



ORION TELECOM NETWORKS INC.

VCL100 - STM-1/4/16 SDH Multiplexer

System Guide

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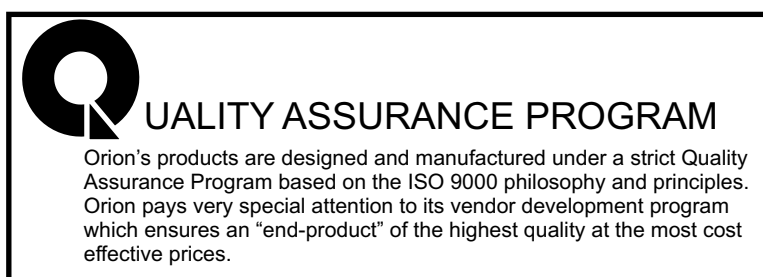
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Foreword

The VCL100 - STM-1/4/16 SDH Multiplexer is an ultra-compact, carrier class, and cost-effective bandwidth provisioning equipment designed to manage and deliver services from the optical core to the access.

This manual presents the technical specifications along with the functions and features of the product. It gives a brief description of the Hardware and software associated with the VCL100 - STM-1/4/16 SDH Multiplexer. This manual also gives an overview of the various applications in which VCL100 - STM-1/4/16 SDH Multiplexer can be used. These are explained with the use of application diagrams. These application diagrams are useful for the Network planning and design engineers.

1 Introduction

Traditionally, SDH/SONET was being used for providing high-speed traffic due to its robust architecture and rapid protection schemes. As the traffic pattern changed, there was a need to support multiple services from the same equipment like integrated data transport, better network management etc. This necessitated evolution to Next-Generation SDH/SONET.

Next generation SDH/SONET has emerged as one of the most economical and technologically viable solutions for transmitting both voice and data over carrier networks. This technology offers savings on investments/power and space to service providers. The latest Multi-Service Switching Platforms (MSSPs) and Multi-Service Provisioning Platforms (MSPPs) speed up provisioning of new services and optimize network efficiency through better utilization of its network.

Orion Telecom provides efficient solutions in this field using the VCL100 series products. VCL100 provides a full range of solutions in this evolving field of Next Generation SDH/SONET. VCL100 family provides the unique advantage of carrying both data and voice over SDH/SONET. In addition to being affordable, these products have built-in modularity, which allow easy upgradeability. This upgradeability feature allows the customer to evolve in a “build-as-you-grow” concept. Along with the Orion Telecom as Network Management solution the VCL100 family provides the following features:

- Easy network manageability
- Lower cost per line
- Easy upgradeability
- Carrying both data and voice over SDH/SONET
- Higher reliability

1.1 Architectural Details

VCL100 - STM-1/4/16 SDH Multiplexer, an STM-4/16 (OC-12/48) platform, has been envisaged to address the growing demand for an ultra-compact STM-4/16 (OC-12/48) Add-drop Multiplexer (ADM) and provide Ethernet-over-SDH/SONET mapping functions, including Link Capacity Adjustment Scheme (LCAS) with Virtual Concatenation (VCAT). VCL100 - STM-1/4/16 SDH Multiplexer can support STM-4/OC-12 (622.08 Mbps) and STM-16/OC-48 (2.5 Gbps) aggregate interfaces, E1/DS1 interface cards, E3/DS3 and Ethernet/Fast Ethernet and Gigabit Ethernet. It can be configured in various topologies such as linear, ring and bus.

VCL100 - STM-1/4/16 SDH Multiplexer has a multi-slot chassis with TDM backplane. In the chassis, there are four traffic slots meant for tributary cards (line cards). The line cards can support STM-1/4 (OC-3/12), E1/DS1, E3/DS3, and data interfaces of 10/100Base-T, 100BaseFx and Gigabit Ethernet.



Figure 1: VCL100 - STM-1/4/16 SDH Multiplexer

Two slots are reserved for system cards, which include the cross connect, processor and aggregate interface. There are three variants of this card explained later in this document. A dedicated slot exists for an OAM card.

There is provision of two power supply units and a fan unit. Added to this, there is a provision for two protection slots on the top of the chassis for PDH protection cards.

1.2 Key Features

VCL100 - STM-1/4/16 SDH Multiplexer provides the advanced features and capabilities, listed below:

1.2.1 Multi-service platform:

VCL100 - STM-1/4/16 SDH Multiplexer supports both data and voice traffic. For data traffic, it supports both Ethernet transport and Ethernet switching features. There is also a provision for Fast Ethernet, Gigabit Ethernet with switching.

1.2.2 Flexibility:

It can be configured in various topologies supporting both electrical and optical interfaces. It can take modular cards, which would enable the customers to start small and grow as traffic demands scale. All interfaces are in front for easy access.

1.2.3 Protection:

VCL100 - STM-1/4/16 SDH Multiplexer provides protection features using Sub-Network Connection Protection (SNCP)/Uni-directional Path Switched Ring (UPSR) and MSP/APS with switching time less than 50 ms. and also equipment protection. The Aggregate card, which contains cross-connect, control plane, timing circuitry, can be configured redundant by duplicating the aggregate card.

1.2.4 Configuration:

VCL100 - STM-1/4/16 SDH Multiplexer can be configured as an Add-drop multiplexer (ADM) and Terminal Multiplexer (TMUX). It can support diverse topologies like point-to-point, and ring topologies.

1.2.5 Cross connect capability:

VCL100 - STM-1/4/16 SDH Multiplexer STM-4/OC-12 version, provides a completely non-blocking 16x16 STM-4/OC-12 cross connect at VC-12/VT-2/VC-11/VT-1.5 granularity (1008x1008 VC-12/VT-2 1344x1344 VC-11/VT-1.5s). Cross connect capacity for STM-16/OC-48 version is 7.5 G.

1.2.6 Miniature size:

VCL100 - STM-1/4/16 SDH Multiplexer is one of the most compact STM-4/16 (OC-12/48) products available in the market, and provides an optimal solution for installation in 19-inch and 23-inch racks. VCL100 - STM-1/4/16 SDH Multiplexer is only 4.5U high and has a dense port configuration.

1.2.7 Synchronization:

Stratum-3/G.813 options 1 compliant timing and synchronization functions.

1.2.8 Laser protection:

VCL100 - STM-1/4/16 SDH Multiplexer comes with Small Form-factor Pluggable (SFP)-based optical line interfaces with digital diagnostics capability for SFPs.

2 System Overview

The VCL100 - STM-1/4/16 SDH Multiplexer Multi-Service Provisioning Platform (MSPP) is an STM-1/4/16 (OC-3/12/48) Add-Drop Multiplexer (ADM) designed for optical backbone, high-speed point-to-point links and high-density digital cross connects. The product supports end-to-end provisioning and management of services across all segments of the optical network. The solution box has a multi-slot chassis with modular plugin cards for tributary and aggregate interfaces. The positions of the slots in the chassis are illustrated in Figure 2 below. The following describes the system architecture and functionality of each of its parts.

| Protection 11 | | Protection Slot 12 | |
|------------------|---|--------------------|--|
| PSU # 1 (Slot 1) | Tributary Card 1 (Slot 4) | Fan (Slot 10) | |
| | Tributary Card 2 (Slot 5) | | |
| OAM (Slot 2) | System Card #1 (Slot 6) | | |
| | System Card #2 (Slot 7) for redundancy support | | |
| PSU # 1 (Slot 3) | Tributary Card 3 (Slot 8) | | |
| | Tributary Card 4 (Slot 9) | | |

Figure 2: VCL100 - STM-1/4/16 SDH Multiplexer Line diagram

2.1 Chassis/Backplane

The backplane is on the rear of the chassis providing interconnections between the various plug-in cards. VCL100 - STM-1/4/16 SDH Multiplexer supports high-density PDH and SDH cards. The line cards can terminate a combination of SDH, PDH and Ethernet interfaces.

2.2 OAM Card

The OAM card provides, Craft, Modem and Ethernet Management Interfaces. Its features are:

- External 2 Mbps/2 MHz source (BITS interface/ESI)
- Seven alarm inputs and four alarm outputs based on RJ-45 for external alarm contact. Potential-free contacts are supported for extending the alarms
- Supports one LAN port and one Craft port for management

2.3 Tributary Cards

VCL100 - STM-1/4/16 SDH Multiplexer has four tributary slots, which can provide E1/DS1, E3/DS3, Ethernet or STM-1 o/e (OC-3) interfaces. All the cards are 6 U sizes.

2.3.1 28xE1/DS1 tributary card

Depending on the requirements VCL100 - STM-1/4/16 SDH Multiplexer can be provided with 28-port E1/DS1 card.

2.3.2 3xE3/DS3 tributary card

VCL100 - STM-1/4/16 SDH Multiplexer can provide 3-port E3/DS3 support. VCL100 - STM-1/4/16 SDH Multiplexer carries the E3 traffic in an AU-4 (T3 in STS-1) mode.

2.3.3 2xSTM-1/OC-3 tributary card

This is a SFP Based 2 x STM-1/OC-3 card. Any of STM-1/OC-3 optical (S1.1, L1.1, L1.2) or STM-1e SFPs can be populated in the SFP slots.

2.3.4 8-port 10/100 Base-T Ethernet transport card

The Ethernet data is carried on multiple VC-12/VT2/VC-11/VT1.5 or VC-3/STS-1s in granularities. Depending on the customer requirement each of the eight ports in Ethernet can be configured to carry data in increments of 1.5/2 Mbps, such that the aggregate traffic bandwidth from Ethernet card is 155 Mbps. The Ethernet card supports LCAS, GFP/ X.86, lower and higher order Virtual concatenation, full/half duplex and auto-negotiation.

2.3.5 2xGigE transport card

This is a two-port Fast Ethernet card. The traffic is mapped either into multiple VC-3/STS-1s or VC-4/STS-3Cs.

2.3.6 8x10/100 Base-T and 2x1000 base SX/LX switching card

This card provides interfaces for Ethernet, Fast Ethernet and Gigabit Ethernet along with the layer 2 switching feature.

2.3.7 STM-4/OC-12 aggregate card

This STM-4/OC-12 aggregate card supports integrated **2.5G** cross connect, control and timing module. There are two variants of this card: redundant and non redundant, having one and two STM-4/OC-12 interfaces respectively. SFP based optics allows for transmit and receive optical power, voltage bias and temperature monitoring. Interfaces supported are:

- 1/2xSTM-4/OC-12 (S4.1, L4.1, L4.2)

These cards can also be configured as 1/2xSTM-1/OC-3 (S1.1, L1.1, L1.2)

2.3.8 STM-16/OC-48 aggregate card

STM-16/OC-48 aggregate card supports integrated **7.5G** cross connect, control and timing module. SFP based optics allows for transmit and receive optical power, voltage bias and temperature monitoring. Interfaces supported are:
1xSTM-16/OC-48 (S16.1, L16.1, L16.2)

2.4 Synchronization and Timing

VCL100 - STM-1/4/16 SDH Multiplexer can derive its clock from the following source:

- **Line-timed mode:** In this mode, VCL100 - STM-1/4/16 SDH Multiplexer derives its clock from any one of the E1/DS1 tributaries or STM-1/4/OC-3/12 signals.
- **Externally timed mode:** In this mode, an external 2048 KHz or 2.048/1.544 Mbps signal could be used as the clock source.
- **Holdover mode:** In this mode, VCL100 - STM-1/4/16 SDH Multiplexer uses the stored timing data to control the output frequency for a short duration (of around 24 hrs) beyond this it uses its own internal oscillator in a free-running mode.

VCL100 - STM-1/4/16 SDH Multiplexer supports Synchronization Status Messaging (SSM) as per ITU-T G.813 standards. This is a messaging technique, which enables a SDH/SONET equipment to determine the derivation of a timing source. It uses overhead bytes contained within the SDH/SONET overhead (S1) for transmitting these messages. Thus when a failure occurs, elements communicate timing reconfiguration information across the network. This is used by VCL100 - STM-1/4/16 SDH Multiplexer for the purpose of synchronization.

VCL100 - STM-1/4/16 SDH Multiplexer provides a 2.048 MHz clock and 2.048 Mbps output, which can be used by other equipment.

2.5 Power Supply

VCL100 - STM-1/4/16 SDH Multiplexer is powered by a 48 VDC power supply, which drives the various sub-systems in it.

The following features are supported:

- Allows for power monitoring
- Reverse polarity and inrush current limiting
- 1+1 Redundancy

2.6 Fans

VCL100 - STM-1/4/16 SDH Multiplexer box has provision for force cooling. The fan units are hot swappable and field replaceable and they also allow temperature monitoring.

2.7 Protection Features

VCL100 - STM-1/4/16 SDH Multiplexer provides the following protection features: VC-12/VT-2/VC-11/VT-1.5, VC-3/STS-1, VC-4/STS-3C and VC-4-4C/STS-12C Path protection switching (LO/HO, SNCP/UPSR as per G.841) 1+1 linear MSP/APS (as per G.841)

2.7 Protection Features

VCL100 - STM-1/4/16 SDH Multiplexer provides the following protection features:

- VC-12/VT-2/VC-11/VT-1.5, VC-3/STS-1, VC-4/STS-3C and VC-4-4C/STS-12C Path protection switching (LO/HO, SNCP/UPSR as per G.841)
- 1+1 linear MSP/APS (as per G.841)

3 Applications

The VCL100 - STM-1/4/16 SDH Multiplexer can be configured in Ring, Linear and Bus architectures. It can be used in the core of the network to provide high-speed backbone STM-16/OC-48 rings subtending smaller STM-4/ OC-12 or STM-1/OC-3 rings. This application can be combined with the functionality for data switching and transport.

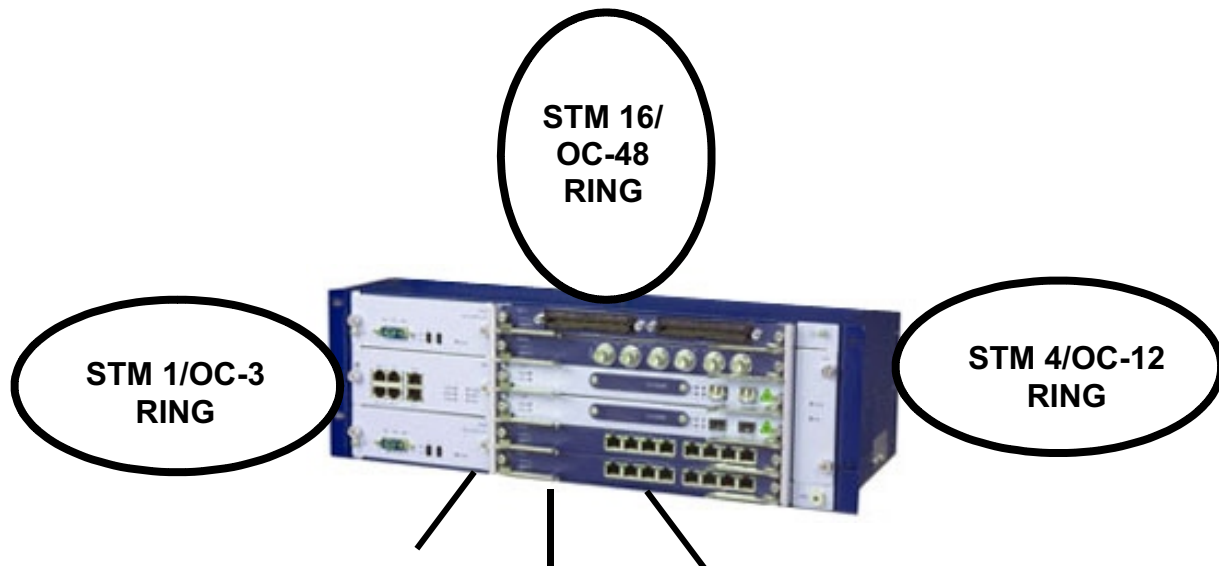


Figure 3. VCL100 - STM-1/4/16 SDH Multiplexer Typical Configurations

The STM-16/OC-48 rings could provide the core for cellular or mobile networks between Mobile Switching Centers with subtended STM-1 (OC-3)/STM-4 (OC-12) networks providing connectivity to the Base Station Controllers.

VCL100 - STM-1/4/16 SDH Multiplexer could also be used to provide versatile cross-connect functionality to connect telephone exchanges in STM-16/OC-48 rings in dense metro areas. Lower speed STM-1 (OC-3)/STM-4 (OC-12) rings dropped by VCL100 - STM-1/4/16 SDH Multiplexer from this ring could connect to local exchanges. VCL100 - STM-1/4/16 SDH Multiplexer could also provide the connectivity between Mobile Switching Centers and Telephone exchanges.

The Gigabit Ethernet drop capacity on VCL100 - STM-1/4/16 SDH Multiplexer could be used to provide Gigabit Ethernet uplink connectivity for large offices, server farms, campus or interoffice LANs.

3.1 Telco Networks Providing Voice and Data Services

VCL100 - STM-1/4/16 SDH Multiplexer is an ideal platform to provide high-end data and voice requirement of clients. VCL100 - STM-1/4/16 SDH Multiplexer can be installed at the regional and gateway Points of Presence (POP) locations in order to cater to the ever-growing data requirements of the customers while supporting legacy services at the same time.

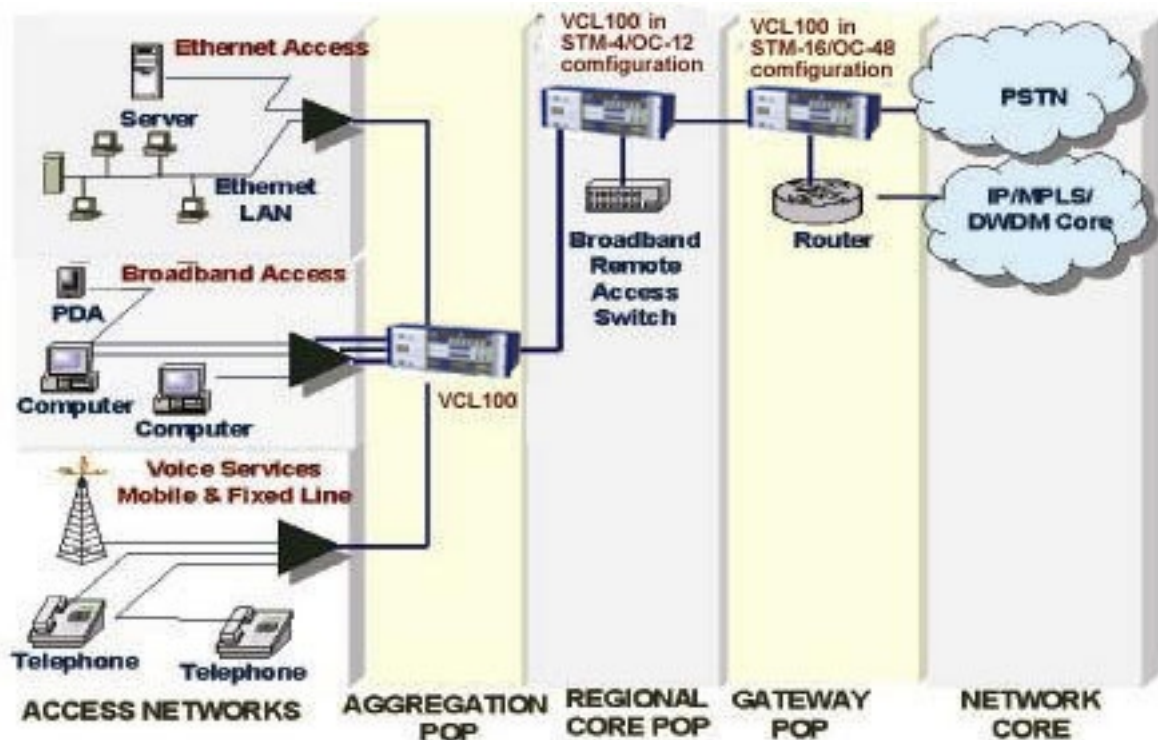


Figure 4. VCL100 - STM-1/4/16 SDH Multiplexer in Telco Networks

The advantage that the VCL100 - STM-1/4/16 SDH Multiplexer provides the Telecom Service provider is as follows:

- The VCL100 - STM-1/4/16 SDH Multiplexer enables network simplifications by collapsing networks, nodes and services into a single multi service device. A smaller number of higher-density nodes and node types enable cost savings as a result of a smaller, more homogenous network to manage.
- The flexible architecture of the VCL100 series ensures that the network is future proof, and the service provider has the flexibility of choosing a technology he thinks useful at any time in the future with minimal investment.
- The VCL100 series is a flexible, carrier-grade platform that offers many levels of resiliency. The solution enables the service provider to offer new data services like video-on-demand and other data services that demand a carrier grade network.

4. Utilities Communications Networks

Utility companies require communications systems that can ensure reliable, safe and secure transmission of data, voice and video across LANs and WANs at all times. Apart from providing the reliability that is so crucial in these networks, the VCL100 - STM-1/4/16 SDH Multiplexer also supports Ethernet switching and transport thereby ensuring that the network evolves with evolving needs.

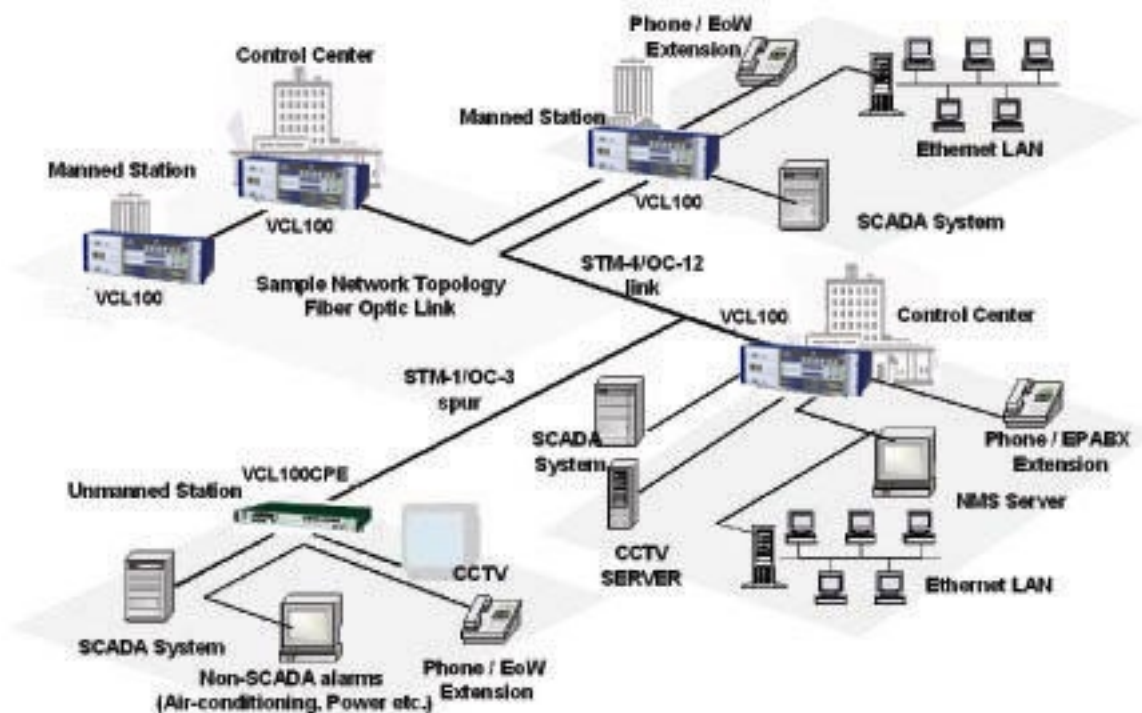


Figure 6. VCL100 - STM-1/4/16 SDH Multiplexer in Utilities Networks

5. Software

VCL100 - STM-1/4/16 SDH Multiplexer can be managed locally using Orion as Network Element Software. Also, it is possible to centrally maintain large number of VCL100 - STM-1/4/16 SDH Multiplexers using Orion as Network Management Software.

5.1 NES

VCL provides the following key features:

- Node-wise operations & maintenance
- User programmable severity levels for alarms
- Node-wise alarming & remote login
- Performance monitoring as per the standard specifications (G.826)
- In-service monitoring of E1/DS1 tributaries
- Supports full FCAPS functionality via web browser interface

VCLNES allows user to configure all the abovementioned features using a standard Hyper Text Transfer Protocol (HTTP) based web browser. VCLNES makes the physical data connection using the Ethernet interface in the management interface module in VCL100 - STM-1/4/16 SDH Multiplexer. VCLNES also allows users to control remote nodes using the web browser interface. For this purpose, VCLNES uses DCC bytes in the STM-1 (OC-3)/ STM-4 (OC-12) frame for carrying the management Information to the remote node.

5.2 NMS

VCL100 - STM-1/4/16 SDH Multiplexer provides support for a centralized network management through VCLNMS.

For this, VCL100 - STM-1/4/16 SDH Multiplexer provides the following operation interfaces:

10/100 Mbps half-duplex LAN interface for NMS data connection to VCL100CP node (RJ-45 connector)

6. Specifications

6.1 Network Details

- Topology supported: Linear, Ring and Bus

6.2 Element Configuration

- Terminal Multiplexers (TMUX)
- Add-Drop Multiplexers (ADM)
- Regenerator

6.3 Aggregate Card

- STM-1/4/16 (OC-3/12/48)
- Lasers with rate and wavelengths of S4.1, L4.1, L4.2, S16.1, L16.1, L16.2

6.4 Tributary Interfaces

- 28xE1/DS1
- 3xE3/DS3
- 2xSTM-1/OC-3 (S1.1, L1.1, L1.2)
- 8x10/100 Base Ethernet
- 2xGigE Transport card
- 8x10/100 Base-T and 2 x GigE switching card

6.5 Cross connect

- 1008x1008 VC-12/VT2/ 1344x1344 VC-11/VT1.5 (2.5G)
- 3024x3024 VC-12/VT2/VC-11/VT1.5 (7.5G)
- Fully non-blocking
- Line to line, Line to tributary, Tributary to line, Tributary to tributary

6.6 Timing and Synchronization

- G.813 compliant
- External 2.048/1.544 Mbps and 2.048 MHz inputs and outputs
- Internal G.703 compliant stratum-3 oscillator
- SSM byte support

6.7 Protection

- MSP/APS, SNCP/UPSR

6.8 Maintenance

- Higher-order and lower order POH, SDH/SONET alarms
- Performance monitoring as per G.829 and G.784
- Local and remote loop-back
- Remote software download

6.9 Management

- VCL, WUI which support FCAPS feature
- SNMP interface (for NMS)
- V.24/V.28 modem interface (for remote management) (connectivity is through RJ-45 from NE)
- In-band channel control
- 10/100 BaseT (RJ-45) Management interface
- External alarm interface and indicators

6.10 User Data Channel

- Seven input alarms and four output alarms
- F1 byte for user data channel

6.11 Power Supply

- -48 VDC
- Consumption: STM-4/OC-12: 130 W

6.12 Environmental

- Operating Temperature: 0° to 45° C
- Relative Humidity: 10- 90 %, non-condensing

6.13 Physical Dimensions

- HxWxD: 176 mm x 442 mm x 238 mm (with protection panel)
- 152 mm x 442 mm x 238 mm (without protection panel)
- 19", 21" and 23" rack mountable
- Weight 11.60 Kg

Appendix A: Acronyms

| Acronym | Expansion |
|----------------|---|
| ADM | Add-Drop Multiplexer |
| APS | Automatic Protection Switching |
| BITS | Building Integrated Timing Supply |
| DWDM | Dense Wavelength Division Multiplexing |
| GFP | Generic Framing Procedures |
| HO | Higher Order |
| IP | Internet Protocol |
| ITU-T | International Telecommunications Union Telecommunication Standards |
| LAN | Local Area Network |
| LCAS | Link Capacity Adjustment Scheme |
| LO | Lower Order |
| MPLS | Multi-Protocol Label Switching |
| MSP | Multiplex Section Protection |
| NE | Network Element |
| NMS | Network Management System |
| OAM | Operation, Administration and Maintenance |
| PDH | Plesiochronous Digital Hierarchy |
| POH | Path Overhead |
| PSTN | Public Switched Telephone Network |
| STM | Synchronous Transport Module |
| SDH | Synchronous Digital Hierarchy |
| SFP | Small Form-factor Pluggable |
| SNCP | Sub-Network Connection Protection |
| SONET | Synchronous Optical Network |
| UPSR | Unidirectional Path Switched Ring |
| VC | Virtual Container |
| VCAT | Virtual Concatenation |
| WAN | Wide Area Network |
| WUI | Web User Interface |

Notes : _____

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