

ROADM Architecture Evolution - Official Technical Overview & Hardware Datasheet

EXECUTIVE SUMMARY

The relentless growth of global data traffic, driven by 5G deployment, cloud-native services, and AI workloads, demands a fundamental evolution of the optical transport layer. The traditional fixed-grid Wavelength Division Multiplexing (WDM) infrastructure is no longer sufficient to meet the dynamic capacity and agility requirements of modern networks. This whitepaper introduces the next-generation Reconfigurable Optical Add/Drop Multiplexer (ROADM) platform, a pivotal advancement in optical networking that delivers unprecedented flexibility, scalability, and operational efficiency.

This document provides a comprehensive technical overview of this innovative ROADM architecture. It details the hardware design, system capabilities, and performance parameters that establish this solution as the definitive choice for carriers, cloud providers, and large-scale enterprises transitioning to a software-defined, automated optical future. By leveraging advanced silicon photonics and a highly modular chassis design, this platform enables true wavelength agility, colorless, directionless, and contentionless (CDC) operation, and significant reductions in both capital and operational expenditures.



ARCHITECTURE & CHASSIS DESIGN

The foundation of this next-generation ROADM platform is a purpose-built, high-density chassis engineered for carrier-grade reliability and future-proof scalability. The architectural design is centered around a fully non-blocking backplane that provides a massive data switching capacity, enabling any wavelength on any incoming fiber to be directed to any outgoing fiber or local drop port without contention. This is achieved through a highly integrated optical backplane that minimizes signal loss and power consumption while maximizing system density.

The platform supports a flexible and modular design, accommodating a mix of Wavelength Selective Switch (WSS) cards, transponder/transceiver modules, and management controller cards within a compact form factor. The chassis is

available in multiple configurations, from a 2RU variant suitable for edge aggregation to a high-capacity 9RU version for metro-core and regional hub deployments. The system architecture separates the optical switching layer from the digital processing layer, allowing for independent technology upgrades and unparalleled investment protection. A key design feature is the implementation of a true CDC architecture, eliminating the need for external wavelength blocking devices and drastically simplifying network planning and operations.

HARDWARE FEATURES

This ROADM platform distinguishes itself through a suite of advanced hardware features engineered to optimize performance, reliability, and manageability:

- * ****Colorless, Directionless, Contentionless (CDC) Operation:**** The core WSS technology supports full CDC functionality on all degree directions. This allows for remote provisioning of any wavelength to any port without manual intervention, maximizing network utilization and reducing service turn-up times.

- * ****High-Port-Count WSS Modules:**** The system utilizes cutting-edge Liquid Crystal on Silicon (LCoS) or MEMS-based WSS technology to support up to 32 or 48 switchable ports per module. This high level of integration reduces the

number of modules required, saving valuable rack space and reducing system power consumption.

* **Integrated Optical Channel Monitor (OCM):** Each line card features an integrated OCM for real-time monitoring of the optical spectrum. This provides critical visibility into channel health, power levels, and OSNR, enabling proactive fault management and automated power balancing across the network.

* **Silicon Photonics Coherent Pluggables:** The platform natively supports high-speed coherent pluggable optics (e.g., 400ZR/400ZR+ and future 800G standards), enabling cost-effective, high-capacity transport over DCI and metro distances. This integration bridges the gap between IP and Optical layers for a more streamlined architecture.

* **Advanced Thermal and Power Management:** A highly efficient airflow design coupled with intelligent fan speed control ensures optimal thermal performance across all operating conditions. The power supplies are hot-swappable and 1+1 redundant, with support for both AC and DC input options to suit diverse data center and central office environments.

COMPLIANCE & STANDARDS

The ROADM platform is designed and rigorously tested to meet the most stringent industry standards for telecommunications equipment. Compliance ensures seamless interoperability within multi-vendor network environments

and guarantees operational reliability.

- * **Optical Standards:** Adherence to ITU-T G.694.1 (DWDM frequency grid), G.959.1 (Physical layer interfaces), and G.697 (OTDR and OPM) standards.

- * **Management & Control:** Full compliance with the OpenROADM (Open Reconfigurable Optical Add/Drop Multiplexer) specification and support for standard NETCONF/YANG data models. This enables seamless integration with SDN controllers and orchestration platforms for automated, closed-loop network operations.

- * **Safety & Environmental:** Certified to meet UL 60950-1/CSA C22.2 (Safety) and IEC 60825-1 (Laser Safety) requirements. The system is also designed to comply with RoHS (Restriction of Hazardous Substances) directives and NEBS (Network Equipment-Building System) Level 3 for operation in a central office environment.

- * **Electromagnetic Compatibility (EMC):** Compliance with FCC Part 15 Class A and EN 55032/CISPR 32 standards for electromagnetic emissions, ensuring trouble-free operation in diverse deployment scenarios.

TECHNICAL SPECIFICATIONS

The following table summarizes the key operational and technical specifications for the ROADM platform. For detailed datasheets on specific module types,

please refer to the 'Ordering Options' section.

Parameter	Specification
Form Factor	2RU / 5RU / 9RU Modular Chassis
Switching Capacity	Up to 6.4 Tbps (fully non-blocking backplane)
WSS Port Count	1x32, 1x48, or 2x32 per module
Wavelength Range	C-band (1528.77 nm - 1563.86 nm) / L-band (1570.03 nm - 1610.06 nm)
Power Supply	1+1 Redundant AC (100-240V) or DC (-48V)
Management Interfaces	RJ-45 10/100/1000Base-T, RS-232 Console (micro-USB)
Operating Temperature	0°C to 45°C
MTBF	> 500,000 Hours (per module)

ORDERING OPTIONS

The ROADM platform is available in a variety of pre-configured packages and modular line cards to address specific network requirements. The key ordering components are:

1. **Chassis Base:** Available in 2RU (5-slot), 5RU (12-slot), and 9RU (20-slot) variants. Each chassis includes a backplane, a system controller card, and a 1+1 redundant power supply bay.
2. **WSS Line Cards:** Available in 1x32, 1x48, and 2x32 port count options for various degree directions. These cards support both C-band and L-band operation.
3. **Transponder/Access Cards:** High-density line cards supporting multiple pluggable optical transceivers (e.g., QSFP-DD, OSFP) for client-side and line-side interfaces.
4. **Mux/Demux Cards:** Fixed-grid passive cards for applications requiring simple wavelength aggregation or disaggregation. (Note: This is largely superseded by the CDC architecture, but kept for legacy support).
5. **Optical Amplifier Cards:** A range of EDFA and Raman amplifier cards to provide the required optical power budget for varying span lengths.

