Automated Control and Orchestration within the Juniper Networks Mobile Cloud Architecture

White Paper

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Executive Summary

Automated control and orchestration are one of the five central pillars of Juniper Network’s Mobile Cloud Architecture (MCA). MCA is Juniper’s complete solution for building a secure, reliable, cost-effective mobile cloud network today and scaling that network to meet future mobile needs—for example, those related to 5G and IoT.

This white paper is divided into the following sections:

• Challenges and Trends
• Overview: Juniper Solutions and a Partner-enabled Ecosystem
• A Closer Look: Juniper Products and Services
• Services
• Automated Control and Orchestration within Juniper’s Mobile Cloud Architecture

The content in this white paper is also available in PPT (blueprint) and video formats at Network Design and Architecture Center: Mobile Cloud.

Challenges and Trends

Anyone designing, deploying, and managing a mobile network is already aware of the challenges that affect day-to-day operations:

• **Network complexity** grows faster than current skillsets and staffing. For example, adding new or customized services is labor intensive and time consuming.
• **Annual OpEx** is usually much higher than the initial cost of the network.
• **Air interface technologies** operate in different bands, at different coverage levels, and at varying levels of RF performance. Many networks are composed of converged or hybrid technologies with different transport types, such as optical, Ethernet, and microwave. Network devices might be self-managed or in leased facilities with different SLAs. These variations make it challenging to reduced operating costs while still maintaining network performance.

To take on these challenges, Juniper Networks wants to help you design for and implement automated solutions to create a self-driving network. Getting to this end goal requires multiple steps, including the use of telemetry and key performance indicators (KPIs) to continually improve network reliability and performance. Big-data analytics and machine learning will also contribute to making your self-driving network predictive, efficient, and adaptive.

Overview: Juniper Solutions and a Partner-enabled Ecosystem

Juniper can help you automate your network in several places:

• **At the device and multi-device layer.** Juniper provides automation solutions in physical and virtual environments and with various devices, including routers, switches, optical equipment, and security appliances. Some can be virtualized, like the vSRX and vMX. All are managed at the device level.
• **At the layer of network awareness.** Juniper offers Junos Space, which includes Network Director, Security Director, and Connectivity Services Director. These applications run on the Junos Space platform for network management across devices.

• **At the SDN controller layer for underlay and overlay.** Juniper offers Contrail for network overlay and NorthStar as an underlay across entire network for label-switched path (LSP) management.

• **At the orchestration layer for multiple domains and the entire network.** Juniper provides Contrail Cloud, which includes Contrail and VMware OpenStack together, and Contrail Service Orchestration.

• **At the business layer.** Juniper works with several partners to provide operations support system (OSS) services, business support system (BSS) services, and other business apps.

**A Closer Look: Juniper Products and Services**

**The Junos Automation Stack**

Designed for automation from the very beginning, the Junos operating system separates the control plane from the data plane and operates through APIs to make it completely programmable. Through Junos, we provide minimal or zero-touch provisioning for all devices, both physical and virtual. We have also designed Junos to adhere to a standards-based model for automation: continuous integration and continuous deployment to meet your SaaS needs, with the same automation experience across our entire portfolio of products.

The lowest layer of the automation stack includes both the chassis and the data plane (PFE) levels. With Junos, it’s important to understand the concept of the ephemeral database, which allows external programmability in Junos to work. As you get further away from the direct OS interaction, there are abstractions that remove some flexibility of command choice and/or OS manipulation; however, for most, IT frameworks and basic scripts will be enough to push configurations and get basic status. When more information is needed from the network, you can use things like JET apps and YANG models to truly unleash the power of an automated Junos platform to make the idea of a software-defined network a reality.
**JET: Junos Extension Toolkit slide**

JET supports application development in C and Python; you can write external applications that take advantage of the programmability of Junos in standard data formats (XML, JSON, TXT). These applications will continue to operate over upgraded versions of the Junos OS so that you don’t have to redesign them for new OS versions.

**On-Box Automation with Python**

On-Box Automation with Python allows you to simplify operations by taking advantage of open APIs to create commit, op, event scripts. Running on the device, these scripts work in real time.
Virtualization and Cloud Networking: Contrail
While open architectures and integrated VNF ecosystems are important elements in the Mobile Cloud Architecture, another framework is needed to support a virtualized solution: a cloud networking environment to allow VNFs to connect to one another.

The Contrail solution is a carrier-grade SDN platform for service provider cloud infrastructure. Contrail is a completely open-source system, developed using standards-based protocols such as BGP to ensure it can interoperate with existing physical networks. The system is completely open with APIs that allow it to interface with automation tools and management systems.

Juniper’s Contrail offering ensures that self-developed VNFs can be completely controlled by this SDN infrastructure.

Contrail Networking
Contrail Networking is a simple, open, and agile SDN solution that automates and orchestrates the creation of highly scalable virtual networks. Contrail Networking provides virtual network capability through virtual routers, or vRouters. Manageable by standard orchestration systems, vRouters are added to compute nodes to provide the routing function of the platform.


Contrail Cloud Platform
Contrail Cloud Platform is an integrated turnkey cloud management platform that is hardened from open source technologies including OpenStack, OpenContrail, Ceph, and Puppet. The Contrail Networking system is part of this larger Contrail Cloud Platform offering.
For more information on Contrail Cloud Platform, see http://www.juniper.net/us/en/products-services/sdn/contrail/contrail-cloud/.

**Contrail Cloud Reference Architecture**

The elements noted above are bundled into the Contrail Cloud Reference Architecture. This reference architecture is a set of verified cloud systems that, combined with Juniper switching and routing platforms, facilitate the design and deployment of an integrated compute, network, and storage system that runs Contrail Cloud Platform to provide an all-in-one turnkey cloud solution for NFV. This reference architecture includes specifications for a standard system design, provides a predefined bill or materials, and includes tools and scripts for automated installation.


**Software-Defined Operations with AppFormix**

AppFormix allows greater analysis of and real-time visibility into the compute environment. Network self-healing, self-pacing and scaling are computed within AppFormix to provide automation. AppFormix presents real-time, actionable data about the state of network, which allows the network to become more autonomous.
Contrail Service Orchestration

There are three components to the Contrail Service Orchestrator:

- **Designer**—allows you to create new services out of combinations of virtual network functions from the same or different suppliers, as well as create service chains that are evaluated against your requirements (PPS, sessions, etc.).
- **Administrative portal**—allows you to manage new tenants, users, and services.
- **End user portal**—validated customers and external users can design their own chains of services and locations for VNFs, as well as instantiate new services.

All three components can be used to orchestrate and manage functions across network—at the data center, within groups of data centers, or throughout different customer locations.
NorthStar: WAN SDN Controller

NorthStar allows you to manage LSPs through the network in a more automated fashion. For example, you can design custom-traffic-engineered paths with a PCEP engine that uses IGP and BGP to discover the network. With NorthStar, you can plan for network maintenance and reroute traffic around a given node with minimal impact.

NorthStar Benefits
- OPEX Savings
- CAPEX Savings
- New Revenue Opportunities

NorthStar Use Cases
- Bin Packing or Network Defragmentation
- Premium Traffic Engineered Paths
- Bandwidth Calendaring
- Maintenance Mode
- Path Diversity (Link, Node, SRLG)
- Inter-domain Routing
- Global Concurrent Optimization

Segment Routing (SPRING) in Northstar 3.0
**IP/MPLSView**

IP/MPLSView uses the same algorithms and path computation as NorthStar, but it is more a network design and optimization tool. It provides multi-vendor visibility for the WAN and guarantees robustness and survivability as part of your planning process.

**Junos Space Overview**

Junos Space is an open platform that allows applications to be designed for particular needs. For example, one key application is Security Director, which is used to manage security appliances, such as SRX series and vSRX series, as well network security policies. Network Director manages connectivity in both campus/branch and data center environments. Connectivity Services Director is used to design Layer 3 services in the network. The Cross Provisioning Platform is used with Connectivity Services Director to manage third-party routers.
Proof Points

The benefits of Juniper’s solutions for disaggregation and virtualization can be defined through several proof points, as shown below.
Services

The complexity of deploying solutions in a virtualized world is greater than ever before. With the separation between hardware, which could be provided by multiple vendors, and software, which is a new way to deploy network functionalities, makes using Juniper Networks’ service offerings more relevant than ever.

Juniper can provide support for the full network lifecycle, from planning through the build and into operation.

Automated Control and Orchestration Within the Juniper Networks Mobile Cloud Architecture

Automated Control and Orchestration is a fundamental component of Juniper’s Mobile Cloud Architecture as it encompasses the entire network. Juniper provides a complete solution through the platforms noted below.
Automated control and orchestration is one of five solution areas within the Juniper Networks mobile cloud architecture.

For further detail on the other solution areas, see Network Design and Architecture Center: Mobile Cloud.