

# **Bellcore**

Ⓐ Bell Communications Research

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## DS3 HIGH-CAPACITY DIGITAL SERVICE OVERALL DESCRIPTION

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## DS3 HIGH-CAPACITY DIGITAL SERVICE

### OVERALL DESCRIPTION

#### 1. GENERAL

1.01 This practice, intended for general use by Operations and Engineering personnel, provides an overall description of DS3 high-capacity digital service. A general knowledge of digital transmission systems such as fiber and digital radio is helpful in using this section.

1.02 When this practice is reissued, reasons for the reissue will be given here.

1.03 The DS3 high-capacity digital service provides point-to-point, full-duplex transmission of serial isochronous pulses at a rate of 44.736 Mb/s. The circuit providing this service terminates at the customer location in a network interface (NI). It is then connected to customer-premises equipment (CPE).

1.04 Related practices for design, installation, and maintenance of these services are as follows:

Maintenance and Test Procedures - BR 314-647-500  
Engineering Considerations - BR 880-612-100

#### 2. INTRODUCTION

2.01 The basic DS3 digital service allows the customer to transmit data, voice, or compressed video. The service is provided over digital facility sections that extend to the customer location and terminate in a digital network interface.

2.02 **DS3 Signal Format.** A standard DS3 signal containing modified-bipolar, 50 percent duty cycle, return-to-zero pulses is used for transmission into and out of digital multiplexers. An example of this format is shown in Figure 1. The signal format is a sequence of digital 1s and 0s. The 0s of the sequence are at the zero-voltage level, while the 1s are alternately positive and negative with respect to the zero level. The fundamental advantage of this transmission code is that the average dc energy in the bipolar pulse train is zero, thus permitting customer terminals and network multiplexers to be transformer-coupled.

2.03 **DS3 Line Code.** The line code for a standard DS3 signal is Bipolar with 3-Zero Substitution (B3ZS). In the B3ZS format, each block of three consecutive zeroes is replaced by one of two predetermined sets of code containing Bipolar Violations (BPVs).

2.04 **Additional Features.** Additional service functions are available, at the option of the customer. The central office (CO) multiplexing option, when used in conjunction with compatible customer-provided multiplexing equipment at the customer's premises, provides for 28 DS1 connections at the CO. This option is most popular with Interexchange Carriers (ICs), but is sometimes provided to general customers as well. Figure 2 shows a DS3 IC access service, channelized with a multiplexer at a "hub" central office, with individual DS1 channels being extended to a customer's premises via an interoffice carrier system. Figure 3 shows a DS3-to-DS3 digital cross-connection system (DCS) being used for the same purpose. In both cases, the DS3 service begins at the IC terminal and ends at the hub office.

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**2.05** To emphasize that access DS1 services may be carried as individual channels of a DS3 or other high-level digital service, Figure 4 shows a DS1 service carried as one of the 28 channels of a DS3. The DS1 service begins at the IC terminal on the left, extends through the hub and the local COs, and ends at the customer premises.

**2.06** A typical name for this general offering is High Capacity Digital Service (HCDS). However, individual exchange carriers have their own names for this offering. The trade press widely refers to these channels as "T-3" service, even though there is no "T-3" span line as such.

**2.07 Applications.** Customer applications for this channel include provision of groups of tie trunks between digital PBXs, usage as a backbone facility for on-premises data multiplexers, use for groups of off-premises PBX stations, interconnection of local-area data networks (LANs), digital broadcast-quality television, video teleconferencing, and other high-capacity/high-speed applications. Figure 5 shows an unchanneled DS3 service of the type widely used in these networks for local access to an IC terminal.

**2.08** Highly developed terminals are available for customers to use on their DS3 circuits. Termed "resource managers," they can be optioned to serve as programmable digital cross-connect systems, channel banks, drop-and-insert multiplexers, statistical data multiplexers, and remote network management systems. Via a flexible framing process, they can mix voice with data at the usual speeds (4.8 kb/s, 56 kb/s, etc.) or special speeds like 512 kb/s. In the larger networks, "compressed" video can be handled along with voice and data. They thus allow the integration of formerly separate PBX and data networks. Further, they provide automatic restoration switching if one of the DS3 channels in a multicircuit network fails.

**2.09** In the future, ICs, and some exchange carriers as well, may offer "fractional T-3" service. This offering would generally apply to the line mileage between two digital cross-connection systems (DCSs). The tariff billing would be in terms of a part of a DS3, typically equivalent to a block of seven or 14 DS1 channels.

**2.10** DS1 services carried on a DS3 service may terminate in a central-office switch. Figure 6 shows a direct-in-dialing service, where 672 DS0 or 28 DS1 circuits terminate on the trunk side of a digital switch set up for trunk-with-line-treatment or direct-inward-dialing (DID) operation. This is common for connection to large PBXs or Radio Common Carrier (RCC) terminals. Figure 7 shows application of a DS3 service in a large corporate network with central-office switched access, DS1 facilities extending to branch locations, and mixed voice-data use.

### **3. FACILITIES**

**3.01** The DS3 digital service normally uses fiber optics for the local loops, but short-haul digital radio can be used. Interoffice facilities may be on fiber or on a digital radio system.

**3.02** In its simplest form, a DS3 circuit connects two stations by means of one central office. The circuit is usually built up from a series of digital facilities, each consisting of a channel on a higher-capacity digital system (565 Mb/s, 810 Mb/s, etc.), or can be on a 45 Mb/s fiber end link. There are two general types of facilities used in providing service: local loop and interoffice.

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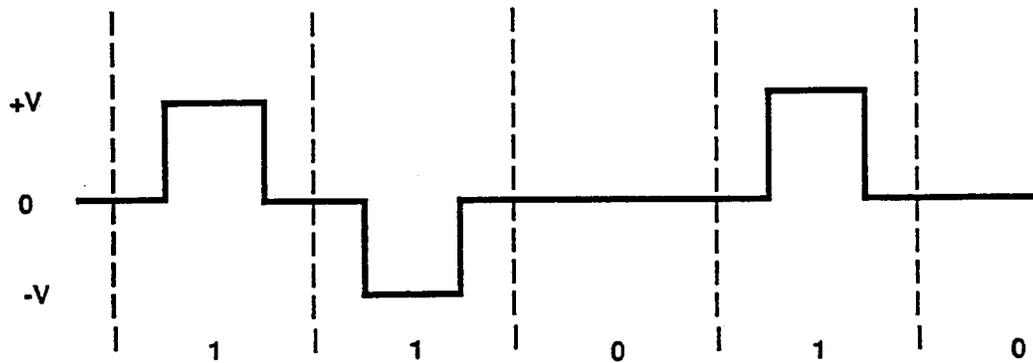


Figure 1. Bipolar Return-To-Zero (BPRZ) Format

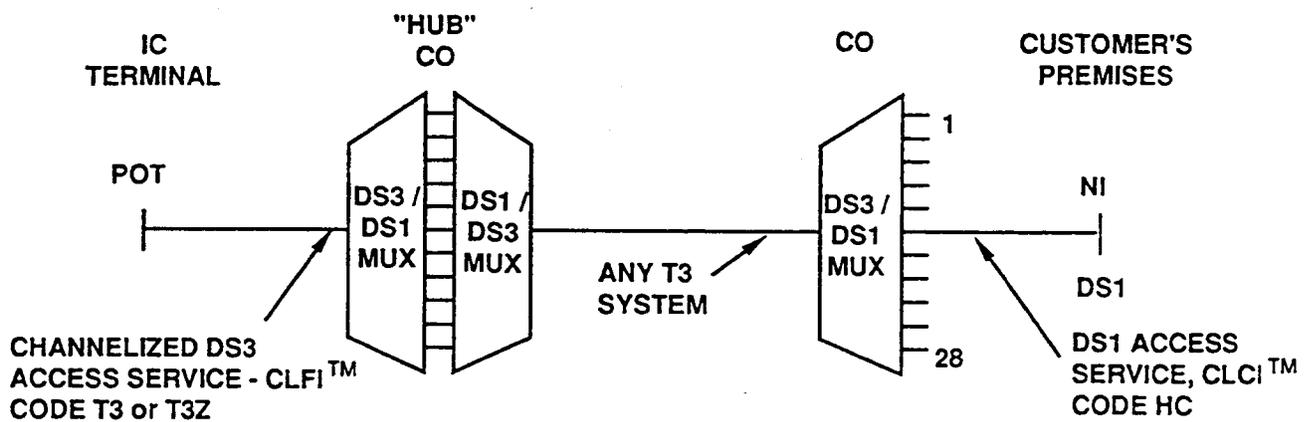


Figure 2. Central Office Multiplexer Configuration

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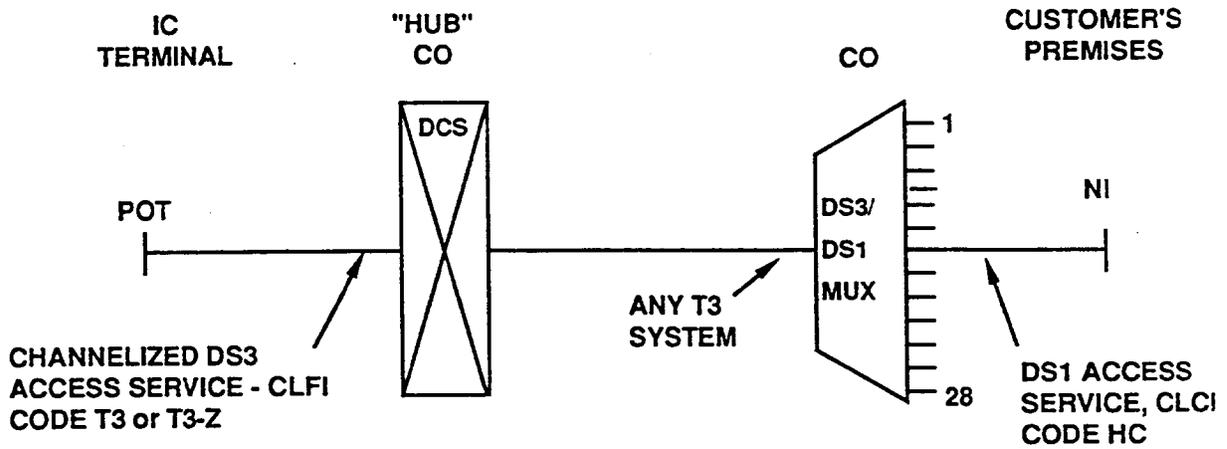


Figure 3. DS3 Access Service, Channelized with DCS

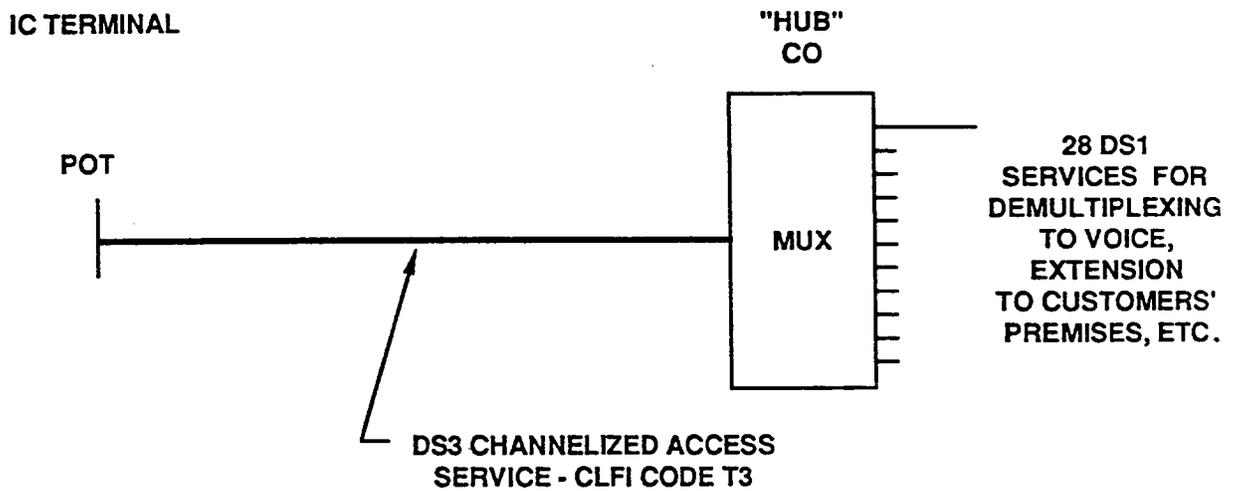


Figure 4. DS1 Access Services Carried on DS3 Access Service

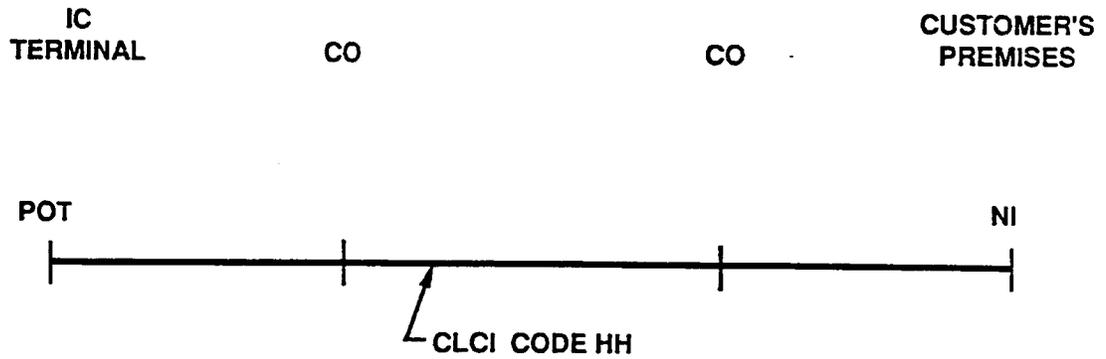


Figure 5. Unchannelized DS3 Access Service

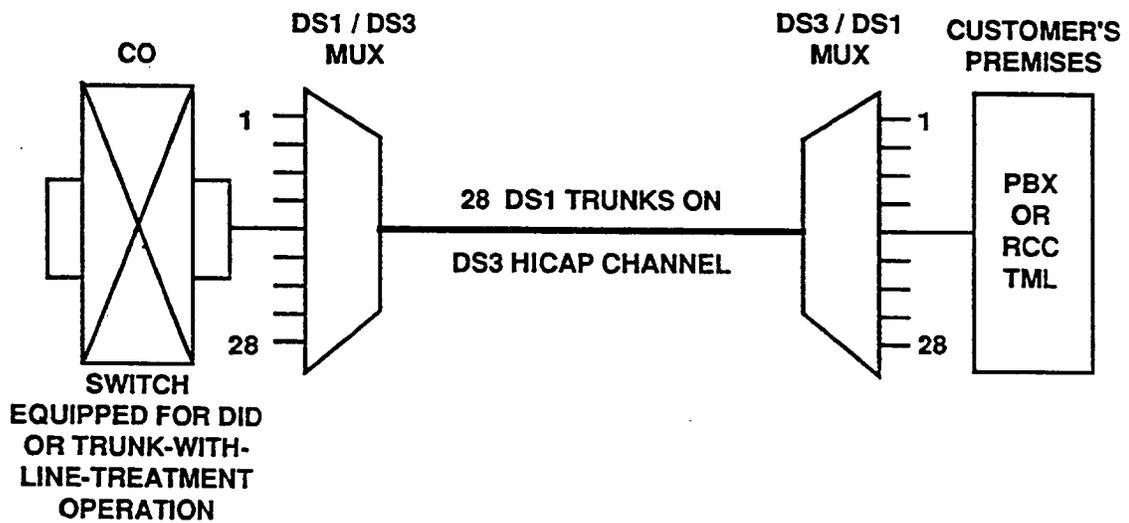


Figure 6. Direct-in-Dialing or Two-Way Trunks on a DS3 Facility

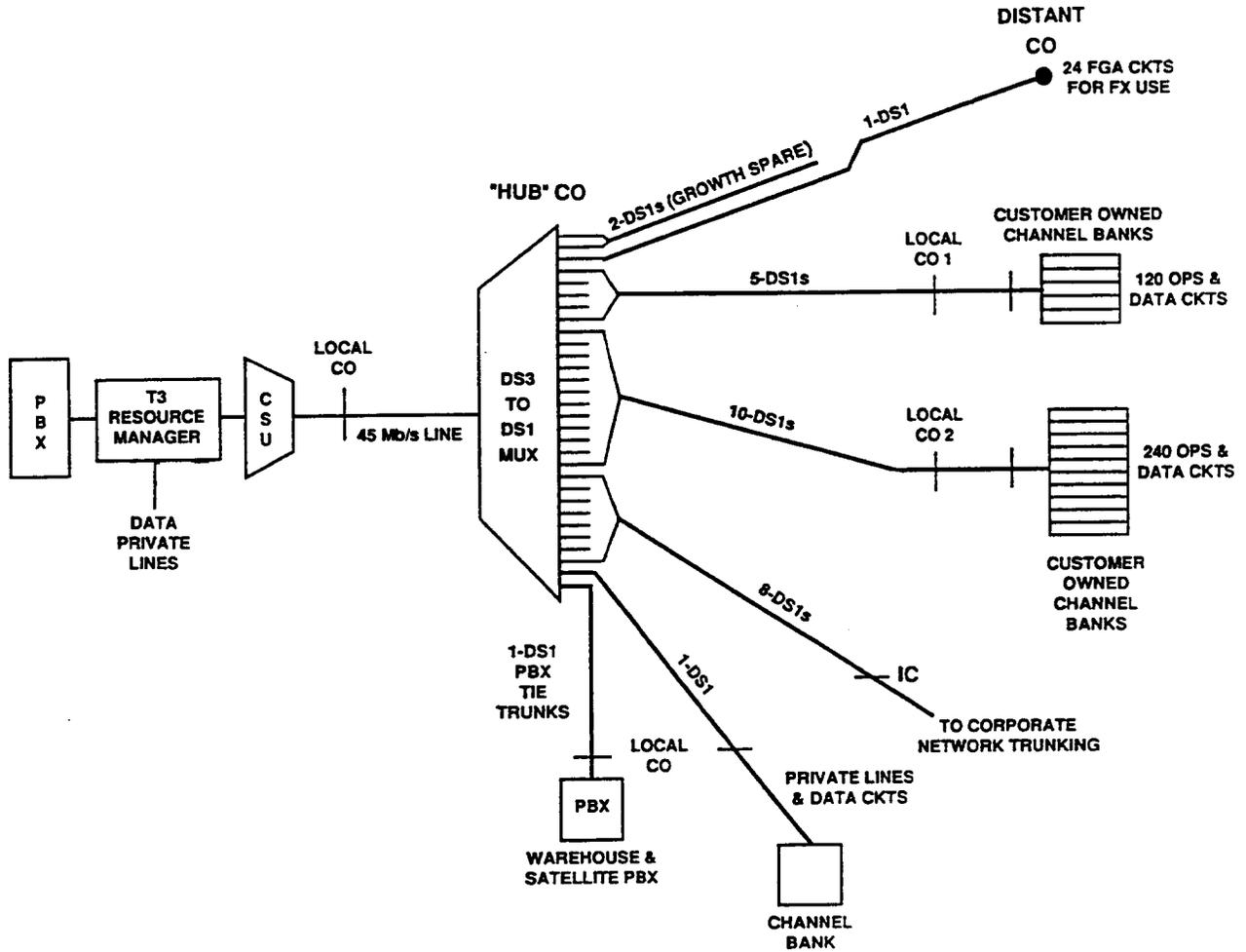


Figure 7. Typical DS3 Digital Service

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**3.03** A loop span connects the NI at the customer premises to the central office over loop facilities. At the CO, it terminates at a digital signal cross-connection (DSX) frame.

**3.04** An interoffice facility connects two central offices, extending between their DSX-3 bays. If "self-healing" route protection is requested, the loop facility may be in a ring configuration with add-drop multiplexers providing protection rerouting.

**3.05 Interface Codes.** Under FCC registration rules, the "registration jack" used for DS3 services terminating at ordinary customers' premises is given the Universal Service Order Code (USOC) SJA44. The customer's receive and transmit interfaces are TNC-type coaxial jacks.

**3.06** This code does not apply at interexchange carriers' terminals, where the usual interface is, or is close to, a DSX-3 cross-connection bay. However, the same TNC connectors are used.

**3.07 CPE Loopbacks.** The loopback, if provided by the CPE, is activated when the network tester sends an application of a continuous repetitive code signal on the DS3 line towards the NI. The loopback is deactivated when the network sends a second continuous repetitive code signal on the DS3 line to the NI. A loopback cannot be performed from the NI toward the CO.

**3.08 Central Office Multiplexing.** The CO multiplexing option consists of the basic DS3 digital service with one end terminated at the customer premises in CPE. The other end terminates at a CO in a digital cross-connection system (DCS) or a multiplexer (DS3 to DS1) as shown in Figures 2 and 3.

#### 4. INSTALLATION

**4.01** To provide these facilities, processing of the Universal Service Order (USO) or Access Service Request (ASR) is normally in accordance with the administration of designed services (ADS) plan as covered in practice 010-505-100, or similar locally developed procedures.

**4.02 Identifier codes.** If the DS3 service does not involve central-office multiplexing to DS1 channels, that is, if it is simply a point-to-point 44.736-Mb/s channel, it is identified by one of the following Special Services CLCI-S/S codes:

- HF - Digital High Capacity, 44.736 Mb/s (access service)
- HH - Digital High Capacity, 45 Mb/s or Higher (access service)
- HI - Digital Service - 45 Mb/s or Higher (ordinary commercial applications)
- UH - Digital High-Capacity (for "restructured" access-style offerings)
- UM - High-Capacity Custom (for "restructured" access-style offerings, with specially developed performance limits)

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For more information on CLCI-S/S Service Codes, Network Channel (NC) and Network Channel Interface (NCI) codes and their relationship, see the following Bellcore Practices:

- BR 781-500-020, "Interoffice Facility Planning and Special Services Forecasting - Description of Special Services," Issue 5 or later.
- BR 795-402-100, "COMMON LANGUAGE® Codes: Special Service Code Set," Issue 8 or later.
- BR 795-403-100, "COMMON LANGUAGE Network (NC) and Network Channel Interface (NCI) Codes," Issue 3 or later.

If the service involves central-office multiplexing, switching, or digital cross-connection, it is generally identified as a T3 carrier system between two points, e.g., the "107 T3 LOC A - LOC Z." Most of these systems are "one-ended," that is, they have an exchange-carrier terminal on one end and a network interface (point of termination) at the other.

4.03 In some companies, the practice on unchannelized services is to build a "single-channel" T3 carrier system between the two customer locations for the purpose of inventory records, and then to assign the high-cap service (HF, HH, etc.) to that system.

For more information on CLFI Code Sets and Facility Detail Code Sets, refer to:

- BR 795-450-100, "COMMON LANGUAGE CLFI Code Description," Issue 6 or later.

## 5. ACRONYMS

5.01 The following terms receive multiple use in this practice.

B3ZS	Bipolar with Three-Zeroes Substitution
B8ZS	Bipolar with Eight-Zeroes Substitution
BPV	Bipolar Violation
CCC	Clear Channel Capability
CPE	Customer Premises Equipment
CSU	Channel Service Unit
DCS	Digital Cross-Connection System
DSX	Digital Signal Cross-Connect
IC	Interexchange Carrier
NI	Network Interface
PBX	Private Branch Exchange
ZBTSI	Zero-Byte Time-Slot Interchange

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## 6. REFERENCES

6.01 The following documents provide more detailed information.

PRACTICE	TITLE
BR 314-647-500	DS3 High Capacity Digital Service – Maintenance and Test Procedures
BR 365-800-500	DS1 Transmission Systems – Verification Test for B8ZS Capability
BR 781-500-020	Interoffice Facility Planning and Special Services Forecasting - Description of Special Services
BR 795-402-100	COMMON LANGUAGE Codes - Special Service Code Set
BR 795-403-100	COMMON LANGUAGE Network Channel (NC) and Network Channel Interface (NCI) Codes
BR 795-450-100	COMMON LANGUAGE CLFI Code Description
BR 855-351-190	Digital Carrier Systems – Application of B8ZS Coding
BR 880-612-100	DS3 High-Capacity Digital Service – Engineering Considerations