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StorReduce 3.4.8 with Veritas NetBackup 7.7 and Hitachi Content Platform v7.2

Lab Validation Report

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October 2016

Hitachi Data Systems

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StorReduce 3.4.8 with Veritas NetBackup 7.7 and Hitachi Content Platform v7.2

Lab Validation Report

Read this lab validation report to see how StorReduce 3.4.8 deduplication affects enterprise content archiving when used with Veritas NetBackup and Hitachi Content Platform (HCP) v7.2 for backup and recovery operations. Testing captured the baseline on throughput and storage capacity gained.

Note — Testing of this configuration was in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow the recommended practice of conducting proof-of-concept testing for acceptable results in a non-production, isolated test environment that otherwise matches your production environment before your production implementation of this solution.

Product Features

This lab validation report covers testing on these products in an environment for object storage management.

Hitachi Content Platform

Hitachi Content Platform is a distributed object store that provides advanced storage and data management capabilities. This helps you address challenges posed by ever-growing volumes of unstructured data. Divide a single Content Platform into multiple virtual object stores, secure access to each store, and uniquely configure each store for a particular workload.

Eliminate storage silos using Content Platform with a single object storage infrastructure that supports a wide range of data types, applications, and users with different service level needs in enterprise and cloud environments.

Hitachi Content Platform supports enterprise content archiving that does the following:

- Ensures content integrity, authenticity, security, completeness and accessibility over the long term, in accordance with relevant laws and regulations
- Offers fast, online access to content
- Allows integrated searching and indexing of the archive, including search of file contents
- Supports business continuity, data recovery, compliance search and retention needs
- Scales horizontally to support multiple applications and content types; and vertically to support continued data growth

StorReduce

StorReduce is a specialized cloud deduplication solution, designed to meet the unique requirements of companies using public, private or hybrid cloud storage for large volumes of data. StorReduce sits between your applications and cloud storage, transparently deduplicating data inline at speeds of up to 1100 MB/sec per server, reducing storage costs, speeding up the time for transfer between clouds and freeing your data for use in the cloud via standard cloud APIs.

Veritas NetBackup

Veritas NetBackup is a single solution for the entire enterprise. It is available on a converged platform, instrumented to require minimal administration in even the largest, most dynamic environments.

Intelligent policies for virtual machines and databases automatically discover new virtual machines and database instances. NetBackup includes them in future backups to help you ensure protection of all data. Operations are load balanced to avoid performance bottlenecks, with centralized configuration for maximum simplicity.

NetBackup has improved Amazon S3–compatible cloud connectors. They continue to improve their virtualization capabilities by improving VMware support and introducing new features for Microsoft® Hyper-V®. Read the NetBackup system requirements for different operating systems and hypervisors.

Test Environment Configuration

Figure 1 shows the high-level components to the test the Hitachi Protection Platform family architecture with StorReduce and Veritas Netbackup for object storage management.

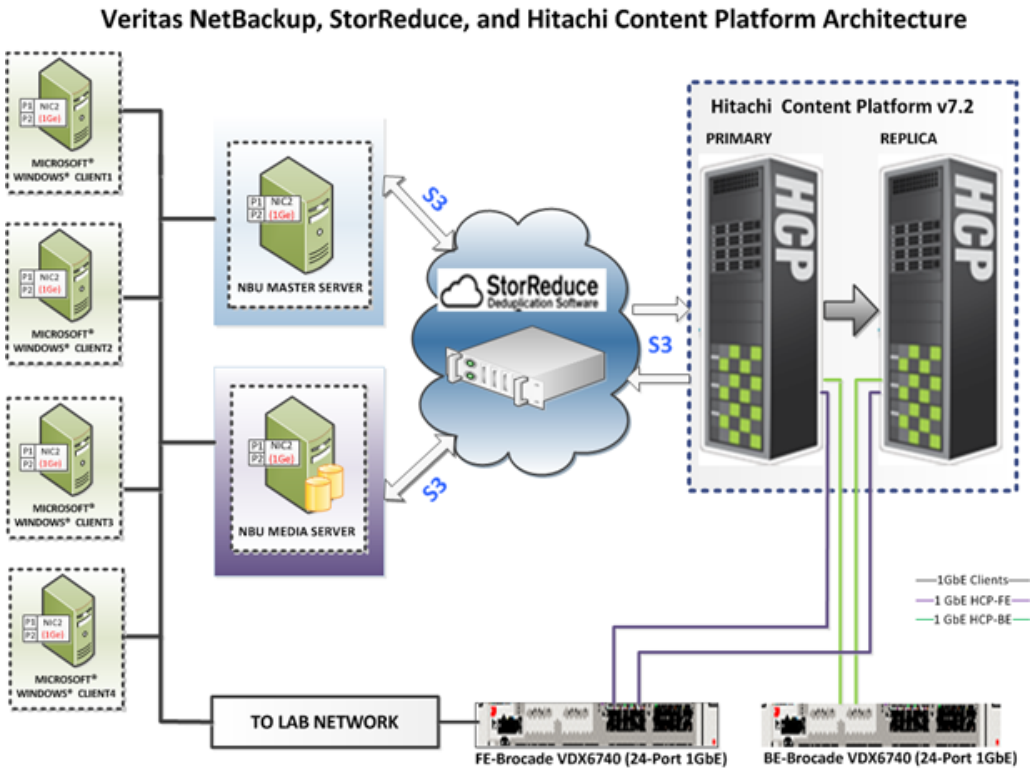

Figure 1

Hardware Components

This is the hardware configuration used to test StorReduce with Veritas NetBackup 7.7 on Hitachi Content Platform v7.2.

- Hitachi Compute Rack 220H (1 unit) with Intel Xeon E5-2620 quad-core processor, 2.4 GHz, 12 GB RAM, 6 × 500 GB HDD. This hosted the Veritas NetBackup master server.
- Hitachi Compute Rack 220H (1 unit) with 2 Intel Xeon E5-5620 quad-core processors, 2.4 GHz, 12 GB RAM, 6 × 500 GB HDD. This hosted the Veritas NetBackup media server.
- VMWare virtual machine (4 units) with 2 Intel Xeon E5-2620 quad-core processors, 2.4 GHz, 4 GB RAM. This hosted the Veritas NetBackup client 1 to client 4.
- VMWare virtual machine (1 unit) with 2 Intel E5-2620 quad-core processor, 2.4 GHz, 4 GB RAM. This hosted StorReduce.
- Hitachi Compute Rack 220S (4 units), with Intel Xeon E5-2420 6-core processor, 1.9 GHz, 32 GB RAM. This hosted the primary Hitachi Content Platform nodes.
- Hitachi Compute Rack 220S (4 units), with Intel Xeon E5-2420 6-core processor, 1.9 GHz, 32 GB RAM. This hosted the replica Hitachi Content Platform nodes.
- Brocade VDX 6740 switch (1 unit), with 24-port, 1 GbE. This is the Hitachi Content Platform back-end network.
- Brocade VDX 6740 switch (1 unit), with 24-port, 1 GbE. This is the Hitachi Content Platform front-end network.

Software Components

This is the software configuration used test StorReduce with Veritas NetBackup 7.7 with on Hitachi Content Platform v7.2.

- Hitachi Content Platform v7.2
- Veritas master server, version 7.7
- Veritas NetBackup media server, version 7.7
- Veritas NetBackup client, version 7.7
- StorReduce 3.4.8
- VMware vSphere ESXi 5.1
- Cloudberry Pro Explorer 4.7.0.99
- Microsoft® Windows Server® 2008 R2, Enterprise version (64bit)
  - Veritas NetBackup master
  - Veritas NetBackup media server
  - Veritas NetBackup client
  - Window Server clients

Test Methodology

The goal of this test was to ensure that StorReduce 3.4.8 integrates with Hitachi Content Platform v7.2 and Veritas NetBackup 7.7. The tested environment has four Microsoft® Windows Server® clients that were used as the user data source for Veritas NetBackup backup and restore operations. There were two test parts:

Part 1: Integration Test

The integration test covered three areas:

- StorReduce integration with Hitachi Content Platform
- Veritas NetBackup integration with StorReduce
- Veritas NetBackup integration to StorReduce and move to Hitachi Content Platform

The integration test covered the configuration of StorReduce 3.4.8 with Veritas NetBackup 7.7 and Hitachi Content Platform v7.2, making the solution work together. StorReduce allows Hitachi Content Platform as a direct object storage target using Amazon S3. In addition, StorReduce was setup as the Veritas NetBackup 7.7 cloud storage target with data moved or migrated to Hitachi Content Platform in real time.

Part 2: Baseline Test

The baseline test covers four areas:

- Cloudberry to StorReduce
- NetBackup to StorReduce
- NetBackup to Hitachi Content Platform
- NetBackup to StorReduce to Hitachi Content Platform

The baseline test measured the throughput and storage capacity gained using StorReduce deduplication. Testing used the StorReduce dashboard and the Veritas NetBackup console to capture results.

Analysis

This analysis includes observations from the test results. All percentage comparisons are made to baseline test results, unless otherwise stated.

Part 1: Integration Test

These analyze the results of integration testing.

StorReduce Integration with Hitachi Content Platform

The integration test of StorReduce 3.4.8 with Hitachi Content Platform v7.2 as a target cloud storage worked. It found no issues.

Veritas NetBackup Integration with StorReduce

The integration test of Veritas NetBackup 7.7 with StorReduce 3.4.8 as the target cloud storage for NetBackup works. It found no issues.

Veritas NetBackup Integration to StorReduce to Hitachi Content Platform

The integration test of Veritas NetBackup 7.7 with StorReduce 3.4.8 as the target cloud storage for NetBackup and then using Hitachi Content Platform as the target cloud storage for StorReduce works. It found no issues.

Part 2: Baseline Test

These analyze the results of the backup and restore operation testing.

Cloudberry to StorReduce

Uploading data directly to StorReduce using Cloudberry Pro explorer between single to four clients resulted in the following:

- **Single Client**

  When uploading a 1 MB file to StorReduce using Cloudberry Pro explorer, increasing the threads up to two results in a 39% increase in average throughput. Increasing the threads to more than two results in no gain.

  When uploading a 10 MB file to StorReduce using Cloudberry Pro explorer, increasing the threads up to two results in no change in average throughput. Increasing the threads to five results in an 11% increase.

- **Four Clients**

  Increasing the threads to two for a 1 MB file, average throughput increased between 68%-72%. For a 10 MB file, increasing the threads to two, the average throughput increased between 9%-15%. Increasing the threads to give resulted in a 26%-37% increase in average throughput.

  Capacity consumption decreased by around 88% when the StorReduce depuplicated the data ingested before moving it to Hitachi Content Platform.

Veritas NetBackup to StorReduce

Veritas NetBackup full backup to StorReduce between single to four clients results in the following:

- **Full Backup with a Single Client**
  - **Average Throughput**

    Increasing from one to two threads resulted in a 98% (10 MB file) and a 225% (1 MB file) increase in average throughput. Increasing from one to five threads resulted a 104% (10 MB file) and a 235% (1 MB file) increase in average throughput.

  - **Capacity Consumption with StorReduce**
    - **10 MB File**

      Capacity consumption for a single thread decreased by 97% when passing the file through StorReduce deduplication. An increase in threads from one to two resulted in a smaller capacity consumption reduction, with only 55%. A further increase in threads from one to five resulted in a further smaller capacity consumption reduction, going down to 53%.

    - **1 MB File**

      Capacity consumption with a single thread decreased by 60% when passing the file through StorReduce. An increase in threads from one to two resulted in a smaller capacity consumption reduction of 59%. A further increase in threads from one to five resulted in no change in capacity reduction.

- **Full Backup with Four Clients**
  - **Average Throughput**

    Increasing from one to two threads resulted in a 29% (10MB file) and 48% (1 MB file) increase in average throughput. A further increase of threads from one to vie resulted in an average throughput decrease of 27% (10MB file) and 57% (1MB file) increase.

  - **Capacity Consumption with StorReduce**
    - **1 MB File**

      Capacity consumption with a single thread decreased by 98% when passing through StorReduce deduplication. An increase in threads from one to two resulted in a smaller reduction, going down to 75%. A further increase of threads from one to give resulted in similar reduction of 75%.

Veritas NetBackup to Hitachi Content Platform

A Veritas NetBackup full backup directly to Hitachi Content Platform between one to four clients resulted in the following:

- **Full Backup with a Single Client**
  - **Average Throughput**

    Increasing a single client from one to two threads resulted in a 6% (10 MB file) decrease and a 15% (1 MB file) increase in average throughput. Increasing threads from one to five resulted in a 5% (10 MB file) decrease and no change (1MB file).

- **Full Backup with Four Clients**
  - **Average Throughput**

    Increasing from one to two threads resulted in a 2% (10 MB file) decrease and a 6% (1 MB file) increase in average throughput. Increasing threads from one to five resulted in an average throughput decrease of 79% (10 MB file) and 43% (1 MB file).

Veritas NetBackup to StorReduce to Hitachi Content Platform

A Veritas NetBackup full backup to StorReduce and then move to Hitachi Content Platform resulted in the following:

- **Full Backup with a Single Client**
  - **Average Throughput**

    Increasing from one to two threads resulted in a 225% (1 MB file) increase in average throughput. Increasing threads from one to five resulted in a 235% (1 MB file) increase.

  - **Capacity Consumption**

    Capacity consumption with a single thread decreased by 97% (10 MB file) and 60% (1 MB File) when passing through StorReduce deduplication. An increase in threads from one to two resulted a smaller reduction, going down to 59% (1 MB file).

- **Full Backup with Four Clients**
  - **Average Throughput**

    Increasing from one to two threads resulted in a 28% (10 MB file) increase in average throughput. Increasing threads from one to five increased average throughput to 22%, which is slightly lower than two threads.

  - **Capacity Consumption**

    Capacity consumption with a single thread decreased by 75% (1 MB file) when passing through StorReduce deduplication. Increasing threads from one to two resulted in a similar reduction of 75% (1 MB file). A further increase in threads from one to five also resulted in a 75% reduction (1 MB file).

Restore Operations

Veritas NetBackup full restore from Hitachi Content Platform passing through StorReduce resulted in the following:

- NetBackup full restore of a 10 MB file (1000) from Hitachi Content Platform passed through StorReduce had a 29.88 MB/sec average throughput. A 1 MB file (1000) resulted in 76.04 MB/sec average throughput.
- NetBackup full restore of 10 MB file (1000) directly from Hitachi Content Platform had a 94.20 MB/sec average throughput. A 1 MB file (1000) resulted in 66.56 MB/sec average throughput.

Conclusions

When uploading to StorReduce using a single client, consider only using up to two threads increase average throughput. Increasing clients from one to four threads boost the average throughput between 68%-72%.

When making a NetBackup full backup to StorReduce, consider using a single client with five threads to gain higher average throughput. A single client with a single thread resulted in a higher reduction in capacity consumption when utilizing deduplication from StorReduce.

Using StorReduce between NetBackup and Hitachi Content Platform during a backup operation resulted in a higher average throughput when compared to using NetBackup direct to Hitachi Content Platform.

If you want higher average throughput, make a NetBackup full backup to StorReduce and then move it to Hitachi Content Platform using a single client with between 2-5 threads. If you want higher capacity consumption, consider using a single client with a single thread using deduplication with StorReduce.

With a NetBackup full restore, results showed a restore operation directly from Hitachi Content Platform resulted in a higher average throughput versus a restore operation from Hitachi Content Platform passing through StorReduce.

Test Results

These are the test results for integration evaluation of StorReduce 3.4.8 deduplication when used with Veritas NetBackup and Hitachi Content Platform v7.2 for backup and recovery operations. All percentage comparisons are made to baseline test results, unless otherwise stated.

Part 1: Integration Test

The integration test covers three areas, namely:

- StorReduce Integration with Hitachi Content Platform
- Veritas NetBackup Integration with StorReduce
- Veritas NetBackup Integration to StorReduce and Move to Hitachi Content Platform

StorReduce Integration with Hitachi Content Platform

The integration test of StorReduce 3.4.8 with Hitachi Content Platform v7.2 as a target cloud storage worked. It found no issues.

Table 1 contains the complete test results of the StorReduce integration with Hitachi Content Platform.

Table 1. StorReduce Integration with Hitachi Content Platform

Test Cases	Results
1. Configure StorReduce in write-read mode.	Pass
2. Configure StorReduce S3 settings.	Pass
3. Configure Hitachi Content Platform tenant and namespace as StorReduce target.	Pass
4. Configure StorReduce as Hitachi Content Platform target.	Pass
5. Configure Hitachi Content Platform to target StorReduce as S3-ompatible device.	Pass
6. Upload single file to StorReduce with Hitachi Content Platform as target.	Pass
7. Verify uploaded file from StorReduce written to Hitachi Content Platform.	Pass
8. Ingest data to StorReduce with Hitachi Content Platform tenant-namespace.	Pass
9. Capture data ingest throughput between StorReduce to Hitachi Content Platform.	Pass
10. Verify directory or data format written to StorReduce for original file.	Pass
11. Read or open file or files from StorReduce and verify retrieval.	Pass

Veritas NetBackup Integration with StorReduce

The integration test of Veritas NetBackup 7.7 with StorReduce 3.4.8 as the target cloud storage for NetBackup works. It found no issues.

Table 2 contains test results of the Veritas NetBackup integration with Hitachi Content Platform.

Table 2. Veritas NetBackup Integration with StorReduce

Test Cases	Results
1. Configure NetBackup to map StorReduce as cloud storage target.	Pass
2. Verify or check NetBackup and StorReduce mapping and folder or directory written.	Pass
3. Configure NetBackup cloud disk pool and disk volumes.	Pass
4. Configure NetBackup backup and restore policies.	Pass
5. Perform NetBackup full backup to StorReduce.	Pass
6. Verify backup completed by checking the folder and files are created in StorReduce.	Pass
7. Capture NetBackup throughput to StorReduce.	Pass
8. Perform NetBackup full restore from StorReduce.	Pass
9. Verify restore completed by checking the folder and files created in target location.	Pass
10. Verify directory and data format written to StorReduce for original file.	Pass
11. Capture NetBackup restore throughput from StorReduce.	Pass

Veritas NetBackup Integration to StorReduce and Move to Hitachi Content Platform

The integration test of Veritas NetBackup 7.7 with StorReduce 3.4.8 as the target cloud storage for NetBackup and then using Hitachi Content Platform as the target cloud storage for StorReduce works. It found no issues.

Table 3 contains test results of the Veritas NetBackup integration with Hitachi Content Platform.

Table 3. Veritas NetBackup Integration with StorReduce and Hitachi Content Platform

Test Cases	Results
1. Configure NetBackup to map StorReduce as target cloud storage.	Pass
2. Configure target tenant or namespace in Hitachi Content Platform primary.	Pass
3. Configure Hitachi Content Platform replication, primary and replica.	Pass
4. Configure StorReduce to map Hitachi Content Platform as object storage target.	Pass
5. Configure NetBackup backup and restore policies for StorReduce to Hitachi Content Platform.	Pass
6. Verify settings for NetBackup, StorReduce, and Hitachi Content Platform, and validate the folders and files created.	Pass
7. Perform NetBackup full backup to StorReduce and then have StorReduce move it to Hitachi Content Platform.	Pass
8. Verify NetBackup backup written to StorReduce and migrated to target Hitachi Content Platform.	Pass
9. Capture and report data capacity stored in StorReduce versus capacity stored to Hitachi Content Platform.	Pass
10. Capture and report throughput during backup operation.	Pass
11. Perform NetBackup full restore from StorReduce or Hitachi Content Platform and capture throughput	Pass
12. Backup NetBackup Media Server and StorReduce database. Verify backup is done	Pass

Table 3. Veritas NetBackup Integration with StorReduce and Hitachi Content Platform (Continued)

Test Cases	Results
13. Simulate failure in NetBackup media server, StorReduce, and Hitachi Content Platform primary.	Pass
14. Perform restore and recovery-rebuild NetBackup Media and StorReduce server using backup.	Pass
15. Reconfigure StorReduce to connect to Hitachi Content Platform replica.	Pass
16. Perform restore operation of backup.	Pass
17. Verify NetBackup folder and files were restored to target path from StorReduce or Hitachi Content Platform.	Pass
18. Capture and report throughput during restore or recovery operation.	Pass

Part 2: Baseline Test

The baseline test covers four areas:

- Cloudberry Upload to StorReduce
- Veritas NetBackup to StorReduce
- Veritas NetBackup to Hitachi Content Platform
- Veritas NetBackup to StorReduce to Hitachi Content Platform

Cloudberry Upload to StorReduce

These are the baseline test results for the various Cloudberry uploads to StorReduce.

Table 4. Clouberry Upload to StorReduce — Single Client

Upload Single File	Single Thread	Two Threads	Five Threads
	System Throughput Average (MB/sec)		
1 MB	12.500	20.400	20.400
10 MB	19.000	19.900	21.000

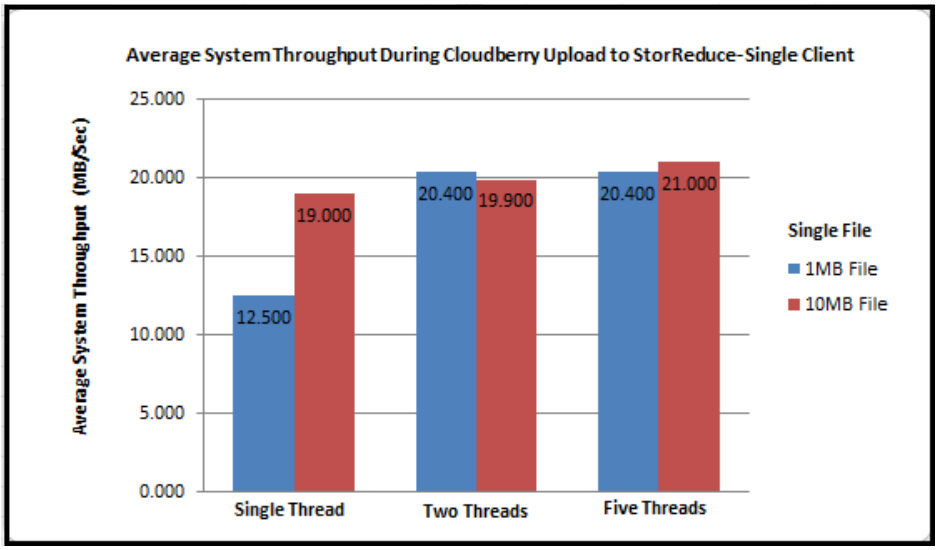

Figure 2

Figure 2 shows that increasing threads to 2 for 1 MB file increases average throughput by 39%.while increasing thread to 5 has no change. For 10 MB file, increasing threads to 2 does not have any impact but increasing to 5 threads increased throughput by 11%.

Table 5. Clouberry Upload to StorReduce — Four Clients

Upload 1000 Files	Single Thread		Two Threads		Five Threads	
	Average Throughput (MB/sec)	Peak Throughput (MB/sec)	Average Throughput (MB/sec)	Peak Throughput (MB/sec)	Average Throughput (MB/sec)	Peak Throughput (MB/sec)
1 KB	0.025	0.049	0.026	0.046	0.001	0.004
1 MB	5.170	5.900	8.900	9.900	8.900	13.700
10 MB	34.970	39.600	40.100	43.200	47.800	49.700

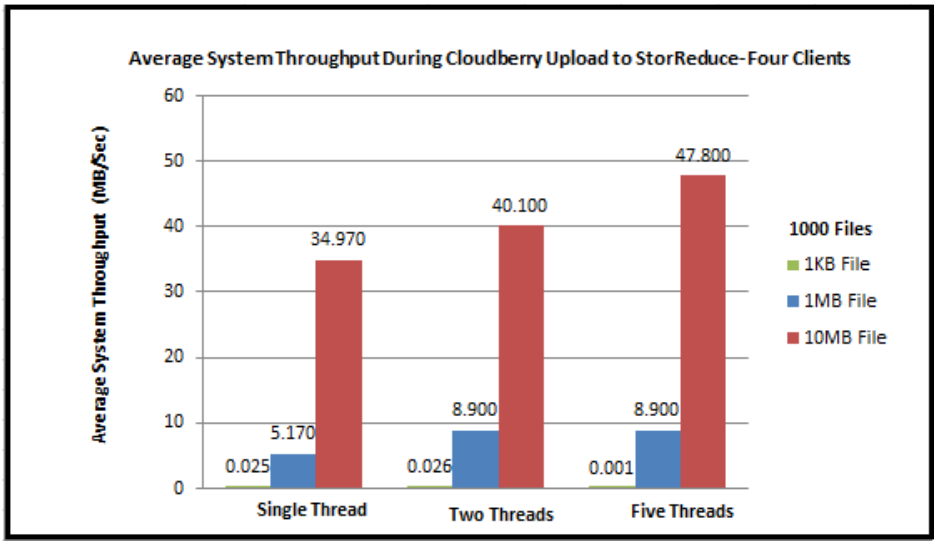

Figure 3

Figure 3 shows that for a 10 MB file, increasing threads from 1 to 2 increases average throughput by 15%, while increasing threads further to 5 increases throughput by 37%. For 1 MB file, increasing threads from 1 to 2 increases average throughput by 72%, while increasing threads further to 5 does not bring any change.

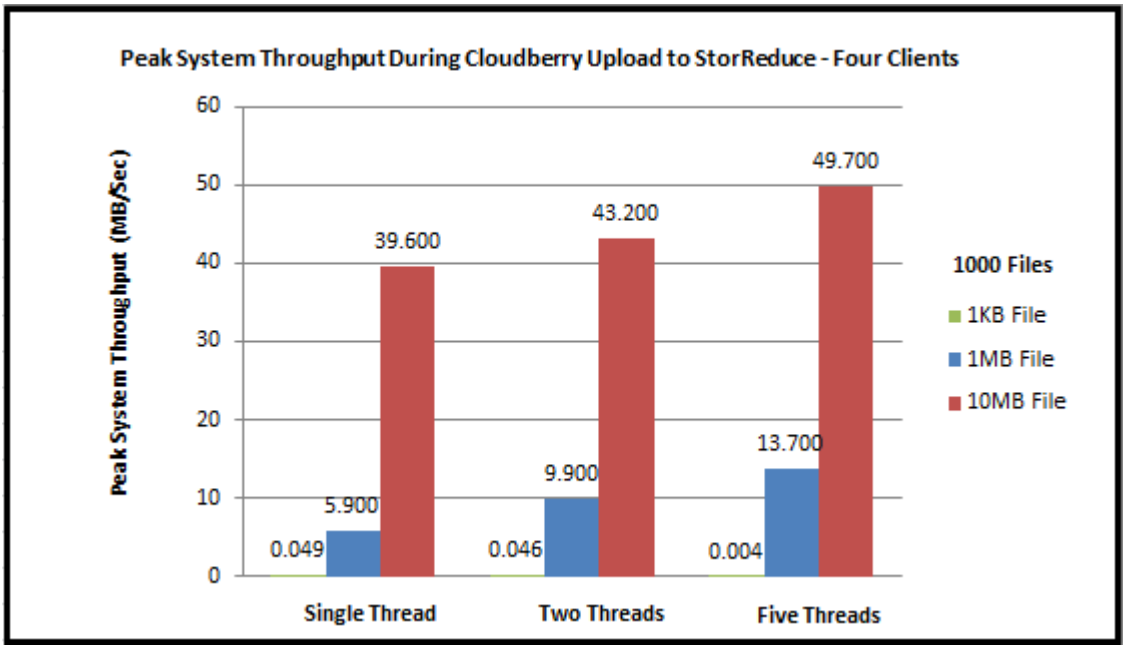

Figure 4

Figure 4 shows that for a 10 MB file, increasing threads from 1 to 2 increases the peak throughput by 9%, while increasing threads further to 5 increases peak throughput by 26%. For a 1 MB file, increasing threads from 1 to 2 increases the average throughput by 68%, while increasing threads further to 5 increased peak throughput to 132%.

Table 6. Capacity Stored During Clouberry Upload to StorReduce — Four Clients, Single Thread

Upload 1000 Files	Single Thread				
	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	3.90	0.99	0.07	N/A	25.49
1 MB	253.00	273.60	273.60	N/A	108.14
10 MB	2390.00	278.50	278.50	N/A	11.65

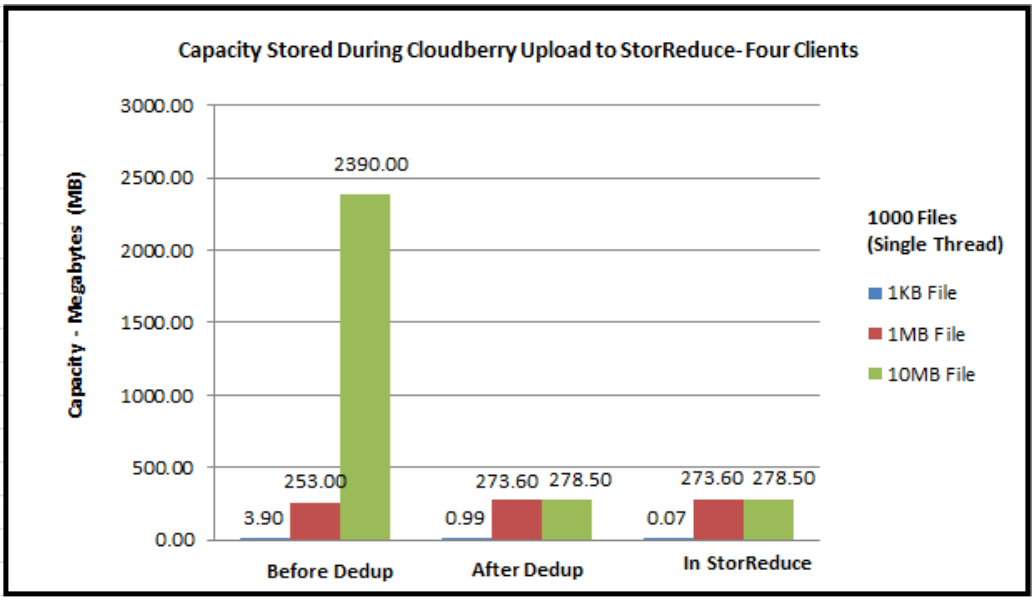

Figure 5

Figure 5 shows that for 10 MB of files (1000 files) uploaded data from four clients using a single thread, StorReduce deduplication results in reduction of consumption in capacity from 2390 MB to 278.50 MB, which is around 88%.

Table 7. Capacity Stored During Clouberry Upload to StorReduce — Four Clients, Two Threads

Upload 1000 Files	Two Threads				
	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	3.90	1.22	0.07	N/A	31.18
1 MB	253.00	274.40	274.40	N/A	108.46
10 MB	2390.00	280.50	280.50	N/A	11.74

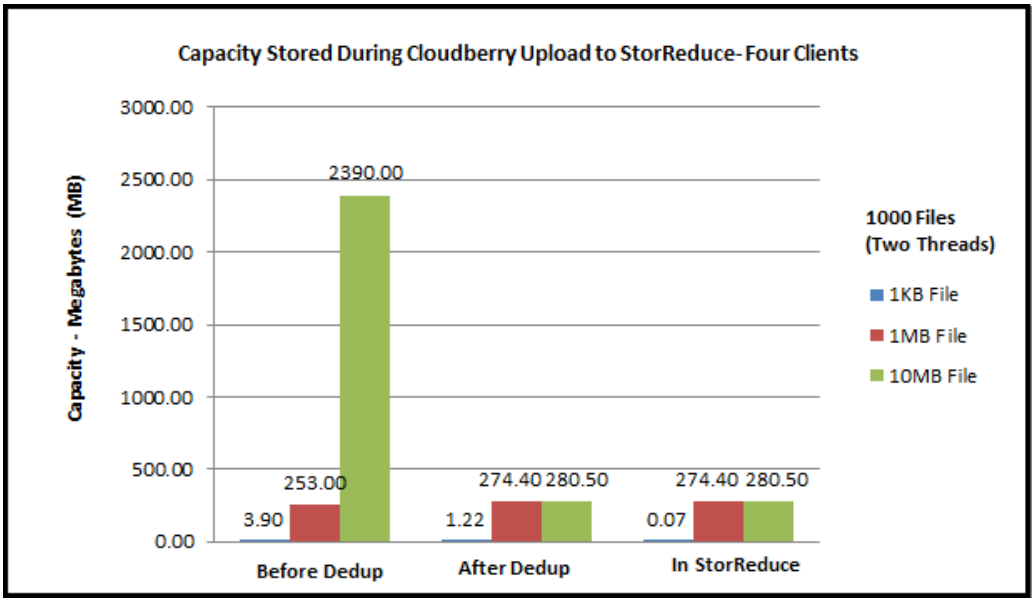

Figure 6

Figure 6 shows that for 10 MB in files (1000 files) uploaded data from four clients using two threads, StorReduce deduplication results in reduction of consumption in capacity from 2390 MB to 280.50 MB, at around 88%.

Table 8. Capacity Stored During Clouberry Upload to StorReduce — Four Clients, Five Threads

Upload 1000 Files	Five Threads				
	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	3.900	1.46	0.07	N/A	37.31
1 MB	253.00	275.30	275.30	N/A	108.81
10 MB	2390.00	282.50	282.50	N/A	11.82

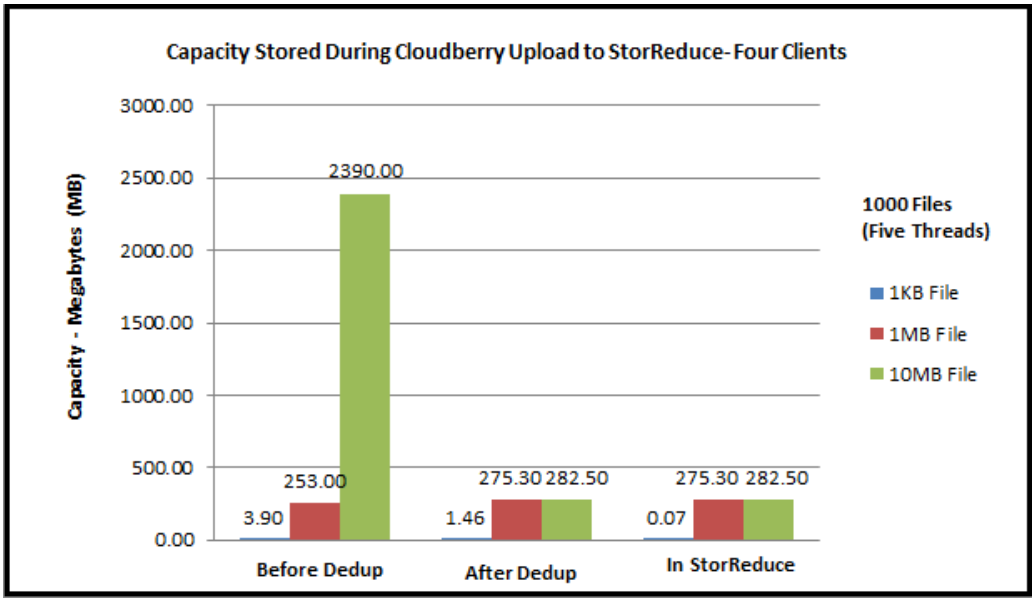

Figure 7

Figure 7 shows that for 10 MB of files (1000 files) uploaded data from four clients with five threads, StorReduce deduplication results in reduction of consumption in capacity from 2390 MB to 282.50 MB, which is around 88%. This is similar to two threads.

Veritas NetBackup to StorReduce

These are the baseline test results for the various Veritas NetBackup uploads to StorReduce.

Table 9. Veritas NetBackup Full Backup to StorReduce Throughput — Single Client, Single File

Full Backup Single File	Single Thread	Two Threads	Five Threads
	System Throughput Average (MB/sec)	System Throughput Average (MB/sec)	System Throughput Average (MB/sec)
1 KB	3.733	3.733	3.920
1 MB	7.871	25.610	26.338
10 MB	12.914	25.610	26.338

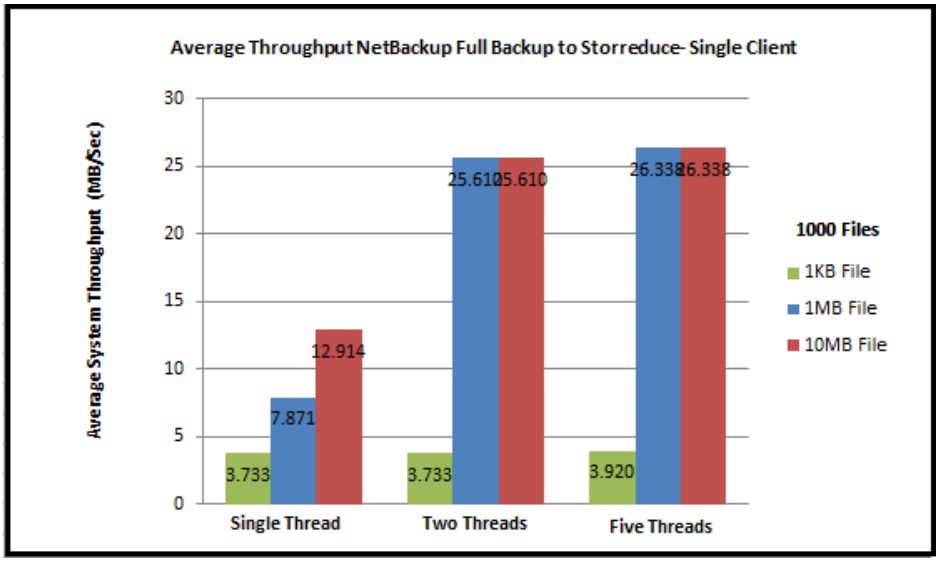

Figure 8

Figure 8 shows that for Veritas NetBackup full backup of 10 MB of files (1000 files) to StorReduce with single client, increasing threads from 1 to 2 increases average throughput by 98% while increasing threads further to 5 increases throughput by 104%. For 1 MB file, increasing threads from 1 to 2 increases average throughput by 225% while increasing threads further to 5 increased average throughput by 235%.

Table 10. Capacity Stored During NetBackup Full Backup to StorReduce — Single Client ,Single Thread

Full Backup	Single Thread				
1000 Files	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	3.90	2.46	2.46	N/A	63.00
1 MB	10800.00	4337.00	4337.00	N/A	40.16
10 MB	9580.00	246.00	246.00	N/A	2.57

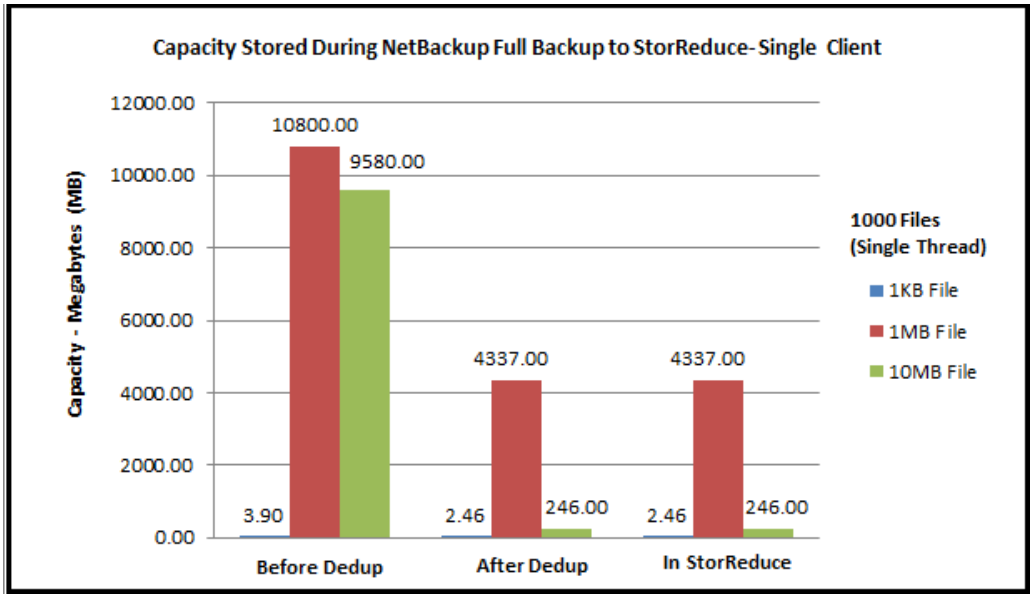

Figure 9

Figure 9 shows that for Veritas NetBackup, a full backup of 10 MB of files (1000 files) data to StorReduce with a single client and single thread, StorReduce deduplication results in reduction of consumption capacity from 9,580 MB to 246 MB of around 97%. A full backup of 1 MB of files (1000 files) data with a single client and single thread results in a reduction of consumption capacity from 10,800 MB to 4337 MB, of around 60%.

Table 11. Capacity Stored During NetBackup Full Backup to StorReduce — Single Client, Two Threads

Full Backup	Two Threads				
1000 Files	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	3.90	2.46	2.46	N/A	63.00
1 MB	10800.00	4469.00	4469.00	N/A	41.38
10 MB	10800.00	4469.00	4469.00	N/A	41.38

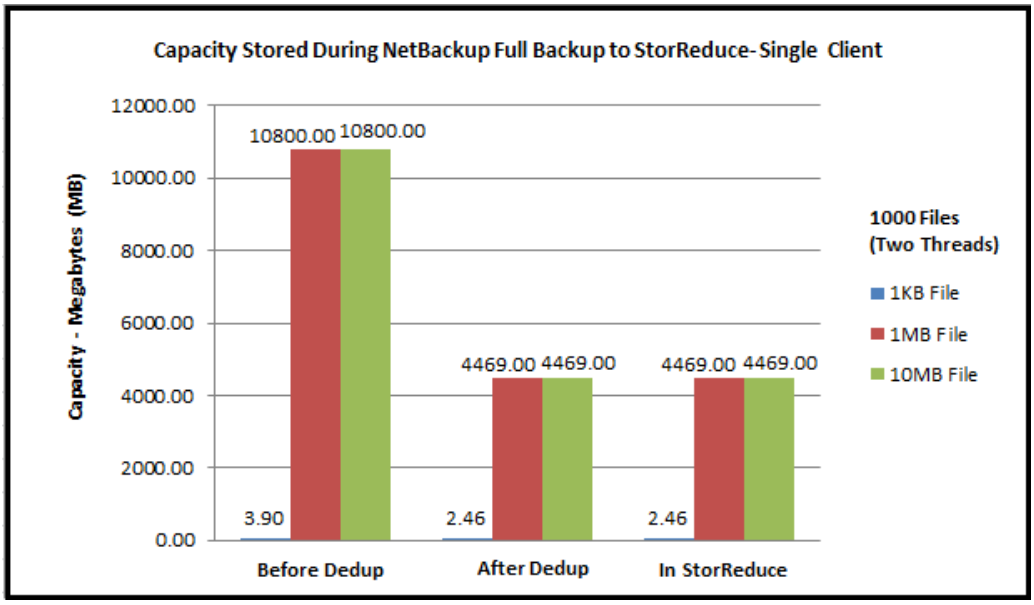

Figure 10

Figure 10 shows that for Veritas NetBackup, a full backup of 10 MB of files (1000 files) data to StorReduce with a single client with two threads results in a reduction of consumption capacity from 10,800 MB to 4469 MB, or about around 59%. A full backup of 1 MB of files (1000 files) data with a single client with two threads results in a reduction of consumption capacity of around 59%, similar to 10 MB file.

Table 12. Capacity Stored During NetBackup Full Backup to StorReduce — Single Client, Five Threads

Full Backup 1000 Files	Five Threads				
	Before Dedup Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	3.90	2.46	2.46	N/A	63.00
1 MB	10800.00	4462.00	4462.00	N/A	41.31
10 MB	9800.00	4462.00	4462.00	N/A	46.58

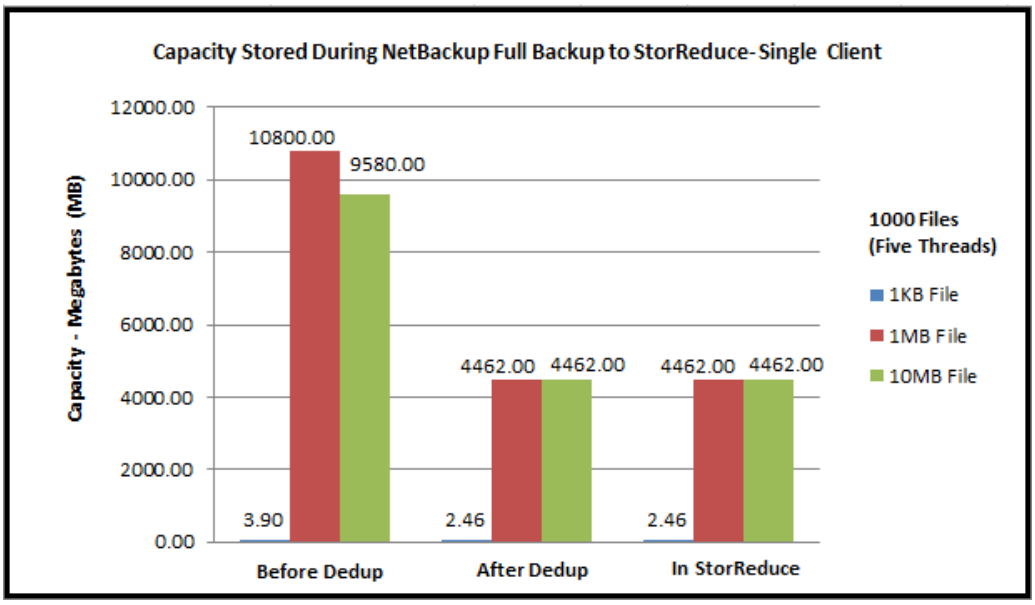

Figure 11

Figure 11 shows that for Veritas NetBackup, full backup of 10 MB of files (1000 files) data to StorReduce with single client and 5 threads, StorReduce deduplication resulted in a reduction of consumption capacity from 9,580 MB to 4462 MB, around 53%. A full backup of 1 MB of files (1000 files) data with single client and 5 threads resulted in a reduction of consumption capacity from 10,800 MB to 4462 MB, around 59%.

Table 13. Veritas NetBackup Full Backup to StorReduce Throughput — Four Clients

Full Backup 1000 Files	Single Thread		Two Threads		Five Threads	
	Average Throughput (MB/sec)	Peak Throughput (MB/sec)	Average Throughput (MB/sec)	Peak Throughput (MB/sec)	Average Throughput (MB/sec)	Peak Throughput (MB/sec)
1 KB	2.053	2.143	2.052	2.143	1.995	2.080
1 MB	3.750	4.173	5.551	6.361	5.877	7.341
10 MB	5.368	5.392	6.914	7.006	6.822	6.917

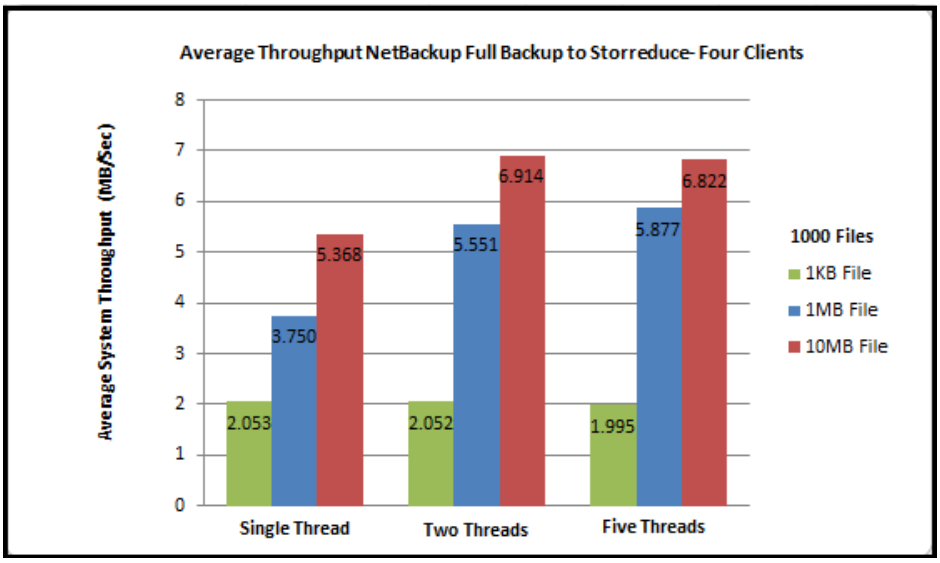

Figure 12

Figure 12 shows that for Veritas NetBackup, a full backup of 10 MB of files (1000 files) to StorReduce with four clients, increasing threads from 1 to 2 increased average throughput by 29%. Increasing threads further to 5 slightly decreases average throughput to from 29% to 27%.

For a 1 MB file, increasing threads from 1 to 2 increased average throughput by 48% while increasing threads further to 5 increased average throughput by 57%.

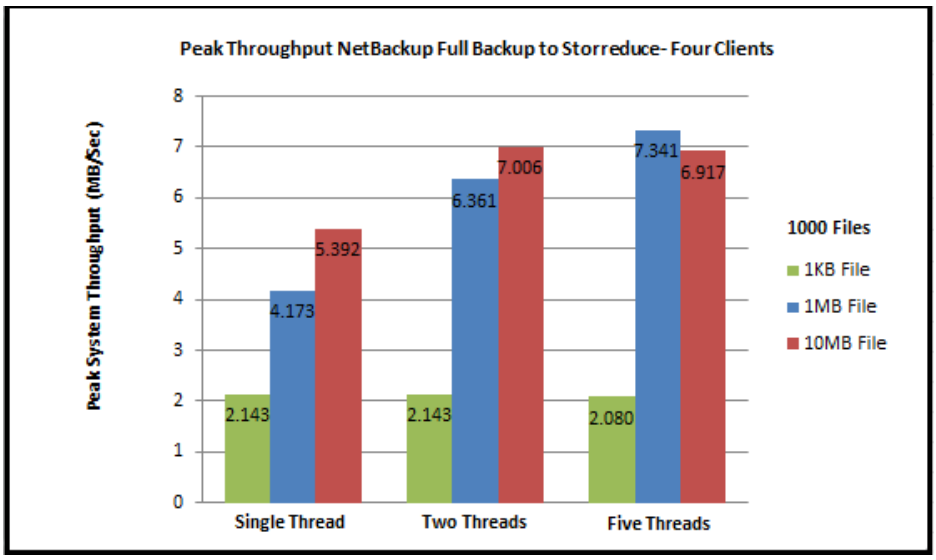

Figure 13

Figure 13 shows that for Veritas NetBackup, a full backup of 10 MB of files (1000 files) to StorReduce with four clients, increasing threads from 1 to 2 increased *peak* throughput by 30%. Increasing threads further to 5 slightly decreased *peak* throughput to 28%.

For a 1 MB file, increasing threads from 1 to 2 increased *peak* throughput by 52%. Increasing threads further to 5 increased *peak* throughput by 76%.

Table 14. Capacity Stored During NetBackup Full Backup to StorReduce — Four Clients, Single Thread

Full Backup 1000 Files	Single Thread				
	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	3.90	0.97	1.11	N/A	24.87
1 MB	10800.00	249.59	249.59	N/A	2.31

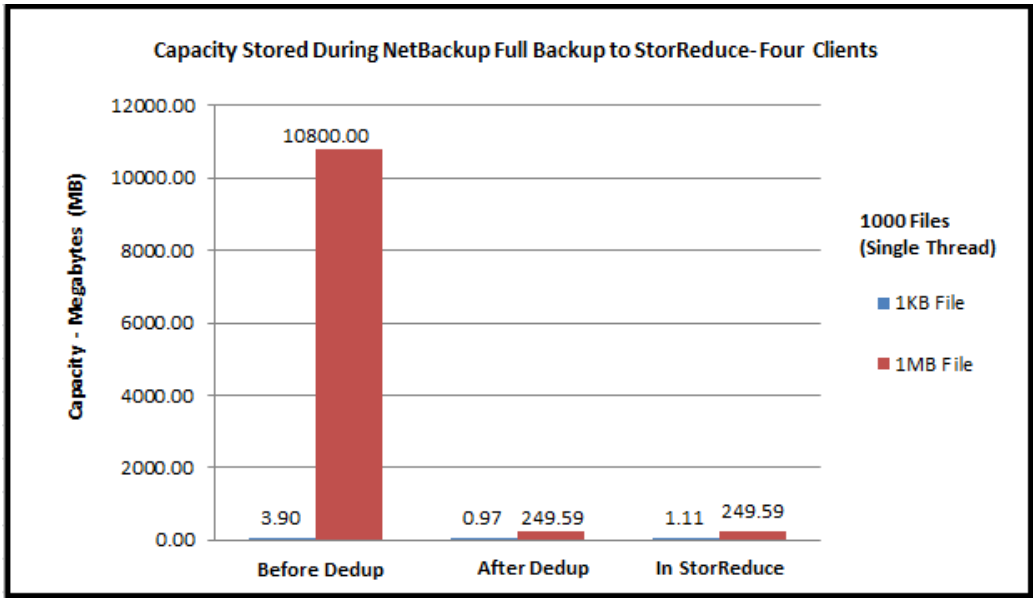

Figure 14

Figure 14 shows that for Veritas NetBackup, a full backup of 1 MB of files (1000 files) data to StorReduce with four clients with a single thread resulted in a reduction of consumption capacity from 10,800 MB to 249.59 MB, around 98%.

Table 15. Capacity Stored During NetBackup Full Backup to StorReduce — Four Clients, Two Threads

Full Backup 1000 Files	Two Threads				
	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	0.97	0.97	1.11	N/A	100.00
1 MB	990.00	249.59	249.59	N/A	25.21

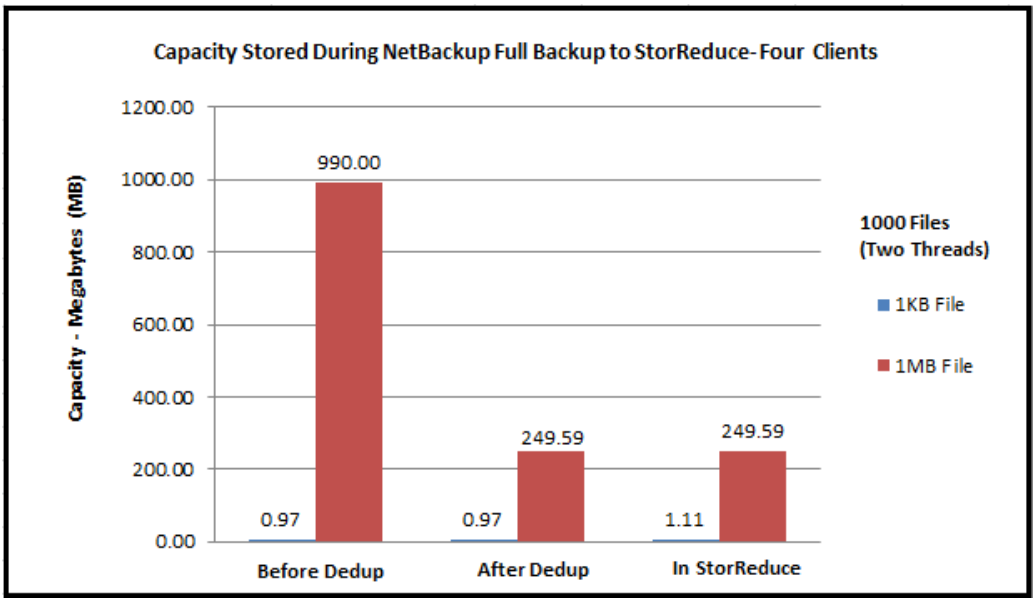

Figure 15

Figure 15 shows that for Veritas NetBackup, a full backup of 1 MB of files (1000 files) data to StorReduce with four clients and two threads resulted in reduction of consumption capacity from 990 MB to 249.59 MB, around 75%.

Table 16. Capacity Stored During NetBackup Full Backup to StorReduce — Four Clients, Five Threads

Full Backup 1000 Files	Five Threads				
	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	0.97	0.97	1.11	N/A	100.00
1 MB	990.00	249.59	249.59	N/A	25.21

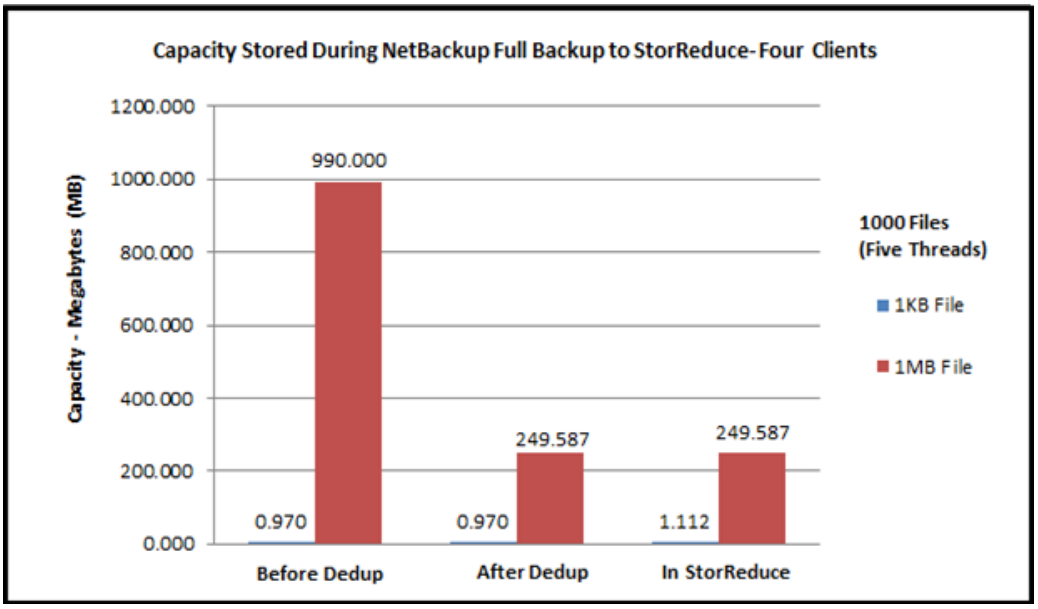

Figure 16

Figure 16 shows that for Veritas NetBackup, a full backup of 1 MB of files (1000 files) data to StorReduce with four clients and five threads resulted in a reduction of consumption capacity from 990 MB to 249.587 MB, around 75%.

Veritas NetBackup to Hitachi Content Platform

These are the test results for Veritas NetBackup uploads to Hitachi Content Platform.

Table 17. Veritas NetBackup Full Backup Direct to Hitachi Content Platform Throughput — Single Client

Full Backup 1000 Files	Single Thread	Two Threads	Five Threads
	System Throughput Average (MB/sec)	System Throughput Average (MB/sec)	System Throughput Average (MB/sec)
1 KB	3.568	3.733	3.568
1 MB	11.752	13.501	13.485
10 MB	12.333	11.600	11.905

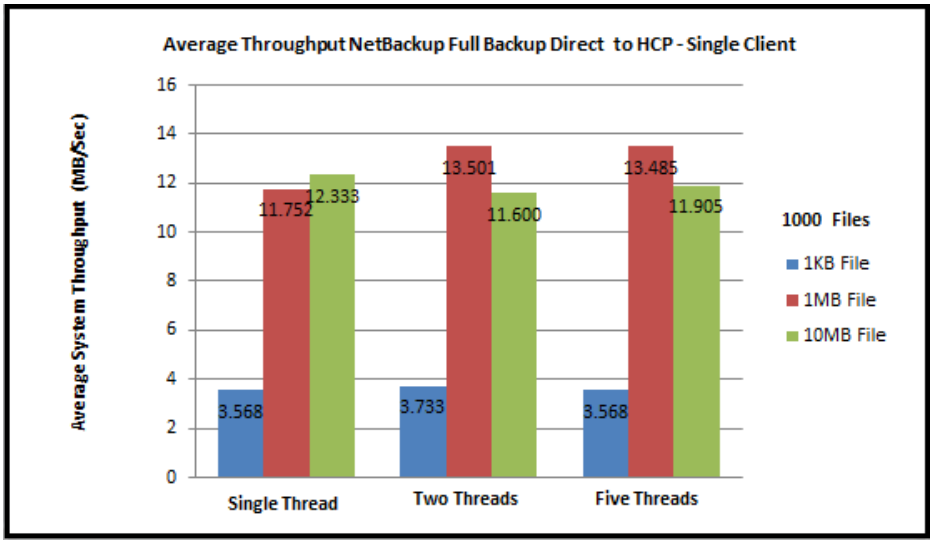

Figure 17

Figure 17 shows that for Veritas NetBackup, a full backup of 10 MB of files (1000 files) direct to Hitachi Content Platform with single client, when increasing the threads from 1 to 2 resulted in a decrease in average throughput by 6%. Increasing the thread further to 5 slightly decreased the average throughput to 4%.

For 1 MB of files, increasing the threads from 1 to 2 increased the average throughput by 15%. Increasing the threads further to 5 had no gain and resulted in the same average throughput.

Table 18. Veritas NetBackup Full Backup Direct to Hitachi Content Platform — Four Clients

Full Backup 1000 Files	Single Thread		Two Threads		Five Threads	
	Average Throughput (MB/sec)	Peak Throughput (MB/sec)	Average Throughput (MB/sec)	Peak Throughput (MB/sec)	Average Throughput (MB/sec)	Peak Throughput (MB/sec)
1 KB	2.127	2.143	2.037	2.080	2.097	2.205
1 MB	9.636	10.465	7.754	9.846	5.261	5.987
10 MB	4.231	4.573	4.380	4.669	7.533	8.194

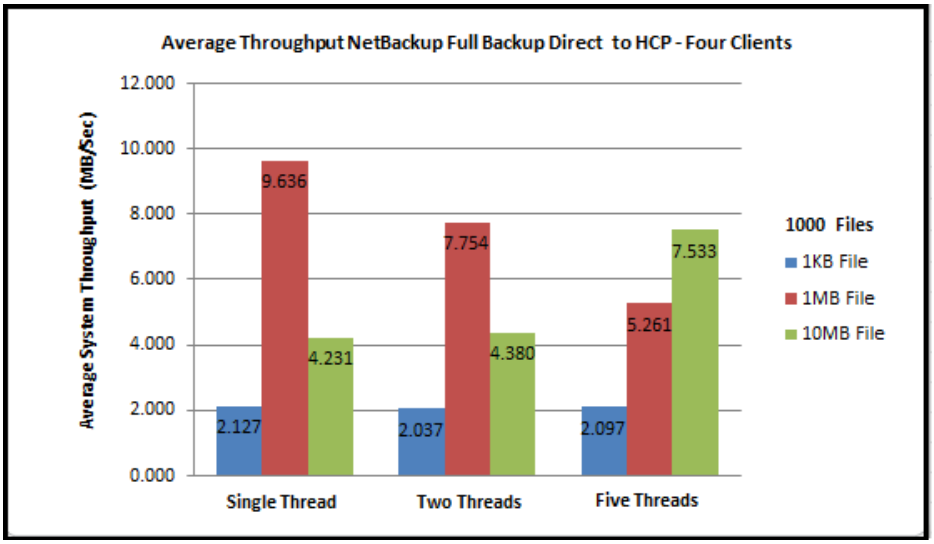

Figure 18

Figure 18 shows that for Veritas NetBackup, a full backup of 10 MB of files (1000 files) directly to Hitachi Content Platform with four clients, increasing the threads from 1 to 2 resulted in a decrease in average throughput by 4%. Increasing the threads further to 5 increased the average throughput to 78%.

For 1 MB of files, increasing the threads from 1 to 2 increased the average throughput by 20%. Increasing the threads further to 5 resulted in a further decrease in average throughput by 45%.

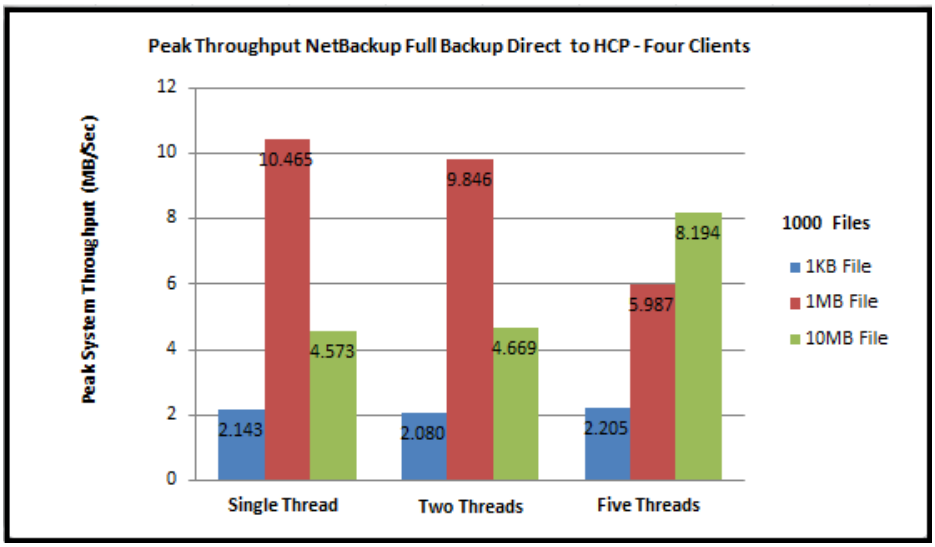

Figure 19

Figure 19 shows that for Veritas NetBackup, a full backup of 10 MB of files (1000 files) directly to Hitachi Content Platform with four clients, increasing the threads from 1 to 2 resulted in a decrease in *peak* throughput by 2%. Increasing the threads to 5 further decreases *peak* throughput to 79%.

For 1 MB of files, increasing the threads from 1 to 2 increased average throughput by 6%. Increasing the threads to 5 results in further decrease in average throughput by 43%.

Veritas NetBackup to StorReduce to Hitachi Content Platform

These are the test results for Veritas NetBackup uploads to StorReduce to Hitachi Content Platform.

Table 19. NetBackup Full Backup to StorReduce to Hitachi Content Platform — Single Client

Full Backup Single File	Single Thread	Two Threads	Five Threads
	System Throughput Average (MB/sec)	System Throughput Average (MB/sec)	System Throughput Average (MB/sec)
1 KB	3.733	3.733	3.920
1 MB	7.871	25.610	26.338

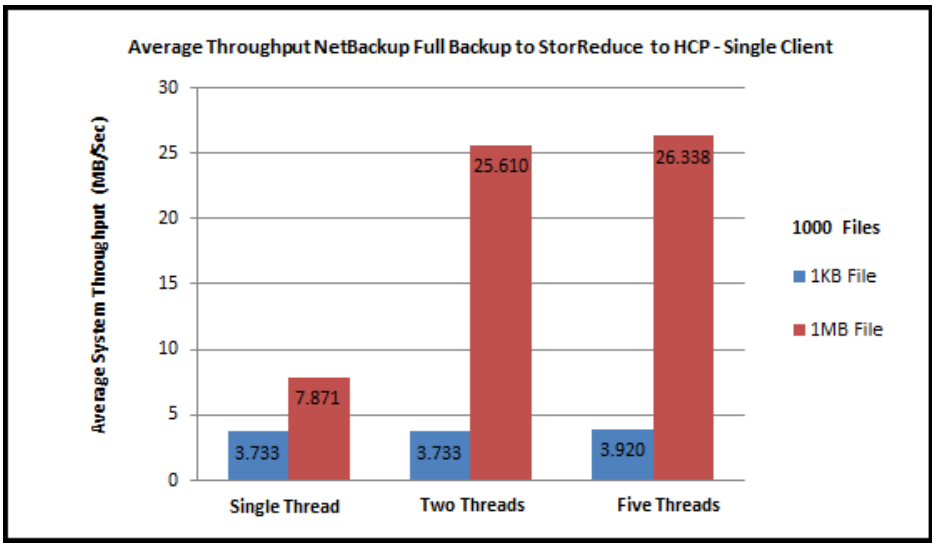

Figure 20

Figure 20 shows that for Veritas NetBackup, a full backup of 1 MB of files (1000 files) to StorReduce and then moving those files to Hitachi Content Platform with single client, increasing the threads from 1 to 2 resulted in increase in average throughput by 225%. Increasing the threads to 5 further increased the average throughput to 235%.

Table 20. Capacity Stored During NetBackup Full Backup to StorReduce to Hitachi Content Platform — Single Client, Single Thread

Full Backup 1000 Files	Single Thread				
	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	3.90	2.46	2.46	N/A	63.00
1 MB	10800.00	4337.00	4337.00	N/A	40.16
10 MB	9580.00	246.00	246.00	N/A	2.57

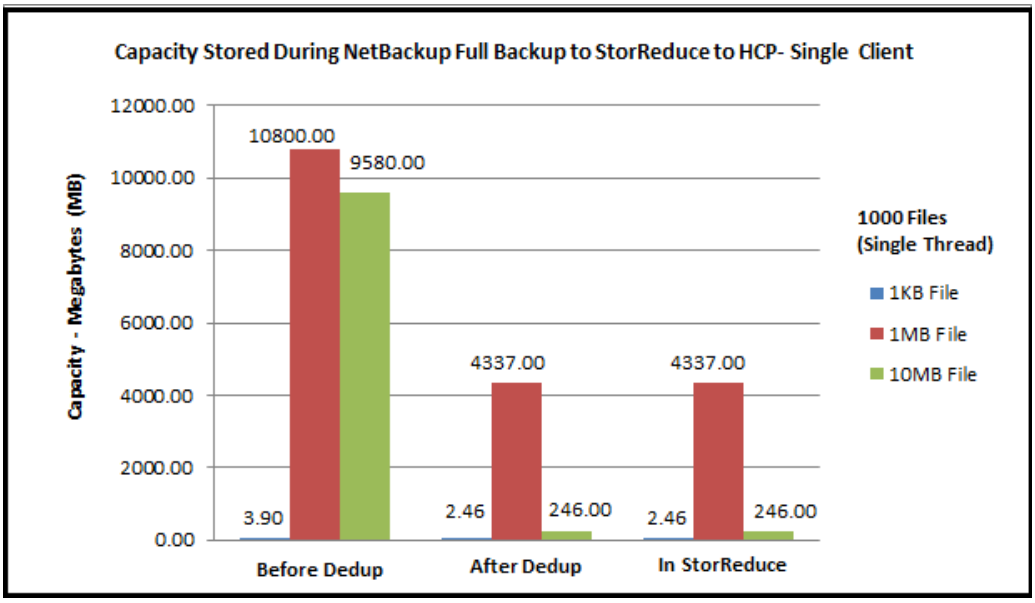

Figure 21

Figure 21 shows that for Veritas NetBackup, a full backup of 10 MB of files (1000 files) to StorReduce and then moved to Hitachi Content Platform with single client and single thread, StorReduce deduplication resulted a in reduction of consumption capacity from 9,580 MB to 246 MB, around 97%.

For 1 MB of files (1000 files), StorReduce deduplication resulted in reduction of consumption capacity from 10,800 MB to 4,337 MB, around 60%.

Table 21. Capacity Stored During NetBackup Full Backup to StorReduce to Hitachi Content Platform — Single Client, Two Threads

Full Backup 1000 Files	Two Threads				
	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	3.90	2.46	2.46	N/A	63.00
1 MB	10800.00	4469.00	4469.00	N/A	41.38

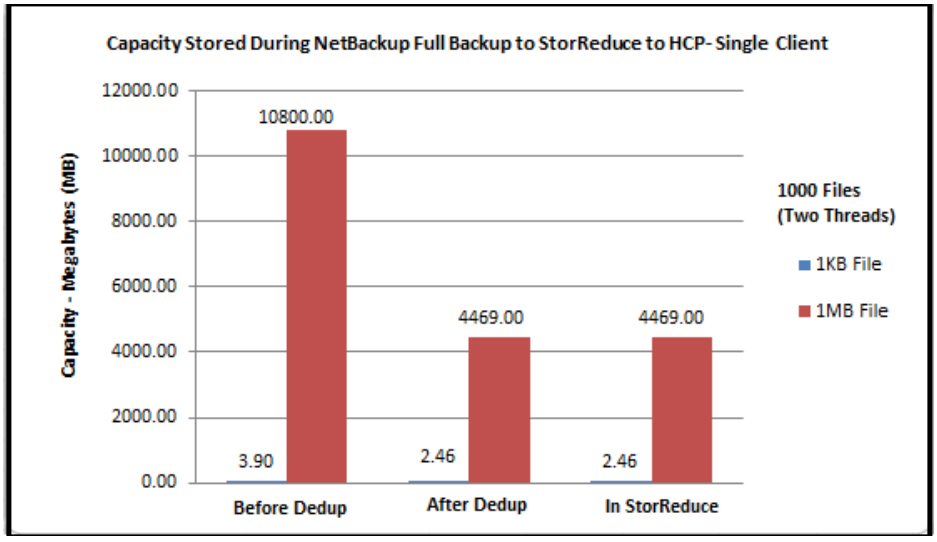

Figure 22

Figure 22 shows that for Veritas NetBackup, a full backup of 1 MB of files (1000 files) to StorReduce and then moved to Hitachi Content Platform with single client and two threads, StorReduce deduplication resulted in reduction of consumption capacity from 10,800 MB to 4469 MB, around 59%.

For 1 KB of files (1000 files), StorReduce deduplication resulted in a reduction of consumption capacity from 3.9 MB to 2.46 MB, around 37%.

Table 22. Capacity Stored During NetBackup Full Backup to StorReduce to Hitachi Content Platform — Single Client, Five Threads

Full Backup	Five Threads				
1000 Files	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	3.90	2.46	2.46	N/A	63.00
1 MB	10800.00	4462.00	4462.00	N/A	41.31

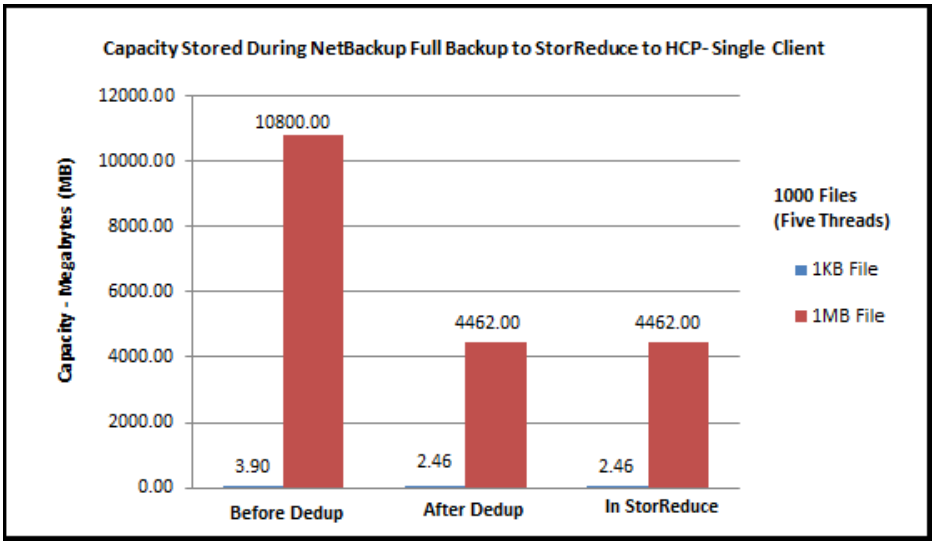

Figure 23

Figure 23 shows that for Veritas NetBackup, full backup of 1 MB of files (1000 files) to StorReduce and then moved to Hitachi Content Platform with single client and five threads, StorReduce deduplication resulted in reduction of consumption capacity from 10,800 MB to 4462 MB, around 59%.

For 1 KB of files (1000 files), StorReduce deduplication resulted in a reduction of consumption capacity from 3.9 MB to 2.46 MB, around 37%.

Table 23. Veritas NetBackup Full Backup to StorReduce to Hitachi Content Platform — Four Clients

Full Backup 1000 Files (StorReduce)	Single Thread		Two Threads		Five Threads	
	Average Throughput (MB/sec)	Peak Throughput (MB/sec)	Average Throughput (MB/sec)	Peak Throughput (MB/sec)	Average Throughput (MB/sec)	Peak Throughput (MB/sec)
1 KB	0.019	0.019	0.019	0.019	0.078	0.078
1 MB	8.900	9.200	16.900	16.900	8.900	9.800
10 MB	23.270	25.100	29.730	31.190	28.300	30.200

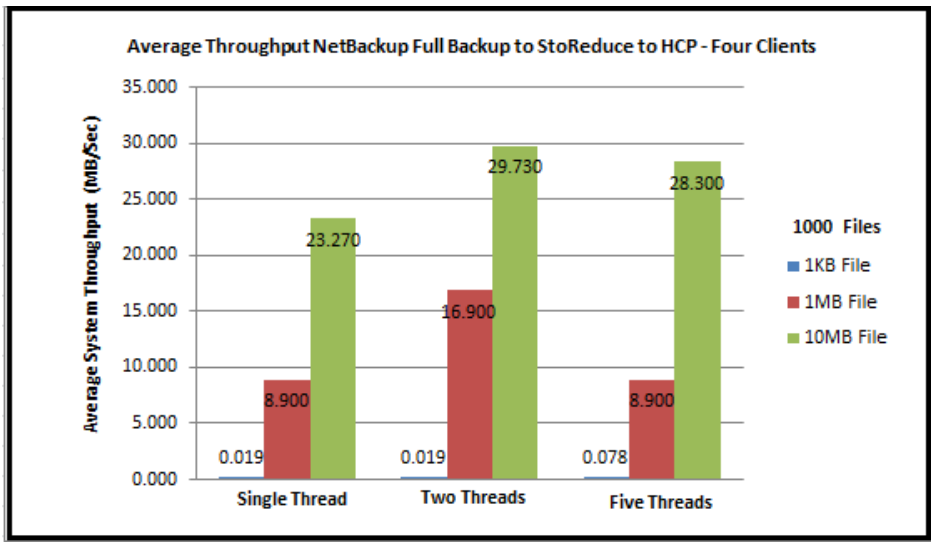

Figure 24

Figure 24 shows that for Veritas NetBackup, full backup of 10 MB of files (1000 files) to StorReduce and then moved to Hitachi Content Platform with four clients, increasing threads from 1 to 2 resulted in increase in average throughput by 28%. Increasing threads to 5 increased average throughput to 22%, but slightly lower than two threads.

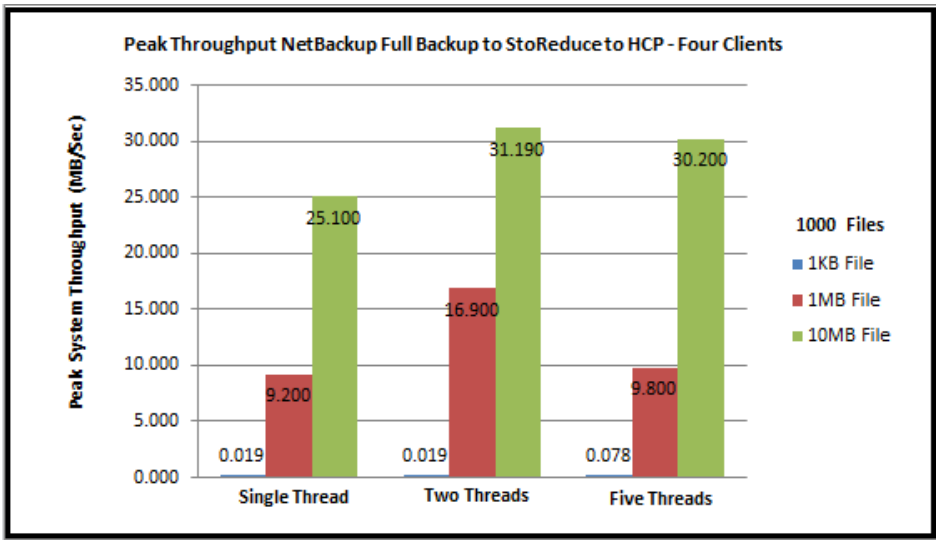

Figure 25

Figure 25 shows that for Veritas NetBackup full backup of 10 MB of files (1000 files) to StorReduce and then moved to Hitachi Content Platform with four clients, increasing threads from 1 to 2 resulted in *peak* throughput increase by 24%. Increasing threads to 5 increased *peak* throughput to 20%, but slightly lower than two threads.

For 1 MB of files (1000 files), increasing threads from 1 to 2 resulted in *peak* throughput increase by 84%. Increasing threads to 5 increased *peak* throughput to 7%.

Table 24. Capacity Stored During Veritas NetBackup Full Backup to StorReduce to Hitachi Content Platform — Four Clients, Single Thread

Full Backup 1000 Files	Single Thread				
	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	0.97	0.97	2.46	0.17	100.00
1 MB	990.00	249.59	4437.00	163.13	25.21

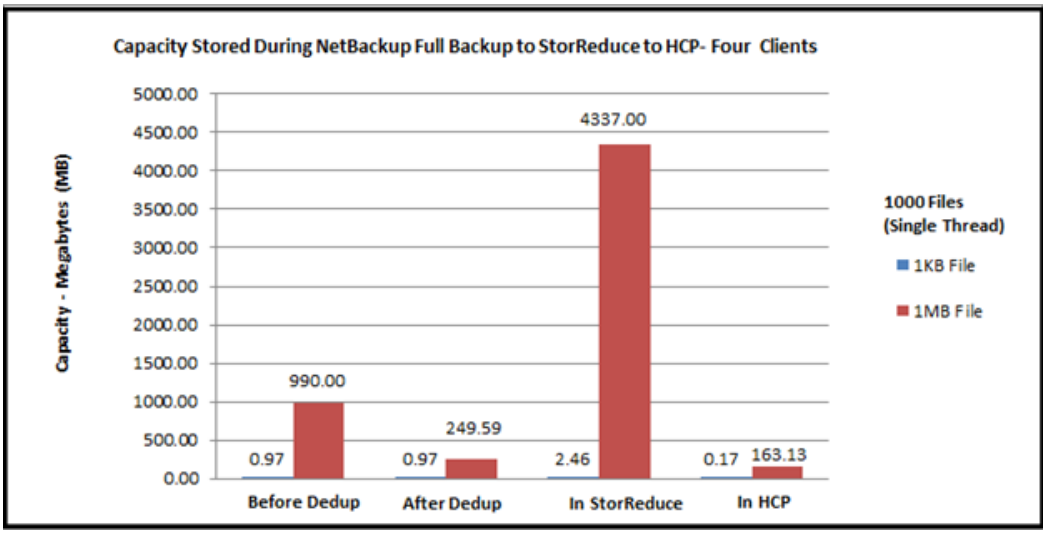

Figure 26

Figure 26 shows that for Veritas NetBackup, a full backup of 1 MB of files (1000 files) to StorReduce and then moved to Hitachi Content Platform with four clients and single thread, StorReduce deduplication resulted in a reduction of consumption capacity from 990 MB to 249.59 MB, around 75%.

Table 25. Capacity Stored During Vertias NetBackup Full Backup to StorReduce to Hitachi Content Platform — Four Clients, Two Threads

Full Backup	Two Threads				
1000 Files	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	0.97	0.97	1.11	0.31	100.00
1 MB	990.00	249.59	249.59	163.13	25.21

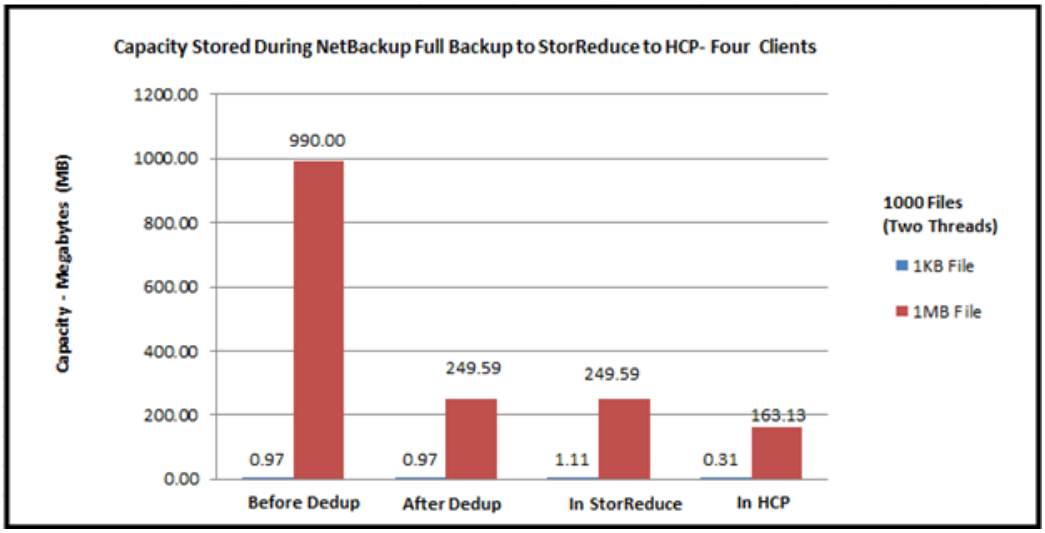

Figure 27

Figure 27 shows that for Veritas NetBackup, a full backup of 1 MB of files (1000 files) to StorReduce and then moved to Hitachi Content Platform with four clients and two threads, StorReduce deduplication resulted in a reduction of consumption capacity from 990 MB to 249.59 MB, around 75%.

Table 26. Capacity Stored During NetBackup Full Backup to StorReduce to Hitachi Content Platform — Four Clients, Five Threads

Full Backup	Five Threads				
1000 Files	Before Dedup (MB)	After Dedup (MB)	Stored Capacity in StorReduce (MB)	Stored Capacity in Hitachi Content Platform (MB)	Percentage (%)
1 KB	0.97	0.97	1.11	0.05	100.00
1 MB	990.00	249.59	249.59	163.13	25.21

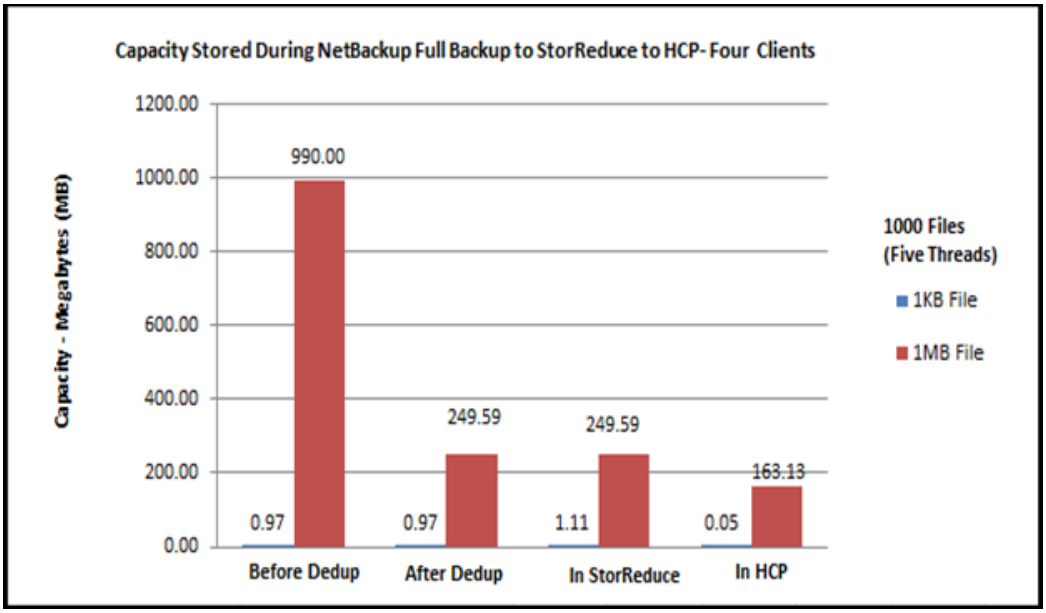

Figure 28

Figure 28 shows that for Veritas NetBackup full backup of 1MB file (1000) to StorReduce then moved to Hitachi Content Platform with four clients five threads, StorReduce deduplication results in reduction of consumption capacity from 990MB to 249.59MB around 75%.

Full Restore

These are the test results for a full restore from Hitachi Content Platform through StorReduce.

Table 27. Average Throughput for a Vertias NetBackup Full Restore From Hitachi Content Platform Through StorReduce

Full Restore 1000 Files	Single Thread
	System Throughput Average (MB/sec)
1 MB	76.040
10 MB	29.878

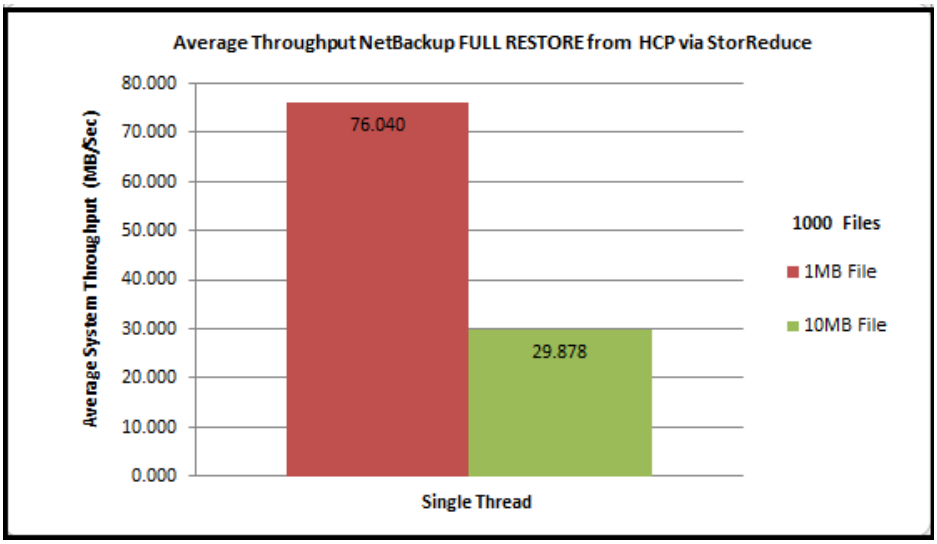

Figure 29

Figure 29 shows that for Veritas NetBackup, a full restore of 10 MB of files (1000 files) from Hitachi Content Platform through StorReduce resulted in average throughput of 29.878 MB/sec.

For 1 MB of files (1000 files) from Hitachi Content Platform through StorReduce resulted in an average throughput of 76.040 MB/sec.

Table 28. Average Throughput for a Vertias NetBackup Full Restore Direct From Hitachi Content Platform

Full Restore 1000 Files	Single Thread
	System Throughput Average (MB/sec)
1 MB	66.652
10 MB	94.203

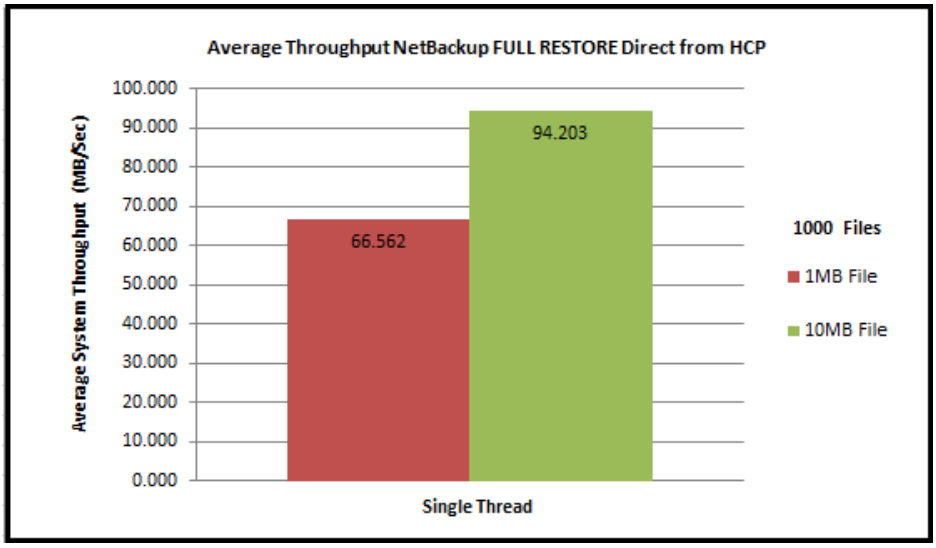

Figure 30

Figure 30 shows that for Veritas NetBackup, a full restore of 10 MB of files (1000 file) direct from Hitachi Content Platform resulted in an average throughput of 94.203 MB/sec.

For 1 MB of files (1000 files), a direct restore from Hitachi Content Platform using NetBackup resulted in an average throughput of 66.562 MB/sec.

Table 29. Average Throughput for Veritas NetBackup Full Restore from StorReduce

Full Restore 1000 Files	Single Thread
	System Throughput Average (MB/sec)
1 MB	76.040
10 MB	29.878

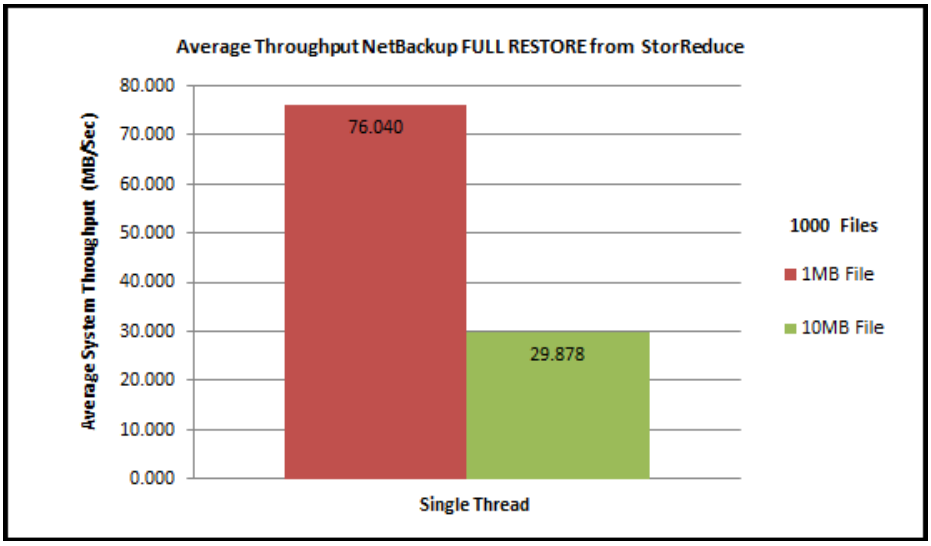

Figure 31

Figure 31 shows that for Veritas NetBackup, a full restore of 10 MB of files (1000 files) from StorReduce resulted in average throughput of 29.878 MB/sec.

For 1 MB of files (1000 files), a direct restore from Hitachi Content Platform using NetBackup resulted in an average throughput of 76.040 MB/sec.

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