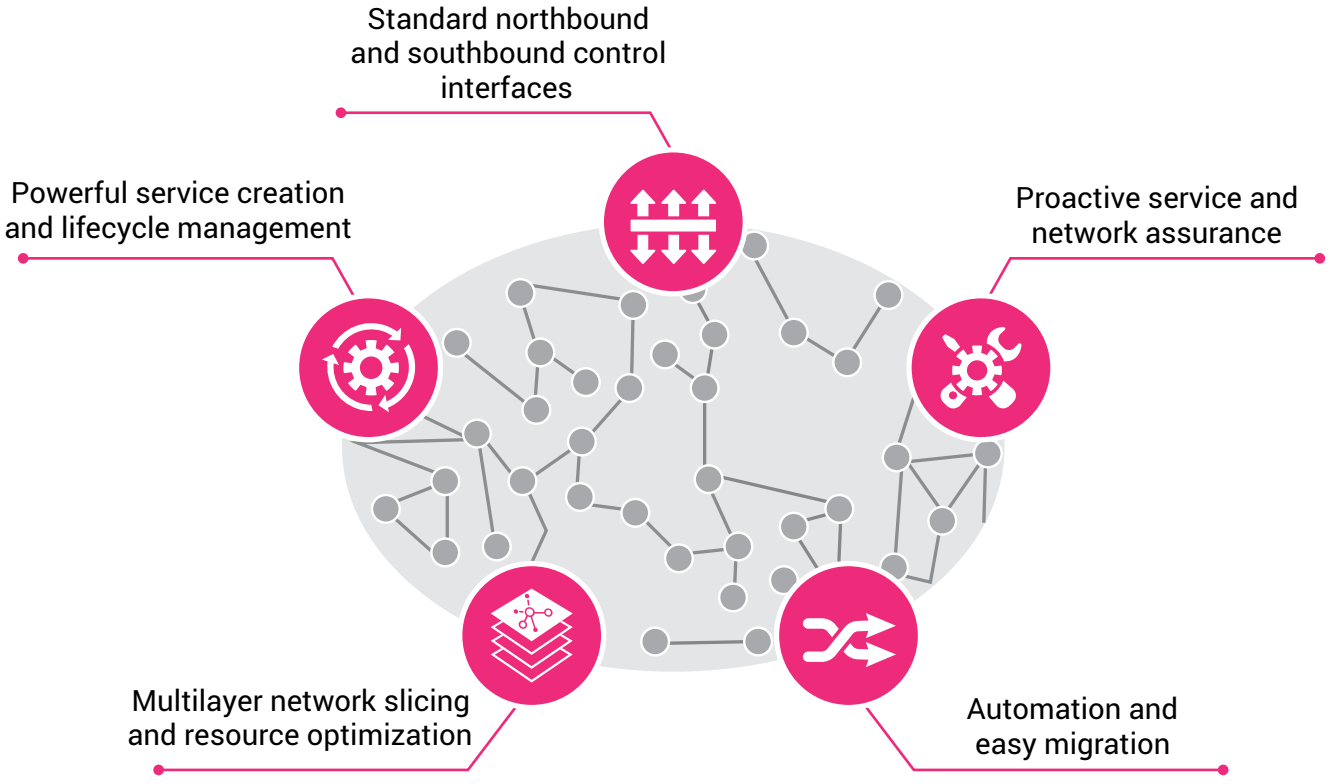
Muse™ Network Controller

Cloud Native Network Monetization

Muse Network Controller (NC) allows Service Providers to launch new services and drive new revenue streams quickly, leveraging new technologies, such as 5G and network slicing. A suite of advanced service and network control applications empower SPs to do more, through simple service creation and lifecycle management, proactive network assurance, network optimization, and automation. Powered by a carrier-grade PaaS, Muse Network Controller delivers real-time control over Ribbon's programmable packet and optical network infrastructure. It guarantees that people and systems receive the right tools to monetize the network effectively through intuitive GUIs or industry-standard APIs.

Network Management | **Service Management** | **Slice Management**



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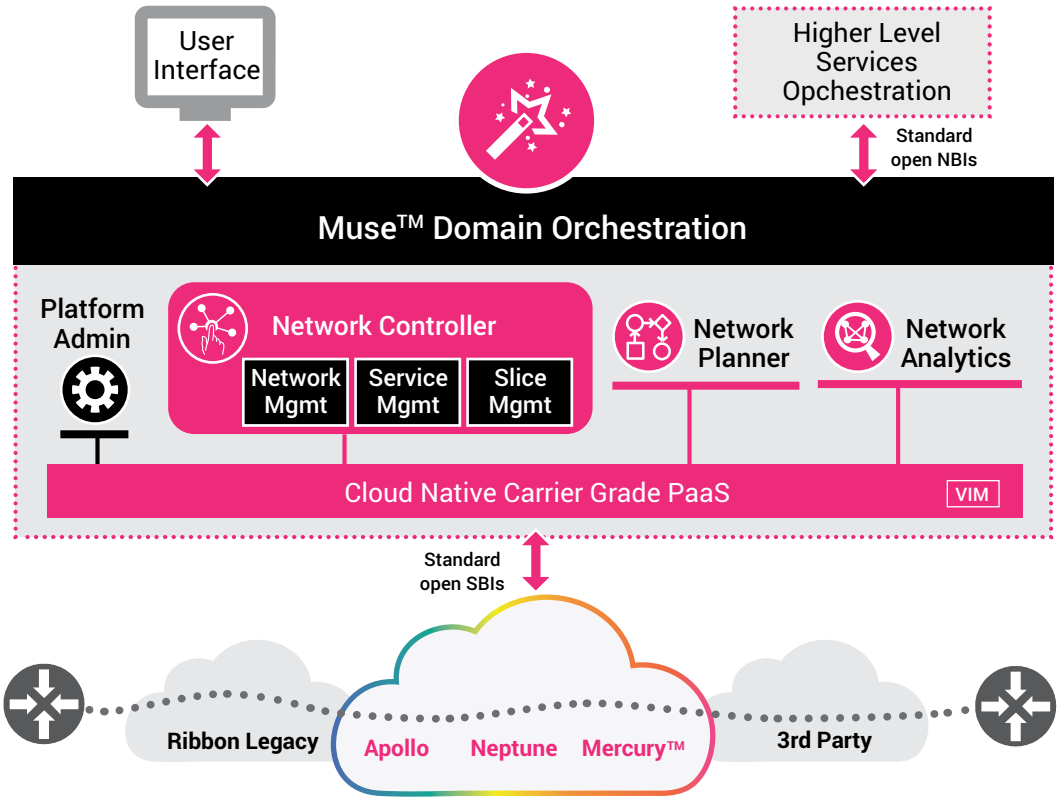
Central Building Block for Domain Orchestration

Muse Domain Orchestration is a modular suite of applications that streamline and automate the service and network operation lifecycles to extract the maximum value from Ribbon's packet, optical, and virtualized networking solutions. The applications create and activate new services rapidly and ensure that the network is optimized, available, and running at peak efficiency.

Muse Network Controller is the central building block for this domain orchestration, delivering three major sets of functionality:

- **Network Management:** Manages the lifecycle of network elements (nodes, links, etc.) for all topology layers, including maintenance, optimization, and efficient allocation of network resources.
- **Service Management:** Creates, modifies, and manages all types of services using smart Path Computation Elements (PCE) and policy-based assurance.
- **Slice Management:** Defines and provides continuous management of multilayer network slice instances, including slice definition, fulfillment, assurance, maintenance, and optimization.

Muse Network Controller works closely with the two other Muse Domain Orchestration applications - Network Planner and Network Analytics. All domain orchestration applications are controllable via an intuitive Muse GUI or through standard and open northbound interfaces that can be exercised by OSS or higher-level orchestrators.



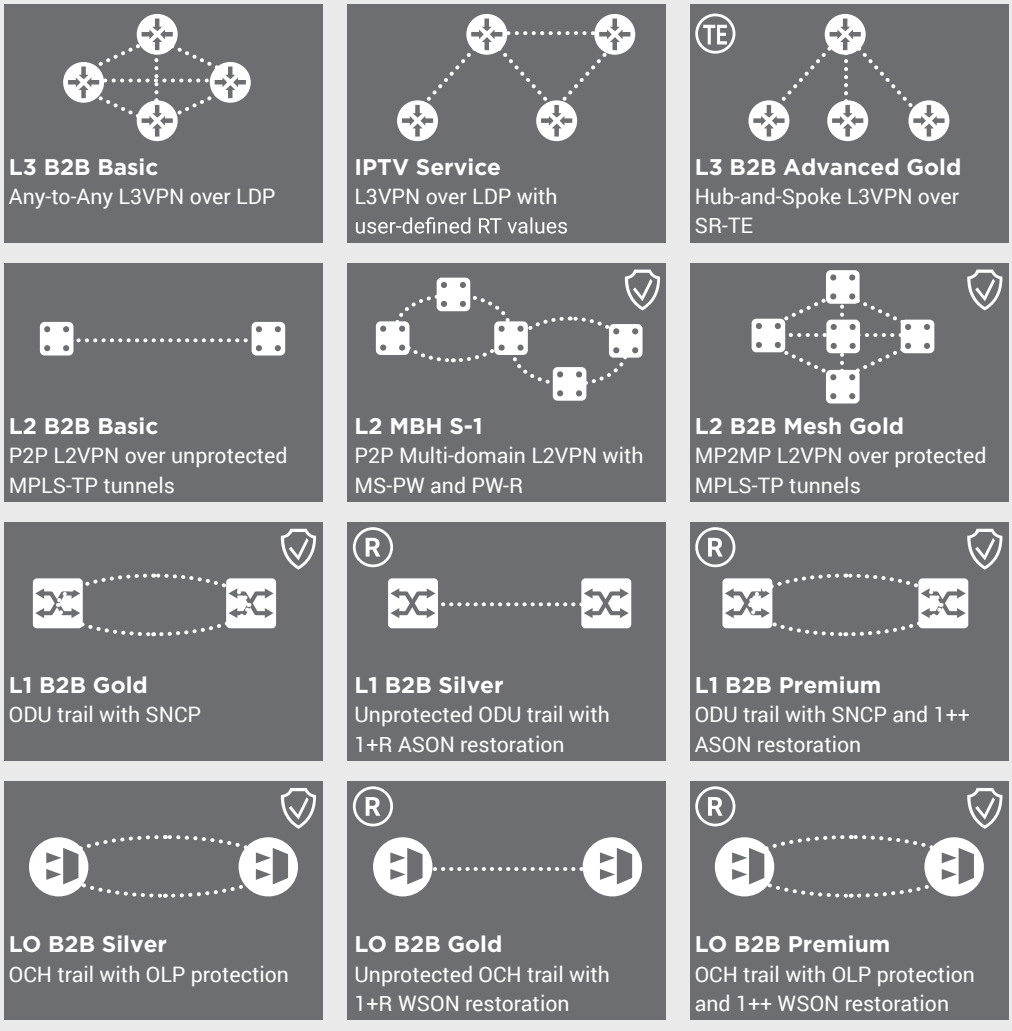
Muse Domain Orchestration applications are truly cloud-native, deployed on top of a carrier-grade PaaS, ensuring scalability and high availability. Through open interfaces on the PaaS, Muse makes it easy to incorporate applications and associated value from other sources. Muse's architecture ensures true vendor-agnostic, real-time control of the network.

Powerful Service Creation and Lifecycle Management

Telecom services used to be just about making connections. Today SPs have begun to add value-added functionality on top of connectivity using virtualization technology. Muse Network Controller not only brings these worlds together for end-to-end service agility and innovation, it also simplifies creating and managing services in this rich environment. Muse NC provides ready-to-use service templates that can be applied to individual customers, as well as tools to design new templates from scratch. They combine powerful abstraction capabilities to create the services with real-time control of underlying network resources to provision them. CRUD controls are available to update and modify services, as needed, to respond to evolving customer needs.

Muse NC uses real-time SDN connection control with cutting-edge path computation algorithms to provide high-performance data paths between endpoints, and makes it easy to specify backup paths in the event of failures for service guarantees. By combining this with virtualized services at the network edge for mobile and fixed applications, SPs can exploit their competitive advantage of physical proximity to end-customers to deliver high-bandwidth, low-latency, and assured performance that is superior to centralized over-the-top solutions.

Sampling of Muse Designed L0-L3 Services



Proactive Network Assurance and Maintenance

Proactive management of networks entails information and speed:

- **Information about what is occurring in your network environment from traffic flows and resource utilization, to warnings and alarms.**
- **Speed, to react quickly to changes that could affect services.**

Leveraging Ribbon's proven expertise in IP-optical transport, traffic engineering, telemetry, monitoring, analytics, and restoration, Muse Network Controller maximizes services and network availability by pinpointing problems rapidly – often, even before they occur. It then suggests or automatically applies solutions like traffic rerouting, or exercising self-healing capabilities, like dynamic multilayer restoration.

Moreover, based on capabilities from monitoring alarms and traffic to measuring KPIs against historical trends, degradations can be recognized and addressed before they become significant.

Early Identification of Network Issues

Raw OSNR data

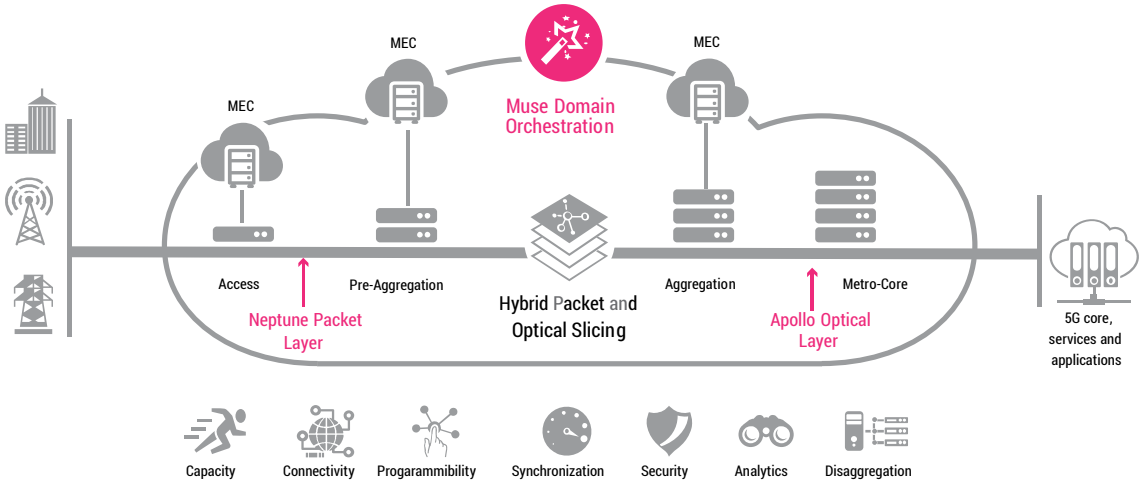
Degradation contribution per span

Multilayer Network Slicing and Resource Utilization

5G is ushering in a new era in communications, supporting multiple service classes with associated performance guarantees, for the first time. The challenge is organizing a common physical network to deliver different combinations of high-bandwidth, low-latency, and high-availability services simultaneously. Network slicing, which assigns network resource pools dynamically to different services, is widely regarded as the most efficient means to achieve this goal.

Muse Network Controller delivers a unique network slicing solution that combines hard and soft slicing across multiple network layers. Hard slicing dedicates resources such as wavelengths, ODU channels, FlexE time slots, and Layer 3 dedicated queues, to provide a high degree of isolation between slices. Soft slicing shares resources to set up L2 and L3 VPNs, and segment-routed topologies.

Using sophisticated design algorithms to assign these hard and soft slicing network resources dynamically to specific services, Muse NC accomplishes two major goals. It enables Service Providers to tailor specific performance and availability guarantees for each service individually, while extracting maximum throughput from a common network for the entire complex mix of services, as a whole.



Automation and Easy Migration

Muse Network Controller speeds up the entire operations lifecycle, smoothing the lines between traditional offline and real-time processes. It balances between automation that removes unneeded human involvement, and allowing human operators to step in anytime to make override decisions. This facilitates network modernization, enabling the addition of automated processes and other advanced capabilities steadily over a period of years.

Muse NC also fits within higher-level modernization initiatives by extending control, using standard northbound interfaces. This enables Muse to interact directly with OSS and end-to-end service orchestration systems, while providing value-added domain control for Ribbon's networking solutions.

Muse Network Controller Maximizes Network Value

Challenge	Muse Network Controller Solution
Maximizes Network Equipment Capabilities	
	Take advantage of unique vendor capabilities Provides the Service Orchestration layer with abstraction and intent-driven over control for the entire range of capabilities of Ribbon's packet and optical networking solutions, maximizing their value.
	Integrate vendor equipment Facilitates integration, including ongoing SW upgrades, while ensuring maximum utilization of NE features through astract NBIs.
	Fast time to market Ensures that the value of new networking technologies is realized immediately – including revenues, and Opex and Capex savings – even before control of these technologies is implemented in a higher-level orchestrator.
Optimizes Through the Layers	
	Multilayer management Provides transparent multilayer management, greatly simplifying service provisioning and troubleshooting. For example, it represents connectivity from a Layer 3 router, via a Layer 2 switch, to a Layer 1 OTN network, in a unified view.
	Multilayer analytics With a deep L0-L3 network view, delivers intelligent insights about network status, failure implications, and root cause analysis. For example, an OSNR degradation on a DWDM link can trigger a warning about the expected affected L3VPN services and their protection status on all layers.
	Network slicing Assigns hard and soft slicing resources dynamically to different service instances for tailored performance and availability guarantees.
Connects to your Network Effortlessly	
	Automate device commissioning Eases initial device installation and configuration with enhanced commissioning tools, like template-based automation and bulk configuration of protocol parameters.
	One-stop-shop NBI Provides a single point of connectivity to the Service Provider's SDN ecosystem via standard NBIs, facilitating the addition of new NE types within the domain.
	Seamless planning to implementation Supports seamless provisioning in both greenfield and brownfield network implementations. Muse Network Planner delivers configuration adds and changes to the Muse Network Controller, which in turn, automatically applies changes to the live 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.

Contact Us Contact us to learn more about Ribbon solutions.