

Hybrid Cloud Is The Foundation For Storage Agility And Economics

Proper Utilization Of Cloud And Enterprise Storage Will Dictate BT Success

by Richard Fichera

April 28, 2017

Why Read This Report

Hybrid clouds are the future state of compute and storage for enterprises in the age of the customer. Hybrid cloud storage can now blend on-premises storage infrastructure with public and hosted cloud services. Advances in storage solutions are paving the way for more organizations to properly and more easily use the powerful hybrid combination. Infrastructure and operations (I&O) professionals must balance cloud mobility and on-premises governance with hybrid cloud storage strategies that are optimal for their business technology (BT) agenda, not just convenient to implement.

This is an update of a previously published report; Forrester reviews and revises it periodically for continued relevance and accuracy. We're updating it now to reflect our latest research on cloud and enterprise storage.

Key Takeaways

New Cloud Connectivity Removes Previous Bottlenecks

The majority of cloud storage deployments were built either for cloud-native applications or to handle unstructured data for low-cost archiving and backup retention, but the physics of data transfer and limited tools have restricted flexibility and usefulness. A new generation of cloud integration options is removing these obstacles.

Global Namespaces And Policy-Based Migration Are The New Hybrid Cloud Frontier

The true value of hybrid cloud lies increasingly in being able to access content as part of a global enterprise/cloud namespace, facilitating transparent BT processes that allow access to content in the optimal location without artificial barriers. Both cloud and legacy storage vendors must adapt to make this a reality.

Hybrid Clouds Will Enhance Collaboration For Highly Distributed Organizations

Global file locking and caching techniques, combined with true global namespace capabilities, will allow clients to expand remote collaboration to more intensive workloads such as engineering and computer-aided design (CAD) while compensating for slow and inconsistent links at remote worksites and providing increased security and control of intellectual property.

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Related Research Documents

[Market Overview: Software-Only Storage](#)

[Velocity: The Only Storage Issue That Matters In The Age Of The Customer](#)

[What The Evolution Of Cloud Storage Means For I&O](#)

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Cloud Storage Workloads Have Diversified

I&O professionals can't build a comprehensive enterprise cloud compute strategy without first building a foundation based on hybrid cloud storage technologies. The elasticity and power of cloud compute and networking resources are game-changing capabilities to win, serve, and retain customers.

However, these services will have limited use beyond test and development scenarios if you can't leverage your company's or partner's enterprise data in ways that are consistent with current and planned business processes. You must also be able to migrate existing workloads and their related data to and from multiple cloud environments.

Cloud Is Far More Than Just Another Storage Tier

Enterprises have largely treated cloud storage resources as complementary storage silos to support next-generation analytics and systems-of-engagement cloud applications, particularly for data generated in the cloud, and to offload menial unstructured storage burdens. But cloud storage has much more to offer. Next-generation hybrid cloud storage technologies are already available and ready to bridge the gap between your on-premises applications and resources and cloud storage services by simplifying workload mobility and cloud federation between service providers. Additionally, the improved flexibility of these solutions is enabling more advanced use cases beyond the traditional niche as secondary storage for unstructured data and storage for cloud-generated data.

Cloud Storage Is Viable For Many Purposes — If You Respect Physics

The footprint of enterprise data resident in cloud storage services has grown dramatically with the popularity of file sync and share and object storage services such as Amazon S3, Google Cloud Storage, and Microsoft Azure.¹ Still, physics and wide-area network (WAN) latency have limited the use cases for cloud storage. Conventional on-premises enterprise applications — such as databases — are designed with the assumption of proximity between compute and storage resources and expect latencies on the order of milliseconds that aren't possible over WAN links. Despite these limitations, cloud storage is now a viable candidate for many more workloads than it's ever been, including:

- › **Secondary storage for unstructured data.** “Cheap and deep” storage was an early driver for the adoption of cloud storage, but organizations have recently also leveraged the networking resources of hyperscale object storage services such as Amazon's S3 to facilitate the delivery of storage services to mobile devices and users. WAN latencies on the scale of hundreds of milliseconds are tolerable for the retrieval of documents and other forms of unstructured data, and for latency-sensitive applications, using premium high-speed connection options can further reduce access times, either directly or through a hosting or colocation provider.

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- › **Backup, archive, and secondary storage for “nonoperational” data.** Some classes of structured storage — data that’s nonoperational and doesn’t require low-latency retrieval — are good candidates for cloud storage if the economics are appropriate. Over the past 24 months, major enterprise backup and recovery vendors such as Acronis, CA Technologies, Commvault, Rubrik, Veeam, Veritas, Zerto, and others have improved and expanded their cloud connectivity options.
- › **Disaster recovery (DR).** Cloud storage, which is a natural extension of the use of cloud for backup, especially in a highly virtualized environment, has become an integral option on full-function DR capabilities, and all major disaster-recovery-as-a-service (DRaaS) providers provide cloud options as both storage targets and recovery environments.²
- › **Cloud storage for cloud compute.** The addition of all-flash storage service offerings such as Amazon Elastic Block Store Provisioned IOPS or Google’s SSD Persistent Disks provides high-performance, block-level storage for running cloud compute applications. While this capability has made it possible to create transactional applications in cloud environments, only cloud compute instances residing in the same cloud and availability zone can use these block storage services.
- › **File sync and share.** In addition to the specialized use case of mobile devices and users, cloud storage serves as the hub for enterprisewide file synchronization and sharing, solving a pernicious problem that’s plagued many industries — how to provide controlled, secure, and efficient sharing of enterprise data across a distributed user population. Today, multiple vendors, such as Avere, Nasuni, and Panzura, all use different combinations of locking, replication, and caching to provide efficient and logically consistent access to shared file resources, including combinations of on-premises and cloud resources. File sync and share solutions are the first place in which a consistent global namespace across clouds becomes attractive, but the utility of this concept will rapidly spread to other use cases as well.

Location Matters: Drawbacks To A Mass Cloud Storage Migration

The rapidly falling price of cloud storage services is pushing organizations to migrate away from expensive conventional storage systems and toward cloud storage services. While cloud storage should absolutely be a part of your future storage infrastructure, keep in mind a few limitations, including these:

- › **Long migrations create lock-in.** The untimely collapse of Nirvanix forced its clients to hastily move away from its cloud storage services, shocked early adopters, and clearly highlighted the need for cloud federation and data migration services.³ Long-distance data migration continues to be a struggle for enterprises, specifically those with large workloads in the scale of hundreds of terabytes to petabytes. The inconsistent network connectivity commonly found in remote sites exacerbates this. Data transfer across IP networks can take a significant amount of time when data payloads go beyond 100 TB (see Figure 1). The cost of outbound bandwidth and time associated with migrations are deterrents that make cloud migrations difficult and effectively lock in clients to a provider unless they use some form of local data transfer appliance, such as Amazon’s Snowball (up to 80 TB per transfer) or Snowmobile (up to 100 PB per transfer).

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- › **Security and compliance may raise questions.** Cloud security is, paradoxically, a major strength and driver of cloud adoption when compared with the security of the average enterprise. It's also still the top impediment to full-scale cloud service adoption, though the steady stream of improvements that cloud providers are making to their environments is countering this objection.⁴ Ultimately, enterprise storage teams are hesitant about handing over control of data to cloud providers and use security and compliance concerns to slow down cloud deployments, a defensive behavior that Forrester believes is harmful to the business — while there may be valid economic arguments for and against cloud storage, overall security of cloud providers is superior to that of the average enterprise. On the compliance front, data residency requirements have become increasingly onerous, catalyzing on-premises solutions as well as specialized cloud environments with guaranteed data location controls.
- › **Poorly understood storage access patterns can lead to sticker shock.** Most cloud storage providers have pricing models that charge for static storage of data as well as movement out of, and sometimes between, different classes of storage within the cloud. Many enterprise storage groups struggle with the basics — how much storage they have, the growth rate, and what SLAs they require for different classes and applications. They've never had to consider the patterns of access and movement of storage, and when they transfer their storage to the cloud, their access patterns can generate unpleasant surprises when all the fees for data movement show up. A major factor in determining eventual data location is the ability to selectively retain data in an on-premises environment where economics aren't sensitive to potentially pathological patterns in the cloud.

FIGURE 1 Big Data Migrations Take Time And Bandwidth

Connectivity	Time to transfer 1 TB	Time to transfer 100 TB	Time to transfer 1 PB
10 Gbps link	12.42 minutes	20.7 hours	8.6 days
1 Gbps link	124.18 minutes	8.6 days	86 days
100 Mbps link	21 hours	88.3 days	883 days

Note: These times are based on theoretical rates. Actual transfer times will be two to three times longer.

Evolving Colocation And Caching Strategies Pave The Way To Workload Migration

While the physical limitations of rapid data movement can't change, progressive enterprises and service providers have come up with clever new strategies to put compute and storage resources closer together, including:

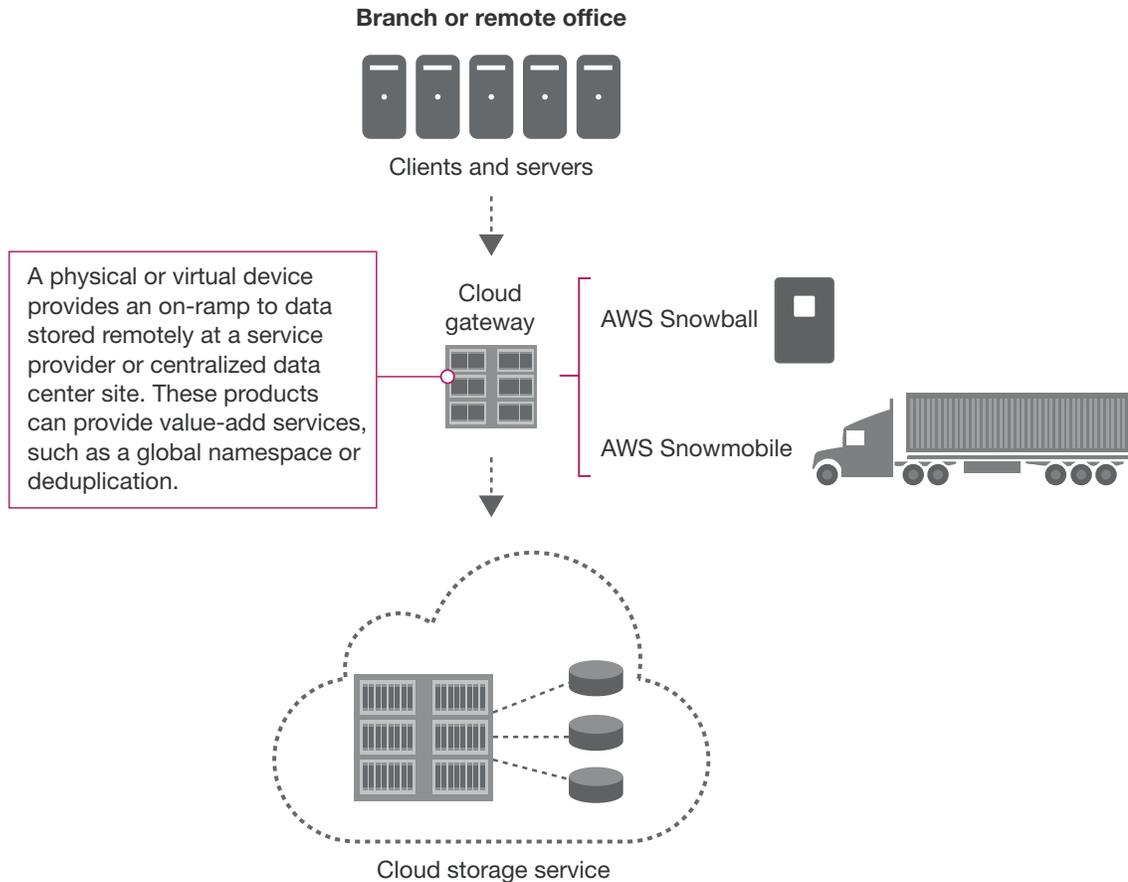
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- › **Accelerated network connectivity with colocation.** A handful of colocation and data center providers, such as CoreSite, Equinix, and others, have facilities that either are physically close to a cloud service provider or house an instance within the data center. This proximity allows customers to bypass the internet and connect directly to their cloud service providers. Fees are often for a flat monthly rate, via fiber-cross-connections at port speeds of 1 gigabit per second or 10 gigabits per second. They can provide sub-millisecond latency, since such networks bypass the internet. This is fast enough for the majority of enterprise applications.⁵ Amazon Web Services' (AWS's) Direct Connect emerged in 2011 as a means of accelerating data movement, and its initial partner, Equinix, demonstrated that Direct Connect can transfer files to Amazon 138% faster than public internet connections.⁶ The upshot of the development of Direct Connect and competing Direct Peering from Google and ExpressRoute from Microsoft Azure has been the development of rich, value-added ecosystems based on connectivity between the major services and a community of other cloud service providers (CSPs), software-as-a-service (SaaS) vendors, and other online services.
- › **Cloud controllers.** These devices have been on the market for a few years and, while they're deployed in only a small fraction of enterprises, use of them has been growing rapidly, with all vendors regularly reporting continued gains in customer count. Cloud controllers are virtual or physical devices that sit on-premises at a client's site and funnel data off to cloud storage services or object storage systems (see Figure 2). These systems provide local caching to minimize the amount of data that must transfer from cloud storage over internet links. Forrester predicts a continuation of rapid growth in this space in 2017, with the accelerating growth of current players CTERA Networks, FalconStor, Nasuni, Panzura, and Talon; new entrants such as ClearSky and ElastiFile; and the major storage and cloud players making acquisitions in this space. These include EMC's acquisition of TwinStrata and Virtustream, Microsoft's acquisition of StorSimple, and NetApp's acquisition of Riverbed Technology's SteelStore gateway. One cloud on the horizon, so to speak, for the cloud controller vendors is the rapid development of embedded S3 cloud gateways in on-premises storage arrays, which will subsume some of the functionality of current cloud controllers, forcing them to look for new value beyond the cloud tiering of data.⁷
- › **Migration appliances.** In a nod to the physics of high-volume data transfer, cloud storage providers are experimenting with hybrid approaches to cloud migration, such as AWS's Snowball and Snowmobile migration appliances, and at least one startup is working on advanced modular data transfer technology for high-volume enterprise and cloud environments. Forrester believes it's only a matter of time until both Azure and Google have matching offerings to Amazon's appliances.⁸

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FIGURE 2 Migration Appliances, Cloud Gateways, And Controllers Funnel Data To Clouds

Raise Infrastructure To The Next Level With Hybrid Cloud Storage

Improved data sharing, mobility, and elasticity are the fundamental benefits for hybrid cloud storage environments. By leveraging accelerated networking and cloud gateway caching technologies, organizations are now able to expand the flexibility of their cloud deployments.

A True Hybrid Marriage Of Public Cloud And On-Premises Storage Is Now Feasible

While cloud gateways and network-accelerated colocation have been around for a few years, they're just now getting closer to mainstream adoption for enterprises. By the end of 2017, the near-ubiquity of S3 interfaces on on-premises storage solutions will accelerate mainstream adoption. Most vendors will provide at least a basic CRUD (create/read/update/delete) interface with the ability to perform policy-based or explicit tag-based tiering to an S3 cloud. Vendors will differentiate by the way they apply

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policies; the simplicity of their (ideally) single namespace, encompassing cloud and local resources; and their economics. These technologies will be key enablers for the next wave of hybrid cloud deployments, allowing much tighter logical integration of on-premises and cloud-based storage.

Shared Storage Unlocks The Full Potential Of Hybrid Clouds

- › **Understand your current environment.** To plan an optimal hybrid storage program, I&O groups must have full information about their current storage — how much they have, where it's located, growth rates, life-cycle and governance considerations, and access patterns. Surprisingly, many Forrester clients don't yet have a detailed picture of their current storage environment, and our consistent counsel to them is to acquire and implement storage management software for discovery of their environment. While they could also do this as a services engagement, the need for continual visibility into the storage environment strongly suggests establishing this as an internal process.
- › **Segment your data between operational and archival data.** This is a crucial first step to building a robust and efficient data architecture. At the heart of many cloud architecture discussions are the issues of costs and access — cloud storage is complex because users generally pay for movement of data, and sometimes access frequency, in addition to raw capacity. Differentiating between data required frequently or rapidly and long-term archival data is critical in any hybrid cloud/enterprise storage design. Frequently accessed data includes file versioning chains, recent snapshots, and disaster recovery/business continuity (DR/BC), while users may need access to archival data only at infrequent monthly or annual intervals or on an event-driven basis, such as eDiscovery.
- › **Create a stepping stone to clouds.** The shared storage cloud deployment allows customers to apply familiar enterprise storage feature sets such as volume sharing, optimization (compression/deduplication), and application integration to their cloud workloads. The costs of these deployments will be substantial, since they entail storage system, physical rack space, and networking costs. On the positive side, for burst and seasonal workloads, organizations should see a significant cost savings for compute since they'll be taking advantage of the elasticity of cloud services. Risk-averse enterprises can justify the cost of the deployment by emphasizing the ability to leverage familiar data protection and storage management capabilities while learning how to optimize workloads in cloud environments. Also, switching cloud providers is likely at some point in the future, so consider colocation networks to make the switch easier.
- › **Add shared storage to accelerate cloud performance.** By placing enterprise storage systems in colocation facilities with accelerated network connectivity — such as AWS Direct Connect or Microsoft's Azure ExpressRoute — machine instances in clouds will be able to access data at the colocation site without forcing a data migration. The initial instances of these deployments, epitomized by early mover NetApp, were created to provide a higher performance alternative to cloud storage services like Amazon EBS. Subsequently, multiple vendors, including Avere, ClearSky, ElastiFile, Microsoft (with a product tied to Azure), Nasuni, Veritas, Zadara Storage, and others, have put markers down in this rapidly growing segment.⁹

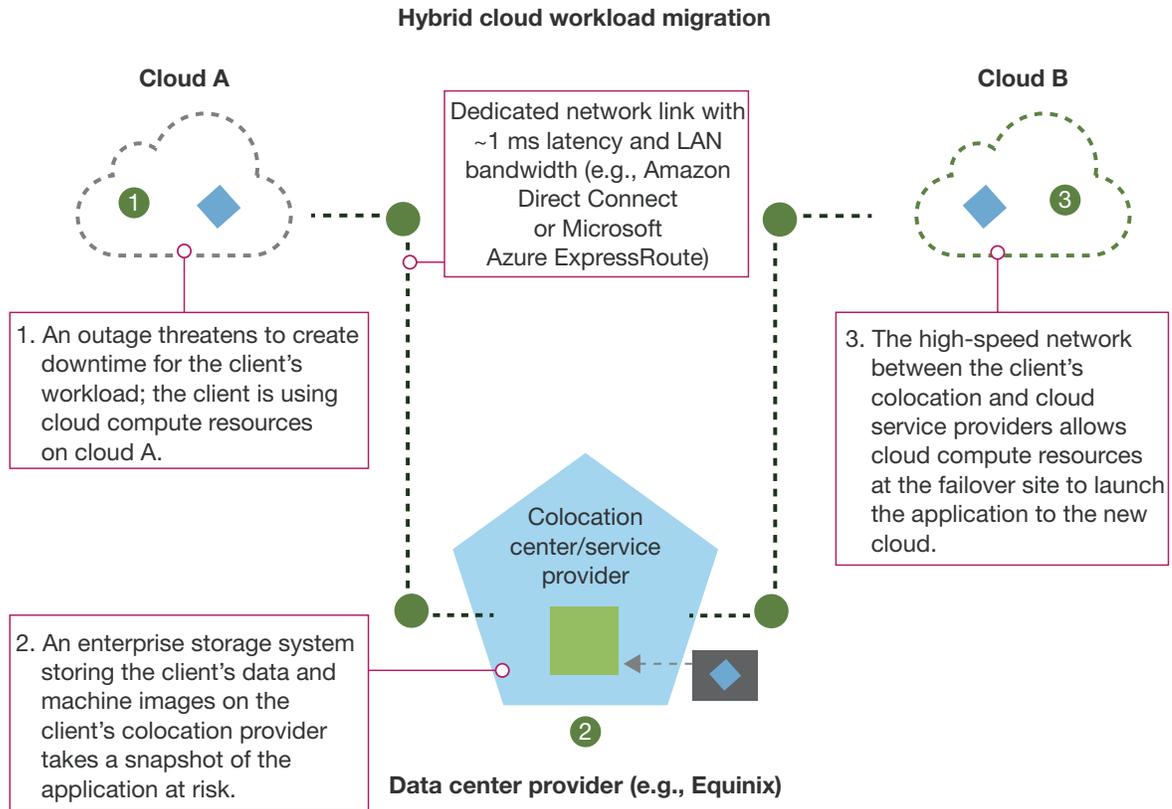
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- › **Facilitate failover across clouds.** The ability to failover workloads across clouds has finally come to fruition, with a number of options available to move data and processing between multiple clouds. Prior to 2016, we saw initial demonstrations of this deployment that allowed workloads to failover from one cloud to another without data movement, and during 2016, this became a commercial reality (see Figure 3). The principles behind how this layout works are similar to how Microsoft's Virtual Machine Live Migration and VMware's vMotion migrate virtual machines (VMs) between physical servers by changing access rights and presenting the data set to the replacement server. In the colocation site, the high-speed connectivity options available provide low-latency access and performance on 10-gigabit ethernet links comparable to conventional Fibre Channel storage area networks (SAN) links. This makes workload migration possible across clouds but may entail additional complexity in terms of multicloud data management, which is an emerging competitive differentiator among the various legacy and emerging storage providers.
- › **Tap into hybrid cloud compute.** The data-sharing capability of these hybrid storage architectures will facilitate hybrid compute. Given the rapid evolution of services in cloud environments, presenting shared storage to new cloud compute or analytics services gives organizations the ability to tap into these services without migrating their entire data set to a particular cloud.

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FIGURE 3 Leverage Hybrid Cloud Storage To Mitigate Workloads Without Moving Data**Accelerate Collaboration With Caching And Global File Locking**

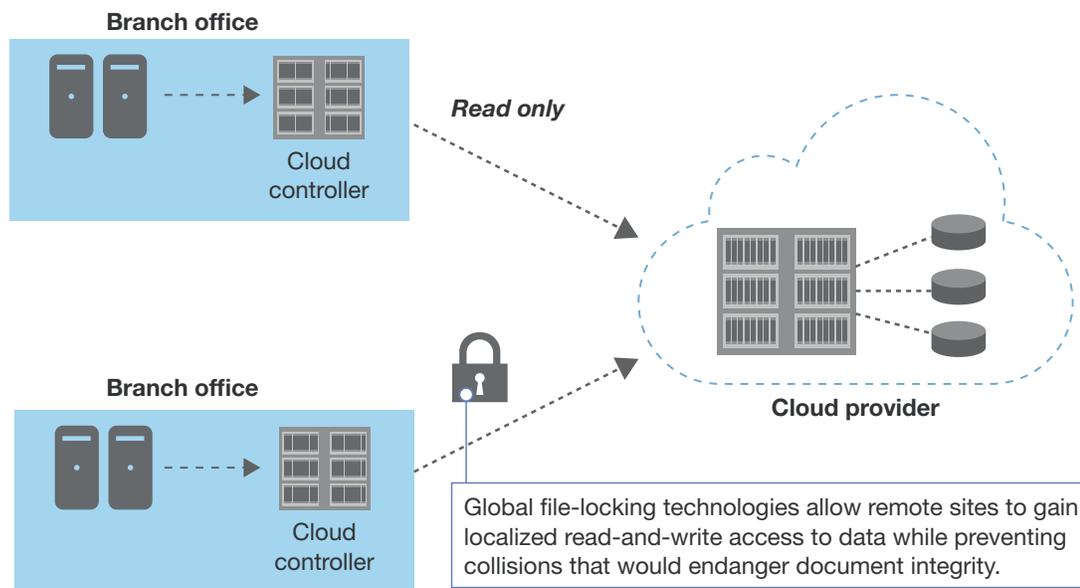
Sharing large files at remote sites is a difficult problem with which many sites still struggle. This problem only gets worse when users at remote sites need to simultaneously edit the same file set. Global file locking is a feature that cloud controller vendors have added to combat this issue, which has been an acute problem for clients with architecture, engineering, and construction (AEC); genomics; media and entertainment; and other applications that require multiuser access to large files. Technologies such as intelligent local caching and file locking are powerful because they can provide:

- › **Latency reduction.** Latency and packet drops cripple data access for remote sites. For example, in the architecture and construction space, C&S Companies, using Panzura controllers, reduced its file open access time from 22 minutes to 8 seconds by leveraging the caching and global file locking capabilities of the gateways (see Figure 4).¹⁰ C&S used the deployment with key ACE applications such as AutoCAD Civil 3D, Bentley MicroStation, and Revit, which slow down because of the thousands of roundtrip transactions required to open, lock, and close files. With files that are highly active, global file locking can prevent accidental file corruptions and collisions, since only one user will be able to have write access at any given time.

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- › **Global data access at remote offices.** J. Walter Thompson, a WPP company, turned to CTERA Networks cloud gateways to provide data access when political instability at its offices in the Middle East forced its office workers to relocate.¹¹ The firm centralized the data storage for its eight Middle Eastern offices and 800 employees, using Amazon S3 cloud storage, and leveraged the security capabilities of the cloud to allow the country manager of each office to control its data sets to meet the company's compliance guidelines. The caching provided by the devices enabled data access despite expensive and inconsistent broadband lines that were available to the offices. It also facilitated data capture at the remote sites, which was invaluable since there are high employee turnover rates at these sites. J. Walter Thompson claims that it was able to reduce costs by 63%, compared with its previous tape-based backup deployed at the branch offices.

FIGURE 4 Global File Locking Can Enhance Collaboration On Cloud Storage**Recommendations****Embrace Hybrid Architectures To Optimize A Cloud-Enabled World**

Clouds, and the workloads they house, are getting larger and more business-critical on a daily basis. Beyond raw scale, you must leverage new strategies and technologies and supercharge your hybrid cloud storage strategy to keep pace with innovation. To help make this evolution to hybrid cloud storage a smooth one, I&O leaders must forge a strategy that:

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- › **Facilitates cloud mobility.** The cloud computing market continues to evolve rapidly, with new services and price wars increasing competition. Any supporting hybrid cloud storage strategy should leverage resources such as AWS Direct Connect, Azure ExpressRoute, NetApp Private Storage for Cloud, and Zadara Storage to make data available to multiple cloud services.
- › **Prioritizes resiliency.** Cloud service outages continue to occur, and we don't expect them to end any time soon. As mission-critical and business-critical workloads make their way into the cloud, your teams should leverage multiple availability zones and colocation sites to ensure that workloads can continue to function in the event of a failure. Also, employ cloud backup solutions to protect data, regardless of its location.¹²
- › **Is mindful of bandwidth costs.** Premium network charges for DirectConnect and similar offerings will save time if large data sets must move to or between clouds, but you need to compare costs with other approaches such as lower bandwidth connections and physical media shipment. Migrations should be cost justified and planned accordingly because these operations could take days or weeks to complete. While inbound data charges have disappeared over the past few years, the fees for outbound network traffic can become significant, and architects need to understand the locality of generation and processing of application data to avoid these costly transitions.
- › **Classifies and optimizes workloads.** While new deployments such as NetApp Private Storage are bringing powerful data sharing capabilities to the mix, these deployments can become costly, as they require a number of expenses, such as colocation space, networking charges, and the deployment of a storage system. Prioritize the workloads that require hybrid cloud computing capabilities and failover for the shared storage deployments at colocation sites and leave less intensive workloads in the cloud to control costs — if they're indeed cheaper in the cloud. To ensure an optimal fit, understand your storage access patterns and SLAs and implement a continual monitoring and optimization process.
- › **Takes security and governance into account.** The security and governance of data in cloud environments is a shared responsibility between clients and their service providers. You can hold the providers responsible only for securing the basic infrastructure, which they do extremely well. You're still liable for your application, governance, life-cycle management, and key metadata for configurations and dependencies. As your organization's use of cloud resources expands across geographies and service providers, security must meet the same standards of your primary data centers.
- › **Tests failover and workload migration operations often.** The pay-as-you-go pricing of cloud computing will allow you and your team to test workload migration without a costly hardware expense. Test early and often to ensure that your DRaaS and cloud deployments are configured correctly and can handle the workload when a migration or failover is necessary.

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What It Means

Cloud Forces A New Architectural Approach To Everything

Cloud services are inevitable because they bring profound benefits. The classic approach to business service design and application architecture simply won't work. The drawbacks of cloud can heavily offset its benefits — most notably, the unresolvable limitations of simple physics. Scientists haven't yet been able to overcome the speed of light, and Einstein has suggested they never will. It's crucial to develop a solution that doesn't depend on brute force throughput over relatively slow and inconsistent WAN links.

Another solution involves more sophisticated architectures that sensibly locate compute and storage resources near one another and limit long-distance communications to more lightweight demands.¹³ I&O professionals have understood these principles for years and implemented them in select situations, but cloud is forcing everyone to embrace them more and to alter their concepts of distance to embrace the costs and overhead of moving data in and out of the cloud as well as across their own networks. This is a good thing, but it will require extra work on the part of I&O professionals, application developers, and enterprise architects, among others. Focus more of this effort on newer systems of engagement and postpone legacy services and systems of record, maybe indefinitely. Rushing these older services into cloud models can prove downright destructive. I&O professionals should evolve to cloud quickly — but responsibly.

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

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Panzura

Talon Storage

Pure Storage

Zadara

Qumulo

Endnotes

- ¹ In addition, there are now hundreds of niche second-tier cloud storage offerings. The de facto adoption of Amazon's S3 API protocol is the foundational API that enables this wide ecosystem. S3 is a complex protocol whose documentation runs to 100 pages, with complex functionality that not many vendors fully support. But they widely support the basic CRUD (create/read/update/delete) semantics.
- ² For more information on the DRaaS market, as well as a breakdown of vendor capabilities, see the Forrester report "[Vendor Landscape: Disaster-Recovery-As-A-Service Providers, Q4 2016.](#)"
- ³ For more information on the Nirvanix collapse, see the Forrester report "[Quick Take: How Enterprises Should Approach Cloud Storage In The Wake Of Nirvanix Closure.](#)"
- ⁴ For more information on cloud drivers and challenges, see the Forrester report "[Adoption Profile: Public Cloud in North America, Q1 2017.](#)"
- ⁵ For more information to help you decide where, how, and why to locate data center facilities, see the Forrester report "[Strategically Locate Your Next Data Center.](#)"
- ⁶ Source: Sean Iraca, "AWS Re-Invent: Network-Ready Your Hybrid IT Environment," SlideShare, November 19, 2013 (<https://www.slideshare.net/AmazonWebServices/networkready-your-hybrid-it-environment-ent108-aws-reinvent-2013>).
- ⁷ Currently, EMC, NetApp, Nimble Storage, Pure Storage, and the majority of object storage vendors offer S3 back ends (cloud gateways) that allow policy-based tiering of data to multiple S3-compatible cloud services. Forrester believes that by the end of 2017, S3 cloud gateways to provide tiering to multiple cloud systems will be a de facto standard feature of on-premises storage arrays and hyperconverged systems.
- ⁸ AWS's Snowball appliance also has the ability to execute a limited subset of AWS functions locally against its data, opening the possibility of integrated enterprise-cloud compute environments. Considering the potential for AzureStack to implement a truly integrated hybrid enterprise-cloud compute and storage stack, Forrester believes that this space will develop rapidly in 2017.
- ⁹ ClearSky Data is an interesting variant on the notion of hybrid storage, in that it's an end-to-end managed service with on-premises appliances integrated with a private hosted storage cloud. Zadara also uses its own dedicated resources to provide the cloud component of its solution.
- ¹⁰ In C&S's deployment, the 22-minute to 8-second access reduction was for accessing files (1.5 MB files) from California to remote workers in New York over a 10 Mbps WAN link. Source: "C&S Companies: C&S Eliminates CAD Latency, Improves Performance with Panzura," Panzura (<http://go.panzura.com/rs/panzura/images/Panzura-CS-C%2BS.pdf>).
- ¹¹ Source: "JWT Saves 63% on its Backup Solution Running with CTERA on AWS," Amazon Web Services YouTube video, March 18, 2015 (<https://www.youtube.com/watch?v=gski-yRXHpQ>).
- ¹² For guidance on cloud-to-cloud backup options, see the Forrester report "[Back Up Your SaaS Data — Because Most SaaS Providers Don't.](#)"
- ¹³ For a detailed breakdown of the important principles of this new architectural approach, see the Forrester report "[Edge Computing: IoT Will Spawn A New Infrastructure Market.](#)"

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