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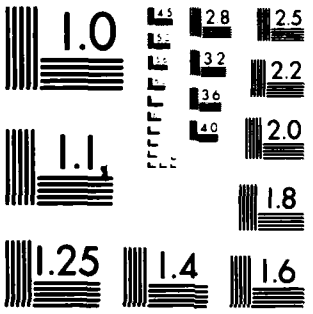

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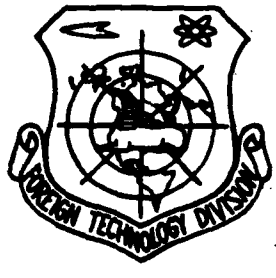
FOREIGN TECHNOLOGY DIVISION

PROCESSING ELEMENTS

by

Waclaw Piwonski



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PROCESSING ELEMENTS

Waclaw Piwonski, engineer

The first computers were single program computers, which was equivalent to the following: the user executing the program had the entire computer capabilities available to him and was able to control in an on-line manner the execution of the program, while another user could begin his program after completion of the first program. This operating mode, however, gave rise to long periods in which the computer was idle. To eliminate this shortcoming, the batch processing mode concept was developed, which entailed reading into the computer not one, but several programs, constituting a certain type of batch. This system also had a number of shortcomings, hence other, better solutions were sought. The time-sharing system involving allocation of the central processor to sequential jobs for a certain time period and memory sharing, providing the possibility of simultaneous use of common internal storage by different jobs, came into being in this manner. The simultaneous execution of several jobs, named multiprogramming, became possible. However, this did not facilitate things for the user, since the jobs were subsequently processed in the batch processing mode. Only the creation of multiple-access systems solved these problems radically by providing the possibility of taking advantage of computer capabilities without being aware of the parallel processing carried out by other users. However, it must be clearly stated that such a statement is not true under all conditions, for example, in the presence of relatively small internal storage and a large number of users, the parallel execution of jobs causes a noticeable prolongation of the processing time, despite

the fact that computer capabilities are used properly. Multiple access can be organized at a small distance from the computer (in this case, it is known as local multiple access) or at a considerable distance from the computer (known as remote multiple access). Each operating mode mentioned above must be solved with the aid of different equipment and different operating system options.

Domestic Hardware

The present assortment of domestic hardware for realizing multiple access and teleprocessing systems is very modest and this state of affairs is further aggravated by difficulties entailed in the purchase of manufactured equipment. The simplest method for realizing multiple access is a local computer display station consisting of a group control unit and type 7910 displays. The displays can be located at a 600 m distance from the central processing unit. Realization of multiple access with remote terminals interacting with the central processor requires use of a type EC 8371-01 teleprocessor, modems, and user stations, which can be computer display systems together with a remote control unit, or batch or conversational user stations. The basing element in a multiple access system is the PTD EC 8371-01 data teletransmission processor. It executes operation from a 51-command list at a speed exceeding half a million operations per second, and it is instrumental in transmitting at least several tens of thousands of bytes per second. EC 8371-01 can interact with any unit in the Riad system, with the condition that it has suitable internal memory (512 K or greater), otherwise processing is inefficient. The EC 3371 processor meets all requirements on modern communication processors controlling a transmission network. It is characterized by high operating reliability and a high degree of error protection in transmission lines. Duplex or half duplex interaction with terminals can be realized in a synchronous and asynchronous mode (SS -- start, stop), BSC -- binary synchronous control, and SDEC -- synchronous data link control. The teletransmission processor is connected to users via permanent or commutated telecommunication lines with type EC 8006 modems connected at the input and output and operating at 600-1200 bit/s rates or faster rates -- EC 8013 (2400 bit/s). Similarly to the local display station described above, a Mera 7900 remote control station can be used as a user group terminal. The latter consists of a EC 7901 group control unit, which makes it possible to connect 32 EC 7910 computer displays and 32

EC 7186 line printers (so-called hard copy). When a large number of terminals is not needed, the independent type EC 7950 display can be used, which makes possible direct operation without a control unit. A data collection system, information systems, and conversational mode operations can be realized with the aid of computer displays. When it is necessary to perform a large number of operations and transmit a large volume of data, so-called heavy-duty terminals (not manufactured in the country) must be used.

Equipment used for the simplest remote information retrieval operations or remote data processing with a single processor was described above. In the case of multiple processing system configurations, connections can be realized with the aid of a teleprocessing processor, which is justified for installations at a considerable distance from each other in view of the heavy load on the processor generated by the remote data transmission service routines. In local multiple-processing systems, it is preferable to use equipment known as CCA (channel-to-channel adapter), which allows one to connect two channels in different computers and to transmit data between them at the rate of the slower channel (for example, for R-32, 150 K/s). Application of CCA does not increase significantly the load on connected central processor units.

Multiple-Access Software, Access Methods

Besides remote processing hardware equipment or a teleprocessing network, teleprocessing software (called the access method) is also required to make possible interaction between remote user stations (terminals) and the central processor. We will discuss a number of the most popular access methods.

Basic Telecommunication Access Method (BTAM)

BTAM software can also operate under the control of the OS or DOS operating system. It makes possible communication with telecommunication equipment by means of a linkage program. BTAM ensures programming on a physical level (the physical record is the unit) and it can realize the following functions: generate channel programs, control input/output operations, call terminals, receive and transmit messages, detect errors, and analyze them. BTAM is a generally applicable

access method and it requires little internal storage compared with other methods. However, it introduces certain limitations:

a) the used link must be a half-duplex link,

b) terminals must be grouped according to characteristics,

c) terminals in a given group must have the same character code and the same buffer storage method.

A string of address characters or identification characters is subordinated to every terminal. When a terminal is connected via a telecommunications telephone network, the computer selects the telephone number and after the connection is established transmits the address characters. The operator of the terminal, who selects the telephone number of the computer, is connected in similar fashion. The described method of establishing a connection is subject to errors resulting from erroneous connections. To avoid such situations, connection checks are used involving a transmission of identification characters after the connection is established. Information transmitted from the transmission program to the user program and vice versa is periodically stored in certain storage areas in accordance with the principle of buffer storage formed with the aid of systems macroinstructions. The BTAM system contains procedures used for execution and correction of errors caused by network or equipment errors. Clearly, these corrections apply to errors occurring periodically. Errors which cannot be corrected are signaled to the operator. The system also keeps records on error statistics.

In addition to the above, BTAM makes possible periodic testing of the system by the operator from the console.

Telecommunication Access Method (TCAM)

The TCAM software performs a greater number of functions (compared to the BTAM method) in that it is not adapted for operation under the control of the DOS operating system. This package uses a sequential method for controlling messages (message control program -- MCP), which releases the operator from monitoring data transmission and reception operations.

In addition to the above, the following limitations are associated with the TCAM method:

a) the network cannot contain mixed links (commutated and permanent),

b) same type of transmission (synchronous or asynchronous),

c) all links in a group are connected to one unit controlling transmission and use a message handling routine (segment of MCP).

The message control program performs the following function: start and stop of user program, definition of data sets, definition of network.

Message handling routines perform the following functions: editing and segmenting of messages, checking of messages, control of transmission, and modification of network. Besides macroinstructions pertaining to teleprocessing control, the TCAM package makes it possible to perform the following additional functions: control and error statistics, testing of equipment, performance of control functions by OS operating system operator.

The TCAM software package permits direct (without linkage program) terminal to terminal communication and creation of a fast response time system.

The advantage of TCAM (compared with BTAM) is that it makes available to the user a higher order macro-language for programming tasks involving teleprocessing. TCAM can take over full servicing of messages in commutated systems and also functions in the field of data collection.

Conversational Remote Job Processing (Conversational Remote Job Entry--CRJE)

In cases when the internal storage capacity is small (512 K or less), the CRJE option can be used, which enables users of a terminal to take advantage simultaneously with other users of central processor capabilities (also in the batch processing mode) and which also makes possible remote entry of job descriptions, immediate output of the results of an operation, on-line control of the progress of operations, access to data sets and programs. In view of the fact that a relatively small portion of internal storage is occupied, this system is especially suitable for multiaccess operation of a local computer display station.

Using CRJE, tasks can be created and entered under the OS operating system in the MVT or MFT versions.

Interaction with the CRJE system takes place by means of commands (subcommands) executed and interpreted by the central processing system. A flicking cursor for message informs the user that a command has been executed and that the next command can be read in.

The period in which the user utilizes the CRJE system is known as a session. A session begins with the input of the LOGON command, identifying the user as an authorized user and ends with the input of the LOGOFF command or the next LOGON command.

Entry of jobs in the input queue for batch processing takes place under the CRJE system and is realized by the user by means of a command (SUBMIT), execution of remotely read-in jobs takes place under the control of systems job management subprograms. The resulting data sets are created with the aid of systems data management subprograms. The job which was read in consists of the program, data, and JCL tasks located in CRJE data sets. These sets can be created and updated with the aid of appropriate CRJE commands. Creation, updating of a set, and specification of job tasks is realized using a working area known as the active area. The active area is a common area on a disk for all users of the CRJE system. A portion of this area intended for a given user (allocated dynamically by CRJE) is known as the active set. Creation of the active set is realized using the EDIT command; deletion of an active set is realized by the subcommand END.

Initially the user reads in the source program instructions, JCL program instructions and the data. These instructions are stored in the active area. The set from the CRJE library can be updated. The active set, which is a copy of the set from the CRJE library, is created using the EDIT command. Changes in this set are made using subcommands of the EDIT command. Subcommands allow one to insert, exchange, delete, and modify individual fields or groups of fields in the active set. The user can retain in the CRJE library a modified version

of the set by adding to the library or by replacing the old version of the set with a modified version.

Before input of a job for processing, a capability is available for syntax analysis of instructions written in FORTRAN or PL/1 (subcommand SCAN). Error diagnostics are obtained immediately and errors can be corrected on the spot.

CRJE allows for the display of output sets on the screen of a display. The latter allows one to compare all or a part of the results of a task and the sets in the CRJE user libraries. Data sets (only those that are cataloged, PS or PO data organization) created by systems data management programs can be displayed using the LIST subcommand after they have been copied into the active set.

The results of a task transferred to a special class of system programs for CRJE can be displayed without their prior copying in the active area. This is achieved by the OUTPUT command.

In addition, the user of the terminal can obtain information about the status of the job that was read in (STATUS), and the sets in his CRJE library (LISTLIB, LISTDS); he can transmit messages to the central processor operator or to other users (SEND); and he can also receive messages from the central processor operator (LISTBC) or other users of the CRJE system.

Time-sharing Subsystem (Time-sharing Option--TSO)

This subsystem, an option of the OS operating system, allows users of terminals to shorten the waiting time for a result. Essentially, the TSO subsystem allocates computer capabilities to individual jobs in such a way that handling of jobs is not noticed by users. Throughout the entire time the computer communicates with the user (in the conversational mode) and informs him about the status of jobs, which creates an impression of exclusive availability of computer capabilities to the user. This communication is conducted using the commands of the TSO computer language, which facilitates the execution of many programming operations, for example, input of programs and data, editing,

execution of programs, and output of the results of calculations. The smallest internal storage capacity for which use of TSO is profitable is 1 megabyte.