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ETL/G/S Henry Gonzalez		2/221 02-ZAP 701 21/2		
Approved	Checked	Date	Rev	Reference
ETL/G/S Karl-Eric K Malberg		30/08/2005	A	

OMS 3260

Product Description

TAKING YOU FORWARD

Marconi is the original manufacturer of this product.
Ericsson and Marconi have had a close relationship since 1995. The Ericsson Optical Network is a transport network portfolio provided in conjunction with Marconi. It includes SDH and DWDM NE's and a common NMS system. The portfolio is broad and complete.

OMS3260
SDH/OTH 40GB/S MULTIPLEXER

Product Description

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Comments:

Marconi Communications Ltd.,
New Century Park,
PO Box 53, Coventry CV3 1HJ,
England
Telephone: +44 (0)24 7656 2000
Fax: +44 (0)24 7656 7000
Telex: 31361 MARCOV

Marconi Communications GmbH
Gerberstraße 33
71522 Backnang
Germany
Telephone: +49 (0) 71 91 13 - 0
Fax: +49 (0) 71 91 13 - 32 12

Marconi Communications SpA,
1A, via Negrone 16153,
Genova, Cornigliano,
Italy.
Telephone: +39–010–60021
Fax: +39–010–6501897

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List of Abbreviations

ADM	Add-Drop Multiplexer
ALS	Automatic Laser Shutdown
APS	Automatic Protection Switching
ATM	Asynchronous Transfer Mode
AUX	Auxiliary (Unit, Channels, Services)
Bw7R	Bauweise 7R (local alarm scheme)
c	Contiguously concatenated signal (VC4-4c)
CIR	Committed Information Rate
CMISE	Common Management Information Service Element (provides services detailed in ISO9595, ISO9596 required by the NE application - OSI layer 7)
CMOX	CMISE over short stack
DCC	Data Communication Channel
DCF	Dispersion Compensation Fibre (also known as PDC)
DCS	Digital Cross–connect System
DWDM	Dense Wavelength Division Multiplexing
DXC	Digital Cross–Connect
EIR	Excess Information Rate
EOW	Engineer Order Wire
EPL	Ethernet Private Line
ETSI	European Telecommunication Standards Institute
FastE	Fast Ethernet
FEC	Forward Error Correction
10GE	10 Gigabit Ethernet
GbE	Gigabit Ethernet
GE	Gigabit Ethernet
GFP	Generic Frame Procedure
GigE	Gigabit Ethernet
GMPLS	Generalised Multi Protocol Label/Lambda Switching
HO	High Order, means n x VC-4
IB FEC	In Band Forward Error Correction
IEEE	Institution of Electrical and Electronic Engineers
I/F	Interface
IP	Internet Protocol
ITU-T	International Telecommunication Union, Telecommunications Sector
LAN	Local Area Network
LAPS	Link Access Procedure SDH
LCAS	Link Capacity Adjustment Scheme (for Virtual Concatenated signals)
LCT	Local Craft Terminal
LO	Low Order, means n x VC-12 level or n x VC-3
LTU	Line Termination Unit
LVDS	Low Voltage Differential Signalling
MNR	Managed Network Release
MPLS	Multi-Protocol Label Switching
MS	Multiplex Section
MSH	Product name for Marconi SDH multiplexers
MSP	Multiplex Section Protection
MS SPRING	Multiplex Section Shared Protection Ring
MV36	Marconi Communications Element Level Management System
MV38	Marconi Communications Network Level Management System
NE	Network Element
NMS	Network Management System
OCH	Optical Channel (ITU–T G.709)
ODU	Optical Data unit (ITU–T G.709)

OH	Overhead
OOB FEC	Out Of Band Forward Error Correction
OPU	Optical Payload Unit (ITU–T G.709)
OS	Operating System
OSI	Open System Interconnection
OTU	Optical Transport Unit (ITU–T G.709)
OTH	Optical Transport Heirarchy
PDC	Passive Dispersion Compensation (also known as DCF)
RS	Regenerator Section
RMON	Remote Network Monitoring
SDH	Synchronous Digital Hierarchy
SFP	Small Form-Factor Pluggable (Optical Transceiver)
SMC	System Memory Card, used in CCU to hold SW for all of the cards (compact flash disks)
SNC	Subnetwork Connection (previously known as Path Protection)
SNCP	Sub-Network Connection Protection
SOH	Section Overhead
SONET	Synchronous Optical Network
STM	Synchronous Transport Module
TE	Termination point
TEP1E	Transmission Equipment Practice 1E (customised local alarm scheme)
TM	Terminal Multiplexer
TMN	Telecommunication Management Network
U	Unit of measure for card slot width on the subrack, 1U = 5.08mm (0.2”)
UPSR	Unidirectional Path Switched Ring
v	Virtually concatenated signal (VC4-4v)
VC	Virtual Container
VCG	Virtually Concatenated Group
VCI	Virtual Channel Identifier
VLAN	Virtual Local Area Network (IEEE 802.1Q)
VPLS	Virtual Private LAN Service
VPN	Virtual Private Network
WAN	Wide Area Network
WDM	Wavelength Division Multiplexing

Foreword

The product information contained herein is independent of product release and does not refer to a defined product release.

The technical information provided in this document is offered, in good faith, as an indication of Marconi's intention to evolve its Optical Networks portfolio to meet the demands of the marketplace. Unless commercially agreed, the information contained herein should not to be taken as implying any commitment or obligation on the part of Marconi.

For details concerning availability and supported features please refer to the SDH Roadmap.

1 Introduction

OMS3260 is a Multi-service optical-electrical-optical (O-E-O) digital cross-connect that provides the capability to switch both wavelength services and higher order synchronous traffic simultaneously in the same network element.

This feature, in a managed optical network, is the key to allow true flexibility and efficiency with the ability to groom traffic at the lower granularity of the SDH networks. The OMS3260 provides this functionality within a single equipment allowing both high capacity ODU switching and higher order synchronous SDH switching. In addition to typical SDH functionality (switching of SDH VC-4/4nc as defined in ITU-T G.707) OMS3260 permits the switching of the basic information structure of the emerging Optical Transport Network (OTN): the Optical Data Unit (ODUk, k=1,2).

In addition the integration of a LO-VC switch allows an operator to use OMS3260 as a cost-effective solution for those network nodes where, in conjunction with a wide HO-VC switch, the capability to groom a percentage of the traffic down to VC-3/VC-2/VC-12 level is required.

OMS3260 can be therefore defined as an SDH/ODU/4 cross-connect with optional LO-VC switching capability.

To cope with the more data-centric network, Ethernet interfaces and Layer 2 Switching are provided. Mapping is via GFP and LCAS can be used to manage the bandwidth. Data transport capabilities are further enhanced by the provision of SAN interfaces.

OMS3260 provides a scaleable, highly resilient 960 Gb/s of non-blocking switch capacity, which is equivalent to 6144×6144 STM-1. It is modularly expandable in-service by adding 80 Gb/s switch cards. OMS3260 is designed to be upgraded in service to higher capacity configurations and it is open to support STM-256/OTM0.3 interfaces.

OMS3260 can also be provided as an in-service upgrade starting from the MSH2K/OMS3250 320 Gb/s SDH/OTH DCS platform. MSH64C/OMS3240 and MSH2K/OMS3250 can be used as native port sub-racks for the OMS3260, protecting operator's investments and allowing existing elements to be incorporated into a larger platform.

The OMS3260 incorporates a fully distributed, network aware control plane to support advanced, dynamic network architectures that require fast network restoration and customer driven routing. Both SDH management and the emerging GMPLS (Generalised Multi-Protocol Label Switching) control mechanisms are included in the realisation.

OMS3260 performs the functional requirements of ITU-T Recs. G.783, G.798 and G.784. STM-N signals are structured according to ITU-T Rec. G.707. OTM-0.k signals are structured according to ITU-T Rec. G.709.

1.1 SDH Hierarchy

OMS3260, when in HO-VC ADM/cross-connect configuration, provides the STM-1 to STM-64 interfaces and supports the following SDH hierarchy, as shown in Figure 1, in accordance with ITU-T G.707.

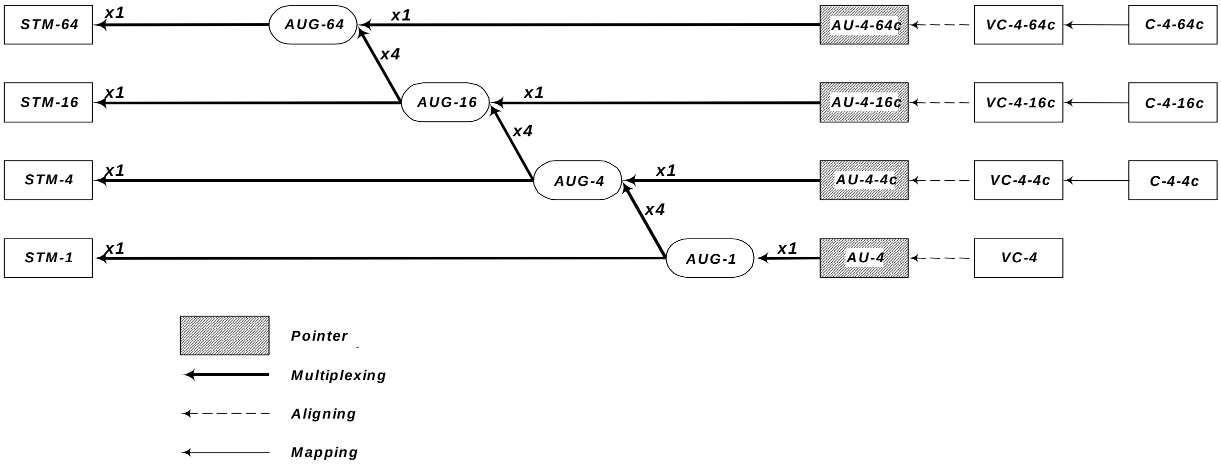
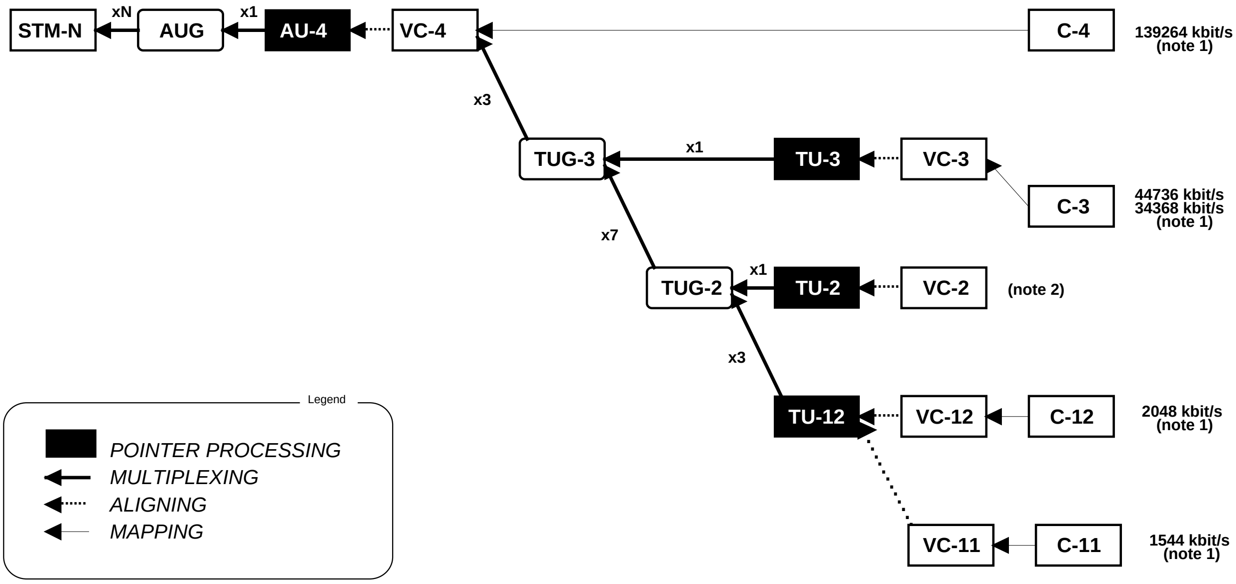


Figure 1: HO SDH Hierarchy

When configured to equip the optional LO-VC switch, the supported hierarchy is the following (Figure 2).



note 1: G.702 tributaries associated with containers C-x are shown. Other signals, e.g. ATM, can also be accomodated.
note 2: Virtual concatenation of VC-2 could be used for the transport of new services at non hierarchical bit rates

Figure 2: SDH multiplexing structure

The optical interface parameters are compatible with the relevant specifications of ITU G.691 and G.957 or better. It is possible to increase the span of optical interfaces by using optical amplifiers.

The product also supports ‘coloured’ optical interfaces to facilitate interworking with Marconi DWDM equipment.

1.2 OTN Hierarchy

Additionally the OMS3260 will also satisfy the ITU-T G.798 and G.709 requirements (please refer to Figure 3).

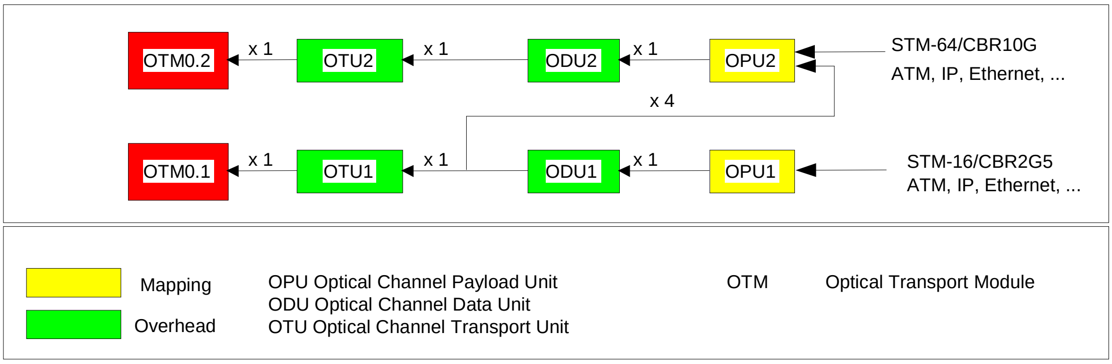


Figure 3: OTN (Optical Transport Network) structure according to ITU-T G.709

2 Equipment Functions and Architecture

2.1 General Diagram

The general diagram of the equipment is shown in Figure 4, where OMS3260 functional blocks are highlighted:

- the block performing the switching functionality;
- the ports;
- the block providing the equipment synchronisation;
- the block assuring the control of the whole equipment;
- the block providing the communication feature.

Optionally a functional block providing LO-VC switching can be added.

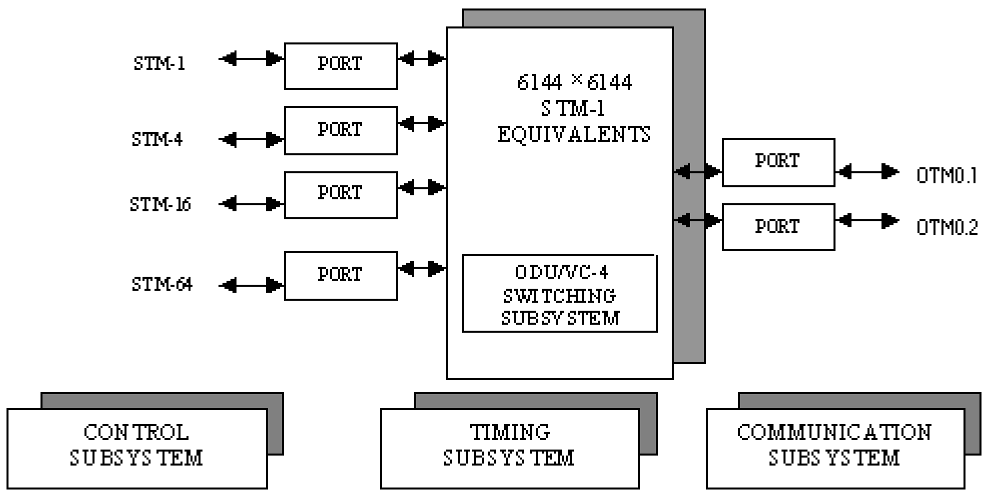


Figure 4: OMS3260 functional blocks

All the common parts of the equipment (Switching Matrix, Control, Communication and Timing subsystems) are duplicated for maximum availability.

Fault location in the equipment is based on on-line diagnostic tests related to the functionality of control, timing, switching, and to internal connections.

The equipment can perform defect detection and performance monitoring functions.

Internal and external loops are available for fault localisation purposes between the transport network and the equipment.

The quality of the incoming signals is continuously monitored at the equipment ports, and the relevant data, after having been processed, is made available to the Contr/Comms card for subsequent network performance evaluations.

All configurable parameters and the status of the system are monitored and controlled via the LCT or a remote management system (the NMS), via a dedicated access (Q interface or Q_{ECC} channel).

2.1.1 Communication/Controller Subsystem

This subsystem supports the high-level control of the equipment, the F and Q interfaces (to provide LCT and Management System services) together with the possible access to the DCC and GCC channels as covered by G.784, G709 and G798.

This subsystem also provides redundant storage for the equipment configuration database.

2.1.2 HO-VC/ODU Switching Subsystem

In OMS3260, this subsystem, composed by the Switching Units in the Core and the Switch i/f Units in the peripheral port subracks, performs the following functions:

- cross connection at VC-4, VC-4-Xc and ODU level;
- equipment timing;
- VC-4, VC-4-Xc and ODU sub-network connection protection;
- multiplex section protection (MSP);
- MS-SPRing protection.

In order to guarantee a high level of availability the switching subsystem is 1+1 protected.

During normal working conditions the traffic is transmitted to both switches. In case of fault, the receiving traffic card selects the traffic from the error-free switch.

The switching matrix, equipped in the core shelf, has a 3-stage Clos structure, and it allows cross-connections for a total capacity of 6144 STM-1 equivalent signals.

All the 2nd stage units must be equipped.

The 1st & 3rd stage units can be equipped in the necessary quantity: each unit is able to manage up to 512×512 STM-1 equivalents.

The Control & Comms Subsystem, the Switching Subsystem and the Timing Subsystem are implemented in a single core subrack, duplicated for redundancy.

2.1.3 LO-VC Switching Subsystem

The integration of a LO-VC Switching Subsystem inside OMS3260 permits Marconi to provide a compact and cost-effective solution for those networks nodes where, in conjunction to a wide HO-switch capacity, a LO-switch is required.

Depending on the capacity required, dedicated LO-VC Switch Units can be added in any traffic slot, providing a 64x64 STM-1 capacity at LO-VC level for each equipped LO-VC Switch Unit.

2.1.4 Configuration

The OMS3260 core layout is shown in Figure 5.

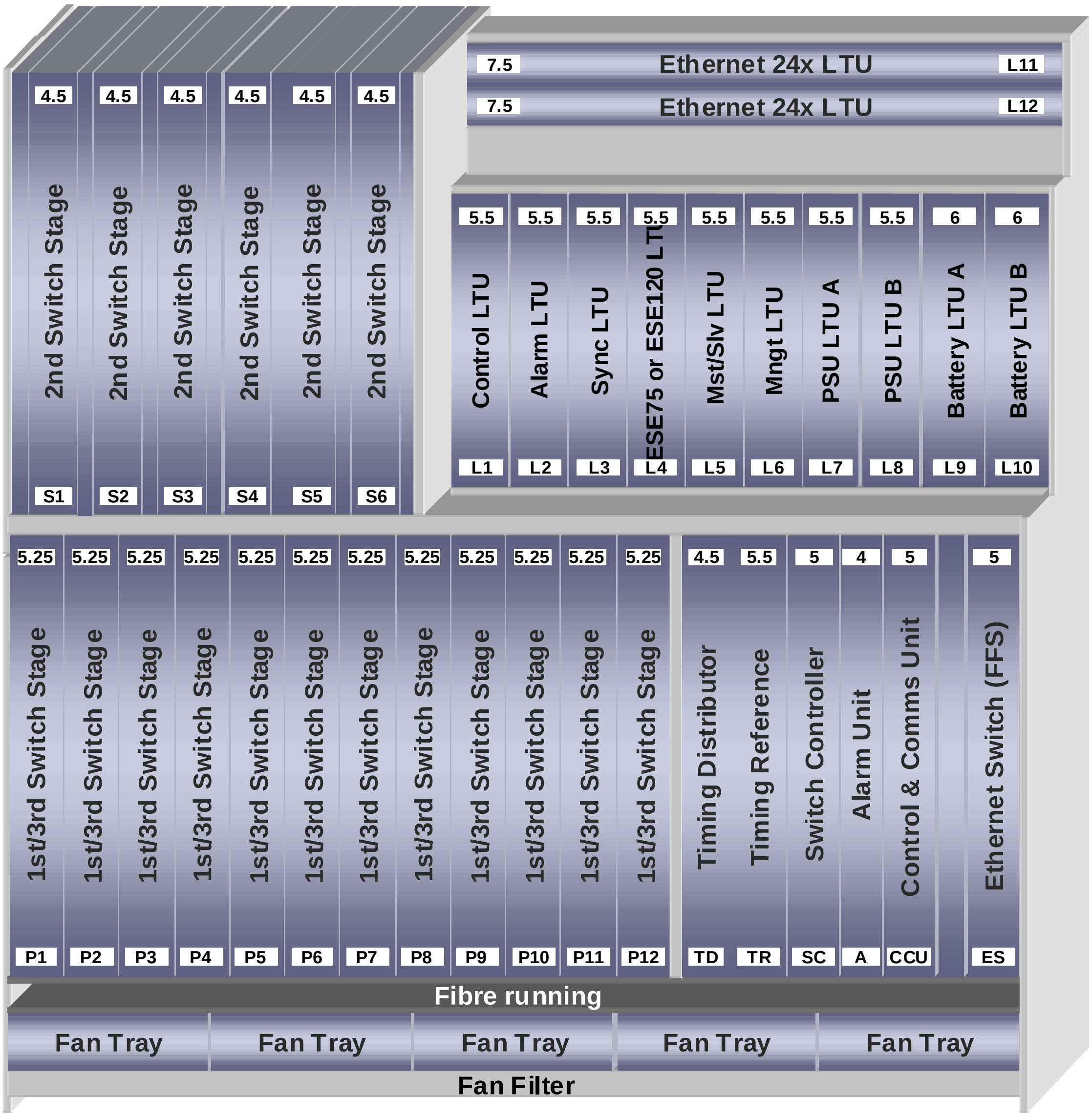


Figure 5: OMS3260 core layout

OMS3260 provides two types of port subracks: the MSH2K/OMS3250 and MSH64C/OMS3240 port subracks.

The MSH2K/OMS3250 port subrack layout is illustrated below (Figure 6):

Figure 6: MSH2K/OMS3250 port subrack layout

The MSH64C/OMS3240 port subrack layout is illustrated in Figure 7:

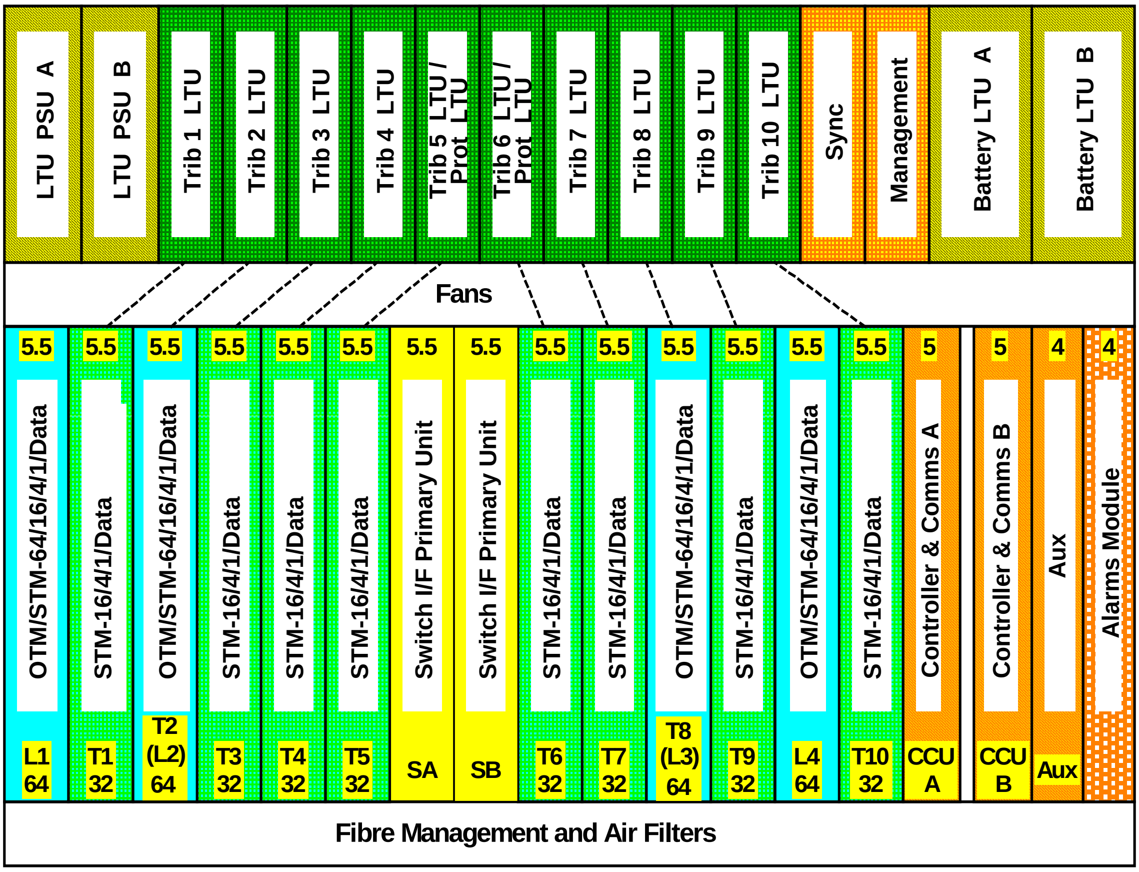


Figure 7: MSH64C/OMS3240 port subrack layout

The MSH64/256R regenerator subrack (10 Gb/s signal regenerator) is available for use in conjunction with the MSH64C/OMS3240 and/or MSH2K/OMS3250 port subracks. It can be equipped as a single or dual regenerator and uses the STM-64 units, configured in regenerator mode.

The regenerator subrack layout is shown below (Figure 8):

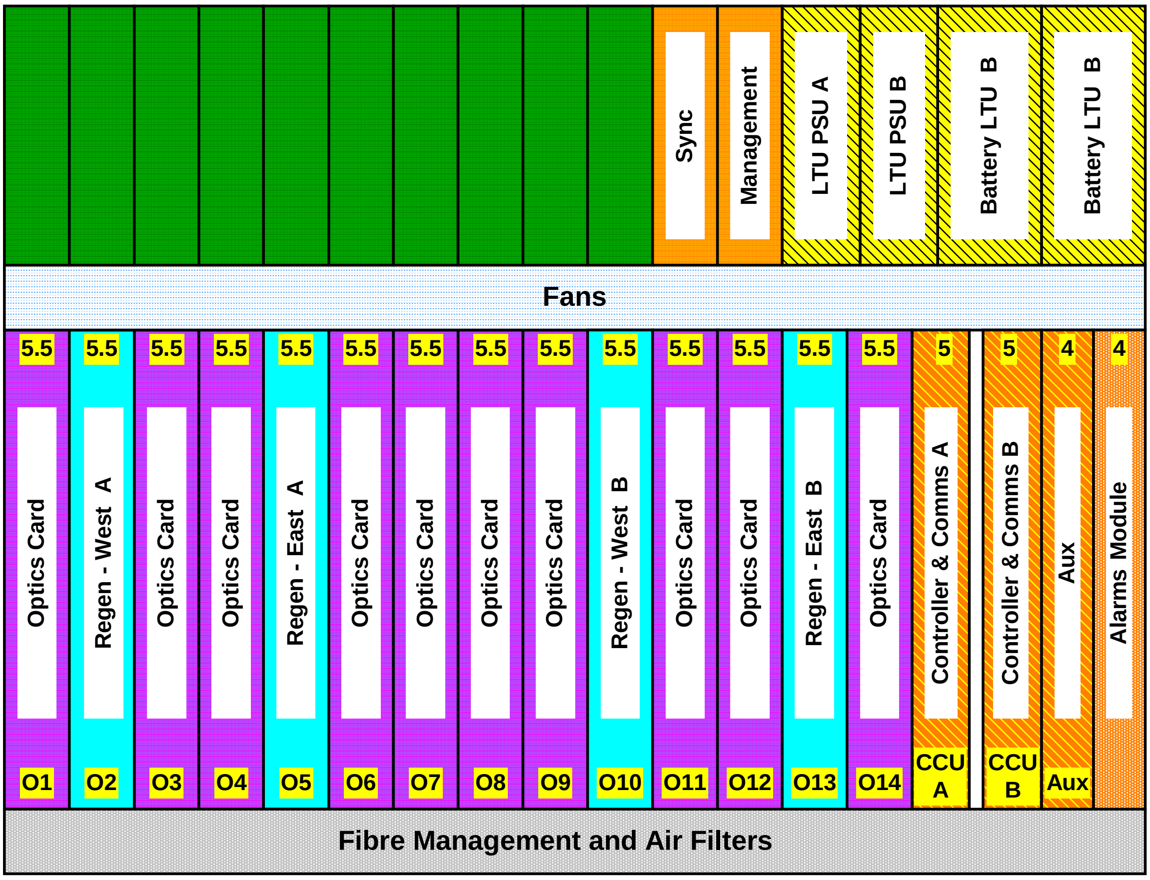


Figure 8: Regenerator Subrack layout

If additional optical units are required (e.g. Booster Amplifier, Preamplifiers), then they can be fitted into any slot of the MSH2K/OMS3250 and/or MSH64C/OMS3240 subracks not occupied by a line/tributary unit.

If more optical units are needed the Amplifier Extension subrack can be used (Figure 9).

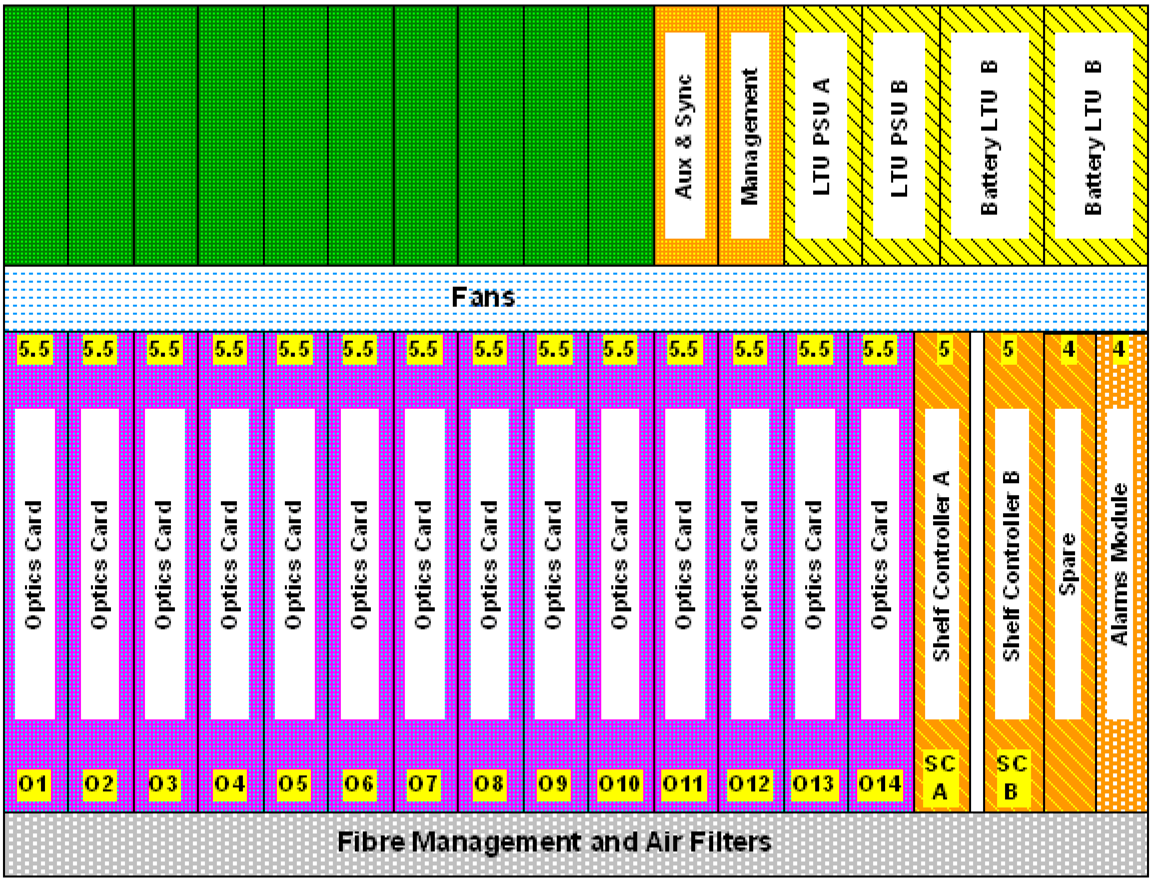


Figure 9: Amplifier Extension Subrack layout

2.2 Types of Ports

OMS3260 can be equipped with the units listed below.

STANDARD SDH INTERFACES:

- 1 × STM-64
- 4 × STM-16
- 8 × STM-4
- 16 × STM-1 opt
- 16 × STM-1 el.

In addition to the SDH cards listed in the above table, each one with its fixed rate/granularity (e.g. 4xSTM-16, 8xSTM-4, 16xSTM-1), OMS3260 can be equipped with an extremely flexible SDH Multirate card - see para. 2.4.1

DATA INTERFACES:

- 10 x GbE
- 10 x Ficon

- 10 x Escon/SBCON
- 10 x Fibre Channel
- 10 x Fast Ethernet
- 10 x DVB-ASI

The above interfaces types can be mixed on one Multiprotocol unit - see para. 2.4.3

- 1 x 10GbE

CONFIGURABLE G.709 PORTS:

- 1 × OTM-0.2 - CBR10G
- 1 x OTM1r.2 (coloured OTN traffic I/F)
- 4 × OTM-0.1 / CBR2G5 (grey) or OTM-1r.1 / CBR2G5 (CWDM)
- open to support 1 × OTM-0.3 - STM-256

2.3 Electrical Interfaces Characteristics

The characteristics for the STM-1 electrical interfaces are in compliance with ITU-T G.703 Recommendations.

2.4 Optical Interfaces Characteristics

The performances of the optical interfaces are in compliance with ITU-T G.691, G.957 or better. The provided optical interfaces, their attenuation ranges and maximum dispersion are as follows (NA means Not Applicable):

STM-1:	S-1.1:	0 - 12 dB	96 ps/nm
	L-1.1/L-1.2/L-1.3	10 - 28 dB	NA / NA / NA
STM-4:	S-4.1	0 - 12 dB	46 ps/nm
	L-4.1	10 - 24 dB	NA
	L-4.2 / L-4.3	10 - 24 dB	1600 ps/nm / NA
STM-16:	I-16	0 - 7 dB	12 ps/nm
	S-16.1:	0 - 12 dB	NA
	L-16.1:	10 - 24 dB	NA
	L-16.2 / L-16.3:	10 - 24 dB	1600 ps/nm / NA
STM-64:	I-64.1r	0 - 4 dB	3.8 ps/nm
	I-64.2r	0 - 7 dB	40 ps/nm
	S-64.1	6 - 11 dB	70 ps/nm
	S-64.2b	3 - 11 dB	800 ps/nm
	L-64.2b / L-64.3 (uses booster)	13 - 22 dB	1600 ps/nm
	V-64.2a (uses booster and preamp)	21 - 36dB	2400 ps/nm

A proprietary STM-64 long-haul card is also available, allowing a 20dB span without a booster.

Application designation: "I" Intra Office, "S" Short-haul, "L" Long-haul.

Suffix number:

- 1 indicates nominal 1310 nm wavelength according to G.652 fibre;
- 2 indicates nominal 1550 nm wavelength according to G.652 fibre for either short-haul and long-haul applications;
- 3 indicates nominal 1550 nm wavelength according to G.653 fibre (i.e. dispersion shifted fibre).

OMS3260 can be equipped with variable Booster Amplifier modules (two per core card) with power output ranges of +5 to +13 dBm and +12 to +18 dBm. Pre-Amplifier modules (two per core card) can also be equipped.

The following additional applications using boosters are available specifically for use on G.653 fibre:

STM-16:	V-16.3 (uses booster)	21 - 36 dB	1600 ps/nm
	V-16.3b17 (uses booster)	28 - 43 dB	1600 ps/nm
STM-64:	V-64.3 (uses booster and preamp)	21 - 37 dB	1600 ps/nm
	U-64.3b12 (uses booster and preamp)	23 - 39 dB	1600 ps/nm
	U-64.3b17 (uses booster and preamp)	28 - 44 dB	1600 ps/nm

For STM-64 opt. Interfaces, if Non-dispersion Shifted Fibre is used (i.e. G.652 fibre) fixed dispersion compensation fibre (DCF) is provided where required.

OMS3260 supports DWDM applications by integrating the following 10Gb/s units, both of which have transmit wavelengths tunable over 16 wavelengths with 50GHz spacing:

- 1xSTM-64 OOB FEC unit supporting a G.709 digital wrapper. This unit provides OTU2/ODU2/RS/MS termination and VC-4 switching;
- 1xOTM-1r.2 unit supporting OTU2 term, ODU1 multiplexing and ODU2/ODU1/VC-4 switching;

In addition OMS3260 is open to support CWDM 2.5Gb/s applications by integrating the 4xOTM-1r.1 unit (supporting OTU1 term and ODU1/VC-4 switching) or the SDH Multirate card. As these cards are provided with hot-pluggable optical transceivers, they can be equipped with SFP modules operating on different lambdas. 2.5Gb/s DWDM applications will also be possible using the same units when suitable SFPs become available.

The basic CWDM application consists of 4 or 8 unidirectional channels with wavelengths ranging from 1471nm to 1611nm with 20nm spacing according to ITU-T Recommendation G.694.2. The associated mux and demux filters are housed in external all-passive filter trays. The 8 channel CWDM filter is also available with an expansion port in order to provide channel upgrade with no traffic interruption, allowing more channels to be accommodated, up to 16 in total, depending on the fibre type and link characteristics. Both Short Haul and Long Haul CWDM modules are available, providing the applications defined in Recommendation G.695. A span loss of typically 22dB (or 21dB) can be achieved for an unamplified single span point to point 4 (or 8) channel configuration over standard G.652 fibre.

The performance of the OMS3250 Optical Line Interfaces can be improved by the FEC function. The FEC would be particularly useful for long-distance systems that suffer from noise accumulation, optical non-linear effects and/or polarisation effects. In Band FEC code is desired to operate within SDH line rates and improves the BER performance. The FEC function can dynamically provide an evaluation of the system margins relatively to the required level of performance. If maintenance of the line appears to be necessary, it can then be planned before any effective degradation of the transmission.

The FEC function essentially comprises:

- FEC encoder in the transmitting Terminal equipment that accepts information bits and adds redundancy, producing encoded data at higher bit rate;
- FEC decoder in the receiving Terminal equipment that performs the error correction while extracting the redundancy to regenerate the data that was encoded by the FEC encoder.

Implementation of the In Band FEC (IB FEC) function uses a Hamming code without modifying the bit rate of the STM-64 line.

Both a proprietary IB FEC and IB FEC as defined in ITU-T G.707 are supported by OMS3260.

Implementation of the Out of Band FEC (OOB FEC) function uses the OTU-2 frame structure (as detailed in figure 11-1/G.709 and Table7-1/G.709) and is supported by OTM-m.2 (m=0, 1r) units.

It is possible to enable/disable the FEC function by a command entered by NMS or LCT.

In case of fibre break an automatic laser shutdown is provided to avoid danger caused by the emission of laser light. The procedure for automatic laser shutdown and restart is based on ITU-T/G. 958 (Appendix 2) and on ITU-T/G.664.

As laser shutdown facility is implemented, as specified in ITU-T G. 958, Section 9.7.

If the Optical Amplifiers are equipped, an automatic power shutdown is provided. The procedures for automatic power shutdown and restart are based on ITU-T G. 681, Section 10 and on ITU-T G.664.

2.4.1 SDH Multirate Card

Three variants of this card provide a maximum of 16, 8 and 4 ports respectively, where each port is equipped with hot-pluggable transceivers. Such transceivers are in the form of SFP modules supporting STM-1, STM-4 and STM-16 with different optical reaches as follows, thus providing a very high degree of flexibility both in terms of traffic management and fibre link length. Each port may be equipped at any time, even after the card has been put into service, without any impairment to the ports already configured.

- STM-1 S-1.1, L-1.1 or L-1.2
- STM-4 S-4.1, L-4.1 or L-4.2
- STM-16 I-16, S-16.1, L-16.1 or L-16.2

SFP electrical modules for STM-1 are foreseen when commercially available.

The SDH Multirate cards can be equipped and programmed to support many different configurations. In their basic form, the cards can be configured to support the following full, single-rate configurations (MULTIPORT functionality) which may also be used to replace previous SDH card types:

- 4xSTM-16;
- 8xSTM-4;
- 16xSTM-1

Then with the addition of a hardware key to enable the MULTIRATE functionality, mixed configurations with STM-1 el, STM-1 opt, STM-4 and STM-16 are also supported, with the constraint not to exceed 1 x STM-64-equivalent bandwidth. Please note that, when the card is used in tributary slots of MSH64C/OMS3240, its maximum bandwidth will be further limited both in single-rate and multi-rate configurations to 2 x STM-16 equivalent. The following table summarises the maximum capacity for each variant of the card:

Card variant	Capacity in OMS3240 Line Slot or in OMS3250	Capacity in OMS3240 Tributary Slot
16 SPF sockets, Multiport	16 x STM-1	16 x STM-1
16 SPF sockets, Multirate	4 x STM-16 or 16 x STM-4 or 12 x STM-1 or a mix of STM-1/4/16	2 x STM-16 or 8 x STM-4 or 12 x STM-1 or a mix of STM-1/4/16
8 SPF sockets, Multiport	8 x STM-4	8 x STM-4
8 SPF sockets, Multirate	2 x STM-16 or 8 x STM-4 or 6 x STM-1 or a mix of STM-1/4/16	2 x STM-16 or 8 x STM-4 or 6 x STM-1 or a mix of STM-1/4/16
4 SPF sockets, Multiport	4 x STM-16	2 x STM-16
4 SPF sockets, Multirate	4 x STM-16 or 4 x STM-4 or a mix of STM-4/16	2 x STM-16 or 2 x STM-4 or a mix of STM-4/16

Table 1: Port capacities for each variant of Multirate card

The card variants support many combinations of mixed STM-1, STM-4 and STM-16 ports in both tributary and line slots. For example, some of the many possible configurations for the 16 port MULTIRATE card equipped in a Line slot are listed below:

- 2 x STM-16 + 2 x STM-4 + 12 x STM-1
- 1 x STM-16 + 6 x STM-4 + 9 x STM-1
- 4 x STM-4 + 12 x STM-1

Marconi Multirate card represents the most flexible and cost-effective solution to provide STM-1/4/16 services. For instance in a node where a low number of different STM-1el/STM-1opt/4/16 signals is required, the user is not forced to equip a card for each type of signal, with the risk to have multiple unused ports. The user can decide to use a single Multirate card to support the required mixed configuration and equip each port as it is required.

2.4.2 Gigabit Ethernet Card

The Gigabit Ethernet cards provide point to point transport of data traffic over SDH, delivered over industry standard Gigabit Ethernet (optical) interfaces.

The Gigabit Ethernet cards are available as tributary cards for the OMS3260.

Key points of the Gigabit Ethernet cards are:

- 4 x 1000BASE-SX, LX , LH and ZX interfaces (provided as SFP optical modules on tributary card) as per IEEE 802.3:
  - Short 850nm Multi-Mode Fibre: 500m
  - Intermediate 1310nm Single Mode Fibre: up to 5km
  - Long 1310nm Single Mode Fibre: up to 10km

- Extra Long 1550nm Single Mode Fibre: up to 80km

- Supports LAN interconnect services (Transparent LAN Service - EPL)
- Cheaper interconnect option for the end user than adding TDM interfaces to his LAN switch/router
- Can upgrade host OMS3260 platform in service, without affecting other services
- Increase range of services and hence revenue from SDH delivery platforms
- No need for a separate LAN switch or router to provide the Gigabit Ethernet interface(s)
- Provide monitored delivery of Ethernet transport services (remotely accessible counters, giving service level information to the operator)
- No need for a separate LAN switch or router to monitor delivery performance
- Map each interface into n x VC-4 capacity across the SDH network
- Remotely configurable, in n x VC-4 steps, up to 1 Gigabit per Ethernet port (7 x VC-4)
- LAPS (X.86))/GFP-F used to map Ethernet frames into SDH
- Ethernet frames from each port can each be mapped into either a separate VC-4, or each into a VC-4-nv virtually concatenated payload, where n is 2 to 7
- LCAS supported
- VC-4-7v provides Gigabit Ethernet transport throughput
- Alternatively, frames can be mapped from each port into a separate VC-4-4c link
- Transparent transport of VLAN frames
- SDH transport protection retained
- Gigabit Ethernet line protection is available

2.4.3 Multi-Protocol Data card

The Multi-Protocol Data card is a tributary card, providing 10 Multi-Protocol user interfaces or one 10 GbE user interface, which maps client signals into SDH Virtual Containers. The type and number of interfaces to be equipped is flexible through the use of pluggable modules (i.e. SFP and XFP). The card provides 11 Sockets: ten can be used when the card is configured as Multi-protocol, while one is dedicated to provide 10GbE services. The types of client signals that can be configured for each Multi-Protocol user interface are divided into three main categories: Ethernet traffic (FastE and GbE), SAN traffic (ESCON/SBCON, Fibre Channel/FICON) and Digital Video (DVB-ASI).

Each client signal is mapped into a single Virtual Concatenation Group through GFP encapsulation. Framed GFP mapping is applied to FastE, GbE and 10 GbE. This type of mapping permits interworking with the Aggregation Data card. The card is open to support Transparent GFP mapping for GbE. Transparent GFP mapping is applied to SAN traffic and DVB-ASI.

The services offered by this card are the same describe in the previous section.

The bandwidth of the SDH Virtual Containers can be flexibly configured in order to carry efficiently Ethernet traffic. Furthermore LCAS bandwidth management protocol can be applied.

Depending on the client signal bandwidth, the GFP encapsulated signals can be transported in the following SDH containers: VC-4, VC-4-nv (n=1 to 64).

2.4.4 Aggregation Data card

The extensive usage of Ethernet connections across the SDH network requires the SDH network to increase functionality to match more and more with the Ethernet L2 needs. The Aggregation Data card covers these needs.

2.4.4.1 L2 transport

Multiplexed Ethernet access:

When a larger number of connections is required per SDH head end node and per core switch or router, using a simple point to point transport service across the SDH network, a break point will be reached in network and equipment costs.

At this site an Aggregation card – presenting these multiple connections as logical flows over a single physical interface – will become the more cost-effective solution. The benefits in utilising such a card include:

- Single connection to core switch/router means less cabling, which is then easier to handle and maintain in the equipment room.
- Single card to present several remote customers to the core switch/router, which means more remote customer served and/or fewer slots used.
- Installation and operational cost savings, as further logical connections can be added remotely once the single interface is installed – no need to make a return visit to add Ethernet link, or to cable multiple Ethernet links on day one.

Ethernet multiplexing into SDH VCGs:

When a number of flows all go (or can be designed to go) from a single site to another, the use of a dedicated VCG per Ethernet flow does not cover all possible services that can be present in the transported Ethernet signal. In the Ethernet Private Line, the service offered to the Ethernet flow can be characterised at SDH level for example via the different type of protection configured (not protected, LCAS protected, SNCP protected, re-routed, fast re-routed via GMPLS…) but in any case a dedicated bandwidth is allocated to it (CIR).

At both ends of the VCG trail (or just at one end if at the other end the flows are presented as aggregated to a core switch/router) an Aggregation card will allow more Ethernet flows to be multiplexed into a single VCG. The benefits in utilising such a card include:

- Increasing the granularity of the network service, no longer limited by the VC-12/VC-4 granularity; in a single VC more than one customer flow can now be transported;

- Increasing the number of services provided; not only a CIR can be set up for an Ethernet flow, but also an EIR can be set up in conjunction with the CIR or just as a unique agreed service.

- Increasing the network bandwidth usage; a service using the EIR can take advantage of bandwidth available in a particular time period, optimising the overall usage of the SDH available bandwidth.

Mixed configurations of multiplexed Ethernet access and Ethernet multiplexing into SDH VCG can also be achieved.

These services are referred as virtual private line (EVPL)

In addition to these, the aggregation card covers EPL applications as in the 4xGigE card.

2.4.4.2 L2 switching:

Layer 2 Switching introduces address learning mechanisms into the transport functions.

The SDH network no longer provides only private lines between local area networks, but also provides an Ethernet bridged network within the operator network.

This service is referred to as virtual private LAN service (EVPLAN).

The Aggregation card configured for the L2 switching function avoids the need for an external Ethernet switch device. The benefits in utilising such a card include:

- Increasing the level of service provided by the SDH operator to the Ethernet customer

- Installation and operational cost savings, as SDH and switching functions are concentrated in one site and one device.

The card has on Ethernet side 8 GigE plus 4 FastE/Eth interfaces on the front of the card and 12 additional FastE/Eth are provided in the LTU area. On the SDH side a bandwidth of 32 STM-1 equivalents is provided, giving a total capacity of 10G full duplex. The Ethernet flows are mapped SDH side via GFP-F into VCGs that can be VC-4-nv, VC-3-nv and VC-12-nv, with or without LCAS.

Please note that the card is able to terminate trails both at VC-4 level and at LO-VC level, avoiding the use of the LO switch where all LO VCs pertaining the Ethernet flows are presented in the right number of VC-4s.

The card inter-works with Ethernet cards using GFP-F mapping across all platforms within the Marconi portfolio, both ‘mapper’ cards (i.e. providing just EPL, like 4xGigE or multiprotocol cards) and ‘aggregation’ cards.

According to the importance of high quality data networks for business applications the performance management is based on several mechanisms:

- on the SDH performance management according to ITU-T G. 826 and 829

- on the Ethernet port management counters based on RMON and RFC2665

- additional SDH-class data transport performance and alarm management based on traffic measurements like packet loss and defect frames, which allows the monitoring of the complete customer traffic flow similar to the way it is already provided for SDH networks.

2.4.5 OTM cards

OMS3260 supports 10G and 4x2.5G cards handling OTM-0/1r.k signals. The following types of cards are available:

- 4xCBR2G5/OTM-0.1;
- 1xCBR10G/OTM-0.2;
- 1xOTM-1r.2.

The first two types are double bit-rate cards. Each port of the card can be configured to accept two different signals from the line:

- CBR2G5 and CBR10G: signals with a Constant Bit Rate of 2 488 320 Kbit/s ± 20 ppm and 9 953 280 kbit/s ± 20 ppm respectively. Examples of these signals are the STM-16 or OC-48, for the CBR2G5, and the STM-64 or OC-192 signal, for the CBR10G, as defined in G.709;
- OTM-0.1 and OTM-0.2 signals as defined in G.709.

In addition a specific 'Coloured' 10Gb/s card version is available (i.e. 1xOTM-1r.2), while the equivalent for the 2.5Gb/s application (i.e. 4xOTM-1r.1) can be obtained plugging 'Coloured' SFP on the card.

Figure 10 shows a generic diagram of the features provided by the OTM-0.2/1r.2 card.

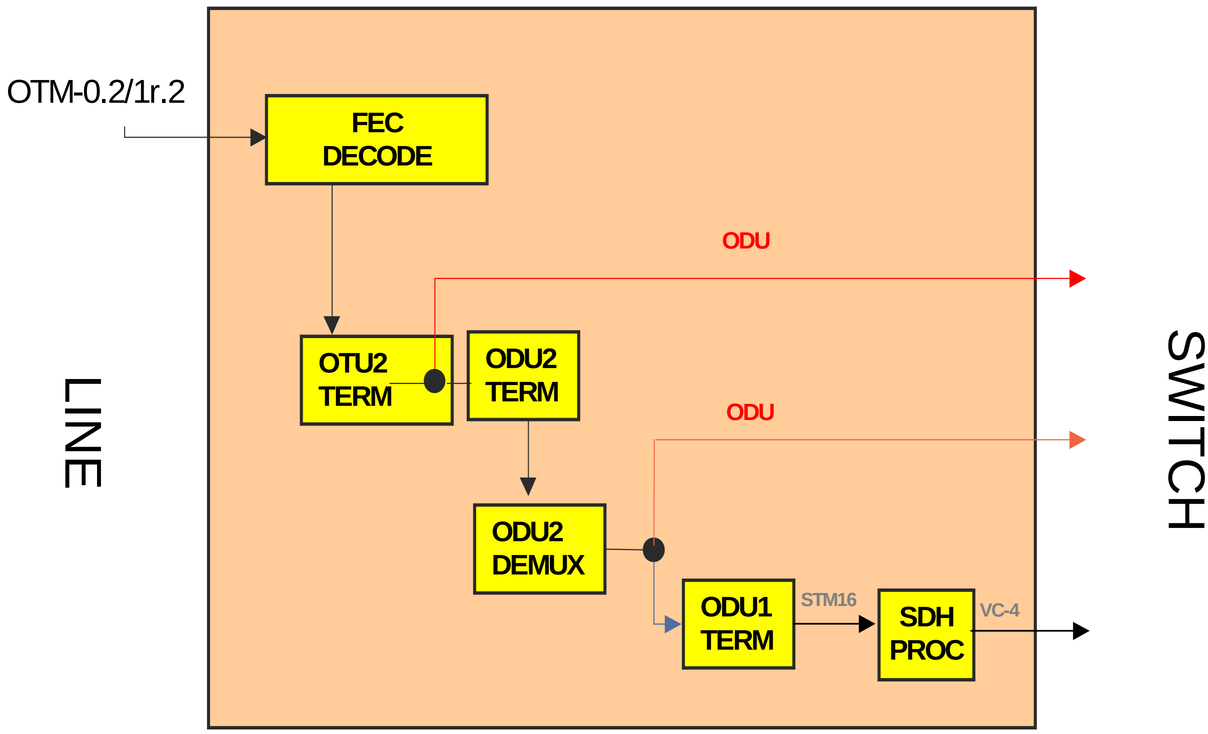


Figure 10: features provided by the OTM-0.2/1r.2 card

If CBR10G frame is received from the line side, the following signal processing is available:

- Mapping of CBR10G signal into ODU2 signal. In this case the equipment is used as gateway between the client and the OTN. The ingress card performs the mapping of the CBR10G signal into the ODU2 according to G.709. After the cross-connection the ODU2 is processed by the egress card to obtain an OTM-0.2/1r.2 signal. In the Switch to Line direction the CBR10G signal is extracted from the ODU2 received from the switching subsystem;

If OTM0.2/OTM1r.2 frame is received from the line side, the following signal processing is available:

- ODU2 cross-connection: In the Line to Switch direction the card first performs error correction decoding the G.709 RS FEC, if enabled, and then terminates the incoming OTU2 frame. The ODU2 is then passed to the switching core for cross-connection. In the Switch Side to Line Side direction the OTU2 frame is generated and, if enabled, FEC is encoded.

- STM-64 termination/generation (option available only for the 'Coloured' version of the card). The ingress card extracts the STM-64 clients from the ODU2 and terminates it down to VC-4 level. In the switch to line direction the VC-4's received from the switch are assembled into an STM-64 and then mapped into ODU2 and subsequently into OTU2 together with FEC encoding (if enabled), in order to forward towards the line the outgoing OTN frame.

- ODU1 multiplexing. In the Line to Switch direction the card performs OTU2 termination and de-multiplexing of ODU2 into 4 x ODU1. At this point the card is able to perform on each ODU1 one of the following actions:

    - ODU1 cross-connection. The ODU1 is passed to the switching core. In the opposite sense the received ODU1 is multiplexed, with other three ODU1's, into a single ODU2 and then mapped into the outgoing OTU2 frame;

    - VC-n cross-connection. The card performs also the extraction of the STM-16 signal from the ODU1, and its termination down to VC-4 level. In the Switch to Line direction the card receives VC-n from the switching core, generates a STM-16 signal, maps it into an ODU1 and then performs ODU1 multiplexing.

Similar processing is available on the 4x2.5Gb/s card apart from the ODU multiplexing and the FEC processing. In addition, if the signal received from the line is STM-16, the port can be configured to perform the 'classic' SDH processing. On this card each port can be independently configured (e.g. two ports can be configured as OTM, while the other two as CBR2G5.

3 Mapping & multiplexing functions

The Mapping and Multiplexing functions provide the capability of mapping, aligning and multiplexing bi-directional logical channels between the SDH physical interfaces. The multiplexing structure used in the equipment is according to ETSI ETS 300 147 and ITU-T G.707.

OMS3260 is open to support the concatenation of up to two hundred and fifty-six (256) contiguous AU-4s according to G.707, using concatenation indication.

OMS3260 also supports the concatenation of four or sixteen (4/16) contiguous AU-4s, by converting them into virtual concatenated AU-4s using the STM-16/STM-4 C/V card (both VC-4-4c and VC-4-16c Contiguous to Virtual conversion are supported). The STM-16/STM-4 C/V card, that uses hot-pluggable optical transceivers, can be configured as:

- 1xSTM-16 AU4-16c/16v or AU4-4c/4v converter;
- 4xSTM-4 AU4-4c/4v converter.

The use of this unit at the edge of a network, permits to provide a VC-4-4c/16c service even if the network doesn't support the routing of VC-4-4c/16c containers.

OMS3260 also allows the mapping of client signal over ODU according to G.709 and ODU multiplexing according to G.709.

SONET transport over SDH can be supported, ie STS-3c carried as AU-4, STS-12c carried as AU-4-4c, STS-48c carried as AU-4-16c and STS-192c carried as AU-4-64c. The SS bits in the AU-4 pointer can be configured to support this.

3.1 Connectivity

The equipment cross connection features are performed by the Switching Matrix and they can be realised at ODUk (K=1,2) level or at VC-4, VC-4-xc (x = 4, 16, 64) level. Optionally LO-VC switching capacity can be provided.

The basic functions of the OMS3260 Switching Matrix subsystem are:

- non blocking: the probability that a particular connection request cannot be met is 0;
- full connectivity: it is possible to connect any input to each available output;
- time sequence integrity (concatenated payloads): concatenated payloads are switched without breaking the time sequence integrity;
- assured correctness of cross-connections: correct cross-connections between the right traffic ports is assured.

The Switching Matrix has a 3-stage Clos structure, and it allows cross-connections for a capacity of 6144 STM-1 equivalent signals.

OMS3260 is designed in order to be upgraded in service to further configurations with higher capacity. The maximum switching capacity (of 6144 STM-1 equivalent) can be achieved in a scalable/non traffic affecting upgrade.

Additionally it is possible to migrate from MSH2K/OMS3250 to OMS3260 by an in-service upgrade.

MSH64C/OMS3240 and MSH2K/OMS3250 can be used as an SDH/ODU port subrack of the OMS3260.

4 Network Applications

OMS3260 has a particular application in the emerging Optical Transport Network, equivalent to the one represented by DXC 4/4 in the present SDH network: a point of maximum flexibility inside the OTN.

OMS3260 is the main candidate to be used as link point between the optical backbone and the lower SDH layer.

In fact the capability to cross-connect ODUk, with the possibility to cross-connect at VC-4 level allows an operator to have, in an unique equipment, the functionality performed by an Optical Cross-connect and a DXC 4/4 (please refer to Figure 11 and Figure 12), with the possibility to add LO-VC switching capability.

OMS3260 merges the benefits of an electrical core (e.g. easier performance monitoring and fault location, traffic grooming, wavelength conversion, regeneration of the signals) and the key benefit, typical of an OXC, of data rate transparency.

Additionally the capability to perform the mapping of CBR signals into the OPU/ODU/OTU (the containers of OTN defined by G.709) permits the OMS3260 to be used as a gateway between the OTN and SDH layers (please refer to Figure 13).

The location of OMS3260 is at the boundary between a SDH network and an OTN.

The availability of the tuneable coloured OTN traffic interface provide OMS3260 with a cost-effective and flexible connection toward the photonic layer and eliminates the use of optical transponders.

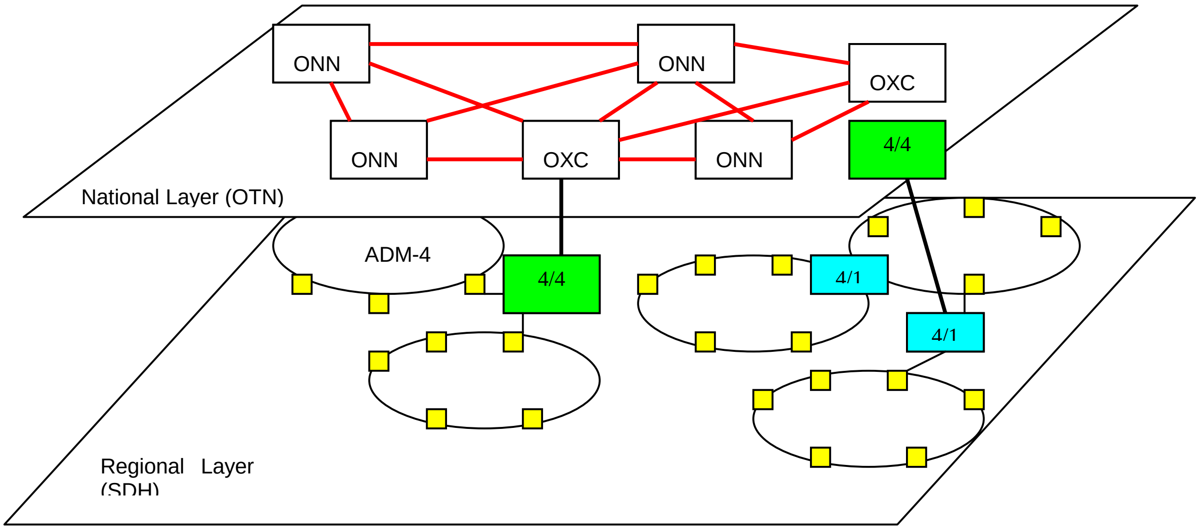


Figure 11: Network layers interconnections using OXC and DXC 4/4/3

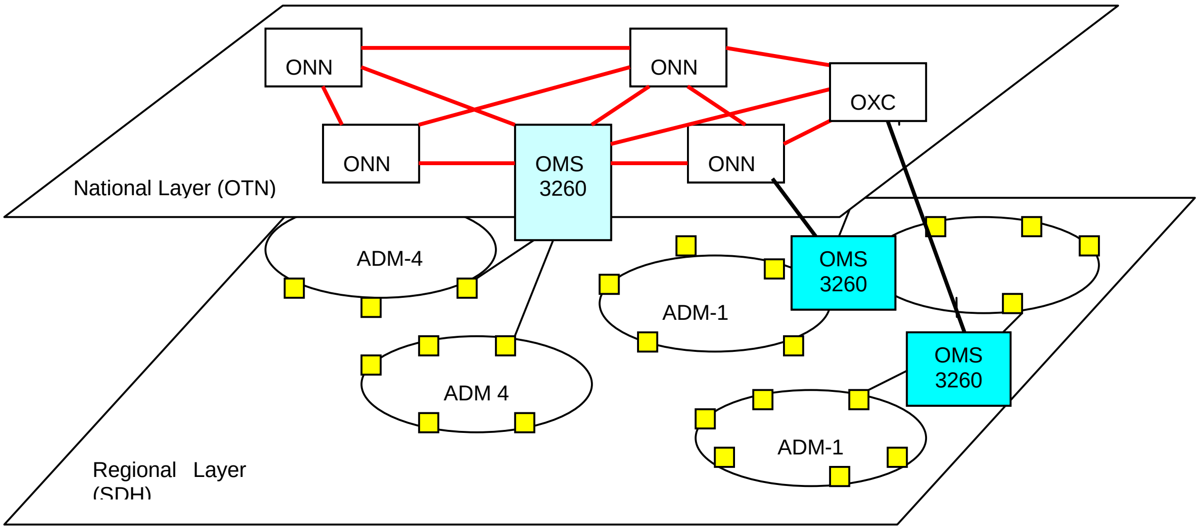


Figure 12: Network layers interconnections using OMS3260

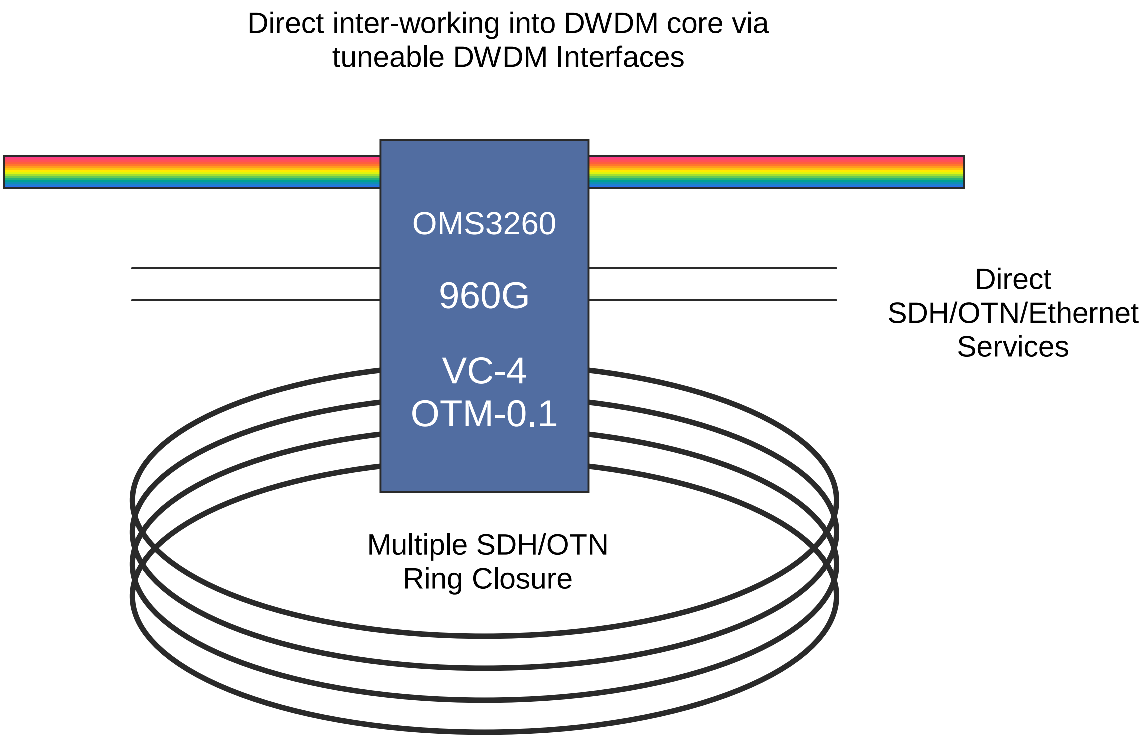


Figure 13: OMS3260 flexibility

The main application is the provision of an automatic reconfiguration of channels through the network. Semi-permanent time-limited connections can be realised under a pre-programmed command. In general, these functions are provided by an external NMS, or by means of the emerging GMPLS mechanism.

5 Equipment Structure

5.1 Mechanical Structure

OMS3260 has a layout similar to the previous SDH DXC (i.e. MSH8x/9x), including a central core for the switching and control subsystems (in 1+1 configuration) and peripheral port subracks. The switching matrix has a centralised structure (i.e. three stages Clos matrix in the same subrack).

Despite of the great amount of traffic supported, OMS3260 guarantees a minimum space occupation.

OMS3260 is composed of subracks designed according to the requirements of ETSI specification ETS 300-119-4.

Each of those subracks is designed to fit within racks designed according to the requirements of ETSI specification ETS 300-119-3.

OMS3260 layout, shown in Figure 14, consists of:

- a single depth (600×300mm, but preferentially 900×300 mm) rack housing the OMS3260 core and core protection subracks (please, note that is possible to fit the core subracks in two different racks and, also, in two different rooms - up to 50m distant).

  Please note that the OMS3260 requires no rear access, so the core subrack can be mounted back-to-back or against a wall.

- single depth (600×300mm, but preferentially 900×300 mm) racks, each housing up to a maximum of 40 peripheral high density port subracks (MSH2K/OMS3250 and/or MSH64C/OMS3240 subracks).

  Note that the OMS3260 reaches the fully equipped configuration by using only 3 MSH2K/OMS3250 port subracks giving a total of 4 racks.

  The port subracks can be located up to 100m away from the core subracks and they can also be mounted back-to-back or against a wall.

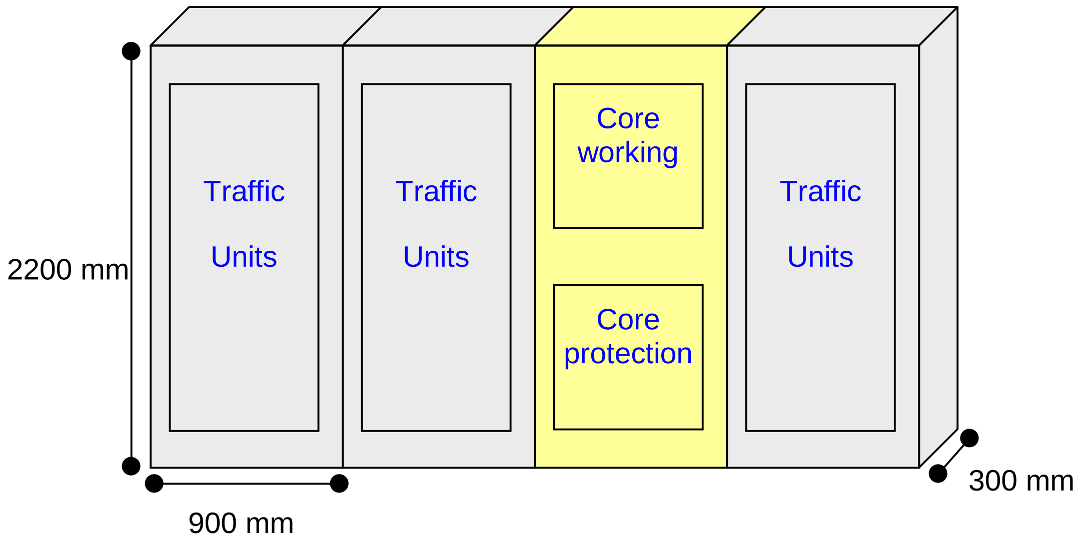


Figure 14: Layout example of OMS3260 fully equipped

6 Alarms

Alarms raised by OMS3260 and the related processing are based on ITU-T G.783 and G.784 requirements for SDH signals and on ITU-T G.798 for OTM-N.

Alarms from each unit are collected and processed by the Central Control Unit, which performs the functions listed below:

- alarm inhibition;
- assignment of a category (e.g., urgent, not urgent) to each alarm;
- alarm reduction (removal of consequential alarms);
- alarm prioritisation: a priority value is assigned to each alarm, depending on its type and source;
- alarm filtering, logging and reporting: capability of selecting, through the above mentioned priorities, the alarm destination (the NMS and/or the local alarm log and/or the LCT);
- driving of equipment alarm displays and ground contacts.

All the alarm processing functions can be configured via NMS or LCT.

A cyclic local alarm log is available within the equipment.

Alarms can be indicated by lamps/ground contacts, sent to the LCT and to the NMS.

Visual indications are provided to indicate both the alarmed equipment and, in case of internal fault, the affected unit. Either by the LCT or by the NMS, the operator is supported during the maintenance operation, e.g., with fault location and testing functions.

7 Equipment Protection

OMS3260 has been designed in order to guarantee a high level of availability.

All the common parts of the equipment ('Switching Matrix and Timing Subsystem', and 'Control and Communication Subsystems'), are fully duplicated. The functionality of the equipment is monitored by an alarm system and by built-in test patterns, which allow the cross-connected paths between the ports to be monitored in service without affecting traffic.

The protected units within the equipment are:

- Switching Matrix and Timing Subsystem (1+1)
- Control and Communication Subsystem (i.e., Q and QECC management) (1+1)
- Control and Communication connections to peripheral subracks (1+1)
- Power Supply (1+1)
- Control Unit on Port Subracks (1+1)
- Connection Units (on Port Subracks) towards the switch (1+1)

8 Network Protection

Network protection is available at each traffic level (i.e. VC-n and STM-N).

In addition to the standard SDH protection (i.e. MSP, 2F/4F MS-SPRING and SNCP), features for the protection of ODU are adopted (i.e. SNC/I and SNC/N).

In order to assure the insertion of OMS3260 into the OTN (Optical Transport Network) a wide range of protection mechanisms are provided.

OMS3260 is able to support network restoration functionality.

Mixed protection can also be applied, for example MS SPRING and SNCP.

8.1 MSP protection

The MSP function provides protection for the STM-N signal against channel-associated failures within a multiplex section. All possible options specified for the "Multiplex Section Protection (MSP) Protocol" (bytes K1 and K2), as defined in ITU-T/G.783 and G.841, can be used.

The following criteria can be used at the receive end for switching to the protection path:

- Signal Fail (LOS, LOF, MS-AIS, Excessive BER) at section level
- Signal Degrade (BER exceeds a preset threshold in the range of 10^{-5} to 10^{-9})
- Command from the Local Terminal or from ServiceOn Optical Element Manager and Management System.

On the STM-1/4/16/64 tributary interfaces, MSP protection is available, using a 1+1 or 1:N architecture.

When the MSP 1:N (N≥1) is provided, optional extra traffic is supported.

8.2 MS-SPRing Protection

OMS3260 equipment provides the MS-SPRing ("SDH Multiplex Section Shared Protection Ring") protection mechanism. Its general features are defined in ITU-T Rec. 803, while the complete description of the protocol can be found in ITU-T Rec. G.841. Both two and four fibre options are supported.

The MS-SPRing protocol manages the NUT (Non Pre-emptable Unprotected Traffic) as defined in the latest G.841 version.

The equipment can be configured for particular network applications to support multiple rings each protected by MS-SPRing.

MS-SPRing is characterised by dividing the total payload (in every STM-N link) equally into working and protection capacity. The working traffic is bi-directional over a single path (e.g. A-B and B-A in Figure 15). The protection capacity is shared by all the working sections and not dedicated to each connection on the ring.

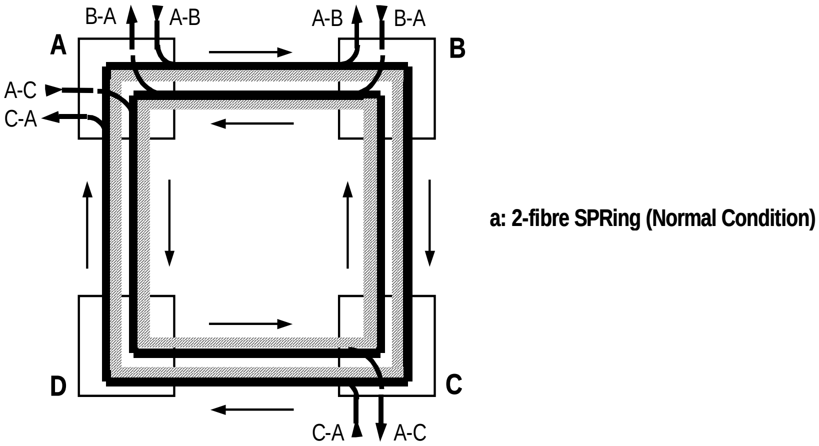


Figure 15: Two fibre MS-SPRing (Normal Condition)

In case of link or node failure a loopback is performed at the nodes adjacent to the failed link or node (see Figure 16 and Figure 17).

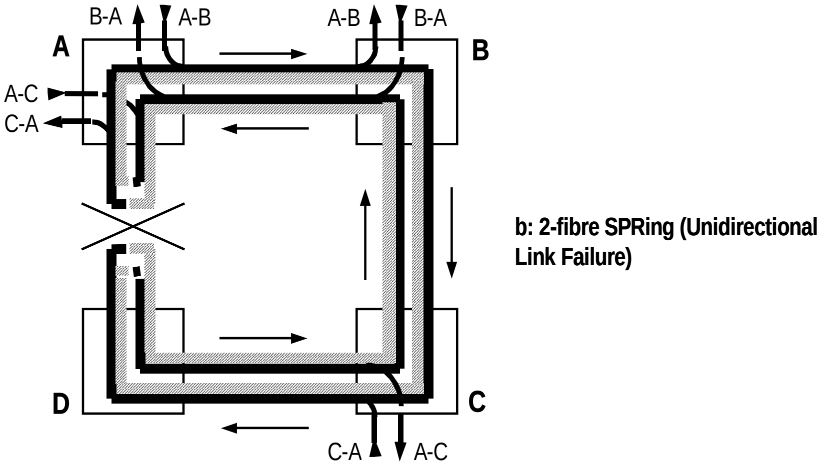


Figure 16: Two fibre MS-SPRing (Unidirectional Link Failure)

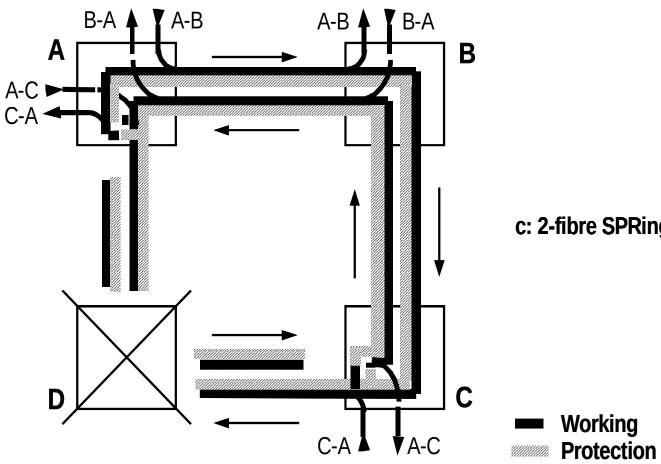


Figure 17: Two fibre MS-SPRing (Node Failure)

The relevant Switch Matrix Unit implements the loopback. The protection mechanism can be activated by the following criteria:

- Signal Fail at section level (LOS, LOF, MS-AIS, excessive BER);
- Signal Degrade (BER exceeds a preset threshold in the range of 10^{-5} to 10^{-9});
- Command from the Local Terminal or Element Manager.

All these procedures are managed by an appropriate APS (Automatic Protection Switching) protocol provided by K1, K2 bytes. As an option low priority traffic can be managed.

8.3 Ring Interworking Protection

Inter-working SDH protection architectures is meant to provide an even greater degree of protection within a network. Ring inter-working is accommodated in such a way that if two rings are connected at more than one node each, a failure at one of these nodes shall not cause loss of any service.

OMS3260 supports interworking between SNCP protected rings, MS-SPRing protected rings and mixtures of the two, according to ITU-T G.842. Overlapping SNCP should be used as an alternative and simpler method.

8.4 OTN Protection

OMS3260 supports the following types of protection architectures for an OTN network:

- Inherent Subnetwork Connection Protection (SNC/I) on ODUk (that is equivalent, for switching criteria point of view, to an OTUk Trail protection);
- Non-intrusive Subnetwork Connection Protection (SNC/N) on ODUk;

Each protection application makes use of pre-assigned capacity between nodes.

The following ODUk protection architectures can be supported:

- <u>1+1 unidirectional SNC/N and SNC/I</u>

  In these architectures, a permanent bridge is utilised at the transmit end. At the receiver end, a protection switch is realized by selecting one of the signals based on purely local information.

  For protection switching criteria, non-intrusive (SNC/N) or server layer (SNC/I) monitoring shall be used.

- <u>1+1 bi-directional SNC/N and SNC</u>/I

  In these architectures, a permanent bridge is utilised at the transmit end. At the receive end, a protection switch is realised by selecting one of the signals based on local or remote information. For protection switching criteria, non-intrusive (SNC/N) or server layer (SNC/I) monitoring is used.

  These types of protection use the automatic protection switching protocol (APS).

- <u>1:N an SNC/I protection</u>

  In this architecture N working subnetwork connections that are to be protected share an additional subnetwork connection for protection purposes. In a normal condition, this protection capacity can be used to carry lower priority “extra traffic”. This extra traffic itself is not protected and is to be replaced by higher priority working traffic under failure conditions. This architecture requires the APS as protection control.

For protection switching criteria, server layer (SNC/I) monitoring is used.

The architecture can be unidirectional or bi-directional.

For 1+1 architecture the revertive or non-revertive mode of operations is available.

For each type of protection, a manual external command is available to the operator.

8.5 OS Restoration

It is possible to perform network protection using rerouting. This protection scheme is mainly operated by the network management system using the capabilities of cross-connection reconfiguration offered by OMS3260.

Spare capacity is reserved on each link of a meshed network in order to provide alternative routes on which traffic can be transported. In case of cable break the traffic transported by the failed link is redirected along pre-programmed or on-line calculated alternative routes using the available reserved capacity.

8.6 Fast Restoration

As well as conventional SDH protection schemes the OMS3260 supports ITU-T (ASON/ASTN) based fast network restoration. This method of protection is particularly effective in mesh network architectures.

The OMS3260 simultaneously supports all SDH protection schemes and network restoration making it the ideal switching solution for operators wishing to migrate from one scheme to another. The Marconi solution offers full scalability to meet the needs of large operators who typically could have hundreds of dynamic elements in their networks.

Spare capacity is reserved on each link of a meshed network, in order to provide alternative routes on which traffic can be transported. In case of a cable break the traffic transported by the failed link is redirected along pre-programmed or on-line calculated alternative routes using the available reserved capacity.

This protection scheme can be applied at any cross-connected level, i.e. VC4, VC4-nc and ODU.

9 AUTOMATIC SWITCHING TRANSPORT NETWORK with OMS3260

The OMS3260 may be introduced into an existing network to provide a new layer of transport network where the concept of ASTN can be applied to achieve faster trail routing, connection set-up and tear down and fast network restoration.

All those operations are currently carried out by the traditional Network Management System with typical execution time in the order of minutes, while a distributed intelligence would allow the same operations to be carried out in hundreds of milliseconds.

The ASTN control plane will allow faster connection set-up thanks to improved automatic routing algorithms and signaling. Such mechanisms allow faster implementation of on-the-fly restoration mechanisms.

The distributed intelligence enables the first NE to recalculate the path and signal the restoration route throughout the network, thus implementing fast restoration mechanisms with the sharing of restoration resources.

UNI interfaces will also be available to support OVPN services and direct connection set-up and tear down from client interfaces.

The ASTN functionality has been realised in three phases:

<u>1. Fully centralised implementation</u> - The function is implemented in a fully centralised solution. UNI interface is implemented in the centralised application. All the network topology information is automatically handled by the function. This implementation can be applied to all network products (including legacy) without a network element field upgrade. Such a centralised solution is provided with NNI and NMI interface to allow interworking with the other control planes.

<u>2. Centralised routing function, distributed routing protocol</u> - A signalling protocol is implemented in the embedded software of the network elements, this will speed up the path implementation process. The signalling protocol is compatible with the traditional OSI based DCN. For some protection schemes, the network elements will also have the capability to store the alternate route without implementing it prior to failure occurrence. The path computation function will remain centralised.

<u>3. Fully distributed implementation</u> - Fully standard UNI interfaces are integrated in the network elements, thus avoiding the need for adapter devices. A fully distributed control plane is available directly in the network elements. This features a Link Management Protocol (LMP) for automatic neighbour discovery, an IP-based Link State Routing Protocol (OSPF-TE) for automatic topology and resource discovery and a signalling protocol with explicit routing capability (RSVP-TE). Centralised functions (e.g., client database) will continue to be supported.

10 Performance Monitoring and Management

Performance Management refers to the capability of controlling the Performance Monitoring process by means of the generation of performance data, the reporting of performance data, and the reporting of threshold crossing.

The monitoring of performance parameters is based on the evaluation of errored blocks (EB). OMS3260 is able to perform Performance Monitoring at SDH and OTN level.

Performance Monitoring and Management are in accordance with ITU-T Recs. G.784, G.826, G.828, G.829, G7710, G874, G798.

The parameters that are related to the performance monitoring are provided in the following:

- BBE (Background Block Error);
- ES (Errored Second);
- SES (Severely Errored Second);
- OFS (Out of Frame Second, only SDH);
- SEP (Severely Errored Period, only OTN)
- FCE (FEC Corrected Errors, only OTN)

The following additional parameters can be optionally monitored:

- CSES (Consecutive SES);
- UAS (Unavailable Seconds);
- AU PJE (Negative/Positive Administrative Unit Pointer Justification Events, only SDH).

All these parameters are evaluated and stored in 15 min and 24 hr registers according to G.784 requirements.

Such performance data is available to the System Manager (operator) (see Equipment Management).

11 Equipment Management

OMS3260 can be monitored and controlled via:

- F interface to a LCT (Personal Computer equipped with appropriate operating system and application software);
- Q interface, to the NMS; on the basis of ITU-T Recs. Q.811 and Q.812 (formerly in ITU-T G.773).
- QECC (from an STM-N interface), as defined by ITU-T Rec. G.784;
- GMPLS (General Multi-Protocol Label Switching) mechanism.

The equipment also supports TCP/IP interface.

The provided OAM&P (Operations, administration, maintenance and provisioning) functions are in accordance with ITU-T/G.784. In particular it is possible to perform:

- configuration management:
- provisioning (configuration of all equipment characteristics, e.g. internal channel routing);
- protection switching management;
- installation;
- fault (maintenance) management:
- alarm surveillance (collection, filtering, reporting);
- testing (equipment and connections);
- performance management:
- performance data collection;
- performance data reporting;
- general functions (e.g. security, software download).

The equipment supports the ITU-T/ETSI standard information model.

More precisely, OMS3260 is designed to support the information model based on:

- ITU-T Recommendations M.3100, G.774;
- ETSI ETS 300 304, ETS 300 371.

12 Services

Communication channels for service functions can be provided using STM-N overhead bytes. All SOH and POH associated accessible bytes are made available, according to Recommendation ITU-T G.707, at the optional Auxiliary subsystem connectors in order to allow customisation of service transport. The optional Auxiliary Unit performs these functions on the equipment.

The following type of services and interfaces are available:

- EOW using E1/E2 bytes with 2 wire analogue interface;
- Data channels transported by standard interfaces.

13 General operating features

The equipment assists the operators in many common tasks, defined as general operating features, related with:

- equipment use;
- plug-in unit handling;
- fault maintenance (self diagnostic);
- recovery from faults;
- equipment robustness;
- inventory.

13.1 Equipment Use

The equipment is designed to support the operator during installation and to provide useful facilities like manual restart, software and hardware consistency check, and the possibility of upgrading the system functionality without disturbing traffic.

13.2 Plug-in Unit Handling

Replacement of one plug-in unit with one of the same type does not require any reconfiguration on all the other units on the shelf. The newly inserted unit is automatically configured the same as the extracted one.

Removal and insertion of the units are reported to the management system.

13.3 Fault Management (Self Diagnostic)

Built-in diagnostic facilities identify the unit that requires to be changed or the faulty interface, for all faults occurring within the equipment are detectable at its interfaces.

This operation is carried out automatically using non-intrusive monitoring inside the network element.

Management and operation of the diagnostic facilities are available both from a remote location and from local operation. The equipment is capable of:

- automatically transferring an alarm report with data about the failure to a remote management centre immediately on detection of a failure;
- automatically switching on detecting a fault to the protection units, if duplicated units are installed.

13.4 Recovery From Faults

A failure in the control unit does not cause traffic outage or affect the operation of network protection. The control unit contains and updates a complete and accurate Management Information Base that corresponds to the hardware state of the equipment.

13.5 Equipment Robustness

The equipment is designed to protect the system data against unintentional modifications.

13.6 Inventory

The equipment maintains a record of all its component units. Each equipment is modelled as a collection of managed objects as detailed in ITU-T Rec. G.774 SDH Information Model.

The equipment performs the following features:

- the Electronic Inventory Data is automatically updated at all times and is the current record of all the parts forming the equipment;
- all inventory information held by the equipment is accessible by the LCT and NMS;
- physical details (e.g. code, serial number, version) of all the hardware and software parts which form the equipment are stored.
- the storage of inventory data within the equipment is non-volatile;
- all inventory information relating to a network element can be accessed remotely

14 Technical Specifications

14.1 Electrical Environment

The equipment is in compliance with: EEC Council Directive 89/336/EEC;

ETS 300 386-2 (EMC/EMI/ESD).

The requirements are met by the subrack alone and do not rely on any features of the rack.

14.2 Climatic and Mechanical Environment

14.2.1 General

The minimal classes of environmental conditions, their severity and general definitions are specified according to ETSI ETS 300-019-1-0.

14.2.2 Storage Endurance

Storage endurance minimal requirements are according to ETSI ETS 300 019-1-1, Class 1.2, "Non temperature controlled storage locations".

14.2.3 Transport Endurance

Transport endurance minimal requirements are according to ETSI ETS 300 019-1-2, Class 2.3, "Public Transportation".

14.2.4 Environmental Endurance For Indoor Operation

Weather-protected stationary use endurance minimal requirements are according to ETSI ETS 300 019-1-3, Class 3.2, "Partly temperature controlled locations".

14.3 System Performance

14.3.1 Error Performance

The general error performance is that no errors are introduced into traffic by the equipment under the most adverse environmental and operational conditions specified.

14.3.2 Transmission Delay

The delay times for a transmission signal from its input to its output for multiplexing functions is $\leq 125\ \mu s$.

14.4 Power Requirements (according to ETSI ETS 300-132)

The equipment operates without pre-setting in the range -38.4 to -72 V, suitable for the battery voltages (supplied by two separate fuse protected and diode connected parallel lines).

Supply voltages: -48V +/- 20%

-60V +/- 20%

The power supply from the mains (duplicated) is also possible by using external AC/DC converters suitable for rack mounting and located on a different shelf.

Earthing is in accordance with ETSI standard ETS 300 253.

14.5 Synchronisation

Synchronisation sources available:

- Independent external reference input:

  2 MHz G.703-13

  2 Mb/s framed G.703-9, G.706

  2 Mb/s unframed G.703-9;

- Recovered tributary timing derived STM-N tributary interface
- Internal oscillator on the Switch Unit (stab. better than 4.6 ppm. acc. to G.813)
- Independent synchronisation outputs are available:

  2 MHz G.703-13

  2 Mb/s framed G.703-9, G.706 with SSM

  2 Mb/s framed G.703-9, G.706 w/o SSM

14.6 Safety

14.6.1 General

The equipment is designed not to cause any harm or danger to personnel installing, maintaining or operating the equipment, and not to produce any damage to the network or other equipment connected to it.

14.6.2 Optical safety requirements

The automatic laser shutdown function complies with ITU-T G.958/G.664.

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