RAD data communications

Installation and Operation Manual

FCD-155

STM-1/OC-3 Terminal Multiplexer

FCD-155

STM-1/OC-3 Terminal Multiplexer

Installation and Operation Manual

Notice

For further information contact RAD at the address below or contact your local distributor.

International Headquarters RAD Data Communications Ltd.	U.S. Headquarters RAD Data Communications Inc.
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 Publication No. 180-200-07/04

Limited Warranty

RAD warrants to DISTRIBUTOR that the hardware in the FCD-155 to be delivered hereunder shall be free of defects in material and workmanship under normal use and service for a period of twelve (12) months following the date of shipment to DISTRIBUTOR.

If, during the warranty period, any component part of the equipment becomes defective by reason of material or workmanship, and DISTRIBUTOR immediately notifies RAD of such defect, RAD shall have the option to choose the appropriate corrective action: a) supply a replacement part, or b) request return of equipment to its plant for repair, or c) perform necessary repair at the equipment's location. In the event that RAD requests the return of equipment, each party shall pay one-way shipping costs.

RAD shall be released from all obligations under its warranty in the event that the equipment has been subjected to misuse, neglect, accident or improper installation, or if repairs or modifications were made by persons other than RAD's own authorized service personnel, unless such repairs by others were made with the written consent of RAD.

The above warranty is in lieu of all other warranties, expressed or implied. There are no warranties which extend beyond the face hereof, including, but not limited to, warranties of merchantability and fitness for a particular purpose, and in no event shall RAD be liable for consequential damages.

RAD shall not be liable to any person for any special or indirect damages, including, but not limited to, lost profits from any cause whatsoever arising from or in any way connected with the manufacture, sale, handling, repair, maintenance or use of the FCD-155, and in no event shall RAD's liability exceed the purchase price of the FCD-155.

DISTRIBUTOR shall be responsible to its customers for any and all warranties which it makes relating to FCD-155 and for ensuring that replacements and other adjustments required in connection with the said warranties are satisfactory.

Software components in the FCD-155 are provided "as is" and without warranty of any kind. RAD disclaims all warranties including the implied warranties of merchantability and fitness for a particular purpose. RAD shall not be liable for any loss of use, interruption of business or indirect, special, incidental or consequential damages of any kind. In spite of the above RAD shall do its best to provide error-free software products and shall offer free Software updates during the warranty period under this Agreement.

RAD's cumulative liability to you or any other party for any loss or damages resulting from any claims, demands, or actions arising out of or relating to this Agreement and the FCD-155 shall not exceed the sum paid to RAD for the purchase of the FCD-155. In no event shall RAD be liable for any indirect, incidental, consequential, special, or exemplary damages or lost profits, even if RAD has been advised of the possibility of such damages.

This Agreement shall be construed and governed in accordance with the laws of the State of Israel.

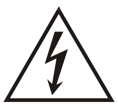
General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

Safety Symbols

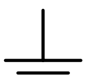
Warning

This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.

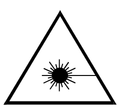


Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.

.



Protective earth: the marked lug or terminal should be connected to the building protective earth bus.



Warning

Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached. Please observe the following precautions:

- **Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter.**
- **Do not attempt to adjust the laser drive current.**
- **Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam.**
- **The use of optical devices with the equipment will increase eye hazard.**
- **Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure.**

ATTENTION: The laser beam may be invisible!

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

Handling Energized Products

General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective earth terminal. If an earth lug is provided on the product, it should be connected to the protective earth at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in earthed racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Connection of AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

Connection of DC Mains

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC mains systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

DC units should be installed in a restricted access area, i.e. an area where access is authorized only to qualified service and maintenance personnel.

Make sure that the DC supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Before connecting the DC supply wires, ensure that power is removed form the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

Connection of Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status	
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV	Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1	Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2	Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3	Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The earthing and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk, there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

Caution

To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

Attention

Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

Electromagnetic Compatibility (EMC)

Note

In order to comply with Class B requirements of EN 55022 and FCC-15, use shielded cables for ETH and RS-232 (V.24) connectors.

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good earth connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the earth bus using braided wire as short as possible.

The use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching earth ground or wear an ESD preventive wrist strap.

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Emission Requirements

This Class B digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Declaration of Conformity

Manufacturer's Name: RAD Data Communications Ltd.

Manufacturer's Address: 24 Raoul Wallenberg St.
Tel Aviv 69719
Israel

declares that the product:

Product Name: FCD-155

conforms to the following standard(s) or other normative document(s):

EMC:	EN 55022:1998	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
	EN 50024: 1998	Information technology equipment – Immunity characteristics – Limits and methods of measurement.
Safety:	EN 60950: 2000	Safety of information technology equipment.

Supplementary Information:

The product herewith complies with the requirements of the EMC Directive 89/336/EEC, the Low Voltage Directive 73/23/EEC and the R&TTE Directive 99/5/EC. The product was tested in a typical configuration.

Tel Aviv, 29 January 2004

Haim Karshen
VP Quality

European Contact: RAD Data Communications GmbH, Otto-Hahn-Str. 28-30, 85521 Ottobrunn-Riemerling, Germany

Preface

Foreword

This manual describes the FCD-155 STM-1 Terminal Multiplexer.

The manual covers the general system characteristics, presents typical system applications, and provides installation, operating procedures and configuration information.

This release of the manual covers the characteristics of FCD-155 running software version 3.0 and higher.

Manual Organization

This manual is organized as follows:

Chapter 1. Introduction

presents the main FCD-155 features and typical applications, describes the various equipment versions, and lists its main technical characteristics.

Chapter 2. Installation

provides detailed installation instructions for FCD-155 units.

Chapter 3. Operation and Preliminary Configuration

provides general operating instructions and preliminary configuration instructions for FCD-155 units.

Chapter 4. Diagnostics

describes the diagnostic functions supported by FCD-155 units.

Appendix A. Connection Data

provides connection data for the FCD-155.

Appendix B. Alarm and Error Messages

explains the alarm and error messages generated by FCD-155 units.

Appendix C. FCD-155 Supervision Utility

provides detailed instructions for using the FCD-155 supervision utility.

Appendix D. Software Updating

provides procedures for updating the FCD-155 software.

Appendix E. Operating Environment

describes the FCD-155 operating environment.

Index of Main Activities

provides an index to help you find instructions for performing the main activities needed to operate and configure the FCD-155.

Conventions

Note *A note draws attention to a general rule for a procedure, or to exceptions to a rule.*

Caution A caution warns of possible damage to the equipment if a procedure is not followed correctly.

Warning **A warning alerts to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the equipment. If these instructions are not followed exactly, bodily injury may occur.**

Quick Start Guide

If you are familiar with the FCD-155, use this guide to prepare it for operation, starting from its factory-default configuration.

Preliminary Preparations

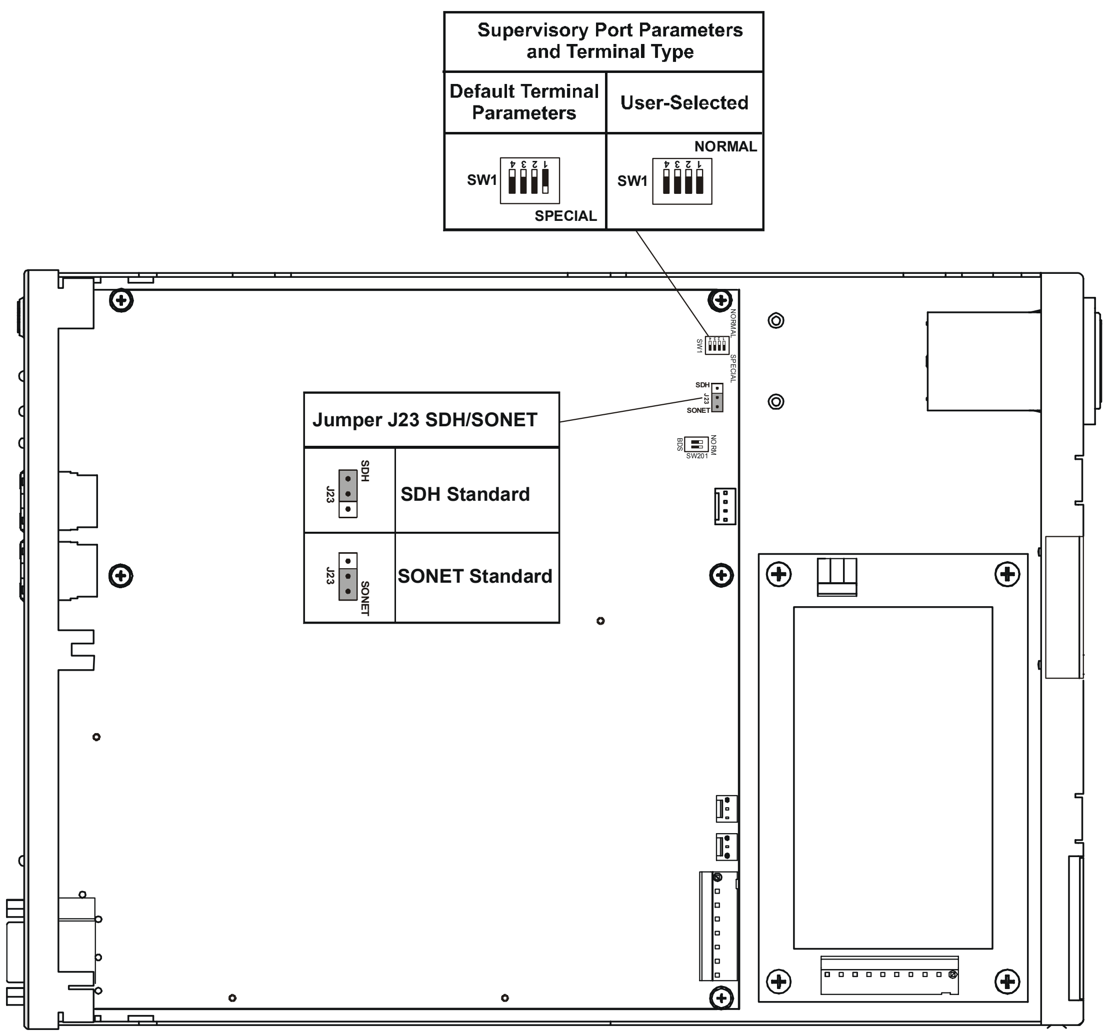
At this stage, do not connect any cables to the FCD-155.

Caution

Before performing the preliminary preparation procedures described below, review the safety precautions given in *Section 2.2*.

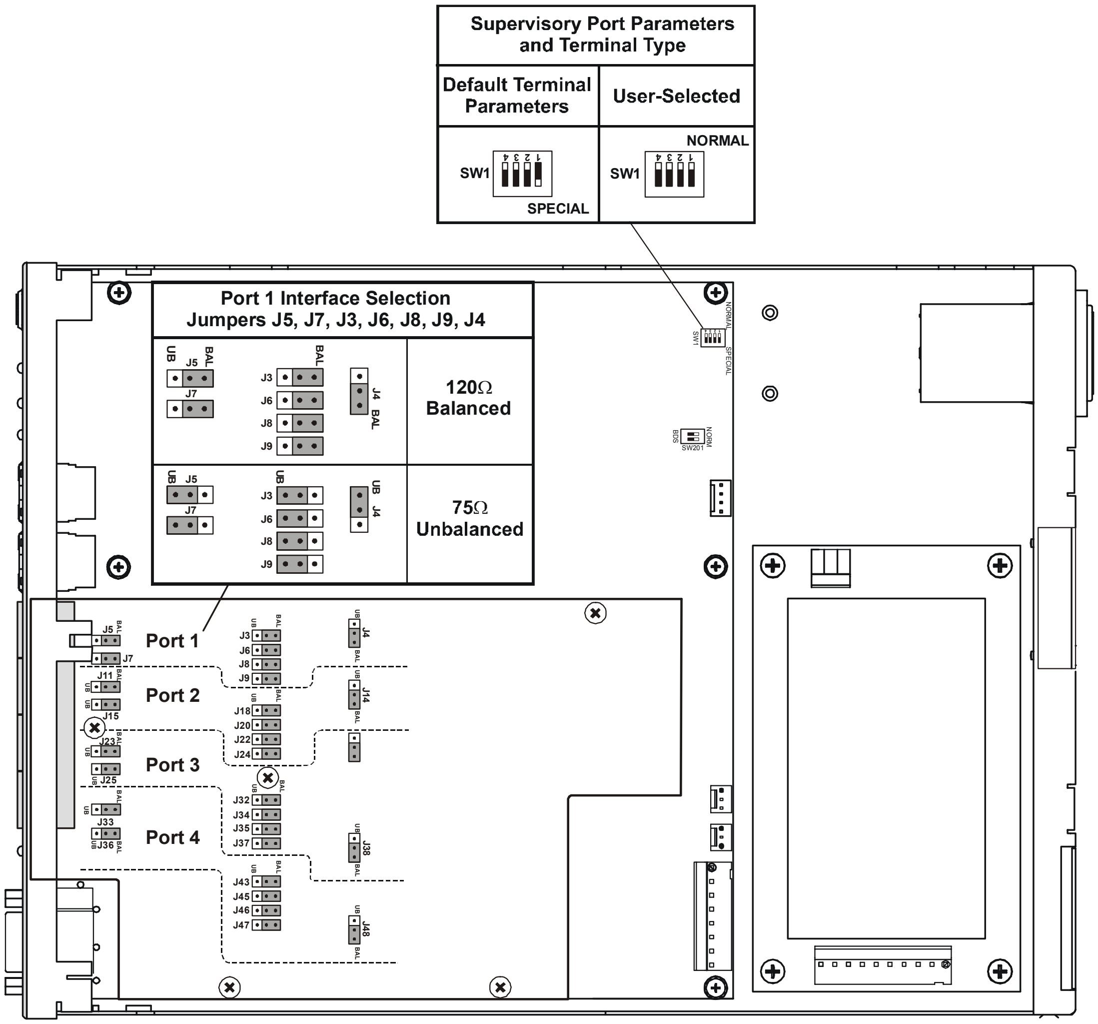
FCD-155 without PDH Interfaces

Select network type (SDH or SONET) using internal jumper J23.



FCD-155 with E1 PDH Interfaces

Select E1 interface type (balanced or unbalanced) using the jumpers listed below.



FCD-155 Configuration Using a Supervisory Terminal

Starting a Preliminary Configuration Session

1. Connect a terminal to the CONTROL port on the FCD-155 front panel (use a straight cable).

   You may use any standard ASCII terminal (dumb terminal or personal computer emulating an ASCII terminal) equipped with an RS-232 communication interface. ***Make sure to use VT-100 terminal emulation.***

2. Configure the terminal for **115.2 kbps, one start bit, eight data bits, no parity,** and **one stop bit**. Select the **full-duplex** mode, **echo off**, and **disable any type of flow control**.

3. Connect the FCD-155 to power.

4. Wait until the PWR indicator stops flashing, and then press **<Enter>** once to obtain the log-in screen.

5. If the FCD-155 default user name and password have not yet been changed, log in as administrator using **admin** as the user name and **1234** for password. If your password is accepted, you will see the FCD-155 main menu.

Note

- *If you cannot establish communication with the FCD-155 or the display is jumbled, reset FCD-155 CONTROL port parameters to the factory defaults using the internal switch SW1 (see figure on page 1 or 2). After configuring the desired CONTROL port parameters, return SW1 to the* ***User Selected*** *setting.*
- *If the password has been changed and is lost, contact RAD Technical Support Department.*

Preliminary Configuration

The purpose of preliminary configuration is to enable management access by management stations, for example, RADview, Telnet hosts and Web browsers.

Step	Action	Using
1	Perform quick setup. You may skip the steps related to virtually concatenated groups: perform them as part of the configuration of transmission parameters	**Configuration – Quick Setup**
2	Configure CONTROL port communication parameters and supervisory terminal type	**Configuration – System – Control Ports**
3	Configure the additional FCD-155 management agent parameters	**Configuration – System – Management – Host IP**
4	Configure FCD-155 management access	**Configuration – System – Management – Management Access**
5	Configure specific management stations (optional)	**Configuration – System – Management – Manager List**
6	Set FCD-155 real-time clock	**Configuration – System – Date & Time Update**
7	Define FCD-155 logistics information	**Configuration – System – Management – Device Info**

Configuration of Transmission Characteristics

The purpose of transmission parameter configuration is to configure the services provided by the FCD-155. Skip steps not relevant to your FCD-155 version and/or to its application mode in your network.

Step	Action	Using
1	Perform quick setup to define FCD-155 main application characteristics (skip configuration of virtual groups and number of VCs/VTs if you will configure manually – Step 5)	**Configuration – Quick Setup**
2	Configure FCD-155 physical ports:	
	• STM-1 or STS-3 ports	**Configuration – System – Physical Ports – STM-1** or **OC-3**
	• LAN ports	**Configuration – System – Physical Ports – LAN**
	• PDH ports (option)	**Configuration – System – Physical Ports – PDH**
3	Configure FCD-155 system timing:	
	• Main (master) timing source	**Configuration – System – Physical Ports – STM-1** or **OC-3 – Master Timing Source** and **Master Rx Clock**
	• Fallback timing source	**Configuration – System – Physical Ports – STM-1** or **STS-3 – Fallback Timing Source** and **Fallback Rx Clock**
4	Configure FCD-155 virtual STM-1 or STS-3 port	**Configuration – System – Virtual Ports – STM-1** or **STS-3**
5	Configure FCD-155 virtual concatenation groups	**Configuration – System – Virtual Ports – Virtual Concatenation – Group 1** to **Group 4,** or **All Groups**
6	Configure FCD-155 GFP mux (when function is used)	**Configuration – System – Virtual Ports – Virtual Concatenation – GFP Mux** (type **a** to add a new GFP mux)
7	Perform mapping:	
	• Map the groups not processed by the defined GFP mux	**Configuration – System – Mapping** (select defined **GRP** entities)
	• Map the primary group of the defined GFP mux	**Configuration – System – Mapping** (select **GRP** defined as primary group of the defined GFP mux)
	• Map active PDH ports (option) • Disconnect unused VCs/VTs	**Configuration – System – Mapping** (select **None** for each unused VC/VT)
8	Configure general bridge characteristics	**Configuration – System – Bridge – General Config**
9	Configure port-based VLANs in accordance with system requirements	**Configuration – System – Bridge – VLAN – Port Based VLAN**

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Chapter 1

Introduction

1.1 Overview

Purpose and Use

FCD-155 is an SDH/SONET terminal multiplexer that enables transporting LAN and legacy (E1, E3, T1 and T3 PDH TDM) traffic over SDH/SONET networks. An FCD-155 installed at the customer's site allows a cost-effective deployment of the SDH/SONET infrastructure for Internet access and LAN connectivity, while providing continued support for all legacy services.

Versions

Basic FCD-155 Versions

The basic FCD-155 version includes:

- Two LAN ports with 10/100BaseT interfaces, connected to a full-function internal Layer 2 Ethernet switch. Both LAN interfaces can carry payload traffic; each one of them may also serve as a management port, in accordance with user's configuration.
- One network port. The basic network port has a single STM-1/OC-3 optical interface. Alternatively, the FCD-155 can be ordered with one of the following network interfaces:
  - A single STM-1/EC-3 electrical interface for intra-office applications
  - Two STM-1/OC-3 optical interfaces, which support 1+1 single-ended multiplex section protection (MSP) for the connection to the SDH/SONET network.

Note *The selection between SDH and SONET is made by an internal jumper.*

With the basic unit, LAN traffic is transported over SDH or SONET using virtual concatenation (when allocating a single VC or VT to LAN traffic, the user can disable the use of virtual concatenation, and directly assign the traffic to any desired VC or VT/SPE in the SDH, respectively SONET, frame). The FCD-155 supports the Link Capacity Adjustment Scheme (LCAS), and therefore enables dynamic adjustment of utilized bandwidth when one or more virtual containers (VCs or VTs) fail.

The LAN traffic encapsulation type (LAPS or GFP) is also configurable. With GFP encapsulation, GFP multiplexing can be used to further improve bandwidth utilization.

Available Options

The services supported by the basic FCD-155 can be expanded by ordering optional ports. The current options include:

- PDH ports:
  - 4 E1 PDH ports with user-selectable balanced or unbalanced ITU-T Rec. G.703 interfaces, for unframed transport of 4 independent E1 (2.048 Mbps) data streams
  - One E3 PDH port with unbalanced ITU-T Rec. G.703 interfaces, for unframed transport of one E3 (34.368 Mbps) data stream
  - 4 T1 PDH ports with balanced ITU-T Rec. G.703 interfaces, for unframed transport of 4 independent T1 (1.544 Mbps) data streams
  - One T3 PDH port with unbalanced ITU-T Rec. G.703 interfaces, for unframed transport of one T3 (44.736 Mbps) data stream.
- 4 additional LAN ports with 10/100BaseT LAN interfaces, for transparent transport over the SDH/SONET network (without passing through an Ethernet switch).

Table 1-1 lists the port options available for each type of network interface. Cells with gray background indicate options not yet offered for the current FCD-155 release: contact RAD for details concerning these options.

Table 1-1. Port Options Available for FCD-155

Network Interface	PDH Interfaces				LAN Ports	
	4 E1	4 T1	E3	T3	Bridge (2)	Transparent (4)
SDH	✷				✷	✷
	✷				✷	
		✷			✷	✷
		✷			✷	
			✷		✷	✷
			✷		✷	
				✷	✷	✷
				✷	✷	
					✷	✷
					✷	
					✷	✷
SONET		✷			✷	
		✷			✷	✷
				✷	✷	
				✷	✷	✷
					✷	✷

Main Features

Network Interfaces

The FCD-155 is available with one of the following types of network interfaces:

- Intra-office electrical STM-1/EC-3 interface
- Optical interfaces. A wide range of optical interface options (see *Table 1-2*), supporting both short-haul and long-haul applications, are available for the FCD-155. Dual-link FCD-155 versions support the MSP 1+1 physical layer protection mechanism.

  As part of the SDH/SONET network, the optical line transmission subsystem provides high quality, availability and performance monitoring of the traffic path down to the customer premises.

LAN Ports

All the 10/100BaseT LAN ports support auto-negotiation for plug-and-play Ethernet connectivity. Alternatively, each port can be configured by the user to operate at the desired rate and mode.

The services provided by the various ports are as follows:

- The Ethernet ports 1 and 2 are served by a built-in Ethernet switch with support for QoS, in full compliance with the IEEE 802.3/Ethernet V.2 standards. The switch supports port-based and IEEE 802.1Q tag-based VLANs, with characteristics configurable on a per-port basis. The switch operates in the IEEE 802.1Q shared VLAN learning mode (SVL): this means that any MAC address learned in one VLAN is also used for forwarding decisions affecting that address in all the other defined VLANs (the total number of VLANs that can be defined is 64).

  The Ethernet switch supports up to four independent WAN ports (groups), where each WAN port can be connected to any desired combination of virtually concatenated groups. The algorithm used for frame forwarding can be configured in accordance with the application requirements:

  - Bridge only
  - Bridge and Spanning Tree Protocol (STP), with selection between standard STP and Rapid STP (RSTP).

  When FCD-155 is equipped with only two LAN ports, the total number of virtually concatenated groups supported by the FCD-155 is 4.

- Each of the 4 optional transparent Ethernet ports, designated 3 through 6, is directly routed to a virtually concatenated group. Any traffic reaching the port is transparently transferred to the associated virtually concatenated group.

  When the FCD-155 is equipped with 6 LAN ports (2 with Ethernet switch and 4 transparent ports), the total number of virtually concatenated groups supported by the FCD-155 is 8.

Handling the Ethernet Traffic

The Ethernet traffic is encapsulated for transmission over SONET/SDH network using one of the following link layers protocols:

- Generic Framing Procedure (GFP) in accordance with ITU-T Rec. G.7041, framed mode, including support for GFP multiplexing
- Link Access Procedure for SONET/SDH (LAPS) protocols – per ITU-T Rec. X.85/X.86 draft recommendations.

The four traffic groups from the Ethernet switch are mapped into SONET/SDH containers using virtually concatenated groups. Mapping is flexible, and enables using any combination of virtually concatenated groups.

Unlike the traffic from the Ethernet switch, which can be switched according to predefined VLAN groups to various virtually concatenated VCs/VTs , the Ethernet traffic from the four optional transparent ports are always connected to a fixed group (port 3 to group 5, etc.).

The fraction of network link bandwidth allocated to each virtually concatenated group can be configured. In addition, LCAS can be used on any virtually concatenated group with more than one VC/VT to hitlessly increase or decrease the capacity in accordance with the application requirements, and remove component VCs/VTs that failed.

E1 PDH Ports (Optional)

The four PDH E1 ports available as an option for the FCD-155 have selectable balanced or unbalanced copper interfaces per ITU-T Rec. G.703, with support for short-haul and long-haul applications. The ports support unframed E1 streams in compliance with ITU-T Rec. G.703. Each E1 port provides loss of signal and AIS indications.

Note *E1 ports can be used only on FCD-155 with SDH network interfaces.*

The E1 multiplex structure is VC-12, TU-12, TUG-2, TUG-3, AU-4, where each E1 port can be placed in any VC-12 inside the STM-1 bandwidth.

T1 PDH Ports (Optional)

The four PDH T1 ports available as an option for the FCD-155 have balanced copper interfaces. The ports support unframed T1 streams in compliance with ITU-T Rec. G.703.

The interfaces include an integral CSU and can also emulate DSU interfaces. Each T1 port provides loss of signal and AIS indications.

- In an FCD-155 with SDH network interface, the T1 multiplex structure is VC-11, TU-11, TUG-2, TUG-3, AU-4, where each T1 port can be placed in any VC-11 inside the STM-1 bandwidth.

Note *When a T1 port is mapped within the SDH frame structure, the structure of the whole TUG-3 containing the corresponding TU-11 is changed: instead of the default structure (3 TUG-2 each comprising 7 TU-12, for a total of 21 VC-12), the structure changes to 4 TUG-2 each comprising 7 TU-11, for a total of 28 VC-11. The structure of any TUG-3 handling VC-12 remains unchanged.*

- In an FCD-155 with SONET network interface, the T1 multiplex structure is VT-1.5, VT group, STS-1, STS-3, where each T1 port can be placed in any VT-1.5 inside the STS-3 bandwidth.

E3 PDH Port (Optional)

The PDH E3 port available as an option for the FCD-155 has an unbalanced copper interface per ITU-T Rec. G.703. The port supports an unframed E3 stream in compliance with ITU-T Rec. G.703. The port provides a loss of signal indication.

Note *E3 ports can be used only on FCD-155 with SDH network interfaces.*

The E3 port can be placed in any VC-3 inside the STM-1 bandwidth.

T3 PDH Port (Optional)

The PDH T3 port available as an option for the FCD-155 has an unbalanced copper interface per ITU-T Rec. G.703. The port supports an unframed T3 stream in compliance with ITU-T Rec. G.703.

The port provides a loss of signal indication.

The T3 multiplex structure is as follows:

- In an FCD-155 with SDH network interface, the T3 port can be placed in any VC-3 inside the STM-1 bandwidth
- In an FCD-155 with SONET network interface, the T3 port can be placed in any STS-1 inside the STS-3 bandwidth.

Management Support

Setup, control and monitoring of status and diagnostics information can be performed using one of the following methods:

- ASCII terminal connected to the V.24/RS-232 control port
- Telnet host, Web browsers and SNMP-based network management stations for example, RADview – RAD’s network management application. The following access options are supported:
  - Out-of-band access via one of the LAN ports connected to the internal Ethernet switch (that is, Ethernet ports 1 and 2)
  - Inband access through the SDH/SONET network, through one of the WAN ports of the internal Ethernet switch, or through the DCC carried in the STM-1/OC-3 link overhead.

The management subsystem supports TFTP for remote software updating and downloading, in addition to cold software downloading using an ASCII terminal directly connected to the FCD-155. TFTP can also be used to upload and download the FCD-155 configuration database. Network administrators can use the download capability to distribute verified configuration files to all the managed FCD-155 units in the network from a central location.

To further expedite the process, it is also possible to upload the configuration data stored by an FCD-155 unit to the management station as a standard disk file, and then distribute this file to other units which use a similar configuration.

FCD-155 has comprehensive diagnostics capabilities including:

- Real-time alarms to alert user on fault conditions. Alarms are reported to the management station and simultaneously relayed via dry contact port
- Ethernet and SDH/SONET link monitoring.

1.2 Typical Applications

Applications for Basic FCD-155

Figure 1-1 shows a typical application for a basic FCD-155 version. In this application, FCD-155 units provide links to carry the LAN traffic among several sites, and enable access to IP networks (Internet or enterprise intranets). The links are provided over the SDH or SONET network.

The advanced Ethernet switch of the FCD-155 enables flexible routing of traffic among the various sites. For example, using appropriately configured port-based VLANs enhances security; using tag-based VLANs enable both segregation of user's traffic in accordance with its source and control over the quality of service (QoS) for each type of traffic.

The whole network can be managed from a single location, using an SNMP-based network management station connected to one of the FCD-155 units. To avoid using link payload-carrying capacity, the management traffic can be carried within the SDH/SONET overhead, using the DCC.

Note *The DCC can only be used when the SDH/SONET network supports access and enables transparent connection to the DCC at the required locations.*

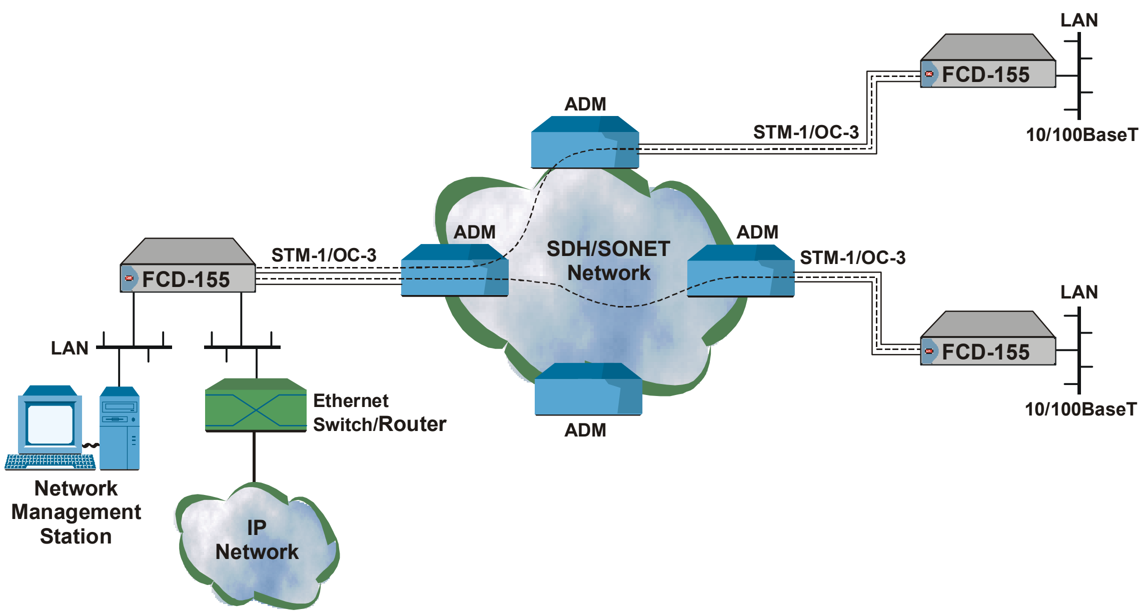


Figure 1-1. Typical Application for Basic FCD-155 Unit

Applications for FCD-155 with Transparent LAN Ports

Figure 1-2 shows a typical application for an FCD-155 unit equipped with 6 LAN ports (2 LAN ports connected to the internal Ethernet switch and 4 additional transparent LAN ports). The user can select the number of transparent LAN ports that are actually used (enabled).

Typically, each transparent LAN port can be used to serve a specific application, or a department within a larger organization.

The traffic passing through each transparent LAN port is routed to a specific virtually concatenated group (port 3 – to group 5, port 4 – to group 6, etc.). This means that each transparent LAN port can be independently routed through the SDH/SONET network, and can be allocated exclusive access to a user-selected fraction of the link bandwidth.

The traffic from each LAN port is transparently transported across the SDH/SONET network, with no processing except encapsulation (LAPS or GFP). Therefore, the FCD-155 link serves as a LAN extender: this means that a user-provided router or Layer 2 switch must be used when it necessary to prevent local traffic from flowing to the remote site through the SDH/SONET network.

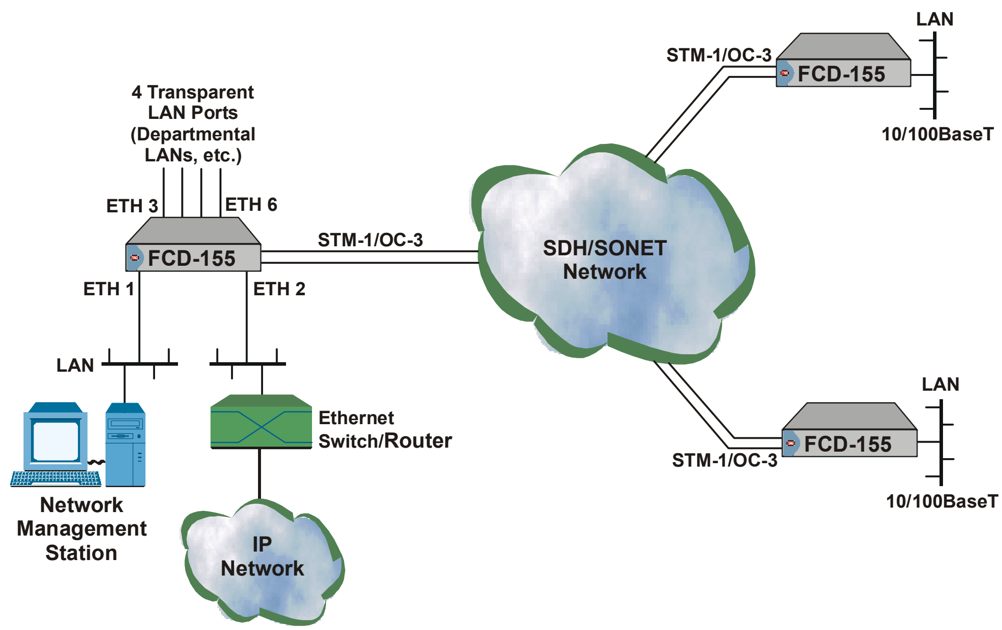


Figure 1-2. Typical Application for FCD-155 Unit with Transparent LAN Ports

Applications for FCD-155 with PDH Interfaces

Adding PDH interfaces to the basic FCD-155 version provides a complete solution for all the internal communication requirements of businesses.

Applications for E1/T1 PDH Interfaces

A typical application for an FCD-155 with quad E1 or T1 PDH Interfaces is shown in Figure 1-3.

Note *Figure 1-3 illustrates equipment with SDH network interfaces, however T1 PDH interfaces can also be used with SONET network interfaces.*

In this application, FCD-155 units provide broadband connectivity for both voice and LAN services between the headquarters and the branch offices:

- The headquarters' voice switch connects to the FCD-155 E1 or T1 interfaces. Its traffic is transparently transported over the network to each branch office. Separate trails can be defined for connection to the PBX of each branch office. Moreover, the branch offices can also connect to the PSTN through headquarters' voice switch, irrespective of their geographical location.

The total bandwidth needed is one VC-12 per E1 trunk (or one VC-11 per T1 trunk), which means that most of the STM-1 link bandwidth is free to carry LAN traffic.

- The remaining link bandwidth can be used to carry broadband LAN traffic, and management.

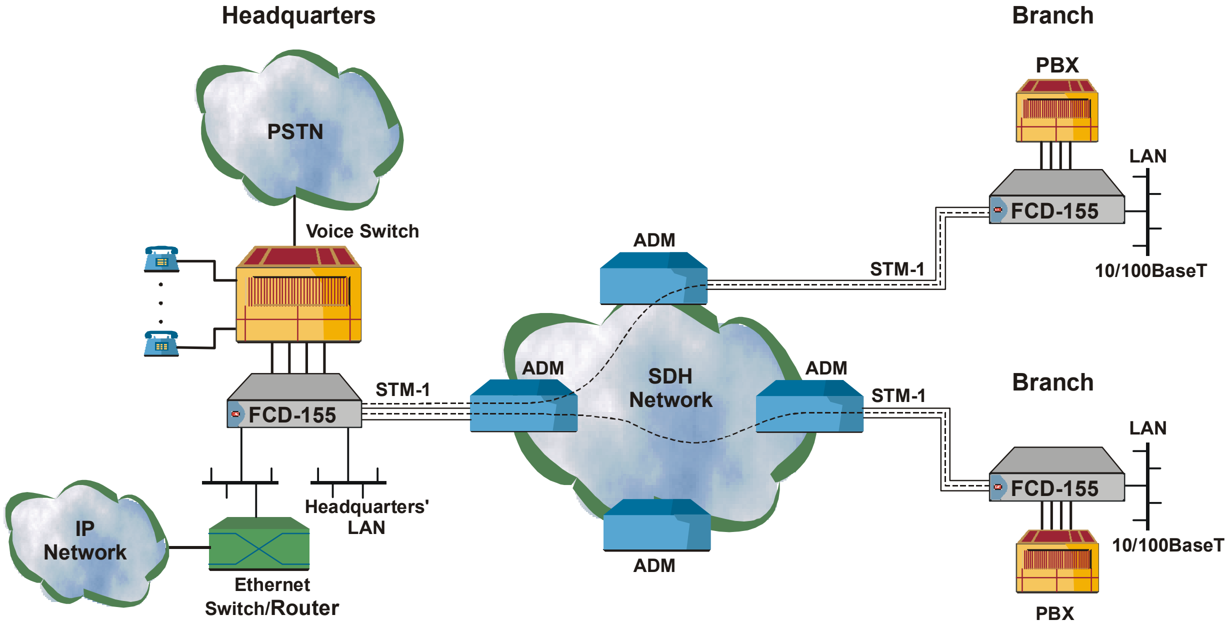


Figure 1-3. Typical Application for FCD-155 Unit with E1 or T1 PDH Interfaces

Applications for E3/T3 PDH Interfaces

The E3 or T3 PDH interface added to the basic FCD-155 version enables transparent transport of the PDH stream through the SDH/SONET network, in the desired VC-3 or STS-1 SPE. A typical application for an FCD-155 with E3 or T3 PDH interface is shown in Figure 1-4.

Note *Figure 1-4 illustrates equipment with SDH network interfaces, however the T3 PDH interface can also be used with SONET network interfaces.*

In this application, FCD-155 units provide broadband connectivity for the DXC-30 multiservice access nodes offered by RAD. The DXC-30 support a wide range of services, down to the level of the individual DS0, for example:

- Non-blocking DS0 cross-connect services for T1, E1 (frame and unframed), n×56/n×64 kbps and ISDN BRI services.
- E3 and T3 multiplexing services.
- Inverse multiplexing capabilities: DXC systems with an inverse multiplexing subsystem support transparent transmission of high-speed data over up to eight E1 or T1 links (equivalent to user rates up to 15.360 Mbps for E1 lines, or 11.776 Mbps for T1 lines).

These capabilities are in addition to the LAN services offered by the basic FCD-155 version.

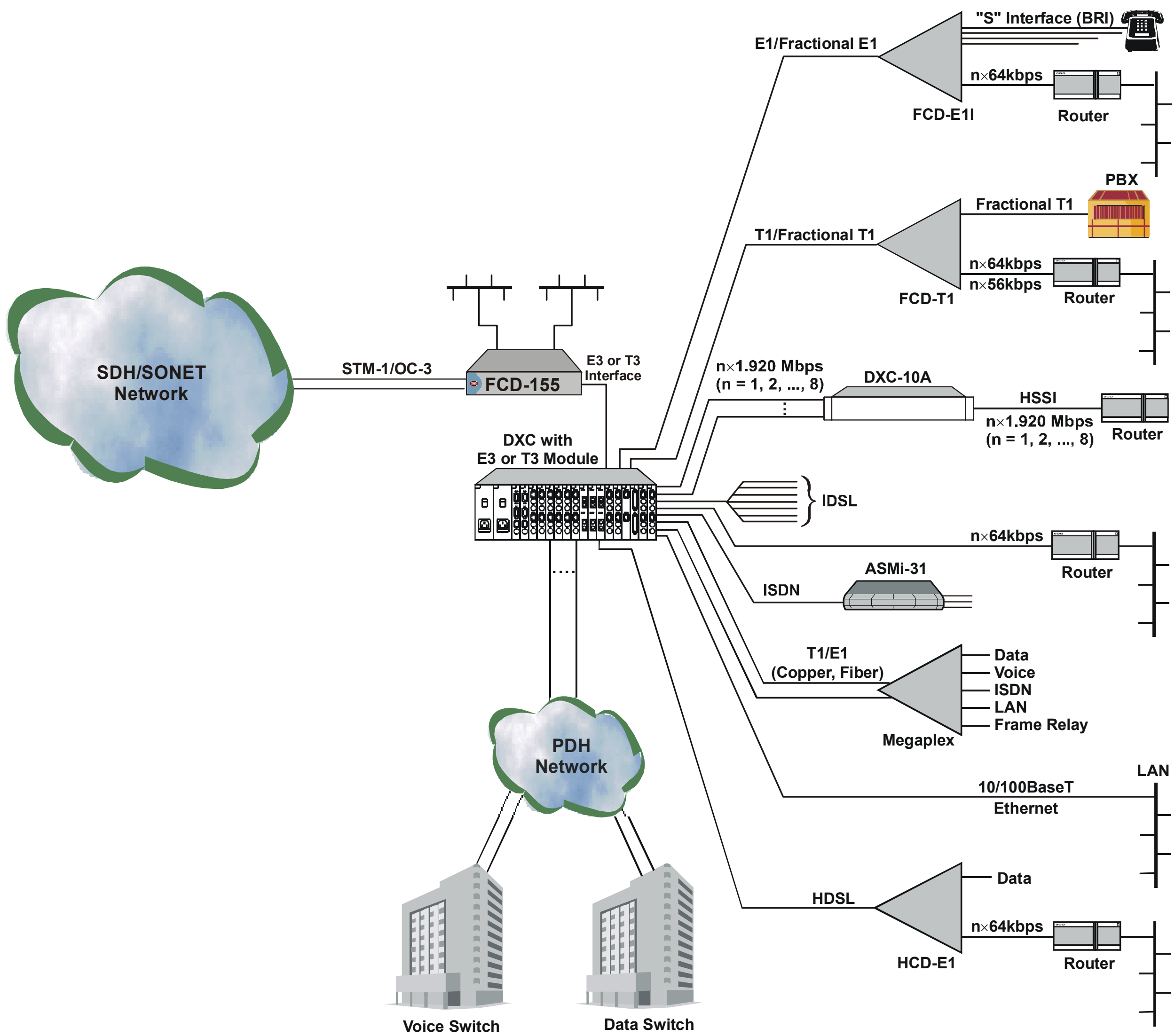


Figure 1-4. Typical Application for FCD-155 Unit with E3 or T3 PDH Interface

1.3 Physical Description

General

Figure 1-5 shows a general view of a typical FCD-155 unit. FCD-155 is a compact unit, intended for installation in 19" racks, on desktops or shelves. The unit height is 1U (1.75 in). An optional rack-mount adapter kit enables installing two FCD-155 units, side by side, in a 19-inch rack.

All the connections, except for the power connection, are made to the front panel. The FCD-155 front panel also includes indicators that indicate its operating status.

Air intake vents are located on the side walls, and an exhaust vent is located on the rear panel.

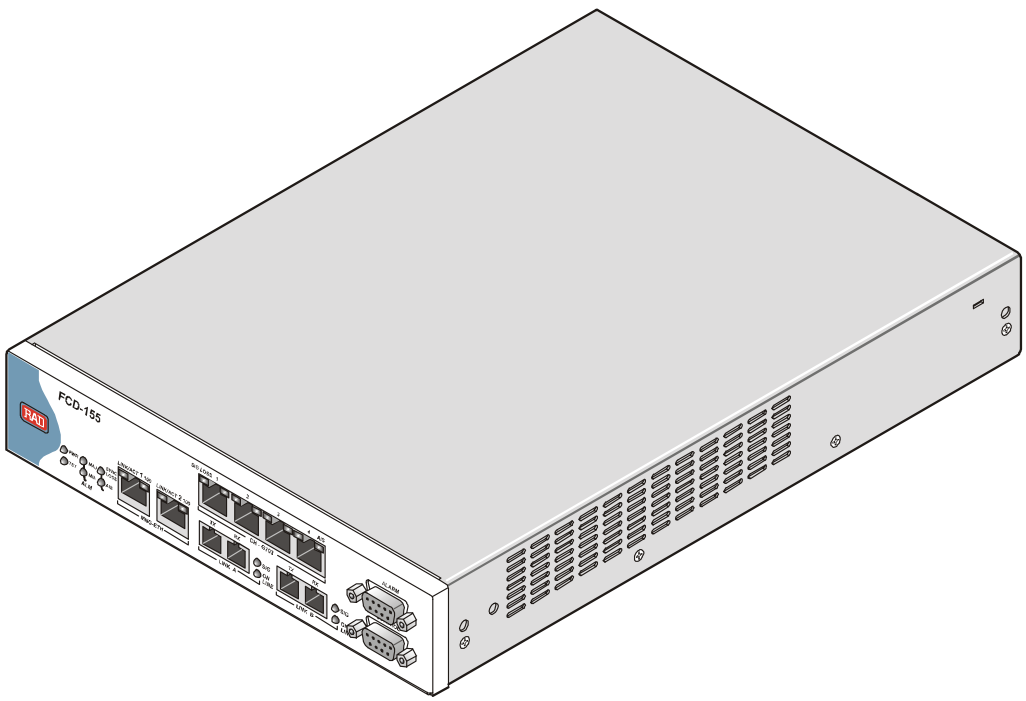


Figure 1-5. Typical FCD-155 Unit, General View

Optional Ports

The FCD-155 units support various optional ports (the complete list is given in *Table 1-1*). Three types of optional ports are available:

- Optional LAN ports
- Optional PDH ports
- Optional aggregate (network side) ports and interfaces.

The various port and interface options are identified in *Figure 1-6*.

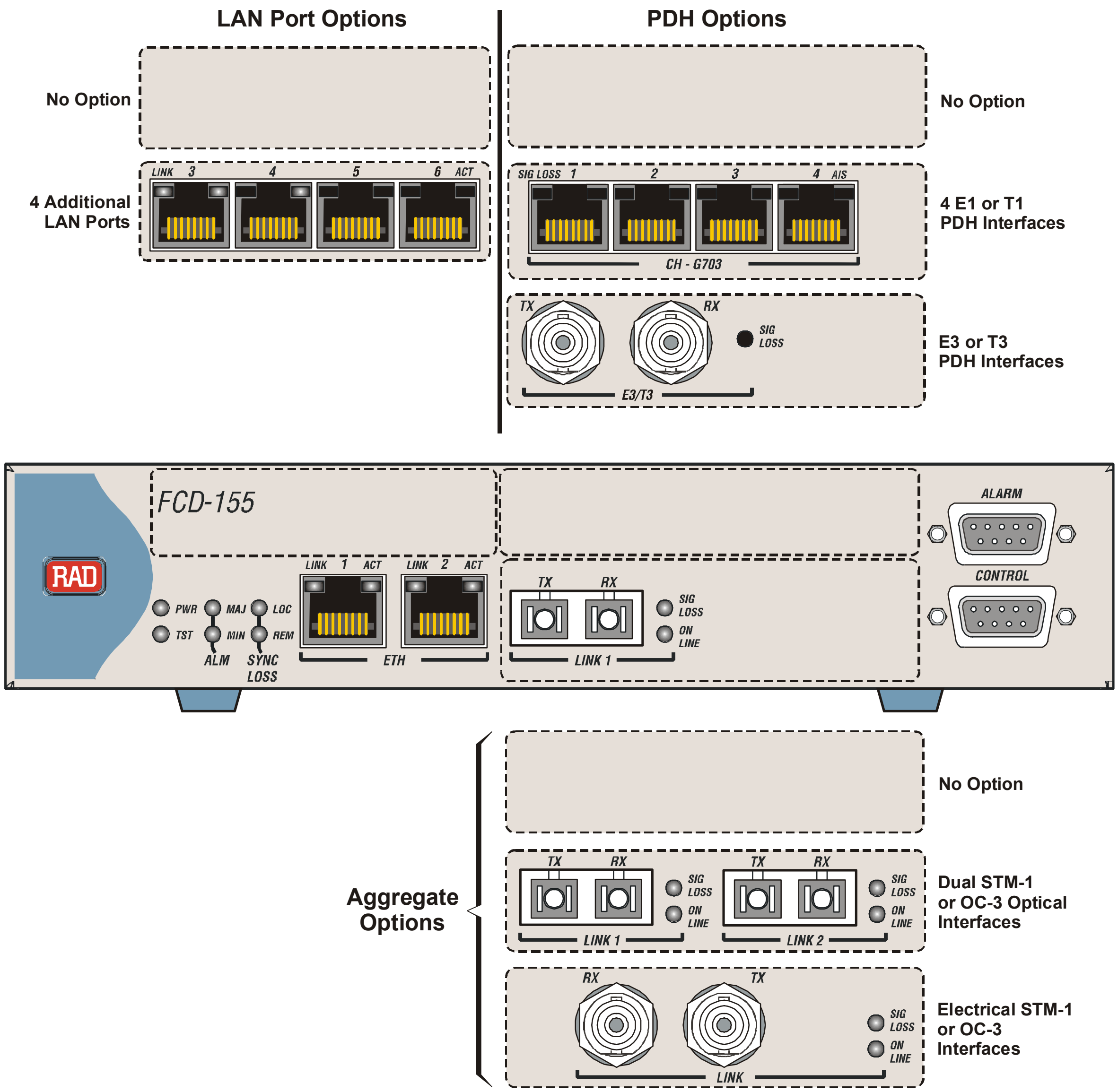


Figure 1-6. Identification of FCD-155 Port and Interface Options

1.4 Functional Description

Figure 1-7 shows the FCD-155 functional block diagram.

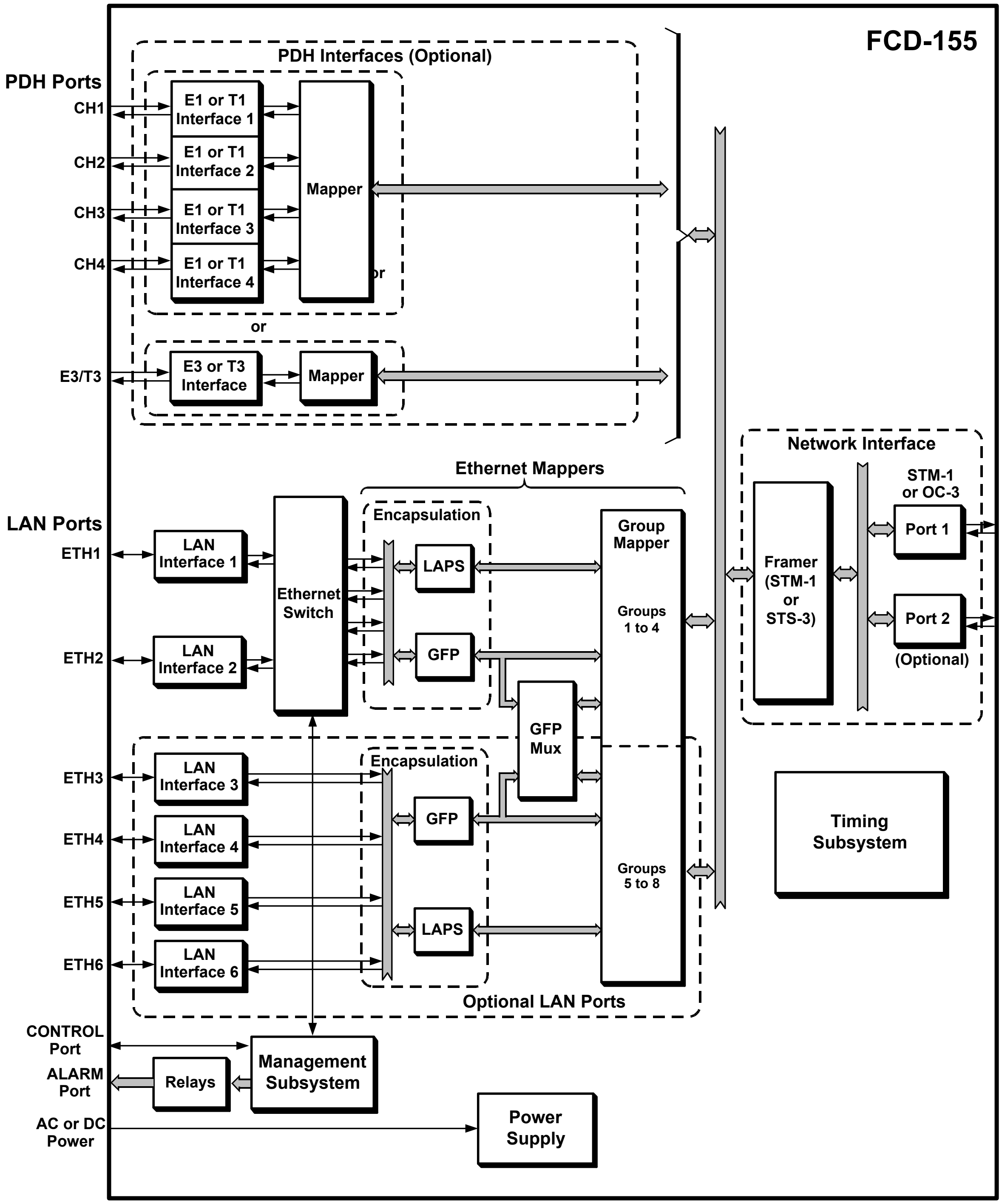


Figure 1-7. FCD-155 Functional Block Diagram

The FCD-155 includes the following main subsystems:

- Network interface subsystem, comprising:
  - SDH/SONET framer subsystem
  - Network link interfaces
- Basic LAN port subsystem, comprising:
  - LAN interfaces
  - Ethernet switch
  - Ethernet mapper for groups 1 to 4
- Optional transparent LAN port subsystem, comprising:
  - LAN interfaces
  - Ethernet mapper for groups 5 to 8
- PDH subsystem, comprising:
  - PDH interfaces (depending on order)
  - Mapper
- Timing subsystem
- Management subsystem
- Power supply subsystem.

Network Interface Subsystem

SDH/SONET Framer Subsystem

The SDH/SONET framer subsystem for the network interface provides the frame assembly/disassembly services and SDH/SONET overhead processing for the link to the network:

- For FCD-155 without PDH interfaces, the operating mode of the framer, SDH or SONET, is selected by means of an internal switch that can be set in the field to the required standard.
- For the other FCD-155 versions, the operating mode of the mapper is determined by the network interface installed on the FCD-155.

The position of the various VCs/VTs within the link frame is determined by the Ethernet and PDH mappers.

Optical Interfaces for Network Link

The FCD-155 can be ordered with one or two STM-1/OC-3 ports, in accordance with order. The ports are available with a variety of interfaces, to optimally meet customer's requirements (see *Table 1-2*).

FCD-155 versions with two network ports support line protection, i.e., at any time, only one port is active and the other is in standby. The protection is implemented by means of the standard multiplex section protection (MSP 1+1) physical layer protection mechanism, which allows the service to the customer to be protected against link failure.

The ports may be ordered with ST, SC, or FC/PC connectors.

Table 1-2. FCD-155 Fiber Optic Interface Characteristics

Wavelength	Fiber Type	Transmitter Type	Power Coupled into Fiber	Receiver Sensitivity	Typical Max. Range (km/miles)
1310 nm	9/125 µm, single mode	Laser	-15 to -8 dBm	-34 dBm	20/13
	9/125 µm, single mode	Laser, long haul	-5 to 0 dBm	-35 dBm	40/26
	62.5/125 µm, multi-mode	LED	-20 to -18 dBm	-30 dBm	2/1.3
1550 nm	9/125 µm, single mode	Laser, long haul	-5 to 0 dBm	-36 dBm	80/52
	9/125 µm, single mode	Laser	-15 to -8 dBm	-32 dBm	20/13

Electrical Interface for Network Link

The FCD-155 may also be ordered with one electrical STM-1/EC-3 interface for intra-office applications (see *Versions* on page *1-1*).

This interface is terminated in two BNC female connectors for operation over 75 Ω coaxial cables. The maximum line attenuation that can be tolerated is 12.7 dB (in accordance with the standards, the attenuation measured at a frequency of 78 MHz). This corresponds to the attenuation of a 135-meter run of RG-59B/U coaxial cable.

LAN Port Interfaces

Basic LAN Port Interfaces

The basic FCD-155 has two identical LAN ports, ETH 1 and ETH 2, with 10/100BaseT Ethernet interfaces for connection to user's LANs. These ports are connected to the Ethernet switch subsystem.

Each Ethernet interface supports auto-negotiation. The user can configure the advertised data rate (10 or 100 Mbps) and operating mode (half-duplex or full-duplex). Alternatively, auto-negotiation can be disabled and the rate and operating mode be directly specified.

Each port is terminated in an RJ-45 connector, wired as a hub port. The interface includes automatic polarity and crossover detection and correction. Therefore, it can always be connected through a "straight" (point-to-point) cable to any other type of 10/100BaseT Ethernet port (hub or station).

Transparent LAN Port Interfaces

The optional transparent LAN ports, ETH 3 to ETH 6, have the same type of interfaces as the basic LAN ports. The only difference is that the transparent ports connect directly to the encapsulation function (see the *Encapsulation Functions* section), and are connected to fixed virtually concatenated groups (ETH 3 to group 5, and so on up to group 8 for ETH 6).

Ethernet Switch Subsystem

Ethernet Switch Description

The FCD-155 includes an Ethernet switch with VLAN support that fully complies with the IEEE 802.3/Ethernet V.2 standards, has user-selectable forwarding algorithms, and provides extensive support for QoS features. The switch has memory-based switch fabric with true non-blocking switching performance.

The switch collects a wide range of performance monitoring parameters, which can be read by management.

The Ethernet switch has seven ports:

- Two external ports, one connected to ETH 1 LAN interface and the other to the ETH 2 LAN interface.
- Four WAN ports. These ports connect to the encapsulation function, part of the Ethernet mapper subsystem, which processes the traffic for transmission through SDH/SONET network using virtual concatenation. Each port connects to one of the virtually concatenated groups 1 to 4.
- Management port, connected internally to the FCD-155 management subsystem.

Each port is supported by an independent MAC controller that performs all the functions required by the IEEE 802.3 protocol.

The frames passed by the MAC controller are analyzed by the ingress policy controller of the corresponding port before being transferred to an internal queue controller, which controls the frame egress priorities and inserts them in four separate queues. The queues are connected to the ports through the port egress policy controllers. This approach provides full control over traffic flow, and ensures that congestion at one port does not affect other ports.

Flow Control Options

The user can enable flow control for the switch ports. When flow control is enabled, it is always activated only on the port (or ports) involved in congestion: other ports are not affected.

Flow control is available in both the half-duplex and full-duplex modes:

- In the half-duplex mode, flow control uses a collision-based scheme to throttle the connected stations when the free buffer space of the corresponding port is too low, to avoid discarding frames during network congestion (this approach is called ***back pressure***). When the buffer space of a port is almost full, its MAC controller forces a collision in the input port when an incoming frame is sensed (the alternative, without flow control, is to discard the incoming frame).
- In the full-duplex mode, the standard flow control method defined in IEEE 802.3x is used, which is based on ***pause*** frames and enables stopping and restoring the transmission from the remote node. However, this method can only be used when auto-negotiation is enabled on the port, and the node attached to the port supports ***pause*** frames.

The Ethernet switch internal MAC controllers discard all the received IEEE 802.3x ***pause*** frames, even when full-duplex flow control is disabled or the port is in the half-duplex mode.

Forwarding Algorithms

The Ethernet switch operates as a MAC bridge, that automatically learns the MAC addresses located on the local LAN, and the port through which frames addressed to a foreign destination are to be transmitted.

The Ethernet switch LAN table can store up to 1024 MAC address/port number mappings. Only active MAC address/port number mappings are actually stored: after a user-defined aging interval, inactive mappings are removed from the switch memory. However, the user can also add static entries, which are not automatically removed.

When used in more complex networks, the forwarding algorithm can be extended to include Spanning Tree Protocol (STP), where the user can select between the basic STP version and the Rapid STP (RSTP) version. The selection is separately made for each switch port.

The STP parameters, which are used in common by the whole switch, can also be selected by the user, to fine-tune the performance. To help locating forwarding problems, the user can read the STP algorithm status and current parameter values.

VLAN Support

The Ethernet switch can use VLAN information to select the ports among which traffic can be forwarded. There are two basic methods:

- Port-based VLANs. See description in the *Support for Port-Based VLAN* section below
- Tag-based VLAN switching per IEEE 802.1Q. This mode is used to handle traffic in accordance with user-defined forwarding rules that are based on the IEEE 802.1Q tags of the frames. For the external LAN ports (ETH 1 and ETH 2), the user can also select whether to discard untagged frames, or process them. See description in the *Support for 802.1Q Tag-Based VLAN Switching* section below.

Note

- *The user can configure, for each port, whether it will participate in a port-based VLAN or will use 802.1Q tag-based switching. However, a port configured to use 802.1Q tag-based switching may still be included in a port-based VLAN, where it will serve as egress port for other ports in the same VLAN.*
- *The switch operates in the IEEE 802.1Q SVL mode.*

QoS Support

The switch provides support for quality-of-service (QoS) features. Four traffic classes are supported, where each class is typically assigned to a type of prioritized frame stream.

The user can specify the QoS criteria from one the following options (or alternatively, can disable the QoS functionality):

- Priority determined in accordance with the VLAN ID; for identical VLAN IDs, the priority is determined by the frame DSCP field (the Differentiated Services Codepoint, specified in RFC2474).
- Priority determined in accordance with the DSCP value, and for identical DSCP values, by the VLAN ID.
- Priority determined only by IEEE 802.1p VLAN tag.
- Priority determined only by the RFC2474 DSCP value.

For more information regarding the use of VLAN tags, see the *Support for 802.1Q Tag-Based VLAN Switching* section below.

Note *As an alternative to using the information carried by each frame to determine the QoS during its forwarding by the switch, the user can assign a fixed priority to any port. Therefore, when the QoS feature is not enabled, the egress priority of any frame received through a certain port is determined only by the user-configured priority of the frame ingress port. This fixed priority can be independently selected for each port.*

The switch also enables the user to configure the egress scheduling mode:

- Strict priority mode: all top priority frames are egressed out of a port until that priority's queue is empty, then the next lower priority queue's frames are egressed. In other words, whenever a queue has a frame to transmit, it goes out to the link before any frame in any lower-priority queue.

  The strict priority mode guaranties minimum latency for the traffic assigned to a queue, but can cause the lower priority queues to be starved out, because it may prevent them from transmitting any frames, but on the other hand ensures that all the high priority frames egress the switch as soon as possible.
- Weighted fair queue mode: 8, 4, 2, 1 weighting is applied to the four priorities. This approach prevents the lower priority frames from being starved out with only a slightly increased delay to the higher priority frames.

  However, only idle bandwidth is used for lower priority frames: to ensure that the bandwidth assigned to a certain traffic class does not decrease below the assigned value, when congestion occurs any class cannot more than the assigned bandwidth.

Support for Port-Based VLAN

The Ethernet switch supports user-defined port-based VLANs. A port-based VLAN is a logical group of ports defined by the user: traffic within the VLAN is forwarded only to the VLAN member ports. Therefore, in addition to their functional value as tools for controlling traffic flow, port-based VLANs are an important security tool.

The Ethernet switch enables defining port-based VLANs that include any of its four WAN ports (which are connected to user-defined virtually concatenated groups in the range of 1 to 4), as well as the port connecting to the FCD-155 management subsystem.

However, any VLAN can include only one external LAN port out of the two connected to the Ethernet switch, that is, either ETH 1 or ETH 2. Therefore, traffic received through one of these ports cannot reach the other port, although it can be forwarded through any desired group connected to the switch, and/or to the internal management port.

See for example *Figure 1-8*, which illustrates the functionality of the two port-based VLANs that are defined in the FCD-155 factory-default configuration:

- One port-based VLAN, designated VLAN Port 1, includes the FCD-155 external port designated ETH 1, the management port, and groups 1 and 3
- The other port-based VLAN, designated VLAN Port 2, includes the FCD-155 external port designated ETH 2, the management port, and groups 2 and 4.

The factory-default configurations described above ensure that the management subsystem can communicate through the external LAN ports ETH 1 and ETH 2, and through any of the virtually concatenated groups 1 to 4.

Note *The factory-default configuration has been designed to separate between even and odd groups, but this is an arbitrary decision: an external port can connect to any, or all of the virtually concatenated groups connected to the Ethernet switch ports.*

The maximum number of port-based VLANs that can be defined is 20. For convenience, the user can also assign a logical name to each VLAN.

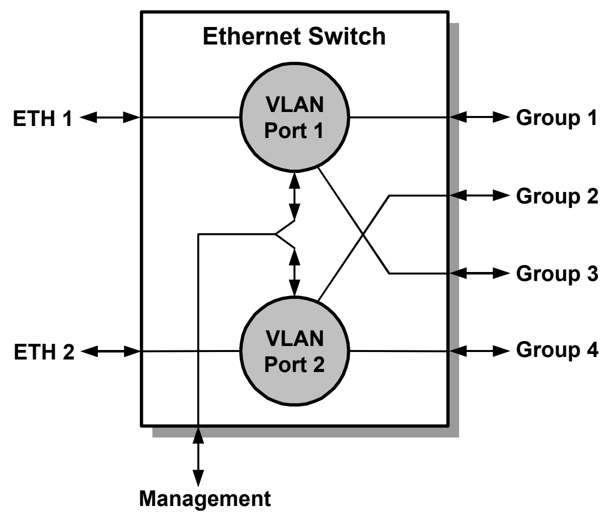


Figure 1-8. Example of Port-Based VLAN Functionality

Support for 802.1Q Tag-Based VLAN Switching

VLAN tags carry additional information that can be used to identify VLAN membership and priority (see *Appendix E* for additional details). Such tags can therefore be used to differentiate among various types of traffic in accordance with the VLAN number (identifier – ID) and priority (desired QoS).

The information needed to specify the handling of frames in accordance with their VLAN ID is given in a VLAN switching table, which contains forwarding rules. One rule must be defined for each VLAN ID to be processed: any frames with VLAN Ids not appearing in the table are ignored (discarded upon ingress). The maximum number of rules that can be defined is 64.

A forwarding rule specifies two types of information:

- The ports that participate in the forwarding of frames with the corresponding VLAN ID.

  Any rule can include a single external (LAN) port – ETH 1 or ETH 2.

  Rules must also be defined to include VLANs switched only among WAN ports, and for the management VLAN, when management VLAN tagging is enabled.
- The handling of frame tags. The available selections include:
  - Unmodified: the port transfers the tags of the frames forwarded to it without change. Therefore, untagged frames egress the port as untagged frames, and tagged frames egress the port as tagged frames. This mode is available for both the external LAN ports (ETH 1 and ETH 2), and for virtually concatenated groups 1 to 4.
  - Untagged: all the frames egress the port as untagged frames. Therefore, untagged frames egress the port unmodified, whereas tagged frames are converted to untagged frames before egressing the port (this is performed by removing their tag and recalculating the frame CRC). This mode is available only for the virtually concatenated groups 1 to 4.
  - Tagged: all the frames egress the port as tagged frames. Therefore, tagged frames egress the port unmodified, whereas untagged frames are converted to tagged frames before egressing the port (this is performed by adding a tag with the VLAN ID defined for the corresponding port, and recalculating the frame CRC). This mode is available only for the virtually concatenated groups 1 to 4
  - Double tagged: a tag is always added to all the frames that egress the port. This mode can be used only when the network supports a frame size of at least 1526 bytes.

Ethernet Mapper Subsystem

The Ethernet mapper subsystem handles all the functions related to the use of virtual concatenation (see *Appendix E* for additional details on virtual concatenation), and the preparation of LAN traffic for efficient transport over the SDH/SONET network.

The subsystem includes the following functions:

- LAPS encapsulation
- GFP encapsulation
- Group mapper. Groups 5 to 8 are available only for FCD-155 with the transparent LAN ports option
- GFP multiplexer.

FCD-155 also supports the Link Capacity Adjustment Scheme (LCAS), covered by ITU-T Rec. G.7042.

Encapsulation Functions

Ethernet frames must be encapsulated before transport over the SDH/SONET network. Two types of encapsulation are supported (see *Appendix E* for additional details):

- LAPS (Link Access Protocol – SDH) encapsulation in accordance with ITU-T Rec. X.86
- GFP (Generic Framing Procedure) encapsulation in accordance with ITU-T Rec. G.7041, using the framed mode.

The user can select the desired encapsulation mode, independently, for each virtually concatenated group. The encapsulation parameters can also be configured, for best performance in specific applications.

The encapsulated frames of each group are applied to the corresponding group mapper.

Group Mapper Functions

The group mappers map the LAN traffic for transmission over the SDH/SONET network. The mappers also create the virtually concatenated groups that enable the user to control the utilization of the bandwidth available on the link to the SDH/SONET network.

Note *For compatibility with equipment from other vendors, the user can configure the group mappers to simulate the use of virtual concatenation even when the group includes a single virtual container/SPE.*

The mapper serving the Ethernet switch can handle up to four groups (these are always groups 1 to 4: the groups 5 to 8 are supported only when the FCD-155 is equipped with transparent LAN ports).

Link bandwidth utilization is configured in two steps:

1. Define the bandwidth allocated to each group: this is made by selecting the type and the number of VCs/VTs allocated to each group. The bandwidth is allocated using virtual concatenation (see *Appendix E* for details). Following are several examples of bandwidth allocation enabled by virtual concatenation:
   - When using VC-3: maximum of two virtually concatenated groups per FCD-155. For example, a group using two VC-3 can be used to used to carry the maximum traffic load of one 100Base-TX Ethernet port.
   - When using VC-12: the 63 VC-12s can be divided as required to create up to 4, respectively 8, groups. For example, a group using 5 VC-12 can be used to used to carry the full traffic load of a 10BaseT Ethernet port over SDH.
   - When using VT-1.5: the 84 VT-1.5s can be divided as required to create up to 4, respectively 8, groups. For example, a group using 7 VT-1.5 can be used to used to carry the full traffic load of a 10BaseT Ethernet port over SONET. However, the maximum number of VT-1.5s in any group cannot exceed 64.

When virtual concatenation is not used, one group can be assigned the full VC-4 bandwidth.

Note *When the FCD-155 is equipped with PDH interfaces, the number of VC-12s or VT-1.5s available for carrying Ethernet traffic is reduced. The reduction is explained in the Bandwidth Occupied by PDH Traffic section.*

It is allowed to build virtually concatenated groups using different types of VCs/VTs: for example, when using VC-12 to carry PDH traffic, one or two groups can use VC-3s, and the remaining bandwidth (17 VC-12) can be assigned to one or two additional virtually concatenated groups.

2. Route the groups. The routing is defined by means of mapping (***mapping*** is the selection of specific VCs/VTs to be used to carry each group, in the number needed to carry the bandwidth selected in *Step 1* above).

   This operation creates the trails that are needed to connect the local users to remote locations through the SDH/SONET network.

Support for LCAS

Each virtually concatenated group with two or more VCs/VTs can be configured to support LCAS. With LCAS, the capacity of a virtually concatenated group can be hitlessly decreased when one of the VCs/VTs fails; when the failure is no longer present, the group will automatically and hitlessly recover and return to the normal capacity.

The user can configure various LCAS protocol parameters, and can also specify a minimum number of VCs/VTs for the group capacity: if the number of VCs/VTs decreases below this minimum, an alarm will be generated.

GFP Multiplexer Function

Virtual concatenation provides the means to transport payloads at rates differing from those available in the standard SDH or SONET hierarchy. Therefore, virtual concatenation is always used by the FCD-155 to carry the LAN traffic (unless a single VC or VT is used).

Although virtual concatenation leads to improved utilization of available bandwidth, better utilization would be achieved by taking into consideration the statistical distribution of traffic generated by multiple Ethernet nodes, and reserving bandwidth only for the average load. This capability is provided by the FCD-155 GFP multiplexer function.

Note *To use GFP multiplexing, all of the multiplexed groups must use GFP encapsulation. Groups not connected to the GFP multiplexer may use LAPS encapsulation.*

To use GFP multiplexing, the groups to be multiplexed are routed, after GFP encapsulation, to the multiplexer, instead of directly to the group mapper. All the virtually concatenated groups to be multiplexed must use the same type of VCs/VTs.

The GFP multiplexer is configured as follows:

1. Selection of the virtually concatenated groups to be multiplexed. For an FCD-155 with two LAN ports, the maximum number of virtually concatenated groups is 4, and therefore 2 multiplexing options (referred to as ***GFP multiplexers***) are available:
   - One multiplexing group of two, three or four virtually concatenated groups. All these groups must use the same type of VCs/VTs.
   - Two multiplexing groups, each consisting of two virtually concatenated groups.

   When the FCD-155 has 6 LAN ports, the maximum number of virtually concatenated groups is 8, and therefore the maximum number of GFP multiplexers that can be defined is 4.
2. Allocation of bandwidth guaranteed to each multiplexed group, in 12.5% increments.
3. Assignment of an individual channel identifier (ID) to each group.
4. Selection of the ***primary*** group. The primary group is the only virtually-concatenated group that is actually mapped as a regular virtually-concatenated group (as explained in the *Group Mapper* section above, this mapping defines the bandwidth and routing within the SDH/SONET network).

   Therefore, by specifying the primary group bandwidth in *Step 2* above you actually specify the bandwidth that is allocated to the multiplexed stream. The bandwidth guaranteed to each of the other multiplexed groups (referred to as ***secondary*** groups) is then calculated as the fraction of the primary group bandwidth.

Note *Only secondary groups that are not mapped can be connected to a GFP multiplexer. For convenience, when a group is added as secondary group to a GFP multiplexer, its encapsulation mode is automatically changed to GFP.*

The GFP multiplexer output is processed by the group mapper, instead of the member groups (the member groups are not connected to the mapper). The mapper output is then inserted into the SDH/SONET frames in accordance with the mapping defined for the primary group.

The main advantage of GFP multiplexing is the way bandwidth allocation is handled:

- The minimum bandwidth provided to any multiplexed group is guaranteed: it is always the fraction of primary group bandwidth specified in *Step 2*.
- If temporarily one of the member groups does not utilize the guaranteed bandwidth, for example, because of low traffic load, the unutilized bandwidth is used to carry the traffic of the other groups. Therefore, no bandwidth is wasted if another user needs it.

The use of GFP multiplexing does not detract in any way from the security conferred by the use of port-based VLANs; moreover, only the end points at which the GFP multiplexing/demultiplexing takes place are aware of the multiplexed group structure.

PDH Interface Subsystem

E1 PDH Ports

FCD-155 operating in SDH networks can be equipped with four independent E1 ports. The ports process the signals as unframed streams.

The E1 interfaces comply with ITU-T Rec. G.703 and support two line interfaces:

- 120Ω balanced line interface, with nominal transmit level of ±3V.
- 75Ω unbalanced interface, with nominal transmit level of ±2.37V.

Only one of these interfaces can be active at any time. The active interface of each port can be selected by internal jumpers.

Both interfaces are terminated in an eight-pin RJ-45C connector. For the unbalanced interface, RAD offers adapter cables terminated in two BNC plugs.

The user can select the maximum line attenuation that may be compensated for by each interface while still meeting the BER objectives:

- Maximum line attenuation of 36 dB: this attenuation corresponds to that required of LTU interfaces. This value should be selected only for the balanced interface.
- Maximum line attenuation of 12 dB: this attenuation corresponds to that required of DSU interfaces. This value should be selected whenever the line attenuation does not exceed 12 dB, because it may provide better performance on noisy lines than the 36 dB setting.

T1 PDH Ports

FCD-155 operating in SDH and SONET networks can be equipped with four independent T1 ports. The ports process the signals as unframed streams.

The T1 line ports comply with the applicable requirements of AT&T TR-62411, ANSI T1.403, and ITU-T Rec. G.703. B8ZS zero suppression is used. Jitter performance complies with the requirements of AT&T TR-62411. The ports have a 100Ω balanced line interface, terminated in an RJ-45 eight-pin connector. The nominal transmit level is ±3V.

The user can select the maximum line attenuation that may be compensated for by each interface while still meeting the BER objectives:

- Maximum line attenuation of 36 dB, for long-haul applications
- Maximum line attenuation of 12 dB, for short-haul applications. This value should be selected whenever the line attenuation does not exceed 12 dB, because it may provide better performance on noisy lines than the 36 dB setting.

The user can configure the operation mode of each interface, CSU or DSU:

- In the CSU mode, the transmit level can be attenuated by 7.5, 15, or 22.5 dB, for compliance with FCC Rules Part 68A.
- In the DSU mode, the line transmit signal is user-adjustable for line lengths of 0 to 655 feet in accordance with AT&T CB-119. The user can enable the activation of the network-initiated line loopback (LLB), and can also cause

each interface to send the LLB activation/deactivation code, thereby permitting the activation of the LLB on the equipment connected to the interface.

E3 PDH Port

FCD-155 operating in SDH networks can be equipped with an E3 PDH port. The port processes the signals as an unframed stream.

The E3 interfaces complies with ITU-T Rec. G.703 and has a 75Ω unbalanced interface terminated in two BNC connectors.

T3 PDH Port

FCD-155 operating in SDH and SONET networks can be equipped with a T3 PDH port. The port processes the signals as an unframed stream.

The T3 line interface of the DXC system complies with the applicable requirements of ANSI T1.102 and ITU-T Rec. G.703, and has a 75Ω unbalanced interface terminated in two BNC connectors.

Bandwidth Occupied by PDH Traffic

When the FCD-155 is equipped with PDH interfaces, some of the bandwidth available on the network link must be assigned to PDH traffic. This reduces the number of VC-12s or VT-1.5s available for carrying Ethernet traffic.

The reduction in bandwidth available for LAN traffic is as follows:

- **E1 PDH interfaces**: the number of VC-12s is reduced by 4, from 63 to 59.
- **T1 PDH interfaces**:
  - With SONET network interface, the number of VT-1.5s is reduced by 4, from 84 to 80
  - With SDH network interface, the number of VC-12s is decreased by 21 (all located in one TUG-3), because the utilization of the TUG-3 is changed from VC-12s to VC–11s.
- **E3 PDH interface**: the number of VC-12s is decreased by 21 (all located in one TUG-3).
- **T3 PDH interface**:
  - With SONET network interface, the number of VT-1.5s is reduced by 28, from 84 to 56 (all of them located in one STS-1)
  - With SDH network interface, the number of VC-12s is decreased by 21, from 63 to 42 (these VC-12s are converted to 28 VC-11s, all of them located in one TUG-3).

In all these cases, only two groups can use VC-3s or STS-1s.

Mappers for PDH Subsystem

The functions provided by the mappers serving the various PDH interface options are described below.

Functions of E1 Mapper for SDH Network Interface

The E1 mapper enables mapping the data stream of each E1 port to any of the 63 VC-12 in the STM-1 signal.

To enable rapid service start-up, default mappings are used:

- When no groups are used, the signal from each E1 port is inserted in the VC-12 with the same number, that is, E1 port No. 1 is inserted in VC-12 No. 1, E1 port No. 2 is inserted in VC-12 No. 2, etc.
- When groups are used, the groups are mapped first, followed by the E1 ports, in the following order:
  - All the defined groups (starting with the group 1 and up the maximum defined) are assigned the first VC-12s
  - The signal from the E1 port is inserted in the first free VC-12 after the last VC-12 assigned to a group, and so on.

In most applications, these defaults need not be changed:

- When the FCD-155 operates as a terminal multiplexer which connects to the transport backbone through an ADM, the ADM can always be configured to perform any cross-connection that may be required
- In a point-to-point connection between two FCD-155, the only reason to change the defaults is to adapt the FCD-155 to changes in the original utilization of its ports.

Functions of T1 Mapper for SDH Network Interface

The T1 mapper enables mapping the data stream of each T1 port to any VC-11 in the STM-1 signal.

When using VC-11, the structure of the TUG-3 to which a VC-11 is mapped is changed from 21 TU-12 (arranged in 3 TUG-2 of 7 TU-12 each) , to 28 TU-11 (arranged in 4 TUG-2 of 7 TU-11 each). The structure of other TUG-3 remains unchanged.

To enable rapid service start-up, default mappings are used, similar to those used for E1 ports (see description above). For example, when no groups are defined, the four T1 ports are mapped to TUG 2-1 of TUG-3 No. 1, and the other two TUG-3 remain available for LAN and management traffic.

Functions of T1 Mapper for SONET Network Interface

The PDH mapper enables mapping the data stream of each T1 port to any of the 84 VT-1.5 in the STS-3 signal.

To enable rapid service start-up, the signal from the each T1 port is inserted, by default, in the VT-1.5 with the same number, that is, T1 port No. 1 is inserted in VT-1.5 No. 1, T1 port No. 2 is inserted in VT-1.5 No. 2, etc.

Functions of E3 Mapper

The E3 port can be inserted into any VC-3 inside the STM-1 bandwidth.

Functions of T3 Mapper

- FCD-155 with SDH network interface: the T3 port can be inserted into any VC-3 inside the STM-1 bandwidth.
- FCD-155 with SONET network interface: the T3 port can be inserted into any STS-1 inside the STS-3 bandwidth.

Timing Subsystem

FCD-155 uses separate and independent system clocks for the various subsystems: one for the SDH/SONET subsystem, and another for the optional PDH subsystem.

The LAN ports timing is derived from a local free-running clock, which is not locked to the other clock signals in the unit.

SDH/SONET Timing Subsystem for FCD-155 with PDH Ports

Figure 1-9 shows the functional block diagram of the SDH/SONET timing subsystem for an FCD-155 with PDH ports.

Notes

- *All the following figures represent FCD-155 units with quad E1 or T1 PDH ports. However, the same options are available for units with E3 or T3 PDH ports (except that only PDH port 1 is available).*
- *When the FCD-155 does not include PDH ports, only the INTERNAL and RX SDH or RS SONET timing options are available.*

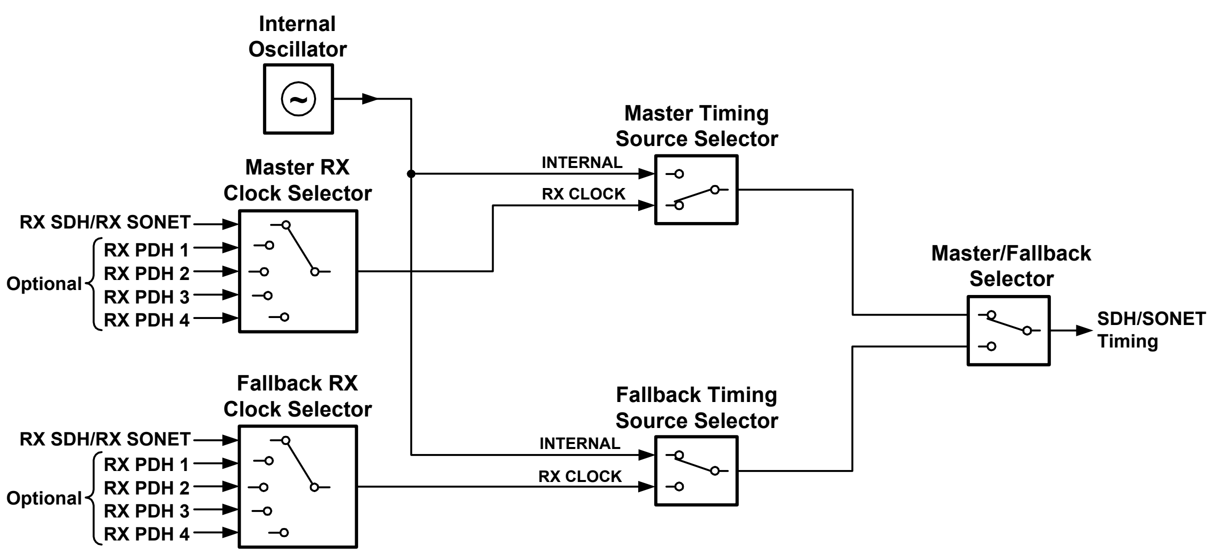


Figure 1-9. SDH/SONET Timing Subsystem (FCD-155 with PDH Ports), Functional Block Diagram

For redundancy, the timing subsystem includes two similar sections, one for selecting the master SDH/SONET clock reference and the other for the fallback clock. In case of a failure, FCD-155 automatically switches from the master clock source to the fallback one. Therefore, different sources must be configured for the master and fallback clocks.

The user can specify the SDH/SONET clock reference source from the following options (the designations appearing below use the terms displayed on the supervisory terminal):

- **Locked to a recovered clock (RX clock option)**. The reference source of the recovered clocks can be selected in accordance with the desired method of clock dissemination in the user's network:
  - **RX SDH** or **RX SONET** – reference source locked to the receive clock recovered from the line signal by the STM-1/OC-3 interface. This timing mode is also called ***loopback timing***.

    A typical application for this timing mode is shown in *Figure 1-10*. In this application, the SDH/SONET timing of the FCD-155 units is locked to the highly accurate master clock of the SDH/SONET network.

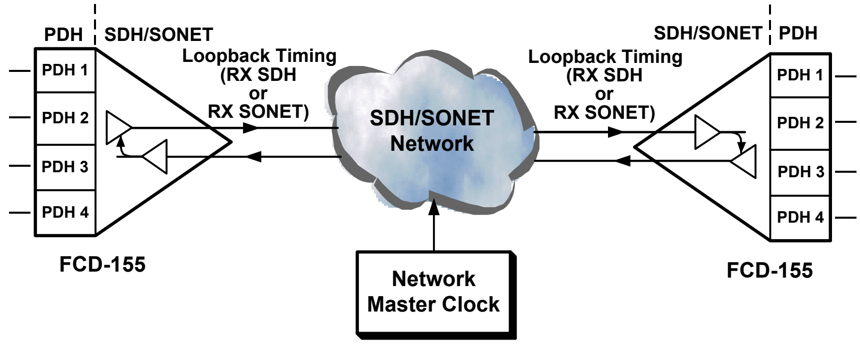


Figure 1-10. Using RX SDH/RX SONET Timing Mode for SDH/SONET Side

  - **RX PDH** – reference clock locked to the receive clock recovered from the PDH line signal received by the desired PDH interface. This timing mode is also called external timing.

    A typical application for this timing mode is shown in *Figure 1-11* (in this figure, the reference clock is supplied by PDH port 2). This timing mode enables locking the SDH/SONET timing of the FCD-155 units used in a private network to the timing of the PDH network.

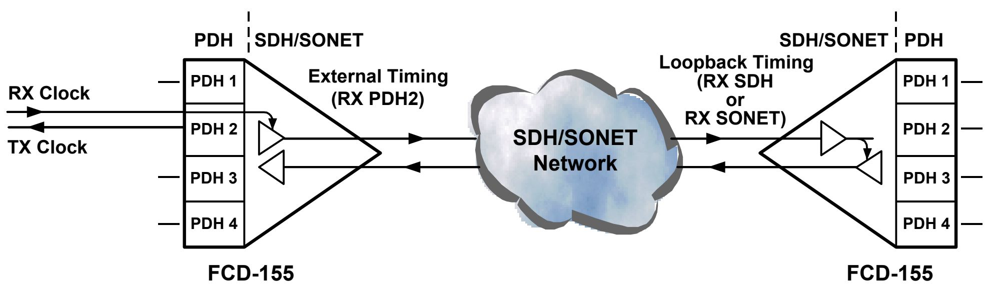


Figure 1-11. Using RX PDH Timing Mode for SDH/SONET Side

- **Internal clock**: in this mode, the internal oscillator of one of FCD-155 units provides the timing reference for FCD-155 units used in a private network. A typical application for this timing mode is shown in *Figure 1-12.*

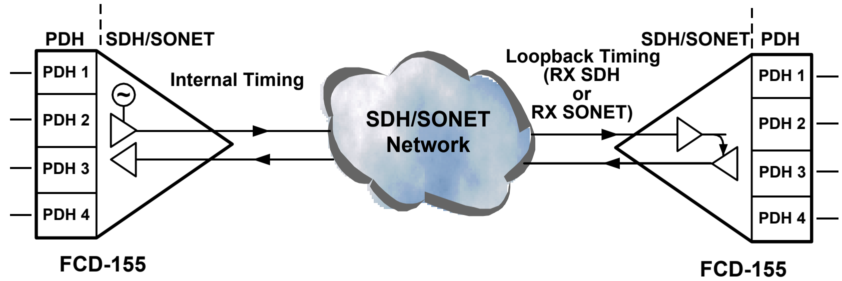


Figure 1-12. Using Internal Timing Mode for SDH/SONET Side

The reference timing source used by the SDH/SONET side is reflected in the S1 byte inserted in the transmit SDH/SONET overhead:

- When the network timing is derived from the FCD-155 internal oscillator, the S1 byte is 0 (corresponding to the ***unknown*** value)
- When the timing reference is a recovered clock signal, the S1 byte is F (hexa), corresponding to the ***do not use (DNU)*** value.

PDH Timing Subsystem

The available timing options for the PDH subsystem are as follows (the designations appearing below use the terms displayed on the supervisory terminal):

- **RX SDH/RX SONET** – PDH reference source locked to the receive clock recovered from the line signal by the STM-1/OC-3 interface.

  A typical application for this timing mode is shown in *Figure 1-13*. In this application, the PDH ports send the received data to the connected equipment at a timing locked to the highly accurate master clock of the SDH/SONET network, and therefore enable locking the timing of the PDH equipment to the SDH/SONET timing.

  Note that the user's PDH equipment must use loopback timing.

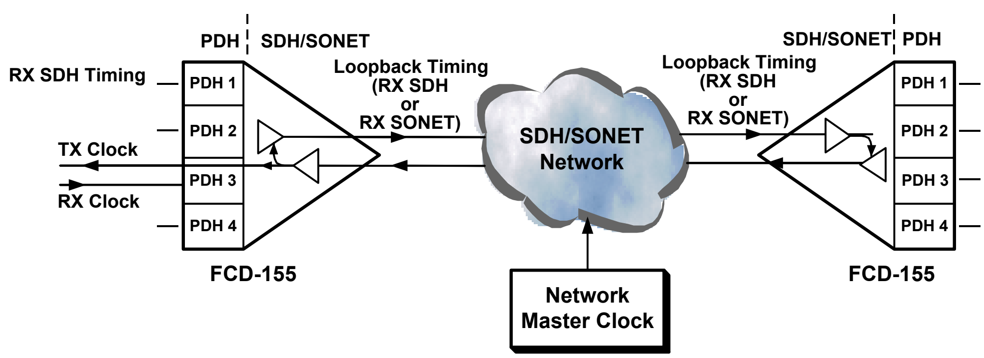


Figure 1-13. Using RX SDH/SONET Timing Mode for PDH Side

- **RX VC12, RX VC11, RX VT1.5** or **RX VC3** – PDH reference source locked to the receive clock recovered from the corresponding VC-12, VC-11, VT-1.5 or VC-3 timing. This mode locks the local timing of the PDH port to the timing of the PDH signal received by the remote equipment. Therefore, in this mode the SDH/SONET transmission link is simply a pipe that transparently conveys the remote timing reference to the local equipment.

A typical application for this timing mode, using RX VC12 as an example, is shown in *Figure 1-14*.

Note that the remote user's PDH equipment must use internal timing, and the local user's PDH equipment must use loopback timing.

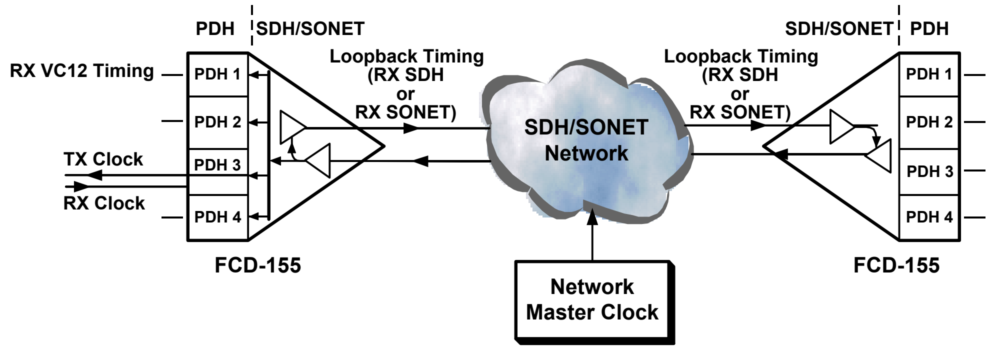


Figure 1-14. Using RX VC12, RX VC11, RX VT1.5 or RX VC3 Timing Mode for PDH Side

Management Subsystem

The FCD-155 management subsystem provides all the functions needed to configure, control and monitor the operation of the FCD-155. The activities that can be performed include:

- Configure the FCD-155.
- Monitor the FCD-155 status and read its performance monitoring statistics.
- Perform FCD-155 tests and diagnostics.
- Display alarms and events detected during FCD-155 operation.

In addition, the management system also enables signaling the FCD-155 alarm status to bay alarm panels or remote operator consoles by means of two sets of dry relay contacts (one for major alarms, the other for minor alarms) included in the dedicated front-panel ALARM connector.

The FCD-155 supervision and configuration activities can be performed using supervision terminals, SNMP-based network management stations, IP hosts using the Telnet protocol, and Web browsers.

FCD-155 units can also be managed by the RADview EMS, a client-server CORBA-based Element Management System offered by RAD.

Supervisory Port Capabilities

All the FCD-155 supervision and configuration functions, and in particular the preliminary configuration activities, can be performed using a "dumb" ASCII terminal (or a PC running a terminal emulation program) directly connected to the FCD-155 serial RS-232 asynchronous supervisory port, located on its front panel. the terminal is controlled by the program stored in the FCD-155. No information has to be stored in the terminal.

After the preliminary configuration is completed, the FCD-155 can also be managed by the other means, for example, Telnet hosts, Web browsers and SNMP network management stations.

The supervisory port has a DCE interface, and supports data rates in the range of 300 bps to 115.2 kbps. The data rate and the word format are user-configurable.

Out-of-Band Management through ETH 1 and ETH 2 LAN Ports

After preliminary configuration, the management subsystem of the FCD-155 can also be accessed through either of its ETH 1 or ETH 2 LAN ports, using Telnet, SNMP or HTML (for Web browsers).

Note *The optional transparent LAN ports cannot be used for management access.*

The connection from the ETH 1 or ETH 2 port to the internal management subsystem is made through the FCD-155 Ethernet switch, as explained in the *Support for Port-Based VLAN* section above.

Alternatively, when tag-based VLAN switching is used, and VLAN tagging is enabled for the internal management port, a forwarding rule must be defined for the management VLAN.

Remote Management through SDH/SONET Network

SNMP-based network management stations connected to one of the FCD-155 units in the user's network can also manage remote units, using inband communication over some of the network link bandwidth. This capability is illustrated in *Figure 1-15*.

The management station is connected to a LAN port (ETH 1 or ETH 2) of the local FCD-155 unit, and its traffic is handled by the Ethernet switch of the FCD-155.

To enable remote management, the management station traffic is directed not only to the internal management subsystem, but is also connected to a dedicated group by defining an appropriate port-based VLAN for management purposes. The dedicated management group is then mapped to one VC-12/VC-11 or VT-1.5 on the SDH/SONET link.

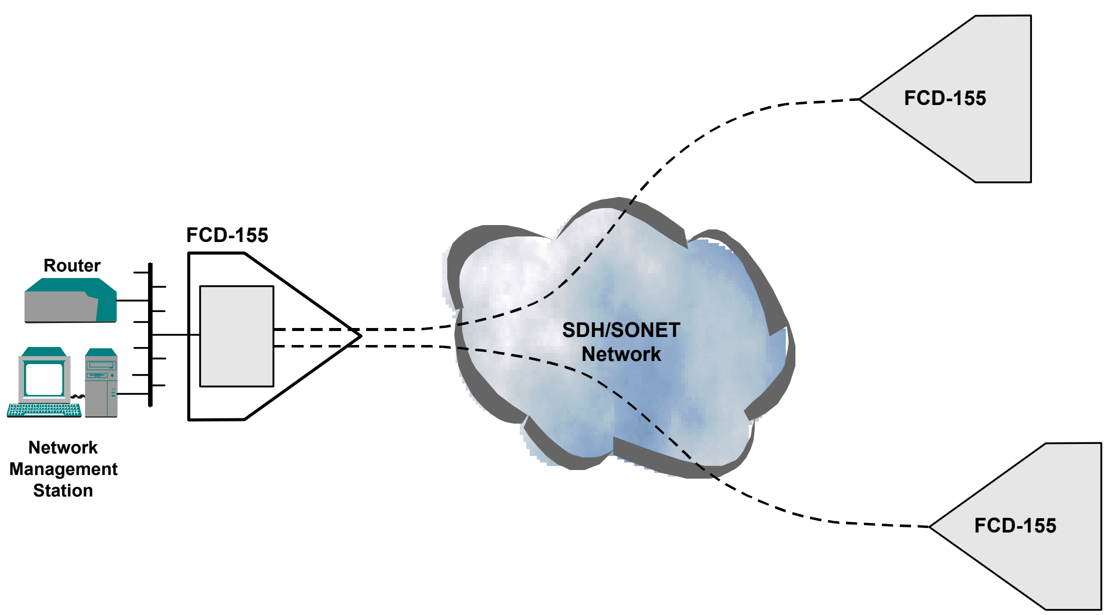


Figure 1-15. Remote Management of FCD-155 Units through SDH/SONET Network

At the remote FCD-155 units, port-based VLANs are used to connect the VC-12/VC-11 (or VT-1.5) carrying the management traffic to the local unit management subsystem. This arrangement enables the management station to manage each remote FCD-155 unit.

Moreover, at each remote FCD-155 unit, the management traffic may also be connected through the Ethernet switch to one of the ETH 1 or ETH 2 ports. This will enable the management station to manage equipment attached to the LAN connected to that port.

The bandwidth needed for management traffic is normally rather low compared with VC-12/VC-11 or VT-1.5 bandwidth. Therefore, assigning a full VC-12/VC-11 or VT-1.5 to management traffic is justified only when free bandwidth is available on the links.

To avoid wasting bandwidth, GFP multiplexing can be used: in this case, the dedicated management group is connected to the GFP multiplexer (see the *GFP Multiplexer Function* section) together with a group carrying payload traffic. The management group is then defined as secondary group and assigned minimal bandwidth (12.5% is often sufficient). The result is that payload traffic gets additional bandwidth whenever the management link is idle.

Inband Management through SDH/SONET Network

FCD-155 supports inband management through the Data Communication Channel (DCC) carried in the SDH/SONET overhead.

Therefore, in point-to-point applications, a Telnet host or an SNMP-based network management station connected to one of the FCD-155 units can also manage the remote unit, using inband communication but without occupying bandwidth that may be used to carry payload.

Note *Inband management can also support more complex topologies. However, this is possible only if the carrier's SDH/SONET network provides access to the DCC and enables transparent transfer of user's data through the DCC. In this case, a Telnet host or an SNMP-based network management station connected to one of the FCD-155 units in the network can manage all the other units, inband.*

Typically, the Telnet host or management station is connected to a LAN port (ETH 1 or ETH 2) of the local FCD-155 unit, and its management traffic is handled by the Ethernet switch of the FCD-155. The other LAN port can be used to connect the management traffic to other local equipment units.

To enable remote management, the management traffic not addressed to the internal management subsystem of the FCD-155 is also connected by this subsystem to the Data Communication Channel (DCC) carried in the SDH/SONET overhead.

At the remote FCD-155 units, the management traffic is extracted from the DCC and connected to the local unit management subsystem. This arrangement enables the management station to manage each remote FCD-155 unit.

Moreover, at each remote FCD-155 unit, the management traffic may also be connected through the Ethernet switch to one of the ETH 1 or ETH 2 LAN ports.

This will enable the management station to manage equipment attached to the LAN connected to that port.

The user can configure the FCD-155 for static routing, by specifying the IP address of the host or subnet to which management traffic is to be sent via the DCC.

As mentioned above, the inband management traffic is carried in the DCC bytes, part of the SDH/SONET overhead. The user can select the DCC bytes to carry the traffic:

- Regenerator section DCC bytes (D1, D2, D3), which provide a 192 kbps channel terminated at SDH/SONET regenerator section terminating equipment
- Multiplex section DCC bytes (D4 to D12), which provide a 576 kbps channel terminated at SDH/SONET multiplex section terminating equipment.

The user can also select the encapsulation and routing protocols used for inband management parameters:

- Two encapsulation options are available: HDLC, or PPP over HDLC in accordance with RFC1661 and RFC1662.

  For compatibility with particular implementations of the PPP over HDLC encapsulation protocol for management purposes, the user can select a Type 1 flavor: with Type 1 encapsulation, the LCP (Link Control Protocol) packets do not include address and control fields in their overhead.
- Two options are also available for the management traffic routing protocol:
  - RAD proprietary protocol. This protocol is sufficient for managing any RAD equipment and should always be used with HDLC encapsulation.
  - RIP2: the FCD-155 transmits RIP2 routing tables. This permits standard RIP routers to reach the FCD-155 SNMP agent through the inband (DCC) channel.

Automatic Configuration (Plug & Play)

The FCD-155 is designed to enable automatic configuration from a remote location (plug & play functionality). This is achieved using DHCP in conjunction with TFTP; to apply this method, the using organization must configure a DHCP server, located at an appropriate location within the operator's network management center.

To use plug & play, the FCD-155 management subsystem can be configured to operate as a DHCP client. In this case, the following process takes place:

1. When the FCD-155 is powered up, it automatically broadcasts a DHCP server discovery message over the out-of-band interfaces.
2. When the dedicated DHCP server answers, it provides the IP address to be configured as the FCD-155 management address. This is sufficient for Telnet access, as well as for TFTP.
3. After the IP address is configured, TFTP is used to download the appropriate configuration file to the new FCD-155.
4. After configuration downloading, the FCD-155 starts using the downloaded configuration.

Software Updating

The operation of the FCD-155 management subsystem and of its other circuits is determined by software stored in flash memory.

The FCD-155 application software can be downloaded and updated using an ASCII terminal directly connected to the FCD-155 serial CONTROL port, using the Xmodem protocol.

However, the software can also be updated using TFTP through any of the management access options described above. Using remote downloading enables network operators to distribute software from a central location rapidly and efficiently.

Power Supply Subsystem

FCD-155 can be ordered with either 100 to 240 VAC, 50/60 Hz or -48 VDC power supply. The unit does not have a power ON/OFF switch and therefore starts operating as soon as power is connected.

Supervision, Diagnostics and Performance Monitoring

The FCD-155 supports comprehensive diagnostics, performance monitoring, supervision and maintenance capabilities, for easy maintenance and rapid detection and location of faults.

Alarm Reporting

FCD-155 generates time-stamped alarm messages that cover all the system events. The time stamp is provided by an internal real-time clock. Up to 255 of the most recent alarms can be stored in an internal buffer; in case the FCD-155 is powered down, up to 100 of the most recent alarms are stored in non-volatile memory, and remain available for display and analysis after the FCD-155 is powered up again.

The alarm messages stored in the buffer can be read on-line by means of the local supervisory terminal, a Telnet host or Web browser, and can also be automatically sent as traps to selected management stations.

Performance Monitoring

Performance monitoring capabilities includes collection of statistics for the application layer, as well as for the physical layer for the user and network ports.

Diagnostic Tests

The maintenance capabilities include the following functions.

- STM-1/OC-3 network links: local and remote loopbacks
- PDH tributaries:
  - Local loopback
  - Local loopback with upstream AIS
  - Remote loopback
  - Remote loopback with downstream AIS

  - For T1 tributaries: network-activated local loopback (LLB) and sending of LLB activation command.
  - For E3 and T3 PDH ports only: BER testing, enables checking the transmission performance of the connection to the local user's equipment.

  The duration of the loopbacks can be limited, by specifying a time-out interval after which the loopback is automatically disconnected.
- ***Ping*** for IP connectivity testing.

These loopbacks enable rapid and efficient isolation of the equipment unit causing the problem, thereby enabling rapid restoration of service.

Physical Characteristics

The FCD-155 is a compact unit (only 1U high). One or two units can be installed side by side in a 19" rack, using appropriate rack-mount kits.

Cooling is by free air convection. In addition, the FCD-155 has a miniature internal cooling fan. The air intake vents are located on the side walls, and the exhaust vent is located on the rear panel.

1.5 Technical Specifications

LAN Ports	*Number of Ports*	2
	Compatibility	Relevant sections of IEEE 802.3u, 802.3x, 802.1p and 802.3q
	Data Rate	• 10BaseT: 10 Mbps • 100Base-Tx: 100 Mbps • Auto-negotiation
	Internal LAN Traffic Processing	Ethernet switch with two external ports, one port for management subsystem, and four WAN ports (toward the network) connected to virtually concatenated groups 1 to 4. Supports QoS, port-based VLANs and tag-based VLAN switching
	LAN Table	1024 MAC addresses with configurable automatic aging (default – 5 minutes)
	Connectors	RJ-45, shielded

Transparent LAN Ports (optional)	*Number of Ports*	4
	Data Rate	• 10BaseT: 10 Mbps • 100Base-Tx: 100 Mbps • Auto-negotiation
	Internal Traffic Processing	Transparent connection to a fixed virtually concatenated group (5 to 8)
	Connectors	RJ-45, shielded
E1 PDH Interfaces (optional)	*Number of Ports*	4
	Compatibility	ITU-T Rec. G.703, unframed
	Nominal Data Rate	2.048 Mbps
	Line Code	HDB3
	Interface Type (selectable by internal jumpers)	• 120 Ω balanced • 75 Ω unbalanced
	Maximum Line Attenuation	• 36 dB (long-haul mode) • 12 dB (short-haul mode)
	Connectors	RJ-45, shielded
T1 PDH Interfaces (optional)	*Number of Ports*	4
	Compatibility	ITU-T Rec. G.703, unframed
	Nominal Data Rate	1.544 Mbps
	Line Code	B8ZS
	Interface Type	100 Ω balanced
	Mode	CSU or DSU
	Transmit Levels	• DSU: ±3V ±10%, software adjustable, measured at 0 through 655ft • CSU: 0, -7.5, -15, -22.5 dB software-selectable LBOs
	Maximum Line Attenuation	• 36 dB (long-haul mode) • 12 dB (short-haul mode)
	Interface Type	100 Ω balanced
	Connectors	RJ-45, shielded

E3 PDH Interface (optional)	*Number of Ports*	1
	Compatibility	ITU-T Rec. G.703, unframed
	Nominal Data Rate	34.368 Mbps
	Interface Type	75 Ω unbalanced
	Connectors	Two BNC, female
T3 PDH Interface (optional)	*Number of Ports*	1
	Compatibility	ITU-T Rec. G.703, unframed
	Nominal Data Rate	44.736 Mbps
	Interface Type	75 Ω unbalanced
	Connectors	Two BNC, female
STM-1/OC-3 Optical Network Interface	*Number of Ports*	1, or 2 providing 1:1 protection using MSP
	Bit Rate	155.52 Mbps ± 20 ppm
	Standard	SDH or SONET, in accordance with order
	Optical Interface Standard Compliance	• SDH: ITU-T Rec. G.957 • SONET: GR-253-CORE
	Framing	• SDH: ITU-T Rec. G.707, G.708, G.709 • SONET: ANSIT1.105 and GR-253-CORE
	Link Connectors	ST, SC, or FC/PC, in accordance with order
	Interface Characteristics	See *Table 1-2*
STM-1/EC-3 Electrical Network Interface	*Number of Ports*	1
	Line Attenuation	Maximum 12.7 dB at 78 MHz
	Impedance	75 Ω
	Connectors	Two BNC, female
Supervisory and Management Ports	*V.24/RS-232 CONTROL Port*	• Interface: V.24/RS-232 • Connector: 9-pin D-type, female • Format: asynchronous • Baud rate: 300 bps to 115.2 kbps • Selectable word format: 7 or 8 bits, no parity, 7 bit odd or even parity
	Out-of-band Access (through internal Ethernet switch)	ETH 1 and ETH 2 ports
	Management IP Address Assignment	DHCP or manual configuration

	Inband Access	• From SDH/SONET side, through DCC (D1 – D3 or D4 – D12 bytes, user-selectable) • Inband, through user-selected VC/VT
Timing	*SDH/SONET Timing Source*	• Internal clock • RX SDH or SONET– Locked to clock recovered from STM-1/OC-3 interface • RX PDH – Locked to clock recovered from selected PDH interface
	PDH Timing Source	• RX SDH or SONET – Locked to clock recovered from STM-1/OC-3 interface • RX VC-12/RX VC-11/RX VC3 – Locked to clock recovered from VC-12/VC-11 or VT-1.5 received from remote end
Indicators	*General System Indicators*	• PWR (green) – Power • TST (yellow) – Test • MAJ ALM – Major alarm • MIN ALM – Minor alarm • LOC SYNC LOSS (red) – Local loss of synchronization • REM SYNC LOSS (red) – Remote loss of synchronization
	LAN Port Indicators	• LINK (green) – LAN link integrity • ACT (yellow) – LAN data activity
	PDH Port Indicators	• SIG LOSS (red) – Signal loss on E1 link • AIS (red) – AIS on E1 link
	STM-1/OC-3 Port Indicators	• SIG LOSS (red) – link signal loss • ON LINE (green) – indicates active link
Alarm Collection and Monitoring	*Alarms*	Last 100 alarms are stored in buffer after resetting and available for retrieval. Each alarm is time stamped
	Alarm Relays	• Major alarm indication by floating change-over contacts • Minor alarm indication by floating change-over contacts
Power	*Supply Voltage*	
	AC Source	100 to 240 VAC, 50/60 Hz
	DC Source	-48 VDC (-40 to -72 VDC)
	Power Consumption	30W

Physical	*Height*	4.4 cm / 1.7 in
	Width	21.5 cm / 8.5 in
	Depth	30.0 cm / 11.8 in
	Weight	2.4 kg / 5.3 lb
Environment	*Operating Temperature*	0 to 50°C / 32 to 122°F
	Relative Humidity	Up to 90%, non-condensing

Chapter 2

Installation

2.1 Introduction

Scope

This Chapter provides installation instructions for the FCD-155.

The Chapter presents the following information:

- Safety precautions for installation personnel and users
- Site requirements
- General description of equipment enclosures and their panels
- Mechanical and electrical installation instructions.

After installing the system, it is necessary to configure it in accordance with the specific user's requirements. The preliminary system configuration, performed by means of a supervision terminal directly connected to the FCD-155 (procedures for using the terminal are given in *Chapter 3*). The software necessary for using the terminal is stored in the FCD-155.

Note *If the FCD-155 software must be updated, refer to Appendix D for detailed software installation instructions.*

After the preliminary configuration and during routine operations, the FCD-155 can also be managed by means of Telnet hosts, Web browsers or SNMP-based network management stations, e.g., RADview. Refer to the User's Manual of the network management station for operating instructions; Telnet hosts use the supervision terminal procedures.

2.2 Safety Precautions

General Safety Precautions

Warning

No internal settings, adjustment, maintenance, and repairs may be performed by either the operator or the user; such activities may be performed only by skilled service personnel who are aware of the hazards involved.
Always observe standard safety precautions during installation, operation, and maintenance of this product.

Grounding

For your protection and to prevent possible damage to equipment when a fault condition, e.g., a lightning stroke or contact with high-voltage power lines, occurs on the cables connected to the equipment, the case of the FCD-155 unit must be properly grounded at any time. Any interruption of the protective (grounding) connection inside or outside the equipment, or the disconnection of the protective ground terminal can make this equipment dangerous. Intentional interruption is prohibited.

Warning

Dangerous voltages may be present on the cables connected to the FCD-155.
- **Never connect cables to an FCD-155 unit if it is not properly installed and grounded.**
- **Disconnect all the cables connected to the electrical connectors of the FCD-155 before disconnecting the FCD-155 power cable.**

Before switching on this equipment and before connecting any other cable, the protective ground terminal of the FCD-155 must be connected to a protective ground. The grounding connection is made through the power cable, which must be inserted in a power socket (outlet) with protective ground contact. Therefore, the power cable plug must always be inserted in a socket outlet provided with a protective ground contact, and the protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

Whenever FCD-155 units are installed in a rack, make sure that the rack is properly grounded and connected to a reliable, low-resistance grounding system.

Make sure that only fuses of the required rating are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders is forbidden. Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Laser Safety Classification

FCD-155 units equipped with laser devices comply with laser product performance standards set by government agencies for Class 1 laser products. The modules do not emit hazardous light, and the beam is totally enclosed during all operating modes of customer operation and maintenance.

FCD-155 units are shipped with protective covers installed on all the optical connectors. Do not remove these covers until you are ready to connect optical cables to the connectors. Keep the covers for reuse, to reinstall the cover over the optical connector as soon as the optical cable is disconnected.

Laser Safety Statutory Warning and Operating Precautions

All the personnel involved in equipment installation, operation, and maintenance must be aware that the laser radiation is invisible. Therefore, the personnel must strictly observe the applicable safety precautions and in particular must avoid looking straight into optical connectors, neither directly nor using optical instruments.

In addition to the general precautions described in this section, be sure to observe the following warnings when operating a product equipped with a laser device. Failure to observe these warnings could result in fire, bodily injury, and damage to the equipment.

Warning

To reduce the risk of exposure to hazardous radiation:

- **Do not try to open the enclosure. There are no user-serviceable components inside.**
- **Do not operate controls, make adjustments, or perform procedures to the laser device other than those specified herein.**

Allow only authorized RAD service technicians to repair the unit.

Protection against Electrostatic Discharge (ESD)

An electrostatic discharge occurs between two objects when an object carrying static electrical charges touches, or is brought near enough, the other object. Static electrical charges appear as result of friction between surfaces of insulating materials, separation of two such surfaces and may also be induced by electrical fields.

Routine activities such as walking across an insulating floor, friction between garment parts, friction between objects, etc. can easily build charges up to levels that may cause damage, especially when humidity is low.

Caution

FCD-155 internal boards contain components sensitive to ESD. To prevent ESD damage, do not touch internal components or connectors.

If you are not using a wrist strap, before touching an FCD-155 unit or performing any internal settings on the FCD-155, it is recommended to discharge the electrostatic charge of your body by touching the frame of a grounded equipment unit.

Whenever feasible, during installation works use standard ESD protection wrist straps to discharge electrostatic charges. It is also recommended to use garments and packaging made of antistatic materials or materials that have high resistivity, yet are not insulators.

2.3 Site Requirements

Physical Requirements

The FCD-155 can be installed in racks, on desktop and shelves. All the connections, except for the power connection, are made to the front panel.

For installation in 19" racks, RAD offers dedicated rack mount kits that enable installing one or two FCD-155 units side-by-side. Two FCD-155 units installed with the rack mount kit occupy a height of 1U.

Power Requirements

AC-powered FCD-155 units should be installed within 1.5m (5 feet) of an easily-accessible grounded AC outlet capable of furnishing the required AC supply voltage, in the range of 100 to 240 VAC, 47 to 63 Hz.

DC-powered FCD-155 units require a -48 VDC power source with positive terminal grounded. In addition, the DC power connector contains the chassis (frame) ground terminal.

Network and User Connections

This section presents general requirements regarding the connections to the various FCD-155 interfaces. For specific information regarding pin allocations in the FCD-155 connectors, refer to *Appendix A*.

Network Connections

- **Optical Ports**. FCD-155 units can be ordered with one or two STM-1/OC-3 optical ports.

  Each port has two optical connectors, one for the receive input and the other for the transmit output. The FCD-155 can be ordered with ST, FC/PC or SC connectors, for use over single-mode or multimode fibers.

  The optical cables to be connected to these ports should use 2-mm optical fibers terminated in the corresponding type of connectors.

  When routing fibers, make sure to observe the minimum bending radius (35 mm). RAD recommends installing plastic supports on each cable connector: these supports determine the fiber bending radius at the connector entry point and also prevent stress at this point.
- **Electrical Port**. The FCD-155 version with electrical STM-1/EC-3 port has two 75 Ω BNC connectors, one for the receive input and the other for the transmit output.

  The electrical interface is intended for short intra-office cable runs (typically up to 135 meter over RG-59B/U coax). This interface must not be directly connected to unprotected public telecommunication networks.

PDH E1 and T1 Port Connections

Each FCD-155 E1 port can be configured to use either of the following interfaces (only one can be active at any time):

- 120 Ω balanced interface for operation over two twisted pairs
- 75 Ω unbalanced interface for operation over coaxial cable.

Both interfaces are terminated in an RJ-45 eight-pin connector.

T1 ports have only 100 Ω balanced interfaces, terminated in RJ-45 connectors.

Caution The FCD-155 E1 and T1 interfaces must not be directly connected to unprotected public telecommunication networks. The connection must be made through a network termination unit that provides separation between the interface conductors and the telecommunication network conductors in accordance with the applicable local regulations.

PDH E3 and T3 Port Connections

The FCD-155 E3 or T3 port has a 75 Ω unbalanced interface in accordance with ITU-T Rec. G.703, for operation over coaxial cable. The port is terminated in two BNC connectors, one for the receive input and the other for the transmit output.

LAN Port Connections

The FCD-155 can have two or six LAN ports (in accordance with order).

Each LAN port has a 10/100BaseTX Ethernet interface terminated in an RJ-45 connector, designated ETH1 and ETH2 or ETH 1 to ETH 6, respectively, for connection to LANs operating on UTP media.

The interface connector is wired as a hub port. The interface includes automatic crossover detection and correction. Therefore, it can always be connected through a “straight” (point-to-point) cable to any other 10/100BaseTX port (hub or station).

Supervisory Terminal Port Connections

The out-of-band supervisory port of the FCD-155, designated CONTROL, has a serial RS-232 asynchronous DCE interface terminated in a 9-pin D-type female connector, designated CONTROL. This port can be directly connected to terminals using a cable wired point-to-point.

Dry-Contact Alarm Relays Connections

The dry-contact alarm interface is included in the ALARM connector (see *Appendix A*).

The interface includes two relays, one for the major alarm and the other for the minor alarm, with floating change-over contacts.

The relay contacts are rated at maximum 60 VDC across open contacts, and maximum 1 ADC through closed contacts. Protection devices must be used to ensure that these ratings are not exceeded, e.g., use current limiting resistors in series with the contacts, and place voltage surge absorbers across the contacts.

Front and Rear Panel Clearance

Allow at least 90 cm (36 inches) of frontal clearance for operator access.

Allow at least 10 cm (4 inches) clearance at the rear of the unit for interface cable connections, however during installation and replacement and cable connections a larger clearance (at least 90 cm (36 inches)) is needed.

Ambient Requirements

The ambient operating temperature of the FCD-155 is 0 to 50°C (32 °F to 122 °F), at a relative humidity of up to 90%, non-condensing.

The FCD-155 is cooled by free air convection, and in addition has a miniature internal cooling fan. The air intake vents are located on the side walls, and the exhaust vent is located on the rear panel. Do not obstruct these vents.

When the FCD-155 is installed in a 19" rack, allow at least 1U of space below and above the unit.

Electromagnetic Compatibility Considerations

The FCD-155 is designed to comply with the electromagnetic compatibility (EMC) requirements of Sub-Part J of FCC Rules, Part 15, for Class B electronic equipment, and additional applicable standards. To meet these standards, it is necessary to perform the following actions:

- Connect the FCD-155 to a low-resistance grounding system.
- Whenever feasible, use shielded cables.

2.4 Package Contents

The FCD-155 package includes the following items:

- FCD-155 unit
- Power cord
- Kit for rack installation (if ordered)
- Technical Documentation CD.

2.5 Equipment Needed

The cables you need to connect to the FCD-155 depend on the FCD-155 application. You can use standard cables or prepare the appropriate cables yourself in accordance with the information given in *Appendix A*.

Contact RAD Technical Support Department if other interface cables are necessary.

2.6 FCD-155 Enclosure

This section presents a physical description of the various FCD-155 versions.

FCD-155 Front Panels

Figure 2-1 shows various typical FCD-155 front panels.

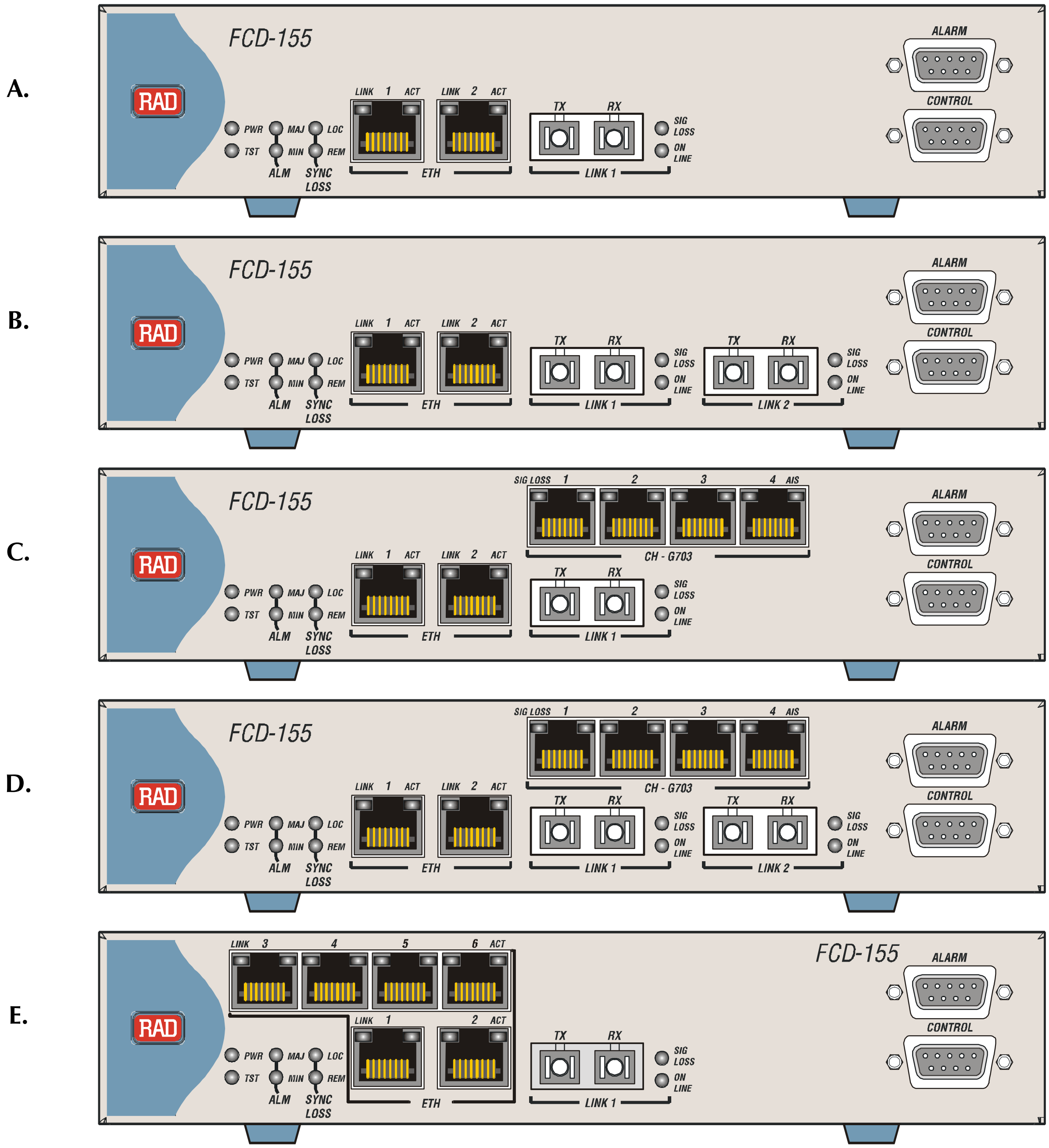


Figure 2-1. Typical FCD-155 Front Panels

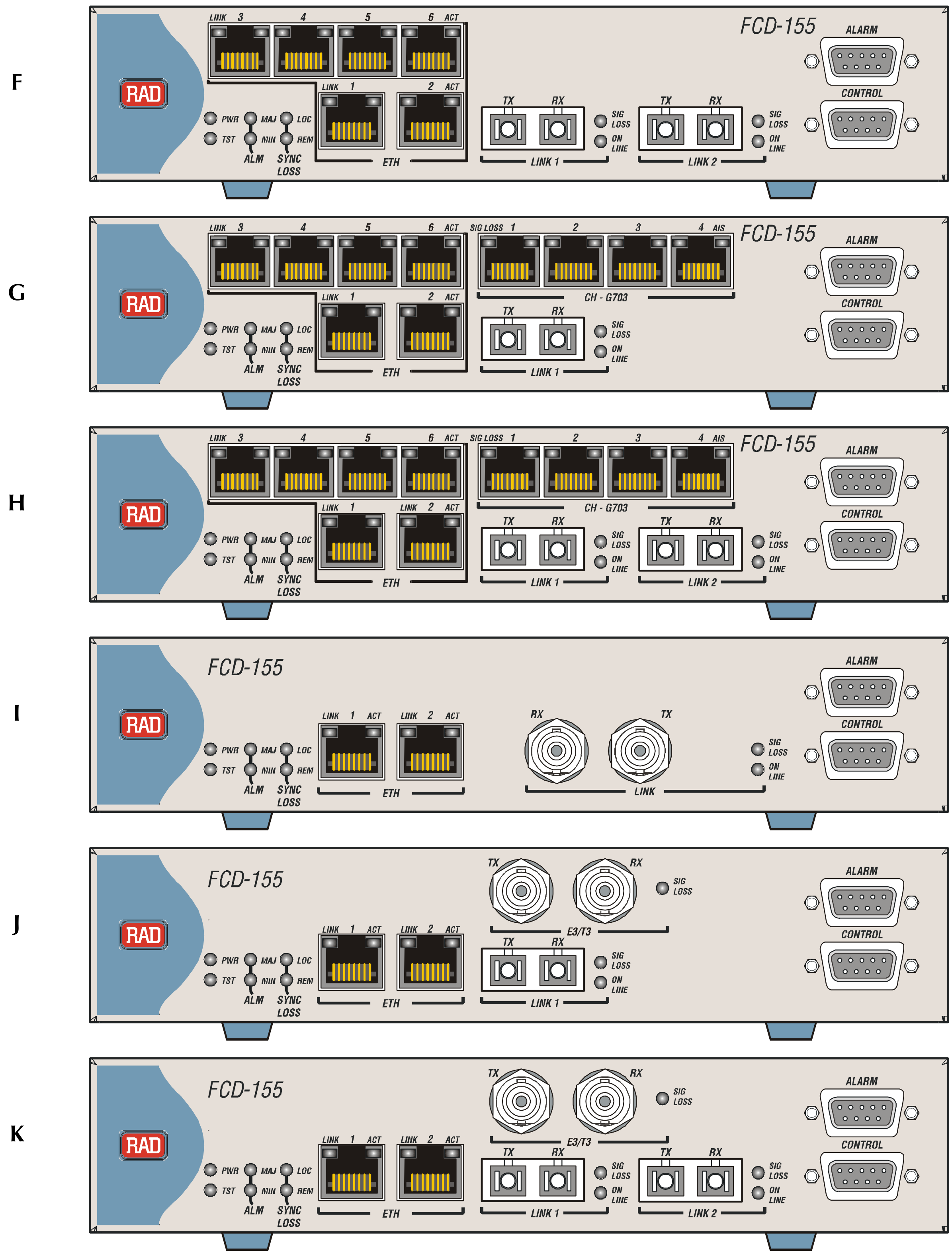


Figure 2-1. Typical FCD-155 Front Panels (Cont.)

The components located on the front panel are arranged in several functional groups:

1. System status indicators: the group of indicators located in the lower left-hand corner of the panel display the system status.
2. Middle area:
   - The lower section includes the basic system interfaces, LAN ports and aggregate interfaces:
     - The LAN ports area (at the left side – see, for example, panels A, B) includes two Ethernet interfaces terminated in the ETH 1 and ETH 2 connectors. Each connector has a pair of built-in indicators.
     - The aggregate interfaces area (at the right side) includes either optical or electrical interfaces.

       The optical interfaces (see, for example, – see, for example, panels A, B), include one or two pairs of optical connectors (one pair for each network link), identified as LINK 1 and LINK 2. Each pair consists of a transmit (TX) connector and a receive (RX) connector. Two link status indicators are located to the right of each pair of connectors.

       The electrical interface (see panel K), includes one pair of BNC connectors, consisting of a transmit (TX) connector and a receive (RX) connector, with two link status indicators.
   - The upper section is intended for the optional user interfaces (two positions, one at the left and the other at the right):
     - The left-hand options area may include additional four Ethernet ports designated ETH 3 to ETH 6 (see panels E, F, G, H), each with its pair of built-in indicators.
     - The right-hand options area may include additional PDH ports.

       The optional quad E1 or T1 PDH interfaces (see panels C, D, G, H) have four PDH interface connectors, identified as CH 1 to CH 4 (G703 indicates that the PDH interfaces comply with ITU-T Rec. G.703). Each connector has a pair of built-in indicators.

       The optional E3 or T3 PDH port (see panels J, K) has two BNC connectors, identified as RX and TX, and a status indicator.
3. Auxiliary connectors area: includes the ALARM and CONTROL connectors.

Table 2-1 explains the functions of all the indicators located on the FCD-155 front panel.

Note *Some of the indicators appearing in Table 2-1 support functions that are ordering options, therefore ignore those not included in your FCD-155 version.*

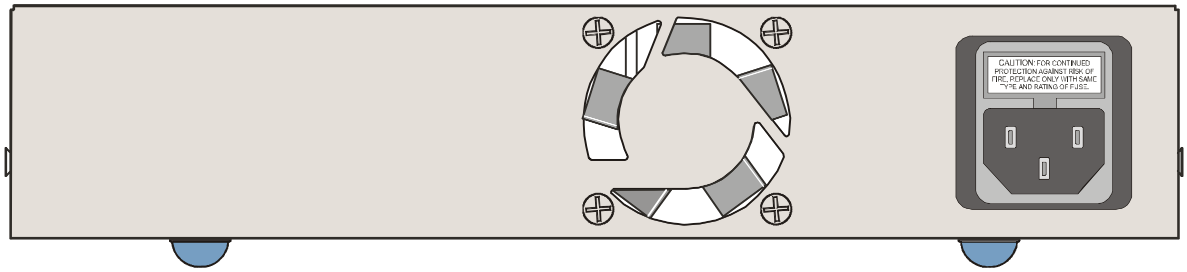
Table 2-1. FCD-155 Front Panel Component

Group	Item	Function
System Indicators	**PWR** Indicator (green)	Lights when the FCD-155 is powered and operating normally Flashes during the power-up self-test
	TST Indicator (yellow)	Lights when a test is activated on the FCD-155
	ALM MAJ Indicator (red)	Lights when major alarm condition is present
	ALM MIN Indicator (red)	Lights when minor alarm condition is present
	SYNC LOSS LOC Indicator (red)	Lights when the local FCD-155 loses frame synchronization to the incoming link signal
	SYNC LOSS REM Indicator (red)	Lights when the remote equipment sends a Far End Receive Fail indication (RDI)
ETH Port Indicators	**LINK** Indicator (green)	Lights when the link integrity signal is detected by the corresponding LAN port (normal operating condition)
	ACT Indicator (yellow)	Flashes in accordance with the transmit and/or receive activity on the corresponding LAN port
LINK Port Indicators	**SIG LOSS** Indicator (red)	Lights when no optical receive is detected by the corresponding link
	ON LINE Indicator (green)	Lights when the corresponding network port is active, that is, carries the traffic (when the FCD-155 network interface has two links, at any time only one of the two ports is active). For FCD-155 with two links, flashes for the redundant (standby) port
PDH E1 or T1 Port Indicators	**SIG LOSS** Indicator (red)	Lights when the receive signal of the corresponding PDH port is missing
	AIS Indicator (red)	Lights when the corresponding PDH port detects an alarm indication signal (AIS)
PDH E3 or T3 Port Indicators	**SIG LOSS** Indicator (red)	Lights when the receive signal of the E3 or T3 port is missing

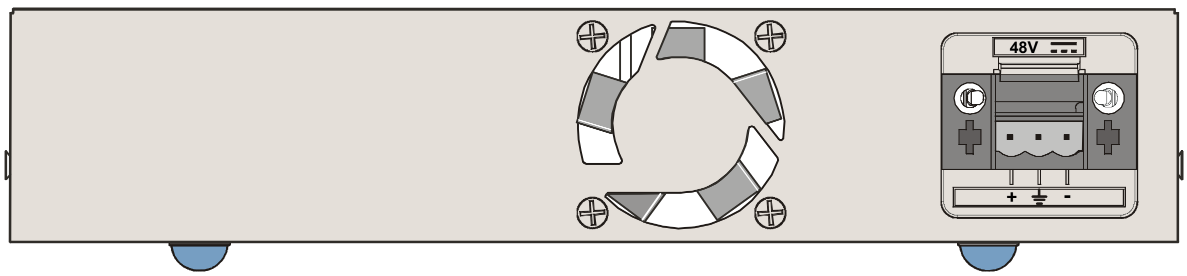
FCD-155 Rear Panels

Figure 2-2 shows typical rear panels of FCD-155 units.

The rear panels include only the AC or DC power connector (in accordance with order), for connection of the FCD-155 supply voltage and protective ground. The AC connector has a built-in fuse.



A. FCD-155 with AC Power Connector



B. FCD-155 with DC Power Connector

Figure 2-2. Typical FCD-155 Rear Panels

2.7 Preparation for Installation

Before installing an FCD-155 unit, it is necessary to check its internal settings and change them as necessary for your particular application.

The procedure depends on your FCD-155 version.

Note *The following procedures also explain how to reset the supervisory port communication parameters to their default values. This is necessary if you cannot establish communication with the FCD-155 by means of a terminal connected to its CONTROL connector (the most probable cause is that the communication parameters have been changed and are not known to you).*

Caution Before performing the procedures described below, review the safety precautions given in *Section 2.2*.

Note *The figures appearing in this section illustrate the positions of the various internal settings on a typical FCD-155 version: your version may include additional boards, depending on the specific unit that has been ordered.*

FCD-155 Units with E1 PDH Interfaces

Units with E1 PDH interfaces have several jumpers that must be set in accordance with the specific installation requirements. Before installing the FCD-155, check the position of the jumpers in accordance with the information given below and change as required.

In addition, the FCD-155 has an internal switch, SW1, which is used to restore the factory-default communication parameters for the supervisory port.

➤ **To prepare an FCD-155 unit with PDH E1 interfaces for installation:**

Follow the procedures given in pages *2-12* to *2-15*.

Opening FCD-155 Case

In the following steps, refer to *Figure 2-3* and *Figure 2-4*.

1. Disconnect all the cables connected to the FCD-155 unit. The power cable must be the last cable disconnected.
2. If the FCD-155 is installed in a rack by means of the rack mount kit:
   - Remove the unit from the rack.
   - Remove the mount brackets attached to the FCD-155 sides.
3. Place the FCD-155 on a clean, flat worktable.
4. Refer to *Figure 2-3* and release the eight screws fastening the cover.
5. Push cover toward the rear about 1.5 cm (0.5 in.), to disengage it.
6. Pull cover straight up to remove it.

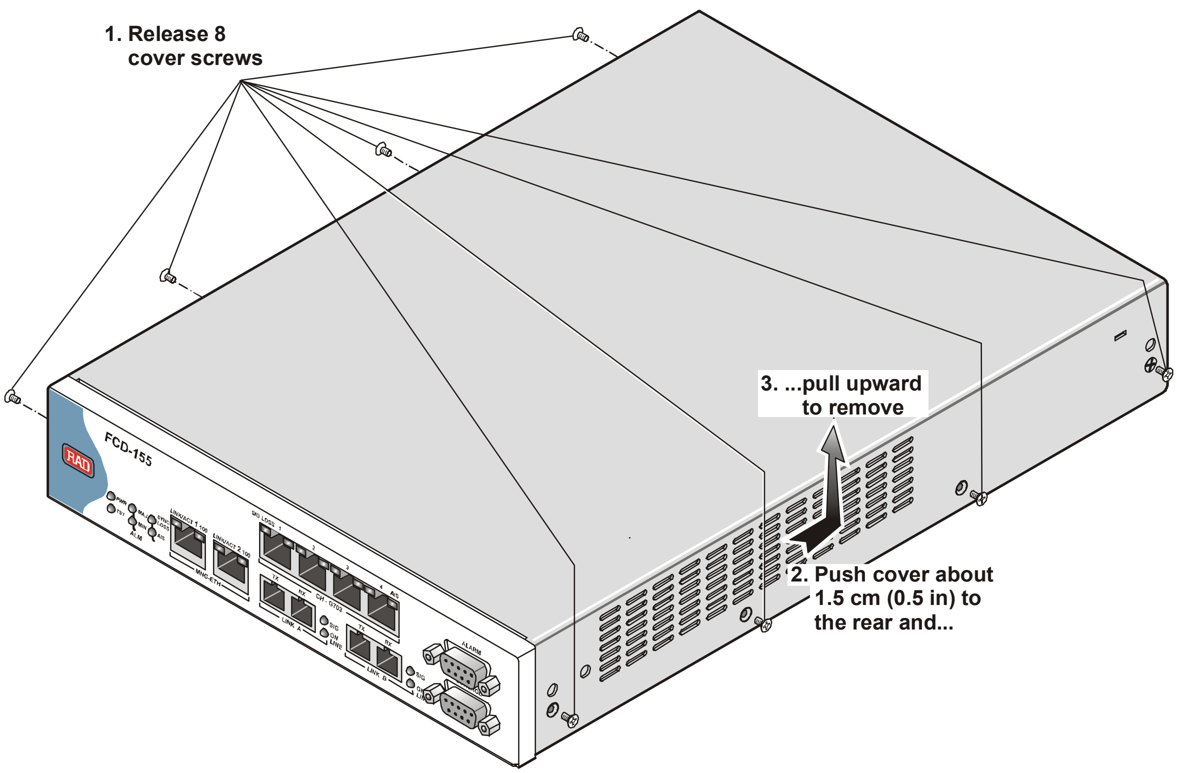


Figure 2-3. Opening FCD-155 Cover

Figure 2-4 shows a general view of the FCD-155 after its cover has been removed.

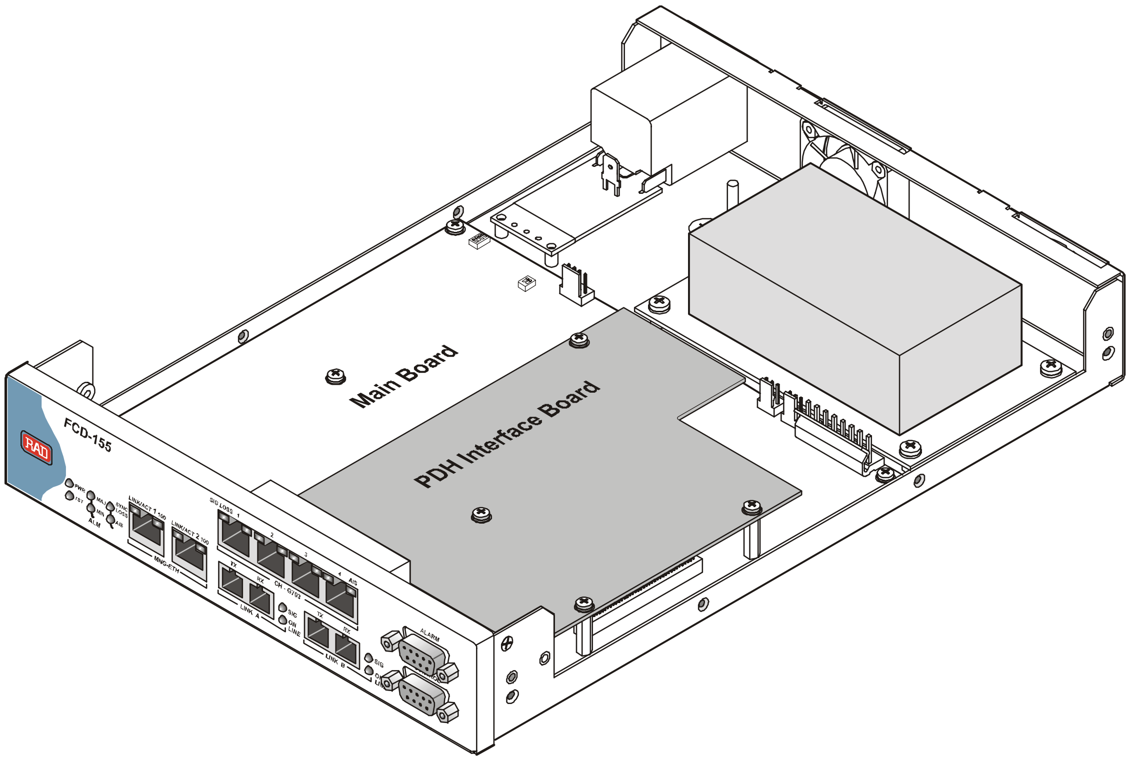


Figure 2-4. General View of FCD-155 with PDH Interfaces without Cover

E1 Interface Selection

The E1 interface jumpers are located on the PDH interface board. *Figure 2-5* identifies the locations and the functions of the jumpers used to select the interface type of each E1 port. Check the settings of each jumper in accordance with the prescribed interface, and change as necessary.

After setting the jumpers to the prescribed positions, if it is not necessary to initialize the supervisory port communication parameters and terminal type, skip to the *Closing FCD-155 Cover* section (page *2-15*).

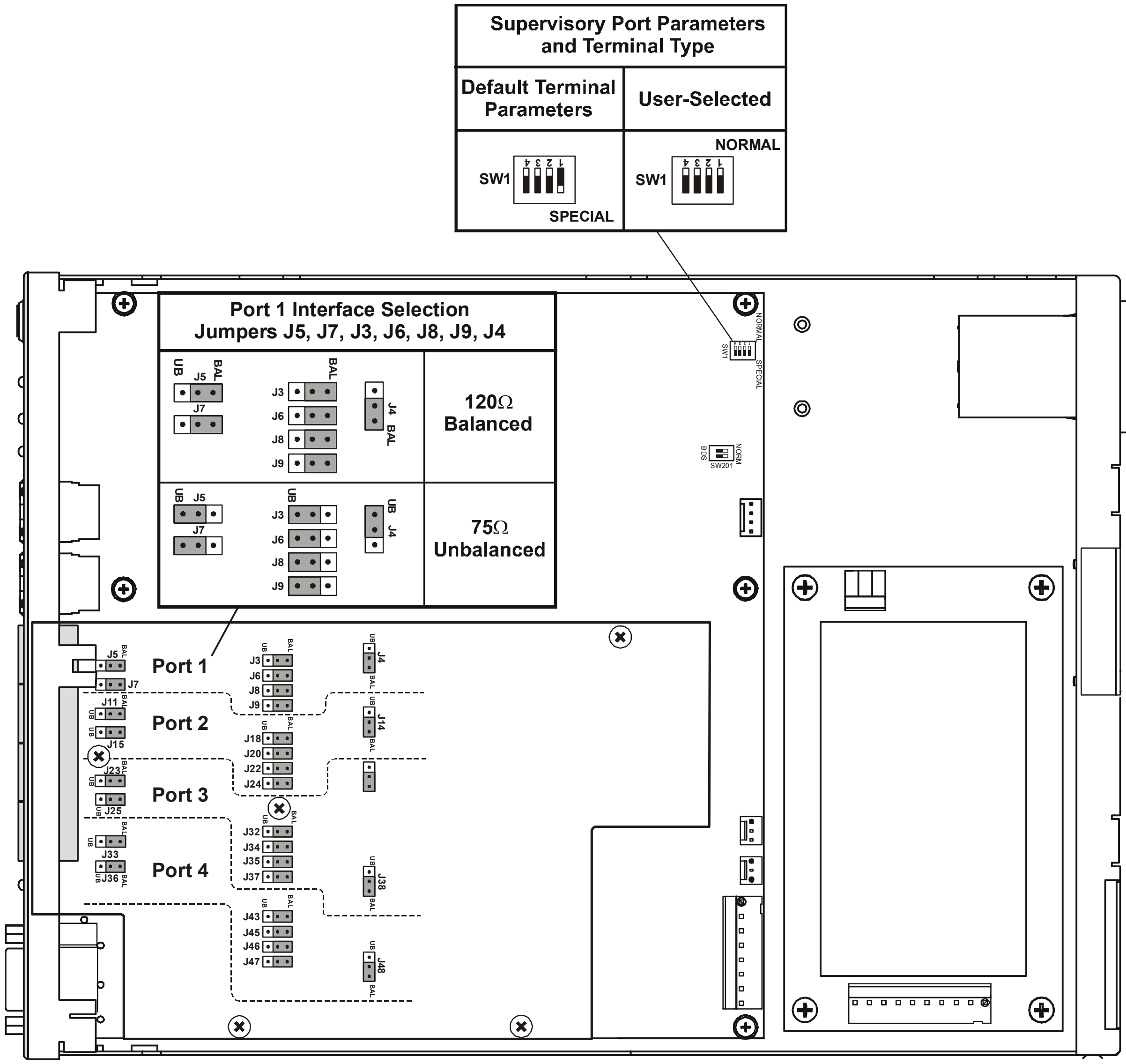


Figure 2-5. FCD-155 with PDH E1 Interfaces, Internal Settings

Initializing Supervisory Port Parameters and Terminal Type

To restore the factory-default communication parameters of the supervisory port and select the default terminal type, refer to Figure 2-5 and use the following procedure:

1. Prepare the FCD-155 for safe operation with the cover open.
2. Change the position of section 1 of the switch SW1 (see Figure 2-5) to SPECIAL. ***Leave other sections at the NORMAL position!***
3. Connect the power cable to the FCD-155 power connector, and then plug its other end into a power outlet with protective ground. The FCD-155 starts operating immediately.
4. Wait about 1 minute until the FCD-155 power-up process ends.
5. Turn the FCD-155 off by disconnecting the power cable from the power outlet, and then disconnect the end connected to the FCD-155.

6. Return the switch SW1 section identified in *Figure 2-5* to NORMAL.

Note *If you leave section 1 of the switch SW1 at SPECIAL, you cannot change the communication parameters of the supervisory port and the terminal type – they will remain at the factory-default values.*

Closing FCD-155 Cover

Caution Before closing the cover, check again the positions of the switch SW1 and make sure all its sections are set to NORMAL (see *Figure 2-5).*

1. Orient the cover as seen in *Figure 2-4.*
2. Place the cover over the case, and push forward until the cover edge touches the front panel.
3. Fasten the cover with the screws removed while opening the cover.

FCD-155 Units without PDH Interfaces

Units without PDH interfaces have one jumper that selects the supported network standard: SDH or SONET. In addition, any FCD-155 has an internal switch, SW1, which is used to restore the factory-default communication parameters and terminal type for the supervisory port.

➤ **To prepare an FCD-155 unit without PDH interfaces for installation:**

Follow the procedures given in pages *2-15* to *2-16*.

Opening FCD-155 Case

Use the procedure given (page *2-12*) above for FCD-155 units with PDH interfaces. After opening the case (see *Figure 2-4*), the only difference you will notice is that the unit does not include a PDH interface board.

Selecting the Network Interface Standards

Refer to *Figure 2-6* and identify the position of jumper J23.

Check J23 position and change as necessary to match the standard of the network (SDH or SONET) to which the FCD-155 unit will be connected.

After setting the jumpers to the prescribed positions, if it is not necessary to initialize the supervisory port communication parameters, skip to *Closing FCD-155 Cover* section (page *2-15*).

Initializing Supervisory Port Parameters and Terminal Type

To restore the factory-default communication parameters for the supervisory port and select the default terminal type, refer to *Figure 2-6* and use the procedure given on page *2-14.*

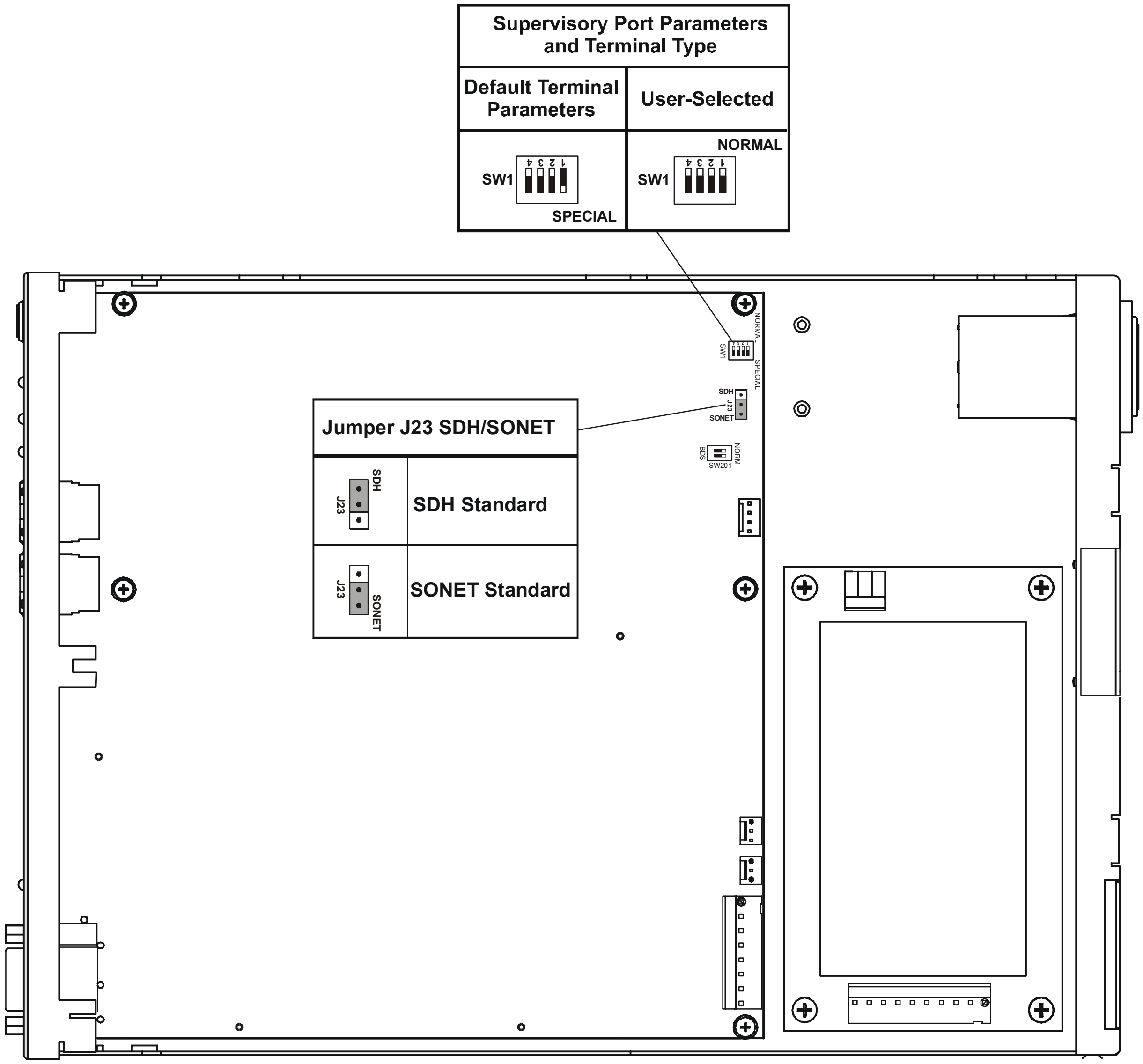


Figure 2-6. Typical FCD-155 without PDH Interfaces, Internal Settings

Closing FCD-155 Cover

Use the procedure given in the *Closing FCD-155 Cover* section (page *2-15*).

2.8 FCD-155 Installation

Caution Before installing an FCD-155 unit, review the safety precautions given in *Section 2.2*.

Installing the FCD-155 Unit

FCD-155 units are intended for installation on desktops, shelves or in 19″ racks.

For rack installation, a rack mount kit is available from RAD. Refer to the installation leaflet of the rack mount kit for detailed instructions.

Do not connect power to the enclosure before it is installed in the designated position.

Cable Connections, General

Before starting, refer to the site installation plan and identify the cables intended for connection to this FCD-155 unit.

For general information regarding the required connections, refer to *Section 2.3*.

General Optical Cable Handling Instructions

When connecting optical cables, make sure to prevent cable twisting and avoid sharp bends (unless otherwise specified by the optical cable manufacturer, the minimum fiber bending radius is 35 mm). Always leave some slack, to prevent stress.

Caution Make sure all the optical connectors are closed at all times by the appropriate protective caps, or by the mating cable connector.

Do not remove the protective cap until an optical fiber is connected to the corresponding connector, and immediately install a protective cap after a cable is disconnected.

Before installing optical cables, it is recommended to clean thoroughly their connectors using an approved cleaning kit.

Connecting FCD-155 to Ground and Power

Any interruption of the protective (grounding) conductor (inside or outside the device) or disconnecting the protective earth terminal can make the device dangerous. Intentional interruption is prohibited.

Grounding

Before switching this FCD-155 unit on and before connecting any other cable, FCD-155 protective ground terminals must be connected to protective ground. This connection is made through the DC or AC power cable.
The power cord plug should only be inserted in an outlet provided with a protective ground (earth) contact. The protective action must not be negated by using an extension cord (power cable) without a protective conductor (grounding).

Warning

Dangerous voltages may be present on the cables connected to the FCD-155:

- **Never connect cables to an FCD-155 unit if it is not properly installed and grounded. This means that its power cable must be inserted in an outlet provided with a protective ground (earth) contact before connecting any user or network (network) cable to the FCD-155.**
- **Disconnect all the cables connected to the connectors of the FCD-155 before disconnecting the FCD-155 power cable.**

Caution

FCD-155 does not have a power on/off switch, and therefore it will start operating as soon as power is applied. It is recommended to use an external power on/off switch to control the connection of power to the FCD-155. For example, the circuit breaker used to protect the supply line to the FCD-155 may also serve as the on/off switch.

Power should be supplied to FCD-155 through a power cable terminated in an appropriate plug, in accordance with the required power source.

➤ **To connect FCD-155 power and ground:**

1. Connect one end of the power cable to the FCD-155 power connector.
2. When ready to apply power, insert the plug at other end of the power cable into a socket (outlet) with a protective ground contact. The PWR indicator of the FCD-155 must light.

Connecting FCD-155 Links to Network Ports

The network connections are made in accordance with the interface type ordered for your FCD-155:

- Optical interfaces: connect to the optical connectors in the LINK 1 and LINK 2 areas (LINK 2 is an ordering option, which may not be installed on your FCD-155), or
- Electrical interfaces: connect to the LINK BNC connectors.

Each link interface has two connectors, marked TX and RX.

Optical Cable Connection Instructions

➤ **To connect optical cables to the FCD-155 network interface:**

1. For each optical interface (LINK 1 or LINK 2), refer to the site installation plan and identify the corresponding pair of cables intended for connection to the corresponding TX and RX connectors.
2. Connect the prescribed transmit fiber (connected to the receive input of the remote equipment) to the TX connector. Leave enough slack to prevent strain.
3. Connect the prescribed receive fiber (connected to the transmit output of the remote equipment) to the RX connector of the same interface. Leave enough slack to prevent strain.

Electrical Cables Connection Instructions

➤ **To connect cables to the electrical network interface:**

Connect cables to the BNC connectors, paying attention to correct connection:

- Transmit cable – to the TX connector
- Receive cable – to the RX connector.

Connecting FCD-155 PDH Ports

➤ **To connect cables to the FCD-155 E1 or T1 PDH ports:**

The connections to the E1 or T1 PDH ports (ordering option) are made to the RJ-45 connectors marked G.703 CH 1, 2, 3 and 4.

When connecting a PDH E1 port to equipment having an unbalanced interface, it is necessary to use an adapter cable terminated in two BNC connectors. RAD offers a suitable adapter cable, CBL-RJ45/2BNC/E1, with one RJ-45 plug at one end and two BNC female connectors at the other end.

Make sure to connect the proper cable to each connector, in accordance with the site installation plan.

➤ **To connect cables to the FCD-155 E3 or T3 PDH port:**

Connect cables to the E3/T3 BNC connectors, paying attention to correct connection:

- Transmit cable – to the TX connector
- Receive cable – to the RX connector.

Make sure to connect the proper cable to each connector, in accordance with the site installation plan.

Connection to LAN Ports

➤ **To connect cables to the FCD-155 LAN ports:**

The connection to the FCD-155 LAN ports is made to the RJ-45 connectors designated ETH (the number of ports, 2 or 6, depends on the ordered FCD-155 version). Use a standard (station) cable wired point-to-point for connection to any type of Ethernet port (hub or station).

Management Connections

➤ **To connect to the FCD-155 supervisory port:**

The connections to the CONTROL connector are made as follows:

- Connection to a supervision terminal with 9-pin connector: by means of a straight cable (a cable wired point-to-point).
- Connection to modem with 9-pin connector (for communication with remote supervision terminal): by means of a crossed cable.

Additional connection options are presented in *Appendix A*.

➤ **To connect to a management station, Telnet host or Web browser:**

The link to network management stations using SNMP, to Telnet hosts and/or Web browsers can be provided in two ways:

- Inband, through the network. This connection is automatically available when the network cables are connected, provided IP connectivity to the management station, Telnet host or Web browser is available through the network port.
- Through the ETH 1 or ETH 2 connector, provided IP connectivity to the management station or Telnet host is available through the LAN this port is connected to (for example, when the management station, Telnet host or Web browsers is attached to the same LAN, or connected to the same WAN).

Connecting to FCD-155 ALARMS Connector

➤ **To connect to the FCD-155 ALARMS connector:**

The connection to the ALARMS connector is made by means of a cable provided by the customer, in accordance with the specific requirements of each site. Refer to *Appendix A* for connector pin functions.

Caution To prevent damage to the internal alarm relay contacts, it is necessary to limit, by external means, the maximum current that may flow through the contacts (maximum allowed current through closed contacts is 1A). The maximum voltage across the open contacts must not exceed 60 VDC.

Chapter 3

Operation and Preliminary Configuration

3.1 Scope

This chapter provides general operating instructions and preliminary configuration instructions for FCD-155 units.

For a complete description of FCD-155 supervision utility, refer to *Appendix C*.

3.2 Operating Instructions

Turn-on Procedure

Preparations

➤ **To prepare the FCD-155 for first-time turn-on:**

1. Before first-time turn-on, check that the installation and the required cable connections have been correctly performed in accordance with *Chapter 2*.
2. To enable monitoring the FCD-155 during preliminary configuration procedures, it is recommended to connect a terminal to the CONTROL connector of the FCD-155, using a straight (point-to-point) cable.

   Any standard ASCII terminal (dumb terminal or personal computer emulating an ASCII terminal) equipped with an RS-232 communication interface can be used to control the FCD-155 operation.

   Make sure to use VT-100 terminal emulation: using a different terminal type will cause display problems, for example, the cursor will not be located at the proper location, text may appear jumbled, etc.

   To monitor the FCD-155, configure the terminal for **115.2 kbps, one start bit, eight data bits, no parity,** and **one stop bit**. Select the **full-duplex** mode, **echo off**, and **disable any type of flow control**.

Turn-on

➤ **To turn the FCD-155 on:**

Caution FCD-155 does not have a power on/off switch, and therefore it will start operating as soon as power is applied.

1. Connect the FCD-155 to power (see detailed instructions in *Chapter 2*).
2. The FCD-155 PWR indicator turns on for a few seconds, and then starts flashing. The other indicators remain off while PWR flashes.
3. Wait for the completion of power-up initialization. This takes about one minute.
4. After the power-up initialization ends, the PWR indicator must light steadily, and the other indicators display the FCD-155 status.

Log-in for Supervision and Configuration

FCD-155 supports several access levels, which determine the functions the users can perform using supervisory terminals, Telnet hosts and Web browsers. The access level is determined by the user name, and the protection against unauthorized access is conferred by passwords.

The access levels supported by FCD-155 are described in *Table 3-1.*

Table 3-1. FCD-155 Access Levels

Access Level	User Name	Menus Accessible at this Level
Administrator	**su**	All the menus
Monitoring	**user**	**Inventory, Monitoring**
Technician	**tech**	**Inventory, Monitoring, Diagnostics**

The default passwords for all the levels are identical, **1234**. The passwords can be changed at the administrator level, using **Configuration – System – Control Ports – Terminal** (see *Appendix C* for detailed instructions).

Notes
- *Pay attention to case: both the user name and the password are case-sensitive.*
- *If the administrator password has been changed and is not known, contact RAD Technical Support Department for help.*

➤ **To log in:**

1. If the terminal is configured as explained in the *Preparations* section above, after the power-up initialization ends it will display the cursor (a blinking underscore) at the home position of the screen (top left-hand corner).
2. Establish communication with the FCD-155 by pressing **<Enter>** once. You will see the log-in screen. A typical screen is shown below.

```
                                   FCD-155

  USER NAME:
  PASSWORD:








ESC - clear; & - exit                                                  1 user(s)
--------------------------------------------------------------------------------
```

Note *If the terminal is configured to different communication parameters (for example, to another rate), you may see only random strings of characters, or there will be no response to pressing* ***<Enter>****.*
Refer to Chapter 2 for instructions on reloading the default communication port parameters and terminal type using an internal switch.

3. If the FCD-155 default user name and password have not yet been changed, log in as follows:
   - Type the default user name, for example **su**, and then press **<Enter>**.
   - Type the default password, **1234**, and then press **<Enter>**.
4. If your password is accepted, you will see the FCD-155 main menu. A typical main menu screen for the administrator level is shown below. For other levels, see *Table 3-1*.

   If your log-in is not accepted, after pressing **<Enter>** the user name and password fields are cleared. In this case, try entering the user name and password again.

```
                              FCD-155

Main Menu

 1. Inventory      []>
 2. Configuration  >
 3. Monitoring     >
 4. Diagnostics    >
 5. File Utilities >






>

Please select item <1 to 5>

ESC-prev.menu; !-main menu; &-exit; @-output                       1 user(s)
-----------------------------------------------------------------------------
```

Figure 3-1. FCD-155 Main Menu (Administrator Level)

Normal Indications

Note *For a description of FCD-155 front panel indicator functions, refer to Chapter 2.*

As long as the FCD-155 is powered, its PWR indicator lights steadily.

The TST indicator must be off, unless a test has been activated on the FCD-155.

The ALM MAJ and/or MIN must be off, however they may light as long as one or more of the FCD-155 ports is not to operational equipment.

Network Interface Status Indications

If the connection to the network has not yet been established:

- The SIG LOSS indicators in the LINK area light
- The SYNC LOSS LOC indicator in the system area lights.

If the equipment at the other end of the links is operational and the links are physically connected:

- The SIG LOSS indicators in the LINK area must turn off, and one of the ON LINE indicators must light
- The SYNC LOSS LOC and REM indicators in the system area must be off.

LAN Interface Status Indications

If an FCD-155 ETH port is not yet connected to an active LAN, the corresponding LINK and ACT indicators are off.

After connecting an ETH port to an active LAN, the corresponding LINK indicator must be off. The ACT indicator of the port will flash, or appear to light steadily, in accordance with the traffic.

PDH Interface Status Indications

If an FCD-155 PDH (E1 or T1) port is not yet connected to operational equipment, the corresponding SIG LOSS indicator light.

If the equipment at the other end of the links is operational and the links are physically connected, the SIG LOSS and AIS indicators must turn off.

Turn-off

➤ **To turn the FCD-155 off:**

Disconnect its power.

3.3 Preliminary Configuration

General

This section covers the general preliminary configuration activities needed for a new FCD-155. These activities are performed by means of an ASCII terminal (or a PC running a terminal emulation program) directly connected to the CONTROL port on the FCD-155 front panel.

Terminal Characteristics

Any standard ASCII terminal (dumb terminal or personal computer emulating an ASCII terminal) equipped with an RS-232 communication interface can be used to control the FCD-155 operation.

Software

The software necessary to run the FCD-155 supervision program is contained in the FCD-155. Moreover, the FCD-155 stores all the configuration information generated or altered during the communication with the terminal: no information is stored in the terminal.

Note

For proper display of screens on terminals, you must:

1. *Select a fixed-pitch system font for the display. Use your operating system documentation to find how to select a proper font.*
2. *Configure the terminal utility to use VT-100 terminal emulation.*

Preparation for Preliminary Configuration

➤ **To start a local configuration session:**

1. Connect a terminal to the CONTROL port on the FCD-155 front panel, as described in *Section 3.2* – *Preparations*.
2. Turn the FCD-155 on as described in *Section 3.2* – *Turn-on.*
3. Log in as administrator in accordance with *Section 3.2* – *Log-in*.
4. You will see the main menu (*Figure 3-1*).

Preliminary Configuration Session

Scope

The purpose of the preliminary configuration session is to enable management access by Telnet hosts and management stations, for example, RADview. After completing the preliminary configuration session, you may also use Web and MIB browsers to manage the FCD-155.

The steps usually included in the preliminary configuration are described in *Table 3-2*. For detailed operating instructions, refer to *Appendix C*.

Table 3-2. General FCD-155 Preliminary Configuration Procedure

Step	Action	Using
1	Perform quick setup	**Configuration – Quick Setup**
2	Configure CONTROL port communication parameters and the desired terminal type	**Configuration – System – Control Ports**
3	Configure FCD-155 management agent	**Configuration – System – Management – Host IP**
4	Configure FCD-155 management access	**Configuration – System – Management – Management Access**
5	Configure specific management stations (optional)	**Configuration – System – Management – Manager List**
6	Set FCD-155 real-time clock (optional)	**Configuration – System – Date & Time Update**

3.4 FCD-155 Supervision Utility

General Terminal Operating Procedures

Screen Organization

The FCD-155 channels are managed via a simple, menu-driven utility that uses a basic terminal user interface. A typical screen is shown in *Figure 3-2*.

Each screen includes the following main (refer to *Figure 3-2* for typical appearance):

- **Header:** identifies the device being configured (FCD-155).
- **Status indicator:** the status indicator appears in the top right-hand corner.
  - **TEST** – displayed when a test is activated on the local FCD-155
  - **ALRM** – indicates that alarm conditions are present
  - **ERROR** – displayed after the user action is rejected, for example, because of an invalid selection or out-of-range value. The indicator disappears after a valid action is performed.

```
                                    FCD-155

Quick Setup

 1. Set Host IP address          ... (0.0.0.0)
 2. Set Subnet Mask              ... (0.0.0.0)
 3. Set Default Gateway          ... (0.0.0.0)
 4. Number of External LAN Ports [1 - 6]... (6)
 5. Number of External PDH Ports [1 - 4]... (4)
 6. Number Of Virtual Groups     [1 - 8]... (8)
 7. Number Of VC12's per Group   [0 - 63]... (7)
 8. Encapsulation               >   (GFP)





>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
---------------------------------------------------------------------------------
ALM  86:       RESET OCCURRED       EVENT      ON   01-01-2003 02:26:32
ALM  14:LINK1  SIGNAL LOSS          ALARM      ON   01-01-2003 02:26:33
```

Figure 3-2. Typical FCD-155 Supervision Utility Screen

- **Work area:** presents the name of the function performed by means of the selected screen (the name of the menu, submenu or parameter selection screen), followed by the items available for the current screen. Each item has its own number.

  The work area is also used to display messages that request you to confirm operations such as configuration changes, resetting, etc. or to alert that errors have been detected during the evaluation of the parameters selected by you.

  In addition, the work area includes the terminal prompt, **>:** the item number you type appears to the right of the prompt.

- **Save/Undo:** after you make a configuration change, you must either save (activate) it or undo (cancel). The indication that changes have been made is provided by the appearance of # **Save** and **% Undo** just above the bottom line:
  - To save all the pending changes, type **#**. You will be requested to confirm.
  - To undo (cancel) all the as-yet unsaved changes, type **%**.

  In either case, the # **Save** and **% Undo** indicators disappear.

- **Bottom line:** displays the keys used for navigation.
  - **ESC** returns to the previous screen (not relevant for main menu)
  - **!** returns directly to the main menu (not relevant for main menu)
  - **&** – ends the utility and displays the log-in screen again.
  - **@ –** increases the area dedicated to the display of alarms.
  - **? –** displays additional help specific to the current screen.

In addition, the number of users currently connected to the FCD-155 is shown at the right-hand corner (in *Figure 3-2*, this is 1). This number indicates the total number of active management sessions active at the instant the screen was displayed, irrespective of type (terminal, Telnet, SNMP or Web browser).

- The last two rows display the last two alarms. The alarms appear only when **Pop Alarm** is enabled using the **Configuration – System – Control Ports – Terminal – Security Timeout**.

Note *If **Pop Alarm** is enabled, it is normal to see at least the **RESET OCCURRED** event after power up. If the FCD-155 is not yet connected to operating equipment, you will also see alarms reporting loss of the STM-1/OC-3 link signal, LAN not connected, etc.*

General Procedures

➤ **How to use the terminal to perform a desired activity:**

- To select a menu item, type the corresponding line number and then press **<Enter>**. This will either:
  - Display a submenu or a parameter selection screen

    or
  - Toggle the current value of the corresponding parameter (relevant to **ENABLE**/**DISABLE** or **ON**/**OFF** selections).
- The type of response to be expected after selecting a menu item is indicated as follows:

>	Selecting that item will display a submenu or a parameter selection screen (see for example item **6** in *Figure 3-2*).
...	Selecting that item will let you type the desired value in the same line (see for example item **1** in *Figure 3-2*).
Nothing	When neither symbol is displayed, selecting that item will toggle the current selection, now shown in brackets (for example, this will change **ENABLE** to **DISABLE** or vice versa).

- When a menu does not fit on one screen (because it includes many lines), it is displayed on two consecutive pages. In this case, you will see **…(N)** after the last line on the first page and **…(P)** after the last line on the second page:
  - While on the first page, press **N** to display the second page
  - While on the second page, press **P** to return to the first page.
- When a configuration screen is organized as a table, a special set of keys is used for navigation within the table (such screens always have a **?** (help) option that displays these keys). The following keys are used for navigation within tables:

^L – scroll to the left	**^R** – scroll to the left
^D – scroll down	**^U** – scroll up
Left Arrow (**←**) – move to the left	**Right arrow** (**→**) – move to the right
Down Arrow (**↓**) –move down	**Up Arrow** (**↑**) – move up

In addition, the following shortcuts are also available:

- **Tab** – select the next cell that may be changed
- **M** – switch to the menu mode
- **G** followed by **<row number>,<col number>** – select a specific cell. For example, type **G2,5** to select the fifth cell in the second row.

- The current value of a parameter is listed within parentheses **( )**. To change a parameter value on a parameter selection screen:
  - Type the line number corresponding to the desired value, and then press **<Enter>**
  - To enter a value which requires free text entry, type in the desired string and then press **<Enter>**. Use backspace to erase the current string.

    Note that whenever applicable, the allowed range of values of a parameter is listed within square brackets **[ ]**.
- The entry is checked after pressing **<Enter>**, and is accepted only if it is valid:
  - If you make an error, for example, if you press a key not active on the current screen or select an invalid parameter value, an ERROR indicator appears in the right-hand corner. This indicator disappears as soon as you make a correct operation.
  - If you select a parameter value incompatible with the current operating state or other parameters, you will see a message that explains the error.

    For screens that may report multiple errors, you will see instead a message that offers to display the list of errors detected: if you accept, you will see a screen similar to that displayed when **Monitoring – System – Display Sanity** is selected.

  After reporting the error, the FCD-155 is ready to accept your next entry.
- When done with the current screen, press ESC to return to the previous screen, or type ! to return directly to the main menu.

On-Line versus Off-Line Configuration

FCD-155 operation is controlled by the parameters contained in its database. The database is stored in flash memory, and therefore the latest configuration parameters are always available upon power-up.

Any changes to the FCD-155 configuration are made to a backup copy of the configuration database, stored separately: therefore, you can make configuration changes and cancel them as required without affecting the traffic flow through the FCD-155. Any changes take effect (are activated) only when they are saved: in this case, the contents of the backup database are copied to the on-line database: the FCD-155 then starts using the new parameters.

For your convenience, FCD-155 offers two configuration display modes (selected by **Configuration – System – Select Configuration**):

- **On Line:** in this mode, the various configuration screens display the parameter values contained in the on-line database.

  The result is that you can see configuration changes made on the current screen, but cannot see new parameter values selected on previous screens during the current configuration session until the new values are saved (activated), because only then are the new parameter values transferred to the on-line database.

- **Off Line**: normal configuration display mode. In this mode, the parameter values displayed on the various configuration screens reflect the last selected values, even if they have not yet been saved. When the new parameter values are ready for activation, save them to the on-line database.

During configuration sessions, it is recommended to use the **Off Line** mode, which enables you to see parameter values that have been changed but not yet saved. Whenever you want to see the current (on-line) parameter values, switch to the **On Line** mode, and then return to the **Off Line** mode to continue the configuration activities.

Saving Changes to Configuration Database

As explained above, the # **Save** and **% Undo** indicators appear when changes have been made but not yet activated.

- To save all the pending changes, type **#**. You will be requested to confirm.

Note *After saving, press* ***<Enter>*** *once to establish communication with the FCD-155.*

- To undo (cancel) all the as-yet unsaved changes, type **%**.

Any unsaved changes are lost when the FCD-155 is powered down.

Ending a Terminal Configuration Session

➤ **To end the current terminal session:**

Type **&** and then press **<Enter>**.

In addition, FCD-155 will automatically terminate the current session after no activity is detected for a user-selected time-out interval (default – 3 minutes, can be increased to 10 minutes). The automatic session termination can however be disabled. The time-out option is selected using **Configuration – System – Control Ports – Terminal – Security Timeout**.

After a session is ended, it is necessary to enter again a valid user name and password to start a new session.

General Telnet Operating Procedures

Telnet (IP) Host Characteristics

Typically, the Telnet host is a PC or a UNIX station with the appropriate suite of TCP/IP protocols. To enable a Telnet host to communicate, it is necessary to configure the IP address of the FCD-155 management subsystem. After this preliminary configuration, you can use a Telnet host directly connected to ETH port 1 or 2 of the managed FCD-155 to perform additional configuration tasks.

However, after configuring the communication parameters of the FCD-155 management subsystem, you may also use a Telnet host located at a remote site, the only requirement being that IP communication be established between the LAN serving that site and the LAN connected to the FCD-155 ETH port 1 or 2.

General Procedures

Telnet uses the terminal utility screens for configuration. See *General Terminal Operating Procedures* on page *3-6*.

The only difference is that Telnet management access is possible only after performing a preliminary configuration of the FCD-155 (see *Table 3-2*).

➤ **To prepare for using Telnet:**

1. Configure the FCD-155 host IP address.

Note *When the Telnet host is not on a LAN connected to FCD-155 port ETH 1 or 2, it is necessary to configure all the IP communication parameters appearing on the* ***Configuration – System – Management – Host IP*** *screen.*

2. Enable Telnet access using **Configuration – System – Management – Management Access**.

General Procedures for Web Browsers

Web Browser Requirements

You may use any Web browser, for example, the Internet Explorer offered with the Microsoft, Inc. Windows™ operating system or equivalent, to access the FCD-155 supervision utility from any location that enables access to the FCD-155 using Internet protocols.

However, before using Web access, it is necessary to perform a preliminary configuration of the FCD-155 (see *Table 3-2*).

➤ **To prepare for using Web access:**

1. Configure the FCD-155 host IP address and all the other IP communication parameters (use the **Configuration – System – Management – Host IP** screen).
2. Enable Web browser access using **Configuration – System – Management – Management Access**.

General Procedures

Before starting, make sure you know the IP address of the FCD-155.

1. Open the Web browser.
2. Enter the IP address of the FCD-155 in the address field of the browser in the following format: **http://'IP address'** (**'IP address'** stands for the actual FCD-155 IP address)**.**
3. After entering the address, press **<Enter>** to command the browser to connect.

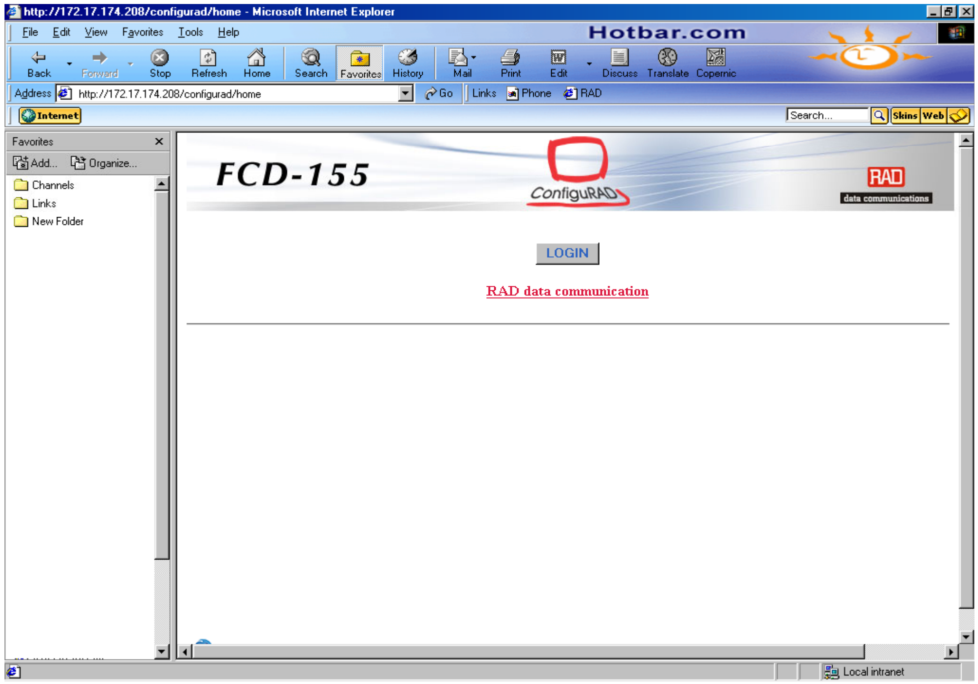


Figure 3-3. Web Browser Access, Typical Opening Window

4. After the opening window (see *Figure 3-4*) is displayed, click **LOGIN**.
5. Perform log-in as described in *Section 3.2* – *Log-in*.
6. You will see the main menu (*Figure 3-5*).
7. Use standard browser operating procedures to perform the desired activities.

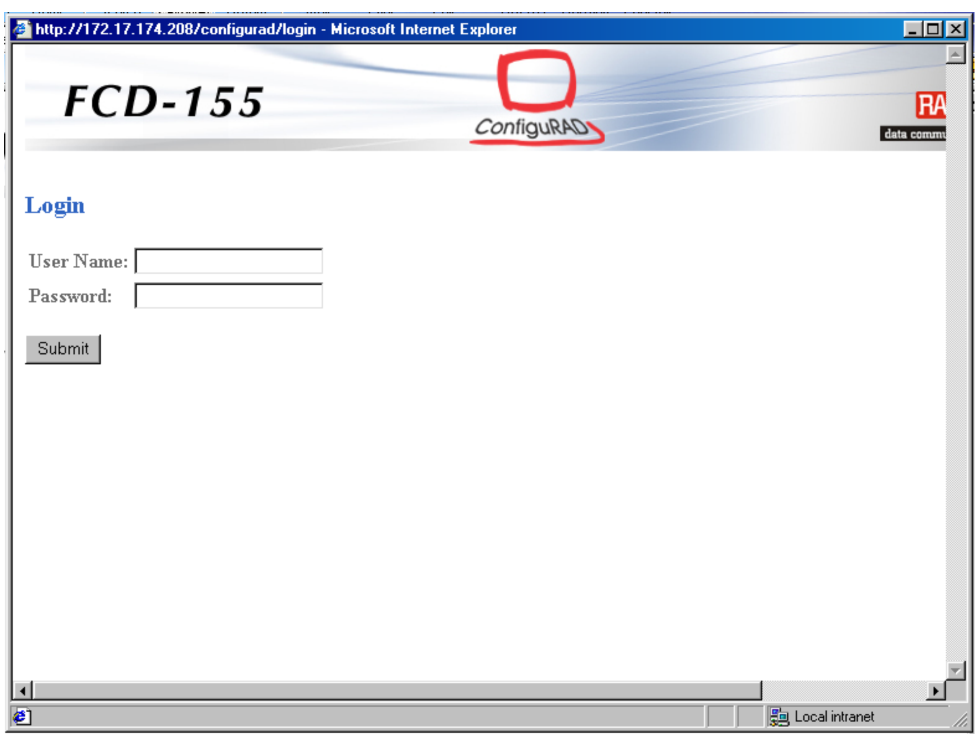


Figure 3-4. Web Browser Access, Typical Log-in Window

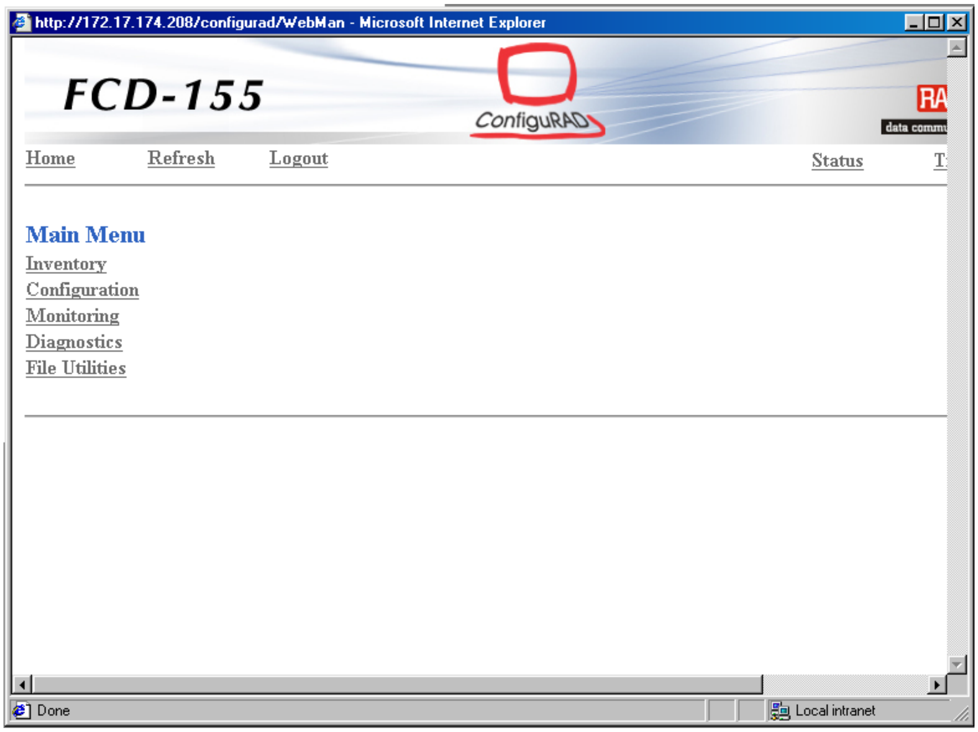


Figure 3-5. Web Browser Access, Typical Main Menu Window

3.5 Menu Structure of Supervision Utility

Figure 3-6 and *Figure 3-7* show the general menu structure of the supervision utility for the various FCD-155 versions.

You may use these figures to find the screen used for any desired activity. For additional details, refer to *Appendix C*, where a detailed view and a description of the functions and parameters available on each screen, as well as additional figures that show the detailed structure of each menu.

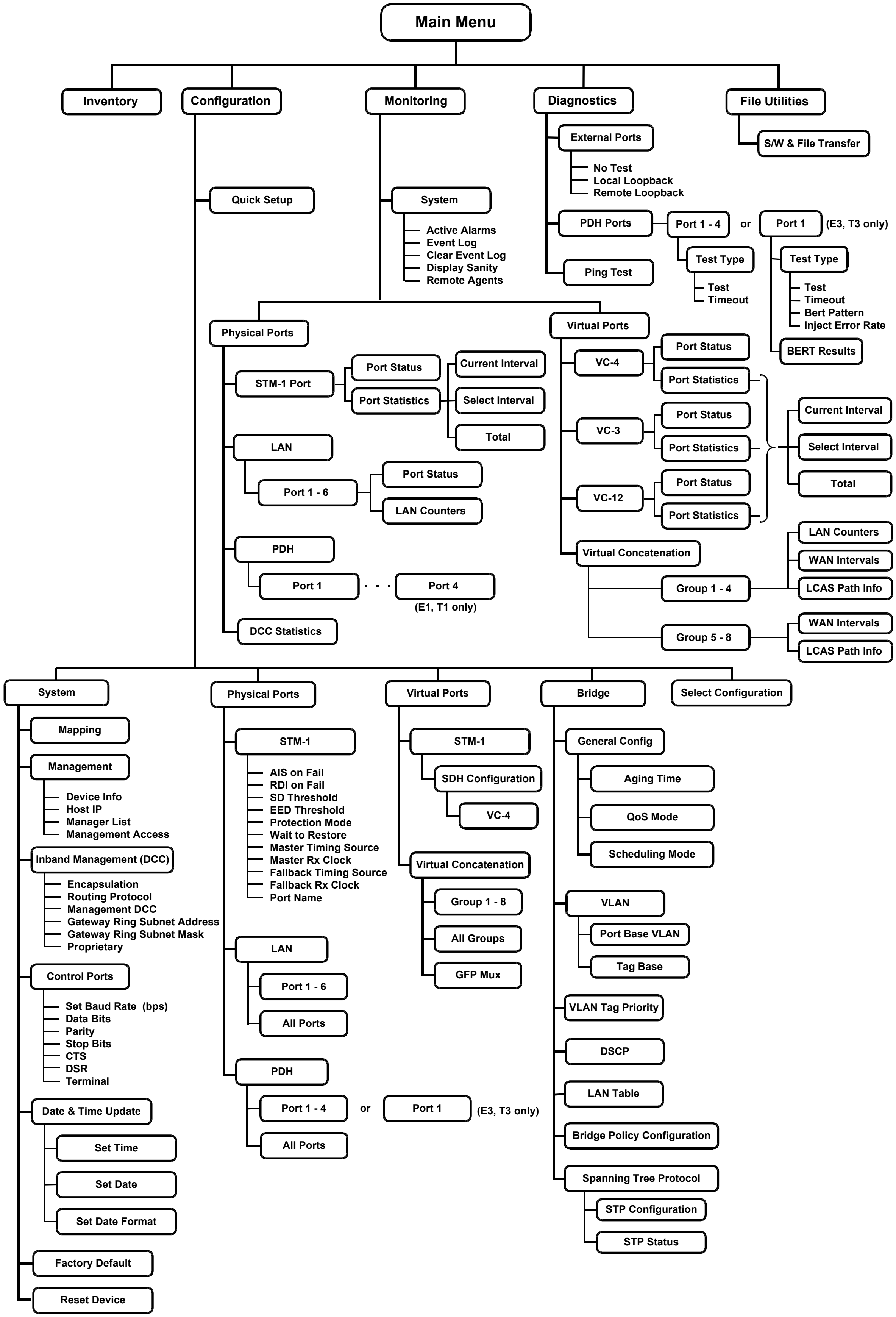


Figure 3-6. Map of Supervision Utility Menus (SDH Versions with PDH Ports)

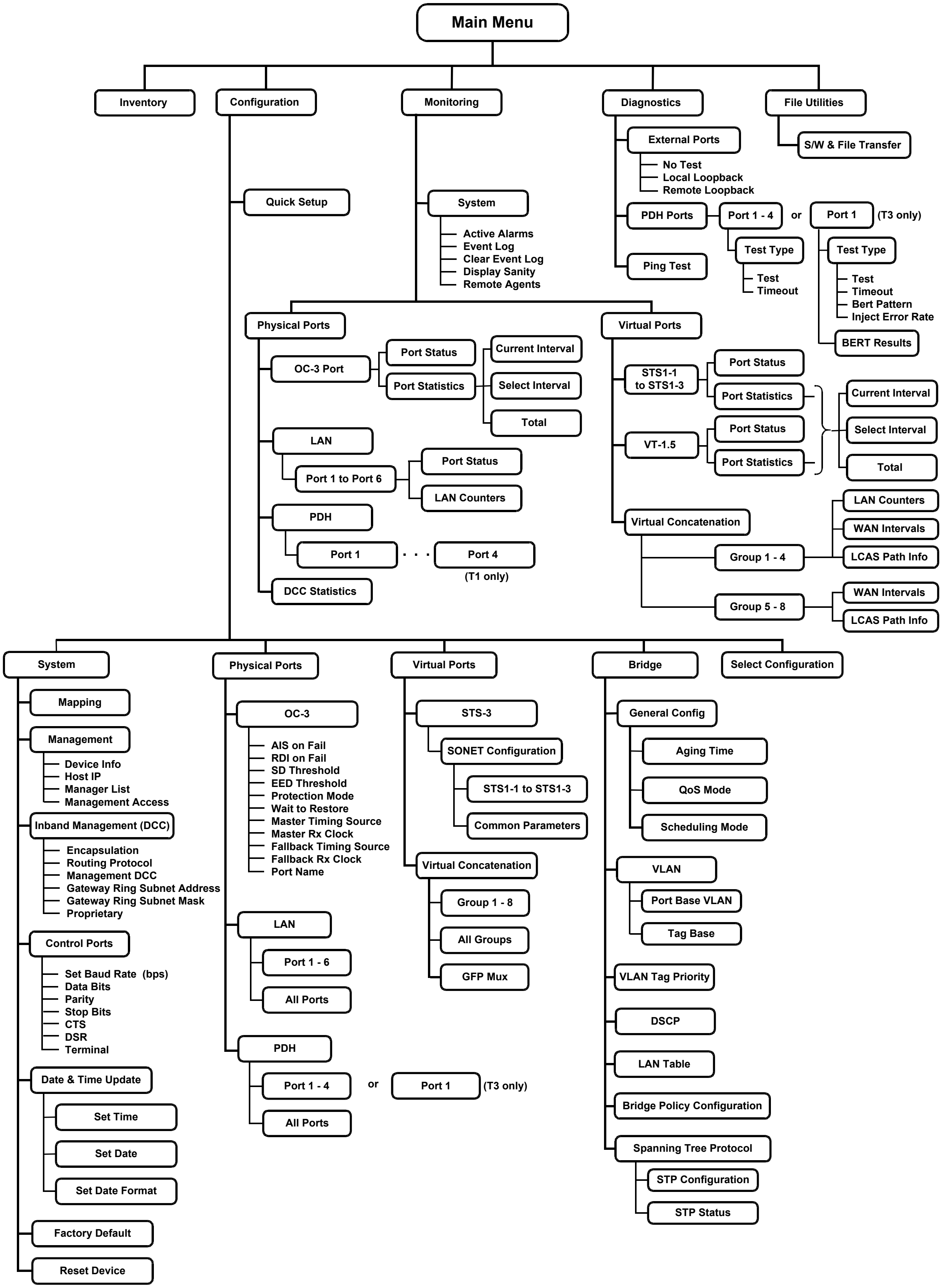


Figure 3-7. Map of Supervision Utility Menus (SONET Versions)

Chapter 4

Diagnostics

4.1 General

This Chapter describes the FCD-155 diagnostic functions. The diagnostic functions available on the FCD-155 include:

- Alarm and event collection
- Collection of performance monitoring data
- Diagnostic tests for checking transmission paths
- ***Ping*** for IP connectivity testing.

These functions can be used to identify problems in the network incorporating FCD-155 units, test the proper operation of each FCD-155 unit, and rapidly locate the cause of the fault: within the FCD-155 itself, in its connections to the network or to a user's equipment unit, or in the another network component.

4.2 Alarm Collection and Reporting

Alarm Buffer

The FCD-155 continuously monitors critical signals and signal processing functions. In case a problem is detected, the FCD-155 generates time-stamped alarm messages that cover all the events. The time stamp is provided by an internal real-time clock.

For continuous system monitoring, the user can enable automatic transmission of alarm messages through the supervisory port. Alarm messages are also automatically sent as traps to the user-specified network management stations.

Internally, the FCD-155 stores alarms in an alarm buffer. This alarm buffer can store up to 255 alarm messages, together with their time stamps. The alarm history buffer is organized as a FIFO queue, therefore after 255 alarms are written into the buffer, new alarms overwrite the oldest alarms.

When the FCD-155 is powered down, the most recent 100 alarm messages are stored in non-volatile memory, and therefore are available when the FCD-155 is powered up again. When using the terminal, a Web browser or a Telnet host, the user also can clear (delete) the alarms stored in this buffer, after reading them.

The alarms can be read on-line by the network administrator using the network management station, a Telnet host, a Web browser or a supervision terminal. The network administrator can then use the various diagnostic tests to determine the causes of the alarm messages and to return the system to normal operation.

Alarm Relays

In addition to the alarm collection and reporting facility, the FCD-155 has two alarm relays with floating change-over contacts: one relay for indicating the presence of major alarms and the other for minor alarms. Each relay changes state whenever the first alarm is detected, and returns to its normal state when all the alarms of the corresponding severity disappear.

The relay contacts can be used to report internal system alarms to outside indicators, e.g., lights, buzzers, bells, etc. located on a bay alarm or remote monitoring panel.

4.3 Performance Monitoring

The FCD-155 enables collecting transmission performance data for its various ports. The collected data enables the system administrator to monitor the transmission performance, and thus the quality of service provided to users, for statistical purposes.

In addition, when problems are reported by users served by FCD-155, the collected data can be used for diagnostic purposes, because it can help identify the source of the problem.

Performance monitoring data are collected for the following objects:

- Physical ports: network (SDH or SONET) ports, DCC (when used), LAN ports and PDH ports.
- Virtual SDH/SONET ports: each VC-4 or STS-3, VC-3 or STS-1 and VC-11/VC-12 or VT-1.5 port, and each virtual concatenation group for LAN traffic.

The data is continuously collected during equipment operation.

For SDH/SONET and PDH ports, the basic performance data is calculated for each second, and accumulated and displayed over a 15-minute (900 second) interval. The data accumulated within the last 24-hour interval is also stored and displayed.

For complete details on the parameters displayed by the various commands, refer to *Appendix C*.

4.4 Diagnostic Tests

General

Diagnostics tests are available at the following levels:

- **External network port (STM-1 or OC-3) level**. The loopbacks that can be activated at this level include:
  - Local loopback, can be used to locate problems within the FCD-155.
  - Remote loopback, can be used for end-to-end testing of SDH/SONET signal paths.
- **PDH port/link level**. The loopbacks that can be activated at this level include:
  - Local loopbacks, can be used to locate problems within the PDH processing sections of the local FCD-155 and in the connections of the local user's equipment to the local FCD-155 PDH ports. The user can select whether to send or not AIS in the upstream direction while the loopback is activated.
  - Remote loopbacks, can be used for end-to-end testing of PDH signal paths, including the link to the remote equipment and the connections of the remote user's equipment to the PDH ports. The user can select whether to send or not AIS in the downstream direction while the loopback is activated.
  - For T1 PDH ports only: the user can enable the activation of the network-initiated line loopback (LLB), and can also cause each port to send the LLB activation/deactivation code, to control the LLB on the equipment connected to the port.
  - For E3 and T3 PDH ports only: BER testing, enables checking the transmission performance of the connection to the local user's equipment connected to the port.

  For units with multiple PDH interfaces, the user can select the PDH port(s) on which the loopbacks are activated, and can also specify a time-out interval after which the loopback is automatically deactivated.
- ***Ping*** for IP connectivity testing.

External Network Port Loopbacks

Caution All the network-side loopbacks are traffic-affecting.

Note *Figure 4-1 and Figure 4-2 show an FCD-155 version with 4 PDH interfaces and 2 LAN ports. However, the information presented below for external network ports is applicable to all the FCD-155 versions.*

Local Loopback on External Network Port

The signal paths during a local loopback on the external network port are shown in *Figure 4-1*.

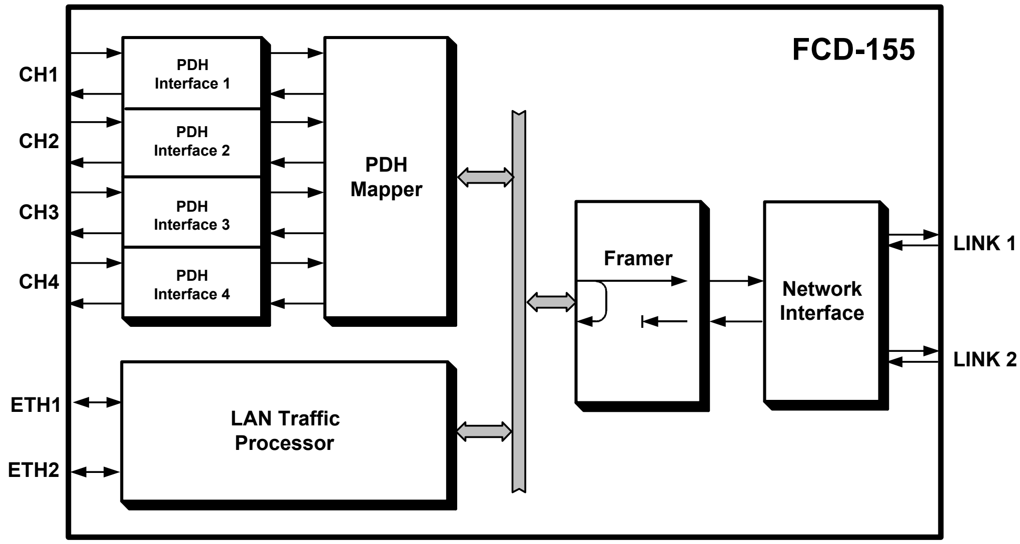


Figure 4-1. External Network Port Local Loopback, Signal Paths

As shown in *Figure 4-1*, the local loopback is activated within the SDH/SONET framer, and therefore the loopback signal paths do not include the network interface.

When the local loopback is activated, the framed SDH or SONET transmit signal is returned to the input of the framer receive path at a point just before the output to the network interface subsystem. To provide a keep-alive signal to the transmission equipment serving the link under test while the loopback is activated, the transmit signal is also sent to the network interface.

While the loopback is activated, the local FCD-155 must receive its own signal, and thus it must be frame-synchronized (its SYNC LOSS LOC and REM indicators must be off), irrespective of the state of the network interface indicators.

In addition, each FCD-155 local port (LAN or PDH) must also receive its own signal:

- For PDH ports, the result is that the port interfaces are synchronized and do not generate alarm indications. Moreover, the signal received from the user's equipment connected to the port is also returned to the user.
- LAN ports, however, cannot receive their own signal: this usually causes a permanent state of collision while the local loopback is activated. Therefore, if the FCD-155 LAN ports are connected to active LANs, ***disconnect the cables from the FCD-155 LAN ports before activating the local loopback and reconnect them after the loopback is deactivated***.

Remote Loopback on External Network Port

The signal paths during a remote loopback on the external network port are shown in *Figure 4-2*.

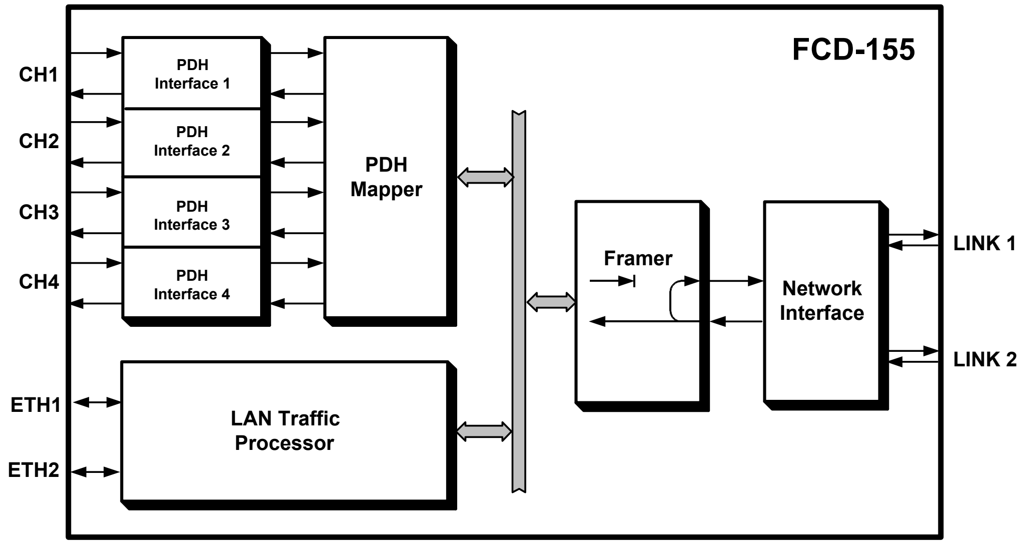


Figure 4-2. External Port Remote Loopback, Signal Paths

As shown in *Figure 4-2*, the remote loopback is activated within the network side circuits of the SDH/SONET framer, and therefore the loopback signal paths includes all the circuits of the local FCD-155 network interface but very few of the framer circuits.

When the remote loopback is activated, the received SDH or SONET signal is processed by the receive path of the local FCD-155 network interface and then returned to the input of the transmit path of the network interface subsystem through the framer. Therefore, when the remote loopback is activated on the external port, the receive signal is returned to the remote unit.

To correct transmission distortions, the returned signal is regenerated by the corresponding port circuits.

The remote loopback should be activated only after checking that the remote unit operates normally with external port local loopback. In this case, the remote unit must receive its own signal, and thus it must be frame-synchronized. The effect on the ports of the remote unit is mixed, as explained above for the local loopback.

The received signal remains connected to the receive path of the local FCD-155. Assuming that the local FCD-155 unit also operates normally when its external port local loopback is activated, then if the port status of the active network port is normal, the local FCD-155 should be synchronized (its SYNC LOSS LOC indicator should be off).

The remote loopback should be activated at only one of the two FCD-155 connected in a link, otherwise an unstable situation occurs.

E1 and T1 PDH Port Loopbacks

Notes

1. *Figure 4-3 through Figure 4-8 show an FCD-155 version with 4 PDH interfaces and 2 LAN ports, and the loopback is shown on PDH port 1. However, the information presented below for E1 and T1 ports is applicable to all the FCD-155 versions with E1 and T1 ports.*
2. *Unless specifically noted otherwise, the PDH loopbacks can be activated on both on E1 and T1 ports.*

Local Loopback on E1/T1 PDH Port

The signal paths during a local loopback on an E1 or T1 PDH port are shown in *Figure 4-3*.

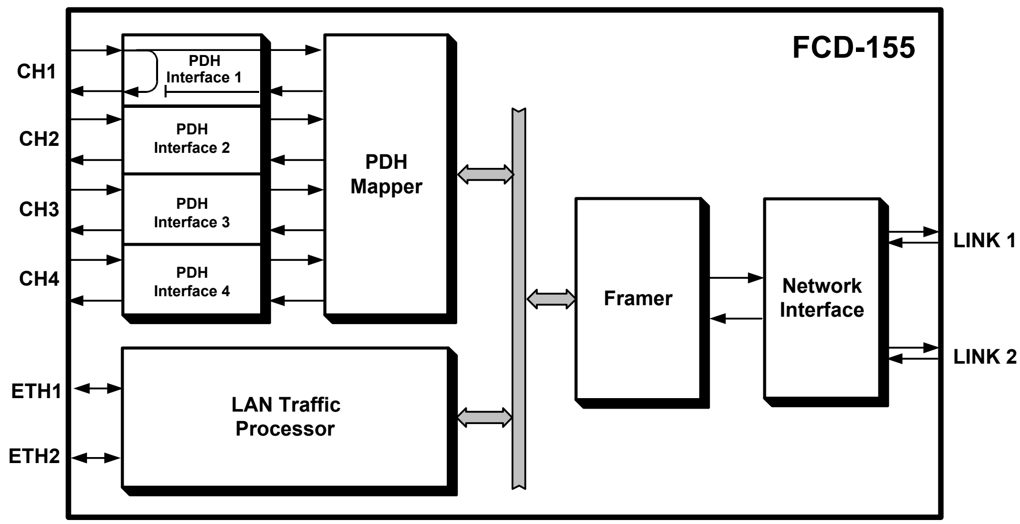


Figure 4-3. Local Loopback on E1/T1 PDH Port, Signal Paths

As shown in *Figure 4-3*, when a local loopback is activated on a PDH port, the line interface unit (LIU) of that port returns the transmit signal received from the local user's equipment connected to the tested port via the receive path of the same port.

While the loopback is activated, the signal received from the remote PDH port is ignored. The signal received from the local user's equipment remains connected to the PDH mapper and it is transmitted to the remote PDH port.

To ensure that the user's equipment is capable of providing a good signal, the local loopback should be activated on the FCD-155 port only after checking that the user's equipment operates normally while its own local loopback is activated.

In this case, if the SIG LOSS indicator of the tested port is off, then while the local loopback is activated on the local FCD-155 port, the user's equipment must receive its own signal, and thus it must be frame-synchronized.

Local Loopback with Upstream AIS on E1/T1 PDH Port

The local PDH port loopback with upstream AIS (shown in *Figure 4-4)* is similar to the local PDH port loopback described above, except that the user's signal is disconnected from the link, and is replaced by an AIS signal.

This enables the remote equipment connected to the tested port to recognize an abnormal condition (in this case, a test loopback).

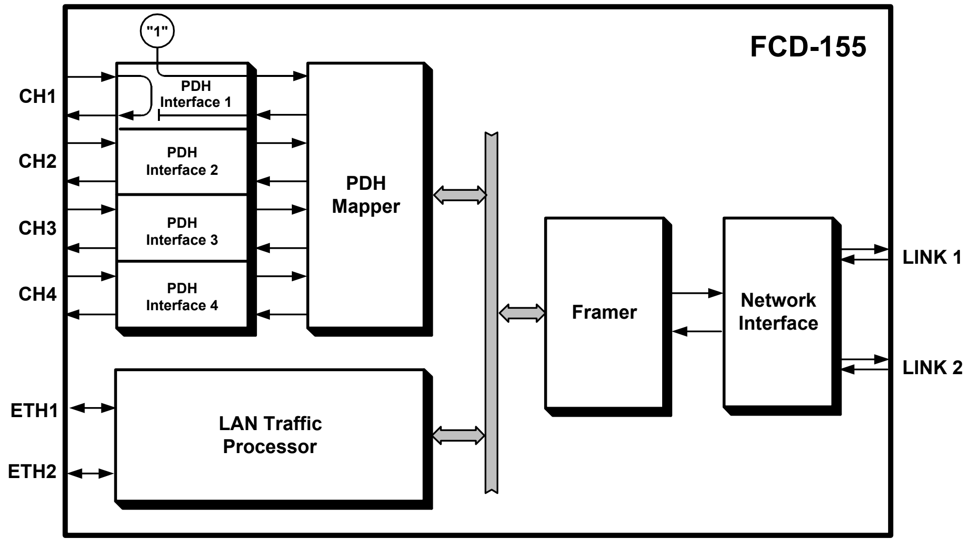


Figure 4-4. Local Loopback with Upstream AIS on E1/T1 PDH Port, Signal Paths

Remote Loopback on E1/T1 PDH Port

The signal paths during a remote PDH port loopback are shown in *Figure 4-5*.

As shown in *Figure 4-5*, when a remote loopback is activated on a local PDH port, the recovered and regenerated receive signal of the port is returned by the port LIU to the input of the port transmit path at a point just before the output to the external interface, and is sent to the remote PDH port through the SDH/SONET link.

While the loopback is activated, the transmit signal arriving from the local user's equipment is ignored.

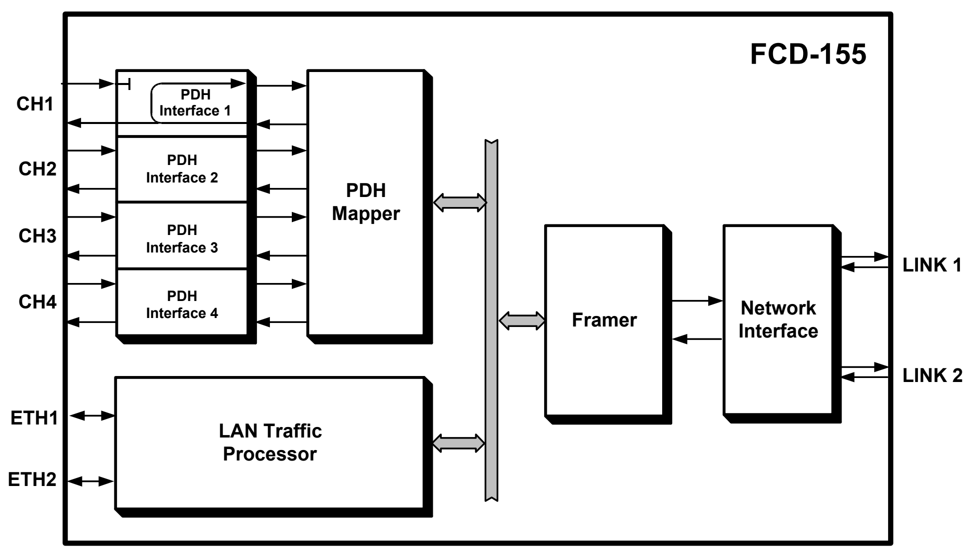


Figure 4-5. Remote Loopback on E1/T1 PDH Port, Signal Paths

To ensure that the remote equipment is capable of providing a good signal, the remote loopback should be activated on the local FCD-155 PDH port only after checking that the remote PDH port operates normally while its own local loopback is activated.

With the remote loopback is activated on the local FCD-155 port, the user's equipment connected to the remote PDH port must receive its own signal, and thus it must be frame-synchronized. The local user's equipment, however, does not receive any signal from the FCD-155 port and it will report loss of incoming signal.

Remote Loopback with Downstream AIS on E1/T1 PDH Port

The signal paths during a remote loopback on E1/T1 PDH port with downstream AIS are shown in *Figure 4-6*.

As shown in *Figure 4-6*, this loopback is similar to the remote loopback explained above, except that an AIS signal is sent toward the local user's equipment, to enable detecting the abnormal condition caused by the loopback. Nevertheless, the local user's equipment will lose frame synchronization.

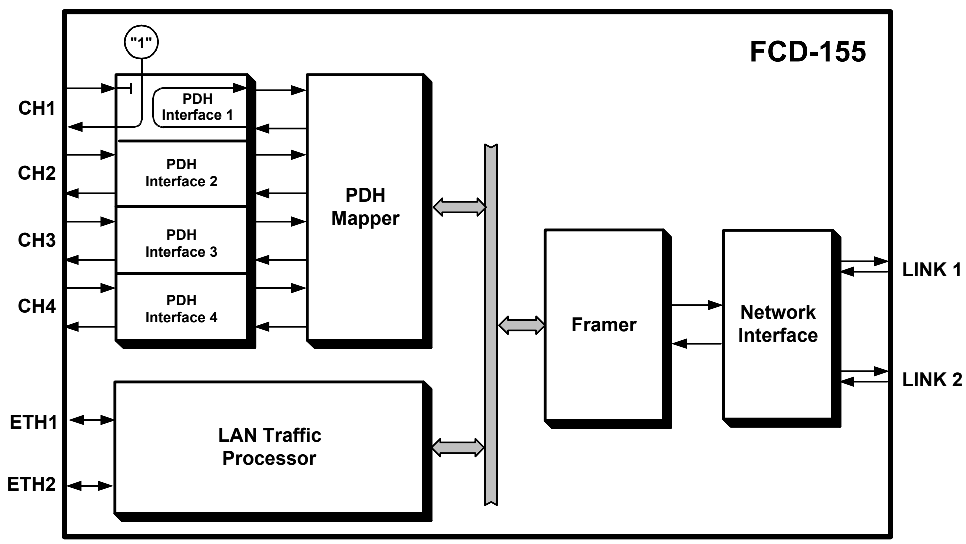


Figure 4-6. Remote Loopback with Downstream AIS on E1/T1 PDH Port, Signal Paths

Network-Activated Line Loopback (LLB) (T1 Ports only)

The network line loopback is a local loopback activated within the line interface (LIU) of a T1 port, after receiving the appropriate code from the network. The loopback signal paths are shown in *Figure 4-7*.

The network line loopback is activated when the port interface detects the continuous transmission of the repeating sequence 10000..... for at least 5 seconds, and is deactivated by the transmission of the sequence 100...... for at least 5 seconds.

The dedicated detector used to detect the LLB activation code can be disabled by the user: in this case, the port will not respond to LLB activation commands. As shown in *Figure 4-7*, when a network-activated line loopback is activated on a T1

PDH port, the LIU of that port returns the transmit signal received from the local user's equipment via the receive path of the same port.

While the loopback is activated, the signal received from the remote PDH port is ignored. The signal received from the local user's equipment remains connected to the PDH mapper and it is transmitted to the remote PDH port.

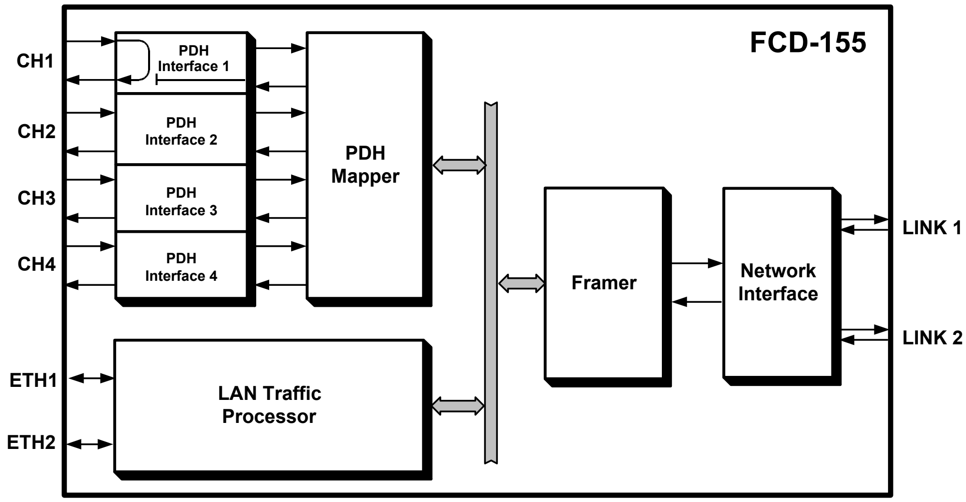


Figure 4-7. Network-Activated Line Loopback (LLB), Signal Paths

Activating LLB on the User's Equipment (T1 Ports only)

The user can request the activation of an LLB on the user's equipment connected to a T1 PDH port, by sending the appropriate activation code. The signal paths for this test are shown in *Figure 4-8*.

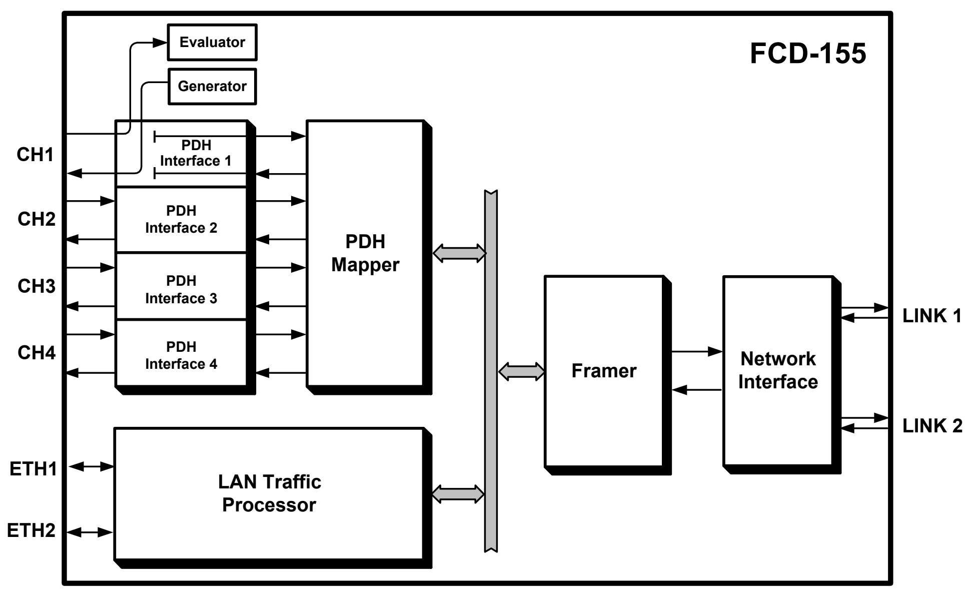


Figure 4-8. Activating LLB on the User's Equipment, Signal Paths

The activation of the LLB is detected by an evaluator, which detects the return of the LLB activation sequence. After the LLB is activated, the user's equipment starts returning the signal sent by the PDH port.

The LLB is cancelled by sending the deactivation sequence.

E3 and T3 PDH Port Loopbacks and Tests

Note *Figure 4-9 through Figure 4-11 show an FCD-155 version with E3 or T3 interfaces and 2 LAN ports. However, the information presented below for E3 and T3 ports is applicable to all the FCD-155 versions with E3 and T3 ports.*

Local Loopback on E3/T3 PDH Port

The signal paths during a local loopback on a local E3/T3 PDH port are shown in *Figure 4-9*.

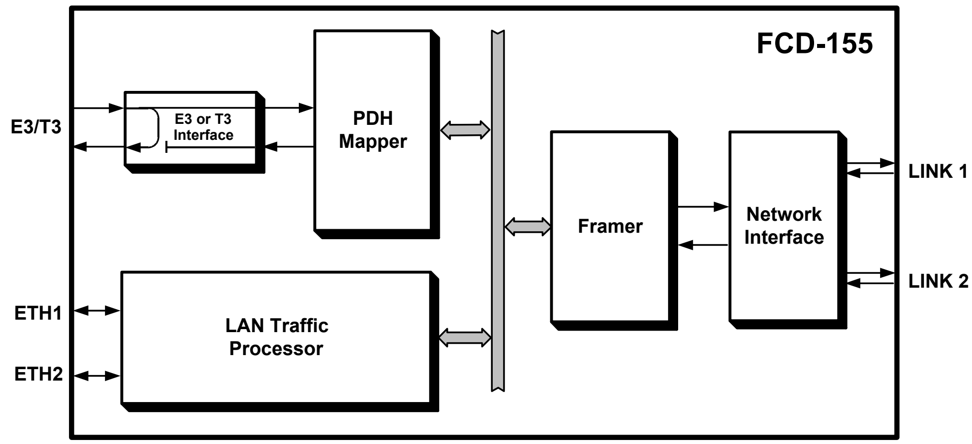


Figure 4-9. Local Loopback on E3/T3 PDH Port, Signal Paths

The signal paths while the local loopback on a local E3/T3 PDH port is activated are similar to those described on page 4-6 for the local loopback on E1/T1 PDH port.

Remote Loopback on E3/T3 PDH Port

The signal paths during a remote loopback on E3/T3 PDH port are shown in *Figure 4-10*.

The signal paths while the remote loopback on a remote E3/T3 PDH port is activated are similar to those described on page 4-7 for the remote loopback on E1/T1 PDH port.

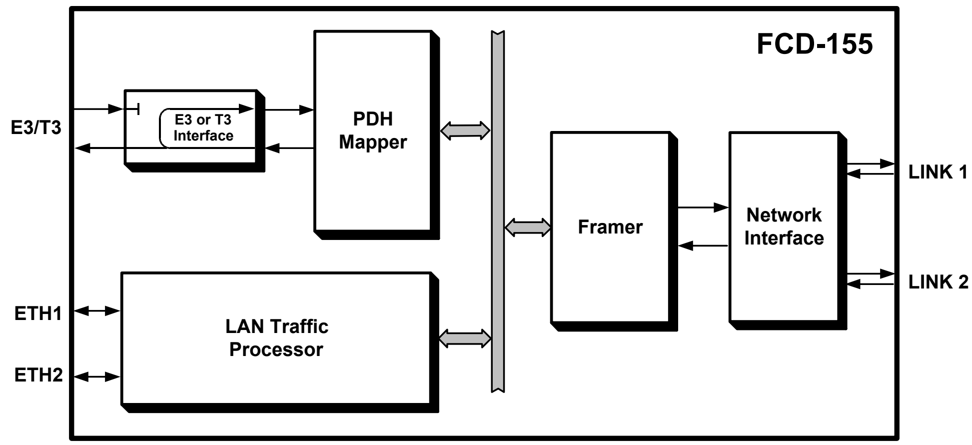


Figure 4-10. Remote Loopback on E3/T3 PDH Port, Signal Paths

Remote Loopback with Downstream AIS on E3/T3 PDH Port

The signal paths during a remote loopback on E3/T3 PDH port with downstream AIS are shown in *Figure 4-11*.

As shown in *Figure 4-11*, this loopback is similar to the remote loopback, except that an AIS signal is sent toward the local user's equipment, to enable detecting the abnormal condition caused by the loopback. Nevertheless, the local user's equipment will lose frame synchronization.

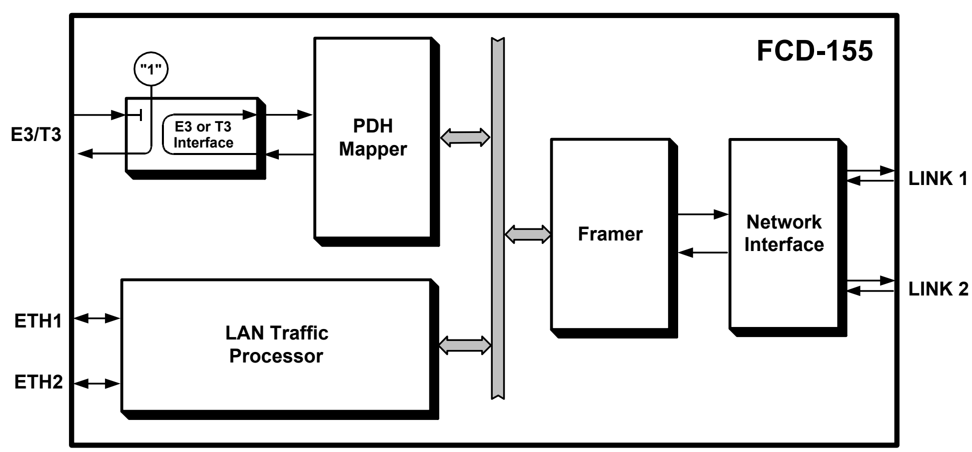


Figure 4-11. Remote Loopback with Downstream AIS on E3/T3 PDH Port, Signal Paths

Local BERT on E3/T3 PDH Port

The BERT is used to check for proper data transmission between the equipment connected to the local E3 or T3 PDH port, and obtain a qualitative evaluation of data transmission without using external test equipment.

During this test, the local BER system is connected to the local E3 or T3 port interface, as shown in *Figure 4-12*.

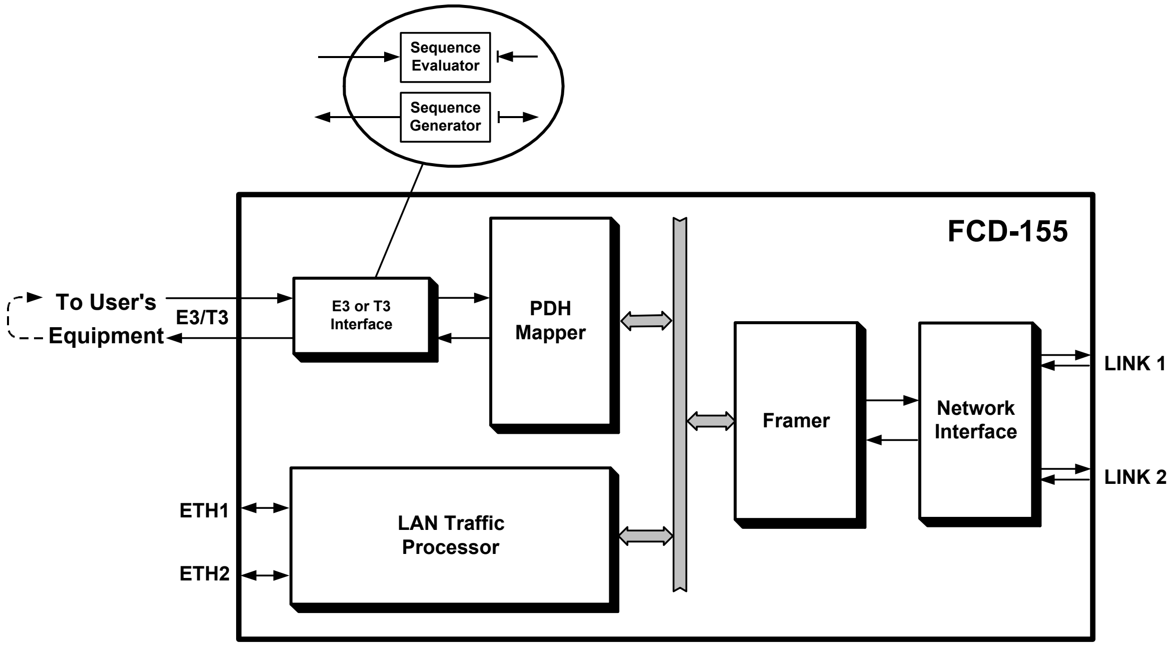


Figure 4-12. Local BERT Test on E3/T3 PDH Port, Signal Paths

The bit error rate is measured by applying the test sequence generated by the generator to the input of the transmit path.

The user can select the appropriate test sequence: pseudo-random sequences per ITU-T Rec. O.151 (2^{15}-1 or 2^{23}-1), or alternating marks and spaces (ALT).

The transmitted data is returned by means of a loopback somewhere along the data path (e.g., by activating a remote loopback on the user's equipment) to the receive path of the E3 or T3 port, and routed to the test sequence evaluator.

The evaluator compares the received data, bit by bit, to the original data and detects any difference (bit error). The total number of errors detected are counted and can be displayed to the user.

The user can read the accumulated test time and the number of errors detected since the test has been started, together with information on the current status of the test sequence evaluator (synchronized or not).

To check that the tested path is "live", the user can inject errors at a desired (calibrated) rate in the test sequence. The available error injects rates are 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6} and 10^{-7}; single errors can also be injected. Theses errors will be counted are regular errors by the test sequence evaluator, thereby increasing the user's confidence in the measured performance.

Ping Function

The FCD-155 supports the **ping** function, part of the ICMP protocol. This function enables checking IP connectivity between an FCD-155 LAN port and a remote IP host.

When sending pings from the FCD-155, the ping source address is the LAN port address defined by the user.

The user can select the destination IP address, the number of pings and the size of the packets being transmitted, together with a time-out interval that automatically ends the test in case the test cannot be completed before the time-out expires (for example, because no response is received from the destination, or the transmission of the requested number of pings has not been completed).

The FCD-155 enables the user to monitor the progress of pinging.

After completing the test, the FCD-155 displays two types of information:

- Packet transmission reliability: the total number of ping packets sent and the number received, and their difference (the number of lost packets)
- Transmission delays: minimum and maximum round trip times, and the average round trip time for the received packets.

4.5 Troubleshooting

In case a problem occurs, check the displayed alarm messages and refer to *Appendix B* for their interpretation.

If the problem cannot be corrected by performing the actions listed in *Appendix B*, refer to *Table 4-1.* Identify the trouble symptoms and perform the actions listed under "Corrective Measures" in the order given, until the problem is corrected.

Table 4-1. Troubleshooting Chart

No.	Trouble Symptoms	Probable Cause	Corrective Measures
1	FCD-155 does not turn on	1. No power	Check that the power cable is properly connected to the FCD-155 POWER connector. Check that both ends of the power cable are properly connected. Check that power is available at the power outlet serving the FCD-155.
		2. Blown fuse	For an AC-powered FCD-155, check and if necessary replace its fuse (located in a compartment within its power connector: a replacement fuse is stored within the same compartment). Replace FCD-155 if fuse blows again
		3. Defective FCD-155	Replace FCD-155

Table 4-1. Troubleshooting Chart (Cont.)

No.	Trouble Symptoms	Probable Cause	Corrective Measures
2	The SIG LOSS indicator of an external (network link) port of the local FCD-155 lights	1. Cable connection problems	Check for proper connections of the cables to the FCD-155 LINK TX and RX connector. Repeat check at the remote equipment.
		2. Incorrect setting of internal SDH/SONET jumper, J23	Chend and if necessary correct the setting of jumper J23. Refer to Chapter 2 for instructions
		3. External problem	Activate the external port remote loopback at the local FCD-155. If the remote equipment connected to the FCD-155 network port does not receive its own signal, check its operation and replace if necessary
		4. Defective FCD-155	Replace FCD-155
3	The SYNC LOSS LOC indicator of the local FCD-155 lights	1. Loss of link signal	Check that the ACTIVE indicator of a network link port lights and that its SIG LOSS indicator is off. If not, refer to No. 2 above
		2. External problem	Activate the external port local loopback at the local FCD-155. If the SYNC LOSS LOC indicator turns off, the problem is external
		3. Defective FCD-155	Replace FCD-155
4	The AIS indicator of a PDH port of the local FCD-155 lights	1. External problem	The remote equipment sends AIS. If problem persists, request troubleshooting of the remote equipment
5	The SYNC LOSS indicator of a PDH port of the local FCD-155 lights, while the SYNC LOSS LOC indicator of the local FCD-155 is off	1. External problem	Activate the PDH port local loopback at the local FCD-155. If the SYNC LOSS LOC indicator turns off, the problem is external
		2. Defective FCD-155	Replace FCD-155 if defective
6	The equipment attached to the LAN port of the local FCD-155 cannot communicate with other equipment on the WAN	1. Configuration problems	Check the LAN port configuration, and the other FCD-155 parameters that affect processing of LAN traffic
		2. Problem in connection to LAN	Check that the LINK indicator of the corresponding LAN port lights. If not, check for proper connection of the cable to the LAN port. Also check that at least one node is active on the LAN, and that the hub or Ethernet switch to which the FCD-155 LAN port is connected is powered
		3. External problem	Check the external equipment (for example, default gateway and other routers) that process the traffic coming from the local FCD-155 LAN port
		4. Defective FCD-155	Replace FCD-155

Appendix A
Connection Data

A.1 CONTROL Connector

The CONTROL connector is a 9-pin D-type female connector with RS-232 asynchronous DCE interface, intended for direct connection to a supervision terminal. The connector is wired in accordance with *Table A-1*.

The connections to the CONTROL connector are made as follows:

- Connection to supervision terminal with 9-pin connector: by means of a straight cable (a cable wired point-to-point).
- Connection to supervision terminal with 25-pin connector: by means of a cable wired in accordance with *Figure A-1*.
- Connection to modem with 25-pin connector (for communication with remote supervision terminal): by means of a cable wired in accordance with *Figure A-1*
- Connection to modem with 9-pin connector (for communication with remote supervision terminal): by means of a crossed cable wired in accordance with *Figure A-2*.

Table A-1. CONTROL Connector Wiring

Pin	Function	Direction
1	Data Carrier Detect (DCD)	From FCD-155
2	Receive Data (RD)	From FCD-155
3	Transmit Data (TD)	To FCD-155
4	Data Terminal Ready (DTR)	To FCD-155
5	Signal Ground (SIG)	Common reference and DC power supply ground
6	Data Set Ready (DSR)	From FCD-155
7	Request to Send (RTS)	To FCD-155
8	Clear to Send (CTS)	From FCD-155
9	Ring Indicator (RI)	To FCD-155

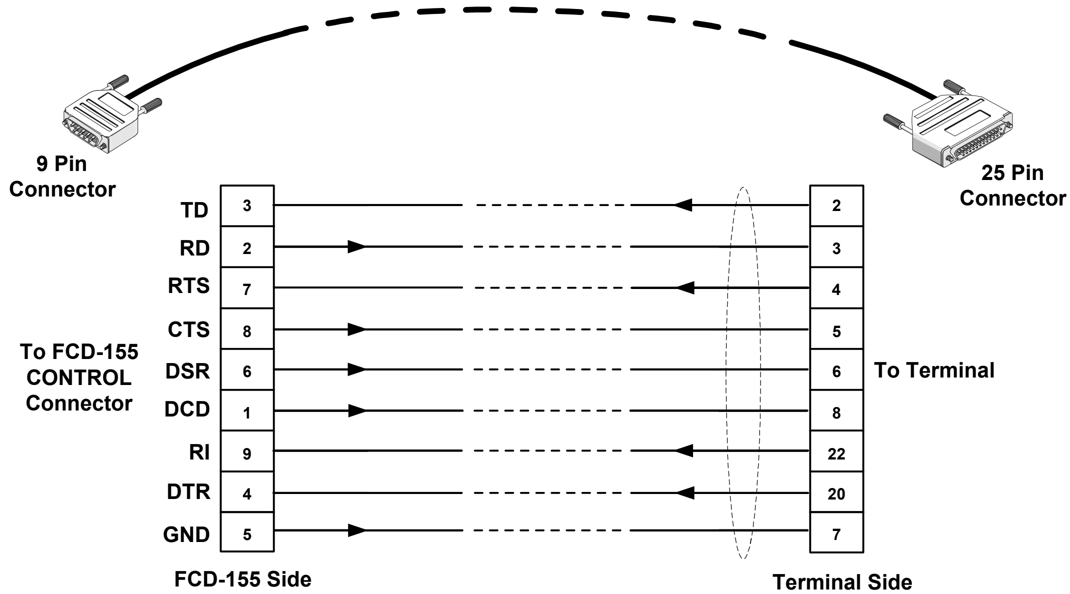


Figure A-1. 25-Pin Terminal Cable Wiring - Connection to CONTROL Connector

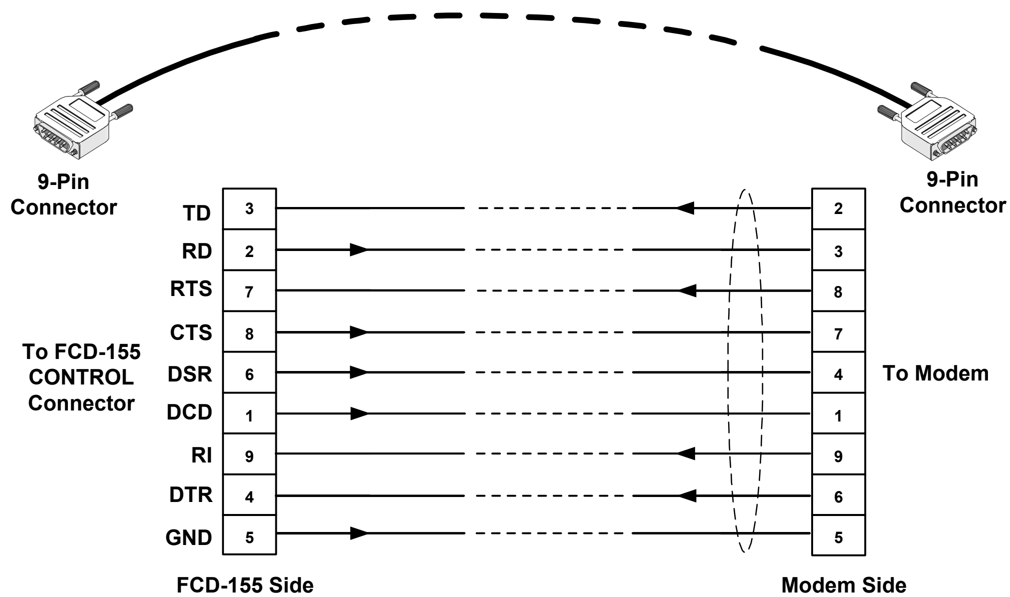


Figure A-2. 9-Pin Crossed Cable Wiring - Connection to CONTROL Connector

A.2 ALARM Connector

The ALARM connector is a 9-pin D-type female connector which provides connections to the major and minor relay contacts, and a +5V auxiliary supply voltage output. Connector pin functions are listed in *Table A-2*.

Caution To prevent damage to relay contacts, it is necessary to limit, by external means, the maximum current that may flow through the contacts (maximum allowed current through closed contacts is 1 A). The maximum voltage across the open contacts must not exceed 60 VDC.

Table A-2. ALARM Connector Wiring

Pin	Function
1	Major alarm relay – normally-open (NO) contact
2	Major alarm relay – normally-closed (NC) contact
3	Minor alarm relay – center contact
4	+5V auxiliary output through 270 Ω series resistor
5	Ground
6	Major alarm relay – center contact
7	Minor alarm relay – normally-open (NO) contact
8	Minor alarm relay – normally- closed (NC) contact
9	Not connected

A.3 ETH Connector

Each FCD-155 ETH port has a 10/100BaseTX Ethernet hub interface terminated in an RJ-45 connector. The port can be connected by a standard station cable to any type of 10/100BaseTX Ethernet port.

Connector pin functions are listed in *Table A-3*.

Table A-3. ETH Interface Connector, Pin Functions

Pin	Designation	Function
1	RxD+	Receive Data output, + wire
2	RxD–	Receive Data output, – wire
3	TxD+	Transmit Data input, + wire
4, 5	–	Not connected
6	TxD–	Transmit Data input, – wire
7, 8	–	Not connected

A.4 SDH/SONET Interface Connectors

The FCD-155 can be ordered with optical or electrical network ports.

- **Optical Ports**. Each port has two optical connectors, one for the receive input and the other for the transmit output. The FCD-155 can be ordered with ST, FC/PC or SC connectors, for use over single-mode or multimode fibers.
- **Electrical Ports**. The FCD-155 version with electrical STM-1/EC-3 port has two 75 Ω BNC connectors, one for the receive input and the other for the transmit output.

A.5 PDH Interface Connectors

E1 Ports

Each PDH E1 port has one RJ-45 eight-pin connector, used for both the balanced and unbalanced interface. Connector wiring is listed in *Table A-4*.

In general, when using the unbalanced interface, it is necessary to connect the RJ-45 connector to equipment using BNC connectors. RAD offers a suitable adapter cable, CBL-RJ45/2BNC/E1, with one RJ-45 plug at one end and two BNC male connectors at the other end.

Table A-4. RJ-45 E1 PDH Port Connector, Pin Functions

Pin	Function – Balanced Interface	Function – Unbalanced Interface
1	Receive Data input (ring)	Ground
2	Receive Data input (tip)	Receive Data input
3	Not connected	Not connected
4	Transmit Data output (ring)	Ground
5	Transmit Data output (tip)	Transmit Data output
6	Not connected	Not connected
7, 8	Not connected	Not connected

T1 Ports

Each PDH T1 port has one RJ-45 eight-pin connector. Connector wiring is as listed in the *Function – Balanced Interface* column of *Table A-4*.

E3 and T3 Ports

The FCD-155 E3 and T3 ports have two 75 Ω BNC connectors, one for the receive input and the other for the transmit output.

A.6 Power Connectors

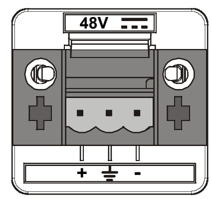
AC Power Connector

AC-powered FCD-155 units have one standard IEC three-pin socket, with integral fuse, for connection to AC power.

DC Power Connector

DC-powered FCD-155 units have one three-pin DC power connector for connection of the -48 VDC supply voltage. Connector wiring is listed in *Table A-5*, together with a view of the connector itself.

Table A-5. DC Connector Pin Functions

Pin	Function	
1	Ground (0V)	
2	Chassis (Frame) Ground	
3	-48 VDC	

Appendix B

Alarm & Error ("Sanity") Messages

B.1 Alarm Messages

Table B-1 lists the alarm messages generated by the FCD-155, specifies their type (event or state), and explains their interpretation. The alarm messages are listed in ascending order of their codes.

Note

A state alarm is an alarm that is in the ON state while a certain condition is present, and automatically changes to OFF when the condition is no longer present. This type of alarm cannot be cleared (removed from the alarm buffer) while it is in the ON state.
An event alarm is an alarm that records the occurrence of an event. This type of alarm can be cleared at any time.

Table B-1. Alarm Messages

Code	Message	Default Severity	Interpretation
1	POWER SUPPLY FAILURE	Major	Replace the FCD-155 unit
2	ALARM BUFFER OVERFLOW	Major	The alarm buffer of the FCD-155 has been filled up and the new alarms are overwriting the oldest alarms (the first alarms stored in the alarm buffer). Read the alarms and then clear the buffer
3	HARDWARE FAILURE	Major	A technical failure has been detected. Replace the FCD-155
4	Reserved for future use	–	
5	CLOCK CHANGE TO FALLBACK	Event	The FCD-155 has switched to the fallback clock source
6	CLOCK CHANGE TO INTERNAL	Event	The FCD-155 has switched to the internal clock source
7	CLOCK CHANGE TO MASTER	Event	The FCD-155 has returned to the master clock source
8, 9	Reserved for future use		
10	SP-PAR SWITCH IS ON	Minor	Section 1 of the internal switch SW1 is set to the OPEN position. This caused reloading of the default communication parameters for the supervisory terminal port (CONTROL connector). If it is no longer necessary to enforce the default parameter values, return this switch section to the CLOSE position
11, 12, 13	Reserved for future use		
14	SIGNAL LOSS	Major	The specified port of the FCD-155 reports loss of input signal
15 to 22	Reserved for future use		

Table B-1. Alarm Messages (Cont.)

Code	Message	Default Severity	Interpretation
23	LINE CODE VIOLATION	Event	A bipolar violation (BPV) error has been detected by the specified PDH port. This alarm may also appear when an excessive zeroes error occurs (more than three consecutive error occurs (more than three consecutive error occurs (more than three consecutive “0”s for an E1 port, or more than 8 consecutive “0”s for a T1 port using B8ZS zero suppression)
24	AIS OCCURRED	Major	The Alarm Indication Signal (AIS), a framed "all ones" sequence, is received by the specified PDH port, VC or VT. AIS on an E1 link is declared when less than three spaces (i.e., 2 or less zeros) are detected in a sequence of 512 bits (256 μsec window). AIS on a T1 link (blue alarm) is declared when less than five spaces are detected in a 3-msec window
25	Reserved for future use		
26	UPPER LAYER CRITICAL ALARM	Major	A critical error has occurred on an upper layer for the specified VC-4/STS-1
27	SIGNAL LABEL UNEQUIPPED	Major	The specified VC-4/STS-1 receives an ***unequipped*** signal label. This alarm condition may often occur while a new trail is being prepared
28	PATH TRACE ID MISMATCH	Major	The path trace ID received from the far end does not match the expected ID for the specified VC-4/STS-1. This may indicate incorrect routing of the corresponding VC-4/STS-1
29	SIGNAL LABEL MISMATCH	Major	A signal label mismatch has been detected for the specified VC-4/STS-1. This may indicate incorrect routing of the corresponding VC. This alarm condition may often occur while a new trail is being prepared
30	FAR END RECEIVE FAIL(RDI)	Major	A FERF indication is received from the remote equipment through the specified STM-1 link
31	LOSS OF POINTER	Major	The STM loss of pointer (LOP) state is entered when N consecutive invalid pointers are received by the specified VC-4, STS-1, VC-3, VC-12, or VT-1.5 (N = 8, 9, ...). LOP state is exited when 3 equal valid pointers or 3 consecutive AIS indications are received
32	SIGNAL DEGRADED ERROR	Minor	The bit error rate of the received STM-1, VC-4, STS-1, VC-3, VC-12, or VT-1.5 signal exceeds the preset signal-degraded threshold
33	EXCESSIVE BIT ERROR RATE	Major	The bit error rate of the received STM-1, VC-4, STS-1, VC-3, VC-12, or VT-1.5 signal exceeds the preset excessive BER threshold
34	FRAME LOSS	Major	The loss of frame (LOF) state is entered when an out-of-frame (OOF) state exists at the specified STM-1 port for up to 3 ms. If OOFs are intermittent, the timer is not reset to zero until an in-frame state persists continuously for 0.25 ms. The LOF state is exited when an in-frame state exists continuously for 1 to 3 ms
35 to 37	Reserved for future use		
38	STM OUT OF FRAME	Major	Loss of frame alignment for the specified STM-1 port

Table B-1. Alarm Messages (Cont.)

Code	Message	Default Severity	Interpretation
39 to 48	Reserved for future use		
49	FAN FAILURE	Minor	The internal cooling fan of the FCD-155 does not operate. Replace the unit as soon as possible
50	LAN NOT CONNECTED	Major	The LAN interface of the FCD-155 is not connected to an active Ethernet LAN (this alarm will not appear when the corresponding LAN port is disabled by the user). Check the connection between the LAN port and the LAN media, or hub port, and make sure that the LAN equipment is operating normally, and at least one station is active on the LAN
51	TX LCAS ADD NORMAL TIMEOUT	Event	When using LCAS, time-out occurred when waiting to transmit an ADD NORMAL message
52	RX LOSS OF SEQUENCE	Event	The sequence number of a received LCAS message is out of sequence
53	RX LCAS CRC ERROR	Event	A CRC error has been detected in an LCAS message
54	Reserved for future use		
55	MAC RX FIFO BUFFER OVERFLOW	Event	The rate of frame ingress from the local LAN port exceeds the egress rate toward the WAN (through the STM-1 link)
56	MAC TX FIFO BUFFER OVERFLOW	Event	The rate of frame ingress from the WAN (from the STM-1 link) exceeds the egress rate to the local LAN.
57 to 59	Reserved for future use		
60	RX LAPS FRAME MISMATCH	Minor	This alarm indicates a mismatch in the ADDRESS, CONTROL or SAPI fields of the received LAPS/LAPF frame. This alarm is set (ON) after the detection of any one of these errors and is reset (OFF) after the user displays the statistics counters.
61, 62	Reserved for future use		
63	NUMBER OF VCS UNDER MINIMUM	Major	When using LCAS, the number of active VCs per group can be changed dynamically. This alarm is set (ON) when the number of active VCs drops below the minimum configured value (defined in the Group Configuration menu), and is reset (OFF) after the failed VCs recover, or the configuration is changed
64	GFP OUT OF SYNC	Major	When GFP is used, the GFP multiplexer subsystem serving the LAN interface has lost synchronization to the incoming stream
65	DIFFERENTIAL DELAY EXCEEDS MAX	Major	This alarm is set (ON) when the differential delay exceeds the maximum delay configured in the database for the corresponding virtual group, and is reset (OFF) when the delay decreases below the maximum value.
66	TX LCAS ADD ACK TIMEOUT	Event	When using LCAS, time-out occurred when waiting to transmit an ADD ACK message
67	TX LCAS REMOVE ACK TIMEOUT	Event	When using LCAS, time-out occurred when waiting to transmit a REMOVE ACK message
68	GFP CHANNEL ID MISMATCH	Event	The GFP multiplexer subsystem detects an unexpected channel number (CID)
69	CLOCK FAIL	Major	The internal clock oscillator serving the STM-1 ports failed
70	LOSS OF MULTIFRAME	Major	Loss of multiframe synchronization occurred on the specified VC-4/STS-1/VC-3/VC-12/VT-1.5
71	Reserved for future use		
72	SOFTWARE DOWNLOAD FAIL	Event	Software downloading to the FCD-155 failed. Repeat the process

Table B-1. Alarm Messages (Cont.)

Code	Message	Default Severity	Interpretation
73	NETWORK LINE LOOPBACK	Major	The alarm is set (ON) when a network-initiated line loopback has been activated on the corresponding port. This loopback cannot be disconnected by the system management. The alarm is reset (OFF) after the loopback is deactivated
74	SOFTWARE DOWNLOAD	Event	Software is being downloaded to the FCD-155
75	FLIP OCCURRED	Event	Flipping to the alternate path occurred
76	REMOTE FAIL INDICATION	Major	A remote fail indication has been received by the specified VC-3, VC-12 or VT1.5.
77	CLK IS DIFF FROM MASTER CLK	Major	The FCD-155 is not using the clock source selected as master source. This indicates a major failure in the source which provided the master clock source
78	UPPER LAYER CRITICAL ALARM	Minor	A critical error has occurred on an upper layer for the specified VC-3, VC-12 or VT1.5.
79	SIGNAL LABEL UNEQUIPPED	Minor	The specified VC-3, VC-12 or VT1.5 receives an ***unequipped*** signal label. This alarm condition may often occur while a new trail is being prepared
80	PATH TRACE ID MISMATCH	Minor	The path trace ID received from the far end for the specified VC-3, VC-12 or VT1.5 does not match the expected value. This may indicate incorrect routing of the corresponding VC or VT.
81	SIGNAL LABEL MISMATCH	Minor	A signal label mismatch has been detected for the specified VC-3, VC-12 or VT1.5. This may indicate incorrect routing of the corresponding VC or VT. This alarm condition may often occur while a new trail is being prepared
82	FAR END RECEIVE FAIL(RDI)	Minor	A FERF indication is received through the specified VC-4/STS-1/VC-3/VC-12/VT-1.5
83	SIGNAL DEGRADED ERROR	Minor	The bit error rate of the signal received through the specified VC or VT exceeds the preset signal-degraded threshold
84	EXCESSIVE BIT ERROR RATE	Minor	The bit error rate of the signal received through the specified VC or VT exceeds the preset excessive BER threshold
85	JITTER BUFFER OVERFLOW	Event	The specified jitter buffer reports an overflow event
86	RESET OCCURRED	Event	The FCD-155 has been reset
87	IP ADDRESS NOT ALLOCATED	Major	No IP address has been allocated by the DHCP server

B.2 Configuration Error ("Sanity") Messages

Table B-2 lists the configuration error messages generated by FCD-155 and explains their interpretation (these messages are often referred to as "sanity errors", because they are detected by the so-called sanity check automatically performed to confirm correct selection of parameters during FCD-155 configuration).

The messages are listed in ascending order of their codes.

Table B-2. Error Messages

Code	Syntax	Meaning
0	LAST CHANGES NEED RESET	You must reset the FCD-155 for the new configuration changes to take effect.
1	Reserved for future use	N/A
2	INVALID MASTER CLOCK SOURCE	The port selected as master clock source is not connected. Check and correct as required
3	INVALID FALLBACK CLOCK SOURCE	The port selected as fallback clock source is not connected. Check and correct as required
4 to 10	Reserved for future use	N/A
11	BAD SUBNET MASK	The IP subnet mask must be compatible with the associated IP address, and must comprise a consecutive string of "1", followed by a string of "0"
12	BAD GATEWAY	The IP address of the gateway must be within the IP subnet of the IP port using the gateway
13 to 19	Reserved for future use	N/A
20	ASSIGNMENT/NUMBER OF VC MISMATCH	Mapping problem: the number of VCs or VTs assigned to a group or port during mapping does not match the number specified during the definition of the corresponding group
21 to 27	Reserved for future use	N/A
28	WRONG GFP MUX SCHEDULING	When using GFP multiplexing, the sum of the assigned bandwidth percentages defined for the GFP group members exceeds 100%
29	MUXED GROUP MUST USE GFP ENCAPSULATION	When using GFP multiplexing, all the groups defined as GFP mux members must be configured to use GFP encapsulation
30	CID MUST BE DIFFERENT IN GFP MUX MEMBERS	When using GFP multiplexing, each group configured as a GFP mux member must be assigned a unique channel ID (CID) number
31	SECONDARY MUX MEMBER MUST NOT BE MAPPED	When using GFP multiplexing, only the group defined as primary group can be mapped. It is not allowed to map groups configured as secondary GFP mux members
32	MUX GROUP CAN'T BE DUPLICATED	The specified group is configured as a member of more than one GFP mux group
33	VCAT NUMBER OF VCS LIMITED TO 64	The maximum number of virtual containers (VC-11, VC-12, or VT-1.5) that can be used by one virtually concatenated group cannot exceed 64

Appendix C

FCD-155 Supervision Utility

C.1 Introduction

Scope

This Appendix provides a detailed description of the FCD-155 supervision utility. This description explains the purpose and parameters that can be selected on each screen, and provides instructions for using each screen.

The information appearing in this Appendix assumes that you are familiar with the general operating instructions for the supervision utility, as described in *Chapter 3*. If necessary, review *Section 3.2* and *Section 3.4*.

You may also want to review *Appendix E*, which describes the FCD-155 operating environment and provides technical background information on the various FCD-155 configuration parameters.

Organization

The information is organized in accordance with the structure of the main menu:

- Main menu structure – *Section C.2*
- **Inventory** menu – *Section C.3*
- **Configuration** menu – *Sections C.4* to *C.53*
- **Monitoring** menu – *Sections C.54* to *C.74*
- **Diagnostics** menu – *Section C.75 to C.79*
- **File Utilities** menu – *Section C.80, C.81*.

To help you find the relevant material, each screen has its own section, and the section title includes both the screen name and the name of the menu under which the screen is located.

Navigation Maps

Figure C-1 and *Figure C-2* show navigation maps of all the supervision utility screens for the main FCD-155 versions.

Note

- *Unless specifically stated otherwise, all the parameter values appearing in the following screens are given for illustration purposes only, and do not reflect recommended values.*
- *Unless specifically stated otherwise, all the screens and menus appearing in this Appendix cover FCD-155 versions with 6 LAN ports. These versions have 8 virtually concatenated groups, versus 4 on FCD-155 units with 2 LAN ports.*
- *Most screens appearing in this Appendix show the parameters used when the FCD-155 is configured for operation in SDH networks. Since the parameters for SONET networks are similar, many specific SONET screen examples are omitted. If necessary, refer to the figures showing the SDH and SONET multiplexing hierarchies given in Appendix E to interpret comparable terms.*

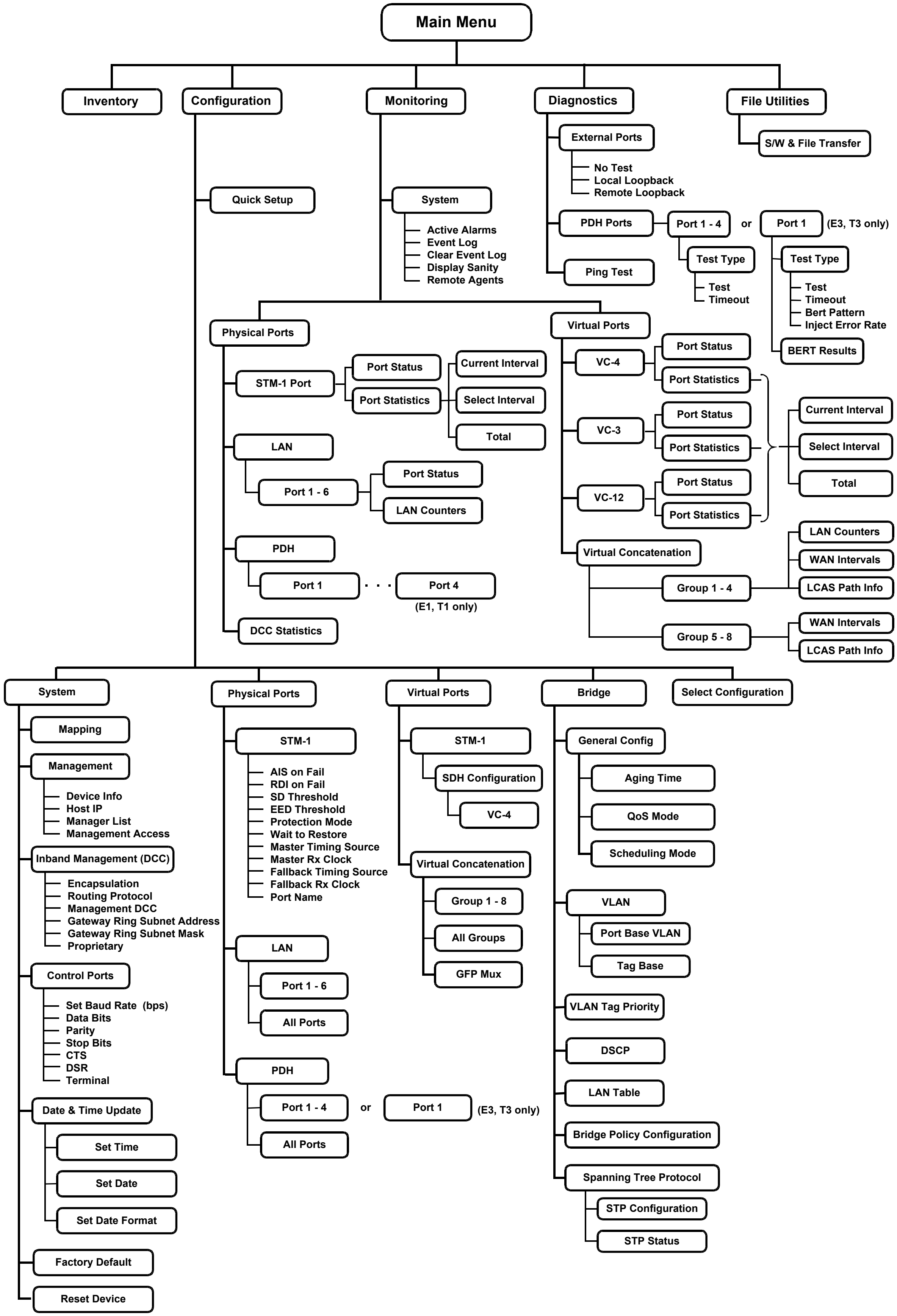


Figure C-1. Map of Supervision Utility Menus (SDH Versions with PDH Ports)

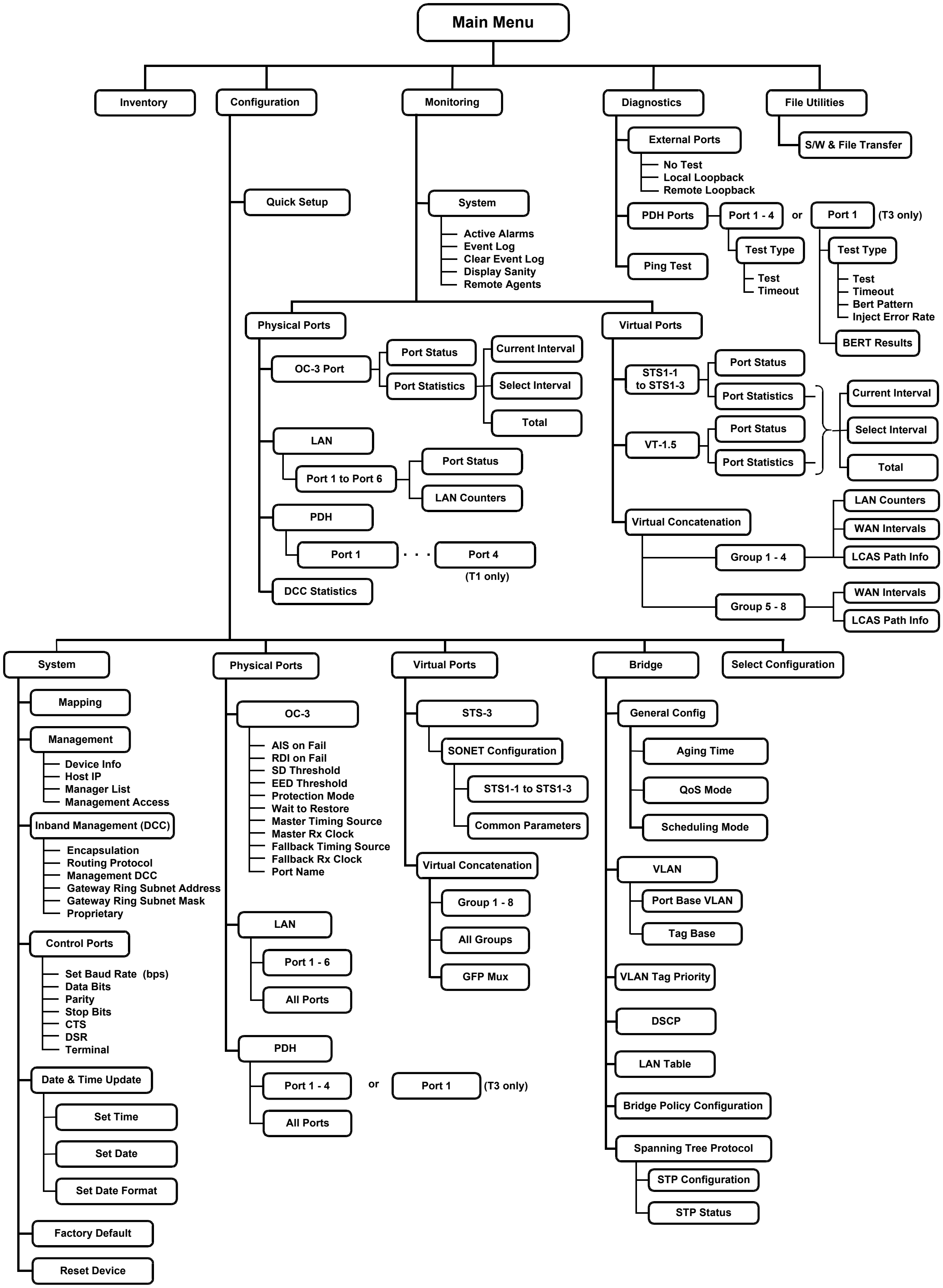


Figure C-2. Map of Supervision Utility Menus (SONET Versions)

C.2 Main Menu

Figure C-3 shows the structure of the main menu.

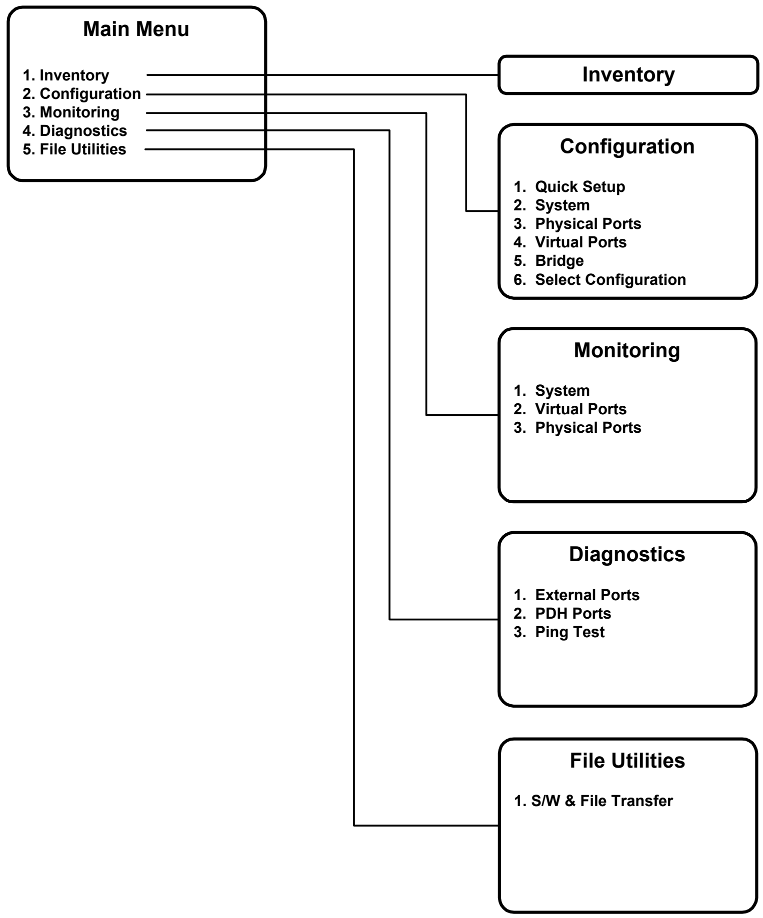


Figure C-3. Main Menu Structure

The functions of the various main menu items are as follows:

Inventory Displays information on the FCD-155 software and hardware versions, and on its subsystems.

Configuration Used to configure all the FCD-155 operational parameters. Includes submenus for configuring the general system parameters, and the parameters of the physical ports, virtual ports and bridge (Ethernet switch).

Monitoring Used to display system information (alarms, events and the remote agents learned by the FCD-155) and the performance monitoring statistics collected for the physical and virtual ports.

Diagnostics Used to initiate test loopbacks on the various external ports, and check IP connectivity.

File Utilities Control the use of TFTP to download software, and upload/download configuration files.

C.3 Inventory Menu

Purpose

Displays information on the FCD-155 software and hardware versions, and logistics data on its subsystems.

The information displayed on the **Inventory** screen cannot be modified.

Use

➤ **To display the Inventory screen:**

Type 1 on the main menu and then press **<Enter>**.

A typical **Inventory** screen is shown in *Figure C-4*.

```
                                              FCD-155
Inventory

       Description          Software Rev     Hardware Rev
     1 Chassis              3.0              1.1
     2 Link Module
|    3 PS Module
v    4 PowerSupply AC
     5 Port SC13M
     6 Eth Port 1
     7 Eth Port 2
      ->>



>


ESC-prev.menu; !-main menu; &-exit; @-Output; ?-help                 1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-4. Typical **Inventory** Screen*

The screen presents the list of the main components installed in the FCD-155 unit. For the main assembly (item 1 – **Chassis**), you can also read the software and hardware versions.

The screen has many additional fields, which can be displayed by scrolling to the right. The additional fields present logistics data, which may be needed by RAD technical support personnel when servicing the unit.

You can learn the keys used for navigation on this screen by typing **?** to display the help screen (a typical help screen is shown *Figure C-5*). While the help screen is displayed, pressing any key returns you to the **Inventory** screen.

Note *The navigation keys appearing on the **Inventory** help screen are standard navigation keys within tables, and therefore have similar functions on all the screens including tables.*

```
Table Hot Keys

^L - scroll left       Left Arrow - move left
^R - scroll right      Right Arrow - move right
Up Arrow - move up
^D - scroll down       Down Arrow - move down
TAB - select next changeable cell
G  <row number>,<col number> - go to cell






Press any key ...                                                   1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-5. Typical **Help** Screen*

C.4 Configuration Menu

Figure C-6 and *Figure C-7* shows the structure of the **Configuration** menu for the main FCD-155 versions.

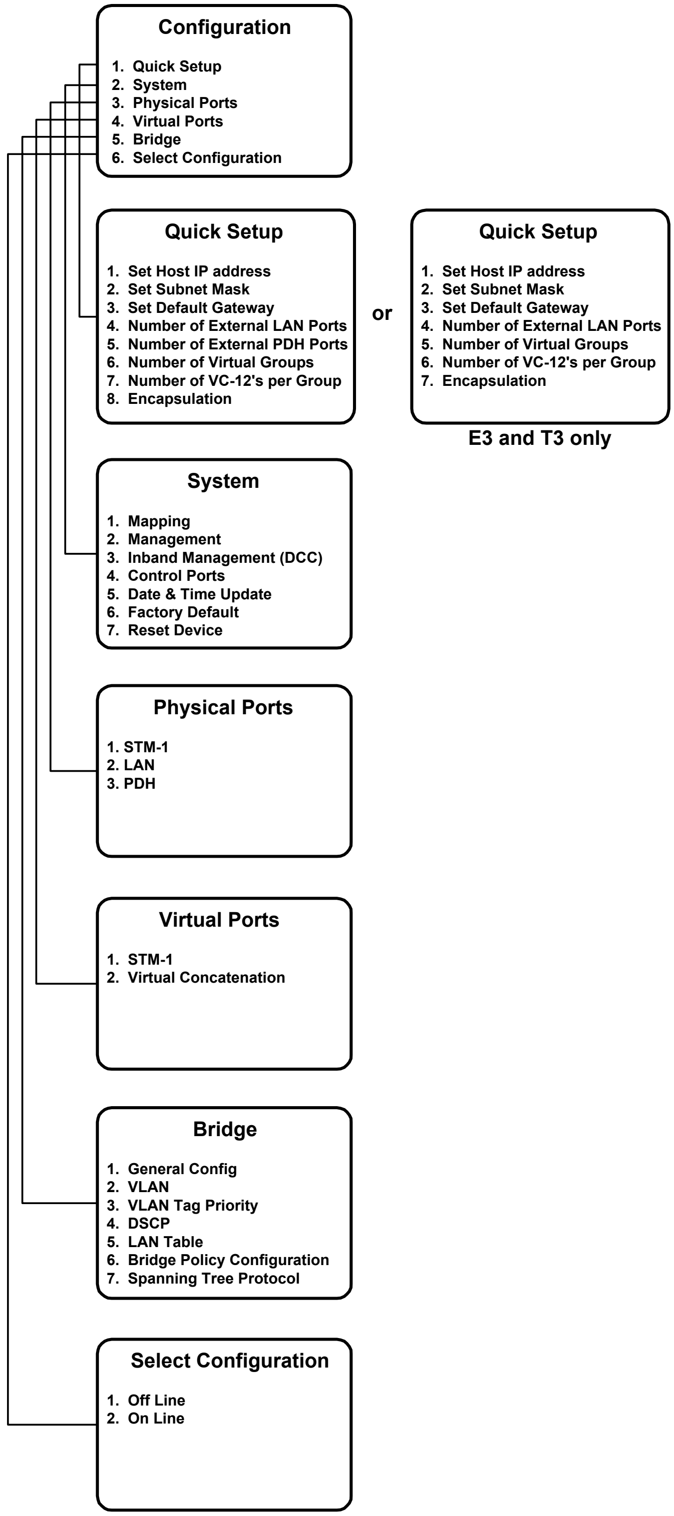


Figure C-6. ***Configuration*** *Menu Structure (SDH Versions with PDH Ports)*

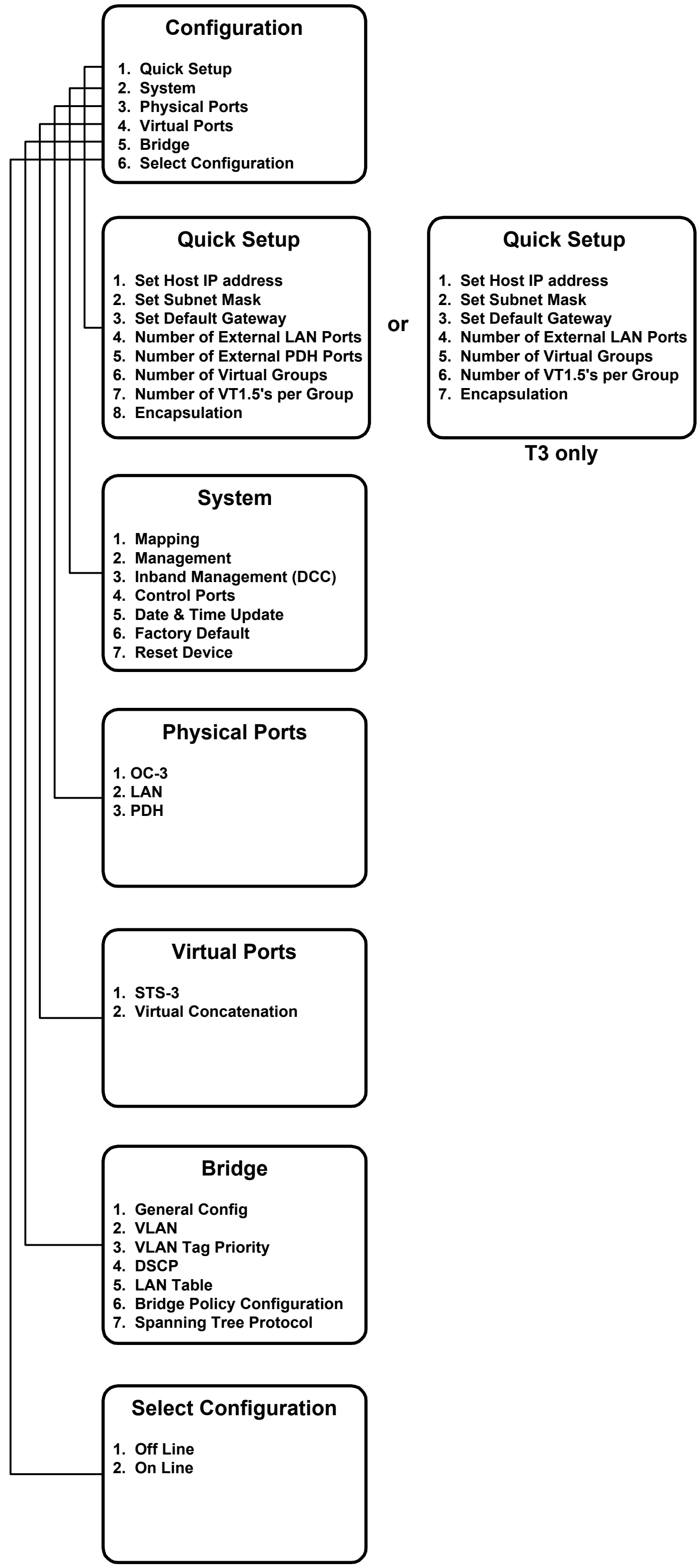


*Figure C-7. **Configuration** Menu Structure (SONET Versions)*

C.5 Configuration – Quick Setup Screen

Purpose

Configure the basic FCD-155 parameters.

Three types of parameters can be configured:

- FCD-155 management IP address and IP subnet (mandatory), and optionally an IP gateway. The IP information can also be defined or modified by means of the **Configuration – System – Management – Host IP** screen.
- Number of active ports of each type (mandatory)
- Set of virtually concatenated groups using low-order VCs/VTs (optional).

Note ***Quick Setup*** *provides a single point of access to the main system parameters (normally reached from several different menus). Its purpose is to help you prepare an initial system configuration, to serve as a starting point for more detailed configuration procedures.*
The ***Quick Setup*** *screen is not intended to replace the specific configuration procedures, some of which modify the parameters initially selected on the* ***Quick Setup*** *screen. Therefore, it is recommended to use the* ***Quick Setup*** *screen only once, when you start configuring an FCD-155 unit from the factory defaults.*

Reached from

Configuration – item 1

Use

A typical **Quick Setup** screen showing the default values for an FCD-155 with SDH network interface is shown in *Figure C-8*. Note that the **Number of External PDH Ports** is displayed only when the FCD-155 is equipped with quad E1 and T1 PDH interfaces.

```
                                   FCD-155
Quick Setup

 1. Set Host IP address           ... (0.0.0.0)
 2. Set Subnet Mask               ... (0.0.0.0)
 3. Set Default Gateway           ... (0.0.0.0)
 4. Number of External LAN Ports [1 - 6]... (6)
 5. Number of External PDH Ports [1 - 4]... (4)
 6. Number Of Virtual Groups     [1 - 8]... (8)
 7. Number Of VC12's per Group   [0 - 63]... (7)
 8. Encapsulation                >   (LAPS)


>


ESC-prev.menu; !-main menu; &-exit; @-output                     1 user(s)
-----------------------------------------------------------------------------
```

Figure C-8. Typical ***Quick Setup*** *Screen (SDH)*

The **Quick Setup** screen for an FCD-155 with SONET network interface, shown in *Figure C-9*, is similar, except that item 5 is **Number of VT1.5s per Group**, and the allowed range is up to 84.

```
                                    FCD-155
Quick Setup

 1. Set Host IP address           ... (0.0.0.0)
 2. Set Subnet Mask               ... (0.0.0.0)
 3. Set Default Gateway           ... (0.0.0.0)
 4. Number of External LAN Ports [1 - 6]... (6)
 5. Number of External PDH Ports [1 - 4]... (4)
 6. Number Of Virtual Groups     [1 - 8]... (6)
 7. Number Of VT1.5's per Group  [0 - 64]... (7)
 8. Encapsulation                >    (LAPS)


>


ESC-prev.menu; !-main menu; &-exit; @-output                         1 user(s)
-------------------------------------------------------------------------------
```

Figure C-9. Typical ***Quick Setup*** *Screen (SONET)*

To configure a parameter on the **Quick Setup** screen, select the corresponding item by typing its number and then pressing **<Enter>**. You can then type the desired value in the same line.

To confirm your entry, press **<Enter>.**

➤ **To configure the FCD-155 management IP address:**

1. Select item **1**.
2. Enter the prescribed IP address of the FCD-155 management agent, in the dotted quad format, and then press **<Enter>**.
3. Select item **2**.
4. Enter the IP subnet mask to be used by of the FCD-155 management agent, in the dotted quad format, and then press **<Enter>**.

   Make sure that the subnet mask is compatible with the specified IP address, and that it consists of consecutive 1s, followed by consecutive 0s.
5. You may also specify a default gateway, which will be used by the FCD-155 management agent to send packets with destinations not located on a local LAN to a specific router. For this purpose, type **3**, and then press **<Enter>:** now enter the IP address of the desired router port in the dotted-quad format, and then press **<Enter>**.

   The default gateway IP address must be within the same IP subnet as the management IP address. The default value, 0.0.0.0, means that no default gateway is defined.
6. To use this option, enter the IP address of the desired router port in the dotted-quad format.

➤ **To configure the active FCD-155 ports:**

For each parameter, select a value within the range indicated in the square brackets:

Number of External LAN Ports — To enable a single Ethernet port (this will always be port ETH 1), select **1**.

To enable more Ethernet ports, up to the maximum supported by your FCD-155 version, select the desired number, **2** to **6**. This will enable the corresponding number of PDH ports, starting with port ETH 1.

Number of External PDH Ports (optional item) — This field appears only for FCD-155 with quad E1 or T1 PDH interfaces.

Select the desired number of PDH ports, up to 4 (0 will disable all the PDH ports). Selecting a smaller number of ports (1, 2 or 3) will enable the corresponding number of PDH ports, starting with port CH1.

➤ **To configure a set of virtually concatenated groups:**

For each parameter, select a value within the range indicated in the square brackets, or select from the list displayed when the corresponding item is selected. See *Configuration Considerations for Virtually Concatenated Groups* section below for configuration considerations and guidelines.

Number of Virtual Groups — Select the number of virtually concatenated groups to be automatically generated and mapped. The supported range is 1 to 4 for FCD-155 units with two LAN ports, and 1 to 8 for FCD-155 units with six LAN ports.

Number of VC12s per Group or **Number of VT1.5s per Group** — Select the number of VCs (when using SDH) or VTs (for SONET) in each virtually concatenated group. The display shows either VCs or VTs, in accordance with the FCD-155 network interface type.

The allowed range is 1 to 63 for SDH, and 1 to 64 for SONET.

Encapsulation — Select the desired encapsulation mode for the virtually concatenated groups defined above:

- **LAPS:** Link Access Procedure for SONET/SDH protocols per ITU-T Rec. X.85/X.86 draft.
- **GFP:** Generic Framing Procedure in accordance with ITU-T Rec. G.7041, framed mode, including support for GFP multiplexing.

Note *Each time you press **<Enter>**, FCD-155 checks your selection. If it is not correct, it is rejected (the previous value remains unchanged) and you see the **ERROR** indicator in the top right-hand corner.*

➤ **To save and activate the new configuration:**

Type **#** and then type **y** to confirm the action.

Configuration Considerations for Virtually Concatenated Groups

The options available in the **Quick Setup** screen enable building the number of virtually concatenated groups selected by you (the groups are then automatically mapped). To avoid configuration errors, use the following step-by-step sequence:

1. When using an FCD-155 with quad E1 or T1 PDH interfaces, always start by defining the number of active (enabled) PDH E1 or T1 interfaces.
2. Refer to *Table C-1* and determine the number of VCs/VTs to be reserved for PDH link traffic.

Table C-1. Bandwidth to be Reserved for PDH Link Traffic

Network Interface	Interface Type	Number of VCs/VTs	Total Bandwidth to be Reserved
SDH	Quad E1	1 VC-12 per interface	4 VC-12
	Quad T1	1 VC-11 per interface	3 VC-12/4 VC-11 in one TUG-2 (occupies only one TUG-2 in the TUG-3)
	E3	1 VC-3 (21 VC-12)	One TUG-3 (21 VC-12)
	T3	28 VC-11	One TUG-3 (the whole TUG-3 carrying VC-11s, which is equivalent to 21 VC-12)
SONET	T1	1 VT-1.5 per interface	4 VT-1.5
	T3	28 VT-1.5	28 VT-1.5 (all in one STS-1)

3. Decide whether management traffic must be carried over the SDH/SONET link. If the answer is ***no*** or you will use the DCC for this purpose, skip to *Step 4* below. If the answer is **yes**, check whether it is necessary to reserve a dedicated management VC-12 or VT-1.5:
   - If management traffic will be encapsulated using LAPS, reserve one dedicated VC-12 or VT-1.5 (the type depends on the network standard)
   - If management traffic will be encapsulated using GFP, you may use GFP multiplexing to combine management traffic with payload traffic in a manually-configured virtually concatenated group:
     - If GFP multiplexing is **not used**, reserve one dedicated VC-12 or VT-1.5
     - If GFP multiplexing is **used**, do not reserve dedicated bandwidth.
4. Select the number of virtually concatenated groups to be defined. The range is 1 to 4, or 1 to 8, depending on the number of LAN ports on your FCD-155 unit. Decrease the number as needed when dedicated bandwidth must be reserved on the SDH/SONET link for management (see *Step 3* above), and/or for future growth.
5. Select the number of VC-12s or VT-1.5s in each group.

   If you want to use more than a few VC-12s or VT-1.5s per group, you must check how many can be assigned to the virtually concatenated groups you are defining now. Calculate the maximum allowed number as follows:
   - If you want to manually configure additional groups (using **Configuration – Virtual Ports – Virtual Concatenation – Group**) or just want to reserve some link bandwidth for future growth, determine how many VC-12s or

VT1.5s to set aside (if using high-order containers, this translates to 21 VC-12s or VT-1.5s per VC-3).

- Now calculate the maximum number of VC-12s or VT-1.5s that remain available:
  - For an FCD-155 with PDH E1 interfaces, this is 63 less the number selected in *Step 2* and *Step 3* above, and the number reserved above.

    Example 1: If all the PDH E1 interfaces are active and one VC-12 is dedicated to management, the available number is **63 – 4 – 1** = **58**.

    Example 2: If all the PDH E1 interfaces are active, no VC-12 is dedicated to management, but you want to add one more group over one VC-3, the available number is **63 – 4 – 0 – 21** = **38**.
  - For an FCD-155 with PDH T1 or T3 interfaces, the number is 84 less the number selected in *Step 2* and *Step 3* above, and the number reserved above.
  - For an FCD-155 without PDH interfaces, the number is 63 when using SDH and 84 when using SONET. Subtract 1 if management uses a dedicated VC-12 or VT-1.5.
- Divide the number calculated above by the number of virtually concatenated groups, and select only the integer part of the result. For example, if you define now four groups and the available number of VC-12s or VT-1.5s is 62, the maximum number per group is 15.

Note *You can select any number that does not exceed the result obtained in the last step.*

The VC-12s or VT-1.5s assigned in this way are consecutively mapped starting with the first one, until all are mapped. For example, the screen shown in *Figure C-10* (displayed using **Configuration – System – Mapping)** shows the result of the automatic mapping when you configure 8 virtually concatenated groups, each using 7 VC-12s. As seen in *Figure C-10*, the automatic mapping completely fills the first two TUG-3, and some of the third TUG-3 remains free. Thus, you may increase the bandwidth assigned to one or more virtually concatenated groups.

```
                                  FCD-155

          TUG3  1                TUG3  2                TUG3  3
       TU1   TU2   TU3       TU1   TU2   TU3       TU1   TU2   TU3
 TUG2-1 Grp1 Grp1 Grp1      Grp4 Grp4 Grp4      Grp7 Grp7 Grp7
 TUG2-2 Grp1 Grp1 Grp1      Grp4 Grp4 Grp4      Grp7 Grp7 Grp7
 TUG2-3 Grp1 Grp2 Grp2      Grp4 Grp5 Grp5      Grp7 Grp8 Grp8
 TUG2-4 Grp2 Grp2 Grp2      Grp5 Grp5 Grp5      Grp8 Grp8 Grp8
 TUG2-5 Grp2 Grp2 Grp3      Grp5 Grp5 Grp6      Grp8 Grp8 Ex1
 TUG2-6 Grp3 Grp3 Grp3      Grp6 Grp6 Grp6      Ex2  Ex3  Ex4
 TUG2-7 Grp3 Grp3 Grp3      Grp6 Grp6 Grp6      None None None

 1. Grp1 3. Grp3 5. Grp5 7. Grp7 9. Ex1 11. Ex3 13. None
 2. Grp2 4. Grp4 6. Grp6 8. Grp810. Ex2 12. Ex4

>

ESC-prev.menu; !-main menu; &-exit; @-Output; ?-help              1 user(s)
------------------------------------------------------------------------------
```

*Figure C-10. Typical **Mapping** Screen after Quick Setup*

C.6 Configuration – System Submenu Structure

Figure C-11 and *Figure C-12* show the structure of the **System** submenu for the main FCD-155 versions.

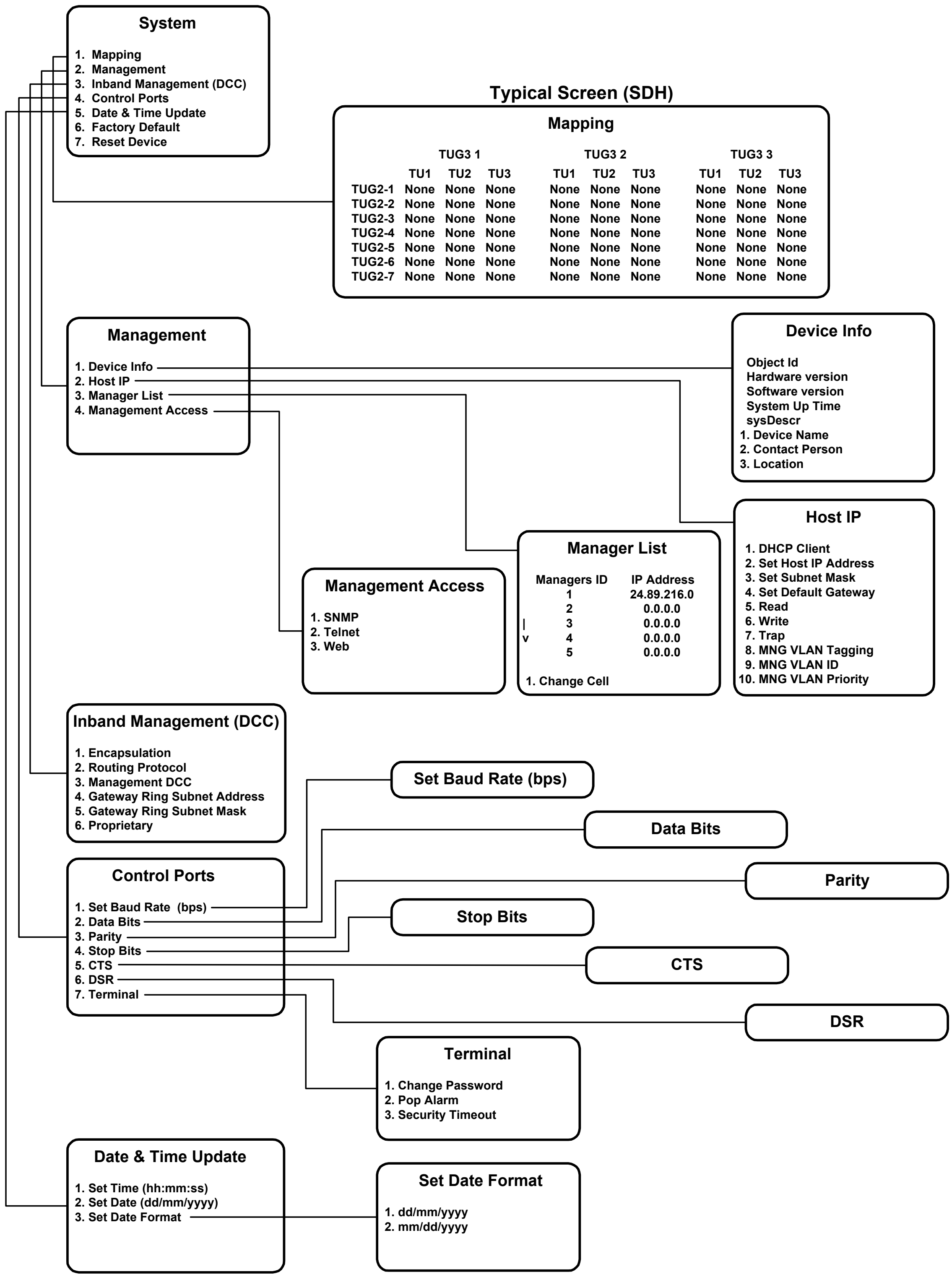


Figure C-11. ***Configuration – System*** *Submenu Structure (SDH)*

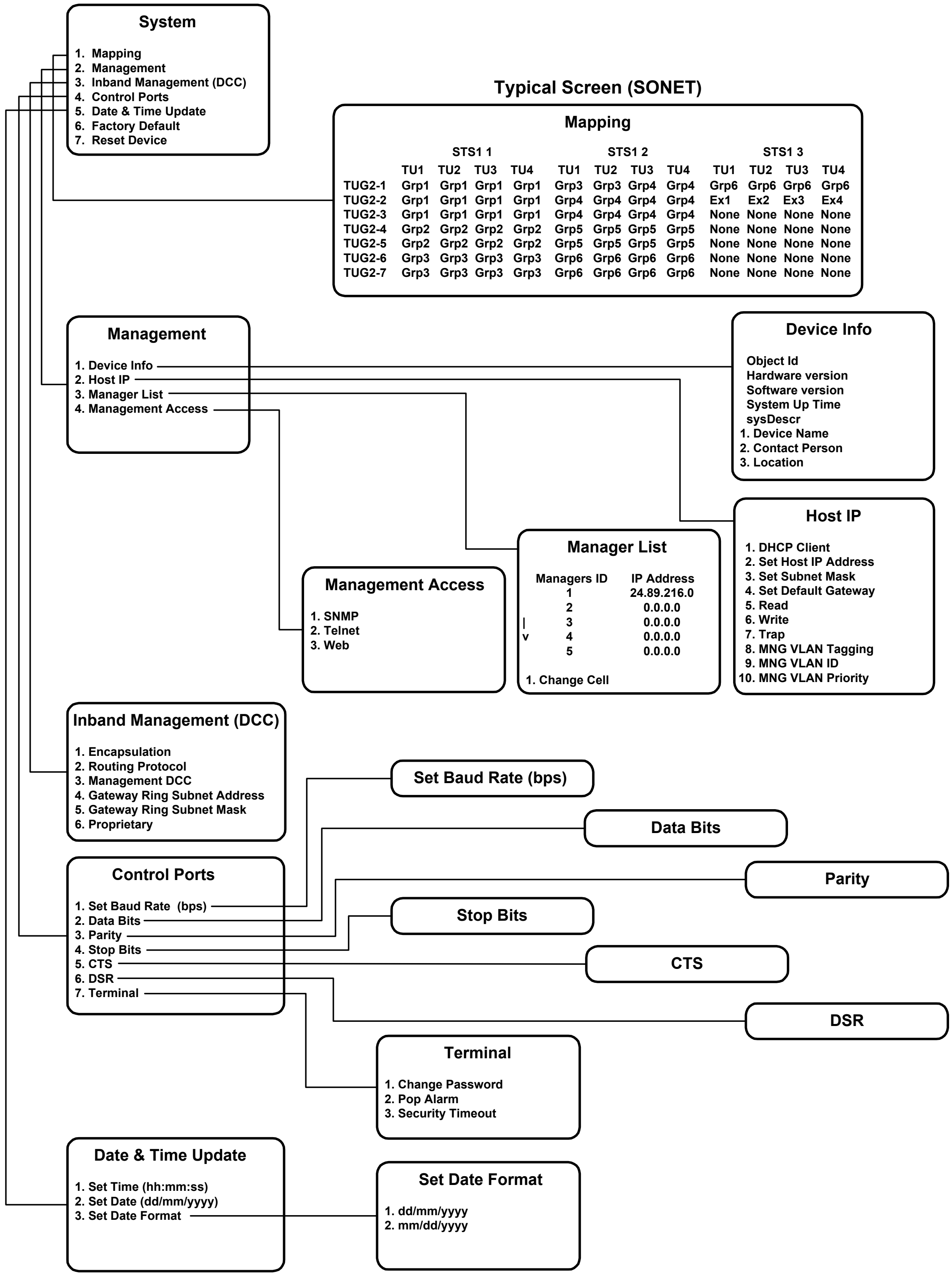


*Figure C-12. **Configuration – System** Submenu Structure (SONET)*

C.7 Configuration – Mapping Screen

Purpose

Map the payload from the various FCD-155 interfaces to specific TUs or SPEs, for transmission through the SDH or SONET link. The FCD-155 is a terminal multiplexer, and therefore you can always optimize the mapping for best utilization of the bandwidth available on network link for your payload.

Reached from

Configuration – System – item 1

Typical Mapping Screens – FCD-155 with PDH Ports

Figure C-13 to *Figure C-15* show typical SONET and SDH mapping screens.

```
                                            FCD-155
Mapping
             STS-1 1                  STS-1 2                   STS-1 3
        TU1  TU2  TU3  TU4                                 TU1  TU2  TU3  TU4
 TUG2-1 Grp1 Grp1 Grp1 Grp2       --- ---- ---- ---        None None None None
 TUG2-2 Grp2 Grp2 None None      |                 |       None None None None
 TUG2-3 None None None None      |                 |       None None None None
 TUG2-4 None None None None      |        Grp3     |       None None None None
 TUG2-5 None None None None      |                 |       None None None None
 TUG2-6 None None None None      |                 |       None None None None
 TUG2-7 None None None None       --- ---- ---- ---        None None None None

 1. Grp1 3. Grp3 5. Grp5 7. Grp7  9. Ex1 11. Ex3 13. None
 2. Grp2 4. Grp4 6. Grp6 8. Grp8 10. Ex2 12. Ex4

>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                  1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-13. Typical SONET **Mapping** Screen (FCD-155 with Quad T1 PDH Ports and 6 LAN Ports)*

```
                                            FCD-155
Mapping
             TUG3 1                   TUG3 2                    TUG3 3
        TU1  TU2  TU3  TU4       TU1  TU2  TU3  TU4        TU1  TU2  TU3  TU4
 TUG2-1 Grp1 Grp1 Grp1 N/A       Grp8 Grp8 Grp8 N/A        None None None None
 TUG2-2 Grp2 Grp2 Grp2 N/A       Ex1  Ex2  Ex3  Ex4        None None None None
 TUG2-3 Grp3 Grp3 Grp3 N/A       None None None None       None None None None
 TUG2-4 Grp4 Grp4 Grp4 N/A       None None None None       None None None None
 TUG2-5 Grp5 Grp5 Grp5 N/A       None None None None       None None None None
 TUG2-6 Grp6 Grp6 Grp6 N/A       None None None None       None None None None
 TUG2-7 Grp7 Grp7 Grp7 N/A       None None None None       None None None None

 1. Grp1 3. Grp3 5. Grp5 7. Grp7  9. Ex1 11. Ex3 13. None
 2. Grp2 4. Grp4 6. Grp6 8. Grp8 10. Ex2 12. Ex4

>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                  1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-14. Typical SDH **Mapping** Screen (FCD-155 with Quad T1 PDH Ports and 6 LAN Ports)*

```
                                     FCD-155
Mapping
                TUG3  1               TUG3  2               TUG3  3
          TU1   TU2   TU3                             TU1   TU2   TU3
 TUG2-1  Grp1   Grp1  Grp2      ---   ----   ---      None  None  None
 TUG2-2  None   None  None     |                |     None  None  None
 TUG2-3  Grp2   Grp2  None     |                |     None  None  None
 TUG2-4  Grp3   Grp3  Grp8     |       Ex1      |     Grp4  Grp4  None
 TUG2-5  Grp8   Grp8  Grp8     |                |     None  None  None
 TUG2-6  None   None  None     |                |     None  None  None
 TUG2-7  None   None  None      ---   ----   ---      None  None  None

 1. Grp1 3. Grp3 5. Grp5 7. Grp7   9. Ex1
 2. Grp2 4. Grp4 6. Grp6 8. Grp8 10. None

>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help              1 user(s)
------------------------------------------------------------------------------
```

Figure C-15. Typical SDH ***Mapping*** *Screen (FCD-155 with E3 PDH Port and 6 LAN Ports)*

Each mapping screen has two main parts:

- **Map section**: displays the current utilization of the link. The map is organized as a table that initially shows all the VC-12s/VC-11s or VT-1.5s in the STM-1 or STS-3 frame; after assigning (mapping) bandwidth to the external ports or virtually concatenated groups, the map changes to show the mapped entities.

  The map is organized as follows:

  The table includes three main sections, one for each TUG-3 (for FCD-155 with SDH network interface) or STS-1 (for FCD-155 with SONET network interface).

  - When an external port or a group uses a whole VC-3 or STS-1 SPE, it is represented as a single block under the corresponding TUG-3/STS-1. See for example *Figure C-13*, where STS-1 No. 2 is assigned to **Grp2**, or *Figure C-15,* where TUG-3 No. 2 is assigned to **Ex1**).
  - For other mappings, these sections are subdivided as follows:
    - SONET: each STS-1 section has four columns, TU1 to TU4, one for each VT-1.5 in each TUG-2. See *Figure C-13* for an example.
    - SDH with T1 interfaces: each TUG-3 section has four columns, TU1 to TU4. The columns represent either VC-12s or VC-11s in each TUG-2. When representing VC-12s, the fourth column is always **N/A** and cannot be changed (for an example, see TUG-3 No. 1 in *Figure C-14*); when representing VC-11s, the fourth column is either **None** or assigned to an external port (for an example, see TUG-3 No. 2 in *Figure C-14*).
    - SDH with E1 interfaces: each TUG-3 section has three columns, one for each VC-12 in each TUG-2 (see *Figure C-15* for an example).

Note *When virtually concatenated groups have been configured by means of the* ***Quick Setup*** *screen, they are automatically mapped according to the factory defaults, and appear on the map in the automatically assigned positions.*

- **List of payload types to be mapped**. Each item in the list is assigned a number. The payload types are identified as follows:
  - **Ex** – external PDH port. The supported range depends on the number of active (enabled) PDH ports. The maximum range is **Ex1** to **Ex4**, in accordance. By default, all the external ports are disabled; you can select the initial number of ports to be enabled on the **Quick Setup** screen (see *Section C.5*), or enable the required number using the appropriate **Physical Ports** configuration screens (see *Section C.18*).
  - **Grp** – virtually concatenated group. The supported range is **Grp1** to **Grp4** for an FCD-155 with 2 LAN ports, and **Grp1** to **Grp4** for an FCD-155 with 6 LAN ports. The numbers shown depends on the number of groups currently defined.

  In addition, there is a **None** selection, used to disconnect a TU.

Use

Note *To see the navigation keys available for the mapping screen, type* **?** *(help). The help screen is automatically updated in accordance with the current position of the cursor: for example, when the cursor is at the leftmost position, the keys for moving the cursor to the left are not displayed.*

➤ **To map a virtually concatenated group or external PDH port payload:**

1. Move the selection block to an unassigned cell (i.e., a cell that shows **None**). The selected cell in all the screens shown above (*Figure C-13* to *Figure C-15*) is that corresponding to the first TU in the STM-1/STS-3 frame.

Note *If the desired cell is currently assigned, before continuing to Step 2 type the number corresponding to* ***None*** *and then press* ***<Enter>****.*

2. When the selection block is in the desired cell, type the number of the desired group or port and then press **<Enter>**. The corresponding designation appears in the selected cell.

➤ **To save the new configuration:**

1. Type **#** to save and then confirm the action. The FCD-155 checks your configuration and saves it only if no errors are detected.
2. If errors are detected in your mapping, the new mapping cannot be saved. In this case, the FCD-155 will display **Error in configuration. Do you want to see errors?**:
   - To ignore, type **n**. Now you can return to the mapping screen and correct the errors.
   - To see the errors, type **y**. You will see the **Sanity** screen (normally reached from **Monitoring – System – Display Sanity**). Now select **1 – Errors and Warnings** to display the list of sanity errors. Refer to *Appendix B* for an explanation of the error messages that may be displayed.

C.8 Configuration – Device Info Screen

Purpose

Display basic information on the FCD-155 unit, and define logistics information.

The information entered by you on this screen can also be displayed by management stations.

Reached from

Configuration – System – Management – Device Info

Use

A typical **Device Information** screen is shown in *Figure C-16*.

```
                                          FCD-155
Device Info

    Object Id                        ... (radFcd155)
    Hardware version                 ... (1.1)
    Software version                 ... (3.00)
    System Up Time                   ... (0 day 01:16:51)
    sysDescr                         ... (FCD-155 HW Version:1.1 SW version:3....)
 1. Device Name                      ... (FCD-155 )
 2. Contact Person                   ... (Name of contact person)
 3. Location                         ... (The location of this device)




>

Standard device information

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-16. Typical **Device Information** Screen*

The **Device Info** screen includes two sections:

- Read-only device information:

Object ID	Displays the formal FCD-155 object identifier (its MIB root).
Hardware Version	Displays the hardware version of the FCD-155 main board.
Software Version	Displays the software version currently used by the FCD-155.
System Up Time	Displays the time elapsed since the FCD-155 has been powered up.
sysDescr	Displays the formal FCD-155 system descriptor (as defined in its MIB).

- Logistics data, which can be defined by the user:

Device Name	Used to assign an arbitrary name to the FCD-155 unit (up to 40 characters).
Contact Person	Used to enter the name of the person to be contacted in matters pertaining to this equipment unit (up to 40 characters).
Location	Used to enter a description of the physical location of this equipment unit.

➤ **To define or modify logistics data:**

1. Type the number of the desired type of data and then press **<Enter>**.
2. Type the desired string. If you exceed the maximum allowed length of the string for the selected field, the excess characters are ignored.
3. After checking your entry, press **<Enter>** to confirm.
4. Repeat the steps listed above to define all the required fields.
5. Type **#** to save and then confirm the action.

C.9 Configuration – Host IP Screen

Purpose

Define the FCD-155 management agent parameters. The following types of parameters must be configured:

- IP address configuration mode – manual or DHCP
- When using the manual IP address configuration mode: IP communication parameters
- SNMP communities.

When VLANs are used for management traffic, you can all configure the management VLAN parameters.

Reached from

Configuration – System – Management – item 2

Use

Typical **Host IP** screens are shown in *Figure C-17* and *Figure C-18*.

The parameters that can be configured by means of the **Host IP** screen are explained in *Table C-2*.

Note *The community names are case-sensitive. See also Appendix E.*

```
                                  FCD-155
Host IP

 1. DHCP Client         >    (No)
 2. Set Host IP address ... (1.2.3.4)
 3. Set Subnet Mask     ... (0.0.0.0)
 4. Set Default Gateway ... (0.0.0.0)
 5. Read                ... (public)
 6. Write               ... (private)
 7. Trap                ... (public)
 8. MNG VLAN Tagging        (No)
 9. MNG VLAN ID         [1 - 4094]... (0)
10. MNG VLAN Priority   ... (0)



>

Management interfaces available on the system

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-17. Typical **Host IP** Screen – Manual IP Address Configuration (DHCP Client Disabled)*

```
                                  FCD-155
Host IP

 1. DHCP Client         >    (Yes)
 2. Read                ... (public)
 3. Write               ... (private)
 4. Trap                ... (public)
 5. MNG VLAN Tagging        (No)
 6. MNG VLAN ID         [1 - 4094]... (0)
 7. MNG VLAN Priority   ... (0)
 8. DHCP_Status         >



>

Management interfaces available on the system

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-18. Typical **Host IP** Screen – Automatic IP Address Configuration (DHCP Client Enabled)*

➤ **To manually define the Host IP parameters:**

1. Select **NO** for **DHCP Client** (the selection is toggled each time you select item **1**).
2. Select the number of the desired parameter and then press **<Enter>**: :
   - For the **MNG VLAN Tagging** item, the selection is toggled each time this item is selected
   - For the other items, you can then enter the desired value in the same line.

➤ **To enable automatic IP address configuration using DHCP:**

1. Select **YES** for DHCP client. After saving this selection, a new item appears, **DHCP Status**.
2. Configure the SNMP communities.
3. To monitor the DHCP protocol status, type **5**. A typical **DHCP Status** screen is shown in *Figure C-19*.

Table C-2. Host IP Parameters

Parameter	Function	Values
DHCP Client	Controls the method used to assign an IP address to the FCD-155 management agent	**NO** The IP address is manually configured using the **Host IP** field. **YES** The FCD-155 management agent operates as a DHCP client, and therefore its IP address must be assigned using the DHCP protocol. **Default: NO**
Host IP Address	When **DHCP Client** is **NO:** used to enter the IP address of the FCD-155 management agent. When **DHCP Client** is **YES**: this field appears only after an IP address has been assigned by the DHCP server. The address displayed in this field cannot be changed	When **DHCP Client** is **NO:** type the desired IP address, using the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods). **Default: 0.0.0.0**
Subnet Mask	When **DHCP Client** is **NO:** used to enter the IP subnet mask of the FCD-155 management agent. When **DHCP Client** is **YES**: this field appears only after an IP subnet mask has been configured by the DHCP server. The address displayed in this field cannot be changed	When **DHCP Client** is **NO:** type the desired IP subnet mask, using the dotted-quad format. Make sure to select a subnet mask compatible with the selected IP address, and whose binary representation consists of consecutive “ones”, followed by the desired number of consecutive “zeroes”. **Default: 0.0.0.0**
Default Gateway	When **DHCP Client** is **NO:** used to specify the IP address (usually an IP router port) to which the FCD-155 management agent will send packets when the destination IP address is not within the subnet specified in the **Mask** field. The default value, 0.0.0.0, means that no default gateway is defined. When **DHCP Client** is **YES:** this field appears only after a default gateway IP address has been configured by the DHCP server. The address displayed in this field cannot be changed	When **DHCP Client** is **NO:** type the desired IP address, using the dotted-quad format. Make sure the IP address address is within the subnet of the host IP address. **Default: 0.0.0.0**

Table C-2. Host IP Parameters (Cont.)

Parameter	Function	Values
Read	Enter here the read-only SNMP community name to be accepted by the FCD-155 management agent. SNMP-based management stations using this community will not be able to modify the FCD-155 configuration, nor initiate diagnostic activities	Enter the desired alphanumeric string (pay attention to case). **Default: public**
Write	Enter here the read-and-write SNMP community name to be accepted by the FCD-155 management agent. Use this community for SNMP-based management stations that must be able to perform all the activities	Enter the desired alphanumeric string (pay attention to case). **Default: private**
Trap	Enter here the SNMP community name that will be specified by the FCD-155 management agent in the traps sent to SNMP-based management stations	Enter the desired alphanumeric string (pay attention to case). **Default: public**
MNG VLAN Tagging	Controls the use of VLAN tagging for the FCD-155 management traffic	**YES** Management VLAN tagging is enabled. In this case, make sure to configure a forwarding rule for the VLAN ID specified in the **MNG VLAN ID** field using the **Tag-Based** screen (see *Section C.44*). **NO** Management VLAN tagging is disabled. **Default: NO**
MNG VLAN ID	When management VLAN tagging is enabled, specifies the VLAN ID number used by the management traffic sent through this port. When management VLAN tagging is disabled, this parameter is ignored	The allowed range is 1 to 4094. **0** means that no VLAN ID has been specified. **Default: 0**
MNG VLAN Priority	When management VLAN tagging is enabled, specifies the priority assigned to the management VLAN traffic sent through this port. When management VLAN tagging is disabled, this parameter is ignored	The allowed range is 7 (highest priority) to 0 (lowest priority). **Default: 0**
DHCP Status	Field displayed only when **DHCP Client** is **YES:** displays DHCP status information (see typical screen in *Figure C-19*)	**See** *Table C-3*

```
                                FCD-155
DHCP_Status

    Current Status       >   (Trying to locate available server)








>



ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-19. Typical **DHCP Status** Screen*

Table C-3. DHCP Status Parameters

Parameter	Meaning
Server ID	Displays the IP address of the DHCP server that provides the IP address, IP subnet and default gateway parameters. This field appears only after a DHCP server has been discovered
Lease Expiration Time	Displays the date and time at which the current set of parameters provided by the DHCP server will expire. This field appears only after the DHCP server has provided the required parameters
Current Status	Displays the status of the DHCP protocol exchange:
	Trying to locate available server: the FCD-155 DHCP client is trying to find a DHCP server (DHCP discovery state)
	Waiting for confirmation of lease: the FCD-155 DHCP client is trying to obtain the required parameters from the DHCP server that has been identified (its IP address appears in the **Server ID** field)
	Holding lease: the FCD-155 has received the required parameters and they are valid. The assigned host IP address, IP subnet and default gateway are displayed in the corresponding fields of the **Host IP** screen (see *Table C-2*). The expiry time is displayed in the **Server ID** field
	T1 expired: Asking for extension of lease: the lease over the original parameters has expired, and the FCD-155 DHCP client is sending a **Renewing** request in accordance with the DHCP protocol
	T2 expired: Asking for extension of lease: the lease over the original parameters has expired, and the FCD-155 DHCP client is in the **Rebinding** state of the DHCP protocol
	Restarting the process: the FCD-155 DHCP client restarts the whole process (sending a DHCP discovery request again)

C.10 Configuration – Manager List Screen

Purpose

Define the IP addresses of network management stations that may manage the FCD-155.

The maximum number of network management stations is 10.

Reached from

Configuration – System – Management – item 3

Use

The first page of a typical **Manager List** screen, which includes the first 5 management stations, is shown in *Figure C-20*. To continue to the next page, type **D** until the 6th line is reached.

Note *To see the navigation keys available for this screen, type **?** (help).*

```
                                  FCD-155
Manager List

    Managers ID      IP Address
         1            0.0.0.0
         2            0.0.0.0
|        3            0.0.0.0
v        4            0.0.0.0
         5            0.0.0.0

 1. Change cell                   ... (0.0.0.0)



>

10 managers may be defined

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                 1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-20. Typical **Manager List** Screen (First Page)*

The screen includes two columns:

Managers ID Index number of management station, 1 to 10.

IP Address The IP address of the management station.

➤ **To define a management station:**

1. Move the selection block to the desired row.
2. Type **1 – Change Cell**, and then press **<Enter>**. Now you can enter the desired IP address, in the dotted-quad format. Press **<Enter>** to end.
3. Repeat the process until all the desired management stations have been defined. When done, type **#** to save and then confirm the action.

C.11 Configuration – Management Access Screen

Purpose

Define the additional management access options: SNMP, Telnet, and/or Web browser.

The supervisory terminal is always available, and therefore does not appear on this screen.

Reached from

Configuration – System – Management – item 4

Use

A typical **Management Access** screen is shown in *Figure C-21*.

```
                                FCD-155
Management Access

 1. SNMP                       >    (On)
 2. Telnet                     >    (On)
 3. WEB                        >    (On)









>

Management Access options

ESC-prev.menu; !-main menu; &-exit; @-output                  1 user(s)
-----------------------------------------------------------------------------
```

Figure C-21. Typical ***Management Access*** *Screen*

➤ **To change the access rights:**

1. Type the number corresponding to the management means to be modified, and then press **<Enter>** to display the selection screen.
2. On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes.
3. Repeat the process until all the desired management access means have been defined.
4. When done, type **#** to save and then confirm the action.

C.12 Configuration – Inband Management Screen

Purpose

Control the use of inband management, and define the FCD-155 inband management parameters.

Reached from

Configuration – System – item 3

Use

A typical **Inband Management** screen is shown in *Figure C-22*.

This screen shows all the parameters that may be configured: as explained in *Table C-4*, the parameters actually displayed on the screen depend on the encapsulation and routing protocol values selected by you. Therefore, it is recommended to configure the parameters in the order they are displayed on the screen.

Note *Some of the required parameter values depend on the equipment used together with the FCD-155 in the same network. Contact RAD Technical Support Department for specific recommendations that take into consideration your special application requirements.*

```
                                    FCD-155
Inband Management (DCC)

 1. Encapsulation                >    (PPP over HDLC)
 2. Routing Protocol             >    (None)
 3. Management DCC               >    (D1-D3)
 4. Gateway Ring Subnet Address... (0.0.0.0)
 5. Gateway Ring Subnet Mask   ... (0.0.0.0)
 6. Proprietary                  >    (No)







>





ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-22. Typical **Inband Management** Screen*

➤ **To change the inband management parameters:**

1. Type the number corresponding to the parameter to be modified, and then press **<Enter>** to display the selection screen.
2. On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes.
3. Repeat the process until all the parameters have been defined.
4. When done, type **#** to save and then confirm the action.

The parameters that can be configured by means of the **Inband Management** screen are described in *Table C-4*.

Table C-4. ***Configuration – Inband Management*** *Parameters*

Parameter	Function	Values
Encapsulation	Selects the encapsulation protocol used for inband management traffic carried over the DCC	**OFF –** No encapsulation protocol selected; inband management is not possible. **HDLC –** HDLC encapsulation. This protocol is compatible with all the RAD equipment, and in particular with Optimux-1551 and Optimux-1553. **PPP OVER HDLC –** PPP over HDLC encapsulation. This protocol is compatible with RAD OptiMux-1550, and equipment from other vendors. **Default: OFF**
Routing Protocol	When the transfer of inband management traffic is enabled, selects the routing protocol for management traffic carried through this main link. This field is not displayed when **Encapsulation** is **OFF**	**NONE** – Dynamic routing of management traffic is not supported. In this case, static routing is used, and you must specify the information needed for routing the management traffic. **PROPRIETARY** – The management traffic is routed using the RAD RIP proprietary routing protocol. In addition, RIP2 routing tables are also transmitted. **Default: NONE**
Management DCC	Selects the DCC bytes used to carry inband management traffic. This field is not displayed when **Encapsulation** is **OFF**	**D1 – D3 –** The management traffic is carried by the regenerator section DCC bytes (D1, D2, D3). **D4 – D12 –** The management traffic is carried by the multiplex section DCC bytes (D4 to D12). **Default: D1 – D3**

*Table C-4. **Configuration – Inband Management** Parameters (Cont.)*

Parameter	Function	Values
Gateway Ring Subnet Address	Specifies the destination IP address for inband management traffic (you may enter an address corresponding to a single IP host, or a subnet address when the traffic is addressed to more than one management station)	Type the desired IP address, using the dotted-quad format. **Default: 0.0.0.0**
Gateway Ring Subnet Mask	Specifies the subnet mask associated with the IP address specified in the **Gateway Ring Subnet Address** field. To increase security, select the minimum subnet size needed: for example, to reach a single host, use **255.255.255.255**	Type the desired IP subnet mask, using the dotted-quad format. **Default: 0.0.0.0**
Proprietary	Selects the PPP over HDLC flavor supported by the FCD-155. This field is displayed only when **Encapsulation** is **PPP OVER HDLC**	**NO** – PPP over HDLC in accordance with RFC1661 and RFC1662. **TYPE 1** – PPP over HDLC based on RFC1661 and RFC1662, but LCP (Link Control Protocol) packets do not include address and control fields in their overhead. **Default: NO**

C.13 Configuration – Control Ports Screen

Purpose

Define the FCD-155 CONTROL port parameters. Two types of parameters can be defined:

- Serial port communication parameters. These parameters are configured directly on the **Control Ports** screen.
- Operational parameters. These parameters are configured on the **Terminal** screen, reached from the **Control Ports** screen.

Reached from

Configuration – System – item 3

Use

A typical **Control Ports** screen is shown in *Figure C-23*. Note that the screen displays the current values of each parameter.

```
                                    FCD-155
Control Ports

 1. Set Baud Rate  (bps) >   (115200Bps)
 2. Data Bits            >   (8)
 3. Parity               >   (None)
 4. Stop Bits            >   (1)
 5. CTS                  >   (equal RTS)
 6. DSR                  >   (On)
 7. Terminal             >




>



ESC-prev.menu; !-main menu; &-exit; @-output                  1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-23. Typical **Control Ports** Screen*

➤ **To change the CONTROL port communication parameters:**

1. Type the number corresponding to the desired parameter, and then press **<Enter>** to display the selection screen.
2. On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes.
3. Repeat the process until all the desired communication parameters (items **1** to **6**) have been defined.
4. To continue to the operational parameters screen, type **7** and then press **<Enter>**.
5. When done, type **#** to save and then confirm the action.

Note *After changing the CONTROL port communication parameters, you must reconfigure the communication parameters of the supervisory terminal before it is possible to establish again communication with the FCD-155.*
The same is true when you change the terminal emulation mode.

The communication parameters that can be configured by means of the **Control Ports** screen are described in *Table C-5*.

*Table C-5. **Configuration – Control Ports** Communication Parameters*

Parameter	Function	Values
Baud Rate	Selects the supervisory port data rate	The supported rates are **300, 1200, 2400, 4800, 9600, 19200, 38400, 57600** and **115200** bps**.** **Default: 115200bps**
Data Bits	Selects the number of data bits in the word format	The available selections are **7** or **8** data bits**.** **Default: 8**
Parity	Controls the use of parity	**ODD** Odd parity. **EVEN** Even parity. **NONE** Parity disabled. **Default: NONE**
Stop Bits	Selects the number of stop bits in the word format	The available selections are **1** or **2** stop bits**.** **Default: 1**
CTS	Controls the state of the CTS line in the CONTROL port	**ON** The CTS line is always ON (active). **=RTS** The CTS line tracks the RTS line. **Default: ON**
DSR	Controls the state of the DSR line in the CONTROL port	**ON** The DSR line is always ON (active). **=DTR** The DSR line tracks the DTR line. **Default: ON**
Terminal	Opens the **Terminal** screen	

➤ **To change the terminal operational parameters:**

1. Type **7** on the **Control Ports** screen (*Figure C-23*) and then press **<Enter>**.
2. You will see the **Terminal** screen. A typical **Terminal** screen is shown in *Figure C-24*. Note that the screen shows the current values for the various parameters (except the password).
3. Type the number corresponding to the desired parameter, and then press **<Enter>** to display the corresponding selection screen.

   The parameters that can be configured by means of the **Terminal** screen are described in *Table C-6*.

Note *See separate procedure for changing the password.*

4. On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes.
5. When done, type **#** to save and then confirm the action.

Table C-6. ***Configuration*** *–* ***Terminal*** *Operational Parameters*

Parameter	Function	Values
Pop Alarm	Enable/disable the automatic display of alarms on the terminal	**YES** The terminal automatically displays any event or new alarm, or change in the state of an alarm. **NO** The automatic display feature is disabled. **Default: NO**
Security Timeout	Controls the idle disconnect time of the CONTROL port	**None** Automatic session disconnection disabled. To disconnect the session, use the **&** (exit) command. **3 min** Automatic disconnection after ten minutes if no input data is received by the CONTROL port. **10 min** Automatic disconnection after ten minutes if no input data is received by the **CONTROL** port. **Default: 3 min**
Change Password	Change the current password. This affects only the **su** (administrator) user name, because under the other user names (**user** or **tech**) it is not possible to change configuration	Alphanumeric string of 4 to 8 characters. See procedure below.

```
                                        FCD-155
Terminal

 1. Change Password>
 2. Pop Alarm            (OFF)
 3. Security Timeout>    (Timeout 3 min)










>



ESC-prev.menu; !-main menu; &-exit; @-output                         1 user(s)
-------------------------------------------------------------------------------
```

Figure C-24. Typical ***Terminal*** *Screen*

➤ **To change the current password:**

1. After typing **1** on the **Terminal** screen and pressing **<Enter>**, you will see the **Change Password** screen. A typical **Change Password** screen is shown in *Figure C-25*.
2. On the **Change Password** screen, select **1.** Now enter the current password, to verify your authorization, and then press **<Enter>**.

Note *Password characters are not displayed on the screen (only an asterisk * appears for each character you type).*

3. If your password is accepted, select **2**: the screen changes to the password entry screen.
4. On the password entry screen, select **1** and then type the new password (4 to 8 characters). Pay attention to case.
5. After pressing **<Enter>**, the screen is updated. Select again **1** and then type the new password a second time for confirmation. Press **<Enter>** when done.
6. To activate the new password, type **#** to save and then confirm the action.

```
                                    FCD-155
Change Password

 1. Old Password    ... ()
 2. New Password    ... ()











>



ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-25. Typical **Change Password** Screen*

C.14 Configuration – Date & Time Update Screen

Purpose

Update the time of day and date of the FCD-155 internal real-time clock, and select the date format displayed on the FCD-155 screens.

Reached from

Configuration – System – item 4

Use

A typical **Date & Time Update** screen is shown in *Figure C-26*.

```
                                  FCD-155
Date & Time Update
 1. Set Time (hh:mm:ss)...   (10:38:25)
 2. Set Date (dd/mm/yyyy)... (1/7/2003)
 3. Set Date Format    >     (dd/mm/yyyy)





>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-26. Typical **Date & Time Update** Screen*

➤ **To change the time:**

1. Type **1**, and then press **<Enter>**.
2. Type the desired time in the 24-hour format. Make sure to type any leading zeroes, for example, for 9 hours type 09 (no need to type the separators :). It is recommended to set the time about one minute beyond the desired time, and then press **<Enter>** at the correct instant.

➤ **To change the date:**

1. Type **2**, and then press **<Enter>**.
2. Type the desired date in the format appearing in the line of item 3 (**dd** stands for day, **mm** for month and **yyyy** for year). Make sure to type any leading zeroes, for example, for September type 09.
3. When done, press **<Enter>**.

➤ **To change the date format:**

1. Type **3**, and then press **<Enter>** to display the **Set Date Format** screen.
2. On the **Set Date Format** screen, type the number corresponding to the desired date format and then press **<Enter>**.
3. When done, type **#** to save and then confirm the action.

C.15 Configuration – Factory Default

Purpose

Reload the factory-default configuration, instead of the user's configuration.

This action can be used to create a clean, known starting point or delete the existing configuration before starting configuring the FCD-155 for operation in a new application.

Reached from

Configuration – System – item 5

Use

➤ **To reload the factory-default parameters:**

1. Select item **5** – **Factory Default** on the **System** menu.
2. You will see **Are you sure you want to initialize to default configuration?:**
   - To abort, type **n**.
   - To confirm, type **y.**
3. If you confirmed, you must save the new configuration before it is actually activated:
   - If you change your mind, undo by typing **%**.
   - To activate the default configuration, type **#** (the **Save** command). In this case, You will see **Are you sure you want to update configuration?** and therefore you must confirm again:
     - To abort, type **n**.
     - To confirm, type **y.**
4. At this stage, the FCD-155 switches to the default parameters.

Note *Usually, you must press **<Enter>** before you see again the menu.*
However, if the FCD-155 did not use the default supervisory port communication parameters, then before you can establish again communication with the FCD-155 you must change the supervisory terminal communication parameters to the default values: 115.2 kbps, one start bit, eight data bits, no parity, one stop bit and VT-100 terminal emulation.

C.16 Configuration – Reset Device

Purpose

Reset the FCD-155.

Resetting does not erase the configuration data changed by the user, even it has not yet saved.

Reached from

Configuration – System – item 6

Use

➤ **To reset the FCD-155:**

1. Select item **6** – **Reset Device** on the **System** menu.
2. You will see **Are you sure you want to reset device?:**
   - To abort, type **n**.
   - To confirm, type **y.**
3. At this stage, the FCD-155 is reset.

C.17 Configuration – Physical Ports Submenu

Figure C-27 and *Figure C-28* show the structure of the **Physical Ports** submenu for the main FCD-155 versions.

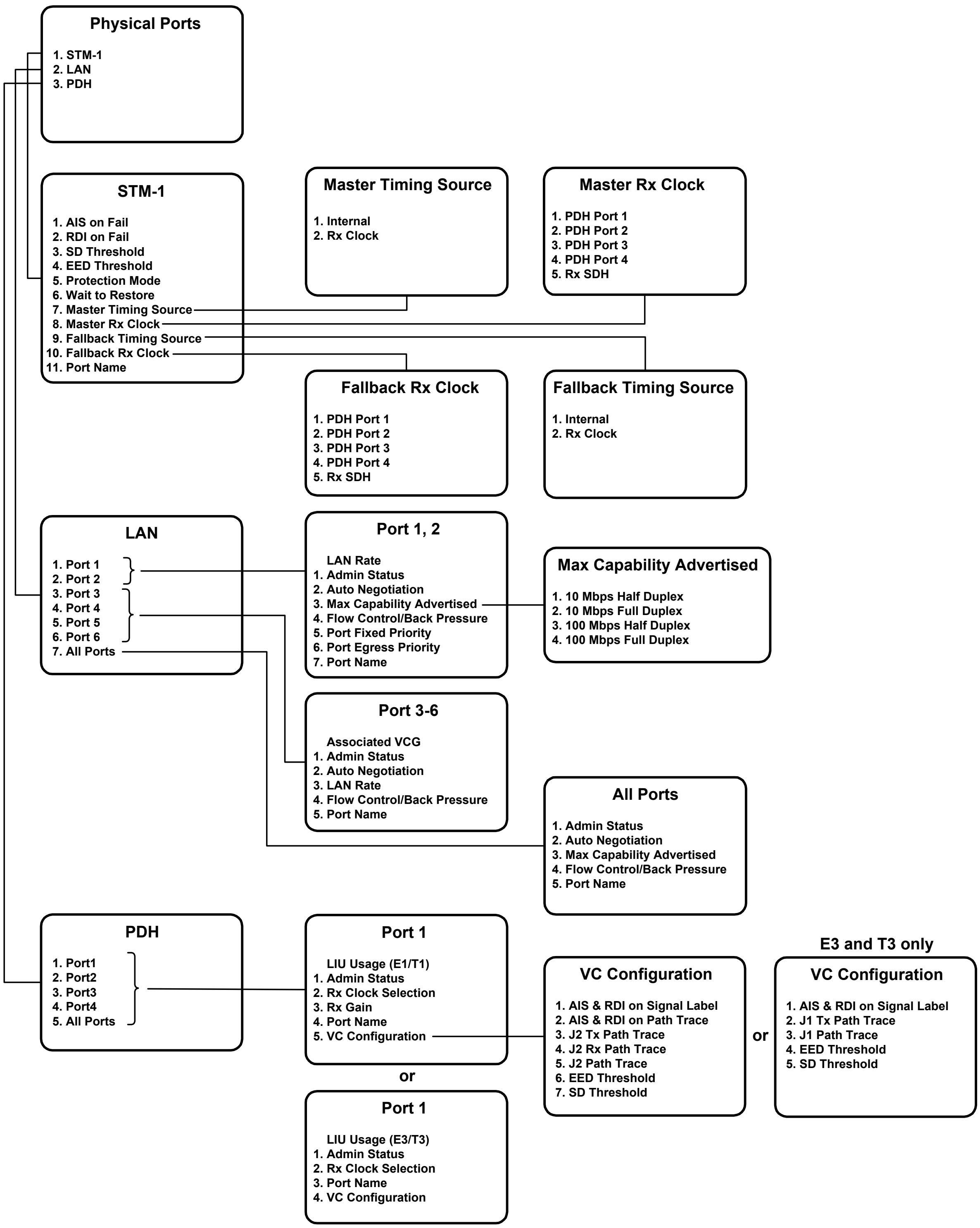


Figure C-27. ***Configuration – Physical Ports*** *Submenu Structure (SDH Versions with PDH Ports)*

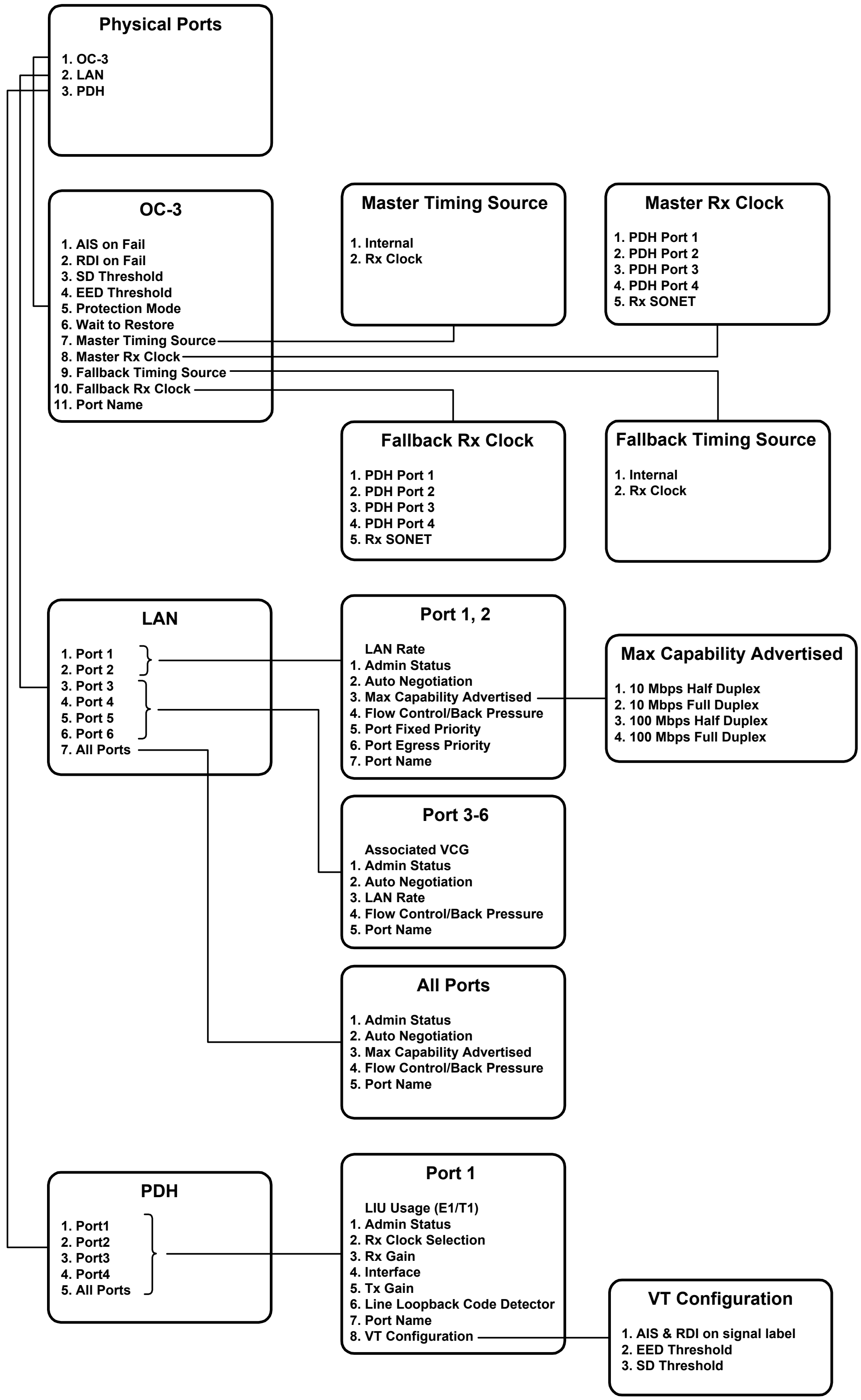


*Figure C-28. **Configuration – Physical Ports** Submenu Structure (SONET Versions)*

C.18 Configuration – Physical Ports Selection Screen

Purpose

Select the type of physical ports to be configured.

Reached from

Configuration – Physical Ports – item 1

Use

The items appearing on the **Physical Ports** selection screen depend on the specific FCD-155 version. A typical screen for an FCD-155 with SDH network interface and PDH ports is shown in *Figure C-29*. The differences between this typical screen and other screens are as follows:

- For FCD-155 with SONET interface: item **1 – STM-1** is replaced by item **1 – OC-3**.
- Item **3 – PDH** is included only for FCD-155 units equipped with PDH interfaces link, respectively.

```
                                FCD-155
Physical Ports

 1. STM-1 >
 2. LAN   >
 3. PDH   >









>



ESC-prev.menu; !-main menu; &-exit; @-Output                  1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-29. Typical **Physical Ports** Selection Screen*

➤ **To select the type of ports to be configured:**

Type the corresponding item number and then press **<Enter>**.

C.19 Configuration – STM-1 (Physical Ports) Screen

Purpose

Configure the physical port parameters of the STM-1 network interface.

Reached from

Configuration – Physical Ports – item 1

Use

A typical **STM-1** screen for an FCD-155 unit with PDH interfaces is shown in *Figure C-30*.

```
                                   FCD-155
STM-1

 1. AIS on Fail             >    (Enable)
 2. RDI on Fail             >    (Enable)
 3. SD Threshold            >    (1E-6)
 4. EED Threshold           >    (1E-3)
 5. Protection Mode         >    (Automatic)
 6. Wait to restore         [1 - 255]... (1)
 7. Master Timing source    >    (Rx Clock)
 8. Master Rx clock         >    (Rx SDH)
 9. Fallback Timing source>    (Rx Clock)
10. Fallback Rx clock       >    (Rx SDH)
11. Port Name               ... ()

>

ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-30. Typical **STM-1** Physical Port Configuration Screen (FCD-155 with PDH Interfaces)*

The parameters that can be configured by means of the **STM-1** screen are described in *Table C-7*.

➤ **To change an STM-1 physical port parameter:**

1. Type the number corresponding to the desired parameter (all references are made to *Figure C-30*), and then press **<Enter>:**
   - For items **1, 2** and **5**, the selection is toggled as soon as you press **<Enter>**
   - For items **6** and **11**, you can type the desired value in the same line. When done press **<Enter>**.
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-7* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **STM-1** screen.
2. When done, type **#** to save and then confirm the action.

Table C-7. ***Configuration – Physical Ports – STM-1*** *Parameters*

Parameter	Function	Values
AIS on Fail	Controls the sending of AIS in case one or more of the following SDH fault conditions is present: • LOS (loss of SDH signal) • LOF (loss of SDH frame) • TIM (failure of internal timing generator) • SSF (synchronization source failure)	**ENABLE** AIS is sent in case one the listed fault conditions is present. **DISABLE** AIS sending is disabled. **Default: ENABLE**
RDI on Fail	Controls the sending of RDI (remote defect indication) in case of failure	**ENABLE** RDI sending is enabled. **DISABLE** RDI sending is disabled. **Default: ENABLE**
SD Threshold	Selects the BER value, which if exceeded results in the generation of the signal-degraded alarm	The available selections are 10E-6 (BER threshold of 10^{-6}), 10E-7 (10^{-7}), 10E-8 (10^{-8}) or 10E-9 (10^{-9}). **Default: 10E-6** (BER of 10^{-6})
EED Threshold	Selects the BER value, which if exceeded results in the generation of the error rate degradation alarm	The available selections are 10E-3 (BER threshold of 10^{-3}), 10E-4 (10^{-4}) or 10E-5 (10^{-5}). **Default: 10E-3** (BER of 10^{-3})
Protection Mode	Controls the use of MSP 1+1 protection switching on the link to the SDH network	**AUTOMATIC –** Protection switching is enabled: the FCD-155 will switch (**flip**) to the other network link in case the currently active link fails. Switching is non-revertive, that is, the FCD-155 will not flip back after the failed link returns to normal operation, but only in case the currently used link fails. This option is available only on FCD-155 units with two network interfaces. **OFF –** Protection switching is disabled. **Default:** **AUTOMATIC** for FCD-155 with two network interfaces. **OFF** for FCD-155 with single network interface
Wait to Restore (Seconds)	When protection switching is enabled and a link interface becomes active, specifies the time during which all the alarms reported by the framer will be ignored	The supported range is **1** to **255** seconds, and **N/A** when protection mode is **OFF**. **Default:** **1** when **Protection Mode** is **AUTOMATIC**. **N/A** when **Protection Mode** is **OFF**

Table C-7. ***Configuration – Physical Ports – STM-1*** *Parameters (Cont.)*

Parameter	Function	Values	
Master Timing Source	Selects the master timing reference source used by the FCD-155 for the SDH side. For details on FCD-155 timing subsystem, refer to *Chapter 1*	**Rx Clock**	The master timing reference is the signal selected by means of the **Master Rx Clock** parameter.
		Internal	The master timing reference is the internal FCD-155 oscillator.
		Default: Rx Clock	
Master Rx Clock	Selects the master receive clock to be used as timing reference source for the SDH side when **Master Timing Source** is **Rx Clock**	**Rx SDH**	Use of clock signal recovered from the received SDH line signal.
		PDH Port 1 to **Port 4**	Use of clock signal recovered from the received line signal of the corresponding PDH port. This option is available only when the FCD-155 is equipped with PDH interfaces.
		Default: Rx SDH	
Fallback Timing Source	Selects the fallback timing reference source used by the FCD-155 for the SDH side. Make sure to select a source different from that selected by the **Master Timing Source** field	**Rx Clock**	The fallback timing reference is the signal selected by means of the **Fallback Rx Clock** parameter.
		Internal	The fallback timing reference is the internal FCD-155 oscillator.
		Default: Rx Clock	
Fallback Rx Clock	Selects the master receive clock to be used as timing reference source for the SDH side when **Fallback Timing Source** is **Rx Clock.** Make sure to select a source different from that selected by the **Master Rx Clock** field	**Rx SDH**	Use of clock signal recovered from the received SDH line signal.
		PDH Port 1 to **Port 4**	Use of clock signal recovered from the received line signal of the corresponding PDH port. This option is available only when the FCD-155 is equipped with PDH interfaces.
		Default: Rx SDH	
Port Name	Used to enter a logical name for the STM-1 port	Up to 8 characters.	
		Default: Empty string	

C.20 Configuration – OC-3 (Physical Ports) Screen

A typical **Configuration – OC-3** screen is shown in *Figure C-31*.

This screen is similar to the STM-1 screen for FCD-155 with PDH interfaces, except that it is displayed when the FCD-155 network interface uses the SONET standard.

```
                                    FCD-155
OC-3

 1. AIS on Fail             >    (Enable)
 2. RDI on Fail             >    (Enable)
 3. SD Threshold            >    (1E-6)
 4. EED Threshold           >    (1E-3)
 5. Protection Mode         >    (Automatic)
 6. Wait to restore         [1 - 255]... (1)
 7. Master Timing source    >    (Rx Clock)
 8. Master Rx clock         >    (Rx SONET)
 9. Fallback Timing source>      (Rx Clock)
10. Fallback Rx clock       >    (Rx SONET)
11. Port Name               ... ()


>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
------------------------------------------------------------------------------
```

*Figure C-31. Typical **OC-3** Physical Port Configuration Screen*

➤ **To change an OC-3 physical port parameter:**

Refer to *Section C.19* for instructions.

The only difference is that the **RX SDH** parameters have been replaced with **RX SONET**.

C.21 Configuration – LAN Port Selection Screen

Purpose

Select the LAN port to be configured. You may also configure all the ports with identical parameters, either as a starting point for configuration, or to avoid repeating the configuration steps.

The number of LAN ports depends on the ordered FCD-155 version: 2 or 6.

Reached from

Configuration – Physical Ports – item 2

Use

A typical LAN port selection screen for an FCD-155 equipped with the maximum number of ports (6) is shown in *Figure C-32*. For an FCD-155 with 2 LAN ports, the number of lines on the screen is reduced accordingly.

```
                                    FCD-155
LAN
 1. Port 1   >
 2. Port 2   >
 3. Port 3   >
 4. Port 4   >
 5. Port 5   >
 6. Port 6   >
 7. All Ports>




>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-32. Typical **LAN** Port Selection Screen*

➤ **To select the LAN port to be configured:**

Type the corresponding item number (**1** to **6**, or **1**, **2**), and then press **<Enter>**.

➤ **To configure all the LAN ports with similar parameters:**

Type the last number on the screen, **3** or **7**, and then press **<Enter>**.

C.22 Configuration – LAN (Physical Ports) Screen

Purpose

Configure the physical layer parameters of the selected FCD-155 LAN port.

The displayed screen depends on your selection: port 1 or 2, port 3 to 6, or all the ports.

Reached from

Configuration – Physical Ports – LAN – item 1 to **7**

Use – LAN Ports 1, 2

A typical **LAN** screen for port 1, with auto-negotiation enabled, is shown in *Figure C-33*. The port is identified in the screen header (port 1 in *Figure C-33*).

When the port is configured for auto-negotiation, the port identification is followed by a **LAN Rate** line that indicates the current operating rate and mode (for example, 100 Mbps full duplex in *Figure C-33*).

```
                                    FCD-155
Port 1

    Lan Rate                    >   (100 Mbps Full Duplex)
 1. Admin Status                    (Enable)
 2. Auto Negotiation                (Enable)
 3. Max capability advertised >     (100 Mbps Full Duplex)
 4. Flow Control/Back Pressure      (Yes)
 5. Port Fixed Priority             (Yes)
 6. Port Egress Priority        >   (3)
 7. Port Name                   ... ()



>

ESC-prev.menu; !-main menu; &-exit; @-output                         1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-33. Typical **LAN** Physical Port Configuration Screen (Ports 1 and 2, Auto-negotiation Enabled)*

The parameters that can be configured by means of the **LAN** screen are described in *Table C-8*.

➤ **To change a LAN physical port parameter:**

1. Type the number corresponding to the desired parameter, and then press **<Enter>:**
   - For items **1, 2, 4, 5**, the selection is toggled as soon as you press **<Enter>**.
   - For item **7**, you can type the desired value in the same line. When done, press **<Enter>**.
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-8* lists the options displayed on the selection screen.

On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **LAN** screen.

2. When done, type **#** to save and then confirm the action.

Table C-8. ***Configuration – Physical Ports – LAN*** *Parameters*

Parameter	Function	Values	
Admin Status	Used to enable/disable the flow of traffic through the selected LAN port	**DISABLE**	The flow of traffic is disabled. This state should be selected as long as the configuration of the corresponding port has not yet been completed, or when it is necessary to stop traffic flow through the port.
		ENABLE	The flow of traffic is enabled.
		Default:	**ENABLE** for all the ports within the number specified in the **Number of External LAN Ports** line of the **Configuration – Quick Setup** screen. **DISABLE** for other ports.
Auto Negotiation	Controls the use of auto-negotiation for the corresponding port. Auto-negotiation is used to select automatically the mode providing the highest possible traffic handling capability	**ENABLE**	Auto-negotiation is enabled.
		DISABLE	Auto-negotiation is disabled.
		Default: ENABLE	
Max Capability Advertised	Specifies the highest traffic handling capability to be advertised during the auto-negotiation process. The operating mode selected as a result of auto-negotiation cannot exceed the advertised capability. This parameter is displayed only when auto-negotiation is enabled	The available selections are listed in ascending order of capabilities: **10Mbps half duplex** – Half-duplex operation at 10 Mbps. **10Mbps full duplex** – Full-duplex operation at 10 Mbps. **100Mbps half duplex** – Half-duplex operation at 100 Mbps. **100Mbps full duplex** – Full-duplex operation at 100 Mbps. **Default: 100Mbps full duplex**	
LAN Rate	Specifies the LAN rate and operating mode. This parameter is displayed only when auto-negotiation is disabled	The available selections are as for the **Max Capability Advertised** parameter. **Default: 100Mbps full duplex**	

*Table C-8. **Configuration – Physical Ports – LAN** Parameters (Cont.)*

Parameter	Function	Values
Flow Control/ Back Pressure	Controls the use of flow control (when operating in the full duplex mode), or back pressure (when operating in the half-duplex mode)	**YES** Flow control or back pressure is enabled. **NO** Flow control and back pressure are disabled. **Default: YES**
Port Fixed Priority	Controls the use of fixed egress priority	**YES** Enables to specify an egress priority by means of the **Port Egress Priority** parameter. **NO** The egress priority of packets is determined by queuing, which is controlled by the **Scheduling Mode** parameter on the **Configuration – Bridge** menu. **Default: YES**
Port Egress Priority	Selects the egress priority, when **Port Fixed Priority** parameter is **YES**	The supported range is 0 (lowest) to 3 (highest). **Default: 0**
Port Name	Used to enter a logical name for the LAN port	Up to 8 characters. **Default: Empty string**

Use – LAN Ports 3 to 6

A typical **LAN** screen for port 4, with auto-negotiation enabled, is shown in *Figure C-34*.

```
                                    FCD-155
Port 4

    Lan Rate                     >    (10 Mbps Half Duplex)
    Associated VCG               >    (Group 6)
 1. Admin Status                      (Enable)
 2. Auto Negotiation                  (Enable)
 3. Max capability advertised >       (100 Mbps Full Duplex)
 4. Flow Control/Back Pressure        (Yes)
 5. Port Name                    ...  (N.Y.)







>

ESC-prev.menu; !-main menu; &-exit; @-output                         1 user(s)
------------------------------------------------------------------------------
```

*Figure C-34. Typical **LAN** Physical Port Configuration Screen (Ports 3 to 6)*

The screen shown in *Figure C-34* is similar to that of *Figure C-33*, except for the following:

- The screen includes an additional line, **Associated VCG**, which displays the number of the virtually concatenated group that is used to transport the port traffic over the SDH/SONET network.
- It is not possible to select port priorities, because the ports 3 to 6 do not pass through an Ethernet switch, but are directly routed to the assigned virtually concatenated group.

Use – All LAN Ports

A typical **LAN** screen for all the ports, with auto-negotiation enabled, is shown in *Figure C-35*.

```
                                           FCD-155
All Ports

 1. Admin Status                   (Enable)
 2. Auto Negotiation               (Enable)
 3. Max capability advertised >    (100 Mbps Full Duplex)
 4. Flow Control/Back Pressure     (Yes)
 5. Port Name                  ... ()




>



ESC-prev.menu; !-main menu; &-exit; @-output                     1 user(s)
------------------------------------------------------------------------------
```

*Figure C-35. Typical **LAN** Physical Port Configuration Screen (All Ports)*

The screen shown in *Figure C-35*is similar to that of *Figure C-34*, except that the screen does not include any status and information lines.

Any selection made on this screen is automatically applied to all the ports (including the name). However, you can change the configuration of each individual port as required, starting from the common parameters defined by means of the **All Ports** screen.

C.23 Configuration – PDH Port Selection Screen

Purpose

Select the PDH port to be configured. You may also configure all the four ports with identical parameters.

This option is available only when the FCD-155 is equipped with PDH interfaces.

Reached from

Configuration – Physical Ports – item 3

Use

A typical PDH port selection screen for an FCD-155 with quad E1 or T1 interfaces is shown in *Figure C-36*. When the FCD-155 is equipped with an E3 or T3 interfaces, the screen includes a single item, **PDH Port 1**.

```
                                  FCD-155
PDH

 1. PDH Port 1    >
 2. PDH Port 2    >
 3. PDH Port 3    >
 4. PDH Port 4    >
 5. All Ports>



>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-36. Typical **PDH** Port Selection Screen (FCD-155 with Quad E1 or T1 Interfaces)*

➤ **To select the PDH port to be configured:**

Type the corresponding item number, **1** to **4,** and then press **<Enter>**.

Note *The number of active PDH ports is selected by means of the **Quick Setup** screen (see Section C.5). You can only select PDH ports up to the number defined as active.*

➤ **To configure all the four PDH ports with similar parameters (only for FCD-155 with quad PDH interfaces):**

Type **5** and then press **<Enter>**.

C.24 Configuration – PDH (Physical Ports) Screen – E1 Ports

Purpose

Configure the physical layer parameters of the selected FCD-155 PDH port.

Reached from

Configuration – Physical Ports – PDH – item s 1 to **5**

Use

A typical **PDH** screen for E1 ports is shown in *Figure C-37*. The selected port is identified in the screen header.

```
                                   FCD-155
Port1

    LIU Usage(E1/T1)             >    (E1)
 1. Admin Status                 >    (Enable)
 2. Rx Clock Selection           >    (RX VC12)
 3. Rx Gain                      >    (Short Haul)
 4. Port Name                    ...  ()
 5. VC configuration             >


>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
------------------------------------------------------------------------------
```

*Figure C-37. Typical **PDH** Physical Port Configuration Screen (E1 Ports)*

The parameters that can be configured by means of the **PDH** port configuration screen are described in *Table C-9*.

➤ **To configure the physical port parameters of an E1 PDH port:**

1. Type the number corresponding to the desired parameter, and then press **<Enter>:**
   - To change the **Admin Status**, type **1** and then press **<Enter>**.
   - For item **4**, you can type the desired name in the same line. When done, press **<Enter>**.
   - See separate procedure for item **5 – VC Configuration.**
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-9* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **PDH** screen.
2. When done, type **#** to save and then confirm the action.

*Table C-9. **Configuration – Physical Ports – PDH** Parameters for E1 Ports*

Parameter	Function	Values
LIU Usage (E1/T1)	Used to display the operating mode of the line interface unit (LIU) of the corresponding port	Always displays **E1** and cannot be changed
Admin Status	Used to enable/disable the flow of traffic through the selected PDH port	**DISABLE** The flow of traffic is disabled. This state should be selected as long as the configuration of the corresponding port has not yet been completed, or when it is necessary to stop traffic flow through the port. **ENABLE** The flow of traffic is enabled. **Default: DISABLE**
Rx Clock Selection	Selects the timing reference source used by the FCD-155 for the PDH side. All the PDH ports must use the same timing reference. For details on FCD-155 timing subsystem, refer to *Chapter 1*	**Rx VC12** PDH reference source locked to the receive clock recovered from the corresponding VC-12 timing. This mode locks the local timing of the PDH port to the timing of the PDH signal received by the remote equipment. This locks the local user's equipment timing reference to that of the remote PDH equipment. **Rx SDH** PDH reference source locked to the receive clock recovered from the line signal by the STM-1 interface. This locks the PDH timing reference to that of the SDH network. **Default: Rx VC12**
Rx Gain	Determines the maximum attenuation of the receive signal that can be compensated for by the port receive path, to obtain the BER performance required by the standards	**SHORT HAUL –** Maximum attenuation of 12 dB, relative to the nominal transmit level (0 dB). **LONG HAUL** – Maximum attenuation of 36 dB, relative to the nominal transmit level (0 dB). The lower attenuation may actually improve the performance when operating over relatively short line sections, especially when operating over multi-pair cables. In such cables, significant interference is generated by the signals carried by other pairs, and therefore a weak desired signal may be masked by the interference. **Default: SHORT HAUL**

*Table C-9. **Configuration – Physical Ports – PDH** Parameters for E1 Ports (Cont.)*

Parameter	Function	Values
Port Name	Used to enter a logical name for the PDH port	Up to 8 characters. **Default: Empty string**
VC Configuration	Used to configure the parameters of the VC-12 used to transport the port payload	See procedure below

➤ **To configure the VC-12 parameters of an E1 PDH port:**

1. Type **5** and then press **<Enter>.** You will see the VC-12 configuration screen. A typical **VC Configuration** screen is shown in *Figure C-38*.
2. Type the desired item number and then press **<Enter>**:
   - For items **1, 2, 3**, the selection is toggled as soon as you press **<Enter>**.
   - For item **5**, you can type the desired value in the same line. When done press **<Enter>**.
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-10* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **VC Configuration** screen.
3. When done, type **#** to save and then confirm the action.

The parameters that can be configured by means of the **VC Configuration** screen are described in *Table C-10*.

```
                                              FCD-155
VC Configuration
 1. AIS & RDI on Signal Label>    (Enable)
 2. AIS & RDI on Path Trace  >    (Enable)
 3. J2 Tx Path Trace         >    (Enable)
 4. J2 Rx Path Trace         >    (Enable)
 5. J2 Path Trace    [0 - ff]...  (2)
 6. EED Threshold            >    (1E-3)
 7. SD Threshold             >    (1E-6)




>

ESC-prev.menu; !-main menu; &-exit; @-output                         1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-38. Typical **VC Configuration** Screen for E1 PDH Physical Ports*

*Table C-10. **VC Configuration** Parameters for E1 PDH Ports*

Parameter	Function	Values
AIS & RDI on Signal Label	Controls the sending of AIS and RDI indications by the corresponding port, in case the received signal label is different from the expected signal label	**ENABLE** AIS and RDI are sent when a signal label mismatch is detected. **DISABLE** AIS and RDI are not sent when signal label mismatch is detected. Nevertheless, AIS and RDI are still sent in case of LOP (loss of pointer) or ***unequipped signal label*** condition. **Default: ENABLE**
AIS & RDI on Path Trace	Controls the sending of AIS and RDI indications by the corresponding port, in case the received path trace label (carried in SDH overhead byte J2) is different from the expected path trace label	**ENABLE** AIS and RDI are sent in case a signal label mismatch is detected. **DISABLE** AIS and RDI are not sent when a signal label mismatch is detected. Nevertheless, AIS and RDI are still sent in case a LOP (loss of pointer) or ***unequipped signal label*** condition is detected. **Default: ENABLE**
J2 Tx Path Trace	Controls the sending of the path trace label (carried in byte J2 of the SDH overhead) by the corresponding port	**ENABLE** The path trace label is sent. **DISABLE** No path trace label is sent. **Default: DISABLE**
J2 Rx Path Trace	Controls the checking of the received path trace label by the corresponding port	**ENABLE** Path trace label is checked. **DISABLE** Path trace label is not checked. **Default: DISABLE**
J2 Path Trace	Specifies the path trace label. This parameter is relevant only when **J2 Tx Path Trace** and/or **J2 Rx Path Trace** is enabled	Alphanumeric string of up to 15 characters. Make sure to configure all the 15 characters **Default: Empty string**
EED Threshold	Selects the BER value, which if exceeded results in the generation of the error rate degradation alarm for the corresponding port	The available selections are 10E-3 (BER threshold of 10^{-3}), 10E-4 (10^{-4}), 10E-5 (10^{-5}). **Default: 10E-3** (BER of 10^{-3})
SD Threshold	Selects the BER value, which if exceeded results in the generation of the signal-degraded alarm for the corresponding port	The available selections are 10E-6 (BER threshold of 10^{-6}), 10E-7 (10^{-7}), 10E-8 (10^{-8}) or 10E-9 (10^{-9}). **Default: 10E-6** (BER of 10^{-6})

C.25 Configuration – PDH (Physical Ports) Screen – T1 Ports

Purpose

Configure the physical layer parameters of a selected FCD-155 T1 PDH port.

Reached from

Configuration – Physical Ports – PDH – items 1 to **5**

Use

Typical **PDH** screens for T1 ports are shown in *Figure C-39* and *Figure C-40*. The selected port is identified in the screen header.

The parameters displayed on the screen depend on the selected interface type: CSU or DSU, and on the network interface – SDH or SONET. The parameters that can be configured by means of the **PDH** port configuration screen, for both interface options, are described in *Table C-11*.

```
                                    FCD-155
Port1
    LIU Usage(E1/T1)            >    (T1)
 1. Admin Status                >    (Enable)
 2. Rx Clock Selection          >    (SONET)
 3. Rx Gain                     >    (Short Haul)
 4. Interface                   >    (CSU)
 5. Tx Gain                     >    (7.5 dB)
 6. Line Loopback code detector>     (Disable)
 7. Port Name                   ...  ()
 8. VT configuration            >

>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-39. Typical **PDH** Physical Port Configuration Screen – T1 Ports with CSU Interface*

```
                                    FCD-155
Port1
    LIU Usage(E1/T1)            >    (T1)
 1. Admin Status                >    (Enable)
 2. Rx Clock Selection          >    (SONET)
 3. Rx Gain                     >    (Short Haul)
 4. Interface                   >    (DSU)
 5. Tx Line Length              >    (0-133 FEET)
 6. Line Loopback code detector>     (Disable)
 7. Port Name                   ...  ()
 8. VT configuration            >

>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-40. Typical **PDH** Physical Port Configuration Screen – T1 Ports with DSU Interface*

➤ **To configure the physical port parameters of a T1 PDH port:**

1. Type the number corresponding to the desired parameter, and then press **<Enter>:**
   - For item **1**, the selection is toggled as soon as you press **<Enter>**.
   - For item **7**, you can then type the desired name in the same line. When done, press **<Enter>**.
   - See separate procedure for item **8 – VC** or **VT Configuration.**
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-11* lists the options displayed on the selection screen. On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **PDH** screen.
2. When done, type **#** to save and then confirm the action.

Table C-11. ***Configuration – Physical Ports – PDH*** *Parameters for T1 Ports*

Parameter	Function	Values
LIU Usage (E1/T1)	Displays the function of the line interface unit (LIU) of the corresponding port	Always displays T**1** and cannot be changed
Admin Status	See *Table C-9*	
Rx Clock Selection	See *Table C-9*	The clock options depend on the FCD-155 network interface: • For SDH interface, the selections are **SDH**, and **RX VC-11** instead of **RX VC-12** • For SONET interface, the selections are **SONET** instead of **SDH**, and **RX VT-1.5** instead of **RX VC-12**
Rx Gain	See *Table C-9*	
Interface	Selects the port interface type	**CSU** CSU interface. **DSU** DSU interface. **Default: CSU**
Tx Gain	Determines the attenuation of the T1 output signal, relative to the nominal transmit level (see *Note*). The T1 output transmit level must be adjusted to ensure reliable operation of the network, and for compliance with FCC Rules Part 68A. This parameter is displayed only when **Interface** is **CSU**	**0 dB** No attenuation. **7.5 dB** Attenuation of 7.5 dB relative to the nominal transmit level. **15 dB** Attenuation of 15 dB relative to the nominal transmit level. **22.5 dB** Attenuation of 22.5 dB relative to the nominal transmit level. **Default: 0 dB**

*Table C-11. **Configuration – Physical Ports – PDH** Parameters for T1 Ports (Cont.)*

Parameter	Function	Values
Tx Gain *(cont.)*	***Note***	*The **Tx Gain** adjustment is used to minimize the interference caused by your transmit signal to other users that transmit their signals on other pairs of the same cable. The required setting depends mainly on the length of the cable that connects between the T1 port and the first repeater down the line.* *Repeaters are usually located every mile, and therefore, they are designed to optimally handle signals attenuated by one mile length of cable. If the T1 port were closer, the repeater would receive your signal at a higher level. This will not significantly improve the handling of your signal, but will certainly increase the interference coupled from your pair to repeaters that serve other pairs in the cable. To prevent this, you can select an attenuation value that will bring your signal level closer to the expected repeater signal level. This is achieved by connecting, as required, one, two, or three artificial line sections in series with your T1 transmit signal. Each line section introduces a nominal attenuation of 7.5 dB (equivalent to the attenuation of approximately 1000 feet of cable). Your system administrator or data carrier will tell you the proper setting for each port.*
Tx Line Length	Controls the T1 line transmit signal characteristics. The transmit signal mask is selected in accordance with the transmit line length, to meet DSX-1 requirements, as specified by AT&T CB-119 and ANSI T1.102-1987. This parameter is displayed only when **Interface** is **DSU**	Select the value corresponding to the length of the cable (in feet) connected between the T1 port connector and the network access point: • **000 to 133 FEET** • **133 to 266 FEET** • **266 to 399 FEET** • **399 to 533 FEET** • **533 to 655 FEET** **Default: 000 to 133 FEET**
Line Loopback Code Detector	Enables/disables the network line loopback (LLB) code detector (see *Chapter 4* for details)	**ENABLE** – The LLB code detector is enabled. In this case, external equipment connected to the port can activate the LLB, for test purposes. **DISABLE** – The LLB code detector is disabled. **Default: DISABLE**
Port Name	See *Table C-9*	
VT or **VC Configuration**	Used to configure the parameters of the VC-11 (for SDH network interfaces) or VT-1.5 (for SONET network interfaces) used to transport the port payload	See procedure below

➤ **To configure the VC-11 or VT-1.5 parameters of a T1 PDH port:**

1. Type **8** on the **PDH Ports** screen, and then press **<Enter>.** You will see the **VT Configuration** or **VC Configuration** screen. A typical **VT Configuration** screen for T1 ports is shown in *Figure C-41*; the **VT Configuration** screen is similar, except for its header.
2. Type the desired item number and then press **<Enter>.** You will see the corresponding selection screen. For a description of the parameters values, refer to the **Values** column in *Table C-10*.

On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **VT Configuration** screen.

```
                                    FCD-155
VT Configuration

 1. AIS & RDI on Signal Label>    (Enable)
 2. EED Threshold             >    (1E-3)
 3. SD Threshold              >    (1E-6)







>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-41. Typical **VT Configuration** Screen for PDH T1 Physical Ports*

3. When done, type **#** to save and then confirm the action.

C.26 Configuration – PDH (Physical Ports) Screen – E3 Ports

Purpose

Configure the physical layer parameters of the FCD-155 E3 PDH port.

Reached from

Configuration – Physical Ports – PDH – item 1

Use

A typical **PDH** screen for E3 ports is shown in *Figure C-42*. The selected port is identified in the screen header.

```
                                   FCD-155
Port1

    LIU Usage(E3/T3)             >    (E3)
 1. Admin Status                 >    (Enable)
 2. Rx Clock Selection           >    (SDH)
 3. Port Name                    ...  ()
 4. VC configuration             >






>

ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
------------------------------------------------------------------------------
```

*Figure C-42. Typical **PDH** Physical Port Configuration Screen (E3 Ports)*

The parameters that can be configured by means of the **PDH** port configuration screen are described in *Table C-12*.

➤ **To configure the physical port parameters of the E3 PDH port:**

1. Type the number corresponding to the desired parameter, and then press **<Enter>:**
   - To change the **Admin Status**, type **1** and then press **<Enter>**.
   - For item **3**, you can type the desired name in the same line. When done, press **<Enter>**.
   - See separate procedure for item **4 – VC Configuration.**
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-12* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **PDH** screen.
2. When done, type **#** to save and then confirm the action.

*Table C-12. **Configuration – Physical Ports – PDH** Parameters for E3 Ports*

Parameter	Function	Values
LIU Usage (E3/T3)	Used to display the operating mode of the line interface unit (LIU) of the port	Always displays **E3** and cannot be changed
Admin Status	See *Table C-9*	
Rx Clock Selection	Selects the timing reference source used by the FCD-155 for the PDH side. For details on FCD-155 timing subsystem, refer to *Chapter 1*	**Rx VC3** PDH reference source locked to the receive clock recovered from the corresponding VC-3 timing. This mode locks the local timing of the PDH port to the timing of the PDH signal received by the remote equipment. This locks the local user's equipment timing reference to that of the remote PDH equipment. **Rx SDH** PDH reference source locked to the receive clock recovered from the line signal by the STM-1 interface. This locks the PDH timing reference to that of the SDH network. **Default: Rx VC3**
Port Name	Used to enter a logical name for the PDH port	Up to 8 characters. **Default: Empty string**
VC Configuration	Used to configure the parameters of the VC-3 used to transport the port payload	See procedure below

➤ **To configure the VC-3 parameters of the E3 PDH port:**

1. Type **4** and then press **<Enter>.** You will see the VC-3 configuration screen. A typical **VC Configuration** screen is shown in *Figure C-43*.

   The parameters that can be configured by means of the **VC Configuration** screen are described in *Table C-13*.

2. Type the desired item number and then press **<Enter>**:
   - For items **1, 2, 3**, the selection is toggled as soon as you press **<Enter>**.
   - For item **4**, you can type the desired value in the same line. When done press **<Enter>**.
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-13* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **VC Configuration** screen.

3. When done, type **#** to save and then confirm the action.

The parameters that can be configured by means of the **VC Configuration** screen are described in *Table C-13*.

```
                                   FCD-155
VC Configuration
 1. AIS & RDI on Signal Label>    (Enable)
 2. J1 Tx Path Trace         >    (Enable)
 3. J1 Path Trace            ...  ()
 4. EED Threshold            >    (1E-3)
 5. SD Threshold             >    (1E-6)





>

ESC-prev.menu; !-main menu; &-exit; @-output                      1 user(s)
------------------------------------------------------------------------------
```

*Figure C-43. Typical **VC Configuration** Screen for E3 PDH Physical Ports*

*Table C-13. **VC Configuration** Parameters for E3 PDH Ports*

Parameter	Function	Values
AIS & RDI on Signal Label	See *Table C-10*	
J1 Tx Path Trace	Controls the sending of the path trace label (carried in byte J1 of the SDH overhead) by the port	**ENABLE** The path trace label is sent. **DISABLE** No path trace label is sent. **Default: DISABLE**
J1 Path Trace	Specifies the path trace label. This parameter is relevant only when **J1 Tx Path Trace** is enabled	Alphanumeric string of up to 15 characters. Make sure to configure all the 15 characters **Default: Empty string**
EED Threshold	See *Table C-10*	
SD Threshold	See *Table C-10*	

C.27 Configuration – PDH (Physical Ports) Screen – T3 Ports

Purpose

Configure the physical layer parameters of the FCD-155 T3 PDH port.

Reached from

Configuration – Physical Ports – PDH – item 1

Use

A typical **PDH** screen for the T3 port of an FCD-155 with SONET network interface is shown in *Figure C-44*. The screen for the T3 port of an FCD-155 with SDH network interface is similar.

The selected port is identified in the screen header.

```
                                   FCD-155
Port1

    LIU Usage(E3/T3)           >    (T3)
 1. Admin Status               >    (Enable)
 2. Rx Clock Selection         >    (SONET)
 3. Port Name                  ...  ()





>

ESC-prev.menu; !-main menu; &-exit; @-output                           1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-44. Typical **PDH** Physical Port Configuration Screen (T3 Ports)*

The parameters that can be configured by means of the **PDH** port configuration screen are described in *Table C-14*.

➤ **To configure the physical port parameters of the T3 PDH port:**

1. Type the number corresponding to the desired parameter, and then press **<Enter>:**
   - To change the **Admin Status**, type **1** and then press **<Enter>**.
   - For item **2**, you will see a selection screen. In this case, the **Values** column in *Table C-14* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **PDH** screen.
   - For item **3**, you can type the desired name in the same line. When done, press **<Enter>**.
2. When done, type **#** to save and then confirm the action.

*Table C-14. **Configuration – Physical Ports – PDH** Parameters for T3 Ports*

Parameter	Function	Values
LIU Usage (E3/T3)	Used to display the operating mode of the line interface unit (LIU) of the port	Always displays T3 and cannot be changed
Admin Status	See *Table C-9*	
Rx Clock Selection	See *Table C-9*	The clock options depend on the FCD-155 network interface: • For SDH interface, the selections are **SDH**, and **RX VC-3** instead of **RX VC-12** • For SONET interface, the selections are **SONET** instead of **SDH**, and **RX STS** instead of **RX VC-12**
Port Name	Used to enter a logical name for the PDH port	Up to 8 characters. **Default: Empty string**

C.28 Configuration – Virtual Ports Submenu

Figure C-45 show the structure of the **Virtual Ports** submenu for FCD-155 with PDH interfaces using the SDH network interface, and *Figure C-46* shows the submenu for an FCD-155 with SONET network interface.

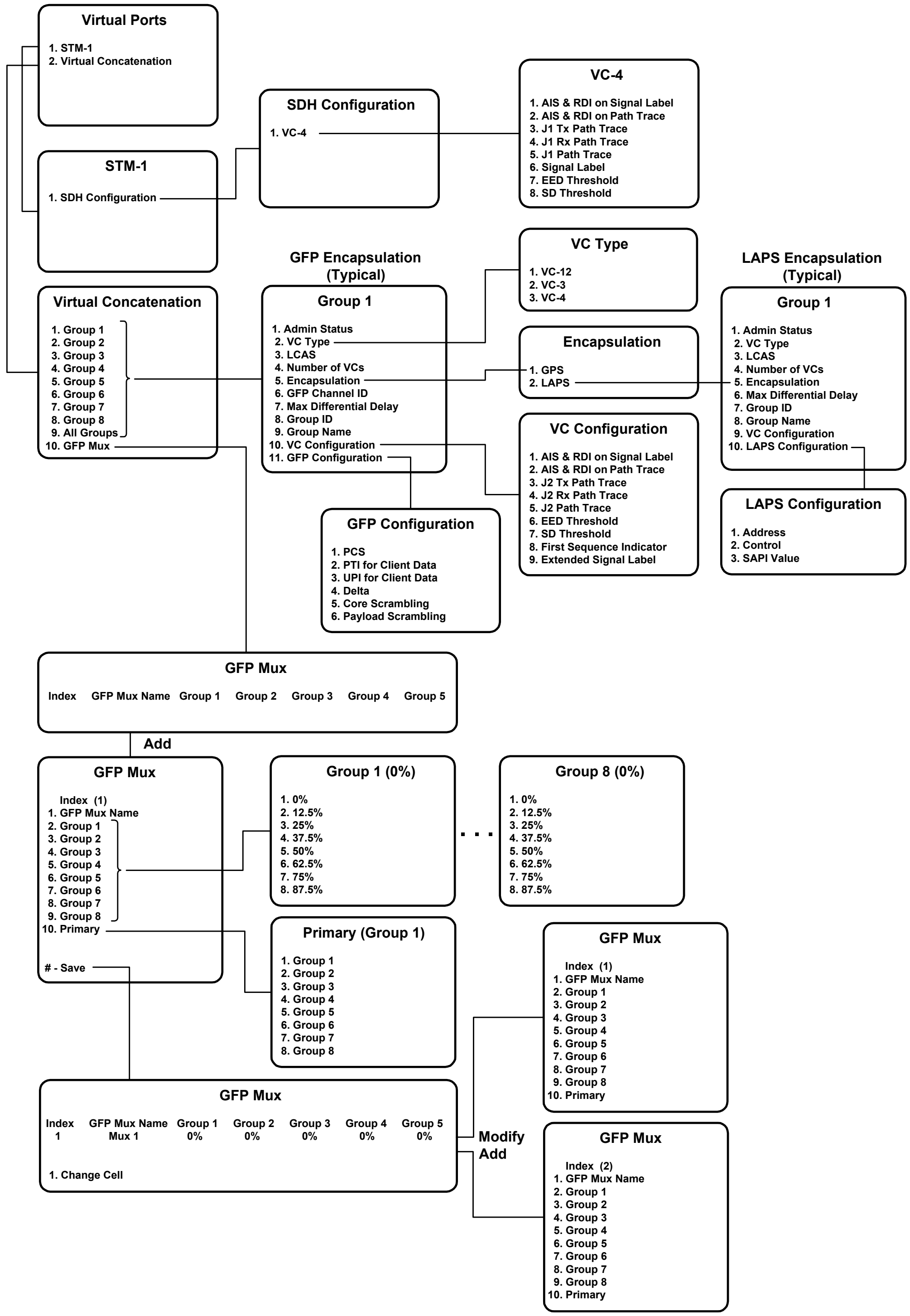


*Figure C-45. **Configuration – Virtual Ports** Submenu Structure (SDH Network, FCD-155 with PDH Interfaces)*

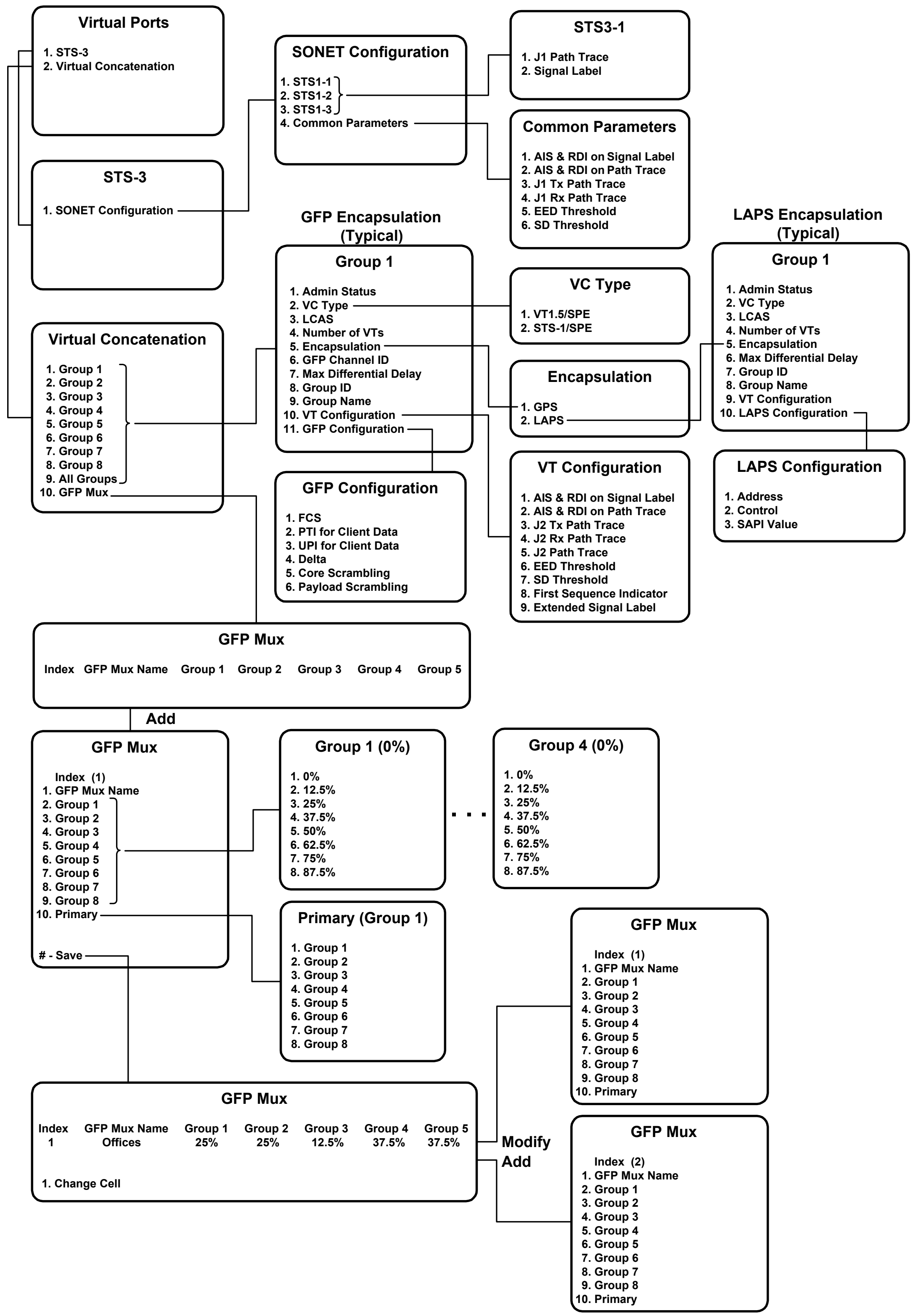


Figure C-46. ***Configuration – Virtual Ports*** *Submenu Structure (SONET Network)*

C.29 Configuration – Virtual Ports Selection Screen

Purpose

Select the type of virtual ports to be configured.

Reached from

Configuration – Virtual Ports

Use

A typical **Virtual Ports** screen for an FCD-155 with SDH network interface is shown in *Figure C-47*.

A typical screen for an FCD-155 with SONET network interface is shown in *Figure C-48*.

```
                                              FCD-155
Virtual Ports

 1. STM-1                >
 2. Virtual Concatenation>







>

ESC-prev.menu; !-main menu; &-exit; @-Output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-47. Typical **Virtual Ports** Selection Screen (SDH Network Interface)*

```
                                              FCD-155
Virtual Ports

 1. STS-3                >
 2. Virtual Concatenation>







>

ESC-prev.menu; !-main menu; &-exit; @-Output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-48. Typical **Virtual Ports** Selection Screen (SONET Network Interface)*

➤ **To select the type of virtual ports to be configured:**

Type the corresponding item number and then press **<Enter>**.

C.30 Configuration – STM-1or STS-3 (Virtual Ports) Screen

Purpose

Select the scope of STM-1 or STS-3 virtual port configuration.

Reached from

Configuration – Virtual Ports – item 1 and **item 3** (when shown)

Use

A typical screen for an FCD-155 with SDH network interface is shown in *Figure C-49*. A typical screen for an FCD-155 with SONET network interface is shown in *Figure C-50*.

```
                                   FCD-155
STM-1

 1. SDH Configuration>





>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-49. Typical **SDH Configuration** Screen*

```
                                   FCD-155
STS-3

 1. SONET Configuration>





>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-50. Typical **STS-3 Configuration** Screen*

➤ **To select the SDH or SONET virtual port configuration target:**

Type **1** and then press **<Enter>**:

- For SDH configuration screens, see *Section C.31*
- For SONET configuration screens, see *Section C.32*.

C.31 Configuration – SDH Configuration – VC-4 Screen

Purpose

Configure the high-order VC parameters for an FCD-155 with SDH network interface.

Reached from

Configuration – Virtual Ports – STM-1 – SDH Configuration – item 1

Use

A typical **SDH Configuration** screen is shown in *Figure C-51*.

```
                                    FCD-155
SDH Configuration

 1. VC-4>









>

ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-51. Typical **SDH Configuration** Screen*

The only option on the **SDH Configuration** screen is **VC-4**. A typical **VC-4** screen is shown in *Figure C-52*.

```
                                   FCD-155
VC-4

 1. AIS & RDI on signal label    (Enable)
 2. AIS & RDI on path trace      (Enable)
 3. J1 Tx path trace             (Enable)
 4. J1 Rx path trace             (Enable)
 5. J1 path trace            ... ()
 6. Signal Label             [0 - ff]... (2)
 7. EED Threshold            >   (1E-3)
 8. SD Threshold             >   (1E-6)


>

ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-52. Typical **VC-4** Screen*

➤ **To configure the VC-4 virtual port parameters for SDH network interfaces:**

1. Type the desired item number and then press **<Enter>**.
   - For items **1, 2, 3, 4**, the selection is toggled as soon as you press **<Enter>**.
   - For items **5** and **6**, you can type the desired value in the same line. When done, press **<Enter>**.
   - For the other items, after pressing **<Enter>** you will see the corresponding selection screen. In this case, the **Values** column in *Table C-15* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **VC-4** screen.
2. When done, type **#** to save and then confirm the action.

The parameters that can be configured by means of the **VC-4** screen are described in *Table C-15*.

*Table C-15. **Configuration – VC-4** Parameters*

Parameter	Function	Values
AIS & RDI on Signal Label	Controls the sending of AIS and RDI indications by the port, in case the received signal label is different from the expected signal label	**ENABLE** AIS and RDI are sent when a signal label mismatch is detected. **DISABLE** AIS and RDI are not sent when signal label mismatch is detected. Nevertheless, AIS and RDI are still sent in case of LOP (loss of pointer) or ***unequipped signal label*** condition. **Default: ENABLE**
AIS & RDI on Path Trace	Controls the sending of AIS and RDI indications by the port, in case the received path trace label (carried in SDH overhead byte J1) is different from the expected path trace label	**ENABLE** AIS and RDI are sent in case a signal label mismatch is detected. **DISABLE** AIS and RDI are not sent when a signal label mismatch is detected. Nevertheless, AIS and RDI are still sent in case a LOP (loss of pointer) or ***unequipped signal label*** condition is detected. **Default: ENABLE**
J1 Tx Path Trace	Controls the sending of the path trace label (carried in byte J1 of the SDH overhead) by the port	**ENABLE** The path trace label is sent. **DISABLE** No path trace label is sent. **Default: DISABLE**
J1 Rx Path Trace	Controls the checking of the received path trace label by the port	**ENABLE** Path trace label is checked. **DISABLE** Path trace label is not checked. **Default: DISABLE**
J1 Path Trace	Specifies the path trace label. This parameter is relevant only when **J1 Tx Path Trace** and/or **J1 Rx Path Trace** is enabled	Alphanumeric string of up to 15 characters. Make sure to configure all the 15 characters **Default: Empty string**

*Table C-15. **Configuration – VC-4** Parameters (Cont.)*

Parameter	Function	Values
Signal Label	Specifies the expected signal label (one byte)	Hexadecimal number in the range of 0 to FF (two digits). **Default: 2**
EED Threshold	Selects the BER value, which if exceeded results in the generation of the error rate degradation alarm for the port	The available selections are 10E-3 (BER threshold of 10^{-3}), 10E-4 (10^{-4}), 10E-5 (10^{-5}). **Default: 10E-3** (BER of 10^{-3})
SD Threshold	Selects the BER value, which if exceeded results in the generation of the signal-degraded alarm for the port	The available selections are 10E-6 (BER threshold of 10^{-6}), 10E-7 (10^{-7}), 10E-8 (10^{-8}) or 10E-9 (10^{-9}). **Default: 10E-6** (BER of 10^{-6})

C.32 Configuration – STS-3 Screen

Purpose

Configure the high-order SPE parameters for an FCD-155 with SONET network interface. The configuration determines two types of parameters:

- Common configuration parameters, used by all the STS-1 SPE
- Signal label and J1 path trace assigned to each STS-1 SPE.

Reached from

Configuration – Virtual Ports – STS-3 – SONET Configuration – item 1

Use

A typical **SONET Configuration** task selection screen is shown in *Figure C-53*.

```
                                FCD-155
SONET Configuration

 1. STS3-1
 2. STS3-2
 3. STS3-3
 4. Common Parameters






>




ESC-prev.menu; !-main menu; &-exit; @-output                      1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-53. Typical **SONET Configuration** Task Selection Screen*

➤ **To configure the J1 path trace and signal label assigned to a specific STS-1 SPE:**

1. Type the number of the desired STS-1 SPE (**1**, **2** or **3**) and then press **<Enter>**.
2. You will see the corresponding **STS** screen (the selected STS-1 is identified in the header). A typical **STS** screen is shown in *Figure C-54*.

```
                                    FCD-155
STS 3-1
 1. J1 path trace              ... ()
 2. Signal Label       [0 - ff]... (2)




>

ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-54. Typical **STS** Screen*

3. Type **1**, and then press **<Enter>.** Now type the desired J1 path trace string (a unique alphanumeric string that must include 15 characters) and then press **<Enter>**.
4. Type **2**, and then press **<Enter>.** Now type the desired signal label (two hexadecimal digits in the range of 00 to FF). The default is **2**.

Note *Make sure the **J1 Tx Path Trace** and/or **J1 Rx Path Trace** parameters on the **Common Parameters** screen are set to **ENABLE**.*

5. Repeat the process for all the other STS-1.

➤ **To define the common parameters of all the STS-1:**

1. Type **4** and then press **<Enter>**.
2. You will see the **Common Parameters** screen. A typical **Common Parameters** screen is shown in *Figure C-55*.

```
                                  FCD-155
Common Parameters
 1. AIS & RDI on signal label    (Enable)
 2. AIS & RDI on path trace      (Enable)
 3. J1 Tx path trace             (Enable)
 4. J1 Rx path trace             (Enable)
 5. EED Threshold            >   (1E-3)
 6. SD Threshold             >   (1E-6)


>

ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-55. Typical **Common Parameters** Screen*

The parameters that can be configured by means of the **Common Parameters** screen are described in *Table C-15*.

C.33 Configuration – Virtual Concatenation Selection Screen

Purpose

Select the desired configuration function related to virtual concatenation:

- Configure the parameters of a specific virtually concatenated group. After configuring a virtually concatenated group, make sure to map its VCs/VTs using **Configuration – System – Mapping** (see *Section C.7* for instructions).
- Configure all the currently-defined virtually concatenated groups with similar parameters.

Note *Virtually concatenated groups may also be defined by means of the* ***Quick Setup*** *screen. When you decide to edit the configuration of such groups, carefully plan ahead the process to avoid failing the sanity checks automatically performed whenever you attempt to save changes.*
Some changes may result in temporary configuration conflicts, and if the configuration fails the sanity check, it is rejected and you must repeat the configuration activities.

- Configure the GFP multiplexing functionality (when this option is used).

Note *If the FCD-155 has only 2 LAN ports, the number of groups displayed on the screens is 4. All the following screens assume that the FCD-155 unit has 6 LAN ports, and therefore show 8 groups.*

Reached from

Configuration – Virtual Ports – item 2

Use

A full **Virtual Concatenation** group selection screen is shown in *Figure C-59*

➤ **To select a specific virtually concatenated group to be configured:**

Type the corresponding item number, **1** to **8**, and then press **<Enter>**.

➤ **To configure all the virtually concatenated groups with similar parameters:**

Type **9** and then press **<Enter>**.

➤ **To configure a GFP multiplexer (relevant only when GFP encapsulation is used for at least one group):**

Type **10** and then press **<Enter>**.

```
                                  FCD-155
Virtual Concatenation

 1. Group 1    >
 2. Group 2    >
 3. Group 3    >
 4. Group 4    >
 5. Group 5    >
 6. Group 6    >
 7. Group 7    >
 8. Group 8    >
 9. All Groups>
10. GFP Mux    []>


>

ESC-prev.menu; !-main menu; &-exit; @-output                       1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-56. Typical **Virtual Concatenation** Group Selection Screen (FCD-155 with 6 LAN Ports)*

C.34 Configuration – Group Screen (SDH Network Interfaces)

Purpose

Configure the parameters of a specific virtually concatenated group, or all the virtually concatenated groups.

The group parameters depend on the encapsulation method used on the group (or groups) being configured: LCAS or GFP.

Note *For configuration instructions regarding the encapsulation parameters, refer to Section C.35 for LCAS and to Section C.36 for GFP.*

This section covers the configuration activities available when the FCD-155 uses the SDH network interface. For FCD-155 with SONET network interface, refer to *Section C.37*.

Reached from

- For FCD-155 with 6 LAN ports:

Configuration – Virtual Ports – Virtual Concatenation – **item 1** to **8**, or **item 9**

- For FCD-155 with 2 LAN ports:

Configuration – Virtual Ports – Virtual Concatenation – **item 1** to **4**, or **item 5**

Use – LAPS Encapsulation

A typical individual **Group** screen for an FCD-155 with SDH network interface that uses LAPS encapsulation over VC-12 is shown in *Figure C-57*. The selected group is identified in the screen header.

```
                                FCD-155
Group 1

 1. Admin Status               (Enable)
 2. VC type                >   (VC12)
 3. LCAS                       (Yes)
 4. Number of VCs          [1 - 63]... (1)
 5. Encapsulation          >   (LAPS)
 6. Max Differential Delay[10 - 64]... (64)
 7. Group ID               >   (1)
 8. Minimum Number Of VCs  [1 - 63]... (1)
 9. Virtual Concatenation      (Yes)
10. Group Name             ... ()
11. VC Configuration       >
12. LAPS Configuration     >

>

ESC-prev.menu; !-main menu; &-exit; @-output                    1 user(s)
------------------------------------------------------------------------------
```

*Figure C-57. Typical **Group** Configuration Screen for LAPS Encapsulation over VC-12, for Groups 1 to 4 (SDH Network Interface)*

The screen shown in *Figure C-57* is for a group in the range of 1 to 4 and using VC-12. A typical screen for groups in the range of 5 to 8 (available only on FCD-155 with 6 LAN ports) is shown in *Figure C-58*. In this case, the screen includes an additional header, **Associated Port,** which displays the number of the LAN port using the selected group: group 5 is associated with port 3, group 6 with port 4, group 7 with port 5, and group 8 with port 6.

The screen shown in *Figure C-58* includes all the available parameters, and therefore it extends on two pages: press **N** to go from the first page to the second, and press **P** to return from the second page to the first.

```
                                FCD-155
Group 5

    Associated LAN Port    >   (Port 3)
 1. Admin Status               (Enable)
 2. VC type                >   (VC12)
 3. LCAS                       (Yes)
 4. Number of VCs          [1 - 63]... (1)
 5. Encapsulation          >   (LAPS)
 6. Max Differential Delay[10 - 64]... (64)
 7. Group ID               >   (1)
 8. Minimum Number Of VCs  [1 - 63]... (1)
 9. Virtual Concatenation      (Yes)
10. Group Name             ... ()
... (N)
>

ESC-prev.menu; !-main menu; &-exit; @-output                    1 user(s)
------------------------------------------------------------------------------
```

A. First Page

*Figure C-58. Typical **Group** Configuration Screen for LAPS Encapsulation over VC-12, for Groups 5 to 8 (SDH Network Interface)*

```
                                FCD-155
Group 5

... (P)
11. VC Configuration      >
12. GFP Configuration     >










>


ESC-prev.menu; !-main menu; &-exit; @-output                    1 user(s)
-----------------------------------------------------------------------------
```

B. Second Page

*Figure C-58. Typical **Group** Configuration Screen for LAPS Encapsulation over VC-12, for Groups 5 to 8 (SDH Network Interface) (Cont.)*

Note *Item **9** of Figure C-57 and Figure C-58 – **Virtual Concatenation** appears only when the value selected in the **Number of VCs** field is **1**.*

If you selected item **9** on the **Virtual Concatenation** screen (or **5** for an FCD-155 with only two LAN ports), the header in Figure C-57 and Figure C-58 is **All Groups**.

The parameters that can be configured by means of the **Group** screen are described in Table C-16.

➤ **To change a virtually concatenated group parameter (for SDH network interfaces):**

1. Type the number corresponding to the desired parameter, and then press **<Enter>:**
   - For items **1**, **3**, **9** (**Virtual Concatenation**), the selection is toggled as soon as you press **<Enter>**.
   - For item **7**, you can type the desired name in the same line. When done, press **<Enter>**.
   - See separate procedure for item **8 – VC Configuration**.
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in Table C-16 lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **Group** screen.
2. When done, type **#** to save and then confirm the action.

Table C-16. ***Configuration – Virtual Ports – Group*** *Screen Parameters*

Parameter	Function	Values	
Admin Status	Used to enable/disable the flow of traffic through the selected virtually concatenated group	**DISABLE**	The flow of traffic is disabled. This state should be selected as long as the configuration of the corresponding group has not yet been completed, or when it is necessary to stop traffic flow through the group.
		ENABLE	The flow of traffic is enabled.
		Default: DISABLE	
VC Type	Selects the type of VC used to carry the corresponding virtually concatenated group. This parameter is one of the parameters that determine the bandwidth made available to the virtually concatenated group. See the *Configuration Considerations for Virtually Concatenated Groups* section on page *C-13* for considerations related to the allocation of main link bandwidth to virtually concatenated groups	The available selections are **VC-12**, **VC-3** and **VC-4**. If no selection has yet been made for the corresponding group, this field displays **Error**. **Default: VC-12**	
LCAS	Used to enable/disable use of the Link Capacity Adjustment Scheme (LCAS) on the corresponding group. LCAS is relevant only when the group includes 2 or more VCs, and is not displayed when selecting **VC-4** for the **VC Type.** This parameter is not displayed when selecting VC-4	**NO**	The use of LCAS is disabled.
		YES	The use of LCAS is enabled.
		Default: NO	
Number of VCs	Selects the number of VCs of the type selected by **VC Type** used to carry the corresponding virtually concatenated group. This is another parameter that determines the bandwidth made available to the virtually concatenated group. When you select the **All Groups** option, take into consideration that the number selected by you is allocated to each active virtually concatenated group. Therefore, you should also review the *Configuration Considerations for Virtually Concatenated Groups* section on page *C-13* for considerations related to the allocation of main link bandwidth to virtually concatenated groups**.** This parameter is not displayed when selecting VC-4: in this case, the number is always 1	The available range for each type are as follows: • For VC-12: **1** to **63** • For VC-11: **1** to **64** • For VC-3: **1**, **2** or **3**. The number that can be selected also depends on the mapping of lower-order VCs assigned to other groups: any groups using lower-order VCs must be mapped in a way that leaves one or two whole VC-3s free. **Default: 1**	

Table C-16. ***Configuration – Virtual Ports – Group*** *Screen Parameters (Cont.)*

Parameter	Function	Values
Encapsulation	Selects the encapsulation used by the virtually concatenated group. When using GFP multiplexing, make sure to configure GFP encapsulation for the primary group; the encapsulation mode of the other groups (referred to as secondary groups) will be automatically changed to GFP when the GFP multiplexer is configured (see *Section C.38* for details).	**LAPS** Link Access Procedure for SONET/SDH protocols per ITU-T Rec. X.85/X.86 draft. **GFP** Generic Framing Procedure in accordance with ITU-T Rec. G.7041, framed mode, including support for GFP multiplexing. **Default: LAPS**
GFP Channel ID	Selects the GFP channel identifier. This field is displayed only when using GFP encapsulation, and is not displayed for VC-4	The allowed range is **0** to **FF**. **Default: 0**
Max Differential Delay	Selects the maximum differential delay among the VCs carrying the selected group, that can be corrected. A larger value increases the latency, therefore always select the minimum value that can compensate for the expected delay variation	The allowed range is **10** to **64** msec. When the number of VCs in the virtually concatenated group is 1, always displays **N/A**. **Default: 64**
Group ID	Selects the virtually concatenated group identifier	The allowed range is **0** to **7**. **Default: 1**
Virtual Concatenation	Used to enable/disable the use of the virtual concatenation format when the number of VCs in the group is 1. This parameter is displayed only when **1** is selected in the **Number of VCs** field**.** This parameter is not displayed when selecting VC-4	**NO** The use of the virtual concatenation format is disabled. **YES** The use of the virtual concatenation format is enabled. This selection is necessary only for compatibility with equipment from other vendors. **Default: NO**
Minimum Number of VCs	Selects the minimum allowed number of operational VCs that must remain in operation**.** If the number decreases below the selected value, an alarm is generated. This parameter is displayed only when LCAS is enabled	The allowed range is **1** to **63**. **Default: 1**
Group Name	Used to enter a logical name for the selected group	Up to 15 characters. **Default: Empty string**

*Table C-16. **Configuration – Virtual Ports – Group** Screen Parameters (Cont.)*

Parameter	Function	Values
VC Configuration	Used to configure the parameters of the VC used to transport the group payload**.** This parameter is not displayed when selecting VC-4	See procedure below
LAPS Configuration	Used to configure the LAPS encapsulation parameters	See procedure in *Section C.35*

➤ **To configure the VC parameters of a virtually concatenated group (or groups):**

1. Type **8** and then press **<Enter>.** You will see the **VC Configuration** screen. A typical **VC Configuration** screen showing the default values for groups using VC-12 is shown in *Figure C-59*; *Figure C-60* shows the screen for groups using VC-3. The parameters that can be configured by means of the **VC Configuration** screen are described in the following tables:
   - For groups using VC-12: *Table C-17* (also applicable to units with E3 PDH interface, as well as to units with T1 or T3 PDH interfaces that use VC-12 for transport):
   - For groups using VC-3: *Table C-18.*
2. Type the desired item number and then press **<Enter>**:
   - For items **1**, **2**, **3**, **4**, the selection is toggled as soon as you press **<Enter>**.
   - For items **6** and **9**, you can type the desired value in the same line. When done, press **<Enter>**.
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-17* or *Table C-18* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **VC Configuration** screen.
3. When done, type **#** to save and then confirm the action.

```
                                    FCD-155
VC Configuration

 1. AIS & RDI on signal label     (Enable)
 2. AIS & RDI on path trace       (Enable)
 3. J2 Tx path trace              (Disable)
 4. J2 Rx path trace              (Disable)
 5. J2 path trace             ... ()
 6. EED Threshold             >   (1E-3)
 7. SD Threshold              >   (1E-6)
 8. Extended Signal Label    [0 - ff]... (D)

>

ESC-prev.menu; !-main menu; &-exit; @-Output                      1 user(s)
------------------------------------------------------------------------------
```

*Figure C-59. Typical **VC Configuration** Screen for Virtually Concatenated Groups Using VC-12*

```
                                    FCD-155
VC Configuration

 1. AIS & RDI on signal label>   (Enable)
 2. AIS & RDI on path trace  >   (Enable)
 3. J1 Tx path trace         >   (Enable)
 4. J1 Rx path trace         >   (Enable)
 5. J1 path trace            ... ()
 6. EED Threshold            >   (1E-3)
 7. SD Threshold             >   (1E-6)
 8. Extended Signal Label    [0 - ff]... (D)

>

ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-60. Typical **VC Configuration** Screen for Virtually Concatenated Groups Using VC-3*

*Table C-17. **Configuration – Group – VC Configuration** Parameters for **VC Type – VC-12***

Parameter	Function	Values
AIS & RDI on Signal Label	Controls the sending of AIS and RDI indications by the corresponding group, in case the received signal label is different from the expected signal label	**ENABLE** AIS and RDI are sent when a signal label mismatch is detected. **DISABLE** AIS and RDI are not sent when signal label mismatch is detected. Nevertheless, AIS and RDI are still sent in case of LOP (loss of pointer) or ***unequipped signal label*** condition. **Default: ENABLE**
AIS & RDI on Path Trace	Controls the sending of AIS and RDI indications by the corresponding group, in case the received path trace label (carried in SDH overhead byte J1) is different from the expected path trace label	**ENABLE** AIS and RDI are sent in case a signal label mismatch is detected. **DISABLE** AIS and RDI are not sent when a signal label mismatch is detected. Nevertheless, AIS and RDI are still sent in case a LOP (loss of pointer) or ***unequipped signal label*** condition is detected. **Default: ENABLE**
J2 Tx Path Trace	Controls the sending of the path trace label (carried in byte J2 of the SDH overhead) by the corresponding group	**ENABLE** The path trace label is sent. **DISABLE** No path trace label is sent. **Default: DISABLE**
J2 Rx Path Trace	Controls the checking of the received path trace label by the corresponding group	**ENABLE** Path trace label is checked. **DISABLE** Path trace label is not checked. **Default: DISABLE**
J2 Path Trace	Specifies the path trace label. This parameter is relevant only when **J2 Tx Path Trace** and/or **J2 Rx Path Trace** is enabled	Alphanumeric string of up to 15 characters. Make sure to configure all the 15 characters **Default: Empty string**

*Table C-17. **Configuration – Group – VC Configuration** Parameters for **VC Type – VC-12** (Cont.)*

Parameter	Function	Values
EED Threshold	Selects the BER value, which if exceeded results in the generation of the error rate degradation alarm for the corresponding group	The available selections are 10E-3 (BER threshold of 10^{-3}), 10E-4 (10^{-4}), 10E-5 (10^{-5}). **Default: 10E-3** (BER of 10^{-3})
SD Threshold	Selects the BER value, which if exceeded results in the generation of the signal-degraded alarm for the corresponding group	The available selections are 10E-6 (BER threshold of 10^{-6}), 10E-7 (10^{-7}), 10E-8 (10^{-8}) or 10E-9 (10^{-9}). **Default: 10E-6** (BER of 10^{-6})
Signal Label	Specifies the expected signal label (one byte). This parameter is displayed only when the value selected in the **Number of VCs** field is **1**, and the **Virtual Concatenation** field is **NO**	Hexadecimal number in the range of 0 to FF (two digits). **Default: 5**
Extended Signal Label	Selects the extended signal label, which is part of the SDH overhead when virtual concatenation is used. The default value, D, is the standard value used to indicate the use of virtual concatenation and therefore should not be changed unless specifically required. This parameter is displayed only when the value selected in the **Number of VCs** field is different from **1**; if the value is **1**, the parameter is displayed only when the **Virtual Concatenation** field is **YES**	Two hexadecimal digits, in the range of 00 to FF. **Default: D**

*Table C-18. **Configuration – Group – VC Configuration** Parameters for **VC Type – VC-3***

Parameter	Function	Values
AIS & RDI on Signal Label	Same as in *Table C-17*	Same as in *Table C-17*
AIS & RDI on Path Trace	Controls the sending of AIS and RDI indications by the corresponding group, in case the received path trace label (carried in SDH overhead byte J1) is different from the expected path trace label	**ENABLE** AIS and RDI are sent in case a signal label mismatch is detected. **DISABLE** AIS and RDI are not sent when a signal label mismatch is detected. Nevertheless, AIS and RDI are still sent in case a LOP (loss of pointer) or ***unequipped signal label*** condition is detected. **Default: ENABLE**
J1 Tx Path Trace	Controls the sending of the path trace label (carried in byte J1 of the SDH overhead) by the corresponding group	**ENABLE** The path trace label is sent. **DISABLE** No path trace label is sent. **Default: DISABLE**

Table C-18. ***Configuration – Group – VC Configuration*** *Parameters for* ***VC Type – VC-3*** *(Cont.)*

Parameter	Function	Values
J1 Rx Path Trace	Controls the checking of the received path trace label by the corresponding group	**ENABLE** Path trace label is checked. **DISABLE** Path trace label is not checked. **Default: DISABLE**
J1 Path Trace	Specifies the path trace label	Alphanumeric string of up to 15 characters. Make sure to configure all the 15 characters. **Default: Empty string**
EED Threshold	Same as in *Table C-17*	Same as in *Table C-17*
SD Threshold	Same as in *Table C-17*	Same as in *Table C-17*
Signal Label	Same as in *Table C-17*	Default values are as follows: • For GFP encapsulation: 1B (hexa) • For LAPS encapsulation: 18 (hexa)

Use – GFP Encapsulation

A typical individual **Group** screen for an FCD-155 with SDH network interface that uses GFP encapsulation is shown in *Figure C-61*.

The screen shown in *Figure C-61* is for a group in the range of 1 to 4: for groups in the range of 5 to 8 (available only on FCD-155 with 6 LAN ports), the screen includes an additional header, **Associated Port,** which displays the number of the LAN port using the selected group (see for example, *Figure C-58* used with LAPS encapsulation).

The selected group is identified in the screen header. When you select item **9** (or **5** for an FCD-155 with only two LAN ports), the header is **All Groups**.

The screen shown in *Figure C-61* includes all the available parameters, and therefore it extends on two pages: press **N** to go from the first page to the second, and **P** to return from the second page to the first.

The parameters that can be configured by means of the **Group** configuration screen are the same as described in *Table C-16* for LAPS encapsulation, with two differences:

- A **GFP Channel ID** item has been added. This item, which consists of two hexadecimal digits (00 to FF), is used to identify the group and must be unique.
- The **LAPS Configuration** item is replaced by the **GFP Configuration** item, used to configure the GFP encapsulation parameters. See *Section C.36*.

```
                                    FCD-155
Group 1

 1. Admin Status              (Enable)
 2. VC type               >   (VC12)
 3. LCAS                      (Yes)
 4. Number of VTs         [1 - 64]... (1)
 5. Encapsulation         >   (GFP)
 6. GFP Channel ID        [0 - ff]... (0)
 7. Max Differential Delay[10 - 64]... (64)
 8. Group ID              >   (1)
 9. Minimum Number Of VCs [1 - 64]... (1)
10. Virtual Concatenation     (Yes)
11. Group Name            ... ()
... (N)

>

ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

A. First Page

```
                                    FCD-155
Group 2

... (P)
12. VC Configuration      >
13. GFP Configuration     >

>

ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

B. Second Page

*Figure C-61. Typical **Group** Configuration Screen for GFP Encapsulation, Groups 1 to 4 (SDH Network Interface)*

C.35 Configuration – LAPS Configuration Screen

Purpose

Configure the LAPS parameters. These parameters are relevant only when LAPS encapsulation is used for at least one virtually concatenated group.

Reached from

Reached from

Configuration – Virtual Ports – Group – **last item on screen**

Use

A typical **LAPS Configuration** screen is shown in *Figure C-62*.

```
                                    FCD-155
LAPS Configuration

 1. Address            [0 - ff]... (4)
 2. Control            [0 - ff]... (3)
 3. SAPI value         [0 - ffff]... (FE01)




>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-62. Typical **LAPS Configuration** Screen*

The parameters displayed on the **LAPS Configuration** screen are explained in *Table C-19*. Any changes to the default values should be carefully considered, to ensure compatibility with other equipment.

*Table C-19. **LAPS Configuration** Parameters*

Parameter	Function	Values
Address	Selects the HDLC address to be used by the LAPS protocol for handshaking. The standardized HDLC address for the Ethernet encapsulated with LAPS is 4	Two hexadecimal digits, in the range of 00 to FF. **Default: 4**
Control	Selects the HDLC control address to be used by the LAPS protocol for handshaking. The standardized HDLC control value for the Ethernet encapsulated with LAPS is 3	Two hexadecimal digits, in the range of 00 to FF. **Default: 3**
SAPI Value	Selects the service access point identifier (SAPI) for the LAPS protocol. The standardized SAPI for the Ethernet MAC is FE01	Four hexadecimal digits, in the range of 0000 to FFFF. **Default: FE01**

C.36 Configuration – GFP Configuration Screen

Purpose

Configure the GFP multiplexing parameters. These parameters are relevant only when GFP encapsulation is used for at least one virtually concatenated group.

Reached from

Reached from

Configuration – Virtual Ports – Group – last item on screen

Use

A typical **GFP Configuration** screen is shown in Figure C-63.

```
                                      FCD-155
GFP Configuration

 1. FCS                     (Yes)
 2. PTI For Client Data[0 - 8]... (0)
 3. UPI For Client Data[1 - 255]... (1)
 4. Delta               [1 - 7]... (1)
 5. Core Scrambling    >   (Both Side)
 6. Payload Scrambling >   (Both Side)




>


ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
------------------------------------------------------------------------------
```

Figure C-63. Typical ***GFP Configuration*** *Screen*

The parameters displayed on the **GFP Configuration** screen are explained in *Table C-20*. Any changes to the default values should be carefully considered, to ensure compatibility with other equipment.

Table C-20. ***GFP Configuration*** *Parameters*

Parameter	Function	Values
FCS	Controls the use of error detection for the payload	**NO** Payload error detection disabled. **YES** Payload error detection enabled. In this case, a frame checksum is calculated, using the 32-bit polynomial recommended by ITU-T, and added to the GFP frame structure. **Default: YES**

*Table C-20. **GFP Configuration** Parameters (Cont.)*

Parameter	Function	Values
PTI For Client Data	Selects the payload type identifier (PTI) inserted in GFP frames	The allowed range is 0 to 8. **Default: 0 (user data)**
UPI For Client Data	Selects the user payload identifier (PTI) inserted in GFP frames	The allowed range is 0 to 255. **Default: 1 (frame-mapped Ethernet)**
Delta	Selects the number of error-free frame headers that must be received before frame synchronization is declared	The allowed range is 1 to 7. **Default: 1**
Core Scrambling	Controls the use of frame core data scrambling	**BOTH SIDES** – Core scrambling enabled for both the transmit and receive directions. **ONLY TRANSMIT** – Core scrambling performed only on transmitted frames. No descrambling performed on the received core data. **ONLY RECEIVE** – Core descrambling performed on the received core data. No scrambling for the core data inserted in the transmitted frames. **DISABLED** – Core scrambling disabled for both the transmit and receive directions. **Default: BOTH SIDES**
Payload Scrambling	Controls the use of payload data scrambling, before insertion in frames	**BOTH SIDES** – Payload scrambling enabled for both the transmit and receive directions. **ONLY TRANSMIT** – Payload scrambling performed only on transmitted frames. No descrambling performed on the received payload. **ONLY RECEIVE** – Payload descrambling performed on the received core data. No scrambling for the payload inserted in the transmitted frames. **DISABLED** – Payload scrambling disabled for both the transmit and receive directions. **Default: BOTH SIDES**

C.37 Configuration – Group Screen (SONET Network Interfaces)

Purpose

Configure the parameters of a specific virtually concatenated group.

The group parameters depend on the encapsulation method used on the group (or groups) being configured: LCAS or GFP.

Note *For configuration instructions regarding the encapsulation parameters, refer to Section C.35 for LCAS and to Section C.36 for GFP.*

This section covers the configuration activities available when the FCD-155 uses the SONET network interface. For an FCD-155 using the SDH network interface, refer to *Section C.34*.

Reached from

- For FCD-155 with 6 LAN ports:

Configuration – Virtual Ports – Virtual Concatenation – **item 1** to **8**, or **item 9**

- For FCD-155 with 2 LAN ports:

Configuration – Virtual Ports – Virtual Concatenation – **item 1** to **4**, or **item 5**

Use

A typical individual **Group** screen for an FCD-155 with SONET network interface that uses GFP encapsulation over VT-1.5 SPEs is shown in *Figure C-64*. The selected group is identified in the screen header.

The screen shown in *Figure C-64* includes all the available parameters, and therefore it extends on two pages: press **N** to go from the first page to the second, and press **P** to return from the second page to the first.

Note *When LAPS encapsulation is used, the screen is slightly different. The differences are as follows:*

- *The **GFP Channel ID** item is removed.*
- *The **GFP Configuration** item is replaced by the **LAPS*** **Configuration** item, used to configure the GFP encapsulation parameters. See Section C.35.
- *All the fields are displayed on one page, instead of two.*

➤ **To change a virtually concatenated group parameter (for SONET network interfaces):**

1. The **Group** screens for an FCD-155 with SONET network interface are similar to those of an FCD-155 with SDH interfaces, except for the following differences:
   - Item **2** – **VC type** is replaced by **VT Type**, and the available selections are as follows:
     - **STS1/SPE** – STS-1 SPE
     - **VT1.5/SPE** – VT-1.5 virtual tributary. This is the default selection.

- Item **3** – **Number of VCs:** the available selections are as follows:
  - For STS-1 SPEs: 1, 2 or 3
  - For VT-1.5: 1 to 64.

2. For operating instructions and configuration guidelines, see *Section C.34*. This section also presents any differences between LAPS and GFP encapsulations.

```
                                   FCD-155
Group 1


 1. Admin Status                  (Enable)
 2. VC type                  >    (VT1.5/SPE)
 3. LCAS                          (Yes)
 4. Number of VTs            [1 - 64]... (1)
 5. Encapsulation            >    (GFP)
 6. GFP Channel ID           [0 - ff]... (0)
 7. Max Differential Delay[10 - 64]...  (64)
 8. Group ID                 >    (1)
 9. Minimum Number Of VCs [1 - 64]... (1)
10. Virtual Concatenation         (Yes)
11. Group Name               ... ()
... (N)
>



ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
------------------------------------------------------------------------------
```

A. First Page

```
                                   FCD-155
Group 1

... (P)
12. VT Configuration         >
13. GFP Configuration        >










>



ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
------------------------------------------------------------------------------
```

B. Second Page

*Figure C-64. Typical **Group** Configuration Screen (SONET Network Interface)*

C.38 Configuration – GFP Mux Screen

Purpose

Configure GFP multiplexing parameters (for information on GFP multiplexing, refer to *Appendix E*).

A GFP multiplexer can handle up to four virtually concatenated groups. However, considering the maximum number of virtually concatenated groups that can be defined on the FCD-155, the maximum number of GFP multiplexers depends on the number of LAN ports:

- For FCD-155 units with two LAN ports, the maximum number is 2 (each handling two virtually concatenated groups).
- For FCD-155 units with six LAN ports, the maximum number is 4 (each handling two virtually concatenated groups).

It is not possible, nor meaningful, to define a GFP multiplexer with a single virtually concatenated group.

Reached from

Configuration – Virtual Ports – Virtual Concatenation – item 6

Use

A typical **GFP Mux** screen for an FCD-155 unit with two LAN ports, as seen before any GFP multiplexers are defined, is shown in *Figure C-65*; a typical screen for an FCD-155 unit with six LAN ports is shown in *Figure C-66*.

```
                                              FCD-155
GFP Mux

    Index   GFP Mux Name    Group 1  Group 2  Group 3  Group 4  Primary



>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                 1 user(s)
------------------------------------------------------------------------------
```

*Figure C-65. Typical **GFP Mux** Screen – Default State (FCD-155 with 2 LAN Ports)*

```
                                               FCD-155
GFP Mux

 Index   GFP Mux Name   Group 1 Group 2 Group 3 Group 4 Group 5



>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                 1 user(s)
------------------------------------------------------------------------------
```

*Figure C-66. Typical **GFP Mux** Screen – Default State (FCD-155 with 6 LAN Ports)*

The parameters displayed on the **GFP Mux** screen are as follows:

Index The GFP multiplexer index number. This number is automatically assigned.

GFP Mux Name Optional field, can be used to assign a logical name to the GFP multiplexer. The name may include up to 15 characters.

Group 1 to **Group 4** or **Group 1** to **Group 8** A number under a group designation indicates that the corresponding virtually concatenated group is processed by the GFP multiplexer (when more than 4 groups are displayed, press the right arrow to display the additional groups).

The number indicates the fraction of the total bandwidth guaranteed to the corresponding group (the bandwidth can be selected in steps of 12.5 %).

The total bandwidth available to the GFP multiplexer output is the bandwidth configured for the primary virtually concatenated group.

Primary Displays the virtually concatenated group that serves as the transport group of the GFP multiplexer output. This is the rightmost field on the screen.

➤ **To display the keys available for the GFP Mux screen:**

1. Type **?** and then press **<Enter>**.
2. You will see the help screen. When the **GFP Mux** screen is empty (for example, as shown in *Figure C-65*), only one item is available: **a** – add a new GFP multiplexer definition.

   A full help screen, as seen after at least one GFP multiplexer is configured and the selection block is moved from its home position, is shown in *Figure C-67*.
3. To return to the **GFP Mux** screen, press any key.

```
Table Hot Keys

Left Arrow - move left
^R - scroll right        Right Arrow - move right
A  - add row             R  - remove row
M  - represent entry as menu
TAB - select next changeable cell
G  <row number>,<col number> - go to cell


Press any key ...                                                  1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-67. Full **Help** Screen for **GFP Mux** Screen*

➤ **To add a new GFP multiplexer:**

Note *Before starting the configuration of a new GFP multiplexer, make sure to define all the virtually concatenated groups to be processed by the GFP multiplexer (see Sections C.33 to C.37), and to map the primary virtually concatenated group (see Section C.7). Do not map the secondary virtually concatenated groups.*
Remember that any virtually concatenated group can be included only in a single GFP multiplexer.

1. Type **a** and then press **<Enter>**.
2. You will see the **GFP Mux** configuration screen. A typical screen, as seen after making the various selections, is shown in *Figure C-68*. The automatically assigned index number is displayed in the header.

Note *Item **11 – Save All** appears only after at least one parameter has been changed.*

3. Define the group logical name: select **1** and type the desired name (up to 15 characters – any characters beyond the first 15 are ignored). Press **<Enter>** to end the string.
4. Define the virtually concatenated groups to be processed by the new GFP multiplexer and the guaranteed bandwidth by selecting the corresponding item, **2** to **9**. For each group to be processed:
   - After pressing **<Enter>**, you will see the group bandwidth assignment screen (see typical screen in *Figure C-69*; the number of the selected group is displayed in the screen header).
   - Type the number corresponding to the desired bandwidth fraction, and then press **<Enter>**.
   - The group bandwidth assignment screen closes, and the assigned fraction appears in the group column on the **GFP Mux** screen.
   - Repeat the procedure for each group.

```
                                   FCD-155
GFP Mux

    Index                           (1)
 1. GFP Mux Name                ... (New York 1)
 2. Group 1                     >   (12.5%)
 3. Group 2                     >   (25.0%)
 4. Group 3                     >   (0%)
 5. Group 4                     >   (37.5%)
 6. Group 5                     >   (12.5%)
 7. Group 6                     >   (0%)
 8. Group 7                     >   (25.0%)
 9. Group 8                     >   (12.5%)
10. Primary                     >   (Group 1)
11. Save All
>

# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-68. Typical **GFP Mux** Configuration Screen*

```
                                  FCD-155
Group 1 (0%)
 1. 0%
 2. 12.5%
 3. 25%
 4. 37.5%
 5. 50%
 6. 62.5%
 7. 75%
 8. 87.5%

>

# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
------------------------------------------------------------------------------
```

*Figure C-69. **GFP Mux** Configuration – Typical Group Bandwidth Assignment Screen*

5. Type **6** to select the primary virtually concatenated group, and then press **<Enter>**. You will see the primary group selection screen (see typical screen in *Figure C-70*):
   - Type the number corresponding to the desired group, and then press **<Enter>**.
   - The primary group selection screen closes, and the assigned fraction appears in the group column on the **GFP Mux** screen.

```
                                  FCD-155
Primary (Group 1)

 1. Group 1
 2. Group 2
 3. Group 3
 4. Group 4
 5. Group 5
 6. Group 6
 7. Group 7
 8. Group 8


>

# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
------------------------------------------------------------------------------
```

*Figure C-70. **GFP Mux** Configuration – Typical Primary Group Selection Screen*

6. At this stage, the configuration of the first GFP multiplexer is complete. *Figure C-71* shows the left-hand section of a typical screen, with the selection block located on the home position. Use the arrows to move the selection block: when the block moves to the right, the end of the screen (including **Primary** as the last field) will be automatically displayed.

```
                                    FCD-155
GFP Mux
 Index   GFP Mux Name      Group 1 Group 2 Group 3 Group 4 Group 5
   1     New-York 1        25%     25%     12.5%   37.5%   Group 1




>

# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-Output; ?-help                 1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-71. Typical **GFP Mux** Screen – After Configuring a GFP Multiplexer*

7. After the configuration of the first GFP multiplexer is complete, you may either save the new configuration, delete an existing GFP multiplexer or add another GFP multiplexer:
   - To add a second GFP multiplexer:
     - Type **a** and then press **<Enter>**.
     - You will see again the **GFP Mux** configuration screen (*Figure C-68*): note that the automatically assigned index number displayed in the header has been incremented by 1.
     - Continue as explained above.

➤ **To delete an existing GFP multiplexer:**

1. Move the selection block to the row to be deleted, type **t** and then press **<Enter>**.
2. When you are ready to save the configuration, check again the information displayed on the screen after configuration (for example, *Figure C-71*).

➤ **To modify the parameters of an existing GFP multiplexer:**

1. Move the selection block to the row to be corrected.
2. Type **m** and then press **<Enter>**.

Note *An alternative method for changing the bandwidth allocated to each group is to move the selection block to the group to be changed: the bandwidth assignment menu is then automatically displayed. Now type the corresponding number and press **<Enter>** to make the change.*

3. You will see the edit screen for the selected row. This screen is similar to the screen shown in *Figure C-68*; the index number displayed in the header is the number of the selected row.
4. Continue as explained above for the configuration of a new GFP multiplexer.

➤ **To save the new GFP multiplexer configuration:**

1. Type **#** to save and then confirm the action. The FCD-155 checks your configuration and saves it only if no errors are detected.
2. If errors are detected in your configuration, the new configuration cannot be saved. In this case, the FCD-155 will display **Error in configuration. Do you want to see errors?**:
   - To ignore, type **n**. Now you can return to the GFP multiplexer screen and correct the errors.
   - To see the errors, type **y**. You will see the **Sanity** screen (normally reached from **Monitoring – System – Display Sanity**). Now select **1 – Errors and Warnings** to display the list of sanity errors. Refer to *Appendix B* for an explanation of the error messages that may be displayed.

C.39 Configuration – Bridge Submenu

Figure C-72 shows the structure of the **Bridge** submenu.

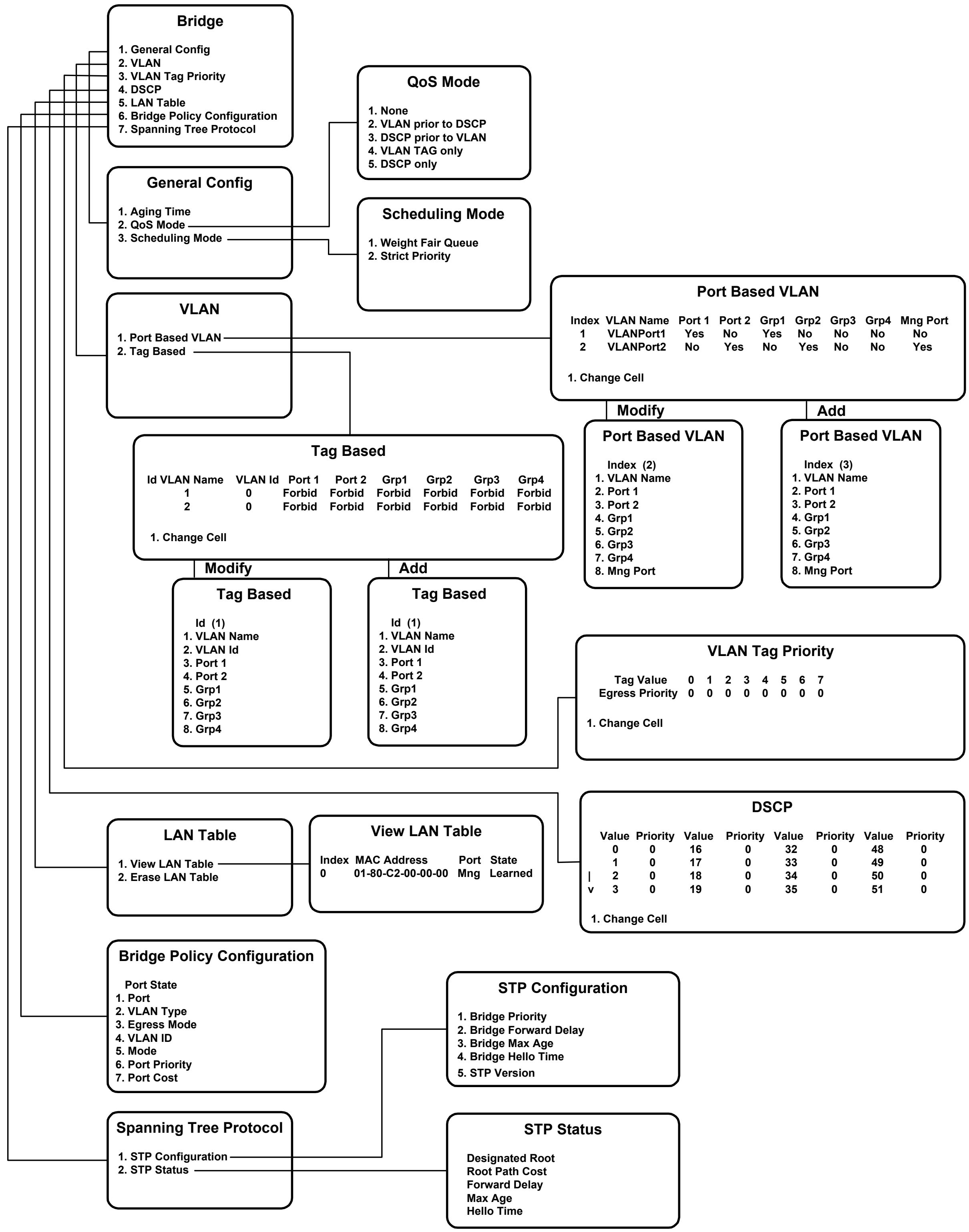


*Figure C-72. **Configuration – Bridge** Submenu Structure*

C.40 Configuration – Bridge Screen

Purpose

Select the type of bridge configuration activity.

Reached from

Configuration – item 5

Use

A typical **Bridge** screen is shown in *Figure C-73*.

```
                                    FCD-155
Bridge

 1. General Config             >
 2. VLAN                       >
 3. VLAN TAG Priority          []>
 4. DSCP                       []>
 5. Lan Table                  >
 6. Bridge Policy configuration>
 7. Spanning Tree Protocol     >





>


ESC-prev.menu; !-main menu; &-exit; @-output                  1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-73. Typical **Bridge** Screen*

➤ **To select the type of bridge configuration activity:**

Type the corresponding item number and then press **<Enter>**.

C.41 Configuration – General Config Screen

Purpose

Configure the general parameters of the FCD-155 Ethernet switch.

As explained in *Chapter 1*, the Ethernet switch handles the LAN ports 1 and 2, the internal management subsystem port, and the groups 1 to 4.

Reached from

Configuration – Bridge – item 1

Use

A typical **General Config** screen, showing the default parameter values, is shown in *Figure C-74*.

```
                                  FCD-155
General Config

 1. Aging Time (Seconds)  [16 - 4080]... (300)
 2. QoS Mode              >    (None)
 3. Scheduling Mode       >    (Weight Fair Queue)





>


ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-74. Typical **General Config** Screen*

The parameters that can be configured by means of the **General Config** screen are described in *Table C-21*.

➤ **To configure the general parameters of the Ethernet switch:**

1. Type the number corresponding to the desired parameter, and then press **<Enter>:**
   - For item **1**, you can then type the desired value in the same line. When done, press **<Enter>**.
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-21* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **General Config** screen.
2. When done, type **#** to save and then confirm the action.

Table C-21. ***Configuration – Bridge – General Config*** *Parameters*

Parameter	Function	Values
Aging Time	Selects the maximum time learned MAC destination addresses are stored. If the information for a given destination is not refreshed before the selected interval expires, that information is deleted from the bridging table	The allowed range is 10 to 4080 sec, in 16-sec increments. If the entered value is not a multiple of 16, the nearest multiple of 16 not exceeding your entry, is actually used. **Default: 300 sec**
QoS Mode	Specifies the QoS criteria for directing frames to the four prioritized egress queues of the Ethernet switch. See the *Selection Guidelines for the QoS Mode* section below	**None** – Support for QoS feature disabled. **VLAN prior to DSCP** – QoS support enabled; priority determined in accordance with the VLAN ID, and for untagged frames, by the DSCP field (the Differentiated Services Codepoint, specified in RFC2474). **DSCP prior to VLAN** – QoS support enabled; priority determined in accordance with the DSCP value, and for frames which do not carry the IPv4 protocol, by the VLAN ID. **VLAN Tag only** – QoS support enabled; priority determined only by IEEE 802.1p VLAN tag. **DSCP only** – QoS support enabled; priority determined only by the RFC2474 DSCP value. **Default: None**
Scheduling Mode	Selects the frame eggress scheduling mode when QoS support is enabled	**Weight Fair Queue** – 8, 4, 2, 1 weighting is applied to the four priorities. This approach prevents the lower priority frames from being starved out with only a slightly increased delay to the higher priority frames **Strict Priority** – All top priority frames are egressed out a port until that priority's queue is empty, then the next lower priority queue's frames are egressed. Note that this selection may prevent lower-priority queues from transmitting any frames. **Default: Weight Fair Queue**

Selection Guidelines for the QoS Mode

The method used by the internal Ethernet switch to determine the egress priority of each frame is controlled by the selection made for the **QoS Mode** parameter, and additional selections made on other screens.

Figure C-75 illustrates the internal process, and identifies the screens on which the parameters that effect the egress priority can be selected (the screen designations appear on a gray background).

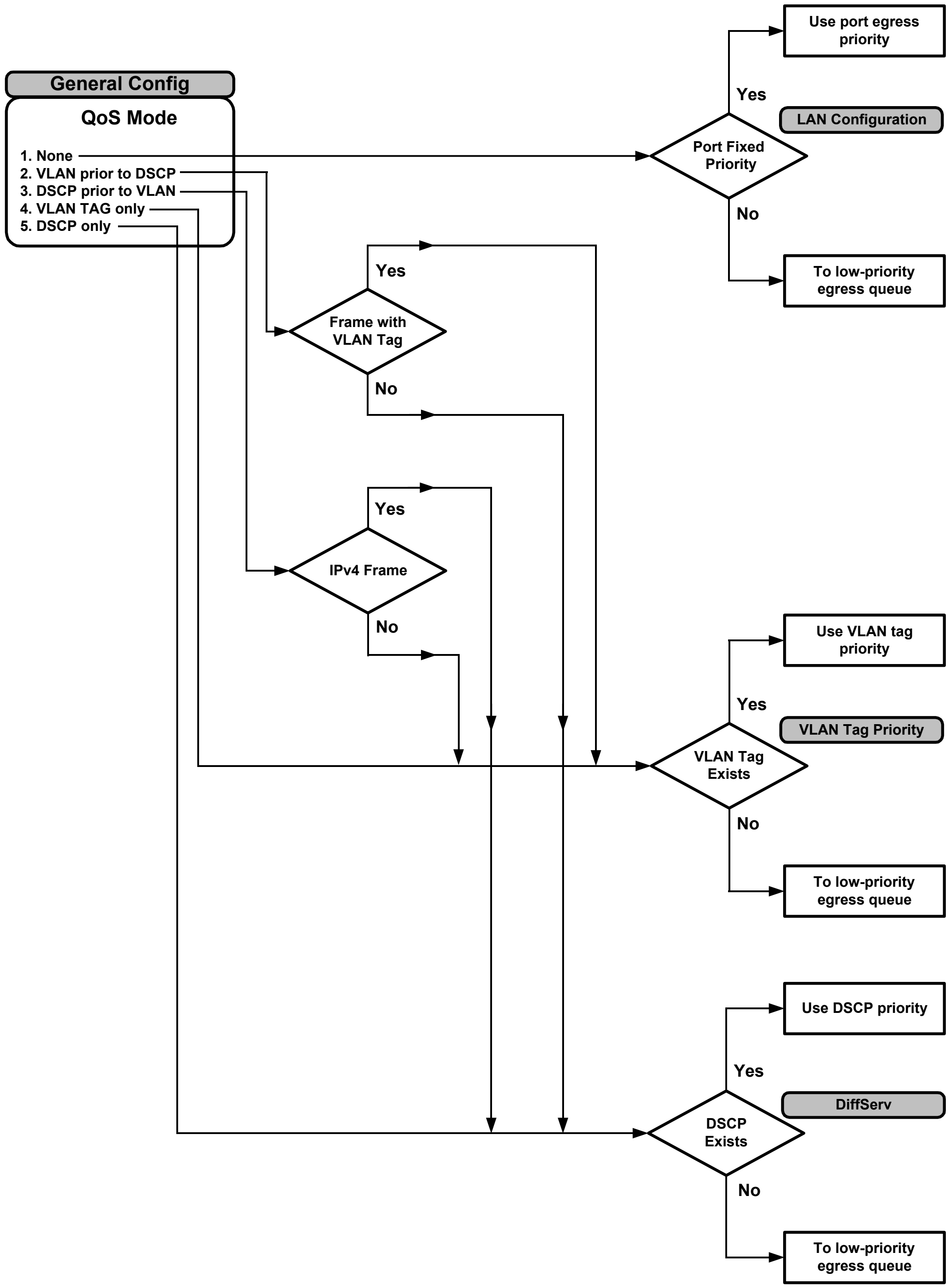


Figure C-75. Determining the Frame Egress Priority

C.42 Configuration – VLAN Type Selection Screen

Purpose

Select the type of VLAN to be configured (refer to *Chapter 1* for additional details).

Reached from

Configuration – Bridge – item 2

Use

A typical screen is shown in *Figure C-76*.

```
                                          FCD-155
VLAN

 1. Port Based VLAN[] >
 2. Tag Based      [] >







>


ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-76. Typical **VLAN** Selection Screen*

➤ **To access the port-based VLAN configuration screen:**

Type **1** and then press **<Enter>**.

➤ **To access the tag-based VLAN configuration screen:**

Type **2** and then press **<Enter>**.

C.43 Configuration – Port-Based VLAN Screen

Purpose

Configure port-based VLANs on the internal FCD-155 Ethernet switch. For additional details, refer to the *Port-Based VLAN Configuration Guidelines* section.

Reached from

Configuration – Bridge – VLAN – item 1

Use

A typical **Port Based VLAN** screen, showing the default port-based VLAN configurations, is shown in *Figure C-77*. When the screen is opened, the selection block is automatically located on the first cell.

```
                                   FCD-155
Port Based VLAN

    Index   Vlan Name    Port 1    Port 2    Grp1    Grp2    Grp3    Grp4    Mng Port
      1     VlanPort1     Yes        No       Yes     No      No      No        No
      2     VlanPort2     No         Yes      No      Yes     No      No        Yes

 1. Change cell                    ... (VlanPort1)



>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                  1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-77. Typical **Port-Based VLAN** Screen*

The parameters that can be configured by means of the **Port-Based VLAN** screen are as follows:

Index The port-based VLAN index number. This number is automatically assigned.

The maximum number of port-based VLANs that can be defined is 20.

VLAN Name Optional field, can be used to assign a unique logical name to each port-based VLAN. The name may include up to 10 alphanumeric characters.

The designations for the default VLANs are **VlanPortn**, where **n** stands for the external LAN port number participating in the corresponding VLAN.

Port 1, Port 2, Grp 1 to **Grp4, Mng** 7 fields for all the various ports that may become members of a port-based VLAN. Under each field, you can see whether it is included (**Yes**) or not (**No**) in the port-based VLAN specified in the corresponding row.

Note that each port-based VLAN may include only one external LAN port (either **Port 1** or **Port 2**).

➤ **To display the keys available for the Port-Based VLAN screen:**

1. Type **?** and then press **<Enter>**.
2. You will see the help screen. A typical help screen is shown in *Figure C-78*.
3. To return to the **Port-Based VLAN** screen, press any key.

```
Table Hot Keys

Left Arrow - move left
Right Arrow - move right
Up Arrow - move up
A   - add row           R  - remove row
M   - represent entry as menu
TAB - select next changeable cell
G  <row number>,<col number> - go to cell



Press any key ...                                                      1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-78. Typical **Help** Screen for **Port-Based VLAN** Screen*

➤ **To add a new port-based VLAN:**

Note *Before starting the configuration of a new port-based VLAN, make sure to define all the relevant virtually concatenated groups (see Sections C.33 to C.37).*

1. Type **a** and then press **<Enter>**.
2. You will see the **Port-Based VLAN** configuration screen. A typical screen with the default values is shown in *Figure C-79*. The automatically assigned index number is displayed in the header.
3. Define the port-based VLAN logical name: select **1** and type the desired name (up to 10 characters – any characters beyond the first 10 are ignored). Press **<Enter>** to end the string.

```
                                    FCD-155
Port Based VLAN
    Index                        (3)
 1. Vlan Name                ... ()
 2. Port 1                   >   (No)
 3. Port 2                   >   (No)
 4. Grp1                     >   (No)
 5. Grp2                     >   (No)
 6. Grp3                     >   (No)
 7. Grp4                     >   (No)
 8. Mng Port                 >   (No)


>

ESC-prev.menu; !-main menu; &-exit; @-Output                           1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-79. Typical **Port-Based VLAN** Configuration Screen*

4. Define the ports to be included as members of the new port-based VLAN. For each port to be added as member:
   - Type the item number for the desired member, **2** to **8**.

Note *Do not select more than one external port per port-based VLAN.*

   - After pressing **<Enter>**, you will see the port membership selection screen (the number of the selected port is displayed in the screen header).
   - Type the number corresponding to the desired status (**1** for **No**, **2** for **Yes**), and then press **<Enter>**.
   - The port membership selection screen closes, and the new status appears in the port column on the **Port-Based VLAN** screen.

Note *Whether a specific port participates in a port-based VLAN or its egress is controlled by VLAN tag-based forwarding rule (that is, frame switching is controlled by IEEE 802.1Q) is determined by the selections made for that port in the **Bridge Policy Configuration** screen (see Section C.49).*

   - Repeat the procedure for each port.

Note *A new item, **9 – Save All** appears on the **Port-Based VLAN** screen, in addition to the **# Save** and % **Undo** commands.*

5. At this stage, the configuration of the new port-based VLAN is complete. Now you may either save the new configuration, delete an existing port-based VLAN or add another port-based VLAN :
   - To add another port-based VLAN:
     - Type **a** and then press **<Enter>**.
     - You will see again the **Port-Based VLAN** screen (*Figure C-79*): note that the automatically assigned index number displayed in the header has been incremented by 1.
     - Continue as explained above.

➤ **To delete an existing port-based VLAN:**

1. To delete an existing port-based VLAN (that is, delete its row), move the selection block to the row to be deleted, type **R** and then press **<Enter>**.

➤ **To modify an existing port-based VLAN:**

1. Move the selection block to the row to be corrected.
2. Type **m** and then press **<Enter>**.

Note *An alternative method for changing the members of the VLAN is to move the selection block to the port to be changed: the **No**/**Yes** menu is then automatically displayed. Now type the corresponding number and press **<Enter>** to make the change.*

3. You will see the edit screen for the selected row. This screen is similar to the screen shown in *Figure C-79*; the index number displayed in the header is the number of the selected row.
4. Continue as explained above for the configuration of a new port-based VLAN.

➤ **To save the new port-based VLAN configuration:**

1. Type **#** to save and then confirm the action.

   Alternatively, you may select item **9 – Save All** on the **Port-Based VLAN** screen.

Port-Based VLAN Configuration Guidelines

Figure C-80 shows a network topology that illustrates the use of port-based VLANs to isolate traffic from different subnets.

The main consideration in the planning of the network is to prevent nodes on one subnet from learning nodes on the other subnets. This can be achieved by isolating the traffic flows from each external LAN port, where each FCD-155 LAN ports serves a single subnet.

When using port-based VLANs, the isolation is the result of the separation of the traffic flows from each external LAN port, obtained by directing them only to the appropriate virtually concatenated groups. Nodes attached to each subnet can then learn only nodes reached by the traffic flow, that is, only nodes within the same subnet.

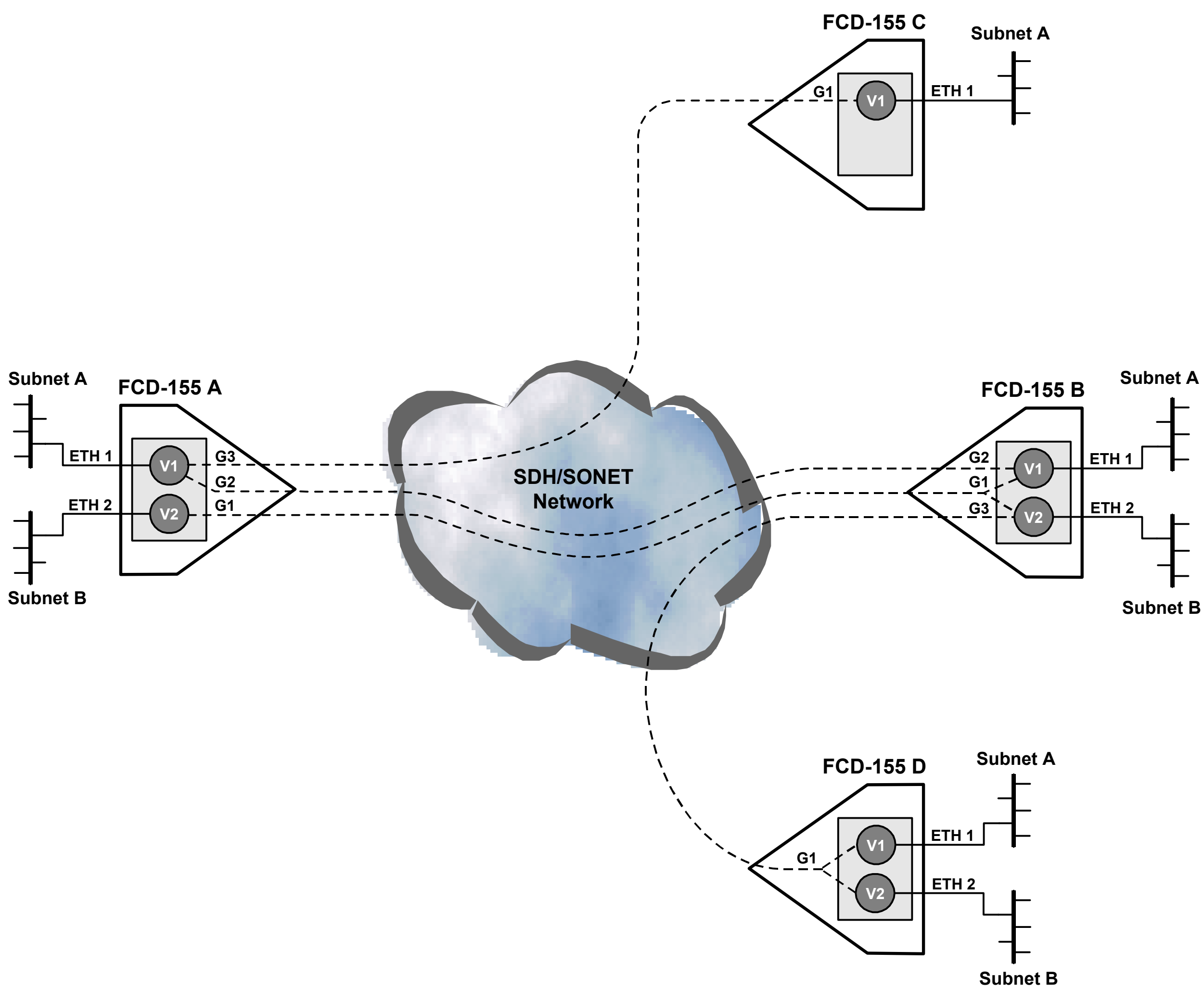


Figure C-80. Port-Based VLAN Configuration Example

For your convenience, the following table identifies the port-based VLANs defined on each unit, as shown in *Figure C-80*.

FCD-155 Unit	VLAN Name	External Port	Groups
FCD-155 A	VLANPORT1	ETH 1	2, 3
	VLANPORT2	ETH 2	1
FCD-155 B	VLANPORT1	ETH 1	2, 3
	VLANPORT2	ETH 2	1, 3
FCD-155 C	VLANPORT1	ETH 1	1
FCD-155 D	VLANPORT1	ETH 1	1
	VLANPORT2	ETH 2	1

C.44 Configuration – Tag-Based (VLAN Switching) Screen

Purpose

Configure static tag-based switching for the desired VLANs.

For a configuration example, refer to the *Tag-Based Switching Configuration Guidelines* section below.

Reached from

Configuration – Bridge – VLAN – item 2

Use

A typical **Tag Based** screen is shown in *Figure C-81*. When the screen is opened, the selection block is automatically located on the first cell. Note that there are no factory default tag-based switching entries.

```
                                  FCD-155
Tag Base

 Id Vlan Name   Vlan Id    Port1    Port2    Grp1     Grp2     Grp3     Grp4
 1  Tag100      100        Forbid   Forbid   Forbid   Forbid   Forbid   Forbid
 2  Tag200      200        Forbid   Forbid   Forbid   Forbid   Forbid   Forbid

 1. Change cell                  ... (Tag100)




>


ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                1 user(s)
------------------------------------------------------------------------------
```

*Figure C-81. Typical **Tag-Based** Screen*

The parameters that can be configured by means of the **Tag-Based** screen are explained in *Table C-22*.

*Table C-22. Tag-Based VLAN Switching Table (**Tag-Based** Screen) Configuration Parameters*

Parameter	Function	Values
Id	The index number of the entry (forwarding rule) within the tag-based switching table. This number is automatically assigned. The maximum number of entries that can be defined is 64.	**Default: The next free number**
VLAN Name	Used to assign a unique logical name to each forwarding rule. This entry is optional. The name may include up to 10 alphanumeric characters.	**Default: Empty string**
VLAN Id	Specifies the VLAN ID (VID) handled in accordance with the corresponding forwarding rule.	The allowed range is 1 to 4094. **Default: Empty string**
Port 1, Port 2, Grp 1 to **Grp4**	6 fields for defining the egress mode for each of the FCD-155 Ethernet switch ports (either external LAN ports or WAN ports (virtually concatenated groups)). Note that each entry may include only one external LAN port (either **Port 1** or **Port 2**).	**Forbid** The port does not serve as egress port for the VLAN ID specified by the corresponding entry. **Unmodif** The port transfers the tags of the frames forwarded to it without change. Therefore, untagged frames egress the port as untagged frames, and tagged frames egress the port as tagged frames. **Tagged** All the frames egress the port as tagged frames. Therefore, tagged frames egress the port unmodified, whereas untagged frames are converted to tagged frames before egressing the port (this is performed by adding a tag with the VLAN ID defined for the corresponding ingress port in the **Bridge Policy Configuration** screen, and recalculating the frame CRC). **Untagged** All the frames egress the port as untagged frames. Therefore, untagged frames egress the port unmodified, whereas tagged frames are converted to untagged frames before egressing the port (this is performed by removing their tag and recalculating the frame CRC). **Default: Forbid**

Note *Unlike the port-based VLAN configuration table (Figure C-79), the tag-based switching table does not include the management port. When management tagging is enabled (see Section C.9), make sure to define an entry (forwarding rule) for the management VLAN.*
*Make sure to configure a forwarding rule for each port configured (by means of the **Bridge Policy Configuration** screen – see Section C.49) to use IEEE 802.1Q tags: if the switching table does not include a rule for each such port, all the traffic received through that port will be discarded.*

➤ **To display the keys available for the Tag-Based screen:**

1. Type **?** and then press **<Enter>**.
2. You will see the help screen. A typical help screen is shown in *Figure C-78*.
3. To return to the **Tag-Based** screen, press any key.

➤ **To add a new tag-based forwarding rule:**

Note *Before starting the configuration of a new tag-based forwarding rule, make sure to define all the relevant virtually concatenated groups (see Sections C.33 to C.37).*

1. Type **a** and then press **<Enter>**.
2. You will see the **Tag-Based** forwarding rule configuration screen. A typical screen with default values is shown in *Figure C-82*. The automatically assigned **Id** number is displayed in the header.
3. Define the logical name of the new tag-based VLAN forwarding rule: select **1** and then type the desired name (up to 10 characters – any characters beyond the first 10 are ignored). Press **<Enter>** to end the string.

```
                                   FCD-155
Tag Base

    Id                           (3)
 1. Vlan Name                ... ()
 2. Vlan Id                  ... (0)
 3. Port1                    >   (Forbid)
 4. Port2                    >   (Forbid)
 5. Grp1                     >   (Forbid)
 6. Grp2                     >   (Forbid)
 7. Grp3                     >   (Forbid)
 8. Grp4                     >   (Forbid)



>

ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-82. Typical **Tag Based** Forwarding Rule Configuration Screen*

4. Define the VLAN ID handled in accordance with the new forwarding rule: select **2** and then type the desired number, in the range of 1 to 4094. Press **<Enter>** to end.

5. Define the required egress mode for each port:
   - Type the item number for the desired member, **3** to **8**.
   - After pressing **<Enter>**, you will see the port egress mode selection screen (see *Figure C-83*). The number of the selected port and its current egress mode is displayed in the screen header.

```
                                  FCD-155
Port1  (Forbid)

 1. Unmodif
 2. UnTagged
 3. Tagged
 4. Forbid





>


ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

Figure C-83. Typical Port Egress Mode Selection Screen

   - Type the number corresponding to the desired egress mode (see explanation of available selections in *Table C-22*), and then press **<Enter>**.

Note *Do not enable egress for more than one external LAN port per forwarding rule.*

   - The port selection screen closes, and the new status appears in the port column on the **Tag-Based** screen.

Note *Whether a specific port participates in a port-based VLAN or in VLAN tag-based switching (that is, performs frame switching in accordance with IEEE 802.1Q) is determined by the selections made for that port in the **Bridge Policy Configuration** screen (see Section C.49).*

   - Repeat the procedure for each port.

Note *A new item, **9 – Save All** appears on the **Tag-Based VLAN** screen, in addition to the **# Save** and **% Undo** commands.*

6. At this stage, the configuration of the new tag-based forwarding rule is complete. Now you may either save the new configuration, delete an existing forwarding rule or add another one:
   - To add another forwarding rule:
     - Type **a** and then press **<Enter>**.
     - You will see again the **Tag-Based** screen (*Figure C-82*): note that the automatically assigned **Id** number displayed in the header has been incremented by 1.
     - Continue as explained above.

➤ **To delete an existing forwarding rule:**

1. To delete an existing forwarding rule (that is, delete its row), move the selection block to the row to be deleted, type **R** and then press **<Enter>**.

➤ **To modify an existing forwarding rule :**

1. Move the selection block to the row to be modified.
2. Move the selection block to the port to be modified.
3. You will see the egress mode selection menu: type the appropriate number and then press **<Enter>** to make the change.

➤ **To save the new configuration:**

1. Type **#** to save and then confirm the action.

   Alternatively, you may select item **9 – Save All** on the **Tag-Based** screen.

Tag-Based Switching Configuration Guidelines

Figure C-84 shows a network topology that illustrates the use of VLAN tag-based switching.

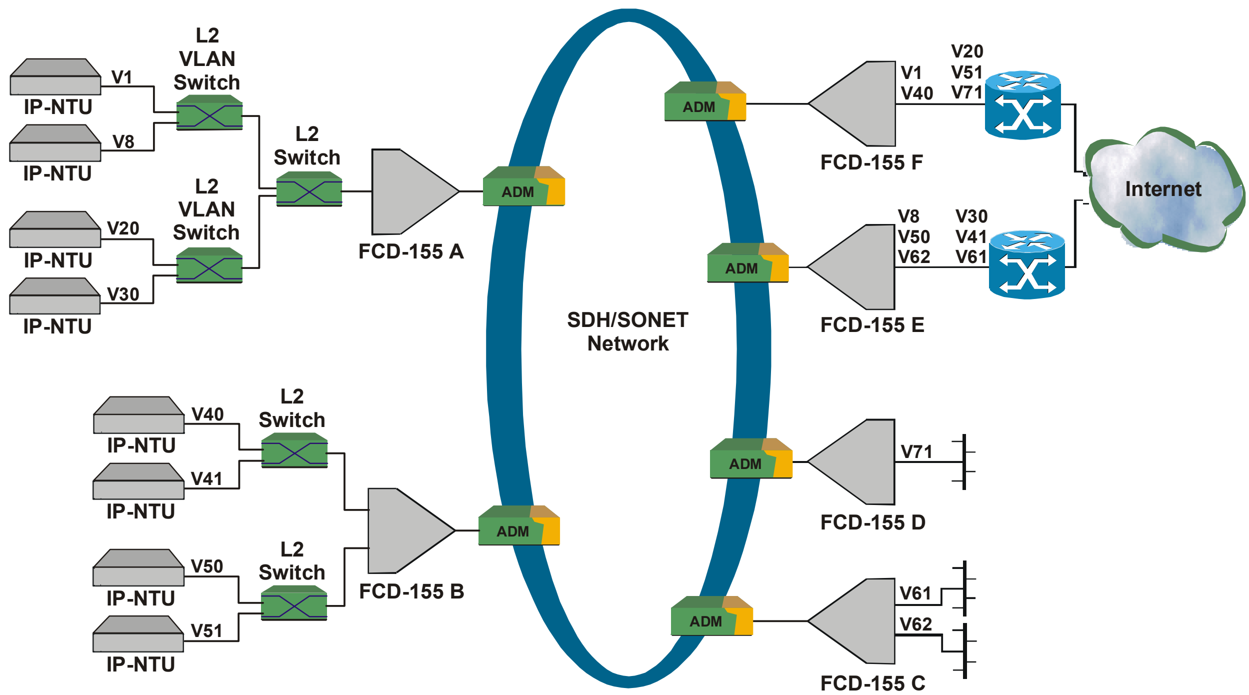


Figure C-84. Typical Application Using VLAN Tag-Based Switching

In the application shown in *Figure C-84*, the FCD-155 units A, B, C and D communicate with the units E and F (this is typical of branch office sites communicating with the headquarters, or sites connecting to the Internet through the ISP PoPs).

The customers' IP-NTU units are controlled by the carrier (or the headquarters network manager), which can then assign the desired VLAN tags and configure the units to use them.

The VLAN tag is then used throughout the network, and each node in the network shown must be configured to switch the traffic in accordance with IEEE 802.1Q. The assigned VLAN IDs are marked near the corresponding ports (the ID is preceded by a **V**).

The required configuration activities are listed below:

FCD-155	Role in Network	VLAN Switching Action
A	Connects Layer 2 switch concentrating traffic from customers' IP-NTUs	VLAN switching must enable using different virtually concatenated groups, to seggregate the served customers' traffic
B	Connects two Layer 2 switchesconcentrating traffic from customers' IP-NT	VLAN switching must enable using different virtually concatenated groups, to seggregate the served customers' traffic
C	LAN ports directly connected to customer's LANs	• Use port-based VLANs to separate among the different customer's networks • VLAN tags must be added to customer's traffic on egress toward the SDH/SONET network
D	LAN port directly connected to customer's LAN	• VLAN tag must be added to customer's traffic on egress toward the SDH/SONET network • VLAN tag must be removed on egress toward the customer's LAN

C.45 Configuration – VLAN Tag Priority Screen

Purpose

Configure the egress priority of the frames when the **QoS Mode** parameter (on the **Configuration – Bridge – General Config** screen) is **VLAN TAG only** (or other value that requires using the VLAN tag to select the egress priority of a frame).

The FCD-155 Ethernet switch has four egress queues, whose priorities are identified as 0 (lowest) to 3 (highest priority), whereas the range of priorities supported by IEEE 802.1p tags is 0 to 7. This screen enables the user to assign each tag priority value to a specific queue, in accordance with user's preferences.

Reached from

Configuration – Bridge – item 3

Use

Typical **VLAN Tag Priority** screens are shown in *Figure C-85*. The default screen view is the table view.

```
                                   FCD-155
VLAN TAG Priority

    Tag Value      0   1   2   3   4   5   6   7
 Egress Priority   0   0   0   0   0   0   0   0

 1. Change cell [0 - 3]          ... (0)




>
ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                 1 user(s)
------------------------------------------------------------------------------
```

A. Table View

```
                                   FCD-155

    Tag Value                        (Egress Priority)
 1. 0[0 - 3]                     ... (0)
 2. 1[0 - 3]                     ... (0)
 3. 2[0 - 3]                     ... (0)
 4. 3[0 - 3]                     ... (0)
 5. 4[0 - 3]                     ... (0)
 6. 5[0 - 3]                     ... (0)
 7. 6[0 - 3]                     ... (0)
 8. 7[0 - 3]                     ... (0)

>
ESC-prev.menu; !-main menu; &-exit; @-output                         1 user(s)
------------------------------------------------------------------------------
```

B. Menu View

*Figure C-85. Typical **VLAN Tag Priority** Screens*

➤ **To assign each tag priority value to a specific Ethernet switch egress queue:**

Note *As an alternative to the procedure displayed below, you may switch to the menu view by typing **m** followed by **<Enter>**.*

1. Bring the cursor to the desired cell.
2. Type **1** on the table view and then press **<Enter>**.
3. You can now type the desired egress priority, 0 to 3, for the selected tag value.
4. Move the cursor to the next tag value field, and type its egress priority. You may select any desired value in the allowed range (0 to 3), even if is has already been entered before.
5. Repeat the procedure until all the desired values have been assigned, and then press **<Enter>**.

C.46 Configuration – DSCP Screen

Purpose

Configure the egress priority of the packets in accordance with their differentiated services (DS) field values, or codepoints (DSCPs). This priority is used when the **QoS Mode** parameter (on the **Configuration – Bridge – General Config** screen) is **DSCP only** (or other value that requires using the DSCP field to select the egress priority of a frame).

The FCD-155 Ethernet switch has four egress queues, whose priorities are identified as 0 (lowest) to 3 (highest priority), whereas the range of values that are supported by the differentiated services field defined in RFC2474 (which supersedes RFC791) is 0 to 255. This screen enables the user to assign each DS codepoint (DSCP) to a specific queue, in accordance with user's preferences.

The DS field, as defined in RFC2474, consists of eight bits, where the 6 most significant define the differentiated services code points, and the least significant pair is currently unused. Therefore, only DSCP values which are multiples of 4 can be used (that is, binary representations with 00 as the least significant bits).

Note that the treatment and forwarding behavior for frames carrying any specific code point is network-specific, and must be coordinated with the network administrator.

Reached from

Configuration – Bridge – item 4

Use

A typical **DSCP** screen is shown in *Figure C-86*.

```
                                   FCD-155
DSCP
   Value  Priority   Value    Priority   Value    Priority   Value    Priority
      0      0         32        0         64        0         96        0
      4      0         36        0         68        0        100        0
|     8      0         40        0         72        0        104        0
v    12      0         44        0         76        0        108        0
     16      0         48        0         80        0        112        0
     20      0         52        0         84        0        116        0
     24      0         56        0         88        0        120        0
     28      0         60        0         92        0        124        0
 1. Change cell [0 - 3]          ... (0)


>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-86. Typical **DSCP** Screen*

Note *You can see the navigation keys available for this screen by typing **?** followed by **<Enter>**.*

➤ **To assign each DS value to a specific Ethernet switch egress queue:**

1. Type **1** and then press **<Enter>**.
2. You can now type the desired egress priority, 0 to 3, for the first value, 0.
3. Move the cursor to the next DS value field, and type its egress priority. You may select any desired value in the allowed range (0 to 3), even if is has already been entered before.
4. Repeat the procedure until all the desired values have been assigned, and then press **<Enter>**.

C.47 Configuration – LAN Table Task Selection Screen

Purpose

Select the task to be performed on the bridge LAN table.

Reached from

Configuration – Bridge – item 5

Use

A typical **LAN Table** task selection screen is shown in *Figure C-86*.

```
                                              FCD-155
Lan Table

 1. View LAN Table []>
 2. Erase LAN Table








>


ESC-prev.menu; !-main menu; &-exit; @-output                                1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-87. Typical **LAN Table** Task Selection Screen*

➤ **To display and/or edit the contents of the LAN table:**

Type **1** and then press **<Enter>**. See *Section C.48* for instructions.

➤ **To erase all the static entries in the LAN table:**

Type **2** and then press **<Enter>**. All the static entries are removed from the table.

C.48 Configuration – View LAN Table Screen

Purpose

Display the current contents of the bridge LAN table, and edit its contents to add/remove static entries.

Reached from

Configuration – Bridge – item 5

Use

A typical **View LAN Table** screen is shown in *Figure C-88*.

```
                                    FCD-155
View LAN Table

 Index MAC Address       Port    State
 0     01-80-C2-00-00-00 Mng     Learned
 1     01-80-C2-00-00-07 Port 2  Static





>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help               1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-88. Typical **View LAN Table** Screen*

Note *You can see the navigation keys available for this screen by typing **?** followed by **<Enter>**.*

The parameters displayed on the **View LAN Table** screen are as follows:

Index The index number of each entry (automatically assigned).

MAC Address Displays the corresponding MAC address.

Port Displays the port through which the corresponding MAC address can be reached: **Mng**, **Port 1**, **Port 2**, and **Grp 1** to **Grp 4** (management, external LAN ports and groups 1 to 4, respectively).

State Displays the port state:

- **Learned** – dynamically learned address
- **Static** – static (user-configured) address.

Note *You can display the information presented for any particular entry in a menu format, by typing **m** followed by **<Enter> B** (when the table includes several entries, first bring the selection block to the desired row).*

➤ **To add a static entry:**

1. Type **a** and then press **<Enter>**.
2. You will see the **View LAN Table** screen, used to add a new entry. The automatically assigned index number is displayed in the header.
3. Type **1** and then press **<Enter>**.
4. Define the MAC address (12 hexadecimal digits) assigned to the new entry and then press **<Enter>**.
5. Type **2** and then press **<Enter>** to display the port selection menu.
6. On the port selection menu, select the desired port or group, and then press **<Enter>**. A typical screen, as seen after pressing **<Enter>** all the values have been selected, is shown in *Figure C-89*.

Note *A new item, **3 – Save All** appears on the screen, in addition to the **# Save** and **% Undo** commands.*

7. At this stage, the configuration of the static entry is complete. Now you may either save the new configuration, or add another entry.

```
                                              FCD-155
View LAN Table

    Index                    ... (3)
 1. MAC Address              ... (01-80-C2-00-00-27)
 2. Port                     >   (Port 1)
    State                    >   (Static)
 3. Save All


>
# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-output                         1 user(s)
------------------------------------------------------------------------------
```

*Figure C-89. Typical **View LAN Table** – **Add** Screen*

➤ **To save the new configuration:**

- Type **#** to save and then confirm the action.

  Alternatively, you may select item **3 – Save All**.

C.49 Configuration – Bridge Policy Configuration

Purpose

Configure the FCD-155 Ethernet switch characteristics for operation in the customer's environment. The ports that can be configured include **Port 1, Port 2**, and **Grp 1** to **Grp 4** (the external LAN ports and groups 1 to 4, respectively).

Each port can be independently configured.

Reached from

Configuration – Bridge – item 6

Use

A typical **Bridge Policy Configuration** screen is shown in *Figure C-88*.

```
                                    FCD-155
Bridge Policy configuration

    Port State    >    (Forwarding)
 1. Port          >    (Port 1)
 2. VLAN Type     >    (Port Based)
 3. Egress Mode   >    (Unmodified)
 4. VLAN ID       [1 - 4094]... (1)
 5. Mode          >    (Bridge)
 6. Port Priority[0 - 255]... (128)
 7. Port Cost     [0 - 65535]... (500)






>


ESC-prev.menu; !-main menu; &-exit; @-output                         1 user(s)
------------------------------------------------------------------------------
```

*Figure C-90. Typical **Bridge Policy Configuration** Screen*

The parameters that can be configured by means of the **Bridge Policy Configuration** screen are described in *Table C-23*.

➤ **To configure the Ethernet switch characteristics:**

1. Select the port to be configured:
   - Type **1** and then press **<Enter>** to display the port selection screen.
   - On the port selection screen, type the number corresponding to the desired port, and then press **<Enter>**.
2. The new port number appears in the **Bridge Policy Configuration** screen, together with its current state:

   Disabled The port does not allow any frames to enter (ingress), nor leave (egress), however it will accept management frames. The bridge does not learn through a disabled port..

Blocking The port does not allow data frames to enter (ingress), nor leave (egress), but passes management frames and frames carrying bridge protocol data units (BPDUs) to the switch. The bridge does not learn through a disabled port.

Listening The port listens to incoming frames, but does not allow data frames to pass in either the ingress or egress direction (only frames carrying BPDUs are allowed to enter; all the other frames are discarded). Learning through this port is disabled.

Learning The port listens to incoming frames, but does not allow frames to pass in either the ingress or egress direction (only frames carrying BPDUs are allowed to enter). The bridge uses the information carried by the incoming frames accepted by the port for learning. Learning takes place on all good frames, even if not they do not carry BPDUs.

Forwarding Normal operation: all the frames are allowed to enter (ingress) and leave (egress) the port. Learning takes place on all good frames.

3. Type the number corresponding to the desired parameter, and then press **<Enter>:**
   - For items **4**, **6** , **7**, you can then type the desired value in the same line. When done, press **<Enter>**.
   - For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-23* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **Bridge Policy Configuration** screen.
4. When done, type **#** to save and then confirm the action.

Table C-23. ***Configuration – Bridge – Bridge Policy Configuration*** *Parameters*

Parameter	Function	Values
VLAN Type	Selects the type of VLAN in which the port participates, and the frame processing mode. Note that a port configured to use 802.1Q tag-based switching may still be included in a port-based VLAN configured in accordance with *Section C.43*: in this case, the port may serve as egress port for the other ports in the same VLAN. To help you select the appropriate VLAN type for your application, refer to the *Controlling Bridge Frame Handling and Forwarding* section, which describes frame processing by the internal bridge, and the effect of the various parameters	**Port Based** – The Ethernet switch will handle traffic through this port in accordance with the configuration prepared by means of the **Port-Based VLAN** screen (see *Section C.43*). **802.1Q** – The Ethernet switch will forward frames even if their ingress port is not a member of the tag-based VLAN. **802.1Q Tagged only** – The Ethernet switch will not forward frames when their ingress port is not a member of the tag-based VLAN. This mode is not available for groups. **Default: Port Based**

Table C-23. ***Configuration – Bridge – Bridge Policy Configuration*** *Parameters (Cont.)*

Parameter	Function	Values
Egress Mode	Specifies the egress mode for the corresponding port of the Ethernet switch. To help you select the appropriate egress mode for your application, refer to the *Controlling Bridge Frame Handling and Forwarding* section, which describes frame processing by the internal bridge, and the effect of the various parameters	**Unmodified** – The port transfers the tags of the frames forwarded to it without change. Therefore, untagged frames egress the port as untagged frames, and tagged frames egress the port as tagged frames. This mode is not available for groups (that is, for the WAN side ports). **Untagged** – All the frames egress the port as untagged frames. Therefore, untagged frames egress the port unmodified, whereas tagged frames are converted to untagged frames before egressing the port (this is performed by removing their tag and recalculating the frame CRC). This mode is not available for groups (that is, for the WAN side ports). **Tagged** – All the frames egress the port as tagged frames. Therefore, tagged frames egress the port unmodified, whereas untagged frames are converted to tagged frames before egressing the port (this is performed by adding a tag with the VLAN ID defined for the corresponding ingress port, and recalculating the frame CRC). **Double Tagged** – A tag is always added to all the frames that egress the port. This mode should be selected only when the network supports a frame size of at least 1526 bytes. **Default: Unmodified**
VLAN Id	Specifies the default VLAN ID (VID) associated with the corresponding port. This VID is used to process untagged frames received through this port, and is assigned to untagged frames that must be tagged before egress through this port	The allowed range is 1 to 4094. **Default: 1**
Mode	Specifies the forwarding algorithm for traffic passing for the corresponding port	**Bridge** – Forwarding in accordance with the MAC bridge rules. **Bridge + STP** – The Spanning Tree Protocol (STP) is activated on this port. The STP type is selected by means of the **Spanning Tree Parameters** screen (see *Section C.51*). **Default: Bridge**

Table C-23. ***Configuration – Bridge – Bridge Policy Configuration*** *Parameters (Cont.)*

Parameter	Function	Values
Port Priority	Specifies the port priority, used by STP to generate the port ID	The allowed range is 0 to 255. **Default: 128**
Port Cost	Specifies the cost added by the port to the total cost to the root bridge	The allowed range is 0 to 65535. **Default: 100 for LAN ports** **500 for WAN ports (groups)**

Controlling Bridge Frame Handling and Forwarding

Figure C-91 describes the processing of the frames within the bridge, as a function of the selections made on the **Bridge Policy Configuration** and on the other relevant screens.

The screens used to select the parameters that effect frame processing , and the parameter designations, are also identified (the designations appear on a gray background).

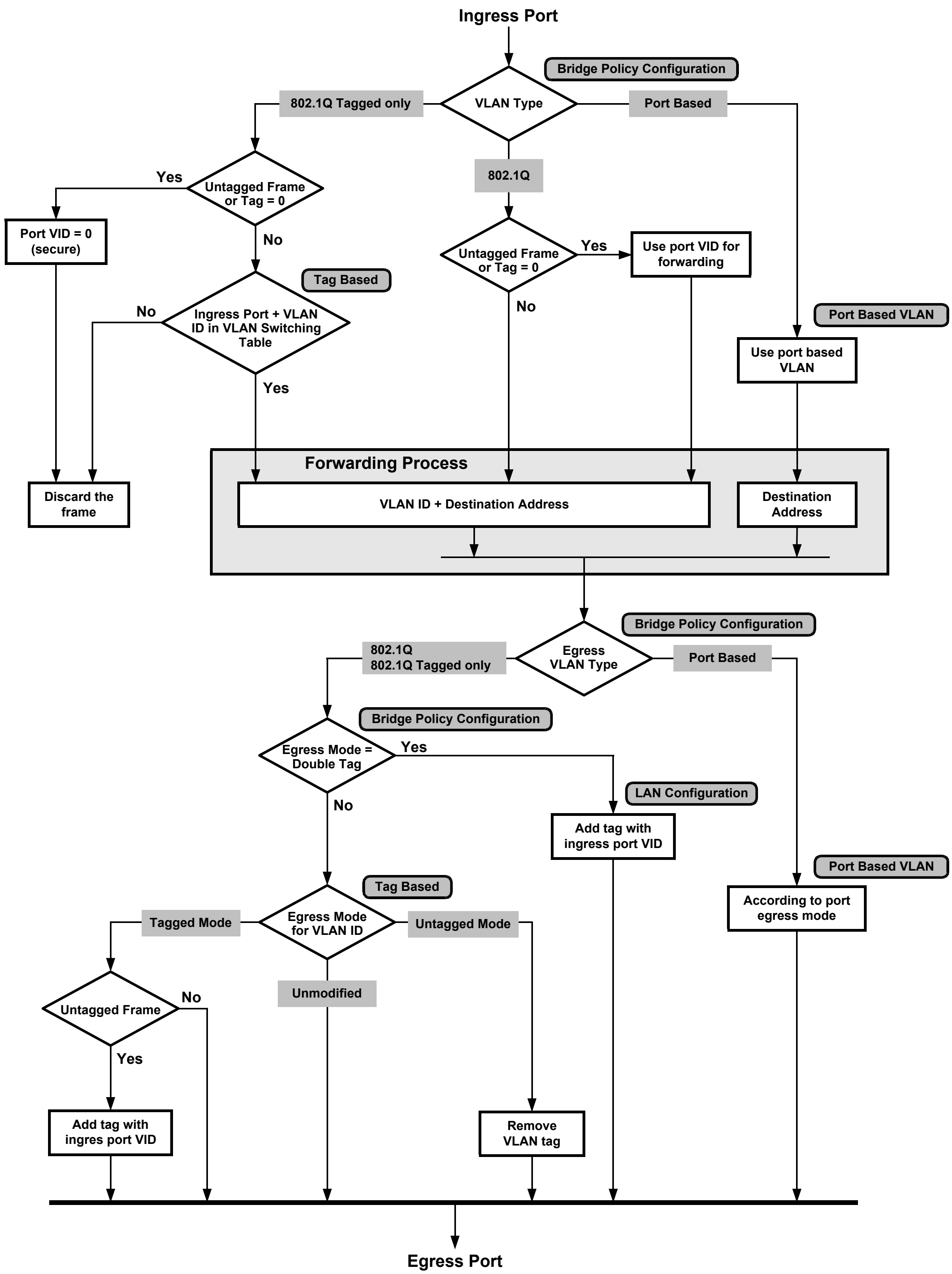


Figure C-91. Frame Processing

C.50 Configuration – Spanning Tree Protocol Task Selection Screen

Purpose

Select the Spanning Tree Protocol-related task to be performed.

Reached from

Configuration – Bridge – item 7

Use

A typical **Spanning Tree Protocol** task selection screen is shown in *Figure C-92*.

```
                                    FCD-155
Spanning Tree Protocol

 1. STP configuration>
 2. STP Status       >








>


ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-92. Typical **Spanning Tree Protocol** Screen*

➤ **To configure the STP parameters:**

Type **1** and then press **<Enter>**. See *Section C.51* for instructions.

➤ **To display information on the current STP status:**

Type **2** and then press **<Enter>**. See *Section C.52* for instructions.

C.51 Configuration – STP Configuration Screen

Purpose

Configure the Spanning Tree Protocol parameters in accordance with the specific requirements of customer's application.

Reached from

Configuration – Bridge – Spanning Tree Protocol – item 1

Use

A typical **STP Configuration** screen is shown in *Figure C-93*.

```
                                     FCD-155
STP configuration

 1. Bridge Priority     [0 - 65535]... (32768)
 2. Bridge Forward Delay[4 - 30]... (15)
 3. Bridge Max Age      [6 - 40]... (20)
 4. Bridge Hello Time   [1 - 10]... (2)
 5. STP Version         >   (STP)




>


ESC-prev.menu; !-main menu; &-exit; @-output                      1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-93. Typical **STP Configuration** Screen*

The parameters that can be configured by means of the **STP Configuration** screen are described in *Table C-24*.

➤ **To configure the STP parameters:**

1. Type the number corresponding to the desired parameter, and then press **<Enter>:**
   - For items **1** to **4**, you can then type the desired value in the same line. When done, press **<Enter>**.
   - For item **5**, you will see the corresponding selection screen. In this case, the **Values** column in *Table C-24* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **<Enter>**. The selection screen closes and the new value appears in the **STP Configuration** screen.
2. When done, type **#** to save and then confirm the action.

Note *Any changes to the values of parameters 2, 3, 4 must be carefully considered, because the effect these parameters have on the network performance and stability.*

Table C-24. ***Configuration – Bridge – STP Configuration*** *Parameters*

Parameter	Function	Values
Bridge Priority	Specifies the bridge priority. This parameter is used, together with the bridge MAC address, to generate the Bridge ID. Since the selection of the root bridge of the STP tree is based on the bridge ID, a bridge can be forced to become root by assigning it a lower bridge priority.	The allowed range is 0 to 65535. **Default: 32768**
Bridge Forward Delay	Specifies the time spent in the listening and in the learning state while moving from the Blocking to the Forwarding state. The configured value is used only when the FCD-155 bridge is the root bridge	The allowed range is 4 to 30 sec. **Default: 15**
Bridge Max Age	Specifies the maximum age of received protocol information before it is discarded. The configured value is used only when the FCD-155 bridge is the root bridge	The allowed range is 6 to 40 sec. **Default: 20**
Bridge Hello Time	Specifies the time interval between consecutive transmissions of bridge protocol data units (BPDUs). The configured value is used only when the FCD-155 bridge is the root bridge	The allowed range is 1 to 10 sec. **Default: 2**
STP Version	Specifies the STP version used by the bridge	**STP** Standard STP. **RSTP** Rapid STP. **Default: STP**

C.52 Configuration – STP Status Screen

Purpose

Display information on the current status of the Spanning Tree Protocol protocol.

Reached from

Configuration – Bridge – Spanning Tree Protocol – item 2

Use

A typical **STP Status** screen is shown in *Figure C-94*.

```
                                    FCD-155
STP Status

    Designated Root[0 - 65535]... (32768)
    Root Path Cost[0 - 65535]... (0)
    Forward Delay [4 - 30]... (15)
    Max Age       [6 - 40]... (20)
    Hello Time    [1 - 10]... (2)








>



ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-94. Typical **STP Status** Screen*

The parameters displayed by means of the **STP Status** screen are as follows (see descriptions in *Section C.51*):

Designated Root The bridge currently selected as root bridge.

Root Path Cost The cost of the path from this bridge to the root bridge.

Forward Delay The forwarding delay of this bridge.

Max Age The aging time of bridge protocol information at this bridge.

Hello Time The interval between consecutive transmissions of bridge protocol information (BPDUs) by this bridge.

For each current parameter value, you can also see the allowed range of values.

C.53 Configuration – Select Configuration

Purpose

Select the FCD-155 configuration display mode.

Two configuration display modes are available:

- **On Line:** in this mode, the various configuration screens display the parameter values contained in the on-line database (the database that actually determines the FCD-155 operating mode).

  The result is that you can see configuration changes made on the current screen, but cannot see new parameter values selected on previous screens during the current configuration session, until the new values are activated using the **Save** command. The reason is that you can see such changes only after the **Save** command transfers the new parameter values to the on-line database.

- **Off Line**: normal configuration display mode. In this mode, the parameter values displayed on the various configuration screens reflect the last selected values, even if they have not yet been saved (such values are temporarily stored in an off-line database, whose contents are lost when the FCD-155 is reset or powered down). When the new parameter values are ready for activation, save them to the on-line database using the **Save** command.

Note *To alert you that parameter values have been changed but not yet saved (activated), the **Save** command appears on each screen. To save, type **#** and then confirm the operation by typing **y** (typing **n** cancels the **Save** command).*

In either mode, you can also undo (delete) any unsaved changes using the **Undo** command (type **%** to undo).

During configuration sessions, it is recommended to use the **Off Line** mode, which enables you to see parameter values that have been changed but not yet saved. Whenever you want to see the actually used (on-line) parameter values, switch to the **On Line** mode, and then return to the **Off Line** mode to continue the configuration activities.

Reached from

Configuration – item 6

Use

A typical display is shown *Figure C-95*. Note that the current mode is displayed in the screen header.

➤ **To change the configuration display mode:**

Type the number corresponding to the desired mode, and then press **<Enter>**.

```
                                    FCD-155
Select configuration (Off Line)
 1. Off Line
 2. On Line






>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-95. Typical **Select Configuration** Screen*

C.54 Monitoring Menu

Figure C-96 and *Figure C-97* show the structure of the **Monitoring** menu for the main FCD-155 versions.

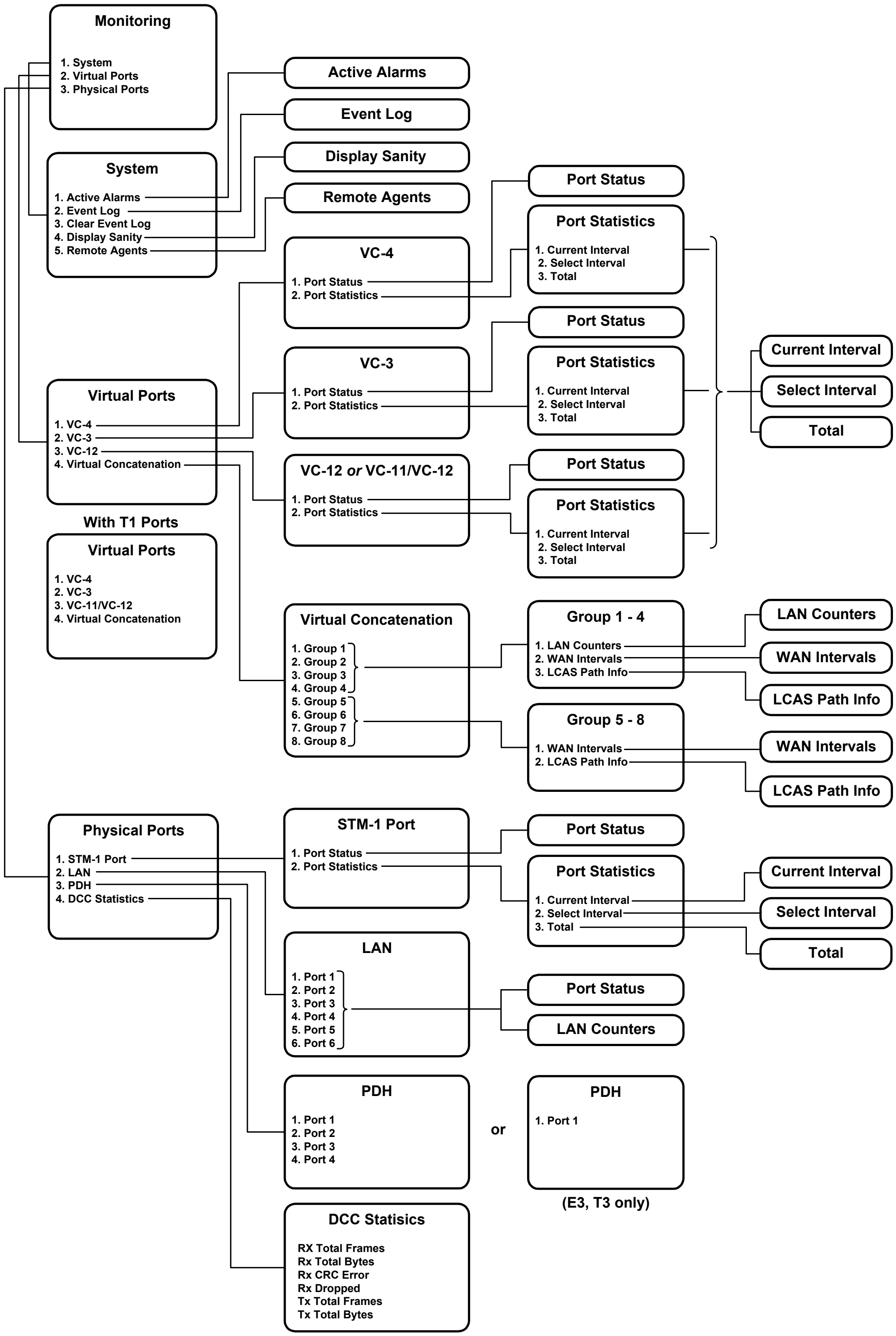


*Figure C-96. **Monitoring** Menu Structure (SDH Version with PDH Ports)*

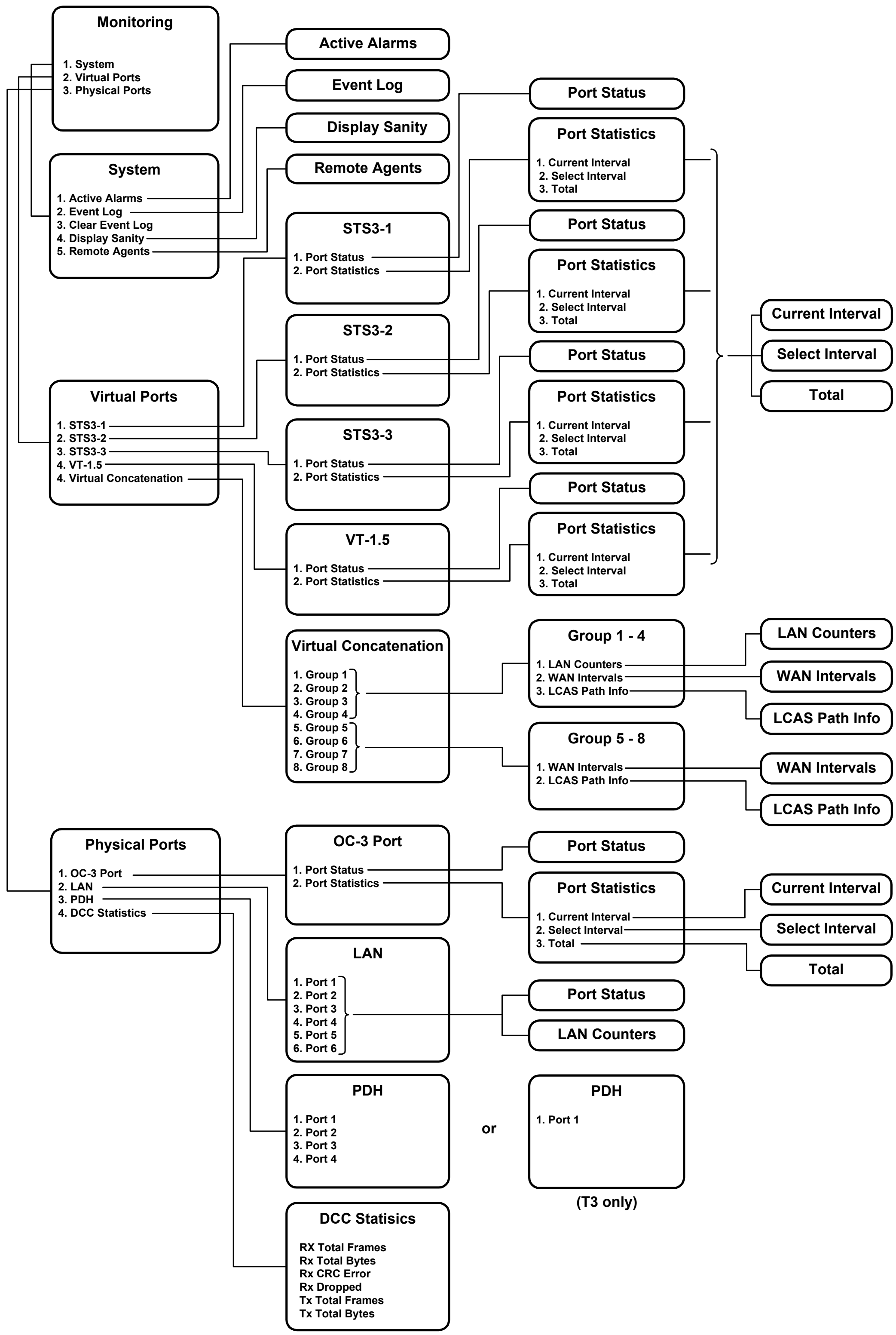


*Figure C-97. **Monitoring** Menu Structure (SONET Version)*

C.55 Monitoring – Selection Screen

Purpose

Select the type of monitoring activity.

Reached from

Monitoring

Use

A typical selection screen is shown in *Figure C-98*.

```
                                    FCD-155
Monitoring
 1. System        >
 2. Virtual Ports >
 3. Physical Ports>




>

ESC-prev.menu; !-main menu; &-exit; @-Output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-98. **Monitoring** – Task Selection Screen*

➤ **To select the type of monitoring activity:**

Type its number and then press **<Enter>**.

C.56 Monitoring – System Submenu

Purpose

Perform system monitoring activities.

Reached from

Monitoring – item 1

Use – Select a System Monitoring Task

A typical **System** monitoring submenu is shown in *Figure C-99*.

```
                                FCD-155                                  ALRM
System
 1. Active Alarms    []
 2. Event Log        []
 3. Clear Event Log
 4. Display Sanity   >
 5. Remote Agents    >


>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-99. Typical **System** Submenu*

➤ **To select the desired system monitoring task:**

1. Type the number of the desired task, and then press **<Enter>**.

Use – Display Active Alarms

➤ **To display the active alarms:**

1. Type **1** and then press **<Enter>**.
2. You will see the **Active Alarms** screen. A typical **Active Alarms** screen is shown in *Figure C-100.*

```
                               FCD-155                                  ALRM
Active Alarms
 Code Port   Description                    Severity  State  Count
 86          RESET OCCURRED                  Event     On      1
 14   LINK-1 SIGNAL LOSS                     Major     On      1
 50   ETH-01 LAN NOT CONNECTED               Major     On      1
 50   ETH-02 LAN NOT CONNECTED               Major     On      1
 32   TUG3-1 SIGNAL DEGRADED ERROR           Minor     On      1
 81   TU-44  SIGNAL LABEL MISMATCH           Minor     On      1

>

ESC-prev.menu; !-main menu; &-exit; @-Output; ?-help                1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-100. Typical **Active Alarms** Screen*

The alarms appear on the **Active Alarms** screen in the order they have been recorded in the log (the last alarm appears at the end of the list).

The information displayed on the **Active Alarms** screen is organized as a table with the following columns:

Code Unique alarm code. Refer to *Appendix B* for a description of the alarm codes.

Port Identifies the FCD-155 port which generated the alarm. See the *Port Identification* section below.

Description Text string that provides a concise description of the alarm condition.

Severity Alarm severity: **major** or **minor.**

State Current state of alarm: **on** (still present) or **off** (no longer present).

Count Total number of times the corresponding alarm has already been detected for that port.

Use – Display the Event Log

➤ **To display the event log:**

1. Type **2** and then press **<Enter>**.
2. You will see the **Event Log** screen. A typical **Event Log** screen is shown in *Figure C-101.*

```
                                  FCD-155                                ALRM
Event Log
 Code Port   Description                       Status Date       Time
 50   ETH-02 LAN NOT CONNECTED                 On     01-01-2000 00:00:25
 50   ETH-01 LAN NOT CONNECTED                 On     01-01-2000 00:00:25
 14   LINK-1 SIGNAL LOSS                       On     01-01-2000 00:00:02
 86          RESET OCCURRED                    On     01-01-2000 00:00:00



>

ESC-prev.menu; !-main menu; &-exit; @-Output; ?-help                 1 user(s)
------------------------------------------------------------------------------
```

*Figure C-101. Typical **Event Log** Screen*

The events appear on the **Event Log** screen in the order they have been recorded in the log (the last event appears at the end of the list). The information is organized as a table with the following columns:

Code Unique alarm code. Refer to *Appendix B* for a description of alarm and event codes.

Port Identifies the FCD-155 port which generated the alarm or event. See the *Port Identification* section below.

Description Text string that provides a concise description of the alarm condition or event.

State Current state of alarm or event: **on** (still present) or **off** (no longer present).

Date The date the alarm or event has been recorded in the log, in accordance with the internal real-time clock of the FCD-155.

Time The **Time** the alarm or event has been recorded in the log, in accordance with the internal real-time clock of the FCD-155.

Use – Clear the Event Log

➤ **To clear the event log:**

Type **3** and then press **<Enter>**.

All the events appearing on the **Event Log** screen are deleted.

Use – Display Sanity Errors and Warnings

➤ **To display the list of sanity errors:**

1. Type **4** and then press **<Enter>**.
2. You will see the **Display Sanity** task selection screen. A typical screen is shown in *Figure C-102*.

```
                                  FCD-155                                 ALRM
Display Sanity
 1. Errors and Warnings[]






>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-102. Typical **Display Sanity** Task Selection Screen*

3. Type **1** and then press **<Enter>**.
4. You will see the **Errors and Warnings** screen. A typical screen is shown in *Figure C-103*.

```
                                     FCD-155                               ALRM
Errors and Warnings
 Index Port    Description
 1     GRP-01  ERROR   (020):ASSIGNMENT/NUMBER OF VC MISMATCH





>

ESC-prev.menu; !-main menu; &-exit; @-Output; ?-help                  1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-103. Typical **Errors and Warnings** Screen*

The information appearing on the **Errors and Warnings** screen is organized as a table with the following columns:

Index Sequence number, automatically assigned.

Port Identifies the FCD-155 physical or virtual port for which the error or warning has been detected. See the *Port Identification* section below.

Description Text string that identifies the type (error or warning), the unique code, and a concise description of the alarm condition or event. Refer to *Appendix B* for a description of sanity error codes.

After an error or warning condition is corrected, it is automatically removed from the screen.

Use – Display Information on Remote Agents

➤ **To display information on the remote agents learned by the FCD-155 management agent:**

1. Type **5** and then press **<Enter>**.
2. You will see the **Remote Agents** screen. A typical **Remote Agents** screen is shown in *Figure C-102*.

```
                                  FCD-155
Remote Agents

 Index IP Address      Name       Phys Distance Log Distance
   1   172.21.208.24   RAD1       12            2





>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                1 user(s)
------------------------------------------------------------------------------
```

*Figure C-104. Typical **Remote Agents** Screen*

The information appearing on the **Remote Agents** screen is organized as a table with the following columns:

Index Sequence number, automatically assigned.

IP Address Displays the IP address of the remote agent.

Name Displays the logical name of the remote agent.

Phys Distance Displays the current number of hops in the path (through the management network) connecting the FCD-155 management agent to the corresponding remote agent.

Log Distance Displays the logical distance (through the management network) to the remote agent. This parameter is a metric taken into consideration by routing protocols during the selection of optimal routes.

Port Identification

The various types of physical and virtual ports are identified as follows:

Link Port `LINK` followed by its number, 1 or 2.

LAN Port `ETH` followed by its number, 01 to 06.

Group `Grp` followed by its number, 01 to 08.

PDH Port `E1`, `T1`, `E3`, or `T3` followed by its number, 01 to 04.

TU-11 or **TU-12 Tributary** `TU` followed by its number. The number of the TU depends on the network interface type, and the VC carried by the TU:

- For TU-12 (SDH network interfaces) – refer to *Table C-25*. For example, the VC-12 placed in tributary 1:3:6 is carried by TU-18.
- For TU-11 (SDH network interfaces) and VT-1.5 (SONET network interfaces) – refer to *Table C-26*. For example, the VC-11 or VT-1.5 placed in tributary 2:1:4 is carried by TU-32.

TUG-3 `TUG3` followed by its number, 1, 2 or 3

VC-11, VC-12, VT-1.5 The position of the corresponding TU in the STM-1 or STS-3 frame, as listed in *Table C-25* or *Table C-26*, respectively.

VC-3 or **STS-1** `TUG3` or `STS1` followed by its number: 1, 2 or 3.

VC-4 or **STS-3** `VC4` or `STS3.`

Table C-25. Identification of TU-12 Position in STM-1 Frame

TU Type	TUG-3 No. 1			TUG-3 No. 2			TUG-3 No. 3		
	TU 1	TU 2	TU 3	TU 1	TU 2	TU 3	TU 1	TU 2	TU 3
TUG-2 No. 1	1	2	3	22	23	24	43	44	45
TUG-2 No. 2	4	5	6	25	26	27	46	47	48
TUG-2 No. 3	7	8	9	28	29	30	49	50	51
TUG-2 No. 4	10	11	12	31	32	33	52	53	54
TUG-2 No. 5	13	14	15	34	35	36	55	56	57
TUG-2 No. 6	16	17	18	37	38	39	58	59	60
TUG-2 No. 7	19	20	21	40	41	42	61	62	63

Table C-26. Identification of TU-11/VT-1.5 Position in STM-1/STS-3 Frame

TU Type	TUG-3 No. 1				TUG-3 No. 2				TUG-3 No. 3			
	TU 1	TU 2	TU 3	TU 4	TU 1	TU 2	TU 3	TU 4	TU 1	TU 2	TU 3	TU 4
TUG-2 No. 1	1	2	3	4	29	30	31	32	57	58	59	60
TUG-2 No. 2	5	6	7	8	33	34	35	36	61	62	63	64
TUG-2 No. 3	9	10	11	12	37	38	39	40	65	66	67	68
TUG-2 No. 4	13	14	15	16	41	42	43	44	69	70	71	72
TUG-2 No. 5	17	18	19	20	45	46	47	48	73	74	75	76
TUG-2 No. 6	21	22	23	24	49	50	51	52	77	78	79	80
TUG-2 No. 7	25	26	27	28	53	54	55	56	81	82	83	84

C.57 Monitoring – Virtual Ports Submenu (SDH Network Interfaces)

Purpose

Select the type of virtual ports for which monitoring information will be displayed.

Reached from

Monitoring – item 2

Use

A typical **Virtual Ports** submenu for an FCD-155 with SDH network interfaces is shown in *Figure C-105*.

```
                                        FCD-155
Virtual Ports
 1. VC-4                      >
 2. VC-3                      >
 3. VC-12                     >
 4. Virtual concatenation     >





>

ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
------------------------------------------------------------------------------
```

*Figure C-105. Typical **Virtual Ports** Submenu (SDH Network Interfaces)*

Note *When an FCD-155 using SDH network interfaces is equipped with T1 ports, performance monitoring information is collected for both VC-11s and VC-12s. The screen then displays **VC-11/VC-12**, instead of **VC-12**.*

➤ **To select the type of virtual ports:**

Type the desired number and then press **<Enter>**.

C.58 Monitoring – VC-4 Screen

Purpose

Display performance monitoring information for the VC-4 level.

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring – Virtual Ports – item 1

Use

A typical **VC-4** port task selection screen is shown in *Figure C-106*. The type of port is identified in the screen header.

```
                                    FCD-155
VC-4
 1. Port Status     >
 2. Port Statistics >







>


ESC-prev.menu; !-main menu; &-exit                                 1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-106. Typical **VC-4 Port** Task Selection Screen*

➤ **To display the status of the VC-4 virtual port:**

1. Type **1** on the **VC-4 Port** task selection screen and then press **<Enter>**.
2. You will see the **Port Status** screen. A typical **Port Status** screen is shown in *Figure C-107.*

The parameters displayed on the **Port Status** screen are explained in *Table C-27*.

*Table C-27. VC-4 **Port Status** Virtual Port Status Parameters*

Parameter	Description
J1 Received	Displays the received J1 string
C2 Received	Displays the received C2 byte (signal label)

```
                                       FCD-155
Port Status

 1. J1 Received             ... (F;X)
 2. C2 Received             ... (120)







>

ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
------------------------------------------------------------------------------
```

Figure C-107. Typical VC-4 ***Port Status*** *Virtual Port Screen*

➤ **To display the VC-4 virtual port statistics:**

1. Type **2** on the **VC-4 Port** task selection screen and then press **<Enter>**.
2. You will see the **VC-4** statistics interval selection screen. A typical **VC-4** interval selection screen is shown in *Figure C-108*.

```
                                       FCD-155
VC4
 1. Current Interval>
 2. Select Interval >
 3. Total           >






>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
------------------------------------------------------------------------------
```

Figure C-108. Typical ***VC-4*** *Interval Selection Screen*

➤ **To display VC-4 performance monitoring data for the current interval:**

1. Type **1** and then press **<Enter>**.
2. You will see the **Current Interval** performance monitoring screen for the VC-4. A typical screen is shown in *Figure C-109*.

The information displayed on the performance monitoring screen is explained in *Table C-28*.

Table C-28. Performance Monitoring Data

Parameter	Description
Interval Number	The number of the 15-minute interval to be displayed, in the range of 1 to 96. The default value is **0** (zero), which designates the current interval. However, you can also select another interval, by typing **1** and then pressing **<Enter>**: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.
Valid Intervals	The number of intervals (up 96 intervals) for which performance monitoring information can be displayed.
Elapsed Time	The elapsed time (in seconds) since the beginning of the current interval, in seconds. The range is 1 to 900 seconds.
ES	Displays the number of errored seconds (ES) in the current interval. An errored second is any second containing one or more of the following types of errors: • Severely Errored Frame (SEF) defect (also called Out-of-Frame (OOF) event): ▪ A SEF defect is declared after detection of four contiguous errored frame alignment words. ▪ The SEF defect is terminated when two contiguous error-free frame words are detected. • Loss of Signal (LOS) defect: ▪ A LOS defect is declared after when no transitions are detected in the incoming line signal (before descrambling) during an interval of 2.3 to 100 microseconds. ▪ The LOS defect is terminated after a 125-microsecond interval (one frame) during which no LOS defect is detected. • Loss of Pointer (LOP) defect: ▪ A LOP defect is declared after no valid pointer is detected in eight consecutive frames. The LOP defect will not be reported while an AIS signal is present. ▪ The LOP defect is terminated after a valid pointer is detected. • Alarm Indication Signal (AIS) received in the SDH overhead. • Coding Violation (CV): a coding violation is declared when a Bit Interleaved Parity (BIP) error is detected in the incoming signal. The BIP information is collected using the B1 byte in the Section Overhead.
SES	Displays the number of severely errored seconds (SES) in the current interval. A SES is any second during which multiple error events of the types taken into consideration for an ES have occurred.
UAS(SEFS)	Displays the number of unavailable seconds (UAS(SEFS)) in the current interval. An unavailable second is any second in which one or more SEF defects have been detected.
CV	Displays the number of coding violations (CV) in the current interval.

```
                                        FCD-155
Current Interval
 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (6)
 3. Elapsed time    ... (00:07:38)
 4. ES              ... (0)
 5. SES             ... (0)
 6. UAS(SEFS)       ... (0)
 7. CV              ... (0)

>
C - Clear
ESC-prev.menu; !-main menu; &-exit; @-Output                    1 user(s)
-------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-109. Typical **Current Interval** VC-4 Performance Monitoring Screen*

The information displayed on the screen for the current interval is automatically refreshed every few seconds.

You can clear the displayed parameters (that is, reset the displayed performance monitoring counters) by typing **C**. Note however that clearing the data does not clear the VC-4 data collected for other intervals or for other VCs, nor the number of valid intervals and the start time.

➤ **To display VC-4 performance monitoring data on a selected interval:**

1. Type **2** on the **VC-4** interval selection screen (*Figure C-108*) and then press **<Enter>**.
2. You will see the **Select Interval** performance monitoring screen for the VC-4. A typical screen is shown in *Figure C-110*.
3. Select the desired interval, by typing **1** and pressing **<Enter>**: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.
4. After pressing **<Enter>**, the data displayed on the screen is updated in accordance with your selection.

```
                                        FCD-155
Select Interval
 1. Interval Number [0 - 96]... (1)
 2. Valid Intervals [0 - 96]... (6)
 3. Elapsed time    ... (00:15:00)
 4. ES              ... (0)
 5. SES             ... (0)
 6. UAS(SEFS)       ... (0)
 7. CV              ... (0)


>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-Output                    1 user(s)
-------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-110. Typical **Select Interval** VC-4 Performance Monitoring Screen*

For a description of the displayed parameters, refer to *Table C-28*.

You can clear the displayed parameters (that is, reset the displayed performance monitoring counters for the selected interval) by typing **C**. Note however that clearing the data does not clear the data collected for other intervals and for other types of VCs, nor the number of valid intervals and the start time.

➤ **To display the totaled VC-4 performance monitoring data:**

1. Type **3** on the **VC-4** interval selection screen (*Figure C-108*) and then press **<Enter>**.
2. You will see the **Total** performance monitoring screen for the VC-4. A typical screen is shown in *Figure C-111*.

Note that the number of the 15-minute intervals to be displayed is by default **97**, which means ***all the intervals***. However, you can also select a specific interval for display (the same result as selecting **Select Interval**):

- Type **1** on the screen shown in *Figure C-111* and then press **<Enter**>.
- Now type the desired interval number, up to the number displayed in the **Valid Intervals** field, and then press **<Enter**>:

For a description of the displayed parameters, refer to *Table C-28*.

You can clear the displayed parameters (that is, reset the displayed VC-4 performance monitoring counters for all the intervals) by typing **C**. Note however that clearing the VC-4 performance monitoring data does not clear the number of valid intervals, nor the start time.

```
                                    FCD-155
Total
 1. Interval Number [0 - 96]... (97)
 2. Valid Intervals [0 - 96]... (6)
 3. Elapsed time    ... (00:15:00)
 4. ES              ... (0)
 5. SES             ... (0)
 6. UAS(SEFS)       ... (0)
 7. CV              ... (0)


>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
-------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-111. Typical **Total** VC-4 Performance Monitoring Screen*

C.59 Monitoring – VC-3 Screen

Purpose

Display performance monitoring information for the VC-3 level. You can display performance monitoring statistics only on connected (mapped) VC-3 ports.

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring – Virtual Ports – Port Statistics – item 2

Use

➤ **To select a VC-3 port:**

1. Type the number of the desired VC-3 for which the port statistics data is displayed. The allowed range is 1 to 3, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field will display **Error**.
2. You will see the **VC-3** task selection screen. *Figure C-112* shows a typical screen.

```
                                   FCD-155
VC-3
 1. Port Status      >
 2. Port Statistics  >








>

The statistic is for connected ports
ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
------------------------------------------------------------------------------
```

*Figure C-112. Typical **VC-3** Virtual Port Task Selection Screen*

➤ **To display the status of a VC-3 virtual port:**

1. Type **1** on the **VC-3 Port** task selection screen and then press **<Enter>**.
2. You will see the **Port Status** screen. A typical **Port Status** screen is shown in *Figure C-113*.

```
                                   FCD-155
Port Status

 1. VC Port                (1 - 3)  (1)
 2. J1 Received        ... (F;X)
 3. C2 Received        ... (0)






>

ESC-prev.menu; !-main menu; &-exit; @-output                   1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-113. Typical VC-3 **Port Status** Virtual Port Screen*

The information displayed on the **Port Status** screen includes the following items:

- Item **1 – VC Port**: used to select the VC-3 port for which the port statistics data is displayed. The allowed range is 1 to 3, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.
- The other items are explained in *Table C-27*.

➤ **To display the VC-3 virtual port statistics:**

1. Type **2** on the **VC-3 Port** task selection screen and then press **<Enter>**.
2. You will see the **VC-3** statistics interval selection screen. *Figure C-114* shows a typical **VC-3** interval selection screen.

```
                                   FCD-155
VC-3

 1. Current Interval>
 2. Select Interval >
 3. Total           >






>

ESC-prev.menu; !-main menu; &-exit; @-output                   1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-114. Typical **VC-3** Interval Selection Screen*

➤ **To display VC-3 performance monitoring data for the current interval:**

1. Type **1** on the **VC-3** interval selection screen and then press **<Enter>**.
2. You will see the **Current Interval** port statistics screen for VC-3s. A typical screen is shown in *Figure C-115*.

```
                                    FCD-155
Current Interval
 1. VC Port          [1 - 3] ... (1)
 2. Interval Number  [0 - 96]... (0)
 3. Valid Intervals ... (6)
 4. Elapsed time     ... (00:00:00)
 5. ES               ... (0)
 6. SES              ... (0)
 7. UAS(SEFS)        ... (0)
 8. CV               ... (0)


>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-115. Typical **Current Interval** Port Statistics Screen for VC-3s*

The information displayed for the current interval port statistics screen includes the following items:

- Item **1 – VC Port**: used to select the VC-3 port for which the port statistics data is displayed. The allowed range is 1 to 3, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.
- The other items are explained in *Table C-28*.

➤ **To display VC-3 performance monitoring data on a selected interval:**

Type **2** on the **VC-3** interval selection screen and then press **<Enter>**.

Except for first selecting a specific VC-3 port, use the procedure described on *page C-138* for VC-4.

➤ **To display totaled VC-3 performance monitoring data:**

Type **3** on the **VC-3** interval selection screen and then press **<Enter>**.

Except for first selecting a specific VC-3 port, use the procedure described on *page C-138* for VC-4.

C.60 Monitoring – VC-12 or VC-11/VC-12 Screen

Purpose

Display performance monitoring information for the VC-12 level. You can display performance monitoring statistics only on connected (mapped) VC-12s.

Note *When an FCD-155 using SDH network interfaces is equipped with T1 ports, the performance monitoring information is collected for both VC-11 and VC-12. The screen header is then changed to* ***VC-11/VC-12****.*

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring – Virtual Ports – item 2

Use

A typical **VC-12** task selection screen is shown in *Figure C-116*.

```
                                  FCD-155
VC-12
 1. Port Status      >
 2. Port Statistics  >









>


The statistic is for connected ports
ESC-prev.menu; !-main menu; &-exit; @-output                       1 user(s)
-------------------------------------------------------------------------------
```

Figure C-116. Typical ***VC-12*** *Virtual Port Task Selection Screen (FCD-155 with E1 Ports)*

➤ **To display the status of a VC-12 or VC-11 virtual port:**

1. Type **1** on the **VC-12 or VC-11/VC-12** port task selection screen and then press **<Enter>**.
2. You will see the **Port Status** screen. A typical **Port Status** screen is shown in *Figure C-117.*

```
                                    FCD-155
Port Status

 1. VC Port                       (1 - 63) (1)
 2. J2 Received               ... (F;X)
 3. V5 (Bits 5-7) Received    ... (0)





>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-117. Typical VC-12 **Port Status** Virtual Port Screen (FCD-155 with E1 Ports)*

The information displayed on the **Port Status** screen includes the following items:

- Item **1 – VC Port**: used to select the VC-12 or VC-11 port for which the port statistics data is displayed. The allowed range is 1 to 63 when the FCD-155 is equipped with E1 ports, and 1 to 84 for and FCD-155 with T1 ports. Note however that only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.
- The other items are explained in *Table C-29*.

*Table C-29. VC-12 **Port Status** Virtual Port Status Parameters*

Parameter	Description
J2 Received	Displays the received J2 string
V5 (Bits 5-7) Received	Displays the bits 5 to 7 of the received V5 byte, which serve as signal label

➤ **To display the VC-12 or VC-11 virtual port statistics:**

1. Type **2** on the **VC-12 or VC-11 Port** task selection screen and then press **<Enter>**.
2. You will see the **VC-12 or VC-11** statistics interval selection screen. A typical **VC-12** interval selection screen is shown in *Figure C-118*.

```
                                    FCD-155
VC-12

 1. Current Interval>
 2. Select Interval >
 3. Total           >





>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-118. Typical **VC-12** Interval Selection Screen*

➤ **To display VC-12 or VC-11 performance monitoring data for the current interval:**

1. Type **1** and then press **<Enter>**.
2. You will see the **Current Interval** port statistics screen for VC-12s or VC-11s. A typical screen is shown in *Figure C-119*.

```
                                FCD-155
Current Interval
 1. VC Port            [1 - 63]... (1)
 2. Interval Number [0 - 96]... (0)
 3. Valid Intervals ... (6)
 4. Elapsed time     ... (00:00:00)
 5. ES               ... (0)
 6. SES              ... (0)
 7. UAS(SEFS)        ... (0)
 8. CV               ... (0)


>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-119. Typical **Current Interval** Port Statistics Screen for VC-12s*

The information displayed for the current interval port statistics screen includes the following items:

- Item **1 – VC Port**: used to select the VC-12 port for which the port statistics data is displayed. The allowed range is 1 to 63, when the FCD-155 is equipped with E1 ports, and 1 to 84 for and FCD-155 with T1 ports. Note however that only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.
- The other items are explained in *Table C-28*.

➤ **To display VC-12 or VC-11 performance monitoring data on a selected interval:**

Type **2** and then press **<Enter>**.

Except for first selecting a specific VC-12 or VC-11 port, use the procedure described on *page C-138* for VC-4.

➤ **To display totaled VC-12 or VC-11 performance monitoring data:**

Type **3** and then press **<Enter>**.

Except for first selecting a specific VC-12 or VC-11 port, use the procedure described on *page C-138* for VC-4.

C.61 Monitoring – Virtual Ports Submenu (SONET Networks)

Purpose

Select the type of virtual ports for which monitoring information will be displayed by FCD-155 with SONET network interface.

Reached from

Monitoring – item 2

Use

A typical **Virtual Ports** submenu for an FCD-155 with SONET network interface is shown in *Figure C-120*.

```
                                    FCD-155
Virtual Ports
 1. STS 3-1                    >
 2. STS 3-2                    >
 3. STS 3-3                    >
 4. VT-1.5                     >
 5. Virtual concatenation      >




>

ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-120. Typical **Virtual Ports** Submenu (SONET Network Interfaces)*

➤ **To select the type of virtual ports:**

1. Type the number corresponding to the desired port type and then press **<Enter>**.
2. After selecting the desired port type, use the same procedures described for FCD-155 using SDH network interfaces:
   - For STS-1, use the procedures described in *Section C.58* for VC-4.
   - For VT-1.5, use the procedures described in *Section C.60* for VC-11 and VC-12. The allowed port number range is 1 to 84.

C.62 Monitoring – STS Screen (SONET)

Purpose

Display performance monitoring information for the STS-1 level. You can display performance monitoring statistics only on connected (mapped) STS-1 ports.

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring – Virtual Ports – item 1 to 3

Use

➤ **To select an STS port:**

1. Type the number of the desired STS-1 for which the port statistics data is displayed. The allowed range is 1 to 3, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field will display **Error**.
2. You will see the **STS** task selection screen. A typical **STS** task selection screen is shown in *Figure C-121*.

```
                                  FCD-155
STS 3-1
 1. Port Status      >
 2. Port Statistics  >









>


The statistic is for connected ports
ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-121. Typical **STS** Virtual Port Task Selection Screen*

➤ **To display the status of an STS virtual port:**

1. Type **1** on the **STS** port task selection screen and then press **<Enter>**.
2. You will see the **Port Status** screen.

   A typical **Port Status** screen is shown in *Figure C-122.* The parameters displayed on the **Port Status** screen are explained in *Table C-27*.

```
                                  FCD-155
Port Status

 1. J1 Received       ... (F;X)
 2. C2 Received       ... (0)







>

ESC-prev.menu; !-main menu; &-exit; @-output                    1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-122. Typical STS **Port Status** Virtual Port Screen*

➤ **To display the STS virtual port statistics:**

1. Type **2** on the **STS** port task selection screen and then press **<Enter>**.
2. You will see the **STS** statistics interval selection screen. A typical **STS** interval selection screen is shown in *Figure C-123*.

```
                                  FCD-155
Port Statistics

 1. Current Interval>
 2. Select Interval >
 3. Total           >






>

ESC-prev.menu; !-main menu; &-exit; @-output                    1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-123. Typical **STS** Interval Selection Screen*

➤ **To display STS-1 performance monitoring data for the current interval:**

1. Type **1** on the **STS** statistics interval selection screen and then press **<Enter>**.
2. You will see the **Current Interval** port statistics screen for STS-1s. A typical screen is shown in *Figure C-124*.

```
                                    FCD-155
Current Interval
 1. VC Port          [1 - 3] ... (1)
 2. Interval Number [0 - 96]... (0)
 3. Valid Intervals ... (6)
 4. Elapsed time     ... (00:00:00)
 5. ES               ... (0)
 6. SES              ... (0)
 7. UAS(SEFS)        ... (0)
 8. CV               ... (0)


>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-output                    1 user(s)
-------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-124. Typical **Current Interval** Port Statistics Screen for STS-1*

The information displayed for the current interval port statistics screen includes the following items:

- Item **1 – VC Port**: used to select the STS-1 port for which the port statistics data is displayed. The allowed range is 1 to 3, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.
- The other items are explained in *Table C-28*.

➤ **To display STS-1 performance monitoring data on a selected interval:**

Type **2** on the **STS** statistics interval selection screen and then press **<Enter>**.

Except for first selecting a specific STS-1 port, use the procedure described on *page C-138* for VC-4.

➤ **To display totaled STS-1 performance monitoring data:**

Type **3** on the **STS** statistics interval selection screen and then press **<Enter>**.

Except for first selecting a specific STS-1 port, use the procedure described on *page C-138* for VC-4.

C.63 Monitoring – VT-1.5 Screen (SONET Network Interfaces)

Purpose

Display performance monitoring information for the VT-1.5 level. You can display performance monitoring statistics only on connected (mapped) VT-1.5s.

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring – Virtual Ports – item 4

Use

A typical **VT-1.5** task selection screen is shown in *Figure C-125*.

```
                                  FCD-155
VT-1.5
 1. Port Status      >
 2. Port Statistics  >










>



The statistic is for connected ports
ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-125. Typical **VT-1.5** Virtual Port Task Selection Screen*

➤ **To display the status of a VT-1.5 virtual port:**

1. Type **1** on the **VT-1.5 Port** task selection screen and then press **<Enter>**.
2. You will see the **Port Status** screen. A typical **Port Status** screen is shown in *Figure C-126*.

```
                                FCD-155
Port Status

 1. VT Port                    (1 - 84) (1)
 2. J2 Received            ... (0)
 3. V5 (Bits 5-7) Received ... (0)






>

ESC-prev.menu; !-main menu; &-exit; @-output                 1 user(s)
------------------------------------------------------------------------------
```

Figure C-126. Typical VT-1.5 ***Port Status*** *Virtual Port Screen*

The information displayed on the **Port Status** screen includes the following items:

- Item **1 – VT Port**: used to select the VT-1.5 port for which the port statistics data is displayed. The allowed range is 1 to 84, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.
- The other items are explained in *Figure C-19*. Item 2 – **J2 Received** is displayed only for groups.

➤ **To display the VT-1.5 virtual port statistics:**

1. Type **2** on the **VT-1.5 Port** task selection screen and then press **<Enter>**.
2. You will see the **VT-1.5** statistics interval selection screen. A typical **VT-1.5** interval selection screen is shown in *Figure C-127*.

```
                                FCD-155
VT-1.5

 1. Current Interval>
 2. Select Interval >
 3. Total           >






>

ESC-prev.menu; !-main menu; &-exit; @-output                 1 user(s)
------------------------------------------------------------------------------
```

Figure C-127. Typical ***VT-1.5*** *Interval Selection Screen*

➤ **To display VT-1.5 performance monitoring data for the current interval:**

1. Type **1** and then press **<Enter>**.
2. You will see the **Current Interval** port statistics screen for VT-1.5s. A typical screen is shown in *Figure C-128*.

```
                                        FCD-155
Current Interval
 1. VT Port          [1 - 84]... (1)
 2. Interval Number  [0 - 96]... (0)
 3. Valid Intervals ... (6)
 4. Elapsed time     ... (00:00:00)
 5. ES               ... (0)
 6. SES              ... (0)
 7. UAS(SEFS)        ... (0)
 8. CV               ... (0)


>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

Figure C-128. Typical ***Current Interval*** *Port Statistics Screen for VT-1.5s*

The information displayed for the current interval port statistics screen includes the following items:

- Item **1 – VT Port**: used to select the VT-1.5 port for which the port statistics data is displayed. The allowed range is 1 to 84, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.
- The other items are explained in *Table C-28*.

➤ **To display VT-1.5 performance monitoring data on a selected interval:**

Type **2** and then press **<Enter>**.

Except for first selecting a specific VT-1.5 port, use the procedure described on *page C-138* for VC-4.

➤ **To display totaled VT-1.5 performance monitoring data:**

Type **3** and then press **<Enter>**.

Except for first selecting a specific VT-1.5 port, use the procedure described on *page C-138* for VC-4.

C.64 Monitoring – Virtual Concatenation Group Selection Screen

Purpose

Select the virtually concatenated group for which performance monitoring statistics will be displayed.

You can display statistics only for connected (mapped) groups.

Reached from

Monitoring – Virtual Ports – item 4 (for SDH) or **item 5** (for SONET)

Use

A typical **Virtual Concatenation** group selection screen is shown in *Figure C-129*.

```
                                   FCD-155
Virtual concatenation
 1. Group 1     >
 2. Group 2     >
 3. Group 3     >
 4. Group 4     >
 5. Group 5     >
 6. Group 6     >
 7. Group 7     >
 8. Group 8     >



>


The statistic is for connected ports

ESC-prev.menu; !-main menu; &-exit; @-Output                   1 user(s)
------------------------------------------------------------------------------
```

*Figure C-129. Typical **Virtual Concatenation** Group Selection Screen*

The number of groups displayed on the screen depends on the number of LAN ports:

- For FCD-155 with 2 LAN ports, the number of groups is 1 to 4.
- For FCD-155 with 6 LAN ports, the number of groups is 1 to 8.

➤ **To select a virtually concatenated group for display of performance monitoring statistics:**

Type its number and then press **<Enter>**:

- If the group is configured and mapped, you will see the corresponding **Group** screen, used to select the type of performance monitoring statistics
- If the group is not mapped, you will see an empty **Group** screen.

C.65 Monitoring – Group Task Selection Screen

Purpose

Select the type of performance monitoring statistics for a selected virtually concatenated group.

Reached from

Monitoring – Virtual Ports – Virtual Concatenation – item 1 to **8**

Use – Groups 1 to 4

A typical **Group** statistics selection screen for a group in the range of 1 to 4 is shown in *Figure C-130*. The selected group is identified in the screen header.

```
                                   FCD-155
Group 1
 1. Lan Counters    >
 2. Wan Intervals   >
 3. LCAS Path Info []


>


ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-130. Typical **Group** Statistics Selection Screen (Groups 1 to 4)*

> ***Note*** *The **LCAS Path Info** option is available only when LCAS is used on the selected group.*

➤ **To select the type of performance monitoring statistics for a virtually concatenated group:**

Type the corresponding number and then press **<Enter>**.

Use – Groups 5 to 8

A typical **Group** statistics screen for a group in the range of 5 to 8 is shown in *Figure C-131*. The selected group is identified in the screen header.

```
                                   FCD-155
Group 5
 1. Wan Intervals   >
 2. LCAS Path Info []


>


ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-131. Typical **Group** Statistics Selection Screen (Groups 5 to 8)*

➤ **To select the type of performance monitoring statistics for a virtually concatenated group:**

Type the corresponding number and then press **<Enter>**.

C.66 Monitoring – LAN Counters (Group) Screen

Purpose

Display performance monitoring statistics for the external LAN port, ETH 1 or ETH 2, connected to a selected virtually concatenated group.

Note *The information related to the optional transparent LAN ports, ETH 3 to ETH 6, is presented on the LAN physical ports monitoring screens (see* *Section C.72**).*

Reached from

Monitoring – Virtual Ports – Virtual Concatenation – Group – item 1

Use

A typical **LAN Counters** screen is shown in *Figure C-129*.

```
                                    FCD-155
Lan Counters
    Rx Total Frames      ... (0)            Tx Total Frames     ... (107)
    Rx Unicast Frames    ... (0)            Tx Unicast Frames   ... (0)
    Rx Broadcast Frames  ... (0)            Tx Broadcast Frames ... (0)
    Rx Multicast Frames  ... (0)            Tx Multicast Frames ... (0)
    Rx Total Bytes       ... (0)            Tx Total Bytes      ... (0)
    Rx Pause Frames      ... (0)            ...
    Rx Correct Frames    ... (0)            ...
    Rx Filtered          ... (0)            ...
    Rx 64b Frames        ... (0)            Rx 256b-511b Frames ... (0)
    Rx 65b-127b Frames   ... (0)            Rx 512b-1023b Frames... (0)
    Rx 128b-255b Frames  ... (0)            Rx 1024b-max Frames ... (0)

>
C - Clear
ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-132. Typical **LAN Counters** (Group) Screen*

The information displayed on the screen, which is accumulated continuously, is automatically refreshed every few seconds.

You can clear the displayed statistics (that is, reset the displayed performance monitoring counters) by typing **C**.

The statistics displayed on the **LAN Counters** screen are explained in *Table C-30*.

*Table C-30. **LAN Counters** (Group) Performance Monitoring Statistics*

Parameter	Description
Rx Total Frames	Total number of frames received through the corresponding LAN port
Rx Unicast Frames	Total number of good unicast frames received through the corresponding LAN port
Rx Broadcast Frames	Total number of good broadcast frames received through the corresponding LAN port
Rx Multicast Frames	Total number of good multicast frames received through the corresponding LAN port
Rx Pause Frames	Total number of **pause** frames (used for flow control) received through the corresponding LAN port
Rx Correct Frames	Total number of good frames received through the corresponding LAN port
Rx Total Bytes	Total number of data octets carried by all frames received through the corresponding LAN port
Rx Filtered	If the QoS criteria based on IEEE 802.1Q are not used on this port: Total valid frames received that are not forwarded to a destination port. These are frames for which there is no destination port, or are not forwarded due to the state of the port. Valid frames discarded due to lack of buffer space are not included. If the QoS criteria based on IEEE 802.1Q are used on this port: Total valid frames received (tagged or untagged) that were discarded because of unknown VLAN ID
Rx Frames 64b	Total number of 64-byte frames received through the corresponding LAN port
Rx Frames 65b-127b	Total number of frames with size of 65 to 127 bytes received through the corresponding LAN port
Rx Frames 128b-255b	Total number of frames with size of 65 to 127 bytes received through the corresponding LAN port
Rx Frames 256b-511b	Total number of frames with size of 256 to 511 bytes received through the corresponding LAN port
Rx Frames 512b-1023b	Total number of frames with size of 512 to 1023 bytes received through the corresponding LAN port
Rx Frames 1024b-max	Total number of frames with size of 1024 to 1518 or 1536 bytes received through the corresponding LAN port
Tx Total Bytes	Total number of data octets carried by all the good frames transmitted by the corresponding LAN port
Tx Total Frames	Total number of good frames transmitted by the corresponding LAN port
Tx Unicast Frames	Total number of good unicast frames transmitted by the corresponding LAN port
Tx Broadcast Frames	Total number of good broadcast frames transmitted by the corresponding LAN port
Tx Multicast Frames	Total number of good multicast frames transmitted by the corresponding LAN port

C.67 Monitoring – WAN Intervals Screen

Purpose

Display performance monitoring statistics for the WAN side of the selected virtually concatenated group.

The WAN side statistics depend on the encapsulation mode selected for the group: LAPS or GFP.

Note *When using GFP multiplexing, only the statistics of the primary group can be displayed. This is sufficient for performance monitoring, because these statistics represent the WAN side transmission performance for all the groups handled by the corresponding GFP multiplexer.*

The statistics are collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

For groups 1 to 4:

Monitoring – Virtual Ports – Virtual Concatenation – Group – item 2

For groups 5 to 8:

Monitoring – Virtual Ports – Virtual Concatenation – Group – item 1

Use

A typical **WAN Intervals** selection screen is shown in *Figure C-133*.

```
                                  FCD-155
Wan Intervals
 1. Current Interval>
 2. Select Interval >
 3. Total           >




>
ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-133. Typical **WAN Intervals** Selection Screen*

➤ **To display WAN side performance monitoring data for the current interval:**

1. Type **1** and then press **<Enter>**.
2. You will see the first page of the **Current Interval** performance monitoring screen for the WAN side. The **Current Interval** screen includes a large number of items and therefore it consists of two pages:
   - To continue from the first page to the second page, type **n** (next)
   - To return from the second page to the first page, type **p** (previous).

➤ **To display WAN side performance monitoring data on a selected interval:**

Type **2** and then press **<Enter>**.

➤ **To display totaled WAN side performance monitoring data:**

Type **3** and then press **<Enter>**.

➤ **To clear the accumulated statistics (reset all the counters, except items 2, 3, 4):**

Type **C** and then press **<Enter>**.

WAN Side Statistics – LAPS Encapsulation

The two pages of a typical WAN side statistics screen for a virtually concatenated group using LAPS encapsulation are shown in *Figure C-134* and *Figure C-135*.

The WAN side statistics parameters for groups using LAPS encapsulation are described in *Table C-31*.

```
                                    FCD-155
Current Interval
 1. Interval Number                         [0 - 96]... (0)
 2. Valid Intervals                         [0 - 96]... (1)
 3. Elapsed time                            ... (00:08:40)
 4. Number of Total Rx Frames               ... (0)
 5. Number of Total Tx Frames               ... (0)
 6. Rx Payload Max length violation         ... (0)
 7. Rx Payload Min length violation         ... (0)
 8. FCS error                               ... (0)
 9. Receive Abort Frames                    ... (0)
10. Byte De-stuffing violations             ... (0)
... (N)
>
C - Clear
ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

Figure C-134. Typical WAN Side Statistics Screen – LAPS Encapsulation (First Page)

```
                                  FCD-155
Current Interval
... (P)
11. Receive address field mismatch counter... (0)
12. Receive control field mismatch counter... (0)
13. Receive SAPI field mismatch counter   ... (0)








>
C - Clear
ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

Figure C-135. Typical WAN Side Statistics Screen – LAPS Encapsulation (Second Page)

Table C-31. WAN Side Statistics – LAPS Encapsulation

Parameter	Description
Interval Number	The number of the 15-minute interval to be displayed, in the range of 1 to 96. To select a different interval, type **1** and then press **<Enter>**: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.
Valid Intervals	The number of intervals (up 96 intervals) for which performance monitoring information can be displayed.
Elapsed Time	The elapsed time (in seconds) since the beginning of the current interval, in seconds. The range is 1 to 900 seconds.
Number of Total Rx Frames	Total number of frames received from the WAN
Number of Total Tx Frames	Total number of frames transmitted to the WAN
Rx Payload Max Length violation	Total number of frames received with payload fields exceeding the maximum allowed number of bytes
Rx Payload Min Length violation	Total number of frames received with payload fields shorter than the minimum allowed number of bytes
FCS Error	Total number of frames received with frame checksum errors
Receive Abort Frames	Total number of frames whose reception has been aborted
Byte De-stuffing Violations	Total number of byte destuffing violations detected during the processing of received frames
Receive Address Field Mismatch Counter	Total number of valid received LAPS frames with mismatching address field
Receive Control Field Mismatch Counter	Total number of valid received LAPS frames with mismatching control field
Receive SAPI Field Mismatch Counter	Total number of valid received LAPS frames with mismatching SAPI field

WAN Side Statistics – GFP Encapsulation

The two pages of a typical WAN side statistics screen for a virtually concatenated group using GFP encapsulation are shown in *Figure C-134* and *Figure C-135*.

The WAN side statistics parameters for groups using GFP encapsulation are described in *Table C-32*.

```
                                    FCD-155
Current Interval

 1. Interval Number                         [0 - 96]... (0)
 2. Valid Intervals                         [0 - 96]... (7)
 3. Elapsed time                            ... (00:08:25)
 4. Number of Total Rx Frames               ... (0)
 5. Number of Total Tx Frames               ... (0)
 6. Rx Payload Max length violation         ... (0)
 7. FCS error                               ... (0)
 8. Receive Idle frame error                ... (0)
 9. Receive cHEC single bit error           ... (0)
10. Receive PTI mismatch                    ... (0)
... (N)
>



C - Clear
ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

Figure C-136. Typical WAN Side Statistics Screen – GFP Encapsulation (First Page)

```
                                    FCD-155
Current Interval
... (P)
11. Receive EXI mismatch                    ... (0)
12. Receive UPI mismatch                    ... (0)
13. Receive tHEC single bit error           ... (0)
14. Receive tHEC multi bit error            ... (0)
15. Receive CID mismatch                    ... (0)
16. Receive eHEC single bit error           ... (0)
17. Receive eHEC multi bit error            ... (0)


>



C - Clear
ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

Figure C-137. Typical WAN Side Statistics Screen – GFP Encapsulation (Second Page)

Table C-32. WAN Side Statistics – GFP Encapsulation

Parameter	Description
Interval Number	The number of the 15-minute interval to be displayed, in the range of 1 to 96. To select a different interval, type **1** and then press **<Enter>**: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.
Valid Intervals	The number of intervals (up 96 intervals) for which performance monitoring information can be displayed.
Elapsed Time	The elapsed time (in seconds) since the beginning of the current interval, in seconds. The range is 1 to 900 seconds.
Start Time	The time at which the current interval was initiated, in accordance with the FCD-155 internal real-time clock. Since the FCD-155 time may not be coordinated with the network management station time, or they may be located in different time zones, you should compare the FCD-155 internal time (displayed by means of the **Configuration – System – Date & Time Update**) with the station time.
Number of Total Rx Frames	Total number of GFP frames received from the WAN
Number of Total Tx Frames	Total number of GFP frames transmitted to the WAN
Rx Payload Max Length violation	Total number of GFP frames received with payload fields exceeding the maximum allowed number of bytes
FCS Error	Total number of GFP frames received with frame checksum errors
Receive Idle Frame Error	Total number of GFP IDLE frames received with errors error
Receive cHEC Single Bit Error	Total number of received GFP frames that are detected to have only single-bit errors in the GFP Core header (cHEC field)
Receive PTI Mismatch	Total number of received GFP frames with a mismatch in the PTI field (i.e., PTI value not corresponding to the Client Data or Management frame)
Receive EXI Mismatch	Total number of received GFP frames with a mismatch in the EXI field (i.e., value of EXI is not equal to NULL or LINEAR modes).
Receive UPI Mismatch	Total number of received GFP frames with a mismatch in the UPI field (i.e., EXI value not equal to 00000001).
Receive tHEC Single Bit Error	Total number of received GFP frames with single-bit errors only in the GFP Type header (tHEC field).
Receive tHEC Multi Bit Error	Total number of received GFP frames with multi-bit errors in the GFP Type header (tHEC field).
Receive CID Mismatch	Total number of received GFP frames with a mismatch or unsupported value in the GFP CID field
Receive eHEC Single Bit Error	Total number of received GFP frames with only single-bit errors in the GFP Extension header (eHEC field).
Receive eHEC Multi Bit Error	Total number of received GFP frames that are detected to only have multi-bit errors in the GFP Extension header (eHEC field).

C.68 Monitoring – LCAS Path Info Screen

Purpose

Display information on the LCAS status for the selected virtually concatenated group.

This information is displayed only for virtually concatenated groups configured to use LCAS.

Reached from

For groups 1 to 4:

Monitoring – Virtual Ports – Virtual Concatenation – Group – item 3

For groups 5 to 8:

Monitoring – Virtual Ports – Virtual Concatenation – Group – item 2

Use

A typical **LCAS Path Info** selection screen is shown in *Figure C-138*.

```
                                 FCD-155
LCAS PATH info

 Index VC Number  Source State   Sink State
 0     1:1:1      Add            Fixed
 1     1:1:2      Add            Fixed
 2     1:1:3      Add            Fixed









>



ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                 1 user(s)
------------------------------------------------------------------------------
```

*Figure C-138. Typical **LCAS Path Info** Screen*

The parameters displayed by means of the **LCAS Path Info** screen are as follows:

Index — Displays the index number of the VC within the selected virtually concatenated group. The index number is automatically assigned.

VC Number — Identifies the position of the corresponding VC or VT within the STM-1 or STS-3 frame, using the **TUG-3:TUG-2:TU** format described in the *Port Identification* section starting on page *C-133*.

Source State	Displays the state of the corresponding VC or VT on the local end of the path serving the selected virtually concatenated group (that is, the end located on the FCD-155 to which the supervisory terminal is connected): • **FIXED** – the end uses the fixed bandwidth (not LCAS) • **ADD** – the corresponding VC or VT is about to be added to the virtually concatenated group • **NORM** – normal transmission state • **EOS** – end-of-sequence indication • **IDLE** – the corresponding VC or VT is not part of the virtually concatenated group, or is about to be removed from the group • **DNU** – ***do not use*** the corresponding VC or VT, for example, because the sink side reported a failure. The state is correct at the time the command to display this screen has been received by the FCD-155.
Sink State	Same as above for the sink side (remote end of the path)

For each current parameter value, you can also see the allowed range of values.

C.69 Monitoring – Physical Ports Submenu

Purpose

Select the type of physical port for which monitoring information will be displayed.

Reached from

Monitoring – item 3

Use

The items appearing on the **Physical Ports** selection screen depend on the specific FCD-155 version:

- A typical **Physical Ports** submenu for an FCD-155 with SDH network interface is shown in *Figure C-139*. Item **3 – PDH** is included only for FCD-155 units equipped with PDH interfaces.
- A typical submenu for an FCD-155 with SONET network interface is shown in *Figure C-140*.

```
                                    FCD-155
Physical Ports
 1. STM-1 Port (MS) >
 2. LAN             >
 3. PDH             >
 4. DCC Statistics  >


>


ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-139. Typical **Physical Ports** Submenu (SDH Network Interface)*

```
Physical Ports

 1. OC-3 Port      >
 2. LAN            >
 3. PDH            >
 4. DCC Statistics >



>


ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-140. Typical **Physical Ports** Submenu (SONET Network Interface)*

➤ **To select the type of physical ports:**

Type the desired number and then press **<Enter>**.

C.70 Monitoring – STM-1 or OC-3 (Physical Ports) Screen

Purpose

Display performance monitoring information for the STM-1 or STS-3 physical port (in accordance with the network interface type used by the FCD-155).

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring – Physical Ports – item 1

Use

A typical **Port** task selection screen is shown in *Figure C-141*. The type of port, STM-1 or STS-3, is identified in the screen header.

```
                              FCD-155
STM-1 Port
 1. Port Status     >
 2. Port Statistics >





>



ESC-prev.menu; !-main menu; &-exit                         1 user(s)
------------------------------------------------------------------------
```

*Figure C-141. Typical **STM-1 Port** or **OC-3 Port** Task Selection Screen*

➤ **To display the port status:**

1. Type **1** and then press **<Enter>**.
2. You will see the **Port Status** screen for the selected port. A typical **Port Status** screen is shown in *Figure C-142.*

The parameters displayed on the **Port Status** screen are explained in *Table C-33*.

*Table C-33. STM-1 or OC-3 **Port Status** (Physical Ports) Parameters*

Parameter	Description
Active Link	Displays the number of the network link that carries the traffic: **Link 1** or **Link 2** (may appear only for FCD-155 units with two network interfaces)
Link 1	Displays the status of network link 1: • **Normal** – normal operation • **Signal Loss** – loss of signal
Link 2	Same as **Link 1** for FCD-155 units with two network interface
Section Status	Displays the SDH or SONET section status: • **Normal** – normal operation • **LOS** – loss of signal • **LOF** – loss of frame alignment • **LOS and LOF** – loss of signal and loss of frame alignment
Line Status	Displays the SDH or SONET line (physical layer) status: • **Normal** – normal operation • **AIS** – reception of AIS (alarm indication signal) • **RDI** – reception of RDI (remote defect indication) • **AIS and RDI** – reception of AIS and RDI

```
                                   FCD-155
Port Status
    Active Link   >   (Link 1)
    Link 1        >   (Normal)
    Link 2        >   (Normal)
    Section Status>   (Normal)
    Line Status   >   (Normal)



>

ESC-prev.menu; !-main menu; &-exit; @-Output                     1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-142. Typical STM-1 or OC-3 **Port Status** (Physical Ports) Screen*

➤ **To display the port statistics interval selection screen:**

1. Type **1** and then press **<Enter>**.
2. You will see the **Port Statistics** interval selection screen. A typical **Port Statistics** interval selection screen is shown in *Figure C-143*.

```
                                  FCD-155
Port Statistics
 1. Current Interval>
 2. Select Interval >
 3. Total           >



>

ESC-prev.menu; !-main menu; &-exit                               1 user(s)
------------------------------------------------------------------------------
```

Figure C-143. Typical Interval Selection Screen

➤ **To display STM-1 or OC-3 port performance monitoring data for the current interval:**

1. Type **1** on the **Port Statistics** screen and then press **<Enter>**.
2. You will see the **Current Interval** screen for an STM-1 or OC-3 port. A typical screen is shown in *Figure C-144*.

➤ **To display STM-1 or OC-3 port performance monitoring data on a selected interval:**

Type **2** on the **Port Statistics** screen and then press **<Enter>**.

➤ **To display totaled STM-1 or OC-3 port performance monitoring data:**

Type **3** on the **Port Statistics** screen and then press **<Enter>**.

```
                                   FCD-155
Current Interval
 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (0)
 3. Elapsed time     ... (00:11:45)
 4. ES               ... (0)
 5. SES              ... (0)
 6. UAS(SEFS)        ... (705)
 7. CV               ... (0)



>
C - Clear
ESC-prev.menu; !-main menu; &-exit                                  1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-144. Typical **Current Interval** Screen for STM-1 or OC-3 Physical Port*

The items displayed for the current interval screen are explained in *Table C-28*.

C.71 Monitoring – LAN (Physical Ports) Selection Screen

Purpose

Select a LAN port for display of performance monitoring statistics.

Statistics can be displayed only for enabled (active) ports.

Reached from

Monitoring – Physical Ports – item 2

Use

A typical **LAN** port selection screen is shown in *Figure C-145*. The number of LAN ports displayed on the screen corresponds the number of LAN ports installed on the FCD-155 unit (2 or 6).

```
                                         FCD-155
LAN

 1. Port1    >
 2. Port2    >
 3. Port3    >
 4. Port4    >
 5. Port5    >
 6. Port6    >





>

ESC-prev.menu; !-main menu; &-exit @ - output                         1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-145. Typical **LAN** (Physical Ports) Port Selection Screen (FCD-155 with 6 LAN Ports)*

➤ **To select a LAN port for display of performance monitoring statistics:**

Type its number and then press **<Enter>**.

C.72 Monitoring – Port (LAN Physical Ports) Screen

Purpose

Display performance monitoring information for the selected LAN physical port.

Since statistics can be displayed only for enabled ports, if the LAN port is not enabled, its monitoring display is empty.

The information is accumulated continuously while the FCD-155 operates, and is automatically refreshed every few seconds. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring – Physical Ports – LAN – item 1 or **2,** or **1** to **6**

Use

A typical **Port** task selection screen is shown in *Figure C-146.* The selected port is identified in the screen header.

```
                              FCD-155
Port1
 1. Port Status    >
 2. Lan Counters   >



>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-146. Typical **Port** Task Selection Screen*

➤ To display the LAN port status:

1. Type **1** and then press **<Enter>**.
2. You will see the **Port Status** screen for the selected LAN port. A typical **Port Status** screen is shown in *Figure C-147.*

The parameters displayed on the **Port Status** screen are explained in *Table C-34*.

```
                              FCD-155
Port Status
    Status>    (Down)
    Rate  >    (10 Mbps Half Duplex)



>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-147. Typical **Port Status** (Physical Ports) Screen*

*Table C-34. **Port Status** (Physical Ports) Parameters*

Parameter	Description
Status	Displays the LAN port status: • **Up** – the port is connected to a LAN and operating normally • **Down** – the port does not carry traffic, for example, because it is not connected to an active LAN
Rate	Displays the port current rate and mode: • **10Mbps half duplex** – Half-duplex operation at 10 Mbps. • **10Mbps full duplex** – Full-duplex operation at 10 Mbps. • **100Mbps half duplex** – Half-duplex operation at 100 Mbps. • **100Mbps full duplex** – Full-duplex operation at 100 Mbps.

➤ To display the LAN port counters:

1. Type **1** and then press **<Enter>**.

2. You will see the **LAN Counters** screen for the selected LAN port. For ETH ports 1 and 2, the **LAN Counters** screen includes a large number of items and therefore it consists of two pages:
   - To continue from the first page to the second page, type **n** (next)
   - To return from the second page to the first page, type **p** (previous).

A typical **LAN Counters** screen is shown in *Figure C-148* and *Figure C-149*.

The information displayed on the screen, which is accumulated continuously, is automatically refreshed every few seconds.

You can clear the displayed statistics (that is, reset the displayed performance monitoring counters) by typing **C**.

The statistics displayed on the **LAN Counters** screen are explained in *Table C-35*.

```
                                  FCD-155
Lan Counters

    Rx Total Frames      ... (0)          Tx Total Frames    ... (0)
    Rx Unicast Frames    ... (0)          Tx Unicast Frames  ... (0)
    Rx Broadcast Frames  ... (0)          Tx Broadcast Frames... (0)
    Rx Multicast Frames  ... (0)          Tx Multicast Frames... (0)
    Rx Total Bytes       ... (0)          Tx Total Bytes     ... (0)
    Rx Pause Frames      ... (0)          Excessive Collision... (0)
    Rx Correct Frames    ... (0)          Multiple Collision ... (0)
    Rx Filtered          ... (0)          Single Collision   ... (0)
    Rx Dropped           ... (0)          Late Collision     ... (0)
    Rx Jabber Frames     ... (0)          Total Collision    ... (0)
    Rx Invalid CRC Frames... (0)          ...
... (N)
>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-Output                       1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-148. Typical **LAN Counters** (Physical Ports) Screen (First Page)*

```
                                   FCD-155
Lan Counters
... (P)
    Rx Fragment Frames  ... (0)           Rx 256b-511b Frames ... (0)
    Rx 64b Frames       ... (0)           Rx 512b-1023b Frames... (0)
    Rx 65b-127b Frames  ... (0)           Rx 1024b-max Frames ... (0)
    Rx 128b-255b Frames ... (0)





>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-Output                       1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-149. Typical **LAN Counters** (Physical Ports) Screen (Second Page)*

*Table C-35. **LAN Counters** (Physical Ports) Performance Monitoring Statistics*

Parameter	Description
Rx Total Frames	Total number of frames received through the corresponding LAN port
Rx Unicast Frames	Total number of good unicast frames received through the corresponding LAN port
Rx Broadcast Frames	Total number of good broadcast frames received through the corresponding LAN port
Rx Multicast Frames	Total number of good multicast frames received through the corresponding LAN port
Rx Pause Frames	Total number of **pause** frames (used for flow control) received through the corresponding LAN port
Rx Correct Frames	Total number of good frames received through the corresponding LAN port
Rx Total Bytes	Total number of data octets carried by all frames received through the corresponding LAN port
Rx Filtered (not supported by ports 3 to 6)	If the QoS criteria based on IEEE 802.1Q are not used on this port: Total valid frames received that are not forwarded to a destination port. These are frames for which there is no destination port, or are not forwarded due to the state of the port. Valid frames discarded due to lack of buffer space are not included. If the QoS criteria based on IEEE 802.1Q are used on this port: Total valid frames received (tagged or untagged) that were discarded because of unknown VLAN ID
Rx Dropped	Total number of valid frames received by the corresponding LAN port that have been discarded because of a lack of buffer space. This includes frames discarded at ingress, as well as those dropped due to priority and congestion considerations at the output queues. Frames dropped at egress due to excessive collisions are not included in this count, but are counted by the **Excessive Collision** counter

*Table C-35. **LAN Counters** (Physical Ports) Performance Monitoring Statistics (Cont.)*

Parameter	Description
Rx Jabber Frames	Total number of frames received by the corresponding LAN port during jabber (such frames are frames with a data field length exceeding 1518 or 1536 bytes, and also having invalid CRC)
Rx Invalid CRC Frames	Total number of frames received by the corresponding LAN port which met the following conditions: • Frame data length is between 64 bytes, and 1518 or 1536 bytes (depending on mode) • Frame has invalid CRC • Collision event has not been detected • Late collision event has not been detected
Tx Total Frames	Total number of good frames transmitted by the corresponding LAN port
Tx Unicast Frames	Total number of good unicast frames transmitted by the corresponding LAN port
Tx Broadcast Frames	Total number of good broadcast frames transmitted by the corresponding LAN port
Tx Multicast Frames	Total number of good multicast frames transmitted by the corresponding LAN port
Tx Total Bytes	Total number of data octets carried by all the good frames transmitted by the corresponding LAN port
Excessive Collision	Total number of frames not transmitted by the corresponding LAN port, because the frame experienced 16 retransmission attempts and therefore has been discarded
Multiple Collision	Total number of frames successfully transmitted by the corresponding LAN port that experienced more than one collision
Single Collision	Total number of frames successfully transmitted by the corresponding LAN port that experienced exactly one collision.
Late Collision	Total number of times a collision at the corresponding LAN port has been detected later than 512 bit-times into the transmission of a frame
Total Collision	Total number of collisions detected at the corresponding LAN port
Rx Fragment Frames	Number of fragmented frames received at the corresponding LAN port (a fragmented frame is a frame with a data field length less than 64 bytes and invalid CRC, for which no collision event and no late collision event have not been detected during its reception)
Rx 64b Frames (not supported by ports 3 to 6)	Total number of 64-byte frames received through the corresponding LAN port
Rx Frames 65b-127b (not supported by ports 3 to 6)	Total number of frames with size of 65 to 127 bytes received through the corresponding LAN port
Rx Frames 128b-255b (not supported by ports 3 to 6)	Total number of frames with size of 65 to 127 bytes received through the corresponding LAN port
Rx Frames 256b-511b (not supported by ports 3 to 6)	Total number of frames with size of 256 to 511 bytes received through the corresponding LAN port

*Table C-35. **LAN Counters** (Physical Ports) Performance Monitoring Statistics (Cont.)*

Parameter	Description
Rx Frames 512b-1023b (not supported by ports 3 to 6)	Total number of frames with size of 512 to 1023 bytes received through the corresponding LAN port
Rx Frames 1024b-max (not supported by ports 3 to 6)	Total number of frames with size of 1024 up to 1518 or 1536 bytes received through the corresponding LAN port

C.73 Monitoring – PDH (Physical Ports) Screen

Purpose

Display the performance monitoring statistics for the PDH ports. The displayed parameters depend on the PDH port type: E1, T1, E3 or t3.

Since statistics can be displayed only for enabled ports, if the selected PDH port is not enabled, its monitoring display is empty.

The information is accumulated continuously while the FCD-155 operates, and is automatically refreshed every few seconds. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring – Physical Ports – item 3

Use – FCD-155 with Quad E1 or T1 PDH Ports

A typical **PDH** port selection screen for an FCD-155 with quad E1 or T1 interfaces is shown in *Figure C-150.*

```
                                    FCD-155
PDH
 1. Port1    >
 2. Port2    >
 3. Port3    >
 4. Port4    >









>



ESC-prev.menu; !-main menu; &-exit; @-output                      1 user(s)
--------------------------------------------------------------------------------
```

*Figure C-150. Typical E1 or T1 **PDH** Port Selection Screen*

➤ **To select an E1 or T1 PDH port for display of performance monitoring statistics:**

1. Type the corresponding item number, **1** to **4,** and then press **<Enter>**.
2. You will see the **PDH** port statistics interval selection screen. A typical interval selection screen is shown in *Figure C-151*.

```
                                FCD-155
Port 1
 1. Current Interval>
 2. Select Interval >
 3. Total           >









>

ESC-prev.menu; !-main menu; &-exit; @-output                   1 user(s)
------------------------------------------------------------------------------
```

*Figure C-151. Typical **PDH** Port Interval Selection Screen*

➤ **To display E1 or T1 PDH physical port performance monitoring data for the current interval:**

1. Type **1** and then press **<Enter>**.
2. You will see the **Current Interval** performance monitoring screen for the selected PDH port. A typical **PDH** screen for E1 ports is shown in *Figure C-152*, and a screen for T1 ports is shown in *Figure C-153*. The selected port is identified in the screen header.

```
                                  FCD-155
Port 1
 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (6)
 3. Elapsed time     ... (00:07:38)
 4. Start Time       ... (00:00:00)
 5. ES               ... (0)
 6. SES              ... (0)
 7. UAS(SEFS)        ... (0)
 8. CV               ... (0)





>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-output                   1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-152. Typical **Port** Performance Monitoring Screen for E1 PDH Physical Ports*

```
                                    FCD-155
Current Interval

 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (16)
 3. Elapsed time    ... (00:10:30)
 4. UAS             ... (630)
 5. LES             ... (0)






>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-output                    1 user(s)
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-153. Typical **Port** Performance Monitoring Screen for T1 PDH Physical Ports*

The information displayed on the screen, which is accumulated continuously, is automatically refreshed every few seconds.

You can clear the displayed statistics (that is, reset the displayed performance monitoring counters) by typing **C**.

The statistics displayed on the E1 PDH **Port** screen are explained in *Table C-28*, and those displayed on the T1 PDH **Port** screen are explained in *Table C-36*.

Table C-36. T1 PDH Physical Port Performance Monitoring Data

Parameter	Description
Interval Number	The number of the 15-minute interval to be displayed, in the range of 1 to 96. The default value is **0** (zero), which designates the current interval. However, you can also select another interval, by typing **1** and then pressing **<Enter>**: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.
Valid Intervals	The number of intervals (up 96 intervals) for which performance monitoring information can be displayed.
Elapsed Time	The elapsed time (in seconds) since the beginning of the current interval, in seconds. The range is 1 to 900 seconds.
LES	Displays the number of Line Error Seconds (LES) in the current interval. A LES is any second during which one or more line code violation events have occurred.
UAS	Displays the number of unavailable seconds (UAS) in the current interval. An unavailable second is any second in which one or more Signal Loss or AIS defects have been detected.

➤ **To display E1 or T1 PDH port performance monitoring data on a selected interval:**

1. Type **2** on the E1 or T1 **PDH** port statistics interval selection screen, and then press **<Enter>**.
2. You will see the **Select Interval** performance monitoring screen for the PDH port. This screen is similar to the screens for the current interval, shown in *Figure C-152* and *Figure C-153*, respectively, except for its header, **Select Interval**.
3. Select the desired interval, by typing **1** and pressing **<Enter**>: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.
4. After pressing **<Enter**>, the data displayed on the screen is updated in accordance with your selection.

➤ **To display totaled E1 or T1 PDH port performance monitoring data:**

1. Type **3** on the E1 or T1 **PDH** port statistics interval selection screen and then press **<Enter>**.
2. You will see the **Total** performance monitoring screen for the selected PDH port. This screen is similar to the screens for the current interval, shown in *Figure C-152* and *Figure C-153*, respectively, except for its header, **Total**, and the number of the 15-minute intervals to be displayed, which is by default **97**, which means ***all the intervals***.

   However, you can also select a specific interval for display (the same result as selecting **Select Interval**):

   - Type **1** on the screen shown in *Figure C-152* or *Figure C-153* and then press **<Enter**>.
   - Now type the desired interval number, up to the number displayed in the **Valid Intervals** field, and then press **<Enter**>.

Use – FCD-155 with E3 or T3 PDH Ports

A typical **PDH** port selection screen for an FCD-155 with E3 or T3 port is shown in *Figure C-154.*

```
                                              FCD-155
PDH
 1. Port1    >










>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-154. Typical E3 or T3 **PDH** Port Selection Screen*

➤ **To select the E3 or T3 PDH port for display of performance monitoring statistics:**

1. Type **1** on the screen shown in *Figure C-154* and then press **<Enter>**.
2. You will see the E3 or T3 **PDH** port statistics interval selection screen. A typical interval selection screen is shown in *Figure C-155*.

```
                                  FCD-155
Port 1
 1. Current Interval>
 2. Select Interval >
 3. Total           >







>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------

```

*Figure C-155. Typical E3 or T3 **PDH** Port Interval Selection Screen*

➤ **To display E3 or T3 PDH physical port performance monitoring data for the current interval:**

1. Type **1** and then press **<Enter>**.
2. You will see the **Current Interval** performance monitoring screen for the selected PDH port. A typical **PDH** screen for E3 or T3 ports is shown in *Figure C-156*.

```

                                    FCD-155
Current Interval

 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (16)
 3. Elapsed time    ... (00:10:30)
 4. UAS             ... (630)
 5. LES             ... (0)






>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-156. Typical **Port** Performance Monitoring Screen for E3 or T3 PDH Physical Ports*

The information displayed on the screen, which is accumulated continuously, is automatically refreshed every few seconds.

You can clear the displayed statistics (that is, reset the displayed performance monitoring counters) by typing **C**.

The statistics displayed on the E3 or T3 PDH **Port** screen are explained in *Table C-36*.

➤ **To display E3 or T3 PDH port performance monitoring data on a selected interval:**

1. Type **2** on the E3 or T3 **PDH** port statistics interval selection screen, and then press **<Enter>**.
2. Use the procedure described above for E1 or T1 PDH ports.

➤ **To display totaled E1 or T1 PDH port performance monitoring data:**

1. Type **3** on the E1 or T1 **PDH** port statistics interval selection screen and then press **<Enter>**.
2. Use the procedure described above for E1 or T1 PDH ports.

C.74 Monitoring – DCC Statistics Screen

Purpose

Display the performance monitoring statistics for the DCC.

This option is relevant only when the FCD-155 uses inband management.

The information is accumulated continuously while the FCD-155 operates, and is automatically refreshed every few seconds. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring – Physical Ports – item 3 or **4**

Use

➤ **To display the DCC performance monitoring statistics:**

1. Type **3** or **4** on the **Physical Ports** submenu and then press **<Enter>**.
2. You will see the **DCC Statistics** screen. A typical screen is shown in *Figure C-157*.

The information displayed on the screen, which is accumulated continuously, is automatically refreshed every few seconds.

The statistics displayed on the **DCC Statistics** screen are explained in *Table C-37*.

```
                                 FCD-155
DCC Statistics

    Rx Total Frames... (0)
    Rx Total Bytes ... (0)
    Rx CRC Error   ... (0)
    Rx Dropped     ... (0)
    Tx Total Frames... (8)
    Tx Total Bytes ... (104)




>


ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure C-157. Typical **DCC Statistics** Screen*

*Table C-37. **DCC Statistics** Performance Monitoring Statistics*

Parameter	Description
Rx Total Frames	Total number of management packets received through the DCC
Rx Total Bytes	Total number of data octets carried by all the management packets received through the DCC
Rx CRC	Total number of management packets with invalid CRC received through the DCC
Rx Dropped	Total number of valid management packets received through the DCC that have been discarded because of a lack of buffer space. This includes frames discarded at ingress, as well as those dropped due to priority and congestion considerations at the output queues
Rx Total Frames	Total number of management packets transmitted through the DCC
Rx Total Bytes	Total number of data octets carried by all the management packets transmitted through the DCC

C.75 Diagnostics Menu

Figure C-158 and *Figure C-159* show the structure of the ***Diagnostics*** menu for the main FCD-155 versions.

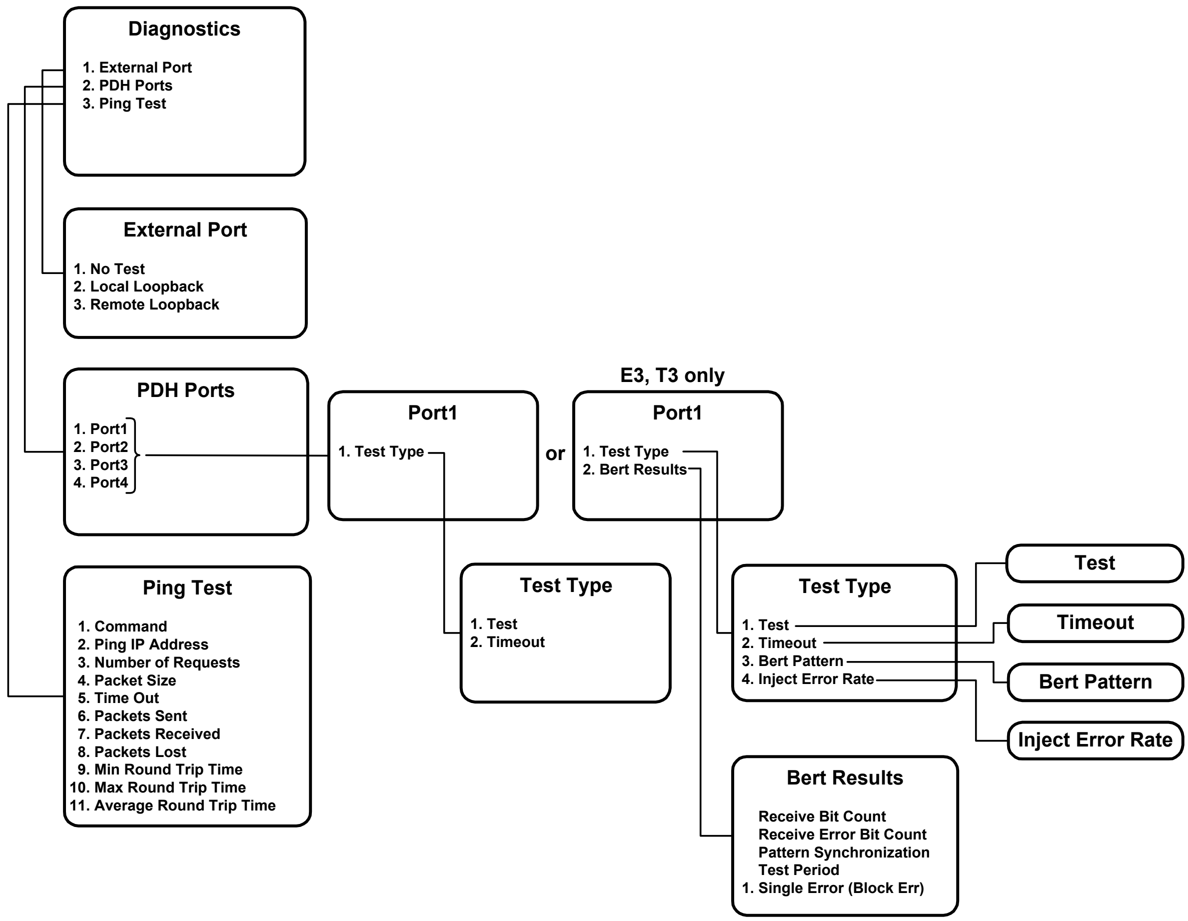


*Figure C-158. **Diagnostics** Menu Structure (SDH Versions with PDH Ports)*

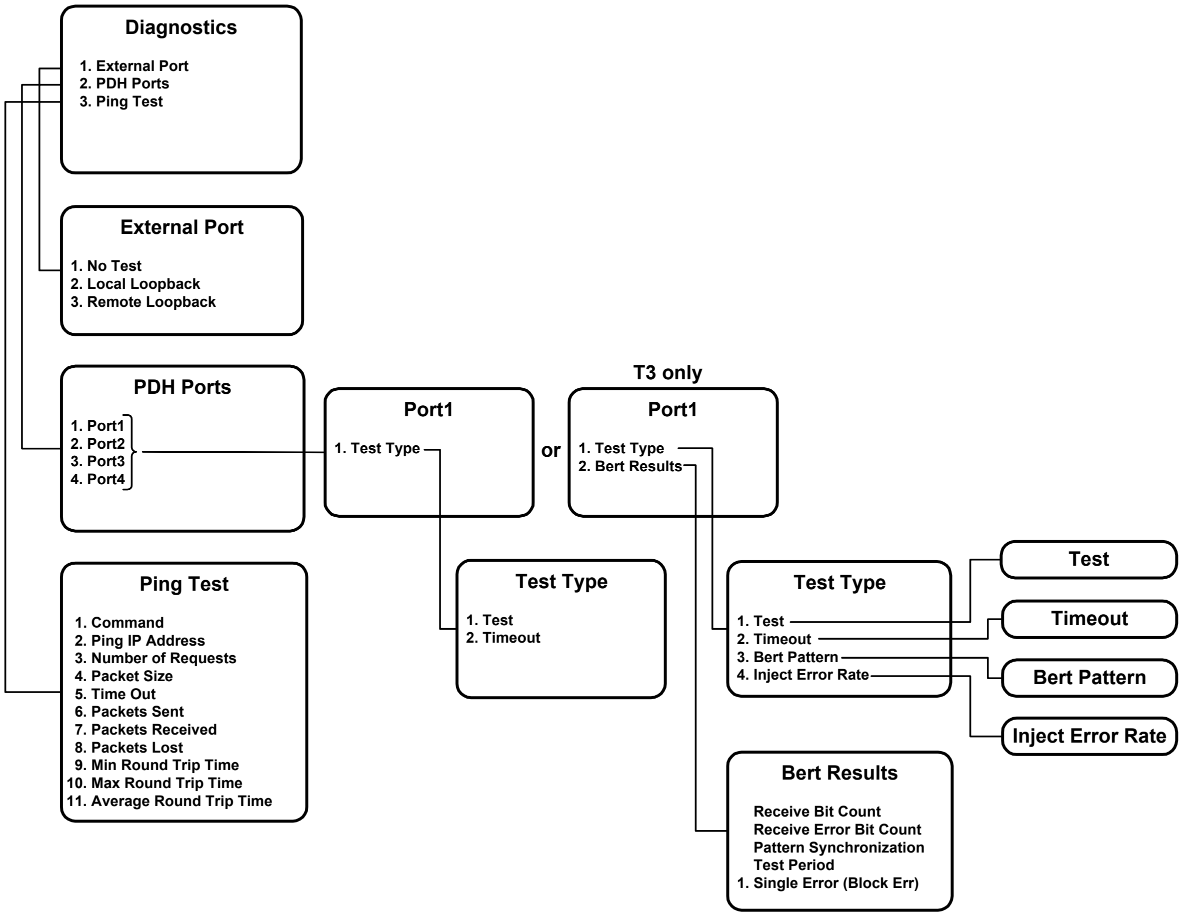


*Figure C-159. **Diagnostics** Menu Structure (SONET Versions)*

C.76 Diagnostics Type Selection Screen

Purpose

Select the type of diagnostic activity to be performed.

Reached from

Diagnostics

Use

A typical **Diagnostics** screen is shown in *Figure C-160*. The PDH option is included only when the FCD-155 is equipped with PDH interfaces.

The screen displays the state of tests (for example, a local loopback is activated on the external port in *Figure C-160*). While a test is active, the TEST indicator is displayed in the right-hand corner of the screen.

```
                                    FCD-155
Diagnostics                                                                  TEST

 1. External Port >    (No Test)
 2. PDH Ports     >    (None)
 3. Ping Test     >





>



ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-160. Typical **Diagnostics** Selection Screen (SDH and SONET – FCD-155 with PDH Interfaces)*

➤ **To select a diagnostics task:**

Type the corresponding item number and then press **<Enter>**.

C.77 Diagnostics – External Port Screen

Purpose

Perform test loopbacks on the FCD-155 network interface. At any time, only one loopback may be active.

Refer to *Chapter 4* for a description of test loopbacks.

Reached from

Diagnostics – item 1

Use

A typical **External Port** loopback control screen is shown in *Figure C-161*. The current state of external port loopbacks is identified in the screen header.

```
                                    FCD-155
External Port  (No Test)
 1. No Test
 2. Local Loopback
 3. Remote Loopback




>



ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-161. Typical **External Port** Loopback Control Screen*

➤ **To change the state of a loopback:**

1. To activate a loopback, type its number and then press **<Enter>**.

   The loopback control screen closes, and the new loopback is displayed on the diagnostic selection screen (*Figure C-161*).

2. To deactivate the current loopback, type **1 – No Test** and then **press <Enter>.**

   The loopback control screen closes, and **No Test** is displayed on the diagnostic selection screen (*Figure C-161*).

C.78 Diagnostics – PDH Ports Screen

Purpose

Perform test loopbacks on an FCD-155 PDH interface. At any time, only one loopback may be active on any interface.

Refer to *Chapter 4* for a description of test loopbacks.

This option is available only when the FCD-155 is equipped with PDH interfaces. Tests may be activated only on active PDH ports.

Reached from

Diagnostics – Physical Ports – item 2

Use – FCD-155 with E1 or T1 PDH Ports

A typical E1 or T1 **PDH Ports** selection screen is shown in *Figure C-162*.

```
                                FCD-155
PDH Ports                                                        TEST

 1. Port 1>
 2. Port 2>
 3. Port 3>
 4. Port 4>







>



ESC-prev.menu; !-main menu; &-exit; @-output                1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-162. Typical E1 or T1 **PDH Ports** Selection Screen*

➤ **To select an E1 or T1 PDH port:**

To select a port, type its number and then press **<Enter>**.

You will see the **Port Test Type** selection screen for the selected port. The selected port number appears in the screen header.

A typical screen is shown in *Figure C-163*.

```
                                  FCD-155
Port 1                                                                 TEST

 1. Test Type    >






>


ESC-prev.menu; !-main menu; &-exit; @-output                      1 user(s)
------------------------------------------------------------------------------
```

Figure C-163. Typical E1 or T1 ***Port Test Type*** *Selection Screen*

➤ **To select the desired test activity for an E1 or T1 PDH port:**

1. Type **1** on the **Port Test Type** selection screen and then press **<Enter>**.
2. You will see the **Test Type** control screen for the selected port. A typical screen is shown in *Figure C-164*. The screen shows the state of loopbacks for the selected port, and the current loopback time-out value.
3. Type the number corresponding to the desired activity and then press **<Enter>**.

```
                                  FCD-155
Test Type                                                              TEST

 1. Test              >   (Local Loopback Upstream Ais)
 2. Timeout           >   (Infinite)





>


ESC-prev.menu; !-main menu; &-exit; @-output                      1 user(s)
------------------------------------------------------------------------------
```

Figure C-164. Typical ***Test Type*** *Control Screen*

➤ **To change the state of a loopback on an E1 or T1 PDH port:**

1. To activate a loopback, type **1** on the **Test Type** control screen.
2. You will see the loopback control screen for the selected port. A typical screen for an E1 port is shown in *Figure C-165.* The selected port number, and the state of any active loopback, appear in the screen header.

Note *If you select an E1 or T1 PDH port defined as inactive, you will see **Error** for the loopback state.*

3. To activate a loopback, type its number and then press **<Enter>**. The loopback control screen closes, the new loopback is displayed on the **Test Type** control screen *Figure C-164*), and the TEST indicator appears in the screen headers.
4. To deactivate the currently active loopback, type **1 – No Test** on the **Test** control screen. The loopback control screen closes, and **No test** is displayed on the **Test Type** control screen (*Figure C-164*).

```
                                FCD-155
Test              (No Test)

 1. No Test
 2. Local Loopback
 3. Remote Loopback
 4. Local Loopback Upstream Ais
 5. Remote Loopback Downstream Ais




>


ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-165. Typical **Test** Control Screen for E1 PDH Ports*

```
                                FCD-155
Test              (No Test)

 1. No Test
 2. Local Loopback
 3. Remote Loopback
 4. Network Loopback
 5. Local Loopback Upstream Ais
 6. Remote Loopback Downstream Ais



>


ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-166. Typical **Test** Control Screen for T1 PDH Ports*

➤ **To select the time-out interval:**

1. To change the selected port time-out interval, type **2** on the **Test Type** control screen.
2. You will see the **Timeout** control screen for the selected port. A typical screen is shown in *Figure C-172*. The current time-out interval appears in the screen header.

```
                                FCD-155
Timeout            (Infinite)
----------------------------

 1.   1 Minute
 2.   2 Minutes
 3.   3 Minutes
 4.   4 Minutes
 5.   5 Minutes
 6.  10 Minutes
 7.  20 Minutes
 8.  30 Minutes
 9.  Infinite



>


ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-167. Typical **Timeout** Control Screen for E1 or T1 PDH Ports*

3. To select a time-out interval, type its number and then press **<Enter>**. The **Timeout** control screen closes, and the new interval is displayed on the **Test Type** control screen *Figure C-164*).

Use – FCD-155 with E3 or T3 PDH Port

➤ **To select the desired activity for the E3 or T3 PDH port:**

A typical E1 or T1 **PDH Ports** selection screen is shown in *Figure C-168*.

```
                                FCD-155
PDH Ports                                                                TEST

 1. Port 1>







>

ESC-prev.menu; !-main menu; &-exit; @-output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-168. Typical E3 or T3 **PDH Ports** Selection Screen*

1. Type **1** on the **PDH Ports** selection screen and then press **<Enter>**.
2. You will see the test activity control screen for the E3 or T3 port. A typical screen is shown in *Figure C-169*.
3. Type the number corresponding to the desired activity and then press **<Enter>**.

```
                                  FCD-155
Port 1                                                          TEST

 1. Test Type    >
 2. Bert Results >




>


ESC-prev.menu; !-main menu; &-exit; @-output                 1 user(s)
------------------------------------------------------------------------------
```

Figure C-169. Typical E3 or T3 ***Port*** *Test Activity Selection Screen*

➤ **To select an E3 or T3 test activity:**

1. Type **1** on the **Port** test activity selection screen and then press **<Enter>**.
2. You will see the **Test Type** control screen for the E3 or T3 port. A typical screen is shown in *Figure C-170*. The screen shows the state of loopbacks for the E3 or T3 port, and the current loopback time-out value; it also provides selections for BER test control and configuration.
3. Type the number corresponding to the desired activity and then press **<Enter>**.

```
                                  FCD-155
Test Type

 1. Test              >    (Local Loopback Upstream Ais)
 2. Timeout           >    (Infinite)
 3. Bert Pattern      >    (2^15-1)
 4. Inject Error Rate>     (None)




>


ESC-prev.menu; !-main menu; &-exit; @-output                 1 user(s)
------------------------------------------------------------------------------
```

Figure C-170. Typical E3 or T3 ***Test Type*** *Control Screen*

➤ **To change the state of a loopback on an E3 or T3 PDH port:**

1. To activate a loopback, type **1** on the **Test Type** control screen.
2. You will see the loopback control screen for the E3 or T3 port. A typical screen for an E3 port is shown in *Figure C-171*. The state of any active loopback appears in the screen header.

Note *If the E3 or T3 PDH port is defined as inactive, you will see* ***Error*** *for the loopback state.*

3. To activate a loopback, type its number and then press **<Enter>**. The loopback control screen closes, the new loopback is displayed on the **Test Type** control screen (*Figure C-170*), and the TEST indicator appears in the screen headers.

4. To deactivate the currently active loopback, type **1 – No Test** on the **Test** control screen. The loopback control screen closes, and **No test** is displayed on the **Test Type** control screen (*Figure C-170*).

```
                                        FCD-155                           TEST
Test                  (Remote Loopback Upstream Ais)

 1. No Test
 2. Local Loopback
 3. Remote Loopback
 4. Local Bert
 5. Remote Loopback Downstream Ais




>


ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-171. Typical **Test** Control Screen for E3 or T3 PDH Ports*

➤ **To select the E3 or T3 PDH port time-out interval:**

1. To change the port time-out interval, type **2** on the **Test Type** control screen.

2. You will see the **Timeout** control screen for the selected port. A typical screen is shown in *Figure C-172*. The current time-out interval appears in the screen header.

```
                                      FCD-155
Timeout               (Infinite)

 1. 1 Minute
 2. 2 Minutes
 3. 3 Minutes
 4. 4 Minutes
 5. 5 Minutes
 6. 10 Minutes
 7. 20 Minutes
 8. 30 Minutes
 9. Infinite


>


ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-172. Typical **Timeout** Control Screen for E3 or T3 PDH Ports*

3. To select a time-out interval, type its number and then press **<Enter>**. The **Timeout** control screen closes, and the new interval is displayed on the **Test Type** control screen (*Figure C-170).*

➤ **To perform a BER test on the E3 or T3 port:**

1. Configure the BER test pattern by selecting item **3** on the **Test Type** control screen.
2. You will see the **BERT Pattern** control screen. A typical screen is shown in *Figure C-173*. The current test pattern appears in the screen header.

```
                                    FCD-155
Bert Pattern      (2^15-1)

 1. 2^15-1
 2. 2^23-1
 3. ALT









>




ESC-prev.menu; !-main menu; &-exit; @-output                         1 user(s)
------------------------------------------------------------------------------
```

*Figure C-173. Typical **BERT Pattern** Control Screen for E3 or T3 PDH Ports*

3. To select a test pattern, type its number, and then press **<Enter>**. The **BERT Pattern** control screen closes, and the new interval is displayed on the **Test Type** control screen (*Figure C-170).*
4. To start the BER test, type **4** on the **Test Type** control screen and then press **<Enter>**.
5. To stop the BER test, type **1** on the **Test Type** control screen and then press **<Enter>**.

➤ **To read the BER test results:**

1. Type **1** on the **Port** test activity selection screen and then press **<Enter>**.
2. You will see the **BERT Results** control screen for the E3 or T3 port. A typical screen is shown in *Figure C-174*.

   The information presented on the screen includes:

   Receive Bit Count The total number of bits transmitted during the test.

   Receive Error Count The total number of errors detected during the test.

Pattern Synchronization Displays the current synchronization state of the error evaluator:

- **Sync** – normal operation, errors can be reliably detected.
- **Sync Loss** – loss of synchronization. This may cause incorrect results.

The information displayed on the screen is automatically updated.

```
                              FCD-155
Bert Results

 Receive Bit Count             ... (10000000)
 Receive Error Count           ... (1)
 Pattern Synchronization       >   (Sync)
 Test Period                   ... (0 day 00:30:21)
 1. Single Error (Block Error)     (Inject)




>


ESC-prev.menu; !-main menu; &-exit; @-output                  1 user(s)
------------------------------------------------------------------------------
```

*Figure C-174. Typical E3 or T3 **BERT Results** Screen*

3. To check that the link is alive when the number of errors is low (a common occurrence on good links), inject an error by typing **1** and pressing **<Enter>:** the **BERT Results** screen should reflect this error.

C.79 Diagnostics – Ping Test

Purpose

Test IP connectivity from the FCD-155 management subsystem to a desired IP destination.

For a description of the ***ping*** function, refer to *Appendix E*.

Reached from

Diagnostics – item 2 or **3**

Use

A typical **Ping Test** screen is shown in *Figure C-175*.

```
                                  FCD-155
Ping Test

 1. Command                            (Execute)
 2. Ping IP address               ... (0.0.0.0)
 3. Number of Requests            [1 - 255]... (5)
 4. Packet size                   [1 - 255]... (32)
 5. Time Out                      [1 - 255]... (5)
 6. Packets Sent                  ... (0)
 7. Packets Received              ... (0)
 8. Packets Lost                  ... (0)
 9. Min Round Trip Time(ms)       ... (0)
10. Max Round Trip Time(ms)       ... (0)
11. Average Round Trip Time(ms)... (0)

>
ESC-prev.menu; !-main menu; &-exit; @-Output                        1 user(s)
-----------------------------------------------------------------------------
```

*Figure C-175. Typical **Ping Test** Screen*

➤ **To check IP connectivity:**

1. Define the ping parameters:
   - Type **2** and then press **<Enter>**. Enter the destination IP address in the **Destination IP** field, and then press **<Enter>** again.
   - Type **3** and then press **<Enter>**. Enter the total number of ping requests to be sent in the **Number of Requests** field, and then press **<Enter>** again.
   - Type **4** and then press **<Enter>**. Enter the size, in bytes, of the ping packets that will be sent in the **Packet Size** field, and then press **<Enter>**.
   - Type **5** and then press **<Enter>**. Specify the maximum time, in seconds, allocated to sending the specified number of pings in the **Time out** field, and then press **<Enter>** again.
2. Type **1** and then press **<Enter>** to start sending pings and collect the results.
3. The lower part of the screen starts showing the progress of the ping. The following information is displayed:
   - **Packets Sent** – shows the total number of pings sent. The number advances until all the pings are sent, or until the specified time-out interval expires.
   - **Packets Received** – displays the number of ping responses received before the time-out interval expires.
   - **Packets Lost** – after all the pings have been sent or the specified time-out interval expires, displays the number of unanswered ping requests.
   - **Success** – displays the percentage of successfully received ping responses, relative to the total number sent.
   - **Min Round Trip Time (ms)** – displays the minimum measured time between the transmission and reception of a ping, in milliseconds.
   - **Max Round Trip Time (ms)** – displays the minimum measured time between the transmission and reception of a ping, in milliseconds.
   - **Average Round Trip Time (ms)** – displays the average time calculated for all the successfully received ping responses, in milliseconds.

C.80 File Utilities Menu

Figure C-176 shows the structure of the **File Utilities** menu.

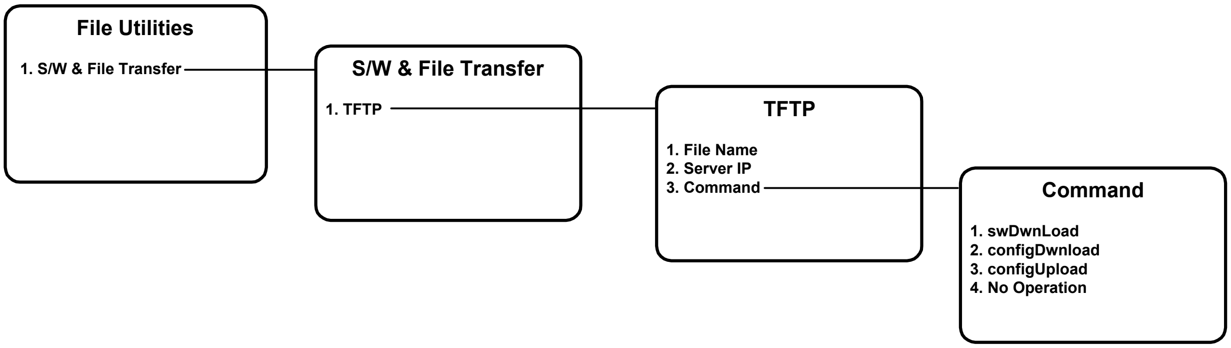


*Figure C-176. **File Utilities** Menu Structure*

C.81 File Utilities – S/W & File Transfer Screen

Purpose

Use TFTP to perform the following operations:

- Download software to the FCD-155. This is usually performed by downloading from a host connected to one of the FCD-155 ETH 1 or ETH 2 LAN ports, or from a remote location that provides an IP communication path to one of these FCD-155 LAN ports.

  For detailed software downloading instructions, refer to *Appendix D*.
- Download a configuration parameters file to the FCD-155.
- Upload the configuration parameters file of the local FCD-155.

Reached from

File Utilities – item 1

Use

A typical **S/W & File Transfer** screen is shown in *Figure C-177*.

```
                                    FCD-155
S/W & File Transfer
 1. TFTP                          >




>


File Transfer operations

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-177. Typical **S/W & File Transfer** Screen*

➤ **To start a TFTP transfer:**

1. Type **1** and then press **<Enter>**.
2. You will see the **TFTP** screen. A typical **TFTP** screen is shown in *Figure C-178*.
3. Define the parameters needed for the TFTP transfer:
   - Type **1** and then press **<Enter>**. Enter the name of the desired software distribution file (make sure to include the path, when necessary). When done, press **<Enter>** to continue.
   - Type **2** and then press **<Enter>**. Enter the IP address of the server that will download the software distribution file (use the dotted quad format), and then **<Enter>** to continue.

```
                                    FCD-155
TFTP
 1. File Name                     ... ()
 2. Server IP                     ... (0.0.0.0)
 3. Command                       >




>


TFTP operations

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-178. Typical **TFTP** Screen*

4. When ready, type **3** and then press **<Enter>**. You will see the **Command** screen. A typical **Command** screen is shown in *Figure C-179*.

```
                                    FCD-155
Command

 1. swDwnLoad
 2. configDwnLoad
 3. configUpLoad
 4. No Operation



>

Please select item <1 to 4>

ESC-prev.menu; !-main menu; &-exit; @-output                        1 user(s)
-------------------------------------------------------------------------------
```

*Figure C-179. Typical **Command** Screen*

5. Select the desired command by typing its number. The available selections are as follows:

swDwnLoad	Download a software distribution file from the specified TFTP server to the FCD-155.
configDwnLoad	Download a configuration parameters file from the specified TFTP server to the FCD-155.
configupLoad	Upload the current configuration parameters file of the FCD-155 to the specified TFTP server.
No Operation	No operation – only closes the **Command** screen.

6. When ready to start the transfer, press **<Enter>**.
7. If no errors are detected, the downloading process starts, and the screen displays its relative progress.
8. After the transfer is successfully completed, the FCD-155 is automatically reset. After the resetting is successfully completed, you will see the FCD-155 log in screen again.

Appendix D

Software Updating

D.1 Scope

This Appendix presents procedures for downloading software. The procedures appearing in this Appendix can be used to update FCD-155 software; they can also be used to download to an FCD-155 not yet loaded or whose software has been corrupted.

Overview of Downloading Options

Using File Utilities Menu

The recommended software downloading method, explained in *Section D.2*, is downloading by means of the TFTP protocol, using the **File Utilities** menu reached from the main menu. Network administrators can use this procedure to distribute new software releases to all the managed FCD-155 units in the network from a central location.

Using Boot Menu

Software downloading may also be performed using the boot menu, as explained in *Section D.3*. The boot menu can be reached while FCD-155 performs initialization, for example, after power-up.

You may need to start the loading from the boot menu when it is not possible to activate TFTP from the **File Utilities** menu (for example, because the FCD-155 software has not yet been downloaded or is corrupted). Note however that the boot menu procedures are recommended for use only by authorized personnel, because this menu provides many additional options that are intended for use only by technical support personnel.

Two software downloading options are available from the boot menu:

- Downloading using the Xmodem protocol. This is usually performed by downloading from a PC directly connected to the FCD-155 CONTROL port.
- Downloading using the TFTP protocol. This is usually performed by downloading from a host connected to a FCD-155 ETH port 1 or 2, or from a remote location that provides an IP communication path to one of these FCD-155 ports.

Note *Unless otherwise specified, all the parameter values appearing in the following screens are given for illustration purposes only, and do not reflect recommended values.*

D.2 Software Updating Using File Utilities Menu

Preparations for Using TFTP

The following conditions must be fulfilled before the TFTP protocol can be used for software downloading:

1. The required suite of protocols (which includes as minimum the TCP/IP stack and the TFTP server and client software) must be installed on the other computer (the computer used to download files and/or accept uploaded files).
2. The FCD-155 must be assigned IP parameters for its management entity (IP address, the associated subnet mask and a default gateway IP address) using **Configuration – System – Management – Host IP** (see *Appendix C* for detailed instructions).
3. You must obtain the IP address of the other computer.
4. The TFTP protocol runs over IP, therefore it is necessary to ensure IP connectivity between the FCD-155 and the other computer. For example:
   - The Ethernet port of the other computer may be directly connected to the FCD-155 port ETH 1 or ETH 2. In this case, their IP addresses must be in the same subnet.
   - Port ETH 1 or ETH 2 of the FCD-155, and the other computer may be attached to the same LAN.
   - The FCD-155 and the other computer may be attached to interconnected LANs (the connection may be provided through the SDH/SONET network).

Note

*IP connectivity can be checked using standard tools such as **ping.***

5. If you intend to initiate TFTP transfer using a supervisory terminal connected to the FCD-155 CONTROL connector, make sure the FCD-155 supervisory port is properly configured. This is performed by means of the **Configuration – System – Control Ports** (see *Appendix C* for detailed instructions).

   Alternatively, you may use a Telnet host that can communicate with the FCD-155 either through ETH port 1 or 2, or through the WAN (network) port.

Software Downloading Procedure

Before Starting

1. Obtain the list of distribution files to be downloaded, and check that the required distribution files are stored on the TFTP server.
2. Make sure that the TFTP server can communicate with the FCD-155, for example, by sending ***ping***s to the IP address assigned to the FCD-155.

Downloading Procedure

1. Open the **File Utilities** menu

2. Start the TFTP process by selecting item 1: **S/W & File Transfer** on the **File Utilities** menu. You will see the **S/W & File Transfer** submenu.

```
                                FCD-155

S/W & File Transfer

 1. TFTP                          >









>

File Transfer operations

ESC-prev.menu; !-main menu; &-exit; @-Output                        1 user(s)
------------------------------------------------------------------------------
```

3. On the **S/W & File Transfer** submenu, select item 1 – **TFTP** to display the TFTP screen.

```
                                FCD-155
TFTP

 1. File Name                     ... ()
 2. Server IP                     ... (0.0.0.0)
 3. Command                       >









>

TFTP operations

ESC-prev.menu; !-main menu; &-exit; @-Output                        1 user(s)
-------------------------------------------------------------------------------
```

4. On the **TFTP** screen, select each of the items to define the parameters needed to perform the TFTP transfer:
   - Select item 1: **File Name**, and enter the name of the desired software distribution file (make sure to include the path, when necessary). When done, press **<Enter>** to continue.
   - Select item 2: **Server IP,** and enter the IP address of the server that will download the software distribution file. Enter the desired IP address in the dotted quad format, and then **<Enter>** to continue.

- Select item 3: **Command**, and then select item 1: **swDwnLoad**, to start the software downloading.

```
                                    FCD-155
Command

 1. swDwnLoad
 2. configDwnLoad
 3. configUpLoad
 4. No Operation




>



Please select item <1 to 4>

ESC-prev.menu; !-main menu; &-exit; @-Output                         1 user(s)
-------------------------------------------------------------------------------
```

5. If no errors are detected, the downloading process starts, and the screen displays its relative progress.
6. After the transfer is successfully completed, the FCD-155 is automatically reset. After the resetting is successfully completed, you will see the FCD-155 log in screen again.

Note *If downloading failed, repeat the whole procedure.*

7. Log in with the default parameters as follows:
   - In the **User Name** field, type the default user name, **su**, and then press **<Enter>**
   - In the **Password** field, type the default, **1234**, and then press **<Enter>.**
8. You will see the main menu screen.

The FCD-155 now uses the downloaded software.

D.3 Software Downloading From the Boot Menu

Software Downloading Procedure Using Xmodem Protocol

Before starting, copy the prescribed software file to the PC disk.

Preparations for Using Xmodem Protocol

1. Connect the serial RS-232 communication port of a PC running a terminal emulation program (for example, the HyperTerminal utility available with most Microsoft Inc. Windows™ releases) to the FCD-155 CONTROL connector. Select the emulated terminal type as VT-100.
2. Configure the communication parameters of the selected serial port for asynchronous communication for 115.2 kbps, no parity, one start bit, eight data bits and one stop bit. Turn flow control off.
3. If the FCD-155 operates, disconnect its power.

Procedure

1. Start the terminal emulation program in accordance with the configuration parameters described above.
2. When ready, connect the power to the FCD-155, and immediately start pressing the **<Enter>** key many times in sequence until you see the boot manager screen. A typical screen is shown below (the exact version and date displayed by your FCD-155 may be different).

Note *If you miss the timing, the FCD-155 will perform a regular reboot process (this process starts with **Loading** and ends with a **Running** message).*

```
RAD FCD155 Boot Version 2.10 (Sep 29 2003)
RAD Boot Manager Version 6.01 (Sep 29 2003)

0 - Exit Boot-Manager
1 - Dir
2 - Set Active Software Copy
3 - Delete Software Copy
4 - Download Files or an Application by XMODEM
5 - format flash
6 - Show basic hardware information
7 - Perform Reset to the board
8 - System Configuration.
9 - Download an Application by TFTP
Press the ESC key to go back to the Main Menu.

Select:
```

3. Type **4**. You will see a message that requests the partition number to which the new software is to be downloaded, and offers a recommended value.
4. If there is no special reason to select a different value, type the recommended number and then press <Enter>. A typical display is shown below:

```
Select Copy number for download ( 1 )
Select: 1
```

5. The process starts, and you will see:

```
Erasing Partition please wait ....
Please start the XMODEM download.
```

6. Start the transfer in accordance with the program you are using. For example, if you are using the Windows HyperTerminal utility:
   - Select **Transfer** in the HyperTerminal menu bar, and then select **Send File** on the **Transfer** menu.
   - You will see the **Send File** window:
     - Select the prescribed FCD-155 software file name (you may use the **Browse** function to find it).
     - In the **Protocol** field, select **Xmodem.**
   - When ready, press **Send** in the **Send File** window. You can now monitor the progress of the downloading in the **Send File** window.

Note *If downloading fails, repeat the whole procedure.*

7. When the downloading process is successfully completed, you will see a sequence of messages similar to the following:

```
Loading ...
Decompressing to RAM.

Processing archive: FLASH
Extracting FCD155.BIN
.........................................................
................................................................... CRC OK
Running ...
******************************************************************
* In order to start working - press the ENTER button for few times*
******************************************************************
```

8. At this stage, press the **<ESC>** key to go to the main menu.
9. Change the PC communication parameters to the default values (115.2 kbps, no parity, one start bit, eight data bits, one stop bit, flow control off).
10. Press <Enter> to display the FCD-155 log-in screen.
11. Log in with the default parameters as follows:
    - In the **User Name** field, type the default user name, **su**, and then press **<Enter>**
    - In the **Password** field, type the default, **1234**, and then press **<Enter>.**
12. You will see the main menu screen.

The FCD-155 now uses the downloaded software.

Software Downloading Procedure Using TFTP Protocol

Enabling TFTP from the Boot Menu

Normally, it is not possible to initiate file transfer using TFTP from the boot menu. When it is necessary to use this function, it must be enabled using an internal switch, SW201. Disable the TFTP function as soon as it is no longer needed, because changing SW201 settings to enable TFTP from the boot menu disables critical service features of the FCD-155.

Warning

No internal settings, adjustment, maintenance, and repairs may be performed by either the operator or the user; such activities may be performed only by skilled service personnel who are aware of the hazards involved. Always observe standard safety precautions during installation, operation, and maintenance of this product, and the safety precautions in *Chapter 2*.

This switch is reached by opening FCD-155 case, in accordance with the procedure described in *Chapter 2*. After opening FCD-155, refer to *Figure D-1* and perform the actions described below.

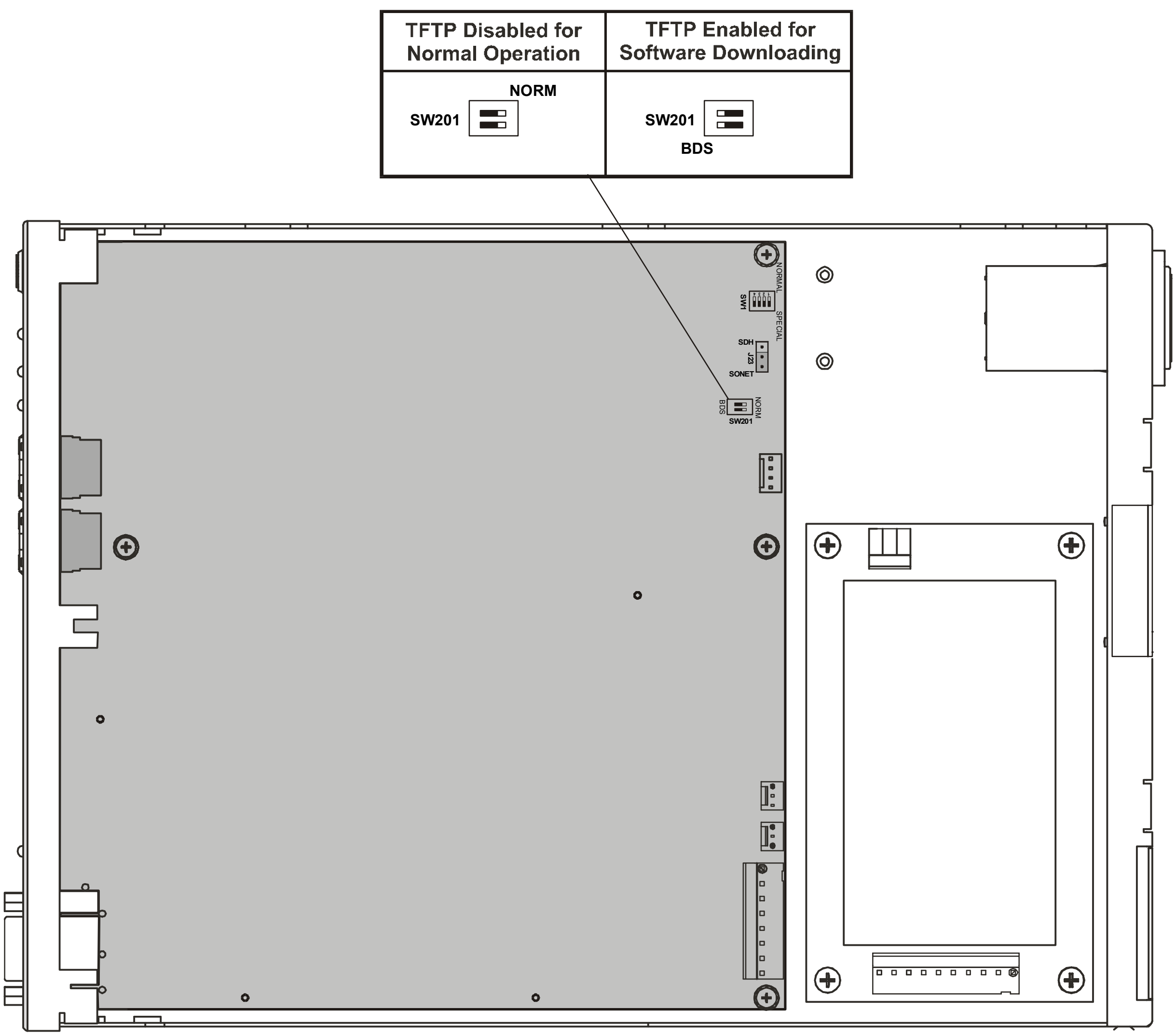


Figure D-1. Enabling TFTP from the Boot Menu

Note *Figure D-1 illustrates the position of the switch SW201 on a typical FCD-155 version: your version may include additional boards, depending on the specific unit that has been ordered.*

➤ **To enable TFTP from the boot menu:**

1. Identify switch SW201 using *Figure D-1*.
2. Set both sections of the switch SW201 to the BDS position.
3. Temporarily close the FCD-155 cover, to enable safe operation.

Preparations for Using TFTP Protocol

The preparations needed for using the TFTP protocol from the boot menu are similar to the preparations needed to download software from the **File Utilities** menu (see *Preparations for Using TFTP* section on page *D-2*).

The main difference is the method used to define the IP parameters for the FCD-155 management entity (IP address, the associated subnet mask and a default gateway IP address): if the current parameters are not correct or assume their default values, the parameters must be defined from the boot menu.

➤ **To define management IP parameters from the boot menu:**

1. Disconnect all the user cables from both FCD-155 ETH connectors.
2. Connect only the Ethernet cable from the TFTP server to the FCD-155 ETH 1 or ETH 2 connector.
3. Use the procedure described on page *D-5* to display the boot menu.
4. Type **8** and then press **<Enter>** to start the configuration of the FCD-155 management IP parameters, as needed for TFTP transfer. The parameters are displayed in consecutive lines. For each parameter, you can accept the current values by simply pressing **<Enter>** to continue, or type a new value:
   - **IP Address**: used to select the IP address of the FCD-155 management entity. To change the current value, type the desired IP address in the dotted quad format, and then **<Enter>** to continue.
   - **IP Mask**: used to select the IP subnet mask of the management entity. To change the current value, type the IP subnet mask address in the dotted quad format, and then **<Enter>** to continue.
   - **Default Gateway Address**: used to define the IP address of the default gateway to be used by the FCD-155 management entity. Make sure to select an IP address within the subnet of the FCD-155 management IP address. To change the current value, type the desired IP address in the dotted quad format, and then **<Enter>** to end the configuration.

     If no default gateway is needed, for example, because the TFTP server is attached to the same LAN as the FCD-155, enter **0.0.0.0**.

```
RAD FCD155 Boot Version 2.10 (Sep 29 2003)
RAD Boot Manager Version 6.01 (Sep 29 2003)

0 - Exit Boot-Manager
1 - Dir
2 - Set Active Software Copy
3 - Delete Software Copy
4 - Download Files or an Application by XMODEM
5 - format flash
6 - Show basic hardware information
7 - Perform Reset to the board
8 - System Configuration.
9 - Download an Application by TFTP
Press the ESC key to go back to the Main Menu.

Select:8

IP Address [172.17.171.139]: 168.119.10.101
IP Mask [255.255.255.0]: 255.255.255.0
Default Gateway Address [172.17.171.1]: 168.119.10.1
```

After pressing **<Enter>**, you will see again the boot menu.

Downloading Procedure

1. On the boot menu, type **9** and then press **<Enter>** to start the TFTP transfer.
2. After you see **Please Enter the Target File Name**, enter the name of the desired software distribution file (make sure to include the path, when necessary). When done, press **<Enter>** to continue.
3. You will see **Please Enter the Server IP address**: enter the IP address of the server that will download the software distribution file, using the dotted quad format, and then **<Enter>** to continue.

```
RAD FCD155 Boot Version 2.10 (Sep 29 2003)
RAD Boot Manager Version 6.01 (Sep 29 2003)

0 - Exit Boot-Manager
1 - Dir
2 - Set Active Software Copy
3 - Delete Software Copy
4 - Download Files or an Application by XMODEM
5 - format flash
6 - Show basic hardware information
7 - Perform Reset to the board
8 - System Configuration.
9 - Download an Application by TFTP
Press the ESC key to go back to the Main Menu.

Select:9

Please Enter the Target File Name: C:\bin\FCD155.IMG
IP Mask [255.255.255.0]: 255.255.255.0
Default Gateway Address [172.17.171.1]: 168.119.10.1
```

4. If no errors are detected, the downloading process starts, and the screen displays its relative progress.
5. After the transfer is successfully completed, the FCD-155 is automatically reset and loads the new software.

Note *If downloading failed, repeat the whole procedure.*

Checking Proper Operation with Downloaded Software

1. Change the PC communication parameters to the default values (115.2 kbps, no parity, one start bit, eight data bits, one stop bit, flow control off).
2. Press <Enter> to display the FCD-155 log-in screen.
3. Log in with the default parameters as follows:
   - In the **User Name** field, type the default user name, **su**, and then press **<Enter>**
   - In the **Password** field, type the default, **1234**, and then press **<Enter>.**
4. You will see the main menu screen.

The FCD-155 now uses the downloaded software.

Returning Switch SW201 to Normal Settings

After it is no longer to initiate file transfer using TFTP from the boot menu, it is necessary to disable this function, to enable normal operation of the FCD-155.

This is performed by returning both sections of the internal switch SW201 to the NORM position.

➤ **To disable TFTP from the boot menu:**

1. Open FCD-155 cover.
2. Identify switch SW201 using *Figure D-1*.
3. Set both sections of the switch SW201 section to the NORM position.

Caution

Before closing the cover, check again the positions of the switch SW1 and make sure all its sections are set to NORM.

4. Close the FCD-155 cover permanently in accordance with *Chapter 2*, to enable safe operation.

Appendix E

Operating Environment

E.1 Scope

This Appendix presents a concise description of the FCD-155 operating environment, to provide the background information required for understanding the FCD-155 configuration and performance monitoring parameters.

This Appendix covers the following issues:

- PDH environment – *Section E.2*
- SDH environment – *Sections E.3* through *E.7*
- SONET environment – *Section E.8*
- Virtual concatenation – *Section E.9*
- Ethernet transmission technology – *Section E.10*.
- IP environment – *Section E.11*
- Management using SNMP – *Section E.12.*

E.2 PDH Environment

Scope

This section presents information on the main characteristics of the Plesiochronous Digital Hierarchy (PDH) signals. *Table E-1* shows the PDH multiplexing hierarchies used in the main geographical areas.

Table E-1. PDH Multiplexing Hierarchy

Multiplex Level	Europe	North America (USA)	Japan
1	E1 – 2.048 Mbps	DS1 – 1.544 Mbps	JT1 – 1.544 Mbps
2	E2 – 8.448 Mbps	DS2 – 6.312 Mbps	6.312 Mbps
3	E3 – 34.368 Mbps	DS3 – 44.736 Mbps	32.064 Mbps
4	E4 – 139.264 Mbps	DS4NA – 139.264 Mbps	97.729 Mbps

FCD-155 can transport E1, T1, E3 and T3 signals. Considering that the FCD-155 prepares the PDH data streams for transport through the SDH/SONET network on a bit-by-bit basis (unframed mode), this section presents only the line signal characteristics of the supported PDH signals.

E1 Line Signal Characteristics

E1 signal characteristics are specified in ITU-T Rec. G.703. The nominal data rate of the E1 signal is 2.048 Mbps. The E1 line signal is encoded in the High-Density Bipolar 3 (HDB3) code.

HDB3 is based on the alternate mark inversion (AMI) code. In the AMI code, "1"s are alternately transmitted as positive and negative pulses, whereas "0"s are transmitted as a zero voltage level. To prevent the transmission of long strings of "0"s, which do not carry timing information, the HDB3 coding rules restrict the maximum length of a "0" string that can be transmitted through the line to three pulse intervals. Longer strings of "0"s are encoded at the transmit end to introduce non-zero pulses.

To allow the receiving end to detect the artificially-introduced pulses and enable their removal to restore the original data string, the encoding introduces intentional coding violations in the sequence transmitted to the line. The receiving end detects these violations and when they appear to be part of an encoded "0" string – it removes them.

Coding violations may also be caused by transmission errors. Therefore, any coding violations that cannot be interpreted as intentional coding violations can be counted, to obtain information on the quality of the transmission link.

T1 Line Signal Characteristics

T1 signal characteristics are specified in ANSI T1.403 and ITU-T Rec. G.703. The nominal data rate of the T1 signal is 1.544 Mbps. The basic T1 line signal is coded using the alternate mark inversion (AMI) rules, explained above.

The AMI format cannot transmit long strings of "zeros", because such strings do not carry timing information. Therefore, the AMI signal source must generate a signal with guaranteed minimum "1" density. The minimum average "1" density required by the applicable standards is 1:8. Therefore, when a T1 signal is transmitted over an AMI line, each frame timeslot must include at least one "1" bit. This effectively reduces user data rate to 56 kbps per timeslot, and precludes the provision of clear channel capability (CCC).

To circumvent this problem, modified line codes are used, that perform zero suppression by substituting special codes for long "0" strings. The generally accepted zero suppression methods are B7 and B8ZS.

FCD-155 uses the B8ZS zero suppression method, because only this method provides clear channel capability, and the "1" density requirement no longer restricts user data characteristics. This means that each T1 frame timeslot can support the full 64 kbps.

E3 Line Signal Characteristics

The nominal data rate of the E3 signal is 34.368 Mbps. The E3 line signal is coded using the High-Density Bipolar 3 (HDB3) coding rules.

T3 Line Signal Characteristics

The T3 line operates at a nominal rate of 44.736 Mbps. The T3 line signal is coded using the B3ZS zero suppression coding rules. B3ZS coding is similar to HDB3, except that it limits the maximum length of zero strings to 2.

E.3 SDH Implementation Principles

This section describes the implementation principles for the Synchronous Digital Hierarchy (SDH), as a background for the detailed presentation of the SDH signal structures. In the following explanations, the following terms are used to describe SDH networks:

- Network node. The SDH network node is a facility at which signals built in accordance with the SDH frame structure are generated and/or terminated. Therefore, a network node provides a convenient access point to add or drop payload signals, e.g., PDH tributary signals, for transmission over the SDH network.
- SDH transport system. An SDH transport system provides the technical means to transfer SDH signals between two network nodes.
- SDH network. An SDH network is formed by interconnecting the required number of network nodes by means of SDH transport systems.

Basic SDH Principles

The Synchronous Digital Hierarchy (SDH) is implemented on the basis of two principles:

1. Direct synchronous multiplexing of individual tributary signals within the structure of the higher-rate multiplexed signal.
2. Transparent transporting of each individual tributary signal through the network, without any disassembly except at the two network nodes that exchange information through that particular signal.

To enable synchronous multiplexing, SDH equipment is designed to permit efficient and reliable synchronization of the whole network to a single timing reference.

Direct Multiplexing Approach

Direct multiplexing means that individual tributary signals can be inserted and removed into the SDH multiplexed signal without intermediate multiplexing and demultiplexing steps. This capability results in the following characteristics:

- Efficient signal transport, as the same SDH transport system can carry various types of payloads (tributary signals).
- Flexible routing, because any tributary can be inserted and removed into the SDH signal as a single unit, without affecting in any way the other tributary signals carried by the same SDH signal. This permits to build cost-effective add/drop multiplexers, the key component of flexible networks, instead of

implementing digital cross-connect systems as entities separated from multiplexing equipment.

In addition, the SDH signal structure includes sufficient overhead for management and maintenance purposes, and therefore provides the network operator full control over all the operational aspects of SDH networks and equipment units. This overhead permits the integration of the network management and maintenance functions within the transport network itself.

General Structure of SDH Signals

The SDH signal is a serial signal stream with a frame structure. *Figure E-1* shows the general structure of SDH signals.

The SDH frame structure is formed by byte-interleaving the various signals carried within its structure. Each SDH frame starts with framing bytes, which enable equipment receiving the SDH data stream to identify the beginning of each frame. The location of the other bytes within this frame structure is determined by its position relative to the framing byte.

The organization of the frame can be easily understood by representing the frame structure as a rectangle comprising boxes arranged in N rows and M columns, where each box carries one byte. In accordance with this representation, the framing byte appears in the top left-hand box (the byte located in row 1, column 1), which by convention is referred to as byte 1 of the SDH frame.

The frame bytes are transmitted bit by bit, sequentially, starting with those in the first row (see arrow in *Figure E-1*). After the transmission of a row is completed, the bits in the next lower row are transmitted. The order of transmission within each row is from left to right. After transmission of the last byte in the frame (the byte located in row N, column M), the whole sequence repeats - starting with the framing byte of the following frame.

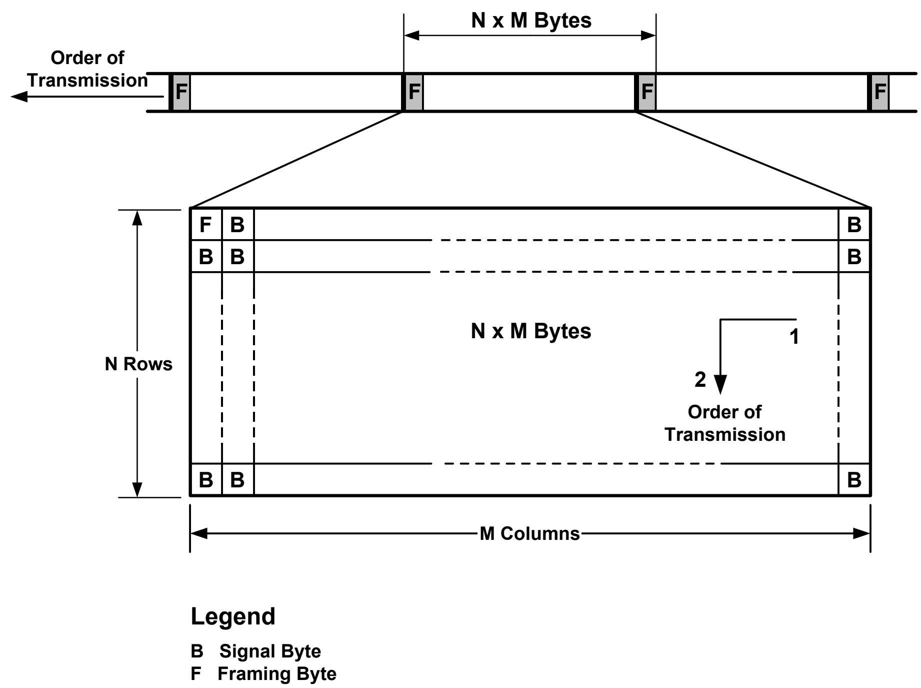


Figure E-1. General Structure of SDH Signals

SDH Frame Organization

As shown in *Figure E-2*, an SDH frame comprises two distinct parts:

- Section Overhead (SOH)
- Virtual Container (VC).

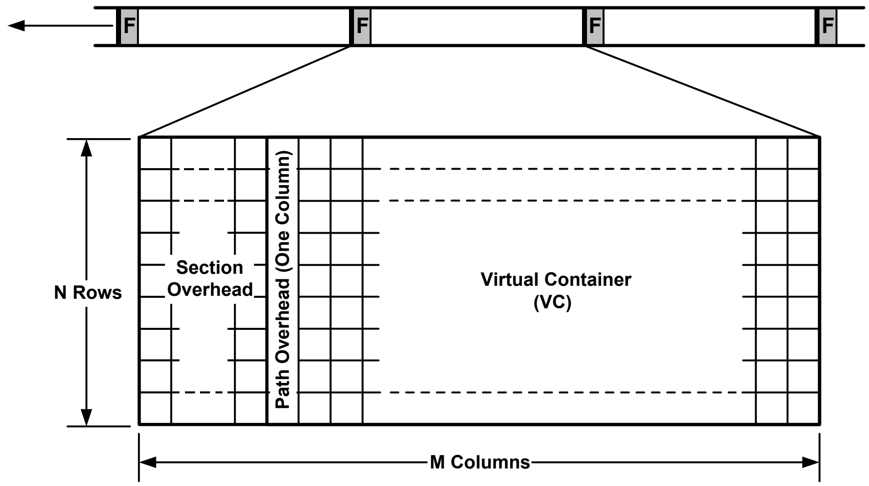


Figure E-2. SDH Frame Organization

Section Overhead

In SDH networks, the term ***section*** refers to the link between two consecutive SDH equipment units of the same type (see *Section E.5*).

Some signal carrying capacity is allocated in each SDH frame for the section overhead. This provides the facilities (alarm monitoring, bit error monitoring, data communications channels, etc.) required to support and maintain the transportation of a VC between nodes in an SDH network.

The section overhead pertains only to an individual SDH transport system. This means that the section overhead is generated by the transmit side of a network node, and is terminated at the receive side of the next network node.

Therefore, when several SDH transport systems are connected in tandem, the section overhead is not transferred together with the payload (VC) between the interconnected transport systems.

Virtual Container (VC)

The VC is an envelope (i.e., a special type of signal structure, or frame) that is used to transport a tributary signal across the SDH network.

The path followed by a VC within the network may include any number of nodes, therefore the VC may be transferred from one SDH transport system to another, many times on its path through the network. Nevertheless, in most cases the VC is assembled at the point of entry to the SDH network and disassembled only at the point of exit.

Since the VC is handled as an envelope that is opened only at the path end points, some of its signal carrying capacity is dedicated to path overhead. The path overhead provides the facilities (e.g., alarm and performance monitoring), required to support and maintain the transportation of the VC between the end points.

VC Assembly/Disassembly Process

The concept of a tributary signal being inserted into a virtual container, to be transported end-to-end across a SDH network, is fundamental to the operation of SDH networks. This process of inserting the tributary signal into the proper locations of a VC is referred to as "mapping".

In all the SDH signal structures, the carrying capacity provided for each individual tributary signal is always slightly greater than that required by the tributary rate. Thus, the mapping process must compensate for this difference. This is achieved by adding stuffing bytes, e.g., path overhead bytes, to the signal stream as part of the mapping process. This increases the bit rate of the composite signal to the rate provided for tributary transport in the SDH structure.

At the point of exit from the SDH network, the tributary signal must be recovered from the virtual container, by removing the path overhead and stuffing bits. This process is referred to as "demapping". After demapping, it is necessary to restore the original data rate of the recovered tributary data stream.

E.4 STM-1 Frame Structure

FCD-155 handles the base-level SDH signal, which is called Synchronous Transport Mode Level 1 (STM-1).

Description of STM-1 Frame

Figure E-3 shows the STM-1 frame structure.

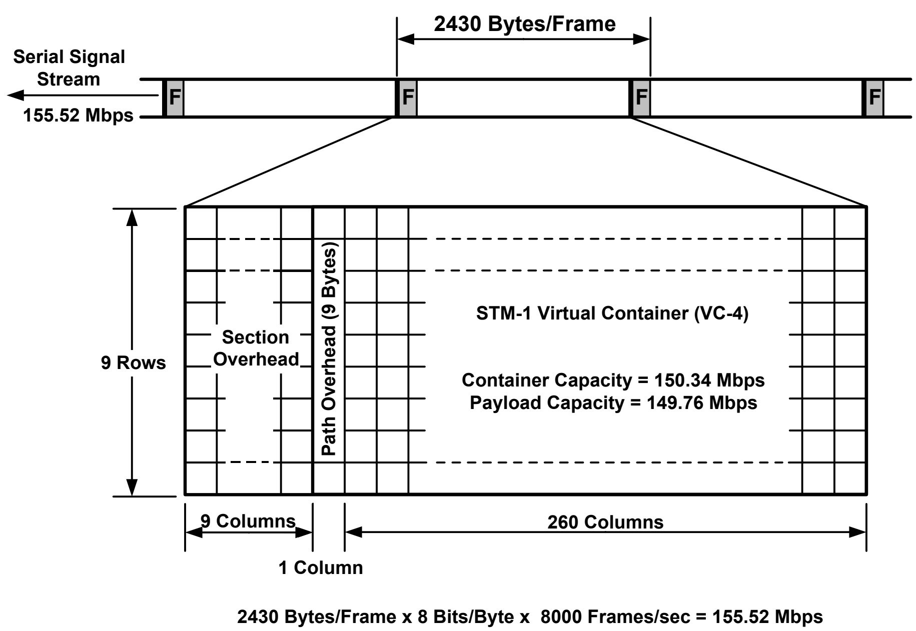


Figure E-3. STM-1 Frame Structure

STM-1 frames are transmitted at a fixed rate of 8000 frames per second.

Note *At a transmission rate of 8000 frames per second, each byte supports a data rate of 64 kbps.*

The STM-1 signal frame comprises 9 rows by 270 columns, resulting in a total signal capacity of 2430 bytes (19440 bits per frame). Considering the STM-1 frame repetition rate, 8000 frames per second, this yields a bit rate of 155.520 Mbps.

The STM-1 frame comprises the following parts:

- **Section Overhead**. The STM-1 section overhead occupies the first nine columns of the STM-1 frame, for total of 81 bytes.
- **Virtual Container**. The remaining 261 columns of the STM-1 frame, which contain a total of 2349 bytes, are allocated to the virtual container. The virtual container itself comprises a container for the payload signal (260 columns), preceded by one column of path overhead.

  The virtual container carried in an STM-1 frame is referred to as a Virtual Container Level 4, or VC-4. VC-4, which is transported unchanged across the SDH network, provides a channel capacity of 150.34 Mbps.

  The VC-4 structure includes one column (9 bytes) for the VC-4 path overhead, leaving 260 columns of signal carrying capacity (149.76 Mbps). This carrying capacity is sufficient for transporting a 139.264 Mbps tributary signal (the fourth level in the PDH signal hierarchy). The VC-4 signal carrying capacity can also be subdivided, to permit the transport of multiple lower-level PDH signals.

Pointers

In *Figure E-3*, the VC-4 appears to start immediately after the section overhead part of the STM-1 frame.

Actually, to facilitate efficient multiplexing and cross-connection of signals in the SDH network, VC-4 structures are allowed to float within the payload part of STM-1 frames. This means that the VC-4 may begin anywhere within the STM-1 payload part. The result is that in most cases, a given VC-4 begins in one STM-1 frame and ends in the next.

Were the VC-4 not allowed to float, buffers would be required to store the VC-4 data up to the instant it can be inserted in the STM-1 frame. These buffers (called slip buffers), which are often used in PDH multiplex equipment, introduce long delays. Moreover, they also cause disruptions in case a slip occurs.

Identifying VC-4 Beginning in the STM-1 Frame

When a VC-4 is assembled into the STM-1 frame, a pointer (byte) located in the section overhead of the STM-1 frame indicates the location of the first byte (J1) of the VC-4 that starts in that STM-1 frame.

Using Pointers to Correct Timing Differences

SDH network are intended to operate as synchronous networks. Ideally, this means that all SDH network nodes should derive their timing signals from a single master network clock. However, in practical applications, network implementation must accommodate timing differences (clock offsets). These may be the result of an SDH node losing network timing reference and operating on its standby clock, or it may be caused by timing differences at the boundary between two separate SDH networks.

The VC-4 is allowed to float freely within the space made available for it in the STM-1 frame, therefore phase adjustments can be made as required between the VC-4 and the STM-1 frame.

To accommodate timing differences, the VC-4 can be moved (justified), positively or negatively three bytes at time, with respect to the STM-1 frame. This is achieved by simply recalculating and updating the pointer value at each SDH network node. In addition to clock offsets, updating the pointer will also accommodate any other adjustment required between the input SDH signal rate and the timing reference of the SDH mode.

Pointer adjustments introduce jitter. Excessive jitter on a tributary signal degrades signal quality and may cause errors. Therefore, SDH networks must be designed to permit reliable distribution of timing to minimize the number of pointer adjustments.

E.5 SDH Overhead Data

SDH Overhead Data Types

In SDH networks, a transmission path can include three equipment functions:

- **SDH terminal multiplexer** – which performs the insertion/removal of tributary signals into SDH frames
- **SDH cross-connect switch** – permits to change the routing of tributary signals carried in SDH frames
- **Regenerator** – used to increase the physical range of the transmission path.

The resulting structure of an SDH transmission path is shown in *Figure E-4.*

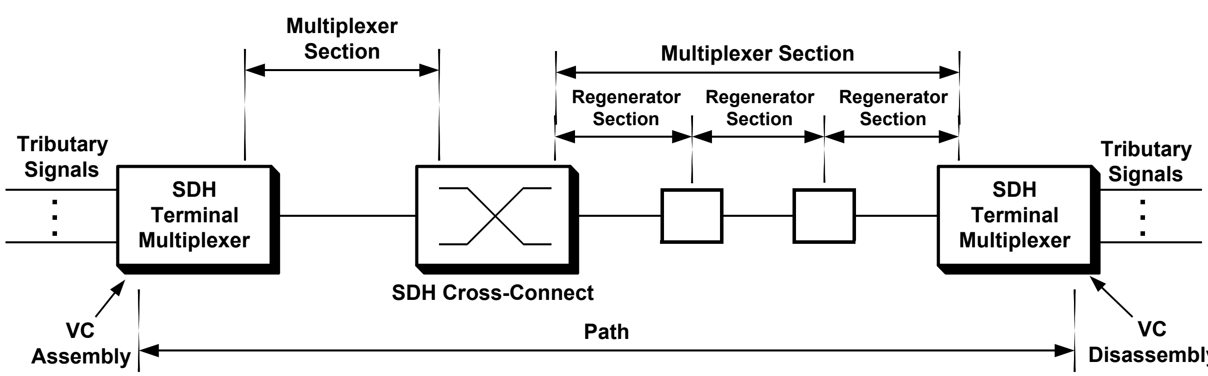


Figure E-4. Structure of Transmission Path in SDH Network

As shown in *Figure E-4*, a transmission path can comprise three types of segments:

- **Multiplexer section** – a part of a transmission path located between a terminal multiplexer and an adjacent SDH cross-connect equipment, or between two adjacent SDH terminal multiplexers.
- **Regenerator section** – a part of a transmission path located between a terminal multiplexer or SDH cross-connect equipment and the adjacent regenerator, or between two adjacent regenerators. A multiplexer section can include up to three regenerator sections.
- **Path** – the logical connection between the point at which a tributary signal is assembled into its virtual container, and the point at which it is disassembled from the virtual container.

To provide the support and maintenance signals associated with transmission across each segment, each of these segments is provided with its own overhead data, hence three types of overhead data:

- **Section overhead**, carried in the first nine columns of the STM-1 frame:
  - Multiplexer section (MS) overhead – carried in overhead rows 5 to 9
  - Regenerator section (RS) overhead – carried in overhead rows 1 to 3
  - AU pointers– carried in overhead row 4.
- **Path overhead**, carried in the first column of a VC-4. The path overhead carried in the VC-4 is called high-order path overhead; see *Section E.6* for a description of the low-order path overhead.

Figure E-5 shows the detailed structure of the overhead data in STM-1 frames.

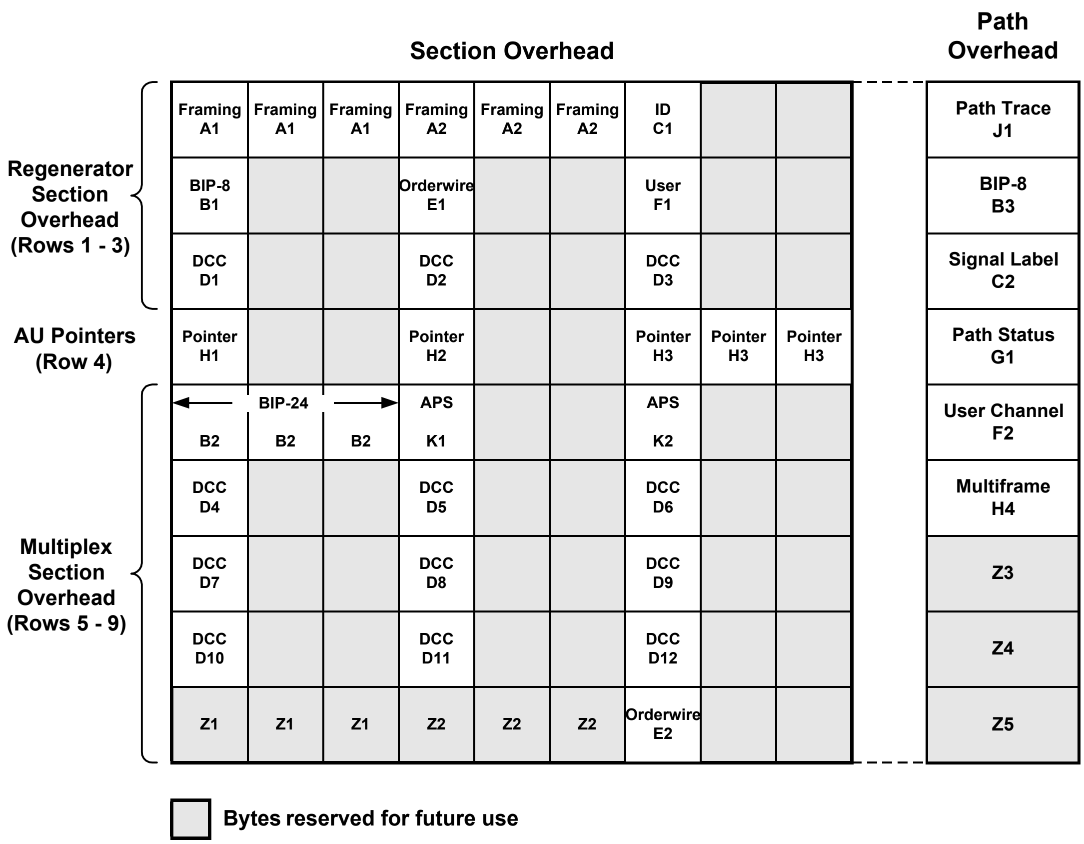


Figure E-5. Organization of STM-1 Overhead Data

Regenerator Section Overhead (RSOH)

A regenerator section of an SDH network comprises the transmission medium and associated equipment between a network element and the adjacent regenerator, or between two adjacent regenerators. The associated equipment includes the aggregate interfaces and SDH processing equipment which either originates or terminates the regenerator section overhead.

The functions of the various bytes carried in the STM-1 regenerator section overhead are described below.

Framing (A1, A2 Bytes)

The six framing bytes carry the framing pattern, and are used to indicate the start of an STM-1 frame.

Channel Identifier (C1 Byte)

The C1 byte is used to identify STM-1 frames within a higher-level SDH frame (STM-N, where the standardized values of N are 4, 16, etc.). The byte carries the binary representation of the STM-1 frame number in the STM-N frame.

Parity Check (B1 Byte)

A 8-bit wide bit-interleaved parity (BIP-8) checksum is calculated over all the bits in the STM-1 frame, to permit error monitoring over the regenerator section. The computed even-parity checksum is placed in the RSOH of the following STM-1 frame.

Data Communication Channel (D1, D2, D3 Bytes)

The 192 kbps Data Communication Channel (DCC) provides the capability to transfer network management and maintenance information between regenerator section terminating equipment.

Orderwire Channel (E1 Byte)

The E1 byte is used to provide a local orderwire channel for voice communications between regenerators and remote terminal locations.

User Communication Channel (F1 byte)

The F1 byte is intended to provide the network operator with a channel that is terminated at each regenerator location, and can carry proprietary communications.

The information transmitted on this channel can be passed unmodified through a regenerator, or can be overwritten by data generated by the regenerator.

AU Pointers (H1, H2, H3 bytes)

The AU (Administration Unit) pointer bytes are used to enable the transfer of STM-1 frames within STM-N frames, and therefore are processed by multiplexer section terminating equipment. Separate pointers are provided for each STM-1 frame in an STM-N frame.

AU pointer function is to link between the section overhead and the associated virtual container(s).

Multiplexer Section Overhead (MSOH)

A multiplexer section of an SDH network comprises the transmission medium, together with the associated equipment (including regenerators) that provide the means of transporting information between two consecutive network nodes (e.g., SDH multiplexers). One of the network nodes originates the multiplexer section overhead (MSOH) and the other terminates this overhead.

The functions of the various bytes carried in the STM-1 multiplexer section overhead are described below.

Parity Check (B2 Bytes)

A 24-bit wide bit-interleaved parity (BIP) checksum is calculated over all the bits in the STM-1 frame (except those in the regenerator section overhead). The computed checksum is placed in the MSOH of the following STM-1 frame.

Protection Switching (K1, K2 Bytes)

The K1 and K2 bytes carry the information needed to activate/deactivate the switching between the main and protection paths on a multiplexer section.

Data Communication Channel (D4 to D12 Bytes)

Bytes D4 to D12 provide a 576 kbps data communication channel (DCC) between multiplexer section termination equipment. This channel is used to carry network administration and maintenance information.

Orderwire Channel (E2 Byte)

The E2 byte is used to provide a local orderwire channel for voice communications between multiplexer section terminating equipment.

Alarm Signals

Alarm information is included as part of the MSOH. These functions are explained in *Section E.7.*

VC-4 Path Overhead Functions

The path overhead (POH) is contained within the virtual container portion of the STM-1 frame. The POH data of the VC-4 occupies all the 9 bytes of the first column. The functions of the various bytes carried in the VC-4 path overhead are described below.

Path Trace Message (J1 Byte)

The J1 byte is used to repetitively transmit a 64-byte string (message). The message is transmitted one byte per VC-4 frame.

A unique message is assigned to each path in an SDH network. Therefore, the path trace message can be used to check continuity between any location on a transmission path and the path source.

Parity Check (B3 Byte)

An 8-bit wide bit-interleaved parity even checksum, used for error performance monitoring on the path, is calculated over all the bits of the previous VC-4. The computed value is placed in the B3 byte.

Signal Label (C2 Byte)

The signal label byte, C2, indicates the structure of the VC-4 container. The signal label can assume 256 values, however two of these values are of particular importance:

- The all "0"s code represents the ***VC-4 unequipped*** state (i.e., the VC-4 does not carry any tributary signals)
- The code "00000001" represents the ***VC-4 equipped*** state.

Path Status (G1 Byte)

The G1 byte is used to send status and performance monitoring information from the receive side of the path terminating equipment to the path originating equipment. This allows the status and performance of a path to be monitored from either end, or at any point along the path.

Multiframe Indication (H4 byte)

The H4 byte is used as a payload multiframe indicator, to provide support for complex payload structures, for example payload structures carrying multiple tributary units (TUs – see *Section E.6*). If, for example, the TU overhead is distributed over four TU frames, these four frames form a TU multiframe structure. The H4 byte then indicates which frame of the TU multiframe is present in the current VC-4.

User Communication Channel (F2 Byte)

The F2 byte supports a user channel that enables proprietary network operator communications between path terminating equipment.

Alarm Signals

Alarm and performance information is included as part of the path overhead. These functions are explained in *Section E.7.*

E.6 SDH Tributary Units

The VC-4 channel capacity, 149.76 Mbps, has been defined specifically for the transport of a fourth level (139.264 Mbps) PDH multiplex signal.

To enable the transport and switching of lower-rate tributary signals within the VC-4, several special structures, called Tributary Units (TUs), have been defined. The characteristics of each TU type have been specifically selected to carry one of the standardized PDH signal rates. In addition, a fixed number of whole TUs may be mapped within the container area of a VC-4.

Tributary Unit Frame Structure

The structure of the tributary unit frame is rather similar to the SDH frame structure, described in *Section 0.0* . With reference to *Figure E-2*, the tributary unit frame also includes a section overhead part and a virtual container part, which comprises a container and path overhead.

In general, the tributary unit frame is generated in three steps:

- A low rate tributary signal is mapped into the TU "container"
- Low-path path overhead is added before the container, to form the corresponding virtual container (VC-11, VC-12, VC-2 or VC-3, depending on the TU type)
- A TU pointer is added to indicate the beginning of the VC within the TU frame. This is the only element of TU section overhead.

The TU frame is then multiplexed into a fixed location within the VC-4.

Because of the byte interleaving method, a TU frame structure is distributed over four consecutive VC-4 frames. It is therefore more accurate to refer to the structure as a TU multiframe. The phase of the multiframe structure is indicated by the H4 byte contained in the VC-4 path overhead.

Tributary Unit Types

As mentioned above, specific containers (C), virtual containers (VC) and associated TU structures have been defined for each standard PDH multiplex signal level. These structures are explained below:

- **TU-11**: Each TU-11 frame consists of 27 bytes, structured as 3 columns of 9 bytes. At a frame rate of 8000 Hz, these bytes provide a transport capacity of 1.728 Mbps and will accommodate the mapping of a North American DS1 signal (1.544 Mbps). 84 TU-11s may be multiplexed into the STM-1 VC-4.
- **TU-12**: Each TU-12 frame consists of 36 bytes, structured as 4 columns of 9 bytes. At a frame rate of 8000 Hz, these bytes provide a transport capacity of 2.304 Mbps and will accommodate the mapping of a CEPT 2.048 Mbps signal. 63 TU-12s may be multiplexed into the STM-1 VC-4.
- **TU-2**: Each TU-2 frame consists of 108 bytes, structured as 12 columns of 9 bytes. At a frame rate of 8000 Hz, these bytes provide a transport capacity of 6.912 Mbps and will accommodate the mapping of a North American DS2 signal. 21 TU-2s may be multiplexed into the STM-1 VC-4.
- **TU-3**: Each TU-3 frame consists of 774 bytes, structured as 86 columns of 9 bytes. At a frame rate of 8000 Hz, these bytes provide a transport capacity of 49.54 Mbps and will accommodate the mapping of a CEPT 34.368 Mbps signal or a North American 44.768 DS3 signal. Three TU-3s may be multiplexed into the STM-1 VC-4.

Figure E-6 illustrates the assembly (multiplexing) of TUs in the VC-4 structure, for the specific case of the TU-12. For other multiplexing options, see *Figure E-7*.

As shown in *Figure E-6,* 63 TU-12s can be packed into the 260 columns of payload capacity (i.e., the C-4 container) provided by a VC-4. This leaves 8 columns in the C-4 container unused. These unused columns result from intermediate stages in the TU-12 to VC-4 multiplexing process, and are filled by fixed stuffing bytes.

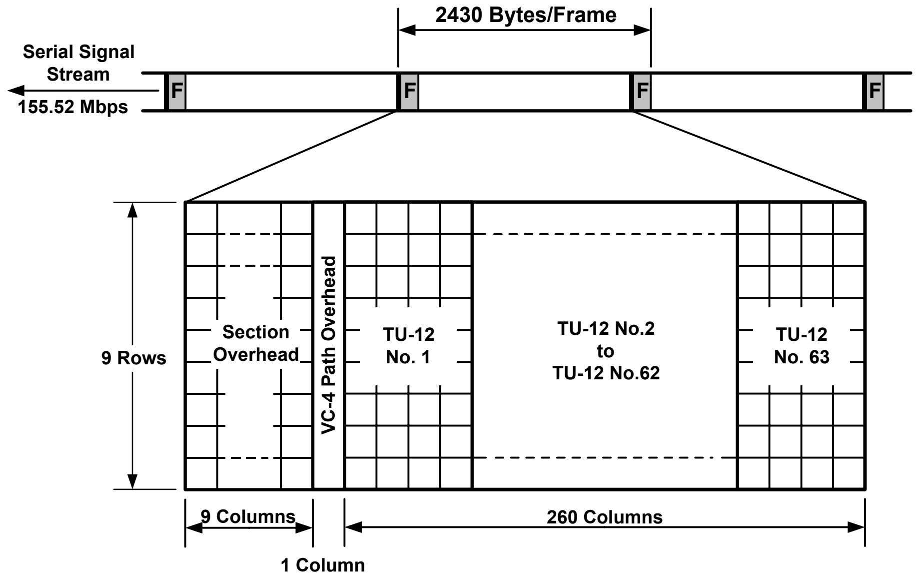


Figure E-6. VC-4 Carrying TU-12 Payload

SDH Multiplexing Hierarchy

Figure E-7 shows a general view of the SDH multiplexing hierarchy. The hierarchy illustrates all the both the European and North American PDH multiplex levels (see *Table E-1* for details on the PDH multiplexing hierarchy).

Figure E-7 also shows the utilization of additional SDH signal structures:

- TUG: tributary unit group, is the structure generated by combining several lower level tributaries into the next higher level tributary. For example, TUG-2 is generated by combining 3 TU-12 or 4 TU-11, and TUG-3 is generated by combining 7 TUG-2.
- AU: administrative unit, is a structure that includes a VC and a pointer to the beginning of the VC. For example, AU-3 contains one VC-3 and includes a pointer to the beginning of the VC.
- AUG: administrative unit group, is the structure generated by combining several lower level administrative units into the next higher level administrative unit. For example, AUG for the STM-1 level is generated by combining 3 AU-3 (several AUG can be combined for generating STM-N (N = 4, 16, etc.) structures).

Note *For simplicity, reference is made only to VCs (the actual structure needed to transport a VC can be found from the SDH or SONET multiplexing hierarchy).*

The flexibility of the SDH multiplexing approach is illustrated by the many paths that can be used to build the various signal structures. For example, *Figure E-7* shows that the STM-1 signal can be generated by the following multiplexing paths:

- Each E1 signal is mapped into a VC-12, which is then encapsulated in a TU-12.
- Each group of 3 TU-12 is combined to obtain a TUG-2 (3 E1 signals per TUG-2)
- Seven TUG-2 are combined to obtain one TUG-3 (21 E1 signals per TUG-3). TUG-3 is carried in a VC-3
- Three VC-3 are combined to generate one VC-4 (63 E1 signals per VC-4). The STM-1 signal carries one VC-4.

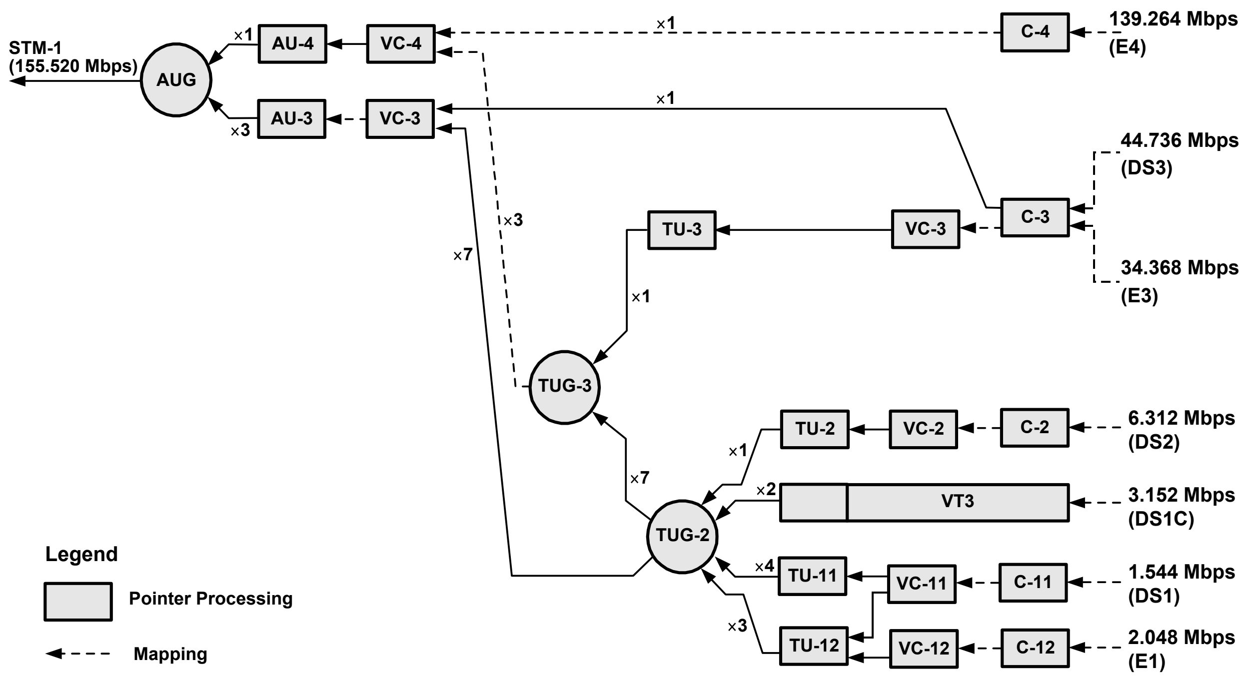


Figure E-7. SDH Multiplexing Hierarchy

E.7 SDH Maintenance Signals

SDH Maintenance Signals

The maintenance signals transmitted within the SDH signal structure are explained in *Table E-2*.

Table E-2. SDH Maintenance Signal Definitions

Signal	Description
Loss of Signal (LOS)	LOS state entered when received signal level drops below the value at which an error ratio of 10^{-3} is predicted. LOS state exited when 2 consecutive valid framing patterns are received, provided that during this time no new LOS condition has been detected
Out of Frame (OOF)	OOF state entered when 4 or 5 consecutive SDH frames are received with invalid (errored) framing patterns. Maximum OOF detection time is therefore 625 µs. OOF state exited when 2 consecutive SDH frames are received with valid framing patterns
Loss of Frame (LOF)	LOF state entered when OOF state exists for up to 3 ms. If OOFs are intermittent, the timer is not reset to zero until an in-frame state persists continuously for 0.25 ms. LOF state exited when an in-frame state exists continuously for 1 to 3 ms
Loss of Pointer (LOP)	LOP state entered when N consecutive invalid pointers are received where N = 8, 9 or 10. LOP state exited when 3 equal valid pointers or 3 consecutive AIS indications are received. ***Note*** The AIS indication is an "all 1's" pattern in pointer bytes.
Multiplexer Section AIS	Sent by regenerator section terminating equipment (RSTE) to alert downstream MSTE of detected LOS or LOF state. Indicated by STM signal containing valid RSOH and a scrambled "all 1's" pattern in the rest of the frame. Detected by MSTE when bits 6 to 8 of the received K2 byte are set to "111" for 3 consecutive frames. Removal is detected by MSTE when 3 consecutive frames are received with a pattern other than "111" in bits 6 to 8 of K2.
Far End Receive Failure (FERF or MS-FERF)	Sent upstream by multiplexer section terminating equipment (MSTE) within 250 µs of detecting LOS, LOF or MS-AIS on incoming signal. Optionally transmitted upon detection of excessive BER defect (equivalent BER, based on B2 bytes, exceeds 10^{-3}). Indicated by setting bits 6 to 8 of transmitted K2 byte to "110". Detected by MSTE when bits 6 to 8 of received K2 byte are set to "110" for 3 consecutive frames. Removal is detected by MSTE when 3 consecutive frames are received with a pattern other than "110" in bits 6 to 8 of K2. Transmission of MS-AIS overrides MS-FERF

Table E-2. SDH Maintenance Signal Definitions (Cont.)

Signal	Description
AU Path AIS	Sent by MSTE to alert downstream high order path terminating equipment (HO PTE) of detected LOP state or received AU Path AIS. Indicated by transmitting "all 1's" pattern in the H1, H2, H3 pointer bytes plus all bytes of associated VC-3 and VC-4). Detected by HO PTE when "all 1's" pattern is received in bytes H1 and H2 for 3 consecutive frames. Removal is detected when 3 consecutive valid AU pointers are received
High Order Path Remote Alarm Indication (HO Path RAI, also known as HO Path FERF)	Generated by high order path terminating equipment (HO PTE) in response to received AU path AIS. Sent upstream to peer HO PTE. Indicated by setting bit 5 of POH G1 byte to "1". Detected by peer HO PTE when bit 5 of received G1 byte is set to "1" for 10 consecutive frames. Removal detected when peer HO PTE receives 10 consecutive frames with bit 5 of G1 byte set to "0"
TU Path AIS	Sent downstream to alert low order path terminating equipment (LO PTE) of detected TU LOP state or received TU path AIS. Indicated by transmitting "all 1's" pattern in entire TU-1, TU-2 and TU-3 (i.e., pointer bytes V1-V3, V4 byte, plus all bytes of associated VC-1, VC-2 and VC-3 loaded by "all 1's" pattern). Detected by LO PTE when "all 1's" pattern received in bytes V1 and V2 for 3 consecutive multiframes. Removal is detected when 3 consecutive valid TU pointers are received. ***Note*** TU Path AIS is only available when generating and/or receiving "floating mode" tributary unit payload structures.
Low Order Path Remote Alarm Indication (LO Path RAI, also known as LO Path FERF)	Generated by low order path terminating equipment (LO FTE) in response to received TU Path AIS. Sent upstream to peer LO PTE. Indicated by setting bit 8 of LO POH V5 byte to "1". Detected by peer LO PTE when bit 8 of received V5 byte is set to "1" or 10 consecutive multiframes. Removal detected when peer LO PTE receives 10 consecutive multiframes with bit 8 of V5 byte set to "0". ***Note*** LO Path RAI is only available when generating and/or receiving "floating mode" tributary unit payload structures.

Response to Abnormal Conditions

This section describes the response to the wide range of conditions that can be detected by the maintenance means built into the SDH frames, and the flow of alarm and indication signals.

Figure E-8 provides a graphical representation of the flow of alarm and indication signals through an SDH transmission path.

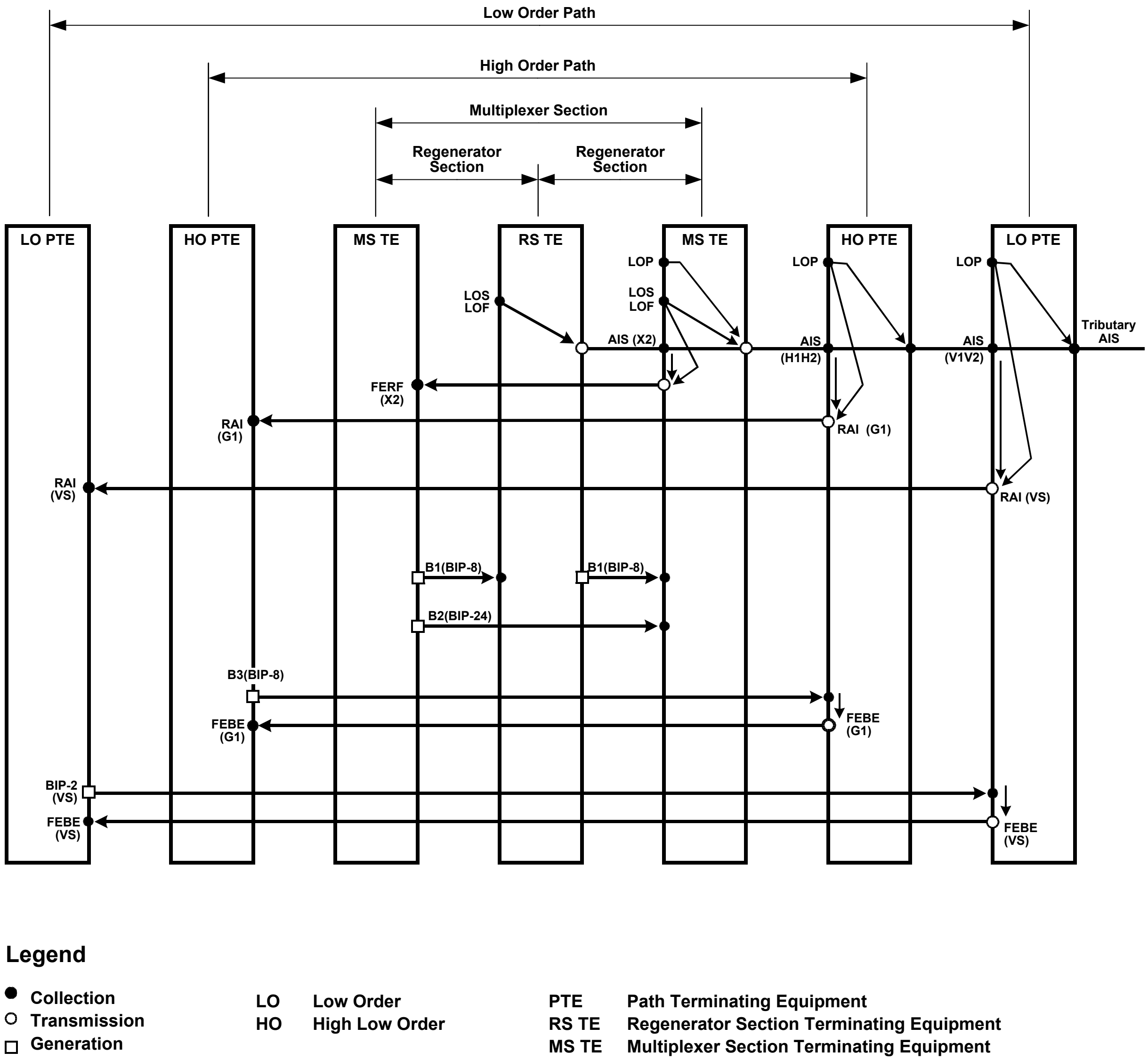


Figure E-8. Flow of Alarm and Indication Signals through an SDH Transmission Path

Flow of Alarm and Response Signals

The major alarm conditions such as Loss of Signal (LOS), Loss of Frame (LOF), and Loss of Pointer (LOP) cause various types of Alarm Indication Signals (AIS) to be transmitted downstream.

In response to the detection of an AIS signals, and detection of major receiver alarm conditions, other alarm signals are sent upstream to warn of trouble downstream:

- Far End Receive Failure (FERF) is sent upstream in the multiplexer overhead after multiplexer section AIS, or LOS, or LOF has been detected by equipment terminating in a multiplexer section span;
- A Remote Alarm Indication (RAI) for a high order path is sent upstream after a path AIS or LOP condition has been detected by equipment terminating a path

- A Remote Alarm Indication (RAI) for a low order path is sent upstream after low order path AIS or LOP condition has been detected by equipment terminating a low order path.

Performance Monitoring

Performance monitoring at each level in the maintenance hierarchy is based on the use of the byte interleaved parity (BIP) checksums calculated on a frame by frame basis. These BIP checksums are sent downstream in the overhead associated with the regenerator section, multiplexer section and path maintenance spans.

In response to the detection of errors using the BIP checksums, the equipment terminating the corresponding path sends upstream Far End Block Error (FEBE) signals.

E.8 SONET Environment

SONET (Synchronous Optical Network) is an alternative standard to SDH, widely used in North America and other parts of the world. SONET uses similar implementation principles, and even the frame structures are quite similar to those used by SDH. Therefore, the following description is based on the information already presented for SDH in *Sections E.3* through *E.7*.

Figure E-9 shows the SONET multiplexing hierarchy.

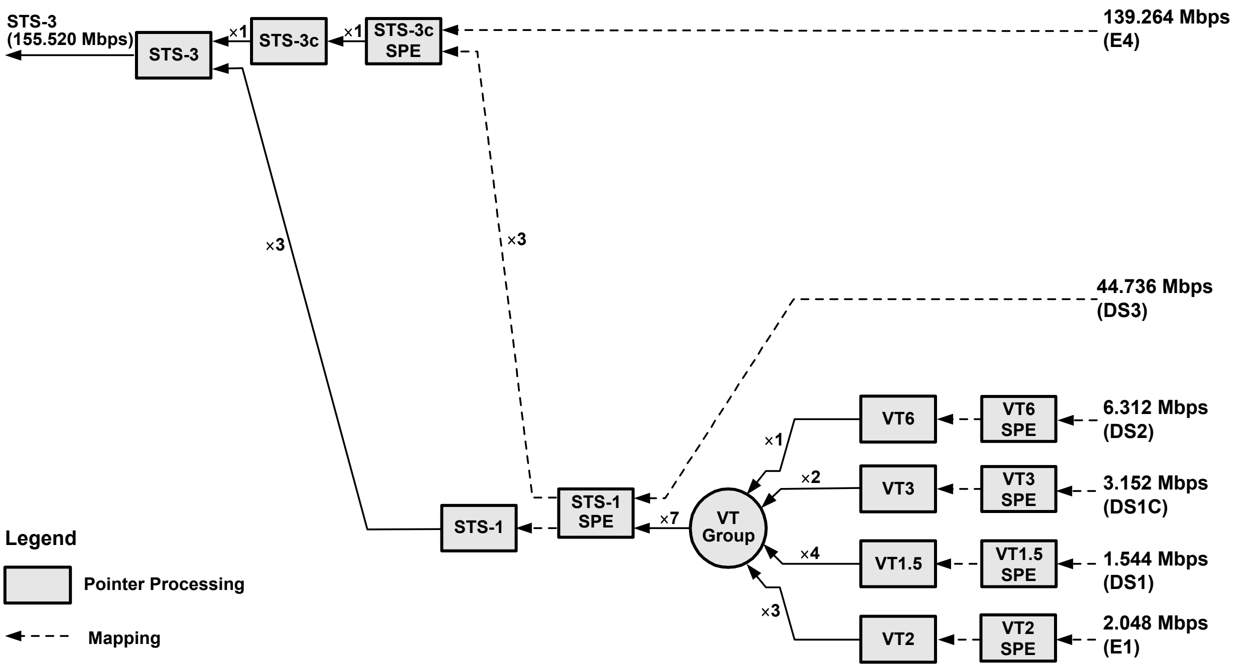


Figure E-9. SONET Multiplexing Hierarchy

The designations of the main signal structures in the SONET hierarchy are as follows:

- Containers are replaced by Synchronous Payload Envelopes (SPE) for the various virtual tributaries (VTs)
- Virtual containers (VCs) are replaced by virtual tributaries (VTs), however the rates are similar to those used in the SDH hierarchy
- Tributary unit groups (TUGs) are replaced by virtual tributary groups
- The VC-3 level is replaced by the Synchronous Transport Signal level 1 (STS-1), and has the same rate (51.840 Mbps). The corresponding optical line signal format is designated OC-1 (an electrical line signal is also defined, EC-1)
- 3 STS-1 can be combined to obtain one Synchronous Transport Signal level 3 (STS-3) at the same rate as STM-1 (155.520 Mbps). Alternately, a concatenated STS-3 structure (STS-3c) is used to carry a single E4 signal. The corresponding optical line signal is designated OC-3.

E.9 Using Virtual Concatenation

Purpose and Main Features

Virtual concatenation is a method that enables carrying payload at other data rates (for example, Ethernet signals), beyond the data rates listed in *Table E-1*, without wasting bandwidth. In this approach, the contiguous bandwidth of the payload signal is divided into several streams, each having the rate necessary for insertion into individual VCs or SPEs.

With virtual concatenation, the individual VCs or SPEs are transported over the SDH or SONET network in the usual way, and then recombined to restore the original payload signal at the end point of the transmission path, using a technology similar to inverse multiplexing.

Virtual concatenation has the following main advantages:

- Scalability: allows bandwidth to be selected in relatively small increments, as required to match the desired payload data rate.
- Efficiency: the resulting signals are easily routed through a SDH/SONET network, without wasting bandwidth, and therefore allows for more efficient utilization of the bandwidth available on existing networks.
- Compatibility: virtual concatenation requires only the end nodes to be aware of the containers being virtually concatenated, and therefore is transparent to the core network elements.
- Resiliency: individual members of a virtually concatenated group can be freely routed across the network.

Implementation

Virtual concatenation is implemented mainly by appropriate management measures, with hardware support needed only at the end points of a transmission path. The processing is as follows:

1. At the source end, the inverse multiplexing subsystem splits the payload signal into several streams at a rate suitable for transmission over the desired type of VC (VC-12, VC-3 or VC-4) or SPE. The required information (type and number of VCs or SPEs) are defined when the virtually concatenated group (VCG) is defined.

Note *FCD-155 management uses the concise term virtual group, instead of virtually concatenated group.*

2. The resulting streams are mapped to the desired VCs/SPEs, also configured by management. The Path Overhead (POH) byte carried by all the group members is used to transfer to the far endpoint the information needed to identify:
   - The relative time difference between arriving members of the virtual group.
   - The sequence number of each arriving member.
3. Each member of the virtual group is independently transmitted through the network. The network need not be aware of the type of payload carried by the virtual members of the group.
4. At the receiving end, the phase of the incoming VCs/SPEs is aligned and then the original payload data stream is rebuilt. This requires using a memory of appropriate size for buffering all the arriving members of the group at the receiving end. The memory size depends on the maximum expected delay, therefore to minimize latency the maximum delay to be compensated can be defined by management.

Table E-3 lists the bandwidth that can be provided by the virtual concatenation containers built using the virtual concatenation method.

Table E-3. Virtual Concatenation Container Bandwidth

SDH Designation of Member Containers	SONET Designation of Member Containers	Maximum Number of Containers in Group	Minimum Resulting Bandwidth (Mbps)	Maximum Resulting Bandwidth (Mbps)	Bandwidth Selection Granularity (Mbps)
VC-11	VT1.5	64	1.600000	102.400000	1.600000
VC-12	VT2	64	2.176000	139.264000	2.176000
–	VT3	64	3.328000	212.992000	3.328000
VC-2	VT6	64	6.784000	434.176000	6.784000
VC-3	STS-1 SPE	256	48.384000	12386.304000	48.384000
VC-4	STS-3c SPE	256	149.760000	38388.560000	149.760000

E.10 Ethernet Transmission Technology

Introduction to Ethernet Transmission

One of the most successful digital transmission technologies is referred to by the generic term ***Ethernet***. The Ethernet technology is suitable for a wide range of physical media: coaxial cable, twisted pairs and optical fibers. The current standards for Ethernet transmission cover rates from 10 Mbps to 10 Gbps. In many office LANs, Ethernet runs at 10 Mbps and 100 Mbps; network interface cards (NICs) for PCs usually support both of these rates.

The basic standard covering Ethernet LANs is IEEE Standard 802.3, which is very similar to the original Ethernet V2.0 specification (ISO/IEC also have a similar standard). In addition to the aspects covered by IEEE 802.3 standards, there is a wide range of LAN standards (the IEEE 802 family) that cover other aspects of LAN transmission, for example, bridging, with particular emphasis on Ethernet LANs.

Ethernet standards (in their broadest interpretation) cover the physical and data link control layers (layers 1 and 2 in the OSI model; IP is a layer 3 protocol). The data link control layer is split into two sublayers: media access control (MAC) and logical link control (LLC).

Ethernet LAN Topologies

Ethernet LANs use a multidrop topology. The LANs can be implemented either in bus or star (hub-based) topology.

For the FCD-155, only the star (hub-based) topology is relevant.

Figure E-10 shows the general structure of a LAN using the star topology.

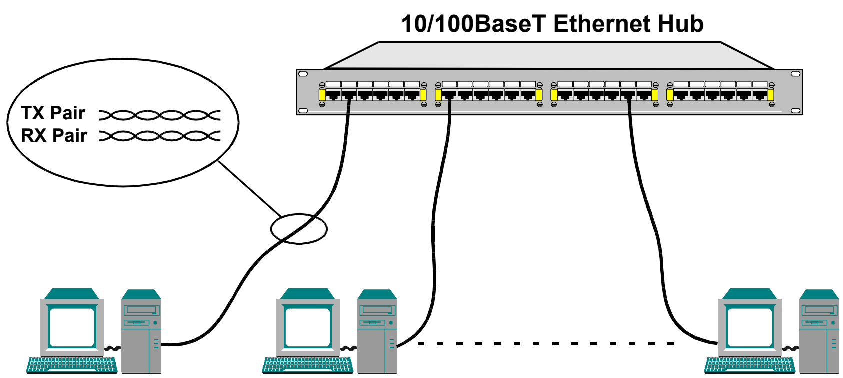


Figure E-10. Star (Hub-Based) Ethernet LAN Topology

In the star topology, all the nodes on the LAN are connected to a common unit, which serves as the hub of the LAN. The hub can be implemented in two ways:

- Simple Ethernet hub, which detects the transmitting node and transparently distributes its signal to all the other nodes. A hub supports only half-duplex communication (the same as in a bus topology).
- Ethernet switch: the switch includes more sophisticated circuits that enable both half-duplex and full-duplex operation and prevent collisions.

In a star topology, the LAN cables are usually made of two twisted pairs (one transmit pair and one receive pair). The standard connector type is RJ-45, and its pin assignment has also been standardized. However, because of the need to use separate transmit and receive pairs, two types of port pin assignments have developed: station ports and hub ports (the difference is interchanging of the transmit and receive pins in the connector).

This permits to interconnect connectors of different types by a cable wired pin-to-pin (straight cable). To interconnect ports of same type, a crossed cable (a cable wired to interconnect the transmit pair at one end to the receive pair at the other end) is necessary.

Interfaces operating on twisted pairs are designated in accordance with data rate: 10Base-T (10 Mbps) or 100Base-TX (100 Mbps, where X is the number of pairs). Interfaces that support both rates are identified as 10/100BaseT. 100 Mbps fiber optic interfaces are identified as 100Base-FX (where X is the number of fibers).

Ethernet Communication Protocol

Today, Ethernet is used as a generic term for a LAN transmission technology that uses Carrier Sense and Multiple Access with Collision Detection (CSMA/CD) to enable the transmission of short bursts of data (called ***frames***) between two or more stations (***nodes***).

All the users have permanent access to the full bandwidth of the transmission medium but can only use it for short times, by transmitting short data bursts. Each data burst has a fixed structure, called a frame. The frame structure is explained below. The connection point of each user to the transmission media is called a node. For identification purposes, each LAN node has its own unique number, called MAC address.

Media Access Method

Media access is performed by means of the carrier sense, multiple access protocol (CSMA) with collision detection (CD), defined by IEEE Standard 802.3. The protocol defines three basic steps:

- A node that wants to transmit checks that the LAN is free. If another node is already transmitting, the node waits until the LAN is free.
- When the LAN is free, the node starts transmission and sends its frame. Each node has equal access rights, therefore the first node that starts transmitting is the one that seizes the LAN.
- When two nodes start transmitting at the same instant, a collision occurs. In this case, the transmitting nodes will continue to transmit for some time, in order to ensure that all transmitting nodes detected the collision (this is called “jamming”). After the jamming period, all transmitting nodes stop the transmission and wait for a random period of time before trying again.

  The delay times are a function of collision numbers and random time delay, therefore there is a good chance that an additional collision between these nodes will be avoided, and the nodes will be able to transmit their messages.

The basic procedure described above has been developed for half-duplex communication, because it declares a collision whenever data is received during a local transmission. However, when using twisted pairs, separate pairs are used for the transmit and receive directions. Therefore, each node is capable of simultaneously transmitting and receiving (full-duplex operation), thereby doubling the effective data rate on the LAN.

Modern Ethernet interfaces, designated 10/100BaseT, are also capable of operation at the two basic rates, 10 Mbps and 100 Mbps. Therefore, the rate and operating mode (half-duplex or full-duplex) are user-configurable options.

When connecting equipment from different vendors to a common LAN, four operating modes are possible. These modes are listed below in ascending order of capabilities:

- Half-duplex operation at 10 Mbps.
- Full-duplex operation at 10 Mbps.
- Half-duplex operation at 100 Mbps.
- Full-duplex operation at 100 Mbps.

To ensure interoperability (which practically means to select the highest transport capability supported by all the equipment connected to the LAN), two approaches can be used: manual configuration of each equipment interface, or automatic negotiation (auto-negotiation) in accordance with IEEE Standard 802.3.

The auto-negotiation procedure enables automatic selection of the operating mode on a LAN, and also enables equipment connecting to an operating LAN to automatically adopt the LAN operating mode (if it is capable of supporting that mode).

When auto-negotiation is enabled on all the nodes attached (or trying to attach) to a LAN, the process is always successful. However, even if the nodes on an operating LAN are manually configured for operation in a fixed mode, a late-comer node with auto-negotiation capability can still resolve the LAN operating rate can be resolved, thereby enabling it to adopt the LAN rate. Under these conditions, an auto-negotiating node cannot detect the operating mode (half or full duplex), and therefore they will default to half-duplex. Therefore, as a practical configuration rule, do not enable the full-duplex mode without enabling auto-negotiation, except when all the nodes have been manually configured for the desired operating mode (which may of course be full duplex).

Basic Ethernet Frame Structure

The frame transmitted by each node contains routing, management and error correction information. For Ethernet LANs, the characteristics of frames are defined by IEEE Standard 802.3.

Basic frame lengths can vary from 72 to 1526 bytes and have the typical structure shown in *Figure E-11*.

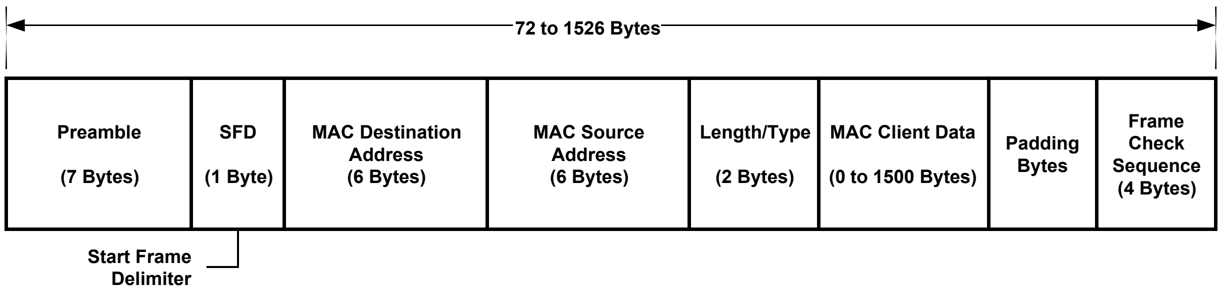


Figure E-11. Basic Ethernet Frame Structure

- **Preamble**. Each frame starts with a preamble of seven bytes. The preamble is used as a synchronizing sequence for the interface circuits, and helps bit decoding.
- **Start-Frame Delimiter (SFD)** field – consists of one byte. The SFD field indicates where the useful information starts.
- **Medium-Access (MAC) Destination Address (DA)** field – consists of six bytes. The MAC DA field carries the address of the destination node.
- **Medium-Access (MAC) Source Address (SA)** field – consists of six bytes. The MAC SA field carries the address of the source node.

Note *In conventional notation MAC addresses are represented as 6 pairs of hexadecimal digits, separated by dashes, for example, 08-10-39-03-2F-C3.*

- **Length/Type** field – consists of two bytes that indicate the number of bytes contained in the logical link control (LLC) data field. In most Ethernet protocol versions, this field contains a constant indicating the protocol type (in this case, this field is designated **EtherType**).
- **MAC Client Data** field. The MAC client data field can contain 0 to 1500 bytes of user-supplied data.
- **Padding** field. The optional padding field contains dummy data, that is used to increase the length of short frames to at least 64 bytes.
- **Frame Check Sequence (FCS)** field – contains four check bytes generated by a cyclic redundancy check (CRC) code. The FCS field is used to detect errors in the data carried in the frame.

Bridging

Communication between Nodes on Same LAN

A MAC address is unique and identifies a single physical port. Therefore, two Ethernet nodes attached to the same LAN exchange frame directly, by specifying the desired MAC destination address, together with the source MAC address.

The node that identifies its MAC address in the destination field can send a response by copying the source address of the frame to the destination address field.

Communication between Nodes on Different LANs

To enable nodes on different LANs to communicate, it is necessary to transfer frames between the two LANs. The device used for this purpose is called ***MAC bridge***, or just ***bridge***. Two types of bridges are used:

- Local bridges, which have Ethernet ports attached to the two LANs. The bridge control mechanism learns the nodes attached to each LAN by reading the source MAC addresses of the frames generated by the nodes. When the destination address of a frame is not on the LAN from which it was received, the bridge transfers it to the other LAN.
- Remote bridges, which are used in pairs. A basic remote bridge has one LAN port and one WAN port. The WAN port communicates through a link with the WAN port of the remote bridge connected to the desired remote LAN. In this case, the traffic addressed to destinations not located on the local LAN is transferred through the WAN link to the remote bridge.

Using Virtual Bridged LANs

VLAN can be used to provide separation between traffic from different sources sharing the same physical transmission facilities, and provide information on the relative priority the user assigns to each frame. The characteristics and use of virtual LANs (VLANs) and of the MAC bridges capable of handling tagged frames are defined in IEEE Standard 802.1Q.

VLANs are made possible by a slight modification to the Ethernet frame structure shown in *Figure E-11.*

The structure of an Ethernet frame with VLAN support is shown in *Figure E-12* (for simplicity, the figure does not include the preamble and SFD fields).

0 4 8 12 16 20 24 28 31

Destination MAC Address (DA)			
Destination MAC Address (DA)	Source MAC Address (SA)		
Source MAC Address (SA)			
Tag Protocol Identifier (8100)	PRI	0	VLAN ID
EtherType (IP = 0800)	Ethernet Payload (42 to 1500 Bytes)		
Ethernet Payload ⋮			
CRC			

Figure E-12. Structure of Ethernet Frame with VLAN Support

Ethernet frames with VLAN support include a tag header immediately after the source MAC address (therefore, such frames are also referred to as ***tagged frames***).

The tag header comprises 4 bytes:

- Two bytes for the tag protocol identifier. For Ethernet-encoded tags in accordance with IEEE802.1Q (these are the tags used by ML-IP modules), these bytes carry the equivalent of 8100.

- Priority (PRI) specified by the user (3 bits: 7 is the highest priority and 0 is the lowest priority).
- One bit for the canonical format indicator (always 0 as shown in *Figure E-12*).
- VLAN ID (12 bits), used to indicate the VLAN to which the frame belongs.

Ethernet Transport over SDH/SONET Networks

Ethernet payloads (10 Mbps or 100 Mbps) can be carried over SDH/SONET using several encapsulation protocols. FCD-155 supports two encapsulation protocols:

- Link Access Protocol – SDH (LAPS) in accordance with ITU-T Rec. X.86
- Generic Framing Procedure (GFP) in the framed mode, in accordance with ITU-T Rec. G.7041. With GFP, it is possible to increase the bandwidth utilization efficiency using the GFP multiplexing method.

LAPS Encapsulation

With LAPS, each Ethernet frame is encapsulated in the frame structure shown in *Figure E-13*. The LAPS frame is delineated by flags, followed by HDLC information (address and control), and by a LAPS service access point identifier (SAPI). The Ethernet frame is followed by a LAPS frame checksum (FCS), for error detection.

LAPS Frame

Ethernet Frame

Flag	HDLC Address	HDLC Control	LAPS SAPI	Ethernet Frame	LAPS FCS	Flag
(1 byte)	(1 byte)	(1 byte)	(2 bytes(	(64 to 1500 bytes)	(4 bytes)	(1 byte)

Figure E-13. LAPS Encapsulation Format

GFP Encapsulation

The GFP encapsulation method uses the basic frame structure of *Figure E-14*.

GFP Frame

Ethernet Frame

Core Header	**Payload Header**	**Ethernet Frame**
(4 bytes)	(4 bytes)	(1500 bytes)

Figure E-14. Basic GFP Encapsulation Format

Figure E-15 shows the detailed structure of the basic GFP frame. The frame includes the following fields:

PLI Payload length indicator

cHEC Core header CRC (calculated using ITU-T CRC-16 polynomial)

Payload Area Carries a framed PDU

Payload Header Header used for client PDU management

pFCS Optional payload FCS (calculated using ITU-T CRC-32 polynomial)

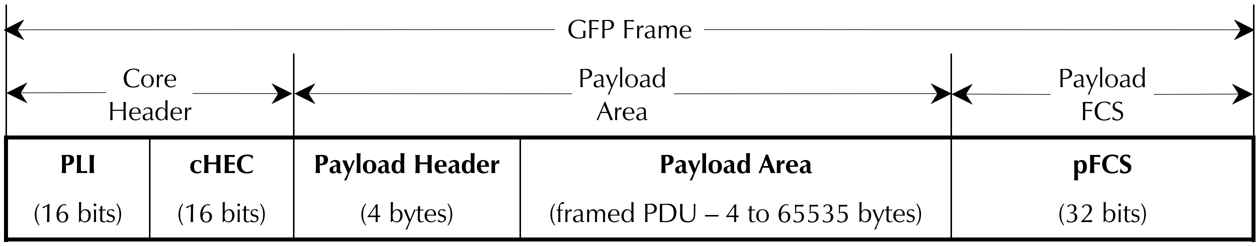


Figure E-15. Detailed Structure of Basic GFP Frame

All the GFP OAM&P functions are handled by the GFP core header.

The payload header supports the payload-specific adaptation functions, which depend on the client application (for FCD-155, the client application is Ethernet). The payload header also supports multiplexing (using extension headers), and any application-dependent link management functions (using dedicated client management frames)

Protection against errors (on a per frame basis) is provided by the optional payload frame checksum (FCS) field.

Idle frames are used for asynchronous rate adaptation.

GFP Protocol Stack

The encapsulation process can be described by means of a GFP protocol stack, illustrated in *Figure E-16*:

- The top layer is the client application, in this case Ethernet. For the FCD-155, the Ethernet switch provides up to four independent application streams (one stream per virtual group).
- The link layer is divided into two sections:
  - GFP client-specific aspects section: handles the frames received from the client application, and presents them in a standardized format to the GFP common aspects section.
  - GFP common aspects section: performs adaptation to the physical layer.
- The physical layer is provided by the SDH or SONET path.

Ethernet
GFP – Client Specific Aspects (Client Dependent)
GFP – Common Aspects (Client Independent)
SDH/SONET Path

Figure E-16. GFP Protocol Stack

GFP Multiplexing

In the FCD-155, the Ethernet switch provides up to four independent data streams. Each stream may be mapped to a different VC or SPE (or to a user-defined virtually concatenated group of VCs or SPEs), however in this case bandwidth may be wasted, because this approach always occupies the full SDH/SONET bandwidth, irrespective of the actual traffic load generated by the client application, which in general varies randomly with time.

To take advantage of the statistical distribution of traffic, multiplexing can be used. GFP provides support for multiplexing, using two approaches (see *Figure E-17*):

- Frame multiplexing in accordance with the frame type, using the PTI (payload type identifier) field:
  - Client data frames have priority over client management frames
  - Client management frames have priority over idle frames.
- Client multiplexing, implemented by adding extension headers. For this purpose, the extension header includes a customer, or channel, identifier (CID). The CID enables discriminating among various data sources using the same transmission path.

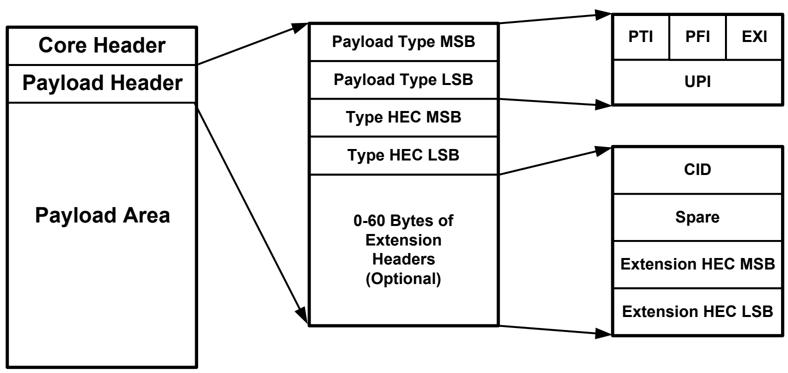


Figure E-17. Support for GFP Multiplexing at the GFP Frame Level

To take advantage of the GFP client multiplexing capability, the user can configure:

- The virtual groups to be multiplexed
- The fraction of physical layer bandwidth to be guaranteed to each virtual group, in 12.5% steps
- The VCs/SPEs to carry the multiplexed groups, and the specific mapping.

With GFP multiplexing, the bandwidth available to each virtual group is never less that the specified minimum. However, if the instantaneous traffic carried by a virtual group does not fully utilizes the reserved bandwidth, any unused bandwidth is made available to the other virtual groups. This ensures the best possible utilization of the available bandwidth, without degrading the quality of service.

E.11 IP Environment

This section describes the IP environment, to provide background information for configuring the parameters that control the routing of management traffic.

The information presented in this section refers to Version 4 of the IP protocol (IP4), currently the most widely used protocol version. IP4 is the only protocol version supported by FCD-155 units and RADView-PC stations.

Introduction to IP

IP means "Internet Protocol". The term ***IP protocol*** is often used to indicate a standardized set of rules and procedures that enable data exchange through a packet-switched network.

Accordingly, the term ***Internet*** indicates the set of networks that use the IP protocol and are interconnected in a way that, at least in principle, permits any entity on one network to communicate with any entity on another network.

Note *The term "suite of IP protocols" is also often used, in recognition of the fact that the operation of the Internet is actually defined by many related protocols.*

IP Networks, IP Hosts and IP Ports

Any entity that can communicate using the IP protocol is called an ***IP host***. The connection point between an IP host and an IP network is called ***IP port***.

An ***IP network*** forms when a number of IP ports can communicate directly (peer to peer) using the IP protocol, without any intermediaries.

An IP host can have any number of IP ports. Moreover, the ports may be located on different IP networks.

IP Addresses

To enable IP communication between two IP hosts, it is necessary to find a route between their IP ports. For this purpose, each IP port is assigned an IP address. The only purpose of an IP address is to permit unambiguous identification of an IP port. Therefore, each IP port must be assigned a distinct and unique IP address.

The IP protocol does not require the IP port to be related in an unambiguous way to a physical (communication) port. This has two main implications:

- Since the IP port is actually a connection to an IP network, any number of IP ports can share a given physical port.
- An IP port may be reached through several physical ports.

Note *By convention, the scope of IP addresses has been extended in two ways:*

- *To permit identification of IP networks*
- *To permit simultaneous addressing of all the ports connected to a IP network (this operation is called broadcasting).*

IP Packet Structure

The information exchanged through IP networks is organized in packets. The structure of an IP packet, as specified by IP protocol Version 4, is as follows (the numbers are byte numbers):

0 4 8 12 16 20 24 28 31

<table>
<tr><td>IP Version
(4)</td><td>IP Header
Length</td><td>IP Type of Service
(IP TOS)</td><td colspan="3">Total IP Packet Length
(total number of octets in header + payload)</td></tr>
<tr><td colspan="3">Fragment Identification
(16 bits)</td><td>Flags
(3 bits)</td><td colspan="2">Fragment Offset
(13 bits)</td></tr>
<tr><td colspan="6">(These fields are used for IP packet fragmentation)</td></tr>
<tr><td colspan="2">Time to Live
(Range: 0 to 255;
when 0, packet is
discarded)</td><td>Number of
Upper-Layer Protocol
Carried in Payload
(IGMP = 2)
(UDP = 17)</td><td colspan="3">IP Header Checksum</td></tr>
<tr><td colspan="6">Source IP Address</td></tr>
<tr><td colspan="6">Destination IP Address</td></tr>
<tr><td colspan="5">Options (when used)</td><td>Padding (as required)</td></tr>
<tr><td colspan="6">Payload (maximum bytes: 65535 – “header length”)</td></tr>
</table>

IP Address Structure

An IP address is a 32-bit number, represented as four 8-bit bytes. Each byte represents a decimal number in the range of 0 through 255.

The address is written in decimal format, with the bytes separated by decimal points, e.g., 164.90.70.47. This format is called ***dotted quad notation***.

An IP address is logically divided into two main portions:

- Network portion
- Host portion.

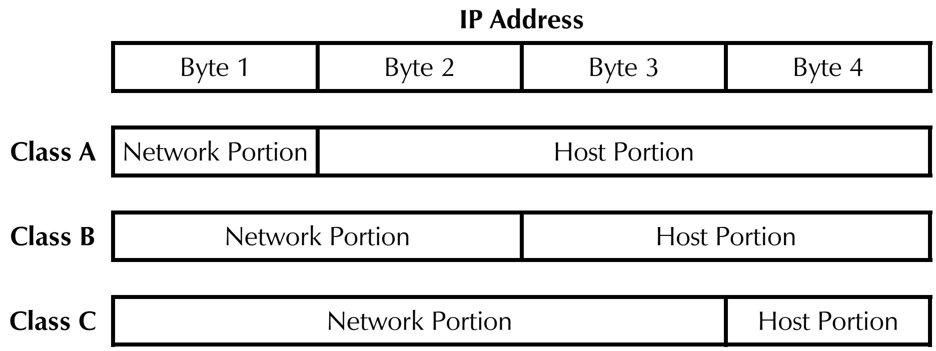
Network Portion

In general, the network portion is assigned by the Internet Assigned Numbers Authority (IANA), and its main purpose is to identify a specific IP network.

There are five IP address classes: A, B, C, D, and E. However, only the A, B and C classes are used for IP addressing. Consult your network manager with respect to the class of IP addresses used on your network.

The network portion of an IP address can be one, two, or three bytes long, in accordance with the IP address class.

This arrangement is illustrated below:



The class of each IP address can be determined from its leftmost byte, in accordance with the following chart:

Address Class	First Byte	Address Range
Class A	0 through 127	0.H.H.H through 127.H.H.H
Class B	128 through 191	128.N.H.H through 191.N.H.H
Class C	192 through 223	192.N.N.H through 223.N.N.H

where:

N – indicates bytes that are part of the network portion
H – indicates bytes that are part of the host portion.

Host Portion

In general, the host portion is used to identify an individual host connected to an IP network.

After obtaining an IP network address, the using organization is free to assign host identifiers in accordance with its specific needs.

Note

The following host identifiers have special meanings, and must not be assigned to an actual host:

- *The "all-zeros" host identifier is interpreted as a network identifier.*
- *The "all-ones" host identifier is interpreted as a broadcast address. Therefore, a message with an "all-ones" host identifier is accepted by all the hosts in the network.*

Subnetting

Given the scarcity of IP network addresses, for organizations operating several relatively small, physically separated, IP networks, e.g., several departmental networks, it is advantageous to enable several physical networks to share a common IP network address. ***Small*** in this context means that the number of IP ports connected to each of these networks is small relative to the host address space for the corresponding IP address class.

The approach taken to enable the sharing of an IP network address by two or more networks is called ***subnetting***, which means ***use of subnets***. The subnetting is relevant only within the using organization, and therefore can be freely selected to meet its specific needs.

To enable subnetting, the meaning of the bits in the host portion of the IP address is further sub-divided into two portions:

- **Subnet number**. For example, subnet numbers can be used to identify departmental subnets. The subnet number follows the network identifier.
- **Host number** – the last bits of the IP address.

This subdivision is illustrated below:

Net Number	Subnet Number	Host Number

For example, when the subnet includes 16 IP hosts, only the last four bits need to be reserved for the host number. For an organization which obtained one global Class C network address, this means that four bits are available to identify subnets. Therefore, this organization can implement 16 IP subnets, each comprising up to 16 hosts (except for two subnets that are limited to 15 hosts).

Subnet Masks

Subnet masks are used to indicate the division of the IP address bits between the net and subnet portion and the host portion.

The mask is a 32-bit word that includes "***ones***" in the positions used for net and subnet identification, followed by "***zeros***" up to the end of the IP address.

For example, the default subnet mask for any Class C address (i.e., all the eight bits in the host address space are used for hosts in the same net) is 255.255.255.000.

However, if the same address is used in a subnet comprising up to 16 hosts and for which the host numbers range is 00 to 15, the subnet mask changes as follows:

IP Address (Dotted-Quad)	192	70	55	13
IP Address (Binary)	1011 1111	0100 0110	0011 0111	0000 0111
Subnet Mask (Binary)	1111 1111	1111 1111	1111 1111	1111 0000
Subnet Mask (Dotted-Quad)	255	255	255	240

In most applications, the binary subnet mask is built as a contiguous string of "***ones***", followed by a number of "***zeros***" (the number of "***zeros***" is selected as needed, to complete the number of subnet mask bits to 32). Therefore, when this conventional approach is used, the subnet mask can also be specified simply by stating the number of "***ones***" in the mask. For example, the subnet mask shown above is specified by stating that it comprises 28 bits.

IP Routing Principles

The exchange of information between IP hosts is made in packets using the structure specified by the IP protocol. As explained in the *IP Packet Structure* section above, IP frames carry, within their header, the IP addresses of the destination and source hosts.

In accordance with the IP protocol, an IP host checks the addresses of all the received frames, and accepts only frames carrying its own IP address as the destination. The source address is then used to enable the destination to respond to the source.

An IP host will also respond to broadcasts (frames whose destination host identifier is “***all-ones***”).

Note *IP hosts support additional protocols within the IP suite, e.g., protocols used for connectivity checking, maintenance, etc. Therefore, IP hosts will accept additional types of messages, which are beyond the scope of this description*.

When checking the destination address of an IP frame, an IP host starts by checking the network identifier. If the network identifier is different, the host will immediately reject the frame. Therefore, IP hosts can communicate only if they have the same network identifier.

For example, this means that when a management station managing the FCD-155 is connected directly, through a LAN, to the FCD-155 Ethernet management port, the network identifier part of the IP address assigned to the FCD-155 Ethernet port must be identical to the network identifier of the management station.

To enable hosts located on different IP networks to communicate, IP routers are needed. The routers monitor the flowing traffic and identify the IP addresses of the local hosts connected to them, and then communicate this information to the other routers which are “known” to it using special protocols. Therefore, a router can determine to which other router to send a packet with a foreign IP address.

The user can increase the routing efficiency by specifying a default gateway to handle IP traffic to other networks (this is always an IP router). When a default gateway address is specified, packets with IP destinations located on other networks are sent to the default gateway for processing: the router serving as default gateway then sends them to their destination.

The default gateway must always be in the same IP subnet as the port sending traffic to the gateway.

Tools for Checking IP Connectivity

The IP protocol is referred to as an unreliable connectionless packet delivery protocol, because each packet transmitted by an IP host travels on its own through the network until it eventually reaches its destination. To ensure reliable delivery, higher layer protocols are used, for example, the widely-used TCP protocol.

However, using higher layer protocols cannot provide an answer to the need to check that it is indeed possible to reach the desired IP destination address, because configuration errors or a network fault, for example, temporary congestion or failure of critical communication links, may still prevent the establishment of an IP connection. Therefore, it is often necessary to check for IP connectivity.

The IP protocol suite includes a special protocol, the Internet Control Message Protocol (ICMP), that enables IP hosts connected to the Internet to report a wide range of errors and provide information about the conditions that caused the errors. Support for this protocol is mandatory on every IP host.

ICMP includes a dedicated connectivity test procedure, implemented by means of two types of ICMP messages: ***echo request*** and ***echo reply***. This procedure is often referred to as ***ping***ing: the host wanting to check IP connectivity to a destination sends one or more ***ping*** (echo request) messages, and the destination returns an echo reply message for each request. By comparing the number of ***pings*** sent to the number received and the time needed for each reply to reach the ***ping*** source, the source host can obtain useful information regarding the transmission conditions.

E.12 SNMP Environment

General

The SNMP management functions of the FCD-155 are provided by an internal SNMP agent.

The SNMP management communication uses the User Datagram Protocol (UDP), a connectionless-mode transport protocol, part of the suite of protocols of the Internet Protocol (IP). This section covers the information related to the SNMP environment.

Note

Telnet management uses the TCP protocol over IP for management communication. After a Telnet session is started, the management interface is similar to that used for the supervision terminal.

SNMP Principles

The SNMP management protocol is an asynchronous command/response polling protocol: all the management traffic is initiated by the SNMP-based network management station (except for trap messages), which addresses the managed entities in its management domain. Only the addressed managed entity answers the polling of the management station.

The managed entities include a function called an "SNMP agent", which is responsible for interpretation and handling of the management station requests to the managed entity, and the generation of properly-formatted responses to the management station.

SNMP Operations

The SNMP protocol includes four types of operations:

getRequest Command for retrieving specific management information from the managed entity. The managed entity responds with a **getResponse** message.

getNextRequest Command for retrieving sequentially specific management information from the managed entity. The managed entity responds with a **getResponse** message.

setRequest	Command for manipulating specific management information within the managed entity. The managed entity responds with a **setResponse** message.
trap	Management message carrying unsolicited information on extraordinary events (e.g., alarms) reported by the managed entity.

Management Information Base

The management information base (MIB) includes a collection of ***managed objects***. A managed object is defined as a parameter that can be managed, such as a performance statistics value.

The MIB includes the definitions of relevant managed objects. Various MIBs can be defined for various management purposes, types of equipment, etc.

An object's definition includes the range of values and the “access” rights:

Read-only	Object value can be read, but cannot be set.
Read-write	Object value can be read or set.
Write-only	Object value can be set, but cannot be read.
Not accessible	Object value cannot be read, nor set.

MIB Structure

The MIB has an inverted tree-like structure, with each definition of a managed object forming one leaf, located at the end of a branch of that tree. Each “leaf” in the MIB is reached by a unique path, therefore by numbering the branching points, starting with the top, each leaf can be uniquely defined by a sequence of numbers. The formal description of the managed objects and the MIB structure is provided in a special standardized format, called Abstract Syntax Notation 1 (ASN.1).

Since the general collection of MIBs can also be organized in a similar structure, under the supervision of the Internet Activities Board (IAB), any parameter included in a MIB that is recognized by the IAB is uniquely defined.

To provide the flexibility necessary in a global structure, MIBs are classified in various classes (branches), one of them being the experimental branch, and another the group of private (enterprise-specific) branch. Under the private enterprise-specific branch of MIBs, each enterprise (manufacturer) can be assigned a number, which is its enterprise number. The assigned number designates the top of an enterprise-specific sub-tree of non-standard MIBs. Within this context, RAD has been assigned the enterprise number `164`. Therefore, enterprise MIBs published by RAD can be found under `1.3.6.1.4.1.164`.

MIBs of general interest are published by the IAB in the form of a Request for Comment (RFC) document. In addition, MIBs are also often assigned informal names that reflect their primary purpose. Enterprise-specific MIBs are published and distributed by their originator, which is responsible for their contents.

Enterprise-specific MIBs supported by RAD equipment, including the FCD-155, are available in ASN.1 format from the RAD Technical Support Department.

Management Domains Under SNMP

SNMP enables, in principle, each management station that knows the MIBs supported by a device to perform all the management operations available on that device. However, this is not desirable in practical situations, so it is necessary to provide a means to delimit management domains.

SNMP Communities

To enable the delimitation of management domains, SNMP uses “communities”. Each community is identified by a name, which is a case-sensitive alphanumeric string defined by the user.

Any SNMP entity (this term includes both managed entities and management stations) can be assigned by its user community names.

Access Restriction Using SNMP Communities

In general, SNMP agents support two types of access rights:

- **Read-only**: the SNMP agent accepts and processes only SNMP *getRequest* and *getNextRequest* commands from management stations which have the same read-only community name.
- **Read-write:** the SNMP agent accepts and processes all the *SNMP* commands received from a management station with the same write community name.

For each SNMP entity it is possible to define a list of the communities which are authorized to communicate with it, and the access rights associated with each community (this is the SNMP community name table of the entity).

For example, the SNMP community name table of the FCD-155 SNMP agent can include three community names.

In accordance with the SNMP protocol, the SNMP community of the originating entity is sent in each message.

When an SNMP message is received by the addressed entity, first it checks the originator's community: if the community name of the message originator differs from the community name specified for that type of message in the agent, the message it discarded (SNMP agents of managed entities report this event by means of an authentication failure trap).

FCD-155 Communities

The SNMP agent of the FCD-155 is programmed to recognize the following community types:

Read	SNMP community that has read-only authorization, i.e., the SNMP agent will accept only *getRequest* and *getNextRequest* commands from management stations using that community.
Write	SNMP community that has read-write authorization, i.e., the SNMP agent will also accept *setRequest* commands from management stations using that community.

Trap	SNMP community which the SNMP agent will send within trap messages.

SNMP Traps

The FCD-155 SNMP agent supports the MIB-II authentication trap, and in addition generates enterprise-specific traps for each alarm message.

Traps are also sent to notify the management station of the following events:

- Resetting (warm start trap)
- Change in status of the management link (up or down)
- Authentication failure (use of wrong community).

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Thank you for your assistance!

Manual Name: FCD-155

Publication Number: 180-200-07/04

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Manual organization	❒	❒	❒	❒	❒
Illustrations	❒	❒	❒	❒	❒
The manual as a whole	❒	❒	❒	❒	❒

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Type of Error(s) or Problem(s):

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Publication No. 180-200-07/04