



CATE Storage and Backup Engineering
Citigroup Architecture & Technology Engineering

NetApp Data ONTAP Compression

CSBE-12033-TP

Test Plan

Version 1.0

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1 Version Control

Version	Date	Author	Reviewed	Comments
0.1	13-JUL-2012	Richard Sopp	-	Initial draft
0.2	23-JUL-2012	Richard Sopp	-	Minor updates
1.0	31-JUL-2012	Richard Sopp	-	Final version

2 Legal Notice

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3 Contact

Please address any comments or questions regarding the information contained in this document via email to the “CATE Storage and Backup Engineering” distribution list or alternatively to gdse@citi.com.

4 Latest Versions

It is recommended that the latest version of the document be used from the CSBE website <https://catecollaboration.citigroup.net/domains/platstor/gdse/Pages/default.aspx>. Newer versions may include certification on additional platforms, or comments on issues discovered after deployment.

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6 Introduction

Data ONTAP is the operating system developed by NetApp to run on its hardware platform ('Filers') which is used in Citi for consolidated CIFS (Windows) and NFS (Unix / Linux) file sharing, as one of the NAS offerings provided by CATE. ONTAP 8.1.1 is the latest release of the ONTAP 8 (7-mode) code line that supports a number of significant new features, one of which is Data Compression.

NetApp data compression is a software-based solution that provides transparent data compression. It can be run inline or post-process and also includes the ability to perform compression of existing data. No application changes are required to use NetApp data compression.

Data compression in Data ONTAP does not compress the entire file as a single contiguous stream of bytes. This would be prohibitively expensive when it comes to servicing small reads or overwrites from part of a file because it requires the entire file to be read from disk and uncompressed before the request can be served. This would be especially difficult on large files. To avoid this, data compression works by compressing a small group of consecutive blocks, known as a compression group. In this way, when a read or overwrite request comes in, we only need to read a small group of blocks, not the entire file. This optimizes read and overwrite performance and allows greater scalability in the size of the files being compressed.

Compression requires that the underlying storage pool (aggregate) be 64-bit format. It is not possible to compress data that resides on a 32-bit aggregate.

The functionality of Data Compression will be assessed and tested in this project which will run in parallel to the overall certification effort regarding ONTAP 8.1.1, which is tracked under the project identifier #[19408](#).

6.1 Caveats and Limitations

The FAS3240 is used as an approximation for the other models in the 3200 series as well as the other NetApp platforms capable of running ONTAP 8.1.1 7-Mode. Therefore it is assumed that what works for a FAS3200 will also work on the other ONTAP 8.1.1 7-Mode ready hardware platforms supported within Citi today. Testing will be conducted using only the CIFS protocol; however compression savings are expected to be the same for the same data files irrespective of file protocol used.

The test data set is relatively small (~20GB) compared to a production volume of 650GB which may be 80% utilized (yielding 520GB worth of data). The larger data set increases the potential de-duplication rate as there is a higher likelihood of common blocks on the volume. It is possible that the de-duplication rates derived in testing will appear conservative compared to production rates. Therefore it is recommended that the Space Savings Estimation Tool be used to provide a more accurate representation of likely savings derived by enabling compression in a production environment.

The reason the test data set is comparatively small at 20GB is that it takes roughly an hour to write the 20GB from a client machine to the Filer within the lab environment. This test plan features 15 different data write tests, each with three iterations to ensure no statistical anomalies, yielding a total of 45 separate tests (each of which takes 90 minutes to execute and 30 minutes to de-stage / clean up). In order to accommodate all the tasks in the three weeks of project time allotted to lab testing, a 20GB data set was large enough to demonstrate potential savings and small enough to achieve timely execution of the test plan.

6.2 Test Environment

This section describes the key metrics and attributes of the lab environment used from this testing. Detailed physical and logical diagrams of the test environment can be found in the appendices.

This testing will be conducted on equipment physically installed in the CATE Storage and Backup Engineering Lab 11 at the Citi Warren facility in New Jersey. The engineers testing the functionality will be situated in another Citigroup location and will manage the lab environment and execute this test plan remotely.

Storage

Model:	FAS3240AE (quantity: 2)
ONTAP version:	8.1.1 (Minimum: RC1 release)
Processors:	Quad 2.33GHz Intel Xeon(tm) Processor (Harpertown)
Memory Size:	8GB per controller
NVMEM:	1GB per controller
BIOS version:	5.1.1
SAS Host Adapter:	PMC-Sierra PM8001 rev. C
SA Host Adapter Firmware rev:	01.31
IOM3 ACP Firmware:	01.20
Service Processor F/W:	1.3
Disk-shelf:	DS4243
Disk-shelf controllers:	IOM3 (F/W 0144)
Disks:	15K 600GB SAS X412_S15K7560A15 NA00
Aggregate / RAID:	14 + 2 (RAID_DP)

Active Directory

Details:	namdev.nsrootdev.net
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Anti Virus

Details:	McAfee VirusScan Enterprise 8.8i with Storage 1.0.2
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OnCommand Unified Manager (formerly Operations Manager/DFM)

Version:	OC 5.1X7 (beta build) – for reporting
Version:	OM 4.0.1D2 – for performance monitoring

OnCommand Systems Manager

Version:	2.0.1
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Special configurations¹:

Disable FlashCache (options flexscale.enable off)
Disable Anti-Virus (ePO policy update)

¹ In order to prevent any comparative bias in the write performance of the test data set these features will be disabled.

6.3 Test plan requirements (High level)

The following items are considered the significant high level test plan requirements for testing data compression with ONTAP 8.1.1 7-mode.

1. Assess potential space savings
 - Given a number of different file services data set types, establish a base line expected saving.
 - Compare with existing savings for same data set with de-duplication only.
2. Assess performance impact
 - Determine the ONTAP processing domain compression in which executes and the expected performance overhead of compression on CPU utilization and changes to I/O latency with various read / write workloads.
 - Compare inline and post-process compression options in terms of performance impact relative to a baseline with no optimization and de-duplication only.
 - Compare performance impact per volume (on a volume by volume basis) to workload of multiple concurrent volumes to test for linear / deterministic performance overhead.
3. Assess compression co-existence with de-duplication
 - Given a number of different file services data set types, establish a baseline set of recommendations for data use cases where de-duplication is already used and whether compression provides significant further utilization savings (versus performance cost).
4. Assess the ability of capacity reporting functionality to show savings derived from compression
 - Using OnCommand 5.1X7 beta determine if utilization savings achieved through compression can be shown in either a canned or customized report
 - Using the ONTAP CLI determine if utilization savings achieved through compression can be shown in disk space query
 - Using Systems Manager 2.0.1 determine if utilization savings achieved through compression can be shown in the user interface and exported as a report
5. Assess the level of compression awareness in Performance Advisor
 - Does OnCommand detect compression being enabled on the storage system?
 - Can Performance Advisor correlate the introduction of compression with any perceived deterioration in performance (increased I/O latency or CPU utilization)?
6. Assess the accuracy of NetApp's Space Savings Estimation Tool v3.0 (SSET)
 - Determine if SSET makes for an accurate indicator of potential savings once compression is enabled on a file system, given a number of different file services data types.
7. Assess compression for mutually exclusive and complementary technologies
 - Determine which other Data ONTAP features do not work well or whose value proposition will be negated with the introduction of compressed data.
 - Determine which other Data ONTAP features work well or are enhanced with the introduction of compressed data.
 - Features for testing include (but not limited to) snapshots, snapmirror (all types), snapvault, deduplication, flexclone, flash cache, vFilers, DataMotion, and Flash Pools.
8. Assess whether enabling compression in Windows Explorer triggers Data Compression to run on the storage system

6.4 Performance data metrics

This section describes the data points that will be collected with the Performance Advisor tool in Operations Manager 4.0.1D2.

1. Storage subsystem throughput

Measurement: Disk blocks per second
 System: 11c2-fas3240-01
 View type: physical
 View name: Aggregate summary view / Throughput in blocks/sec
 Object: aggr1
 Counters: user_reads
 user_writes
 cp_reads
 total_transfers
 Collection interval: 1 minute

2. Processor utilization levels

Measurement: Percent (%) busy
 System: 11c2-fas3240-01
 View type: physical
 View name: Processor summary view / CPU utilization
 Processor summary view / Average CPU busy per domain
 Object: processor0, processor1, processor2, processor3
 Counters: processor_busy
 domain busy:
 idle, kahuna, storage, exempt, raid, target,
 cifs, wafl_exempt, network
 Collection interval: 1 minute

3. File system throughput

Measurement: Count per second
 System: 11c2-fas3240-01
 View type: logical
 View name: Volume summary view / Overall IOPs by OpType
 Object: volumes:
 rs01146_noD_noC
 rs01146_D_noC
 rs01146_noD_C
 rs01146_D_C
 Counters: total_ops
 read_ops
 write_ops
 other_ops
 Collection interval: 1 minute

4. File system latency

Measurement: Time (microsecond or millisecond)
 System: 11c2-fas3240-01
 View type: logical
 View name: Volume latency view / Overall latency by OpType
 Volume latency view / CIFS latency by OpType
 Object: volumes:
 rs01146_noD_noC
 rs01146_D_noC
 rs01146_noD_C
 rs01146_D_C
 Counters:
 avg_latency
 read_latency
 write_latency
 other_latency
 cifs_read_latency
 cifs_write_latency
 cifs_other_latency
 cifs_latency
 Collection interval: 1 minute

5. Network throughput

Measurement: mb per sec, time (microsecond or millisecond), percent (%) busy
 System: 11c2-fas3240-01
 View type: logical
 View name: Storage system summary view / Network throughput
 Storage system summary view / Average latency per protocol
 Storage system summary view / CPU utilization
 Object: volumes:
 rs01146_noD_noC
 rs01146_D_noC
 rs01146_noD_C
 rs01146_D_C
 Counters:
 load_inbound_mbps
 load_outbound_mbps
 load_total_mbps
 nfsv3_avg_op_latency
 nfsv4_avg_latency
 cifs_latency
 cpu_busy
 Collection interval: 1 minute

7 Test Plan

7.1 Lab setup

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
1.0	Prepare lab environment					
1.1	Disable features which may impact / skew I/O rates and performance data					
1.1.1	Disable Flash Cache	ONTAP> options flexscale.enable off Execute this command on both nodes of the system	Flash Cache is disabled			
1.1.2	Disable virus scanning	ONTAP> vscan off	Virus scanning is disabled			
1.1.3	Disable virus scanning	Update McAfee ePO policy to remove Filers from the current AV scanner policy	Scanning servers no longer registered with Filers			
1.1.4	Disabled snapshots	ONTAP> snap sched <vol_name> 0 0 0	Snapshots schedule disabled for the volume			
1.2	Pre-requisites					
1.2.1	ONTAP version	ONTAP> version	ONTAP 8.1 or later			
1.2.2	Aggregate type	ONTAP> aggr status aggr1	Block type = 64 bit			
1.2.3	License keys	ONTAP> license	a_sis and compression features are enabled			
1.3	Create test volumes					
1.3.1	Create test data repository vol (node 02)	ONTAP> Vol create rs01146_compress_test_dataset -l en_US -s none aggr1 100g ONTAP > cifs share -add rs01146_compress_src\$ /vol/rs01146_compress_test_dataset	Volume created CIFS share created			
1.3.2	Create test data optimization comparison volumes (node 01)	ONTAP> Vol create rs01146_noD_noC -l en_US -s none aggr1 100g ONTAP> Vol create rs01146_D_noC -l en_US -s none aggr1 100g ONTAP> Vol create rs01146_noD_C -l en_US -s none aggr1 100g ONTAP> Vol create rs01146_D_C -l en_US -s none aggr1 100g	Volumes created			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
1.3.3	Create test data optimization comparison shares (node 01)	ONTAP > cifs share –add rs01146_noD_noC\$ /vol/ rs01146_noD_noC ONTAP > cifs share –add rs01146_D_noC\$ /vol/ rs01146_D_noC ONTAP > cifs share –add rs01146_noD_C\$ /vol/ rs01146_noD_C ONTAP > cifs share –add rs01146_D_C\$ /vol/ rs01146_D_C	CIFS shares created			
1.3.4	Create test data concurrent workload volumes (node 01)	Create 8 volumes (01 through 08) represented by XX ONTAP> Vol create rs01146_optXX –l en_US –s none aggr1 100g	Volumes created			
1.3.5	Create test data concurrent workload shares (node 01)	Create 8 shares (01 through 08) ONTAP > cifs share –add rs01146_optXX /vol/ rs01146_optXX	CIFS shares created			

7.2 Storage optimization performance and utilization tests

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
2.0	Compression and de-duplication tests – General file services					
2.1	Baseline test – De-duplication and compression set to off					
2.1.1	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_noD_noC\$ /E /H /R	Data copied No storage efficiencies realized			Capture performance metrics as detailed in section 6.4 Capture Windows Explorer, ONTAP CLI and System Manager utilization reports
2.1.2	Reset test environ	Del *.* rs01146_noD_noC\$	Volume empty			Repeat test #2.1 three times
2.2	Baseline test – De-duplication (only) of existing data					
2.2.1	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_D_noC\$ /E /H /R	Data copied No storage efficiencies realized			Capture performance metrics as detailed in section 6.4
2.2.2	De-dupe scan	ONTAP> Sis on rs01146_D_noC ONTAP> sis start -s rs01146_D_noC	De-duplication ran successfully			Capture Windows Explorer, ONTAP CLI and System Manager utilization reports
2.2.3	Reset test environ	ONTAP> Sis off rs01146_D_noC Del *.* rs01146_D_noC\$ ONTAP*> Sis undo rs01146_D_noC	Volume empty			Repeat test #2.2 three times
2.3	Baseline test – De-duplication (only) of new data (finger-printing)					
2.3.1	Enable de-dupe	ONTAP> Sis on rs01146_D_noC	De-dupe enabled			
2.3.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_D_noC\$ /E /H /R	Data copied No storage efficiencies realized			Capture performance metrics as detailed in section 6.4
2.3.3	De-dupe	ONTAP> sis start rs01146_D_noC	De-duplication ran successfully			Capture Windows Explorer, ONTAP CLI and System Manager utilization reports
2.3.4	Reset test environ	ONTAP> Sis off rs01146_D_noC Del *.* rs01146_D_noC\$ ONTAP*> Sis undo rs01146_D_noC	Volume empty			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
2.4	Baseline test – In-line Compression (only) of new data					
2.4.1	Enable compression	ONTAP> Sis on rs01146_noD_C ONTAP>sis config –C true –I true rs01146_noD_C	Compression enabled			
2.4.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\rs01146_noD_C\$ /E /H /R	Data written in a compressed state			Capture performance metrics as detailed in section 6.4
2.4.3	Compression	ONTAP> df –S -g rs01146_noD_C	Compression savings confirmed			Capture Windows Explorer, ONTAP CLI and System Manager utilization reports
2.4.4	Reset test environ	ONTAP>sis config –C false –I false rs01146_noD_C ONTAP> Sis off rs01146_noD_C Del *.* rs01146_noD_C\$ ONTAP*> Sis undo rs01146_noD_C	Volume empty			After SIS config no new data is compressed Sis undo will un-compress existing data
2.5	Baseline test – Post process Compression (only) of existing data					
2.5.1	Duplicate of test #2.7as post process compression cannot execute exclusively and must be run in parallel with the de-duplication process due to how the two post process optimization technologies work together.					
2.6	Baseline test – Inline and post process Compression (only) of new data					
2.6.1	Duplicate of test #2.4 as post process compression must be enabled for in line compression to work					
2.7	Baseline test – De-duplication with post process Compression of new data					
2.7.1	Enable compression	ONTAP> Sis on rs01146_D_C ONTAP>sis config –C true –I false rs01146_D_C	Optimization enabled			
2.7.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\rs01146_noD_C\$ /E /H /R	Data written in an uncompressed state			Capture performance metrics as detailed in section 6.4
2.7.3	De-duplication	ONTAP> sis start rs01146_D_C ONTAP> df –S -g rs01146_D_C	Space savings realized			Capture Windows Explorer, ONTAP CLI and System Manager utilization reports
2.7.4	Reset test environ	ONTAP>sis config –C false –I false rs01146_D_C ONTAP> Sis off rs01146_D_C Del *.* rs01146_D_C\$ ONTAP*> Sis undo rs01146_D_C	Volume empty			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
2.8	Baseline test – De-duplication with in-line compression of new data					
2.8.1	Enable compression	ONTAP> Sis on rs01146_D_C ONTAP>sis config –C true –I true rs01146_D_C	Optimization enabled			
2.8.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_D_C\$ /E /H /R	Data written in a compressed state			Capture performance metrics as detailed in section 6.4
2.8.3	Compression	ONTAP> sis start rs01146_D_C ONTAP> df –S -g rs01146_D_C	Space savings realized			Capture Windows Explorer, ONTAP CLI and System Manager utilization reports
2.8.4	Reset test environ	ONTAP>sis config –C false –I false rs01146_D_C ONTAP> Sis off rs01146_D_C Del *.* rs01146_D_C\$ ONTAP*> Sis undo rs01146_D_C	Volume empty			
2.9	Baseline test – De-duplication with in-line and post-process compression of new data					
2.9.1	Duplicate of test #2.8 as post process compression must be enabled for in line compression to work					

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
3.0	Compression and de-duplication tests – VMware					
3.1	Baseline test – De-duplication (only) of existing data					
3.1.1	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src_ds01\$ \\11c2-fas3240-02\ rs01146_D_noC\$ /E /H /R	Data copied No storage efficiencies realized			Capture performance metrics as detailed in section 6.4
3.1.2	De-dupe scan	ONTAP> Sis on rs01146_D_noC ONTAP> sis start -s rs01146_D_noC	Data de-duplicated			Capture Windows Explorer, ONTAP CLI and System Manager utilization reports
3.1.3	Reset test environ	ONTAP> Sis off rs01146_D_noC Del ** rs01146_D_noC\$ ONTAP*> Sis undo rs01146_D_noC	Volume empty			Repeat test #2.2 three times
3.2	Baseline test – De-dupe and post process Compression (only) of existing data					
3.2.1	Enable compression	ONTAP> Sis on rs01146_noD_C ONTAP>sis config -C true rs01146_noD_C	Compression enabled			
3.2.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src_ds01\$ \\11c2-fas3240-02\ rs01146_noD_C\$ /E /H /R	Data written in an uncompressed state			Capture performance metrics as detailed in section 6.4
3.2.3	Compression	ONTAP> Sis start rs01146_noD_C ONTAP> df -S -g rs01146_noD_C	Compression savings achieved			Capture Windows Explorer, ONTAP CLI and System Manager utilization reports
3.2.4	Reset test environ	ONTAP>sis config -C false rs01146_noD_C ONTAP> Sis off rs01146_noD_C Del ** rs01146_noD_C\$ ONTAP*> Sis undo rs01146_noD_C	Volume empty			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
3.3	Baseline test – De-duplication with in-line compression of existing data (implies post process compression)					
3.3.1	Enable compression	ONTAP> Sis on rs01146_D_C ONTAP>sis config –C true –I true rs01146_D_C	Compression enabled			
3.3.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src_ds01\$ \\11c2-fas3240-02\ rs01146_D_C\$ /E /H /R	Data written in a compressed state			Capture performance metrics as detailed in section 6.4
3.3.3	Compression	ONTAP> sis start rs01146_D_C ONTAP> df –S -g rs01146_D_C	Data de-duplicated as well as compressed			Capture Windows Explorer, ONTAP CLI and System Manager utilization reports
3.3.4	Reset test environ	ONTAP>sis config –C false –I false rs01146_noD_C ONTAP> Sis off rs01146_D_C Del *.* rs01146_D_C\$ ONTAP*> Sis undo rs01146_D_C	Volume empty			
4.0	Compression and de-duplication tests – General File Services concurrent operations – Linear performance scale test					
4.1	De-duplication (only) of existing data – 2 concurrent volumes					
4.1.1	Enable de-dupe	ONTAP> Sis on rs01146_opt01 ONTAP> Sis on rs01146_opt02	De-duplication enabled			
4.1.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_optXX\$ /E /H /R	Date written			Replace XX with volume designation and run multiple xcopy sessions concurrently Capture performance metrics as detailed in section 6.4
4.1.3	De-dupe	ONTAP> sis start rs01146_opt01 ONTAP> sis start rs01146_opt02	Data de-duplicated			
4.1.4	Reset test environ	ONTAP> Sis off rs01146_opt01 ONTAP> Sis off rs01146_opt02 Del *.* rs01146_opt01 Del *.* rs01146_opt02 ONTAP*> Sis undo rs01146_opt01 ONTAP*> Sis undo rs01146_opt02	Volume empty and de-duplication disabled			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.2	De-duplication (only) of existing data – 4 concurrent volumes					
4.2.1	Enable de-dupe	ONTAP> Sis on rs01146_opt01 ONTAP> Sis on rs01146_opt02 ONTAP> Sis on rs01146_opt03 ONTAP> Sis on rs01146_opt04	De-duplication enabled			
4.2.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_optXX\$ /E /H /R	Date written			Replace XX with volume designation and run multiple xcopy sessions concurrently Capture performance metrics as detailed in section 6.4
4.2.3	De-dupe	ONTAP> sis start rs01146_opt01 ONTAP> sis start rs01146_opt02 ONTAP> sis start rs01146_opt03 ONTAP> sis start rs01146_opt04	Data de-duplicated			
4.2.4	Reset test environ	ONTAP> Sis off rs01146_opt01 ONTAP> Sis off rs01146_opt02 ONTAP> Sis off rs01146_opt03 ONTAP> Sis off rs01146_opt04 Del *.* rs01146_opt01 Del *.* rs01146_opt02 Del *.* rs01146_opt03 Del *.* rs01146_opt04 ONTAP*> Sis undo rs01146_opt01 ONTAP*> Sis undo rs01146_opt02 ONTAP*> Sis undo rs01146_opt03 ONTAP*> Sis undo rs01146_opt04	Volume empty and de-duplication disabled			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.3	De-duplication (only) of existing data –8 concurrent volumes					
4.3.1	Enable de-dupe	ONTAP> Sis on rs01146_opt01 ONTAP> Sis on rs01146_opt02 ONTAP> Sis on rs01146_opt03 ONTAP> Sis on rs01146_opt04 ONTAP> Sis on rs01146_opt05 ONTAP> Sis on rs01146_opt06 ONTAP> Sis on rs01146_opt07 ONTAP> Sis on rs01146_opt08	De-duplication enabled			
4.3.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_optXX\$ /E /H /R	Date written			Replace XX with volume designation and run multiple xcopy sessions concurrently Capture performance metrics as detailed in section 6.4
4.3.3	De-dupe	ONTAP> sis start rs01146_opt01 ONTAP> sis start rs01146_opt02 ONTAP> sis start rs01146_opt03 ONTAP> sis start rs01146_opt04 ONTAP> sis start rs01146_opt05 ONTAP> sis start rs01146_opt06 ONTAP> sis start rs01146_opt07 ONTAP> sis start rs01146_opt08	Data de-duplicated			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.3.4	Reset test environ	ONTAP> Sis off rs01146_opt01 ONTAP> Sis off rs01146_opt02 ONTAP> Sis off rs01146_opt03 ONTAP> Sis off rs01146_opt04 ONTAP> Sis off rs01146_opt05 ONTAP> Sis off rs01146_opt06 ONTAP> Sis off rs01146_opt07 ONTAP> Sis off rs01146_opt08 Del *.* rs01146_opt01 Del *.* rs01146_opt02 Del *.* rs01146_opt03 Del *.* rs01146_opt04 Del *.* rs01146_opt05 Del *.* rs01146_opt06 Del *.* rs01146_opt07 Del *.* rs01146_opt08 ONTAP*> Sis undo rs01146_opt01 ONTAP*> Sis undo rs01146_opt02 ONTAP*> Sis undo rs01146_opt03 ONTAP*> Sis undo rs01146_opt04 ONTAP*> Sis undo rs01146_opt05 ONTAP*> Sis undo rs01146_opt06 ONTAP*> Sis undo rs01146_opt07 ONTAP*> Sis undo rs01146_opt08	Volume empty and de-duplication disabled			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.4	In line compression (only) of existing data – 2 concurrent volumes					
4.4.1	Enable compression	ONTAP> Sis on rs01146_opt01 ONTAP> Sis on rs01146_opt02 ONTAP>sis config –C true –I true rs01146_opt01 ONTAP>sis config –C true –I true rs01146_opt02	Compression enabled			
4.4.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_opt01\$ /E /H /R	Date written			Replace XX with volume designation and run multiple xcopy sessions concurrently Capture performance metrics as detailed in section 6.4
4.4.3	Compression	ONTAP> df –S -g rs01146_opt01 ONTAP> df –S -g rs01146_opt02	Savings realized			
4.4.4	Reset test environ	ONTAP>sis config –C false –I false rs01146_opt01 ONTAP>sis config –C false –I false rs01146_opt02 ONTAP> Sis off rs01146_opt01 ONTAP> Sis off rs01146_opt02 Del *.* rs01146_opt01 Del *.* rs01146_opt02 ONTAP*> Sis undo rs01146_opt01 ONTAP*> Sis undo rs01146_opt02	Volume empty and compression disabled			
4.5	In line compression (only) of existing data – 4 concurrent volumes					
4.5.1	Enable compression	ONTAP> Sis on rs01146_opt01 ONTAP> Sis on rs01146_opt02 ONTAP> Sis on rs01146_opt03 ONTAP> Sis on rs01146_opt04 ONTAP>sis config –C true –I true rs01146_opt01 ONTAP>sis config –C true –I true rs01146_opt02 ONTAP>sis config –C true –I true rs01146_opt03 ONTAP>sis config –C true –I true rs01146_opt04	Compression enabled			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.5.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\rs01146_opt01\$ /E /H /R	Date written			Replace XX with volume designation and run multiple xcopy sessions concurrently Capture performance metrics as detailed in section 6.4
4.5.3	Compression	ONTAP> df -S -g rs01146_opt01 ONTAP> df -S -g rs01146_opt02 ONTAP> df -S -g rs01146_opt03 ONTAP> df -S -g rs01146_opt04	Savings realized			
4.5.4	Reset test environ	ONTAP>sis config -C false -I false rs01146_opt01 ONTAP>sis config -C false -I false rs01146_opt02 ONTAP>sis config -C false -I false rs01146_opt03 ONTAP>sis config -C false -I false rs01146_opt04 ONTAP> Sis off rs01146_opt01 ONTAP> Sis off rs01146_opt02 ONTAP> Sis off rs01146_opt03 ONTAP> Sis off rs01146_opt04 Del *.* rs01146_opt01 Del *.* rs01146_opt02 Del *.* rs01146_opt03 Del *.* rs01146_opt04 ONTAP*> Sis undo rs01146_opt01 ONTAP*> Sis undo rs01146_opt02 ONTAP*> Sis undo rs01146_opt03 ONTAP*> Sis undo rs01146_opt04	Volume empty and compression disabled			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.6	In line compression (only) of existing data – 8 concurrent volumes					
4.6.1	Enable compression	ONTAP> Sis on rs01146_opt01 ONTAP> Sis on rs01146_opt02 ONTAP> Sis on rs01146_opt03 ONTAP> Sis on rs01146_opt04 ONTAP> Sis on rs01146_opt05 ONTAP> Sis on rs01146_opt06 ONTAP> Sis on rs01146_opt07 ONTAP> Sis on rs01146_opt08 ONTAP>sis config -C true -I true rs01146_opt01 ONTAP>sis config -C true -I true rs01146_opt02 ONTAP>sis config -C true -I true rs01146_opt03 ONTAP>sis config -C true -I true rs01146_opt04 ONTAP>sis config -C true -I true rs01146_opt05 ONTAP>sis config -C true -I true rs01146_opt06 ONTAP>sis config -C true -I true rs01146_opt07 ONTAP>sis config -C true -I true rs01146_opt08	Compression enabled			
4.6.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_opt01\$ /E /H /R	Date written			Replace XX with volume designation and run multiple xcopy sessions concurrently Capture performance metrics as detailed in section 6.4
4.6.3	Compression	ONTAP> df -S -g rs01146_opt01 ONTAP> df -S -g rs01146_opt02 ONTAP> df -S -g rs01146_opt03 ONTAP> df -S -g rs01146_opt04 ONTAP> df -S -g rs01146_opt05 ONTAP> df -S -g rs01146_opt06 ONTAP> df -S -g rs01146_opt07 ONTAP> df -S -g rs01146_opt08	Savings realized			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.6.4	Reset test environ	ONTAP>sis config -C false -I false rs01146_opt01 ONTAP>sis config -C false -I false rs01146_opt02 ONTAP>sis config -C false -I false rs01146_opt03 ONTAP>sis config -C false -I false rs01146_opt04 ONTAP>sis config -C false -I false rs01146_opt05 ONTAP>sis config -C false -I false rs01146_opt06 ONTAP>sis config -C false -I false rs01146_opt07 ONTAP>sis config -C false -I false rs01146_opt08 ONTAP> Sis off rs01146_opt01 ONTAP> Sis off rs01146_opt02 ONTAP> Sis off rs01146_opt03 ONTAP> Sis off rs01146_opt04 ONTAP> Sis off rs01146_opt05 ONTAP> Sis off rs01146_opt06 ONTAP> Sis off rs01146_opt07 ONTAP> Sis off rs01146_opt08 Del *.* rs01146_opt01 Del *.* rs01146_opt02 Del *.* rs01146_opt03 Del *.* rs01146_opt04 Del *.* rs01146_opt05 Del *.* rs01146_opt06 Del *.* rs01146_opt07 Del *.* rs01146_opt08 ONTAP*> Sis undo rs01146_opt01 ONTAP*> Sis undo rs01146_opt02 ONTAP*> Sis undo rs01146_opt03 ONTAP*> Sis undo rs01146_opt04 ONTAP*> Sis undo rs01146_opt05 ONTAP*> Sis undo rs01146_opt06 ONTAP*> Sis undo rs01146_opt07 ONTAP*> Sis undo rs01146_opt08	Volume empty and compression disabled			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.7	Data de-duplication and in line compression of existing data – 2 concurrent volumes (implies post process compression as well)					
4.7.1	Enable compression	ONTAP> Sis on rs01146_opt01 ONTAP> Sis on rs01146_opt02 ONTAP>sis config –C true –I true rs01146_opt01 ONTAP>sis config –C true –I true rs01146_opt02	Optimization enabled			
4.7.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_optXX\$ /E /H /R	Data written in a compressed state			Replace XX with volume designation and run multiple xcopy sessions concurrently Capture performance metrics as detailed in section 6.4
4.7.3	Compression	ONTAP> sis start rs01146_opt01 ONTAP> sis start rs01146_opt02 ONTAP> df –S -g rs01146_opt01 ONTAP> df –S -g rs01146_opt02	Space savings realized			
4.7.4	Reset test environ	ONTAP>sis config –C false –I false rs01146_opt01 ONTAP>sis config –C false –I false rs01146_opt02 ONTAP> Sis off rs01146_opt01 ONTAP> Sis off rs01146_opt02 Del *.* rs01146_opt01\$ Del *.* rs01146_opt02\$ ONTAP*> Sis undo rs01146_opt01 ONTAP*> Sis undo rs01146_opt02	Volume empty			
4.8	Data de-duplication and in line compression (only) of existing data – 4 concurrent volumes (implies post process compression as well)					
4.8.1	Enable compression	ONTAP> Sis on rs01146_opt01 ONTAP> Sis on rs01146_opt02 ONTAP> Sis on rs01146_opt03 ONTAP> Sis on rs01146_opt04 ONTAP>sis config –C true –I true rs01146_opt01 ONTAP>sis config –C true –I true rs01146_opt02 ONTAP>sis config –C true –I true rs01146_opt03 ONTAP>sis config –C true –I true rs01146_opt04	Optimization enabled			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.8.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_optXX\$ /E /H /R	Data written in a compressed state			Replace XX with volume designation and run multiple xcopy sessions concurrently Capture performance metrics as detailed in section 6.4
4.8.3	Compression	ONTAP> sis start rs01146_opt01 ONTAP> sis start rs01146_opt02 ONTAP> sis start rs01146_opt03 ONTAP> sis start rs01146_opt04 ONTAP> df -S -g rs01146_opt01 ONTAP> df -S -g rs01146_opt02 ONTAP> df -S -g rs01146_opt03 ONTAP> df -S -g rs01146_opt04	Space savings realized			
4.8.4	Reset test environ	ONTAP>sis config -C false -I false rs01146_opt01 ONTAP>sis config -C false -I false rs01146_opt02 ONTAP>sis config -C false -I false rs01146_opt03 ONTAP>sis config -C false -I false rs01146_opt04 ONTAP> Sis off rs01146_opt01 ONTAP> Sis off rs01146_opt02 ONTAP> Sis off rs01146_opt03 ONTAP> Sis off rs01146_opt04 Del *.* rs01146_opt01\$ Del *.* rs01146_opt02\$ Del *.* rs01146_opt03\$ Del *.* rs01146_opt04\$ ONTAP*> Sis undo rs01146_opt01 ONTAP*> Sis undo rs01146_opt02 ONTAP*> Sis undo rs01146_opt03 ONTAP*> Sis undo rs01146_opt04	Volume empty			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.9	Data de-duplication and in line compression (only) of existing data – 8 concurrent volumes (implies post process compression as well)					
4.9.1	Enable compression	ONTAP> Sis on rs01146_opt01 ONTAP> Sis on rs01146_opt02 ONTAP> Sis on rs01146_opt03 ONTAP> Sis on rs01146_opt04 ONTAP> Sis on rs01146_opt05 ONTAP> Sis on rs01146_opt06 ONTAP> Sis on rs01146_opt07 ONTAP> Sis on rs01146_opt08 ONTAP>sis config –C true –I true rs01146_opt01 ONTAP>sis config –C true –I true rs01146_opt02 ONTAP>sis config –C true –I true rs01146_opt03 ONTAP>sis config –C true –I true rs01146_opt04 ONTAP>sis config –C true –I true rs01146_opt05 ONTAP>sis config –C true –I true rs01146_opt06 ONTAP>sis config –C true –I true rs01146_opt07 ONTAP>sis config –C true –I true rs01146_opt08	Optimization enabled			
4.9.2	Write data	xcopy \\11c2-fas3240-02\ rs01146_compress_src\$ \\11c2-fas3240-02\ rs01146_optXX\$ /E /H /R	Data written in a compressed state			Replace XX with volume designation and run multiple xcopy sessions concurrently Capture performance metrics as detailed in section 6.4

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.9.3	Compression	ONTAP> sis start rs01146_opt01 ONTAP> sis start rs01146_opt02 ONTAP> sis start rs01146_opt03 ONTAP> sis start rs01146_opt04 ONTAP> sis start rs01146_opt05 ONTAP> sis start rs01146_opt06 ONTAP> sis start rs01146_opt07 ONTAP> sis start rs01146_opt08 ONTAP> df -S -g rs01146_opt01 ONTAP> df -S -g rs01146_opt02 ONTAP> df -S -g rs01146_opt03 ONTAP> df -S -g rs01146_opt04 ONTAP> df -S -g rs01146_opt05 ONTAP> df -S -g rs01146_opt06 ONTAP> df -S -g rs01146_opt07 ONTAP> df -S -g rs01146_opt08	Space savings realized			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
4.9.4	Reset test environ	ONTAP>sis config -C false -I false rs01146_opt01 ONTAP>sis config -C false -I false rs01146_opt02 ONTAP>sis config -C false -I false rs01146_opt03 ONTAP>sis config -C false -I false rs01146_opt04 ONTAP>sis config -C false -I false rs01146_opt05 ONTAP>sis config -C false -I false rs01146_opt06 ONTAP>sis config -C false -I false rs01146_opt07 ONTAP>sis config -C false -I false rs01146_opt08 ONTAP> Sis off rs01146_opt01 ONTAP> Sis off rs01146_opt02 ONTAP> Sis off rs01146_opt03 ONTAP> Sis off rs01146_opt04 ONTAP> Sis off rs01146_opt05 ONTAP> Sis off rs01146_opt06 ONTAP> Sis off rs01146_opt07 ONTAP> Sis off rs01146_opt08 Del *.* rs01146_opt01\$ Del *.* rs01146_opt02\$ Del *.* rs01146_opt03\$ Del *.* rs01146_opt04\$ Del *.* rs01146_opt05\$ Del *.* rs01146_opt06\$ Del *.* rs01146_opt07\$ Del *.* rs01146_opt08\$ ONTAP*> Sis undo rs01146_opt01 ONTAP*> Sis undo rs01146_opt02 ONTAP*> Sis undo rs01146_opt03 ONTAP*> Sis undo rs01146_opt04 ONTAP*> Sis undo rs01146_opt05 ONTAP*> Sis undo rs01146_opt06 ONTAP*> Sis undo rs01146_opt07 ONTAP*> Sis undo rs01146_opt08	Volume empty			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
5.0	Accuracy of NetApp Space Savings Estimation Tool					
5.1	De-duplication (only) estimation – File services					
5.1.1	Benchmark	Run SSET against the dataset used in test #2.3	Estimation tool is within 98% of actual savings			
5.2	Compression (only) estimation – File services					
5.2.1	Benchmark	Run SSET against the dataset used in test #2.4	Estimation tool is within 98% of actual savings			
5.3	De-duplication and compression estimation – File services					
5.3.1	Benchmark	Run SSET against the dataset used in test #2.8	Estimation tool is within 98% of actual savings			
5.4	De-duplication (only) estimation – VMware					
5.4.1	Benchmark	Run SSET against the dataset used in test #3.1	Estimation tool is within 98% of actual savings			
5.5	Compression (only) estimation – VMware					
5.5.1	Benchmark	Run SSET against the dataset used in test #3.2	Estimation tool is within 98% of actual savings			
5.6	De-duplication and compression estimation – VMware					
5.6.1	Benchmark	Run SSET against the dataset used in test #3.3	Estimation tool is within 98% of actual savings			
6.0	Read Performance					
6.1	Compare non-compressed data and compressed data read performance					
6.1.1	IStream	Select a random list of files from home drive data set	File read operations take longer to complete for compressed data			Compare uncompressed and compressed data performance
6.1.2	SIO workload	75% read and 50% random	File read operations take longer to complete for compressed data			
6.1.3	Random file read	Test files at 32K size boundary and subset sizes and files that cross 32K boundary	File read operations take longer to complete for compressed data			

7.3 Compression related supplemental tests

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
7.0	Miscellaneous					
7.1	Windows Explorer compression					
7.1.1	Properties	Select file properties from Windows Explorer and on the General tab click the advanced button. Tick the Compress Contents to Save Disk Space	The advanced button is not available as it is not supported by ONTAP			https://kb.netapp.com/support/index?page=content&id=3010462
7.2	License requirements					
7.2.1	ONTAP licenses	Which licenses are required to enable de-duplication and compression?	License keys are no longer required for de-dupe, compression and nearstore with ONTAP 8.1			https://kb.netapp.com/support/index?page=content&id=3013159
7.3	Compression as a complementary and mutually exclusive ONTAP technology (documentation review only)					
7.3.1	Snapshots	Review docs and perform basic functional test	Compression supported			Storage efficiency management guide TR3958
7.3.2	Snapmirror async volume	Review docs and perform basic functional test	Compression supported			
7.3.3	Snapmirror async qtree	Review docs and perform basic functional test	Compression supported			
7.3.4	Snapmirror semi-sync volume	Review docs and perform basic functional test	Compression not supported			
7.3.5	Snapmirror sync volume	Review docs and perform basic functional test	Compression not supported			
7.3.6	Snapmirror compression	Review docs and perform basic functional test	Compression supported			
7.3.7	SnapVault	Review docs and perform basic functional test	Compression supported			
7.3.8	SnapLock	Review docs and perform basic functional test	Compression supported			
7.3.9	Qtree quotas	Review docs and perform basic functional test	Compression supported			
7.3.10	HA pair	Review docs and perform basic functional test	Compression supported			

Test #	Test Conditions	Action / Test Procedure	Expected Results / Acceptance Criteria	Actual Results / Observed Results	Pass / Fail	Notes
7.3.11	vFilers	Review docs and perform basic functional test	Compression supported			
7.3.12	ONTAP root volume	Review docs and perform basic functional test	Compression not supported			
7.3.13	32-bit aggregate	Review docs and perform basic functional test	Compression not supported			
7.3.14	Flash Cache	Review docs and perform basic functional test	Compression supported			
7.3.15	Tape backup	Review docs and perform basic functional test	Compression supported			
7.3.16	Flash Pools	Review docs and perform basic functional test	Compression supported			

8 Appendices

8.1 Lab Diagram

This section contains a reference diagram that describes the logical representation of the lab environment used to execute this test plan.

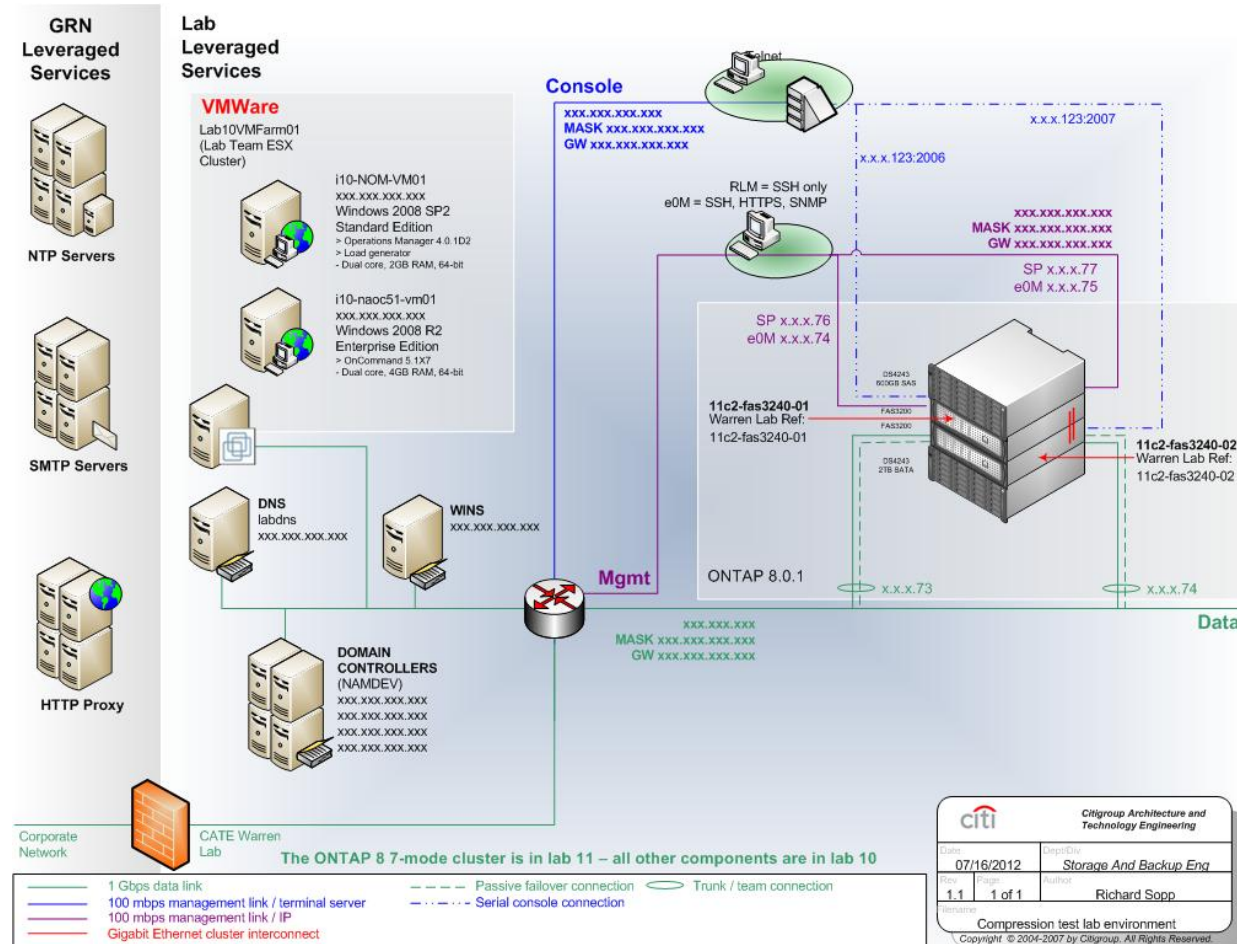


Figure 8.1 Lab Network (logical)

8.2 General file services – user home directory test data set

The following table describes the classification and size of the data set used in testing general file services user home directory data.

File Type	Sub Type	Count of Files	Sum of File Size (mb)	
Application (Undefined)		1684	3170.2	
Archive		292	4868.6	
Other	Database	357	9.2	
Docs / MS Office		1118	7356.8	
Docs / PDF		324	261.4	
Docs / Text		28511	635.1	
Other	Firmware Image	55	27.2	
Other	ISO	1	49.7	
Media	Audio	12	0.1	
Media	Image	1260	145.8	
Media	Video	11	8.0	
Other	O/S Files - Linux	1	0.4	
Other	O/S Files - Windows	504	589.6	
Other	Source Code	377	115.7	
Other	Temp	2	0.6	
Unknown		1648	62.1	
Total		34509	17238.43	16.83 (GB)

Home Directory Test Data Set (by file type)

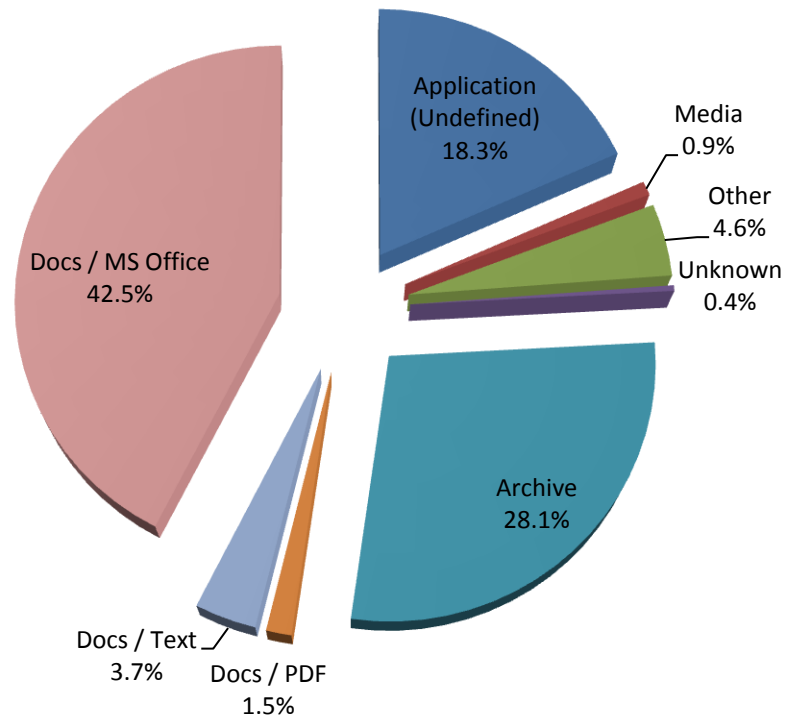


Figure 8.2 - User home directory data set

9 Document Version Control

This section contains a detailed list of the updates made during each document release. Section 1 is purely an overview.

Version	Changes
0.1	Initial draft
0.2	- Corrected inconsistencies in the syntax of the sis config command when configuring compression (post process compression '-C' must be enabled to permit inline compression '-I' to be used). Corrected tests #2.6, #2.9, #3.3 and #4.4 through #4.9 accordingly - Changed test #3.2 from 'post process compression' to 'dedupe and post process compression' based updated understanding that post process compression requires a-sis to be enabled - During the planning stages of testing it was discovered that certain combinations of optimization approaches were not viable due to how they were implemented in ONTAP. For example inline compression requires post process compression to be enabled, and post process compression cannot be executed exclusively, thereby meaning de-dupe and post process compression must be run together. The following tests from version 0.1 of the test plan were cancelled accordingly: #2.5, #2.6 and #2.9
1.0	Removed draft document designation