DELL EMC

ACCELERATING DIGITAL TRANFORMATION AT A LOWER TCO THAN PUBLIC CLOUD

Comparing On-Prem Object-Storage-as-a-Service with Public Cloud Storage Services

ABSTRACT

This white paper provides businesses with information needed to compare the benefits of on-prem Object-Storage-as-a-Service powered by Dell EMC® Elastic Cloud Storage (ECS™) with public cloud storage services. The paper also demonstrates how a fair pricing comparison can be made from ostensibly different offers, by reducing and comparing at a single Cost of Service metric.

July 2017

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EXECUTIVE SUMMARY

Digital Transformation is changing today's business landscape, with technology helping organizations provide customers with new services and products. Digital Transformation offers an opportunity for strong, long-term growth through new business-models, new revenue streams, and ultimately more satisfied and engaged customers. Companies that are able to harness digital technology to transform themselves will flourish. On the other hand, laggards will run the risk of experiencing rapid market disruption, and being marginalized by fast moving competitors. The new world of Digital Business, along with the advent of the Internet of things (IoT), Big Data, Automation and development of cloud-native web and mobile applications has resulted in the proliferation of data, which is rapidly becoming a critical asset for businesses. These new applications are not only disrupting traditional business models, but also generating unprecedented amounts of data. IDC estimates that data is roughly doubling every two years. By 2017, 80% of this data will be of the unstructured variety. The nature of unstructured data makes it unsuited for traditional storage platforms.

Object storage introduces a new architecture that manages data as objects in one global flat system containing rich metadata, as opposed to file systems architectures, which manage data as a file hierarchy. As organizations use storage to capture, store and use vast amounts of unstructured data, they are faced with challenges of complexity at scale, increasingly long provisioning times, and redundant layers of technology for resilience and global access.

In the face of these challenges, public cloud storage offered by Amazon Web Services (AWS), Microsoft Azure and others have quickly become a very popular option for storing and accessing data. However, despite its many advantages - low up-front investment, negligible set-up time, and on-demand capacity – public cloud storage poses its own unique challenges, especially at high storage capacity levels.

IT organizations must weigh the costs and benefits of consuming cloud storage from the public cloud or deploying an on premises object storage solution. Considerations span a variety of factors, such as capacity, capability and economics. Additionally, organizations should take into account latency, predictability of expenses, centralized compliance and governance of data, etc.

This paper aims to help organizations understand the implications of utilizing public cloud storage vs. an on-premises object storage platform. The paper compares a leading public cloud storage offering with an on-premises storage-as-a-service offering built with Dell EMC's Elastic Cloud Storage (ECS). As Dell EMC's third generation object-based storage platform, ECS is uniquely suited to help create an Object-Storage-as-a-Service offering, at price points lower than those of major public cloud storage vendors. Additionally, ECS provides the significant technological advantages over public cloud storage environments as a platform for cloud-native applications.

ASSESSING PUBLIC CLOUD STORAGE

In many organizations, IT plays a critical role in the embrace of Digital Transformation. However, in cases where IT cannot move fast enough to meet the needs of the business, it can also be seen as a roadblock to the same transformation. Often, the difference between the two lies in the technology infrastructure, with storage being a critical differentiator, especially in light of the explosion in amount of data being generated by todays' digital businesses. Traditional storage platforms, while still a critical part of any organization's IT infrastructure, are beset by a number of challenges, which when taken together can lead to a lack of agility in responding to business needs. It's no surprise that business units (BUs) end up looking to public-cloud vendors for their needs, leading to instances of "Shadow IT" cropping up in various parts of the company.

Public cloud storage offerings such as AWS S3, Azure Blob Storage, etc. have seen rising adoption over the last few years owing to a variety of reasons.

BENEFITS OF PUBLIC CLOUD STORAGE

- **Ease of provisioning:** Public cloud providers like AWS and Microsoft Azure have significantly lowered the barriers to getting IT infrastructure up and running. Through use of self-service portals, organizations often need nothing more than a credit card to get started.

- **Elasticity to scale:** With the public cloud, organizations can scale up by adding more storage as their data grows. Capacity can be easily added by using the providers' self-service portal, and the added storage is usually available for immediate use.

- **Low upfront costs:** One of the most commonly cited benefits of public cloud storage is the ability to spin up large amounts of storage capacity without the need for large upfront investments or CAPEX (capital expenditure). This can be an enormous benefit for small businesses or startups that typically do not have as much cash on hand as enterprise organizations.

- **Flexibility of Utility Pricing Model:** In the public cloud, organizations only pay for the storage they use. Therefore, if they are consuming only 6 TB of storage, that's what they would have to pay for. Organizations that are not expecting to utilize a large amount of storage can benefit from this "pay as you go" model. Additionally, companies receive monthly bills for their use of storage services, which allows them to move to an OPEX (Operational Expenditure) model. This can be attractive to companies that are looking to reduce their CAPEX footprint.

Despite these advantages, organizations that are using public cloud storage are finding that adoption of these services also requires navigating some fundamental tradeoffs.

CHALLENGES WITH PUBLIC CLOUD STORAGE

- **High cost over time:** Despite low "cents/GB per month" advertised costs, the actual costs of storing large amounts of data in the cloud can add up very quickly as you access, analyze, modify or move data. Public cloud providers have a long fine-print list of charges for accessing data, manipulating data or using tools outside of pure storage including network access that add unpredictability to the cost structure.

- **Unpredictable monthly bills:** The cost of public cloud storage depends on the amount of data stored, as well as data access patterns. This can lead to unpredictable costs from month to month, making it difficult for organizations to plan for and forecast IT spend accurately.

- **Data residency concerns:** Depending on the industry and countries a business operates in, there can be data residency issues related to keeping enterprise data in the cloud.

- **Potential for vendor lock-in:** Once in the cloud, migrating large amounts of data off a public cloud platform is extremely costly and difficult. This can lead to lack of flexibility for organizations if the changes in the business landscape require a change in direction.

OBJECT-STORAGE-AS-A-SERVICE: A CRITICAL ENABLER FOR DIGITAL TRANSFORMATION

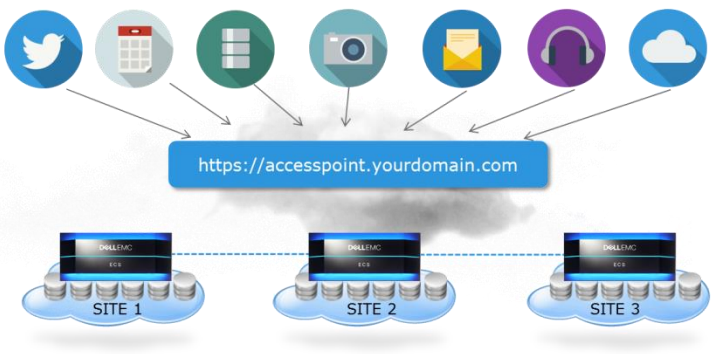
IT teams in enterprise organizations today provide a catalog of services to their BUs, such as Infrastructure-as-a-Service (IaaS), Database-as-a-Service (DBaaS) and Desktop-as-a-Service (DaaS). Object-Storage-as-a-Service is a critical addition to this catalog for IT teams looking to be enablers for their company's Digital Transformation. IT organizations can offer their BUs a solution that provides public-cloud benefits such as portal-based access, rapid provisioning, scalability and simplicity, but at a lower cost, and without the data residency concerns.

FEATURES OF OBJECT-STORAGE-AS-A-SERVICE

Deploying an Object-Storage-as-a-Service solution can address traditional archive and data silos, which are inefficient and complex. Object-Storage-as-a-Service enables the provisioning of a multi-site, active/active architecture with a single global namespace. Geo-protection optimizes remote access, and small-file optimization ensures storage efficiency. Objects are written once and can be read many times; updates to the data results in the creation of a new version of the object.

- **Self-Service Portal:** Object-Storage-as-a-Service offerings provide a public cloud like experience through a web-based self-service portal. This portal allows users to create credentials, associate themselves with a cost-center, and create storage capacity for their apps or workloads without having to create IT tickets.

- **REST-based API Interface:** An Object-Storage-as-a-Service platform makes data access much easier through the use of a simple REST-based interface (usually S3). It also makes it simple to share data across many different platforms and development technologies.



With REST-based APIs, developers can build applications that use data storage over HTTP such as the Amazon S3 API interfaces. Furthermore, data can be read from any location using a single URL-based gateway for users.

- **Anywhere data access:** For enterprises with many locations and branches, Object-Storage-as-a-Service provides location independence and allows for the decoupling of servers and applications from where the data resides. This is critical for enterprises with extensive data access from mobile devices and distributed locations. Users can access their data from a gateway or URL where every transaction is authenticated, validated, and tracked. The gateways reside at the edge of the architecture and then synchronize data queues to the object store. In addition, the service allows users to write files from one location to another using the HTTP protocol - a practice that would likely incur additional charges with a public cloud provider.

- **Chargeback/Billing:** Usage of the object store is monitored constantly, and users are charged only for the storage capacity they use. Depending on how an organization sets up chargeback capabilities, cost centers can be billed at regular intervals, e.g. monthly for the storage they consume in a given month.

- **Encryption:** The Object-Storage-as-a-Service architecture automatically stores, encrypts and makes data available across multiple enterprise sites. All data written into the object store is AES 256-bit encrypted to protect data. Only the bucket and object owners originally have access to objects they create.

- **Data Protection:** Object store data is protected from multiple failure conditions. The solution protects data locally using mirroring and erasure coding, which enables multiple paths for recovering lost data via multiple parities. This approach protects against broken components and complete site outages. The solution is designed for extremely long-term data retention without the need for external data backups. The architecture is designed to be redundant and resilient and provides a multi-site availability model for 99.99999% durability.

- **Compatibility with object protocols like S3:** On-demand object platforms are compatible with the AWS S3 protocol (or other object protocols like OpenStack SWIFT), so applications can interface with the object store in the same way they interact with storage platforms in the public cloud. Applications make programmatic calls through the API using the credentials created through the portal.

ADVANTAGES OF OBJECT-STORAGE-AS-A-SERVICE OVER PUBLIC CLOUD STORAGE

ECS is a software-defined object storage platform built to help manage the explosive growth of unstructured data. It helps lower operational costs with unmatched storage efficiency, resiliency and simplicity, and is uniquely suited to be the backend of Object-Storage-as-a-Service platforms. ECS is very effective for global content repositories—tiering and storing data for archive and backup purposes. Traditional storage solutions have difficulties with storing large amounts of small files, sharing the data globally, and handling low-level replication logic. By contrast, ECS provides anywhere access to geo-replicate content and can cost-effectively store petabytes of large and small files. In addition, while many open source competitors do not have meta-data search, NFS access, or HDFS (Hadoop Distributed File System) support for analytics, ECS provides native support for all three access protocols.

With ECS, organizations can build an Object-Storage-as-a-Service offering that can help them realize the benefits of public cloud storage without the challenges.

LOWER TCO THAN PUBLIC CLOUD

There are many reasons for the adoption of public cloud storage, but few are as commonly cited as the perceived low cost. Public cloud storage services like AWS S3 have a strong economic appeal due to the lack of an upfront investment, a pay as you go model, as well as low $/GB/month pricing. However, as their storage footprint on public cloud services grows, organizations often find that they are surprised by the amount of money they end up spending. At high storage capacity levels, recurring monthly payments can add up, and factors like data access costs and support can have a significant impact on Total Cost of Ownership (TCO) of public cloud storage.

Let's take a look at the cost drivers for a public cloud storage service like AWS S3, and how they impact TCO over a sustained period.

- **Cost of Storage:** As it is presented in a "cents/GB/month" format, the price of a service like AWS S3 appears to be quite low at first glance. However, what happens when an organization pays this low cost as a recurring charge for large amounts of data? Quite simply, the costs add up very quickly. Most organizations are surprised to find that storing even 1 Terabyte (TB) of data on AWS S3 over 3 years can cost more than $1000. Enterprise organizations that are looking to tier multiple Petabytes (PBs) of data to the cloud will incur extremely high costs over time, even with volume discounts. These costs are likely to be even higher when one considers how long companies expect to keep their mission critical data. In the new digital economy,

data is fast becoming a strategic asset to businesses, and is therefore seeing an ever-increasing shelf life. It is not uncommon for enterprises to expect to keep their data for more than 10 years.

In retrospect, the fact that public cloud storage is surprisingly expensive when used over a long period of time is not entirely surprising once we realize that using cloud storage is akin to renting a car. Although renting is very useful for small periods, over time the economic advantages of buying are hard to compete with.

- **Data Access Charges:** Public cloud providers charge a small fee every time data is accessed. The amount an organization ends up paying for data access depends on data usage patterns. For example, if an organization is using public cloud for primarily Long Term Retention (LTR), where data is accessed very infrequently, the data access costs could be low. On the other hand, if an organization runs frequent analytics on data stored in the public cloud, their access costs will be material to the overall TCO of public cloud storage. Furthermore, if data access patterns for an organization are not consistent, then this can add an element of variability to monthly bills, which are difficult to plan and budget for.

- **Support/Maintenance:** The low $/GB/mo number for AWS S3 or other public cloud storage offerings does not include costs for support. Specifically for AWS S3, organizations have to pay between 5%-10% as maintenance/support fees that includes phone-support. In fact, organizations that want on-site support have to pay an additional fee on top of the standard support tier.

Thanks to these cost drivers, organizations often find that the TCO of public cloud storage can be surprisingly high, especially when storing large quantities of data in the cloud over long periods of time.

By contrast, ECS has been built to drive down TCO for organizations, thanks to a variety of factors such as use of industry-standard hardware, high storage efficiency, and low management overhead, as well as an absence of data access charges.

An Illustrative Example to Compare TCO

To best illustrate the TCO advantages of ECS over AWS storage services, let us consider the following hypothetical scenario. An organization is evaluating the best storage option for the following data footprint:

- Approximately 2 PB of data that it expects to use for a period of 5 years.

- Both read and write requests will come in from various parts of the world, and applications will access the data using the AWS S3 API.

- On average, 5% of the data will be accessed in any given month (around 100 TB per month).

AWS has three object-based storage services –Amazon S3 Standard, Amazon S3 Standard – Infrequent Access and Amazon Glacier (Archive). Using the publically available pricing from the AWS website[1], we can calculate the cost/GB/month for each of the cost drivers discussed earlier in this section

All costs in ¢/GB/Month	AWS S3	AWS S3 – Infrequent Access	AWS Glacier
Cost of Storage	2.11 ¢	1.25 ¢	0.40 ¢
Cost of Data Access	0.29 ¢	0.34 ¢	0.34 ¢
Cost of Requests	0.05 ¢	0.11 ¢	1.62 ¢
Cost of Support/Maintenance	0.14 ¢	0.10 ¢	0.05 ¢
Total Cost of Ownership (TCO)	2.58 ¢	1.79 ¢	2.41 ¢

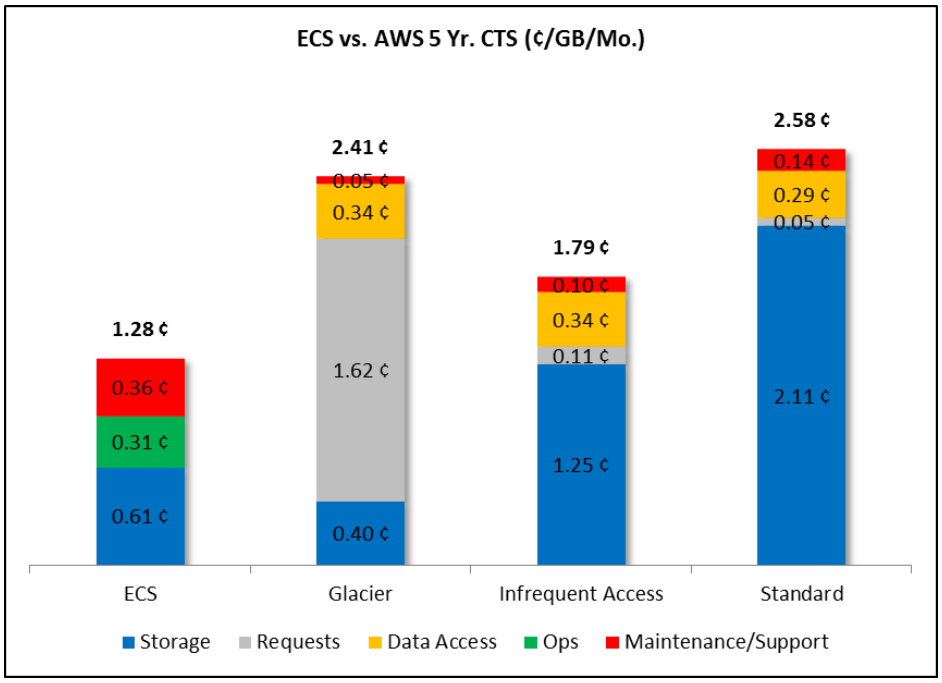
[1] AWS Pricing as of July 2017 for US East (Virginia) Datacenter

- To calculate the TCO for an on-prem Object-Storage-as-a-Service using ECS, a variety of cost drivers are considered:
- Up-front costs such as the cost of hardware, software, deployment and support/maintenance contract
- On-going costs such as cost of IT staff to manage ECS, power/cooling, as well as datacenter floor space

When the data footprint assumptions are applied to ECS cost drivers, we arrive at the following TCO calculation[2].

ECS TCO Calculation	Costs in ¢/GB/month
Hardware Costs	0.32 ¢
Software Costs	0.28 ¢
Deployment Costs	0.01 ¢
Support/ Maintenance Costs	0.36 ¢
Total Upfront Costs	0.97 ¢
IT Administrative Costs	0.21 ¢
Power/Cooling Costs	0.06 ¢
Floor Space Costs	0.04 ¢
Total On-Going Costs	0.31 ¢
ECS Total Cost of Ownership	**1.28 ¢**

The graph below compares the 5-year TCO of ECS in this example with the 5-year TCO for the three AWS S3 services. Under these assumptions, ECS has a TCO that is almost half that of the AWS S3 Standard service. In fact, the ECS TCO is lower than that of AWS Glacier despite having substantially more functionality.



[2] Assumptions for calculating ECS TCO are provided in the appendix of this whitepaper

ECS Cost to Serve (CTS) Model

To help organizations create a customized TCO comparison similar to the illustration above, Dell EMC has created a "Cost-to-Serve" (CTS) model for ECS. Organizations can use the CTS financial model to compare the TCO of ECS with Amazon's monthly pricing fee structure through an apples-to-apples "$/gigabyte/month" number. The illustrative example used the CTS model, and assumptions used in the model are explained in more detail later in the Appendix. Using the CTS model under a variety of scenarios, the following conclusions can be drawn:

- ECS has substantially lower TCO/CTS than the functionally comparable AWS option – S3 Standard Service.
- Despite providing significantly more functionality such as high availability, durability and faster retrieval times, ECS has a lower TCO than Amazon's S3 Infrequent Access (IA) service if an organization expects to read data (i.e. incur data transfer costs).
- Even in situations where customers don't expect to read data from the S3 IA service, ECS has a comparable TCO.

Real-life Dell EMC customers have validated ECS' TCO advantage over public cloud providers as well. For example, a major sports league in the United States has seen savings of 25% compared to costs on AWS, while a major biomedical research institute has seen a TCO reduction of 30% when comparing Google Cloud storage with ECS.

ADVANCED CAPABILITIES AT NO EXTRA COST

ECS offers a range of capabilities that public cloud providers charge extra for. For example, ECS provides capabilities for users to perform meta-data searches directly on their stored and archived data, enabling much quicker retrieval. There is no need for a dedicated data base for system and user-defined metadata providing ECS users with the ability to identify new business opportunities quickly and efficiently. By contrast, organizations using AWS storage would need to pay for services like AWS Relational Database Service (RDS) to implement meta-data search for data stored on S3.

Another example includes ECS' support for HDFS and NFS protocols, which facilitate a wider variety of workloads. By contrast, AWS users would have to move S3 data to a more expensive tier and process it using additional tools. This involves multiple steps with increased costs of data management. Additionally, this leads to multiple, unsynchronized copies of the same data, which leads to consistency issues.

CONSUMPTION FLEXIBILITY

Designed as a software-defined storage platform, ECS provides organizations with the ability to deploy this platform on their terms – as a turnkey storage appliance, as a software-only solution that can run on certified industry-standard hardware, through public cloud solutions via Virtustream, or as a Dell EMC dedicated cloud hosted solution. With the wide range of options, organizations can choose the path that works best for them, safe in the knowledge that they are not locked into one particular consumption model.

REDUCED DATA RESIDENCY AND COMPLIANCE RISKS

Organizations should carefully consider the potential legal ramifications of a public cloud storage service. Governments across the world have instituted laws regulating the location and control of personal, corporate, and government data. For example, some governments such as those within the European Union have imposed stringent data residency laws to safeguard the privacy of individual citizens. Other governments, like the U.S., may require service providers to hand over private data due to the Patriot Act. Cloud service providers can be compelled to comply with U.S. government requests to release data stored in their European datacenters, in conflict with EU laws, exposing both service provider and customers to potential local legal action.

Unlike public cloud storage, Object-Storage-as-a-Service powered by ECS allows organizations to choose the physical location of their data so as to eliminate residency and compliance risks. A common regulatory or legal factor is the geographical hosting location of your data. If your data needs to be stored within a specific country or region, and a provider doesn't host in that location, on-premises object storage would be a better solution for your business.

Finally, ECS simplifies data governance and management with policy-based retention, analytics enabled by HDFS and built-in optimizations for speed and storage efficiency. Additionally, ECS comes with enterprise grade features for protection, availability, encryption, authentication and fine grain access controls, making it a highly secure platform.

BUILT FOR GLOBAL NATURE OF BUSINESS TODAY

As businesses expand their global footprint, storing data coming in from different geographies can pose unique challenges for traditional storage platforms, often leading to silos of data that increase complexity. Even public cloud platforms can struggle with issues like ensuring strong/immediate consistency of data across various global datacenters. Thanks to its ability to grow to an Exabyte scale, as well as its flat, non-hierarchical structure, ECS enables organizations to consolidate silos of data distributed across the globe into a single, globally accessible content repository. Furthermore, ECS is optimized to support ingest and access of both small and large files with strong global consistency, which means that data updated in one datacenter will be instantly updated in other datacenters around the world without the IT administrator or app developer having to do anything.

FLEXIBILITY FOR APPLICATION DEVELOPERS

Unlike public cloud storage platforms, ECS supports multiple REST-based protocols, such as S3, OpenStack SWIFT, Dell EMC Atmos and CAS, and HDFS. This allows application developers within an organization more flexibility when building cloud-native apps. Additionally, as it supports file-based protocols like NFS and CIFS/SMB as well, eliminating the need for cloud storage gateways and reducing the effort required to modernize legacy file-based applications.

CAPABILITIES FOR INCREASED IT AGILITY

IT teams can use ECS to set up a self-service portal for BUs to request storage themselves. This provides a public cloud like experience through a web-based self-service portal for BUs and developers. The portal allows users to create credentials, associate themselves with a cost-center, and create storage capacity for their apps or workloads without having to create IT tickets.

Additionally, the enhanced management capabilities for ECS enable IT administrators to reduce management overhead and respond to business needs quickly. ECS provides a single point of management through the ECS Portal and provisioning services. Using a Web-based GUI, administrators can manage and provision ECS nodes quickly in response to BU needs. The portal has comprehensive reporting capabilities that include capacity utilization, performance monitoring, replication progress, as well as diagnostic information such as node and disk recovery status which help identify potential performance and system bottlenecks.

GEO-PROTECTION OF DATA

Object-Storage-as-a-Service powered by ECS is designed to protect data both against local component failures as well as major disasters that result in site failures. Locally, ECS uses triple mirroring and erasure coding, which enables multiple paths for recovering lost data via multiple parities. This approach protects against broken components. ECS also provides geo-replication capabilities to ensure that data is protected against site failures/disasters. Geo-replication provides enhanced protection against site failures by having multiple copies of the data, i.e., a primary copy of the data at the original site and a secondary copy of the data at a remote site/VDC. Through this process, ECS eliminates any single points of failure (both locally and geographically) improves the performance of the system, and lowers storage overhead as your environment grows and scales. Unlike other solutions in the marketplace, ECS does not generate WAN traffic while recovering from local disk failures. ECS gives customers the options to link geographically dispersed systems and bi-directionally replicate data among these sites across the WAN. Several strategies, such as geo-caching as well as accessing the physically closest array, reduce WAN traffic for data access. This on-premises approach to object storage can increase performance of your applications, with lower latency for employees or customers, compared to a public cloud provider's geographically remote hosting location.

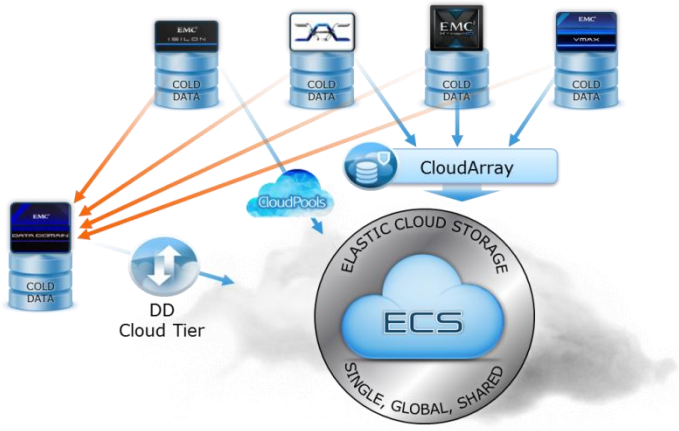
UTILITY/OPEX BASED PAYMENT OPTIONS

Dell EMC offers flexibility in payment/financing options for organizations that prefer the utility based pricing model of the public cloud. Through the Dell EMC OpenScale Solutions program, ECS can be purchased through a range of flexible, capacity-on-demand procurement options to fit most organizations' IT needs and expense plans. With these options, customers can take advantage of many of the benefits of public cloud storage services, such as no/low upfront payment, "pay-as-you-go" billing, and OpEx treatment of IT spend.

KEY USE CASES FOR OBJECT-STORAGE-AS-A-SERVICE POWERED BY ECS

Object-Storage-as-a-Service is well suited to organizations looking to embrace Digital Transformation, including those with many distributed locations serving a large number of end users, or those that generate and analyze a large amount of unstructured content. Thanks to ECS' unique suitability for large-scale Object-Storage-as-a-Service environments, Dell EMC has assisted multiple customers in a number of industries, including financial services, healthcare, life sciences, and media & entertainment to deploy such offerings. Common use cases for Object-Storage-as-a-Service based on Dell EMC ECS include:

- **Modern Archive/Cloud Backup:** The easiest way to leverage Object-Storage-as-a-Service is to consolidate storage into a common, "modern" archive or as a target for cloud-based backup. An ECS based archive is highly consolidated, geo-distributed, and pervasively integrated with primary storage. It can be used to reduce the data volume on primary storage like SAN (Storage Area Network) and NAS (Network Attached Storage) systems, in the process drastically reducing storage costs and simplifying operations. ECS supports market leading Dell EMC and 3rd-party tiering and archiving solutions.



- **Tape Replacement:** Object-Storage-as-a-Service powered by ECS can help organizations looking to eliminate or reduce the footprint of their aging tape infrastructure. ECS can deliver an active-archive with the same scalability and low cost benefits of tape-based solutions, but without the operational challenges, lack of IT agility, and reliability concerns. Additionally, ECS makes business data available to BUs in an on-demand fashion. This allows organizations to fully embrace Digital Transformation, which relies on insights mined from business data to create more compelling experiences for customers.

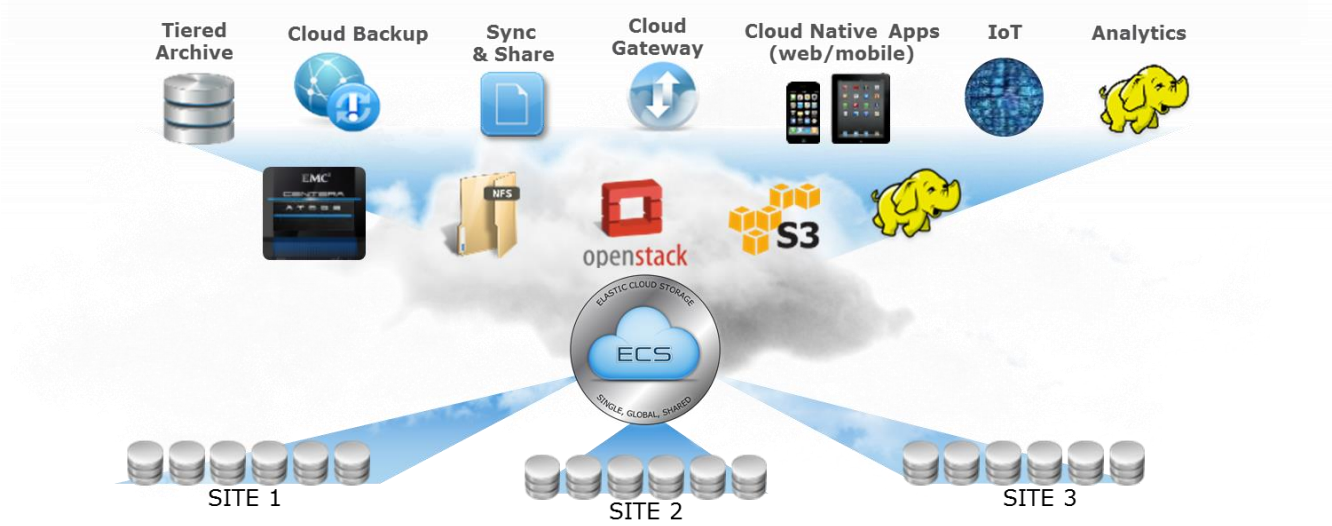
- **Legacy application modernization**: Object-Storage-as-a-Service can serve as ideal storage platforms for organizations looking to modernize legacy applications built on traditional NAS platforms. Modifying legacy apps to point to ECS using the S3 (or other REST-based APIs like OpenStack Swift) protocol can help reduce costs, simplify maintenance of the application, and allow them to scale to handle massive amounts of data.

- **Simplified cloud-native/P3 app development**: Object-Storage-as-a-Service based on ECS is designed for cloud-native applications that utilize the S3 protocol (or other REST-based APIs like OpenStack Swift). This results in the need for considerably fewer lines of code—up to a 10X reduction—for a given application. ECS natively performs many functions like geo-distribution, ensuring strong data consistency and data protection, therefore allowing application developers to focus on what moves their business forward. Organizations find that Object-Storage-as-a-Service is a great way to simplify the storage stack while improving developer productivity.

- **Data analytics**: Big data analytics and data science continue to emerge as competitive needs for enterprise businesses. Object-Storage-as-a-Service is the predominant cloud-scale data storage model that can handle the high volume and velocity, as well as the specific nature and rapid growth of IoT (Internet of Things) data, in a cost-effective manner. ECS is certified and compatible with most industry standard Hadoop distributions and does not require the traditional ETL (extract, transform, and load) processes associated with traditional HDFS deployments. ECS provides in-place analytics with no data massaging or movement required providing superior time to results and utilization of storage resources.

- **Enterprise sync and share**: Object-Storage-as-a-Service is ideal for enterprise synchronization and sharing of data for collaboration and distribution. The object store can replace home drives and team share sites, which can enhance productivity and increase enterprise control of where data resides.

ECS has enabled multiple other Object-Storage-as-a-Service use-cases with customers, such as **Internet of Things (IOT), storage of website static content, software depot/code repository, storage of logs, seeding of CDN caching.**



CONCLUSION

Cloud computing offers businesses a wide range of benefits, such as low cost, and capabilities such as global access, with speed and ease. Small organizations with little or no technical expertise can compete against giants with decades of investments and capabilities; and sometimes beat them due to their agility. Large organizations have to carefully consider their long-term strategy and the fit of a public cloud service in their overall strategy.

As with most organizations, cost is the primary motivator to get started. Public cloud providers like Amazon employs a complex pricing algorithm that incorporates a variety of variables that are often difficult to understand, and difficult to predict. If purchasing an Amazon-based solution, IT planners should carefully study their pricing scheme to get a full understanding of the total solution cost. Additional monthly data requests, transfers, as well as acceleration and replication fees can easily equal or exceed monthly storage costs. Planners should also consider networking infrastructure investments and risk factors when exploring public cloud options.

Our cost-to-serve comparison reveals that over the long term, businesses can significantly reduce TCO by implementing a private cloud storage solution with ECS. More specifically, the ECS solution costs 60% less than the comparable Amazon offering over a four-year period. Further, investing in a long-term strategy to build and own your own infrastructure is easier to consider and evaluate in light of a more rationalized approach presented in this whitepaper.

Organizations wanting the reassurance and confidence of a turnkey solution can turn to a partner like Dell EMC for end-to-end software, support and pre-configured commodity hardware—with the Dell EMC ECS Appliance. ECS offers all of the capabilities of the typical cloud providers like better economics, improving economies of scale, speed and the ability to go global with ease. Also, ECS offers flexible consumption models as well as a multi-purpose platform with enterprise grade features that is independent of the public cloud and is completely under your control. With ECS, there is no compromise – you get all the benefits of low cost, simplicity, and scale without the risk and security concerns. Manage data sovereignty on your own and eliminate the unpredictable runaway storage costs.

For more information on ECS, please visit www.dellemc.com/ecs or try it for free for non-production with our Free & Frictionless download at www.dellemc.com/getecs.

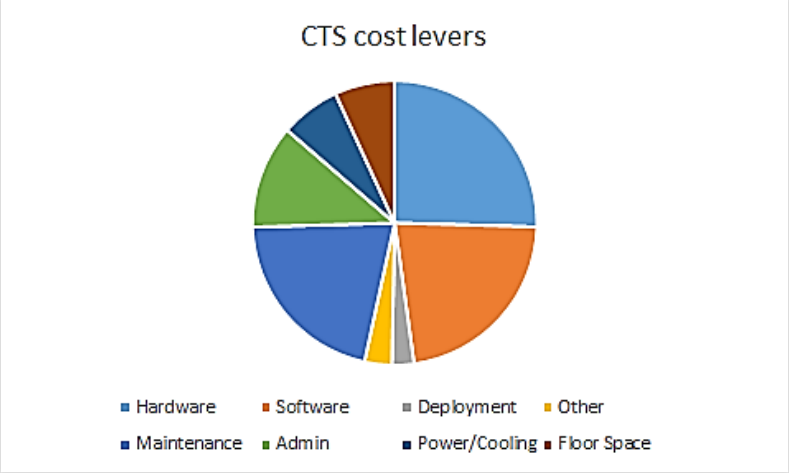
APPENDIX: ECS COST-TO-SERVE MODEL

To help customers compare the cost of ECS to the cost of public cloud storage, Dell EMC has created a "Cost-to-serve (CTS)" model. Organizations can use the CTS financial model to compare the true costs of ECS with Amazon's monthly pricing fee structure through an apples-to-apples "$/gigabyte/month" number.

To convert the Total Cost of Ownership (TCO) for ECS into a $/GB/Month number, the model assumes usage of ECS over a 4 year period. It considers various cost levers, such as investment in ECS hardware and software, as well operational costs such as cooling, on-going management etc. Cost levers are categorized into one-time upfront expenses as well as on-going recurring expenses.

Upfront Expenses

- Capital equipment – initial hardware and software expenses, including networking infrastructure upgrades and additional costs associated with data durability
- Deployment – initial installation, set up and configuration expenses
- Maintenance – upfront product support and maintenance fees



Recurring Expenses

- Environment – on-going power, cooling and floor space costs
- Administration – on-going system administrative expenses

The ECS CTS financial model and Amazon's pricing tool[3] was used to directly compare the costs of the different solutions to deliver identical storage capacity.

Assumptions for ECS CTS:

- 3 Sites – Active Archive Erasure Coding
- Five years of premium maintenance
- $0.085/kWh energy and cooling
- $750/month/40U floor space
- $130k/year loaded admin cost (salary+ cost)

[3] Pricing for Amazon's Virginia data center, retrieved July 2017. Includes business-level support (telephone-only) and assumes 5% data access/egress per month.