CenturyLink Corporation Technical Publication

Synchronous Service Transport (SST)

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The purpose of this document is to describe CenturyLink 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 CenturyLink 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

- Grandfather non-multiplexed OC-192

1.3 Scope

This document describes CenturyLink Synchronous Optical Transport offered by CenturyLink 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. Finally, it presents the electrical and optical interface configurations available with this service.

Chapter 4 Ethernet Features: Describes the general Ethernet over SST capabilities as well as available interfaces and SONET transport bandwidth options

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

Chapter 6 Maintenance Responsibilities: Provides the CenturyLink 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. 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 155.52 Mbit/s, 622.08 Mbit/s, 1.244 Mbit/s, 2.488 Gbit/s or 9.953 Gbit/s. SST's Synchronous Optic Transport provides Synchronous Optic NETwork (SONET) based transport channels between:

- Customer-designated premises through a local or remote CenturyLink Central Office
- A customer-designated premises and its CenturyLink Serving Wire Center (SWC) Central Office, known as the Hub
- A customer-designated premises and a remote CenturyLink Central Office
- Two CenturyLink Central Offices

SST consists of a Central Office (CO) Node, possibly a Remote Node at a distant CenturyLink Central Office or CO Node at another SWC, a Remote Node at the customer premises and the SONET transport connecting the nodes. SST Nodes in the CO are always CenturyLink-owned and provisioned equipment. The Remote Node at a customer premises may be either CenturyLink-owned and provided equipment or Customer-Provided Equipment (CPE). When the Remote Node at a premises location is customer-provided, CenturyLink shall identify equipment types compatible with the CO Node terminating equipment.

An option called Managed Bandwidth SONET Service or MBSS was available, but has been grandfathered. It is limited to those MBSS services that were purchased and are in service. 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 CenturyLink 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 CenturyLink Central Office node sites are specific wire centers where established, shared SONET ring infrastructure encompasses multiple wire centers throughout particular Metropolitan Service Area (MSA).

While this document describes Synchronous Service Transport as provided by CenturyLink to its customers, other non-standard designs may be considered on an Individual Case Basis.

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, and 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.

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. See Section 2.10 for information on UPSR and SST over GeoMax architectures.

Note that in Figures 2-1 and 2-2, "OG-- (OC-192)" is Grandfathered. Grandfathered services will continue to be supported on existing contracts until the platform supporting that service has reached end of life or the contract expires. No new orders will be accepted.

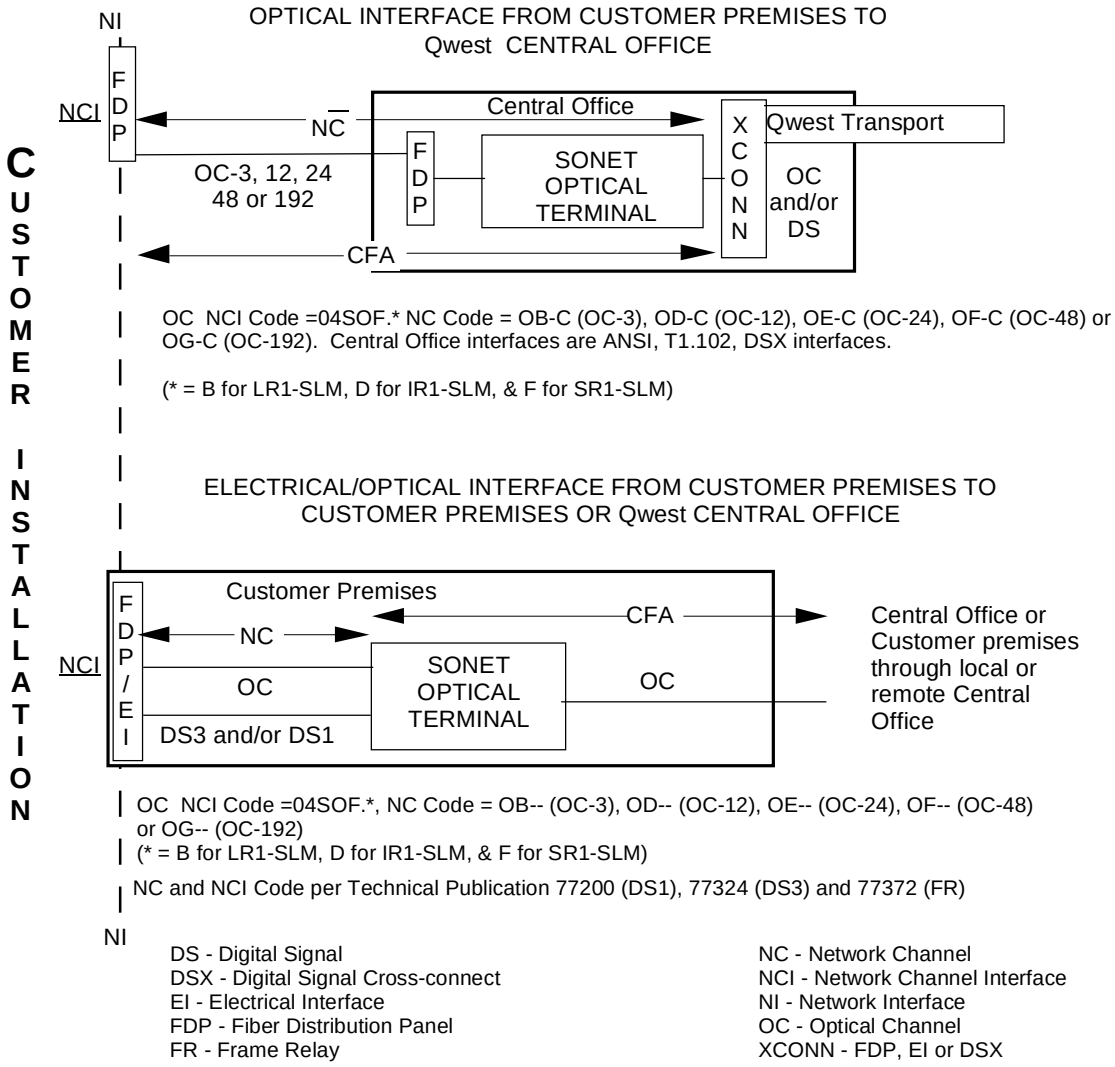


Figure 2-1 Typical Network Interface Arrangements
Note: "OG-- (OC-192)" is Grandfathered

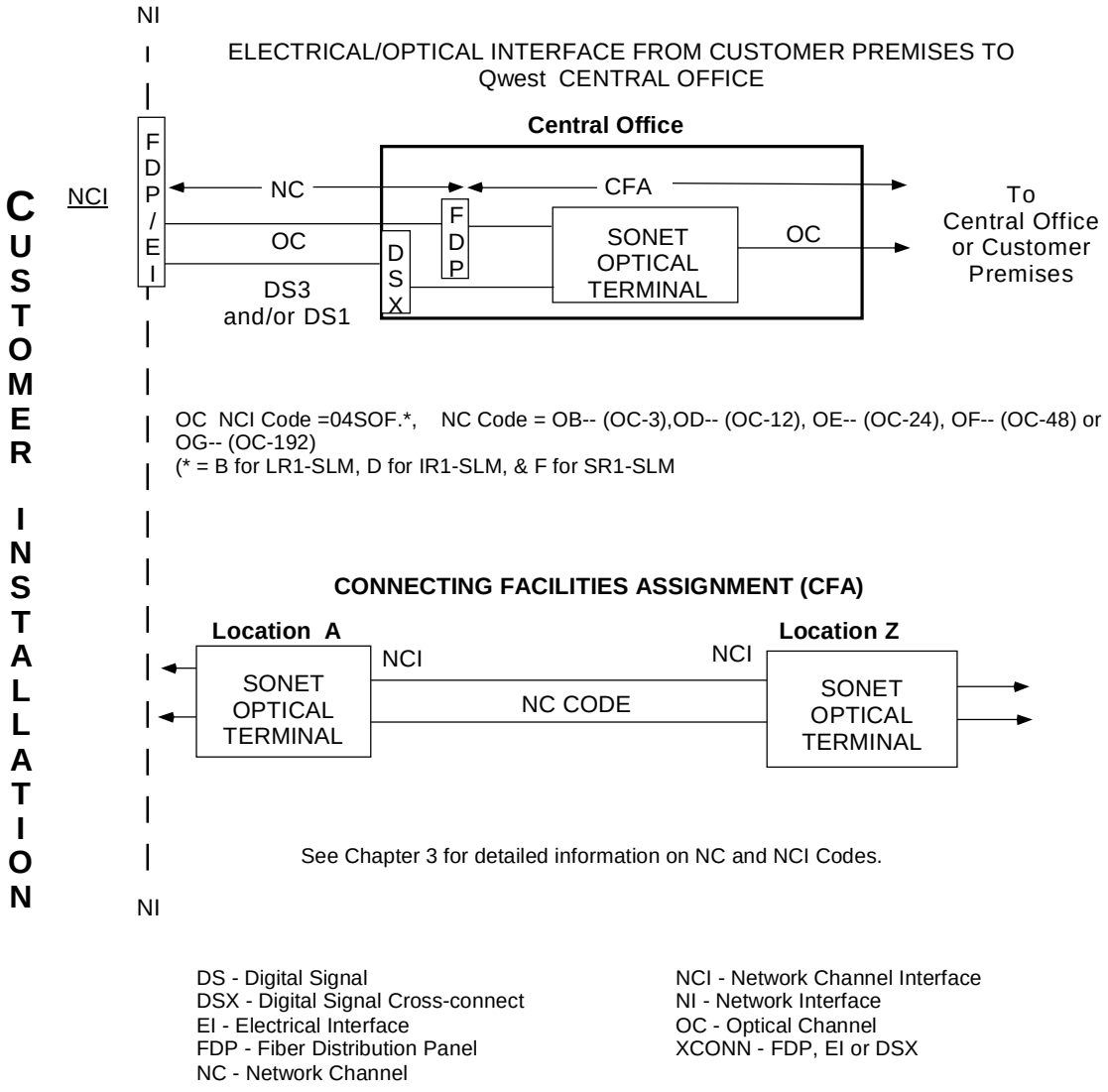


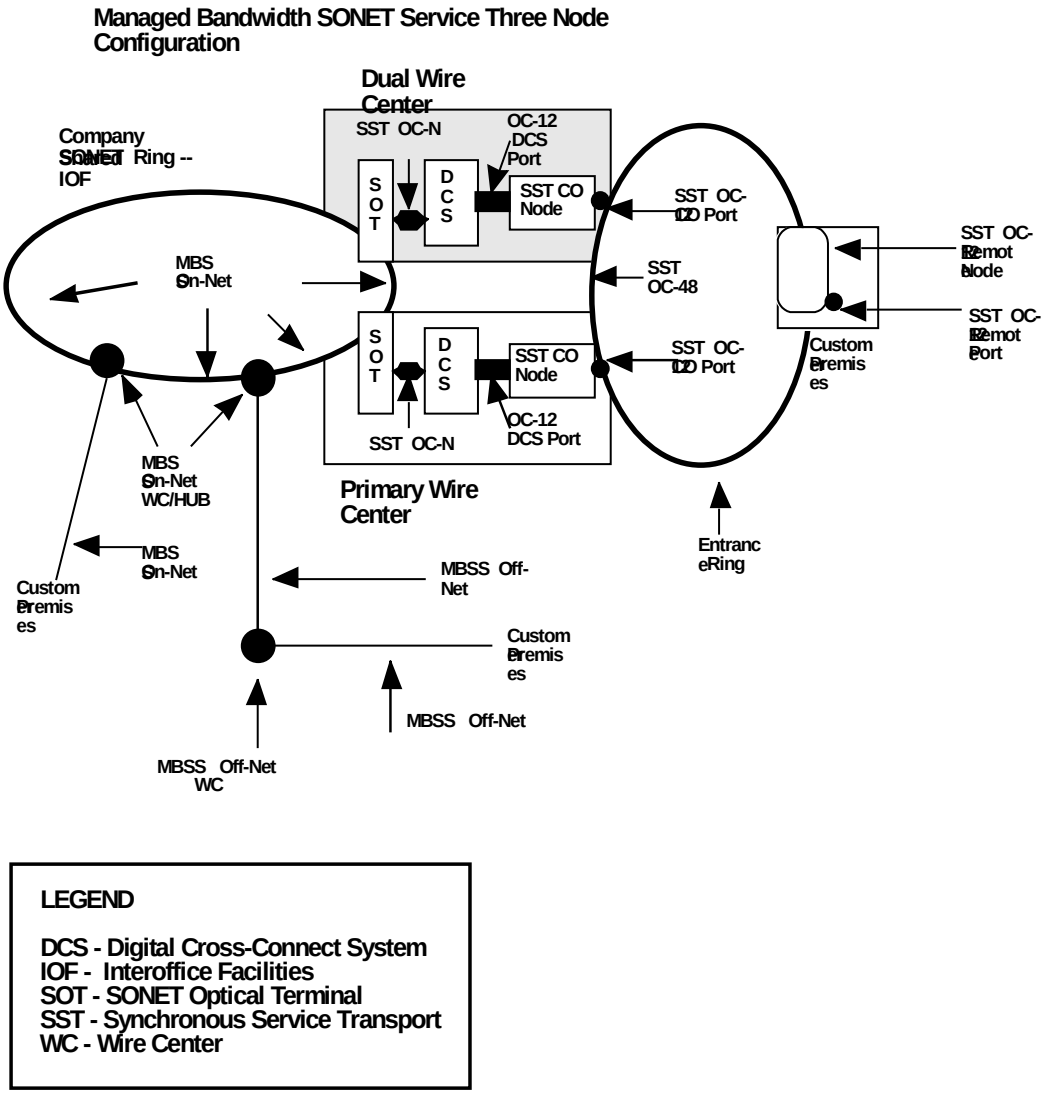
Figure 2-2 Typical Connecting Facility Assignment Arrangements
Note: "OG-- (OC-192)" is Grandfathered

2.3.2 Managed Bandwidth SONET Service Applications (grandfathered)

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 primary and secondary CenturyLink 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 CenturyLink 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 illustrates a typical Three Node MBSS application.



LEGEND

DCS - Digital Cross-Connect System
IOF - Interoffice Facilities
SOT - SONET Optical Terminal
SST - Synchronous Service Transport
WC - Wire Center

Figure 2-3 Typical MBSS Arrangement in Three Node Configuration

2.4 Interface Capacities Available

The following customer Network Interface types are available on the corresponding SST transport capacities:

Table 2-1 Interface Availability

INTERFACE TYPE	SST TRANSPORT CAPACITY				
	OC-3	**OC-12**	**OC-24**[1]	**OC-48**	**OC-192**
DS1	YES	YES[2]	YES[2]	YES[2]	YES[2]
10Base-T[3,4]	YES	YES	YES	YES	YES
DS3	YES	YES	YES	YES	YES
DS3 Transmux[4]	YES	YES	NO	NO	NO
STS-1	YES	YES	YES	YES	YES
STS-1 Transmux[4]	YES	YES	NO	NO	NO
100Base-TX[3,4]	YES	YES	YES	YES	YES
100Base-LX10[3,4]	YES	YES	YES	YES	YES
100Base-FX[3,4,5,11]	YES	YES	YES	YES	YES
OC-3	YES	YES	YES	YES	YES
OC-12	NO	YES	YES	YES	YES
1000Base-LX[3,6]	YES[8]	YES[8]	YES[9]	YES[9]	YES[9]
1000Base-ZX[3,4,10]	YES[8]	YES[8]	YES[9]	YES[9]	YES[9]
1000Base-SX[3,7,11]	YES[8]	YES[8]	YES[9]	YES[9]	YES[9]
OC-48	NO	NO	YES[12]	YES	YES
OC-192	NO	NO	NO	NO	YES

Table 2-1 Notes:

1. OC-24 is a CenturyLink bandwidth capacity option and does not reflect a specific transport line rate.
2. DS1 ports are limited to a maximum of 84 per Node and may be less depending upon the quantity of other interfaces ordered at a site as well as the equipment used by CenturyLink to provide the customer's SST.
3. See Table 4-1 for available Ethernet over SONET transport bandwidth options.
4. Where available (equipment dependant)
5. 1310 nm, Multi-Mode Fiber
6. 1310 nm, Single-Mode Fiber only
7. 850 nm, (50 or 62.5 um) Multi-Mode Fiber
8. Data rate is bandwidth rate-limited.
9. There is a maximum of 20 Gigabit Ethernet ports per Node.
10. 1550 nm, Single-Mode Fiber
11. Available at customer premises locations only
12. This customer Network Interface consists of 24 contiguous STS-1s or equivalent of customer usable (e.g., cross-connected) SONET transport bandwidth.

2.5 VT Transmux and SONET Multiplexing Capabilities

VT Transmux and SONET multiplexing are optional SST features, which afford 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 DS1 circuits to be aggregated into a single, larger DS3 or DS3 mapped into an STS-1 interface. An example of SONET multiplexing is DS1 services from a location VT1.5 mapped into an STS-1 channel and passed to another location via an OC-3.

Tables 2-2 and 2-3 list the bandwidth options:

Table 2-2 VT Transmux High and Low Bandwidth Possibilities

High Bandwidth Interface	VT Transmuxed	Low Bandwidth Interface Possibilities
DS3	To	DS1
STS-1[1]	To	DS1

Table 2-3 SONET Multiplexing High and Low Bandwidth Possibilities

High Bandwidth Interface[2]	SONET Multiplexed	Low Bandwidth Interface Possibilities
STS-1	To	DS3/DS1
OC-3	To	STS-1/DS3/DS1
OC-12	To	OC-3/ STS-1/DS3/DS1
OC-48	To	OC-12/OC-3/ STS-1/DS3/DS1
OC-192	To	OC-48/OC-12/OC-3/ STS-1/DS3/DS1

Table 2-2 and 2-3 Notes:

1. This STS-1 interface option with embedded DS1s, DS3 mapped is equipment dependant and offered on a where available basis only.
2. All CenturyLink-provided DS1 interface combinations will be VT1.5 mapped.
3. Ethernet to SONET customer Network Interface combinations with or without other TDM circuits are also supported (e.g., FastE over an STS-1-3v, GigE over an STS-3c-4v, GigE over an STS-3c-7v, 6 DS3s and 2 OC-3cs STS multiplexed to an OC-48 customer Network Interface at the far-end).

2.6 Ethernet Asymmetric Interface Configurations

CenturyLink transport equipment using mapper/demapper chips operating at or just below the OSI Layer of the incoming customer protocol as with ITU-T G.7041 Framed-mapped Generic Framing Procedure (GFP-F) encapsulation for rate-adjustable EoS services or Ethernet Transport on SST, enables the ability to provision asymmetric Ethernet interfaces at the A and Z end locations. As indicated in Section 3.14, an SST customer may order a point-to-point circuit with a FastE Network Interface at one end and a GigE Network Interface (via a speed-specific Ethernet NCI Code) at the other. This configuration is identical to a single FastE circuit with the only difference being a physical GigE interface at one end.

With GFP-F, the incoming Ethernet line encoding, Preamble/Start of Frame Delimiter (SFD) fields and Inter-Packet Gap (IPG) characters are removed at ingress and subsequently restored (with minimum IPG) per IEEE 802.3-2008 requirements by the GFP-F demapper chip at egress along with the de-encapsulated frame (on a frame by frame basis) for outgoing transmission to the attached customer-provided Ethernet device. Thus, a general note that potential aspects of interoperability such as Physical Layer (PHY) link signaling for Auto-Negotiation on twisted pair at one end of the circuit vs. 1000Base-X at the other would be processed or alternatively discarded at the local Ethernet port and not transported to the far-end with only the incoming Ethernet frames from MAC Destination Address (DA) through Frame Check Sequence (FCS), inclusive (with or without any Customer Edge or CE-VLAN tags) placed in the GFP payload information field for adaptation to SONET.

2.7 Performance Monitoring

Performance monitoring capability provides detailed, digital transmission quality information of a SST service to CenturyLink 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, *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 Section and Line Data Communications Channels (DCCs) will be turned off from the network provider's last network element to the customer's equipment. This is per GR-253-CORE. Without any 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 Synchronous Service Transport's Protection Configuration

Standard SONET redundancy of optical fibers and equipment is always provided with an SST service. Protect path diversity may also be provided, where available. Protect path diversity provides a "standby" protect fiber path that is routed over facilities physically separated from the normal path, 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.

With point-to-point SST, the customer's A-to-Z OC-N end-node to end-node traffic may be transported within the CenturyLink network using SONET 1+1 Linear, UPSR and/or 2F BLSR architecture(s). At the customer Network Interface however, the SST Automatic Protection Switching will be SONET 1+1 (or unprotected 0X1) Linear. UPSR or BLSR customer interfaces are not available options.

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 Telcordia Publications GR-436-CORE, *Digital Network Synchronization Plan*, and GR-378-CORE, *Timing Signal Generator (TSG) Requirements and Objectives*.

CenturyLink 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 CenturyLink Technical Publication 77386 for details on CenturyLink synchronization services.

2.11 SST over GeoMax

- SST over GeoMax is an option that allows the customer to specify which SONET fiber facility spans or SST Node-to-Node connections they want transported over their GeoMax in conjunction with ordering the appropriate OC-N ports/wavelength channels and providing CFA.
- Figure 2-4 illustrates the individual SST components that may connect to each other as well as over a customer's GeoMax service; actual port availability will be as indicated in Table 2-1.
- The customer's SST over GeoMax architecture may include CenturyLink local loop facilities and/or SONET IOF infrastructure segments in alignment with the SST Tariff CO Node and Transport Channel rate elements respectively in lieu of customer-specified SONET over wavelength channel transport with GeoMax Node-to-Node network connection(s).
- In general, 2 GeoMax unprotected OC-N ports (east & west wavelength channels) will be required per site for the SST Remote or CO Node to provide the desired originating/terminating circuits such as DS1s & DS3s.
- As many designs are possible, it's recommended that the customer work with CenturyLink to ensure an appropriate and fully supported SST over GeoMax finished service.
- At least one SST CO Node or 'standalone' SST Remote Node in a CenturyLink CO is required per SST OC-N system over GeoMax.
- The SST Remote or CO Node handoff for cross-connect to GeoMax must be at the OC-N SONET system capacity level.

- Though an SST OC-M (where OC-M < OC-N) Central Office Connecting Channel (COCC) is also available, DS1, DS3, etc. ports hairpinned to an OC-M interface are not supported whereas all DS1, DS3, etc. traffic will be multiplexed into the SONET OC-N transport system or SST capacity handoff.
- The SST transport (including when riding over a customer's GeoMax network) from customer-ordered SST OC-N near-end Node to customer-ordered SST far-end Node will always be protected and with point-to-point SST may be provided by CenturyLink via SONET 1+1 Linear, 1+1 UPSR and/or 2F BLSR architecture(s).
- Unprotected SST transport (e.g., a CenturyLink provisioned SONET 0+1 Linear point-to-point system) is not an available customer option.
- With customer-ordered SST UPSRs, all ring nodes must be CenturyLink-provided; SONET OC-N UPSR (or BLSR) customer Network Interfaces are not currently available.
- All customer OC-M/N Network Interfaces (e.g., to CPE) must be 2 or 4 fiber SONET Linear, 0X1 unprotected or 1+1 protected.
- SHARP or Optical SHARP requires the customer to order an SST CO Node and is not an available service option to OC-N local loop facilities when transported over GeoMax, which has its own diversity, performance, CenturyLink response & restoral time and service credit requirements. See the SST and GeoMax Tariff sections as well as GeoMax Tech Pub for further information and possible restrictions.
- The individual SST-to-GeoMax Node cross-connects are 2 fiber and while typically in pairs they may not be if/when the customer orders the end-to-end service such that the SST UPSR Node or ring segment (if consisting of multiple consecutive SST Nodes) east & west fiber facilities are connected to different GeoMax Nodes at physically different customer-specified locations.
- In some applications, an individual SST Node OC-N handoff may consist of a 2 fiber cross-connect to a GeoMax Node with the other 2 fibers connecting to another or different SST Node.
- Even with a 4 fiber single GeoMax Node cross-connect the 2 GeoMax OC-N ports may actually connect to 2 different SST UPSR Nodes such as a collocated Remote Node and a CO Node.

Figure 2-4 SST (over GeoMax) Components

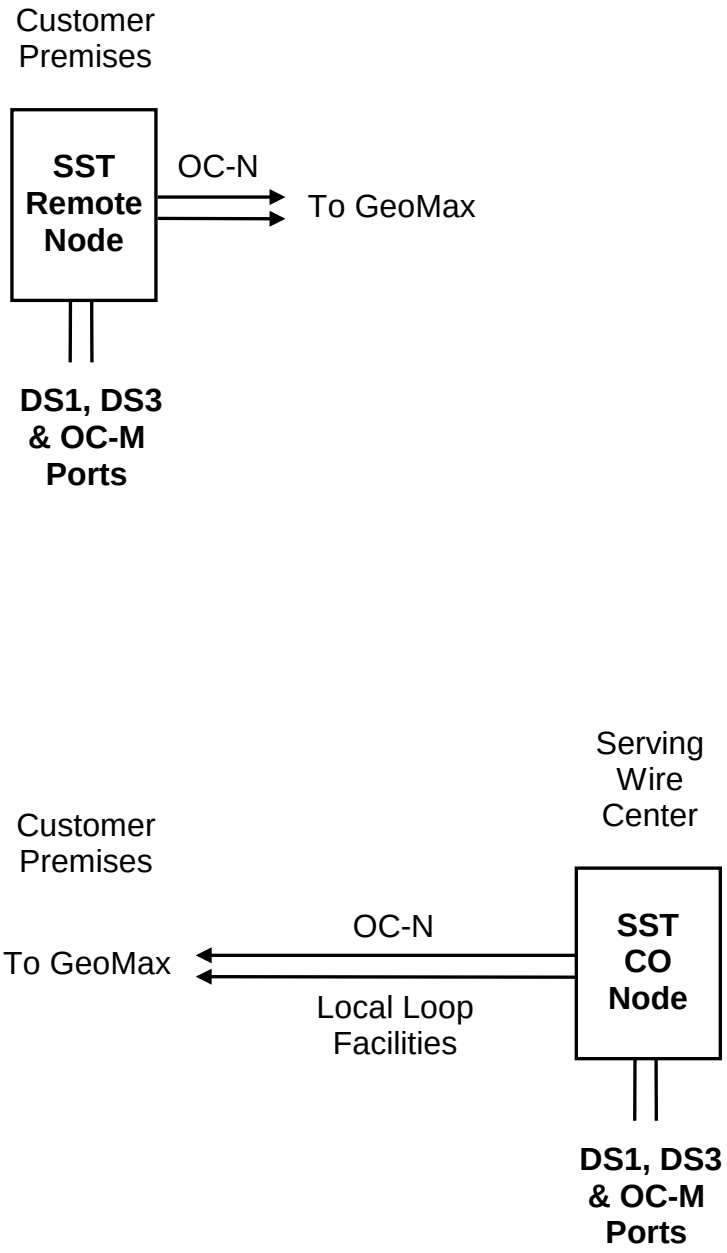
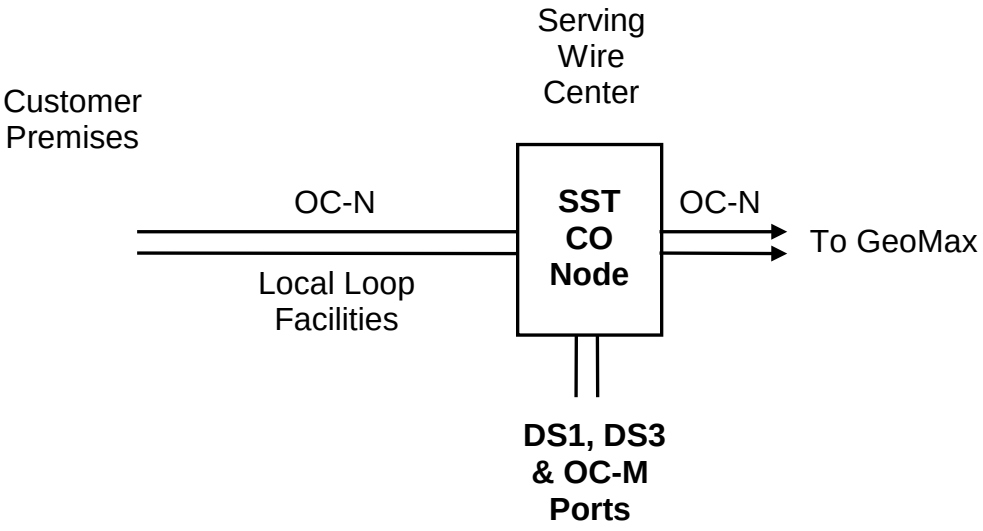


Figure 2-4 SST (over GeoMax) Components – Continued



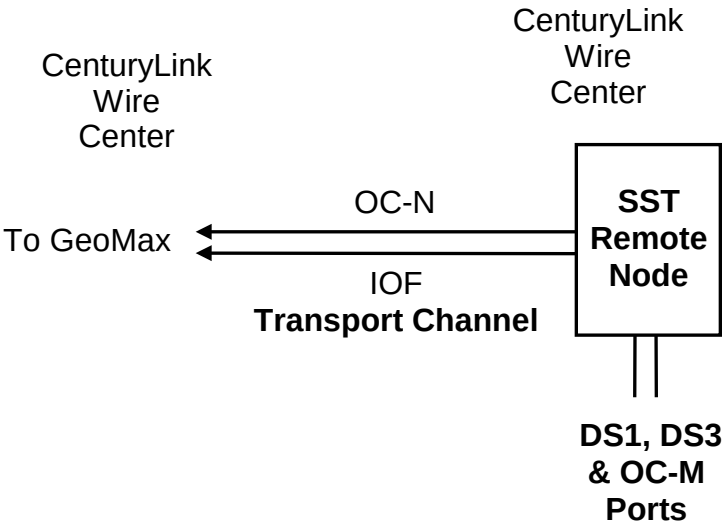
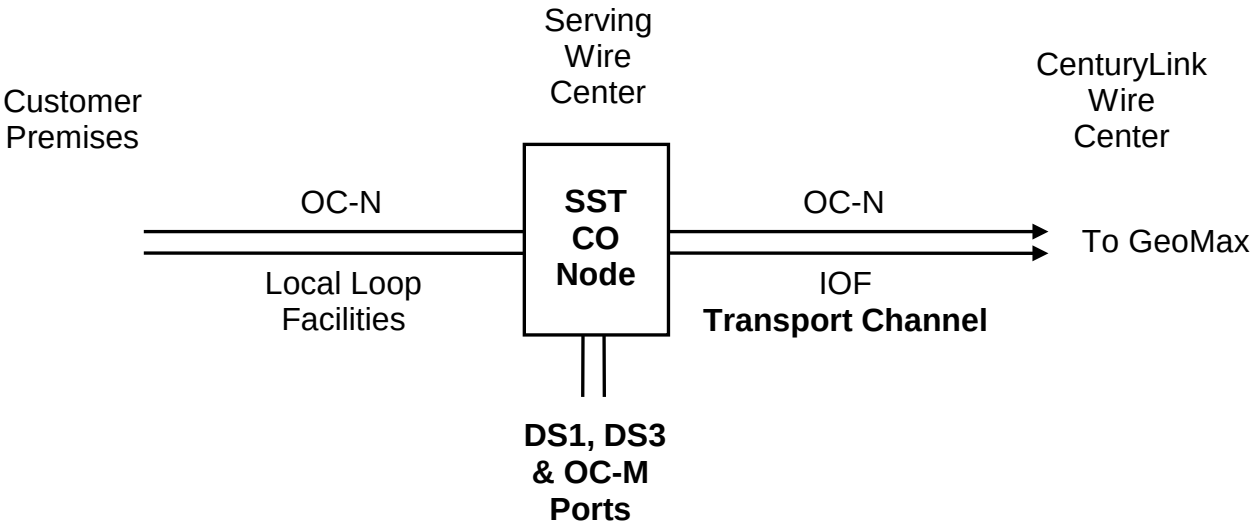
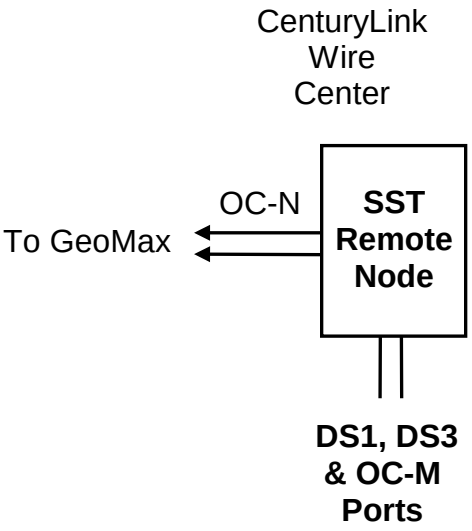


Figure 2-4 SST (over GeoMax) Components – Continued





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3. Network Interfaces

3.1 Applicability of Technical Specifications

Technical specifications presented in this document are applicable to CenturyLink 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 CenturyLink 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, *Synchronous Optical Network (SONET) – Basic Description including Multiplex Structure, Rates, and Formats,* which defines the North American version of the Synchronous Digital Hierarchy (SDH). This interface is also in accordance with ANSI T1.105.06, *Synchronous Optical Network (SONET): Physical Layer Specifications*. This technology allows CenturyLink to transport, provision and to deliver interfaces at the DS1, 10Base-T, DS3, STS-1, 100Base-TX/LX10/FX, OC-3, OC-12, 1000Base-LX/ZX/SX, OC-48 and OC-192 levels.

3.3 Interface Overview

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

Optical interfaces will be delivered to the Network Interface at a CenturyLink-provided Fiber Distribution Panel or equivalent and shall be equipped to terminate SC, FC or LC UPC duplex connectors. SC/UPC (with Ultra Physical Contact polish) is the CenturyLink default connector for new SST optical interfaces whereas FC and LC are customer-specified options, where available at premises locations only. As there are no (e.g., NCI) codes for ordering, the customer should make the request to their Sales or Account Team, or the connector type would be determined during the field visit and captured on the site survey form.

SC (Subscriber Connector) is a push-pull type of fiber optic connector with a square barrel that conforms to ANSI/TIA/EIA-604-3-B, *FOCIS (Fiber Optic Connector Intermateability Standard) 3, Type SC and SC-APC.* While SC, FC and LC UPC all have very good performance parameters for SONET, optical Fast and Gigabit Ethernet transport, SC connectors will be used to terminate all SST Single-Mode Fiber optical Network Interfaces in CenturyLink COs.

The Network Interface must be located in an accessible, environmentally controlled space. To be accessible, CenturyLink technicians must be able to work and perform tests at the NI without delay, at any time of day, any day of the year.

CenturyLink Tech Pub 77368, *CUSTOMER PREMISES ENVIRONMENTAL SPECIFICATIONS AND INSTALLATION GUIDE*, describes the environmental and installation requirements as well as the powering and grounding options for CenturyLink telecommunications equipment placed on customer premises.

CenturyLink Tech Pub 77419, *SPECIFICATIONS FOR THE PLACEMENT OF CENTURYLINK EQUIPMENT IN CUSTOMER-OWNED OUTDOOR CABINETS*, describes the environmental (including electromagnetic compatibility), power, and grounding requirements for customer-owned outdoor cabinets (if provided) in order to allow the placement of CenturyLink-owned equipment inside these cabinets for the provisioning of SST to the customer.

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.

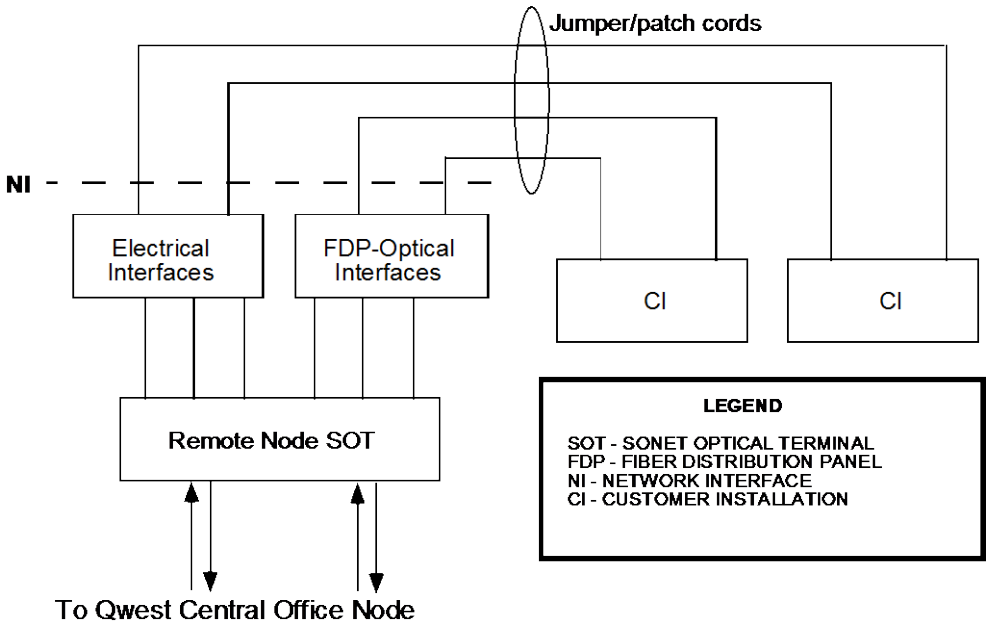


Figure 3-1 Network Interfaces

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 CenturyLink 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 CenturyLink Technical Publication 77375 which should be studied before a selection is made. Conventional interfaces use one of the Registration Jacks described by the Universal Service Ordering Codes (USOC) RJ48M and RJ48H. Conventional interface requests require special ordering.

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

3.4.2 10Base-T Interface

Point-to-point 10Base-T Ethernet over STS-1 channels are provided to Carrier's and to End-User's (EU's) premises. The Network Interface (NI) will be at a Category 5 Patch Panel with physical layer signal characteristics as described in IEEE 802®.3-2002, *Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*.

Carrier Customers have two options at their premises:

- Carrier Customers may elect to terminate their cables on the CenturyLink Category 5 Patch Panel in the space provided for CenturyLink's transmission equipment.
- Have CenturyLink terminate CenturyLink cable on the Carrier's Category 5 Patch Panel located in the Carrier's workspace.

The NI to an EU customer will be at a Registration Jack, RJ-45 connector receptacle on a CenturyLink-provided Category 5 Patch Panel. Chapter 4 provides further information on SST Ethernet Network Interfaces including RJ-45 pinouts.

At the discretion of CenturyLink, 10Base-T Ethernet interfaces may be cross-connected in the Central Office via a fiber optic interface.

3.4.3 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 CenturyLink Technical Publication 77324.

Carrier Customers have two options at their premises:

- Carrier Customers may elect to terminate their cables on the CenturyLink DSX-3 cross-connect panel in the space provided for CenturyLink's transmission equipment.
- Have CenturyLink terminate CenturyLink 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 CenturyLink Technical Publication 77324.

3.4.4 STS-1 Interface

STS-1 channel services terminate at NIs located at the premises of a Carrier or End-User. The STS-1 Electrical interface is also known as an Electrical Carrier Level 1 (EC-1) signal.

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, *Synchronous Optical Network (SONET) – Basic Description including Multiplex Structure, Rates, and Formats* and Telcordia 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 CenturyLink-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, *Digital Hierarchy – Electrical Interfaces* and Telcordia GR-253-CORE.

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

- Terminate their cables on the CenturyLink cross-connect panel in the space provided for CenturyLink's transmission equipment.
- Have CenturyLink terminate CenturyLink's cable on the Carrier's cross-connect panel located in the Carrier's workspace.

3.4.5 100Base-TX, 100Base-LX10 and 100Base-FX Interfaces

Point-to-point 100Base-TX, 100Base-LX10 and 100Base-FX Fast Ethernet over STS-1-1v, STS-1-2v, STS-1-3v or STS-3c-1v transport channels are provided to Carrier's and to End-User's (EU's) premises. With 100Base-TX, the Network Interface (NI) will be at a Category 5 Patch Panel.

Carrier Customers have two options at their premises:

- Carrier Customers may elect to terminate their cables on the CenturyLink Category 5 Patch Panel in the space provided for CenturyLink's transmission equipment.
- Have CenturyLink terminate CenturyLink cable on the Carrier's Category 5 Patch Panel located in the Carrier's workspace.

The NI to an EU customer will be at a Registration Jack, RJ-45 connector receptacle on a CenturyLink-provided Category 5 Patch Panel. Chapter 4 provides further information on SST Ethernet Network Interfaces including RJ-45 pinouts.

With optical Fast Ethernet, the NI for all customers will be at a CenturyLink-provided Fiber Distribution Panel (FDP) designed to terminate 1310 nm Single-Mode Fiber for 100Base-LX10 (ex-100Base-FX over Single-Mode fiber) and1310 nm Multi-Mode Fiber for 100Base-FX interfaces via SC, FC or LC (at customer premises locations) UPC connectors. 100Base-FX Network Interfaces are available at customer premises locations only and not in CenturyLink COs. The physical layer signal characteristics will be as described in IEEE 802.3-2008.

3.4.6 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 CenturyLink-owned Line Terminating Equipment. Unless otherwise specified, the OC-3 is expected to consist of STS-1 signals, each with an STS-1 Synchronous Payload Envelope (SPE). The OC-3 shall be a 1+1 (or 0X1 unprotected) Linear at the customer Network Interface.

3.4.7 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 CenturyLink-owned Line Terminating Equipment. Unless otherwise specified, the OC-12 is expected to consist of STS-1 signals, each with an STS-1 SPE. The OC-12 shall be a 1+1 (or 0X1 unprotected) Linear at the customer Network Interface.

3.4.8 1000Base-LX, 1000Base-ZX and 1000Base-SX Interfaces

Point-to-point 1000Base-LX, 1000Base-ZX and 1000Base-SX Gigabit Ethernet over STS-1-1v, STS-1-2v, STS-1-3v, STS-1-6v, STS-1-9v, STS-1-12v, STS-21v or STS-3c-1v, STS-3c-2v, STS-3c-3v, STS-3c-4v or STS-3c-7v transport channels are provided to Carrier's and End-User's (EU's) premises. The NI for all customers will be at a CenturyLink-provided Fiber Distribution Panel (FDP) designed to terminate 1310 nm Single-Mode Fiber for 1000Base-LX, 1550 nm Single-Mode Fiber for 1000Base-ZX and 850 nm Multi-Mode Fiber for 1000Base-SX Gigabit Ethernet optical interfaces via SC, FC or LC (at customer premises locations) UPC connectors. 1000Base-SX Network Interfaces are available at customer premises locations only and not in

CenturyLink COs. The physical layer signal characteristics will be as described in IEEE 802.3-2008. Chapter 4 provides further information on SST Ethernet Network Interfaces.

3.4.9 OC-48 Interface

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

An OC-48 interface provides a high capacity channel for the transmission of 2.488 Gbit/s, using an optical interface, delivered from CenturyLink-owned Line Terminating Equipment. Unless otherwise specified, the OC-48 is expected to consist of STS-1 signals, each with an STS-1 SPE. The OC-48 shall be a 1+1 (or 0X1 unprotected) Linear at the customer Network Interface.

3.4.10 OC-192 Interface

An OC-192 interface provides a high capacity channel for the transmission of 9.953 Gbit/s, using an optical interface, delivered from CenturyLink-owned Line Terminating Equipment. Unless otherwise specified, the OC-192 is expected to consist of STS-1 signals, each with an STS-1 SPE. The OC-192 shall be a 1+1 (or 0X1 unprotected) Linear at the customer Network 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 (B-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) SONET signal.

CenturyLink currently offers the customer Network Interfaces listed below that are capable of carrying an STS-Nc payload, which will be provided using equipment that meets technical and operational requirements specified in GR-253-CORE, *Synchronous Optical Network (SONET) Transport Systems: Common Criteria.*

- OC-3 Network Interface - One STS-3c can be transported on an OC-3.
- OC-12 Network Interface - One STS-12c can be transported on an OC-12.
- OC-48 Network Interface - One STS-48c can be transported on an OC-48.
- OC-192 Network Interface - One STS-192c can be transported on an OC-192.
  Transport of One STS-192c inside an OC-192 is Grandfathered. Grandfathered services will continue to be supported on existing contracts until the platform supporting that service has reached end of life or the contract expires. No new orders will be accepted.

Support of customer-mapped OC-12 and OC-48 subrate concatenated payload combinations are also possible, where available via SONET NEs deployed by

CenturyLink that provide the capability to automatically change between different combinations of paths based on the provisioned cross-connections and the presence or absence of concatenation indicators in the STS payload pointers.

Customer-Provided Equipment (CPE) solutions using an STS-Nc SPE containing multiple payload mappings, which is outside of that currently defined in GR-253-CORE or ATIS-0900105.02 (and thus proprietary at the originating/terminating SONET PTE or Path layer within the CPE), should also function with SST. Other potential options include customers using STS-1 inverse multiplexing (Virtual Concatenation) over an OD/OF/OG-- non-concatenated (STS-1 channelized) SONET circuit for example or ordering multiple individually concatenated point-to-point circuits from CenturyLink. Note that OG-- is Grandfathered. Grandfathered services will continue to be supported on existing contracts until the platform supporting that service has reached end of life or the contract expires. No new orders will be accepted.

3.6 Signal Formats

The DS1, DS3, STS-1, OC-3, OC-12, OC-48 and OC-192 signal interfaces provided by CenturyLink, conform to: ANSI T1.105, *Synchronous Optical Network (SONET) – Basic Description including Multiplex Structure, Rates and Formats*, ANSI T1.102, *Digital Hierarchy – Electrical Interfaces*, and ANSI T1.107, *Telecommunications – Digital Hierarchy - formats specifications*.

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

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

10Base-T, 100Base-TX/LX10/FX and 1000Base-LX/ZX/SX interfaces delivered by CenturyLink will conform to the physical layer signal characteristics only as specified in IEEE 802.3-2008.

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 Laser		
OC-3	155.52 Mbit/s	- 20 dBm
OC-12	622.08 Mbit/s	- 17 dBm
1000Base-ZX	1000 Mbit/s	- 19 dBm
OC-24	2.488 Gbit/s[1]	-17 dBm
OC-48	2.488 Gbit/s	-17 dBm
OC-192	9.953 Gbit/s	-17 dBm
Intermediate Reach -- Single Longitudinal Mode Laser		
100Base-LX10	100 Mbit/s	- 19 dBm
OC-3	155.52 Mbit/s	- 20 dBm
OC-12	622.08 Mbit/s	- 19 dBm
1000Base-LX	1000 Mbit/s	- 19 dBm
OC-24	2.488 Gbit/s[1]	-11 dBm
OC-48	2.488 Gbit/s	-11 dBm
Short Reach -- Multi-Longitudinal Mode Laser[2]		
OC-3	155.52 Mbit/s	- 19 dBm
OC-12	622.08 Mbit/s	- 19 dBm
100Base-FX	100 Mbit/s	- 20 dBm
1000Base-SX	1000 Mbit/s	- 17 dBm

Notes:

1. Although the equipped channel capacity is that of an OC-24, the line rate is OC-48.
2. While Multi-Longitudinal Mode lasers are used as low power transmitters, all SONET Optical Carrier Network Interfaces will be delivered over Single-Mode Fiber.

CenturyLink and customer signal parameters for DS3 and DS1 electrical Network Interfaces are provided in Technical Publications 77324 and 77375, 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 CenturyLink network interface for Synchronous Service Transport. The NC and NCI codes are provided by the customer to the CenturyLink Service Representative at the time a request for service is initiated.

Additional information concerning NC/NCI Codes is available in ANSI T1.223, *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, CenturyLink offerings differ from those described by Telcordia in their published Industry Support Interface, SR-307, *COMMON LANGUAGE NC/NCI Dictionary*. Furthermore, definitions of NC and NCI's evolve. Therefore, it is important to request CenturyLink 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 CenturyLink 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 *CenturyLink 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 Ethernet over SONET (EoS) channel interfaces, the first two characters are KD, KQ or KR.
- For Ethernet Transport channel interfaces, the first two characters are KR or KQ.
- For optical channel interfaces, the first two characters are OB (OC-3), OD (OC-12), OE (OC-24), OF (OC-48) or OG (OC-192). 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

Tables 3-2 and 3-3 list Network Channel codes available for CenturyLink Synchronous Service Transport. Section 2.10 provides further information including requirements for Uni-directional ring segment (UPSR) and SST over GeoMax architectures.

Table 3-2 SONET NC Codes available with SST

NC Code	Description
	Optical
OB--	OC-3 SONET Point-to-Point
OB-C	OC-3 SONET Point-to-Point with Central Office Terminal Add Drop Multiplexer
OB-D	OC-3 SONET Point-to-Point with Non-CO Multiplexer
OB-E	OC-3 SONET Point-to-Point with Multiplexer both ends
OB-R	OC-3 SONET Point-to-Point, STS-3c Payload
OBAQ	OC-3 SONET Point-to-Point, Loop timing, Termination on a higher bit rate Add-Drop Multiplexer
OBU-	OC-3 SONET Ring Segment, Uni-Directional
OD--	OC-12 SONET Point-to-Point
OD-2	OC-12 SONET Point-to-Point, Custom Mapped STS Facility[1] (Facility defaults to individual STS-1 assignments but allows for customer-designated concatenation of sub-rate payloads, i.e. up to four STS-3cs)
OD-C	OC-12 SONET Point-to-Point with Central Office Terminal Add Drop Multiplexer
OD-D	OC-12 SONET Point-to-Point with Non-CO Multiplexer
OD-E	OC-12 SONET Point-to-Point with Multiplexer both ends
OD-R	OC-12 SONET Point-to-Point, STS-12c Payload
ODAQ	OC-12 SONET Point-to-Point, Loop timing, Termination on a higher bit rate Add-Drop Multiplexer
ODU-	OC-12 SONET Ring Segment, Uni-Directional
OE--	OC-24 SONET Point-to-Point
OE-C	OC-24 SONET Point-to-Point with Central Office Terminal Add Drop Multiplexer
OE-D	OC-24 SONET Point-to-Point with Non-CO Multiplexer
OE-E	OC-24 SONET Point-to-Point with Multiplexer both ends

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

NC Code	Description
	Optical
OF--	OC-48 SONET Point-to-Point
OF-2	OC-48 SONET Point-to-Point, Custom Mapped STS Facility[1] (Facility defaults to individual STS-1 assignments but allows for customer-designated concatenation of sub-rate payloads, i.e. any combination of STS-3c and/or STS-12cs)
OF-C	OC-48 SONET Point-to-Point with Central Office Terminal Add Drop Multiplexer
OF-D	OC-48 SONET Point-to-Point with Non-CO Multiplexer
OF-E	OC-48 SONET Point-to-Point with Multiplexer both ends
OF-R	OC-48 SONET Point-to-Point, STS-48c Payload
OFAQ	OC-48 SONET Point-to-Point, Loop timing, Termination on a higher bit rate Add-Drop Multiplexer
OFU-	OC-48 SONET Ring Segment, Uni-Directional
OG--	OC-192 SONET Point-to-Point (Grandfathered)
OG-C	OC-192 SONET Point-to-Point with Central Office Terminal Add Drop Multiplexer
OG-D	OC-192 SONET Point-to-Point with Non-CO Multiplexer
OG-E	OC-192 SONET Point-to-Point with Multiplexer both ends
OG-R	OC-192 SONET Point-to-Point, STS-192c Payload (Grandfathered)
OGU-	OC-192 SONET Ring Segment, Uni-Directional

Table 3-2 Note:

1. Available on an Individual Case Basis only where the end-to-end SST network consists of CenturyLink equipment capable of supporting a 'Custom Mapped STS Facility', which on SST will provide for auto concatenation and enable the customer with the ability to change their mix of CPE mapped payloads (without subsequent service orders) based on the presence or absence of concatenation indicators in the STS Payload Pointers of the incoming customer OC-12 or OC-48 SONET standard signal.
2. Grandfathered services will continue to be supported on existing contracts until the platform supporting that service has reached end of life or the contract expires. No new orders will be accepted.

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

NC Code	Description
	Electrical
JI--	Point-to-Point, STS-1 Channel
JI-A	Point-to-Point, STS-1 Channel with an asynchronously mapped DS3 and Central Office Multiplexing to DS1 Services
JI-B	Point-to-Point, STS-1 Channel with an asynchronously mapped DS3 and Field End Multiplexing to DS1 Services
JIA-	Point-to-Point, STS-1 Channel VT1.5 structured
JIAA	Point-to-Point, STS-1 Channel VT1.5 structured and Central Office Multiplexing to DS1 Services
JIAB	Point-to-Point, STS-1 Channel VT1.5 structured and Field End Multiplexing to DS1 Services
JIG-	Point-to-Point, External Timing STS-1
Besides the below DS3 services; SST supports DS3 Services from other offerings such as Technical Publication 77324 or 77372.	
HF-Q	DS3 Channel, Customer Premises Multiplexing, M2/3 Format
HFCQ	DS3 Channel, C-Bit Parity, Customer Premises Multiplexing
SST supports DS1 Services from other offerings such as Technical Publication 77200 or 77372.	

Table 3-3 Ethernet NC Codes available with SST

NC Code	Description
	Ethernet
KDAP	Ethernet at 10 Mbps, Full Duplex LAN, Protected
KQFM	Rate-Adjustable 100 Mbps Ethernet, Full Duplex - Rate based on SONET Transport, STS-3c-1v, 149.76 Mbps Nominal Payload Rate
KQP	Rate-Adjustable 100 Mbps Ethernet, Protected Full Duplex - Rate based on SONET Transport,
C	STS-1-1v, 48.384 Mbps Nominal Payload Rate
D	STS-1-2v, 96.768 Mbps Nominal Payload Rate
T	STS-1-3v, 145.152 Mbps Nominal Payload Rate
KRP	Rate-Adjustable 1 Gbps Ethernet (Full Duplex), Protected, Rate based on STS Transport
F	STS-1-6v, 290.304 Mbps Nominal Payload Rate
I	STS-1-9v, 435.46 Mbps Nominal Payload Rate
0	STS-1-12v, 580.608 Mbps Nominal Payload Rate
U	STS-1-21v, 1016.064 Mbps Nominal Payload Rate
Y	STS-1-1v, 48.384 Mbps Nominal Payload Rate
Z	STS-1-3v, 145.152 Mbps Nominal Payload Rate
KRSB	Rate-Adjustable 1 Gbps Ethernet (Full Duplex), Rate based on SONET transport level, STS-1-2v, 96.768 Mbps Nominal Payload Rate
KRSY	Ethernet, Rate-Adjustable 1 Gbps Ethernet (Full Duplex), Rate based on SONET transport level, STS-1-1v, 48.384 Mbps Nominal Payload Rate
KRR	Rate-Adjustable 1 Gbps Ethernet (Full Duplex), Rate based on SONET transport with Hi-Order VCAT,
A	STS-3c-1v, 149.76 Mbps Nominal Payload Rate
B	STS-3c-2v, 299.52 Mbps Nominal Payload Rate
C	STS-3c-3v, 449.28 Mbps Nominal Payload Rate
D	STS-3c-4v, 599.04 Mbps Nominal Payload Rate
G	STS-3c-7v, 1048.32 Mbps Nominal Payload Rate
Q	Protected, STS-3c-7v, 1048.32 Mbps Nominal Payload Rate

Note: Protected = over SST SONET transport and applies to all EoS circuits whether explicitly identified in the NC Code or not.

Table 3-4 shows the Ethernet over SONET Network Channel codes with available SST transport bandwidth.

Table 3-4 EoS NC Codes and SST Transport Bandwidth

Ethernet Port	Transport Bandwidth								
	10 Mbps	**48 Mbps**	**97 Mbps**	**100 Mbps**	**145 or 150 Mbps**	**290 or 300 Mbps**	**435 or 449 Mbps**	**580 or 599 Mbps**	**1000 Mbps**
10 Mbps	KDAP								
100 Mbps		KQPC	KQPD	KQPT or KQFM					
1000 Mbps		KRPY	KRSB	KRSY	KRPZ or KRRA	KRPF or KRRB	KRPI or KRRC	KRP0 or KRRD	KRPU,KRRQ, or KRRG

Note: See Section 5.5.1 for actual customer Ethernet throughput.

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, *CenturyLink 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, *Digital Hierarchy – Formats Specifications.* It uses the C-bit parity application per ANSI T1.107.

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 3-2 Electrical DS3 NCI Code Example

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

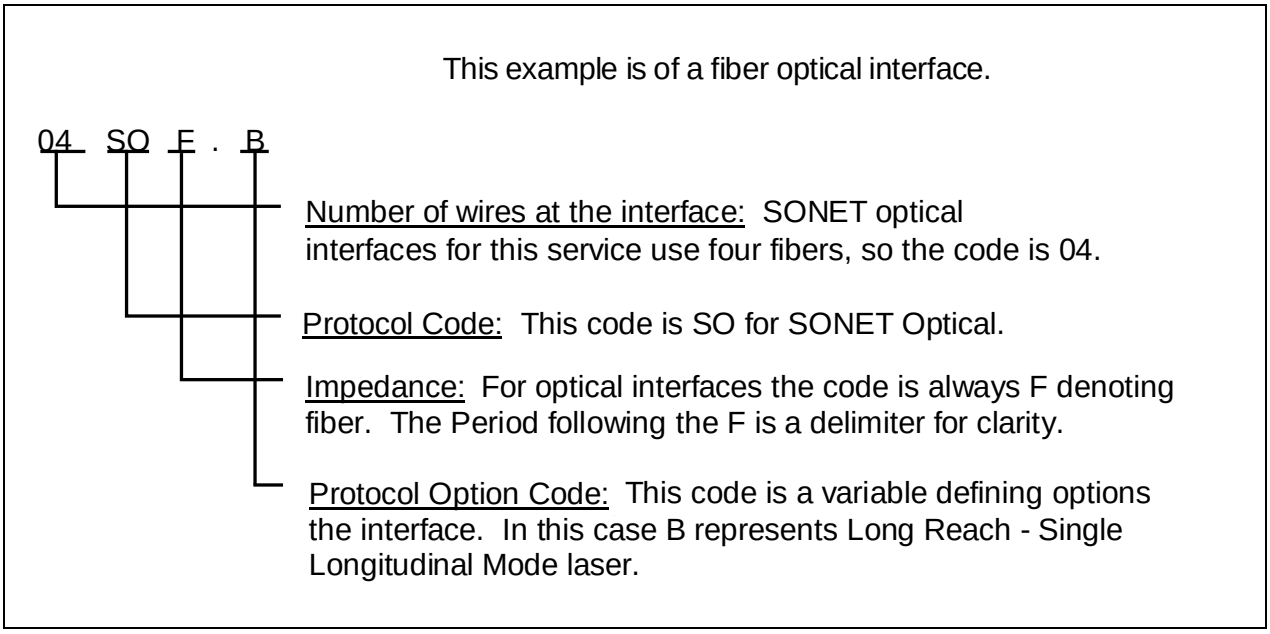


Figure 3-3 Optical NCI Code Example

3.13 Available Electrical NCI Codes

The electrical NCI codes listed in Table 3-5 are available with CenturyLink Synchronous Service Transport (Synchronous Optical Transport).

Table 3-5 Electrical Network Channel Interface (NCI) Codes
CenturyLink Synchronous Service Transport

NCI Code	CenturyLink Synchronous Service Transport – Electrical Interfaces
	STS-1 Electrical Interface
04ST6.A	STS-1 Synchronous Transmission Signal level 1, an EC-1 signal
	DS3 Electrical Interfaces (See CenturyLink Technical Publication 77324)
04DS6.44	DS3 M-frame structured signal with M23 Multiplex format (28 DS1 Channels)
04DS6.44A	DS3 M-frame structured signal, C-bit parity – unchannelized
04DS6.44R	DS3 M-frame structured signal – unchannelized
04DS6.44I	DS3 M-frame structured signal with M23 Multiplex format and C-bit parity
	DS1 Electrical Interfaces (See CenturyLink Technical Publication 77375)
04DS9.15	DS1 Carrier or CenturyLink CO Premises Interface, SF with AMI
04DS9.15B	DS1 Carrier or CenturyLink CO Premises Interface, SF with B8ZS
04DS9.15K	DS1 Carrier or CenturyLink CO Premises Interface, non-ANSI ESF with AMI
04DS9.15S	DS1 Carrier or CenturyLink CO Premises Interface, non-ANSI ESF with B8ZS
04DS9.1K	DS1 Carrier or CenturyLink CO Premises Interface, ANSI ESF with AMI
04DS9.1S	DS1 Carrier or CenturyLink CO Premises Interface, ANSI ESF with B8ZS
04DS9.15J	DS1 Carrier or CenturyLink 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

Notes:

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, Non-ANSI ESF - Format: reference AT&T PUB 54016

SF = Superframe format

3.14 Available Ethernet NCI Codes

Tables 3-6 and 3-7 list the Ethernet NCI Codes and corresponding customer Network Interfaces available with CenturyLink Synchronous Service Transport.

Table 3-6 Ethernet Network Channel Interface (NCI) Codes at Access Carrier and End User Customer Premises

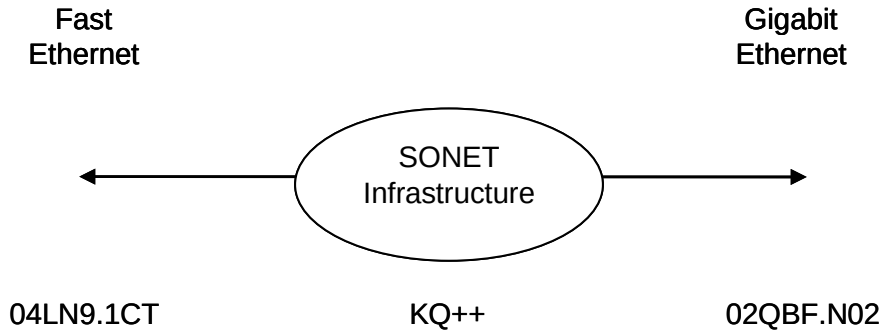
NCI Code	CenturyLink Synchronous Service Transport – Ethernet Interfaces DESCRIPTION	Network Interface
04LN9.10T	Local Area/Wide Area Network (LAN/WAN) Interface, 100 Ohms, 10Base-T Ethernet Connection	10Base-T
04LN9.1CT	Local Area/Wide Area Network (LAN/WAN) Interface, 100 Ohms, 100Base-T Ethernet Connection	100Base-TX
02LNF.A02	Local Area/Wide Area Network (LAN/WAN) Interface, 1310 nm, Single-Mode Fiber	100Base-LX10 1000Base-LX
02LNF.C02*	Local Area/Wide Area Network (LAN/WAN) Interface, Ethernet Asymmetric Interface at 1 Gbps, 1310 nm, Single-mode Fiber	1000Base-LX
02LNF.A03	Local Area/Wide Area Network (LAN/WAN) Interface, 1550 nm, Single-Mode Fiber	1000Base-ZX
02LNF.C03*	Local Area/Wide Area Network (LAN/WAN) Interface, Ethernet Asymmetric Interface at 1 Gbps, 1550 nm, Single-mode Fiber	1000Base-ZX
02LNF.A04	Local Area/Wide Area Network (LAN/WAN) Interface, 850 nm, 50 micron Multi-Mode Fiber	1000Base-SX
02LNF.C04*	Local Area/Wide Area Network (LAN/WAN) Interface, Ethernet Asymmetric Interface at 1 Gbps, 850 nm, 50 micron Multi-mode Fiber	1000Base-SX
02LNF.A05	Local Area/Wide Area Network (LAN/WAN) Interface, 1310 nm, 50 micron Multi-mode Fiber	100Base-FX
02LNF.A07	Local Area/Wide Area Network (LAN/WAN) Interface, 850 nm, 62.5 micron Multi-Mode Fiber	1000Base-SX
02LNF.C07*	Local Area/Wide Area Network (LAN/WAN) Interface, Ethernet Asymmetric Interface at 1 Gbps, 850 nm, 62.5 micron Multi-mode Fiber	1000Base-SX
02LNF.A08	Local Area/Wide Area Network (LAN/WAN) Interface, 1310 nm, 62.5 micron Multi-mode Fiber	100Base-FX

Table 3-7 Ethernet Network Channel Interface (NCI) Codes at CenturyLink COs

NCI Code	CenturyLink Synchronous Service Transport – Ethernet Interfaces DESCRIPTION	Network Interface
04QB9.10T	Central Office Manual Cross Connect Termination With No Sub-Rating Capability, 100 Ohms, Ethernet 10Base-T	10Base-T
02QBF.K02	Central Office Manual Cross Connect Termination With No Sub-Rating Capability, Ethernet, 1310 nm, Single-Mode Fiber	100Base-LX10 1000Base-LX
02QBF.N02*	Central Office Manual Cross Connect Termination With No Sub-Rating Capability, Ethernet Asymmetric Interface at 1 Gbps, 1310 nm, Single-mode Fiber	1000Base-LX
02QBF.K03	Central Office Manual Cross Connect Termination With No Sub-Rating Capability, Ethernet, 1550 nm, Single-Mode Fiber	1000Base-ZX
02QBF.N03*	Central Office Manual Cross Connect Termination With No Sub-Rating Capability, Ethernet Asymmetric Interface at 1 Gbps, 1550 nm, Single-mode Fiber	1000Base-ZX

*** Tables 3-6 and 3-7 Note: For use with FastE to GigE (or visa-versa) configurations only whereas these NCI Codes apply at the location with the GigE customer Network Interface, see the following Figure 3-4 as well as Section 2.6 for further information**.

Figure 3-4 Ethernet Asymmetric Interface NC/NCI Code Example



The 02LNF.C0_ and 02QBF.N0_ NCI Codes are used to identify the higher speed asymmetric interface on a dedicated (STS-mapped) point-to-point Ethernet circuit over the CenturyLink SONET infrastructure with the position that the speed or data rate of the EoS service as specified within the NC Code is the same as and limited by the lower speed Ethernet interface at the other end of the circuit. Only electrical or optical FastE to optical GigE interface combinations are supported on SST and as a single point-to-point circuit over an STS-1-1v, STS-1-2v, STS-1-3v or STS-3c-1v (no Layer 2 aggregation or Service Multiplexing).

3.15 Available SONET Optical NCI Codes

Traditional, four-fiber SONET optical NCI codes listed in Table 3-8 are available with CenturyLink Synchronous Service Transport (Synchronous Optical Transport). For customers employing equipment that uses two-fiber interfaces that does not provide SONET, Automatic Protection Switching (APS), SST can support two-fiber interfaces. In those situations, four-fiber, redundant SONET facilities and equipment are placed throughout the CenturyLink network including on-site, path or line terminating equipment.

Requests for two-fiber interfaces without SONET based transport protection and associated on-site equipment can be made. For example; four-fiber, redundant SONET facilities and equipment throughout the network, with two-fiber facility extended from Central Office Node at the Serving Wire Center to the customer premises. Normal service objectives shall not apply.

Table 3-8 Optical Interface NCI Codes (SONET)

NCI CODE	DESCRIPTION
04SOF.F	SR-MLM: Short Reach – Multi-Longitudinal Mode Light Source, Single Mode Fiber
04SOF.D	IR1-SLM: Intermediate Reach – Single - Longitudinal Mode Light Source, Single Mode Fiber
04SOF.B	LR1-SLM: Long Reach – Single-Longitudinal Mode Light Source, Single Mode Fiber
Two fiber without Automatic Protection Switching at the interface	
02SOF.F	SR-MLM: Short Reach – Multi-Longitudinal Mode Light Source, Single Mode Fiber
02SOF.D	IR1-SLM: Intermediate Reach – Single-Longitudinal Mode Light Source, Single Mode Fiber
02SOF.B	LR1-SLM: Long Reach – Single-Longitudinal Mode Light Source, Single Mode Fiber

Notes:

1. 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.
2. All four fiber interfaces shall be 1+1 Linear. In general, Linear APS will be provisioned with bidirectional mode, non-revertive switching.
3. All interfaces expect Single Mode Fiber. Multi Mode Fiber (MMF) is not an available interface.
4. Two fiber interfaces may apply to customer Network Interfaces (to CPE or another service provider, e.g. IXC) where four-fiber transport protection is provided by CenturyLink, on-site, SONET Line or Path Terminating Equipment. All CenturyLink involved infrastructure may use redundant, SONET architecture. Customers may request two fiber interfaces without SONET based transport protection architecture. In those cases, normal service objectives do not apply.
5. See CenturyLink Technical Publication 77386 for Central Office Cross-Connect NC and NCI Codes.

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 CenturyLink 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.

3.16 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 3-12. 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.

For each electrical DS1 or DS3/STS-1 interface on a multiplexer, there will be a corresponding NC code specified and ordered for that level of service. When a higher bit-rate channel from an SST transport, e.g., a multiplexed OC-3 with a fiber network interface, encompasses the physical interface at the edge of the CenturyLink network, it is the optical interface that would be reflected on the lower bit-rate service.

With a multiplexed, to a higher-bit rate channel configuration, the customer will not provide, for example, a DS1 electrical NCI code at the optical interface with their DS1 order. Instead, the customer will provide the actual optical interface NCI code of the SST service from Table 3-8 as used on the SST channel. The customer can also provide assignment information to advise CenturyLink of the channel of the higher bit-rate multiplexer to be used.

3.16.1 OC-3 Optical Multiplexer Configuration NCI Codes

Table 3-9 lists NCI codes for CenturyLink Optical Transport SONET Next Generation Multiplexer operating at the OC-3 rate that MUST be used to order all SST OC-3 UPSR orders with OBU- (see Table 3-2), the NCI codes in Table 3-10 will not apply.

Table 3-9 Configuration Network Channel Interface (NCI) Codes - OC-3 SONET Next Generation Multiplexer or equivalent

NCI Code	Description
One Code must be specified at each Multiplexer Site	
04SSF.	SONET Next Generation Multiplexer Supporting Drops of:
E20	GigE, 100 Mbps Ethernet, STS-1, DS3, DS3 Transmux, 10 Mbps Ethernet, DS1

Table 3-10 lists NCI codes for CenturyLink Optical Transport SONET Optical multiplexer operating at the OC-3 rate.

Table 3-10 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

3.16.2 OC-12 Optical Multiplexer Configuration NCI Codes

Table 3-11 lists NCI codes for CenturyLink Optical Transport SONET Next Generation Multiplexer operating at the OC-12 rate that MUST be used to order all SST OC-12 UPSR orders with ODU- (see Table 3-2), the NCI codes in Table 3-12 will not apply.

Table 3-11 Configuration Network Channel Interface (NCI) Codes - OC-12 SONET Next Generation Multiplexer or equivalent

NCI Code	Description
One Code must be specified at each Multiplexer Site	
04SSF.	SONET Next Generation Multiplexer Supporting Drops of:
E18	GigE, OC-3, 100 Mbps Ethernet, STS-1, DS3, DS3 Transmux, 10 Mbps Ethernet, DS1

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

Table 3-12 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.E	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 3-12 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.

3.16.3 OC-24 Optical Multiplexer Configuration NCI Codes

Table 3-13 lists NCI codes for CenturyLink Optical Transport SONET Next Generation Multiplexer operating at the OC-24 rate that MUST be used to order all SST OC-24 UPSR orders with OE-- (see Table 3-2) the NCI codes in Table 3-14 will not apply.

Table 3-13 Configuration Network Channel Interface (NCI) Codes - OC-24 (Virtual) SONET Next Generation Multiplexer or equivalent

NCI Code	Description
One Code must be specified at each Multiplexer Site	
04SSF.	SONET Next Generation Multiplexer Supporting Drops of:
E19	GigE, OC-12, OC-3, 100 Mbps Ethernet, STS-1, DS3, DS3 Transmux, 10 Mbps Ethernet, DS1

Table 3-14 lists NCI codes for CenturyLink Optical Transport SONET Optical Multiplexer operating at the OC-24 rate.

Table 3-14 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.

3.16.4 OC-48 Optical Multiplexer Configuration NCI Codes

Table 3-15 lists NCI codes for CenturyLink Optical Transport SONET Next Generation Multiplexer operating at the OC-48 rate that MUST be used to order all SST OC-48 UPSR orders with OFU- (see Table 3-2), the NCI codes in Table 3-16 will not apply.

Table 3-15 Configuration Network Channel Interface (NCI) Codes - OC-48 SONET Next Generation Multiplexer or equivalent

NCI Code	Description
One Code must be specified at each Multiplexer Site	
04SSF.	SONET Next Generation Multiplexer Supporting Drops of:
E19	GigE, OC-12, OC-3, 100 Mbps Ethernet, STS-1, DS3, DS3 Transmux, 10 Mbps Ethernet, DS1

Table 3-16 lists NCI codes for CenturyLink Optical Transport SONET Optical Multiplexer operating at the OC-48 rate.

Table 3-16 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 3-16 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.

3.16.5 OC-192 Optical Multiplexer Configuration NCI Codes

Table 3-17 lists NCI codes for CenturyLink Optical Transport SONET Next Generation Multiplexer operating at the OC-192 rate that MUST be used to order all SST OC-192 UPSR orders with OGU- (see Table 3-2), the NCI codes in Tables 3-18 to 3-21 will not apply.

Table 3-17 Configuration Network Channel Interface (NCI) Codes - OC-192 SONET Next Generation Multiplexer or equivalent

NCI Code	Description
One Code must be specified at each Multiplexer Site	
04SSF.	SONET Next Generation Multiplexer Supporting Drops of:
F14	OC-48, GigE, OC-12, OC-3, 100 Mbps Ethernet, STS-1, DS3, DS3 Transmux, 10 Mbps Ethernet, DS1

Table 3-18 shows the general structure for determining NCI codes for CenturyLink 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 3-12 lists the available codes.

Table 3-18 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 3-18 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 = 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	°

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 3-11, NCI codes are physically possible or available. Table 3-12 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 CenturyLink representative for details.

Table 3-19 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 3-19 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 3-19 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 3-19 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 3-19 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 3-19 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 3-19 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 3-19 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.AS4	0	60	12
04SNF.AR8	0	56	24
04SNF.AQC	0	52	36
04SNF.APG	0	48	48
04SNF.ANH	0	44	60
04SNF.AMI	0	40	72
04SNF.ALJ	0	36	84
04SNF.AKK	0	32	96
04SNF.AJL	0	28	108
04SNF.AIM	0	24	120
04SNF.AHN	0	20	132
04SNF.AGO	0	16	144
04SNF.ACP	0	12	156
04SNF.A8Q	0	8	168
04SNF.A4R	0	4	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 OC-192 nodes can drop OC-48, OC-12, OC-3, and STS-1/DS3 services. The code set SN supports OC-12, OC-3, and STS-1 services. The SN code set is to be used when number of OC-48s at the Node is zero. The SQ code set is used when dropping OC-48s from an OC-192 Node. The following table lists NCI codes for CenturyLink 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 tale is listed.

Table 3-20 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 3-20 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	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 OC-192 nodes can drop OC-48, OC-12, and OC-3 services. The code set SP supports OC-48, OC-12, and OC-3 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 3-21 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 3-21 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

3.17 Grandfathered, MBSS Network Channel and Network Channel Interface Codes

Grandfathered, Managed Bandwidth SONET Service is a very special application, there is a limited set of code combinations were available. A Self-Healing option that provided a separate facility path for the MBSS Entrance Facility was 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 that were available for MBSS.

Table 3-22 SONET Optical Transport Network Channel Code 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 3-23 SONET Optical Network Channel Interface Codes with MBSS

NCI Code	Description
Location: Customer Premises -- Interface with CenturyLink, 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.E	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 3-24 SONET Optical NC and NCI Code Combinations with MBSS

NC	NCI with CenturyLink MBSS Transport	NCI with Customer Installation
ODAQ	04SMF.AC	04SOF.F
ODAQ	04SMF.B9	04SOF.F
ODAQ	04SMF.C6	04SOF.F
ODAQ	04SMF.D3	04SOF.F
ODAQ	04SMF.E	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 CenturyLink 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 3-22.

3.18 OC-3, MBSS Network Channel and Network Channel Interface Codes

The following Table provides a listing of OC-3 Network Channel codes that may additionally have had an MBSS service option.

Table 3-25 OC-3 Network Channel Codes with MBSS

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

Table 3-26 Optical, End-User Premises Network Channel Interface (NCI) Codes for MBSS Arrangements

NCI Code	CenturyLink Synchronous Service Transport – Optical Interfaces
OC-3 Optical Interfaces (See Table 3-7)	
04SOF.F	SR-MLM (Short Reach - Multi--Longitudinal Mode Laser)
02SOF.F	SR-MLM (Short Reach - Multi--Longitudinal Mode Laser)

Note: Two fiber interfaces may apply to customer Network Interfaces (to CPE or another service provider, e.g. IXC) where four fiber transport protection is provided by CenturyLink, on-site, SONET Line or Path Terminating Equipment. Customers may request two fiber interfaces without SONET based transport protection architecture only at premises locations. In those cases, normal service objectives do not apply.

3.19 Premium, DS3 and DS1, MBSS Network Channel and Network Channel Interface Codes

The following Table provides a listing of 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 3-27 DS1 and DS3 Network Channel Codes with MBSS

NC Code	Description
MBSS, Premium DS3 Service	
HFP-	Point-to-Point DS3
MBSS, Premium DS1 Services	
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

Notes:

1. AMI = Bipolar Alternate Mark Inversion line code
2. B8ZS = Binary, 8 zero substitution line code
3. ESF = Extended Superframe format, ANSI ESF - Format: reference ANSI T1.403, Non-ANSI ESF - Format: reference AT&T PUB 54016
4. SF = Superframe format

In addition to the electrical Network Channel Interface codes in Table 3-5, the following table supplies DS1 Network Channel Interface Codes allowable for MBSS. These codes are used **only** in those instances where the MBSS end-user location is **not** served by an on-site, optic terminal.

Table 3-28 Additional Electrical, End-User Premises Network Channel Interface (NCI) Codes for MBSS Arrangements

NCI Code	CenturyLink Synchronous Service Transport – Electrical Interfaces
DS1 Electrical Interfaces (See CenturyLink 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

Notes:

1. AMI = Bipolar Alternate Mark Inversion line code
2. B8ZS = Binary, 8 zero substitution line code
3. ESF = Extended Superframe format, ANSI ESF - Format: reference ANSI T1.403, Non-ANSI ESF - Format: reference AT&T PUB 54016
4. SF = Superframe format

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Tables

4. Ethernet Features

4.1 General

- The CenturyLink-provided Next Generation multiservice SONET ADM equipment will encapsulate and adapt the customers' incoming Ethernet frames via a 10Base-T, 100Base-TX/LX10/FX or 1000Base-LX/ZX/SX Network Interface into a customer-orderable (via NC code) Synchronous Transport Signal (STS)-1-1v, STS-1-2v, STS-3c-1v (or STS-1-3v), STS-3c-2v (or STS-1-6v), STS-3c-3v (or STS-1-9v), STS-3c-4v (or STS-1-12v) or STS-3c-7v (or STS-1-21v) Synchronous Payload Envelope (SPE).
- Point-to-point, bidirectional, full duplex (only) Ethernet circuits over SONET provide for SST Layer 1 protected, low latency packet transport.
- The customers' Ethernet frames will be delivered with the header information/ MAC addresses and frame contents unchanged.
- With GFP-F, the Ethernet Preamble and Start of Frame Delimiter as well as Inter-Packet Gap characters within the customer's Ethernet bit stream will not be transported across the SST network.
- Layer 2 (including IEEE 802.1Q VLAN tagged frames) as well as Layer 3 protocols that can be encapsulated and transported over standard Ethernet frames such as IP or IPX, will be tunneled or transparently forwarded across the SONET network. The customer will handle the specific applications with CenturyLink providing a Layer 1 pipe, which is agnostic to the higher levels of customer data being carried.
- This service will support the transport of all standard Ethernet frame sizes up to the IEEE 802.3/802.1Q maximum untagged/VLAN tagged frame size of 1518/1522 bytes. In general, jumbo frames up to at least 9000 bytes will also be delivered across the SST network.
- The Ethernet interface cards in the SONET ADMs are (0:1) unprotected. Customers desiring further redundancy could order for example, two (or more) parallel, identical data rate, full duplex Ethernet over SONET (EoS), or Ethernet Transport circuits and run Link Aggregation Control Protocol in order to provide line-level redundancy and interface port/card protection.

4.2 Ethernet Interfaces and SONET Transport Bandwidth Options

Table 4-1 lists the Ethernet interfaces and corresponding SONET transport bandwidth options available on SST.

Table 4-1 Available Ethernet Interfaces and SONET Transport Bandwidth Increments[1]

ETHERNET INTERFACE	SONET TRANSPORT CAPACITY				
	OC-3	OC-12	OC-24	OC-48	OC-192
10Base-T	STS-1-1v	STS-1-1v	STS-1-1v	STS-1-1v	STS-1-1v
100Base-TX 100Base-LX10 100Base-FX	STS-1-1v	STS-1-1v	STS-1-1v	STS-1-1v	STS-1-1v
	STS-1-2v	STS-1-2v	STS-1-2v	STS-1-2v	STS-1-2v
	STS-1-3v or STS-3c-1v	STS-1-3v or STS-3c-1v	STS-1-3v or STS-3c-1v	STS-1-3v or STS-3c-1v	STS-1-3v or STS-3c-1v
1000Base-LX[2] 1000Base-ZX 1000Base-SX	STS-1-1v	STS-1-1v	STS-1-1v[3]	STS-1-1v[3]	STS-1-1v[3]
	STS-1-2v	STS-1-2v	STS-1-2v	STS-1-2v[3]	STS-1-2v[3]
	STS-1-3v or STS-3c-1v	STS-1-3v or STS-3c-1v	STS-1-3v or STS-3c-1v	STS-1-3v or STS-3c-1v	STS-1-3v or STS-3c-1v[3]
		STS-1-6v or STS-3c-2v	STS-1-6v or STS-3c-2v	STS-1-6v or STS-3c-2v	STS-1-6v or STS-3c-2v[3]
		STS-1-9v or STS-3c-3v	STS-1-9v or STS-3c-3v	STS-1-9v or STS-3c-3v	STS-1-9v or STS-3c-3v[3]
		STS-1-12v or STS-3c-4v	STS-1-12v or STS-3c-4v	STS-1-12v or STS-3c-4v	STS-1-12v or STS-3c-4v
			STS-1-21v or STS-3c-7v	STS-1-21v or STS-3c-7v	STS-1-21v or STS-3c-7v

Notes:

1. Per Ethernet port, where each port or customer Network Interface maps to a unique dedicated point-to-point STS circuit
2. Over Single-Mode Fiber
3. There is a maximum of 20 Gigabit Ethernet ports per SST Node.

The customer may order either an identical speed physical Ethernet interface at both ends of an EoS circuit, which will be delivered from CenturyLink-owned Next Generation SONET ADM/DCS, or an Ethernet over SONET (EoS) virtual interface at one end of the service with a CenturyLink-provided Ethernet interface at the other.

In general, EoS interfaces or Ethernet virtual OC-M/N ports will require far-end destination Customer-Provided SONET Path Terminating Equipment with matching encapsulation type, framing mode, Frame Check Sequence/Cyclic Redundancy Check size, Contiguous or Virtual Concatenation Group (VCG) Synchronous Payload Envelope mappings, multi-frame STS Path Overhead usage (H4 bytes) for High Order VCG indicators & control messages (if/where applicable) and Ethernet link integrity (Automatic Laser Shutdown/Loss of Carrier) implementations. While CenturyLink will deploy ITU-T G.7041/Y.1303 standards based GFP-F, where available it's important to note that other of these EoS interface attributes may be vendor specific and impact Customer-Provided Equipment (CPE) termination of an Ethernet circuit.

The Ethernet over SONET SPE or VCAT Group encapsulation and framing standard protocols associated with the CenturyLink Next Generation SONET ADM/DCS are listed in the EoS Network Interface disclosure available at: http//www.CenturyLink.com/disclosures/netdisclosure478.html.

It is the customer's responsibility to provide equipment which is compatible with any SST Network Interfaces, and should work with CenturyLink to appropriately option and ensure a successful end-to-end Ethernet transport service.

Table 4-2 indicates the Synchronous Payload Envelope (SPE) capacity or maximum SONET bandwidth available for transport of customer Ethernet frames per Ethernet over SST circuit, including that required for encapsulation and framing.

Table 4-2 EoS Payload Mapping Capacities

SPE Mapping Increment	Payload Capacity
STS-1	48.384 Mbps
STS-1-2v	96.768 Mbps
STS-1-3v	145.152 Mbps
STS-3c-1v	149.760 Mbps
STS-1-6v	290.304 Mbps
STS-3c-2v	299.520 Mbps
STS-1-9v	435.46 Mbps
STS-3c-3v	449.280 Mbps
STS-1-12v	580.608 Mbps
STS-3c-4v	599.040 Mbps
STS-1-21v	1.016 Gbps
STS-3c-7v	1.048 Gbps

Note: Where required, STS-3c-Xv mappings may be provided by CenturyLink using the equivalent, but slightly lower payload capacity STS-1-Xv increments.

Table 4-3 Ethernet Interface Details

Interface	Data Rate	Transport Bandwidth	Mode	Impedance or Central Wavelength	Cable or Fiber Type	Modal Bandwidth (MHz/km)	Maximum Distance[1]	Connector
10Base-T	10 Mbps	STS-1-1v	Full Duplex	100 ohms	Two pairs of twisted-pair telephone or Category 3, 4 or 5/5E (recommended[2]) copper wire	NA	100 m (328 ft)	RJ-45
100Base-TX	100 Mbps	STS-1-1v STS-1-2v STS-1-3v STS-3c-1v	Full Duplex	100 ohms	Two pairs of Category 5/5E Unshielded Twisted-Pair (UTP) or Shielded Twisted-Pair (STP) copper wire	NA	100 m (328 ft)	RJ-45
100Base-LX10	100 Mbps[3]	STS-1-1v STS-1-2v STS-1-3v STS-3c-1v	Full Duplex	1310 nm	One pair of Single-Mode Fiber	NA	10 km (6.2 mi)	Duplex SC, FC or LC UPC[4]
100Base-FX[5]	100 Mbps[3]	STS-1-1v STS-1-2v STS-1-3v STS-3c-1v	Full Duplex	1310 nm	One pair of 50 micron Multi-Mode Fiber	500	2 km (1.2 mi)	Duplex SC, FC or LC UPC[4]
					One pair of 62.5 micron Multi-Mode Fiber	200		

Table 4-3 Ethernet Interface Details (Continued)

Interface	Data Rate	Transport Bandwidth	Mode	Impedance or Central Wavelength	Cable or Fiber Type	Modal Bandwidth (MHz/km)	Maximum Distance[1]	Connector
1000Base-LX	1000 Mbps[3]	STS-1-1v STS-1-2v STS-1-3v STS-3c-1v STS-1-6v STS-3c-2v STS-1-9v STS-3c-3v STS-1-12v STS-3c-4v STS-1-21v STS-3c-7v	Full Duplex	1310 nm	One pair of Single-Mode Fiber	NA	5 km[6] (3.1 mi)	Duplex SC, FC or LC UPC[4]
1000Base-ZX	1000 Mbps[3]	STS-1-1v STS-1-2v STS-1-3v STS-3c-1v STS-1-6v STS-3c-2v STS-1-9v STS-3c-3v STS-1-12v STS-3c-4v STS-1-21v STS-3c-7v	Full Duplex	1550 nm	One pair of Single-Mode Fiber	NA	70 km (43.5 mi)	Duplex SC, FC or LC UPC[4]

Table 4-3 Ethernet Interface Details (Continued)

Interface	Data Rate	Transport Bandwidth	Mode	Impedance or Central Wavelength	Cable or Fiber Type	Modal Bandwidth (MHz/km)	Maximum Distance[1]	Connector
1000Base-SX[5]	1000 Mbps[3]	STS-1-1v STS-1-2v STS-1-3v STS-3c-1v STS-1-6v STS-3c-2v STS-1-9v STS-3c-3v STS-1-12v STS-3c-4v STS-1-21v STS-3c-7v	Full Duplex	850 nm	One pair of 50 micron Multi-Mode Fiber	400	500 m (1,640 ft)	Duplex SC, FC or LC UPC[4]
						500	550 m (1,804 ft)	
					One pair of 62.5 micron Multi-Mode Fiber	160	220 m (722 ft)	
						200	275 m (902 ft)	

Table 4-3 Notes:

1. Including CenturyLink cable from the SST Ethernet port to customer Network Interface
2. Although the customer may use Category 3, 4 or 5 copper wire when connecting to 10Base-T ports, CenturyLink will use Category 5E balanced copper cabling from the SST Ethernet port to the Category 5 Patch Panel NI for all electrical Ethernet interfaces.
3. While the data rate for 100Base-LX10/FX and 1000Base- LX/ZX/SX Network Interfaces is 100 and 1000Mbps respectively, the actual signaling rate is 125 and 1250 Mbps.
4. FC and LC connectors are not an available customer option in CenturyLink COs.
5. 100Base-FX and 1000Base-SX User-Network Interfaces are not an available customer option in CenturyLink COs.
6. The guaranteed maximum distance is as specified in the IEEE 802.3-2008 standard, although most 1000Base-LX Gigabit Ethernet Interface Converter (GBIC) or Small Form-factor Pluggable (SFP) modules have a higher optical quality allowing a reach of up to 10 kilometers (6.2 miles) over 1310 nm Single-Mode Fiber. See Table 3-1 for the minimum interface power level.
7. In general, Auto-negotiation will be enabled along with flow control (for subrates) at the customer Network Interface. Without flow control, packet loss can occur if the input customer traffic data rate is higher than the available bandwidth of the STS circuit for an extended period of time or when the buffer memory on the Ethernet port exceeds capacity.
8. Single-Mode Fiber is 9 or 10/125 µm and shall meet the requirements in GR-20-CORE, *Generic Requirements for Optical Fiber and Optical Fiber Cable* and ITU-T Recommendation G.652, *Characteristics of a single-mode optical fibre and cable*.
9. Multimode fiber is either or 50 or 62.5/125 µm and shall meet the requirements in GR-20-CORE, ANSI/TIA-492AAAB-A-2009, *Detail Specification for 50-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers* and ANSI/TIA-492AAAA-B-2009, *Detail Specification for 62.5-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers*.
10. Customer Network Interfaces shall meet the electrical, optical, mechanical and environmental performance requirements of ISO/IEC 11801: 2002+A1:2008, *Information technology - Generic cabling for customer premises*.
11. nm = nanometer
12. UPC = Ultra Physical Contact

4.3 Connecting to 10Base-T and 100Base-TX Network Interfaces

The CenturyLink SST 10/100 Mbps electrical interfaces use standard RJ-45 connectors at the Network Interface (NI). Table 4-4 shows the pinouts.

Table 4-4 10/100 Mbps Electrical NI RJ-45 Pinouts

Pin	Assignment/Label
1	TX/TP0+
2	TX/TP0-
3	RX/TP1+
6	RX/TP1-

CenturyLink will always use a straight-through cable to connect to the Category 5 Patch Panel for electrical Ethernet NIs and the customer will use either a straight-through or crossover cable depending upon the equipment they are connecting to the NI. For connecting to servers, workstations and routers a straight-through cable is required, and for switch connections a crossover cable is required. The NI associated with CenturyLink Synchronous Service Transport for LAN interconnection will not provide the repeater functionality as described in IEEE 802.3-2008.

When connecting to 10Base-T and 100Base-TX compatible devices, the customer will use a two twisted-pair cable. Table 4-5 shows the two twisted-pair, straight-through cable and Table 4-6 shows the two twisted-pair, crossover cable RJ-45 connections at the NI.

Table 4-5 Two Twisted-Pair Straight-Through Cable RJ-45 Connections for 10/100 Mbps Electrical NIs

RJ-45	RJ-45
1 RD+	1 TD+
2 RD–	2 TD–
3 TD+	3 RD+
6 TD–	6 RD–

Table 4-6 Two Twisted-Pair Crossover Cable RJ-45 Connections for 10/100 Mbps Electrical NIs

RJ-45	RJ-45
1 RD+	3 TD+
2 RD–	6 TD–
3 TD+	1 RD+
6 TD–	2 RD–

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Tables

5. Performance Specifications

Note: For customers who choose to order SST services in conjunction with/over GeoMax via a single service order, the performance objectives for the end-to-end (on-net <--> off-net) circuit will be as specified below.

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)	9.953 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.

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, designed consistent with standard SONET, four fiber architectures and apply at maximum short-haul design length. Two fiber interfaces may apply to customer Network Interfaces (to CPE or another service provider, e.g. IXC) where four-fiber, transport protection is provided by CenturyLink, on-site, SONET Line or Path Terminating Equipment. Customers may

request two fiber interfaces without SONET based transport protection architecture only at premises locations. 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 5-2. 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, CenturyLink provides such DS1s without performance objectives.

Table 5-2 DS1 and DS3 SST and MBSS Long-Term Accuracy and Availability Objectives

Transport Segment	DS1 1.544 Mbit/s	DS3 44.736 Mbit/s
Availability		
Access	99.99 %	99.99 %
End-to-End	99.99 %	99.99%
Accuracy - Error Free Seconds		
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 5-3. 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 5-3 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)	9.953 Gbit/s (STS-192c)
End-to-End	BBER	(Note 1)	(Note 1)	10^{-5}	10^{-5}	10^{-4}
	% 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)	5×10^{-6}	5×10^{-6}	5×10^{-5}
	% 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.

5.3 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 a 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 to customer Network Interfaces (to CPE or another service provider, e.g. IXC) where four-fiber transport protection is provided by CenturyLink, on-site, SONET Line or Path Terminating Equipment. Customers may request two fiber interfaces without SONET based transport protection architecture only at premises locations. 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 5-4; Percent (%) Availability, the same as applied to DS1 and DS3 services.

Table 5-4 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)	9.953 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.

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 Telcordia 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, *Telecommunications - Carrier-to-Customer Installations - DS1 Metallic Interface Specification;* ANSI T1.404, *Telecommunications - Carrier-to-Customer Installation - DS3 Metallic Interface Specification* and ANSI T1.105.03, *Synchronous Optical Network (SONET) - Jitter at Network Interfaces*. The purpose of these limits is to limit broadband jitter appearing anywhere in the CenturyLink Network.

5.4.3 Timing Jitter Specifications - Optical Interfaces

Optical interface jitter performance will follow the standards as stated in ANSI T1.105.03, *Synchronous Optical Network (SONET) - Jitter at Network Interfaces;* GR-253-CORE, *Synchronous Optical Network (SONET) Transport Systems: Common Criteria* and GR-499-CORE, *Transport Systems Generic Requirements (TSGR): Common Requirements*.

5.5 Ethernet Performance

For Ethernet over SONET (EoS), or Ethernet Transport (ET) circuits on SST, the following additional performance parameters will apply. It's recommended that customers rate limit or shape their traffic to the subscribed STS capacity before transmission to CenturyLink otherwise increased latency or packet loss may occur.

5.5.1 Throughput

The customer-orderable EoS transport bandwidth is a physical layer limit on the rate at which the customer's Ethernet frames can traverse the SONET network and represents the STS payload capacity available for customer data including that required for encapsulation and framing protocols. The SST Ethernet throughput objectives for 10Base-T, 100Base-TX/LX10/FX and 1000Base-LX/ZX/SX are shown in Table 5-5 as a function of the STS mapping increment as well as incoming untagged MAC frame size (and would be adjusted accordingly if the customer has inserted any VLAN tags). The throughput was derived using GFP-F and is based on the maximum MAC bit rate after removal of the 12-byte Inter-Packet Gap (IPG), 7-byte Preamble and 1-byte Start of Frame Delimiter fields (which are subsequently restored by the GFP terminating node) relative to the SPE capacity with 8 bytes of overhead per frame. See ITU-T G.7041/Y.1303, *Generic framing procedure (GFP)* Appendix V – Bandwidth requirements for Ethernet transport for further information. Where required, STS-3c-Xv mappings may be provided by

CenturyLink using the equivalent, but slightly lower payload capacity STS-1-Xv increments.

Table 5-5 Ethernet Throughput Objectives

Ethernet Interface	SPE Mapping Increment	Payload Capacity	MAC Frame Size (bytes)	Maximum Throughput
10Base-T	STS-1-1v	48.384 Mbps	All	100%
100Base-TX; 100Base-LX10; 100Base-FX	STS-1-1v	48.384 Mbps	64	56.4%
			128	52.7%
			256	50.6%
			512	49.5%
			1,024	48.9%
			1,518	48.8%
			9,000	48.4%
	STS-1-2v	96.768 Mbps	64	100.0%
			128	100.0%
			256	100.0%
			512	99.0%
			1,024	97.9%
			1,518	97.5%
			9,000	96.9%
	STS-1-3v	145.152 Mbps	All	100%
	STS-3c-1v	149.760 Mbps	All	100%

Table 5-5 Ethernet Throughput Objectives (Continued)

Ethernet Interface	SPE Mapping Increment	Payload Capacity	MAC Frame Size (bytes)	Maximum Throughput
1000Base-LX; 1000Base-ZX; 1000Base-SX	STS-1-1v	48.384 Mbps	64	5.6%
			128	5.3%
			256	5.1%
			512	5.0%
			1,024	4.9%
			1,518	4.9%
			9,000	4.8%
	STS-1-2v	96.768 Mbps	64	11.3%
			128	10.5%
			256	10.1%
			512	9.9%
			1,024	9.8%
			1,518	9.8%
			9,000	9.7%
	STS-1-3v	145.152 Mbps	64	16.9%
			128	15.8%
			256	15.2%
			512	14.9%
			1,024	14.7%
			1,518	14.6%
			9,000	14.5%
	STS-3c-1v	149.760 Mbps	64	17.5%
			128	16.3%
			256	15.7%
			512	15.3%
			1,024	15.2%
			1,518	15.1%
			9,000	15.0%
	STS-1-6v	290.304 Mbps	64	33.9%
			128	31.6%
			256	30.3%

			512	29.7%
			1,024	29.4%
			1,518	29.3%
			9,000	29.1%

Table 5-5 Ethernet Throughput Objectives (Continued)

Ethernet Interface	SPE Mapping Increment	Payload Capacity	MAC Frame Size (bytes)	Maximum Throughput
1000Base-LX; 1000Base-ZX; 1000Base-SX	STS-3c-2v	299.520 Mbps	64	34.9%
			128	32.6%
			256	31.3%
			512	30.6%
			1,024	30.3%
			1,518	30.2%
			9,000	30.0%
	STS-1-9v	435.46 Mbps	64	50.8%
			128	47.4%
			256	45.5%
			512	44.6%
			1,024	44.1%
			1,518	43.9%
			9,000	43.6%
	STS-3c-3v	449.280 Mbps	64	52.4%
			128	48.9%
			256	47.0%
			512	46.0%
			1,024	45.5%
			1,518	45.3%
			9,000	45.0%
	STS-1-12v	580.608 Mbps	64	67.7%
			128	63.2%
			256	60.6%
			512	59.4%
			1,024	58.7%
			1,518	58.5%
			9,000	58.1%
	STS-3c-4v	599.040 Mbps	64	69.9%
			128	65.2%

			256	62.6%
			512	61.3%
			1,024	60.6%
			1,518	60.4%
			9,000	60.0%

Table 5-5 Ethernet Throughput Objectives (Continued)

Ethernet Interface	SPE Mapping Increment	Payload Capacity	MAC Frame Size (bytes)	Maximum Throughput
1000Base-LX; 1000Base-ZX; 1000Base-SX	STS-1-21v	1.016 Gbps	All	100%
	STS-3c-7v	1.048 Gbps	All	100%

5.5.2 Latency

Latency or delay is defined as the time interval between the transmission of a signal at one point and the reception or detection of the same signal at another point. Unidirectional or One-Way Delay (OWD) is the elapsed time between when a node sends a packet and when the packet is received by another node. OWD is also referred to as end-to-end transit delay.

For store-and-forward devices including CenturyLink Synchronous Service Transport with EoS Layer 1 transport using GFP-F, the one-way delay is the time measured between when the first bit of a customer Ethernet frame enters the ingress Network Interface to when the last bit of the same frame leaves the egress Network Interface. The latency performance objective across a single SST network will be as indicated in Table 5-6.

Table 5-6 SST Ethernet Latency

Performance Parameter	Objective
Latency (one-way)	Less than 5 milliseconds

The EoS latency applies to all supported Ethernet interfaces, STS transport bandwidth increments, frame sizes, alternate fiber routes where applicable (SHARP) and represents the total delay attributable to the CenturyLink SST network. As

diverse or Split Routing of VCAT Group members is not supported, the latency objective does not include that for Differential Delay.

5.5.3 Packet Loss

The packet or frame loss performance parameter identifies the percentage of in-profile Ethernet frames not reliably delivered between Network Interfaces (NIs) over a given measurement interval. Specifically, over any calendar month the CenturyLink SST network will successfully deliver at least 99.99% of a customer's packets from NI to NI.

Any customer frames that are out-of-profile may be blocked or discarded at the Network Interface and will not be counted towards the packet loss objective such as:

- Exceeding the customer-ordered EoS transport bandwidth
- Frame sizes less than 64 bytes
- Jumbo frames (see Section 4.1)
- Corrupted frames with Cyclic Redundancy Check (CRC), Frame Check Sequence (FCS) or alignment errors

5.6 Protection Switching

Automatic protection switching improves the availability and reliability performance of CenturyLink '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, OC-48 or OC-192 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.

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6. Maintenance

6.1 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 CenturyLink 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 CenturyLink Central Office may sometimes be necessary to isolate the trouble.

6.2 CenturyLink Responsibilities

CenturyLink 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).

CenturyLink will furnish the customer a trouble reporting telephone number.

Upon receipt of a trouble report for SST service, CenturyLink 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.

Notes:

1. For customers who choose to order SST with/over GeoMax via a single service order, the CenturyLink response and restoral times for the end-to-end (on-net <--> off-net) circuit will be as specified above.
2. For customers who choose to order SST with OC-12 or OC-48 auto-concatenation, CenturyLink will not be responsible for any issues associated with the customer-mapped subrate concatenated payloads.

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7. Definitions

7.1 Acronyms

ANSI	America National Standards Institute
Cat-5	Category 5 balanced cable
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
EC-1	Electrical Carrier Level 1
EI	Electrical Interface
EoS	Ethernet-over-SONET
ET	Ethernet Transport
FC	Fiber Connector
FDP	Fiber Distribution Panel
GBIC	Gigabit Interface Converter
Gbit/s	Gigabits per Second
IEEE	Institute for Electrical and Electronics Engineers
INE	Intelligent Network Element
IP	Internet Protocol
IPX	Internetwork Packet Exchange
ISO/IEC	International Organization for Standardization/International Electrotechnical Commission
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
LAN	Local Area Network
LC	Lucent or Local Connector
MMF	Multi-Mode Fiber
NC	Network Channel
Mbit/s	Megabits per Second
NCI	Network Channel Interface

NI	Network Interface
OC-3	Optical Carrier level 3
OC-12	Optical Carrier level 12
OC-48	Optical Carrier level 48
OC-192	Optical Carrier level 192
OC-M	Optical Carrier level M, M < N
OC-N	Optical Carrier level N
OWD	One-Way Delay
SC	Subscriber Connector
SMF	Single-Mode Fiber
SONET	Synchronous Optical NETwork
SPE	Synchronous Payload Envelope
STP	Shielded Twisted-Pair
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
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
μm	Micron
UPC	Ultra Physical Contact
UTP	Unshielded Twisted-Pair

7.2 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.

Auto-Negotiation

The algorithm that allows two devices at either end of a link segment to negotiate common data service functions.

Balanced Cable

A cable consisting of one or more metallic symmetrical cable elements (twisted pairs or quads).

Bandwidth

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

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.

Category 5 Balanced Cabling

Balanced 100 (and 120) ohm cables and associated connecting hardware whose transmission characteristics are specified up to 100 MHz.

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.

EC-1

The signal that results from an electrical conversion of an STS-1 signal.

Ethernet

A packet-switched local network design (by Xerox Corp.) employing Carrier Sense Multiple Access with Collision Detection (CSMA/CD) as access control mechanism.

Facilities

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

Frame

A unit of data transmission on an IEEE 802 LAN MAC that conveys a Protocol Data Unit (PDU) between MAC Service users.

Full Duplex

Simultaneous transmission in both directions between two points.

Gigabit Interface Converter (GBIC)

Hot-swappable input/output devices that plug into a Gigabit Ethernet port to link the port to the fiber-optic network.

Gigabits per Second (Gbit/s)

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

Hub

A CenturyLink-designated Serving Wire Center (SWC) at which bridging and multiplexing functions are performed.

Intelligent Network Element (INE)

A software programmable network component.

Internetwork Packet Exchange (IPX)

Novell's Layer 3 protocol that is similar to IP, and is used in NetWare networks.

Layer 1

Physical Layer of the OSI model which allows the protocol to provide the transmission of information on the transmission facility. It is concerned with the physical and electrical characteristics of the interface.

Link

The transmission path between any two interfaces of generic cabling

Local Area Network (LAN)

A network permitting the interconnection and intercommunication of a group of computers, primarily for the sharing of resources such as data storage devices and printers.

Megabits per Second (Mbit/s)

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

Micron (µm)

One millionth (10^{-6}) of a meter and commonly used to express the geometric dimensions of optical fiber.

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 CenturyLink '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.

Packet

A unit of data, consisting of binary digits including data and call-control signals, that is switched and transmitted as a composite whole.

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.

Port

The physical point at which energy or signals enter or leave a device, circuit, etc.

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.

Shielded Twisted-Pair (STP) Cable

An electrically conducting cable, comprising one or more elements, each of which is individually shielded.

Signaling

The transmission of information to establish, monitor, or release connections and/or provide network control.

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.

Throughput

The total capability of equipment to process or transmit data during a specified time period.

Transparent

In communication systems, that property which allows transmission of signals without changing the electrical characteristics or coding beyond the specified limits of the system design.

Twisted-Pair

A cable element that consists of two insulated conductors twisted together in a regular fashion to form a balanced transmission line.

Twisted-Pair Cable

A bundle of multiple twisted pairs within a single protective sheath.

Unshielded Twisted-Pair Cable (UTP)

An electrically conducting cable, comprising one or more pairs, none of which is shielded.

Untagged Frame

An untagged frame is a frame that does not contain a tag header immediately following the Source MAC Address field of the frame or, if the frame contained a Routing Information field, immediately following the Routing Information field.

Virtual Local Area Network (VLAN)

A group of devices on one or more LANs that are configured (using management software) so that they can communicate as if they were attached to the same wire, when in fact they are located on a number of different LAN segments.

VLAN-Tagged Frame

A tagged frame whose tag header carries both VLAN identification and priority information.

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 (R1999)	*Digital Hierarchy – Electrical Interfaces*
ANSI T1.105-2001	*Synchronous Optical Network (SONET) – Basic Description including Multiplex Structure, Rates, and Formats*
ANSI T1.105.01-2000	*Synchronous Optical Network (SONET) – Automatic Protection Switching*
ANSI T1.105.03-2003	*Synchronous Optical Network (SONET) – Jitter and Wander at Network and Equipment Interfaces*
ANSI T1.105.06-2002	*Synchronous Optical Network (SONET): Physical Layer Specifications*
ANSI T1.105.09-1996 (R2002)	*Synchronous Optical Network (SONET) Network Timing and Synchronization*
ANSI T1.107-2002 (R2006)	*Digital Hierarchy – Formats Specifications*
ANSI T1.117-1991	*Digital Hierarchy – Optical Interface Specifications (SONET) (Single Mode – Short Reach)*
ANSI T1.223-1997	*Structure and Representation of Network Channel (NC) and Network Channel Interface (NCI) Codes for the North American Telecommunications System*
ANSI T1.231-1997	*Digital Hierarchy – Layer 1 In-Service Digital Transmission Performance Monitoring*
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ANSI/TIA-526-7-2008	*OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant*
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ANSI/TIA/EIA-758-A-2004	*Customer-Owned Outside Plant Telecommunications Cabling Standard*
ATIS-0900105.02-2007	*Synchronous Optical Network (SONET) – Payload Mappings*

8.2 Telcordia Documents

GR-20-CORE	*Generic Requirements for Optical Fiber and Fiber Optical Cable*
GR-253-CORE	*Synchronous Optical Network (SONET) Transport Systems: Common Criteria*
GR-342-CORE	*High-Capacity Digital Special Access Service Transmission Parameter Limits and Interface Combinations*
GR-378-CORE	*Generic Requirements for Timing Signal Generators*
GR-436-CORE	*Digital Network Synchronization Plan*
GR-496-CORE	*SONET Add-Drop Multiplexer (SONET ADM) Generic Criteria*

GR-499-CORE	*Transport Systems Generic Requirements (TSGR): Common Requirements*
GR-1230-CORE	*SONET Bidirectional Line Switched Ring Equipment Generic Criteria*
GR-1377-CORE	*SONET OC-192 Transport System Generic Criteria*
GR-1400-CORE	*SONET Dual-Fed Unidirectional Path Switched Ring (UPSR) Equipment Generic Criteria*
SR-307	*COMMON LANGUAGE NC/NCI Dictionary*

8.3 CenturyLink Technical Publications

PUB 77200	*CenturyLink DS1 Service and CenturyLink DS1 Rate Synchronization Service*, Issue F, September 2001
PUB 77324	*CenturyLink DS3 Service*, Issue F, January 2005
PUB 77340	*Self-Healing Alternate Route Protection (SHARP)*, Issue H, January 2011
PUB 77344	*DIVERSITY AND AVOIDANCE*, Issue B, September 2001
PUB 77368	*CUSTOMER PREMISES ENVIRONMENTAL SPECIFICATIONS AND INSTALLATION GUIDE*, Issue F, July 2009
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PUB 77372	*CenturyLink Frame Relay Service*, Issue H, December 2000
PUB 77375	*1.544 Mbit/s Channel Interfaces*, Issue G, June 2008
PUB 77386	*Interconnection and Collocation for Transport and Switched Unbundled Network Elements and Finished Services,* Issue M, October 2007
PUB 77419	*SPECIFICATIONS FOR THE PLACEMENT OF CENTURYLINK EQUIPMENT IN CUSTOMER-OWNED OUTDOOR CABINETS*, Issue A, June 2010

8.4 Institute of Electrical and Electronics Engineers Documents

IEEE 802.3-2008	*IEEE Standard for 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

8.5 International Telecommunication Union - Telecommunication Standardization Sector (ITU-T) Recommendations

G.652 *Characteristics of a single-mode optical fibre and cable*

G.7041 *Generic framing procedure (GFP)*

8.6 International Organization for Standardization/International Electrotechnical Commission Publications

ISO/IEC 11801: 2002+A1:2008 *Information technology – Generic cabling for customer premises*

8.7 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 CenturyLink employees may order;

- ANSI documents and ISO/IEC publications from:

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

  ANSI has a catalog available that describes their publications.

- Telcordia documents from:

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  8 Corporate Place, PYA 3A-184
  Piscataway, NJ 08854-4156
  Fax: (908) 336-2559
  Phone: (800) 521-CORE (2673) (U. S. and Canada)
  Phone: (908) 699-5800 (Others)
  Web: http://www.telcordia.com

- CenturyLink Technical Publications from:

  http://www.CenturyLink.com/techpub/

- IEEE documents may be obtained from:

  Institute of Electrical and Electronics Engineers
  445 Hoes Lane
  P.O. Box 1331
  Piscataway, NJ 08855
  Web: http://standards.ieee.org/

- ITU-T publications from:

  International Telecommunications Union
  General Secretariat
  Place des Nations, CH-1211
  Geneva 20, Switzerland
  Web: http://www.itu.int/home/

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