Infrastructure Requirements for a Cloud-Native World

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Henry Baltazar is a Research Director for the storage practice at 451 Research, a part of S&P Global Market Intelligence. Henry returned to 451 Research after spending nearly three years at Forrester Research as a senior analyst serving Infrastructure & Operations Professionals and advising Forrester clients on datacenter infrastructure technologies. Henry has evaluated and tested storage hardware and software offerings for more than 15 years as an industry analyst and as a journalist.

Prior to 451 Research and Forrester, Henry spent nearly nine years working as a technical analyst for eWeek Labs, where he covered storage, server hardware and network operating systems. At eWeek Labs, he initiated the testing coverage of various technologies, including data replication, clustering, virtual tape libraries, storage virtualization, SAN management, NAS, iSCSI and email archiving. In addition, Henry was a member of eWeek's editorial board and provided content for the magazine's enterprise storage blog. Henry has been widely quoted in the press, including such media outlets as Silicon Valley Business Journal, Computerworld and SearchStorage.com.

Henry holds a BA in environmental sciences from the University of California, Berkeley.

Executive Summary

Organizations are struggling to find a balance between their traditional infrastructure and the new requirements for running containerized workloads efficiently. Business stakeholders are demanding new infrastructures that not only manage workloads across on-premises and cloud environments, but also provide the rapid provisioning and scalability needed for ever-changing container environments. The infrastructure transformation that many organizations are embracing will require a next-generation infrastructure to provide flexibility and scalability for the next-generation agile containerized cloud-native workloads.

Organizations have mixed environments that must support physical, virtual and container-based workloads, and these diverse requirements will not change any time in the near future. Next-generation infrastructures must provide a common infrastructure foundation that can handle heterogeneous workloads, deployed across bare metal, VMs and containers, in order to best meet the customer requirements of their gradual modernization journey.

Cloud-Native Infrastructure Provides Benefits

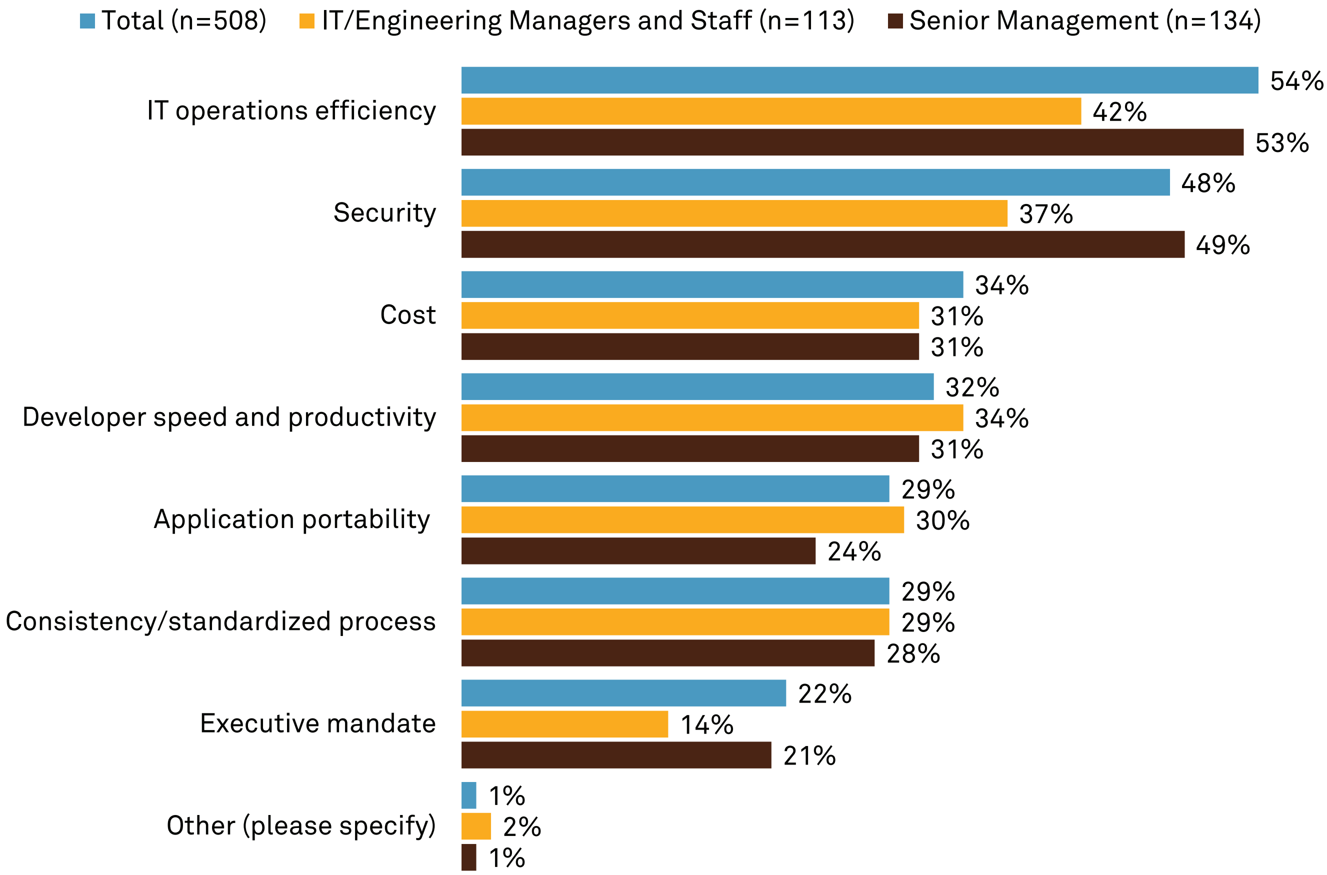
Benefits Organizations Seek with Cloud-Native infrastructure

Use of cloud-native software and methodologies has historically been driven by developers' desire for improved speed and productivity and IT operations' need for efficiency, scalability and portability. Frustration with the slowness and rigidity of traditional infrastructure provisioning and management drove the rise of DevOps tools and patterns, and meanwhile, key stakeholders pushed their organizations to embrace cloud-native technologies. In our research, we found that organizations are looking for a number of key benefits from the deployment of cloud-native infrastructure (Figure 1):

- **IT operations efficiency.** More than half (54%) of all respondents cited efficiency as a driver, the highest among the categories. In addition, 53% of senior management respondents chose this, along with 42% of IT engineering managers and staff. Given that many senior managers are sensitive to rising operational costs, the higher selection rate for this benefit is logical.
- **Developer speed and productivity to match the rapid pace of application development.** Nearly a third (32%) of respondents in the study view improved productivity as a primary driver for going cloud native, with IT engineering managers and staff slightly more vocal about this than the total.
- **Security.** Just under half (48%) of respondents chose this as a desired benefit, though we would note this was more impactful for senior managers (49% of respondents) compared to IT engineering managers and staff (37% of respondents).
- **Cost reduction.** The third-highest percentage of respondents selected cost reduction as a desired benefit (34%), which highlights that the need for speed cannot be satisfied by just pouring expensive resources into a cloud-native infrastructure.

- **Application portability.** The ability to move workloads among hybrid or multicloud environments is a key benefit of cloud-native infrastructures for 29% of respondents. Portability will become more important as organizations look to run workloads in the most appropriate execution environment, based on cost, performance, compliance and many other factors.
- **Improved consistency and standardization.** This benefit was important for 29% of respondents and will be necessary as organizations look to implement automation.

Figure 1: Desired Benefits of Going Cloud Native



Q: What are the primary drivers/benefits of cloud-native technology, such as containers, Kubernetes and serverless, for your organization? Please select all that apply.

Base: All respondents

Source: 451 Research's Voice of the Enterprise: DevOps, Workloads & Key Projects 2020

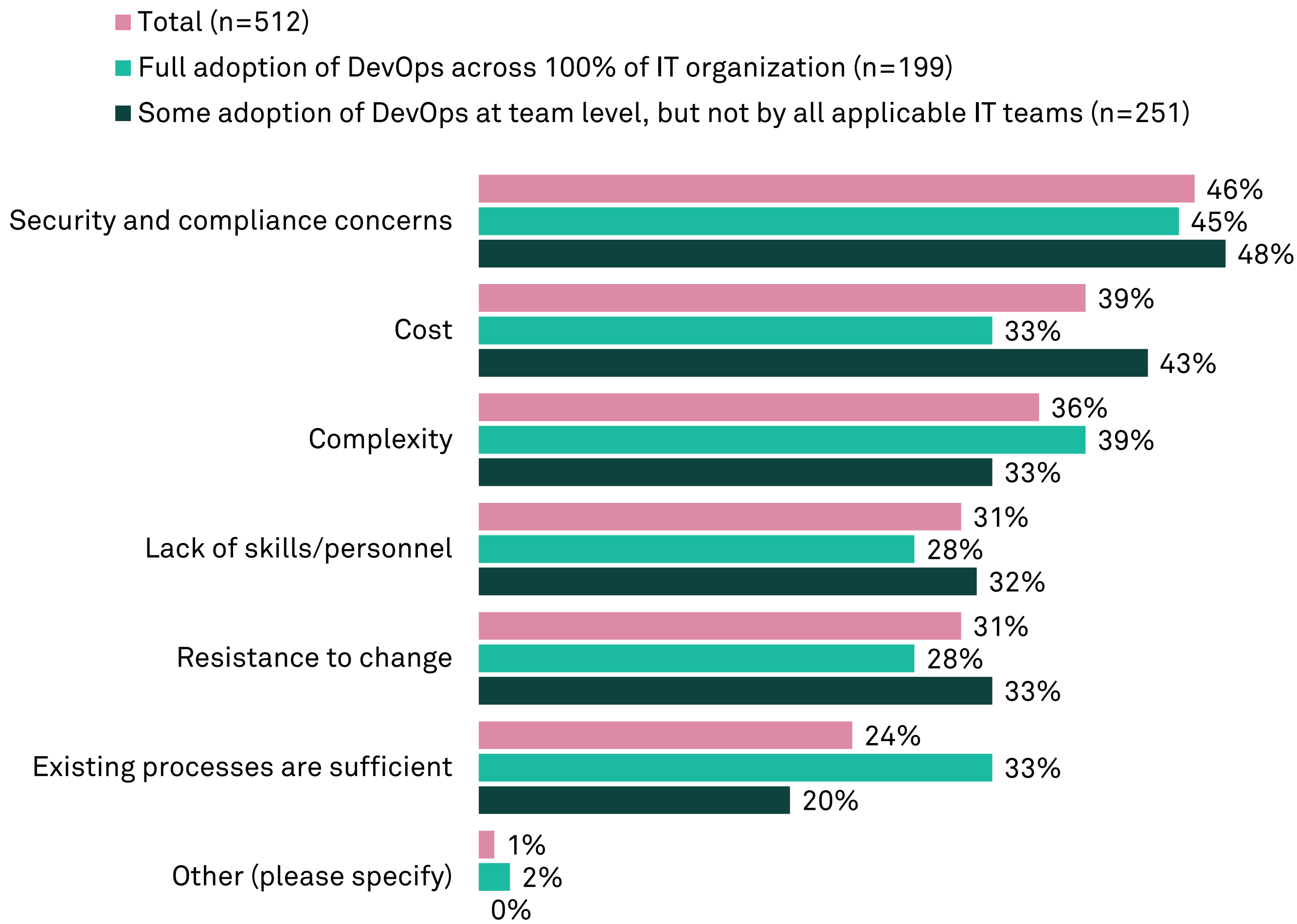
Senior management respondents were much more likely to identify IT operations efficiency and security as cloud-native advantages compared to IT/engineering managers and staff, who prioritized application portability more than senior management. This highlights how management and leadership tend to be focused on cloud-native for efficiency, security and cost, while practitioners are focused on supporting consistency across hybrid and multicloud architectures that include on-premises, private clouds and multiple public clouds, a capability centered on cloud native.

Cloud-Native Deployment Challenges

Organizations looking to re-architect their infrastructure to suit cloud-native workloads face numerous challenges (Figure 2):

- **Cost.** This is a concern for 39% of respondents. While most cloud-native software is open source and can provide savings on licensing and other costs with access to community support, many organizations will pay for support subscriptions, which adds to the cost.
- **Skills shortage.** The transition to cloud native usually represents a steep learning curve for organizations that lack experience and talent and may require costly investments in retraining or hiring. For that reason, it is not surprising that 31% of respondents cited skills shortage as a challenge.
- **Complexity.** Over a third (36%) of respondents cited complexity as a concern, but this rose to 39% of respondents from organizations that have full adoption of DevOps across their organization. Given that most environments will be a mix of cloud native and traditional workloads, complexity will continue to be an issue deep into the future.
- **Security/compliance.** Although containers provide security advantages, such as lighter weight and smaller attack surface, they still generally lag in multi-tenant security compared to VMs, which have been battle-tested in the enterprise for more than a decade.
- **Resistance to change**. Not quite a third (31%) of respondents cited resistance to change as an issue, and the percentage is slightly higher for organizations that haven't completely adopted DevOps on their IT teams. Beyond the shift in technology, some organizations are resistant to adopting key practices like automation because they lack programming skills, and some fear that they may automate their way out of a job.
- **Existing processes are sufficient.** Nearly a quarter (24%) of respondents don't believe they need to improve beyond their existing processes, which reinforces the resistance to change that we highlighted previously.

Figure 2: Cost, Complexity and Security Are Hurdles to Adopting Cloud-Native Technologies



Q: What are the primary hurdles/challenges of using cloud-native technology such as containers, Kubernetes and serverless in your organization? Please select all that apply.

Base: All respondents

Source: 451 Research's Voice of the Enterprise: DevOps, Workloads & Key Projects 2020

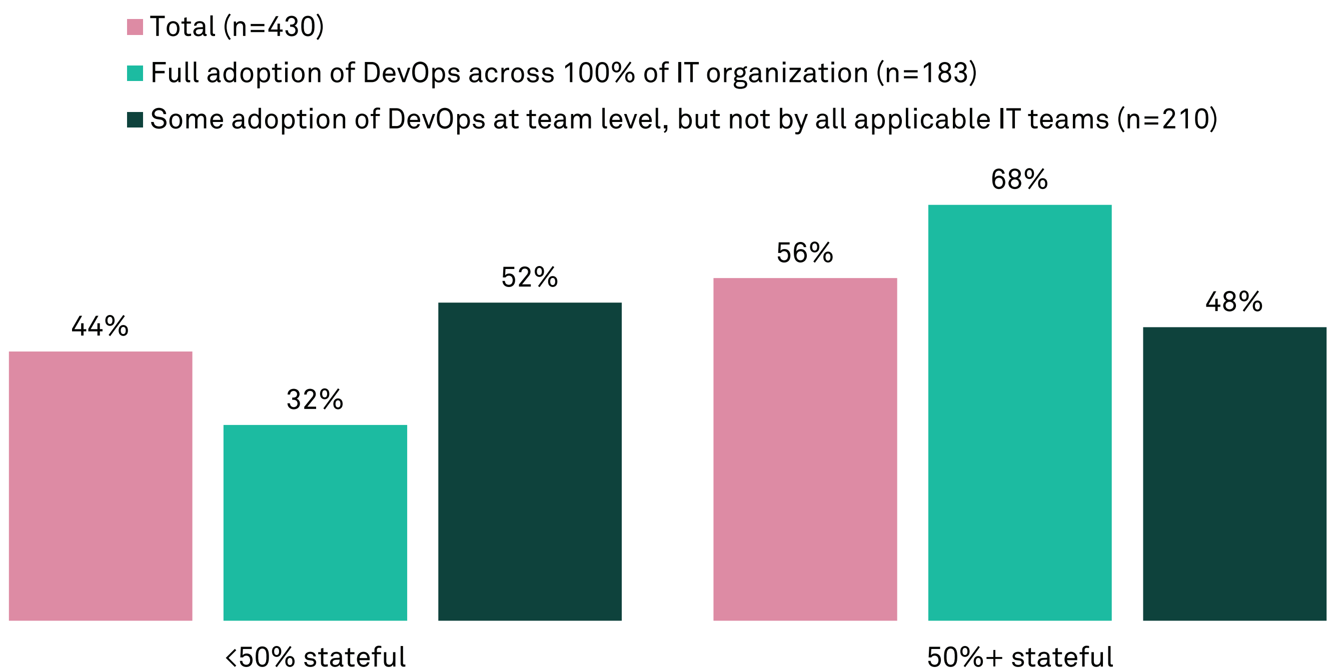
Regardless of the extent of their DevOps deployment, most organizations rank security and compliance concerns among the biggest hurdles to DevOps. However, organizations that have implemented DevOps fully across their IT organization are less concerned about cost than their counterparts that have only implemented DevOps across some teams. This may indicate that as DevOps deployments spread and mature within organizations, they prove their value and return on investment.

Required Capabilities for Cloud-Native Infrastructure

The Rise of Stateful Apps Drives the Need for Persistence

While much of the emphasis on the benefits of cloud-native infrastructure is focused on speed, the rise of stateful containerized applications will force organizations to take resiliency, storage performance and data services more seriously. According to our research (Figure 3), 56% of organizations have more than 50% applications that are stateful. While some traditional IT professionals are still under the impression that containers are mostly used to run ephemeral workloads where data is not permanently modified and outages are not impactful to the business, this is an outdated notion given the rise of persistent cloud-native applications. **In organizations with full DevOps adoption, the percentage of stateful apps is even higher: 68% of those respondents reported that more than half of their applications are stateful today.**

Figure 3: Stateful Container Applications Are Becoming the Norm



Q: What percentage of your container applications are stateful vs. stateless?

Base: Users of containers

Source: 451 Research's Voice of the Enterprise: DevOps, Workloads & Key Projects 2020

Stateful apps rely on persistent storage to function well, and this goes beyond the basic task of storing the data. The ability to provide adequate data access to workloads makes performance a key attribute for storage, and we note that different applications will have specific performance requirements. For example, while database and other transaction-sensitive applications need storage resources that can sustain thousands to millions of transactions per second, other workloads such as analytics and video need high throughput performance to provide access to massive files and objects. Performance consistency is another key attribute when evaluating storage resources, and intelligent shared storage systems need to be able to divvy up performance and capacity resources appropriately when occasional spikes of demand occur.

It is important to note that within a storage system, or cluster of systems, data placement is extremely important since it impacts the performance, reliability and effective cost of storing the workload data. Even within all-flash storage systems, there is a performance and cost differential between low-cost SATA SSDs and SAS SSDs and high-performance NVMe SSDs. With the rise of storage class memory (SCM) providing yet another medium that is even faster than NAND Flash SSDs, the need for intelligent data placement should continue to be a key attribute when evaluating next-generation storage systems and clusters.

As nodes are added to a cluster, the ability to load-balance the infrastructure resources at the storage performance and capacity level becomes more important since it ensures that idle capacity and storage processors are used to service critical workloads that need those resources immediately. Given that load balancing and data placement are time-intensive tasks, organizations should seek out platforms that intelligently detect workload and infrastructure changes and automatically optimize data placement to meet the changing needs of applications and business stakeholders.

The need for persistent storage also raises the stakes for data protection capabilities such as snapshots, replication, backup and disaster recovery. Even when it comes to non-mission-critical and non-business-critical workloads such as test/dev, organizations have minimal tolerance for downtime or data loss. The rising customer expectations for resiliency will only increase pressure on organizations to implement storage systems with rich data protection capabilities and the ability to automate the deployment of these features based on the importance of a particular workload.

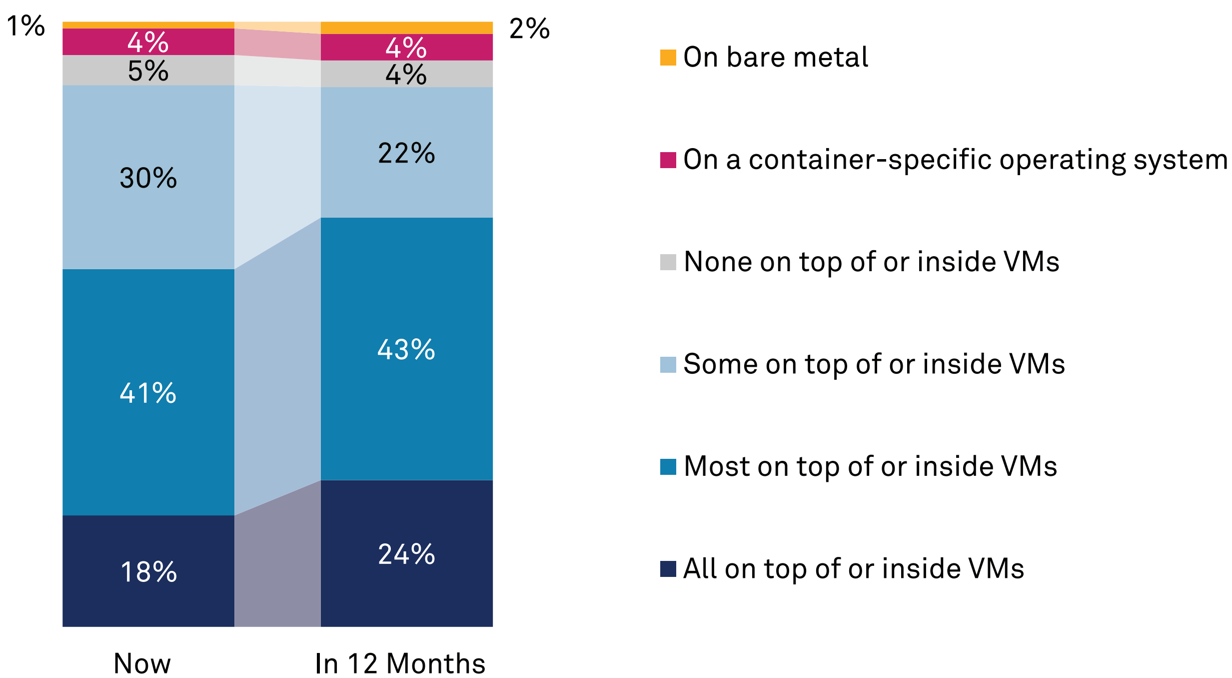
Containers Are Running in Mixed Environments

One key cloud-native cost benefit containers can provide is the ability to slice up the resources of virtual machines the same way VMs are used to slice up physical servers for greater density, efficiency and cost-effectiveness. It is unlikely that physical and virtualized environments will disappear any time soon. In contrast to the segregated physical and virtual infrastructure silos that still exist today, VMs and containers introduce an opportunity to create environments where resources can be shared and transformed based on current business needs.

Although containers provide benefits beyond what was previously available with VMs, the vast majority of respondents in our study said that these technologies will be running side by side into the foreseeable future. The security and isolation management for VMs is ahead of containers today, and organizations are also looking to maximize the use of existing infrastructure when possible to avoid the creation of additional infrastructure silos. In the study, 18% of respondents said they are currently running all of their containers on top of or inside a VM, but that figure increases to 24% in 12 months (Figure 4). In addition, **71% of the respondents reported that they are currently running most or some of their containers on top of or inside VMs today.**

Container-specific operating systems (4% of respondents) and bare metal (1%) represent emerging deployment models for the future, but at this point, neither of these implementations is close to mainstream adoption for the respondents in the study.

Figure 4: Where Organizations Are Running Containers, Now vs. in 12 Months



Q: Where do your containers run now? In 12 months?

Base: Users of containers/future container users

Source: 451 Research's Voice of the Enterprise: DevOps, Workloads & Key Projects 2020

Conclusions

Although cloud-native workloads have advantages that go well beyond the initial designs of traditional infrastructure in terms of provisioning speed, scalability and performance, next-generation infrastructures must still be able to support older technologies since they will not disappear any time soon.

It's important to choose a platform that provides:

- **A software-defined infrastructure that can support a variety of mixed workloads.** The majority of organizations today are running containers either side by side or on top of VMs, and this demands a flexible infrastructure that can integrate well with VMs and containers.
- **Support for bare-metal workloads.** This is important in a variety of markets, especially where high performance and mission-critical resiliency are required. Although bare-metal containers are still not mainstream, future infrastructures must be able to support them if they wind up becoming mainstream.
- **Flexibility to scale compute and storage independently in small increments.** Workloads come in a variety of shapes and sizes, which can be challenging for traditional infrastructures to handle simultaneously. While some workloads such as databases require high transactional performance with low latency, other workloads – some analytics workloads, for example – require high-throughput performance to rapidly ingest data. Data-centric workloads such as archiving and large-scale file repositories require a tremendous amount of storage scalability, though they do not often require high-performance CPUs and a large memory footprint, unlike their database counterparts. To satisfy these needs, organizations will need a flexible infrastructure that can meet all of these various requirements on demand in order to match the dynamic changes that take place in cloud-native environments.
- **Fluidity to avoid costly and disruptive migrations and upgrades associated with appliances.** A key advantage of software-defined infrastructure, as opposed to purpose-built appliances, is that organizations can easily add and replace hardware. In contrast, with traditional appliances, organizations typically run expensive and disruptive three-to-five-year refresh cycles. These require data migration to the new asset, as well as the retirement and sanitation (secure deletion to digitally scrub storage media of all traces of data) of the old systems to ensure that they do not unintentionally leak data when removed from the datacenter.
- **Automation that simplifies full lifecycle management and provides APIs for integration.** Automation continues to be a key requirement for organizations, but the lack of support for APIs often prevents them from automating the provisioning, management and optimization of infrastructure resources. In our Voice of the Enterprise: Storage, Transformation 2020 study, 39% of respondents said existing infrastructure that cannot fully support automation is their top IT automation challenge for their organization. Companies should seek out infrastructure platforms that can support a range of container management frameworks such as OpenShift, Tanzu, Rancher and 'vanilla' Kubernetes distributions.
- **Flexible consumption and billing.** The rise of cloud has made opex consumption models more popular in on-premises environments, which traditionally favored capex. To match this market transition, customers should seek out vendors that provide storage as a service or other flexible billing models that adjust cost based on the amount of resources consumed in a given month. This allows customers to cut costs when their workloads are idle and ensure they only pay for peak performance and capacity consumption when the organization needs it.

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Dell Technologies: Dell EMC PowerFlex

Dell EMC PowerFlex software-defined infrastructure is strongly positioned to support the needs of customers adopting Cloud-Native Workloads as described in this Special Report. PowerFlex supports physical, virtual, and container-based workloads while providing a common infrastructure foundation that handles heterogeneous workloads deployed across bare-metal, virtual, and containerized environments.

PowerFlex enables organizations to harness the power of software and embrace change while achieving consistently predictable outcomes for mission-critical workloads. PowerFlex is a dynamic foundation that delivers extreme flexibility, massive predictable performance, and linear scalability.

In addition to delivering high-performance block storage with rich data services, PowerFlex offers a simple yet comprehensive toolset for IT operations and lifecycle management of the entire infrastructure, helping automate local and third-party application workflows. It's the ideal foundation for organizations to modernize their datacenter, consolidate heterogeneous workloads, and build agile private and hybrid clouds.

You can find more information at:
https://www.delltechnologies.com/powerflex

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