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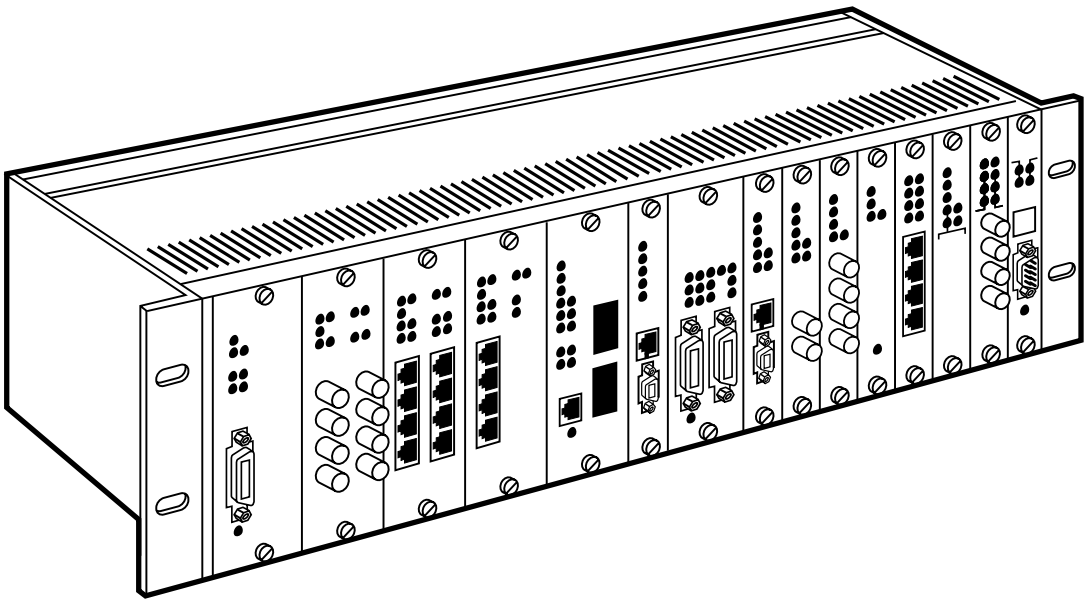
BLACK BOX®
NETWORK SERVICES

SEPTEMBER 1997

LT0005A-RR2	LT0005A-T4SD	LT0005A-MLB
LT0005A-RRNM	LT0005A-T4SU	LT0005A-FTB
LT0005A-TEDS	LT0005A-T4U	LT0005A-EPAUI
LT0005A-TEDU	LT0005A-TCR	LT0005A-EPRAUI
LT0005A-T2FS	LT0005A-TST	LT0005A-4TFL
LT0005A-T2FSA	LT0005A-TIO	LT0005A-EP8T
LT0005A-T4AS	LT0005A-TFC	LT0005A-EPR8T
LT0005A-T4ASD	LT0005A-T1ST	LT0005A-IB
LT0005A-T4AU	LT0005A-T2ST	LT0005A-CMLIB
LT0005A-T4CX	LT0005A-TXC	LT0005A-TJA
LT0005A-T4S	LT0005A-8D35	LT0005A-PS1

Modular Intelligent Hub



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FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS

This equipment generates, uses, and can radiate radio-frequency energy, and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

INSTRUCCIONES DE SEGURIDAD (Normas Oficiales Mexicanas Electrical Safety Statement)

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.
12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
    - A: El cable de poder o el contacto ha sido dañado; u
    - B: Objectos han caído o líquido ha sido derramado dentro del aparato; o
    - C: El aparato ha sido expuesto a la lluvia; o
    - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
    - E: El aparato ha sido tirado o su cubierta ha sido dañada.

TRADEMARKS USED IN THIS MANUAL

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1. Specifications

1.1 Hub Enclosure with Power Supply (LT0005A-RR2 with LT0005A-PS1)

Speed—16 or 4 Mbps

Temperature—32 to 104°F (0 to 40°C)

Humidity—Up to 90%, noncondensing

Radiation Suppression—Complies with FCC part 15, subpart B, class A

Indicators—(4) LEDs for included CML Module: PS1 ON and FLT, PS2 ON and FLT

Connectors—(1) DB25 female (management, on rear), (1) IEC Power connector

Power—90 to 260 VAC, 47 to 63 Hz, 100 VA max. (fully loaded system), 200 VA max. (High Power, fully loaded system); *AC Connection:* IEC 3-prong power socket; *Controls:* ON/OFF Power Switch; *Overload Protection:* Integral 2A fuse, One or two power supplies, P/N LT0005A-PS1

Size—*Chassis:* 5.2"H (3U) x 19"W x 9.6"D (13.3 x 48.3 x 24.8 cm); *Power Supply:* 5.1"H x 6.3"D (13 x 16 cm)

Weight—9.3 lb. (4.2 kg) (includes one power supply and CML/NM card)

1.2 Lobe Access Modules

1.2.1 Four-Lobe Active Module with STP and Dual Slot (LT0005A-T4AS)

LAN Type—Token Ring

Hardware Type—Hub/MAU

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, 16M, 4M, and (1) for each lobe insert

Connectors—(4) DB9 female (4 nodes)

Power—1.2 A (max.) at 5 VDC

Size—5"H x 1.6"W x 6.7"D (12.7 x 4 x 17 cm)

Weight—7 oz. (198 g)

1.2.2 Four-Lobe Active Module with UTP Connector (LT0005A-T4AU)

LAN Type—Token Ring

Hardware Type—Hub/MAU

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps, switch-selectable

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, 16M, 4M, and (1) for each lobe insert

Connectors—(4) RJ-45 female

Power—1.2 A (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.2.3 Four-Lobe Active Module with STP and Single Slot (LT0005A-T4ASD)

LAN Type—Token Ring

Hardware Type—Hub/MAU

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps (switch-selectable)

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, 16M, 4M, and (1) for each lobe insert

Connectors—(2) DB9 female (4 nodes)

Power—1.2 A (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.2.4 Four-Lobe Active Module with Screened Twisted Pair and Single Slot (LT0005A-T4ASU)

LAN Type—Token Ring

Hardware Type—Hub/MAU

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps (switch-selectable)

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0-40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, 16M, 4M, and (1) for each lobe insert

Connectors—(2) RJ-45 female

Power—1.2 A (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.2.5 Two-Lobe Extended Distance with STP (LT0005A-TEDS)

LAN Type—Token Ring

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(4) LEDs: PWR, MNG, 1, 2

Connectors—(2) DB9 female

Power—200 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.2.6 Two-Lobe Extended Distance with Screened UTP (LT0005A-TEDU)

LAN Type—Token Ring

Protocol—Token Ring

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90% noncondensing

Indicators—(4) LEDs: PWR, MNG, 1, 2

Connectors—(2) RJ-45 female

Power—200 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.2.7 Two-Lobe Extended Distance with UTP (LT0005A-EDU)

LAN Type—Token Ring

Protocol—Token Ring

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90% noncondensing

Indicators—(4) LEDs: PWR, MNG, 1, 2

Connectors—(2) RJ-45 female

Power—200 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.2.8 Two-Lobe Fiber Module with SMA Connector (LT0005A-T2F)

LAN Type—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(5) LEDs: PWR, MNG, 1, 2, SAT

Connectors—(2) SMA

Power—500 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.8 x 2 x 17 cm)

Weight—8 oz. (227 g)

1.2.9 Two-Lobe Fiber Module with ST Connector (LT0005A-T2FS)

LAN Type—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(5) LEDs: PWR, MNG, 1, 2, SAT

Connectors—(2) ST

Power—500 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.2.10 Two-Lobe Fiber Module with SMA Connectors and Satellite Option (LT0005A-T2FSA)

LAN Type—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(5) LEDs: PWR, MNG, 1, 2, SAT

Connectors—(2) SMA

Power—1300 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.8 x 2 x 17 cm)

Weight—8 oz. (227 g)

1.2.11 Two-Lobe Fiber Module with ST Connectors and Satellite Option (LT0005A-TF1300)

LAN Type—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(5) LEDs: PWR, MNG, 1, 2, SAT

Connectors—(2) SMA

Power—1300 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.8 x 2 x 17 cm)

Weight—8 oz. (227 g)

1.2.12 Four-Lobe Module with Coax Connector (LT0005A-T4CX)

LAN Type—Token Ring

Hardware Type—Hub/MAU

Protocol—Token Ring

Hardware Data Rate—16 or 4 Mbps switch-selectable

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(6) LEDs: PWR, MNG, and (1) insert for each lobe port

Connectors—(4) coax

Power—350 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.2.13 Four-Lobe Module with STP Connector, Double Slot (LT0005A-T4S)

LAN Type—Token Ring

Hardware Type—Hub/MAU

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps, switch-selectable

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(6) LEDs: PWR, MNG, and (1) insert for each port

Connectors—(4) DB9 female

Power—200 mA (max.) at 5 VDC

Size—5"H x 1.6"W x 6.6"D (12.8 x 4 x 17 cm)

Weight—7 oz. (198 g)

1.2.14 Four-Lobe Module with UTP Connector (LT0005A-T4U)

LAN Type—Token Ring

Hardware Type—Hub/MAU

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps (switch-selectable)

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, 16M, 4M, and (1) for each lobe insert

Connectors—(4) RJ-45 female

Power—200 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.2.15 Four-Lobe Module with STP Connector, Single Slot (LT0005A-T4SD)

LAN Type—Token Ring

Hardware Type—Hub/MAU

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps (switch-selectable)

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, 16M, 4M, and (1) for each lobe insert

Connectors—(2) DB9 female (4 nodes)

Power—200 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.2.16 Four-Lobe Module with Shielded RJ-45 (LT0005A-T4SU)

LAN Type—Token Ring

Hardware Type—Hub/MAU

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps (switch-selectable)

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, 16M, 4M, and (1) for each lobe insert

Connectors—(4) RJ-45 female

Power—200 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3 Ring-In/Ring-Out Modules

1.3.1 Ring In/Ring Out Module (LT0005A-TIO)

LAN Type—Token Ring

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(5) LEDs: PWR, MNG, FLT, RI, RO

Connectors—(1) RJ-45 female, (1) DB9 female

Power—60 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.2 One-Channel Fiberoptic Converter with SMA Connector (LT0005A-TFC)

LAN Type—Token Ring

Hardware Type—Hub/MAU

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, (2) FLT, (2) RI, (2) RO

Connectors—(2) SMA fiber

Power—*Input Voltage:* Powered by chassis bus

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.3 One-Channel Fiberoptic Converter with ST Connector (LT0005A-T1ST)

LAN Type—Token Ring

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, (2) FLT, (2) RI, (2) RO

Connectors—(2) ST fiber

Power—*Input Voltage:* Powered by chassis bus

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.4 One-Channel Fiberoptic Converter with ST Connector (LT0005A-T11300)

LAN Type—Token Ring

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, (2) FLT, (2) RI, (2) RO

Connectors—(2) ST fiber

Power—1300 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.5 Two-Channel Fiberoptic Converter with SMA Connector (LT0005A-T2SM)

LAN Type—Token Ring

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, (2) FLT, (2) RI, (2) RO

Connectors—(4) SMA fiber

Power—*Input Voltage:* Powered by chassis bus

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.6 Two-Channel Fiberoptic Converter with ST Connector (LT0005A-T2ST)

LAN Type—Token Ring

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, (2) FLT, (2) RI, (2) RO

Connectors—(4) ST fiber

Power—*Input Voltage:* Powered by chassis bus

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.7 Two-Channel Fiberoptic Converter with ST Connector (LT0005A-T21300)

LAN Type—Token Ring

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, (2) FLT, (2) RI, (2) RO

Connectors—(4) ST fiber

Power—1300 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.8 4/16 Mbps Copper Repeater (LT0005A-TCR)

LAN Type—Token Ring

Hardware Type—Repeater

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(7) LEDs: PWR, MNG, FLT, 4MB, 16MB, RI, RO

Connectors—(1) RJ-45 female, (1) DB9 female

Power—550 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.9 4/16 Mbps Fiberoptic Repeater with SMA Connector (LT0005A-TFR)

LAN Type—Token Ring

Hardware Type—Repeater

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(7) LEDs: PWR, MNG, FLT, 4MB, 16MB, RI, RO

Connectors—(2) SMA fiber

Power—650 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.10 4/16 Mbps Fiberoptic Repeater with ST Connector (LT0005A-TST)

LAN Type—Token Ring

Hardware Type—Repeater

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(7) LEDs: PWR, MNG, FLT, 4MB, 16MB, RI, RO

Connectors—(2) ST fiber

Power—650 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.11 4/16 Mbps Fiberoptic Repeater with ST Connector (LT0005A-T1300)

LAN Type—Token Ring

Hardware Type—Repeater

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(7) LEDs: PWR, MNG, FLT, 4MB, 16MB, RI, RO

Connectors—(2) ST fiber

Power—1300 mA (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.3 oz. (150 g)

1.3.12 Token Ring to Coax Converter (LT0005A-TXC)

LAN Type—Token Ring

Hardware Type—Balun

Protocol—Token Ring

Hardware Data Rate—4 and 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90% noncondensing

Indicators—None

Connectors—BNC w/ 93-Ω coax cable to balun with DB9 connector

Power—N/A

1.4 Ethernet Modules

1.4.1 Four Port 10BASE-T Module with AUI Port (LT0005A-EPAUI)

LAN Type—Ethernet

Link Length—10BASE-T: 393 ft. (120 m) over 24 AWG UTP or Screened UTP, AUI: 164 ft. (50 m)

Switches—MAN, SA

Hardware Data Rate—10 Mbps

Standards—IEEE 802.3

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—0 to 90%, noncondensing

Indicators—(8) LEDs: PWR, MNG, SA, C, R, 1:4, PWR (AUI), STAT (AUI)

Connectors—(4) shielded RJ-45, (1) DB15 female AUI

Power—2.5 A (max.) at 5 VDC

Size—5"H x 1.6"W x 6.7"D (12.8 x 4 x 17 cm)

Weight—9.5 oz. (269 g)

1.4.2 Four Port 10BASE-T Module with AUI Port w/o Ethernet Backplane (LT0005A-EPRAUI)

LAN Type—Ethernet

Protocol—Ethernet

Hardware Data Rate—10 Mbps

Standards—IEEE 802.3

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: PWR, MNG, C, R, 1:4, PWR (AUI), STAT (AUI)

Connectors—(4) shielded RJ-45, (1) DB15 female

Power—2.5 A (max.) at 5 VDC

Size—5"H x 1.6"W x 6.7"D (12.8 x 4 x 17 cm)

Weight—9.5 oz. (269 g)

1.4.3 Four Port 10BASE-T Module with Two 10BASE-FL Ports (LT0005A-EPFL2)

LAN Type—Ethernet

Protocol—Ethernet

Hardware Data Rate—10 Mbps

Standards—IEEE 802.3

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: PWR, MNG, SA, C, R, 1:4, PWR (AUI), STAT (AUI)

Connectors—(4) shielded RJ-45, (1) DB15 female

Power—2.5 A (max.) at 5 VDC

Size—5"H x 1.6"W x 6.7"D (12.8 x 4 x 17 cm)

Weight—9.5 oz. (269 g)

1.4.4 Four Port 10BASE-T Module with Two 10BASE-FL Ports w/o Ethernet Backplane (LT0005A-EPRFL2)

LAN Type—Ethernet

Protocol—Ethernet

Hardware Data Rate—10 Mbps

Standards—IEEE 802.3

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: PWR, MNG, C, R, 1:6

Connectors—(4) shielded RJ-45, (4) ST

Power—1.0 A (max.) at 5 VDC

Size—5"H x 1.6"W x 6.7"D (12.8 x 4 x 17 cm)

Weight—9.5 oz. (269 g)

1.4.5 Four Port 10BASE-FL Module (LT0005A-4TFL)

LAN Type—Ethernet

Protocol—Ethernet

Hardware Data Rate—10 Mbps

Standards—IEEE 802.3

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: PWR, MNG, C, R, 1:6

Connectors—(4) shielded RJ-45, (4) ST

Power—1.0 A (max.) at 5 VDC

Size—5"H x 1.6"W x 6.7"D (12.8 x 4 x 17 cm)

Weight—9.5 oz. (269 g)

1.4.6 Eight Port 10BASE-T Module (LT0005A-EP8T)

LAN Type—Ethernet

Protocol—Ethernet

Hardware Data Rate—10 Mbps

Standards—IEEE 802.3

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: PWR, MNG, SA, C, R, 1:8

Connectors—(8) shielded RJ-45

Power—0.6 A (max.) at 5 VDC

Size—5"H x 1.6"W x 6.7"D (12.8 x 4 x 17 cm)

Weight—9.5 oz. (269 g)

1.4.7 Eight Port 10BASE-T Module w/o Ethernet Backplane (LT0005A-EPR-8T)

LAN Type—Ethernet

Protocol—Ethernet

Hardware Data Rate—10 Mbps

Standards—IEEE 802.3

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: PWR, MNG, SA, C, R, 1:8

Connectors—(8) shielded RJ-45

Power—0.6 A (max.) at 5 VDC

Size—5"H x 1.6"W x 6.7"D (12.8 x 4 x 17 cm)

Weight—9.5 oz. (269 g)

1.5 Router/Bridge Modules

1.5.1 Token Ring Extender Module, Two Link V.35 (LT0005A-8D35)

LAN Type—Token Ring

Hardware Type—Bridge

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps (selectable)

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: PWR, MNG, READY, 4 Mbps, 16 Mbps, MAIN, REMOTE, LAN TX, LAN RX, LAN ERR, LINK TX, LINK RX, LINK ERR

Power—1.0 A (max.) at 5 VDC

Size—5:H x 1.6"W x 6.7"D (12.8 x 4 x 17 cm)

Weight—13.4 oz. (380 g)

1.5.2 Token Ring Local Bridge (LT0005A-MLB)

LAN Type—Token Ring

Hardware Type—Bridge

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: Power, Ready, MNG, MAIN, SEC, For each LAN: 4M, 16M, TX, RX, ERR

Connectors—(1) RJ-45 female

Power—1.5 A (max.) to 5 VDC

Size—5”H x 1.6”W x 6.7”D (12.8 x 4 x 17 cm)

Weight—12.3 oz. (349 g)

1.5.3 Token Ring Local Bridge (LT0005A-MLBM)

LAN Type—Token Ring

Hardware Type—Bridge

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: Power, Ready, MNG, MAIN, SEC, For each LAN: 4M, 16M, TX, RX, ERR

Connectors—(1) RJ-45 female

Power—1.5 A (max.) to 5 VDC

Size—5"H x 1.6"W x 6.7"D (12.8 x 4 x 17 cm)

Weight—12.3 oz. (349 g)

1.5.4 Token Ring to FDDI Bridge (LT0005A-FTB)

LAN Type—Token Ring, FDDI

Hardware Type—Bridge

Hardware Data Rate—100 Mbps (FDDI), 4 or 16 Mbps (Token Ring)

Standards—ANSI X3T9.5 SMT Version 7.3 (FDDI), IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(13) LEDs: PWR, MNG, FLT, THR, WRAP-A, WRAP-B, ISO, (2) OK, (2) LOAD, ACTIVE, 16M, 4M

Connectors—FDDI: Duplex SC

Power—3.0 A (max.) at 5 VDC

Size—5"H x 1.6"W x 6.7"D (12.8 x 4 x 17 cm)

Weight—12 oz. (349 g)

1.6 System Modules

1.6.1 Jitter Attenuator (LT0005A-TJA)

LAN Type—Token Ring

Protocol—Token Ring

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—(7) LEDs: PWR, MNG, FLT, ON , OFF, 4M, 16M

Connectors—None

Power—*Input Voltage:* Powered by chassis bus

Size—5"H x 0.8"W x 6.7"D (12.7 x 2 x 17 cm)

Weight—5.5 oz. (156 g)

1.6.2 Common Logic Module (LT0005A-RR-NM)

LAN Type—Token Ring

Protocol—Token Ring

Bit Rate—2.4 to 19.2 kbps selectable

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: PS-1 ON, PS-1 FLT, PS-2 ON, PS-2 FLT

Connectors—None

1.6.3 In-Band Management Agent Module for Token Ring (LT0005A-IB)

LAN Type—Token Ring

Protocol—Token Ring

Hardware Data Rate—4 or 16 Mbps, switch-selectable

Standards—IEEE 802.5

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: PWR, MNG, INS, FLT, 4M, 16M

Connectors—None

Power—1 A (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.8 x 2 x 17 cm)

Weight—11.8 oz. (335 g)

1.6.4 In-Band Management Agent Module for Ethernet (LT0005A-CMLIB)

LAN Type—Ethernet

Protocol—Ethernet

Hardware Data Rate—10 Mbps

Standards—IEEE 802.3

Operating Temperature—32 to 104°F (0 to 40°C)

Operating Humidity—Up to 90%, noncondensing

Indicators—LEDs: PWR, MNG, RDY, FLT

Connectors—None

Power—0.5 A (max.) at 5 VDC

Size—5"H x 0.8"W x 6.7"D (12.8 x 2 x 17 cm)

Weight—9.5 oz. (269 g)

2. Introduction

2.1 Description

The Modular Intelligent Hub is a highly compact Token Ring/Ethernet/FDDI connectivity center. It supports Token Ring networks at 4 and 16 Mbps, Ethernet networks at 10 Mbps, and FDDI networks at 100 Mbps. The system provides a modular approach to the implementation of IEEE 802.5 and IEEE 802.3 LANs.

Shielded/unshielded or screened twisted pair, fiberoptic, and coaxial cabling are supported for Token Ring networks, while 10BASE-T, 10BASE-FL, and AUI are supported for Ethernet networks.

The Hub combines a highly flexible, modular design with the capability to create a system that can easily adapt to changing user requirements. The system is ideally suited for Token Ring and Ethernet installations of any size.

Diagnostic LEDs on each module indicate power, management and activity status. All modules can be inserted and removed under hot plug in/plug out conditions without network disruption.

The Hub can be installed as either a single centralized access center, capable of providing up to 80 Token Ring/Ethernet port connections, or as part of a larger network, through connection of additional hubs.

Data integrity is ensured at the port, module and segment level. This is provided through automatic fault detection, bypass, and recovery. Full backup support can be extended to the connectivity center through an optional redundant power supply.

Internetworking support is integrated into the hub to provide connectivity to local and remote LANs. The elementary bridge modules perform MAC level filtering and forwarding that enable workgroups to connect to the backbone either locally or remotely via a WAN link.

Connection to an FDDI backbone is supported by using the FTB Token Ring to FDDI translation bridge. This dual-slot module plugs into the Hub backplane and connects to the FDDI from its front panel.

Improved network performance is provided through a special jitter-attenuator module that increases the number of stations per ring and simplifies network design.

Multiple rings can coexist as independent LANs within the same Hub.

The Hub accepts up to 20 modules. A proprietary Management System provides in-band (SNMP) and out-of-band network management for Ethernet and Token Ring via a user-friendly graphical interface. RADview enables complete monitoring and control of the network from a central management station.

Table 2-1 lists available modules and their properties.

Table 2-1. Modules.

Category	Module	No. of Ports	Media	Max. Distance at 16 Mbps	Operation
Lobe Access Modules	4AS	4	STP	350 m	Active
	4AU	4	UTP	180 m	Active
	4ASD	4	STP	350 m	Active
	4ASU	4	Screened TP	180 m	Active
	TEDS	2	STP	300 m	Active
	TEDU	2	Screened TP		
	EDU	2	UTP	150 m	Active
	T2F	2	Fiberoptic	3 km	Active
	T2FS	2	Fiberoptic		
	T2FSA	2	Fiberoptic		
	TF1300	2	Fiberoptic		
	T4CX	4	RG-62 Coax	100 m	Active
	T4S	4	STP	200 m	Active
	T4U	4	UTP	100 m	Passive
	T4SD	4	STP	200 m	Passive
	T4SU	4	Screened TP	100 m	Passive
	SFSAT	8 via remote LAU	UTP/STP	200 m	Active w/LAU
Ring In/Ring Out Modules	TIO	1	STP/UTP	N/A	RI/RO
	TFC	1	Fiberoptic	3 km	Converter
	T1ST	1	Fiberoptic	3 km	Converter
	T11300	1	Fiberoptic	3 km	Converter
	T2SM	1	Fiberoptic	3 km	Converter
	T2ST	1	Fiberoptic	3 km	Converter
	T21300	1	Fiberoptic	3 km	Converter
	TCR	1	STP/UTP	350 m	Repeater
	TFR	1	Fiberoptic	3 km	Repeater
	TST	1	Fiberoptic	3 km	Repeater
	T1300	1	Fiberoptic	3 km	Repeater
	TXC				Converter
Ethernet Modules	EPAUI	5	UTP/AUI	100 m	10BASE-T/AUI
	EPRAUI	5	UTP/AUI		10BASE-T/AUI
	EPFL2	6	UTP/Fiberoptic	100 m/2 km	10BASE-T/10BASE-FL
	EPRFL2	6	UTP/Fiberoptic		10BASE-T/10BASE-FL
	4FL	6	Fiberoptic	2 km	10BASE-FL
	EP8T	8	UTP	100 m	10BASE-T
	EPR8T	8	UTP		10BASE-T
Router/Bridges	8D35				
	MLB				
	MLBM				
	FTB				
System Modules	TJA				
	RR-NM				
	IB				
	CML/IB				

2.2 Centralized Network Management

The Microsoft Windows® based Management System provides in-band (SNMP) and out-of-band network management for Token Ring networks. The Management System enables complete monitoring and control of the network from a central management station. Three management agents are provided:

1. Common Logic Module CML/NM (LT0005A-RRNM) included with the LT0005A-RR2)—Provides physical monitoring and control of the Hub and modules. It also provides out-of-band serial communication with the management station. The communication link is V.24/RS-232. The interface operates multipoint up to 19.2 kbps for local and remote (modem) communication. The agent continues to provide management functions even when the network is down.

2. In-Band Management Agent Module (LT0005A-IB for Token Ring and LT0005A-CMLIB for Ethernet)—Supports SNMP protocol, enabling in-band monitoring and control from RADnet to a generic SNMP management station. When used in conjunction with the logic module, it provides advanced automatic recovery from network failure, and MAC address port security. The Module also provides alert support to IBM LAN Manager and NetView.

   Under the Management system, network problems can be easily identified, isolated, and resolved under both operational and non-operational conditions. This alleviates the necessity for local intervention, while reducing system downtime to a minimum.

The Management System operates under Microsoft Windows 3.1 and provides the following functions:

- Graphical representation of the network and modules.
- Alarms and events recording.
- Status Monitoring for modules, repeaters, lobes, and interconnecting cables.
- Forced lobe and module bypass/insertion.
- Loop to backup path control on RI and RO ports.
- Alert support to NETVIEW and IBM LAN Manager.
- In addition to supporting the Hub, the Management System also provides comprehensive central network management to other Token Ring products such as standalone Token Ring access and repeater units.

NOTE

UTP distances refer to category IV or V UTP cables such as the Black Box EYN715A and EYN737A. Distances will be shorter when a lower-level cable (such as IBM Type 3) is used.

2.3 System Configuration

2.3.1 General

There are five types of Modular Intelligent Hub Modules:

- Lobe Access modules—Active or passive, repeater
- Ring In/Ring Out modules
- System modules: Management, Jitter Attenuator
- Elementary Bridge modules
- Ethernet segment modules

Lobe access modules let you connect stations to the Token Ring using a variety of media types; Ring In/Ring Out modules enable the network to be expanded to adjacent hubs.

Ring In/Ring Out modules operate in pairs to provide typical Ring In and Ring Out connectivity to the Modular Hub.

NOTE

Ring In/Ring Out modules require that the ring's leftmost module be assigned as Ring-In and the rightmost module be assigned as Ring-Out.

System modules provide features to the entire hub/network, such as network management and jitter attenuation.

Elementary Bridge Modules connect the main and secondary LANs by only forwarding frames intended for the other LAN.

Ethernet segment modules let you add an Ethernet segment to your Token Ring LAN.

The Modular Intelligent Hub provides flexibility in network design. Typical system configurations can be broken down into the following:

- Standalone hub
- Multi-hub
- Satellite
- Mixed Hub and access units
- Multiple-ring hub

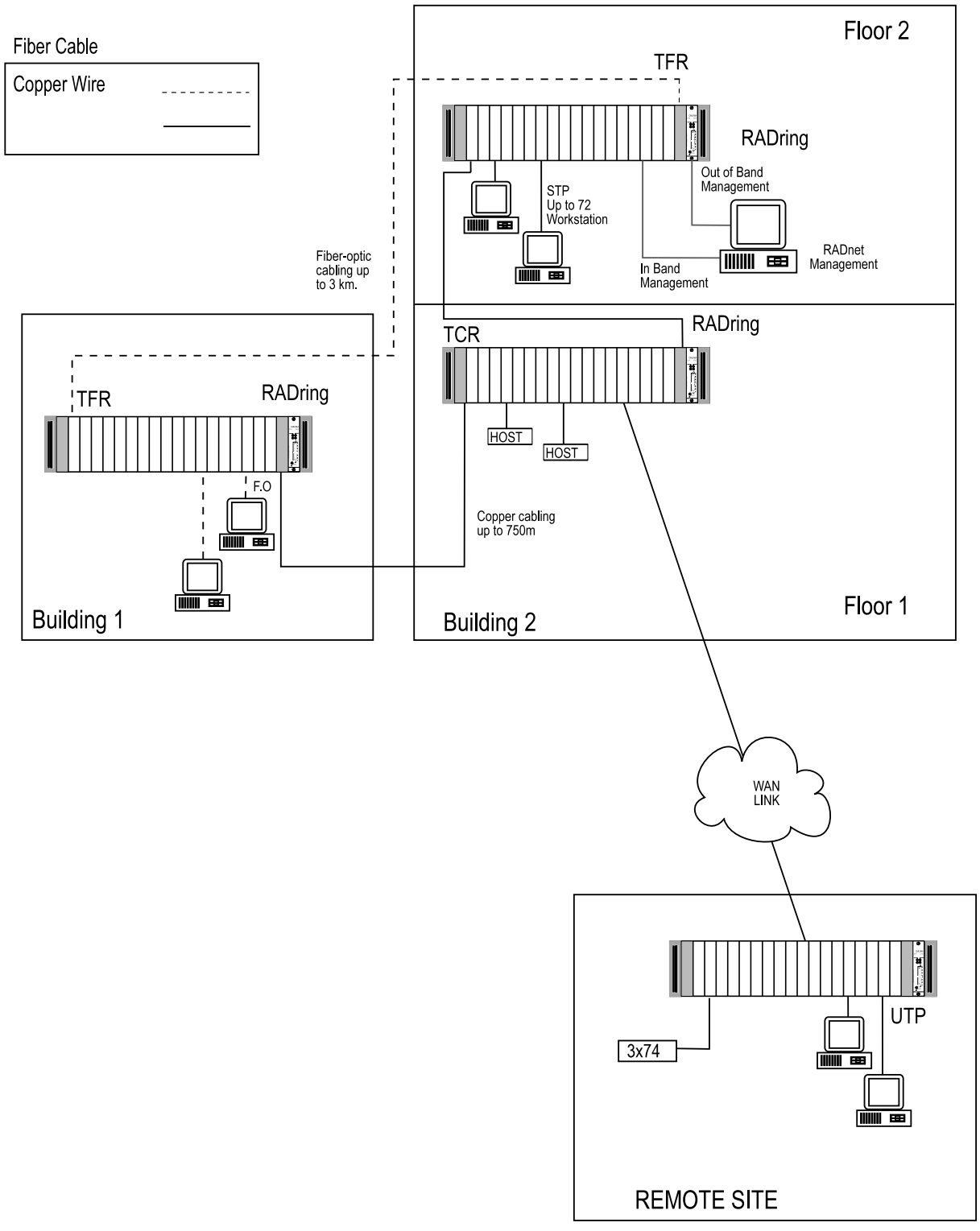

Figure 2-1. Multimedia, integrated remote connectivity, centralized management.

2.3.2 Standalone Hub Configuration

The standalone hub, installed as a single central access center, provides up to 80 Token Ring lobe connections (without RI/RO modules). In the standalone hub configuration, the Modular Intelligent Hub can function as a single active central hub (i.e., a central hub that is not connected to another TAU [Trunk Access Unit], MAU, or hub) or as multiple, separate rings through termination of access modules (see **Figure 2-2**). The hub's backup path is used to complete the ring without compromising the ring fault protection.

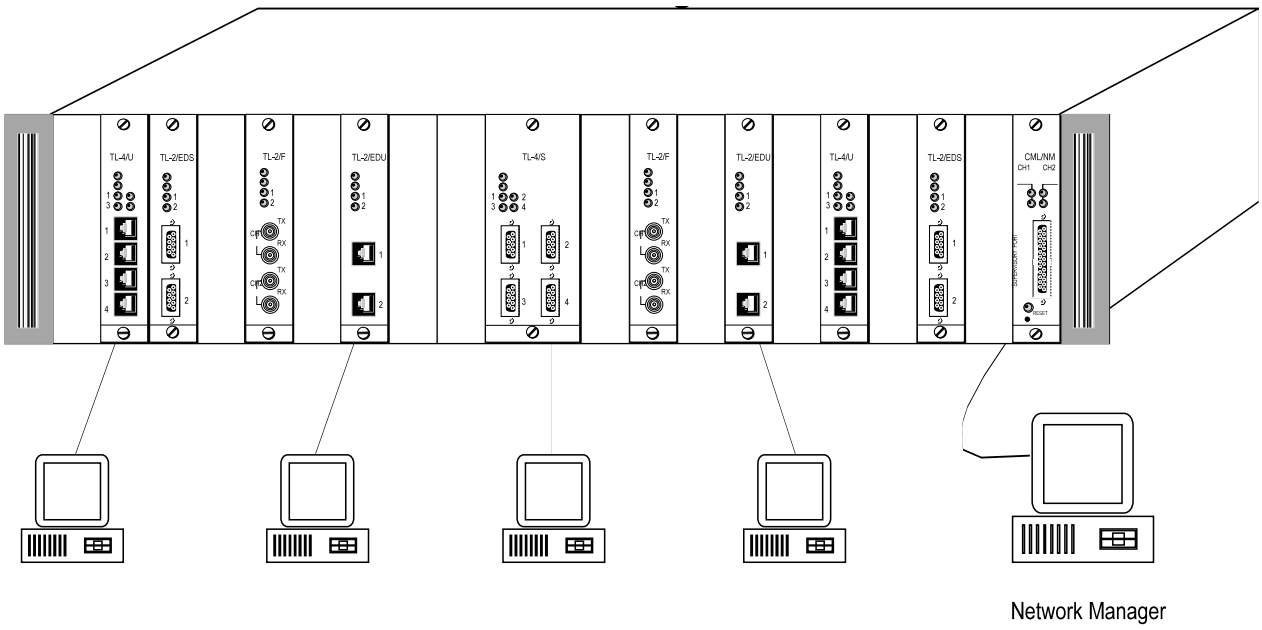

Figure 2-2. Standalone Hub Application.

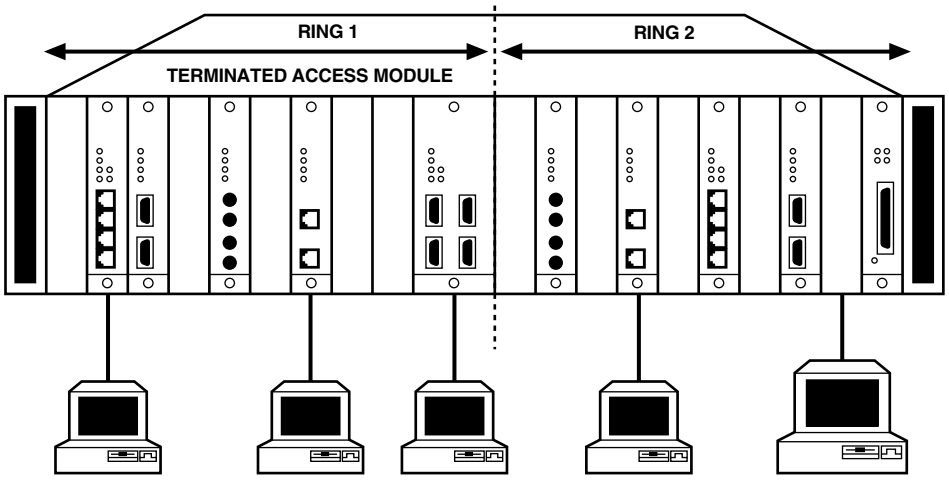

Figure 2-3. Multiple Rings in Standalone Hub.

2.3.3 Multi-Hub Configuration

The multi-hub configuration is defined as a number of hubs connected via Ring-In/Ring-Out modules, for expanding the ring size. Ring In/Ring Out modules and repeaters enable expansion of the system through connection to other hubs or TAUs. Detailed application information for each of the RI/RO and repeater modules is provided in **Chapter 3**.

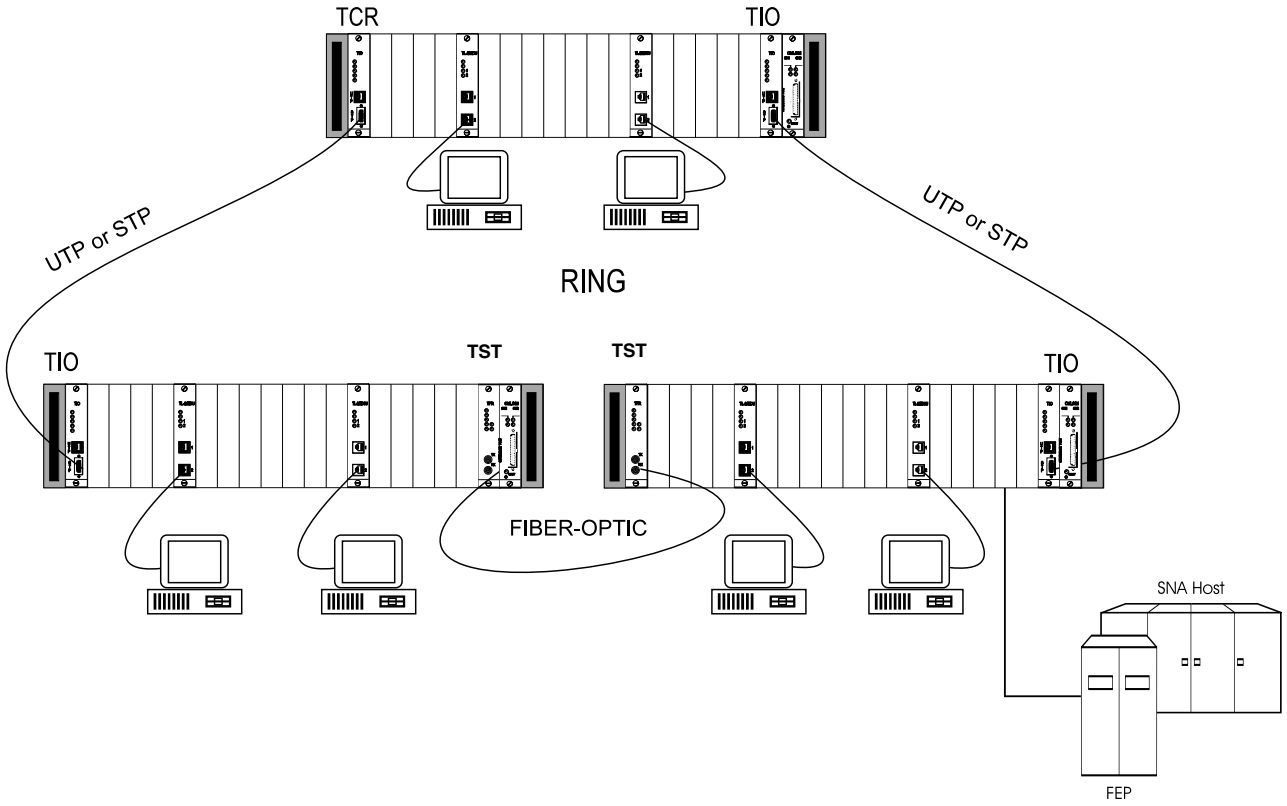

Figure 2-4. Multi-hub Application.

2.3.4 Satellite Configuration

The satellite configuration is installed as part of a larger network by connecting additional hubs as in the Multi-hub configuration. The satellite configuration lobes are used to create a star topology by connecting access units or hubs to the lobes of a central hub rather than RI/RO ports. The remaining lobes can be used to connect to the stations. The satellite configuration allows central connection of all the hubs, enabling easy management of large installations (multistory, campus, etc.). The Ring-In port of the satellite hub can be connected over UTP, STP, or fiber media, with the use of an appropriate module.

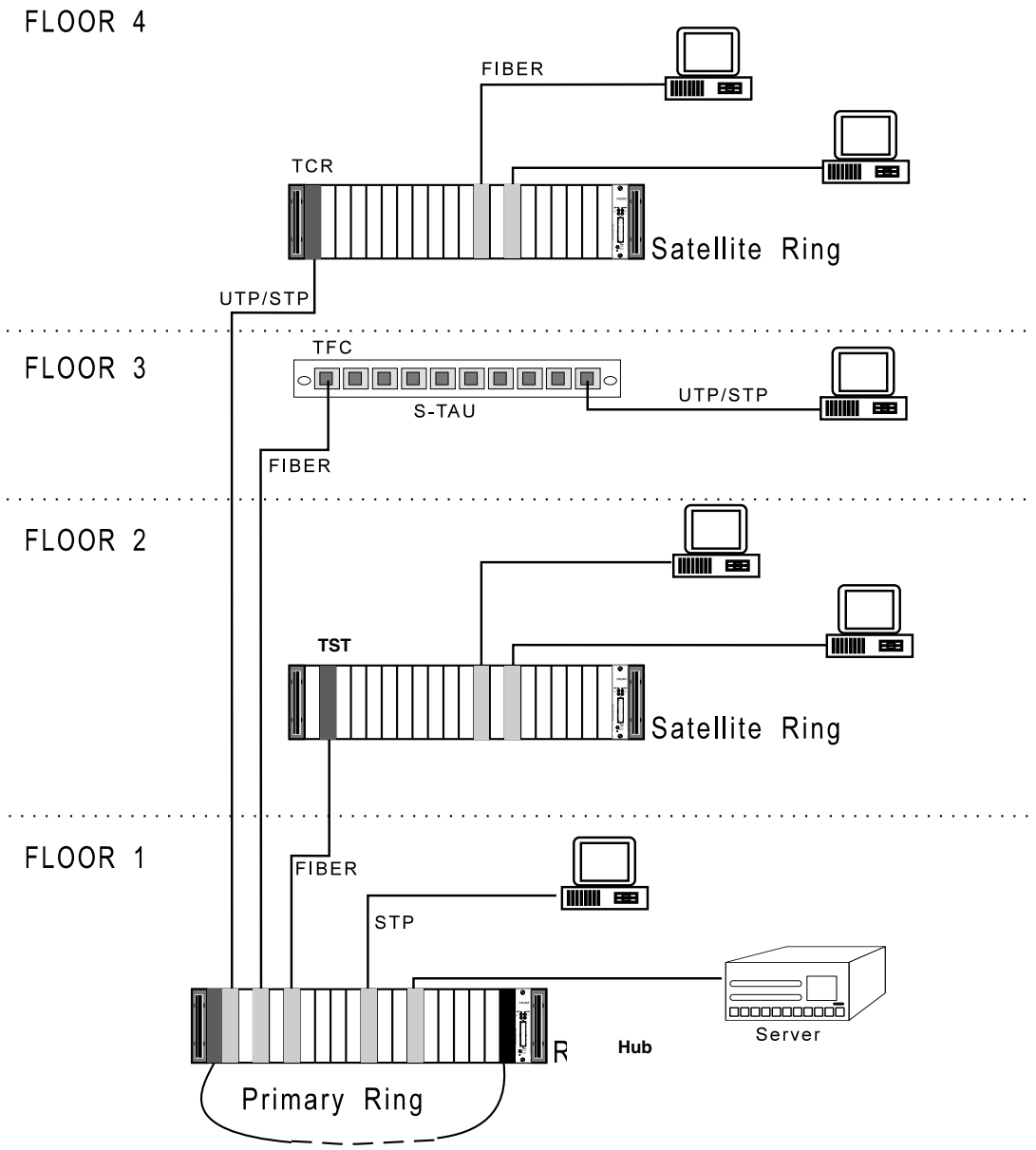

Figure 2-5. Satellite Application (Fiber, STP/UTP).

2.3.5 MIXED CONFIGURATION

The mixed configuration, consisting of the Modular Intelligent Hub and the trunk access unit, is installed as part of a large network, as in the Multi-hub and access units. This configuration is useful in applications where certain locations of the ring do not justify the placement of a hub, because a small number of workstations require connections, or in applications where you can use existing discrete access units.

The Ring In/Ring Out and repeater modules are compatible with their standalone or card versions, which are used together with access units. This compatibility allows both types of network components to co-exist in the same ring. Ring In/Ring Out and repeater modules, such as the LT0005A-TIO, TCR, TFC, T1ST, or T2ST, facilitate system expansion through interconnection to other hubs or TAUs. In a typical application, the Hub is attached to adjacent Trunk Access Units (TAUs) via repeaters or converters. A combination of fiber or copper can be used for expansion of the ring.

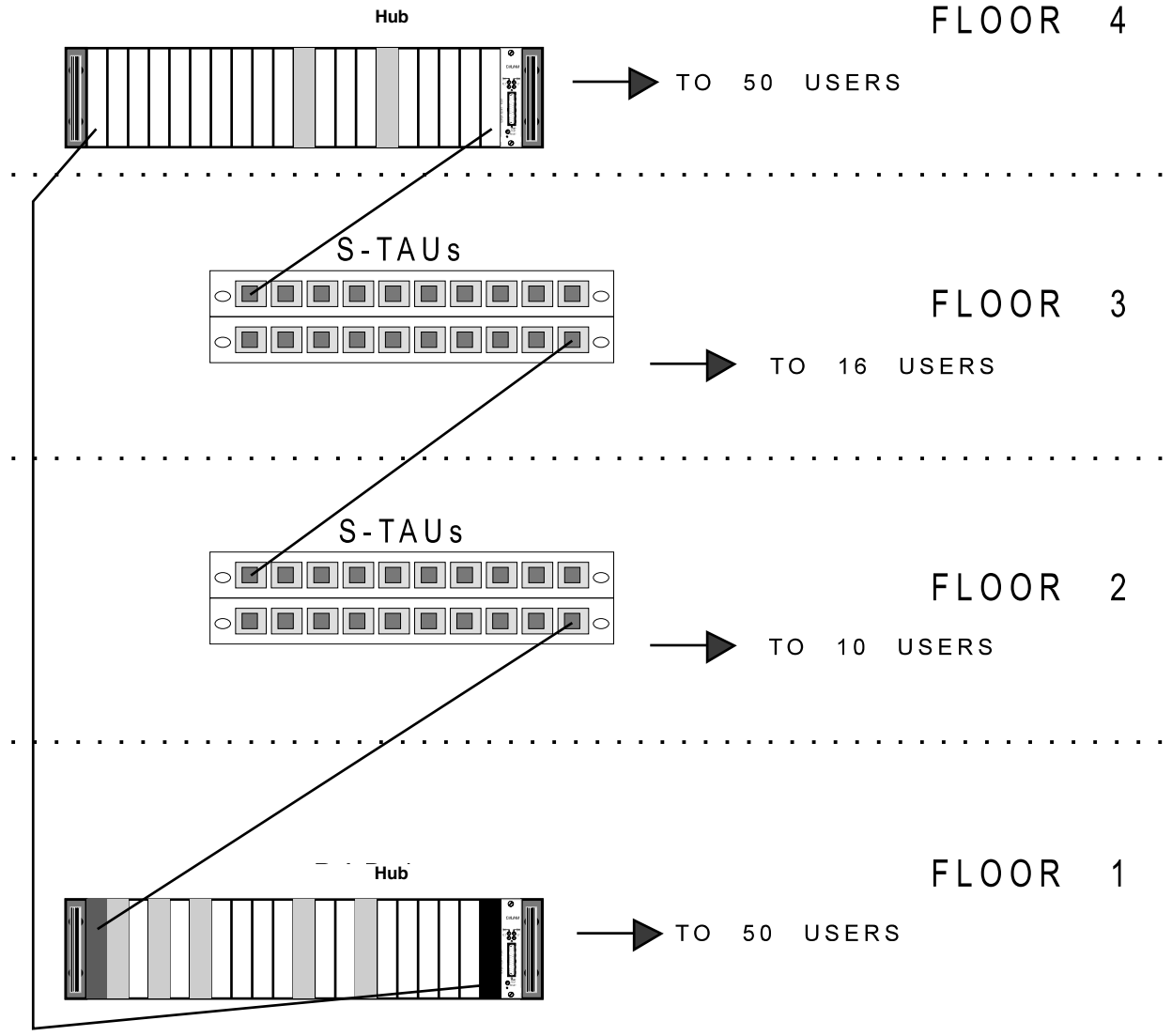

Figure 2-6. Mixed Hub/Access Unit Application.

2.3.6 Multiple Ring Configuration

The Modular Intelligent Hub supports multiple independent rings in the same hub. You can separate rings by placing Ring In/Ring Out modules between the rings, or by setting an access module to terminate the ring. The number of separate rings is not limited and allows a mix of 4-Mbps or 16-Mbps rings. An example is shown in **Figure 2-7**, where 4- and 16-Mbps rings are connected via bridges to a 16-Mbps backbone. The bridge can be provided either by an external local Token Ring bridge or an integrated elementary bridge.

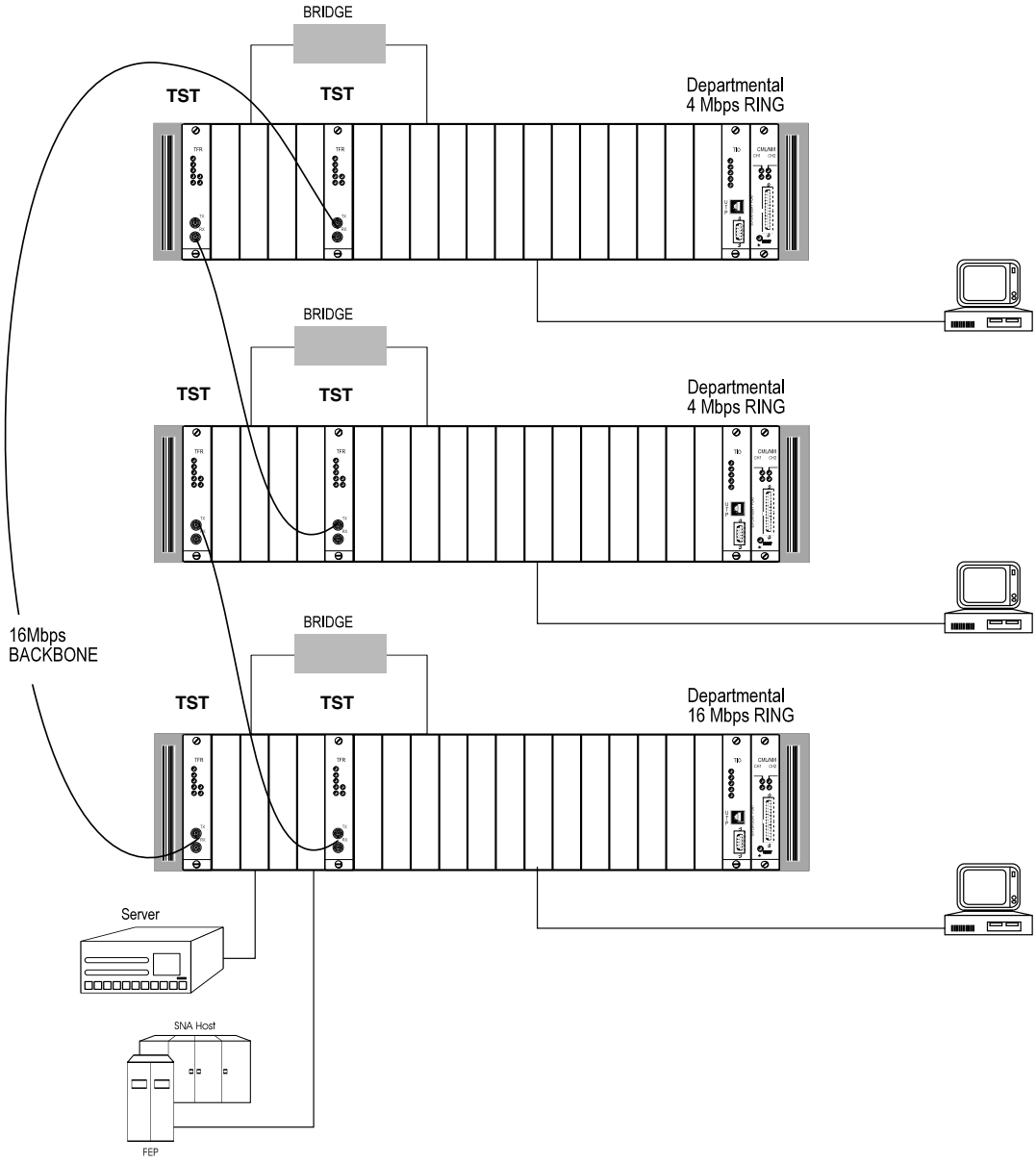

Figure 2-7. Multiple Ring Configuration.

3. Functional Description

This chapter provides a basic introduction to Token Ring operation, and describes the functional operation of the Hub and each of the modules.

3.1 How Token Ring Works

Logical Topology

In a Token Ring LAN, computers, devices, and stations are connected in a closed path called a ring. The data signal is transmitted from one station to the next on the ring, and retransmitted by every active station on the ring (see **Figure 3-1**).

The transmission of data on the ring is synchronized by circulating a single special frame, called a "free token." A token is an access-granting frame that circulates from node to node. A node may transmit a data packet only after it receives the free token. Only one node can have control of the token at any one time, thereby preventing data collisions (two or more nodes attempting to transmit at the same time).

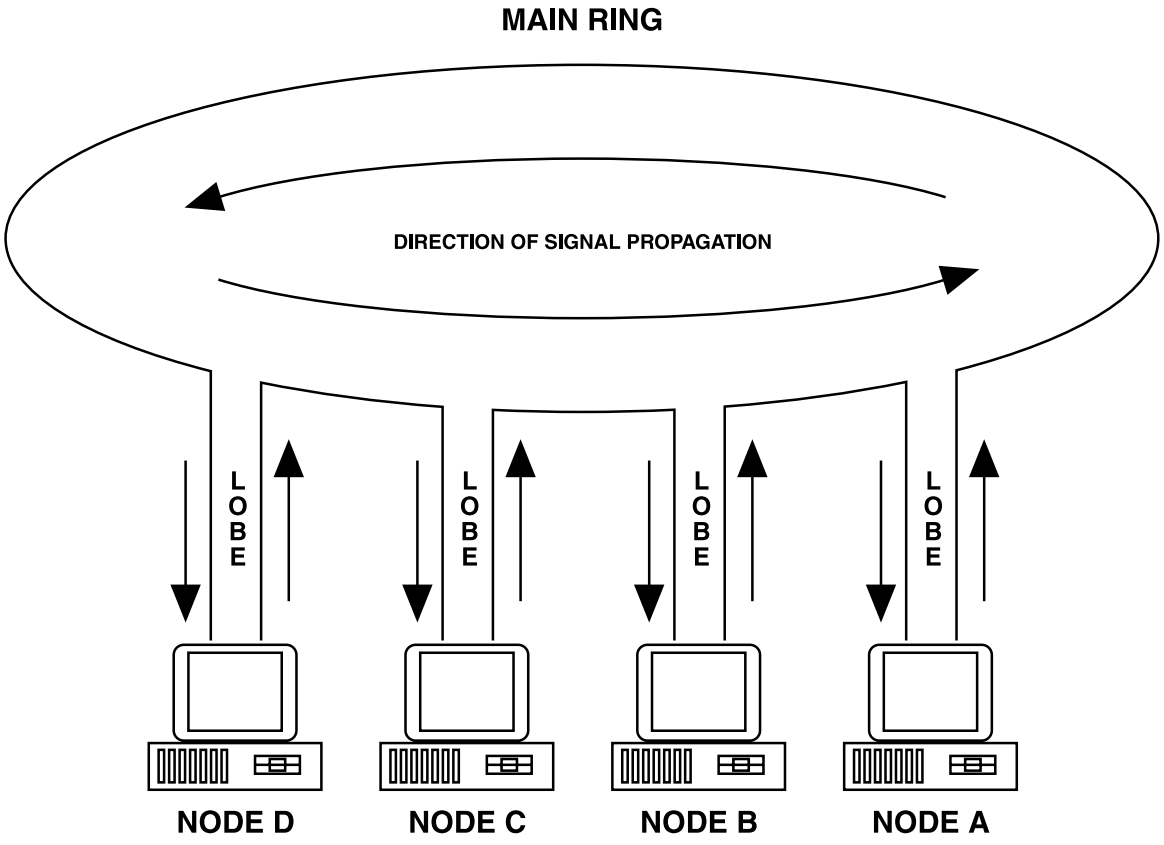

Figure 3-1. Token Ring Logical Topology.

Physical Topology

Stations are connected to the ring by means of access units (wire concentrators) or hubs, so that the physical topology is that of a star (see **Figure 3-2**). This topology allows central connection and management of the cabling. The access unit or hub will insert the station into the ring only on request from the station; otherwise, the station will be bypassed.

Ring Physical Limitations

The ring size is physically limited by the attenuation of the transmitted signal as it passes through the ring. To overcome this limitation, repeaters can be placed in the ring. The number of stations that can be attached to a single ring is limited by the jitter accumulated by the signal as it is transmitted around the ring. Without the use of jitter-reduction circuits (found in the repeaters), the number of stations is limited to 260 over STP cabling, 72 over regular UTP cabling, and 104 over enhanced UTP cabling.

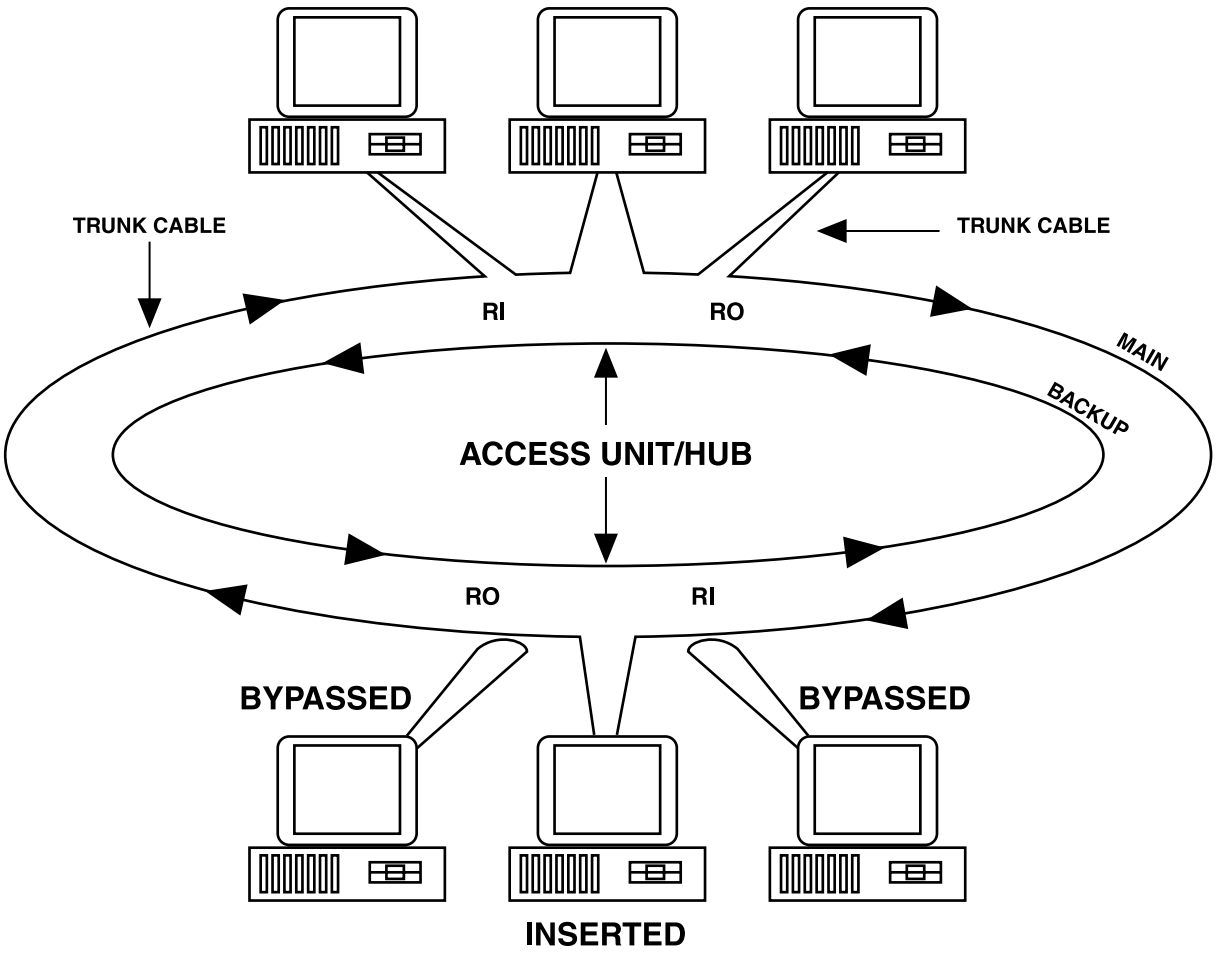

Figure 3-2. Hub Physical Connection.

3.2 How the Modular Intelligent Hub Works

3.2.1 General

The Modular Intelligent Hub is a compact modular access center enabling connection of stations to IEEE 802.5 Token Ring networks.

The Hub provides a highly flexible approach to building a Token Ring network. It also ensures high network reliability and fault tolerance.

3.2.2 Hub Enclosure

The Modular Intelligent Hub enclosure provides housing for a single common logic card, a maximum of 20 modules, up to two power supplies, and up to two cooling fans (one for each power supply in High Power model). The passive backplane ensures continued integrity of the ring even when modules are not inserted. In addition, the backplane provides a communications bus between the common logic card and all modules. The operation of each module is independent of the operation of the common logic card. An in-band management card (LT0005A-IB) can be installed in up to two rings per hub, to provide in-band management and connectivity to NetView.

The optional redundant power supply ensures the continued operation of the entire hub if one of the power supplies fails. The power supplies are located at the rear of the chassis, each unit with its own AC mains connection (we recommend that you connect the power supplies to separate mains sources). The power supplies share the load when the Hub is on, so there is no interruption in power if one of the power supplies fails. Hot insertion and removal of the power supplies can also be performed without affecting the network. In the case of a general power failure (blackout, etc.), the hub is bypassed without interfering with any other units on the ring.

3.2.3 System Configuration

How the Hub system works depends on the configuration of the hub. The Hub operates in a similar way to regular TAUs (Trunk Access Units). Each ring is defined as a group of lobe modules enclosed by Ring In and Ring Out modules. The main path signal enters the ring from the left-hand side via a Ring In card. The signal continues to travel through the ring until it encounters a Ring Out card, or terminating card. Because the Hub is a split bus, it can support multiple rings within a single hub. The following examples explain the signal path in different configurations.

Standalone

The Hub can be configured as a standalone hub without RI or RO modules. The ring is automatically closed by use of the backup path on the back plane.

A station is connected into the ring when a phantom current from the station is detected. If the station is turned off, or the cable disconnected or faulty, the lobe is automatically disabled. An empty slot is automatically bypassed.

In the standalone configuration, the hub can support up to 80 UTP, STP, or coax lobe connections and up to 40 fiber connections.

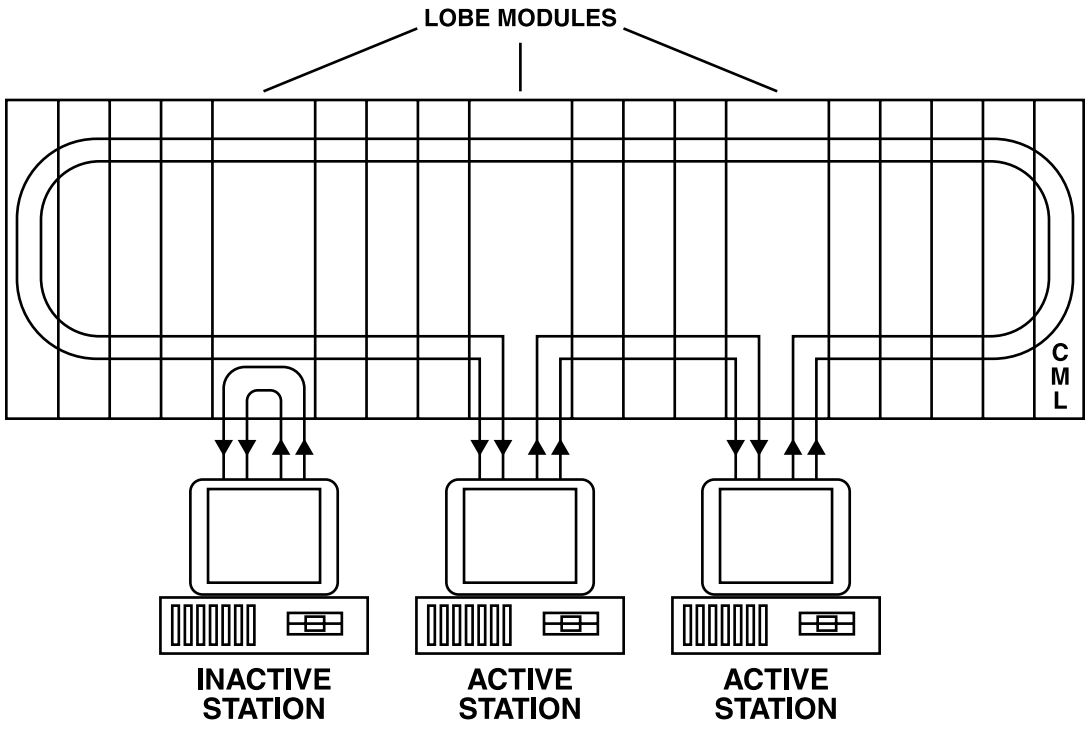

Figure 3-3. Functional Diagram of a Standalone Hub.

Multiple Rings

The Hub can be configured to support separate rings in two ways:

1. Lobe access module termination—By setting a lobe access module to be a terminating module, separation is provided between the module group to the left (with which the access module is associated) and the module group to the right (with which the access module is not associated). Termination of the module provides loopback of main to backup path in both directions. An ON/OFF jumper on the lobe access module cards is used to set termination.

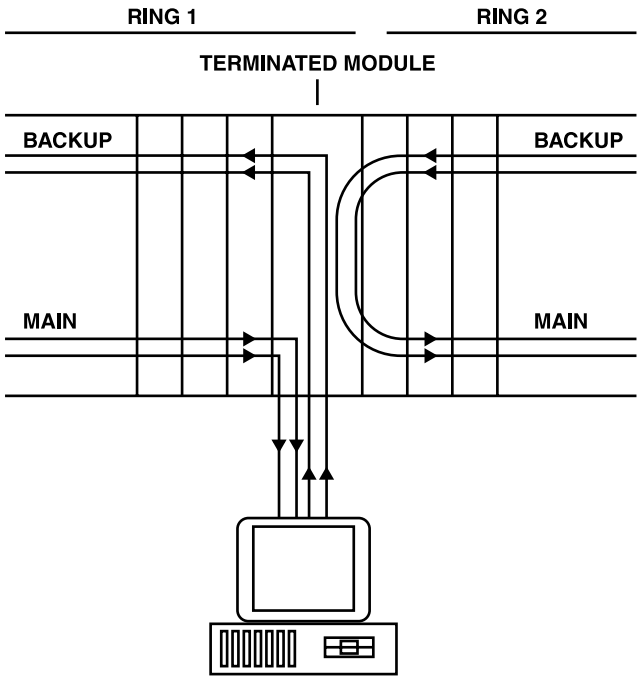

Figure 3-4. Lobe Access Module Termination.

2. RI/RO Module Termination—By inserting one or two RI/RO modules between two groups of lobe access modules, two separate rings are automatically formed.

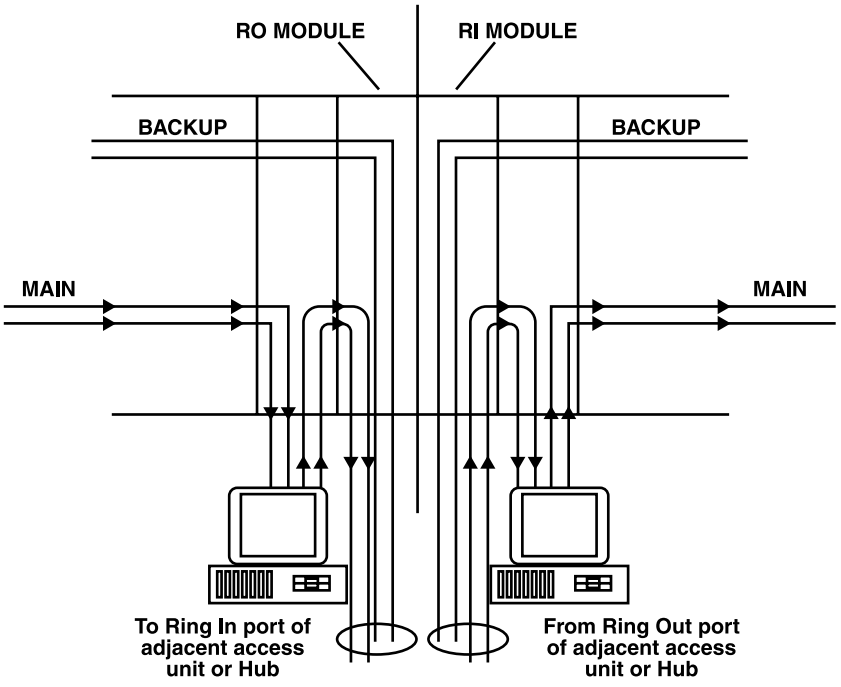

Figure 3-5. RI/RO Module Termination.

Multiple Hub Configuration

Several Hubs can be connected together to form a single large ring, by connecting Trunk cables between Ring In and Ring Out ports of adjacent hubs/access units. Hub RI/RO or repeater modules provide automatic cable-break protection. Distances between hubs are defined by the type of RI/RO or repeater module being used, and by the media quality.

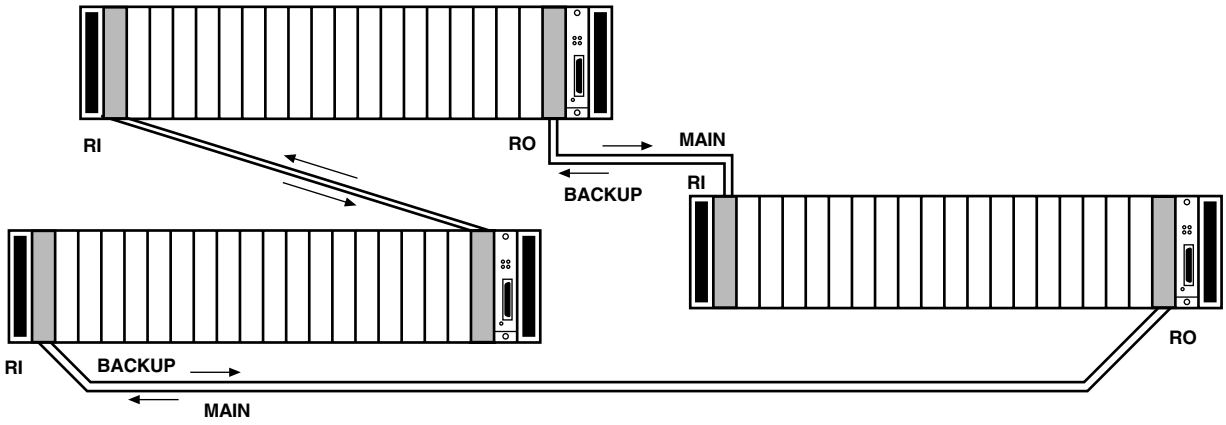

Figure 3-6. Multiple Hubs.

Satellite Configuration

Connection of the Hub's RI modules TFC, TCR, T1ST, or T2ST to the lobe of a central access unit enables a hierarchical star topology. This topology provides central connection of dispersed hubs.

The module on the RI of the satellite hub monitors the satellite hub in order to recognize the insertion of at least one station into a lobe port. If no station is inserted into the satellite hub, the RI module does not request insertion into the central access unit/hub.

Upon insertion of at least one single station into the satellite, the RI module requests insertion into the ring.

For added fault tolerance, the T2ST provides redundant connection of the satellite to the central hub, so that if one link fails, the second automatically takes over.

In the case of all stations on the satellite becoming inactive, the RI module will deinsert from the central hub.

Design information for satellite configuration is given in **Chapter 7**.

NOTE

A satellite connected hub can't be cascaded to another access unit by RO to RI connection. Only one hub can be connected by satellite connection to a port in the primary ring.

Mixed Configuration

The mixed Hub and TAU configuration is installed as part of a large network, as in the multi-hub and satellite configurations, by connecting additional hubs and IEEE 802.5 compatible access units. This configuration is useful in applications where certain locations of the ring do not justify the placement of a hub, because of the small number of workstations that require connecting or alternatively where access units have already been installed in order to use existing equipment.

The Hub Ring In/Ring Out and repeater modules are totally compatible with their standalone or card versions which are used together with access units, allowing both types of network components to coexist in the same ring. Modules (Ring In/Ring Out and Repeater Modules) such as the TIO, TCR, T1ST, or T2ST facilitate system expansion through the interconnnection of other hubs or TAUs. In a typical application, the Hub is attached to adjacent TAUs via repeaters such as the TST or TCR, or converters such as the TFC or T1ST.

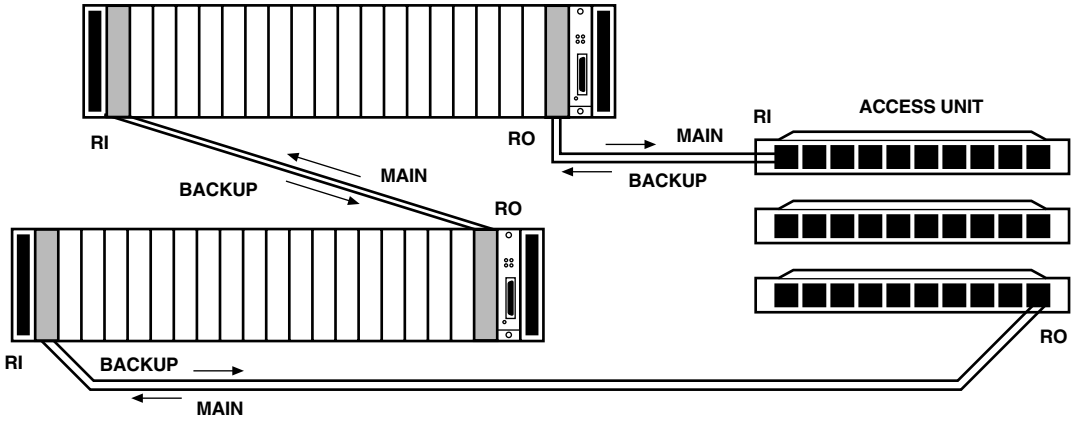

Figure 3-7. Mixed Hub and TAU Configuration.

3.3 How Modules Work

3.3.1 General

All Hub modules support both 4 and 16 Mbps Token Ring over the following media:

- UTP (100 Ω)—Regular Unshielded Twisted Pair such as IBM Type 3 and AT&T SYSTIMAX PDS 1010. Use of UTP requires media filters at active stations (it is not supported by the station's adapter card). UTP connection is via RJ-45 connectors.
- Enhanced UTP (100 Ω)—Enhanced performance Unshielded Twisted Pair such as AT&T SYSTIMAX PDS 1061 or 2061. UTP connection is via RJ-45 connectors. Use of enhanced UTP also requires media filters at active stations.
- Screened UTP (100 Ω)—Screened UTP ensures immunity of the signal from external interference. It also ensures RFI compliance. Screened UTP is commonly defined for 100 Ω and uses a shielded RJ-45 plug and socket to ensure continuity of the shield. 150 Ω versions of the modules can be provided upon special request.
- Coaxial Cable (93 Ω)—Coaxial cable can be used only on the lobes. RG-62 option is available. The use of coax also requires a (TXC) balun to be used at the station interface. Both transmit and receive signals are carried on a single coaxial cable. Connection is via a single BNC connector.
- STP (150 Ω)—Shielded Twisted Pair as defined by IBM Types 1, 2, 6, or 9. Connection is via a 9-pin D-type connector, enabling connection to the patch panel via the standard station cable.
- Fiberoptic—Fiberoptic cables can be either 50/125-micron, 62.5/125-micron, or 100/140-micron multimode fiber. Special options are also available for single mode fiber modules. Connection is via SMA or ST connectors.

Impedance matching of each module to the 150-ohm backplane enables mixing of different media in the same hub and on the same ring. This prevents problems of signal reflections, distortion, and power loss due to mismatching.

Active UTP modules all incorporate integrated media filters for compliance with RFI regulations.

3.3.2 Modules

These modules meet all the applicable requirements of the IEEE 802.5 standard. They support both 16- and 4-Mbps Token Ring networks, and are fully compatible with IBM Token Ring.

The modules can be divided into the following categories:

- Lobe access modules: Active, Passive, Repeater, Ethernet segment
- Ring In/Ring Out modules
- System modules: Management, Jitter Attenuator
- Elementary bridges

Lobe Modules

Lobe modules enable workstations to be connected to the access center using a variety of media types.

- Four-port Passive Access Modules
- Four-port Active Access Modules
- Two-port Active Access Modules

Ring Modules

Ring In/Ring Out modules enable the network to be expanded.

- TIO Ring In/Ring Out
- TFC One-Channel Fiberoptic Converter with SMA Connector
- T1ST One-Channel Fiberoptic Converter with ST Connector
- T2ST Two-Channel Fiberoptic Converter with ST Connector
- TXC Token Ring to Coax Converter

System Modules

- TJA Jitter Attenuator
- IB In-Band Management Agent Module
- IBSNMP In-Band Management Module with SNMP
- NMSNMP Common Logic Module with SNMP

Elementary Bridge Modules

- 8D35 Token Ring Extender Module, Two Link V.35
- MLB Token Ring Local Bridge
- FTB Token Ring to FDDI Bridge

3.4 Access Modules Functional Description

3.4.1 Four-Port Lobe Access Modules

These lobe access modules include four independent lobe interfaces, enabling attachment of four stations to the ring. Each lobe circuit is normally in bypass unless the attached station requests insertion into the ring. The lobe circuit remains in bypass if the station is inactive, to indicate that the lobe cable is disconnected or there is a cable fault. Under Network Management, the bypass state can also be independently controlled. Status indicators are provided for module power, to indicate that at least one port is under management, and to each port to indicate inserted/bypassed status.

The lobes do not require resetting upon installation. Each module is completely independent of the modules preceding or following it, enabling hot insertion or removal of the module from the ring, unless the module has been set to "TERMINATE" via a jumper.

The module can be configured as a terminating card to provide ring separation between two adjacent modules. When the module is positioned as the (furthest right) end card of a lobe's module group (and is configured as the terminating card), it isolates the module group from the other lobe access modules on its right to establish ring separation. If, in this instance, the terminating module is removed, the two module groups join together to form a single module group.

The phantom circuit for the module has an operating voltage of 4.5 ±0.6 V, and an operating current of 1.0 mA @ 5.0 V. The DC resistance from transmit to receive is 5.00 ±0.15 Kohm; the insertion time and the removal time are both 5 msec for each lobe.

Active Access Modules

The lobe circuits are active with regard to the Token Ring signal, with the exception of the T4CX. The IEEE 802.5 signal is regenerated in the direction of the station with clock extraction at each lobe interface, in accordance with the IEEE 802.5 draft for active retiming lobes. The T4AS modules ensure added reliability by providing bit-match detection and correction. If an interface card, set to the incorrect speed (4/16 Mbps) with respect to the rest of the network, attempts to insert into the network, it will be automatically bypassed. This ensures continuous network operation. The T4CX transmits the signal over a coaxial cable without retiming. At the station end of the T4CX module, a TXC balun must be used to allow connection of the coaxial cable to the interface card (NIC).

Table 3-1. Distances for Access Modules.

Media Type	4 Mbps	16 Mbps
T4AS & T4ASD	500 m	300 m
T4AU Level II (IBM Type 3)	100 m	100 m
T4AU Level IV (AT&T 1061)	250 m	150 m
T4AU Level V (AT&T 2061)	300 m	180 m
T4SU	250 m	150 m
T4CX	300 m	100 m

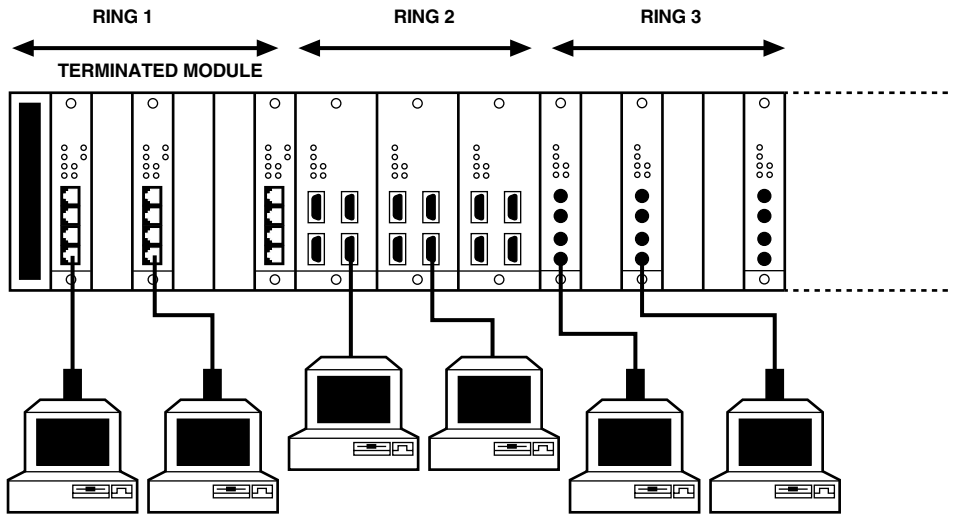

Figure 3-8. Access Modules.

The Four-Lobe Active Modules are available in three media versions:

- Four-Lobe Active Module with STP and Dual Slot (LT0005A-T4AS)—This module has four DB9 female connectors, occupying two slots. This version is intended for use with shielded twisted-pair (STP) cables (150-ohm characteristic impedance), such as IBM Type 1, 2, 6, or 9 cables.
- Four-Lobe Active Module with STP and Single Slot (LT0005A-T4ASD)—This module has two DB9 female connectors, occupying one slot. This version is intended for use with shielded twisted-pair (STP) cables (150-ohm characteristic impedance), such as IBM Type 1, 2, 6, or 9 cables. Use T cable at each port, for connection of up to four workstations.
- Four-Lobe Active Module with UTP Connector (LT0005A-T4AU)—This module has four RJ-45 connectors, occupying one slot. This version is intended for use with unshielded twisted-pair (UTP) cables, such as IBM Type 3, AT&T 1010, 1061, or Northern Telecom BDN. Type-3 media filters, such as the RAD MF-3, must be used at the workstation connection, if no media filter is integrated in the Token Ring Adapter. A media filter is integrated into each lobe, to comply with RFI and impedance requirements.

The active modules listed above provide retiming and high-quality regeneration of the 802.5 signal, minimizing the accumulated jitter at each lobe.

UTP, STP, coaxial, and fiberoptic modules can be mixed on the same ring.

The pinout signals originate from the DTE. Pinouts of the DB9 and RJ-45 connectors can be found in **Tables 3-2** and **3-3**.

Maximum lobe distances for the modules can be defined for the configuration where the Hub is in standalone configuration, or when the Jitter Attenuator module is installed.

Passive Access Modules

Lobe circuits attached to passive access modules are passive with regard to the Token Ring signal. The IEEE 802.5 signal is transparently transferred to the lobe cable if the attached station is inserted, or to the next lobe circuit if the station is not inserted.

The Four-Lobe passive access modules are available in five media versions:

- Four-Lobe Module with Coax Connector (LT0005A-T4CX)—This module has four BNC female connectors for attaching multiple workstations to the Token Ring via coaxial cable.
- Four-Lobe Module with STP Connector, Double Slot (LT0005A-T4S)—This module has four DB9 female connectors, occupying two slots. This version is intended for use with shielded twisted-pair (STP) cables (150-ohm characteristic impedance), such as IBM Type 1, 2, 6, or 9 cables.
- Four-Lobe Module with STP Connector, Single Slot (LT0005A-T4SD)—This module has two DB9 female connectors, occupying one slot. This version is intended for use with shielded twisted-pair (STP) cables (150-ohm characteristic impedance), such as IBM Type 1, 2, 6, or 9 cables. Use T cable at each port, for connection of up to four workstations.
- Four-Lobe Module with Shielded RJ-45 (LT0005A-T4SU)—This module has four shielded RJ-45 connectors, occupying one slot. This version is intended for use with screened unshielded twisted-pair cables (100-ohm characteristic impedance).
- Four-Lobe Module with UTP Connector (LT0005A-T4U)—This module has four RJ-45 connectors, occupying one slot. This version is intended for use with unshielded twisted-pair (UTP) cables (100-ohm characteristic impedance), such as IBM Type 3, AT&T 1010, 1061, or Northern Telecom BDN. Type 3 media filters, such as the RAD MF-3, must be used at the workstation connection, if no media filter is integrated in the Token Ring Adapter.

UTP, STP, coaxial, and fiberoptic modules can be mixed on the same ring.

The maximum insertion loss for the Four-Lobe passive modules, where all ports are bypassed, is 0.1 dB for 4 MHz and 0.3 dB for 16 MHz. The transmit to receive loss is 0.5 dB for 4 MHz and 0.8 dB for 16 MHz for each individual lobe, and the loss for the backup path of the module is 0.1 dB for 4 MHz and 0.2 dB for 16 MHz. The pinout signals originate from the DTE. Pinouts of the DB9 and RJ-45 connectors can be found in **Tables 3-2** and **3-3**.

Maximum lobe distances for the modules can be defined for the configuration where the Hub is in the standalone configuration, or when the Jitter Attenuator module is installed.

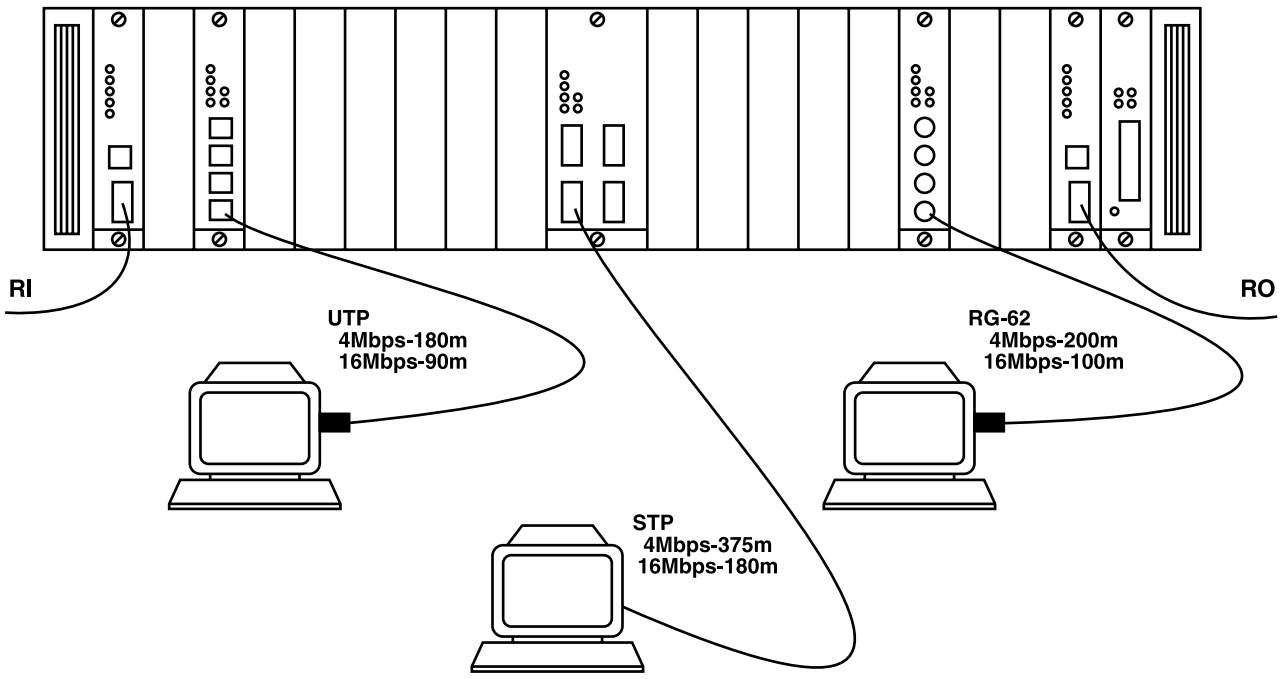

Figure 3-9. Passive Access Modules.

3.4.2 Two-Port Extended Distance Lobe Access Modules

The Two-Lobe modules provide two independent lobe interfaces for connection of two stations over extended lobe distances. The IEEE 802.5 signal from the station is regenerated at each lobe interface.

Each lobe circuit is normally in bypass unless the attached station requests insertion into the ring. Before insertion into the ring, the station carries out the Lobe Media Test according to the IEEE 802.5 protocol. Since the lobe regenerates the test signal, the station can access the ring, even if it is at a distance that would preclude its insertion on a regular passive lobe.

Extended-distance and passive lobe access modules can be mixed in the same hub, so that extended-distance modules can be used according to the lobe distance requirement. When using mixed modules, a repeater such as the Jitter Attenuator module should be used (see **Chapter 7**).

The Two-Lobe modules also support the LAU-4 and satellite configurations for expanding the number of stations that can be connected to a single lobe circuit.

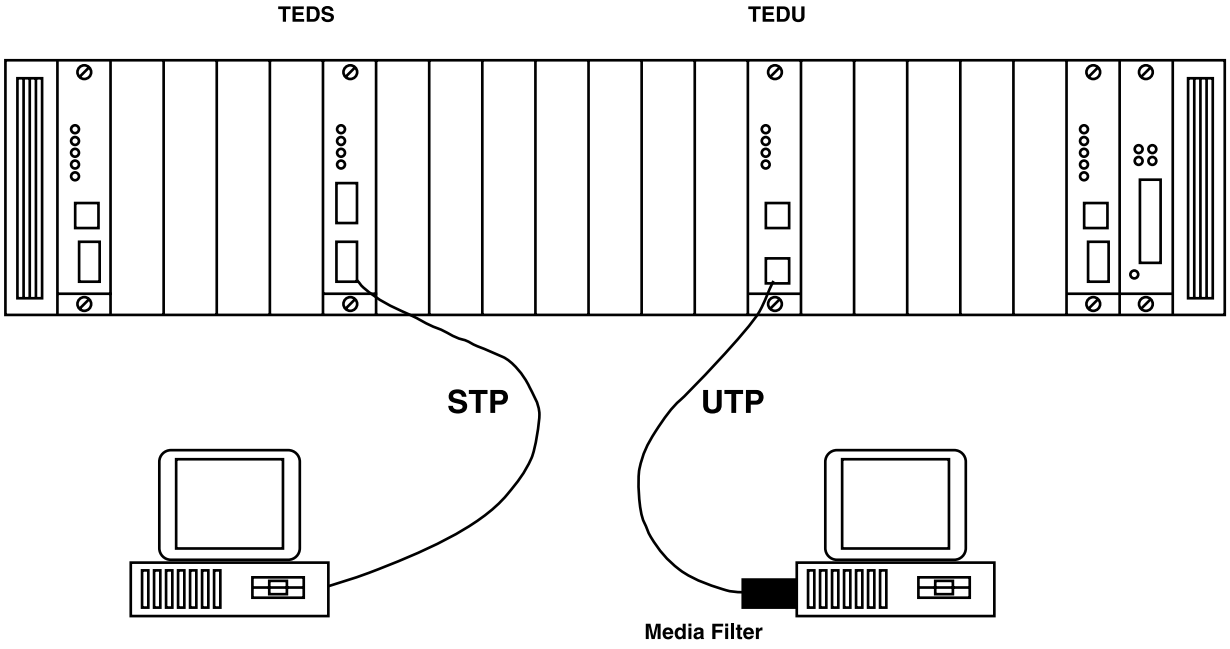

Figure 3-10. Two-Lobe Access Modules.

Status indicators are provided for module power management and lobe activity.

The Two-Lobe Module is available in three interface versions, occupying a single slot:

- Two-Lobe Extended Distance with STP (LT0005A-TEDS)—This module is for shielded twisted pair (STP) providing a 9-pin D-type connection. This version is intended for use with the IBM Cabling System, Type 1 cable or compatible 150-ohm shielded twisted-pair cable.
- This module is for unshielded twisted pair (UTP) providing RJ-45 connection. This version is intended for use with common UTP cabling systems such as AT&T PDS SYSTIMAX 1010, 1061, and 2061 cables, IBM Type 3 and compatible 100 Ω unshielded twisted pair cable. Each lobe incorporates a media filter, complying with RFI and impedance matching requirements. A RAD MF-3 media filter should be used at the workstation end, if the adapter card does not have an integrated media filter.
- Two-Lobe Extended Distance with Screened UTP (LT0005A-TEDU)—This module is for Screened Twisted Pair providing shielded RJ-45 connection. This module is compatible with 100 Ω screened UTP.

3.4.3 Two-Port Fiberoptic Lobe Access Module

The Two-Lobe Fiber Module provides a fiberoptic interface for connection of stations or satellite hub/access units to the ring over fiberoptic cable. Fiberoptic cabling ensures future upgradability to high-speed technologies together with noise immunity, security, and greater distances.

Two models are available:

- Two-Lobe Fiber Module with ST Connector (LT0005A-T2FS)
- Two-Lobe Module (with SMA connector) (LT0005A-T2FSA)

The Two-Lobe Fiber Module operates in conjunction with the Token Ring interface card, or Token Ring fiberoptic converters, which are located at the station end of the fiber lobe. The various configuration supported by the Module are shown in **Figure 3-12**.

Lobe distances of up to 3 km can be achieved over multimode fiber cables. The Module supports 50-, 62.5-, and 100-micron fibers, and either SMA or ST connectors. A special single-mode 1300-nm version is also available.

The lobe circuit of the Module is bypassed unless the remote equipment requests access to the ring by transmitting an activate “key.” If either cable link (TX or RX) is faulty, access is not granted and the lobe circuit remains in bypass. If the attached equipment needs to deinsert from the ring, it transmits a “break” key to the Module, causing the lobe circuit to revert to bypass.

The Module can be used as a ring terminator when located at the right-hand end of a Hub card group. This feature eliminates the need for the use of Trunk I/O cards, allowing the Hub card group to operate as a completely closed network.

The Module operates at a data rate of 4 or 16 Mbps at a wavelength of 850 nm, and has a transmission range of 1.9 miles (3 km). The single-mode version operates up to 20 km.

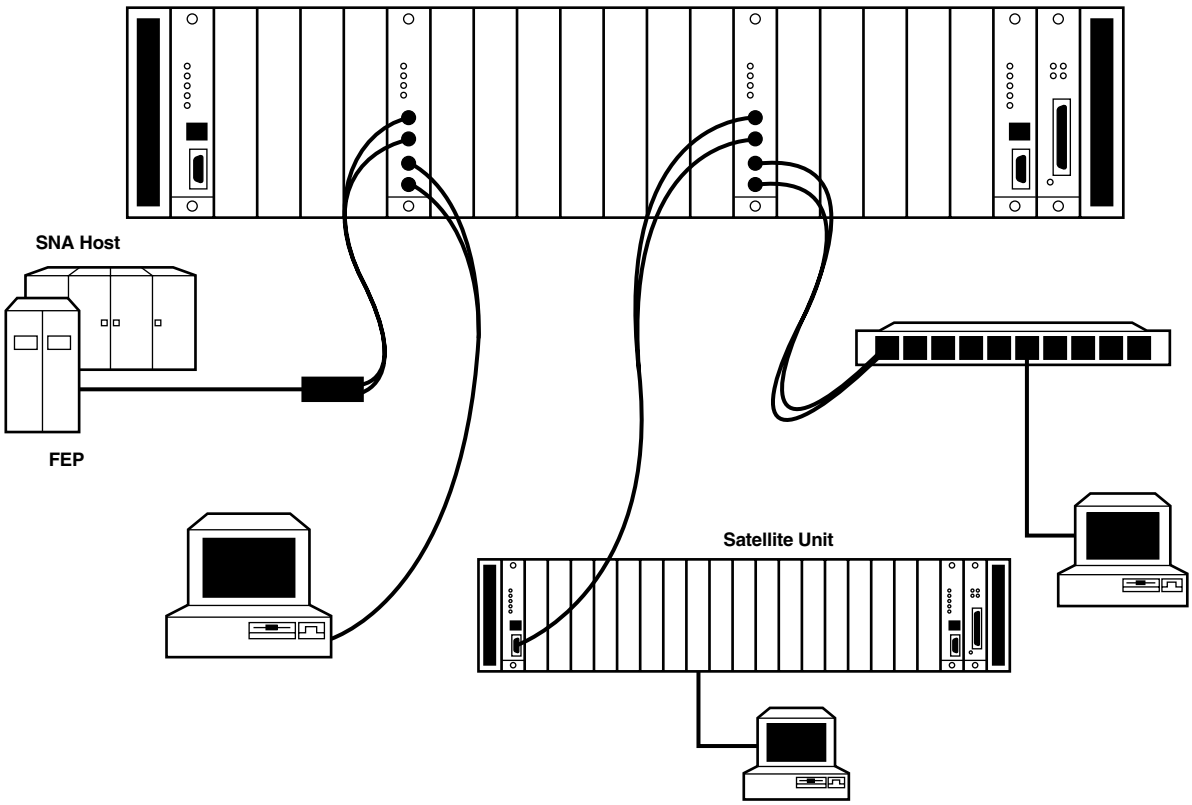

Figure 3-11. Fiberoptic Lobe Access Modules.

The optical output power for the Two-Lobe Fiber Module is:

- -22 dBm into 50/125 fiber
- -18 dBm into 6.25/125 fiber
- -14 dBm into 100/140 fiber

The receiver sensitivity for the Module is a minimum -32 dBm, with a dynamic range of a minimum 20 dB.

The optical power budgets for three grades of fiber are:

- 10 dB for 50/125 fiber
- 14 dB for 62.5/125 fiber
- 18 dB for 100/140 fiber

NOTE

When using a Two-Lobe Fiber Module in a network, we recommend that you place a Jitter Attenuator module for every 30 to 40 connected stations, in each ring segment, if there are no repeaters.

3.5 How RI/RO Modules Work

The RI/RO modules provide connection to adjacent hubs/access units, enabling ring expansion. There are three types of RI/RO modules:

- Transparent RI/RO (LT0005A-TIO)—This module is transparent to the Token Ring signal.
- Repeaters: 4/16 Mbps Copper Repeater (LT0005A-TCR) and 4/16 Mbps Fiberoptic Repeater with ST Connector (LT0005A-TST)—These modules provide full retiming, regeneration, and jitter attenuation of the Token Ring signal. This enables the limitation of signal attenuation to be overcome, thus increasing the maximum ring length.

  Repeaters are used to increase distances. A repeater is similar to an active station: it regenerates the received ring signal and retransmits it down the ring at the nominal level. However, unlike an active station, the repeater is always inserted into the ring. A copper repeater nominally doubles the recommended distance covered by a ring segment. In addition, it provides a method of ensuring that large rings will continue to operate even if only one station is active on the ring. The jitter attenuation feature in each repeater ensures optimal performance and increased station counts.

  To achieve significantly greater ranges, fiberoptic cables are used. Among other advantages, fiberoptic cable provides a reliable medium for the backbone and for increased distances.
- Converter: One-Channel Fiberoptic Converter with SMA Connector (LT0005A-TFC), One-Channel Fiberoptic Converter with ST Connector (LT0005A-T1ST), Two-Channel Fiberoptic Converter with ST Connector (LT0005A-T2ST)—These modules provide inexpensive signal conversion between copper and fiber media. This also involves signal regeneration enabling extended distance over fiber media. There are, however, limitations to using converters instead of repeaters (see **Chapter 7** for details).

  All types of Hub RI/RO modules provide automatic cable-break protection and recovery. This ensures continued operation if a segment fails, so there is no single point of failure.

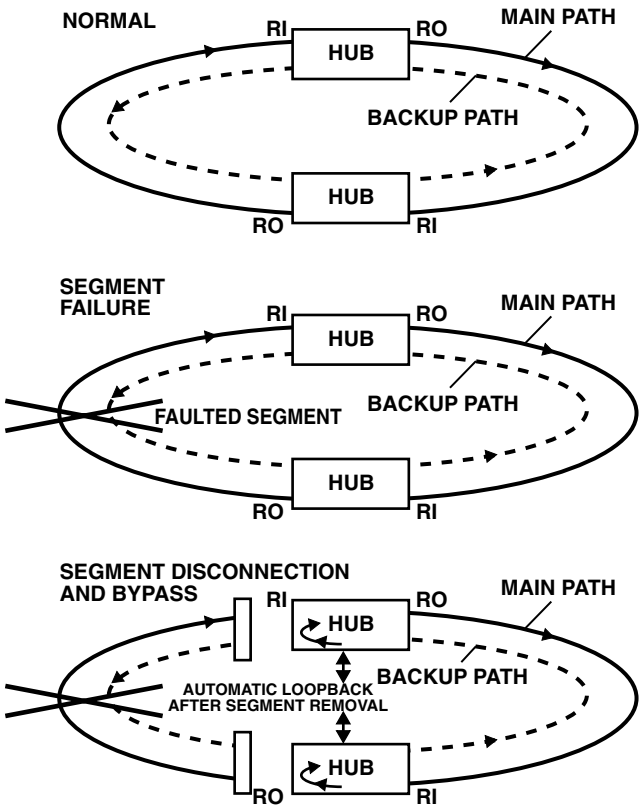

Figure 3-12. Cable Break Protection.

3.5.1 Ring-In/Ring-Out Module (LT0005A-TIO)

The TIO module functions as a Ring In or Ring Out port for connection to adjacent hubs and access units over shielded twisted-pair (STP) cables, such as IBM Type 1 or over unshielded twisted-pair (UTP) cables, such as IBM Type 3. Both options are provided in the same module with a DB9 female connector for STP and an RJ-45 connector for UTP. The TIO works at data rates of 4 or 16 Mbps.

Automatic cable-break protection will automatically loop the ring around (using the backup path) when the cable is damaged, as in the short-circuit-on-disconnect function of the IBM data connector. This feature will function when installed opposite another Hub equipped with the TIO, or to TAUs equipped with the Token Ring Cable Protection (TCP) option. It can be disabled to achieve plug compatibility with equipment that does not have a cable break protection facility. The cable break detection is provided by means of a phantom current on the trunk cable.

The TIO module is switch-selectable for either Ring-In or Ring-Out. Since the TIO does not regenerate the signal, the segment cable distance between the TIO Ring-Out module of one hub and the TIO Ring-In module of the next hub is not defined and varies depending on the configuration of the ring. In any case, the distance should not exceed 80 meters for IBM Type 3 cable at 16 Mbps and 200 meters for Type 1 cable at 16 Mbps.

The TIO can be set to three positions: On, Off, or Termination.

- On—The TIO module is set to ON whenever the cable-break protection (TCP) facility with automatic loopback is to be used on the Hub. (The TIO should only be set to the ON position when working in conjunction with equipment containing a TCP.) Automatic loopback, in this state, is only activated if a cable break is detected on the ring and is activated at both ends of the broken cable. When a cable break is detected, the FLT indicator is lit.
- Off—The TIO module should be placed in the OFF position whenever it is not working in conjunction with a remote TCP.
- Termination—The TIO module should be set to TERMINATION ON whenever the automatic loopback is to be initiated by the user, and not by a cable break on the ring. A card is kept in the TERMINATION position to allow a single Hub to operate as a standalone. In this situation, one generally prefers the card to be in an active state so that the network can be tested by carrying out the automatic loop.

NOTE

The fault indicator will not light up for a TERMINATION setting.

3.5.2 4/16 Mbps Copper Repeater Module (LT0005A-TCR)

The TCR 4/16 Copper Repeater Module is used to extend the distance over a shielded or unshielded twisted pair trunk operating between Modular Intelligent Hubs. Normally operating in pairs, the TCRs ensure that there is always signal regeneration on the ring, regardless of which stations are active on the ring. The TCR meets all the applicable IEEE 802.5 and IBM Token Ring requirements, and supports both 16- and 4-Mbps networks.

TCR Functions

The diagrams presented in this section show the basic applications of the TCR. The TCR repeater can be switched to either Ring-In or Ring-Out. The Ring-Out repeater provides retiming regeneration and jitter reduction on the main path, and the Ring-In repeater provides the same on the backup path.

In the application diagrams below, Hubs located at distant sites are interconnected by the ring segment, terminated by TCR repeaters.

In **Figure 3-13**, the TCR connected at the RO port of the Hub receives the main path ring signal, recovers its timing, and then regenerates a clean retimed signal. In addition, the TCR also performs jitter attenuation. Lower jitter increases the maximum number of stations that can be connected to the ring.

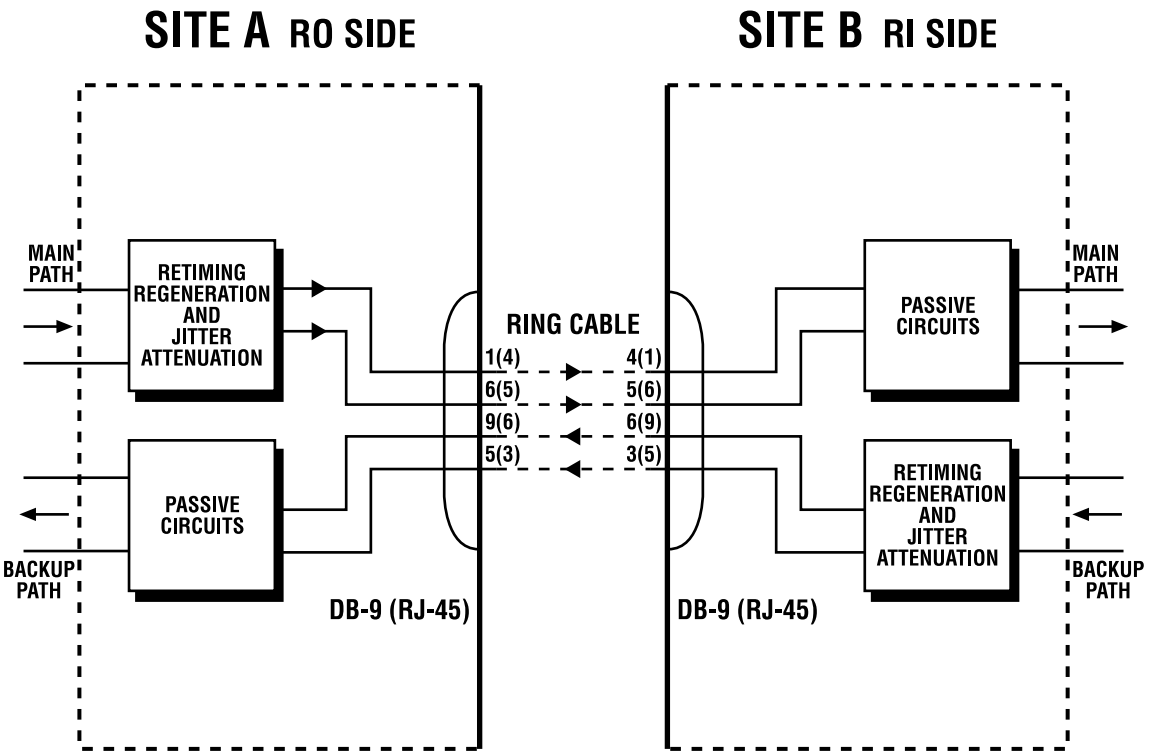

Figure 3-13. TCR Ring Segment and Functional Diagram.

The TCR provides the same functions for the backup path. The repeater serving the backup path is included in the TCR configured as Ring In.

Cable-Break Protection

All the TCR repeater models include cable-break protection. The cable-break protection automatically detects any break in the ring cable and loops the main path to the backup path to maintain ring continuity. This is illustrated in the diagram below, which shows what happens on the ring segment when one of the cable pairs breaks or is accidentally disconnected at a patch panel.

For fault tolerance, the TCR automatically shorts the main and backup paths via an on-board relay when power is off. When a cable fault exists, repeater output is looped back with signal regeneration.

A switch located on the TCR card allows the user to disable this function when one TCR operates in a link terminated at the other end in a repeater, or other unit, that uses an incompatible cable-break protection method or no cable-break protection at all.

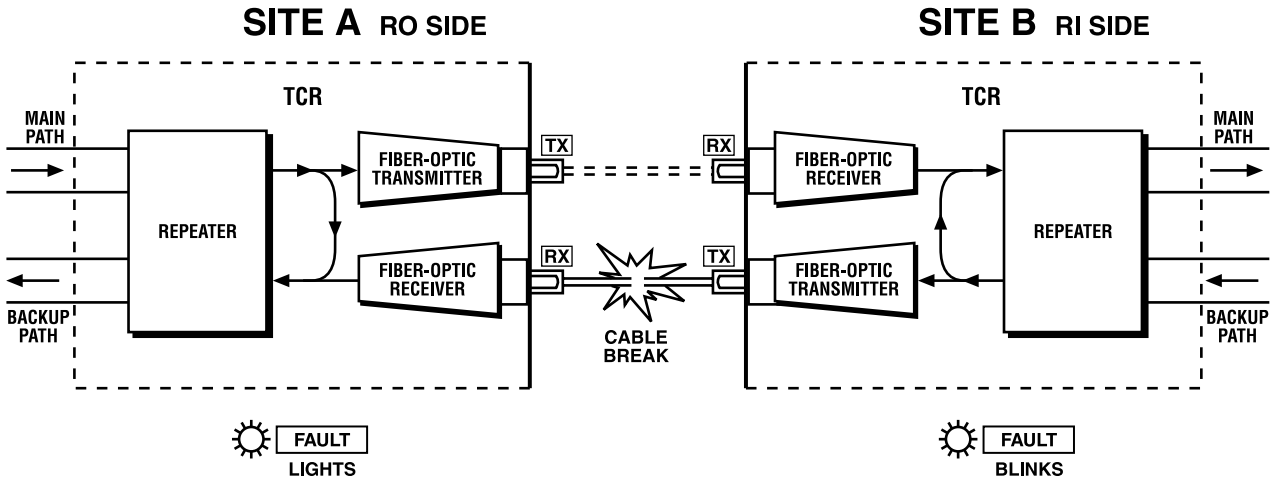

Figure 3-14. TCR Cable Break Protection.

For a situation where the cable connected to the RO connector of site A breaks, the TCR at site A detects the loss of the phantom signal and performs the following actions:

1. It loops the main path to the backup path after passing through the repeater section. This ensures that the TCR returns a regenerated ring signal.
2. After looping the main path to the backup path, the phantom signal to site B is disconnected causing the main path at site B to be looped back to the backup path.

These two operations maintain ring continuity in case of any break in the ring segment. To notify the user that a fault condition exists, the FLT indicators of the two TCRs light to indicate the receive signal is missing.

Protection in Case of Power Loss

In case of power loss, the TCR automatically loops the main path to the backup, as shown below. Note that in this case, the repeater is not included in the ring (because it is not powered).

When the cable break protection function is enabled and the input signal is lost, the TCR at the far end will detect this condition, and will also perform looping to the backup path.

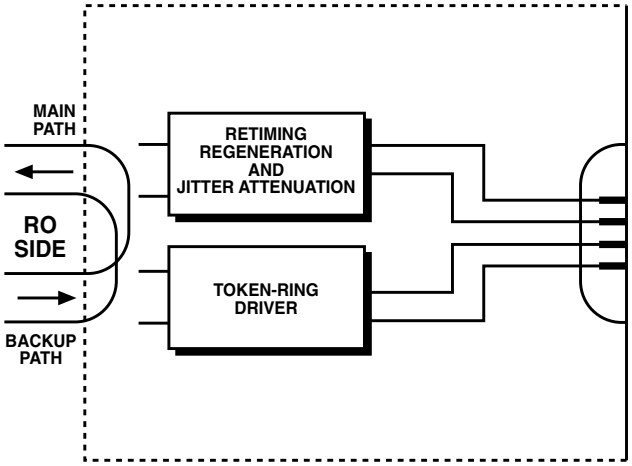

Figure 3-15. TCR Loops to Backup Path.

The TCR contains two connector types: a DB9 ring connector, intended for use with shielded twisted-pair STP cables, such as IBM Type 1, and an RJ-45 connector, intended for use with unshielded twisted-pair (UTP) cables. For connection to UTP, an internal media filter is integrated into the TCR module, ensuring impedance matching and RFI protection.

The TCR occupies one slot in the Hub enclosure. Operation is full duplex over 4-wire twisted pairs. Data rates of 4 or 16 Mbps are switch-selectable. The TCR operates with a transmission range for IBM type 1 cable of 2500 feet (750 m) at 4 Mbps and 1250 feet (375 m) at 16 Mbps. For IBM type 3 cable, the range is 1100 feet (350 m) at 4 Mbps and 550 feet (175 m) at 16 Mbps.

The (nominal) output level is 4 V ptp (on 150 ohms), while the minimum input level is 200 mV ptp. The input impedance used by the TCR is 150 ±15 ohms for STP and 100 ±10 ohms for UTP. Design rules with TCR are provided in **Chapter 7**.

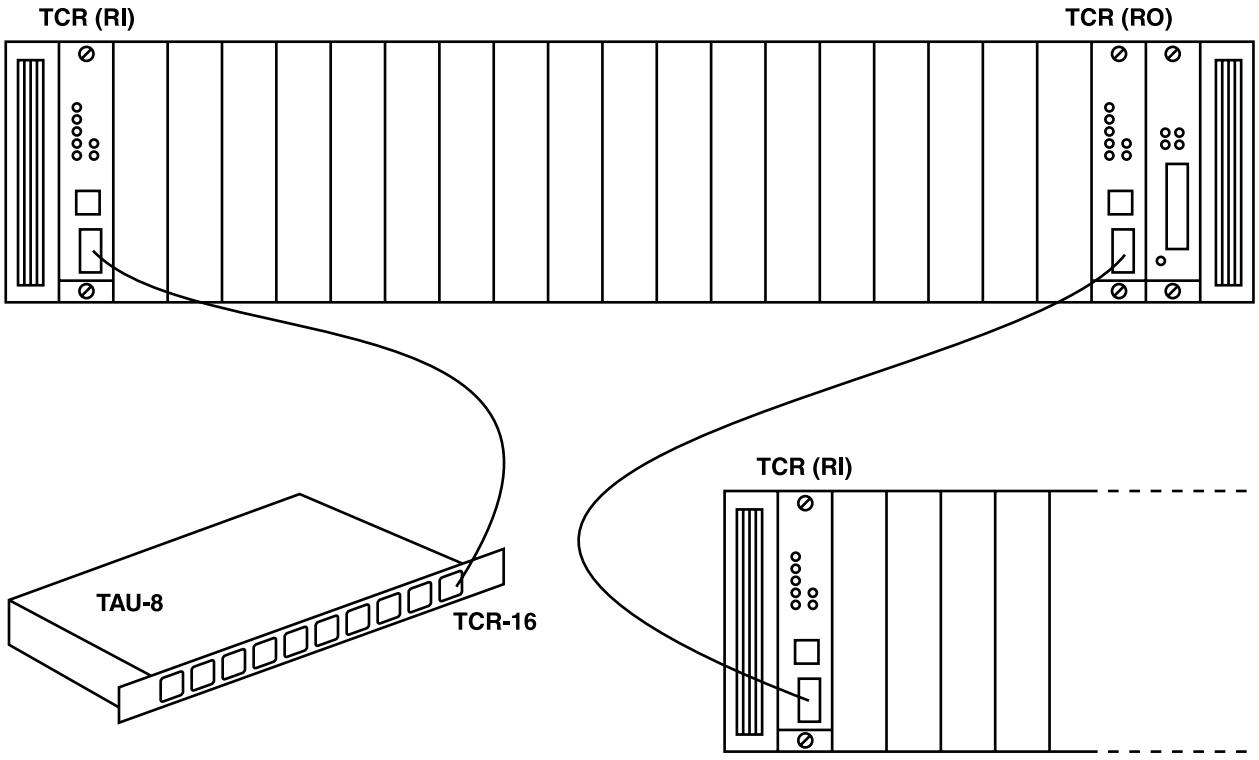

Figure 3-16. TCR Application.

3.5.3 4/16 Mbps Fiberoptic Repeater with ST Connector (LT0005A-TST)

The Fiberoptic repeater module extends the distance between adjacent Hubs up to 1.9 miles (3 km) over multimode fibers. Module configuration is switch-selectable for either Ring In or Ring Out operation and is displayed by means of RI/RO front-panel indicators. The Module also functions as the terminating card of the lobe access module cards, enabling coexistence of independent networks on the same hub.

The Module can operate in conjunction with the TFR-16, either as a standalone unit or installed in the RI/RO port of a TAU, to enable fiberoptic connection to an adjacent TAU. The Module also enables remote connection of the Hub to a fiberoptic lobe interface of a central concentrator, such as an F-TAU or Hub equipped with a TL-2/F module, for satellite configuration.

TST Functions

The fiberoptic repeaters perform two functions: conversion between electrical and optical signals, and repeating.

In the application diagrams below, Hubs located at distant sites are interconnected by a fiberoptic segment, terminated by two TST modules.

The TST module implemented as the RO module of the Hub receives the main path ring signal, recovers its timing and then regenerates a clean and jitter-free retimed signal, by using a unique jitter-attenuator circuit.

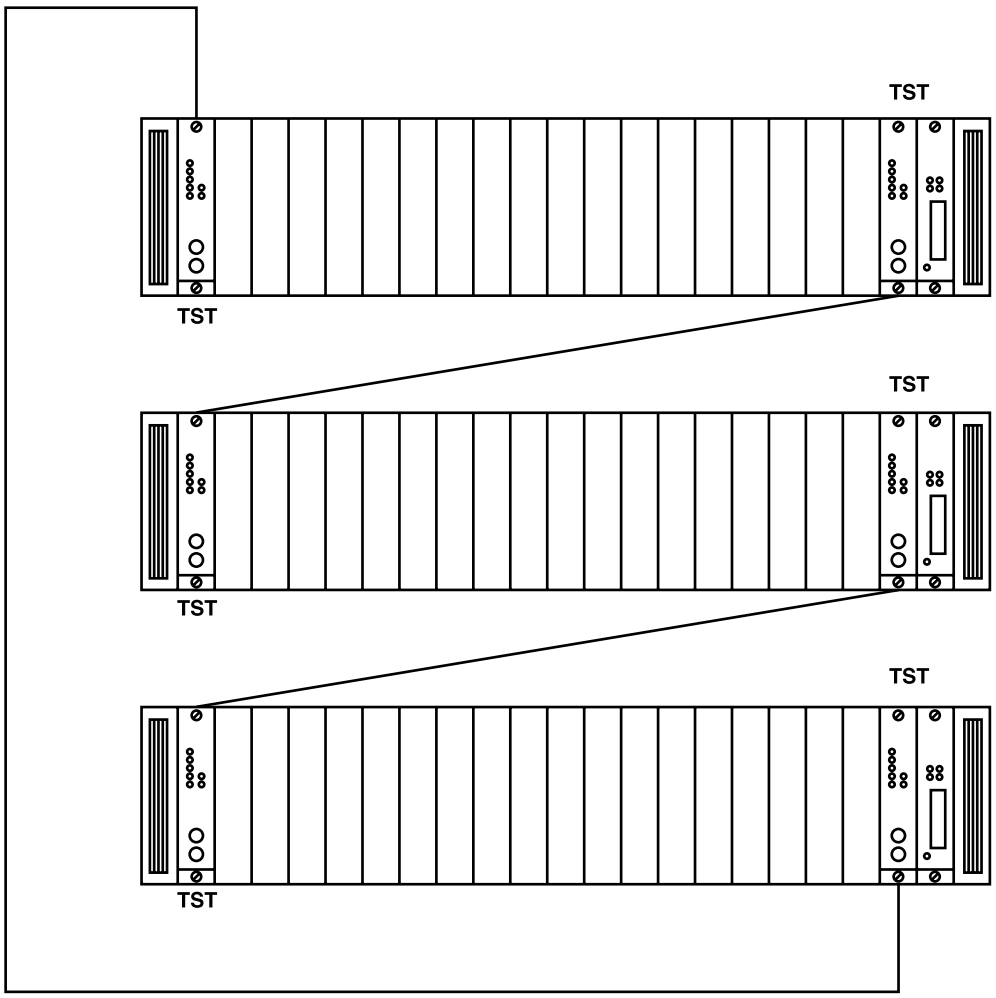

Figure 3-17. TST Application.

Lower jitter increases the maximum number of stations that can be connected to the ring. The jitter attenuator can be switched on or off by a DIP switch. The regenerated signal is applied to the fiberoptic transmitter, which converts the electrical signal to an optical one, and sends it via the fiberoptic cable to the other site.

The TST module implemented as the RI port of the Hub receives the optical signal and reconverts it to an electrical token ring signal with full amplitude, in effect operating as another repeater circuit in the direction of the next station.

The TST provides the same functions for the backup path. The repeater serving the backup path is included in the TST in the RI port.

The optical section of the TST supports 50/125, 62.5/125, and 100/140 micron graded-index multimode fibers with a nominal range of 3 km. A single-mode option is provided, extending the distance up to 20 km. **Chapter 7** provides information for calculating the attenuation of fiberoptic links and evaluating the available range.

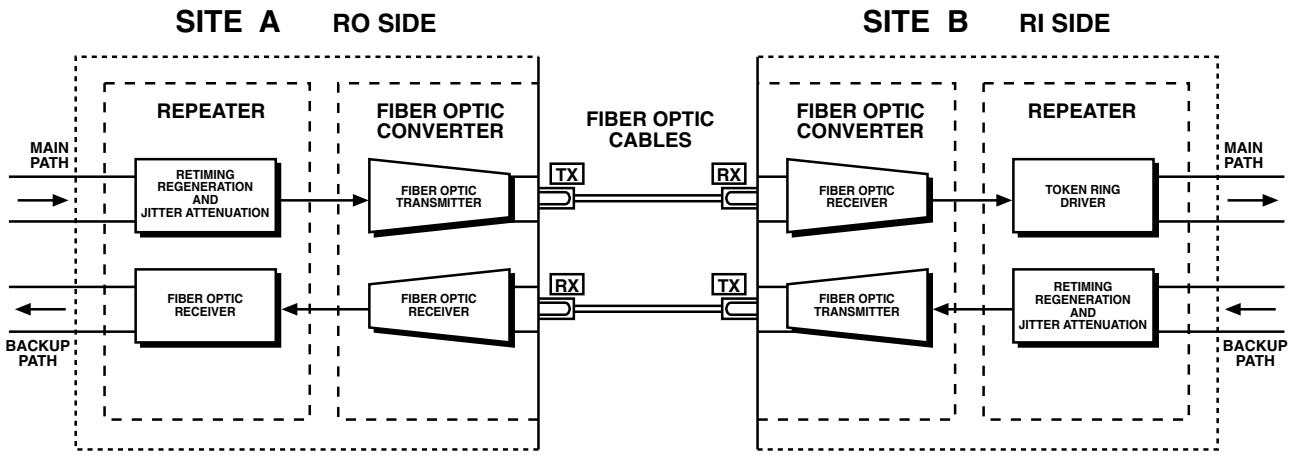

Figure 3-18. Functional Diagram of a Fiberoptic Segment.

Cable Break Protection

All the repeater modules include cable-break protection. A DIP switch located on the TST card allows the user to disable this function when one TST operates in a link terminated at the other end in a fiberoptic repeater or converter using an incompatible cable-break protection method or no cable-break protection at all.

The cable-break protection automatically detects breaks in the fiberoptic cable and loops the main path to the backup path, in order to maintain ring continuity. This is illustrated in the diagram below, which indicates what happens on the fiberoptic segment when one of the cable fibers breaks or is accidentally disconnected at an optical patch panel.

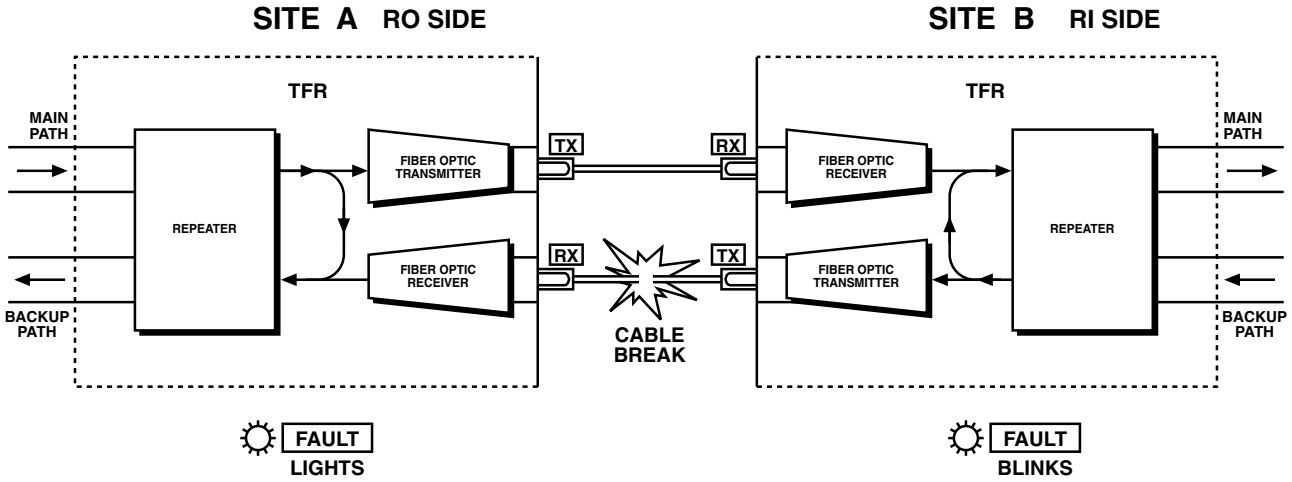

Figure 3-19. TST Cable Break Protection.

If the fiber connected to the RX connector of site A breaks, the TST detects the loss of the optical signal and carries out the following actions:

1. Loops the main path to the backup path after passing through the repeater section. This ensures that the TST returns a regenerated ring signal.
2. Sends a fault pattern on the TX fiber. The TST at site B detects this pattern and loops the main path to the backup path (after regeneration of the signal by the repeater).

These two actions maintain ring continuity in case of a break in the fiberoptic segment.

To notify the user that a fault condition exists, the two TSTs provide fault indication as follows:

- At the receiving TST, the FLT indicator lights continuously to indicate that the receive light is missing.
- At the second TST, the FLT indicator flashes to indicate that the transmit fiber is disconnected.

The cable-break detection operates even when the Token Ring network is inactive—that is, when all the stations are deinserted and there is no ring signal.

Protection in Case of Power Loss

In case of power loss, the TST automatically loops the main path to the backup path, as shown below. Note that in this situation, the repeater is not included in the ring (as it is not powered).

When the cable break protection is enabled and the optical input signal is lost, the TST at the far end will also detect the loss and will perform looping to the backup path.

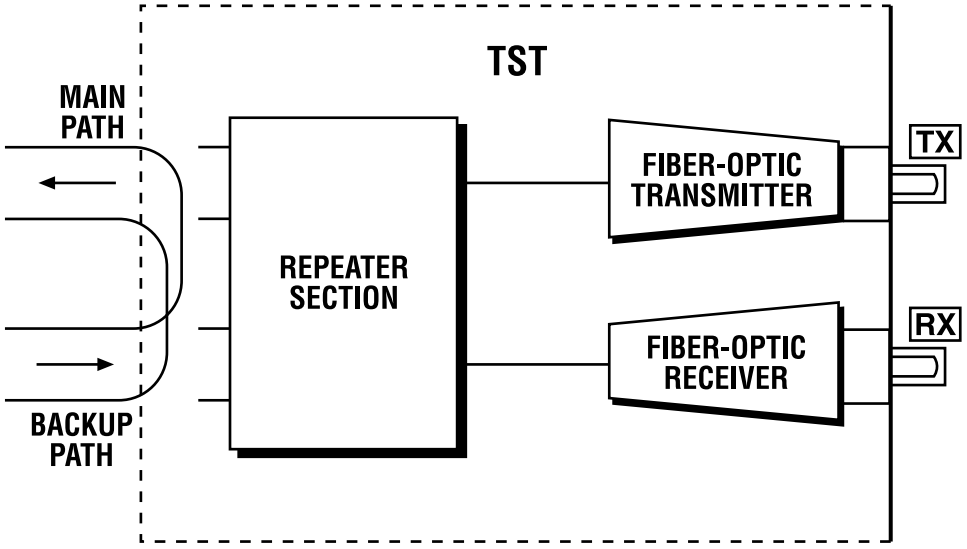

Figure 3-20. TST Loops to Backup Path.

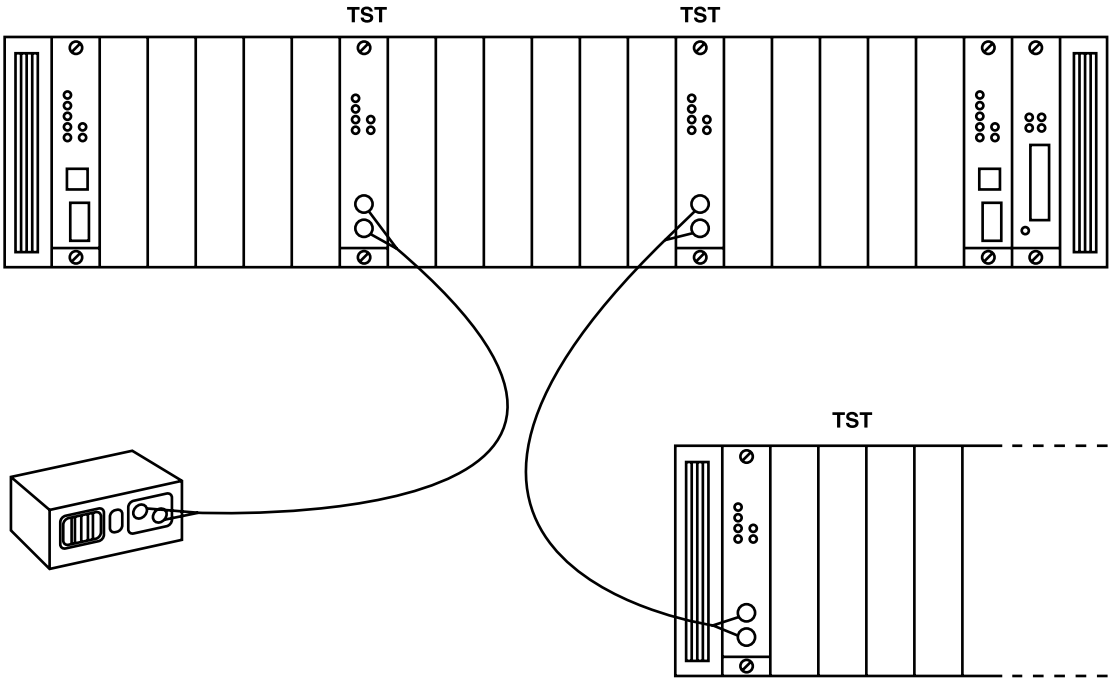

Figure 3-21. TST Application.

3.5.4 Fiberoptic Converter Modules

The following fiberoptic modules connect trunks to adjacent hubs or access units over fiberoptic cable.

- One-Channel Fiberoptic Converter with SMA Connector (LT0005A-TFC)
- One-Channel Fiberoptic Converter with ST Connector (LT0005A-T1ST)
- Two-Channel Fiberoptic Converter with ST Connector (LT0005A-T2ST)

The Module converts the electrical signal to an optical one and vice versa. It can be configured to work as Ring In or Ring Out in the fiberoptic trunk. The Module also supports the satellite configuration.

Special circuitry provides fault protection by detecting a drop in optical signal and initiating automatic ring partitioning. Detection is also provided for remote fault condition, where the remote side does not receive the optical signal; automatic partitioning is also activated at the remote side. The Module has a redundant-channel option whereby a fault on the active link will automatically activate the redundant link. By switching to the redundant link instead of using the backup, added fault tolerance is provided, so that even if there is a security failure somewhere else in the ring, the ring will continue to operate. This feature is also suited to high-reliability satellite applications.

Since the Module is only a converter and not a repeater, certain limitations are introduced when using the Module. Lobe lengths are limited on the Hub to 50 m at 16 Mbps on Type 1 and 100 m at 4 Mbps on Type 1. In addition, we recommend that only 3 Module links be cascaded one after the other to prevent jitter problems. These jitter limitations can be overcome by using the Jitter Attenuator Module in conjunction with the Hub. See **Chapter 7** for more details on planning with the Module. The fiberoptic module is also compatible with the TFC card integrated in TAUs.

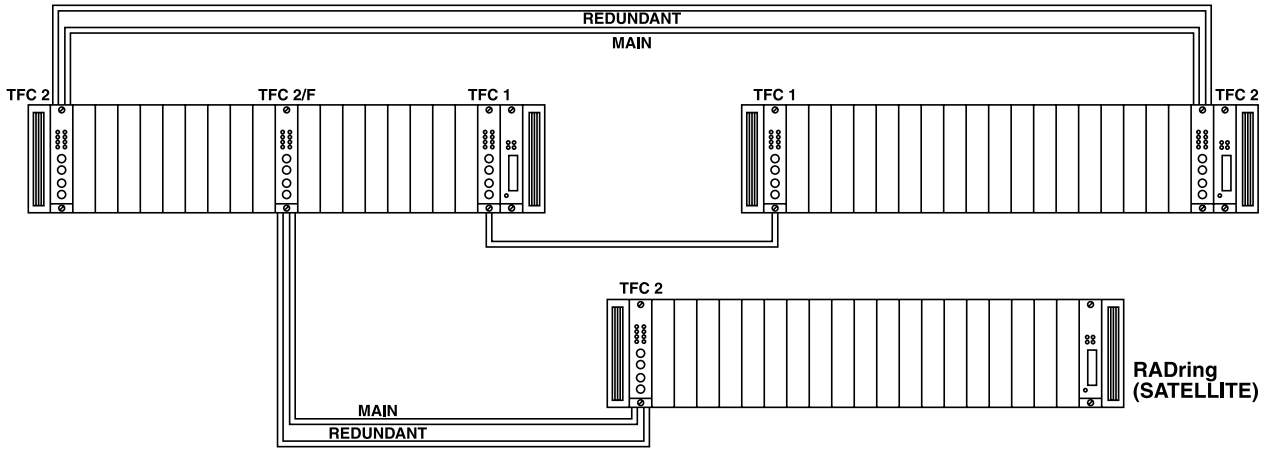

Figure 3-22. Redundant Fiberoptic Link with TFCs.

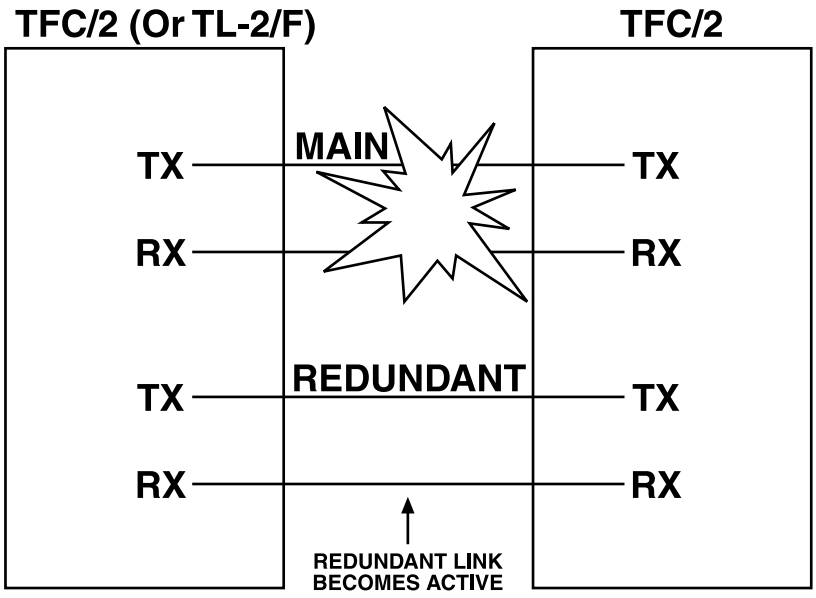

Figure 3-23. Functional Diagram of Redundant Fiberoptic.

Indicators for the Fiberoptic Converter Module include: Power On, Fault (ON when optical siganl loss condition exists, BLINKING when remote Module is under optical signal loss condition), Module configured as Ring In and Module configured as Ring Out, and Module under network management control. LEDs will all flash when the Module is set to a configuration that is not allowed.

The Two-Channel Fiberoptic Converter Module provides automatic backup to the second channel in case of cable break on the first channel.

The Module operates in full duplex over dual fiberoptic cable for data rates of 4 or 16 Mbps. The Module can obtain a range of 1.9 miles (3 km) at a wavelength of 850 nm. The optical output power for the Module is:

-22 dBm into 50/125 fiber

-18 dBm into 62.5/125 fiber

-14 dBm into 100/140 fiber

The receiver sensitivity in the Module is a minimum -32 dBm, with a dynamic range of a minimum 20 dB. The optical power budget for three grades of fiber is:

10 dB for 50/125 fiber

14 dB for 62.5/125 fiber

18 dB for 100/140 fiber

For extended distance, a special single-mode version is available, providing distances over single-mode fiber of up to 29 km.

Cable Break Protection

In addition to the fault tolerance of the Two-Channel Fiberoptic Converter redundant link, cable-break protection is provided on each link. The cable-break protection automatically detects breaks in the fiberoptic cable and loops the main path to the backup path, in order to maintain ring continuity.

If the fiber connected to the RX connector of site A breaks, the Module detects the loss of the otpical signal and carries out the following actions:

1. Loops the main path to the backup path. This ensures that the Module returns a regenerated ring signal.
2. Sends a fault pattern on the TX fiber. The Module at site B detects this pattern and loops the main path to the backup path.

These two actions maintain ring continuity in case of a break in the fiberoptic segment.

To notify the user that a fault condition exists, the two Modules provide fault indication as follows:

- At the receiving Module, the FLT indicator lights continuously to indicate that the receive light is missing.
- At the transmitting Module, the FLT indicator flashes to indicate that the transmit fiber is disconnected.

The cable break detection operates even when the Token Ring network is inactive—that is, when all the stations are deinserted and there is no ring signal.

In the case of cable break protection for the Two-Channel Fiberoptic Converter with redundant fiberoptic channel, switch both modules to the redundant channel (without activating the backup path of the ring signal).

Protection in Case of Power Loss

In case of power loss, the Module automatically loops the main path to the backup path.

When the cable-break protection is enabled and the optical input signal is lost, the Module at the far end will also detect the loss and will perform looping to the backup path.

Compatibility Rules for Cable Break Protection

Always enable cable-break protection at both ends of the link, unless a compatibility problem exists. This implies that cable-break protection should always be enabled when operating two Modules in the same link.

3.6 Elementary Bridge Modules Functional Description

TOKEN RING EXTENDER MODULE AND TOKEN RING BRIDGE MODULE

These Modules connect a LAN consisting of 80 remote workstations to the central Token Ring LAN. Connection is made through a sycnhronous or asynchronous serial communication link, operating at data rates of 1.2 to 512 kbps, over point-to-point or public networks. Link operation at data rates of 9.6 kbps or higher is recommended to reduce response time and link delay.

Three models are available:

- Token Ring Extender Module, Two Link V.35 (LT0005A-8D35)
- Token Ring Local Bridge (LT0005A-MLB)
- Token Ring to FDDI Bridge (LT0005A-FTB)

The Module operates in conjunction with TRE-1 and TRE-8 standalone units, the TRE/PC card/software, or with other TRE Modules (see application diagram). Up to ten Modules can be plugged into a single Hub.

The Module operates like a MAC-level remote bridge, performing filtering and forwarding of only those packets addressed to the remote stations. The Modules use a different algorithm from that used by full bridges, providing optimum performance for applications requiring connection of small remote LANs to a central LAN.

The Module includes status indicators for module power, management control, LAN's data rate, and activity.

TRE Operation

The Module operates as follows:

1. The Module connected to the remote LAN is self-learning, recognizing the addresses of all attached workstations. This information is transmitted to the Module connected to the main LAN. The remote Module forwards all packets whose destination address is not in the remote site and ignores the other frames.
2. The Module connected to the main LAN forwards (to the remote LAN) only those packets whose destination address belongs to the remote site and ignores the other frames.
3. Broadcast and multicast frames are forwarded to both LANs, unless they are masked out.

TRE operation is automatic and includes serial-link start-up and recovery.

The serial link interface can be V.35, V.24/RS-232, X.21, V.36/RS-422 or RS-530, via conversion cable to a 25-pin D-type connector. This allows interfacing to a wide range of modems and public networks, including connection over the ISDN network. In synchronous mode, the TRE is configured as a DTE, with clocking provided by the serial link. In asynchronous mode, the bit rate and data format are programmed by the user.

The TRE module supports the physical and data link layers of the OSI model, and is completely transparent to higher-level protocols such as TCP/IP, DECNET, XNS, ISO, and to operating systems such as NetWare, 3COM, and VINES.

RADnet Support

The TRE Module supports the RADnet Management System, allowing the status and parameters of the LAN, and the serial link, to be displayed at the RADnet Management Station. Commands can be performed on the TRE module by the station operator using graphical representation, pull-down menus, and dialog boxes. Management of the remote sites is provided via the TRE's link using the in-band management procotocol. For full control of a remote site, the Hub at the remote site must incorporate a CML/IB management module.

3.7 How Management Modules Work

The Modular Intelligent Hub and all resident modules are managed from the management station via the Common Logic Module (LT0005A-NMSNMP) which acts as the Hub module agent, and the In-Band Management Agent Module (LT0005A-IB) or In-Band Management Module with SNMP (LT0005A-IBSNMP), which provides in-band management of the network.

The Management Software application runs on an IBM compatible PC with a 386 or better processor, under DOS/Microsoft Windows 3.1. It provides powerful, user-friendly monitoring and control of Hubs and the Token Ring network. The Management station can manage up to 124 Hubs. The Management Software allows full monitoring and control with continuously updated representation of the network and attached devices. All network events and alarms are immediately reported to the Station and are represented graphically. Events and alarms may also be reported to an IBM LAN Manager Station/NetView on the network.

Bad lobes and failed main-ring segments are automatically reported and the appropriate ports bypassed or looped back to ensure continuous ring operation.

A network administrator can use the network management station to remotely alter portions of the ring's physical configuration by altering the graphical element on the network management display. This enables him to rapidly trace and isolate faults without leaving the console. Where cabling is widely distributed, such as large multistory networks, this capability is particularly useful. The management station can also monitor, control, and troubleshoot off-site or remote networks.

RADnet provides both in-band and out-of-band communication paths for controlling and monitoring the network, so the network can still be controlled even under worst-case conditions of a network failure (hard error condition).

3.7.1 Common Logic Module with SNMP (LT0005A-NMSNMP)

The Common Logic Module acts as an agent between the RADnet management station and the individual modules. It provides an RS-232 out-of-band connection for communication with the management station using a modified version of DDCMP asynchronous protocol. The management communication can operate at 2400, 4800, 9600, or 19200 bps. The Module also provides management of the hub in the case when communication with the management station is in-band via the in-band agent.

The Module can be directly connected to one of the serial ports of the RADnet station, or through a modem link, a multipoint modem link or sharing device. Each Module can be set to one of 31 addresses, and when connected to the management station are polled according to address.

The Module has its own database, kept in a non-volatile memory. The database stores the Hub configuration, which it collects by communicating with the individual modules, and the status of each module, which is automatically updated to reflect the latest changes. The database also stores the events reported by the modules. Event collection continues even when communication with the management station is not in operation. The Module is not necessary for continued Hub operation, so that it does not constitute a single point of network failure.

The Module communicates any events or modification when polled by the management station. The Module is the Hub equivalent to the Token Ring Management Adapter (TMA) which is the agent for S-TAUs and F-TAUs. Hubs and TAUs can be managed under the same Hub management station.

In addition, the management card features power supply monitoring LEDs to indicate the power supply status for the hub, a LAMP TEST pushbutton to check all the indicator LEDs of the hub modules, and a RESET button to initialize the hardware and software. The Module has a seven-segment status display, which provides status information about the Hub and the Token Ring network.

3.7.2 In-Band Management Agent Module and In-Band Management Module with SNMP

The In-Band Management Module is an in-band management agent. It is a fully compliant SNMP agent, supporting MIB II with private extensions.

The Module enables full management of the network and allows extensive monitoring and control from RADnet management station, or any generic SNMP management station.

The single-slot Module provides four major management functions: Network Monitoring, Network Control, Advanced Intelligence, and IBM LAN Manager/NetView support.

Network Monitoring

The Module monitors the Token Ring, collecting ring status, statistics, and statistics and error information for retrieval by the management station. To provide monitoring, a Module must be inserted in each ring.

Network Control

The Module enables full control of the Hub from the management station. It acts, in conjunction with the Common Logic Module, upon management commands received over the network. The Common Logic Module supports up to two In-Band Management Modules, enabling management of two separate rings in the same hub.

Advanced Intelligence

The In-Band Management Module provides advanced intelligence features including self-healing and automatic recovery from network failure. These recover the network from a beaconing state without the connection of a management station. Maximum network up-time and minimum interference is ensured. In addition, for increased manageability and network security, the Module performs a correlation between the station MAC address and the actual physical connection of the station. Security can be provided on each port by enabling access to only predefined addresses.

IBM LAN Manager/NetView Support

The In-Band Management Module can be configured to provide alerts to an IBM LAN Manager and NetView using the Alert Transport Service. This feature is supported simultaneously with the SNMP support.

Communication with the RADnet Management station continues even upon loss of in-band communication, via the out-of-band management connection. This ensures continued management of the network under worst-case conditions.

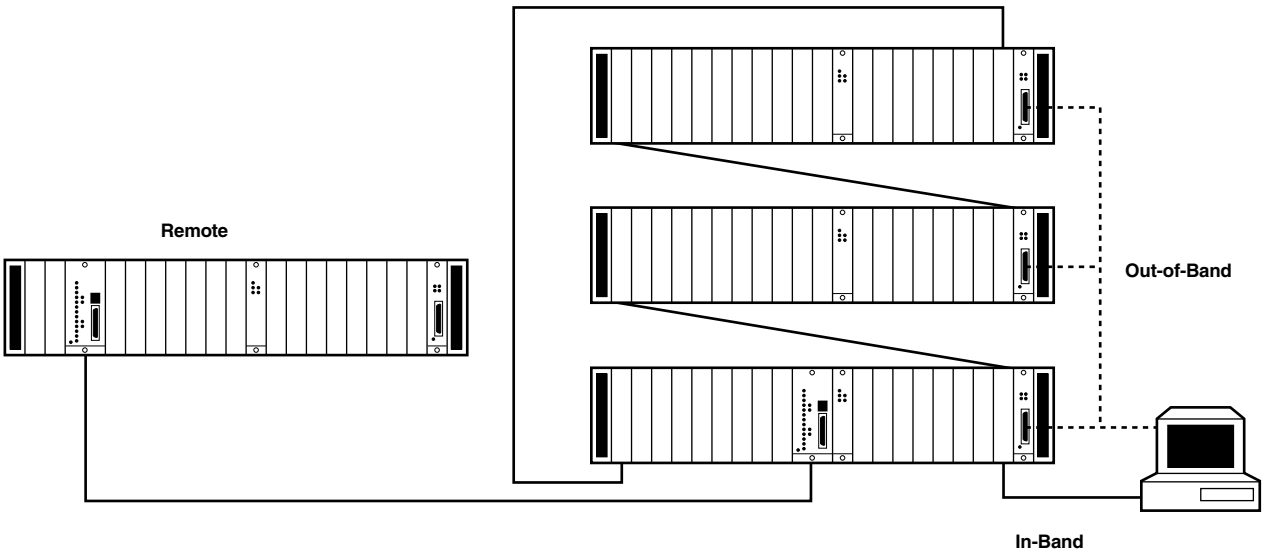

Figure 3-25. Application with Management Modules.

4. System Installation

4.1 General

The Modular Intelligent Hub is a compact 3U-high 19" enclosure accepting up to 20 Modules. The Hub incorporates a common logic module, which can optionally include network management support and one or two power supplies. When two power supplies are installed, additional reliability is achieved, with each power supply capable of fully supporting a fully loaded hub.

The Hub can be installed as a single centralized access center, capable of providing up to 80 Token Ring lobe connections, or as part of a larger network, through connection of additional hubs (or other IEEE 802.5 compatible access units) to Ring In/Ring Out modules.

The Hub is delivered completely assembled and is designed for installation in a 19" rack on a bench or shelf. Make sure the air flow is not restricted and that the cooling fan located at the rear of the enclosure is not obstructed. Equipment emitting a large amount of heat, which can raise the ambient temperature, should not be installed in the vicinity of the enclosure.

This chapter describes the mechanical and electrical installation procedures for the Hub. If you encounter any problems, refer to **Section 5.3** for operating instructions.

4.2 Unpacking

1. After unpacking, inspect the product for damage. Note and report evidence of damage immediately.
2. Attach handles to the rack.

4.3 Site Requirements

4.3.1 Power

The Hub unit should be installed within 5 feet (1.5 m) of an easily accessible grounded 115/230 V AC outlet. The power supply accepts 90-260 VAC mains supply.

4.3.2 Front and Rear Panel Clearance

Allow at least 36 inches (90 cm) of frontal clearance for operator access. Allow at least 4 inches (10 cm) clearance at the rear of the unit for management and power cables.

CAUTION

Installation, maintenance, or repair of the instrument should be carried out by qualified personnel.

4.3.3 Ambient Requirements

The ambient operating temperature of the Hub should be from 32 to 104°F (0 to 40°C) at a relative humidity of up to 90%, noncondensing.

4.4 Installation of the Hub Enclosure

1. Place the Hub enclosure in the intended location.
2. Remove blank panels (if existing) from the slots in which the modules are to be installed.
3. Specify on the Common Logic Module through switch selection which of the two power supply options will be used.
4. Check that the Common Logic Module, with network management, is in its proper position; it must be inserted in the very last slot on the right of the Hub.
5. Set the internal jumpers and switches in accordance with the specific requirements of your installation. Install modules in the enclosure slots as required by the configuration. See **Chapter 6** for module installation instructions.
6. Prepare and connect the required cabling to the installed modules.
7. When ready for operation, connect the mains power cord to the designated power receptacle on the back of the enclosure. The power receptacle must provide reliable, high-quality grounding. After the unit has been switched on, the fan will begin to operate.
8. Initialize LAMP TEST in order to check that all of the indicators are functioning properly.

After power connection, the Hub is ready for operation.

WARNING

Before switching on the Hub, verify that the protective earth terminals are connected to the protective connector of the mains cord. Only insert the mains plug in a socket outlet provided with a protective earth contact. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor.

4.5 Common Logic Module Setting and Installation

Before inserting the Common Logic Module (LT0005A-NMSNMP), the following switch settings must be set (details of each strap selection are given in **Table 4-1**).

- DCE-DTE—Set to DCE for direct connection to a management station.
- Bit Rate—Set the bit rate used on the RS-232/V.24 link connected to the RADview station (DIP switch selection can be 1, 2, or 3 bits).
- Address—If out-of-band management is in operation, each Hub must be assigned a unique management address that differs from any other Hub or other agent on the same out-of-band link. This address is entered on the binary-coded ADDRESS switch. Each binary address has five bits (32 addresses—Version 1.0) or eight bits (256 addresses—Versions 2.0 and 3.0) which correspond to the number of sections on the ADDRESS switch. For decimal to binary conversion, refer to Table A in **Appendix A**.

- Power Supply—An optional redundant power supply is available for additional reliability. Each power supply can support a fully loaded Hub. If the Hub is configured with a redundant power supply, make sure that both switches on the Common Logic Module are placed in the same position and that each power supply is switched ON. If the Hub was ordered with a single power supply, the appropriate switch must be set to ON.

Once all the straps have been set for the desired application, the following installation procedures should be carried out before inserting the module:

1. Before plugging in the electricity, the user must specify which of the two power supplies will be used and set the appropriate switch.

2. When the unit has been turned on, LAMP TEST should be performed in order to check that all the indicators are functioning properly. Press RESET to initialize the hardware and software.

3. If the Common Logic Module management system has been ordered, the user must first connect the connector to the supervisory port, either from the front of the card or from the back of the Hub enclosure. If for any reason the management address or bit rate of the Common Logic Module needs to be changed during a system operation, follow these steps:

   a. Remove the card and set the switches to the required position.

   b. Re-insert the card in the proper slot of the Hub.

Insertion of the Common Logic Module is straightforward:

1. Insert the module into the last slot. Check that the component side of the board faces to the right. Push the module into the slot until it reaches the end.

2. Press firmly on the module to fully insert it into the connector on the motherboard.

3. Secure the module by tightening its panel screw.

Table 4-1. Strap Selection.

Item	Function
DCE-DTE Selector	Selects the operating mode of the RS-232/V.24 interface: DCE—for direct connection to the RS-232 port DTE—for connection via a modem
ADDRESS Selector	The switch titled "AGENT ADDRESS" provides an eight-bit address. Note the LSB markings. An address of all "1"s is reserved for maintenance purposes.
Bit Rate Selector	The three furthest sections to the left of the switch SW1 determine the bit rate of the RS-232/V.24 interface. Bit Rate — Switch Setting 1 2 3 1.2 K — Down Down Down 2.4 K — Down Down Up 4.8 K — Down Up Down 7.2 K — Down Up Up 9.6 K — Up Down Down 14.4 K — Up Down Up 19.2 K — Up Up Down 38.4 K — Up Up Up
Power Supply Selector	Selects the power-supply source: PS1—ON for Power Supply 1 PS2—ON for Power Supply 2
AGENT COMM Selector (Versions 2.0 and 3.0 only)	Selects data rates for the out-of-band communication and Parity "ON" or "OFF." Parity "OFF" indicates 10-bit data (ID, 1 start, 1 stop).

4.6 Inserting Module Cards

Each slot in the 20-slot rack will accept any type of module, outside of the Common Logic Module. You don't have to power off the Hub to insert or remove modules, and this does not affect the operation of other modules already installed in the Hub.

CAUTION

Static electricity can severely damage micro-circuits. Avoid contact with components on the modules, and avoid placing them on metal surfaces.

1. Select an appropriate slot for the module, according to the required configuration.
2. Set the jumper settings as required (see **Chapter 6**).
3. Before insertion, check that the component side of the board faces to your right.
4. Slide the module into the slot until it is properly aligned with the connector of the motherboard.
5. Press gently on the module to fully insert it into the connector on the motherboard.
6. Secure the module by hand-tightening its panel screws.
7. If the rack unit is under power, the PWR LED will light.

4.7 Removing Module Cards

You don't have to power off the Hub to insert or remove modules, and this does not affect the operation of other modules already installed in the Hub.

CAUTION

Removal of a lobe access module that has termination set for "ON" may cause two separate rings to form a single ring. (The exception is if the adjacent ring is terminated by a Ring In module.)

1. Locate the module to be removed.
2. Loosen the panel screw holding the module in place.
3. Release the module by gently pulling the lever forward on its bottom grip.
4. Pull the module card clear of the card slot, avoiding contact with its components.

4.8 Connecting Redundant Power Supply

1. Disconnect all power from the Hub and place the Hub upside-down on a flat surface.
2. Remove the panel covering the opening for the additional power supply. The cover is held in place by four screws.
3. Connect the Molex connector of the cord attached to the power supply to the JP2 connector on the motherboard.
4. Place the power supply in the opening and align the holes on the power-supply cover with the holes on the unit enclosure.
5. Fasten the cover to the enclosure using the four screws provided in the installation kit.
6. Attach the rubber feet (provided in the installation kit) to the power supply cover using the adhesive surface. Affix the rubber feet to match the positions of the two rubber feet on the enclosure.

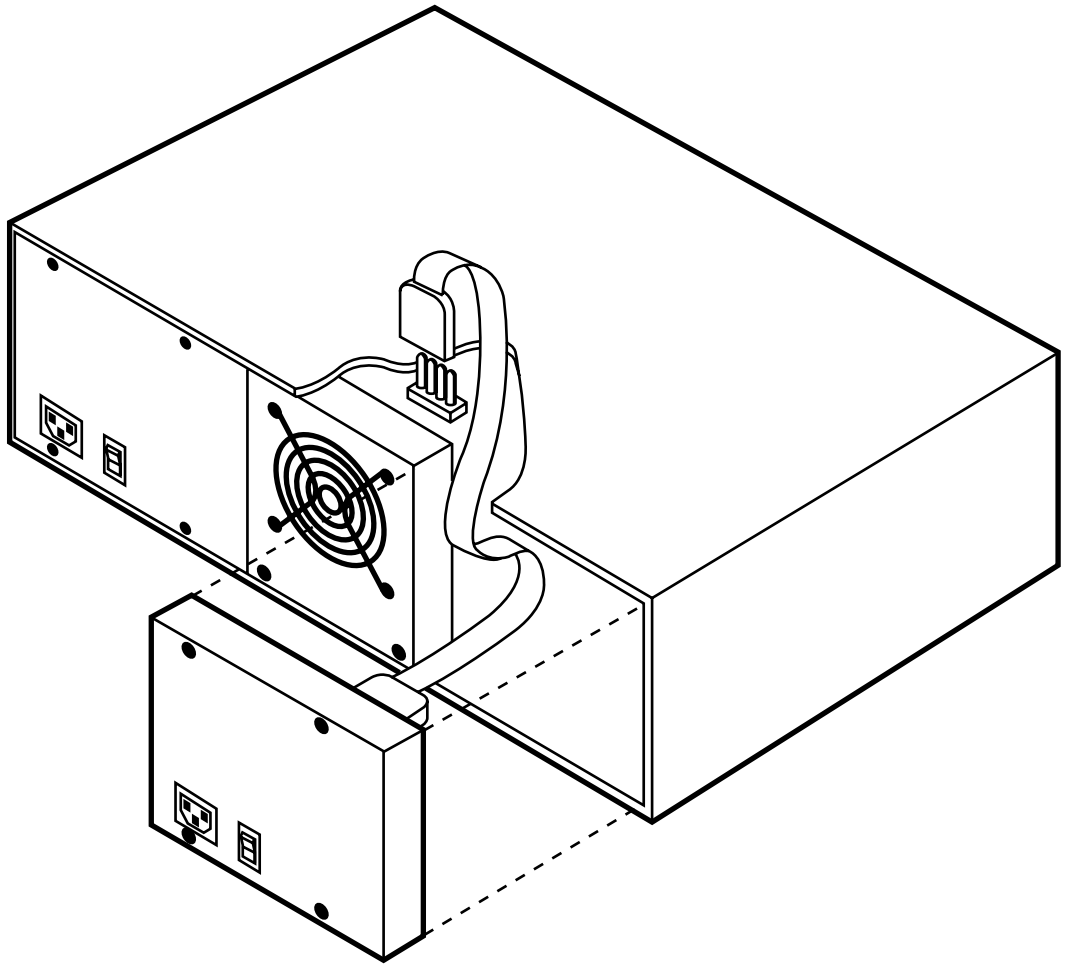

Figure 4-1. Connecting the Power Module.

4.9 Connector Types

RJ-45 Connectors

Table 4-2 lists the pin assignment and functions for the various types of RJ-45 connectors included in the modules.

Table 4-2. RJ-45 Connector Pin Assignment.

RJ-45 Pin	Corresponding IBM Cabling System Wire Color	Function Lobe Connector	RI RO
6 3	Orange Black	Transmit (TX) pair (from node) to module	Backup path
4 5	Red Green	Receive (RX) pair (from module) to node	Main path
7, 8	Shield		Connects wire shield to Hub shield

DB9 Connectors

Table 4-3 lists the pin assignment and functions for the various types of DB9 connectors.

Table 4-3. DB9 Connector Pin Assignment.

DB9 Pin	Corresponding IBM Cabling System Wire Color	Function Lobe Connector	RI RO
9 (8)* 5 (4)	Orange Black	Transmit (TX) pair (from node) to module	Backup path
1 (2) 6 (7)	Red Green	Receive (RX) pair (from module) to node	Main path
Case	Shield		Connects wire to Hub shield

*Numbers in parentheses are for T4SU ports.

4.10 Cabling

Cabling is one of the most critical components in any data network, especially in high-speed networks such as the Token Ring. Only by using high-quality cabling of certified performance, manufactured by reputable companies, can significant improvement in network reliability and performance be achieved. Cabling for use with Token Ring networks is usually classified in accordance with the closest-matching cable type specified by ICS, the IBM cabling system.

Table 4-4. Cabling.

Cable Types	Description	Approximate attenuation dB/km 4 Mbps	16 Mbps	Longest recommended segment (4 Mbps)	Next crosstalk @ 16 MHz
Type 1 Data Cable P/N 9688	Two shielded twisted pairs of #22 AWG solid copper conductors. Available: plenum, non-plenum	22	45	300 meters	-40 dB
Type 2 Data and Telephone Cable P/N 9689	Two shielded twisted pairs (as Type 1) plus four voice grade pairs #22 AWG	22	45	300 meters	-40 dB
Type 3 "Telephone Twisted pair" P/N 1227A	Available: 2, 3, 4 or 25 twisted pair of #24 AWG UTP	50	100	100 meters	-28 dB
Type 5 Fiberoptic Cable P/N EFN62A	Two multi-mode optical fibers in three grades: 50/100 62.5/125 100/140	 3 4 6	 3 4 6	Up to 3000 meters	None
Type 6 Patch Cord Cable	Two twisted pairs of #26 AWG with braided shield	33	66		
Type 9 Low Cost Data Cable	Two shielded twisted pair of #26 AWG copper conductors	33	66	200 meters	-34 dB

Call Technical Support for more information about cables.

SPECIAL CONSIDERATIONS

Impedance of STP and UTP

The normal characteristic impedance of unshielded twisted-pair (UTP) cable, e.g. IBM Type 3 cable, is 100 ohms, and that of shielded-twisted pair (STP) cable, e.g. IBM Type 1, 2, and 6, is 150 ohms.

Token Ring Network Interface Cards

Token Ring network interface cards use DB9 female connectors and are designed for STP (150 ohms) cables. Some NICs also provide interface to UTP via RJ-45 connectors.

Media Filters for UTP

When using UTP cabling, media filters must be installed on the Token Ring stations. The media filter performs the 100/150 ohm impedance conversion and signal filtering, and also adapts the DB9 station connector to the RJ-45 connectors used in UTP.

NOTE

Some adapter cards already contain the on-board media filter and RJ-45 connector.

Coaxial Cable Connection

Token Ring stations can be connected via a single (93-ohm) RG-62 coaxial cable. At the station end, a special balun (part number LT0005A-TXC) should be used to connect the adapter card (equipped with DB9 connector) to the BNC connector of the coaxial cable.

4.11 Module Placement Guidelines

4.11.1 MANAGEMENT CARDS

The Common Logic Module is always installed in the far right-hand slot (slot 21).

In order to use the In-Band Management Module, a Common Logic Module with compatible software and hardware versions must be installed. Up to two rings per Hub may be installed with In-Band Management Modules. In-Band Management Modules can be placed anywhere within the ring.

4.11.2 RING SEPARATION

Install the TL/2 and TL/4 modules serving one ring side by side, in one continuous cluster. There can be empty slots between modules; the signal continues along the backplane to the next station that is inserted into the ring.

Make sure you don't mix data rates within a single ring. Each individual ring contains a group of TL-2 and/or TL-4 modules, surrounded by ring terminators. The Ring In module is on the left side of the ring and the Ring Out module is on the right. Ring separation is achieved in two ways:

Lobe access module termination

TL modules can be configured as a ring terminator, providing separation between the module group to the left (with which the access module is associated), and the module group to the right (with which the access module is not associated). Termination of the module provides loopback of main to backup path in both directions.

RI/RO module termination

The TIO, TFR, TCR, and TFC modules can be configured as Ring In or Ring Out modules. By inserting one or two RI/RO modules between two groups of lobe access modules, two separate rings are automatically formed.

The TCP option should be set to "ON" on both the RI and RO modules to enable wraparound to a backup path in case of cable malfunction.

Before removing a ring separator (RI/RO module or terminated lobe access module), make sure that the adjacent ring is properly terminated. Otherwise, two rings may be joined together, causing unexpected errors (for example, mixed data rates).

4.11.3 Jitter Attenuator

The TJA module can be placed anywhere within the ring to provide guaranteed lobe distances, higher station counts, and simplified network design. For design recommendations, see **Chapter 7**.

4.12 Replacing the Ventilation Fan

1. Remove the four screws holding the power supply to the Hub enclosure. The screws are marked 1 through 4 on the illustration below.
2. Remove the four screws, marked **a** through **d**, that attach the fan to the faceplate.

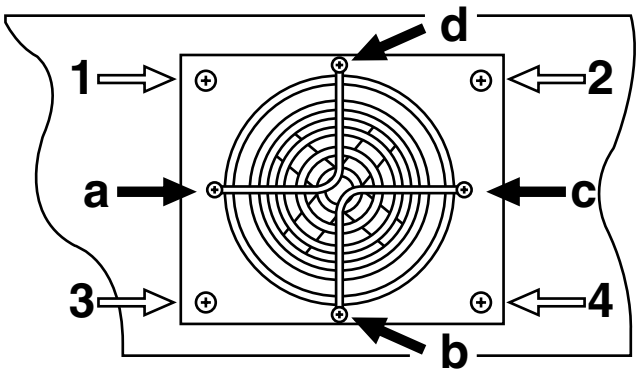

Figure 4-2. Four Screws on the Basic Module.

3. Disconnect the connector terminating the fan wires from the Hub.
4. Cut the fan wires approximately at mid-length and discard the fan.

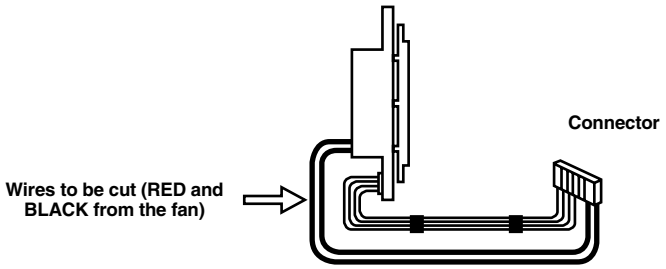

Figure 4-3. Cutting the Wires.

5. Attach the wires of the replacement fan to the connector wires using the joiner supplied in the replacement kit. Be sure to attach the RED wire to the BLACK fan wire. When the wires are inserted in the joiner, press firmly on the joiner top to lock the wires in place.

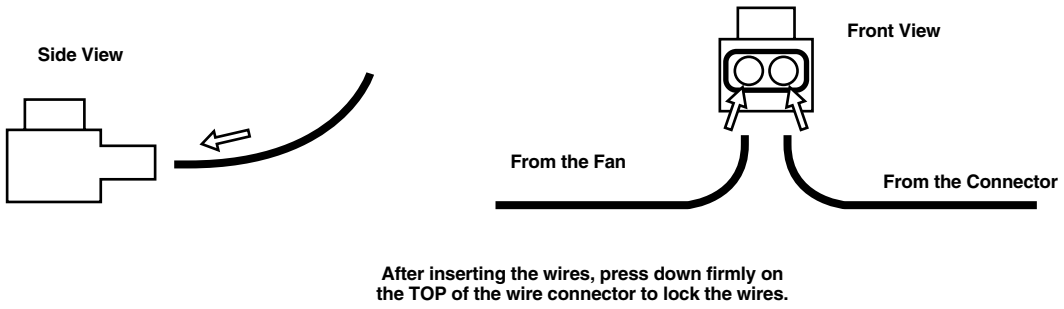

Figure 4-4. Attaching the Wires of the Replacement Fan.

6. Reattach the connector to the Hub.
7. Reattach the fan to the faceplate using the screws **a** through **d**.
8. Secure the faceplate to the Hub enclosure with screws 1 through 4.

5. Operation

5.1 Operating Procedure

After completion of System Installation Procedures (**Chapter 4**), attach the AC power cord to the Hub and then plug it into an outlet provided with a protective earth contact.

NOTE

Before plugging the unit into an electrical outlet, make sure that the power-supply switch or switches are set on the Common Logic Module according to the desired use.

CAUTION

The Hub should always be grounded through the protective earth lead of the power cables.

The protective action must not be negated by using an extension cord without a protective conductor (grounding).

If you are using a redundant power supply, connect its power cord, too.

5.1.1 Initialization

Once the power cables are connected, turn on the Power switch(es) on the back panel of the Hub. If everything is working, the power switches will light as well as all of the green power (PWR) LEDs of the modules.

PS1 only:	PS2 only:	With redundant power supply:
PS1 set to ON	PS1 set to OFF	PS1 set to ON
PS2 set to OFF	PS2 set to ON	PS2 set to ON

Verify that the ON LEDs on the Common Logic Module are functioning properly. If there is any type of failure, however, the FLT LED will light, indicating that there is a failure in the corresponding power supply.

5.1.2 Operation

The Hub operates entirely unattended. Operator intervention is only required when a cable fault exists, or when the DC power supply has failed.

The Hub can be monitored and controlled from the Hub management station. Alternatively, the Hub status can be monitored from the front panel.

5.2 Diagnostics and Troubleshooting

All of the modules use a common set of indicators.

- PWR—This green LED lights when the module receives power from the backplane.
- MNG—This green LED lights when a command received from network management is being executed on the individual card.

Power LED does not light:

- Check that the module is properly inserted in the slot. Remove and reinsert it if necessary.
- Check whether the other Hub modules have power. If not, check that the power cable is connected and switch is on. Check the fuse and power supply. If it is blown, replace.
- Check whether a different module has power when inserted in this slot: If not, there may be a problem on the backplane.

  If a different module does have power in this slot, the malfunction is in the module card itself. Try to replace the fuse on the module card.

Management LED lights:

- This indicates that a management operation is currently in process. This may be from the management station or an automatic recovery initiated by the Common Logic/IB agent.

Modules can be divided into a few different types, based on their LEDs and troubleshooting procedures: Lobe modules, Ring In/Ring Out modules, TRE modules, STC modules, Management modules, and MLB-T.

5.2.1 Lobe Modules

These are the lobe modules:

- T4AS
- T4AU
- T4ASD
- T4ASU
- TEDS
- TEDU
- EDU
- T2F
- T2FS
- T2FSA
- TF1300
- T4CX
- T4S
- T4U
- T4SD
- T4SU

These modules have PWR, MNG, and PORT LEDs. PORT LEDs show the status of the network connection:

- PORT LED continously ON—Station inserted into ring
- PORT LED continously OFF—Station bypassed
- PORT LED blinking—Port disabled by management

In addition, the active T4 modules have 4M and 16M LEDs, indicating data rate configured for operation. The TEDS and TEDU modules have a TLR LED, indicating operating mode.

Port LED does not light (station bypassed)

A workstation is automatically bypassed whenever:

It becomes inactive.

Its port connector is unplugged.

Bit rate mismatching is detected.

It receives a disable command from Network Management.

- Check whether station is active.
- Check cable connections between station and lobe.
- Make sure that the bit rate is correctly configured.
- Do diagnostic test at stations side to see if any malfunction was recorded.

Blinking Port LED (port disabled by management)

Check at management station to see any events indicating reason for disabling the port.

5.2.2 RI/RO Modules

Ring In/Ring Out consist of the following:

TIO, TFC, T1ST, T2ST, TI1300, T2SM, T2ST, T21300, TCR, TFR, TST, T1300, TXC

All of the Ring In/Ring Out Modules share a common set of LEDs, which are presented in the table below.

Table 5-1. Ring In/Ring Out Module Indicators.

LED Name	Color	Meaning
FLT	Red	Cable break detected automatic loopback performed
4	Green	Module is selected to operate at 4 Mbps rate
16	Green	Module is selected to operate at 16 Mbps rate
RI	Green	Module configured as Ring In
RO	Green	Module configured as Ring Out

FLT LED lights (cable-break detection)

- Check all cable connections.
- Check unit connected to other end for connections and power status.

5.2.3 Common Logic Module

The Common Logic Module has a FLT LED that indicates module faults.

FLT LED lights

- Check the module's connections. Try the Reset button.
- Check the module's fuse. If it is faulty, replace it.
- Check the power-supply units. The Common Logic Module requires a power supply of 5.2–5.5 VDC. Replace the power-supply modules if they do not meet this requirement.

5.2.4 TRE Modules

The TRE module LEDs are presented in **Table 5-2**.

Table 5-2. TRE Module Indicators.

LED Name	Color	Meaning
POWER	Green	ON when unit is powered on
MNG	Green	Lights when a command received from network management is being executed on the TRE module
READY	Green	ON when packets can be transferred BLINKS when TREs are synchronized but remote workstation did not require insertion. BLINKS FAST during the insertion process of a remote workstation into the ring
4	Green	Module is selected to operate at 4 Mbps
16	Green	Module is selected to operate at 16 Mbps
MAIN	Green	Module is configured as Local
REMOTE	Green	Module is configured as Remote
LAN TX	Yellow	Packet is transmitted to LAN
LAN RX	Yellow	Packet received from LAN
LAN ERR	Red	ON during insertion into the LAN, or when conection to LAN failed BLINKS when LAN interface indicates an error
LINK TX*	Yellow	Packet transmitted to link
LINK RX*	Yellow	Packet received from link
LINK ERR*	Red	BLINKS when serial link interface received error: When the link is disconnected, or When the TREs are synchronized and communication errors are reported

*The TRE-1D and TRE-8D have an LED for each of the two link channels.

6. Installing and Using Modules

6.1 Modules

The modules for the Hub are divided into the following groups:

Lobe Access Modules

- T4AS—Four-Lobe Active Module with STP and Dual Slot (**Section 6.2**)
- T4ASD—Four-Lobe Active Module with STP and Single Slot (**Section 6.2**)
- T4AU—Four-Lobe Active Module with UTP Connector (**Section 6.2**)
- TEDS—Two-Lobe Extended Distance with STP (**Section 6.3**)
- TEDU—Two-Lobe Extended Distance with Screened UTP (**Section 6.3**)
- T2FS—Two-Lobe Fiber Module with ST Connector (**Section 6.4**)
- T4CX—Four-Lobe Module with Coax Connector (**Section 6.5**)
- T4S—Four-Lobe Module with STP Connector, Double Slot (**Section 6.6**)
- T4SD—Four-Lobe Module with STP Connector, Single Slot (**Section 6.6**)
- T4SU—Four-Lobe Module with Shielded RJ-45 (**Section 6.6**)
- T4U—Four-Lobe Module with UTP Connector (**Section 6.6**)

Ring In/Ring Out Modules

- TIO—Ring In/Ring Out Module (**Section 6.7**)
- TFC—One-Channel Fiberoptic Converter with SMA Connector (**Section 6.8**)
- T1ST—One-Channel Fiberoptic Converter with ST Connector (**Section 6.8**)
- T2ST—Two-Channel Fiberoptic Converter with ST Connector (**Section 6.8**)
- TCR—4/16 Mbps Copper Repeater (**Section 6.9**)
- TST—4/16 Mbps Fiberoptic Repeater with ST Connector (**Section 6.10**)
- TXC—Token Ring to Coax Converter (**Section 6.11**)

Ethernet Segment Modules

- EPAUI—Four UTP Ports and One AUI Port (**Section 6.12**)
- EPRAUI—Four UTP Ports and One AUI Port w/o Ethernet Backplane (**Section 6.13**)
- EPFL2—Four Port 10BASE-T Module with two 10BASE-FL Ports (**Section 6.14**)
- EPRFL2—Four Port 10BASE-T Module with two 10BASE-FL Ports w/o Ethernet Backplane (**Section 6.15**)
- 4TFL—Four Port 10BASE-FL Module (**Section 6.16**)
- EP8T—Eight Ethernet Ports (**Section 6.17**)

- EPR8T—Eight Ethernet Ports w/o Ethernet Backplane (**Section 6.18**)

Elementary Bridges

- 8D35—Token Ring Extender Module (**Section 6.19**)
- MLB—Token Ring Local Bridge (**Section 6.20**)
- FTB—Token Ring to FDDI Bridge (**Section 6.21**)

Special Functions

- TJA—Jitter Attenuator Module (**Section 6.22**)

Network Management

- IB—In-Band Management Agent Module (**Section 6.23**)
- CMLIB—In-Band Management Agent Module for Ethernet (**Section 6.24**)

6.2 Four-Lobe Active Module

6.2.1 Description

The Four-Lobe Active Module is a modular plug-in wiring concentrator for interconnecting workstations to the Token Ring network. The Module meets all the applicable IEEE 802.5 and IBM Token Ring requirements, and supports both 16- and 4-Mbps networks. The Module monitors and checks station bit rate before inserting into the ring. When operating at 16 Mbps, the Module performs signal retiming and reshaping at each port. The Module performs all the functions of the IEEE 802.5 station access unit, including automatic station bypass on cable disconnection.

The Modules are compatible with the RADnet Network Management System. LEDs are provided to indicate port status for each lobe interface, power, and management status.

The Module is available in three interface versions:

LT0005A-T4AS

Module with four DB9 connectors, occupying two slots. This version is intended mainly for use with shielded twisted pair (STP) cables, such as IBM Type 1. Up to 10 Modules can be installed within the Hub enclosure for connection of up to 40 workstations via STP cable.

LT0005A-T4ASD

High-density module with two DB9 connectors, occupying one slot. Each connector supports two workstations. This version is intended for use with shielded twisted-pair (STP) cables, such as IBM Type 1. Up to 20 Modules can be installed in the Hub enclosure for connection of up to 80 workstations.

LT0005A-T4AU

Module with four RJ-45 connectors, occupying one slot. This version is intended for use with unshielded twisted pair (UTP) cables, such as IBM Type 3. Up to 20 Modules can be installed within the Hub enclosure, permitting the connection of up to 80 workstations to the Token Ring via UTP cables.

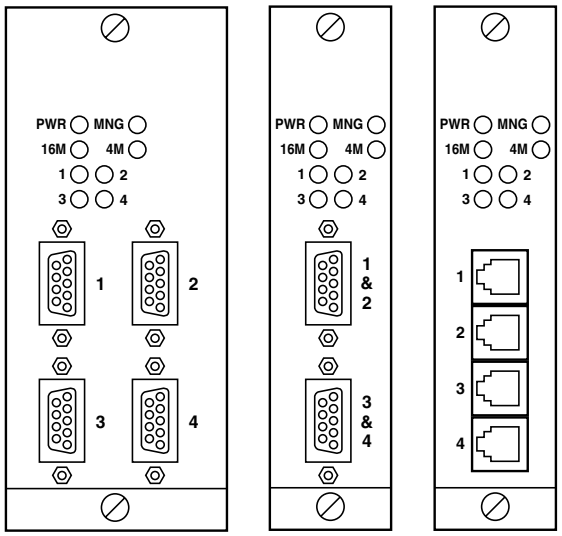

Figure 6-2-1. Four-Lobe Active Modules.

The Module has the following front-panel controls and indicators.

- PWR—Power On (green). Lights when the Module receives power.
- MNG—Module under network management control (green). Lights when bypass command is being forced by the Management System on at least one of the Module's ports.
- PORT—Four port-status indicators (green). Light when the station connected to the corresponding port is inserted into the ring. Flash when the port is disabled by network management, or disabled automatically when inconsistent bit rate is detected.
- 4m, 16m—Data-rate indicators (green). Lights when the module is configured to operate at that data rate.

6.2.2 SETUP

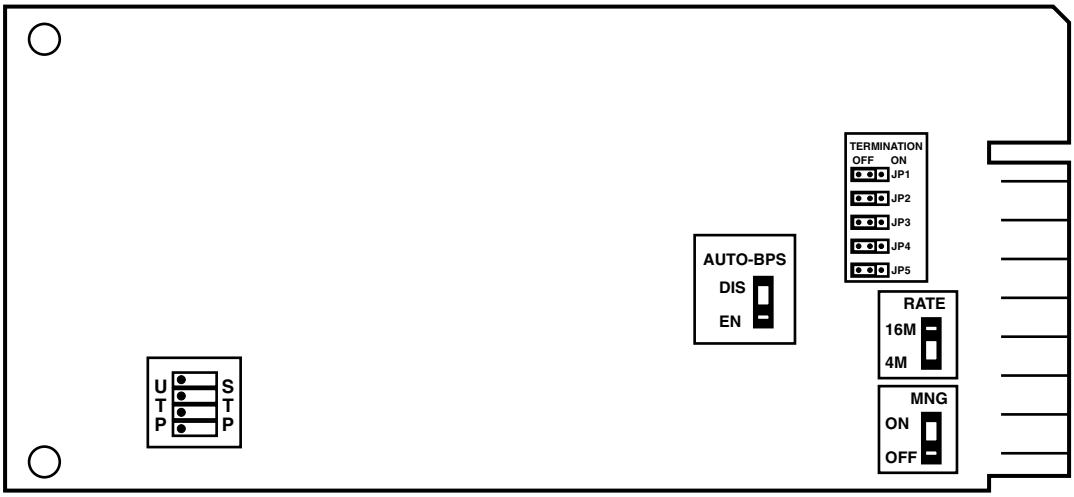

Figure 6-26. Module Strapping Diagram.

Table 6-2-1. Module Jumper Settings.

Strap Identity	Function	Possible Settings	Factory Setting
UTP/STP	Selects cable type	UTP or STP	UTP
TERMINATION	Enables physical separation between two LANs	OFF ON	OFF
RATE	Selects data rate	4 or 16 Mbps	16 Mbps
MNG	Selects management control source	OFF (jumper settings) ON (management station)	OFF
AUTO-BPS	Enables/disables the auto-bypassing function	EN or DIS	EN

1. Set the four UTP/STP jumpers (one for each port) to: UTP for lobe connection of UTP (IBM type 3 or compatible) cables, or STP for lobe connection of STP (IBM Type 1) cables.

2. Set the five Module TERMINATION jumpers to:

   ON if a physical separation is desired between two Token Rings. When the Module is positioned as the (furthest right) end card of the Module group, it functions as the terminating card.

   OFF if no physical separation is desired between modules to its left and to its right.

3. Set the RATE jumper to: 4 or 16 Mbps, according to the ring rate.

4. Set the MNG jumper to:

   OFF if the card setup should be determined by the jumper positions.

   ON if the card setup should be determined by the management station.

5. Set the AUTO-BPS jumper to:

   EN to enable automatic port bypassing, which can occur during the stations open process. The station will be bypassed automatically when it tries to insert into a ring with an incompatible data rate.

6.2.3 Installation—T4AU, T4ASD

The T4AU and the T4ASD modules occupy one slot of the Hub enclosure and can be inserted into any free position. Install the modules serving one ring side-by-side, in one continuous cluster.

NOTE

These modules can be installed or removed while power is applied to the enclosure without affecting the operation of the network, unless it is set to termination "ON."

1. Plug the module into a free enclosure slot, as marked on the site installation plan.
2. Fasten module via its panel screw. Do not overtighten.
3. If installing the T4ASD, you can use a Y cable to connect two workstations to each port.
4. If installing the T4U, use a media filter at the workstation side if the adapter card is without UTP interface.

NOTE

When using a group of access modules without retiming, we recommend that you place a Jitter Attenuator module between a group of active modules and a passive group of modules.

To minimize the accumulated jitter and achieve maximum station count with optimal performance, we recommend that you use a Jitter Attenuator module after every 30–40 stations connected to active modules.

6.2.4 Installation—T4AS

The T4AS occupies two slots of the Hub enclosure and can be inserted into any free position. Install the modules serving one ring side-by-side, in one continuous cluster.

NOTE

The 4AS can be installed or removed while power is applied to the enclosure without affecting the operation of the network, unless the module is set to terminate.

1. Identify the two slots allocated to the module or the installation plan.
2. Insert the interconnection card in the leftmost of the two slots assigned to the Module. Make sure that the card fits into the motherboard connector.
3. Insert the Module itself in the rightmost of the two slots assigned to the 4AS, and fasten the module by its panel screw.
4. Refer to the site installation plan to identify the cables intended for connection to the module.
5. Connect the station cables to the module connectors.

6.3 Two-Lobe Extended Distance Module

6.3.1 Description

The Two-Lobe Extended Distance Module—with STP (LT0005A-TEDS) and the Two-Lobe Extended Distance Module—with Screened UTP (LT0005A-TEDU) are modular plug-in wiring concentrators for connecting two independent workstations to the Token Ring network over extended distances. They can be configured as a wiring concentrator or a lobe repeater.

The Two-Lobe Extended Distance Module meets all the applicable IEEE 802.5 and IBM Token Ring requirements, and supports both 16 and 4 Mbps networks. The Module performs all the functions of the IEEE 802.5 station access unit, including automatic station bypass on cable disconnection. The signal is regenerated at each lobe interface, ensuring station access at extended lobe distances.

The modules are compatible with the RADnet Network Management System. LEDs are provided to indicate port status for each lobe interface, power and management status, and lobe repeater mode.

The Module is available in two interface versions:

- Module (part number LT0005A-TEDS) with two DB9 connectors, occupying one slot. This version, is intended mainly for use with shielded twisted-pair (STP) cables, such as IBM Type 1. Up to 20 modules can be installed within the hub enclosure for connection of up to 40 workstations via STP cables.

• Module (part number LT0005A-TEDU) with two shielded RJ-45 connectors, occupying one slot. This version is intended for use with Screened Twisted-Pair cables. Up to 20 modules can be installed within the hub enclosure, permitting the connection of up to 40 workstations.

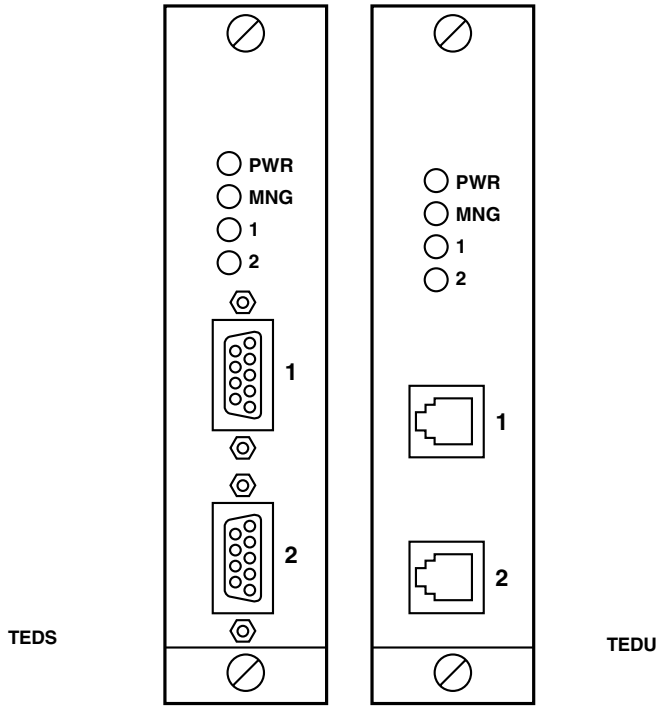

Figure 6-3-1. Two-Port Extended Distance Module.

The Module has the following controls and indicators:

• PWR—Power On (green). Lights when the Module receives power.

• MNG—Module under network management control (green). Lights when bypass command is being forced by the Management System on at least one of the Module's ports.

• PORT—Two port-status indicators (green). Light when the station connected to the corresponding port is inserted into the ring. Flash when the port is disabled by network management.

• TLR—Lights when module is in TLR mode (green).

6.3.2 MODULE SET-UP

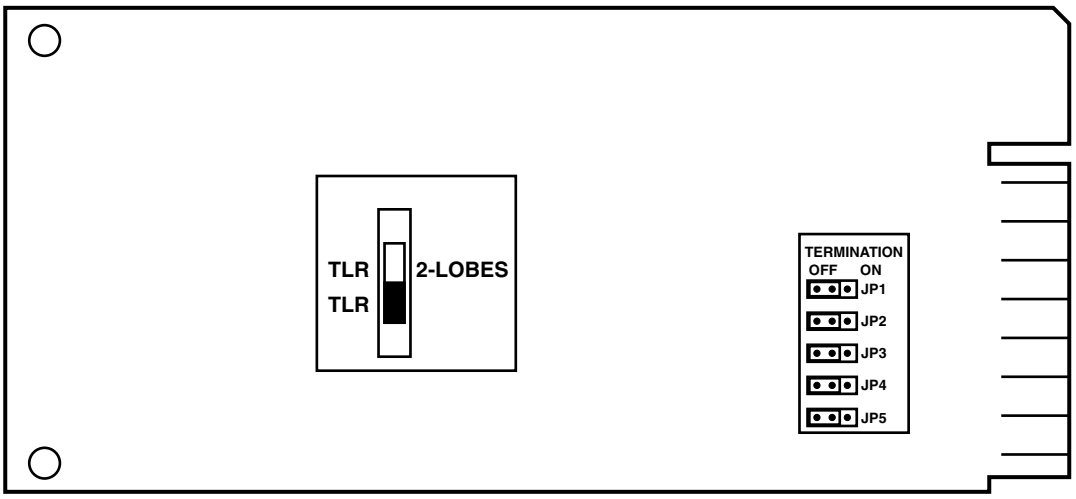

Figure 6-3-2. Module Strapping Diagram.

Termination Jumpers

Set the Module to termination ON if a physical separation is desired between two Token Rings. When the Module is positioned as the (furthest right) end card of the module card group, it functions as the terminating card.

Set the Module to termination OFF if no physical separation is desired between modules to its left and to its right.

TLR Mode

Set the TLR switch to 2-LOBES for standard configuration with two connected workstations. To configure the Module as a Token Lobe Repeater (for a single lobe), set this switch to TLR. When the Module is used as a lobe repeater, a jitter-attenuator module should be installed in the slot to the immediate left of the Module.

NOTE

These modules can be installed or removed while power is applied to the enclosure without affecting the operation of the network, unless it is set to termination "ON."

Table 6-5. Module Jumper Settings.

Strap Identity	Function	Possible Settings	Factory Setting
TERMINATION	Enables physical separation between two LANs	OFF ON	OFF
TLR	Enables Module to operate as a lobe repeater for a single lobe.	TLR	2-LOBES

6.3.3 Installation

The modules occupy one slot of the Hub enclosure and can be inserted into any free position. Install the modules serving one ring side-by-side, in one continuous cluster.

1. Plug the module into a free enclosure slot, as marked on the site installation plan.

NOTE

The modules can be installed or removed while power is applied to the enclosure.

2. Fasten module by means of its panel screw. Do not overtighten.
3. If installing the TL-2/EDU or TL-2/EDSU, use the RAD media filter MF-3 at the workstation side if the adapter card is without UTP interface.

6.3.4 Application

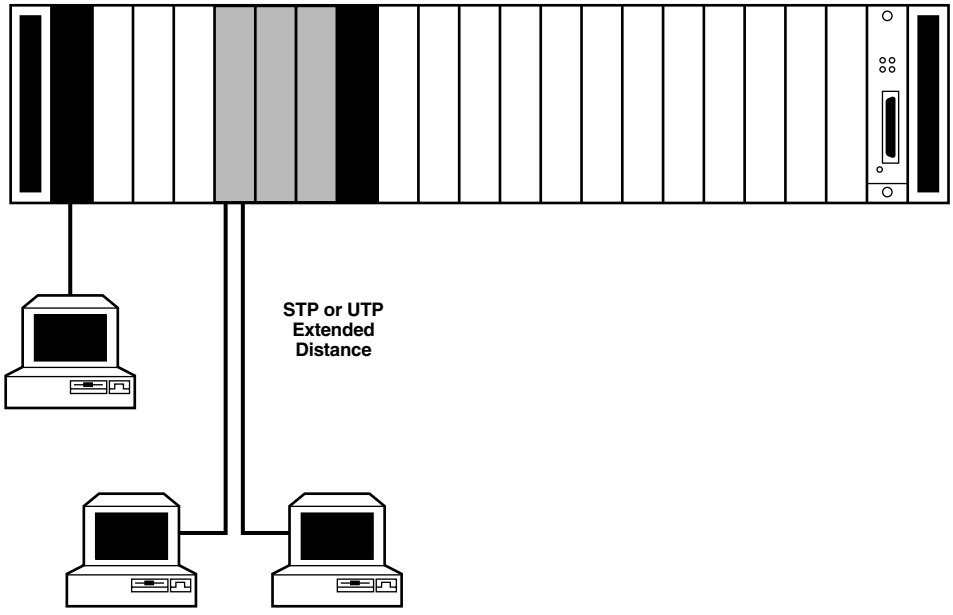

Figure 6-3-3. Extended Lobe Distances over UTP and STP.

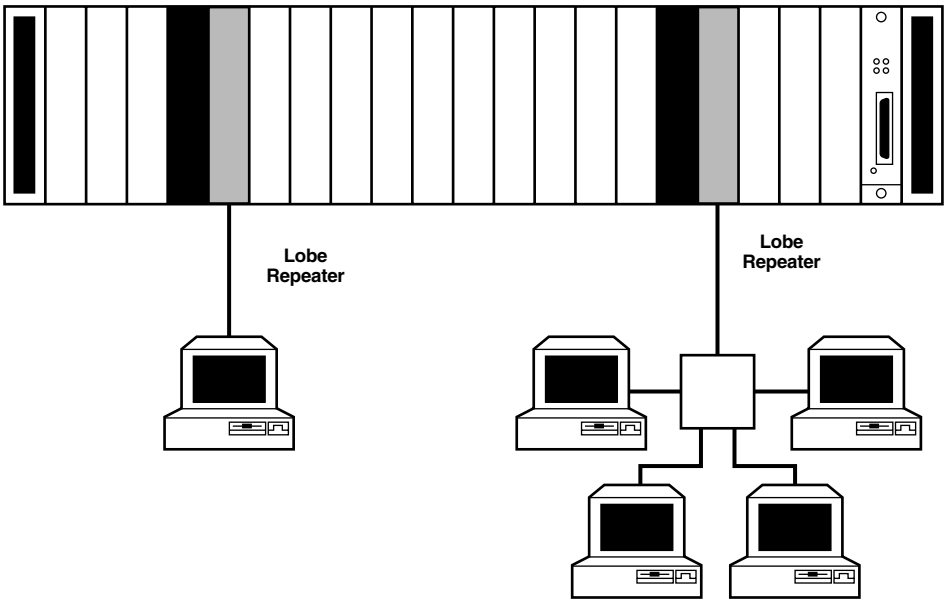

Figure 6-3-4. Module in Lobe Repeater (TLR) Mode.

6.4 Two-Port Fiber Module with ST Connector

6.4.1 Description

The Two-Port Fiber Module with ST Connector (LT0005A-T2FS) is a modular wiring concentrator for interconnecting workstations to the Token Ring network. The Module meets all the applicable IEEE 802.5 annd IBM Token Ring requirements, and supports both 16- and 4-Mbps networks. The Module performs all the functions of the IEEE 802.5 station bypass when the cable is disconnected.

The Two-Port Fiber Module is compatible with RADview Network Management System. LEDs are provided to indicate port status for each lobe interface, SAT option, power, and management status.

The Module has two sets of fiberoptic ST connectors, and occupies one slot. This version is intended for use with fiberoptic cable. Up to 20 Modules (for fiberoptic media) can be installed within the Hub enclosure, letting you connect up to 40 workstations to the Token Ring via fiberoptic cables.

As an option, the Two-Port Fiber Module can support management in a satellite configuration, providing autocorrelation and security features. The optional card that can be installed on the Module counts the satellite stations on each lobe and updates the agent accordingly.

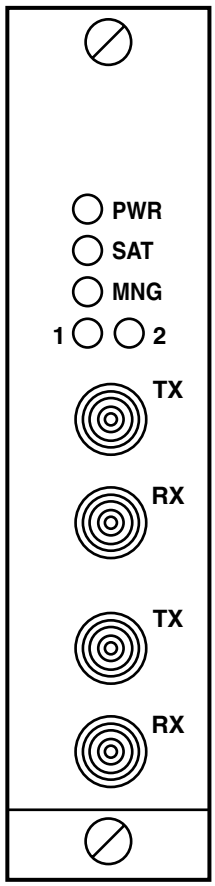

Figure 6-4-1. Two-Port Fiber Module.

The Module has the following LEDs:

- PWR—Power on (green). On when the Module receives power.
- SAT—SAT option on (green). On when the Module fully supports management features in a satellite configuration (the optional card is installed).
- MNG—Module under network management control (green). On when bypass command is being forced by the Management Station on at least one of the module ports.
- PORT 1, 2—Two port-status indicators (green). On when a station connected to the corresponding port is inserted into the ring.

6.4.2 Installation

The Two-Port Fiber Module occupies one slot of the Hub enclosure, and can be inserted into any free position. Always install the modules serving one ring side-by-side, in one continuous cluster.

1. Set the Module's jumpers according to the table below for the required application.
2. Identify the slot allocated to the Module on the installation plan.
3. Plug the Module into a free enclosure slot, as marked on the site installation plan. Make sure the card fits into the motherboard connector.

NOTE

The modules can be installed or removed while power to the enclosure is ON.

4. Fasten the module via its panel screw; do not overtighten.

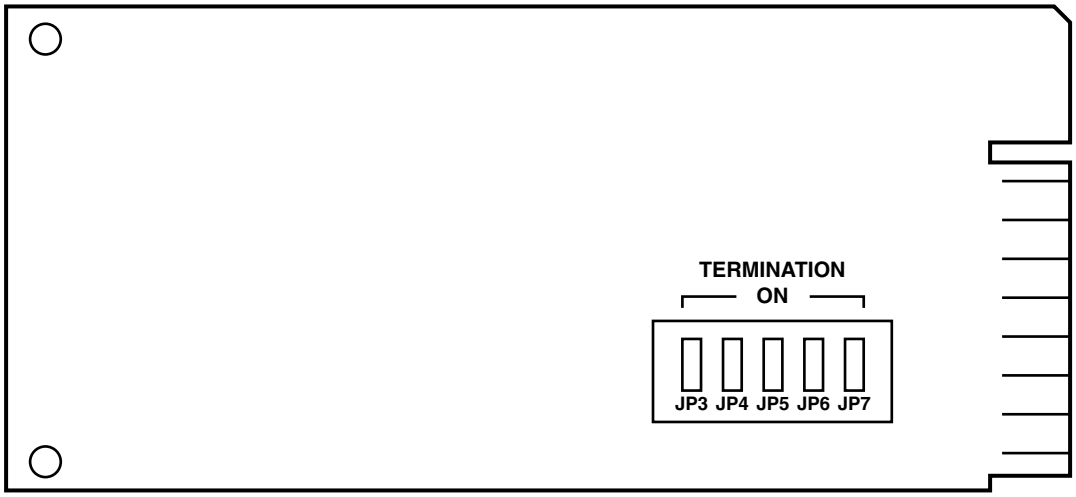

Figure 6-4-2. Jumpers on the Two-Lobe Fiber Module.

Table 6-4-1. Two-Lobe Fiber Module Jumper Setting.

Strap Identity	Function	Possible Settings	Function Setting
TERMINATION	Selects module for proper termination interface	OFF or ON for: JP3	OFF
		JP4	OFF
		JP5	OFF
		JP6	OFF
		JP7	OFF

6.4.3 APPLICATION

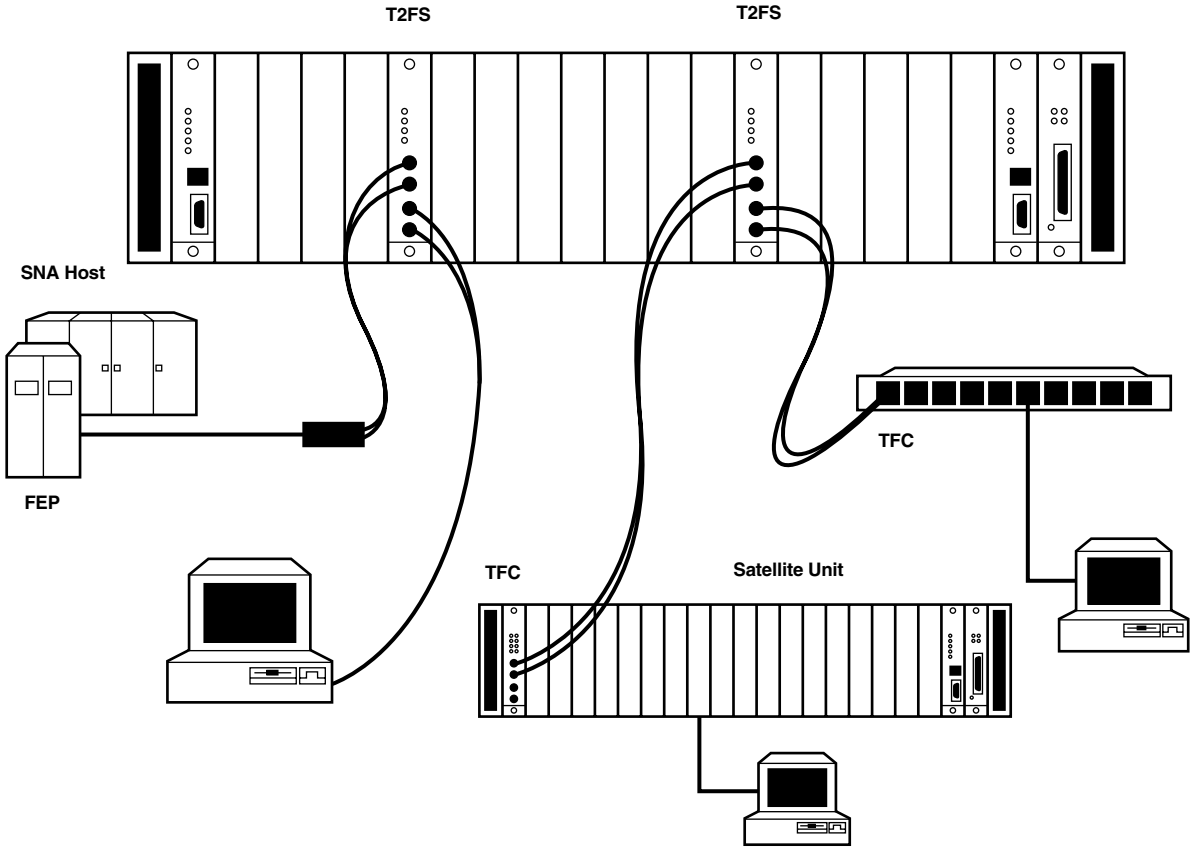

Figure 6-4-3. Typical Application.

6.5 Four-Lobe Module—with Coax Connector

6.5.1 Description

The Four-Lobe Module—with Coax Connector (part number LT0005A-T4CX) is a modular plug-in wiring concentrator for interconnecting workstations to the Token Ring network. The Module meets all the applicable IEEE 802.5 and IBM Token Ring requirements, and supports both 16- and 4-Mbps networks. The Module performs all the functions of the IEEE 802.5 station access unit, including automatic station bypass on cable disconnection.

The Module is compatible with the Network Management System. LEDs are provided to indicate port status for each lobe interface, power status, and management status.

The Module contains four BNC connectors, occupying one slot. This version is intended for use with RG 62 coaxial cables. Up to 20 T4CX modules can be installed within the hub enclosure, permitting the connection of up to 80 workstations to the Token Ring.

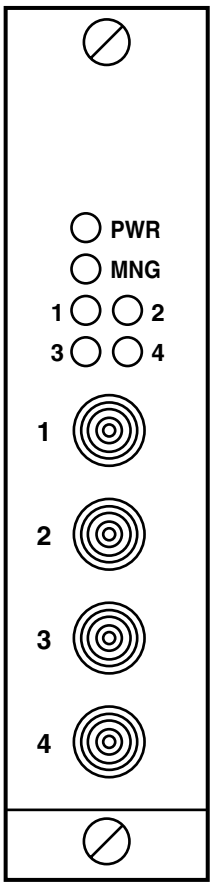

Figure 6-5-1. Four-Lobe Module—with Coax Connector.

The Module has the following front-panel indicators:

- PWR—Power On (green). Lights when the module receives power.
- MNG—Module under network management control (green). Lights when bypass command is being forced by the Management System on at least one of the module's ports.
- PORT—Four port status indicators (green). Light when the station connected to the corresponding port is inserted into the ring. Flash when the port is disabled by network management.

6.5.2 SET-UP

Termination Jumpers

Set the Module to termination ON if a physical separation is desired between two Token Rings. When the T4CX Module is positioned as the (furthest right) end card of the module card group, it functions as the terminating card.

Set the T4CX Module to termination OFF if no physical separation is desired between modules to its left and to its right.

Table 6-5-1. Jumper Settings.

Strap Identity	Functionn	Possible Settings	Factory Setting
TERMINATION	Enables physical separation between two LANs	OFF ON	OFF

6.5.3 INSTALLATION

The T4CX Modules occupy one slot of the Hub enclosure and can be inserted into any free position. Install the modules serving one ring side-by-side, in one continuous cluster.

NOTE

The T4CX Module can be installed or removed while power is applied to the enclosure, without affecting the operation of the network unless it is set to termination ON.

NOTE

A TXC balun should be used at the workstation site to convert the DB9 interface into coaxial interface.

1. Plug the module into a free enclosure slot, as marked on the site installation plan.

NOTE

The modules can be installed or removed while power is applied to the enclosure.

2. Fasten module by means of its panel screw. Do not overtighten.

6.5.4 Application

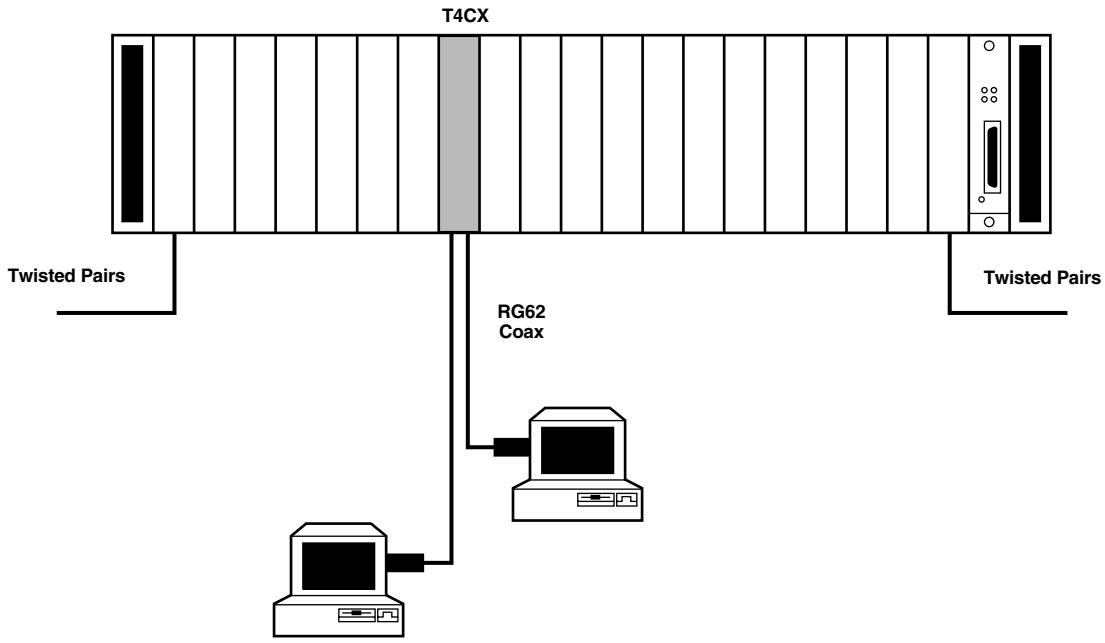

Figure 6-5-2. Connection to Workstation Through T4CX.

6.6 Four-Lobe Module

The Four-Lobe Module is a modular plug-in wiring concentrator for interconnecting workstations to the Token Ring network. The Module meets all the applicable IEEE 802.5 and IBM Token Ring requirements, and supports both 16- and 4-Mbps networks. The Module performs all the functions of the IEEE 802.5 station access unit, including automatic station bypass on cable disconnection.

The modules are compatible with the Network Management System. LEDs are provided to indicate port status for each lobe interface, power status, and management status.

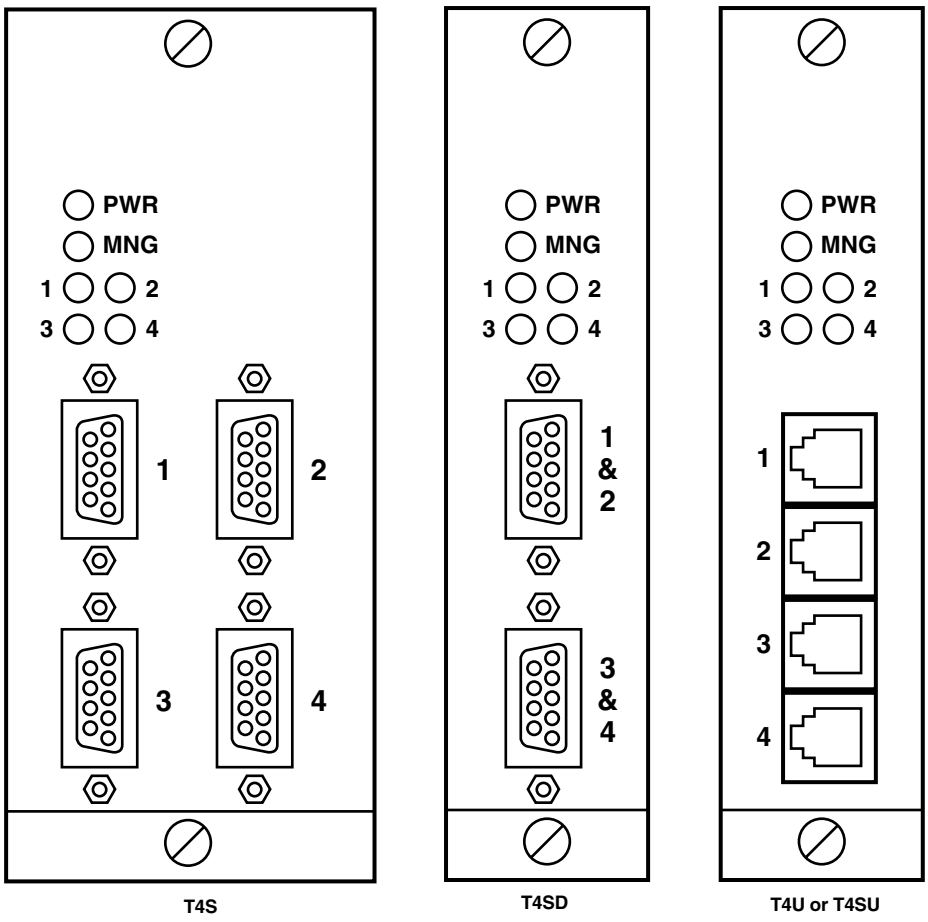

Figure 6-6-1. Four-Lobe Modules.

The Four-Lobe Module is available in five interface versions:

LT0005A-T4U

Module with four RJ-45 connectors, occupying one slot. This version is intended for use with unshielded twisted-pair (UTP) cables, such as IBM Type 3. Up to 20 modules can be installed within the hub enclosure, permitting the connection of up to 80 workstations to the Token Ring via UTP cables.

LT0005A-T4SU

Module with four shielded RJ-45 connectors, occupying one slot. This version is intended for use with Screened Twisted-Pair cables. Up to 20 modules can be installed within the hub enclosure, permitting the connection of up to 80 workstations.

LT0005A-T4SD

Module with two DB9 connectors, occupying one slot. Each connector supports two workstations. This version is intended for use with shielded twisted-pair (STP) cables, such as IBM Type 1. Up to 20 Modules can be installed in the Hub enclosure for connection of up to 80 workstations.

LT0005A-T4S

Module with four DB9 connectors, occupying two slots. This version is intended mainly for use with shielded twisted pair (STP) cables, such as IBM Type 1. Up to 10 Modules can be installed within the Hub enclosure for connection of up to 40 workstations via STP cables.

The Module has the following front-panel controls and indicators:

- PWR—Power On (green). Lights when the Module receives power.
- MNG—Module under network management control (green). Lights when bypass command is being forced by the Management System on at least one of the Module's ports.
- PORT—Four port-status indicators (green). Light when the station connected to the corresponding port is inserted into the ring. Flash when the port is disabled by network management.

6.6.2 Module Setup

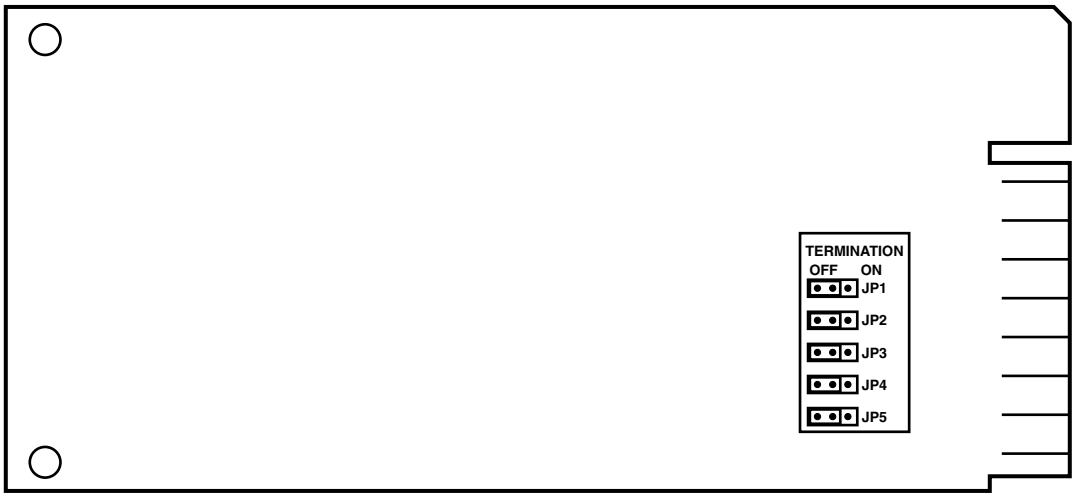

Figure 6-6-2. Module Strapping Diagram.

Table 6-6-1. Module Jumper Settings.

Strap Identity	Function	Possible Settings	Factory Setting
TERMINATION	Enables physical separation between two LANs	OFF	OFF
		ON	

Termination Jumpers

Set the Module to termination ON if a physical separation is desired between two Token Rings. When the Module is positioned as the (furthest right) end card of the module card group, it functions as the terminating card.

Set the Module to termination OFF if no physical separation is desired between modules to its left and to its right.

6.6.3 Installation—Single-Slot Modules

The T4U, T4SU, and T4SD modules occupy one slot of the Hub enclosure and can be inserted into any free position. Install the modules serving one ring side-by-side, in one continuous cluster.

Plug the module into a free enclosure slot, as marked on the site installation plan. Note: The modules can be installed or removed while power is applied to the enclosure.

Fasten module by means of its panel screw. Do not overtighten.

If installing the T4SD, a Y cable can be used to connect two workstations to each port.

NOTE

These modules can be installed or removed while power is applied to the enclosure, without affecting the operation of the network unless it is set to termination "ON."

NOTE

If installing the T4U, use a media filter at the workstation side if the adapter card is without a UTP interface.

6.6.4 Installation—2-Slot Module

The T4S occupies two slots of the Hub enclosure and can be inserted into any free position. Install the modules serving one ring side-by-side, in one continuous cluster.

NOTE

The T4S can be installed or removed while power is applied to the enclosure without affecting the operation of the network, unless the module is set to terminate.

1. Identify the two slots allocated to the module or the installation plan.
2. Insert the interconnection card in the leftmost of the two slots assigned to T4S. Ensure that the card fits into the mother board connector.
3. Insert the module itself in the rightmost of the two slots assigned to T4S, and fasten the module by its panel screw.
4. Refer to the site installation plan to identify the cables intended for connection to this module.
5. Connect the station cables to the module connectors.

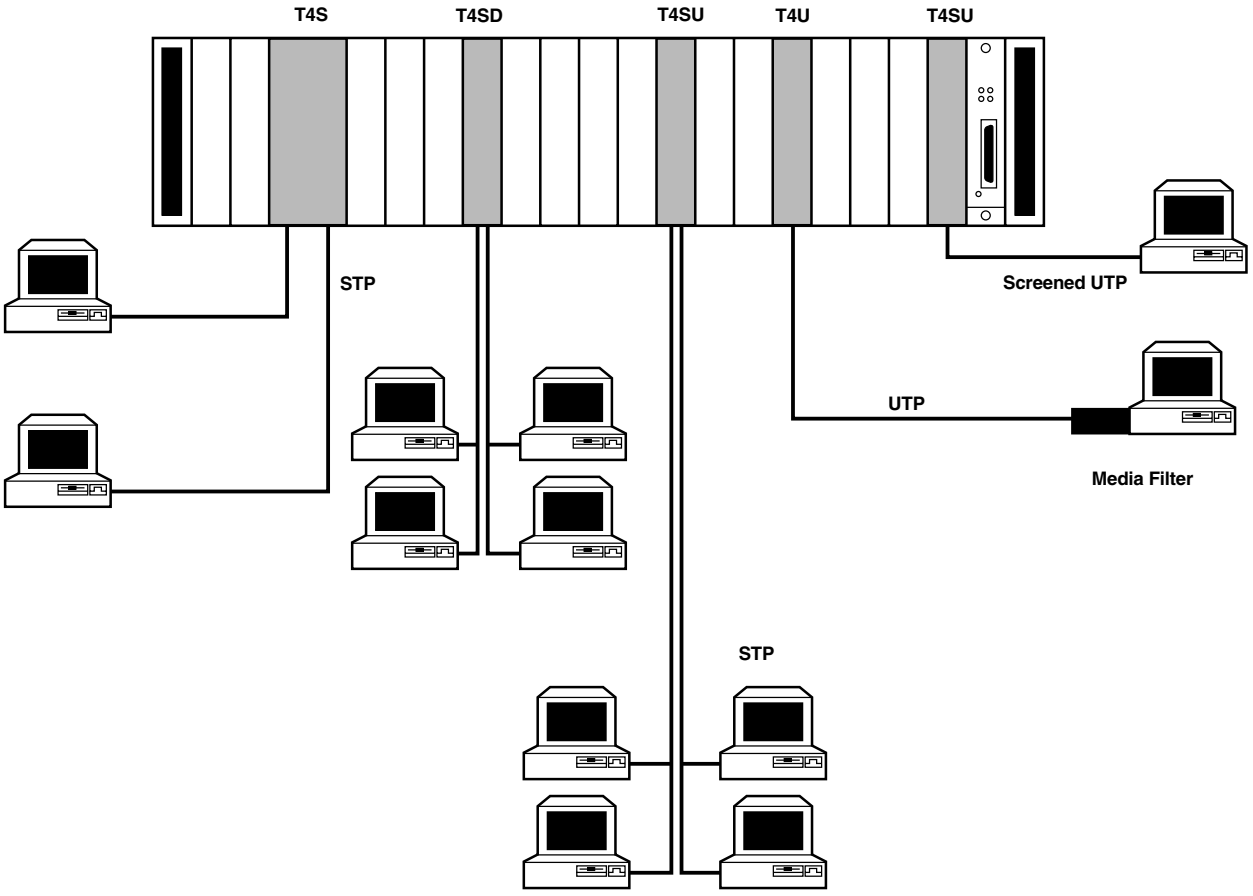

Figure 6-6-3. RI/RO Application.

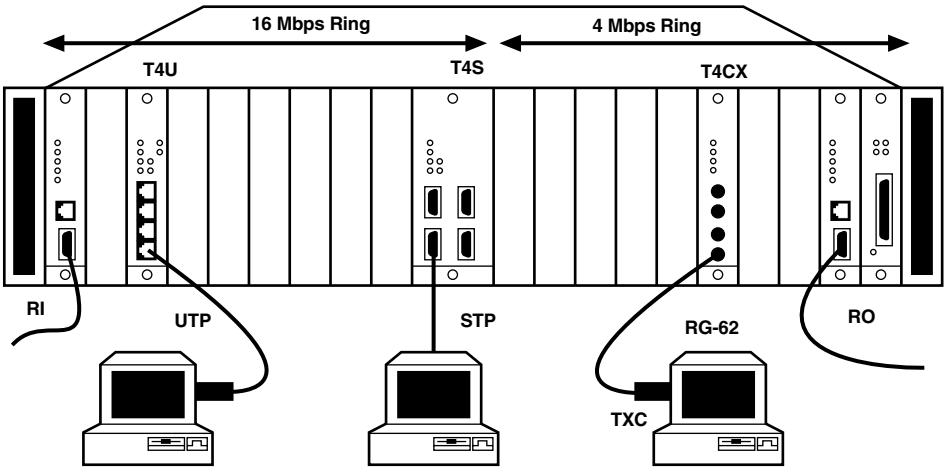

Figure 6-6-4. Termination Application.

6.7 TIO Ring In/Ring Out Module

The TIO, Token Ring In/Ring Out Module, is used for the direct connection of Token Ring shielded or unshielded twisted pair to the Modular Intelligent Hub. The TIO meets all the applicable IEEE 802.5 and IBM Token Ring requirements, and supports both 16- and 4-Mbps networks. The TIO can be placed at either end of the access-station modules group in order to provide a modular TAU.

The TIO has user-selectable automatic cable-break protection (TCP) with automatic loopback-on-cable-disconnect for both the Ring In and Ring Out ports (an electronic function similar to the short-circuiting feature of the IBM data connector).

The TIO module is compatible with the RADnet Management System. Status indicators are provided for Ring In/Ring Out interfaces, in addition to power, fault, and management indicators.

The TIO module comes with one DB9 ring connector, intended for use with shielded twisted-pair (STP) cable, such as IBM Type 1, and one RJ-45 connector, intended for use with unshielded twisted-pair (UTP) cables, such as IBM Type 3.

The TIO has the following indicators:

- PWR—Power On (green). Lights when the TIO module receives power.
- MNG—Module under network management control (green). Lights when a loop command is performed at the module.
- FLT—Lights when a cable break is detected (automatic loopback performed).
- RI—Lights when module configured as the ring in port (green).
- RO—Lights when module configured as the ring out port (green).

6.7.1 SET-UP

1. Set the TIO Ring In/Ring Out A (switch SW3) to:

- RI for the leftmost TIO module in cluster (RING IN of the access-station module group)
- RO for the rightmost TIO module in cluster (RING OUT of the access-station module group)

2. Set the TIO Ring In/Ring Out B (switch SW4/SW2) to:

- RI for the leftmost TIO module in cluster
- RO for the rightmost TIO module in cluster

NOTE

Both SW3 and SW1/SW2 switches must be set to either Ring In or Ring Out.

3. Set the TCP (cable-break protection switch) SW1 to:

- TCP enabled—Set cable protection switch to ON. Used only when connected to equipment operating opposite the Hub and having the TCP feature.
- TCP disabled—Sets corresponding section to OFF.
- TCP terminated—Forces the module into permanent loopback. (The fault indicator will not light up for a TERMINATION setting.)

4. Set the UTP/STP jumpers (JP2-JP5) to:

- UTP—For working with UTP (IBM Type 3 cables or compatible) or screened UTP cables, 100-ohm characteristic impedance.
- STP—For working with STP (IBM Type 1) cables, 150-ohm characteristic impedance.

NOTE

All four jumpers must be placed in the same position, whether it be UTP or STP. For the purpose of impedance matching, the inherent impedance difference between the two cables is 100 ohms for UTP and 150 ohms for STP.

Table 6-7-1. TIO Jumper/Switch Settings.

Strap Identity	Function	Possible Settings	Factory Setting
In/Out A	Selects module to be either Ring In or Ring Out	Ring In or Ring Out	RI
In/Out B	Selects module to be either Ring In or Ring Out	Ring In or Ring Out	RI
UTP/STP	Selects cable type	UTP or STP	STP
Cable Protection	Selects cable protection to ON, OFF, or TERMINATION	ON, OFF, or TERMINATION	ON

6.7.2 Installation

The TIO module occupies one slot of the Hub. Always install the TIO modules serving a ring so that they surround the access station modules: TIO RI module to the left, TIO RO module to the right. TIO modules can be installed or removed under power on conditions.

NOTE

Installing TIO modules in an operating ring, or removing them from it, may alter the configuration of the network.

To install the module:

1. Set jumpers to required settings
2. Plug the module gently into the designated enclosure slot indicated on the site installation plan. Fasten the module by means of its panel screw. Do not overtighten.
3. Refer to the site installation plan to identify the cables intended for connection to this module.
4. Connect the cables to the module connectors.
5. Check that one of the RI or RO indicators lights.

6.7.3 Applications

Application diagrams are presented on the next pages for:

- Hub with TAU and TCP
- Hub Integrated in MAU Network (without TCP)
- Standalone Network

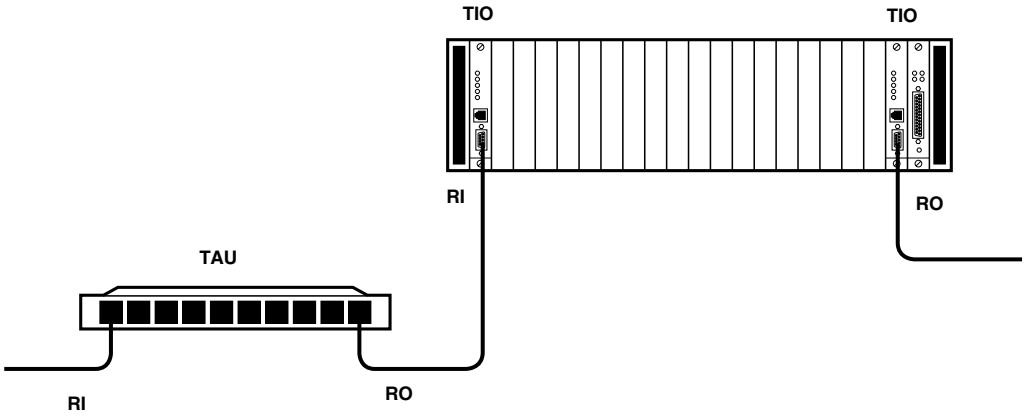

Figure 6-7-3. Hub with TAU and TCP.

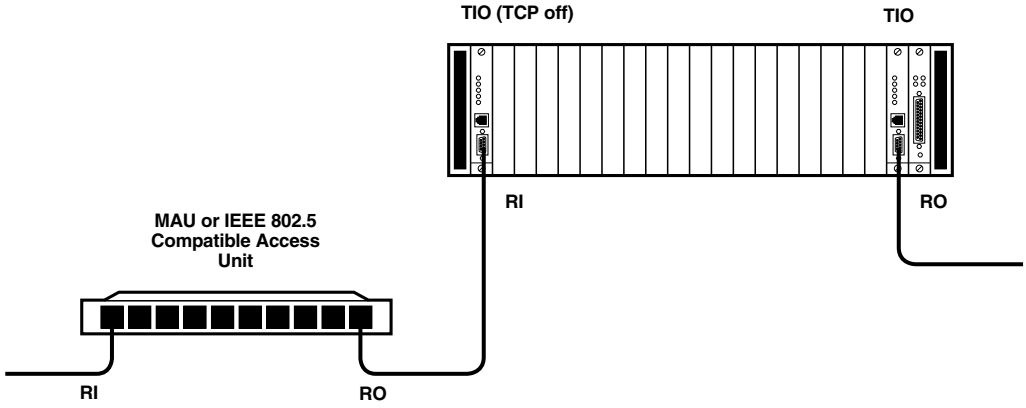

Figure 6-7-4. Hub Integrated in MAU Network (without TCP).

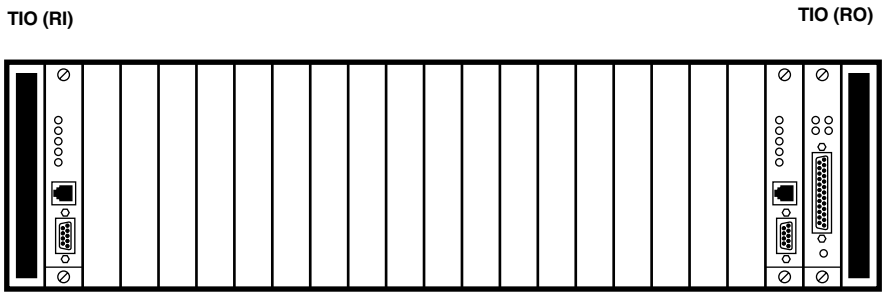

Figure 6-7-5. Standalone Network: Both TIO Modules Configured for Termination ON.

6.8 Fiberoptic Converters

6.8.1 Description

The Fiberoptic Converters (TFC, T1ST, T2ST) are used to connect adjacent hubs together, and enable the network to be expanded. They provide inexpensive signal conversion between copper and fiber media. Three models are available:

- TFC—One-Channel Fiberoptic Converter with SMA Connector
- T1ST—One-Channel Fiberoptic Converter with ST Connector
- T2ST—Two-Channel Fiberoptic Converter with ST Connector

These modules provide automatic cable-break protection and recovery. This ensures continued operation if a segment fails, so there is no single point of failure.

Front Panel Indicators

The TFC, T1ST, and T2ST modules each have the following front-panel indicators:

- PWR—Power ON (green). This LED lights when a loopback command is being forced by the management station.
- MNG—Module under management control (green). This LED lights when loopback command is being forced by the management station.
- FLT—ON when cable fault exists (red).
- RI—Lights when module is configured as Ring-In (green).
- RO—Lights when module is configured as Ring-Out (green).

6.8.2 Setup

Fiberoptic Converter Modules occupy one slot of the Hub enclosure. If you configured the module as RI, install the module to the left of the lobe access module cluster. If you configured the module as RO, install the module to the right of the lobe access module cluster.

1. Set the switches for the required application. Call Technical Support for more information.
2. Plug the module into the designated enclosure slot, as marked on the site installation plan. Fasten the module via one screw. Do not overtighten.
3. Refer to the site installation plan to identify the cables intended for connection to this module.
4. Connect the cables to the module connectors.
5. Check that on each module LEDs light according to the setup.

6.9 Token Ring Copper Repeater Module

6.9.1 Description

The TCR, Token Ring Copper Repeater Module, is used for extending the trunk distance between adjacent hubs over shielded or unshielded twisted pair. The TCR meets all the applicable IEEE 802.5 and IBM Token Ring requirements, and supports both 16- and 4-Mbps networks.

The TCR normally operates in pairs, with one unit placed at the RO (Ring Out) port to provide reclocking, reshaping and regeneration on the main ring data, and the other at the RI (Ring In) port to provide reclocking, reshaping and regeneration on the back-up ring data. The TCR performs all the functions of a copper repeater, in addition to cable-fault protection with network partitioning and jitter attenuation. It also supports monitoring and control by Network Management.

The TCR has user-selectable automatic cable-break protection (TCP) with automatic loopback upon cable fault or disconnection.

The module supports connection to UTP or STP on the same module, and provides a DB9 ring connector intended mainly for use with shielded twisted-pair (STP) cables, such as IBM type 1, and one RJ-45 connector intended mainly for use with unshielded twisted-pair (UTP) cables, such as IBM Type 3.

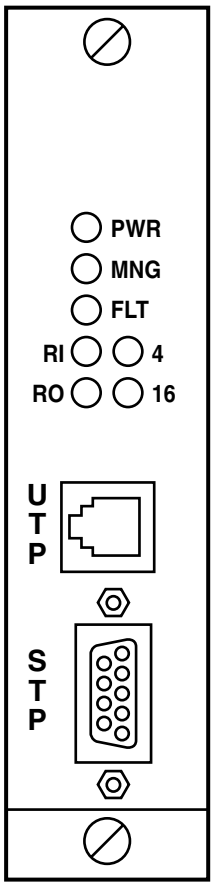

Figure 6-9-1. Copper Repeater Module.

TCR Front Panel Indicators

- PWR—Power On (green). Lights when the TCR module receives power.
- MNG—Module under network management control (green). Lights when loopback command is being forced by the management station.
- FLT—ON when cable fault condition exists (red).
- RI—Lights when module configured as Ring In (green).
- RO—Lights when module configured as Ring Out (green).
- 4—Lights when module selected to operate at 4 Mbps (green).
- 16—Lights when module selected to operate at 16 Mbps (green).

6.9.2 SET-UP

TCR modules occupy one slot of the Hub enclosure. Always install the TCR modules serving one ring to the sides of the lobe access module cluster: RI TCR to the left, RO TCR to the right. The modules can be installed or removed while power is applied to the enclosure.

1. Set the TCR switches according to the table below for the required application.
2. Plug the module into the designated enclosure slot, as marked on the site installation plan. Fasten module by means of one screw. Do not overtighten.
3. Refer to the site installation plan to identify the cables intended for connection to this module.
4. Connect the cables to the module connectors.
5. Check that on each TCR module LEDs light according to the set-up.

NOTE

Installation or removal of the TCR during network operation may affect the configuration of the network.

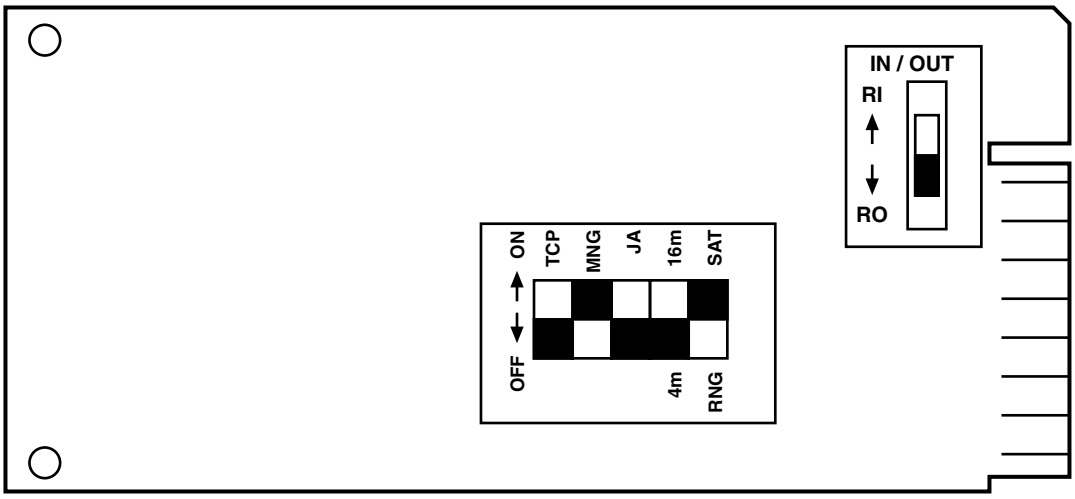

Figure 6-9-2. TCR Strapping Diagram.

Table 6-9-1. TCR Jumper/Switch Settings.

Strap Identity	Function	Possible Settings	Factory Setting
IN/OUT	Selects module to operate as either Ring In or Ring Out	RI or RO	RI
TCP	Selects cable protection to ON, OFF	ON or OFF	ON
MNG	ON—Controls the JA by the MNG system OFF—Controlled by the switch positions	ON or OFF	OFF
JA	Jitter attenuation ON or OFF	ON or OFF	ON
4M/16M	Operation in 4 Mbps or 16 Mbps	4 Mbps or 16 Mbps	16 Mbps
RNG/SAT	Module operating as RI or RO port, or as satellite port of the hub (NOTE: Satellite setting requires the unit to be set as RI with TCP ON)	RNG or SAT	RNG

6.10 4/16 Token Ring Fiberoptic Repeater Module with ST Connector

6.10.1 Description

The Token Ring Fiberoptic Repeater Module (LT0005A-TST), is used for extending the distance between adjacent hubs. Placed at either end of a group of access modules, the TST functions as the Ring In/Ring Out port for the group.

The TST operates in pairs, with one unit being placed at the RO (Ring Out) port providing reclocking, reshaping and regeneration on the main ring data and the other at the RI (Ring In) port for back-up ring data in both directions. The TST also performs cable-fault protection with network partitioning and jitter attenuation, and supports monitoring and control by Network Management. These options may be enabled or disabled by DIP switches.

The TST has user-selectable automatic cable-break protection with automatic loopback upon cable fault. The TST is also switch selectable for operation at 4 Mbps or 16 Mbps, and for RI/RO or satellite configuration.

The module is available with ST connectors.

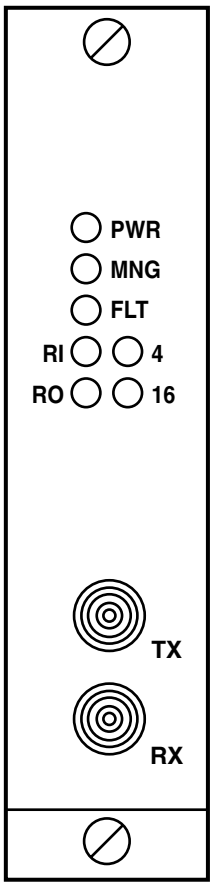

Figure 6-10-1. TST Panel.

TST Front Panel Indicators

- PWR—Power On (green). Lights when the TFR module receives power.
- MNG—Lights module under network management loop control (green).
- FLT—ON when optical-signal loss condition exists (red); BLINKING when remote TFR is under optical-signal loss condition
- RI—Lights when module configured as Ring In (green).
- RO—Lights when module configured as Ring Out (green).
- 4—Lights when module selected to operate at 4 Mbps (green).
- 16—Lights when module selected to operate at 16 Mbps (green).

6.10.2 SET-UP

TST modules occupy one slot of the Hub enclosure. Always install the TST modules serving one ring to the sides of the Hub access modules: RI TST to the left, RO TST to the right. The modules can be installed or removed while power is applied to the enclosure; however, this may alter the configuration of the network.

1. Set the TST switches according to the Table below for the required application.
2. Plug the module into the designated enclosure slot, as marked on the site installation plan. Fasten module by means of the panel screw. Do not overtighten.
3. Refer to the site installation plan to identify the cables intended for connection to this module.
4. Connect the cables to the module connectors.
5. Check that on each TFR module LEDs light according to the module setting.

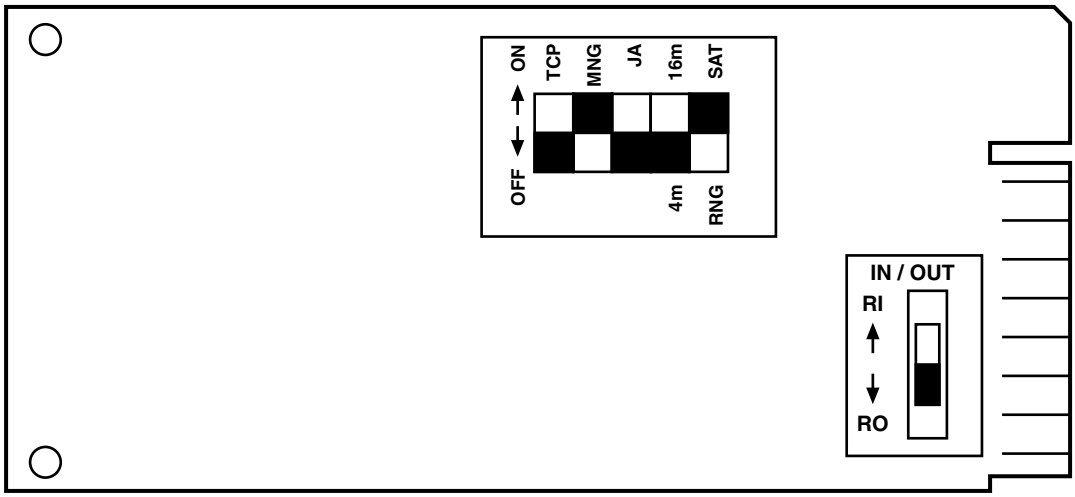

Figure 6-10-2. TST Strapping Diagram.

Table 6-10-1. Jumper Settings.

Strap Identity	Function	Possible Settings	Factory Setting
IN/OUT	Selects module to operate as either Ring In or Ring Out.	RI or RO	RI
TCP	Selects cable protection to ON, OFF	ON or OFF	ON
MNG	ON—Controls the JA by the MNG system OFF—Controlled according to the switch positions	ON or OFF	OFF
JA	Jitter attenuation ON or OFF	ON or OFF	ON
4M/16M	Operation in 4 Mbps or 16 Mbps	4 Mbps or 16 Mbps	16 Mbps
RNG/SAT	Module operating as RI or RO port, or as satellite port of the hub. (NOTE: Satellite setting requires the unit to be set as RI with TCP ON)	RNG or SAT	RNG

6.11 Token Ring to Coax Converter

6.11.1 Description

The Token Ring to Coax Converter (LT0005A-TXC) works in conjunction with the T4CX module. The TXC is a balun used to connect coaxial cable to an interface card.

If an interface card, set to the incorrect speed (4/16 Mbps) with respect to the rest of the network, attempts to insert into the network, it will be automatically bypassed. This ensures continuous network operation. The T4CX module transmits the signal over a coaxial cable without retiming. At the station end of the T4CX module, a TXC balun must be used to allow connection of the coaxial cable to the interface card (NIC).

This balun has no LED indicators or switches to set.

6.8.2 Setup

The balun comes with an attached 93-ohm coax cable and has a DB9 connector. The balun's DB9 connector attaches to the interface card (NIC) at the station end of the T4CX module.

For more information about the balun, please call for technical support.

6.12 Four 10BASE-T Port/AUI Port Module

6.12.1 Description

The Four 10BASE-T Port/One AUI Port Module (part number LT0005A-EPAUI) connects Ethernet LANs to a Modular Intelligent Hub enclosure. The module functions as a repeater, allowing Ethernet LANs to coexist with other types of networks, such as Token Ring, on a common hub.

The Module meets all applicable IEEE 802.3 requirements, and supports 10-Mbps networks. Up to four standard 10BASE-T links and one AUI drop cable or transceiver can be connected to each module.

The 10BASE-T ports can be connected with an additional Hub Ethernet module in an InterRepeater Link (IRL). One crossover cable is required in this type of application.

The AUI port (DTE side) can be connected to any standard AUI transceiver interface (without SQE). This enables the Hub to be connected to coax segments, through AUI drop cables to fiberoptic standalone external equipment, or to a 10BASE2 segment through a transceiver.

The Module is functional only in a Modular Intelligent Hub. It has two operating modes—Normal and Standalone. In Normal mode, the module is connected to the hub's Ethernet bus as part of an Ethernet segment. In standalone mode, the module is an independent multiport repeater.

The Module performs automatic partitioning and reconnection when a port violates transmission protocols. LAN operation continues uninterrupted while the module checks the affected port. The Module activates jabber lockup protection to ensure that LAN operation is not affected by the transmission of excessively long packets. The module also corrects reversed packet waveform polarity.

The Module performs a self-test after reset. If a failure is detected, the module stops operation and all LEDs remain on continuously (except "C" in case of clock or IMR failure). For example, connection of a Module to a Hub without and Ethernet bus is indicated when all LEDs remain on constantly (except "C").

The AUI port has overload protection on its 12 V power source. In cases of current overload or short-circuit, the power source becomes dormant and sends an alarm to the management station.

The Module is supported by RADView SNMP Network Management System. From the management station, the manager can select operating modes and disable each 10BASE-T port and the AUI port independently. LEDs indicate port operating status, operating mode, packet transfer, collisions, power, and management status.

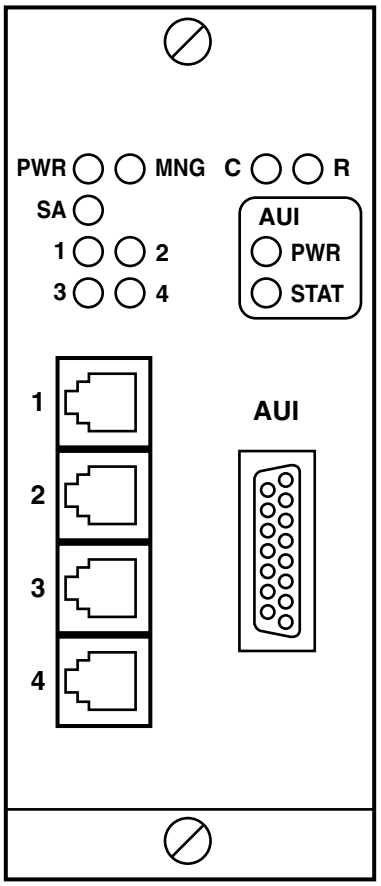

Figure 6-12-1. Four 10BASE-T Port/AUI Port Module Panel.

The Module has the following front panel indicators:

- PWR—On when module is powered (green).
- MNG—On when module is under management control, SNMP or Monitor (green).
- C—Blinks when at least one port is involved in a collision (green).
- R—Blinks when a port receives a packet (yellow).
- SA—On when module operates in standalone mode (green).
- 1, 2, 3, 4—Port status indicators (green). On when the station connected to the corresponding port is inserted into the LAN. Blinks when the port is autopartitioned or disabled by network management. Off when no station is connected to the corresponding port.
- PWR (AUI)—On when 12 V power source is activated (green). Blinks when AUI power line is overloaded. Off when AUI power line is shut down by network management.
- STAT (AUI)—Blinks when the AUI port is autopartitioned or disabled by network management.

6.12.2 SETUP

1. Set the MAN switch to:
   ON to set operating mode manually.
   OFF to set operating mode through RADview Network Management System.

2. The SA switch is only activated when the MAN switch is set to ON.
   Set the SA switch to:
   ON to operate the Module in standalone mode.
   OFF to operate the Module in normal mode.

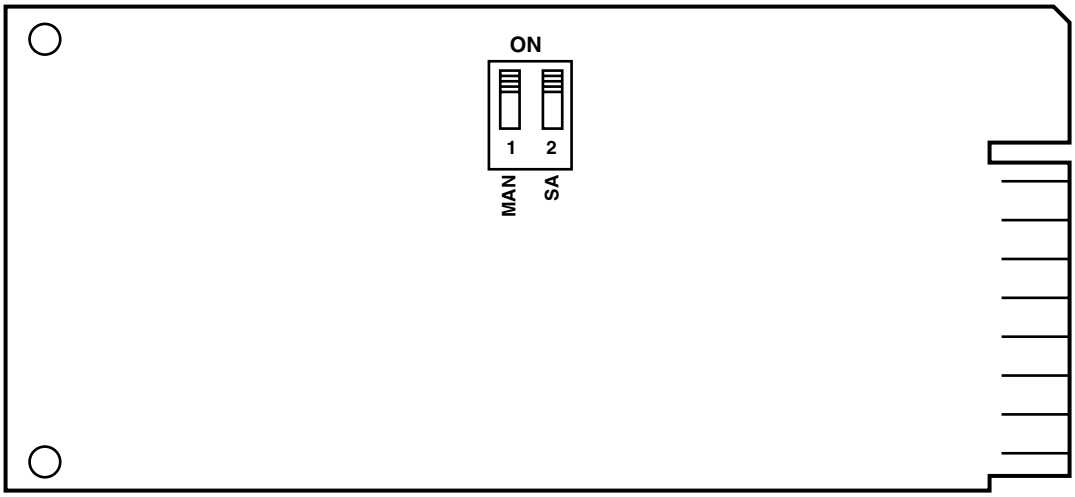

Figure 6-12-2. Module Switches Diagram.

Table 6-12-1. DIP Switch Settings.

Strap Identity	Function	Possible Settings	Factory Setting
MAN	Selects procedure for setting operating modes	ON or OFF	OFF
SA	Standalone mode on/off (only active if MAN switch is set to ON)	ON or OFF	OFF

6.12.3 Installation

The Module occupies two slots of the Hub enclosure and can be inserted into any free position. The Module can be installed or removed while power is applied to the enclosure. To retain a well-organized hub, install the modules serving an Ethernet LAN side-by-side, in one continuous segment.

1. Insert the interconnection card into the Hub. Make sure that the card fits into the motherboard connector.
2. Fasten the module by its panel screw. Do not overtighten.
3. Refer to the site installation plan to identify the cables intended for connection to this module.
4. Connect the station cables to the port sockets on the front panel.

6.12.4 Application

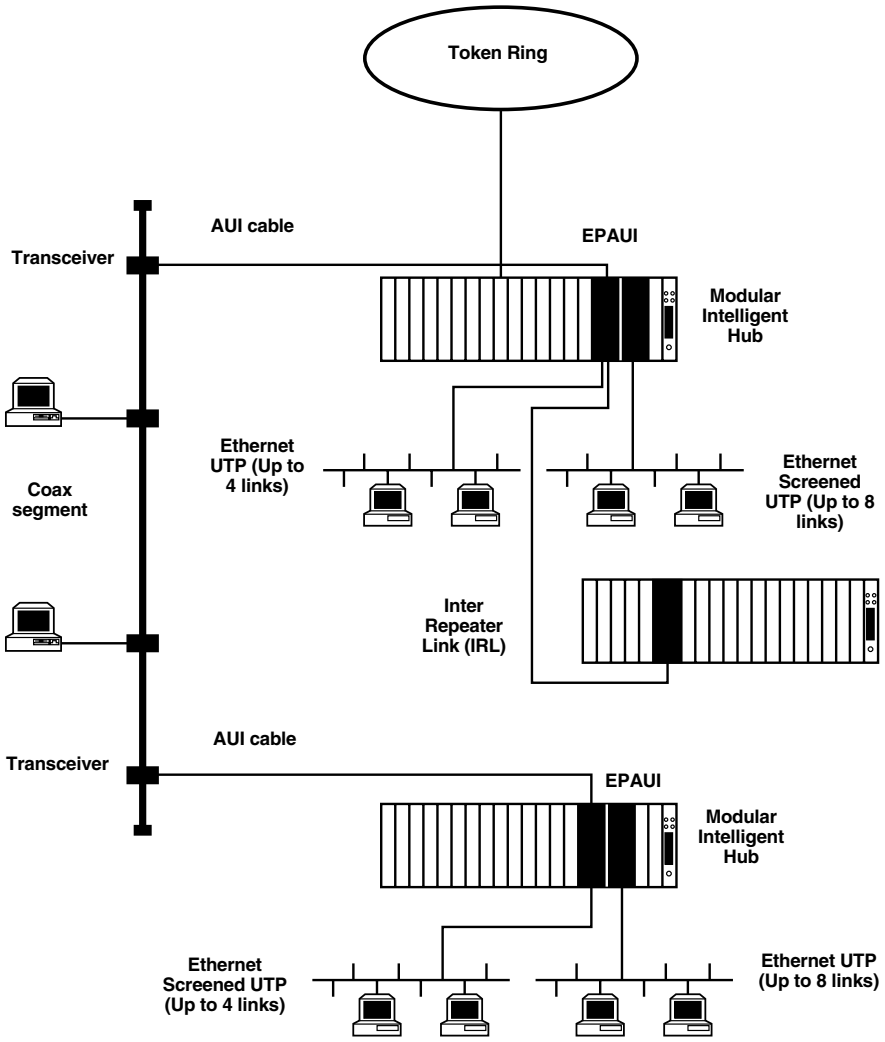

Figure 6-12-3. Typical Application.

6.13 Four 10BASE-T Port/AUI Port Module

6.13.1 Description

The Four 10BASE-T Port/One AUI Port Module (part number LT0005A-EPRAUI) is a 5-port module connecting Ethernet LANs to a Hub enclosure without an Ethernet bus on its backplane. The module functions as an independent multiport repeater, allowing Ethernet LANs to coexist with other types of networks, such as Token Ring, on a common hub.

The Module meets all applicable IEEE 802.3 requirements, and supports 10-Mbps networks. Each module includes four standard 10BASE-T ports and one AUI port.

The 10BASE-T ports can be connected with an additional Hub Ethernet module in an Inter-Repeater Link (IRL). One crossover cable is required in this type of application.

The AUI port (DTE side) can be connected to any standard AUI transceiver interface (without SQE). This enables the Hub to be connected to coax segments through AUI drop cables, to fiberoptic standalone external equipment, or to a 10BASE2 segment through a transceiver.

The module automatically partitions a port that violates transmitting protocols. LAN operation continues uninterrupted while the module checks the affected port. When proper criteria are met, the module reconnects the port.

The module activates jabber-lockup protection to make sure that LAN operation is not affected by faulty excessive transmission. The module also corrects reversed packet waveform polarity on its 10BASE-T ports.

The Module performs a self-test after reset. If a failure is detected, the module stops operation and all LEDs remain on continuously (except “C” in case of clock or IMR failure).

The AUI port has overload protection on its 12 V power source. In cases of current overload or short-circuit, the power source becomes dormant and sends an alarm to the management station.

The module is supported by SNMP Network Management System. From the management station, the manage can disable each 10BASE-T port and the AUI port independently. LEDs indicate port operating status, packet transfer, collisions, power, and management status.

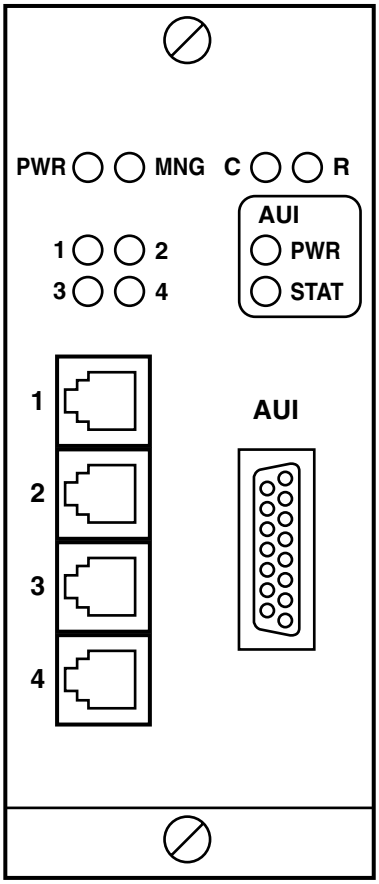

Figure 6-13-1. Four 10BASE-T Port/AUI Port Module Panel.

The Module has the following front-panel indicators:

- PWR—On when module is powered (green).
- MNG—On when module is under management control, SNMP or Monitor (green).
- C—Blinks when at least one port is involved in a collision (yellow).
- R—Blinks when a port receives a packet (yellow).
- 1, 2, 3, 4—Port status indicators (green). On when the station connected to the corresponding port is inserted into the LAN. Blinks when the port is autopartitioned or disabled by network management. Off when no station is connected to the corresponding port.
- PWR (AUI)—On when 12 V power source is activated (green). Blinks when AUI power line is overloaded.
- STAT (AUI)—Blinks when the AUI port is autopartitioned or disabled by network management. Off when the AUI port is not autopartitioned or disabled.

6.13.2 Installation

The Module occupies two slots of the Hub enclosure and can be inserted into any free position. The Module can be installed or removed while power is applied to the enclosure. To retain a well-organized hub, install the modules serving an Ethernet LAN side-by-side, in one continuous segment.

1. Insert the interconnection card into the Hub. Make sure that the card fits into the motherboard connector.
2. Fasten the module by its panel screws. Do not overtighten.
3. Refer to the site installation plan to identify the cables intended for connection to this module.
4. Connect the station cables to the port sockets on the front panel.

6.13.3 Application

Figure 6-13-2 (on the next page) shows a typical application.

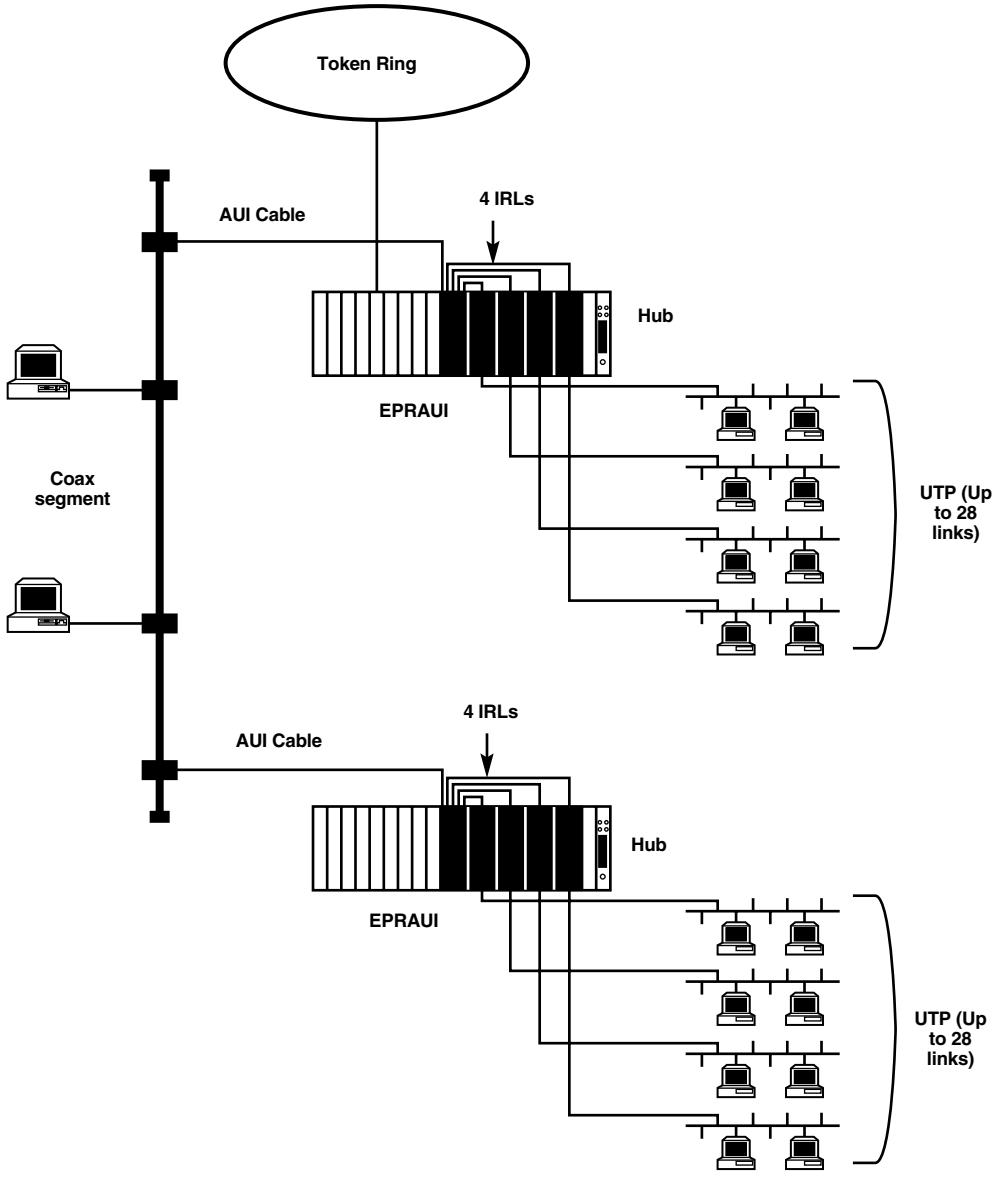

Figure 6-13-2. Typical Application.

6.14 Four Port 10BASE-T Module with two 10BASE-FL Ports (EPFL2)

The EPFL2 is an Ethernet module that provides four standard 10BASE-T ports and one or two 10BASE-FL ports. This module can form a single Ethernet segment together with other Hub modules. The Ethernet segment coexists with Token Ring segments to form a multimedia solution for mixed-environment LANs.

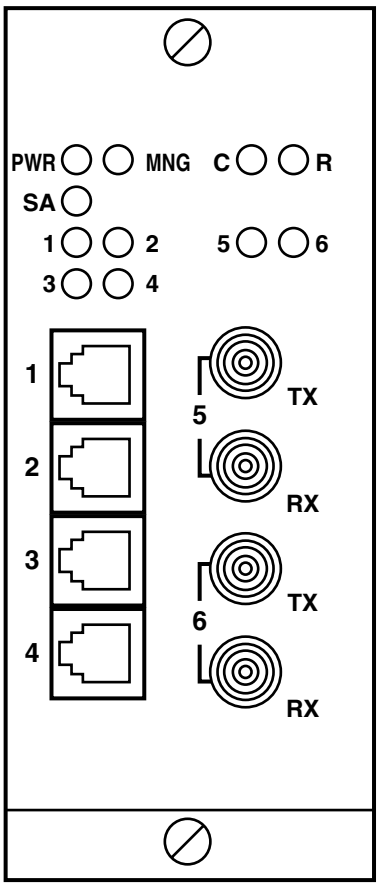

Figure 6-14-1. EPFL2 Module.

The EPFL2 can operate in two modes:

- Normal mode—the module is connected to the Hub's Ethernet bus, and is part of the Ethernet segment of the Hub.
- Standalone mode—the module is disconnected from the Hub's Ethernet bus. It functions as an independent five/six-port segment or as an independent multiport repeater.

The 10BASE-T ports have a range of up to 393 feet/120 meters over standard UTP cable such as 24 AWG. The 10BASE-FL ports have a range of 1.2 miles/2 km.

For transceivers/station connection to the 10BASE-T ports, a straight cable is required. A crossover cable is necessary when connecting to another Ethernet module in order to form an Inter-Repeater Link (IRL) connection.

The 10BASE-FL ports can be used to form a fiberoptic IRL when connecting two repeaters, or to connect Ethernet Stations over fiberoptic cable to the LAN.

The module automatically partitions a port that violates transmitting protocols, and reconnects it when the proper criteria are met. It also corrects the polarity of received data on the 10BASE-T ports if the packet waveform polarity has been reversed.

Jabber-lockup protection ensures that network operation continues uninterrupted in the presence of excessively long transmitted packets.

The EPFL2 provides a display of the module, ports, and management status.

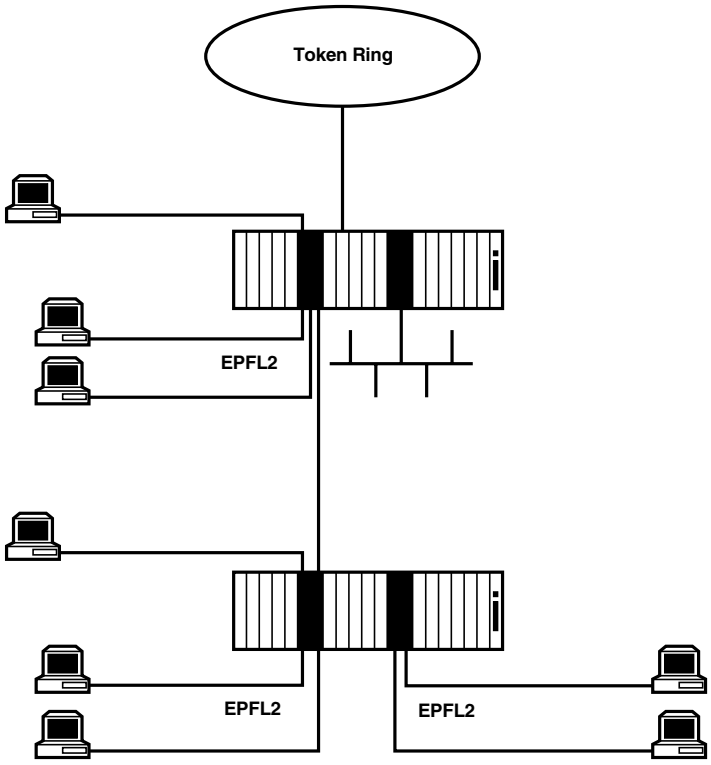

Figure 6-14-2. Typical Application.

6.15 Four Port 10BASE-T Module with two 10BASE-FL Ports (EPRFL2)

The EPRFL2 is an Ethernet module, consisting of four standard 10BASE-T ports and two 10BASE-FL ports, that provides full repeater functionality. The module operates in standalone mode and supplies Ethernet connectivity to Hubs that do not have an Ethernet bus on their backplane. The Ethernet module coexists with Token Ring segments to form a multimedia solution for mixed-environment LANs.

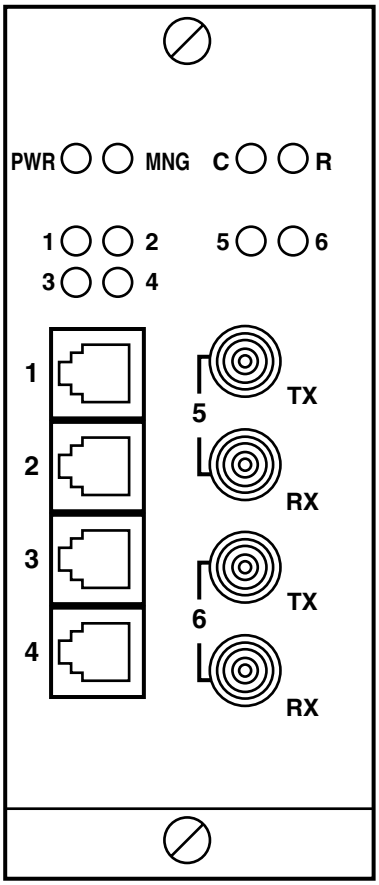

Figure 6-15-1. EPRFL2 Module.

The 10BASE-T ports have a range of up to 393 feet (120 m) over standard UTP cable such as 24 AWG. The 10BASE-FL ports have a range of 1.2 miles (2 km).

For transceivers/station connection to the 10BASE-T ports, a straight cable is required. A crossover cable is necessary when connecting to another Ethernet module in order to form an Inter-Repeater Link (IRL) connection.

The 10BASE-FL ports can be used to form a fiberoptic IRL when connecting two repeaters, or to connect Ethernet stations over fiberoptic cable to the LAN.

The module automatically partitions a port that violates transmitting protocols, and reconnects it when the proper criteria are met. It also corrects the polarity of a received data on the 10BASE-T ports if the packet waveform polarity has been reversed.

Jabber-lockup protection ensures that network operation continues uninterrupted in the presence of excessively long transmitted packets.

The EPRFL2 provides a display of the module, ports, and management status.

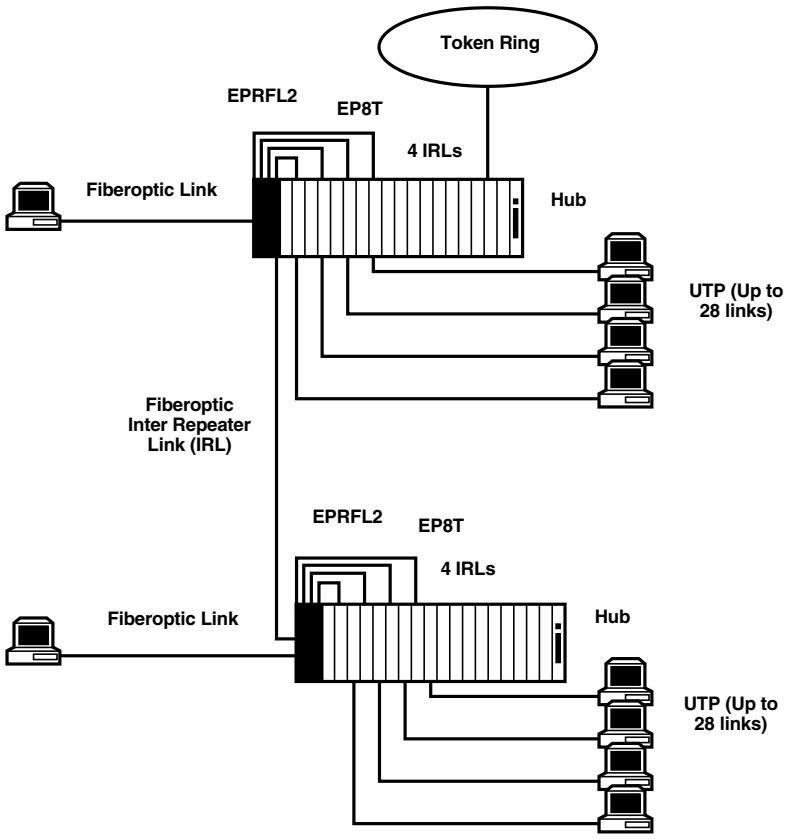

Figure 6-15-2. Typical Application.

6.16 Four Port 10BASE-FL Module (4TFL)

The 4TFL is a four-port 10BASE-FL Ethernet module that provides full repeater functionality. This module can form a single Ethernet segment together with other Hub modules. The Ethernet segment coexists with Token Ring segments to form a multimedia solution for mixed-environment LANs.

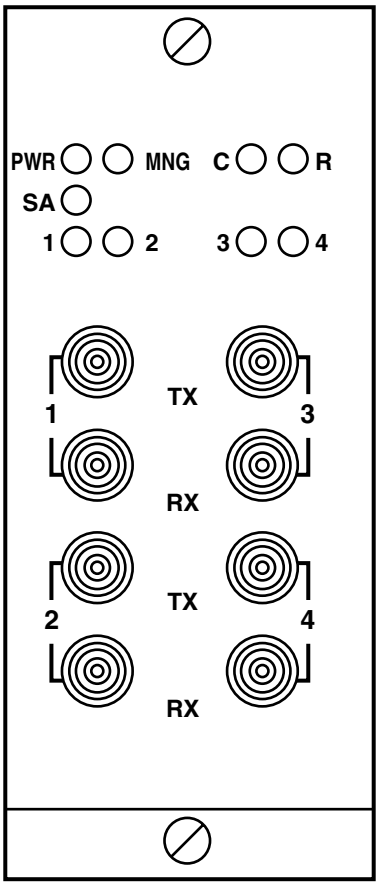

Figure 6-16-1. 4TFL Module.

The 4TFL can operate in two modes:

- Normal mode—the module is connected to the Hub's Ethernet bus, and is part of the Ethernet segment of the Hub.
- Standalone mode—the module is disconnected from the Hub's Ethernet bus. It functions as an independent four-port segment or as an independent multiport repeater. The 4TFL has a range of up to 1.2 miles (2 km) on each port.

The 10BASE-FL ports can be used to form a fiberoptic Inter-Repeater Link (IRL) when connecting two repeaters, or to connect Ethernet stations over fiberoptic cable to a LAN. Up to four hub/repeaters can be connected in star topology to a central repeater over fiberoptic IRLs.

The module automatically partitions a port that violates transmitting protocols, and reconnects it when the proper criteria are met.

Jabber-lockup protection ensures that network operation continues uninterrupted in the presence of excessively long transmitted packets.

The 4TFL provides a display of the module, ports, and management status.

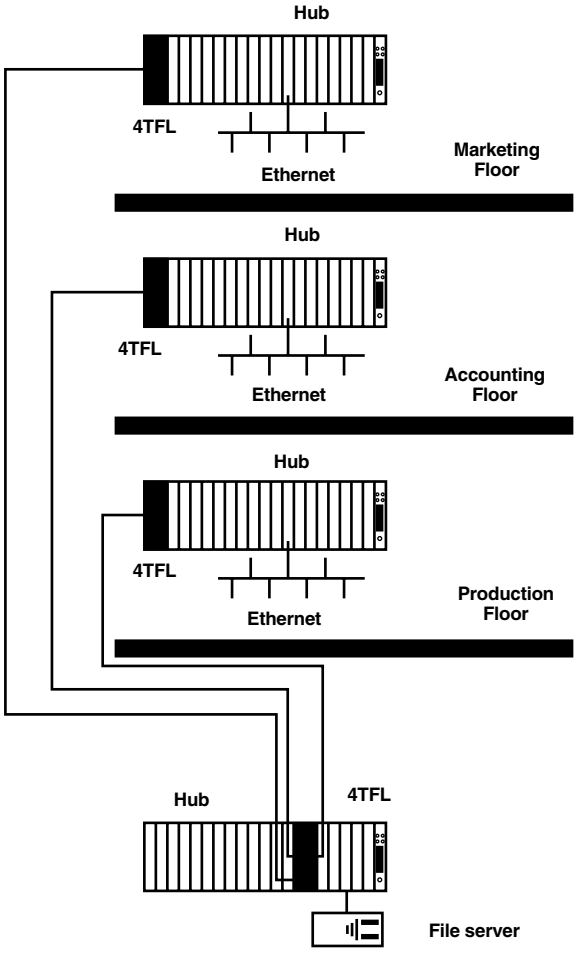

Figure 6-16-2. Typical Application.

6.17 Eight Port 10BASE-T Module (EP8T)

The EP8T is an eight-port 10BASE-T module. The module can form a single Ethernet segment together with other Hub Ethernet modules. The Ethernet segment coexists with Token Ring segments to form a multimedia solution for mixed-environment LANs.

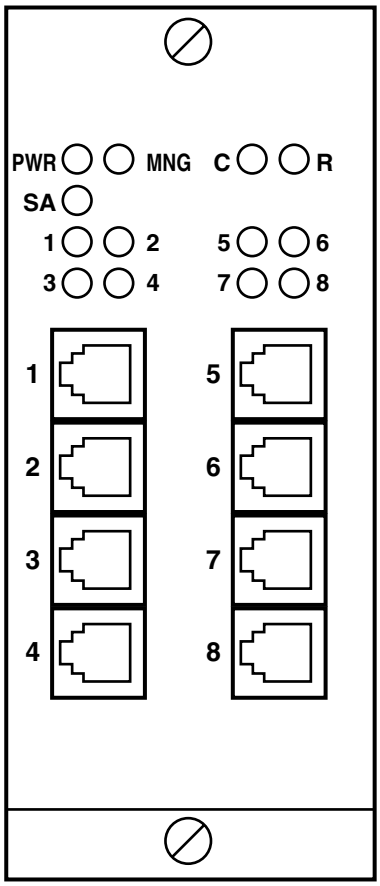

Figure 6-17-1. EP8T Module.

The EP8T can operate in two modes:

- Normal mode—the module is connected to the Hub's Ethernet bus, and is part of the Ethernet segment of the Hub.
- Standalone mode—the module is disconnected from the Hub's Ethernet bus. It functions as an independent eight-port 10BASE-T segment or as an independent multiport repeater.

Shielded RJ-45 connectors are used on all ports, supporting UTP (Unshielded Twisted Pair) or Screened UTP at a range up to 393 feet (120 meters).

The EP8T automatically partitions a port that violates transmitting protocols, and reconnects it when the proper criteria are met. It also corrects the polarity of received data if the packet waveform polarity has been reversed.

Jabber lockup protection ensures that network operation continues uninterrupted in the presence of excessively long transmitted packets.

For connecting a transceiver or a station to EP8T, a straight cable is required. A crossover cable is needed when connecting to another Ethernet module to form an Inter-Repeater Link (IRL) connection.

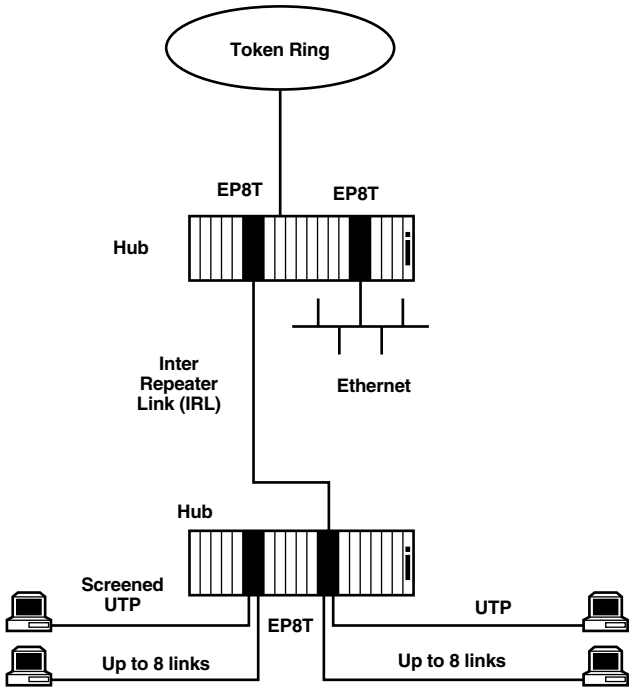

Figure 6-17-2. Typical Application.

6.18 Eight-Port 10BASE-T (Ethernet) Module

6.18.1 Description

The 8-Port 10BASE-T module (part number LT0005A-EPR8T) connects Ethernet LANs to a Modular Intelligent Hub enclosure without an Ethernet bus on its backplane. The module functions in standalone mode as an independent multiport repeater, allowing Ethernet LANs to coexist with other types of networks, such as Token Ring, on a common hub.

The Module meets all applicable IEEE 802.3 10BASE-T requirements, and supports 10-Mbps networks. Up to eight Ethernet links can be connected to each module. The module can be connected with an additional Hub Ethernet module in a Inter-Repeater Link (IRL). One crossover cable is required in this type of application.

The Module performs automatic partitioning and reconnection when a port violates transmission protocols. LAN operation continues uninterrupted while the module checks the affected port. The module activates jabber-lockup protection to ensure that LAN operation is not affected by the transmission of excessively long packets. The module also corrects reversed packet-waveform polarity.

In conjunction with up to four repeaters, the Module allows implementation of up to 98 workstations on an Ethernet network.

The Module performs a self-test after reset. If a failure is detected, the module stops operation and all LEDs remain on continuously (except "C" in case of clock or IMR failure).

The Module is supported by SNMP Management System. From the management station, the manager can select operating modes and disable each 10BASE-T port independently. LEDs indicate port operating status, operating mode, packet transfer, collisions, power, and management status.

The Module occupies two slots and has eight shielded RJ-45 connectors. The module is used with unshielded (UTP) and/or shielded (STP) cables.

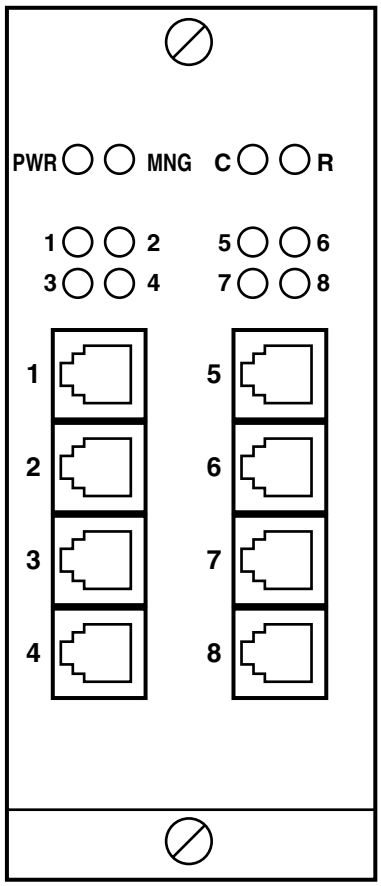

Figure 6-18-1. Eight-Port 10BASE-T Module.

The Module has the following front-panel indicators:

- PWR—On when module is powered (green).
- MNG—On when module is under management control, SNMP or Monitor (green).
- C—Blinks when at least one port is involved in a collision (yellow).
- R—Blinks when a port receives a packet (yellow).
- 1, 2, 3, 4, 5, 6, 7, 8—Port status indicators (green). On when the station connected to the corresponding port is inserted into the LAN. Blinks when the port is autopartitioned or disabled by network management. Off when no station is connected to the corresponding port.

6.18.2 Installation

The Module occupies two slots of the Hub enclosure and can be inserted into any free position. The Module can be installed or removed while power is applied to the enclosure. To retain a well-organized hub, install the modules serving an Ethernet LAN side-by-side, in one continuous segment.

1. Identify the two slots allocated to the module on the installation plan.
2. Insert the interconnection card into the Hub. Make sure that the card fits into the motherboard connector.
3. Fasten the module by its panel screw. Do not overtighten.
4. Refer to the site installation plan to identify the cables intended for connection to this module.
5. Connect the station cables to the RJ-45 port sockets.

6.18.3 Application

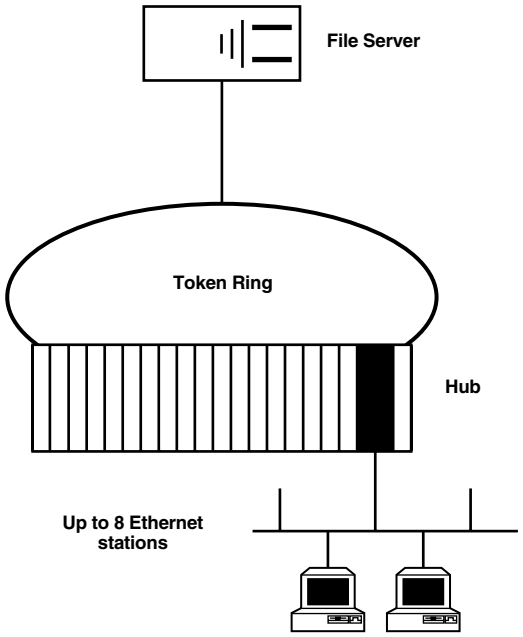

Figure 6-18-2. Typical Application.

6.19 Token Ring Extender Module

6.19.1 Description

The TRE Token Ring Extender Module (LT0005A-8D35) is an elementary bridge which connects a remote Token Ring LAN containing up to 80 remote workstations to a local Token Ring LAN.

The TRE module filters and forwards only those packets addressed to the remote stations. The TRE meets all the applicable IEEE 802.5 and IBM Token Ring requirements, and supports both 16- and 4-Mbps networks.

The TRE module operates as a local unit in conjunction with remote standalone extenders, with a TRE/PC card, or with other TRE modules. The TRE module sends to the remote TRE only those frames whose address belongs to the remote LAN. From the remote TRE, the TRE module receives the LAN's address table and all frames whose address does not belong to that LAN.

The TRE module occupies two Hub slots. Up to ten TRE modules connecting up to 20 remote Token Ring LANs can be inserted into a single hub.

The TRE module's front panel has LEDs indicating module power, management control, data rate, and LAN activity. The serial interface link is V.35.

The TRE module is compatible with the Network Management System. In addition, the TRE supports the physical and data link layers of the OSI model, and is completely mode transparent to higher-level protocols such as TCP/IP, DECNET, XIS, ISO, and to operating systems such as NetWare, 3COM, and VINES.

The TRE is available in three versions:

- Token Ring Extender Module, Two Link—V.35 (LT0005A-8D35)
- Token Ring Local Bridge (LT0005A-MLB)
- Token Ring to FDDI Bridge (LT0005A-FTB)

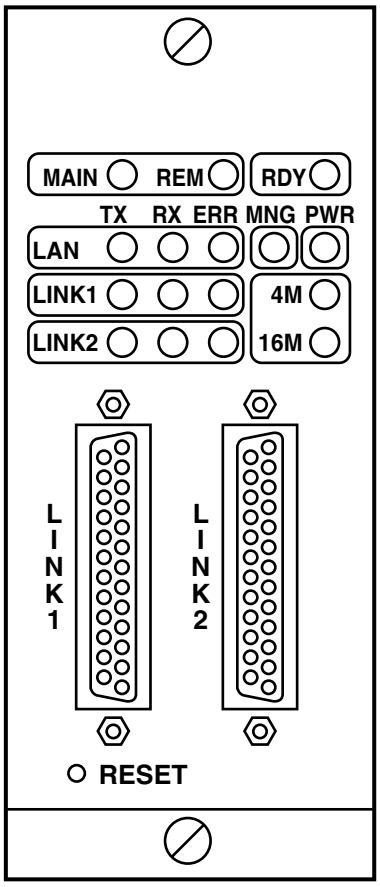

Figure 6-19-1. Token Ring Module.

The TRE has the following indicators:

- PWR—Green. ON when unit is powered.
- MNG—Green. Lights when a command is received from network management is being executed on the TRE module.
- RDY—Green. ON when packets can be transferred. BLINKS when TREs are synchronized but remote workstation did not require insertion. BLINKS FAST during the insertion process of a remote workstation into the ring.
- 4M—Green. Module is selected to operate at 4 Mbps.
- 16M—Green. Module is selected to operate at 16 Mbps.
- MAIN—Green. Module is configured as Local.
- REMOTE—Green. Module is configured as Remote.
- LAN TX—Yellow. Packet is transmitted to LAN.
- LAN RX—Yellow. Packet is received from LAN.
- LAN ERR—Red. ON momentarily during insertion into the LAN, or when connection to LAN failed. BLINKS when LAN interface indicates an error.
- LINK TX—Yellow. Packet transmitted to link.
- LINK RX—Yellow. Packet received from link.
- LINK ERR—Red. BLINKS when serial link interface received an error: The link is disconnected, or the TREs are synchronized and communication errors are reported.

6.19.2 CONFIGURATION

TREs operate in pairs, with one TRE located at the main Token Ring LAN, and a second TRE located at the remote LAN. Each TRE is configured differently depending on its location in the link and the application. Configuration is accomplished through hardware and software configuration modules.

Before inserting the module into the Hub, set the jumpers according to the application requirements. The possible settings are described in the following paragraphs.

LAN Data Rate

The LAN RATE switch is used to set the LAN data rate. Select 4 Mbps or 16 Mbps for the TRE module's operating data rate.

Location

Select MAIN to configure the TRE as a local extender, or select REMOTE to configure the TRE as a remote extender.

Link Interface

The serial link interface is preset to V.2, V.35, or V.11 (for X.21 or V.36). To modify the link interface, move the jumper to the correct strap.

Table 6-19-1. TRE Jumper Settings.

Strap Identity	Function	Possible Settings	Factory Setting
LAN Rate	Selects the LAN operating data rate	4M 16M	16M
LOCATION	Configures the TRE as LOCAL or REMOTE	LOCAL REMOTE	LOCAL
V.24, V.35, V.11	Selects the Serial Link Interface	V.24 V.35 V.11	As specified in ordering information

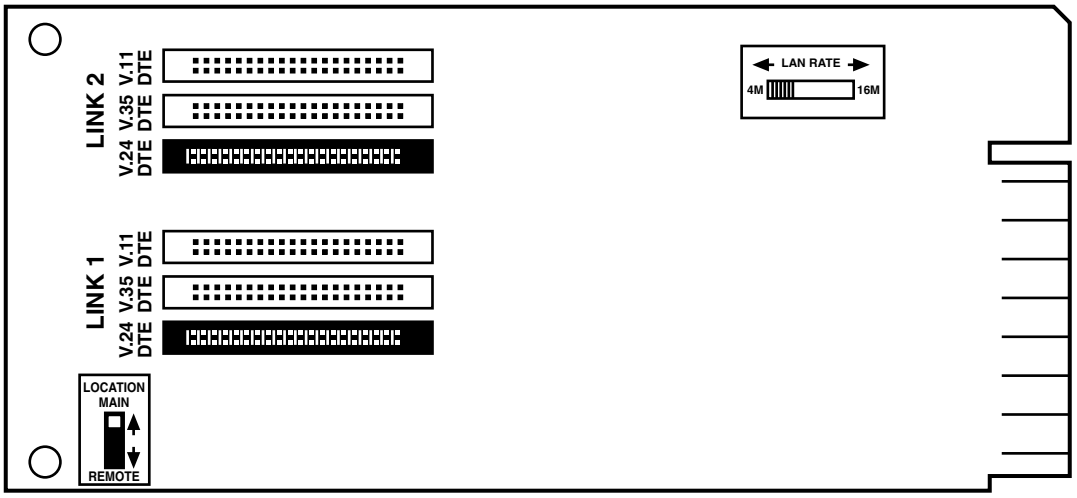

Figure 6-19-2. Board Layout.

6.19.3 INSTALLATION

The TRE occupies two slots of the Hub enclosure and can be inserted into any free position.

NOTE

The TRE can be installed or removed while power is applied to the enclosure without affecting the operation of the network.

1. Identify the two slots allocated to the module or the installation plan.
2. Insert the interconnection card in the leftmost of the two slots assigned to the TRE. Make sure that the card fits into the motherboard connector.
3. Insert the module itself in the rightmost of the two slots assigned to the TRE, and fasten the module by its panel screw.
4. Refer to the site installation plan to identify the cable(s) intended for connection to this module.
5. Connect the serial link cables to the module connectors.

6.12.4 OPERATION

Operating Procedure

Power-On

Insert the TRE module into a powered Hub enclosure slot to operate the module.

The TRE module goes through a power-on sequence. The LAN ERR indicator lights momentarily. When the module is ready for normal operation, the RDY indicator lights continuously.

Operation

TRE operation is completely automatic. During normal operation, when the remote workstations are active, the RDY indicator should light continously, the TX and RX indicators should blink occasionally and the LAN and LINK error indicators should remain OFF.

Power-Off

Remove the TRE module from the Hub enclosure to disconnect the module.

Self-Test

At the beginning of the self-test sequence, all indicators blink twice, and then turn off one after the other. The module then performs the following self-tests:

- RAM Check
- EEPROM Check
- Burnt-in Address Check
- Token Ring Adapter Check Phase 1 (Bring-up Adapter)
- Token Ring Adapter Check Phase 2 (Initialize Adapter)

If a fault occurs in one of the self-tests, the appropriate error indicator lights and the entire self-test sequence enters into endless loopback.

Normal Operation

The TRE begins normal operation upon successful completion of the above self-tests. The PWR, RDY, and MAIN/REMOTE (depending on configuration as Main/Remote) indicators should be continously lit. The LAN and LINK Tx, Rx indicators light occasionally. The LINK/LAN Error indicators should remain unlit at all times.

Table 6-19-2. Self-Test Sequence—Indicator Status.

Stage	Check	Indicator	Condition
1	RAM CHECK	POWER	ON
		READY	ON
		MAIN	ON if TRE is configured for local operation
		REMOTE	ON if TRE is configured for remote operation
		LAN Tx	ON
2	EEPROM CHECK	POWER	ON
		READY	ON
		MAIN	ON if TRE is configured for local operation
		REMOTE	ON if TRE is configured for remote operation
		LAN Rx	ON
3	ADDRESS CHECK	POWER	ON
		READY	ON
		MAIN	ON if TRE is configured for local operation
		REMOTE	ON if TRE is configured for remote operation
		LAN Tx	ON
		LAN Rx	ON
4	CAM CHECK	POWER	ON
		READY	ON
		MAIN	ON if TRE is configured for local operation
		REMOTE	ON if TRE is configured for remote operation
		LINK Tx	ON
		LINK Rx	ON
5	TOKEN RING ADAPTER CHECK (Phase-1 Bring up adapter)	POWER	ON
		READY	ON
		MAIN	ON if TRE is configured for local operation
		REMOTE	ON if TRE is configured for remote operation
		LINK Tx	ON
6	TOKEN RING ADAPTER CHECK (Phase-2 initialize adapter)	POWER	ON
		READY	ON
		MAIN	ON if TRE is configured for local operation
		REMOTE	ON if TRE is configured for remote operation
		LINK Tx	ON

Fault Isolation and Troubleshooting

The following table lists some common faults and their remedies. Observe safety precautions while working on the unit. Some faults may occur due to incorrect hardware configuration settings for TRE application and location. If a fault condition persists, confirm that both the local and remote TREs are configured properly. Link errors are sometimes cause by loose contact between connectors or lack of cable continuity. Check that all connectors are plugged in properly and that cable quality is good.

Table 6-19-3. Troubleshooting Guide.

Symptom	Remedy
All front panel indicators are OFF	1. Check that power is applied to the unit. 2. Check that the unit is properly inserted in the enclosure. 3. Check the fuse and replace if necessary.
Red LINK ERR indicator ON	1. Check local and remote TREs, modems, and Link. 2. Switch on the monitor terminal and check DTR mode settings.
Red LAN ERR indicator is ON properly.	1. Check local and remote LANs. 2. Make sure that the LAN rate switches on both TREs are set.
RDY indicator is OFF	1. Check that power is supplied to the unit. 2. Check that the unit is properly inserted in the enclosure.
RDY indicator blinks slowly (One time per second)	1. Temporary Buffer Overflow.
Yellow link Tx and Rx blink simultaneously at the rate of one time per second.	1. Check local and remote TREs, modems, and link.
Self-Test sequence entered into endless loopback.	—RAM and EEPROM Test failed—Call for technical support. —Address Check failed–Call for technical support. —CAM Check failed—Call for technical support.

6.19.5 Setup and Monitoring

The TRE features an embedded setup and monitoring program that can be run from an ASCII terminal or a PC terminal emulator connected to the CML/NM Hub Management Module in the Hub enclosure.

This section describes the setup and configuration procedure for the TRE module.

Installation and Setup

Connecting the Terminal to the CML/NM Module

1. Connect a cable between the CML/NM module's DB9 port (front panel) and a DB25 port on the terminal.
2. Set the terminal to work at any baud rate from 4.8 to 19.2 kbps, No Parity, 8 Data Bits, 1 Stop Bit.
3. Switch on the terminal's monitor.
4. The self-test screen appears. Press the space bar several times to invoke the main menu.

Line Setting

The TRE features automatic baud-rate detection. If the terminal is set to a rate other than 9.6 kbps (Default), press the ENTER key or space bar several times to display the Self-Test screen. The terminal's baud-rate setting is saved in EEPROM, and the TRE will work with this rate when it is powered again.

The default TRE line settings are:

- 9600 bps
- No Parity
- 8 Data Bits
- 1 Stop Bit

Press the ENTER key or the space bar several times to display the self-test screen.

It is necessary to redefine line settings if you replace a monitor terminal. To do so, reset the TRE module by pressing the Reset button on the module's front panel and press the ENTER key or the space bar several times.

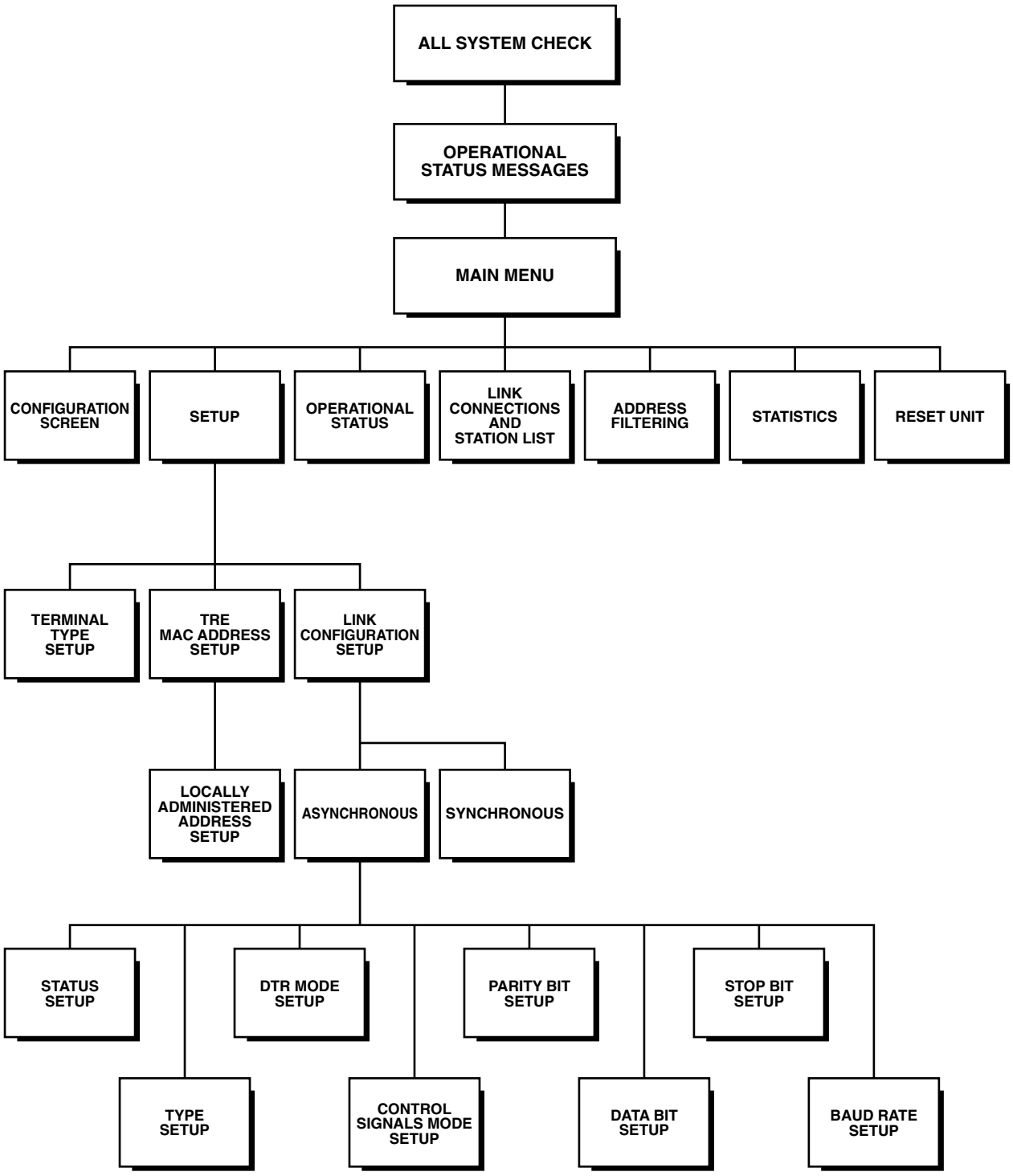

Figure 6-19-3. Hierarchy of Menus and Screens.

Menus and Screens

Self Test (All System Check)

The self-test screen displays the result of each test. If a particular test fails, the test sequence enters into endless loopback from that point. To skip over a failed test, press the space bar several times.

```
ALL SYSTEM CHECK
----------------
RAM Check----------------------------passed
EEPROM Check-------------------------passed
Address Check------------------------passed
CAM Check----------------------------passed
Token Ring Adapter Check (Phase 1)---passed
Token Ring Adapter Check (Phase 2)---passed
```

Figure 6-19-4. Self Test Screen.

RAM/EEPROM Checks. These tests check both types of memory in the TRE.

Address Check. Checks burned-in addresses on the Token Ring.

CAM Check. Filtering-block hardware and associative memory test.

Token Ring Adapter Checks. Checks LAN systems.

The Main Menu

The Main menu opens on successful completion of the self-test sequence.

The type of TRE connected to the terminal appears at the top of the screen.

The Main menu lists nine options. To choose an option, type the number preceding the option.

```
MAIN MENU (Local TRE)
---------
1.  Configuration
2.  Setup
3.  Filtering
4.  Link connections & stations list
5.  Statistics
6.  Diagnostics               (not supported)
7.  Operational status messages
8.  Monitoring other unit     (not supported)
9.  Reset unit

Choose one of the following:
```

Figure 6-19-5. The Main Menu.

Descriptions of the Main Menu options are provided below:

1. **Configuration—**Displays the TRE configuration settings.

2. **Setup—**Displays the Setup screen for adjusting setup parameters and link configuration when the TRE is in operation.

3. **Address Filtering—**Facilitates masking of source and destination addresses to be forwarded or blocked, thus removing unwanted traffic from the network link. Use this option also to restrict communication between specified workstations.

4. **Link Connections and Stations List—**Lists all enabled link connections and address tables of Remote Workstations connected to those links.

5. **Statistics—**Lists network performance statistics.

6. **Diagnostics—**This option is not supported by present software versions.

7. **Operational Status Messages—**Displays real-time operational information.

8. **Monitoring other unit—**This option is not supported by present software versions.

9. **Reset unit—**Resets the TRE/Link (same as manual reset).

Configuration

Select option 1 from the Main menu to display the Configuration information screen. This menu lists TRE configuration parameters and their existing values.

```
CONFIGURATION (Local TRE)

Hardware rev                    : 1.0 (01.09.93)
Software rev                    : 0.00 (01.09.93)
Burned-in MAC address           : 0020 00FF 003C
Locally administered address    : 4444 4444 4444 (active)
Link 1:  Asynchronous           , BaudRate  : 115.2 kbps, Enable
Link 2:  Synchronous            , Internal Clock : 512 kbps, Enable

Esc — return to main menu
For more information about link configuration - press link number :
```

Figure 6-19-6. Configuration Information Screen.

The parameters are divided into three categories.

1. **System Information and Factory Setting:**

- TRE Model
- Hardware Revision
- Software Revision
- Burned-in MAC Address

2. **Hardware configuration values:**

- Location

• Link Interface

These parameters represent the last TRE switch setting before the TRE module was inserted. Any change of the TRE switch setting during operation will not be reflected in the configuration menu.

3. **Parameters that can be adjusted during operation:**

• Locally administered address

• Link configuration

- For more information on a specific link, type the number assigned to that link. For example, typing the number 1 opens the Link 1 configuration screen.

- Press the Esc key to return to the configuration menu.

- For information on any other links, type the link number; the relevant link configuration screen appears.

Setup

• Select option 2 from the Main menu to display the Main Setup menu. This menu allows changes to TRE settings during operation.

```
SETUP (Local TRE)
-----

1. MAC address
2. Link configuration
3. Terminal type

Esc—return to main menu

Choose one of the following:
```

Figure 6-19-7. Main Setup Menu.

NOTE

Adjusting a parameter does not change the corresponding TRE setting immediately. Once a parameter has been changed and saved, the TRE must be reset either manually or through software-initiated Reset for the new setting to take effect.

The setup options are:

1. **TRE MAC Address—**Unique burned-in MAC address provided by the manufacturer or an address specified by the user. The user-defined address is called the locally administered address.

2. **Link Configuration—**Configure the link.

3. **Terminal Type—**Set terminal type.

TRE MAC Address Setup

The TRE can be used with a burned-in MAC address provided by the manufacturer, or with a locally administered address defined by the user.

The current setup field lists the burned-in address of the TRE in hexadecimal code and states if it is active. The locally administered address is also listed if the user has previously specified one.

```
MAC ADDRESS SETUP (Local TRE)

CURRENT SETUP:
-------------
Burned-in address:  0020 00FF 003C
Locally address:  4444 4444 4444 (active)

1. Set locally administered address
2. Activate burned-in Address
3. Activate Locally administered Address

Esc—return to setup main menu

Choose one of the following:
```

Figure 6-19-8. MAC Address Setup Menu.

To set up the locally administered address:

- Select option 1 from the Setup menu to dipslay the TRE MAC address setup menu.
- Select option 1 from the MAC Address Setup Menu to display the Locally Administered Address Setup screen.
- Type the address. The first digit in the address should be either 4, 5, 6, or 7.
- Press the ENTER key after typing the last character in the address.
- Press Esc to return to the MAC Address Setup Menu.
- Select option 3 from the MAC Address Setup Menu to activate the locally administered address.

```
LOCALLY ADMINISTERED ADDRESS SETUP (Local TRE)
----------------------------------

(First digit must be 4, 5, 6, or 7)

(Press ENTER after the last digit)

Esc—return to mac address setup menu

Current locally administered address:  444444444444
Enter new locally administered address:  454545111111
```

Figure 6-19-9. Locally Administered Address Setup Screen.

Link Configuration Setup

- Select option 2 from the Setup menu to display the Link configuration menu. If more than one link is connected, the screen prompts you to enter the link number.
- Enter the link number (1 or 2).

```
Link configuration can be defined through the Link Configuration Setup menu.

Link number 1 ASYNCHRONOUS SETUP (Local TRE)
--------------------------------

                                CURRENT          NEW


1. Status                       Enable           Enable
2. Type                         Asynchronous     Asynchronous
3. DTR mode                     On always        On always
4. Control signals mode         Ignore           Ignore
5. Baud rate                    115.2            115.2
6. Data bits                    8                8
7. Parity                       None             None
8. Stop bit                     1                1


Esc—return to setup main menu

Choose one of the following:
```

Figure 6-19-10. The Link Configuration Setup.

Link Status Setup

- Select option 1 from the Link Configuration menu to disable or enabled a particular link.
- Type the numeral 1 to disable link 1. To enable link 1, type the numeral 2.
- Press the Esc key to return to the link setup menu.

```
Link number 1 STATUS SETUP (Local TRE)
--------------------------

1. Disable
2. Enable

Esc—return to link setup menu

Choose one of the following:
```

Figure 6-19-11. The Link Status Menu.

Link Type Setup

- Select option 2 from the Link Configuration Menu to display the Link Type Setup Menu.
- Type the numeral 1 to set the link for asynchronous operation or 2 to set the link for synchronous operation.
- Press the Esc key to return to the link setup menu.

```
LINK number 1 TYPE SETUP (Local TRE)
------------------------

1. Asynchronous
2. Synchronous

Esc—return to link setup menu

Choose one of the following:
```

Figure 6-19-12. The Link Type Setup Menu.

Synchronous link

To configure the Link interface for synchronous data transmission:

- Select Option 2 (Synchronous) from the Link Type Setup menu.
- Press Esc to return to the Link Setup menu.
- Press the RESET button on the TRE front panel.

Asynchronous link

To configure the Link interface for asynchronous data transmission:

- Select option 1 from the Link Type Setup Menu to display the Link Configuration Menu.

Select option numbers for further asynchronous link configuration. For example, selecting Option 7 in the Link Configuration menu opens the Parity Bit Setup menu from which you can select Option 1 (No Parity), Option 2 (Odd Parity), or Option 3 (Even Parity).

- Press the RESET button on the front panel of the TRE. This saves the settings in the NEW settings column. When opened next, this menu will display these new settings in the CURRENT column.

DTR Mode Setup

DTR (Data Terminal Ready) is the equivalent of DSR (Data Set Ready) for the DTE. This feature is used when bridging over dialup modems or ISDN terminal adapters. Both devices can establish connection when DTR is active, and disconnect when DTR is off, allowing linkage only when requested by a workstation.

Use the DTR Mode option to switch the DTR signal on always or on only when the workstation is inserted into the network. The default DTR signal is On Always.

```
LINK number 1 DTR MODE SETUP (Local TRE)
----------------------------

1. On always
2. On while station in
3. Disable


NOTE:  DTR always ON in local unit !

Esc—return to link setup menu

Choose one of the following:
```

Figure 6-19-13. The DTR Mode Setup Menu.

• Select option 3 from the Link Configuration Setup Menu to display the DTR Mode Setup Menu.

- Select option 1 to set the DTR signal always on, or,

- Select option 2 to set DTR on only when the station is inserted into the Token Ring.

- Press Esc to return to link setup menu.

Control Signals Mode Setup

The TRE can be set to ignore Control signals RTS (Request To Send), CTS (Clear To Send), and CD (Carrier Detect), or acknowledge these signals. This feature allows usage of the TRE with synchronous devices that require flow-control signals. The TRE should be set to ignore the signals when configured for synchronous operation and to acknowledge these signals when configured for asynchronous operation.

• Select option 4 from the Link Configuration Setup Menu to display the Control Signals Mode Menu.

```
LINK number 1 CONTROL SIGNALS SETUP (Local TRE)
-----------------------------------
Control signals (RTS, CTS, CD):

1. Set control signals 'Ignored'
2. Set control signals 'On'

NOTE:  In synchronous link normally should be 'Ignore'
       In asynchronous link always 'ON'

Esc—return to link setup menu

Choose one of the following:
```

Figure 6-19-14. The Control Signals Mode Setup Menu.

The Control Signals Mode Setup Menu

Baud Rate Setup

- Choose Option 5 from the Link Configuration Setup Menu to display the Baud Rate Menu.
- To specify a rate, type the option number assigned to that rate. For example, in order to specify 2.4 kbps, type the number 1.
- Press Esc to return to the link setup menu.

```
LINK number 1 BAUD RATE SETUP (Local TRE)
-----------------------------

1. 2.5 kbps
2. 4.8 kbps
3. 9.6 kbps
4. 14.4 kbps
5. 19.2 kbps
6. 38.4 kbps
7. 56.0 kbps
8. 57.6 kbps
9. 64.0 kbps
A. 115.2 kbps

Esc—return to link setup menu
Choose one of the following:
```

Figure 6-19-15. The Baud Rate Setup Menu.

Data Bits Setup

- Select Option 6 from the Link Configuration Setup Menu to display the Data Bits Setup Menu.
- Select Option 1 for 8 data bits or Option 2 for 7 data bits.
- Press Esc to return to main setup menu.

```
LINK number 1 DATA BITS SETUP (Local TRE)
-----------------------------

1. 8 Data bits
2. 7 Data bits

Esc—return to link setup menu

Choose one of the following:
```

Figure 6-19-16. The Data Bits Setup Menu.

Parity Setup

- Select Option 7 from the Link Configuration Setup Menu to display the Parity Setup Menu.
- Select the relevant parity. Type 1 for No Parity, 2 for Odd Parity, or 3 for Even Parity.
- Press Esc to return to the link setup menu.

```
LINK number 1 PARITY SETUP (Local TRE)
--------------------------


1. No parity
2. Odd parity
3. Even parity

Esc—return to link setup menu

Choose one of the following:
```

Figure 6-19-17. The Parity Setup Menu.

Stop Bit Setup

- Select Option 8 from the Link Configuration Setup menu to display the Stop Bit Setup Menu.
- Type the numeral 1 for 1 stop bit or 2 for stop bits.
- Press Esc to return to the Main Setup Menu.

```
LINK number 1 STOP BIT SETUP (Local TRE)
---------------------------

1. 1 stop bit
2. 2 stop bits

Esc—return to link setup menu

Choose one of the following:
```

Figure 6-19-18. The Stop Bit Setup Menu.

Terminal Type Setup

The Terminal Type Setup menu allows you to identify your terminal type for the TRE, since each terminal type uses different ASCII control codes for cursor control. The TRE requires this information in order to display screens on the terminal properly. If an existing terminal that has already been identified is replaced by a terminal of another type, the terminal-type setup procedure should be repeated.

- Select option 3 from the Main Setup Menu to display the Terminal Type Menu.
- Selet the option that corresponds to your terminal type.

- Type Y to save the terminal type or N if you do not want to save.
- Press Esc to return to the Main Setup Menu.

```
TERMINAL TYPE SETUP (Local TRE)
-------------------

1. VT-100, VT-200, VT-220, ANSI terminals
2. VT-52, IBM 3101 terminals

Esc—return to main menu

Choose one of the following:
```

Figure 6-19-19. The Terminal Type Setup Menu.

Filtering

The TRE features a filter that allows you to control traffic by forwarding or blocking frames that meet user input specifications in a mask. You can specify masks using binary or hex code. The mask can be offset from the MAC or LLC word.

- Select Option 3 from the Main Menu to display the filtering screen.

```
FILTERING (Local TRE)
---------

0. ALL BLOCK  :offset from MAC:  0, mask:  1111 0000 x00x xxxx FALSE
               offset from LLC:  0, mask:  11xx xxxx xxxx xxxx TRUE
               offset from MAC:  0, mask:  1234


A—Add mask, C—Clear all, D—Delete mask, E—Edit mask
L—Load saved masks     , S—Save mask


ESC—return to main menu
```

Figure 6-19-20. The Filtering Screen.

The available commands in the Filtering Screen are displayed at the bottom. Use these commands to build a new mask, delete a mask, or abort current changes and revert to previously saved masks.

NOTE

A new mask, once created, is active even though it may not have been saved to EEPROM. However, resetting the TRE will cause all unsaved masks to be discarded. Therefore, it is necessary to save masks that are likely to be reused.

Changes can be made to a mask through the Mask Edit Screen.

- Type E in the filtering screen to display the Mask edit screen.

```
MASK EDIT (Local TRE)
---------


ENTER     — Enter data
T         — Toggle
SPACE     — Move right
BACKSPACE — Move left
ESC       — Return to filtering screen

Mask All, Broadcast or Multicast Frames? ALL
Block or Forward? FORWARD

WORD #1:  offset from: MAC: 0, mask (in BIN): xxxx xxxx xxxx xxxx TRUE
WORD #2:  offset from: MAC: 0, mask (in BIN): 11xx xxxx xxxx xxxx FALSE
WORD #3:  offset from: LLC: 12, mask (in HEX): xxxx
```

Figure 6-19-21. The Mask Edit Screen.

The commands available in the Mask Edit screen are listed at the top of the screen. Use the toggle command to toggle values.

The following paragraphs list and explain filter parameters.

All/Broadcast/Multicast (Frame Type)

Frames addressed to a specific workstation are called All frames. Frames addressed to several workstations are referred to as Broadcast frames. If you wish to mask broadcast frames, you do not have to specify a destination mask. However, a source mask can be specified.

Block/Forward

Block/Forward are the commands to be carried out on any frames that meet the conditions set by the mask. The Block command blocks the frame, that is, it prevents the frame from being forwarded to the link. The Forward command, on the other hand, forwards all frames that meet conditions set by the mask. Since the software checks for a block command, we recommend that you specify a forward mask prior to a block mask.

Offset

Masks can be offset from MAC or LLC in increments of one byte. For example, to mask a source address only, an offset of 6 bytes from MAC sets the mask to the first byte in the Source address. Masks can also be offset from LLC to filter frames with respect to protocol. Note that an offset of 2 bytes from LLC can also be specified as offset 16 bytes from the MAC frame for all frames having a “type” word between the source address word and the DSAP.

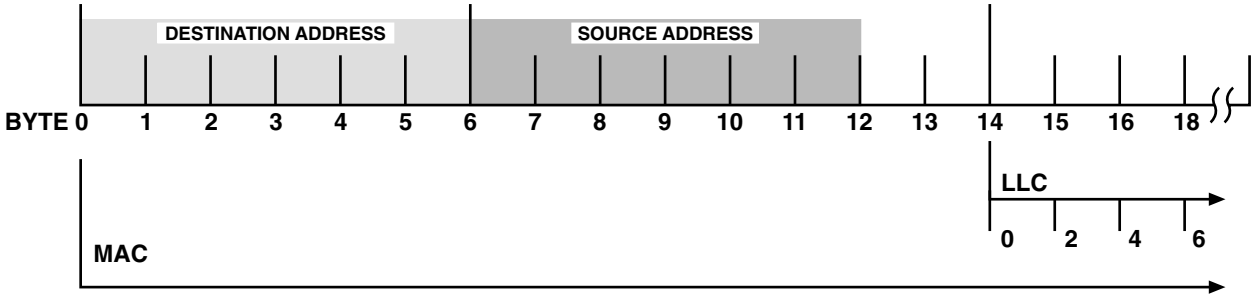

Figure 6-19-22. The Offset Principle.

Hex/Binary code (Address Format)

Select the type of code you want to use for address specification (Hex/Binary). Binary code addresses allow finer filtering, since you can specify 48 address bits as either 0, 1, or X (don't care). Hexadecimal code allows you to specify 12 hex digits, 0 to F or X (4 bits for don't care). The first two offsets from MAC or LLC should be masked using binary code and the third offset masked using hex code. "Don't care" can be used for those bits that are not crucial to the proper operation of the mask.

True/False (Logic Operators)

True applies the mask to all frames with addresses matching the mask pattern. False applies the mask to all frames with addresses not matching the mask pattern.

Examples

See the two examples to understand the filtering module better.

Example 1:

This example illustrates a mask that blocks all frames with destination addresses 0123 4567 89AB, thereby barring the workstation bearing this address from receiving frames from any other station on the network.

```
FILTERING (Local TRE)
---------
0. ALL BLOCK : offset from MAC: 0, mask: 0000 0001 0010 0011 TRUE
               offset from MAC: 2, mask: 0100 0101 0110 0111 TRUE
               offset from MAC: 4, mask: 89AB

A—Add mask, C—Clear all, D—Delete mask, E—Edit mask
L—Load saved masks

ESC—return to main menu
```

Figure 6-19-23. Mask Example 1.

Example 2:

This example details a mask blocking broadcast frames originating from a workstation bearing the address 4000 xxxx xx22.

```
FILTERING (Local TRE)
---------
1. BROADCAST BLOCK : offset from MAC: 6, mask: 0100 0000 0000 0000 TRUE
                   : offset from MAC: 8, mask: XXXX XXXX XXXX XXXX TRUE
                   : offset from MAC: 10, mask: XX22

A—Add mask, C—Clear all, D—Delete mask, E—Edit mask
L—Load saved masks

ESC—return to main menu
```

Figure 6-19-24. Mask Example 2.

Stations List Screen

Select option 4 from the Main menu to display the Stations List. The Stations List Screen lists the addresses of all workstations (up to 80) connected to the TRE.

```
-------------------------------------------------------------------
1. TRE-8                        ON     0     002
2. TRE-8                        ON     0     003


Esc—return to main menu
```

Figure 6-19-25. The Stations List Screen.

- To return to the Main menu, press Esc.
- For further information on a link, type the link number.

Statistics Screen

Select option 5 from the Main menu to display the Statistics Screen. The statistics information allows analysis of traffic between the networks connected by the TREs. The listed statistics enable identification of networks that require a higher speed link or Multicast/Broadcast masking.

```
STATISTIC FOR THE LAST 0:24 min (Local TRE)


LINK 1 STATISTICS (per second)       CURRENT    MAX        AVE
-----------------
1) Rx rate (kbits/sec)               00000      00000      00000
2) Tx rate (kbits/sec)               00000      00000      00000
3) Received good frames              00000      00000      00000
4) Received masked frames            00000      00000      00000
5) Transmitted good frames           00000      00000      00000
6) Received error frames             00000      00000      00000
7) Transmit error frames             00000      00000      00000
8) Overflow events                   00000      00000      00000

Press: C—Clear statistics, U—Update average, L—Toggle LAN/LINK
```

Figure 6-19-26 The Statistics Screen.

Each parameter in the Statistics menu has three values:

- Current—the current value updated every one second
- Maximum—the maximum value attained by a parameter since the Statistics Screen was last cleared
- Average—the average value attained during the preceding 10 minutes or during the time displayed on the screen.

- Type C to clear and reset all statistics to zero.

- Type U to update the Average Statistics (AVE) column.

- Type L to toggle between LAN and LINK statistics (LINK 1 and LINK 2 for dual link models only).

Operational Status Messages

Select option 7 from the Main menu to display the Operational Status Message Screen. This screen provides real-time event reports—for example, "Trying to synchronize with other TRE." The Operational Status Message Screen does not list messages during normal operation.

```
OPERATIONAL STATUS MESSAGES (Local TRE)
---------------------------


Esc—return to main menu
```

Figure 6-19-27. The Operational Status Messages Screen.

To return to the Main menu, press the Esc key.

Reset Unit

Select Option 9 from the Main Menu to reset the unit. The Reset Menu appears.

```
RESET (Local TRE)
-----


1. Reset LINK
2. Reset TR


Esc—return to main menu


Choose one of the following:

DO YOU WANT TO RESET THE UNIT (Y/N)?
```

Figure 6-19-28. The Reset Screen.

- Type 1 to reset the link or 2 to reset the TRE. If more than one link is connected, select Reset Link. The program prompts you to enter the link number for resetting.

A prompt at the bottom of the screen requests confirmation of the reset command.

- Type Y to reset, or N if you do not want to reset.

6.12.6 Applications

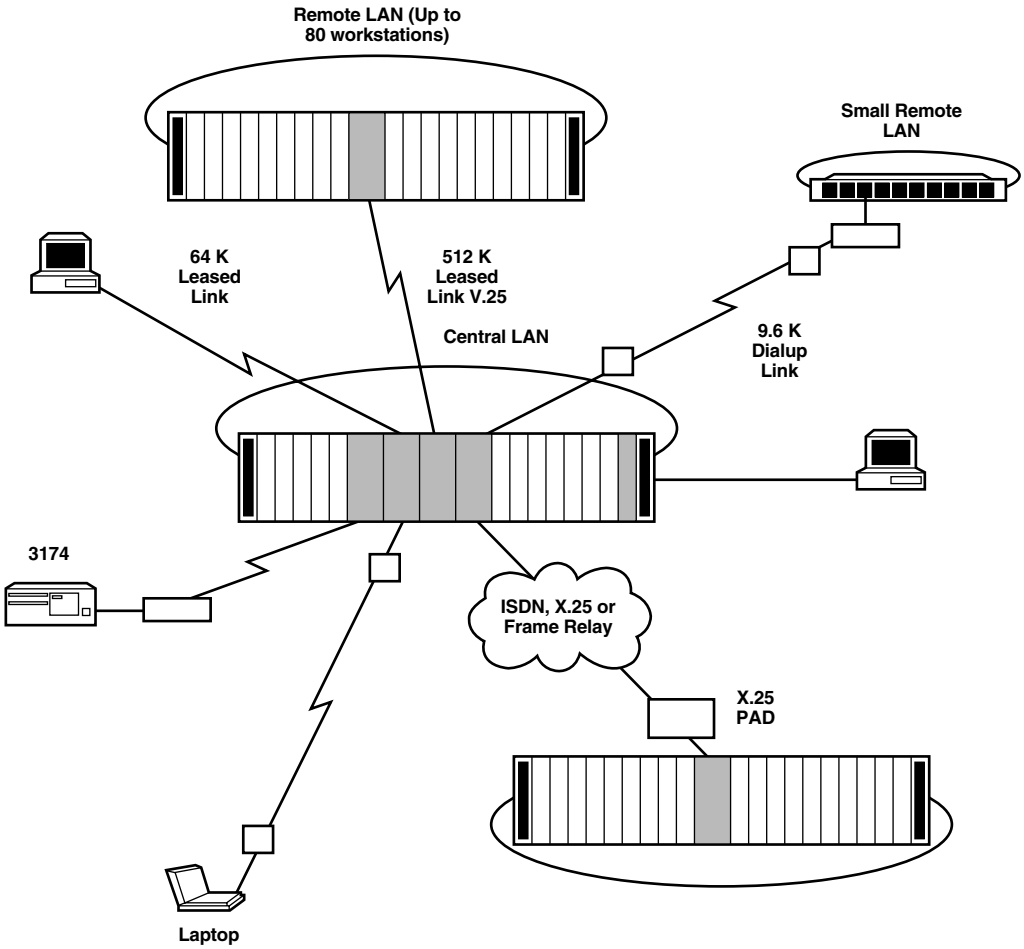

Figure 6-19-29. Typical Application.

6.19.8 Functional Interface Specifications

Table 6-19-4 V.35 Interface Specifications.

Signal Function	V.35 34-Pin female Pin	Circuit	Description
Protective Ground	A Frame	101	Chassis ground. May be isolated from Signal Ground.
Signal Ground	B Signal GND	102	Common Signal and DC power-supply ground.
Transmitted Data	S TD(B) P TD(A)	103 103	Serial digital data from TRE. The data transitions must occur on the rising edge of the transmit clock.
Received Data	R RD(A) T RD(B)	104 104	Serial digital data at the output of the modem receiver. The data transitions occur on the rising edge of the transmit clock.
Request to Send	C RTS	105	ON from the TRE upon completion of self-test.
Clear to Send	D CTS	106	TRE expects CTS ON.
Data Set Ready	E DSR	107	Not used.
Data Terminal Ready	H DTR	108	Constantly ON.
Carrier Detect	F DCD	109	TRE expects DCD ON.
Transmit Clock	Y SCT(A) a SCT(B)	114 114	TRE requires clock for synchronization.
Receive Clock	X SCR(B) V SCR(A)	115 115	TRE requires clock for synchronization.

6.20 Token Ring Local Bridge Module

6.20.1 Description

The Token Ring Local Bridge Module (part number LT0005A-MLB) is an elementary local bridge module for Token Ring LANs. It connects a main Token Ring ("backbone") directly to a secondary LAN ("departmental ring") through a Modular Intelligent Hub.

Operation of the Module is completely automatic and includes LAN start-up and recovery, address learning and appropriate filtering and forwarding of Token Ring packets. Addresses of stations connected to the segment are contained in a single LAN address table. The Module isolates local traffic on the main LAN from traffic on the secondary LAN by filtering and forwarding packets appropriately:

- Filters out packets on the segment whose destination addresses are in the Module's address table. Forwards other packets to the "backbone."
- Forwards packets from the backbone whose addresses are in the Module's address table to the segment. Filters out other packets.
- Forwards Broadcast and Multicast packets in both directions (unless masked out by user-defined software filters).

The Module provides diagnostics, configuration, and monitoring on an optional basis from a CML-NM module, an SNMP management station, or a remote terminal connected to the Module's front panel. These management functions include:

- Masking of frames to reduce network loading and provide security
- Monitoring network performance
- Statistics of traffic through the Module, including communication failures between the main LAN and the secondary LAN

The LAN interfaces are compatible for STP (IBM type 1) and UTP (IBM type 3) connections, or fiberoptic connections.

The Module supports the physical and data link layers of the OSI model. It is completely transparent to higher-level protocols, such as IPX, DECnet, and XNS. In addition, the Module supports operating systems such as NetWare, OS/2 LAN Server, and IBM PC Support Program.

The Module is compatible with the Management System. Status and parameters of the LANs can be displayed at the management station.

An unlimited number of Modules may be installed in a backbone, without limiting the connection bridges, routers, or gateways. However, a Module's secondary LAN must be an end ring with no additional bridge or router connections. The secondary LAN can support up to 250 workstations.

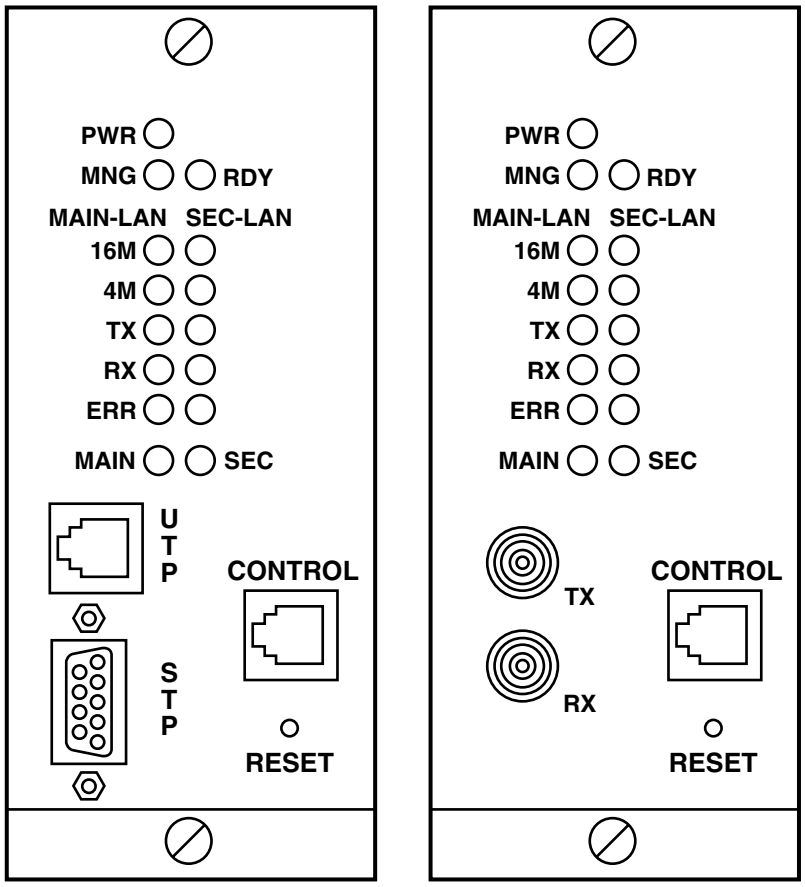

Figure 6-20-1. Token Ring Local Bridge Module Panel.

The Module has the following front-panel indicators:

- PWR—Green. ON when module is powered.
- MNG—Green. ON when module communicates with CML/NM module in transparent mode.
- RDY—Green. ON during normal operation.
- 16M—Green. ON when module is operating at 16 Mbps.
- 4M—Green. ON when module is operating at 4 Mbps.
- TX—Yellow. BLINKS when packets are transmitted to segment.
- RX—Yellow. BLINKS when packets are received from segment.
- ERR—Red. ON if an error occurs during transmission to/from LAN.
- MAIN—Green. ON when main LAN is connected to front panel.
- SEC—Green. ON when secondary LAN is connected to front panel.

6.20.2 Hardware Setup

Set the MLB-T switch for the required application according to the following table.

Table 6-20-1. Switch Settings.

Strap Identity	Function	Possible Settings	Factory Setting
4M/16M MAIN LAN	Operating data rate for main LAN	4 Mbps or 16 Mbps	16 Mbps
4M/16M SEC LAN	Operating data rate for secondary LAN	4 Mbps or 16 Mbps	16 Mbps
FRONT LAN	Sets the LAN connected to front panel	Main or Secondary	Secondary
Termination	Separates Hub into segments. The Module is an integrated part of the segment to the immediate left. When Termination is on, the segment to the right of the Module is part of another ring.	Off or On	Off

6.20.3 Installation

The Module occupies two slots of a Hub enclosure between RI/RO modules of a LAN. The Module can be installed or removed while power is applied to the enclosure.

1. Identify a free enclosure slot within an RI/RO segment, as marked on the site installation plan.
2. Make sure that the LAN speed settings of the backplane LAN and the Module rear LAN are the same (4 or 16 Mbps).
3. Plug the module into the chosen slot.
4. Fasten the module via one screw. Do not overtighten.

6.20.4 Setup and Monitoring

The Module features an embedded setup and monitoring program that can be run from an ASCII terminal or a PC terminal emulator connected to the CML/NM Hub Management Module in the Hub enclosure.

This section describes the setup and configuration procedure for the Module.

Setup and configuration can also be done via any SNMP management station.

Installation and Setup

Connecting the Terminal to the Control Port

1. Connect a cable between the CML/NM module's DB9 port (front panel) and a DB25 port on the terminal.
2. Set the CML/NM baud rate switches according to the terminal setting.
3. Enter the monitor mode on CML/NM.

4. When entering the Monitor, a list of the installed cards appears on the screen. Select the MLB card.
5. Operational status messages appear on the screen. Press <ENTER> or <SPACE> to display the password prompt.

NOTE

To end the session with the module, press <N>.

MLB Setup Menu Options

The MLB setup menu options are described below.

1. Configuration—Provides information about the MLB Module configuration.
2. Setup—Enables changes to MLB settings during operation.
3. Filtering—Prevents the MLB from forwarding unwanted frames from LAN to LAN, thus removing excess traffic from the networks.
4. Station List—Displays a list of workstations connected to the secondary LAN.
5. Statistics—Provides statistics about data transfer through the MLB.
6. Diagnostics—This option has no effect. It is included to leave room for future upgrades.
7. Reset unit—Enables reset of the MLB, main LAN, or secondary LAN.
8. Operational status messages—Displays information about MLB operational status and events.

Configuration

Select option 1 from the Main menu to display the configuration screen. This read-only screen provides factory settings and the most recent MLB configuration parameter settings.

```
RR-MLB-T


CONFIGURATION (Device name—RR-MLB-T)
-------------


Device type      :  RR-MLB-T
Contact person   :  name of contact person
System location  :  the location of this device
Hardware version :  0.1 (01.10.94)
Software version :  1.00 (30.03.95)
IP Address       :  0.0.0.0
MAIN LAN:
Burned-in MAC address:  0020 D2FE BC1B (active)
Locally administered address:  4020 D2FE BC5A
Token-Ring LAN rate  :  16 MHz


Esc—Return to Main Menu
```

Figure 6-20-2. Configuration Screen.

The following paragraphs describe the configuration parameters:

- Device Type—The model name of the device.
- Contact Person—The name of a contact person.
- System Location—The physical location of the device.
- Hardware Version—Hardware version number and date.
- Software Version—Software version number and date.
- IP Address—The IP address of the device (in the format 0-255.0-255.0-255.0-255).
- Main and Secondary LAN—The burned-in MAC address (and status) and locally administered address for the device on the main and secondary LANs, and the Token Ring LAN rate for the main and secondary LANs.
- Press <ESC> to return to the Main menu.

Setup

Select option 2 from the Main menu to display the Setup menu. This menu provides options for setting configuration parameters.

```
                  RR-MLB-T

SETUP (Device name—RR-MLB-T)
-----

1.  Device ID
2.  Define permanent stations
3.  SNMP parameters
4.  Terminal type
5.  Reset to factory default
```

Figure 6-20-3. Setup Screen.

Device ID

Select option 1 from the Setup menu to set up device identification parameters, including main and secondary MAC addresses and statuses.

```
                  RR-MLB-T

DEVICE ID SETUP (Device name—RR-MLB-T)
---------------


1.  Device name  :RR-MLB-T
2.  Contact person:  name of contact person
3.  System location:  the location of this device
4.  Main MAC address:  0020 D2FE BC1B (Active: Burn In)
5.  Sec MAC address:  0020 D2FE BC5A (Active: Burn In)

ESC—Return to setup main menu


Choose one of the following:
```

Figure 6-20-4. Device ID Setup Screen.

The following paragraphs describe the Device ID parameters:

- Device Name—The name of the device (for example, RR-MLB-T).
- Contact Person—The name of a contact person (up to 50 characters).
- System Location—The physical location of the device (up to 50 characters—for example, "Hong Kong").
- Main and Secondary MAC Address—The IEEE MAC address of the MLB. The MLB can be used with a burned-in MAC address provided by the manufacturer, or with a locally administered address defined by the user. The active address is indicated by the word (`active`) after the address.

Select option 4 from the Device ID Setup menu to define the MAC addresses of the main LAN (or option 5 for the secondary LAN). The following submenu is displayed:

```
                  RR-MLB-T

MAIN LAN MAC ADDRESS SETUP (Device name—RR-MLB-T)
-------------------------

CURRENT SETUP:
-------------
Burned-in address:  0020 D2FE BC1B (active)
Locally address:  4020 D2FE DB1B

1.  Set locally administered address
2.  Activate burned-in Address
3.  Activate Locally administered Address

Esc—return to setup main menu

Choose one of the following:
```

Figure 6-20-5. Main LAN MAC Address Setup Screen.

NOTE

The Secondary MAC Address Setup menu is similar to the Main MAC Address menu.

To set up the locally administered address:

1. Select option 1 from the MAC Address Setup menu. The following submenu is displayed:

```
                  RR-MLB-T

LOCALLY ADMINISTERED ADDRESS SETUP (Device name—RR-MLB-T)
---------------------------------

(First digit must be 4,5,6, or 7)
(Press ENTER after the last digit)

Esc—return to mac address setup menu

Current locally administered address:  4020D2FEBC1B
Enter new locally administered address:  600010002000
```

Figure 6-20-6. Locally Administered Address Setup Screen.

2. Enter the new address. The first digit of the address must be 4, 5, 6, or 7.
3. Press <ENTER> after the last digit.
4. Press <ESC>. To store the terminal type setup in the MLB EEPROM, press Y.
5. To implement the address setup, perform Reset on the MLB.

To activate the burned-in address:

1. Select option 2 from the Main MAC Address Setup menu.

2. Press <ESC>. To implement the address setup, perform Reset on the MLB.

To activate the locally-administered address:

1. Select option 3 from the Main MAC Address Setup menu.
2. Press <ESC>. To implement the address setup, perform Reset on the MLB.

To exit the Device ID Setup menu:

1. Press <ESC>. If any Device ID parameters were changed, the following message appears:

```
Saving the changes
will be followed by resettting
the device
Do you want to save new setup ? (Y/N) :
```

Figure 6-20-7. Device ID Parameters Message.

2. To save changes, type Y. Operational status messages, a password prompt, and then the Main Menu appear on the screen. To cancel changes, type N. The main Setup menu appears.

Permanent Stations Parameters

Select option 2 from the Setup menu to set up permanent station parameters.

```
                  RR-MLB-T

PERMANENT STATIONS SETUP
------------------------


1.  Automatic stations learning : [Enable]
2.  Permanent stations list

ESC—Return to setup menu

Choose one of the above:
```

Figure 6-20-8. Permanent Stations Setup Screen.

Automatic Stations Learning

The MLB Module has the ability to cancel the Automatic Stations Learning of the bridge. In that case, the Module will transfer data according to the manually configured station list (up to twenty stations). The stations can be connected to the secondary LAN or beyond the secondary LAN. This adds a new means of security to the Module's normal operation.

The Module defaults for the supervisory terminal port are: 8 data bits, 1 stop bit, no parity, and a baud rate of 9.6 kbps. If the terminal was set for these values, you will see the operational status messages.

Define Permanent Stations

The Define Permanent Stations option is used to set the learn station topology status and to enter the MAC addresses of stations to be registered as permanent.

- To access the Permanent Stations List screen, select option 2 from the Setup menu.
- Select option 1 to toggle between disabling and enabling the automatic stations learning feature.
- Select option 2 to display the Permanent Stations List screen.

The MAC addresses of stations to be marked static can be entered into this screen. A total of 20 addresses can be entered.

```
                  RR-MLB-T

LINK NUMBER 1 PERMANENT STATIONS LIST
-------------------------------------

1.  EEEFFFFF4563                          11.  EE5678403CFF
2.  FFFF43523232                          12.  454536789EEE
3.  565748349303                          13.  33333333333A
4.  45EEFEE64534                          14.  EE0099483321
5.  4757494FFFBB                          15.  45638992FABC
6.  45456779FFAA                          16.  45675555F6D0
7.  345464689FBB                          17.  ED34DE435555
8.  34353532121B                          18.  34343999BBBB
9.  73890BDDD000                          19.  4540091672AD
10. 65759040421F                          20.  00000000000C

A—Add station, C—Clear stations, D—Delete stations

ESC—return to set up main menu
Choose one of the above or another link number to display:
```

Figure 6-20-9. Permanent Stations Screen.

- Select A to add a static station. Insert the static station MAC address at the prompt that appears.
- Select C to clear all stations.
- Select D to delete a specific static station. Enter the number of the station to be deleted at the prompt that appears.

Specify SNMP Parameters

Select option 3 from the Setup menu to open the SNMP Setting menu.

```
                  RR-MLB-T

SNMP SETTING (Device name—RR-MLB-T)
------------

                                 CURRENT           NEW
1.  Set IP address          000.000.000.000      000.000.000.000
2.  Set IP mask             000.000.000.000      000.000.000.000
3.  Set Read community public  public
4.  Set Write community public public
5.  Set Trap community public  public
6.  Set Default gateway     000.000.000.000       000.000.000.000
7.  Set Manager table

ESC—Return to setup menu

Choose one of the following:
```

Figure 6-20-10. SNMP Setting Screen.

IP Address

IP Address of the MLB. Each IP address is 32 bits (4 octets) long and is composed of a network address (net ID) and a host address (host ID).

- The net ID identifies a network.
- The host ID identifies a device (for example, the MLB) on that network (a host is any computer or device connected to an internetwork).

IP Mask

A 32-bit number corresponding to the 32-bit IP address.

- A "1" in the mask means the corresponding IP address bit is interpreted as part of the net ID or subnet ID.
- A "0" in the mask means the corresponding IP address bit is interpreted as part of the host address.

  In this way, the orginal host ID is divided into a subnet ID and a host ID.

Read Community

The MLB's authorized community name that enables read-only communication from the SNMP management station to the MLB.

Write Community

The MLB's authorized community name that enables write-only communication from the SNMP management station to the MLB.

Trap Community

The MLB's authorized community name that enables communication of trap messages from the SNMP management station to the MLB.

Default Gateway

The default gateway (address) for communication with a management station whose address is on a different IP network.

Manager Table

Enter up to 10 SNMP managers (addresses, masks and community names) residing on the network. The MLB will send all management-related messages to these managers.

Terminal Type Setup

Each terminal uses a different ASCII code for the Up key. To allow cursor control, you must set the terminal type. Perform this procedure every time you replace a terminal. The latest definition is stored in the MLB EEPROM.

To set the terminal type:

1. Select option 4 from the Setup menu. The following submenu is displayed:

```
                  RR-MLB-T

TERMINAL TYPE SETUP (Device name—RR-MLB-T)
-------------------

1.  VT-100, VT-200, VT-220, ANSI terminals
2.  VT-52, IBM 3101 terminals
3.  Other terminals
```

Figure 6-20-11. Terminal Type Setup Screen.

2. Select a terminal from the list (options 1 or 2) or select `Other terminals` (option 3) if your terminal is not in the list.

3. Press <ESC> to return to the Setup menu. To store the terminal-type setup in the MLB EEPROM, press Y.

Automatic Terminal Configuration

If your monitor type is not listed in the Terminal Type Setup menu, the MLB can learn your monitor's "cursor-up" character. Select option 3 to display the Automatic Terminal Configuration screen.

```
                  RR-MLB-T

AUTOMATIC TERMINAL CONFIGURATION (Device name—RR-MLB-T)
--------------------------------

Esc—return to setup main menu

Press the "CURSOR-UP" Key:

Do you want to save and apply new setup ? (Y/N) :
```

Figure 6-20-12. Automatic Terminal Configuration Screen.

1. Press the Cursor-Up key twice. To store the terminal type setup in the MLB EEPROM, press Y.
2. Press <ESC> to return to the Setup menu.

Reset to Factory Default

1. Select option 5 from the Setup menu to reset selected systsm parameters to their default factory settings. The following message is displayed:

```
                  RR-MLB-T

RESET TO FACTORY DEFAULT (Device name—RR-MLB-T)
------------------------

Reset MONITOR parameters to default factory setting (Y/N) ? : N
Reset DEVICE ID parameters to default factory setting (Y/N) ? : N
Reset MASKS parameters to default factory setting (Y/N) ? : N
Reset SNMP parameters to default factory setting (Y/N) ? :
```

Figure 6-20-13. Reset to Factory Default Screen.

2. Type Y to reset the specified group of parameters. This action overwrites the user-defined configuration for the specified parameters. Type N to retain the current setting.

Filtering

Filtering enables you to filter selected protocols (for example: IP, IPX, SNA, NetBIOS, and so on) and selected frames—using software address filters, such as masks. The MLB operates in forwarding mode as the default, but the default mode of operation may be specified as required.

Select option 3 from the Main Menu. The Filtering Menu appears.

```
                  RR-MLB-T

FILTERING MENU (Device name—RR-MLB-T)
--------------

1.  QUICK FILTERING
2.  ADVANCED FILTERING
3.  DEFAULT OPERATION

Esc—Return to main menu
```

Figure 6-20-14. Filtering Menu Screen.

Default Operation

You can define default operations (FORWARD or BLOCK) for all frames sent from the Main LAN to the Secondary LAN, and from the Secondary LAN to the Main LAN.

If no other filters are specified, the MLB operates according to the defaults defined in this screen.

Select option 3 from the Filtering Menu to display the Default Operations screen.

```
                  RR-MLB-T

FILTERING (Device name—RR-MLB-T)
---------

The default operation is:

Main LAN—FORWARD
Sec. LAN—FORWARD

1. change Main LAN default operation
2. change Sec. LAN default operation
Esc—Return to main filtering menu

Choose one of the following:
```

Figure 6-20-15. Filtering Screen.

Selecting the Main LAN or Secondary LAN selection number (1 or 2, respectively) toggles the default operation for that LAN between FORWARD and BLOCK.

Quick Filtering

Quick Filtering allows you to forward or block specific protocols.

1. Select option 1 from the Filtering Menu.

```
                  RR-MLB-T

QUICK FILTERING (Device name—RR-MLB-T)
---------------

Choose the protocols you want to block or forward:

1.  IP            FORWARD
2.  IPX           DEFAULT
3.  SNA           DEFAULT
4.  NetBIOS       BLOCK

0.  OTHERS        BLOCK

Esc—Return to main filtering menu

Choose one of the following:
```

Figure 6-20-16. Quick Filtering Screen.

2. Select the selection number of a protocol to toggle among FORWARD, BLOCK, and DEFAULT.

- FORWARD—All frames of the selected protocol will be forwarded.
- BLOCK—All frames of the selected protocol will be blocked.
- DEFAULT (forward or block)—The MLB will forward or block the protocol's frames according to the default settings for the Main and Secondary LANs, as specified in the Default Operation menu.
- OTHERS (option 0)—Includes all frames that do not belong to one of the protocols specifically listed in the Quick Filtering screen.

Advanced Filtering

Advanced Filtering allows you to define masks, per protocol, according to source and destination addresses, high and low level protocols, ports and sockets, where applicable.

Select option 2 from the Filtering Menu to display the Advanced Filtering Menu:

```
                    RR-MLB-T

ADVANCED FILTERING MENU (Device name—RR-MLB-T)

Total Filters used=4
ID  Protocol  From  Operation  Src-Addr  Dst-Addr  HighLevel  Port/socket  Mask

1.  IP    Na Main LAN FORWARD  Src-Mac   Dst-Net   many       ---          0
2.  SNA      Main LAN BLOCK    ---       ---       ---        ---          0
3.  BIOS     Main LAN BLOCK    ---       ---       ---        ---          0
4.  OTHER    Main LAN BLOCK    ---       ---       ---        ---          0

A—Add, E—Edit, C—Clear all, D—Delete
V—Detailed View, L—Load saved filter, S—Save filters
ESC—Return to Main Menu
```

Figure 6-20-17. Advanced Filtering Menu.

This screen lists the defined filters of all protocols, displaying some of the filters' details but not all. To view all details of a particular filter, press V, and execute the prompts.

"Total Filters used" displays the total number of filters specified for all protocols.

If the letters "Na" are displayed adjacent to the Protocol field for a particular filter, the respective filter has been defined and saved in memory—but is not active. This is useful for testing various combinations of filters to achieve a desired result, without having to redefine filters from scratch. The status of a filter (Active, Not Active) can be defined or changed when adding or editing a filter.

Use the menu at the bottom of the screen to:

- Add a filter
- Edit a filter
- Clear all filters
- Delete a particular filter
- View full filter details
- Load saved filters from flash memory
- Save the new filters to flash memory
- Return to the Main Menu

To operate on a particular filter (for example, to delete the filter):

1. Select the letter corresponding to the operation (for example, D).

2. At the prompt, enter the filter selection number (ID).

The following paragraphs describe the columns in the Advanced Filter Menu.

- **ID–**A selection number for viewing, editing, or deleting the particular filter. The system automatically assigns a unique reference number to each filter.

- **Protocol—**The type of protocol on which the respective filter operates (IP, IPX, SNA, NetBIOS, OTHER, USER DEFINED).

- **From—**Displays the direction in which the filter operates.

  You can filter frames traveling from the Main LAN to the Secondary LAN, or vice versa. The source and destination addresses are assigned to the appropriate LANs.

- **Operation—**Displays the main operation of the filter (FORWARD or BLOCK).

- **Src-Addr—**Displays the type of source address for the filter (for example, Net ot MAC).

- **Dst-Addr—**Displays the type of destination address for the filter (for example, Net or MAC).

- **HighLevel—**

- For IP, displays specification of high-level protocols in the filter, such as FTP, TFTP, SNMP, RIP, and TELNET. If only one high-level protocol is specified in the filter, that high-level protocol is displayed. If more than one high-level protocol is specified in the filter, “many” is displayed.

- For IPX, displays specification of high-level protocols in the filter, such as RIP, SAP, and SPX.

- **Port/Socket—**Displays the port number or socket (address) of a specific application. Applicable only when no high-level protocol is specified.

- **Mask—**Displays the number of masks specified in the filter.

- **Add/Edit a Filter—**Select the letter A for Add (or E for Edit) from a Filters screen (for example, from the IPX FILTERS screen).

```
                    RR-MLB-T

   ADD FILTER (Device name—RR-MLB-T)
   ----------

   ENTER             —Enter data
   T                 —Toggle
   N                 —Next line (skip this one)
   SPACE             —Move right
   BACKSPACE         —Move left
   ESC               —Return to filtering screen

   Filter Id         —5
   Protocol          —IPX
   Operation         —BLOCK
   LAN               —Sec. LAN
   Src Addr          —NET (HEX)
                     —Net —1234 5678
                     —Node — 3333 4444 5555
                     —Socket — x6666 TRUE/FALSE
   Dst Addr          —NET (HEX)
                     —Net — 1111 xxxx
                     —Node — 2222 xxxx 3333
                     —Socket — xxxx TRUE
   Low Level         —____/RIP/SAP/SPX  TRUE
   Mask 1            —Offset from:  MAC:  0, mask in HEX:  1234  TRUE
   WORD #2:          —Offset from:  LLC:  2, mask in HEX:  4567  TRUE/FALSE
   WORD #3:          —Offset from: DATA:  4, mask in BIN:  1001 x11x 0x01
0xxx T

   Status            —Active/Not Active
```

Figure 6-20-18. Add Filter Screen.

NOTE

The Edit Filter screen is similar to the Add Filter screen.

Use the menu at the top of the screen to enter data, toggle options, move to the next line, move right/left, and return to the filtering screen.

- Select the <ENTER> key to move among the fields of a parameter. You cannot return to a previous field, but you can backspace within a field. Pressing the <ENTER> key does not advance to the next line.
- Select the letter N to display the next line of the filter. You cannot return to the previous line.
- Select the letter T to toggle among the options of a parameter/field.

The following paragraphs describe the filter parameters:

- **Filter ID—**The system automatically assigns a unique reference number to each filter.

• **Protocol**—Define the type of protocol on which the respective filter will operate (IP, IPX, SNA, NetBIOS, OTHER, USER DEFINED).

- OTHER—The MLB will check the mask in all frames that are not of the defined protocols.

- USER DEFINED—The MLB will check the mask in all frames, regardless of protocol.

• **Operation**—Define the operation—FORWARD or BLOCK—to be applied to all frames meeting all of the criteria specified in the filter.

• **LAN**—Specify whether to filter frames travelling from the Main LAN to the Secondary LAN or vice versa.

• **Src Addr**—Define the type of address (for example, MAC or NET), the format of the address (for example: HEX or DECIMAL), the complete source address, and the condition (TRUE or FALSE).

If you define a NET address under IP, use the decimal format (0-255.0-255.0-255.0-255). For example, specify XXX.XXX.XXX.XXX for all sources ("don't care").

• **Dst Addr**—Define the type of address (for example: MAC, NET, All, BroadCast, or MultiCast), the format of the address (for example: HEX or DECIMAL), the complete destination address, and the condition (TRUE or FALSE).

- Normally, a frame has a particular destination, as specified in the destination address field of the frame. Such frames are referred to as "All" frames.

- "BroadCast" frames are intended for all stations. If you specify BroadCast, do not specify a mask pattern.

• **HighLevel** (IP only)—Define one or more high-level protocols for the filter, such as FTP, TFP, SNMP, RIP, and TELNET. Also, define a TRUE/FALSE condition.

Press the letter T to toggle between specifying a high-level protocol or "don't care" (Xs), and use the <ENTER> key to move along the fields (options) of high-level protocols.

• **Port/Socket**

- For IP only—applicable only when no high-level protocol is specified. If you define the port number in decimal format, specify the low-level protocol to be either UDP or TCP. If you do not define a port number, ICMP may be defined as a low-level protocol.

- For IPX only—if a socket address or low-level protocol is not defined, you may define a socket number.

• **LowLevel**—Define a low-level protocol for the filter.

- For IP only—if you define a port number in decimal format, specify the low-level protocol to be either UDP or TCP. If you do not define a port number, ICMP may be defined as a low-level protocol.

- For IPX only—if a socket is defined in the destination address, you may not specify a low-level protocol or socket number. Conversely, if a socket address or low-level protocol is not defined, you may specify a socket number.

• **Mask**—Define the mask pattern to be compared to the relevant portions in each frame.

- For MAC, LLC, and DATA portions of the frame, specify offset, format, mask pattern, and condition.

- In binary, specify 48 address bits to be either 0, 1, or X ("don't care").

- In hexadecimal, specify 12 hex digits to be 0-F or X (4 bits of "don't care").

- "True" applied the filter to all frames with portions that match the mask pattern. "False" applies the filter to all frames with portions that do not match the mask pattern.

• **Detailed View of Filter—**To view all the details—parameters and addresses—of a filter:

1. Select the letter V from a Filters screen.

2. Enter the ID number of a particular filter to view full details of the filter.

```
                  RR-MLB-T

IP FILTERS (Device name—RR-MLB-T)
----------

Filter Id—1
Operation—FORWARD
Status—Active
LAN—Main LAN
Src Addr—MAC (HEX) 1234 5678 2x4x TRUE
Dst Addr—NET (DECIMAL) 123.122.255.xxx TRUE
LowLevel—____
HighLevel—FTP xxxxx TELNET xxxx xxxx SNMP xxxxxxxxx RIP TRUE
PortNum—
Mask—

E—Edit, D—Delete
Esc—return to previous menu
```

Figure 6-20-19. IP Filters Screen.

Filtering Hints

Use as few filters as possible! For example:

- If the default operations specified in this screen satisfy your filtering requirements, do not define a Quick Filtering protocol filter (leave the protcol filter blank).
- To block a particular set of frames from the Main LAN to the Secondary LAN, define the default opeartion of the Main LAN as FORWARD, and create a filter/mask to block the particular set of frames.
- To forward only a particular set of frames from the Main LAN to the Secondary LAN, specify the default operationn of the Main LAN as BLOCK, and create a filter/mask to forward the particular set of frames.

Filtering Definition Concepts

MLB address filters follow certain rules.

Logical ANDing

If more than one address mask is specified within a filter, the address mask and conditions are logically ANDed together.

Precedence of Forwarding

In filtering, the Forward operation takes precedence. This principle has the following results:

- If no filters are defined, all frames are filtered and forwarded/blocked according to the defaults set in the Default Operation Menu.
- If the sets of frames specified by two or more filters logically "intersect," then Forward takes precedence as the operation.
- To block a selected group of frames, define a filter that blocks those frames.
- To forward a selected group of frames, first define a filter to block all frames (for example, by blocking all the frames of the associated protocol via Quick Filtering, or change the Default Operation to BLOCK). Then, define another filter to forward the specified group of frames.

How Address Filtering Affects Performance

Software address filtering affects the performance of the MLB. Performance is better if fewer filters are specified. Therefore, use the minimum number of filters required.

Look for patterns in the addresses you want to specify. Careful use of "don't cares" (Xs) may enable you to specify the required stations in one mask instead of several masks.

Saving Filter Parameters

All masks are stored in the MLB's flash memory, so that they are preserved if the power goes down. When Filtering is selected, all of the masks are copied into RAM. The RAM copy is then used to activate the software filtering process. As soon as any filter is modified (clear all, delete one, or enter the last parameter for a particular filter), the entire filter, including previously defined filters, goes into effect immediately.

1. To exit Filtering and return to the Main Menu, press the <ESC> key. The following prompt appears:

   ```
   Do you want to save in EEPROM (Y/N) ?
   ```

2. Press Y to save the changes in the EEPROM (FLASH memory). Press N to cancel your changes. The system loads the previous set of masks (stored in flash memory) the next time the power goes down and comes up again.

Station List

Select option 4 from the Main menu to view a list of workstations connected to the secondary LAN (up to 250).

```
                  RR-MLB-T

STATION LIST (Device name—RR-MLB-T)
------------
1.  0000 1A00 4C25                          2.  0020 D2FE BC5A

Esc—return to main menu
```

Figure 6-20-20. Station List Screen.

Press <ESC> to return to the main menu.

Statistics

Select option 5 from the Main menu to analyze traffic between the networks connected by the MLB. The Statistics screen displays quantities of received/transmitted frames, Broadcast/Multicast frames, and masked frames.

```
                  RR-MLB-T

STATISTICS FOR THE LAST 00:07:32 (Device name—RR-MLB-T)

MAIN LAN STATISTICS (per second)            CURRENT   MAX     AVE
-------------------
1) Total network frames                     01665     01694   00040
2) Received good frames                     01668     01694   00040
3) Received good broadcast/multicast        00000     00000   00000
4) Received masked frames                   00000     00000   00000
5) Transmitted frames                       01668     01694   00041
6) Memory overflow error                    00000     00000   00000
7) LAN error                                00000     00000   00000
8) Receive missed frames error              00000     00000   00000
9) LAN buffers overflow                     00000     00000   00000


Press:  C—Clear statistics, U—Update average, L—Toggle MAIN/SEC
Esc—return to main menu
```

Figure 6-20-21. Statistics for the Last Screen.

Each item in the menu has three values as follows:

- Current—the current value updated every one second
- Max—the maximum value since the last Clear command
- Ave—the average value for the last 10 minutes or the time indicated on the top of the screen
- Press L to toggle between the main and secondary LAN statistics.
- Press U to update the statistics screen immediately.
- Press C to clear the statistics screen and set all values to zero.
- Press <ESC> to return to the Main menu.

Statistics Explanations

This section describes the statistics displayed on the Statistics screen.

Total Network Frames

The total number of frames passing on the LAN, regardless of whether or not the MLB received them.

Received Good Frames

The number of good frames received by the MLB from the LAN.

Received Good Broadcast/Multicast

The number of good broadcast and multicast frames received by the MLB (broadcast frames are sent to all nodes in the network, multicast frames are sent to certain groups in the network).

Received Masked Frames

The number of masked frames received by the MLB.

Transmitted Frames

The total number of frames transmitted by the MLB.

Memory Overflow Error

The number of frames not transmitted because of MLB system memory overflow.

LAN Error

The total number of LAN errors for frames received by the MLB over the LAN.

Received Missed Frames Error

The number of frames that the MLB did not receive because of excessive LAN traffic.

LAN Buffers Overflow

The number of frames that the MLB did not receive because of LAN adapter buffers overflow.

Reset Unit

1. Select option 7 from the Main Menu. The Reset Menu appears, enabling you to reset the main and secondary LANs and/or the MLB.

```
                  RR-MLB-T

RESET (Device name—RR-MLB-T)
-----

1.  Reset LAN
2.  Reset Unit

Esc—Return to main menu

Choose one of the following:
M—for Main, S—for Secondary LAN:
```

Figure 6-20-22. Reset Screen.

2. To reset the LAN only, select option 1. At the prompt, type M to reset the Main LAN, or S to reset the Secondary LAN.

3. To reset the MLB and the LANs, select option 2 and confirm the action.

Operational Status Messages

Select option 8 from the Main menu to view event reports. A typical Operational Status Messages screen is displayed below.

```
                  RR-MLB-T

Terminal Autosynchronization

Press "ENTER" several times to get the main menu
Trying to open 16M token ring adapter (MAIN)
Trying to open 16M token ring adapter (SEC)
Bring-up adapter (MAIN):  passed.
Bring-up adapter (SEC):  passed.
Initialize adapter (MAIN):  passed.
Initialize adapter (SEC):  passed.
Opening adapter (MAIN)...
Opening adapter (SEC)...
Open command (MAIN): passed.
Open command (SEC):  passed.
```

Figure 6-20-23. Terminal Autosynchronization Screen.

To return to the Main menu, press <ENTER> several times.

6.20.5 APPLICATION

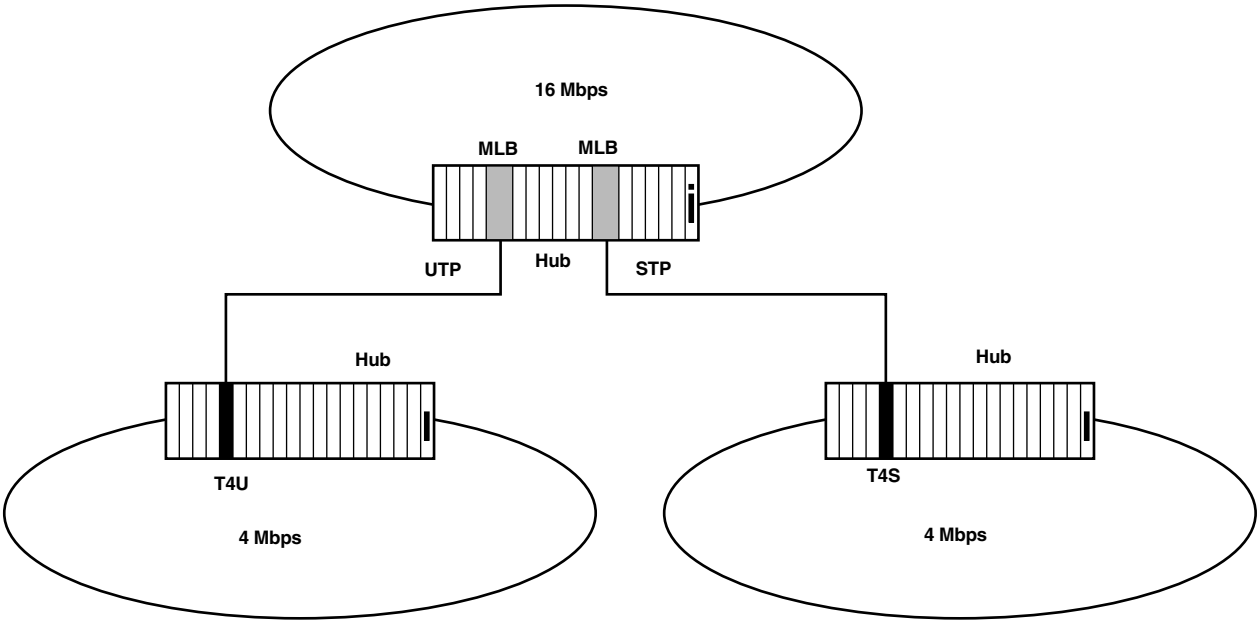

Figure 6-20-24. Typical MLB Application.

6.21 Token Ring to FDDI Bridge

6.21.1 Description

The Token Ring to FDDI Bridge (part number LT0005A-FTB) connects a Token Ring departmental LAN to an FDDI backbone, and can segment the network to improve LAN and LAN-to-LAN performance and response time. Servers can connect directly to the FDDI backbone and communicate with Token Ring clients. The module supports connection of up to 256 stations on the Token Ring port side.

The FTB performs positive filtering on the FDDI side, and negative filtering on the Token Ring port side. All addresses on the Token Ring side are automatically learned by the bridge. An aging process causes inactive stations to be deleted from the bridge tables.

The RISC processor architecture ensures a forwarding rate of 15,000 frames per second. The FDDI and Token Ring frames are filtered by hardware filters that support the maximum frame rates on both FDDI and Token Ring.

The FTB supports backup (dual homing) connection on the tree, using port “B” as the main connection and port “A” as the redundant connection. For greater reliability, ports “A” and “B” may be connected to two different concentrators.

The FTB performs extensive testing and diagnostics. Whenever a problem is detected, a combination of LEDs indicates the nature of the fault. If the FDDI Bypass switch is installed, the FTB is bypassed.

The FTB can be configured and fully diagnosed through the CML-NM management port. Masks by protocol or by MAC address may be entered through the port, as well as software downloading.

Management is provided through an SNMP agent located on the Token Ring or FDDI. The FTB is supported by RADview-PC SNMP Network Management System. From the management station, the manager can perform configuration and monitoring tasks. Source routing and transparent protocols are supported for Token Ring management stations.

Any number of FTBs can be connected to the FDDI backbone. Additional bridges (transparent and source routing) can be connected on the Token Ring LANs, supporting up to 256 stations on the Token Ring side.

The FTB can be configured as a dual-attached or single-attached FDDI station. Single-mode and multimode fiberoptic interfaces are available.

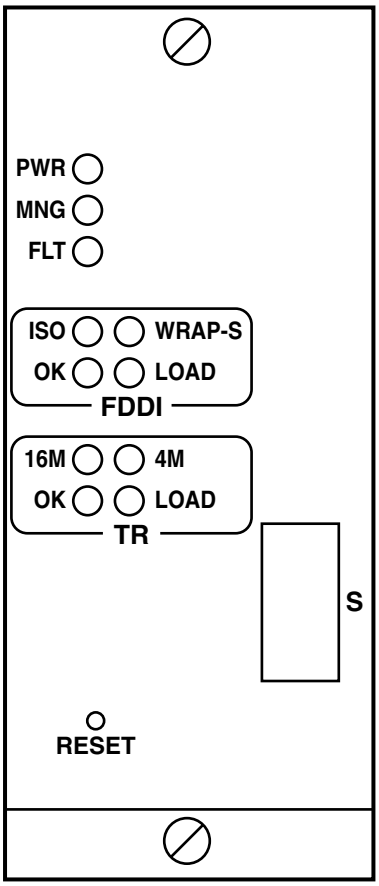

Figure 6-21-1. FTB Panel.

The FTB has the following front-panel indicators:

- PWR—ON when module is powered (green).
- MNG—ON when module is operating in Setup mode (green).
- FLT—ON when at least one of the self-tests failed (red).
- THR—ON when ports A & B are connected in through mode (green).
- WRAP—ON when a port is wrapped (green).
- ISO—ON when ports are isolated (green).
- OK—ON when FDDI ring/Token Ring is operational (green).
- LOAD—ON when data is transmitted or received at the LAN interface (green).
- ACTIVE—ON when bypass switch is inserted (dual-attached only) (green).
- 16M—ON when Token Ring operates at 16 Mbps (green).
- 4M—ON when Token Ring operates at 4 Mbps (green).

6.21.2 THEORY

Bridging

The FTB runs several parallel tasks. The main task runs in the foreground and the others run in the background.

The main task of the bridge is "Packet Switching" between the two LANs and the two different internal management entities (the SMT and the SNMP). At each LAN port, the FTB can receive a frame with the following destinations:

a) The same LAN

b) The other LAN

c) One of the bridge MAC addresses (each port has its own MAC address) for frames intended for the following:

- The bridge internal SMT entity

- The bridge internal SNMP entity

When the FTB forwards a frame between the FDDI and the Token Ring sides, a "translation" must be done; that is, the bridge converts between the frame-format representations on the Token Ring and the FDDI.

The first important background task of the FTB is SMT management of the FDDI ports. FTB port management entails connecting, configuring, and tuning the manageable parameters according to the FDDI standard. The FTB is fully compliant with SMT version 7.3.

The second important background task of the FTB is SNMP management fo the FTB. The SNMP agent can communicate with the NMS in-band.

An important task of the bridge is to "filter" out the frames that are not destined to the second bridge's port. Filtering of incoming frames at the FDDI and Token Ring interfaces is done in the hardware by using CAMs (Content Addressable Memory).

<u>FDDI Filter</u>

The hardware filter is based on a CAM (Content Addressable Memory) and is placed between the physical layer and the MAC layer of the FDDI interface.

The filter monitors the incoming data stream. For LLC frames that are not sent by the FTB itself, the filter decides whether or not to copy the frame. The decision is passed to the MAC layer through dedicated control signals.

The frame is copied (filtering is positive) only if:

- The frame is a multicast frame and does not exist in the CAM table.
- The DA (destination address) of the frame exists in the CAM table.

All the Token Ring stations addresses (from the Token Ring segment) reside in the CAM. The filter does not check the source address of the incoming frame for any purpose. The FDDI filter copies all the multicast/broadcast frames except those frames that appear in the CAM table (this feature enables blocking or masking in hardware of multicast traffic), and the unicast frames having destination addresses appearing in the CAM table (positive filtering).

The FDDI filter does not learn source addresses at the FDDI side.

The FDDI frames that were copies by the FDDI filter are checked by the CPU and forwarded to the Token Ring LAN or to the internal SMT or SNMP entities.

Token Ring Filter

The Token Ring filter is based on a CAM. This CAM contains the addresses learned from the Token Ring side. The filter checks the DA of the incoming frames and copies frames not sent by the FTB, using a negative filtering algorithm.

A frame is copied if:

- The frame is a multicast frame.
- The DA of the frame does not exist in the CAM table.

The Token Ring filter also learns new addresses from the Token Ring side based on the source address (SA) and executes the aging operation of inactive Token Ring stations.

The learning process updates the CAM table and refreshes the active stations on the Token Ring side.

This refreshing action is known as "aging" because old stations that were learned some time ago (one day or week) will be erased if they are not refreshed. If the SA of the incoming frame is not in the CAM table, this SA must be learned. If the SA exists in the table, the process refreshes the MAC address by setting the refresh bit at the table.

Every time a new address is inserted in the table, the CAM status must be checked for full status (if the CAM is not full).

Addresses can be manually added or deleted in the LAN TABLE through the ASCII terminal or SNMP management. Manually-entered new addresses may be made permanent, so that they do not participate in the "aging" process.

The aging time can be changed through the ASCII terminal or SNMP management. The default value is 500,000 seconds (five and a half days).

The entire LAN table, except for the permanent addresses, can be erased through the ASCII terminal or SNMP management. This feature is useful when the topology of the network changes dramatically.

Permanent MAC addresses may be deleted only one at a time.

Masking

Every port in the FTB has a receive mask table. Every received frame is checked against the receive mask table, and the frame passes to the transmit side only if mask does not reject the frame.

The mask tables are 18 rows long and 3 columns wide.

All rows are ORed, and inside the rows, all columns are ANDed.

Once the destination address is identified (filtering), each frame undergoes an additional masking process. The mask process is performed on a set of pre-defined parameters in order to solve problems of network protocols, registration, or security.

Definition

A mask is a set of logical operations performed by the bridge on frames. Frames processed in the bridge can be selected according to filtering criteria defined in the mask statements. Frames can be compared to a mask statement based on protocol type, network layer address, or other criteria. Frames matching or not matching a filter are blocked or transmitted, depending on the operation required.

Memory Location

All masks are located in two places in the table-like form: in the NVRAM and in the DRAM. All changes are performed in both these locations.

Mask Table Logical Structure

A mask table has 18 lines (to contain up to 18 different mask statements). Each frame is processed against each of the mask statements appearing in the mask table, in the order of their appearance in the table. Statements in the table are connected to one another by the logical operator OR. A principal logical structure of the mask table is shown in the following table.

Table 6-21-1. Mask Table Logical Structure.

Entry No.	Address Destination Address	Mask Pattern (Number) 1 Base1	Offset1	Condition 1	Mask Bit Pattern	Mask Pattern (Number) 2 Base 2	Offset2	Condition 2	Mask Bit Pattern2	Mask Pattern (Number) 3 Base3	Offset3	Condition 3	Mask Bit Pattern3	Oper. Operation
1	NO	LLC	244	T	11X0	MAC	444	T	0010..	LLC	948	T	1111..	FWRD
2	ALL	MAC	24	T	1010..	MAC	702	T	001X..	LLC	888	T	XXX1..	BLOCK
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18	MC	LLC	180	F	1100..	MAC	180	T	1111..	MAC	180	T	XXXX..	FWRD

- Address (destination address type)—specifies a type of frame destination address. Frames with this type of destination address are checked against the mask. The five types are:

- BC—Broadcast

- MC—Multicast

- ALL—Single address

- DA (Deactivate)—The mask exists in the table but is not applied.

- NO—Mask statement deactivated.

- Operation—defines the operation (block or forward) to be performed on frames that match the mask statement.

- Mask Number—each entry of the mask table has three mask patterns that are logically “ANDed” together.

- Mask base address—specifies the base in the frame from which the offset is calculated. The parameters are selected between the MAC DA field and the LLC field. The default offset base is the MAC destination address (DA) field.

- Mask Offset—specifies the offset within the frame (in bytes) from the base defined by the Mask Base Address. The mask offset is an even decimal number. The offset range is 0 to 4500.
- Mask Bit Pattern—specifies a 16-bit binary pattern, each bit of which can take on the value 0, 1, or don't care character X.
- Mask Condition—specifies the logical condition of the mask bit pattern. Two logical conditions are defined:

- T (True): Condition is valid if the 16 data bits contained in the frame, starting with the bit at the specified offset, match the specified mask bit pattern.

- F (False): Condition is valid if the 16 data bits contained in the frame, starting with the bit at the specified offset, do not match the specified mask pattern.

All of the above mask table elements are accessible to the user.

Priorites

All mask operations (Forward and Block) have their own priorities: Foward operation has the higher priority and Block operation has the lower priority:

- If at least one Forward decision is obtained as a result of the mask table entries, the frame is forwarded.
- If no forward decision is obtained and at least one block decision results from the mask table entries, the frame is blocked.
- If no Forward or Block decisions are obtained, the frame is forwarded (default).

Access to Mask Table

There are two main possibilities to access the mask table: through terminal sesssion or SNMP Agent. The mask table is usually filled in during the initialization period, but corrections may be made during operational mode at any time.

Algorithm of Frame Checking

First, during initialization, the sorted link of the masks is built based on the information in the mask table. The main goal of this is to exclude any non-installed masks from the analysis and to accelerate the processing by sorting. Sorting is performed according to type of destination address criteria. After sorting and linking, the list appears as shown below:

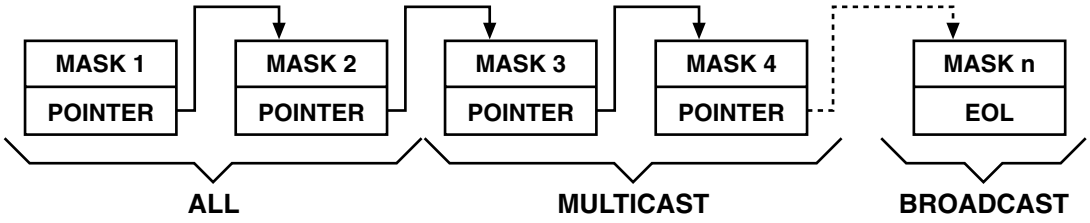

Figure 6-21-2. Sorted List of Masks.

Any new mask is added to the end of the group with a corresponding destination address type; that is, the list must be broken and relinked. A very important rule significantly simplifies and accelerates the processing of the mask link list:

- Mask with destination type BROADCAST must be applied to broadcast frames only.
- Mask with destination type MULTICAST must be applied to multicast frames as well as to broadcast frames.
- Mask with destination type ALL must be applied to all the frames.
- Mask with destination type DEACTIVATE is not applied to any frame.

Checking any frame starts from the first element of the list and finishes:

- Within ALL group if it is a single frame
- Within ALL + MULTICAST groups if it is a multicast frame, or
- Within ALL + MULTICAST + BROADCAST groups if it is a broadcast frame.

The possible results of the full check of any frame against the mask table are:

- Match with the highest table priority operation occurred, checking stops immediately, and this operation must be performed.
- End of link list was reached and some matches took place; the operation with the highest priority must be performed.
- End of link was reached and no match was found; frame must be forwarded.

Functionality of the Mask and the Load LEDs

The Load LEDs are ON if frames are forwarded from or to the corresponding port. If a frame is received at a port, the Load LED for the port is ON. If the frame passes the mask and is transmitted to another port, it also turns the port Load LED ON.

These features are useful when setting an appropriate mask.

Hardware FDDI Multicast Rx Mask

The FTB has a built-in hardware multicast mask that helps you to efficiently mask multicast frames coming from the FDDI port. This mask enables the addition of masks without any degradation of bridge performance.

To add such a mask through the LAN...TABLE interface, enter the particular multicast address as a permanent address with a -M attribute.

You can define these masks through the LAN table menu at the ASCII terminal, or through the SNMP Management Station. Every user-defined multicast address is permanent and not affected by the aging mechanism.

MIBs

The FTB has an SNMP agent that includes general MIBs as well as the specific RAD Data Communication MIB. The agent permits management by SNMP-based network management stations.

Supported MIBs

MIB-2 Groups

- system
- if
- at
- ip
- icmp
- udp
- snmp

Refer to RFC-1213 for variables included in MIB-2.

FDDI-7.3 MIB Groups (all groups)

- fddimibSMT
- fddimibMAC
- fddimibMACCounters
- fddimibPATH
- fddimibPORT

Refer to RFC-1512 for variables included in FDDI-7.3 MIB.

Bridge MIB Groups

- dot1dBase
- dot1dTp

Refer to RFC-1493 for variables included in the bridge MIB.

6.21.3 Switches and Jumper Setup

Token Ring Data Rate

The 4M/16M switch (SW1) is used to set the FTB Token Ring interface operating data rate.

- Select 4M for 4 Mbps.
- Select 16M for 16 Mbps (factory setting).

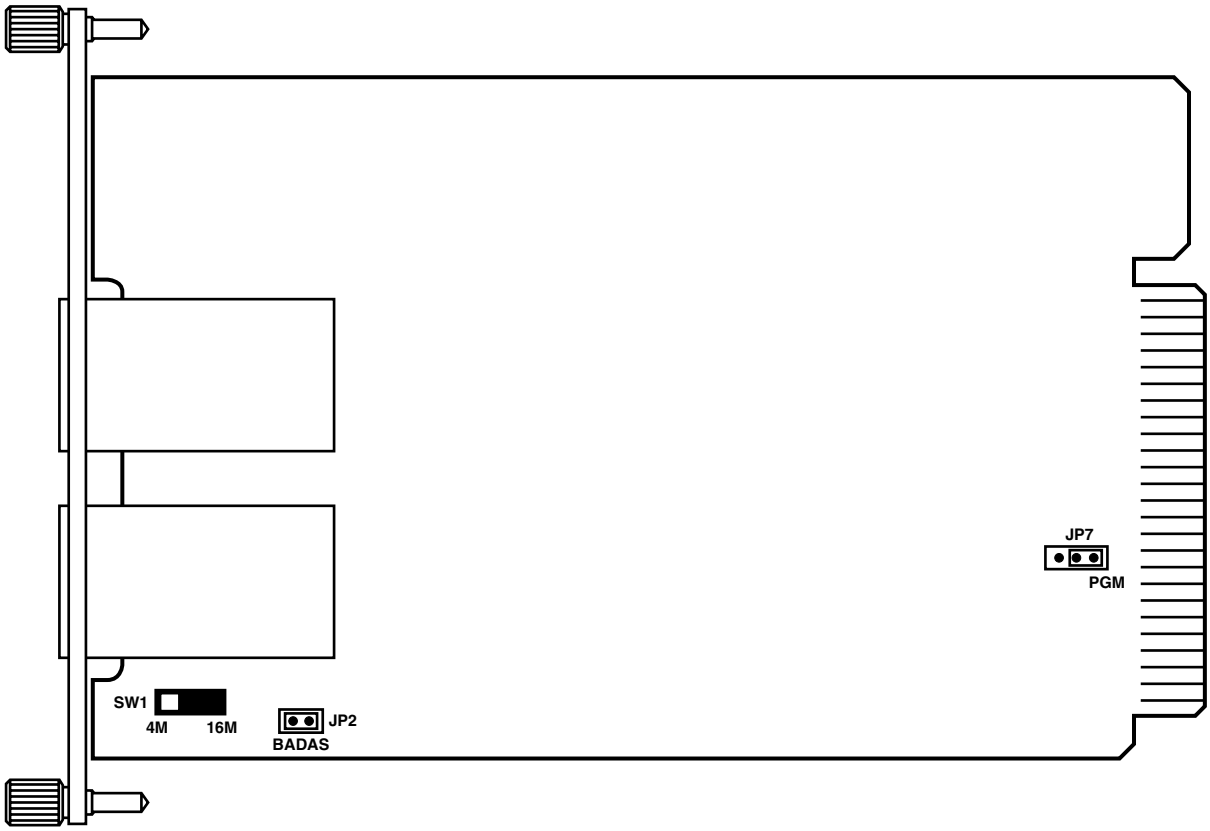

Figure 6-21-3. FTB Strapping Diagram.

Table 6-21-2. FTB DIP Switches and Jumper Settings.

Strap Identity	Function	Possible Settings	Factory Setting
SW1	Selects FTB Token Ring interface operating data rate.	4M, 16M	16M
JP2	Restores the default value of the password and other parameters when the FTB is powered ON and the JP2 jumper is set.		Open
JP6			Open
JP7			Open

NOTE

All jumpers are factory-set. Do not change the settings.

6.21.4 Installation

The FTB module occupies two slots of the Hub enclosure and can be inserted into any free position. The FTB can be installed or removed while power is appliced to the enclosure without affecting the network's operation.

1. Identify the two slots allocated to the module in the installation plan.
2. Insert the module into the two slots assigned to the FTB. Fasten the module by its panel screws.
3. Refer to the site installation plan to identify the ables intended for connection to this module.
4. Connect fiberoptic cables between the FDDI ports of the FTB and other FDDI devices.

FDDI Interface Connectors

Duplex SC Connector(s)

The FTB is supplied with one or two duplex SC connectors. Each connector is mechanically polarized to prevent wrong connection of fibers (such as TX to TX, etc.).

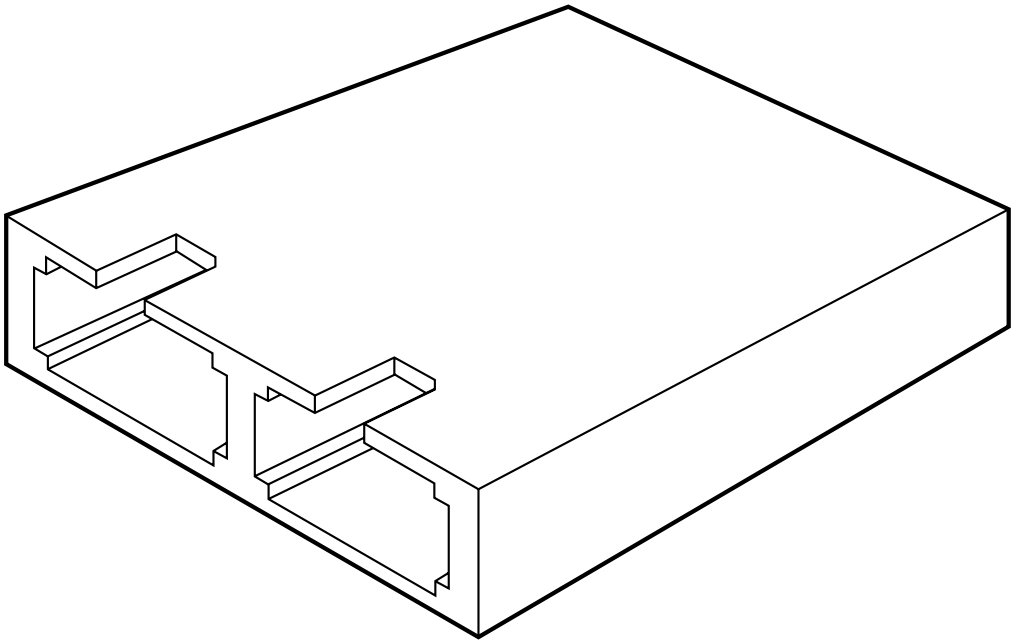

Figure 6-21-4. Duplex SC Connector.

Optical Bypass Switch

The Optical Bypass switch maintains the continuity of the FDDI rings when the FTB is turned off or is faulty. A typical Optical Bypass Switch is shown below.

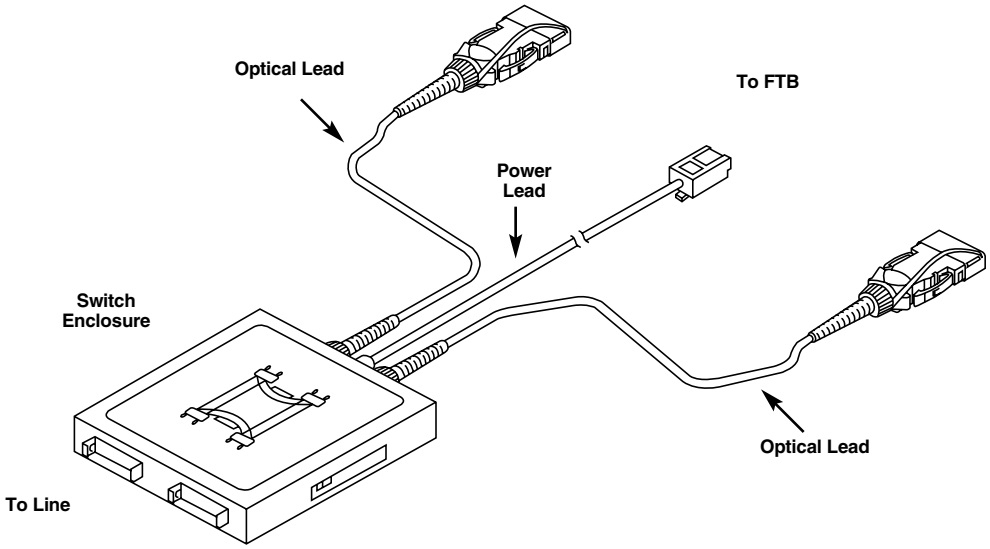

Figure 6-21-5. Optical Bypass Switch.

The Optical Bypass switch has two optical receptacles, two optical leads, and a power lead.

- When power is applied to the Optical Bypass Switch, the switch is in insert mode, meaning that the FTB is optically connected to the rings.
- When power is cut off from the Optical Bypass Switch, the switch is in bypass mode, meaning that the FTB is optically disconnected from the rings.

The four optical connectos are mechanically keyed to ensure correct connections. The following figure shows the connection of an Optical Bypass Switch to the FDDI network. The two receptacles are connected to the FDDI backbone rings (designated LINE) and the two optical leads with the power lead are connected to the FTB.

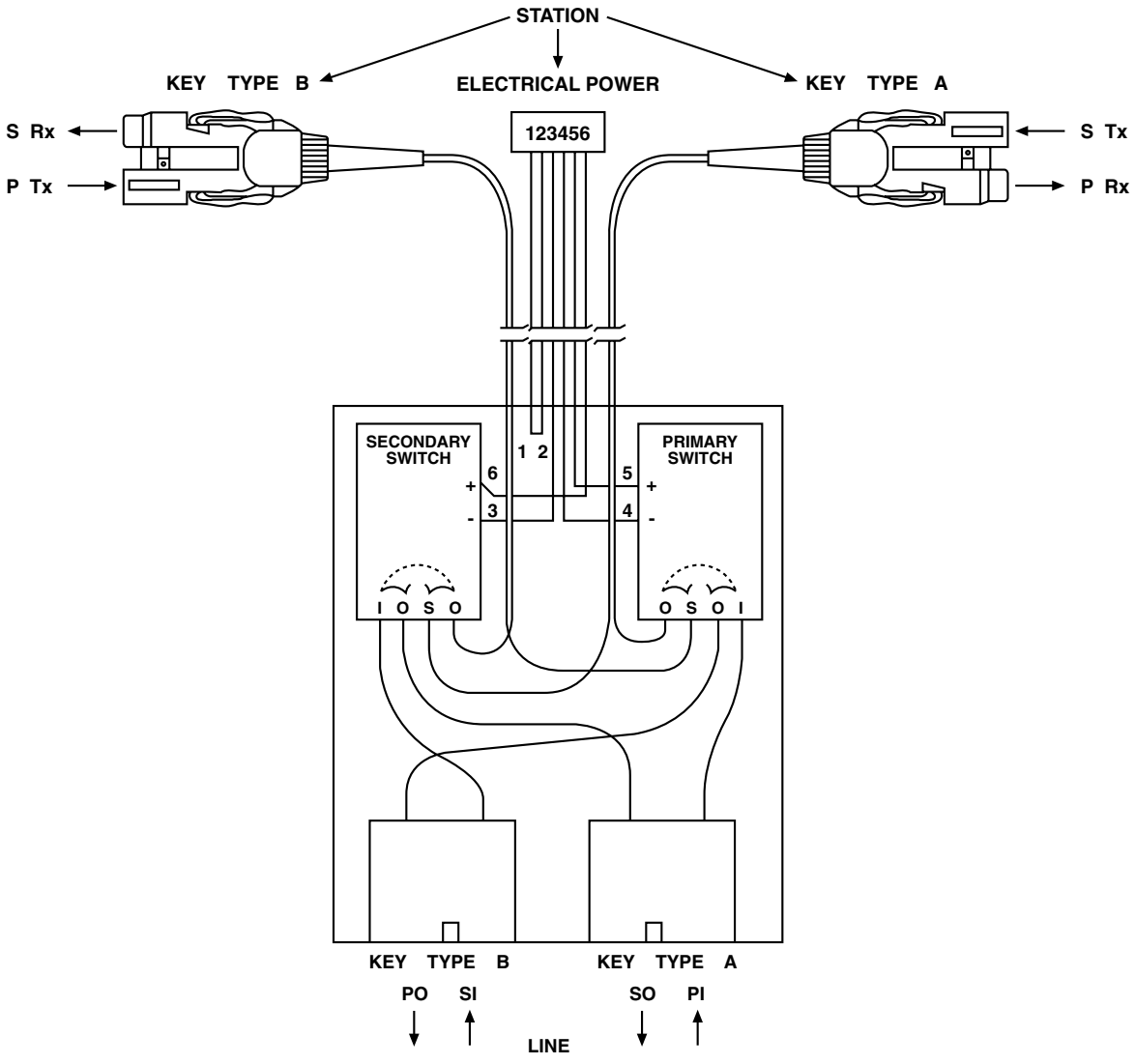

Figure 6-21-6. Optical Bypass Switch Connections.

The FTB supplies the necessary signals required to guarantee correct operation of the Optical Bypass Switch. These signals are shown in the following figure. The SMT controls the Optical Bypass Switch and can set it to the bypass mode when required.

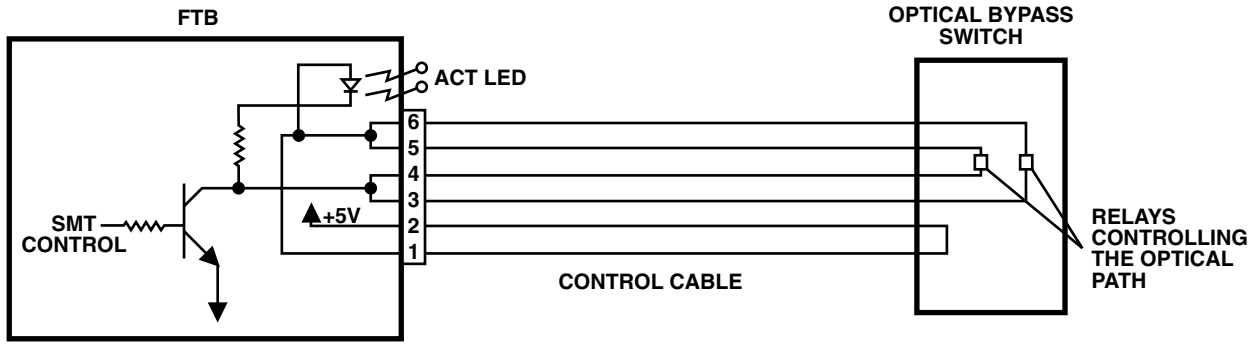

Figure 6-21-7. Optical Bypass Switch Electrical Signals.

6.21.5 Operation

Power On

The FTB module starts up automatically when inserted into a powered Hub enclosure.

At startup, the FTB module performs a comprehensive self-test that includes the following stages:

1. All LEDs are on for 2 seconds and then turn off (PWR LED stays on).
2. The module performs a series of tests. If a test fails, the appropriate LEDs indicate the faulty test and the FLT LED turns on. The following table describes the respective LED indications on the panel for each self-test.

Table 6-21-2. Self-Test LED Indications.

Test	TR LEDs 16M	4M	OK	LOAD
DRAM Test	Off	Off	Off	Off
FLASH Test	Off	Off	On	Off
DUAL PORT RAM Test	Off	Off	On	On
NVRAM Test	Off	On	Off	Off
TOKEN RING CAM Test	Off	On	Off	On
FDDI CAM Test	Off	On	On	Off
EEPROM Test	Off	On	On	On
TIMERS Test	On	Off	Off	Off
HDLC Test	On	Off	Off	On
UART Test	On	Off	On	Off
FDDI Test	On	Off	On	On
FDDI FILTER Test	On	On	Off	Off
TOKEN RING Test	On	On	Off	On
TOKEN RING FILTER Test	On	On	On	Off

If beaconing occurs on the ring during FTB setup, the FTB will attempt insertion into the LAN periodically.

Normal Operation

After passing the self-tests, the FTB becomes operative and the LEDs indicate its status.

FDDI Interface

The FDDI LEDs indicate connection status of the FTB to the FDDI network:

Table 6-21-3. FDDI LEDs.

Indicator	Function
WRAP A	ON when port A is wrapped (green).
WRAP B/S	ON when port B is wrapped (green) (Dual attached). ON when port B is wrapped (green) (Single attached).
ISO	ON when ports are isolated (green).
THR	ON when ports A & B are connected in thru mode (green).
ACT	ON when external bypass switch is inserted (dual-attached only) (green) (FDDI ring passes through the FTB).
OK	ON when FDDI ring is operational (green).
LOAD	ON when data is transmitted between the FTB and the FDDI network (green).

The following figure shows examples of WRAP, THRU, and ISO.

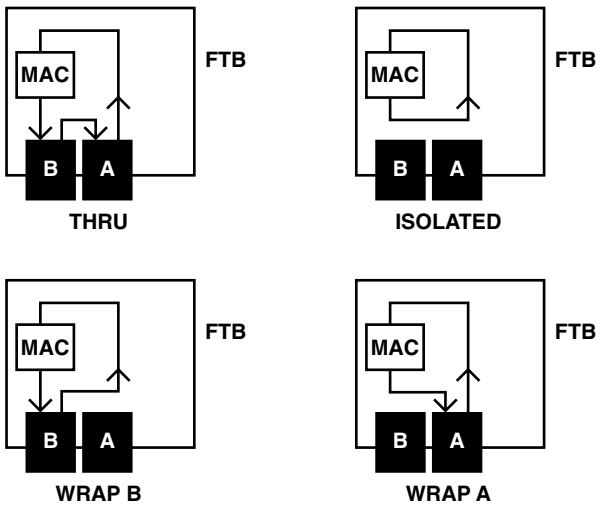

Figure 6-21-8. WRAP/THRU/ISO Examples.

Token Ring Interface

The Token Ring LEDs indicate connection status of the FTB to the Token Ring network.

Table 6-21-4. Token Ring LEDs.

Indicator	Function
16M	ON when Token Ring operates at 16 Mbps (green).
4M	ON when Token Ring operates at 4 Mbps (green).
OK	ON when the FTB is inserted into the Token Ring LAN (green).
LOAD	ON when data is transmitted between the FTB and the Token Ring LAN (green).

6.21.6 Setup and Monitoring

The FTB features an embedded setup and monitoring program that can be run from an ASCII terminal or a PC terminal emulator connected to the CML/NM Hub Management Module in the Hub Enclosure.

This section describes the setup and configuration procedure for the FTB module.

Installation and Setup

Connecting the Terminal to the CML/NM Module

1. Connect a cable between the CML/NM module's DB9 port (front panel) and a DB25 port on the terminal.
2. Set the terminal to work at any baud rate from 9.6 to 38.4 kbps, No Parity, 8 Data Bits, 1 Stop Bit.
3. Set the AGNT COMM switch of the CML/NM in accordance with the selected baud rate.
4. Switch the terminal's monitor on.
5. If the physical connection is correct, the main menu of the CML/NM appears on the screen. To communicate with the FTB, answer the CML/NM memnu prompt appropriately.

If the FTB does not appear in any string in the CML/NM main menu, an unrecoverable problem exists in the FTB, and the FTB panel LEDs indicate the probable source of the problem.

After the module is powered or reset, the FLASH validity is checked.

• If an error is detected during FLASH testing, the following screen appears.

```
Start BOOT Process
DRAM Test Passed

Checking the FLASH> Please wait.....
FLASH isn't valid!
Would you like to erase the FLASH and download the software [y/n]?

FLASH erasing.  Please wait....

Waiting for download
```

Figure 6-21-9. Error Detected During FLASH Testing.

At this point, proceed with the Download process. After the "Waiting for Download" message appears, run the X-MODEM protocol on the connected PC in order to transfer the software file to the FTB. The downloading takes approximately 8 minutes at 38,400 bps.

• If the FLASH is valid, or after software download, the FTB performs initialization and the second phase of the self-test. If a fault is encountered, a message is displayed.

Whether or not any errors are detected, the ASCII terminal is accessible to the user. However, if an error exists, it will be the only executable task of the FTB.

To enter the ASCII terminal, type the FTB password. The default password is "ftb" (in lower-case letters) followed by five spaces (total of eight characters).

6.18.7 CONFIGURATION

The first screen that appears is the main configuration menu. This menu enables you to:

• Configure Masks

• Edit and inspect the LAN table

• Read the internal MAC addresses of each port

• Set up SNMP parameters

```
CONFIGURATION MENU

0.  Exit
1.  LAN Table
2.  Masking
3.  Password management
4.  Version information
5.  Software downloading
6.  Port MAC addresses
7.  Reset to default setting
8.  SNMP parameters

Enter a choice:  1
```

Figure 6-21-10. Configuration Menu.

LAN Table Menu

From this menu, you may:

- Examine the contents of the LAN table
- Add/delete MAC addresses
- Add/delete hardware-based multicast masks

```
LAN TABLE MENU

0.  Exit
1.  View LAN table
2.  Change LAN table
3.  Erase LAN table
4.  Change aging time

Enter a choice:
```

Figure 6-21-11. LAN Table Menu.

LAN Table

Use this table to examine the contents of the LAN table. Each MAC address is displayed in non-canonical format.

```
LAN TABLE

MAC Address                  MAC Address          MAC Address

0.1.23.45.67.32.21 M         00.06.09.56.54.33    00.03.24.44.21.45

01.00.42.34.22.67            00.00.77.46.53.2E

0.  Exit
1.  Continue...

Enter a choice:
Type 1 for previous page, 2 for next page, ESC to cancel:
```

Figure 6-21-12. LAN Table.

Addresses with an M index are only multicast addresses and represent hardware-based multicast masks set by the user. FDDI frames with these multicast addresses will be rejected by the FDDI hardware filter. This prevents a mask from causing degradation to FTB performance.

The LAN table may contain permanent or non-permanent MAC addresses. Permanent MAC addresses are displayed in inverse video. MAC addresses learned automatically by the FTB are non-permanent addresses. Therefore, if a station with a non-permanent MAC address does not send any frame during two “Aging Time” periods, it will be erased from the table.

Manually-added MAC addresses may also be permanent (unaffected by the Aging process). Multicast masks can only be permanent.

If you select the "Erase LAN Table" menu or the "Reset to default setting" menu, all non-permanent MAC addresses will be erased from the LAN table bu the permanent MAC addresses will remain. To erase permanent MAC addresses, delete them one by one using the "Delete MAC Address" menu.

If the power fails, the LAN table will be restored at power-on with the same MAC addresses.

NOTE

MAC address should be typed in the following format:
XX.XX.XX.XX.XX.XX-M
where XX.XX.XX.XX.XX.XX indicates the MAC address, and
M indicates masked Multicast MAC address (optional)

Change LAN Table

Use this menu to add/delete MAC addresses to/from the LAN table.

```
CHANGE LAN TABLE

NOTE:  MAC address should be typed in the following format:
XX.XX.XX.XX.XX.XX-N
where:  XX.XX.XX.XX.XX.XX indicates MAC address,
M for masked multicast MAC address (optional)

0.  Exit
1.  Add MAC address
2.  Add permanent MAC address
3.  Delete MAC address

Enter a choice:  2

Enter permanent MAC address to add, ESC to cancel:
00.02.20.56.AF.6E

Permanent MAC address has been added to the LAN table.
```

Figure 6-21-13. Change LAN Table Screen.

- MAC addresses without an M index can be unicast addresses only.
- MAC addresses with an M index can be multicast addresses only.

Multicast addresses entered for masking purposes must be entered from the "Add Permanent MAC Address" menu.

Erase LAN Table

Use this menu to delete all non-permanent MAC addresses. As a safeguard against accidental deletion of the LAN table, you must type "erase" to delete the LAN table.

NOTE

In order to remove a user-defined permanent MAC address from the bridge LAN table, use the "CHANGE LAN TABLE" menu.

```
ERASE LAN TABLE

Note:  In order to remove a user defined permanent MAC address from the
bridge LAN table, use the "CHANGE LAN TABLE" menu.

0.  Exit
1.  Erase LAN table

Enter a choice:  1

Type "erase" to confirm erasing LAN table, ESC to cancel:

erase

LAN table has been erased
```

Figure 6-21-14. Erase LAN Table Screen.

Permanent MAC addresses can be deleted from the "Delete MAC Address" menu only.

Change Aging Time

All non-permanent MAC addresses in the LAN table are checked every aging time period for activity. If a station does not send any frame during two consecutive aging times, its MAC address will be erased from the LAN table.

```
CHANGE AGING TIME

0.  Exit
1.  Aging time (seconds):  500000

Enter a choice:  1

Enter new aging time (10...1000000 seconds), ESC to cancel:

40000
```

Figure 6-21-15. Change Aging Time Screen.

The FTB default Aging Time value is 500000 seconds (approximately 5.75 days).

If 256 or more Token Ring stations are attached to the FTB, then the Aging Time must be set to a low value. This enables faster "refreshing" of the non-active stations.

After a major change is made in the network topology, set the Aging Time to a low value: this "refreshes" the LAN table. After a period of time, return to the previous value.

The Aging Time parameter is also saved in the NVRAM and is restored at power-on.

Masking Menu

Use this menu to define 18 receive masks to each port independently.

```
MASKING MENU

0.  Exit
1.  Edit masking parameters
2.  Erase mask table

Enter a choice:
```

Figure 6-21-16 Masking Menu.

The use of masks slows down the forwarding rate of the FTB in proportion to the number of masks. For this reason, use the hardware-based multicast FDDI mask whenever possible.

Masks can be detected individually, or all at once using the "Erase Mask Tables" menu. In the latter case, all the masks in every port will be deleted.

Edit Masking Parameters

Use this menu to define the Rx masks of each port.

```
MASK TABLE

0.  Exit
1.  Type                    Rx
2.  Port No.                TR
3.  Entry Number            1
4.  Operation               Block
5.  Address                 All
6.  Mask #1                 0000 0000 1000 0000
7.  Mask #1 base address                 LLC
8.  Mask #1 offset          0
9.  Mask #1 condition                    True
10. Mask #2                 XXXX XXXX XXXX XXXX
11. Mask #2 base address    MAC
12. Mask #2 offset          0
13. Mask #2 condition                    True
14. Mask #3                 XXXX XXXX XXXX XXXX
15. Mask #3 base address    MAC
16. Mask #3 offset          0
17. Mask #3 condition                    True

Enter a choice:  0
```

Figure 6-21-17. Mask Table.

The mask can be applied to:

- All frames in a specific port at a specific queue (Rx)
- All of the multicast frames in this queue selectively
- Only the broadcast frames

To temporarily disable the Mask, type "None" after the Address query (option 5).

The newly-defined mask affects the forwarding process only after you exit from the "Edit Mask" menu. All defined masks are saved in the NVRAM and are re-installed automatically at power-on.

Erase Mask Tables

Use this menu to erase all masks defined in the FTB. To perform this operation, type the word "erase."

```
ERASE MASK TABLE

0.  Exit
1.  Erase all mask tables

Enter a choice:  1

Type "erase" to confirm erasing mask tables, ESC to cancel.

erase

Mask tables have been erased!!
```

Figure 6-21-18. Erase Mask Table Screen.

Password Management

The Monitor Password is eight characters long and is sensitive to upper/lower-case letters. The default value is "ftb" followed by five spaces.

```
PASSWORD MANAGEMENT

0.  Exit
1.  Set new monitor password

Enter a choice:  1

Enter new monitor password (8 symbols):

ftb_____

Verify new monitor password:

ftb_____

New password has been saved!!
```

Figure 6-21-19. Password Management Screen.

NOTE

If you forget the password, the only way to return to the default password is by removing the FTB front panel and plugging in the BDS jumper. Turn the power off before doing this. Turning on the FTB will set all the FTB parameters to default.

Remove the jumper before remounting the front panel.

Version Information

This menu shows the software and hardware FTB versions.

```
VERSION INFORMATION

Hardware revision is          B

Software version isFTB-VER-1.19

0.  Exit

Enter a choice:  0
```

Figure 6-21-20. Version Information Screen.

Flash Erasing

Use this menu to erase the FLASH in order to prepare the FTB for software download. As this is a potentially "destructive" action, confirm your choice by typing the word "erase."

```
FLASH ERASING

Note:  After erasing the FLASH you should reset the bridge and download
a new version of software.

0.  Exit
1.  Erase FLASH

Enter a choice:  1

Type "erase" to confirm FLASH erasing, ESC to cancel
```

Figure 6-21-21. Flash Erasing Screen.

NOTE

Verify the diskette with the software file before erasing the flash.

Port MAC Addresses

This menu shows the internal MAC addresses of the FTB in non-canonical format.

```
PORT MAC ADDRESSES

Token Ring - 00.D2.02.00.00.00
FDDI - 00.20.D2.02.00.01

0.  Exit

Enter a choice:  0
```

Figure 6-21-22. Port MAC Addresses Screen.

SNMP Parameters

From this menu, view and change the IP/SNMP parameters.

```
SNMP PARAMETERS

0.  Exit
1.  IP host parameters
2.  Community names
3.  Permanent managers

Enter a choice:  1
```

Figure 6-21-23. SNMP Parameters Screen.

IP Addresses

To change the IP host parameters, select item 1 from the SNMP parameters menu.

```
IP ADDRESSES

NOTES:
1.  IP address should be typed in the following format:  X.X.X.X
    where X—decimal number from 0 to 255.
2.  Non-contiguous subnet masks are not allowed.
3.  Inband IP address and default gateway must belong to the subnet,
   defined by subnet mask.

0.  Exit
1.  Inband IP address:        192.9.200.6
2.  Subnet mask:   255.255.255.0
3.  Default gateway:          192.9.200.5
4.  IP Broadcast:  255.255.255.255

Enter a choice:  1
Enter Inband IP address, ESC to cancel:
```

Figure 6-21-24. IP Addresses.

- In-band IP address—The Bridge IP address. To change this address, select this option.
- Subnet mask—The Bridge IP subnet address mask.
- Default gateway—The router to which all non-local IP datagrams are forwarded.
- IP broadcast—The IP layer broadcast address.

NOTE

1. The Bridge IP address and the default gateway address must belong to the same subnet.
2. All changes will take effect only after reset.

Community Names

To open the Community Names menu, select item 2 from the SNMP parameters menu.

From this menu, you can view, add, or change the SNMP community names.

```
COMMUNITY NAMES

0.  Exit
1.  Trap community name
2.  Read-only community names
3.  Read-write community names

Enter a choice:  1
```

Figure 6-21-25. Community Names Screen.

Trap Community Name

To set the trap community name, select option 1 from the Community Names menu.

The community name will be transmitted by the bridge when sending traps.

```
TRAP COMMUNITY NAME

0.  Exit
1.  Trap community name:  snmp_Trap

Enter a choice:  1
Enter trap community name (max. 32 chars.), ESC to cancel:  SNMP_Public
```

Figure 6-21-26. Trap Community Name Screen.

Read-only Community Names

To enter a read-only community name, select option 2 from the Community Names menu.

Management stations with one of the listed community names can only read (get) MIB parameters from the FTB.

```
READ-ONLY COMMUNITY NAMES

Name number         Name

1.                  RAD_user
2.
3.
4.

0.  Exit
1.  Add read-only community name
2.  Delete read-only community name

Enter a choice:  1
Enter read-only community name to add (max. 32 chars.), ESC to cancel:
Everyone
```

Figure 6-21-27. Read-Only Community Names.

Read-Write Community Names

To enter a read-write community name, select option 3 from the Community Names menu.

Management stations with one of the listed community names can read (get) MIB parameters and write (set) MIB parameters from/to the FTB.

```
READ-WRITE COMMUNITY NAMES

Name number         Name

1.                  Private
2.
3.
4.

0.  Exit
1.  Add read-write community name
2.  Delete read-write community name

Enter a choice:  1
Enter read-write community name to add (max. 32 chars.), ESC to cancel:
Read_Access
```

Figure 6-21-28. Read-Write Community Names Screen.

Permanent Managers

To open the Permanent Managers menu, select item 3 from the SNMP parameters menu.

This table indicates the destination addresses of the FTB traps.

```
   PERMANENT MANAGERS

   NOTE:  Permanent manager IP address should be typed in the following
format:
   X.X.X.X
   where:  X—decimal number from 0 to 255.

   Number              Permanent Manager

   1.                  192.114.28.94
   2.                  0.0.0.0
   3.                  0.0.0.0
   4.                  0.0.0.0
   5.                  0.0.0.0

   0.  Exit
   1.  Add permanent manager
   2.  Delete permanent manager

   Enter a choice:  1
   Enter permanent manager IP address to add, ESC to cancel:
   193.8.135.45
```

Figure 6-21-29. Permanent Managers Screen.

Any management station that wishes to receive traps from the FTB must register by entering its IP address to the table by the ASCII terminal or through SNMP private MIB table using Trap IP Table.

Reset to Default Setting

This menu is useful if serious changes have been made to the Network Topology, as it allows you to "start from the beginning." The FTB erases the entire LAN table (except the permanent MAC addresses) and all the masks; all user-definable parameters are set to default values.

NOTE

After this operation, all Bridge parameters will be set to factory-defined values except password and IP addresses.

```
RESET TO DEFAULT SETTING

0.  Exit
1.  Reset to default setting

Enter a choice:  1

Type "reset" to confirm reset to default setting, ESC to cancel:

reset

All parameters have been set to default:
```

Figure 6-21-30. Reset to Default Setting Screen.

In addition, all SMT MIB Get/Replace Attributes (as defined in the ANSI X3T9.5 Standard) return to default values.

Table 6-21-5. Get/Replace Attributes Defaul Values.

Parameter	Default Value
Aging Time	500,000 seconds
Password	Not affected
LAN Table	Non-Permanent MACs erased
Masks	Erased
SMT MIB Get/Replace Attributes	Default according to ANSI X3T9.5
IP Addresses	Not affected

In order to prevent accidental erasing of parameters, type the word "reset" to return to the default values.

6.21.8 Fault Isolation and Troubleshooting

The following table lists some common faults and their remedies.

Table 6-21-6. Common Faults and Remedies.

Symptom	Remedy
All front panel indicators are off.	1. Check that power is supplied to the unit. 2. Check that the unit is properly inserted in the enclosure. 3. Check the fuses and replace if necessary.
Self-test sequence fails.	1. Contact technical support.
FDDI port does not connect.	1. Check fiberoptic connection. Verify proper Tx/Rx connections between FDDI equipment. 2. Check for proper transmit and receive optical power levels, in accordance with the fiberoptic interface specifications.
The FTB is connected with the FDDI, but does not communicate with the existing FDDI stations.	1. Verify that each A port is connected to a B port (in case of A-A and B-B connection, two logical rings may result).
The Token Ring OK LED is off.	1. Check that the FTB Token Ring data rate corresponds with the Token Ring LAN rate.

6.21.9 Application

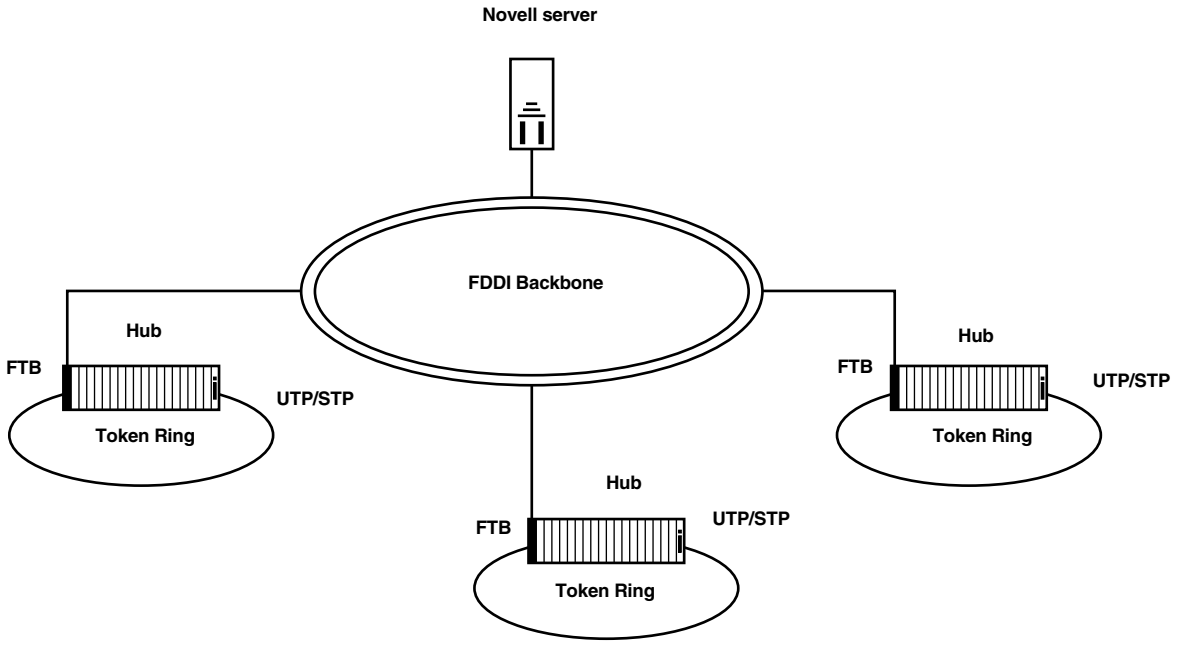

Figure 6-21-31. Ring Connection to the FDDI Backbone.

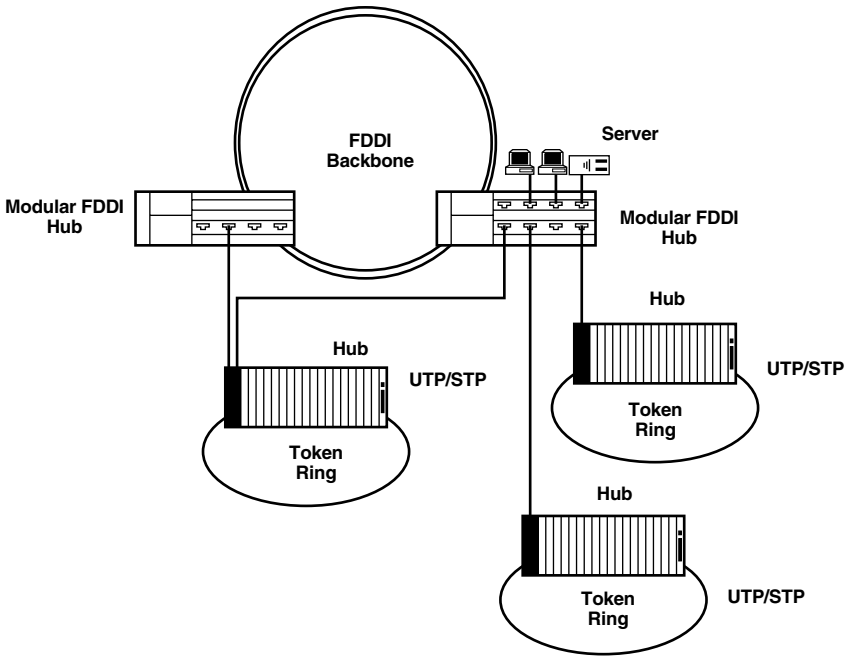

Figure 6-21-32. Tree and Dual Homing Connection to the FDDI Backbone.

6.21.10 FDDI Fiberoptic Cabling Design Considerations

Although the multimode F/O interface (MM) is specified for 62.5/125 micron fiber, other types of fibers can also be used. The fiber diameter affects the launched optical power and the distance of the F/O link.

Another important parameter to consider is the optical cable bandwidth (MHz x km). Each cable has a specified bandwidth. In order to use a cable for FDDI, the total end-to-end bandwidth must be at least 125 MHz and the cable bandwidth required is 125 MHz x link length. When the optical cable bandwidth is too small, it can become the limiting factor for the overall link distance, rather than the optical power budget which is usually the limiting cause.

The following tables describe the cable lengths supported by the different 1300 nm F/O interfaces, based on typical cables in wide production.

Table 6-21-5. Multimode Option (MM).

Fiber size (µm)	Minimum launched power (dBm)	Receiver sensitivity (dBm)	Optical margin (dB)	Safety margin (dB)	Link budget (dB)	Cable loss (dB/km)	Loss limited distances km (miles)	Cable bandwidth required MHz x km	Assumed cable bandwidth MHz x km	Bandwidth limited distances km (miles)
50/125	-23	-31	8	4	4	1	4 (2.5)	600	500	4 (2.5)
62.5/125	-19	-31	12	4	8	1	8 (5)	1000	500	4 (2.5)
100/140	-16.5	-31	14.5	4	10.5	3	3.5 (2.2)	437.5	200	1.6 (1)

Table 6-21-6. Single Mode Option (SM).

Fiber size (µm)	Minimum launched power (dBm)	Receiver sensitivity (dBm)	Optical margin (dB)	Safety margin (dB)	Link budget (dB)	Cable loss (dB/km)	Loss limited distances km miles	Cable bandwidth required MHz x km	Assumed cable bandwidth MHz x km	Bandwidth limited distances km miles
9/125	-7	-31	24	4	20	0.5	40 25	6000	100000	40 25

6.22 Jitter Attenuator Module

6.22.1 Description

The Jitter Attenuator Module (LT0005A-TJA) is a Jitter Attenuator and Lobe Distance Extender module for the Modular Intelligent Hub, which provides improved operation of the Token Ring network and extended distances on the lobes. The TJA placed in any slot of the hub receives the IEEE 802.5 signal on the main path of the backplane of the hub, and using a unique jitter-reduction and repeater circuit, regenerates a clean jitter free signal in the direction of the next inserted station on the ring.

When operating in conjunction with repeater modules TCR (UTP/STP) or TST (fiberoptic), the use of the TJA enables guaranteed extended distances on the lobes, regardless of the configuration of the rest of the ring. This accommodates easy planning and calculation of the network.

Operation in conjunction with extended-distance lobe access modules TEDU (UTP), TEDS (STP), or T2FS or T2FSA (fiberoptic) provides a lobe repeater function for connection of remote workstations or satellite access units and hubs.

The jitter attenuation function can be enabled by means of an internal switch or by management command from the management station. In addition, 4- or 16-Mbps operation can be defined manually by a switch or by the management. The TJA can also be bypassed by means of a management command.

Front-panel LEDs provide indication of management intervention, fault condition, jitter-attenuation activity, and 4- or 16-Mbps operation.

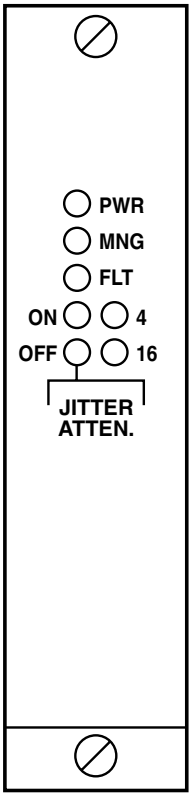

Figure 6-22-1. Jitter Attenuator Module.

The Jitter Attenuator Module has the following indicators:

- PWR—Power On (green). Lights when the TJA module receives power.
- MNG—Module under network management control (green). Lights when bypass command is being forced by the management station.
- FLT—ON when signal fault condition exists (red).
- ON—Lights when jitter attenuator is enabled (green).
- OFF—Lights when jitter attenuator is disabled (green).
- 4—Lights when module selected to operate at 4 Mbps (green).
- 16—Lights when module selected to operate at 16 Mbps (green).

6.22.2 SETUP

TJA modules occupy one slot of the Hub enclosure. The modules can be installed or removed while power is applied to the enclosure.

1. Set the TJA switches according to the table below for the required application.
2. Plug the module into the designated enclosure slot, as marked on the site installation plan. Fasten module by means of one screw. Do not overtighten.
3. Check that on each TJA module LEDs light according to the set-up.

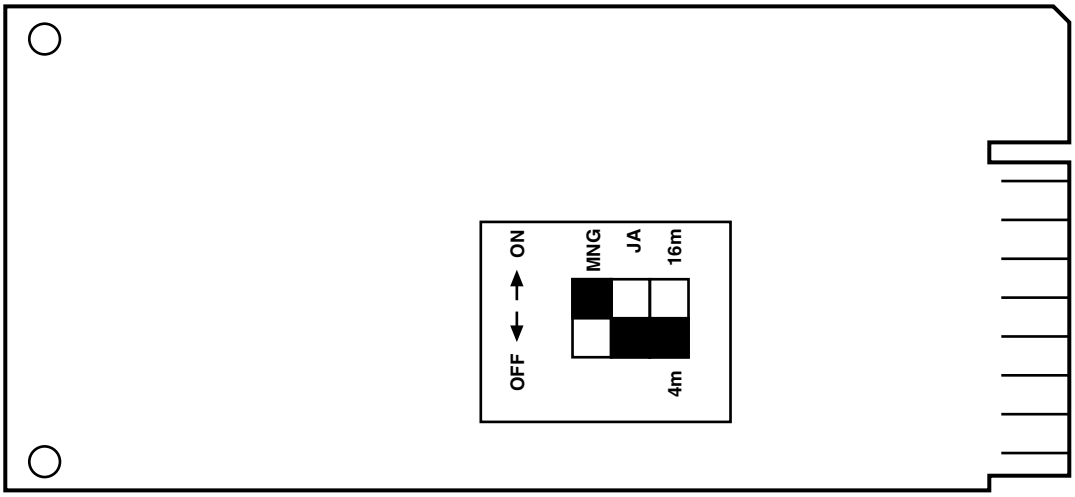

Figure 6-22-2. TJA Strapping Diagram.

Table 6-22-1. TJA Jumper/Switch Settings.

Strap Identity	Function	Possible Settings	Factory Setting
MNG	Controls jitter attenuation by the management system	ON or OFF	OFF
JA	Jitter Attenuator On/Off	ON or OFF	ON
4M/16M	Operating data rate	4 Mbps or 16 Mbps	16 Mbps

6.22.3 Application

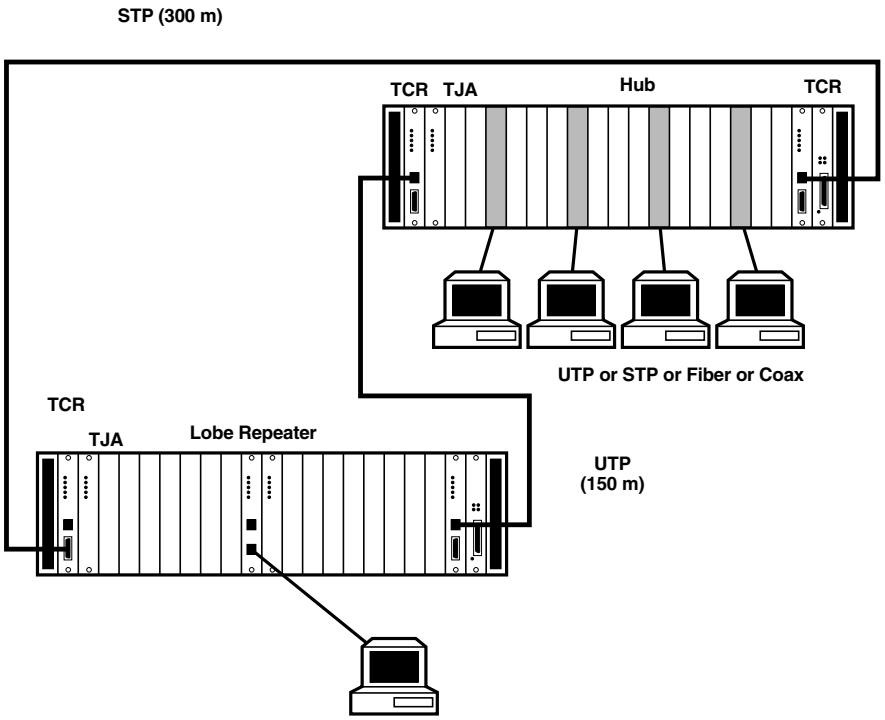

Figure 6-22-3. Typical Application for TJA.

6.23 CML/NM—Common Logic Network Management

6.23.1 Description

The CML/NM is a Hub Management module for enabling the complete monitoring and control of Intelligent Modular Hub enclosures from SNMP management station. Together with an SNMP agent card (CML/IB or CML/IB-E), the system provides direct online supervison of configurations, diagnostics, and monitoring.

The SNMP management station applies the Microsoft Windows graphical user interface and advanced database management techniques (SQL). Color graphics, representing system components, together with pull-down menus and dialog boxes guide the station operator in executing selected tasks. The operator may zoom in on individual modules up to the port level.

Communication with Hub agent passes through in-band or out-of-band channels. An out-of-band (SLIP) channel enables full control of the network even if there are LAN problems. In-band communication is provided through LAN connection of the SNMP agent card (CML/IB or CML/IB-E). At least one SNMP agent card is necessary to provide SNMP management functions in the Hub.

Management port connection can be used for:

1. Backup out-of-band management connection by SLIP protocol (in this case, SNMP agent card is still needed).
2. Software downloading. Using XMODEM protocol, module software can be downloaded for Hub modules with this capability (TRE, FTB, CML/IB, CML/IB-E, CML/NM and others).
3. Hub module configuration from a dumb terminal. Limited management functions can be performed if no SNMP agent card is present in the Hub enclosure.

The CML/NM has the following front-panel controls and indicators:

- PS1 ON, PS2 ON—On when specified power supply is operating
- PS1 FLT, PD2 FLT—On when specified power supply is not operating properly
- RESET—Pushbutton to reinitialize the hardware and software of the CML/NM module
- STATUS—Provides status information about Hub and the network

6.23.2 CML/NM Setup

1. Set the DCE-DTE switch to DCE when direct connection to a terminal or SNMP management station is desired, or to DTE when the connection is made through a modem link.

2. Set the bit rate used on the RS-232/V.24 link to match that of the terminal or SNMP management station.

3. Set the AGNT COMM. switch to the out-of-band communication data rate.

4. Set the PRTY switch to OFF for 10-bit data (ID, one start bit and one stop bit) or to ON for 11-bit data (one start bit, one bit of even parity, and one stop bit) to match the SNMP terminal.

5. To change the bit rate of the CML/NM during routine operations, remove the module from the Hub enclosure, set the baud rate as required (see Strapping Diagram) and return the module to the Hub enclosure.

Table 6-23-1. CML/NM Jumper/Switch Settings.

Strap Identity	Function	Possible Settings	Factory Setting
DTE/DCE Switch	Selects the operating mode of the RS-232/V.24 interface	DTE interface DCE interface	DCE
BAUD RATE Selector	The three leftmost sections of the AGNT COMM switch determines the bit rate of RS-232/V.24 interface	1 2 3 BIT RATE OFF OFF OFF 2.4 K OFF OFF ON 4.8 K OFF ON OFF 9.6 K OFF ON ON 14.4 K ON OFF OFF 19.2 K ON OFF ON 38.4 K ON ON OFF 52.6 K ON ON ON 115.2 K	9.6 K
PS1	Switched to ON if PS-1 power supply is operational	ON, OFF	ON
PS2	Switched to ON if PS-2 power supply is operational	ON, OFF	OFF
PRTY Selector	Enables or disables data parity OFF defines data as 8-bit, 1 start bit and 1 stop bit ON defines data as 8 bit, 1 start bit, EVEN parity bit and 1 stop bit	ON, OFF	OFF
JP 10	Forces software to run from BOOT	OFF (1-2 connected) ON (2-3 connected)	OFF

6.23.3 Installation

The CML/NM occupies one slot of the Hub enclosure, and must be installed in the last slot of the Hub. The CML/NM can be installed or removed while power is applied to the enclosure.

1. Identify the slot allocated to the Module on the installation plan.
2. Insert the module as specified on the site installation plan.
3. Fasten module by tightening one screw. Do not overtighten. Make sure that the handle is facing down.

6.23.4 Operation

Activating the CML/NM

To activate the CML/NM:

1. Connect the terminal to the management port on the front panel of the CML/NM or Hub back panel.
2. Insert the CML/NM module into the Hub. The module performs self-test and is ready for operation. The following message appears:

```
RADring CML/NM Rev x.xx
For MONITOR mode enter <CR>monitor<CR>
```

NOTE

At this point, the non-ASCII strings of the SLIP protocol can be displayed on the attached terminal.

Changing Configuration Modes:

To change the mode to MONITOR for Hub configuration through the dumb terminal:

1. Press <ENTER>.
2. Type "Monitor" (not case-sensitive) and press <ENTER> again. The following screen appears:

```
RADring CML/NM Rev 8.01

SLOT 1    EP-4T/AUI  SLOT 11    *CML/IB-E
SLOT 2    EMPTY      SLOT 12    EMPTY
SLOT 3    EP-8T/U    SLOT 13    EMPTY
SLOT 4    EMPTY      SLOT 14    EP-4T/1FL
SLOT 5    EP-8T/SU   SLOT 15    EMPTY
SLOT 6    EMPTY      SLOT 16    EMPTY
SLOT 7    EP-4T/2FL  SLOT 17    EPR-4FL
SLOT 8    EMPTY      SLOT 18    EMPTY
SLOT *9   CML/IB     SLOT 19    EMPTY
SLOT 10   EMPTY      SLOT 20    EMPTY
Enter slot number or 21 for CML/NM to start setup
```

Select any slot (except EMPTY and DISCONNECTED) to see the card status. For some cards, the configuration settings can be modified. Cards noted by an * have their own configuration menu and are called "smart" cards.

3. To configure the CML/NM settings, select slot 21. The following menu appears:

```
     SetUp CML_NM card
1.   Initialization of the Data Base
2.   Set New Password
3.   Set the Real Time Clock
4.   Set the SLIP mode
5.   Tests
6.   Software Downloading[1]
-----------------------------------
0.   Quit
Enter a command number ->
```

[1]Software downloading menu is present only when CML/NM features FALSH memory (hardware revision is 2.0 or higher).

Initializing the Database:

Use this option to reset the NVRAM-saved database to the default state. All previous configuration and security tables will be lost.

1. From the Card Setup menu, select the option, "Initialization of the Data Base." Type the password. The following confirmation screen appears:

```
WARNING!

All configuration will be lost!

Are you sure you want to perform
configuration reset? (Y/N)
```

2. Press Y to reset.

   The NVRAM is initialized and the module performs reset.

Set New Password:

To change the password:

1. From the Card Setup menu, select "Set New Password."
2. Type the old password. The following message appears:

```
Enter new password ->

Enter new password again ->
```

3. Type the new password. An * appears for each character.

Setting the Real Time Clock:

To display or change the current time:

1. Select “Set the Real Time Clock” from the Card Setup menu.

   The following message appears:

   ```
   TIME:  <current>, enter new time ->
   ```

2. Type the new time, using the *hh:mm:ss* format, or press <ESC> to leave this menu without maing any changes.

Setting the SLIP mode:

To enter the SLIP mode:

1. Select “Set the SLIP mode” from the Card Setup menu.

   CML/NM switches to slip mode.

To return to monitor mode:

1. Press <ENTER>.
2. Type “Monitor” and press <ENTER> again.

Software Download

- CML/NM software can be loaded in-band using TFTP protocol or out-of-band using XMODEM protocol.
- Downloading can be activated from SNMP for TFTP download, or from a configuration terminal.

Activation from a Configuration Terminal

To activate the software download from a terminal:

1. Connect the terminal to the serial port of the CML/NM and select the monitor mode.
2. Select the “Software Downloading” option from CML/NM setup menu.
3. Select the menu options that are required for setting TFTP configuration (see the SNMP documentation for more information about these parameters):

```
Set TFTP Download Filename (same as fileName in SNMP)
Set TFTP Server IP Address (same as fileServerIP in SNMP)
CML/NM TFTP download
CML/NM X-MODEM download
-------------------------------------------------
Quit
     Enter a command number ->
```

A description of the Downloading options follows:

Set TFTP Download Filename

Displays the current TFTP download filename and allows a new filename to be entered. To change the download filename:

1. Select the "Set TFTP Download Filename" option from the Software Downloading menu. The following screen appears:

```
Set TFTP download filename
Current setting TFTP download filename:
<current filename>

TFTP download filename ->
```

2. Type the filename and press <ENTER>.

Set TFTP Server IP Address

The IP address is necessary to perform TFTP downloading. The address is entered in decimal form and is saved in NVRAM.

To display and modify the current server IP address:

1. Select the "Set TFTP Server IP Address" option from the Software Downloading menu. The following screen appears:

```
Set TFTP server IP address
Current setting TFTP server IP address:
<current IP address>

Enter IP Address (0-255.0-255.0-255.0-255)->
```

2. Type the IP address and press <ENTER>.

TFTP Download

1. Select the option "CML/NM TFTP Download." Type the password. The following confirmation screen then appears:

```
WARNING!

Software will be reloaded:

Are you sure you want to start
software downloading? (Y/N)
```

The TFTP server should be configured beforehand and the supplied file should be located in the proper directory. The CML/IB agent should also be present in the Hub enclosure and configured properly.

2. Press Y to confirm. The module resets and starts TFTP protocol using the CML/IB or CML/IB-E agent as a LAN interface.

3. When downloading is complete, the module resets and then runs the software from FLASH memory.

NOTE

TFTP downloading is not performed if no active agent card is inserted in the Hub enclosure.

XMODEM Download

1. From the Card Setup menu, select the option "CML/NM XMODEM Download." Type the password. The following message appears:

```
WARNING!

Software will be reloaded!

Are you sure you want to start
software downloading? (Y/N)
```

2. Press Y to confirm and reset the module. While reset is being performed, the following message is displayed:

```
Erasing Flash, Wait....
```

Then, another message is displayed:

```
Xmodem started - please enter Upload command on
your local machine
```

The agent module then starts the XMODEM session and sends NACK. Activate the XMODEM protocol using the proper file. File transmission may take several minutes, depending on the baud rate.

Activating TFTP from SNMP

1. Before downloading the software from the network, verify that the following MIB variables are configured correctly:

fileServerIP: The IP address of the server from which the file is loaded
::={fileTransfer 1}

fileName: The name of the file to be loaded. For protection, read returns null string.
::={fileTransfer 2}

tftpRetryTimeOut: Time between transmissions (seconds).
::={fileTransfer 4}

tftpTotalTimeOut: Total time elapsed while the module performs retransmissions (seconds).
::={fileTransfer 5}

2. Set the fileTransCmd parameter to coprocDwnLoad(4). This parameter causes the CML/NM to perform reset and initialize the BOOT program.

The CML/NM activates the TFTP twice. During the first activation, it checks if the file can be opened. This prevents erasing of the FLASH memory in case some TFTP parameters are wrong. If successful, the TFTP session is initialized again and the FLASH memory is erased.

If software downloading is successful, the agent then performs reset and executes the CML/NM program from the FLASH.

If a TFTP fault occurs, the CML/NM resets but the result depends on the cause of the fault. If the fault occurs during the first initialization, the FLASH is not erased and the CML/IB-E runs from the FLASH again. If the fault occurs after the FLASH was erased, the CML/IB starts to run the basic version from the BOOT sector.

6.24 CML/IB Common Logic In-Band Management Module

6.24.1 Description

The CML/IB is an in-band management module. It is a fully compliant SNMP agent, supporting MIBII and private extensions. Working in conjunction with the CML/NM module, the CML/IB enables in-band and out-of-band monitoring and control of the Hub from the management station.

The CML/IB enables full management of the network and allows extensive monitoring and control from the management station, or from any generic SNMP management station (NetView 6000, HP OpenView, etc.).

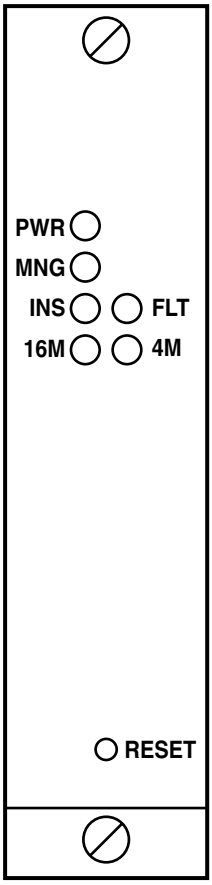

Figure 6-24-1. CML/IB Panel.

The CML/IB module provides additional functions such as:

- Automatic recovery if beaconing occurs.
- Correlating the MAC address to the physical address of stations connected to Hub lobe ports.
- Providing security by allowing only authorized stations to access the network via designated physical ports.

Diagnostic LEDs on each module indicate power, management, and activity status.

The Module has the following front-panel indicators:

- PWR—Green. Power ON.
- MNG—Green. Operating in setup mode.
- INS—Green. Agent is inserted into the ring.
- FLT—Red. Beaconing is detected.
- 16M—Green. Module is operating at 4 Mbps.
- 4M—Green. Module is operating at 16 Mbps.

6.24.2 SETUP

Set the CML/IB switch for the required application according to the following table.

Table 6-24-1. CML/IB Switch Settings.

Strap Identity	Function	Possible Settings	Factory Setting
4M/16M	Operating data rate	4 Mbps or 16 Mbps	16 Mbps
J5	Forces the software to run from BOOT.	SET or NOT SET	NOT SET (Run FLASH)*

*For CML/IB Hardware Rev. 1.0.

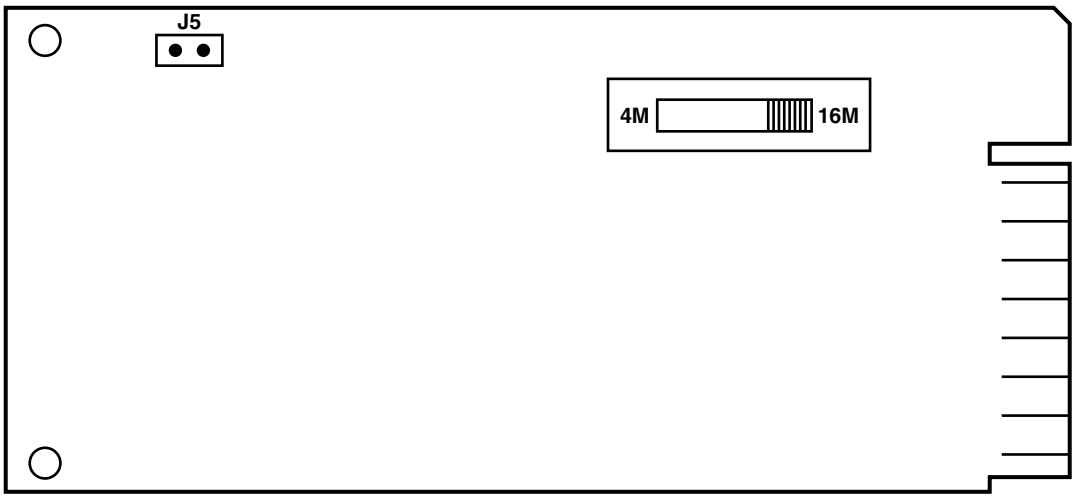

Figure 6-24-2. CML/IB Strapping Diagram.

6.24.3 Installation

The CML/IB module occupies one slot of a Hub enclosure and must be inserted within an RI/RO segment. The CML/IB module can be instaled or removed while power is applied to the enclosure.

1. Identify a free enclosure slot within an RI/RO segment, as marked on the site installation plan.
2. Plug the module into the chosen slot.
3. Fasten the module via one screw. Do not over tighten.

6.11.4 Operation

Important Terms

The following terms are used widely in describing the CML/IB module's functionality.

Segment—All Hub modules residing between RI and RO, where:

RI can be:

TIO, TCR, TFR, TFC, or a card after a terminated lobe card or a lobe card in slot 1 (the first available slot) of the Hub or a CML/IB card in slot 1.

RO can be:

TIO, TCR, TFR, TFC, or any lobe card with termination set to "ON" or a lobe card in slot 20 (the last available slot) of the Hub.

If RI is detected, the previous segment ends before the RI card.

If RO is detected (for example, a lobe card with termination set to ON), the next segment will start with the card to the right.

Ring—One or more segments physically connected together, without any intermediate bridge.

Pure Lobe Environment—A segment/ring where each lobe is attached to only one device (server, workstation). No LAUs or satellites are used except S-LAU, connected to SAT/SU card or SAT/SD card, and a satellite, connected to TL2-F/SAT card.

Operation Rules

- The CML/IB operates only in a hub containing a CML/NM module.
- The CML/IB card should be positioned within a segment of the Hub enclosure. Only one CML/IB module is allowed per segment.
- To receive statistics and status of a segment, the CML/IB must exist in the segment.

  To receive statistics and status of a Hub, a segment with a CML/IB configured as a Hub agent must exist in the Hub.
- Up to six CML/IB modules, one of which is defined as a Hub agent during setup, can be configured in a single enclosure.
- Security is provided only if correlation is performed.
- The CML/IB Correlation and Security functions operate reliably only in a pure lobe environment.
- Autorecovery is implemented (if autorecovery is defined in the configuration) regardless of the correlation process results. If correlation is not available (as in a non-pure lobe environment), the autorecovery takes longer.

Configuration as an SNMP Agent

CML/IB Setup in Management System

At least one CML/IB module per Hub enclosure must be configured as a hub agent in order to manage the enclosure using the RADview management system.

To perform the configuration:

1. Connect the Network Management PC to either the MANAGEMENT interface on the Hub enclosure's CML/NM module or the DB25 interface on the back of the Hub enclosure.
2. Use the Terminal Emulation function on the PC to run the Hub configuration console.

3. At Hub startup, a list of the installed cards appears on the PC screen. Select the CML/IB card to open the Setup menu:

```
               SETUP MENU of CML/IB-T
               Software Ver - x.xx  Hardare ver - x.xx
1.  Set SNMP Agent View
2.  Set LAN IP Parameters
3.  Set SLIP IP Parameters
4.  Set SNMP Communities
5.  Set Default Gateway
6.  Set IP Manager Table
7.  Set Local MAC Address
8.  Set Address Option
9.  Set Password
10. Set TFTP download filename
11. Set TFTP server IP address
12. Set TFTP total timeout
13. Set TFTP retry timeout
14. Set software download
0. Quit

               Enter a command number ->.
```

4. To select an option from the menu, type its corresponding number after the "Enter a command number" prompt.

5. An option-specific submenu and/or prompt appears. Enter the update information as required.

CML/IB Setup Option Submenus

The CML/IB setup option submenus are shown below.

1. Set SNMP Agent View

```
Current setting SNMP Agent View:  <setting>
               Setting SNMP Agent View
1. Hub agent
2. Ring monitor
Enter a command number
```

2. Set LAN IP Parameters

```
Enter IP Address (0-255.0-255.0-255.0-255) ->
Enter IP Mask (0-255.0-255.0-255.0-255) ->
Current setting IP address for LAN - <setting>
Current setting IP mask for LAN - <setting>
```

The default mask is set in accordance with the class (A, B, C) of the IP address.

3. Set SLIP IP Parameters

```
Current setting IP address for SLIP - <setting>
Current setting IP mask for SLIP - <setting>
```

4. Set SNMP Communities

```
Current setting read community - <setting>
Current setting write community - <setting>
Current setting trap community - <setting>
```

Then, each of the following messages appears after its corresponding value was defined. To save the value, press <ENTER>.

```
Setting communities:
read community ->
write community ->
trap community ->
```

5. Set Default Gateway

```
Current setting Default Gateway:  <setting>
Enter IP Address (0-255.0-255.0-255.0-255)
```

6. Set Manager Table

```
Select table entry
(entries 1-10, 0-all entries) ->
              Manager Table Line:  <selected entry>
```

Upon selection of an entry, the following prompts appear one at a time.
As each value is defined, the next prompt appears:

```
Current setting IP Address - <setting>
Enter IP Address (0-255.0-255.0-255.0-255)
<setting>
```

7. Set Local MAC Address

```
Current setting Local MAC Address: <setting>
Enter Local MAC Address ->
```

8. Set Address Option

```
Current setting Address Option: <setting>
              Setting Address Option
1.  Local Address
2.  BurnedIn Address
Enter a Command Number ->
```

9. Set New Password

```
Enter password ->
Enter new password ->
Enter new password again ->
```

10. Set TFTP Download File Name

```
Current setting TFTP download file name:  <setting>
TFTP download filename ->
```

11. Set TFTP Server IP Address

```
Current setting TFTP server IP address : <setting>
Enter IP address (0-255.0-255.0-255.0-255) ->
```

12. Set TFTP Total Timeout

```
Current setting TFTP total timeout: <setting>
TFTP total timeout ->
```

13. Set TFTP Retry Timeout

```
Current setting TFTP retry timeout:  <setting>
TFTP retry timeout ->
```

14. Set Software Download

A prompt requesting the password (defined in step 9) appears on the screen. After the correct password is entered, the following submenu is displayed:

```
1.  CML/IB TFTP download
2.  CML/IB X-MODEM download
```

0. Quit

```
1.  Quit without saving setup
2.  Quit and save setup
Select an option.
```

Select 2 to display additional prompts as follows:

```
Save all Set Up (y/n)
```

Select y to save the entire configuration. Selecting n allows you to save each individual parameter. Each prompt appears one at a time, after the previous prompt is answered.

```
Save SNMP Agent View (y/n)
Save LAN IP Parameters (y/n)
Save SLIP IP Parameters (y/n)
Save Default Gateway (y/n)
Save Local MAC Address (y/n)
Save Address Option (y/n)
Save Community (y/n)
Save TFTP Parameters (y/n)
```

After the last prompt is answered and all parameters are saved, the following message appears on the screen:

```
End of Transparent Mode.  Press any key to continue
```

Software Download

- CML/IB software can be loaded in-band using TFTP protocol or out-of-band using XMODEM protocol.
- Downloading can be activated from SNMP for TFTP download, or from a configuration terminal.

Activation from a Configuration Terminal

To activate the software download from a terminal:

1. Connect the terminal to the serial port of the CML/NM.
2. Press <ENTER> until the CML/IB setup menu opens on the screen.

TFTP Download

1. From the Card Setup menu, select the menu options that are required for setting TFTP configuration (see the SNMP documentation for more information about these parameters):

```
Set TFTP Download Filename (same as fileName in SNMP)
Set TFTP Server IP Address (same as fileServerIP in SNMP)
Set TFTP Total Timeout (same as tftpTotalTimeOut in SNMP)
Set TFTP Retry Timeout (same as tftpRetryTimeOut in SNMP)
Software Download
```

2. To execute the downloading, select the option "Software Download." After you type the password, the following menu appears on the screen:

```
1. CML/IB TFTP download
2. CML/IB X-MODEM download
```

   Select option 1 to download the software using TFTP protocol. The TFTP server should be configured beforehand and the supplied file should be located in the proper directory.

   After selection and confirmation, the module performs reset. TFTP is activated automatically after reset.

XMODEM Download

1. From the Card Setup menu, select the option "Software Download." After you type the password, the following menu appears on the screen:

```
1. CML/IB TFTP download
2. CML/IB X-MODEM download
```

2. Select option 2 to download the software using XMODEM protocol.

   After the selection, a confirmation request appears. Press Y to confirm and reset the module. When reset is completed, the following message appears on the screen:

```
End of Transparent Mode.  Press any key to continue.
```

3. Select the CML/IB module again from the CML/NM main setup menu. The following message appears:

```
Erasing Flash, Wait......
```

   Then, the following message is displayed:

```
Xmodem started - please enter Upload command on
your local machine.
```

   The agent module then starts the XMODEM session and sends NACK. Activate the XMODEM protocol using the proper file. File transmission may take several minutes, depending on the baud rate.

Activating TFTP from SNMP

1. Before downloading the software from the network, verify that the following MIB variables are configured correctly:

   fileServerIP: The IP address of the server from which the file is loaded
   ::={fileTransfer 1}

   fileName: The name of the file to be loaded. For protection, read returns to null string.
   ::={fileTransfer 2}

   tftpRetryTimeOut: Time between transmissions (seconds).
   ::={fileTransfer 4}

   tftpTotalTimeOut: Total time elapsed while the module performs retransmissions (seconds).
   ::={fileTransfer 5}

2. Set the fileTransCmd parameter to swDwnLoad(1). This parameter causes the agent to perform reset and initialize the program from the EPROM.

The CML/IB activates the TFTP twice. During first activation, it checks if the CML/IB file can be opened. This prevents deletion of the FLASH memory in case some TFTP parameters are wrong. If successful, the TFTP session is initialized again and the FLASH memory is erased.

If software downloading is successful, the agent then performs reset and executes the CML/IB program from the FLASH.

If a TFTP fault occurs, the CML/IB performs reset but the result depends on the cause of the fault. If the fault occurs during the first initialization, the FLASH is not deleted and the CML/IB runs from FLASH again. If the fault occurs after the FLASH was deleted, the CML/IB starts to run from the EPROM.

Agent Configuration by BOOTP Protocol

BOOTP protocol is used to configure the agent automatically from the BOOTP server. BOOTP is activated after agent power-up if the agent has no IP address (set to 0).

The following parameters are set by the BOOTP.

- Agent IP address
- Agent IP mask (item code 1)
- Default router IP address (item code 3)
- Read SNMP community (vendor-specific item code 131)
- Write SNMP community (vendor-specific item code 129)
- SNMP manager IP address (vendor-specific item code 130)

After configuration, the CML/IB agent runs using the new parameters (for specific configuration instructions, see the BOOTP server documentation).

CML/IB Setup from Generic Network Management Stations

The CML/IB module supports other generic SNMP based management stations, such as IBM LAN Manager or NetView.

When using one of these network managers, run the CML/IB configuration according to the specific manager's agent setup program. For further details, see your network manager's documentation.

6.11.5 FUNCTIONS

Network Monitoring

The CML/IB module monitors the Token Ring operation, collects ring status data, and provides statistical data on ring performance and error conditions. The collected data is available to SNMP protocol management stations.

Alerts and statistics of soft errors are transmitted to the management station for real-time viewing and analysis.

For full network coverage, CML/IB modules should be installed in each Hub.

Network Control

The CML/IB module allows full control of the Hub from the management station. A Hub supports up to six CML/IB modules, thereby allowing the management of up to six independent rings within the same hub.

Support of IBM LAN Manager and NetView

The CML/IB module can be configured to provide alerts to the IBM LAN Manager and NetView using the Alert Transport Service.

Automatic Recovery

If beaconing is detected, the CML/IB module automatically performs the following sequence of actions, even if not connected to a management station:

- Activates loopbacks at the RI and RO ports, thus removing the Hub from the ring. If beaconing stops, the problem is outside the hub. The CML/IB module then disconnects the loopbacks and reinserts the hub into the ring.
- If beaconing persists when the Hub is removed from the network, the CML/IB module locates the problem and the faulty lobe is left bypassed. The CML/IB then returns the hub to normal operation.

MAC Address—Port Correlation

The CML/IB module correlates the MAC address of the station physically connected to each Hub lobe port (provided there is only one station per port).

Security

The CML/IB module implements a port-level security access feature, which allows only authorized stations to connect via designated physical port(s).

After correlation has been performed and security is set to ON, the port security access is checked. Only authorized stations with a proper security level remain in the ring; unauthorized stations are disabled. A Lobe Disable trap due to security violation is then sent to the management station.

Security is checked when:

- Station tries to connect to port with security setting, and Security is set to ON.
- Station is already inserted and Security is set to ON.
- Security is already defined to a port and Security was also set to ON.

6.24.6 Application

The figure on the next page shows central management of local and remote LANs through CML/IB modules.

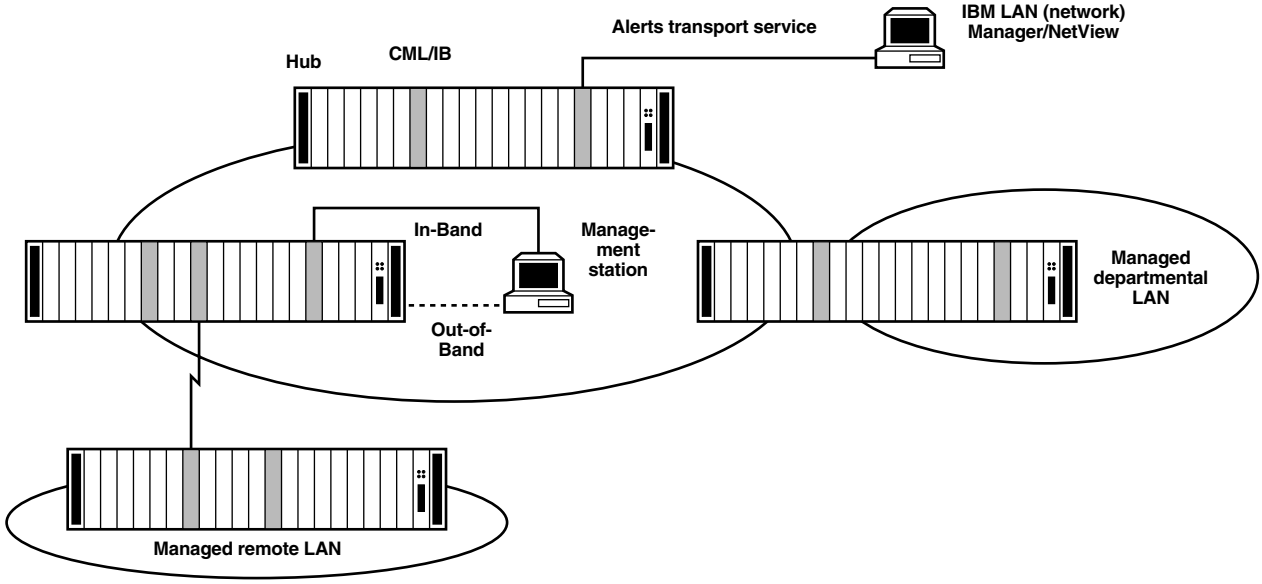

Figure 6-24-3. Central Management of LANs via CML/IB Modules.

6.25 In-Band Management Agent for Ethernet (CMLIB)

The CMLIB is an in-band management agent for the Hub. It is a fully compliant SNMP agent, supporting MIB II with private extensions. This allows management in heterogeneous environments from any SNMP management station.

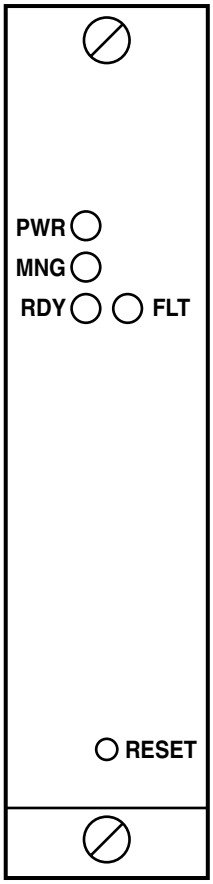

Figure 6-25-1. CMLIB Module for Ethernet.

The CMLIB enables full network management and allows extensive monitoring and control from the management station, or from any generic SNMP management station.

The CMLIB single slot module provides full network control over the Hub through an Ethernet connection.

The CMLIB enables full control of the Hub from the management station. Management commands received over the network are acted upon in conjunction with the CML/NM card.

Communication with the Management station continues even upon loss of in-band communication, via the out-of-band management connection of the CML/NM serial management port. This ensures continued management of the network under worst-case conditions.

The CMLIB features FLASH memory. TFTP protocol is used for upgrading the software over an Ethernet link. Also, XMODEM downloading is supported via the serial management port on the CML/NM front panel.

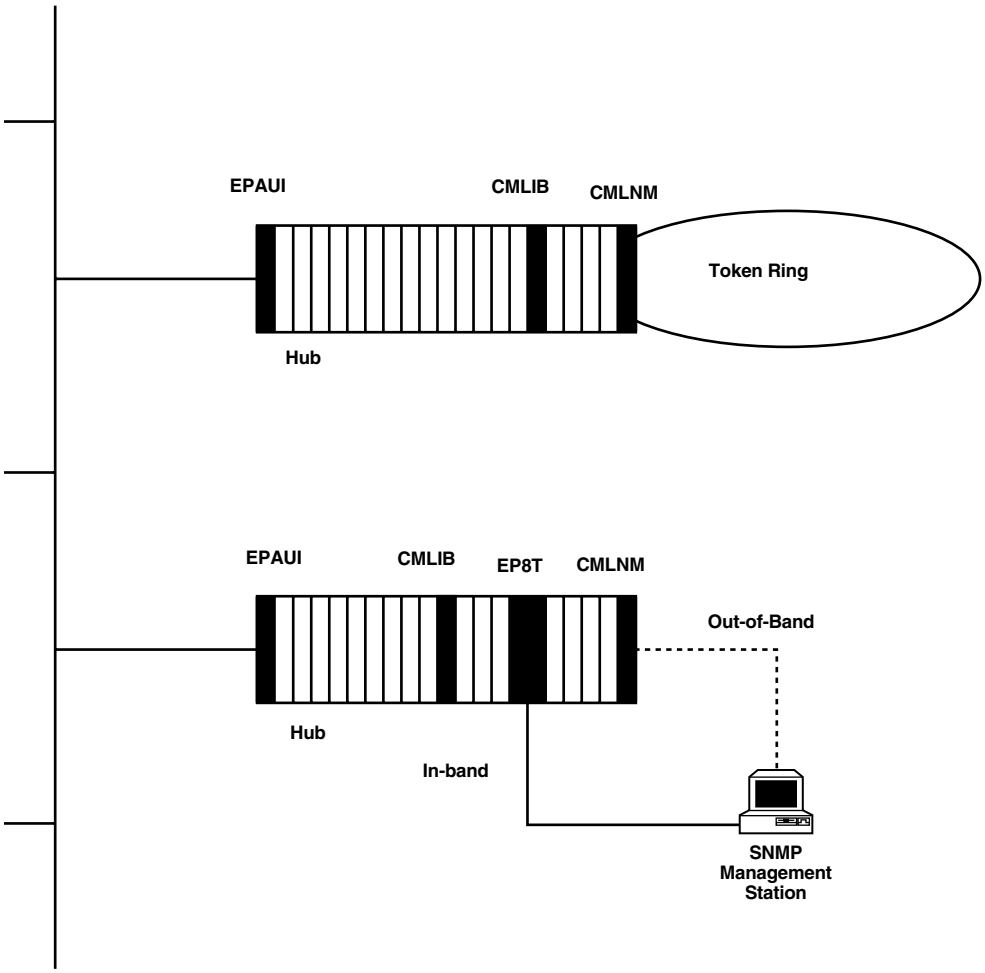

Figure 6-25-2. Typical Application.

7. Token Ring Design Considerations

7.1 Introduction

The planning of a new Token Ring LAN, or the extension of an existing LAN, must take into consideration a number of objectives including:

- Which organizational expectations should be fulfilled by the LAN.
- What types of functions are required by the end users.
- The geographic extent of the network and the number of users.
- The LAN environment's special requirements with regards to reliability, security, noise immunity, indoor/outdoor connections, etc.
- Manageability, in terms of day-to-day maintenance of the network and cabling system, fault diagnosis, and recovery.

Once the basic requirements of the token ring have been established, the actual design can start. In general, the basic topology of the LAN is determined by the special requirements of your system. After the system requirements have been determined, you must implement a LAN that interconnects a specified number of users and servers located at predetermined locations.

Therefore, you should begin with a predetermined network configuration and analyze this configuration to determine whether it is technically feasible.

The goal is to design a network that will continue to provide service even when a single fault occurs.

If problems are found, network design is refined by adding repeaters, using cable with lower attenuation, segmenting rings into smaller rings and similar solutions.

After several iterations, a reliable, cost-efficient design is obtained.

A typical design procedure consists of the following steps:

1. Define location of nodes
2. Define location of future nodes
3. Select the topology
4. Define location of wiring closets
5. Select the media to be used
6. Complete a cabling table
7. Calculate the worst-case scenario
8. If required, decide upon placement of repeaters and/or bridges
9. Verify network design
10. Calculate the cost per node
11. For large networks, select a new topology and repeat the procedure
12. Implement the design which best meets the objectives listed above.

The Modular Intelligent Hub, together with some of its modules, can be used to simplify steps 7, 8 and 9 and to shorten the design process. This section provides a description of and guidelines to simplified network design using the Hub.

7.2 Token Ring Physical Design

7.2.1 Design Methods

When determining the physical feasibility of your Token Ring Network, there are two basic limitations that have to be taken into account:

- Distance limitations
- Station count limitations.

The design approach of many suppliers of Token Ring equipment is based on the mechanical use of tables and/or arithmetic formulas provided by the supplier, which define segment length, maximum number of stations and wiring concentrators, etc. Although this approach seems simple, it can really work only in relatively simple cases. It certainly does not allow optimization of network design, nor does it provide any insight on the critical points of the network layout.

Our design method is based on the recognition that the factors limiting the number of stations and the physical distance that can be covered by a Token Ring are attenuation and jitter. The explicit approach recommended by us allows the designer to identify critical areas and select an optimal and cost-effective solution.

In addition, we provides special configurations which provide guaranteed lobe/trunk distances and maximum station counts. These configurations utilize repeaters, jitter attenuators, active access modules and passive access modules to ensure simplification of the design procedure.

7.2.2 Design Rules—Basics

Attenuation

The total attenuation of the ring electrical signal in a LAN without repeaters, under the worst-case scenario, must not exceed 26dB. The maximum allowable attenuation is increased by 26dB for each repeater, and can be translated into distance according to the attenuation of each type of cable (See Tables 7.1 and 7.2).

Explanation: The transmit level of the token-ring components is nominally 4 volts peak-to-peak. The sensitivity of a token-ring receiver is also limited, to avoid random errors caused by noise (usually 0.2 volts peak-to-peak). These two factors limit the maximum attenuation permitted between any transmitter and the next downstream receiver to a maximum of 26dB.

This value of maximum allowable attenuation, 26dB, is called “power (or loss) budget.”

If the maximum attenuation is exceeded, the signal must be amplified by means of a repeater (a special device that is not a ring node, and has only the function of regenerating the ring signals). The repeater restores the signal to its nominal transmit levels. However, to be effective, a repeater must be positioned at a location where signal levels are low, for example, in a long ring segment.

Jitter

The jitter limits the maximum number of stations that can be connected in a ring, because each device on a token ring acts as a repeater that receives signals from an upstream neighbor and retransmits these signals to the next active downstream neighbor on the ring. During this process, small timing errors (“jitter”) occur in the regenerated signal.

Timing errors introduced during regeneration accumulate. This effect increases with the number of devices (stations and repeaters) on the ring. Since there is a limit to the jitter a station, and in particular the active monitor of the ring, can tolerate, there is a limit to the number of devices on a ring. The limit depends on cable characteristics:

- For a ring using IBM Type 1 (STP) cable or equivalent, the limit is 260 devices.
- For a ring using IBM Type 3 (UTP) cable or equivalent, the limit is 72 devices.

Table 7-1. IBM Cabling System.

Cable Types	Description	Attenuation 4 Mbps	Attenuation 16 Mbps	NEXT @ 16 MHz	Application
Type 1 Data Cable	Two shielded twisted pairs of non-plenum AWG 22 solid copper conductors (plenum).	22	45	-40 dB	Main ring path. Long lobes.
Type 2 Data and Telephone Cables	Two shielded twisted pairs same as type 1, plus four voice grade pairs AWG 22.	22	45	-40 dB	Main ring path, long lobe cables, RS-232 data up to 19.2 kbps. Voice grade pairs may be used for connecting a token ring management system.
Type 3 Telephone Twisted Pair	Four telephone twisted pairs of AWG 24.	50	100	-23 dB	Used for connection of workstation to wall faceplate. Requires Type 3 media filter for use with Token Ring.
Type 5 Fiberoptic Cable	Two multi-mode optical fibers in three grades: 50/100, 62.5/125, 100/140	3 4 6	3 4 6	None	Main ring path between TAU/MAUs. Also for 16 Mbps backbones.
Type 6 Patch Cord Cable	Four twisted pairs of AWG 26 with braided shield.	33	66	-34 dB	Patch cable for wiring closets and connection of repeaters to the Ring-In, Ring-Out ports of TAU/ MAU. Same characteristic impedance as Type 1.
Type 8	Two shielded twisted pairs of AWG 26 parallel with braided shield.				Flat cable for use under carpet.
Type 9 Low Cost Data Cable	Two shielded twisted pairs of AWG 26 with copper conductors.	33	66	-34 dB	Same application as Type 1. Physically more flexible than Type 1 but has higher attenuation. Main paths (plenum)

Table 7-2. UTP Cabling System.

Cable Types	Description	Attenuation (dB/Km) 4 Mbps	16 Mbps	Characteristic Impedance @ 10 MHz	NEXT @ 16 MHz
IBM Type 3	Two or more individually twisted pair.	50	100	85-115 Ω	23 dB
Typical EIA RS-568 Cable	EIA standard UTP.	50	105	100 Ω	30 dB
AT&T Systi-max 2061A	Super UTP cable with special polymer insulator.	40	82	100 Ω	33 dB
Northern Telecom BDN	Super UTP cable with special polymer insulator.	45	93	100 Ω	37 dB

7.2.3 Overcoming Lobe Distance Restrictions, and Simplifying Design

In designing a Token Ring Network, the maximum number of stations per ring and the longest lobe length are major considerations in ensuring good operation of the network.

Step 1 - Lobe Media Test

The first limitation to the lobe length (distance between station and hub) is the lobe media test. This test includes a loop test so that the signal transmitted from the station is looped back, in order for the station to receive and check it (see **Figure 7.1**). If it does not pass the test, the station cannot enter the network. In this context, the differences between a passive lobe and an active lobe are important, since the active lobe ensures a longer distance at this stage of inserting into the network. The passive lobe is transparent to the signal, so that the signal must overcome attenuation of twice the lobe length. The active lobe regenerates the signal so that the signal need overcome attenuation of only once the lobe length.

Step 2 - Worst Case Design

Once the station is inserted, the second limitation comes into play. This limitation is defined in terms of a worst-case situation, where the station in question is the first station on the ring, and in addition is situated on the longest lobe (the lobe with the highest attenuation). If passive lobes are used and there are no repeaters on the ring, the whole drive distance around the ring must be taken into consideration in calculating whether the drive distance is within the attenuation limit of 26dB, the nominal budget allowed (see **Figure 7.2**). The worst case situation occurs when the shortest trunk segment is broken, forcing the signal to travel along the backup path as well. In a large ring consisting of several wiring centers, these calculations can become complicated. One way to simplify the calculations is to isolate each wiring center in terms of network calculations. This can be done simply by use of the repeater and jitter attenuation modules (see **Section 7.5** for standard configurations). Alternatively, once again, the active lobe modules can be implemented to provide amplification of the signal at each lobe.

Step 3 - Selecting Active or Passive Access Lobe Modules

In the case that the lobe media test were to fail, the only solution is to use the active lobe modules, since repeaters on the ring will not help.

Even with low grade UTP, a passive lobe can support up to 70 meters of lobe length at 16 Mbps.

In the majority of network lobes this distance is sufficient. Where possible, it is preferable to use passive lobes rather than active lobes for two reasons:

1. Passive lobes are low-cost and high-density.
2. Active lobes introduce added unwanted jitter, which decreases the maximum number of stations possible or, alternatively requires jitter attenuation.

7.3 Maximum Number of Stations per Ring and the TJA Module

A limiting factor in determining the maximum number of stations per ring is the correlated jitter introduced into the token ring-signal by active stations, active lobes, and long, low-quality cables.

In order to overcome the inherent limitations in using active modules or when using lower quality cables, the TJA ensures that the token-ring signal is cleared of jitter, thus ensuring increased station count under these conditions.

7.3.1 TJA Unique Benefits

Unlike an adapter card, the TJA is designed to correct frequency jitter. The TJA dampens the frequency jitter of the incoming data, so that the TJA output restores the pure frequency phase state created by the active monitor. This means that if a TJA unit is inserted into every Modular Intelligent Hub, the frequency jitter will never be enough to overrun the active monitor's elastic buffer and cause soft errors. With the TJA in every Modular Intelligent Hub, the number of users on the ring may increase to the original 250, irrespective of media types and quality.

7.3.2 TJA Configuration

Since the active monitor can at any time be any adapter card on the ring (it will tend to move around as users are inserted and deinserted), the use of only one TJA is not recommended. For example, if the active monitor is the adapter card directly preceding the TJA unit, the unit won't really be cleaning up any jitter at all because the data will be clean at that point. So, at least two units should be used, and they should be placed so that an approximately equal number of users are between them. Table 6.3 defines the frequency with which TJA should be used to achieve maximum station count according to media and module type.

7.4 Simplified Design Rules

Just as no two organizations have exactly the same needs, no two networks are created equal. For this reason, instead of providing strict rules for implementation of Token Ring networks using Modular Intelligent Hubs, the following configurations should provide guidelines which will enable your organization to utilize the benefits of Token Ring to their maximum.

The configuration should be used to provide guaranteed lobe distances and station count irrespective of the topology of the ring and wiring closets, and without the need to calculate the worst-case ring length. The simplified design rules can be divided into two parts:

1. Distance between hubs
2. Lobe distances

Distance Between Hubs

The maximum guaranteed distance between hubs is defined in **Table 7-3** with respect to which RI/RO modules are used and which media.

Table 7-3. Distance Between Hubs.

RI/RO Module	Max. Distance Between Hubs @ 16 Mbps	Lobe Distances (l)	Automatic Cable Break	Other Features
RR-TCR Copper Repeater	350 m (STP) 150 m (UTP) 200 m (Level IV.V)	If TJA follows Ring in TCR	+	Jitter Attenuator Media Filter
RR-TFR Fiber Repeater	14 dB Multimode (up to 3 km) 15 dB Single Mode (up to 20 km)		+	Jitter Attenuator SMA or ST
RR-TFC	14 dB Multimode (up to 3 km) 15 dB Single Mode (up to 20 km)	Up to 50 m over STP	+	Redundant Link Option
RR-TIO	Dependent on total ring length	Dependent on total ring length	+	

Guaranteed Lobe Length

In order to provide guaranteed lobe length irrespective of the ring configuration, each Hub is isolated from the rest of the ring in terms of network design. This is done by use of repeaters and/or TJA modules which together ensure that a new jitter-free signal enters each Hub, allowing us to treat the network design on each Hub separately. These configurations complement the previous guidelines.

7.5 Fiberoptic Design Considerations

7.5.1 TFR Network Design Considerations

- Use TFR repeaters on long ring segments, as a replacement for copper repeaters. You will achieve better performance and higher ring availability.
- Use TFR repeaters to carry sensitive information by fiberoptic cable on exposed, outdoor segments.
- Use TFR repeaters to convert copper segments to fiberoptic segments where strong electrical interference (from industrial machines, nearby radar, or radio transmitters) may disrupt Token Ring operation, or lightning strikes or high-voltage lines present a safety hazard.

7.5.2 Fiber Network Design Considerations

In general, Token Ring networks with two different transmission media—copper (STP or UTP) and fiber optic cable—can incorporate either TFC modules or TFR modules. The major differences between the TFC and the TFR are:

1. The TFR provides full repeating and jitter attenuation while the TFC simply converts from copper to fiber.
2. The TFC is available with a two-link option.
3. The TFC is a more cost-effective solution than the TFR.

NOTE

While using TFC, its fiber-link distance is equal to the TFR's, although the copper distance is shorter because of jitter considerations.

These recommendations are based on the fact that jitter is the major range-limiting factor. Since the TFC contains only conversion circuits, it does not perform the functions of a full repeater, although the TJA jitter attenuator module can be used in conjunction with the TFC to reduce jitter.

The design recommendations are:

- The distance between the "previous" active station (workstation, server, repeater, etc.) and the TFC must not exceed the following values:

  At 4 Mbps, maximum 100 meters on Type 1 cable.

  At 16 Mbps, maximum 50 meters on Type 1 cable.

- The maximum allowable number of fiberoptic TFC links in a ring segment without repeaters is three.

6.5.3 Fiber Optic Budget Calculations

A separate analysis must be performed on fiberoptic ring TFR and TFC segments and T2FS or T2FSA lobe links, to ensure that their attenuation is not excessive. The maximum allowable attenuation of a fiber optic link is determined as a function of the optical power budget (described below).

Power Coupled in a Fiber

For short-distance links, the preferred light source is a LED. The LED radiates a wide conus of light. The optical fiber has a much smaller diameter, and the result is that a large part of LED light energy is lost. In fact, the larger the fiber diameter, the more power is coupled into it.

The most common fiber diameters are: 50/125, 62.5/125 and 100/140 microns, where the first digits indicate core diameter (the active part), and the second group of digits indicate clad diameter.

For example, let us compare the ratio of energy coupled into a 100/140 micron fiber, with respect to that coupled into a 50/125 micron fiber. Since the LED is assumed to radiate uniformly within the angles of interest, the power ratio is directly proportional to the area ratio, which is $(100/50)^2=4$.

In dB, this means that 6dB more power (10 log4 = 6) is coupled into the 100/140 micron fiber. In practice, the ratio is even higher (close to 7dB, considering the N.A. factor of the fiber). For the same reasons, the power coupled into a 100/140 micron fiber is 4dB higher than the energy coupled into a 62.5/125 micron fiber.

NOTE

The Hub modules can operate with all the common core diameters: 50/125, 62.5/125 and 100/140 microns.

Losses in Optical Fibers

Losses are expressed in dB.

Losses (dB) = $10\log P_{in}/P_{out}$

P out

Where P_{in} is the power coupled into the fiber, and P_{out} is the power reaching the other end of the fiber.

Typical losses of graded-index fibers at a wavelength of 820 mm (the common LED wavelength) are as follows:

50/125 micron: 3.0 to 3.5dB/km
62.5/125 micron: 3.5 to 4.0dB/km—Multimode
100/140 micron: 4.5 to 5.0dB/km
9/125 micron: 0.6 to 1dB/km (at 1300 nm wavelength) Singlemode

Calculation of Optical Link Budgets

The maximum link attenuation (optical "link budget") equals the power coupled into the fiber at transmitter side minus receiver sensitivity.

Table 7-54. Typical Values of Link Budgets.

Fiber type	50/125 micron	62.5/125 micron	100/140 micron	9/125 micron
Output power	-22 dBm	-18 dBm	-14 dBm	-18 dBm
Sensitivity	-32 dBm	-32 dBm	-32 dBm	-33 dBm
Link Budget	10 dB	14 dB	18 dB	15 dB

Losses in Optical Fibers

Typical losses that must be considered when calculating losses in actual fiberoptic links are as follows:

Table 7-5. Losses in Optical Fibers.

Cable Losses	3-5 dBm/km
Connector Losses	1-2dB/connector
Splice Losses	0.1-0.3 dB/splice
Aging, Temperature	3 dB

The values given above are to be used as guidelines. Always use cable and connector losses specified by the manufacturer.

Connectors are the weakest point. The "cost" of a "bad" connector may be as high as 1 km of fiber.

NOTE

Do not design in too many connectors!

Connector losses decrease as fiber diameter increases.

Example: Optical link (ring segment) with 3 km of 100/140 micron fiber.

Table 7-6. Example of Optical Fiber Loss.

Cable Loss	3 x 4.5 dB/km=13.5 dB
Connector Loss	2 x 1.5=3.0 dB
Total Losses	16.5 dB
Link Budget	18dB
Link Margin (aging, splices)	1.5dB

The link margin indicates the reserve for unexpected increases in link attenuation, such as splices, increased attenuation due to fiber aging, or decreased transmit power due to component aging.

Fiberoptic Calculation Example with Connectors and Splices

- TFR or TFC singlemode or multimode
- Over 9, 50, 62.5 or 100 microns fiber
- Two splices and one connector

Table 7-7. Example.

Standard 850 nm 1300 nm Fiber Type	50 microns	62.5 microns	100 microns	9 microns (singlemode)
Input Power	-22 dBm	-18 dBm	-14 dBm	-18 dBm
Sensitivity	-32 dBm	-32 dBm	-32 dBm	-33 dBm
Budget	10 dB	14 dB	18 dB	15 dB
Conn. Loss	0.8 dB	0.8 dB	0.5 dB	1.0 dB
Splice. Loss	0.4 dB	0.4 dB	0.4 dB	0.4 dB
Aging	2.0 dB	2.0 dB	2.0 dB	2.0 dB
Rem. Budget	6.8 dB	10.8 dB	15.1 dB	11.6 dB
Att dB/km	3.0 dB	3.5 dB	4.0 dB	0.7 dB
Max. Distance	2.3 km	3.1 km	3.7 km	16.5 km

Preventing Saturation of Optical Receivers

Optical receivers are optimized for operation at low optical power levels (long cable runs). When the optical input power reaching the receiver is too high, the receiver may saturate. Saturation causes pulse distortion, resulting in very high bit-error rate, high enough to disrupt data transmission. It is therefore essential to prevent receiver saturation.

The dynamic range of the optical receivers used by the TFC is 20 dB, and their sensitivity is -32 dBm. Therefore, the maximum optical input power before saturation occurs is: -32 dBm + 20 dBm = -12 dBm.

The saturation power is high enough to ensure that the TFC receiver will never saturate when receiving the signal generated by another TFC, even when operating with short 100/140 micron cable having a very low attenuation.

7.6 Configuration Examples

Table 7-8. Standalone Hub—Passive Lobes.

Access Module Type	Media Type	Guaranteed Lobe Distance (L) 4 Mbps	16 Mbps
TL-4/U	Type 3	100 m	70-80 m
TL-4/U	Level 4, 5	180 m	100 m
TL-4/S	Type 1	375 m	200 m
TL-4/CX		300 m	100 m

Table 7-9. Multiple Hubs: Copper RI/RO, Passive lobes.

Access Module Type	Media Type	Guaranteed Lobe Distance (L) 4 Mbps	16 Mbps
TL-4/U	Type 3	100 m	70-80 m
Tl-4/U	Level 4,5	180 m	100 m
TL-4/S	Type 1	375 m	200 m
TL-4/CX		300 m	100 m

Table 7-10. Multiple Hubs: Fiber RI/RO, Passive lobes.

Access Module Type	Media Type	Guaranteed Lobe Distance (L) 4 Mbps	16 Mbps
TL-4/U	Type 3	100 m	70-80 m
TL-4/U	Level 4, 5	180 m	100 m
TL-4/S	Type 1	375 m	200 m
TL-4/CX		300 m	100 m

Table 7-11. Satellite Hub: Passive lobes.

Access Module Type	Media Type	Guaranteed Lobe Distance (L) 4 Mbps	16 Mbps
TL-4/U	Type 3	100 m	70-80 m
TL-4/U	Level 4, 5	180 m	100 m
TL-4/S	Type 1	375 m	200 m
TL-4/CX		300 m	100 m

For redundancy, TFC-2 module should be followed by TJA module in next slot and in last slot.

Table 7-12. Single Hub: Active lobes.

Access Module Type	Media Type	Guaranteed Lobe Distance (L) 4 Mbps	16 Mbps
TL-4/U	Type 3	100 m	70-80 m
TL-4/U	Level 4	250 m	150 m
TL-4/AU	Level 5	300 m	200 m
TL-4/ASU	Screened	250 m	150 m
TL-4/AS	Type 1	500 m	300 m
TL-2/F	Multimode	3000 m	3000 m
TL-2/F	Single mode	20 km	20 km

Recommened TJA per 30-40 stations for UTP or fiberoptics @ 16 Mbps.

Table 7-13. Mixed Passive and Active Lobes.

Access Module Type	Media Type	Guaranteed Lobe Distance (L) 4 Mbps	16 Mbps
TL-4/U	Type 3	100 m	70-80 m
TL-4/U	Level 4	250 m	150 m
TL-4/AU	Level 5	300 m	150 m
TL-4/ASU	Screened	300 m	150 m
TL-4/U	Level 4,5	100 m	100 m
TL-4/S	Type 1	375 m	200 m

Active and passive lobes are separated by TJA module.

The TJA provides a regenerated, clean, jitter-free signal to the following passive lobes.

Table 7-14. Integrated TLR Application.

Access Module Type	Media Type	Guaranteed Lobe Distance (L) 4 Mbps	16 Mbps
TL-2/EDU	Type 3	350 m	180 m
TL-2/EDU	Level 4	400 m	200 m
TL-2/EDU	Screened	400 m	200 m
TL-2/EDS	Type 1	700 m	350 m
TL-4/CX	RG62	250 m	100 m
TL-2/F	Multimode	3 km	3 km