Red Hat

Top considerations for building a

modern edge infrastructure

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Introduction

Our view of edge computing

Across industries, organizations are using operational and user-generated data to make critical business decisions, solve challenges, and gain a competitive advantage.

From aboard the International Space Station to ships at sea to hospitals and factory floors, data-driven insights are accelerating business operations and transforming every organization into a digital one.

However, the insights informing these critical business decisions aren't being processed in the traditional datacenter or cloud environment—**they're happening at the edge.**

At Red Hat, we see edge computing as an opportunity to extend hybrid cloud capabilities all the way to data sources and end users. With a hybrid cloud strategy designed to support edge computing, applications and services can provide insights and deliver experiences when and where they're needed.

Extending hybrid cloud capabilities to edge sites not only creates new opportunities. It can also help organizations reduce operational expenses in an increasingly competitive market.

Organizations have an urgent need to deliver and scale applications that offer better services, fix problems faster (or prevent them from happening in the first place), disrupt industries, and even save lives. They are looking for technology solutions to help them:

- Connect existing infrastructures.

- Accelerate application development.

- Support continuous innovation.

- Create new opportunities.

To succeed in these efforts, companies need to develop an edge computing platform that uses the same management tools and infrastructure from their core datacenter or cloud and out to the network edge. This consistency allows companies to apply the same skills and scale across environments.

How can containers and Kubernetes help deliver the benefits of edge computing?

Containers and Kuberentes can power innovation at the edge because they are:

Portable

Containerized applications can run across core datacenters, public cloud, or edge infrastructure—supporting a flexible approach that lets organizations evolve their application strategy to meet business needs.

Lightweight

Containerized applications can start more quickly and are lightweight enough to meet smaller hardware requirements. Lightweight applications are ideal for edge sites, which generally have quite limited physical footprints, storage capacity, and power and cooling resources.

Consistent

To make edge computing successful, containerization supports a consistent application development and deployment experience to deliver consistent life cycle management across a wide variety of systems and at a large scale.

Edge computing places compute, networking, and storage services outside of core datacenters or cloud environments and closer to end users and data sources, often across a large number of locations. While the work done at edge sites isn't new to organizations, edge computing offers a new way to achieve business goals at these sites, quickly.

Examples of edge computing locations might include:

- A manufacturing plant.
- A hospital.
- A remote oil well.
- A retail store.
- A train.

These locations are where organizations already run their business operations that directly generate value.

The adoption of edge computing is growing quickly. IDC estimates that by 2025, worldwide edge technology spending will reach US$274 billion, with a compound annual growth rate of 14.1%.[1]

And according to the 2022 Red Hat® Global Tech Outlook, 61% of survey respondents ranked the Internet of Things (IoT), edge computing, or both as a priority emerging tech workload for 2022.[2]

This e-book will explore considerations for building a modern edge infrastructure, including:

- The benefits of edge computing.

- Use case examples.

- The complexities of operating at the edge.

- How the Red Hat portfolio can help.

The increase in budget allocation toward connected technologies addresses immediate challenges and is also an investment in the future.

Short-term benefits:

- Gather and process data faster to increase productivity, efficiency, and speed up decision-making.

- Control where data lives, improving security and compliance.

Long-term benefits:

- Offer new products and services.

- Support continuous innovation to improve critical business operations.

1 IDC Spending Guide. "Worldwide Edge Spending Guide," accessed Aug. 2021.
2 Red Hat, 2022 Global Tech Outlook, June–August 2021.

There is no single edge

Device or sensor

End-user premises edge

Edge server, gateway, or endpoint

Infrastructure edge

Provider edge

Provider far edge

Provider access edge

Provider aggregation edge

Provider or enterprise core

Regional datacenter

Core datacenter

Non-edge tiers–within the provider or enterprise core–are owned and operated by public cloud providers, telecommunications service providers, or large enterprises.

Service provider edge:

These edge tiers are located between the core or regional datacenters and the "last-mile" access, which is commonly owned or operated by a telecommunications provider or internet service provider who serves multiple customers.

End-user premises edge:

These edge tiers include the enterprise edge–such as a retail store, a factory, or a train–or the consumer edge, such as a residential household or a car.

Device edge:

This edge tier is comprised of standalone systems that directly connect sensors or articulators via non-internet protocols.

This e-book primarily focuses on the **end-user premises edge**.

Chapter 1

Exploring the benefits of edge computing

Companies deploying edge infrastructure have new opportunities to improve their operational outcomes and offerings. By moving data analysis and decision-making applications closer to data sources, they can increase efficiencies—and enhance customer and employee experiences.

See how edge computing can benefit your organization:

1

Accelerate decision-making

When data is analyzed locally at the edge, organizations can make critical decisions more quickly, bypassing time-consuming latency and bandwidth bottlenecks that come with centralized computing.

This data can be used to make real-time decisions to:

- Help automate operations.

- Lower operational costs.

- Develop new service offerings.

- Prevent costly service interruptions.

- Avoid harm to critical infrastructure or workers.

How can edge computing help organizations with quicker decision-making?

Predictive maintenance in manufacturing: Use cloud best practices to manage edge applications and infrastructure at each plant or site to collect, process, and act on data from sensors on the factory floor. Sensor data such as heat, vibration, or pressure can predict an equipment or process failure. Getting ahead of a malfunction can reduce direct impacts to the bottom line, including wasted raw material, unplanned downtime, and lost revenue.

Real-time analysis in finance: Financial institutions can use artificial intelligence (AI) and machine learning (ML) at the edge to identify financial fraud detection patterns. Additionally, edge computing can be valuable in real-time facial recognition, both in banks themselves, as well as at ATMs.

2

Enhance user experience

When data and applications are closer to the end user, customer experiences are improved through near real-time engagement.

Edge computing allows organizations to:

- Provide new and unique service offerings.

- Capture new revenue streams.

- Gain and maintain their competitive advantage.

How can edge computing help organizations deliver better user experiences?

Asset tracking: Keep customers informed and updated on what they might be waiting for within the supply chain. Track deliveries and provide more accurate estimates using AI and ML at the edge.

Digital signage: Trigger personalized and timely offers for customers using user proximity and profile information, which can improve their experience, encourage upsell, and strengthen brand awareness. Enterprise retail applications could feature real-time analysis of in-store behavior, such as tracking aisles a customer walks down, products they pick up, and what's in their cart.

How can edge computing help organizations continue processing even with intermittent connectivity or limited bandwidth?

Because processing is done locally, edge computing can keep operations working if connectivity to the central site fails or if there is a known issue with intermittent connectivity due to environmental or location-based concerns. Plus, connectivity can be restored, and the ability to send alerts or resync can be enabled with the right edge computing solutions.

Actively monitor remote distribution and transmission facilities: Monitor and respond to changes or fluctuations for facilities such as oil pipelines or hydroelectric power plants.

Remain active regardless of external failures: Ensure safety for train switching and control points by staying resilient.

Maintain continuous operations for sites with intermittent connectivity or limited bandwidth

3

Implement resilient processes and applications for edge sites that experience intermittent connectivity, possibly because of their:

- Remote location.

- Limited bandwidth.

- Access issues, such as storms knocking out connectivity.

4

Meet compliance demands and requirements more securely

Adhere to data residency and sovereignty requirements regarding the movement of sensitive data—including personal, financial, and medical data, among others—across boundaries or borders.

How can edge computing help organizations meet data residency and sovereignty requirements?

Handle personally identifiable information (PII) appropriately: Use ML to remove PII and anonymize data at the edge before sending to back-end systems. For example, blur faces in camera feeds before streaming video off-site.

Meet regulatory requirements: Make sure that PII generated by local healthcare providers or financial institutions adheres to varying country and international regulations.
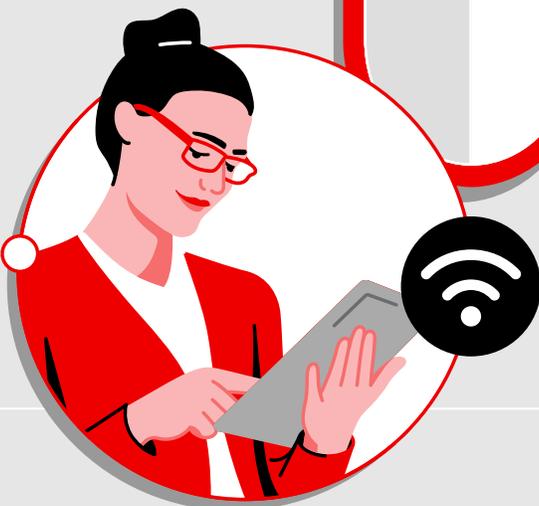
Read more →

Learn how Alstom was able to transform its railway IoT devices to a more **flexible and modern solution for data acquisition and edge processing.**

Chapter 2

Complexities and considerations when building a modern edge infrastructure

While edge computing introduces numerous benefits, there are also challenges and complexities to consider. At edge sites, many organizations struggle to manage environments built with heterogeneous hardware, industry-specific proprietary solutions, and do-it-yourself code.

The challenges of operating in this mixed environment can keep an organization from computing at the edge, even though the latency and bandwidth limitations and the security and compliance issues inherent in centralized cloud computing warrant the effort.

To overcome these complexities, organizations need to take these **five challenges** into consideration:

1 Deployment and management at scale

Scaling for your organization's needs can be a complex endeavor, especially when handled manually. It's time consuming and error-prone when it's not automated, especially when you need to deploy to and manage thousands of sites. Automation can help you scale deployment, operations, and management as your architecture scales.

ⓘ **Consideration**

Find a technology partner that lets you maintain control, visibility, and management of hundreds to thousands of locations consistently so you can deploy applications wherever your business needs them, even in the most remote locations. Choose a platform that works consistently across edge, cloud, and core datacenters. Take advantage of the numerous benefits that an automation platform or automation tools provide for managing and deploying at scale.

2

Vendor lock-in

Edge sites are where companies most often create value and differentiation. To continuously innovate and improve their intellectual property at these sites, organizations need edge computing solutions that offer agility and flexibility. Proprietary solutions and vertically integrated cloud offerings can be limited and can hinder innovation. This closed approach can also prevent a company from differentiating itself by working with third-party providers and independent software vendors (ISVs). No single vendor can build an entire edge stack, and organizations need to ensure interoperability within a multivendor hardware and software environment to continue to innovate and operate nimbly.

ⓘ **Consideration**

Choose an extensible platform that allows you to grow, change, adapt, and scale without needing to completely re-evaluate your edge computing solutions and vendors each time your business needs change. Find solutions that allow you to differentiate in a crowded market. Vertically integrated stacks can limit your ability to differentiate from others using identical technology, so choose a vendor that has a certified vendor ecosystem to help you extend your capabilities where necessary.

Security and compliance

3

The rapid adoption of edge computing means that organizations are implementing it in locations that may not have IT staff, such as on a remote oil rig or on a transport fleet. These remote locations can make it challenging to ensure the controls and policies are in place to maintain proper security, governance, and compliance.

ⓘ **Consideration**

Work with a trusted vendor that helps you to set policy, ensures that software is updated properly to prevent vulnerabilities, and can help put data security measures in place. Consider automation solutions, which improve security posture through consistency.

4

Intermittent connectivity

Remote operations—or use cases that require intermittent connectivity due to security and regulatory constraints—must have predictable, stable platforms for edge computing. These zero-touch platforms require minimal on-site maintenance while still being easily discoverable and replaceable.

ⓘ **Consideration**

Build a common platform that gives you choice, working across cloud platforms and environments while extending the same capabilities to the edge, letting you manage remotely.

5

Data management

The more nodes and sensors implemented into an edge computing environment, the more data will be produced. When a single sensor can generate hundreds or even thousands of data points per minute, it's easy for an organization to become overwhelmed when it comes to processing, managing, and moving the data in a timely manner. Managing large numbers of edge computing sites, as well as the data streams they generate, is a monumental task.

For example, a transportation and logistics company may need to track transport and inventory nationwide or globally. Or a manufacturer may operate hundreds of machines and processes, each of which is potentially streaming thousands of data points per minute. This volume of data can be overwhelming and unwieldy without the proper infrastructure in place.

ⓘ **Consideration**

Embrace simple event-driven automation, along with storage, and AI/ML. Find a technology vendor that can help you make the most of your data in a timely manner.

Now that you know what to expect and what you should consider, how will you build your edge-enabled cloud environments? To achieve their desired flexibility and agility, companies looking to the future of cloud and edge computing are choosing interoperable solutions—adopting an open hybrid cloud approach that extends to the edge.

Read about how the Mayflower Autonomous Ship, an unmanned marine research vessel, uses edge computing powered by Red Hat Enterprise Linux®.

Learn more →

Chapter 3

How Red Hat Edge can help

Edge computing is a natural extension of Red Hat's open hybrid cloud strategy, which is to support any workload on any footprint in any location.

As your organization looks at the best technologies to help you reach more customers, deliver differentiated experiences, or increase innovation, your options shouldn't be limited by your architecture. Extending the deployment of your applications to include edge sites further widens these opportunities. The Red Hat portfolio has the solutions and expertise to get you where you need to go.

Red Hat Edge provides:

A common platform from edge to core to any cloud

Move to a modern, cloud-native application platform that supports DevSecOps application development and life cycle management processes. Run your core IT functions in the datacenter and cloud and extend modern application development and infrastructure management to the edge. Red Hat Edge supports public and private cloud and edge footprints through a vast hardware and software partner ecosystem. Our open approach to collaboration means that anyone can suggest improvements or contribute meaningful changes. We then take that innovation and add the features, tools, services, and support that make them viable for the enterprise.

Open platforms

Benefit from a flexible platform that supports continuous innovation, allowing you to differentiate your current business while preparing you for future changes. With freedom from vendor lock-in, you have the ability to change your infrastructure as your requirements evolve.

Management and automation at scale

Red Hat Edge provides the basis for automating the deployment, configuration, and maintenance of your edge computing landscape through third-party integrations. With Red Hat, you can manage both the foundational compute platforms as well as the full application life cycle of edge applications across hundreds, even thousands, of locations. Scale without adding complexity through consistent operations across your entire deployment—not just at the edge.

Additional value from existing IT skills

With Red Hat edge solutions, you can make the most of your existing IT skills to extend cloud-native capabilities for DevSecOps to build new edge applications. Your organization can apply hybrid cloud solutions at the edge while minimizing the need for on-site IT support through remote management.

A robust edge portfolio

Red Hat can provide you with the solutions you need to create lightweight applications, process and store data on site, and access business rules and algorithms to accelerate decision-making.

Validated patterns for edge computing

Red Hat Edge offers <u>validated patterns</u>, which are detailed deployments created for different edge use cases. These predefined edge computing configurations bring together the Red Hat portfolio and technology from our partner ecosystem to help you stand up your edge architecture faster.

Security at every layer

Red Hat can help you implement a layered security approach across your infrastructure, application stack, and life cycle for improved workload security on-premise, in the cloud, or at edge sites.

Red Hat can play a critical role in helping you navigate your transformation with and adoption of edge computing effectively and efficiently.

Red Hat's portfolio can help you can help you deploy a <u>modern edge compute infrastructure</u> and includes:

Products

Red Hat
Enterprise Linux

Red Hat
OpenShift

Red Hat
Ansible Automation Platform

Red Hat
OpenStack Platform

Red Hat
Integration

Services
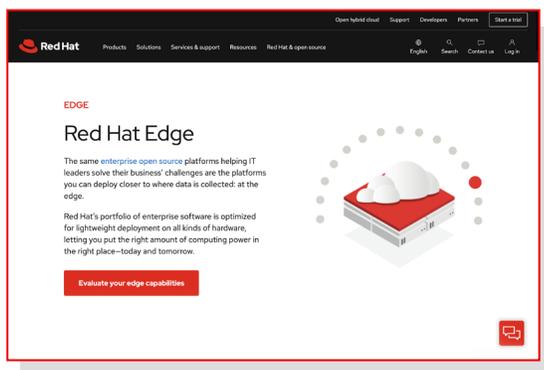
Red Hat
Consulting

Red Hat
Open Innovation Labs

Read how edge computing solves problems →

Explore Red Hat's approach to edge computing.

Chapter 4
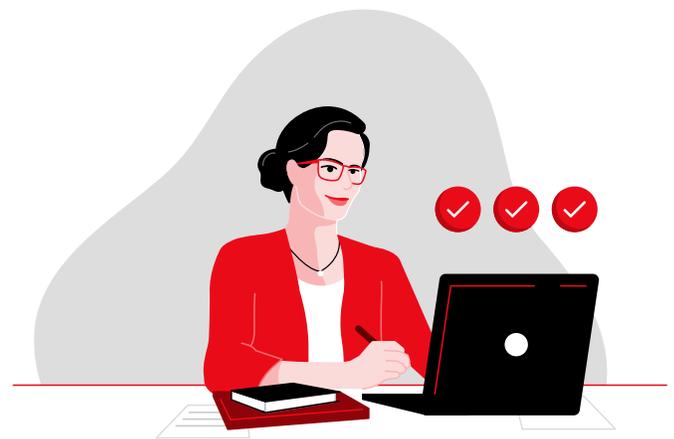
How to get started with edge computing

Ready to make the move to the edge? Red Hat is here to help.

Learn more about our approach to edge computing, dive into relevant use cases, and read about organizations that are benefitting from operating at the edge.

Visit our web page →

Once you're ready to take the next step, Red Hat Consulting can perform an edge platform architecture review to evaluate your edge capabilities and get you started.

Learn more →