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ELECTRONIC EQUIPMENT IN MULTI-USER DATA PROCESSING SYSTEMS,(U)
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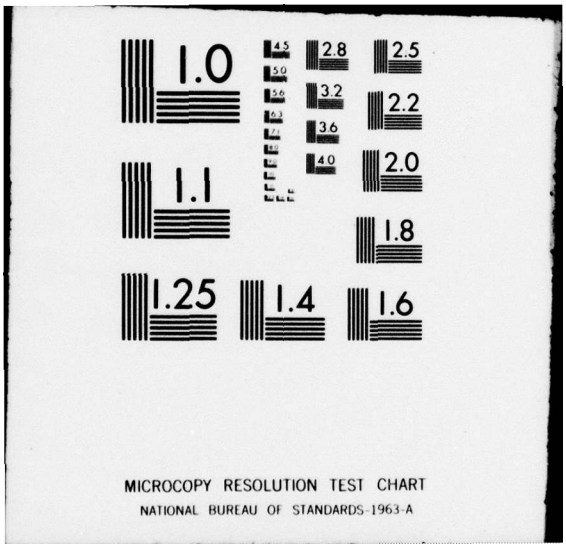
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FOREIGN TECHNOLOGY DIVISION

ELECTRONIC EQUIPMENT IN MULTI-USER DATA PROCESSING SYSTEMS

By

Jacek Ochman

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EDITED TRANSLATION

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By: Jacek Ochman

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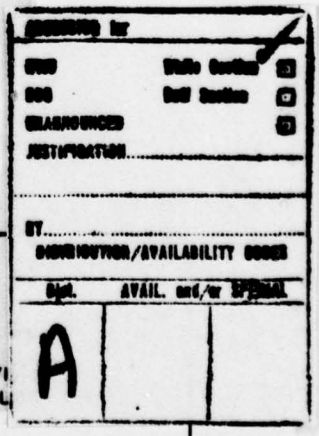

PREPARED BY:

TRANSLATION DIVI
FOREIGN TECHNOL
WP-AFB, OHIO.

Electronic Equipment in Multi-user Data Processing Systems

by

Jacek Ochman

Introduction

In the development of electronic data processing (EDP) in Poland, one can distinguish two parallel directions: one, including the construction of modern EDP centers with their equipment, and the other, including the creation of computer systems, tailored to the needs of management of national economy.

With the construction of large and complex systems the need arose for the studies of organization of the data transmission in multi-user systems. At the same time the development work continues towards more efficient utilization of electronic equipment in the face of rising demand for EDP services.

According to the experience in Poland, the basic means to satisfy these demands is to centralize the computing power by installing the large computers in EDP centers serving the large institutions. The broadening of services can be achieved by forming the subscriber systems for the problem-oriented remote data processing.

The multiuser systems have the advantage of simultaneous and direct utilization of machine computing power for a large number of users, but only if the system is properly organized. This is why the multiple entry creates many problems in the area of system organization, and especially in the organization of digital system.

The cost-effectiveness of the multi-user system is determined basically by three factors:

- determination of the correct use profile,
- proper choice of computer and its configuration,
- choice of reliable data transmission devices.

The solution of these problems can be illustrated on the example of few selected, presently operating multi-user EDP systems in Poland.

One of the typical multi-user systems is known as POLRAX-2 [1]) developed and operated by the Center for Electronic Computation Technology (ZETO) in Wroclaw. The project of building the multi-user POLRAX-2 system continues since 1971, as a part of the major Government effort to develop a standard multi-user system based on ODRA-1300 series computer.

The system configuration is based on requirements submitted by the direct users and on numerous consultations with the management of interested companies. The system profile, ie.interaction with the environment, or the user communication with the system, was also based on planned expansion of ZETO capabilities.

The goal of POLRAX-2 system was to allow the computer access and utilization of its computing power by a wide range of users.

To determine the range of utilization, the analysis of user profile was made, by creating the list on which the following information was contained:

- general users description and its ID,
- users location and telecommunication needs,
- present and planned usage.

The choice of application range was especially difficult, since ZETO is a service organization only. Without a doubt, the proper prediction

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[1]) RAX - from English for random access

of profile change direction is one of the main factors deciding the success in the data processing market.

The limitations adopted by knowing the EDP service market, Government policy on production and importation of EDP equipment, and manpower capabilities, which were determined by the modelling, made the final determination of elements and structure of POLARX-2 systems.

In designing the system, the present experience was used in development of software and applications programs for ZETO and its clients, assuring easy adaptation of existing own programs, and the design was adapted allowing the expansion through more effective utilization of hardware and computing capability. The limitation of this paper doesn't allow for more detailed description of these subjects.

Computer Configuration Description for POLARX-2

The system is based on ~~the~~ Polish-made ODRA-1305 ~~computer~~ hardware and British-made ICL data transmission equipment.

The choice was determined by practical considerations, in particular:

- use of domestically-made computer simplifies the development and installation of multi-user computer systems without additional training;

- easy duplication in the country, ie. ease of installing the system in other areas of the country,

- lowering the organization and ~~exploitation~~ operation costs.

The decision to use ODRA-1305 CPU decided the choice of telecommunication equipment.

The use of ICL telecommunication equipment is the result of two basic reasons:

- lack of manufacturers of this type of equipment in Socialist

countries,

- full compatibility of ICL 1900 and ODRA- 1300 series computers.

The configuration of ODRA-1305 computer for POLRAX-2 system is shown in Fig 1. For the efficient operation of remote multi-user POLRAX-2 system, the CPU should have at least 128K words of memory. There is a possibility for expansion to 256K words.

The devices listed in Table 1 are connected to the CPU channels.

The further expansion of operational memory (up to 192K) is planned, and in the future, the expansion of direct access memory.

The configuration of telecommunication equipment is shown in Fig 2, and it includes the message buffer system. This type of equipment is used in heavy traffic EDP networks.

The ODRA-1305 CPU is freed from the teletransmission control function, which allows for greater utilization of computing power. The communication equipment consists of:

- ICL 7903/0 communication processor, that includes F 1313 multichannel unit as a interprocessor buffer,
- 7930/9 scanning selector,
- 7930/1 universal scanner,
- 7930/3 universal scanner,
- 7930/0 scanner control units.

The following telecommunication units are connected to the scanner channels:

- 200 baud GH 1151 A-11 modems,
- 1200/2400 baud GH 2054 A-16 modems,
- 7924/2 display with 7924/0 controller,
- 7922/2 line terminators with 7922/0 controller.

The system serves the following subscriber terminals:

- 7071/3 local teletypes	4 units
- 7071/7 remote teletypes	9 units
- ICL 7503 terminals	3 units
- ICLVDU 7181/2 CRT display	1 unit
- Datapoint 2200 terminal	2 units
- RC 3600 terminal	3 units

Description of the communication equipment

ICL 7903/0 processor - connected between the CPU and scanning device, performs the following functions:

- controls the data transmission under the program control. Change of the number of remote terminals in this system doesn't require any hardware changes,

- receives and formats the characters from the scanning selector and transmits the complete messages to the CPU,

- due to the standardization of messages formatted by the users programs, the program procedures in the CPU are simplified, and the remote peripheral devices are served by a relatively small number of CPU programs,

- it contains the buffer memory allowing for "remembering" of the message.

Because of that, the data transmission speed is not limited by the users programs.

The 7903 telecommunication processor has 24K words of operational memory. The words have the byte structure. Each word consists of 16 bits, ie. two 8-bit bytes. The processor frame contains the interprocessor module consisting of buffer and code converter. The buffer has one word capacity and is placed between two synchronously working processors.

The converter translates the 8-bit code into 6-bit code used in CPU.

7930/9 scanning processor allows for connecting a large number of scanners to the single Standard Interface of 7903 processor. It also converts the signal levels used in the 7900 series devices to the requirements of CPU.

7930/1 and 7930/3 universal scanners are the participating in receiving the information from the telecommunication lines to the telecommunication processor and reverse. Single bits of information collected from the modem interfaces are formed into characters, in the character buffers, separate for each line, and then transmitted to the processor. In addition, the scanners perform such function as: conversion of internal ICL 1900 code and 8-bit transmission code, recognition of the ECMA/ISO control characters and the additional nonstandard characters, character parity control.

GH 1151 A-11 and GH 2054 A-16 modems provide the data transmission through telephone or telegraph lines. The line termination units enable the signal conversion between the telegraph interface and the scanner interface. These modems convert the signals from the 1900 equipment to the form suitable for the telephone line transmission and reverse. The GH 1151 A-11 modems allow for the full duplex operation[1)] on one or two-channel links with 200 b/s speed, while modem GH 2054 A-16 permits a rate of 1200 or 2400 b/s. Both modems can operate with the telephone receivers, the line-telephone switch can be controlled automatically or manually.

7924/2 display with 7924/0 control unit and the 7922/2 line termination with 7922/0 control unit are the group allowing the data transmission through the telephone or telegraph lines.

[1)] Full-duplex operation-simultaneous two-directional exchange of information requiring wire links

The line terminators convert the signals between the telegraph line interface and scanner interface.

The system uses two types of teletypes local 7071/3 and remote 7071/7. The remote teletypes utilize the telegraph lines and modems. The local teletypes are connected through the telegraph lines to the line termination units (LTU) which condition the telegraph line signals to the CCITT interface requirements (scanner channel input). Both types of teletype have the same functional parameters. These devices can receive the variable length records. The maximum speed is 9 ch/sec. The output data are generated in ICL transmission code.

7071 teletype is equipped with a keyboard and the tape reader for the data input, and the printer and perforator for data output. The teletypes can work in local and on-line mode. In the first case, the user can prepare the data in the following combinations: keyboard - printer - perforator, tape reader - printer - perforator, that is, using the source devices output the data on any output device, or both at once. In the on-line mode, the teletype is connected to the system and allows for data input or output in the conversational manner. The information transmission is done using the start-stop system, that is, each character contains start and stop bits. The transmitted information are coded according to ICO - 7 code, which was determined by the CCITT. The teletype keyboard has an assortment of character keys, consisting of alphanumerics and control characters. The teletypes do not have the devices for the automatic error detection. The retransmission of error containing message can be requested by an operator through the appropriate message.

ICL 7503 remote terminal together with the 7503/1 processor (minicomputer) allows for the connection of several peripheral devices, such as: card reader, line printers, VDU console, or teletype, casette units etc. A standard installation contains at least one magnetic cassette reader for program loading and the operators console for the process control.

The terminal can be used in the on-line system, connected to another terminal, or to another processor directly or through the telephone line. It can also be programmed for the local data copying or for the data editing. The processor memory is from 16 to 64K bytes and it can be increased by 8 K bytes by adding additional memory modules. In the POLRAX-2 system the device works under the software loaded emulator, which controls all the data transmission processes and the choice of peripheral devices. The terminal works under the loaded system sent to the remote ICL 7020 station. The data can be sent with a speed of 600 to 4800 b/sec.

VDU 7161/2 CRT monitor. In the POLRAX-2 system it is designated for the conversational operation. The equipment consists of a alphanumeric keyboard with 92 characters and the display with 2000 character capacity. The information is displayed in a format of 25 lines with 80 characters each. The monitor has a buffer. The messages entered from the keyboard are held in the buffer, and written on the screen. The formatting and editing of messages can take place without the communication with processor, unless there is a need for a text transmission. The monitor allows for the data transmission with speeds up to 4800 b/sec. In order to obtain a hard copy of the displayed text, one can connect a teletype or a line printer. The message formatting and the retransmission of errors takes place under the processor control.

Datapoint 2200 minicomputer

1. Hardware. The Datapoint 2200 minicomputer, purchased by ZETO from A/S REGNECENTRALEN, consists of the following units:

- -CPU with the operational memory
- CRT monitor
- card reader
- matrix line printer
- two cassette storage units
- keyboard

2. Software. The ~~received~~ obtained by ZETO software consisted of:

- operating system (CTOS)
- ASSEMBLER 4 processor
- EDITOR program
- DATABUS language
- 7020 emulator
- diagnostics
- demonstration programs.

3. Usage. The DATAPOINT 2200 configuration allows both, local operation and remote, as a CORA - 1305 terminal. As a terminal using the telecommunication lines and the data transmission devices, it works as a data processor emulating ICL 7020.

The DATABUS language allows for the data processing in a closed local system. Additional numerical programs and ease of programming allows the use of DATAPOINT 2200 for the APZ type of calculations.

In the POLRAX-2 the RC 3600 type of terminations were added to the system. A typical terminal configuration consists of the following devices: line printer, card reader/punch, paper tape reader/ punch. The terminal memory, containing the software 7020 emulator, will perform all the control functions of data transmission to and from the system.

In the case of remote processing through the telephone lines, the 7020 device must be connected with its equipment. The remote 7020/4 processing station contains the half-duplex communication terminal, working with a speed of 2400 b/sec, to which the following devices can be connected:

- 7026/1 paper tape reader (250 ch/sec),
- 7026/1 paper tape punch (110 ch/sec),
- 7022/1 card reader (320 card min),
- 7021/4 line printer (612 l/m),
- 7023/3 monitor (10 ch/s).

The remote processing station allows for the transfer of a large number of data between the CPU and the remote terminal equipped with peripheral devices.

The remote job entry to the installation under the GEORGE operating system, allows the transmission of: source and object programs, data and the job control. In addition, it allows for the local operation between the I/O devices (copying, listing).

The expansion of the communication equipment will be performed from the viewpoint of adding more subscribers. That will imply the addition of more terminals.

Short characteristics of POLRAX-2 software

To realize the POLRAX - 2 system, the third generation digital system with the GEORGE-3 (General Organizational Environment) operating system was adopted. This system allows for programmed local processing and for programmed remote and interactive processing, where the communication with the system takes place through the terminals.

The choice of GEORGE-3 operating system was dictated by a need for most effective utilization of ODRA -1305 computing power. Independently, the system allows for the multi-user operation, which at the present moment has a great significance.

The GEORGE-3 in the POLRAX-2 system accomplishes basically seven main tasks:

- assures parallel noninterfering operation of all peripheral devices and increases their throughput by an appropriate I/O techniques;

- increase the effectiveness of utilizing the computer capabilities such as: computations, operational memory, communication equipment, peripheral devices, software, etc.;

- allows for time-sharing by many users and providing satisfactory response time for the on-line users;

- automatically executes the program written in higher level language and reports the processing progress;

- automatically charges the computer user;

- protects against the unauthorized acess and protects the user from the consequences of system failure;

- allows for adding new functions and new users, which allows for the system expansion depending on need.

Summing all these, the GEORGE -3 manages the entire computer installation.

Every addition of a new user to the POLRAX-2 system involves the space assignment in the direct connection of external devices to the program, space for the Device Table, space for the data storage, assignment of time and charge account. The GEORGE-3 in the POLRAX-2 system allows for planning the allowed usage of the system resources.

Before the start of any job, the budgets are automatically checked, which constitutes one of the conditions for the job acceptance, and after the job termination the account is charged accordingly. In the POLRAX-2 system, a multi-entry system, this is especially significant, since the budget control is otherwise impossible due to the nature of the remote entry.

The multiple entry user jobs have a priority over the computing center batch jobs. For this purpose, a part of GEORGE for the multiple entry was used, known as MOP (multiple on-line programming), which allows the simultaneous job execution for a certain number of users, while the batch jobs executed in the background.

The ability of dialog between the user and the processor in the MOP system is provided by the operating system command languages. One can also use the following conversational languages:

- JEAN - simple language for the arithmetic and logical expressions, used most often for the construction engineering calculations;
- BASIC - a language similar to FORTRAN with the simplifications in I/O and matrix calculations, is also used for all kinds of engineering and scientific calculations;
- FORCON - system for the FORTRAN language, used similarly to BASIC.

The operation in multiple entry system using the conversational languages is based on the transmission by the terminal user, the simple commands and data, and on receiving the final results from the machine. The advantages of conversational operation in POLRAX-2 system are:

- simplicity of operation,
- ease of terminal use,
- high speed of data input,
- quick response time,
- free access to the computer.

The GEORGE-3 operating system used in POLRAX enabled the customers to create their own programs through simple and effective compilers of the following languages: PLAN, COBOL, FORTRAN and ALGOL.

The user of POLRAX-2 system can control from terminal the execution of his programs, start and terminate his own batch jobs. The instructions entered by the users are directly compiled and executed, allowing for real-time error correction, which to a great extent shortens the programming cycle and computation tasks.

Principles of the POLRAX-2 system use.

In order to coordinate the work related to the POLRAX-2 usage, the POLRAX-2 users council was formed. The duties of the users council include:

- control over the proper system function,
- coordination of all system profile modifications.

There are three users groups within POLRAX system:

a) data processing users,

b) scientific and technical computation users,

c) the users who both process the data and conduct the scientific and technical calculations.

Fig 3 shows the activity structure of POLRAX-2 users, and Table 2 shows the topics of their work.

Within these groups, ZETO coordinates the work of each user, the information flow, trains and provides the consultations.

Presently, ZETO guarantees the operation of multi-entry system during their normal working hours, but also guarantees the computing time for all users in the amount of 1250 hours per month.

The basis of users acceptance is the application for the system use including the following:

- name of the institution,
- address,
- bank account,
- type of use,
- data on the contract administrator,
- reason for the order (customers letter, contract, etc)

On the basis of application and the ZETO capabilities, the decision is made to appoint the user. In the case of acceptance the following is determined: users name in the system file directory, expiration time and the budget.

The above informations are transmitted to the management of the system that appoints the user. The user's administrator receives the confirmation of the acceptance and the users code name.

To determine the users for the jobs run by organizational units of ZETO, the section directory is used according to the current ZETO directive.

The entire installation resources are shared by the users, utilizing the MANAGER users table. If the user transfers part of his budget to his subordinates, then this part is subtracted from his budget.

There are three kinds of budgeting: storage, time and the amount to be paid for the services.

Storage budget is the space allocation in the system and is measured for example in amount of magnetic tape or memory words.

Time budget refers to the amount of CPU time and is the time allocation for the jobs in different priorities.

Monetary budget is the amount of money or other units allocated to the user as a payment for the ZETO services.

In the GEORGE-3 operating system there is a program which automatically calculates the charges for the executed jobs. Using this program the

charges for the used memory, CPU time and peripheral use are calculated for each user.

The service of data transmission network and the subscribers sets.

The POLRAX-2 system is based exclusively on the telephone links. Considering the poor quality of the country's telephone network, the leased lines are used, which allow for the data transmission at 1200/2400 b/sec speed. The data transmission network is based on the existing telecommunication network owned by the Polish Post Office, Telephone and Telegraph (PPTiT). The responsibility for the proper link preparation, operation within the parameters set by CCITT, and repair service rests with the PPTiT.

The maintainance and the service of the computer equipment presents no problems and is performed by ZETO. However, the need arose for the proper service of usesrs equipment. The creation of POLRAX-2 system caused the creation of subscribers equipment service, which maintains and repairs the system's communication equipment.

The service is responsible also for identifying the malfunctions in the communication links. Because of that, the terminal service is interested in the proper equipment functioning, starting at the scanner channel up to the user.

Final remarks.

The article presents the results of a study in the area of POLRAX-2 operation, which was organized by ZETO in Wroclaw.

On the basis of this study, one has to state that the creation of data transmission network in Poland still encounters many difficulties, especially:

- insufficient number of appropriate equipment which would allow for

creating a large number of multiple entry systems;

- lack of free cable pairs in the local or trunk cables;

- organizational difficulties in the area of link allocation and other data tramission equipment,

- lack of properly trained manpower.

Despite these difficulties on the performed studies it was determined that the exploitation of POLRAX-2 system provides many advantages, some of which are:

- ability of the system for collecting the data from geographically distant locations and the ability of large volume data processing;

- ability of fast transaction recording and the ability of performing the transaction at large distances;

- ability of complex data analysis, and fast turn-around time;

- ability of simultaneous service of many users;

- high speed of reaction to any irregularities taking place in the controlled processes, or the possibility of control of many parameters.

In summary, one can state that the implementation and operation of POLRAX-2 system based on the equipment described here, implies many advantages, the most important of which is the lowering of data processing costs and satisfying the needs of data processing market.

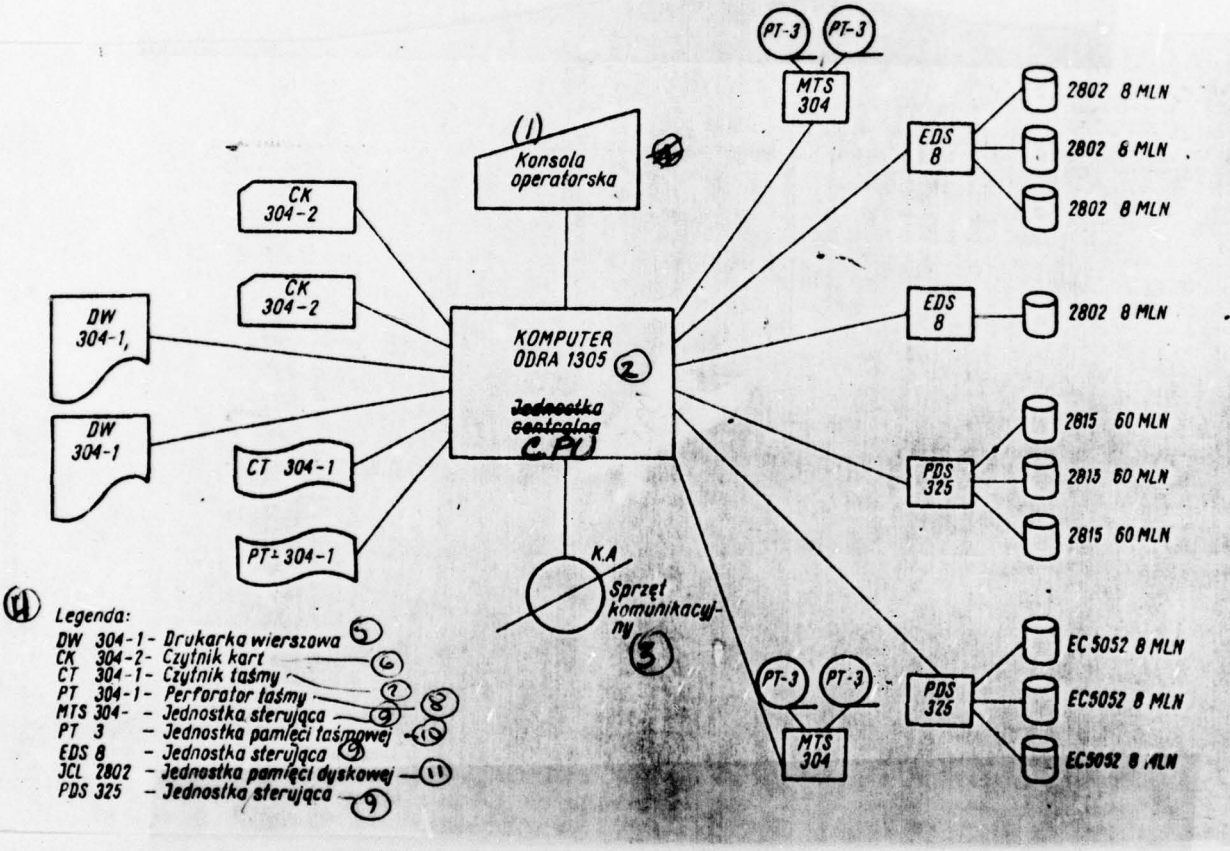

Fig 1. ODRA-1305 computer configuration for the POLRAX-2 system. 1- operator's console, 2- ODRA-1305 CPU, 3- communication equipment, 4- description, 5- line printer, 6- card reader, 7- tape reader, 8- paper tape punch, 9-control unit, 10-magnetic tape unit, 11- disc unit.

Rys. 2. Konfiguracja sprzętu komunikacyjnego wielodostępnego systemu POLRAX-2

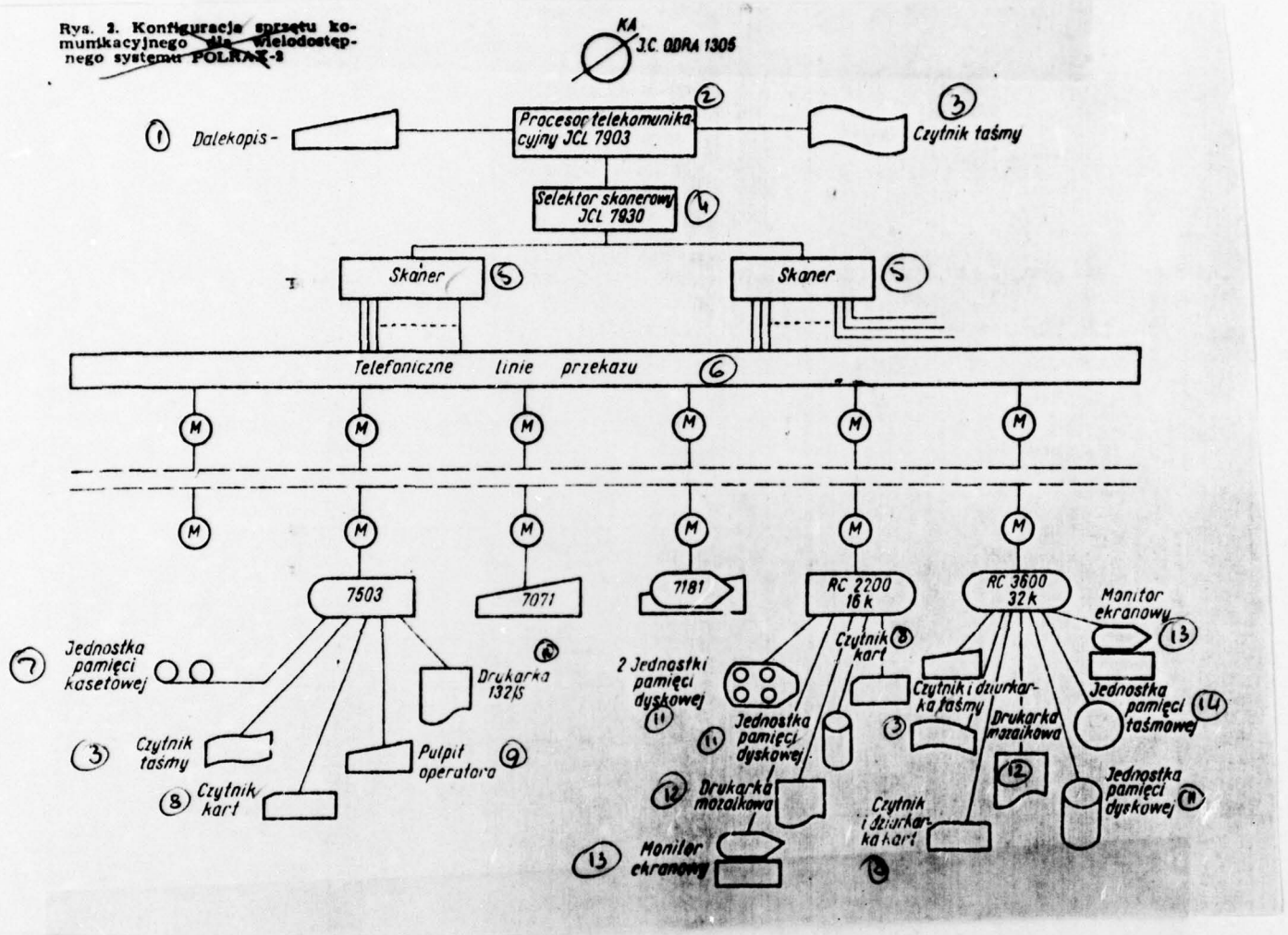

Fig 2. Communication equipment configuration for the POLRAX-2 system.

1- teletype, 2- telecommunication processor, 3- tape reader, 4-scanning selector, 5- scanner, 6- telephone lines, 7- cassette tape unit, 8- card reader, 9- operator's console, 10- printer, 11- disk unit, 12- matrix printer, 13- CRT monitor, 14- magnetic tape unit.

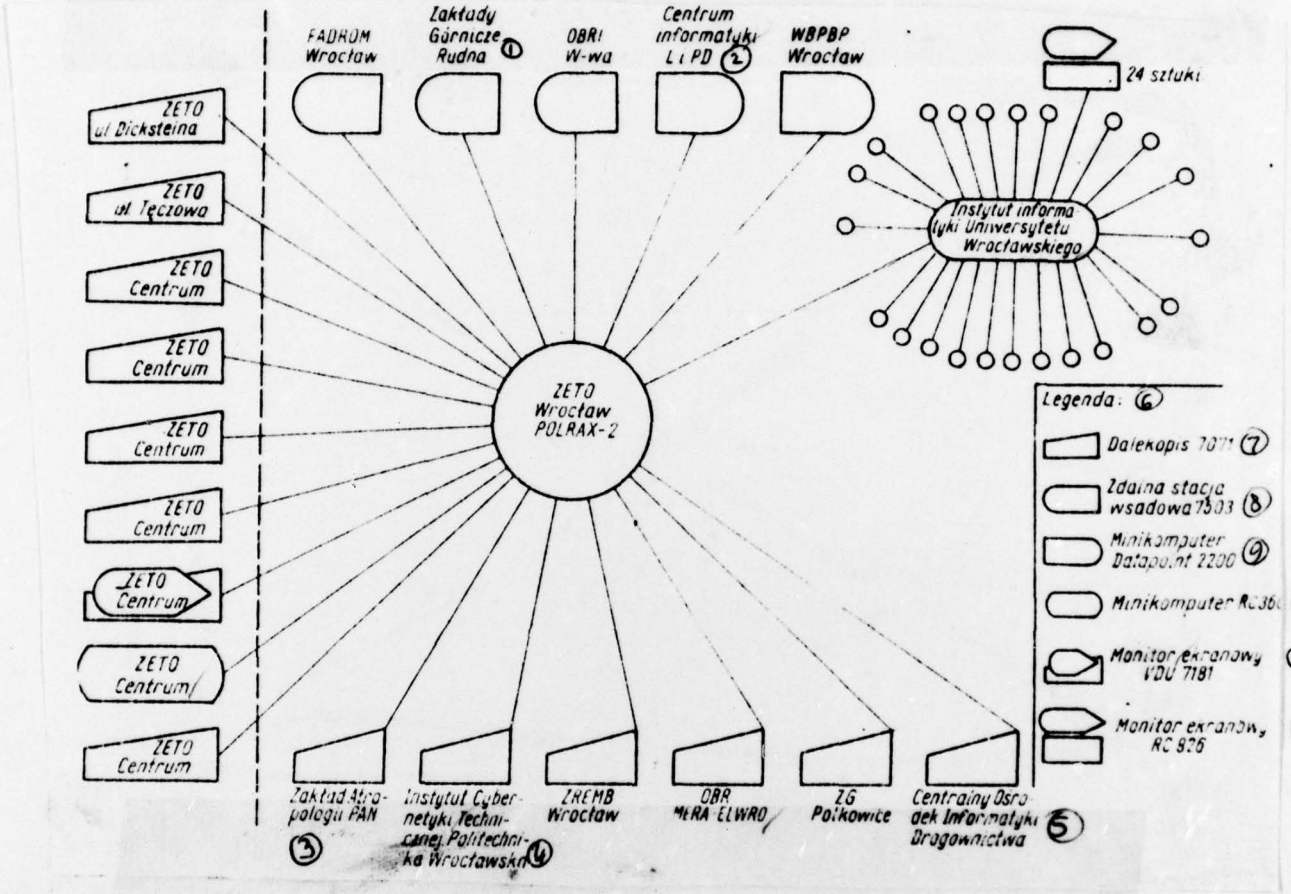

Fig 3. POLRAX-2 system users.

1- Rudna Mine, 2- EDP Center of LiPD, 3- Anthropology Section of PAN, 4- Technical Cybernetics Institute of Wroclaw Polytechnics, 6- description, 7- 7071 teletype, 8- 7503 RJE station, 9- Datapoint 2200 minicomputer, 10- RC 360 minicomputer, 11- VDU - 7181 CRT monitor, 12- RC 826 CRT monitor. 5- EDP center of Highway Dept.

①	czytnik taśmy	—	CT-304-1 1 sztuka ⑨
②	perforator taśmy	—	PT-304-1 1 sztuka ⑨
③	czytnik kart	—	CK-304-2 2 sztuki ⑨
④	drukarka wierszowa	—	DW-304-1 2 sztuki ⑨
⑤	adapter pamięci taśmowej (do adaptera podłączone są 4 jednostki taśmowe typu PT-3)	—	MTS-304-1 2 sztuki ⑨
⑥	jednostki pamięci dyskowej ICL 2082	—	3 jednostki sterujące EDS 8 ⑩
⑦	jednostki pamięci dyskowej EC 5052 (do wszystkich jednostek sterujących podłączonych jest 10 dysków o łącznej liczbie około 236 mln słów pojemności	—	1 jednostka sterująca PDS 325 ⑩
⑧	monitor operatora typu FACIT	—	1 sztuka ⑨

Table 1.

1- tape reader, 2- tape punch, 3- card reader, 4- line printer, 5- magnetic tape controller (with ~~3~~ 4 units of PT-3 tape drives), 6- ICL-2080 ~~7~~ 3 disk units, 7- EC-5052 disk units (10 disk drives can be connected to a controller with a total shortage of 236 M words) 8- FACIT operator's monitor, 9- unit, 10- control unit.

Table 2. Type of usage in the POLRAX-2 system.

1- user, 2- terminal type, 3- usage profile, 4- Institute of Anthropology, 5- Technical Cybernetics Institute, 6- EDP Center of the Highway Dept., 7- Rudna Mine, 8- EDP center of Forestry Dept., 9- EDP Institute, 10- Wroclaw University, 11- Program development, New system testing, Maintenance of the multiple entry system, 12- Engineering calculations, 13- Inventory and Literature search, 14- Statistical analysis, 15- Program development, 16- Payroll, 17- PROMPT management system, 18- material management. manpower inventory, 19- processing for the Ministry of Higher Education, Science and Technology, 20- EDP training, conversational languages, 21- Minicomputer application for multiple entry systems.

(1) Użytkownik	(2) Rodzaj końcówki	(3) Profil zastosowania
ZETO CENTRUM	ICL 7071 (4 szt.)	Prace programistyczne. Uruchamianie i testowania systemów. Konserwacja i rozwój systemu wielodostępnego. (11)
ZETO TĘCZOWA (Ulica)	ICL 7071	Obliczenia inżynierskie. (12)
ZETO DICKSTEINA (Ulica)	ICL 7071	Prace programistyczne. Uruchamianie i testowanie systemów (11)
ZETO INTE	ICL 7181	Ewidencja i wyszukiwanie informacji bibliograficznych. (15)
(4) ZAKŁAD ANTROPOLOGII PAN	ICL 7071	Programy analizy statystycznej. (14)
(5) Instytut Cybernetyki Technicznej		
POLITECHNIKA WR.	ICL 7071	Prace programistyczne. (15)
ZREMB WROCŁAW	ICL 7071	Obliczenia inżynierskie. Lista płac. (12), (16)
OBR MERA - ELWRO	ICL 7071	Prace programistyczne. (15)
COID WARSZAWA	ICL 7071	Prace programistyczne (15)
(6) (Centralny Ośrodek Informatyki Drogownictwa)		
FADROMA WROCŁAW	ICL 7503	System PROMPT w zarządzaniu przedsiębiorstwem. (17)
(7) Zakłady Górnicze RUDNA	ICL 7503	Gospodarka materiałowa. Ewidencja kadrowa. (18)
OBRI WARSZAWA	ICL 7503	Zestawienia dla Ministerstwa Szkolnictwa Wyższego, Nauki i Techniki (19)
WBPBP WROCŁAW	DP 2200	Obliczenia inżynierskie. (12)
CILIPD POZNAŃ	DP 2200	Obliczenia inżynierskie (12)
(8) (Centrum Informatyki Leś. i Przem. Drzew.)		
(9) Instytut Informatyki		(20)
(10) UNIWERSYTET WROCŁ.	RC 3600 (VDU)	Dydaktyka w zakresie informatyki. Języki konwersacyjne. (21)
ZETO CENTRUM	RC 3600	Wdrażanie minikomputerów do pracy w syst. wielodostępnych.

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C509	BALLISTIC RES LABS	1
C510	AIR MOBILITY R&D LAB/FIO	1
C513	PICATINNY ARSENAL	1
C535	AVIATION SYS COMD	1
C591	FSTC	5
C619	MIA REDSTONE	1
D008	NISC	1
H300	USAICE (USAREUR)	1
P005	DOE	1
P050	CIA/CRB/ADD/SD	1
NAVORDSTA (50L)		1
NASA/KSI		1
AFIT/LD		1
LLL/Code L-389		1

ORGANIZATION		MICROFICHE
E053	AF/INAKA	1
E017	AF/RDXTR-W	1
E403	AFSC/INA	1
E404	AEDC	1
E408	AFWL	1
E410	ADTC	1
	FTD	
	CCN	1
	ASD/FTD/NIIS	3
	NIA/PHS	1
	NIIS	2