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Red Hat's Edge Computing Architecture:

A Modern Solution for the U.S. Federal Government

Managing dispersed IT infrastructure with the confidence and security of a centralized data center

Executive summary

As the technology landscape continues to rapidly evolve, organizations are growing overwhelmed by the volume of data generated on the periphery of their networks. This influx of data stretches traditional, centralized infrastructure to its limits. Centralized data processing, once the standard, now experiences challenges gathering and processing data at the "edge" of networks. When IT extends to locations away from central data centers, organizations encounter latency issues, bandwidth constraints, scalability concerns, and demand for immediate insights.

1

LATENCY ISSUES

Globally dispersed user bases can experience access delays which hinder real-time decision making

2

BANDWIDTH CONSTRAINTS

Network infrastructure limitations can bottleneck performance

3

SCALABILITY CONCERNS

As data processing needs expand, infrastructure may struggle to keep up

4

IMMEDIATE INSIGHT DEMANDS

Organizations require instant data analysis for rapid responses

5

DATA SOVEREIGNTY REQUIREMENTS

Adherence to policies regulating storage and transmission of sensitive data is crucial

Graphic 1. 5 challenges with centralized data processing at federal agencies.

Deloitte has a deep track record for helping IT teams assess their own current challenges and formulate customized, future-thinking strategies that unlock the technical expertise, platforms, and solutions of our most trusted alliance partners.

In the edge computing space, that means leveraging Deloitte's award-winning alliance partnership with Red Hat to connect clients with an edge computing architecture that enables efficient data processing, closer to the source, without sacrificing security, performance, or the benefits of centralized IT control.

Large clients, such as government agencies, telecommunications providers, and manufacturing companies, know these IT challenges well. However, government agencies confront additional complexities and constraints not found in the commercial sector. These include demands like low latency operation, offline operability, and strict data compliance across locations both domestic and abroad. Red Hat's edge computing capabilities, combined with Deloitte's professional consultancy services, can help address and resolve these challenges.
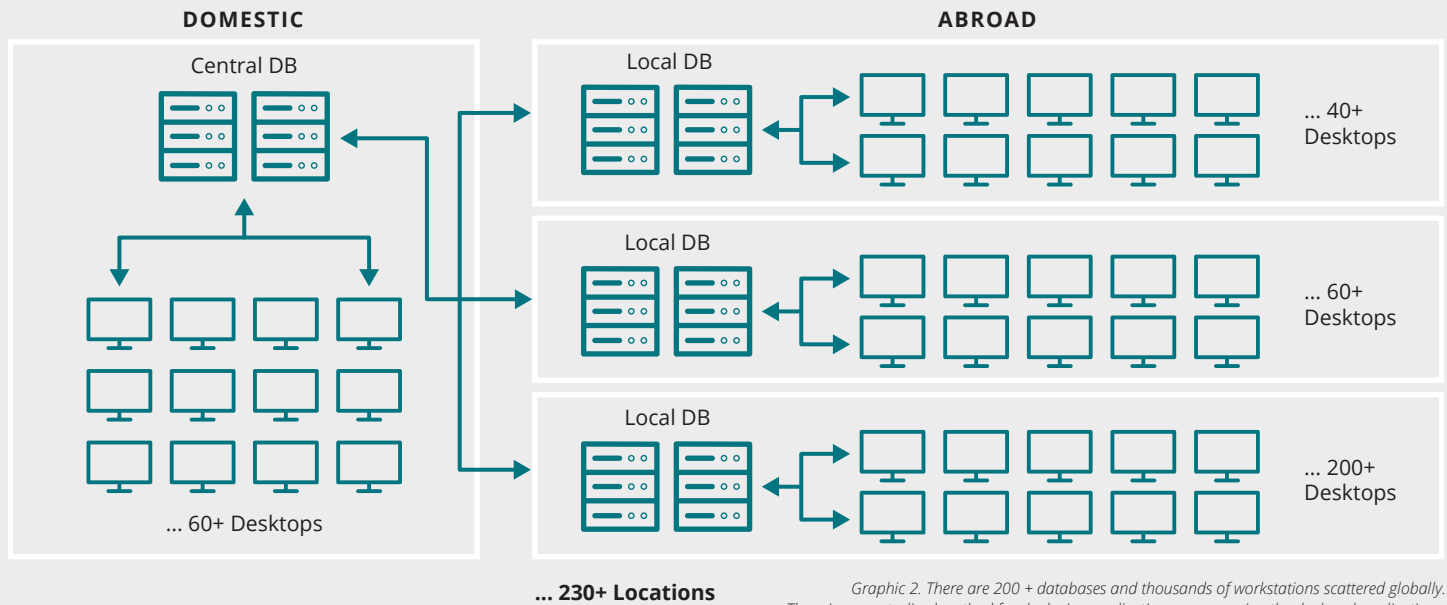
Red Hat's edge computing architecture empowers organizations to process data closer to its source, optimizing the efficiency and responsiveness of their dispersed IT infrastructures. While often associated with Internet of Things, Red Hat's edge capabilities extend far beyond this, offering a comprehensive digital transformation that can solve federal agencies' performance and data security challenges. By implementing a Red Hat edge computing architecture that's led by Deloitte's tactful implementation oversight and due diligence, federal agencies can not only address their immediate IT concerns but establish a strong foundation for future application modernization.

Throughout this paper, we'll discuss a notional implementation of Red Hat's edge computing architecture for a large government agency, as well as provide two case studies from the field.

Defining the problem

In our first example, a government agency manages an expansive, global IT infrastructure anchored by a centralized database and supplemented by over 200 decentralized databases. Data is processed by monolithic thick client apps deployed to over 5,000 Windows desktops around the world. This infrastructure is integral to the successful execution of the agency's mission, but also introduces significant operational complexities. These operational complexities lead to deployment delays, involve extensive manual processes, and produce limited insight into the operation and performance of the applications. Understanding and resolving these challenges is paramount to identifying and implementing a holistic solution.

DOMESTIC

Central DB

... 60+ Desktops

... 230+ Locations

ABROAD

Local DB

... 40+ Desktops

Local DB

... 60+ Desktops

Local DB

... 200+ Desktops

Graphic 2. There are 200 + databases and thousands of workstations scattered globally. There is no centralized method for deploying applications or managing the deployed applications.

Operational challenges

1. DEPLOYMENT DELAYS

- Deployment of thick client applications can take up to a year to fully complete to 5000+ Windows desktops dispersed globally.

- Deployment teams are often forced to perform advanced troubleshooting and manual installations during deployments.

2. LACK OF CENTRALIZED OVERSIGHT

- A lack of centralized oversight inhibits visibility into the deployed applications and decentralized databases, thereby limiting monitoring, managing, and supporting the applications.

- Difficulty ensuring compliance and adherence with organizational standards, such as OMB-M-21-31

3. LIMITED INSIGHT INTO END-USER EXPERIENCE

- Insights into end-user behavior are limited, complicating production support.

- Prompt resolution of production issues is challenging, affecting end-user satisfaction and productivity.

To effectively modernize the agency's IT infrastructure, the solution must tackle the challenges outlined above, while simultaneously ensuring users experience minimal latency, regardless of their location. The solution must also guarantee offline operability and strictly conform to the regulatory and compliance mandates governing data movement and storage.

To address these complexities, the organization has explored the following solutions, each of which present limitations of their own

1. PUBLIC CLOUD OR SAAS

a. Public Cloud or SaaS are not viable modernization solutions, as Public Cloud and SaaS solutions would be U.S. hosted, leading to high latency; this also wouldn't support offline operation of decentralized applications.

2. COMMERCIAL CLOUD

a. Commercial Cloud is not a viable modernization solution, as Commercial Cloud would necessitate hosting sensitive data outside the U.S.; data sovereignty requirements limit where data can travel and reside.

3. REGIONAL DATACENTERS

a. Regional Datacenters are not the best approach for modernization of decentralized apps—like Government Cloud, Regional Datacenters would not support offline operation of decentralized applications.

The constraints faced by this federal agency necessitate a nuanced modernization approach for its IT infrastructure, as traditional solutions fall short. The identified solution of Red Hat's edge computing architecture will be discussed in the next section, as this solution is comprehensive, and delivers an innovative and flexible approach to meeting the many demands of the agency

Solution

Taking competitive advantage of Deloitte's depth and breadth of experience in helping link government agencies to ideal IT infrastructure solutions, Red Hat's edge computing architecture emerges as an innovation beacon, offering a transformative approach for modernization that aligns seamlessly with the agency's needs and challenges. .
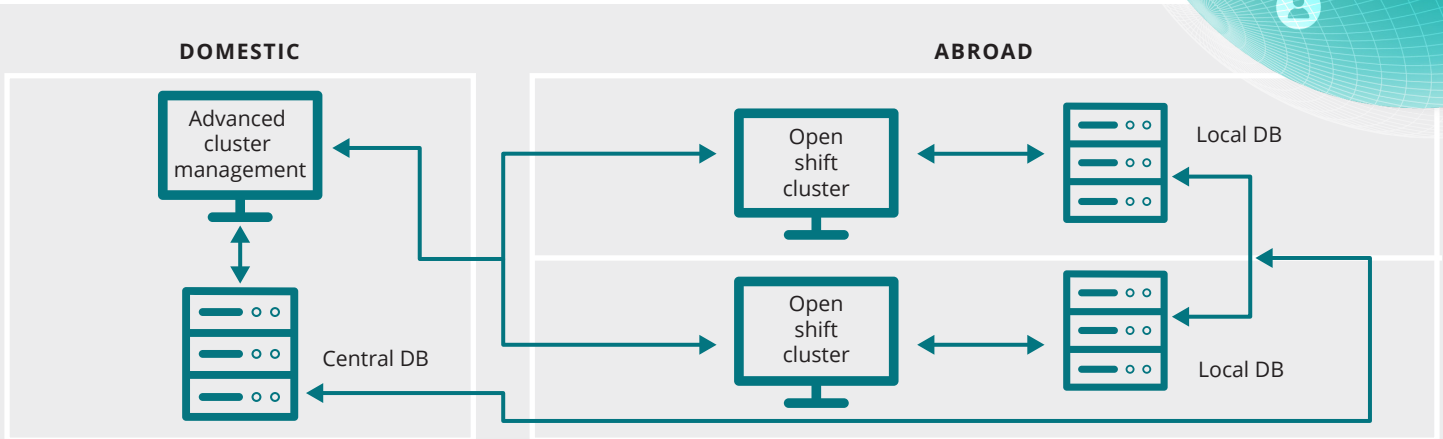
Graphic 3. Red Hat Edge Computing architecture implemented with centralized management via Advanced Cluster Management and an OpenShift Cluster at each decentralized location.

RED HAT'S EDGE COMPUTING ARCHITECTURE PROVIDES A HOLISTIC SOLUTION TO THE AGENCY

FEATURE	BENEFIT
Accelerated and Streamlined Deployments	• Deployments of modernized applications to Red Hat's edge servers are centrally scheduled and managed via Red Hat Advanced Cluster Management. 　° Centrally managed deployments drastically reduce the time it takes to deploy desktop applications to Red Hat's edge servers from years to hours, with minimal involvement from local administrators. 　° Deployed applications remain local to the decentralized locations, eliminating the latency and offline operation issues commonly associated with cloud-based deployments.
Centralized Oversight	• Red Hat Advanced Cluster Management provides a "single pane of glass" to monitor the health of edge servers, enabling the effective management of deployed applications. • Centralized management provides the agency with insight into and control over application compliance and maintenance.
Ample Insight into End-User Experience	• Red Hat Advanced Cluster Management provides robust monitoring and analytics capabilities, offering improved insights into end-user behavior. • This management enables the agency to understand how deployed applications are utilized, identify areas for optimization, and provide more efficient production support.
Enhanced Data Processing with Low Latency	• Red Hat's edge computing processes data closer to its source, reducing delays and enhancing responsiveness. • Localized processing ensures optimal performance, particularly critical for applications demanding real-time data insights.
Robust and Advanced Security Measures	• Red Hat's edge computing strictly adheres to protocols governing the transit and storage of sensitive data. • By default, it encrypts both data in transit and communication between platform components. Plus, for heightened data protection needs, Red Hat OpenShift can operate in FIPS mode, ensuring cryptographic operations are FIPS-compliant.
Comprehensive Offline Device Management	• Red Hat's edge computing enables management of a spectrum of devices—from mobile devices and tablets to kiosks—directly at their deployment sites, ensuring uninterrupted operation.
Gateway to Extended Modernization	• Red Hat's edge computing is not just a solution but an avenue to further modernization opportunities. • The Agency, by leveraging this modernized Red Hat framework, can integrate container-ready technologies like .NET, Java, COTS, and packaged low-code platforms. This integration augments efficiency across installation, configuration, and troubleshooting, while setting the stage for future-ready deployment techniques.

Red Hat's edge computing architecture hosts applications on centrally managed OpenShift Clusters at decentralized locations, so instead of deploying and managing applications on 5,000+ desktops, the agency will only need to deploy and manage 230 OpenShift Clusters. These Clusters will be managed via Red Hat's Advanced Cluster Management, as displayed in Graphic 3. Advanced Cluster Management empowers the agency to centrally deploy and centrally manage applications once deployed.

This enables accelerated deployments and enhanced oversight and insight into the applications.

Beyond addressing immediate concerns, Red Hat's edge computing architecture paves the way for a future of continued modernization. With this infrastructure, the agency not only surmounts present challenges but positions itself to harness emerging technologies and deployment strategies, reinforcing its commitment to continuous evolution.

Case Studies

Modernizing Weather Forecasting with Red Hat Edge Computing

CHALLENGE

A leading meteorological agency relies on a software system essential for interpreting and disseminating weather information. The legacy application was originally designed for intermittent connectivity, which posed challenges with real-time weather monitoring, forecast prediction, and timely data distribution. It became evident that a transition to a contemporary application development platform was necessary for optimizing the performance of the software system.

SOLUTION

Red Hat's edge computing architecture emerged as a transformative solution for these challenges. By implementing a network of edge data centers and servers, ranging from single-node to 3-node OpenShift Clusters, Red Hat provided a secure, automated, and hands-off centralized management framework. The servers were positioned on the periphery or "edge" of the network and were equipped with the meteorological software, enabling the processing of weather data much closer to its collection point.

GitLab
Provides cluster configuration information

Red Hat Advanced Cluster Management
Offers control over clusters and applications

OpenShift Clusters

Equipment
Supports field operations.

Edge Devices
Deployed in the field for data processing.

Edge Servers
Deployed in controlled enviroments for application hosting
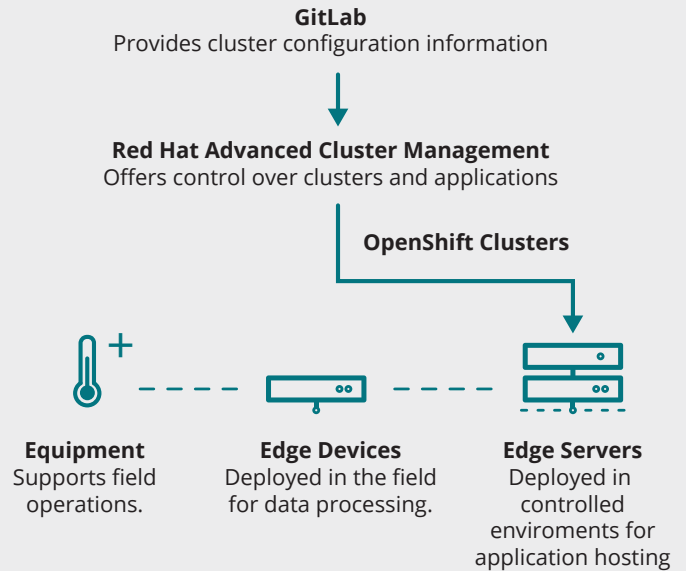
Graphic 4. Implementation approach.

Impact

By leveraging Red Hat Edge computing, the meteorological agency experienced a profound transformation in weather data interpretation and dissemination. **The agency experienced:**

1
REDUCED LATENCY

With data processing shifted closer to collection sites, latency issues were drastically mitigated.

2
ENHANCED EFFICIENCY

Real-time weather monitoring became more streamlined, ensuring rapid and accurate predictions.

3
RELIABILITY

The system's architecture and central management bolstered data distribution, making forecasts timelier and more dependable.

4
LEGACY INTEGRATION

The initiative successfully modernized crucial legacy applications, aligning them with contemporary application development platforms, without compromising their initial functions.

For meteorological entities, Red Hat Edge computing proves itself as a viable and robust solution, demonstrating the power of edge computing in enhancing real-time data processing and insights. This case stands as a testament to Red Hat Edge's adaptability and efficiency.

Challenge

A premier security defense agency operates across more than 100 sites, each of which lacks direct internet access. This presents inherent challenges, particularly when it comes to updating, upgrading, and managing various services and applications crucial to the agency's operations.

Solution

To address this challenge, the agency implemented a shared-services cluster designed to be both managed and scaled to the various locations, ensuring seamless and offline support of operations and post-operations forensics.

1

QUAY, THE CONTAINER IMAGE REGISTRY

This system acts as a central repository for all container images, ensuring that even in the absence of internet access, vital images are accessible across the agency's network.

2

UPDATE GRAPH SERVICE:

To cater to the agency's upgrade needs, the Update Graph Service was integrated. It publishes validated pathways for both updates and upgrades, ensuring that all systems remain current and secure despite their isolation from the broader internet.

3

ADVANCED CLUSTER MANAGER

Serving as the linchpin of this setup, the Advanced Cluster Manager acts as the provisioning engine, configuration applier, and a comprehensive status dashboard. Its role ensures that all systems, despite their geographical location, remain aligned and coherent in their operations.

4

OPENSHIFT:

Leveraging the capabilities of OpenShift further streamlines operations, offering a robust platform for container orchestration, thereby enhancing application deployment and scaling.

Impact

By adopting this holistic solution, the agency experienced:

1

ENHANCED ACCESSIBILITY

The agency can now easily access container images and essential updates without relying on direct internet connectivity.

2

CENTRALIZED MANAGEMENT

The Advanced Cluster Manager ensures all sites, regardless of their location, are uniformly managed, configured, and monitored.

3

OPERATIONAL EFFICIENCY

With OpenShift in the mix, the agency benefits from streamlined application deployment and management, ensuring that resources are utilized optimally.

4

SECURITY AND COMPLIANCE

The validated pathways provided by the Update Graph Service ensure that all updates and upgrades are secure and compliant with the agency's standards.

The agency's decision to adopt Red Hat's edge computing and OpenShift capabilities showcases the potential of taking an integrated approach to tackling operational challenges in environments with limited internet access. This case underscores the adaptability and resilience of solutions like Quay, Update Graph Service, Advanced Cluster Manager, and OpenShift in ensuring operational continuity, security, and efficiency.
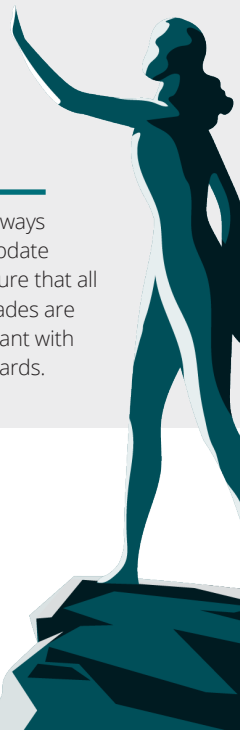
Conclusion

The unique combination of Deloitte's professional consultancy and implementation services, its long-running alliance with Red Hat, and Red Hat's edge computing architecture form a strong foundation to help federal government agencies address their unique computing challenges. This is especially true within the context of agencies' vast, complex and often globally dispersed IT infrastructure. By decentralizing compute processes and processing data closer to the source, Red Hat's edge computing provides immediate operational benefits and positions agencies well for future technological advancements. The case studies further highlight the adaptability and robustness of this solution across diverse operational scenarios.

Red Hat's edge computing capabilities can be applied to:

1

Modern microservice architectures developed using technologies such as Java, .NET Core, TypeScript, and more.

2

Traditional 3-tiered server-based web applications built on the .NET framework and Java platforms. These applications could benefit greatly from easier deployment and management.

3

Reducing the complexity of multi-site deployments for VDI setups. For instance, deployment of templatized Windows VMs hosting legacy applications across a dispersed edge environment.

As federal agencies plan for the future, leveraging Deloitte's integration experience and well-established alliance partnership with Red Hat is a smart first step in solving their unique IT challenges with Red Hat Edge. Not only does the architecture provide a platform for modernizing—it can unlock agencies' full potential to support working smarter, innovating, and delivering outstanding service. Tomorrow isn't just about having data; it's about making the most of it in real-time. With Deloitte and Red Hat's edge computing connections and capabilities, agencies can stand ready to champion this next wave of digital evolution.

GLOSSARY

IT: Information Technology

IoT: Internet of Things

OMB-M-21-31: A U.S. federal government memorandum that provides guidelines for federal agencies regarding managing and securing information.

SaaS: Software as a Service

FIPS: Federal Information Processing Standards

COTS: Commercial Off-The-Shelf

VDI: Virtual Desktop Infrastructure

VM: Virtual Machine