Muse SDN Applications Overview

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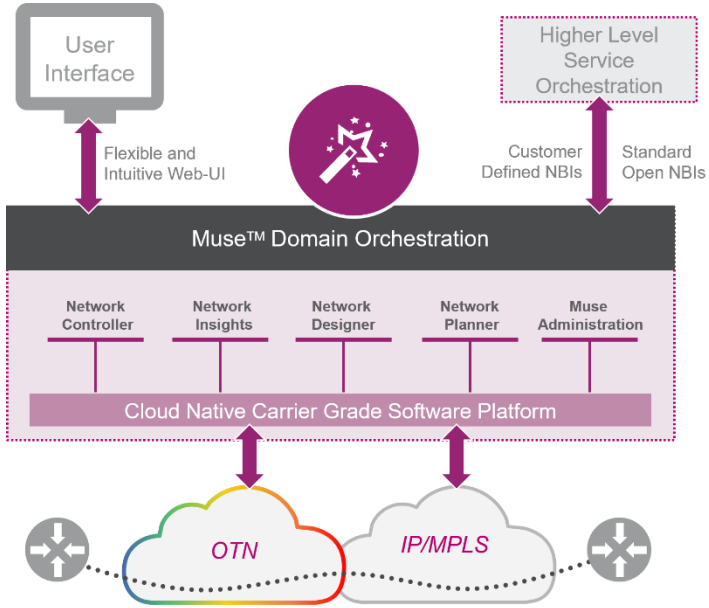
AGENDA

- Introduction
- Muse Applications
- Roadmap
- Muse and LightSOFT

Introduction

What is Muse?

- Ribbon's SDN Applications Suite
- Multiple roles:
  - "Legacy" FCAPS
    - NMS and EMS functionalities for IP-Optical networks
  - SDN Capabilities
    - Open Interfaces, Automation, Insights and Analytics
  - Network Planning
    - Topology and site design, Optical Simulations, Demands Optimization
- Cloud-Native Eco-System
- Multi-vendor Architecture
  - Separation between SBIs and Business Logic



SDN Market Trends and Requirements

Network **Automation** to **reduce OpEx** and **improve Time to Market**

Advanced **Analytics** to **improve CapEx utilization**

Multi-Vendor capability to **remove vendor-locking**

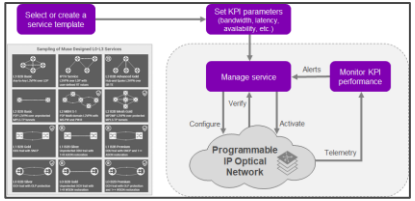
Flexible integration with OSS/BSS/Service Orchestrator systems

Cloud Native architecture to meet **modern security and infrastructure** standards

Muse – Answering Market Trends

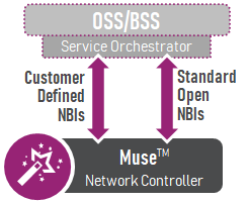
Network Automation

Workflow Engine

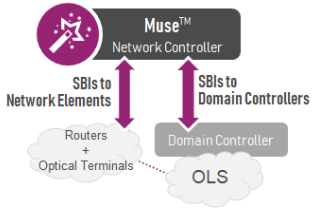


Closed Loop Automation

Multi-Vendor and OSS Integration

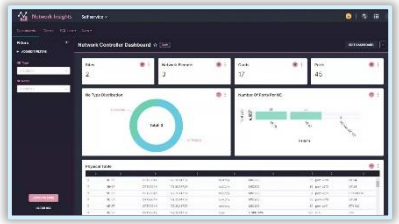


Flexible NBI



Flexible SBI

Advanced Analytics



Network Insights

Network Health

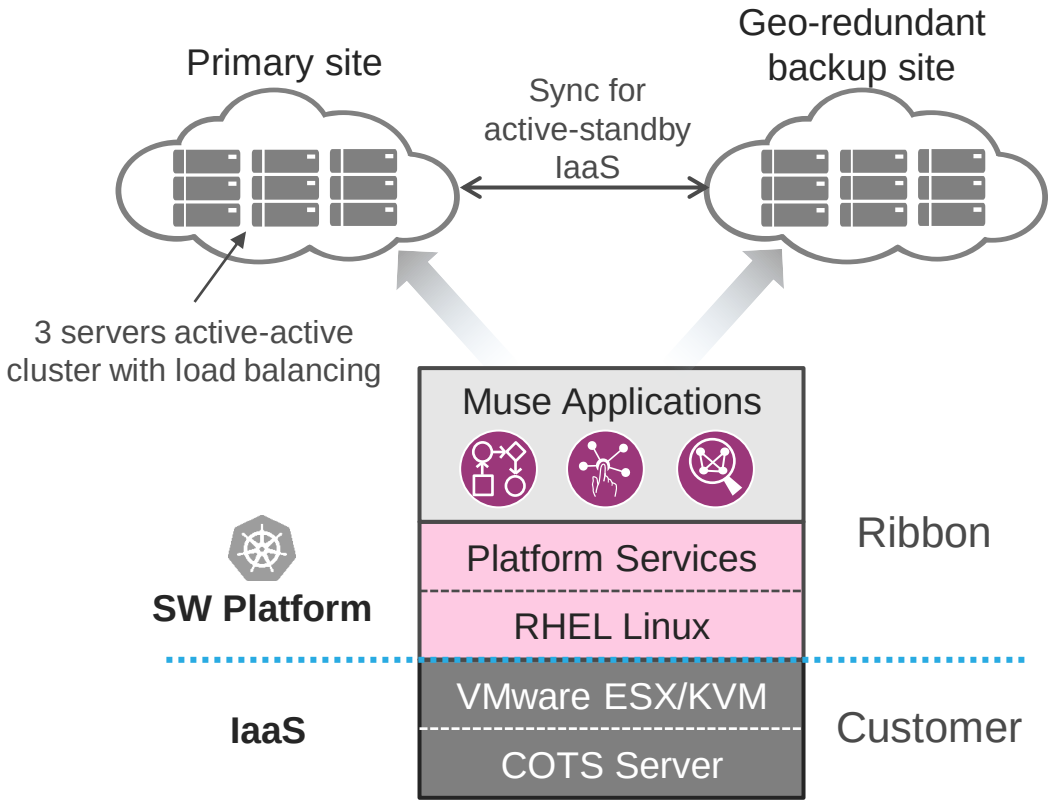
Cloud Native Architecture

Microservices Architecture

K8S Infrastructure

High Availability and Geo-Redundant Cloud Native Deployment

- **Agnostic to the IaaS**
  - Hardware
  - Host OS/Hypervisor
- **Carrier-Grade Platform**
  - High availability
  - Flexible scaling
  - Licensing
  - Security
  - Users Management
  - DevOps with CI/CD
  - Centralized logging



Muse Applications

Muse Applications

 Network Controller	Live network control system for topology commissioning, service provisioning, fault management, maintenance and automations.
 Network Insights	Self-Service BI application for analyzing the network inventory, performance, utilization and other KPIs.
 Network Designer	Graphical Low-Code tools for designing service templates, network elements, tasks and automation workflows.
 Network Planner	Network planning tool for designing and optimizing topology, optical services and equipment allocation, and export all the required reports.
 Muse Administration	Administrating the entire Muse applications suite, including user management, authentication and authorization, licensing, system health, and more.

MUSE Network Controller - Fundamental Capabilities in a Nutshell

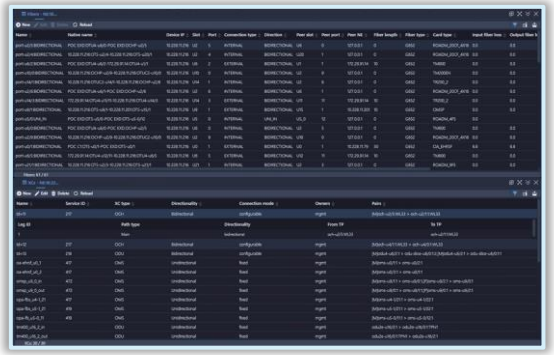
What

- Full L0-L3 services life-cycle management
  - OCH and ODU with WSON and ASON
  - FlexE, MPLS-TP, SR-TE and FlexAlgo
  - IP/MPLS L2/L3VPNs, EVPN
  - Network Slicing, Spectrum Sharing
- IP and Optical nodes configuration
- Template based provisioning automation
- Fault Management and Performance Monitoring
- Network health analysis tools
- Planning to Fulfillment
  - Integration between Network Planner and Network Controller

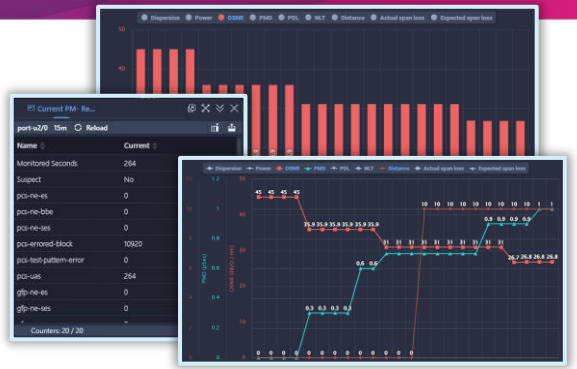
How

- Intuitive Web-UI and summary dashboard
- Northbound interfaces for topology, alarms and service CRUD

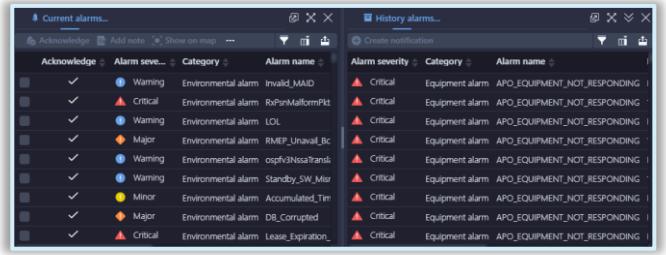
Advanced Web-UI



NEs and Links Lists



PM Counters Tables and Graphs



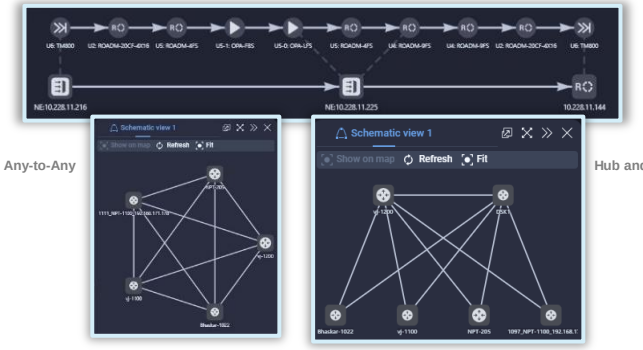
Current and History Alarms lists

Shelf View

Ethernet + Physical

Dual Layer View

Flat-View

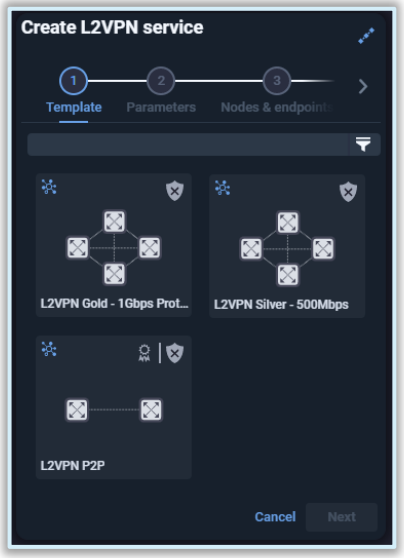


Service Schematic View and Trail Flat-View

Service Templates Architecture

Service Catalog

Service templates improve time-to-market and reduce human mistakes by defining all the service parameters allowed and default values.



- **Global Parameters** – Topology, Protection, Scale, etc.
- **End-Points Parameters** – Interface Role, VLANs, Optical Channel, etc.
- **Rates and Bandwidth** – Bandwidth and QoS Profiles, OTN Rates, etc.
- **Path Computation** – Path metrics (latency, number-of hops, etc.), Include/Exclude admin-sections, etc.
- **SLA and Assurance** – KPI thresholds, assurance tests schedules, etc.

Network Health Analysis

Signal Health
Monitor Optical Channels

Fiber Health
Enhanced OTDR Monitoring

Network Health Analysis

Signal Health

Assisting in focusing troubleshooting resources

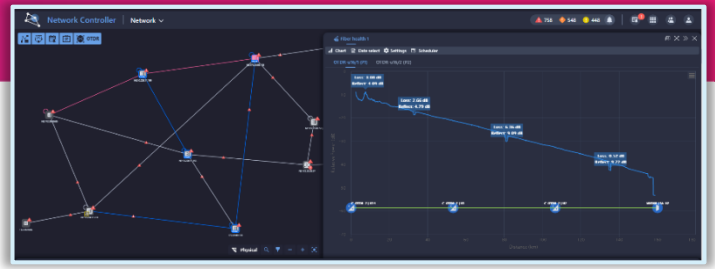
- Real time OCH status
- Calculating span loss contribution to OSNR degradation
- Comparing current and historical optical impairments data
- Support for native and alien lambda

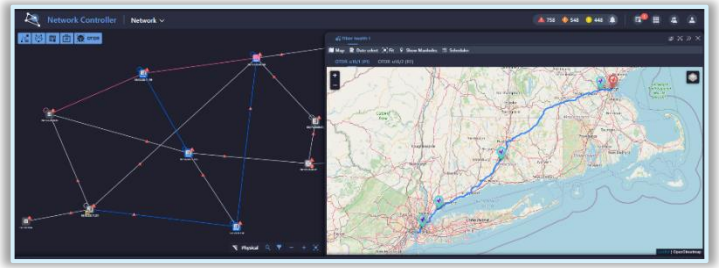
Network Health Analysis

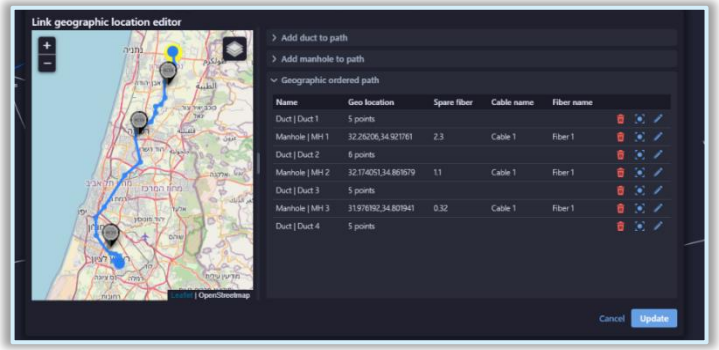
Fiber Health

Enhanced OTDR Capabilities

- OTDR chains topology
- Integration with GIS system
- Auto Trigger OTDR test based on network events
- Historical trend analyses to catch degradations early







Network Automation in Muse

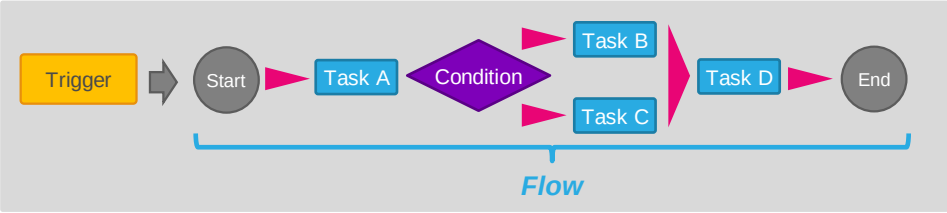
Network Automation

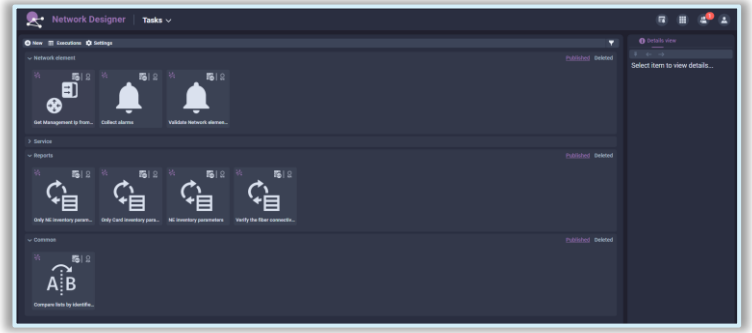
Save OpEx and CapEx with automation on all network lifecycle processes, avoid human mistakes, and improve services SLA.

- **Workflow Engine** – Create automation workflows for any NOC operation.
- **Topology Management** – Automatic Topology discovery and information propagation between layers.
- **Trails Provisioning** – Automatic provisioning of ODU servers and OCH between direct ports.
- **Policies and Profiles Distribution** – Required policies are automatically downloaded to NEs when needed.
- **Machine to Machine** – Flexible NBI to integrate Muse in any SDN eco-system.
- **Service Assurance** – Automatic and periodic SLA and assurance tests.
- **Planning to Fulfillment** – Commissioning and provisioning automation based on Network Planner design.

Tasks and Workflows

- Automate any repetitive action
  - Bulk Operations
  - Troubleshooting
  - Maintenance
  - NE Upgrades
- Create automation flows with triggers and tasks
  - Triggers based on network events, alarms, schedules, or REST NBI
  - Add conditions, timers, gateways, variables
- Build workflow using pre-defined tasks
  - Tasks have inputs and outputs to pass information throughout the flow
- Create your own tasks to be used in the workflows
  - Based SSH, HTTP/S (REST), Python, Shell, JavaScript, Perl





Muse Low-Code Capabilities

Service Templates

- Define services properties
- Define services SLA and Assurance tests
- Templates customize the provisioning wizards

Automation Workflows

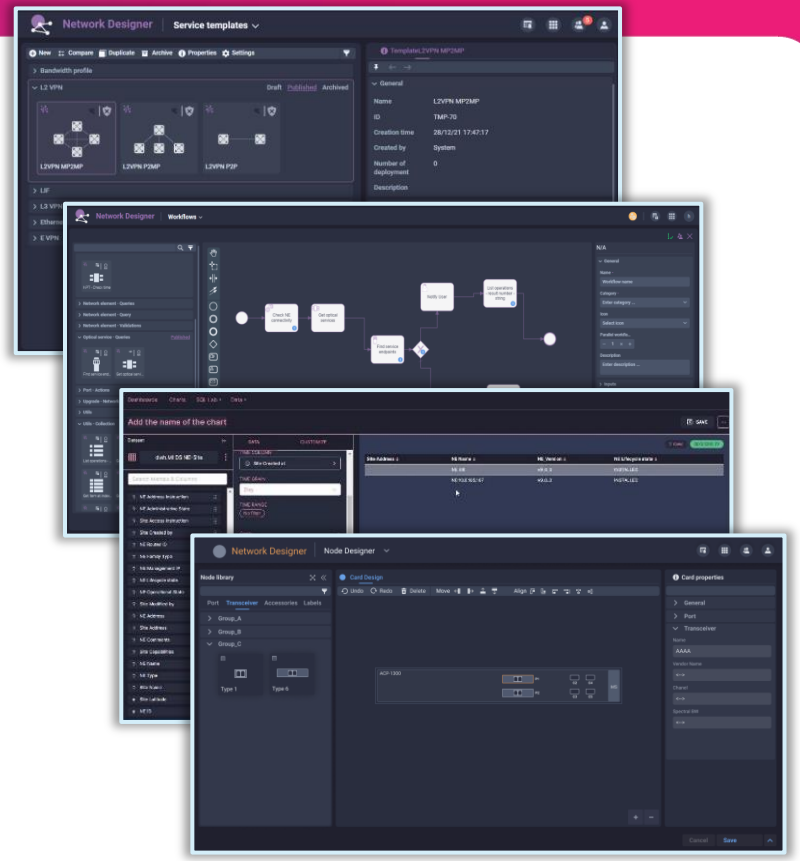
- Create automation flows with triggers and actions
- Create your own actions using scripts
- Automate any repetitive action – Troubleshooting, Upgrades, etc.

BI and Analytics

- Self service Business Intelligent tool
- Create your own widgets and dashboards
- Create user defined analytics reports

Network Elements Templates

- Model any 3rd party NE to be presented in Muse
- Define size, slots, cards, capabilities
- Add the models to the network for representation, and manage them via dedicated SBIs



Applications Programing Interfaces (APIs)

NBI

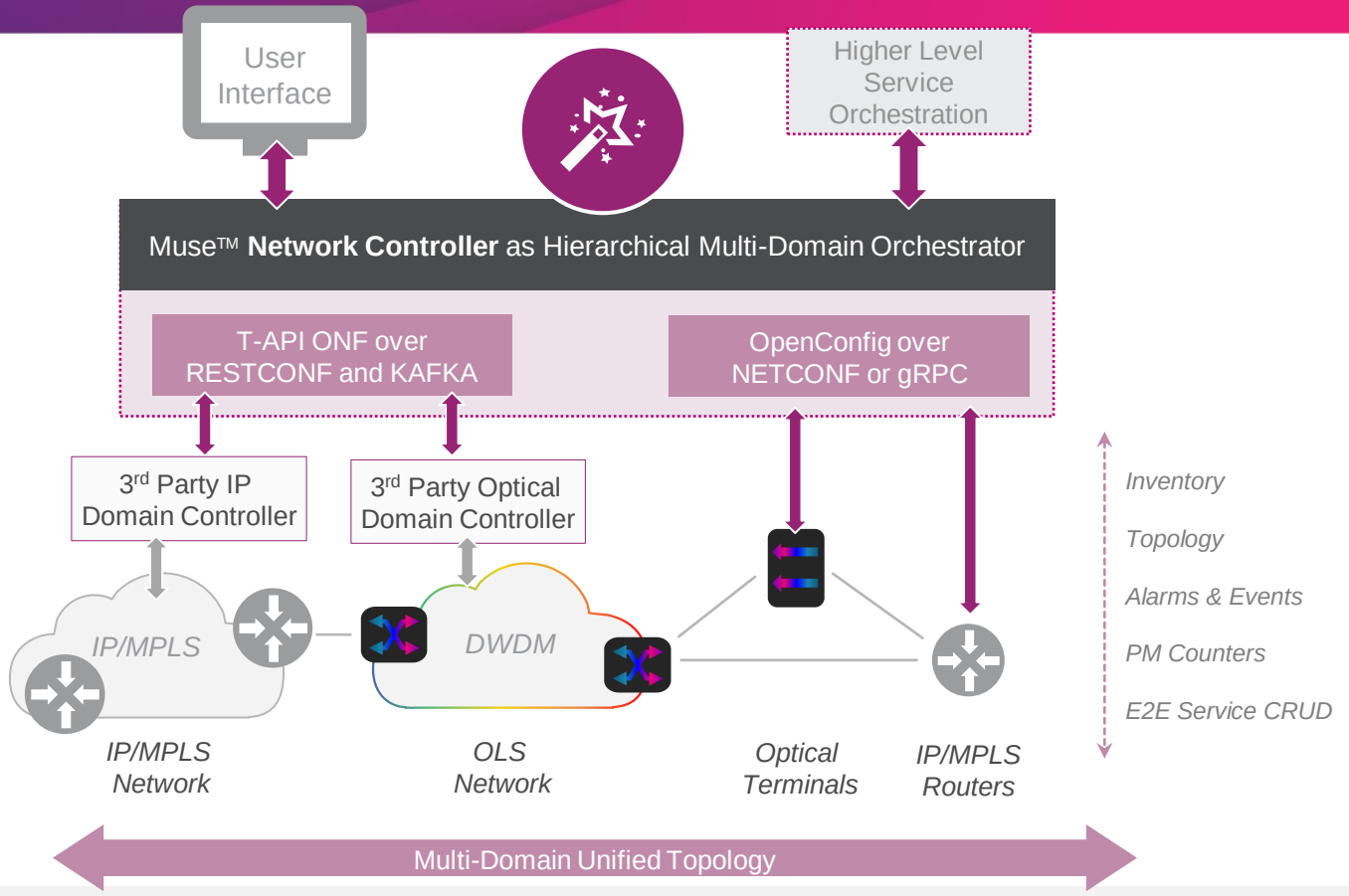
	Standard	Interface
Inventory and Topology	T-API ONF	RESTCONF, Kafka
Optical Services CRUD	T-API ONF	RESTCONF
IP Services CRUD	IETF L3SM & L2SM	RESTCONF
Alarms	T-API ONF	Kafka, SNMP
Performance Monitoring	T-API ONF	RESTCONF, Kafka

Secured Standard APIs

SBI

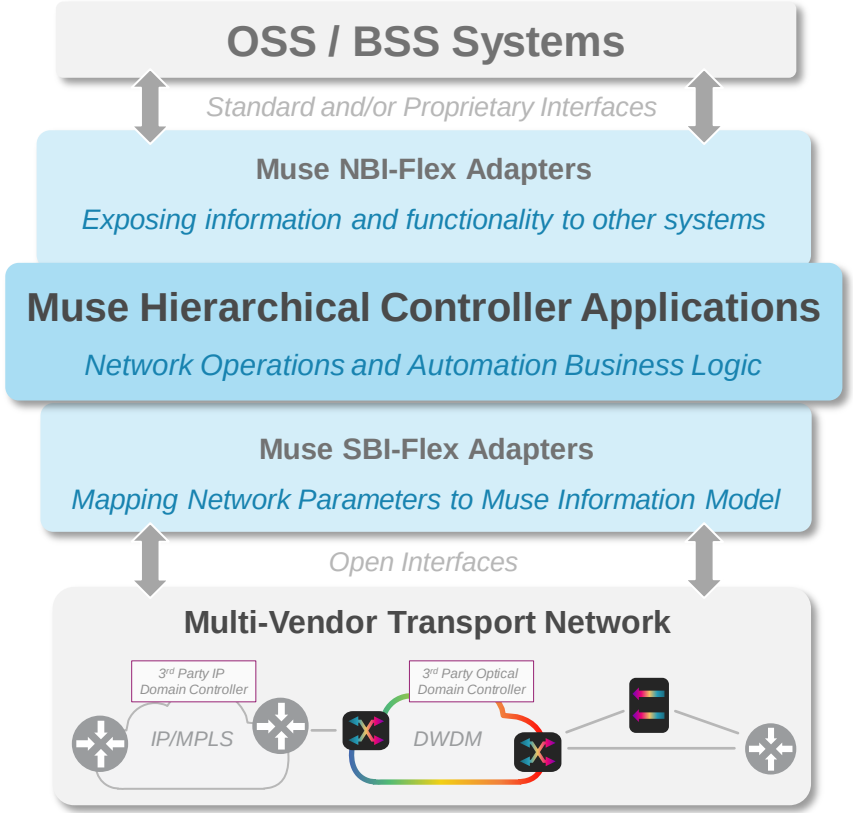
NE Configurations	Netconf, CORBA, CLI
SR-TE Provisioning	PCEP
Topology Discovery	BGP-LS, LLDP
Telemetry Collection	gRPC/gNMI

Muse Multi-Domain Orchestrator Architecture



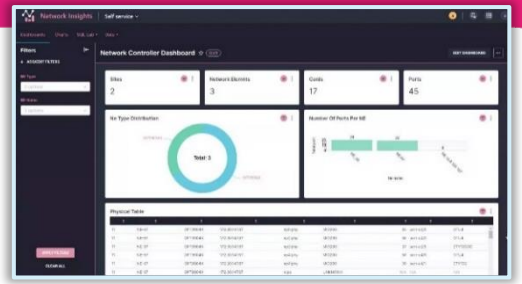
Muse SBI and Business Logic Separation

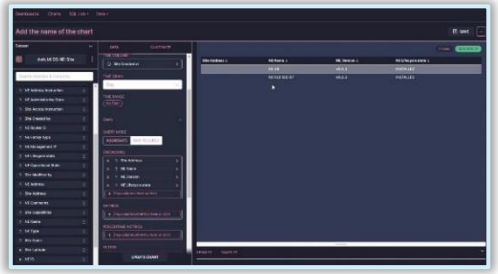
- SBI-Flex Microservices
  - Dedicated for each controller or NE Type
  - Can be added using DevOps methods with independent life cycle
  - Normalizing the 3rd party information model
- 3rd Party Information added to the Muse Applications
  - 3rd Party inventory, topology services and alarms are added together with Ribbon's NEs
  - All Business Logic is separated from the interfaces
  - Revise SBI/NBI without having to roll MUSE release
- NBI-Flex Microservices
  - Customized NBI structure
  - Based on the Customer's SDN Eco-System requirements



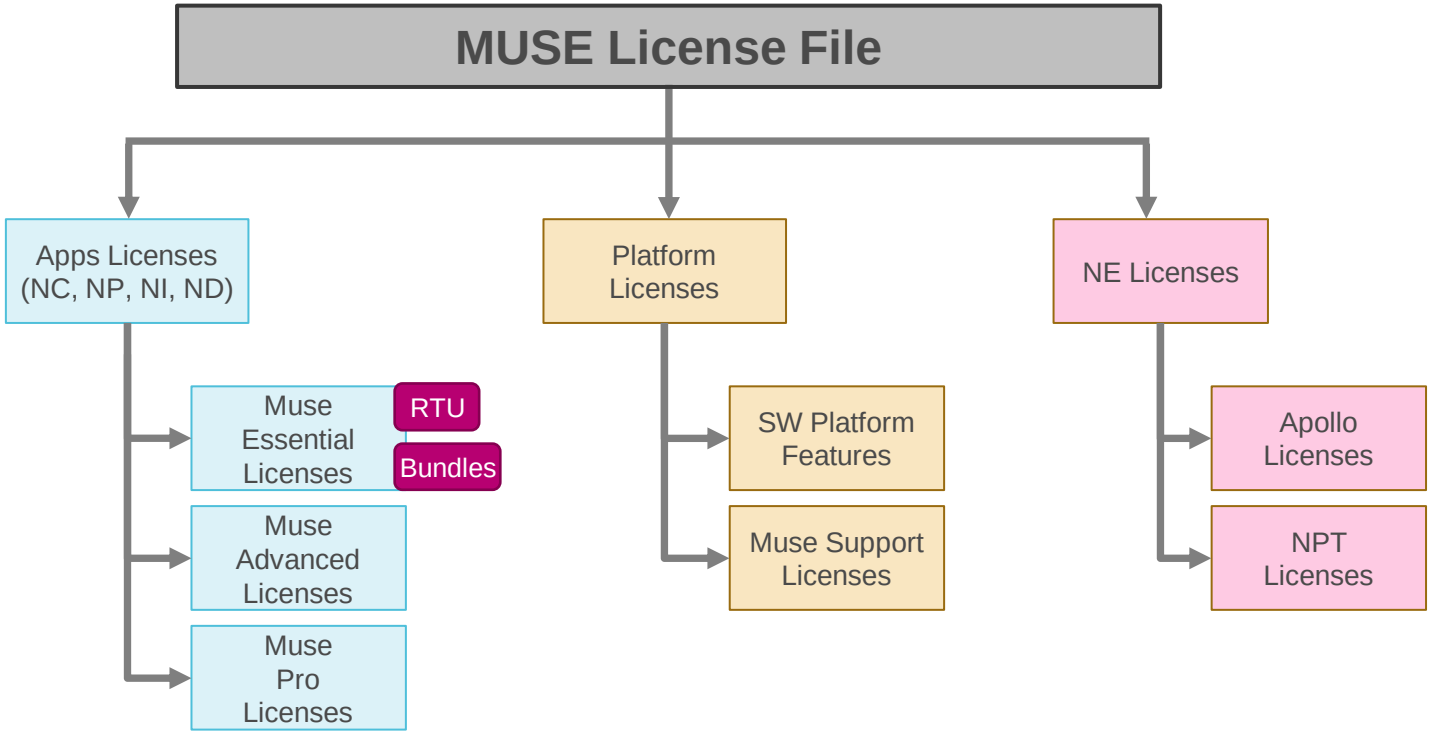
MUSE Network Insights - Fundamental Capabilities in a Nutshell

- Pre-defined and user-defined BI reports and dashboards
  - On demand, scheduled, REST API
- Analyzing IP and Optical physical and logical inventory
  - Utilization trends and peaks, OSNR and span-loss reports, protection status
- Inventory tracking
  - Changes history, availability reports
- Notifications on user-defined thresholds and KPIs crossing
- Automatic synchronization with Network Controller





Muse License Structure



Roadmap

Muse Roadmap

Network Controller R7 Sep 2023

We are here

NC - General
- Alarms Profile (Set Severity/Mask)
- IP and Optical Uncontrolled NEs (“UME”)

NC - IP Technologies
- Dynamic L2VPN with CES – SONET/SDH Interfaces
- EVPN Additions
  - VPWS, E-NNI I/F, Port-Active Ethernet-Segment
- MPLS-TP (DiffServ)

NC - Optical Technologies
- L-Band
- OSNR/GOSNR Metric

Network Designer
- Optical Service Templates
- MPLS-TP Tunnels Templates
- Node Designer

Network Insights
- Physical Inventory and utilization
- OTN Inventory and Performance

Network Controller R8 Feb 2024

NC - General
- Topology and Inventory NBI Notifications
- Bulk Maintenance Operations

NC - IP Technologies
- L3VPN - OSPFv2 as PE-CE
- LAG CRUD
- MS-PW
- MPLS-TP Tunnel CAC
- MPLS-TP Insert/Remove PE

NC - Optical Technologies
- WSON – 1++ “X” Services
- Unidirectional services
- Optical Migration – Replace Card

Network Designer
- NBI for Workflows Executions
- ODU and OMS XC for UNEs

Network Insights
- OTN Ethernet Services Utilization Report
- L3VPN Inventory and Performance

Network Controller R9 Jul 2024

NC - General
- SNMP Alarms SBI
- Slicing and Multi-tenancy
- LLDP Topology Discovery

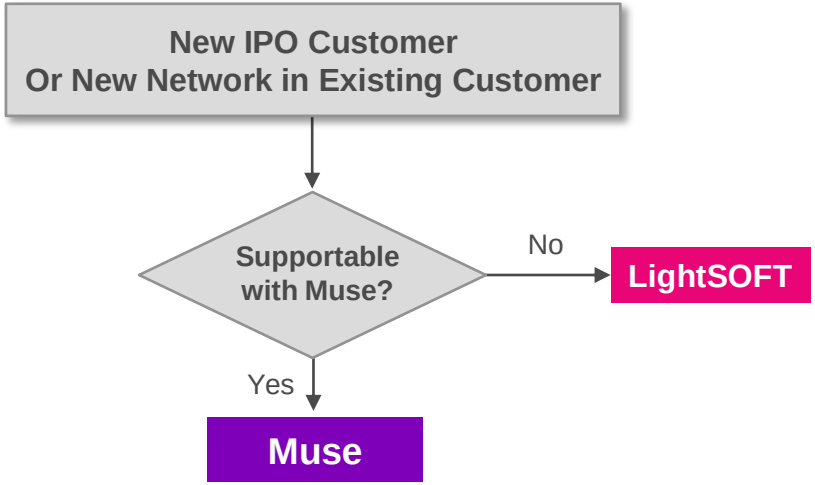
NC -IP Technologies
- FlexAlgo
- Assurance Tests
  - Y.1564 Test, Y.1731 CFM, RFC-2544

NC - Optical Technologies
- ASON Restoration

Network Insights
- L2VPN Inventory and Performance
- EVPN Inventory and Performance
- Alarms Reports

Muse and LightSOFT

Always Go with Muse Where Possible



Muse-Only Features:
SR-TE, FlexAlgo, FlexE, Flex-NBI, Automation, Shared Spectrum

Main features not yet supported by Muse in 2023:
ASON, Lite Packet, PB Services, PHT

Out of Muse Scope: Native SDH, Legacy Equipment – Syncom, BGs, XDMs, EZC NPTs (non-IP)

Existing Customers – Migrations to Muse

- Migration to Muse is available for Apollo optical networks
  - Customer should pay for Muse licenses
  - Existing NE tokens are free of charge
  - Contact Ribbon to confirm support
    - Some features might not be supported (XDMs optics, ASON, etc.) and migration will not be available
  - Migration procedure is available

- Migration for NPT Networks (IP/MPLS and MPLS-TP) will be available during 2024
  - Customer should pay for Muse licenses
  - Existing NE tokens are free of charge
  - Specific cases can be evaluated before – Contact Ribbon if needed

Existing Customers – Staying with LightSOFT

- Some customers cannot be migrated to Muse
  - Networks with features not yet available in Muse – ASON, Lite Packet, PHT, PB Services
  - Networks with legacy equipment - EZC NPTs, XDMs, BGs – Will not be managed by Muse

- LightSOFT and EMS will support most of the 2023-2024 new NPT and Apollo HW
  - Including: New Apollo 96xx cards, new NPT-2xxx family
  - Excluding: Apollo 94xx family
  - Minimal to no support for new capabilities
  - Continue maintenance for PRs and simple CRs

- In cases where Muse is required, two management systems will be used
  - The split will be decided for each network based on its structure and parameters. Examples:
    - Based on technology - EZC MPLS-TP part in LS and BCM IP Part in Muse, Apollo+XDM “OLS” in LS and 94OT in Muse
    - Based on Geography – Legacy equipment on one part of the network in LS, new equipment in other part in Muse
  - We will add tools to “ease” the work with two systems
    - Unified Alarm list (NC will present alarms from LS in its Alarms List)
    - Option to open the LS GUI from Network Controller

MUSE Main UVPs

Advanced Workflow Automations

Intent-Based Provisioning

Insights and Analytics

Optical Health Monitoring

Flexible NBI

Flexible Multi-Vendor SBI

Intuitive Web-UI

Advanced Multi-Layer

Cloud-Native Deployment

Thank You!