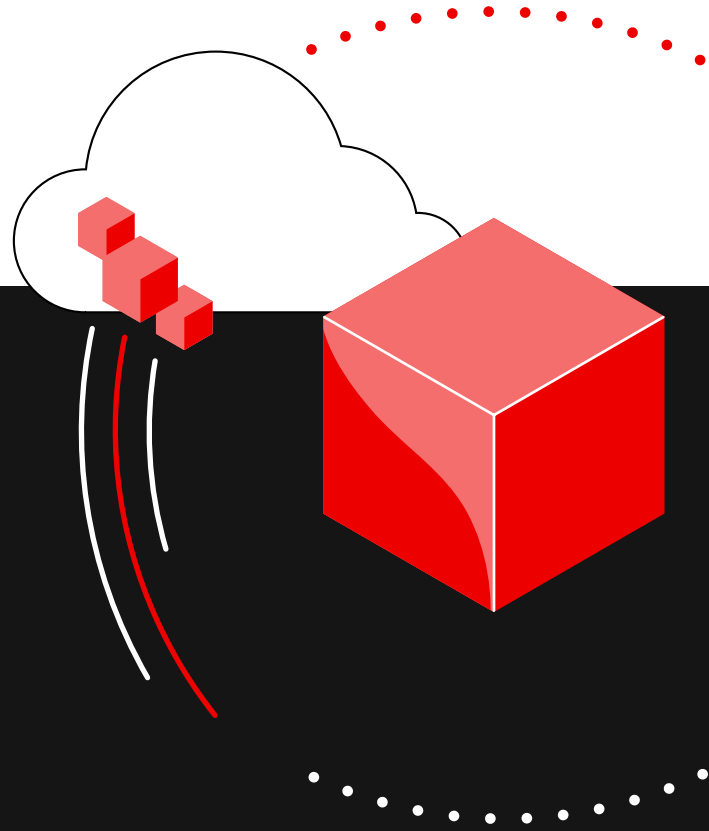
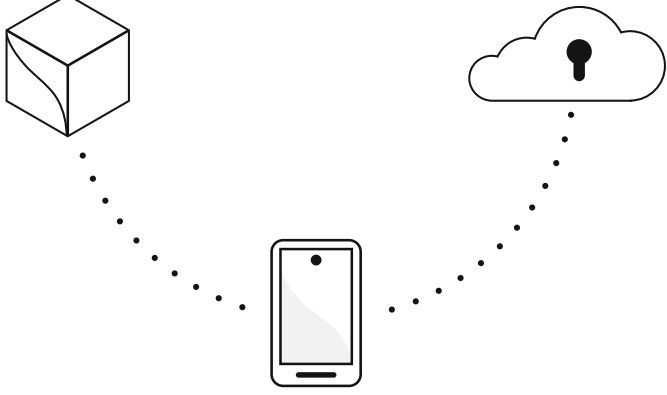


Open transformation in telecommunications

The path to agility
and innovation





Contents

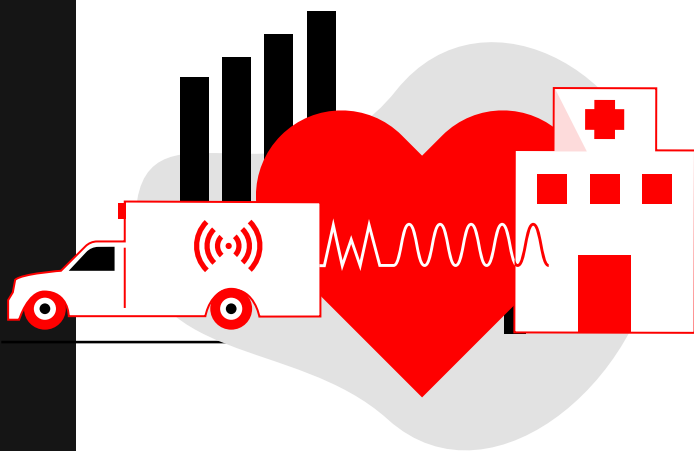
- 3.1 5G
- 3.2 Edge computing
- 3.3 Hybrid cloud
- 3.4 OSS/BSS modernization

- 4.1 Network functions virtualization
- 4.2 Cloud-native development
- 4.3 Automation
- 4.4 Artificial intelligence

Digital service providers:

Build your future today

Your services connect the world, making a critical impact on our lives and safety. Even as you serve customers 24/7, you are preparing for the future with modern, automated cloud-native infrastructures and processes—not only for business and operations support systems, but also for networks and service delivery.



Amid constant pressure and change, you continue to innovate and bring us closer together.

Whether it's virtual reality in remote surgery or smart grids changing traffic lights to allow ambulances to safely speed through, technology advancements offer the promise of radically improved and optimized experiences nearly impossible to imagine before now.

Modernize technology

To meet new challenges and possibilities, telecommunications service providers must transform their networks and operations by adopting modern IT architectures and operational management approaches.

Hyperscale public cloud providers have raised the bar, demonstrating how cloud-native architectures and open source development create opportunities to accelerate service delivery, deployment, and iteration.

Traditional service providers taking this same approach can operate with greater agility, flexibility, resilience, and security.

Transform culture

Beyond modernizing their networks and operations, traditional service providers must also shift their culture. Providers who adopt more agile cross-functional teams and service delivery models see rewards like:

- **Higher change management effectiveness.**
- **Faster, safer software delivery.**¹

Keep your options open

Open source is a proven foundation for virtualized and cloud-native network functions—and modernized operational support systems and business support systems (OSS/BSS).

Red Hat has deep expertise to help you use open source to **accelerate innovation** and operate with more agility and control.



97% of telecommunications service providers say that **open source is important to their organizations.**²

This e-book highlights the technologies and approaches powering telecommunications transformation and how Red Hat® products and services support you on your journey.

¹ Puppet. "2020 State of DevOps Report," 2020.

² Red Hat. "The State of Enterprise Open Source: Key findings from the telecommunications industry." A Red Hat Report, conducted by Red Hat via Illuminas, 2020.

The role of open source in telecommunications

Rapid innovation

Open source communities encourage new players to join the conversation, creating greater diversity of thought and more robust solutions. Multiple perspectives working together also leads to increased and more rapid innovation.

Freedom of choice

Open source software provides freedom from vendor lock-in. Open standards keep products portable and compatible, giving digital service providers freedom and agility and flexibility to innovate.



Innovate with confidence

Telecommunications service providers increasingly recognize the value of commercial open source solutions, listing the top benefits as:³

- **The ability to safely use open source technology.**
- **Access to the latest innovations.**
- **Designed for cloud and cloud-native environments.**

Explore more

Learn why CSPs and telecommunications providers increasingly view open source as a foundation for operating their businesses and fostering innovation.

Read the TM Forum report: "Open source accelerates beyond experimentation." →

³Red Hat. "The State of Enterprise Open Source: Key findings from the telecommunications industry." A Red Hat Report, conducted by Red Hat via Illuminas, 2020.

Catalysts for digital transformation

The compelling value of advancements like 5G and edge computing are shaping changes to network infrastructure and operations.



In this section:

- 3.1 5G
- 3.2 Edge computing
- 3.3 Hybrid cloud
- 3.4 OSS/BSS modernization



5G



5G technology offers:

- More capacity.
- Higher speed and performance.
- Lower cost per bit.

Capitalize on 5G

Because 5G can help reshape industries, companies that compete in the same market space now collaborate to develop industry-specific services and applications.

Digital service providers that can capitalize on 5G's advantages can capture a fair share of its opportunity.

However, hyperscale cloud providers are positioning for that as well. This competition means that digital service providers must minimize the cost and speed gap with hyperscalers and innovate to offer differentiated services. Doing so requires new thinking around automation, continuous integration/continuous delivery (CI/CD), cloud-native development, and other advanced technologies.

Explore more

Leading digital service providers and their technology partners discuss their 5G deployment strategies, challenges, and insights.

[Watch the Open5GCon event →](#)



Edge computing

Deploying processing power and network functions closer to the network edge helps improve application performance, reduce bandwidth and cost, and create new, differentiated, low-latency services.

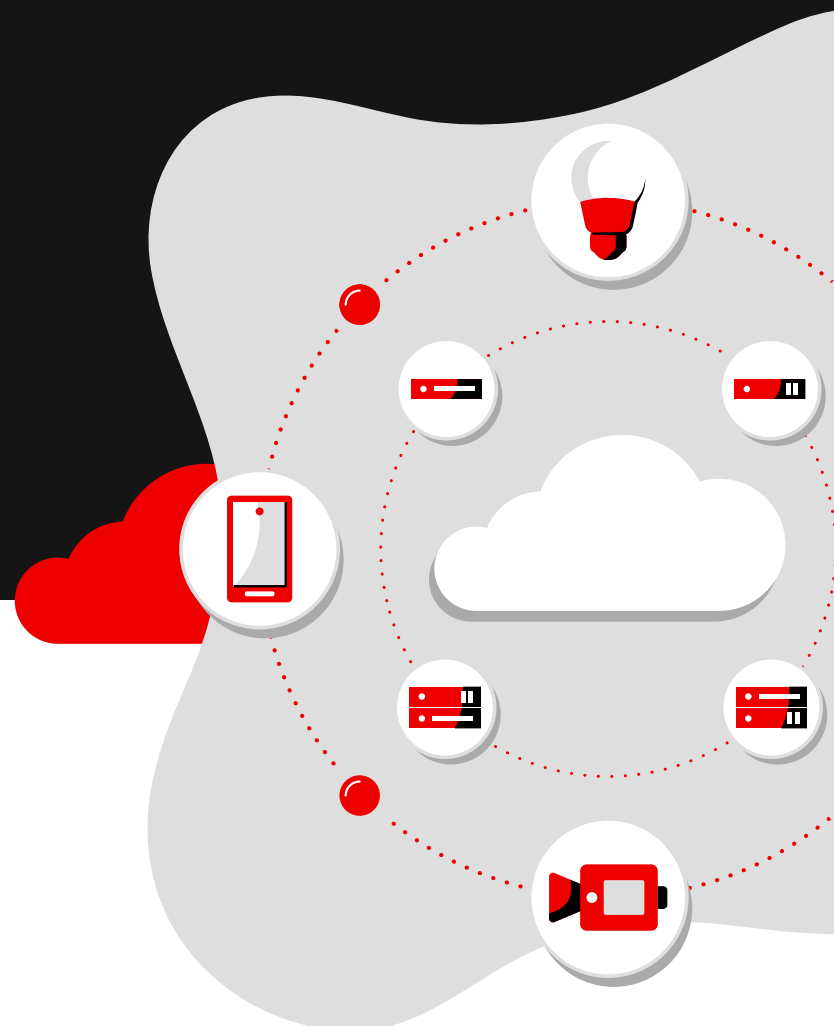
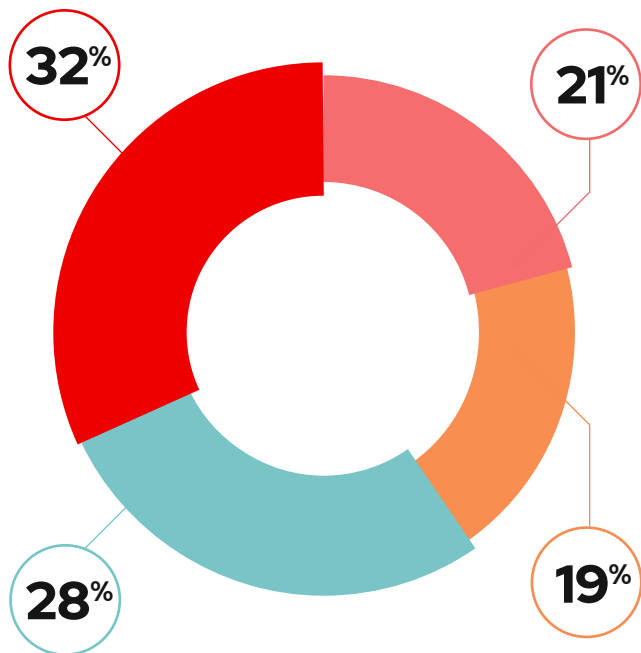


Figure 1

Benefits of moving workloads to the edge of the network⁴



- Ensure application performance
- Reduce bandwidth use/cost
- Offer differentiated communications services (vs. competitors)
- Offer vertical industry services (e.g., in-vehicle scanning for ambulances, advanced real-time analytics for investment banking)

⁴ Brown, Gabriel. "5G edge cloud infrastructure and security." Heavy Reading, sponsored by Red Hat, June 2020.

Edge computing can also shorten provisioning times and improve network scalability and agility.

Plus, there are resources for local data analysis and management.

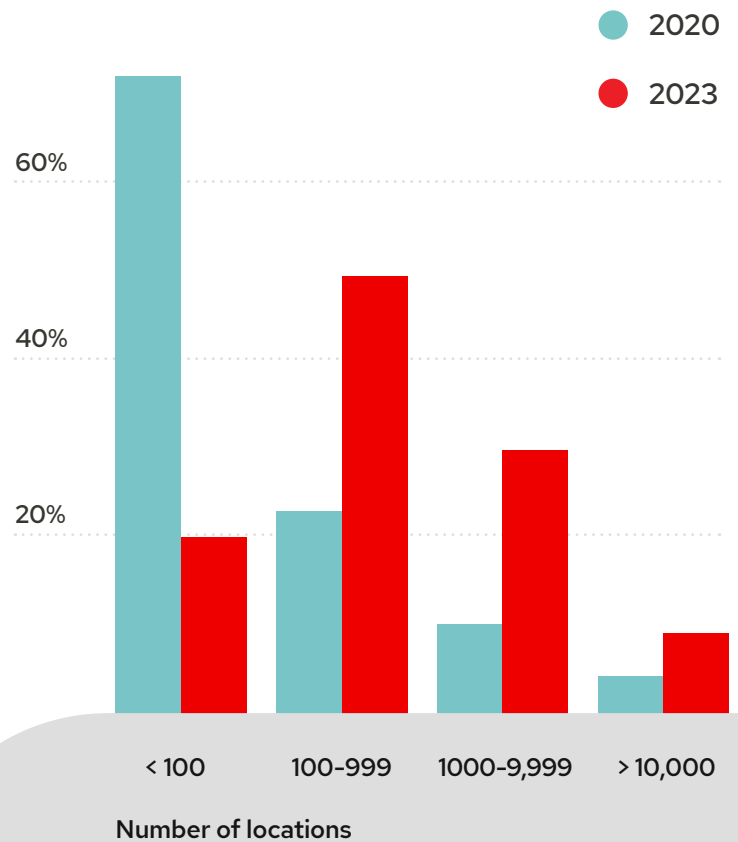
More than 80% of digital service providers expect to deploy over 100 edge locations by 2023.⁴

If edge computing is going to be a realistic future for enterprise IT, it needs the hybrid cloud AND open source to thrive.⁵

Paul Cormier
Red Hat President & CEO

Figure 2

Edge deployment expectation⁴



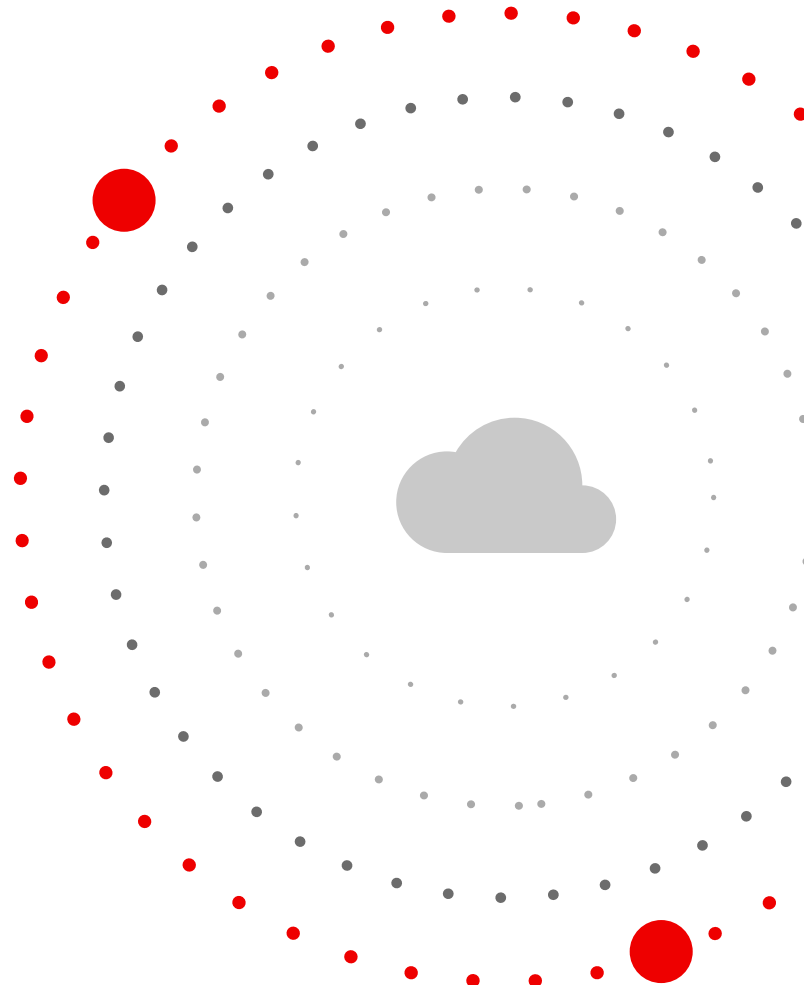
⁴Brown, Gabriel. "5G edge cloud infrastructure and security." Heavy Reading, sponsored by Red Hat, June 2020.

⁵Cormier, Paul. "The edge is open: Why scale-out computing doesn't exist without open hybrid cloud." Red Hat blog, Feb. 20, 2020.

Why deploy at the edge?

With computing infrastructure outside of traditional centralized locations, telecommunications companies can:

- **Seamlessly automate** and manage infrastructure from core datacenters to remote edge sites.
- **Consistently provision**, update, and maintain firmware and software across the infrastructure.
- **Manage remotely** and continue to operate despite connection issues.
- **Support workloads** that include virtual machines, containers, and microservices.
- **Scale the software platform** and services.
- **Run a consistent deployment model** across small and large footprints.



Explore more

Learn how Red Hat's hybrid cloud solutions position digital service providers for edge success.

Read why Red Hat CEO believes edge computing is "hybrid or die" →

Read more about edge computing and how Red Hat can help →

Hybrid cloud

Red Hat hybrid cloud solutions offer an integration layer, orchestrating across public, hybrid, and multicloud platforms—with workload portability and unified management.

Organizations adopt hybrid cloud strategies to improve business and IT agility.⁶

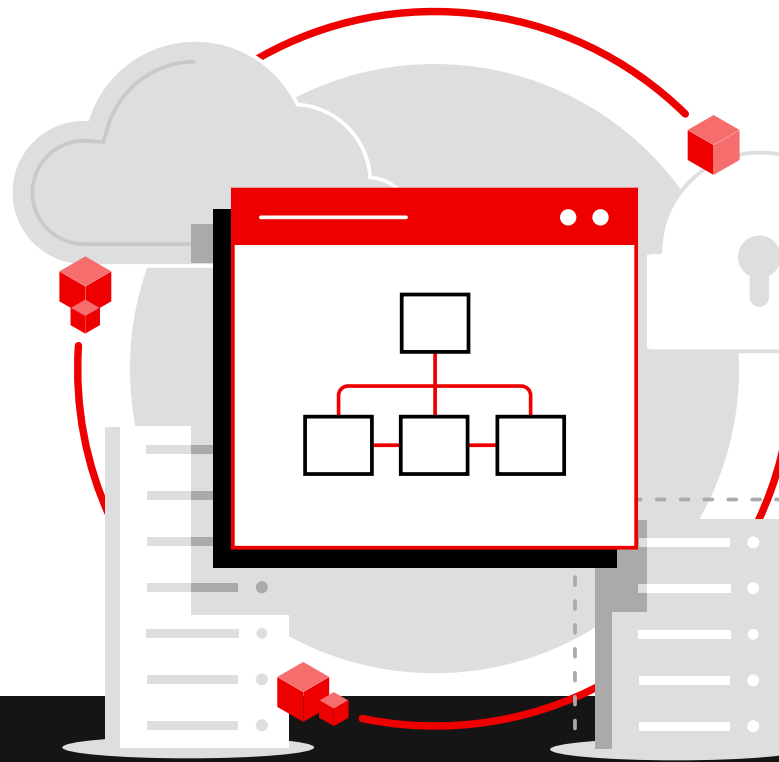


Figure 3

Expectations for implementing a hybrid cloud strategy ⁶

Which **business outcomes** do you hope to achieve?



Which **IT outcomes** do you hope to achieve?



⁶ Juengst, Dan. "Insights into hybrid cloud: Here's what to consider." Red Hat Blog, May 28, 2020.

Consistency is key to an effective cloud strategy.

It lets operations deploy and orchestrate workloads across multiple infrastructures according to performance, security, compliance, and cost requirements.

Choosing the optimal cloud for a given workload means considering performance and cost, as these can change dynamically.



Digital service providers with hybrid cloud infrastructure⁷

Today

71%

+

12%

In the next two years

⁷ Red Hat. "The State of Enterprise Open Source: Key findings from the telecommunications industry." A Red Hat Report, conducted by Red Hat via Illuminas, 2020.

Use private and public cloud

A hybrid cloud approach lets digital service providers take advantage of the economics and services available in public cloud. Private cloud remains an option if needed to reduce security concerns or support local data regulations. Providing multiple routes to customers gives them access to their applications from anywhere, at any time, with a consistent experience.

Increasingly, digital service providers use private cloud infrastructure at the edge for real-time processing and use centralized public cloud infrastructure for more complex, non-time-sensitive workloads.



Public cloud can help:

- **Reduce capital expenditures (CapEx).**
- **Shorten time to market.**
- **Lower the cost of ongoing life-cycle management** for certain infrastructures and some virtualized network functions (VNFs).

Explore more

Learn how a well-planned implementation strategy will help you avoid potential pitfalls, including security risks.


Download the hybrid cloud strategies checklist →



Hybrid cloud is about a capability. It's not about an end state. It's not about having this percentage in public cloud, and this percentage in a private cloud, and this percentage on bare metal. It's about the ability and the capability to be able to move and adapt and adjust as you see fit—based upon your needs.⁸

Stefanie Chiras

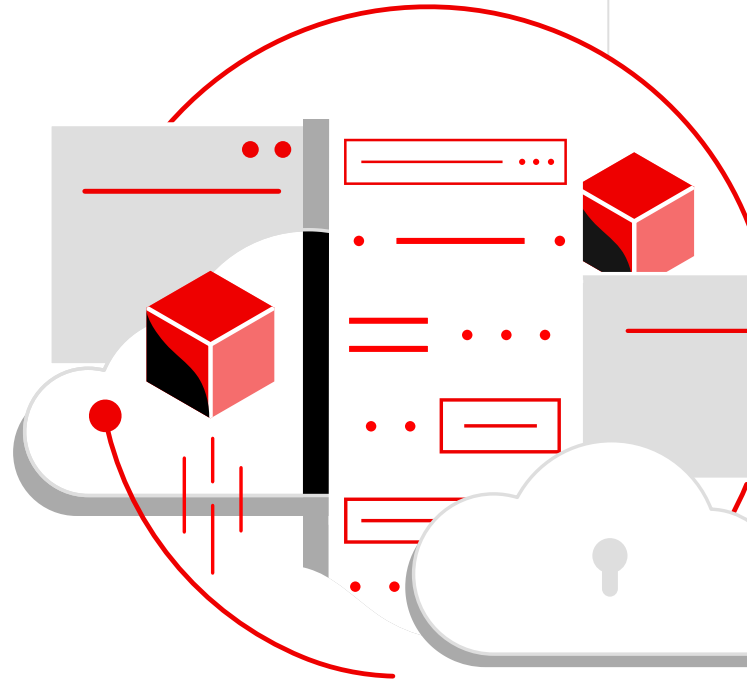
Senior Vice President and General Manager,
Red Hat Enterprise Linux Business Unit



⁸ Red Hat. "Red Hat's approach to hybrid cloud," September 10, 2020.

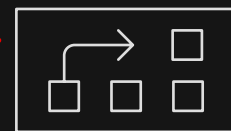
OSS/BSS modernization

Access to data and resources from a provider's operations support systems (OSS) and business support systems (BSS) is key to service speed.



IT development and operations teams can modernize OSS and BSS platforms to be cloud native, improving **scalability** and **flexibility** and **simplifying integration** with other systems.

Moving away from disparate and monolithic solutions can allow them to support the evolving requirements of innovative 5G applications and services.

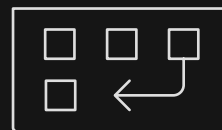




What to expect from modernized systems

As part of a cloud-native framework, a container-based microservices architecture:

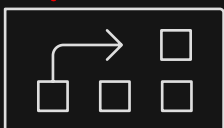
- Provides elastic **scalability**, higher **reliability**, and better **integration** capabilities.
- Offers **greater efficiency** for services and operations, including a consolidated view of network and customer data and higher levels of network and business process **automation**.
- Increases **flexibility** in where to deploy and scale resources. For example, because requests for artificial intelligence (AI) capabilities are less predictable, they can be **more economical to run** in a public cloud, while OSS-related functions requiring more stringent service levels can run in a private or telco cloud.
- Supports faster **innovation** and an improved ability to quickly adapt to customer demand and requirements.



Explore more

Most telco CEOs are convinced that their companies must transition into digital service providers, and this transformation requires cloud migration and a cloud-native approach to OSS and BSS.⁹

[Read the TM Forum report to find out why and how to get there →](#)



Sunrise Communications AG

accelerates time to market by 75%¹⁰

Sunrise Communications AG, a Swiss telecommunications company, built a hybrid cloud-ready platform with Red Hat and adopted an agile DevOps culture to speed innovation and reduce time to market. Using microservices, containers, and automation, the company achieved 75% faster time to market for new services.

[Read the case study →](#)

⁹ Newman, Mark. "Cloud native OSS and BSS." TM Forum, May 2020.

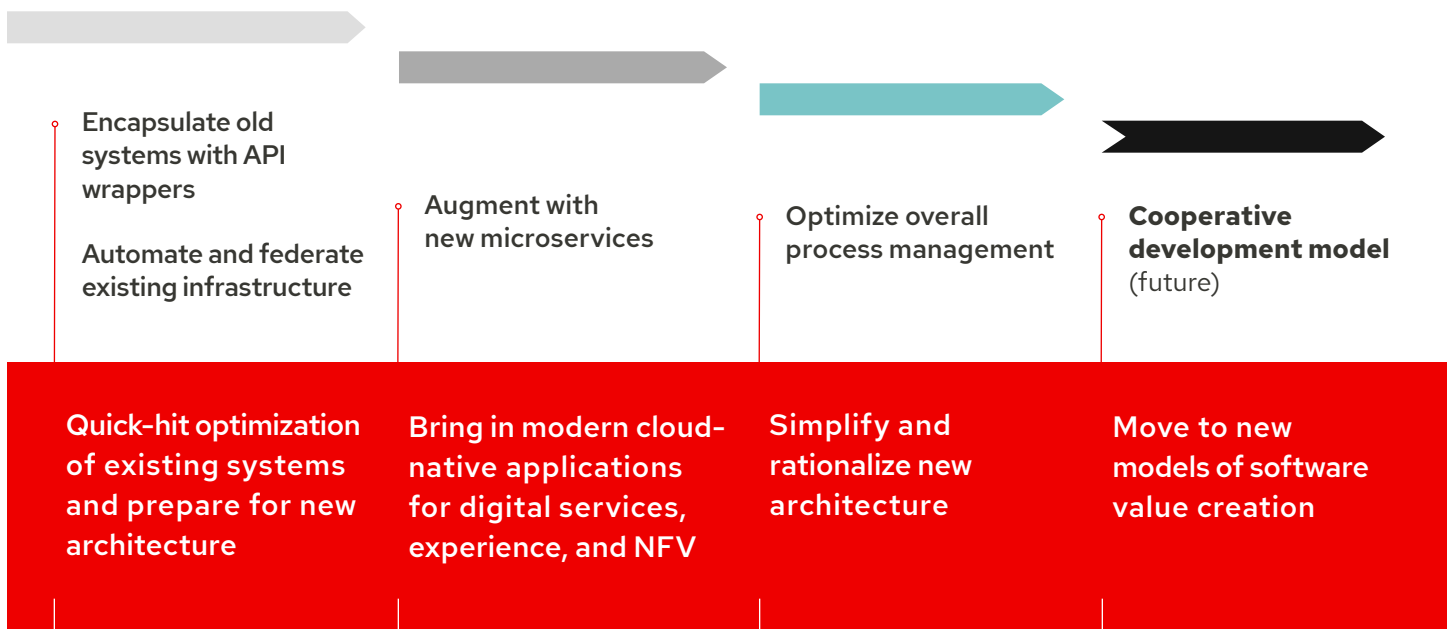
¹⁰ Red Hat customer case study. "Swiss service provider cuts time to market by 75% with agile and Red Hat," November 2020.

Digital transformation requires modern cloud-native OSS/BSS and is essential for monetizing 5G.

Figure 4

OSS/BSS infrastructure modernization journey¹¹

Key steps to creating efficient, flexible OSS/BSS to meet current and future demands.

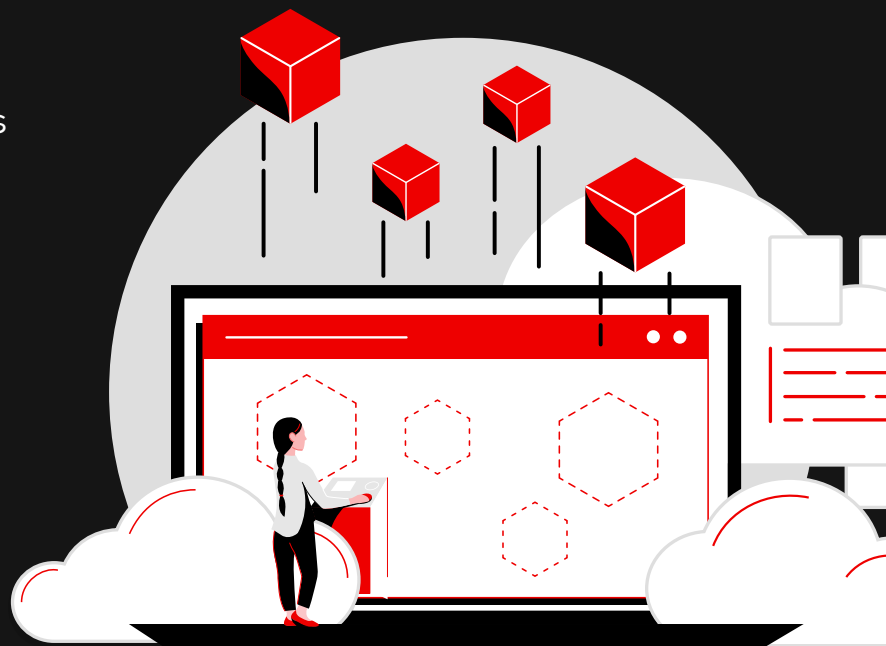


¹¹ACG Research. "Open source for modernizing telecoms OSS/BSS," October 2019.

The open advantage: Key digital transformation technologies

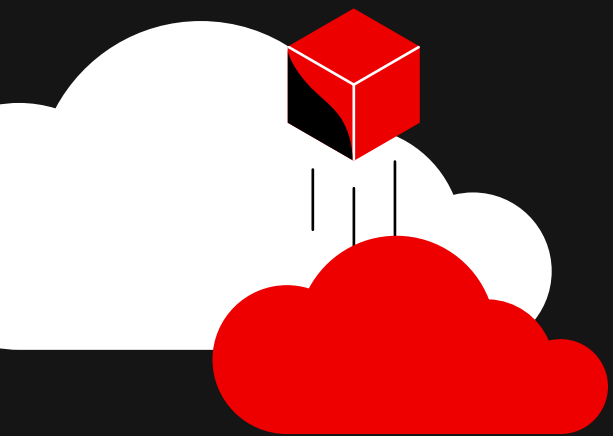
An **open**, consistent foundation gives digital service providers confidence that the services they deliver will run reliably, regardless of footprint.

Building that foundation on network functions virtualization (**NFV**) and **cloud-native architectures** results in improved flexibility and agility. **Automation** plays a critical role in keeping that foundation operating at scale.



In this section:

- 4.1 Network functions virtualization
- 4.2 Cloud-native development
- 4.3 Automation
- 4.4 Artificial intelligence (AI)



Network functions virtualization

Most digital service providers are already committed to **NFV**.

This approach:

- Uses less (and less expensive) hardware.
- Increases flexibility and workload portability.
- Provides the ability to spin workloads up and down with minimal effort.
- Allows resources to be scaled elastically to address changing network demands.

○ A horizontal telco cloud with network functions virtualized on Red Hat OpenStack® Platform delivers these benefits:¹²

- **US\$462,500 additional revenue** per year per virtualized network function (VNF) while reducing operating costs.
- **45% faster new service delivery.**
- **79% less unplanned downtime.**

NFV has allowed digital service providers to break the hardware dependencies of traditional, vertically integrated infrastructure and run multiple functions on a single, horizontal cloud platform.



The next generation of mobile networks isn't defined by inflexible, proprietary solutions; it is frequently founded in cloud-native technologies driven by open source. From 5G to augmented reality, many advancements in mobile services are being powered by open software on open standards-based hardware.¹³

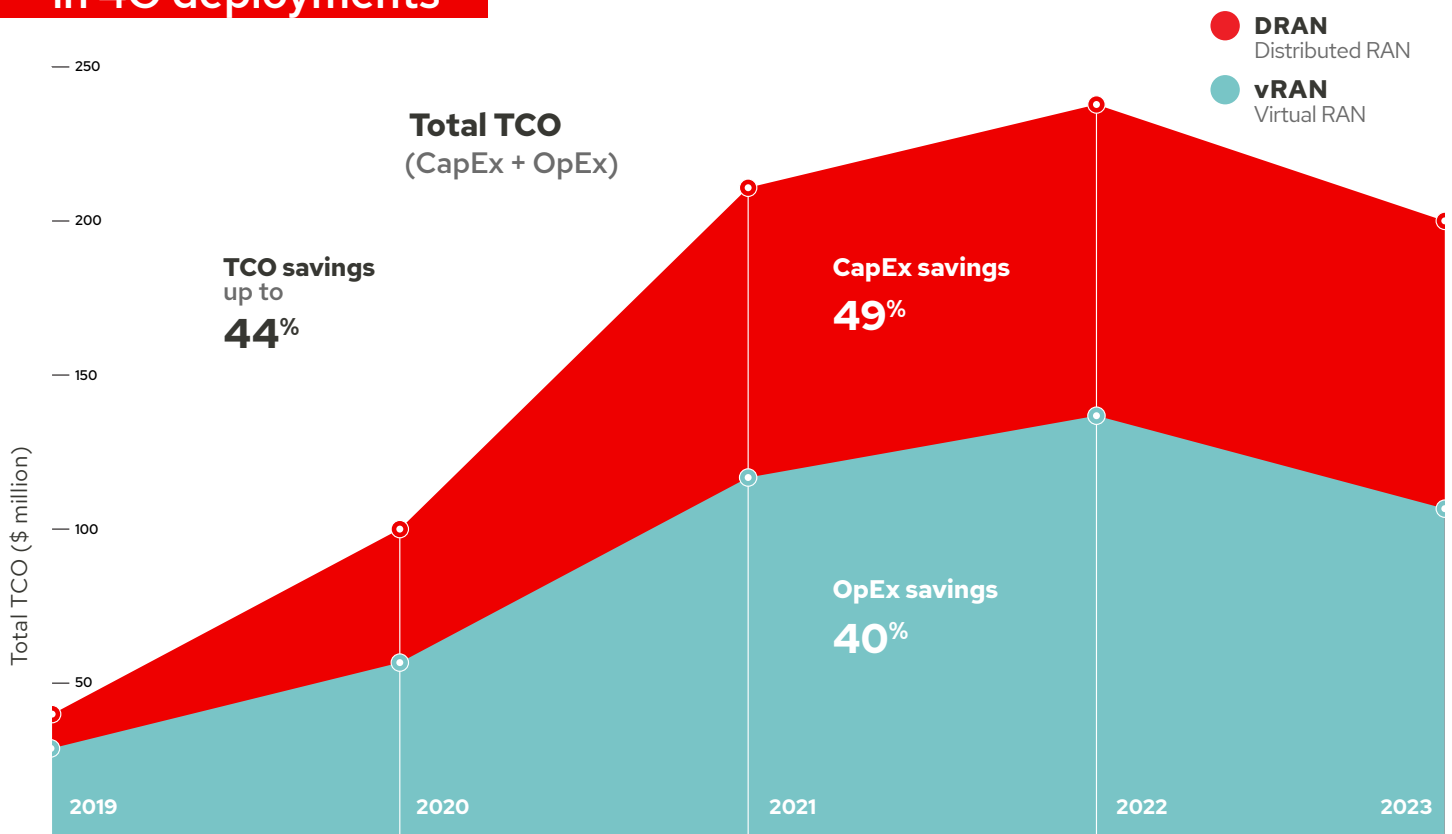
Chris Wright
Red Hat CTO

¹² IDC Business Value Snapshot, sponsored by Red Hat. "The business value for telecommunications in virtualizing network functions with Red Hat OpenStack Platform," June 2020.

¹³ Red Hat press release. "Red Hat supports Rakuten Mobile Network's end-to-end cloud-native mobile network with open source technologies," February 27, 2019.

Figure 5

Economic advantages of using vRAN configurations in 4G deployments¹⁴



Explore more

A Heavy Reading survey shows that the next two years will see a sharp uptick in virtual RAN (vRAN) deployments.¹⁵ Find out why—and how leading digital service providers will build them.

Read the survey →

Learn how Red Hat and Samsung are partnering to accelerate the next wave of virtualization in 5G RANs.

Read the press release →

Return on investment

The economic benefits of virtualizing network infrastructure can be significant, with Radio Access Networks (RANs) representing an important transformation opportunity.

ACG Research estimates (Figure 5) that network operators who virtualize the entire RAN can see total cost of ownership (TCO) savings up to 44%.¹⁴

¹⁴ ACG Research. "Economic advantages of virtualizing the RAN in mobile operators' infrastructures," 2019.

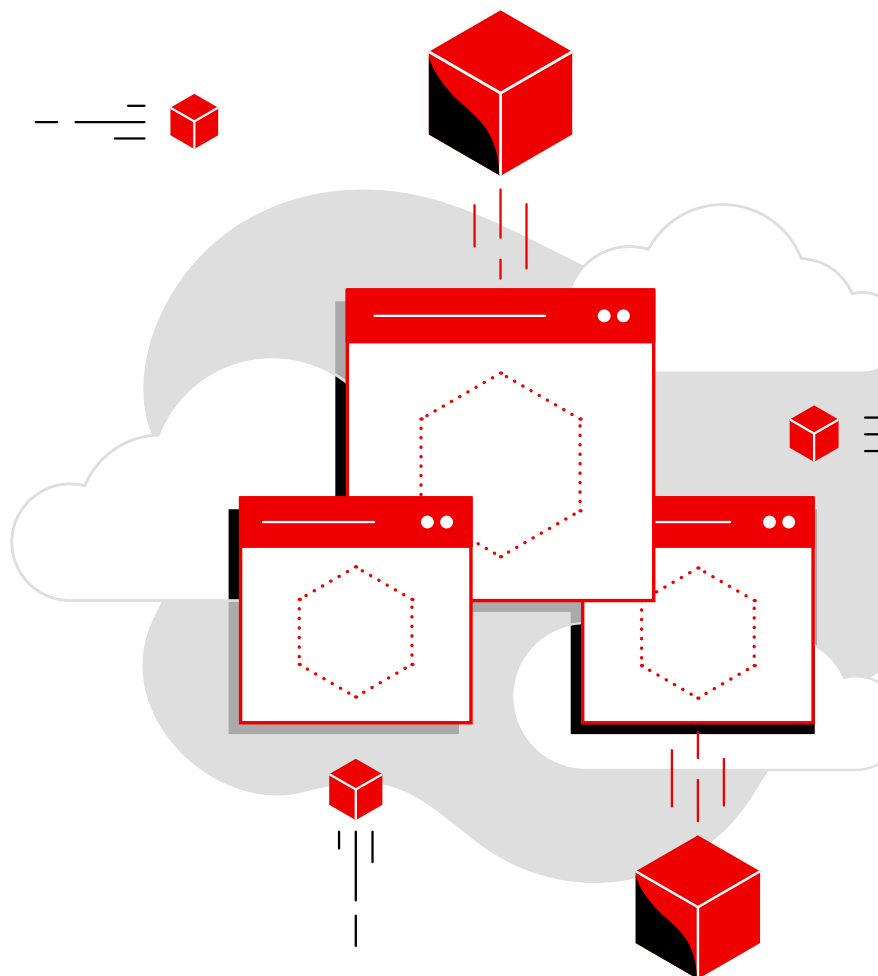
¹⁵ Clark, Jennifer. "Virtualized RAN: 4G/5G Strategies, Opportunities, and Pitfalls." Heavy Reading, sponsored by Red Hat, March 2020.

Cloud-native development

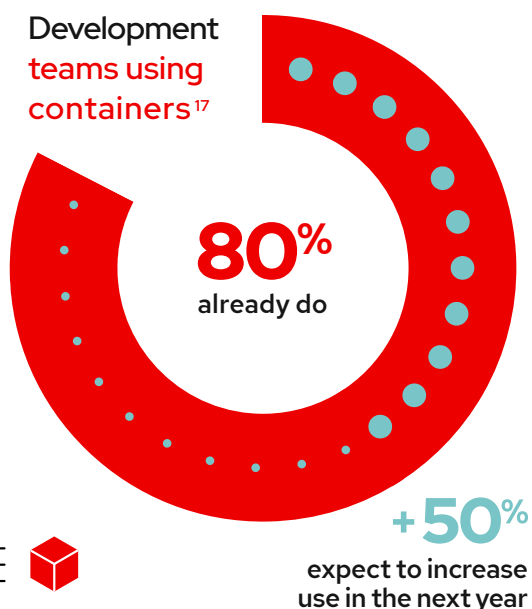
The Cloud Native Computing Foundation defines cloud-native as: computing that uses an open source software stack to deploy applications as microservices, packaging each part into its own container, and dynamically orchestrating those containers to optimize resource utilization.¹⁶

Digital service providers that adopt a cloud-native approach, using both centralized and distributed locations for applications, can benefit from increased agility, scalability, reliability, flexibility, and portability.

Moving beyond virtualization to a fully cloud-native design provides the efficiency and agility needed to rapidly deploy innovative, differentiated offers that markets and customers demand.



Development teams using containers¹⁷



A cloud-native approach uses **containers** rather than virtual machines (VMs)—an important distinguishing feature.

Containers allow you to package and isolate applications with their entire runtime environment—all of the files necessary to run.

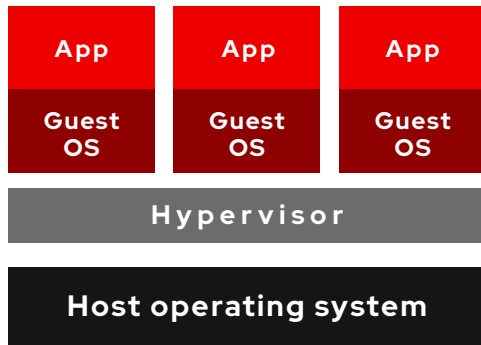
This approach makes it easy to move the contained application between environments (development, test, production, etc.) while retaining full functionality.

¹⁶ Cloud Native Computing Foundation LinkedIn page, accessed November 2020.

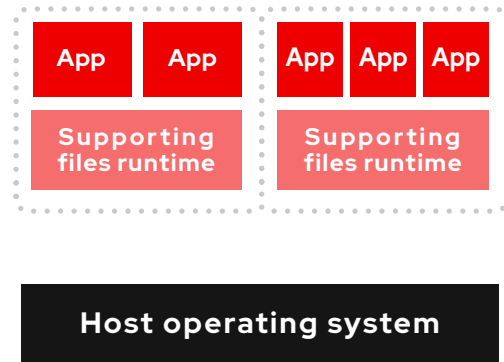
¹⁷ Red Hat. "The State of Enterprise Open Source: Key findings from the telecommunications industry." A Red Hat Report, conducted by Red Hat via Illuminas, 2020.

Figure 6

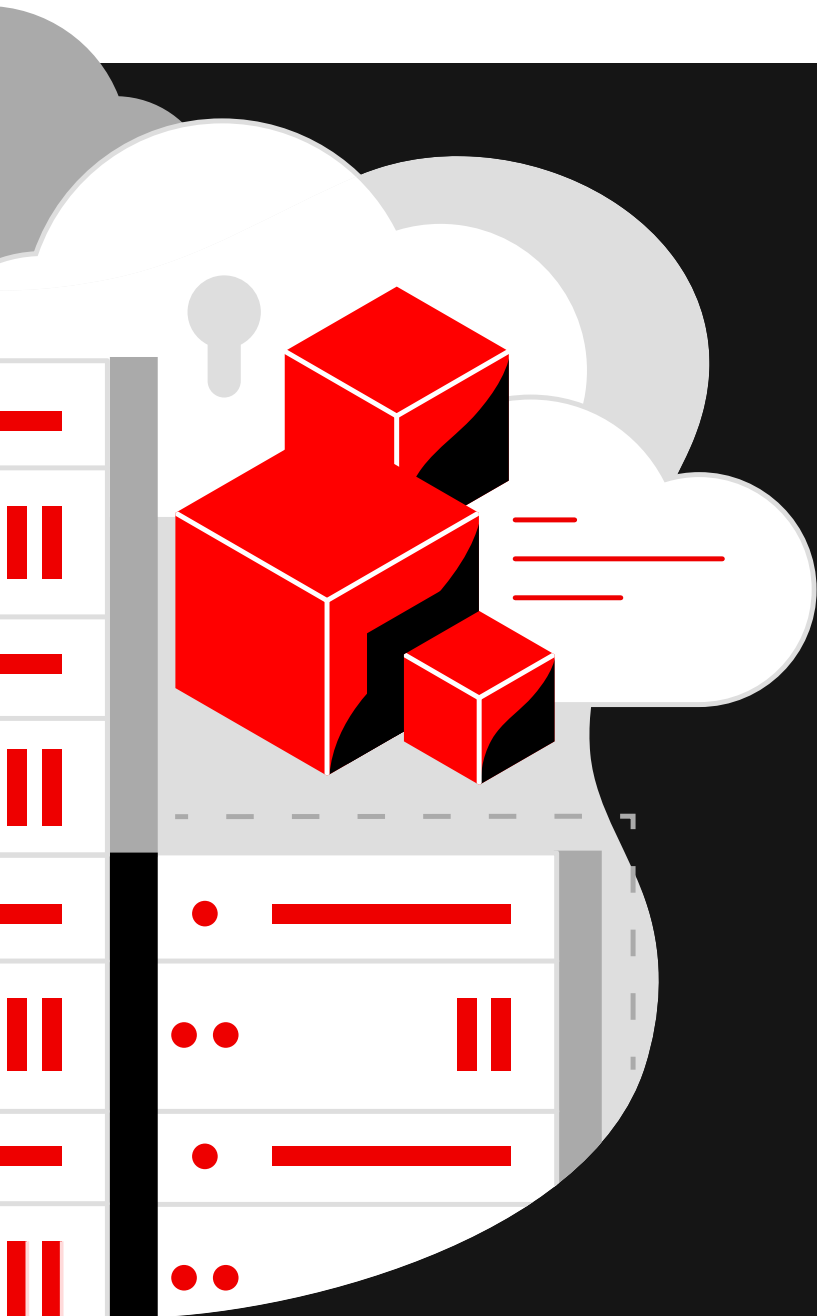
Virtualization



Containers



VS.



Compared to VMs, containers:

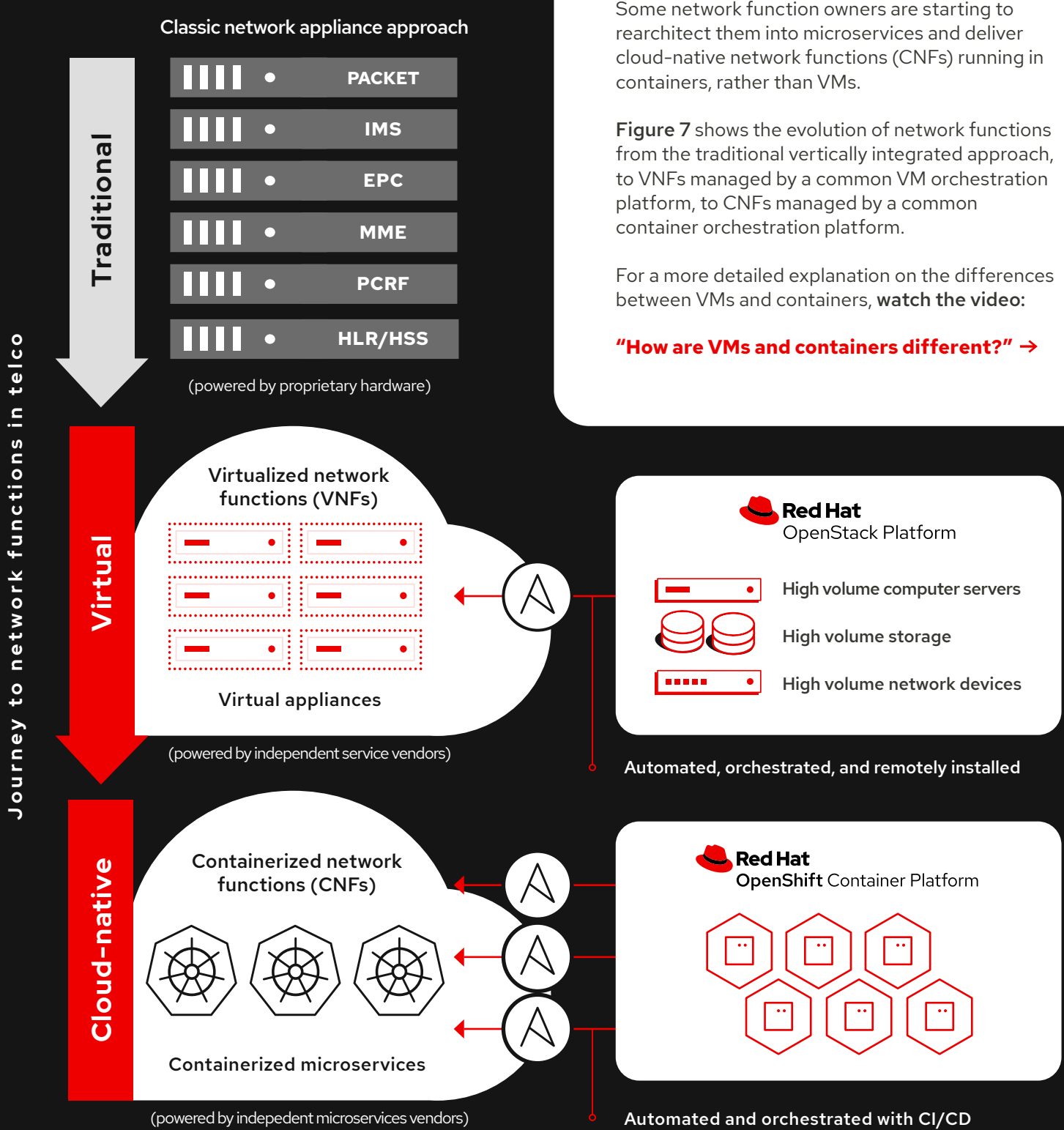
- Need fewer resources to run—containers are typically measured by the megabyte, while VMs are measured by the gigabyte.
- Package only an application and the files necessary to run the app. Containers are often used to package single functions that perform specific tasks.
- Share the server operating system (OS), allowing:
 - Easier portability with a lightweight construction.
 - Increased density of functions on a given level of compute power.
 - Easier life-cycle management.
 - A smaller footprint.

These features make containers particularly appropriate for the edge where resource constraints are common.

While VMs can run in containers to achieve a common orchestration environment for VNFs and CNFs, Red Hat and the open source community are working to enable Kubernetes orchestration to control VMs natively.

Figure 7

The evolution of telecommunications network functions¹⁸



Virtualizing physical network functions into VMs was the first step in network operator transformation. Evolving them to run in containers is next.

Some network function owners are starting to rearchitect them into microservices and deliver cloud-native network functions (CNFs) running in containers, rather than VMs.

Figure 7 shows the evolution of network functions from the traditional vertically integrated approach, to VNFs managed by a common VM orchestration platform, to CNFs managed by a common container orchestration platform.

For a more detailed explanation on the differences between VMs and containers, watch the video:

"How are VMs and containers different?" →

¹⁸ IP multimedia subsystem (IMS), evolved packet core (EPC), mobility management entity (MME), policy and charging rules function (PCRF), home location register/home subscriber server (HLR/HSS).

Automation



Automation is essential to managing telecommunications network complexity.

By spending time on manual tasks, digital service providers miss opportunities to innovate and maximize their network and service potential.

Automation benefits include the ability to adapt and scale quickly, reliably, and economically.

Sharing a common automation platform across teams helps maximize automation benefits.

What to automate

Many service providers already automate key processes, such as security and network automation and system and security updates. However, further automation offers the potential for even greater time and resource savings management.

Consider automating:

- Server deployment and provisioning.
- Utilization reporting.
- Process and dynamic resource management.
- Workflow optimization.
- Issue diagnosis and remediation.
- Core business functions and rules.

Figure 8

Automation priorities for telecommunications firms¹⁹

According to a study by Forrester Consulting, service providers experience better system performance, improved consistency, better risk management, and faster innovation as a result of a strong automation strategy.¹⁹

Telecommunications firms prioritize automation initiatives over an array of competing goals; 72% of respondents report automation as one of their top initiatives.¹⁹

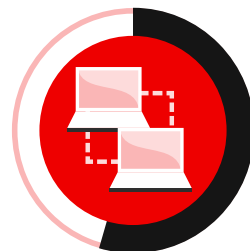
The most commonly automated infrastructure management tasks include:



64%
Security



62%
Network automation



55%
System/security updates



In the end, it's down to money and quality. Automation reduces costs and time to market and gives you the ability to change more quickly through life-cycle management, which breaks the annual engineering cycle. **In the end, that's the Holy Grail.**²¹

Tom Waldrop

Senior Director,
Telecommunications Services, Red Hat



¹⁹ Forrester. "Open source automation drives innovation for telecommunications organizations." Sponsored by Red Hat. July 2020.

²⁰ Red Hat press release. "NTT DOCOMO Inc. introduces Red Hat Ansible Automation Platform to automate over 10,000 devices in ISP services," July 21, 2020.

²¹ Lessing, Marlese. "Red Hat's Tom Waldrop: In the Era of COVID-19, 'Automate Everything.'" SDxCentral, sponsored by Red Hat, June 25, 2020.

Explore more

Leading digital service providers rely on Red Hat Ansible® Automation Platform. Hear some of their stories.

NTT Docomo used Red Hat Ansible® Automation Platform to automate over 10,000 devices.²⁰

[Learn how →](#)

100% of telecommunications decision makers surveyed report technology and business benefits from their automation software investments.¹⁹

[Read the Forrester Consulting study →](#)

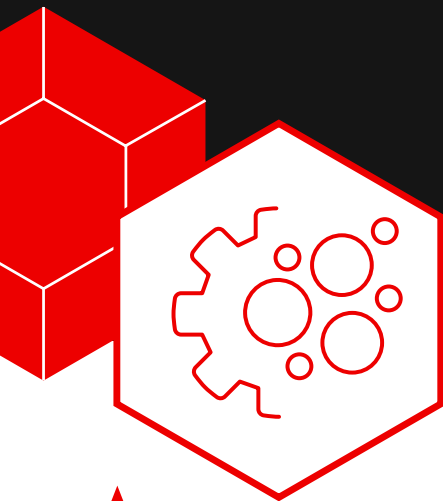
Artificial intelligence



Digital service providers can build AI into operations for the rapid detection of anomalies and connect it with automation for closed-loop remediation actions, heading off problems before they escalate.

They can also use AI to boost revenue by creating add-on offers to customers based on buying affinities, behaviors, and actions.

At the edge of the network, AI and analytics services can help process massive amounts of data from sensors, monitoring devices, and usage patterns and locally manage the decision to communicate alerts to central resources.



AI/ML is the top emerging technology workload consideration over the next 12 months.²²

Benefits of AI

AI increases the efficiency and productivity of operations teams, lowering operational costs. It provides a path to incremental revenues and new services. In addition, AI can help reduce customer churn and improve Net Promoter Scores by increasing service availability and reliability.

Explore more

Learn how PerceptiLabs simplified machine learning (ML) with Red Hat OpenShift →

²² Red Hat. "2020 Red Hat Global Customer Tech Outlook Report," 2020.

Red Hat's role in open source

Leading digital service providers from around the world partner with Red Hat on their open transformation initiatives because, **for more than 25 years, Red Hat has played a leadership role in open source software development.**²³

We have helped by:

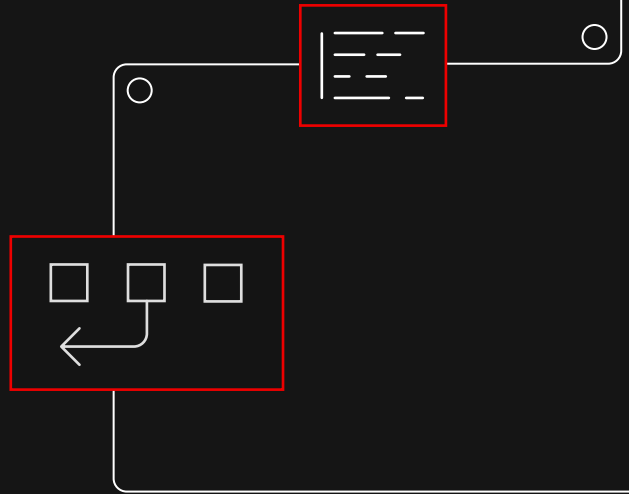
1 Navigating open source communities and advocating on your behalf so your requirements are addressed and the solutions developed provide maximum business value.

2 Aggregating open source code to make sure you can easily use the solutions coming out of open source communities. This refinement and maturation process delivers stability, security, and performance and gives organizations the tools needed to manage software at scale, which is critically important.

3 Handling the integration, testing, and compliance that you and your customers demand.

²³ Red Hat. "Creating better technology with open source," Accessed Nov. 2020.

4 Collaborating with hardware and software partners to take advantage of the newest innovations, allowing disruptors to embrace new opportunities with confidence. With Red Hat, ecosystem partners can develop solutions once, and then you can deploy anywhere, providing consistent experiences. This ecosystem can also provide ongoing support to sustain solutions long term.



5 Advising and mentoring on the behaviors, collaboration, and open practices needed to help customers adopt agile **DevOps methodologies**, evolving cultures to succeed with open technologies. **Red Hat Open Innovation Labs** provides an immersive residency program that demonstrates how an open approach can create sustained competitive advantage. We share the processes, tools, and expertise that can help you increase your pace of innovation.



Red Hat products and solutions

Modernizing networks requires moving workloads and services out of the core network (in datacenters) toward the network's edge: around points of presence and central offices. From here, services can be delivered to subscribers more efficiently with lower latency and higher bandwidth.

Our NFV solution is open source and standards-based, creating a stable, interoperable foundation to build upon.

It is the result of Red Hat's leading contributions to the OpenStack, Kernel-based Virtual Machine (KVM), Data Plane Development Kit (DPDK), Kubernetes, and OpenShift Origin Community Distribution (OKD) projects.

With a robust ecosystem, the choice is yours

Red Hat's strategic partners are ready to help you transform your network and operations.

Watch the short video to learn how an open ecosystem benefits service providers →

Learn about certifying network functions or nominate a network function for certification →

Red Hat is among the top contributors to many of these core projects,²⁴ giving us insight into where the community is going, and allowing us to inform telecommunications companies about future trends.

Red Hat works with the open source communities to make sure the needs of these customers, beyond applications, are addressed, for example: DPDK, single root input/output virtualization (SR-IOV), virtual data path acceleration (vDPA), and support for hardware acceleration.

²⁴Stackalytics and The Linux Foundation, "Commits by company." See also Red Hat's Open Source Program Office for a list of Red Hat's software contributions.

How Red Hat products help you

Red Hat Enterprise Linux® is a foundation for **Red Hat OpenStack Platform** and **Red Hat OpenShift®**, so the security, reliability, performance, ecosystem, and other benefits of Red Hat Enterprise Linux apply up the entire stack. As a result, workloads behave the same, regardless of form (VNF, CNF) or infrastructure (datacenter, private cloud, public cloud).

Red Hat Ansible Automation Platform is a foundation for building and operating automation across an organization. The platform includes all the tools needed to implement enterprise-wide automation.

OpenStack is widely used to manage NFV infrastructure, and **Red Hat OpenStack Platform** is a leading commercial OpenStack distribution.

Kubernetes is the dominant infrastructure technology for managing container environments, and **Red Hat OpenShift Container Platform** is a leading commercial Kubernetes platform.

Red Hat Storage delivers software-defined storage that scales as needed across the varied data sources in an operator's infrastructure.

Red Hat Integration provides messaging, application programming interface (API) security and management, and runtimes solutions that help telecommunications companies develop their own cloud-native applications and implement an automated, more secure CI/CD pipeline to get them into production.

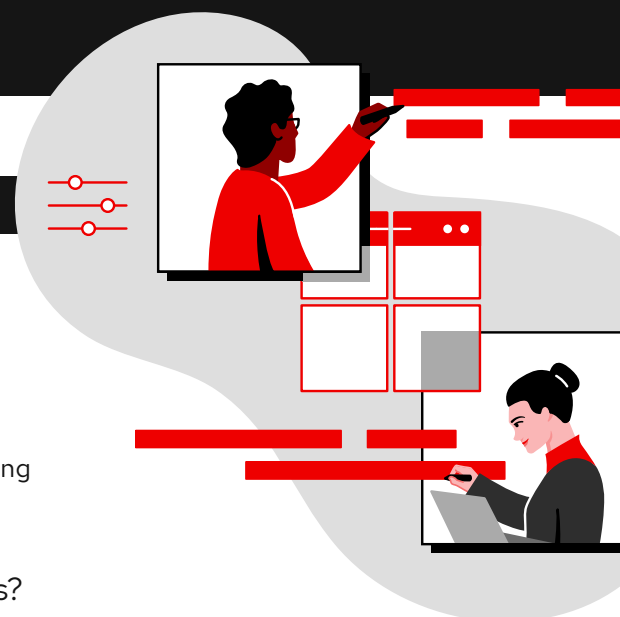
Red Hat's extensive ecosystem

Delivering and scaling a modern core-to-edge network solution requires partnership.

Red Hat has close relationships with a wide set of **global independent software vendors (ISVs)**, systems integrators (SIs) and networking equipment providers (NEPs) that certify, validate, and optimize networking applications on telecommunications companies' cloud platforms.

Do you offer a commercial solution for digital service providers?

[Read the e-book to learn how to become a digital service provider →](#)



Visit redhat.com/telco to get started.

Red Hat, with its experience, knowledge, and rich ecosystem of partners, can help you embrace change **as you build your tomorrow today.**



About Red Hat

Red Hat is the world's leading provider of enterprise open source software solutions, using a community-powered approach to deliver reliable and high-performing Linux, hybrid cloud, container, and Kubernetes technologies. Red Hat helps customers integrate new and existing IT applications, develop cloud-native applications, standardize on our industry-leading operating system, and automate, secure, and manage complex environments. Award-winning support, training, and consulting services make Red Hat a trusted adviser to the Fortune 500. As a strategic partner to cloud providers, system integrators, application vendors, customers, and open source communities, Red Hat can help organizations prepare for the digital future.



facebook.com/redhatinc



[@RedHat](https://twitter.com/RedHat)



linkedin.com/company/red-hat

Contact us:

North America

1-888-REDHAT1

www.redhat.com

Europe, Middle East, and Africa

00800 7334 2835

europa@redhat.com

Asia Pacific

+65 6490 4200

apac@redhat.com

Latin America

+54 11 4329 7300

info-latam@redhat.com

Copyright © 2021 Red Hat, Inc. Red Hat, the Red Hat logo, Ansible, and OpenShift are trademarks or registered trademarks of Red Hat, Inc. or its subsidiaries in the United States and other countries. Linux® is the registered trademark of Linus Torvalds in the U.S. and other countries.

The OpenStack word mark and the Square O Design, together or apart, are trademarks or registered trademarks of OpenStack Foundation in the United States and other countries, and are used with the OpenStack Foundation's permission. Red Hat, Inc. is not affiliated with, endorsed by, or sponsored by the OpenStack Foundation or the OpenStack community.