IP Wave Portfolio

Optimized, Automated, Open
IP Optical Network Solutions

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State of the Art IP and
Optical Networking

# Optimized, Automated, Open IP Optical Network Solutions

Ribbon's IP Wave portfolio builds IP Optical network solutions that deliver innovative services rapidly with better overall economics. Its solutions are:

- **Optimized** – tailored to meet feature and performance requirements without costly over-engineering, while being scalable to handle future traffic growth

- **Automated** – from human-assisted to closed loop, covering the entire operations lifecycle

- **Open** – able to incorporate best-of-breed innovations in a competitive multi-vendor environment

The IP Wave portfolio consists of three interoperable product families:

NPT IP Networking	Delivers multiservice aggregation and transport using a state-of-the-art IP stack with common NOS, while providing the right fit with a range of form factors and capabilities
Apollo Optical Networking	Delivers industry leading performance for 1.2T/800G/400G wavelengths over software reconfigurable DWDM/OTN solutions with smooth capacity growth
Muse SDN Orchestration	Delivers multilayer IP Optical operations lifecycle management, with practical automation to speed up services delivery, streamline operations, and integrate into multi-vendor ecosystems
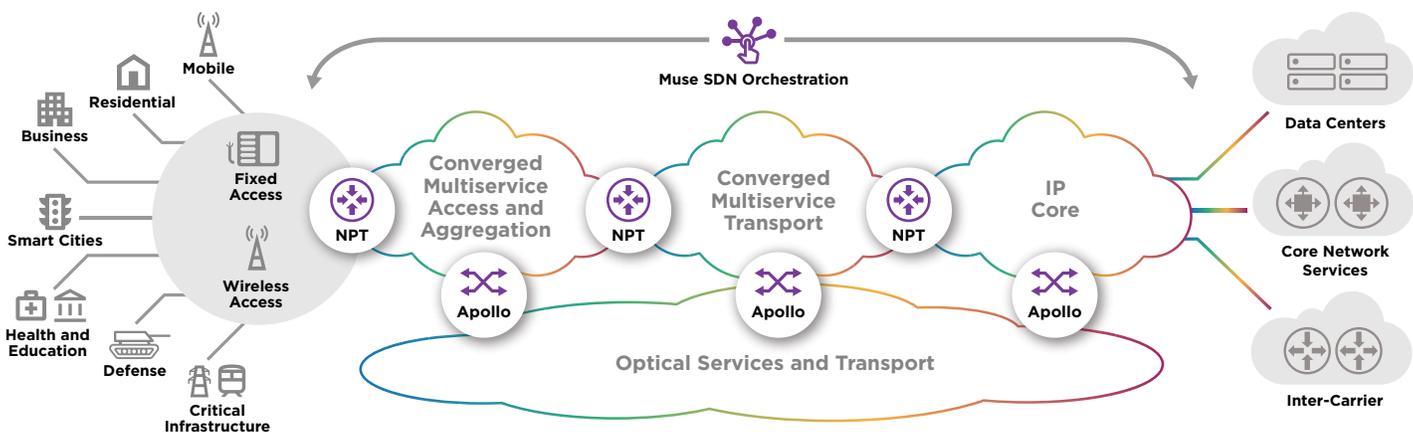
IP Wave solutions are agile enough to support multiple network topologies and geographies for a broad range of Service Provider, Private Network and regulated industry customers.

Service Providers
- Telcos
- Broadband Service Providers
- Internet Service Providers
- Mobile Network Operators (Cellular)
- Multi-System Operators (Cable)
- Rural carriers and altnets
- Carrier of Carriers

Private Networks
- Enterprises
- Regulated industries such as eletric power, oil, gas water utilities.
- Transportation communications for rail, highways and ports
- Research and education networks
- Defense networks
- Cloud service providers

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Apollo

Powerful, Programmable and Open Optical Networks

Apollo programmable and open optical networks satisfy the economy's insatiable appetite for bandwidth while providing network operators with fit-for-purpose and future-proof solutions.

Built around flexibility and choice, Apollo provides industry-leading 140Gbaud-powered high-performance links to 1.2T, filling up fiber channels to their theoretical limits, as well as 400G ZR+ power-cost optimized links for pay-as-you-grow networks. An erector set of SDN-controlled ROADM and OTN switching modules provide unlimited configurations to route links and the services they carry dynamically from the access to the core. Above all Apollo is easy to deploy and to manage, and open control interfaces enable Apollo to participate in disaggregated, multivendor environments.

| **1.2T Wavelengths** for maximum speed and capacity | **Programmable** for automated provisioning and restoration | **Modular** for tailorable fit to application | **Open** for disaggregated solutions |

OTN/DWDM Transport

9400 Series
High Capacity Applications

- Compact modular
- Data center optimized with telco NEBS

OT9408　**OLS9408**

9600 Series
Tailored Applications

- Rich set of transmission and OLS cards, usable across all platforms without engineering rules
- Telco and data center

9603　**9608/D**　**9624**

OTN Switching

9900 Series
Scalable OTN Switching

- Optimize wavelength fill
- Point-and-click provisioning
- Dynamic ASON restoration

9901X 400G　**9904X** 2.8T　**9914** 5.6T　**9932** 16T

Apollo Benefits

Performance choice
- Capacity-reach optimized for 1.2T DCI, 800G regional, 400G ultra long haul
- Cost-power optimized 400G for most metro applications

Feature rich
- Multi-service clients GbE/SAN/TDM/OTN
- Per service L1 optical encryption
- Up to 32 degree CDC ROADMs
- Power efficient, as low as 0.11W/Gigabit

Intelligent
- Programmable for SDN control
- Integrated optical performance and fiber health monitoring
- Dynamic network restoration

Open
- Optical line systems with for alien wavelengths and shared spectrum
- Disaggregated OpenConfig control
- OpenROADM interoperable

NPT

Converged, Optimized, Open and Automated IP Networking

NPT is optimized for access edge, aggregation, and IP transport. It provides operators with the automated, programmable platform they need to collapse all their services onto a single converged IP network, and the agility to evolve the network as services and customer needs evolve.

NPT is made up of the XDR and AR router families. NPT XDR routers with their state-of-the art merchant silicon, 400G interfaces and disaggregated or fully integrated deployment options are optimized for transporting high-performance, high-capacity services. NPT AR routers provide the hardware redundancy and modular architecture required to support mission and business critical services. The IP Wave rNOS provides a common set of industry proven features and capabilities across both the NPT XDR and NPT AR router families.

Automated and Programmable	Common NOS, multiple form factors	Converged Multi-access Edge	High Performance and High Availability Options

IP Wave rNOS

XDR Family
High Performance, High Capacity Routing

AR Family
Access and Aggregation Routing

Optimized for High Performance:
• Increased Performance
• Increased Agility
• Increased Capacity
• Better Economics

Optimized for mission critical services:
• Multi-stack IP/MPLS, MPLS-TP and SR
• High Availability, redundant
• Modular
• Optimized form factors

2032	2100	2300	2400	2700	1012D	1022	1050	1100	1250	1300	1800
Trident 3	Qumran-2a	Jericho 2C	Jericho 2C	Jericho 2C	Qumran-UX	Qumran-UX	Monterey	Qumran-UX	Qumran-UX	Qumran-UX	Jericho+
3.2T	800G	2.4T	4.8T	8T	32G	64G	300G	300G	300G	1T	2T

NPT Benefits

Converged Multiaccess, Multiservice
• EVPN-MPLS, MEF 3.0 Services, L3 VPN, L2 VPN
• Provide right-fit IP backbone/backhaul functionality for xHaul, broadband backhaul, CIN
• Industry leading TDM to IP migration
• Provide interfaces and mission critical performance required by regulated industries.

Advanced Service Assurance and Availability
• Network telemetry
• Real-time, right-first time, OAM, and analytics
• Transport and service restoration
• AR family provides modular redundant hardware

Automated and Programmable
• Programmable IP transport with multiple traffic engineering options: IP/MPL, SR-TE, RSVP-TE, MPLS-TP FlexE, FlexAlgo
• Open ecosystem integration with standards-based, field-proven, interfaces such as PCEP, BGP-LS, NETCONF/YANG, sFlow, Telemetry
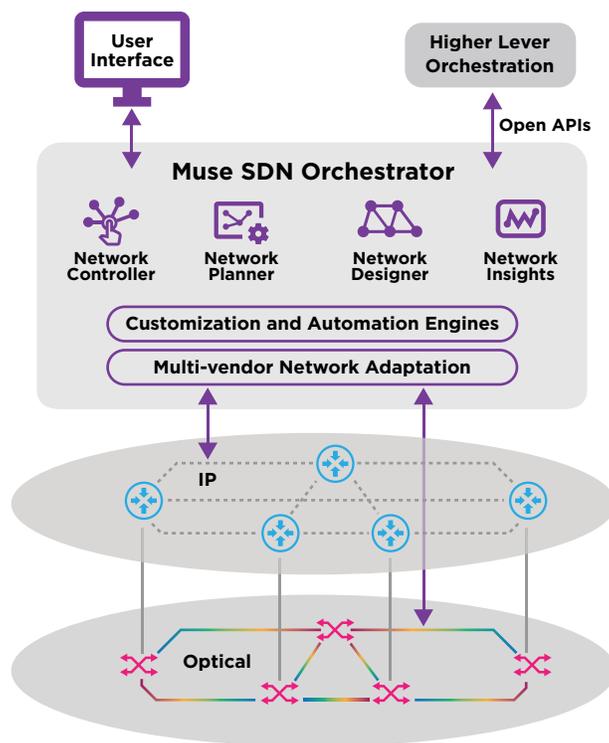
Open
• Proven IP Wave rNOS supporting fully integrated and disaggregated router deployment options.
• Pluggable 400G ZR and OpenZR+ provide support for IPoDWDM

Muse

SDN Orchestrator

Muse delivers real-time control over IP and optical networks, providing people and systems with the capabilities they need to maximize the value of network investments.

Muse speeds up services creation and provisioning, assures that services meet commitments, and reconfigures the network on failures. Additionally, Muse streamlines network operations, optimizing capital outlays and reducing costs. To this end, Muse integrates network planning with equipment commissioning, continually analyzes and optimizes the use of network resources, and prevents failures before they happen or sectionalizes them quickly when they do occur.

Muse achieves service-centric streamlined network operations through five central elements of design and functionality: complete IP optical network control, practical automation, multi-vendor adaptation, low code customization, and secure cloud-native deployment.

Challenge	Muse SDN Orchestrator Solution
Seamless planning to implementation	Iterative planning for greenfield and brownfield networks allows balancing between performance and investment. Plug-and-play features ensure rapid and error-free installation and turn up.
Fast time to market and service differentiation	Template driven service creation processes rapidly define and provision services; includes tools to design new templates from scratch for service differentiation.
Service assurance	Continuous network and services monitoring plus analytics identifies issues before they become service affecting. Dynamic restoration recovers from outages using shared resources.
Streamlining operations and reducing costs	Low code tools enable practical automation at your own pace from human-assisted to closed loop. Operates on an integrated multilayer IP Optical network view.
Multivendor environment	Standard and open NBIs and SBIs enable integration with higher level orchestration as well as other vendors' network equipment.

Contact Us Contact us to find out how to Transform your Network with IP Wave

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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.