

VISION REPORT

The Future Of Cloud

Cloud Becomes Abstracted, Intelligent, And Composable

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Summary

Over the past decade, cloud-native technologies have transformed enterprise IT. In the next decade, we'll see the rise of the intelligent composable cloud. Customers will compose their own clouds — not only for IT but also for operational technology (OT), commercial, and consumer cloud capabilities — and cloud providers will adapt by allowing users to compose services by industry, role, and use case. This report examines the technological changes giving rise to the abstracted, intelligent, and composable cloud and helps technology leaders plot their cloud strategies for the future.

Multiple Technologies Will Converge To Transform Cloud

From 2007 to 2015, at-scale implementations of virtualization technologies, first used in customer data centers, dominated public cloud's first phase. The years 2015 to 2022 saw the eclipse of the cloud "as a service" and the rise of open source cloud-native technologies — centrally, Kubernetes — that mitigated dependencies on hyperscale cloud providers. The third phase will move us toward abstracted, intelligent, and composable cloud, in which AI and automation will allow users to create and curate integrated services running in public cloud, in software as a service (SaaS), on-premises, and at the edge.

With Kubernetes at the helm, this transition has already begun. Enterprises are embracing the Kubernetes cloud-native ecosystem to transform applications, optimize workload placement, and innovate within an active community. These transformations are underway to set the stage for a modern cloud reality, all powered by the cloud-native revolution (see Figure 1):

- **Architecture modernization.** Early waves of adoption cloudified legacy IT, shortchanging the value of cloud as the architectural and operational constraints of the past continued to handcuff it. A 10-year journey to application modernization has begun atop cloud-native services; the interim state blends the old and new. This approach to modernization, i.e., cloud-native abstractions, infuses workload affinity across the IT estate, from edge to data center to public cloud and SaaS. With the flexibility to adapt as necessary, standardized but composable Kubernetes platforms enable enterprise architects to closely align technology to organizational need.
- **Workload decentralization.** Cloud absorbed data center workloads, giving organizations scale and relief from the operational burdens and expense associated with data centers. But organizations didn't always realize the financial benefits they expected, and data gravity and sovereignty concerns posed barriers to complete centralization on cloud. Edge added another layer to this hybrid reality. Cloud-native assuages these challenges by allowing modernized apps to run anywhere, from cloud to edge, and with apps, data processing, and storage in alignment with technology needs and regulatory requirements.
- **Platform driven innovation.** Microprocessors profoundly disrupted mainframe computing decades ago by decentralizing compute with PCs and placing apps in the hands of individuals. Cloud-native is another watershed. [Kubernetes facilitates experimentation and investment](#) in emerging and established technologies on its

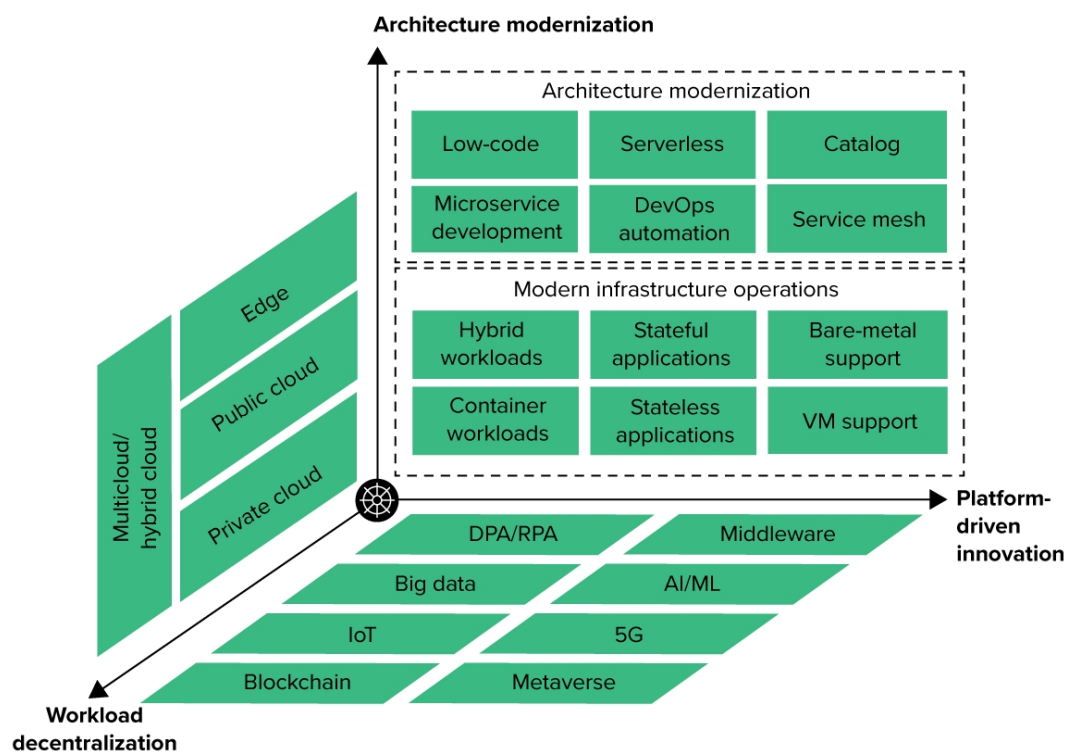
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platform, lowering the barrier to acquiring new technologies and testing it in preestablished landing zones. This spans automation, AI/ML, IoT, 5G, metaverse precursors, and more.

Figure 1
Kubernetes Drives Cloud-Native Innovation Today



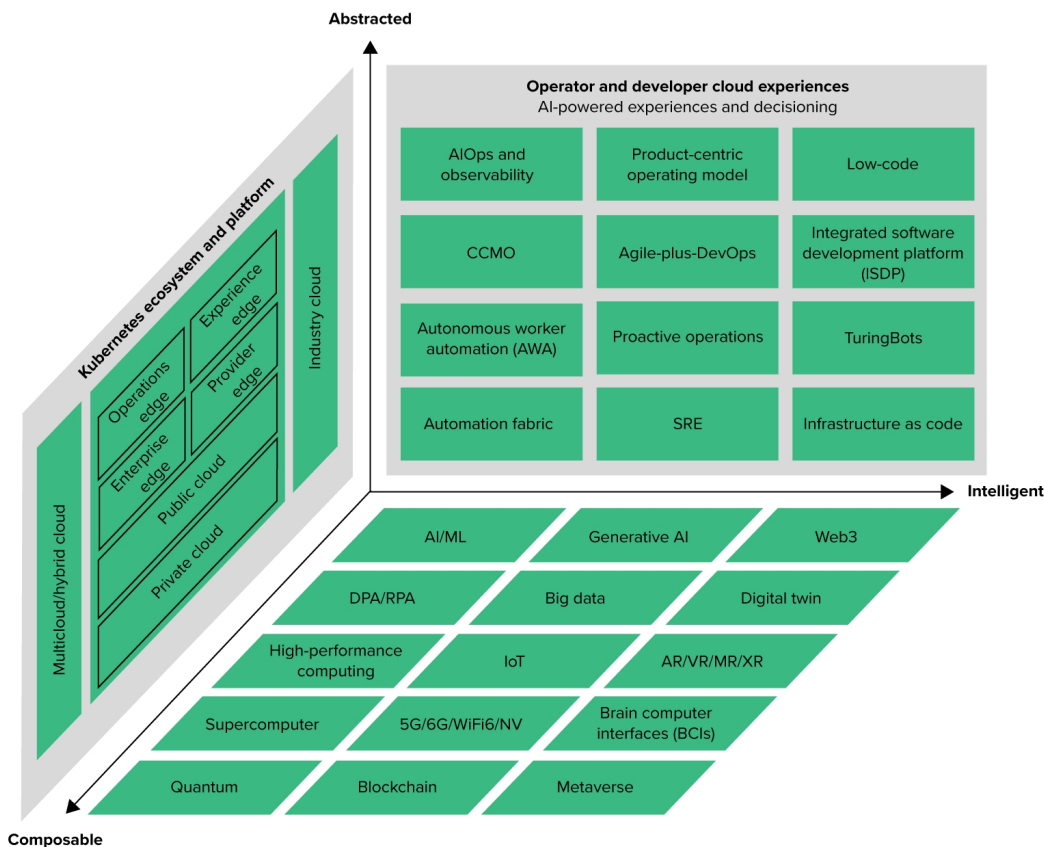
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The Future Is Abstracted, Intelligent, And Composable

The future holds an abstracted, intelligent, and composable cloud (see Figure 2). Cloud platforms will be polycentric, spanning multiple clouds, general and industry-specific cloud services, microdata centers, hybrid, and edge infrastructure along with application services and integrations that users create or curate. This flexibility will accommodate legacy IT such as mainframe and address security, regulatory, and data sovereignty requirements. Higher levels of abstraction will emerge based on collections of services that create quasi platforms to use across clouds, data center, and edge.

Intelligence will suffuse cloud services at every level, enabling a greater focus on outcomes. And the proliferation of Kubernetes platform capabilities and community creations (e.g., automation, extensions, and GitOps) will offer a substantial degree of composability of cloud services — all on the platforms you want and in the experiences you need. Some of this will be via your own composed collection, but increasingly, prebuilt or fully finished platforms based on cloud-native technology will cater to your industry or role.

Figure 2
The Future Of Cloud Is Abstracted, Intelligent, And Composable



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The Transformation Has Already Begun

Each aspect of this future state has already begun. The permeation of generative AI in cloud services and the generalization of Kubernetes-based cloud-native infrastructure have initiated the abstracted, intelligent, composable cloud.

- **Abstracted: independence from infrastructure and hidden complexity.** Cloud freed enterprise compute from the constraints of individual data centers but not from the relatively standard x86 architecture. The rise of ARM, GPU, and other custom cloud-provider silicon, as well as limited-compute edge platforms, counters this standard for the first time. Virtualization, containers, infrastructure as code (IaC), multicloud container platforms, and functions-as-a-service (FaaS) serverless further abstract away from infrastructure. Complexity is similarly abstracted to some extent via low-code, integrated software development platforms, IaC, templates, and multicloud container platforms.
- **Intelligent: automation and AI to enable smart ops and higher value work.** Enterprises commonly use public cloud to gain business intelligence via AI/ML. More recently, AI has helped optimize cloud operations and decisioning with intelligence in both the platform and surrounding management tooling. The advent of large language models and generative AI, paired with automation, has started to reshape platform operations and free up developer and operations time.
- **Composable: same-platform composability with cross-cloud via cloud-native.** The rise of the Kubernetes-based cloud-native ecosystem enabled users to compose their own cloud by drawing directly from open source and hosting in the cloud or clouds of their choice. Those choosing to do so, however, were few, given the complexity involved. Today, most organizations seeking flexibility build on multicloud container platforms (MCPs) or create federated platforms that include MCPs and cloud providers' Kubernetes platforms. The major hyperscalers offer marketplaces to bring services from other independent software vendors (ISVs) and global systems integrators (GSIs) into their platforms. Early signs of industry cloud have started to appear in the form of industry-specific resources, with case studies and limited architectural examples, on hyperscaler websites.

Everything Depends On Capital, Politics, And Tech Expansion

Per respondents to [Forrester's Infrastructure Cloud Survey, 2022](#), the average enterprise spent nearly \$33 million on public cloud in the previous 12 months. For some organizations, cloud spend exceeded \$250 million last year. This puts Alibaba in China, plus Amazon Web Services (AWS), Google, and Microsoft in the US, in a unique position, given their sheer size. The three US cloud giants provide critical inputs to the wider economy, recalling the great steel and oil trusts of more than a century ago. They also function as common carriers, akin to railroads. The hyperscalers are bank-like because of enormous infrastructure investments that enable other technology providers as well as through their role in monetizing data. Regulatory responses to

cloud providers' power will thus shape the market. At the same time, cloud-native technologies are opening the door to disruptive challengers, especially at the edge, as Big Tech struggles through an economic slowdown with layoffs and a loss of market valuation.

- **Data sovereignty imperatives, regulation, and national security will deglobalize cloud.** Economic nationalism, government regulation, and geopolitical instability will fragment the public cloud market. The Pentagon's Joint Warfighting Cloud Capability (JWCC) contracts and cloud providers' collaborations with the US military during the Russia-Ukraine war link the US hyperscalers to US national security strategy. The Chinese government's shift to government-run clouds shows a similar dynamic. In Europe, requirements for data sovereignty via GAIA-X and other initiatives are creating opportunities for vendors such as OVHcloud. Cloud providers will adapt, turning over some foreign operations to subsidiaries (e.g., Microsoft in China), pursuing local partners (e.g., Google), or offering dedicated regions (e.g., Oracle). Moderate regulatory intervention is likely, and major intervention is possible.
- **Limited access to capital will constrain medium-term challenges to cloud providers.** The hyperscalers hope to compete at the edge against content delivery network (CDN) and hardware players alike. The CDN vendors will embrace WebAssembly (Wasm) as an edge development platform for an end run around cloud provider dominance. Telcos will also have a play, using low-power wireless technologies such as 5G to connect IoT devices and enable [distributed software systems](#) without cloud providers. Edge-oriented chipsets will help edge providers outmaneuver hyperscalers in diverse scenarios. However, these challengers face financial limitations and will require backing from telcos and major investments from venture capital and private equity in the near term.
- **Cloud providers will resist disintermediation.** Cloud set the expectations for enterprise-class IT providers of all sorts — ISVs, SaaS vendors, database services, data management platforms, hardware suppliers, and MCPs. Forced to adapt, these players embraced them as hosts while disintermediating their customers' consumption of cloud services where possible. Over the next decade, however, cloud providers will pursue counter-disintermediation with workflow-based, enterprise, and generative AI to challenge ISVs and SaaS. This will be an epic battle of "coopetition."
- **The next horizon of innovation will be AI infrastructure and advanced compute.** Cloud platforms have moved far beyond commodity infrastructure to provide specialized compute to the masses. Even as they bid down the cost of white-box

compute with ARM and RISC-V chipsets for cost-effective services at scale, the hyperscalers are racing to scale out pricier AI infrastructure with custom silicon that can compete with NVIDIA (although cloud providers will compete for NVIDIA workloads). High-performance computing (HPC) infrastructure will increasingly be a priority, and the cloud providers will take quantum from the lab to real-world applications.

- **The categories of public cloud, edge, and data center will blur.** Customers will eventually leverage multiple types of edge technologies. That future landscape is yet to be determined. Cloud providers will try to both beat these challengers and join them with cloud-at-customer hardware, small data centers, industry clouds, and cloud application services, all with AI-driven automation and management. Telcos are countering with cloud services, especially as Wasm emerges alongside Kubernetes as a compute runtime with emergent edge intelligence. The cloud providers' own private 5G investments will impact edge and mobile markets; they'll both partner with and compete against telcos for 5G. At the same time, the big cloud players will steal a page from the CDN playbook and embrace application-specific integrated circuits (ASICs) to bolster edge infrastructure. Which will win? The answer's up in the air, but we're unlikely to see just a single victor.

The Evolution To The Future Abstracted, Intelligent, Composable Cloud

Forrester believes that the future of cloud is abstracted, intelligent, and composable — a reality that will play out over the next decade, not overnight. We analyzed changes and opportunities over three horizons: short term (one to two years), middle term (three to five years), and long term (six to 10 years).

The Short Term: Generative AI That Powers Cloud-Native And Operator Maturity

In the short term (one to two years), cloud-native technology and the diffusion of generative AI will lay the basis for a generalized set of cloud capabilities that can embrace multiple public cloud providers and standalone providers of cloud services (see Figure 3). Generative AI and foundational models will be built into new cloud services, including the interpretation of workload type and applying the right compute and services. Hyperscalers will fight off disintermediation through industry clouds, with a short-term focus on AI services and unique infrastructure to power industry-specific use cases.

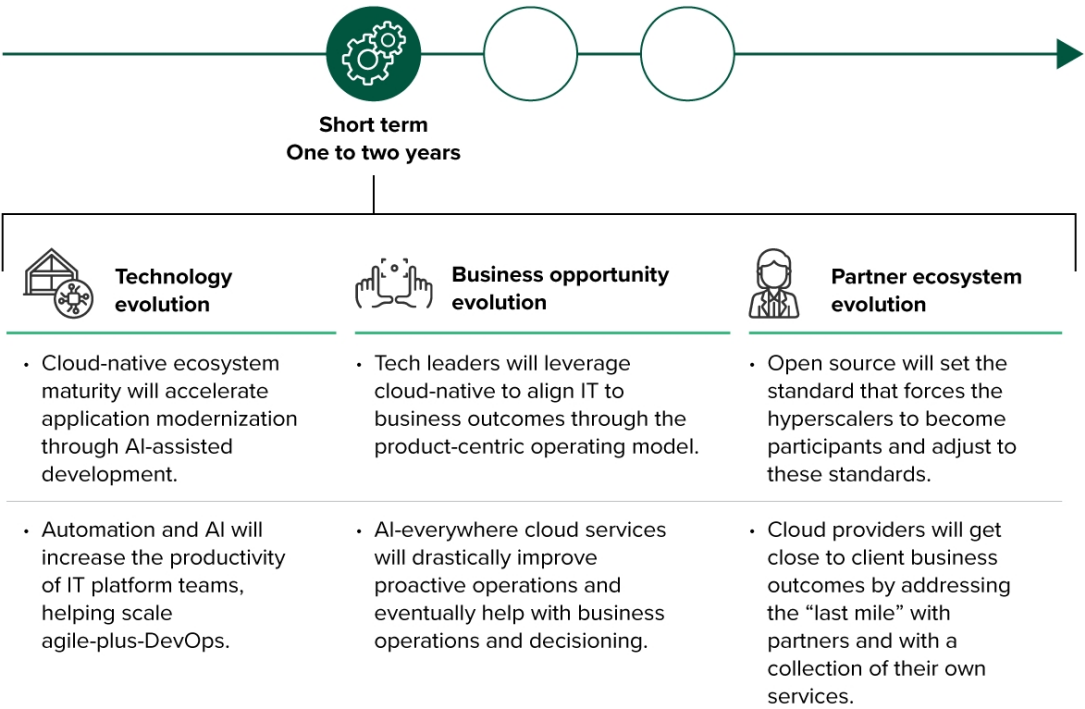
- **Open source displacement of proprietary cloud infrastructure will accelerate.**

Kubernetes projects that automate operations (GitOps); streamline management (Cluster API); support development (Backstage or KubeVela); and enable service mesh (Dapr, eBPF, or Istio) and multicloud operations (Crossplane) will close the gap between DIY and enterprise-ready Kubernetes. Generative AI will reduce the need for prebuilt Kubernetes platforms; Kubernetes-oriented IaC providers such as Pulumi offer automation based on large language models today. These capabilities will become commonplace in the short term. The maturity of automated, enterprise-grade, cloud-native open source solutions will allow users to optimize workload placement dynamically, which mitigates vendor lock-in, limits hyperscaler scope for price hikes, and displaces proprietary cloud infrastructure.

- **The operator cloud will be smarter, automated, and flexible.** The first generation of cloud platforms was designed for operators, i.e., technical users, as were the surrounding management solutions. These solutions weren't particularly smart or automated. This will change in the near term; operator experience will be more automated, and its operational insights will target developer audiences, too. Third-party solutions for Kubernetes management, AIOps, and cloud cost management and optimization (CCMO) — all making use of generative AI — will lead to greater platform operations enablement for multicloud. The gap between cloud operations and network operations will begin to close as users leverage AI to help transform hybrid cloud networks into a [businesswide network fabric](#). These new IT capabilities will buttress the emerging product-centric operating model.

- **Industry clouds will expand to fight off disintermediation.** Hyperforce, Salesforce, and SAP Business Technology Platform have disintermediated hyperscalers on key platforms. These integration and development clouds come complete with low-code and no-code platforms for business users. Hyperscalers are responding by enhancing industry clouds beyond case studies and a handful of architectural blueprints. These newly refreshed solutions will leverage mostly existing cloud services that collectively solve for common industry use cases, with a particular focus on strengths in unique infrastructure such as HPC; supercomputers; and quantum and AI-infused services for big data, analytics, and AI/ML. Why start this journey? By projecting their own platform offerings beyond IT infrastructure into the users' business operations, the cloud providers will seek to consolidate long-term relationships — in other words, to lock customers into their platforms.

Figure 3
The Short Term: Cloud-Native Maturity, Generative AI Enhancements, And Industry Cloud



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The Middle Term: Platform-Based Industry Cloud, AI-Centric Competition, And A Push Into OT

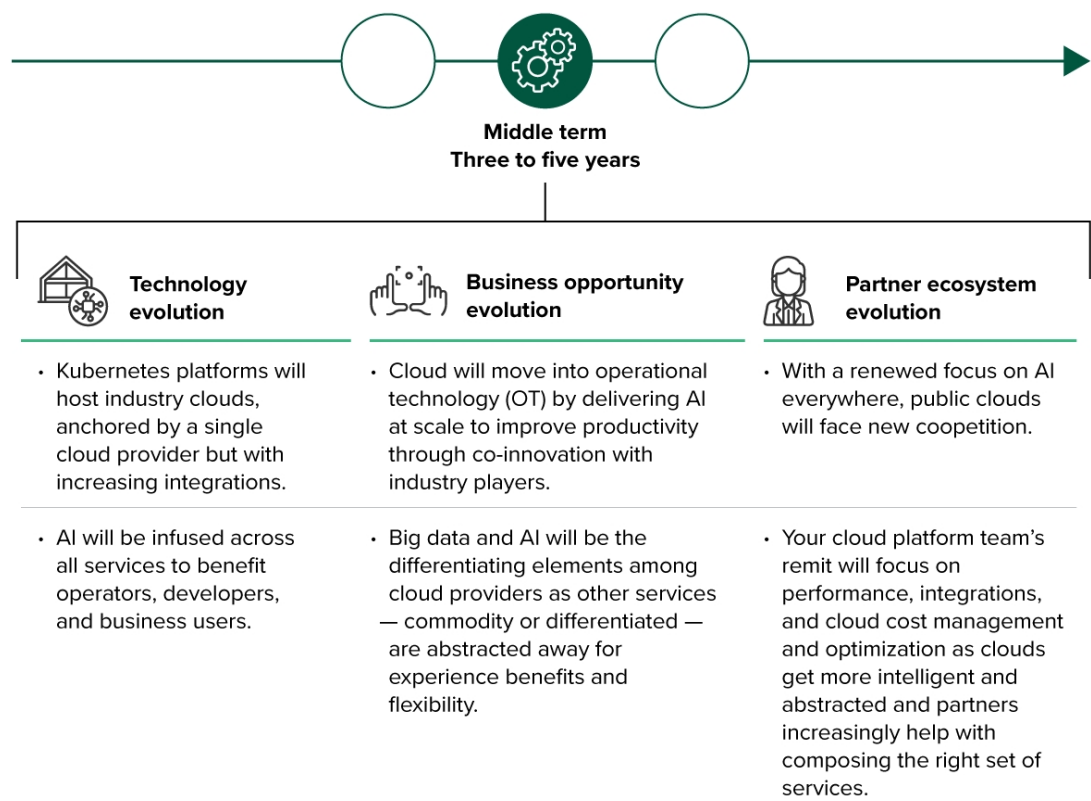
In the middle term (three to five years), hyperscalers will differentiate through AI as they tackle industry use cases. Instead of disparate services, expect comprehensive collections of services delivered in targeted industry platforms within Kubernetes platforms. Hyperscalers will make aggressive moves to extend to the industrial edge beyond existing private 5G investments (see Figure 4).

- **Industry cloud will evolve into platforms to displace service-by-service deployment.** Cloud providers and edge innovators will deliver prebuilt or semifinished platforms by encapsulating multiple services as Kubernetes platforms, serverless containers, and FaaS converge. In the interim, these will anchor on a single cloud. Cloud providers will offer government and industry clouds, with AI tuned to specific use cases; users or third parties will customize

these offerings with security and compliance appropriate for those contexts. Hands-on cloud infrastructure-building will be the preserve of users with requirements beyond standardized offerings. Cloud providers will push back against platform disintermediation in multiple ways, including tying [enterprise generative AI](#) to cloud services, attempting to shape the [automation fabric](#), and offering practical Web3 services.

- **Cloud innovation will spread to OT, bringing both opportunities and complications.** Hyperscalers are crossing the threshold from IT to OT in factories, transportation networks, and extractive industries through bespoke deals with customers and sometimes-uneasy partnerships with industrial equipment and automation providers. Manufacturers see cloud providers as both strategic partners and rivals, similar to the development of electric and autonomous vehicles. AI-enhanced workflow automation and industrial metaverse use cases will give cloud providers an opportunity on the factory floor. But as IT generalists, cloud providers will focus on AI-based augmentation rather than replacement of equipment and processes. Variation in manufacturing precludes an all-purpose “factory cloud,” and edge providers will stake out considerable market share to meet industry-specific needs.
- **Data platforms and AI will define cloud.** The AI arms race began with search and advertising, but its next wave in enterprise IT will be far sharper as the major clouds seek to win through AI, both as services to sell and infused within their core products. This will be apparent in their many investments and strategic moves. Expect competing solutions to enterprise AI platforms, such as C3 AI, Palantir, and SAS; extendable platforms, such as Google Vertex AI; AI-infused services with new low-code/no-code capabilities, such as Microsoft Power Platform; and repackaging of AI/data services into industry cloud solutions. Where data and AI are necessary in multicloud or hybrid environments, challengers such as IBM and Oracle will be able to compete against the hyperscalers.

Figure 4
The Middle Term: AI-Centric Clouds And A Push Into Operational Technology



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The Long Term: Cloud That Fuses With The Four Edges

In the long term (six to 10 years), major cloud providers will enable, integrate, and manage a broad swath of IT, OT, commerce, and consumer cloud services in curated experiences that feature multicloud services. Cloud will continue to serve as an innovation launchpad for tomorrow’s tech, including metaverse capabilities (see Figure 5).

- **Cloud will become synonymous with multicloud as it blends into more edges.** Multicloud brought additional cognitive burdens, with multicloud integrations often prohibitively expensive even when technically viable. Cloud providers will — however grudgingly — meet user demand for multicloud networking without high egress fees and easier multicloud interoperability. They’ll have no choice: The

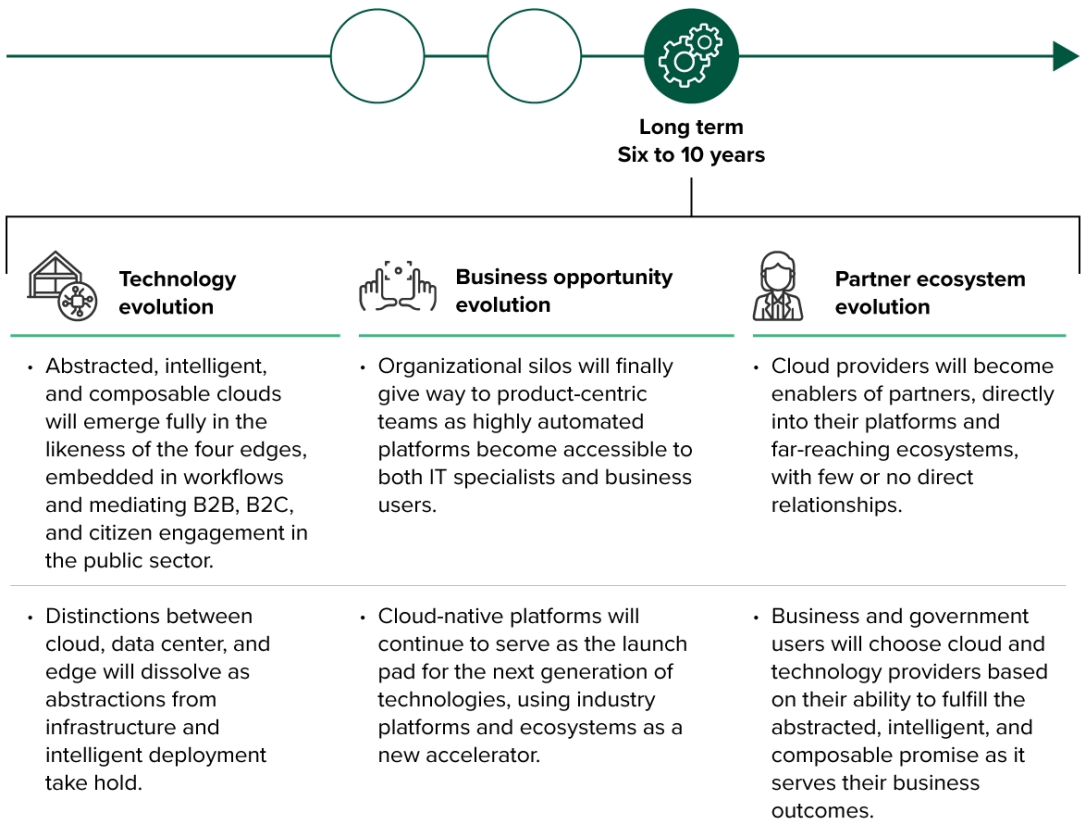
Wasm technology embraced by Adobe and Fastly and edge-to-cloud offerings such as Akamai's will enable a development platform with the ease of FaaS but without cold-start issues. Alongside Kubernetes, Wasm's server-side complement, WASI, will become a key element of cloud-native infrastructure. Telcos, in cooperation with cloud providers, will provide additional investments for this transformation. This will bring cloud providers to [even more edges](#).

- **Services across platforms will unite in prebuilt platforms.** Cloud providers will shift from primitive to prebuilt or fully finished platforms based on cloud-native technology. Users will have the option to consume such offerings as is; implement their own integrations and customizations; or draw from cloud partner ecosystems, edge providers, and telcos. Industry cloud itself will not only serve your use cases but also bring you closer to your ecosystem in a curated manner.

Your curated cloud experience will align to the four edges: 1) an IT cloud that uses AIOps for SaaS-like stability and application-centric enterprise technology; 2) an OT cloud with subtypes optimized for manufacturing, extractive industries, or consumer goods; 3) a commerce cloud that includes both B2C and B2B capabilities, such as supply chain integration; and 4) a consumer cloud for media, entertainment and apps, resembling the Apple iCloud ecosystem more than the current sprawl of services such as Google's Android apps and YouTube.

- **The metaverse will exist atop cloud technology.** As metaverse moves from [precursor elements](#) and [single-vendor platform activations](#) such as Meta's, hyperscalers will flex their muscle with their unmatched scale and resources. Only cloud providers have the data centers, AI infrastructure, networking, and IoT resources to dominate the metaverse technology foundation that's [already visible in China](#). They'll differentiate in approaches to the business engine and engagement interfaces, with Microsoft leveraging gaming and other consumer properties while AWS facilitates metaverse commerce through the engagement interface. Hyperscalers will use their stack as leverage to provide user experience where they can — but will partner when they must. Thus, cloud won't be synonymous with the metaverse; rather, the composable IT, OT, commerce, and consumer clouds will offer metaverse capabilities. Facebook will use the metaverse as a bridge from social media to consumer cloud.

Figure 5
The Long Term: Abstracted, Intelligent, Composable Cloud



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Supplemental Material

Companies We Interviewed For This Report

We would like to thank the individuals from the following companies who generously gave their time during the research for this report.

- Adobe
- Amazon Web Services
- Audi
- Cloud Native Computing Foundation

Cosmonic

Discover

Docker

Fermyon

IBM

Isovalent

Liberty Mutual

NW Natural

Red Hat

SUSE

VMware

Forrester Analysts Who Contributed To This Report

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