



**Unbundled Dark Fiber (UDF)
Technical Specifications**

NOTICE

This Technical Reference describes Unbundled Dark Fiber (UDF). This Unbundled Network Element (UNE) can provide a Competitive Local Exchange Carrier (CLEC) a fiber transmission path between customer designated premises and a BellSouth Telecommunications, Inc. (BST) Serving Wire Center or between BST Central Offices.

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Unbundled Dark Fiber (UDF) Technical Specifications

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Unbundled Dark Fiber (UDF) Technical Specifications

1. General

This document provides the technical specifications for Unbundled Dark Fiber (UDF) offered by BellSouth Telecommunications, Inc. (BST). This Unbundled Network Element (UNE) can provide a Competitive Local Exchange Carrier (CLEC) a fiber transmission path between a customer designated premises and a BST Serving Wire Center or between BST Central Offices. This service is sometimes referred to as Dry Fiber service but will be referred to as Dark Fiber service in this document. The term “dry” applies to the absence of DC power, whereas the term “dark” applies to the absence of regeneration.

1.1 Scope

This Technical Reference (TR) provides the technical specifications necessary for compatible operation between BST and CLECs. The requirements in this document were developed to establish a practical interface. Compliance with these specifications 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 suppliers. BST encourages customer participation to ensure an orderly, functional and mutually trouble-free interface at all locations.

1.2 Use of This Document

Technical specifications have been established based upon Industry Standards developed by the American National Standards Institute (ANSI) and Bellcore. This TR articulates BST variations from these standards and provides clarification of specification and performance requirements as necessary.

2. Service Description

UDF service is offered as a point-to-point arrangement between a customer designated premises and BST Serving Wire Center or between BST Central Offices. UDF is offered without signal regeneration to compensate for signal losses. The service arrangement consists of four optical fibers and fiber terminating equipment as shown in Figure 1 and 2. UDF service will be routed through a BST Central Office for testing and maintenance functions. Current policies concerning recombination will be adhered to.

3. Network Rearrangements

BST reserves the right to rearrange its network and to modify the manner in which it provides service in order to meet its overall service requirements. This includes, but is not limited to, the right to engineer and construct its fiber optic facilities in accordance with its normal operations without the requirement to modify its materials, splicing techniques, or planned facility rearrangements to suit a specific customer request.

4. Fiber Transmission Media

UDF service shall be provided via single-mode fiber with a nominal zero dispersion wavelength at 1310 nanometers. The conventional dispersion-unshifted single-mode fiber (also known as EIA/TIA Class IVa fiber) shall generally meet the requirements detailed in Bellcore GR-20-CORE, *Generic Requirements for Optical Fiber and Optical Fiber Cables*, and ITU Recommendation G.652, *Characteristics of a Single-Mode Optical Fiber Cable*.

4.1 Operating Wavelengths

The service is provided over BST single-mode fiber optic cable which support operating wavelengths of 1310 nanometers (nm) and 1550 nm.

4.2 Typical Performance Characteristics

Table 1 provides typical characteristics of optical fiber and components commonly utilized in BST’s network:

Table 1 – Typical Technical Characteristics of BST Optical Fiber and Components

Wavelength λ	1310 nm	1550 nm
Typical Fiber Loss	0.5 dB/km	0.35 dB/km
Discrete Reflectance (Splices, Connectors)	-40.0 dB	-40.0 dB
Return Loss (Fiber Cable)	+24.0 dB	+24.0 dB
Medium Zero Dispersion Wavelength	1310 \pm 3 nm	Not Applicable
Chromatic Dispersion (Fiber Cable)	3.5 ps/nm-km	18.0 ps/nm-km
Chromatic Dispersion Slope (Fiber Cable)	0.093 ps/(nm-km ²)	0.093 ps/(nm-km ²)
Polarization Mode Dispersion (Fiber Cable)	10 ps	10 ps

The transmission characteristics of a specific UDF application may differ from the above typical performance characteristics.

5. Mechanical Interface

At the four fiber Network Interface (NI), BST will provide duplexable SC type (EIA/TIA SCFOC/2.5) plug and jack type connectors. BST will install the connector jack to serve as the NI. BST and the customer must each provide connector plugs to terminate their fibers at the NI. Each connector plug will contain 2 fibers, one for each direction of transmission. The connector jack will be the demarcation point between BST and the Customer Installation (CI). Figure 3 depicts the Fiber Optic Mechanical Network Interface.

5.1 Optical Fiber Termination and Arrangement

Optical fibers are terminated at the customer premises in a BST approved and constructed cabinet or Fiber Distributing Frame (FDF). BST typically uses a “tray” type splice on the customer premises and connectorized fibers from that splice to the cabinet or FDF.

6. Optical Power Limitations

Customer provided lasers shall not exceed +17.0 dBm in output power at 1550 nm (Class IIIB laser). In addition, the customer shall tell BST which class of laser (see Section 9) that they will be utilizing on their equipment.

7. Engineering Design Information

BST uses a design approach based on EIA/TIA–559, *Single–Mode Fiber Optic System Transmission Design*, and GR–253–CORE, *Synchronous Optical Network (SONET) Transport Systems: Common Criteria Physical Layer*, procedures for elements in its network.

For the purpose of optical parameter specifications, optical interfaces are referred to the Optical System Reference Diagram (Points S and R) as shown in Figure 4.

Point S is a reference point on the optical fiber just after the transmitter (Tx) optical connector (C_{Tx}). Point R is a reference point on the optical fiber just before the receiver (Rx) optical connector (C_{Rx}). Points S and R provide a convenient separation of the optical link into a transmitter subsection, a receiver subsection, and an optical path subsection. Optical parameters are specified for the transmitter at point S, for the receiver at point R, and for the optical path between Points S and R. All parameter values specified are worst–case values and are to be met over the ranges of standard operating conditions (i.e., temperature and humidity ranges); they include aging effects. The parameters are specified relative to an optical section design objective of a bit error ratio (BER) better than 1×10^{-10} .

To ensure proper system performance it is necessary to specify attenuation and dispersion characteristics of the optical path. This specification is assumed to represent worst–case values including losses due to splices, connectors, optical attenuators (if used), or other passive optical devices, and any additional cable margin to cover allowances for the following:

- (1) future modifications to the cable configuration (additional splices, increased cable lengths, etc.),
- (2) fiber cable performance variations due to environmental factors, and
- (3) degradation of any connector, optical attenuator (if used), or other passive optical device when provided.

For customer design purposes, BST will provide the following information, when it is available:

- Length of the fiber cable including 3% extra for possible cable reroute.
- Loss budget value in decibels/kilometer (dB/km) of fiber cable at $\lambda = 1310$ nm or $\lambda = 1550$ nm.
- Number of splices constructed and anticipated number of maintenance splices.
- Loss budget value of each splice in dB/splice.
- Loss budget value of single–mode fiber jumper in dB/jumper.

- Loss budget value of jumpers and connectors at the Lightguide Terminal Interconnect Equipment (LTIE) in dB at customer premises.
- Loss budget values of jumpers and connectors in dB used to connect fibers in BST office(s).

Note: Loss Budget Values are end-of-life values which account for aging and are usually greater than actual measured values.

8. Regeneration

UDF service is offered without regeneration, so it will be incumbent that the customer maintain adequate margins to insure proper working of the fiber optic system.

9. Safety Requirements

The fiber optic system and required optical test equipment used in conjunction with UDF service must be registered and certified with the Department of Health, Education and Welfare Bureau of Radiological Health as specified in 21 CFR 1040.10. This document specifies performance requirements, labeling requirements and informational requirements. Documentation demonstrating system certification shall be available to assist in the determination of fiber optic safety precautions required to install, operate and maintain the system.

Optical powers from lasers are also classified by the International Electrotechnical Commission (IEC). Depending on the potential danger, IEC 825 requires that all laser equipment be classified into one of the following classes; 1, 2, 3a, 3b, or 4. Because the minimum power limits for class 4 lasers are not used in telecommunications, they are not considered for the purposes of this document. The other classes of lasers, the power limitations and the accompanying safety requirements are summarized in Table 2 on the following page.

Table 2 – IEC 825–1 and 825–2 Classes of Lasers, Power Limits & Safety Requirements

Laser	Maximum Power Levels		Safety Requirements
	1310 nm	1550 nm	
Class 1	9.4 dBm	10.0 dBm	Inherently Safe <ul style="list-style-type: none"> ● Protective housing to prevent higher than classified emission. ● Safety interlock in the housing to prevent access to non–classified emission levels. ● Classification labels on the product and in the promotional literature. ● Caution labels on service panels, interlocked or not ● User safety information in operator and service manuals.
Class 2 ¹	NA	NA	NA
Class 3a	13.8 dBm	17.0 dBm	Safe unless viewing aids are used Additional requirements to all of the above: <ul style="list-style-type: none"> ● Key control ● Beam stop to automatically disable the laser if no access is required. ● Audible or visible “Laser On” warning.
Class 3b	27.0 dBm	27.0 dBm	Additional requirements to all of the above: <ul style="list-style-type: none"> ● Remote control switch to allow disabling the laser by a door circuit. ● Aperture label to indicate the location of the radiation output.

Special precautions and requirements for installation and use of optical systems (including amplifiers) and a description of viewing aids are given in IEC 825–2.

¹ Class 2 is used for visible laser products emitting wavelengths from 400 to 700 nm, these requirements are not considered pertinent.

10. Maintenance

The customer must cooperatively disable (turn-off) any optical transmission equipment on a dark fiber arrangement whenever BST must perform maintenance on those facilities.

11. References

GR-20-CORE, Generic Requirements for Optical Fiber and Optical Fiber Cable, Issue 1, September, 1994

GR-63-CORE, Network Equipment-Building System (NEBS), Generic Equipment Requirements, Issue 1, October 1995

GR-253-CORE, Synchronous Optical Network (SONET) Transport Systems: Common Criteria Physical Layer, Issue 2, December 1995

GR-326-CORE, Generic Requirements for Single-Mode Connectors and Jumper Assemblies, Issue 2, December 1996

Bellcore Technical References may be ordered by contacting:

Bellcore Customer Relations
8 Corporate Place – Room 3A-184
Piscataway, NJ 08854-4156
1-800-521-2673

EIA/TIA-559, Single-Mode Fiber Optic System Transmission Design

OFSTP-2, Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable

OFSTP-3, Fiber Optic Terminal Receiver Sensitivity and Maximum Receiver Input

OFSTP-10, Measurement of Dispersion Power Penalty in Single-Mode Systems

OFSTP-11, Measurement of Single Reflection Power Penalty for Fiber Optic Terminal Equipment

EIA/TIA documents may be ordered by contacting:

Telecommunications Industry Association
Engineering Department
2001 Pennsylvania Avenue N.W.
Washington, D.C. 20006
(202) 457-4966

IEC 825-1, Safety of Laser Products, Part 1: Equipment classification, requirements and user's guide, First Edition, 1993-11

IEC 825-2, Safety of Laser Products, Part 2: Safety of optical fiber communication systems, First Edition, 1993-09

ANSI Z136.2-1998, American National Standard for the Safe Use of Optical Fiber Communications Systems Utilizing Laser Diode and LED Sources

IEC and ANSI documents can be ordered from:

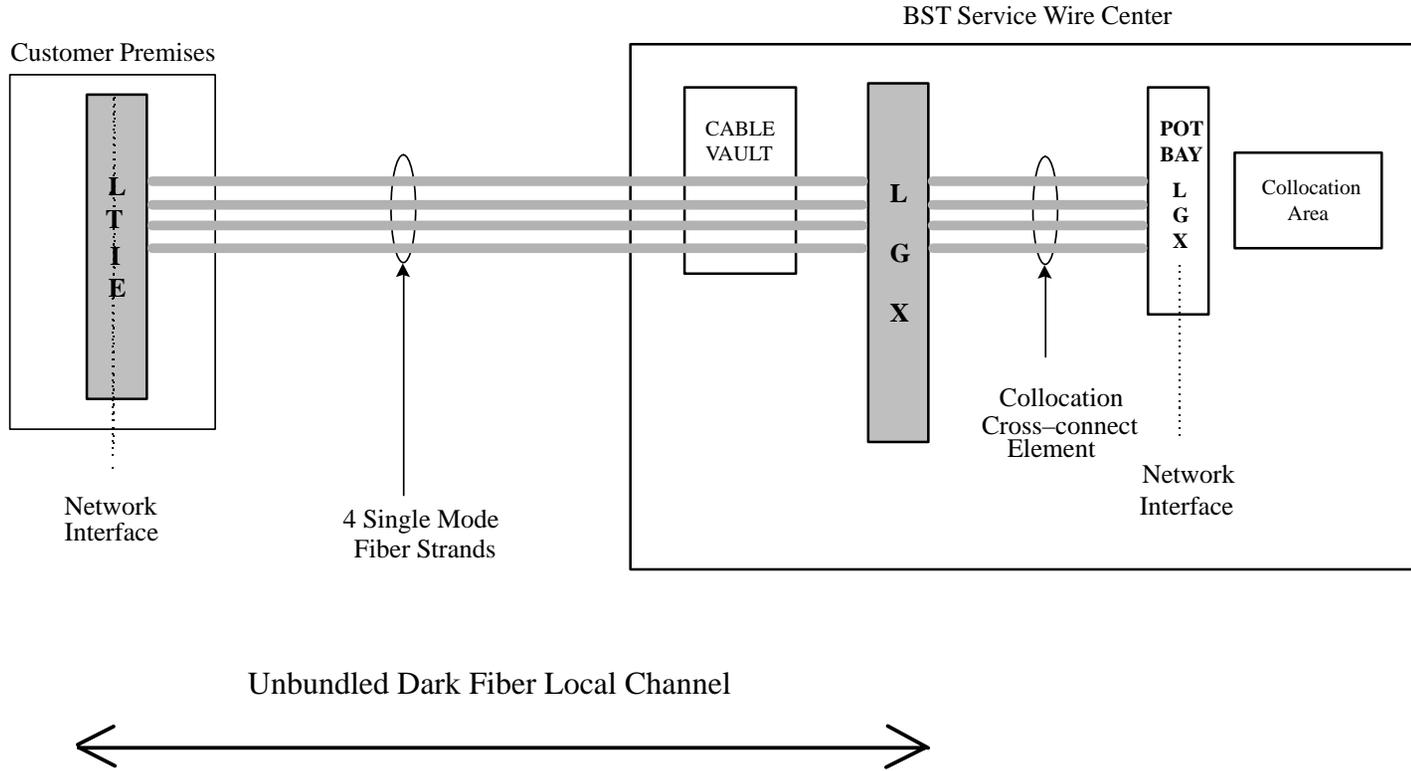
Global Engineering Documents
15 Inverness Way East
Englewood, CO 80112-5704
(800) 854-7179

21 CFR 1040, Performance Standard for Laser Products

This document may be obtained by contacting:

Director, Division of Compliance
Bureau of Radiological Health
5600 Fishers Lane
Rockville, MD 20857

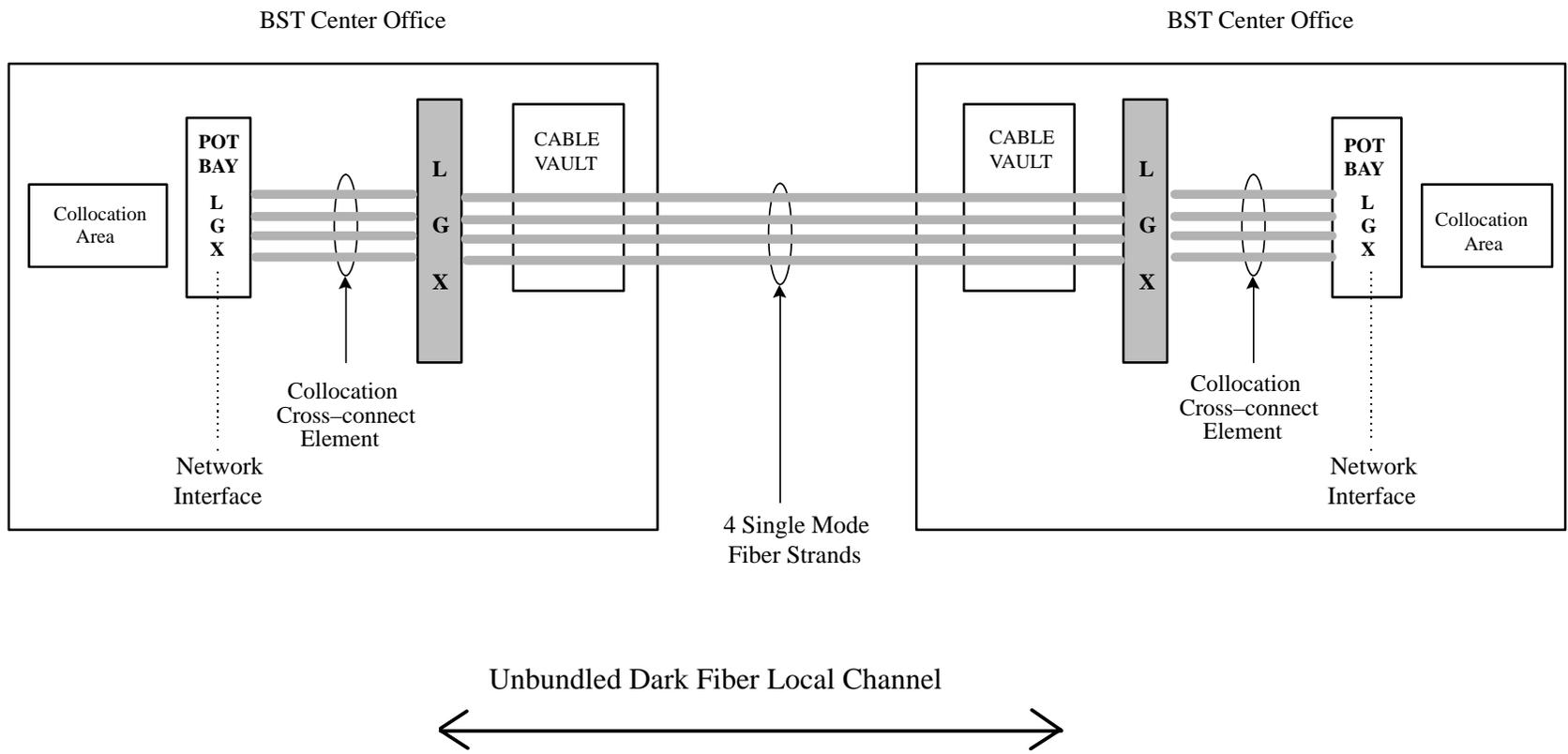
Figure 1 – Unbundled Dark Fiber Customer Premises to BST Serving Wire Center



- LTIE Lightguide Terminal Interconnection Equipment
- LGX Fiber Distribution Frame
- POT BAY Point of Termination Bay

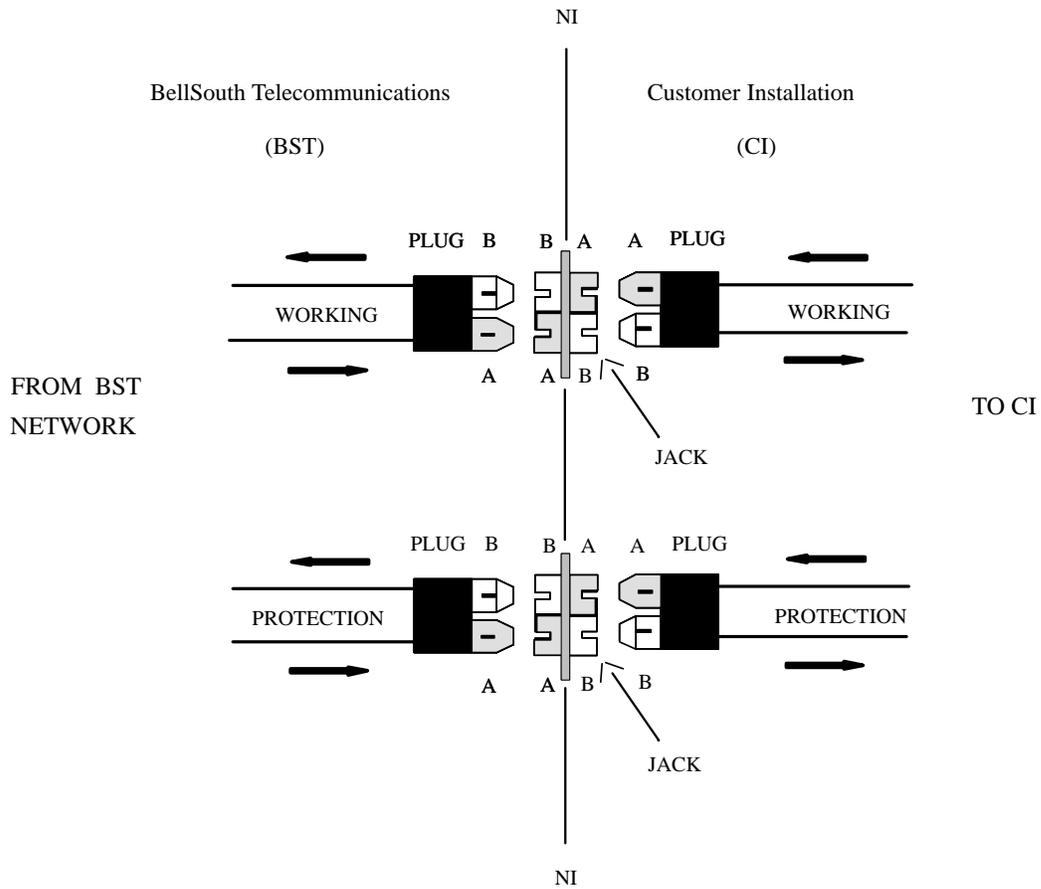
Note: The arrangement shown above is applicable to Physical Collocation.
 Current polices concerning recombination of elements will be adhered to.

Figure 2 – Unbundled Dark Fiber BST Central Office to BST Central Office



LTIE Lightguide Terminal Interconnection Equipment
 LGX Fiber Distribution Frame
 POT BAY Point of Termination Bay

Note: The arrangement shown above is applicable to Physical Collocation. Current polices concerning recombination of elements will be adhered to.



NOTES:

- 1 LIGHT LEAVES "A" PLUG AND ENTERS "A" JACK
 - 2 LIGHT LEAVES "B" JACK AND ENTERS "B" PLUG
 - 3 JACK AT NI PROVIDED BY BST (OPTIONALLY MAY BE PART OF OTHER NETWORK EQUIPMENT)
 - 4 A SINGLE FIBER IS USED FOR EACH DIRECTION OR TRANSMISSION
 - 5 FOR 4 FIBER INTERFCE BOTH WORKING AND PROTECTION PROVIDED
- ➔ DIRECTION OF LIGHT

Figure 3 – 4 Fiber Optic Mechanical Network Interface

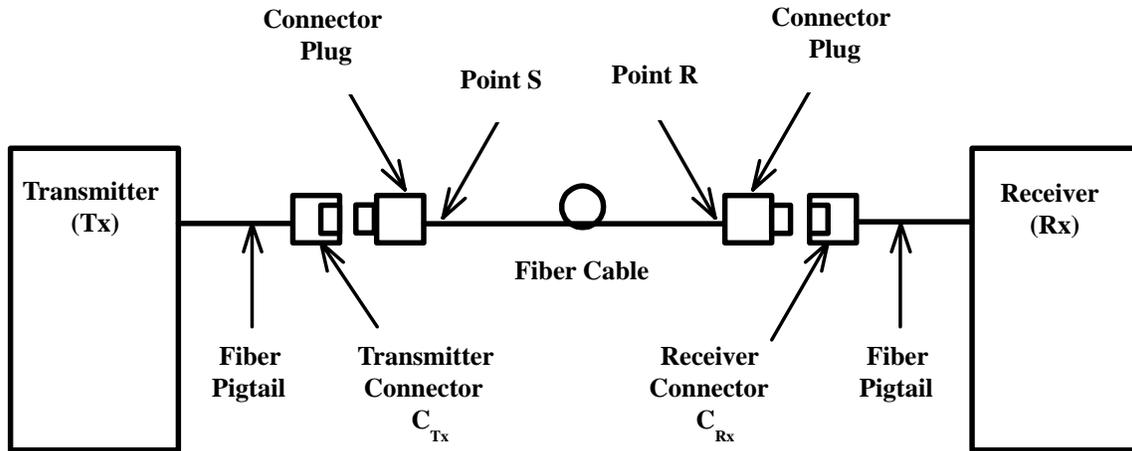


Figure 4 – Optical System Interfaces (Points S and R)

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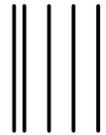
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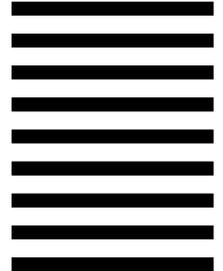
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