clear:

- **Improved customer service** with a faster return of mishandled baggage to the passenger.
- **Reduction in lost baggage claims** and "out of pocket" passenger expenses, through a more efficient baggage tracing system, at a reasonable cost.
- **Increase in the mishandled baggage recovery rate and improvement of staff productivity; less workload and paper to handle for local baggage tracing offices at every network station; less workload for Headquarters' Lost & Found Office,** with fewer missing baggage reports and unclaimed bags to process in the race against time to avoid the payment of a claim.
- **Provides useful management information:** A monthly statistical report generated for each carrier, by station, on the first day of each month for the previous month's tracing activity.
- **BAGTRAC reduces lost baggage claims on average by 25%:** BAGTRAC represents a typical transborder data flow application that could not be solved otherwise and that has clearly only positive aspects.

1.3.3 SITA's Meteorological Service

The Meteorological Services, currently provided to several airlines, consist of the selection of global meteorological data obtained from the US National Meteorological Center (NMC) in Suitland, USA.

SITA's Meteorological Service provides worldwide meteorological forecasts of wind speed and direction plus temperature for three upper air levels and also gives the so-called tropopause height.

The service dispatches information using SITA TYPE B telegrams or short delay TYPE A messages either automatically or on specific request.

According to specific user requirements, data are transmitted twice daily to the service participants for flight planning purposes.

The forecasts are generated by the NMC approximately 5-6 hours subsequent to the observation periods of 0000 GMT (midnight) and 1200 GMT (noon). Each forecast is sub-divided into so-called bulletins, which consist of all the data for one altitude category, such as high level, for one major geographical area such as South Pacific, and for one time period (12, 18, 24 or 30 hours after observation time). Each bulletin is further sub-divided into so-called blockettes, each consisting of one ten-degree square area within the major geographical area. (A blockette can contain up to eight sub-squares.)

It allows participants to select the specific information they wish to receive, based on observation period, altitude level, geographical area, and time period.

Each METEO participant will be allowed to identify the specific information to be received, as follows:

• Observation Period	(0000 and/or 1200 GMT)
• Altitude Level	(Low/Medium/High)
• Geographical Area	
• Time Period	(Forecasts for 12, 18, 24 or 30 hours after observations)

- Blockette Area (10-degree square area)

Forecast structure

Each forecast can be structured according to the following specifications:

- **Observation Time**
- **Altitude Category** (mb = millibar)

  (Low, middle and high level data--winds and temperatures).
- **Geographical Area**

  The forecasts for the entire globe are broken down into geographical regions, such as countries of the Northern Hemisphere (North America, North Atlantic, Arctic, North Pacific, Japan, Caribbean, Philippines, Pacific, Asia, Arabian Sea) and of the Southern Hemisphere (South America, South Pacific, Africa, Indian Ocean, Antarctic).

Benefits

METEO Provides accurate and up-to-date worldwide meteorological information essential for optimum **flight planning**, thus saving fuel, time, and operating expenses.

It permits selective choice of data thereby reducing transmission and processing costs, transmits via reliable channels the information as soon as it is received from NMC and provides a 24-hour service, 7 days a week.

1.3.4 SITA Departure Control Services

The SITA Departure Control Services (DEPCON) are based on a standalone system aimed at catering for the requirements of a group of airlines or individual carriers whose passenger volumes do not exceed 1000 per peak hour. The system provides for three basic functions, namely check-in, weight-and-balance, and boarding pass printing.

At present there are installations in Budapest (1978), Sofia (1979) and Abidjan (1981).

The Budapest installation will be expanded to include a flight information display system that will provide the airport and airlines with automated flight arrival and departure information.

2.4. Planned SITA Services

As mentioned above the services provided by the SITA network are being extended gradually with new facilities and services. By their nature, these tend to be more and more digitalized, being based on new information and telecommunication technologies.

The following telecommunications and data processing services are being evaluated technically and economically or are under development by SITA:

- Digital Air-Ground Communication Service (AIRCOM)
- Shared Air Cargo Service
- Shared Aeronautical Database (AERODAT)
- Tariff Reference System
- Data Processing Fallback (Disaster or Contingency Planning)
- Flight Planning

1.4.1 Digital Air-Ground Communication Service (AIRCOM)

In October 1981 SITA completed the implementation of an AIRCOM test facility consisting of a computerized central site and two remote ground stations. Service implementation is planned for the first half of

1984. This service will be an interesting new transborder data flow application in the sense that it will provide flow of digital data between fixed ground stations and mobile stations on the planes.

Background

Efficient and reliable air/ground communications facilities are a major requirement of the air transport industry.

As mentioned earlier, until recently the internal operational communications requirements of an airline were satisfied by and restricted to **voice** communication only, using VHF (Very High Frequency) or HF (High Frequency) radio transmission between aircraft and ground stations.

In 1977, the first operational air/ground digital service was introduced in North America by Aeronautical Radio Inc. (ARINC). This system, referred to as ACARS (ARINC Communications Addressing and Reporting System) has been successfully adopted by a large segment of the North American airline industry.

The requirements for the provision of a similar facility in other parts of the world remain to be fulfilled. At the request of its member airlines, SITA has initiated a digital air/ground communications study for those regions that are not covered by ACARS. This has resulted in the definition of a new SITA service called **AIRCOM**, which is proposed to be put into operation in the forthcoming years and which will be fully compatible with ACARS as provided in North America.

Service Overview

The basic function of the AIRCOM service is to allow the exchange of data in digital form between an aircraft and the airline ground based flight operation personnel and facilities.

The current voice communications system requires human intervention at several levels, and as a result suffers from multiple limitations, among which are:

- High overhead of redundant procedures required for reliable communication.
- Impossibility of transmitting automatically acquired data.
- No real-time data exchange capability.
- Limited efficiency in the utilization of the frequency spectrum.

The development of AIRCOM will introduce a 2400 bps air/ground data link capability for automatic, accurate, real-time data exchanges between an aircraft and a ground-based communication network. This link will take advantage of error detection and recovery features provided by modern communications protocols. It is intended to **complement** the existing air/ground voice communication and will provide a communication capability between the advanced avionics of current and future aircraft and ground-based airline data processing facilities.

AIRCOM is intended to support a wide range of data exchanges to fulfill a large spectrum of airline applications.

The availability of the AIRCOM Service to exchange digital data will facilitate the progressive automation of key airline operation applications in the fields of flight operations (flight movement supervision and flight management applications), aircraft maintenance and engineering, logistics support, etc.

AIRCOM System Architecture

From a technical standpoint, the AIRCOM service will be provided by a network of dedicated VHF ground stations (referred to as remote ground stations) supporting downlink and uplink data exchanges connected to the nearest SITA Network Interface System (i.e., Satellite Processor or any other type "A" access facility).

All AIRCOM traffic received by the remote ground stations will be routed as type "A" data blocks via the SITA Network to a so-called SITA "AIRCOM Service Processor" central computer system in charge of so-called AIRCOM Service supervision and AIRCOM message processing (addressing and routing, format and code conversions, end-to-end communications control, etc. ..). From the Service Processor, messages are then sent to the airline ground destination facility (terminal or computer system) via the Network.

This system architecture makes extensive use of the existing SITA Network infrastructure and facilities, thus minimizing system deployment investments and circuit costs.

Furthermore, the AIRCOM Service will benefit from the high performance (message delivery in a few seconds) and reliability of the SITA Network.

Applications

Company applications of digital air/ground communications encompass a very wide spectrum of activities and will depend upon each airline's procedures, organization, and general policy for computer assisted operations. For the above reasons, the "application profile" of air-ground data link technology will remain specific to each airline, while being related to general application fields that can be recognized and identified as being common to most airlines. The following are given for illustration purposes.

a) Flight Operations

- The automatic generation and transmission of flight events, and the transmission of additional information from or to the crew should provide the means to achieve accurate and efficient aircraft movement control.
- Cockpit delivery of Preflight Information/Documentation (Flight Plans, Weight and Balance, etc...).
- Transmission of flight operation parameters such as fuel status, engine thrust levels, etc...
- Transmission to the aircraft of weather updates and route diversion information.
- Flight Management Computer data exchanges for FMC database updates, etc...
- Transmission of Meteorological Data (Up and Down).
- Crew Registration.

b) Aircraft Maintenance and Engineering

Initially, so-called aids acquired engine operation data using short delay transmission can be used for urgent and fast computer aided analysis of incidents occurring at locations far remote from the home base. To reduce the number of such events there will be a continuous monitoring of flight times as extracted from flight events. The crew, at its own initiative, will provide direct transmission of maintenance related information from the cockpit to further shorter intervention delays on the ground.

This application will be extended to a more general trend of analysis of engine behavior involving very short "turnaround" delays. This approach will be very useful for preventive verifications/interventions and for more accurate management of engine performance data.

c) Logistic Support

- Transmission of flight events,
- Transmission of fuel status,
- Route diversion reporting,
- Seating arrangements,
- Miscellaneous information as needed by each particular airline procedure.

AIRCOM Development Plan

SITA plans a phased deployment of AIRCOM. At the end of 1981 a pilot AIRCOM unit including two remote ground stations and a basic AIRCOM Service Processor was available for service evaluation by the airlines (KLM was the first airline considering participation in the experiment). The operational deployment will start with the installation of 50 VHF ground stations offering coverage of major international airports and air routes in Western Europe and the Mediterranean Basin.

From the initial phase and according to airline needs, it is planned to extend the service coverage to other parts of the world, such as Asia, Africa and the Middle East, by adding ground stations connected to existing SITA type "A" access facilities.

The worldwide coverage of the SITA telecommunications network, and the already existing large number of ground station connection points, will permit SITA to provide AIRCOM coverage over very large continental areas at very moderate cost. For these reasons, SITA believes that VHF and HF data link technologies should not be considered redundant, but complementary, and that they should be combined so as to provide an optimum global coverage in terms of costs and performance.

AIRCOM is a typical example of how new information and telecommunication technology n specific applications help personnel (crew and land) cope with the growing amount of information, rather than just "kill" jobs.

1.4.2 Shared Air Cargo Service

This service is of interest to airlines that have not yet automated their cargo functions. The service is designed to monitor and control the entire cargo operation of an airline and includes reservation functions, warehouse control, flight load preparation, etc.

With the growth of the Air Cargo business and the pressure on airlines to reduce costs and to increase revenue, more and more airlines are placing emphasis on the profitability and marketability of their freight operations. This coupled with the increasing need for detailed, accurate and timely information about the cargo operation, has led many airlines to automate cargo functions, or to investigate the possibility of doing so.

Therefore, SITA decided to offer a Shared Cargo Service to the airline industry in 1981. This SITA service will be the first shared computerized airline cargo service in the world. It will offer to carriers a real time system featuring data capture and control functions for Airline Cargo Service and Cargo Revenue Accounting.

The Alitalia FAST III system, together with the Swissair online schedule change, has been selected for this new SITA service.

System Aspects

In early 1983 the SITA Shared Cargo Service will be operated on IBM equipment (IBM 4341) and located at the Paris Head Office premises. The configuration chosen is fully duplicated, which will ensure continuity and smooth operation of the system.

Like other services, the SITA Cargo service will be a continuous service operating 24 hours a day, 7 days a week.

Functional Aspects

A brief list of the major system functions is as follows:

- Capacity Control
- Reservations

  A reservation agent may display cargo availability either for a specific flight or city pair on a specific date/time.
- Warehouse Control and Inventory

  The system includes every aspect of warehouse management.
- Air Waybill Data Input/Printing

  The SITA system provides for the complete capture of all air waybill data, including total quantitative and charges information.
- Flight Preparation

  Prior to flight departure, the system will be requested to produce a pre-list of shipments based on a certain priority of selection established in the system.

These lists will be used in the terminal to assemble the flight, the agent having the ability to override the system selection by adding/deleting shipment records from a displayed list.

- Flight Manifesting and Dispatch

  At the conclusion of the pre-list preparation a request will be made for manifest product.

  At the time of actual flight departure a confirmation message will be entered in the system, which will update the status of all associated air waybill records.

- Flight Arrival

  Due to the early accessibility of information concerning flight load details, a receiving station has greater flexibility to preplan workloads and special shipment handling.

- Flight Delivery/Transfer

  The final air waybill record entry, will be to inform the system of shipment delivery, or transfer to another airline.

- Cargo Revenue Accounting Functions

  A major design feature of the SITA system is the data capture of all finalized air waybill record transactions, providing total information for the airlines accounting and billing needs.

System Benefits

Taking advantage of the facilities described above, a SITA Shared Cargo Service user will benefit from improvements in:

- Customer service - Immediate ability to provide customer with current shipment status and information.
- Flight capacity - Improved utilization of flight capacity and allocation procedures.
- Freight claims - Reductions in shipment loss claims.
- Personnel Productivity - Improved accuracy of terminal control information.
- Accounting - Reduction in air waybill billing cycle times - Improved cash flow - Audit security.

The Shared Air Cargo Service will also be a typical transborder data flow application that could not otherwise be done.

1.4.3 Shared Aeronautical Database (AERODAT)

This new service plan covers the implementation of an aeronautical database containing information relevant to air navigation, flight preparation and operation. It is being defined in close cooperation with several airlines and should be of interest to the whole airline community. Work on the service is still being carried out; definite date for service introduction will be defined later.

1.4.4 Tariff Reference System

The purpose of this planned new service is to provide airlines with an efficient tool to perform fare calculations. This service also includes the maintenance and distribution of fare information.

As very few airlines are currently equipped with this type of facility, the proposed service would be of interest to a majority of SITA members.

1.4.5 Data Processing Fallback (also referred to as Disaster or Contingency Planning)

This service would make available real-time computer facilities to airlines with their data processing centers temporarily disabled by unforeseen events. Such a capability is of interest to a number of airlines and is being evaluated for implementation in 1983.

1.4.6 Flight Planning

This service provides for the automatic preparation of flight plans for those airlines not equipped with the necessary facilities, and is of interest to a large number of airlines.

The development of the SITA Flight Planning Service started early 1982. It is planned that the implementation of the service will take place in 1983.

Objectives

The objective of the system is to provide improvements in the accuracy and accessibility of Flight Planning Services through utilization of the SITA Network and State-of-the-Art data processing equipment. Basically, the system entails the execution of a number of software modules to find the optimum route from origin to destination for an airlines flight segments. The effects of weather and aircraft performance are considered over the authorized navigational routes to find the route that yields the minimum cost, minimum fuel, or minimum time as requested by the user. Starting in 1983 an airline may access this system through either CRT or teletype terminal for rapid delivery of tailor-made flight plans for any or all of its flight segments.

Obviously, the first priority in all flight operations activities is safety. Governmental and industry standards for proper fuel loads and navigational procedures must be strictly adhered to. Therefore, the system will be designed for use by licensed airline personnel (dispatchers and pilots) as a means of making an extensive analysis of all relevant parameters for the dual purpose of ensuring safety and generating the optimum route. The speed and accuracy of high speed computers will be used to aid the decision-maker in selecting the best route available under the prevailing circumstances.

Flight planning fits very well with other flight operations applications that are either already available or under review for possible future offering by SITA-METEO, AIRCOM, and AERODAT.

AIRCOM--as mentioned earlier--is a SITA project to provide an air to ground communications facility from the cockpit to flight operations. Flight planning will feature a direct utilization of this application for onboard delivery of flight plans either before departure or while actually en route in the event that a pilot desires to re-evaluate the data affecting the flight. An additional feature that many leading aviation authorities are discussing is the possibility of directly loading a flight plan generated at the ground based central site computer facility into the onboard Flight Management Computer (FMC) that will be present in many of the new generation of aircraft, such as the Boeing 757, Boeing 767, and Airbus 310. AIRCOM may provide the necessary communications link between the large database and very fast ground processors and the new intelligence of the microprocessor based onboard systems. The result could be another step forward in the technological advance toward more accurate and up to date flight plans.

AERODAT also fits very well into the group of Flight Operations Applications under discussion by supplying a new level of precision and comprehensive coverage in navigational data. This project is the result of a movement within the international airline community to improve upon and enhance existing sources of navigational data. SITA Flight Planning will benefit from this service by having a direct interface to this worldwide database to provide expanded geographical coverage and a new precision in the accuracy of the data elements themselves. An additional benefit for the user who chooses to use both AERODAT as the basis of onboard FMC data and SITA Flight Planning for optimum route selection is the added confidence to be gained in the knowledge that total compatibility is guaranteed since both the systems depend on the same source of data.

Features

While SITA Flight Planning will be offered on the same basis as other SITA Data Processing services and therefore will continuously evolve over time to reflect changing user requirements it is appropriate to describe those features that will be available to the first users when the service is initially handed over in 1983.

Typically, a user of the SITA Flight Planning Service will access the system through a CRT (Type A) or Teletype Terminal (Type B) located within the Airline Flight Operations Department.

By executing the appropriate transaction he may either display or update elements within the Data Base or direct that a Flight Plan be calculated for a specific flight. As mentioned above, the meteorological data and navigational data will be made available to the user by direct interface to SITA services such as METEO and AERODAT. In addition, the user will be provided with user friendly transactions for the entry of aircraft performance data and preferred company routes. Naturally all data will be edited for accuracy and reasonability. At the user's direction a number of mathematical algorithms will be executed to generate the optimum flight plan. A printed copy of the Operational Flight Plan and the ICAO Flight Plan will then be automatically delivered to the user. The

Operational Flight Plan will be tailored to reflect each individual user's format requirements. The ICAO Flight Plan will be automatically calculated.

A number of additional functional features will be available. Among these are:

- The availability of Organized Track System (OTS) fixed tracks in areas such as the North Atlantic and Pacific through an interface to the ICAO sponsored AFTN.
- The automatic mathematical formation of overwater route networks for three-dimensional selection of the optimum route.
- Variable speed and altitude changes during cruise phase.
- Special Flight Plans will be available to minimize reserve fuel requirements for those carriers who select this option.
- Reanalysis will be available to generate revised flight plans in the event that new forecasts become available or any other parameter can be modified while actually in flight.
- Equitime and point of no return will be available.
- Both Jet and turboprop Aircraft will be considered.

Benefits

Finally, through the shared services concept all participating carriers will benefit from lower costs. This will be true in direct benefits from reduced flight operations costs (fuel, aircraft, and pilot time) and also through lower administrative activity in the preparation of each flight plan. Also, a very important benefit is in the enhanced features that will result from shared ideas and concepts emerging as more users participate in the service and also from periodic user meetings.

Suggestions for improvements and cost saving measures will benefit not only the airline who originates the suggestion but also all other users. Last but not least this transborder data flow application will give an excellent example of how new information and telecommunication technologies can help to save energy and materials. It also provides services that help aviation staff to digest the vast flow of information, which would not be possible otherwise.

2. AERONAUTICAL FIXED TELECOMMUNICATION NETWORK (AFTN) [3]

Let us now have a look at the less known network that supports at present the Air Navigation Services system. Compared to the SITA network the so-called Aeronautical Fixed Telecommunication Network (AFTN) is not so advanced. This government operated network, which came into existence before the SITA network started to operate, is a dedicated telecommunication network for air traffic control purposes. It also allowed business information of airlines to be transmitted but only on a low degree of priority. This actually led some airlines as early as 1948 to pool their telecommunication resources and as we know in 1949 SITA was founded.

As mentioned above, AFTN is less advanced from the technical point of view. It is first of all considerably slower, is not suited for interactive traffic and does not support the distribution of large portions of information. Due to these deficiencies it only carries a small part of the total amount of information exchange within the Air Navigation Services

System (ANS). In [3] it has been found that about 175 different data types are distributed over six so-called Aeronatural Data Categories (Table 2). Many of these data types are presently exchanged by mail, standard telephone, or if speed is required, on dedicated lines. In fact only 35 of these are distributed through AFTN.

Table 2. Aeronautical data categories

Notam information	**ANS system internal information**
Class I	Emergency procedures
Snowtam	Letters of agreement
Airac	Hi-jack procedures
•	Fuel jettison areas
•	•
•	•
AFTN messages	**Meteorological messages**
distress message	Metar
Accident message	Sigmet
Flight plan	Current air pressure (QNH/QFE)
Departure message	•
•	•
•	•
•	•
AIP information	**Technical Status message**
Regulations	Nav-aid status data
Routes	•
Reporting points	•
Zones	•
Areas	•
•	
•	
•	

There is a strong feeling by many experts that this system is hardly able to meet today's requirements. Apart from growing air traffic, meaning growing quantities of information, there is an increasing demand within the ANS system for more efficient methods of access to Aeronautical Information data. And modern information and telecommunication technologies favor the satisfaction of such demands.

The above demand is also reflected in the work of the UN organization for civil aviation (ICAO), which created already in 1967 a special panel working on the definition of a better ANS communications system, the common ICAO, Data Interchange Network (CIDIN). In Figure 2 a projected implementation plan for the European part of AFTN (CIDIN) is presented. As can be seen from its topology it is different and separate from the telecommunication network used by SITA.

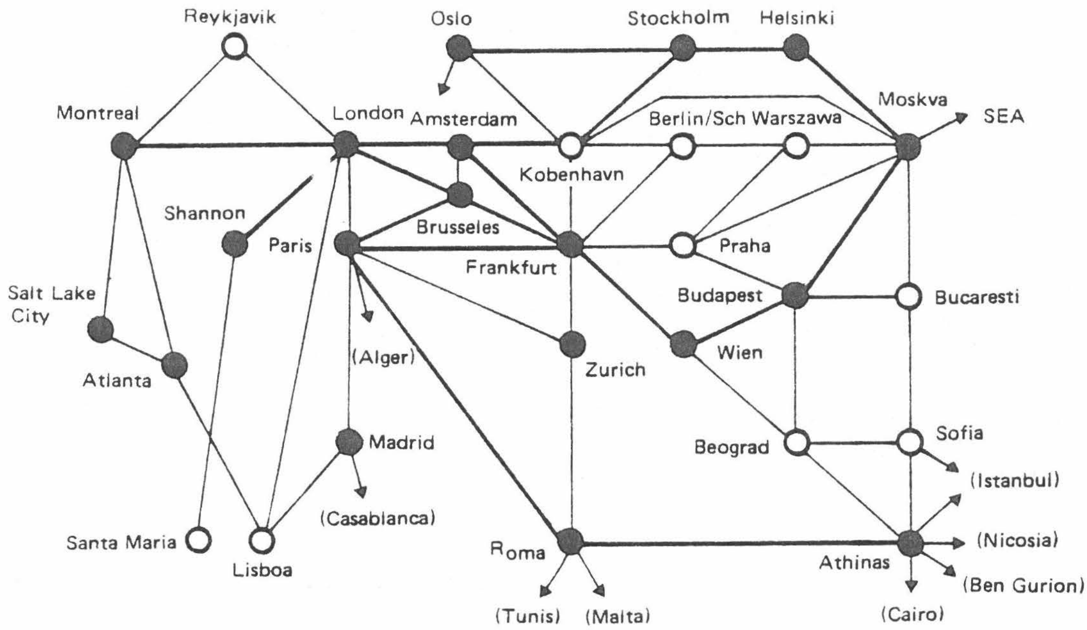


Figure 2. Typical example of AFTN development in the Eighties (CIDIN)

According to [3] up to the end of 1981 no concrete decision has been taken how CIDIN should actually be implemented.

It is, however, worthwhile to note that SITA, seemingly independently of AFTN, plans to introduce its AIRCOM system in 1984 to cover most aeronautical data categories anyway. In this respect we might see a convergence of these two network activities in the future.

3. CONCLUSIONS

It has been shown that data communication for aviation purposes is currently one of the most important transborder data flow applications. There are at present two networks, SITA and AFTN, which provide the telecommunication, data communication, and partly the data processing basis for such types of applications worldwide. Their importance is constantly growing and new services are continually being added. Major developments are expected in the field of digital air-ground communication services, which would provide better means for flight operations, for aircraft maintenance and engineering, and for logistics support.

With regard to transborder data flow problems the flow of aviation related information, be it for passenger reservation or for flight control, seems to be less sensitive; it is, however, not without any issues of worry. One problem, for example, is that data for passenger reservation systems crossing borders fall into the sensitive category of flow of personal information into foreign countries. Although this type of information is primarily serving "transactional" purposes, such as booking a seat for Mr. X on flight Y, or checking whether Mr. X is already a passenger of flight Y, a theoretical long term archiving of such information at the reservation computer's site or at one of the SITA switching nodes could bring major concerns in some countries with privacy legislations. A general legal problem is, for example, when reservation data (which are private data thus subject to privacy protection) have to be transferred from a country with strong privacy legislation to the reservation computer system of a carrier in another country, which is not protected that much or at all by local privacy laws. Usually, national privacy legislations or guidelines call for an equivalent privacy protection when such data is transferred, processed and stored abroad. If such regulations, however, were strictly followed then, for example, no one could fly from Sweden to the GDR by Interflug. The number of similar relations between other countries is vast.

In Hungary, for example, according to the Hungarian data regulations transmission of personal data over borders is is in principle possible, but all personal data are regarded as so-called "office secrets", which only can be transmitted over the border if crypted [4]. It is known, however, that the SITA transmission protocols do not entail cryptography of data, thus strictly speaking no single reservation request to GABRIEL could be made from any Hungarian terminal.

In other countries, such as Austria, any transmission of data from and to abroad requires export and import licenses, which would also make any booking reservation transaction impossible.

There are also other transactions of concern to many information policy making bodies, that are daily practice on SITA to everyone's greatest satisfaction. Database services containing personal data are operated in foreign countries, personal data flow between two countries is routed through a third, where the information for networking purposes is stored--and all these between countries with all possible political colors. The fact that in spite of these no-no's the whole system works to the full satisfaction of its users, and this for more than a decade, suggest that regulation of transborder data flow--if it has to be introduced--should also be approached from the different major application categories, rather than from a universal point of view.

There is, however, a tendency to drive towards a convergence and rapid change of the different application categories, which makes the regulatory process even more difficult. As we have shown the SITA network of yesterday, which carried primarily passenger bookings, air cargo and airlines information, in addition is carrying today and tomorrow, meteorological air navigation data and new types of data.

Another well known problem is that with the growing u tilization of new tele :ommunication and information technologies we witness a growing dependence of developing nations on the developed nations. Problems of export and import embargoes and other trade restrictions are familiar in this field too.

All in all, data communication for aviation purposes is an essential field of transborder data flow applications, which could not be done without cooperation and mutual understanding between nations.

Many of the applications looked at prove that when new information and telecommunication technologies are rightly applied they do not have to kill jobs, they can also enable new services to be implemented (which could not be done otherwise) and lead to savings in energy and materials.

REFERENCES

[1] SITA, 1982. Various SITA brochures and annual reports. Paris, France.

[2] TDR correspondent, 1982. SITA's 154-country Airline Data Network, TDR Vol. V. No. 5., page 233. North-Holland Publishing Company, Amsterdam.

[3] Vonk, W.J.A., 1981. Data Communications within the Air Navigation Services System, Controller, Vol 20, No.4, pp 17-18.

[4] Hungarian ministerial regulation 1/1981. (1.27)(by the Minister for Internal Affairs) on the security, property and fire protection of computer systems, 1981. Magyar Közlöny, 1981, No. 5, Pp. 130-136. Budapest, Hungary.

Chapter 13:
FLOW OF INTERNATIONAL NEWS OVER DATA NETWORKS

I. Sebestyén

FLOW OF INTERNATIONAL NEWS OVER DATA NETWORKS

I. Sebestyén

0. INTRODUCTION

The history of news agencies goes back well into the last century. The first French news agency Havas--a predecessor of AFP, the present French News Agency-- was founded as early as 1835; Reuters--a news agency owned by the newspapers of the UK, Australia, and New Zealand--was created in 1851 by the German-born Paul Julius Reuter; and Associated Press (A.P.), the oldest and largest US agency, started its activities in May of 1848 when six New York City dailies joined to finance a telegraphic relay of foreign news brought by ships to Boston, the first US port for westbound transatlantic ships.

According to Encyclopedia Brittanica [1]

> a news agency is an organization that supplies news reports to newspapers, magazines, radio and television stations, and other users. It does not publish news itself but supplies news to its subscribers who, by sharing costs, obtain services they could not otherwise afford. All of the mass media depend upon the agencies for the bulk of the news, even including those few that have extensive news-gathering resources of their own.
>
> The news agency has a variety of forms. In some cities, newspapers, and radio and television stations have joined forces to obtain routine coverage of news about the police, courts, government offices, and the like. National agencies have extended the area of such coverage by gathering and distributing stock-market information, sports results, and election reports. A few agencies have extended their service to include news interpretation, special columns, news photographs, and motion-picture film for television news reports.
>
> Many agencies are co-operatives and the trend has been in that direction since World War II. Under this form of organization, individual members provide news from their own circulation areas to an agency pool for general use. In major news centers the national and worldwide agencies have their own reporters to cover important events, and they maintain offices to facilitate distribution of their service.

1. NEWS OVER DATA NETWORKS

Thus, the business with news is a most traditional one with well established business rules and practices. From the technical point of view of the early days of news agencies, the dissemination and exchange of information was carried by telegraph channels. These were slowly taken over by telex networks, which started in the 1930s. With the advance of new information and telecommunication technologies, the nature of how news agencies work is just about to change. It was soon recognized in the 1960s that computers were extremely suitable for collecting, editing, archiving, retrieving, and disseminating news information. With the advance of modern telecommunication technologies, in particular of computer networks, it became technically feasible to build information networks based on computer mediated communication. Such networks obviously by their nature, represent a special category of transborder data flow of computerized information.

East and West were interlinked by news networks naturally, long before special computerized news networks started to emerge. The development in this field obviously does not stop on the border between countries, and we are witnessing, also in East-West relations, the increased computerization of the news agencies' networks.

One of the first news agencies that started to use computer networks for their news services was Reuters, who, in 1973 in London, launched their Reuter Monitor Service, enabling foreign exchange dealers, banks, commodity traders, and brokers, to receive up-to-the-minute, market-related news on terminals. According to [2] the Reuter Money Rates Service had only 14 subscribers on its launch date in 1973 but by 1981 had nearly 5000 located in 350 centers in 58 countries.

Reuter News Services include up-to-date minute news on *traditional news* and *money rate news* on the major international monetary "stages" of the world including

- foreign exchange
- a money news service
- economical data services on trade, balance of payments, consumer prices, money supply, official reserves, and discount rates, etc.

-- rate quotation of domestic and international markets, etc.

Also offered are *commodity* and *oil market news*, *securities news service*, and *shipping news service*.

In the Reuter News Services two types of information are provided: that generated by Reuters itself, and the so-called contributed data provided by subscribers to the service. In the Monitor Oil Service, for example, subscribers receive data directly from the dealing rooms of major oil brokers, merchants, and traders. Any subscriber to the Oil Service may contribute prices, observations, and other information to the system using his standard terminal. Such information is then stored in computers and is available for retrieval by all subscribers, provided they are permitted by the contributor to see it. This facility to grant selective permission or inhibit access to contributed data ensures that any particular competitors are barred from access to the contributor's data. Information contributed by subscribers complements the news and prices content of the service.

The Reuter Monitor Commodity Service operates in a similar fashion. Information contributed by subscribers complements the news and prices content of the service and is in the following categories: Softs, Grains/Oilseeds, Non-Ferrous Metals, and Precious Metals.

The Reuter Monitor Shipping Service is designed for international shipping markets. It enables essential market data such as Enquiries, Fixtures, and Market Reports to be channelled rapidly and accurately to the required destination. The service enhances and reinforces existing systems between shipbrokers, owners, and charterers. By subscribing to the service, shipbrokers, owners, and charterers can use their terminal to receive fast-moving market information vital to their business. They can use the system either as contributors or recipients. Contributors inset items of information into their terminal and this information, under their own name, becomes available to the shipping market worldwide. Market data may be directed to recipients at the discretion and under the control of the contributor.

The philosophy adopted by Reuters, i.e., that both Reuters and its subscribers may put up information, is somewhat similar to the philosophy applied in PTT videotex services, where the PTTs, although often information providers themselves, primarily collect and distribute information provided by so-called information providers who are often the users of the system themselves. One of the main functions of such a service is not only the distribution of information by the news agency, but also to provide a broad, active information forum for the entire business community. The broad online user community in this sense is an essence of such services. International applications of this philosophy--such as in the case of Reuters--create a typical example of transborder data flow, which could not be done otherwise.

Reuters is, however, not the only news agency providing computerized information services. AP and UPI have also been providing news data services for a couple of years. AFP--the French News Agency--has recently introduced its Agora Service with three databases allowing selective and retrospective search of information. The database AGORA GENERAL stores all the information generated by the general AFP Service for the last 12 months. AGORA DOCUMENTATION stores the total AFP-

Documentation, such as biographies of politicians, with no time limit.

According to [3], the computerization of national news agencies has been developed so far that about 90% of the news agencies today already have starshaped computer networks for their domestic services. In this fashion, collecting, editing, and storing of their own messages are done on small, medium sized computer configurations. The distribution of messages to the domestic network is naturally supported by computer too. The Austrian Press Agency (APA) runs for its domestic purposes on an IBM S/7 "store and forward" system linked to a Thompson-CSF computer used for text preparation purposes. Similar computerized systems are applied at other national news agencies and the agencies of the Eastern European countries are no exception from this practice. However, according to [3], the computerized systems used for domestic services in East-West relations do not yet provide news internationally, but there is good reason to assume that this will be the direction of development.

2. INTERNATIONAL TRADE OF NEWS INFORMATION

Regardless of whether normal telex or computer supported distributing systems are used, the trade of news information between news agencies is not new but daily practice. With the growing interest in international trade for computerized information it is worthwhile for other categories of the information industry to learn from the experiences of the news agencies in this respect.

As an example, according to [3], APA, which is a consortium of its subscribers, buys and sells information from and to the news agencies in the West and exchanges information with the agencies of the Socialist countries. Business with, say, Reuters, is also partly done on a compensative basis. For example, if APA, buys information for 100 units and Reuters buys back APA news for 30 units, then APA will transfer in cash the difference from the total. With Socialist countries the deal is on an exchange basis, for example, APA services MTI the Hungarian News Agency, and in return MTI provides APA with its export service free of charge. The export services of the news agencies of the Socialist countries are in English, French, or German. Although the domestic services are already computerized as mentioned earlier, the export services are not yet.

APA in total receives about one million words per day in three languages from all agencies around the world. From this they filter out and condense 50,000 words per day for domestic distribution in German.

The philosophy of mutual dependence is the guiding one for the work of news agencies and this is certainly the notion that should be taken over by other transborder data flow applications wherever possible.

3. NETWORK TOPOLOGY OF NEWS AGENCIES

Each news agency is practically the source and destination of information. The physical networks that connect the agencies are very complicated and often the result of a long historical development. Figure 1, for example, shows the European section of Reuters' worldwide communication network, the computer data centers being located in London, Paris, Amsterdam, and Frankfurt. In East-West relations, access from the Socialist countries is made through the Frankfurt center. As an example, according to [3], the dedicated channels to Budapest from Frankfurt go

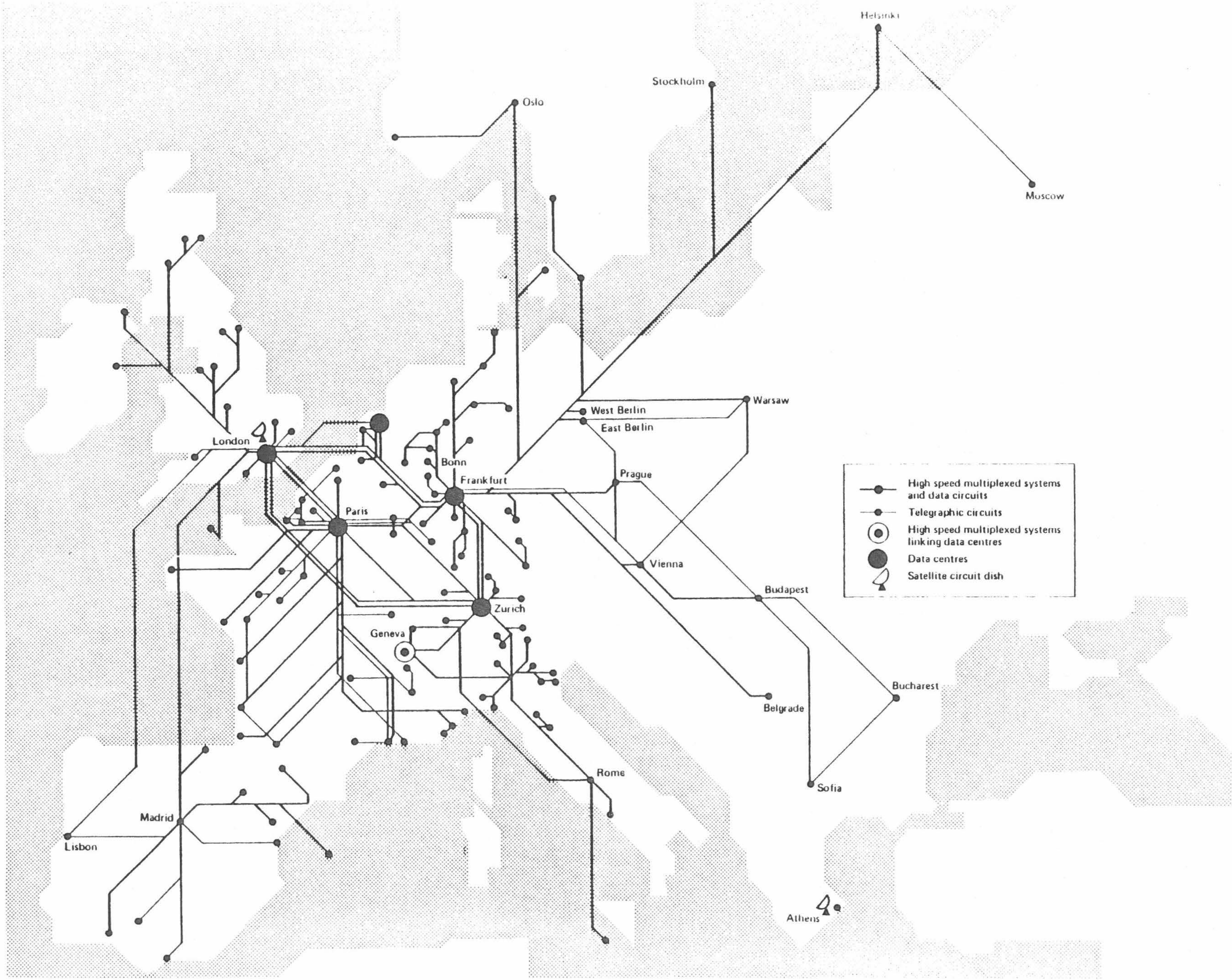


Figure 1. Reuters Communication Network (European part)

via the direct link APA (Vienna) - Reuters (Frankfurt) in a multiplexed mode. This line is rented by APA and is also used for their own purposes. In addition, the line has dedicated channels for carrying traffic between DPA--the West German News Agency--and MTI. As a rule, APA will establish such connections provided appropriate agreement and willingness between the two destination news agencies exists. With this policy, APA and Austria are playing an important role in exchanging news information between East and West.

The multiplexed high speed connection between MTI in Budapest and APA in Vienna is provided by MTI. Through this arrangement there is no need for MTI to establish a direct channel to Frankfurt or for APA to maintain direct links to news agencies in Socialist countries, which are brought to Vienna over the dedicated channels multiplexed by MTI. This fine example of cooperation demonstrates how effectively news agencies support each other's work and how dependent they are on each other.

Figure 2 [3] shows the communication network used by APA. It can be seen that this complicated network is built upon different technologies, depending on the partner news agency concerned. According to [3], their present main connection to the CMEA countries goes through the multiplexed high speed line to Budapest, which, however, is only used for sending text and data. The multiplexed connections to Prague, Warsaw, and Belgrade carry both facsimile pictures and text. MTI Budapest, which has its own extensive network and is itself linked to other news agencies, can get facsimile services through its other channels. In practice, this very dense and sophisticated mesh of networks ensures that all information, be it text, data, or pictures, gets to the news agencies in some form or

Figure 2. APA World News Network

another instantaneously, even if some hardware problems should occur.

4. FUTURE TECHNICAL DEVELOPMENTS

New, more "unorthodox" developments in the field of news agencies network distribution are already visible at this point. John Ison [4] reports that the Reuter Monitor Shipping Service is increasingly used by ships sailing on oceans through the data communication channels provided by the communication satellite services of INMARSAT.

Another satellite communication technology is used for terrestrial communication of networks news services in the USA and Canada by IDR Inc., a subsidiary of Reuters [5]. Their information system, called the IDR Row-Grabbing System, is the result of the marriage between Reuters information services and their television and satellite technologies (Figure 3). Row-Grabbing is actually a sophisticated full-channel teletext system allowing a one way information stream of 30 million characters a minute in a cyclical fashion, from which users with the appropriate terminals can select information for display, printout, or processing. Terminal types range from highly sophisticated multi-function, professional units to very low-cost display-only terminals using standard television sets.

The system has, among others, two interesting aspects from the information policy point of view. First, it shows an increasing tendency for major "news monopolies" to try to reach end users, even residential users, directly without utilizing the services of an intermediary such as local newspapers. Second, the system is already linked to Canadian cable television network, which brings these services over the border to domestic and business users in Canada.

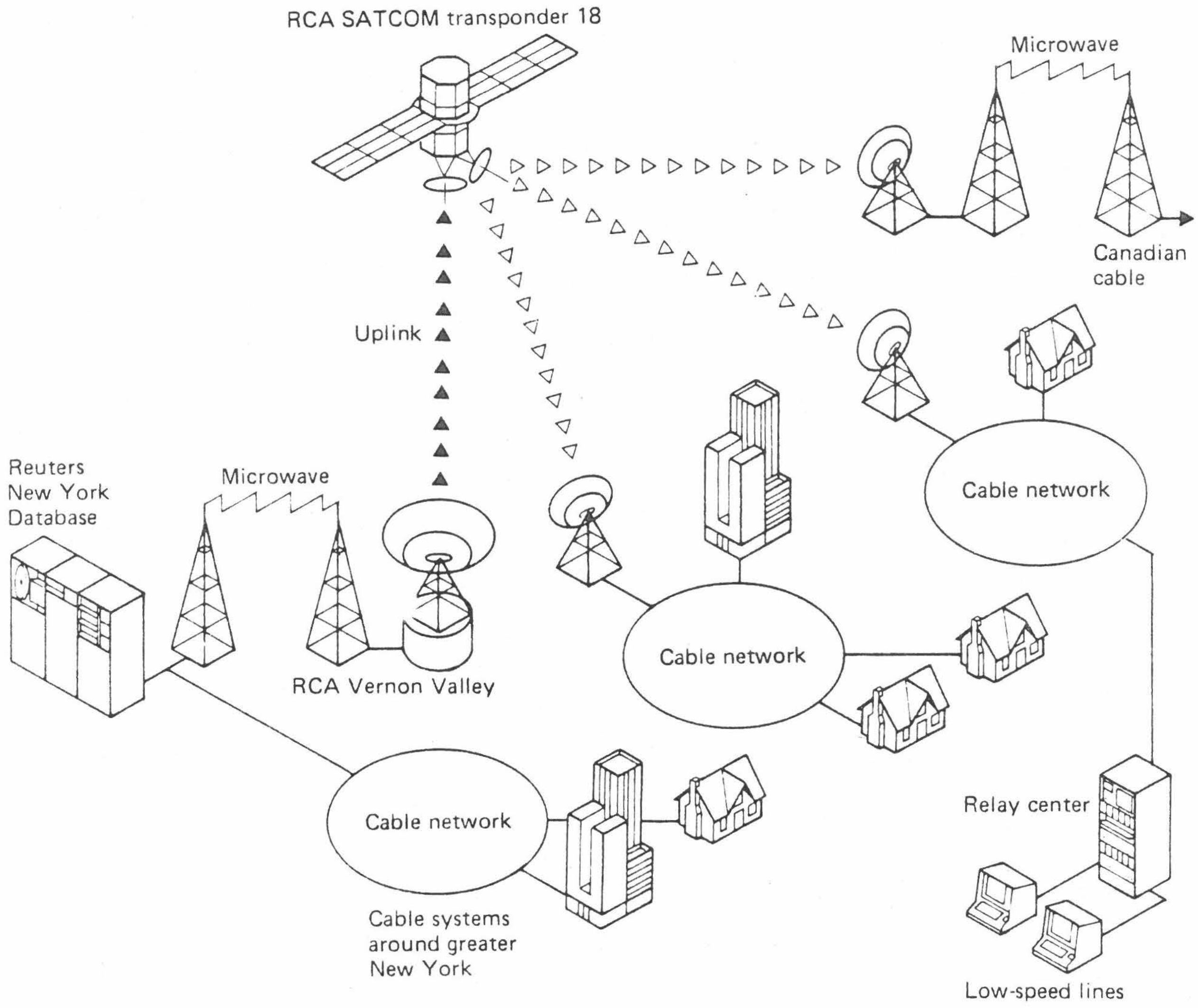


Figure 3. IDR Row-Grabbing System.

5. SUMMARY

To sum up, most of the present transport of news information between East and West is done on telex channels, but there can be no doubt that with the further development of computerized systems, exchange of news will be the internal affair of computers.

There are early signs that in the future major news agencies will service and users--business, and public--directly without the involvement of intermediaries such as national news agencies or local papers. This might not only impose some problems domestically but also internationally in many countries, also in the sense that the public at large will be confronted with transborder data flow problems.

REFERENCES

[1] *Encyclopedia Britannica*, Volume 16:377-378, Encyclopedia Britannica, Inc.

[2] *Reuters Monitor Service Information Brochures*, 1981, Reuters Ltd.

[3] Poltzer, Ritschka, K., 1982, Personal communication, Austria Press Agentur, Vienna.

[4] Ison, J., 1982, The Missing Link *Ocean Voice- - The Journal of Maritime Satellite Communications* Vol. 2, No. 1, INMARSAT, London.

[5] *IDR Row- Grabbing System Information Brochure*, 1982, IDR Inc. (Reuters), USA.

SUMMARY AND CONCLUDING REMARKS

The last chapter of any study has to be the summary. How can one sum up all the information that was given throughout the previous chapters? How can one sum up a study whose main aim was to collect information and map the state of the art in datacommunication between East and West and the appropriate administrative procedures through which it is governed? Well, with regard to the completeness of information we have tried to collect and structure the information that we could get as well as possible. This did not succeed in every respect — there are still many "information gaps" to be filled. We hope, however, that even with its incompleteness we were able to provide a correct general picture and that some of the information will be useful to those groups who want to understand and promote transborder data flow applications between East and West, both in theoretical and in practical terms. I am confident that our information will help users in as much as early — not too accurate — geographical maps helped venturesome travelers in the middle ages...

What conclusions can be drawn from this study? Well, many conclusions, depending on how the reader interprets the vast amount of data gathered by the study. What are my own main conclusions?

(1) The datacommunication infrastructure for East-West computer connections is still in its infancy. The telecommunication network carrying data will in this decade still primarily be that of the analog telephone. The situation, however, is beginning to change slowly. In the regions studied, Austria and Hungary already provide digital services, while in other countries the introduction of digital services is known. Taking into account the speed of penetration of the digital services in all the countries in question, the analog services will still play an important role in this decade.

(2) The administrative procedures for datacommunication are, in principle, rather similar in every country; they all basically follow the respective CCITT recommendations. There is a law in force in Austria with regard to privacy in transborder data flows and we know the governmental regulations in Hungary and in other countries but, in general, not much has been done yet. All these rules and regulations are of the first generation, and in my opinion not all the related aspects of this phenomenon are fully understood yet. At the moment technology is changing too fast for legislation to be able to respond to it.

(3) The domestic telecommunication equipment produced by the CMEA countries and Yugoslavia reflect two important facts. At present almost all datacommunication equipment is focused towards the analog telecommunication networks — telephone, telegraph, and telex — which will continue to be used during the 1980s for datacommunication. Only a limited amount of data terminal equipment with digital interfaces are just about to appear. This is here obviously also a chicken-egg problem. Why should a PTT provide digital services if users cannot be easily connected to it? Why should a firm produce equipment with digital interfaces if there are no digital data services to be linked to? In addition, some of the PTTs think that due to the relatively low number of network terminating points, they will be able to carry the upcoming data traffic during the rest of the 1980s with leased or switched analog services. The other important fact, which is characteristic for most datacommunication equipment produced in CMEA countries, is that they are part of well defined series (i.e., Ryad ES and SM), thus there is less focus on general purpose telecommunication hardware. Private switched computer networks are in operation in many CMEA countries. To introduce such systems as public services (and at the beginning of the service they could be rather small) is in my view not a technical problem but only a question of PTT policy.

(4) There are already a few successful transborder data flow applications that have been operational for a couple of years. The usefulness of these applications is beyond doubt. I expect that

further applications will be introduced soon, such as for banking and computerized message sending (teletex). It lies within the nature of communications that, as soon as there are any PTT services to be interconnected (similar to the telephone, telegraph and telex networks), they will be. The first sign of this can already be seen.

(5) Surprising as it may sound, I expect less problems in East-West transborder data flows than in West-West or North-South. The majority of East-West transborder data flow applications will be linked to "geographical" distances, such as message sending, banking transactions, observing and exchanging meteorological data, exchanging news, etc. There are basically no serious concerns about these and they cannot be performed otherwise.

Data exchanges linked to the operation of transnational corporations — since they do not operate in the Socialist countries to such an extent — will be minimal and of very little concern, unlike in the Western world and in the developing countries. The problem expressed by many nations is not transborder data flow per se, but the existence and practice of transnational corporations and the fear that the different transborder data flow applications can be used as an even more powerful tool for management and many other purposes. This issue is, however, not an East-West problem. In East-West relations, concerns such as negative impact of transborder data flows on the labor market or on the vulnerability of society — I would guess — are not likely to come up. Those transborder data flow applications that will dominate will rather create jobs, e.g., in database production and servicing, sending and processing transactions, but I do not expect that this movement of labor market will be weight significant. As to the vulnerability of society — in spite of the long awaited peaceful coexistence between East and West, which I hope will come — I do not expect that either party will allow the build up of any transborder data flow applications that could seriously make their own country vulnerable (e.g., it is certain that all databases vital to a given country will be stored on a computer in that country).

(6) The present transborder data flow applications between East and West are overshadowed by the fears of certain groups in the West that they promote the undesirable transfer of such technologies to the East. I personally believe that in the long run these fears will diminish and will be of much less significance. Why? First of all the basic hardware technology is available on both sides. It might well be that the average level of technology and technical characteristics of Western datacommunication hardware is a few years ahead of the East; however, the latest technology in the East is already powerful enough to satisfy most of the present transborder data flow needs. The very rapid pace of development on both sides will even improve this situation, although as pointed out in [1] I do not expect that the "time lag" — which is not equal to a technology gap — between the different major world economic regions in the field of computers and datacommunication will soon disappear. This,

however, will not be a blocking factor in transborder data flow applications, since the statement "Only the latest technology counts" for the fast developing supporting hardware and software elements for TDF is in my view not true. A few examples of this are provided in this study: the TPA/70-X.25 gateway network of IIASA is built on "outdated" Hungarian made computer hardware. Nontheless it can be used without any difficulty in linkage with the latest packet switching technologies and services — such as DATEX-P of the Austrian PTT. Another example is the database service center of CISTI, equipped with a small hardware configuration by Western standards. Nonetheless with clever organization and scheduling of database operations it provides satisfactory services to its users (ask them!).

On the other and, the gap between East and West in the quality of customer servi e, in my view, leaves a lot to be desired and a lot has to be done by the East to catch up. The difference is already felt when buying a piece of hardware. Often, and for no apparent good reason, the installation will take much longer than it should. Maintenance and trouble-shooting services are also often not as prompt as they could be. However, I believe that this is not so much a technology as a service problem. In my view one of the keys to the success of the Western data industry is their high quality customer services. While this is a very labor intensive and not very attractive task it can be measured in the ratio of satisfied customers. As surprising as it may sound, in my view the present practice in the restrictive technology transfer policy of some Western countries seriously harms the service quality and the good reputation of their own industry and this could affect their trade in this field badly.

(7) Last but not least, the role of transborder data flows in East-West relations will continue to grow. Not a surprising statement after all...

REFERENCES

[1] Sebestyén, I., 1982, *Perspective of Policy Development in the Field of Informatics: The Example of Videotex Technology*. Proceedings of an International Information Industry Conference held in Quebec City, June 1982. CBEMA, Toronto, Canada.