QWEST Communications International Inc. Technical Document

Primary Rate ISDN Service

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Issue A
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1. Introduction

1.1 General

Technical Publication 77400, QWEST Primary Rate ISDN Service, describes Primary Rate ISDN service (PRS) in QWEST.

1.2 Reason For Reissue

This is a new publication. If it is reissued, the reason will be noted in this paragraph.

1.3 Scope

PRI service has many uses. It can be used to provide a digital interface to the network for PBX, Intelligent Peripheral Processor, Internet Interface, or other equipment that meets the Network Termination 2 (NT2) OSI layer 3 requirements identified in this document. This document covers service features, technical specifications and defines valid interfaces.

The PRI (Primary Rate Interface) implementation in QWEST is based on the National ISDN requirements developed by Telecordia and the other companies with support from switch manufactures. The purpose of National ISDN is to provide a standard interface for CPE. With the standard interface, CPE can be moved anywhere in the United States and connecting to a switch.

This document provides only an overview of the PRI requirements and should be used in conjunction with the provided references. While the QWEST implementation is based on National ISDN, a customer should reference the switch vendor's specifications.

1.4 Publication Organization

Chapter 1 **Introduction** provides the purpose and general information about this document.

Chapter 2 **Overview of QWEST Primary Rate ISDN Service,** describes the service and its options.

Chapter 3 **QWEST PRI Services and Features Offered,** provides other services and enhancements in which PRI can be used.

Chapter 4 **Network Channel and Network Channel Interface Codes,** provides a general explanation of the codes and the available NC and NCI code combinations.

Chapter 5 **Maintenance,** Customer and QWEST responsibilities.

Chapter 6 **Definitions and Acronyms, Acronyms** and a glossary of terms.

Chapter 7 **References and Document Ordering Information, List** of references with ordering instructions and a list of trademarks.

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2. Overview of QWEST Primary Rate Service

2.1 Service Description

ISDN PRI is a multipurpose, high speed, multiplexed digital interface. This interface is based on international standards (ITU-T), national standards (ANSI T1S1), and Telecordia (Bellcore) technical references. PRI uses a 1.544 Mpbs (DS1) digital interface, structured to contain bearer channels for the transport of user information with a message-oriented out of band-signaling channel for control of the bearer channels.

An ISDN PRI consists of one or more DS1 time-division-multiplexed signals provided on 4-wire copper circuits (using standard regenerators as necessary). Each DS1 facility allows 24 bi-directional, symmetric digital channels to a CPE. A PRI includes a D-Channel that supports 64 Kbps of signaling information flow in each direction. A D-Channel has a message oriented protocol that supports call control signaling. The remaining channels on the PRI are B-Channels. Each B-Channel supports 64 Kbps information flow in each direction. A typical ISDN PRI consists of a single DS1 and is configured as 23B+D interface. 23B-Channels and 1 D-Channel provides for 1.536 Mbps of user information in each direction. A PRI may consist of multiple DS1 facilities. Currently up to 479 B-Channels can be supported with 1 D-Channel (20 DS1).

Figures 2-1, 2-2, and 2-3 depict various possible network configurations. The configuration used depends on the resources available between the ISDN Switch and the customer premise.

PRI ISDN integrates the access arrangement for speech and various types of data calls referred to as bearer capabilities. QWEST supports the following bearer capabilities:

1. Circuit-Mode/Speech,
2. Circuit-Mode 3.1kHz Audio,
3. Circuit-Mode Unrestricted Digital Information-Rate Adapted from 56 Kbps to 64 Kbps.
4. Circuit-Mode Unrestricted Digital Information – 64kbps.

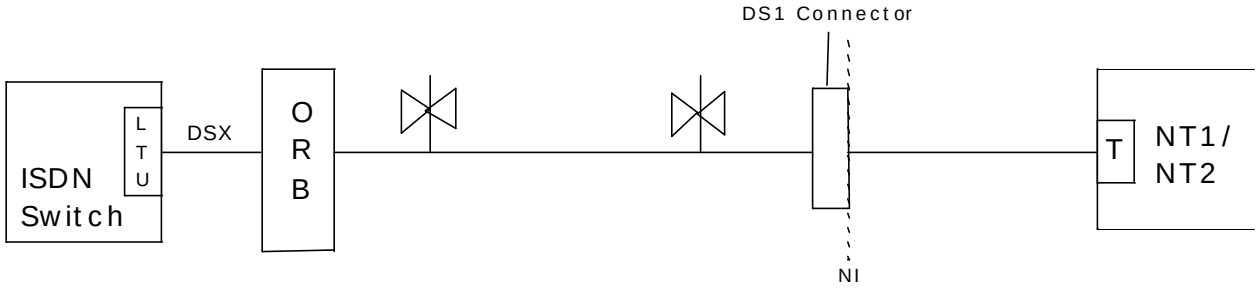

Figure 2-1: T-1 Carrier

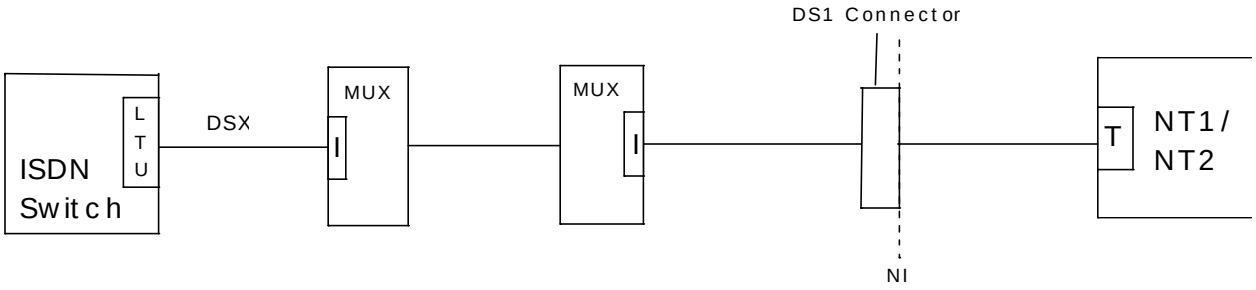

Figure 2-2: Fiber Optic Multiplexer

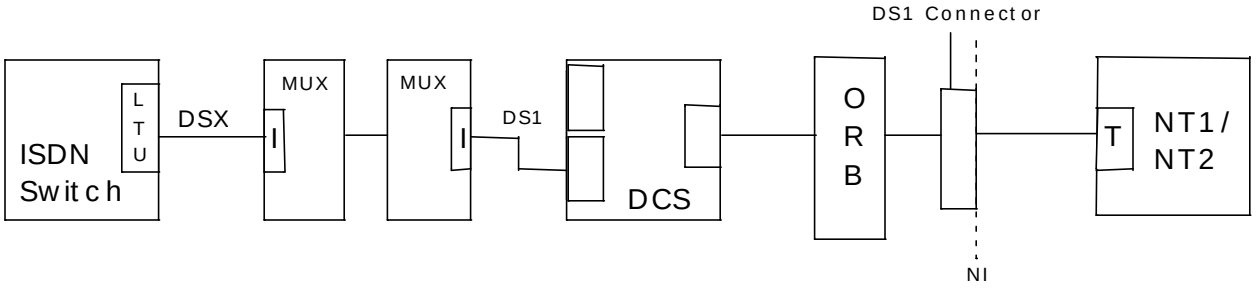

Figure 2-3: Digital Cross Connect System

2.2 Layer 1 – Physical Interface

Layer 1 is the Physical Interface between the central office and NT2 (Network Termination 2) compatible equipment. The physical layer consists primarily of a standard DS-1 interfaces with Extended SuperFrame (ESF) or D4 framing. The specifications include requirements on electrical characteristics, channel structure, line code, e.g. B8ZS, pulse density, clear and restricted channels and the use of bit inverted HDLC on certain restricted channels. Physical Layer specifications are at the ISDN reference points S, T, and U. It should be noted that NT1, NT2, and TEI are functional or logical units and are not necessarily physically discrete. The reference points S, T, and U are demarcation points between the functional units. Functional units may be merged within equipment.

There are a number of DS-1 options that have to be specified for this application. In order to ensure the correct options are used, a customer needs to determine the switch type that will be serving their application. Once the switch type has been determined the switch vendor's specifications should be consulted. See section 6 for listing of vendor documents.

The physical layer interface specifications scope is for the ISDN PRI network-to-CPE interface (U reference point) demarcated at the NI in Figure 2.4.

These specifications address:

Terminating Impedance – Nominal Terminating Impedance at the NI will be 100 ohms with return loss over the frequency band from 100kHz to 1000kHz greater than or equal to 26dB.

Transmission Rate and Synchronization – The network will deliver a signal synchronized from a timing source that is traceable to a Primary Reference Source.

Line Code – The line code for the DS1 signal at the NI will be B8ZS (Bipolar with 8-Zero Substitution)

Interface Signal Characteristics – A standard pulse with the exception of a lower limit on the standard pulse amplitude of 2.25 Volts rather than 2.4 Volts, attenuated by a cable pair loss in the range of 0.0 to 16.5dB at 772kHz between 100 ohm terminations.

Wander, Jitter, Phase Transients – See vendor Specifications

ESF Frame Format and Channel Combinations – ESF is a basic frame of 192 information digit time slots preceded by one digit time slot containing the Framing bit for a total of 193 digit time slots. The 192 information bits will be partition into 34 eight-bit frame slots. The 192 information digit time slots correspond to the DS1 payload of 1.536 Mb/s, whereas the F bit adds 8 Kbps for a total of 1.544 Mbps.

Physical Characteristics – Provides the Interface Cable Requirements, Wiring Polarity Integrity, and Connector.

These are Standard requirements. Consult-equipment manufacturer specifications for more specific information.

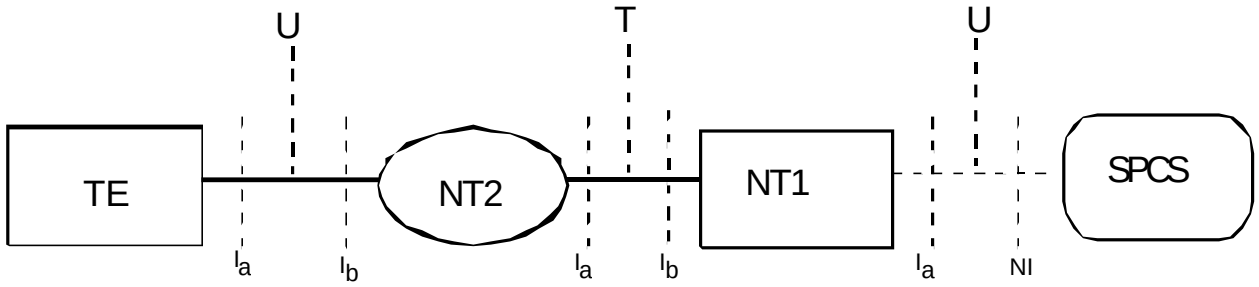

Figure 2-4: ISDN Functional Reference

Figure 2-4 depicts the ISDN PRI configuration with functional reference points S, T, and U physical interface points I_a and I_b, and network interface NI with respect to ISDN Terminal Equipment (TE, Network Termination 2 (NT2), Network Termination 1 (NT1), and the SPCS. The physical interface points on the network and user side of the termination equipment, respectively.

Reference points I_a and I_b are defined in American Standard Institute (ANSI) T1.408. Physical interface point I_a is the 4-wire (2-pair) bi-directional PRI point on the user side of the network side of the terminal equipment (that is, NT1 and NT2). Physical interface point I_b is the 4-wire (2-pair) bi-directional PRI point on the user side of the terminal equipment. Figure 2-1 shows the location of these physical interface points with respect to an NT1, NT2, and TE.

2.3 Layer 2 – Data Link Layer

The ISDN Primary Rate ISDN data link layer is based on ITU-T recommendation Q.921 (I.441). The data link layer provides a nearly error-free path to higher layers across the Primary Rate user-to-network interface. LAPD is the Layer 2 protocol for the interface. It is independent of transmission rate, and requires a duplex, bit transparent D-channel. LAPD protocol defines the procedures required to establish, maintain, and disconnect a link. It transports the information between Layer 3 entities across the ISDN primary rate interface using the D-channel. It defines the data transmission frame structure, field formats, and proper procedures for operation of the Link Access Protocol on the D-channel. It provides peer-to-peer protocol for the transfer of information and control between any pair of service access points on the data link layer. It specifies the interaction between the data link layer and physical layer (Layer 1) and between the data link layer and network layer (Layer 3).

For National ISDN Standards Requirements of the Link Layer Protocol, consult Telecordia SR 3887, 1997 Version of National ISDN Primary Rate Interface Customer Premises Equipment

Generic Guidelines. In addition the switch vendor Interface Specification that will be providing the interface should be reviewed.

These documents will provide the following definitions and requirements for Layer 2 connectivity:

Timers and Counters
Formats for peer-to-peer exchanges.
Commands and responses
Primitives for Layer to Layer communications
Peer-to-peer Procedures
Exception conditions for reporting and recovery.
Error codes and conditions.
Layer 2 SDL diagrams.

2.4 Layer 3 – Network Layer

Layer 3 is a message-oriented out of band-signaling channel for control of the bearer channels (B-Channels). There are a specified set of messages and information elements required to establish, maintain, and clear network connections and to control supplementary services. Call signaling is based on Q.931 (I.451), ISDN user-network interface Layer 3 specifications and ANSI T1.607. Table 2-1 shows the general message structure and Table 2-2 identifies the Layer 3 messages. The Call Control Procedures in Layer 3 defines the requirements for Inband Tones and Announcements, Interworking with call origination and termination, delay procedures, B-channel selection, addressing information for En Block Signaling, and Timers.
For detailed information to establish, maintain, and clear network connections at the ISDN user-network interface for support of circuit switched calls, identify messages supported and the call control procedures, consult the switch vendors interface specifications and Telecordia SR3887.

8	7	6	5	4	3	2	1	
Protocol Discriminator								
0	0	0	0	Length of Call Reference Value (In Octets)				2
Flag	Call Reference Value							3
0	Message Type							Etc.
Other Information Elements as Required								

Table 2.1: General Message Organization Example

Table 2-1 identifies the messages used on the D-channel for control of the bearer channels. The first three elements of these messages are common to all messages and are always present, while other information elements are specific to each message type. For a more detailed description of the elements of each message refer to the vendor specification and Telecordia SR3887.

Message	User > Network	Network > User
ALERTing	The called CPE sends the SPCS this message to indicate that called user alerting has been initiated.	The SPCS sends the calling CPE this message to indicate the called user is being alerted.
PROGress	The CPE sends this message when interworking occurs with a non-ISDN network, the call is routed to an inband tone or announcement, or if the CPE wishes to report a call progress delay at the destination interface.	The SPCS sends this message when interworking occurs with non-ISDN trunks, the call is routed to an inband tone or announcement, or the SPCS wishes to report a call progress delay at the destination interface.
CONNect	The called CPE sends the SPCS this message to indicate call acceptance by the called user.	The SPCS sends the calling CPE this message to indicate the called user has answered the call (circuit-mode) or the access connection to the Packet Handling Function (PHF) has been established (packet-mode).
CONNect ACKnowledge	The calling CPE can send the SPCS a CONNect ACKnowledge message (although not required) to promote symmetrical call control procedures.	The SPCS sends the called CPE this message to acknowledge the receipt of a CONNect Message.
CALL PROCeeding	A called CPE sends this message to the SPCS to indicate that more time is necessary either to begin alerting or to accept the call.	
DISConnect	The CPE sends the SPCS this message to initiate call clearing.	The SPCS sends this message to indicate initiation of call clearing procedures when a B-channel had been allocated for the call.
RELease	The CPE sends this message to the SPCS to initiate call clearing or to	The SPCS sends this message to indicate it has disconnected the channel and

	continue call clearing initiated by the SPCS.	initiated procedures to clear the network connection and the call to the remote user, or for certain clearing sequence exception conditions.
RELease COMplete	The CPD sends this message to the SPCS to initiate call clearing or to continue call clearing by the SPCS.	The SPCS sends this message to indicate that it has released the B-channel and call reference, and that they are available for reuse.
RESTart	This message is sent by the CPE to request the SPCS to restart (i.e., return to an idle condition) the indicated channel(s) or interface.	This message is sent from the SPCS to the CPE to restart (i.e., return to an idle condition) the indicated channel(s) or interface.
RESTart ACKnowledge	This message is used by the CPE to acknowledge the receipt of the RESTart message and to indicate the requested restart is complete.	This message is used by the network to acknowledge the receipt of the RESTart message and to indicate the requested restart is complete.
SERVice	This message is sent by the CPE to indicate a D-channel switchover, or to control B channel availability.	This message is sent by the network to indicate a D-channel switchover, or to control B-channel availability.
SERVice ACKnowledge	This message is sent by the CPE to acknowledge a D-channel switchover, or to acknowledge the availability (status) change of a B-channel	This message is sent by the SPCS to acknowledge a D-channel switchover, or to status change of a B-channel.

SETUP	The CPE sends this message to originate a call.	The SPCS sends the SETUP message to terminate a call to the CPE.
STATus ENQuiry	The CPE sends this message to request the call state from the SPCS.	The SPCS sends this message to indicate that a protocol error has been detected and that information identified by the cause information element has been discarded or in response to a STATus ENQuiry received from the CPE.
STATus ENQuiry	The CPD sends this message to request the call state from the SPCS.	The SPCS sends this message to request the call state from the CPE .
FACILITY	The CPD sends the FACILITY message when a component is to be sent, related to supplementary services such as ISDN Calling Name Identification or Two B-channel Transfer.	The SPCS sends the FACILITY message when a component is to be sent related to supplementary services, such as, ISDN Calling Name Identification or Two B-channel Transfer.

Table 2-2: Layer 3 Messages

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3 QWEST Primary Rate Services and Features

There are many features available with Qwest Primary Rate Services. The following are a description of some of the features available with this service. For information about additional features contact the Qwest Primary Rate Services Product Management.

3.1. ISDN Trunk Connection

A Trunk Connection (TC) is central office translation that provisions each B-Channel in a PRS. The TC allows access to the exchange network. One ISDN TC is required for each B-Channel used in a PRS.

3.2. Call-By-Call PRS

The PRS B-Channels are configured to support in-only call flexibility predetermined by the customer's traffic flow.

3.3. Dedicated PRS

Each B-Channel is dedicated to inward, outward or two-way traffic.

3.4. Calling Number Identification

This feature displays the call identification information and the calling parties DN (including non-published and non-listed directory numbers) prior to the call being answered. Callers have the ability to inhibit the display of calling party information to the terminating number.

3.5. Calling Number Identification Blocking-All Calls

All outgoing calls will be blocked for PRS customers where technically feasible as determined by the Company. Most Company switches do not have this capability and will be a function of the customer's PBX.

3.6. Direct Inward/Outward Dialing

Allows a station user to place or receive calls bypassing the attendant.

3.7 Circuit Switched Data

Allows the transmission of circuit-switched data on a voice channel.

3.8. Uniform Access Solution (UAS) Network Connection

The UAS network connection provides switching to the local exchange and toll networks, and includes the channel trunk-side configuration for the entire T1.

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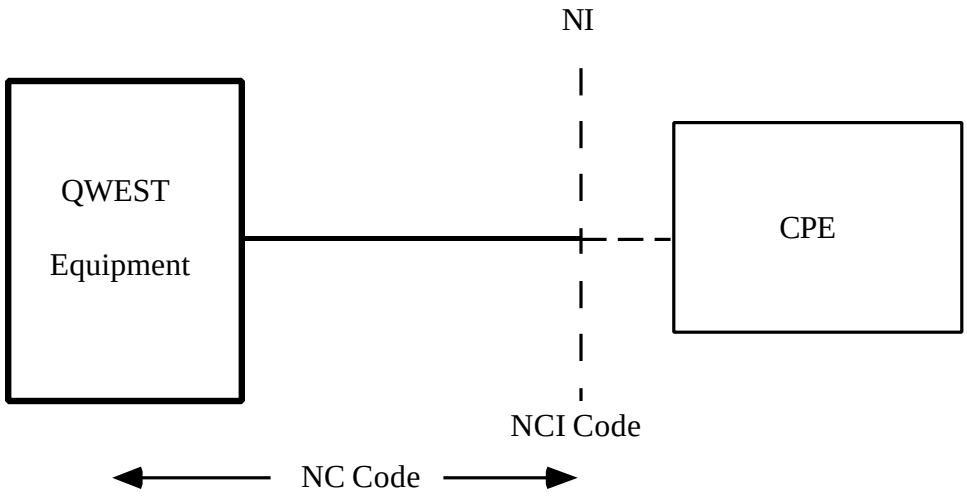
4. Network Channel and Network Channel Interface Codes

4.1 NC/NCI General Information

Network Channel (NC) codes describe, in standard format, the characteristics of the service channel. Network Channel Interface (NCI) codes describe the physical and electrical characteristics of the Network Interface (NI). *Industry Support Interface (ISI); NC/NCI Code Dictionary*, Telcordia Special Report SR-STS-000307 fully describes these coding schemes.



Key
NI = Network Interface
NC = Network Channel
NCI = Network Channel Interface
CPE = Customer Provided Equipment

Figure 4-1: NC/NCI Code Description

4.2 NC Code Components

The Network Channel (NC) Code is an encoded description of the channel that is provided by the Access Provider (AP) from the Point of Termination (POT) at the Access Customer's (AC) POT to an AP Central Office (CO), or to an end-user location. For a complete list of NC and NCI Codes, see BR 795-403-100.

The NC Code is a 4-character code consisting of two elements.

A. Channel Code - (character positions 1 and 2) is a 2-character alpha or alphanumeric code that describes the channel service type in an abbreviated form. The Channel Code must be specified.
B. Optional Feature Code - (character positions 3 and 4) identifies the option codes available for each Channel Code. Varying combinations of this code will allow the customer to specify the technical performance of the requested channel.

All four characters of the NC must be filled to retain its 4-character structure.

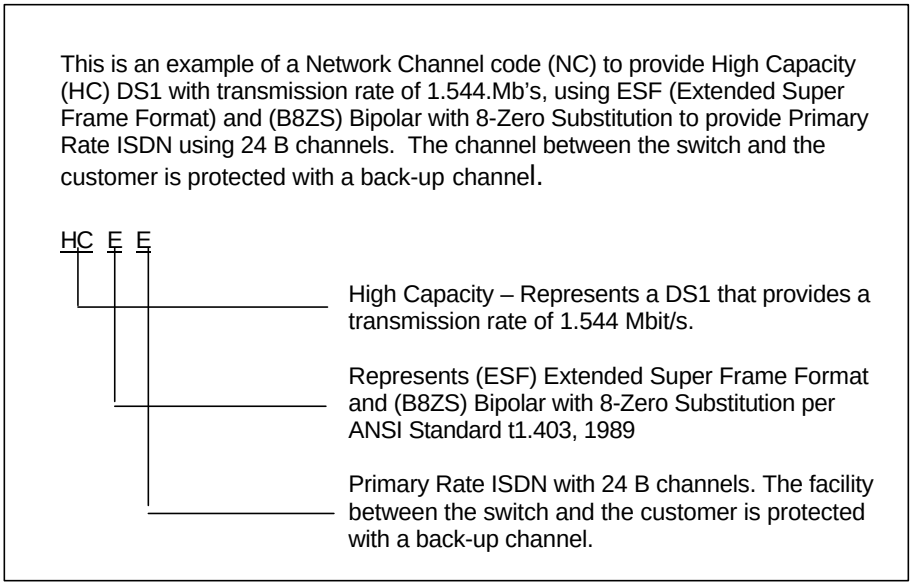


Figure 4-2: Example NC Code Components

4.3 NCI Code Components

The NCI Code is a maximum 12-character code comprised of five elements and two delimiters.

1. Total Conductors (character positions 1 and 2) is an assigned 2-character numeric code that represents the total number of conductors to be used at the interface.
2. Protocol (character position 3 and 4) is an assigned 2-character alpha code that defines the requirements for the interface regarding signaling/transmission.
3. Impedance (character position 5) is an assigned 1-character alpha or numeric code, representing the nominal reference impedance that will terminate the channel, for the purpose of evaluating transmission performance.
4. Protocol Options (character positions 7-9) is an assigned 1- to 3-character alpha, numeric or alphanumeric code that describes additional features of the protocol code.
5. Transmission Level Point (character positions 11 and 12) is assigned two alpha codes (a hyphen "-" may be used as a filler) corresponding to a value for the transmission level points.

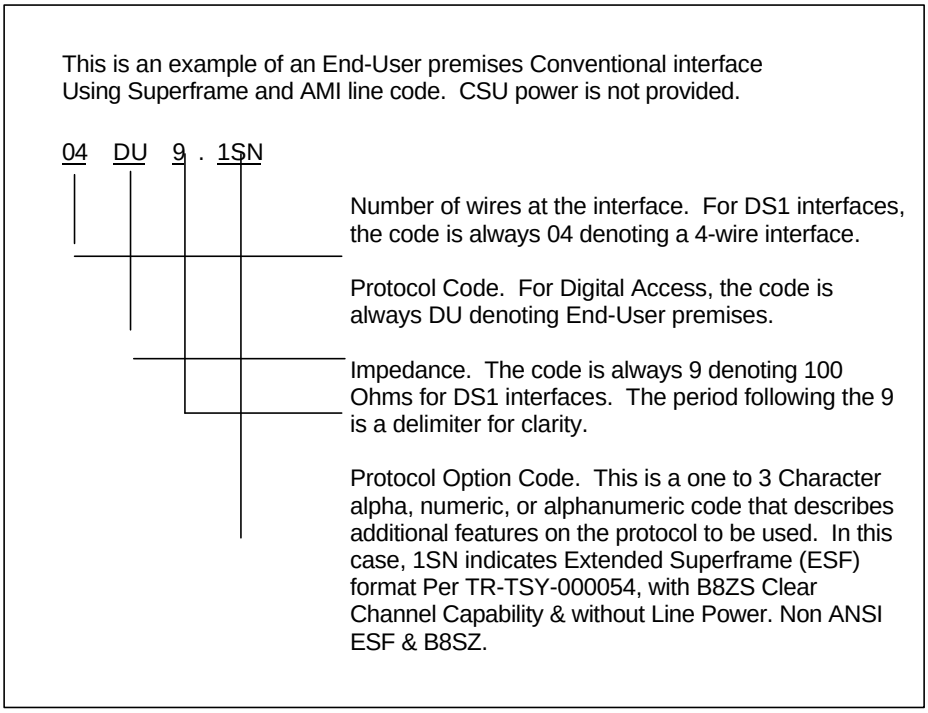


Figure 4-3: Illustration of NCI Code Components

4.4 Available PRI-ISDN Network Channel Codes

The following table contains the available Network Channel codes for Primary Rate ISDN services.

Table 4-1 Available Primary Rate ISDN Network Channel Codes

Network Channel Code	Primary Rate ISDN Description
1.544 Mbit/s DS1 (also see 77375)	
HCEI	ANSI ESF & B8ZS, Primary Rate ISDN, 23 B + D Channels
HCEU	ANSI ESF & B8ZS, Primary Rate ISDN, 24 B Channels
HCGI	Non-ANSI ESF & B8ZS, Primary Rate ISDN, 23 B + D Channels
HCGU	Non-ANSI ESF & B8ZS, Primary Rate ISDN, 24 B Channels
HCHT	Self Healing and Disaster Recovery, Primary Rate ISDN, 23 B + D Channels
HCHU	Self Healing and Disaster Recovery, Primary Rate ISDN, 24 B Channels

4.5 Available PRI-ISDN Network Channel Interface Codes

The following table contains the available Network Channel Interface codes for Primary Rate ISDN services. End User, DSX-1 interfaces are applicable to those sites where transport for the DS1 is provided using a higher rate signal, e.g., a SONET based transport.

Table 4-2 Primary Rate ISDN, NCI Protocol and Protocol Option Codes

Protocol		Definition
Code 3 4	Option 7 8 9	
D U		End User Digital Access Interface
	1 S N	1,544 Mbit/s, ANSI ESF, Binary 8-Zero Substitution (B8ZS), without Line Power
	1 S X	1,544 Mbit/s, ANSI ESF, Binary 8-Zero Substitution (B8ZS), without Line Power, DSX-1 Interface.
	S N	1,544 Mbit/s, Non-ANSI ESF, B8ZS, without Line Power.
	S X	1,544 Mbit/s, Non-ANSI ESF, B8ZS, without Line Power, DSX-1 Interface.

4.6 Available PRI-ISDN NC/NCI Code Combinations

Table 4-3 lists NC/NCI Code combinations for PRI-ISDN

Table 4-3: Primary Rate ISDN NC/NCI Code Combinations

NC Code	NCI Code		DESCRIPTION
	Qwest CO-NI	End-User EU-NI	
1.544 Mbit/s DS1 (ALSO SEE 77375)			
HCEI	N. A.	04DU9.1SN 04DU9.1SX	ANSI ESF & B8ZS, Primary Rate ISDN, 23 B + D Channels
HCEU	N. A.	04DU9.1SN 04DU9.1SX	ANSI ESF & B8ZS, Primary Rate ISDN, 24 B Channels
HCGI	N. A.	04DU9.SN 04DU9.SX	Non-ANSI ESF & B8ZS, Primary Rate ISDN, 23 B + D Channels
HCGU	N. A.	04DU9.SN 04DU9.SX	Non-ANSI ESF & B8ZS, Primary Rate ISDN, 24 B Channels
HCHT	N. A.	04DU9.1SN 04DU9.1SX 04DU9.SN 04DU9.SX	Primary Rate ISDN, 23 B + D Channels, Self Healing and Disaster Recovery. Line Code and Frame Format is communicated by the Network Channel Interface Code
HCHU	N. A.	04DU9.1SN 04DU9.1SX 04DU9.SN 04DU9.SX	Primary Rate ISDN, 24 B Channels, Self Healing and Disaster Recovery. Line Code and Frame Format is communicated by the Network Channel Interface Code

N.A. = Not Applicable. Since the service terminates in a switch, only End User NCI codes apply.

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5. Maintenance

5.1 Customer Responsibilities

The customer is responsible for all equipment and cable on the customer side of the Network Interface at their location.

The customer or their agent must sectionalize the trouble and verify that the trouble is not in the customer owned equipment or cable before calling the QWEST Customer Service Center.

If the trouble is isolated to the customer owned equipment or cable, the customer is responsible for clearing the trouble and restoring the service to normal.

Joint testing between the customer location and QWEST Central Office may sometimes be necessary to isolate the trouble.

5.2 QWEST Responsibilities

QWEST is responsible for all equipment and cable on their side of the Network Interface at the customer locations and for maintaining the transmission facility between customer location and the Central Office.

QWEST will furnish the customer a trouble reporting telephone number.

Upon receipt of a trouble report, QWEST will initiate actions as specified in the Service Interval Guide to clear the trouble.

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6. Acronyms & Definitions

6.1 Acronyms

ANSI	-	American National Standards Institute
B8ZS	-	Line Coding scheme where a binary 0 is represented by no line signal, and a binary 1 is represented by a positive or negative pulse. Any string of eight zeros is replaced by a string with two code violations.
CPE	–	Customer Premises Equipment
ESF	-	Extended Super Frame
ITU-T	–	International Telephone Union – Telecommunication Standard Sector
NC	-	Network Channel
NCI	-	Network Channel Interface
NT1	-	Network Termination 1 – Includes functions related to layer 1 associated with physical and electrical terminations.
NT2	-	Network Termination 2 – An intelligent device that may include that can perform switching and concentration functions.
OSI	–	Open Systems Interconnection - Layered Reference Model developed by the International Organization for Standards.
PBX	-	Private Branch Exchange – used to interconnect telephones within a building or office.
PRI	–	Primary Rate ISDN Interface
PRS	–	Primary Rate ISDN Service
SPCS	-	Stored Program Control System
TC	-	Trunk Controller
TEI	-	Terminal Endpoint Identifier

6.2 Glossary

Asynchronous Transfer Mode

An information transfer method in which the information is organized into fixed length (53 octet) cells. It is asynchronous in the sense that the recurrence of cells containing user information is not necessarily periodic.

BIT (Binary Digit)

A binary unit of information. It is represented by one of two possible conditions, such as the value 0 or 1, on or off, high potential or low potential, conducting or not conducting, magnetized or demagnetized. A Bit is the smallest unit of information, by definition.

Central Office

A local switching system and its associated equipment located at a wire center. It is also used to refer to the building that houses the switching system.

Channel

An electrical or photonic, in the case of fiber optic based transmission systems, communications path between two or more points of termination.

dBm

A decibel in which the reference power is one milliwatt. Decibel reference to one milliwatt.

Facilities

Facilities are the transmission paths between the demarcation points serving customer locations, a demarcation point serving a customer location and a Qwest Central Office, or two Qwest offices.

Gigabit per Second (Gbit/s)

One -13824 (1,000,000,000) bits per second

Hub

A Qwest designated serving wire center at which bridging and multiplexing functions are performed.

Intelligent Network Element (INE)

A software programmable network component.

Kilobit/Second (kbit/s)

One thousand (1000) bits/second

Megabit per Second (Mbit/s)

One million (1,000,000) bits per second

Network Channel (NC) Code

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

Network Channel Interface (NCI) Code

The NCI code is an encoded representation used to identify five (5) interface elements located at a point of Termination (POT) at a Central Office (CO) or at the Network Interface at a customer location. The Interface code elements are; Total Conductors, Protocol, Impedances, Protocol Options, and Transmission Level Points (TLP). (At a digital interface, the TLP element of the NCI code is not used.)

Network Interface

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

Optical Carrier (OC)

Optical carrier, the nomenclature for the line rate of the optical transmission signal described in this document.

Optical Interface (OI)

The OI is the transmit point wherein light waves move away from the interface toward an optical receiver.

Point of Termination (POT)

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

Point-To-Point

A circuit connecting two (and only two) points.

Protocol Code

The protocol (character positions three and four of the Network Channel Interface [NCI] Code) is a two character alpha code that defines requirements for the interface regarding signaling and transmission.

SONET

An acronym of Synchronous Optical NETwork - A standard providing electrical and optical specifications for the physical and higher layers, the first stage of which is at 51.84 Mbit/s, the Optical Channel 1 (OC-1) level. Other rates, defined as OC-N where n=3 through a number not yet firm, are possible.

SONET Optical Terminal

A terminal which uses SONET multiplexing to interleave the lower rate payloads, thereby creating a high rate synchronous signal.

Synchronous Transmission

A transmission process such that between any two significant instants in the overall bit-stream there is always an integral number of unit intervals.

Wire Center

A building in which one or more central offices, used for the provision of local exchange services, are located.

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7. References and Document Ordering Information

7.1 American National Standards Institute

ANSI T1.101-1999 Synchronization Interface Standard

ANSI T1.102-1993 (R1999) *Digital Hierarchy - Electrical Interfaces*

ANSI T1.107-1995 *Digital Hierarchy - Formats Specification*

ANSI T1.403-1999 Carrier-to-Customer Installation - DS1 Metallic Interface

ANSI T1.408-1990 *ISDN Primary Rate Customer Installation Interfaces, Layer 1 Specification*

ANSI T1.510-1999 *Network Performance Parameter for Dedicated Digital Service for Rates Up to and Including DS3 - Specifications*

ANSI T1.601-1992 *Telecommunications ISDN Basic Access Interface for use on Metallic Loops for Application on the Network Side of the NT, Layer 1 Specification*

ANSI EIA/TIA-547-1989 *Network Channel Terminating Equipment for DS1 Service*

ANSI EIA/TIA-594-1991 *Private Digital Network Synchronization*.

7.2 Lucent Publications

Primary Rate Interface
235-900-342 – 5E9 Generic Program

7.3 Nortel Publications

NIS A220-1 – Primary Rate
Interface Specification (Issue 5.02 April 95= BCS 36 and up

7.4 Telcordia Publications

TR-NPL-000054	High-Capacity Digital Service (1.544 Mb/s) Interface Generic Requirements for End Users, Issue 1, April 1989
TR-TSY-001268	ISDN Primary Rate Interface Call Control Switching and Signaling Generic Requirements for Class II Equipment, Issue 1, December 1991, plus Revision 1, December 1992, Revision 1, December 1992, Revision 2, December 1992
SR-3338	1996 Version of National ISDN - 1996 Primary Rate Interface Customer Premises Equipment Generic Guidelines, Issue 1 (Bellcore, August 1995).
SR-3875	National ISDN 1995, 1996 and 1997, Issue 1 (Bellcore, June 1996).
SR-NWT-001937	National ISDN - 1, Issue 1 (Bellcore, February 1991); plus Supplement 1 (Bellcore, February 1993).

SR-NWT-002120	National ISDN - 2, Issue 1 (Bellcore, May 1992); plus Revision 1 (Bellcore, June 1993).
SR-NWT-002457	National ISDN -3, Issue 1 (Bellcore, December 1993).
SR-NWT-002343	ISDN Primary Rate Interface Generic Guidelines for Customer Premises Equipment, Issue 1 (Bellcore, June 1993); plus revisions.
SR-3238	Generic Guidelines for ISDN Customer Premises Equipment on National ISDN - 3 Primary Rate Interfaces, Issue 1 (Bellcore, September 1994).
TR-TSY-000754	ISDN Primary Rate Access Transport System Requirements (A module of TSGR, TR-TSY-000440), Issue 1 (Bellcore, July 1990).
TR-TSY-000793	ISDN D-Channel Exchange Access Signaling and Switching Requirements, Issue 1 (Bellcore, October 1988); plus Revision 1 and bulletin.
TR-NWT-001268	ISDN Primary Rate Interface Switching and Signaling Generic Requirements for Class II Equipment, Issue 1 (Bellcore, December 1991), plus revisions.
TR-NWT-001270	Generic Requirements for ISDN PRI Call-by-call Service Selection for Non-ISDN Foreign Exchange Facilities, Non-ISDN Tie Trunks, OUTWATS, and INWATS, Issue 1 (Bellcore, May 1992); plus Bulletin 1 and 2.
TR-NWT-001187	ISDN Calling Number Identification Services for Primary Rate Interfaces, Issue 1 (Bellcore, March 1992); plus Revision 1.
SR-3138	A Summary View of the Use of Uniform Cause Values on National ISDN-3 (NI-3) Primary Rate Interfaces (PRI), Issue 1 (Bellcore, September 1994).

7.5 Document Ordering Information

All documents are subject to change and their citation in this document reflects the most current information available at the time of printing. Readers are advised to check status and availability of all documents.

American National Standards Institute (ANSI) documents may be obtained from:

American National Standards Institute
Attn: Customer Service
11 West 42nd Street
New York, NY 10036
Phone: (212) 642-4900
Fax (212) 302-1286

Telcordia Technical Reference (TR) documents may be obtained from:

Telcordia - Customer Services
8 Corporate Place
Piscataway, NJ 08854-4196
Telex: (201) 275-2090
Fax: (908) 336-2559
Phone: (800) 521-CORE (U.S. calls only)

Federal Communications Commission (FCC), Code of Federal Regulations 47, Part 68 may be obtained from:

Superintendent of Documents
Government Printing Office
Washington D.C. 20402
Phone: 202 783-3238

QWEST Technical Publications may be obtained from:

http://www.qwest.com/techpub

Ordering Information for Employees of QWEST Communications, Inc.

Central Distribution Center (CDC)
1005 17th St. S-30
Denver, CO 80202
Telephone: (303) 896-9446
Fax: (303) 965-8652

Lucent Technologies documents may be obtained from:

P.O. Box 19901
Indianapolis, IN 46219
or call 1-888-LUCENT8

Northern Telecom documents may be obtained from:

Merchandising
P.O. Box 13010, Dept. 6611
Research Triangle Park, NC 27709
or call 1-800-347-4850

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