TELECOMMUNICATIONS HARDWARE AND SOFTWARE SYSTEMS MADE IN CMEA COUNTRIES AND YUGOSLAVIA

István Sebestyén

February 1983
WP-83-22

PREFACE

ACKNOWLEDGMENTS

CONTENTS

TELECOMMUNICATIONS HARDWARE AND SOFTWARE SYSTEMS
MADE IN CMEA COUNTRIES AND YUGOSLAVIA

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

Data
Processing
Functions

Standard Transport Service
Interface

Transport
Service

Data
Transmission
Functions

Communication
Network
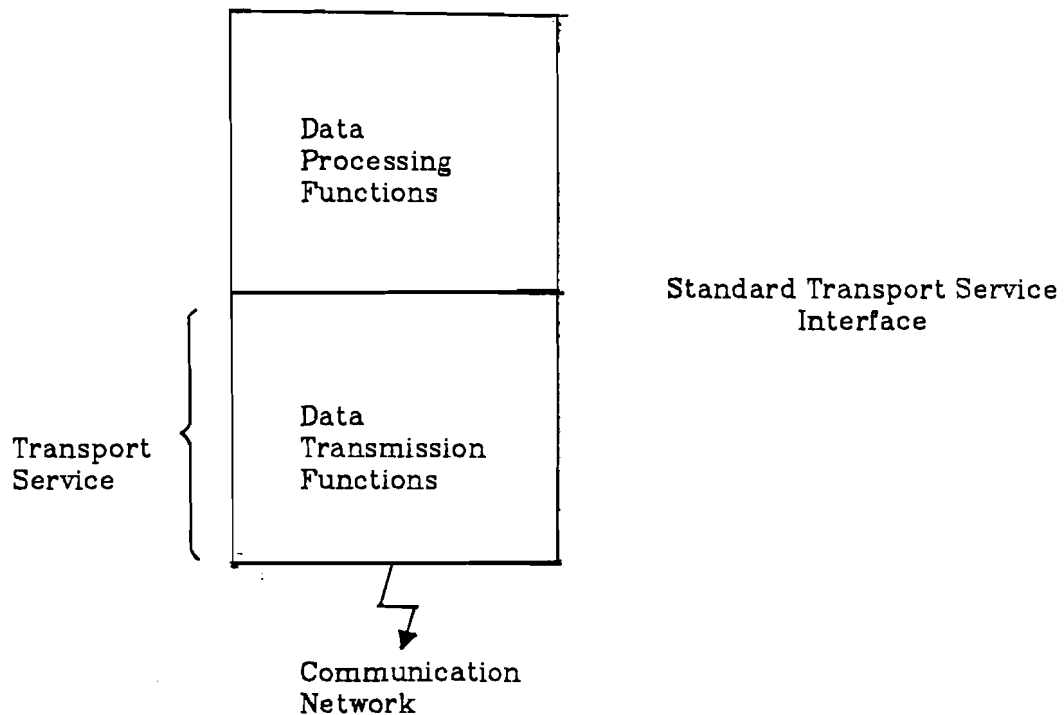
Figure 1. Basic functions of an open system interconnection.

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 phy-
sical (layer 1), the link control (layer 2), the network control (layer 3),
and the transport (layer 4). The present ISO model divides the higher lev-
els — 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.

| H | - host |
TP	- telecommunication processor
SH	- subhost
C	- cluster controller
T	- terminal
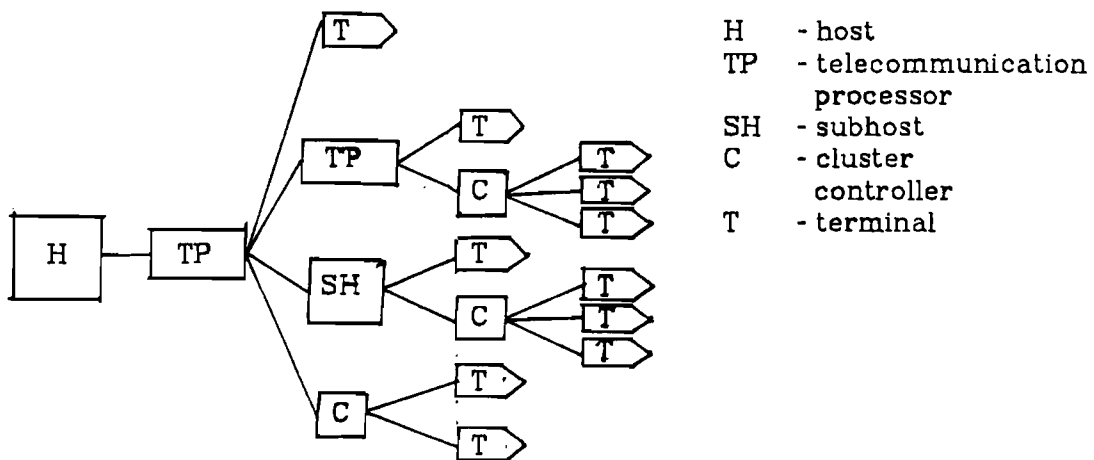
Figure 2. Hardware elements of the Ryad network concept.

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 program 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 multi-plexers 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)

Type of equipment	Country	Technical characteristics
Modem 200 ES-8001	USSR Bulgaria Romania	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
Modem 200 ES-8002	DDR Hungary CSSR Poland	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

Modem 200 ES-8004	Hungary	duplex, speed ≤ 200 bit/sec asynchronous, according to CCITT V.21 on switched telephone network, with accoustic coupler. frequencies:
		
		                send **receive**
		request: 980 Hz 1,650 Hz blank
		               1,180 Hz 1,850 Hz signal
		answer: 1,650 Hz 980 Hz
		               1,850 Hz 1,180 Hz

Type of equipment	Country	Technical characteristics

Modem 1200 ES-8005	Bulgaria USSR Romania	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	Romania	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

Type of equipment	Country	Technical characteristics
		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.

Possible combinations:

low speed channels bit/sec	high speed bit/sec							
	1200	1200	1200	1200	1200	1200	600	600
50 (5 or 7 databit)	23	-	-	10	-	2	10	1
100 (8 data bit code)	-	10	-	6	4	3	-	5
200 (8 data bit code)	-	-	5	-	5	3	-	-

Type of equipment	Country	Technical characteristics
Line concentrator TERTA TETA-1210	Hungary	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
Line concentrator TERTA TETA-1220	Hungary	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
Error protection device ES-8122	Hungary	Speed: 600, 1200 bit/sec reverse channel 75 Bd, according to CCITT Rec. 41 (sending, receiving, sending-receiving)
Programmed asynchronous multiplexer SM-8503	Bulgaria	Up to 16 lines, with speeds up to 9600 bit/sec

Type of equipment	Country	Technical characteristics	
Multiplexer-concentrator SM-	GDR	Channels:	telephone, telegraph, physical
		Speeds:	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:	switched on leased telephone channels, physical link;
		Internal storage:	0.128 KByte
		Speed:	up to 9600 bit/sec
Remote group control unit ES-7911	Poland	Channels:	leased telephone lines
		Mode:	synchronous, block
		Speed:	1200 - 4800 bit/sec
		Number:	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:	leased telephon lines
		Mode:	synchronous, block
		Speed:	600/2400, 4800 bit/sec;
		Number:	up to 32 of ES-7927 or
			up to 32 of ES-7934, ES-7936
			(part of the sysetem 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 $\leq$ 1200 bit/sec, 1300-2100 Hz for speed $\leq$ 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 $\leq$ 100 bit/sec on telegraph lines, $\leq$ 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 $\leq$ 600 bit/sec), 32 (with the speed $\leq$ 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)	Romania	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 COMMUNI-
CATION 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: Romania (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 IV-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 5089, 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 COM-
MUNICATION, 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) Computer
- 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 com-munication mode, connec-tion through multiplexers ES-8402 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)	Romania	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 transmission 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 trans-mission, 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 preparation, 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 7928 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 + 48 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 trans-mission 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-7186 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 transmission 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 8252 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: Interna-
tional 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 Sys-
tems Analysis.

[3] Rajki, P. and R. Szentes. 1981. Videoton Network System — General
Overview. In Csaba, et al. ed., Proceedings of the COMNET '81 Confer-
ence in Budapest *Networks From the User's Point of View*. Amster-
dam: North-Holland Publishing Company.

[4] Fenyves, L. et al. 1981. Session and Transport Control in the Video-
ton 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 Publish-
ing 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.