SBC-002-316-011
SINGLEMODE FIBEROPTIC SPLITTERS

Abstract

Presented in this document are the methods and procedures to implement Fiberoptic Splitters.

Audience: The primary audience for this document is SBC Local Exchange Carrier personnel in the following disciplines, Switch Capacity Planner/Engineer, Resident Engineer, Transport Equipment Engineer (TEE), Facility Equipment Engineer (FEE), Digital Transport Engineer (DTE), Space Planner, Frame Planner, Long Range Technical Planners, and NSS/CPOC organizations.
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1.0 Reasons for Issue/Reissue

Issue 2.0, All Sections: Issued to incorporate provisioning changes and to change the protection scheme.

Issue 3.0, Author and Document Coordinator Change.

Issue 3.0, Section 3.0: Highlight in red on the optional use of this product.

Issue 3.0, Section 3.0: All paragraphs now numbered.

Issue 3.0, Section 3.2: New Paragraph covering Collocation Applications.

Issue 3.0, Section 4.0: All paragraphs are now numbered.

Issue 3.0, Section 6.0: Contact List Updated.

Issue 3.0, Section 7.0: Reference Table updated in its entirety.

Issue 3.0, Section 4.1: “except for Collocation Applications” has been added.

2.0 Introduction

The primary audience for this document is SBC Local Exchange Carrier personnel in the following disciplines; Switch Capacity Planner/Engineer, Transport Equipment Engineer (TEE), Facility Equipment Engineer (FEE), Digital Transport Engineer (DTE), Space Planner, Frame Planner, Long Range Technical Planners, and NSS organizations. This document is to be used internally and have a limited distribution subject to the header/footer information. This M&P may be found on the Internal Web Site: http://home.sbc.com/commonsystems/ or http://apex.sbc.com

Fiberoptic Splitters (otherwise known as Optic Couplers) are passive SingleMode optical glass devices used to distribute fiber optic signals to multiple fiber optic output locations. Optical Splitters produce output signals in varying combinations. The most common SingleMode splitters provide a 90/10 or a 50/50 percent split of the input signal intensity. The SBC Local Exchange Carriers has specified enhanced performance characteristics on approved for use SingleMode units that are expected to operate successfully on services up to OC-192. Optical Splitters and associated connector hardware are used to provide a near non-intrusive test/monitor location for optical signals. MultiMode Optical splitters are not approved nor intended for use in or connected to the SBC Local Exchange Carrier SingleMode Network.

With the proliferation of optical signal handoffs to our customers there has been a growing need to implement near non-intrusive tests at optical interface points. The solution is the deployment of 1x2 90/10 SingleMode optical splitters at key interfaces throughout our network. These splitters will provide a passive device that will allow technicians to perform near non-intrusive monitoring and testing of live optical signals. When used with the doubler version for the transmit and receive in the same splitter card, a fiber jumper may be placed from the line 100% receive to the 90% transmit that effectively provides a “keep alive” loopback signal on SBC Local Exchange Carrier equipment. **These fiber optic splitters are not to be used with WDM or DWDM technologies.**

For point of clarity, Fiberoptic Splitters are used on Fiberoptic facilities for Optical Carrier transmission. A recent development in accordance with FCC Report & Order 99-355 requires the use of POTS-SPLITTERS that are used on copper twisted pairs services supporting xDSL over standard POTS services. POTS-SPLITTERS are a different product not associated with fiberoptics or this document. Reference the Line Sharing M&P for further information regarding this topic.

3.0 Fiberoptic Splitter Description

3.1 Splitters and their Applications

The 1x2 50/50-type splitter fits the criteria of an Optical Coupler that can effectively take a SingleMode fiber signal and permit the signal to pass to two signal outputs of equal strength. This passive "bridge" induces loss to both downstream primary paths and should only be used after careful analysis has been performed as to their absolute need and applicability. Future broadband applications and testing is currently being reviewed on the potential suitability of advanced coupler applications to the network. The availability of these potential products will only be authorized through the SBC Local Exchange Carrier Network Planning & Engineering (Common Systems Standards) in a Product Approval Notices (PAN). The use of the 50/50-type SingleMode optical splitter for this testing and loopback is strongly discouraged. These fiber optic splitters are not to be used with WDM or DWDM technologies.

Applications: It is important to understand that these devices are not recommended for all optical connections within our network. The deployment will be strictly optional and will be based on an exception basis dictated by the application, service and the Engineer requirements. They are recommended as a customer interface/demarc device that will allow optical test access. They are not to be recommended for general Interoffice Facility (IOF) fiber optic span use. Recommended applications are as follows:

1. OC-n/Fiber Distributed Data Interface (FDDI), Broadband Circuit Service (BCS) and ReliaNet service handoffs to customer owned equipment. The splitter may be used as a monitoring, testing and point of demarcation.

2. Intra-office OC-n connectivity between Network Elements that have no SONET layer interoperability. An example would be an ATM OC-Nc interface that points into our optical network.

3. Optical interface points at Inter-nodal Links (INL) for non-intrusive testing and monitoring at the ATM layer.

4. Physical Collocation handoffs in accordance with FCC 99-48 Report and Order. {Mandatory only if the CLEC requests a grandfathered Point of Termination (POT) on a positive request basis - see next paragraph}.

5. Demarcation Points for Dark SingleMode Fiber optic handoffs.

6. All other applications would be considered as non-standard.

A maximum of two splitter devices is the recommended overall network design on any unidirectional or bi-directional transmission path between Optical termination equipment. This will include a maximum of one in a Central Office location for each optical transmission path. If span loss design will not support two splitters, then one is required at the customer optical demarc. This will limit the optical signal loss introduced by these devices into the network while allowing appropriate non-intrusive access points for trouble isolation and testing. Span Design Engineering will be responsible for identifying the total loss budget for the span and determining if splitter devices would be applicable for the optical circuit design. The total loss budget will include the span loss

plus the splitter loss. In the central office optical splitters generically terminate in vertical module Generation II type frames. The Splitters are designed to fit the miscellaneous shelves located at the top shelf of the primary Fiber Distribution Frame within the CO.
In Dark Fiber design, Splitters are required at both ends of the fiber span for adequate testing, if they are ordered.

3.2 Collocation Applications

Optical Splitters are only provided for Collocation when the CLEC positively requests that a Fiber Point of Termination (POT) be placed. The Collocation Application will have this entry marked. When this occurs, all downstream ILEC documentation must make a positive entry that this product has been requested. If the CLEC does not identify on his application that it is desired, the Fiber Splitter will not be placed and the terminations will be placed as connector ended services (SC-UPC in PB, AIT, SNET, NB and ST-UPC in SWBT) in a POT-Less arrangement. Refer to SBC-002-316-002, *Collocation Provisioning Guidelines*, Issue 11.1, dated January 2001 for more information.

When the POT termination option is requested, the optical splitter will be provisioned as the Demarcation point between the ILEC and CLEC services within close proximity to the CLECs Caged or Cageless assigned space, generally within 5-feet. The Splitter will be placed in a Miscellaneous Panel and also provided in an ILEC provided POT Relay Rack. The CLEC will be required to cable from their equipment space to the POT Bay for interconnection.

In the event that the CLEC requests a POT-Less cable placement, the ILEC will not use the Optical Splitter and will provide optical jumper handoffs (not cable) using the correct connector with sufficient slack for the CLEC to interconnect to the bottom of their bay (no more than 10-feet). Do not lay the cable on the Central Office floor.

As another option, the CLEC may elect to install their own cable between their CLEC assigned space and the Fiber Distribution Frame. If this option is requested, the ILEC will not provide a Optical Splitter at any point in the interconnection arrangement or at the FDF. For further details on this option, please refer to SBC-002-316-008, *CLEC Cable Placement M&P*, Issue 4,1, dated February 2001.

3.3 Optical Terminators

For Optical Facilities with transmission speeds of OC-48 or higher, the use of Fiber-optic Terminators is required. These Fiber-optic Terminators are to be placed on all unterminated ports of splitters that are in use with these transmission speeds in order to reduce the negative effects of optical signal reflectance. It is recommended to place these terminators on all non-terminated ports of these splitters when they are not connected with a fiber jumper. In any case, any active signal, regardless of transmission speed or capacity, should have the end caps placed on all non-terminated access points in the circuit.

3.4 Approved Vendors

Corning Cable System's Optical Splitter Module is rated as Standard for Use (with ADC Telecommunications shortly to provide a second source followed by Lucent Technologies). All other suppliers' splitter products are non-standard and will not be used in our network unless an authorized Product Approval Notice is issued.. Corning's family of products exceeds the Telcordia (formerly Bellcore) specifications for use and shall not be substituted by a non-rated product within

the SBC Network. Splitter monitor modules will be used in two basic configurations. A protected interface with Primary and Protect optical interface units and a non-protected installation, where splitter monitor modules do not have a corresponding protect module. The modules provide either single or double splitter functionality via 1x2 90/10 Split Ratio, ST/UPC or SC/UPC. The modules are mounted in a housing which can be placed in the Fiber Distribution Frame, a standard 23" wide relay rack, as a Demarcation /Network Interface at a customer's premises, or even wall mounted. The purchase of a 1x2 50/50 Split Ratio, ST/UPC or SC/UPC may also be purchased but with Extreme Caution. These splitters are not recommended for use as a non-intrusive test and monitor access device. The 1x2 50/50 splitters insert an excessive loss into the network and should only be used after careful analysis has been performed as to their absolute need and applicability. The units are rated standard as follows:

Approved as Standard for Use

	SWBT[1]	Nevada Bell	Pacific Bell	AIT	SNET
SC-UPC SingleMode	**Approved for new Technologies only[1]**	**Approved for Use**	**Approved for Use**	**Approved for Use**	**Approved for Use**
ST-UPC SingleMode	**Approved for Use**	Not Approved	Not Approved	Not Approved	Not Approved
SC-UPC MultiMode	**Not Approved**	**Not Approved**	**Not Approved**	**Not Approved**	**Not Approved**
ST-UPC MultiMode	**Not Approved**	**Not Approved**	**Not Approved**	**Not Approved**	**Not Approved**

3.5 Optical Patch Panels

The optical patch panel (typically an interconnect panel) was intended to be used where a small number of fibers would be terminated. These panels mounted in standard relay racks, are typically configured as an "interconnect" system in which only the Outside Plant fiber appears at a connector on the panel. A Fiber Optic Terminal "cables" to the OSP connection with a fiber optic jumper, run in a fiber protection system, from the FOT bay to the bay containing the optical patch panel. The interconnect panel is not specifically designed as a cross-connect point using fiber patch cords. It has limited devices for managing excess jumper slack or to prevent micro bending of the jumpers. Interconnect panels such as a stand-alone LUSCIE panel shall not be installed in the Central Office. Older Interconnect panels should have the fiber cable rolled to the FDF at the first opportunity as described in the Planning Guidelines. Small applications of fiber services at customer locations may utilize this technology. **Do not use MultiMode Fiber Patch cords (jumpers); use**

[1] Southwestern Bell Telephone (SWBT) currently uses the ST-UPC as the standard connector except when a new technology is introduced into the Central Office. Only at that time will the SC-UPC connector be provisioned as the going-forward corporate standard connector. All other connectors will remain as a ST-UPC. No other connectors are authorized for use besides the ST (only in SWBT) or SC connectors (all other locations).

SingleMode only. The use of a MultiMode Patch cord will disable or severely restrict the circuit.

SingleMode Fiber Optic Splitters may be used as an optical patch panel and will be placed within the Central Office Fiber Distribution Frame or on the customer's premises as the fiber optic demarcation point. These units may be used as the Demarcation Point for the regulated service, a handoff point for a Certified Local Exchange Company (CLEC), or at the Transport to Switch handoff point within a Central Office. Product Approval Notice (PAN) 20001026, Fiber Splitters and Associated Housings, dated March 2000 specifies the approved products for use. **Multi-mode Splitters are not approved or suitable in the SBC Local Exchange Carrier Network.**

3.6 Optical Terminations

The use of Fusion Splices is rated as Standard within SBC Local Exchange Carriers. Mechanical Splices will only be permitted on an exception basis for the immediate service restoration of damaged facilities. Mechanical splices will not remain in place for any longer than 30 days before conversion to a fusion splice.

Biconic Splices shall not be used for new Fiber Optic Services. Existing Optical Signals and spare fiber terminations with Biconic Termination Connectors must be replaced at the first opportunity or activity associated with that facility. The standard termination for Pacific Bell, Nevada Bell, Ameritech and Southern New England Telecommunications is the SC-UPC connector. The standard termination for Southwestern Bell Telephone is the ST-UPC connector, except as mentioned above for new technology deployments. These connector uses will be handled as standard within the respective Local Exchange Companies for all Fiber Optic provisioned services (Asynchronous, OC3, OC3C, OC12, OC48, OC192, WDM, DWDM and any other Fiber Optic speeds not listed). Effective September 1999, Biconic Termination Connectors were manufacturer discontinued; this product can only be used from existing Procurement Purchased stock from Lucent Technologies. Future cabling should be reterminated with the standard connector for their area in the existing LUSCIE panel or transition the cable to a FDF panel.

3.7 Attenuators

Attenuators are placed at the Fiber Distribution Frame (FDF) panel supporting the Network Element. FOT and OSP panels in the FDF normally are ordered with a 0-dB attenuation. The connector may be changed in the FDF and replaced with the proper attenuator in the connector socket to pad the signal in 5-dB increments. These "Bulkhead" attenuators are flush mounted with the panel face and are color coded for proper use. In addition, "In-Line" attenuators may be placed to pad the signal and shall only be placed between the FOT panel and the fiber cross-connect jumper. Never place an attenuator between two fiber optic patchcords in the Fiber Protection System (Yellow Raceway) or the FDF troughs, but in the FOT panel itself. Attenuators should not be placed on the Network Element equipment side of the fiber optic patchcord except under unusual circumstances where the fiber connections are secured from incidental hazards and potential service outages. **Do not place an attenuator on the front connectors of Fiberoptic Splitters.**

4.0 Placement of Fiberoptic Splitters in the Network

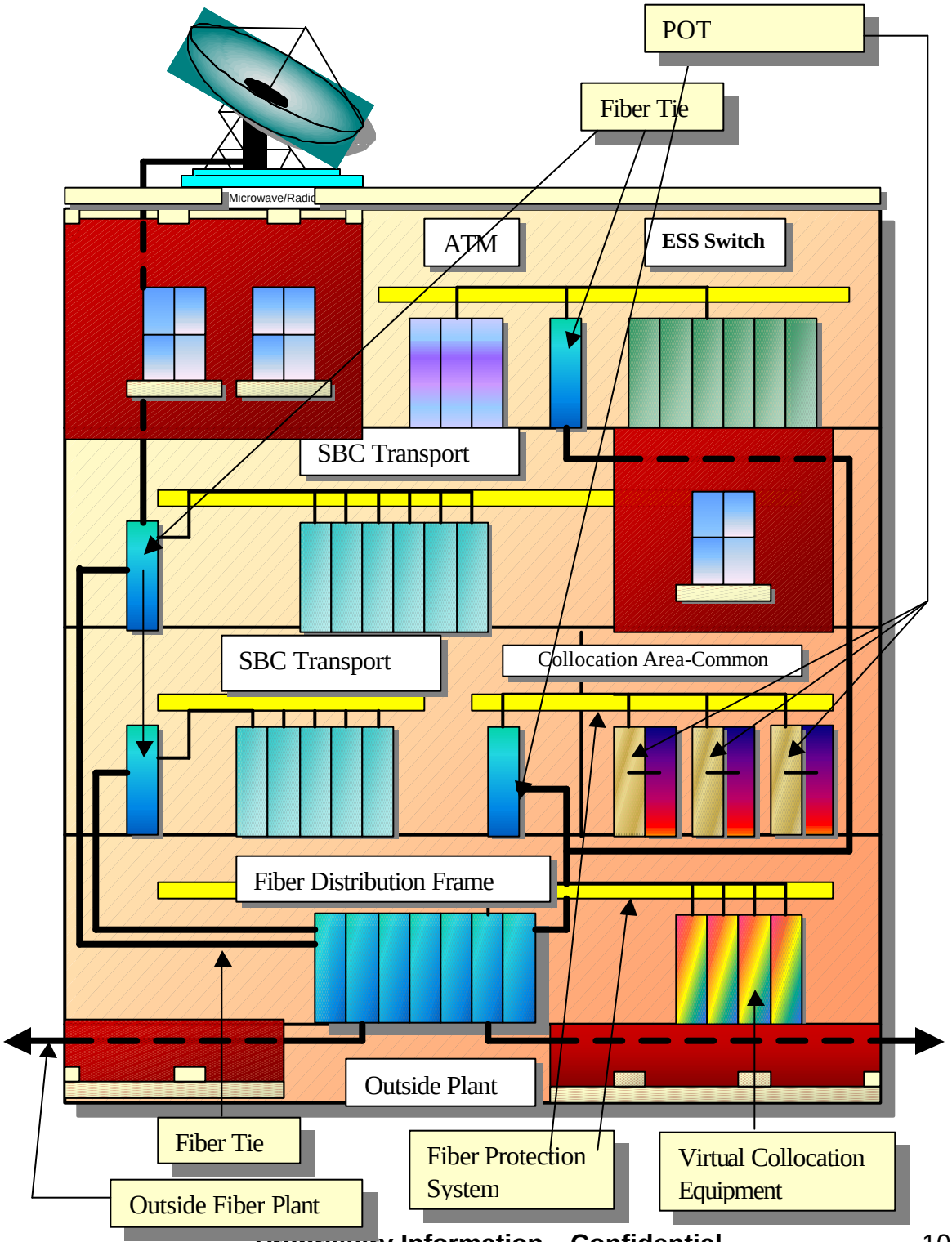
4.1 Placement

Fiber optic Splitters shall be placed in the Fiber Distribution Frame (FDF) except for Collocation Applications. The FDF serves as the primary cross-connect frame point for all intraoffice fiber equipment and the termination point for outside plant fiber facilities. It provides for the logical test and sectionalization point for service isolation in the optical network. As shown by the following illustration, the FDF provides the backbone infrastructure throughout the Central Office. The Fiber Optic Splitters shall be placed in a Miscellaneous Splitter Panel located in the top panel slot of a FOT bay in the FDF. When the FOT panels are filled, the OSP top panel spacing may also be used for this facility.

A Miscellaneous Splitter Panel should be placed in all Central Offices that currently do not have at least one splitter housing mounted in the FDF. The driver behind this action is that when a service that requires splitters is being provisioned, the design will fail because there are no splitters available. Unfortunately, the service in not usually designed until on or near the Records Issue Date (RID). As a rule, the Interoffice Facilities Current Planning Center (IFCPC) or the InterOffice Facilities (IOF) group checks for spare transport equipment and spare facilities. Optical splitters are treated more like a Network Channel Termination Equipment (NCTE) and do not fall into the normal spare equipment check routines. Also, there are many instances when the IFCPC or the IOF would not be involved in looking for spares, but a splitter would be required in the CO. The normal installation of a splitter housing is greater than 30 days and would cause the RID to be in jeopardy.

The vertical Splitter shelf will house 12 modules or cards. Each module may have either one or two Fiber Splitters in the module. The shelf can support 6 rings or 24 individual strands of terminations (for collocation). The count proceeds in a sequential ring count with the first ring using the 1st module for the primary path and the next adjacent module for the protect path. Point-to-Point optical services without a protect path will have the protect module slot skipped on the panel. Under no circumstances should the Primary and Protect paths be placed on the same splitter module. The separation of modules provides for diversity of ring configurations and cross-connects.

4.2 Fiberoptic Provisioning Illustration



Caution: Optical Facilities are transmitted using laser transmission sources and can damage eyes. Do not look directly into a fiber cable, fiber patch cord or Fiber optic Splitter at any time, regardless if light is present or not. Always keep cap covers on connector terminations unless cross-connected.

Traditionally, the Fiber Splitter is provided as a "doubler" where two splitters are placed in each card. This permits the T and R of a Primary or Protect Path to be placed together in the same module and provides for the best use of twin zip patch cords. These units use ST-UPC or SC-UPC connectors (depending on the region) connected via cross-connect fiber jumpers. **Fiber Cables will not terminate on these units.**

Fiber optic Splitters have three connector terminations per splitter. As shown below, the "doublers" have two splitters within each module housing. Each module then can provide for an entire Protect or Primary Path and use only two Modules for a complete ring.

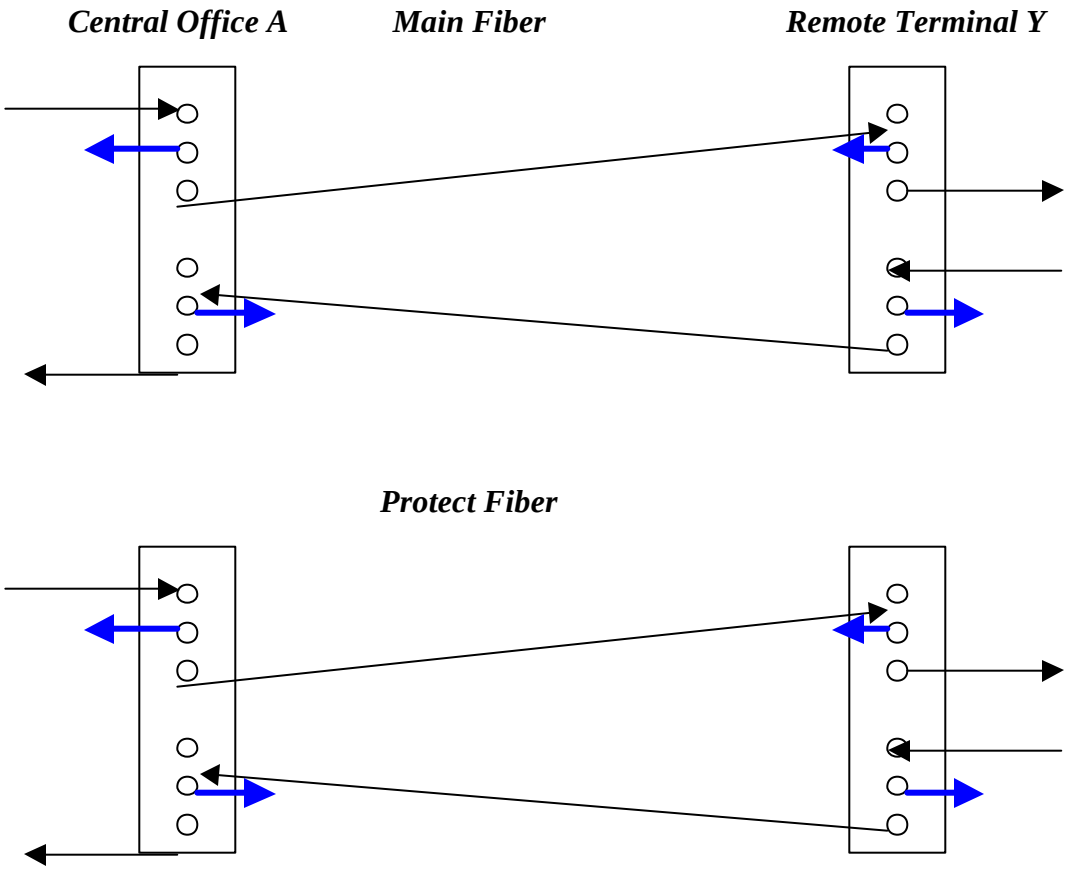
We must remember that this is a passive device that does not require power to operate; but it does take some portion of the existing transmission path to route light to the alternate path used for a monitor jack. The splitter must be downstream from the TXMT path of light. The 100% IN jack is the TXMT to the device. The 90% OUT is the cable point to further downstream devices and will be the TXMT downstream. The 10% MONITOR is the jack used for meter reading.

Traditionally the typical ring will use the T and T1 as a TXMT to the Fiberoptic Splitter and the R and R1 will be the RCV to the device. The TXMT paths will be placed on the 100% IN jacks and the RCV will be placed on the 90% OUT jacks.

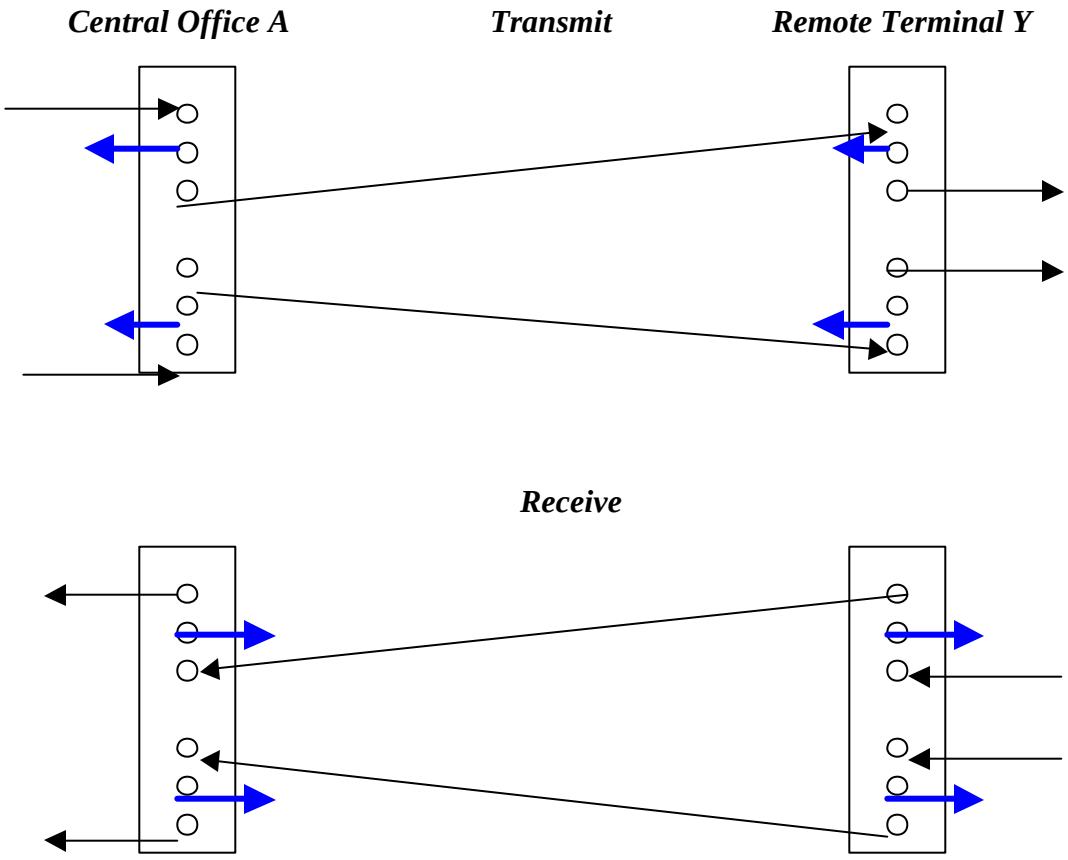
For Collocation, the termination of services from the ILEC 72/96-port panel is strand one terminated on the first module, first splitter 100% IN jack as the TXMT. Use the OUT-IN Cross-connect standard used on DSX-1 and DSX-3 services, just the labeling is different.

4.3 Test Access Illustration

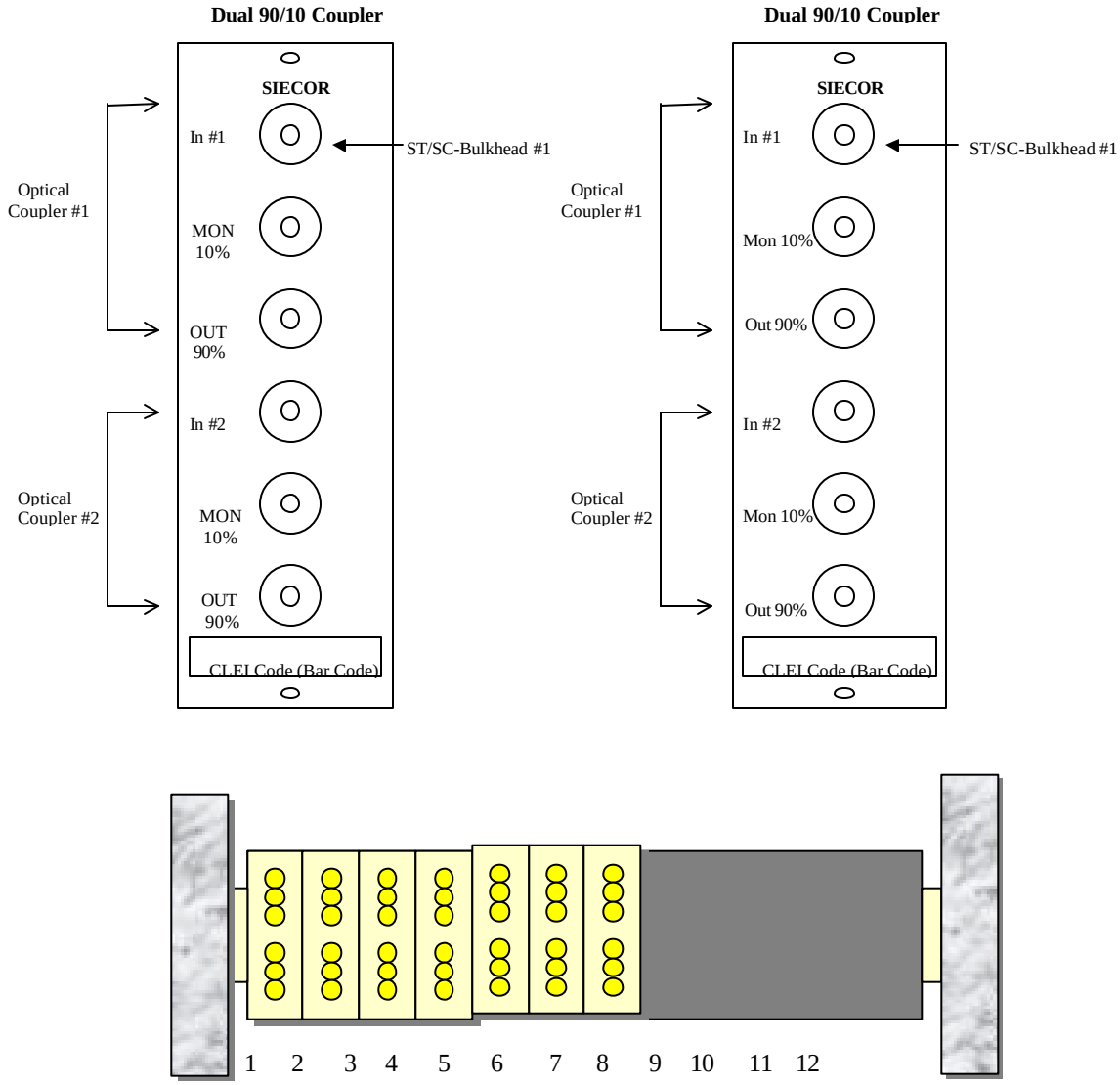
Bi-Directional Transmission. The Test directions (blue arrows) should be oriented toward the light source. This represents the normal ring and collocation configuration.



Uni-Directional Transmission. The Test directions (blue arrows) should be oriented toward the light source.



4.4 Fiberoptic Splitter Illustration



12-slot Miscellaneous Fiber Splitter Panel. As shown in pictorial above, Ring 1 Primary Path is SLOT 1, Protect SLOT 2, Ring 2 Primary Path is SLOT 3, Protect SLOT 4, Point to Point CKT 3 Primary Path is SLOT 5, Ring 4 Primary Path is SLOT 6, Protect SLOT 7.

5.0 Testing & Records Management with Fiberoptic Splitters

These products will be designed into the TIRKS WORD/9350 documents and must be accounted for in the overall loss budget of the fiberoptic service. Separate TIRKS guidelines will be forwarded to cover the design of this equipment into the Network. All optical splitter products will insert a loss in transmission levels that must be accounted for in the overall design. TIRKS Lightguide designs will require Expected and Actual Measured Loss (EML/AML) levels for benchmark testing at various access points to insure the proper levels. The splitters can perform the test access function for benchmarks, but test measurements must be taken with the appropriate test sets at these points to verify the loss budget.

For Optical Facilities with transmission speeds of OC48 or higher, the use of Fiberoptic Terminators placed on all unterminated legs of splitters is required. It is also recommended to place these same terminators on all unterminated connectors of these splitters, regardless of transmission speed, when they are not connected with a fiber jumper for optimal performance and safety.

The most appropriate benchmark tests for dark fiber are performed using an Optical Time Domain Reflectometer (OTDR) for all readings. This reading should be performed from the same reference test access point and use the same OTDR. The readings need to be recorded on a permanent basis. Test Equipment will need to be checked to insure that the optical power transmitters and receivers are of good quality capable of identifying an optical signal to the –45 dB range for light measurements. Any optical protocol test sets will be product dependent and will need to be purchased in accordance with manufacture recommendations.

Fiberoptic Splitters may be used for facility testing for a go, no-go test capability looking toward the light transmission source. This needs to be performed by a preset transmission light source and analyzed by a standard light meter. All light sources placed on the fiber are additive. Measurements when the customer has their traffic (i.e. light source turned on) will show the loss referenced to the power of the customer's laser. If at any point the ILEC adds another light source upstream, verify that the transmission signal strength (power) is extremely low (below 30 dB) and the wavelength is different from the customer transmission wavelength. For services that are provided by SBC, it is recommended that a power reading be taken both before a normal light source is placed and after with the normal expected transmission power. Record both readings. Thereafter, the Fiberoptic Splitter can permit the user the ability to measure the intrusive readings with an open circuit (no light) and with the expected measured loss with the normal power reading.

Do not forget to measure the overall circuit reading. Once the total loss measurements are determined from end-to-end, it may be determined that the loss inserted by the Fiberoptic Splitters may exceed the thresholds for the service. In this case, the splitters should be removed from the circuit.

It is anticipated in the near future to deploy new mechanized and remotely accessible optical test vehicles that will monitor service performance and long term fiber degredation. Until that time occurs, the Fiberoptic Splitter can perform an adequate interim solution.

6.0 References

For further information or electronic copies of this document and related information, visit the internal SBC Local Exchange Carrier Web site: http://home.sbc.com/commonsystems/ or http://apex.sbc.com

Document	Description	Issue & Date
SBC-002-316-002	Collocation Provisioning Guidelines (M&P)	Issue 11.1, Jan 2001
SBC-002-316-003	Frame Forecast M&P	Issue 7, Jan 2001
SBC-002-316-008	CLEC Cable Placement M&P	Issue 4.1, Feb 2001
SBC-002-316-009	ADSL for the Central Office M&P	Issue 12.1, Jan 2001
SBC-002-316-011	SingleMode Optical Splitters M&P	Issue 3, Apr 2001
SBC-002-316-021	Fiber Administration System (FAS) M&P	Issue 1, Feb 2001
SBC-002-316-026	3? Wavelength WDM M&P	Issue 1, Apr 2001
Infrastructure Deployment Guidelines (IDG), Transport, Tab 12	Optical Splitters	May 2001 (Pending)
Infrastructure Deployment Guidelines (IDG), Transport, Tab 13	WDM, DWDM, Optical Amplifiers & FDM	May 2001 (Pending)
Infrastructure Deployment Guidelines (IDG), Transport, Tab 4	Fiber Distribution Frames	May 2001 (Pending)
TP 76200MP	Network Equipment – Building Systems	Issue 4, Apr 2000
TP 76300MP	Installation Guide within the Central Office	Issue 5, Jul 2000
TP 76400MP	Detail Engineer Requirements for the C.O.	Issue 5, Aug 2000
TP 76299MP	Unbundled Network Elements	Issue 1, 2000
BSP 636-299-900MP	SBC – Fiber Distributing Frames	Issue A, Jan 2000
PBSD-ED-1140	SBC Equipment Drawing FDF for PB/SWBT	Issue 2
PBSD-ID-1140	SBC Interconnect Drawing FDF for PB/SWBT	Issue 1
SNE J95145-71	SBC Equipment Drawing FDF 12” for SNET	Issue 13
SNE T95145-31	SBC Interconnect Drawing FDF 12” for SNET	Issue 6
SNE J95218-71	SBC Equipment Drawing FDF 15” for SNET	Issue 3
SNE T95218-31	SBC Interconnect Drawing FDF 15” for SNET	Issue 1
AM-E-01582-10	SBC Interconnect Drawing FDF for AIT	Issue 1
PAN 20010800	SBC 3? WDM Module Standard	Issue 1, May 2001 (Pend)
PAN 20001026	SBC Corning Fiberoptic Splitters	Issue 1, Mar 2000
PBEL No. 3210	SBC-PB 3-Wavelength WDM Coupler	Issue 1, Dec 1997
PAN 19995018	SBC Fiber Distribution Frame (FDF)	Issue 1, Jun 1999
PAN 19985043	SBC Fiber Protection Systems (Raceways)	Issue 1, Aug 1998
SO.520.99.043	SBC-TRI Recommendation to Replace Biconic Con.	Issue 1, Mar 1999
ADCP-95-007	ADC FDF Interbay Cross-Connect Wiring Procedures	Issue 1, Jun 1999

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