Qwest Communications International Inc.
Technical Publication

Qwest SELF HEALING NETWORK SERVICE

NOTICE

The purpose of this document is to describe Qwest Self Healing Network Service appropriate for the majority of applications. It furnishes sufficient technical detail to allow a customer, such as an Interexchange Carrier or End-User, to select a service that may be incorporated into an end-to-end communications channel. It is not the intent of this document to provide specific ordering information, but to describe the technical features of this service offering.

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1.   Introduction

1.1   General

The purpose of this document is to describe Qwest Self Healing Network Service as appropriate for the majority of applications. It furnishes sufficient technical detail to allow a customer, such as an Interexchange Carrier, Local Exchange Carrier or End-User, to select a service that may be incorporated into an end-to-end communications channel. It is **not** the intent of this document to provide specific ordering information, but to describe the technical features of this service offering.

1.2   Scope

This document describes Qwest Self Healing Network Service offered by Qwest Corporation to their customers. It covers distinguishing service features, technical specifications, and defines valid interfaces.

1.3   Reason for Reissue

This document is being reissued at this time to:

- Add Network Channel, Network Channel Interface and application information for Transmux capabilities,

- Add more Network Channel Interface possibilities for OC-192 Ring Nodes.

1.4   End-User and Carrier Customer Premises - Mandated DS1 Differences

Both End-Users and Carriers may purchase 1.544 Mbit/s (DS1) channels with a number of optional enhancements.

Federal Regulations mandate certain technical differences between interfaces provided at End-User premises and at Carrier premises, and these differences are explained in Technical Publication 77375, *1.544 Mbit/s Channel Interfaces*. The differences have no qualitative affect on the service being provided.

When a Carrier orders services, not for resale but for their own internal use, the appropriate End-User interface(s) should be ordered.

1.5   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, interface options and configurations of SHNS.

Chapter 3   Network Interfaces: Describes the physical electrical and optical interfaces 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.

Chapter 4   LAN Connection Service: Provides details of LAN connectivity service available on established SHNS networks.

Chapter 5   Performance Specifications: Furnishes expectations for accuracy, availability, and jitter.

Chapter 6   Maintenance Responsibilities: Provides the Qwest and corresponding customer responsibilities of this service.

Chapter 7   Definitions: Presents a glossary of terms and a listing of acronyms related to the Publication.

Chapter 8   References: Provides titles and ordering information for documents referenced in this Publication.

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2.   Description of Service

2.1   Applicability of Technical Specifications

Technical specifications presented in this document are applicable to Qwest Self Healing Network Service (SHNS) only. This document does not attempt to describe the various types of transmission equipment used to provide this service. It does not provide detailed ordering information.

2.2   Description of Service

Qwest Self Healing Network Service offers a premium service arrangement designed to provide high capacity digital services between multiple, customer designated premises or between customer designated premises and Qwest Wire Centers. The SHNS dedicates available bandwidth on the Network exclusively to a single customer. That bandwidth may be dedicated fiber optic facilities or dedicated spectrum (wavelengths) on fiber optic facilities.

- The SHNS is an arrangement that automatically detects a fault in the Network and reconfigures itself to maintain a near continuous flow of information between locations. The arrangement can be described as two concentric rings that connect two or more customer specified locations (see Figure 2-1). Upon detection of a network failure, such as a cable cut, the SHNS will automatically reconfigure itself to bypass the affected area thereby allowing continued communications.

- The SHNS consists of drop and insert locations (also referred to as nodes) in a closed ring configuration. All nodes are interconnected with optical fibers that are configured into working (primary) and protection (alternate) systems. The nodes are designed into the system when the service is established. There is a minimum of three nodes required. Regenerators may be inserted in the network as required.

- Fiber optic facilities connecting each node are routed diversely from each other. That is, from the first utility vault outside the serving wire center's Central Office to the last terminal prior to the customer premises, the fiber paths of the closed loop are physically separated by 25 feet or more. A second entrance to the customer's premises affords further diversity protection. When desired, it is a customer's responsibility to provide a second entrance. That second entrance must meet existing Qwest entrance facility standards. For additional information see Publication 77344, *Diversity and Avoidance.*

- Each Self Healing Network will include at least one Qwest Wire Center Hub node. The purpose of this Hub node is to provide an access connection between Qwest public network and a customer's private Network. It will also be used to provide access to the maintenance and performance monitoring functions.
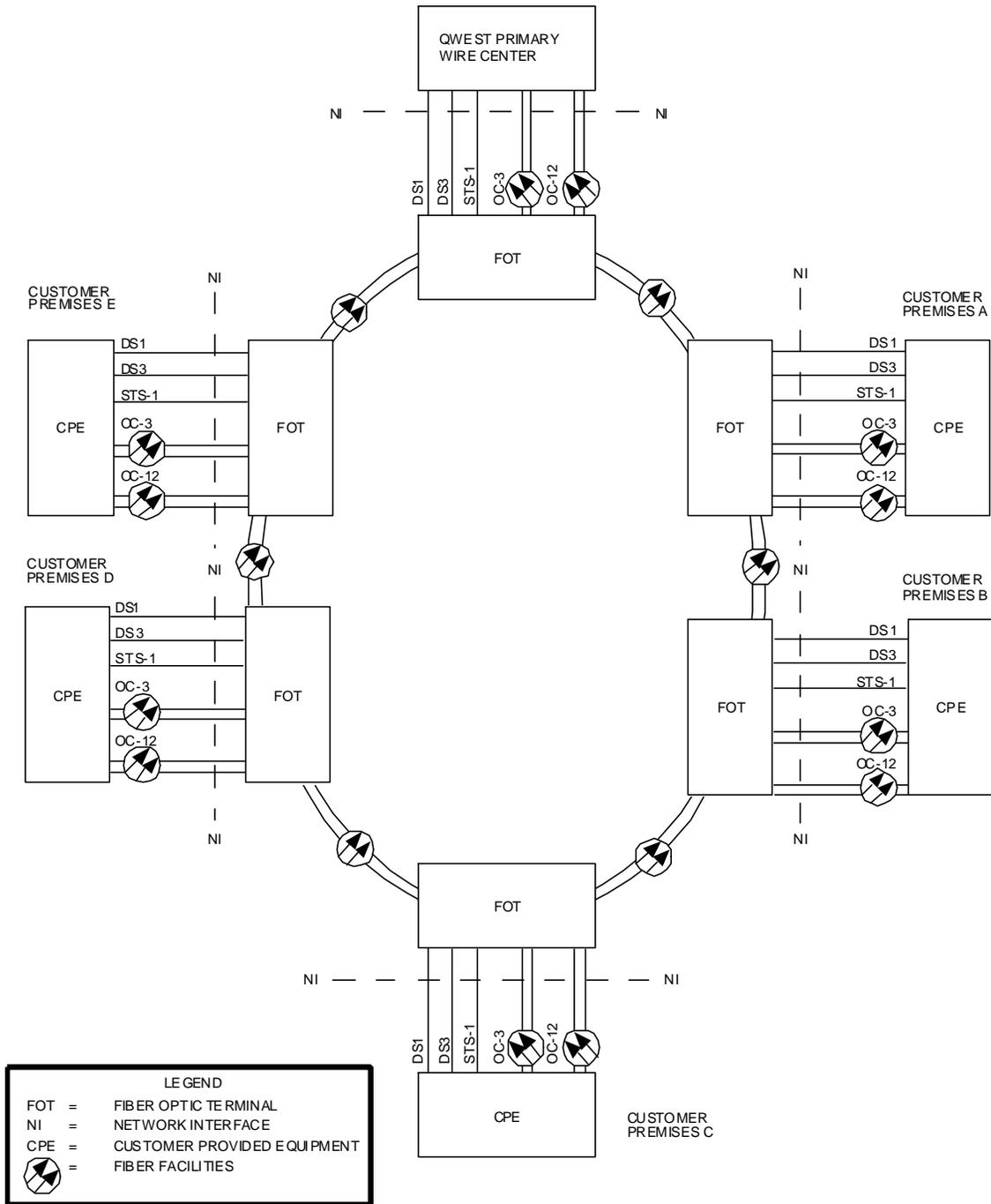
Figure 2-1 Self Healing Network Example

2.2.1   Interface Overview

The SHNS is available with the capacity to transport the SONET rates of 155.52 Mbit/s, 622.08 Mbit/s, 2.488 Gbit/s, or 9.865 Gbit/s. Within the 155.52 Mbit/s transport and the 622.08 Mbit/s transport, the customer may order a combination of electrical DS1, DS3, Ethernet, and STS-1 interfaces. A Virtual Tributary 1.5 structured STS-1 may carry 28 DS1's. The STS-1 may also be arranged to carry an asynchronously mapped DS3 that could then carry 28 DS1's. Accessing DS1's within a DS3 carried by an STS-1 requires multiplexing equipment additional to basic SHNS arrangements. Interfaces at the customer premises will conform to standard IEEE and ANSI rate and format specifications. The STS-1 interface rate is 51.840 Mbit/s, DS3 interface is 44.736 Mbit/s, and the DS1 is 1.544 Mbit/s. DS3 and DS1 interfaces are disclosed in Qwest Technical Publications 77324 and 77375, respectively.

- Ethernet interfaces will be delivered to the NI as IEEE 802.3 10Base-T compliant, RJ-45 connector receptacle.

- The STS-1 interface at an end user premises will be an SJA44 connector interface, delivered from Qwest owned Line Terminating Equipment (LTE). The STS-1 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 and Bellcore GR-253CORE.

  As with DS3 Service, Carriers 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, accessible workspace.

- OC-3 interfaces are available with SHNS capacities of 622.08 Mbit/s, and 2.488 Gbit/s. The OC-3 interface provides a high capacity channel for the transmission of 155.52 Mbit/s, using optical interfaces, delivered from Qwest owned Line Terminating Equipment .

- OC-12 interfaces are available with SHNS capacities of 2.488 Gbit/s and 9.865 Gbit/s. The OC-12 interface provides a high capacity channel for the transmission of 622.08 Mbit/s, using optical interfaces, delivered from Qwest owned Line Terminating Equipment.

- OC-48 interfaces are available with SHNS capacity of 9.865 Gbit/s. The OC-48 interface provides a high capacity channel for the transmission of 2.488 Gbit/s., using optical interfaces, delivered from Qwest owned Line Terminating Equipment.

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The optical interfaces will be delivered to the NI at a Fiber Distribution Panel (FDP), equipped to terminate FC-PC type connectors. The FC-PC type connector is a 2.5 mm ferrule, keyed bayonet format connector with very good performance parameters, applicable for SONET rate transport.

2.2.2   Synchronous Transport Signal (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 carried by an OC-n (or higher level) line signal.

Qwest offers interfaces listed below that are capable of carrying three, 12 or 48 concatenated STS-1's. These are STS-3c, STS-12c or STS-48c circuits with transmission rates of 155.52 Mbit/s, 622.08 Mbit/s or 2.488 Gbit/s respectively. STS-nc signals are provided using equipment which 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-48 Interface - One STS-48c or Four STS-12c's or 16 STS-3c's can be transported on an OC-48.

2.3   Service Configuration

Depending upon the design of the system, SHNS may use interoffice and/or local loop facilities. Each SHNS shall be dedicated to a single customer and can provide customer interfaces using many combinations of electrical and/or optical signal levels.

The SHNS will have nodes located at customer designated locations and in at least one Qwest Wire Center. A typical network is shown in Figure 2-1.

The SHNS will be available in the following service configurations:

2.3.1   Ring Bandwidth Capacity of 155.52 Mbit/s

Bandwidth Capacity of 155.52 Mbit/s with DS1, Ethernet, DS3 and STS-1 electrical interfaces. A combination of DS1, Ethernet, DS3 or STS-1 ports (where 28 DS1's are the equivalent of one DS3 or STS-1) may be ordered. This system can provide a capacity of up to 3 DS3's or STS-1's. The total service bandwidth ordered shall not exceed the ring bandwidth capacity of 155.52 Mbit/s. A point-to-point pair of Ethernet ports requires dedicated STS-1 bandwidth on the ring. Multiple Ethernet pairs may share the same ring bandwidth. Service requirements at each node should be known or forecast to build an optimal ring network.

2.3.2   Ring Bandwidth Capacity of 622.08 Mbit/s

Bandwidth Capacity of 622.08 Mbit/s with DS1, Ethernet, DS3 and STS-1 electrical interfaces and OC-3 optical interfaces. A combination of DS1, Ethernet, DS3, STS-1 and OC-3 ports may be specified. This system can provide a capacity of up to 12 STS-1's or 12 DS3's. Each DS3 or STS-1 may be channelized to provide up to 28 DS1's. This system will also provide up to four OC-3's. The total service bandwidth ordered shall not exceed the ring bandwidth capacity of 622.08 Mbit/s. A point-to-point pair of Ethernet ports requires dedicated STS-1 bandwidth on the ring. Multiple Ethernet pairs may share the same ring bandwidth. Service requirements at each node should be known or forecast to build an optimal ring network.

2.3.3   Ring Bandwidth Capacity of 2.488 Gbit/s

Bandwidth Capacity of 2.488 Gbit/s with DS1, Ethernet, DS3 and STS-1 electrical interfaces and OC-3 and OC-12 optical interfaces. This system capacity can provide a capacity of up to 48 DS3's or STS-1's. Additionally, some DS3's and STS-1's may be configured to provide SHNS DS1's and Ethernet ports. This system can provide up to 16 OC-3's or up to 4 OC-12's. For the 2.488 Gbit/s capacity, a combination of DS1, DS3, STS-1, OC-3 and OC-12 ports may be specified. The total service bandwidth ordered shall not exceed the ring bandwidth capacity of 2.488 Gbit/s. A maximum of 168 DS1 ports is available at an individual node. There is a ring system, maximum of 336 DS1 ports. A point-to-point pair of Ethernet ports requires dedicated STS-1 bandwidth on the ring. Multiple Ethernet pairs may share the same ring bandwidth. Service requirements at each node should be known or forecast to build an optimal ring network.

2.3.4   Ring Bandwidth Capacity of 9.865 Gbit/s

Bandwidth Capacity of 9.865 Gbit/s with Ethernet, DS3 and STS-1 electrical interfaces and OC-3, OC-12 and OC-48 optical interfaces. This system capacity can provide a capacity of up to 192 DS3's or STS-1's. Additionally, some DS3's and STS-1's may be configured to provide SHNS Ethernet ports. This system can provide up to 64 OC-3's, up to 16 OC-12's or 4 OC-48's. For the 9.865 Gbit/s capacity, a combination of DS3, STS-1, OC-3, OC-12 and OC-48 ports may be specified. The total service bandwidth ordered shall not exceed the ring bandwidth capacity of 9.865 Gbit/s. A point-to-point pair of Ethernet ports requires dedicated STS-1 bandwidth on the ring. Multiple Ethernet pairs may share the same ring bandwidth. Service requirements at each node should be known or forecast to build an optimal ring network.

2.4   Transmux Capability

Transmux Capability is an optional SHNS feature, which affords the customer the possibility to have high bandwidth interfaces at some locations connecting to multiple lower bandwidth interfaces in other locations. 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 multiple locations on a ring passed to one location via an OC3. 2. DS1s may be either DS3 or VT1.5 mapped into an STS1.

Table 2-1 lists the bandwidth options:

Table 2-1 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

2.5   Software Reconfiguration Capability

Software Reconfiguration Capability is an optional SHNS feature which affords the customer the ability to reconfigure their existing channels within the SHNS via software commands. Selection of this capability has a direct impact on how the service is provisioned. It must be either (1) ordered with the initial service, or (2) it must be stated that at some future point in time, the customer may want to add the remote reconfiguration capability feature. This will ensure the equipment capable of providing this feature, is ordered and installed.

This reconfiguration capability is customer accessible via a customer provided terminal compatible with the Qwest provided equipment used to provision the Self Healing Network.

2.6   Performance Monitoring Capability

Performance Monitoring Capability is an optional SHNS feature that affords customers access to detailed information pertaining to the performance of the Self Healing Network. The level of the performance monitoring capability will vary depending upon the transport equipment used to provide this service. This capability is available to the customer via a customer provided terminal compatible with the Qwest provided equipment used to provision the SHNS. This option must be specified when the service is initially ordered. Possible performance parameters include:

*   Major and Minor Alarms

*   Path Coding Violations (CV)

*   Path Severely Errored Frame Seconds (SEFS)

*   Line and Path Errored Seconds (ES).

Office alarms for failed conditions may additionally be made available when the Performance Monitoring Option is selected. This additional feature will always present an alarm circuit ground condition at the customer premises. The alarm will always be generated by extension of the visual alarm indicator from the network equipment installed to provide the Self Healing Network Service. When this option is selected, alarm cutoff circuitry shall be provided by the customer.

2.7   Secondary Serving Wire Center

The customer may additionally elect to be served from both a primary and a secondary Wire Center on the Self Healing Network as shown in Figure 2-2. With this arrangement, a customer could order customer premises services out of two different Wire Center nodes on the Network guarding against a single Wire Center node failure disrupting SHNS communications. The two-Wire Center option may be selected with any of the above listed configurations.

2.8   Central Office Multiplexing

Central Office Multiplexing option gives additional flexibility to STS-1, DS3, DS1 and DS0 services with its ability to interleave lower bit-rate channels into a higher bit-rate service, or perform the reverse. With the Secondary Serving Wire Center option, the channel between the two Qwest Wire Centers (the inter-Central Office channel) may be within the SHNS bandwidth or may be from another digital service.

Refer to Publications 77324; *Qwest DS3 Service*, 77375; *1.544 Mbit/s Channel Interfaces* and 77200; *Qwest DS1 Service and Qwest DS1 Rate Synchronization Service, Network Channel and Network Channel Interface Code Combinations* for additional information regarding this option.
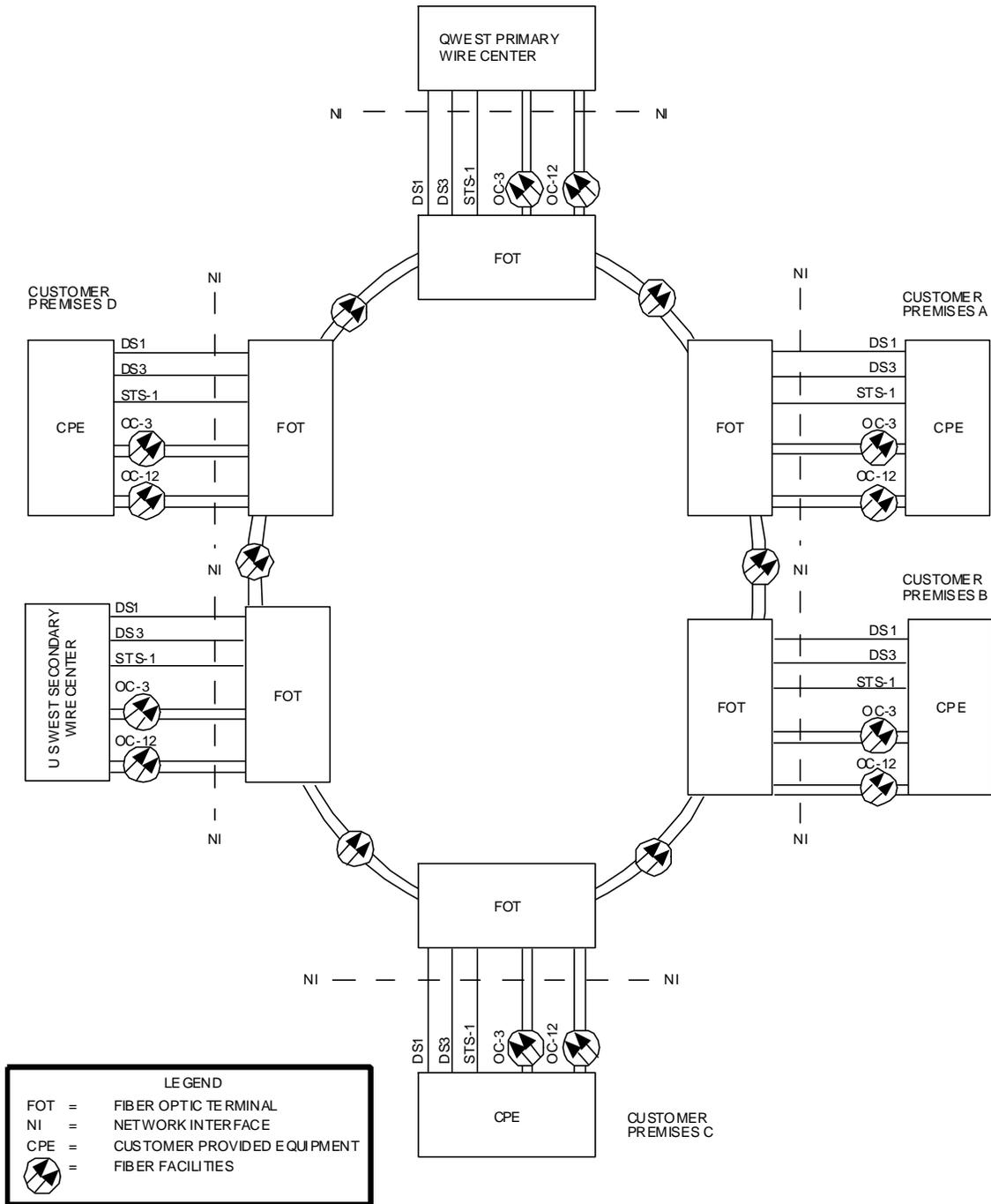
Figure 2-2 Network Example With Primary and Secondary Wire Centers

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3. Network Interfaces

3.1 Description of Interfaces

Allowable North American Digital Hierarchy interfaces to Qwest Self Healing Network Service are at electrical DS1, DS3 and STS-1 levels and at optical OC-3 and OC-12 levels. Local Area Network (LAN) interfaces are as specified by the Institute of Electrical and Electronic Engineers (IEEE) Standard 802.3.

3.2 Interface Overview

Electrical interfaces will be delivered to the Network Interface (NI) per Qwest Technical Publication 77375, *Qwest 1.544 Mbit/s Channel Interfaces* and Technical Publication 77324, *Qwest DS3 Service*.

Optical interfaces will be delivered to the NI at a Fiber Distribution Panel (FDP), equipped to terminate FC-PC type connectors. The FC-PC type connector is a 2.5 mm ferrule, keyed bayonet format connector with very good performance parameters, applicable for SONET rate transport. Additional information pertaining to the optical interfaces is contained in Technical Publication 77346, *Qwest Synchronous Service Transport (Qwest Synchronous Optical Transport Line Interface)*.

3.2.1 DS1 Interface

DS1 channels are provided to Carrier's and to End-User's (EU's) premises. The Network Interface (NI) at the premises will be at the end of a DSX-1 jumper wire or cable with DSX-1 templated, signal characteristics as described in Qwest Technical Publication 77375. DS1 interfaces, using Registration Jacks described by Universal Service Ordering Codes (USOC) RJ-48C, RJ-48H and RJ-48M can be made available with additional engineering and construction charges.

Detailed information on physical RJ-48 DS1 and DSX-1 NI configurations may be found in Qwest Technical Publication 77375.

3.2.2 IEEE 802.3 Ethernet Interface

Point-to-point, 10 M Mbit/s, Ethernet channels are available between Carrier or End-User's (EU's) premises. The Network Interface (NI) at the premises will be at the end of a twisted pair cable with signal characteristics as described in IEEE Standard 802.3. The maximum, twisted pair, cable distance from the Qwest SHNS node equipment to the NI shall be 20 meters.

The physical interface will be a Registration Jack, RJ-45 connector receptacle. This is an eight pin, industry standard arrangement with pin assignments shown below.

Table 3-1 Pin Assignments of the RJ-45, Ethernet 10Base-T Interface.

Pin	Assignment
1	TX+
2	TX–
3	RX+
6	RX–

3.2.3   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 SJA-44 connectors with signal characteristics described in Qwest Technical Publication 77324.

3.2.4   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 T1.105-1991, *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 STS-1 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.

3.2.5   OC-3 Interface

The OC-3 interface provides a high capacity channel for the transmission of 155.52 Mbit/s, utilizing an optical interface, delivered from Qwest owned Line Terminating Equipment. Additional information pertaining to the OC-3 Interface may be found in Qwest Technical Publication 77346, *Qwest Synchronous Service Transport.*

3.2.6   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. Additional information pertaining to the OC-12 Interface may be found in Qwest Technical Publication 77346.

3.2.7   OC-48 Interface

The 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. Additional information pertaining to the OC-48 Interface may be found in Qwest Technical Publication 77346.

3.3   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 carried by an OC-n (or higher level) line signal.

Qwest offers interfaces listed below that are capable of carrying three, 12 or 48 concatenated STS-1's. These are STS-3c, STS-12c or STS-48c circuits with transmission rates of 155.52 Mbit/s, 622.08 Mbit/s or 2.488 Gbit/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-48 Interface - One STS 48c, Four STS-12c's or 16 STS-3c's can be transported on an OC-48.

3.4   Performance Monitoring and Remote Reconfiguration

These functions are available to the customer via a customer provided terminal. The terminal will be connected to the transport equipment through an interface that meets the applicable requirements and specifications. The customer must also provide the interface cable that connects the terminal to the PM interface.

3.5   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 Self Healing Network Services. 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-STS 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.

3.6   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 3-1 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.* For complete information on OC-3 and OC-12 optical interfaces, refer to Technical Publication 77346, *Qwest Synchronous Service Transport (Qwest Synchronous Optical Transport Line Interface).*

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.

DS3 Electrical Interface

04 = 4 Conductors - Number of wires at the interface. For DS3, the code is always 04 denoting a 4-wire interface.

DS = Digital Hierarchy Interface - Protocol Code. This code is always DS for electrical DS3 interfaces.

6 = 75 Ohm Impedance - Impedance. For DS3 interfaces, the code is always 6 denoting 75 Ohms. The period following the 6 is a delimiter for clarity.

44A = 44.736 Mbit/s (DS3) M-framed structured per ANSI T1.102 - Protocol Option Code. This code is a variable. 44 denotes the DS3 rate of 44.736 Mbit/s. The 'A' suffix denotes it is an unchannelized application with the C-bit parity application.

Figure 3-1 Electrical DS3 NCI Code Example

3.7   Network Channel Interface (NCI) Codes and Combinations

The compatible NCI codes for SHNS are listed in Tables 3-1, 3-2 and 3-3. Some locations may not have all codes available. Check with a Qwest representative to determine specific availability.

Table 3-2 Optical Network Channel Interface (NCI) Codes -
Qwest Self Healing Network Service Ring Capacity - Synchronous (SONET)

NCI CODE	OPTION Qwest	OPTION ISI-SR-STS-000307
Ring Description		
02SOF	Digital Fiber Optic: OC-3, OC-12, OC-48 or OC-192 **	SONET Optical
Low Speed SONET Interface to Ring (from Ring Description above)		
04SOF.B	Digital Fiber Optic interface, LR1-SLM: OC-3, OC-12 or OC-48**	LR1-SLM (Long Reach - Single-Longitudinal Mode)
04SOF.D	Digital Fiber Optic interface, IR1-SLM: OC-3, OC-12 or OC-48**	IR1-SLM (Intermediate Reach - Single - Longitudinal Mode)
04SOF.F	Digital Fiber Optic interface, SR-SLM: OC-3, OC-12 or OC-48**	SR-SLM (Short Reach - Multi - Longitudinal Mode)

** An NC Code is required in addition to the NCI code for the Optical Interface to identify SONET capacities of OC-3, OC-12 or OC-48.

Additional information on the optical interface NCI codes may be found in Technical Publication 77346.

Table 3-3 lists NCI codes for Qwest Self Healing Service, Optical multiplexer to an OC-3 Ring, from ring description in Table 3-2.

Table 3-3 Configuration Network Channel Interface (NCI) Codes -
OC-3 SONET Ring -- Optical Multiplexer

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.B	1	0	0
04SMF.A3	0	3	0
04SMF.A21	0	2	28
04SMF.A12	0	1	56
04SMF.A03	0	0	84

Table 3-4 lists NCI codes for Qwest Self Healing Service, Optical multiplexer to an OC-12 Ring, from ring description in Table 3-2.

Table 3-4 Configuration Network Channel Interface (NCI) Codes -
OC-12 SONET Ring -- Optical Multiplexer

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 3-4 Configuration Network Channel Interface (NCI) Codes -
OC-12 SONET Ring -- 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.

Table 3-5 lists NCI codes for Qwest SONET Ring Optical Multiplexer operating at the OC-48 rate.

Table 3-5 Configuration Network Channel Interface (NCI) Codes -
OC-48 SONET Ring -- Optical Multiplexer.

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 3-5 Configuration Network Channel Interface (NCI) Codes -
OC-48 SONET Ring -- 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.

The following table lists NCI codes for Qwest Self Healing Service, Optical multiplexer to an OC-192 Ring arranged to only provide OC-12 through DS3 or STS-1 interfaces, from a ring description in Table 3-2.

Table 3-6 General Format for Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Ring -- 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
One Code must be specified at each Multiplexer Site			
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 3-6 General Format for Configuration Network Channel Interface (NCI) Codes -
OC-192 SONET Ring -- 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
One Code must be specified at each Multiplexer Site			
04SNF.	Q = 16	G = 16	H = 60
	°	H = 20	I = 72
	°	I = 24	J = 84
	°	J = 28	K = 96
	°	K = 32	L = 108
	°	L = 36	M = 120
	°	M = 40	N = 132
	°	N = 44	O = 144
	°	P = 48	P = 156
	°	Q = 52	Q = 168
	°	R = 56	R = 180
	°	S = 60	S = 192
	°	T = 64	°

Not all combinations of Table 3-6, NCI codes are physically possible or available. Additionally
OC-48 interfaces are available and are ordered without using the Multiplexer NCI code at this
time. Consult your Qwest representative for details.

Table 3-7 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 3-7 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 3-7 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 3-7 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 3-7 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 3-7 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 3-7 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 3-7 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 0C48s 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 Self Healing Service, Optical multiplexer to an OC-192 Ring 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 tale is listed.

Table 3-8 General Format for Configuration Network Channel Interface (NCI) Codes -
OC-192 SONET Ring -- 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
	S = 2/4	H = 20	I = 72
	T = 2/5	I = 24	J = 84
	U = 2/6	J = 28	K = 96
	V = 2/7	K = 32	L = 108
	W = 2/8	L = 36	M = 120
	X = 3/0	M = 40	N = 132
	Y = 3/1	N = 44	O = 144
	Z = 3/2	P = 48	P = 156
	1 = 3/3	Q = 52	Q = 168
	2 = 3/4	R = 56	R = 180
	3 = 4/0	S = 60	S = 192
		T = 64	

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 tale is listed.

Table 3-9 General Format for Configuration Network Channel Interface (NCI) Codes -
OC-192 SONET Ring -- 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	0 = 0	1 = 1
	B = 1	1 = 1	2= 2
	C = 2	2 = 2	3= 3
	D = 3	3 = 3	4= 4
	E = 4	4 = 4	5= 5
		5 = 5	6= 6
		6 = 6	7= 7
		7 = 7	8= 8
		8 = 8	9= 9
		9 = 9	A= 10
		A = 10	B= 11
		B = 11	C= 12
		C = 12	D= 16
			E= 20
			F= 24
			G= 28
			H= 32
			I= NA
			J= 36
			K= 40
			L= 44
			M= 48
			N= 52
			O= NA
			P= 56
			Q= 60
			R= 64

Table 3-10 Electrical Network Channel Interface (NCI) Codes
Qwest Self Healing Network Service

NCI Code	Qwest Self Healing Network Service – Electrical Interfaces DESCRIPTION
	STS-1 Electrical Interface
04ST6.A	STS-1 Synchronous Transmission Signal level 1
	DS3 Electrical Interfaces (See Qwest Technical Publication 77324)
04DS6.44	DS3 M-frame structured signal with M23 Multiplex format
04DS6.44R	DS3 M-frame structured signal – unchannelized
04DS6.44A	DS3 M-frame structured signal, C-bit parity – unchannelized
04DS6.44I	DS3 M-frame structured signal with M23 Multiplex format and C-bit parity
	LAN Electrical Interface
04LN9.10T	Local Area Network, Ethernet 10Base-T Connection
	DS1 Electrical Interfaces (See Qwest Technical Publication 77375)
04DS9.15	DS1 Carrier or Qwest CO Premises Interface, SF with AMI
04DS9.15B	DS1 Carrier or Qwest CO Premises Interface, SF with B8ZS
04DS9.15K	DS1 Carrier or Qwest CO Premises Interface, non-ANSI ESF with AMI
04DS9.15S	DS1 Carrier or Qwest CO Premises Interface, non-ANSI ESF with B8ZS
04DS9.1K	DS1 Carrier or Qwest CO Premises Interface, ANSI ESF with AMI
04DS9.1S	DS1 Carrier or Qwest CO Premises Interface, ANSI ESF with B8ZS
04DS9.15J	DS1 Carrier or Qwest CO Premises Interface, Free Framing with B8ZS
04DU9.AX	DS1 End-User Premises Interface, Free Framing/B8ZS/DSX-1
04DU9.BX	DS1 End-User Premises Interface, SF/AMI/DSX-1 Interface
04DU9.CX	DS1 End-User Premises Interface, non-ANSI ESF/AMI/DSX-1 Interface
04DU9.DX	DS1 End-User Premises Interface, SF with B8ZS/DSX-1 Interface
04DU9.SX	DS1 End-User Premises Interface, non-ANSI ESF/B8ZS/DSX-1 Interface
04DU9.1KX	DS1 End-User Premises Interface, ANSI ESF/AMI/DSX-1 Interface
04DU9.1SX	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.

3.8   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 (OC-3), OD (OC-12) and OF (OC-48). For additional information, see Technical Publication 77346.

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 Special Access services. This section describes the NC codes that apply specifically to SHNS.

3.9   NC Codes Used with Qwest SHNS

Table 3-11 Network Channel (NC) Codes - DS1, DS3 and STS-1 on SHNS

NC CODE	DESCRIPTION
DS1's on Qwest's Self Healing Network Service	
HCPS	DS1 Channel, Premium Service, Self Healing Network
HCPQ	DS1 Channel, Premium Service, Self Healing Network with Central Office Multiplexing
DS3's on Qwest's Self Healing Network Service	
HFPS	DS3 Channel, Premium Service, Self Healing Network
HFPQ	DS3 Channel, Premium Service, Self Healing Network with Central Office Multiplexing
HF-Q	DS3 Channel, Customer Premises Multiplexing
HFCQ	DS3 Channel, C-BIT Parity, Customer Premises Multiplexing
STS-1's on Qwest's Self Healing Network Service	
JI--	STS-1 Channel. Includes unspecified STS-1 mappings and asynchronously mapped DS3
JI-A	STS-1 Channel with an asynchronously mapped DS3 and Central Office Multiplexing to DS1 Services
JI-B	STS-1 Channel with an asynchronously mapped DS3 and Field End Multiplexing to DS1 Services
JIA-	STS-1 Channel, VT1.5 Structured
JIAA	STS-1 Channel, VT1.5 Structured with Central Office Multiplexing to DS1 Services
JIAB	STS-1 Channel, VT1.5 Structured with Field End Multiplexing to DS1 Services

Table 3-12 Network Channel (NC) Codes - LAN Transport on SHNS

NC CODE	DESCRIPTION
Local Area Network	
HM-F	LAN transport with self healing network service, point-to-point

Table 3-13 Network Channel (NC) Codes - SONET

NC CODE	DESCRIPTION
SONET Ring (Note 1)	
O B F -	SONET OC-3 Ring, External Timing.
O B F A	SONET OC-3 Ring, External Timing, with Customer Network Management. See Section 2.4.
O D F -	SONET OC-12 Ring, External Timing.
O D F A	SONET OC-12 Ring, External Timing, with Customer Network Management. See Section 2.4.
O F F -	SONET OC-48 Ring, External Timing.
O F F A	SONET OC-48 Ring, External Timing with Customer Network Management. See Section 2.4.
O G F -	SONET OC-192 Ring, External Timing.
O G F A	SONET OC-192 Ring, External Timing with Customer Network Management. See Section 2.4.
Low Speed SONET Interface to Ring (Note 2)	
O B B -	SONET OC-3, External Timing
O B - R	SONET OC-3, STS3c Payload
O B - -	SONET OC-3
O B A Q	SONET OC-3, Point-to-Point, Loop Timing, Termination on a higher bit rate Add-Drop Multiplexer
O D B -	SONET OC-12, External Timing
O D - R	SONET OC-12, STS12c Payload
O D - -	SONET OC-12
O D A Q	SONET OC-12, Point-to-Point, Loop Timing, Termination on a higher bit rate Add-Drop Multiplexer
O F B -	SONET OC-48, External Timing
O F - R	SONET OC-48, STS48c Payload
O F - -	SONET OC-48
O F A Q	SONET OC-48, Point-to-Point, Loop Timing, Termination on a higher bit rate Add-Drop Multiplexer

Note 1: These NC Codes are for the ring in its entirety.

Note 2: Terminates at the SONET Optical Terminal, or in the CO on a Fiber Distribution Panel if dropped from a higher rate, ring system. May cross-connect via Central Office Connecting Channel, or through a Connecting Facility Arrangement order to higher rate systems.

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4. LAN Services

4.1 Overview

A Local Area Network (LAN) is a network providing high-speed connectivity to a small geographic area. Qwest SHNS Service can provide LAN physical interfaces and dedicated transport to connect pairs of customer designated, premises nodes on their dedicated SONET ring. The appearance of a LAN interface at Qwest Central Office Nodes is not available.

LAN connectivity uses ring bandwidth and therefore reduces allowable ring capacity for North American Digital Hierarchy interfaces to Qwest Self Healing Network Service. Service requirements at each node should be known or forecast to order and construct an optimal SHNS network.

4.2 Ethernet Interface

SHNS Ethernet 10 M Mbit/s LAN service operates in a bridged, point-to-point configuration between Carrier or End-User's (EU's) premises nodes. SHNS Ethernet service and ports conform to the IEEE 802.3 Standard.

The Network Interface (NI) at the premises will be at the end of a twisted pair cable with signal characteristics as described in Institute of IEEE Standard 802.3. The maximum, twisted pair, cable distance from the Qwest SHNS node equipment to the NI shall be 20 meters. The remaining Ethernet cable budget of 80 meters of 100 Ohm, 2-pair, unshielded twisted-pair, EIA/TIA category 5, 4, or 3 cable is available to the Customer for connection to their installed equipment. SHNS LAN Service delivers Ethernet interfaces to the NI as IEEE 802.3, 10Base-T compliant transport at RJ-45 connector receptacles. The RJ-45 jack is an eight pin, industry standard arrangement with pin assignments shown in Chapter 3, Table 3-1.

4.3 Ethernet Bridging

The SHNS LAN service connects pairs of customer nodes providing connectivity between customer, local area networks of like architecture using bridge functionality. Bridges are protocol transparent, they do not provide flow control or recognize higher-level protocols. They use only the physical and link layers of the Open Systems Interconnect Reference Model (OSIRM). Therefore, the customer's LAN equipment shall provide all addressing and protocol translation independent of the Qwest SHNS service.

Bridges on the SHNS ring have no knowledge of the networks to which they are attached. They operate at the media access and control (MAC) layer of the OSIRM data link layer. Conventional Ethernet MAC layer bridging applies. The bridge terminates Ethernet frames so collisions will not be propagated.

4.4   Available NC and NCI Code Combinations for SHNS LAN Service

Since SHNS LAN service connects pairs of customer designated, premises nodes on their dedicated SONET ring only End User NCI are applicable. Table 4-1 below lists NC and NCI code combinations that are available for this service.

Table 4-1 Available NC and NCI Code Combinations for -
Qwest SHNS LAN Service

NC CODE	END USER LOCATION NCI CODE	END USER LOCATION NCI CODE
ETHERNET		
HM-F	04LN9.10T	04LN9.10T

See Chapter 3 for detailed descriptions of NC and NCI codes.

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5.   Performance Specifications

5.1   Error Performance Parameters

Error performance parameters are:

5.1.1   Background Block Error (BBE)

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

5.1.2   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.

5.1.3   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 5-1 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).

5.1.4   Bit Error Ratio (BER)

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

5.1.5   Errored Second (ES)

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

5.1.6   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.

5.1.7   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. SONET overhead capabilities will indicate the condition of the STS-n.

5.1.8   Percent Errored Seconds (% ES)

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

5.1.9   Percent Severely Errored Seconds (% SES)

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

5.2   Error Performance

Objectives given in this section are for all one-way system options and apply at the maximum short-haul design length.

For systems interfacing at the DS1 level, the long-term percentage of Errored Seconds (measured at the DS1 rate) shall not exceed 0.14%. This is equivalent to 99.86% Error Free Seconds. This requirement applies in a normal operating environment *and is also an acceptance criterion.* It is equivalent to not more than 10 Errored Seconds during a 2-hour, one-way (loopback) test.

For end-to-end systems interfacing at the DS3 level, the long-term percentage of Errored Seconds (measured at the DS3 rate) shall not exceed 1.0%. This is equivalent to 99.0% Error Free Seconds (EFS). These requirements apply in a normal operating environment, and *are also an acceptance criterion*. An EFS measure of 99.0% is equivalent to not more than 72 Errored Seconds during a 2-hour, one-way (loopback) test. Access DS3 systems shall meet or exceed 99.5% EFS.

For systems interfacing at the STS-n performance objectives are stated in terms of the parameters provided in Table 5-2. Accuracy performance should 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 service.

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

Table 5-2 STS-n Long-Term Accuracy Objectives

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)
BBER	(NOTE 1)	(NOTE 1)	10^{-5}	10^{-5}
% ES	0.25	0.5	(NOTE 2)	(NOTE 2)
% SES	0.035	0.035	0.035	0.035

NOTE 1: BBER is only specified for rates above 160 Mbit/s.

NOTE 2: Due to the lack of information on the performance of paths operating above 160 Mbit/s, no % ES objectives are recommended at this time. Nevertheless, ES processing should be implemented within any error performance measuring device operating at these rates for maintenance or monitoring purposes (including SONET section and line layer monitoring).

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.

5.3   Service Availability

Availability requirement for SHNS is 99.99 percent minimum. 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.

STS-n availability objectives are stated in terms of the parameter in Table 5-3. Percent (%) Availability, the same as applies to DS1 and DS3 services, characterize usability of STS-n services over time.

Table 5-3 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 (Monthly)	99.99	99.99	99.99	99.99	99.99

Availability requirement of 99.99% applies only to SHNS. For channels connecting to the Network at Central Office (CO) Hub nodes, the standard availability requirement will apply for the portion of the circuit not on the Self Healing Network.

5.4   Jitter Performance

5.4.1   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.

5.4.2   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.

5.4.3   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*.

5.5   Protection Switching

Automatic protection switching improves the availability and reliability performance of Qwest Self Healing Network Service by substituting standby equipment or alternate channels when failure occurs.

The protection switch will operate and switch the failing channel to the protection system when the BER on the transport system exceeds 1×10^{-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. (If the Remote Reconfiguration Option is chosen, the switching time may be longer and result in a possible temporary service interruption.)

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6.   Maintenance Responsibilities

6.1   Customer Responsibilities

Customers are responsible for all equipment and cable on the customer side of the Network Interface (NI) at their locations.

Customers or their responsible agent shall 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 isolates 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 locations and a Qwest Wire Center may sometimes be necessary to isolate the trouble.

6.2   Qwest Responsibilities

Qwest is responsible for all equipment and cable on the Qwest side of the NI at the customer premises.

Qwest is responsible for maintaining the transmission facility between customer locations and between the Wire Center Hub and the customer locations.

Qwest will furnish the customer a trouble reporting telephone number.

Upon receipt of a trouble report, Qwest Communications, Inc. will initiate action within twenty minutes to clear the trouble. Trouble reports include autonomous, Qwest, system generated reports.

Qwest is committed to 30 minute restoral in the event of a service interruption on Self Healing Network Services with the following two exceptions:

- Two (2) hours maximum restoral time in the event that the working or protection path fails as a result of an electronics failure.

- Eight (8) hours maximum restoral time if the path failure is a result of a cable failure.

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7. Definitions

7.1 Acronyms

ANSI	American National Standards Institute
BBER	Background Block Error Ratio
BER	Bit Error Ratio
Bellcore	Bell Communications Research, Inc.
CECO	Civil Enforcement Consent Order
CFA	Connecting Facility Arrangement
CLLI™	COMMON LANGUAGE® Location Identification
CO	Central Office
COCC	Central Office Connecting Channel
CPE	Customer Provided Equipment
CSS	Controlled Slip Seconds
CV	Coding Violations
DS1	Digital Signal Level 1 (1.544 Mbit/s)
DS3	Digital Signal Level 3 (44.736 Mbit/s)
EC	Exchange Carrier
EDIMS	Electronic Documentation Information Management System
ES	Errored Seconds
ESP	Enhanced Service Provider
EU	End-User
FCC	Federal Communications Commission
FDP	Fiber Distribution Panel
Gbit/s	Gigabits per second (1,000,000,000 bit/s)
IC	Interexchange Carrier
IEEE	Institute for Electrical and Electronic Engineers
IR1	Intermediate Reach
ITU-T	International Telecommunications Union -- Telecommunications Standardization Sector
kbit/s	kilobits per second (1,000 bit/s)

LATA	Local Access and Transport Area
LR1	Long Reach
LTE	Line Terminating Equipment
Mbit/s	Megabits per Second (1,000,000 bit/s)
MFJ	Modification of Final Judgment
NC	Network Channel
NCI	Network Channel Interface
NI	Network Interface
OC-n	Optical Carrier level n. The optical counter part of STS-n. It is the direct optical conversion of an STS-n after frame synchronous scrambling.
ONA	Open Network Architecture
OSIRM	Open Systems Interconnect Reference Model
PV	Path Coding Violations
SEFS	Severely Errored Frame Seconds
SHNS	Self Healing Network Service
SIE	Short Interruption Event
SIEC	Short Interruption Event Count
SLM	Single Longitudinal Mode
SONET	Synchronous Optical NET-work
STS-1	Synchronous Transport Signal level 1 (51.840 Mbit/s)
STS-n	Synchronous Transport Signal level n. Integer multiple of an STS-1 signal. It is the rate of an STS-n is equal to n times the rate of an STS-1.
TAG	Technical Advisory Group
TOC	Table of Contents
VT	Virtual Tributary
VTx	VT of size x (currently x = 1.5, 2, 3, or 6)

7.2   Glossary

Bandwidth

Analog - The range of frequencies that contain most of the energy or power of a signal; also, the range of frequencies over which a circuit or system is designed to operate.

Digital - The amount of information that a signal can carry over a fixed time interval. A system with a high bandwidth can carry more information over a fixed time interval than a low bandwidth system.

Binary n- Zero Substitution (BnZS)

Binary n- Zero Substitution is an application of BPRZ, and is an exception to the Alternate Mark Inversion (AMI) line-code rule. It is one method for providing bit independence for digital transmission, by providing a minimum 1's density of 1 in n-bits. For DS3, n=3; for DS1, n=8; for 56 kbit/s service, n=7, and for subrates, n=6. The rule of BnZS is:

- Successional binary 1s (Marks) will be of opposite polarity (AMI) unless they are separated by n consecutive binary zeros, in which case the n 0s will be replaced by an n-bit byte containing 1s, having or causing, an intentional bipolar violation (bpv).

- For example in B6ZS, if the preceding binary 1 was +, then binary 100000011 is transmitted as signal voltage values: -000+0+-+ (the B6ZS byte is underlined). Assume the leftmost bit is transmitted first.

- In the decoding process, the BnZS signature is recognized and replaced by an all zero n-bit byte.

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 (CO)

A local switching system (or a portion thereof) 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.

Customer Premises Equipment (CPE)

All telecommunication equipment located at a customer's location.

Customers

Denotes any individual, partnership or corporation who subscribes to the services provided by Qwest Communications, Inc. Customers are divided into two distinct and separate categories: (1) carriers, who provide interexchange services for hire for others, and (2) end-users, who request services only for their own use.

Customer Installation (CI)

Equipment and wiring at the customer's location on the customer side of the Network Interface.

Customer Premises

Denotes a building or portion(s) of a building occupied by a single customer or end-user either as a place of business or residence. Adjacent buildings and the buildings on the same continuous property occupied by the customer and not separated by a public thoroughfare, are also considered the customer's premises.

Customer Provided Equipment (CPE)

Equipment owned and maintained by the customer and located on their side of the End-User Point Of Termination (EU-POT), i.e., the network interface.

End-User (EU)

The term "End-User" denotes any customer of telecommunications service that is not a carrier, except that a carrier shall be deemed to be an "end-user" to the extent that such carrier uses a telecommunications service for administrative purposes without making such service available to others, directly or indirectly. The term is frequently used to denote the difference between a Carrier interface and an interface subject to unique regulatory requirements at non-Carrier customer premises (FCC Part 68, etc.).

End-User POT (EU-POT)

The Network Interface at the end-user's premises at which Qwest Communications, Inc.'s responsibility for the provision of service ends.

Error Free Second (EFS)

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

Errored Second (ES)

A one second interval with one or more bit errors.

> Note - A period of no signal shall be considered a period of errored bits.

Exchange

A unit established by Qwest Communications, Inc. for the administration of communications service in a specified geographic area that usually embraces a city, town, or village and its environs.

Extended Superframe (ESF) Format

An Extended Superframe consists of twenty-four consecutive DS1 frames. Bit one of each frame (the F-bit) is time shared during the 24 frames to describe a 6 bit frame pattern, a 6 bit Cyclic Redundancy Check (CRC) remainder, and a 12 bit data link. The transfer rate of each is 2 kbit/s, 2 kbit/s, and 4 kbit/s respectively.

Facilities

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

Interexchange Carrier (IC)/(IEC) or Interexchange Common Carrier

Any individual, partnership, association, joint-stock company, trust, governmental entity or corporation engaged for hire in interstate or foreign communication by wire or radio, between two LATAs.

Interface Code

See Network Channel Interface

Jitter

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

Kilobit/Second (kbit/s)

One thousand (1000) bits/second

Line Terminating Equipment (LTE)

Network elements that originate and/or terminate line (OC-N) signals. LTEs can originate, access, modify, or terminate the transport overhead, or can perform any combination of these actions.

Local Exchange Carrier (LEC)

The regulated entity providing Access and Intra-LATA services.

Multiplex

See multiplexer

Multiplexer (Mux)

An equipment unit to multiplex, or do multiplexing: Multiplexing is a technique of modulating (analog) or interleaving (digital) multiple, relatively narrow bandwidth channels into a single channel having a wider bandwidth (analog) or higher bit-rate (digital). The term Multiplexer implies the demultiplexing function is present to reverse the process so it is not usually stated.

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 Network Channel Interface (NCI) code is an encoded representation used to identify five (5) interface elements located at a Point of Termination (POT) at a central office or 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 (NI)

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.

Protocol

The rules for communication system operation that must be followed if communication is to be effected; the complete interaction of all possible series of messages across an interface. Protocols may govern portions of a network, types of service, or administrative procedures.

Protocol Code

The Protocol (character positions 3 and 4 of the Network Channel Interface [NCI] Code) is a two-character alpha code that defines requirements for the interface regarding signaling and transmission.

Serving Wire Center

The term "Serving Wire Center" denotes a Qwest Communications, Inc. Central Office from which dial tone for the Local Exchange Service would normally be provided to the demarcation point on the property at which the customer is served.

SONET

Synchronous Optical NET-work (SONET): 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 OCn where n=3 through a number not yet firm, are possible.

SONET Optical Terminal (SOT)

A terminal that uses SONET multiplexing to interleave the lower rate payloads, thereby creating a high rate synchronous signal. It is the terminating or originating portion of a fiber optic system that performs both an electrical to optical conversion and a multiplexing function.

STS Synchronous Payload Envelope (SPE)

A 125-microsecond frame structure composed of STS Path Overhead and bandwidth for payload. The term generically refers to STS-1 SPEs and STS-nc SPEs.

Superframe Format (SF)

A superframe consists of 12 consecutive DS1 frames. Bit one of each frame (the F-bit) is used to describe a 12-bit framing pattern during the 12 frames.

Synchronous Transport Signal Level 1 (STS-1)

The Basic logical building block signal with a rate of 51.840 Mbit/s.

Synchronous Optical NET-work (SONET)

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.

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.

Transmission Path

Denotes a path capable of transporting signals within the range of the service offering. A transmission path is comprised of physical or derived facilities consisting of any form or configuration of plant typically used in the telecommunications industry.

Transmission Service Channel

A one-way transmission path between two designated points.

Virtual Tributary (VT)

A structure designed for transport and switching of sub-STS-1 payloads. There are currently four VT sizes.

VT Group

A 108-byte structure that carries one or more VT's of the same size. Seven VT groups are byte-interleaved within the VT-organized SPE.

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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8. References

8.1 American National Standards Institute Documents

ANSI T1.102-1993   *Telecommunications - Digital Hierarchy - Electrical Interfaces*

ANSI T1.105-1995   *Telecommunications - Synchronous Optical Network (SONET) - Basic Description including Multiplex Structure, rates and Formats*

ANSI T1.105.01-1995   *Telecommunications - Synchronous Optical Network (SONET) - Automatic Protection Switching*

ANSI T1.105.02-1995   *Telecommunications - Synchronous Optical Network (SONET) - Payload Mappings*

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 Specifications (SONET) (Single Mode - Short Reach)*

ANSI T1. 223-1991   *Information Interchange - Structure and Representation of Network Channel (NC) and Network Channel Interface (NCI) Codes for the North American Telecommunications System.*

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 T1.404a-1996   *Telecommunications - Carrier-to-Customer Installation-DS3 Metallic Interface Specifications -- Supplement*

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*

8.2   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-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.

8.3   Institute of Electrical and Electronics Engineers (IEEE) Documents

IEEE 802.1D   *Information technology--Telecommunications and information exchange between systems--Local area networks--Media access control (MAC) bridges.* Institute of Electrical and Electronics Engineers, Inc., 1993.

IEEE 802.3   *Information technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements--Part 3: Carrier sense multiple access with collision* detection (CSMA/CD) access method and physical layer specifications. Institute of Electrical and Electronics Engineers, Inc., 1993.

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

8.4   Qwest Documents

PUB 77200   *Qwest DS1 Service and Qwest DS1 Rate Synchronization Service, Network Channel and Network Channel Interface Code Combinations.* Issue D, October 1995.

PUB 77324   *Qwest DS-3 Service.* Issue C, April 1993.

PUB 77344   *Diversity and Avoidance,*   Issue A, November 1990.

PUB 77346   *Qwest Synchronous Service Transport (Qwest Synchronous Optical Transport Line Interface).* Issue G, January 2001.

PUB 77371   *"COMMAND A LINK^{SM} Technical Description And Interface Combinations".* Issue C, May 1997.

PUB 77375   *1.544 Mbit/s Channel Interfaces.* Issue D, October 1995.

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