Junos Space Connectivity Services Director

Product Overview

Service providers and enterprises must be able to rapidly provision and offer new MPLS and Carrier Ethernet services across their networks. In order to reduce operational costs and enable quick service rollouts, these network operators need an intelligent provisioning application that facilitates the design, deployment and management of services.

Junos Space Connectivity Services Director facilitates lifecycle management of connectivity services such as L2VPN and L3VPN services, QoS profile configuration, service performance validation and monitoring, and synchronization management. In addition to an intuitive graphical user interface, the application also supports a rich set of API functions to enable northbound integration and service orchestration with other OSS platforms.

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Junos Space Network Management

Junos Space Connectivity Services Director is part of Junos Space, a comprehensive network management solution that simplifies management of Juniper's switching, routing, and security devices. Junos Space is a critical component of Juniper's SDN strategy as it provides a centralized management plane with a single point-of-access into the network and a common management platform for managing and creating applications to meet your specific needs. With Junos Space, you can simplify and automate the network, improve network agility, and deliver new services quickly, all from a single console. Junos Space is composed of the following software elements:

- Junos Space Network Management Platform: Provides comprehensive FCAPS and element management of Juniper devices which improves operator efficiencies, providing a programmable interface and exposable APIs that enable the development and integration of third-party applications.
- Junos Space Management Applications: Plug-and-play, domain-specific applications to help you provision new services and optimize workflow tasks across thousands of Juniper devices.

While the Junos Space Network Management Platform offers broad fault, configuration, and device provisioning capabilities with a task-specific user interface, Junos Space Management Applications extend the breadth of the platform to optimize network management for various domains. The Connectivity Services Director application runs on the Junos Space platform, where it enables users to automate the end-to-end provisioning of new services across thousands of devices with a simple point-and-click GUI, and to optimize management for specific domains such as core, edge, access and aggregation, data center, WAN, and campus and branch.

Junos Space Connectivity Services Director Product Description

Companies that offer MPLS and Carrier Ethernet services face common business challenges such as controlling capital and operating expenses, accelerating time to market and increasing customer satisfaction. At the same time, these companies also have to deal with technical challenges such as:

- Provisioning a customer service rapidly and accurately
- Scaling to keep up with customer demand
- Tracking site-specific quality of service (QoS)
- Troubleshooting and pinpointing problems in the network

Figure 1: Junos Space Connectivity Services Director Functions

Junos Space Connectivity Services Director allows service providers and enterprises to rapidly enable new service offerings. It facilitates an automated and streamlined approach to the service design and provisioning process and helps reduce fallout from misconfigured customer services, thereby increasing customer satisfaction and retention. Besides automating key provisioning tasks, Junos Space Connectivity Services Director also provides a complete network management solution, including automated service discovery, MPLS resource management, point-and-click service provisioning, validation, and troubleshooting for legacy ATM/TDM, MPLS and Carrier Ethernet environments.

The Junos Space Connectivity Services Director essentially manages the lifecycle of L2 and L3 services comprised of resource pool management, service design and provisioning, troubleshooting and performance monitoring, and service decommissioning. The high-level capabilities of the product include:

- Automating the design, activation, and validation of the provisioning process for L2 and L3 VPNs across ATM/TDM, MPLS and Carrier Ethernet networks, enabling service providers to efficiently and cost-effectively manage deployments while reducing fallout from misconfigured services.
- Designing, provisioning and activation of RSVP-signaled label-switched paths (LSPs), as well as static LSPs, which can be configured as end-to-end, P2P, P2MP or full mesh.
- Monitoring faults and performance of VPN services using standards-based protocols and technologies such as Ethernet Connectivity Fault Management (CFM), Ethernet link-level fault detection and management, and Bidirectional Forward Detection (BFD).
- Provisioning synchronization interfaces such as IEEE1588-2008(PTP) and Synchronous Ethernet (SyncE).

The Junos Space Network Management Platform and Junos Space Connectivity Services Director are all accessible through a northbound Representational State Transfer (REST)-based API. This enables network providers to tap into the rich functionality of Junos Space and build native applications on their Operations/Business Support Systems (OSS/BSS) as they begin to embrace SDN architectures in their networks.

The Junos Space Network Management Platform infrastructure provides the basic capabilities for device management and system administration, such as:

- Device discovery
- Device image management
- Device inventory management
- Script management
- Log files management
- User and security administration
- Fault management
- Performance management

In addition to these basic functions, the Junos Space Network Management Platform facilitates a multi-tenant, plug-and-play application environment that enables fast start up and in-service device upgrades.

Rapid Device Discovery

The Junos Space Network Management Platform uses a variety of methods to discover network devices and bring them under management. Once the devices are under management, the Junos Space platform collects the entire physical inventory of these network elements and maintains a centralized repository of real-time information about each device, such as:

- List of line cards (FPC)
- Interface cards (PIC)
- Serial number for each chassis component
- Juniper Networks Junos OS version
- Operational, administrative state, speed/duplex of the interfaces
- Chassis type

Device Pre-Staging

Once devices have been discovered, pre-staging takes the devices already under Junos Space management and prepares them for service activation. Connectivity Services Director automatically detects the MPLS roles and the corresponding UNIs of discovered devices. The pre-staging process discovers network provider edge (N-PE) devices in the Junos Space database and assigns roles to those devices and their interfaces. This simplifies the service provisioning task, because only qualified devices are allowed to be selected for services.

Automated MPLS Resource Management

Deploying Carrier Ethernet services requires multiple network resources to be allocated and tracked per customer site. The most common network resources are VLAN ID, Virtual Circuit (VC) ID, route targets, and route distinguishers. In the case of VLAN IDs, these are usually allocated per customer-facing interface. When a service provider is potentially handling hundreds of customers, each being provisioned hundreds of services, tracking network resources can quickly become unmanageable and unscalable—particularly when the resources are tracked manually. For example, consider a scenario where a customer is experiencing loss of packets from one site to another. How quickly can a help desk operator troubleshoot the problem to help this customer?

Connectivity Services Director provides automated MPLS resource management. It auto allocates VLAN IDs to the UNIs, VC IDs and IPV4 addresses, and it tracks used resources. This not only minimizes user input during provisioning but also guarantees that the service provisioning pushed to the devices does not conflict with existing resources on the network.

Rapid Service Design

Predefined service definitions in Connectivity Services Director capture Juniper best practices for standard services in terms of the options selected, prefilled values for attributes such as bandwidth and more. Privileged users can create custom service definitions for non-standard network configurations.

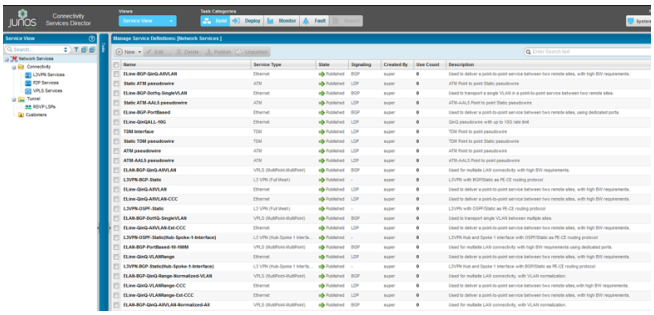

Figure 2: Predefined Service Definitions

Juniper-recommended configurations for various service types include the following:

- P2P E-LINE service
- Full mesh and hub-and-spoke VPLS service
- Full mesh and hub-and-spoke L3VPN service

Automated Service Provisioning

Seventy-five percent of network outages are due to human error, such as misconfiguration when changing an existing customer configuration. Imagine that you have to activate a 20-site virtual private LAN service (VPLS) for a customer. How do you get started? Start a spreadsheet and keep track of the endpoints, PE routers, interfaces, VLANs per interfaces, route targets, route distinguishers, and other MPLS resources? You start by configuring the first site with great attention to detail, update your spreadsheet or piece of paper, and slowly make your way to the twentieth site by the end of the week. Now, how do you know that the VPLS for the twentieth site is working? You need to go site by site and verify that you have reachability to all remote sites, issuing 20x19 pings.

What happens when you lose the spreadsheet that contains all of the information for this customer VPN? What do you do if you need to add a twenty-first site to this VPN and verify that this new site is working with the 20 preceding sites?

Connectivity Services Director provides a simple GUI-based provisioning tool that allows the operator to easily select the endpoints for activating a customer's multisite VPN. It also provides pre-validation before applying a VPN configuration to target devices, verifying that there are no collisions with existing configurations on the target devices and ensuring that set of network parameters ultimately works and renders the VPN connection functional.

Connectivity Services Director also facilitates bulk provisioning of pseudowires for mobile backhaul deployments. This capability greatly simplifies provisioning of thousands of cell sites simultaneously with a configuration that is somewhat similar. Connectivity Services Director helps to design, provision, and activate RSVP signaled label-switched paths (LSPs), as well as static LSPs. These LSPs can be configured as P2P, P2MP or full mesh LSPs.

Automated MPLS Service Validation and Troubleshooting

Generating an accurate configuration and applying that configuration is the first step. But ensuring that the service is operational is an additional step that Connectivity Services Director provides. Verifying that the control plane and data plane are functional guarantees the VPN service is actually up and running.

The real value of Junos Space Connectivity Services Director comes when the number of VPN sites is large. The application detects all of the sites in a VPN and is able to verify that the label-switched paths (LSPs) are operational on all sites—issuing a full-mesh MPLS Operation, Administration, and Maintenance (OAM) verification to validate that the data plane is operational.

If one or more sites are not reachable, the operator is immediately alerted to the broken sites with a detailed analysis of the failure conditions.

Connectivity Services Director—with its built-in auto-discovery (AD), resource management capabilities and service design—allows service providers to quickly start offering Carrier Ethernet services in a very cost-effective manner.

Connectivity Services Director provides the following benefits:

- Removal of all possible manual configuration errors
- One centralized location for all L2VPN and L3VPN services
- Reduced mean time to recovery (MTTR) when troubleshooting customer connectivity issues

Synchronization Management

Junos Space Connectivity Services Director includes an optional component that manages synchronization devices such as Juniper's TCA Series Timing Appliances as well as synchronization subsystems within other Juniper devices that support the IEEE 1588-2008 standard—commonly known as Precision Time Protocol, or PTP. In addition to managing device level synchronization attributes, Connectivity Services Director also manages logical timing entities or domains that comprise groups of devices or subsystems. Users can create timing domains, assign various synchronization devices and subsystems to a domain and then apply a specific timing service template to each domain. Connectivity Services Director scans through the devices in the timing domain and performs configuration operations one-by-one based on the service template, thus automating and greatly simplifying the configuration process.

Connectivity Services Director provides configuration management, health monitoring and discovery of synchronization devices.

Service Validation and SLA Monitoring

After a service has been provisioned, the service provider must be able to monitor the service in order to guarantee SLAs. Monitoring involves checking end-to-end path connectivity of the control plane and data plane. Control plane validation involves verifying that the MPLS edge routers have indeed established logical connections. For E-LINE LDP and BGP, LSPs have to be peered, and pseudowires from both PE routers have to be operationally in "up" status. For VPLS multipoint-to-multipoint, each site/leg has to have all the configured LSPs operationally "up."

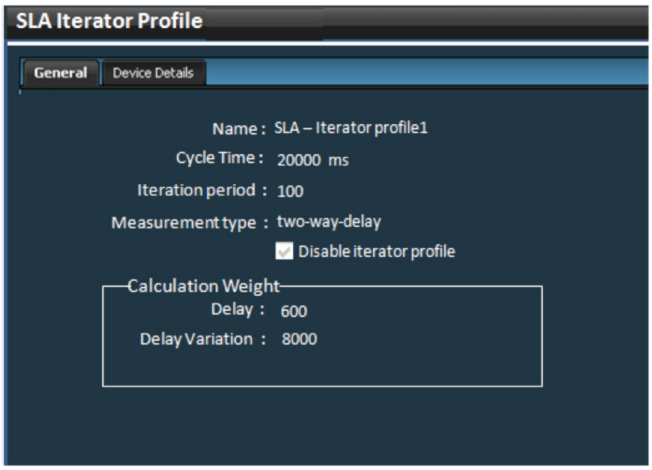

Figure 3: SLA Iterator profile

Data plane validation is one last step that leverages exiting MPLS OAM pings to ensure that the data plane is indeed working. The Connectivity Services Director application provides the following monitoring capabilities:

- Connectivity Fault Management (CFM) configuration at the port and interface level
- Service level CFM for P2P (E-Line) and VPLS (E-LAN) services
- Support for Y.1731 based one-way and two-way measurements for frame delay, frame delay variation, frame loss and service availability

Connectivity Services Director enables users to set up CFM flows between service endpoints in order to monitor the end-to-end service using Y.1731 frames. Users can choose to gather performance data on demand, or create SLA Iterators and assign them to a service in order to periodically measure the data. In addition to these iterators, users can also associate an Action Profile with a service to describe actions that must be performed when connectivity problems are detected with the service.

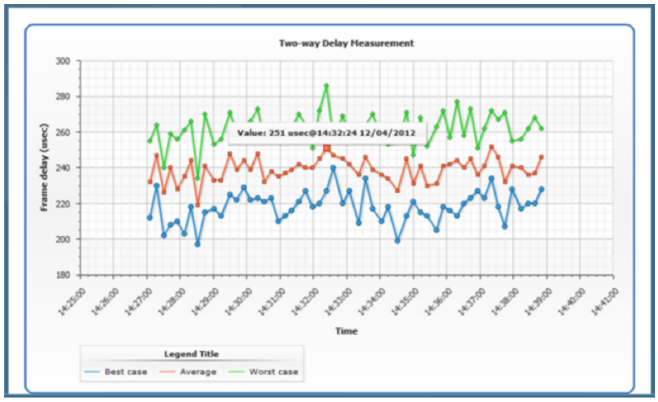

Figure 4: Performance data collected through OAM flows

Features and Benefits

Feature	Feature Description	Benefits
Reliable and scalable architecture	• The Junos Space Connectivity Services Director runs on a distributed and scalable architecture. • The Junos Space fabric can be expanded organically, as administrators can simply add nodes to increase scalability. • Users can monitor the health of the fabric, and adjust node membership, as needed. The application automatically load-balances the processing across any new nodes as required.	• Allows for a resilient application infrastructure. • Allows for expansion of the application infrastructure with the growth of the number of devices, number of GUI operators and northbound operations support systems (OSS) clients. • Enables geographically distributed data centers to operate on the same Junos Space fabric. In case one data center is not operational, the secondary data center can still provide full management capability to continue operations.
Auto-discovery (AD) and inventory of network devices	• Using IP address range, IP subnet and hostname, Connectivity Services Director is able to connect to and bring in the complete physical inventory of the managed devices. • Extends network discovery to MPLS VPN roles including ATM and OCx.	• Provides a complete and accurate device inventory of line cards, PICs, interfaces, Junos OS version, chassis type, and serial number that is accessible in one single place. • Improved pseudowire support is available.
Automated MPLS and network resource management	• Leveraging Juniper best practices, there is a set of predefined network signature rules that help with the MPLS role, UNI, NNI, and VLAN ID pools assignment. • Once these rules are applied to the discovered network devices, automatic role assignment, UNI selection and corresponding VLAN ID tagging occur.	• When configuring carrier Ethernet services, a large number of network resources typically need to be allocated and tracked for a given MPLS service. • Provisioning Ethernet services at scale becomes fast and efficient by automating network resource allocation.
Service design	• Leveraging Juniper MPLS best practices, Connectivity Services Director has predefined service offering designs for E-LINE and ELAN-VPLS services. Service designers can further customize a carrier's predefined service offering designs.	• Time to market is shortened, providing a turnkey service model that can be leveraged rapidly. • Custom service definitions allow for flexibility in service provisioning.
Multihoming	• VPLS multihoming connects a customer site to multiple PE routers.	• Redundant connectivity is provided in the event of a PE router-to-CE device link failure or the failure of a PE router.
Point-and-click provisioning	• Simple point-and-click provisioning allows the operator to easily select the endpoints for activating a customer VPN. • MPLS services supported are carrier Ethernet E-LINE and ELAN-VPLS.	• Removes all possible manual configuration errors. • Provides one centralized location to track all customer VPN services (E-LINE, ELAN-VPLS). • Reduces MTTR when troubleshooting customer connectivity issues.
Configuration pre-validation	• Before deploying carrier Ethernet services, pre-validation is done to determine if there are any conflicts with selected network parameters in the network—VLAN IDs, VC ID, Route Targets (RTs) collision, uniqueness of Route Distinguisher (RD).	• All of these network pre-validations provide a certain level of assurance that the service intended by the operator has no conflicts and is configured correctly without errors.
Configuration post-validation	• Connectivity Services Director validates at a configuration level to determine if the intended configurations are present on all targeted devices.	• Ensures that the service configurations are present as intended by the operator.
Operational validation	• In order to ensure that carrier Ethernet services are operational, two validation levels are executed—control plane and data plane validations.	• Provides the operator with a clear assurance that carrier Ethernet services are indeed working.
Create, Read, Update, and Delete (CRUD) functionality	• CRUD is applied to resource management for MPLS VPN service deployment. • IP address pool handling is available. • Provides automation of attributes such as AS#, RD pools.	• Customers can easily assign IP address selections, reducing multiple manual steps. • Improves handling of additional L3VPN attributes.
Synchronization management (option)	• Connectivity Services Director allows configuration of PTP and SyncE interfaces across Juniper devices.	• Network-wide consistency in management of synchronization—a critical requirement for 3G/4G/LTE networks.
Performance monitoring	• Connectivity Services Director facilitates fault monitoring of ports, interfaces and services and provides network performance data.	• Provides early warning about network problems and allows service providers to meet SLAs.
OSS/BSS integration (option)	• Connectivity Services Director provides REST API for northbound OSS/BSS to access the applications and orchestrate other services.	• Simple interface to achieve platform extensibility, multivendor support and service orchestration.

Table1: Supported Platforms and the Software Versions for Connectivity Services Director

Supported Platforms	Qualified Junos OS Release
ACX Series Universal Access Routers: • ACX500 router • ACX1000 router • ACX1100 router • ACX2000 router • ACX2100 router • ACX2200 router • ACX4000 router • ACX5000 router (ACX5048 and ACX5096) • ACX500 router	Release 12.3R1 through Release 12.3X54-D10 for ACX1000, ACX1100, ACX2000, ACX2100, ACX2200, and ACX4000 routers Release 15.1X54-D20 for ACX5000 routers Release 12.3X54-D20 for ACX500 routers
MX Series 3D Universal Edge Routers	Release 12.2R1 through Release 15.1R1 for MX80, MX104, MX240, MX480, and MX960 routers Release 13.3R1 through Release 15.1R1 for MX2010 and MX2020 routers
M Series Multiservice Edge Routers	Release 10.0 through Release 12.2R1.8 for M320 router Release 10.0 through Release 14.2R1.12 for M7i and M10i routers
PTX Series Packet Transport Router	Release 13.2R2.2 for PTX3000 router Release 13.2R1.7 for PTX5000 router

Juniper Networks Services and Support

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About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at www.juniper.net.

Corporate and Sales Headquarters
Juniper Networks, Inc.
1133 Innovation Way
Sunnyvale, CA 94089 USA
Phone: 888.JUNIPER (888.586.4737)
or +1.408.745.2000
Fax: +1.408.745.2100
www.juniper.net

APAC and EMEA Headquarters
Juniper Networks International B.V.
Boeing Avenue 240
1119 PZ Schiphol-Rijk
Amsterdam, The Netherlands
Phone: +31.0.207.125.700
Fax: +31.0.207.125.701

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