

Accelerating Network Transformation

Apollo Family

Programmable Optical Networking System



Programmable Optical Networks

Apollo integrates programmability with a comprehensive set of optical transmission and wavelength management capabilities to offer adaptable optical networking solutions that can evolve with changing traffic demands.

Designed for choice and flexibility, Apollo provides capacity-reach optimized links up to 1.2T to maximize spectrum efficiency, as well as 400G/800G ZR+ power-cost optimized links for scalable networks. A modular set of ROADMs and OTN modules enables configurations to route links and transport services across all optical networking applications.

Apollo operates under Ribbon's Muse Multi-domain SDN Controller for maximum automation benefits and operational efficiency. Additionally, all Apollo Network Elements (NEs) feature open control interfaces for compatibility with third-party controller environments.





Family and Capabilities Overview

Apollo OTN/DWDM transport and OTN switching platforms work together seamlessly to provide superior optical networking solutions covering all performance requirements and network topologies.



Capabilities	OTN/DWDM Transport 9400 High Capacity 9600 Modular		9900 Scalable OTN Switching
Client transport	100/400/800GbE, OTU4, 100ZR	1/10/25/100/400GbE, SAN, TDM, OTN, 100ZR	1/10/100GbE, SAN, TDM, OTN
Capacity-reach (performance) optimized line interfaces	140Gbaud 400G-1200G	140Gbaud 400G-800G	
Power-cost optimized line interfaces	400G and 800G ZR+	400G and 800G ZR+	400G ZR+
Spectrum	C+L Bands	C+L Bands	C+L Bands
L1 optical encryption	Wavelength level	Service selectable; wavelength level	Wavelength level
ROADMs and Open Optical Line Systems	C+L band, 20-degrees, CDC-F, Alien wavelengths, Shared spectrum	C+L band, 20-degrees, CDC-F, Alien wavelengths, Shared spectrum	
OTN Switching		10G/400G/800G switchponders	400G to 16T XC fabrics
GMPLS control plane	WSON wavelength restoration	WSON wavelength restoration	ASON service restoration
Performance monitoring	Optical transmission, Physical fiber (OTDR)	Optical transmission, Physical fiber (OTDR)	Optical transmission
Disaggregated open control with Netconf	OpenConfig with gNMI telemetry, OpenROADM, SNMP	OpenConfig with gNMI telemetry, OpenROADM, SNMP	OpenROADM, SNMP
Control interfaces	ZTP, Web UI, CLI	ZTP, Web UI, CLI	CLI, Web UI for 9901X
Cooling	Data center	Telco, data center	Telco



Capacity-Reach or Power-Cost Optimized 400G+ Transport

To transport predominant 100GbE, 400GbE and emerging 800GbE client traffic, Apollo offers two types of 400G+ transmission, delivering the lowest cost per bit for any application.



Apollo power-cost optimized transport delivers performance suitable for most metro-regional and some long haul optical networking applications. Apollo achieves this through broad use of 400G ZR+ technology designed for multi-hop ROADM networks and is ready to incorporate 800G ZR+ as this technology rolls out. Apollo uniquely offers a line card supporting QSFP-DD 400G ZR+ pluggables which are upgradeable to 800G ZR+ variants. This solution delivers the industry's:

- Highest density with 25.T line capacity in 2RU
- Lowest power consumption at less than 0.07W/G

Apollo capacity-reach (performance) optimized transport provides software controllable "knobs" that tune the baud rate, modulation scheme, and flexible grid channel width, to maximize the line rate for any distance and fiber condition. It squeezes every bit of spectral capacity from a channel to the edge of the nonlinear Shannon Limit. Apollo's uses field-proven 5nm-140Gbaud technology that delivers:

- Shorthaul 1.2T to about 100km
- Regional 800G with three times the reach of current 7nm solutions
- Unlimited 400G for ultra long haul and trans-oceanic submarine applications

Multiservice Transport and L1 Optical Encryption

Besides 100GbE, 400GbE, and 800GbE client traffic, Apollo also transports a wide variety of other clients for Enterprise and low speed aggregation applications, including 1GbE, 10GbE, Fibre Channel up to FC64, OTN, SDH/ SONET, and various video interfaces.

To protect against information interception using fiber tapping, Apollo provides the highest level of AES-256 layer 1 optical encryption. Individual clients can be encrypted selectively, and Enterprises can use EKM to manage keys themselves. Besides conventional key exchange, Apollo also supports post quantum cryptography (PQC) and quantum key distribution (QKD) methods.





Open Optical Line System

Featuring an extensive set of ROADM and amplification building blocks, Apollo's open OLS provides equal support for Ribbon or alien wavelengths, whether they originate from optical transport systems or from coherent optics directly embedded in routers. Key capabilities include:

- C +L band spectrum in common ROADM modules.
- 2-degree to 20-degree nodes, for both low insertion loss route-and-select and economical broadcast-and-select architectures.
- Any mix of colorless, directionless, and contentionless (CDC) wavelength add/drop.
- EDFA, Raman, and Hybrid EDFA/Raman amplifiers.
- Fixed-grid and flexible-grid channel spacing.

Apollo open OLS also supports two types of shared spectrum which can be used for revenue generation. Alien spectrum provides point-to-point spectral pipes over which a thirdparty can run their own wavelengths. Spectrum slicing takes this a step further with ROADM control and can be used to carve out and offer virtual optical networks.







Dynamic Restoration

In the event of a fiber failure, Apollo OLS uses Wavelength Switched Optical Network (WSON) signaling to reroute wavelengths dynamically to restore services. This can be exercised using GMPLS signaling or under centralized SDN control.

Hitless L-band Expansion

Apollo OLS modular C+L band solution enables optical network operators to expand fibers seamlessly to L-band only when that step is needed and without impacting traffic on the fiber.



Submarine Applications

Apollo OLS combines capabilities to support submarine applications.

Super-channels allow wavelengths from multiple vendors to run in parallel on a common fiber, where each vendor is assigned a spectrum slice.

Power management monitors the super-channels and inserts ASE noise in the event of wavelength failures to ensure constant power across the entire spectrum.



OTN Switching and Switchponders

To achieve optimal economics, Apollo offers different schemes to handle higher speed and lower speed services. For higher speed services, with a low ratio (about 4:1) between the line and service rates, Apollo relies on muxponders and transponders to **map** these services directly onto wavelengths.

However, for lower speed services, where there is a much larger ratio (about 40:1) Apollo also relies on OTN fabrics to **switch or cross-connect** the services onto the wavelengths. This delivers benefits including:

- Maximizing wavelength fill to reduce capex
- · Rapid provisioning of bandwidth services to business customers
- Using ASON (automatic switched optical network) to reroute individual services in the event of link failures

Apollo supports this capability for low to medium speed services with four access to core OTN switching platforms with switching capacities scaling from 400G to 16T, as well as with three of 10G/400G/800G switchponders for its 9600 series platforms.





Muse SDN Lifecycle Management and Automation

When coupled with Ribbon's Muse Multi-domain SDN Controller, Apollo expresses its full value.

Muse uses advanced algorithms to optimize Apollo network architectures for Capex and ensures errorfree network commissioning with plug-and-play configuration downloads to Apollo NEs. Service templates streamline provisioning, and links are verified before activation. Muse monitors network health using Apollo telemetry streams and uses analytics to predict potential issues before they impact service. Dynamic rerouting quickly restores links and services caused by hard problems, while diagnostic tools quickly identify the failure source for prompt repair.

Muse low-code tools let network operations staff automate tasks, turning manual processes into automated ones. This streamlines operations and cuts costs without expensive software development.





Muse offers exceptional insights into the health of optical networks. Utilizing proven algorithms, it transforms integrated power measurements into OSNR and other transmission parameters. OTDR monitors physical fibers and integrates with Geographic Information Systems to precisely locate failures within meters. Historical trend analysis enables the identification of potential issues before they impact service.



Disaggregated Open Control

Apollo network elements can be deployed and managed in both partially and fully disaggregated optical networks via OpenConfig, OpenROADM, and ONF APIs. This unleashes Apollo's unique benefits in multi-vendor networks, including capacity-reach and power-cost optimized transport, an optical line system that elevates alien wavelengths to shared spectrum, and OTN switching that enables rapid delivery of L1 business services.



Contact Us Contact Us to Find Out How Apollo can Power your Optical Network



About Ribbon

Ribbon Communications (Nasdaq: RBBN) delivers communications software, IP and optical networking solutions to service providers, enterprises and critical infrastructure sectors globally. We engage deeply with our customers, helping them modernize their networks for improved competitive positioning and business outcomes in today's smart, always-on and data-hungry world. Our innovative, end-to-end solutions portfolio delivers unparalleled scale, performance, and agility, including core to edge software-centric solutions, cloud-native offers, leading-edge security and analytics tools, along with IP and optical networking solutions for 5G. We maintain a keen focus on our commitments to Environmental, Social and Governance (ESG) matters, offering an annual Sustainability Report to our stakeholders. To learn more about Ribbon visit rbbn.com.