Today’s digital-native consumers have evolved from wanting “any content, at any place, from any device” to a whole new expectation of service delivery. People don’t simply want instant access to information, whether to receive entertainment, make payments, or get directions. They also want their network their way. In the age of personalization, no two smartphones are alike. Whether it’s business, residential, or mobile, today’s customers want more than basic connectivity; they want customized offerings from the cloud. They want to pay incrementally for value based on what they use. These demands are having a profound impact on the nature of service fulfillment, which must now elastically spin up and down, grow and shrink on demand.

In this evolution towards more agile service delivery, service customization, and service provisioning automation, over-the-top providers are the front-runners, shifting values away from traditional service providers with rapid service innovation based on software. The competitive environment is pressuring traditional service providers to transform their business models and operations models with network functions virtualization (NFV) technologies.

The Challenge
Service provider networks are populated with a large and growing variety of proprietary hardware appliances. Creating a new network service often requires new hardware appliances that not only need additional space and power, but also new skillsets to operate. It is becoming unwieldy to design, integrate, and operate these networks of increasingly complex hardware-based appliances. Moreover, hardware-based appliances take longer to deploy and offer less growth flexibility than pay-as-you-grow models. These rigid and complex networks prevent providers from quickly changing infrastructure configuration and require extensive qualification and testing investments, making the price of innovation too high and the risk of failure too formidable. New service creation can take months and must be deployed at massive scales before overcoming fixed costs. That stagnates innovation and limits choices designed to lock in customers with extended contracts to recoup investment costs. Service providers will continue to struggle to meet customer expectations, resulting in diminishing brand value and eroding profit margins.

The desire to stay competitive by providing innovative new services quickly and cost-effectively motivates network operators to transform their operations with NFV technologies. They must re-architect their service delivery infrastructure to be policy-driven, programmable, scalable, and automated, and they are looking to smoothly transition from a hardware-based, static, and manual process to a new virtualized and automated way of service provisioning.

Contrail Cloud Platform Delivers Solutions for NFV
Juniper Networks® Contrail Cloud Platform is a turnkey software suite for delivering NFV solutions. The suite seamlessly works with supporting hardware to intelligently orchestrate and automate the provisioning, operations, and management of a wide range of virtualized network functions (VNFs) and physical network functions (PNFs).
from Juniper and its ecosystem of partners. This solution, which empowers service providers to achieve service creation agility with uncompromised carrier-grade performance and reliability, is European Telecommunications Standardization Institute (ETSI) NFV compatible and can seamlessly interoperate with other standards-based solutions. With Contrail Cloud Platform, service providers can quickly and easily build a dynamic and elastic cloud foundation based on commercial-off-the-shelf (COTS) servers in either a distributed fashion in central office locations or a centralized fashion in data centers. Hardware resources are abstracted, pooled, and presented to hosted network functions and allocated on demand through programmatic APIs. Service providers have full control over how they want to customize the service chains and communicate that through Contrail Cloud Platform using a set of high-level policies.

With its open and modular design, Contrail Cloud Platform supports a rich ecosystem of Juniper and third-party services, orchestrators, and operations and business support systems (OSS/BSS) options. This growing ecosystem gives service providers greater levels of freedom to select best-in-class technologies and customize their infrastructure based on their diverse requirements to differentiate and stand out from the competition. The Juniper Networks Professional Services team and certified partners bring a wealth of experience in helping service providers with infrastructure migration, design, and customization.

**Features and Benefits**

- **Automated Resource Provisioning:** Contrail Cloud Platform can intelligently automate the provisioning, configuration, and operation of compute, storage, and networking resources needed by network functions, minimizing any manual intervention of the service creation process while improving operational efficiency and reducing operational cost.

- **Dynamic Service Chaining:** Contrail Cloud Platform creates policy-driven, software-controlled, on-demand service chain customization based on customers’ business policies, greatly increasing resource utilization efficiency and enabling service providers to extract more value from differentiated service offerings with tiered pricing.

- **Full Life Cycle Management of Network Functions:** Contrail Cloud Platform provides full life cycle management of instantiation, update, query, scaling, and termination of virtualized and physical network functions, reducing the complexities associated with provisioning and operating carrier applications. Services can be provisioned through the definition of a set of high-level policies; monitoring, scaling, and recovery of network functions are automated to form a healthy infrastructure provisioning feedback loop.

- **High Availability and Scalability:** Contrail Cloud Platform supports high availability (HA) and scalability for VNFs through a scale-out software architecture that can expand
elastically and is built to handle failures gracefully. With built-in software deployment redundancy and backup, Contrail Cloud Platform provides anytime availability of the cloud for operation, activation, and management of new and existing VNF workloads.

- **Rich and Prescriptive Analytics:** Powered by a high-speed data collection engine, Contrail Cloud Platform provides granular infrastructure telemetry information through very large-scale ingestion and querying of structured and unstructured data. Real-time and historical data is available via a simple REST API, providing visibility into a wide range of information. The Contrail Cloud Platform also provides correlation of information from virtual and physical layers to facilitate system monitoring and troubleshooting.

**Contrail Cloud Reference Architecture**

The Contrail Cloud 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 gives details of:

- **Standard system design:**
  - A predesigned and validated compute, storage, networking, and management system
  - Consistent hardware, software, and logical configuration across solution deployments
  - Predefined rack elevation, power, and cable map

- **Predefined Bill of Materials (BOMs) framework:**
  - Multiple “models” based on performance and scale requirements
  - In-model BOM variance based on capacity requirements

- **Automated installation:**
  - APIs, GUIs, and scripts that allow for fast, consistent, and easy deployment experiences

The Contrail Cloud Reference Architecture reflects Juniper’s deep cloud-building expertise and makes standing up and scaling an NFV cloud effortless. Service providers can deploy the Contrail Cloud Platform for NFV based on the reference architecture directly, or with the help of Juniper Networks Professional Services or a certified Juniper Partner Advantage Cloud partner.

**Contrail Cloud Platform**

The Contrail Cloud Platform virtualizes, orchestrates, and automates network function provisioning and operations. Built on top of several leading open source projects such as OpenContrail, OpenStack, KVM, Docker, and Ceph, Contrail Cloud Platform is significantly enhanced to boost availability, security, scalability, and performance. It is compatible with the ETSI NFV Architectural Framework and assumes the responsibilities of the orchestration and lifecycle management of physical and/or software resources that support the infrastructure virtualization, the lifecycle management of VNFs, and the service chaining and scaling of both VNFs and PNFs. It follows an open and modular design so that users can easily plug in new modules and replace certain modules with guidance from Juniper’s Professional Services or a certified Juniper partner. The NFV Orchestration module implements the following key functionalities:

- Resource management and dynamic resource provisioning covering compute, distributed storage, and various networking equipment and physical service appliances deployed either in the LAN or WAN environment
- Automated network function lifecycle management
- Overall orchestration to instantiate, configure, and chain services based on policies

**Contrail Cloud Platform for the NFV Ecosystem**

Contrail Cloud Platform is supported by a rich and fast-growing partner ecosystem. This community includes three key types of partners:

- **Technology Partners:** This group of partners provides VNFs that run on Contrail Cloud Platform. The Contrail Cloud Platform solution for NFV includes support from a strong set of technology partners that cover a wide spectrum of network functions to meet service providers’ most urgent virtualization needs. The set of network functions include content delivery network (CDN) from Akamai; application delivery controller (ADC) from Riverbed; virtualized session border controller (SBC) for IP Multimedia System (IMS) or VoLTE from Sonus; virtualized evolved packet core (EPC) from Nokia; virtualized mobility management entity (MME) from Hitachi; and deep packet inspection (DPI) from Sandvine.

- **Orchestration Partners:** This group of partners complements the orchestration capabilities provided in Contrail Cloud Platform, giving service providers the option of continuing to use the orchestration platform they are already using. Red Hat, IBM, Amdocs, and Canonical are among many of the orchestration partners.

- **System Integration Partners:** This worldwide group of more than 100 partners has the assets and the skills to deliver a fully functional customized cloud solution for NFV. They provide global coverage and are well trained and capable of expanding and complementing Juniper abilities.

**What Makes Contrail Cloud Platform for NFV Different**

On the journey to an agile, virtualized future, it’s best to work with an innovative technology leader who understands the service provider industry intimately, who has significant experience in both networking and IT, and who builds solutions based on open principles. Contrail Cloud Platform for NFV stands out by delivering virtualization in a way that gives services providers freedom of choice, intelligent automation, and always-on reliability.
Freedom of Choice
Contrail Cloud Platform for NFV gives service providers the freedom to deploy NFV in any location they like, be it a central office of distributed deployment, one or more centralized data centers, or a mixture of both. The solution can orchestrate and automate not only VNFs but also PNFs, providing a maximum level of investment protection and allowing service providers to decide based on service-level agreement (SLA) requirements. With support of multiple hypervisors, Linux containers such as Docker, and bare metal, customers can select the best compute infrastructure based on the application requirements and SLA. In addition, the Contrail Cloud Platform is based on open, proven standards and exposes a set of open APIs to interoperate with products and solutions in the ecosystem. This not only allows customers to pick best-in-class modules to customize their own infrastructure, but also supports a healthy and growing ecosystem so that more vendors are involved to ignite innovations in this space, and more software entrants can develop services on top of the NFV platform.

Intelligent Automation
The Contrail Cloud Platform for NFV does a lot more than moving network functions from special-purpose appliances to virtual machines on COTS. Much better agility is achieved through automated orchestration and chaining of these network functions through SDN and technologies such as cloud and big data. Contrail Cloud Platform helps service providers achieve operational excellence and OpEx optimization through the intelligent automation of resource allocation, service chaining, and network function life cycle management. It does this by establishing a service provisioning feedback loop to use the insights derived from rich infrastructure analytics that drive service adjustment and optimization. The Contrail Cloud Platform for NFV builds a policy-driven infrastructure so that it can easily accept service creation/update requests as high-level declarative policies and convert those policies into low-level machine understandable configurations. This feedback loop and the automation it enables minimize manual intervention of service provisioning.

Always-On Reliability
Whether virtualized or physical, service providers have much stricter requirements on infrastructure reliability. Contrail Cloud Platform has been meticulously designed to make sure that during the virtualization process, service providers don’t sacrifice on availability, security, and scalability so that the same level of SLAs can be maintained. Reliability can be enhanced through high availability, robust security, and elastic scalability.

Figure 2: Contrail Cloud Platform for NFV: Cloud or virtual customer premises equipment use case
• **High Availability:** The traditional “five nines” of reliability for telecom networks requires that services be 99.999 percent available. Legacy purpose-built telecom hardware meets that standard, but NFV is predicated on using COTS hardware that is not built to the same standards. Contrail Cloud Platform has been architected to run in distributed fashion and scale out for high availability and horizontal scaling. By reducing the size of the failure domain and performing backup and replication consistently, Contrail Cloud Platform enables in-service software upgrades and error recovery without downtime.

• **Robust Security:** With Contrail Cloud Platform, security for virtualized environments can be enforced in a more granular way at the hypervisor level, automatically “following” mobile workloads. In addition, a wide range of security functions from both Juniper and ecosystem partners is available to run on top of Contrail Cloud Platform, protecting the infrastructure and workload.

• **Elastic Scalability:** Contrail Cloud Platform is responsive enough to change service provisioning levels on demand. This is reflected in three ways: elastically scale virtualized services up and down on demand; scale network infrastructure beyond data center and cloud boundaries; and scale software out to meet any control and management demands.

### Key Solution Use Cases

Contrail Cloud Platform is built to help service providers build the right cloud infrastructure for NFV solutions and orchestration to meet their business needs and objectives. While new use cases for NFV are being created at a rapid pace, the following list describes a few of the leading areas where Contrail Cloud Platform is delivering the agility to optimize operating costs and drive new revenue streams today.

Cloud or Virtual Customer Premises Equipment (CPE)

In the virtual CPE use case, Contrail Cloud Platform can be deployed to enhance the enterprise network by replacing appliances with NFV-compliant virtualized solutions located at either the enterprise cloud or the managed service provider’s cloud. Contrail Cloud Platform will automate the activation, configuration, and scaling of these network functions and transform the economics of network-based service delivery.

**Subscriber-Aware Services**

With automated resource orchestration and dynamic service chaining, Contrail Cloud Platform not only reduces the service provisioning time from months to minutes, but also enables granular customization for the subscriber. Service providers can offer personalized combinations of services quickly and efficiently to meet the needs of organizations that want their network their own way. Contrail Cloud Platform can dynamically set up service chains based on subscriber requirements on demand, and program the network to steer different subscribers to different service chains based on their identity.

This use case manifests itself in two ways in mobile and fixed broadband networks:

- **Gi-LAN value-added, application-oriented services for mobile subscribers:** The current practice of deploying mobile value-added services is operationally complex and practically inflexible. Contrail Cloud Platform can transform the mobile services architecture to quickly and cost-effectively support personalized service offerings for mobile subscribers with different tariffs, or dynamically set up different service chains for mobile connected branches, dial-backup connections, or temporary event connections, presenting new revenue-generating opportunities to mobile operators.

![Figure 3: Contrail Cloud Platform for NFV: Gi-LAN use case](image-url)
• Value-added services for broadband subscribers: Due to the high cost of personalization associated with hardware-based network functions, the broadband subscribers normally get one-size-fits-all types of services. Contrail Cloud Platform unlocks the benefits of cloud service automation for service providers to achieve mass customization cost effectively, so they can rapidly create, deploy, and modify personalized services that increase market penetration and improve customer satisfaction.

Summary—Virtual Revolution, Real Benefits, Now

Contrail Cloud Platform solves for a variety of NFV use cases by intelligently automating service chaining of virtualized or physical network functions from multiple vendors, enabling them to create differentiated offerings in minutes, not months. It empowers service providers to develop and launch more ideas more quickly than ever, without compromising performance and reliability. With the support of an extensive ecosystem of partners and Juniper’s Professional Services team, you can deploy with confidence.

It’s time your network evolved as fast as your business. It’s time to deploy personalized services at lower risk. It’s time to exceed customer expectations. It’s time to leverage Contrail Cloud Platform to create and deliver NFV solutions.

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.