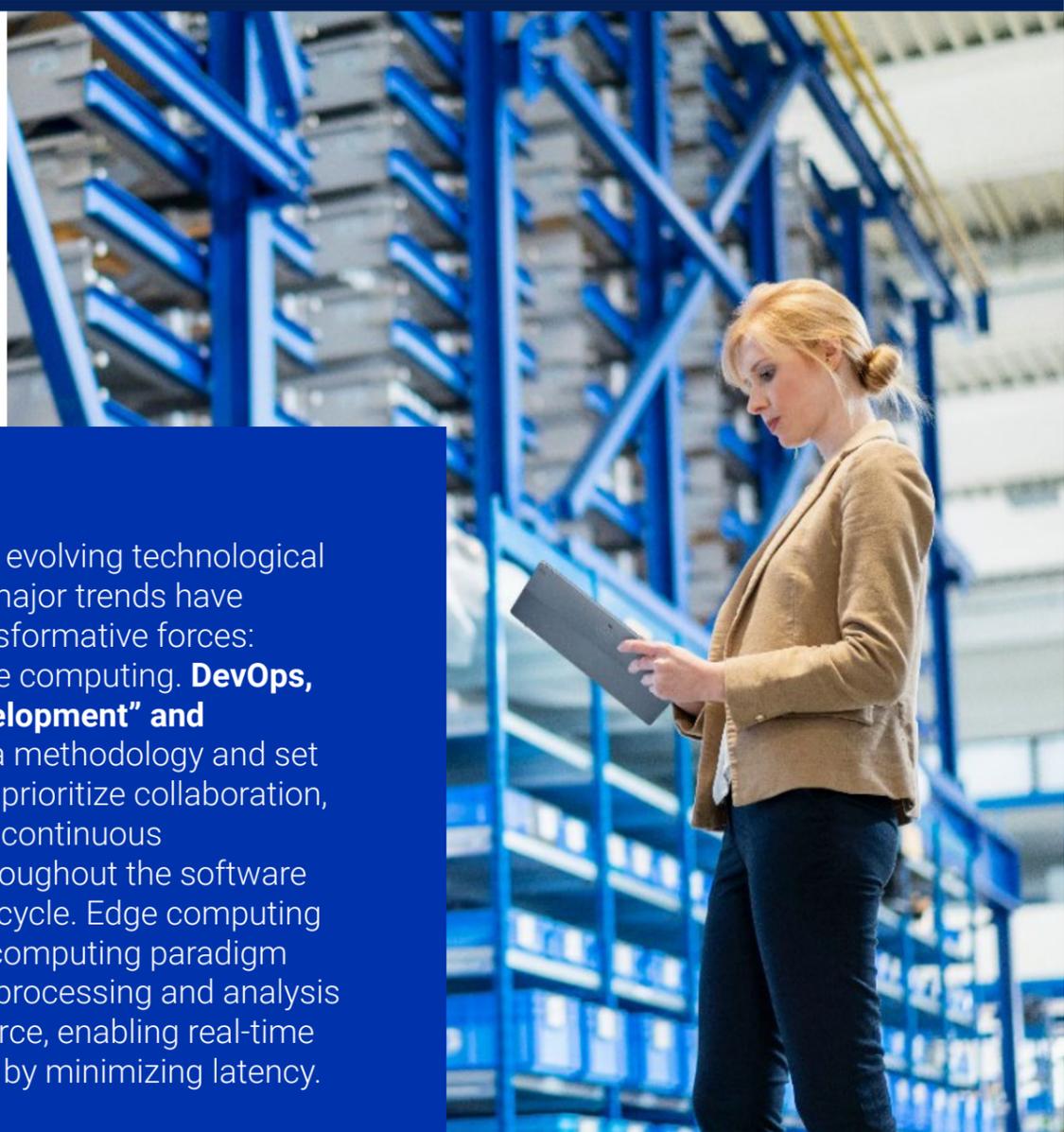


DevEdgeOps:  
DevOps at  
the Edge





In today's rapidly evolving technological landscape, two major trends have emerged as transformative forces: DevOps and edge computing. **DevOps**, a fusion of **"Development"** and **"Operations"**, is a methodology and set of practices that prioritize collaboration, automation, and continuous improvement throughout the software development lifecycle. Edge computing is a distributed computing paradigm that brings data processing and analysis closer to the source, enabling real-time decision-making by minimizing latency.

At the convergence of these influential forces lies the concept of merging the two, which we term as DevEdgeOps. DevEdgeOps is the seamless integration of DevOps principles with the unique challenges and opportunities presented by edge computing. It's a strategic approach that combines the agility and efficiency of DevOps while addressing the distinct complexities of edge environments.

In this whitepaper, we discuss the interplay between these two influential trends and investigate how DevOps principles can be adapted to tackle the distinctive challenges posed by edge computing environments. As we unpack the significance of DevOps including its benefits in IT operations, we demonstrate how these principles can be harnessed to propel the domain of edge computing.

## What is DevOps?

Before we dive into DevOps at the edge, let's establish a fundamental understanding of what DevOps encompasses. It is a collection of tools and practices that integrates and automates the work of software development and IT management to improve and expedite the software development lifecycle. DevOps champions a set of principles designed to eliminate silos between development and IT operations teams. It promotes automation, collaboration, and the relentless pursuit of efficiency, thereby fostering a harmonious and agile software development ecosystem.

## Benefits of DevOps with a Focus on IT Operations

The adoption of DevOps brings a lot of benefits, many of which profoundly impact IT operations:



### Automation

DevOps process automates repetitive and error-prone manual tasks, significantly reducing the risk of human error and accelerating critical processes.



### Enhanced Security

DevOps integrates security practices throughout the development and deployment pipeline, leading to fortified security postures.



### Improved Efficiency

Through streamlined processes and the embrace of Infrastructure as Code (IAC) principles, IT operations teams can efficiently manage and scale infrastructure resources.



### Cost Efficiency

By optimizing resource utilization, DevOps leads to cost savings, ensuring that resources are utilized judiciously.



### Continuous Integration and Continuous Delivery (CI/CD)

DevOps facilitates CI/CD practices, allowing for the rapid and automated testing, integration, and delivery of software changes, ensuring a more streamlined and efficient development pipeline.



### Collaboration

DevOps fosters a culture of collaboration between development and operations teams, fostering better communication, shared goals, and effective problem-solving.

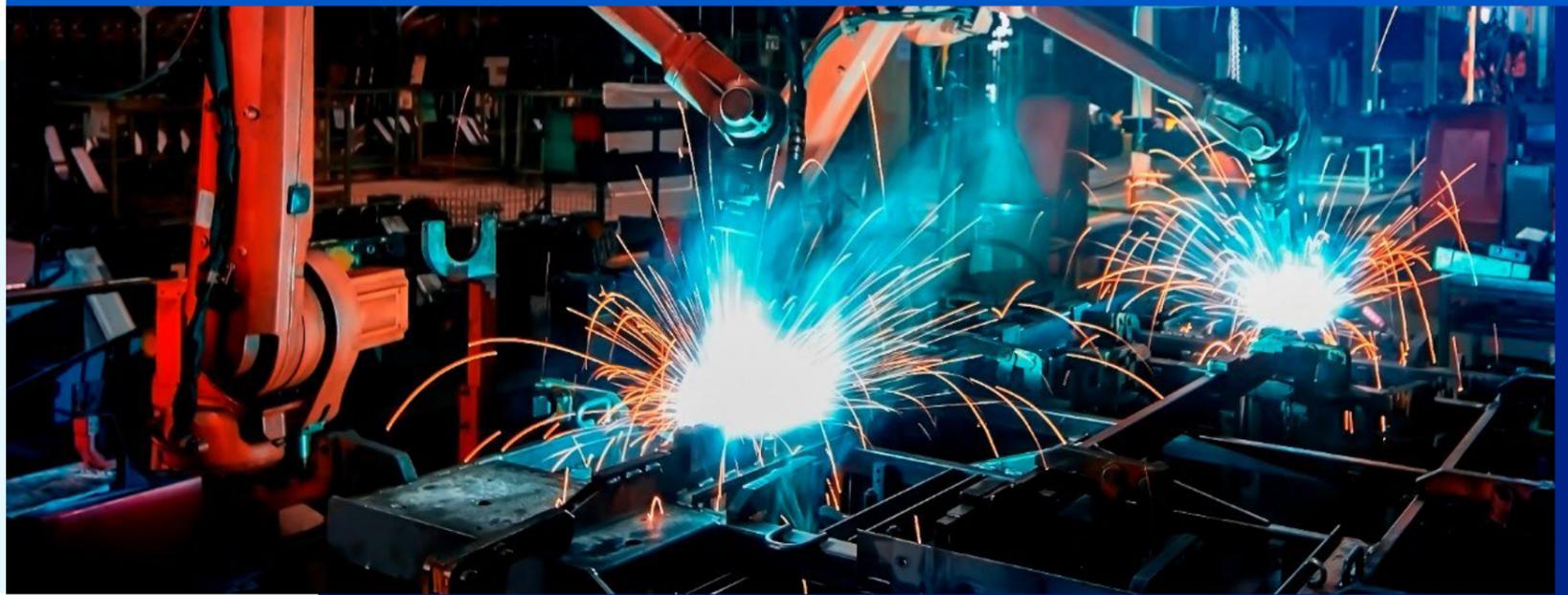


### Continuous Monitoring

DevOps advocates for continuous monitoring of applications and infrastructure, enabling proactive detection and resolution of issues before they wreak havoc on end-users.

# DevOps and Edge Computing

The rapid ascent of edge computing, projected to reach \$208 billion in spending in 2023 and soar to \$317 billion by 2026<sup>[1]</sup>, has ushered in a paradigm shift in the way data is processed and utilized. Unlike traditional cloud-centric approaches, edge computing positions computational resources closer to where data is generated. This architectural shift adds a new layer of complexity and opportunity for DevOps, necessitating a closer look at its relevance in the realm of edge environments.



## Challenges for DevOps at the Edge

The edge environment presents a unique set of challenges, distinct from the cloud-centric paradigms DevOps has been primarily designed for. These challenges include:

### Scale

Edge deployments can encompass a vast number of devices, each with its own unique requirements and constraints, ranging from tiny sensors to robust servers.

### Connectivity

Many edge devices operate in remote or intermittently connected scenarios, demanding specialized approaches to data transmission and communication.

### Location

Data sources and types vary by location and are often geographically distributed. This introduces a requirement to be able to place the right application with the right data set based on physical locational awareness.

### Diversity

Edge devices come in various forms, sizes, and capabilities, contributing to the need for tailored management solutions.

### Security

Ensuring the security of distributed edge nodes is paramount, given the diverse threat landscape and the criticality of the workloads running at the edge.

These challenges underscore the necessity for DevOps practices to adapt to the traits of edge computing environments. As the digital landscape evolves, the need for efficient and scalable management of edge computing environments becomes increasingly apparent.

<sup>[1]</sup> IDC Edge Computing Spending Guide 2023, <https://www.idc.com/getdoc.jsp?containerId=prUS50386323>

## The Emergence of DevEdgeOps

The convergence of DevOps and edge computing is not a coincidence – it is a strategic response to the evolving technological landscape. DevOps has proven its strength in streamlining software development and IT operations, while edge computing has brought about a fundamental shift in data processing and analysis. Together, they form the foundation for a groundbreaking approach – DevEdgeOps.



### DevEdgeOps Defined

DevEdgeOps is the seamless integration of DevOps principles and practices, with the unique challenges and opportunities presented by edge computing.

It is about adapting DevOps to fit the edge and harnessing the full potential of edge computing while leveraging the best practices of DevOps.



### Why DevEdgeOps Matters

The emergence of DevEdgeOps is driven by the recognition that the edge environment necessitates a holistic approach. Traditional DevOps practices, while highly effective in cloud-centric scenarios, fall short when applied directly to the edge. The “one-size-fits-all” approach no longer suffices in the face of the unique challenges posed by the edge, including scale, connectivity, security, and device diversity.

DevEdgeOps serves as the bridge that connects these two technological powerhouses, allowing organizations to benefit from the agility and automation of DevOps while navigating the intricacies of edge environments. As an example, let’s consider the DevOps concept “Shift Left” and its adaptation at the edge.



## Shift Left and DevEdgeOps



The “Shift Left” phenomenon revolutionized software development by moving activities traditionally performed mostly at the production stage to an earlier phase in the development lifecycle. DevEdgeOps embraces a similar paradigm. It brings operational tasks that were traditionally executed closer to the deployment phase into the earlier stages of edge application development. “Shift Left” approach in DevEdgeOps integrates activities such as network connectivity, security considerations, scalability planning, and edge deployment management into the development phase itself. This proactive strategy addresses potential challenges specific

to edge environments and minimizes operational friction, ensuring that applications are optimized for the unique characteristics of the edge environment from the outset. By incorporating key elements from the broader Shift Left concept, DevEdgeOps enables teams to comprehensively test code, including security checks, configuration updates, blast radius assessment, cost estimation, and policy enforcement, all in the early stages of development. This not only streamlines edge operations but also contributes to a more secure and efficient deployment process, echoing the overarching benefits of Shift Left in DevOps practices.

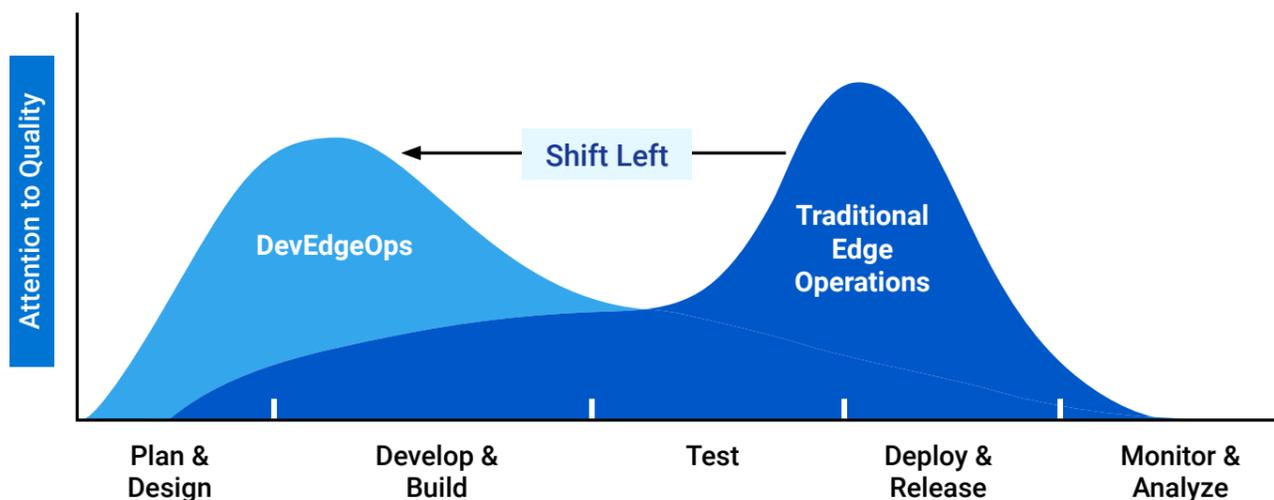


Figure 1: Similar to Shift Left in DevOps, DevEdgeOps focuses on pushing the operational challenges of edge computing to the development stage.

# Key Features

## for delivering DevOps at the edge with DevEdgeOps

To deliver DevOps at the edge, the edge platform needs to have a range of features:

**Edge simulation and testing** capabilities that empower developers to validate the functionality and performance of edge applications under a spectrum of edge-specific conditions, such as low-bandwidth networks, intermittent connectivity, and edge device failures.

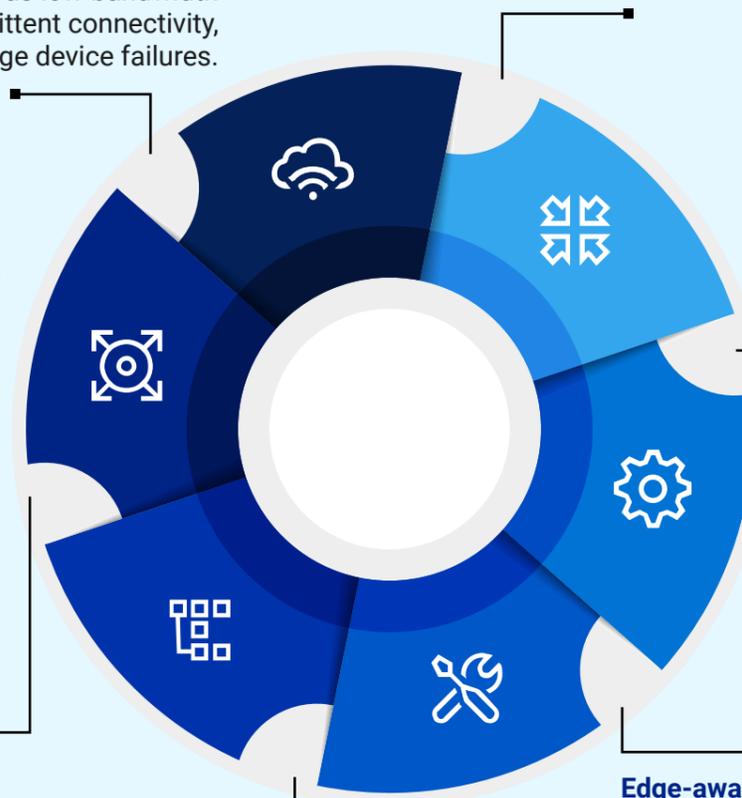
**Centralized management** offering centralized dashboards and APIs, facilitating real-time monitoring and efficient management of distributed edge nodes.

**Location-aware edge deployments** to inventory and monitor resources at various edge locations and deploy applications only when their resource requirements align with the available resources at a specific edge location.

**Integration with edge infrastructure** by seamlessly connecting development environments with edge infrastructure components to simplify deployment and scaling.

**CI/CD Pipelines for edge deployments** as automation is at the heart of DevEdgeOps platforms, allowing for the configuration of continuous integration and deployment (CI/CD) pipelines that consider the unique demands of edge environments.

**Edge-aware development tools** tailored for edge computing, including code editors, debuggers, simulators, and testing frameworks designed to optimize applications for edge scenarios.



# Delivering DevOps at the edge with Dell NativeEdge

Reimagining the approach to edge operations, Dell introduced NativeEdge. This innovative solution offers a simplified, automated approach to deploying, managing, and securing dynamic edge environments. Enabling better DevEdgeOps, Dell NativeEdge helps organizations to reduce operational complexity at the edge, maximize their edge investments, and enhance security.

Dell NativeEdge streamlines edge operations at scale through centralized management, secure device onboarding, zero-touch deployment, and automated management of infrastructure and applications. It paves the way for simplified, efficient, and consistent operations from the edge to the multicloud environment.

The platform optimizes edge investments by offering an open design that seamlessly integrates with various software applications, DevOps toolsets, IoT frameworks, multi-vendor operational technology (OT) solutions,



and multicloud environments. This not only reduces proof-of-concept development time but also delivers a consistent user experience across multiple hardware form factors and price points.

Security is a paramount concern in DevEdgeOps, and Dell NativeEdge ensures security from design to deployment and throughout the supply chain. By adhering to Zero Trust security principles, Dell NativeEdge protects applications, data, and infrastructure across the entire edge estate.

## Automation with Blueprints

Blueprints are at the core of automation with Dell NativeEdge. Think of a blueprint as a comprehensive, declarative automation plan that encapsulates the entire configuration required for deploying an edge solution. It combines critical components including application settings, infrastructure resources, network configurations, custom workflows, and scripts. Using a single command, developers or IT operators can deploy an application leveraging the blueprint

across many edge devices as well as across various development stages, from testing to production, by just inputting the relevant configuration details. Moreover, blueprints streamline day-2 operations, incorporating all post-deployment tasks such as configuration updates and service alterations within the solution stack. This simplifies the ongoing process of updates and day-2 operations, offering a significantly smoother and more streamlined DevOps experience at the edge.

## Automating Application Deployment with Blueprints

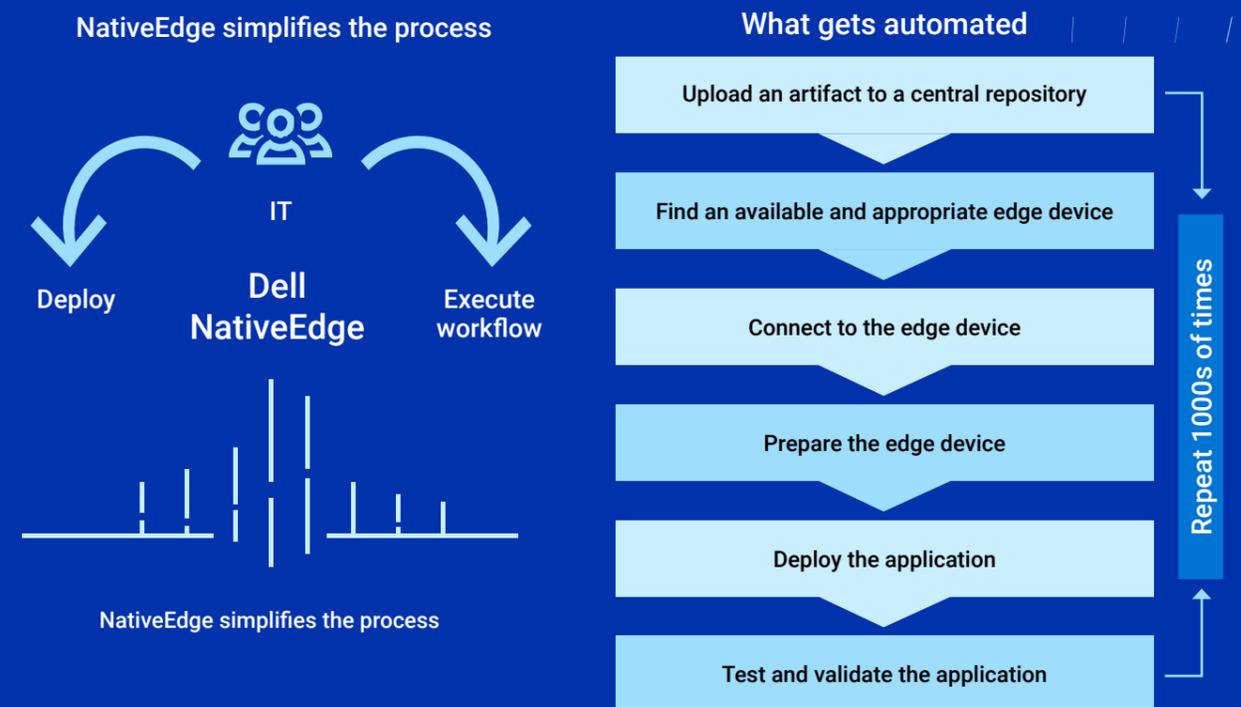


Figure 2: Dell NativeEdge application deployment automation by workflow execution.



With blueprints, Dell NativeEdge aligns with the DevEdgeOps paradigm and envisions fulfilling essential requirements through a three-step process:

## 01

### Importing existing edge resources

Dell NativeEdge facilitates application orchestration by incorporating existing automation scripts and modules. Users import these resources to create their blueprints within the Dell NativeEdge catalog, ensuring consistency in management and relationship mapping. Additionally, users have the flexibility to curate composite environments by integrating multiple resources into a unified custom blueprint.

## 02

### Planning and creating edge services

The platform seeks to empower developers or IT operators to effortlessly create and deploy new services from a selection of blueprints with a simple one-step installation workflow. This deployment process can potentially be initiated through various actions like REST API calls, user interfaces, CI/CD pipelines, or GitOps in upcoming releases.

## 03

### Provisioning and continuous updates

Dell NativeEdge ensures a seamless update workflow across diverse infrastructure resources, enabling tasks such as updating and/or adjusting existing stacks by adding or removing services. This holistic approach streamlines the in-place upgrades of resources, ensuring consistent and efficient management for the multitude of edge devices across different sites.

## Conclusion

DevEdgeOps represents a transformative new approach that strategically combines the speed and efficiency of DevOps with the unique challenges of edge computing environments. Adopting DevEdgeOps brings tangible benefits like streamlined operations, improved efficiency, and strengthened security. By integrating development, operations, and edge environments, organizations can unlock new potential and optimize complex edge deployments. Without this cohesive approach, organizations risk impeding progress amidst the intricacies of distributed edge networks.

Some may hesitate to undertake this shift due to perceived complexity or challenges in transforming established systems. However, early adopters gain a substantial competitive edge. They experience the advantages of rapid innovation, leading the way in maximizing edge computing while setting new standards for operational agility, security, and efficiency.

In contrast, organizations that fail to embrace DevEdgeOps may face unmanageable complexity, silos, and bottlenecks that restrict operational agility. The lack of integrated automation and processes can only lead to missed opportunities.

In an era of exponential data growth, DevEdgeOps provides the key to unlocking the full promise of the edge. Dell NativeEdge is the transformative edge operations software platform that reimagines the approach to edge operations by simplifying and securing dynamic edge environments, thereby maximizing edge investments while reducing operational complexity. This innovative solution from Dell integrates seamlessly into the DevEdgeOps landscape, providing essential features and addressing critical challenges, further enabling organizations to unlock the potential of edge computing and ensuring a cohesive approach between development, operations, and edge environments.

## Additional resources

### Webinar

#### How the Edge Breaks DevOps

[YouTube Link](#)

### Blog

#### How the Edge Breaks DevOps

[Link](#)

### Blog

#### DevEdgeOps Defined

[Link](#)

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