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U S WEST Communications, Inc. Technical Publication

SwitchNet 56® SWITCHED 56 kbit/s DIGITAL SERVICE

77329
Issue B
August 1992

NOTICE

SwitchNet 56® service is a high speed digital transport which provides end-to-end 56 kilobit per second (56 kbit/s) switched digital connectivity. It comprises those features needed to link Customer Provided Equipment (CPE) to switching systems and digital transmission facilities. SwitchNet 56® has the potential to support many different customer applications, such as, bulk data/file transfer, high speed facsimile, remote job entry, video teleconferencing, simultaneous voice/data, computer graphics, encrypted voice/data and high fidelity voice. Each SwitchNet 56® call provides full duplex two-way transmission.

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EXHIBITS

1.00 GENERAL

1.01 SwitchNet 56® service is a high speed digital transport which provides end-to-end 56 kilobit per second (56 kbit/s) switched digital connectivity. It comprises those features needed to link Customer Provided Equipment (CPE) to switching systems and digital transmission facilities. SwitchNet 56® has the potential to support many different customer applications, such as, bulk data/file transfer, high speed facsimile, remote job entry, video teleconferencing, simultaneous voice/data, computer graphics, encrypted voice/data and high fidelity voice. Each SwitchNet 56® call provides full duplex two-way transmission.

1.02 This service utilizes a switching and dialing scheme that is very similar to a Direct Distance Dialing (DDD) call. At present there are three methods of providing the service:

A. Two of the methods use Time Compression Multiplexing (TCM) to provide 56 kbit/s over a 2-Wire loop. This is accomplished by increasing the transmission rate of the local loop to over 144 kbit/s. The other method is to use a 4-Wire loop, thus keeping to similar guidelines that 56 kbit/s digital services follow today.

B. The cities of Minneapolis, Des Moines and Omaha are using a 2-Wire offering of SwitchNet 56®, which is described in Bellcore Technical Reference TR-880-22135-84-01, "Circuit Switched Digital Capability Network Access Interface Specifications". U S WEST Technical Publication 77329 addresses how SwitchNet 56® is provided using a 4-Wire loop. This version is used in every other location where U S WEST Communications, Inc. offers SwitchNet 56® service.

2.00 DESCRIPTION OF OPERATION

2.01 The method of providing 56 kbit/s service utilizing a 4-Wire loop is accomplished by using the 1AESS® switch as a wideband digital switch which is accomplished by literally transmitting a 72 kbit/s unipolar signal through the 1A switch (see Exhibit 1). The digital signal progresses through the switch as a normal call would, with the exception that on an intra-office call, the call enters and exits the trunk link network. This method was chosen due to the bandwidth limitation of the junctor circuits which are normally encountered on an intra-office call. Bypassing these circuits allows the 1AESS® to function as a wideband switch. As can be seen in Paragraph 5.02, SwitchNet 56® can also be provided with AT&T's 5ESS® and Northern Telecom's DMS™100 switches.

3.00 RESPONSIBILITY OF U S WEST COMMUNICATIONS, INC.

3.01 U S WEST Communications, Inc. is responsible for ensuring that SwitchNet 56® services furnished to the customer are installed and operating properly.

3.02 U S WEST Communications, Inc. will furnish the customer with a trouble reporting telephone number.

3.03 U S WEST Communications, Inc. will keep the customer advised, as appropriate, of the status of trouble reports.

3.04 U S WEST Communications, Inc. will direct the customer to the appropriate party [e.g., Interexchange Carrier (IC), CPE supplier, if the trouble still exists and has not been isolated to our Network].

4.00 RESPONSIBILITY OF THE CUSTOMER

4.01 Refer to owners manual of customer owned equipment to sectionalize the trouble, and verify that it is not in customer owned equipment before calling the Customer Service Center. [Isolate the trouble to either Data Terminal Equipment (DTE), Channel Service Unit (CSU)/Data Service Unit (DSU) or the network].

A. If the trouble is isolated to customer owned equipment, call the equipment supplier.

B. If customer owned equipment is operating as designed, and the customer has problems on local calls, call U S WEST Communications, Inc.

C. If the customer has problems on long distance calls only, call the IC (Long Distance Telephone Company).

4.02 Joint testing with a U S WEST Communications, Inc. Customer Service Center may be necessary to further isolate troubles.

5.00 GENERAL ARCHITECTURE

5.01 This SwitchNet 56® network architecture consists of:

A. A CSU/DSU on the customer's premises.

B. A 4-Wire non-loaded loop.

C. A Loop Interface Shelf (LIN) in the 1AESS® equipped with an Office Channel Unit (OCU) and Digital Signal Zero (DS0) plug-ins.

D. A stored program switch and digital trunking facilities.

5.02 The LIN is the component that is unique to 4-Wire SwitchNet 56® service. The service can be provided in Central Offices' (CO's) with AT&T 's 1AESS®, 5ESS® and Northern Telecom's DMS™ switching equipment. The 1AESS® switch interfaces with the Loop Interface Shelf (see Exhibit 1), while the digital switches can be accessed through a D4 Bank (see Exhibit 2) or using an integrated Digital Loop Carrier (DLC) arrangement (see Exhibit 3). 1AESS® Offices utilizing 4-Wire SwitchNet 56® service must be equipped with Digital Carrier Trunk (DCT) or Miniature Universal Trunk (MUT) frames, to provide trunking functions.

5.03 Channel Service Unit/Data Service Unit (CSU/DSU)

A. A CSU/DSU is required on the customer's premises to provide the proper interface to both the network and the customer's DTE. Customer access is over 4-Wire metallic loops that terminate in the LIN, a D4 Bank, or via a DLC (see Exhibits 1, 2 and 3).

B. Customers not served directly by a pre-equipped CO may access SwitchNet 56® service by the appropriate remote access arrangement (see Exhibit 4).

C. There are several vendors that manufacture compatible CSU/DSU units for the 4-Wire SwitchNet 56® offering, selection of which is at the customer's discretion.

D. The CSU/DSU unit performs the following functions:

1. Interface with customer DTE. Dataport: V.35 via 34 pin connector. Cable Length: 100 feet. Auto Dial: RS232C, D or RS366 (specified when ordered). Dialer may be integrated.

2. Interface with U S WEST Communications, Inc. Network. Eight pin modular jack (RJ48S). See T1E1.4/90 - 006R3. The SJA56 Jack may also be used, but at the time of issue, it was not yet registered.

3. Coding and decoding of 56 kbit/s signal and line equalization.

4. Timing recovery.

5. Call set-up.

6. Generation and recognition of control signals (local and remote loopback).

E. All of the above functions meet Network Interface (NI) requirements per AT&T Technical Reference (Predivestiture Document) PUB 62310, "Digital Data System Channel Interface Specification".

F. See Appendix 1 for CSU/DSU options and pin assignments for interfaces.

5.04 Physical Network Interface (NI)

A. The interface consists of four leads which are paired to provide a receive data pair and transmit data pair. The four leads are provided on a miniature 8-position RJ48S series jack without a shorting bar as shown in "Federal Communication Commission (FCC) Rules and Regulations", Part 68, Subpart F, Figures 68.500 (d1) and (d2).

B. The following are the pin assignments for the jack:

Pin #	Function	Signal Direction
8	Receive Data (R1)	From network to customer
7	Receive Data (T1)	From network to customer
2	Transmit Data (T)	From customer to network
1	Transmit Data (R)	From customer to network

Pins 3, 4, 5 and 6 will not be connected.

5.05 Loop Signals

A. Signal Format

1. Bipolar Return-to-Zero (BPRZ) signalling format is used for transmission over the local loop and is described by the following coding rules:

   a. A binary 0 is represented by the absence of a pulse.

   b. A binary 1 is transmitted as either a positive or negative pulse, opposite in polarity to the previous binary 1.

   c. An example of bipolar signalling is shown in Exhibit 5.

2. Through the use of bipolar violations, additional information capacity is achieved to provide a convenient way of transmitting network control information. A bipolar violation occurs when the alternate polarity rule is violated. For example, the bipolar rule is violated if the last "1" was transmitted as a positive pulse, and the next "1" is also transmitted as a positive pulse.

3. Using the following notations, Exhibit 6 shows a typical bipolar sequence containing bipolar violations.

   0 - denotes zero volts transmitted.

   B - denotes +/-E volts (polarity determined by bipolar rule).

   V - denotes +/-E volts (polarity in violation of bipolar rule).

B. Encoding and Decoding Rules

1. To be compatible, the transmit and receive data signals must use bipolar violations to indicate control information (Idle and out-of-service) and zero suppression. The zero suppression sequence is necessary since long sequences of zeros do not provide the transitions necessary to maintain timing recovery in some network equipment.

2. Unrestricted insertion of violations in the pulse stream would produce an undesirable DC component. A means of solving this problem is to reserve a time slot prior to a violation for application of a binary pulse or no-pulse in such a way that successive violations (V) alternate in polarity. The reserved time slot is designated by the symbol X. The desired polarity alternation of V's is achieved by assigning a value 0 or B to the X, such that the total number of B's since the last V is odd.

3. If pulses of the same polarity were adjacent, performance would be degraded. Therefore, X and V bits are separated by a ZERO, resulting in an X0V pattern in each bipolar violation sequence.

4. The following are standard bipolar violation sequences:

   IDLE SEQUENCE: BBBBX0V

   This sequence may be used as a supervisory signal. For example, it could indicate that the terminal does not have data to transmit, similar to "request-to-send off" indication in Electronic Industries Association (EIA) Standard RS232C. It consists of one or more repetitions of BBBX0V at 56 kbit/s.

   ZERO SUPPRESSION SEQUENCE: 0000X0V

   At 56 kbit/s, any sequence of seven consecutive zeroes must be encoded as 0000X0V.

   OUT OF SERVICE SEQUENCE: 000BX0V

   This sequence is an indication of trouble in the network.

   LOOPBACK SEQUENCE: 00B0X0V

   This sequence requests the loopback of the received signal onto the transmit circuit. It consists of three consecutive repetitions of the sequence at 56 kbit/s.

5. It is important to note that a Zero Suppression sequence may not be received when one was transmitted and vice versa. If a Zero Suppression sequence follows a B00000 data sequence, then the received data could have eleven consecutive zeroes at 56 kbit/s. However, the pulse density will be maintained with a minimum 1 in 7.

5.06 Customer Loops

A. Subscriber loops will be full-duplex 4-Wire metallic circuits. All SwitchNet 56® loops must be non-loaded, not have more than 2.5 kilo feet of total bridged tap, with each leg of bridged tap limited to 2.0 kilo feet. Loop lengths are limited to 18 kilo feet on 26 gauge cable. The insertion loss limit is 40.0db @ 28 kilo-hertz (see Table D).

B. To initiate a call, the customer has two options: Manual dialing or by auto-calling equipment. With both options, the call is set up by first making sure the CSU/DSU is in the ready mode, then dialing the required digits and waiting for a call established response.

C. After receiving the call established response, the originating CSU/DSU unit is in the data mode and ready to transmit information.

D. The CSU/DSU transmits a 56 kbit/s Digital Data Service (DDS) formatted digital signal over the 4-Wire loop to the CO, where it terminates in an OCU10A plug. The OCU10A plug formats the signal and outputs a standard 64 kbit/s DSX-0A signal to a DS010A plug. Both the OCU10A and DS010A plugs reside in the LIN.

E. The DS010A plug inserts 8 kbit/s of signaling information and outputs a 72 kbit/s signal to the 1AESS® switch. The line link network of the 1AESS® receives this signal and connects to the appropriate trunk link network.

F. If the called party fails to answer the call, and the calling party's CSU/DSU is not equipped with a timer to abandon the call after a specified interval, the call will remain in the ringing state indefinitely, as with an ordinary voice call. However, the calling party can go on-hook and terminate the call at any time.

5.07 Switching

A. Initial service will be provided to SwitchNet 56® customers using 1AESS® switching equipment. Initially a single 1AESS® office with SwitchNet 56® equipment can serve an entire metropolitan area through Foreign Exchange (FX) lines to neighboring wire centers or via a DLC. As the number of SwitchNet 56® customers increases, the equipment can be added on a line by line basis. SwitchNet 56® requires no hardware or software modifications to the 1AESS® switch.

B. The 1AESS® can direct all the digital data traffic originated by SwitchNet 56® subscribers to digital data facilities using standard translation procedures.

C. Signaling between 1AESS® offices may be Multifrequency (MF) or dial-pulse.

5.08 Remote Access Customers

A. For remote access services, two additional plug-in devices are required: The DS0-DP, which is functionally similar to an FX Office Unit (FXO), and the Office Channel Unit-Dataport (OCU-DP), which is similar to the FX Subscriber Unit (FXS). These plugs provide:

1. Signaling and supervisory functions.

2. Four-Wire DDS local loop interface on drop side of D4 or Digital Loop Carrier Remote Terminal (DLC-RT) Channel Bank.

3. DS1 interface to #5ESS® or DMS™100 Digital Switches.

B. Both of the above plug directly into a D4 channel bank or a DLC.

5.09 Digital Loop Carrier (DLC)

For customers served by DLC, the OCU-Dataport and the DS0-DP are also required. The OCU-DP interfaces the customer loop with the digital loop carrier remote terminal, while the DS0-DP residing in the central office interfaces with the DS0 channel unit in the LIN.

5.10 Trunking

A. SwitchNet 56® calls require dedicated trunk groups. SwitchNet 56® can not use Public Switched Network (PSN) trunks, nor can PSN calls use SwitchNet 56® trunks. A SwitchNet 56® call is recognized at the intermediate or destination office according to the class of the incoming trunk.

B. SwitchNet 56® line-to-trunk or trunk-to-trunk call set up sequences and address signaling appear to the 1AESS® exactly the same as a voice call. Multifrequency (MF) or Dial-Pulse (DP) signaling is supported during call set-up between 1A switches. Trunk circuits will switch to the "data mode" upon receipt of answer supervision from the terminating CO.

C. Interoffice transport of SwitchNet 56® service is performed via a Feature Group D type facility. These trunk circuits are terminated in a 56 Originating Dataport (ODP) and 56 Terminating Dataport (TDP) (D4 channel bank) for non-DCT application see Exhibit 7). For DCT applications, the trunk circuit terminates in the wideband Digital Trunk Circuit (DTC) in the Miniature Universal Trunk (MUT).

D. Feature group D groups must be utilized to interface with ICs.

E. Trunking arrangements are shown graphically in Exhibits 8 though 10. Exhibit 8 shows both configurations which can be used for inter-office trunking. The MUT frames are used with D4 channel banks in the CO at the top of the Exhibit, while DCT are used in the office in the bottom half of the Exhibit.

NOTES:

1. The Data Trunk Unit (DTU) plug-in is installed in the digital carrier trunk frame. The DTU can be configured as either one-way incoming, oneway outgoing, or as two-way via 1AESS® translations.

2. The DTC plug-in is installed in the miniature universal Trunk Frame. The DTC can be configured as either one-way incoming, one-way outgoing, or as an intra-office trunk via a manual option switch.

F. Exhibit 9 simply shows the intra-office trunking arrangement using a MUT frame. The Exhibit depicts this by showing the Outgoing Trunk (OGT) looped to the Incoming Trunk (ICT). The DTC plug can be optionally set, via a manual switch, for intra-office or inter-office trunking.

G. Exhibit 10 shows the intra-office trunking arrangement using a DCT frame. In this case, an intra-office trunk group must be set up to handle intra-office calls.

6.00 CALL SET-UP AND DISCONNECT (1AESS®)

6.01 The SwitchNet 56® system allows customers to dial up a data phone number via a CSU/DSU at the customer premise. After the call is set up, the customer can send full duplex 56 kbit/s digital data. This section describes the call set-up procedures in a 1AESS® (see Exhibit 11).

6.02 Call Establishment

A. To set up a SwitchNet 56® call, the End-User (EU) must first go off-hook. The CSU/DSU repeats the off-hook as a digital code to the OCU channel unit in the Loop Interface Shelf. The OCU passes the off-hook digital code to the DS0 channel unit, where the mark hold code is detected and converted to a ground on the ring conductor being monitored by the 1AESS® line scanner. This condition is reported to the 1AESS® Central Processor (CP), which then connects an idle Customer Dial Pulse Receiver (CDPR) to the line.

B. When the DS0 plug detects the CDPR, it sends a digital code (mark hold) MH to the CSU/DSU to indicate start dialing. The CSU/DSU then signals the customer terminal to start dial pulsing. A series of mark-hold to Control Mode Idle (CMI) signal transitions are passed between the CSU/DSU and the DS0 channel unit. These signals are converted to dial pulses by the DS0 channel unit which in turn are detected by the CDPR and passed on to the CP.

C. The dialed digits are decoded by the CP to determine the destination of the call. Assuming the destination requires an interoffice connection, the CP will select an appropriate outgoing wideband trunk circuit and attach to it a MF transmitter. The outgoing wideband trunk circuit is placed in the bypass state, providing direct metallic access between the MF transmitter and the ODP (originating dataport in D4 channel bank).

D. The ODP plug converts the steady off-hook DC signal into a digital off-hook (bit 8-1). The associated TDP (terminating dataport in D4) at the 1AESS® office detects the digital off-hook code through the T-Carrier and proceeds to close the loop toward the incoming wideband trunk circuit.

E. The incoming trunk ferrod in the terminating 1AESS® detects the off-hook condition and reports it to the CP. The terminating office CP then attaches the appropriate MF receiver to the incoming wideband trunk circuit. This circuit is also placed in the bypass state, providing direct metallic access between the MF receiver and the TDP plug.

F. The terminating office CP will cause the MF receiver to transmit a wink start pulse. The TDP plug detects and repeats the wink to the ODP plug, which also detects and repeats the wink to the MF transmitter. When the originating office CP detects the wink, it triggers the MF transmitter to send the address digits to the far end MF receiver.

G. Upon completion of outpulsing, the originating office CP disconnects the MF transmitter and the CDPR from the DS0 line circuit. The CP will then connect the DS0 channel unit to the outgoing trunk, which sets up a data path through the originating 1AESS®.

H. The outgoing trunk will be placed in the talk local state. Busy, idle supervision of the calling party is transferred to the line side ferrod of the outgoing wideband trunk.

I. The terminating office CP disconnects the MF receiver and connects audible ring tones to the incoming trunk, which is placed in the tandem-free-state. The called line is connected to a 20Hz ringing generator, which is detected by the terminating DS0 channel unit, and digitally encoded to mark-hold toward the called CSU/DSU, over the 4-Wire loop.

J. The receiving CSU/DSU then alerts the customer data terminal (via the ringing generator) of an incoming data call. When the terminal answers, the CSU/DSU detects off-hook and sends mark-hold to the DS0 channel unit. The DS0 channel unit translates the mark-hold to off-hook toward the ringing generator. This causes ringing to be removed and the terminating DS0 channel unit to be connected to the incoming wideband trunk.

K. The terminating office CP then checks the line side ferrod of the incoming trunk for a busy signal, to ensure that the transfer took place. After a short interval, the terminating CP places the incoming trunk in the talk-local-charge state, reverse battery and ground on tip and ring toward the TDP plug. This is answer supervision, and the TDP plug repeats the condition to the ODP plug and to the outgoing wideband trunk. The originating CP detects answer supervision and proceeds to make an AMA record of the call.

L. When the ODP and TDP plug detect answer supervision, they change from the MF pulsing mode to the data mode for baseband data transmission. The ODP also sends a digital answer code to the originating DS0 channel unit. The DS0 responds to this signal by transmitting mark-hold to the CSU/DSU, which alerts the DTE that the network has answered its request to send data. At this point, a switched connection capable of simultaneously transmitting and receiving 56 kbit/s baseband data is established.

6.03 Misdialing

A. Misdialing SwitchNet 56® calls to voice lines will receive answer supervision if the voice line answers the call. However, a two-way communications link is not cut through, but the call could be charged to the originating SwitchNet 56® subscriber, similar to misdialed voice calls.

B. Permanent signal partial dial treatment by the 1AESS® on SwitchNet 56® lines that seize a CDPR, but fail to complete dialing, will return the SwitchNet 56® line to idle. If the originating station remains off-hook, no further action is taken by the DS0 channel unit to initiate a new call. The originating station must return to on-hook in order to recycle the DS0 channel unit to idle.

6.04 Disconnect Sequence

A. Called Party On-Hook

1. The terminating CSU/DSU transmits CMI toward the DS0 channel unit, which in turn (after a delay of approximately 300 msec.), removes the low resistance bridge across the tip and ring toward the incoming wideband trunk. The terminating 1A ESS® CP will detect the called party disconnect, restore the tip to ground, and ring to battery polarity toward the TDP plug, as a disconnect signal.

2. The TDP plug transmits the called party on-hook signal, inband (bit 8-0) to the associated ODP plug. The originating 1AESS® CP eventually detects called party disconnect at the outgoing wideband trunk, but maintains the off-hook supervision toward the TDP until the calling party disconnects, or the timed release disconnects interval of 10-11 seconds expires. Afterwards, the originating 1AESS® CP will remove the low resistance bridge across the tip and ring toward the ODP plug by restoring the outgoing wideband trunk to idle.

3. The ODP plug transmits calling party on-hook (bit 8-0) to the associated TDP plug, which then removes the low resistance bridge across the tip and ring toward the incoming wideband trunk. The terminating 1AESS® CP detects calling party disconnect and restores the incoming wideband trunk and the DS0 line circuit to idle. The called party is now free to originate a new call or to receive another incoming call.

B. Calling Party On-Hook

1. The originating CSU/DSU transmits CMI toward the DS0 channel unit, which in turn (after 300 msec.), removes the low resistance bridge across the tip and ring toward the outgoing wideband trunk. The originating 1AESS® CP will detect the calling party disconnect and respond without timing, by releasing the calling party from the outgoing wideband trunk and transfer line supervision to the 1AESS® line scanner.

2. As a consequence of the transfer, the tip conductor is open circuited toward the DS0 channel unit. After approximately 300 msec., the DS0 will transmit CMI toward the CSU/DSU. The originating 1AESS® CP also restores the outgoing trunk to idle. The ODP plug associated with the outgoing wideband trunk, detects open circuit and transmits calling party on-hook (bit 8-0) to the associated TDP plug, which detects the condition and responds by removing the low resistance bridge across the tip and ring toward the incoming wideband trunk.

3. The terminating 1AESS® CP detects disconnect and transfers supervision of the called party to the 1AESS® line scanner and idles the incoming wideband trunk. Transfer of supervision to the line scanner open circuits the tip conductor toward the called party DS0 channel unit, which detects on-hook and transmits CMI to the called party's CSU/DSU.

4. When the called party terminal equipment detects disconnect, it returns CMI to the DS0 channel unit and completes the disconnect sequence. The 1AESS® will not terminate a new call to this ground start line for several seconds, but will respond to originations immediately after the line scanner has indicated called party disconnect.

5. The reason for this time delay is that a disconnect indication is automatic when supervision is transferred to a line arranged for ground start operation. The tip conductor is open circuited; therefore, the scanner element responsible for tip and ring supervision is not referenced to ground. The low resistance bridge across the tip and ring from the DS0 channel unit is not detectable by the line scanner, and disconnect is reported to the 1AESS® CP prematurely.

6. If ringing from a new call is connected before the called party actually disconnects, the DS0 channel unit will operate the pre-trip detector in the 1AESS® ringing trunk and cause the call to be aborted. This 1AESS® CP action is not unique to SwitchNet 56® calls, but is the standard operating procedure for ground start lines on a 1AESS®.

7.00 CALL SET-UP AND DISCONNECT (#5ESS® OR DMS™100)

7.01 This section describes setting up a SwitchNet 56® call using the OCU-DP in a #5ESS® or DMS™100. (See Exhibit 12.)

7.02 Call Establishment:

A. In the on-hook state the CSU/DSU transmits Control Mode Idle (CMI). In turn the OCU-DP transmits bit 8 equal to zero in all twelve frames toward the CO.

B. The customer originates a call toward the CO.

C. The CSU/DSU detects customer request and transmits all "ones" MH (Mark Hold) toward the OCU-DP.

D. The OCU-DP detects mark hold and inserts a "one" into all "bit eights" in all twelve frames toward the CO. Bit eight in the sixth frame equal to one is detected by the CO as an off hook origination (request for dial tone).

E. The CO, using the information stored in translations, identifies the subscriber and determines that the originator requires line treatment, including AMA records. The CO translations for this line directs the switch to attach (software provided) a trunk dial pulse receiver to the calling line, and then transmits a wink start pulse ("A" bit equal to one for 250-500 ms., then "A" bit equal to zero toward the calling party).

F. When the OCU-DP detects the "A" bit equal to one, it transmits Mark Hold toward the customer's CSU/DSU. When the "A" bit returns to zero, the OCU-DP transmits CMI to the CSU/DSU. This constitutes a wink and the CSU/DSU will now proceed to toggle between MH and CMI transmitting the address information to the OCU-DP in the form of dial pulses (10 pulses per second).

G. The OCU-DP detects the incoming address information and retransmits it toward the CO by toggling the "A" bit (all bit eights equal to one, followed by all bit eights equal to zero, in all twelve frames).

H. The CO detects the "A" bit toggling as incoming digits and translates that information into routing, which results in the selection of an outgoing trunk assigned to 56 kbit/s traffic at zero digital loss. The originating CO exchanges the address information with the next CO in the network; usually called the Access Tandem (AT) CO. Eventually the CO serving the called party receives the address information and proceeds to complete the call.

7.03 Call termination:

A. The terminating CO converts the received directory number into a line equipment number and then proceeds to set the "A" bit equal to one toward the D4 channel bank assigned to the called line. The OCU-DP assigned to the called party will detect "A" bit equal to one, and transmit MH toward the called customer's CSU/DSU which detects the MH and automatically answers the incoming call by transmitting MH back toward the OCU-DP and, simultaneously alerts the customer's data terminal via the V.35 interface. When the called party OCU-DP detects answer from the CSU/DSU, it inserts all ones into bit eight toward the CO which detects "A" bit equal to one, and interprets that a ring trip (called party off hook). The CO will then transmit the "A" bit equal to one toward the originating CO. The originating OCU-DP detects the "A" bit equal to one and interprets it as answer supervision, and transmits MH to the originating CSU/DSU which indicates "Call Established For End Answer". A connection has been established between two data lines capable of passing full duplex 56 kbit/s data a DDS compatible error rates.

B. Intra-office call setup interconnection can utilize intra-office time slot interchanges and complete calls without going through the outpulsing sequence. The "A" bit signaling sequence remains as described. Intra- or inter-office connections must transfer answer supervision to the calling party before data can be transmitted.

7.04 Disconnect Sequence:

A. Calling party on hook, called party off hook; The originating CSU/DSU transmits CMI toward the OCU-DP. If this condition persists for longer than 250 ms., the OCU-DP forces all "bit eights" to equal zero. The CO will then detect the "A" bit equal to zero for longer than 100 ms. and proceed to pull down the trunk-to-trunk connection by transmitting "A" bit equal to zero toward the called party CO.

B. When the called party responds by transmitting CMI, the called party OCU-DP will set the "A" bit to zero. The terminating CO idles the called line and transmits "A" bit zero toward the originating office. If the called party does not initiate a disconnect, the called OCU-DP continues to transmit CMI to the terminating CSU/DSU, which after 250 ms. will automatically disconnect and transmit CMI to the called party's OCU-DP which in turn sets the "A" bit to zero (all bit eights are set to zero since the OCU-DP does not have access to framing on the transmit leg), and the CO marks the line idle. The DTE is made aware of the disconnect (through the V.35 interface and must recycle through the call originating sequence to initiate another call.

C. Called party disconnects, calling party off-hook; under these conditions the calling party CO will maintain the connection, despite detecting on hook from the called party ("A" bit zeroed) for up to approximately 10 seconds. After the timed release disconnect interval expires, the originating CO transmits disconnect,"A" bit equal zero toward the calling party and the called party. The calling party DDA-4 detects "A" bit equals zero and transmits CMI to the CSU/DSU, which automatically disconnects after 250 ms. The calling party OCU-DP sends "A" bit equal zero to the CO, which then idles the line in memory. At the called party end, the "A" bit from the CO is zeroed, causing the terminating OCU-DP to transmit CMI to the called party's CSU/DSU, which has been set to automatically release. The called party CSU/DSU is now able to initiate a new call. The connect, disconnect sequences described are equally valid for intra- or inter-office connections.

8.00 SYNCHRONIZATION

8.01 The Loop Interface Shelf housing the OCU and DS0 channel units, is equipped with a Power, Alarm and Clock Card (ALM) circuit pack that distributes bit and byte clock to the backplane of the shelf. The clock input to the ALM plug, should be provided from a Stratum-3 or higher composite clock source, traceable to the Primary Reference Source (PRS), as shown in Exhibit 12. The ALM plug is set to external timing. The Composite Clock (CC) should be derived from a common source in each office, to keep the same phase relationship in all source/sink devices.

8.02 D4 channel banks housing the ODP and TDP channel units must be equipped with an OIU2 or OIU4 circuit pack, set to external timing. This pack distributes composite clock to the D4 channel bank backplane. The clock input to the D4 bank must be provided by the same composite clock source that feeds the Loop Interface Shelf. Digital Loop Carrier (DLC) terminals optioned for external timing at the Central Office Terminal (COT), and loop timed at the RT. Digital Carrier Trunk (DCT) frames, must also be equipped with an OIU2 or OIU4 circuit pack, set to external timing.

9.00 SERVICE OPTIONS

9.01 Hunt group options are available. Hunt groups allow the customer to have one or more lines assigned to the same number. An example of an application of this feature would be an office that has several terminals, all assigned to a SwitchNet 56® number. When a call comes in on that number, it will hunt for the first available terminal. If all terminals associated with the number are in use, the caller will get a busy signal.

9.02 Direct Digital Access Line (DDAL) is an option of DDS which provides a direct digital access connection to another provider's switched digital service. It is currently limited to the 56 kbit/s data rate, which means that it could be SwitchNet 56®. However, the reader should be aware that some equipment and features used in the SwitchNet 56® service, are not compatible with DDAL. Refer to U S WEST Technical Publication 77312, Issue C "U S WEST Digital Data Service, Technical Product Description, Transmission Parameter Limits, and Interface Combination", for further information on this option.

10.00 MAINTENANCE

10.01 Both local and remote maintenance capabilities are available using procedures very similar to those used on DDS circuits. The maintenance plan for this service requires that a SwitchNet 56® data test line, associated with a DS0 channel unit, be assigned a line appearance in the 1AESS®. The DSO Test Interface (DSX) plug-in is also required to provide a jack access arrangement by the Dialing Address Translator (DAT) test controller, and the KS-20908/9 or TPI-108/109RT. The CSU/DSU and the OCU are both capable of performing local loopback and remote loopback functions. With the capability, trouble reports can be essentially sectionalized to a specific segment, customer loop or switch.

10.02 The technician will initiate a call to gain access to the SwitchNet 56® line to be tested. Once the connection is completed, the test sets are bridged on to generate test patterns and loopback codes. Refer to the maintenance section in the manufacturer's System Manual for additional information. See Exhibits 13 through 15 for configurations of line and trunk testing.

11.00 PERFORMANCE OBJECTIVES

11.01 Inherent in any communications network are impairments associated with the transmission of messages. In digital networks, impairments include errors, out-of-frame occurrences and jitter. Complete outages and delays are also possible, but less likely to occur, due to the proven reliability of digital service over analog. At this point some definitions are necessary.

11.02 Bit Error - the event in which the value of a received bit is opposite to its intended state. A bit error results in an errored block.

> NOTE:
>
> The design objective for error performance on SwitchNet 56® will only be realized from a customer viewpoint, when customer provided terminal equipment properly equalizes, filters, samples the received signal, and meets the requirements for the transmitted signal. Properly designed terminal equipment will provide virtually error free transmissions when connected to SwitchNet 56®. It is assumed that customer wiring will not significantly affect the capability of the circuit to meet background and impulse noise parameters given in the loop requirements section.

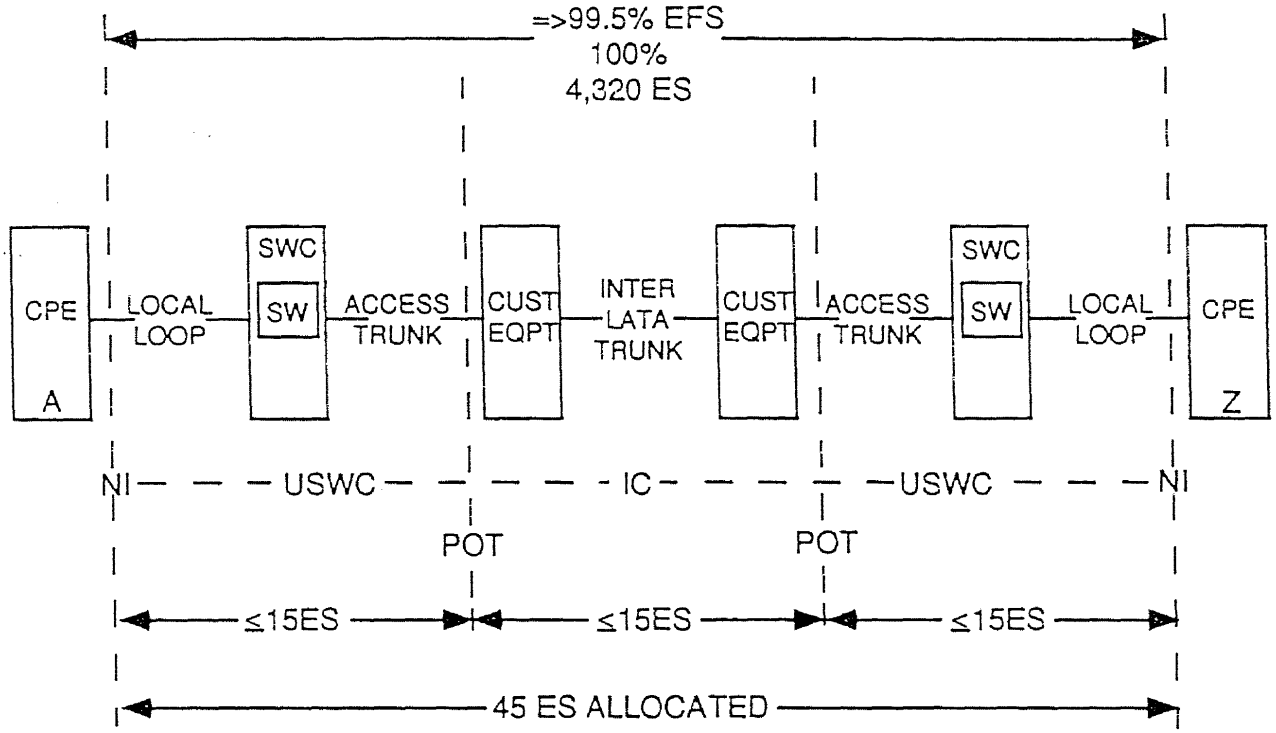
A. The performance goal for SwitchNet 56® service is 99.5% Error Free Seconds (EFS) on 95% of the calls. The definition of digital performance and the allocation of performance parameters among network elements are subjects still being defined by the ANSI accredited T1 committee. In the interim, the performance plan defined below is to be used:

1. ERRORED SECOND ALLOCATION FOR SwitchNet 56® SERVICE - U S WEST COMMUNICATIONS, INC. RECOMMENDATION -

   CPE to CPE 99.5% EFS.
   86400 Seconds per day.
   86400 x 5% = 4,320 Errored Seconds (ES) for allocation in 24 hours.
   45 ES for allocation in 15 minutes.
   15 ES for allocation in 5 minutes.

11.03 The drawing on the following page (15) shows a total SwitchNet 56® service from customer location A to customer location Z. The Local Loops, Access Trunks and the InterLocal Access and Transport Area (InterLATA) Trunk are indicated. The InterLATA Trunk could also be an Interstate Trunk. The total of 45 Errored Seconds for the entire service, is divided into three sections of equal to or less than 15 errored seconds which are alocated for those specific sections.

INSTALLATION AND MAINTENANCE LIMITS FOR U S WEST SwitchNet 56® SERVICE:



BER: 1 times 10 to the minus 6 ($1x10^{-6}$) for local loops.

1 times 10 to the minus 7 ($1x10^{-7}$) for interoffice feature group D trunks.

EFS - Error Free Seconds
ES - Errored Seconds
CPE - Customer Provided Equipment
NI - Network Interface
SW - Switch
IC - Interexchange Carrier
SW - Serving Wire Center
BER - Bit Error Rate
POT - Point of Termination

12.00 FUNCTIONAL ELEMENTS

12.01 The following paragraphs are summaries of the functional elements of the various circuit packs used in providing 4-Wire SwitchNet 56® Service.

A. Loop Interface Shelf: It consists of 17 slots that can accommodate up to 8 - OCU 56 kbit/s channel units, 8 - 2-Wire DS0 channel interface units, and 1 - ALM power/alarm card, which is dedicated to the first slot (stenciled "P"). One OCU and one DS0 channel unit are required per customer (4-Wire loop). A maximum of 8 4-Wire customer lines can be accommodated on one shelf. All devices in this shelf are powered by -48VDC.

B. ALM: (Power, Alarm and Clock card) It supplies the power, alarm and clock signals for the channel units in the Loop Interface Shelf. It converts -48VDC into +12VDC, -12VDC and +5VDC, and provides protection against short circuits within the shelf. The ALM card also provides loss of power and/or clock alarm signals for use by CO alarm systems.

C. OCU: (Office Channel Unit) Plugs into Loop Interface Shelf and performs the following functions: (1) Receives the 56 kbit/s digital signal from the CSU/DSU and converts it from bipolar to unipolar format. (2) Performs line equalization functions. The output of this OCU is fed to the DS0 channel unit at a 64 kbit/s rate.

D. DS0-10A: (Channel Unit) Plugs into Loop Interface Shelf and performs the following functions: (1) Bipolar to Unipolar conversion. (2) Dial tone detection. (3) Line equalization. (4) 4-Wire to 2-Wire conversion. (5) Loopback feature. (6) 64 kbit/s to 72 kbit/s conversion. (7) 8 kbit/s of signaling and framing information are added to the output. (8) Provides the proper interface to the 1AESS® switch, to supervise, originate or terminate calls through the 1AESS® switch (ringing tip ground, loop current etc.). In order to provide future 64 kbit/s Clear Channel Capability (CCC) and Integrated Services Digital Network (ISDN) applications, an additional 8 kbit/s of information is added to the 64 kbit/s signal.

E. DTC: (Wideband Trunk Circuit) Plugs into the 1A MUT, and interfaces the 1A ESS® trunk link network with the D4 channel bank. It also performs the following additional functions: (1) Supervisory actions. (2) 2-Wire to 4-Wire conversion to interface with digital carrier facilities. (3) Automatic hybrid balancing. (4) Cable equalization. (5) 72 kbit/s to DS0 conversion for transmission over digital carrier. On an intra-office call, the service is switched between the incoming and outgoing ports of the wideband channel unit. On an inter-office call, it progresses through this channel unit.

F. TDP: (Terminating Dataport) Plugs into D4 channel bank and performs the following functions: (1) Signaling conversion/interface. (2) Line equalization. (3) 2-Wire to 4-Wire conversion. (4) Rate conversion of 64 kbit/s to 72 kbit/s. This device is functionally similar to a DPO and DPT, and is required for terminating and interfacing the facilities with the switch.

G. ODP: (Originating Dataport) Plugs into D4 channel bank and is identical to the TDP terminating plug, with the exception that it is for originating traffic.

H. DTU: (Wideband Data Trunk Unit) Plugs into 1AESS® DCT frame. It allows the CP to carry out the trunk interface functions required at the output or incoming trunk circuits, to handle data calls that originate locally or switched tandem. It provides busy/idle supervision, network continuity check, DC isolation and battery feed functions, during call progression.

I. OCU-DP-ER: (56 kbit/s Office Channel Unit-Dataport-Extended Range). Plugs into a DLC-RT, or the D4 a bank of a #5ESS® or DMS™100 switch, to provide SwitchNet 56® capability. It provides a DDS 4-Wire loop interface for 56 kbit/s data transmission over T-Carrier, and on the drop side of the DLC RT bank, for access to customers. The OCU-DP also interfaces with the 4-Wire loop directly from the D4 bank of the switch, and extends the local loop transmission limit to 18 kft. of 26 gauge cable or equivalent. It also performs normal OCU-DP functions, including: OCU, CSU, and DSU loopbacks.

J. DS0-20A : (2-Wire Channel Unit) A modified version of the DS0-10A channel unit. It recognizes loopback codes as off-hook signals, while the DS0-10A recognizes them as on-hook signals. This DS0 is used only with the Test Station Line.

K. DSX: (Test Interface Unit) In conjunction with the DAT test controller, it provides the interface between the test sets and the DS0-20A channel unit.

L. DAT: (Test Controller) Controls the function of the DSX test interface unit, to which it is connected, via the 9-pin connector plug. It also translates the dialing address to standard pulse dialing signals, to be processed by the DSX test interface unit, and supports last number re-dial with the "#" key.

13.00 NETWORK CHANNEL (NC) AND NETWORK CHANNEL INTERFACE (NCI) CODES

13.01 Network Channel Code:

NETWORK CHANNEL (NC)		
SERVICE CODE	OPTIONS	REMARKS
1-2	3-4	
SD	GG	FOREIGN EX-CHANGE DTMF GROUND START TWO-WAY

13.02 Network Channel Interface Code:

NETWORK CHANNEL INTERFACE (NCI)				
Interface	# Wires	Protocol Code	Impedance	Protocol Option
Central Office	04	DU (Digital Access)	5 (135 Ohms)	56 (56 kbit/s)
Customer	04	DU (Digital Access)	5 (135 Ohms)	56 (56 kbit/s)

14.00 NETWORK CHANNEL (NC) FORMAT STRUCTURE

14.01 Network Channel (NC) Code Format Structure. The NC code is a four-character code that consists of two (2) data elements (See Figure 1).

1	2	3	4
Channel Service Code		Optional Feature Code	
X	X	X or -	X or -

FIGURE 1
NETWORK CHANNEL CODE FORMAT STRUCTURE

X = Alpha-numeric
- = Hyphen

15.00 DATA ELEMENT DESCRIPTIONS

15.01 Figure 1 shows the format of the NC structure. The following paragraphs explain each data element.

15.02 Channel Service Code. The Channel Service Code (character positions 1 and 2) is a two-character alpha or alpha-numeric code that describes the channel service in an encoded form. The channel service code will typically be specified as the service code of the special service circuit or the transmission grade of the message trunk circuit. The NC channel service code field is always filled.

15.04 Optional Feature Code. The Optional Feature Code (positions 3 and 4) is a two-character alpha, alpha-numeric or hyphen that represents the option codes available for each channel service code. A hyphen (-) is a special character that is used in positions 3 or 4 of the NC code to indicate the absence of features or options. Standard combinations of this code will allow the customer to enhance the technical performance of the requested channel, or to further identify the type of service. It is also used to specify options such as conditioning, effective 4-Wire, multi-plexing, etc.

15.05 Network Channel (NC) Fill Requirements. The NC optional feature code field is always filled. All four character positions of a NC code must be filled.

16.00 NETWORK CHANNEL INTERFACE (NCI) FORMAT STRUCTURE

16.01 The NCI code format is a maximum twelve-character code that consists of five (5) data elements (see Figure 2).

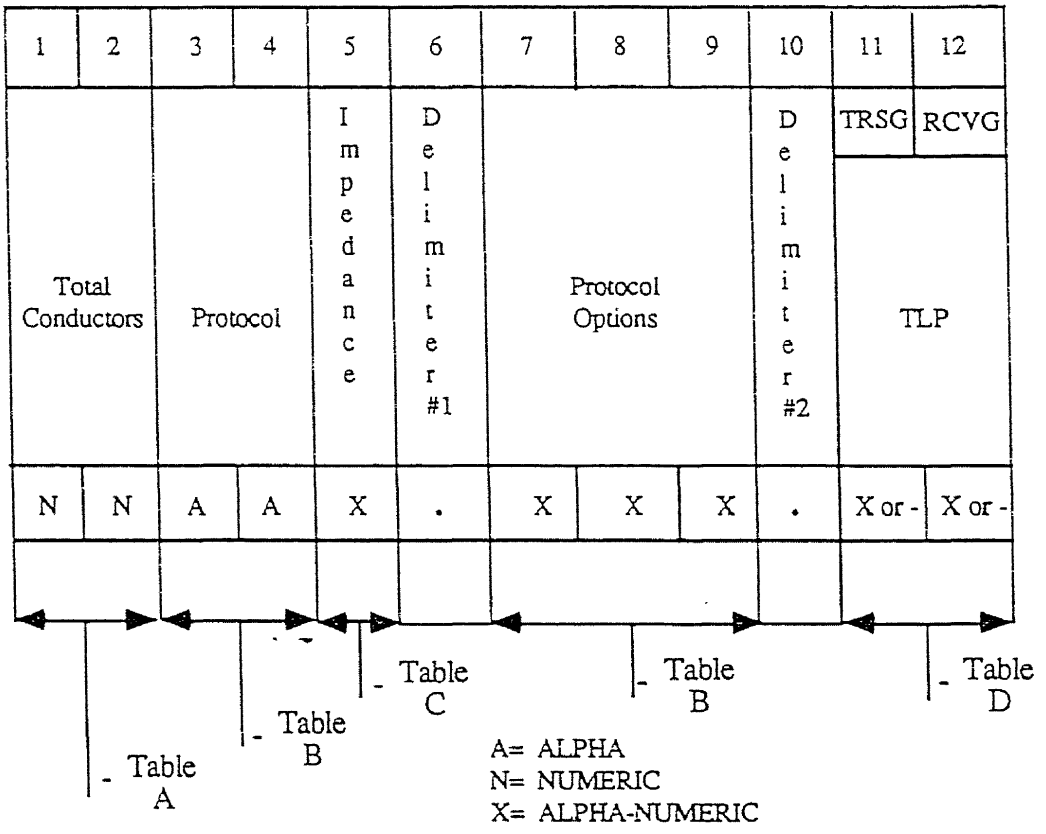


FIGURE 2
NETWORK CHANNEL INTERFACE (NCI) FORMAT STRUCTURE

16.02 Figure 2 shows the format of the NCI code. The following paragraphs explain each data element.

16.03 Total Conductors. Total conductors (character positions 1 and 2) is a two-character numeric code that represents the total number of physical conductors (e.g., wires) required at the interface. This field is always filled.

16.04 Protocol. Protocol (character positions 3 and 4) is a two-character alpha code that defines requirements for the interface regarding signaling and transmission. This field is always filled.

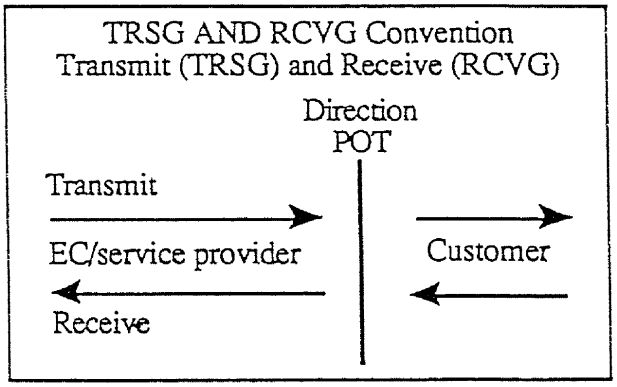
16.05 Impedance. Impedance (character position 5) is a one-character alpha or numeric code representing the nominal reference impedance that will terminate the channel for the purpose of evaluating transmission performance. This field is always filled.

16.06 Protocol Options. Protocol Options (character positions 7, 8,and 9) is a one to three-character alpha, numeric, or alphanumeric code that describes additional features (e.g., bit rate, band width, etc.) on the Protocol to be used. It is an optional field that is always left-justified when less than three characters are specified.

16.07 Transmission Level Point(s) (TLPs). Transmission Level Point(s) (TLPs) (character positions 11 and 12) are the Transmit and Receive characters that may appear anywhere between positions 8 and 12 due to left-justification rules. The TLPs are assigned a one or two-character alpha code corresponding to a value for TLPs from either the Exchange Carrier (EC)/service provider or customer end, and immediately follows Delimiter #2.

(1) TRSG TLP LEVEL signifies the TLP transmit signal level at the EC/service provider when transmitting to the customer (see Figure 3).

(2) RCVG TLP LEVEL signifies the TLP receive signal level at the EC/service provider when receiving from the customer.



TRSG AND RCVG CONVENTION
FIGURE 3

(3) If TLP is entered in one character position only (TRSG or RCVG), a hyphen (or the letter "O") is required as a filler in the associated TLP character position.

(4) If TLPs are not to be coded, default levels found in the Bellcore Technical Publications will apply and the TLP character positions will be left blank. Delimiter #2 will not be specified if both TRSG and RCVG TLP character positions are blank.

NOTE:

See Paragraph 16.08 and 16.09 for left-justification and delimiter rules.

16.08 Network Channel Interface (NCI) Left Justification. An NCI code of fewer than twelve (12) characters long is left-justified. Blank spaces are not filled or shown in the code.

16.09 Network Channel Interface (NCI) Delimiter Usage. Delimiters are required for overall code readability when using the NCI code format in a manual or mechanized mode. For purposes of this practice and to be consistent with most service order and mechanized systems, delimiters will be counted as characters of information. The actual character used as the delimiter may differ from system to system, but is generally either a period (.) or a virgule (\/). Delimiter representation for the NCI code may not be specified as alpha, numeric, or hyphen.

16.10 The NCI code delimiters will be labeled as Delimiter #1 and #2 to show the difference between the delimiters (see Figure 2).

A. Delimiter #1 is used to indicate the start of the Protocol Option field if a Protocol Option code is assigned. When specified it will be in character position six (6).

B. Delimiter #2 is used to indicate the start of the TLP field if a TLP level is assigned to TRSG or RCVG or both. Delimiter #2 will not be assigned if both the TRSG and RCVG TLP character positions are blank.

16.11 If the Protocol Option Field is not coded and the TLP is coded, a double Delimiter #1 and #2 will be placed after character position five (5). In this case Delimiter #1 will be in character position six (6), and Delimiter #2 will be in character position seven (7). The TLP will be left-justified into character positions eight (8) and nine (9) accordingly.

16.12 If the Protocol Option code is assigned, Delimiter #2 character position will be dependent on the length of the Protocol Option code. Delimiter #2 is used in character position ten (10) if a three-character Protocol Option code is assigned. Delimiter #2 will be in character position nine (9) if a two-character Protocol Option code is assigned. Delimiter #2 will be in character position eight (8) if a one-character Protocol Option code is assigned.

17.00 DEFINITIONS

17.01 A = Alpha characters, A-Z.

17.02 Code Structure. The basic characteristic of a code; its length and generic representation.

17.03 Data Element. A uniquely named and defined category of data, e.g., Protocol Format Structure, a combination of data elements grouped in a prescribed sequence.

17.04 N = Numeric characters, 0-9.

17.05 Network Channel (NC) Code. The NC code is an encoded representation used to identify both switched and non-switched services. Included in this code set are customer options associated with individual channel services, or feature groups and other switched services.

17.06 Network Channel Interface (NCI) Code. The NCI code is an encoded representation used to identify five (5) interface elements located at a Point of Termination (POT) at a central office or customer location. The Interface elements are: Total Conductors, Protocol, Impedance, Protocol Options and Transmission Level Points (TLP).

18.00 TEST PLAN

18.01 The following tests assure the integrity of the metallic facility which connects the CO and the CPE.

A. 135 Ohm insertion loss at 28 kHz (in dB).

1. Customer Provided Equipment (CPE) to CO direction.

2. Central Office (CO) to CPE direction.

a. Maximum Loss: Less than 40.0 dB either direction.

B. Background noise measurement (Ref. PUB 62310, 1983 Version, see Reference Section). Using a Noise Measuring Set, assuming a properly balanced 135 ohm termination, use of 40Hz to 30kHz filter, and measurement with a voltage magnitude averaging device.

1. Central Office (CO) end of loop, CPE to CO direction.

2. Customer Provided Equipment (CPE) end of loop, CO to CPE direction.

a. Required value: Less than -56 dBm.

C. Impulse noise events (Ref. PUB 62310, 1983 Version, see Reference Section). Bandwidth and terminations as specified in (2) above. Impulse noise threshold set to -40 dBm. An event is defined as an impulse greater than -40 dBm. Following any crossing of the threshold, additional crossings are ignored for a period of 200 msec.

1. Central Office (CO) end of loop, CPE to CO direction.

2. Customer Provided Equipment (CPE) end of loop, CO to CPE direction.

a. Required value: Less than 7 events in a 15 minute period.

18.02 Call Set-up Tests

A. Calls shall be placed and successfully completed in all combinations to and from each station. Requirement: No wrong numbers or incompleted calls in any of 100 attempts. It is assumed that the script of calls is arranged in such a way that there is never a shortage of trunking equipment for this test. Wrong numbers due to pressing the wrong CSU/DSU keys are acceptable.

NOTE:
The tests described below shall be performed from the customer station through all access methods.

18.03 Data Transmission Tests

A. Basis Data Integrity

1. Establish a call from the east-end equipment to west-end equipment. Use the Remote Loopback (RL) key to put the west-end equipment in digital loopback. Measure the Bit Error Rate (BER) and EFS of the complete circuit, using a long (1024 bits or more) pattern. At the end of the measurements, disconnect the modular line cord.

   Requirements: BER not to exceed $2X\ 10^{-6}$
   EFS should be greater than 99.5%

2. Establish a second call in pairs adjacent to the first circuit cited above. Perform measurements the same as above. Reconnect the line cord disconnected in "1" above.

   Requirements: Same as (1) above.

B. Customer End Cross-talk Immunity Verification:

1. Re-establish calls on the same two circuits to run simultaneously.

   Requirements: Both circuits shall meet or exceed the BER and EFS requirements as above.

18.04 Maintenance Capability Tests

A. Using either a KS-20908/9, TPI 108/109 RT test set, or access through a DDS Hub:

1. Send OCU loopback and verify the system's OCU loopback capability.

2. Send OCU loopback and verify the system's CSU loopback capability.

3. Send DSU loopback and verify the system's DSU loopback capability.

TEST FORM
(used in conjunction with Test Plan)

PARAMETER MEASURED	EXPECTED VALUE	MEASURED VALUE
135 ohm Insertion Loss:		
CPE to CO	= or <40.0dB	_____
CO to CPE	= or <40.0dB	_____
Comments:_____		
Background Noise:		
CPE to CO	<-56.0 dBm	_____
CO to CPE	<-56.0 dBm	_____
Comments:_____		
Impulse Noise: (Threshold -40 dBm)		
CPE to CO	≤7 in 15 mins	_____
CO to CPE	≤7 in 15 mins.	_____
Comments:_____		
Call Set-up/Disconnect:		
East CPE to West CPE	No fail	_____
West CPE to East CPE	No fail	_____
Signaling:		
East CPE to West CPE	No fail	_____
West CPE to East CPE	No fail	_____
Comments:_____		
Data Transmission:		
1a. East CPE to West CPE: (First Circuit)	BER <2x10^{-6}	_____
	EFS >99.5%	_____
1b. East CPE to West CPE: (Second Circuit)	BER <2x10^{-6}	_____
	EFS >99.5%	_____
2. First Circuit (1a) (Second Circuit)	BER <2x10^{-6}	_____
	EFS >99.5%	_____
Second Circuit (2a) (Second Circuit)	BER <2x10^{-6}	_____
	EFS >99.5%	_____
Comments:_____		
Office A:_____ Office B:_____		

18.05 CSU/DSU DESCRIPTION AND OPTIONS

A. Data Terminal Equipment (DTE) interface is V.35

B. Auto-Dial interface is either RS-232 or RS-366. (25 pin D-type subminiature connector)

C. Interface to network. Eight pin modular jack (RJ 48S). See T1E1.4/90-006R3

D. Options - External Timing

1. Turn Data Set Ready (DSR) off to the DTE when either Out of Service (OOS) or No Signal (NS) is received.
2. Switched Data circuit.
3. Activate Front Panel keypad.
4. Permanent RTS off.
5. Permanent Data Terminal Ready (DTR) off.
6. Circuit assurance on.
7. Data mode during local loopback.
8. Remote digital loopback.

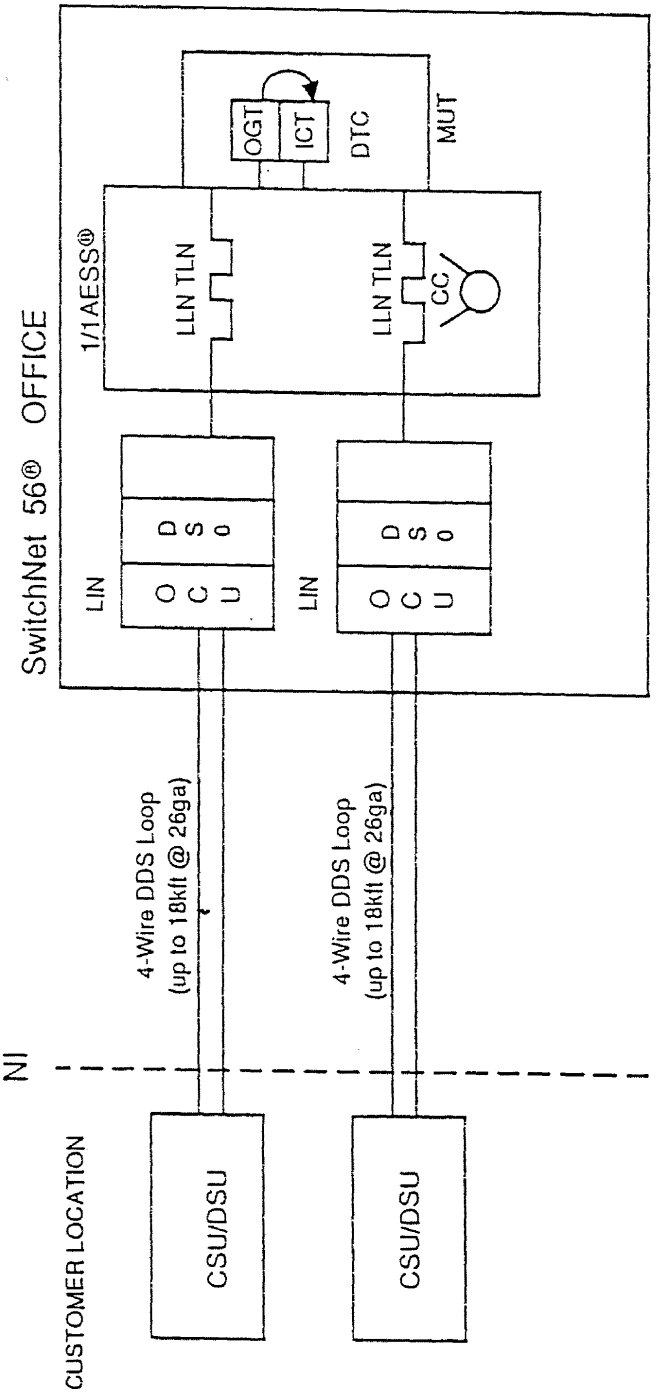


EXHIBIT 1
INTRA-OFFICE SWITCHED 56 kbit/s

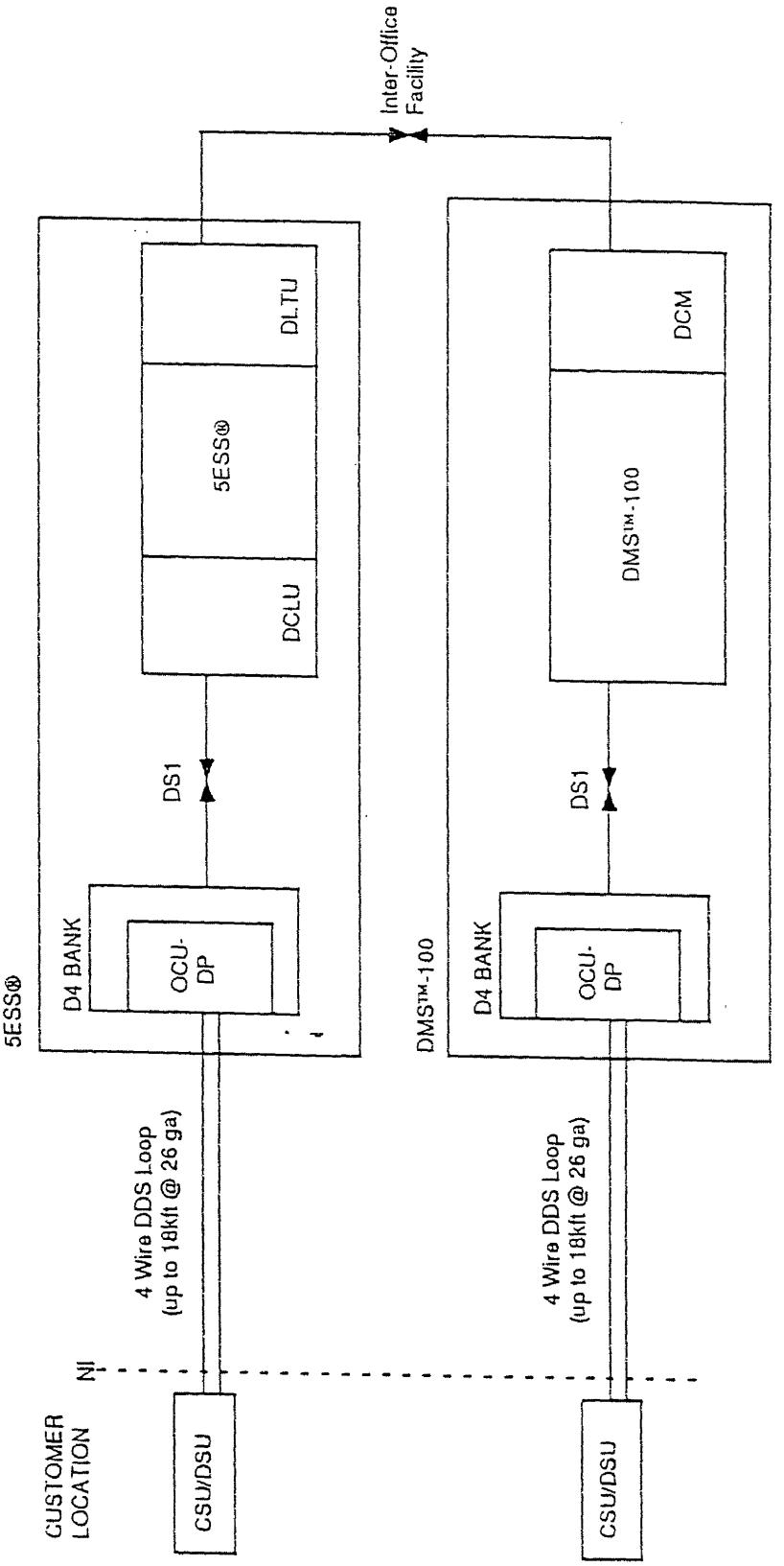


EXHIBIT 2
INTER-OFFICE SWITCHED 56 kbit/s DIGITAL OFFICES

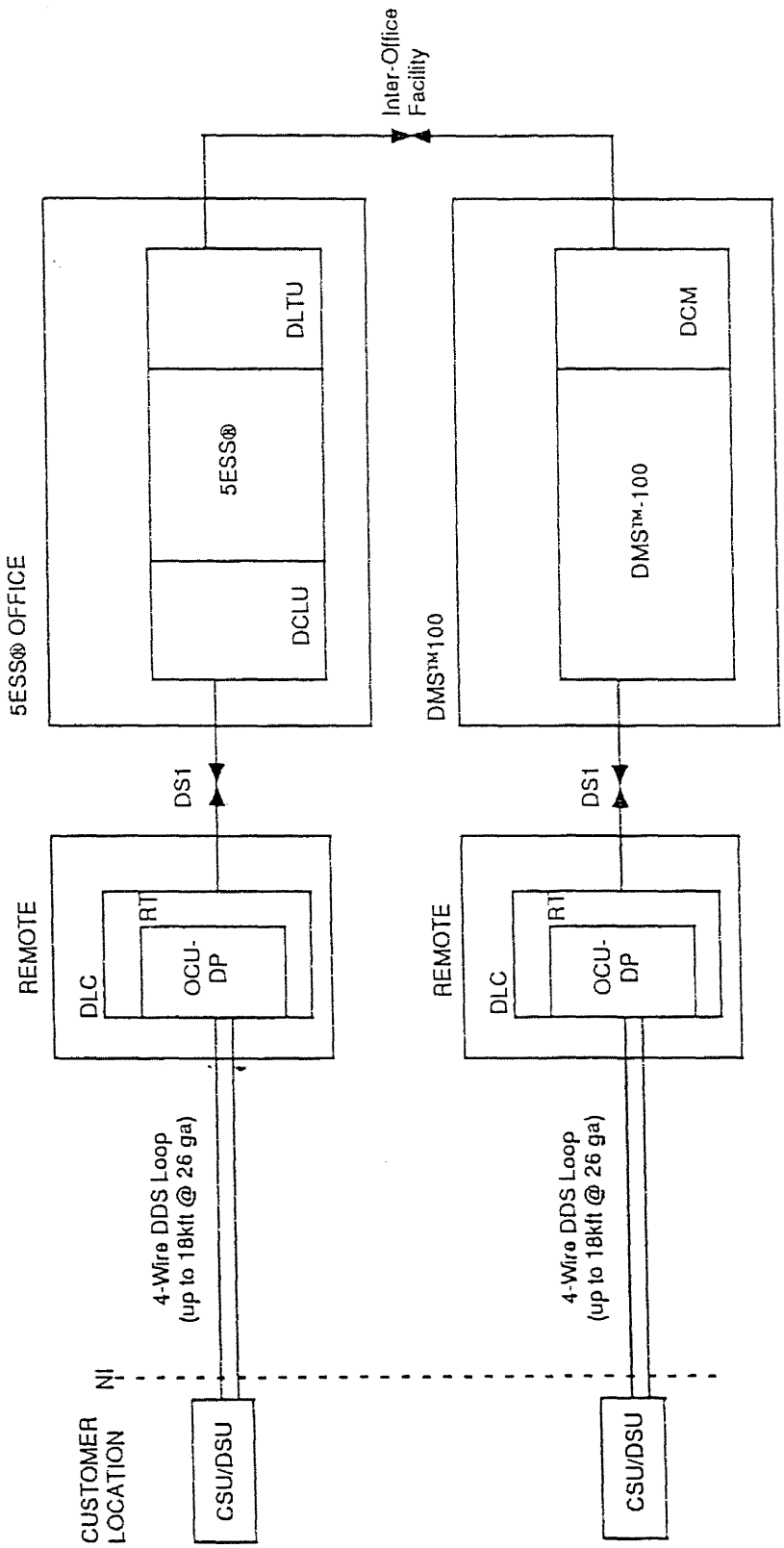


EXHIBIT 3
INTER-OFFICE SWITCHED 56 kbit/s DIGITAL OFFICES (WITH REMOTES)

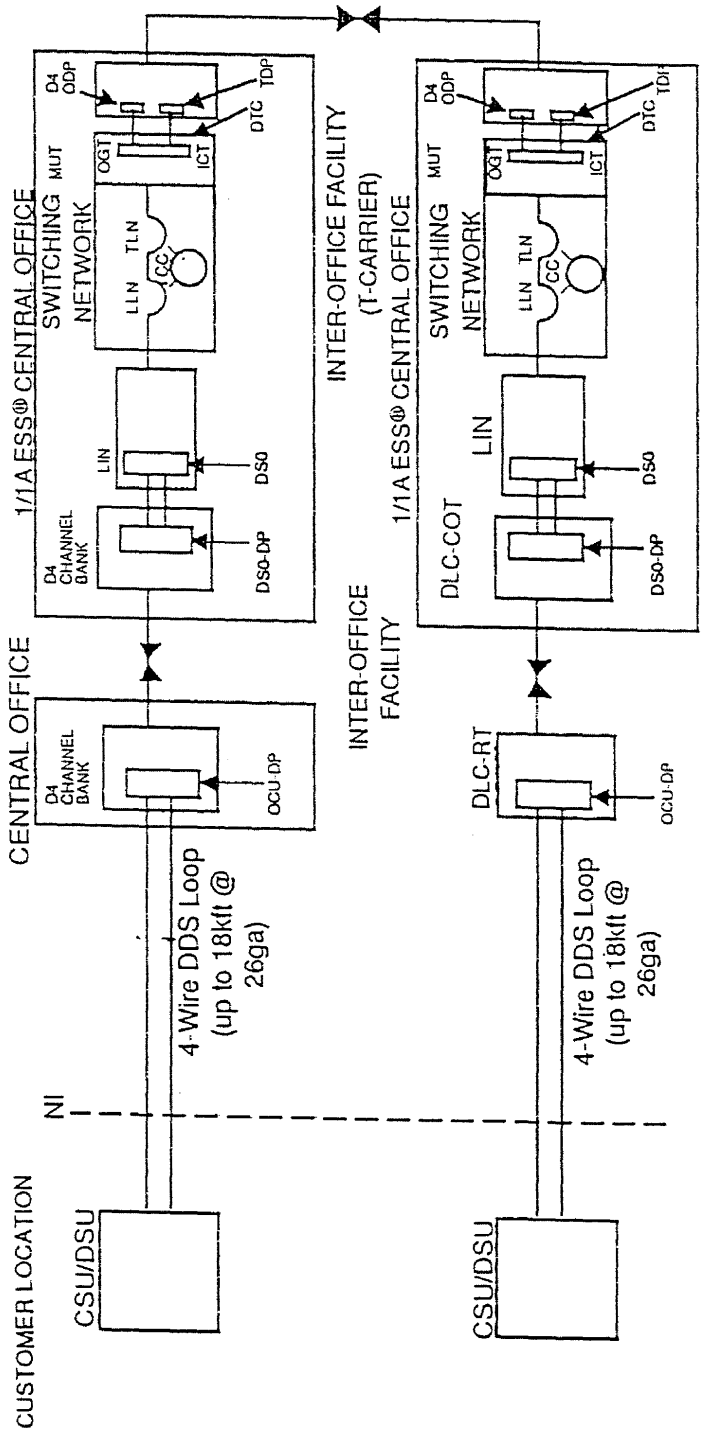


EXHIBIT 4
INTER-OFFICE SWITCHED 56 kbit/s WITH DLC AND REMOTE ACCESS

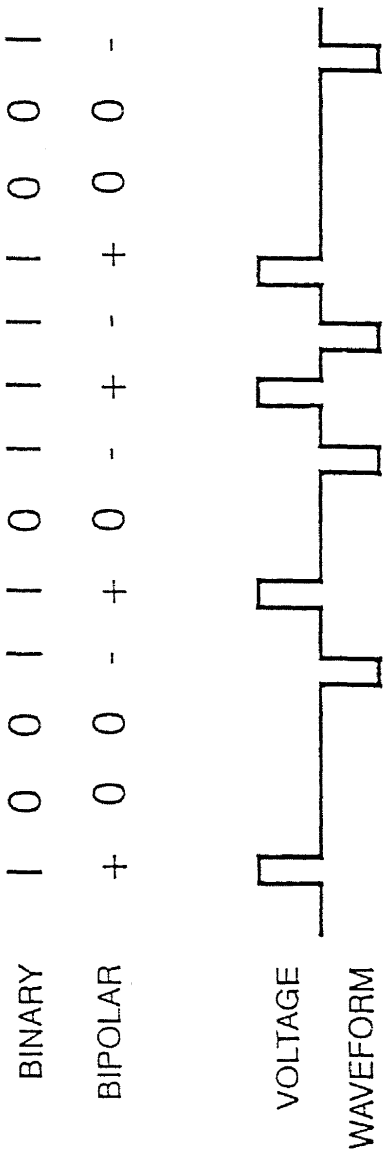


EXHIBIT 5
BIPOLAR SEQUENCES

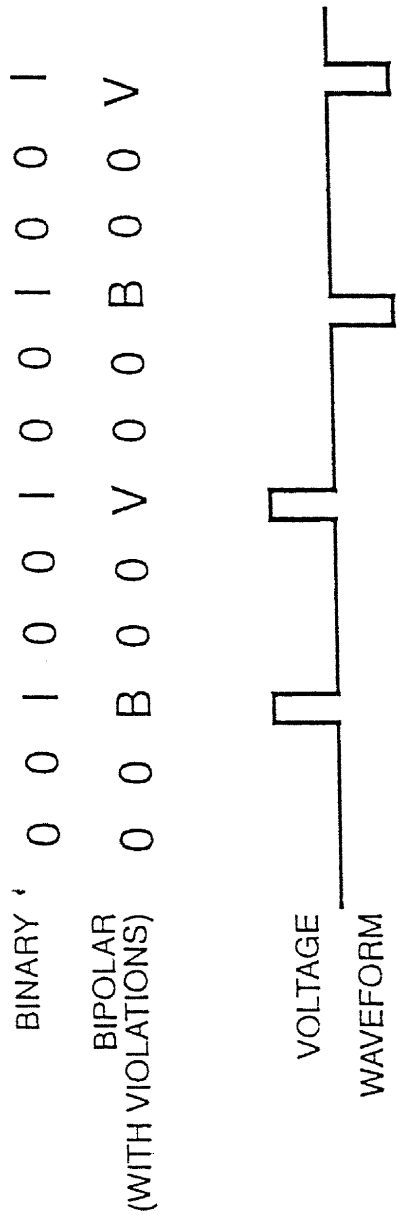


EXHIBIT 6
BIPOLAR VIOLATIONS

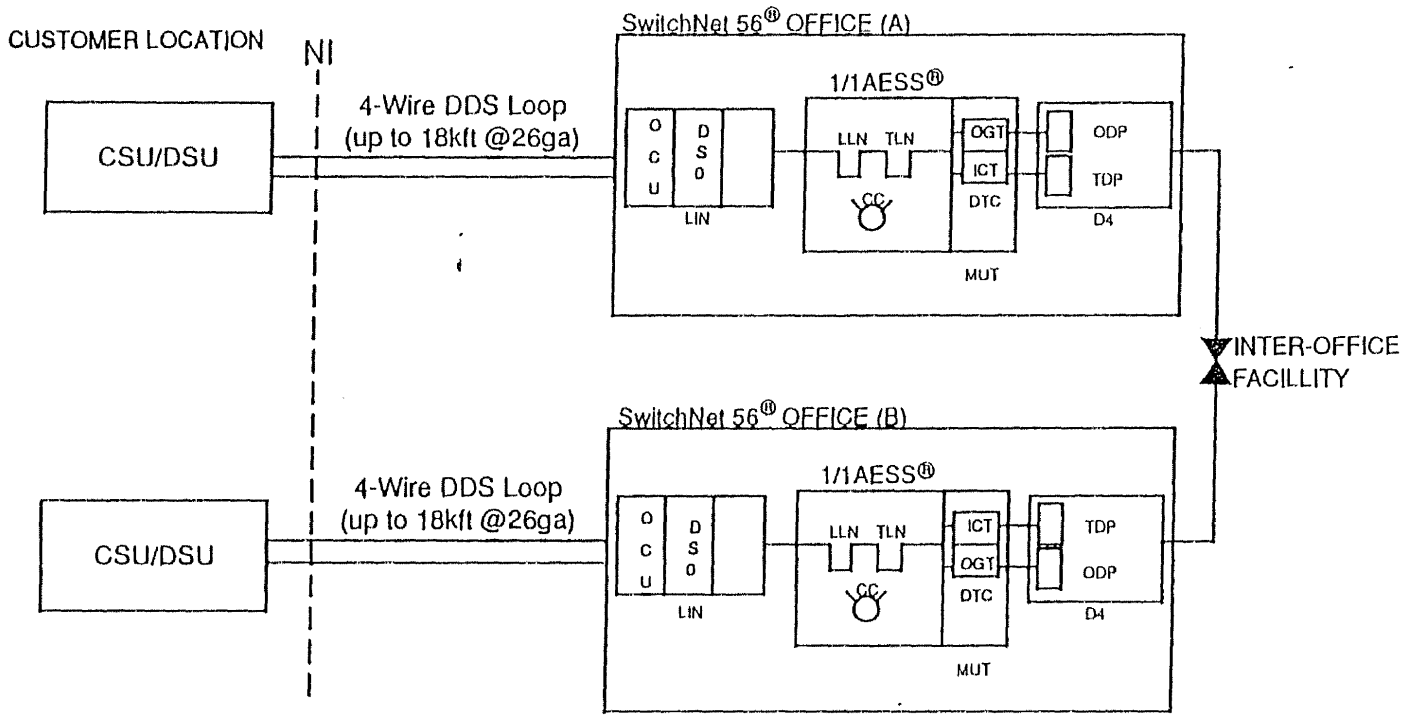


EXHIBIT 7
INTER-OFFICE SWITCHED 56 kbit/s
(MUT/D4 - MUT/D4)

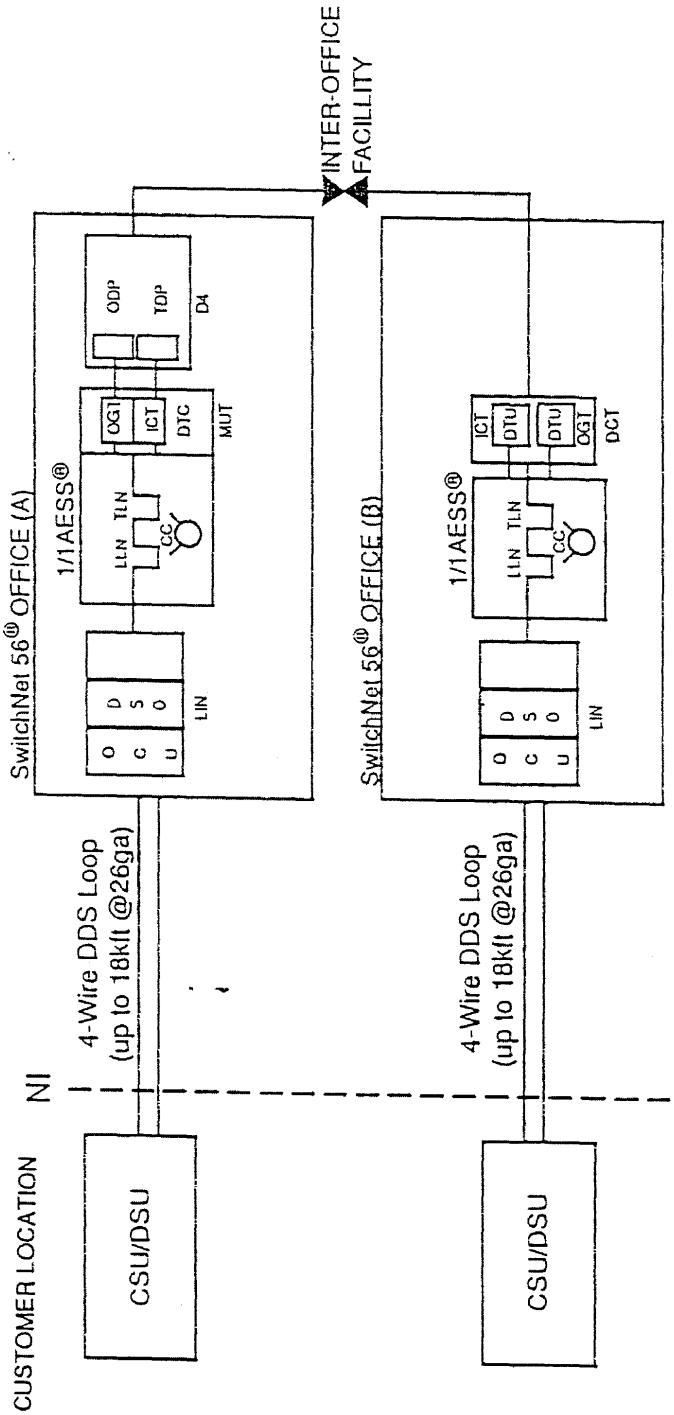


EXHIBIT 8
INTER-OFFICE SWITCHED 56 kbit/s
(MUT/D4 - DCT)

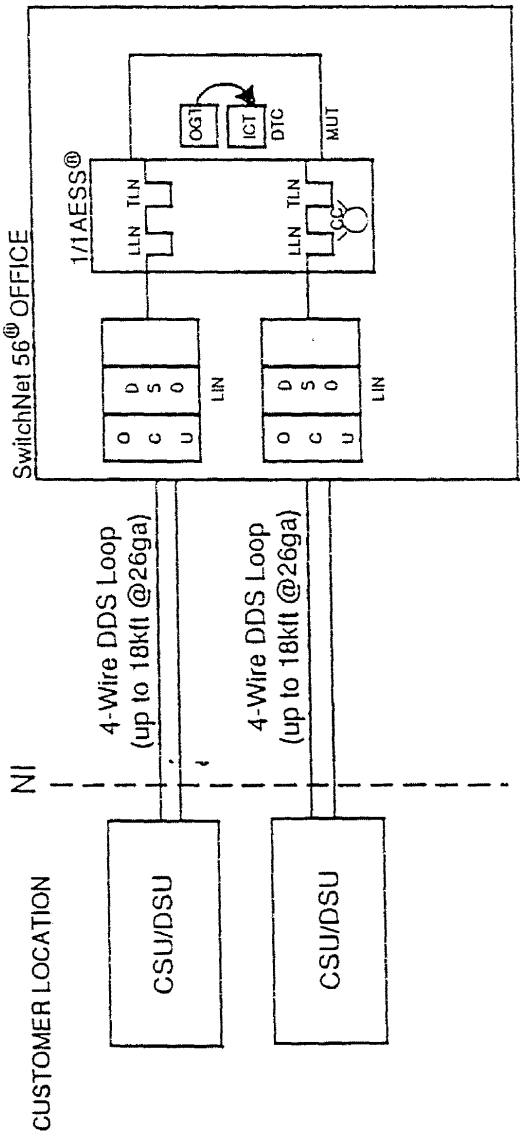


EXHIBIT 9
INTRA-OFFICE SWITCHED 56 kbit/s
(USING MUT FRAME)

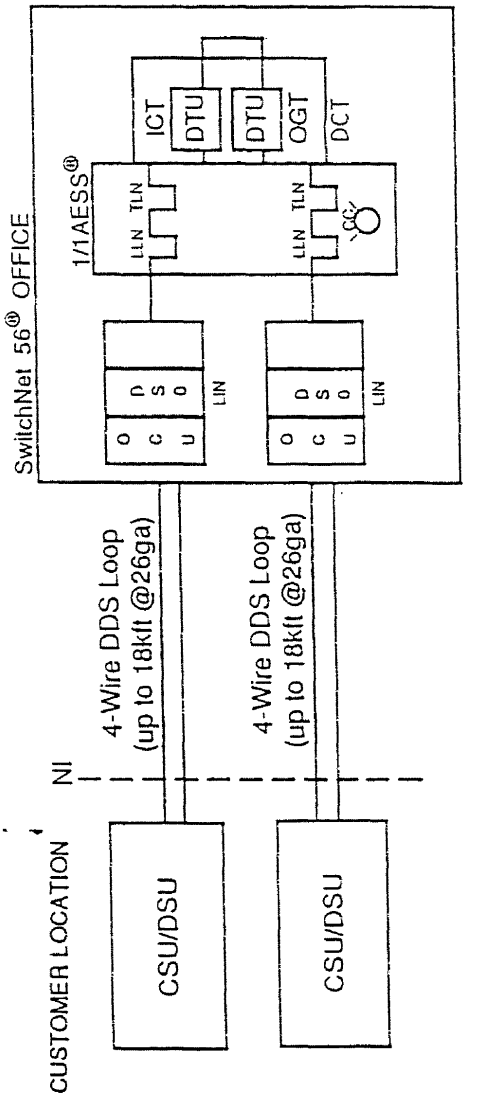


EXHIBIT 10
INTRA-OFFICE SWITCHED 56 kbit/s

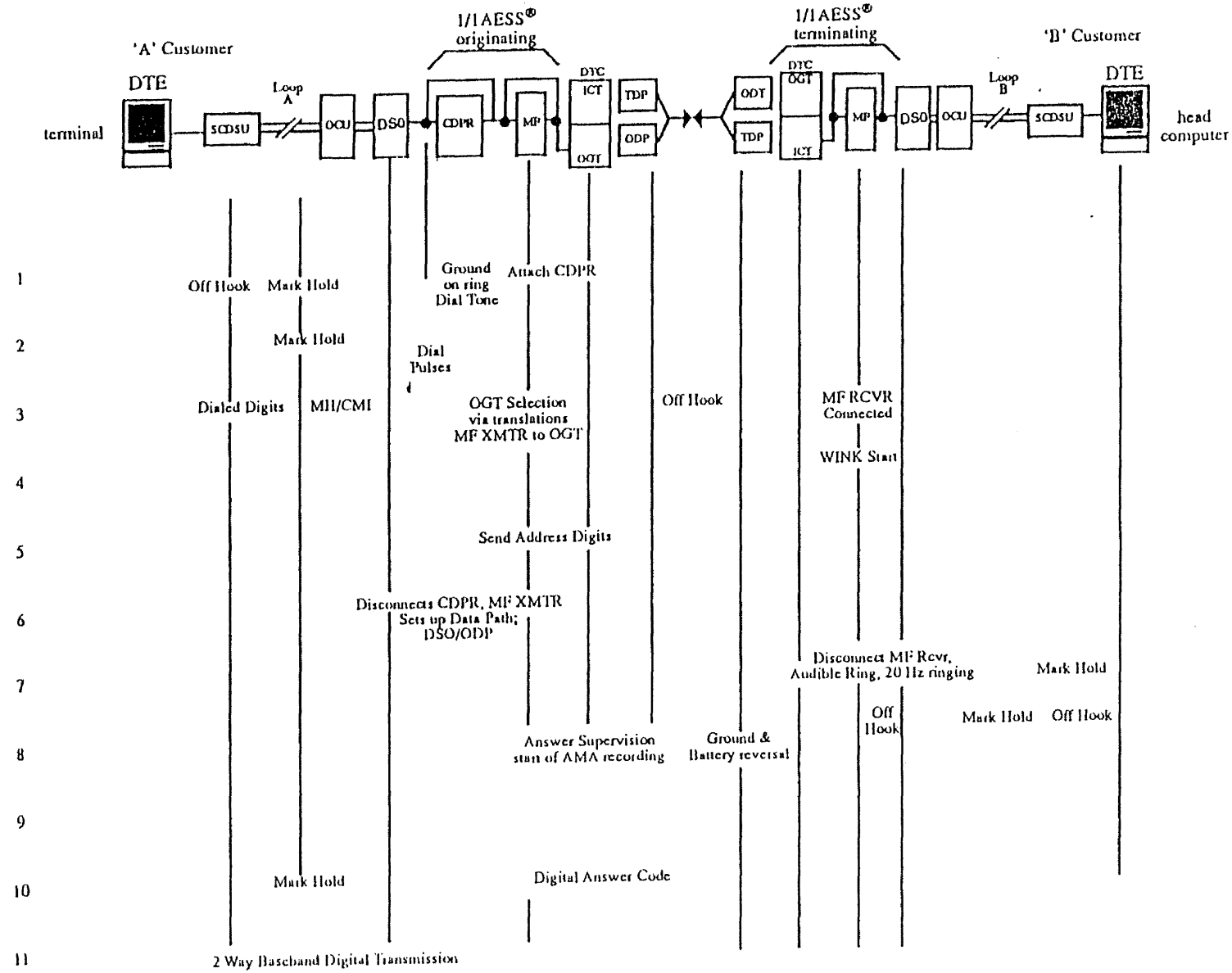


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EXHIBIT 11
CALL ESTABLISHMENT PROCEDURE (INTER-OFFICE)

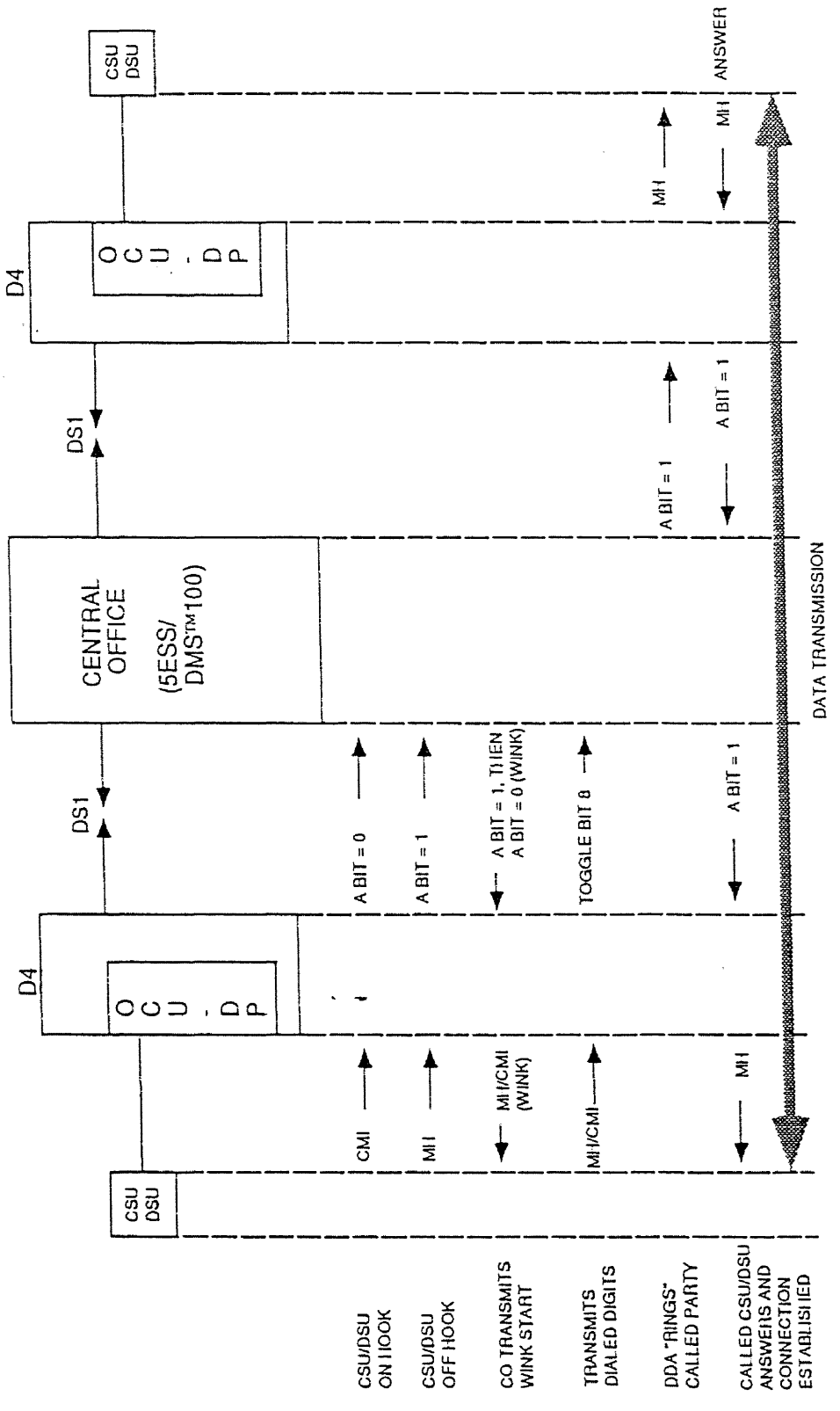


EXHIBIT 12
CALL ESTABLISHMENT PROCEDURE (INTRA-OFFICE)

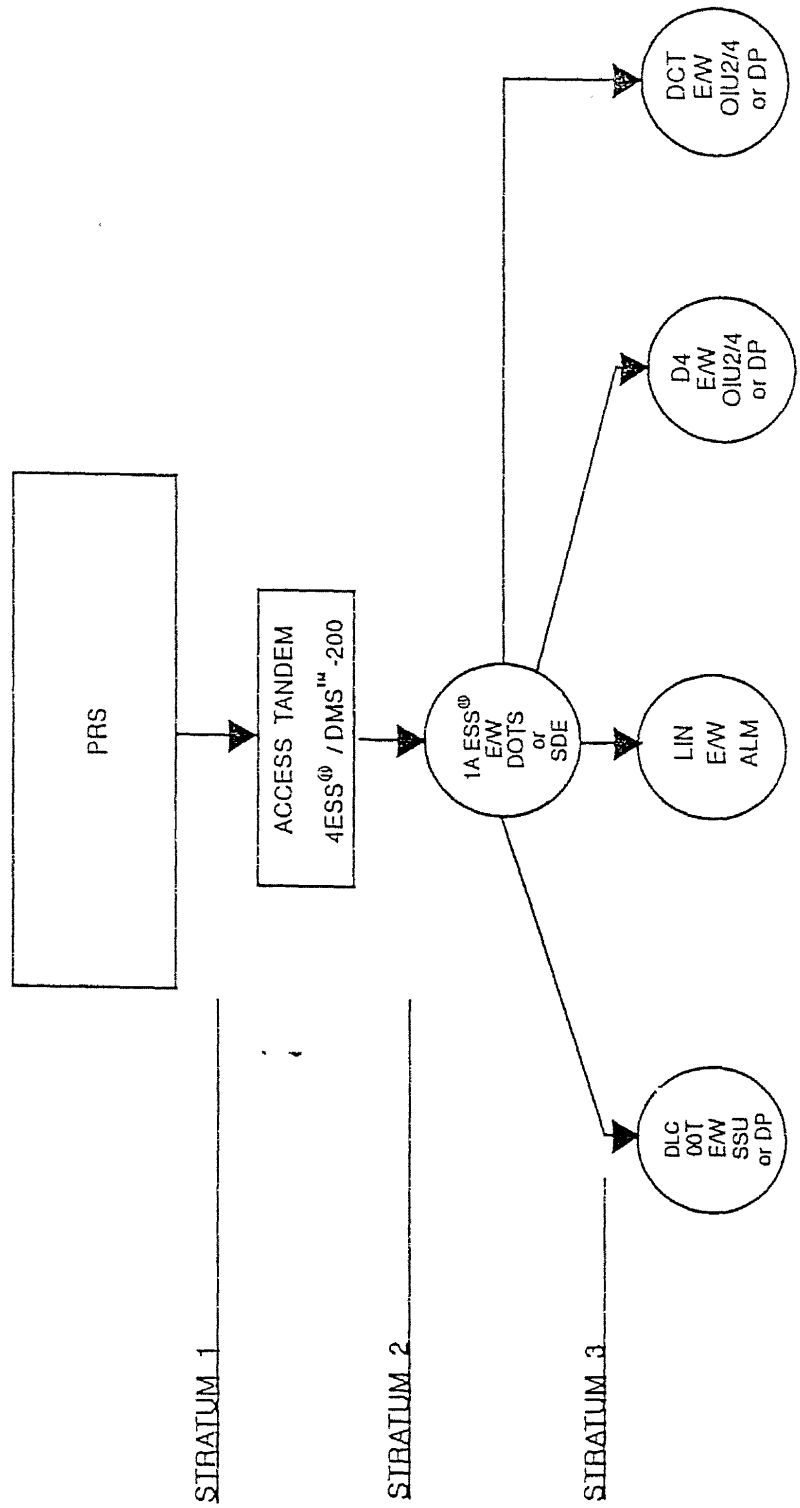


EXHIBIT 13
SYNCHRONIZATION REQUIREMENTS FOR SwitchNet 56®

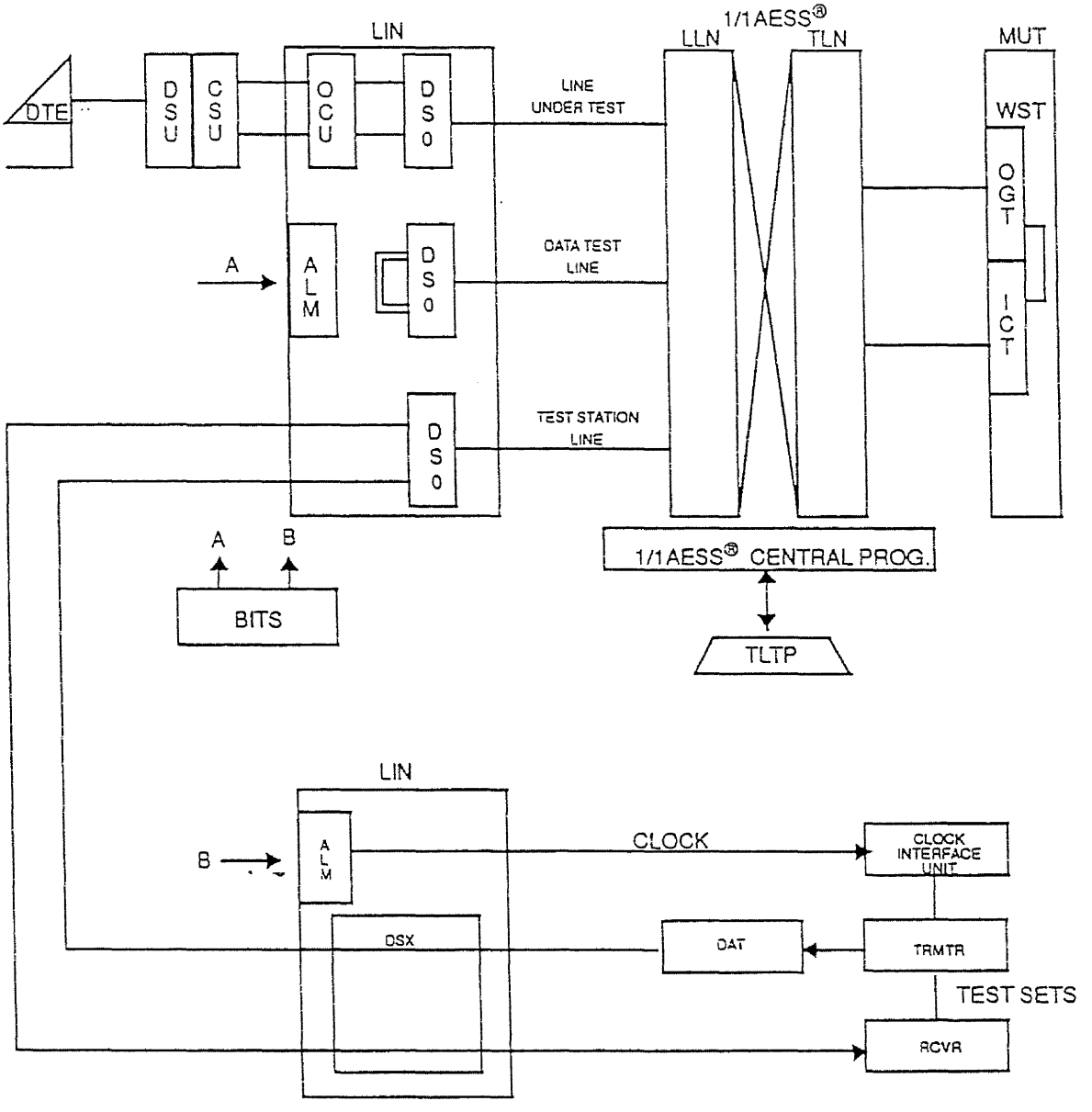


EXHIBIT 14
LINE TEST SYSTEM CONFIGURATION

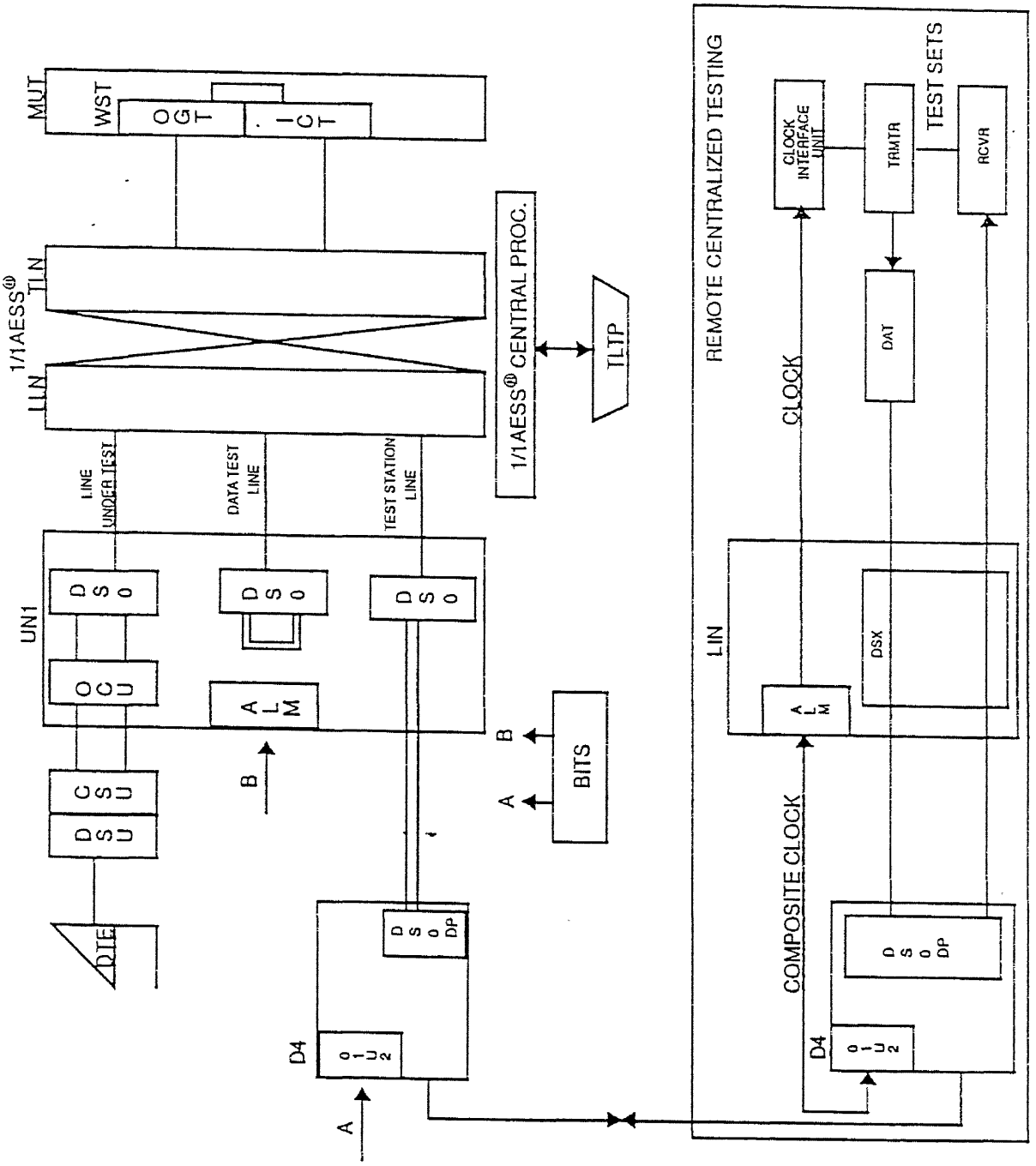


EXHIBIT 15
REMOTE LINE TEST CONFIGURATION

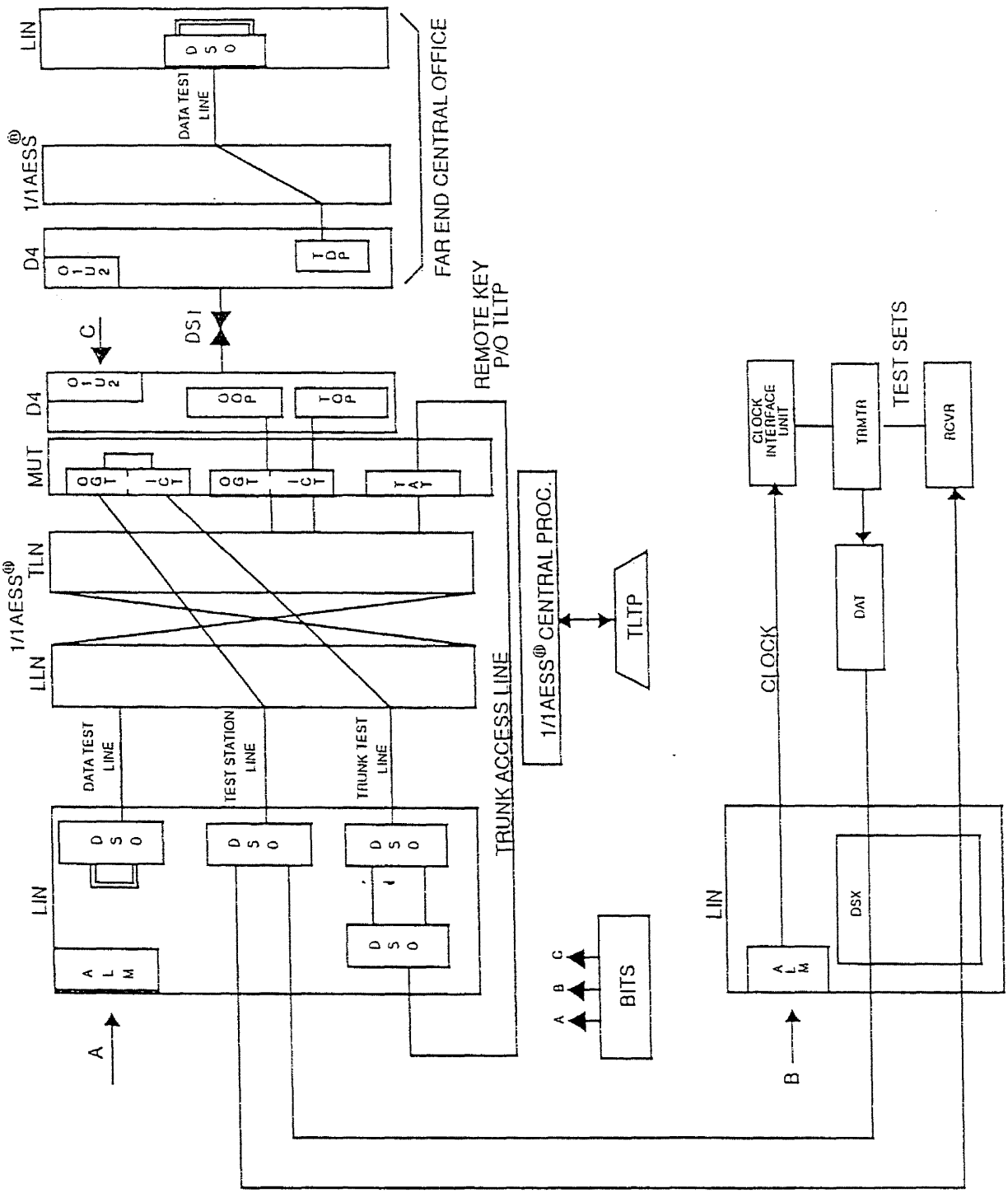


EXHIBIT 16
TRUNK TEST CONFIGURATION

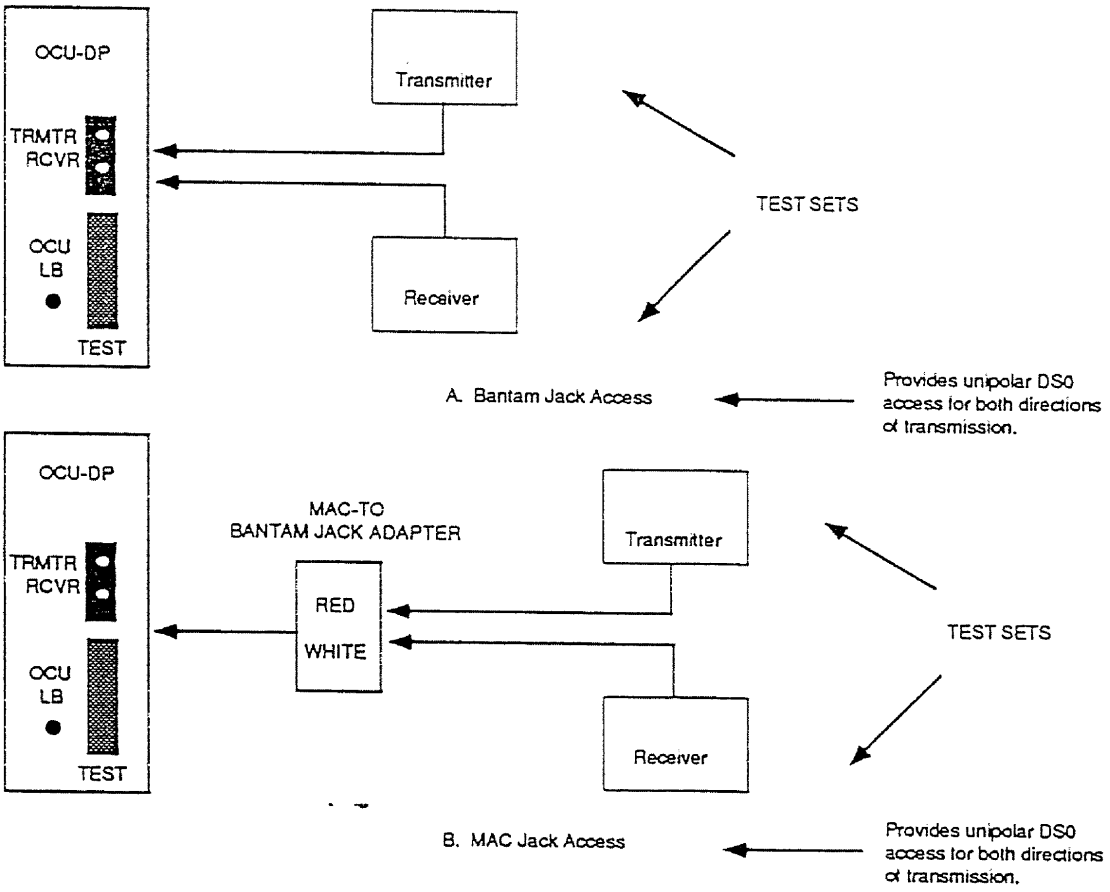
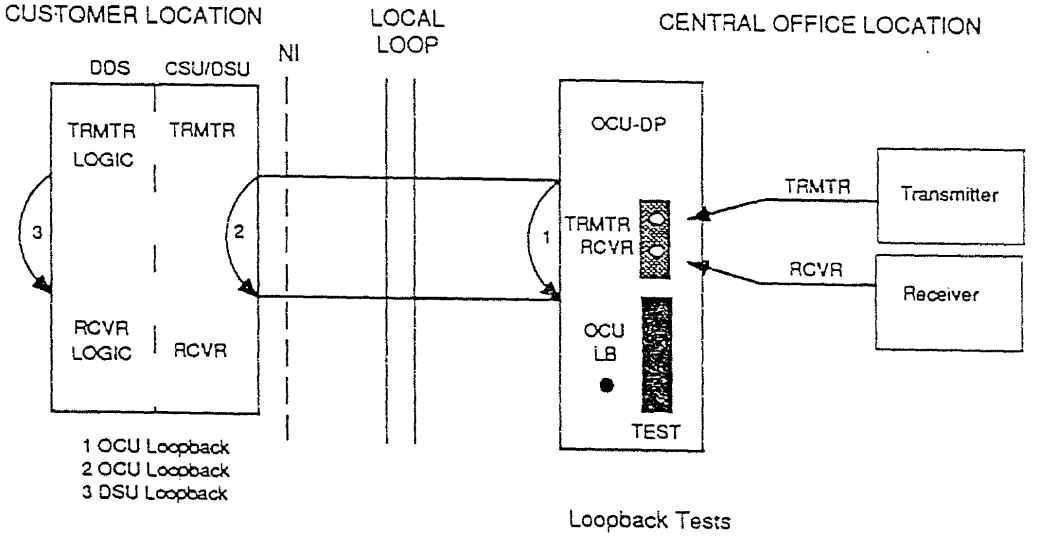
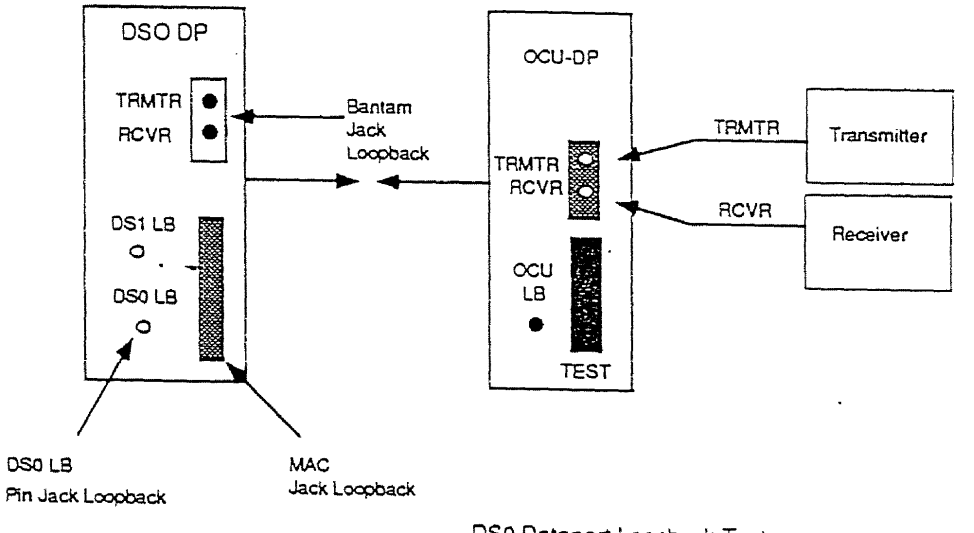


EXHIBIT 17
JACK ACCESS FOR OCU DATAPORT



Loopback Tests



DS0 Dataport Loopback Test

EXHIBIT 18
LOOPBACK TESTS

TABLE A
PIN ASSIGNMENTS

V.35 INTERFACE PIN ASSIGNMENTS:

Pin Name	Pin Designation
Frame Ground	A
Signal Ground	B
Request to Send	C
Clear to Send	D
Data Set Ready	E
Received Line Signal Detector	F
Transmitted Data A	P
Transmitted Data B	S
Received Data A	R
Received Data B	T
Receiver Element Timing A	V
Receiver Element Timing B	X
Transmitter Element Timing A	Y
Transmitter Element Timing B	AA
Data Terminal Ready	H

NETWORK MODULAR JACK PIN ASSIGNMENTS:

Pin Name	Color	Pin Designation
R Data from CSU/DSU	Red	1
T Data from CSU/DSU	Green	2
T1 Data from Network	Black	7
R1 Data from Network	Yellow	8

RS 232C or D PIN ASSIGNMENT:

Pin Name	Pin Designation
Frame Ground	1
Transmit Data	2
Receive Data	3
Request to Send	4
Clear to Send	5
Data Set Ready	6
Signal Ground	7
Data Carrier Detect	8
Data Terminal Ready	20

TABLE B
PIN ASSIGNMENTS

RS 366 PIN ASSIGNMENTS:

Pin Name	Pin Designation
Frame Ground	1
Digit Present	2
Abandon Call and Retry	3
Call Request	4
Present Next Digit	5
Power Indicator	6
Signal Ground	7
Distant Station Connected	13
Low Order Binary Digit	14
Second Order Binary Digit	15
Third Order Binary Digit	16
High Order Binary Digit	17
Data Line Occupied	22

TABLE C
TRANSMISSION LIMITS

LOCAL LOOP LIMITATIONS:

Length: 18 Kilofeet (26 Gauge Cable worst case)
Gauge: 26, 24, 22, 19
Bridged Taps: <2.5 Kft. Total, <2Kft. per leg
Loading: None Permitted
Digital Subscriber Carrier Limitations: Assignable to any slot
Adjacent Pair Restriction: None
Binder Group Restriction: None
Cable Type Restriction: None
Maximum Loss: 40.0 dB @ 28 kHz
Longitudinal Balance: >60 dB (Typical)
Noise: <28 dBrnC
Impulse Noise: -40 dBm threshold (maximum of 7 counts in 15 minutes)
Digital Signal Format: Bipolar
Service Restrictions:

Program Service:	Adjacent Binder Group separation
Data Over Voice:	Impact dependent on modulation scheme and spectral allocation.
Data Under Voice:	Impact dependent on modulation scheme and spectral allocation.
1544 kbit/s Service:	None

CENTRAL OFFICE WIRING:

Line Side: The length of the intra-office 2-Wire cable between the DS0 and the 1AESS® line scanner circuit must be less than 1.2 kft.

Wiring multiples (if they exist) should be removed from the distribution frame terminal pairs, assigned to interconnect the DS0 channel unit to the 1AESS® line scanner circuit.

Trunk Side: The length of the intra-office 2-Wire cable between the trunk line network and the DTC wideband trunk circuit must not exceed 0.15 kft. Wiring multiples (if they exist), should be removed from the frame.

The length of the 2-Wire cable between the DTC wideband trunk circuit facility side and the ODP or TDP dataports, must be less than or equal to 1.5 kft. Any wiring multiples must be removed.

SIGNAL LEVEL:

Transmit +1.4 ±1dBm into 135 ohms for cable loss of ≤40 dB @ 28 kHz; or Transmit +7.4 ±1dBm into 135 ohms for cable loss of >40 dB @ 28 kHz.

ACRONYMS

ALM	Power, Alarm and Clock Card
ANSI	American National Standards Institute
BLER	Block Error Rate
CC	Composite Clock
CDPR	Customer Dial Pulse Receiver
CMI	Control Mode Idle
CO	Central Office
COT	Central Office Terminal
CP	Central Processor
DAT	Dialing Address Translator
DCT	Digital Carrier Trunk
DDAL	Direct Digital Access Line
DDD	Direct Distance Dialing
DDS	Digital Data Service
DLC	Digital Loop Carrier
DS0	Digital Signal Zero
DSU	Data Service Unit
DSX	DS0 Test Interface
DTC	Digital Trunk Circuit
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
DTU	Data Trunk Unit
ES	Error Seconds

FXO	FX Office Unit
FXS	FX Subscriber Unit
IC	Interexchange Carrier
ICT	Incoming Trunk
LATA	Local Access and Transport Area
LEC	Local Exchange Carrier
LIN	Loop Interface Shelf
LLN	Line Link Network
MF	Multifrequency
MH	Mark Hold
MUT	Miniature Universal Trunk
NC	Network Channel
NCC	Network Channel Code
NCI	Network Channel Interface
NS	No Signal
OCU	Office Channel Unit
OCU-DP	Office Channel Unit Dataport
ODP	Originating Dataport
OGT	Outgoing Trunk
OOF	Out-of-Frame
OOS	Out of Service
PL	Private Line
POI	Point of Interface
PRS	Primary Reference Source
PSN	Public Switched Network

RL	Remote Loopback
RPL	Restructured Private Line
RT	Remote Terminal
SSU	Special Service Unit
TAT	Test Access Trunk
TCM	Time Compression Multiplexing
TDP	Terminating Dataport
TIRKS®	Trunk Inventory Record Keeping System
TLP	Transmission Level Points
TLN	Trunk Line Network
TLTP	Trunk Line Test Panel
WBT	Wideband Trunk

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GLOSSARY

Bit Error Rate (BER)

The ratio of the number of bit errors to the total number of bits transmitted in a given time interval.

Channel Service Unit (CSU)

This unit provides regeneration of the signal received from the network, controls the pulse shape and amplitude for transmission of the signal into the network, and possibly provides loop-back. The CSU function is frequently found within a Data Service Unit (DSU).

Control Signal

Signal used for status indication, synchronization and remote testing.

Customer Provided Equipment (CPE)

Equipment owned and maintained by the customer and located on their side of the End-User Point of Termination (EU-POT) network interface. In the U S WEST Digital Data Service application, CPE typically includes the DSU (CSU/DSU) and data terminal equipment which are connected to the channel.

Data Service Unit (DSU)

Digital, customer premises equipment used to recover timing from a baseband BPRZ signal, and which converts from BPRZ line signals to a business machine interface signal such as V.35. At 64 kbit/s and below, DSU and Channel Service Unit (CSU) functions are, in modern equipment, combined in a single unit sometimes called a General Service Unit (GSU), Basic Service Unit (BSU) or Data Service Unit-A (DS0-A) so that it is part of the Data Communications Equipment (DCE). Above 64 kbit/s, DSU functions are frequently contained in the Data Terminal Equipment (DTE). The DSU usually contains circuitry to recognize, and respond to, loop-back commands from the serving test center.

NOTE: For SwitchNet 56® service, the CSU/DSU are combined in one unit.

Data Terminal Equipment (DTE)

A generic term for customer terminal equipment that connects to the network through a modem or through digital Network Channel Terminating Equipment (NCTE), e.g., a computer or a PBX.

Dial Pulse (DP)

A means of signaling consisting of regular momentary interruptions of a direct or alternating current path at the sending end in which the number of interruptions corresponds to the value of a digit or a character. The interruptions are usually produced by a rotary telephone dial, but may be produced by a sender switching system.

Encryption

A process of encoding and decoding information so that it is not easily decipherable by unintended recipients.

Equalization

A process of correcting frequency and/or phase distortion of a circuit by the introduction of networks to compensate for the difference in attenuation and/or time delay at the various frequencies in the transmission band.

Error Free Seconds (EFS)

A one-second interval which does not contain any bit-errors. Usually expressed as a percent over a consecutive 24-hour period.

Full Duplex

Simultaneous transmission in both directions between two points.

Jitter

Random timing distortions of a digital signal, whereby the appearance of a pulse differs from where the pulse should occur relative to time.

Kilobit/Second (kbit/s)

One thousand (1000) bits/second

Loopback

An out-of-service test procedure applied to a full duplex channel that causes a received signal to be returned to the source.

Network Interface (NI)

The point of demarcation on the customer's premises at which U S WEST's responsibility for the provision of service ends.

Out-of-Frame Occurrence

Terminal equipment transition when failures are detected in four succesive framing tests.

Point of Termination (POT)

The physical telecommunications interface that establishes the technical interface, the test point(s), and the point(s) of operational responsibility. (See Network Interface).

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI TI.101 — Synchronization Interface Standards for Digital Networks.1987

ANSI T1E1.4/90-006R3 — Subrate Metallic Customer Installation Interface. November 1990

AT&T TECHNICAL REFERENCES
(Pre-Divestiture Documents)

PUB 41021 — Digital Data System-Channel Interface Specifications. March 1973, Addendum October 1991

PUB 62310 — Digital Data System Channel Interface Specifications. September 1983

BELLCORE DOCUMENTS

TA-NPL-000436 — Digital Synchronization Network Plan. Issue 1, November 1986

TR-880-22135-84-01 — Circuit Switched Digital Capability Network Access Interface Specifications. Issue 1, July 1984

U S WEST TECHNICAL PUBLICATIONS

PUB 77312 — Digital Data Service, Technical Product Description, Transmission Parameter Limits, and Interface Combinations. Issue C, March 1992

PUB 77365 — Network Channel and Network Channel Interface Combinations. Issue A, March 1989

OTHER TECHNICAL DOCUMENTS

INCS-USDC-56-002 — Integrated Network Corporation, USDC-56 System Description. April 1988

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