

**QWEST Communications  
International Inc.  
Technical Publication**

**Synchronous Service Transport  
(Synchronous Optical Transport)**

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## NOTICE

The purpose of this document is to describe QWEST Synchronous Service Transport (Synchronous Optical Transport). Sufficient technical detail is furnished to enable a customer to select options, bandwidth and interfaces suitable for their application needs. This document describes the technical features of the offering. It is not the intent of this document to provide ordering information beyond specific, available Network Channel and Network Channel Interface Codes.

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## **1. Introduction**

### **1.1 General**

The purpose of this document is to describe QWEST Synchronous Service Transport (Synchronous Optical Transport). Sufficient technical detail is furnished to enable a customer to select options, bandwidth and interfaces suitable for their application needs. This document describes the technical features of the offering. It is not the intent of this document to provide ordering information beyond specific, available Network Channel and Network Channel Interface Codes.

### **1.2 Reason For Reissue**

This publication is being revised to:

- Add the option of ordering a point-to-point STS-1 Transport Channel.

### **1.3 Scope**

This document describes QWEST Synchronous Optical Transport offered by QWEST to its customers. It covers distinguishing interface features, technical specifications, and defines valid interfaces.

### **1.4 Organization of Document**

- |           |                                                                                                                                                                                                                                                                                                                                                                   |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chapter 1 | Introduction: Provides the purpose, scope and summary of the Publication and its organization.                                                                                                                                                                                                                                                                    |
| Chapter 2 | Description of Service: Presents the available functions, features and interface options of Synchronous Service Transport.                                                                                                                                                                                                                                        |
| Chapter 3 | Channel and Interface Specifications: Describes the physical electrical and optical interface ports offered by this service. Also briefly addresses the form and function of Network Channel codes and Network Channel Interface codes as they pertain to this service. Presents the electrical and optical interface configurations available with this service. |
| Chapter 4 | Performance Specifications: Furnishes expectations for accuracy, availability, and jitter.                                                                                                                                                                                                                                                                        |
| Chapter 5 | Maintenance Responsibilities: Provides the QWEST and corresponding customer responsibilities of this service.                                                                                                                                                                                                                                                     |
| Chapter 6 | Definitions: Presents a glossary of terms and a listing of acronyms related to the Publication.                                                                                                                                                                                                                                                                   |
| Chapter 7 | References: Provides titles and ordering information for documents referenced in this Publication.                                                                                                                                                                                                                                                                |

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## **2. Service Description**

### **2.1 General**

Synchronous Service Transport (SST) is a high capacity private line transport service that provides synchronous transmission at line transport rates of 51.840 Mbit/s, 155.52 Mbit/s, 622.08 Mbit/s 2.488 Gbit/s or 9.865 Gbit/s. SST's Synchronous Optic Transport provides Synchronous Optic NETWORK (SONET) based transport channels between:

- Customer designated premises through a local or remote QWEST Central Office.
- A customer designated premises and its QWEST serving wire center Central Office, known as the Hub.
- A customer designated premises and a remote QWEST Central Office.
- Two QWEST Central Offices.
- Two QWEST Central Offices and one or two customer designated premises with the Managed Bandwidth SONET Service (MBSS) option.

Point-to-point SST consists of a Central Office (CO) Node, possibly a Remote QWEST Premises or Central Office Node, a Remote Node and the SONET transport connecting the two nodes. CO and QWEST Premises Nodes are always QWEST owned and provisioned equipment. The Remote Node may be either QWEST owned and provided equipment or customer provided equipment. When the Remote Node is customer provided equipment QWEST shall identify equipment types compatible with the CO Node terminating equipment.

The MBSS option consists of a high capacity SONET ring with end point transport available in OC-12 increments. MBSS rings are either three or four node configurations. Each configuration contains a primary and a secondary QWEST Central Office node. The configuration may have a single customer premises or a pair of primary and secondary customer premises nodes. The primary and secondary QWEST Central Office node sites are specific wire centers where established, shared SONET ring infrastructure encompasses multiple wire centers throughout that particular Metropolitan Service Area (MSA). Wire centers with established shared SONET ring infrastructure are specified in the National Exchange Carrier Association Tariff, F.C.C. No. 4.

Wavelength Division Multiplexing (WDM) is not presently an option with this service.

## **2.2 Applications**

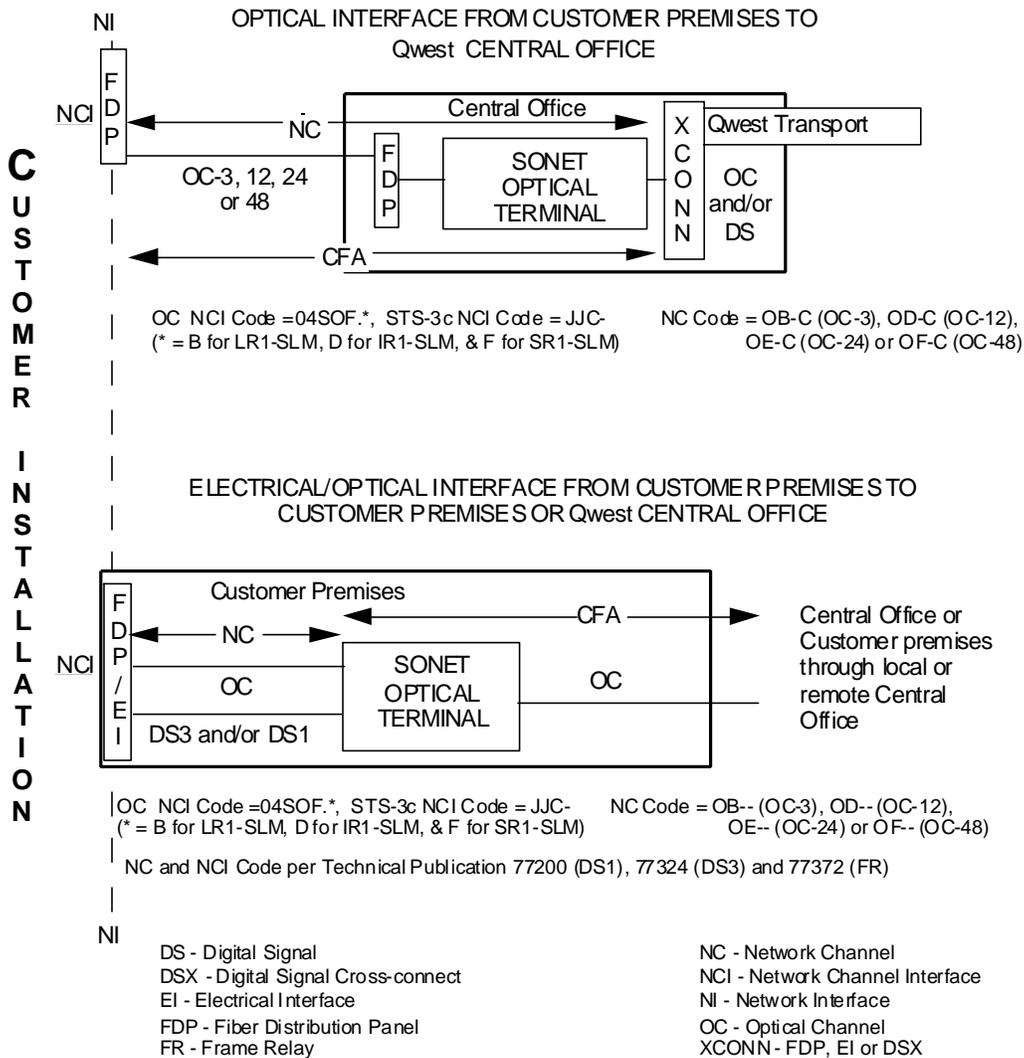
Synchronous Service Transport (SST) applications include:

- **Gather/Distribute** - The user collects a number of smaller bandwidth services and consolidates them over a single transport service. In a distribution application, a large bandwidth service is transported to a secondary location, then de-multiplexed into various smaller bandwidth services.
- **Big Pipe** - This is strictly a point to point transport of a large amount of data that exceeds DS3 capacities. For example; a large business may design and manufacture in multiple locations and needs very high speed connections between the sites.
- **Transport Facility** - This application is unique to SST. Many newer data protocols need broadband delivery systems and SST becomes that transport mechanism. An example is delivering video using Asynchronous Transfer Mode (ATM). ATM can also connect LANs.
- **MBSS Entrance Facility** - A SONET ring containing features that deliver an extreme level of survivability; designed to preclude any single event (including catastrophic events) from interrupting service to an entire MSA network. MBSS also manages provisioning of the customer's high capacity channels.

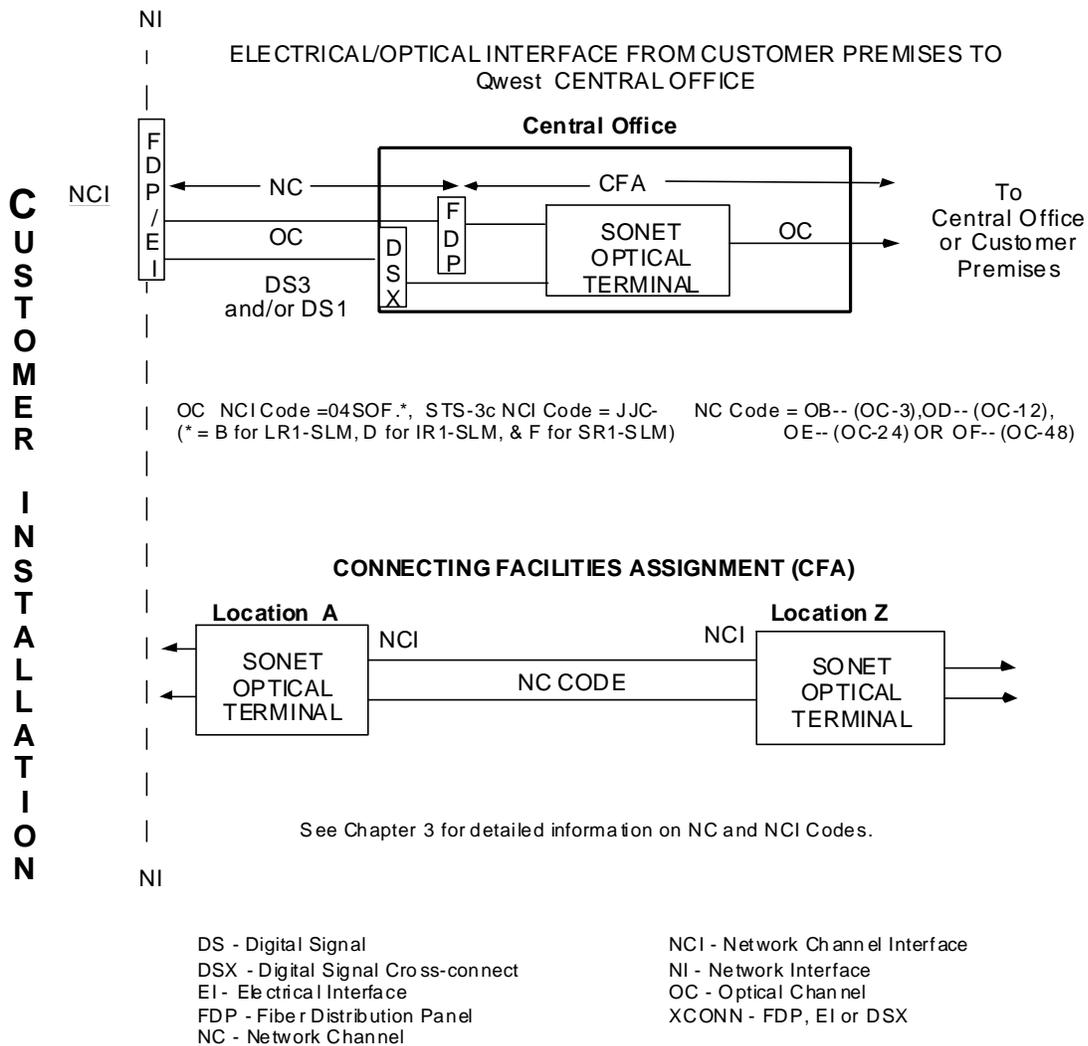
## **2.3 Interface Configurations**

### **2.3.1 Point-to-Point Applications**

Synchronous Service Transport (Synchronous Optical Transport) may be configured in many ways to meet most any customer transport requirement. Figures 2-1 and 2-2 illustrate typical Point-to-Point applications.



**Figure 2-1** Typical Network Interface Arrangements



**Figure 2-2** Typical Connecting Facility Assignment Arrangements

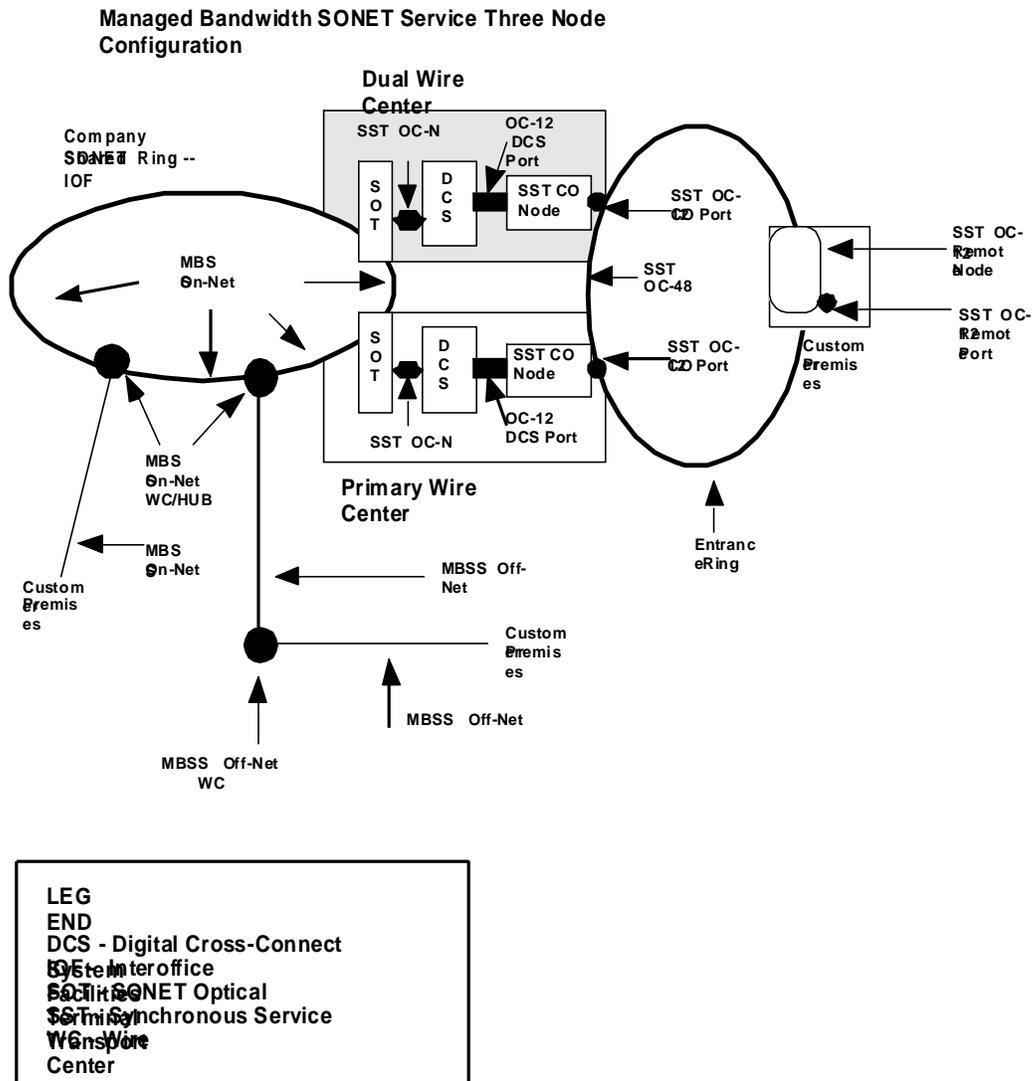
### **2.3.2 Managed Bandwidth SONET Service Applications**

Managed Bandwidth SONET Service uses SONET ring with additional technologies to deliver an extreme level of survivability; designed to preclude any single event (including catastrophic events) from interrupting service to an entire MSA network. SONET equipment continually monitors service quality and will automatically re-route around a point of failure using redundant protect components or physical protection paths. MBSS also manages the provisioning of the customer's high capacity channels.

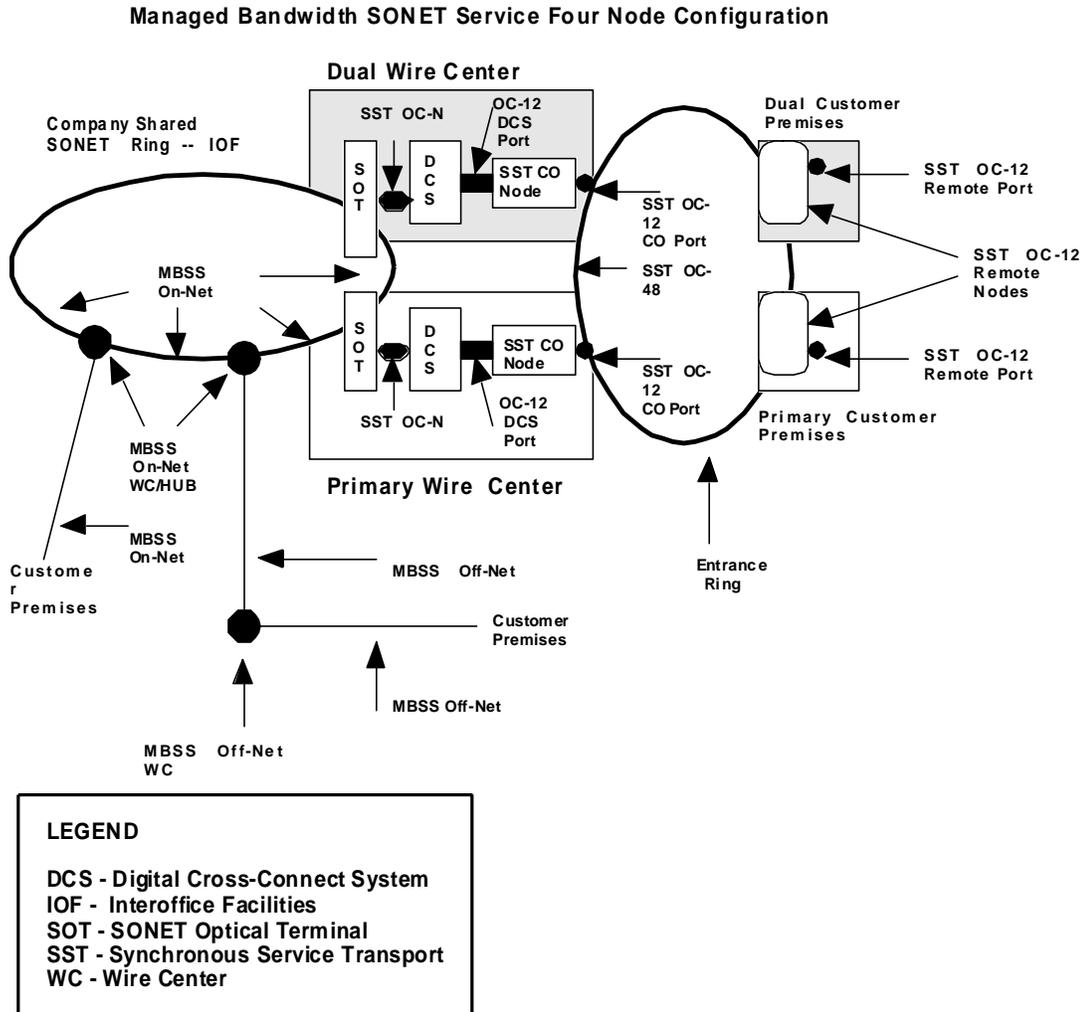
The MBSS option consists of a high capacity SONET ring with transport available in OC-12 increments. MBSS rings are either three or four nodes configuration. Each configuration always contains a primary and secondary QWEST Central Office nodes. The configuration may have either a single customer premises or a pair of primary and secondary customer premises nodes. The primary and secondary QWEST Central Office node sites are wire centers with established, shared SONET ring infrastructure that encompasses multiple wire centers throughout that particular Metropolitan Service Area (MSA). Wire centers with established shared SONET rings are specified in the National Exchange Carrier Association

Tariff F.C.C. No. 4.

Figures 2-3 and 2-4 illustrate typical Three and Four Node MBSS applications.



**Figure 2-3** Typical MBSS Arrangement in Three Node Configuration



**Figure 2-4** Typical MBSS Arrangement in Four Node Configuration

## 2.4 Interface Capacities Available

The following interface types are available on the corresponding transport capacities:

**Table 2-1** Interface Availability

INTERFACE TYPE	TRANSPORT CAPACITY						
	STS-1	OC-3	OC-3c*	OC-12	OC-24#	OC-48	OC-192
DS1	YES	YES	NO	YES	NO	NO	NO
DS3/STS-1	YES	YES	NO	YES	YES	YES	YES
STS-1	YES	YES	NO	YES	YES	YES	YES
OC-3	NO	YES	NO	YES	YES	YES	YES
OC-3 with an STS-3c	NO	NO	YES	YES	YES	YES	YES
OC-12	NO	NO	NO	YES	YES	YES	YES
DS1 & DS3/STS-1	NO	YES	NO	YES	NO	NO	NO
DS3/STS-1 & OC-3	NO	NO	NO	YES	YES	YES	YES
OC-3 & OC-12	NO	NO	NO	NO	YES	YES	YES
DS3/STS-1, OC-3 & OC-12	NO	NO	NO	NO	YES	YES	YES
OC-24	NO	NO	NO	NO	YES	YES	YES
OC-48	NO	NO	NO	NO	NO	YES	YES

Notes: \* The OC-3c Transport Capacity indicates a single OC-3 containing an STS-3c signal

# OC-24 is a capacity option. It does not reflect a specific transport line rate.

## 2.5 Transmux Capability

Transmux Capability is an optional SST feature, which affords the customer the possibility to have high bandwidth interfaces at one location connecting to lower bandwidth interfaces at another location. Traditional designs have been to ensure that circuits enter and leave a facility at the same bandwidth. Transmuxing allows multiple circuits to be aggregated into a single, larger channel. An example of this are DS1 services from a location passed to another location via an OC3. DS1s may be either DS3 or VT1.5 mapped into an STS1.

Table 2-2 lists the bandwidth options:

**Table 2-2** Transmux High and Low Bandwidth Possibilities.

High Bandwidth Interface	Transmuxed	Low Bandwidth Interface Possibilities
DS3/STS1	to	DS1
OC3	to	DS3/STS1
OC12	to	OC3/DS3/STS1
OC48	to	OC12/OC3/DS3/STS1

## 2.6 Allocated Bandwidth

The interface will make available the bandwidth of 2.4 Gbit/s, 622 Mbit/s and 155 Mbit/s and can be used for services requiring OC-48 and lower rates.

## 2.7 Performance Monitoring

Performance monitoring capability provides detailed, digital transmission quality information of a SST service to QWEST Operations Systems. The level of performance monitoring will vary depending upon the need for path or section and line overhead information. Path performance monitoring, appropriate to the ordered interfaces, is available with most network arrangements. Section and line information requires that the SST service be a private network. Performance monitoring is on a 24 hours, seven days a week basis.

Performance data collection refers to the accumulation for each of the performance parameters defined in ANSI T1.231-1997, *Telecommunications - Layer 1 In-Service Digital Transmission Performance Monitoring*. The network terminating equipment may monitor only two directions (i.e., near-end, far-end) and collect parameters shown as required. For a given monitored entity, certain performance parameters are inhibited during periods of unavailability, during Severely Errored Seconds, or during seconds containing defects on that monitored entity. Inhibiting on a given monitored entity (such as a DS1 path) is not explicitly affected by conditions on any other monitored entity (such as a DS1 line).

The inhibiting rules are as follows:

- Unavailable Second, Failure Count, Protection Switching Count, and Protection Switching During parameter counts shall not be inhibited.
- All other performance parameter counts shall be inhibited during Unavailable Second, when the Unavailable Second parameter is implemented.
- The Code Violation parameter count shall be inhibited during Severely Errored Seconds when the Severely Errored Seconds parameter is implemented.

- When the Severely Errored Seconds parameter is not implemented the Code Violation parameter count shall be inhibited during seconds containing one or more defects.

For entities where no Unavailable Second parameter is defined, there shall be no inhibiting of performance parameter counts except for the Code Violation parameter as described above.

ANSI T1.231 contains SONET parameter definitions.

## **2.8 Data Communications Channel**

The Data Communications Channel (DCC) will be turned off from the network providers last network element to the customer's equipment. This is per GR-253-CORE. Without the Data Communications Channel, the network provider will not have an operations interface to customer equipment and the customer will not have an interface into the operations communications functions.

When a customer is the sole user of the network; the Data Communications Channel can be left on. If additional users are added to a network, which had a single customer using the DCC, the DCC shall be turned off.

## **2.9 Point-to-Point Transport's Protection Configuration**

Protect path diversity is provided, where available, with Synchronous Service Transport. Protect path diversity provides loop and Inter-Office Facility (IOF) diversity. Protect path diversity provides a "standby" protect fiber path that is routed over facilities separated from the normal path by a minimum of 25 feet, from the first utility vault outside the serving wire center CO to the last utility vault or terminal before the customer premises. The alternate path provides enhanced protection to the customer against an accidental cutting of the working path facility. If special construction charges are required to build an alternate facility route, QWEST will present the customer with the option of having SST service without diversity. Standard SONET redundancy of optical fibers and equipment is always provided with an SST service.

SST provides transport protection on a 1+1, non-revertive basis. The 1+1 protection is defined as: An architecture in which the head-end signal is permanently bridged (at the electrical level) to working and protect equipment to enable the same payload to be transmitted identically to the tail-end working and protect equipment. At the tail end, each working and protect optical signal is monitored independently and identically for failures. The receiving equipment selects either the working or the protected signal as the one that carries traffic, based on the switch initiation criteria.

Equipment protection will be provided with redundancy of components and 1:N protection of service affecting plug-in units. A 1:N protection scheme is an architecture in which any of the N working units can be bridged to a single protected unit. Permissible values of N are from 1 to 14.

### **2.10 Synchronization**

Synchronization, as used here, refers to an arrangement for operating digital transmission and switching systems at a common (or synchronized) clock rate. A main feature of SONET, and an important difference from early and proprietary optical transmission systems, is that it is synchronous. As a SONET based, synchronous system SST requires integration into the global synchronization network. Further information on synchronization is in Bellcore Publications GR-436-CORE, *Digital Network Synchronization Plan*, and GR-378-CORE, *Timing Signal Generator (TSG) Requirements and Objectives*.

QWEST Central Office equipment will have a timing source traceable to a Stratum 1 level source. Additionally, where the customer chooses to interface DS1 or DS3 services to SST, customer installed equipment must have a timing source traceable to a Stratum 1 level source. See QWEST Technical Publication 77386 for details on QWEST synchronization services.

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### **3. Network Interfaces**

#### **3.1 Applicability of Technical Specifications**

Technical specifications presented in this document are applicable to QWEST Synchronous Service Transport (Synchronous Optical Transport) only. This document does not attempt to describe the various types of transmission equipment used to provide this interface. Since Managed Bandwidth SONET Service is a special application, there is a limited set of transport type and interface combinations available. Please see Sections 3.13 and 3.18 on MBSS for details.

#### **3.2 QWEST Synchronous Service Transport Interfaces**

Synchronous Service Transport (SST) (Synchronous Optical Transport) will be provisioned on Synchronous Optical Network (SONET) based fiber optic systems. Transmission standards employed will be SONET as defined in ANSI T1.105-1995, *Telecommunications - Digital Hierarchy-Optical Interface Rates and Formats Specifications (SONET)* which defines the North American version of the Synchronous Digital Hierarchy (SDH). This interface is also in accordance with ANSI T1.105.06-1996, *Telecommunications - Synchronous Optical Network (SONET): Physical Layer Specifications*. This technology allows QWEST to transport, provision and to deliver interfaces at the DS1, DS3, OC-3, OC-12, OC-48 and OC-192 levels.

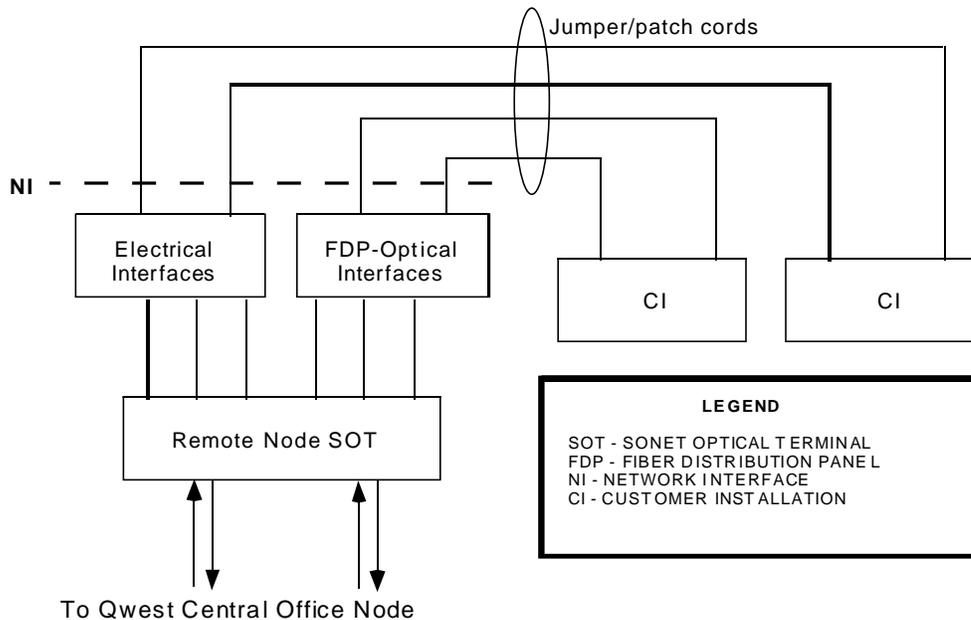
#### **3.3 Interface Overview**

Electrical interfaces will be delivered to the Network Interface per this publication and QWEST Technical Publication 77375, *QWEST 1.544 Mbit/s Channel Interfaces, Technical Specifications for Network Channel Interface Codes Describing Electrical Interfaces at Customer Premises and at QWEST Communications, Inc. Central Offices*, and Publication 77324, *QWEST Technical Specifications DS3 Service*.

Optical interfaces will be delivered to the Network Interface at a QWEST provided Fiber Distribution Panel or an equivalent, or the end of a fiber optic cable. All interfaces shall be equipped to terminate FC-PC type connectors. The FC-PC type connector is a 2.5 mm ferrule, keyed bayonet format connector with performance parameters suitable for SONET transport. The Network Interface must be located in an accessible, environmentally controlled space. To be accessible, QWEST technicians must be able to work and perform tests at the NI without delay, at any time of day, any day of the year.

### 3.4 Available Interface Types

Figure 3-1 illustrates interfaces between an SST Remote Node and customer installed equipment. The following subsections detail applicable characteristics for electrical and optical Network Interfaces. The SST customer shall provide jumper/patch cords connecting their equipment to the Network Interfaces.



**Figure 3-1** Network Interfaces

#### 3.4.1 DS1 Interface

DS1 channels are provided to Carrier's and to End-User's (EU's) premises. The Network Interface (NI) at a Carrier premises will be at the end of a DSX-1 jumper wire or cable with signal characteristics described in QWEST Technical Publication 77375.

The NI at an EU customer premises may be either a DSX-1 interface or a conventional interface. Signal characteristics, limitations, and the physical means of connection at the NI for each interface are described in QWEST Technical Publication 77375 which should be studied before a selection is made. Conventional interfaces use one of the Registration Jacks described by the three Universal Service Ordering Codes (USOC) RJ48C, RJ48M and RJ48H. Conventional interfaces are available with MBSS Arrangements where the end user's premises is not served by an on-site, optic terminal. In all other situations, conventional interface requests require special ordering.

Additional information on the physical DS1 and DSX-1 NI configurations may be found in QWEST Technical Publication 77375.

### **3.4.2 DS3 Interface**

DS3 channel services terminate at NIs located at the premises of a Carrier or End-User (EU).

The Network Interface to a Carrier Customer will be at the DSX-3 cross connect panel with signal characteristics described in QWEST Technical Publication 77324.

Carrier Customers have two options at their premises:

- Carrier Customers may elect to terminate their cables on the QWEST DSX-3 cross-connect panel in the space provided for QWEST 's transmission equipment.
- Have QWEST terminate QWEST cable on the Carrier's DSX-3 cross-connect panel located in the Carrier's workspace.

The NI to an EU customer will be SJA44 connectors with signal characteristics described in QWEST Technical Publication 77324.

### **3.4.3 STS-1 Interface**

STS-1 channel services terminate at NIs located at the premises of a Carrier or End-User.

For the DS1 multiplexing option, the STS-1 must be comprised of a bulk-mapped DS3 or be Virtual Tributary (VT) structured, containing 28 VT1.5's. Since there presently are no available VT1.5 interfaced service offerings, each VT1.5 (1.728 Mbit/s) shall have a DS1 payload mapped into it. The signal mappings shall conform to ANSI T1.105-1995, *Telecommunications - Digital Hierarchy-Optical Rates and Formats (SONET)* and Bellcore GR-253-CORE, *Synchronous Optical Network (SONET) Transport Systems: Common Criteria*.

The STS-1 interface at an end user 's premises will be an SJA44 connector interface, delivered from QWEST owned Line Terminating Equipment (LTE). The STS1 interface at a Carrier premises will be at a cross-connect panel dedicated for STS-1 use. The signal characteristics shall conform to those described in ANSI T1.102-1993, *Telecommunications - Digital Hierarchy-Electrical Interfaces* and Bellcore GR-253-CORE.

As with DS3 Service, Carrier Customers have two options at their premises:

- Terminate their cables on the QWEST cross-connect panel in the space provided for QWEST 's transmission equipment.

- Have QWEST terminate QWEST 's cable on the Carrier's cross-connect panel located in the Carrier's workspace.

#### **3.4.4 OC-3 Interface**

An OC-3 interface provides a high capacity channel for the transmission of 155.52 Mbit/s, using an optical interface, delivered from QWEST owned Line Terminating Equipment.

#### **3.4.5 OC-12 Interface**

The OC-12 interface provides a high capacity channel for the transmission of 622.08 Mbit/s, using an optical interface, delivered from QWEST owned Line Terminating Equipment.

#### **3.4.6 OC-24 Interface**

An OC-24 interface provides a high capacity channel for the transmission of 1.244 Gbit/s, using combinations of varying capacities at the discretion of QWEST. Usually the transport is an OC-48, 2.488 Gbit/s optical path, partially equipped, delivered from QWEST owned Line Terminating Equipment.

#### **3.4.7 OC-48 Interface**

An OC-48 interface provides a high capacity channel for the transmission of 2.488 Gbit/s, using an optical interface, delivered from QWEST owned Line Terminating Equipment.

#### **3.4.7 OC-192 Interface**

An OC-192 interface provides a high capacity channel for the transmission of 9.865 Gbit/s, using an optical interface, delivered from QWEST owned Line Terminating Equipment. The OC-192 shall be a linear interface.

### **3.5 STS Concatenation**

Multiples of Synchronous Transport Signal level 1 (STS-1) rates are needed for Super-Rate services that require greater bandwidth. Super-Rate services can include broadband Integrated Services Digital Network (ISDN) channels, or Asynchronous Transfer Mode (ATM) service. To provide Super-Rate services, the bandwidth of n STS-1's are linked (concatenated) to create an individual STS-nc circuit of a greater bandwidth. The STS-nc can be transported by an OC-n (or higher level) line signal.

QWEST offers interfaces listed below that are capable of carrying three or 12 concatenated STS-1's known as STS-3c or STS-12c circuits with transmission rates of 155.52 Mbit/s and 622.08 Mbit/s respectively. STS-nc signals are provided using equipment that meets technical and operational requirements specified in

GR-253-CORE, *Synchronous Optical Network (SONET) Transport Systems: Common Criteria*.

- OC-3 Interface - One STS-3c can be transported on an OC-3
- OC-12 Interface - One STS-12c or four STS-3c's can be transported on an OC-12
- OC-24 Interface - Two STS-12c's or eight STS-3c's can be transported on an OC-24
- OC-48 Interface - One STS-48c, or Four STS-12c's or 16 STS-3c's can be transported on an OC-48.
- OC-192 Interface - Four STS-48c's, or 16 STS-12c's or 64 STS-3c's can be transported on an OC-192.

### **3.6 Signal Formats**

The DS1, DS3, STS-1, OC-3, OC-12, OC-48 and OC-192 signal interfaces provided by QWEST, conform to: ANSI T1.105-1995, *Telecommunications - Digital Hierarchy-Optical Interface Rates and Formats Specifications (SONET)*, ANSI T1.102-1993, *Telecommunications - Digital Hierarchy - Electrical Interfaces*, and ANSI T1.107-1995, *Telecommunications - Digital Hierarchy - formats specifications*.

Any variations from ANSI T1.105.06-1996, *Telecommunications - Digital Hierarchy - Optical Interface Specifications (Single Mode)*, are available in QWEST Network Disclosure document #91.

QWEST Technical Publications 77375, *1.544 Mbit/s Channel Interfaces* and 77324, *QWEST DS-3 Service*, provide full details on available DS1 and DS3 interfaces.

### **3.7 Additional Options Available**

*Self Healing Alternate Route Protection*, Technical Publication 77340, and *Diversity and Avoidance*, Technical Publication 77344, are available options to this point-to-point service. These options are in no way unique to the interface.

### 3.8 Optical Interface Power Levels

It is the transmitting party's responsibility to achieve the minimum interface power. Not all interface types are available at all locations. The optical power level at the interface shall meet the minimum fixed power point levels listed in Table 3-1:

**Table 3-1** Minimum Fixed Optical Power Point

Interface	Rate	Minimum Fixed Power Point
Long Reach -- Single Longitudinal Mode		
OC-3	155.52 Mbit/s	- 20 dBm
OC-12	622.08 Mbit/s	- 17 dBm
OC-24	2.488 Gbit/s *	-17 dBm
OC-48	2.488 Gbit/s	-17 dBm
OC-192	9.865 Gbit/s	-17 dBm
Intermediate Reach -- Single Longitudinal Mode		
OC-3	155.52 Mbit/s	- 20 dBm
OC-12	622.08 Mbit/s	- 19 dBm
OC-24	2.488 Gbit/s *	-11 dBm
OC-48	2.488 Gbit/s	-11 dBm
Short Reach -- Multi-Longitudinal Mode		
OC-3	155.52 Mbit/s	- 19 dBm
OC-12	622.08 Mbit/s	- 19 dBm

\* While the equipped channel capacity is of an OC-24 the line rate is that of an OC-48.

QWEST and customer signal parameters at network electrical interfaces are provided in Technical Publications 77324 and 77375 for DS1 and DS3, respectively.

### 3.9 NC and NCI Codes

Network Channel (NC) and Network Channel Interface (NCI) codes convey service and technical parameters. The following sections explain the codes in a general manner and provide code combinations to aid in ordering the QWEST network interface for Synchronous Service Transport. The NC and NCI codes are provided by the customer to the QWEST Service Representative at the time a request for service is initiated.

Additional information concerning NC/NCI Codes is available in ANSI T1.223-1991, *Information Interchange- Structure and representation of Network Channel (NC) and Network Channel Interface (NCI) codes for North American Telecommunications Systems*. See Chapter 7 for ordering information.

In some instances, QWEST offerings differ from those described by Bellcore in their published Industry Support Interface, ISI-SR-ST5 000307, *NC/NCI Code Dictionary*. Furthermore, definitions of NC and NCI's evolve. Therefore, it is important to request QWEST Services as defined in this Publication.

### 3.10 NC Code Function and Format

Primarily, service considerations are encoded into Network Channel (NC) codes. The 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. The NC code is specified by the customer to advise QWEST of the required service connection of the channel.

An NC code consists of four alpha/numeric characters, which may include a dash (-). There are neither spaces nor delimiters between the characters.

- For electrical channel DS1 interfaces, the first two characters are HC. For additional information, see *QWEST DS1 Service*, Publication 77200.
- For electrical channel DS3 interfaces, the first two characters are HF. For additional information, see Technical Publication 77324.
- For electrical channel STS-1 interfaces, the first two characters are JI.
- For optical channel interfaces, the first two characters are OB or JJ (OC-3), OD (OC-12), OE (OC-24) and OF (OC-48). An example of this form is OB--.

The third and fourth characters are variable to denote additional protocols and service features as described in the following sections.

The customer must specify NC codes for the desired service when ordering High Capacity Digital services.

### 3.11 Available Network Channel Codes

Table 3-2 lists Network Channel codes available for QWEST Optical Transport.

**Table 3-2** SONET and DS3 NC Codes available with SST

NC Code	Description
OB--	OC-3 SONET Point-to-Point
OB-C	OC-3 SONET Point-to-Point with Central Office Multiplexing
OB-D	OC-3 SONET Point-to-Point with Field-End Multiplexing
OB-E	OC-3 SONET Point-to-Point with Multiplexing both ends
OB-R	OC-3 SONET Point-to-Point, STS3c Payload
OBAQ	OC-3 SONET Point-to-Point, Loop timing, Termination on a higher bit rate Add-Drop Multiplexer
OD--	OC-12 SONET Point-to-Point
OD-C	OC-12 SONET Point-to-Point with Central Office Multiplexing
OD-D	OC-12 SONET Point-to-Point with Field-End Multiplexing
OD-E	OC-12 SONET Point-to-Point with Multiplexing both ends
OD-R	OC-12 SONET Point-to-Point, STS12c Payload
ODAQ	OC-12 SONET Point-to-Point, Loop timing, Termination on a higher bit rate Add-Drop Multiplexer
OE--	OC-24 SONET Point-to-Point
OE-C	OC-24 SONET Point-to-Point with Central Office Multiplexing
OE-D	OC-24 SONET Point-to-Point with Field-End Multiplexing
OE-E	OC-24 SONET Point-to-Point with Multiplexing both ends
OF--	OC-48 SONET Point-to-Point
OF-C	OC-48 SONET Point-to-Point with Central Office Multiplexing
OF-D	OC-48 SONET Point-to-Point with Field-End Multiplexing
OF-E	OC-48 SONET Point-to-Point with Multiplexing both ends
OF-R	OC-48 SONET Point-to-Point, STS48c Payload
OFAQ	OC-48 SONET Point-to-Point, Loop timing, Termination on a higher bit rate Add-Drop Multiplexer
OG--	OC-192 SONET Point-to-Point
OG-C	OC-192 SONET Point-to-Point with Central Office Multiplexing
OG-D	OC-192 SONET Point-to-Point with Field-End Multiplexing
OG-E	OC-192 SONET Point-to-Point with Multiplexing both ends

**Table 3-2** SONET and DS3 NC Codes available with SST (Continued)

NC Code	Description
J1--	Point-to-Point, STS-1 Channel
J1-A	Point-to-Point, STS-1 Channel with an asynchronously mapped DS3 and Central Office Multiplexing to DS1 Services
J1-B	Point-to-Point, STS-1 Channel with an asynchronously mapped DS3 and Field End Multiplexing to DS1 Services
J1A-	Point-to-Point, STS-1 Channel VT1.5 structured
J1AA	Point-to-Point, STS-1 Channel VT1.5 structured and Central Office Multiplexing to DS1 Services
J1AB	Point-to-Point, STS-1 Channel VT1.5 structured and Field End Multiplexing to DS1 Services
J1G-	Point-to-Point, External Timing STS-1
J2G-	Point-to-Point, External Timing STS-3
J2C-	Point-to-Point, Concatenated STS-3c
J2E-	Point-to-Point, External Timing, Concatenated STS-3c
J3G-	Point-to-Point, External Timing STS-12
J3D-	Point-to-Point, Loop Timing, Concatenated STS-12c
J3E-	Point-to-Point, External Timing, Concatenated STS-12c
HF-Q	DS3 Channel, Customer Premises Multiplexing, M2/3 Format
HF-M	DS3 Channel, Central Office Multiplexing
HFCQ	DS3 Channel, C-Bit Parity, Customer Premises Multiplexing

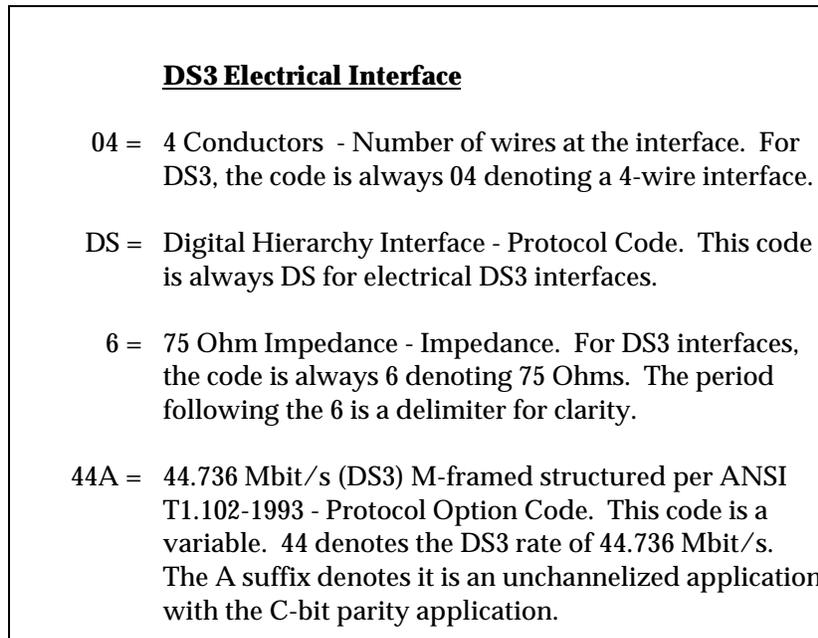
### 3.12 NCI Code Form and Components

The full NCI code format has fields not used for digital services. Only those fields relevant to digital interfaces are discussed here.

An NCI code has the form 04DS6.44A. The period between the numbers is a delimiter, which is used for improved clarity. It causes the Protocol Option Code, discussed later, to stand out. An NCI code has no dashes (-).

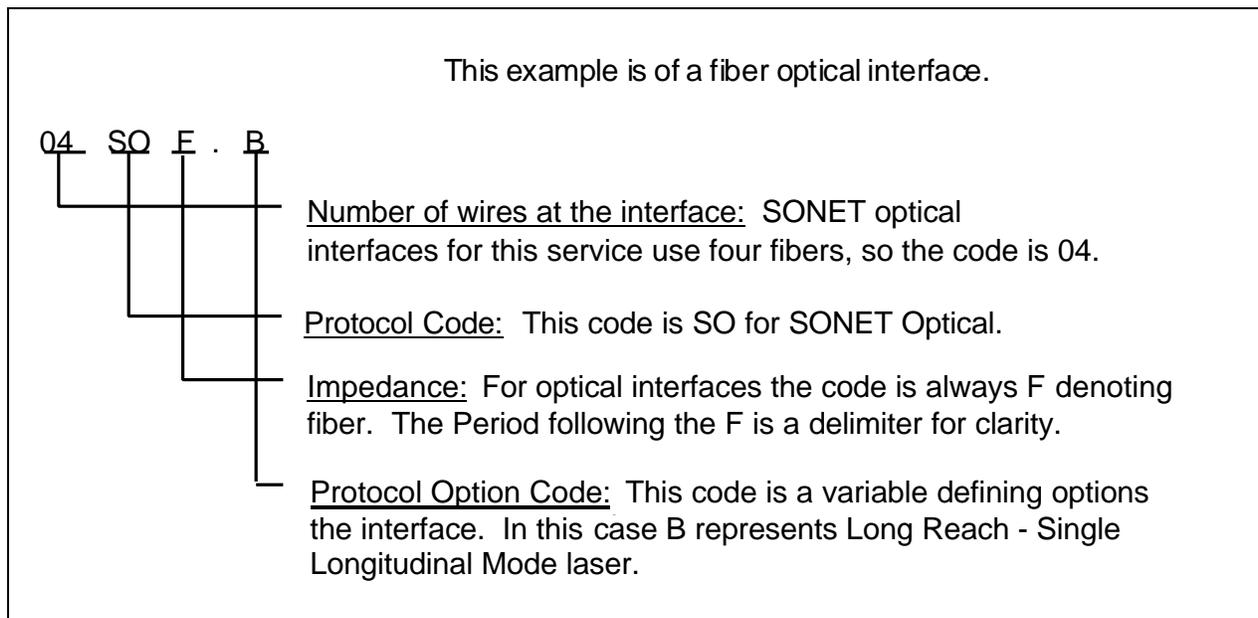
Digital NCI Codes have four components. Figure 3-2 provides an example of an electrical DS3 interface NCI code. For complete information on DS1, refer to Technical Publication 77375, *1.544 Mbit/s (DS1) Channel Interfaces*. For complete DS3 information, refer to Technical Publication 77324, *QWEST DS3 Service*.

The following example, 04DS6.44A, is the DS3 M-frame structured signal. It is an unchannelized application, supporting a user payload of 44.210 Mbit/s per ANSI T1.107-1995, *Digital Hierarchy -Formats Specifications*. It may or may not use the C-bit parity application per ANSI T1.107-1995.



**Figure 3-2** Electrical DS3 NCI Code Example

Figure 3-3 illustrates a SONET Optical Network Channel Code.



**Figure 3-3** Optical NCI Code Example

### 3.13 Available Electrical NCI Codes

The electrical NCI codes listed in Table 3-3 are available with QWEST Synchronous Service Transport (Synchronous Optical Transport).

**Table 3-3** Electrical Network Channel Interface (NCI) Codes  
QWEST Synchronous Service Transport

NCI Code	QWEST Synchronous Service Transport – Electrical Interfaces
<b>04ST6.A</b>	<b>STS-1 Electrical Interface</b> STS-1 Synchronous Transmission Signal level 1
<b>04DS6.44</b>	<b>DS3 Electrical Interfaces</b> (See QWEST Technical Publication 77324) DS3 M-frame structured signal with M23 Multiplex format (28 DS1 Channels)
<b>04DS6.44A</b>	DS3 M-frame structured signal, C-bit parity – unchannelized
<b>04DS6.44R</b>	DS3 M-frame structured signal – unchannelized
<b>04DS6.44I</b>	DS3 M-frame structured signal with M23 Multiplex format and C-bit parity
<b>04DS9.15</b>	<b>DS1 Electrical Interfaces</b> (See QWEST Technical Publication 77375) DS1 Carrier or QWEST CO Premises Interface, SF with AMI
<b>04DS9.15B</b>	DS1 Carrier or QWEST CO Premises Interface, SF with B8ZS
<b>04DS9.15K</b>	DS1 Carrier or QWEST CO Premises Interface, non-ANSI ESF with AMI
<b>04DS9.15S</b>	DS1 Carrier or QWEST CO Premises Interface, non-ANSI ESF with B8ZS
<b>04DS9.1K</b>	DS1 Carrier or QWEST CO Premises Interface, ANSI ESF with AMI
<b>04DS9.1S</b>	DS1 Carrier or QWEST CO Premises Interface, ANSI ESF with B8ZS
<b>04DS9.15J</b>	DS1 Carrier or QWEST CO Premises Interface, Free Framing with B8ZS
<b>04DU9.AX</b>	DS1 End-User Premises Interface, Free Framing/B8ZS/DSX-1
<b>04DU9.BX</b>	DS1 End-User Premises Interface, SF/AMI/DSX-1 Interface
<b>04DU9.CX</b>	DS1 End-User Premises Interface, non-ANSI ESF/AMI/DSX-1 Interface
<b>04DU9.DX</b>	DS1 End-User Premises Interface, SF with B8ZS/DSX-1 Interface
<b>04DU9.SX</b>	DS1 End-User Premises Interface, non-ANSI ESF/B8ZS/DSX-1 Interface
<b>04DU9.1KX</b>	DS1 End-User Premises Interface, ANSI ESF/AMI/DSX-1 Interface
<b>04DU9.1SX</b>	DS1 End-User Premises Interface, ANSI ESF/B8ZS/DSX-1 Interface

AMI = Bipolar Alternate Mark Inversion line code.

B8ZS = Binary, 8 zero substitution line code.

ESF = Extended Superframe format. ANSI ESF - Format: reference ANSI T1 403.1995.  
Non-ANSI ESF - Format: reference AT&T PUB 54016.

SF = Superframe format.

### 3.14 Available Optical NCI Codes

The SONET optical NCI codes listed in Table 3-4 are available with QWEST Synchronous Service Transport (Synchronous Optical Transport).

**Table 3-4** Optical Interface NCI Codes (SONET)

NCI CODE	DESCRIPTION	Application
04SOF.F	SR-MLM (Short Reach - Multi--Longitudinal Mode)	Digital fiber optic interface: OC-3 and OC-12 *
04SOF.D	IR1-SLM (Intermediate Reach - Single - Longitudinal Mode)	Digital fiber optic interface: OC-3, OC-12 and OC-48 *
04SOF.B	LR1-SLM (Long Reach - Single-Longitudinal Mode)	Digital fiber optic interface: OC-3, OC-12, OC-48 and OC-192 *
02SOF.F	SR-MLM (Short Reach - Multi-Longitudinal Mode)	Digital fiber optic interface: OC-3 *
02SOF.D	IR1-SLM (Intermediate Reach - Single - Longitudinal Mode)	Digital fiber optic interface: OC-3, OC-12 and OC-48 *
02SOF.B	LR1-SLM (Long Reach - Single-Longitudinal Mode)	Digital fiber optic interface: OC-3, OC-12, OC-48 and OC-192 *

\* An NC Code is required in addition to the Optical Interface NCI Code to identify the service application and effective rate of OC-3, OC-12, OC-24, OC-48 or OC-192.

- Notes:
1. Not all interfaces are available for every SONET rate.
  2. Two fiber interfaces apply only to customer premises interfaces where four-fiber transport protection is provided by QWEST, on-site, SONET Line or Path Terminating Equipment. Customers may request two fiber interfaces without SONET based transport protection architecture. In those cases, normal service objectives do not apply.

The optical NCI codes listed above can be combined at the Remote Node, SONET Optical Terminal (SOT) and/or over Carrier Facility Assignment (CFA) facilities in many combinations. Low speed drops of a SONET terminal can not be connected through the equipment to other low speed drops of the same equipment. The sum of the optical low speed drops can only be equal to or less than the high speed SST optical capacity level delivered to that particular SOT from the QWEST Central Office Node (see Figure 3-1). SST service can establish multiple Remote Nodes at a site to fill the needs of almost any bandwidth requirement.

### 3.15 Available SONET Optical Multiplexer Configuration Network Channel Interface Codes

When an SST service is ordered with Multiplexing Options, the order must specify NCI codes that describe the configuration of each Central Office and Remote Node multiplexer. The following tables list Multiplexer Network Channel Interface Codes available with SST service. For example, an order stipulates the NCI Code 04SMF.D21 from Table 3-6. This code calls for an OC-12 capacity SONET Optical Multiplexer that shall provide capabilities for three OC-3 interface ports, two DS3 or STS-1 interface ports and 28 DS1 interface ports. Supplementary order activity provides NC/NCI code information on the application of each individual port.

#### 3.15.1 OC-3 Optical Multiplexer Configuration NCI Codes

Table 3-5 lists NCI codes for QWEST Optical Transport SONET Optical multiplexer operating at the OC-3 rate.

**Table 3-5** Configuration Network Channel Interface (NCI) Codes - OC-3 SONET Optical Multiplexer or equivalent

CONFIGURATION NCI CODE	QUANTITY OF OC-3's	QUANTITY OF DS3' s/STS-1's	QUANTITY OF DS1's
One Code must be specified at each Multiplexer Site			
04SMF.A3	0	3	0
04SMF.A21	0	2	28
04SMF.A12	0	1	56
04SMF.A03	0	0	84

### 3.15.2 OC-12 Optical Multiplexer Configuration NCI Codes

Table 3-6 lists NCI codes for QWEST Optical Transport SONET Optical Multiplexer operating at the OC-12 rate.

**Table 3-6** Configuration Network Channel Interface (NCI) Codes - OC-12 SONET Optical Multiplexer or equivalent

CONFIGURATION NCI CODE	QUANTITY OF OC-3's	QUANTITY OF DS3' s/STS-1's	QUANTITY OF DS1's
One Code must be specified at each Multiplexer Site			
04SMF.E0	4	0	0
04SMF.D3	3	3	0
04SMF.D21	3	2	28
04SMF.D12	3	1	56
04SMF.D03	3	0	84
04SMF.C6	2	6	0
04SMF.C51	2	5	28
04SMF.C42	2	4	56
04SMF.C33	2	3	84
04SMF.C24	2	2	112
04SMF.C15	2	1	140
04SMF.C06	2	0	168
04SMF.B9	1	9	0
04SMF.B81	1	8	28
04SMF.B72	1	7	56
04SMF.B63	1	6	84
04SMF.B54	1	5	112
04SMF.B45	1	4	140
04SMF.B36	1	3	168
04SMF.B27	1	2	196
04SMF.B18	1	1	224
04SMF.B09	1	0	252
04SMF.AC	0	12	0

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**Table 3-6** Configuration Network Channel Interface (NCI) Codes -  
 OC-12 SONET Optical Multiplexer (Continued)

CONFIGURATION NCI CODE	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's	QUANTITY OF DS1's
One Code must be specified at each Multiplexer Site			
04SMF.AB1	0	11	28
04SMF.AA2	0	10	56
04SMF.A93	0	9	84
04SMF.A84	0	8	112
04SMF.A75	0	7	140
04SMF.A66	0	6	168
04SMF.A57	0	5	196
04SMF.A48	0	4	224
04SMF.A39	0	3	252
04SMF.A2A	0	2	280
04SMF.A1B	0	1	308
04SMF.A0C	0	0	336

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

### 3.15.3 OC-24 Optical Multiplexer Configuration NCI Codes

Table 3-7 lists NCI codes for QWEST Optical Transport SONET Optical Multiplexer operating at the OC-24 rate.

**Table 3-7** Configuration Network Channel Interface (NCI) Codes -  
OC-24 (Virtual) SONET Optical Multiplexer or equivalent

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.C	2	0	0
04SNF.B4	1	4	0
04SNF.B31	1	3	3
04SNF.B22	1	2	6
04SNF.B13	1	1	9
04SNF.B04	1	0	12
04SNF.A8	0	8	0
04SNF.A71	0	7	3
04SNF.A62	0	6	6
04SNF.A53	0	5	9
04SNF.A44	0	4	12
04SNF.A35	0	3	15
04SNF.A26	0	2	18
04SNF.A17	0	1	21
04SNF.A08	0	0	24

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**3.15.4 OC-48 Optical Multiplexer Configuration NCI Codes**

Table 3-8 lists NCI codes for QWEST Optical Transport SONET Optical Multiplexer operating at the OC-48 rate.

**Table 3-8** Configuration Network Channel Interface (NCI) Codes - OC-48 SONET Optical Multiplexer or equivalent.

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.E	4	0	0
04SNF.D4	3	4	0
04SNF.D31	3	3	3
04SNF.D22	3	2	6
04SNF.D13	3	1	9
04SNF.D04	3	0	12
04SNF.C8	2	8	0
04SNF.C71	2	7	3
04SNF.C62	2	6	6
04SNF.C53	2	5	9
04SNF.C44	2	4	12
04SNF.C35	2	3	15
04SNF.C26	2	2	18
04SNF.C17	2	1	21
04SNF.C08	2	0	24
04SNF.BC	1	12	0
04SNF.BB1	1	11	3
04SNF.BA2	1	10	6
04SNF.B93	1	9	9
04SNF.B84	1	8	12
04SNF.B75	1	7	15
04SNF.B66	1	6	18

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**Table 3-8** Configuration Network Channel Interface (NCI) Codes -  
OC-48 SONET Optical Multiplexer. (Continued)

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.B57	1	5	21
04SNF.B48	1	4	24
04SNF.B39	1	3	27
04SNF.B2A	1	2	30
04SNF.B1B	1	1	33
04SNF.B0C	1	0	36
04SNF.AG	0	16	0
04SNF.AF1	0	15	3
04SNF.AE2	0	14	6
04SNF.AD3	0	13	9
04SNF.AC4	0	12	12
04SNF.AB5	0	11	15
04SNF.AA6	0	10	18
04SNF.A97	0	9	21
04SNF.A88	0	8	24
04SNF.A79	0	7	27
04SNF.A6A	0	6	30
04SNF.A5B	0	5	33
04SNF.A4C	0	4	36
04SNF.A3D	0	3	39
04SNF.A2E	0	2	42
04SNF.A1F	0	1	45
04SNF.A0G	0	0	48

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**3.15.5 OC-192 Optical Multiplexer Configuration NCI Codes**

Table 3-9 shows the general structure for determining NCI codes for QWEST Optical Transport SONET Optical Multiplexer operating at the OC-192 rate. OC-192 Multiplexers can provide OC-12 through DS3 or STS-1 interfaces. Not all logically possible combinations are available. Table 3-10 lists the available codes.

**Table 3-9** General Configuration Network Channel Interface (NCI) Codes -- OC-192 SONET Optical Multiplexer

CONFIGURATION NCI CODE Positions 1 through 6	QUANTITY OF OC-12's  Position 7	QUANTITY OF OC-3's  Position 8	QUANTITY OF DS3's/STS-1's  Position 9
04SNF.	A = 0	0 = 0	1 = 3
	B = 1	1 = 1	2 = 6
	C = 2	2 = 2	3 = 9
	D = 3	3 = 3	4 = 12
	E = 4	4 = 4	5 = 15
	F = 5	5 = 5	6 = 18
	G = 6	6 = 6	7 = 21
	H = 7	7 = 7	8 = 24
	I = 8	8 = 8	9 = 27
	J = 9	9 = 9	A = 30
	K = 10	A = 10	B = 33
	L = 11	B = 11	C = 36
	M = 12	C = 12	D = 39
	N = 13	D = 13	E = 42
	O = 14	E = 14	F = 45
	P = 15	F = 15	G = 48

**Table 3-9** General Configuration Network Channel Interface (NCI) Codes -  
OC-192 SONET Optical Multiplexer. (Continued)

CONFIGURATION NCI CODE Positions 1 through 6	QUANTITY OF OC-12's Position 7	QUANTITY OF OC-3's Position 8	QUANTITY OF DS3's/STS-1's Position 9
04SNF.	Q = 16 ◦ ◦ ◦ ◦ ◦ ◦ ◦ ◦ ◦ ◦ ◦	G = 16 H = 20 I = 24 J = 28 K = 32 L = 36 M = 40 N = 44 P = 48 Q = 52 R = 56 S = 60 T = 64	H = 60 I = 72 J = 84 K = 96 L = 108 M = 120 N = 132 O = 144 P = 156 Q = 168 R = 180 S = 192 ◦

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

Not all combinations of Table 3-9, NCI codes are physically possible or available. Table 3-10 lists the available codes. Additionally OC-48 interfaces are available from an OC-192 service and are ordered without using a Multiplexer NCI code at this time. Consult your QWEST representative for details.

**Table 3-10** Available Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Optical Multiplexer or equivalent.

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.Q	16	0	0
04SNF.P4	15	4	0
04SNF.P31	15	3	3
04SNF.P22	15	2	6
04SNF.P13	15	1	9
04SNF.P04	15	0	12
04SNF.O8	14	8	0
04SNF.O71	14	7	3
04SNF.O62	14	6	6
04SNF.O53	14	5	9
04SNF.O44	14	4	12
04SNF.O35	14	3	15
04SNF.O26	14	2	18
04SNF.O17	14	1	21
04SNF.O08	14	0	24
04SNF.NC	13	12	0
04SNF.NB1	13	11	3
04SNF.NA2	13	10	6
04SNF.N93	13	9	9
04SNF.N84	13	8	12
04SNF.N75	13	7	15
04SNF.N66	13	6	18
04SNF.N57	13	5	21
04SNF.N48	13	4	24
04SNF.N39	13	3	27

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**Table 3-10** Available Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Optical Multiplexer. (Continued)

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.N2A	13	2	30
04SNF.N1B	13	1	33
04SNF.N0C	13	0	36
04SNF.MG	12	16	0
04SNF.MF1	12	15	3
04SNF.ME2	12	14	6
04SNF.MD3	12	13	9
04SNF.MC4	12	12	12
04SNF.MB5	12	11	15
04SNF.MA6	12	10	18
04SNF.M97	12	9	21
04SNF.M88	12	8	24
04SNF.M79	12	7	27
04SNF.M6A	12	6	30
04SNF.M5B	12	5	33
04SNF.M4C	12	4	36
04SNF.M3D	12	3	39
04SNF.M2E	12	2	42
04SNF.M1F	12	1	45
04SNF.M0G	12	0	48
04SNF.LH	11	20	0
04SNF.LG4	11	16	12
04SNF.LF5	11	15	15
04SNF.LE6	11	14	18
04SNF.LD7	11	13	21
04SNF.LC8	11	12	24

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**Table 3-10** Available Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Optical Multiplexer. (Continued)

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.LB9	11	11	27
04SNF.LAA	11	10	30
04SNF.L9B	11	9	33
04SNF.L8C	11	8	36
04SNF.L7D	11	7	39
04SNF.L6E	11	6	42
04SNF.L5F	11	5	45
04SNF.L4G	11	4	48
04SNF.L0H	11	0	60
04SNF.KI	10	24	0
04SNF.KH4	10	20	12
04SNF.KG8	10	16	24
04SNF.KF9	10	15	27
04SNF.KEA	10	14	30
04SNF.KDB	10	13	33
04SNF.KCC	10	12	36
04SNF.KBD	10	11	39
04SNF.KAE	10	10	42
04SNF.K9F	10	9	45
04SNF.K8G	10	8	48
04SNF.K4H	10	4	60
04SNF.K0I	10	0	72
04SNF.JJ	9	28	0
04SNF.JI4	9	24	12
04SNF.JH8	9	20	24
04SNF.JGC	9	16	36

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**Table 3-10** Available Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Optical Multiplexer. (Continued)

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.JFD	9	15	39
04SNF.JEE	9	14	42
04SNF.JDF	9	13	45
04SNF.JCG	9	12	48
04SNF.J8H	9	8	60
04SNF.J4I	9	4	72
04SNF.J0J	9	0	84
04SNF.IK	8	32	0
04SNF.IJ4	8	28	12
04SNF.II8	8	24	24
04SNF.IHC	8	20	36
04SNF.IGG	8	16	48
04SNF.ICH	8	12	60
04SNF.I8I	8	8	72
04SNF.I4J	8	4	84
04SNF.I0K	8	0	96
04SNF.HL	7	36	0
04SNF.HK4	7	32	12
04SNF.HJ8	7	28	24
04SNF.HIC	7	24	36
04SNF.HHG	7	20	48
04SNF.HGH	7	16	60
04SNF.HCI	7	12	72
04SNF.H8J	7	8	84
04SNF.H4K	7	4	96

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**Table 3-10** Available Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Optical Multiplexer. (Continued)

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.H0L	7	0	108
04SNF.GM	6	40	0
04SNF.GL4	6	36	12
04SNF.GK8	6	32	24
04SNF.GJC	6	28	36
04SNF.GIG	6	24	48
04SNF.GHH	6	20	60
04SNF.GGI	6	16	72
04SNF.GCJ	6	12	84
04SNF.G8K	6	8	96
04SNF.G4L	6	4	108
04SNF.G0M	6	0	120
04SNF.FN	5	44	0
04SNF.FM4	5	40	12
04SNF.FL8	5	36	24
04SNF.FKC	5	32	36
04SNF.FJG	5	28	48
04SNF.FIH	5	24	60
04SNF.FHI	5	20	72
04SNF.FGJ	5	16	84
04SNF.FCK	5	12	96
04SNF.F8L	5	8	108
04SNF.F4M	5	4	120
04SNF.F0N	5	0	132
04SNF.EP	4	48	0

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**Table 3-10** Available Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Optical Multiplexer. (Continued)

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.EN4	4	44	12
04SNF.EM8	4	40	24
04SNF.ELC	4	36	36
04SNF.EKG	4	32	48
04SNF.EJH	4	28	60
04SNF.EII	4	24	72
04SNF.EHJ	4	20	84
04SNF.EGK	4	16	96
04SNF.ECL	4	12	108
04SNF.E8M	4	8	120
04SNF.E4N	4	4	132
04SNF.E0O	4	0	144
04SNF.DQ	3	52	0
04SNF.DP4	3	48	12
04SNF.DN8	3	44	24
04SNF.DMC	3	40	36
04SNF.DLG	3	36	48
04SNF.DKH	3	32	60
04SNF.DJI	3	28	72
04SNF.DIJ	3	24	84
04SNF.DHK	3	20	96
04SNF.DGL	3	16	108
04SNF.DCM	3	12	120
04SNF.D8N	3	8	132
04SNF.D4O	3	4	144

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**Table 3-10** Available Configuration Network Channel Interface (NCI) Codes -  
OC-192 SONET Optical Multiplexer. (Continued)

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.D0P	3	0	156
04SNF.CR	2	56	0
04SNF.CQ4	2	52	12
04SNF.CP8	2	48	24
04SNF.CNC	2	44	36
04SNF.CMG	2	40	48
04SNF.CLH	2	36	60
04SNF.CKI	2	32	72
04SNF.CJJ	2	28	84
04SNF.CIK	2	24	96
04SNF.CHL	2	20	108
04SNF.CGM	2	16	120
04SNF.CCN	2	12	132
04SNF.C8O	2	8	144
04SNF.C4P	2	4	156
04SNF.C0Q	2	0	168
04SNF.BS	1	60	0
04SNF.BR4	1	56	12
04SNF.BQ8	1	52	24
04SNF.BPC	1	48	36
04SNF.BNO	1	44	48
04SNF.BMH	1	40	60
04SNF.BLI	1	36	72
04SNF.BKJ	1	32	84
04SNF.BJK	1	28	96

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

**Table 3-10** Available Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Optical Multiplexer. (Continued)

CONFIGURATION NCI CODE	QUANTITY OF OC-12's	QUANTITY OF OC-3's	QUANTITY OF DS3's/STS-1's
One Code must be specified at each Multiplexer Site			
04SNF.BIL	1	24	108
04SNF.BHM	1	20	120
04SNF.BGN	1	16	132
04SNF.BCO	1	12	144
04SNF.B8P	1	8	156
04SNF.B4Q	1	4	168
04SNF.B0R	1	0	180
04SNF.AT	0	64	0
04SNF.AS1	0	60	3
04SNF.AR2	0	56	6
04SNF.AQ3	0	52	9
04SNF.AP4	0	48	12
04SNF.AN5	0	44	15
04SNF.AM6	0	40	18
04SNF.AL7	0	36	21
04SNF.AK8	0	32	24
04SNF.AJ9	0	28	27
04SNF.AIA	0	24	30
04SNF.AHB	0	20	33
04SNF.AGC	0	16	36
04SNF.ACG	0	12	48
04SNF.A8K	0	8	96
04SNF.A4O	0	4	144
04SNF.A1R	0	1	180
04SNF.A0S	0	0	192

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

Certain OC192 nodes can drop OC48, OC12, OC3, and STS-1/DS3 services. The code set SN supports OC12, OC3, and STS-1 services. The SN code set is to be used when number of OC48s at the Node are zero. The SQ code set is used when dropping OC48s from an OC192 Node. The following table lists NCI codes for QWEST Synchronous Service Transport, Optical Multiplexer to an OC-192 Path, arranged to support drop rates of OC-48, OC-12, OC-3, and STS-1/DS3. This code shall be only for multiplexers that support ALL of these specified drops. Due to the quantity of possible Position combinations, only the General Format table is listed.

**Table 3-11** General Format (SQ) for Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Path -- Optical Multiplexer

CONFIGURATION NCI CODE Positions 1 through 6	QUANTITY OF OC-48/OC-12's  Position 7	QUANTITY OF OC-3's  Position 8	QUANTITY OF DS3's/STS-1's  Position 9
One Code must be specified at each Multiplexer Site			
04SQF.	A = 1/0	0 = 0	1 = 3
	B = 1/1	1 = 1	2 = 6
	C = 1/2	2 = 2	3 = 9
	D = 1/3	3 = 3	4 = 12
	E = 1/4	4 = 4	5 = 15
	F = 1/5	5 = 5	6 = 18
	G = 1/6	6 = 6	7 = 21
	H = 1/7	7 = 7	8 = 24
	I = 1/8	8 = 8	9 = 27
	J = 1/9	9 = 9	A = 30
	K = 1/10	A = 10	B = 33
	L = 1/11	B = 11	C = 36
	M = 1/12	C = 12	D = 39
	N = 2/0	D = 13	E = 42
	P = 2/1	E = 14	F = 45
	Q = 2/2	F = 15	G = 48
	R = 2/3	G = 16	H = 60

**Table 3-11** General Format (SQ) for Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Path -- Optical Multiplexer (Continued)

CONFIGURATION NCI CODE Positions 1 through 6	QUANTITY OF OC-48/OC-12's  Position 7	QUANTITY OF OC-3's  Position 8	QUANTITY OF DS3's/STS-1's  Position 9
One Code must be specified at each Multiplexer Site			
04SQF.	S = 2/4 T = 2/5 U = 2/6 V = 2/7 W = 2/8 X = 3/0 Y = 3/1 Z = 3/2 1 = 3/3 2 = 3/4 3 = 4/0	H = 20 I = 24 J = 28 K = 32 L = 36 M = 40 N = 44 P = 48 Q = 52 R = 56 S = 60 T = 64	I = 72 J = 84 K = 96 L = 108 M = 120 N = 132 O = 144 P = 156 Q = 168 R = 180 S = 192

Note: Each OC-3 can provide either three DS3s or three STS-1s but not a combination of DS3s and STS-1s.

Certain OC192 nodes can drop OC48, OC12, and OC3 services. The code set SP supports OC-48, OC12, and OC3 services. This code set applies only for multiplexers that support ALL of these specified drops. Due to the quantity of possible Position combinations, only the General Format table is listed.

**Table 3-12** General Format (SP) for Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Path -- Optical Multiplexer

CONFIGURATION NCI CODE Positions 1 through 6	QUANTITY OF OC-48s  Position 7	QUANTITY OF OC-12's  Position 8	QUANTITY OF OC-3's  Position 9
One Code must be specified at each Multiplexer Site			
04SPF.	A = 0 B = 1 C = 2 D = 3 E = 4	0 = 0 1 = 1 2 = 2 3 = 3 4 = 4 5 = 5 6 = 6 7 = 7 8 = 8 9 = 9 A = 10 B = 11 C = 12	1 = 1 2 = 2 3 = 3 4 = 4 5 = 5 6 = 6 7 = 7 8 = 8 9 = 9 A = 10 B = 11 C = 12 D = 16 E = 20 F = 24 G = 28

**Table 3-12** General Format (SP) for Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Path -- Optical Multiplexer (Continued)

CONFIGURATION NCI CODE Positions 1 through 6	QUANTITY OF OC-48s Position 7	QUANTITY OF OC-12's Position 8	QUANTITY OF OC-3's Position 9
One Code must be specified at each Multiplexer Site			
04SPF.			H= 32 I= NA J= 36 K= 40 L= 44 M= 48 N= 52 O= NA P= 56 Q= 60 R= 64

### 3.16 Available MBSS Network Channel and Network Channel Interface Codes

Since Managed Bandwidth SONET Service is a very special application, there is a limited set of code combinations available. A Self-Healing option that provides a separate facility path for the MBSS Entrance Facility is also available. The MBSS customer has the obligation to ensure that the building owner of their premises provides structure for diverse entrance facilities when requesting this option.

The following tables supply SONET Optical Network Channel and Network Channel Interface Codes and allowable combinations for MBSS.

**Table 3-13** SONET Optical Transport Network Channel Code available with MBSS

NC Code	Description
ODAQ	OC-12 SONET, Point-to-Point, Loop Timing, Termination on a higher bit rate Add-Drop Multiplexer

Note: For timing applications see GR-253-CORE.

**Table 3-14** SONET Optical Network Channel Interface Codes available with MBSS

NCI Code	Description
Location: Customer Premises -- Interface with QWEST, MBSS Transport Ring	
04SMF.AC	SONET Multiplexer, arranged for 12 STS-1 paths
04SMF.B9	SONET Multiplexer, arranged for 1 STS-3 path and 9 STS-1 paths
04SMF.C6	SONET Multiplexer, arranged for 2 STS-3 paths and 6 STS-1 paths
04SMF.D3	SONET Multiplexer, arranged for 3 STS-3 paths and 3 STS-1 paths
04SMF.E0	SONET Multiplexer, arranged for 4 STS-3 paths
Location: Customer Premises -- Interface with the Customer Installation	
04SOF.F	SR-MLM (Short reach Multi-Longitudinal Mode)

Note: STS-1s shall be VT1.5 structured or shall carry an asynchronously mapped DS3.

**Table 3-15** SONET Optical NC and NCI Code Combinations available with MBSS

NC	NCI with QWEST MBSS Transport	NCI with Customer Installation
ODA Q	04SMF.AC	04SOF.F
ODA Q	04SMF.B9	04SOF.F
ODA Q	04SMF.C6	04SOF.F
ODA Q	04SMF.D3	04SOF.F
ODA Q	04SMF.E0	04SOF.F

Specification of the quantity of STS-1s and STS-3s carried within an OC-12 link to the MBSS Transport Ring triggers equipment engineering and cabling at QWEST Network nodes. Once that physical work is complete, changes may not be reasonably implemented. Therefore, it is essential that customers carefully forecast their capacity needs and request appropriate NCI codes. Each STS-3 ordered shall have an NC code from Table 3-13.

### 3.17 Available OC3, MBSS Network Channel and Network Channel Interface Codes

The following Table provides a listing of available OC3 Network Channel codes that may additionally have an MBSS service option.

**Table 3-16** OC3 Network Channel Codes available with MBSS

NC Code	Description
MBSS, OC3 Service	
OB--	OC-3 SONET, Point-to-Point
OB-R	OC-3 SONET, Point-to-Point, carrying an STS-3c Payload

**Table 3-17** Optical, End-User Premises Network Channel Interface (NCI) Codes available for MBSS Arrangements

NCI Code	QWEST Synchronous Service Transport – Optical Interfaces
OC3 Optical Interfaces (See Table 3-4)	
04SOF.F	SR-MLM (Short Reach - Multi--Longitudinal Mode Laser)
02SOF.F	SR-MLM (Short Reach - Multi--Longitudinal Mode Laser)

Note: Two fiber interfaces apply only to customer premises interfaces where four fiber transport protection is provided by QWEST, on-site, SONET Line or Path Terminating Equipment. Customers may request two fiber interfaces without SONET based transport protection architecture. In those cases, normal service objectives do not apply.

**3.18 Available Premium, DS3 and DS1, MBSS Network Channel and Network Channel Interface Codes**

The following Table provides a listing of available DS3 and DS1 Network Channel codes that may additionally have an MBSS service option. These Premium High Capacity services have the assurance that all On-Network channels are protected from outages by SONET ring architectures with automatic, self-healing capabilities. These On-Net, DS3 and DS1 services will not suffer an outage greater than one second. For channels that have Off-Net segments, standard availability objectives apply to the portions of the channel that are not on an MBSS Entrance Facility or shared SONET ring infrastructure. A customer establishes MBSS service separately before ordering these lower bandwidth services.

**Table 3-18** DS1 and DS3 Network Channel Codes available with MBSS

NC Code	Description
<b>MBSS, Premium DS3 Service</b>	
HFP-	Point-to-Point DS3
<b>MBSS, Premium DS1 Services</b>	
HCP-	Point-to-Point SF/AMI
HCPD	Direct Digital Connection on a Switch, SF/AMI
HCPG	CO Multiplexed Analog and Digital to DS0, SF/AMI
HCT-	Point-to-Point SF/B8ZS
HCTG	CO Multiplexed Analog and Digital to DS0, SF/B8ZS
HCU-	Point-to-Point ANSI ESF/AMI
HCUD	Direct Digital Connection on a Switch, ESF/AMI
HCUG	CO Multiplexed Analog and Digital to DS0, ANSI ESF/AMI
HCV-	Point-to-Point ANSI ESF/B8ZS
HCVD	Direct Digital Connection on a Switch, ANSI ESF/B8ZS
HCVG	CO Multiplexed Analog and Digital to DS0, ANSI ESF/B8ZS
HCW-	Point-to-Point NON-ANSI ESF/AMI
HCWD	Direct Digital Connection on a Switch, NON-ANSI ESF/AMI
HCWG	CO Multiplexed Analog and Digital to DS0, Non-ANSI ESF/AMI
HCY-	Point-to-Point NON-ANSI ESF/B8ZS
HCYD	Direct Digital Connection on a Switch, NON-ANSI ESF/B8ZS
HCYG	CO Multiplexed Analog and Digital to DS0 Non-ANSI ESF/B8ZS
HCJ-	Point-to-Point Free Framing/B8ZS

AMI = Bipolar Alternate Mark Inversion line code.

B8ZS = Binary, 8 zero substitution line code.

ESF = Extended Superframe format. ANSI ESF - Format: reference ANSI T1 403.1995. Non-ANSI ESF - Format: reference AT&T PUB 54016.

SF = Superframe format.

In addition to the electrical Network Channel Interface codes in Table 3-3, the following table supplies DS1 Network Channel Interface Codes allowable for MBSS. These codes are available **only** in those instances where the MBSS end-user location is **not** served by an on-site, optic terminal.

**Table 3-19** Additional Electrical, End-User Premises  
 Network Channel Interface (NCI) Codes available for MBSS Arrangements

NCI Code	QWEST Synchronous Service Transport – Electrical Interfaces
<b>DS1 Electrical Interfaces</b> (See QWEST Technical Publication 77375)	
04DU9.AN	DS1 End-User Premises Interface, Free Framing/B8ZS, without Line Power
04DU9.BN	DS1 End-User Premises Interface, SF/AMI, without Line Power
04DU9.CN	DS1 End-User Premises Interface, non-ANSI ESF/AMI, without Line Power
04DU9.DN	DS1 End-User Premises Interface, SF with B8ZS, without Line Power
04DU9.SN	DS1 End-User Premises Interface, non-ANSI ESF/B8ZS, without Line Power
04DU9.1KN	DS1 End-User Premises Interface, ANSI ESF/AMI, without Line Power
04DU9.1SN	DS1 End-User Premises Interface, ANSI ESF/B8ZS, without Line Power

AMI = Bipolar Alternate Mark Inversion line code.

B8ZS = Binary, 8 zero substitution line code.

ESF = Extended Superframe format. ANSI ESF - Format: reference ANSI T1 403.1995.  
 Non-ANSI ESF - Format: reference AT&T PUB 54016.

SF = Superframe format.

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## **4. Performance Specifications**

### **4.1 Error Performance Parameters**

Error performance parameters are:

#### **4.1.1 Background Block Error (BBE)**

An errored block is not occurring as part of an SES.

#### **4.1.2 Background Block Error Ratio (BBER)**

The ratio of Background Block Errors (BBE) to total blocks in available time during a fixed measurement interval. No blocks that occur during an SES shall be used for the computation of BBER.

#### **4.1.3 Block**

A block is a set of consecutive bits associated with the connection; each bit belongs to one and only one block.

The following block sizes are applied in assessing SONET performance.

**Table 4-1** SONET Block Sizes

Rate	51.84 Mbit/s (STS-1)	155.52 Mbit/s (STS-3c)	622.08 Mbit/s (STS-12c)	2.488 Gbit/s (STS-48c)	9.865 Gbit/s (STS-192c)
Bits/block	6,264	18,792	75,168	300,672	1,202,688

The block size corresponds to the number of bits in 125 microseconds for the SONET path (equivalent to synchronous payload envelope (SPE)); 50.112 Mbit/s, 150.336 Mbit/s, 601.344 Mbit/s, 2.405 Gbit/s and 9.622 for STS-1, STS-3c, STS-12c, STS-48c and STS-192c paths respectively. Performance objectives apply at these rates to the SONET path that is not constrained to a particular physical signal type (i.e., objectives apply for electrical (STS-n) or optical (OC-n) signals).

#### **4.1.4 Bit Error Ratio (BER)**

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

#### **4.1.5 Errored Second (ES)**

An Errored Second is any one-second interval containing at least one error.

#### **4.1.6 Severely Errored Second DS1/DS3 (SES)**

A one-second period having a Bit Error Ratio of  $10^{-3}$  or worse.

**Note:** A period of loss of signal shall be considered a period of errored bits.

#### **4.1.7 Severely Errored Second STS-n (SES)**

A one-second period that contains  $\geq 30\%$  errored blocks or at least one severely disturbed period.

A severely disturbed period occurs when, over a period of time equivalent to 1 ms, all the contiguous blocks are affected by a high bit error density.

**Note:** A period of loss of signal or a bit error density of  $\geq 10^{-2}$  shall be considered a period of errored blocks with high bit error density. It is not required to verify this BER by an actual in-service or out-of-service measurement.

#### **4.1.8 Percent Errored Seconds (% ES)**

100 X the ratio of ES to the total seconds in available time during a fixed measurement period.

#### **4.1.9 Percent Severely Errored Seconds (% SES)**

100 X the ratio of SES to the total seconds in available time during a fixed measurement period.

### **4.2 Error Performance**

Objectives given in this section are for all one-way system options, designed consistent with standard SONET, four fiber architectures and apply at maximum short-haul design length. Two fiber interfaces may apply only to customer premises interfaces where four-fiber, transport protection is provided by QWEST, on-site, SONET Line or Path Terminating Equipment. Customers may request two fiber interfaces without SONET based transport protection architecture. In those cases, the following service objectives can not apply.

For basic services interfacing at DS1 and DS3 levels, the long-term percentage of Error Free Seconds (the measure of accuracy) and Availability are shown in Table 4-2. These objectives apply in normal operating environments and only for the SST or MBSS provided portion of a service. For services where SST or MBSS provides only a segment of the entire path, performance of the service is dictated by the segment with the lowest objectives. In the special and uncommon case of a free-framed DS1 Service, there is no reasonable method to monitor its accuracy or availability. Therefore, QWEST provides such DS1s without performance objectives.

**Table 4-2** DS1 and DS3 SST and MBSS Long-Term Accuracy and Availability Objectives

Transport Segment	DS1 1.544 Mbit/s	DS3 44.736 Mbit/s
<b>Availability</b>		
Access	99.99 %	99.99 %
End-to-End	99.99 %	99.99%
<b>Accuracy - Error Free Seconds</b>		
Access	99.86 %	99.875 %
End-to-End	99.86 %	99.750 %

For systems interfacing at the STS-n performance, objectives are stated in terms of the parameters provided in Table 4-3. Accuracy performance shall be evaluated relative to a measurement period of 30 days or more. As determination of compliance with the performance objectives would require excessively long test periods, the objectives are also used in deriving timed test limits. Background Block Error Ratio (BBER), Percent Errored Second (% ES), and Percent Severely Errored Second (% SES) characterize the transmission quality of the STS-n service.

The long-term accuracy objectives are expressed as a ratio (or percentage) because they apply over long periods of time.

**Table 4-3** STS-n Long-Term Accuracy Objectives

Segment	Parameter	51.84 Mbit/s (STS-1)	155.52 Mbit/s (STS-3c)	622.08 Mbit/s (STS-12c)	2.488 Gbit/s (STS-48c)	9.865 Gbit/s (STS-192c)
End-to-End	BBER	(Note 1)	(Note 1)	10 <sup>-5</sup>	10 <sup>-5</sup>	10 <sup>-4</sup>
	% ES	0.25	0.5	(Note 2)	(Note 2)	(Note 2)
	% SES	0.035	0.035	0.035	0.035	0.035
Access	BBER	(Note 1)	(Note 1)	5 x 10 <sup>-6</sup>	5 x 10 <sup>-6</sup>	5 x 10 <sup>-5</sup>
	% ES	0.125	0.25	(Note 2)	(Note 2)	(Note 2)
	% SES	0.01	0.01	0.01	0.01	0.01

NOTES

1. BBER is only specified for rates above 160 Mbit/s.
2. Percent ES objectives tend to lose significance for applications at high bit rates and are therefore not specified for paths operating at bit rates above 160 Mbit/s. Nevertheless, it is recognized that the observed performance of synchronous digital paths is error free for long periods of time even at Gigabit/s rates; and that significant ESR indicates a degraded transmission system. Therefore, for maintenance purposes, ES monitoring is implemented within any error performance measuring devices operating at these rates.

Loopback tests should be made using the one-way limits because one direction is likely to be controlling. If these tests fail, the failed direction should be sectionalized and appropriate one-way tests made.

### 4.3 Service Availability

The service is available when it is in a state where it is fully useable. A service is assumed to be in the available state unless a transition to the unavailable state is observed without a subsequent transition to the available state.

Transitions between the available and unavailable states are:

- Transition to the Unavailable state occurs at the beginning of 10 consecutive SES.
- Transition to the Available state occurs at the beginning of 10 consecutive seconds none of which is an SES.

Each direction of a service is assumed to be in the available state unless a transition to the unavailable state is observed without a subsequent transition to the available state. Objectives given in this section are for all one-way system options, designed consistent with standard SONET, four fiber architectures and apply at maximum short-haul design length. Two fiber interfaces may apply only to customer premises interfaces where four-fiber transport protection is provided by QWEST, on-site, SONET Line or

Path Terminating Equipment. Customers may request two fiber interfaces without SONET based transport protection architecture. In those cases, the following service objectives can not apply.

Availability objective is 99.75 percent minimum for DS1 and 99.83 percent minimum for DS3 Services.

STS-n availability objectives are stated in Table 4-4; Percent (%) Availability, the same as applied to DS1 and DS3 services.

**Table 4-4** STS-n Availability Objectives

PARAMETER	51.84 Mbit/s (STS-1)	155.52 Mbit/s (STS-3c)	622.08 Mbit/s (STS-12c)	2488 Gbit/s (STS-48c)	9.865 Gbit/s (STS-192c)
% Service Availability (Annual)	99.83	99.83	99.83	99.83	99.83

For channels connecting to the Network at Central Office (CO) Hub nodes, the standard availability requirement will apply for that portion of the circuit.

#### **4.4 Jitter Performance**

##### **4.4.1 Definition of Timing Jitter**

Timing jitter is defined as the short-term variations of the significant instances of a digital signal from their ideal positions in time, where short term implies phase oscillations of frequency greater than or equal to 10 Hertz.

##### **4.4.2 Timing Jitter Specifications - Electrical Interfaces**

The limits given in Bellcore Technical Reference GR-499-CORE, *Transport Systems Generic Requirements (TSGR): Common Requirements*, represent the maximum permissible levels of output jitter for Carrier-to-Carrier Network Interfaces. Carrier-to-End-User (EU) Network Interface jitter requirements are addressed in ANSI T1.403-1995, *Telecommunications - Carrier-to-Customer Installations - DS1 Metallic Interface Specification* and ANSI T1.404-1994, *Telecommunications - Carrier-to-Customer Installation - DS3 Metallic Interface Specification*. The purpose of these limits is to limit broadband jitter appearing anywhere in the QWEST Network.

##### **4.4.3 Timing Jitter Specifications - Optical Interfaces**

Optical interface jitter performance will follow the standards as stated in GR-253-CORE, *Synchronous Optical Network (SONET) Transport Systems: Common*

*Criteria and GR-499-CORE, Transport Systems Generic Requirements (TSGR): Common Requirements.*

#### **4.5 Protection Switching**

Automatic protection switching improves the availability and reliability performance of QWEST 's Service by substituting standby equipment or alternate channels when failure occurs.

The protection switch function will operate and switch the DS1, DS3, STS-1, OC-3, OC-12 or OC-48 channel to the protection system when the BER on the transport system exceeds  $1 \times 10^{-6}$  and operates at that BER for 10 consecutive seconds or longer.

Once a decision is made to switch to a protection system, the additional time required to complete the switch will not exceed 50 milliseconds.

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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 a 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 Hub(s).

QWEST will furnish the customer a trouble reporting telephone number.

Upon receipt of a trouble report for SST service, QWEST will initiate action to clear the trouble within twenty minutes after receiving the trouble report and will commit to a four hour maximum service restoration time in the event of a service interruption due to an electronic component failure. If the trouble is caused by a cable failure, the maximum service restorable time will be eight hours.

Upon receipt of a service interruption trouble report for MBSS On-Net Channel Terminations, MBSS Off-Net Channel Terminations, MBSS Off-Net Transport Channels, MBSS SST OC-48 Transport Channels and MBSS Central Office multiplexing arrangements QWEST will initiate action to clear the trouble within twenty minutes after receiving the trouble report. QWEST commits to a four-hour maximum service restoration time in the event of such a service interruption in accordance with terms and conditions as set in the appropriate tariffs.

An MBSS Entrance Package outage event is defined as a failure within the SONET ring based transport that does not switch to redundant facilities and equipment to route the MBSS service around the failure. This switch to protect shall occur within 50 milliseconds of a SONET failure detection and the decision to switch is made.

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## **6. Definitions**

### **6.1 Acronyms**

ANSI	America National Standards Institute
CFA	Carrier Facility Assignment
CLLI™	COMMON LANGUAGE Location Identification
DS1	Digital Signal Level 1 (1.544 Mbit/s)
DS3	Digital Signal Level 3 (44.736 Mbit/s)
DSX	Digital Signal Cross-connect
EI	Electrical Interface
FDP	Fiber Distribution Panel
Gbit/s	Gigabit per Second
INE	Intelligent Network Element
NC	Network Channel
Mbit/s	Megabit per Second
NCI	Network Channel Interface
NI	Network Interface
OC	Optical Carrier
OC-3	Optical Carrier level 1
OC-12	Optical Carrier level 12
OC-48	Optical Carrier level 48
OC-N	Optical Carrier level N
SONET	Synchronous Optical NETWORK
STS	Synchronous Transport Signal
STS-1	Synchronous Transport Signal level 1
STS-N	Synchronous Transport Signal level N
STS-Nc	Concatenated Synchronous Transport Signal level N

## **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.

### **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

### 7.1 American National Standards Institute Documents

- ANSI T1.102-1993      *Telecommunications - Digital Hierarchy - Electrical Interfaces*  
(R 1999)
- ANSI T1.105-1995      *Telecommunications - Digital Hierarchy-Optical Interface Rates and  
Formats Specifications (SONET)*
- ANSI T1.105.01-1998      *Telecommunications - Synchronous Optical Network (SONET) -  
Automatic Protection Switching*
- ANSI T1.105.06-1996      *Telecommunications - Synchronous Optical Network (SONET):  
Physical Layer Specifications*
- ANSI T1.107-1995      *Telecommunications - Digital Hierarchy - Formats Specifications*
- ANSI T1.117-1991      *Telecommunications - Digital Hierarchy - Optical Interface  
(R 1997) Specifications (SONET) (Single Mode - Short Reach)*
- ANSI T1.223-1997      *Information Interchange - Structure and Representation of Network  
Channel (NC) and Network Channel Interface (NCI) Codes for the  
North American Telecommunications System.*
- ANSI T1.231-1997      *Telecommunications - Digital Hierarchy - Layer 1 In-service Digital  
Transmission Performance Monitoring*
- ANSI T1.403-1995      *Telecommunications - Carrier to Customer Installation, DS1  
Metallic Interface*
- ANSI T1.404-1994      *Telecommunications - Carrier-to-Customer Installation-DS3  
Metallic Interface Specifications*
- ANSI T1.510-1999      *Telecommunications - Network Performance Parameters for  
Dedicated Digital Services -- Specifications*
- ANSI T1.514-2000      *Telecommunications - Network Performance Parameters for  
Dedicated Digital Services -- SONET Bit Rates*

## 7.2 Telcordia Documents

- GR-253-CORE Telcordia, Synchronous Optical Network (SONET) Transport Systems: Common Criteria
- GR-342-CORE Telcordia, High-Capacity Digital Special Access Service Transmission Parameter Limits and Interface Combinations
- GR-378-CORE Timing Signal Generator (TSG) Requirements and Objectives.
- GR-436-CORE Digital Network Synchronization Plan,
- GR-499-CORE Telcordia, Transport Systems Generic Requirements (TSGR): Common Requirements,
- ISI-SR-STS 000307 Telcordia, NC/NCI Code Dictionary Industry Support Interface. Published each year.

## 7.3 QWEST Documents

- PUB 77200 *QWEST DS1 Service and QWEST DS1 Rate Synchronization Service, Network Channel and Network Channel Interface Code Combinations.* Issue F, September 2001.
- PUB 77324 *QWEST DS-3 Service.* Issue D, September 2001.
- PUB 77344 *Diversity and Avoidance,* Issue B, September 2001.
- PUB 77371 *COMMAND A LINK<sup>SM</sup> Technical Description And Interface Combinations.* Issue D, September 2001.
- PUB 77372 *QWEST Frame Relay Service.* Issue H, December 2000.
- PUB 77375 *1.544 Mbit/s Channel Interfaces.* Issue F, December 2001.

## 7.4 Other Publications

- IEEE Std 100-1992 *The New IEEE Standard Dictionary of Electrical and Electronics Terms [Including Abstracts of All Current IEEE Standards].* Institute of Electrical and Electronics Engineers, Inc. Copyright © 1993.

## 7.5 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.

Those who are not QWEST employees may order;

- American National Standards Institute (ANSI) documents from:

American National Standards Institute  
Attn.: Customer Service  
11 West 42nd Street  
New York, NY 10036  
Phone: (212) 642-4900  
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- Telcordia documents from:

Telcordia Customer Relations  
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- QWEST Technical Publications from:

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- IEEE Documents may be obtained from:

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CLLI	Trademark of Bell Communications Research, Inc.
COMMAND A LINK	Service Mark of QWEST Communications International, Inc.
COMMON LANGUAGE	Registered Trademark of Bell Communications Research, Inc.
DIGICOM	Registered Trademark of Pacific Northwest Bell Telephone Company
Macintosh	Registered Trademark of Apple Computer, Inc.
Microsoft	Registered Trademark of Microsoft Corporation
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