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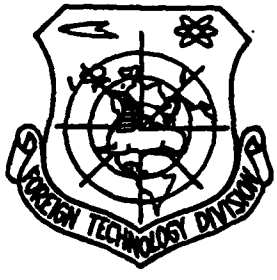
by

Edward Kowalczyk



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CONCEPT UTILIZING TELEX NETWORK FOR OPERATIONAL MANAGEMENT REQUIREMENTS*

Edward Kowalczyk, professor, doctor

The problem of improving the efficiency of management processes by utilizing data processes and transmission techniques constitutes the basis of successful organizational results, freeing of resources, administrative efficiency, and savings both in the material and human domain. An understanding of this fact, however, was reflected more in a striving to apply large-scale computer technology for data processing than in a proper taking into account of the needs and capabilities in the field of collection, transmission, and introduction of data and in decision-making methods using small computer facilities.

Meanwhile, the basic assumptions during the design and realization of various engineering systems in the field of information science must be: uniform procedures for transmission and processing, dependence of efficient processing on proper processes generating and collecting data, and full utilization of the existing technical potential. It turns out that transmission problems and the necessity of constructing a network for data transmission purposes associated with the latter constitute the most difficult problem requiring the greatest investments and corresponding

* A program report announced at a scientific-engineering conference organized by the Ministry of Communications and the Association of Polish Electrical Engineers on 18 October 1978.

scientific-engineering efforts in the field of elaborating suitable systems, equipment, and devices.

The rapid economic development in the country which took place in the last few years brought about an increase in the demand for fast and error-free transmission of an increasing volume of data that has not been noted so far. This in turn necessitated the creation of data transmission and processing systems or remote data transmission systems, sometimes bringing on feverish activity in various centers in this field. However, it quickly became evident that an adaptation of the domestic telecommunications network to the transmission of an increasing volume of information may constitute a proper and cost-efficient solution of this problem for users of remote data transmission systems.

The simplest and least expensive means ensuring fast transmission of documented (recorded) information on a country-wide scale for all kinds of users is the telex network, which is fully automated at this time (except for foreign message traffic) with more than 17,000 subscribers. As a digital network, the telex network constitutes, in principle, a base network that is ready for use to transmit information as part of remote data transmission systems.

At the same time, the possibility of an ever-wider and better use of this means of communication constitutes a resource of the highest order, the availability of which can and ought to be one factor maintaining the high rate of development of the country.

The advantages of telex services can be appreciated by considering the avalanche growth in the demand for these services, which brought about in addition to an approximately 22% annual increase in the number of telex subscribers, an increasing number of subscribers each year waiting for the installation of telex stations (at the present time, the number of overdue applications is 7000, with an annual capability of the communications sector to extend telex services to about 3000 new subscribers).

Recording various needs in the field of information techniques in adminstration, on one hand, and the diverse capabilities of modern engineering devices, on the other, the following conclusions can be drawn:

a) slow data transmission systems will be adequate for the management and administrative purposes;

b) in many cases, sufficient protection from data distortions and possible errors can be achieved using uncomplicated equipment;

c) simple and easy servicing of equipment is a great advantage;

d) the necessary data processing frequently reduces to ordering the latter, for example, in the form of a table, diagram, to appropriate selection or separation of the data, which can be achieved without using large computers;

e) organizational systems subordinated to operational management are usually widespread over an area;

f) certain engineering systems in the field of information science already exist, which are presently insufficiently utilized and the basic telecommunications network in which information is transmitted is also not fully utilized (telex systems and networks).

In addition, the following are available:

1) a fully automated slow data transmission network in the form of the telex network--the most expensive part of the system, which is also most difficult to realize;

2) generally used, relatively simple terminals in the form of teleprinters;

3) minicomputers manufactured in the country, which can be used for operational ordering of data. Here we lack certain organizational concepts.

These concepts would allow us to combine the operation of these elements in an interactive mode in a particular system and efficiently utilize the latter, (which we are already producing in the country for operational management purposes), or to create a general information science system based on the telex network, supported in suitable centers by minicomputers. Such operational data preparation centers for making management decisions (in the form of minicomputer-telex stations) can be created in institutions conducting daily administrative, management "games" in systems spread throughout the entire country. These institutions are associations, large management organizations, trade centers, cooperative centers (about 300 such institutions exist in Poland).

Hence, the existing, fully automated telex network and the existing terminals of this network in the form of teleprinters and about 300 minicomputer-telex stations could form a basic telex information system on which complete remote data transmission systems could slowly grow like "spawning mushrooms" followed by network-computer systems with fast transmission routes, error protection, etc. Such an organizational, engineering system appears to be inexpensive. It can undoubtedly be achieved by utilizing available resources in our country. It could satisfy basic needs in the field of data transmission and data processing in daily operational management of our economy and save considerable sums allocated for these purposes as part of general expenditures for remote data transmission and computerized information systems.

The present telex network comprises 23 automated telex centers. By the end of 1977, operational telex stations have already been installed in all localities representing administrative seats of communities on the territory of the country (in conformity with the decision of the Presidium of the Government Administration dated 31 May 1975).

By 1980, the telex network will be expanded more than two times and the number of telex centers will increase to 43. Thereafter, however, 10 new provinces will not be equipped with telex centers, mainly due to lack

of accommodations and subscribers in these provinces will have to be connected to centers in other neighboring provinces.

However, it must be frankly stated that the present existing telex network, besides the above-mentioned advantages, creates many technical limitations when it is used for remote data transmission; among which, the most important ones are:

a) limited modulation rate up to 50 baud, which permits transmission up to 400 characters (letters or digits) per minute;

b) a utilization of codes limited basically to the CCITT Number 2 code, i.e., a 5-element code, and a lack of a possibility of using the CCITT Number 5 code (a 7-element code);

c) lack of possibility of forming closed groups of users not accessible to other telex subscribers;

d) lack of possibility of establishing circular connections, that is, simultaneous transmission of the same information to many users (usually subordinate units). This possibility, however, will be created in the next few years;

e) lack of possibility of detecting errors in transmission without using additional equipment;

f) inadequate quality of most teleprinters.

The above-mentioned shortcomings of the existing telex network (partially eliminated in the proposed Basic Telex Information System BIST) gave rise and continue to give rise to separate closed networks, among which the majority is formed on the basis of telegram or telephone lines leased from the communications sector. These lines are underloaded. At the same time, a strong tendency exists towards an unjustified formation of additional separate telecommunications networks, mainly for remote data transmission.

This tendency is especially dangerous for economic reasons, since the purchase of many small commutating remote data transmission systems in countries accepting payments only in hard currencies brings about hard-currency expenditures, which are many times higher than the purchasing cost of one large system for all users, to whom such a system is indispensable.

Regardless of the above-mentioned shortcomings, which can be considerably diminished, the telex system can and must be used now and in the next few years for remote data transmission purposes as the most extensive base network in all fields of socioeconomic life in the country, in particular, in the following fields: government administration and management, central and regional planning, statistics, commerce and purchasing centers, agricultural services, industry, public health services, and finance.

Systems taking advantage of the telex network for these purpose can be subdivided into several groups, beginning with the simplest, local methods of taking advantage of this network to complex country-wide systems.

Methods for taking advantage of this network can be represented as follows:

the first method involves introducing into the computer data transmitted over the telex network by the off-line method in accordance with Fig. 1, using punched tape. Telex teleprinters equipped with a tape punch are usually installed in the data processing center for this purpose. This method, being the simplest method, can be introduced without purchasing any additional equipment and has been applied already by many institutions. When data transmitted over a telex network must be protected from errors to a greater degree than that provided by the telex network, special protection equipment for detection and correction of errors, for example, equipment manufactured by WZT Teletra in Poznan can be installed in the presence of teleprinters operating in an interactive mode. In the case when secrecy of the transmitted information must be ensured, encoding equipment can be installed besides teleprinters.

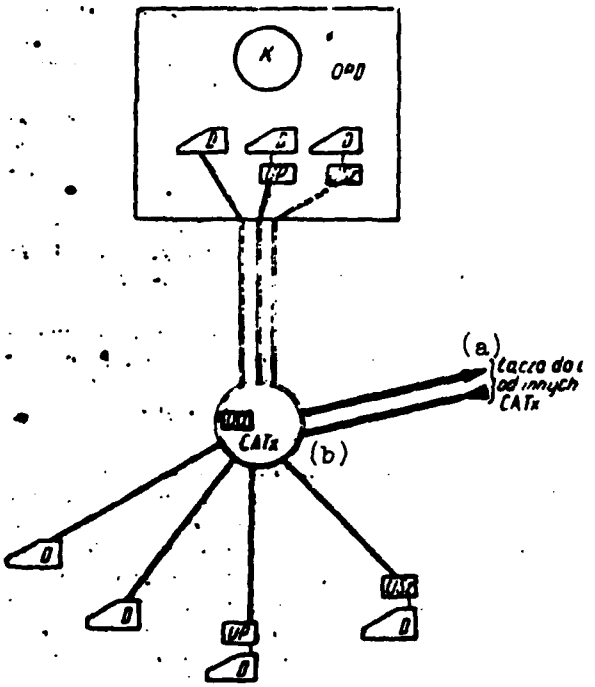

Fig. 1. Off-line structure. System utilizing a telex network
D = teleprinter; OPD = data processing center; UP = protection equipment; USz = encoding equipment; UO = circulating equipment

Key: (a) lines to and from other automated telex centers
(b) automated telex center

To facilitate data transmission from the data processing center to remote telex terminals, equipment can be used for simultaneous transmission of these data to all users. This equipment known as circulating equipment has been developed in the communications sector.

The second method allows us to better utilize a telex network for remote data transmission purposes and it involves direct input of data (on-line) in the computer, which are transmitted over the telex network as shown in Fig. 2. For this purpose, equipment which allows to directly connect telex lines to a computer, i.e., suitable adapting equipment (telegraph adapters) must be installed in the data processing center.

Similarly as in the first method, if necessary, protection equipment, encoding equipment, and circulating equipment is used. Data banks can be protected from access by unauthorized telex subscribers by means of software

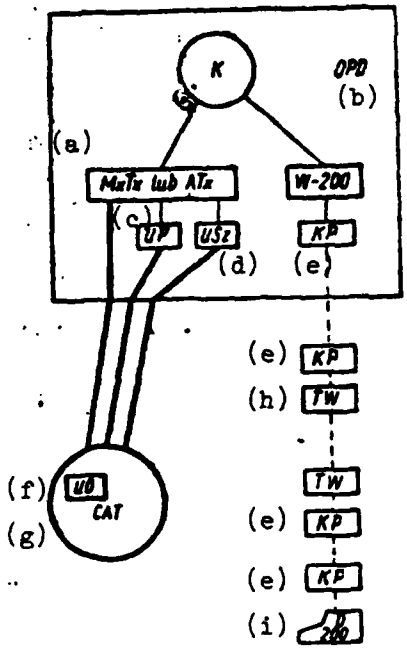

Fig. 2. On-line structure. System using telex network

Key: (a) minicomputer-telex or automated telex
(b) data processing center
(c) protection equipment
(d) encoding equipment
(e) computer
(f) circulating equipment
(g) automated telex center
(h) multiplex telegraphy channel
(i) teleprinter

in the data processing center, since the present telex network does not have a capability for this type of protection.

In cases when data transmission between the data processing center and the terminal station requires a rate which is higher than 50 baud, in this stage, above all, permanent (leased-out) 200-baud lines can be formed on multiplex telegraphy channels, which is shown in Fig. 2. To transmit 200-baud signals on sectors between the terminals of multiplex telegraphy channels, the data processing center and the remote teleprinter, signal converters can be used, which have been elaborated by the Communications Institute.

In the third method, constituting the next development stage, instead of using separate leased-out lines for 200-baud transmission in reports between Warsaw and provincial cities, an electronic automated data center (CD-200) in Warsaw can be used (this center could also constitute a part of the international telex center). A schematic diagram of the network system used in the third method is presented in Fig. 3.

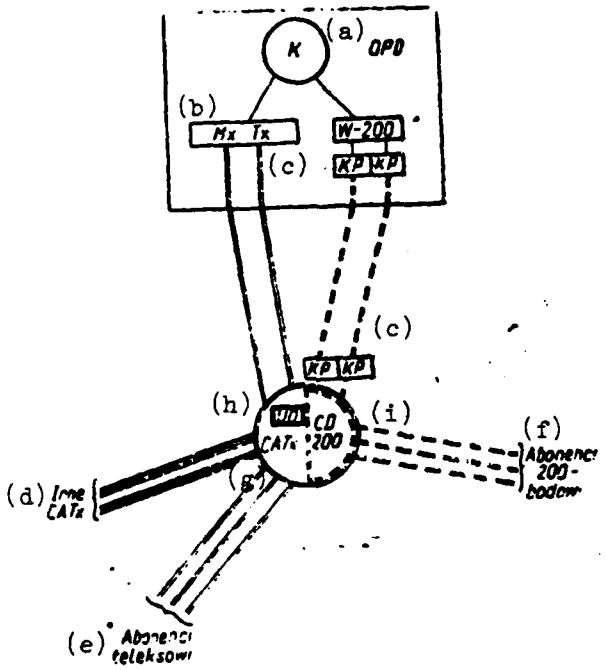

Fig. 3. Network system in third stage

Key: (a) data processing center
(b) minicomputer-telex
(c) computer
(d) other automated telex centers
(e) telex subscribers
(f) 200-baud subscribers
(g) automated telex center
(h) circulating equipment
(i) CD-200 automated data center

In subsequent years (after 1980), as a result of gradual modernization of the telex network, the following telex centers must acquire sequentially capability to commutate data at a rate of at least 200 baud.

In the fourth phase (in the future), a capability to commutate data at higher rates must be available already, which will require an operational center for this purpose, at least in Warsaw. The engineering design of the Warsaw center must constitute a part of the commutating system adopted for the entire country or for all CMEA countries.

As an example, I present below one possible solution, a universal data center with data commutation, the possible purchase of which, along with its putting in operation must depend on a cost analysis performed on the basis of demand on the part of users representing central units, such as the Chief Central Statistical Office, the Planning Commission at the Council of Ministers, the National Bank of Poland, ministries, etc. This type of center (Fig. 4) would make it possible to:

1) commutate data at various rates, from 50 to 9600 baud;
2) form closed groups of users;
3) use various formats for transmitted information;
4) change formats of transmitted information;
5) allow selected telex subscribers to participate in remote data transmission systems of particular groups of users.

It should be emphasized that the telex network is already being used on an ever-increasing scale for remote data transmission purposes, however, predominantly in an uncoordinated manner.

Many developed countries, such as France, Sweden, Japan, the FRG, or England, have solved a long time ago the problem of using telegraph channels for remote data transmission.

A network with channel commutation operating in the interactive mode with the network at 50, 200 baud rates is operational in France. In the FRG, the first stage of data transmission development was based on the telegraph network in the Datex system. Type EDS centers adapted to a 200-baud transmission rate and higher rates have been introduced here. In Japan, the

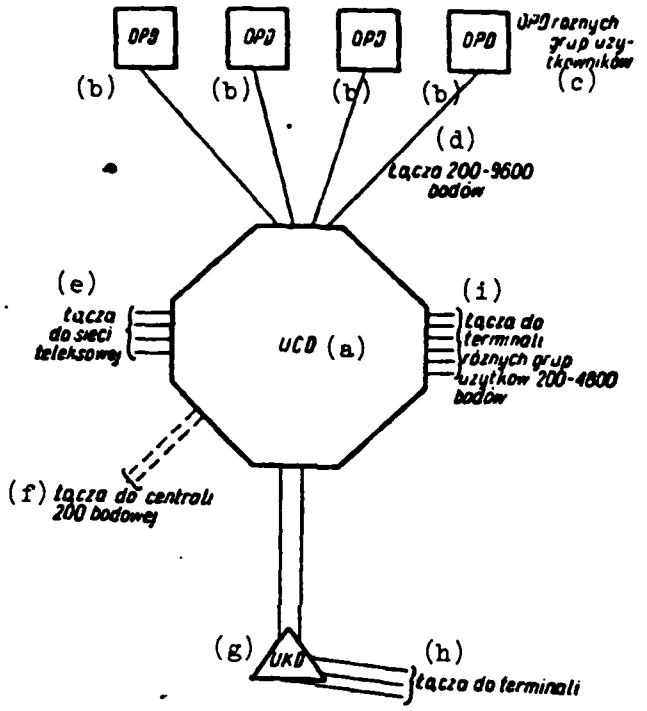

Fig. 4. Network in fourth construction stage

Key: (a) universal data center
(b) data processing center
(c) data processing centers of various groups of users
(d) 200-9600 baud lines
(e) lines to telex network
(f) lines to 200-baud center
(g) data commutation system
(h) lines to terminals
(i) lines to terminals of various groups of 200-4800 baud users

telex network is also being used for operational information science purposes, and the corresponding services are provided to clients by the Japanese Post Office. In England the telex network operates interactively with the

experimental EPSS information science system, providing wide access to users to data processing systems.

In principle, one can observe everywhere the use of relatively slow and moderate data transmission rates for operational management purposes.

A characteristic feature of processes using telex networks for opertional information science purposes serving operational management, such as intervention of a factor automating human activity in the fields of data transmission and reception, is the application of minicomputers together with complex software and introduction (to complement the software) of organizational rules constituting specific "Codes of the Information Flow" adapted to concrete transmission tasks and utilization of operational data.

In this connection, without waiting for the development of conditions which would allow full utilization of the presented systems method using the telegraph network for operational information science purposes, work was initiated on an organizational-engineering system. Besides the idea of the Basic Telex Information System, presented at the beginning of this article, the PIAST system is currently in the experimental phase. The latter involves an elaboration and implementation of suitable information flow rules and regulations in community-provincial office reports and proper ordering of data collected in an organized manner over time, which will allow the provincial administration office to make operational decisions.

The Basic Telex Information System is a further continuation of this kind of organized collection and ordering of data via the telex system, however in addition to rules governing the flow of data, another factor appears here--automation of transmission and reception of data and automated ordering of data. The tasks performed in the PIAST system by an analyst are performed in the Basic Telex Information System by a suitably programmed minicomputer. The automated interactive operation with the telex network is controlled via a suitable telegraph adapter by a minicomputer.

The telegraph adapters that have been elaborated in the communications sector made possible the direct reception of telegrams and telex messages by a type MERA 300 minicomputer (instead of teleprinters). Information received in this manner can be printed on a DZM 180 printer, or stored for archive purposes, or for additional processing on a large computer.

The system makes it possible to communicate with a large computer in the on-line or off-line mode, for example, using magnetic tape. Suitable terminal equipment has been developed in this field, which constitutes a part of the Basic Telex Information System and allows one to realize remote reception and transmission of data, collection, preliminary checking, preliminary processing of data, creation of data banks, updating the latter, retrieving the necessary operations and also performing operations in the interactive mode.

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