

Bell System

TECHNICAL REFERENCE

DATA LINE

CONCENTRATOR SYSTEM
(DLCS)

ARRANGEMENTS

MAY, 1971



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(DLCS)
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May, 1971



ENGINEERING DIRECTOR - TRANSMISSION SERVICES



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Initial DATREX* Service Arrangements with Bell System Teletypewriters Computer Port Interface – July, 1970

TABLE OF CONTENTS

	Page
1. SYSTEM DESCRIPTION	1
1.1 General Description	1
1.2 System Features and Options	1
1.2.1 Simplified Channel Establishment	1
1.2.2 Camp-On	1
1.2.3 Alternate Access to the Message Telephone Network or to a Second Computer	2
1.2.4 Accessing a Computer from the Message Telephone Network	2
1.2.5 Provision for Customer-Provided Terminals	2
1.2.6 Disconnect Methods	2
1.2.7 Trunk Out of Service	3
1.2.8 Half-Duplex or Full-Duplex Transmission	3
1.2.9 "BREAK" or Interrupt	3
1.2.10 Sequential Trunk Selection	3
1.2.11 Installation of Concentrator Equipment on Customer's or Telephone Company premises	3
1.2.12 Modular Design	3
1.2.13 Compatibility	4
1.2.14 Tandem Concentration	4
1.3 Sample Calls	4
1.3.1 A Call From A Bell System-Provided Terminal to a Computer Port	4
1.3.2 A Call from a Customer-Provided Terminal to a Computer Port	5
1.3.3 A Call From a DLCS Station through the Message Telephone Net- work to a Computer Port on DATA-PHONE Service.	5
1.3.4 A Call from a DLCS Station through the Concentrator to an Alternate Computer	6
1.3.5 A Call From a DATA-PHONE Station, Through the Concentrator, to the Computer Associated with the Concentrator	6
2. CUSTOMER-PROVIDED TERMINAL AND COMPUTER COMMUNICATION PORT INTERFACES	6
2.1 Interface Characteristics Common to Both the Terminal and Port Interfaces	7
2.1.1 Interface Leads Provided	7
2.1.2 Data Circuit Signal Characteristics	7
2.1.2.1 Transmission Speed and Code	7
2.1.2.2 Data Signal Distortion	8
2.1.2.3 Break Signals	8

	Page
2.2 Interface Characteristics Peculiar to the Computer Communication Port	8
2.2.1 Functional Description of Interface Leads	8
2.2.2 Supervisory Signal Characteristics	10
2.2.2.1 Call Origination	10
2.2.2.2 Disconnect Options	10
2.2.2.3 Trunk Out of Service	12
2.3 Interface Characteristics Peculiar to the Customer-Provided Terminal Inter- face	12
2.3.1 Functional Description of Interface Leads	12
2.3.2 Supervisory Signal Characteristics	13
2.3.2.1 Idle Condition	13
2.3.2.2 Request for Service	13
2.3.2.3 Camp-On	13
2.3.2.4 Request-To-Disconnect	13
2.3.2.5 Data Carrier Failure	14
2.3.2.6 Data Set Test Mode	14
3. PHYSICAL CHARACTERISTICS	15
3.1 Equipment at Concentrator Location	15
3.1.1 Concentrator	15
3.1.2 Private Line Data Channel Adapter Arrangements	15
3.1.3 1A Data Stations	16
3.1.4 Multiple Mounting of 109-Type Data Sets	16
3.2 Data Sets for Customer-Provided Terminals	16
3.2.1 1A Data Stations	16
3.2.2 Data Set 108A or 108C with Data Auxiliary Set 820D	16
3.2.3 Data Set 109H	16
4. ALARM FEATURES	16

1. SYSTEM DESCRIPTION

1.1 General Description

The Data Line Concentrator System (DLCS) provides for the connection of any of up to 128 stations to any of up to 32 computer communication ports. The system includes data stations, transmission facilities including data sets, and line switching equipment called a data line concentrator. The concentrator connects data station lines with trunks associated with communication ports of computers. Communication between the station and computer can be at a rate up to 150 bits per second. A simple system layout and terminology used to describe the component parts is shown in Figure 1.

When transmission considerations permit, metallic loops with 109-type data sets will be used to allow sending and receiving low dc (3 mA direct current) data signals between the stations and the computer. Arrangements are available to serve those stations that require ac (alternating current) facilities (see Figure 2). For isolated stations, data channels can be provided with either a voiceband facility terminated in 108-type data sets or a facility using the Private Line Telegraph Network.

DLCS arrangements can also be used to serve a cluster of stations that is located a substantial distance from the computer by locating the concentrator near the cluster and communicating from the concentrator to the communications ports over multiplexed low-speed channels (provided with 1A Data Stations) directly or through a second concentrator. Stations are connected to a remote concentrator using the same methods as in a simple system. The term tandem concentration is used to refer to configurations where connections involve two concentrators.

Bell System provided Model 33 or 35 KSR or ASR teletypewriters or customer-provided terminals may be used.

DLCS arrangements provide for calls originated by stations to computer communication ports but not to other stations nor from communication ports to stations. A user

originates a call by pressing a key at the station. This causes a request for service to be sent to the concentrator. The next idle communication port at the computer is selected by the concentrator and then the trunk associated with the communication port and the station's line are connected. The user is now connected to the computer.

Other optional types of calls are described in the next section.

1.2 System Features and Options

The system and service features and options that are available with DLCS arrangements are described in this Section.

1.2.1 Simplified Channel Establishment

An important feature of a DLCS is the capability of establishing a channel to a computer communication port in a simplified manner. No dialing is necessary. The user requests service by pressing a key on the teletypewriter. Connect time is about 100 milliseconds if an idle trunk is available.

1.2.2 Camp-On

If all trunks are busy when a station requests service, the station is camped-on and its request for service is placed in a queue. An all-trunks-busy or camp-on signal is sent to the station to alert the user that the station is camped-on. The first station to request service after all trunks become busy is connected to the first trunk that becomes idle. Additional stations that request service when all trunks are busy are not necessarily served in the order of the requests, but no station requesting service a second time will be served while another station is waiting to be served a first time.

The concentrator switching network is nonblocking, therefore, no station can be denied service while a trunk is idle.

1.2.3 Alternate Access to the Message Telephone Network or to a Second Computer

Those stations which are connected to the concentrator via metallic loops can be optionally arranged to access, at the user's choice, either of two distinct trunk groups.

One trunk group would be to the computer associated with the concentrator, and the alternate trunk group could be used to provide access to the message telephone network (through a local PBX or central office) and thus to the ports of any computer having DATA-PHONE® service. The alternate trunk group could also be used to provide access to the ports of a second computer in the same manner as for the computer on the primary trunk group.

Stations arranged for alternate access must be equipped with either TOUCH-TONE® or rotary dialing, as desired; however, a particular concentrator can be arranged for only one type of dialing. TOUCH-TONE dialing is limited to those systems where the concentrator is within one mile of a serving TOUCH-TONE central office.

1.2.4 Accessing a Computer from the Message Telephone Network

Access from a DATA-PHONE station through the concentrator to computer ports is available as an optional feature.

1.2.5 Provision for Customer-Provided Terminals

Provision is made for the use of customer-provided terminals at stations. The data set terminating the line from the concentrator provides an EIA interface toward the customer-provided terminal.

1.2.6 Disconnect Methods (See Section 2.2.2.2)

Several methods are provided for releasing a connection between a station and a multiaccess computer.

A. Bell System-Provided Terminals

1. Stations are equipped with an OFF key for manual initiation of disconnect.
2. Stations can optionally be arranged to initiate a disconnect upon receipt or transmission of the ASCII character EOT.
3. The computer port can initiate a disconnect by turning OFF an interface lead to its associated data set for an appropriate period of time.

B. Customer-Provided Terminals

1. Stations served using a 109-type data set are equipped with an OFF key for manual initiation of disconnect and, in addition, a disconnect can be initiated by turning OFF an appropriate interface lead to the data set.
2. Stations served using 108-type data sets or 1A Data Stations can initiate a disconnect by turning OFF an appropriate interface lead to the data set. In addition manual ON-OFF control is available as an option at remote stations with the exception of those served by a 1A Data Station.
3. Stations, in which the terminal portion is appropriately equipped, can initiate a disconnect upon receipt or transmission of a discrete character or character sequence. As noted previously, where Bell System terminals are involved, the character EOT is used for disconnect purposes.
4. The computer port can initiate a disconnect by turning OFF an interface lead to the data set for an appropriate period of time.

1.2.7 Trunk Out of Service

Trunks can be selectively taken out of service from the computer location either manually with a switch that is associated with each trunk-terminating data set or through the use of an interface lead. The switch is provided to facilitate removal of trunks from service by customer or Telephone Company personnel at the computer location.

Where alternate access capability to the message telephone network is provided, the trunks in the alternate trunk group include a DATA-PHONE adapter arrangement. In this case, a key is provided at the adapter arrangement for taking the trunk out of service.

1.2.8 Half-Duplex or Duplex Transmission

Transmission on a duplex or half-duplex basis is provided on a system basis. With half-duplex transmission, the channel established between the station and the computer is capable of nonsimultaneous 2-way transmission. Transmission can be reversed without supervisory control operations. With duplex transmission, provided by duplex data sets, the channel established is capable of simultaneous 2-way transmission. Duplex channels are required between 1A Data Stations.

1.2.9 "BREAK" or Interrupt

Break signals may be used in the DLCS as means of signaling the computer from the station, or the station from the computer, to stop transmitting. Generation of and recognition of break signals are functions provided by the computer or the terminal, not the data set.

When a break signal is detected at a Bell System terminal equipped with the break detection option, an indicator lamp is lighted and transmission from the station is inhibited until the "BREAK" condition is manually cleared at the station.

1.2.10 Sequential Trunk Selection

The concentrator selects trunks sequentially in a fixed sequence. Because of this, the trunk selection procedure is uniform and, on the average, no trunk is selected more often than any other trunk. This feature can be used by the customer as a maintenance aid to detect trunk or communication port failures. Note that, not only should ports receive the same average usage, but the next trunk to be selected should always be the next idle trunk in the sequence.

1.2.11 Installation of Concentrator Equipment

The concentrator is designed to be installed on a customer's premises. The concentrator is mounted in a cabinet and will require 60 Hz power as specified in Section 3 of this document.

1.2.12 Modular Design

DLCS arrangements are provided on a modular basis. Switching network modules are available for handling various numbers of trunks. Switching network configurations are available for concentrators with up to 8, 16 or 32 trunk terminations. Each size can be equipped for up to 128 lines in increments of 32. Table I can be used to determine the concentrator size required for a system. In addition, concentrator line and trunk circuits are "plug-in" and only the required number of line and trunk terminations need be equipped. For example, consider a system which has 22 stations and needs 5 trunks. For this system a 32 x 8 (line terminations x trunk terminations) switching module equipped for 22 stations and 5 trunks, would be appropriate. The system could be expanded by adding more line and/or trunk terminations for up to 32 lines and 8 trunks. If it is necessary to increase the number of line terminations above 32, additional 8-trunk switching modules would be added. If it is necessary to increase the number of trunk terminations above 8, the 8-trunk switching modules would be replaced with 16- or 32-trunk modules, as required.

<u>No. Lines</u>	<u>No. Trunks</u>	<u>Concentration Ratio</u>	<u>No. and Type of Switching Network Modules</u>
32	8	4:1	1-8 trunk
64	8	8:1	2-8 "
96	8	12:1	3-8 "
128	8	16:1	4-8 "
32	16	2:1	1-16 "
64	16	4:1	2-16 "
96	16	6:1	3-16 "
128	16	8:1	4-16 "
32	32	1:1	1-32 "
64	32	2:1	2-32 "
96	32	3:1	3-32 "
128	32	4:1	4-32 "

Table I – Available Concentrator Sizes

1.2.13 Compatibility

DLCS arrangements are compatible with the computer-communication-port arrangements for use with Private Line Data and DATA-PHONE services except that circuit CE, Ring Indicator, is not provided and the OFF state of circuit CD (Data-Terminal-Ready) is used to signal an out-of-service condition as explained in 1.2.7, preceding.

1.2.14 Tandem Concentration

Concentrators can be operated in tandem, not exceeding two concentrators, with derived channels from a voiceband facility being used to implement interconcentrator trunks. Tandem concentration provides for serving small clusters of stations (a substantial distance from the computer) without restricting access to a small group of computer communication ports. The best arrangement for a particular computer system will depend upon the number of stations, the distances involved, station usages, holding times and quality of service desired.

1.3 Sample Calls

The use of DLCS arrangements are summarized in this section in terms of calls from:

- a. A Bell System-provided terminal to a computer port.
- b. A customer-provided terminal to a computer port.
- c. A DLCS station, through the concentrator and message telephone network, to a computer having DATA-PHONE service.
- d. A DATA-PHONE station, through the concentrator, to the computer associated with the concentrator.

1.3.1 A Call from a Bell System-Provided Terminal to a Computer Port

When a station user wishes to access the multi-access computer, he presses a key at the station. His request for service is detected by the concentrator. If a communication port is available, the concentrator selects the trunk associated with the port and connects the station's line to the trunk. The station and computer may now interact. An indication, via an interface lead, is given to the computer port that a station has been connected; but there is no indication provided to the station that the connection is completed. The station user must be alerted to the completion of the connection by a message from the computer.

If there are no idle communication ports available when the user requests service, the station is camped-on and the concentrator places the user's request for service in a waiting "queue" until a communication port is available. While the station is in the camped-on state, the concentrator sends a signal that appears to the station as a DEL character occurring at regular intervals of 2 to 3 seconds. The character does

not print but the resultant operation of the teletypewriter mechanism produces an audible camp-on signal. When a communication port becomes available, the station that requested service first is served. Other stations having requests in the waiting queue are served in an equipment order. This assures that no station requesting service a second time will be served before all camped-on stations are served a first time.

When the user has completed his use of the computer, a disconnect procedure is initiated. This may consist simply of the user pressing an OFF key to which the concentrator will respond by breaking the connection. Alternatively, the computer system operation may involve computer control of disconnect, either through the use of computer port interface circuit CD, Data Terminal Ready, or the transmission of an EOT character. Appropriately equipped stations respond to an EOT character by initiating a disconnect as though the OFF key had been pressed by the user. However, the lamps associated with the OFF and LINE keys will remain ON until the attendant operates the OFF key. If the computer port interface circuit CD is turned OFF for an interval of about one character, the concentrator will respond by disconnecting the line from the trunk, making the trunk available to another station, and placing the station in a "holding" or "locked-out" state; the station remaining ON. The station user would turn the teletypewriter OFF at his convenience to stop the motor and would turn it ON again to originate a new request for service.

1.3.2 A Call from a Customer-Provided Terminal to a Computer Port

When a station user wishes to access the computer, a request for service is made either by operating a key on the data set or via an interface lead to the data set. Distant stations may be served by a 1A Data Station which is not equipped with key control, therefore, in this case the interface lead must be used. The request for service is detected by the concentrator and, if a trunk to a communication port is available, the concentrator connects the station line to the

trunk. The station and computer may now interact with one another. The station user must be alerted to the completion of the connection by a message from the computer.

If there are no idle communication ports available, a camp-on signal is sent to the station as described in the preceding Section. However, the camp-on signal may or may not produce an audible indication depending on the type of customer-provided terminal. All arrangements, with the exception of station arrangements using the 1A Data Station, are equipped or can be equipped with a camp-on lamp to indicate when a camp-on signal is received.

When the user has completed his use of the computer, a disconnect procedure is initiated. The user may initiate a disconnect by operating a key on the data set or, if an interface lead to the data set was used in requesting service, by turning OFF the interface lead. The computer port can also initiate a disconnect by giving a disconnect indication to the concentrator as described in the preceding section.

1.3.3 A Call from a DLCS Station Through the Message Telephone Network to a Computer Port on DATA-PHONE Service

As noted previously in Section 1.2.3, only stations served by metallic facilities and 109-type data sets can be arranged to access two different trunk groups. The data set at the station is equipped with two keys to enable the user to select either trunk group. In this type of call where the alternate trunk group connects with the message telephone network, dialing capabilities must also be provided at the station to enable the user to dial a specific station after the connection to the message telephone network is established.

A call to the computer associated with the concentrator is made as described in Sections 1.3.1 or 1.3.2.

When the user wishes to make a call to a computer having DATA-PHONE service, the data set key associated with the alternate trunk group is pressed to request service from the

concentrator. The station line is then connected, by the concentrator, to a trunk that includes a DATA-PHONE adapter arrangement. When this connection has been completed, dial tone is received by the user and he can then dial the computer station on the message telephone network in a normal manner. The station user must be alerted to the completion of the connection to the computer by a message from the computer since voice communication is not possible.

When the user has completed his use of the computer, he may initiate a disconnect by operating a key on the data set. The computer port, which is a DATA-PHONE station, can also initiate a disconnect either by disconnecting or by sending a long space signal (1.5 seconds nominal) and then disconnecting. This will result in the concentrator disconnecting the station line from the trunk.

Only one type of dialing, rotary or TOUCH-TONE, is available in a given concentrator arrangement.

1.3.4 A Call from a DLCS Station Through the Concentrator to an Alternate Computer

When a user wishes to access either of two computers associated with a concentrator, he presses the appropriate key on the data set to request service. The call is then the same as described in Sections 1.3.1 or 1.3.2. Where an interface lead is used to request service, the user must operate the appropriate key on the data set to select the desired computer before the interface lead is turned on.

Only stations served by metallic facilities and 109-type data sets can be arranged with the alternate access capability.

1.3.5 A Call from a DATA-PHONE Station, Through the Concentrator, to the Computer Associated with the Concentrator

In order for a DATA-PHONE station to access the concentrator over the message telephone network and thus to the computer served by the concentrator, the concentrator must be

appropriately equipped with a DATA-PHONE line adapter arrangement.

When the user at a DATA-PHONE station wishes to access the computer, he dials the number of the DATA-PHONE line connection arrangement assigned to the concentrator and establishes a connection in the manner prescribed for his station to any other DATA-PHONE station. When originating a call, the user should consider that the DATA-PHONE line at the concentrator will be wired to answer in the data mode only.

After the connection has been established between the DATA-PHONE station and the concentrator interconnect arrangement, the concentrator will proceed to connect the station line and the connection arrangement to a trunk associated with a computer port, provided a port is available. The station and computer may now interact with one another. The station user must be alerted to the completion of the connection by a message from the computer.

If no port is available, a camp-on signal is sent to the station as previously described. It should be noted that the camp-on signal does not affect the DATA-PHONE connection established to the concentrator DATA-PHONE adapter arrangement. That connection will remain established while the station is camped-on and awaiting availability of a port. If the DATA-PHONE station user wishes, he may initiate a disconnect when he receives a camp-on signal.

When the user has completed his use of the computer, he may initiate a disconnect in the manner prescribed for his station. The computer port can also initiate a disconnect by giving a disconnect indication to the concentrator. The resulting long space signal or loss of carrier sent to the station from the concentrator DATA-PHONE adapter arrangement will cause the station to disconnect.

2. CUSTOMER-PROVIDED TERMINAL AND COMPUTER COMMUNICATION PORT INTERFACES

The electrical, physical and timing characteristics of the customer-provided terminal interface and communications port interface are described in this Section.

Characteristics common to both interfaces are described in Section 2.1; those applicable to the port interface only are in Section 2.2; and those applicable to the terminal interface are in Section 2.3.

2.1 Interface Characteristics Common to Both the Terminal and Port Interfaces

2.1.1 Interface Leads Provided

The leads which are provided in the computer port and the terminal interfaces are:

<u>Pin Assignment</u>	<u>Circuit</u>	<u>Function</u>
1	AA	Protective Ground
2	BA	Transmitted Data
3	BB	Received Data
4	CA	Request to Send
5	CB	Clear to Send
6	CC	Data Set Ready
7	AB	Signal Ground
8	CF	Received Line Signal
9	+P	Detector
10	-P	Data Set Test
20	CD	Data Set Test
		Data Terminal Ready*

Functional descriptions of these circuits for the port and terminal interfaces differ and are included later in the appropriate section.

* Optional in some interfaces.

+ Bell System Data Communications Technical Reference, "Data Set Interface Connectors," July 1963.

** For definitions of degree of start-loop distortion, net margin, and gross start-stop distortion, reference should be made to:

EIA Standard RS-363

Standard for Specifying Signal Quality for Transmitting and Receiving Data Processing Terminal Equipments Using Serial Transmission at Interface with Nonsynchronous Data Communication Equipment.

The electrical signals on the leads contained in the interfaces meet the requirements of Section 4, "Electrical Signal Characteristics" of the Electronics Industries Association (EIA) Standard RS232-C. A standard 25-pin connector+ is used as the interface point between the terminal or port and the associated data set.

2.1.2 Data Circuit Signal Characteristics

The characteristics of signals that appear or are impressed on circuits BA (Transmitted Data) and BB (Received Data) are defined in this section.

2.1.2.1 Transmission Speed and Code

Bell System stations that connect to the concentrator will operate at 100 wpm (10 characters per second) using the American National Standard Code for Information Interchange (ANSI X 3.4-1968). The on-line character structure consists of 11 units, including a 1-unit start pulse, seven 1-unit information bits, a 1-unit parity bit, and a 2-unit stop pulse. Even parity is employed for all characters transmitted on-line. Transmission of information bits within a character is low order bit first. The parity bit is the eighth bit following the start pulse.

For customer-provided terminals, speeds up to 150 bits per second are permissible and the character structure used is unrestricted.

However, if terminals utilizing different speeds or character structures are to be used in the same application, the computer ports must be capable of handling them and careful consideration given to the length of camp-on signal chosen which must be the same for all terminals served by a concentrator as described later in Section 2.3.2.3.

2.1.2.2 Data Signal Distortion

The degree of start-stop distortion* in received data signals (from interface circuit BB) will vary depending upon the length of circuit (line plus trunk), the type of transmission facilities involved, and the quality of the signal transmitted. Terminal equipment and port equipment should be able to respond correctly to signals received on circuit BB (Received Data) which have a gross start-stop distortion of 40 percent and the signals provided by the terminal equipment or port equipment on circuit BA (Transmitted Data) should have a gross start-stop distortion not greater than 5 percent.

2.1.2.3 Break Signals

Break Signals (spacing signals longer in duration than a character) may be used in half-duplex arrangements for terminal users to signal the computer to halt output if the computer is properly equipped. Break signals may also be used by the computer to halt input from a terminal that is properly equipped. Break signals are transmitted from the terminal or computer port on the Transmitted Data lead, BA, and received on the Received Data lead, BB. Recognition of the break signal and the response thereto is a function of the terminal or computer, not the data set. However, since some data set arrangements disconnect on a long space signal, the terminal or computer must control the length of any spacing signal sent as a break signal. The break signal transmitted should be between 380 and 750 milliseconds in duration. The minimum length of a BREAK signal appearing on circuit BB may be less than 380 milliseconds if characters are being transmitted on circuit BA when the BREAK signal is received. The minimum duration of a received BREAK signal will be 190 milliseconds. An exception to this occurs when the BREAK signal

is sent through a tandem concentrator arrangement while characters having all bits spacing are being transmitted, in which case the received space interval may occasionally be less than 100 milliseconds. It will be necessary to send a second BREAK signal in the event an insufficiently long BREAK signal fails to stop transmission.

It should be noted that since some station line arrangements use a continuous spacing signal to signal the idle state, spacing signals of equal or longer duration than BREAK signals may be received by the computer when some stations disconnect. The possible conflict in the detection of BREAK signals with long-space disconnect can be avoided. To accomplish this, the response of the computer BREAK detection arrangements should be inhibited when the port interface circuit CC is turned OFF within 100 milliseconds following the end of a spacing signal that appears to be a BREAK signal.

2.2 Interface Characteristics Peculiar to the Computer Communication Port

2.2.1 Functional Description of Interface Leads

Interface connector pin assignments of the interface leads presented to the computer communication port are listed in Section 2.1.1. Functional descriptions of these circuits when used in DLCS are as follows:

- AA — Protective Ground — This circuit is connected electrically to the equipment frame and the AC power service ground.
- AB — Signal Ground — This circuit provides the common ground reference potential for all other interface circuits except circuit AA. It may optionally be connected to protective ground by a strap. Because many of the trunk terminating data sets (or 1A-Data-Station-channel-deriving equipments for long-haul trunks from remote concentrators) may utilize the same power supply and equipment cabinet, connection of the circuit AB to circuit AA in any one port interface or associated

data set will have the effect of connecting these two leads together in all ports and associated data sets having a common cabinet and power supply.

- BA — Transmitted Data — Signals on this circuit are generated by the communications port for transmission to the connected station.
- BB — Received Data — Signals on this circuit are generated by the trunk-terminating data set in response to signals received from the connected station. Circuit BB is clamped marking whenever circuit CC, CF or CD, if used, is in the OFF condition.
- CA — Request to Send — This circuit may optionally be strapped to circuit CB where signals are required on circuit CB in response to signals on circuit CA.
- CB — Clear-to-Send — This circuit may optionally be made an open circuit, or strapped to circuit CA if a Clear-to-Send indication is required after a Request to Send is made, or it may be strapped to circuit CC, Data Set Ready, to provide an alternate supervisory signal source for those computer ports that require supervisory signals on Clear-to-Send, circuit CB.
- CC — Data Set Ready — Signals on this circuit are supervisory signals from the data set and indicate when connections are established or when disconnect occurs. An ON condition on this circuit indicates that, in response to a station's request for service, the concentrator has connected the station's line to the trunk associated with the interface in question. An OFF condition indicates that the trunk has been disconnected (as described in more detail in Section 2.2.2.2). In addition, CC is held OFF when

circuit CF is OFF or when the data set is in the test mode for maintenance purposes. The signals on circuit CC may be duplicated on circuit CB as previously mentioned.

- CD — Data Terminal Ready — The use of this circuit is optional. When the circuit is not used, the trunk-terminating data set is wired so that the system operates as though circuit CD were permanently ON. When it is used, signals on circuit CD are supervisory signals generated by the communication port to control the operations of the concentrator and indicate when a port is ready to accept a request for service or is out of service. An ON condition on this circuit indicates the readiness of the communication port to accept a request for service from an outlying station. An OFF condition indicates that a connected station, if one exists, should be disconnected and that no station lines should be connected to the associated trunk. If the trunk terminating data set is wired to use circuit CD, and the circuit is opened (e.g., the removal of the 25-pin connector) the data set will cause the OFF supervisory signaling state to be transmitted as though CD were OFF.
- CF — Received Line Signal Detector — The meaning of signals on this circuit depends upon the application and whether the type of trunks are short and terminate with 109-type data sets or whether the trunks are long and terminated in 1A Data Station arrangements. If the terminating data sets are of the 109-type, an ON condition on circuit CF indicates that the data set is connected and has power on. If the trunks are long and are terminated with 1A Data Station equipment, circuit CF indicates the presence or absence of suitable incoming carrier signal in the 1A

Data Station channel, an ON condition indicating the presence of carrier. Therefore, regardless of the type of data set that terminates the trunk, CF being OFF signifies a trouble condition.

- +P — Positive power: For Telephone Company use only.*
- P — Negative power: For Telephone Company use only.*

2.2.2 Supervisory Signal Characteristics

The sequence and timing characteristics for supervisory signals relative to the port interface are described in this section. The interface circuits of primary interest are CC, Data Set Ready, and CD, Data Terminal Ready. Response times are given for all station line and trunk arrangements. The most significant response time differences among arrangements are between those in which trunks are metallic loops terminated in 109-type data sets and those in which the concentrator is a substantial distance (remote) from the computer and trunks are provided with voiceband channels terminated with 1A Data Stations.

2.2.2.1 Call Origination

When a user at a station desires to access the computer, he presses a key on the station as outlined in 1.2.1, preceding. The pressing of the key results in circuit CC (optionally also CB) in the next idle communication port interface being turned ON. If no port is available, the station will be "camped-on". When another station disconnects, circuit CC in the interface of the associated communication port involved is turned OFF to signal disconnect. The camped-on station is then connected to the idle trunk and circuit CC is turned ON to signal the connection. As mentioned in 1.2.2, the first station camped-on is connected to the first idle trunk. Following this, other camped-on stations are selected in equipment order. While circuit CC in a communication port interface going ON indicates that a station has been connected and a communication channel established for the

exchange of data between the computer and station, some Bell System stations will not be ready to receive data for up to 1 second after CC is turned ON.

In order for a communications port to be selected, the port must:

- a. not be interconnected with a station,
- b. have circuit CD (if equipped) ON,
- c. have the NORMAL-OFF switch, in simple systems or the CHANNEL MODE switch, in remote concentrator arrangements, in the NORMAL position, (See Section 2.2.2.3)
- d. have lead BA in a marking condition.

If any of these conditions are not met, the communications port will not be selected by the concentrator.

The interval that a computer port remains idle between connections can be extended or a trunk taken out of service without interfering with calls from stations by turning circuit CD OFF after CC goes OFF (see Fig. 3B and Table A). In remote concentrator arrangements with trunks as long as 1,000 miles, circuit CD must be turned OFF within 50 milliseconds (100 milliseconds for dual access concentrators) of the time that circuit CC goes OFF to avoid possible interference with new calls from stations. The transmission delay through facilities as long as 3,000 miles can be so large that circuit CD must be turned OFF immediately after circuit CC goes OFF. However, in simple systems it is only necessary that circuit CD be turned OFF within 170 milliseconds (220 milliseconds for dual access concentrators) of circuit CC going OFF to avoid possible interference with new calls from stations.

2.2.2.2 Disconnect Options

As described in 1.2.6 preceding, there are several ways of releasing a connection. It is important to note when the various interface leads at the

* Not provided in 109-type data sets.

communications port change state and when the concentrator actually releases the trunk.

a. Station Disconnect

Depression of the OFF key on the station or turning OFF the Data Terminal Ready lead, where utilized, causes disconnect to occur. Disconnect is signaled at the communications port by circuit CC (optionally also circuit CB) being turned OFF. Circuit CC will not be turned ON to signal a new connection to the trunk following circuit CC being turned OFF for at least 210 milliseconds (260 ms for dual access) in remote concentrator arrangements and 230 milliseconds (280 ms for dual access) in simple systems (see Fig. 3A and Table A).

As noted previously, since some station arrangements use a continuous spacing signal to signal the idle state, spacing signals of equal or longer duration than BREAK signals may be received by the computer when these stations disconnect.

b. Discrete Character Disconnect Option

The transmission of a discrete character or character sequence by the station or the computer causes appropriately equipped stations to initiate disconnect as though the OFF key had been pressed or the Data Terminal Ready lead, where utilized, had been turned OFF. The delay, between the time the character is sent (time starting at the end of the character) from the computer and the time circuit CC goes OFF to signal that disconnect has been effected, will range from 40 to 80 milliseconds for stations in simple systems and from 90 to 300 milliseconds for stations in remote concentrator arrangements, including those involving tandem concentration, or for stations connected with 1A Data Station derived channels. The delay may be as long as 2.2 seconds in the case of stations connected with data channels that use the Private Line Adapter Arrangement (see Fig. 2). The ASCII EOT character is the discrete character used when this option is provided with Bell System terminals.

c. CD OFF Disconnect Option

Disconnect may be initiated by the computer if circuit CD, Data Terminal Ready, is included in the communication port interface and is turned OFF. In simple systems circuit CC will be turned OFF within 20 milliseconds after circuit CD is turned OFF and independent of any response by the concentrator (see Fig. 3A and Table A). In remote concentrator arrangements with trunks up to 1,000 miles in length, circuit CC will be turned OFF within 140 milliseconds after circuit CD is turned OFF, (a delay up to 180 milliseconds being possible for trunks as long as 3,000 miles). In order to assure disconnect, circuit CD should be held OFF for at least 110 milliseconds in simple systems and 130 milliseconds in remote concentrator arrangements. As long as it is held OFF no station lines will be connected to the associated trunk.

A station line that is disconnected by the concentrator is placed in a state where it is no longer connected to the trunk but the station is not OFF. It is put in a holding state, connected to the concentrator with its motor still running. In order to put the station in an OFF state, the user must press the OFF key or the appropriate station interface lead (where used) must be turned OFF. It is also necessary for the station to be returned to the OFF state before a new request for service can be initiated.

- BA — Transmitted Data — Signals on this circuit are generated by the customer terminal for transmission toward the computer.
- BB — Received Data — Signals on this circuit are repeated by the data set in response to signals received from the transmission line.
- CA — Request to Send — Signals on this circuit are not used by the data set. However, a strapping option is provided for connecting CA to CB as explained below.
- CB — Clear to Send — This lead is not required to be used by the data set.

Strapping options are provided on the data set for connecting CB to CA so as to make supervisory signaling available on CB in response to a request on circuit CA or for connecting CB to CC so as to provide a supervisory signal on CB when circuit CC is in an ON condition if such responses are required by the station.

- CC — Data Set Ready — An ON condition of this circuit indicates that a request for service has been made; however, it does not necessarily indicate a connection to the computer has been established. An OFF condition on circuit CC will occur as a result of any of the following: (1) a power failure, (2) loss of received carrier or loss of loop current (optional for local stations), and (3) circuit CD being turned OFF or operation of an OFF key on the data set. More specific information as to when circuit CC is turned ON and OFF during a call is given in Section 2.3.2.

In tandem concentration arrangements both concentrators will disconnect. The interconcentrator trunk is then made available for use by another station. The more remote concentrator would be delayed in effecting disconnect until after the concentrator nearest the computer has been disconnected. The duration of time that CD (at the computer port) must be held OFF to effect disconnect is not increased.

2.2.2.3 Trunk Out of Service

A switch, which allows that trunk to be taken out of service, is associated with each concentrator trunk. In simple systems the switch has two positions, NORMAL and OFF; in remote arrangements the switch has three positions, NORMAL, OFF and TEST. With the switch in the OFF position, the concentrator will not attempt to select the trunk. With the

switch in the NORMAL position and circuit CD (if provided) ON, the trunk is available for service. The TEST position, in the remote arrangement, is used in making "loop-around" tests by the Telephone Company.

2.3 Interface Characteristics Peculiar to the Customer-Provided Terminal Interface

2.3.1 Functional Description of Interface Leads

Interface connector pin assignments of the interface leads presented to the terminal are listed in Section 2.1.1. Functional descriptions of these circuits when used in DLCS are as follows:

- AA — Protective Ground — This circuit is connected electrically to the equipment frame.
- AB — Signal Ground — This circuit establishes the common ground reference potential for all other interface circuits except circuit AA above. A strapping option is provided for connecting AB to AA.
- CD — Data Terminal Ready — Signals on this lead allow the customer terminal to maintain control of the transmission facility. In applications where a key on the data set is provided as a means for requesting service, that key must be ON to enable terminal control via the CD lead. An ON condition of the CD lead indicates a request for service. An OFF condition initiates the termination of a call and the return to the idle condition.
- CF — Received Line Signal Detector. At station arrangements using 108-type data sets or 1A Data Stations, an ON condition on this circuit indicates the presence of suitable received carrier or normal loop currents. An OFF condition indicates a loss of received carrier or loop current. For station arrangements using 109-type data sets, it is expected that the CF lead

would not be used, generally; therefore, it is connected to +8vdc and an OFF condition indicates a loss of power. However, an option is available to enable its active use in which case its operation is the same as that described for the remote station. More specific information concerning the operation of the CF circuit is given in Section 2.3.2.

+P — Positive Power: For Telephone Company use only.*

—P — Negative Power: For Telephone Company use only*

2.3.2 Supervisory Signal Characteristics

The sequence and timing requirements for supervisory signals relative to a customer-provided terminal are described in this section. The interface circuits of primary interest are CC, Data Set Ready, and CD, Data Terminal Ready.

2.3.2.1 Idle Condition

In an idle condition, Data Terminal Ready, CD, where provided, and Data Set Ready, CC, are OFF. The Received Data lead is in a MARKING condition.

2.3.2.2 Request for Service

A request for connection to a computer port is made by turning the Data Terminal Ready lead ON or, for those arrangements where the CD lead is not used, by the attendant operating an appropriate key on the data set. The Transmit Data Lead, BA, should be kept MARKING until the connection to the computer port has been established.

The Data Set Ready lead, CC, will turn ON when the CD lead is turned ON. An exception occurs when using a 1A Data Station, where the CC lead is not turned ON until the

corresponding 1A Data Station near the concentrator returns a response indicating it is connected to the concentrator. In 1A Data Station arrangements with lines up to 1000 miles in length, circuit CC will be turned ON within 120 milliseconds after circuit CD is turned ON; but with lines as long as 3000 miles, a delay of 160 milliseconds is possible. When the Data Set Ready lead is turned ON, the MARKING clamp on the Received Data lead, BB, is removed by the data set and received data signals will appear on the BB lead.

A dual access option may be provided in DLCS whereby local stations are given access to two distinct trunk groups. The Data Set 109H is required at the station when dual access is provided. This data set has two keys, one for each trunk group to be accessed. If the CD lead is not used, a request for service is made by the attendant operating the appropriate key for the trunk group desired. If the CD lead is used, it is necessary, before the Data Terminal Ready lead is turned ON, for the station attendant to operate the appropriate key on the data set. In this case, the key need not be changed between calls but may be left operated until selection of the other trunk group is desired.

2.3.2.3 Camp-On

When a request for service is made and no computer ports are available, the station is put in a camp-on state until a port becomes available. To signal the user that the station is camped-on, a spacing pulse is transmitted to the station approximately every 3 seconds. The space interval is 3 ± 0.6 , 6 ± 1.2 , or $10 \frac{1}{2} \pm 2.1$ milliseconds, the choice depending on the operating speed of stations served by the concentrator. The same interval applies to all lines served by the concentrator.

2.3.2.4 Request to Disconnect

A request for disconnect is made by turning the Data Terminal Ready lead, CD, OFF or, in those arrangements where the CD lead is not used, by

* Not provided in 109-type data sets.

the attendant operating the OFF key on the data set. Data Set Ready lead, CC, will turn OFF when the CD lead is turned OFF with the exception of a 1A Data Station, in which case the CC lead is not turned OFF until the corresponding 1A Data Station near the concentrator returns a response indicating it has disconnected from the concentrator. In 1A Data Station arrangements with lines up to 1,000 miles in length, circuit CC will be turned OFF within 140 milliseconds after circuit CD is turned OFF; but, with lines as long as 3,000 miles, a delay of up to 180 milliseconds is possible.

As noted previously, appropriately equipped Bell System stations can initiate a disconnect upon receipt of an EOT character sent from the computer. Likewise, customer-provided terminals could initiate a disconnect upon receipt of a discrete character or character sequence by turning OFF the Data Terminal Ready lead.

The computer port can also request the concentrator to disconnect the station line from the trunk by turning OFF its Data Terminal Ready lead for at least 110 milliseconds in simple systems. The concentrator disconnects the station line from the trunk and, if the terminal has not initiated a disconnect, puts the line on a holding circuit. If the station line is put in a holding state, it is no longer connected to the trunk but the station is not in an idle condition. The Received Data lead is held in a MARKING condition. The 109-type data sets will detect the change in the state of the line that occurs before the concentrator puts the line on a holding circuit and indicates this by turning the CC lead OFF. However, the CC lead does not stay in an OFF condition and will turn ON again within 35 milliseconds unless the CD lead has been turned OFF. While in this holding state, transmission from the station would not be received anywhere. If the station were receiving data from the computer, the flow of data would cease. Although the station line is still connected to the concentrator when it is put in a holding state, this will not be

interpreted as a request for service. It is necessary for the station to go to an idle condition first before it can make another request for service.

2.3.2.5 Data Carrier Failure

For station arrangements that require 108-type data sets or 1A Data Stations, the data set will indicate an OFF condition on the CF, Received Line Signal Detector, lead upon detecting a loss of received carrier or a loss of normal loop current. For a loss of carrier to be indicated, the received carrier must be lost for a minimum time interval which depends on the data set being used. This interval can be from 10 to 300 milliseconds. During this time, spurious signals can be expected to appear on the Received Data lead, BB.

While the CF lead is OFF, the BB lead is held in the MARKING condition. Reception of appropriate carrier for 10 to 500 milliseconds will restore the CF lead to an ON condition.

For station arrangements using a 109-type data set, calls are originated and terminated by turning the loop current ON and OFF. The CF lead is connected to +8V dc and, in this case, an OFF condition indicates a loss of power. However, an option is available to allow the use of the CF lead as a current indicator. If it is used, a loss of loop current for 10-20 milliseconds will cause the CF lead to turn OFF and a restoral of loop current for 10-20 milliseconds will cause CF to turn ON. When a disconnect is initiated by the computer port (see Section 2.3.2.4) and the CF lead is functional, it will be turned OFF. It will be held OFF if the station responds by returning to the idle state. Alternatively, it will be turned ON again when the line is put in the holding state at the concentrator. It should be noted that CF will be OFF in the idle state.

2.3.2.6 Data Set Test Mode

The data set or the data set in conjunction with a data auxiliary set is equipped with one or more

test buttons which allow the Telephone Company to test the transmission performance of the set and the connecting facilities. These buttons should be operated only as directed by the Telephone Company.

3. PHYSICAL CHARACTERISTICS

The physical characteristics, power requirements and environmental limitations of the various equipments that may be installed on a customer's premises are described in this section. The packaging and cabinet arrangement of equipments installed on a customer's premises will vary among installations and, for a given installation, will depend upon available space and the particular configuration involved. Therefore, the following descriptions are largely in terms of typical arrangements. Maximums are given where appropriate.

3.1 Equipment at Concentrator Location

3.1.1 Concentrator

It was noted in 1.2.12 preceding, that the concentrator is designed on a modular basis, the number and type of modules required being determined by the numbers of lines and trunks involved. However, regardless of size, the modules comprising a concentrator are, for customer's premises installations, mounted in a cabinet that is 34 inches wide, 30.5 inches deep and 72.18 inches high. The cabinet is designed to be free standing on four adjustable levelers. Arrangements involving 8- or 16-trunk modules or fewer than four 32-trunk modules (for 97- to 128 lines) do not use all of the space available in the cabinet. The unfilled space may be used to house other associated equipments as discussed below. Concentrators will vary in weight from about 400 to 1000 pounds depending upon size.

The cabinet has doors on both the front and back for access to the equipment. Therefore, space must be provided in front and in back of the cabinet for installation and maintenance personnel. Space provided should have a minimum depth of 3 feet.

The cabinet is designed for cables to be brought in through the bottom of the cabinet where the installation is on a false floor. Alternatively, cables can be brought in through the top of the cabinet.

Concentrators require ac power, 60 Hz \pm 3 Hz at 105 to 129 volts. The ac power drain is up to 115 watts for concentrators having 1 switch module for serving up to 32 lines with up to 32 trunks. The ac power drain is up to 345 watts for larger concentrators. The power receptacle must accept a plug equipped with a U-blade ground and supply a valid ground to the ground pin.

Concentrators modules will operate satisfactorily over an ambient temperature range of 40° to 120° Fahrenheit with a relative humidity of 10 to 95 percent. However, unless special provision is made, ventilation of the cabinet is by natural convection and the temperature rise within the cabinet may be as large as 15° Fahrenheit. The maximum tolerable ambient temperature must be reduced by the amount of the cabinet temperature rise. To facilitate ventilation, the space to a height of 1 1/2 feet above the cabinet should be essentially free of obstacles that would inhibit the free flow of air.

3.1.2 Private Line Data Channel Interface Arrangements

Special equipment is required at the concentrator for each station served on a private line data channel using 108-type data sets. Such equipments may be mounted in the concentrator cabinet, if space is available, or a separate cabinet that is 30 inches high, 24 inches wide and 17 inches deep. Space must be available for both front and rear access to the cabinet. The maximum weight of a full cabinet is about 150 pounds.

The power drain from a 60 \pm 3 Hz supply is about 25 watts at 105 to 129 volts for each interface arrangement. In other respects, space and environmental requirements are the same as the concentrator.

3.1.3 1A Data Stations

Multiplexed line arrangements for serving small remote clusters of stations and long-haul trunk arrangements involve 1A Data Station equipment located with the concentrator. Long-haul trunks also involve 1A Data Station arrangements located near the computer; 1A Data Station equipments may be mounted in the concentrator cabinet, in a separate cabinet identical to the concentrator cabinet or in a small cabinet like the cabinet described in 3.1.2, preceding. The small cabinet will house 1A Data Station equipment for up to 8 data channels. Its weight (total occupancy) is approximately 145 pounds. The larger concentrator cabinet described in 3.1, preceding, can house 1A Data Station equipment for up to 32 data channels. The weight of this large cabinet installation (total occupancy) is about 700 pounds.

The ac power drain per derived data channel is about 7.5 watts at 105 to 129 volts and 60 ± 3 Hz.

In other respects, the space and environmental requirements are the same as for the concentrator described in 3.1.1 preceding.

3.1.4 Multiple Mounting of 109-Type Data Sets

Trunks in local arrangements where the concentrator is close to the computer are terminated in 109- data sets. These data sets may be mounted in the concentrator cabinet or in a separate cabinet like that described in 3.1.2, preceding. As many as 64 data sets can be mounted in one 30 inch high cabinet for a total weight of about 60 pounds. The ac power drain for each group of 16 or fewer data sets can be up to 75 watts at 105 to 129 volts and 60 ± 3 Hz. In other respects the space and environmental requirements are the same as for the concentrator described in 3.1.1, preceding.

3.2 Data Sets for Customer-Provided Terminals

The physical characteristics, power requirements and environmental limitations of the data sets

for which provision on the customer's premises should be made are described in this section.

3.2.1 1A Data Stations

The 1A Data Station equipment that may be used to serve remotely located terminals is described in Section 3.1.3.

3.2.2 Data Set 108A or 108C with Data Auxiliary Set 820D

The Data Set 108A or 108C is mounted within the Data Auxiliary Set 820D housing which is 11 inches wide, 11 inches long and 5.5 inches high. Weight of the combination is 12 pounds. Power drain is 15 watts at 117 ± 10 volts ac and 60 ± 0.45 Hz.

3.2.3 Data Set 109H

The basic Data Set 109H is housed in a desk top type housing 8-7/8 inches wide, 9 inches deep and 3-5/8 inches high. It weighs about 4 pounds. The set is powered by a wall mounted transformer. Power drain is approximately 3 watts at 117 ± 10 volts ac and 60 ± 3 Hz.

4. ALARM FEATURES

Alarms are provided on key functional components of the concentrator to signal a failure. The alarms are available collectively for removing the alarm indication. A set of transfer contacts on an alarm relay can be used to light a lamp or operate such other alarm indicators as may be provided in a remote location to signal the alarm condition. Access to the contacts is obtained through the top or the bottom of the cabinet along with other cables as described in 3.1.1, preceding. The contacts have a maximum current capacity of 500 milliamperes (dc or ac rms) and an open circuit voltage limit of 50 volts (dc or ac rms). The alarm is of the nonlocking type, i.e., it clears when the failure causing it is cleared.

Similar provisions for removing alarm indicators are available on 1A Data Station arrangements.

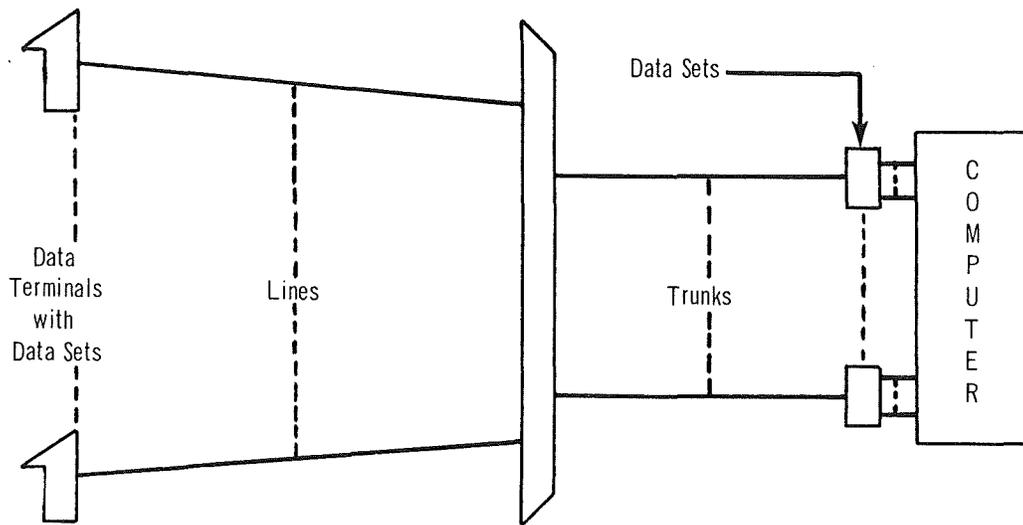
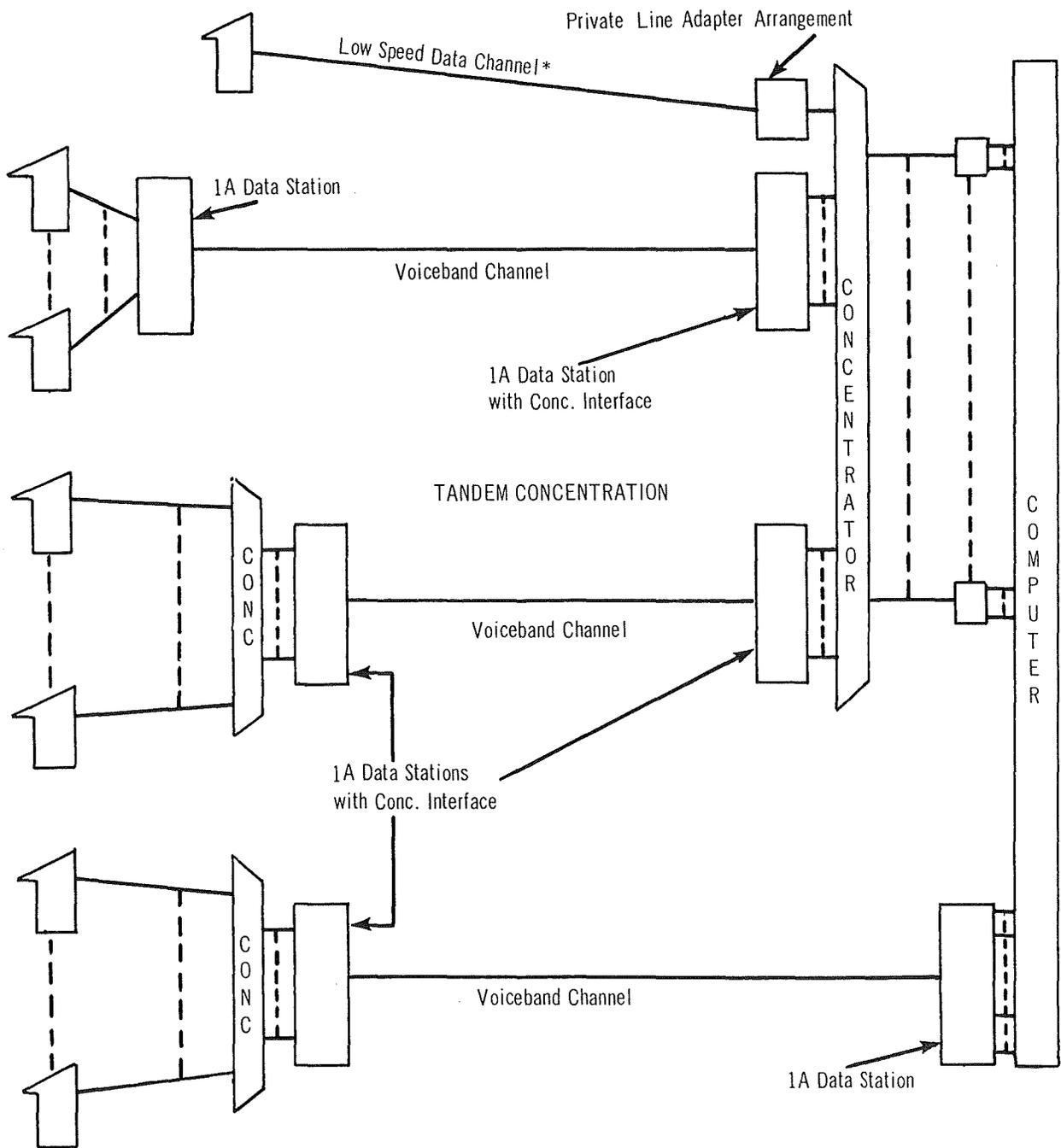


Figure 1 – Simple Data Line Concentration System

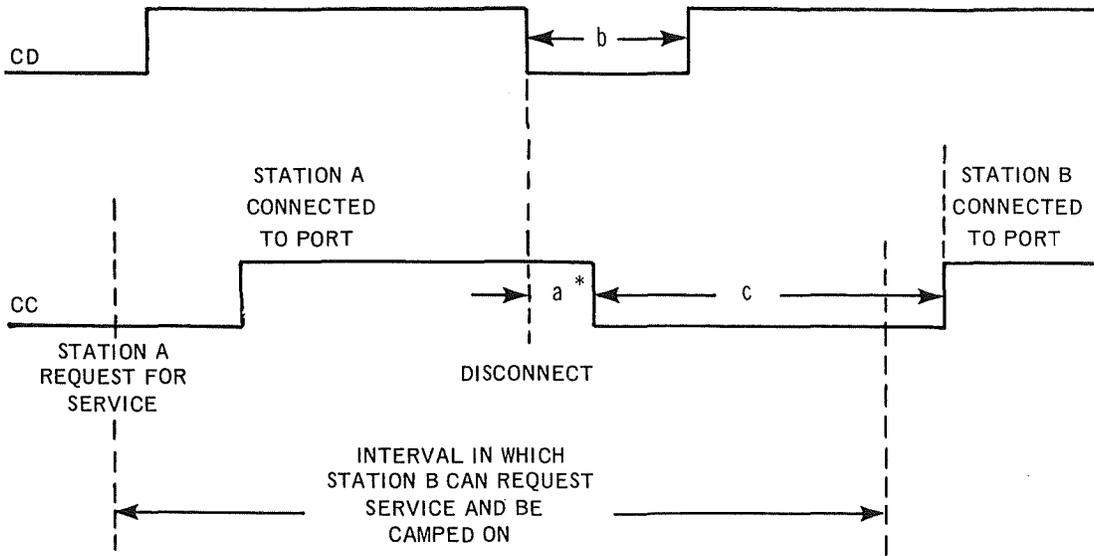


* Low speed data channel can be either a voiceband channel terminated with 108-type data sets or a facility provided with the private telegraph network.

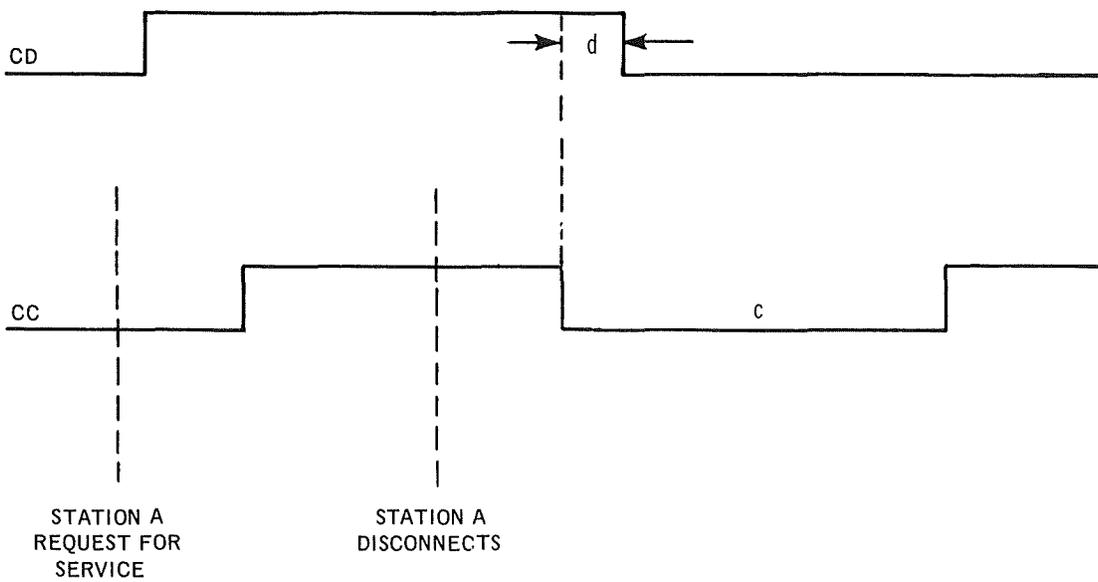
Figure 2 – Arrangements for Stations Requiring AC Facilities

COMPUTER PORT DISCONNECT SEQUENCE CHART

A) COMPUTER INITIATED DISCONNECT



B) STATION INITIATED DISCONNECT



*Values for intervals a, b, c, and d are listed in Table A.

FIGURE 3

TABLE A
VALUES FOR INTERVALS IN FIGURE 3

	INTERVAL IN MILLISECONDS			
	A	B	C	D
	DATA TERM RDY-OFF TO DATA TERM RDY-OFF MAXIMUM	DATA TERM RDY- OFF TO DATA TERM RDY-ON MINIMUM	DATA SET RDY-OFF TO DAT SET RDY-ON MINIMUM	DATA SET RDY-OFF DATA TERM RDY-OFF MAXIMUM
Simple System				
Single Access	20	110	230	170
Dual Access	20	110	280	220
Remote Concentrator				
Single Access				
Max. 1,000 Mile Circuit	140	130	210	50
Max. 3,000 Mile Circuit	180	130	210	0
Dual Access				
Max. 1,000 Mile Circuit	140	130	260	100
Max. 3,000 Mile Circuit	180	130	260	50

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