The Innovation Leader's Guide to Navigating the Cloud-Native Container Ecosystem

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Initiatives: Technology Innovation

Cloud-native technologies are evolving to encompass a broad set of technologies, projects and vendors. Enterprise architects and CTOs can use this research to assess this ecosystem's technologies and vendors, as well as create robust strategies to accelerate their digital transformation.

Overview

Impacts

- Container platform technologies are rapidly proliferating, creating an ecosystem of new open-source projects, products and vendors that enterprise architecture/technology innovation leaders find difficult to navigate.
- Kubernetes platform vendors are broadening their portfolios, but making diverse bets across the technology stack and use cases, which complicates platform selection decisions.

Recommendations

EA/TI leaders, including CTOs driving business transformation through technology innovation, should:

- Create a weighted decision matrix for selecting a container platform by considering the factors outlined in this research, along with other key criteria to ensure that objective decisions are made.
- Standardize on consistent platforms, to the extent possible across use cases, because this enhances architectural consistency, democratizes operational know-how, simplifies developer workflow and provides sourcing advantages.

- Map your functional requirements to the container management platforms and identify any gaps that can be potentially filled by open-source projects and products outlined in this research for effective deployments.
- Reduce the risks of working with startups through constant communication and feedback on product quality, support issues and functionalities desired.

Strategic Planning Assumptions

By 2026, more than 90% of global organizations will be running containerized applications in production, which is a significant increase from fewer than 40% in 2020.

By 2026, 20% of all enterprise applications will run in containers, which is an increase from fewer than 10% in 2020.

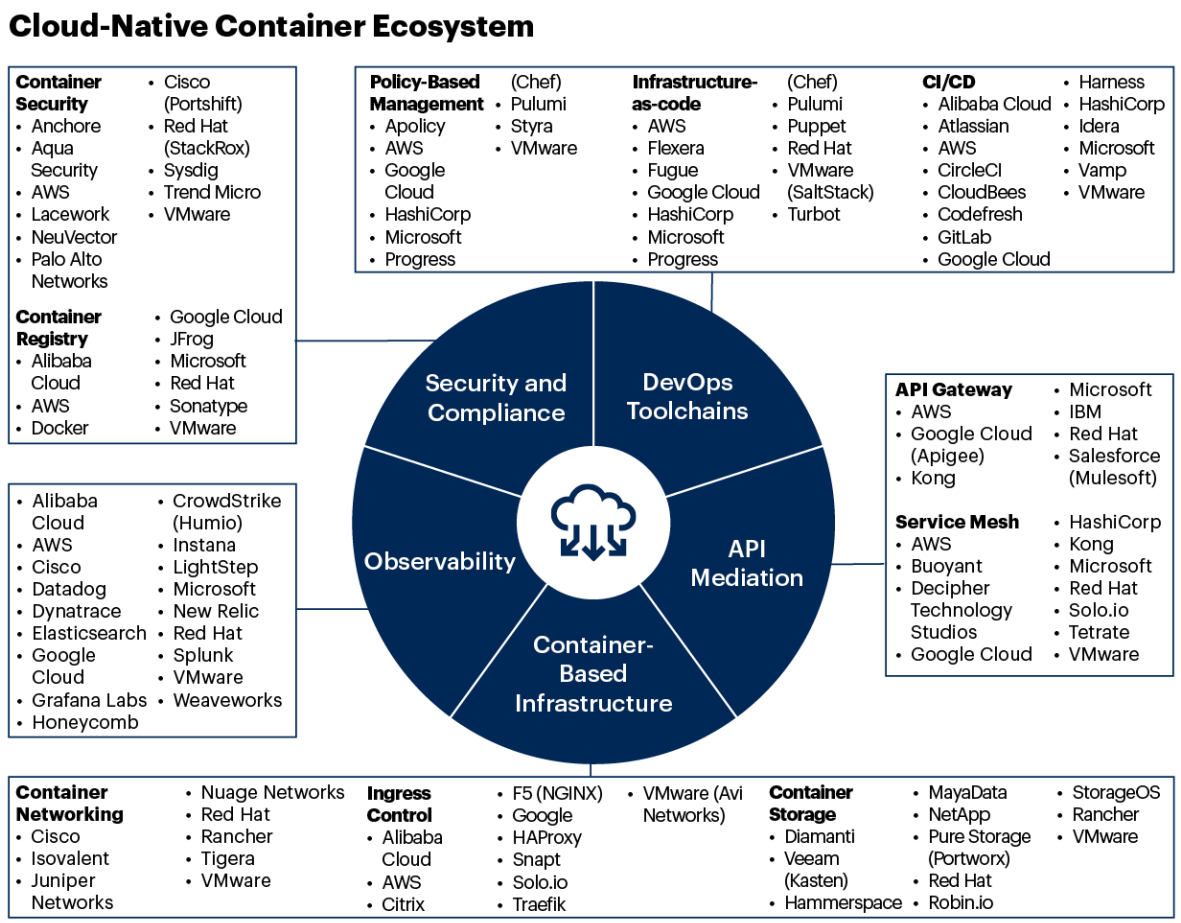
By 2026, more than 50% of commercial OSS vendors in the container ecosystem will offer their software as SaaS.

Introduction

Cloud computing technologies are becoming the foundation of digital business platform strategies. Innovation leaders, such as enterprise architecture (EA) leaders and CTOs, are being measured on their ability to modernize application environments, enhance software velocity and nurture a collaborative culture that emphasizes innovation and agility. Containers and Kubernetes are becoming popular technologies for cloud-native applications and have significantly grown in adoption during the past five years. Gartner estimates that more than one-third of enterprises are running containerized workloads in production and nearly 10% of total workloads run on containers today.

Despite the apparent progress, the container ecosystem continues to be chaotic, fast paced and fragmented. This makes it difficult for EAs and CTOs to build robust cloud-native architectures and institute operational governance. Containers are not a monolithic technology; however, the ecosystem is a hodge podge of several components vital for production readiness. The key technology categories of a container ecosystem are summarized in the chart below:

Figure 1: Cloud-Native Container Ecosystem



Source: Gartner
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Gartner

Impacts and Recommendations

Proliferating Container Platform Technologies Have Created an Ecosystem of Open-Source Projects, Products and Vendors

The containerized platform architecture has several components. At its foundation is a container runtime that enables developers to deploy applications, configurations and other dependencies in a container image. The most common container engines are Containerd (originated from Docker) and CRI-O.

Container orchestrators include capabilities for policy-based deployment, managing application configuration, ensuring highly available cluster resources and integrated containers with the rest of IT infrastructure tools. The most common orchestrators are Kubernetes (which is the most widely deployed and supported), Amazon ECS and HashiCorp Nomad.

Container management platforms take this to the next level by providing management console, automation features and developer tools. They integrate many components vital for running containerized workloads in production. The Cloud-Native Computing Foundation (CNCF) is the governance body that hosts several of the open-source projects in this space. Table 1 summarizes the key architectural components of a container management platform (beyond container runtime and orchestrators), so that EAs and CTOs are aware of the choices for making informed decisions.

Table 1: Container Management Platform Components

(Enlarged table in Appendix)

Container Technology/Market Category	*What Is It?*	*Key OSS Projects*	*Sample Vendors*
Networking	Software that manages communication inside the container pod, between container clusters, and from the outside world. Incumbent network vendors and cloud service providers (CSPs) offer CNI plug-ins that integrate with their cloud platform and networking products and offer capabilities such as policy management and multitenancy.	Antrea, Calico, Container Network Interface (CNI), Cilium	Tigera, Isovalent, Cisco, Juniper Networks, SUSE (Rancher), Red Hat, VMware
Storage	Container native storage products deliver granular data services, high availability and performance for stateful applications with deep integration with the container management systems.	Container Storage Interface (CSI), Longhorn, OpenEBS, Rook	Diamanti, Hammerspace, MayaData, NetApp, Pure Storage (Portworx), Red Hat, Robin.io, StorageOS, SUSE (Rancher), Veeam (Kasten), VMware
Ingress control	This component functions as the network communications gatekeeper of a container orchestration cluster. All inbound traffic to services running inside the cluster must pass through the ingress gateway.	Envoy, Contour, Traefik	Alibaba, Amazon Web Services (AWS), Citrix, F5 (NGINX), Google, HAProxy, Snapt, Traefik, VMware (Avi Networks), Solo.io
Observability	Observability tools enable a skilled observer — a software developer or site reliability engineer (SRE) — to effectively explain unexpected system behavior	Elastic Stack, Fluentd, Grafana, Jaeger, Kiali, Open Telemetry, OpenTracing, Prometheus, Zipkin	Alibaba, AWS, Cisco, Datadog, Dynatrace, Elasticsearch, Google, Grafana Labs, Honeycomb, CrowdStrike (Humio), Instana, LightStep, Microsoft, New Relic, Red Hat, Splunk, VMware, Weaveworks
Security and Compliance	Container security starts in development with an assessment of the risk/trust of the content of the container, secrets management and Kubernetes configuration assessment. It also extends into production with runtime container threat protection and access control.	Clair, Falco, HashiCorp Vault, Trivy	Anchore, Aqua Security, AWS, Cisco (Portshift), Google, Lacework, NeuVector, Palo Alto Networks, Rapid7, Red Hat (StackRox), Sysdig, Trend Micro, VMware
Policy-Based Management	Policy-based management tools allow IT organizations to express IT requirements programmatically, which is critical for ephemeral, container-based environments. The automation toolchain can then enforce these policies automatically.	Open Policy Agent (OPA), Gatekeeper	Apolicy, AWS, Google, HashiCorp, Progress (Chef), Pulumi, Styra, VMware
Registry	Container images and associated deployment manifests need to be managed and version-controlled. Registry services offered by public cloud providers are fully managed, while private registries incur greater management overhead, but they can reside in a private network, typically resulting in better performance than you would expect from a remote registry.	Harbor, Quay	AWS, Docker, Google, JFrog, Microsoft, Red Hat, Sonatype, VMware
Infrastructure as Code (IaC)	IaC is the creation, provisioning and configuration of compute, network and storage infrastructure as source code. IaC is a foundational requirement to scale infrastructure automation in containerized environments.	Ansible, Chef, Puppet, SaltStack, HashiCorp (Terraform)	AWS, Flexera, Fugue, Google, HashiCorp, Microsoft, Progress (Chef), Pulumi, Puppet, Red Hat, VMware (SaltStack), Turbot
Continuous Integration/Continuous Delivery (CI/CD)	The CI/CD approach enables DevOps teams to create an automated pipeline for producing software in short cycles.	Argo, Concourse, Jenkins, Jenkins X, Tekton, Spinnaker	Atlassian, AWS, CircleCI, CloudBees, Codefresh, GitLab, Google, Harness, HashiCorp, Idera, Red Hat, Vamp, VMware
API Gateway	API gateways enforce policies around operational management, security, format translation and analytics for the collection of business and technical metrics associated with API use.	Ambassador, Gloo, WSO2	Kong, AWS, Microsoft Azure, Google (Apigee), Mulesoft, IBM (Red Hat)
Service Mesh	Service mesh is a distributed computing middleware that optimizes communications among application services, especially in microservices architecture. Microservices require a distributed middleware that optimizes service-to-service communications (e.g., dynamic discovery and self-healing connections) in a secure, dynamic and reliable fashion, which is what service mesh enables.	Envoy, Istio, Linkerd, Open Service Mesh, Zuul, Service Mesh Interface	AWS, Buoyant, Decipher Technology Studios, Google, HashiCorp, Kong, Microsoft, Red Hat, Solo.io, Tetrate, VMware

Source: Gartner (August 2021)

Recommendations:

- Map your functional requirements to the container management platforms and identify any gaps that can be potentially filled by open-source projects and products outlined in this research for effective deployments.
- Start with the embedded capabilities that your platform vendors provide. Most platform vendors operate on a “batteries included” model, where they provide foundational capabilities. Augment with open-source projects or commercial startups on an as-needed basis.
- Choose open-source projects carefully, based on software release history, permissiveness of software licensing terms, and vibrancy of community, characterized by a broad ecosystem of supported vendors.
- Startups can deliver innovation in advance of established vendors, but carry risks. Reduce the risks of working with startups by evaluating their viability and through constant communications and feedback to them on product quality, support issues and functionalities desired.

With Broadened Portfolios, Kubernetes Platform Vendors Are Making Diverse Bets Across the Technology Stack and Use Cases

Several components make up a container platform. Large vendors integrate these components as a cohesive unit. There are two main types of container platform vendors:

- Hyperscale cloud providers offer integrated cloud infrastructure and platform services (CIPS) capabilities that allow users to develop and operate cloud-native applications with a unified environment. Almost all of these providers can deliver an effective experience only within their public cloud environments; however, they also offer hybrid and multicloud solutions to cater to growing customer needs beyond a single provider environment. Key cloud providers include Alibaba Cloud, AWS, Google cloud, Microsoft Azure, Oracle Cloud, IBM Cloud and Tencent.
- Software vendors offer platform software that can be used to deploy a private IT or public cloud service. Vendors in this category offer on-premises, edge solutions and may offer either marketplace or managed services offerings in multiple public cloud environments. Key software vendors include Red Hat, VMware, SUSE (Rancher), D2IQ, Mirantis, Diamanti, HashiCorp (Nomad), Hewlett Packard Enterprise (HPE). There are MSP style offerings here from vendors such as Giant Swarm, Platform9 and Rafay.

The following factors are becoming a critical determinant in choosing the right platform provider:

1. Distributed cluster management
    1. Hybrid and multicloud
    2. Edge optimization
    3. Support for bare metal
2. Application modernization
    4. Developer tools
    5. Service mesh support
    6. Windows container support
3. Open-source commitment
4. Pricing

The container platform vendors outlined in Table 2 are the most commonly referenced ones in Gartner client inquiries — hence, deserve a more-detailed comparison.

Table 2: Container Platform Vendors

(Enlarged table in Appendix)

Selection Factor	AWS	Google Cloud	Microsoft Azure	Red Hat (IBM)	SUSE (Rancher)	VMware
On-Premises	Amazon ECS Anywhere, Amazon EKS Anywhere, EKS Distro (Self-supported)	Anthos	AKS on Azure Stack Hub and AKS on Azure Stack HCI	OpenShift Subscriptions — OKE, OCP and OpenShift Plus	RKE	TKG, TAS
Multicluster management for Hybrid Cloud	Amazon ECS Anywhere, Amazon EKS Anywhere	Anthos Fleet Multi-cluster management, Anthos config management	Azure Arc	Red Hat Advanced Cluster Management	Rancher Management Server	Tanzu Mission Control
Multicloud	N/A	Multicloud support for Anthos on AWS, Anthos on VMware and bare-metal. Anthos on Azure is in preview. In addition, management support for EKS, AKS clusters	Azure Arc for Kubernetes supports conformant Kubernetes clusters, including managed services running in other clouds. Certified support for Kubernetes distributions from Canonical, Nutanix, Rancher, Red Hat, and VMware	OpenShift Dedicated on AWS and Google Cloud Platform (GCP); native managed service on AWS and Azure	Cluster life cycle management for RKE, EKS, AKS and GKE clusters	Support for both own and conformant Kubernetes clusters including EKS, AKS, GKE and OpenShift clusters
Managed Cloud Services	ECS, EKS	GKE, including GKE autopilot	AKS	OpenShift Dedicated on AWS and GCP. Native managed service on AWS and Azure	Hosted Rancher provides managed Rancher Management Server	NA
Edge	AWS IoT Greengrass; ECS/EKS on Wavelength; Amazon ECS Anywhere	Anthos at Edge	Azure IoT Edge	OpenShift — three-node configuration	K3s (Light weight distribution for edge)	TKG can be deployed on edge
Bare-Metal Support	Yes	Anthos clusters on bare metal	Yes on Azure Arc	Yes	Yes	No Kubernetes runtime provided, but bare-metal management on TMC.
Dev Tools	Marketplace, AWS CodeBuild, AWS CodePipeline, AWS Copilot, AWS CodeDeploy	Marketplace, Cloud Build, Cloud Code (IDE for K8S Apps), and Cloud deployment manager	Marketplace, Azure DevOps, GitHub Actions for AKS, Support for major IDE engines	Developer console, CodeReady Workspaces (IDE), Red Hat Runtimes, Red Hat Marketplace, OpenShift Pipelines and OpenShift GitOps	App catalog, Fleet (GitOps CD)	Bitnami Marketplace, Tanzu Build Service, Tanzu Data Services Spring Cloud Services
Service Mesh	AWS AppMesh — Envoy based; Hosted control plane (Proprietary)	Anthos Service Mesh (Envoy and Istio based) — available on Anthos and GCP	No GA product; Open Service mesh is in preview	OpenShift Service Mesh (Istio and Envoy-based)	Istio	Tanzu Service Mesh (Envoy and Istio-based)
Windows Support	Yes	Yes	Yes	Yes	Yes	Only supported in TKGi and TAS.
Open Source	ECS is proprietary, EKS is CNCF Conformant. EKS Distro is an OSS distribution but AWS doesn't provide support directly for it.	CNCF conformant distribution	CNCF conformant distribution	CNCF conformant and upstream release is OpenShift Kubernetes Daemon (OKD) available under Apache 2.0 license.	CNCF conformant and fully open source under Apache 2.0 license	CNCF conformant distribution

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Recommendations:

- Strive to standardize on a consistent platform, to the extent possible across use cases, because this enhances architectural consistency, democratizes operational know-how, simplifies developer workflow and provides sourcing advantages.
- Create a weighted decision matrix by considering the factors outlined above, along with other key criteria to ensure an objective decision is made.
- Prioritize developers' needs and their inherent expectations of operational simplicity, because any decision that fails to prioritize the needs of developers is bound to fail.

Evidence

Detailed briefings were conducted with most vendors represented in this research. In addition, the co-authors handled more than 1,000 client inquiries and other interactions on this topic during the past 12 months.

Gartner Container Survey, 2020.

Recommended by the Authors

Some documents may not be available as part of your current Gartner subscription.

CTO's Guide to Containers and Kubernetes — Answering the Top 10 FAQs

Market Guide for Container Management

Solution Path for Implementing Containers and Kubernetes

Best Practices to Enable Continuous Delivery With Containers and DevOps

A CIO's Guide to Serverless Computing

A CTO's Guide to Top Practices for Open-Source Software

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