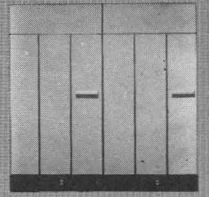UNIVAC
STANDARD
COMMUNICATION
SUBSYSTEM

GENERAL MANUAL

UNIVAC STANDARD COMMUNICATION SUBSYSTEM

This manual is published by the UNIVAC® Division in loose leaf format as a rapid and complete means of keeping recipients apprised of UNIVAC Systems developments. The UNIVAC Division will issue updating packages, utilizing primarily a page-for-page or unit replacement technique. Such issuance will provide notification of hardware and/or software changes and refinements. The UNIVAC Division reserves the right to make such additions, corrections, and/or deletions as, in the judgment of the UNIVAC Division, are required by the development of its respective Systems.

1. CONTENTS

ILLUSTRATIONS

2. INTRODUCTION

Great emphasis today is placed on the capabilities of large scale, high speed, data processing systems. They have been rapidly developed to the point where their speed, storage capacity and logical power will handle even the most complex business problems. Historically proven in applications such as inventory control, production scheduling, sales analysis and market forecasting, data processing systems are now entering an entirely new era made possible by the application of communications techniques to advanced computer design. A unique concept in data processing has resulted — Real Time Systems.

A. AN HISTORICAL REVIEW

In past years, the majority of data processing systems were operated on a batch or bulk processing basis. Since program changes were time consuming and prevented efficient utilization of computer time, input data was divided into batches and processed only after a sufficient volume had been accumulated to justify a program change. Input data may have been in the form of punched cards, magnetic tape or paper tape. In any case, a considerable amount of time consuming manual effort was required to prepare the data for processing. Coupled with the problem of preparing the data was the equally important problem of collecting the raw data at the computer site. This combination of data collection, data preparation and batch processing frequently resulted in management reports which provided little more than an historical look at a corporation's progress. Computers were serving only to a limited degree as the management tool for which they were intended.

In an effort to alleviate the long time delay between the creation of data and the ultimate processing of this data into usable management reports, processing systems were made larger, faster and more versatile. This did little, however, to comply with management's request for timely data since the obstacles of data preparation and data collection were not given an equal amount of attention and improvement. Additional efforts resulted in computer decentralization or the installation of several small or medium sized computers to handle the data processing for a particular division, department or geographic area. Although this step reduced the time delay usually associated with transporting data from one location to another, it appreciably reduced the amount of centralized control which management could exert.

In further attempts to solve the total systems problem, communications equipment which had been used exclusively for administrative messages was applied to data processing. The first practical application of this principle involved converting the data to be processed into punched paper tape, using teletypewriters or business machines at remote locations. At periodic intervals, the information on paper tape would be transmitted over telegraph lines to the computer site and fed directly to a computer or converted into some media, such as punched cards, which was compatible with the particular system employed.

The use of data communications equipment was a definite step toward the solution of the data collection aspect of the problem. However, the actual processing of the data was still performed on a batch basis. Many transactions were transmitted at one time and were processed when a sufficient volume had accumulated. What was lacking was the ability to operate upon a transaction as it took place.
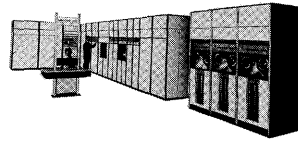
CENTRAL PROCESSOR
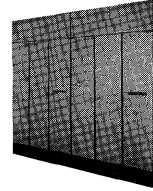
STANDARD COMMUNICATION SUBSYSTEM

MODEL 28
AUTOMATIC
SEND-
RECEIVE
SET
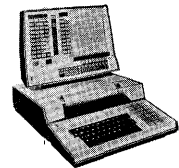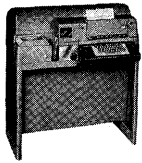
UNISET
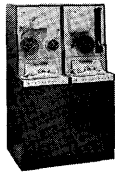
DATA SPEED

MODEL 35
KEYBOARD
SEND-RECEIVE
TELETYPEWRITER
(4 ROW KSR)
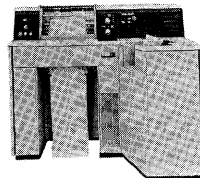
UNIVAC 1004 DLT-1
CARD PROCESSOR

B. REAL TIME PROCESSING

To close this gap in time between the actual transaction and its recognition by the processing system, a new concept has been devised, Real Time processing. A real time system is a combined data processing and communications system which involves the direct communication of transaction data between remote locations and a central computer, via communication lines, and allows the data to be processed while the business transaction is actually taking place. A real time system may be thought of as a communications oriented data processing system which is capable of performing batch processing functions while concurrently processing inquiries or messages, and generating responses in a time interval directly related to the operational requirements of the system.

C. UNIVAC STANDARD COMMUNICATION SUBSYSTEM

The UNIVAC Standard Communication Subsystem was developed to serve as the electronic link between UNIVAC Data Processing Systems and the various communications facilities available to industry. Featuring a wide range of capacities and capabilities, the Standard Communication Subsystem offers to the UNIVAC user the most modern techniques in data communications and makes Real Time Data Processing an economic reality.

3. GENERAL DESCRIPTION

To allow its Central Processors to function most effectively as real time systems, Univac has designed the Standard Communication Subsystem. This most recent addition to the family of UNIVAC subsystems enables a Central Processor to exchange data simultaneously with a number of remote locations over standard common carrier communications facilities. The Subsystem consists of a Multiplexer or Multiplexers, each of which allows up to 64 simplex communication circuits to share a computer I/O channel, and Communication Line Terminal units which properly terminate the communication circuits and translate the data from these circuits to a form compatible with the Central Processor.

The UNIVAC Standard Communication Subsystem is a result of extensive research and experience in communication oriented data processing. Operation of the subsystem is accomplished under Central Processor program control, providing a degree of adaptability which would otherwise be impossible to achieve. Personnel responsible for programming the Standard Communication Subsystem will feel completely at ease with it because of its similarity to other standard subsystems. Excellence in hardware design, combined with complete Central Processor control, result in a fully integrated total system which is capable of handling the most complex communications problems.

Outstanding features of the Subsystem are:

■ **FLEXIBILITY**

The UNIVAC Standard Communication Subsystem enables a Central Processor to utilize all available common carrier tariff offerings by transmitting and receiving data in any accepted code structure up to eight bits per character, and at all standard transmission rates up to 4800 bits per second.

■ **MODULARITY**

The Subsystem has been designed on a modular basis so that no customer need be penalized by a system which is too large or too small for his actual demands. As few as one or as many as several hundred lines may be terminated by the Subsystem.

■ **RELIABILITY**

Simplicity and standardization in basic design, coupled with the same standards of manufacturing excellence which have always been associated with UNIVAC products, result in a subsystem which will enable the user to approach the ultimate in system reliability.

■ **SPEED**

The Standard Communication Subsystem is capable of transfer rates up to 62,500 characters per second. High speed multiplexing of communication lines permits the most stringent demands, relative to response times, to be met with ease.

■ **ECONOMY**

The UNIVAC Standard Communication Subsystem offers an approach to communications oriented data processing which is unsurpassed in economic justification. Hardware configurations are priced to meet the exact requirements of the user's system.

A. SUBSYSTEM COMPONENTS

The UNIVAC Standard Communication Subsystem consists of two principal elements: Communication Line Terminals (CLTs), which establish direct connection with the communications facilities; and Communication Multiplexers, through which the CLTs deliver data to or receive data from the Central Processor. A third element, Scanner Selectors, may also be employed for special high volume applications.

1. Communication Line Terminals (CLTs)

There are three basic kinds of input and output CLTs: low speed (up to 300 bits per second); medium speed (up to 1600 bits per second); and high speed (2000 to 4800 bits per second). Each is easily adjusted to the speed and other characteristics of the communications line with which it is to operate. These CLTs are used when data is transmitted to or from the Central Processor.

In addition to these CLTs, the Standard Communication Subsystem also provides a special output CLT which is not used for data transmission, the CLT-Dialing. This CLT is used to permit the Central Processor automatically to establish connections with remote points via the common carrier's switching network. Since the CLT-Dialing does not transmit data, it is always used in conjunction with an output CLT, an input CLT or, for two way communications, both.

Each CLT requires one position, either input or output, of the Communication Multiplexer.

a. Interface Modules

Modules are provided to interface CLTs with currently available modems* in addition to telegraph facilities** for which no modem is necessary. Where required, interface modules conform to EIA*** specifications. The modular concept of the Standard Communication Subsystem permits the addition of new interface modules as new offerings are made available by the common carriers. Jacks are provided on each telegraph interface module which permit a teletypewriter to monitor all data passing through the interface.

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*Modem — contraction of modulator-demodulator. A modem is a device which converts data from a form which is compatible with data processing equipment to one which is compatible with transmission facilities and vice-versa. Interfaces are available for the following AT&T Data Sets: 103A, 202A, 202B, 402A, 402B, 402C, 402D, 201A, 201B, and 801A. An interface is also available for the IBM 068 Telephone Signal Unit.

** For telegraphic applications, a relay type interface is provided which is compatible with with neutral telegraphic lines.

*** Interface modules are available which conform to the Electronic Industries Association standards defined in EIA RS-232.

Fig. 3-1. Basic Data Set

b. Clocks

All CLTs require a timing source to establish the proper sequencing of data bits or characters as they are transferred to and from the communication facilities. Medium speed parallel input CLTs, dialing CLTs, and high speed synchronous input and output CLTs use the modem or dialing unit to which they are connected as their timing source, while all other CLTs use electronic clocks which are components of the Standard Communication Subsystem as their timing source.

Each asynchronous input CLT has its own clock; however, all asynchronous or parallel output CLTs which operate at the same speed share a common clock. Up to six output clocks are provided with the Subsystem.

c. Registers

Communication facilities usually operate in a bit serial, character serial mode in contrast to UNIVAC processing systems which handle data characters in a bit parallel, character serial mode. One of the principal functions of serial CLTs is to provide compatibility by performing a serial to parallel conversion for each input data character, or a parallel to serial conversion for each output data character. To accomplish this function, input CLTs are equipped with an assembly register in which each serial character, as it is received, (5, 6, 7 or 8 bits per character, depending on the code structure) is assembled into a complete parallel data character. Output CLTs are similarly equipped with a disassembly register.

With low speed CLTs, data must be transferred between the CLT and the Central Processor in the time interval between the arrival of the last data bit of one character and the start bit of the next character. Medium and high speed CLTs, however, contain a single character buffer or queuing register which permits a time interval corresponding to the length of a complete data character between data transfers.

Parallel CLTs (CLT Parallel and CLT Dialing) contain no registers. A time interval corresponding to the time between characters elapses between data transfers. The communications facilities to which they are attached operate in a bit parallel, character serial mode which eliminates the need for assembly or disassembly registers.

INPUT COMMUNICATION LINE TERMINALS (CLT's)

	LOW SPEED		MEDIUM SPEED		HIGH SPEED
NAME	CLT51L	CLT81L	CLT81M	CLT81P	CLT81H
CODE	5 LEVEL	6,7, or 8 LEVEL	5,6,7, or 8 LEVEL	8 LEVEL	5,6,7, or 8 LEVEL
MODE	*ASYNCHRONOUS	ASYNCHRONOUS	ASYNCHRONOUS	***TIMING SIGNAL	**SYNCHRONOUS
	BIT SERIAL	BIT SERIAL	BIT SERIAL	BIT PARALLEL	BIT SERIAL
SPEED	UP TO 300 bps	UP TO 300 bps	UP TO 1600 bps	UP TO 75 cps	2000-4800 bps

OUTPUT COMMUNICATION LINE TERMINALS (CLT's)

	LOW SPEED		MEDIUM SPEED		HIGH SPEED	† DIALING
NAME	CLT50L	CLT80L	CLT80M	CLT80P	CLT80H	CLT DIALING
CODE	5 LEVEL	6,7, or 8 LEVEL	5,6,7, or 8 LEVEL	8 LEVEL	5,6,7, or 8 LEVEL	4 LEVEL
MODE	ASYNCHRONOUS	ASYNCHRONOUS	ASYNCHRONOUS	TIMING SIGNAL	SYNCHRONOUS	TIMING SIGNAL
	BIT SERIAL	BIT SERIAL	BIT SERIAL	BIT PARALLEL	BIT SERIAL	BIT PARALLEL
SPEED	UP TO 300 bps	UP TO 300 bps	UP TO 1600 bps	UP TO 75 cps	2000-4800 bps	VARIABLE

COMMUNICATION MULTIPLEXER

NAME	FUNCTION
C/M–4	Connects 2 input and 2 output CLT's to General Purpose Channel
C/M–8	Connects 4 input and 4 output CLT's to General Purpose Channel
C/M–16	Connects 8 input and 8 output CLT's to General Purpose Channel
C/M–32	Connects 16 input and 16 output CLT's to General Purpose Channel
C/M–64	Connects 32 input and 32 output CLT's to General Purpose Channel

Types of Communication Service provided:

PRIVATE LINE TELETYPEWRITER
WIDE AREA DATA SERVICE (WADS)
TELETYPEWRITER EXCHANGE SERVICE (TWX)
WIDE AREA TELEPHONE SERVICE (WATS)
PRIVATE LINE TELEPHONE
DIRECT DISTANCE DIALING (DDD)

Fig. 3-2. UNIVAC Standard Communication Subsystem Characteristics

†*CLT — Dialing — This is an output CLT employed when the Central Processor is automatically to establish communications with remote points via the common carrier's switching network.*

*ASYNCHRONOUS — Employs start and stop bit with each character to establish timing.

**SYNCHRONOUS — Uses timing characters at pre-determined intervals between data characters.

***TIMING SIGNAL — Indicates the presence of a character at a Data Set.

LOW SPEED ASYNCHRONOUS CLTS

INPUT

FROM COMMUNICATION FACILITIES

TO INPUT CHANNEL   TO C/M
VIA C/M
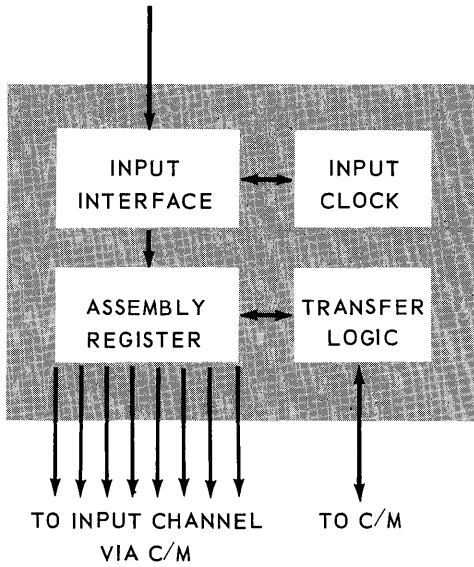
Figure 3-3

MEDIUM SPEED ASYNCHRONOUS CLTS

INPUT

FROM COMMUNICATION FACILITIES

TO INPUT CHANNEL   TO C/M
VIA C/M
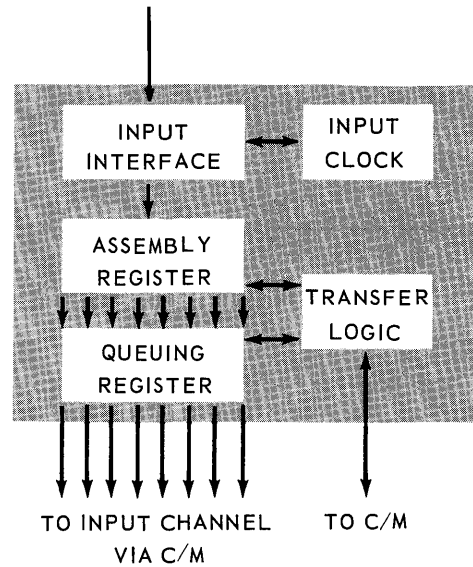
Figure 3-5

OUTPUT

TO COMMUNICATION FACILITIES

FROM OUTPUT CHANNEL   TO C/M
VIA C/M
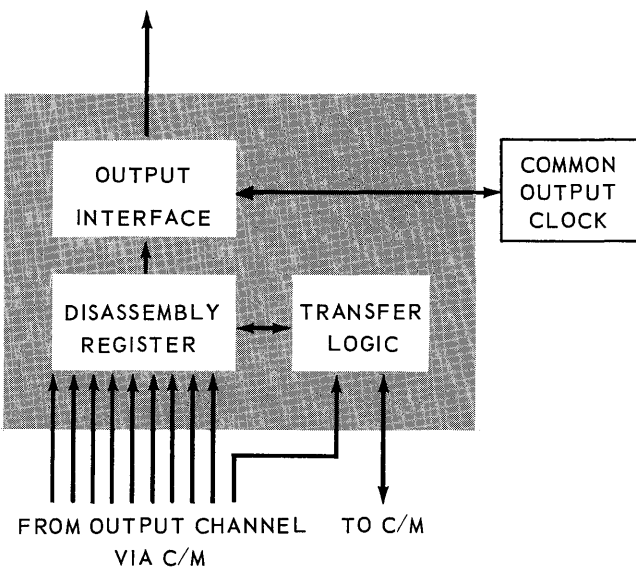
Figure 3-4

OUTPUT

TO COMMUNICATION FACILITIES

FROM OUTPUT CHANNEL   TO C/M
VIA C/M
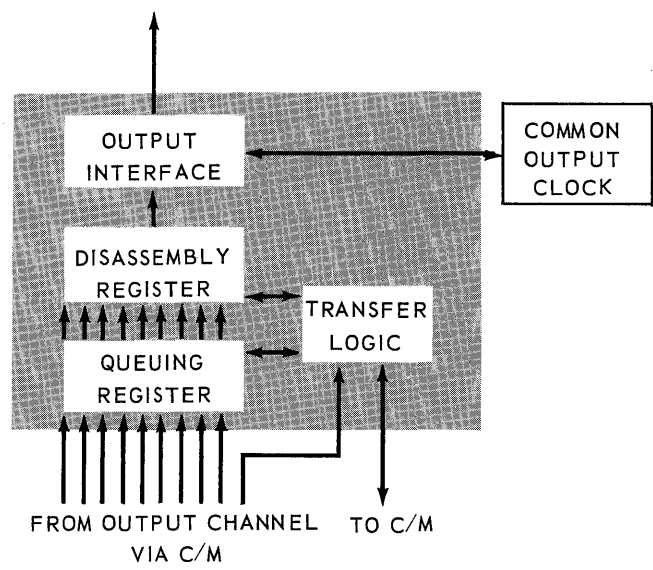
Figure 3-6

MEDIUM SPEED PARALLEL CLTS

INPUT

FROM COMMUNICATION FACILITIES
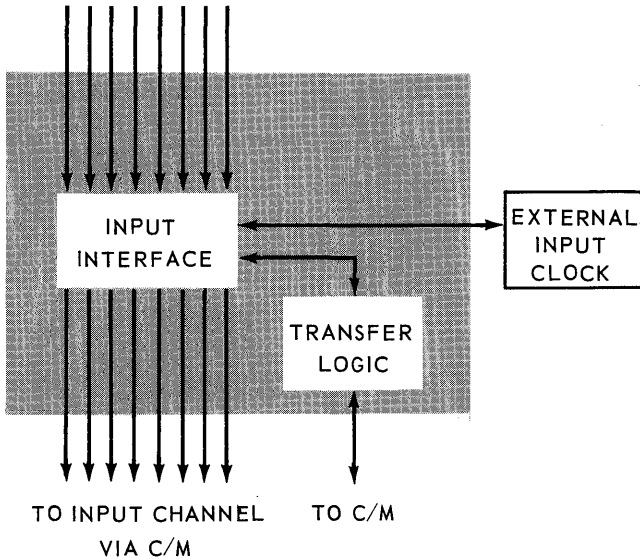
INPUT INTERFACE

EXTERNAL INPUT CLOCK

TRANSFER LOGIC

TO INPUT CHANNEL VIA C/M   TO C/M

Figure 3-7

OUTPUT

TO COMMUNICATION FACILITIES

OUTPUT INTERFACE

COMMON OUTPUT CLOCK

TRANSFER LOGIC

FROM OUTPUT CHANNEL VIA C/M   TO C/M

Figure 3-8

HIGH SPEED SYNCHRONOUS CLTS

INPUT

FROM COMMUNICATION FACILITIES

INPUT INTERFACE

EXTERNAL INPUT CLOCK

ASSEMBLY REGISTER

TRANSFER LOGIC

QUEUING REGISTER

TO INPUT CHANNEL VIA C/M   TO C/M
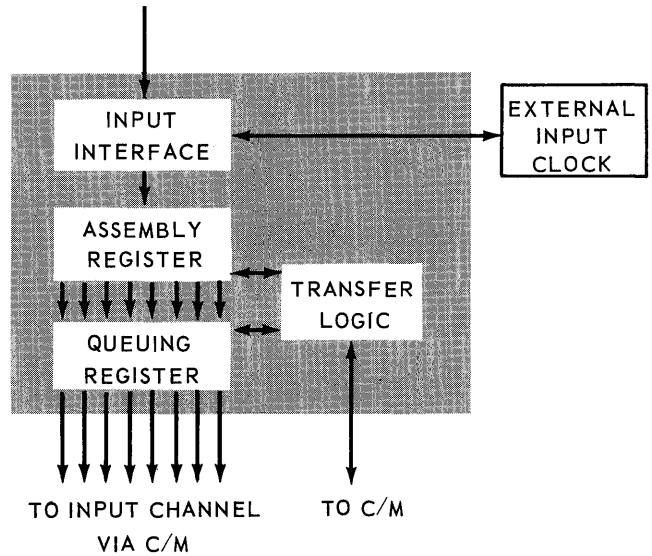
Figure 3-9

OUTPUT

TO COMMUNICATION FACILITIES

OUTPUT INTERFACE

EXTERNAL OUTPUT CLOCK

DISASSEMBLY REGISTER

TRANSFER LOGIC

QUEUING REGISTER

FROM OUTPUT CHANNEL VIA C/M   TO C/M
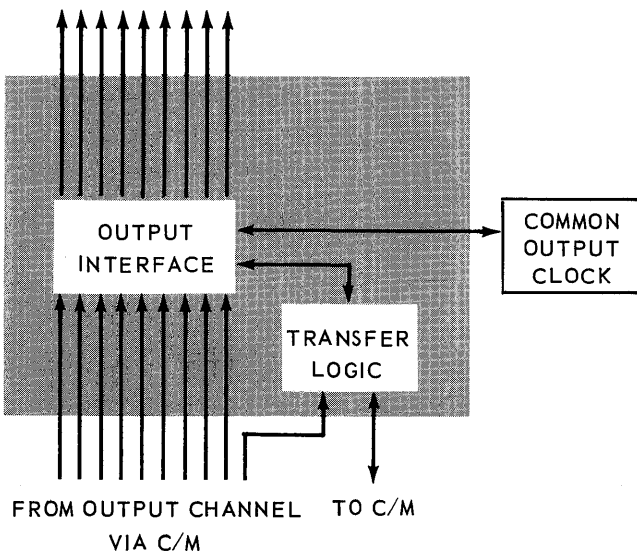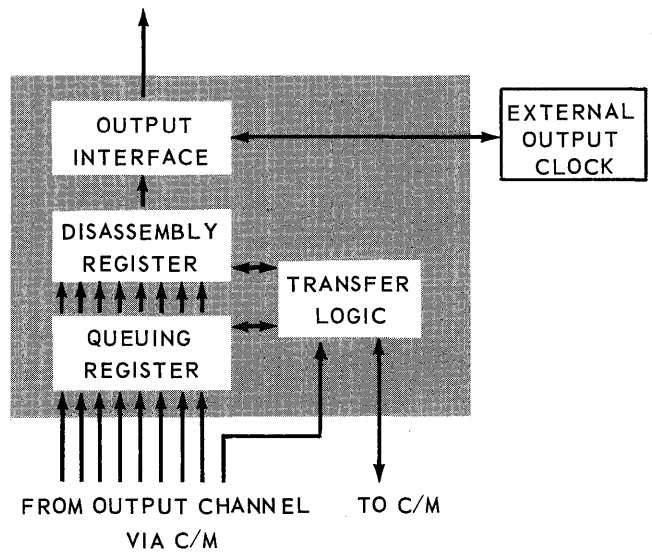
Figure 3-10

d. CLT Identifier

The CLT Identifier is used in all Standard Communication Subsystem Function Words, (computer generated instructions to the Subsystem.) Each pair of input/output CLTs in a UNIVAC Standard Communication Subsystem has a unique seven bit address (CLT Identifier) which enables a Central Processor to distinguish it from other input/output pairs in the Subsystem.

e. Unattended Operation

Connections established through the common carrier's dial switching network for the purpose of data transmission are in many ways identical to similar connections for voice communication. A telephone number must be dialed and the called party must answer before any transmission or conversation can take place. When the transmission or the conversation is finished; both the calling and the called party must hang up before another call can be made or received.

The UNIVAC Standard Communication Subsystem can be equipped automatically to dial remote locations using the CLT-Dialing and automatically to hang up upon the completion of a data transmission by using the unattended operation feature on any output CLT.

Most Telephone Company Data Sets can be equipped for unattended operation. This means that the Data Set will automatically answer any incoming calls which are directed to it. The Data Set, however, has no way of recognizing the termination of a transmission and, for this reason, the signal to disconnect must come from the associated CLT.

Similarly, when the Central Processor dials a remote location, the CLT must signal its associated Data Set to disconnect after the transmission is completed.

Automatic Calling Units, supplied by the Telephone Company, must be disconnected from their associated transmission lines between every call. The CLT-Dialing must signal the Automatic Calling Unit to disconnect after a connection has been established.

The ability to hang up or disconnect is provided by the unattended operation feature. This feature is provided on output CLTs only; however, the function of hanging up after input data transmission can be performed by an output CLT.

2. Communication Multiplexer

The Communication Multiplexer functions as the link between the processor and the CLT's and is available in modules to handle 4, 8, 16, 32, or 64 CLT's. In each of these modules, an equal number of input and output CLT positions are provided. For example, a 64 position Communication Multiplexer can accommodate up to 32 input and up to 32 output CLT's.

One or more Communication Multiplexers may be connected to any general purpose computer input/output channel through a Scanner Selector. Some UNIVAC computer systems have the ability to utilize several input/output channels for Communication Multiplexers. The total number of multiplexers which may be connected to any channel or to any system is dependent on the number, speed and activity of the communication lines linked to the multiplexers.

a. Externally Specified Index Address

Access to the Central Processor input/output channel is granted only when a Communication Line Terminal requests such access. Any data transfer, input or output, is therefore initiated by the Communication Line Terminal since only it responds directly

to its associated communication line's data needs. Since the data volumes and trans-
mission rates (bits or characters per second) may be completely variable for a number of
communication lines associated with a Communication Multiplexer, the Communication
Line Terminals will initiate data transfers in a completely random pattern over a given
period of time. Therefore, the Communication Multiplexer must identify, in a unique way,
the Communication Line Terminal requesting the data transfer each time an access is
made to the processor input/output channel. This identification is accomplished by an
Externally Specified Index Address (ESI Address).

Each Communication Multiplexer is capable of generating 64 unique ESI Addresses. The
ESI Address consists of 15 bits which are transferred to the Central Processor with each
input data transfer and with each request for output data. The six low order bits of the
ESI Address originate at a specific CLT. These six bits are fixed in the sense that each
of the 64 positions of the Communication Multiplexer is permanently wired to generate a
unique six bit code. The remaining nine high order positions of the ESI Address are
plugboard wired and may be varied to meet the user's requirements.

b. Priority

The UNIVAC Standard Communication Subsystem has been designed to handle a multiplic-
ity of different speed communications facilities in the most efficient manner possible. The
Communication Multiplexer contains priority logic which permits high speed facilities to
be serviced more frequently than low speed facilities on a completely random basis. Each
of the 64 positions of the Communication Multiplexer has a number (00-77 octal) which is
used to establish service priority. Input CLTs are connected to the odd numbered positions
while output CLTs are connected to the even numbered positions. The Communication
Multiplexer simultaneously samples all CLTs requesting service and grants service priority
to the CLT connected to the highest numbered position, regardless of whether it is input or
output. After each data transfer, all service requests are re-examined to determine the
highest remaining priority.

3. Scanner Selector

In cases where more than one Communication Multiplexer is used on a single input/output
computer channel, a Scanner Selector must be employed to control the simultaneous operation
of the multiplexers. A maximum of four multiplexers may be connected to one Scanner Selector.
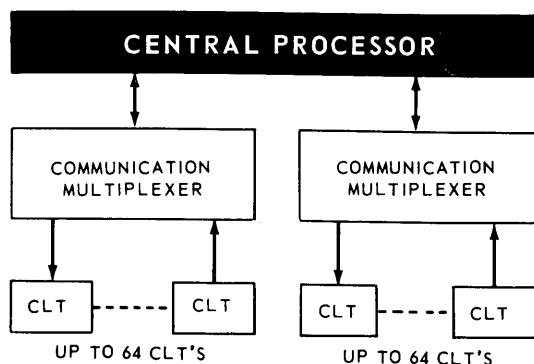
Figure 3-11. One Communication Multiplexer per
General Purpose Channel
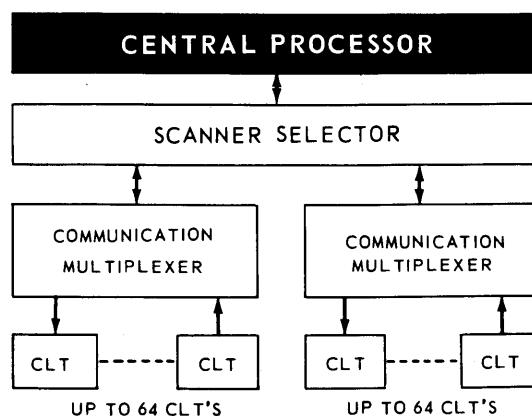
Figure 3-12. Multiple Communication Multiplexers per
General Purpose Channel using Scanner Selector

B. PHYSICAL DESCRIPTION

The Standard Communication Subsystem is housed in two central site peripheral cabinets. One cabinet contains the power supply for the Subsystem as well as space for interface modules for all of the currently available communications offerings. The second cabinet contains the Communication Multiplexer as well as space for 32 input and 32 output CLTs, space for a spare Communication Multiplexer, and space for six output clocks.

1. Operator's Control Panel

An Operator's Control Panel, located at the computer console or in some other strategic position depending on the processing system to which the Standard Communication Subsystem is attached, provides all of the necessary switches and indicators to keep the operator advised of the status of the Subsystem. The following switches and indicators are provided:
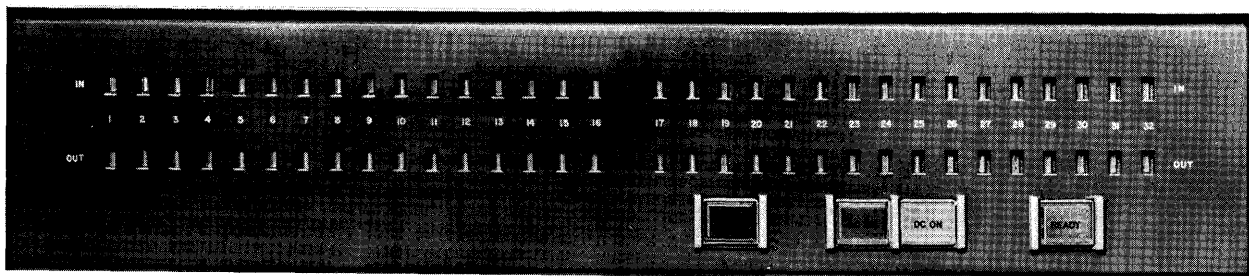
Fig. 3-13. Operator's Control Panel

a. Ready (Switch/Indicator)

The Ready indicator is lit when all conditions necessary to operate the Standard Communication Subsystem are satisfied. When any of the following conditions are detected, the Subsystem is placed in a nonready condition and the Ready indicator is turned off.

    1. AC Power Fault

    2. DC Power Fault

    3. Overheat

If none of the above conditions are present, depression of the Ready switch will render the Subsystem available for use and cause the Ready indicator to be lit.

b. AC-ON (Indicator)

With the AC circuit breaker open, the AC-ON indicator will not be lit and the DC power cannot be energized. With the circuit breaker closed and the power on, the AC-ON indicator will be lit. If a power fault condition exists, the indicator will be extinguished.

c. DC-ON (Switch/Indicator)

When the AC-ON indicator is lit, the DC switch can be depressed to bring the DC power to its operating level. Loss of DC power will place the Subsystem in a nonready condition. The DC-ON indicator is lit when DC power is on.

d. TEMP (Indicator)

This indicator will light and a warning buzzer will sound when the temperature within the cabinet reaches 95°F due to unfavorable external conditions. The buzzer can be stopped by pressing the TEMP switch on the Diagnostic panel. When an excessive heat condition of 105°F is reached, the Subsystem will be placed in the nonready condition and the AC and DC power will be shut down automatically. This will remove all power to the blowers.

e. Active Line (Indicator)

An Active Line Indicator is provided for each of the 64 possible CLTs connected to the Subsystem. These indicators light whenever their respective CLTs are receiving or transmitting data.

2. Diagnostic Panel

A Diagnostic Panel is located on the front of the Subsystem cabinet. It is hidden from view but accessible to the operator for corrective action as required. The Diagnostic Panel contains the following indicators:

a. Ready (Indicator)

Operates in the same manner as the Ready indicator on the Operator's Panel. However, there is no Ready switch so that maintenance personnel cannot accidentally activate the Subsystem.

b. AC-ON (Indicator)

Same as on Operator's Panel.

c. DC-ON (Switch/Indicator)

Same as on Operator's Panel.

d. TEMP (Switch/Indicator)

Same as on Operator's Panel with a switch added. When this switch is depressed, the TEMP buzzer will be stopped.

C. PHYSICAL SPECIFICATIONS

Cabinets Required (adjacent)	2 per Communication Multiplexer
Cabinet Dimensions	Width – 48 inches Depth – 26 inches Height – 96 inches 80 inches optional
Clearance Required	Front – 48 inches Rear – 42 inches
Weight per Cabinet	2,000 pounds
Power	208 volt, 3 phase, 4 wire, 5.3 KVA 120 volt, single phase, 2 wire, .6 KVA

Heat Dissipation per Cabinet   6,000 BTU

Temperature Limits   Maximum — 80°F
                                            Minimum — 60°F

Humidity Limits   Maximum — 70%
                                            Minimum — 40%

1. Inter Cabinet Cabling

From	To	Maximum Length
Multiplexer	Processor	300 feet
CLT	Modem	50 feet
CLT	Telegraph Line	Unlimited
CLT	Operator's Panel	250 feet

4. SUBSYSTEM OPERATION

The UNIVAC Standard Communication Subsystem operates in a manner much like any other UNIVAC peripheral subsystem. When adapted to a processor input/output channel, it controls the transfer of data between the processor and a broad range of remote input/output devices.

A. PROCESSOR INTERFACE

The transfer of data between the processor and the Standard Communication Subsystem takes place through input data leads connected to the processor input channel, and output data leads connected to the processor output channel. In addition to the data leads, there are several control leads which are used to control the flow of data.

1. Output Data Leads

There are ten output data leads. They originate at the processor output channel and they terminate at the output CLT. The External Function lead is monitored by the CLTs to distinguish between Function Words and data characters. If the External Function lead is active, the character on the output data leads is interpreted as a Function Word; if it is not active, the character is interpreted as data. Only the data characters are transferred to the transmission facilities.

2. External Function

This lead is activated by the processor when the character on the output data leads is a Function Word rather than data.

3. Input Acknowledge

This lead is activated by the processor upon completion of an input data transfer.

4. Output Acknowledge

This lead is activated by the processor upon completion of an output data transfer.

5. Externally Specified Index Leads

There are 15 Externally Specified Index leads. Six of these leads originate at the CLT positions of the Communication Multiplexer, while the remaining nine leads originate at a plugboard in the Communication Multiplexer. All 15 leads terminate at the processor input channel. These leads are active with each input data character and with each Output Data Request.

6. Input Data Leads

There are eight input data leads. They originate at the input CLT and they terminate at the processor input channel.

7. Output Data Request

This lead is activated by the Communication Multiplexer whenever it is signaled by a CLT that the CLT is ready to receive another data character from the processor.

8. Input Data Request

This lead is activated by the Communication Multiplexer whenever an input CLT has a data character ready to transfer to the processor.

9. Externally Specified Index Line

This line is active when operating in the ESI mode.
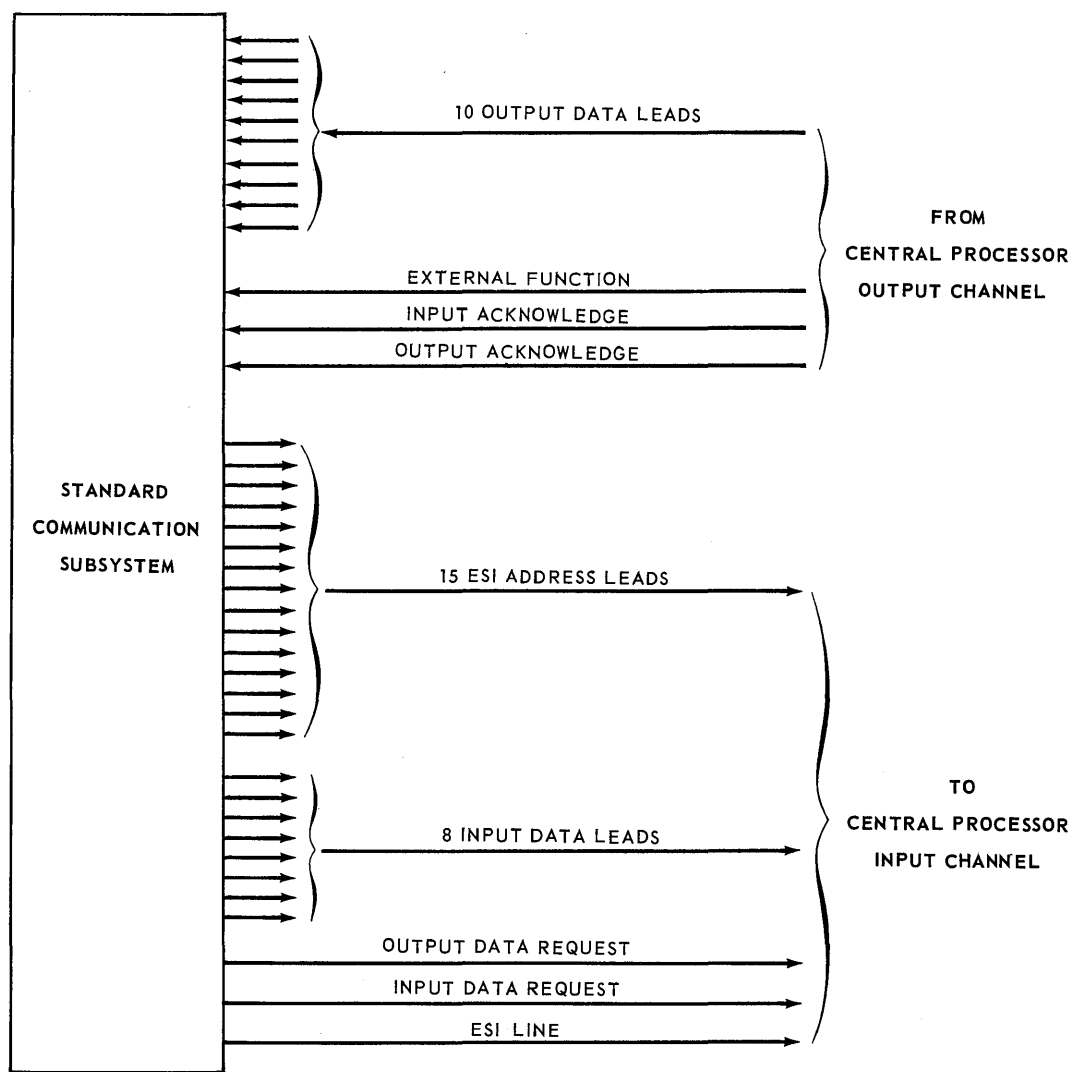
Figure 4-1. UNIVAC Standard Communications Subsystem Control and Data Leads

B. INPUT DATA TRANSFERS

An input data transfer will generally be accomplished in the following manner:

1. The input CLT receives a complete data character from the communication line.

2. CLTs with queuing registers transfer the data character to the queuing register and are ready to receive the next data character from the communication line.

3. The CLT signals the Communication Multiplexer that it has a complete data character ready to transfer to the processor.

4. When the Communication Multiplexer priority circuitry determines that it is ready to transfer the data character, it connects to the processor input channel the eight input data leads, the six Externally Specified Index leads which originate at the CLT, and the nine Externally Specified Index leads which originate at the Communication Multiplexer. It simultaneously activates the Input Data Request lead to the processor.

5. When the processor has accepted and stored the data character, it will activate the Input Acknowledge lead.

6. Receipt of the Input Acknowledge signal will cause the Communication Multiplexer to release its Input Data Request. It will also disconnect the Input Data leads and Externally Specified Index leads from the processor input channel. The Communication Multiplexer is then free to service another Communication Line Terminal.

This cycle will be repeated for each input CLT when it receives a complete data character from its associated communication line.

1. High Speed Input Data Transfers

The transfer of data using high speed CLTs is exactly as described above. However, one additional step is necessary before the actual transfer of data can take place.

High speed input CLTs have the ability to compare the character received in their assembly registers with some predetermined bit configuration called a synchronizing character. The CLT analyzes each character as it is received from the communication facility, but does nothing with these characters until it detects a synchronizing character. The CLT then reverts to a data transfer mode.

More than one synchronizing character may preceed each data message. Any character received after the detection of not less than two synchronizing characters will be interpreted as a data character and will be transferred to the processor.

When a complete message has been received, the Central Processor must instruct the CLT to go back into a search mode and await the arrival of the next synchronizing character. The processor activates its External Function lead and simultaneously sends a Function Word on its ten Output Data Leads. The Function Word contains a CLT Identifier Code which selects the desired CLT, as well as a Function Code which instructs the CLT to go into the search mode.

C. OUTPUT DATA TRANSFERS

All data transfers must be initiated by a Communication Line Terminal; however, an output Communication Line Terminal may not initiate an output data transfer until the processor instructs it to do so. An output data transfer will generally be accomplished in the following way:

1. *The processor activates its External Function lead and simultaneously sends a Function Word on the ten Output Data leads. The Function Word contains a CLT Identifier Code which selects the desired CLT, as well as a Function Code which signals the CLT that the processor has a message ready to send.*

2. *The CLT, recognizing the Function Code, checks its associated communications facilities to be sure they are ready for transmission.*

3. *Having determined transmission ability, the CLT signals the Communication Multiplexer that it is ready to receive a data character.*

4. *When the Communication Multiplexer priority circuitry determines that it is able to service the CLT, it connects the six Externally Specified Index leads which originate at the CLT and the nine Externally Specified Index leads which originate at the Communication Multiplexer to the processor input channel and simultaneously activates the Output Data Request lead.*

5. *When the processor has recognized the Output Data Request signal and has located the proper character for the CLT as defined by the Externally Specified Index Address on the input channel, it will place the character on the Output Data leads and activate the Output Acknowledge lead.*

6. *Recognizing the Output Acknowledge signal, the CLT will accept and store the character from the Output Data leads in its storage register. The Output Acknowledge signal will also cause the Communication Multiplexer to release its Output Data Request and disconnect the Externally Specified Index leads from the processor input channel. The Communication Multiplexer is now free to service another Communication Line Terminal.*

7. *When the CLT which just effected the output data transfer has moved the character out of the register in which it was originally stored, either by transmitting it to the communication facilities or by moving it from a queuing register to a disassembly register, depending on the type of CLT, it will again signal the Communication Multiplexer that it is ready to transmit another character.*

8. *As the last character in a transmission is transferred from the processor to the CLT, it is accompanied by a programmed End of Transmission indication as well as by the normal Output Acknowledge signal. The End of Transmission indication will cause the CLT to stop requesting data characters until the processor sends another Function Word.*

D. TIMING CONSIDERATIONS

The UNIVAC Standard Communication Subsystem is character oriented. That is, it deals with a group of bits which represent a character rather than a single bit at a time. Data characters, as they are transferred to and from transmission facilities, present a number of variables which must be carefully analyzed to assure proper operation of the Subsystem. Start and stop bits may or may not accompany each character, and the number of data bits per character as well as the character transfer rate may vary depending on the type of line facility connected to the Subsystem. Each of these factors must be taken into consideration to establish the timing relationships between the Central Processor and the Subsystem and between the Subsystem and the communications facilities.

1. Asynchronous Data Transmission

In this type of data transmission, each character consists of information bits, 5, 6, 7 or 8 depending on the code structure, preceded by a start bit (zero condition) and followed by a stop bit (one condition). Each bit in a data character is of equal time duration with the exception of the stop bit which may be one, one and one half, or two times as long as the other bits in the data character.

An asynchronous input CLT recognizes the initial change of state from the one condition as the start of a data character. It then looks at the condition of the line facilities at time intervals corresponding to the middle of each of the following information bits in order to transfer a complete data character into the assembly register.

a. Low Speed Input

Low speed input CLTs signal the Communication Multiplexer that they have an assembled character ready to transfer to the Central Processor at the same time the last information bit in the data character is transferred to the assembly register from the line. This leaves a time interval corresponding to one half an information bit plus the stop bit before the CLT recognizes the start of the next data character. The data character in the assembly register must be transferred to the Central Processor during this interval.

LOW SPEED INPUT CLT CHARACTER AVAILABILITY TIME IN MILLISECONDS

TRANSMISSION RATE – BITS/SEC.	STOP BIT(S)		
	1	1.5	2
50	30.0	40.0	50.0
75	20.0	26.6	33.3
110	13.8	18.2	22.7
300	5.0	6.7	8.3

ASYNCHRONOUS DATA TRANSFERS

5 LEVEL – 1 START – 2 STOP

—IDLE LINE —————— | ←—————— CHARACTER 1 ——————→ | ←—————— CHARACTER 2 ——————→ | ←—————— CHARACTER 3 ——————→ |

START   DATA   STOP

AVAILABLE TIME PERIOD
LOW SPEED CLT

TRANSFER CHAR. 1

TRANSFER CHAR. 2

TRANSFER CHAR. 3

AVAILABLE TIME PERIOD
MEDIUM SPEED CLT

TRANSFER CHARACTER 1

TRANSFER CHARACTER 2
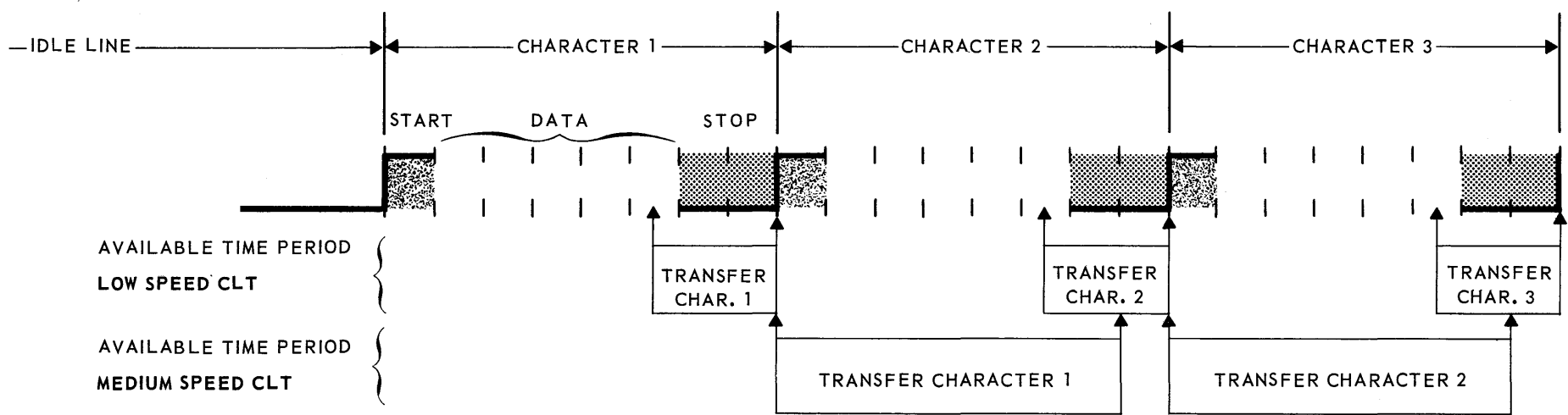
SYNCHRONOUS DATA TRANSFERS

6 LEVEL

—IDLE LINE —————— | ←— SYNCHRONIZING CHAR. —→ | ←—————— CHARACTER 1 ——————→ | ←—————— CHARACTER 2 ——————→ | ←—————— CHARACTER 3 ——————→ |

AVAILABLE TIME PERIOD
HIGH SPEED CLT

TRANSFER CHAR. 1
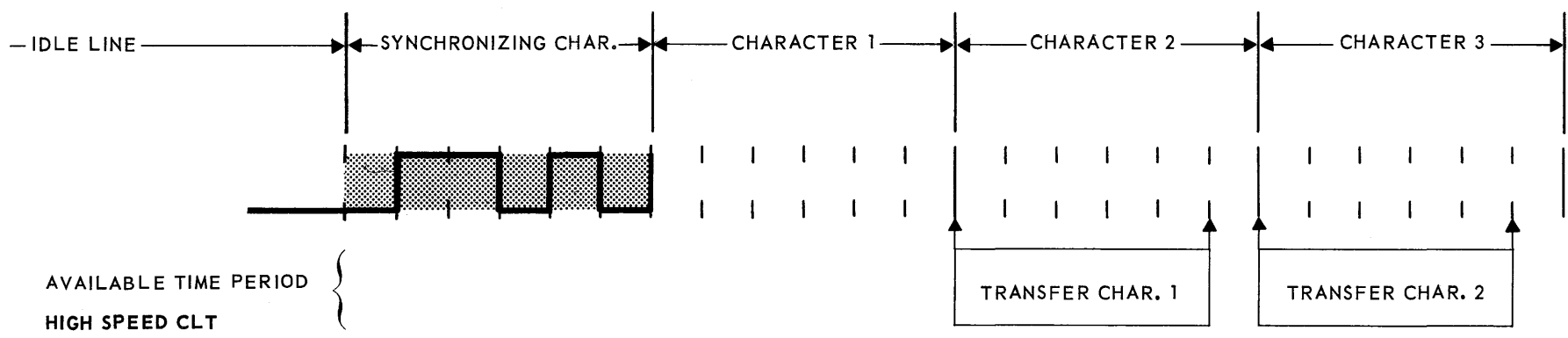
TRANSFER CHAR. 2

Figure 4-2. Time Period Available for Character Transfers

b. Medium Speed Input

Medium speed input asynchronous CLTs signal the Communication Multiplexer that they have an assembled character ready to transfer from the queuing register to the Central Processor as soon as the character has been placed in the queuing register. This character must be transferred to the Central Processor before the last bit of the following character is clocked into the assembly register.

MEDIUM SPEED INPUT ASYNCHRONOUS CLT CHARACTER AVAILABILITY TIME IN MILLISECONDS

TRANSMISSION RATE – BITS/SEC.	TOTAL BITS PER CHARACTER (INCLUDING START & STOP)								
	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0
600	10.00	10.83	11.66	12.49	13.33	14.16	15.00	15.83	16.66
750	8.00	8.66	9.33	10.00	10.66	11.33	12.00	12.66	13.33
1200	5.00	5.41	5.83	6.25	6.66	7.08	7.50	7.91	8.33
1600	3.75	4.06	4.37	4.68	5.00	5.31	5.62	5.93	6.25

c. Asynchronous Output

Timing on asynchronous output data transfers is not time critical. Since each output data character is preceded by a start bit and followed by a stop bit, the time interval between characters will appear to the transmission facilities as nothing more than an extra long stop bit. Although no information is lost if a data character is not transferred from the Central Processor to the asynchronous output CLT within the "character availability interval", a failure to do so will result in a reduced transmission rate.

2. Synchronous Data Transmission

In this type of data transmission, each character consists of 5, 6, 7 or 8 information bits depending on the code structure. There are no start and stop bits. Timing is derived through synchronizing characters at the beginning of each message or block of data.

a. High Speed Input

High speed input CLTs have the ability to recognize a synchronizing character just as low and medium speed CLTs have the ability to recognize a start bit. High speed input CLTs do not request service from the Communication Multiplexer, however, until they have assembled a complete data character following the recognition of a synchronizing character. The assembled character is placed in a queuing register from where it must be transferred to the Central Processor before the last bit of the following character is clocked into the assembly register.

HIGH SPEED CLT CHARACTER AVAILABILITY TIME IN MILLISECONDS

TRANSMISSION RATE – BITS/SEC.	TOTAL BITS PER CHARACTER			
	5	6	7	8
2000	2.00	2.50	3.00	3.50
2400	1.66	2.08	2.50	2.91
3000	1.33	1.66	2.00	2.33
4800	0.83	1.04	1.25	1.46

b. High Speed Output

Since there is no transition from the idle condition (stop bit) to a start bit to indicate to a receiving terminal the beginning of a new data character, pauses between characters will be interpreted by the receiving terminal as data bits. It is therefore important that a data character be transferred from the Central Processor to the high speed output CLT within the "character availability time". Failure to do so will result in erroneous data reception at the receiving terminal and will necessitate a re-transmission. However, proper systems analysis until provide for transfer of the data character within the "character availability time".

3. Communication Multiplexer Switching Time

As discussed elsewhere in this manual, the Communication Multiplexer contains priority logic which enables it to determine, on a priority basis, which CLT in the Subsystem should be serviced first. Thirteen microseconds elapse from the time the Communication Multiplexer is freed from its previous CLT, by receiving either an Input Acknowledge or an Output Acknowledge signal from the Central Processor, until it is able to make the next Input Data Request or Output Data Request. During this 13 microsecond interval, the Communication Multiplexer must analyze the status of all CLTs in the Subsystem, determine which CLT requesting service is connected to the Highest number multiplexer position, and perform all of the necessary switching to permit the data transfer.

4. Processor Transfer Time

Once the Communication Multiplexer has performed the necessary priority analysis and activated its Input Data Request or Output Data Request lead, some finite period of time elapes while the actual transfer of data takes place and before the Central Processor activates its Input Acknowledge or Output Acknowledge lead. This time interval is independent of the UNIVAC Standard Communication Subsystem and depends solely on the internal cycle time and channel transfer rate of the Central Processor to which the Subsystem is attached.

Example: In order to determine the ability of the Standard Communication Subsystem to handle a particular communication problem, all of the previously mentioned timing considerations must be analyzed. Assume a 32 position Communication Multiplexer connected to 16 half duplex, 1200 bit per second transmission lines using a nine level code. 16 CLT-80Ms and 16 CLT-81Ms would be used.

From the Character Availability Time chart for medium speed CLTs, a character availability time of 6.66 milliseconds is determined. This means that, in the worst possible case, 16 CLTs, either input or output, must be serviced within 6.66 milliseconds. Assume also that the Central Processor transfer time is 37 microseconds, a representative time for UNIVAC large scale systems. The total time devoted to each CLT is equal to the Communication Multiplexer switching time plus the processor transfer time or 13 microseconds plus 37 microseconds for a total of 50 microseconds. For 16 CLTs, the total time equals 16 times 50 microseconds or 0.8 milliseconds. The 16th CLT will then be serviced in 0.8 milliseconds, which is within the 6.66 millisecond character availability time. 5.86 milliseconds remain before the next data transfer will take place. This time can be used for internal processing.

APPENDIX A.

TYPICAL CONFIGURATIONS

This appendix contains simplified block diagrams depicting UNIVAC and Common Carrier equipment configurations required for operation with various remote devices and tariff offerings. These diagrams by no means cover all available equipment but are meant to represent a cross section of the state of the art in communications equipment. Only data leads are shown at the CLT/Communication line interface (complete interface descriptions are contained in the body of this manual.) Common carrier hardware and tariff offerings may change in nomenclature and nature from time to time. This appendix will be continuously updated to reflect these changes and also to add any new configurations which may appear.

TO REMOTE STATIONS

```
        ┌──────────────┐
        │  TELEPHONE   │
        │   SWITCHED   │
        │   NETWORK    │
        └──────────────┘

        WATS ACCESS LINE
           OR DDD*

   ┌──────────┐      ┌──────────┐
   │   202A   │      │   801    │
   │  MODEM   │      │  ACU**   │
   └──────────┘      └──────────┘

┌──────────┐  ┌──────────┐  ┌──────────┐
│   CLT    │  │   CLT    │  │   CLT    │
│   80M    │  │   81M    │  │   DIAL   │
└──────────┘  └──────────┘  └──────────┘

   ┌──────────────────────────────────┐
   │    COMMUNICATION MULTIPLEXER      │
   └──────────────────────────────────┘

   ┌──────────────────────────────────┐
   │             UNIVAC               │
   │        CENTRAL PROCESSOR         │
   └──────────────────────────────────┘
```
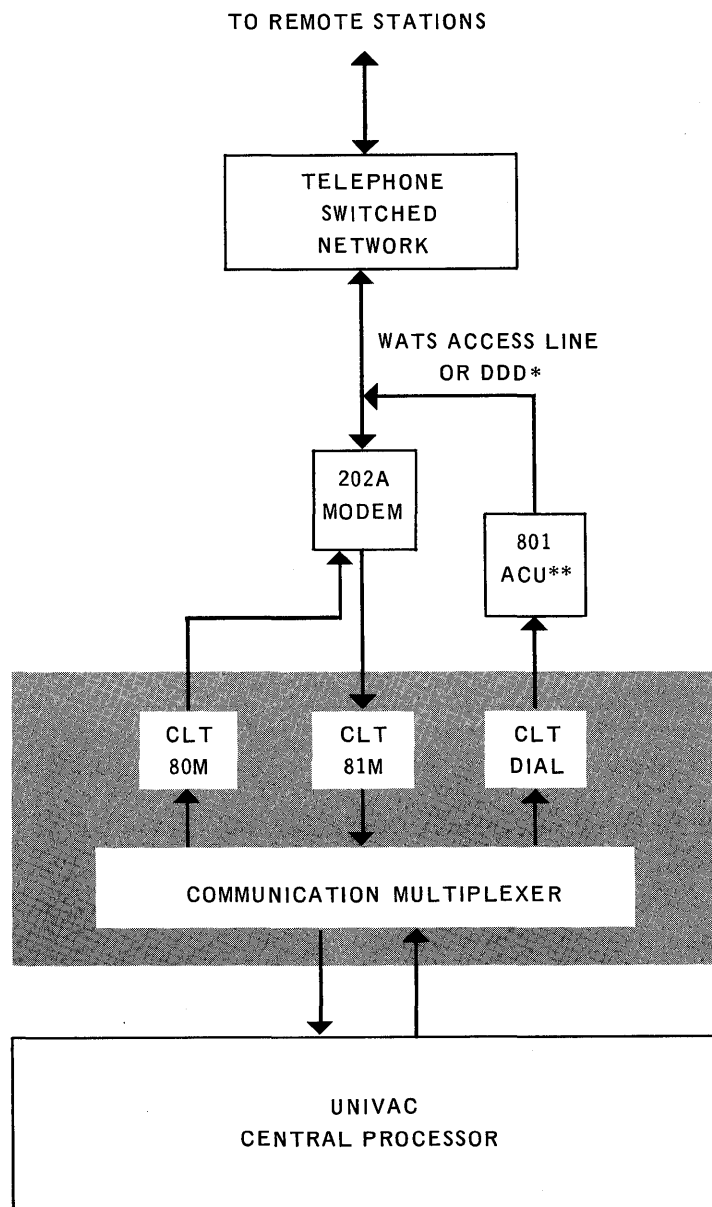
*Direct Distance Dialing
**Automatic Calling Unit

REMOTE DEVICE — Serial Data Speed Transmitter and/or
Receiver — 202A Modem (no handset)

OPERATION — Central Processor dials remote location
and establishes a connection for sending
or receiving. Remote stations input data
from paper tape and receive data on paper
tape. Maximum transfer rate — 1050 wpm,
8 level code.

Figure A-1. Computer Connection to WATS or DDD

TO REMOTE STATIONS

```
          ┌──────────────┐
          │  TELEPHONE   │
          │   SWITCHED   │
          │   NETWORK    │
          └──────────────┘
             WATS ACCESS LINE
                 OR DDD

   ┌───────────┐      ┌──────────┐
   │   201A    │      │   801    │
   │  MODEM    │      │   ACU    │
   └───────────┘      └──────────┘

  ┌────────┐  ┌────────┐  ┌────────┐
  │  CLT   │  │  CLT   │  │  CLT   │
  │  80H   │  │  81H   │  │  DIAL  │
  └────────┘  └────────┘  └────────┘

  ┌──────────────────────────────────┐
  │    COMMUNICATION MULTIPLEXER      │
  └──────────────────────────────────┘

  ┌──────────────────────────────────┐
  │             UNIVAC               │
  │       CENTRAL PROCESSOR          │
  └──────────────────────────────────┘
```
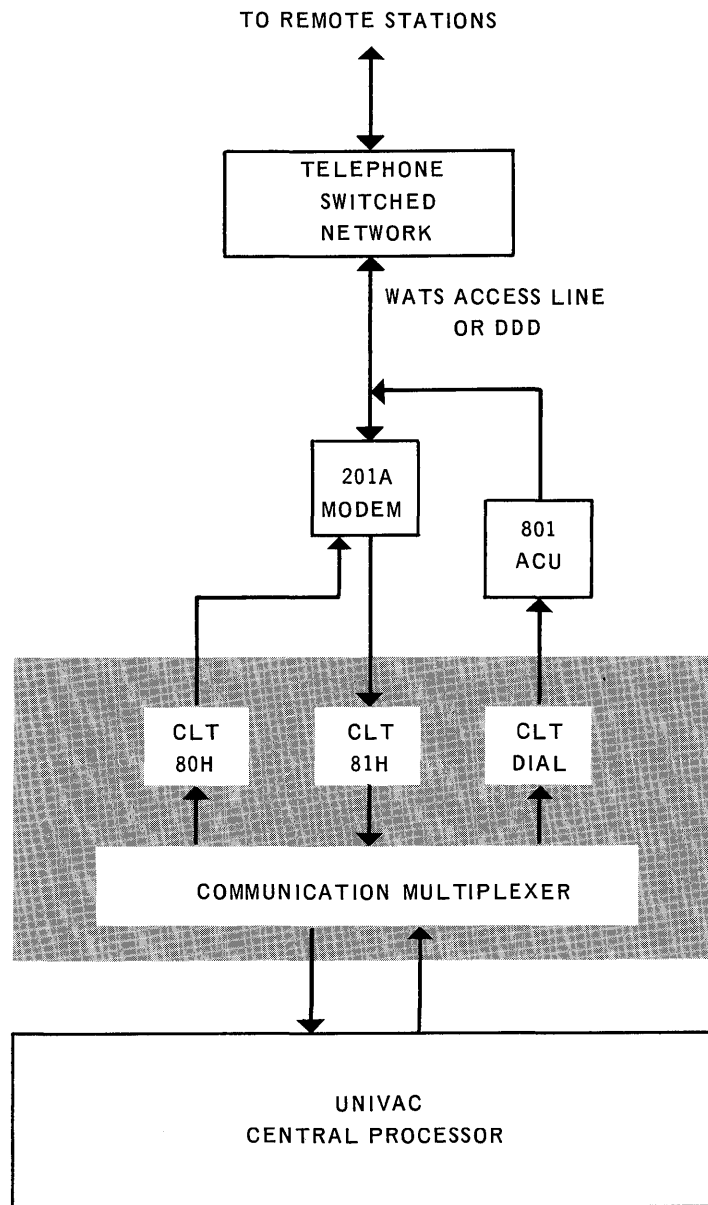
REMOTE DEVICE — UNIVAC 1004 DLT-1 System (Data Line Terminal included) — 201A Modem (no handset)

OPERATION — Central Processor dials remote location and establishes connection for nonsimultaneous sending and receiving. Remote stations input data from punched cards and receive data on punched cards or hard copy. Typical transfer rates:

Print (80 chars/line, full font) — 130 1pm
Punch (40 column)   — 200 cpm

Figure A-2. Computer Connection to WATS or DDD

TO REMOTE STATIONS

```
                    ┌─────────────────┐
                    │   TELEPHONE     │
                    │   SWITCHED      │
                    │   NETWORK       │
                    └─────────────────┘

                     WATS ACCESS LINE
                         OR DDD

         ┌──────────┐        ┌──────────┐
         │  402C    │        │   801    │
         │  MODEM   │        │   ACU    │
         └──────────┘        └──────────┘

              ANSWER
               BACK

    ┌─────────┐  ┌─────────┐  ┌─────────┐
    │  CLT    │  │  CLT    │  │  CLT    │
    │  80P    │  │  81L    │  │  DIAL   │
    └─────────┘  └─────────┘  └─────────┘

    ┌──────────────────────────────────────┐
    │      COMMUNICATION MULTIPLEXER        │
    └──────────────────────────────────────┘

    ┌──────────────────────────────────────┐
    │                                       │
    │            UNIVAC                     │
    │       CENTRAL PROCESSOR               │
    │                                       │
    └──────────────────────────────────────┘
```

REMOTE DEVICE — Parallel Data Speed Receiver — 402D
Modem

OPERATION — Central Processor dials remote locations
and establishes connection for sending
only. Remote stations receive data on
paper tape. Maximum transfer rate — 75
characters/second, 8 level code.

Figure A-3. Computer Connection to WATS or DDD

TO REMOTE STATIONS

```
                  ┌─────────────┐
                  │  TELEPHONE  │
                  │  SWITCHED   │
                  │  NETWORK    │
                  └─────────────┘

              WATS ACCESS LINE
                 OR DDD

        ┌──────────┐        ┌──────────┐
        │  402D    │        │   801    │
        │  MODEM   │        │   ACU    │
        └──────────┘        └──────────┘

  ANSWER BACK

┌──────────┐  ┌──────────┐  ┌──────────┐
│  CLT     │  │  CLT     │  │  CLT     │
│  80L     │  │  81P     │  │  DIAL    │
└──────────┘  └──────────┘  └──────────┘

┌──────────────────────────────────────┐
│     COMMUNICATION MULTIPLEXER         │
└──────────────────────────────────────┘

┌──────────────────────────────────────┐
│              UNIVAC                    │
│         CENTRAL PROCESSOR             │
└──────────────────────────────────────┘
```
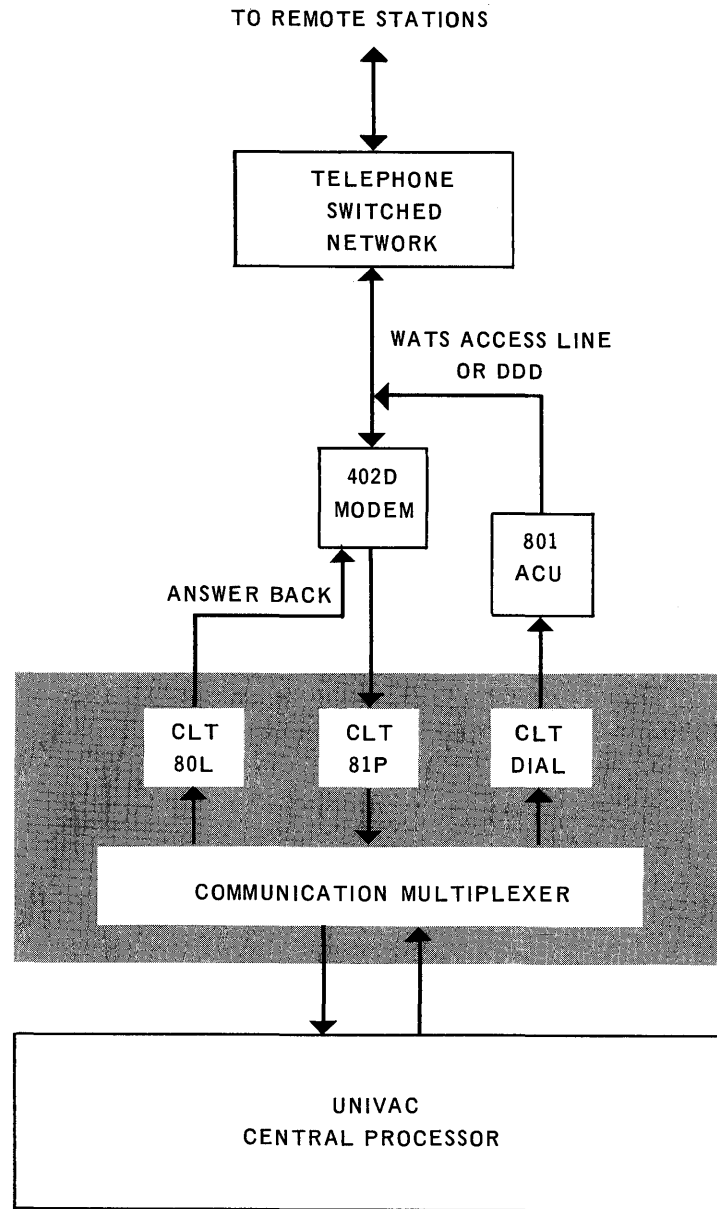
REMOTE DEVICE – Parallel Data Speed Transmitter – 402C
Modem.

OPERATION – Central Processor dials remote locations
and establishes connections for receiving
only. Remote stations send data from paper
tape. Maximum transfer rate – 75
characters/second, 8 level code.

Figure A-4. Computer Connection to WATS or DDD

TO REMOTE WADS
OR TWX STATIONS

TELEPHONE
SWITCHED
NETWORK

WADS OR TWX ACCESS LINE

103
MODEM

801
ACU

CLT
80L

CLT
81L

CLT
DIAL

COMMUNICATION MULTIPLEXER

UNIVAC
CENTRAL PROCESSOR
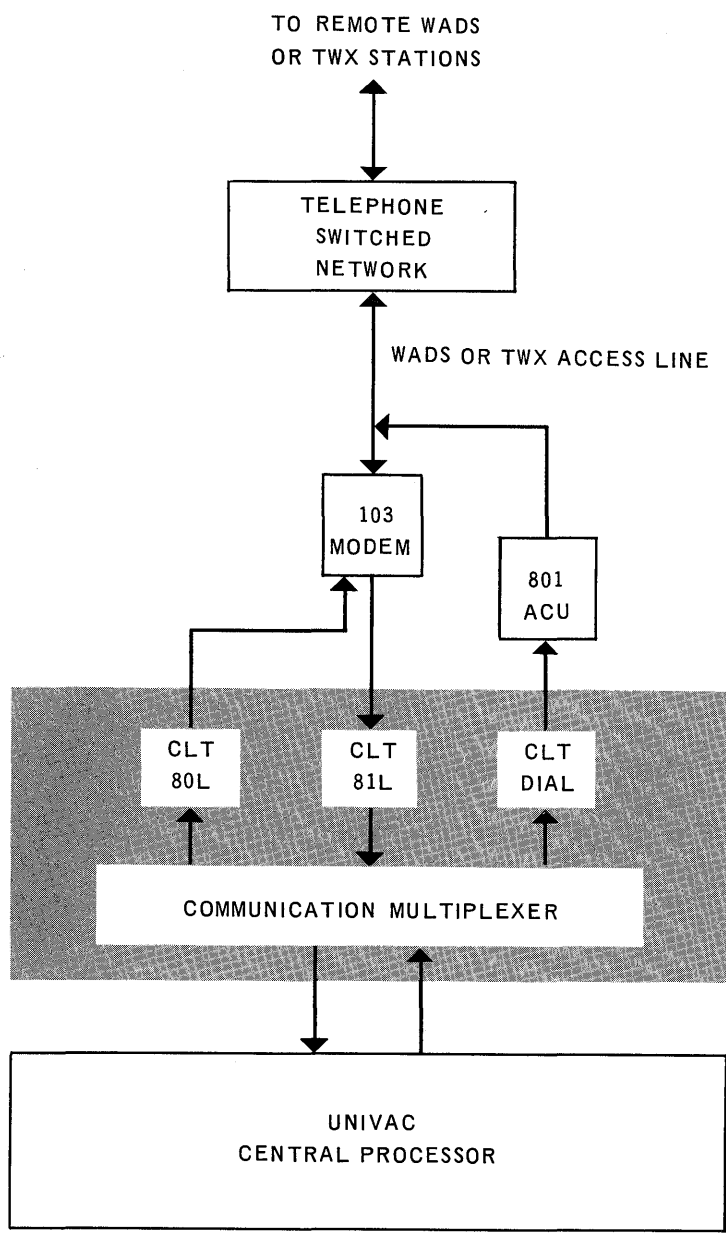
REMOTE DEVICE – 30 series Teletype ASR and 103 Modem

OPERATION – Central Processor dials remote locations and establishes initial direction of transmission. Remote stations input data from keyboard or paper tape and receive data on paper tape or hard copy.
Maximum transfer rate – 100 wpm, 8 level code.

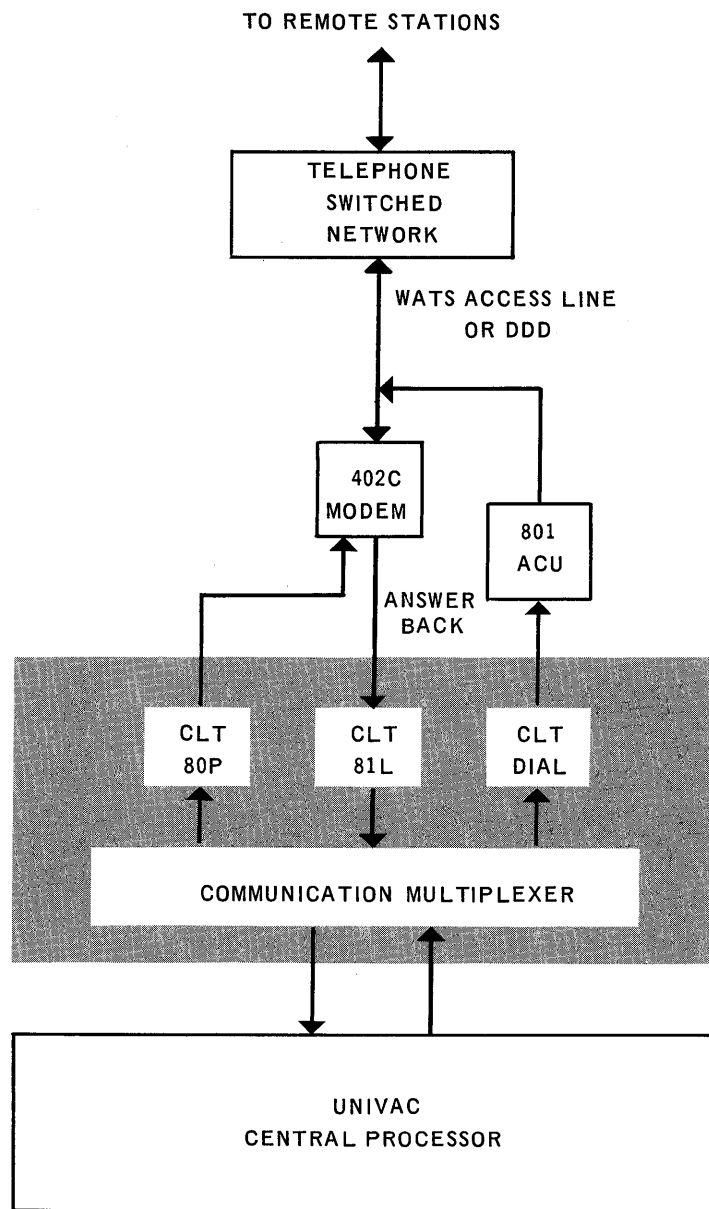*Figure A-5. Computer Connection to WADS or TWX*

TO REMOTE LOCATIONS

LEASED TELEPHONE FACILITY
(HALF OR FULL DUPLEX)

MODEM

UNATTENDED
OPERATION

CLT
OUT

CLT
IN

COMMUNICATION MULTIPLEXER

UNIVAC
CENTRAL PROCESSOR
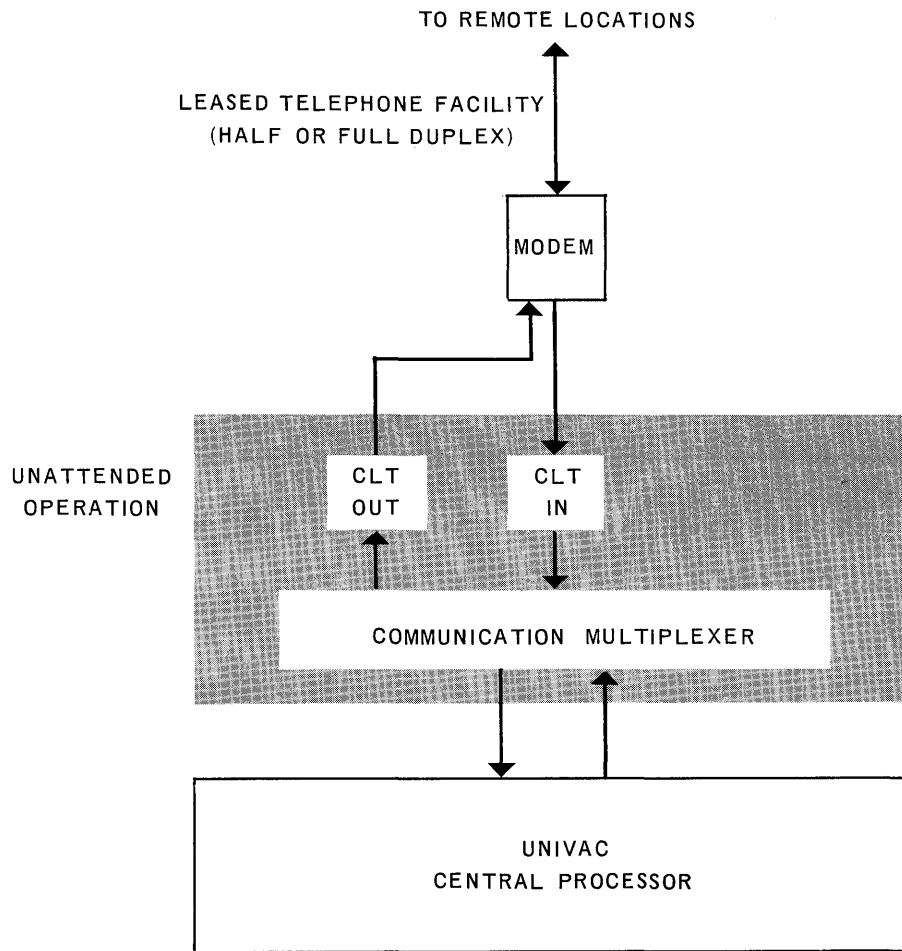
REMOTE DEVICE – UNIVAC 1004 DLT-1 System, serial Data Speed,
30 series Teletype, Friden Teledata, each
working with appropriate modem.

OPERATION – Central Processor and remote device ex-
change data over leased fixed circuit.
Modem and CLT requirements are the same
as for dial operation with the exception of
the CLT Dial unit and 801 ACU. Half Duplex
facility allows nonsimultaneous send/receive,
Full Duplex allows simultaneous operation.

Figure A-6. Computer Connection to Leased Data Line

TO REMOTE STATIONS

FULL DUPLEX   HALF DUPLEX   SIMPLEX

LEASED TELEGRAPH
FACILITIES

CLT 50L	CLT 51L	CLT 50L	CLT 51L	CLT 50L

COMMUNICATION MULTIPLEXER

UNIVAC
CENTRAL PROCESSOR
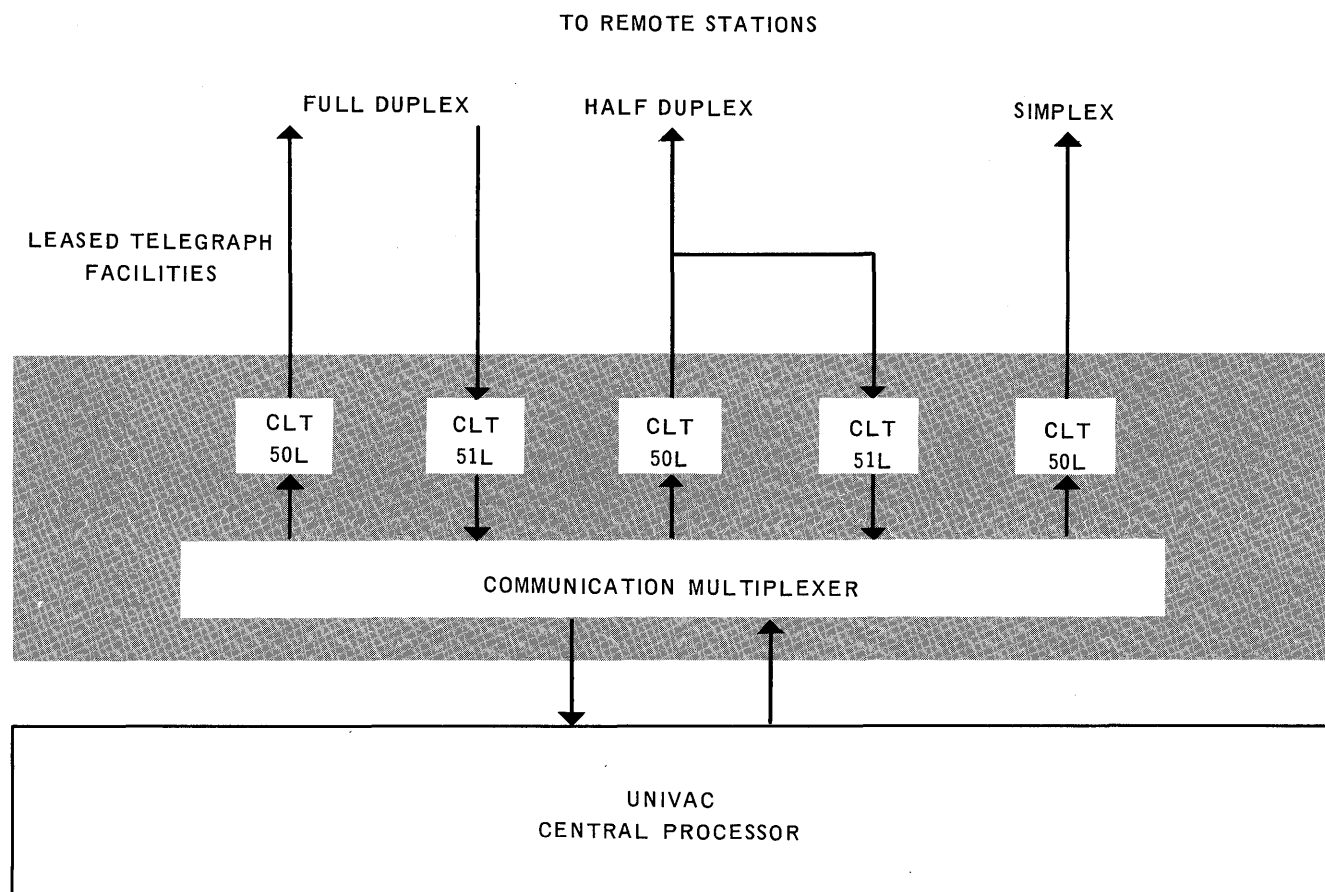
REMOTE DEVICE – 28 series Teletype

OPERATION   – Central Processor and remote device exchange data over leased fixed
circuit. Teletype equipment can accept keyboard or tape input and
produce tape or hard copy output. Simplex output circuit shown;
Simplex input also possible through CLT-51L.
Maximum transfer rate – 100 wpm, 5 level code.

Figure A-7. Computer Connection to Leased Telegraph Line

TO REMOTE STATIONS

FULL
DUPLEX

HALF
DUPLEX

SIMPLEX*
(OUTPUT)

LEASED MULTIPOINT
TELEGRAPH FACILITIES

| CLT 50L | CLT 51L | CLT 50L | CLT 51L | CLT 50L |

COMMUNICATION MULTIPLEXER

UNIVAC
CENTRAL PROCESSOR
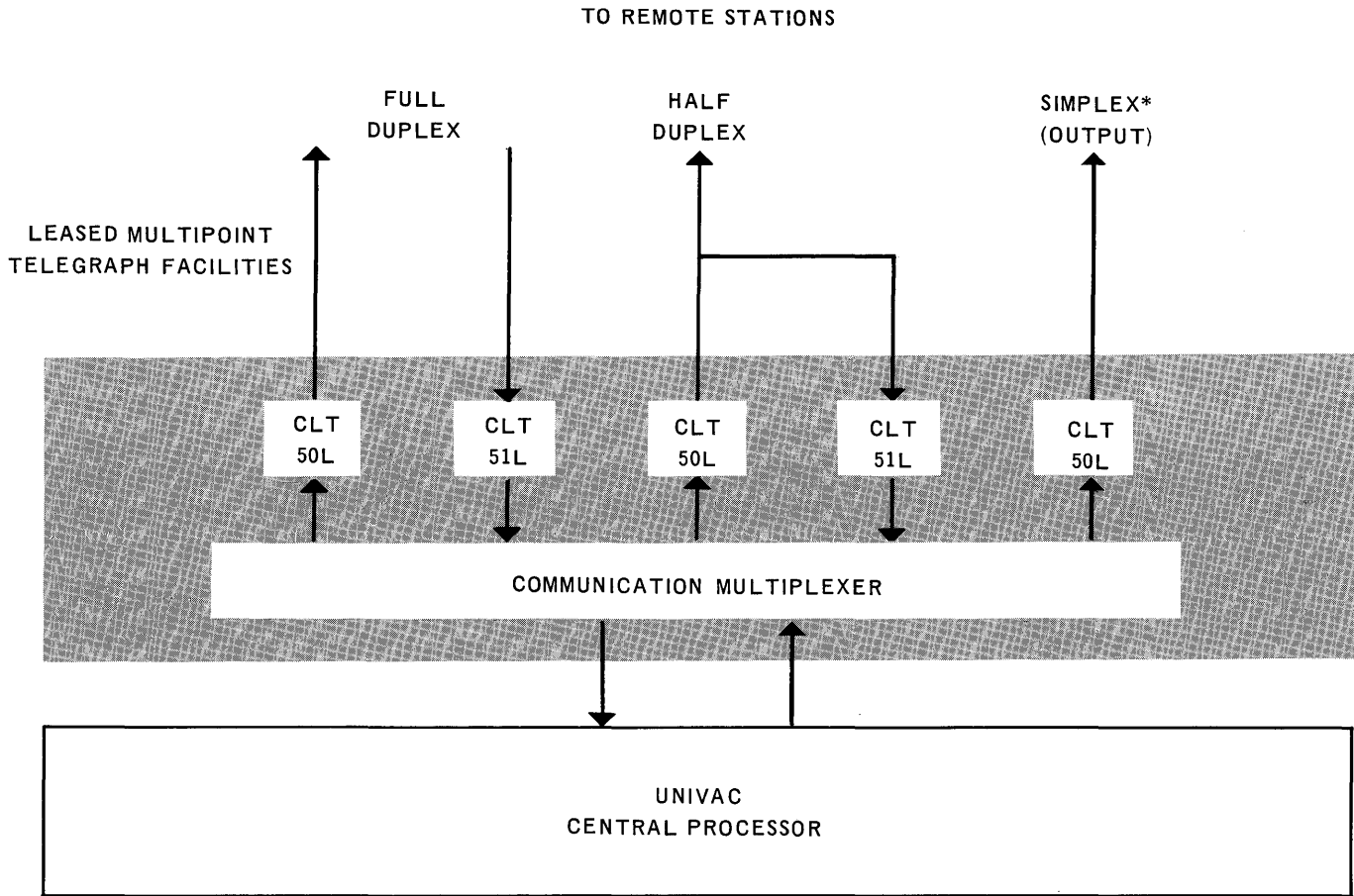
*Simplex input requires CLT-51L

REMOTE DEVICE — 28 series Teletype plus selection and direction equipment as directed
by particular system.

OPERATION — As dicated by particular system.

Figure A-8. Computer Connection to Message Switching Circuits

APPENDIX B. UNIVAC 490

PROGRAMMING FEATURES

The following section describes some of the programming features of the UNIVAC 490 System which are used with the UNIVAC Standard Communication Subsystem. It assumes that the reader is familiar with UNIVAC 490 programming techniques as well as with the Real Time Executive routine, REX. Special emphasis is placed on the composition of computer words for use with the Subsystem as well as on the various arrangements of input/output buffers which may be used. Other areas such as checking, polling, and so forth, have not been included since they vary so greatly from one application to the next.

A. BUFFER MODE DATA TRANSFERS

A buffer mode transfer, which occurs independent of main program control, is used to transfer data between UNIVAC 490 core storage and the Standard Communication Subsystem. Before execution of a buffer mode transfer of data, the program must perform the following steps:

1. *Load the address locations specified by the Externally Specified Index addresses with Buffer Control Words. (The lower and upper halves of the Buffer Control Words contain the beginning and ending addresses of the sections of core storage involved in the data transfer.)*

2. *Activate the channel to be used for the data transfer.*

3. *Send the proper Function Word to the Standard Communication Subsystem. (This step is not required to activate data transfers from low or medium speed input CLTs.)*

Step #2 is accomplished with one of the Initiate Buffer instructions, 73, 74, 75 or 76; and step #3 is performed by the Enter External Function instruction, 13.

Data is then transferred between the computer core storage and the Standard Communication Subsystem without main program intervention. When a word is transferred to or from storage, 1 is added automatically to the lower half of the Buffer Control Word. When the upper and lower half of the Buffer Control Word become equal, the computer will generate an Internal Interrupt (instruction 75 or 76).

B. WORD ARRANGEMENT

The Standard Communication Subsystem accommodates four types of computer input/output words. They are the Function Word, Input Data Word, Output Data Word, and Output Data Request Word. These words are explained and illustrated in the following paragraphs.

1. Function Words

The Standard Communication Subsystem is controlled by Function Words which activate External Function control lines and instruct a specific CLT to perform a particular action. The use of program generated Function Words, rather than processor instructions, in controlling the Standard Communication Subsystem, allows the processor logic to be completely independent of the Subsystem logic.

	C/M	CLT	FC
29 14	13 10	9 3	2 0

FC = 3 Bit Function Code

CLT = 7 Bit CLT Identifier Code

C/M = 4 Bit Communication Multiplexer Code

The function Code for the Standard Communication Subsystem may be one of three possible instructions:

OCTAL CODE	BINARY CODE	FUNCTION
01	001	Send Data Request output character from processor and continue to request characters until EOT is received.
02	010	*Remote Release (Dial lines only) Output CLT — Release dial connection. Dial CLT — Release Automatic Calling Unit.
04	100	Look for Synchronizing Character Stop transferring data characters into the processor and start to look for synchronizing characters.

---

*Used only with the unattended operation feature

The CLT Identifier is a three out of seven code which is used to identify a specific CLT. Since only 35 combinations are available, a pair of input/output CLTs uses the same identifier.

The Communication Multiplexer Identifier is a one out of four code used to select a specific Communication Multiplexer when a Scanner Selector is used to connect up to four Communication Multiplexers to a single processor input/output channel.

Bit positions 14 to 29 are unused.

2. Input Data Words

Data is transferred from the Standard Communication Subsystem to the processor in Input Data Words. Input Data Words have the following format:

| | IDC | ESI | |
		CM	CLT
29 23	22 15	14 6	5 0

IDC = Input Data Character

ESI = Externally Specified Index Address

The Input Data Character may consist of 5, 6, 7 or 8 data bits depending on the code structure. The first bit of the character is always located in bit position 15.

The Externally Specified Index address consists of two parts: an input CLT portion in bit positions 0 to 5, and a Communication Multiplexer portion in bit positions 6 to 14. The CLT portion of the ESI address contains any one of the 32 possible *odd* combinations of six bits which originate at a specific input CLT, while the multiplexer portion consists of nine bits which are plugboard wired at the programmer's discretion and originate at a specific Communication Multiplexer.

Bit positions 23 to 29 are unused.

On input data transfers, an Input Acknowledge signal is sent to the Standard Communication subsystem after each Input Data Word has been successfully stored in the memory location defined by the Buffer Control Word. In the case where the transfer of the Input Data Character causes the input buffer area to become filled (upper and lower halves of Buffer Control Word equal), an Internal Interrupt will be generated. In order to determine which input CLT is responsible for filling an input buffer area and thereby causing the interrupt, the Input Data Character and Externally Specified Index address must be held on the input channel; therefore, the Input Acknowledge signal is not generated immediately. The interrupt will cause the computer to revert to a series of instructions within REX which are associated with communication interrupts. One of these instructions will be a Store Channel instruction which causes the 30 bit word on the input channel to be stored in a memory location specified by the instruction. The lower 15 bits of this word contain the Externally Specified Index address of the CLT causing the interrupt. The Store Channel instruction will also cause the computer input/output logic to generate the Input Acknowledge signal to the Standard Communication Subsystem.

3. Output Data Words

Data is transferred from the Central Processor to the Standard Communication Subsystem in Output Data Words. Output Data Words have the following format:

		E O T	S	ODC	
29		10	9	8 7	0

EOT = 1 Bit End Of Transmission Code

S = 1 Bit Start Bit (used only in asynchronous output)

ODC = 8 Bit Output Data Character

A "1" bit in the 2^9th position of the Output Data Word indicates to the CLT that the character received from the output buffer is the last character of a message and will cause the CLT to stop requesting additional characters. Bit positions $2^0 - 2^8$ must also be programmed as "1s" except when instructing low speed output CLTs employed for full-duplex data transmission.

The Start bit is the first bit of a character that is transmitted to the communications facility in asynchronous data transmission. It indicates to the receiving terminal the start of a character. Under normal asynchronous operation, the Start bit is a zero. Under special conditions, such as selective calling or End of Transmission, the Start bit as well as the data bits can be programmed as "1s" in order to make the transmission line look idle.

The Output Data Character consists of 5, 6, 7 or 8 data bits, depending on the code structure. The first bit of the character is always located in position zero.

Bit positions 10 to 29 are unused.

4. Output Data Request Words

Each time a data character has been transmitted from an output CLT to the transmission facilities, the CLT requests another Output Data Word from the Central Processor by sending it an Output Data Request Word on the input channel and simultaneously activating its Output Data Request lead.

		ESI		
	CM		CLT	
29	15 14	6	5	0

ESI = Externally Specified Index Address

Bit positions 0 to 5 of the Externally Specified Index Address contain any one of the thirty-two possible *even* combinations of six bits which identifies a specific output CLT, while bit positions 6 to 14 contain the nine bits which identify the Communication Multiplexer.

C. BUFFERS

Any part of the UNIVAC 490's internal core storage can be used as an input/output data buffer storage area, with the exception of the few special core storage locations that are reserved for the Incremental Clock and the Interrupt Words. Information is transferred between the computer and the Standard Communication Subsystem in blocks of data or messages. A message may contain any number of characters. Each character occupies a half word of computer memory. Characters in a message must occupy consecutive core memory addresses, starting with a program determined first character address and ending with a program determined last character address.

1. Full Word Input/Output Buffers

Since Output Data Characters are located in the lower half of Output Data Words, while Input Data Characters are found in the upper half of Input Data Words, it is possible to use the same computer word in core storage for both input and output buffers. Since each buffer is controlled by its own Buffer Control Word, there need be no relationship between the input and output buffers other than that they use the upper and lower halves of the same computer words.

2. Special Input/Output Buffer Arrangements

In order to increase the flexibility of the Standard Communication Subsystem, two additional options are available to the systems designer which relate to input/output buffers.

a. Half Word Input/Output Buffer

If, for reasons of previous program compatibility or to facilitate systems design, it becomes desirable to use the upper half of the computer word for both Input Data Characters and Output Data Characters, this arrangement can be made when the system is ordered. This technique leaves the lower half of the buffer area words free to be used for some entirely unrelated purpose such as the storage of constants.

b. Pooled Input Buffer

Another option is available on input communication buffers. To exercise this option, the ESI line from the Communication Multiplexer to the computer is disabled (plugboard connection), thus activating the Internally Specified Index (ISI) mode. ISI is the data transfer mode used by all standard peripherals. It allows for only one input and/or one output buffer per channel. Under these conditions, the entire word presented by the C/M–CLT would be transferred to memory under the control of the Buffer Control Word associated with the channel. With this approach, the characters from all CLTs serviced by the Communication Multiplexer would be intermixed in the buffer. As a separate operation under program control, the characters could be sorted into individual messages based upon the ESI address which would be in memory in the lower half of the buffer words.

The reasons for using the pooled buffer concept are that it reduces the number of interrupts and consequent excursions through REX and makes a more efficient use of the assigned buffer area. However, the system programming required to sort and analyze characters in pool buffer may become excessive as the number of CLTs increases. It should be noted that under a pool buffer concept, the output and input buffers must be assigned to different words in memory.

D. END OF TRANSMISSION RECOGNITION

A major point that may not be obvious from the prior discussion of Input Data Words is that an incoming transmission may end before the associated input buffer area is filled. For example, if an input buffer area for a particular Communication Line Terminal is fifty processor words in length and an incoming transmission ends with the fortieth processor word, there will not be an Internal Interrupt to signal the UNIVAC 490 System to begin processing this segment of data. The UNIVAC Standard Communication Subsystem does not recognize End of Transmission codes and, therefore, would not interrupt the Central Processor.

It is suggested that when an input buffer area is established, the program calculate an estimated time to fill the buffer. This can be done since the data transmission rate in characters per second as well as the total character capacity of the input buffer area in question would be known. On some time schedule, the UNIVAC 490 System may interrupt itself and search through the estimated time of terminations stored with the corresponding Buffer Control Word locations to determine if any input buffer area has not been filled in the estimated time. If such a situation were discovered, the program could then locate the last character in the questionable input buffer area by the associated Buffer Control Word. At this time, the program would decode the last character or characters, depending on the data transmission scheme, to determine if the End of Transmission code is stored in the buffer area.

The above condition would generally not exist in the case of output since the last segment of an output transmission would have been put in an output buffer area which is as long as the data segment. When the End of Transmission was transmitted, the Buffer Control Word(s) would normally interrupt the UNIVAC 490 System.

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