DIGITAL FIBER-OPTIC TRANSMISSION SYSTEM
FOX-2 T-HUB
GENERAL DESCRIPTION

1. GENERAL

1.01 This section is a cover sheet for the Telco Systems Fiber Optics Corporation Digital Fiber-Optic Transmission System FOX-2 T-HUB General Description. This section is reproduced with permission of Telco Systems Fiber Optics Corporation and is the equivalent of Telco practice 832-100-001, Issue 1.

1.02 Whenever this section is reissued the reason(s) for reissue will be listed in this paragraph.

1.03 This section describes the FOX-2 T-HUB DS-2 Fiber-Optic Transmission System.

1.04 If corrections are required in the attached document, use Form-3973 as described in Section 000-010-015.

1.05 If equipment design and/or manufacturing problems should occur, refer to Section SW 010-522-906 for procedures on filing an Engineering complaint.

2. ORDERING PROCEDURE

2.01 For information concerning equipment and parts availability contact Telco Systems, Order Administration Department, In Norwood, Massachusetts, at:

1-800-44-SALES
1-617-551-0300

2.02 To order additional copies of this practice, use TELC 365-407-861SW as the section number.

3. REPAIR/RETURN

3.01 For defective modules and assemblies contact the Repair and Return Department at the following number:

8:00 a.m. - 5:00 p.m. (617) 551-0300 - Ext. 2778

Attachment: Telco Systems Fiber Optics Corporation
Digital Fiber-Optic Transmission System
FOX-2 T-HUB
General Description

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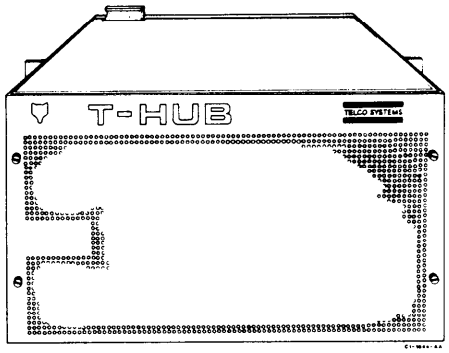

Figure 1-1. FOX-2 T-HUB

1. SCOPE

1.01 This section describes the FOX-2 T-HUB DS-2 Fiber-Optic Transmission system (see Figure 1-1). Figure 1-2 illustrates the circuit card layout and design of the T-HUB unit.

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

2. MANUAL ORGANIZATION

2.01 This manual contains the following sections:

SECTION 1. GENERAL DESCRIPTION provides an overview of the FOX-2 T-HUB, describing its capabilities, options, and network applications.

SECTION 2. THEORY OF OPERATION presents a detailed discussion of FOX-2 T-HUB equipment subsystems and circuit card operation to the block diagram level, highlighting the interrelationship of individual cards to unit-level operation.

SECTION 3. ORDERING INFORMATION presents guidelines for ordering the FOX-2 T-HUB cage, equipment rack, circuit cards, cables, options, and related accessories.

SECTION 4. SPECIFICATIONS lists the FOX-2 T-HUB physical, electrical, power/thermal, and environmental specifications.

SECTION 5. INSTALLATION outlines unit installation guidelines including rack mounting, cabling, and possible equipment configuration.

SECTION 6. INITIAL OPERATION TESTING details specific procedures for unit-level initial turn-up and alignment that must be performed prior to in-service use.

SECTION 7. MAINTENANCE
details procedures for in-service unit-level maintenance, including fault isolation, card and module replacement, and return procedures necessary for factory repair of components.

SECTION 8. SPECIAL TEST CARDS
describes the Manual Control Interface and T1 Monitor cards and the various functions of these cards.

SECTION 9. DRAWINGS
contains equipment reference drawings, motherboard wiring schematics, and related equipment assembly prints.

3. GENERAL INFORMATION

A. Safety Precautions

3.01 Care should be exercised when working with any type of optical transmission equipment. Even though the infrared LEDs used on the LTUs (Line Terminating Units) have a much lower output power than equivalent laser devices, caution should be exercised to avoid prolonged eye exposure to the unterminated optical output connector of all LTUs.

3.02 As with any product, care must be exercised when working near the -48 Vdc office power. For equipment and personnel safety, an ACX025G1 or ACX043G1 Fuse and Alarm Panel must be used to individually fuse main and standby primary power inputs to the FOX-2 T-HUB unit.

3.03 Verify that the equipment bay is properly grounded to the office ground system, and that all power interconnections are properly insulated.

3.04 All cards contained in the FOX-2 T-HUB unit, except for the Power Supply modules, are designed to enable removal or insertion without defusing the equipment.

Warning: To prevent possible equipment damage from electrical arcing at the end of the -48 Vdc office power line, always defuse primary power before disconnecting the primary power input to the unit.

3.05 Circuit cards can be damaged by electrostatic discharge. Before handling any circuit cards, connect your wrist to an equipment frame ground using an approved antistatic wrist strap (EMX031-1). Ensure that all circuit cards removed from the equipment are properly stored in antistatic packing material (PKG033-1). When working with circuit cards, always place the card on an electrically grounded, approved antistatic mat.

B. References

3.06 Since the FOX-2 T-HUB interfaces with remote wall- or rack-mounted FOX-2 units via individual 6 Mb/s optic transmission spans, other reference material may be required for system-level installation, configuration, and test. The following is a list of related Telco Systems product manuals that may be useful in FOX-2 T-HUB system planning or installation, in conjunction with other Telco Systems products:

TELCO SYSTEMS FIBER OPTICS CORPORATION:

828A Digital Multiplexer
Operation/Maintenance Manual

FOX-2 DS-2 Optical Extension
Operation/Maintenance Manual

FOX-2R Optical Extension
Operation/Maintenance Manual

TELTRAC
Users Manual
Configuration Manual

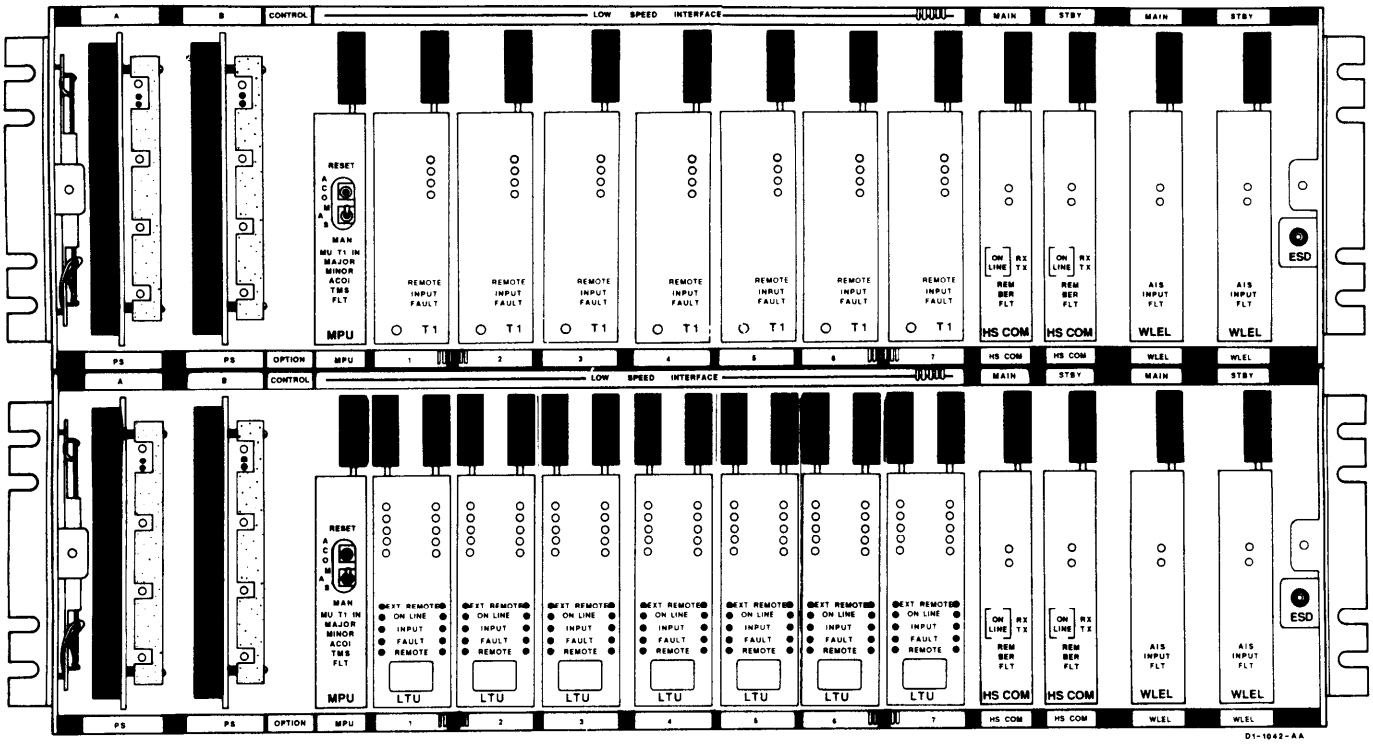

Figure 1-2. FOX-2 T-HUB Unit Layout

TELCO SYSTEMS NETWORK ACCESS CORP:

DCB-24 Digital Channel Bank:
Section 2424-00-100
Section DCB-24-200

DDI-24 Digital Drop/Insert Unit:
Section 2400-00-101
Section 2400-00-200

4. UNIT DESCRIPTION

4.01 FOX-2 T-HUB is a rack-mountable unit. The unit is capable of distributing up to 28 T1 or 14 T1C channels as seven DS-2 (6.312 Mb/s) single-mode or multimode fiber-optic spans from a central T1 access location to seven individual FOX-2 units in remote locations. Based upon 828A multiplexer technology, the FOX-2 T-HUB provides a cost-effective alternative for low-density point-to-point T1 distribution via optical fiber from a hub location in centralized star network configurations.

4.02 The single 12-inch high unit is designed for 23-inch rack mounting and consists of two shelves; each shelf contains an 828A multiplexer unit. The upper shelf utilizes T1/T1C Low-Speed Interface cards to provide T1/T1C electrical interface, while the lower shelf contains LTU circuit cards used for DS-2 optical interface. M23 (DS-2 to DS-3) high-speed multiplexing and B3ZS CODEC (Bipolar with Three-Zero Substitution Code/Decode) stages within each shelf unit allow the FOX-2 T-HUB to be conveniently reconfigured into two independent 828A MX-3 multiplexers to address changing network requirements. Unit configurations include cost-effective unprotected operation or optional 1:1 optical span and high-speed interface protection.

4.03 The basic equipment configuration for the FOX-2 T-HUB provides each shelf unit with redundant power supplies which can be interconnected with independent -48 Vdc office voltage sources for protected dc primary power. Each of these power supply modules converts the incoming -48 Vdc office voltage into the lower secondary voltage potentials required for normal circuit card operation. A single Fuse and Alarm Panel (ACX025G1 or ACX043G1) is mounted in the same bay to provide independent primary power fuse protection and a common interconnection facility for remote alarm reporting and serial TELTRAC (Telco Systems Telecommunications Remote Alarm and Control) channel interface. Other representatives of the 828A, 828AF, and TLX-140 product families can likewise be interconnected within the bay to the same Fuse and Alarm panel.

4.04 Channel capacity is modularly expandable from a single channel to up to 28 T1 or 14 T1C channels. Prewired for maximum expansion, FOX-2 T-HUB channel capacity can be increased in increments of four T1s or two T1Cs by installing additional Low-Speed Interface and LTU circuit cards. As network complexity increases, additional DS-2 optical channels can be added as required without service interruption on existing optical spans.

4.05 Incorporating HS COM (High-Speed Common) cards for DS-3 multiplexing and WLEL (Wire-Line Entrance Link) cards for B3ZS line coding into the interface between the two shelves, FOX-2 T-HUB can be separated conveniently into two MX-3 multiplexer terminals without direct unit replacement. To accommodate further network reconfiguration and enhancement, the WLEL circuit cards can be replaced with fiber-optic transceivers to convert FOX-2 T-HUB into two independent 45 Mb/s fiber-optic terminals, each with the equivalent capacity of up to 28 T1 channels.

4.06 FOX-2 T-HUB employs a dual MPU (Microprocessor Unit) architecture to monitor the operational status of all circuit cards. The upper shelf Control MPU monitors all T1 and T1C Low-Speed Interface cards along with associated high-speed interfacing circuitry, and initiates switching to redundant M12 (DS-1 to DS-2) and/or M23 MULDEM (Multiplexer/Demultiplexer) circuitry as a result of multiplexing/demultiplexing circuit failure. The lower shelf MPU is dedicated to monitoring the LTUs and their respective high-speed circuit cards. Each LTU provides DS-2 optical span transmission to remote FOX-2 units. In the presence of optical failure, this MPU controls DS-2 switching circuits within the MAIN and STBY LTU cards to route data traffic to redundant LTU circuitry and associated optical transmission paths.

4.07 If the network is equipped for TELTRAC network monitoring and control, each MPU transmits alarm telemetry information and responds to remote commands and status interrogation when polled from a central TELTRAC master terminal station. A serial RS-422 TELTRAC communications channel is accessible via an RS-422 port on the Fuse and Alarm panel to transmit TELTRAC alarm and remote command information. This alarm telemetry and control channel is transmitted from remote FOX-2/FOX-2R sites to the Optional MPU-II card of the FOX-2 T-HUB via an overhead channel incorporated into the optical line coding of each DS-2 span.

4.08 Local FOX-2 T-HUB alarms are transmitted, along with the alarm information collected by the Optional MPU-II card, to the master TELTRAC terminal station. If the master terminal is not within proximity of the FOX-2 T-HUB unit, this serial channel can be transmitted via modems using conventional telephone channels or via the service channel or embedded data channel of other span transmission and/or multiplexing equipment.

4.09 If the FOX-2 T-HUB unit is within proximity of an 828A or 828AF multiplexer(s), the optional RAC-II (Remote Alarm Card II) card contained in the 828A/828AF can be utilized to access the vendor-definable DS-3 X-bit embedded within the DS-3 masterframe structure to transmit and receive serial TELTRAC information.

5. FEATURES AND OPTIONS

Equipment Size

5.01 Occupying only 12.25 inches, FOX-2 T-HUB requires only seven standard rack mount spaces to provide the transmission facilities for up to seven 1:1 protected DS-2 optical spans. Consequently, the FOX-2 T-HUB occupies only 27% of the vertical rack mount space required by four FOX-2R units to support an equivalent transmission capacity. Up to four FOX-2 T-HUB units can be mounted along with a Fuse and Alarm Panel and an air baffle/fiber management unit in a single 23-inch wide, 7-foot bay.

Equipment Upgrade

5.02 FOX-2 T-HUB can be configured for additional DS-2 optical transmission spans without affecting existing optical links. Channel expansion is accomplished by simply adding Low-Speed Interface and associated LTU circuit cards for each new optical span as required.

5.03 As network requirements increase in complexity, embedded DS-3 high-speed circuitry allows the FOX-2 T-HUB to be conveniently split into two 828A MX-3 multiplexers for direct DS-3 coaxial cable interface to high-speed fiber-optic transmission equipment. With the addition of an optical XCVR (Transceiver) card(s), FOX-2 T-HUB can be converted into two 828AF 45 Mb/s fiber-optic terminals, suitable for T1, T1C, and/or T2 low-speed channel interface to remote 828AF/828AFXT terminals or the DOX (Dual Optical Transceiver) card of an M560 terminal unit.

Selectable Low-Speed Interface

5.04 FOX-2 T-HUB can be equipped for T1 (1.544 Mb/s) and/or T1C (3.152 Mb/s) low-speed interface in groups of four T1 or two T1C channels. Fully loaded, the unit supports up to an equivalent of 28 T1 channels.

Fully Redundant Protection

5.05 All M12 and M23 multiplexing, high-speed interface and optical transmission circuit cards are 1:1 protected with redundant circuitry. Load sharing power supplies in each shelf are likewise 1:1 protected and can be driven from dual isolated office voltage sources via the Fuse and Alarm Panel. Control MPUs monitor the operational status of all circuits and initiate automatic protection switching to restore service. To perform routine equipment maintenance, FOX-2 T-HUB can be locally switched to standby circuitry, either manually via the Control MPU or Manual Control Interface card, or remotely from a master terminal site via TELTRAC.

Comprehensive Fault Monitoring

5.06 FOX-2 T-HUB is controlled by two microprocessors monitoring low-speed interface and LTU equipment shelves for the fault conditions or degraded unit-level performance. Hardware failures result in LED indications on the faulty card.

Alarm Lockout

5.07 Through the use of lockout software sympathetic alarms, which may mask the source of failure, are suppressed. This prevents the generation of multiple alarms during equipment failure, and thereby assists in efficient fault isolation.

Remote Terminal Functions

5.08 A serial communications channel between the local FOX-2 T-HUB MPU and the remote FOX-2 MPU is used to transmit fault and status information between the two units relating to the operation of the optical span. EXT REM (External Remote) LEDs on each LTU card illuminate in conjunction with the BAY FAULT lamp on the Fuse and Alarm Panel to indicate the presence of any unit-level or DS-2 span-level failure associated with individual far-end FOX-2/FOX-2R unit(s).

Internal DS-2 Loopback Testing

5.09 Loopback circuitry incorporated into each LTU circuit card allows each DS-2 optical span to be looped back at the DS-2 electrical level in the equipment and span directions, simultaneously. This test function can be utilized by technicians working at opposite ends of a FOX-2 T-HUB and FOX-2/FOX-2R DS-2 optical span to expediently isolate the faulty unit from the network without extensive end-to-end system testing and troubleshooting.

Fuse and Alarm Panels

5.10 The rack-mounted ACX025 Fuse and Alarm Panel (see Figure 1-3) provides up to 12 protected fused power lines (two protected lines per T-HUB) for up to four FOX-2 T-HUB units. Additionally, the panel provides remote alarm and TELTRAC interface via wire-wrap pin blocks and connectors, respectively. BAY, FUSE, ACO (Alarm Cutoff), INT FUSE, and REMOTE alarm indicator lights are provided for unit-level fault indication. Relays are provided for visual and audible MAJOR and MINOR alarms. FUSE, ACO, and REMOTE closures are available as single contacts.

5.11 In system applications not requiring MAJOR/MINOR remote fault reporting, an ACX043 Fuse and Alarm Panel (See Figure 1-4) can be substituted as a cost-effective alternative to provide up to six protected power feeds to support multiple rack-mounted FOX-2 T-HUB units.

External Alarm Reporting

5.12 Major and minor fault indications in response to equipment failure can be coupled to visual and audible alarm reporting equipment via a Form-A relay contact closure. Since separate microprocessors monitor the Low-Speed Interface and LTU sections of the FOX-2 T-HUB, major and minor fault conditions for electrical and/or optical failures can be uniquely reported via relay contact closure.

5.13 Form C BAY and FUSE fault conditions can likewise be coupled via wire-wrap terminals located on the ACX025 Fuse and Alarm Panel. An ACO function on each MPU silences audible major or minor relay contact closure during equipment maintenance. Relay contacts dedicated to visual alarm reporting functions remain unaffected during alarm cutoff.

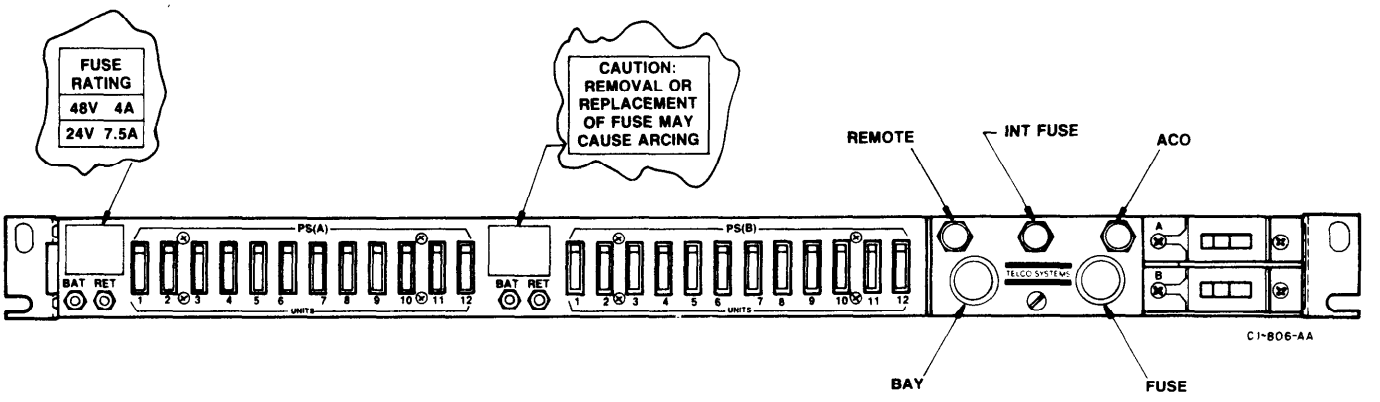

Figure 1-3. ACX025 Fuse and Alarm Panel

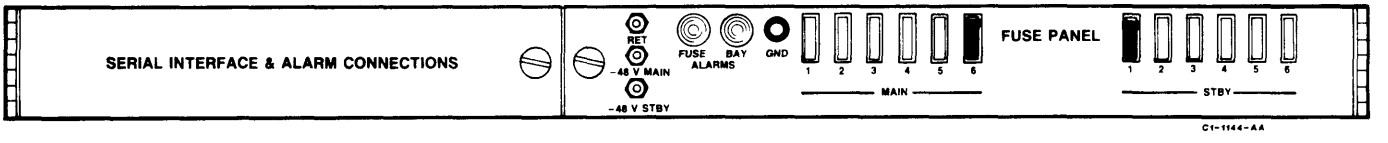

Figure 1-4. ACX043 Fuse and Alarm Panel

Maintenance Interface Card

5.14 Through the use of a Maintenance Interface card (see Figure 1-5), replacement T1/T1C Low-Speed Interface cards can be tested prior to in-service operation. When set to the TEST mode position, an off-line M12 MULDEM DS-2 loopback is performed. A pair of test jacks, incorporated into the Maintenance Interface card, allows T1 or T1C data integrity measurement using external digital transmission test equipment. When set to the NORMAL position, the receive M12 MULDEM circuits of the off-line Low-Speed Interface card are bridged to on-line data traffic to ensure system compatibility prior to on-line use.

Manual Control Interface Card

5.15 The Manual Control Interface card is an I/O (Input/Output) board, which allows immediate and direct access to the Control MPU card. This access is used to initiate testing functions, and provide status through interrogation of the local and remote terminals.

Remote Monitoring System

5.16 The Control MPU card interfaces with a TELTRAC network. TELTRAC provides comprehensive network remote alarm and status reporting. Diagnostic fault isolation and remote-controlled switching are also provided.

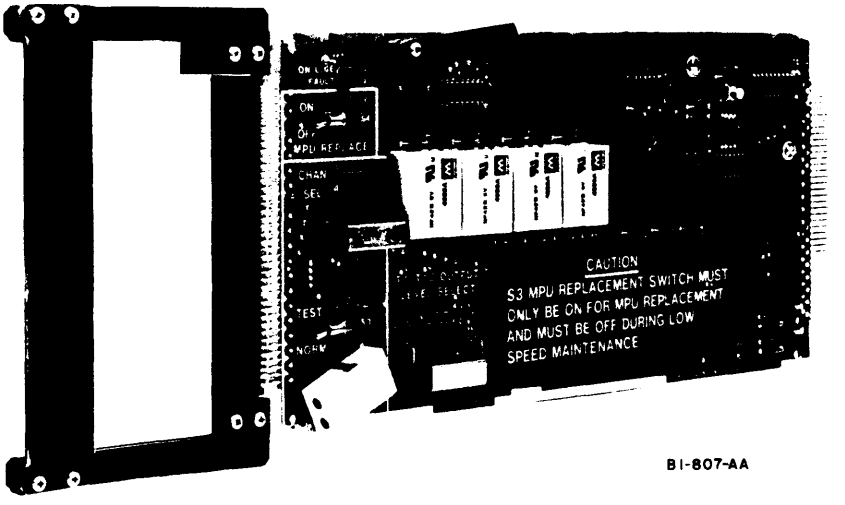

Figure 1-5. Maintenance Interface Card

6. SYSTEM APPLICATIONS

FOX-2 T-HUB Terminal Fiber Hub Distribution Application

6.01 Figure 1-6 illustrates the FOX-2 T-HUB as a fiber distribution hub from a central office or other wire plant location used to provide T1 transmission service to multiple remote locations. Since the unrepeatered distance of a DS-2 optical span (8 to 10 km) far exceeds the typical T1 regenerator spacing of 1.83 km (6000 ft), fiber-optics prove to be simpler to install, more flexible and more cost-effective for low-capacity interoffice T1 transmission than networks based exclusively on T1/T1C metallic transmission technologies.

6.02 In the application illustrated, FOX-2 T-HUB is used as a DS-2 optical distribution interface from a central office switch, channel banks, and/or existing repeatered T1 spans to up to seven remote customer premise locations.

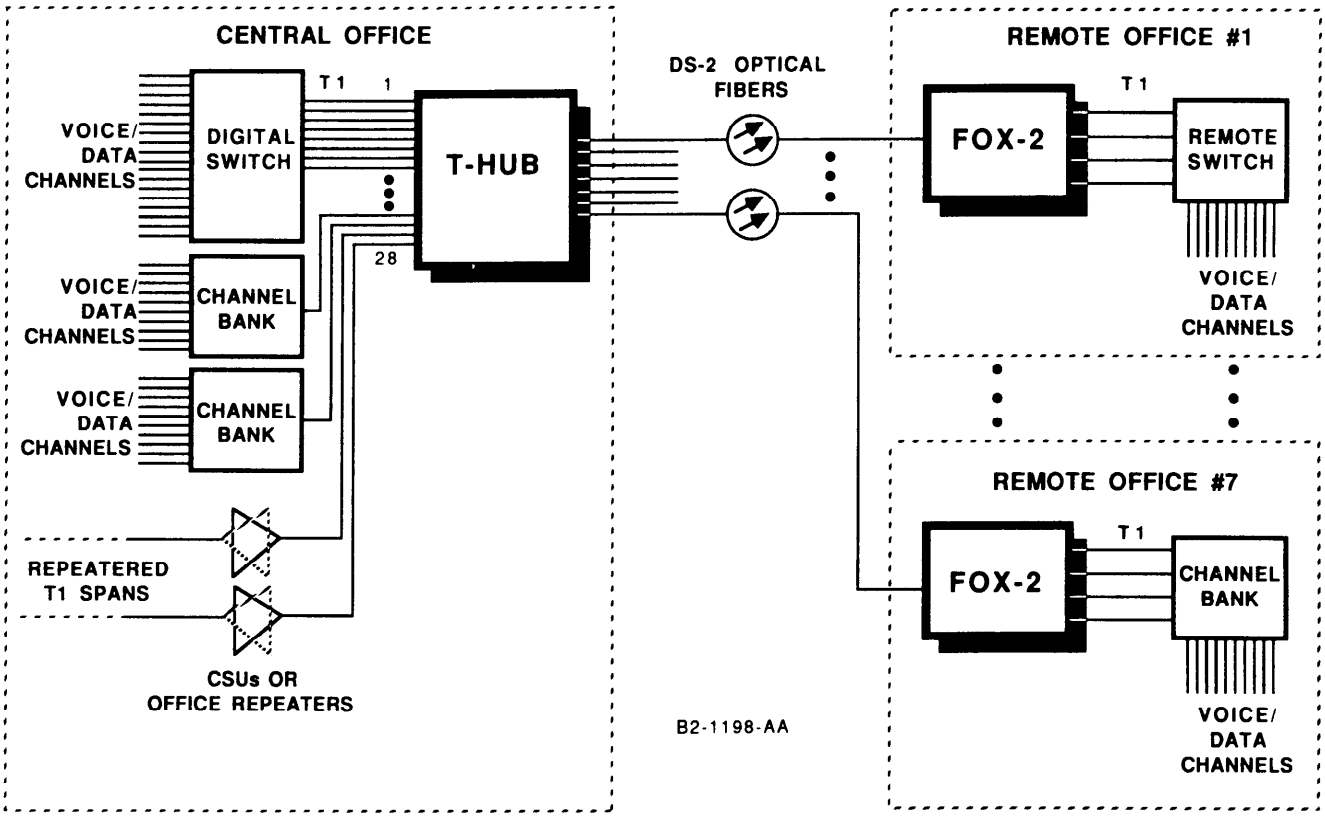

Figure 1-6. FOX-2 T-HUB Terminal Fiber Hub Distribution Application

FOX-2 T-HUB Drop/Insert Application

6.03 Individual DS-2 channel pairs from a single FOX-2 T-HUB or two separate units can be utilized as a DS-2 fiber-optic span interface to a digital switch or DCS (Digital Cross-connect System), as illustrated in Figure 1-7. Local voice and data service can be extracted from individual T1 channels, as required, allowing all interoffice trunking to be accomplished via 6 Mb/s optical span transmission. Direct-connection channels can be either bypassed around the switch, via DSX-1 patches, and/or accessed for local unsorted voice and data service, via T1 drop and insert equipment such as Telco Systems DDI-24 drop and insert unit.

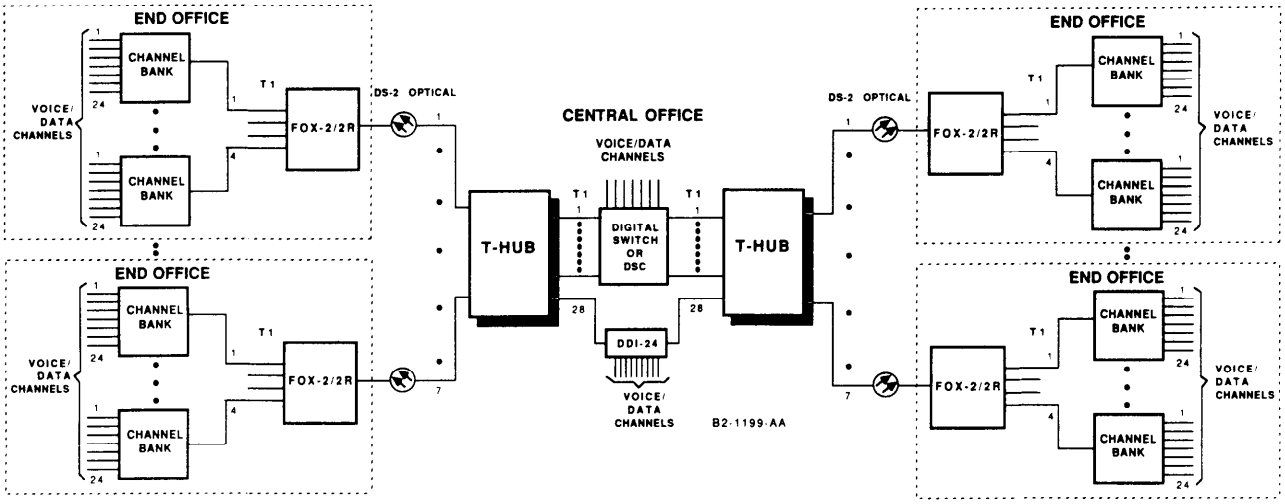

Figure 1-7. FOX-2 T-HUB Drop/Insert System Application