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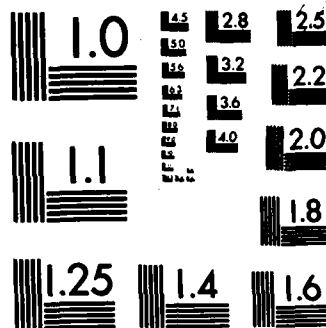
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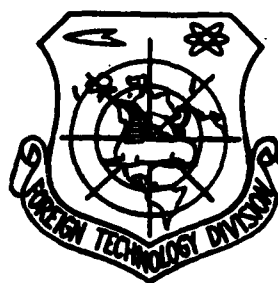
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TELECOMMUNICATIONS

(Selected Articles)



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FTD-ID(RS)T-0818-83

EDITED TRANSLATION

FTD-ID(RS)T-0818-83

21 July 1983

MICROFICHE NR: FTD-83-C-000911

TELECOMMUNICATIONS (Selected Articles)

English pages: 47

Source: Przegląd Telekomunikacyjny, Vol. 52,
Nr. 9, 1979, pp. 266-271; 272-274; 275-278

Country of origin: Poland

Translated by: SCITRAN

F33657-81-D-0263

Requester: RCA

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PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

FTD-ID(RS)T-0818-83

Date 21 Jul 19 83

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THE E-10 AUTOMATED INTERNATIONAL TELEPHONE EXCHANGE

The E-10 systystem's electronic telephone central exchanges are produced by the Pan Polish Teleelectronic Plant, TELCKOM-TELETRA in Poznan under license from the French firm CIT-ALCATE. The license allows the production of local, transit, trunk, combined and subscriber exchanges based on the E-10's equipment.

The E-10 system's automatic telephone central exchanges are for programmed control. The control program contains the functions of the administration, exploitation and performance of commutation requirements. The administration and exploitation functions are carried out by the Technical Exploitation Center (CET), equipped with an R-12 computer unit, containing disk and tape memory, and dialogue devices. The center is connected by transmission lines in all commutation units. It obtains from them information about the exchange's condition and sends them instructions and information. The information produced about the exchange's condition (the Commutation Center) can be peripherally directed to notational devices or stored in the CET's mass memory.

Since commutation problems require prompt attention, they are processed by the Commutation Center (CK). Specialized units, such as multiregisters, computers, markers and incoming sets work in harmony with instructions stored in the program memory.

The E-10's exchange system is characterized by the great elasticity and relative ease (in comparison with other systems) of the direction's adjustment to various commutation requirements. The selection of functions performed by the exchange is determined for the most part by the programmed operative Commutation Center and the CET's programming system. This allows the construction of different types of exchanges combined on the basis of this equipment.

The E-10 exchange system has many advantages, such as:

- an automated and centralized system of administration and exploitation;
- the possibility of the exchange's relatively easy adjustment to various and sometimes difficult demands;
- lower cost per circuit (especially in transit exchanges).
- the small surface necessary for the equipment's installation.

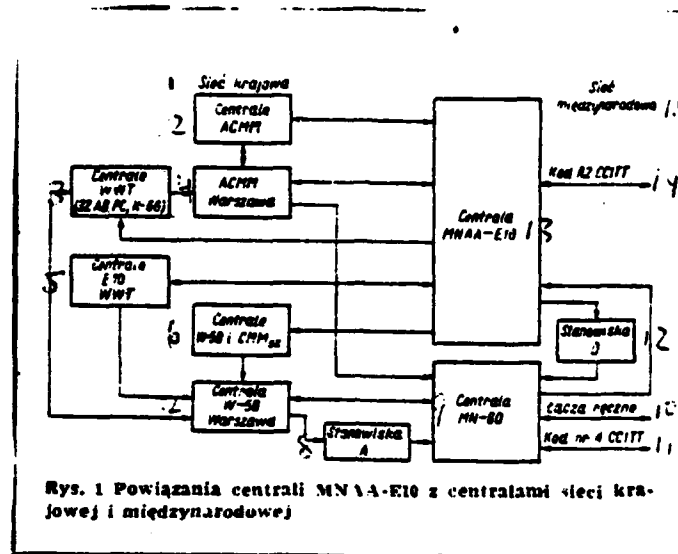
These advantages have caused the Ministry of Communications to choose the E-10 system as the automatic telephone exchange serving international traffic. This exchange, called the MNAA-E10, will be installed in the Main International Communications Center in Warsaw in the second half of 1980. The initial capacity amounts to around 1800 circuits in which 600 are international, and the ultimate capacity--3600 circuits.

LINKING THE MNAA-E10 INTERNATIONAL TELEPHONE EXCHANGE TO THE INTERNATIONAL AND NATIONAL NETWORK

The MNAA-E10 international telephone exchange is meant to handle automatic circuits entering and leaving the international network, semi-automatic circuits entering the international network and (to a relatively small extent) transit circuits in the international network. The exchange collaborates with the international network through circuits with R.2 (CCITT) line and registration signalling.

The MNAA-E10 exchange will handle international traffic together with the existing MN-60 exchange which collaborates with circuits exploited in the Nr 4 (CCITT) signalling system and manual circuits. Both exchanges will strictly cooperate with each other. After the first stage of construction, the MNAA-E10 will serve around 65% of the international circuits. The general scheme of

the two exchanges' coordination and with the national and international networks is shown in illustration 1.



Ill. 1 Linking MNAA-E10 exchanges with the national and international network

1. national network, 2. ACMM exchanges, 3. WWT exchanges, 4. ACMM Warsaw,
5. E10 exchanges, 6. W-58 and CMM exchanges, 7. W-58 exchange, Warsaw, 8. Station A,
9. MN-60 exchange, 10. manual circuit, 11. Code Nr 4 CCITT, 12. Station D,
13. MNAA-E10 exchange, 14. R2 Code CCITT, 15. international network

In handling international traffic in this particular way, subscribers of the Warsaw Telecommunication Knot (WWT) are dealt with, who make up around 60% of the total international connections in the country.

A circuit leading from the WWT's individual exchanges (with the exception of the E-10 exchanges) intended to handle international and trunk traffic, will

be connected directly to the ACMM in Warsaw. This exchange will direct international connections to the MNAA-E10 and MN-60. The circuit bundle to the MN-60 will decrease to the extent new international circuits are activated with R.2 signalling (CCITT), when the MNAA-E10 takes over the major part of the traffic.

An exception to this rule is the traffic generated by WWT subscribers connected to the E-10 system's local exchanges. This traffic will be directed along direct circuits to the MNAA-E10's exchange. International conversations dialed by operators will be facilitated in the present manner. Circuits from every WWT exchange (both for international and trunk traffic) run to a W-58 exchange, from where international connections are directed to the MN-60 exchange's station (a type A station).

International traffic, which comes to the WWT along circuits with R.2 signalling (CCITT), will be directed straight from the MNAA-E10 to individual WWT exchanges. The peak traffic will be redirected to WWT exchanges through the ACMM in Warsaw or through the WWT's E-10 exchanges. International traffic coming to the MN-60 exchange will be directed to the WWT network in the present way, that is through the W-58 exchange in Warsaw.

Automatic international connections can also be made by subscribers of zones served by the ACMM exchanges in Gdansk, Cracow and Poznan. Trunk terminal exchanges can be connected to them. Each of the ACMMs mentioned will be tied to the MNAA-E10 exchange by circuit bundles. Peak traffic will be redirected to the MNAA-E10 through the ACMM in Warsaw. International traffic, generated by the trunk network's other subscribers (served by the W-58 and CMM's exchange), will be facilitated in the present way, that is through the operators of the MN-60 exchange.

Trunk circuits, for both trunk and international traffic, are run from the CMM and W-58's individual exchanges to that of the W-58 in Warsaw, from where international connections are directed to operators in the MN-60 exchange.

All the incoming international traffic will be directed to the trunk exchanges in the country (ACMM, W-58, CMM) through the MNAA-E10 exchange. To process this traffic to the MNAA-E10 exchange, a bundle of corresponding international circuits will be connected, which come from the MN-60. Such a system allows the retention of uniform numbering of the trunk directions and the reduction of the number of trunk circuits handling the incoming international traffic. The handling of difficult connections in the incoming international traffic along circuits with R.2 (CCITT) signalling will be carried out with the help of Code 12 stations (D stations) of the MN-60 exchange. These stations will be linked by the incoming side to the MNAA-E10 exchange, or by the outgoing side to the MN-60.

EQUIPPING THE MNAA-E10 EXCHANGE

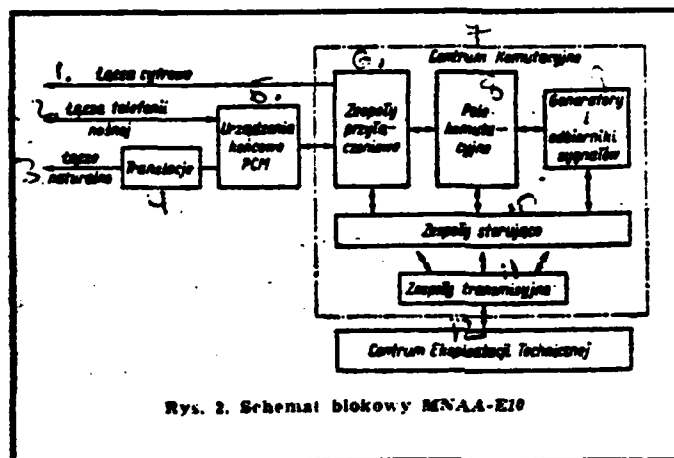
The commutation equipment of the E-10 system was used in the MNAA-E10 exchange. The exchange's simplified structure is shown in ill. 2. It is a typical exchange of the E-10 transit system.

Three functional blocks make up the exchange:

- PCM multipliers and repeaters (adapters),
- the technical exploitation center,
- the commutation center.

The technical exploitation center is equipped with the R-12 computer system produced by Videoton (Hungary) which contains:

- a central unit,
- a traffic unit,
- a disc memory unit for greater capacity,
- tape memory,
- a reader--perforated paper tape,
- peripheral dialogue equipment (a slow line printer, t.v. monitor, system teleprinter, operator's teleprinter).



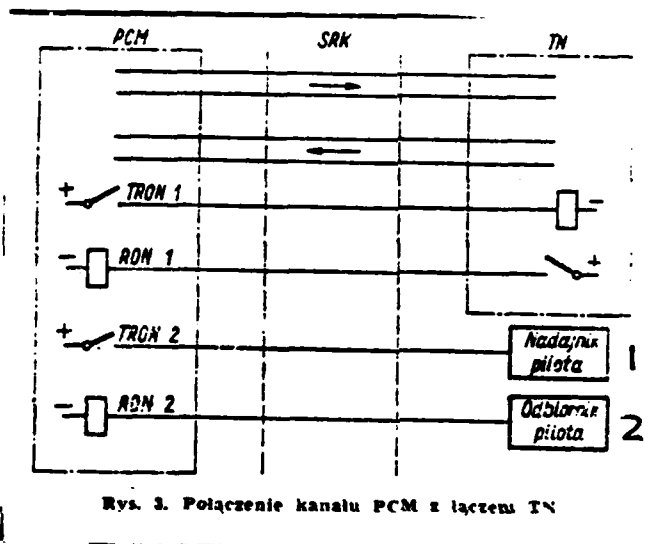
Ill. 2 Block schema of the MNAA-E10

1. digital circuits, 2. carrier telephony circuits, 3. natural circuits, 4. repeater, 5. PCM terminal equipment, 6. incoming sets, 7. commutation center, 8. commutation panel, 9. generators and signal receivers, 10. directing units, 11. transmission units, 12. technical exploitation center.

In addition to the typical information equipment, the CET also has extra-system equipment for the automatic and manual testing of international and trunk circuits (the ATME-2, ABA-3, SRK frames and SBS).

The commutation center (ill. 4) is composed of the following:

- the commutation panel (CX),
- tone signal and R.2 code generator units, and R.2 code receivers (ETA),
- directing units,
- incoming sets,
- transmission units.



III. 3 Linking the PCM channel with the Carrier Telephony Circuit

1. pilot transmitter, pilot receiver

Traffic units are, for the most part, typical for the E-10 system's exchanges. They are described individually in the book, System komutacji elektronicznej E-10 [The E-10's Electronic Commutation System] (a collection of papers edited by J. Blaszyk)--WKiL, Warsaw 1977.

Construction changes, intended to allow the equipment to meet the demands of an international exchange, were carried out only in the incoming sets and directing units.

GSM incoming sets are used in the MNAA-E10 exchange. These allow direct collaboration with international circuits.

Connecting and marking equipment have remained in the group of directing units. Instead of installing multiregister frames with a program memory for a capacity of 36 bit 2K words in the local exchanges, a new version was used, equipped with two program memories for a doubled capacity (4K). The new equipment is characterized by greater reliability (each multiregister has its own program memory and the ability to use highly developed commutation programming).

The tariff calculator was eliminated in the MNAA-E10 exchange, because this exchange will not calculate the charges for telephone calls. Instead, a new unit (ZRC) was created, whose task is to assure the registering of the conversation's duration in case the circuit from the CET is disconnected.

Part of the original design used in the MNAA-E10 is its operation (without matching repeaters) with analog carrier telephony circuits. The linking of the carrier telephony circuit to the MNAA-E10 is shown in a simplified manner in ill. 3.



III.4. Commutation Center Frames.

PCM terminal equipment can collaborate with other equipment by aid of a channel (circuit) which contains four signalling cables: two for signalling backwards (RON 1, RON 2) and two for signalling forwards (TRON 1, TRON 2). With collaboration by carrier telephony circuits, the RON 1 and TRON 1 cables are utilized for the transmission of line signalling. The application of "0" ("+" potential) in the TRON 1 cable causes the transmission of the signalling's current into the channel by signalling the given carrier telephony circuit. The use of "1" (removing the "+" potential) causes a break in the current's transmission. The current's reception in the signalling channel causes the application of the "0" position in the RON 1 signal cable.

The RON 2 and TRON 2 cables are used to safeguard against breaks in the transmission. The alarm contact of the pilot receiver of the carrier telephony's duodecimal circuit group is connected to the RON 2 cable. The application of the "0" position in the RON 2 means pilot alarm. The TRON 2 can be utilized to signal the break of the PCM track's synchronization and is connected to the input of the transmitter of the duodecimal group's pilot current (the synchronization's break is signalled by removing the "+" potential from the TRON 2 cable).

PRINCIPLES OF THE COLLABORATION OF THE MNAA-E10 EXCHANGE WITH THOSE OF THE INTERNATIONAL AND National NETWORK

The MNAA-E10 exchange will collaborate with other international exchanges by aid of the R.2 (CCITT) register and line signalling system (the version is analogous to line signalling). The meaning of the individual line signals are shown in table 1.

The line signalling shown in the table is quite sensitive to interruptions

in transmission, which can be treated as useful signals, such as "ready for operation" or "raising of the microtelephone by subscriber B." This makes it necessary to use in the circuits rather complicated safeguards against interruptions, established by the CCITT. Both the algorithms exchange of line signals and the safeguard against interruptions in transmission are carried out in the MNAA-E10 by the corresponding programming of the multiregisters and incoming sets.

The R.2 register signalling used in the MNAA-E10 fully agrees with the CCITT's recommendations, for which in the present article are presented only certain specific R.2 signalling characteristics for the MNAA-E10.

It has been adopted in the MNAA-E10 that in both the outgoing international connections (required by the CCITT) and incoming ones, the MNAA-E10 exchange's register will operate in tandem. Such a design makes possible the rearranging of the function of the mutual translation of the national and international network's signals. At the same time, the quality of the exchange of R.2 signals is essentially improved because the signals are regenerated in both directions of the completed connections in the MNAA-E10 exchange.

The principle was adopted that the MNAA-E10 exchange will always determine the length of the number of the international (outgoing connections) or national (incoming connections) subscriber demands. The determination of the length of numbers, especially international ones, given the rule, by analysis, is difficult and sometimes even impossible. Only the maximum length of the number, which appears in an assortment of numbers defined by the analyzed digits, is determined in the MNAA-E10 exchange--on the basis of the number's first two, three or four digits. The MNAA-E10 exchange's register

recognizes that the transmission of subscriber B's number has ended if:
--the number of digits received is equal to the number's maximum length,
--when required by the next digit, the outgoing exchange answers by the signal,
"end of scanning" (I-15),
--the waiting period for the numeral's next digit is excessive (5s).

In other cases the MNAA-E10's register will transmit in the outgoing exchange's direction the pulsed 1 signal, "category requirement"(A-3). The MNAA-E10's register does not in principle have to receive the pulsed 1 signal, A-3, because, when required by the number's next digit (A-1), it can always answer by the number's digit or the signal, I-15).

The identification of the outgoing international exchange by the MNAA-E10's register is not expected. This means that the MNAA-E10's incoming international register will not demand the transmission of the digits of the outgoing international exchange's indicator. In case the outgoing international register receives such a demand, it will answer with the signal, "demand rejected"--in accordance with the procedure recommended by the CCITT.

The MNAA-E10 exchange will collaborate with automatic trunk exchanges (ACMM) along carrier telephony circuits aided by R.2 register signalling according to the version of national and pulsed 1 line signalling actually used in the ACMM network. The signal assortment of this signalling is shown in table 2. The line signalling shown is more resistant to interruptions in transmission than R.2 (CCITT) line signalling. From this, the safeguards against interruptions are reduced in principle to that which would make the occupation of a free line impossible in the duodecimal group, in which pilot failure appeared, or in the PCM track in which a break in the synchronization ensued.

Collaboration with the ACMM in Warsaw is accomplished in a somewhat different manner, because the PCM tracks are terminated in the various ACMMs (collaboration along digital circuits). From this, either pulsed line signalling

(without taking into account the cables of the safeguard against interruption) or digital line signalling (see table 3) can be utilized on the circuits to the ACMM.

TABELA 1. Sygnalizacja liniowa R.2 CCITT (wersja analogowa).

1	Znaczenie sygnału	Kierunek nadawania	Wyposażenie przyściowe	
			RON 1	TRON 1
4	Spoczynek (stan gotowości)	→		
5	Wzięcie do pracy	→	0	0
6	Podniesienie mikrotelefonu przez AbB	→	1	0
7	Położenie mikrotelefonu przez AbB	→	1	1
8	Rozłączenie	→	1	0
9	Blokada	→	0	0 lub 1
		←	0	1
			TRON 1	RON 1
			Wyposażenie wyjściowe	

Uwaga: stan „0” przewodów sygnałowych kanału PCM jest równoważny przelaniu prądu w kanale sygnałowym telefonii nożnej.

Table 1 R.2 CCITT line signalling (analog version)

1. signal meaning, 2. transmission direction, 3. incoming equipment, 4. rest (state of readiness), 5. ready for operation, 6. raising the microtelephone by subscriber B, 7. hanging up the microtelephone by subscriber B, 8. disconnection, 9. Blocking 10. Outgoing equipment

Note: condition "0" of the PCM channel's signal cables is equal to the transmission of the current in the carrier telephony signal channel.

1.	Znaczenie sygnału	2. Kierunek nadawania	3. Czas trwania [ms]
4	Wzięcie do pracy	→	120+180
5	Podniesienie mikrotelefonu przez AbB	→	120+180
6	Położenie mikrotelefonu przez AbB	→	400+720
7	Rozłączenie	→	400+720
8	Zwolnienie blokady	→	11 (powtarzany co 10 s)
9	Blokada (ręczna)	→	400+720
10	Oferowanie	→	12 sygnał ciągły
			120+180

Table 2 Pulsed line signalling for the collaboration between the MNAA-E10 and

ACMM exchanges

1. signal meaning, 2. transmission direction, 3. duration, 4. ready for operation,
5. raising of microtelephone by subscriber B, 6. hanging up the microtelephone
- by subscriber B, 7. disconnection, 8. blocking release, 9. blocking (manual),
10. offering, 11. repeats at 10 s, 12. continuous signal

Note: as the significant condition, the "0" of the PCM channel's signal cables is equal to the transmission of the current in the carrier telephony channel.

1. Znaczenie sygnału	2. Kierunek nadawania	3. Wypoczątkowe przyjęcie			
		RON 1	RON 2	TRON 1	TRON 2
4. Specyficzny	→	1	0	1	0
5. Wzięcie do pracy	→	0	0	1	0
6. Potwierdzenie wzięcia do pracy	→	0	0	1	1
7. Podniesienie mikrotelefonu przez AbB	→	0	0	0	1
8. Położenie mikrotelefonu przez AbB	→	0	0	1	1
9. Rozłączenie	→	1	0	0/1	1
10. Zwolnienie blokady	→	1	0	1	0
11. Oferowanie	→	0	1	1	1
12. Wybieranie	→	1	0	1	1
timp 67 ms (nom)	→	0	0	1	1
ty 33 ms (nom)	→	0	0	1	1
		TRON 1	TRON 2	RON 1	RON 2
		13. Wypoczątkowe wyjście			

Table 3. Digital line signalling of the MNAA-E10 exchange

1. signal meaning, 2. transmission direction, 3. incoming equipment, 4. rest,
5. ready for operation, 6. ready for operation verification, 7. raising of
- microtelephone by subscriber B, 8. hanging up the microtelephone by subscriber
- B, 9. disconnection, 10. blocking release, 11. offering, 12. scanning,
13. outgoing equipment

1	Znaczenie sygnału	2	Kierunek nadawania	3	Czas trwania [ms]
4	Włączenie do pracy	→		50 + 80	
5	Wybieranie timp/tp	→		67/33 nom.	
6	Podniesienie mikrotelefonu przez AbB	→		50 + 80	
7	Polaknienie mikrotelefonu przez AbB	→		240 + 360	
8	Rozłączenie	→		900	
9	Zwolnienie blokady	→		12 (powtarzany co 10 s)	
10	Blokada (ręczna)	→		240 + 360	
11	Ofiarowanie	→		13 sygnał ciągły	
				240 + 360	

Table 4. Pulsed line signalling for the collaboration of the MNAA-E10 exchange with those of the W-58 and CMM

1. signal meaning, 2. transmission direction, 3. duration, 4. ready for operation, 5. scanning, 6. raising of microtelephone by subscriber B, 7. hanging up the microtelephone by subscriber B, 8. disconnection, 9. blocking release, 10. block (manual), 11. offering, 12. repeated at 10s, 13. continuous signal

Note: the signal's significant condition is that the condition "o" of the PCM channel's signal cables is equal to the transmission of the current in the carrier telephony signal channel.

The register signalling used between the MNAA-E10 and ACMM is in accordance with the national requirements in Code R.2. For outgoing international connections, the algorithms of the exchange of the R.2 code signals, used in the ACMM network, are supplemented by the transmission sequence of the tariff number from the MNAA-E10 exchange to the outgoing R.2 national register.

The MNAA-E10 exchange is connected with the other trunk exchanges (CMM and W-58) with the aid of carrier telephony outgoing circuits. These exchanges collaborate with each other with the help of selective decadic signalling and pulsed line signalling presently used in the CMM and W-58 network (table 4).

Collaboration with the MN-60 exchange will be accomplished along digital circuits with the use of the digital version of line signalling and selective decadic signalling. Matching adapters (repeaters) will be installed in the MN-60 exchange.

The MNAA-E10 exchange will collaborate with WWT exchanges in a manner analogous to the E-10 system's local exchanges. Hence, the MNAA-E10 can collaborate with the exchanges:

- of the E10 system along digital circuits with R.2 register signalling and digital line signalling,
- of the Pentaconta system (PC 1000C) along either digital circuits, with signalling as mentioned above, terminal ones with a corresponding repeater in the PC 1000C exchange or natural ones with line signalling by direct current with repeaters located in the E-10 exchange,
- of the K-66 system, along natural circuits with signalling by direct current and selective decadic signalling (repeaters in the E10 exchange),
- of the Strowger and 32 AB system along digital circuits (repeaters in the 32 AB exchange) or natural ones with selective decadic signalling.

EXPLOITATION AND MAINTENANCE OF THE MNAA-E10 EXCHANGE

The centralization and automation of exploitation requirements are the characteristic traits of both the E-10 system's exchanges and the MNAA-E10. The MNAA-E10 exchange will be equipped with a corresponding exploitation system which can accomplish the following tasks:

- registration of the duration of conversations for international accounts,
- changes in the direction tables by traffic and the opening and closing of circuits,
- testing and measuring circuit parameters,

- signalling and localizing damage,
- measuring the load of the exchange's circuit bundles and units (load observation),
- traffic observation.

These tasks are accomplished by the corresponding equipment of the technical exploitation center.

In accordance with the recommendations of the CCITT, the MNAA-E10 exchange must determine the approximate duration of conversations in the automatic outgoing traffic. The duration of conversations will be calculated in the CET on the basis of the report of their beginning and end, transmitted to the CET by multiregisters and subsequently added to the caller's corresponding meter. The exchange will be equipped with separate meters for each destination country. When several tariff zones exist in a destination country, an individual meter will be assigned to each of the zones. When there is a failure in the CET which prevents the registration of the conversation, all the data necessary for calculating the conversation's duration is directed by the multiregisters to the protection unit for the registration of the conversation's duration (ZRC). Transformed and supplemented in the ZRC, the data will be registered on paper tape. After the failure is eliminated, this data is directed to the CET system, which enables the caller's meters to be brought up to date. The position of these meters will be periodically shown on the operator's monitor.

The MNAA-E10 exchange will have system or extrasystem equipment for the automatic and manual measuring of circuit parameters. It is expected that the measuring of international circuit parameters will be performed by using an automatic apparatus which meets the CCITT requirements for the ATME-2. In addition, in order to perform tests manually, distribution control frames

(SRK) and individual testing stations will be installed in the MNAA-E10 exchange. The testing of trunk circuits will be carried out by means of a ABA-3 type automatic apparatus, SRK frames and SBS. Local circuits (for WWT exchanges) will be tested by the equipment of the E-10 system, that is by hypsometers.

The linking of test equipment with the MNAA-E10 exchange is shown in ill.

5. The principle has been adopted that through the MNAA-E10 exchange's commutation panel, test connections will be joined from the test equipment to outgoing test circuits and from the circuits, along which come test connections to the corresponding responders (depending upon the test equipment completing the connection).

The controlling part of the ATME-2, ABA-3, SRK and SBS equipment will be linked to the MNAA-E10 exchange by means of matching equipment which will collaborate with that exchange along special test circuits, by using R.2 register signalling and digital line signalling. It can be expected that both outgoing circuits with R.2 register signalling and circuits with selective decadic signalling will be acquired. Test connections entering the MNAA-E10 will be directed to the corresponding responders on the basis of the number transmitted by the test equipment's control apparatus. The responders will be linked to the MNAA-E10 exchange through the matching units and will work in circuits with digital line signalling.

The outgoing (HD) and incoming hypsometers (HA), serving for circuit testing in the WWT, are connected by means of special repeaters to circuits with digital line signalling. The outgoing hypsometer is directly controlled by the CET, from which it receives the appropriate commands and to which it transmits the results obtained. The hypsometer secures tested circuits, sending the MNAA-E10 the designated number (numbers) of the special test directions. The Technical Exploitation Center, modifying the circuit's number in the computer's

memory, makes possible the testing of the required group of circuits. These tests are performed in an automatic manner according to the program set beforehand.

Abnormalities in the units' and circuits' functioning are detected in the MNAA-E10 on the basis of the programs' analysis and by detection systems. Each of the exchange's units is equipped with a series of detection systems, detecting damage or disturbances. Information about abnormalities detected in the functioning of the exchange's units is sent to the CET. Each of the exchange's programmed units (control units and incoming sets) can analyze received and transmitted information and signals. When abnormalities are detected (for ex. a defect in the response from the called unit, disturbances in the reception of the R.2 code signals or erroneous line signalling), these units will notify the CET. Information reaching the CET is shown on the CET's monitor, facilitating the application of the appropriate remedial means and localizing the damage.

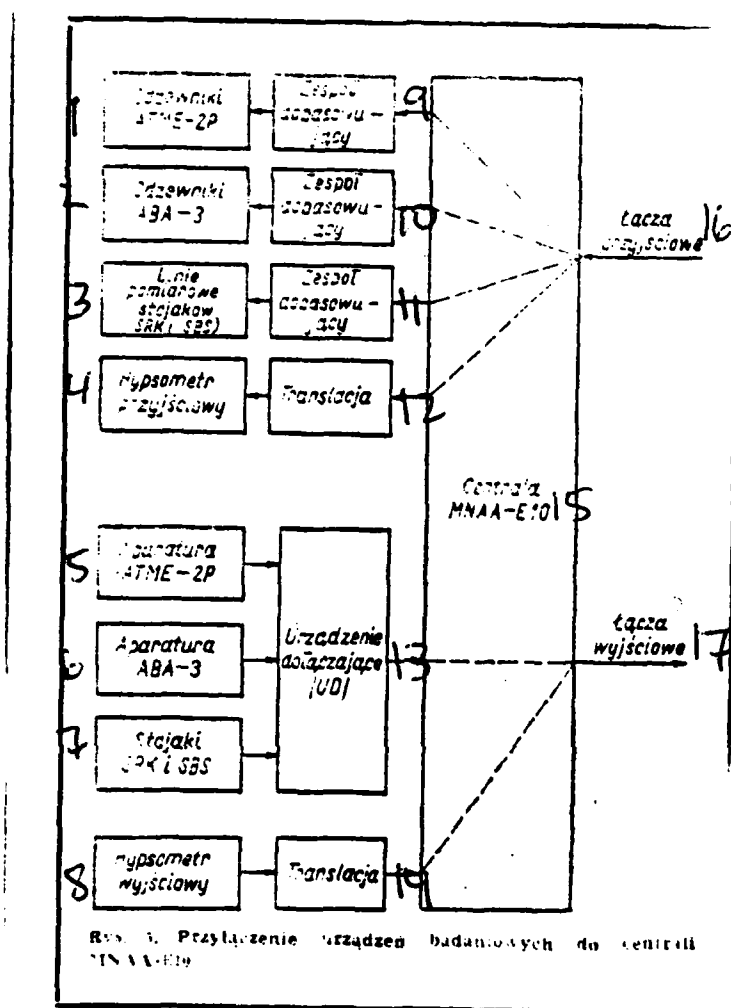
The Technical Exploitation Center is equipped with a special system for localizing damages (Locavar), facilitating the automatic testing of the exchange's units and the localization of damages with great precision. This system also allows the monitoring and localization of damage in the program memory. The testing of the exchange's units by aid of the above mentioned system is performed either periodically, in accordance with the graphic schedule of the exchange's testing, or as a result of the reception of damage signals.

The measuring of the load of exchange's units and the circuit bundles (load observation) has to provide the exchange information about traffic processed by the exchange and its individual elements. The following measurements can be expected to be performed in the MNAA-E10:

- the global exchange load,
- the exchange's unit loads (multiregisters, commutation panel and R.2 code

receiver),

--the bundle load.



III. 5 The linking of the test equipment to the MNAA-E10 exchange

1. ATME-2P responders, 2. ABA-3 responders, 3. survey lines of the SRK and SBS frames, 4. incoming hypsometer, 5. ATME -2P apparatus, 6. ABA-3 apparatus, 7. SRK and SBS frames, 8. outgoing hypsometer, 9. matching unit, 10. matching unit, 11. matching unit, 12. repeater, 13. connecting equipment (UD), 14. repeater, 15. MNAA-E10 exchange, 16. incoming circuit, 17. outgoing circuit

The global exchange load is measured by aid of meters for traffic statistics. The MNAA-E10 exchange will be equipped with seven meters in which will be tallied information transmitted into the connection's blending track by the multiregisters. These meters will register:

- the number of calls directed to the exchange,
- the number of calls, for which complete information is received, gathered in connections leaving the country, connections entering the country, connections entering the MNAA-E10 from the MN-60, transit connections in the international network (four meters),
- the number of completed calls,
- the number of failed calls caused by disturbances in the exchange's operation, busy R.2 code receivers and busy circuits.

The unit and circuit bundle load is calculated on the basis of how busy the exchange's observed elements are. At predetermined times, the CET sends information about its load. The responses are kept in the CET's mass memory and serve in the calculation of traffic data. The CET system allows various measurements to be carried out depending upon the real exploitation needs. Individual continuous and cyclical measurements can be expected.

Individual measurements are performed in one or several of the exchange's elements, during the busiest hours over a period of several days. The observed elements' load is tested for 30 seconds over a predetermined period of time. The results are issued daily, after the observation, in the form of the observed elements' average load (traffic versus that non-processed) during the required observation time. This type of measurement yields very accurate data about the traffic processed by the exchange. Continuous load measurement is supposed to signal either the observed elements' total load or the surpassing of a load limit predetermined beforehand. This limit established from

regulations is 80%, but can be changed by operators for individual units or bundles. The observed units' load is determined on the basis of data taken from two tests, each several minutes long. If both tests indicate the limit is being surpassed or the total load, a corresponding notification is shown on the CET's monitor.

Cyclical load measurement provides information about the momentary global load and that of the exchange's individual elements. The load is calculated on the basis of two tests carried out in 30 s intervals. After all required measurements are completed, an assortment of printouts given for all the observed elements is shown on the CET monitor. The observations are repeated every few minutes. The CET system allows the simultaneous performance of all the types of measurements for the exchange's observed elements.

Traffic observation allows the analysis of the kind and propagation of traffic processed by the exchange and contributes to a significant degree to the detection of circuit damage. The analysis is carried out in the CET on the basis of special notification about the connection's course, transmitted by the multiregisters. These notifications allow the exchange operators to follow the course of connections in chosen circuits and to obtain information about processed traffic. Depending upon the exploitation needs, MNAA-E10 operators can make use of:

- the observation of outgoing and incoming circuit bundles,
- direction observation ,
- test observation .

Bundle observation yields data about the traffic processed by the observed bundles. The inclusion of observations in the CET initiates the transmission by the multiregisters of notifications characterizing the course of completed

connections. These notifications signal either a connection's completion or provide the cause for the failure of a connection directed to a given bundle. The information arriving in the CET is totaled on specialized meters. Each of these totals the occurrence of designated types of events. After the observation, an operator can request a printout of the data obtained from the observation. This data is divided into a part describing the traffic processed by the entire bundle and that describing the traffic processed separately by each circuit of the bundle. The basic data obtained for the bundle is:

- the number of calls directed into a bundle,
- the number of completed calls,
- the number of calls not processed in the exchange (busy circuits, busy R.2 code receivers, disturbances in the exchange's operation).

Data characterizing the traffic handled by individual circuits is:

- the number of calls directed into a circuit,
- the number of completed calls,
- the number of failed calls caused independently of the exchange, which can be broken up into individual causes (for ex. subscriber B's error, subscriber B being busy, a backlog in a distant exchange, disturbances in the signalling on the circuits, etc.).

Direction observation provides quantitative and qualitative data about the traffic directed to a designated group of subscribers. This group (or direction) is defined by the first two, three or sometimes four digits of the international (connections leaving the country) or national number (connections entering the country). Each connection directed to the observed group of subscribers causes the transmission to the CET of a notification signalling either a successful connection (entering into the "conversation" position), or giving the reason why the connection was not made. Upon the observation's

completion, the operator receives (for each observed direction) a printout containing the total number of calls, the number of completed calls, and the number of failed calls caused by:

- a backlog in other exchanges,
- subscriber B being busy,
- subscriber B making an error,
- disconnection by subscriber A before finishing dialing,
- backlog in the circuits or the MNAA-E10's units,
- disturbances in the exchange's operation.

A test observation is performed for a limited number of circuits and is intended to accurately analyze the causes of the circuits' decreased efficiency. It also localizes the sources of the disturbances. This type of observation is included as a rule for those circuits, which during bundle observation are discovered to have decreased or zero efficiency. For this type of observation, all notifications sent by the multiregisters are immediately shown on the operators' monitors, allowing them to keep track of connections carried out in the circuit.

CONCLUSION

The construction of the E-10 international system of automatic exchanges will allow the meeting of constantly growing needs in the field of international traffic. Presently, only WWT subscribers are utilizing automatic international connections. Upon the MNAA-E10's activation, the utilization of automatic international connections can be extended to all the subscribers of the zones served by ACMM exchanges. Thanks to this, the number of subscribers entitled to make or receive international connections will be increased. The MNAA-E10 exchange will also lead to a significant improvement in the quality of the service of international traffic.

THE USES OF MODEMS AND CONVERTERS PRODUCED BY THE TELKOM-TELETRA PLANT

It is expected that the wider usage of digital computers, the growth in their number, their greater calculating power and the versatility of their usage will cause more and more information to be sent them over telecommunication circuits. The usage of a telecommunications network for the transmission of digital information (data transmission) provides access to the computer for every need and from any location.

Within the framework of the RWPG there exists, as mentioned, the operating unit, the Uniform System of Electronic Digital Computers (JSEMC), concentrating the producers of digital computers and teleinformation equipment and the representatives of the administration of communications. This organization is charged with normalizing and putting into effect the joint testing of the qualifying system of equipment for use in the territories of the RWPG. The majority of CCITT recommendations for modems have their own counterpart in JSEMC determinations.

In the CCITT recommendations and for the JSEMC modems are described by the electric and temporal dependencies of the modem's contact with the circuit (the S1 contact) and with the terminal equipment for data transmission (the S2 contact). The requirements for the S1 and S2 contacts, binding in Poland, are described in the Polish Standards and are: the S1 contact in standard PN-76/T-05051 and the S2 contact in standard PN-75/T-05052.

Modems produced by the TELKOM-TELETRA plant will be discussed below.

THE 200/300 BAUD MODEM, WHICH MEETS THE CCITT'S RECOMMENDATION V21 AND THE JSEMC'S REQUIREMENT EC 8002

The most frequently used modem (over 50% of the total number) is that for a limited rate of information transmission. The 200/300 baud modem is designated

mainly for the transmission of information across an automatically commutated telephone line. When operating on such lines, the modem engages the line only when relaying data. The rest of the time, the line is at the disposition of the telephone subscriber.

The subscriber's leads (those line segments leading from the exchange to the subscriber) are mainly one-way lines. This creates a certain difficulty for transmitting data simultaneously in both directions. Part of the data transmission systems requires return coupling between the receiver and transmitter, and then the need arises for the simultaneous transmission of information in both directions. The 200/300 baud modem was designed so that the operating band of the telephone channel is divided into two, distinct frequency channels. This allows for the simultaneous two-way transmission of information at various rates selected from a range of 0 to 300 bauds in each direction.

The modem's collaboration from one side with a telephone line and from the other with terminal equipment for data transmission (UKTD), requires control facilitating not only the transformation of binary signals into analog and the reverse, but also the fulfillment of other demands resulting from collaboration with the telecommunications network. With this in mind, the modem's S2 contact with the UKTD contains, in addition to circuits for data transmission, a series of directing circuits whose functions, in short, are explained below.

The functions of the contact circuits, the interdependency between them and the electric parameters of the contact circuits are individually stated in the CCITT's recommendation V24 and the recommendation relating to the designated modem (in this case, V21) and the Polish Standard, PN-75/T-05052.

The circuit 108.2-UTKD ready is the basic circuit. The "YES" condition in this circuit means the UKTD is ready and then the modem can be hooked up to the line in order to obtain the call signal (ring) or the operator can initiate the process of entering into a connection with a distant subscriber. The condition of circuit 107-modem being ready, depends upon that of circuit 108.2 and the call signal. If the 108.2 circuit is in the YES condition and modem has received the call signal, the modem can be connected to the line and in circuit 107 the YES condition occurs. This causes the sending of the appropriate signals into the line which confirm the station is connected. Then, after reception of the signals from the distant station, circuit 106-ready to transmit, enters into a Yes condition which means that the distant station is ready to function and all the information transmitted by circuit 103-data transmitted, will be sent into the line.

* The YES and NO conditions in designated circuits determine the electric signals fixed levels, measured in the circuits for the entire length of these conditions.

The reaction of the contact circuits to the appropriate signals follows with a certain delay, necessary for preparing the distant station for the mentioned information. For the entire transmission time the level of the signal emanating from the line is controlled by the modem, which is signalled by the condition of circuit 109 (the level of the signal received). The YES condition signifies that the signal received from the line is contained within the range of regular sizes (levels). The NO condition signifies that the signal received is found outside the range of regular sizes (for a lower level of signal received or an interruption in the line). The NO condition of circuit 109 causes the blockage of circuit 104 (data received) not allowing the appearance of accidental information, originating from line disturbances and noises.

As seen, the modem's regular functioning and that which concerns it, the regular transmission of information, demands a designated procedure for controlling the modem's contact circuits. Because the modem must be only an intermediary in the exchange of information, the task of securing the appropriate parameters and control procedures for the contact circuits should fall to the UKTD. Some modems perform certain simple functions independently, for ex. making the decision to break off the connection in case of the carrier wave's excessive decay.

The use of the 200/300 baud modem in the automatically commutated telephone network allows the optional selection of a second data transmission station. This service is accomplished by dialling the number of a second subscriber equipped with the appropriate data transmission station. The station's connection is then carried out in the so-called point-point system. Since the simultaneous transmission and reception of information is possible in the two distinct frequency channels, it is important that the channel designated for transmission in one modem be the reception channel in the collaborating modem. The channel's readjustment is carried out automatically when the connection is made and as the signal selecting the channel going to the telephone is the ring (the modem is always connected to the ring detector line). This allows the two modems' direct connection. Some simpler (cheaper) 200/300 baud modems do not have an automatic system for setting up channels and this the operator must do before transmission according to a previous telephone agreement with the other station's operator.

In addition to channel readjustment, the modem must guarantee simultaneous bidirectional transmission, accordingly controlling the line. In long telephone trunk lines echo dampers are sometimes used to block the unused transmission direction. The modem, before the initiation of information transmission,

sends into the line the so-called "autoresponse" signal neutralizing the echo damper's operation, making possible in this way the simultaneous bidirectional transmission of data. The 200/300 baud modem is designated for operation on commutated lines; however, it is not excluded from use on permanent lines (private) in the point-point system. Control by means of the S2 contact in this case is somewhat different than with operation on commutated lines.

Specially equipped lines of the 200/300 baud modem allow the transmission of data on permanent lines in the so-called "all point system." To one permanent telephone line is connected a main station controlling the system's operation and several substations. The main station can send data to individual substations or to all simultaneously. The substation can only transmit data to the main station. Substations cannot transmit data between themselves. The use of one permanent line to connect several data transmission stations is appropriate especially if the substations run sporadically or if they are "instructed to" by the central station. This guarantees transmission without disturbance, because only information for a designated UKTD will be sent on the line. The use of the all point system lessens the cost considerably for private lines (instead of several lines leading between the main and substations, one is sufficient).

THE 600/1200 BAUD MODEM, WHICH MEETS THE CCITT'S RECOMMENDATION V23 AND THE JSEMC'S REQUIREMENT EC 8006

The 600/1200 baud modem is the next normalized by the CCITT and in accordance with the JSEMC. A greater transmission rate requires a wider frequency band. Bidirectional information transmission is impossible on one-way lines at equal rates. In order to assure, however, return coupling between the receiver and transmitter, a considerably narrower frequency channel is necessary,

which allows the return transmission of information at a rate of 75 (and in some modems), 150 bauds. Two transmission channels are created in this way: one transmitting at a rate of 600 or 1200 bauds, called the destination channel and the second--called the return channel.

Generally, the 600/1200 baud modem fulfills the same needs as the 200/300 baud modem. This means that that modem can operate on commutated lines and on permanent lines in the point-point system. Also, transmission can be carried out synchronously or asynchronously. When it operates asynchronously the modulation rate does not have to fall within the required limits of 0 to 600 baud or 0 to 1200 baud. Synchronized operation allows data transmission only at a rate of 600 or 1200 baud.

As for the 200/300 baud modem, the telephone line is occupied only during data transmission. Depending upon the need, it is possible to use a rate of 600 or 1200 baud. The standard teletransmission line of practically any length together with a one-way subscriber lead is sufficient for transmission at a rate of 1200 baud. Especially with a poorer quality of line it is possible to use the 600 baud rate (a narrower frequency band is then necessary).

Some data transmission systems are not suited for the use of a return channel. Then, the return information is sent in a terminal channel at a rate of 600 or 1200 baud. This requires each time the reversal of the transmission direction (the modem which transmitted is connected to the receiver and that which received--to the transmitter). This manner is rather widespread. It leads, however, to a less efficient use of transmission time. The reversal of the transmission direction requires a longer period than is necessary for returnable information transmission. The matter is additionally complicated by synchronous transmission, because then a synchronization period must be expected (the bits synchronizing the preceding return information). The modem's

duplex operation (simultaneous bidirectional data transmission) is possible only on two-way lines and hence is only possible on permanent lines.

The S2 contact of the 600/1200 baud modem is much more developed than that of the 200/300 baud modem. Besides data circuits (103-data transmitted in primary channels and 104-data received in primary channels) and control circuits, there are also time base circuits (114-the elemental transmitting time base and 115-the elemental receiving time base), data circuits controlling the return channel (118-data transmitted by the return channel, 119-data received by return channel, 120-requiring transmission in the return channel, 122-line signal detector in the return channel).

Control by the operation of the 600/1200 modem is much more complicated than that of the 200/300 baud modem and the task of assuring the appropriate parameters and control procedures falls to the UKTD.

THE 1200/2400 BAUD MODEM, WHICH MEETS THE CCITT'S RECOMMENDATION V26 AND THE JSEMC'S REQUIREMENT EC 8013

The 1200/2400 modem is used just like the 600/1200 baud modem. They are differentiated by transmission rate and by the fact that the 1200/2400 modem only operates synchronously. The 600/1200 modem cannot collaborate with the 1200/2400 modem because of different modulation methods.

Data transmission at a rate of 2400 bit/s is possible on good quality lines. Available lines often require the correction of parameters before transmission. With this in mind, the 1200/2400 modem is equipped with a corrector adjusted manually which

allows the correction of a permanent line. For operation on automatically commutated lines, the modem is equipped with a permanent corrector, whose characteristics are the combination of many statistically tested lines with one-way subscriber leads.

The 1200/2400 modem collaborates in the commutation network with a typical CB telephone with a numerical dial and all functions tied to a completed telephone connection are performed by the telephone.

Understanding the data transmission station's operator during operation on permanent lines is possible by means of a specially constructed telephone adapter strictly collaborating with the modem.

THE BASIC CONVERTER

In some transmission systems, information is sent over short distances. This takes place especially in many factories, educational institutions, scientific-research posts, hospitals, etc. Typical physical lines usually made from one or two pairs of cables, hence, are used for transmitting information. With such connections, the frequency band possible is significantly wider than that of a telephone, practically from 0 Hz to tens, sometimes even several hundreds of kHz. Hence, modems which use a complicated method of signal modulation and demodulation are not needed.

Quite frequently for transmission over short distances, the symmetrical lines of a local telephone network (cable pairs which telephone subscribers also use) are utilized. The equipment used

for data transmission on physical lines are called, as mentioned, basic converters.

Control by means of the S2 contact occurs in the converter just as it does in the modem. Thanks to special line equipment, the basic converter allows a duplex transmission on a one-way line. In the TELKOM-TELETRA plant is now produced the AKP 4800 basic converter, enabling asynchronous transmission at rates from 0 to 4800 bit/s across one or two-way lines, formed from a pair of symmetrical cables. The transmission range depends upon the transmission path's properties and the transmission rate. The orientation range amounts to: for a local cable with .9 copper wires for duplex transmission at a rate from 200 bit/s to 4800 bit/s on a one-way line from 28 to 14 km, as well as on a two-way line from 40 to 16 km. As can be seen, these ranges assure a high quality information transmission even within a large city.

Recently production has started on a basic converter operating also synchronously and a frame version allowing the trouble free collection of a larger number of converters in one place, for ex. multiplexers operating with a large number of data transmission subscriber points. The low price, small dimensions, low power input and universality allow the converter to be used at many points of the data transmission network. Besides the typical S2 contact produced by TELKOM-TELETRA, the basic converter has a contact allowing its direct connection to a multiple telegraph channel. Depending upon the need, the creation of many other transmission connections is possible.

TELEGRAPH CONVERTERS

As is known, it is also possible to utilize a telegraph network for data transmission. The binary signalling parameters recommended by the CCITT are, however, different from those of the signal transmitted by a telegraph network. The telegraph converter differs from the modem only in the S1 contact (the contact with the telegraph line). The S2 contact is the same for both the telegraph converter and the 200/300 baud modem and hence, the control procedures must also be the same. The converter functions asynchronously at a rate of up to 200/300 baud.

A line contact allows collaboration by a commutated telegraph network with a one-way subscriber lead, as well as by a permanent telegraph line with one and two-way leads. On one-way lines alternating operation is possible and on two-way lines simultaneous bidirectional operation is possible.

In order to fulfill all requirements imposed on the subscriber telegraph station, the data station must be equipped with a teleprinter and a so-called teleprinter caller. A connection is made by means of the caller, and the exchange of designated signs and official correspondence by means of a teleprinter. The station can reach the data exchange stage either by operator manipulation or automatically by transmission of sequence nr. 19 of the alphabet nr. 2 CCITT-SSSS. The sequence detector after obtaining the four S signs, commutates the station automatically from telegraphic operation to data exchange.

THE AUTOCALLER

In previously described modems during operation on commutated lines, a telephone was usually used to make the connection. If we accept the fact that one of the data transmission stations operating automatically in a commutated network is a station equipped with a digital computer for transmission control, the question arises, in what manner will the digital computer make a connection with other data transmission stations. The AW-1 autocaller produced by TELKOM-TELETRA makes this possible.

The autocaller is connected to the computer by means of the S2 contact equipped, however, with a different circuit than the modem. The computer controls the autocaller, creating in a commutated telephone network all the conditions necessary for making a connection with a distant subscriber. The autocaller simulates the microtelephone's raising and after the exchange's connection sequentially sends the digits of the distant subscriber's telephone number. The computer sequentially gives out the telephone number digits over the S2 contact's circuits.

After selecting the number, the autocaller sends the interrupted signal into the line advising the operator of the distant station of the collaboration with the computer. With the signal's interruption, the autocaller awaits the arrival of an autoresponse signal. This signal is necessary for neutralizing the echo dampers, and is used simultaneously by the autocaller as verification of the distant modem's connection to the line. After receiving the autoresponse signal, the autocaller informs the computer of this (over the S2 contact) and simultaneously connects the tele-

phone line to the local modem. The computer from this moment on can begin data transmission across the completed circuit in the commutated telephone network.

Special control procedures by the autoresponse and modem when the connection is made are given in the CCITT's recommendation V25 and in the Polish Standard's PN-77/T-05050.

THE EACT-200 ELECTRONIC SUBSCRIBER CENTRAL TELEPHONE EXCHANGE

Setting up a programmed control in a small capacity telephone exchange can have interesting effects, such as decreasing equipment load and extending the range of additional services offered to the subscriber.

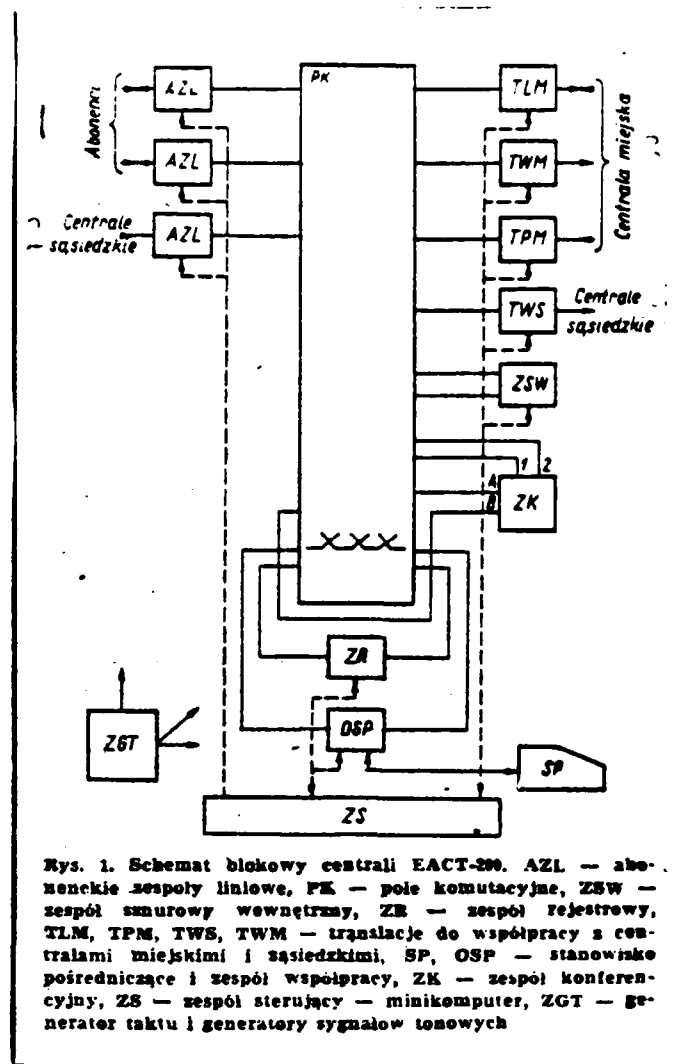
We will attempt to present these advantages of programmed control, describing the EACT-200 electronic subscriber telephone exchange, constructed in the Pan-Polish Teleelectronic Plant, TELKOM-TELETRA on the basis of the concept developed in the Military Technical Academy's Telecommunication Systems Institute.

This exchange is intended to perform the following connections:

- internal ones processed automatically,
- outgoing and incoming ones from the publically used telephone network, which can be processed either semi or fully automatically,
- outgoing and incoming ones from neighboring exchanges, carried out automatically. The exchange also allows return connections, the relaying of connections on another internal number, the interception of local connections during the return connection, connections which can provide calls to subscribers already engaged with a call, and also conferencing and shortened selection.

It is possible to connect circuits in accordance with the table to the EACT exchange--depending upon its equipment. The average traffic for a subscriber amounts to .15 erl.

The exchange regularly completes calls made on telephones with numerical dials at 8:12 Hz frequencies, and an interruption to dead circuit ratio from 1:1 to 4:1. The maximum loop resistance for a line with the apparatus is 1500 Ω , the minimum insulation--22 k Ω .



Ill. 1. A block schema of the EACT-200 exchange

AZL--line subscriber units, ZR--register units, TLM, TPM, TWS, TWM--repeaters for collaboration with local and neighboring exchanges, SP, OSP--translator and collaborative unit, ZK--conferencing unit, ZS--control unit-minicomputer, ZGT--cadence generator and tone signal generators.

1.subscribers, 2.neighboring exchanges, 3. local exchange, 4. neighboring exchanges

Pojemnost centraly	Druha		
	abonentov	vnějších	vnitřních
50 NN	50	1	1
100 NN	102	2	2
200 NN	194	3	3

The number of outgoing and incoming circuits of the EACT exchange depending upon its capacity

1. exchange's capacity, 2. subscriber, 3. local, 4. neighboring
5. circuit

Subscribers connected to the exchange can be divided into 6 classes according to the connections: cited below:

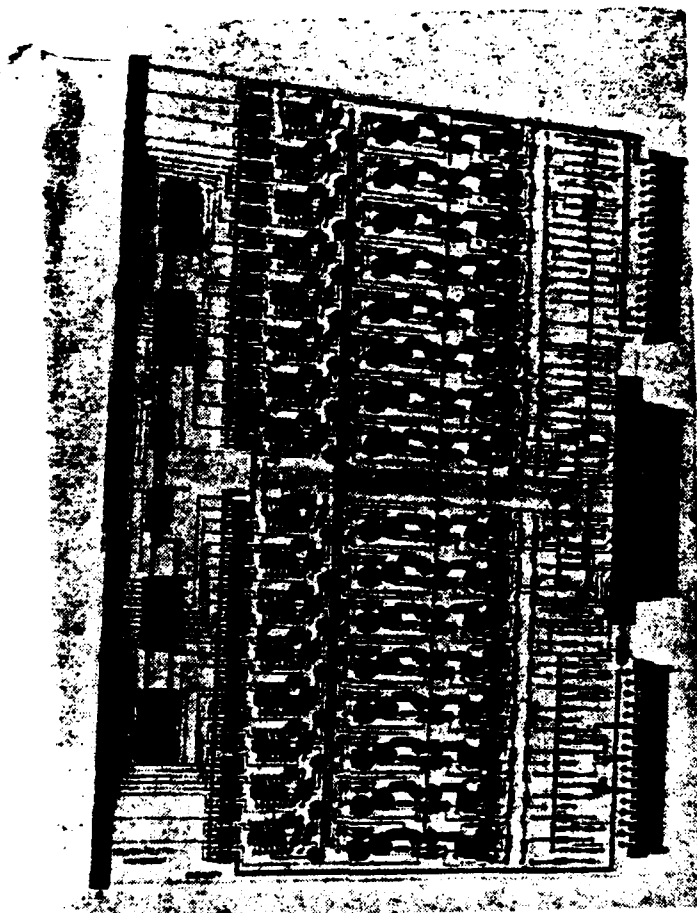
- a) in exchanges and those coming from neighboring exchanges;
- b) as in pt a and for connections coming from local exchanges;
- c) as in pt b and for outgoing connections within the area of a numbering zone;
- d) as in pt c and for connections within an entire numbering zone;
- e) as in pt d and for trunk connections carried out in automatic traffic;
- f) as in pt e and for international connections carried out in automatic traffic.

THE EXCHANGE'S SYSTEM OF OPERATION

The exchange's block schema is shown in ill 1. The following functional blocks can be distinguished in it:

The line subscriber units (ill. 2) constructed by aid of optotrons, serve for the signalling of the subscriber circuit's condition (they detect the micro-telephone's raising).

the commutation panel is a tri-stage panel built by aid of matrices with reed relays. The panel's configuration guarantees the maintenance of the exchange's appropriate traffic parameters.



111.2 A box of line subscriber units operating with the aid of optotrons

Cord and register units, and repeaters complete the connection in the appropriate directions on the basis of instructions from the control unit.

The translator is used when semiautomatic connections are made in other exchanges.

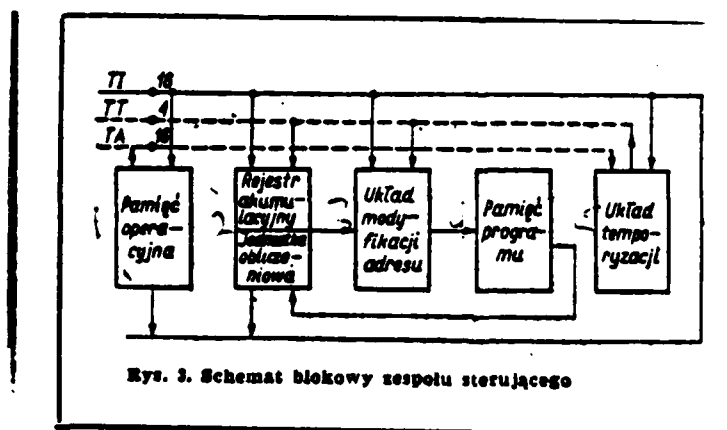
The conferencing unit is used when conferencing connections are made.

The control unit is programmed as the exchange's decision-making unit, which--based on information obtained from other units and the operational program--makes decisions about commutation.

The cadence generator together with tone signal generators provide synchronizing and acoustic signals, necessary for the exchange's operation.

PROGRAMMED CONTROL

Programmed control is accomplished by means of the control unit, whose schema is shown in ill. 3. The basic blocks of this unit are the analytical unit, the operational memory, the accumulation registers, the address modification system and temporization system. These blocks are connected by aid of telestrades: informational TIs, address TAs and test TTs.



Ill. 3. The block schema of the control unit

1. operational memory, 2. accumulation register-calculating unit, 3. address modification system, 4. operational memory, 5. temporization system

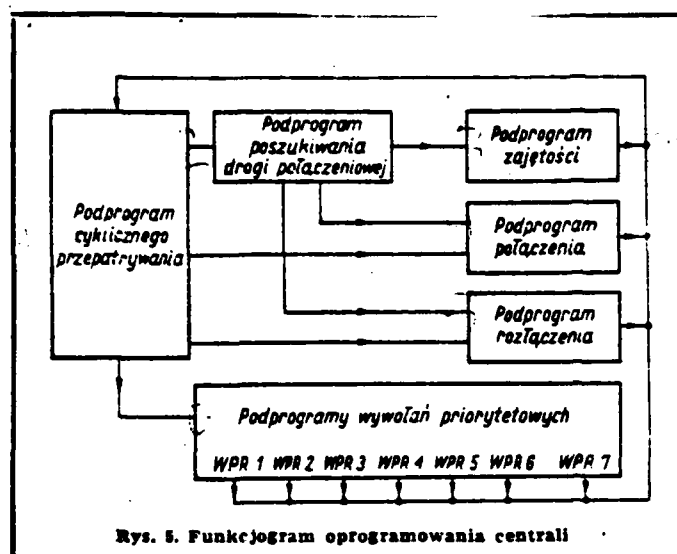
Information tied to the performance of designated sections of the program is stored in the operational memory. The address of information written or read provides in principle the program memory by means of TA address telestrades. Otherwise, information is sent by informational telestrades. In the program memory (ill. 4) are also found instructions, addresses and parameters assuring the proper directing of the information flow and its modification. If it turns out that in the program realization track, the source information requires modification or verification, it is sent by aid of a TI telestrade to the accumulation registers, and then to the analytical unit. The transformed information can be entered into the operational memory, used for modifying the next word of the program memory or--by aid of a TI telestrade--relayed to the registers of the exchange's terminal units. The TT telestrades relay information from the source registers.

In the temporization system, information is transferred from the TI to the TT telestrades; the performance of designated instructions is delayed and priorities are transmitted to selected connections.

The exchange's program of operation is entered into the reprogramming memory. It is composed of a series of subprograms used in different phases of the exchange's operation. The programmed functiogram is shown in ill. 5. The following subprograms can be distinguished in it: cyclical observation, connection path investigation, connection and disconnection, and priority calls.



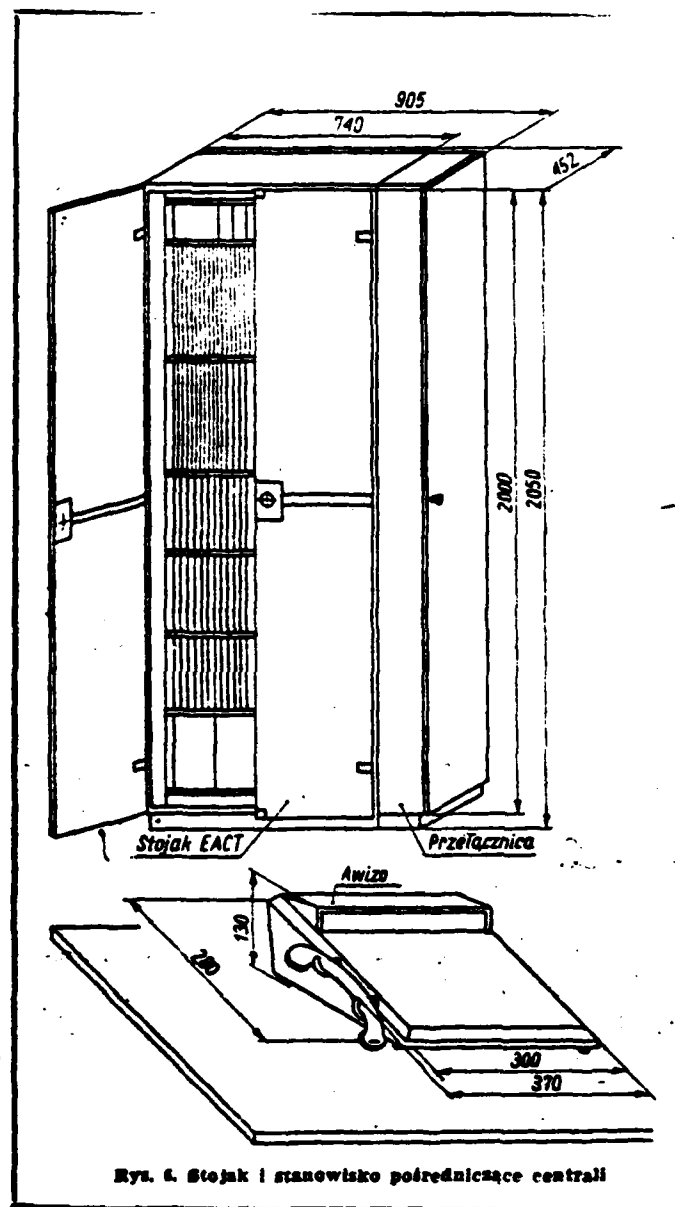
Ill. 4 A typical box of the exchange--program memory



Rys. 5. Funkcyjogram oprogramowania centrali

Ill. 5. The exchange's programmed functiogram

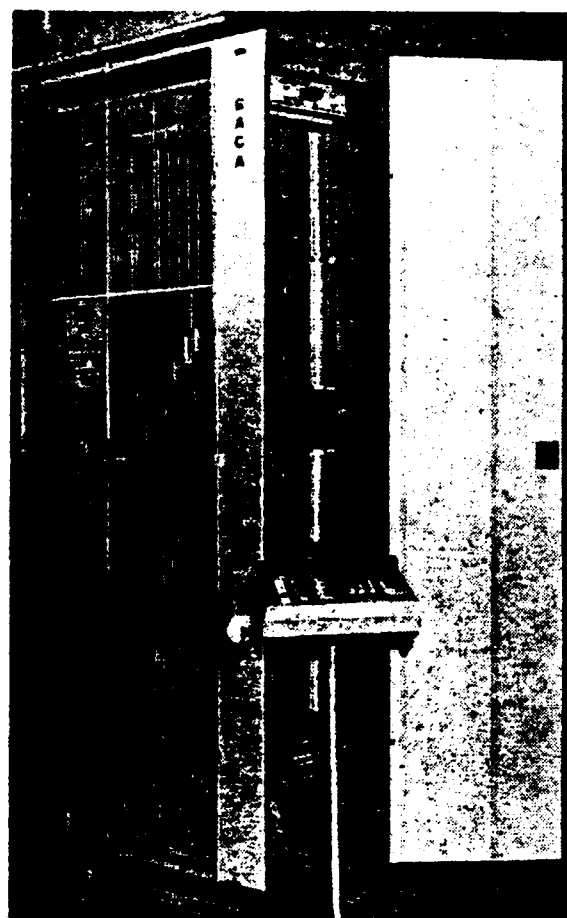
1. cyclical observation subprogram, 2. connection path investigation subprogram,
3. busy circuit subprogram, 4. connection subprogram, 5. disconnection subprogram,
6. priority calls subprogram



Rys. 6. Stojak i stanowisko pośredniczące centrall

Ill. 6. The exchange's frame and translator

1. EACT frame, 2. distribution frame



11

Ill. 7. the EACT-200 exchange. On the first plane is the translator, on the right side of the frame is the distribution frame.

The following occur in the cyclical observation subprogram:

- observation of the internal cord units, register unit repeaters designated by the processor for the completion or disconnection of connections,
- the observation of subscriber line units to determine if the subscriber has lifted the microtelephone,
- traffic observation.

The connection path investigation subprogram constructs a path over the commutation panel, checks if the path is free and then the processor enters into the connection or busy circuit subprogram.

The connection subprogram links the subscriber's connection with the cord unit, the register unit or the repeater.

The priority call subprogram can interrupt the processor's functioning only when the observation subprogram has been run; then the processor analyzes the call's source for one of the following priority calls:

WPR 1--from the control desk operator in order to supervise the exchange's units;

WPR 2--initiating services: transferring calls, relaying conversations, return connections;

WPR 3--exceeding authority; the call informs the processor that the subscriber connected to the outgoing repeater has transmitted a sequential digit and it must be verified that he has exceeded his authority;

WPR 4--notification of the processor about a change in the condition of the loop in the subscriber circuit or the announcement that the time has elapsed designated for the given sequence;

WPR 5--informing the processor that the time has elapsed designated for an operation's performance, for ex. closing the relay's circuit and verifying the operation's legitimacy.

WPR 6--the need for maintenance on the part of the register units and repeaters; this is, for ex., an incoming call, the subscriber's transmission of a sequential digit, etc.;

WPR 7--a priority task established by the control desk operator; for ex. the cessation of a program at a desired sequence, a program's running by the "step-by-step system.

THE EXCHANGE' CONSTRUCTION

The exchange's frames are in the form of a metal cabinet, 2 m high,

shown in ill. 6 and 7. From the frame's side is mounted the station's distribution frame. The entire unit is enclosed by means of a double winged door, made from transparent material, facilitating observation of the signalling elements. The exchange's units are in the box. Within the exchange is the control board for observing the processor's operation and measuring equipment for checking subscriber and interexchange circuits.

A translator is also placed within the framework of the exchange, enabling the semi-automatic completion of outgoing and incoming connections. This was constructed in the form of a panel board adapted for installation into a control panel. A multicore cable, which cannot exceed 60 m, serves to connect the translator with the exchange. The exchange runs silently and thanks to this, can be installed in the same locale as the translator.

END

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DTIC