

## NetApp Data Lakehouse Solution with Dremio

**NetApp Solutions** 

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# NetApp Data Lakehouse Solution with Dremio

## Introduction

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In this document, we cover the deployment details of Dremio with different source of data from NetApp storage controllers such as ONTAP S3 and NAS as well as storageGRID. In the deployment, we used TPC-DS benchmarking tool to run 99 SQL queries on top of various sources. The document further delves into customer use cases within NetApp as well as auto parts sales customer use-case.

## **Solution Overview**

The solution provides unique benefits to address customer challenges faced by Lakehouse customers. By Leveraging NetApp ONTAP, StorageGRID, NetApp Cloud solutions can add significant values to their business operations. The solution not only provides access to multiple NetApp sources to Lakehouse but also enhance performance to business growth.

### **NetApp Overview**

- NetApp's offerings, such as ONTAP and StorageGRID, allow for the separation of storage and compute, enabling optimal resource utilization based on specific requirements. This flexibility empowers customers to independently scale their storage using NetApp storage solutions.
- By leveraging NetApp's storage controllers, customers can efficiently serve data to their vector database using NFS and S3 protocols. These protocols facilitate customer data storage and manage the vector database index, eliminating the need for multiple copies of data accessed through file and object methods.
- NetApp ONTAP provides native support for NAS and Object storage across leading cloud service providers like AWS, Azure, and Google Cloud. This wide compatibility ensures seamless integration, enabling customer data mobility, global accessibility, disaster recovery, dynamic scalability, and high performance.

### **Dremio overview**

Dremio is the unified Lakehouse platform for self-service analytics and AI. Our Unified Analytics Platform brings users closer to the data with Lakehouse flexibility, scalability, and performance at a fraction of the cost. Dremio enables shift-left analytics to eliminate complex and costly data integration and ETL, delivering seamless enterprise-scale analytics with no data movement.

Easy-to-use self-service analytics enabled through a universal semantic layer and a tightly integrated, highly performant SQL query engine makes it easier to connect, govern, and analyze all data, both in the cloud and on-premises.

Dremio's Apache-native Lakehouse Management capabilities simplify data discovery, and automate data optimization, delivering high-performance analytics with Git-inspired data versioning.

Foundationally built on open source, Dremio lets companies avoid lock-in and remain positioned for innovation.

Enterprise companies trust Dremio as the easiest-to-use Lakehouse platform with the best price-performance on all workloads

### What values Dremio and NetApp partnership adds to customers ?

- Improved Data Management and Accessibility: Dremio is known for its data lake engine that allows organizations to query data directly from their data lakes at high speed. NetApp, on the other hand, is a leading provider of cloud data services and data storage solutions. A partnership could potentially offer a comprehensive solution for storing, managing, and accessing data efficiently.
- Performance Optimization: With NetApp's expertise in data storage and Dremio's capabilities in data processing, the partnership could potentially offer solutions that optimize the performance of data operations, reducing latency and increasing speed. We also noticed the Dremio brings performance benefits to NetApp IT team.
- Scalability: Both Dremio and NetApp offer solutions that are designed to scale. A partnership could provide customers with highly scalable data storage and processing solutions, capable of handling the needs of growing businesses.
- Data Security and Governance: Both companies have a strong focus on data security. Together, they could offer robust security features, ensuring that data is protected and that data governance requirements are met.
- Cost Efficiency: By integrating Dremio's data lake engine with NetApp's storage solutions, customers might be able to reduce costs associated with data management, as they could potentially eliminate the need for costly data movement and duplication.

## **Technology Requirements**

The hardware and software configurations outlined below were utilized for validations performed in this document. These configuration serve as a guideline to help you setup your environment, However, please note the specific components may vary depending on individual customer requirements.

#### Hardware requirements

Hardware	Details
NetApp AFF Storage array HA Pair	<ul> <li>A800</li> <li>ONTAP 9.14.1</li> <li>48 x 3.49TB SSD-NVM</li> <li>Two S3 Buckets: Dremio metadata and customer data.</li> <li>Data is a ONTAP S3 volume</li> </ul>
4 x FUJITSU PRIMERGY RX2540 M4	<ul> <li>64 CPUs</li> <li>Intel® Xeon® Gold 6142 CPU @ 2.60GHz</li> <li>256 GM Physical Memory</li> <li>1 x 100GbE network port</li> </ul>

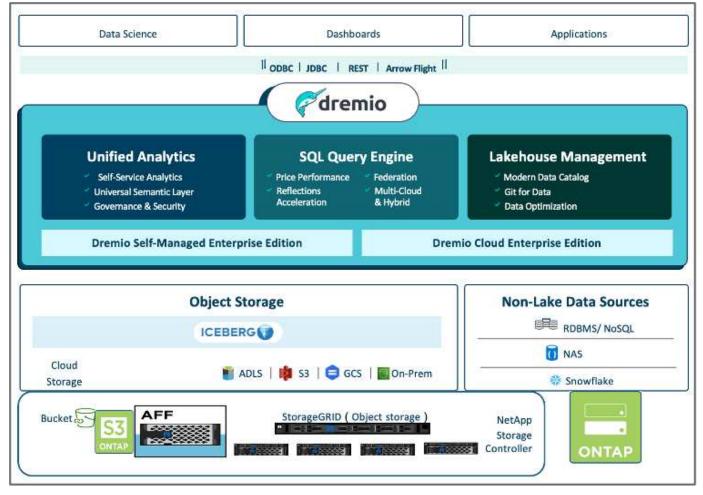
Hardware	Details
Networking	• 100 GbE
StorageGRID	* 1 x SG100, 3xSGF6024 * 3 x 24 x 7.68TB

### Software requirements

Software	Details
Dremio	<ul> <li>version - 25.0.3-202405170357270647-d2042e1b</li> <li>Enterprise Edition</li> </ul>
On-Prem	<ul><li>5 node Dremio cluster</li><li>1 Master coordinator and 4 executors</li></ul>

## **Deployment Procedure**

In this validation, we used one coordinator and four executors



#### NetApp setup

- Storage system initialization
- Storage virtual machine (SVM) creation
- · Assignment of logical network interfaces
- NFS, S3 configuration and licensing

Please follow the steps below for NFS (Network File System):

- Create a Flex Group volume for NFSv4 or NFSv3. In our set up for this validation, we have used 48 SSDs, 1 SSD dedicated for the controller's root volume and 47 SSDs spread across for NFSv4]]. Verify that the NFS export policy for the Flex Group volume has read/write permissions for the Dremio servers network.
- 2. On all Dremio servers, create a folder and mount the Flex Group volume onto this folder through a Logical Interface (LIF) on each Dremio servers.

Please follow the steps below for S3 (Simple Storage Service):

- 1. Set up an object-store-server with HTTP enabled and the admin status set to 'up' using the "vserver objectstore-server create" command. You have the option to enable HTTPS and set a custom listener port.
- Create an object-store-server user using the "vserver object-store-server user create -user <username>" command.
- 3. To obtain the access key and secret key, you can run the following command: "set diag; vserver objectstore-server user show -user <username>". However, moving forward, these keys will be supplied during the user creation process or can be retrieved using REST API calls.
- 4. Establish an object-store-server group using the user created in step 2 and grant access. In this example, we have provided "FullAccess".
- 5. Create a two S3 buckets by setting its type to "S3". One for Dremio configuration and one for customer data.

#### Zookeeper setup

You can use Dremio provided zookeeper configuration. In this validation, we used separate zookeeper. we followed the steps mentioned in this weblink https://medium.com/@ahmetfurkandemir/distributed-hadoop-cluster-1-spark-with-all-dependincies-03c8ec616166

#### Dremio setup

We followed this weblink to install Dremio via tar ball.

1. Create a Dremio group.

```
sudo groupadd -r dremio
```

2. Create a dremio user.

```
sudo useradd -r -g dremio -d /var/lib/dremio -s /sbin/nologin dremio
```

3. Create Dremio directories.

```
sudo mkdir /opt/dremio
sudo mkdir /var/run/dremio && sudo chown dremio:dremio /var/run/dremio
sudo mkdir /var/log/dremio && sudo chown dremio:dremio /var/log/dremio
sudo mkdir /var/lib/dremio && sudo chown dremio:dremio /var/lib/dremio
```

- 4. Download the tar file from https://download.dremio.com/community-server/
- 5. Unpack Dremio into the /opt/dremio directory.

```
sudo tar xvf dremio-enterprise-25.0.3-202405170357270647-d2042e1b.tar.gz
-C /opt/dremio --strip-components=1
```

6. Create a symbolic link for the configuration folder.

sudo ln -s /opt/dremio/conf /etc/dremio

- 7. Set up your service configuration (SystemD setup).
  - 1. Copy the unit file for the dremio daemon from /opt/dremio/share/dremio.service to /etc/system/dremio.service.
  - 2. Restart system

sudo systemctl daemon-reload

3. Enable dremio to start at boot.

sudo systemctl enable dremio

- 8. Configure Dremio on coordinator. See Dremio Configuration for more information
  - 1. Dremio.conf

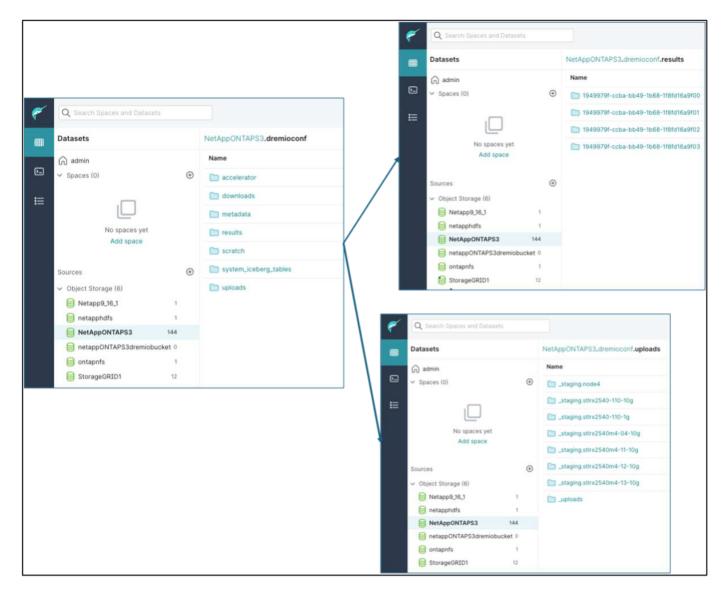
```
root@hadoopmaster:/usr/src/tpcds# cat /opt/dremio/conf/dremio.conf
paths: {
  # the local path for dremio to store data.
  local: ${DREMIO HOME}"/dremiocache"
  # the distributed path Dremio data including job results,
downloads, uploads, etc
  #dist: "hdfs://hadoopmaster:9000/dremiocache"
  dist: "dremioS3:///dremioconf"
}
services: {
 coordinator.enabled: true,
  coordinator.master.enabled: true,
 executor.enabled: false,
 flight.use session service: false
}
zookeeper: "10.63.150.130:2181,10.63.150.153:2181,10.63.150.151:2181"
services.coordinator.master.embedded-zookeeper.enabled: false
root@hadoopmaster:/usr/src/tpcds#
```

#### 2. Core-site.xml

```
root@hadoopmaster:/usr/src/tpcds# cat /opt/dremio/conf/core-site.xml
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<!--
 Licensed under the Apache License, Version 2.0 (the "License");
 you may not use this file except in compliance with the License.
 You may obtain a copy of the License at
   http://www.apache.org/licenses/LICENSE-2.0
 Unless required by applicable law or agreed to in writing, software
  distributed under the License is distributed on an "AS IS" BASIS,
 WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.
 See the License for the specific language governing permissions and
 limitations under the License. See accompanying LICENSE file.
-->
<!-- Put site-specific property overrides in this file. -->
```

```
<configuration>
    <property>
        <name>fs.dremioS3.impl</name>
        <value>com.dremio.plugins.s3.store.S3FileSystem</value>
    </property>
    <property>
                <name>fs.s3a.access.key</name>
                <value>24G4C1316APP2BIPDE5S</value>
    </property>
    <property>
                <name>fs.s3a.endpoint</name>
                <value>10.63.150.69:80</value>
        </property>
    <property>
            <name>fs.s3a.secret.key</name>
            <value>Zd28p43rgZaU44PX ftT279z9nt4jBSro97j87Bx</value>
    </property>
    <property>
            <name>fs.s3a.aws.credentials.provider</name>
            <description>The credential provider type.</description>
<value>org.apache.hadoop.fs.s3a.SimpleAWSCredentialsProvider</value>
    </property>
    <property>
                <name>fs.s3a.path.style.access</name>
                <value>false</value>
        </property>
    <property>
            <name>hadoop.proxyuser.dremio.hosts</name>
            <value>*</value>
    </property>
    <property>
            <name>hadoop.proxyuser.dremio.groups</name>
            <value>*</value>
    </property>
    <property>
            <name>hadoop.proxyuser.dremio.users</name>
            <value>*</value>
    </property>
    <property>
        <name>dremio.s3.compat</name>
        <description>Value has to be set to true.</description>
        <value>true</value>
    </property>
    <property>
        <name>fs.s3a.connection.ssl.enabled</name>
```

9. The Dremio configuration are stored in netapp object storage. In our validation, the "dremioconf" bucket resides in ontap s3 bucket. The below picture shows some details from "scratch" and "uploads" folder of the "dremioconf" s3 bucket.



- 1. Configure Dremio on executors. In our setup, we have 3 executors.
  - 1. dremio.conf

```
paths: {
  # the local path for dremio to store data.
  local: ${DREMIO HOME}"/dremiocache"
  # the distributed path Dremio data including job results,
downloads, uploads, etc
  #dist: "hdfs://hadoopmaster:9000/dremiocache"
  dist: "dremioS3:///dremioconf"
}
services: {
 coordinator.enabled: false,
 coordinator.master.enabled: false,
 executor.enabled: true,
  flight.use session service: true
}
zookeeper: "10.63.150.130:2181,10.63.150.153:2181,10.63.150.151:2181"
services.coordinator.master.embedded-zookeeper.enabled: false
```

2. Core-site.xml – same as coordinator configuration.

#### Multiple sources setup

- 1. Configure ONTAP S3 and storageGRID as a s3 source in Dremio.
  - 1. Dremio dashboard  $\rightarrow$  datasets  $\rightarrow$  sources  $\rightarrow$  add source.
  - 2. In general section, please update AWS access and secret key
  - 3. In advanced option, enable compatibility mode, update connection properties with the below details. The endpoint IP/Name from NetApp storage controller either from ontap s3 or storageGRID.

```
fs.s3a.endoint = 10.63.150.69
fs.s3a.path.style.access = true
fs.s3a.connection.maximum=1000
```

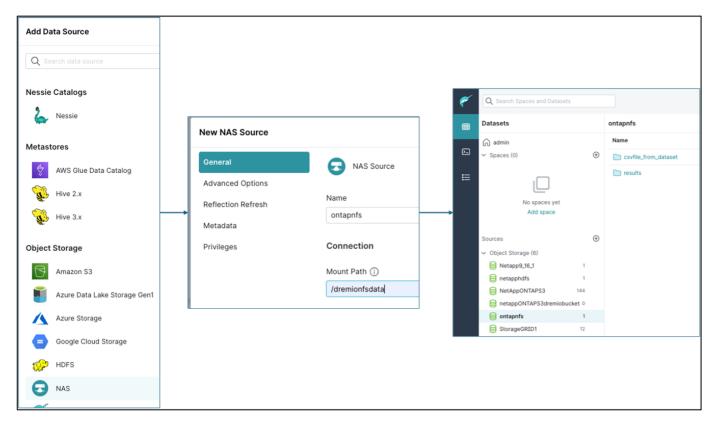
- 4. Enable local caching when possible, Max Percent of total available cache to use when possible = 100
- 5. Then view the list of buckets from NetApp object storage.

d Data Source	×						
Channel and souther		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2					
ssie Catalogs		Source Settings					
Nessie		General	Amazon S3 Source				
tastores		Advanced Options					
AWS Glue Data Catalog		Reflection Refresh	Name NetAppCN174P53				
🔁 Hive 2 x		Metadata					
Hove 3.x	→	Privileges	Authentication		F		
ect Storage			O AWS Access Key	EC2 Metadata 🔿 AWS Profile 🚫 No Au	thentication		
Amazon 53				ed) buckets associated with this access key (	or IAM role to assume of specified) will be available.		
Azure Date Lake Storage Gen1			AWS Access Key 24G4C1316APP2BIPDE5	-			
Azure Storage				9			
Google Claud Storage			AWS Access Secret				
b HOFS							
9 MAS			Source Settings			×	
Q. Swerch Spaces and Datasets Datasets	NetAppONTAPS3		Adhamced Optimes Reflection Rahvah Metadata	Enable compatibility mode     Apply requester gays to 33 requests     Enable file status check     Enable partition culumn inference			
admin	Name		Prisinges	Root Peth			
- Spaces (0)	dremsobucket						
				Server side encryption key ABN			
_	C dremioconf			Server side encryption key AMs			
	🛅 dremiocont			Server side encryption key Ality Default CTAS Format			
No spaces yet						4	
No spaces yet Add space	Em mévuseb			Default CTAS Format			
Add space	En mivusdu En mivusduvolt En mivuspv			Default CTA3 Format 2028/00 Connection Properties Name	Van		
Add space Sources	in mivusdo En mivusdovolt			Default CHAS Format 2018/HD Connection Properties Nome fs x3a.emgoard.	10:43.150.69		
Add space	mivusab     mivusab     mivusab     mivusabvott     mivusapv     mivusa     mivusap     mivusa     mivusa     mivusa		_	Default CTA3 Format 2028/00 Connection Properties Name			
Add space Sources 	milvusdb milvusdbvolt milvusdpv milvusdpv			Default CTAS Format DEBRIS Connection Properties Name fs.x3.a.endpoint Name fs.x3.a.endpoint Name fs.x3.a.endpoint Name	104335049 Value true Value	>	
Add space Sources ( Object Storage (6) Retapp9,16,1 1	mivusab     mivusab     mivusab     mivusabvott     mivusapv     mivusa     mivusap     mivusa     mivusa     mivusa			Default CTAS Format SCEEDE Connection Properties Nome fs.s2a.embjoet Nome fs.s2a.pdfb.style.access	1040315049 Value Stue	;	
No spaces yet Add space Sources Object Storage (6) Netapp9,16,1 1 Petapphdfs 1	mivusab     mivusab     mivusab     mivusabvott     mivusapv     mivusa     mivusap     mivusa     mivusa     mivusa			Default CTAS Format DEBRIS Connection Properties Name fs.x3.a.endpoint Name fs.x3.a.endpoint Name fs.x3.a.endpoint Name	104335049 Value true Value		
Add space Sources / Cipiect Storage (6) Im Netapp0,16,3 1 Im NetApp0NTAP53 144	mivusab     mivusab     mivusab     mivusabvott     mivusapv     mivusa     mivusap     mivusa     mivusa     mivusa			Default CFAS Format ICEBING Connection Properties Nome fs.s.Sta.peth.style.access Name fs.s.Sta.peth.style.access Name fs.s.Sta.connection.maximum	104335049 Value true Value	2	

6. Sample view of storageGRID bucket details

۴	Q. Search Spaces and Datasets		
m	Datasets		StorageGRID1
Ð	ດ admin		Name
	Spaces (0)	۲	mib2
	No spaces yet Add space		xcpbucket1
	Sources	۲	
	<ul> <li>Object Storage (6)</li> </ul>		
	Netapp9_16_1		
	netapphdfs 1		
	NetAppONTAPS3 144		
	netappONTAPS3dremiobucket 0		
	ontapnfs 1		
	StorageGRID1 12		

- 2. Configure NAS (specifically NFS) as a source in Dremio.
  - 1. Dremio dashboard  $\rightarrow$  datasets  $\rightarrow$  sources  $\rightarrow$  add source.
  - 2. In general section, enter the name and NFS mount path. Please make sure the NFS mount path is mounted on the same folder on all the nodes in the Dremio cluster.



```
root@hadoopmaster:~# for i in hadoopmaster hadoopnode1 hadoopnode2
hadoopnode3 hadoopnode4; do ssh $i "date;hostname;du -hs
/opt/dremio/data/spill/ ; df -h //dremionfsdata "; done
Fri Sep 13 04:13:19 PM UTC 2024
hadoopmaster
du: cannot access '/opt/dremio/data/spill/': No such file or directory
Filesystem
                            Size Used Avail Use% Mounted on
10.63.150.69:/dremionfsdata 2.1T 921M 2.0T 1% /dremionfsdata
Fri Sep 13 04:13:19 PM UTC 2024
hadoopnode1
12K /opt/dremio/data/spill/
Filesystem
                            Size Used Avail Use% Mounted on
10.63.150.69:/dremionfsdata 2.1T 921M 2.0T 1% /dremionfsdata
Fri Sep 13 04:13:19 PM UTC 2024
hadoopnode2
12K /opt/dremio/data/spill/
Filesystem
                            Size Used Avail Use% Mounted on
10.63.150.69:/dremionfsdata 2.1T 921M 2.0T 1% /dremionfsdata
Fri Sep 13 16:13:20 UTC 2024
hadoopnode3
16K /opt/dremio/data/spill/
Filesystem
                            Size Used Avail Use% Mounted on
10.63.150.69:/dremionfsdata 2.1T 921M 2.0T 1% /dremionfsdata
Fri Sep 13 04:13:21 PM UTC 2024
node4
12K /opt/dremio/data/spill/
Filesystem
                            Size Used Avail Use% Mounted on
10.63.150.69:/dremionfsdata 2.1T 921M 2.0T 1% /dremionfsdata
root@hadoopmaster:~#
```

### Solution verification overview

In this section, we have done the SQL query from multiple sources to verify the functionality and also verify the spill over to NetApp storage.

#### SQL query on Object storage

1. Set the memory to 250GB per server in dremio.env

```
root@hadoopmaster:~# for i in hadoopmaster hadoopnode1 hadoopnode2
hadoopnode3 hadoopnode4; do ssh $i "hostname; grep -i
DREMIO MAX MEMORY SIZE MB /opt/dremio/conf/dremio-env; cat /proc/meminfo
| grep -i memtotal"; done
hadoopmaster
#DREMIO MAX MEMORY SIZE MB=120000
DREMIO MAX MEMORY SIZE MB=250000
MemTotal:
               263515760 kB
hadoopnode1
#DREMIO_MAX_MEMORY_SIZE MB=120000
DREMIO MAX MEMORY SIZE MB=250000
MemTotal: 263515860 kB
hadoopnode2
#DREMIO MAX MEMORY SIZE MB=120000
DREMIO MAX MEMORY SIZE MB=250000
MemTotal:
               263515864 kB
hadoopnode3
#DREMIO MAX MEMORY SIZE MB=120000
DREMIO MAX MEMORY SIZE MB=250000
MemTotal:
               264004556 kB
node4
#DREMIO MAX MEMORY SIZE MB=120000
DREMIO MAX MEMORY SIZE MB=250000
MemTotal:
               263515484 kB
root@hadoopmaster:~#
```

2. Check the spill over location (\${DREMIO\_HOME}"/dremiocache) in dremio.conf file and storage details.

```
paths: {
  # the local path for dremio to store data.
  local: ${DREMIO HOME}"/dremiocache"
  # the distributed path Dremio data including job results, downloads,
uploads, etc
  #dist: "hdfs://hadoopmaster:9000/dremiocache"
  dist: "dremioS3:///dremioconf"
}
services: {
 coordinator.enabled: true,
 coordinator.master.enabled: true,
 executor.enabled: false,
  flight.use session service: false
}
zookeeper: "10.63.150.130:2181,10.63.150.153:2181,10.63.150.151:2181"
services.coordinator.master.embedded-zookeeper.enabled: false
```

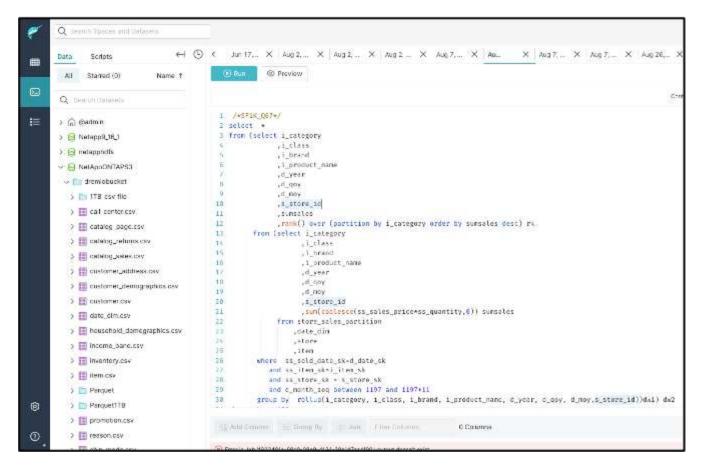
3. Dremio spill over location to NetApp NFS storage

```
root@hadoopnode1:~# ls -ltrh /dremiocache
total 4.0K
drwx----- 3 nobody nogroup 4.0K Sep 13 16:00 spilling stlrx2540m4-12-
10g 45678
root@hadoopnode1:~# ls -ltrh /opt/dremio/dremiocache/
total 8.0K
drwxr-xr-x 3 dremio dremio 4.0K Aug 22 18:19 spill old
drwxr-xr-x 4 dremio dremio 4.0K Aug 22 18:19 cm
lrwxrwxrwx 1 root root 12 Aug 22 19:03 spill -> /dremiocache
root@hadoopnode1:~# ls -ltrh /dremiocache
total 4.0K
drwx----- 3 nobody nogroup 4.0K Sep 13 16:00 spilling stlrx2540m4-12-
10g 45678
root@hadoopnode1:~# df -h /dremiocache
Filesystem
                                       Size Used Avail Use% Mounted on
10.63.150.159:/dremiocache hadoopnode1 2.1T 209M 2.0T 1%
/dremiocache
root@hadoopnode1:~#
```

 Select the context. In our test, we ran the test against TPCDS generated parquet files resides in ONTAP S3. Dremio Dashboard → SQL runner → context → NetAppONTAPS3→Parquet1TB

Select Context	×
> 🞧 @admin	
> 📄 netapphdfs	
V NetAppONTAPS3	
✓	
> in 1TB_csv_file	
> 🛅 Parquet	
✓ □ Parquet1TB	
> 🛅 vectordbdata	
> 📄 netappONTAPS3dremiobucket	
> 🥃 ontapnfs	
> 😝 StorageGRID1	
Cancel No context Se	lect

1. Run the TPC-DS query67 from Dremio dashboard



1. Check the job is running on all executor. Dremio dashboard  $\rightarrow$  jobs  $\rightarrow$  <jobid>  $\rightarrow$  raw profile  $\rightarrow$  select EXTERNAL\_SORT  $\rightarrow$  Hostname

w Profile										
04-xx-04 - FILTER										
04-xx-05 - WINDOW										
04-xx-06 - EXTERNAL_SO	RT									
Thread	Setup Time	Process Time	Walt Time	Max Botches	Max Records	Peak Memory	Hostname	Record Processing Rate	Operator State	Last Schedule Tim
04-00-05	0.0066	0.000s	0.000s	0	0	125405	stirs2540-110-10g	0	CAN_CONSUME	16.35.1
04-01-05	0.0036	0.000s	0.000s	0	0	128428	stm2540m4-04-10g	e	CAN, CONSUME	16:35:5
04-02-06	0.002s	0.000e	0.0008	0	0	126425	stin/2540m4-12-10g	0	CAN_CONSUME	16/35/5
04-03-05	0.017s	0.000s	0.000e			126435	stin/2540m4-13-10g	0	CAN, CONSUME	16:35:5
04-04-05	0.004s	0.000s	0.000s	0	0	128435	stind540-110-10p	0	CAN_CONSUME	16:35 5
04-05-05	0.0056	0.000e	0.000s	0	0	129KB	attri2540m4-04-10g	0	GAN_CONSUME	16:35:
04-06-05	0.6278	0.000s	0.900s	0	0	128KB	stin/2540m4-12-10g	0	CAN, CONSUME	16:35:
04-07-06	0.003a	0.000s	0.000s	0		129KB	stin2540m4-13-10p	0	CAN, CONSUME	16:35:

1. when the SQL query running, you can check the split folder for data caching in NetApp storage controller.

```
root@hadoopnodel:~# ls -ltrh /dremiocache
total 4.0K
drwx----- 3 nobody nogroup 4.0K Sep 13 16:00 spilling_stlrx2540m4-12-
10g_45678
root@hadoopnodel:~# ls -ltrh /dremiocache/spilling_stlrx2540m4-12-
10g_45678/
total 4.0K
drwxr-xr-x 2 root daemon 4.0K Sep 13 16:23 1726243167416
```

2. The SQL query completed with spill over

🎸 Q. Q67 Sta	art Time: All 👻 🔄	itatus 👻 UI, +1		~ Queue	v		
Job ID	User 4	Dataset	Query Type	Queue	Start Time	Duration	SQL
a0a5-9dab-2b/16-e2ec24459900-19335115	admin	tore_sales_partition	UI (run)	High Cost User Q	08/26/2024, 12:35:53	00:08:25 R	/+SFIR_G67+/ select + from (select i_category ,i_class ,i_brand ,i_product_mame ,d_year ,d_ouy ,d_m.
9 19383301-5cd9-0a48-1e38-e215b4140100	admin	store_sales_partition	JDBC Client	High Cost User Q	08/22/2024, 19:42:54	This query was s	FIR_QGD+/ select + from (select i_category ,i_class ,i_brand ,i_product_mame ,d_year ,d_qoy ,d_m_
19384ar3-285d-a01c-52f7-46d861ddd200	admin	tore_sales_partition	JDBC Client	High Cost User Q	08/22/2024, 18:00:44	00.08.23 🕄	/+SFIR_QGJ+/ select + from (select i_category ,i_class ,i_brand ,i_product_mame ,d_year ,d_qoy ,d_m_
1938650f-0f9d-a265-6ea3-673aaa3c7a00	admin	store_sales_partition	JDBC Client	High Cost User Q	08/22/2024, 16:09:20	00.08.26 ft	/+SFIR_Q6D+/ select + from (select i_category ,i_class ,i_brand ,i_product_mame ,d_year ,d_qoy ,d_m_
19387983-2031-1d4f-cd9e-57c6c287bd00	admin	store_sales_partition	(run) 1U	High Cost User Q	08/22/2024, 14:42:04	00:07:26 ft	/+SFIR_Q6J*/ select + from (select i_category ,i_class ,i_brand ,i_product_mame ,d_year ,d_qoy ,d_m.
9 19387e04-3dc3-34bd-13e5-d7t536fa4a00	admin	tore_sales_partition	UI (run)	High Cost User Q	08/22/2024, 14:22:51	00:07:48 ft	/+SFIR_Q674/ select + frum [select ]_category ,i_class ,i_brand ,i_product_mame .d_year ,d_boy .d_m_

### 3. Job completion summary.

lobs » 📀 19335115-a0a5	-9dab-2b16-e2ec24459900 [	)	E Overview	E SQL
Summary		Sub	mitted SQL 💭	
Status: Total Memory: CPU Used: Query Type: Start Time: Duration: Walt on Client: User: Queue: Input:	COMPLETED 287.16 GB 02h:18m:52s UI (run) 08/26/2024 12:35:53 08m:25s <1s admin High Cost User Queries 21.32 GB / 563:2M Rows	3 4 5 6 7 8 9	/*SFIK_Q67*/ select * from (select i_cc ,i_c ,i_p ,d_y ,d_y ,d_m	lass rand roduct_name ear oy
Output: Total Execution Time Pending	6.92 KB / 100 Tows 08m:25s (100%) 2ms (0.0010)		data dim	iobucket.Parquet1T iobucket.Parquet1T
Metadata Retrieval	22ms (0.00%)	Sho	w more >	NUMBER OF STREET
Planning	140ms (0.03%)	Sca	ns	
Queued	30ms (0.01%)	3	store_sales_par	tition
Execution Planning	116ms (0.02%)	>	date_dim	
Starting	569ms (0.11%)	>	store	
Running	8m/24s (09.83%)	2	item	

4. Check the spilled data size

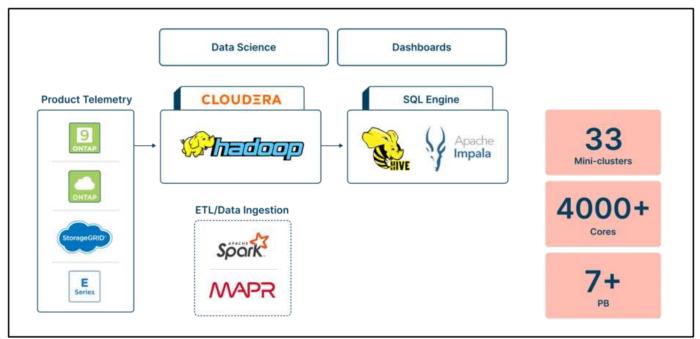
EXTERNAL_SORT 04-	06 →
Runtime	1.68m (100%)
Startup	49.09ms (0.05%)
Processing	39.62s (39.36%)
IO Wait	1.02m (60.6%)
Overview/Main Batches Processed: Records Processed: Peak Memory: Bytes Sent: Number of Threads:	104333 387.6M 199 MB 44 GB 180
Operator Statistics	
Merge Time Nanos:	Ons
Spill Count: Spill Time Nanos:	360 37.68m
Total Spilled Data Size:	20,339,702,765
Batches Spilled:	97,854

The same procedure applicable for NAS and StorageGRID Object storage.

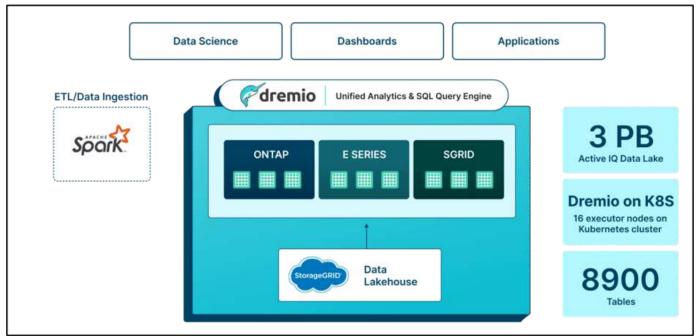
## **Customer Use Cases**

We discuss about two customer use cases

### NetApp ActiveIQ use case



**Challenge**: NetApp's Active IQ solution, initially designed for support use cases, has evolved into a comprehensive offering for both internal users and customers. However, the underlying Hadoop/MapReduce-based backend infrastructure posed challenges due to the rapid growth of data and the need for efficient data access. Scaling storage meant adding unnecessary compute resources, resulting in increased costs. Additionally, managing the Hadoop cluster was time-consuming and required specialized expertise. Data performance and management issues further complicated the situation, with queries taking an average of 45 minutes and potential resource starvation due to misconfigurations. To address these challenges, NetApp sought a solution like Dremio that could reduce costs, decouple storage and compute, improve performance, simplify data management, offer fine-grained controls, and provide disaster recovery capabilities. **Solution**:



Dremio enabled NetApp to modernize its Hadoop-based data infrastructure in a phased approach, providing a roadmap for unified analytics. Unlike other vendors that required significant changes to data processing, Dremio seamlessly integrated with existing pipelines, saving time and expenses during migration. By transitioning to a fully containerized environment, NetApp reduced management overhead, improved security, and enhanced resilience. Dremio's adoption of open ecosystems like Apache Iceberg and Arrow ensured future-proofing, transparency, and extensibility. As a replacement for the Hadoop/Hive infrastructure, Dremio offered functionality for secondary use cases through the semantic layer. While the existing Spark-based ETL and data ingestion mechanisms remained, Dremio provided a unified access layer for easier data discovery and exploration without duplication. This approach significantly reduced data replication factors and decoupled storage and compute.

#### Benefits:

With Dremio, NetApp achieved significant cost reductions by minimizing compute consumption and disk space requirements in their data environments. The new Active IQ Data Lake comprised 8,900 tables holding 3 petabytes of data, compared to the previous infrastructure with over 7 petabytes. The migration to Dremio also involved transitioning from 33 mini-clusters and 4,000 cores to 16 executor nodes on Kubernetes clusters. Despite the decrease in compute resources, NetApp experienced remarkable performance improvements. By directly accessing data through Dremio, query runtime decreased from 45 minutes to 2 minutes, resulting in a 95% faster time to insights for predictive maintenance and optimization. The migration yielded over 60% reduction in compute costs, over 20 times faster queries, and over 30% savings in total cost of ownership (TCO).

#### ==Auto Parts Sales customer use-case.

**Challenges**: Executive and corporate Financial Planning and Analysis are unable to see consolidated sales reporting and have to read individual line of business sales metrics reports. This results in customer making decisions with data that is 1 day old. The lead time can typically take over 4 weeks. Troubleshooting data pipelines requires additional 3 days to complete. Current performance of reports requires our analyst community to wait for data to process or load, rather than finding insights and driving new business behavior. Today, there are different databases for different lines of businesses. Resulting in numerous data silos. This complicates Data Governance as there are too many ways for analysts to come up with their own version of the truth vs a single source of truth. The current approach is costing \$1.9 million in Data platform & people costs. Maintaining the current platform and filling data requests costs roughly 7 Field Technical Engineer(FTE)s per year. With data requests growing, Customer's data intelligence team will need to scale by 2025. **Solution**: Cost effectively store and manage large Iceberg tables in Object Store (NetApp). Build Data Domains within Dremio's semantic layer, allowing business users to easily create, search, share data products

#### Benefits to customer:

- Improve and optimize existing data architecture to reduce time to insights from 4 weeks to hours
- Reduce troubleshooting time from 3 days to hours
- Decrease Data platform & Management costs by over \$380,000
- ~2 FTEs of Data Intelligence effort saved per year

## Conclusion

In conclusion, this technical report has provided comprehensive deployment details of Dremio in conjunction with various data sources from NetApp storage controllers, including ONTAP S3, NAS, and storageGRID. The deployment process was successfully executed, and the TPC-DS benchmarking tool was utilized to perform 99 SQL queries across the different data sources. The report has also explored customer use cases within NetApp, demonstrating the versatility and effectiveness of Dremio in meeting diverse business requirements. Additionally, a specific use case involving an auto parts sales customer was examined, highlighting the practical application and benefits of leveraging Dremio for data analytics and insights. Overall, this document serves as a valuable resource for understanding the deployment and usage of Dremio with NetApp storage controllers, showcasing its capabilities and potential for driving data-driven decision-making and optimization in various industries.

### Where to find additional information

To learn more about the information that is described in this document, review the following documents and/or websites:

Zookeeper installation

https://medium.com/@ahmetfurkandemir/distributed-hadoop-cluster-1-spark-with-all-dependincies-03c8ec616166

Dremio

https://docs.dremio.com/current/get-started/cluster-deployments/deployment-models/standalone/standalone-tarball/

Configuring Dremio with storageGRID

https://docs.netapp.com/us-en/storagegrid-enable/tools-apps-guides/configure-dremio-storagegrid.html# configure-dremio-data-source

NetApp use case

https://www.dremio.com/customers/netapp/

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