

# CONNECTING THE DIGITAL WORLD

Modernize telecommunications  
infrastructure using an open framework



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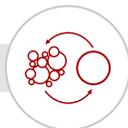
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# DISRUPTION

## The new normal for telecommunications

The days of the voice and messaging business model are over. Telecommunications service providers today must reinvent themselves to overcome multiple challenges in an ever-shifting market landscape. Service providers face:

**INCREASING COMPETITION** New technologies invite new competitors—and create new business opportunities. Public cloud providers have redefined the datacenter and colocation business while other over-the-top (OTT) competitors, including Amazon, Facebook, Google, and Netflix, have subverted the mobile and data subscription model by offering services directly to subscribers over service provider networks. Future trends, including augmented and virtual reality and Internet of Things (IoT), will bring additional opportunities and competitors.

**DECREASING REVENUE** Revenues from traditional mobile services have plateaued despite a continued upward trend in data usage and costs.<sup>1</sup> Service providers likely need to explore new technologies, such as software-defined networking (SDN) and network functions virtualization (NFV), for new revenue streams.

**TRADITIONAL INFRASTRUCTURE** Traditional networks consist of tens of thousands of proprietary hardware devices. New service delivery often requires network reconfiguration and additional hardware, adding to space and power requirements, increased costs, and delayed time to market.

**EVOLVING SKILLS** With infrastructure modernization, service providers must reorganize and realign their workforce to maximize resources for innovation. Some job roles will change due to automation, allowing these resources to focus on revenue-oriented or other value-added services.

<sup>1</sup> Federal Communications Commission, "Average mobile data usage per smartphone in the United States from 2010 to 2016 (in megabytes per month)." In Statista - The Statistics Portal. Retrieved July 1, 2018, from <https://www-statista-com.proxy3.library.mcgill.ca/statistics/801229/mobile-data-usage-per-smartphone-in-the-us/>.

**GLOBAL GROWTH** Some telecommunications networks were not originally designed to scale for the continued proliferation of mobile devices and increased data usage.

To survive in this dynamic and rapidly evolving market space, service providers must reduce costs and create new sources of revenue while addressing infrastructure modernization and existing demand across these market segments:



**Network**

NFV and NFV infrastructure (NFVI)



**Media**

Media functions virtualization (MFV)



**Support systems**

Operations support systems (OSS) and business support systems (BSS)



**Information technology**

IT modernization

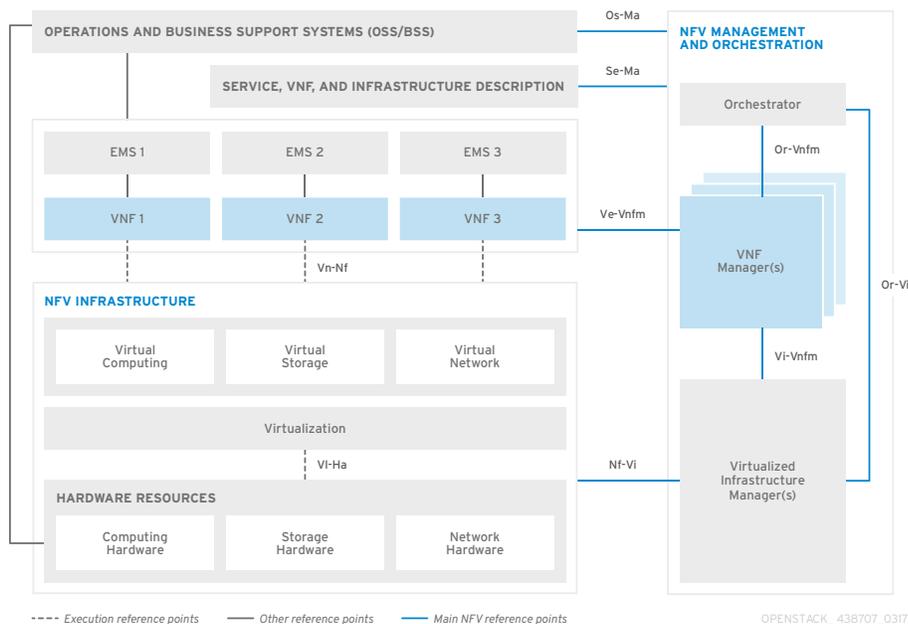
An open source, standards-based approach to NFVI addresses network and media-related use cases. Other modernization projects evolve existing virtualization solutions for OSS/BSS and IT optimization and integration.



# NETWORK FUNCTIONS VIRTUALIZATION STANDARDS

In 2012, to address the need for a standardized network architecture, the European Telecommunications and Standards Institute (ETSI) formed the NFV industry specification group (ISG).<sup>2</sup> Originally comprised of seven prominent telecommunications companies, the ETSI ISG NFV has grown to over 300 companies and telecommunications service providers.

**FIGURE 1.**  
ETSI/NFV  
architectural framework<sup>3</sup>



To accelerate NFV adoption, multiple members of the ETSI ISG NFV joined the independent Open Platform for NFV (OPNFV) community. This group's purpose is to take the ETSI NFV architecture framework and create a path for NFV implementation.<sup>4</sup>

<sup>2</sup> European Telecommunications and Standards Institute (ETSI), "Network functions virtualisation." <http://www.etsi.org/technologies-clusters/technologies/nfv>

<sup>3</sup> European Telecommunications and Standards Institute (ETSI), "Network functions virtualisation (NFV) architectural framework," October, 2013. [https://www.etsi.org/deliver/etsi\\_gs/nfv/001\\_099/002/01\\_01\\_01\\_60/gs\\_nfv002v010101p.pdf](https://www.etsi.org/deliver/etsi_gs/nfv/001_099/002/01_01_01_60/gs_nfv002v010101p.pdf)

<sup>4</sup> Cohen, Marc, guest blog post for Opnfv, "Enabling the transition: Introducing OPNFV, an integral step towards NFV adoption." September 30, 2014. <https://www.opnfv.org/blog/2014/09/30/enabling-the-transition-introducing-opnfv-an-integral-step-towards-nfv-adoption>



Red Hat makes continual and significant contributions to OPNFV and many other open source communities, including OpenStack® and OpenShift®. Network functions were originally virtualized for deployment in virtual machines (VMs), and, as container technologies mature, will evolve to be deployed in containers and microservices. Other technologies, such as automation and IT management tool technologies, will be implemented in combination with NFV solutions.

## DIGITAL TRANSFORMATION AND MODERNIZATION WITH NFV

Implemented correctly, NFV addresses services and traffic demands, similar to how automated and configurable cloud environments manage and support applications. Modernized OSS/BSS processes use virtualization to create additional operational efficiencies, helping service providers develop new services in shorter innovation cycles and generate revenue faster than existing services. Risk is minimized with the ability to easily spin up and test new services for market viability, and data generated by the network can be used to optimize services and application performance.

### NFV SUPPORTS REVOLUTION AT THE EDGE

Service providers are not only in a race to deliver new and innovative services, they are competing to deliver radically enhanced customer experiences. Modern consumers have redefined the service consumption model, creating the need for a far more robust customer experience when accessing and utilizing mobile services. Moreover, low-latency and high-bandwidth applications, such as broadband IoT, will generate even more data, necessitating additional data processing capacity across edge environments and 5G deployments. To provide the required customer experience and resources, service providers are focusing on transforming the edge with NFV, starting with the central office.

## Central office virtualization

Central office virtualization brings the flexibility and software-defined infrastructure of NFVI to the edge. The ability to automate deployment and scaling of edge infrastructure is critical for future growth and service delivery. With these capabilities, the virtualized central office (VCO) facilitates services that address numerous consumption patterns and customer experience use cases, including:



### Enterprise services

Virtual customer premise equipment (vCPE) with other virtualized network functions (VNFs), such as virtual firewalls, software-defined WAN (SD-WAN), and virtual private network (VPN). VCO benefits also extend to media and streaming use cases, which allow service providers to move from expensive and highly specialized customized hardware to software platforms with MFV operating on commodity hardware.



### Mobile services

Virtual and cloud radio area network (V-RAN/C-RAN), voice over LTE (VoLTE), IoT, virtualized IP Multimedia Subsystem (vIMS)/virtualized evolved packet core (vEPC), mobile VPN, and network slicing.



### Residential services

vRouter, virtual firewall (vFW), cloud storage, cloud backup, and cloud DVR.

## Modern infrastructure and operational support

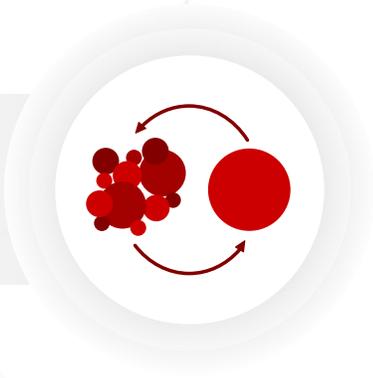
Consumer demand requires interconnection between IT, networks, services, data, and content at the point where services are accessed: the central office edge. To support this approach, traditional OSS and BSS will utilize the NFVI as part of a unified, integrated platform. No longer will OSS and BSS have separate services and data—consumers and businesses will touch all pieces of the platform when connecting to mobile services delivered from a VCO.

Service providers can use integrated OSS/BSS capabilities to create additional efficiencies using automation, machine learning (ML) and artificial intelligence (AI), as illustrated in the following list:

**OSS/BSS:** Telemetry, service assurance, monitoring, billing, subscriber management

**IT:** Continuous integration/continuous delivery (CI/CD), DevOps, security management, provisioning, onboarding

VCOs provide the cost-effective, performant, and agile platform needed for the delivery of mobile, business, and other services—including IoT, video streaming, virtual content, and the generation of new revenue streams.



## MAXIMIZING DIGITAL TRANSFORMATION WITH AN OPEN APPROACH

So how do service providers get started with NFV and build momentum? Service providers must select technologies and vendors that best meet their needs, which means understanding the meaning and value of an open approach. An open approach includes:



### Accelerated innovation

Ideas originate from many different people and organizations, increasing innovation to a level not seen in a single vendor environment. Innovative ideas build on one another, generating enhancements and extensions of an idea by others in the community or eliciting completely new ideas. No single organization has the resources to contribute as much or as rapidly to software development as the open source community. Security vulnerabilities are identified and fixed far more efficiently, and overall risk and research and development costs are reduced.



### Ongoing collaboration

Organizations have the access and ability to contribute to advancements and updates, helping organizations to stay current and competitive in their industry.



### **Flexible, agile platforms**

Refinements are a result of the community working as a whole toward a common goal. This approach provides long-term results with no vendor restrictions and allows organizations to focus on innovating in their industry, rather than supporting their platform.

In short, adopting an open approach helps foster flexible platforms, collaboration, and innovation. The open paradigm of the NFV framework strongly supports the use of open source technologies with which service providers can select from a broader set of vendors and partners, have a voice in the development of the technology, and focus on delivering services—not building them. Open source solutions use open phases across design, development, quality assurance, problem solving, and delivery. If service providers do not use the power of open source, they risk falling behind those who do. Open source software-defined NFVI supports the rapid incorporation of ideas, whether they come from the open source community, network vendors, internal application developers, or even competitors.



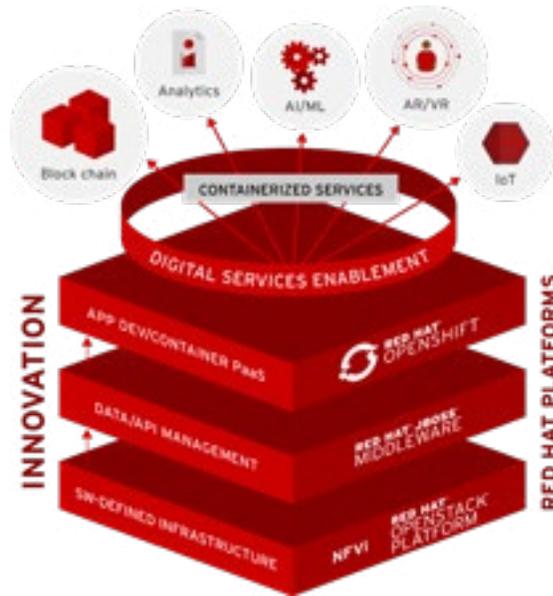
## **GETTING STARTED**

### **The Red Hat NFV solution**

Over the last several years, open source technology leader Red Hat has invested heavily in solving the unique challenges facing the telecommunications industry. Red Hat has developed an open source NFV solution, providing a scalable, high-performance, and reliable platform based on the NFV reference architecture.

The Red Hat® NFV solution helps transform networks, infrastructure, and the organization itself, allowing service providers to compete in the marketplace with services that meet consumer consumption and experience needs.

**FIGURE 2**  
The digital services transformation platform



Major areas for innovation are defined using three platforms, which form the building blocks for NFV adoption and modernized operations and IT:



### **Application development**

The application development platform consumes data from the data management platform and delivers data via network infrastructure, allowing service providers to use data for the creation of new revenue. The entire application workflow is supported with DevOps, CI/CD, containers, and microservices for the production of cloud-native application code. The Red Hat NFV solution supports the entire life cycle of the business, including service development, management, storage, and delivery.



### **Data management**

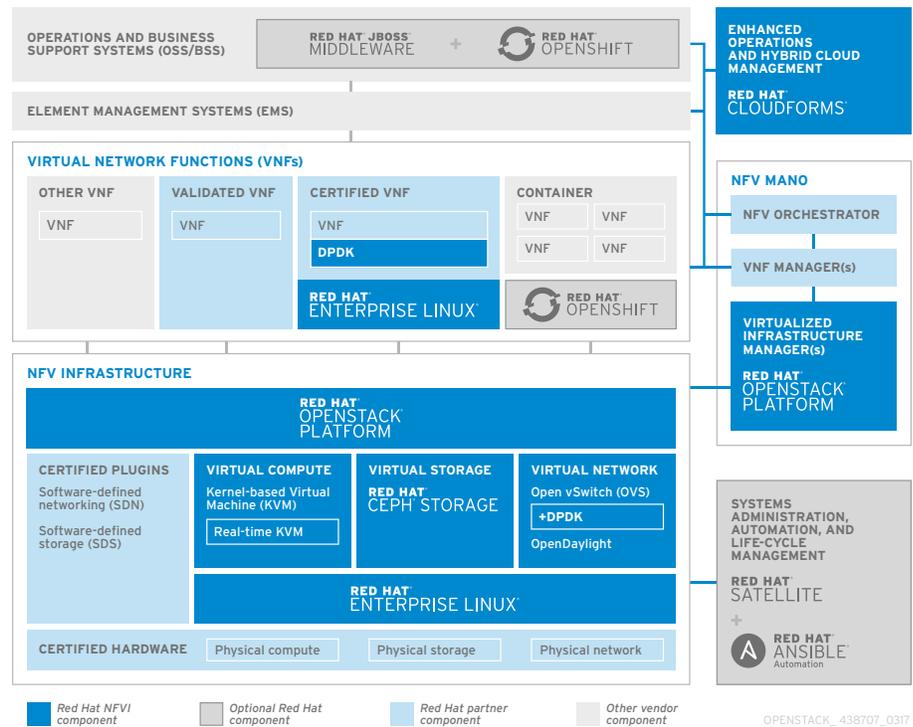
The data management platform collects device and network telemetry data from the network end-user devices. Data is then transformed, distributed, and stored for application use. The data management platform also provides governance and application programming interfaces (APIs) to manage access to data.



### **Software-defined infrastructure (NFVI)**

The network is the common language that all service providers understand. It transports user and network data while generating telemetry data that can be used for OSS/BSS and network configuration purposes. Network infrastructure can be deployed and configured using automation tools like Red Hat Ansible® Automation.

**FIGURE 3**  
NFV ETSI architecture  
and components



Red Hat provides technologies to modernize the entire IT stack. For NFVI, the Red Hat portfolio includes operating system, storage, management, and virtualization solutions. Other Red Hat products provide support for VNF implementation, and Red Hat’s middleware portfolio and container technologies address OSS/BSS application development and deployment needs.

NFV adoption moves service providers toward a tightly integrated organization and more efficient and effective OSS/BSS processes. OSS processes can be modernized to provide additional network performance and analytics benefits while automation, integration, and business intelligence can bring cost savings to BSS processes. Cloud-native and microservices-based architectures for OSS and BSS provide the necessary agility and speed to market, allowing analytics, ML, and AI tools to personalize the customer experience. Red Hat middleware and container technologies support this OSS/BSS evolution, and Red Hat has in-depth experience working with service providers to identify primary use cases and necessary outcomes for IT and OSS/BSS transformation.



Red Hat's ecosystem lets you build an adaptable foundation that unifies your network and IT infrastructure. A choice of partner technologies lets you deploy the applications and workloads you need today while evolving your infrastructure for the future. The Red Hat NFV solution combines the power of open source with unique Red Hat expertise and provides the reliability, security, and longevity that service providers need to survive.

## EXPERIENCING DIGITAL TRANSFORMATION

Change is hard. And digital transformation requires more than just technology change. Service providers have had decades of experience using a waterfall project management framework, which is very different from the agile development framework that supports NFV development and deployment. As a result, service providers are transforming policies, workflows, and job roles. Various job functions will become automated, allowing service providers to shift focus to innovation and other revenue-generating tasks.

Some organizations choose to embark on digital transformation using in-house resources to define and implement the supporting infrastructure. This can be a daunting task, particularly if no one in the organization has first-hand knowledge and experience. The costs of an in-house technology installation, operationalization, and maintenance strategy are often hard to gauge without appropriate experience. In addition, valuable resources are dedicated to discovering the right mix and configuration of technologies instead of creating and delivering new services. Time and personnel are likely allocated using a "best guess" approach and progress is difficult to measure. When in uncharted territory, enlisting the right expertise can minimize time and resource impacts and maximize results.

Red Hat Consulting has been assisting service providers with NFV-related initiatives well before Red Hat products first emerged as the NFV platform of choice. Regardless of where you are in your NFV transformational journey, Red Hat Services' [NFV adoption program](#) guides you through the culture, platform, and portfolio changes required to adopt NFV and realize benefits. Multiple, well-defined service components can be used as building blocks to create tailored 90-day increments within the broader transformation journey, working toward customer self-sufficiency.

**TABLE 1.***Stages of NFV adoption with Red Hat Consulting*

This table provides a high-level road map for NFV adoption and details how Red Hat can help.

The NFV adoption program starts with a journey mapping exercise. This session defines or clarifies an end-state vision and structures the transformational change required into a series of consumable 90-day increments within a broader journey map extending 18-24 months.

Each increment is tailored to create discrete business value while also increasing the skills and confidence in virtualized infrastructure management.

STEPS	ACTIVITIES COVERED
<p>Review business initiatives and use cases.</p> <p>Review current infrastructure for limitations.</p>	<p>No-cost Red Hat Discovery Session</p> <p>Red Hat offers a no-cost discovery session to clarify where a service provider is in their NFV transformational journey, understand their priorities, and assess their requirements. The discovery session provides the Red Hat Consulting team with sufficient detail to develop a preliminary program scope and present the customer with a formal proposal.</p>
<p>Collaborate with subject-matter experts to define strategy, key capabilities, and initial infrastructure for a core team to successfully deploy VNFs end to end.</p> <p>Establish a platform and approach to new product introduction that follows agile practices with automated workflows and customer feedback loops in place to inform prioritization.</p> <p>Continuously improve and refine both business approaches and technology implementations to address challenges as they emerge in the market and create continued opportunity for innovation.</p>	<p>Red Hat NFV Adoption Program</p> <p>The NFV adoption program provides a phased approach that simplifies, organizes, and automates the process of introducing and operationalizing an NFV environment. This effort establishes the architectural and operational foundation to effectively deploy virtualized network functions, allowing for a strong culture of innovation.</p>
<p>Immerse your people in a 4-to 12-week residency that provides an open source technology stack, processes, and skills to excel in today's landscape.</p> <p>Create a strategy for business process optimization through automation, integration, and business intelligence.</p> <p>Execute strategy for organization and job role transformation.</p>	<p>Red Hat Open Innovation Labs</p> <p>Red Hat Open Innovation Labs immerses customer teams in the tools, methods, and culture to catalyze innovation in the business. Red Hat Open Innovation Labs provides direct exposure to behaviors, processes, and tools needed to automate and collaborate for long-term digital transformation success.</p>
<p>Identify skills gaps and create a plan for skills updates.</p>	<p><b>Red Hat Training</b> Lab-intensive, hands-on, real-world training prepares students to maximize the value of Red Hat technologies.</p> <p><b>Red Hat Learning Subscription</b> Online training provides up-to-date knowledge and skills required to solve today's business challenges and prepare for tomorrow.</p>



## LOOKING AHEAD

Service providers must continue to evolve organizationally and technologically to meet ever-changing consumer demand. As more devices and services consume data, infrastructures must support the seamless, on-demand exchange of data between increasing numbers of providers and locations. Cost and lack of scalability prohibit the use of additional dedicated hardware as a solution. Network technology must become software-driven and IT-oriented to provide the flexibility and agility needed to stay competitive. To ensure interoperability with other provider networks and services, service providers will have to adopt common network standards.

Red Hat Enterprise Linux® is the de facto standard operating system for telecommunications service providers and their enterprise customers, and Red Hat OpenStack® Platform has become the standard cloud platform for NFV. The Red Hat NFV solution contains Red Hat technologies that are optimized specifically for service provider cloud environments. Because Red Hat prioritizes involvement in many key organizations and communities that lead the open telecommunications model, working with Red Hat means having a partner that will continue to influence the direction of key service provider initiatives. Choose Red Hat for a successful digital transformation.



## LEARN MORE

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**Network Functions Virtualization**

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**Red Hat services program: NFV adoption**

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