Enterprise Application Migration in Hybrid Clouds

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Executive Summary

One of the most significant trends occurring within Information Technology over the past decade is the adoption of public cloud computing combined with the use of existing IT infrastructure into new hybrid cloud environments. Although the flexibility, agility and time to market advantages of hybrid clouds can be significant, so too are the technology challenges and impacts on IT professionals.

Often one of the first challenges faced by companies who want to increase their use of public cloud computing is how to move or migrate their existing applications and data. For some applications that utilize file-based data or have minimal data use requirements, this may not be a significant issue. However, for enterprise applications that cannot tolerate downtime, those with significant amounts of data in databases or that utilize block storage, migration can be a major impediment to moving the application.

Cirrus Data has been a leading developer of technologies that enable companies to protect and migrate data non disruptively for more than a decade. With the Cirrus Data Cloud portfolio of products, IT consumers now have several options for moving applications from on-premise to the cloud, between clouds, from captive cloud storage to 3rd party storage and back again, all without application disruption.

Evaluator Group tested Cirrus Data Cloud in two separate use cases, the first was designed to analyze the ability to migrate applications to a public cloud environment, and the second evaluated the ability to migrate data from captive cloud storage to Cloud Virtual Array storage accessible from public clouds. The primary factor in the evaluation was the impact on application availability, specifically measuring any downtime required. Additional factors included the preservation of storage efficiency features along with flexibility, security and ease of use aspects.

Evaluator Group Comments: Our testing found that Cirrus Data Cloud portfolio provides significant advantages over alternative tools for data migration. By supporting migration between any cloud and any storage, companies can realize the benefits of Hybrid Clouds.

In summary, the results of testing Cirrus Data Cloud products showed:

- No downtime for applications during data migration (minor interruption for cutover)
 - Migration using an on-premise appliance (Cirrus Migrate On-Premises) to the cloud required a few minutes of application impact to finalize the migration process.
 - Migration using host-based migration (Cirrus Migrate Cloud) from captive cloud storage to a 3rd party cloud array had no application impact (with no application downtime).
- Appliance based migration (Cirrus Migrate On-Premises) supports any OS and application either to on-premises storage or to major public cloud providers.
- Host software-based migration (Cirrus Migrate Cloud), supports migration between systems residing in any location, using any storage including captive cloud storage to 3rd party cloud array storage.

Enabling Hybrid Clouds

The premise of a hybrid cloud is the ability to move applications between locations in order to meet cost, performance, availability or other objectives. Most applications require some amount of data in order to operate and as a result the challenges many companies face with hybrid clouds is how to migrate application data without any loss or downtime. Moreover, the key enabling factor that makes hybrid clouds a reality is the ability to effectively migrate data while maintaining application availability and reliability objectives.

Evaluator Group works with organizations across industries and geographies to assist with the adoption of technologies and planning their IT strategy. Additionally, Evaluator Group performs research into emerging technologies for CIOs and IT professionals. As companies increase their usage of public clouds, they are also working to create a hybrid cloud environment that spans their on-premise and cloud resources. In a recent Evaluator Group survey of over 300 IT users looking at trends in Hybrid Cloud Computing, over 98% indicated that they perform data migrations between cloud locations. Additionally, over 92% of respondents indicated that they maintain copies of data in multiple locations, for either data or application availability purposes.

Additional results of Evaluator Group's research study found that the biggest concern IT consumers have around storage in public clouds is the lack of data reduction capabilities, followed by the limited management interfaces and the ability to replicate data.¹ For these and other reasons, a natural solution for the problems companies face is to utilize storage that provides enterprise class features including management interfaces, data reduction, thin snapshots, replication and all the other capabilities inherent with enterprise class storage.

However, despite the promise of hybrid cloud computing, today's reality is that the dearth of tools to enable data movement are inhibiting the potential benefits of hybrid clouds. Moreover, the ability to transparently migrate application data provides substantial benefits by enabling hybrid clouds.

Important considerations for application and data migration include:

- No data loss: It is imperative that no data is lost or corrupted while moving / migrating
- Minimal downtime: Ideally application downtime should be close to zero (an RPO of 0)
- Ease of use: Easy to deploy and use by IT staff without extensive training
- Efficient data movement: Utilize data reduction if possible (compression and thin provisioning)
- Data security in transit: Such as encryption during transfer
- Support for block accessed storage
- Flexible deployment options, including on-site and public clouds
- Scalable performance and capacity to meet application service level requirements

¹ Evaluator Group – "Hybrid Cloud in the Enterprise" Research Study, Question #5, to be released July 2021

Cirrus Data Overview

Cirrus Data developed one of the leading platforms for data migration that enables enterprises and service providers to easily migrate block-level data from any host, any OS and any storage array to any location. Their Cirrus Data Cloud is powered by patented Transparent Datapath Intercept (TDI) technology, which eliminates downtime when migrating data, removing risk and application downtime often incurred with other data migration solutions.

There are two primary deployments for Cirrus Data Cloud, either an on-premises appliance or host-based software. Cirrus Data Cloud features include:

- Utilizes Cirrus' patented Transparent Datapath Intercept (TDI) technology
 - Note: Cirrus Data provides a variant of TDI, a software agent called mTDI
- Multiple Deployment options to support a variety of migration environments
 - Cirrus Migrate On-Premises: Appliance based migration support for all open system storage including Windows, Linux and other Unix OS's
 - Utilizes FC and iSCSI path based migration for on-premises options
 - Cirrus Migrate Cloud: Scalable solution with no limitations on capacity or number of systems, or migration sessions
 - Operates across hybrid clouds, regardless of deployment (Public cloud, physical system, VM, etc.)
- Support for any type of storage (Local SCSI, iSCSI, FC, VMFS, AWS EBS, Azure Managed Disks, etc.)

Note 1: CirrusData's list of technology partners includes both public cloud providers and technology partners that provide public cloud accessible storage. Evaluator Group performed testing using one of the major public cloud providers, (AWS, Azure and IBM), combined with storage solutions from three of the four virtual cloud array providers (Dell Technologies, HPE, NetApp and Pure Storage).

Note 2: The intent of testing multiple cloud array solutions was <u>not to compare</u> these solutions to each other, but rather to validate that despite differences in how these services operate, Cirrus Data Cloud is able to perform data migrations to and from these systems without any application downtime, i.e. a "Zero RPO".

Benefits of Cloud Array Storage

One of the primary objectives of testing migration was to measure the benefits of using Virtual Cloud Array Storage (aka 3rd party cloud storage) in comparison to captive storage such as AWS EBS or Azure managed disks. Although there were some differences between cloud array offerings, in general we found cloud arrays provided better data protection, enhanced metrics and more choices for performance and substantially better capacity utilization. Additionally, two of the three cloud arrays provided data reduction features, while the third vendor did not specifically provide capacity saving metrics.

Evaluator Group Comments: We found that Cloud Virtual Array storage delivered significantly more enterprise class storage features than captive cloud storage. This includes instant snapshots and in most cases, lower capacity utilization due to thin provisioning and data reduction features, which all significantly reduce storage costs while improving application availability and performance.

In order to best highlight all of the different features in comparison to captive cloud storage, the following Table 1 summarizes the most important features.

Requirement	Captive Cloud Storage	Cloud Array Vendor "A"	Cloud Array Vendor "B"	Cloud Array Vendor "C"
Offering Type	Storage Service: Pay for provisioned storage, managed as service	Storage Service: Pay for provisioned storage, managed as service	Full Cloud Array: Pay for consumed storage as a full feature array	Full Cloud Array: Pay for consumed storage as a full feature array
Thin Snapshots for Protection	No: Full clones only, require 100% capacity of volume	Unknown : Instant snapshots, no efficiency provided	Yes: Instant snapshots use only changed capacity	Yes: Instant snapshots use only changed capacity
Storage Replication for DR	No: Full clones referred to as snapshots only, not PIT copies	Yes: Replication to on-premises volumes from same vendor supported	Yes: Replication to other cloud array volumes from same vendor supported	Yes: Replication to other cloud array volumes from same vendor supported
Thin Volumes to Reduce Costs	No : Capacity is charged based on provisioned capacity	No : Capacity is charged based on provisioned capacity	Yes: Thin volumes reduce consumed storage use	Yes: Thin volumes reduce consumed storage use
Data Reduction to Reduce Costs	No : Data reduction benefits not visible to user	No : Data reduction benefits not visible to user	Yes: Data reduction benefits are visible to user	Yes: Data reduction benefits are visible to user
Multiple Performance Options	Good : Two tiers with charges for higher I/O rates	Good : Two tiers with charges for higher I/O rates	Excellent : Multiple options for performance	Excellent : Multiple options for performance
Full Storage Mgmt. Console	Basic : Rudimentary storage metrics and management features	Limited: Basic storage metrics and management features	Excellent : Full array management UI with metrics	Excellent : Full array management UI with metrics

Table 1: Comparison of Cloud Storage Options (source: Evaluator Group)

Evaluation of Cirrus Data Cloud

Evaluator Group tested Cirrus Data Cloud in two separate deployment scenarios. The first scenario was the ability to migrate applications from on premises data centers into the public cloud. For testing the first scenario, Evaluator Group's on-site equipment was used to migrate multiple applications running as VM's into the public cloud.

The first test environment consisted of the following:

- Cirrus Migrate On-premises appliance with a target virtual appliance in the public cloud
- Two virtual machines running on premises, utilizing FC SAN storage
 - A database application utilizing Windows Server 2019 with SQL Server 2019
 - $\circ~$ A database application utilizing CentOS 7.9 with a MySQL database

In the second scenario, we tested the ability to migrate application data from proprietary public cloud storage (such as AWS EBS or Azure managed disks) to a virtual cloud array (such as HPE Cloud Volumes, NetApp Ontap Select, or Pure Cloud Block Storage). Additionally, we tested migration from public cloud back to an on-premise environment. The intent of testing was to assess the features and ability to perform migrations without data loss and with no downtime.

The second environment tested consisted of the following:

- Cirrus Migrate Cloud with a Cirrus mTDI agent installed on cloud VM instances
- Virtual machines running in the public cloud, utilizing proprietary block storage (Blob, EBS, etc.)
 - $\circ~$ A database application utilizing CentOS 7.9 with a MySQL database
- Multiple different 3rd party storage available on VM as a migration target

Test Overview

Evaluator Group was asked to examine two different migration use case scenarios; the first being movement of data and applications from an on-premises deployment to a public cloud environment, and the second scenario involved migration of data from a public cloud provider's proprietary storage to that of a 3rd party storage provider, generically referred to as a Cloud Virtual Array. In both cases we compared Cirrus Data Cloud to other alternative tools and options in order to assess the features and relative advantages of each tool. Additionally, our testing was designed to verify that all the tested storage solutions functioned well with Cirrus Data Cloud, highlighting both any issues and benefits derived from using Cloud Virtual Array (3rd party) storage solutions in the public cloud.

There were several criteria measured, including aesthetic and qualitative aspects such as "Ease of use" and overall usability. Other measured criteria included the number of options supported, such as the variety of OS and storage environments supported. However, one of the key metrics was the recovery point objective (RPO) of the tool, measured either by the amount of application downtime required, or the amount of time the application wasn't able to operate. Related to this was the recovery time objective (RTO), which is the amount of time required to perform the migration.

In general, we found that there were several options available for data migration, all of which generally fit into one of two categories. The first set of tools were "Public cloud migration tools" which supported migration into a specific public cloud only, but rarely supporting migration out of their cloud. Another category of tools were those that supported migration between a storage vendor's system on-premises and their specific cloud array, but did not support any other vendors' storage.

Requirement	Public Cloud vendor specific tools	Cloud Array vendor specific tools	Cirrus Data Cloud migration tools
Migration Options	Limited: On-premise to one cloud only	Limited : Limited to on- premise and cloud to specific cloud array	Excellent : Any source to any target (Note: Current OS limits based on Cirrus tool used)
Ease of Deployment and Management	Good : Install into on premises as VM, Web portal UI.	Very Good: Typically part of array replication options	Excellent : Single command install. Web portal UI
Support Multiple OS, Application and Storage Types	Limited : Few OS and applications supported, limited storage options	Good : Many OS and applications supported, single storage option	Excellent : Many storage and application options, Linux and Windows for cloud-to-cloud array migrations
Support private, public clouds and cloud array products	Poor : Limited support for single public cloud, no support for cloud array products	Poor : Limited support for on-prem to a single cloud array product only	Excellent : Support for private and public clouds and storage types including cloud array products
Data Efficiency (Dedupe, Compress, Delta and Thin)	Poor : All data is migrated, data efficiency not preserved	Excellent : Only changed data migrated, maintains data reduction	Excellent : Only changed data migrated, maintains data reduction
RPO and RTO Capability	Poor : RPO was measured in tens of minutes, up to an hour in some cases	Excellent : Very low RPO available between supported source and target	Excellent : As low as zero RPO (no loss) for migrations, regardless of source or target
Data Security	Good: Many (but not all) tools support encryption of data in- flight	Good: Many (but not all) vendors support encryption of data in- flight	Excellent: Support for encryption of data inflight

A high-level summary of the migration tools and their capabilities available are shown below in Table 2.

Table 2: Comparison of Data Migration Tools (source: Evaluator Group)

Evaluator Group Comments: We found that Cirrus Migrate Cloud had almost no limitations in terms of OS environments, clouds or storage types while also supporting block mode migration. There was no other option we found that provided these same capabilities.

Scenario 1: On-Premise to Cloud Migration

As discussed previously, the adoption of public clouds as part of an overall hybrid cloud strategy is one of the biggest trends in IT over the past several decades. Hybrid clouds have, as a premise, the idea that application and data movement can be performed quickly, efficiently and with limited or no application impact. There are many tools that help facilitate the movement of file-based data, but very few tools are designed to support databases or other applications that access data at a more granular level than files.



Figure 1: Cirrus Migrate Testing – On-prem to Public Cloud (source: Evaluator Group)

Evaluator Group was tasked with comparing migration tools available for databases and other block oriented applications and evaluating their ability to support transparent data migrations in hybrid clouds. The first scenario was to evaluate migration of data from on-premises to the cloud and then back again. Many customers have found that their data is captive once moved into a public cloud, with few options for migrating back out of a particular cloud. Our analysis included the entire round-trip process.

Application Migration Summary

The process of migrating an application has two components: 1) Setup a system or VM as the destination target, 2) After the target system is configured then the application data must be migrated. There are

many methods for creating a destination target and they are often dependent upon the specific environment where the application will reside. Public cloud providers have specific instance or VM formats and may require either setting up a new system, or converting from an existing application environment. Our focus during testing was on the second portion of this process, namely replicating or migrating the application data from the existing location to the new environment and location.

We utilized three different methods for migrating applications from on-premises into the cloud. 1) Cirrus Migrate On-Premises appliance, 2) Cirrus Migrate Cloud and, 3) Public cloud tools. We found significant differences issues with most public cloud tools impact on application availability (measured by RTO and RPO).

Measured RTO and RPO

- Cirrus Migrate On-Premises: (For on-premises to cloud migration)
 - Less than 4 Minutes of RPO with 0 RTO
 - No Application impact during migration (0 RTO)
 - During migration, volume is logically attached to a virtual Cirrus Data Cloud appliance
 - To complete migration, volume must be attached to cloud VM then rebooted
 - Less than 4 minutes to finalize volume change (4 minutes RPO)
 - Migration was performed on-prem to cloud
 - No known open-systems storage limitations
- Cirrus Migrate Cloud: (For cloud to on-premises migration)
 - Zero (0) RTO and RPO
 - No Application impact during migration (0 RTO)
 - Migration may be completed, then finalized without a reboot or offline requirement (Cirrus Data refers to this as "Cloud Motion" or "cMotion")
 - Migration was performed in both directions, on-prem to cloud and back again
 - Tested with Linux only, Windows currently in Beta (to be released shortly after paper published)
- Typical public cloud tool: (For on-premises to cloud migration)
 - Average of 50 minutes of RTO / RPO (Application unavailable for 50 minutes)
 - Multiple "public cloud tools" were utilized, although none are specifically identified here
 - Average RTO of 50 minutes or more (application unavailable for at least 50 minutes)

Additional Considerations

Supported Environments

Two critical considerations when selecting migration tools are the environments supported and how efficiently data is migrated. Application environments may be complex, consisting of where an application runs (public cloud or on-premises), the database, operating system, hypervisors and storage utilized. An effective tool must support a wide variety of environments, including both hybrid clouds, with multiple OSes and storage choices.

Comparison of Environments Supported:

- Cirrus Migrate On-Premises:
 - Support for any OS, uses appliance in data path for replication
 - Support for specific public cloud's captive storage
 - Not able to migrate from cloud back to on-premise
- Cirrus Migrate Cloud:
 - Support for any Windows and Linux OS by insertion into host data path
 - Note: Support for Windows OS available in the near future, but <u>not</u> tested
 - Support for public cloud's captive storage and 3rd party storage
 - Ability to migrate from cloud back to on-premise
 - Maintains efficiency (maintains "thin" and migration of only changed data, and compression of data are target dependent)
- Public cloud tools:
 - No support for 3rd party storage, captive storage only
 - No ability to migrate between clouds, from Public Cloud back to on-premises
 - Very limited data efficiency support

Scenario 2: Migration to Cloud Array Storage

This scenario was designed to both validate the ability to migrate from captive cloud storage to 3rd party cloud array offerings, and also measure the benefits of cloud arrays compared to captive storage offerings.

In Figure 2 below we show a logical diagram of the migration test that was performed. Although the two clouds are labeled as belonging to a different virtual private cloud (VPC), the migration could occur within the same VPC within a public cloud, or between two different public clouds altogether.



Figure 2: Cirrus Data Cloud Testing – Captive Storage to Cloud Virtual Array (source: Evaluator Group)

Evaluator Group Comments: We found that Cirrus Data Cloud can migrate any application data between any two locations and any storage, including on-premises to the cloud, from one cloud to another and then back again, all without application downtime for migration.

Measured RTO and RPO

- Cirrus Migrate Cloud: Zero (0) RTO and RPO
 - No Application impact during migration (0 RTO), with no downtime to finalize volume change (0 RPO)
 - Prior to migration target volume is target VM running application
 - Migration may be completed, then finalized without a reboot or offline requirement (Cirrus Data refers to this as "Cloud Motion" or "cMotion")
 - Migration was performed in both directions, on-premise to cloud and back again
 - Tested with Linux only, Windows currently in Beta (to be released shortly)
- Typical Public Cloud Tools: Average of 50 minutes of RTO / RPO (Application unavailable for 50 minutes)
 - None of these tools supported migration back to on-premises
 - There were significant OS, VM and application configuration requirements in order to support application migration.

Benefits of Cloud Virtual Array Storage

Using Cloud Virtual Array storage may provide economic benefits due to lower data utilization through data efficiency features, including thin snapshots, thin provisioning along with deduplication and compression. Additionally, there can be direct and indirect business costs associated with any application downtime event. Thus, combining the data efficiency and availability benefits of Cloud Virtual Arrays can provide substantial cost benefits vs. alternatives.

It is common for enterprise applications to create and retain multiple snapshots per day, resulting in as many as 20 – 50 retained snapshots depending on the degree of data protection required. With captive cloud storage requiring minutes or hours to create snapshots and providing no space efficiency, this can result in up to 50x greater storage utilization when using captive, public cloud storage.

However, one of the inhibitors has been the lack of migration tools available, and the potential downtime associated. Our testing was designed to measure any downtime, along with data efficiency benefits in order to provide a complete analysis of the potential advantages of moving applications to a Cloud Virtual Array.

Comparison of Cloud Array Data Efficiency to Captive Cloud Storage

Evaluator Group testing looked at the data efficiency benefits available, along with the time required to create snapshots for captive storage and Cloud Virtual Arrays.

- Instant Snapshots
 - Yes, instant snapshots for all three of the tested Cloud Array offerings
 - Captive Cloud Storage: No, snapshots required over 30 minutes to create
- Data Efficiency of Volumes
 - Volume efficiency varies by vendor, two provide efficiency data, one did not
 - Vendor "A" : No volume efficiency information provided
 - Vendor "B" : Yes, volumes provided thin, deduplication and compression
 - Vendor "C" : Yes, volumes provided thin, deduplication and compression
 - Captive Cloud Storage: No, volumes are not space efficient, pay for full capacity
- Data Efficiency of Snapshots
 - Snapshot efficiency varies by vendor, two provide efficiency data, one did not
 - Vendor "A" : No snapshot efficiency information provided
 - Vendor "B" : Yes, snapshots were space efficient (thin, dedupe, compress)
 - Vendor "C" : Yes, snapshots were space efficient (thin, dedupe, compress)
 - Captive Cloud Storage: No, snapshots are not space efficient, pay for full capacity

Application Migration to Cloud Virtual Array

These tests utilized a cloud deployed version of Cirrus Migrate Cloud, that provides a web console/portal with the ability to deploy a host agent onto any Linux/Windows system. Using the host agent, an administrator can migrate any block volume to any other block volume, either on the same host/VM or to a remote host/VM. Either host can reside in any data-center including public or private clouds and may utilize any storage.

Measured RTO and RPO

- Cirrus Migrate Cloud: Zero (0) RTO and RPO
 - No Application impact during migration (0 RTO), with no downtime to finalize volume change (0 RPO)
 - Prior to migration target volume is target VM running application
 - Migration may be completed, then finalized without a reboot or offline requirement (Cirrus Data refers to this as "Cloud Motion" or "cMotion")
 - Migration was performed in both directions, on-prem to cloud and back again
 - Tested with Linux only, Windows currently in Beta (to be released shortly after paper published)

Evaluator Group Comments: The data efficiency benefits alone make using Cloud Virtual Array's a more cost-effective option than captive cloud storage in many cases. Combined with the additional enterprise class features of enhanced availability, reliability and other data services make this a compelling option for enterprise applications in the cloud.

Final Thoughts

Operating a true hybrid cloud environment, with the ability to move workloads as desired to achieve improved cost, security or performance is a goal for most IT organizations. Although the capabilities now exist to run applications using hybrid clouds, several challenges remain; primarily how to move applications and data non-disruptively.

Cirrus Data Cloud portfolio of products is one solution to the issue of migrating data with limited or no application downtime. Although other solutions exist that enable non-disruptive data migration, they are typically limited to file data only, or migration into a specific public cloud, with no way to move data out when required. Storage specific tools also exist, but these are often limited to supporting the use of a particular vendor's storage in all locations. Software based database migration tools may also provide an option, but again are limited to specific OS, hypervisor and application versions.

Although some Cloud Virtual Array offerings ostensibly cost more per GB than proprietary cloud storage, it is possible to reduce storage costs due to their data efficiency benefits. Moreover, a key use case for Cirrus Migrate Cloud is its ability to transparently migrate application data off captive cloud storage and onto an enterprise 3rd party storage service. In doing so, the application is able to utilize enterprise storage class features including space efficient snapshots, compression, deduplication and thinly provisioned storage while also benefiting from enterprise class availability and performance features.

Cirrus Data's product line enables companies to use a single suite of tools for all of their migration needs, including on-premises to a public cloud and back, between public cloud environments, and even from a captive cloud storage to 3rd party cloud array. In many cases, the use of cloud arrays provides the enterprise storage features IT consumers desire, such as snapshots or replication, along with higher levels of performance and storage efficiency that enables customers to actually lower their storage costs while enjoying enterprise storage system benefits.

Appendix

Test Environment Details

The test environment utilized the following hardware / infrastructure, along with software and application workload setup described below.

Hardware and Infrastructure

- Scenario #1 (On-premises migration to Cloud)
 - Cirrus Data On-Premises appliance
 - Dual node FC attach appliance
 - Cirrus Data public cloud instance (replication partner for appliance)
- Scenario #2 (Migration from captive Cloud storage to 3rd Party Virtual Cloud Storage)
 - Cirrus Data Cloud (Cirrus Migrate Cloud) Platform/Portal
 - Host agent (mTDI) installed on Linux OS of source and target VM instances

Cirrus Data Tools

Latest version of Cirrus Data software at time of testing (service is upgraded continually)

3rd Party Cloud Arrays

- Three different Cloud Array storage offerings were tested as migration targets
- Storage was provisioned utilizing the appropriate management tool
- Storage volumes were presented to system instances (VMs) via iSCSI
- Within each VM instance, device multi-pathing and iSCSI tools were used to create a multi-path accessible logical device

Application Environment

- For Cirrus Migrate On-Premises migrations:
 - Windows Server 2019 w/ SQL Server 2019
 - CentOS 7.9 OS, w/ MySQL version 8.0 community
- For Cirrus Migrate Cloud migrations:
 - CentOS 7.9 OS, w/ MySQL version 8.0 community

Test Process Overview

The test environment utilized the following hardware / infrastructure, along with application workload setup described above. The following general steps were performed.

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Test Steps

- While application workload is running, perform following
- Migrate data from source storage device to target device using one of the tested tools
 - Cirrus Data On-Premises
 - Cirrus Data Cloud
 - Third party cloud migration tools
- Complete migration process, including any database sync required (measure time for this step)
- Measure amount of time application was unavailable

Selected Screenshots During Testing

During testing we captured hundreds of screenshots, provided are a few highlights.

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Figure 3: Cirrus Migrate – Linux Agent Installation (source: Evaluator Group Testing)

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Figure 4: Cirrus Migrate – Selecting Host for Migration (source: Evaluator Group Testing)



Figure 5: Cirrus Migrate – Selecting Local Target for Migration (source: Evaluator Group Testing)



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ල Integrations	241 59 GB / 241 59 GB	Migration Rate		0.00 B/s Host iP				
	Migrated	Transfer Rate	0.00 B/s	0.00 B/s Created		2021-05-19 13:07:40 by Russ Fellows		
	Last sync completed 25 seconds ago	Current Changed Data	0.00 B iQOS Impact Level		N RELENTL			
⑦ Help Center		Thin Data Ratio	44.42%	Re-sync Interval		60 M	linutes	
ToS Privacy Policy EULA								
2021 Cirrus Data Solutions Inc.	Session Volumes							
	nvme1n1		dn	n-0				
	241.59 GB /dev/disk/by-id/nvme- Amazon_Elastic_Block_Store_vol0d9538695	\$\$ 83b83ffc	268.44 GB /dev/disk/by-id/dm-uuid-mpath- 2c475a7ad7dc89ccb6c9ce900b6cec8f7			<u> </u>		
	Tracking Changes	Sync Progress - 100.00% 241.59 GB / 241.59 GB	Total Change 0.00 B (0.0	-s (New) 00 B)	Migration Rate 0.00 B/s	Rer 0.0	naining)0 B	

Figure 7: Cirrus Migrate – Migration Initial Sync Complete (source: Evaluator Group Testing)



Figure 8: Cirrus Migrate – Remote Migration Target (source: Evaluator Group Testing)

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ල Integrations	Phone							
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⑦ Help Center	Contains informational	and error e	vents from all deployments	from this project				
ToS Privacy Policy EULA © 2021 Cirrus Data Solutions Inc.	6 minutes ago	 (8) 	MIGRATION_DELETED MIGRATION_DELETED				RF	
	10 minutes ago	 (8) 	FINAL_CUTOVER_TRIGGE Final Cutover Triggered on Mi	RED Igration Session from cent7-rdm.egi1.vdi.local			RF	
	10 minutes ago	 (8) 	CMOTION_TRIGGERED cMotion™ Triggered on Migra				RF	
	11 minutes ago	 (2) 	MIGRATION_SYNC_TRIGG Synchronization Triggered on	SERED Migration Session from cent7-rdm.egi1.vdi.loca			RF	
	51 minutes ago	 (19) 	MIGRATION_CREATED Migration Session Created fro				RF	
	2 hours ago	 (1) 	GMLINK_CREATED Galaxy Migrate Link created b		egi1.vdi.local		RF	
	2 hours ago	(8) 	DEPLOYMENT_REGISTER GalaxyMigrate Deployment co	ED ent7-rdm.egi1.vdi.local Registered				
	2 hours ago		DEPLOYMENT_REMOVED	ent7-rdm.eqi1.vdi.local removed from project		Testing)	RF	

Figure 9: Cirrus Migrate – Migration Timeline (source: Evaluator Group Testing)

About Evaluator Group

Evaluator Group Inc. is dedicated to helping **IT professionals** and vendors create and implement strategies that make the most value of their storage and digital information. Evaluator Group services deliver **in-depth**, **unbiased analysis** on storage architectures, infrastructures, and management for IT professionals. Since 1997 Evaluator Group has provided services for thousands of end-users and vendor professionals through product and market evaluations, competitive analysis, and **education**. **www.evaluatorgroup.com** Follow us on Twitter @evaluator_group

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