

To: Distribution

From: D.R. Vinograd

Subject: Interface Requirement for Low Speed Data Access to Multics

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This document is intended to describe the kinds of modems and their required options that can be used to access a 6180 Multics system. The information described herein is based on operational experience to date and may not be exhaustive. Questions about modems and/or options not described here should be referred to the site's system engineer. Further information about any of the BELL modems described here can be gotten from the appropriate Telephone Technical specification.

For speeds up to and including 300 baud a BELL type 103 modem should be used. This speed range uses the LSLA hardware interface. If available, the following options should be specified:

- a) Loss of Carrier Disconnect
- b) Long Space Disconnect
- c) Answer Mode Indication Off
- d) Send Disconnect
- e) Answer Control Combined
- f) Auto Answer - Key Controlled

- g) Terminal Will Respond to Disconnect
- h) Initiates Disconnect
- i) Mark Hold

For speeds to above 300 baud up to 1200 baud a Bell 202C data set should be used. The options which should be specified are:

- a) Reverse Channel
- b) Auto Answer - Key Controlled
- c) Carrier Soft Turn-Off In
- d) Squelch In
- e) Demodulator Clamp In
- f) Delay Equalizer In
- g) Amplitude Equalizer In
- h) Terminal Impedence 900 ohms
- i) Transmit Level (-6dBm)
- j) EIA Voltage Interface
- k) 801 Type ACU

The attached appendix is a general discussion of data communications. It is attached as reference material for the interested reader.

General Information, Lines and Modems

Summary of Common Carrier Services:

Data Transmission:

Data transmission is the discipline of moving electrical signals, to which significance has been assigned by users of a new generation of communication devices. Computers, cathode ray tube graphic devices, keyboard terminal devices, etc. are only a few of the devices that produce output signals for transmission.

Common Carriers:

The operation, rate structure and types of service provided by common carriers are regulated by the Federal Communication Commission. The Bell System and Western Union are two of the largest common carriers operating in the United States and offer several types of services.

There are about 200 telephone companies operating in the United States. The various Bell Companies, almost totally owned by AT&T, and some owned by GT&E (General Telephone and Electronics) comprise the majority of common carrier services, Bell owning in excess of 75 percent. Any time lines are interconnected beyond the realm of one of the operating companies, trunks are provided by the AT&T Long Lines Division.

Western Union provides some services which overlap those above, plus a TWX-Telex switched teletype network. There are some newer companies who, based on a recent FCC ruling, will offer a higher speed data path primarily limited to telecommunications.

Services Available:

As a generalization, three speeds are available:

Narrowband - limited to about 300 bps (bit per second)

Voice Grade - limited to about 2000 or 2400 bps over switched or private lines respectively

Wideband - more or less synonymous with the terms broadband and Telpak services. The possible transfer rates include a range from 19.2 KHz to 500 KHz.

Speed, however, is not enough to categorize a service, the physical arrangement must also be considered:

A teletype may be operated over Voice Grade lines for purposes of alternate voice capability or an acoustical coupler may be used.

A given line may be public switched (dial up) or private (point to point).

There are many restrictions, features, and options which affect the physical arrangements. The speed and physical arrangements combined result in these services.

Narrowband - may be categorized into:

PRIVATE LINE TELEGRAPH

This is a service for written communications between two or more points via common carrier telegraph-grade circuits. Each circuit is provided by using a standard telegraph transmission line or by subdividing a telephone voice-grade circuit into 12 telegraph circuits. A transmission rate of 30 characters per second is the approximate upper limit of this service. Private line service offers the subscriber unlimited use of the circuit.

PUBLIC SUBSCRIPTION SERVICE

The Bell System offers TWX (Tele-typewriter Exchange Service) and Western Union offers TELEX. Both tele-typewriter services offer user-to-user communications by means of dial-up operating much like the public telephone network. This service is available on a 24-hour-a-day, 7-day-a-week basis and charges are based on a per-use basis, plus a minimal monthly charge.

Voice Grade Circuits

Voice grade service is provided by common carrier over circuits having higher transmission speed characteristics than narrow-band circuits.

DDD (Direct Distance Dialing) permits the user equipped with a digital subset to place a regular telephone call without operator intervention. Transmission speeds of up to 7200 bits per second can be achieved with high quality DDD network equipment.

WATS (Wide Area Service) is offered to large-volume communications users who seek reduced rates. Users may subscribe to full time or measured service. WATS access lines may be obtained to any one of the six geographic zones into which the United States has been subdivided for billing purposes. Data transmission speed of 7200 bits per second can be achieved.

Private line voice grade service is available, affording the customer a direct connection between two or more terminals on a full time basis. The quality of the line is generally superior to those available through the switched network, resulting in a reduced error rate and a transmission speed of up to 9600 bits per second.

Broad-Band Service

This is an offering both from the Bell System and Western Union designed to give very large volume communication users economic benefits by selling what is essentially bulk service. Communication paths of various band widths may be

provided as a single wideband channel for high speed data or subdivided into smaller channels. Current facilities provide transmission rates of up to several million bits per second.

Broad band services are available in several categories.

Three of these categories are summarized below.

CLASSES OF BROADBAND SERVICE

CLASS	MAXIMUM BIT PER SECOND DATA RATE	NUMBER OF EQUIVALENT VOICE CHANNELS
Series 8000	50,000	12
TELPAK-C	240,000	60
TELPAK-D	960,000	240

Communications Facility:

A communications facility is the means by which data is transmitted between two or more points. A partial list of facilities includes telephone and telegraph cables, coaxial cable, radio, and microwave.

The facility can operate in one of several basic modes:

SIMPLEX - Communications in one direction only

HALF-DUPLEX - Communications in both directions but only one direction at a time.

FULL-DUPLEX - Communications capability in both directions simultaneously. Although the facility is

full-duplex, it may not necessarily be used in that fashion. For example, if the system operation is simultaneous transmission in both directions it is called two-way simultaneous. However if the full-duplex facility is operated with transmission in one direction the true mode of operation is two-way alternate.

Synchronization Techniques:

Synchronization between transmitting and receiving stations must be provided because the transmitted data signals are time-dependent. Each bit is transmitted at precise time intervals. Two common methods of transmission synchronization are known as "Synchronous" and "Asynchronous."

Asynchronous Systems

Asynchronous transmission uses additional bits identifying the beginning and the end of each data character. Model 33 and 35 teletypewriters both generate one Start bit preceding the eight bit ASCII character and two Stop bits to bracket the current character being transmitted. No definite relationship between successive characters exists and gaps in time between characters are permitted.

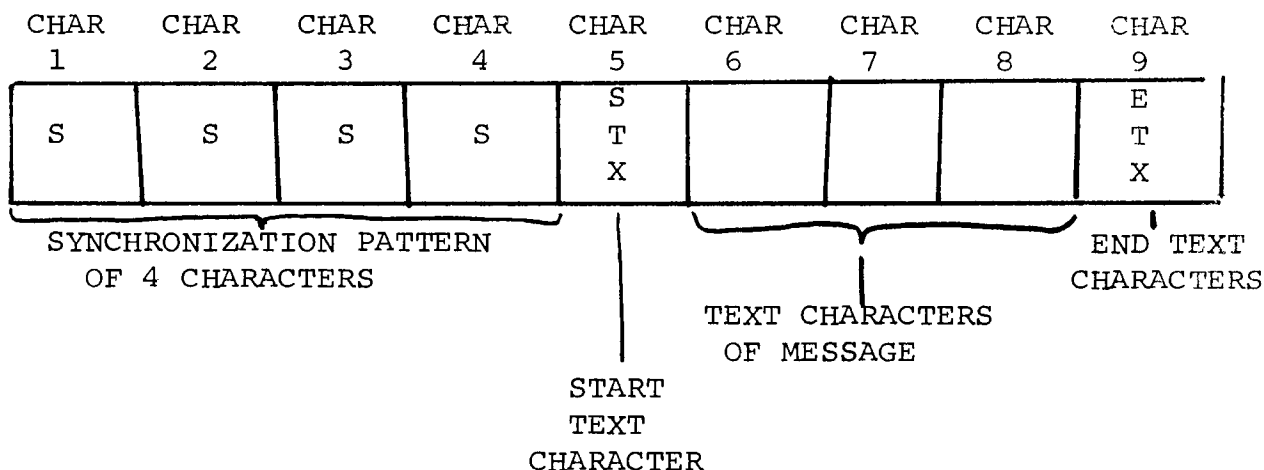


Two Asynchronous Characters

S is Start bit. 1-7 and P contains 7 Data + 1 Parity bit.
SP represents Stop bits.

Synchronous Systems

Synchronous transmission requires that a predetermined character be transmitted preceding each message. Upon detection of the synchronizing character, the receiving equipment maintains itself in synchronism with the transmitted information. This type of synchronization permits higher data transmission rates than the asynchronous technique. No time-delay is permitted between the first bit of character and the last bit of preceding character within a message.



Example of Message Format using Synchronous Transmission

Conditioning and Rating of Lines:

A given voice grade line can be utilized for voice only and a certain amount of distortion and frequency offset can be tolerated without unpleasant effects on conversation. However, when the same line is used for transfer of data, it must first

be equalized (filtered) and compensated in order to eliminate distortion.

Certain standards are established, either in the form of FCC Tariff regulations or as administrative practices of Common Carriers.

Conditioning refers to the equalization and compensation necessary to qualify a line for certain performance characteristics. These characteristics are:

- 1) Frequency response and amplitude variation. This is not greatly different from a popular qualification for Hi-fidelity home phonographs.
- 2) Envelope delay - This specifies how much delay is introduced on a modulated envelope - again over a frequency range.

The detailed performance specifications will not be given here, rather a summary of what a specific grade of conditioning will accomplish in applications. This is summarized in the following table.

COMMON CARRIER NOTATION

Transfer Rate (in bps)	AT&T (NEW)	AT&T (OLD)	Western Union
<u>Narrow Band</u> 45	1002	Sched. 1	Class A
55	1002	Sched. 2	Class B
75	1005	Sched. 3	Class C
150	1008	Sched. 4	

Transfer Rate (in bps)	AT&T (NEW)	AT&T (OLD)	Western Union
<u>Voice Grade</u>			
1200	3002	Sched. 4	Class G
1400 to 2000	3002 Plus C1 Cond.	Type 3003	Class E
2400	3002 Plus C2 Cond.	Type 3004	Class F
4800	3002 Plus C4 Cond.	Type 3005	Class H
<u>Wide Band</u>			
19,200	Type 8803	-	
40,800	Type 8801	-	Wideband
105,000	5700 or 5800	Telpak C	Telpak C
240,000	5700 or 5800		
50,000	5800	Telpak D	Telpak D

- NOTES:
- 1) All links except Wideband are either half or full duplex.
 - 2) All wideband links are full duplex.
 - 3) There are other transfer rates available in narrow band that are not denoted.
 - 4) Transfer rates are for synchronous applications for voice grade and wide band, i.e., Asynchronous is slower than synchronous.