western union

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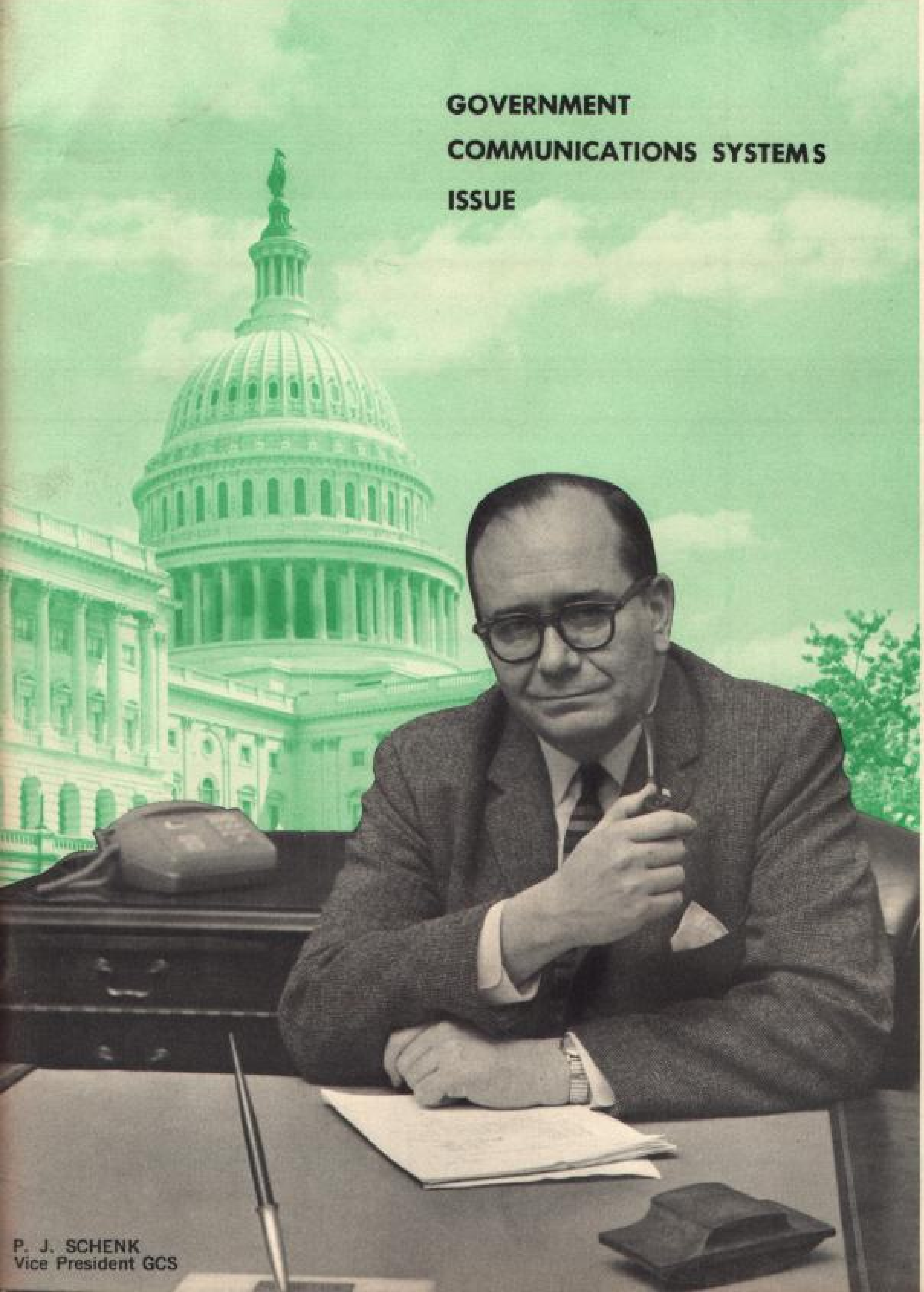

P. J. SCHENK
Vice President GCS

THE WESTERN UNION TECHNICAL REVIEW

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serves
the federal government

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high speed
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form feed
message delivery system

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advanced record system

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expansion of
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expansion of
AUTODIN-OVERSEAS

WESTERN UNION
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western union

Technical Review

Volume 20
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JANUARY 1966

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western union serves the federal

The Federal Government, including the Department of Defense and the Civil Government Agencies, has many specialized and unique requirements for communications. Government communications must have very high reliability and must be immune to any form of catastrophic failure. They must operate in accordance with detailed specifications and routines. In spite of stringent operational requirements, Government communications systems are among the most advanced in the world and usually lead in the development and implementation of new communications concepts.

The Government Communications Systems Department has overall business management responsibility for furnishing Western Union systems and services to agencies of the Federal Government. GCS technical people work closely with their counterparts in government agencies to understand and, at times, to help develop requirements. They formulate conceptual system designs for applying Western Union's technology to the solution of government communications problems. Our colleagues in the Information Systems and Services Department support GCS by carrying out systems and equipment engineering.

government

We foresee an increasing need on the part of our Government customers for message-switched and circuit-switched data communications systems, together with high speed data terminals and transmission facilities. As Government operations become increasingly automated, we anticipate a greater interplay between data communications and other data processing functions.

The location of GCS Headquarters in Arlington, Virginia, in close proximity to the headquarters offices of most government agencies, provides an interface between the customer and those departments of our Company which are charged with providing the systems technical solutions, installation, maintenance, training, and accounting support.

GCS intends to provide the Federal Government with the most efficient data communications systems consistent with the capabilities of men and mechanisms. We look forward to a growing and profitable business and greater technical challenges for Western Union.

P J Schenk

P. J. SCHENK, VICE PRESIDENT
Government Communications Systems

high speed tape reader

—Stan A. Kirkowski

The tape transmitters used in early Western Union telegraphic systems were of the reciprocating pin variety where the sensing pins move in one direction seeking the information holes in the message tape and then retract, in conjunction with the advancement of the tape, to the next information character. To provide this reciprocating pin action in a tape transmitter, an elaborate and complicated mechanical system was required, plus motive power of sufficient magnitude to drive this system.

A comparison of the moving mechanisms used in reciprocating pin 24-B Transmitter and the star wheel 12080 Tape Reader is best illustrated in Figures 1 and 2. Compared to the Tape Reader, the 24-B Transmitter requires many more parts to perform the same tape reading operation. More parts in any unit require more adjustments, add to the weight of the unit, increase the cost of the unit, and decrease the reliability of the unit.

The need for elimination of these multicomponent mechanical systems of tape reading and their comparable heavy motors initiated the research that led to the development of Tape Reader 12080 with many less parts. It uses a simplified method of tape reading, and a new type of driving motor. A modification of the Tape Reader used in the AUTODIN system has been designated Tape Reader 12080.10.

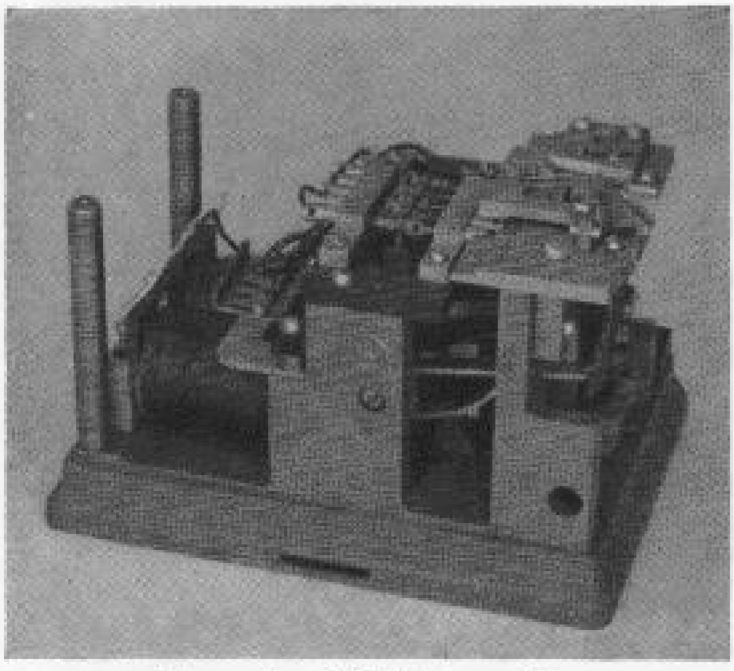

Figure 1. 24-B Transmitter

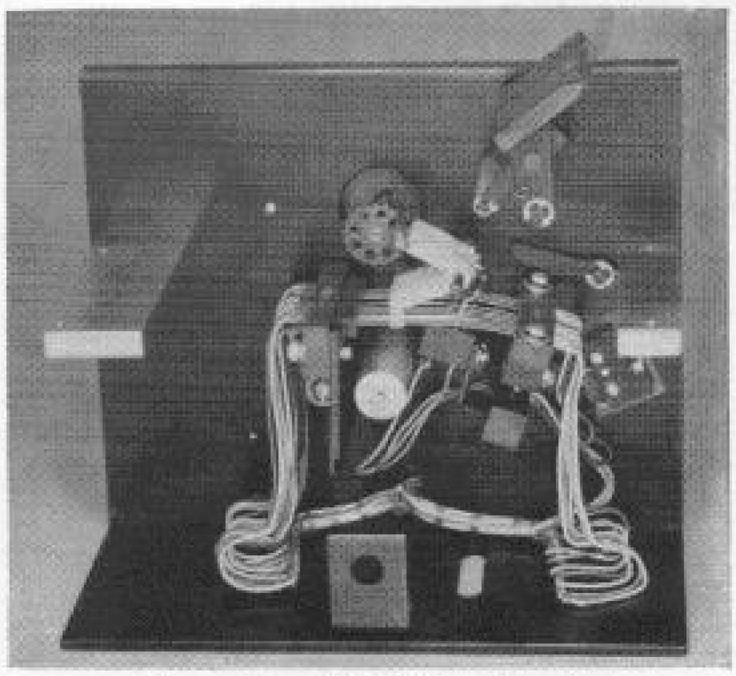

Figure 2. 12080 Tape Reader

Salient Features of the Tape Reader

Tape Reader 12080 is a high speed reader that provides parallel output of information from a tape.

The 12080 unit has the following fixed features: a feed sprocket wheel, "in-line" feed holes, star wheel sensing, the use of chad or chadless tape, a tight tape switch, tape-out sensing contacts, and a 50-point connector wired to accommodate all fixed and variable features. The variable features are: asynchronous parallel output to provide any output up to a rate of 200 characters per second, sensing for 5-, 6-, 7-, or 8 channel punched tape, tape stepping in either a unidirectional or bidirectional mode, and tape motion-sensing contacts.

In addition to the fixed features, Tape Reader 12080.10 has the following features selected from the variable group: operates at a rate of 10 characters per second, senses for 5-channel tape, has a unidirectional motor, and tape motion-sensing contacts. Tape Reader 12080.10 also has shielded wiring and the stepping motor is radiation shielded.

Stepping Motor

The Tape Reader is equipped with a single phase, high torque stepping motor which has two coils. The operation of the motor is similar to that of a polar relay, that is, the two coils are pulsed alternately. The motor shaft and sprocket wheel rotate 20 discrete steps per revolution and stop after each pulse in precise 18 degree increments. Each pulse transports the tape between two adjacent feed holes, a distance of 0.100".

Stepping Circuits

There are many ways to drive the stepping motor, but laboratory investigation of various drive circuits indicated that two different circuits should be used. One circuit should be used for low speed operation (0 to 20 characters per second); the other for high speed operation (21 to 200 characters per second).

The low speed driving circuit consists of a capacitor and resistor which generate a pulse to step the motor for each charge or discharge portion of the cycle. The motor is effectively driven by a non-sinusoidal alternating current actuated by a polar relay. The capacitor and resistor are adjusted to provide critical damping.

The high speed driving circuit uses a pulse transformer which is driven by a flip-flop at its primary input. The secondary output will alternately turn on two transistors which drive the stepping motor coils. The "on" time for either power transistor is approximately 5 milliseconds (for operation at 200 steps/sec. or slower) and is determined by the number of laminations in the pulse transformer. Driven by a pulse transformer, a maximum rate of 300 steps per second "with load," and up to 500 steps per second "without load," is attainable with a proportional decrease in the power transistor "on" time. "With load" includes the damper, the feed wheel and the drag of the tape.

The stepping circuit for the 12080.10 Tape Reader (a variation of the high speed driving circuit) as it is applied in the AUTODIN system, is shown in Figure 3. (Even

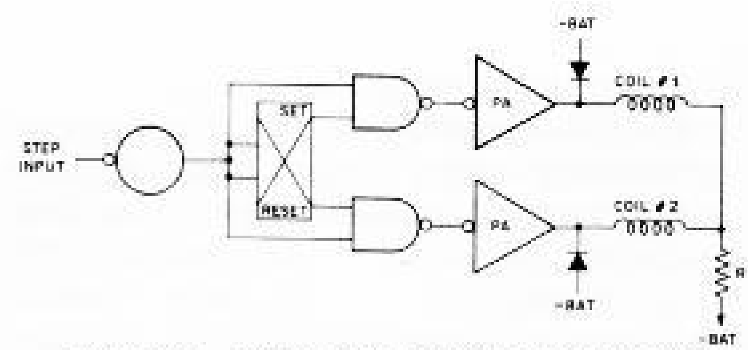

Figure 3. Schematic of Stepping Circuit

though the 12080.10 Tape Reader is considered a low speed reader, a high speed circuit was chosen to operate it because of future applications where the reading speed might be increased and the bidirectional mode might be utilized.) A train of step pulses applied to the input of the flip-flop is gated with the output of the flip-flop to energize alternately coils #1 and #2 of the stepping motor. A comparison of these pulses is shown in Figure 4. When the step pulses (A) are gated with the set output (B), the resultant energizing pulse applied to coil #1 is shown in (D). When the step pulses (A) are gated with the reset output (C), the resultant energizing pulse applied to coil #2 is shown in

(E). A common battery supply resistor (R) is used to prevent burnout of the coils, if failure of the circuit should leave both coils energized. If this condition should occur, the voltage across the coils will drop (in proportion to the relative magnitudes of R and the coil resistance) and yield a wattage dissipation well within the recommended safety value.

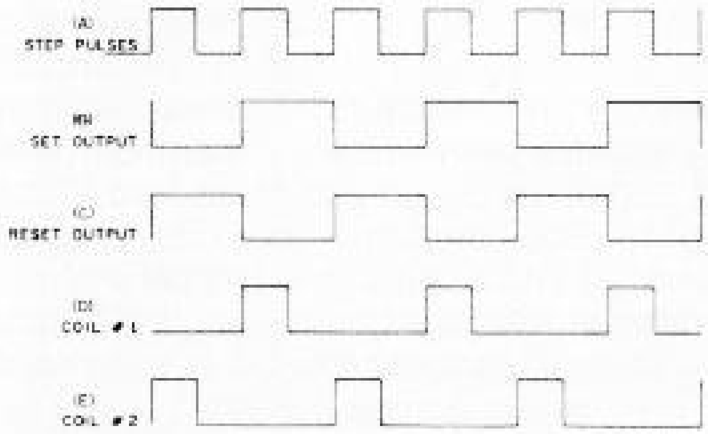

Figure 4. Train of Step Pulses applied to Flip-Flop

Tape Reading Contacts

The tape reading contacts in this reader are of the non-return-to-zero mode and operate in the following manner: 1) With no tape in the reader the sensing star wheels, the sensing levers (in the form of bell cranks made of insulating material), and the contact wires are in the upper or normally closed position. Two contact wires associated with each sensing level provide bifurcated contact operation. 2) With tape inserted under the tape lid, two conditions can occur: (a) When a no-hole condition is sensed, the star wheel rides the underside of the tape and the movable pair of contact wires are switched to the lower position as shown in Figure 5. (b) When a hole is sensed in the tape, the star wheel rises through the hole as shown in Figure 6 and the contact wires are switched upward to the upper position. Therefore, a closure to the upper contacts signifies a marking condition, and a closure to the lower contact signifies a spacing condition, and the contact assembly behaves as a form "C" contact. In addition a fine adjustment is built into the sensing wire block to produce the correct operating force for the sensing wires.

Tape-Out Pin

The end of tape is detected by a similarly shaped sensing lever that is equipped with a tape-out pin instead of a star wheel, and this tape-out pin rides the forward underside edge of the tape. When tape is latched under the tape lid, the tape depresses the tape-out pin and its lever. This lever switches the contact wires to the lower position and keeps the stepping circuit activated until the end of the tape passes over the tape-out pin. The tape-out pin then rises and opens the stepping circuit.

Tight Tape Switch

A tight tape condition to the tape reader is recognized by the tight tape roller, which is fastened to the tight tape arm, which in turn is pivoted in the tape lid bracket. With slack tape feeding into the Tape Reader, the tight tape roller, which rests on the moving tape, is in its lower position and the stepping circuit is in the operating position.

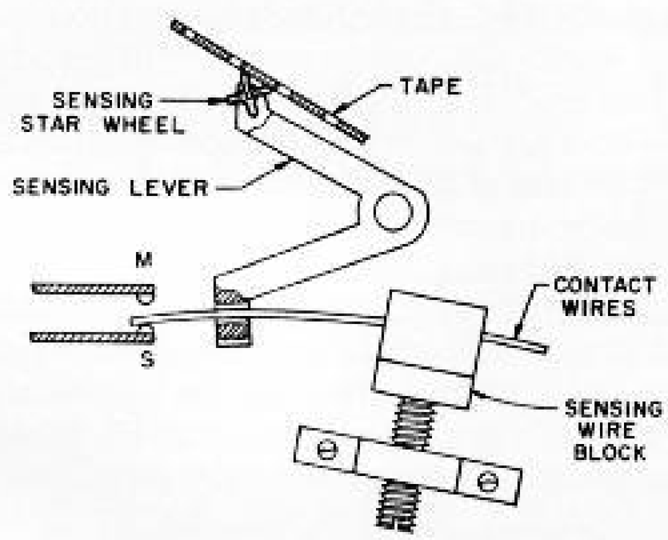

Figure 5. "No-hole" condition

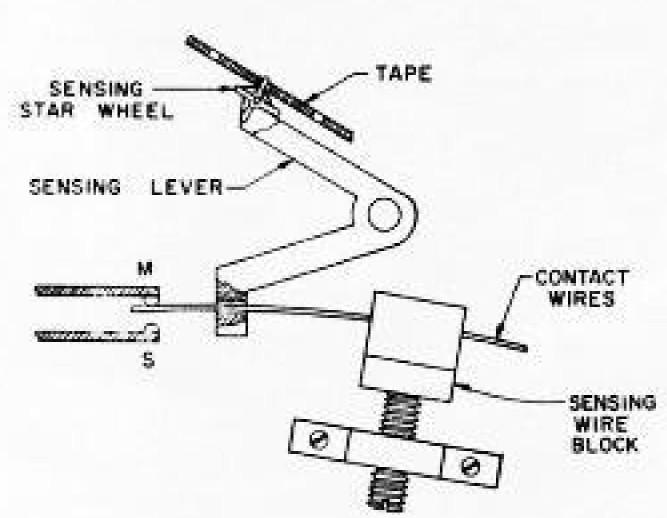

Figure 6. "Hole" condition

When a tight tape condition occurs, the tape raises the tight tape roller which rotates the switch lever against the switch arm located under the top plate, opening the stepping circuit. The transmission ceases until a slack tape condition again occurs.

Chad or Chadless Tape

When it was designed, Tape Reader 12080 was the only available tape reader employing star wheel sensing that could read chad or chadless tape. This was made possible by locating the sensing star wheels underneath the tape, rather than above it, so that the chads in the tape could be displaced upward.

Tape Motion Sensing

A special feature designed particularly for the AUTODIN Tape Reader is the motion sensing contact, shown in Figure 7.

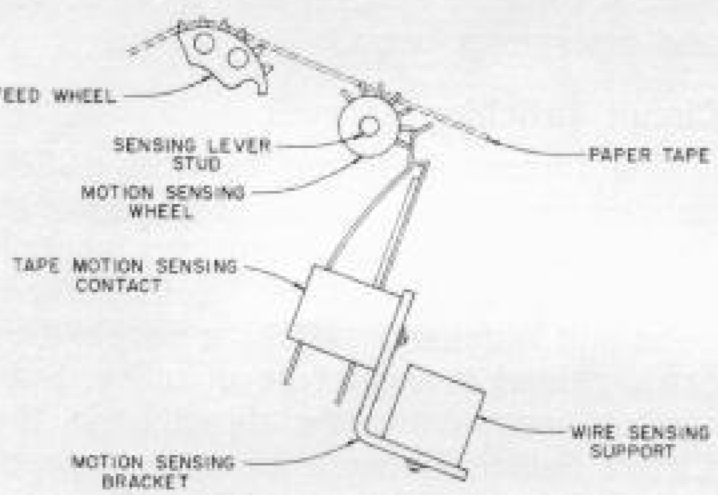

Figure 7. Tape Sensing Contact

The function of the motion sensing contact is to deliver an electrical pulse to the associated AUTODIN logic circuitry for every incremental step in the movement of the tape. The feed wheel pulls the tape. The tape, in turn, rotates the motion sensing wheel by means of engaging it in the feed holes of the tape. Thus, the rotation of the motion sensing wheel closes and opens the motion sensing contact as the tape is pulled hole by hole.

Potential for High Speed Reader

While the High Speed Tape Reader was first used in the AUTODIN program, it has many applications in other systems, both old and new installations. The Tape Reader is a light, compact, low-cost unit. It is extremely versatile, reliable, and almost free of maintenance. Because of its high speed capability, it has been selected for operation in the EDAC (Error Detection Automatic Correction) system. Consideration is also being given to the Tape Reader for use in the Plan 38 Switching System.

Acknowledgements

The author wishes to acknowledge the contributions of Mr. W. V. Johnson, Senior Engineer and Mr. Vincent Chan, Project Engineer, who were responsible for the design of the first prototype of Tape Reader, 12080.

STAN A. KIRKOWSKI, Senior Project Engineer in the Information Systems and Services Department, has specialized in mechanical equipment design for the company.

He received his Mechanical Engineering degree in 1950, and a Masters Degree in Industrial Engineering, majoring in Business Management in 1958, from Stevens Institute of Technology.

He joined Western Union in June of 1954 and from then through 1957 designed original equipment for the Apparatus Engineer and the Ocean Cable Division. He later was engaged in the development and engineering of the automatic switching systems for Plans 57 and 59. Mr. Kirkowski was responsible for the development of the Telegraphic Projector, the Chad Disposal Unit and the Tape Neck Belt Drive. He holds one patent and has several others pending.

ars
advanced record system

—Donald E. Carruth

In January 1966, Western Union completed for GSA, General Services Administration, a new network for the transmission of data and teleprinter information, known as ARS, the Advanced Record System. This system provides a single, integrated common-user record communication system for Federal agencies. It ties together over 1,600 teleprinter terminals located in more than 600 cities throughout the United States. It is also capable of handling wideband communications among government subscribers using appropriate high-speed data terminals.

In order to transmit messages and data information in "real time" from user to user, a Circuit Switch Network (CSN) is provided. In order to transmit multiple address messages and to provide interconnection with other existing telecommunications systems, a group of Message Switching Centers (MSC) are provided to perform the "store and forward" function of the ARS. Thus, the ARS is a combined network composed of a nation-wide automatic Circuit Switching Network (CSN) and three automatic Message Switching Centers (MSC).

The system provides subscribers with point-to-point transmission and receipt of the conventional teleprinter messages, as well as a medium for handling data information from magnetic tape, punched cards, facsimile, or other terminal devices. Thus, these subscribers are offered the full range of message switching services provided by Western Union.

As part of the Federal Telecommunication System, the Advanced Record System will meet all forseeable future agency requirements for services such as teleprinter, high-speed data, facsimile, and special voice service, on both a day-to-day and emergency basis.

Circuit Switching Network

The Circuit Switching Network (CSN) handles message transmission through two types of switching centers: junction offices and district offices. Both narrowband and wideband switching capabilities are provided in each type of office. Subscribers communicating directly via the Circuit Switch Network must use speed- and code-compatible machines. Communication between non-compatible machines involves the use of an MSC in conjunction with the CSN.

Initially, the CSN consists of three junction offices (high echelon centers) and twenty-four district offices (low echelon centers) located throughout the country. All junction offices (J/Os) have interconnecting trunk groups and each district office (D/O) has separate trunk groups to two of the three junction offices. Under the present trunking configuration, the Central Junction Office has separate trunk groups to all junction and district offices in the system. Initially, the transmission link between junction offices is inherently wideband; however, part of it is channelized down to voice bandwidth (4 KC) circuits. Some of these circuits are further channelized down to handle the narrowband (teleprinter) traffic at transmission rates up to 150 bauds.

The junction and district offices are designed to switch both narrow and wideband channels at each location. For the sake of economy and convenience all three junction offices (and their respective MSCs) are co-located with the Western Union microwave transmission network junction points. Thus, this network can supply the necessary bandwidth for either narrowband or wideband transmission.

Common control equipment is provided in both junction and district offices, and it is shared by both the wideband and narrowband switching portions of each office. The common control equipments mentioned throughout the following text material perform the various functions of message path scanning, selection, and ultimately, subscriber to subscriber connections.

of the other two J/Os by appropriately-sized trunk groups. Separate trunk groups of suitable bandwidth are provided for both narrowband and wideband traffic, since the design of the offices provides separate switching matrices for each type of service. This arrangement requires that each D/O be connected by two trunk groups (one narrowband and one wideband) to its primary (usually closest) J/O. Similarly, each D/O is connected to the central J/O to provide an alternate routing capability and to enhance system reliability.

Groups of dedicated trunks of suitable bandwidth are used for communication between the MSC and the CSN at the junction sites. Narrowband trunks for subscribers using Baudot code and ASCII are provided in accordance with corresponding traffic requirements. Presently, there are no wideband subscribers served by the MSC via the CSN. Thus, there are no

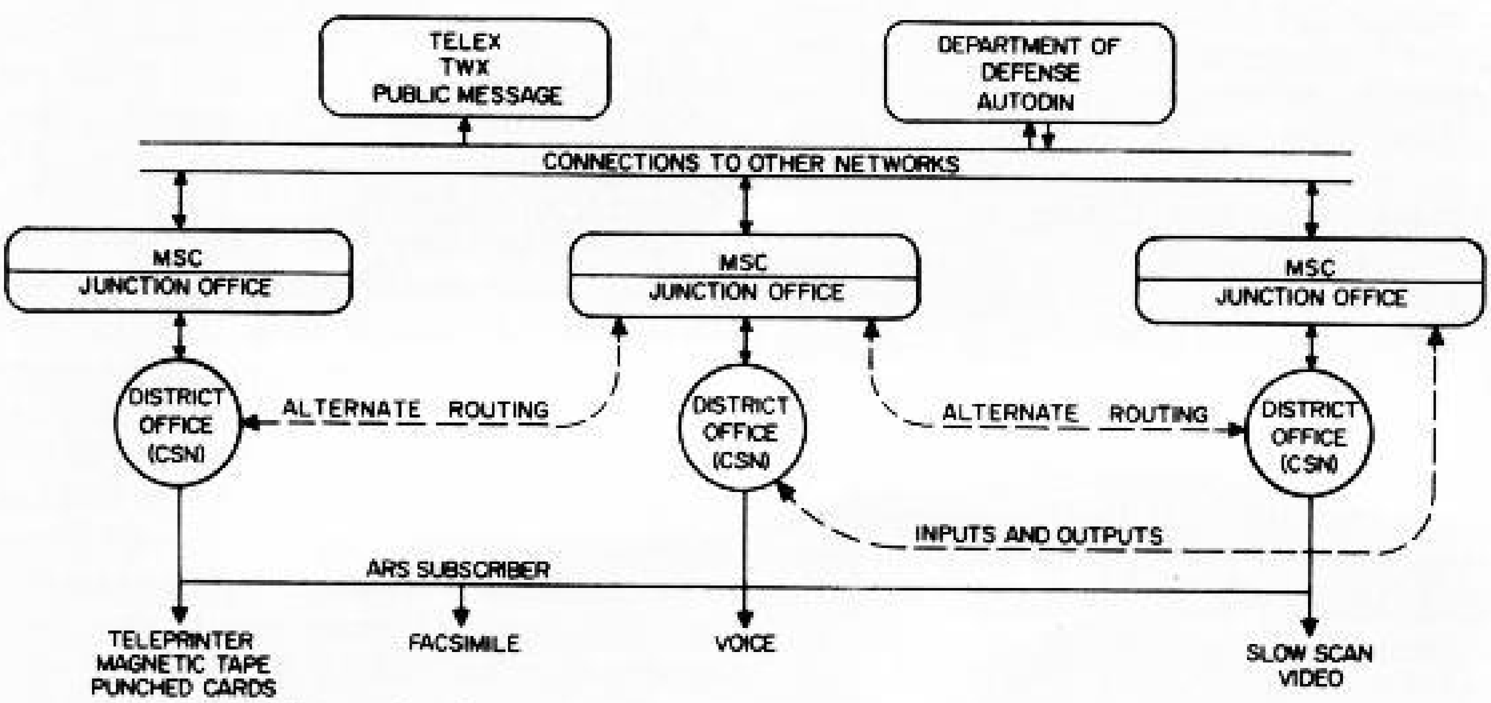

Figure 1. Overall Configuration for Advanced Record System

Interconnections of CSN with MSC

Figure 1 shows the overall configuration of the ARS, and illustrates the interconnections between the MSCs, the junction offices (J/Os), and the district offices (D/Os) and the CSN. Each MSC is connected to each of the other two MSCs by a full-duplex 2400-bit per second dedicated channel, employing AUTODIN-type line coordination and signaling methods. Similarly, each J/O is connected to each

wideband trunks between the MSCs and their respective co-located J/Os. As stated above, the MSC-J/O sites are located at the junction points of the Western Union transcontinental Microwave System: the eastern site is located at Romney, West Virginia, the central site at Berwick, Kansas and the western site at Mt. Aukum, California. These sites are provided with emergence no-break power equipment and living accommodations for GSA operating

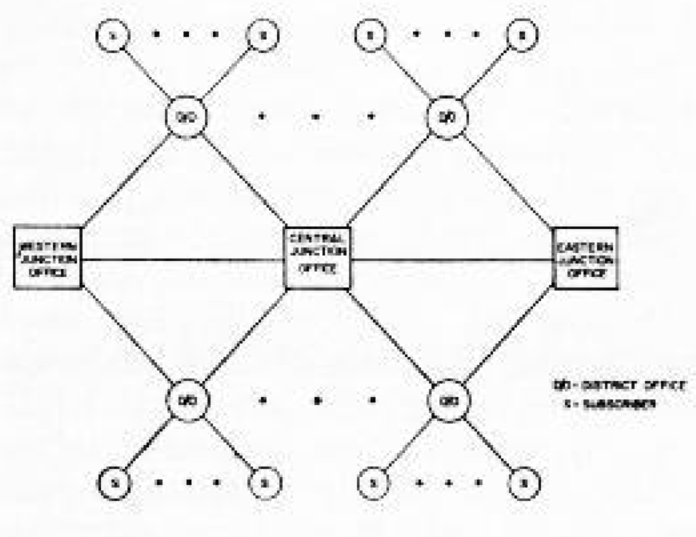

Figure 2. Interconnection of Junction Office with District Office and Subscriber

personnel. They are located outside prime target areas and are specially constructed to minimize radiation exposure to personnel and equipment.

Subscribers gain access to the CSN by means of D/Os. Figure 2 shows the central J/O and a representative group of D/Os and subscribers. Subscribers gain access to the MSCs via the CSN. However direct connection of subscribers to the MSCs is permitted. An example of this is a dedicated wideband subscriber.

Message Switching Center

The Message Switching Centers serve subscribers via the CSN, providing them with the capabilities of book message transmission, code and speed conversion, and deferred delivery. The MSCs also serve as the interconnection points between the ARS and other communications networks, and perform the ancillary functions necessary in a message switching system.

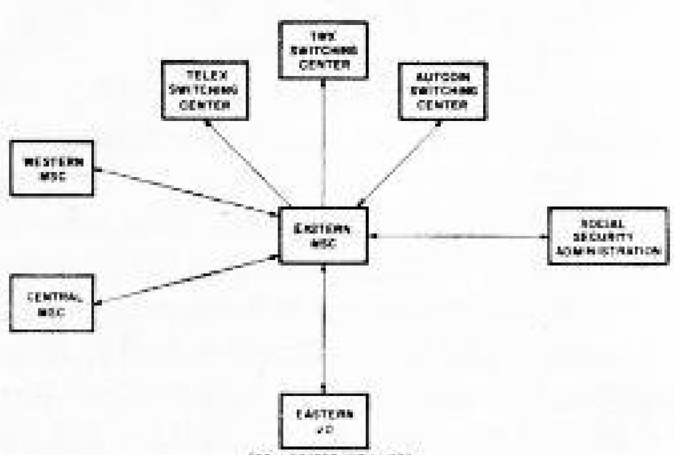

Figure 3. Interconnections for a Typical Message Switching Center

Figure 3 illustrates the interconnections for a typical Message Switching Center, the Eastern MSC. Two-way communication is indicated between this Eastern MSC and each of the other two MSCs, an AUTODIN Switching Center, and the co-located junction office. A special dedicated full-duplex 2400-bit per second connection to the Social Security Administration located in Baltimore is also provided at this MSC and at the Central MSC. Outgoing-only trunks to nearby Telex and TWX switching centers provide refile capability into these networks. Refile into Western Union's public message system is also possible. This capability is provided as a manual refile by means of Model 35 ASR teleprinters located in strategically placed Western Union Public Message Offices.

District and Junction Offices

Common control equipment adequate to provide an overall 1-percent grade of service is provided in both junction and district offices. It is shared by both the (broadband) wideband and narrowband switching portions of each office. The common control equipment in the J/Os is more sophisticated than that in D/Os. Figures 4 and 5 show, respectively, the message flow through the D/O and J/O. The J/Os perform the function of long haul tandem switching, analogous to toll-center switching in a telephone network. In addition, these J/Os are connected by direct ties (trunks) to their respective collocated message switches. The D/Os, with their less complex common control equipment, are necessary to concentrate the relatively light subscriber line traffic for more economical trunk usage, and to permit flexible connections of these trunks to any line. They also serve, by means of link circuits, to make the necessary connections for local calls.

The additional capabilities of the common control equipment at each J/O permit the examination of a number of alternate routes to find suitable paths within the network to handle overflow traffic. In addition, the common control at a J/O monitors the setting up of the connection all the way to the termination D/O or MSC.

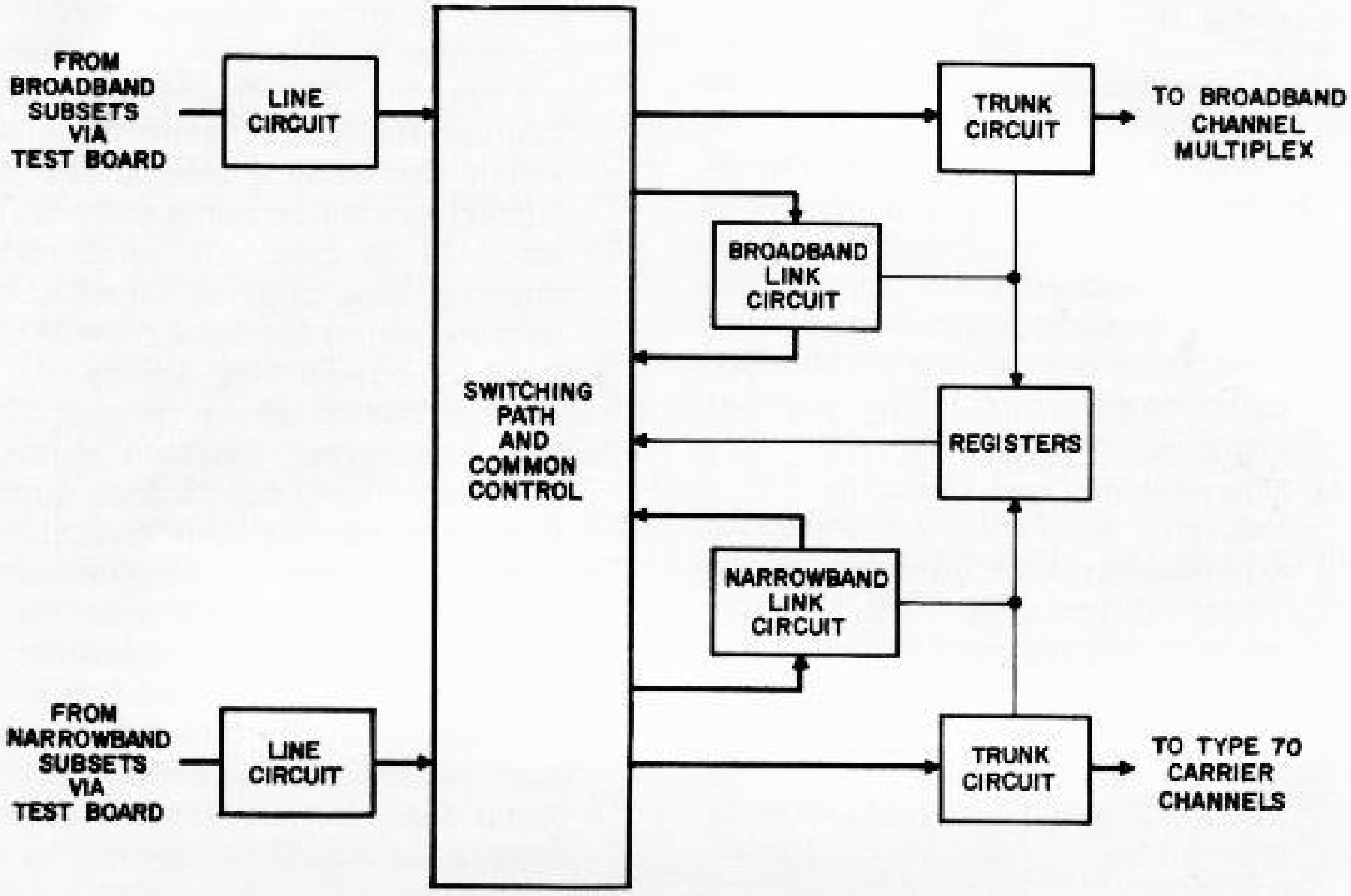

Figure 4. Message Flow Through District Office

Should the connection fail to be set up correctly, because of abnormal conditions in the transmission network or other reasons, the J/O attempts the call several times, each time over an alternate route. All available routes are tried in order to get the call through to its destination. These operations are carried on at high speed by electronic circuitry without the need for any re-initiation by the subscriber.

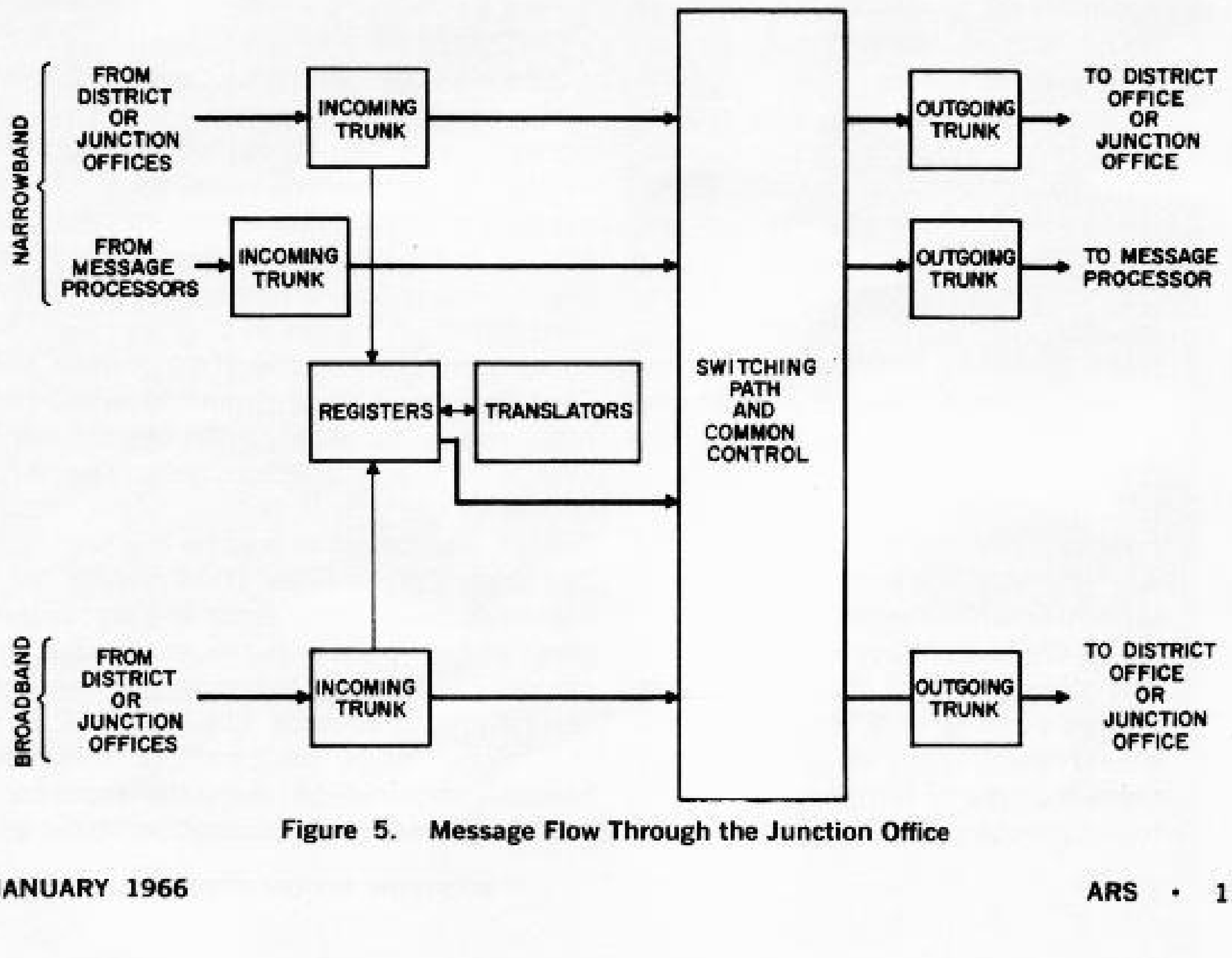

Figure 5. Message Flow Through the Junction Office

Special Features of CSN Design

The CSN equipment has been designed and manufactured by the Federal Laboratories of IT&T. The special features of the design are:

- ***Solid State Circuits***
  The CSN is composed principally of solid state electronic switching circuits; cross points in the matrices are glass-enclosed reed relays.
- ***Expandability and Flexibility***
  Particular emphasis was placed on expandability and flexibility in the design of the CSN. Plug-in matrix modules are employed for the switching arrays and most other circuitry. The wiring changes needed for expansion within the common controls are minimized by providing independently-wired sub-racks that are interconnected by means of plug-in cables. Inter-bay wiring is also accomplished by means of plug-in cables so that additional racks can be added at minimum cost and effort as the office expands. The design also allows relatively easy modification of the offices to incorporate additional capabilities, as described in more detail later in this article.
- ***Message Protection***
  In order to insure message protection, an answerback checking capability is included in the design of the switching offices. The sending subscriber initiates a WRU sequence both before and after message transmission. A confirming "Answerback" from the called subscriber is received and recorded at the beginning and end of the message, insuring that the connection was good both before and after the message transmission, and that the desired party was reached. The answerback checking is performed in the sending D/O.
- ***Many Classes of Service***
  The offices also are instrumented for a large number of different "classes of service." Class of Service indicates the type of terminal equipment to assure compatibility of calling and called outstations. Assignments of subscriber lines to a class of service are programmable by means of plug boards. This allows great flexibility within the CSN. It also allows for subscribers with a community of interest to be given the same class marking, thus creating, in effect, a network within the total network.
- ***Pre-Programmed Plug Boards***
  Reconfiguration of the network (for class of service, alternate routing, or other options) can be done quickly in emergency or other critical situations by means of pre-programmed plug boards. As many of these as are needed can be prepared in advance and held in readiness. A new board can be installed in less than one minute's time.
- ***Status Indicators***
  Both J/Os and D/Os are equipped with status indicators for all major units of equipment. Failures of equipment to set up connections are displayed on a trouble indicator panel. Also, a comprehensive system of audible and visual alarms continuously monitor the switching system equipment.

Components of MSC

The Message Switching Center provides the necessary computation, data storage, control, and input/output capabilities needed to perform the required ARS message switching functions. The heart of the MSC is the UNIVAC 418 Real Time Processor. Figure 6 is a photograph of a 418 installation; it shows the processor, the console subsystem, the 1004 Printer and Card Processor, the magnetic tape subsystem, and a number of Communications Line Terminal (CLT) cabinets. The 418 Processor controls the computation, Input-Output, and storage tasks for the Message Switching Center. The 1004 serves as a high speed printer for error and status logging, while the drum is the in-transit storage device. The tape transports contain the several journal records. The DLT, CLT, and Multiplexer units perform the interface function required between the processor and the several communication lines.

Figure 7 is a block diagram of the hardware of the MSC, showing the interconnection of the equipments. Exact quantities of each peripheral unit, connected to the central processor are indicated. The software of the MSC constitutes the computer programs, operation manuals, training and maintenance manuals and test procedures.

The hardware and software complements for each of the three MSCs are essentially the same. The chief difference is in the number of units of communication line terminal (CLT) equipment. This number is determined by the trunking requirements between each MSC and its collocated J/O. Thus, the make up of each complement (1) permits any single MSC to handle all of the network message switching tasks during periods of light traffic, (2) allows any one MSC to serve as a back-up to the other two during maintenance periods, (3) results in efficiencies in operation and programming and (4) simplifies personnel training.

The major capabilities of the MSC's include:

- Book message delivery
- Speed and code conversion
- Deferred delivery
- Interconnection to foreign networks
- Message accounting and analysis

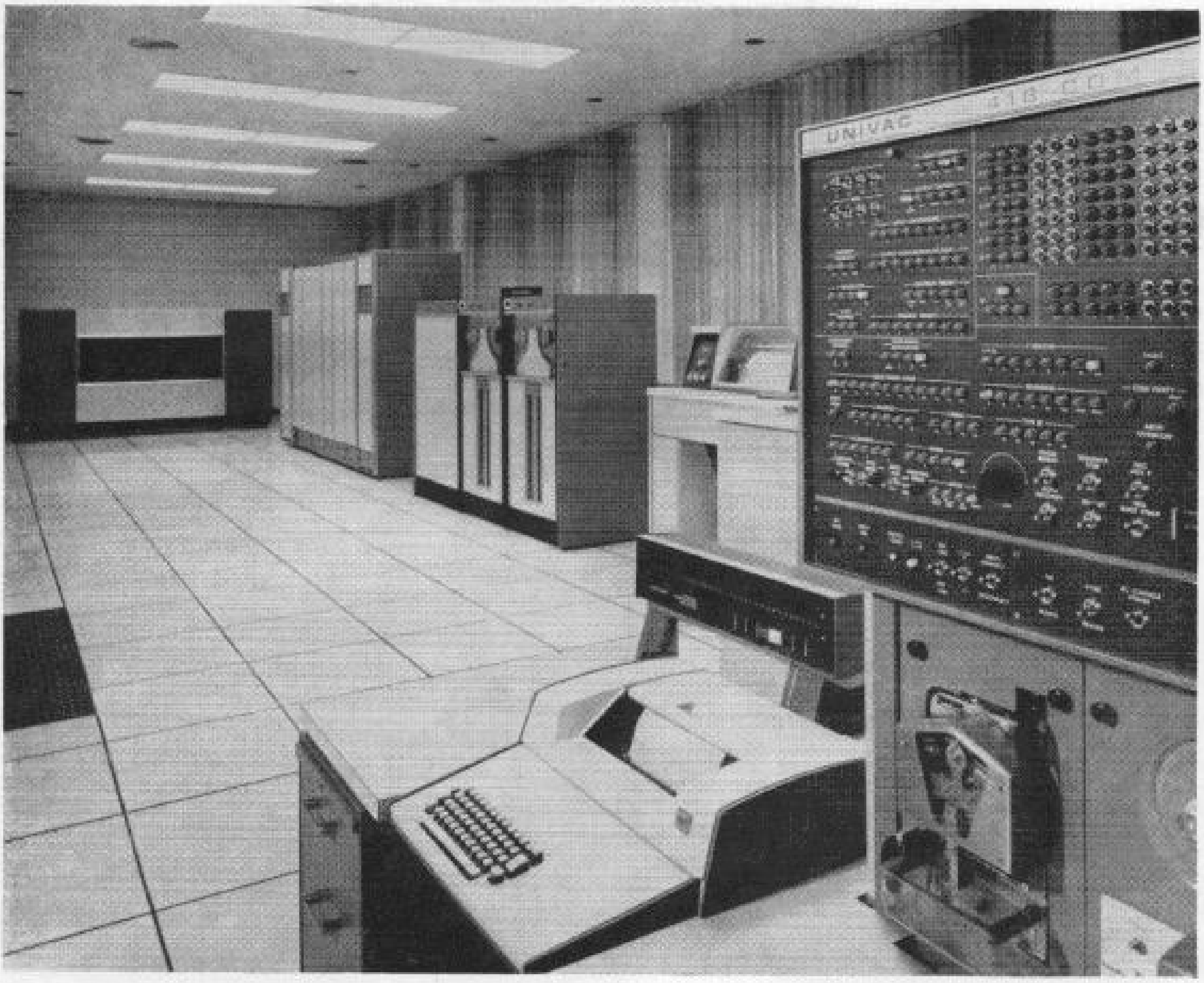

Figure 6. Typical Message Switching Center

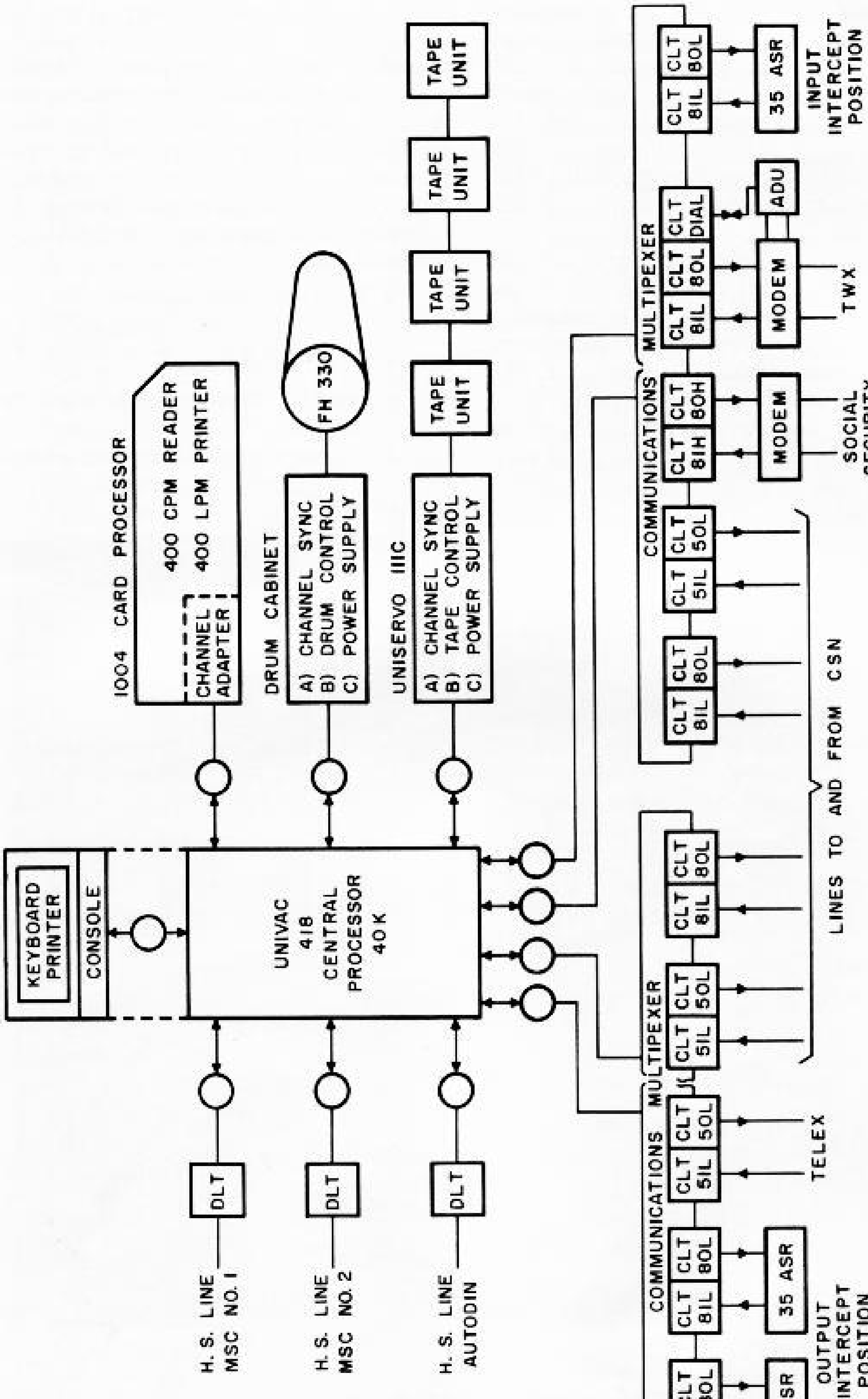

Figure 7. Block Diagram of Interconnections of Components in Message Switching Center

Operation of ARS

The MSC receives traffic addressed to it via the CSN as does an ordinary teleprinter subscriber. After the connection is set-up, the MSC delivers its answerback to the sender, receives and stores the message, again delivers its answerback, and finally effects a disconnect. The processor then proceeds to call, via the CSN, the one or more addresses and make delivery to them. As before, the answerback checks are made both before and after the transmission. The processor makes the necessary speed, code, and format conversions required by each addressee. It also performs necessary journalling, error detection, validation, supervisory and retrieval services as required.

An outline of the operation of the system follows in a description of the types of calls made in the system.

Types of Calls

Calls made within the Circuit Switch Network (CSN) may be classified as either broadband or narrowband in nature. For communication within the CSN, the narrowband mode of operation is used. This type of transmission does not exceed 75 baud for Baudot machines or 110 baud for ASCII machines, therefore it is considered to be narrowband. Since the point of separation between wideband and narrowband transmission for the system has been chosen as 150 baud, facsimile, voice and high speed data transmissions are referred to as wideband or broadband. These transmissions will use rates from 150 baud up to a maximum of 36 kilobits per second.

a) **Narrowband Call Between Subscribers in Same (DO)**
A subscriber establishes a connection to another subscriber by requesting a connection to the district office. If a line is available, a connection is made to the control equipment. Connection to a district office provides signaling which allows the calling subscriber to proceed with the desired subscriber's address code. Comparisons are made at the district office to verify the compatibility of the called and calling machines. After verification and seizure of the called subscriber's line and equipment, the district office transmits the "Who Are You" challenge, to which the called subscriber equipment automatically replies with the programmed "Answer-Back."

b) **Narrowband Call to a Subscriber in a Distant District Office via an Alternate Junction Office**
This type of call starts with the same initial steps given in the previous call (a). Beyond these steps, which established the connection to the originating district office, the call attempt is made to the preferred junction office which normally serves both subscribers. If the call path from this junction to the final district is busy, the call is passed through the preferred office to a second or alternate junction office.

c) **Narrowband Call to an MSC**
The process of setting up the district subscriber line to the junction office is as follows: The calling subscriber forwards an MSC address code, and a junction office trunk is seized. Class of service information is then sent via the trunk and stored at the junction office. Assuming that the addressed MSC is directly connected to this junction office, common controls there seize a trunk connected to the MSC.

d) **Narrowband Call from MSC**
When an MSC operator places a call to a subscriber through the co-located junction and district offices, a connection to the junction office equipment signals the MSC that such a connection has been established. Recognition of this type of call and the resulting junction office signaling, is followed by MSC to junction signaling of subscribers address information.

A more detailed description of these calls will be published in a subsequent article on the Circuit Switch Network, which will appear in the April 1966 issue of the Technical Review.

Computer Programs

The computer programs for the MSC consist of an Executive Program, an Operational Program, a Utility Program, and a Facility Program. The four programs are closely inter-related in function.

The Executive Program controls and sequences the Operational and Facility Programs and the major portions of the Utility Program. The Operational Program, working under executive control performs the real time message processing. The Utility Program performs general data handling operations such as printing tapes and assembling programs. The Facility Program provides "system assurance"; it creates test message data, furnishes that data to the Operational Program and records and reduces the test results. Thus, it is an exerciser of the other three programs.

The Operational Program performs the on-line message handling functions under executive control as described above. The Executive Program may remain functional during the time that the MSC is not responsible for switching messages. Upon supervisory request it may call from tape and initiate programs of the Utility Program. It controls the various Utility Programs operating concurrently with any other portion of the system.

The Facility Program is a specialized set of software tools designed to exercise the Operational Program for testing purposes. The Facility Program consists of input message tape generation, operational interface and report generation routines. The functions are under control of the Executive Program in testing the operational routines when the MSC is not responsible for on-line switching of messages.

The Executive Program also reacts to the call of the computer operator, and in conjunction with the Operational Program, restores the MSC to a message-switching condition. The normal Start-up procedure, or the more extraordinary Recovery/Start-over programs, are the means by which this is accomplished.

An occasionally-used mode of MSC operation involves concurrent operation of the Operational Program with a portion of the Utility Program. Use of this mode is usually restricted to periods of light message traffic. In this mode, the Executive Program gives first priority to the Operational Program by sequencing its outstanding tasks and I/O requests ahead of the corresponding utility tasks and I/O requests. The utility routines occupy an overlay area in core at this time.

The total program package occupies about 40,000 words of core storage. The UNIVAC 418 processor has a capacity of over 65,000 words, allowing for considerable future program expansion.

Terminal Equipments

Terminal equipments in ARS may be narrowband or broadband:

Narrowband

—if they operate at data rates of 150 bits per second or less, and

Wideband

—if they operate at data rates higher than 150 bits per second.

The most common narrowband terminal units used in ARS are teleprinters. Model 33 or 35 ASR units are used for subscribers who require ASCII code, while Model 28 or 32 units serve Baudot code subscribers. Low - speed punched card and paper tape terminals can also be used as narrowband ARS terminal equipment. Wideband subscribers of ARS may employ any known terminal device which will operate within 48 kc bandwidth. Of course, network signaling standards must be observed. Thus, terminal devices employing such media as high speed punched cards, paper tape, hard copy, magnetic tape are readily accommodated. Voice, facsimile and slow-scan video terminals can also be handled.

Broadband Switching Capabilities

Broadband switching capability is achieved in the wideband portion of the CSN, in conjunction with appropriate wideband facilities. ARS provides a high grade, data-voice transmission network within the system. It also provides a time measured service to its agency customers on a call-up basis. Users of facsimile, high speed data terminals or data processing machines may establish voice or automatically coordinated connections to send and receive data via the CSN. Voice instruments establish the initial connection between stations, provide voice communication, and coordinate the subsequent use of the communication path for transmission of high speed data and/or facsimile. This system allows for selective switching between agency customers; consequently, customers are billed only for the line time used. Initially, the system is capable of switching circuits of 4-, 8-, 16- or 48 kc bandwidth on a four wire basis. With the addition of special switching matrices, the offices will be able to switch even higher bandwidths.

Local circuits will be extended to subscribers on a four-wire basis. These circuits will be engineered for the specific bandwidth requirements of the agency customer. Automatic safeguards will be included to insure that non-compatible subscribers will not be connected. Suitable indications of unsuccessful calls will also be provided.

Additional Capabilities

The ARS hardware and software are modular in design so that expansion, or addition of new capabilities is easy. For instance, new message switching and circuit switching services, or new types of terminal equipment can be readily added. Specific additional capabilities include:

- Extended Geographic Coverage
- Greater Traffic Capacity
- Conference and Broadcast Capabilities
- Hot/Line Services
- Abbreviated Keying
- Touch-tone 4-wire Subsets
- Data File Storage and Retrieval
- Real Time Computer Inquiry
- Computer-to-Computer Transmission
- Automatic Terminal Equipment Control
- Special Trunks for High Volume Users
- Facsimile and Other High Speed Terminals

Acknowledgements

The author wishes to acknowledge gratitude to Mr. B. Rider for his guidance and direction in assembling the information for this article—and to Mr. R. H. Leonard and his staff who were responsible for the system design of ARS.

DONALD E. CARRUTH, Director Computer Systems in the Government Communications Systems Department, is responsible for the hardware and software aspects of the computer-controlled communications systems produced for government agencies. Previously, he served as Program Manager for the Advanced Record System.

Prior to joining Western Union in 1964, Mr. Carruth was Manager of the Digital Command Department at Litton Industries. He was responsible for the marketing and engineering activities related to real-time computer systems.

His managerial and technical experience in communications has involved both message switching systems and ground-to-satellite radio links controlled by computers.

Mr. Carruth received a BSEE degree from the University of Maryland in 1957.

form-feed message delivery system

—John R. Cowan

The USAF Form-Feed Message Delivery System was developed by Western Union for use in the Air Force Communications Center at the Pentagon in Washington, D. C. Many messages received in this Communications Center require distribution to more than one addressee. The Form-Feed Message Delivery System is used to automate the in-office handling of these messages and speed their delivery to the recipient.

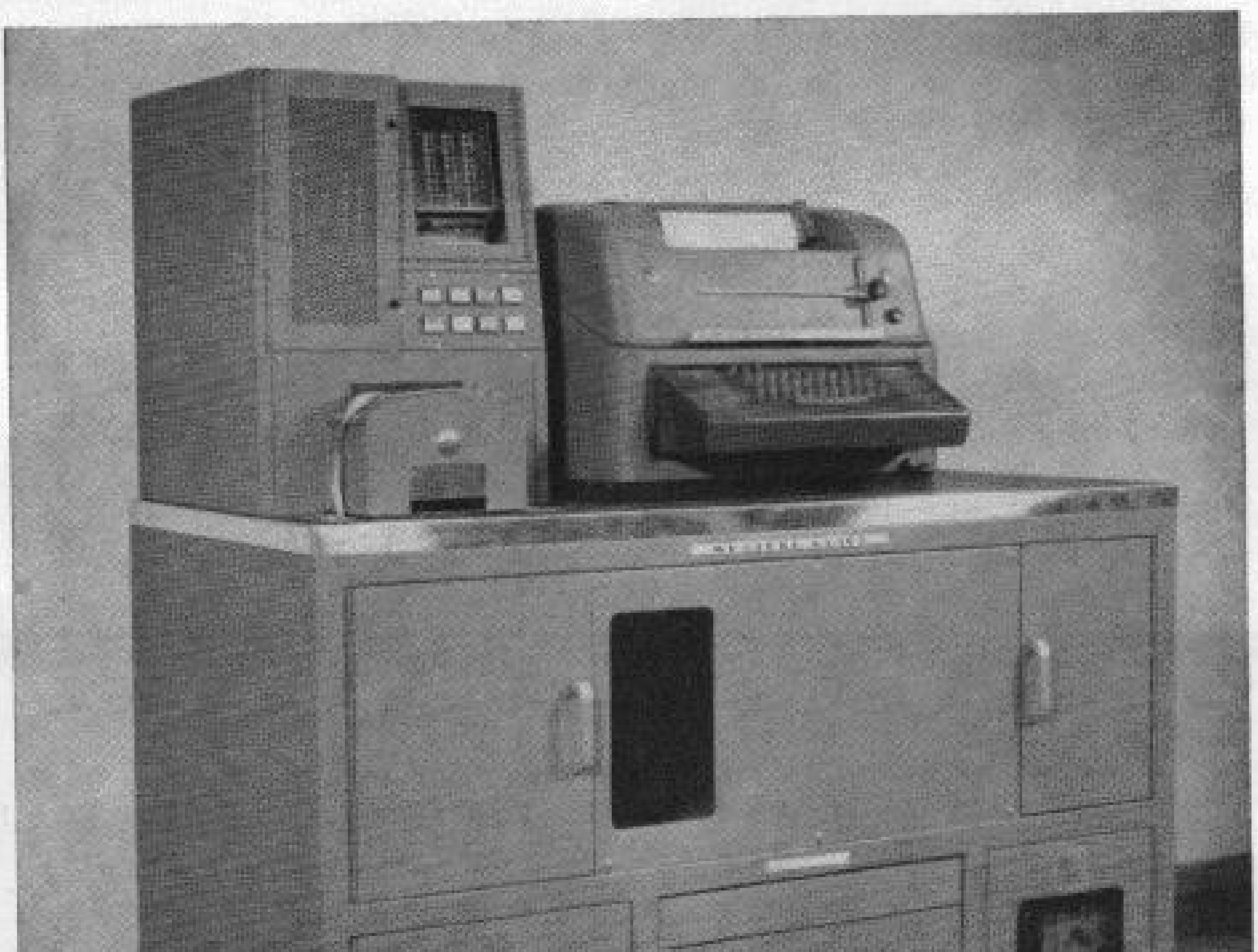

Figure 1. Operating Table for Form Feed Message Delivery System

Problems on Delivery

Prior to installation of the Form-Feed Message Delivery System, messages were received on printed-perforated tape, and retransmitted into a teleprinter equipped with a roll of multilith paper. The messages were manually watched as they were transcribed to the multilith to insure that no more than 20 lines of text were printed within certain boundaries of the roll of paper. When 20 lines were printed, the paper was torn out of the teleprinter as a sheet. Heading and ending information was manually placed on each sheet. The sheet was then given to the reproduction staff for compiling the necessary copies for distribution. This handling between the time of receipt of the message in the Communications Center and its delivery to the reproduction staff caused unacceptable delay in getting the information to its recipients.

In order to reduce message processing time and to automate the message delivery system, Western Union developed a system which would transmit a preset maximum number of lines of text to a fan-fold, perforated continuous sheet of multilith paper. These perforations permit the continuous sheet to be separated into separate pages. A message received in this manner could then be reproduced by placing these individual, multilith pages directly in the reproducing machine with no manual cutting, editing, pasting or other such handling of the paper. The resultant efficiency reduces the number of personnel required to handle the messages and also reduces the time between receipt of the message in the Communications Center and its final reproduction and delivery.

Components

The USAF Form-Feed Message Delivery System is comprised of an Operating Table and a special Teleprinter Console. The Operating Table transmits to, and controls the Teleprinter Console. The Teleprinter Console houses the receiving teleprinter and the mechanism which feeds out the individual sheets of multilith paper.

a) Operating Table

This Operating Table comprises an LBXD-2 Transmitter-Distributor, an Automatic Message Numbering Machine, a KSR Monitor Teleprinter and a Card Chassis, as illustrated in Figure 1. The Card Chassis contains forty-three Western Union standard transistorized logic cards, the low-voltage power supplies and associated transmitting relays. The logic circuits perform all the functions required to read and control the message tape and to control what is transmitted to the line.

b) Teleprinter Console

Teleprinter Console 12177-A, shown in Figure 2, is the receiving terminal of the system. The console houses a 100 wpm Model 28 Teleprinter, a Stunt Box, a "Form-Feed" mechanism, and a Wiring Cabinet. A box of perforated fan-fold, standard-size sheets of multilith paper is stored in the bottom of the console and are fed through the back of the teleprinter to the sprocket-fed platen. The Stunt Box is coded so that a pair of contacts close when the "Form-Feed" sequence, [consisting of four consecutive carriage-return characters (CR)], is received from the Operating Table. The closing of the contacts causes a rotary solenoid to energize and activate the "Form-Feed" mechanism, which places a new sheet of paper in the teleprinter.

Figure 2. Teleprinter Console

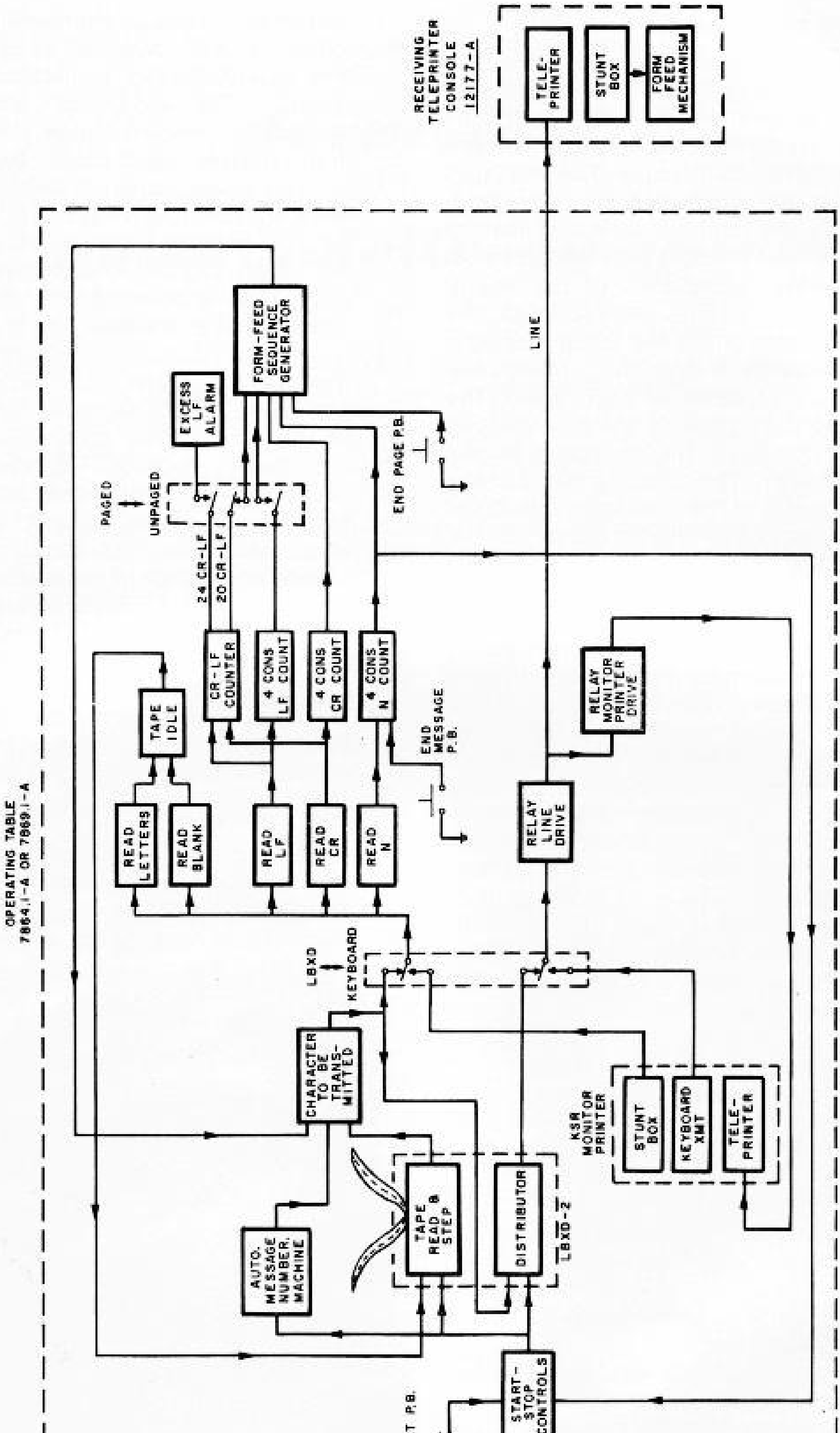

Figure 2. Block Diagram of Form-Feed Message Delivery System

Operation

A block diagram of the system operation is shown in Figure 3. When the perforated tape is placed in the LBXD-2 Transmitter-Distributor, it reads and "idles past" all LETTERS and BLANK characters and stops on the first character of the message. When the CONNECT pushbutton is pressed, the table functions begin with a message number being transmitted from the Automatic Message Numbering Machine. After the message number is completed, the message on the tape is transmitted to the line. The reading of four consecutive N characters (End-of-Message sequence) in the tape causes the Operating Table to terminate transmission and reset the table circuitry.

The automatic numbering machine precedes each message with a sequential number. This is a safeguard which precludes the possibility of loosing a message due to line or equipment failures. Four characters can be easily coded to precede the number as desired by the customer.

The tape must be stopped at various times during message transmission in order to automatically transmit the "Form-Feed" sequence which consists of four consecutive CRs. This sequence causes the receiving Teleprinter Console to feed out a new sheet of multilith paper. The conditions which will cause the automatic transmission of four consecutive CRs are as follows:

a) Transmission of four consecutive LFs, if the Operating Table is in the "PAGED" mode. (Four consecutive LFs indicate a page number will follow.)

b) Transmission of twenty lines of the message, if the Operating Table is in the "UNPAGED" mode.

c) Transmission of four consecutive Ns (End-of-Message sequence.)

The four Line Feed (LF) characters and four End-of-Message (N) characters are read by means of independent solid state shift registers. The twenty Line Feed characters are read by a 5-stage binary counter.

After the automatic transmission of four consecutive CRs, there is a four second pause before message transmission is allowed to resume. This pause prevents the transmission of characters while the receiving teleprinter feeds out a new sheet of multilith paper.

By means of a manual switch the table can be set up to operate in either the PAGED or UNPAGED mode.

a) PAGED Mode

The Operating Table is placed in the "PAGED" mode of operation if the messages which are to be transmitted are in such a form that after twenty-four lines or less of message text, a series of four or more LF characters occur which are followed by a page number. In the old system, the four or more consecutive LFs provided a space in which to separate the continuous roll of multilith paper to form individual pages of the message with the page number at the top of each sheet. In the new USAF Delivery System, under normal operating conditions, the number of lines of message text which is transmitted to one page of multilith paper will vary from one to twenty-four lines, depending on where the four consecutive LFs and page designation occur. If twenty-four lines of text are transmitted on one page before transmission of four or more consecutive LFs, then transmission will be stopped and an alarm sounded. Transmission will be resumed after the "END PAGE" pushbutton is pressed. This silences the alarm and automatically transmits four consecutive CRs.

b) UNPAGED Mode

The Operating Table is placed in the "UNPAGED" mode of operation if the messages which are to be transmitted have no page separation or page numbering as mentioned above. In this case the number of lines of message text which are transmitted to one page of multilith paper will always be twenty lines with the possible exception of the last page.

Excess Line Feeds are deleted from transmission. This insures an even twenty lines of text on each page.

Flexibility of System

Eight systems of the original version were put into operation for the Air Force and six new systems will be installed in the Joint Chiefs of Staff Communications Center. The Form Feed Message Delivery System has proven to be a tremendous asset in expediting the delivery of Communications Center messages. Further, the flexibility of the equipment lends itself to almost any type of installation.

A new, more advanced version of the system has just been engineered for general Communications Center use. This new system incorporates all the features available in the previous system and in addition provides the following:

a) Line Signal adaptation to either make-break (neutral) signals or polar signals.

b) "PAGED" messages can be sent in the "UNPAGED" mode. When this option is used, the page designations appearing in the message tape will be automatically deleted from the final received copy. Each page will contain an equal number of 20 lines of information. The last page may contain less than 20 lines.

c) Text "overlining" is prevented by insuring that a transmitted carriage return character is followed by a Line Feed Character.

d) A tape reperforator is located at the Operating Table to provide a continuous perforated tape of all transmitted messages. (This item is included at the customer's option.) The tape may be used if re-runs of messages are required.

Unique Feature

The unique feature of this system is the absence of any control wires between the Operating Table and the remote Receiving Teleprinter. The Receiving Teleprinter is controlled entirely by means of characters transmitted over the one sending line.

An "END OF MESSAGE" pushbutton is provided at the Operating Table which will automatically transmit the four consecutive CRs and disconnect the Operating Table from the line if a message is incomplete.

A "KBD-IN" switch is provided which allows transmission to the line to originate from the KSR Monitor Printer keyboard. Characters which are transmitted from the keyboard are recognized and counted where necessary. The keyboard is primarily used for correcting errors in the tape.

Figure 4. Advanced Version of Operating Table

JOHN COWAN was a Senior Project Engineer in the Information Systems and Services Department. He joined Western Union in June, 1960 and had been engaged primarily in the design of Solid-State Switching Systems. Some of the projects he had been associated with are EDAC, TELTEX, Optical Character Reader, On-Line Translator, and various Reperforator Switching Systems.

Mr. Cowan was a Radio Technician in the U. S. Army Signal Corps in 1957-58 and received his BEE degree from Pratt Institute in 1960.

Mr. Cowan is no longer employed by Western Union. His work on the U.S.A.F. Message Delivery System is being continued by his supervisor, Mr. R. K. Lewis, Jr.

western union technical review

—Mary C. Killilea

Our Company's technical publication serves the Federal Government in documenting for it the growth of Western Union in the field of record and voice telecommunications. It also bridges the transition of our Company's growth from this field of telecommunications, to its future role in the Information Revolution.

The Western Union TECHNICAL REVIEW enters its 20th volume with this issue, January 1966. It has grown from an in-company publication to one of world-wide readership. This issue will be mailed to subscribers in 19 countries outside the United States. These readers are subscribers who request our publication because of the educational material it publishes in the areas of our public and private message services.

Originally, the publication was written for and distributed to management, supervisory and engineering personnel at headquarters and in the field. A few copies were distributed to transportation people because of our interests in their rights-of-way. The circulation of the first issue, Vol. 1, No. 1, July 1947—was 2047 copies. The anticipated circulation of this issue, Vol. 20, No. 1, January 1966 is about 10,000 copies. Our audited readership has grown from approximately 2,000 to over 8,000 copies—a 400 percent increase.

Our technical publication is basically printed for our Western Union personnel, for the purpose of presenting technological advances and their application to the broad field of communications. It is published quarterly by the Information Systems and Services Department in January, April, July and October. Because of its educational value, about 10 percent of the circulation is distributed to universities and colleges, to technical libraries in related companies in industry and to many agencies of the Federal Government. Because of the interest of many of Western Union's customers in our public and private services, about 8 percent of our circulation is also distributed to our customers at a paid subscription rate. These paid subscribers are interested in our technical publication, so that they, too, may be educated in our technological advances and their application to our services. The growth in our paid subscriptions has increased over 200 percent since 1962.

The success and the growth of Western Union's TECHNICAL REVIEW is best illustrated in the number of "Letters to the Editor" received daily, from our readership—and to the recognition of Western Union's management in our capability to "Serve."

The Editor

autodin —conus expansion

—Harold F. Caley and

Fred W. Schultz

The AUTODIN system, designed and developed by Western Union with the support of RCA, IBM and many other electronic companies, was made operational in early 1962.[1 2 3] Since then, many new features and capabilities have been added under the direction of the Defense Communications Agency (DCA). The expansion of the domestic portion of the AUTODIN system, AUTODIN-CONUS, will be described in this article. The expansion of the overseas portion of the AUTODIN System will be described in another article on page 34 of this January 1966 issue. Some of the management techniques employed to insure the technical adequacy and the timely implementation of the overall system will be included.

AUTODIN-CONUS

AUTODIN is the world's largest computer-controlled communications system operated for and managed by the DCA. It provides both direct user-to-user and store-and-forward communications service for the Department of Defense and other government agencies.

The original AUTODIN network consisted of five switching centers each serving a group of tributaries and interconnected by high speed trunks or intra- and inter-area exchange of traffic. Figure 1 illustrates the initial configuration of the AUTODIN-CONUS system.

This system was the result of the original COMLOGNET and subsequent AF DATACOM system. It is a replacement for several manual data networks.

Some of the operational characteristics and services provided by the system are:

- Direct user-to-user circuit switching,
- Store-and-forward message switching,
- Compatibility of transmission media, terminal equipment, codes, speeds and formats,
- Automatic error detection and correction,
- Message processing by precedence,
- Maximum security protection,
- Choice of service modes to satisfy subscriber requirements,
- Automatic alternate routing,
- Message accounting and protection,
- Automatic processing of single and multiple-address messages.

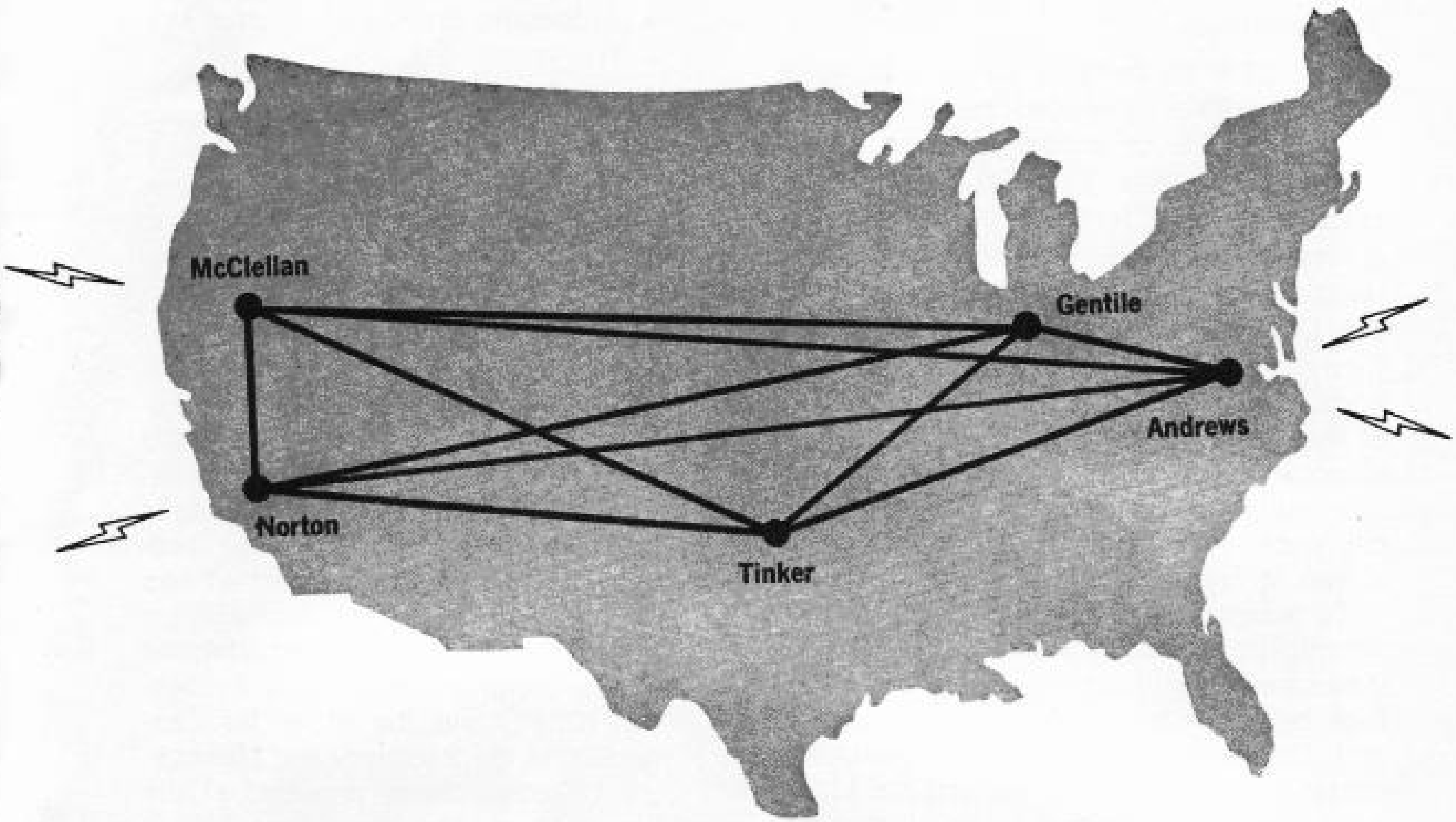

Figure 1. Initial AUTODIN Configuration

DCA Study

In its initial configuration, the automatic portion of the AUTODIN system was equipped to accommodate a total of 550 tributaries and interconnecting trunks, located within the continental United States. This network of tributaries and trunks was used primarily for the exchange of digital data processed in whole, or in part, by business machines and computers at one or both ends of the line (originator and addressee). Shortly after the activation of the initial network, the system was adopted by DCA as its digital communications network. That agency, in turn, immediately evaluated the capabilities and performance characteristics of the system, compared them with its teletype systems, and late in 1963, obtained approval of a plan to expand the AUTODIN system. Their plan was to provide a capability to absorb all of the record communications traffic generated by the various military departments and agencies into the AUTODIN system, and to inactivate several major teletype networks then in operation. Their plan provided for a number of electronic switching centers at overseas locations, as well as for the expansion of the CONUS portion of the system then in operation. The contract for the overseas centers was awarded to Western Union in February, 1964.[4]

Western Union's Responsibility

In our role as prime contractor, Western Union has total system responsibility. This means that all changes required for the Expansion and/or the adaptation of new equipment were monitored throughout the development, testing, and implementation phases by Western Union engineers. Intra-system compatability, operator flexibility, maintainability, human factors, and economic considerations were all features that were evaluated and controlled by this means. In exercising these responsibilities, it was necessary for knowledgeable Western Union personnel to participate in the evaluation and selection of technical approaches in the recommendations of new peripheral equipment.

The Expansion

The DCA study revealed a need for a system within the continental United States capable of accommodating in excess of 2,000 lines. To satisfy this requirement and allow for normal growth of a system of this type, Western Union is expanding the line terminating capacity, of the CONUS system from its initial configuration of 550 lines to a total of 2,700 lines. This is being done by providing each of the original five centers with the ability to accommodate 300 lines and by adding four additional centers of 300-line capacity each. The Expanded Configuration is shown in Figure 2.

To accomplish this without declaring a significant portion of the system obsolete, it was necessary to change the basic interface between the communications media and the automatic electronic switching center processors, from the original character storage technique to a bit storage technique and to revise the line servicing procedures. Thus, Bit Buffers Units (BBUs) and Buffer Control Units (BCUs) were added and the Accumulation Distribution Units (ADUs) were modified to accommodate these changes.

Added Features

Additional features were added to improve the system capacity, performance, and operational characteristics and to take advantage of the latest advancement in the state of the art. These added features are:

A. Switching Equipment

1. System Console
   The system console was changed from a display of conditions on all lines simultaneously, to a program-controlled display of one channel at a time. The intermediate storage capability had to be substantially expanded. In order to permit an operator to exercise surveillance, over a larger number of channels, the system console was modified to provide:
   - Channel status information on a one channel-at-a-time basis,
   - Automatic display of various system conditions,
   - Easily operated controls for the required display and reset functions.
   - Considerable expanded capability to accommodate additional indications not provided previously in this program and an improved monitor printer.
2. Analex High Speed Printer
   The Analex High Speed Printer provides a printing capability of 1,000 lines per minute. It is now being installed in the new centers and also is replacing the original printer provided in the existing centers. It has a dual interface capability; one for connection to the transfer channel of the Communication Data Processor (CDP), and the other for connection to the Recovery and Management System being provided at the new centers. The Tape Search Unit provided at the original centers is being modified to permit it to print out on the high speed printer. Thus the speed of operation of the Tape Search Unit is considerably increased.
3. Tape Stations
   The new centers are being equipped with CDC Model 9103 Tape Stations, instead of the tape stations initially provided in the complement of switching centers. These tape stations offer numerous advantages over the previous tape stations. They provide greater packing density, read-after-write, check of both vertical parity for each character and horizontal parity for each record and numerous mechanical and technical improvements which will improve the operational performance.
4. Intermediate Storage Facilities
   The new centers are being equipped with two Librascope magnetic discs memory units called Mass Memory Units (MMUs), which function in the same manner as the drum storage units in the original centers. These units are capable of accommodating 12 million bits of intermedi-

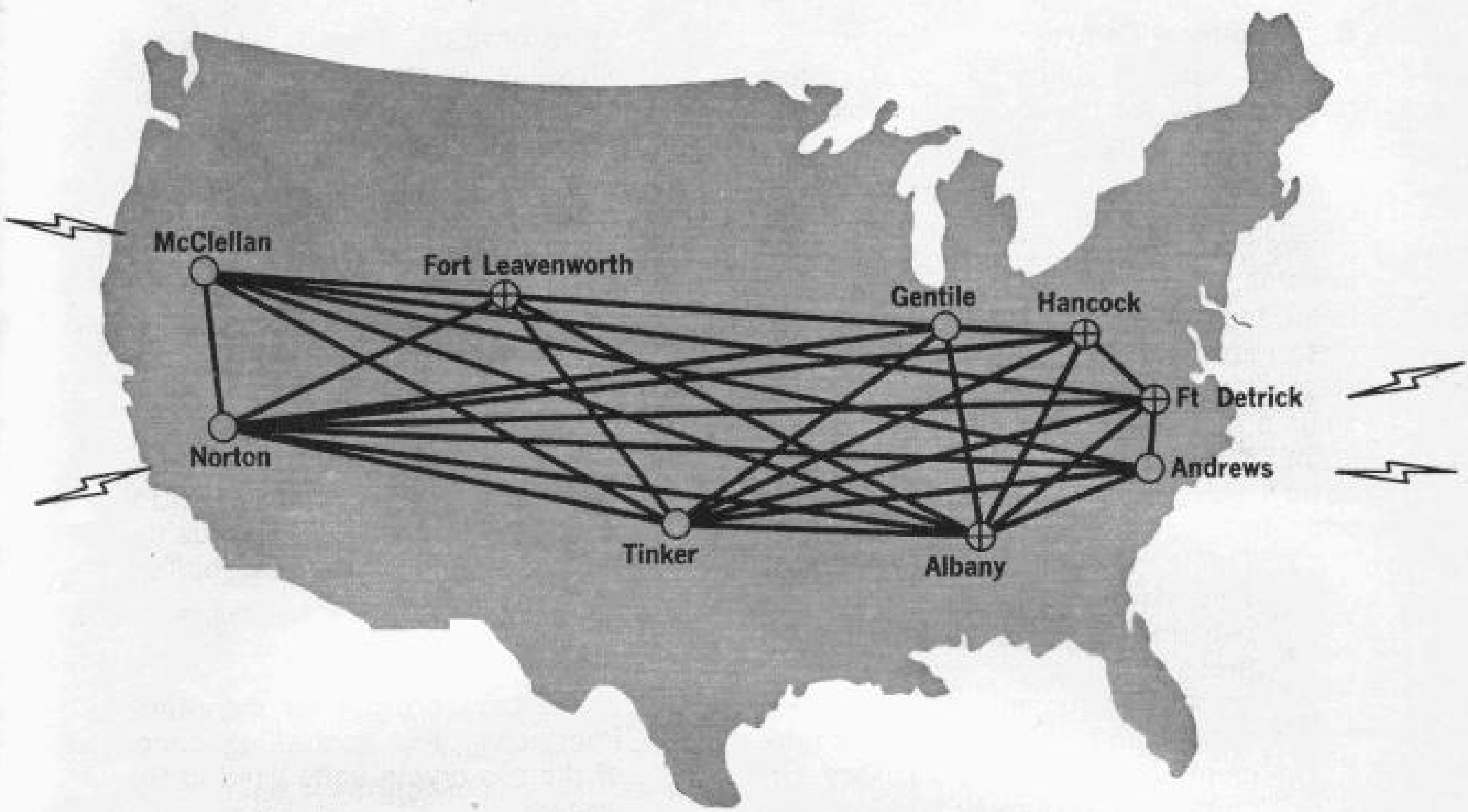

Figure 2. Expanded Configuration

ate storage per unit and they are expandable to double this capacity. At the existing centers, one Mass Memory Unit has been provided to expand the intermediate storage capability of these centers. The possibility of further expanding the intermediate storage capacity of all centers is now being studied.

5. Monitor Printers
   An asynchronous Monitor Printer, provided by Kleinschmidt, is being used in the new centers, in lieu of the Flexowriter printers provided with the original centers. This substitution will increase the printout capability approximately four fold and will reduce maintenance problems considerably. Each of the new centers is being provided with three of these printers and a follow-on order provides for one such printer at each of the original centers.
6. ADU Data Memory Stacks
   All locations have been provided with additional memory stacks to expand the data handling capability of the respective ADUs.
7. Automatic Selection Center
   This feature provides for automatic routing of Circuit Switching Unit (CSU) terminal-originated traffic through the Message Switching Unit (MSU), in all cases where the addressee is not normally served by a CSU. Originally, the originating operator was required to determine the type of terminal serving the originator and select the transmission path accordingly.
8. Recovery and Management System
   An RCA Model 301 Computer is being provided at the new centers to perform the tape search function offline statistical tasks, and ultimately the off-line recoveries. By separate order, the Tape Search Units at the original centers are also being modified to permit greater utilization and flexibility.
9. Software Modifications
   In order to accommodate the modified equipment and the new peripheral devices, it was necessary to completely reaccomplish the software package.

B. Technical Control

While Western Union has total system responsibility for the expansion program, RCA, as the principal subcontractor, has assumed a major role in the engineering, design, development, testing, production, programming and installation of the actual switching center hardware. On the other hand, the requirement for an almost complete redesign of the Tech Control System to meet newly established criteria represents a most significant effort in this program. Some of the areas which required basic redesign and engineering effort, in addition to new installation effort are:

1. Traffic Patching Bay (Red)
   This bay provides the necessary patching facilities for circuits between the message switch and the crypto equipment for alternate routing and replacement of equipment. Miscellaneous auxiliary circuits such as dummy terminations, and spare equipment appearances are present. Circuits are provided for shunt monitoring of the sync and information lines and interruption of the information link by push button control from the crypto control and monitor controls.
2. Clocking Bay (Red)
   This bay provides the line clock (one cycle per bit signal) for clocking send cryptos and the output buffers of the message switch. There is a separate output for each send line. The receive clock for start-stop buffers (16 cycles per bit) is also provided from this bay. The chassis for loss of set detection of the synchronous crypto units are mounted in this bay.
3. Relay Rack
   This rack provides the relays for switching the ADU-Buffer equipment into and out of active communications circuits. When the spare ADU-Buffer equipment is substituted for a failed unit, all patches on the Traffic Patch Bay associated with the unit are preserved when the switch is made. The controls for switching are of the interlocked type and are remoted to a supervisor position. Crypto Set on the message switch circuits is also preserved during the substitution.
4. Power Bay (Red)
   This bay provides the DC power required in the Red area of the Technical Control. This bay provides standby equipment with automatic switching capability. The bay comes equipped with its own power distribution panel.
5. Distribution Frame (Red)
   This frame provides for the interconnection of all Technical Control equipment in the Red area plus the inputs and outputs of the buffers in the message switch.
6. Crypto Control Bays
   (Red and Black)
   These bays provide for mounting, interfacing, and controlling either of the two crypto units used in the system.
7. Crypto Control Console
   (Red and Black)
   This console provides the displays and controls for both the manual and semi-automatic synchronization of the crypto devices. A push button circuit selection is provided so that line signals can be monitored on the red side to determine if crypto set has been achieved. The monitoring device is a character framing and reading unit which is capable of framing on the idle line character, reading certain control characters and constantly checking the parity of the line signals. Means are provided to synchronize the crypto units in groups or in mass. In the event of special crypto synchronization problems, the circuit selection can be utilized to place a teleprinter on the line before the crypto units to talk to the distant end of the circuit.
8. Monitor Console (Red and Black)
   This console provides the central point for the control and supervision in the Tech Control area. Access is provided to all communication circuits by push button, and to all auxiliary communications such

as intercom, base telephone, and inter-center phone. By interrupting the line, a teleprinter associated with the console, can be used to talk to all outstations and centers. DC test equipment such as Bias and Distortion (B&D) meters, pattern generator, oscilliscope, character reader, parity checker and line monitors are mounted in this console. The master alarm displays for the switching center clock, power supplies, bias detectors from the receiving sync adapters and crypto calls, and display for loss of sync are located on this console.

9. Master Clock Bay (Black)
This bay provides the oscillators, count down, and distribution of the timing for all synchronous and asynchronous equipment in the Tech Control, Modem, Crypto and the Message Switch Buffer units. Redundancy is provided in all components of the bay to provide continuous service in the event of internal failure. Means are provided to check each oscillator against each other and against external standards. Complete alarm checkings of all failure detection circuits is also provided.

10. Synchronizing Adapter Bay (Black)
This bay provides the per line equipment which generates a bit clock for each synchronous receiving circuit by sampling the dc output of the Modem and comparing it to a time base from the Master Clock. These Sync Adapters will compensate for up to a 50 percent bias and distortion of the receive bits. A threshold type of distortion indication is available from each Sync Adapter and is remoted to the Monitor Console.

11. Equipment Patching Bay (Black)
This bay provides dc power in the Black area and is identical to the power bays provided in the Red area.

12. Audio Filter Bay (Black)
This bay provides the filters in a shielded enclosure for filtering of all communications channels leaving the Switching Center.

13. Control Filter Bay (Red and Black)
This bay provides the filters and isolators in a shielded enclosure for control, timing and unencrypted circuits that must pass between the red and black areas.

14. Distribution Frame (Black)
This frame provides for the interconnections between Tech Control equipment in the Black area. It is similar to the frame provided in the Red area.

15. Synchronizing Adapter Bay (Red)
This bay provides the per line equipment which generates a bit clock for each synchronous sending circuit by sampling the dc output of the Circuit Switching Unit (CSU) and comparing it to a time base from the Master Clock. A Synchronizer is required on every output line of the CSU since the output will always assume the phase of the new input line, which is connected to the output line.

Expansion of the Technical Controls in the present AESCs to increase the synchronous line capability and to add a large volume of asynchronous (teleprinter) lines to each AESC, requires the following:

- Expansion of existing frames,
- Expansion of patching facilities,
- Expansion of dc power bays,
- Expansion of synchronizing adapter equipment,
- Expansion of crypto control console displays,
- Addition of crypto bays for both types of crypto units,
- Modification of monitor console to house asynchronous test equipment,
- Clocking bay added to provide more send clock capability, and receive (asynchronous) clocking,
- Conformance with recently established security criteria.

New Mode V Teleprinter Operation

The plan for expansion of the CONUS AUTODIN system included a requirement to serve many 60-, 75- and 100 words per minute teleprinter terminals. At the outset of the AUTODIN program, it was considered necessary for the receiving terminal to exercise control over the sending station. This was accomplished by means of a line coordination system which, in addition to providing automatic error detection and correction, also permitted the receiving station to start and stop the sending station. This technique is referred to as Mode I operation. Special terminals were developed to operate in this mode permitting selection of input/output devices, depending upon the type of traffic being handled. This selection permitted the delivery of a message to one or more of the following: card, paper tape, page copy, or magnetic tape.

Additionally, the AUTODIN system was designed to accommodate standard teleprinter input/output without control of the sender or transmitter by the receiver. This method is called Mode II. However, in its original development plan AUTODIN was used for only a few low volume teleprinter users.

At the outset of the Expansion Program, it became obvious that in order to maintain a high degree of operational performance it would be necessary to exercise control over teleprinter input in a manner similar to that exercised over Mode I terminals. To accommodate this requirement, a new Communications Mode now commonly referred to as Mode V is being provided as a third mode of operation in the CONUS System.

To permit this mode of operation, Western Union developed a Control Unit which is being provided at the teleprinter location. This unit operates as an integral part of the teleprinter. The control procedures and interface characteristics are designed to operate in either an encrypted or unencrypted environment on a full duplex basis. The control procedures make use of a special signalling technique which makes the Mode V system transparent to the complete teleprinter character set.

Mode V provides the following facilities:

1) A means for the receiver to start and stop the transmitter.

2) A means for the transmitter to interrogate the receiver and obtain the status of each message transmitted.

3) A means for the transmitter to receive a "reject message" signal from the receiver if the message is incomplete or otherwise not acceptable.

4) A means for detection of facility, cryptographic, or equipment failures.

Two operating conditions are accommodated with Mode V, the standard duplex condition and an emergency condition.

Standard Duplex

The standard condition of operation normally is used. In this condition, the terminating apparatus can send and receive data simultaneously, and as a consequence both legs of the full duplex channel are used for the transmission of control sequences as well as for data. Return control sequences are interspersed with data on the legs. Thus when it is necessary to acknowledge receipt of an inbound message, the outbound message is interrupted in order to send the return control signal. The receive apparatus filters out the control signals so they do not appear on the printed copy of the message being received and acknowledges all the control sequences as required.

Emergency

The emergency condition is for use when only one leg of the full duplex channel is operable, or when equipment failure requires the use of this channel. This Mode is identical to Mode II operation. The control sequences normally used in Mode V are omitted, and transmission proceeds from one message to the next without receipt of acknowledgements. The message format, line code, and line speeds are identical to those used on the line when operating in the normal controlled condition.

Work Progress Charts

Within Western Union, the Expansion Program has involved almost every department of our headquarters and field organization. However, the principal interface between the various Western Union elements and the customer has been through the Government Communications Systems Department, the engineering project manager, and the installations and maintenance groups within the Technical Facilities Department.

Charts were developed to monitor all of the major tasks and sub-tasks in the broad sense. These fell into four major categories, namely; engineering, programming, production, and installation. Separate major task charts are maintained for Western Union and RCA, as a means of clearly defining the responsibilities, and to simplify the reporting procedures. Each of these major tasks was further divided into subtasks to simplify the procedures and permit identification of significant milestones within major tasks. In addition to the management charts mentioned above, PERT-type flow-charts, shown in Figure 3, were developed for the entire job with much of the field implementation charted to the exact number of minutes or hours required for each identifiable field action.

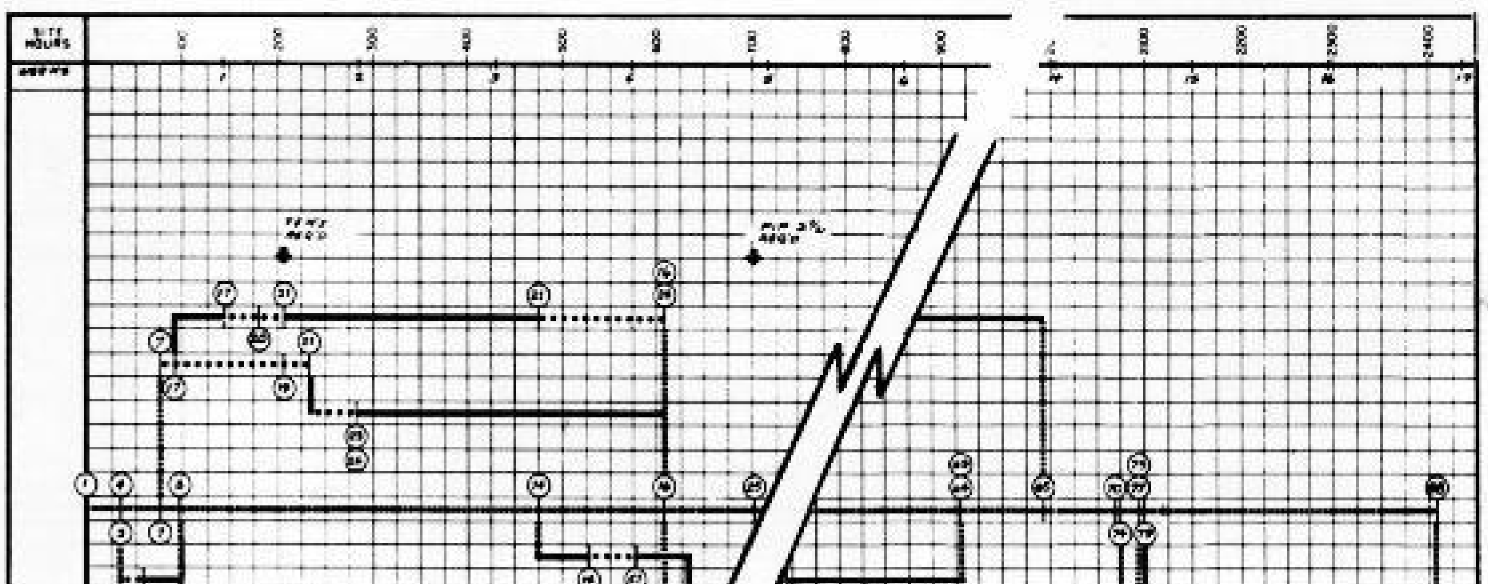

Figure 3. PERT Flow Chart

At the outset of the program, major tasks and subtasks were identified as illustrated in Figure 4. These tasks were assigned to the various activities within the respective departments, or to subcontractors. Reporting procedures were established, monthly reports were published and distributed to all activities, regular meetings were held to examine problem areas and develop courses of action to be followed.

The use of these various management tools aided the individual department heads in their decision making.

Status of Expansion

All the original centers have been modified to the extent that government-provided space and other support facilities have permitted.

In summary, it is our belief that the Expansion Program, when completed, will provide the the Government Agencies with a greatly enhanced system. While the problems have been manifold, the successful implementation of the Program to date has resulted from the cooperative effort of the many contributing elements within Western Union beginning with the Marketing and Contract Management Groups and extending through Engineering and Technical Facilities, Accounting and Finance and Field Divisions. We recognize that the field effort which involved the simultaneous installation of Tech Control, Crypto Facilities, Communications Media and Terminal Facilities represents an unprecedent effort in the annals of Western Union history.

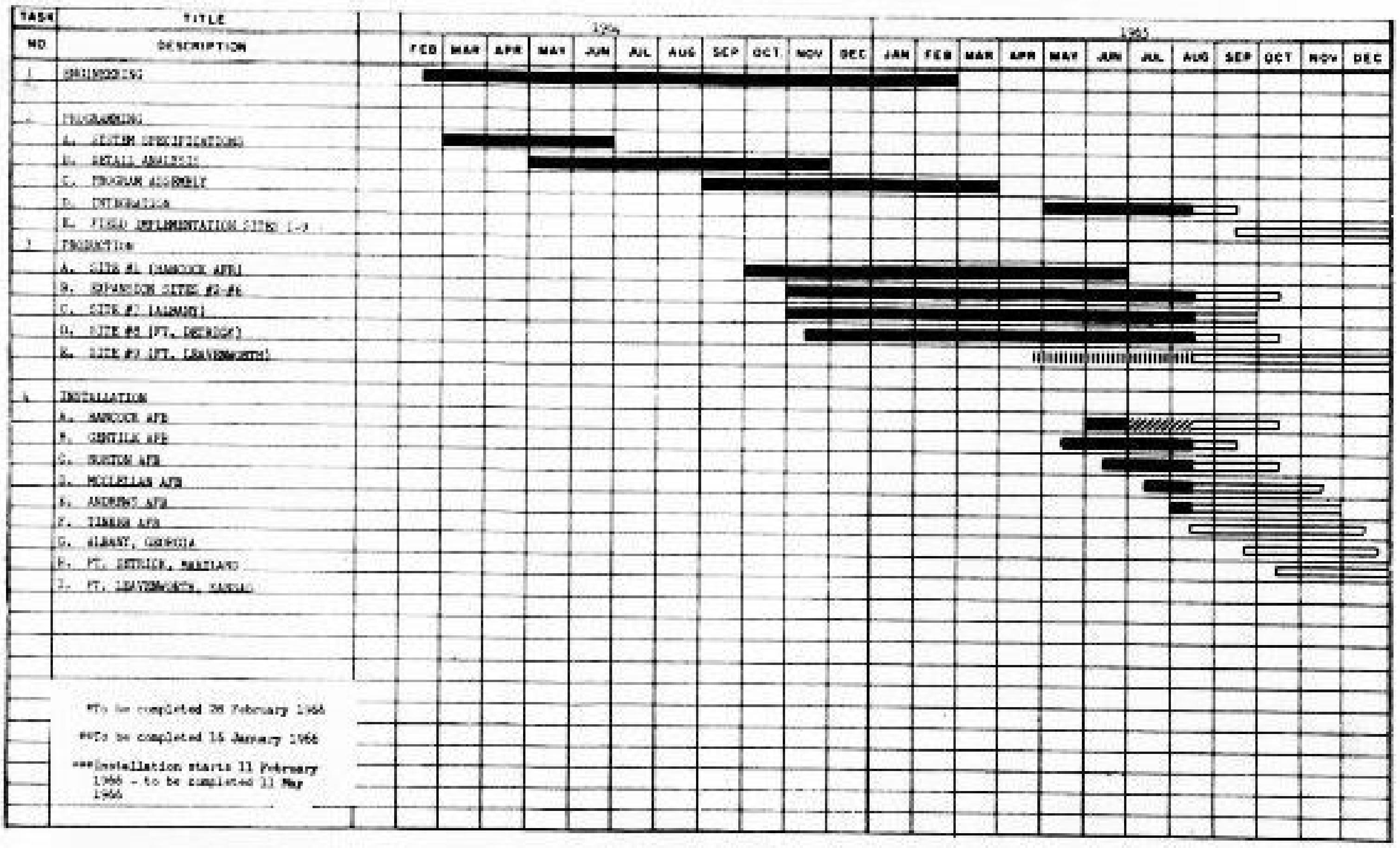

Figure 4 Work Progress Charts

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1. **AUTODIN**—Technical Control Facility F. B. Faulknor, Western Union TECHNICAL REVIEW, VOL 17, No 4 October 1963
2. **AUTODIN**—System Description Part 1—Network and Subscriber Terminals H. A. Jansson, Western Union TECHNICAL REVIEW, VOL 18, No 1 January 1964
3. **AUTODIN**—System Description Part 2—Circuit and Message Switching Centers H. A. Jansson, Western Union TECHNICAL REVIEW, VOL 18, No 2 April 1964
4. **AUTODIN**—Systems to be Expanded, Western Union TECHNICAL REVIEW, VOL 18, No 2 April 1964

HAROLD F. CALEY, Director of AUTODIN, in the Information Systems and Services Department has been concerned with the engineering phases of this project since 1959. He has had an active part in the development of data processing equipment and data processing services.

Mr. Caley joined Western Union after completing military service in 1946. His activities included the preparation of installation specifications for the Plan 21 Switching Centers and the supervision of the installation of radio beam equipment.

He has been Chairman of the Electronic Industries Association for Data Transmission Equipment and Chairman of the IEEE Data Communications Committee.

FRED W. SCHULTZ, system implementation manager in the Government Communications Systems Department, is Program Manager for the AUTODIN Expansion Program.

Prior to joining Western Union, Mr. Schultz was Advisory Engineer in the Communications System Development Laboratories at IBM. Prior to that, he served as a Communications Command and Staff Officer in the United States Air Force. During his Air Force career, he participated in the development implementation, and operational management of many new communications systems, such as Western Union's Plan 51, Plan 55, and AF DATACOM Systems.

Mr. Schultz received his BS Degree from the University of Maryland. He also attended several technical schools while in the USAF, received his commission as a 2nd Lt. at Yale University, and attended the Air Command and Staff School at the Air University, Montgomery, Alabama.

autodin
—overseas expansion

—Ralph M. Pool

The initial AUTODIN configuration adopted by DCA in 1963 as the nucleus for a planned world-wide network was called AUTODIN-CONUS. It comprised five automatic electronic switch centers of the Continental United States (CONUS). This CONUS portion was approved, in 1964, by the Department of Defense and is now being expanded by Western Union[1,2,3]. The Overseas expansion or the world-wide portion, is the subject of the article.

AUTODIN is a world-wide, high-speed common user data communications system. In the United States it is operated by Western Union and in the Overseas areas it is operated by specific Military Departments. Originally, it was designed to meet the growing USAF demands for faster logistic support of the ever-expanding, complex, global air operations. AUTODIN now serves as an integral part of the Defense Communications Agency world-wide communications complex.

AUTODIN-Overseas provides data communications from overseas points to government agencies of the United States. The Department of Defense has purchased ten new switching centers overseas — three in Europe, five in the Pacific area, one in Panama, and one in Alaska as shown in Figure 1. The automatic digital message switching centers (ADMSCs) were designed, installed, and are being tested by The Philco Corporation. Philco will provide maintenance of these centers for a period of one year after they have been cutover to active service.

Western Union Responsibility

Western Union is providing engineering assistance to the Defense Communications Agency in the procurement of both the main switching center complex, and the tributary or subscriber equipment. This systems assistance will continue through the final cutover to active service of the overseas portion of AUTODIN. To furnish this assistance, Western Union established an AUTODIN Overseas Project Office in Arlington, Virginia in midsummer of 1963. The project office is directly responsible to the Defense Communications Engineering Office (DECEO), a field engineering organization of the Defense Communications Agency. The procuring agency for this effort is designated as Air Force Systems Command.

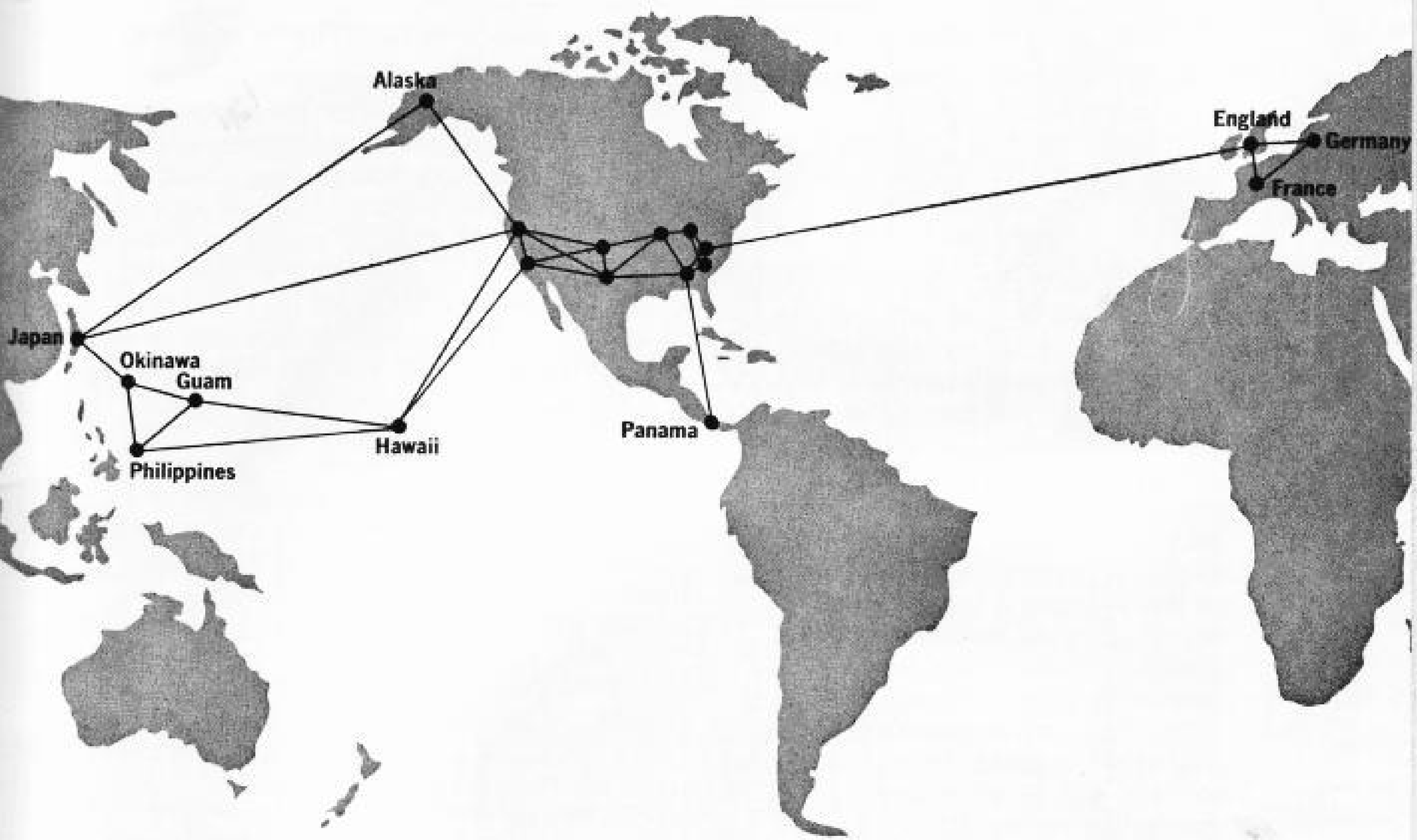

Figure 1. AUTODIN Overseas Worldwide Data Communications System

Western Union's Overseas Office

The AUTODIN Overseas Project Office is a division of Western Union's Information Systems and Services Department and is staffed by engineering personnel from each of Western Union's major departments. These personnel represent the field divisions as well as the Headquarter's research and engineering departments of Western Union. In addition, communications engineers with a variety of technical knowledge have been recruited from the military and industry.

The major task within the Western Union AUTODIN Project Office is to provide the systems engineering services to support the Defense Communications Agency in implementing the AUTODIN program in overseas areas. The Project Office is responsive to the Defense Communication Agency (DCA) in performing these broad system engineering and systems integration functions. The duties and responsibilities of the Western Union office include:

1. To provide technical procurement specification for switching center equipment, high- and low-speed modems, crypto ancillary units, teleprinter control units and the Digital Subscriber Terminal Equipment (DSTE) or tributary equipment.
2. To assist DCA in evaluating bidders' proposals.
3. To provide monitoring of in-plant technical design of all major equipment for the Government.
4. To perform systems analyses for compatibility of each supplier's equipment and for compatibility of each off-line computer.
5. To assist in site selection, design, and construction of the ten overseas switching centers.
6. To participate in the Government acceptance test for each switching center.
7. To provide continuing systems engineering assistance to DCA in their overseas headquarters during the implementing cutover stages.

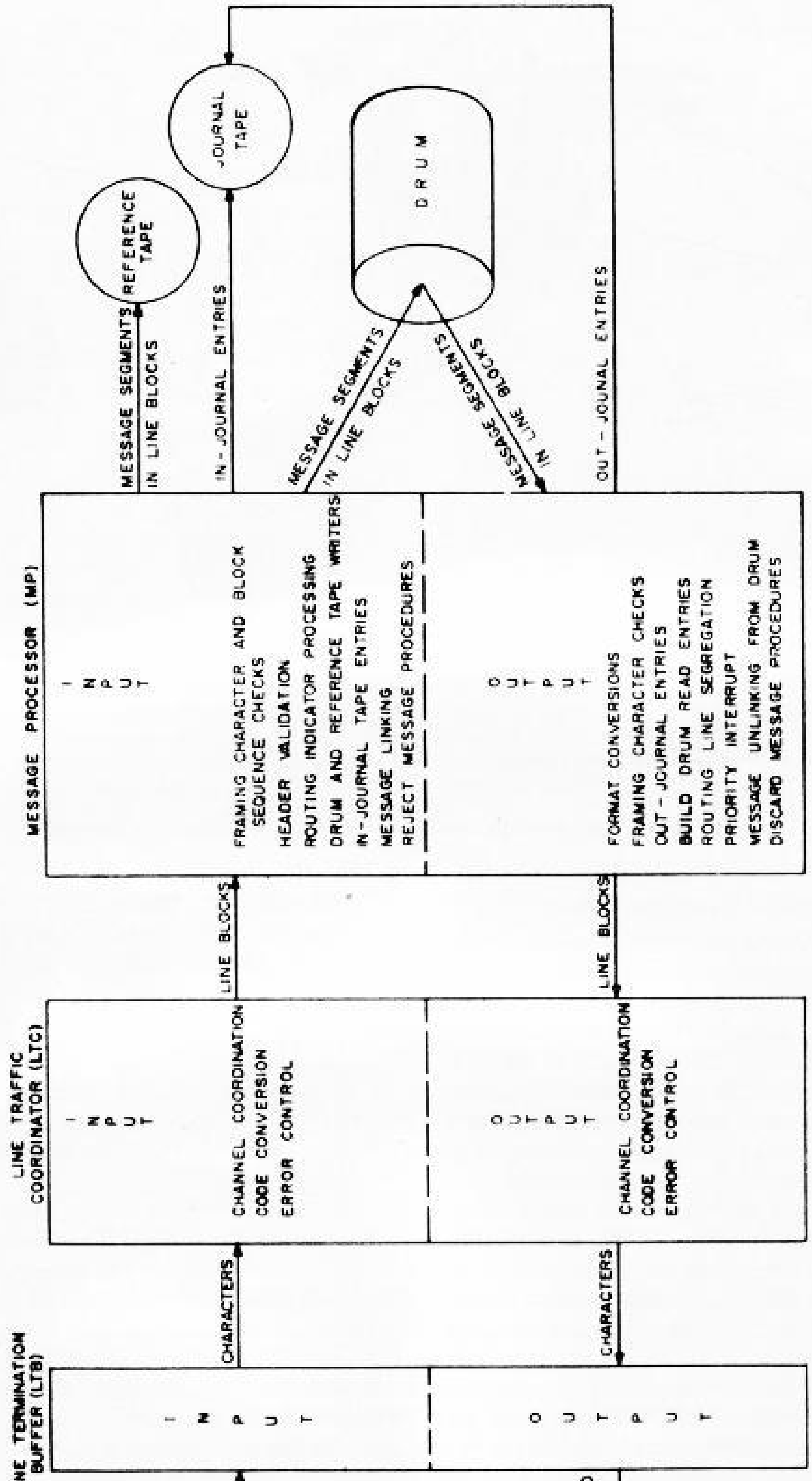

Figure 2. Traffic Flow within the Switching Center

Operation of AUTODIN Overseas

In the Continental United States (CONUS) portion of AUTODIN, message traffic may be exchanged in two ways: (1) directly from user to user—Circuit Switching or (2) on a store-and-forward basis between switching centers and the user—Message Switching.

However, in the AUTODIN Overseas system, there is no Circuit Switching. Overseas traffic will flow only on a store-and-forward or a Message Switching basis. Traffic flow within the switching center complex is shown in Figure 2. Tributary subscribers send bit serial stream information into the Line Termination Buffers (LTBs). Complete characters are formed and sent in parallel configuration to the Line Traffic Coordinator (LTCs). The LTCs send line blocks of 80 information characters into the Message Processors (MPs). The MPs perform the main message switching process, place delayed messages into drum storage and queue messages in proper sequence back through the LTC and LTB to the destination.

The AUTODIN Overseas system accepts traffic asynchronously at 45-, 75-, and 150 bauds, and synchronously at 300-, 600-, 1200-, and 4800 bauds. When the system is installed in early 1967, the tributary operating speed is expected to be limited to 1200 bauds. The AUTODIN Overseas system will exchange traffic on a store-and-forward basis between users operating at different speeds, i.e., one user at 75 baud and another user at 1200 baud. The switching center can accept International Telegraphic Alphabet (ITA #2) traffic and messages in the new American Standard Code of Information Interchange (ASCII). It will accept traffic from an ITA #2 user and code convert it into ASCII and deliver it to an ASCII coded tributary. Code conversion from ASCII to ITA #2 will be performed prior to final delivery, as required.

Reliability built into the equipment keeps errors to a bare minimum. Reliability is assured by parity checks, controlled environmental conditions, and spare or standby equipment that can be instantly and automatically switched into the system should equipment fail.

Capabilities of the Centers

Each of the ten overseas AUTODIN automatic electronic switching centers is capable of providing as many as 200-user terminations. During the initial cutover period, some centers will be configured to accept only 100 terminations. The capability of the switching centers include:

- Ability to accept a total input of 76,000 bits per second.
- Ability to handle an output of 86,000 bits per second.
- Accuracy of the overall system prevents the occurrence of a single character error more frequently than once in every 100,000 characters.
- Reliability and accuracy of the switching center equipment will not allow a character error to be generated and transmitted undetected more frequently than once in every 100,000 billion characters.
- Prevention of message misrouting with a probability of less than one message in 10 million being undetected.
- Automatic change of message configuration. The logic and software program package will automatically change the format and code of messages when necessary. (For example, to send a narrative form of message from a tributary, using ITA #2 code, to a destination using punch cards, the switching centers perform message conversion by putting it into 80-character blocks and adding or deleting characters for line feed and carriage return as may be necessary.)
- Provision for routing codes, to send single or multiple-address messages, is available to the user, by means of programming in the system. Collective routing codes may be used to select a preassigned list of destinations if desired.
- Provision for automatic alternate routing is provided if a major circuit route or trunk becomes inoperable.
- Provision for normal journal records, header checking of each message, and priority handling is provided.

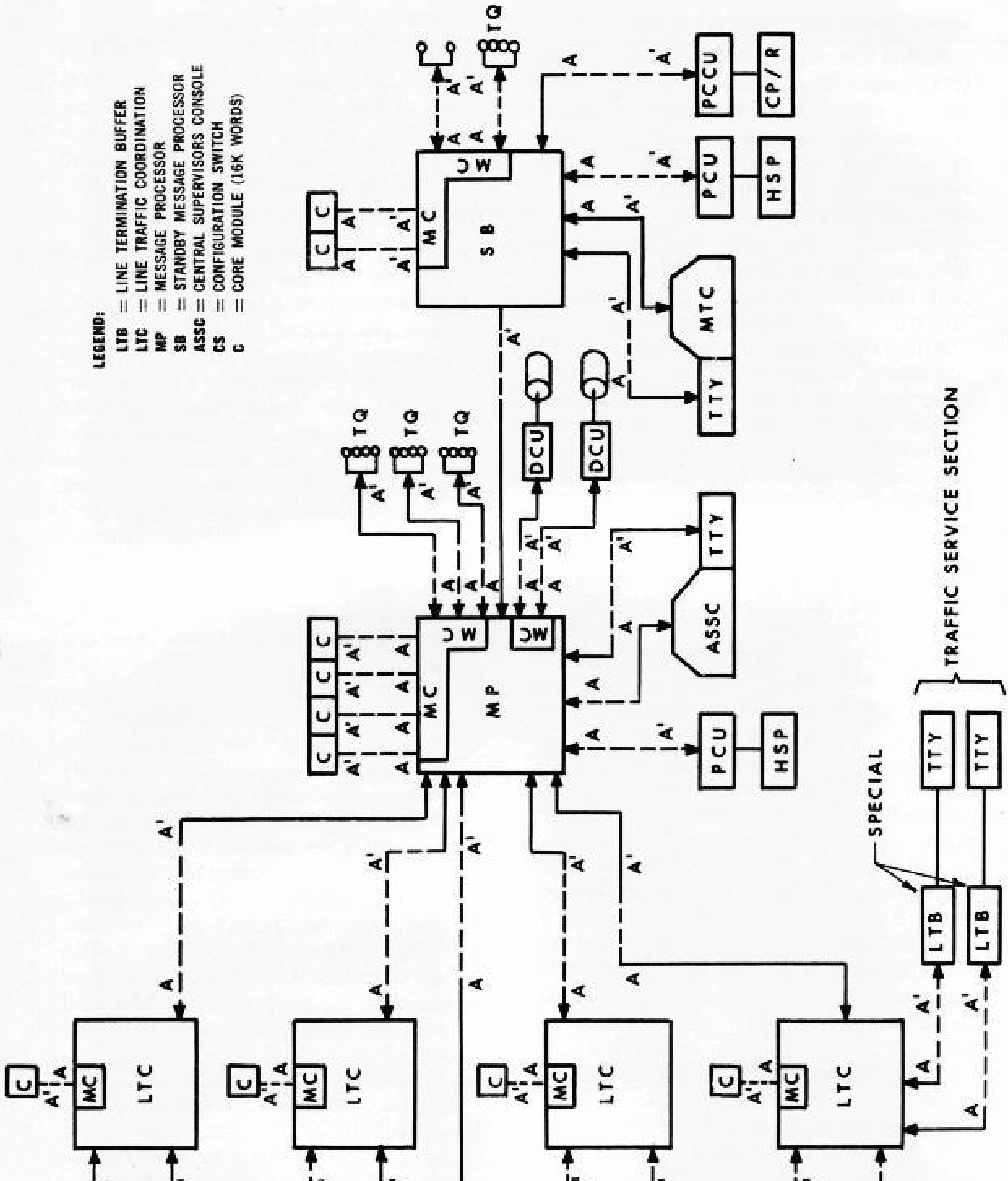

Figure 3. Block Diagram of a 200-Line ADMS

Unique Features of ADMSC

The AUTODIN Overseas ADMSCs have many unique features:

1. Modular Design.

One such feature is the modular construction of the ADMSC using the Model 102 processor. A typical center has six basic processors (5 on-line and 1 standby) and ten 16,000-word core memory banks (8 on-line and 2 standby). Four processors will serve as buffer storage for the input/output terminations, channel acknowledgement and coordination, and character processing.

A block diagram of the flow of traffic through a typical 200-line ADMSC is shown in Figure 3. A typical 200-line switching center has 6 processors, 18 magnetic tape drives, 10 core memory banks, 2 eleven million character magnetic drums, and other peripheral equipment, such as high speed printers, tech control and system supervisors consoles. The processors, when used in this configuration, are called Line Traffic Coordinators or LTCs. The fifth model 102 processor serves as the main Message Processor (MP), performing message servicing, operation supervision, such as directing a message to a magnetic drum or magnetic tape unit for interim storage and directing the printout of supervisors messages and data pertaining to traffic flow. The sixth processor is the standby processor (SB) which performs only off-line functions while in a standby status. Some of the off-line functions are the ability to perform any function of the other five online processors and/or to act as an off-line processor in a maintenance program or to debug a software program.

2. Economy.

Because of the many identical pieces of equipment, the switching center complex provides economies in manufacture, maintenance provisioning, maintenance training, and system simplicity. For instance the Model 102 Processor functions equally well as a Line Traffic Coordinator providing the buffering for 50 lines. It also serves as a Message Processor in directing the flow of data bits within the computer complex.

A third configuration of the basic Model 102 Processor is in the standby or off-line condition. The ability to check out a particular software program, to process or checkout a maintenance routine, can all be done with this redundant processor. Ease of maintenance is illustrated in Figure 4. The logic cards in the Model 102 Processor are shown when door is swung open. Maintenance provisioning is simplified because of the large quantities of similar modules. Maintenance training time is likewise reduced for this reason.

Additionally, ease of operation results from the speed and efficiency with which the ADMSC can recover and restart in the event of a catastrophic failure. Economies are achieved in the transmission area as well. Alternate use of data-voice trunks are utilized from a coherent voice-switched network during heavy traffic periods.

These additional circuits are called up manually or by software techniques as required.

3. Crossbar Switching Matrix.

Another unique feature of the ADMSC is its ability to detect a malfunctioning piece of equipment, switch it off-line by means of a crossbar switching matrix and replace it with a spare unit. Every possible systems configuration that can be effected by the crossbar switching matrix can be ordered either by program action via a processor or by manual action from the supervisory console. Thus, by means of the software program, the standby processor may be placed into service automatically as a Line Traffic Coordinator or Message Processor. The crossbar switches are also capable of allowing any magnetic tape drive to be assigned to any of the magnetic tape controllers. The equipment in the switching centers is designed to be interconnected in such a manner that maximum use is made of the crossbar matrix to interconnect various subsystems. Through such maximum utilization of the crossbar switching matrix, system reliability is greatly improved and a high degree of flexibility is attained within the ADMS.

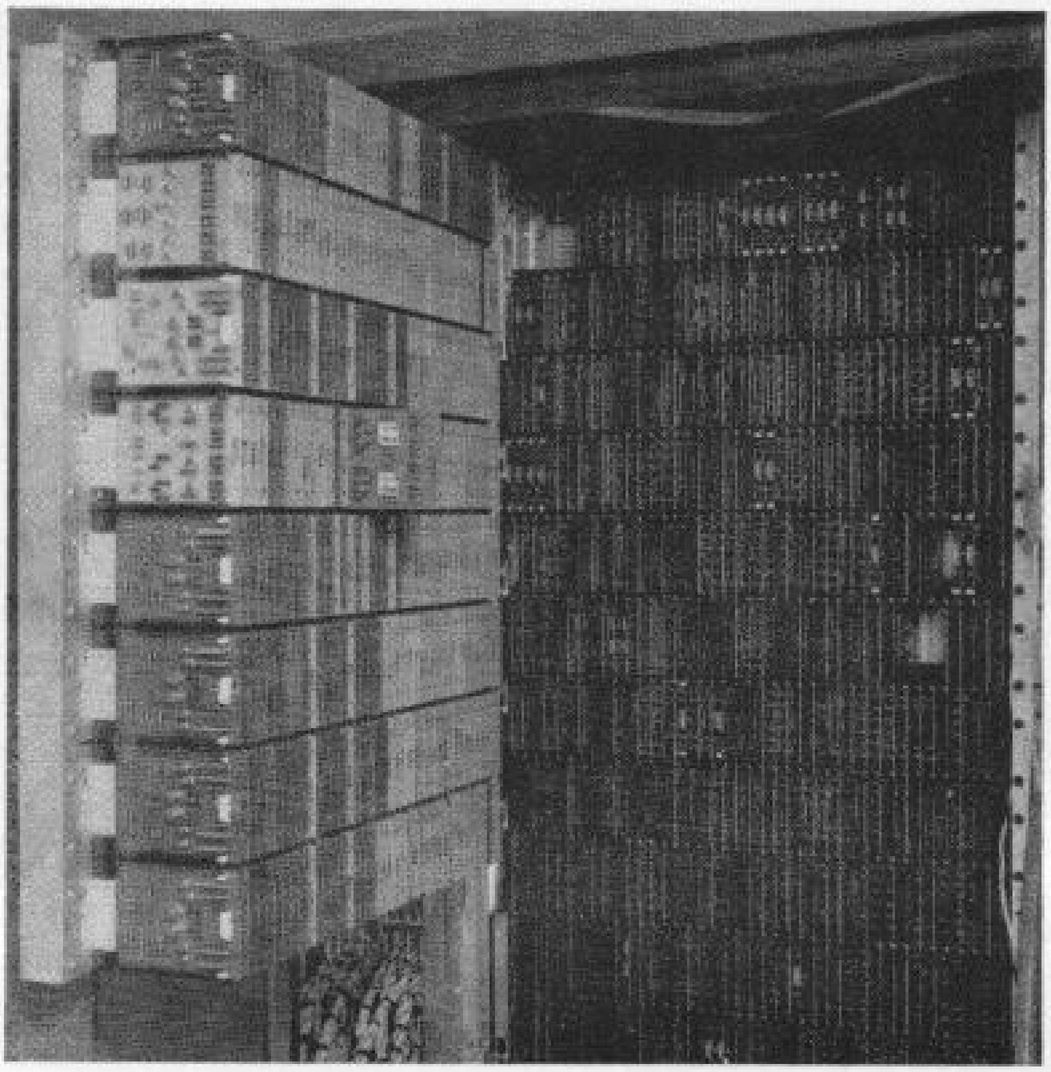

Figure 4. Model 102 Processor—(rear view) with Back Door swung open to show ease of maintenance and access to logic cards

Line Termination Buffers

The Line Termination Buffers (LTB), serve as gateway points for data information into the switching center. LTBs may be synchronous or asynchronous and are configured in groups of 14. The buffers perform the first manipulation on a received piece of data information. The information is changed from bit serial stream into an assembled character within the buffer unit. The character is then ready for parallel transfer into the Line Traffic Coordinator (LTC).

The asynchronous line termination buffer may assemble 5-bit or 8-bit characters to match a particular line. They are capable of being timed at 45-, 75-, and 150 bauds. The synchronous Line Termination Buffers operate at 150-, 300-, 600-, and 1200 bauds. The asynchronous buffers will also recognize open circuit conditions on both sides of the line. The synchronous buffers will recognize a no-transition condition on either side of the line.

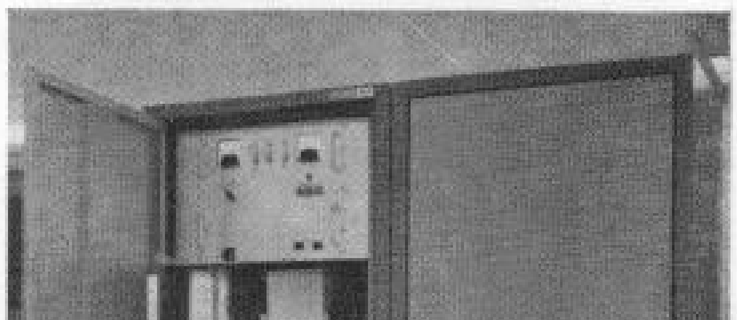

Figure 5a. Memory Bank showing Core Storage Unit at Bottom—(an enlarged view of the core storage unit is shown on the opposite page)

Line Traffic Coordinator

The Line Traffic Coordinator (LTC) is a Model 102 Message Processor providing channel coordination, character processing, and storage for the Automatic Digital Message Switch (ADMS) input/output. In a typical 200-line switching center there are four LTCs, each of which interfaces the Message Processor (MP) via a processor Configuration Switch unit.

The major function of the LTC concerns control and coordination of communications channels and the traffic received from and sent to these channels.

To facilitate these functions the memory in the LTC contains a stored program which handles channel coordination for each transmission mode, associated tables, and variable sized buffer areas to store the incoming and outgoing data. In coordination the receipt and transmission of data, the LTC provides for bulk storage of the traffic. Line blocks of data are accumulated and exchanged between the LTC and the MP. The number of blocks accumulated for a particular line is dependent upon the speed of the line. Validity checks are made on all transferred traffic. Code translation (to and from the internal ASCII) is performed and channel coordination characters are recognized and acted upon.

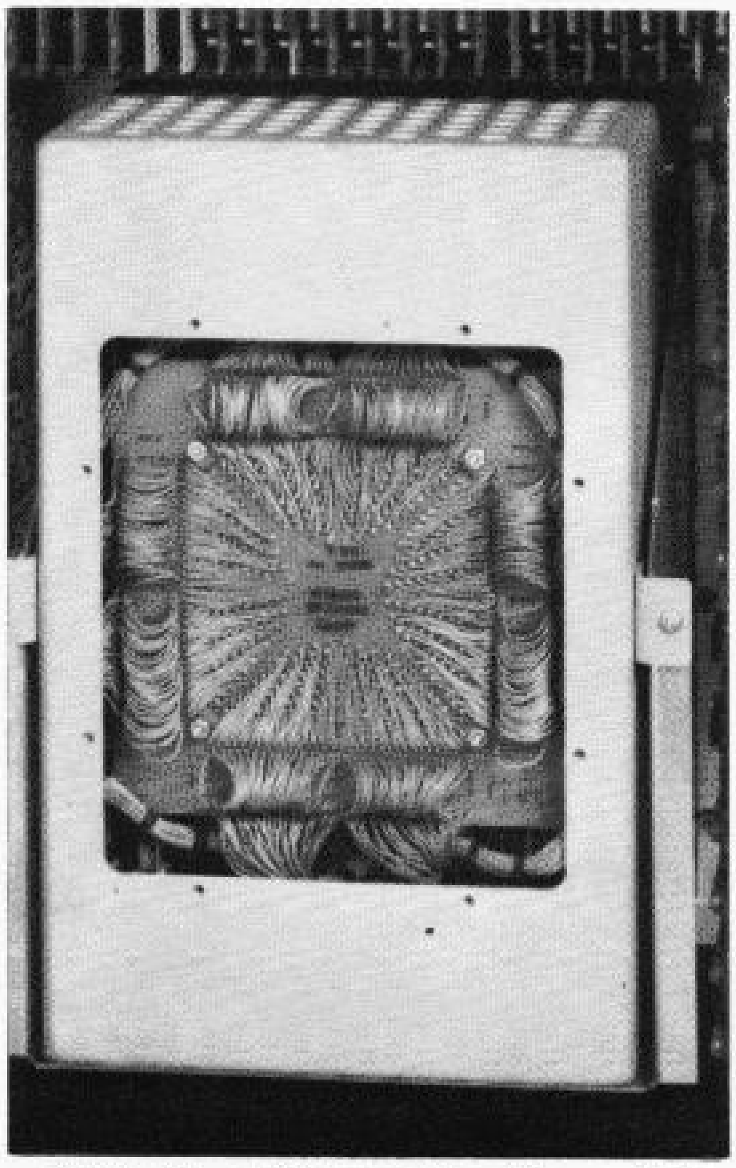

Figure 5b. 16K Magnet Core Storage Unit Model 173

Message Processor

The Model 102 Message Processor used in the AUTODIN Overseas system provides the main function to the system—routing the message. In addition, various other functions necessary in the processing of the message take place. Two of these functions are message protection and statistical information storage for off-line record keeping. To do all its jobs, the MP requires four 16,000 computer-word core storage unit shown in Figures 5a and 5b, two magnetic drums, a central supervisor's control console, a high-speed printer and access to 12 magnetic tape drives.

An Analex High Speed Printer is shown in Figure 6.

The program stored in the MP core memory banks assists in the transfer of data from the LTBs via the LTC to the MP and in turn to intransit storage on the magnetic drums, as shown in Figure 1. If the 11-million character drum storage unit (more than 4000 average length messages) becomes full, the magnetic tape drive units are pressed into service as secondary storage units. The message, in the store-and-forward system, awaits its turn by precedence to be forwarded to its destination. High priority messages are given special treatment. These tape units, plus the Reference and Journal tape units, are shown in Figure 1.

Directing the data to the proper output lines from the drum via the Line Traffic Coordinator is a function of the Message Processor. The magnetic tape unit assigned to store the journal records is also directed by the Message Processor program. This journal record is a necessity for off-line manipulation to obtain traffic data. Complete copies of all messages are stored on the Reference Tape unit.

Figure 6. Model 153 Analex High Speed Printer

Configuration Switch

The Configuration Switch shown in Figure 7 is the heart of the AUTODIN Overseas system. It provides a very novel and unique method of upgrading reliability. Basically, it provides: (1) that single functional units of equipment be automatically disconnected electrically from the online system. Some of these units may be core memory modules, line termination buffer groups, tape controllers, and magnetic tape units. The equipment is disconnected through programming control or manual intervention at the supervisor's console shown in Figure 8, and (2) the vehicle for rapidly changing circuits between functional units with a minimum of down time.

The Configuration Switch functions between;

- Line Termination Buffers and Line Traffic Coordinator processor.
- Line Traffic Coordinator processor and any other processor.
- Core memory modules and processors.
- Magnetic drum primary storage units and processors.
- Processors and tape controllers.
- Tape controllers and tape transports.
- Processors and various peripheral devices including maintenance and central supervisor's console, high speed printers, and printers for the service supervisor's position.

If a manual or program change is attempted which would provide an invalid connection, the control circuit is denied the execute cycle and an alarm condition is created. A system of checks and cross checks are also in effect during normal operation. The Line Traffic Coordinator continually indicates to the Message Processor that it is functioning normally. The Message Processor in turn is sending a similar indication to a hardware monitor. Should the Message Processor fail, the hardware monitor will detect it and, in turn, select a processor to replace the MP. The new MP will have the ability to control the Configuration Switch. During configuration switching operation the program within the Line Traffic Coordinator initiates signals automatically to the tributaries to hold their traffic.

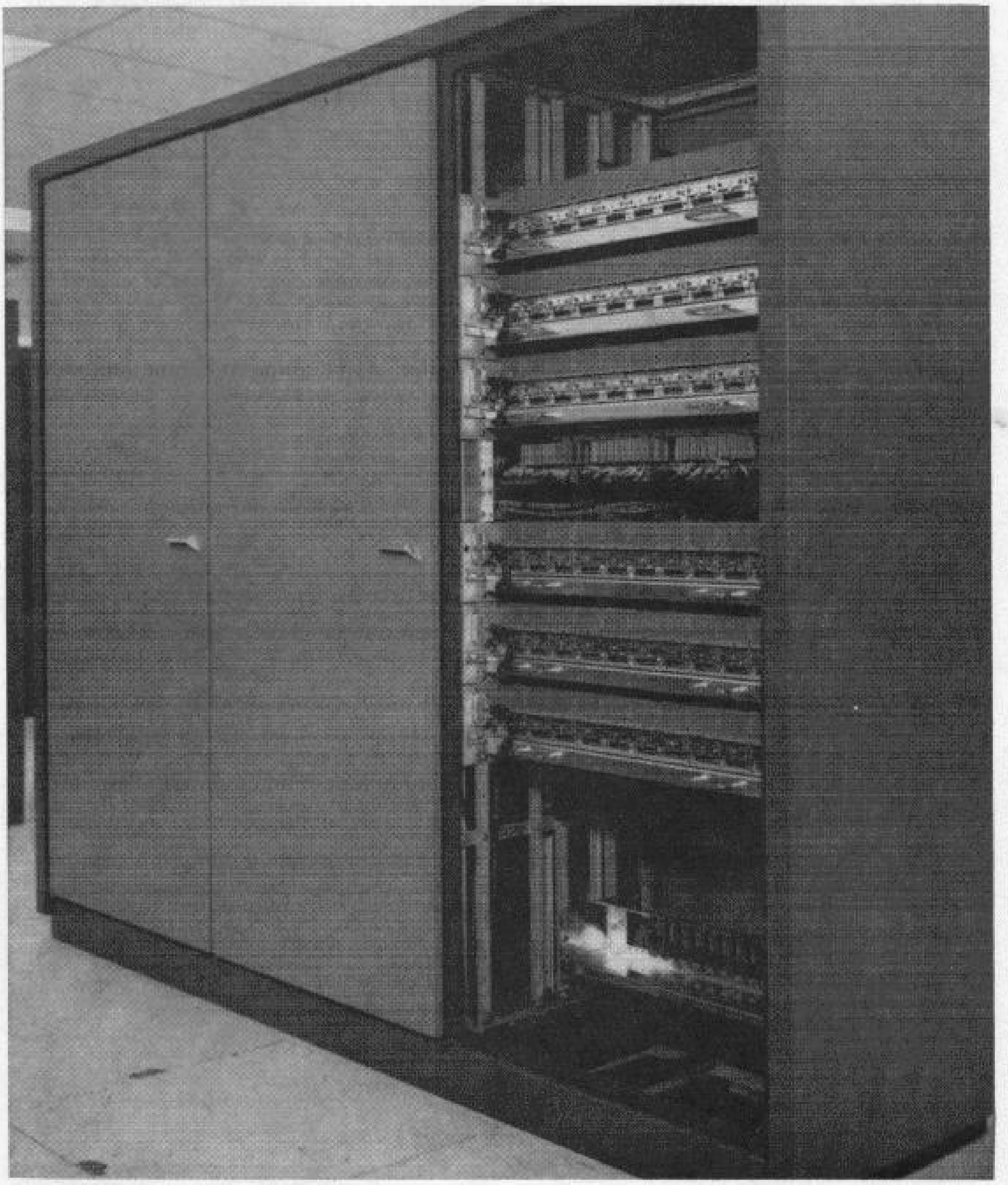

Figure 7. Configuration Switch

Sense Point Scanner

The Sense Point Scanner (SPS) is a scanning device that detects faults not directly associated with the Configuration Switching unit. The SPS reports the status of sense points to the processor giving the location of the fault area. The processor can classify the fault and light the proper indicator lights at the central supervisor's console (ASSC). The SPS is capable of watching over 2000 of these sense points.

The sense points are of two general types: one, which watches each line for incoming and outgoing failures and patching abnormalities; another, which senses the main ac power system condition, the main dc power condition, the critical power bus, the master clock, and environmental (temperature and humidity) conditions within the switching center.

Technical Control

The function of the Technical Control area is to maintain continuity of service with other communications centers and tributaries. The Tech Control also controls and regulates the external transmission facilities to the ADMSC complex. It is the most modern of a family of digital technical control complexes and employs the latest testing and measuring devices available.

A Tech Control console, which is in the communications subsystem area, will provide a means for monitoring all incoming and outgoing signals. Provisions are available on the console to test, coordinate and monitor the orderly control of the transmission facilities. The Tech Control area will contain entrance, black and red dc patch bays for transfer and testing of both lines and equipment. Isolation is provided in the Tech Control area for the red and black signals.

The master station timing system, for the Automatic Digital Message Switching Center is located in the communications subsystem area. The timing system supplies the timing base for all synchronous and asynchronous equipment speeds and serves as a master or timing source to compare each tributary operating out of the switch. This station clock oscillator uses a frequency synthesizer to derive the various desired timing rates. The stability of this timing source is in the order of one part in one hundred million. Each overseas ADMSC is expected to have a VLF receiver available for establishing and maintaining an accurate, stable station timing system.

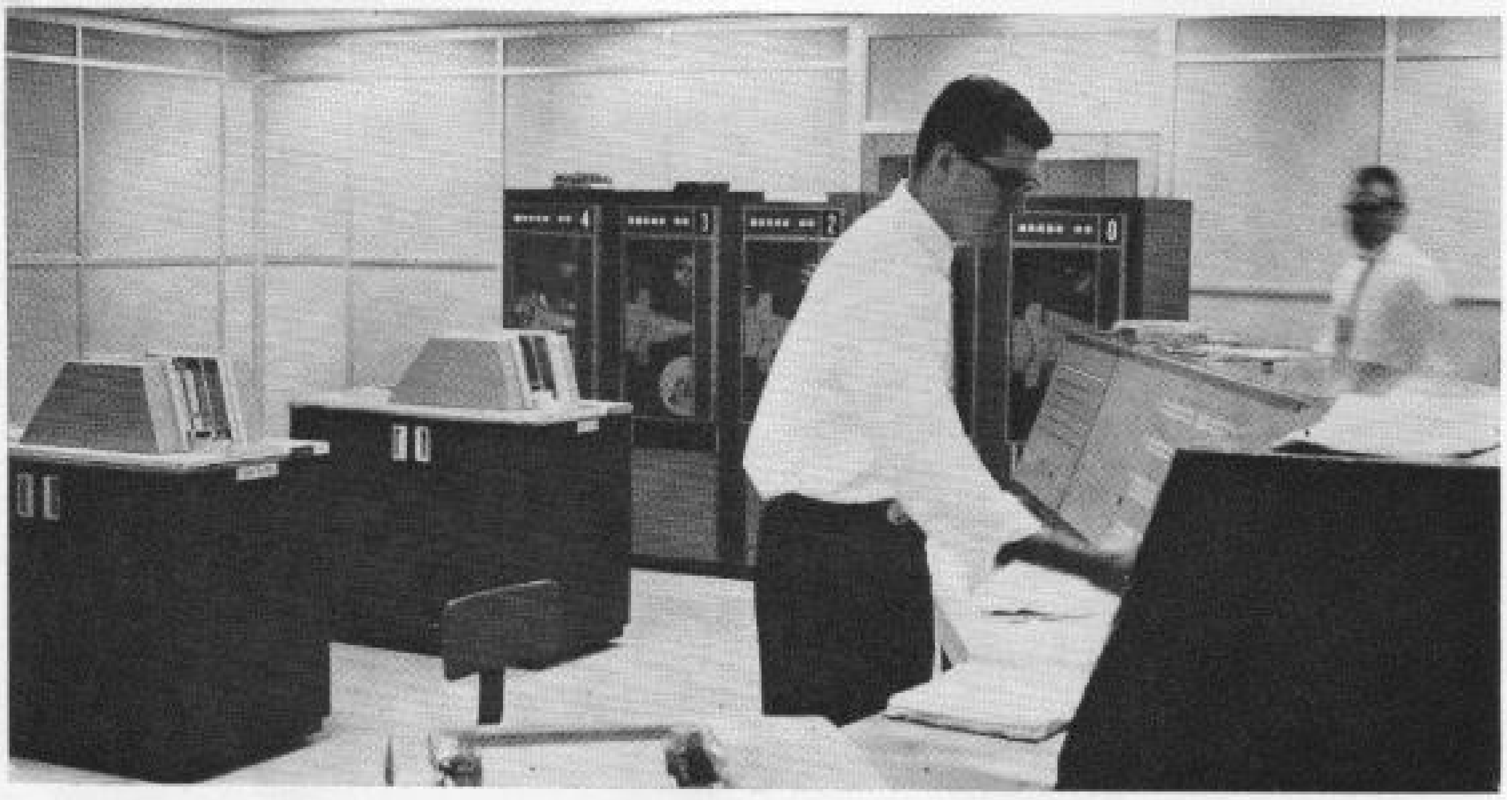

Figure 8. Supervisor's Console

Intermarriage of Communications with Computers

The world-wide AUTODIN network is another step toward the intermarriage of sophisticated communications equipment and data computers. The Overseas system when integrated with the CONUS system will provide the Department of Defense with a world-wide capacity of over producing 40 million punched cards daily or the equivalent of approximately 600 million words per day. This is a dramatic example of modern day data communications accomplishments.

What are some of the problems to be solved in the next generation of communications equipment? Perhaps the distribution of data communications at different speeds and format for several agencies within a local geographical area is a reality at the present time.

Further research studies on existing systems should reduce software memory space and provide more efficient use of the computer. This may result in increased standby real time of the computer. The standby time should be utilized for off-line manipulations. Such an off-line use during non-peak hours might take the form of an information repository for warehouse inventories, maintenance spare parts inventories, manpower and other administrative data. Just as the present Message Processors distribute parts of data information to many terminals, this new information repository would enable subscribers or a central administrative office to gather, store, process, program, retrieve, and distribute this information on the broadest possible scale.

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1. **AUTODIN**—System Description, Part I Network and Subscriber Terminals—H. A. Jansson, Western Union TECHNICAL REVIEW, January 1964 Vol. 18 No. 1.
2. **AUTODIN**—System Description Part II—Circuit and Message Switching Centers—H. A. Jansson, Western Union TECHNICAL REVIEW, April 1964 Vol. 18 No 2.
3. **AUTODIN**—Switching System—Technical Control Facility—F. B. Falknor, Western Union TECHNICAL REVIEW, October 1963 Vol. 17 No. 4.
4. Message Protection in the AUTODIN Message Switch—R. L. Snyder, Western Union TECHNICAL REVIEW, July 1964 Vol. 18, No. 3.
5. **AUTODIN**—System Description DCS—Defense Communications Agency—Defense Communications Engineering Office (DECEO) Engry Publication H500-2-65.

RALPH M. POOL, Director of AUTODIN Overseas, in the Information Systems and Services Department, is responsible for the AUTODIN Overseas Project. He is responsible for system integration, system planning, cutover for service, procurement evaluation, and monitoring.

Mr. Pool joined Western Union in 1947. During his field career, he has been responsible for the systems planning and cutovers, including Plans 21, 51, 55, and 111, bomb alarm sensors, line-of-sight microwaves, and AUTODIN Users.

Mr. Pool received a BSEE from Northeastern University, Boston, Massachusetts, in 1947. He graduated from the United States Army Air Corps, Navigation and Radar School, Hondo, Texas, with honors and outstanding achievement in 1944.

He has been active in the Institute of Electrical and Electronics Engineers and the Armed Forces Communications and Electronics Association.

Vice President's Message
Announcements

Schenk, P. J.: Western Union Serves the Federal Government
Western Union TECHNICAL REVIEW, Vol. 20, No. 1 (January 1966)
pp. 2 to 3

Since the Federal Government has many specialized needs for message-switched and circuit-switched data communications systems, Western Union established the Government Communications Systems Department, with headquarters in Arlington, Va.

This announcement defines the objectives of the Government Communications Systems Department.

AUTODIN
Tape Transmitters
Circuits
Stepping Motors

Kirkowski, S. A.: High Speed Tape Reader
Western Union TECHNICAL REVIEW, Vol. 20, No. 1 (January 1966)
pp. 4 to 7

The High Speed Tape Reader was designed by Western Union for the AUTODIN system. It has many applications in other systems such as EDAC and the Plan 38 Switching System.

It is a light, compact, low-cost unit, extremely versatile, reliable and almost free of maintenance.

The salient features of the Tape Reader, including its special motion sensing contact, are described in this article. A stepping circuit used in the unit permits the reading speed to be varied and the bi-directional mode to be utilized.

GSA—Advanced Record System
Switching Systems
Computer Techniques
Data Processing

Carruth, D. E.: ARS Advanced Record System
Western Union TECHNICAL REVIEW, Vol. 20, No. 1 (January 1966)
pp. 8 to 17

The Advanced Record System was developed for the General Services Administration to provide a single, integrated common-user record communication system for the various agencies of the Federal Government.

This is a general article covering the interconnection of the two major components of the system, the Circuit Switching Network and the Message Switching Centers. It includes block diagrams of the Message Flow through the District Office and through the Junction Office. The special features of the Circuit Switching Network are outlined and the interconnection of the hardware components of the Message Switching Center are described briefly. Some of the Narrowband calls made within the Circuit Switch Network are cited as well as a definition of the Computer Programs used in the Message Switching Center.

Switching Systems
PWS
Message Switching

Cowan, J. R.: Form-Feed Message Delivery System
Western Union TECHNICAL REVIEW, Vol. 20, No. 1 (January 1966)
pp. 18 to 22

The Form-Feed Message Delivery System was developed by Western Union for the United States Air Force to automate the in-office handling of these messages and to speed their delivery to the addressees. Many such messages require distribution to more than one addressee.

This article points out some of the delivery problems which were overcome by this system. A description of the components and the operation of the system is included.

The unique feature of the system is the absence of any control wires between the Operating Table and the Receiving Teleprinter.

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SERVICE TO OUR READERS: As a service to our readership, articles will be abstracted so that a complete file may be kept for future reference.

History
Production
Announcements

Killilea, M. C.: Growth of the Western Union TECHNICAL REVIEW
Western Union TECHNICAL REVIEW, Vol. 20, No. 1 (January 1966)
pg. 23

This announcement describes the circulation growth of Western Union's technical publication.

AUTODIN
Switching Systems
Management Techniques
Technical Control

Caley, H. F. and Schultz, F. W.: AUTODIN—CONUS Expansion
Western Union TECHNICAL REVIEW, Vol. 20, No. 1 (January 1966)
pp. 24 to 33

The AUTODIN system, designed and developed by Western Union with the support of RCA, IBM and many other electronic companies was made operational in early 1962. Many new features and capabilities have been added since then under the direction of the Defense Communications Agency (DCA).

These added features and the expansion of the domestic portion of the AUTODIN system, AUTODIN-CONUS are included in this article. Some of the management techniques employed to insure the technical adequancy and the timely implementation of the overall system are outlined.

AUTODIN
Switching Systems
Management Techniques
Technical Control

Pool, R. M.: AUTODIN—Overseas Expansion
Western Union TECHNICAL REVIEW, Vol. 20, No. 1 (January 1966)
pp. 34 to 45

This article covers the expansion of the world-wide portion of AUTODIN. The Department of Defense purchased 10 new switching centers overseas to provide data communications from these points to government agencies in the United States.

Western Union's responsibility in serving the government is spelled out in this article. It also includes the operation of the centers, some special features of the centers, a description of the modern equipment used, and the function of the Technical Control area.

The initial AUTODIN configuration, adopted by the Defense Communications Agency in 1963 and called AUTODIN-CONUS, is the nucleus for the world-wide network.

Announcements
Trademarks

Western Union's New Trademark
Western Union TECHNICAL REVIEW, Vol. 20, No. 1 (January 1966)
p. 48

Western Union's new trademark appears on the TECHNICAL REVIEW cover of the January 1966 issue.

It will appear on all company publications.

western union

western union's new trademark

Western Union's new trademark appears on the front and back covers of this issue of the TECHNICAL REVIEW. The new logo will soon appear on advertising, sales promotion brochures, trucks, signs in Western Union offices and on company publications.*

The bold, modern design is symbolic of strength, stability and progress. The initials, WU, long associated with the name Western Union, are a formal part of the new trademark identification.

*Logo from Logogram—meaning word letter a phonogram representing a word