ITT 7300 ADX SYSTEM

FEATURES MANUAL

ITT INFORMATION SYSTEMS DIVISION

ITT 7300 AUTOMATIC DATA EXCHANGE SYSTEM

INTRODUCTION

The ITT 7300 ADX (Automatic Data Exchange) System is a high-speed, versatile, and fully automatic message switching and control system. It is the first commercially available electronic system designed to meet the record communications requirements of modern enterprise—and represents a synthesis of communication and computer technologies. The ADX System is a significant step forward in fulfilling management's information needs, when needed, and where needed.

ADX SYSTEM CONCEPT

3 to 7

OPERATING FEATURES OF THE ADX SYSTEM

9 to 13

DESCRIPTION OF SYSTEM COMPONENTS

15 to 19

SYSTEM RELIABILITY

27 to 29

SYSTEM ADVANTAGES

31 to 35

APPLICATIONS

21 to 25

ITT—THE BROAD PICTURE

38 to 39

Simple in concept and operation, advanced in design the ADX System provides:

Extremely high speed, fully automatic switching of messages and data

Real-time communications operation and control

Automatic translation of messages from any coded format to any other coded format

Automatic control of a large number of transmission devices which operate at various speeds

The ability to perform message accounting

In other words, it is the vital key to a completely integrated local, national or international communications system, providing the speed and reliability necessary for the information network of today and tomorrow.

Whether used to replace and/or expand upon an already existing electro-mechanical switching system or to serve as the basis for a new man-computer or computer-computer information network, the ADX System provides the flexibility inherent in the synthesis of computers and communications that it represents. For example, it provides, as no other available communications system can:

True modularity, for growth in volume and function

True flexibility, through internal stored programming

An economic approach to solution of record communications problems

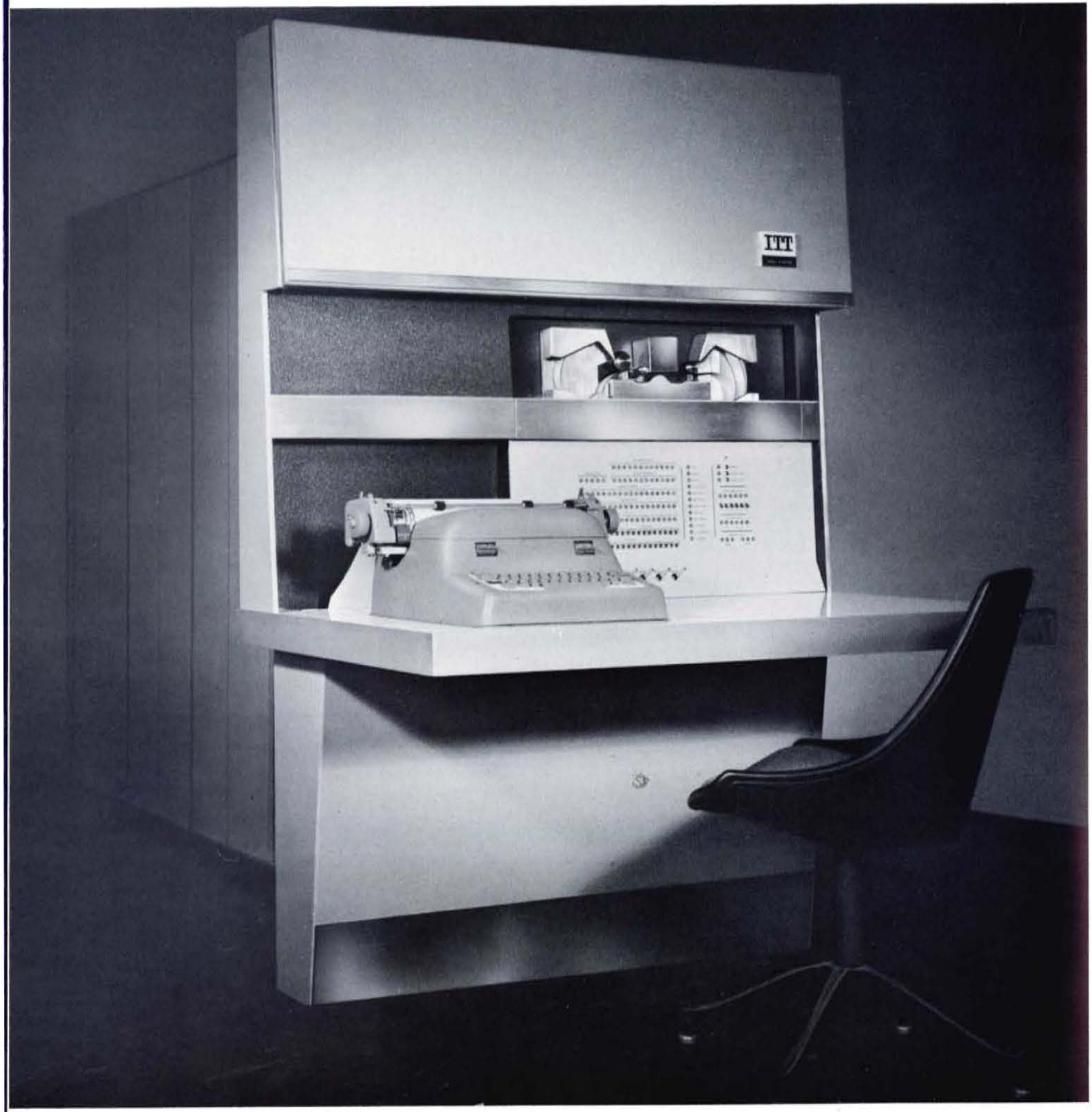
The capability for instantaneous or delayed transmission, random or batch-sequential transmission, programmed to automatically process priorities.

The capability for serving as a universal real-time link between previously incompatible computer systems.

In the ADX System, ITT has brought together a wealth of commercial and military telecommunications experience, including development of the Air Force 465L SAC Command and Control System, one of the world's most advanced military computer-communications system. The ADX System applies the combined advantages of solid-state circuit reliability and speed, with stored program electronic logic to an area which has always been ITT's prime concern—telecommunications.

The ITT 7300 ADX System is a product of the ITT Information Systems Division. This Manual has been prepared to provide a general description of the structure, operation, and capabilities of the ADX System.

ADX SYSTEM CONCEPT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Like so many answers to complex problems, the basic concepts underlying design and operation of the ADX System are inherently simple. The problem was to provide a central system capable of controlling, manipulating, and forwarding a great variety of messages—different in code, priority, and speed — between a great variety of input and output devices. The System had to be economic for a wide range of volume and function, but at the same time provide a very high degree of reliability.

The answer was found in these design concepts:

Use the latest in reliable solid-state circuits, with their great switching speeds and inherent modularity.

Provide large storage facilities: high speed for storage of programs and messages being worked on, slower speed for temporary or permanent storage of messages and data.

Take full advantage of the advances in stored program logic used in today's most modern information processing systems, to provide the complex control and manipulation needed at the speeds needed.

Application of these concepts in design of the ADX System has resulted in a system versatile enough to provide the full range of switching speeds from real-time data transfer compatible with modern computer operations to delayed off-hour transmission of low-priority messages at inexpensive slow speed batch transmission rates. The system developed—and operating today—has utilized these simple concepts to become a universal communications system "interface"; the ADX System:

Is thoroughly compatible with any record communication system, and will remain so because of the versatility of the stored program processing unit.

Is expandable to service more than 400 duplex lines.

Permits communication between all types of input and ouput devices. Speed conversion is inherent in machine design, and code conversion is easily executed by the stored program.

Can be adapted to simple system configurations or expanded for the most complex configurations, through modular design.

Enables all units to operate simultaneously, on-line, and in real time.

ADX SYSTEM COMPONENTS

The ADX System generally requires a Multiplexed Message Processor (MMP), Magnetic Tape Units and their associated controls, and cabinets containing Line Termination Units, Level Converters, and the Master and Dual Line Switches. Optional units include Magnetic Disk Units, Electric Typewriters, Cathode Ray Display Units, as well as additional core and magnetic tape storage.

The Multiplexed Message Processor serves as the control and nerve center for the ADX System. It includes the Operator Console, Control Circuits and the core memory, which provides for program and working storage. The storage element is magnetic core, arranged in one to eight banks of 4,096 words each, for a maximum capacity of 32,768 MMP words. The additional storage units require additional cabinets, each of which will accommodate two storage elements and their associated circuitry.

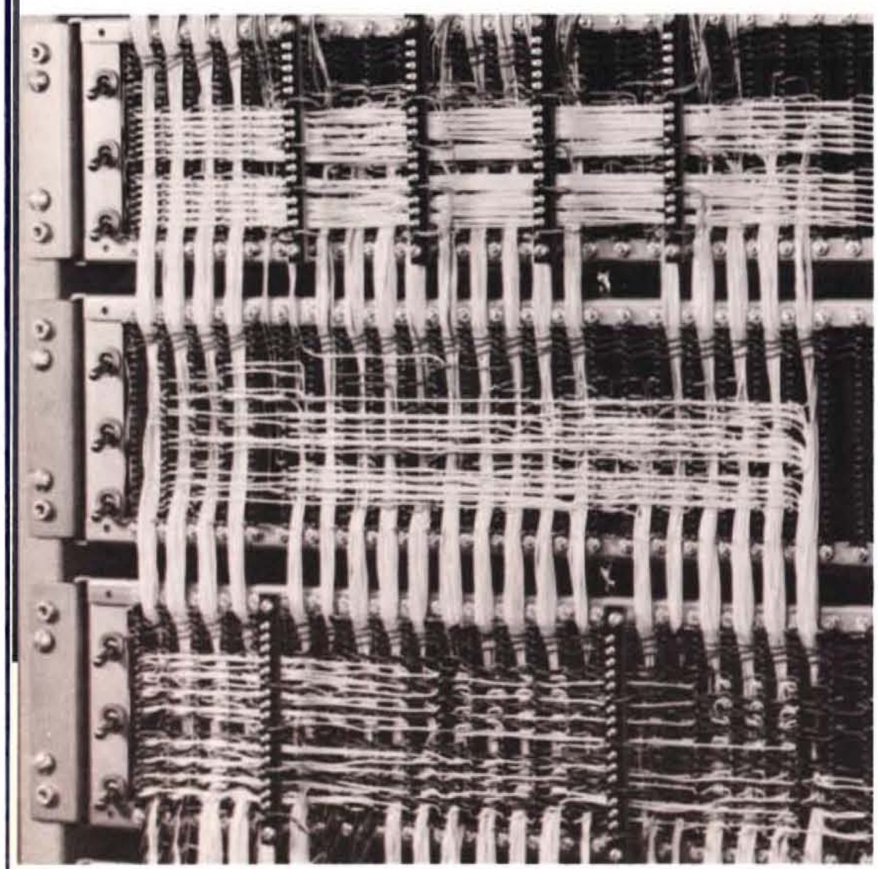
An MMP word consists of 18 binary bits. Assuming three 6-bit characters per word, it is possible to store 12,288 characters per memory bank, or a maximum of 98,304 characters.

Cycle time in the MMP is five microseconds. For single-access instructions, the system is capable of performing 200,000 operations per second. For double-access instructions, the system can perform one hundred thousand operations per second.

Tape Controls are capable of controlling a maximum of eight Magnetic Tape Units each. Three Tape Controls can be included in the standard ADX System.

A Line Termination Unit is required for each incoming and outgoing communications line. The cabinets in which the line units are housed also include the Level Converters and the Line Switches. Transmission lines of the same speed may be grouped, and terminated as a group. A maximum of eight lines may be terminated in a group. High-speed data lines are terminated individually.

Each ADX System is independently engineered to meet the special requirements of the customer, and system configurations can be easily adapted to changing needs. Many changes can be made without changing hardware. If, for example, the user adds stations, or assigns different priorities to the operating stations, complete reprogramming is not necessary; simple modifications will suffice. All programs operate independently and changes in a program are easy to make. In the ADX System, the equipment adapts to customer needs; the customer is not required to conform his operation to machine requirements.



ADX SYSTEM PROGRAMMING CONCEPTS

Building upon the specific advantage of a stored program communications control unit, ITT Information Systems Division has designed a system that is basically simple to program and it has provided a useful variety of programming aids to make the job even simpler.

The ADX System instruction word consists of six numeric characters. The first two characters define the operation code (there are thirty-two basic operations and variations), the remaining four specify a data address or modify the instruction. Instructions are program sequenced automatically.

ITT supplies with the ADX System a complete "software" package. Included are the Basic Operating Program, the ADX Assembler-Compiler, several Utility Programs, and a complete package of diagnostic programs for testing the entire ADX System. The ADX Assembler-Compiler permits:

- **Use of English language instructions**
- **Automatic address assignment**
- **Automatic insertion of sub-routines**
- **Inclusion of automatic testing aids**
- **Use of the ADX Peripheral Equipment Subroutine**

CONCEPTS OF CUSTOMER SERVICE

The ITT Information Systems Division carries forward the traditional service policies associated with ITT. The user of the ADX System will have the following services:

Pre-installation Services include provision of suggested floor plans, and analysis of power requirements and heat dissipation.

Installation Services include unloading and positioning all cabinets, wiring the equipment, and connecting cables and power. ITT personnel will assist the customer in final acceptance tests. All phases of installation and acceptance will be coordinated with the customer by ITT personnel.

Training Services include special instruction for switching center supervisory personnel and other key personnel concerned, including operators and programmers. In addition, procedures manuals are provided describing the components and operation of the ADX System.

Diagnostic programs are provided for testing all phases of the ADX System.

Maintenance and Operation Services include the supervision of an installation until it has been accepted by the customer. If desired, a contract can be signed providing for complete maintenance by ITT engineers. If the user elects to operate and/or maintain his own system, arrangements may be made for the provision of only those services specifically requested.

Optional Services If desired an ADX user can be provided with a completely operating system; his only responsibility being to supply ITT personnel with necessary information. For those users who have qualified personnel available for programming, ITT offers the option of procuring only the equipment, or of procuring both the hardware and any programming services desired, depending on time and personnel requirements.

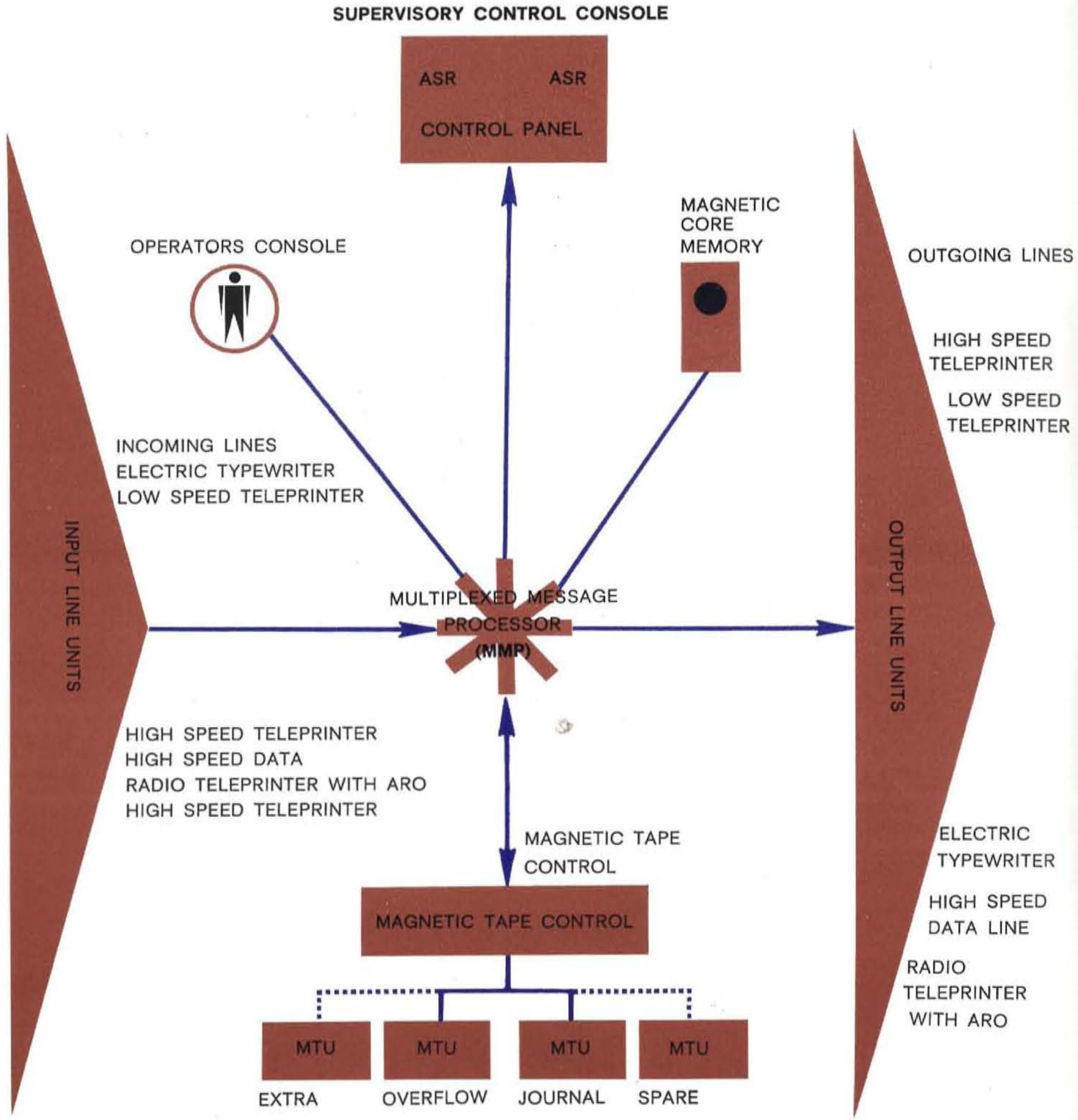
Other Service Options include numerous additional benefits:

- Communication System Consulting is always available.
- Analysis and programming are provided on a "time and material" basis.
- As special programs are developed, they will be distributed to ADX users.
- Because ITT operates internationally, its personnel in foreign countries can act as the customer's liaison consultants.

  This can be an extremely important service to users whose personnel do not have an intimate knowledge of the countries in which they are operating or intend to operate.

Supporting services are most important to the success of any advanced electronic installation. ITT's entire experience and resources form a broad base of support available to each customer.

OPERATING FEATURES OF THE ADX SYSTEM



BLOCK DIAGRAM OF THE ADX SYSTEM

The ADX System, under program control, monitors and controls the switching and processing of information traffic over transmission lines. A complete ADX System includes all necessary units and hardware to permit interconnection of computers and terminal devices over various transmission channels such as telegraph, telephone or broad band circuits. The great flexibility brought about by the integration of engineering and programming makes possible the following operating features:

Flexible and automatic routing of multiple address, multiple priority, group address, and broadcast transmissions.

Better line utilization and faster handling of multiple addressed messages.

Automatic handling of overflow traffic through diversion to magnetic tape or magnetic disk storage.

Automatic speed conversion is inherent due to design (for example, 60 words per minute teletypes can be interconnected with twenty-four hundred bits per second machines).

Automatic code conversion by programming.

Automatic detection of transmission and internal errors, with error control programmed in accordance with customer requirements.

Insertion of the date and time on messages at input to or output from the communication center.

Insertion of channel identification numbers at input to or output from the communication center.

Automatic on-line trouble diagnosis routines to detect, bypass, and report faulty lines and equipment.

Automatic message traffic accounting
Automatic alternate routing.

MESSAGE SWITCHING

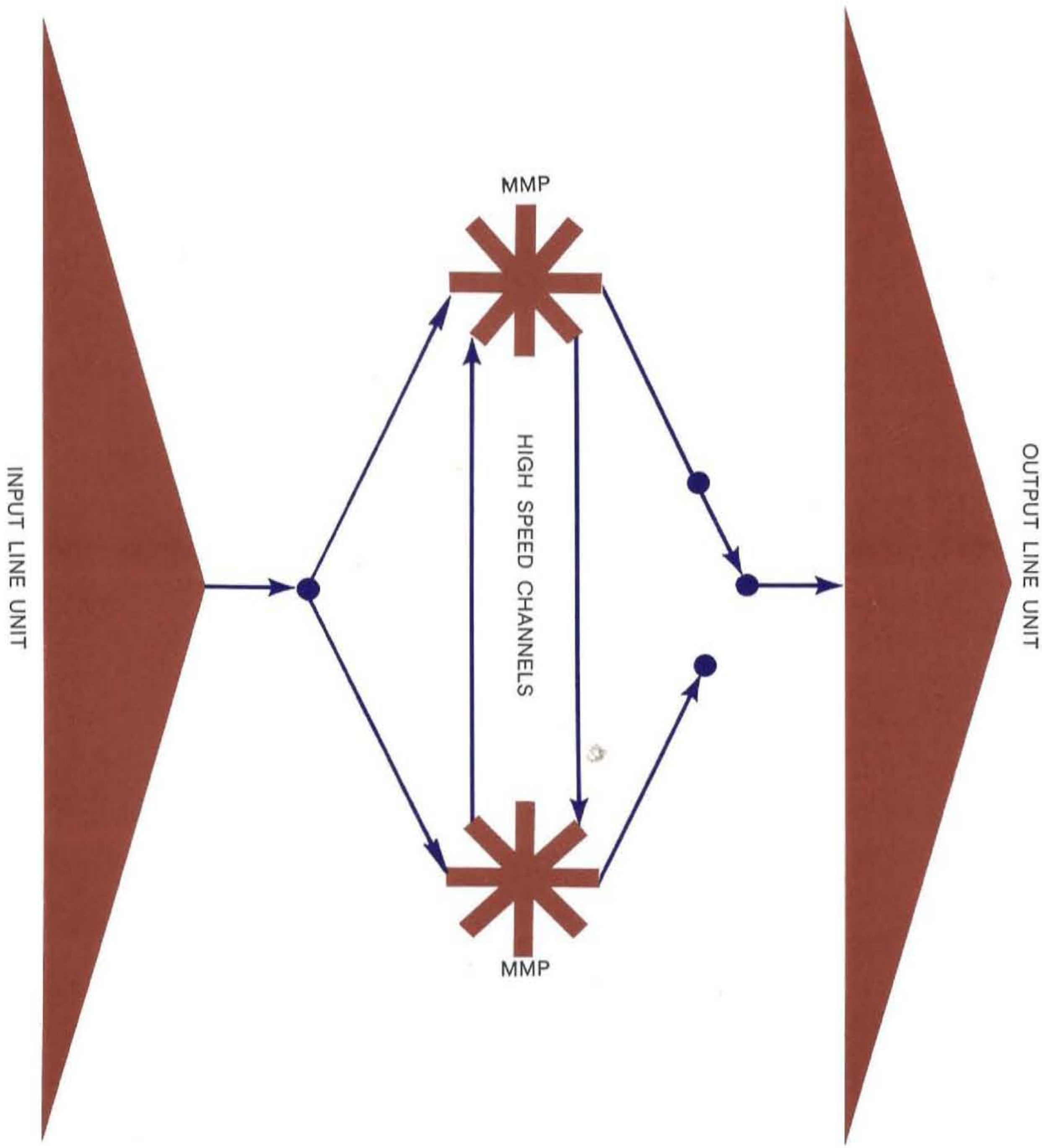
Messages on any incoming channel are always accepted by the ADX System. The destination and priority of each message are automatically determined. If the required outgoing circuit is available, the message is forwarded. If the outgoing circuit is not available, the message is stored. Each message entering the system is logged, and if desired, each message is also dated and timed. The ADX System forwards a message as soon as the designated channel is available. Messages are forwarded in strict accordance with the message priorities. All messages forwarded from the switching center can, if desired, also be logged and channel information, channel number, and date and time of transmission may be inserted in the message.

To function efficiently, an automatic switching system should have a routing plan identifying each input station. The ADX System can accommodate any routing plan, and is easily integrated into present systems. Messages with special codes can be automatically routed to any designated station, or group of stations, through the use of group coding.

An efficient communications system also should provide for priorities in handling messages. The ADX System may be programmed to process practically an unlimited number of priorities. If messages cannot be routed directly to the desired destination, they will be selected for forwarding over an alternate route. If two or more messages of equal priority are waiting for a transmission route, they will be forwarded in the order of their time of arrival at the switching center. All priorities are automatically processed by the ADX System.

Multi-route messages are forwarded from the ADX System to the designated station as soon as each route becomes available. This assures that the message is not delayed pending the availability of all routes, and avoids holding circuits idle until all necessary routes are available.

Way station circuits can be controlled by the ADX System by a number of different methods. The choice of control method is at the discretion of the user.

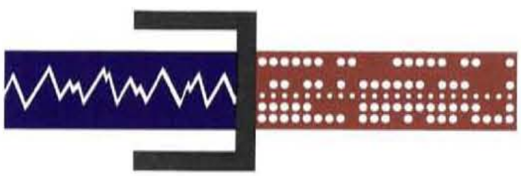


A DUAL MMP SYSTEM
(PARALLEL OPERATION OF MMPS)

MESSAGE STORAGE

A significant aspect of control of the entire communication system is the provision of sufficient storage to meet the user's peak hour traffic requirements. Magnetic tape or magnetic disk storage is used to handle overflow traffic. This diversion to overflow storage is controlled automatically by the ADX System for each route and each priority. It does not take any longer to forward a message from overflow storage than from regular core storage. This is accomplished because the ADX System is programmed to retrieve the message from overflow storage in anticipation of the outgoing circuit becoming available.

In order to ensure management control of the entire communication system, all information concerning the status of the ADX System and all communication circuits are directed to the supervisor's control position. Here the supervisor can send and receive messages; he can busy-out non-operating stations, answer inquiries, and can initiate a search of the magnetic tape file for any message about which any question arises.



MESSAGE PROCESSING

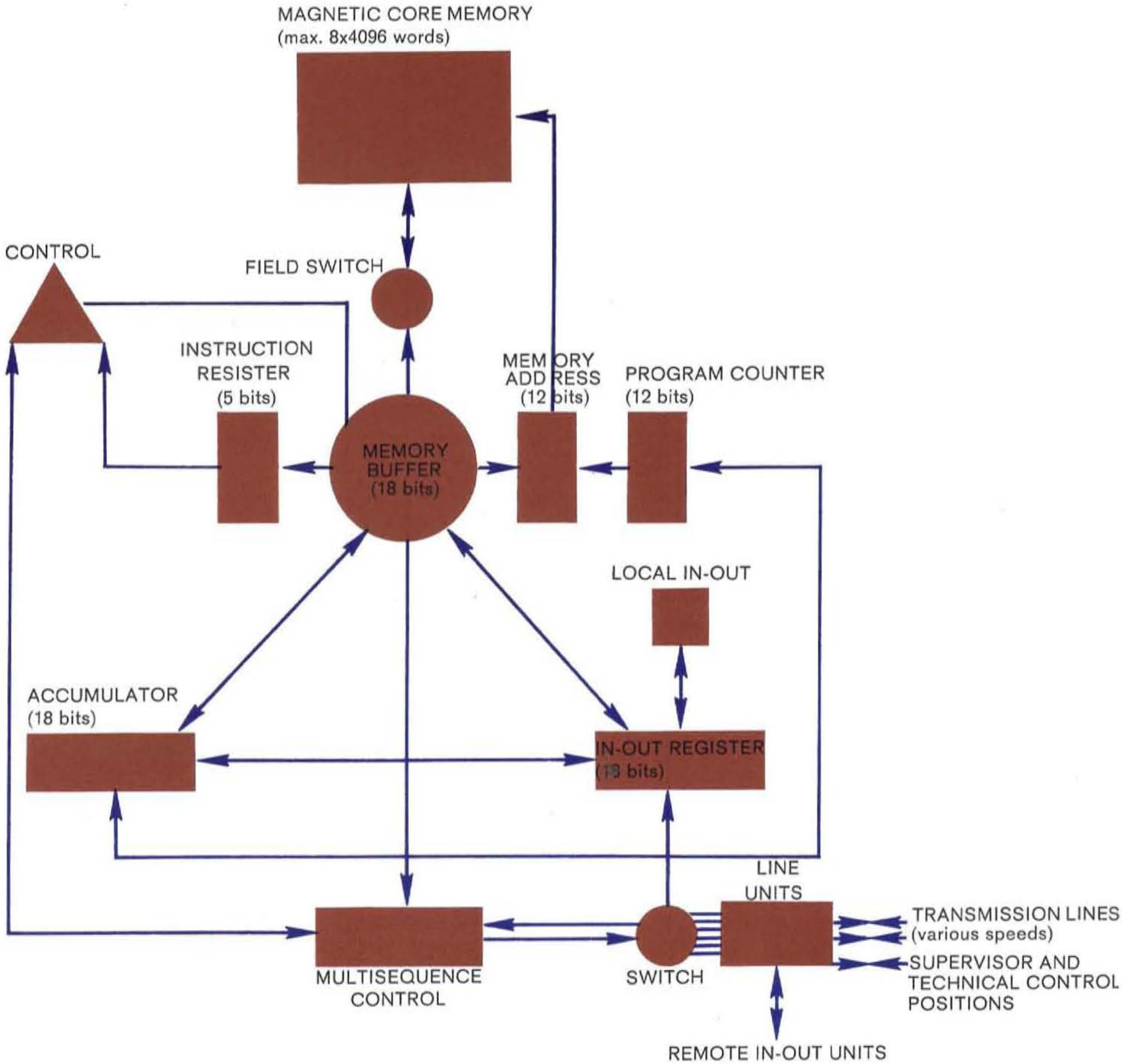
The ADX System permits extremely flexible processing of messages. It can be programmed to recognize and take action on all elements in a message format, including the optional elements or any combination of mandatory and optional elements. The ADX System will handle messages with different formats, even when the messages come over the same circuits. For example, an airline may wish to process seat reservation traffic with priority break-in procedures over the same circuits which handle operational and administrative traffic.

The ability of the ADX System to handle messages of different formats and to convert from one message format to another means that the ADX System can be integrated with existing electro-mechanical systems with a minimum disruption of service. In addition, since the ADX System is compatible with all electro-mechanical and electronic computer and communications systems, it can be used on-line in networks which have a variety of devices utilizing different codes.

MESSAGE ACCOUNTING

The ADX System can be programmed to perform message accounting and message analysis, as a by-product of the principal functions. Each incoming and outgoing message can be automatically identified. This identification can be printed in the input or output journals. To reduce cost and improve line identification need not be transmitted, it can appear only in the journals.

DESCRIPTION OF SYSTEM COMPONENTS



MMP BLOCK DIAGRAM

MULTIPLEXED MESSAGE PROCESSOR (MMP)

The Multiplexed Message Processor, the heart of the ADX System is a stored program, fixed word length, single address, sequential processor. Solid state components are used throughout the MMP.

The basic machine is equipped with 4,096 words of core storage, expandable in modules of 4,096 words to a maximum of 32,768. Each MMP word consists of 18 binary bits, which may be retrieved within 5 micro-seconds. There are 32 basic machine instructions, although the total number of instructions may be extended through variations of the address bits. The MMP has a maximum transfer rate of 3.6 million bits per second.

To perform the store-and-forward message switching function, the MMP provides the following types of storage:

Buffer Storage—used to store temporarily incoming messages until they can be forwarded over an outgoing line, or transferred to overflow storage. Magnetic core memory is used as a buffer store.

Overflow Storage — used to store incoming messages which cannot be forwarded immediately because of queueing on out-going lines. Magnetic tape or magnetic disk is used for overflow storage.

Program Storage—used to store the instructions necessary to perform message switching and information processing. Core memory is used.

Table Storage—used to store address indicators and routing instructions. Magnetic core or magnetic disk memory are used.

Other parts of the MMP are the **control element,** the **memory buffer register,** the **arithmetic element,** the **memory addressing element,** and the **multi-sequence** unit.

The **control element** governs the complete operation of the computer, including memory timing, instruction execution, and the initiation of input-output commands. This element communicates with the instruction register, the memory address register, and the memory buffer register, and is responsible for manipulating the contents of these registers.

The **memory buffer** (18 bits) is used as a buffer between core storage and the rest of the system. The memory buffer serves as staticizer for arithmetic operations.

The **arithmetic element** consists of an 18 bit accumulator which holds the intermediate results and an in-out register which is used as an extension of the accumulator.

The **memory addressing element** includes the memory address register, the program counter, and the instruction register. The exact location of the core storage word being read or written is determined by the 12 bit memory address register. The program counter is a 12 bit register and holds the address of the next instruction of the program to be executed. The instruction register, a five bit register, retains the number representing the operation code of the instruction being executed.

The **multi-sequence** unit provides 256 intercept channels, grouped into 16 priority groups of 16 channels each. A service request by a channel may interrupt a channel from a lower priority group, but it cannot interrupt a channel in the same or higher group. The multi-sequence unit makes it possible for the system to handle up to 256 separate in-out channels in a basic machine, and, with additional hardware and programming, a system can be expanded in modules of 256 channels to handle a maximum of 2,048 separate in-out channels.

These channels are assigned to communication lines or to peripheral equipment. The priorities assigned to the devices do not depend upon the priorities of the information being transferred, but depend upon the speed of response required by the MMP. In general, this results in input devices having higher priorities than output devices and in high speed devices having higher priorities than low speed devices. Output lines of the same speed may be operated in synchronism, and they may be serviced by a single channel.

Since the time required to perform an MMP operation is much less than that required to transmit characters over incoming telegraph or telephone lines, one MMP can service many lines. The MMP is capable of providing concurrent operation of all in-out devices and their associated programs along with the main program. This "multi-sequence" principle was employed in the Electronic Data Transmission Control Center used in the Strategic Air Command (SAC) 465L System designed by ITT.

The multi-sequence system operates by automatically retaining the contents of the accumulator, the instruction counter, and other necessary information, whenever a program is interrupted to process another program of higher priority. The actual operation takes place as follows. Upon receipt of a character in a message, arriving on an incoming line, the line unit sets a flag which will automatically interrupt programs of lower priority. The character is read into the main core memory by program in its proper relationship to the rest of the message.

The service request flag is turned off until the next character arrives and other channels of lower priority are serviced. Since lines of higher speed must be serviced more often, they will be given higher priorities.

All completed messages are processed for accounting purposes by one of the lower priority sequences. Below the priority system is a main sequence, which remains idle until all priority level indicators have been turned off, after which it automatically becomes operational. The main sequence operates when there are no transfers to handle. It is used for message processing and for internal checking to increase reliability. The main sequence may also be used for on-line computations and information processing, without interfering with ordinary message processing. Ordinarily, the multi-sequence system controls all in-out data transfers. However, the program may turn the multi-sequence system off for a period, during which uninterrupted operation with selected registers or peripheral devices is desired.

MMP CONTROL CONSOLE

The MMP Control Console is structurally a part of the MMP. In a basic ADX System, the MMP Control Console is equipped with a paper tape reader, a paper tape punch, and an electric typewriter. The punched tape reader is a photoelectric device capable of reading 400 lines per second. Five, six, seven, and eight hole paper tapes may be read. The paper tape punch operates at a speed of 20 characters per second. The electric typewriter operates in the input or output modes. The input speed is commensurate with the operator's typing speed and the output speed is approximately 10 characters per second.

OPTIONAL CONSOLE EQUIPMENT

Optional equipment associated with the control console includes tabulating card input and output units, a cathode ray tube display unit, various types of line printers, a 110 characters per second paper tape punch, or other peripheral equipment as needed.

LINE UNITS

The input-output line units enable direct data transmission with remote terminals via either telegraph or telephone lines. The line units buffer and convert information between parallel and series modes, permitting transmission between the lines and the MMP. Whenever an input line commands service, the MMP program being processed is automatically interrupted by a special program written especially for that input line. Upon completion of the special program, the interrupted MMP program is restored and operation continues as before the interruption.

Transmission lines of the same speed are terminated in groups (up to a maximum of eight lines per group). Each group of units contains its own power and timing mechanism. High speed data lines are terminated individually and have their own timing units.

MAGNETIC TAPE UNITS

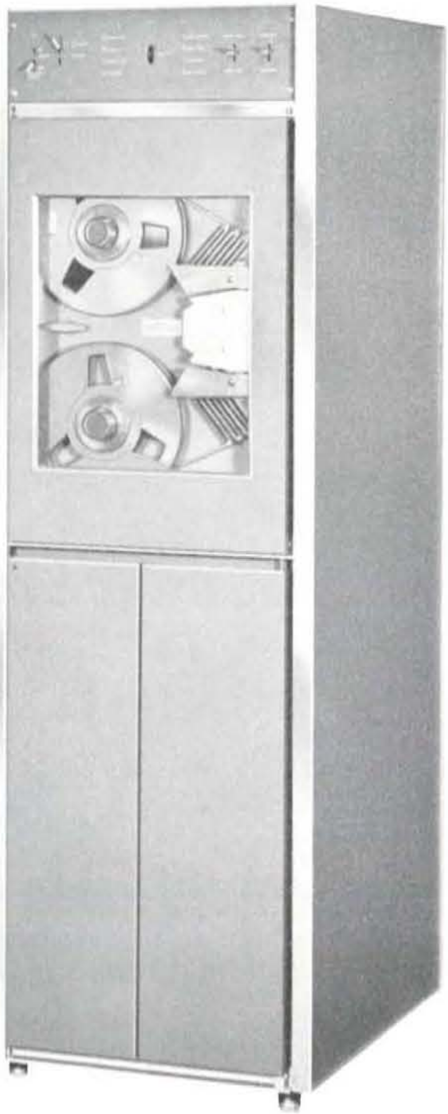
Magnetic tape is used for storing in-transit messages, and information being processed, and for logging messages. The magnetic tape system consists of a Magnetic Tape Control and one or more Magnetic Tape Units. The MTC directs block transfers of data on a break-in basis, to or from any core field, concurrent with MMP activity. Magnetic Tape Units operate at 75 inches per second, with a recording density of 200 characters to the inch, and can read and write 15,000 characters per second. The standard tape reel length is 2400 feet. Records on tape are of variable lengths. The inter-record gap is ³/₄ of an inch. Start-stop time is 5 milliseconds. Each tape unit is equipped with "read-after-write" heads to insure the accuracy of the written data. Information is recorded on seven tracks; six are binary (alphanumeric) bits, and the seventh is used to check lateral parity. At the end of a record, a longitudinal parity character is written. ADX Magnetic Tape Units are compatible with other tape systems, assuring intercommunication between various data processors.

MAGNETIC DISK STORAGE

Disk storage involves the Magnetic Disk and a Magnetic Disk Control. The latter unit directs block transfers of data to and from the MMP, independently of concurrent message processing activity. There are six models of the Disk Storage Unit, as below.

Model	Number Disks	Number Arms	Total Bit Capacity	ADX System Word Capacity	Six-Bit Character Capacity
1	1	1	9,700,000	538,887	1,283,332
2	4	1	38,800,000	2,155,554	6,433,332
3	16	1	155,000,000	8,611,110	25,833,332
4	16	3	155,000,000	8,611,110	25,833,332
5	64	1	622,000,000	34,555,554	103,666,665
6	64	3	622,000,000	34,555,554	103,666,665

Density	400 bits per inch
Fast section, average access	25 milliseconds
Fast section, maximum access	50 milliseconds
Slow section, average access	158 milliseconds
Slow section, maximum access	200 milliseconds



SUPERVISORY CONTROL CONSOLE

The Supervisory Control Console permits simplified but complete control of all message flow. Pertinent information concerning the status of the entire ADX System and all interconnected lines may be directed to this console by the MMP. The Supervisory Control Console may be located in the room with the major components of the ADX System, or it may be located in another room near the line terminations.

By means of this unit, the supervisor can send or receive messages using an ASR Unit or an electric typewriter. A control panel indicates the status of all communication lines at all times. From the control position, the supervisor can busy-out non-operating stations, answer inquiries concerning messages or line status, initiate a search for in-transit messages, or answer questions concerning any message on the tape journal.

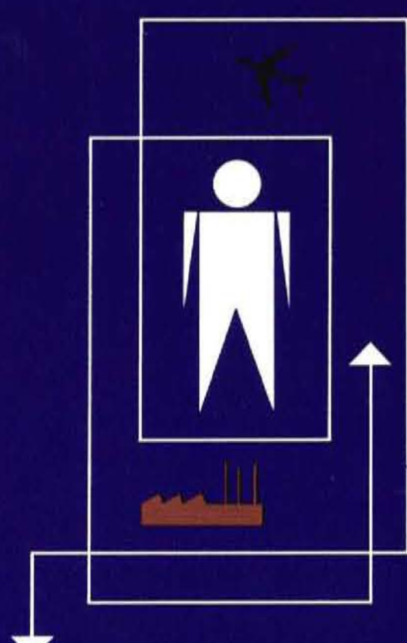
The unit can indicate to the supervisor all messages which the MMP determines to be unreadable or improperly addressed. Various warning lights, signals, or printed messages may be provided to inform the maintenance staff of hardware failures. The Supervisory Control Console is individually designed for each system installation. It is the means for a supervisor to exercise complete control over his entire communications system.

ILLUSTRATIVE SYSTEM CONFIGURATIONS

System Components	A Small System	An Intermediate System	A Large System
MMP	1(2)*	1(2)*	1(2)*
Extra Core Banks	1(2)	2(4)	4(8)
Tape Control	1(2)	1(2)	1(2)
Magnetic Tape Unit	3(4)	5(6)	7(8)
Mag Disk Control	—	1(2)	1(2)
Magnetic Disk Unit	—	1(2)	4(4)
Incoming Line Unit	16(16)	60(60)	136(136)
Outgoing Line Unit	16(16)	60(60)	136(136)
Level Converter	32(32)	120(120)	272(272)
Master Switch Control and Dual Switches	—(1)	—(1)	—(1)

*Figures in parentheses are for dual systems; other figures are for single systems.

APPLICATIONS



THE ADX System can be profitably applied in any organization—business or government—with large scale data processing and communications requirements. The ADX System provides the following capabilities for more effective management and control and more profitable operations:

central control of widely dispersed geographic activities

integration of separate, local data processing operations

prompt availability of critical information for management decisions

faster implementation of control measures

improved customer service through more efficient handling of situations involving critical time problems

lower operating costs through unified control of equipment, inventories, and personnel

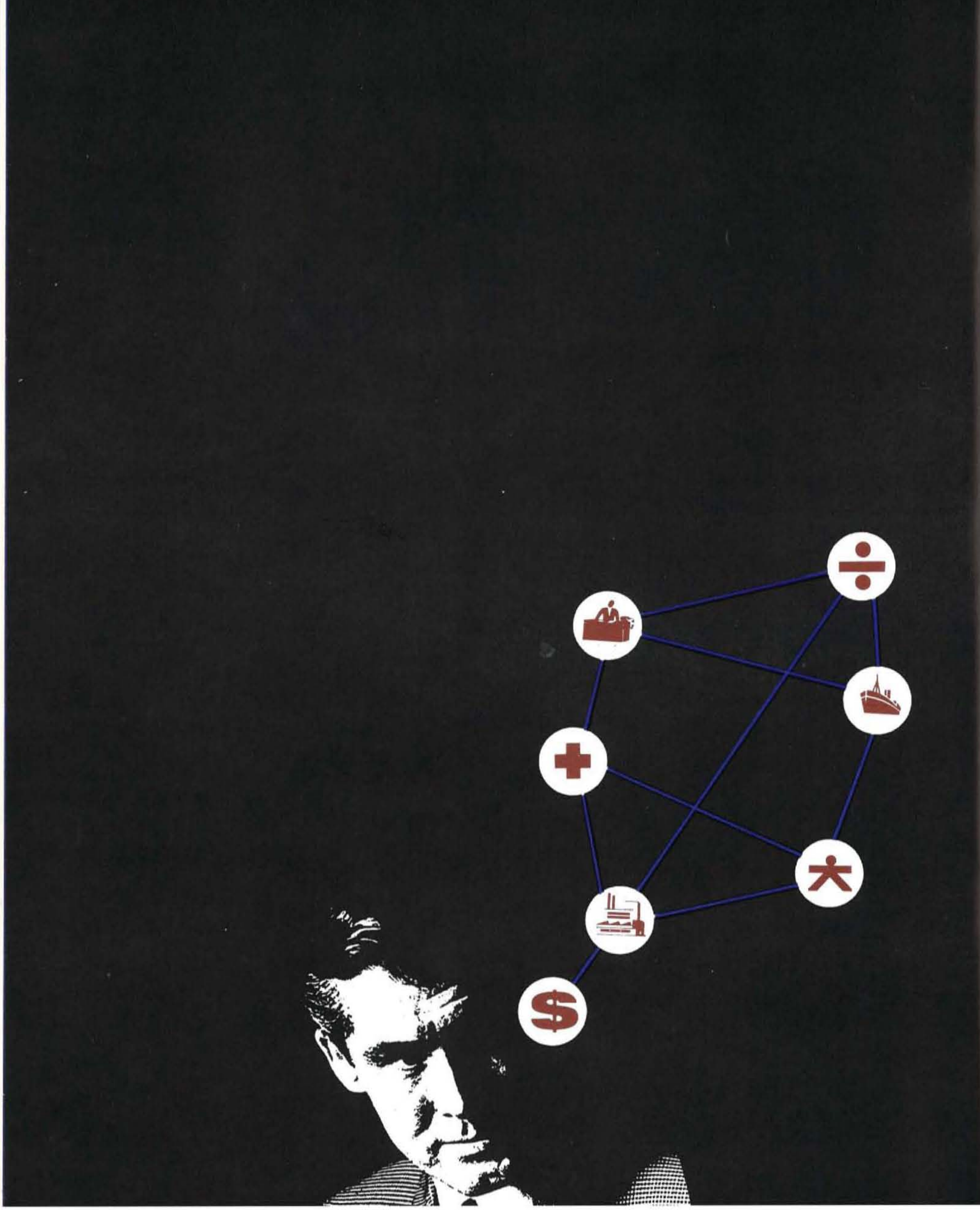
These capabilities can be effectively utilized by management to improve operations through a variety of specific applications in nearly every sector of business and government(s). The following represent some typical examples:

■ Military Operations. The ADX System provides a practical and powerful means of achieving unification in command control situations. It offers major economies through improved communications for logistics systems through better coordination of transportation and storage needs, lower stocks, and coordination of dispersed storage locations. Most important of all, it helps assure quick reaction to emergency needs, for both operational and logistics activities.

■ Federal and State Government Agencies, The ADX System can materially assist efforts towards centralized, integrated data processing and communications systems. Its use can achieve major economies in the data processing operations of individual federal government agencies, and of the entire operations of state governments. Its application to centralized data processing and faster communication can materially improve performance and control. It is effective in permitting the use of joint computer facilities, in developing integrated budgeting and accounting systems, and in making better use of available resources.

■ Transportation. ADX System applications in the transportation industry include:

Scheduling and control of freight, passengers, and equipment



Controlling and selling of available, perishable space

Adjusting equipment and manpower to changing local needs, improving utilization of reserve equipment

Providing better customer service through faster response to customer needs

Optimizing spare parts inventories

Integrating and improving the efficiency of existing communication systems

- Manufacturing. For the manufacturing company, the ADX System can be profitably applied to the development of data systems in the following areas:

Fast, long distance order processing to reduce stocks and to improve customer service

Availability of information to facilitate and improve production scheduling and allocation of work between plants

Day to day management control of local performance

Coordinated inventory control and materials management throughout the entire manufacturing cycle

- Financial: ADX System solves the real time problems which exist in various types of financial companies, for example:
- Savings Banks: Reduces the limitation of communication problems and accelerates the processing of input-output inquiries and account updating.
- Stock Brokerage: Simplifies nationwide custom trading and communications.
- Commercial Banks: Eliminates administrative data transmission bottlenecks for multibranch operations.
- Insurance Companies: Can provide faster, and improved customer service for processing claims, policies, and regional operating data. Provides the basis for a nationwide communication system which enables every company to satisfy statutory requirements and operating efficiencies.
- Service Industries: The service industries including independent telephone companies and data processing service centers can use the high speed switching and message forwarding capabilities to strengthen their competitive capabilities and to broaden the services to business.

The above applications areas are indicative of the capability and universality of ADX. The development of the ADX System was the result of a careful analysis of the problem of total computer-communication system operation. The result had to be a unique product, such as ADX because the needs dictated the development of such a system.

SYSTEM RELIABILITY

A modern communications system must perform reliably and continuously, precluding any possibility of loss, excessive delay or duplication of messages. Reliability and error-free communications are obtained by especially-designed equipment, by carefully engineered configuration, by automatic error detection devices, and by diagnostic test programs.

ERROR CHECKING

The Supervisory Control Console is the focal point of error checking. Some of the errors identified at this point are: invalid routing indicators, lost end-of-message indicators, lost start-of-message indicators, garbled message indicators, out-of-service lines (party lines by polling methods and other lines by character rates), and status of all communication channels. When an error is detected, the normal procedure at the control console provides for an alarm or other indication whereby the supervisor is notified of the error condition, and in many cases the message containing the error is printed out for the supervisor. If necessary, the message containing the error is forwarded to the addressee with advice that an error exists.

Error control on the high speed data circuits will be accomplished by a vertical parity on each character arriving and a longitudinal parity on the entire message. Each character will be examined for parity, and if found in error, a program will be initiated that requests re-transmission of the message. After receipt of the entire message, the program will compute longitudinal parity, and compare it with a set of longitudinal parity characters transferred by the sending device. If there are no parity errors (either vertical or longitudinal) and acknowledgment will be transmitted. If the longitudinal parity does not check, a request for a message repeat will be initiated. In the event of heavy line noise or in the case of messages in which minor errors may be tolerated, provisions may be made to accept the messages, regardless of parity error. In a similar manner, messages being transmitted will be examined by the receiver and, if found in error, a re-transmission will be requested.

The usual checking devices are included in the MMP to check for errors in the paper tape input and on the magnetic tapes. Word parity checks on all memory transfers can be provided. As noted elsewhere, thorough checking operations may be programmed, and the program or the equipment can call on certain maintenance or diagnostic test programs. The ADX System can be programmed to alert a special diagnostic routine after the detection of an error. All pertinent information concerning the error source can be made to appear on the teleprinter at the Supervisory Control Console.

If a virtually error-free transmission system is desired, additional precautions can be taken to assure uninterrupted transmission of records. Two Multiplexed Message Processors can be operated in parallel. On a basic ADX System, only one MMP is used. Such a system is referred to as a single system. When two MMP units are operated in parallel, we refer to the system as a dual system. Such an arrangement provides a much more reliable system. The ADX System permits each user to determine the optimum balance between the economic factors and the maximum degree of error-free transmission.

OPERATIONAL PROGRAMS

There is a very close interrelationship between enginering and programming. They are complementary. The ADX System has been carefully engineered to provide the highest reliability in operation. The programming also contributes to overall reliability of operations.

In addition to the diagnostic programs, the various operating routines also activate error routines, which lead the system to one or more of the following actions. The message originator is notified of an error, the communications supervisor is signalled concerning error condition, the message may be processed with the error condition noted, the message containing the error may be rejected, the system may request the sender to re-transmit the message, or the circuit detecting the error may be reset for additional attempts to read the message.

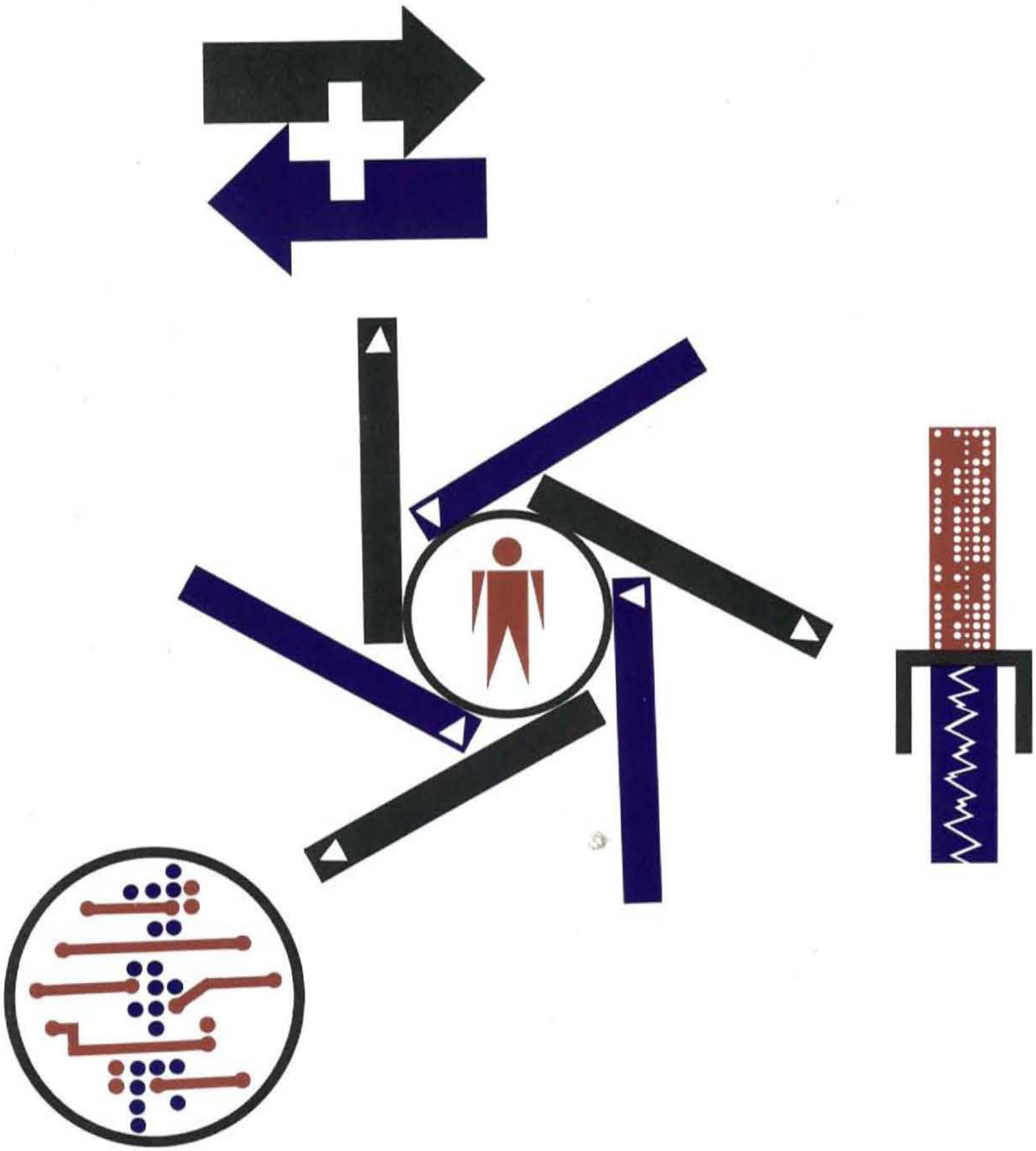
From the above, it can be seen that system reliability is a paramount consideration; it is foremost to the designers, the programmers, and to the entire ITT technical staff, ready to provide any necessary support services for the customers.

EASE OF MAINTENANCE

Several factors contribute to making the ADX System easy to maintain. The dominant reason for the ease with which this system can be maintained is a result of its simplicity of design and construction. All equipment is mounted in free access cabinets with swing-out panels. The equipment is constructed with solid-state components. The system also has been provided with numerous diagnostic programs and test routines which are available to assist maintenance personnel in detecting errors and in finding conditions which would lead to errors, so that the conditions can be remedied prior to equipment failures.

If the customer elects not to maintain the equipment, arrangements can be made for ITT personnel to assume complete responsibility for the maintenance of the entire ADX System. ITT has experienced maintenance personnel throughout most of the countries of the world, and ITT has a backlog of experience in maintaining all types of records communication systems. This wealth of maintenance experience is available to all customers.

SYSTEM ADVANTAGES



/33 The dominant advantage of the ADX System is that it is the most efficient system to handle record communications. The following factors give the ADX System its prime advantages over other communication systems:

Designed to meet modern communications requirements.

Complete hardware and software packages available.

Extremely flexible in operation, can process different line speeds.

Stored program flexibility.

Permits simplified operation due to flexible procedures.

Minimal site preparation.

Permits simplified but complete supervision of message flow.

Low space and power requirements.

Minimum personnel requirements in switching center.

Operates at extremely high speed.

Numerous checking features provide great reliability.

Simplicity of design means ease of maintenance and increased reliability.

System and equipment tested in operation—now operating.

Realistic delivery schedules.

Economical to operate.

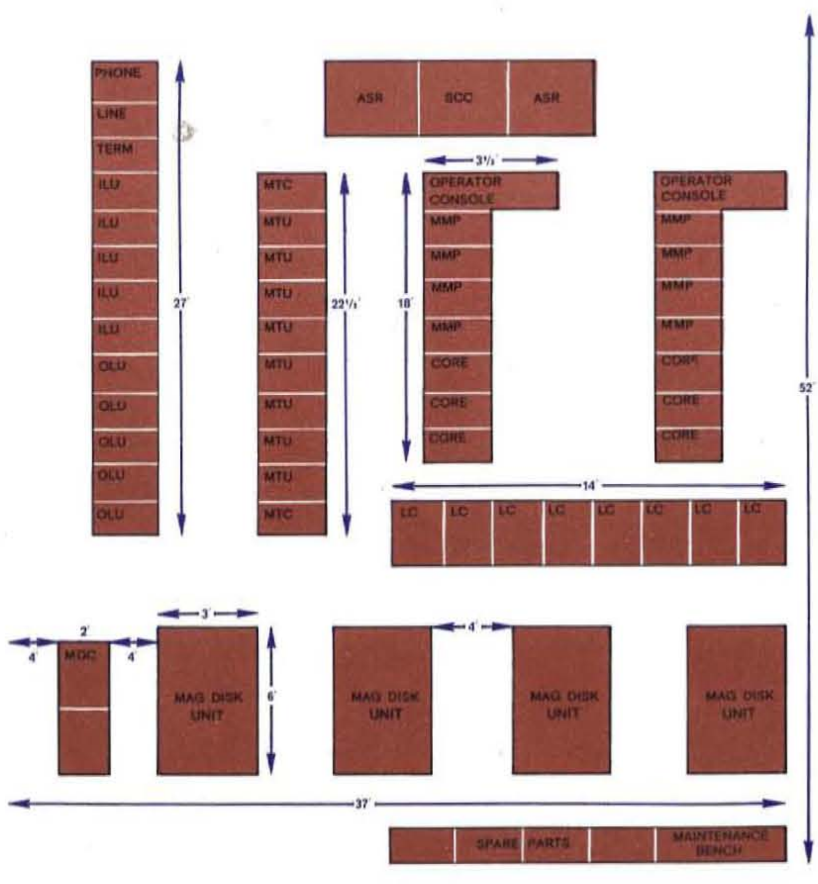
Complete system support from a recognized international communications company.

INSTALLATION REQUIREMENTS

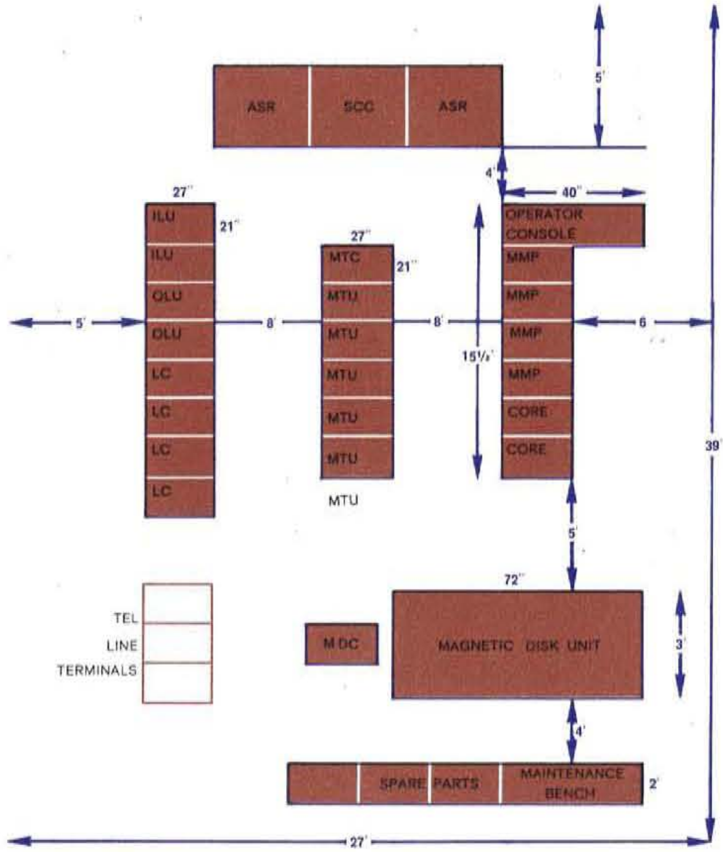
ITT personnel will assist the user in determining the physical requirements necessary to accommodate an ADX installation. Because the ADX System is composed of solid-state modules, is simply designed and compactly packaged, the system requires minimal floor space. Each system module will average 125 lbs. per square foot, with a maximum loading of 150 lbs. per square foot. The modular units in an ADX System are 27" x 21", with a height of 69". Since each ADX System will be different, depending upon customer requirements, the total floor space requirements will differ. To provide some indication of floor space requirements, three floor plans have been included. The floor plans included are based upon the illustrative systems described earlier. It should be noted that the equipment requirements are not rigid, but are shown for illustrative purposes only.

To provide for easier maintenance, at least three feet of space should be provided in the front and rear of all units.

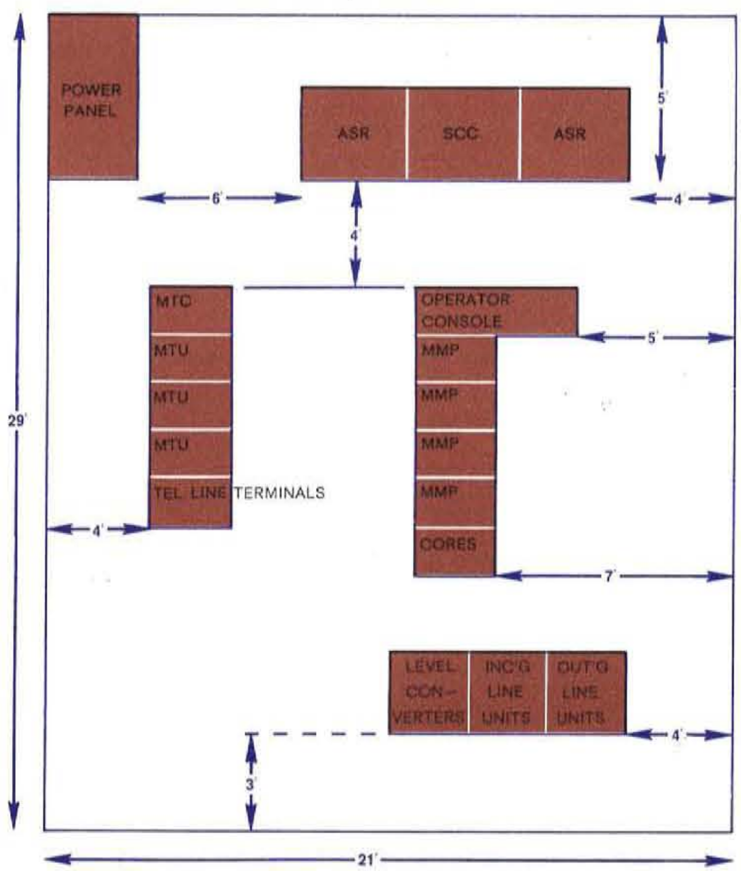
The ADX System will provide maximum reliability if the switching center environment is controlled. It is recommended that the ADX switching center be kept at a temperature of 75° Farenheit and the relative humidity be maintained at 50%. The equipment will perform very satisfactorily, as long as the temperature ranges between 60°-80° Farenheit, and the humidity ranges between 20%-60%. Operations can be maintained even under normal room conditions in case of emergencies. No special air conditioning ducts are required to the equipment cabinets.



ILLUSTRATIVE FLOOR PLAN FOR A LARGE DUAL SYSTEM



ILLUSTRATIVE FLOOR PLAN FOR A INTERMEDIATE SINGLE SYSTEM



ILLUSTRATIVE FLOOR PLAN FOR A SMALL SINGLE SYSTEM

ITT—THE BROAD PICTURE

International Telephone and Telegraph Corporation is a company unique in the variety and scope of its activities in the twin fields of telecommunication and electronics. ITT products range from miniature hearing aids to some of the world's largest automatic telephone and telegraph exchanges, and from broadband radio installations designed to carry television signals as far as 500 miles without relay, to a myriad of electronic components made under microscope and small enough to be scooped up by the handful. Companies of the ITT System engineer powerful aeronautical and astronautical flight systems, as well as pneumatic tube systems for factories, hospitals, and office buildings. ITT makes electrical cords for household appliances as well as mammoth cable that carries both communications and power over land and under the sea. ITT designs, manufactures and markets vacuum tubes, tiny quartz crystals, and also great electronic computers capable of reducing months of paper work to seconds. Contributions to the age of automation include analog-to-digital converters the size of a flashlight battery, as well as production and systems management of the intricate test, launching, and guidance mechanisms for the guided missiles that guard the free world from attack, and the communication satellites that will soon make world-wide television a reality.

The history of ITT contains an impressive record of pioneering achievements. The System provided South America with its first radiotelephone service to Europe and North America; Europe with its first multichannel commercial radiotelephone link and its longest coaxial cable network; the United States with its first selenium rectifiers; Belgium and Switzerland with pioneer nationwide telephone dialing equipment; and the world with its first commercial microwave radio communication system, its first mechanized post office, and two of the basic patents in both surface and airborne radar—PPI (plan position indicator) and MTI (moving target indicator). Every 30 seconds, somewhere in the free world, an aircraft is landed safely by ITT-developed ILS (instrument low-approach system); and in the jet age, aircraft are determining their positions through ITT-pioneered Tacan, Vortac, or DMET (Distance-Measuring Equipment—Tacan).

Men of the ITT System operate and maintain the DEW (distant early warning) Line of radar posts stretching from Alaska to Iceland. ITT also mans marine radio stations along the Atlantic, Gulf, and Pacific coasts of the United States, and marine radio equipment aboard ships at sea.

ITT companies provide telephone or telegraph service in eight Latin American lands and link the United States to the rest of the world by cable and radio circuits.

Founded in 1920, ITT includes many units far older. Two of its operating companies date from 1878 and 1883; two of its manufacturing companies, from 1879 and 1880. The wide geographical extent and varied activities of the corporation are thus backed by experience nearly as old as the electrical communication industry itself. Long a major supplier of telephone and telegraph equipment overseas, the ITT System began during World War II to expand its research and manufacturing in the United States, where it now ranks among the leaders in electronics and telecommunication.

Recent examples of ITT's experience in the planning, management and implementation of extensive communication systems are two major military programs vital to the defense of our nation: the Air Force Strategic Air Command's 465L and AIRCOM's 480L projects. These two projects are indicative of the scope of capabilities that **are** ITT.

The ITT 7300 ADX System—a product of the ITT Information Systems Division is the latest contribution in an already impressive array of ITT accomplishments.

The broad base of ITT's activities has given the corporation great vitality throughout its history. ITT is uniquely prepared by its nearly 42 years of world-wide service to satisfy the electronics and telecommunication needs of government and industry.

ITT 7300 ADX SYSTEM MNEMONIC OPERATION CODES

ARITHMETIC GROUP

add	add
sub	subtract
mus	multiply step
dis	divide step
idx	index
isp	index & skip if positive

LOGICAL GROUP

and	logical "and" to ac
xor	exclusive "or" to ac
ior	inclusive "or" to ac
lac	load ac
dac	deposit ac
dap	deposit address part
dip	deposit instruction part
lio	load io register
dio	deposit io register
dzm	deposit zero in memory

SPECIAL GROUP

xct	execute
sad	skip if ac & y differ
sas	skip if ac & y are the same
cdf	change data field
jmp	jump
cal	call subroutine
jfd	jump field
jsp	jump & save program counter
jda	jump & deposit ac
jfs	jump field & save program counter

SHIFT/ROTATE GROUP

rar	rotate ac right
ral	rotate ac left
sar	shift ac right
sal	shift ac left
rcr	rotate ac & io right
rcl	rotate ac & io left
scr	shift ac & io right
scl	shift ac & io left
rir	rotate io right
ril	rotate io left
sir	shift io right
sil	shift io left
law	load ac with n

SKIP GROUP

sza	skip on zero ac
spa	skip on plus ac
sma	skip on minus ac
szo	skip on zero overflow
spi	skip on plus io
szsi	skip on zero switch i
szfi	skip on zero program flag i

OPERATE GROUP

cli	clear io register
lat	load ac from test word
cma	compliment ac
hlt	halt
cla	clear ac
tpc	transfer program counter
opc	"or" program counter
clfi	clear program flag i
stfi	set program flag i
nop	no operation

MULTISEQUENCE GROUP

msi	multisequence inoperative
mso	multisequence operative
msc	multisequence system cleared
cfgi	clear service request flag i
sct	set channel trap
jfd	clear priority indicator

MAGNETIC TAPE GROUP

stp	stop
rew	rewind
bks	backspace
fws	forward space
wte	write tape even parity
wto	write tape odd parity
rce	read check even parity
rco	read check odd parity
rte	read tape even parity
rto	read tape odd parity
gwte	mri gather write tape even parity
gwto	mrf gather write tape odd parity
srce	scatter read check even parity
srco	scatter read check odd parity
srte	scatter read tape even parity
srto	scatter read tape odd parity
its	initiate tape sequence
isr	interrogate state reg.
ica	interrogate current address reg.

STANDARD ON-LINE EQUIPMENT GROUP

rpa	read paper tape alpha
rpb	read paper tape binary
rrb	read reader buffer
ppa	punch paper tape alpha
ppb	punch paper tape binary
tyo	type out
tyi	type in
ttti	teleprinter i in or out

INFORMATION SYSTEMS DIVISION

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