PRIVATE LINE SERVICE
OVERALL DESCRIPTION
DIGITAL DATA SYSTEM

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1. GENERAL

1.01 This practice provides an overall transmission description of the private line service for the DDS (Digital Data System). The description is based on the integration of several individual components into a system meeting a set of overall transmission objectives.

1.02 This practice is reissued for the following reasons:

- To add new terms throughout the practice as a result of new technologies and divestiture
- To describe test equipment necessary for turn-up and maintenance
- To add information on the level of spare circuit packs necessary for proper operation
- To delete coverage of and reference to the 950A testboard
- To replace DSU/CSU (data service unit/channel service unit) terminology with DTE (digital terminating equipment) terminology
- To add information on the hierarchical structure and boundaries of intra- and inter-LATA (local access and transport area)
- To add references to the ABATS (Automated Bit Access Test System) and the DTSS (Digital Transmission Surveillance System)

- To add information on secondary channel capability.

Revision arrows are used to emphasize the more significant changes.

2. INTRODUCTION

A. System Summary

2.01 The DDS is a general purpose facility network for data transmission. A major use of the network is for a private line synchronous data transmission service. Data transmission occurs in both directions simultaneously (full duplex transmission). A synchronization network ensures the transmission is synchronous; that is, the data is accepted from and delivered to the DDS at network-controlled clock times.

2.02 The DDS provides point-to-point and multipoint (multistation) service. Multipoint service eliminates the need for an individual data route between a centralized customer location and each of its branches. The DDS accepts data rates of 2.4, 4.8, 9.6, and 56 kb/s. There is no provision for alternate voice or voice coordination. The basic data rates are multiplexed to achieve efficient fills on the transmission facilities and on shared equipment. Offices are arranged in a hierarchy from hub offices to end offices. A hub office serves as the cross-connect and testing point for all circuits that have end points in the office serving area.

2.03 ➧A new feature called secondary channel capability is being introduced in the DDS. This feature provides an independent, lower speed channel the customer can use to control or monitor its own network. This channel will operate in parallel with the primary data channel through the DDS network and will have comparable quality. To implement secondary channel capability, the excess capability inherent in the eighth bit (network control bit) of each network byte will be shared with the customer.

2.04 Secondary channel capability will be provided on all customer data rates and circuits (2.4, 4.8, 9.6, and 56 kb/s) and will use the same basic network equipment and transmission facilities as the primary channel. Figure 1 is a block diagram of the DDS with secondary channel capability plus the new or modified equipment codes necessary for secondary channel capability.

2.05 Secondary channel capability will be derived at the DTE and can be used independently of the primary channel. To support secondary channel operation in the DDS, every third control bit is replaced by a secondary channel bit. The resulting secondary channel capacity at the different customer rates is shown in Table A➧.

B. Comparison of Analog and Digital Transmission

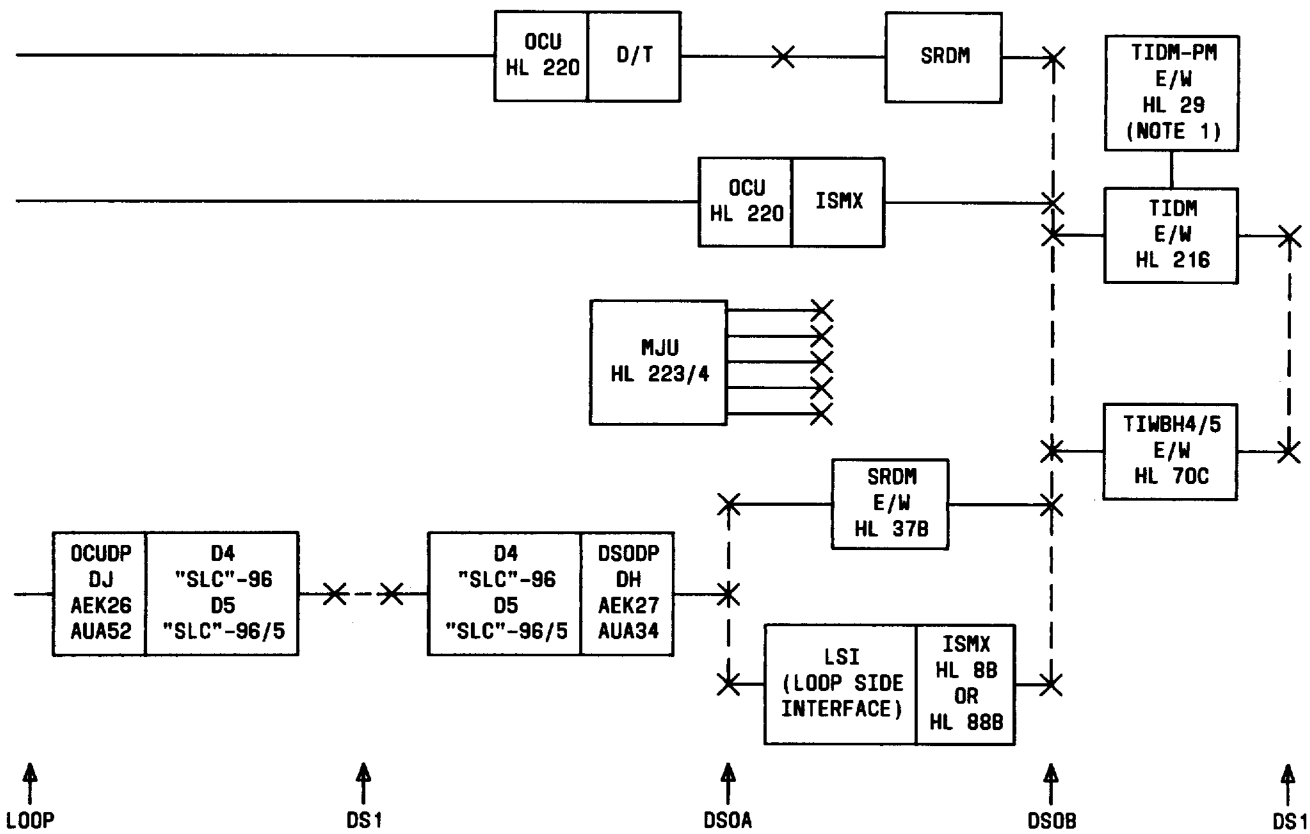
2.06 The DDS is designed to transmit data in digital form. A bit is a unit of digital information. Bits are represented by the presence or absence of pulses during a specific interval of time and are commonly known as ones (pulses) and zeros (no pulses). Once the pulses have been formed, the exact amplitude is of little significance; therefore, digital pulses may be freely regenerated between two points of transmission. The only restriction on regeneration is that it must occur before extraneous signals and noise have obscured the ones and zeros. This risk of error is minimized by the proper spacing of regenerators. Noise and distortion that normally accumulate in analog signals are completely removed each time a digital signal is regenerated. In addition, the DDS, being strictly digital from end to end, eliminates the need for the digital-to-analog-to-digital conversion required by analog data transmission facilities. This eliminates the cost and complexity of extra equipment and the distortion caused by repeated conversions.

C. Integration into Present Digital Hierarchy

2.07 The DDS has been designed to be integrated into the digital hierarchy, which is divided into levels according to data rate. The higher the data rate, the higher the level in the hierarchy. A 1.544-Mb/s rate defines the first level in the hierarchy, called the DS-1 level. The DDS transmits to these facilities at the DS-1 level. This level may be multiplexed into higher rate facilities, but it is still used as a DS-1 facility (Fig. 2). Facility information is documented in the appropriate division of practices according to the type of facility.

2.08 The DDS circuits must be changed to implement the secondary channel capability for the following reasons:

(a) The loop signal format must be changed to provide for increased information transmission rate.



NOTE:
1. This circuit pack will be modified with a Class A change.

Fig. 1—Digital Data System With Secondary Channel Capability

(b) The method by which the secondary channel information is carried within the network produces data bytes which contain more zeros than those produced by the existing system. The existing equipment, in many cases, will suppress these bytes so the equipment must be modified to transmit the information.

(c) Processing of secondary channel information is added to the MJU (multipoint junction unit).

(d) Subrate circuit assignment is restricted to those channels within a DS-0B signal that contains a one in the subrate framing bit, and 56 kb/s customers cannot transmit all-zeros data with a zero in the secondary channel.

2.09 The 1.544-Mb/s DS-1 signal is organized into frames of 193 bits each. Each frame is subdivided into twenty-four 8-bit bytes, accounting for 192 bits. The 193rd bit is used for frame synchronization. A rate of 8,000 frames per second can be derived by dividing the total number of bits per second by the number of bits per frame (1,544,000 divided by 193). Each of the twenty-four 8-bit bytes represents one channel. Therefore, each channel contains information at the rate of 64 kb/s (8 bits x 8000 frames per second), and the DS-1 signal consists of twenty-four 64-kb/s data channels multiplexed into a single 1.544-Mb/s data stream. Typically, the 24th channel byte is used for frame synchronization (in addition to the 193rd bit), so only the first 23 bytes in a frame carry customer data.

TABLE A

CUSTOMER BYTE FORMATS AND DATA RATES

BYTE FORMAT (NOTE 1)	PRIMARY CHANNEL RATE	SECONDARY CHANNEL RATE	OVERALL CHANNEL RATE AT NETWORK INTERFACE
$D_1D_2D_3D_4D_5D_6$ F c/s	2.4 kb/s	133 1/3 b/s	3.2 kb/s
$D_1D_2D_3D_4D_5D_6$ F c/s	4.8 kb/s	266 2/3 b/s	6.4 kb/s
$D_1D_2D_3D_4D_5D_6$ F c/s	9.6 kb/s	533 1/3 b/s	12.8 kb/s
$D_1D_2D_3D_4D_5D_6$ D_7 F c/s	56.0 kb/s	2666 2/3 b/s	72.0 kb/s

Note:
- $D_{1\text{-}7}$ = primary channel data
- F = framing signal (repeated 101100 pattern)
- c/s = shared secondary channel data (s) and network control (c) information (repeated secondary channel capability pattern).

2.10 If secondary channel capability is present, the control bit is used for any secondary channel information. The customer can use the control bit in every third byte at all subrate speeds as well as 56 kb/s channels.

2.11 The 64-kb/s data rate is called the DS-0 level. Each DS-0 channel can carry customer data from a single 56-kb/s station or from several subrate stations. A DS-0 level signal is divided into two types of signals: DS-0A and DS-0B (described in paragraph 3.14).

2.12 The DS-CS (digital signal at the customer service) level represents the customer data rate (2.4, 4.8, 9.6, or 56 kb/s).

3. DDS SIGNAL STRUCTURE

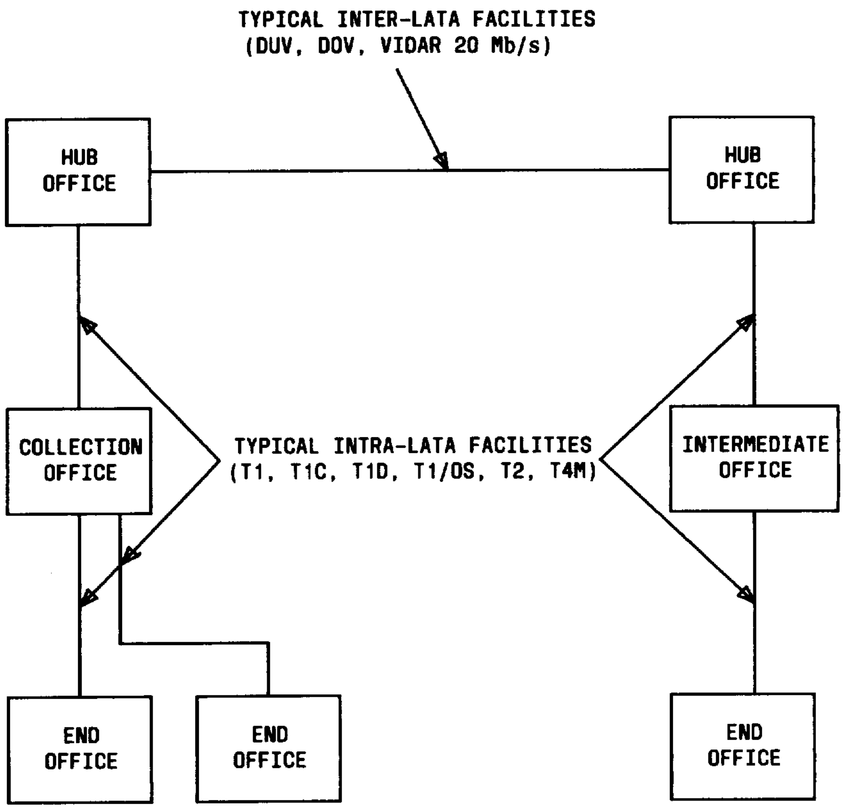
A. Customer Stations and Local Loops

3.01 The DDS channel is terminated at the customer location in one of two possible equipment arrangements. In one arrangement, the customer provides the timing recovery and interface circuitry. The DDS provides loop cable equalization and maintenance testing capabilities. In the other arrangement, a single piece of DDS equipment at the customer location provides these functions.

3.02 The connection between the customer and the office is a 4-wire loop. A balanced bipolar signal is transmitted over this local loop. The signal is still at the customer data rate and is in a modified BPRZ (bipolar return-to-zero) format as shown in Fig. 3A. Signaling capability is provided by transmitting successive pulses of the same polarity, deliberately violating the bipolar encoding rule. This type of signaling is used for two main purposes: (1) to show that a channel is idle, and (2) to perform loop-back tests over the local loop.

B. Office Channel Terminating Equipment

3.03 In a DDS office, the local loop is terminated by an OCU (office channel unit) that receives data from and transmits data to the customer. The OCU provides byte organization and timing and produces a 64-kb/s (DS-0 level) signal toward the network. Figure 3B shows that the output of the OCU toward the network is always in a 64-kb/s BPNRZ (bipolar nonreturn-to-zero) format. The OCU DP (office channel unit dataport) is a special services plug-in unit for use in digital channel banks and the remote terminal of an SLC® 96 carrier system. The



♦Fig. 2—DS-1 Transmission Facilities♦

OCU DP serves the same functions as the OCU unless it is specified for a different function.

3.04 The 56-kb/s customer data stream is divided into 7-bit bytes of information at the OCU. To each of these bytes, one C (control) bit is added, forming a sequence of 8-bit bytes. The control bit is a one if the byte contains customer data, or a zero if the byte contains network control information such as the idle code. This control bit is used to transmit secondary channel information. Since a 56-kb/s data stream is organized into eight thousand 7-bit bytes every second, an extra bit added to each byte means that 8000 additional bits are added to the stream each second. The result is a 64-kb/s (DS-0 level) stream.

3.05 The subrate (2.4-, 4.8-, and 9.6-kb/s) data streams are organized into 6-bit information bytes. An additional bit, a zero, is added at the front of each byte for later use by a multiplexer. A control bit is added at the end. The subrate byte is then repeated the number of times required to achieve the 64-kb/s rate (a technique known as byte stuffing). For example, at the 9.6-kb/s data rate, 9600 customer data bits are sent toward the network every second. Two bits are added for every six of these to form bytes, a total of 3200 more bits every second. Each byte is repeated five times. The mathematics of this example of byte stuffing is (9600 + 3200) x 5 = 64 kb/s coming from the OCU every second. Figure 4 shows the output signals of an OCU toward the network and illustrates byte stuffing.

3.06 ♦Even after the customer data has been byte stuffed, the information rate is still the same as it was originally. The bytes have merely been repeated enough (according to customer rate) to achieve a 64-kb/s data stream. The data stream is then at the DS-0A signal level; that is, it contains data from only one customer.

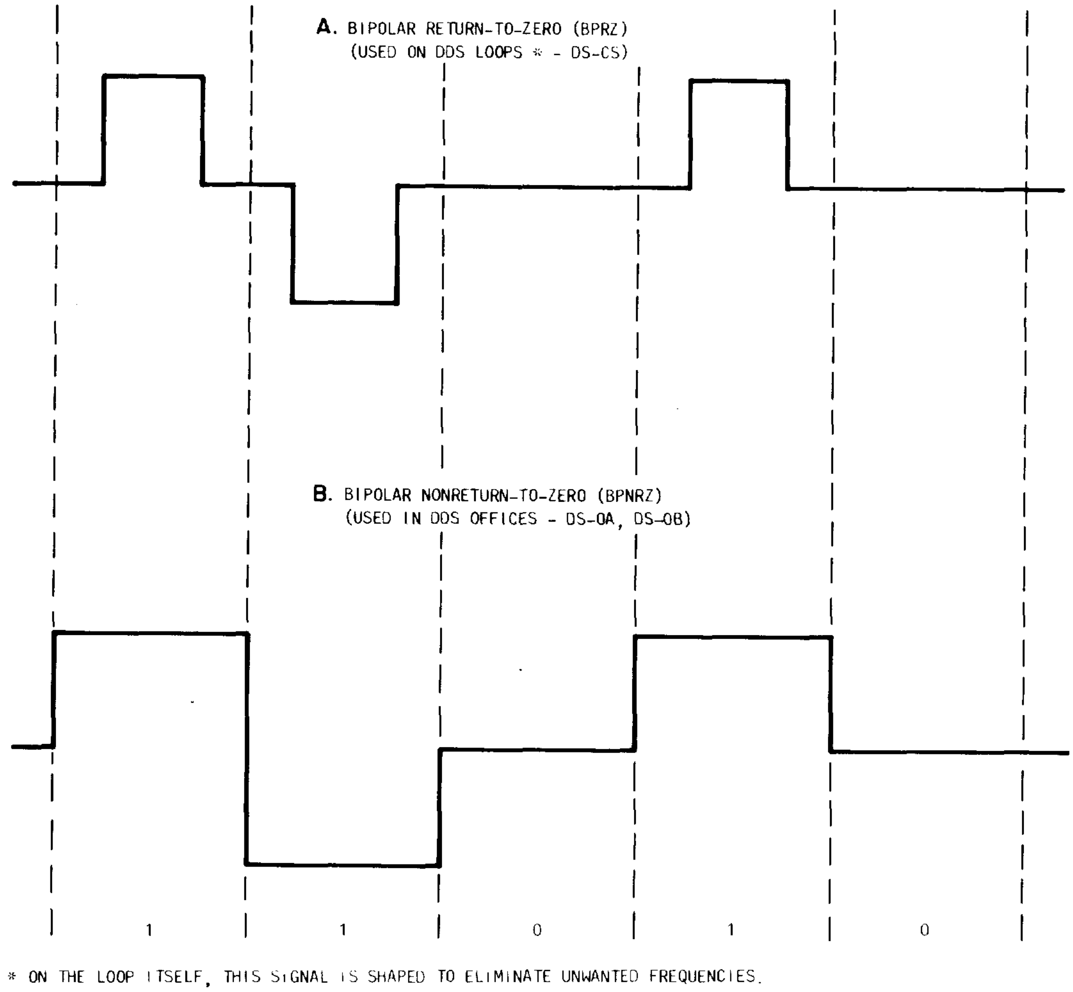


Fig. 3—Bipolar Formats

C. Signal Format and Protocols for Secondary Channel Capability

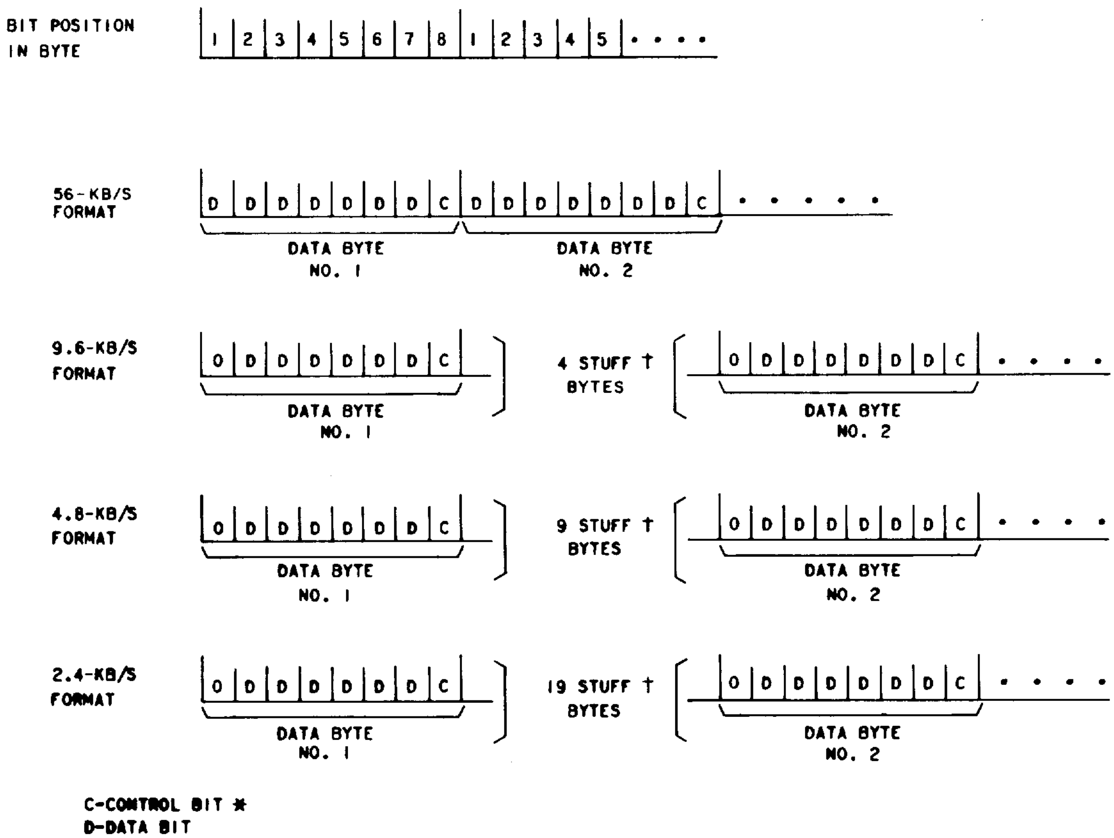
3.07 Secondary channel capability requires the imposition of a byte structure on the user data which allows differentiation of the primary and secondary channel information, both at the user equipment and in the network.

Byte Structure

3.08 Information transmitted to the network must be formatted in either 8-bit bytes containing 6 primary channel data bits (D bits) for primary channel rates of 2.4, 4.8, and 9.6 kb/s, or 9-bit bytes containing 7 primary channel bits for 56 kb/s primary channel data. Each byte contains two bits which are not primary channel data. One of these two bits contains a framing sequence (F bit). The other bit is shared between secondary channel information (S bits) and network control information (C bits) and, thus, designated S/C bit. Table A shows the format and the capacity of the primary and secondary channels to carry this information, and the overall channel transmission rates.

Secondary Channel Information (S Bit)

3.09 The secondary channel information is carried through the network on a specified bit which is time shared with network control information. On two-point circuits and in the control station to tribu-



* THE CONTROL BIT IS A LOGICAL 1 IF THE BYTE CONTAINS CUSTOMER DATA, AND A LOGICAL 0 IF THE BYTE CONTAINS CONTROL INFORMATION (FOR EXAMPLE, CONTROL INFORMATION INDICATING IDLE CODE IS 1111110).

† A STUFF BYTE IS A REPETITION OF THE PREVIOUS DATA BYTE (IE, DATA BYTE NO. 1 IS REPEATED THE NUMBER OF TIMES INDICATED).

Fig. 4—Output Signals

tary station direction of multipoint circuits, every third S/C bit may be used to carry secondary channel information. Fewer bits may be used if desired. In the opposite direction of transmission on multipoint circuits, every third bit must be used when the secondary channel is active. Framing circuits in the network multipoint junction units depend on this characteristic.

3.10 The network delay for primary and secondary channels will be identical for two-point circuits and for the control station to tributary station direction of transmission in multipoint circuits. For transmission from tributary stations to the control station, delay will be experienced in the secondary channel which will not exceed three bits at the secondary channel rate for each multipoint junction unit in the circuit.

Two-Point Circuits

3.11 Secondary channel data may be encoded as desired for 2.4, 4.8, and 9.6 kb/s primary channel circuits. For 56 kb/s operation, the S-bit must be set at 1 when the primary channel data is set at all zeros. Note that a byte containing all zeros primary channel data and a zero S-bit will be overwritten by the network with the sequence 0001100F0.

Multipoint Circuit

3.12 The downstream transmission of secondary channel information, from the control station to the tributaries, operates in the broadcast mode and may be treated as a two-point circuit.

3.13 In the upstream direction, the primary and secondary channels may be operated independently. They may have common or different sources.

D. First Stage Multiplexing

3.14 First stage multiplexing is necessary to make second stage multiplexing more efficient. If the 64-kb/s DS-0A signal is formed from a 56-kb/s customer data rate, each byte contains new customer data. The 8000 bits added each second to the 56-kb/s customer data rate are all supervisory bits. None of the customer bytes are repeated, and a DS-0A signal that contains the 56-kb/s customer rate bypasses first stage multiplexing since it is already carrying the maximum amount of customer information. The DS-0A signals formed from subrate customer inputs (2.4, 4.8, and 9.6 kb/s) use byte stuffing to reach the 64-kb/s rate. Table B shows the number of times each subrate information byte is repeated to form a 64-kb/s signal. For example, a 2.4-kb/s information byte must be repeated 20 times each second to reach the DS-0A level. The first stage multiplexer time division multiplexes 20 different DS-0A signals into a single DS-0B signal that contains 20 different 2.4-kb/s information bytes. Therefore, a DS-0B level signal could contain data from as many as 20 customers. The numbers in Table A also represent how many subrate channels can be multiplexed together by the first stage multiplexer.

3.15 To achieve maximum packing efficiency, a different multiplexer is required for each subrate. Because of the uniform 64-kb/s data stream coming from the OCU, a first stage multiplexer can accept data at a rate lower than or equal to its designated capability. A 9.6-kb/s multiplexer, for example, can accept 2.4- or 4.8-kb/s data streams, but at a loss in efficiency since it can accept no more than five channels even at the lower rates. Accordingly, two different subrate multiplexers may be employed: (1) a multiplexer that is arranged to operate at any of the subrates and, therefore, efficiently packs together the maximum number of subrate channels such as the SRDM (subrate digital multiplexer); and (2) a multiplexer that accepts a limited number of subrate channels such as the 5-channel and 10-channel ISMXs (integral subrate multiplexers) (HL8B or HL88B). The latter is physically integrated with the OCU equipment, whereas the former is physically separated.

TABLE B

BYTE STUFFING

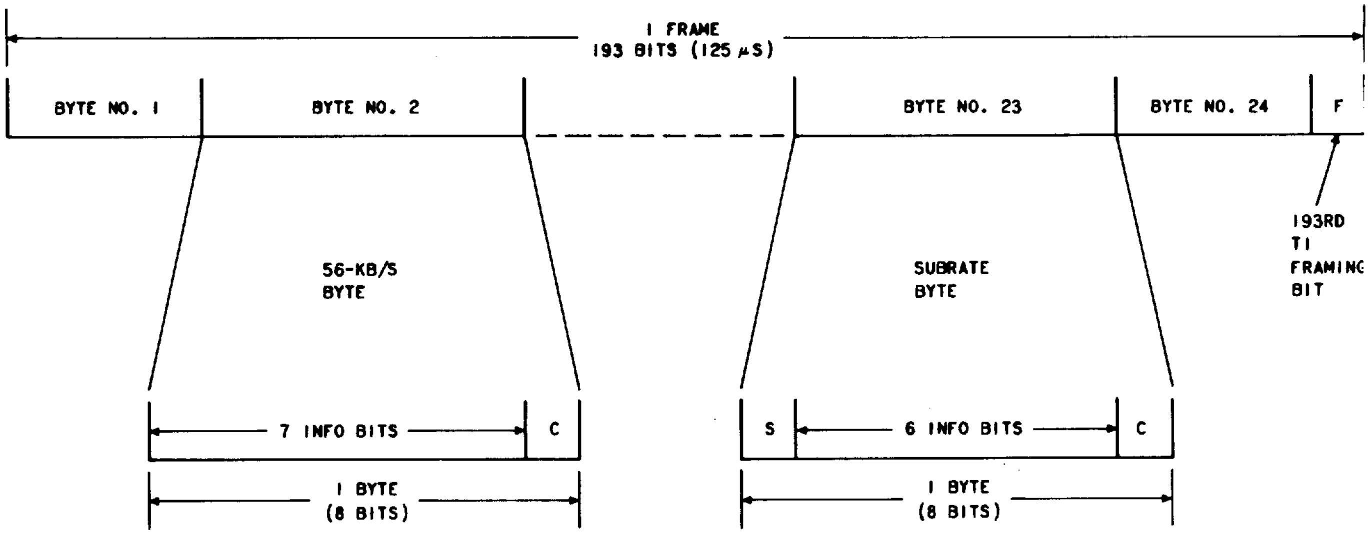
DATA RATE (kb/s)	NUMBER OF BYTE(S) REPEATED IN DS-0A SIGNAL
56	1
9.6	5
4.8	10
2.4	20

E. Second Stage Multiplexing

3.16 Second stage multiplexing integrates the DS-0 signal into the hierarchy of digital transmission equipment. The output of this multiplexing stage is a 1.544-Mb/s bit stream. The output signal is at the DS-1 level in the digital hierarchy.

3.17 Multiplexing from the DS-0 signal to the DS-1 signal can be done by two different types of multiplexers. The first type of multiplexer accepts a maximum of twenty-four 64-kb/s data streams plus a framing bit and selects one 8-bit byte from each in succession. For new equipment, the 24th byte and the framing bit are used for synchronization (Fig. 5). Eight thousand of these frames are placed on the line every second, resulting in a 1.544-Mb/s bit stream. Examples of this type of equipment are the T1DM (T1 data multiplexer) and the channel banks equipped with dataports. Table C shows the maximum number of customer data channels of each rate that can be multiplexed at the DS-1 signal level with this type of multiplexer.

3.18 The other type of multiplexer used in second stage multiplexing constructs the T1 signal similarly to the first. Here, however, the T1 frame may simultaneously carry data channels and PCM (pulse code modulation) voice channels received from a D1D, D2, D3, or D4 channel bank. This multiplexer (T1WB4 or T1WB5) is used only in the metropolitan areas, not on long-haul facilities.



F-BIT: USED BY SECOND STAGE MULTIPLEXER TO RECOGNIZE BYTE POSITIONS.
S-BIT: USED BY FIRST STAGE MULTIPLEXER TO RECOGNIZE BYTE POSITIONS.
C-BIT: USED TO SATISFY T1 1s DENSITY OR TO INDICATE A CONTROL CODE.
56-KB/S BYTE: CARRIES 7 CUSTOMER BITS PER FRAME EVERY FRAME.
SUBRATE BYTE: CARRIES 6 CUSTOMER BITS PER FRAME EVERY 5, 10, OR 20 FRAMES WHEN FIRST STAGE MULTIPLEXING IS USED. IF NOT USED, SUBRATE BYTE APPEARS EVERY FRAME.
FRAME RATE: 8000 FRAMES/SECOND

Fig. 5—Frame of T1 Data Stream

TABLE C

EFFECTS OF MULTIPLEXING

DATA RATE (kb/s)	MAXIMUM NUMBER OF CHANNELS AT DS-1 SIGNAL LEVEL
56	23
9.6	115
4.8	230
2.4	460

4. NETWORK STRUCTURE

A. End-to-End Connection

4.01 Figure 6 shows examples of the overall DDS network structure. A 4-wire local loop connects the customer to a DDS office. This office may be any of the offices shown in Fig. 6, depending on its location in the serving area. The customer signal may be multiplexed with other customer signals. Assuming the receiving customer is in a distant DLSA (digital LATA serving area), the multiplexed signal is sent over long-haul facilities and possible short-haul facilities at each end. Then the multiplexed signal undergoes the reverse process (demultiplexed) and is routed to the proper customer over a local loop.

B. Long-Haul Transmission

4.02 A 3-level hierarchy for intercity circuit routing is employed in the DDS. Enough demand between any pair of locations results in an express path between those locations; but all other circuits are routed through the hierarchy to improve the use of facilities. Figure 7 shows that each class 3 (metro) city has a single class 2 (sectional) city to which it routes all nonexpress circuits. Similarly, each class 2 city has a single class 1 (regional) city to which it routes all nonexpress circuits.

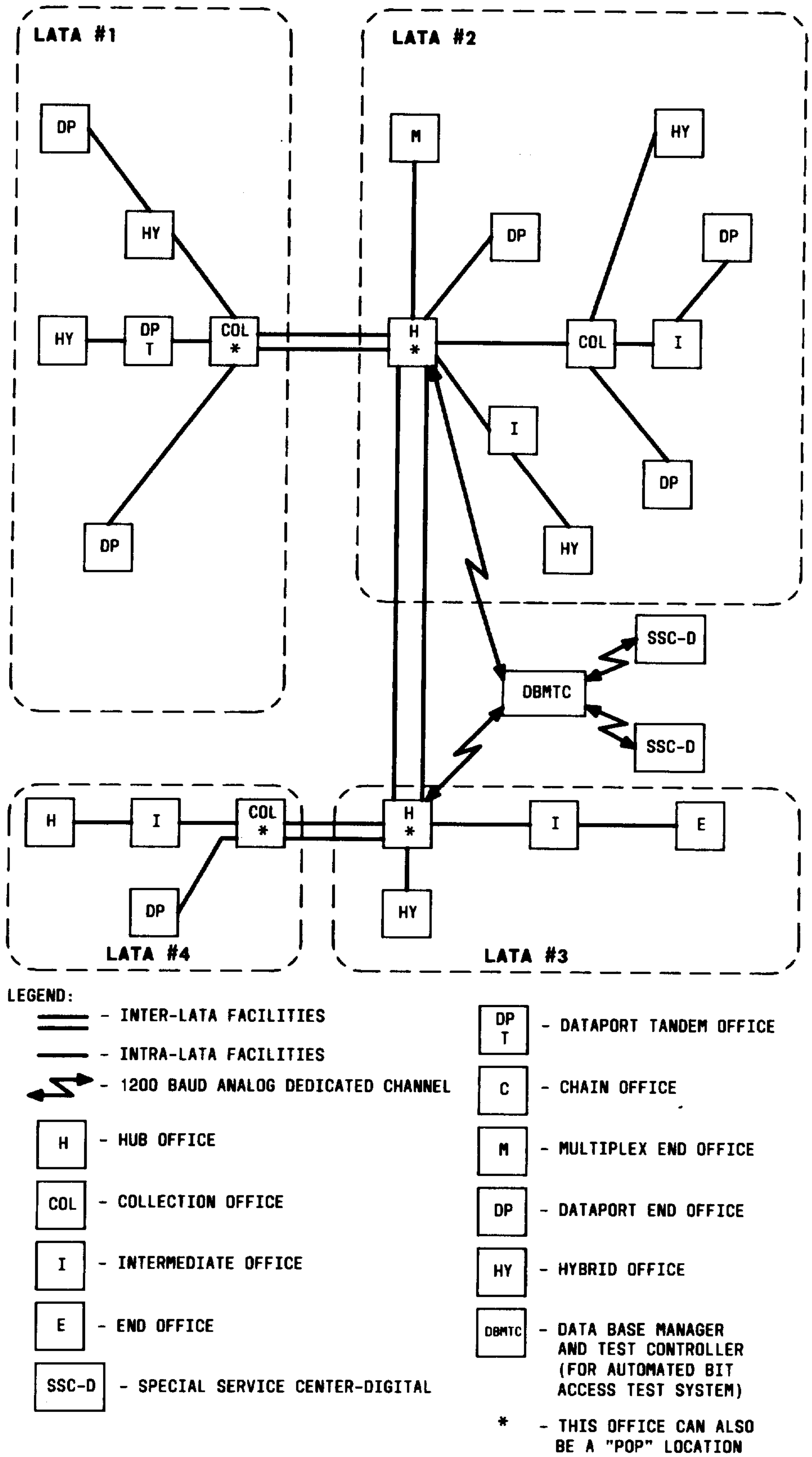
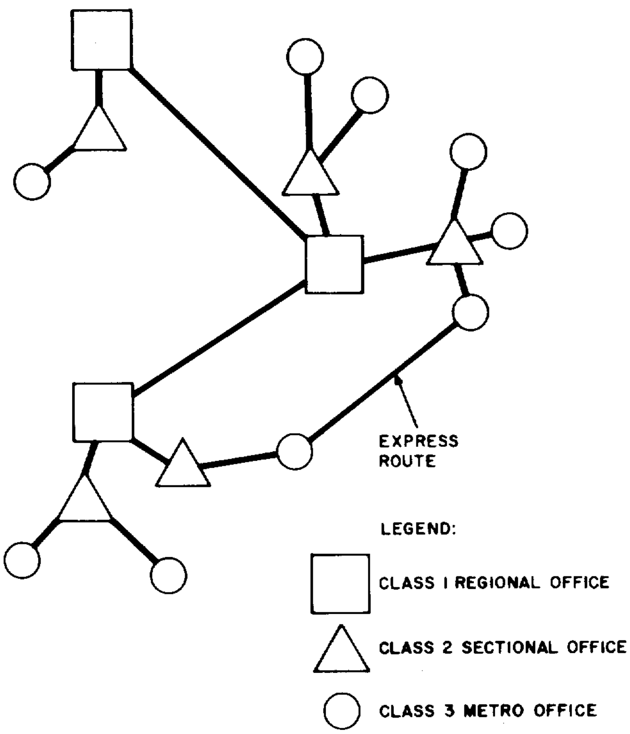


Fig. 6—Digital Data System Hierarchy Block Diagram



♦Fig. 7—Diagram of DDS Inter-LATA Routing Structure♦

4.03 Long-haul transmission for the DDS is at the DS-1 level in the digital hierarchy. Typical long-haul (inter-LATA) facilities include DUV (data under voice) on TD2, TD3, or TH radio; DOV (data over voice) on L4/L5 cable; and VIDAR 20 Mb/s using DM-12A terminals on TD-2 radio as shown in Fig. 3. Other facilities used for long-haul service include DMG-1 digital master group, 46-Mb/s terminals on TD-2 radio, and the FT-3 lightwave digital transmission system. The DUV provides most of the digroups in the inter-DLSA portion of the DDS.

4.04 ♦Each long-haul system must be individually designed to meet or be consistent with the original DDS long-haul performance network objective of 99.75 percent EFS (error-free seconds). This is equivalent to 216 ES (errored seconds) at 56 kb/s for a 4000-mile route length. The revised long-haul objective is 99.7 percent EFS, which is equivalent to 260 ES at 56 kb/s. The revised long-haul objective permits the use of digroups that include the following:

- More than one long-haul quality facility type
- More than one short-haul quality facility type
- A combination of short-haul and long-haul facilities.

C. Short-Haul Transmission

4.05 Short-haul facilities that have been properly engineered and designed to satisfy the new objectives allocated to the long-haul portion of the network can be used as inter-DLSA facilities. The short-haul (intra-LATA) facilities are T1, T1C, T1D, T1/OS (T1 out-state), T2, T4M, and digital radio at 6 and 11 GHz as shown in Fig. 2. The revised short-haul error performance objective of 99.975 percent EFS at 56 kb/s is for half of the normal maximum length. The new acceptance criteria of a T1 line is as follows:

- There must be no more than 20 ES at the DS-1 level in a 2-hour test performed during the business day for a one-way test.
- There must be no more than 33 ES at the DS-1 level for a looped test.♦

D. Digital LATA Serving Area

4.06 ♦A DLSA for the DDS is a geographic area. Typical intra-LATA facilities are used between DDS offices within a DLSA. The DDS offices depicted in Fig. 6 serve as circuit concentration points which provide efficient fills of facilities. By aligning these offices within the DLSA and between DLSAs, certain basic structural names are created, such as hub office, collection office, intermediate office, and end office.♦

4.07 The DDS offices use many different equipment arrangements that result in different names for these offices. The equipment names, along with the structural names associated with DDS offices, create considerable confusion. To help alleviate this confusion, paragraphs 4.08 through 4.14 define the more common office names.

4.08 ♦Hub offices are distinguished in two different ways to identify their important characteristics: (1) position in the inter-LATA routing hierarchy, and (2) DLSA function. The hub office serves as the cross-connect and testing point for circuits that have end points in that serving area. It also serves as a concentration point for the efficient packing of data streams that are transmitted over inter-LATA facilities. The hub office is the interface between the DLSA and the inter-LATA facilities. Customer circuits are routed to the hub office individually over 4-wire local loops or in multiplexed streams over intra-LATA facilities from other offices. Multiplexed customer streams are necessary because the radius of a DLSA often exceeds the range of the local loops.◀

4.09 A hub office provides multiplexing, demultiplexing, and manual testing or remote access testing. Manual testing is done by the BATS (bit access test system). The BATS is also known as a KS-21899 data test system. Remote access testing is done by using the ABATS and ALATS (automated line access test system). The ABATS/ALATS is remoted to a DBM (data base manager) and TC (test controller) and receives commands from an SSC/CTC (special service center/centralized test center). ▶The CTCs are evolving to SSC-D (special service centers-digital) and will be referred to as SSC-Ds throughout the remainder of this practice. A hub office that provides DDS testing assumes the administrative and maintenance responsibilities as specified in Practice 660-230-100.◀

4.10 All DDS hub offices were originally intended to have testing capability, but some offices function more like an intermediate office with respect to customers and circuit fill. The DDS circuits in these offices are tested from another hub office by back-hauling these circuits. Back-hauling will continue until an intermediate office can justify the expense of providing circuit testing capability.

4.11 A collection office and an intermediate office serve as concentration points for the efficient packing of data streams that are sent to a hub office. Both offices may receive data streams over short-haul facilities and local loops. A collection office is connected to other DDS offices (more than one). An intermediate office is connected to only one end office. Neither a collection office nor an intermediate office has circuit testing responsibility.

4.12 An end office passes on toward the hub office circuits that entered that office over local loops. A large end office has the potential of becoming an intermediate or collection office because it contains the same type of equipment.

4.13 ▶Offices within a DLSA are linked together in tree-like structures to achieve efficient fills of the intra-LATA facilities.◀ These offices may be associated with other office terms, such as dataport, chain, hybrid, and multiplex, depending on the equipment serving the DDS.

(a) A dataport office serves local customers and employee channel banks equipped with dataport channel units for its interoffice facilities.

(b) A dataport tandem office uses digital channel banks configured back-to-back. These banks are equipped with DS0-DP channel units. This configuration functions like an intermediate or collection office, depending on the number of end offices feeding the tandem office.

(c) A multiplex office has two stages of multiplexing. The first stage may use ISMXs and the second stage uses T1DM, T1WB4, or T1WB5 to extend dataport facilities.

(d) A hybrid office multiplexes together subrate signals from several local customers and feeds the resulting DS-0B signal over dataport facilities toward the hub office. This office uses a hybrid of conventional DDS and dataport techniques.

(e) A chain office is equipped with a T1WB4 or T1WB5 that is operated in the chained data mode. The DS-0 signals may be added to or dropped from the DS-1 signal passing through the chain office. No more than two chain offices should share a single ▶intra-LATA◀ facility.

4.14 ▶The offices in the DLSA can be arranged in a star configuration or in a collection or concentration point configuration.◀

(a) The star configuration uses no collection or intermediate offices. ▶All intra-LATA◀ facility connections go from the hub office directly to an end office. This arrangement is used in areas where large numbers of customers can be reached by local loop from an end office.

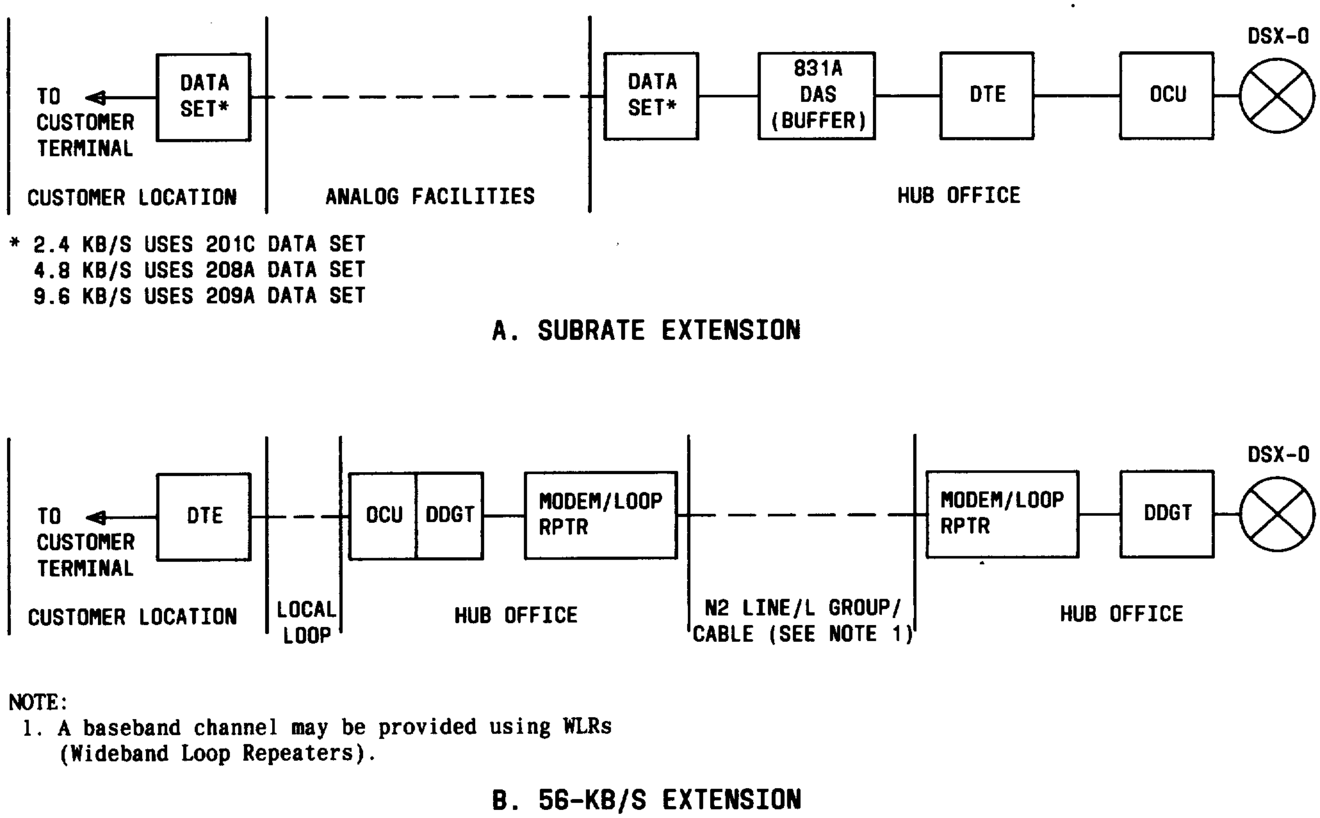
(b) The collection or concentration point configuration uses collection or intermediate offices to achieve more efficient facility fills. In this arrangement, end offices are connected to a collection or intermediate office in a star-like way and the collection or intermediate office is, in turn, connected to the hub office in a star-like manner.

E. Local Loops

4.15 The customer location and the DDS office are connected by a 4-wire local loop that does not normally have repeaters. If, however, the customer location is beyond the maximum range of the nonrepeatered loop, other arrangements must be used. For 56-kb/s customers that do not have secondary channel capability, regenerative repeaters can be used to extend the range of the 4-wire loop. Another possible arrangement is off-net extension. Some local loops are routed through non-DDS hub offices (called baseband offices) and then over interoffice cable to DDS offices.

F. Off-Net Extensions

4.16 The ➧DLSA➧ for the DDS is defined in the appropriate tariffs. Customers served by end offices located within the DLSA receive on-net DDS service. If a customer is located outside an area defined by the tariff, DDS service may be provided in one of two ways: (1) the present tariff can be supplemented to add the central office that serves the customer, or (2) service may be provided from a present DDS hub office using an off-net extension. Off-net extensions connect to the DDS only at hub offices and are available in a single-circuit or a multiple-circuit arrangement. A typical arrangement is shown in Fig. 8. The subrate configuration (Fig. 8A) uses analog data sets. The off-network extension bay requires "essential" ac power; that is, power that can be switched either automatically or manually to a back-up source. A buffer device, the 831A data auxiliary set, provides the interface with the DDS. The 56-kb/s configuration (Fig. 8B) makes use of a DDGT (digital data group terminal) over analog facilities. Testing access to the analog connection is provided from an analog test center.



➧Fig. 8—DDS Off-Net Extension➧

5. EQUIPMENT FUNCTIONAL DESCRIPTION

A. Introduction

5.01 ♦Figure 9 shows an example of the DDS office structure in a DLSA, including the equipment the offices may contain. The offices may contain modified equipment if secondary channel capability is present. In one DLSA, the customer signal is multiplexed with others and sent over inter-LATA facilities to another DLSA, where it is demultiplexed and routed to the proper point.♦

B. Customer Stations

5.02 The ♦DTE♦ must provide the following: a complete customer interface, including clock recovery, regeneration, network protection, loop cable equalization, maintenance testing capability, and the circuitry necessary to transfer the customer signals to and from the DDS network. The DTE is provided by the customer. ♦Secondary channel capability will be derived at the DTE which will be located on the user premises.♦

5.03 The serial data coming from the customer is sampled and encoded into a modified bipolar format by the transmitting section of the ♦DTE♦. Sequences of six or seven consecutive zeros in the data stream, depending on the service rate, must be replaced with zero suppression codes. The signal is finally converted into a balanced, limited, bipolar signal and is transmitted to the local loop through a line-coupling transformer and a lightning protection arrangement.

5.04 The functions required for the ♦DTE♦ in the receiving direction are slightly more complex than those in the transmit direction. Loss is added to the signal path to compensate for differences in local loop length. The signal is filtered, equalized, and amplified to overcome transmission loss. Clock recovery circuitry derives a sampling clock from the received signal. This clock is used to regenerate the incoming bipolar pulses. The regenerated data stream is examined for a zero suppression code or a network control code. If a zero suppression code is detected, the code is replaced by the appropriate zeros. If a network control code is detected, the appropriate indication is given to the customer.

C. Office Equipment

OCU and ISMX

5.05 The OCU terminates the local loop in the DDS office. It receives data at the customer data rate and provides a 64-kb/s output signal toward the network. This signal is organized into 8-bit bytes.

5.06 Timing signals are passed on to all OCUs within an office from the office clock system. These signals provide office bit and byte rates.

5.07 The receiving section of the OCU first equalizes, filters, and amplifies the signal from the loop to provide a standardized line signal. Then it retimes the received signal with 64- and 8-kHz clocks to convert these signals to the byte-organized "universal" office format (paragraphs 3.03 through 3.06).

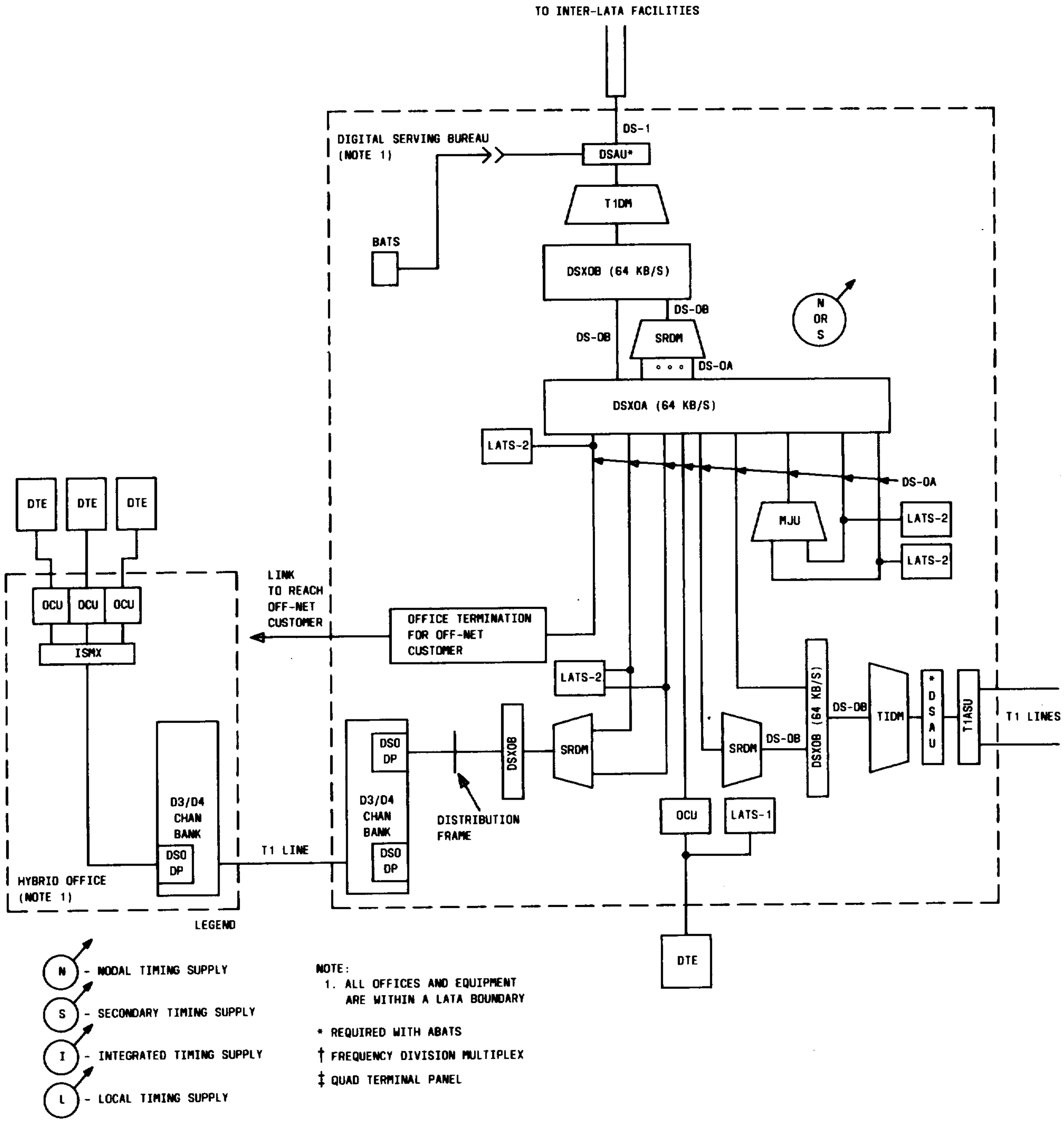
5.08 The transmitting section of the OCU formats data coming from the network into the basic data rate of the customer for transmission over the local loop. It processes the control codes coming from the hub office and going to the customer ♦DTE♦. The signal is level-controlled and shaped before being sent over the loop.

5.09 Included in the OCU shelf is a D-T (driver-terminator) circuit that provides DS-0A outputs. In some offices, subrate multiplexing is done by replacing the D-T circuit with an ISMX. The ISMX provides a single DS-0B output and splitting jack access to the individual signals.

5.10 The ISMX is available in a 5-channel and a 10-channel arrangement and will accept any subrate data stream. The 10-channel ISMX will accept up to ten 2.4-kb/s or 4.8-kb/s channels. The rates can be mixed. The 10-channel ISMX is protected by internal duplication and alarms.

Dataport Channel Units

5.11 There are two types of dataport channel units: the OCU and the DS0. The OCU DP terminates the local loop in a DDS dataport end office. It receives data at the customer data rate and provides a 64-kb/s signal. Specific changes to the common



▶Fig. 9—Example of DLSA Structure◀ (Sheet 1 of 2)

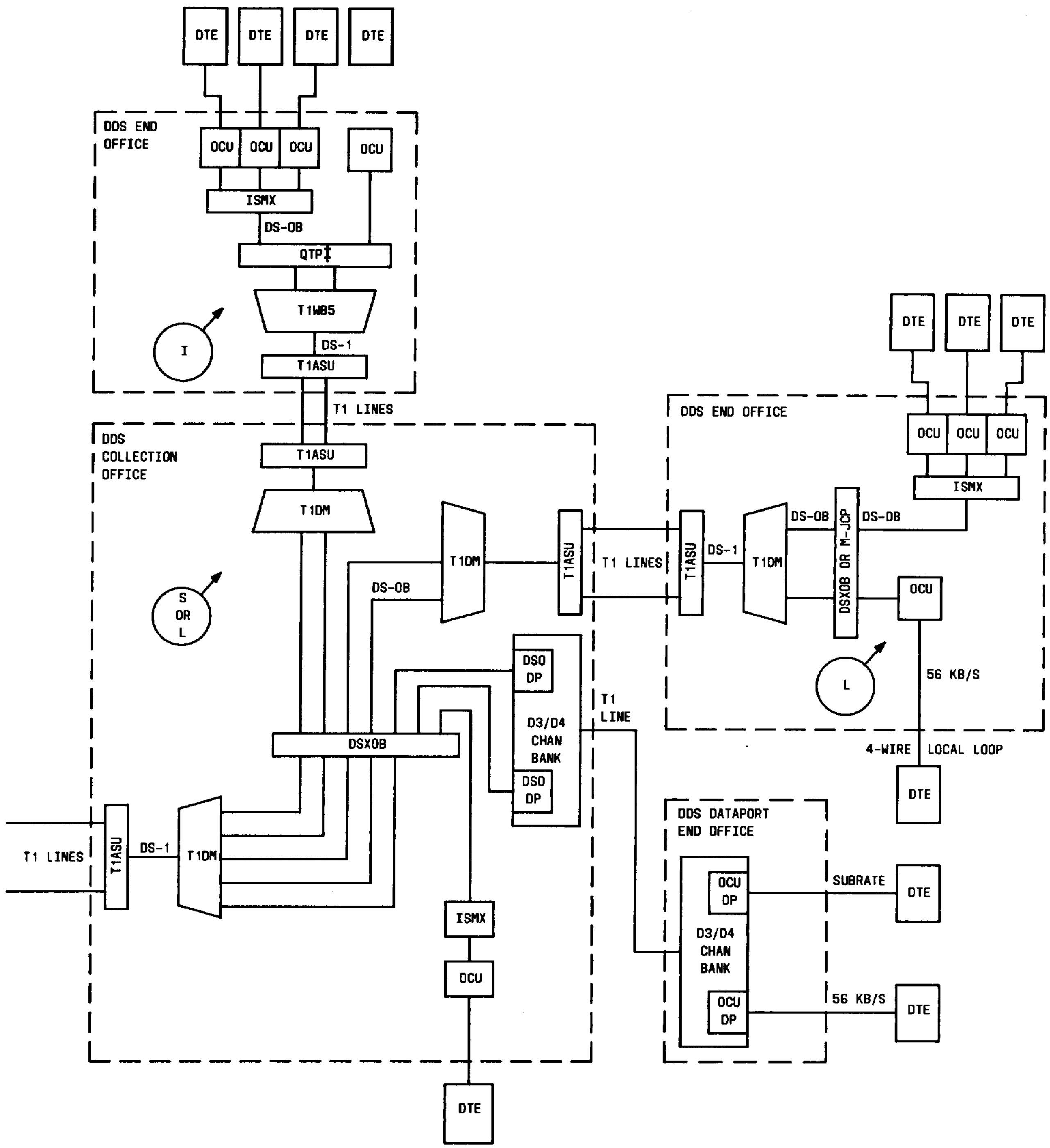


Fig. 9—Example of DLSA Structure (Sheet 2 of 2)

equipment and DDS timing are described fully in the following AT&T Practices:

- 365-150-107 — Dataport Operation Description, Application and Troubleshooting—D3B Channel Bank
- 365-170-120 — Dataport Channel Units—Channel Unit Description
- 363-202-400 — SLC® 96 Carrier System—Central Office Terminal—Pair Gain Systems
- 363-202-401 — SLC® 96 Carrier System—Remote Terminal—Pair Gain Systems.

Subrate Digital Multiplexer

5.12 The SRDM is a synchronous time division multiplexer, the output of which is a DS-0B signal efficiently packed with information for second stage multiplexing. The 2.4-kb/s SRDM can multiplex up to 20 channels; the 4.8-kb/s SRDM, up to 10 channels; and the 9.6-kb/s SRDM, up to 5 channels.

5.13 The SRDMs are byte oriented. Each DS-0A channel port is sequentially scanned and one byte is multiplexed onto the DS-0B signal. The SRDM inserts multiplex framing into the first bit of each byte. Each subrate has a different framing pattern.

5.14 At the same time as it multiplexes, the SRDM demultiplexes an incoming DS-0B signal into DS-0A signals. The framing bits inserted into the bytes by the SRDM at the far-end allow the demultiplexer to identify the byte of each channel.

5.15 The SPM (subrate performance monitor), located in the SRDM bay, can scan a maximum of 48 SRDM terminals and a spare about once every 1/2 second. The SPM determines the data rate and then tests for proper framing and data transmission in both directions. It passes on to the next terminal if all tests are normal. If a protection switch is needed, the SPM automatically provides the proper rate spare, lights an alphanumeric display to assist in troubleshooting, and actuates an office alarm.

5.16 ♦If secondary channel capability is present, the SRDM and ISMXs must be changed under some conditions. In the network-to-loop direction, both of them insert a zero in the first bit position of each data byte of each of the DS-0A signals which they produce. Since the user is allowed to transmit all-zeros data and simultaneously transmit a zero secondary channel bit, the result would be an 8-bit byte which is all zeros. If this signal is applied to a DS-0 to DS-1 multiplexer, the multiplexer will suppress the byte in order to enforce the T-carrier ones-density constraint. In order to avoid this, the following rule should be followed. The HL37 in the SRDM and HL8 and HL88 ISMXs should be changed to the HL37B, the HL8B (5-channel), and the HL88B (10-channel), respectively, whenever any one or more DS-0A signals are to be connected to other than an OCU or tandem subrate multiplexer.

DS-0 to DS-1 Multiplexers

5.17 All DS-0 to DS-1 multiplexers must be modified if any circuit using the secondary channel is routed through it. This includes T1DMs, T1WB4s, T1WB5s, and D-type channel banks equipped with DS-0 dataports. The changes in each case are required to modify the zero suppression algorithm. The various terminals currently suppress any byte whose last seven bits are set to zero. Since the customer is allowed to transmit all-zeros data in the primary channel and also zeros data in the secondary channel, the resultant byte could contain zeros in the last seven bit positions. In order to allow transmission of this byte, the terminal must be changed to suppress only bytes which contain eight zeros. It should be noted that an unmodified bay will work satisfactorily with a modified bay on an end-to-end basis as long as no circuits which carry secondary channel information are applied to the system.♦

T1DM

5.18 The T1DM multiplexes the DS-0 signals with a synchronization byte and a single framing bit into a DS-1 signal. It has 23 input ports, each of which can accept a DS-0A or DS-0B signal. To build a complete frame, the 23 data bytes are combined with a single "sync byte" and a single framing bit, which are used in combination to furnish synchronization information to the receiving T1DM.

5.19 The T1DM uses the 64-kHz office clock for sampling the DS-0 signals and the 8-kHz clock to locate the control bit in the byte. For the demultiplexer to present incoming data at the right time, the phase of the office clock and the incoming T1 digital frame must be uniquely related. The T1DM contains a variable 256-bit buffer, called the elastic store that aligns the incoming data stream with the office clock. Thus, the demultiplexer input (output of the elastic store) and the multiplexer output are in phase, since both have the same relation to the office clock.

5.20 A T1DM-PM (T1DM performance monitor) located in the bay can scan a maximum of 16 T1DMs, including a spare, as well as itself about once every 1/2 second. If the data flow is abnormal in any T1DM, the T1DM-PM automatically switches to the spare, lights an alphanumeric display to assist in troubleshooting, and actuates an office alarm.

T1WB4 and T1WB5

5.21 The T1WB4 permits the efficient use of a digital carrier by allowing data and PCM voice to be multiplexed together. A maximum of 12 data (DS-0) channels may be multiplexed into a DS-1 signal, and other services may occupy the remaining slots (total capacity of 24 channels). However, a T1WB4 can also operate alone. An unassigned channel code is sent over any unused channels. The DS-1 stream produced is in the regular 193-bit T1 format. Data bytes and voice bytes may appear in any preselected order.

5.22 The T1WB5, like the T1WB4, can multiplex data and other services together into a DS-1 signal. The T1WB5, however, is usually used to multiplex a maximum of 23 data channels into a 1.544-Mb/s stream.

5.23 A T1WB4 or T1WB5 can, with an extra circuit pack, generate a DS-1 bit stream that can be terminated in a T1DM. The circuit pack, called a byte framing generator, is inserted into the 24th channel and generates the same bit pattern as the T1DM. In this arrangement, the maximum number of data channels is 23 and voice sharing is not possible. This is the normal use of the T1WB5.

5.24 Like the T1DM, the T1WB4 and T1WB5 use a 64-kHz clock signal for sampling and an 8-kHz clock signal to identify the eighth bit of each byte. They also have elastic stores that enable the demultiplexer to present the data to the output when the 64- and 8-kHz clock signals dictate.

5.25 The T1WB4 and T1WB5 contain 1-for-1 automatic protection spares for common equipment circuits and an ACU (alarm control unit) that shows the status of these circuits and of all incoming and outgoing DS-1 signals. A failure in the common circuitry causes an automatic switch to spare common circuitry. In a data-voice mode, a failure in the incoming voice signal causes an automatic switch to an independent data mode of operation to maintain data service.

Cross-Connects and Panels

5.26 At end and intermediate offices, subrate data and 56-kb/s data connect to a panel. This panel serves as a test access point for portable test sets and a connecting point between the OCU and the first stage multiplexer. The panel may be an SM-JCP (subrate data multiplexer jack and connector panel), an M-JCP (multiplexer jack and connector panel), or a QTP (quad terminal panel). The last two panels are preferred because end offices use ISMXs to M-JCPs instead of SRDMs to SM-JCPs. An end or intermediate office using a T1DM (J70177A) bay may be connected to a QTP.

5.27 After first stage multiplexing (ISMX), 56-kb/s data and subrate data are connected to an M-JCP. The M-JCP provides test access to each multiplexer port and serves to connect the ISMX or OCU to the second stage multiplexer, or back-to-back channels between two second stage multiplexers, or both.

5.28 The M-JCP is used in end and intermediate office bay arrangements that contain T1DMs, T1WB5s, and T1WB4s. The QTP is the same panel used in the digital system cross-connect (DSX-0) for use in T1WB5 and T1DM bay arrangements.

5.29 In hub offices, the DSX-0A provides routing for subrate data signals to the appropriate SRDM and 56-kb/s data signals to the DSX-0B. The DSX-0B connects T1DM, T1WB5, and T1WB4 ports with SRDMs and connects ports for through or bypass circuits. Because of the universal 64-kb/s DS-0 signal, identical hardware can be used for the DSX-0A and the DSX-0B. However, any disturbance of the signals appearing at the DSX-0B can affect many customers, whereas the appearance at the DSX-0A is dedicated to only one customer. Dataport signals can come in mixed and appear at the DSX-0A.

5.30 The QTP, which is one panel of a DSX-0, provides routing of 64-kb/s DS-0B level signals to the ports of a T1WB5. The QTP allows for T1WB5 port selection but does not provide monitoring or test access.

5.31 When traveling from one office to another, the DS-1 signal leaves one office and enters the next office through a digital cross-connect for the DS-1 level (DSX-1 or equivalent). The DSX-1 serves as an interconnection point and provides monitoring and splitting test access to DS-1 channels.

Testing

5.32 ♦A hub office has DSX-1 access and test capability for customer circuits in a DLSA. The hub office test arrangement may be a KS-21899 data test system (also called bit access test system), or an ABATS with ALATS. The ABATS has DSX-1 access through the DSAUs (digital signal access units). The secondary circuit is tested using the same methods and procedures that are used for DDS circuits.

5.33 The ABATS has remote testing access from an SSC-D/CTC that is located away from a hub office. An SSC-D/CTC has testing responsibilities for more than one hub office.♦ The model 40 test terminal, minicomputer, and ABATS equipment at the hub office are interconnected by 1200-baud analog dedicated channels. A block diagram of this arrangement is shown in Fig. 10.

Timing Supplies

5.34 Each office in the DDS contains a timing supply to provide timing information (both byte and bit timing) to all other DDS equipment in the office. The NTS (nodal timing supply) is normally used in hub offices. The STS (secondary timing supply) may be used in hub, intermediate, or large end offices. Small end or chain offices use the ITS (integrated timing supply) associated with the T1WB4 or T1WB5. Other offices in the DDS contain the LTS (local timing supply) in T1DM bay arrangements.

5.35 The ED-73669-30 G1 composite clock cross-connect panel assembly provides the capability of cross-connecting a DDS clock to digital channel banks on an as-needed basis. A group of timing taps is cabled from the OTS (office timing supply) to this small cross-connect field assembly. Each channel bank bay is cabled to the ED-73669-30 assembly. In this way, entire bays can be prepared to receive timing, with those needing timing later to be cross-connected quickly to meet customer service intervals. This method is crucial when it is necessary to conserve timing taps. Such cases are: (a) when using an LTS with 42 taps or an ITS with 6 taps, (b) when there are many DDS bays which are using CP HL49 that requires two timing taps for each DDS bay, and (c) when there are large numbers of D3 and/or D4 bays.

5.36 The ED-73669-30 assembly is mounted in the D-bank area, such as a miscellaneous bay or at the top of the DSX-1 bay. The DSX-1 bay is electrically compatible and in an area where each jumper is handled with extra caution because each jumper carries multiple circuits. The ED-73669-30 assembly is capable of the same output as the DDS timing bay, plus 180 channel-bank bays. Also, it can be expanded to 180 more bays.

5.37 Timing to the channel banks uses one tap per 11-foot bay, not per bank or per digroup. Timing is multipled to all banks in the bay, so each tap appears at up to 7 digroups on D3 banks or 12 digroups on D4 banks. Nondataport banks in the bay have timing available but do not use it.

T1ASU (T1 Automatic Standby Unit)

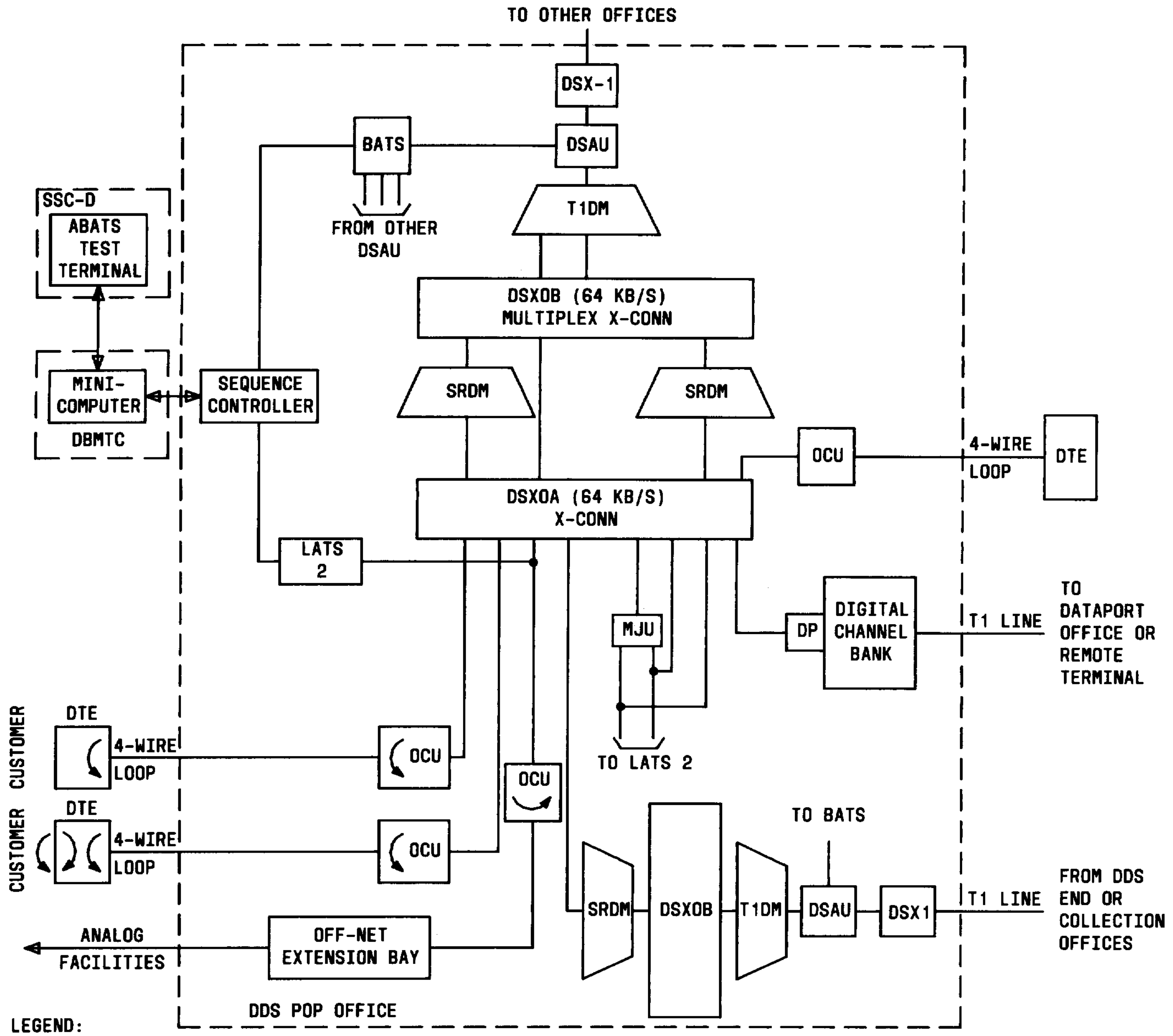
5.38 The T1ASU, using two separate detectors, monitors a T1 digital line for bipolar violations and for the absence of 16 or more consecutive bits. Continuous output from either or both of these detectors causes an automatic switch to a standby line in one second. The T1ASU continues to monitor the failed primary line and, if the line is found to be restored, service is returned manually.

MJU (Multipoint Junction Unit)

5.39 The MJU is employed in hub offices to establish a circuit between a control station (usually a computer) and two or more remote terminals, all operating at a uniform rate. The MJU adds multiparty duplex capability to the basic point-to-point duplex capability of the DDS. Multipoint service is discussed more fully in Part 8.

D. Long-Haul Equipment

5.40 The 1A-RDT (1A radio digital terminal) is typically used for long-haul transmission. Other approved facilities for ♦inter-LATA♦ usage in DDS are DOV and VIDAR 20 Mb/s. The DOV derives two DS-1 digital signal channels from the spectrum



LEGEND:

ABATS - AUTOMATED BIT ACCESS TEST SYSTEM
BATS - BIT ACCESS TEST SYSTEM MEASURES DIGITAL TRANSMISSION PARAMETERS TO AND FROM NEAR AND FAR CUSTOMER LOCATIONS
DSAU - DIGITAL SIGNAL LEVEL 1 ACCESS UNIT
DSX - DIGITAL SIGNAL LEVEL 1 CROSS CONNECT
DTE - DIGITAL TERMINAL EQUIPMENT
LATS 2 - LINE ACCESS TEST SYSTEM PROVIDES DSXOA (64KB/S) TEST ACCESS
MJU - MULTIPOINT JUNCTION UNIT
OCU - OFFICE CHANNEL UNIT
POP - POINT OF PRESENCE
SRDM - SUBRATE DATA MULTIPLEXER
T1DM - T1 DATA MULTIPLEXER
SSC-D - SPECIAL SERVICE CENTER - DIGITAL
DBMTC - DATA BASE MANAGER AND TEST CONTROLLER
COT - CENTRAL OFFICE TERMINAL OF "SLC"*-96 CARRIER SYSTEM
◄► 1200-BAUD ANALOG DEDICATED CHANNEL
(REMOTE LOOPBACK
) CUSTOMER LOOPBACK
* TRADEMARK OF AT&T TECHNOLOGIES

Fig. 10—Block Diagram of Hub Office Using ABATS

above group 6 (19.66 to 21.38 MHz) on L4 carrier. A VIDAR 20 Mb/s facility is provided over TD-2 radio using DM-12A terminals and provides 12 DS-1 signal channels.

5.41 Only the 1A-RDT is discussed here because it is the primary inter-LATA facility used for the DDS. In the direction toward the ♦inter-LATA♦ network, the 1A-RDT accepts DS-1 signals from a T1DM (through a DSX-1). The 1A-RDT reduces the DS-1 signal to a 0- to 500-kHz bandwidth and provides this modified signal to interface and combine equipment for transmission over a radio channel. In the opposite direction, the 1A-RDT reverses this operation and delivers the DS-1 signal to the T1DM receiver. The 1A-RDS (1A radio digital system) includes the 1A-RDT and the interface equipment required to insert the signal into the radio channel.

6. NETWORK SYNCHRONIZATION

6.01 A timing network is employed in the DDS to ensure that sampling at the DS-1 level and below takes place at the same frequency and phase throughout the network. If timing control is broken, data transmission that traverses the break may be subject to skipping or double reading of bytes. This occurrence, known as a "slip," may seriously impair data service. Inherent stability of the NTSs (nodal timing supplies), however, is such that timing control will generally be reestablished before slips can occur.

6.02 The timing control network is made up of the connections between a hierarchy of timing supplies that are all eventually slaved to a single MTS (master timing supply) through a tree-like network. No closed loops are allowed in the timing network (Fig. 11). The hierarchy of the timing supplies is, from the top down, MTS, NTS, STS (secondary timing supply), LTS (local timing supply), and T1WB4 or T1WB5. Timing supplies may be slaved to other timing supplies that are higher or equally positioned in the hierarchy, but never to another timing supply that is lower in the hierarchy.

6.03 All the timing supplies in the hierarchy are provided with redundant circuits. Therefore, if a circuit fails, the timing supply can continue to provide the proper timing signals.

6.04 The MTS is actually an NTS that is slaved to the ♦Master♦ reference supply at Hillsboro, Missouri. All other NTSs are slaved indirectly to this MTS. The NTS extracts the framing bits from one of two selected incoming DS-1 signals before it reaches any multiplexer. A phase-locked loop forces an internal oscillator to agree in frequency and phase with this input signal. The oscillator output is divided down to 8 kHz, from which the output of the NTS is formed. This output is a bipolar signal that contains both byte timing (8 kHz) and bit timing (64 kHz) in a single waveform (Fig. 12). This waveform is distributed to all other equipment bays in the office. Even if the input signal is lost, the internal oscillator is stable enough to supply useful timing information for at least 2 weeks without severe degradation of service.

6.05 The STS is made up of many of the same circuits as the NTS, but its internal oscillator is not as stable when its input signal is lost. Therefore, the STS can bridge outages of only 5 seconds maximum without slips. Network connections are made similarly to those in the NTS. Protection is provided by supplying redundant units for the main circuits.

6.06 The LTS is electrically and logically identical to the STS, but it provides other circuit functions not related to office timing. All offices that contain a T1DM must also have an LTS (or a timing supply higher in the timing hierarchy). The LTS is located in local offices that use T1DM and OCU bay arrangements.

6.07 The T1WB4 or T1WB5 has an integrated timing supply that can extract 1.544-MHz timing from the T1 digital line and derive the required 8- and 64-kHz signals from it. Therefore, a separate timing supply is not required in a T1WB4 or T1WB5 office, since all the equipment runs off the ITS. However, a T1WB4 or T1WB5 should receive timing from an LTS, STS, or NTS if one is available in the office.

6.08 Dataport channel units function as part of the DDS network and, hence, must be synchronized to the DDS timing hierarchy. External clocking from the office timing supply at a hub or intermediate office must be distributed to all banks in that bay that are intended for dataport applications. End offices are loop timed by an equipment option. The loop option is set at the data logic unit or office interface unit for D3 or D4 type channel banks and at the special services unit of the remote terminal for an SLC® 96 carrier system.

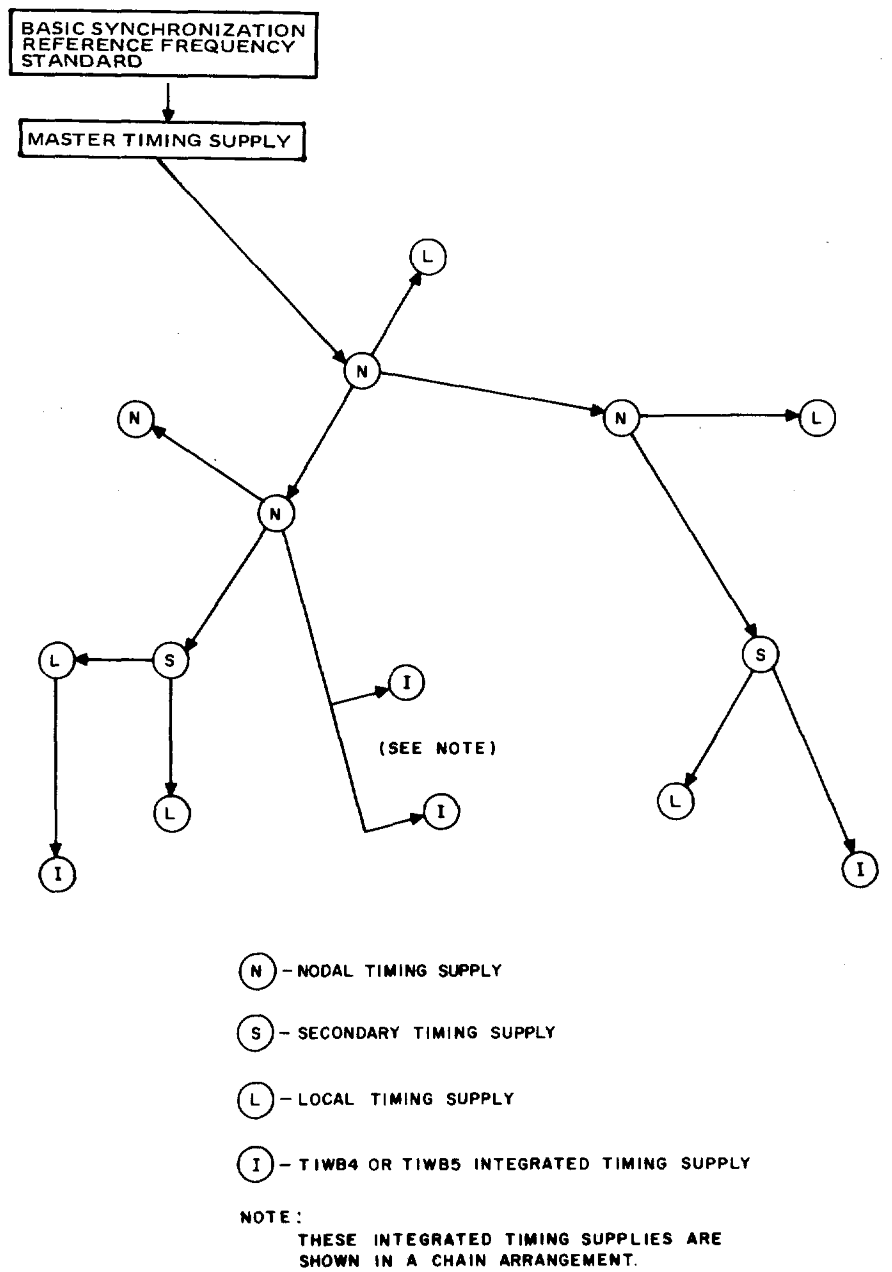


Fig. 11—Synchronous Timing Network

7. DDS BAY ARRANGEMENTS

A. Equipment Assemblies

7.01 Most DDS office equipment (multiplexers, OCUs, timing supplies, power distribution equipment, etc.) is supplied in prewired shelf assemblies. Plug-ins (circuit packs, power units, etc.) are inserted into the shelves. A diagram of a typical assembly with plug-ins is shown in Fig. 13.

B. Equipment Bays

7.02 The equipment assemblies are arranged in different subsystems and are available in two bay sizes of cable-duct framework—11 feet 6 inches

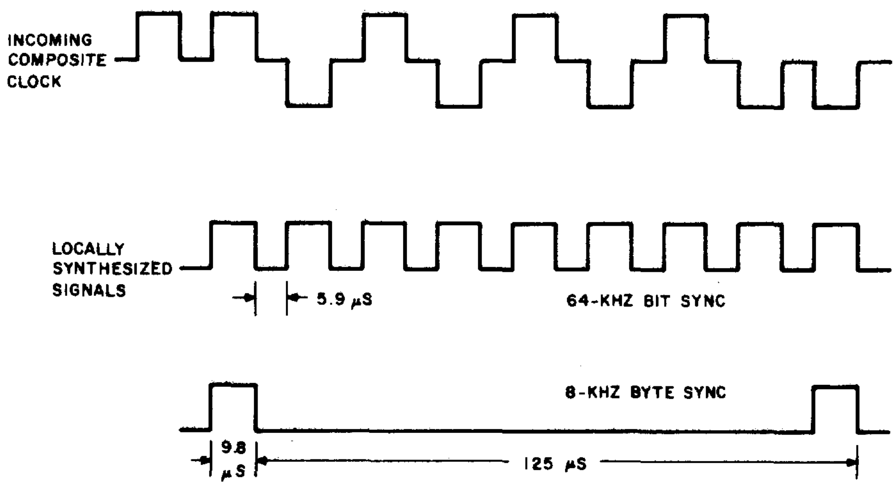
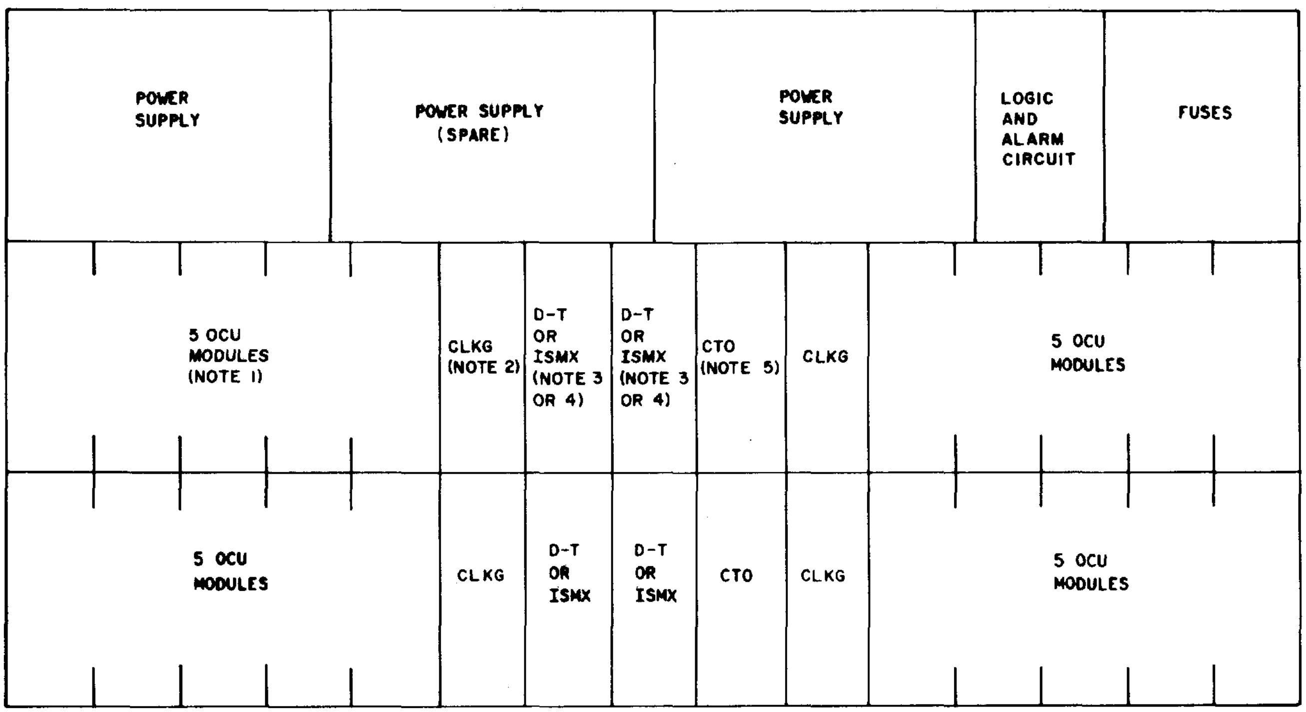


Fig. 12—Timing Waveforms



NOTES:
1. EACH GROUP OF FIVE OCU MODULES MUST BE THE SAME RATE
2. CLKG-2.4-KB/S, 4.8-/9.6-KB/S, OR 56-KB/S CLOCK GENERATOR
3. D-T - DRIVER-TERMINATOR
4. ISMX-5-CHANNEL INTEGRAL SUBRATE MULTIPLEXER
5. CTO-COMMON TIMING AND OSCILLATOR

Fig. 13—Typical DDS Equipment Assembly

and 7 feet. A subsystem may be supplied in a single 11-foot 6-inch frame or in a 7-foot, 1- or 2-bay arrangement, the latter using either two single-bay frames or a single double-bay frame. An exception to these bay arrangements is the 1A-RDT bay, which is also supplied in a 9-foot unit. A 1A-RDT bay contains only 1A-RDT equipment.

7.03 The NTS and the STS are housed in their own separate bays. The LTSs used in end offices are arranged in a prewired shelf assembly with two T1DM shelves. The LTS distributes timing directly to the equipment in its own single- or double-bay arrangement. Timing is distributed to all other office bays and to all hub office bays (from the NTS or the STS) through the BCPA (bay clock, power, and alarm) circuit. The BCPA circuit accepts the standard timing waveform from the office timing supply and then distributes the waveform to all equipment in its own single- or double-bay arrangement. The BCPA circuit also contains alarm indicators and the power distribution fusing for its own single- or double-bay arrangement.

7.04 The BCPA shelf is always located near eye level and is in the left-hand bay of a 2-bay arrangement. The spare T1DM is always located immediately below the T1DM-PM in any T1DM bay arrangement, and the SRDM spare and the SPM are always located in the fifth shelf of an SRDM bay.

D3 and D4 Channel Banks

7.05 The D3 subrate dataport channel units can only be plugged into positions 4, 5, 16, and 17 of a properly wired and equipped D3 channel bank. The 56 kb/s units can occupy only adjacent positions: 3 and 4, 4 and 5, 5 and 6, or 15 and 16, 16 and 17, 17 and 18. The D3 channel bank requires a common equipment plug-in called a DLU (data logic unit), which replaces the INTERFACE or 1-kHz CG (clock generator) and, where used, the reframe counter plug-ins. Interunit wiring between the units and DLU is done via small connectors at the front of the D3 channel bank. Dataport channel units may be plugged into any slot of a D4 channel bank. The D4 channel bank requires an OIU-2 (office interface unit-2) plug-in in place of the OIU plug-in.

SLC® 96 Carrier System

7.06 Dataport channel units may be used in an SLC® 96 carrier system. These units are the same OCU DP and DS0 DP channel units as that used for D4 channel banks (same list codes). The dataport function of providing local or external clocking is done by the SSU (special service unit). The number of DP channel units per shelf is limited, depending on the operating mode of the carrier system. A general description is documented in Practice 363-202-100.

7.07 The usual application of dataports in carrier systems is to extend the ♦DLSA♦ into the suburban and rural areas without adding cable pairs. A COT (central office terminal) is housed in an existing building and connects to an RT (remote terminal) that is located in a hut or building in the area to be served. The T-carrier lines connect the COT and RT. Both the COT and RT must be equipped with the SSU for dataport channel unit applications.

7.08 Synchronization for dataports in SLC® 96 carrier systems is similar in concept to a D-type channel bank operation. The COT is put into an external time mode by its SSU, with the clock being supplied from an office timing supply in that end office. The office timing supply is fed from an office higher in the DDS network. A DS0 DP in the COT passes and receives the digital signal with the error correction option used as needed. The COT sends data to and receives data from the RT using its T-carrier facilities.

7.09 The RT is loop-timed by its SSU and directly serves the customers by local cable pairs. The OCU DPs are mounted in the RT and provide all the subrates or the 56-kb/s rate. The RT may be referred to as a "mini" end office.

C. Equipment Addressing

7.10 A scheme of equipment addresses is used in the DDS to show the exact location of equipment in an office. The address of a given piece of equipment consists of as much of the addressing format as is required to distinguish it from other similar equipment. A position indicated by d in the addressing format is one of the following capital letters: F (front-mounted bay of a 2-sided bay), B (back-mounted bay of a 2-sided bay), L (left side of a double-bay frame), or R (right side of a double-bay frame).

7.11 All DDS bay arrangements are stamped with the appropriate bay and shelf location numbers at the time of installation. This stamping eliminates guesswork about shelf location, especially within partially equipped bays.

T1WB4 and T1WB5

7.12 Each shelf of a T1WB4 or T1WB5 assembly is addressed according to the addressing format ffll.bb.d.ss. For example, 1003.11.F.12 indicates floor 10, lineup 03, bay ll, front-mounted bay, bay shelf 12. For assignment purposes, the addressable shelves within these assemblies are those containing the channel circuit packs.

SRDM

7.13 The equipment address for the SRDM allows for the addressing of quarter- or half-shelves according to the addressing format ffll.bb.d.ss.pp. The pp can be any of the numbers listed in Table D. For example, 0102.08.F.03.11 indicates floor 01, lineup 02, bay 08, front-mounted bay, bay shelf 03, 4.8, or 9.6 SRDM in first quarter-shelf.

TABLE D

BAY SHELF POSITION NUMBER MEANING IN AN SRDM

PP NUMBER	MEANING
10	2.4 SRDM in left-half shelf
11	4.8 or 9.6 SRDM in first-quarter (leftmost) shelf
12	4.8 or 9.6 SRDM in second-quarter shelf
20	2.4 SRDM in right-half shelf
21	4.8 or 9.6 SRDM in third-quarter shelf
22	4.8 or 9.6 SRDM in fourth-quarter (rightmost) shelf

ISMX

7.14 The 5-channel ISMX uses the addressing format ffll.bb.d.ss.pp. The pp can be any of the numbers listed in Table E. For example, 1004.06.F.11.10 indicates floor 10, lineup 04, bay 06, front-mounted bay, bay shelf 11, left half-shelf. The 10-channel ISMX uses the addressing format ffll.bb.d.ss. For example, 0703.09.F.06 indicates floor 07, lineup 03, bay 09, front-mounted bay, bay shelf 06. The pp number is not used here since there is only one 10-channel ISMX for each OCU shelf.

TABLE E

BAY SHELF POSITION NUMBER MEANING IN AN ISMX

PP NUMBER	MEANING
10	5-channel ISMX in left-half OCU shelf
20	5-channel ISMX in right-half OCU shelf

OCU

7.15 The OCUs use the addressing format ffll.bb.d.ss.pp. The pp, which indicates the plug-in, can be any of the numbers listed in Table F. For example, 0115.17.F.14.21 indicates floor 01, lineup 15, bay 17, front-mounted bay, bay shelf 14, plug-in 1 in right half-shelf.

MJU

7.16 Individual MJUs, each consisting of one or two circuit packs, may be addressed according to the addressing format ffll.bb.d.ss.pp. The pp number can be 1 through 8, since there are eight MJUs for each shelf. For example, 0216.18.F.02.07 indicates floor 02, lineup 16, bay 18, front-mounted bay, bay shelf 02, MJU 07.

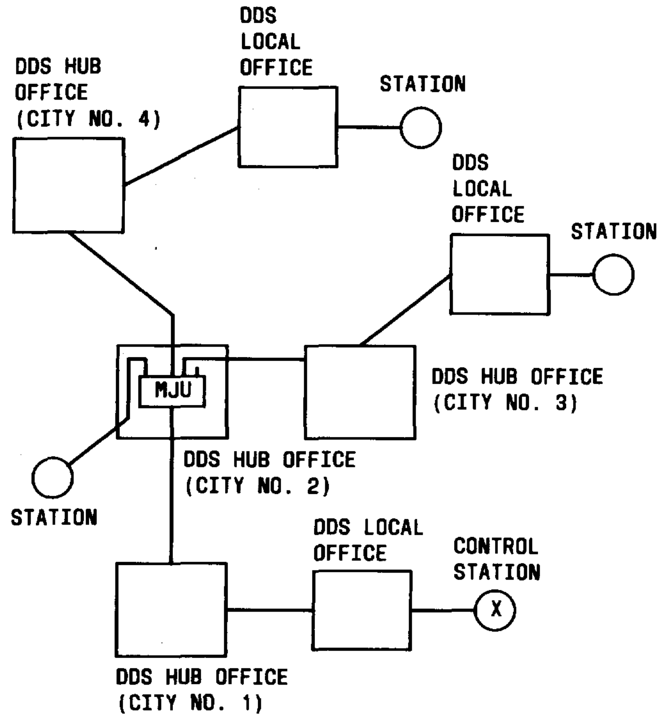
Full-Shelf Assemblies

7.17 Full-shelf assemblies, such as T1DMs, BCPA circuits, etc., are addressed according to the addressing format ffll.bb.d.ss, where ss indicates the bay shelf number.

TABLE F

BAY SHELF POSITION NUMBER MEANING IN AN DCU

ADDRESS	MEANING
11	Plug-in 1 in left-half shelf
12	Plug-in 2 in left-half shelf
13	Plug-in 3 in left-half shelf
14	Plug-in 4 in left-half shelf
15	Plug-in 5 in left-half shelf
21	Plug-in 1 in right-half shelf
22	Plug-in 2 in right-half shelf
23	Plug-in 3 in right-half shelf
24	Plug-in 4 in right-half shelf
25	Plug-in 5 in right-half shelf



♦Fig. 14—Station Multipoint Circuit♦

8. MULTIPOINT SERVICE

8.01 To set up a DDS multipoint circuit, an MJU is employed in hub offices to connect a control station with a maximum of four branches of the circuit (Fig. 14). In the direction away from the control station, the MJU merely splits the signal and sends it on to all the remote stations downstream from the MJU. The customer must provide coding to allow each remote station to pick out its own message. In the direction toward the control station, the MJU simply passes the messages from its branches on to the control station. When secondary channel service is provided, the primary and secondary channels are controlled independently. The customer must ensure that two messages are never sent toward the control station simultaneously, since the MJU will combine them and will probably cause them to be garbled. The MJU is independent of data rate because it receives and delivers uniform 64-kb/s signals.

8.02 A single MJU can combine a maximum of four branches into one signal. ♦Figure 15 shows more branches can be combined at a single hub office or at various hub offices by cascading the MJUs.♦

9. MAINTENANCE FEATURES

A. Automatic Monitoring and Protection Switching

9.01 Performance monitoring is used at various points in the DDS hierarchy to ensure that equipment is performing at or above its required performance level. To provide continuity of service, protection switching to spare equipment takes place when these thresholds of performance are not met. Some equipment, such as certain T1 lines and the T1WB4 and T1WB5 common equipment, is protected on a 1-for-1 basis by automatic monitoring and switching. The T1DM is protected on a 1-for-11 or fewer basis (1-for-16 for a double 7-foot bay), and the SRDM on a 1-for-48 or fewer basis. Both are protected with automatic monitoring and switching. The multiplexing equipment is monitored only for its own errors, independent of transmission errors. The 1A-RDT has automatic internal monitoring, but switching must be done manually. The 1A-RDT is manually protected on a 1-for-8 basis.

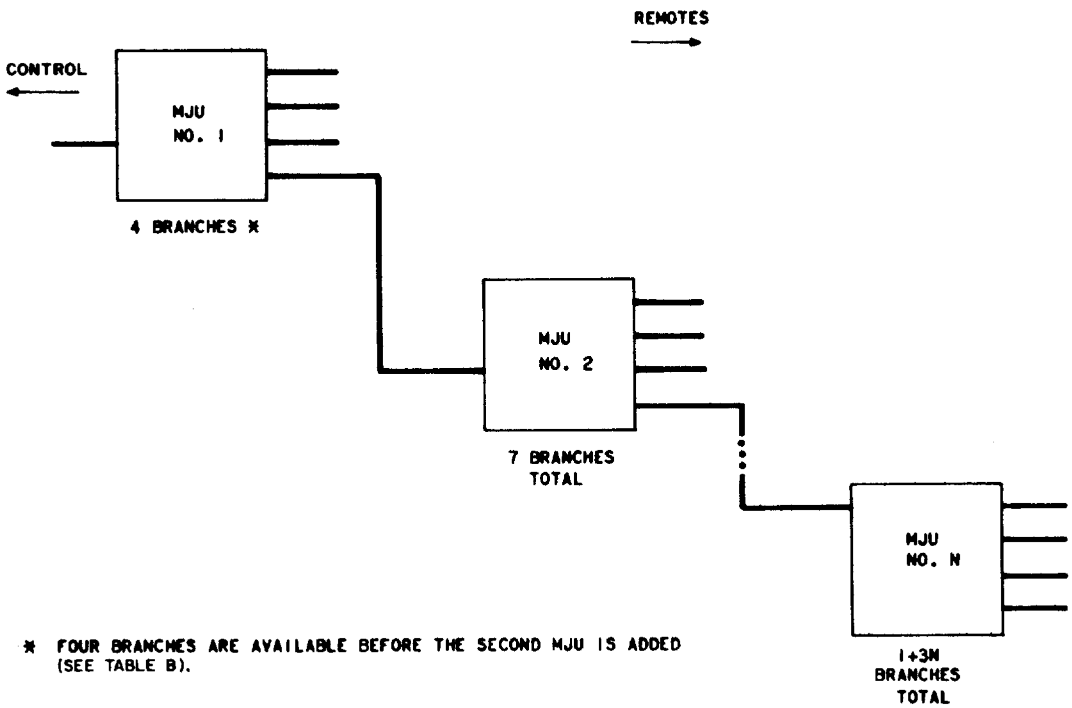


Fig. 15—Cascading of MJUs

B. Alarm and Status Indications

9.02 Transmission terminals and multiplexing equipment provide alarm indications at the offices in which they are located. These alarms may be telemetered to an ♦SSC-D♦ or to another appropriate maintenance center. Failures that occur in the local loop, OCU, DP, or 5-channel ISMX (other than OCU-ISMX power failures), are not reported by alarms.

C. Status Bytes

9.03 Certain status bytes are generated by various equipment in the DDS to notify other sections in the system of the network status. These bytes are generated to show an idle customer channel, test conditions, a second stage multiplexer out of synchronization, or an unassigned second stage multiplexer channel.

D. Loopback Tests

9.04 The loopback tests are initiated by different loopback commands. They can be generated by using test sets that are portable or automatically by ABATS. The purpose of the loopback tests is to isolate trouble in the network.

E. Test Access

9.05 In the hub office, the BATS (KS-21899 data test system) or ABATS/ALATS provides centralized test access for the DDS. In addition to direct test access, bridging bipolar access points at the 64-kb/s level for portable test equipment is provided with the terminal equipment (e.g., OCU, MJU, and DDGT) and multiplexing equipment (e.g., T1DM and SRDM). The DSX-1 provides monitoring and splitting (transmit and receive) test access to DS-1 channels used in the DDS.

9.06 Test access at the local office level uses portable test equipment only. The jack and connector panels provide splitting and monitoring access at the 64-kb/s level. Bridging access at the terminal equipment (e.g., OCU, etc.) and multiplexing equipment (e.g., T1DM, ISMX, etc.) is also available. The ISMX provides splitting and bridging access to individual circuits at the logic level, and the DSX-1 provides monitoring and splitting test access to DS-1 channels.

F. DDS DS-0 Loop Codes

9.07 As a result of the development of DACS/SRDC (digital access and cross-connect system/subrate digital capability), latching loopbacks, second generation MJUs, and DDS related CSDC (circuit switched digital capability) equipment, several new control sequences have been defined to serve various DDS network maintenance and testing functions. Table G gives the DDS DS-0 loop control codes.

9.08 The loop codes given in Table G are a result of the DS-0 code mapping in the network-to-loop direction by an OCU operating in the non-secondary channel mode. The loop codes have the format B1 D2 D3 D4 X0V, where B1 is identical to B1 of the originating DS-0 byte and is only present for 56 kb/s service and X0V follows the standard DDS bipolar violation sequence. For each of these control codes B1=0, where Ø is the do not care symbol, and B8=Ø. When certain loop patterns (e.g., B1 001001 B8) are presented to an OCU operating in the non-secondary channel mode, various control codes can appear in the DDS network. These control codes should not be used for future applications. The loop patterns include the following:

- Ø001X0V
- Ø011X0V
- Ø101X0V
- Ø100X0V.

9.09 The loop patterns can result from loop errors, or appear during a channel loopback of the corresponding network control codes that are mapped into those patterns by the OCU. These control codes and the loop patterns are given in Table G.

9.10 Table H gives the DDS DS-0 loop data mode codes. For the data mode codes, B1=Ø, which is the do not care symbol, and B8=1.

G. ➧DTSS

9.11 This system monitors the performance of DS-1 facilities between DLSAs. The DTSS monitors, transmits, centrally processes, and retrieves performance data from a remote location. This is done on a digroup basis to identify troubles in each direction of transmission. The performance data is gathered and stored by an SU (surveillance unit). The SU transmits the information to a central minicomputer on a poll from the minicomputer. The polled information becomes a data base for the generation of DTSS reports, which are categorized into real-time and administrative reports. These reports will aid in the maintenance and isolation of trouble for the DDS. A general description of DTSS is given in Practice 314-984-100; the administration procedures, in Practice 314-984-101; the circuit pack installation and test procedures, in Practice 314-984-200; and the overall system maintenance requirements and test procedures, in Practice 314-984-500.➧

10. REFERENCES

10.01 Tables I, J, and K give a comprehensive list of references providing more detailed information. References for customer stations and local loops are given in Table I; for office equipment, including the type of office in which the equipment can be found, in Table J; and for transmission, in Table K. The letter(s) in parentheses following the practice number describe the content of the practice as follows:

(D)	Description
(M)	Maintenance
(T)	Test
(I)	Installation
(C)	Connection
(O)	Ordering (summarizing specification)
(CV)	Conversion
(ID)	Identification
(OPR)	Operation
(TOP)	Task Oriented Practice.

♦TABLE G♦ (NOTE 1 AND 2)

DDS NETWORK CONTROL CODES

DS0 (LOOP) CONTROL CODES								
B2-B4	B5-B7							
	000	001	011	010	110	111	101	100
000	ZS				*		BLOCK	*
001		† Ø001X0V		*	TEST ←	ASC ←	OOS (B1 001X0V)	UMC →
011		† Ø011X0V			←		TIP (T1DM FRAMING PATTERN) (B1 011X0V)	→
010					DTE LB (B1 010X0V)		OCU LB (B1 010X0V)	CHAN LB (B1 010100)
110	*	*			TA		* (B1 110X0V)	
111		MA			←	CMI ←	(B1 111X0V)	RLS →
101			LBE				FEV (B1 101X0V)	
100		† Ø100X0V		*			* (B1 100X0V)	

Notes:

1. The following are control code definitions:

   ASC — abnormal station code
   CMI — control mode idle
   DTE — digital terminal equipment
   FEV — far-end voice
   LB — loop back
   LBE — loop-back enable
   MA — MJU alert
   OCU — office channel unit
   OOS — out-of-sync
   RLS — release
   TA — test alert
   TIP — transition in progress
   UMC — unassigned multiplexer channel
   ZS — zero suppression

2. The DS0 codes are 8-bit network bytes with format: B1 B2 B3 B4 B5 B6 B7 B8; where B1=Ø (do not care symbol) and B8=0. The X0V pattern follows the standard DDS bipolar violation sequence.

* This code is associated with CSDC and should not be used for future DDS applications.

† This code (Ex: Ø001X0V) appears in the DDS network when this loop pattern (Ex: B1 001001B8) is presented to an OCU operating in the non-secondary channel mode.

▶TABLE H◀ (NOTES 1 AND 2)

DDS DATA MODE CODES

DS-0 (LOOP) DATA MODE CODES

B2-B4	B5-B7							
	000	001	011	010	110	111	101	100
000	ZS (B1 000X0V)			LSC (DS0 DP)				
001		MAP 0 (B1 = 1)						
011	LSC (CSU)							
010					BR3	BR4	BR2	BR1
110					MAP 1 (B1 = 0)			
111	LSC (Spare)		LSC (Spare)			DMI		
101	LBID			LSC (OCU)				
100	LSC (Spare)		LSC (LSI)					

Notes:

1. The following are data code definitions:
   BR(x) — branch(x)
   DMI — data mode idle
   LBID — loop-back identification
   LSC — loop-back select code
   LSI — loop side interface (HL222)
   OCU — office channel unit
   ZS — zero suppression

2. The DS-0 codes are 8-bit network bytes with format: B1 B2 B3 B4 B5 B6 B7 B8, where B1=(Ø) (do not care symbol) and B8=1. The X0V pattern follows the standard DDS bipolar violation sequence.

11. GLOSSARY

ABATS: The Automated Bit Access Test System is used for remote digital testing of DATAPHONE Digital Service.

BATS: The Bit Access Test System is also referred to as a KS-21899 data test system. The BATS consists of the equipment mounted in a hub office that can be manually or remotely (ABATS) operated.

BCPA Shelf: Bay Clock, Power, and Alarm shelf. A DDS equipment shelf used with the timing source for providing power and timing to equipment within the bays and for accommodating alarms from that equipment.

TABLE I

REFERENCES FOR CUSTOMER STATION ARRANGEMENTS AND LOCAL LOOPS

EQUIPMENT	SECTIONS
550A-type CSU	595-100-100 (D) 595-100-200 (I) 595-100-300 (M) 595-100-500 (T) 595-100-180 (O)
500A-type DSU	595-200-100 (D) 595-200-200 (I) 595-200-300 (M) 595-200-500 (T) 595-200-180 (O)
56-kb/s regenerative repeater (office mounted)	314-920-100 (D) 314-920-300 (M) 314-920-500 (T)
56-kb/s regenerative repeater (outside mounted)	640-251-106 (D) (I) 640-251-107 (T) (M)

BPNRZ: Bipolar Nonreturn-to-Zero. A 3-level code in which alternate ones change sign (for example, 1011 becomes +1, 0, −0, +1) and in which transitions between adjacent ones do not pause at the zero voltage level (Fig. 3B).

BPRZ: Bipolar Return-to-Zero. Same as BPNRZ except that transitions between adjacent ones pause at the zero voltage level (Fig. 3A).

BPV: Bipolar Violation. A violation of the alternating +1, −1 pattern in a 3-level code.

Byte: In the DDS, byte refers to a group of eight consecutive binary digits associated with a single customer.

Byte Stuffing: In the DDS, the technique by which the bit rate of a digital stream is increased by repeating bytes and transmitting them at a faster rate. The information content of the stream is not increased.

Chain: An arrangement using T1WB4s or T1WB5s, or both, to allow a small local end office and no more than two chain offices to share a single T1 facility.

Chain Office: An office having a T1WB4 or T1WB5 that is operated in the chained data mode.

Collection Office: An office in the DDS that serves as a channel concentration point from more than one other office. It has the equipment configuration of a hub office but does not do the hub functions. All data channels appearing at a collection office are routed to a hub office for testing and cross-connection.

Control Signals: A signal transmitted from the master station to reset the DSS (data station selector), step the DSS to the next port, or execute a DSS control function.

CP: Circuit Pack. A unit that contains part of the DDS circuitry and that can be inserted into equipment shelves where required.

Cross-Connect: A piece of hardware used to interconnect line terminating equipment, multiplexers, and other equipment. Access to signals is often available through jacks associated with a testboard located near the cross-connect.

DBM and TC: Data Base Manager and Test Controller. A central location containing minicomputers with associated equipment. The minicomputers are designated as data base manager and test controller.

DDGT: Digital Data Group Terminal. A terminal providing the electrical interface between a DDS channel at the DS-0 level and a duplex analog group band transmission facility. The test controller minicomputer has a complete backup system for continuous on-line operation.

DDS: Digital Data System. ➧The abbreviation DDS cannot be used to represent DATAPHONE® Digital Service.➧

➧**DLSA:** Digital LATA Serving Area is a geographic area covering all DATAPHONE® Digital Service customer stations as defined in the Federal Communications Commission Tariff.➧

DOV: Data Over Voice is a technique used on digital facilities that derives two 1.544-Mb/s digital channels from the spectrum above mastergroup 6 (19.66 to 21.38 MHz) in L4 carrier systems.

DP: Dataport. A family of special channel units that are required for the D3 and D4 channel banks when

TABLE J

REFERENCES FOR GENERAL OFFICE EQUIPMENT

EQUIPMENT	TYPE OF OFFICE				SECTIONS
	END	INTERMEDIATE	COLLECTION	HUB	
OCU	X	X	X	X	314-910-100 (D) 314-910-300 (M) 314-910-500 (T)
ISMX	X	X	X		
DSAU				X	314-960-100 (D) 314-960-300 (M)
5V power supply shelf	X	X	X	X	314-970-101 (D)
M-JCP and SM-JCP	X*				314-970-100 (D)
QTP	X†				314-914-100 (D) 314-914-300 (M) 314-914-400 (C)
DSX-0	X	X	X	X	
SRDM			X	X	314-911-100 (D) 314-911-300 (M) 314-911-501 (T) 314-911-502 (T)
SPM			X	X	314-983-110 (D) 314-983-310 (M) 314-983-510 (T)
T1DM	X	X	X	X	314-912-100 (D) 314-912-300 (M) 314-912-500 (T)
T1DM-PM	X	X	X	X	314-983-100 (D) 314-983-300 (M) 314-983-500 (T)
T1WB4	X			X	314-915-100 (D) 314-915-300 (M) 314-915-501 (T)
T1WB5	X		X		314-915-110 (D) 314-915-310 (M) 314-915-510 (T)
T1ASU	X	X	X	X	365-200-104 (D) 365-200-204 (I) 365-200-504 (T)
DSX-1	X	X	X	X	365-301-101 (D)

See footnote explanations at end of table.

TABLE J (Contd)

REFERENCES FOR GENERAL OFFICE EQUIPMENT

EQUIPMENT	TYPE OF OFFICE				SECTIONS
	END	INTERMEDIATE	COLLECTION	HUB	
LTS	X	X	X		314-913-120 (D) 314-913-320 (M) 314-913-520 (T)
BCPA circuit	X	X	X	X	314-916-100 (D) 314-916-300 (M) 314-916-500 (T)
KS-20908 (receiver)	X	X	X	X	107-601-100 (D)
KS-20908 (transmitter)	X	X	X	X	107-600-100 (D)
NTS				X	314-913-110 (D) 314-913-310 (M) 314-913-510 (T)
STS		X	X	X	314-913-115 (D) 314-913-215 (CV) 314-913-315 (M) 314-913-515 (T)
KS-21899 DTS				X	107-605-100 (D) 107-605-200 (I) 107-605-300 (OPR) 107-605-500 (M)
DDGT	X‡			X	314-918-100 (D) 314-918-300 (M)
MJU				X	314-917-100 (D) 314-917-300 (M) 314-917-500 (T)
Off-Net extension (subrate)				X	314-919-100 (D) 314-919-200 (I) 314-919-300 (M) 314-919-500 (T)
831A data auxiliary set				X	598-083-101 (ID)

See footnote explanations at end of table.

TABLE J (Contd)

REFERENCES FOR GENERAL OFFICE EQUIPMENT

EQUIPMENT	TYPE OF OFFICE				SECTIONS
	END	INTERMEDIATE	COLLECTION	HUB	
Dataport channel unit					
D3B channel bank	X	X	X	X	365-150-107 (D)
D4B channel bank	X	X	X	X	365-170-120 (D)
Central office terminal §	X	X	X	X	363-202-400 (TOP)
Remote terminal §	X	X	X	X	363-202-401 (TOP)

* Not used in T1WB5 bay and newer T1DM bay

† Used in T1WB5 bay and T1DM bay

‡ Used in non-DDS end (hub) office

§ Part of SLC® 96 subscriber loop carrier system

used in the provision of DATAPHONE® Digital Service.

DSAU: A DS-1 Signal Access Unit that provides 1.544-Mb/s access for the ABATS.

DS-CS: Digital Signal at the Customer Service Level. A modified BPRZ signal at a customer data rate (2.4, 4.8, 9.6, or 56 kb/s). The bipolar format is modified by the inclusion of bipolar violations for network control.

DS-0: Digital Signal at the 0 level. A BPNRZ signal at the 64-kb/s rate.

DS-0A: A DS-0 signal that carries data for only one customer. For subrates, customer data is byte stuffed as necessary to obtain the DS-0 signal level.

DS-0B: A DS-0 signal identical to a DS-0A signal when carrying 56-kb/s customer data, but capable of carrying data from several subrate customers. For subrates, successive bytes carry data for different customers so that each customer-generated bit appears only once in the DS-0B signal. The DS-0B data signals appear at the DSX-0B.

DS0 DP: Digital Signal at 0 level dataport channel unit. A plug-in circuit pack that is used to recover a DS-0 signal for further connections. The input and output signals of the DS0 DP are at the 64-kb/s rate.

DS-1: Digital Signal at the first level is a BPRZ signal at the 1.544-Mb/s rate.

DS-2: Digital Signal at the second level is a BPRZ signal at the 6.312-Mb/s rate.

DSX-0: A Digital Cross-Connect used to interconnect equipment at the DS-0 level.

DSX-0A: The Digital Cross-Connect where individual customer circuits are cross-connected.

DSX-0B: The Digital Cross-Connect used to connect submultiplexed circuits to T1WB4/B5 ports and to connect T1DM and/or T1WB4/B5 ports together for through or bypass circuits.

DSX-1: A Digital Cross-Connect used to interconnect lines and equipment, to provide patch capability, and to provide test access at the DS-1 level.

D-T: Driver Terminator. A circuit pack used in an OCU shelf when individual OCU outputs are required from the shelf.

TABLE K REFERENCES FOR TRANSMISSION	
SUBJECT	**SECTIONS**
Customer loop	314-410-310 (M) 314-410-510 (T)
DS-0 facility	314-902-200 (I)
DS-1 to DS-1	314-903-300 (M)
DS-1 facility	314-903-200 (I)
Hub identification code plan	314-901-011 (D)
Point-to-point and multipoint circuits	314-901-200 (I)
Overall DDS	314-900-100 (D) 314-900-300 (M)
2-point and multipoint	314-901-300 (M) 314-901-500 (T)
T1 line qualification	365-228-500 (T)
1A-RDT	356-454-010 (D) 356-454-020 (M) 356-454-1ZZ (D) 356-454-3ZZ (OPR) 356-454-5ZZ (T)

➧**DTE:** Digital Terminating Equipment is equipment located on customer premises and is required to terminate the loop and provide interface leads.➧

Duplex: A communications mode in which transmission can occur in both directions simultaneously (sometimes referred to as full duplex).

End Office: A local office that passes on toward the hub office only those circuits that entered the office over local loops or dataport.

Frame: Twenty-four bytes plus one framing bit (193 bits) on a T1 line.

Hub Office: The main LEC (local exchange company) within a LATA. The hub office provides multiplexing, demultiplexing, and test access.

Idle Code: A bipolar violation sequence transmitted by the ➧DTE➧ to show that no data is being sent over the line by the customer.

Intermediate Office: ➧In a DLSA, a local office that passes on toward the hub office circuits that entered it from one end office in addition to those that entered it over local loops.➧

ISMX: Integral Subrate Multiplexer.

JCP: Jack and Connector Panel. A unit used in a local office to connect the various pieces of equipment and to provide test access for portable test sets (see M-JCP and SM-JCP).

➧**LATA:** Local Access and Transport Area.➧

Local Loop: That portion of an individual customer channel between the station and its associated OCU dataport channel unit.

Local Office: A DDS office concentrating on-net customer circuits into T1 streams for transmission to a hub office.

Long Haul (inter-LATA): Transmission distances typically beyond 50 miles, using the 1A-RDS, DOV, VIDAR 20 Mb/s, or other digital transmission systems.

Loopback: A testing procedure causing a received signal to be returned to its source.

LTS: Local Timing Supply. A common timing source for a DDS local office. In the absence of input timing information, this unit has the same stability as the STS.

Metro Office: A hub office at the lowest of three levels in the long-haul routing hierarchy. Also referred to as a class 3 office.

M-JCP: Multiplexer Jack and Connector Panel. A jack and connector panel that gives access to the DS-0B level ports of a T1DM, T1WB4, or T1WB5.

MJU: Multipoint Junction Unit is a unit employed at a hub office to link together three or more segments of a multipoint circuit.

MTS: Master Timing Supply. A modified NTS that receives input timing information from the ➧Master➧

Reference Frequency Standard and provides this timing information to the rest of the DDS.

Multipoint: ♦A customer circuit with three or more end points.♦

NTS: Nodal Timing Supply. A common timing source for a DDS office. This unit is highly stable in the absence of input timing information.

OCU: ♦An Office Channel Unit is used to terminate the local loop and provide remote loopback features.♦

OCU DP: Office Channel Unit Dataport. A plug-in circuit pack that terminates the customer loop for data speeds of 2.4, 4.8, 9.6, and 56 kb/s. The OCU DP output is put into a 64-kb/s time slot directly on the T-carrier system.

Off-Net: ♦An analog location not filed for DATAPHONE® Digital Service.♦

On-Net: ♦An analog location filed for DATAPHONE® Digital Service.♦

PCM: Pulse Code Modulation. The process in which analog signals are sampled, quantized, and coded into a digital bit stream.

QTP: Quad Terminal Panel is a panel of a DSX-0 providing routing of 64-kb/s DS-0B level signals to the ports of a T1WB5.

♦**Regional Hub Office:** A hub office at the highest of three levels in the long-haul routing hierarchy. Also referred to as a class 1 office.♦

♦**Sectional Hub Office:** A hub office at the second of three levels in the long-haul routing hierarchy. Also referred to as a class 2 office.♦

Short Haul (Intra-LATA): Transmission distances typically less than 50 miles.

Skinny Hub Office: A hub office that was originally intended to have testing capability that was never instituted. It functions like an intermediate office.

Slip: A defect in timing that causes a single bit or a sequence of bits to be skipped or read twice.

SM-JCP: Submultiplexer Jack and Connector Panel. A jack and connector panel that gives access to DS-0A level signals in a local office.

SRDM: Subrate Data Multiplexer.

STS: Secondary Timing Supply. A common timing source for a DDS office. This unit may be used in hub offices and large local offices.

Subrate: In the DDS, the 2.4-, 4.8-, and 9.6-kb/s customer data rates.

TDM: Time Division Multiplexing. The process of combining several lower rate digital signals into a higher rate signal by sampling each one in order.

Testing Area: A geographic area including all DDS customer stations that home on a single hub office.

T1 Digital Line: A digital transmission line used for short-haul work that carries data at the DS-1 (1.544-Mb/s) rate.

T1ASU: T1 Automatic Standby Unit. A unit that monitors a regular T1 line and its standby T1 line. It automatically switches to the standby, based on the bipolar violation rate of the regular line.

T1WB4: T1WB4 data-voice multiplexer. A piece of equipment capable of time division multiplexing a maximum of 12 DS-0B data channels with PCM-encoded voice channels from a voice channel bank into a DS-1 stream.

T1WB5: T1WB5 data-voice multiplexer. A piece of equipment capable of time division multiplexing a maximum of 23 DS-0B data channels with a T1DM at the hub office.

VIDAR 20 Mb/s: A long-haul transmission system that provides 12 DS-1 channels over TD-2 radio using DM1-2 terminals.

1A-RDS: The 1A Radio Digital System. A system that provides for the transmission of one DS-1 signal over a microwave radio link.

1A-RDT: The 1A Radio Digital Terminal. This is part of the 1A-RDS that converts the DS-1 signal into a signal suitable for transmission over radio.