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SMARTPath® Service
Interface & Performance Specification

Technical
Reference

NOTICE

This Technical Reference describes the DS1 metallic interfaces, referred as the Network Interface (NI), between BellSouth Telecommunications, Inc. (BST), End-Users (EU) and Carriers (CXR) for SMARTPath® Service.

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SMARTPATHSM SERVICE INTERFACE AND PERFORMANCE SPECIFICATION

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SMARTPATHSM SERVICE

INTERFACE AND PERFORMANCE SPECIFICATION

1. SCOPE

This Technical Reference (TR) describes SMARTPath Service DS1 metallic interfaces, referred to as the Network interface (NI), between BellSouth Telecommunications, Inc., (BST) and the Customer Installation (CI) or Carrier Point of Termination (CXR–POT). In addition, performance requirements for the SMARTPath Service segment are defined. It defines electrical, physical, and protocol requirements at the NI necessary for compatible operation between BST and the CI or Carrier. Interfaces such as PBX–to–PBX, PBX–to–computer and PBX–to local area network are not covered in this document.

Signals that appear as a result of the environment (e.g., induced voltages and currents, lightning hits, etc.) are not covered in this document.

1.1 PURPOSE

The requirements in this document were developed to establish a functional and practical interface. Compliance with them should provide a satisfactory interface in a high percentage of installations. If cases arise that have not been adequately addressed in this document, any resulting problems should be resolved through the cooperation of the user, BST and equipment suppliers.

1.2 USE OF THIS DOCUMENT

This document describes SMARTPath Service to be offered by BST. An overview of the service description is provided in Section 2. Technical details of the DS1 interface are covered in Section 3. Network Channel Interface (NCI) codes are identified in Section 4. Performance objectives and requirements are included in Section 5. Operational maintenance responsibilities are outlined in Section 6. A Glossary which defines terms and acronyms is included in Section 7. A list of references is provided in Section 8.

2. SERVICE DESCRIPTION

2.1 GENERAL

SMARTPath Service is a shared high capacity network service capable of transporting 1.544 Mbit/s isochronous serial data with high reliability and availability performance parameters. It provides a level of redundancy/diversity designed to limit a single event from interrupting service. This service is available only in those locations within specified SMARTPath Service Areas which BST determines can be incorporated into the SMARTPath network enabling BST to provide the specified level of performance and reliability. SMARTPath Service Areas are defined in the National Exchange Carrier Tariff FCC No. 4.

SMARTPath Service provides a transport link between a customer designated premises where the network is accessed and (1) another customer designated premises, in the same SMARTPath Area or (2) a serving wire center in the same SMARTPath Area for connection to (a) DS1 Basic Channelization, FlexServ[®] Service, LightGate[®] Service, SMARTRingSM Service, Expanded Interconnection Services, or (b) a SMARTPath Area Junction of another SMARTPath Service Area in the same SMARTPath Metropolitan Area.

SMARTPath Service can be utilized to provide end-to-end transport within specific geographic areas between End User Point of Termination (EU-POT), Carrier Point of Termination (CXR-POT), EU-POT to CXR-POT, or between either an EU-POT or CXR-POT and a BST serving wire center. Further channelization is available in conjunction with DS1 SMARTPath Service to provide for network access to voice grade or digital data services that operate at 64 Kbit/s or below. Such channelization may be provided entirely by Customer Premises (CP) multiplexing that is provided by the end user.

2.2 SERVICE RATE ELEMENTS

The SMARTPath Area Connection provides for the connection at the designated premises where the customer gains access to SMARTPath Service and transport to a designated junction in the same SMARTPath Service Area.

The SMARTPath Area Junction provides for the connection between the SMARTPath network and (1) another customer designated premises, in the same SMARTPath Area or (2) a serving wire center in the same SMARTPath Area for connection to (a) DS1 Basic Channelization, FlexServ Service, LightGate Service, SMARTRing Service, or Expanded Interconnection Service, or (b) a SMARTPath Area Junction of another SMARTPath Service Area in the same Metropolitan Area.

2.3 LIMITATIONS

SMARTPath Service can only be provided where suitable facilities are available. SMARTPath Service is available only in those locations within specified SMARTPath Service Areas which BST determines can be incorporated into the SMARTPath network enabling BST to provide the specified level of performance and reliability. SMARTPath Service Areas and associated wire centers are identified in the National Exchange Carrier Association Tariff F.C.C. No. 4 by wire center. For locations where a customer requests SMARTPath Service and facilities are not available, special construction charges will apply, as set forth in BST's Special Construction Tariff, F.C.C. No. 2.

3. DS1 NETWORK INTERFACE

3.1 GENERAL

This section defines the DS1 Network Interface (NI) requirements for End-User (EU) and Carrier (CXR) locations. It denotes existing documentation which details electrical and signal specifications. The information in this document complements the equipment information in Part 68, Subpart D, of the FCC Rules and Regulations which contains regulations for the registration of Customer Installation (CI) equipment to protect the network from harm. Tariffs, contracts, or regulatory acts in various jurisdictions may contain more stringent requirements than those in this document.

3.2 END–USER INTERFACE

The EU interface specifies requirements for DS1 signals delivered by BellSouth Telecommunications, Inc. (BST) and the Customer Installation (CI) to the Network Interface (NI) at a customer location. A sketch of the NI is shown in Figure 1. The signal delivered to the NI by BST is identified as the BST signal, and the signal delivered by the customer is identified as the CI signal. At the NI, some of the electrical requirements for the carrier signal differ from corresponding requirements for the CI signal.

The customer is required to provide network protection, signal recovery, LBO as specified by BST and test access functionality. These functions are normally included in a device called a Channel Service Unit (CSU)

3.2.1 ELECTRICAL SPECIFICATIONS AT END–USER NI

The EU interface is compatible with the requirements specified in Bellcore Technical Reference TR–NPL–000054, High–Capacity Digital Service (1.544 Mb/s) Interface Generic Requirements for End–Users. Electrical specifications for DS1 signals delivered to the NI by BST and CI are defined in BellSouth Technical Reference TR 73525, MegaLink and MegaLink Channel Service Exchange Network Interface Specifications. TR 73525 contains information which details electrical specifications, framing formats, clear channel operation, maintenance, physical interface requirements and channelization.

3.2.1.1 BST SIGNAL AT END–USER NI

The BST pulse characteristics at the NI shall be those of a standard pulse, as defined in TR 73525, transmitted through a cable pair with a loss in the range of 0.0 to 16.5 dB at 772 kHz between 100 ohm terminations.

3.2.1.2 CI SIGNAL AT END–USER NI

In those installations with the Network Channel Terminating Equipment (NCTE) set to 0 dB, the CI pulse characteristics shall be those of a standard pulse, as defined in TR 73525, transmitted through a cable pair with a loss in the range of 0.0 to 1.5 dB at 772 kHz between 100 ohm terminations. When additional CI signal attenuation is required it may be inserted by selecting the appropriate Line Buildout (LBO) in the CI NCTE. BST shall advise the customer of the required CI signal attenuation using NCTE LBO codes A, B, or C.

3.2.2 PHYSICAL INTERFACE AT END–USER NI

One balanced–twisted pair shall be used for each direction of transmission. Interconnection at the DS1 NI is through one of four Universal Service Order Code (USOC) connectors RJ48C, RJ48X, RJ48M, or RJ48H as shown in ANSI T1.403–1989 and Part 68 of FCC Rules and Regulations as revised by Public Notice Numbers 4609 and 4752, September 21, 1988 and October 3, 1988 respectively. The RJ48H is the preferred multiple circuit jack. BST encourages customer participation to ensure an orderly, functional and mutually trouble–free interface at these and all locations.

3.3 CARRIER INTERFACE

The Carrier interface specifies requirements for DS1 signals delivered by BST and the Carrier to the Network Interface (NI) at a carrier location. A sketch of the NI is shown in Figure 2. The signal delivered to the NI by BST is identified as the BST signal, and the signal delivered by the Carrier is identified as the CXR signal.

3.3.1 ELECTRICAL SPECIFICATIONS AT CARRIER NI

Electrical specifications for DS1 signals delivered to the NI by BST and the Carrier are defined in Bellcore TR-INS-000342, High-Capacity Digital Special Access Service Transmission Parameter Limits and Interface Combinations. This TR contains information which details electrical specifications, framing formats, clear channel operation, maintenance, and physical interface requirements.

3.3.1.1 SIGNALS AT CARRIER NI

Both BST and Carrier pulse characteristics at the NI shall be those of a standard DSX-1 cross-connect pulse, as defined in TR-INS-000342.

3.3.2 PHYSICAL INTERFACE AT CARRIER NI

One balanced-twisted pair shall be used for each direction of transmission. Interconnection at the DS1 NI is via an appropriate DS1 rate digital cross-connect panel. Alternatively, suitable mechanical connecting arrangements may be the RJ48C, RJ48X, RJ48M, or RJ48H connectors. BST encourages customer participation to ensure an orderly, functional and mutually trouble-free interface at these and all locations.

3.4 FRAMING FORMAT

The BST and End-User or Carrier signal at the NI shall be framed in the Extended Superframe (ESF) format and provide ANSI T1.403-1989 ESF to support improved testing and in-service performance monitoring.

3.5 CLEAR CHANNEL CAPABILITY

BST uses the Bipolar with Eight Zero Substitution (B8ZS) method to provide a Clear Channel Capability (CCC), framed DS1 signal with unconstrained payload information bits (payload may represent any combination of zeros and ones). BST does not support the Zero-Byte Time Slot Interchange (ZBTSI) method of providing CCC.

3.6 MAINTENANCE SIGNALS

Maintenance signals are transmitted in-band and in the data link of the ESF format. TR 73525 provides information regarding specific maintenance, alarm and loopback signals.

3.7 SYNCHRONIZATION

To insure proper operation when connected to the BST digital network, channelized DS1 circuits should comply with Bellcore Technical Advisory, TA-NWT-000436, Digital Synchronization Network Plan and ANSI T1.101-1994. Timing information may be transmitted as part of the DS1 signal. Improper timing will result in transmission impairing slips which can cause loss of data information.

Synchronization may be achieved by deriving timing from a BST channelized DS1, by deriving timing from a different DS1 traceable to a Primary Reference Source (PRS) and timing all other facilities from it, or by providing timing traceable to a PRS. For BST services with central office channelization, it has been recommended that the customer equipment be loop-timed (slaved) to the incoming bit stream from the network.

Synchronous Optical Network (SONET) transport systems may introduce phase transients due to pointer adjustments. DS1s transported in the SONET Virtual Tributary (VT) payload are not recommended for Building Integrated Timing Supply (BITS) interoffice synchronization distribution because of the potential impact on the clocks from jitter and wander resulting from VT pointer justification. For customer to network interfaces, its impact is under study – see proposed revision of ANSI T1.403 (T1E1.2/93–003R3). When timing is taken from the BST network, customer equipment must be capable of accommodating SONET transport system pointer adjustments.

4. INTERFACE DESCRIPTIONS

4.1 GENERAL

This section provides information on Network Channel Interface (NCI) codes including interface descriptions. The NCI code describes the number of conductors, protocol, impedance, protocol options and transmission level point(s) reflecting characteristics at the Network Interface (NI)/Point of Termination (POT). Existing Network Channel (NC) codes will be used for SMARTPath Service. The appropriate interface ordering procedures, which use these NCI and NC codes, are covered in other publications such as Bellcore SR–STS–000307.

4.2 NETWORK CHANNEL INTERFACE (NCI) CODE COMPONENTS

The electrical characteristics of the interface are identified by an NCI code. Compatible NCI codes for the service desired must be specified by the customer when ordering SMARTPath Service and other network special access services. Definitions of specific NCI codes that apply to SMARTPath Service are covered in this section. Descriptions of the component parts of the NCI code are provided to aid the customer in understanding the relationship of these codes to the electrical characteristics of the interface.

The components of an NCI code furnish the information concerning the electrical characteristics for the NI at the POT. Positions 1 and 2 of the NCI code are numeric characters indicating the total number of conductors at the interface. Positions 3 and 4 are two alphabetic characters indicating the protocol code. Position 5 indicates the reference impedance. Position 6, if used, is a delimiter and indicates the start of the protocol option code. Positions 7, 8, and 9, if used, indicate options available for the protocol code in use. The component parts of the NCI codes and their definitions are listed in the tables in this section. Additional information about Network Channel Interface Codes may be found in Bellcore SR–STS–000307.

4.2.1 NUMBER OF CONDUCTORS

This component describes the number of conductors required to provide the service. Table 4–1 lists allowable entries for this component. The appropriate number of conductors for DS1 SMARTPath Service is Code 04 – indicating 4 conductors.

TABLE 4–1. NUMBER OF CONDUCTORS¹

Number of Conductors	Code
2	02
4	04
6	06
8	08

4.2.2 PROTOCOL CODE

The protocol code is the most significant component of the NCI code, since it is associated with the basic electrical function of the interface. The protocol code broadly describes the technical capabilities of the interface at the EU–POT, CXR–POT or serving wire center.

The protocol code combinations specified for the CXR–POT and the EU–POT may be the same or different. However, only certain combinations are technically possible. Table 4–2 lists the protocol codes that apply to SMARTPath Service.

TABLE 4–2. SELECTED PROTOCOL CODES AND OPTIONS²

Code	Option	Definition
DS1 Digital Hierarchy Interface at the CXR–POT		
DS	1 K	1.544 Mbit/s (DS1) "ANSI" T1.403 Extended Superframe (ESF) format per TR–INS–000342
	1 S	1.544 Mbit/s (DS1) "ANSI" T1.403 Extended Superframe (ESF) format and B8ZS Clear Channel Capability per TR–INS–000342
DS1 Digital Hierarchy Interface at EU–POT		
DU	1 K N	1.544 Mbit/s (DS1) "ANSI" T1.403 Extended Superframe (ESF) format per TR–NPL–000054 without line power
	1 S N	1.544 Mbit/s (DS1) "ANSI" T1.403 Extended Superframe (ESF) format and B8ZS Clear Channel Capability per TR–NPL–000054 without line power

¹ Wire Code is in Character Positions 1 & 2

² Protocol Code is in Character Positions 3 & 4.
Option Code is in Character Positions 7, 8 & 9.

4.2.3 NOMINAL REFERENCE IMPEDANCE

The nominal reference impedance is the third component of the NCI code. This is the impedance at which the customer will terminate the service for the purpose of evaluating transmission performance. Table 4–3 lists some allowable values. The appropriate impedance for SMART-Path Service is Code 9 – 100 ohms.

Table 4–3. REFERENCE IMPEDANCE CODE³

Impedance Value ⁴	Code
110	0
135	5
75	6
100	9

4.3 COMPATIBLE NCI CODE COMBINATIONS

NCI code selection for SMARTPath Service should be coordinated between the customer and BST during the initial service order discussion. Table 4–4 lists compatible SMARTPath NCI interface combinations. DS1 interfaces can only be interconnected with DS3 interfaces or vice-versa, if the customer purchases DS3/DS1 multiplexing. For codes associated with interconnecting High Capacity Digital Access services consult existing technical publications or a Marketing Representative.

TABLE 4–4. COMPATIBLE NCI INTERFACE COMBINATIONS

EU–POT	EU–POT
04DU9.1KN	04DU9.1KN
04DU9.1SN	04DU9.1SN

EU–POT	CXR–POT
04DU9.1KN	04DS9.1K
04DU9.1SN	04DS9.1S

CXR–POT	CXR–POT
04DS9.1K	04DS9.1K
04DS9.1S	04DS9.1S

³ Reference Impedance Code is in Character Position 5.

⁴ The reference impedance is the impedance the customer is expected to use to terminate the channel for the purpose of evaluating transmission performance.

5. PERFORMANCE

5.1 GENERAL

The performance objective for SMARTPath Service pertains to the BST provided DS1 bit stream on the network side of the NI. The performance of DS1 subrate services are covered in documents that pertain to those services. Verification of circuit performance up to the NI may be performed by BST using a variety of testing techniques.

5.2 DS1 QUALITY OBJECTIVES

ANSI T1.403–1989 ESF is required on all circuits in order to support enhanced performance objectives. The performance quality objectives of a SMARTPath Service circuit on the network side of the NI are stated in terms of four parameters: Error Free Seconds, Severely Errored Seconds, Service Availability and Service Continuity. SMARTPath performance objectives are summarized in Table 5–1.

TABLE 5–1. DS1 QUALITY PERFORMANCE OBJECTIVES

Performance Parameter	Objective (Long Term)
%Error Free Seconds (%EFS)	EFS > 99.95%
%Severely Errored Seconds (%SES)	SES < 0.009%
%Annual Service Availability	Availability > 99.99%
Service Continuity	Single Event Restoration < 60 seconds

5.2.1 ERROR FREE SECONDS

The long term (i.e., 30 or more days) Error Free Seconds (EFS) performance objective is better than 99.95% EFS when the circuit is available. An EFS is defined as any second in which there is no bit errors. Conversely, an Errored Second (ES) is one in which there is one or more bit errors. ES are typically transient in nature, arise from a variety of causes, and have a small probability of occurring at any given time.

5.2.2 SEVERELY ERRORED SECONDS

The long term (i.e., 30 or more days) Severely Errored Second (SES) performance objective is less than 0.009% SES when the circuit is available. A SES is defined as any second in which the Bit Error Ratio is 10^{-3} or worse. At 1.544 Mbps a SES would result in greater than 1544 bit errors in a second. For an ESF circuit, an SES is a second with 320 or more path coding violations.

5.2.3 ANNUAL SERVICE AVAILABILITY

The long term Availability performance objective is better than 99.99% availability over 12 consecutive months. Circuit availability is a measure of the amount of time that the service is “usable” by the customer. Availability objectives are stated in terms of the % Annual Service Availability. According to the American National Standards Institute (ANSI) and The International Telegraph and Telephone Consultative Committee (CCITT) 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. The transitions between the available and unavailable states are:

- Transition to the unavailable state occurs at the beginning of 10 consecutive Severely Errored Seconds (SES).
- Transition to the available state occurs at the beginning of 10 consecutive seconds none of which is a SES.

5.2.4 SERVICE CONTINUITY

The Service Continuity performance objective is that in the event of primary facility failure, service will switch to the alternate facility path in 60 seconds or less.

6. OPERATIONAL MAINTENANCE

6.1 GENERAL

Maintenance of SMARTPath Service circuits on the network side of the NI is the responsibility of BST. In the event of reported trouble, an attempt to diagnose and isolate the source of the trouble will be made with a variety of verification, monitoring and testing techniques. Once the trouble has been confirmed and isolated a dispatch will be made to correct it.

The greatest difficulty occurs in situations where trouble reports cannot be confirmed by remote diagnostics. BST will offer to dispatch to the customer’s premises for additional testing, but with the understanding that maintenance charges may apply. The trouble resolution process will be slowed considerably.

This situation is of course frustrating to the customer as well as to BST. It is in the customer’s interest to try to avoid requesting BST to expend time attempting to isolate a problem that may exist in the customer’s equipment.

Customer provision of NCTE loopbacks and ANSI T1.403–1989 ESF capabilities in conjunction with proper test equipment supports improved testing, maintenance and in–service performance monitoring capabilities. This enhances the likelihood of achieving circuit performance objectives.

7. GLOSSARY

7.1 DEFINITIONS

Alarm Indication Signal (AIS)

A signal transmitted in lieu of the normal signal to maintain transmission continuity, and indicate to the receiving terminal that there is a transmission fault which is located either at the transmitting terminal or upstream of the transmitting terminal.

American National Standards Institute (ANSI)

The officially recognized accrediting organization for the development of Industry Standards in the U.S.

Bipolar (Alternate Mark Inversion) Signal

A pseudo-ternary signal, conveying binary digits, in which successive “ones” (marks, pulses) are of alternating, positive (+) and negative (–) polarity, equal in amplitude, and in which a “zero” (space, no pulse) is of zero amplitude.

B8ZS (Bipolar with 8–Zero Substitution)

A code in which eight consecutive “zeros” are replaced with the sequence 000VB0VB, where V is a binary one in which the polarity is in violation of the bipolar rule and B is a binary one in which the polarity is in conformance with the bipolar rule.

Bipolar Violation

In a bipolar signal, a one (mark, pulse) which has the same polarity as its predecessor.

Bit

An abbreviation of binary digit. One of the members of a set of two in the binary number system. Either digit 0 or 1. Also, a unit of information; one bit of information is sufficient to specify one of two equally likely possibilities.

B3ZS (Bipolar with 3 Zero Substitution)

A code where three consecutive “zeros” are replaced with the sequence B0V or 00V, where B represents a pulse conforming with the bipolar rule and V represents a pulse violating the bipolar rule. The choice of B0V or 00V is made so that the number of B pulses between consecutive V pulses is odd.

Carrier

An organization that provides telecommunications service to the public.

Central Office (CO)

A local switching system and its associated equipment located at a wire center.

Channel

An electrical or optical communication path between two or more locations.

Channelize

The process of multiplexing and demultiplexing channels using analog or digital techniques.

Clear Channel Capability

A characteristic of a DS1 transmission path in which the 192 “information” bits in a frame can represent any combination of zeros and ones.

Customer Installation (CI)

Equipment and wiring at the customer’s location on the customer side of the NI.

Customer Premises (CP)

The premises of the end–user of the telecommunications service.

Cyclic Redundancy Check (CRC)

A method of checking the integrity of received data, where the check uses a polynomial algorithm based on the content of the data.

DS1 (Digital Signal Level 1)

A digital signal transmitted at the nominal rate of 1.544 Mbit/s.

DS3 (Digital Signal Level 3)

A digital signal transmitted at the nominal rate of 44.736 Mbit/s.

Duplex Channel

A channel capable of supporting simultaneous transmission in both directions.

Encode

To apply a set of unambiguous rules specifying the way in which data may be represented such that subsequent decoding is possible.

Exchange

A unit established by the telephone company for the administration of communication services in a specified geographic area that usually embraces a city, town or village and its environs.

Frame

In digital communications, a group of bits that constitute the smallest independently definable entity in a continuous data stream.

Framing Bits

Non–information carrying bits used to make possible the separation of information in a serial bit stream.

In–Band

Using or involving the information digit time slots of a DS1 frame; i.e., bit assignments of a frame exclusive of the framing bit.

Isochronous Transmission

A transmission process in which there is always an integral number of unit intervals between any two significant instants. The transmission is characterized by a constant pulse rate, a constant time interval or multiples thereof between voltage or electromagnetic field intensity transitions and gating by a controlled clock.

Isolated Pulse

A pulse free from the effects of the other pulses in the same signal. (A suitable testing signal is a repetitive pattern of one “one” and seven “zeros.”)

Jitter

Short-term variation of the significant instants of a digital signal from their ideal positions in time. Short-term implies that these variations are high frequency (greater than 10Hz).

Line Loopback

A loopback in which the signal transmitted beyond the loopback point (the forward signal), when the loopback is activated, is the same as the received signal at the loopback point.

Loopback

A state of a transmission facility in which the received signal is returned towards the sender.

Mbit/s

Megabits per second.

Multiplex

A technique to use a single transmission channel to provide several transmission channels, such as by sharing the time of the channel (time-division multiplexing) or superimposing many frequencies at the same time (frequency-division multiplexing) in order that many signal sources and sinks may communicate during a given time period.

Network

A collection of transmission and switching facilities used to establish communications channels.

Network Interface (NI)

The point of demarcation between the Network and the CI or Carrier.

Open Systems Interconnection (OSI)

A model used to describe layered network architecture. OSI has seven layers that define categories of modularized functions that are provided by hardware and software.

Payload

The 192 information bits of a DS1 frame.

Pulse Density

A measure of the number of “ones” (marks, pulses) in relation to the total number of digit time slots transmitted.

Quasi-Ransom Signal (QRS)

A signal consisting of a bit sequence which approximates a random signal.

Regenerator

Equipment that reconstructs and retransmits a received pulse train.

Serial

Pertaining to the sequential or consecutive occurrence of two or more related activities in a single device or channel. In the telecommunications network, binary digital data is transmitted serially.

Terminal Equipment (TE)

Equipment which originates or terminates signals at the specified rate.

T1 Line

A full duplex digital transmission facility that is composed of two twisted metallic pairs and regenerators that carry one DS1 signal.

Unit Interval

The nominal difference in time between consecutive significant instants of an isochronous signal.

Voice Grade Channel

A channel with frequency response characteristics such that it effectively transmits voice frequency signals. Such a channel will provide a pass-band of approximately 300 Hz to 3000 Hz.

Wander

Long-term variations of the significant instants of a digital signal from their ideal positions in time. Long-term implies that these variations are low frequency (less than 10 Hz).

ZBTSI (Zero-Byte Time Slot Interchange)

A technique used on a DS1 signal to ensure that pulse density requirements are met, where zero octets are replaced by an address chain which is decoded by the receiving terminal.

8. REFERENCES

ANSI T1.101–1994, Synchronization Interface Standards for Digital Networks.

ANSI T1.102–1987, Digital Hierarchy – Electrical Interfaces.

ANSI T1.107–1988, Digital Hierarchy – Formats Specifications.

ANSI T1 107b–1991, Digital Hierarchy – Supplement to Formats Specifications (Synchronous Digital Data Format).

ANSI T1.403–1989, Carrier–to–Customer Installation – DS1 Metallic Interface.

ANSI Draft American National Standard for Telecommunications – Network–to–Customer Installation – DS1 Metallic Interface (T1E1.2/93–003R3).

ANSI/NFPA 70 National Electric Code.

Code of Federal Regulations, Title 47, FCC Rules and Regulations, Part 68, Revised December, 1987.

Rules and Regulations, Part 68, Federal Communications Commission.

BellSouth
TR 73501

LighGate® Service Channel Interface Specifications.

BellSouth
TR 73525

MegaLink and MegaLink® Channel Service Exchange Network Interface Specifications.

BellSouth
TR 73545

SynchroNet® Service Network Interface Specifications.

Bellcore
TR–NPL–000054

High–Capacity Digital Service (1.544 Mb/s) Interface Generic Requirements for End–Users.

Bellcore
TR–TSY–000194

Extended Superframe Format Interface Specification.

Bellcore
TR–INS–000342

High Capacity Digital Special Access Service Transmission Parameter Limits and Interface Combinations.

Bellcore
TA–NWT–000436

Digital Synchronization National Plan.

Bellcore
SR–STS–000307

Industry Support Interface (ISI): NC/NCI Code Dictionary.

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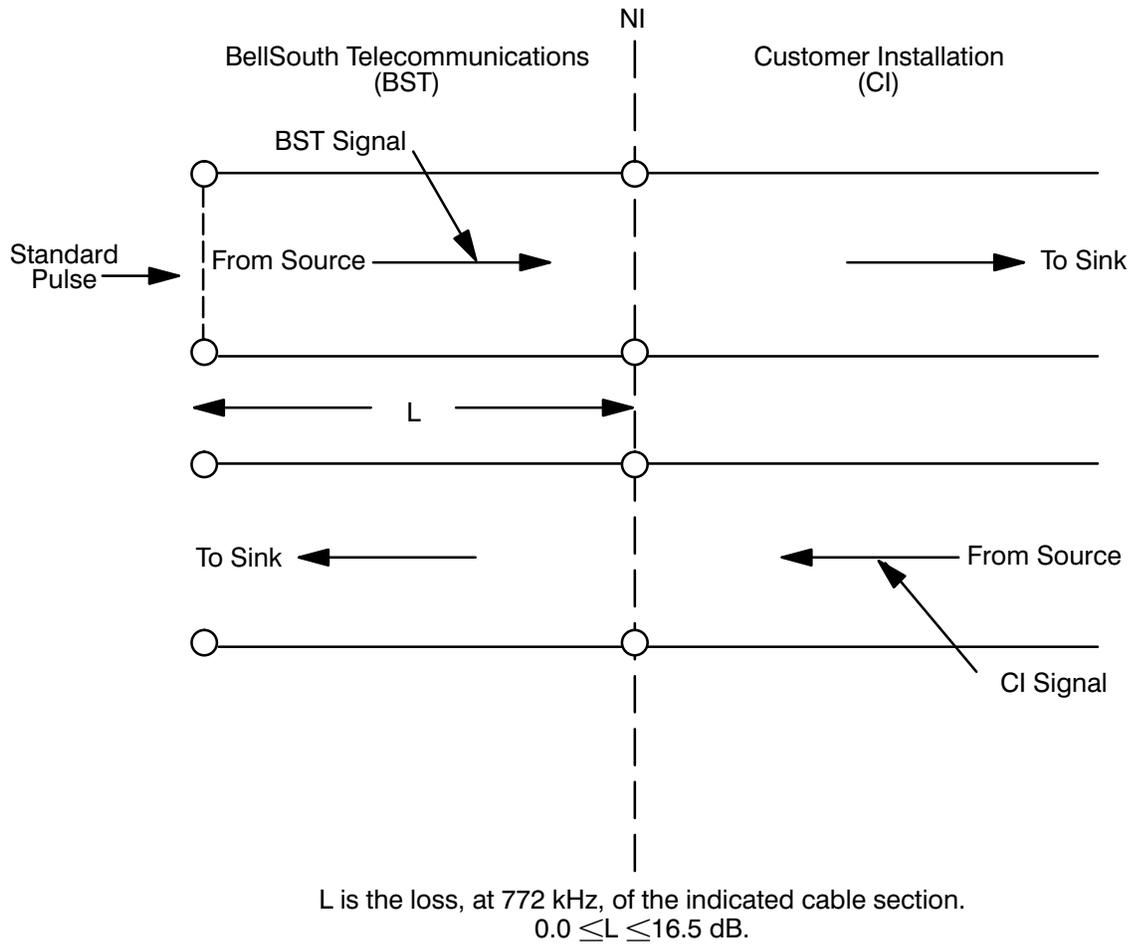


Figure 1 – End-User Network Interface

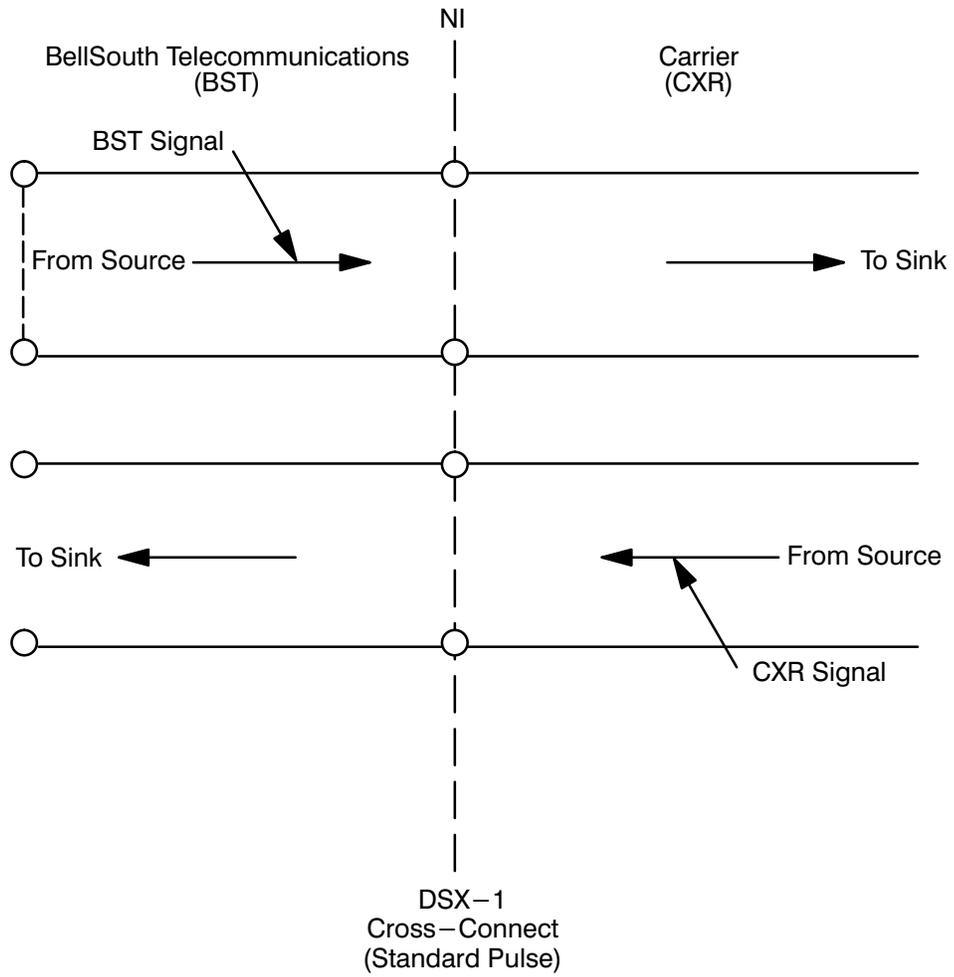


Figure 2 – Carrier Network Interface