# Contrail for Service Providers

Networking for the Virtual World

## Table of Contents



## List of Figures

## Executive Summary

Service providers around the world are in the center of a profound shift to cloud networking. Enabled by access to high-performance, low-cost broadband, the unprecedented shift to mobility, and success of software delivered as a service, service providers are investing heavily to host and deliver cloud-based solutions—to meet customer demand as well as derive new revenues.

Honed in the enterprise, virtualization technology has rapidly matured to become carrier-grade, providing a platform for service delivery. However, the same level of agility is not yet available to networking. For service providers who deliver networking as a service, a new approach is needed to meet the demands of a massive new cloud architecture.

Juniper Networks® Contrail, Juniper's open SDN controller, brings a new paradigm of networking specifically optimized for the virtual world. Contrail brings the agility of virtualization to networking, automating support for Network Function Virtualization (NFV). It enables service providers to rapidly scale up (and out) cloud architectures with its simplified networking solution. As an open software architecture, Contrail gives service providers the freedom to customize the network without being locked into a single vendor or approach.

Contrail is networking for the virtual world.

## Moving to the Clouds

The availability of high-performance mobile (and fixed) data networks, as well as low-cost smartphones and tablets, has mobilized today's workforce. Always-on, always-available applications and network services are required for people who can work anywhere and at any time.

To meet this need, traditional network service providers, as well as new cloud service providers, are rapidly expanding to meet the needs of XaaS (IT as a service, Infrastructure as a Service, Software as a Service, Platform as a Service, etc.). Existing network architectures are too rigid to meet the rapidly growing demands of enterprises and consumers alike.

Traditional virtualization technologies, developed to meet the needs of enterprise IT environments, have matured to achieve a carrier-grade scalability and reliability requirement demanded of commercial cloud service environments. Virtualization has ushered in an era of automated compute resources—need a CPU to handle a specific service? It's available in a matter of seconds. Elasticity is the name of the game.

Yet, networking these virtual machines and virtual services has remained a very manual process. In fact, configuring networks today is still often managed through a command-line interface (CLI)—not unlike early computer programming handled through DOS or UNIX text commands. While the programming world evolved, wrapping simpler and more natural language interfaces around the computer like C, object-oriented and even Java programming networks have remained stuck in the 1980s.

Rudimentary technologies such as VLAN pools have limitations that are quickly exceeded in commercial cloud operations and severely restrict the ability to operate the network with the same virtualization principles available to applications or service resources.

Businesses need to run at "Internet" speed, and many cloud providers have infrastructure that hinders, rather than helps, achieve this level of agility.

## Cloud Networking in a Virtual World

To maintain profitable growth, service providers need to evolve their infrastructure and business processes to manage changing market dynamics. A recent survey of enterprise IT managers indicated that security and reliability remain top concerns when these managers are considering a cloud service provider service.

Today's cloud infrastructures must be:

**Agile**—They must be able to support today's requirements, and diagnose current networking trends and tomorrow's future opportunities. Virtualized networking enables service providers to connect and reconnect networks in a matter of seconds. Analytics play a large role in helping service providers visualize the network, and specifically traffic patterns, to see future opportunity. Customers are demanding the flexibility that comes from hybrid (public/private) clouds, along with the ability (and in some cases, requirement) to interface with Amazon Web Services, and service providers need agile systems to keep up.

**Simple**—Simplifying the network comes down to simplifying how networks are created, and how services are deployed and managed within the network. Translating high-level operational objectives ("connect this network to the Internet") into actionable commands that seamlessly network together physical and virtual resources overcomes the complexities of manual configuration. Support for NFV and the ability to instantiate, service chain, and connect the functions automatically both simplifies the network and reduces operational expense.

**Open**—Service providers don't want to rely on a single vendor, especially with technology advancements happening so quickly. Support for open protocols, the ability to interface with a range of northbound orchestration and operational support systems, and support for multiple hypervisors are all requirements for an open cloud solution.

## Building Better Service Provider Cloud Networks with Contrail

Contrail SDN Controller is a software-defined network virtualization and service delivery solution that brings advanced network virtualization capabilities into cloud environments. Contrail automates the provisioning of networks in a virtualized environment; orchestrates networks across public, private, and hybrid clouds; enables elastic service chaining of network and security services; and provides advanced analytics capabilities and real-time view into network operations for simpler and more rapid troubleshooting.

### Network Virtualization

Contrail provides a robust network virtualization solution by leveraging L3VPN standards for IP networking overlays, E-VPN standard for L2 networking overlays. It supports a multitude of data-encapsulation standards like MPLSoGRE, MPLSoUDP, VxLAN, etc. The VPN containers provide a clean approach to address networking requirements in a multi-tenant cloud environment. Contrail also alleviates the challenges associated with a rudimentary VLAN or L2-based segmentation approach (limited number of virtual tenant networks, instability associated with L2 switching technologies, extensibility across data center locations, etc.)

### Network Function Virtualization (NFV)

Contrail is the industry's first NFV solution that provides comprehensive management of the infrastructure (compute, storage, and networking) and virtualized or physical networking services. In addition to support for both Juniper and third- party service instantiation, Contrail scales out of the networking services based on network demand, load-balances the traffic to the multiple instances of the networking service, and monitors these services to ensure high availability and uptime. With integrated service-chaining capabilities, these networking services are then automatically linked using MPLS and BGP so that there is no disruption to the operational paradigm of the physical network.

### Network Programmability and Automation

Contrail exposes the concept of "SDN as a compiler" by translating abstract commands into specific rules/policies to automate the provisioning of workloads and enable service chaining of network and security services. The customer can request for virtual machines without getting into details of underlying elements such as ports, VLANs, subnets, switches, routers, etc. In addition, a unified information model for configuration, operation, and analytics is exposed through REST APIs as well as libraries in various programming languages such as Python, JavaScript, Java, etc.

### Big Data for Infrastructure

Contrail's analytics engine is designed for very large-scale ingest and querying of structured and unstructured data and is exposed using REST APIs and a rich GUI. It allows the customer to get better insights and easily diagnose issues in the infrastructure as it provides both real-time and historical information on application usage, infrastructure utilization, system logs, and network statistics like flows, latencies, jitter, etc. In addition, customers can use the REST APIs and modern techniques such as Apache Hadoop to write their own custom applications for reporting and infrastructure automation.

### Open Source, Open Standards for Seamless Interoperability

Contrail eliminates the need for rip and replace by supporting many standards-based protocols to enable interoperability in a multivendor physical infrastructure, thus maximizing investment protection for customers. In addition, complete source code and product binaries are available under the Apache v2.0 open source license for all our customers and partners. For more details and the latest status, visit www.opencontrail.org.

## Business Opportunities with Contrail

Beyond a standard cloud service, there are three dynamic use cases evolving for service providers:

### Hybrid Cloud – Seamless Inter-Cloud Orchestration

Many service provider customers today have to choose a private cloud, a managed private cloud, or a public cloud to run their workloads. Private clouds are more secure and rely on an enterprise's business model for QoS and reliability, whereas public clouds can be more cost effective and readily available.

This situation leads to two critical challenges and service provider opportunities:

- First is the ability to expand workloads from private enterprise IT data centers into the clouds. IT departments might need or want the ability to dynamically grown in-house capacity to meet peak demand loads. Or they might want to migrate lower priority workloads to a trusted service provider partner's cloud service. Either way, the ability to provide seamless interworking between the private IT infrastructure and the public cloud is critical.
- Second is the reverse of the first challenge. All too often, groups and departments initiate projects with cloud service providers outside the purview of the IT department. Migrating the workloads back into the enterprise becomes a problem for the IT department as well as the cloud service provider.

#### The Contrail Solution

By facilitating the networking of cloud service pools, Contrail allows service providers to have a multiple cloud or a hybrid cloud strategy. Contrail creates virtual private clouds in a service provider network and has the ability to extend them securely to the enterprise data center using an existing L3VPN link (or IPsec connection).

Workloads—on a branch office network, in a public cloud, in the IT data center, or in a private cloud—are now on the same virtual network and can access each other irrespective of which cloud they are on over a secure channel. This type of flexibility allows service providers to offer unmatched flexibility to enterprise IT departments.

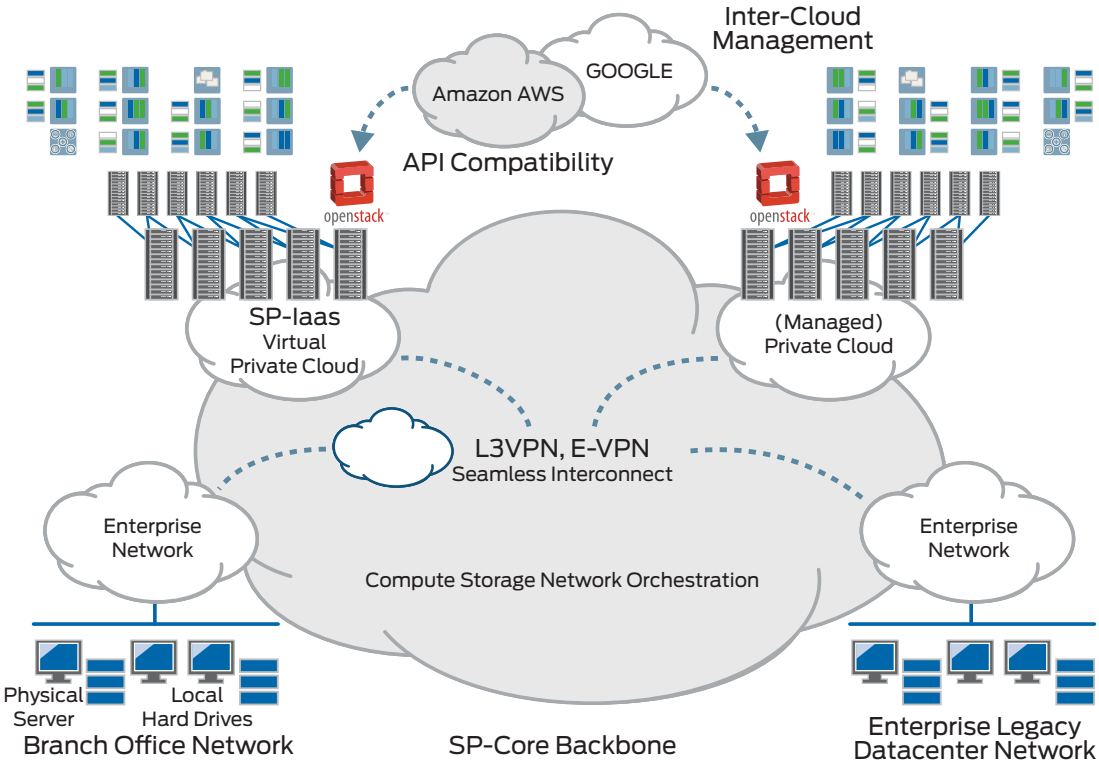


Figure 1: Multiple cloud and hybrid cloud approach

## Cloud Brokerage Service

Service providers have continued to move up the value chain with regard to enterprise service delivery—starting with basic connectivity, then simplified networking and managed services, and into hosting services (Web, mail, etc.). But today, much value-added software is being delivered as a service directly to the enterprise, leaving the service provider out of the value equation.

Some service providers have begun to assert their strategic position in the value chain. By residing between the enterprise customer and the myriad of SaaS products available on the Internet, service providers now have the ability to add value to the delivery of these services to their enterprise customers—and they have become "cloud brokerage service providers."

Service providers can offer added value in terms of network functions—QoS/QoE, security, and availability/reliability of transport. By aggregating service delivery from third parties, service providers can assert their value in customer relationship management and add value to their position as trusted providers of value-added services.

By becoming a broker of third-party SaaS, service providers can simplify the operational aspects of an enterprise, bringing new services online (authentication, authorization, and accounting). Service providers can also offer streamlined contract management as well as centralized billing.

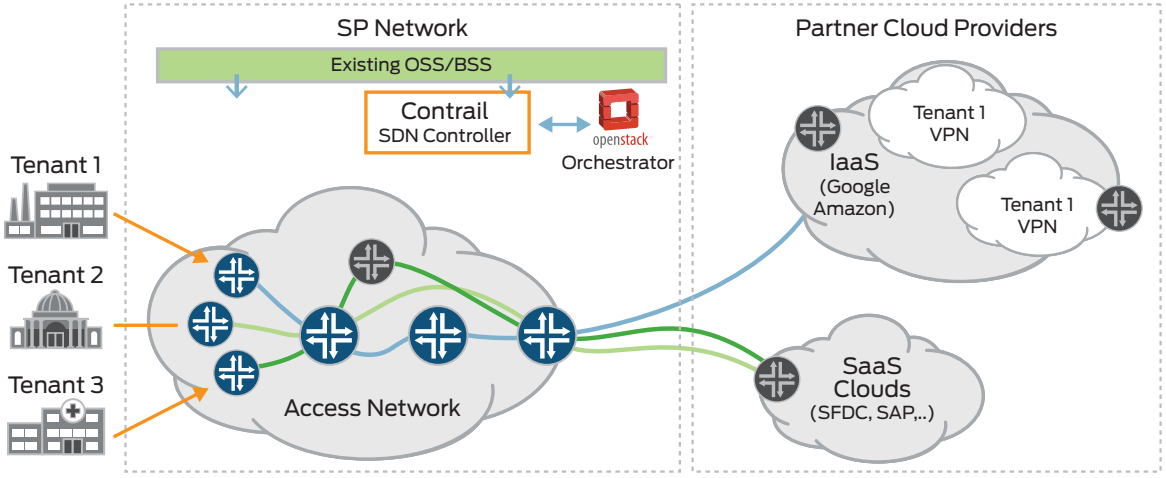


Figure 2: Enabling service providers to broker existing cloud services

### The Contrail Solution

In this use case, Contrail simplifies the vast array of secure links arriving from third-party SaaS partners and cross-connects them with the relevant enterprise connections. Contrail monitors service efficiencies, ensuring uptime and reliability agreements are monitored. With the service-chaining and NFV capabilities, Contrail can insert various network services dynamically into the service chain, from security to load balancing to QoS/flow control.

## NFV and Dynamic Service Chaining

Service provider networks are expanding at a rapid pace to keep up with the increases in data traffic. To keep up with demand, new appliances, servers, and network functions are being added to the network—increasing overall complexity and adding to operational expense.

To address this issue, many service providers are turning to the concept of Network Function Virtualization (NFV) or the ability to migrate logical network functions or services away from service-specific hardware into resource pools running as virtual machines.

Today, many of the companies developing these network functions still view them as standalone entities and leave the complexity of managing, provisioning, and scaling the network functions up to a nebulous "other" company.

Plus, to truly derive maximum benefit from NFV, a network control/orchestration function must be able to create dynamic service chains between both virtual and physical network functions.

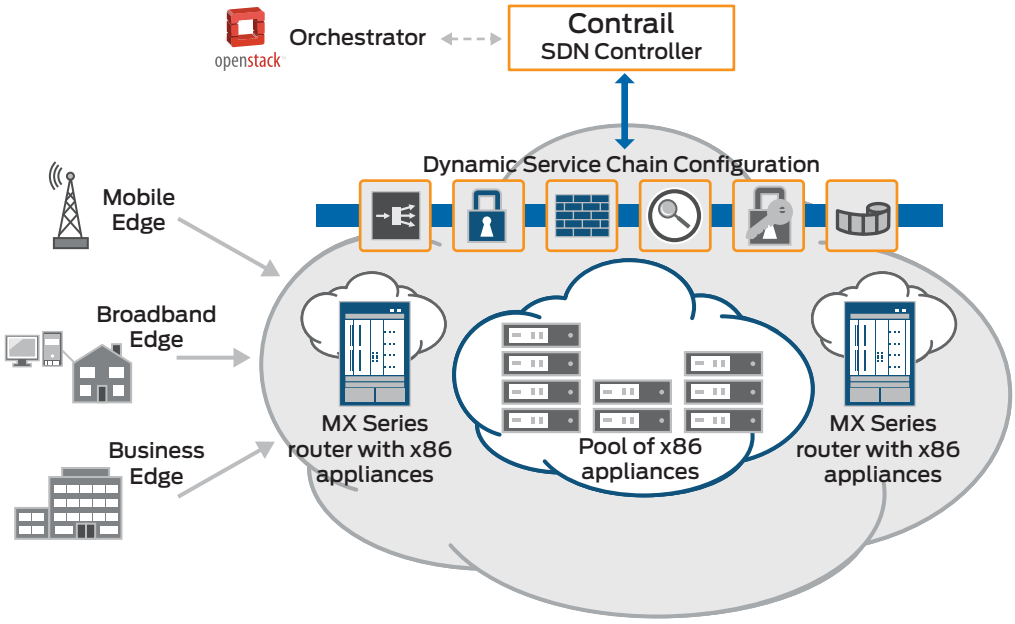


Figure 3: Dynamic service chaining in the data center

### The Contrail Solution

The network virtualization capability inherent in Contrail facilitates service chaining—between virtual as well as physical network elements. In addition, Contrail's management and analytics capabilities enable deep understanding of network flows, and they can automatically provision and route to achieve maximum efficiencies.

## Contrail Competitive Differentiation

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|---|---|
| Open source and Open standards compliance | · Provides multi-hypervisor and open orchestration system support<br>· Built on standards-based protocols (ETSI, IETF)<br>· Enables open source via OpenContrail |
| Seamless Integration with physical equipment | · No software gateways required<br>· No scaling issues |
| Distributed architecture | · Uses BGP control plane to federate across clusters for boundaryless virtual networks<br>· Offers active/active, high availability, and very high scale<br>· Provides ISSU/rolling upgrades with zero downtime |
| Automated service chaining | · Juniper and third-party service instantiation and monitoring<br>· Service scale-out with load balancing<br>· Network services automatically chained using MPLS and BGP |
| Analytics | · Provides very large-scale ingest and querying of structured and unstructured data<br>· Allows for real-time and historical information on app usage, infrastructure utilization, system logs, and network statistics (flow, jitter, latency, etc.) |

## Conclusion

In order to address the challenge of bridging the multivendor physical and virtual networks at scale, Contrail is delivering the industry's first truly open, modular, standards-based, and software-based solution for cloud service providers.

Using Contrail, service providers can seamlessly connect existing infrastructure and virtualized network functions in the service provider edge network as well as the data center.

With Contrail, service providers can seamlessly extend services to a managed private cloud or hybrid cloud infrastructure over an L3VPN network.

Through automation and orchestration, Contrail provides both agility and cost savings (CapEx and OpEx) to service providers.

## 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.

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