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Modern digital business strategies depend on microservices and cloud-native architectures. Large-scale operations across multiple clouds and clusters pose management challenges beyond what Kubernetes can manage on its own.

Digital Business Success Depends on Effective Multicluster Kubernetes Management

February 2021

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Digital Business Is Built on Containers and Kubernetes

IDC expects that by 2025, 57% of business and services will be delivered using digital infrastructure. Enterprises around the world are accelerating moves to online digital business as a result of pandemic restrictions, global economic disruptions, and ongoing uncertainty. Digital business transforms many aspects of market dynamics. Data about every aspect of business activity and interaction can be captured and analyzed. Applications can be created modularly and updated continuously. Customers, employees, and partners can collaborate on demand.

To enable these types of highly dynamic business activities, many organizations are investing in DevOps-driven innovation and microservices architectures to accelerate agile software development and take advantage of automated continuous integration/continuous delivery (CI/CD) toolchains to create and deploy digital business applications faster than ever. Increasingly, these solutions are being designed as cloud-native applications optimized for highly scalable container infrastructure orchestrated using Kubernetes. Fully 99% of organizations are using or evaluating the use of containers to support modern applications and microservices. Approximately 50% of containerized applications are net new, while the other half are existing applications that have been refactored or lifted and shifted to container platforms to improve scalability and portability.

IDC's research shows that worldwide, 97% of enterprises expect to take advantage of connected hybrid and multicloud infrastructure spanning both on-premises resources and one or more public cloud platforms to support these cloud-native applications. Depending on business priorities, each organization will make its own unique decisions about the best mix of infrastructure and application architectures that will optimize business agility, control costs, and maintain security. Moreover, 71% of organizations recognize the need for consistent cross-cloud management and automation to ensure effective application performance and business operations.

AT A GLANCE

KEY STATS

According to IDC research:

- 57% of business and services will be delivered using digital infrastructure by 2025.
- 97% of enterprises expect to use connected hybrid and multicloud infrastructure to support cloud-native applications.
- 99% of organizations are using or are evaluating the use of containers and microservices to enable future application development activities.

KEY TAKEAWAYS

The ability to consistently manage multiple, distributed container and Kubernetes clusters across diverse on-premises and public cloud platforms is crucial to digital business success.

Despite the rapid adoption of containers, many organizations are struggling to manage and secure them effectively. Only 15% of organizations surveyed by IDC have developed optimized or fully mature strategies for managing and taking full advantage of containers across the application life cycle.

As shown in Figure 1, organizations that are implementing containers and Kubernetes are finding that the provisioning, scaling, migrating, management, security, and control of container infrastructure across multiple clouds and multiple container clusters can be challenging, particularly as applications become more distributed and global. Organizations are particularly concerned about the impact on cloud cost management, workload placement decisions, adapting to new automation GitOps strategies built for containers, and maintaining security, compliance, and observability strategies.

FIGURE 1: ***Top Cloud Management Challenges Resulting from Use of Containers and Kubernetes***

n = 409

Source: IDC's Cloud Pulse Survey, 1Q20

Multicluster Kubernetes Management Ensures Consistent Security, Performance, and Control

Software containers are an operating system (OS) virtualization technology, similar in concept to hypervisors except they abstract an OS instead of server hardware. Each application is presented with a pristine virtual copy of the OS, and the application is made to believe that it is the only application installed and running on that OS. Because each container can operate in isolation from another, developers can use containers to modularize development using microservices and work on each microservice individually. Rather than being patched and updated while running, containers are simply

terminated, and new updated containers are launched as needed to introduce new functions or to repair performance problems. This allows for the rapid scaling and deployment of updates in a consistent manner across a cluster.

Developers can run hundreds of small containers on a laptop, and CI/CD automation tools can manage testing, integration, and deployment at scale. To run many containers in production requires sophisticated orchestration and automation. From an operational perspective, individual containers are generally grouped into pods, and the underlying infrastructure supporting the pods is managed by a container orchestrator. Kubernetes, an open source container orchestration technology, has been widely adopted across the industry and is supported by many on-premises distributions and public cloud container services. Kubernetes automatically manages container service discovery, incorporates load balancing, tracks resource allocation, and scales container deployments based on compute utilization. It also checks the health of individual resources and enables apps to self-heal by automatically restarting or replicating containers.

Kubernetes is focused on managing individual clusters. It is not designed to control multicluster operations or security. As a result, as use of containerized applications increases, many enterprises are adopting multicluster Kubernetes architectures that allow each cluster to be configured to meet specific local configuration, compliance, and performance requirements as needed in different physical locations, geographies, and clouds.

Multicluster architectures allow better alignment of security and operational policies with different application and business needs, but they also pose a number of operational challenges. Specifically:

- **Ensuring container image security and compliance across multiple clusters.** Containers allow for rapid deployment of changes to applications but also carry a risk that corrupted code will be unintentionally distributed far and wide. Enterprises need to be able to validate, curate, and constantly audit code as it is broadly distributed and customized for the needs of specific locations.
- **More complex network and enterprise infrastructure architectural decision making about where to deploy workloads across on-premises and hosted datacenters, public clouds, and edge locations.** Organizations need to be able to balance latency, availability, cost, and compliance demands to optimize business outcomes and application service-level agreements (SLAs).
- **Consistently configuring and securing the servers and underlying infrastructure used to support container platforms so that containerized code will be able to run as expected when deployed to physically diverse platforms.** Consistent operational policies, configuration templates, and provisioning workflows are required.
- **Fragmented visibility into the end-user experience, end-to-end transaction throughput, and operational dependencies and workflows.** Organizations need to transform governance, automated workflows, observability, and operational reporting capabilities to maintain comprehensive oversight on mission-critical SLAs and key performance indicators (KPIs).

Multicluster Kubernetes management is an emerging technology area that specifically enables policy-based operations and consistent control across multiple Kubernetes clusters, whether they are deployed on premises, in public clouds, or at the edge. Effective multicluster Kubernetes management must be a priority for organizations that are building out cloud-native, agile DevOps programs for business transformation.

Evaluating Multicluster Kubernetes Management Solutions

As use of containers has expanded, many organizations have relied on ad hoc approaches for cross-cluster coordination or have opted to manage each cluster independently. These approaches create operational risk because of configuration errors and potential security breaches. In addition, application performance suffers when clusters face capacity limits and multiple applications compete for resources or are impacted by latency.

Multicluster Kubernetes management solutions help ensure consistent configuration, security, and compliance management at scale across multiple on-premises and cloud-based infrastructure platforms. Some of the most important capabilities enterprises should evaluate are as follows:

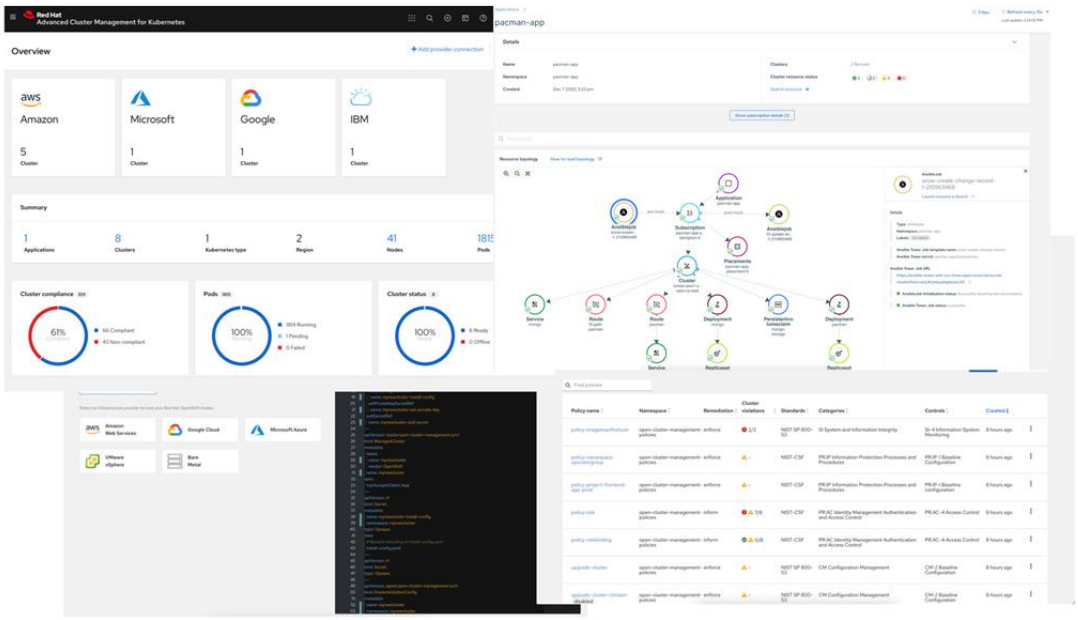
- Provide a single unified view to discover, define, provision, update, and destroy clusters consistently regardless of whether the clusters are running in physical, virtual, and private cloud and public cloud environments or at the edge
- Centrally set policies to automatically configure and maintain consistency of security controls required by regulatory, industry, or corporate standards (Users should be able to enforce compliance policies with each new cluster, allowing their fleet to remain compliant with governance or corporate standards as it grows.)
- Provide in-depth, on-demand access to and reporting on compliance posture and change control
- Automate application deployments using placement policies that are integrated into existing CI/CD pipelines, infrastructure automation tools, and governance controls
- Aggregate observability metrics for reporting and in dashboards to monitor and optimize the health of containers, pods, and clusters
- Provide deep integration with existing Kubernetes platforms and cloud service control planes
- Consistently support Kubernetes clusters regardless of where they are deployed, including on-premises virtual machine (VM) and bare metal platforms and a range of public cloud services

Each organization will need to evaluate existing skills and tools and determine how to best implement multicluster management strategies. In many cases, organizations that expect to rely on open source Kubernetes management solutions will find that these technologies are not optimized for secure, enterprise-scale operations and are not designed for reliable, large-scale multicluster management. Vendor-supported open source technologies often provide a faster path to value while reducing the level of in-house time and talent that needs to be assigned to support and continuously update the tool itself.

Red Hat Advanced Cluster Management for Kubernetes Overview

Red Hat Advanced Cluster Management (ACM) addresses the runtime management needs of multicluster Kubernetes environments by providing unified, policy-based governance across clusters, regardless of where they are deployed. Rather than requiring customers to manually align infrastructure configuration and management across different clusters, Red Hat ACM provides a single control plane for consistent, secure configuration and hybrid multicloud multicluster operation (see Figure 2). The control plane enables automated infrastructure discovery, provisioning, inventory, and tagging as well as support for predefined configuration code, GitOps templates, and policy-based governance.

FIGURE 2: ***Red Hat ACM***



Source: Red Hat, 2021

For organizations that are struggling to standardize, secure, and scale multicluster Kubernetes clusters, ACM addresses the following use cases:

- **Unified multicluster management.** Organizations can create, update, and delete Kubernetes clusters across multiple private and public clouds. ACM is able to search, find, and modify any Kubernetes resource across the entire domain and quickly troubleshoot and resolve issues across federated domains.
- **Policy-based governance, risk, and compliance.** ACM allows organizations to set and enforce policies for security, applications, and infrastructure in order to visualize detailed auditing on configuration of apps and clusters and gain visibility into compliance posture based on defined standards.

- **Advanced application life-cycle management.** By defining and deploying applications across clusters based on policy, IT organizations can view service endpoints and pods associated with application topology and dependencies. In addition, organizations can automatically deploy applications to specific clusters based on channel and subscription definitions and automate day 2 configurations such as networking and databases via integrations with Red Hat Ansible Automation Platform.
- **Multicluster observability for health and optimization.** ACM can provide organizations with an overview of multicluster health and optimization, including the ability to store long-term data as well as easily sort, filter, and do a deep scan of individual clusters at the aggregated multicluster level. Organizations can also gain an aggregated view of cluster metrics and supporting troubleshooting including integrations with Grafana dashboards.

Red Hat ACM is optimized for Red Hat OpenShift Platform. The Red Hat ACM user interface integrates with the Red Hat OpenShift management console, and ACM will run as an application on Red Hat OpenShift, regardless of where Red Hat OpenShift is physically deployed. ACM is updated by OpenShift Operators. Red Hat has committed to open sourcing ACM in order to promote ongoing industry innovation in the area of multicluster Kubernetes management.

Challenges

IDC's research shows that successful digital innovation and application modernization depend as much on people and process updates as they do on technology. Organizations that are committed to multicluster architectures need to develop collaborative decision-making strategies that reach across line-of-business, development, and technology teams to focus on how to best optimize end-to-end application performance, cost, and security using containers, automation, and observability.

Red Hat offers customers powerful technology for multicluster operations. However, to be successful, Red Hat customers will need to align on standard policies across all Kubernetes resources. To the extent that Red Hat can help customers modernize standards, policies, and operational models, the company can become an important partner in the evolution of customer DevOps and application modernization efforts.

Next Steps for Large-Scale Multicluster Kubernetes Management

IDC expects that enterprise adoption of cloud-native applications based on containers and Kubernetes will continue to increase in the coming years. The container clusters will be deployed across a range of physical infrastructure and geographic locations.

Simultaneously, modular, microservices-based application architectures enabled by containers will mean that mission-critical applications change more frequently and require increasingly dynamic access to on-premises and public cloud computing infrastructure. The end-user experience will depend on the smooth and continuous integration of many distributed application services and containers, with operations coordinated across multiple clusters.

Maintaining consistent security, performance, and control across multiple Kubernetes platforms will be critical to ensuring business resiliency and agility in the age of modern cloud-native applications and DevOps-driven software innovation. IDC believes that consistent, policy-based multicluster management will be required for effective business

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operations going forward. Organizations that are exploring or deploying containers at any level of enterprise scale will need to quickly grapple with the challenges of multicluster management and invest in appropriate tools, skills, and process updates in order to ensure application performance.

About the Analyst

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Mary Johnston Turner is Research Vice President for Cloud Management, part of IDC's Infrastructure and Operations Management software research team. Her research focuses on emerging software and solutions for cloud, container and DevOps IT operations, cost optimization, automation, performance, and analytics. She contributes to vendor analysis as well as enterprise IT buyer advisory and custom consulting activities.

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Learn more about Red Hat Advanced Cluster Management for Kubernetes: ***https://www.redhat.com/en/technologies/management/advanced-cluster-management***

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