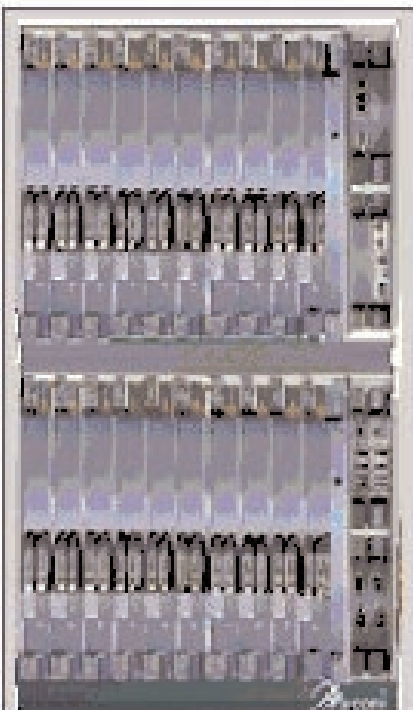




# Every bit better

Multihaul 3000 reduces cost per bit km from metro to core



Marconi Multihaul 3000 is a single, versatile DWDM platform offering unique flexibility, best-in-class performance and operational synergies for highly optimized applications ranging from metro to ultra-long-haul.

Incorporating a wide range of consolidated world firsts, as well as innovative future-proof technologies, Multihaul 3000 improves an operator's business planning, offering low first-in costs and minimal incremental investment as the network expands to accommodate new services.

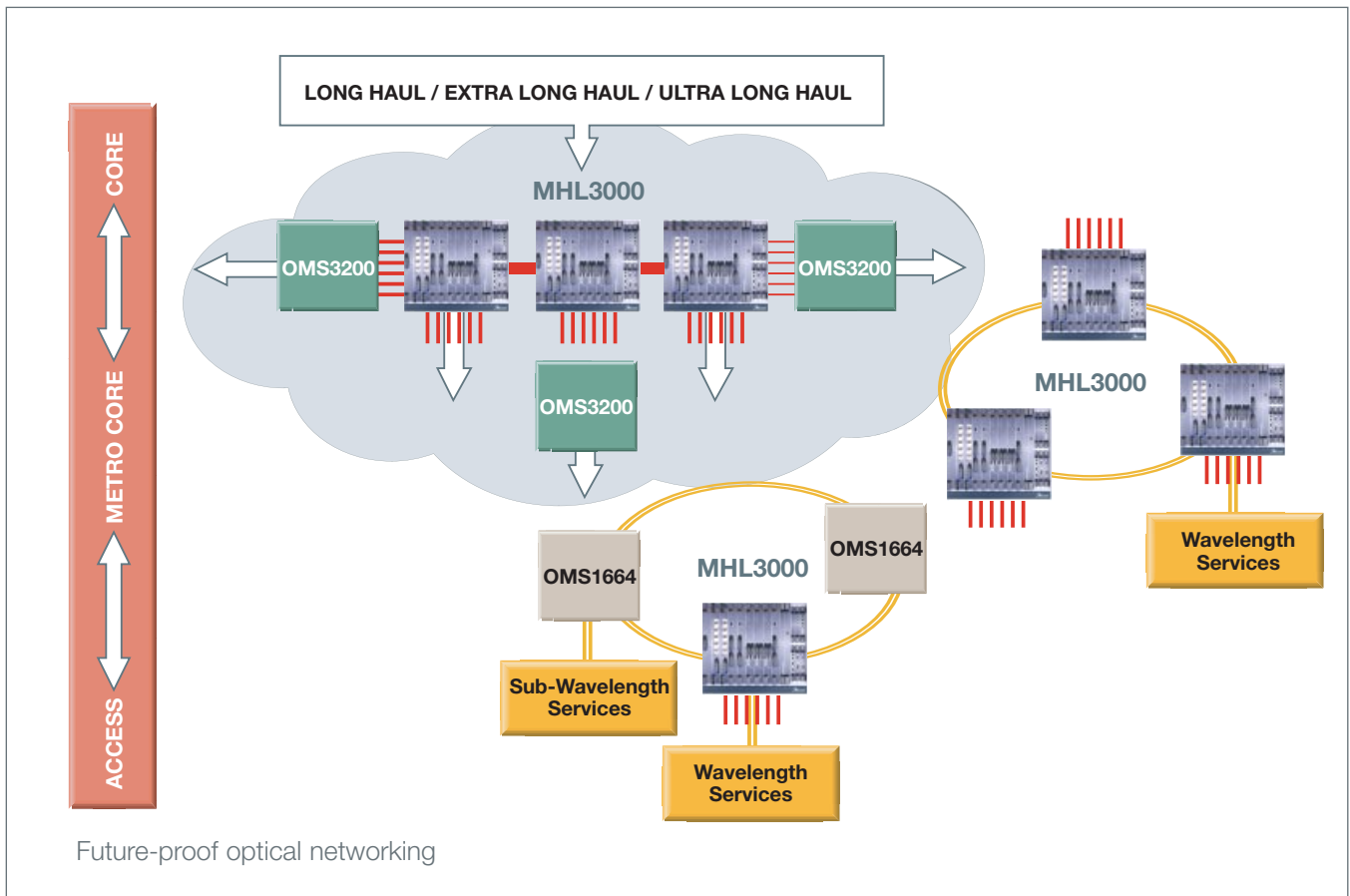
Multihaul 3000's modular design provides scalable capacity up to 6.4 T/bits and delivers, in a flexible manner, transparent data, SDH and wavelength services, through wavelength translators and sub-rate aggregators.

A pioneering and field-proven, re-configurable optical add-drop (R-OADM), supporting transparent optical switch functionality, enhances network connectivity and provides dynamic response to operators' evolving needs.

Seamless integration with Marconi's Optical Multiservice (OMS) portfolio and ASTN technology radically transform the efficiency and dynamics of optical networking, which are further enhanced by outstanding Optical Transport Network (OTN) functionality, to provide a carrier-class solution.

#### Key benefits

- Reduced cost/bit km from the edge to the core
- Modularity, density and flexibility enable adaptation to business requirements
- Transparent optical switching provides planning flexibility and regeneration saving
- Full Optical Transport Networking (OTN) for carrier-class networking
- Extensive 'plug and play' reduces commissioning time and enables smooth and efficient response to network needs
- Product and management integration with Marconi OMS family.



Multihaul 3000 combines simplicity and minimized upfront costs, driving down the cost per bit km of transport

### Single multihaul platform

Multihaul 3000 modular building-block design efficiently supports core as well as metro access applications, reducing network complexity and cost of ownership.

- The latest transmission format and dispersion compensation technologies make Multihaul 3000 responsive to metro requirements. Unnecessary entry cost is completely removed, preserving upgrade to faster rates as soon as customer service take-up dictates. A complete set of physical and logical network configurations – linear, ring or meshed – are supported to satisfy operators' practical and cost constraints.
- Highly versatile configuration options provide unique performances in core networking. Multihaul 3000's modular technology adapts to diverse span characteristics – metro, long-, extended- and ultra-long-haul – minimizing entry as well as incremental investment and improving network connectivity. Its strength and resilience for distances up to 4000 km completely eliminate the need for costly regeneration.
- Multihaul 3000 addresses challenging, unrepeatable single-span land interconnection or sea festoon-type applications – granting commonality of resources with other parts of the network and removing the need for submerged repeater technology.

### Modular and scalable

Wide choices in transmission format and amplifier technologies allow the deployment of advanced networks, giving carriers a great deal of flexibility and sharing of operational resource.

Contained entry-cost scenarios, matching today's customer needs, can be rapidly and flexibly scaled to satisfy variable future traffic flows:

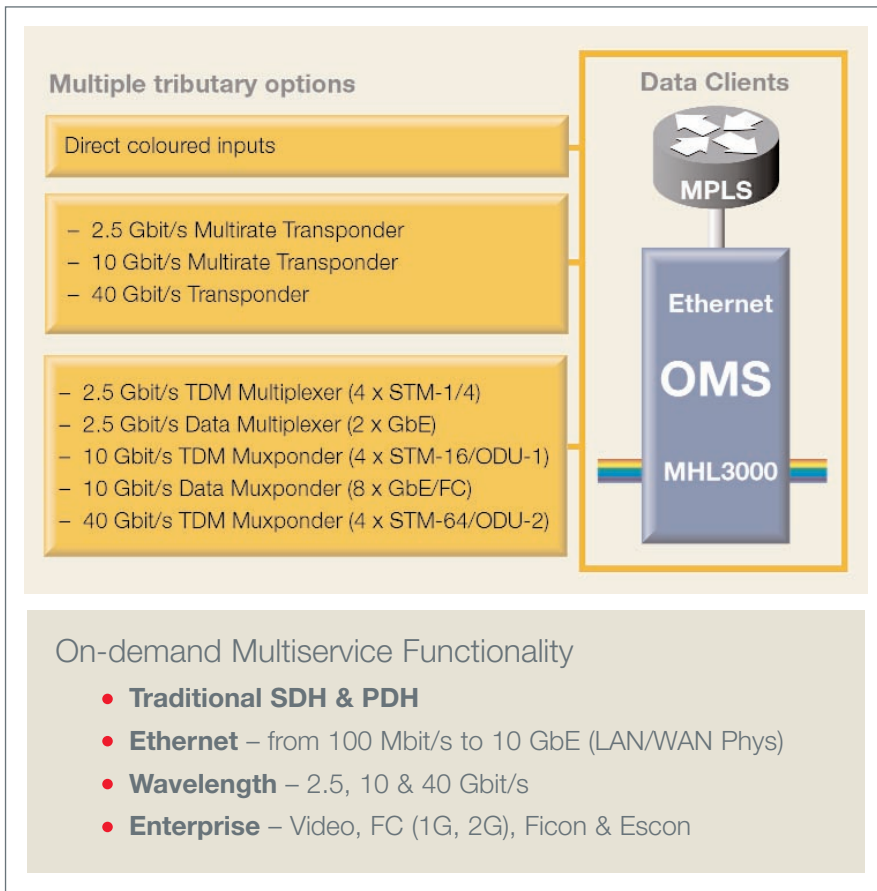
- In metro applications, rings can be smoothly upgraded from two-channel entry scenarios to 48 channels, while long-haul applications can evolve from 40 to 160 channels
- Core networks carrying 800 Gbit/s capacity, can smoothly evolve to 6.4 Tbit/s.

The system architecture is based on the use of universal shelves housing different mixes of all transmission units, which can be equipped in a fully flexible 'mix and match' way according to operators' requirements.

A leading system density provides 400 Gbit/s transponder capacity in a single shelf, as well as an efficient and compact extension of wavelength service to customer premises.

Multihaul 3000 enables seamless introduction of 40 Gbit/s by upgrading an existing 10 Gbit/s DWDM network.

Leveraging the benefit of spectrally compressed modulation formats, no special aids on signal format, tuned dispersion map or ad-hoc EDFA setting are required and there is no need to change existing link characteristics.



### Standardized OTN solution

Multihaul 3000 supports standardized (ITU-T/G.709) OTN functionality, which delivers:

- True and outstanding end-to-end monitoring capability
- Full signal transparency: SDH as well as data traffic
- Improved wavelength utilization
- Interoperability in multivendor environment, while preserving path continuity
- Wavelength services in multicarrier environments

This offers operators a direct resource for Service Level Agreement (SLA) protection, as well as considerable operational cost saving.

### Plug and play

To reduce commissioning time and to provide fast service provisioning, Multihaul 3000 introduces 'intelligence' at the network element level, allowing full reconfiguration and transmission optimization.

Traffic upgrades are carried out without any manual intervention: all units, once inserted, are immediately recognized and configured to preset values.

The Multihaul 3000 provides rapid response to increasing demand.

### Efficient and transparent multiservice delivery

Multihaul 3000 delivers protocol-independent, global services, supporting SDH and data ranging from 100 Mbit/s to 40 Gbit/s, as well as SAN applications. Lower bit-rate aggregation options improve bandwidth utilisation, consistently reducing the cost per service.

### Optical bypass and switching

Multihaul 3000 increases network connectivity and supports remote service provisioning, enabling dynamic response to operator demands and consistent cost saving.

All intermediate nodes can be configured with Marconi's world-first R-OADM, allowing transparent optical bypass of express traffic. Electrical regeneration can be virtually removed in terrestrial networks, significantly improving network economics compared with conventional architectures that require additional transponders and infrastructure.

Transparent optical switch functionality, built on the R-OADM, enables network topologies to be smoothly upgraded from linear to mesh, as required by changing business demand.

### Optical network integration

Multihaul 3000 has complete synergy with Marconi's OMS portfolio, improving the efficiency and economics of optical networking.

Multihaul 3000 creates a flexible wavelength-routed overlay, complementing OMS1664 in the edge, while integration with the OMS3200 family and ASTN technology completely transform the core – enabling new, revenue-generating services, yet driving down operating cost. The electrical core switch provides aggregation, intermediate grooming, selective wavelength regeneration and wavelength conversion. Integrated DWDM interfaces, feeding directly into the Multihaul 3000 optical express plane, allow the cost of wavelength translation to be removed.

Marconi's optical portfolio is managed by the proven, scalable, multi-technology management system, ServiceOn Optical. This provides centralized operation, efficient use of resources, speedy service deployment and fast, effective fault location.

Dynamic channel power equalization prevents disturbances to signals passing through respective nodes, simplifying network set-up and reducing operational and maintenance costs.

Advanced analogue performance monitoring and processing allows effective preventive maintenance actions, as well as fast fault identification and correction, as prescribed in the newly approved ITU-T G.697 recommendation.

### System architecture

Multihaul 3000 design 'mixes and matches' components with different performance characteristics, enabling system adaptability to network characteristics, as well as striking a balance between entry cost and optimized long-term capacity demand.



## Mechanical structure

Multihaul 3000 architecture is based on three universal shelf variants, 20 slots, 9 slots and a compact shelf, into which the various transmission units such as amplifiers, traffic cards and monitors can be fitted. The three shelves house the same card variants and each universal slot can be equipped with any card type in a flexible interchangeable manner, as dictated by network application and capacity demand.

Multihaul 3000 offers an outstanding channel density, packing 20 channels at 10 Gbit/s, including all terminal equipment such as amplifiers and multiplexers/demultiplexers into a single rack, while a full 40- or 80-channel terminal fits into two or three racks, respectively.

## Tributary interfaces

Multihaul 3000 offers choices in technology, with Non-Return to Zero (NRZ), Return to Zero (RZ), and Duo-Binary (DB) transmission formats, allowing the technology to be matched to the application, both in metro and core networks, thereby providing the most cost-effective solution for each particular configuration.

The system provides several transponder options, at 2.5 Gbit/s, 10 Gbit/s and 40 Gbit/s rate, whilst bandwidth optimization is achieved via 10 Gbit/s and 40 Gbit/s muxponders, as well as 2.5 Gbit/s and 10 Gbit/s data muxponders.

All interfaces, including 40 Gbit/s, implement an ITU-T G.709-conformant wrapping function which adds completely protocol-independent overhead data and either standard forward error correction (FEC) or enhanced FEC (EFEC) codes to increase system margin and performance, allowing the most cost-effective network implementation.

Multihaul 3000 features wideband tuneable interfaces, simplifying network planning, reducing time to services with more manageable inventory and maintenance procedures.

Pluggable optics, such as SFPs, provide flexibility in interface characteristic and card modularity, enabling the system to use the newest DWDM pluggable modules.

## Amplifier modules

Effective metro and core designs are achieved through an advanced and modular amplifier technology, which can cope with span losses up to 40 dB.

Extended reach amplifiers, with greater output power, better noise figure and gain flatness, are employed in extended-long-haul and ultra-long-haul high-capacity applications, while standard-reach amplifiers are cost-optimized for metro and regional applications.

Amplified Recirculating Ring (ARR) technology enables optimized metro configurations, providing self-stabilisation and removing gain variations when channels are added or dropped. Network design, installation and maintenance are simplified, while no manual intervention is required to stabilize the ring system after repair in case of fibre breaks.

All amplifier units incorporate advanced control circuitry, which ensures fast and accurate control of amplifier gain. Amplifiers respond dynamically to changes in the number of channels without the need for manual intervention or realignment, and can compensate for variations in span attenuation due to ageing and splicing.

Raman amplification can be employed, as required, to cope with higher span losses or to improve the noise performance of the system.



## Improved dispersion compensation

Multihaul 3000 supports dispersion management schemes to allow for optimal signal propagation under different network conditions.

Exploiting the broadband nature of amplifiers, broadband dispersion compensation reduces the overall system cost, while the adaptive electrical receiver equalization of signal distortion, enables uncompensated transmission in metro and regional scenarios. This provides a consistent saving on network entry cost and enables 10 Gbit/s in-service upgrade, without any modification to the original 2.5 Gbit/s design.

## Flexible optical add-drop

Diverse optical add-drop modules deliver network flexibility and connectivity tailored to business needs:

- Full reconfigurable optical add-drop (R-OADM) – with access to all channels provides 100% flexibility, allowing instant reaction to service requirements and support of new differentiated services
- Fixed optical add-drop (F-OADM) – results in a lower-cost solution, with the ability to select add/drop channels in blocks of up to eight per line
- Two-channel add-drop filter – provides high and scalable granularity for effective metro applications.

Network connectivity is further enhanced by multiple island connection options:

- Extended OADM is the natural evolution of R-OADM, delivering fully multidirectional transparent switching
- Interchange node completely eliminates intermediate regeneration, via manual routing, minimizing network investment.

## Protection options

Full network resiliency is provided through several forms of protection:

- 1+1 OSNC protection delivers protection on a per wavelength bases
- 1+1 Client port protection is offered when the client provides an MSP connection
- 1+1 Optical Line protection is used against fibre cut
- Optical path restoration is supported via Marconi ServiceOn network manager.

## Data Summary

<b>Applications</b>	Core: Long-haul, extended-long-haul and ultra-long-haul Metro												
<b>Topology</b>	Linear, ring, meshed												
<b>Bands</b>	C and L Band												
<b>Capacity</b>	6.4 Tbits												
<b>Fibre types</b>	G.652, G.653, G.654 and G.655												
<b>Channel Spacing</b>	50 GHz												
<b>Transmission Format</b>	NRZ, RZ, DB												
<b>Optical performances (examples)</b>	Core: up to 4000 km      Optimised Metro Single span: 68 dB      Linear: 150 km LH : 10 spans at 20 dB      Ring: 300 km ELH: 20 spans at 20 dB ULH: 40 spans at 20 dB												
<b>Optical amplifier modules</b>	EDFA: Standard reach (+19.5dBm) Extended reach (+21.5dBm) Raman amplifier: Counter- and co-propagating												
<b>Optical add-drop</b>	R-OADM - 80 channels add-drop F-OADM - 8 channels add-drop Two channels add-drop filter												
<b>Tributary cards</b>	Transponder: 2.5 Gbit/s Multirate 10 Gbit/s Multirate 40 Gbit/s Embedded multiplexer: 2.5 Gbit/s TDM Multiplexer (4xSTM-1/4) 2.5 Gbit/s Data Multiplexer (2xGbE) 10 Gbit/s TDM Muxponder (4xSTM-16/OC-48/ODU-1->ODU-2) 10 Gbit/s Data Muxponder (8xGbE/FC->ODU-2) 40 Gbit/s TDM Muxponder (4xSTM-64/OC-192/ODU-2->ODU-3)												
<b>Client Interfaces</b>	SDH/SONET/CBR: STM-4/OC-12/CBR-622 Mbit/s STM-16/OC-48/CBR-2.5 Gbit/s STM-64/OC-192/CBR-10 Gbit/s STM-256/OC-768/CBR-40 Gbit/s Ethernet: 1G Gigabit Ethernet 10G Gigabit Ethernet WAN/LAN-Phy Video: 270 Mbits Fiber Channel: 1G/2G												
<b>OOB-FEC</b>	Standard G.709 FEC and EFEC												
<b>Tunability</b>	80 channels												
<b>Optical Connectors</b>	Standard optical connector: SC High-density card connectors: LC												
<b>Management</b>	Management protocols: Q Ethernet OSI or IP-based DCN Element Manager: ITU-T 3010 Q.Protocol: ITU-T G.733, Q.811 and Q.812 Qecc Protocol: ITU-T G.784												
<b>Mechanical specification</b>													
Shelf :	<table border="1"> <thead> <tr> <th></th> <th>No. of slots</th> <th>Dimension (w x d x h)</th> </tr> </thead> <tbody> <tr> <td>Dual row</td> <td>20</td> <td>500 mm x 280 mm x 930 mm</td> </tr> <tr> <td>Single row</td> <td>9</td> <td>500 mm x 280 mm x 500 mm</td> </tr> <tr> <td>Compact</td> <td>3</td> <td>450 mm x 280 mm x 200 mm</td> </tr> </tbody> </table>		No. of slots	Dimension (w x d x h)	Dual row	20	500 mm x 280 mm x 930 mm	Single row	9	500 mm x 280 mm x 500 mm	Compact	3	450 mm x 280 mm x 200 mm
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Dual row	20	500 mm x 280 mm x 930 mm											
Single row	9	500 mm x 280 mm x 500 mm											
Compact	3	450 mm x 280 mm x 200 mm											
Rack:	ETS 300 119-3 (2200 x 600 x 300 mm racks) ANSI 23"												
<b>Supply Voltage</b>	-48 VDC to -60 VDC nominal												
<b>Standard Conformance</b>	Optical Safety: IEC 60825: Hazard Level 1M Climatic: ETSI 300-019-1-3: - Class 3.1e (traffic-terminating NE) - Class 3.2 (non-traffic-terminating NE) Transport: ETSI 300-019-1-2: Class 2.3 Storage: ETSI 300-019-1-1: Class 1.2 Acoustic noise: ETSI 300-753 Electromagnetic Compatibility: ETSI 300-753												



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