MARKET OVERVIEW

Next-Gen Computing: The Enterprise Computing Model for the 2020s

The Future Is No Longer Cloud-Only—the Reality Is Workload Portability

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EXECUTIVE SUMMARY

This Market Overview describes a new computing paradigm for the enterprise that frees enterprises from workload lock-in, whether on-premises or in the cloud. Apart from an emphasis on workload portability, it postulates that enterprises benefit from a single pane of glass, and vendors need to provide service offerings accordingly.

We also take a closer look at (in alphabetical order) Amazon Web Services Greengrass and Snowball Edge, Google Kubernetes Engine (on-premises version), IBM Cloud Private, Microsoft Azure Stack and the Oracle Cloud at Customer portfolio (this includes Oracle Exadata Cloud at Customer, Oracle Big Data Cloud at Customer, Oracle SaaS at Customer and Oracle Cloud at Customer).

The report concludes with a set of tangible recommendations for CxOs, most prominently asking CxOs to realize the need to accept the new computing landscape and to embrace it sooner rather than later.
MARKET DESCRIPTION

Market Definition

There has been a lot of confusion around the term “cloud,” with vendors accusing each other of “cloud washing”—that is, trying to rebrand an old product by adding the word “cloud” to its name. In reality, cloud definitions vary from vendor to vendor and even from enterprise to enterprise.

For the purpose of this Market Overview, we are defining cloud as the elastic provisioning of computing, storage and networking. The elasticity manifests itself in the form of dynamic ramping up and ramping down of resource availability, driven by workload demand, even on a per-second basis. The mechanics for this kind of computing have been established and have matured with public cloud infrastructure-as-a-service (IaaS) vendors.¹

CxOs who have to manage on-premises loads also find that value proposition—the elasticity of computing resources—attractive. IaaS vendors have realized this and added offerings that make parts of their IaaS infrastructure available on-premises.

The computing paradigm of running the same infrastructure (with some limitations) for or by an enterprise on-premises when it is available in the public cloud is the focus of this Market Overview. We refer to this as next-gen computing infrastructure.

Market Trends

The following market trends characterize the management of computing infrastructure (see Figure 1):

Heterogeneous Computing Demands

CxOs see themselves confronted with rapidly changing computing demands. Barely having satisfied the business need for big data, the computing requirements that CIOs must answer stretch from support for machine learning to speech-recognition support for internal and external assistant/chatbot solutions and all the way to the edge of the enterprise. New computing platforms have entered the data
center—for instance, with the advent of large GPU racks to run machine learning. A never-before-seen platform diversity manifests itself at the edge of the enterprise to support the Internet of Things (IoT). And the pace of change is not slowing down, as shown by new demands for additional workforce support (e.g., augmented/mixed/virtual reality) and new user experience support (e.g., holographic displays).

**Data Center Utilization**

As more workloads move from enterprise data centers to public cloud vendors, CIOs struggle to reach the level of utilization they intended when originally planning and investing in their data centers. One part of the challenge is the business practice of letting divisions choose their automation tools, and with that creating a lower degree of predictability for what workloads are available in on-premises data centers. An additional hurdle for CIOs is that physical infrastructure requests are moving slower and have a much longer-lasting financial impact. Data center utilization can turn from being out of capacity to
quickly dropping to only two-thirds of utilization. Dropping a single server-refresh cycle will create that scenario, which CxOs experience as they move workloads to the public cloud.

The Need for a Single Control Pane

The era of CxOs simply accepting that new products bring a new control pane are history. CxOs operating next-generation applications must run them as efficiently as possible, via a single control pane. This not only allows for more efficiency to manage infrastructure but also is the best way to manage a heterogeneous landscape effectively. Ramping down and ramping up resources as demand requires cannot be done from a “zoo” of instrumentation. At the same time, the automation of resource scaling is essential, so humans can focus on oversight instead of spending time and energy on operational tasks.

Rising Complexity of IT Operations

The cloud has not simplified IT for almost all organizations because they are operating on a fluid automation pane that includes the public cloud and on-premises computing resources. Business priorities, timing, and write-down cycles all determine at what time what load may be moved to the public cloud or should remain on-premises. Changes in executive management often result in a shifting workload mix (for instance, due to software-as-a-service, or SaaS, portfolio changes) that affects the overall computing portfolio. A greater diversity in workloads and new next-gen application use cases create more heterogeneity and increase the complexity of IT operations.

Compliance Pressure

Enterprises see themselves confronted with a rise in compliance needs that, because of the operation of larger software portfolios, affect more of the computing infrastructure than ever before. Data privacy and data residency regulations often require enterprises to move loads to different physical locations, and sometimes from the cloud back to on-premises. Enterprises have not even recovered from the European Union’s recently activated General Data Protection Regulation requirements, and they see more data residency rules coming their way, such as the California Consumer Privacy Act. The rate of regulation will only increase, making CxOs desire a more fluid way to move workloads.
Degrees of Cloud Skepticism

Although many next-generation application use cases are best (and sometimes only) operated in the cloud, there is still a degree of skepticism over computing in the public cloud. It ranges from rational challenges (such as whether IaaS vendor data instances are available inside of a necessary jurisdiction) to reasonable challenges (hardware write-downs, connections to existing on-premises computing resources, such as mainframes) to less rational concerns (for instance, regarding data safety). Nonetheless, it means that CIOs need to implement and operate workloads in local data centers for at least the next decade.

IMPORTANCE TO BUYERS

Buyer Challenges

CxOs face the following challenges operating computing infrastructures (see Figure 2):

Old-Guard Vendors Are No Longer Viable

Humans are driven by habits, and CxOs are no exception. If they could still procure all of their computing needs from the vendors they dealt with in the 1990s, the majority of CxOs would likely do so. The problem with these “old-guard” vendors is that they have failed to innovate, are no longer viable from a cost perspective and often have switched to business models that are perceived as extortion. Therefore, innovation and commercial necessities require CxOs to deal with a new set of computing vendors.

Employee Scarcity and the Skills Shortage

The first world is quickly running out of hands because of unfavorable aging dynamics. Enterprises in general and IT departments more specifically are not immune to these changes, and CxOs find it increasingly harder to find employees with the right skills. Enterprises often pay regal amounts to IT outsourcing firms to solve this challenge. And enterprises that do not outsource find it increasingly hard to train and improve the skills of their workforce—a good reminder that no enterprise function is being more disrupted by the cloud than IT.
For decades now, CxOs have been asked to do more with less, especially on the IT side. For a long time, the benefits of Moore’s Law have bailed out CIOs because they were able to offer better computing power at the same costs or equal computing at lower costs. But Moore’s Law is running out of runway, and at the same time new next-generation application use cases require innovative new platforms that charge a premium.

The Innovation Imperative

While software is eating the world, enterprises are turning into software companies, and, as such, they need to innovate faster than ever. This makes CxOs look for winning platforms and ideally allows them to move workloads as seamlessly across them as possible. As enterprises flock to platform-as-a-service
(PaaS)⁴ products to help them build these next-generation applications,⁵ workload portability is a key acquisition criterion and overall success factor for the selection of a PaaS⁶ platform.

**Contractual Challenges**

While the technology has enabled computing elasticity on a per-minute, even per-second basis, contractual terms have not shown a similar flexibility. Technology vendors want to lock in enterprises to longer-term contracts, providing an incentive for the move with lower costs. Suggesting dedicated instances as a form of rebate proves to be a synergetic relationship between the enterprise and the vendor but is anathema to desired workload elasticity.

**Selection Criteria**

CxOs selecting next-generation computing platform vendors should make the selection around the following criteria⁷ (see Figure 3):

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**Figure 3. Six Criteria for a Next-Gen Computing Platform**

![Figure 3. Six Criteria for a Next-Gen Computing Platform](image)

*Source: Constellation Research*
Workload Portability

In uncertain times like ours, investment protection is paramount for CxOs. This means that operational next-generation application assets should be able to run both in the public cloud and on-premises. Legislative, data residency, privacy and performance concerns are the main drivers behind this capability, apart from better resource utilization and flexibility. Vendors with a broader overlap of cloud and on-premises capabilities generally do better for this selection criterion.

Innovation Speed

Platforms cannot stand still and, as such, need to add new capabilities at a fast pace. CxOs expect that capabilities will be available at the same time for both cloud and on-premises platforms so that their application loads do not get shackled to one form of deployment. On the other hand, CxOs realize that much of the desired capabilities for next-generation applications have been developed in the cloud and may only gradually become available on-premises. Some capabilities are not commercially viable or desirable to be available on-premises.

Portfolio Identicality

Beyond workload portability, CxOs expect that the functional portfolios offered in the cloud and on-premises are as identical as possible. This is a critical selection criterion as rapidly expanding next-generation application portfolios quickly consume additional services and, with that, may become dependent on a cloud-only deployment. CxOs do not want that form of lock-in and therefore want to see the same capabilities, with seamless usage, work across the cloud and on-premises.

Advanced Service Offerings

In the cloud, vendors have been able to scale far beyond what is possible for any CxO with an on-premises deployment. When running the workloads of thousands of customers, vendors can scale much better than single IT organizations. And the sort of scale IaaS vendor can reach is not even considering the skills challenge caused by the complex nature of cloud platform technology stacks, if enterprises
want to run these stacks in-house. Therefore, CxOs want vendors to offer them remote management capabilities, while they are only responsible for physical security, networking and power.

**Single Pane of Glass**

Managing workloads is a complex process, and because enterprises have only limited resources available, CxOs require a single pane of glass to manage workloads in a next-generation computing platform. This is a win/win for enterprises and vendors as enterprises would like to see the integration of all computing resources into a single operational console, and vendors can charge a premium for the additional capabilities while gaining transparency into workload profiles and ensuring customer success.

**Elastic Commercial Terms**

As mentioned earlier, there is a disconnect between technological capability and commercial reality. Vendors try to lock enterprises into long-term contracts, which in most cases are not in a customer’s best interest. CxOs need to negotiate smartly to avoid overly lengthy contract terms that cement their procured computing capacity into a too-rigid format because it is clear that the future will need even more rapidly shifting computing demands.

**VENDOR LANDSCAPE**

**Vendors & Offerings**

As part of this Market Overview, we look at the on-premises capabilities of selected vendors. What all vendors listed have in common is more functionality available in the cloud than on-premises, but at the same time, almost all on-premises capabilities have been developed originally for the cloud or leverage synergies with the respective cloud platforms. It is a matter of go-to-market, time and use cases as to how fast and far these vendors will deploy their cloud functionality in an on-premises form. The vendors are presented in alphabetical order.
AWS Offerings: Snowball Edge, Greengrass and Storage Gateway

As the early leader in public cloud and a general cloud promoter, Amazon Web Services (AWS) has been slower to offer local and on-premises computing capabilities but is currently on an accelerated path to provide more offline capabilities and services. Two years ago, AWS unveiled its Edge capabilities, but they were storage-centric. In 2017, AWS expanded its Snowball devices to AWS Snowball Edge, which can run local computing. Originally deployed as storage option to ship data to AWS, the additional computing capabilities make Snowball Edge an option for deployments with little data connectivity (for instance, on ships) or none at all (such as underground operation in mines). AWS Snowball Edge allows customers to run Elastic Compute Cloud (EC2) and AWS Lambda code, allowing for the reuse of code assets. The main use cases are data security, preparation and processing. The nature of deployments is supposed to be temporary, however, with the AWS Snowball Edge device ultimately returning to a location with good connectivity and reconnecting to AWS.

Another key AWS offering is the AWS Storage Gateway, which allows data connectivity between on-premises hardware and the AWS Cloud. While mainly intended as a data transfer and backup offering, it also allows enterprises to keep storage assets on-premises by setting up a local cache. This allows next-generation applications to operate on local data, potentially even offline, with no connection to the AWS Cloud.

On the IoT side, AWS offers AWS Greengrass, which also offers local computing capabilities. More interestingly, AWS Greengrass can also reuse AWS Lambda functions as well as C/C++-based assets, allowing next-generation application teams to reuse code assets. Evidently, these Lambda function assets have to be designed and built to run on an AWS Greengrass device. Moreover, machine learning (ML) assets may be made available with the same design points for the AWS Greengrass ML Inference capabilities.

**Constellation’s POV:** AWS offers good code portability to locations where CxOs need to reuse code assets, such as places with network connectivity challenges as well as IoT devices. But the core of most next-generation applications, which are generally defined by big data capabilities and ML and artificial intelligence (AI) functions aided by cheap computing in the cloud, must remain in the AWS public cloud. Although AWS offers some capabilities to run offline applications, through its support of OPC Unified...
Architecture, there is no current offering that can move an AWS cloud-built application seamlessly to an on-premises environment. This gives CxOs no option to run these applications on-premises if they are required to operate them locally. In practice, this has not been a drawback because enterprises have been well aware of AWS being a cloud-only platform. But it is good to see AWS moving more capability to be available offline (see, for instance, the announcement of EC2 code assets to run on AWS Snowball Edge), in an approach driven by use cases (most prominently, IoT and storage).

**Google GKE On-Prem**

Google has for a long time focused on providing offerings directly integrated into its public cloud infrastructure. Only recently, at its Google Next conference in 2018, has Google unveiled an option to run software locally, via Google Kubernetes Engine (GKE) On-Prem. As the name suggests, the product uses the Kubernetes container standard as a platform, and with that allows for the portability of Kubernetes-built software artifacts. Google GKE On-Prem allows customers to connect to local storage and database resources, enabling important enterprise use cases. Google allows the registration of the local Kubernetes infrastructure with Google Cloud Platform (GCP), making a migration from local workloads easier. With Stackdriver, Google offers enterprises a single pane of glass to manage these workloads, and they are equally visible in the GCP Console. Google uses its Cloud Identity capabilities to provide identity and access management for Google GKE On-Prem. This makes it easier for born-in-the-cloud next-gen apps to move on-premises but is a hurdle when the use case is just to manage applications on-premises.

**Constellation’s POV:** Google is late to offer on-premises computing capabilities relative to other IaaS providers, but it has the advantage of riding the Kubernetes trend. CxOs know about Google being the initiator and a major supporter of Kubernetes, and Google is smart at using this to its advantage to help Google GKE On-Prem penetrate the enterprise. However, Google will have to expand Google GKE’s on-premises capabilities quickly, especially to support machine learning, which is one of the major differentiators of GCP. Because TensorFlow already runs locally, it comes back to compatibility and packaging, something Google does not want to burden CxOs and their teams with for too long.
IBM Cloud Private

More than three years ago, IBM realized that enterprises want to be able to run workloads on-premises, starting with its PaaS product, Bluemix Local. IBM learned quickly that enterprises not only wanted the build and test capabilities of their next-generation applications on-premises but also the run capabilities. Today, the origins of this effort find themselves in the IBM Cloud Private offering, which uses the popular Kubernetes standard to both abstract and manage an enterprise’s next-generation applications as well as IBM’s platform offerings. IBM is also moving products in its database and AI portfolio toward IBM Cloud Private, as part of the IBM Cloud Private for Data offering.

IBM offers vital parts of its technology stacks to customers as part of IBM Cloud Private, most prominently its WebSphere Application server, via the WAS VM Quickstarter. This allows enterprises to reuse assets that depend on WebSphere. Moreover, IBM offers IBM Microclimate, a development environment that runs on IBM Cloud Private. IBM also has built capabilities to run AI use cases in a hybrid mode, where the AI capabilities reside in the public cloud (for IBM, that’s Watson) and potentially sensitive enterprise data remains local.

Constellation’s POV: IBM was one of the first IaaS providers to realize the need for a local computing platform, likely due to the deep enterprise ties it has had for many decades. And while the traditional development orientation is a good start, IBM needs to bring more of its popular platform products to IBM Cloud Private.

Microsoft Azure Stack

Microsoft was an early proponent of on-premises cloud infrastructure, announcing Azure Stack more than three years ago. Azure Stack took some time to get delivered because Microsoft changed its strategy from building its own hardware to a partner-based offering, but Azure Stack has now been available for more than a year and is seeing good traction in the market. Azure Stack is almost a complete replica of the technology stack that Microsoft runs in Azure, the biggest omissions being capabilities that are not technically and/or commercially viable in an on-premises deployment (for instance, many of the Microsoft AI capabilities at present).
The completeness of the Azure Stack offering allows enterprises to build completely new applications on-premises, leveraging the power and R&D investment that Microsoft has put into Azure. Code assets can move seamlessly across Azure and on-premises, and Microsoft promotes hybrid capabilities that, for instance, allow leveraging on-premises data with cloud-based machine learning. Microsoft offers enterprises a single pane of glass to manage this next-generation computing platform. For deployment, Microsoft offers a traditional setup managed by the enterprise and a managed-services setup through partners. Moreover, Microsoft offers a true elastic commercial model with a pay-as-you-go offering of Azure Stack, though it requires an enterprise agreement.

**Constellation's POV:** Microsoft Azure Stack is an on-premises cloud technology stack that leverages the strengths of the Microsoft partner ecosystem, because it runs on partner hardware, and offers multiple complementary service offerings. With a very large part of the Azure cloud technology stack available in Azure Stack, CxOs can have the peace of mind that their next-generation applications remain deployable across cloud and on-premises infrastructure. Microsoft has to focus on closing gaps between Azure and Azure Stack to give CxOs the assurance of being able to migrate their workloads seamlessly. Microsoft builds most of the relevant products itself (e.g., Microsoft SQL Server), which is an advantage.

**Oracle Cloud at Customer Portfolio**

Oracle has for a long time stressed that its technology stack is the same between its cloud infrastructure and its on-premises technology stack with the Oracle Cloud at Customer portfolio. The functional scope is nearly identical, with only very few capabilities not being available in Oracle Cloud at Customer. Overall, Oracle has the largest functional scope available on-premises, including all its SaaS, PaaS and IaaS capabilities, running on Oracle Exadata and storage. Oracle Cloud at Customer is the closest that customers can get to having the Oracle “Chip to Click” (cloud) stack running in their own data centers. On-premises deployments of the Oracle Cloud at Customer portfolio are technically implemented in such a way that the on-premises installations are instances of the Oracle Cloud. This allows Oracle to offer the hardware and services on a subscription basis.

The large functional scope and the required technological setup and complexity could make operating Oracle Cloud at Customer a potential challenge for IT departments. Oracle solves that issue by including operational management of Cloud at Customer, where Oracle makes the overall system management
and operation work and customers are responsible only for security, networking and power. The functional similarity of the Oracle Cloud at Customer portfolio to Oracle’s public cloud theoretically and technically would allow it to offer the movement of machines between cloud and on-premises and vice versa. This assures CxOs that no matter what reasons they may have for either deployment form, they can deploy the identical capabilities in the cloud and on-premises—just as demanded by the nature and demands of the enterprise.

**Constellation’s POV:** Oracle offers the most complete on-premises offering across all vendors in this Market Overview with the Oracle Cloud at Customer portfolio. Running a cloud stack on customer premises comes with a level of complexity that customers should not underestimate. However, Oracle Cloud at Customer includes all operational management in the standard offering to simplify deployment. Furthermore, the ability to move workloads back and forth between cloud and on-premises is a big differentiator, and a proof point for the capabilities that the Oracle integrated technology stack delivers.

Oracle’s challenges are less on the technical and functionality side of its offering and more on the side of its commercial behavior and history. Many CxOs do not like to do business with Oracle, and Oracle often only wins business if it’s the only feasible, viable option. CxOs esteem Oracle for its technical ability, but Oracle could do much better if it became more customer-friendly. The introduction of a credit model that can be used for consumption across the Oracle PaaS portfolio has been a step in the right direction, as has the addition of bring-your-own-license abilities for Oracle database licenses to Oracle Cloud at Customer.

**Differentiation**

Constellation sees differentiation around the following areas (see Figure 4):

- **Maturity of offering.** CxOs do not want to be at the bleeding edge for something as vital as a computing platform. A solid understanding of the maturity of a platform and services is key. Good maturity can be achieved after 12 months, and high maturity 24 months after the start of an offering.
Figure 4. Vendor Comparison

<table>
<thead>
<tr>
<th></th>
<th>AWS</th>
<th>GOOGLE</th>
<th>IBM</th>
<th>MICROSOFT</th>
<th>ORACLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maturity of offering</td>
<td>Low to medium</td>
<td>Low</td>
<td>Medium</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Range of on-premises capabilities compared with cloud</td>
<td>Small</td>
<td>Small</td>
<td>Medium</td>
<td>Large</td>
<td>Very large</td>
</tr>
<tr>
<td>Expected TCO</td>
<td>Good</td>
<td>Good</td>
<td>Better</td>
<td>Better</td>
<td>Better</td>
</tr>
<tr>
<td>Degree of managed services</td>
<td>None direct/partner</td>
<td>None direct/partner</td>
<td>Direct</td>
<td>None direct/partner</td>
<td>Direct</td>
</tr>
<tr>
<td>CxO comfort factor</td>
<td>Good</td>
<td>Average</td>
<td>Average</td>
<td>Good</td>
<td>Below average</td>
</tr>
</tbody>
</table>

Source: Constellation Research

- **Range of on-premises capabilities.** The more cloud capabilities that are available on-premises, the more flexibility CxOs have, as they can deploy and move assets between the cloud and on-premises.

- **Expected total cost of ownership (TCO).** TCO is a complex figure, and each enterprise will experience different TCO situations, often even varying across deployments. Lower TCO is obviously better, and Constellation rates this criterion based on regular conversations with CxOs.

- **Degree of managed services.** Enterprises face challenges finding people in general and especially people with specific skills. Therefore, getting the on-premises stack managed by the vendor is very attractive. Achieving this through a partner is better than no service but, given the rapid innovation rate of cloud technology stacks, CxOs usually prefer direct management by the respective vendor.

- **CxO comfort factor.** People buy from people, and the comfort level of a CxO to buy from a vendor is a substantial differentiation and purchasing factor. Constellation bases this criterion on regular conversations with CxOs.
RECOMMENDATIONS

All five vendors featured in this Market Overview are viable for CxOs. As described, they fall in various categories and have different pros and cons. Moreover, each business is different, so applicability of these recommendations will vary from enterprise to enterprise. But here are some general recommendations:

• **Stay with your vendor.** The biggest synergies and the lowest risk for a next-generation computing platform can only be achieved when staying with your vendor because only the vendor could provide the out-of-the-box offerings fully integrated. Becoming the system integrator for different platforms can work but is a riskier strategy.

• **Adopt Kubernetes ruthlessly.** The best strategy to avoid vendor lock-in as much as possible is to adopt the very popular Kubernetes framework. The industry has not seen a piece of open source/common standard become de facto reality so quickly. Also consider Kubernetes for traditional on-premises loads to future-proof them.

• **Determine your enterprise’s next-generation application needs.** What applications your enterprise will need to survive or disrupt a market should be the topic of a board-level conversation, which should consider multiple platforms. Find out what will have to be built and which vendor can sell you its best. Sometimes, that will be just one of the vendors, making selection simple.

• **Create a five-year plan for on-premises computing demand.** The shift from capex to opex is in full swing. Don’t underestimate the draw of the cloud, and don’t end up with an oversized data center landscape—few things are costlier for an enterprise in the era of digital disruption than badly allocated, inflexible capex, as in a data center. On the flip-side, if data centers are needed, make them as cost-efficient as possible.

• **Evaluate data center capex needs for the next five years.** If there is not a five-year plan for data center capex, it’s time to create one and have it approved by the board.
During the process, CxOs need to foster the understanding among their non-technical colleagues that this investment can barely be cut down.

• **Assess personnel demand and complexity with a sense of realism.** History is full of CxOs who overestimated the learning speed of their personnel. Cloud technology stacks are the first ones built to be run not by an enterprise but by an IaaS vendor with totally different scale and automation. This scenario doesn’t fit even the largest enterprise, so CxOs need to keep an active eye on managed-service offerings, ideally ones offered directly by the cloud technology vendor (because service providers struggle with improving skills as well).

• **Assess personal and enterprise-wide comfort levels.** There is both a personal and an enterprise comfort level to be weighed with any of the five vendors. Both need to be in sync to a close-enough degree, as a disconnect between the two will not work when things are getting rough. Decision makers as well as the overall enterprise need to be comfortable with a vendor selection. Plan for rough patches, so comfort levels at selection time are key to make it through those challenges.

• **Get going.** It is clear by now, with all vendors offering almost all or slices of their technology stack, that on-premises computing is here to stay. Legal requirements, especially in the area of privacy and data residency, will become more frequent. Performance requirements are real because network speeds are not going to pick up dramatically in the near future (5G being the possible exception). And senior-management/board-level comfort with public cloud is not going to be at a super-comfortable level any time soon. Therefore, CxOs need to plan for a next-generation computing architecture. If nothing major can happen in the next 12 months, CxOs should at least invest in instrumentation/single pane of glass and improving the skills of their people.
ENDNOTES


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Holger Mueller is vice president and principal analyst at Constellation Research, providing guidance for the fundamental enablers of the cloud, IaaS, PaaS, with forays up the tech stack into big data, analytics and SaaS. Holger provides strategy and counsel to key clients, including chief information officers (CIO), chief technology officers (CTO), chief product officers (CPO), investment analysts, venture capitalists, sell-side firms and technology buyers.

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