

# AUTOMATION POWERS CLOUD-NATIVE TELCO AND EDGE CLOUDS

*Unifying private and public telco clouds with agility, speed, and service assurance*

## Challenge

*Delivering telco and edge cloud services across hybrid and multicloud networks is difficult, requiring operational skills that span networking and various private and public cloud software stacks and tools. Workload portability is complex, requiring software customization and cross-platform integration that is tedious and costly.*

## Solution

*Juniper Networks' telco and edge cloud solution delivers high-performance network virtualization and digital services with on-demand capacity and scale across a cloud-native ecosystem. Purpose built for service providers it integrates physical network functions (PNFs), virtual network functions (VNFs), and cloud-native network functions (CNFs) into an automated cloud platform with service agility and cloud operational economics from RAN to data center.*

## Benefits

- *Minimizes business risks by maintaining agility and flexibility across a hybrid cloud*
- *Achieves operational excellence and reduces operational costs using automation across all cloud layers*
- *Assures excellent customer experiences with built-in observability and security across private and public clouds*

*Edge clouds and 5G represent new ways for network operators to build, deploy, and monetize network services. They are a necessary answer to the network becoming a ubiquitous cloud fabric connecting all compute and storage from the radio access network (RAN) to the WAN and core. In this new environment the geographic distribution of edge compute mandates an automated, cloud-native, software-defined approach to make telco and edge cloud platforms easy to design, deploy, scale, and operate. This strategy builds on previous investments using cloud-native technologies and a consistent operational model for on-demand capacity and scale with a seamless experience across private and public clouds.*

## The Challenge

Some of the world's largest service providers have successfully invested in telco and edge clouds to achieve agility, speed, and improved economics. However, Network Functions Virtualization (NFV) has not been a point-and-click experience for all. Many operators have dealt with operational complexity and vendor lock-in as they relied heavily upon Virtualized Network Function (VNF) vendors to build and operationalize the telco cloud. Siloed and optimized for a single service, most first-generation clouds were an expensive lift-and-shift from physical to VNFs. The platforms were difficult for service providers to deploy and operate, and they provided limited return on investment.

In the 5G era, service providers need a more open, cloud-native approach to automate the design, deployment, and lifecycle management (LCM) of a distributed cloud that extends from the data center to the edge. The evolution to cloud native is fundamental to growth but challenging as Kubernetes-based technologies must integrate with existing OpenStack VNF investments to avoid costly service disruptions. Network security, troubleshooting, and service assurance across multiple levels of physical and virtual abstractions is complex, impacting uptime, quality, and customer satisfaction.



## The Juniper Networks Automated, Cloud-Native Telco Cloud

### Solution Overview

Juniper's telco and edge cloud is an SDN-enabled, universal cloud architecture deployed across the service provider network—from the far RAN edge to the data center. Operationally, it unifies private, public, and multicloud environments.

Juniper's solution integrates high-performance IP fabric underlay networking, scalable SDN-based overlay networking, and multi-layered automation to simplify the deployment and LCM of secure, multivendor telco and edge clouds.

Juniper's automation-first approach simplifies Day-0 to Day-2 operations, integrating each layer of the cloud into a network-wide cloud fabric to economize and simplify access to compute, storage, services, and applications. Using DevOps methodologies and GitOps tools for Continuous Integration/Continuous Delivery (CI/CD), Juniper's solution streamlines operations, increases service agility, and delivers an assured service experience across private and public clouds.

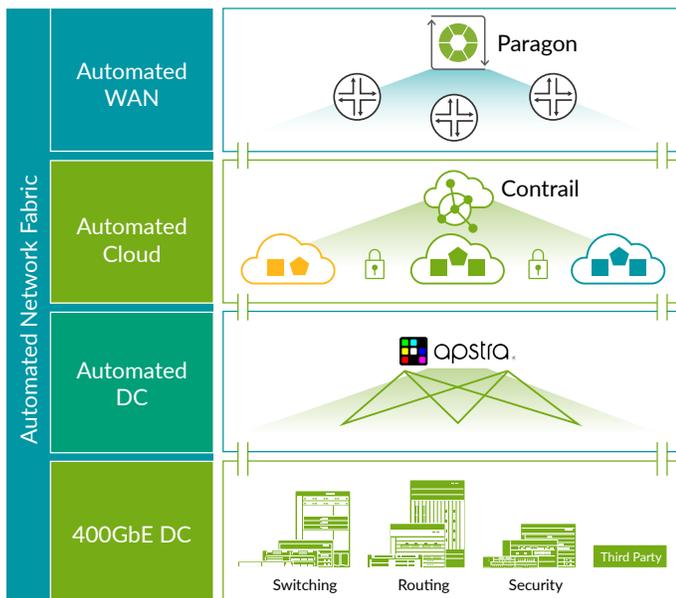


Figure 1: Juniper's automated, secure, telco cloud architecture

### Automated, Secure, 400GbE Data Center High performance IP underlay fabric

Juniper is uniquely positioned to offer a complete IP fabric underlay of industry-leading routing, switching, and security products for building next-generation, cloud-native telco, edge, and data center clouds.

Juniper Networks® [MX Series](#), [PTX Series](#), [QFX Series](#), and [EX Series](#) lead the industry with best-in-class throughput and scalability, including 400GbE interfaces, advanced routing, the open programmability of the Junos® OS, and comprehensive Ethernet VPN-Virtual Extensible LAN (EVPN-VXLAN) and IP fabric capabilities.

The QFX Series and EX Series switches establish a high capacity, highly resilient underlay fabric consisting of spine, leaf, and top-of-rack switches. The MX and PTX Series Routing Platforms provide advanced L3 routing and gateway router functions for intra- and inter-cloud networking.

Securing the telco and edge clouds, Juniper Networks [SRX Series Services Gateways](#) of physical, virtual, and containerized firewalls protect users, applications, and infrastructure. [Juniper Cloud Workload Protection](#) extends security to telco and edge workloads, defending against advanced and zero-day exploits to keep business-critical services connected and resilient.

### Data Center Automation

Achieving operational economics and agility at telco scale depends on automation of the IP fabric underlay. Juniper Networks Apstra System integrates the underlay into a programmable EVPN-VXLAN IP fabric to automate Day-0 to Day-2 operations. Apstra System is an intent-based data center automation product that is powerful and intuitive to make the deployment of telco and edge cloud fabrics simple, scalable, and repeatable. Apstra supports a range of switching platforms including Juniper, Cisco, Arisa, and Dell.

The Apstra EVPN-VXLAN fabric is efficient and resilient, leveraging the full capacity of all physical links to provide optimized, seamless, and standards-compliant L2 and L3 connectivity. Easy-to-use blueprints, templates, and default multi-vendor libraries automate the design, deployment, and LCM of greenfield and brownfield fabrics to reduce manual errors and focus operations on high-value tasks.

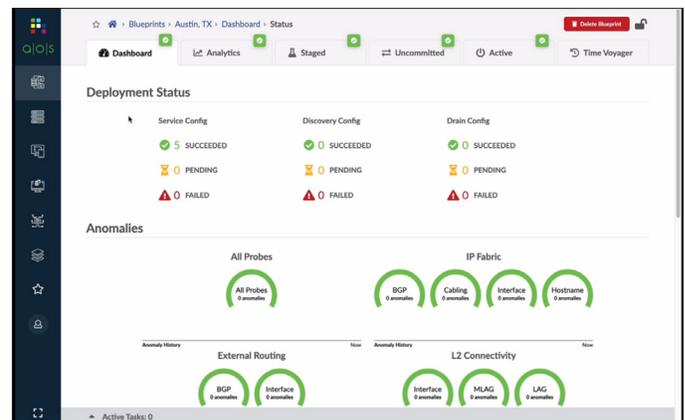


Figure 2: Juniper Apstra system data center automation interface

## Automated SDN Overlay Networking

Connecting ephemeral cloud workloads and applications with service-level agreements (SLA) compliance, security, and scale is a networking challenge.

**Cloud-Native Contrail Networking (CN2)**, Juniper's Kubernetes-native, software-defined networking (SDN) solution, automates the creation and management of virtualized networks to connect, isolate, and secure virtual machines (VMs), containers, microservices, workgroups, applications, and services.

Using standard Neutron and Container Network Interface (CNI) APIs, CN2 integrates with any OpenStack and Kubernetes distributions to preserve investments in platforms, licenses, skills, and processes. Contrail integrates physical network functions (PNFs), virtual network functions (VNFs), and cloud-native network functions (CNFs) into a ubiquitous cloud fabric to unify networking, policy management, security, and observability through a single SDN to simplify operations and reduce costs.

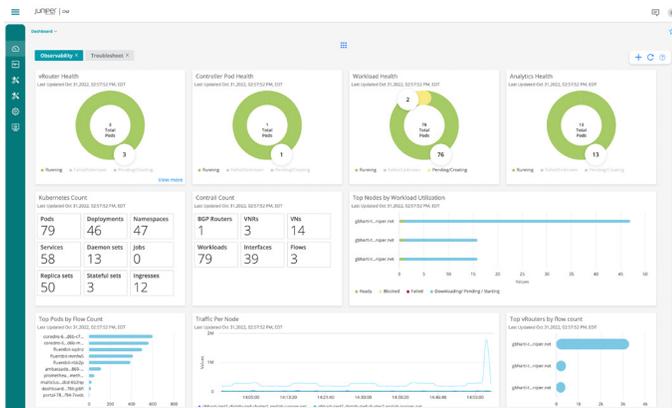


Figure 3: CN2 Web GUI

Integrating with Apstra, Contrail abstracts the physical underlay using embedded BGP-as-a-Service (BGPaaS) and overlay tunnels (MPLS over UDP, MPLS over GRE, or VXLAN) to provide high scale, high availability, and high performance with always-on service reliability. Contrail unifies and simplifies VM, container, and microservices security, using metadata and attributes, as opposed to IP addresses alone, to simplify policy and deliver network isolation for multitenant environments across hybrid and multicloud networks where ephemeral workloads can dynamically appear and migrate.

Advanced routing features like BGPaaS, native ECMP, and L3 multihoming are supported through a fully distributed carrier-grade routing stack featuring MP-BGP and EVPN. Typical cloud-native bolt-ons such as Ingress controller, multi-NIC capabilities, and load balancing are built-in. Support for InterAS options seamlessly extend the network into existing MPLS networks.

Multi-cluster management, control-plane federation, and Kubernetes Cluster Federation (KubeFed) provide one-to-many centralized management and control to achieve operational scale and reduce TCO for highly distributed telco and edge cloud deployments.

For monitoring and troubleshooting, Contrail provides enhanced observability with plug-and-play usability for some of the most popular open-source projects like Prometheus, Grafana, FluentD, and Elastic Stack for ease of use, platform flexibility, and low cost. Traffic mirroring and flow analytics can be used for regulatory compliance.

A modern, cloud-native solution, Contrail is tested, qualified, and deployed using Contrail Pipelines, a CI/CD model for NetOps to deliver on-demand, production-quality software at hyperscaler speed. Open-sourced test suites simplify operator qualification and LCM of CN2 with any Kubernetes distribution.

## Service Assurance

Multi-layered cloud abstraction and dynamic workload orchestration provide service agility but verifying the quality of experience for customers can be difficult.

Juniper Networks **Paragon Active Assurance** is a cloud-native software application delivering service assurance across physical, hybrid, and virtual networks to test, measure, and guarantee the customer experience.

Paragon Active Assurance uses real-time, active service quality monitoring to ensure that services delivered from the cloud meet performance, latency, and uptime expectations. For example, measuring the end-to-end throughput and latency comparing it to the individual performance of each function (routing, firewall, and others) in a service chain, to accurately pinpoint which function may be degrading the service level.

Extending across the WAN, Paragon Active Assurance measures the end-to-end performance of applications and workloads delivered from multivendor and hybrid clouds to extend visibility across the telco cloud layers and resolve quality issues before they are discovered by customers to eliminate the cost of churn.

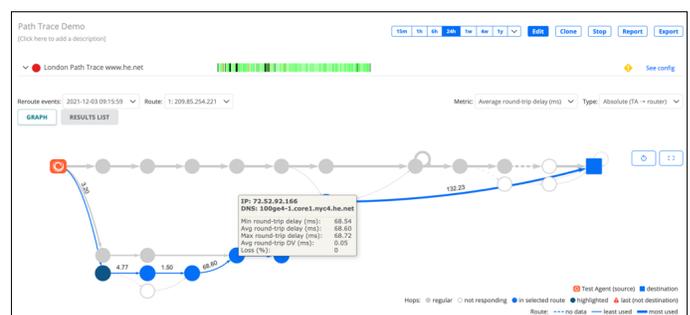


Figure 4: Paragon Active Assurance Path Trace

## Deployment and Operational Services

Professional services, available from Juniper as well as from selected partners, helps customers accelerate and optimize the use of these solution components to achieve a complete service automation solution. Customers can leverage planning services to assess and design a cloud that eases the transition to NFV. Moving from planning to implementation, Juniper Professional Services will help users build, optimize, and protect their telco cloud architecture. Shifting to production, Juniper also provides the support and maintenance required to keep the cloud running smoothly. Education Services from Juniper help staff better understand how to use the technologies incorporated in your NFV solution.

## Features and Benefits

When moving to a collaborative, cloud-native future, it's best to work with innovative technology leaders that understand the service provider industry intimately, have significant experience in both networking and IT, and build solutions based on open principles. Juniper's telco and edge clouds deliver best-in-class products with multi-layered automation to exploit the dynamic resource availability and scalability of modern, cloud-native clouds.

**Investment protection:** Protects and integrates existing VNF workloads, tools, and operations into a hybrid OpenStack and Kubernetes cloud to reduce training, time to market, and cost while seamlessly evolving to cloud native.

**Cloud economics:** Automates the orchestration and management of distributed telco and edge clouds to simplify operations at telco scale.

**Operational consistency:** Unifies operational expertise and processes to enable workload portability and operational independence across a hybrid-cloud ecosystem to improve economics and deliver partnership flexibility, simplicity, and choice.

## Solution Components

**CN2:** The leading Kubernetes-native SDN solution for service providers, CN2 offers the highest level of scalability, availability, and performance for virtualized and cloud-native telco and edge clouds.

**Apstra System:** Juniper's data center automation product enables service providers to automate the entire data center network lifecycle across multivendor environments from design to ongoing operations with continuous validation, a single source of truth, powerful analytics, and rapid root-cause identification.

**QFX Series Switches:** Industry-leading line of switches delivers superior throughput and scalability, a comprehensive routing stack, the open programmability of Junos OS, and the broadest set of EVPN-VXLAN and IP fabric capabilities.

**MX Series Routers:** A robust portfolio of SDN-enabled routers that provide industry-leading system capacity, density, security, and performance with unparalleled longevity. MX Series platforms are the key to digital transformation for service providers, cloud operators, and enterprises in the cloud era.

**Paragon Active Assurance:** A programmable, active test and monitoring solution for physical, hybrid, and virtual networks. Unlike passive monitoring approaches, Paragon Active Assurance uses active, synthetic traffic to verify application and service performance at the time-of-service delivery and throughout the life of the service.

**SRX Series Services Gateways:** Next-generation physical, virtual, and containerized firewalls protect and secure the network edge, data center, and cloud applications.

**Juniper Cloud Workload Protection:** A lightweight software agent that defends application workloads in any cloud or on-premises environment in and against advanced and zero-day exploits, automatically as they happen. It ensures that production applications always have a safety net against vulnerability exploits, keeping business-critical services connected and resilient.

## Key Solution Use Cases

Juniper's telco and edge clouds help service providers build the right cloud infrastructure to meet their business needs and objectives. While new use cases for NFV are being created rapidly, the following list describes four leading telco and edge cloud use cases.

### Remote Compute

Contrail's Remote Compute simplifies cloud orchestration and operations of a distributed edge cloud network to deliver operational scale and reduced OpEx. Remote Compute gives operations centralized SDN control of remote, low profile vRouter data planes to reduce footprint and cost for thousands of space constrained edge sites. Contrail's vRouter delivers high-performance routing for VNF, CNF, and bare metal server workloads with Data Plane Development Kit (DPDK) and SmartNIC implementations to optimize CPU resources, space, and cost.

## Advanced Federation and Multicluster

The proliferation of edge clouds increases the number of Kubernetes clusters managed by the operations team. CN2 reduces the cost and complexity of multi-cluster networking, using a single Contrail instance to serve as the CNI for many Kubernetes clusters for intra- and inter-cluster connectivity as well as cluster load balancing to enhance performance and availability. Kubernetes Cluster Federation automates multi-cluster control plane management, using the API to coordinate the propagation and configuration of multiple Kubernetes clusters from a single Contrail instance. BGP distributes network federation across multiple clusters while centralizing management.

## Distributed RAN

Delivering high capacity and low latency 5G services requires a highly distributed RAN to potentially tens of thousands of space- and power-constrained sites. Kubernetes-native and containerized, the Juniper Cloud Native Router (J-CNR) is a high-performance, software-based router built upon Juniper's advanced containerized routing process daemon (cRPD) routing technology and the CN2 DPDK vRouter forwarding plane. Designed to co-exist with the ORAN Distributed Unit (ODU) to share a common 1RU FlexRan server, the J-CNR economizes valuable edge compute resources, eliminates truck rolls, and integrates seamlessly with Kubernetes orchestration to simplify operations and reduce TCO.

## Dynamic Subscriber Services

Mobile and wireline broadband services are converging, adopting cloud-native and disaggregated architectures built upon containers and microservices. Juniper's universal, cloud-native telco and edge cloud delivers the high-performance, automaton, and service assurance to meet the demanding SLAs of these dynamic, distributed applications. 5G core and JUNOS BNG control plane services may be hosted in private data centers, telco clouds, or public availability zones for on-demand economics, elasticity, and scale. Juniper's automated telco fabric extends to the distributed edge to deliver cloud hosted user plane functions (UPF) and converged 5G Access Gateway Function (AGF) plus UPF services available on most MX Series Universal Routing Platforms.

## Summary—Building and Partnering for Success, Value, and Control

Service providers are moving away from function-led and siloed virtualization, and they are standardizing on cloud-native technologies that allow them to deliver services faster and at a lower cost. With a fully automated, cloud-native architecture, Juniper's telco and edge cloud transforms service provider network facilities into cloud-native telco and edge clouds to plug seamlessly into the ecosystem of application developers and public cloud providers.

As an open cloud, service providers can deploy any cloud-native telco or digital service to match opportunity with timely innovation. Using the common platforms, tools, and software as the public cloud providers, service providers gain the operational consistency to build and deploy private clouds and partner seamlessly with hyperscalers when it makes economic sense. By building and partnering to create the hybrid-multicloud, service providers realize true workload and application portability across private and public cloud domains and gain the ability to deliver flexibility, agility, and improved economics in a fast paced, dynamic, and competitive market.

Juniper is one of few networking vendors with both service provider and cloud provider expertise, a comprehensive hardware and software product portfolio, and the breadth and depth of technologies to integrate physical and virtual networks into a universal telco and edge cloud network. With end-to-end automation, a Kubernetes-native SDN, scalable overlay tunneling, and powerful security, service providers can deliver advanced services and telco use cases at hyperscaler speed.

## Next Steps

For more information about Juniper's cloud native telco and edge cloud solution, please visit <https://www.juniper.net/telco-cloud> or contact your local Juniper Networks representative for more information.

## About Juniper Networks

At Juniper Networks, we are dedicated to dramatically simplifying network operations and driving superior experiences for end users. Our solutions deliver industry-leading insight, automation, security and AI to drive real business results. We believe that powering connections will bring us closer together while empowering us all to solve the world's greatest challenges of well-being, sustainability and equality.



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