NetApp NFS Connector for Hadoop

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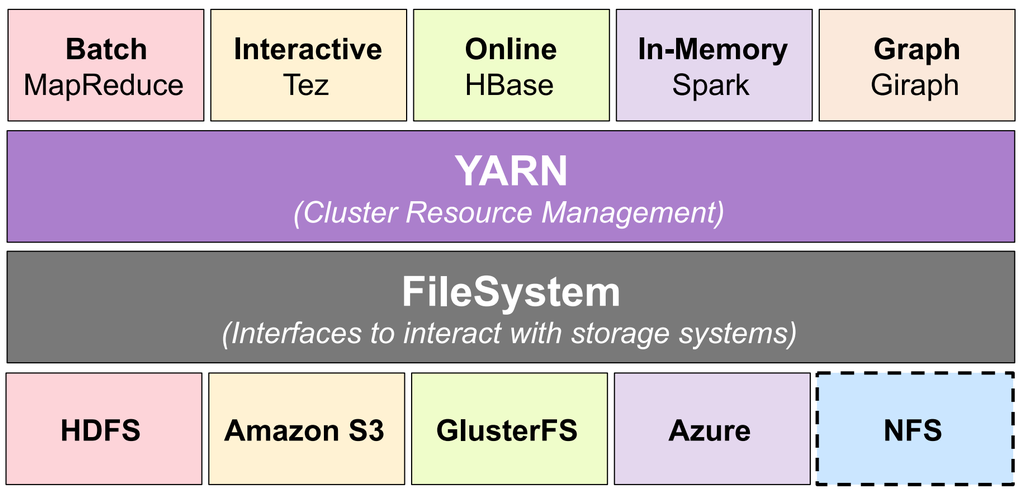
Introduction

- Large Volume of Data Stored in Enterprise Storage
  - Walmart: > 1 million transactions/hour
  - Bank: > 100 TB customer data
  - Emails, home dirs, databases, etc.
- Big Data Analytics
  - Widely used: distributed pattern matching, machine learning, statistics analysis, etc
  - Active community: Hadoop, Spark, Tachyon, etc.
- ***Emerging Requirements***
  - Run analytics on data stored in enterprise storage (NetApp FAS Systems)

Motivation



There is no native NFS integration with Hadoop!

Current Approaches

1. Copy from NFS into HDFS
   - Need to ingest into HDFS
   - Need to maintain multiple copies
   - Need to periodically synchronize
2. Mount with Linux NFS Client
   - Optimized for small random I/O
   - Not integrated with Hadoop scheduler

Mambo: Hadoop NFS Connector

Benefits

- Designed for large streaming I/O
- Tight integration with Hadoop
  - Commit data to disk only when a task succeeds
  - Intelligent prefetching for streaming reads; aware of task sizes
  - Single copy of data stored in NFS
- Allows NFS to be on the same level as others
  - RedHat GlusterFS, Ceph, Amazon S3, and others
- Drop in replacement
- Supports multiple NFS controllers

Easy to Use

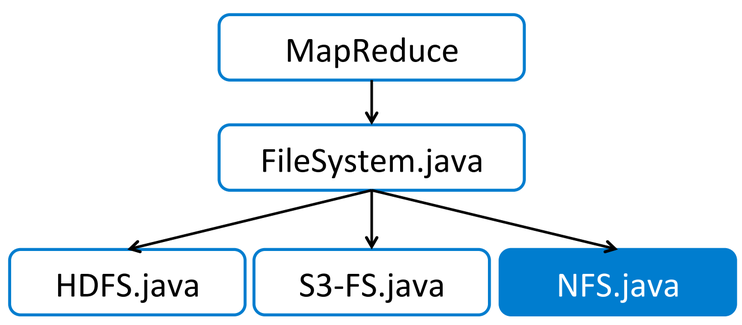
- Just modify configuration

```
<property>
    <name>fs.defaultFS</name>
    <value>hdfs://namenode:54310/</value>
</property>
```

Changes to

```
<property>
    <name>fs.defaultFS</name>
    <value>nfs://nfsserver:2049/</value>
</property>
<property>
    <name>fs.nfs.configuration</name>
    <value>path-nfs-configuration</value>
</property>
```

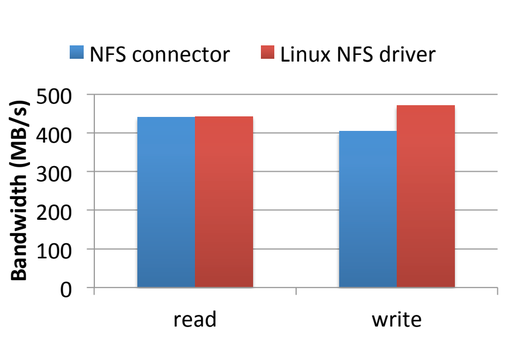
Implementation



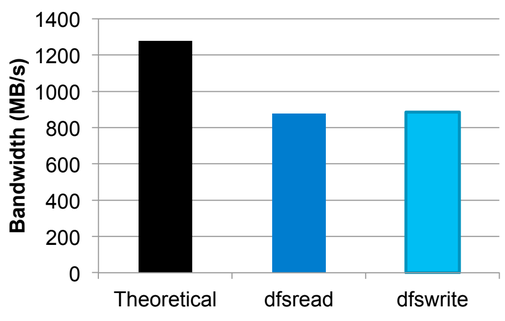
- Implemented NFSv3 protocol
  - 14 of 22 procedures
- Implemented MOUNT protocol
  - 5 of 8 procedures
- 1 MB I/O
- 64 prefetching threads

Evaluation

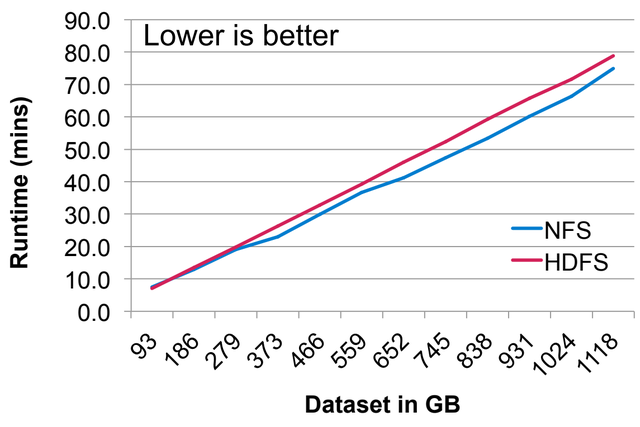
- NFS connector vs. Linux NFS driver
  - Read/write a 10 GB file
  - 10 Gb/s link



- DFSIO (standard HDFS benchmark)



- TeraSort
  - 4 server nodes
    16 cores, 48 GB Memory
    21 containers/node
  - NetApp E-Series (SAS)
    48 data disks
  - NetApp FAS-8060
    48 data disks



Summary

- Built NFSv3 connector
  - Allows Hadoop to natively use NFS
  - Uses a single copy of data
  - Easy to use
  - Good performance
  - Works for Hadoop and Spark

- Acknowledgements
  - We thank Scott Dawkins, Pranoop Erasani, Jeff Heller, AJ Mahajan, Beth Schwartz, and Kaladhar Voruganti for their support in this process.

- Try it from Github !!!
  - https://github.com/NetApp/NetApp-Hadoop-NFS-Connector