TEKCRUX
We ReDefine IT

hadoop

HDFS

HADOOP DISTRIBUTED FILE SYSTEM

Agenda

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- ✓ HFDS Design
- ✓ HDFS Architecture
- ✓ HDFS Storage Daemons
- ✓ Name Node, Data Node
- ✓ Secondary Name Node & Check-pointing
- ✓ HDFS Storage Architecture
- ✓ HDFS File Write & Read
- ✓ Hadoop High Availability
- ✓ Basic HDFS Operations

HDFS Design

HDFS is a filesystem designed for storing very large files with streaming data access patterns, running on clusters of commodity hardware.

Very Large Files

100s of GBs or even TBs.

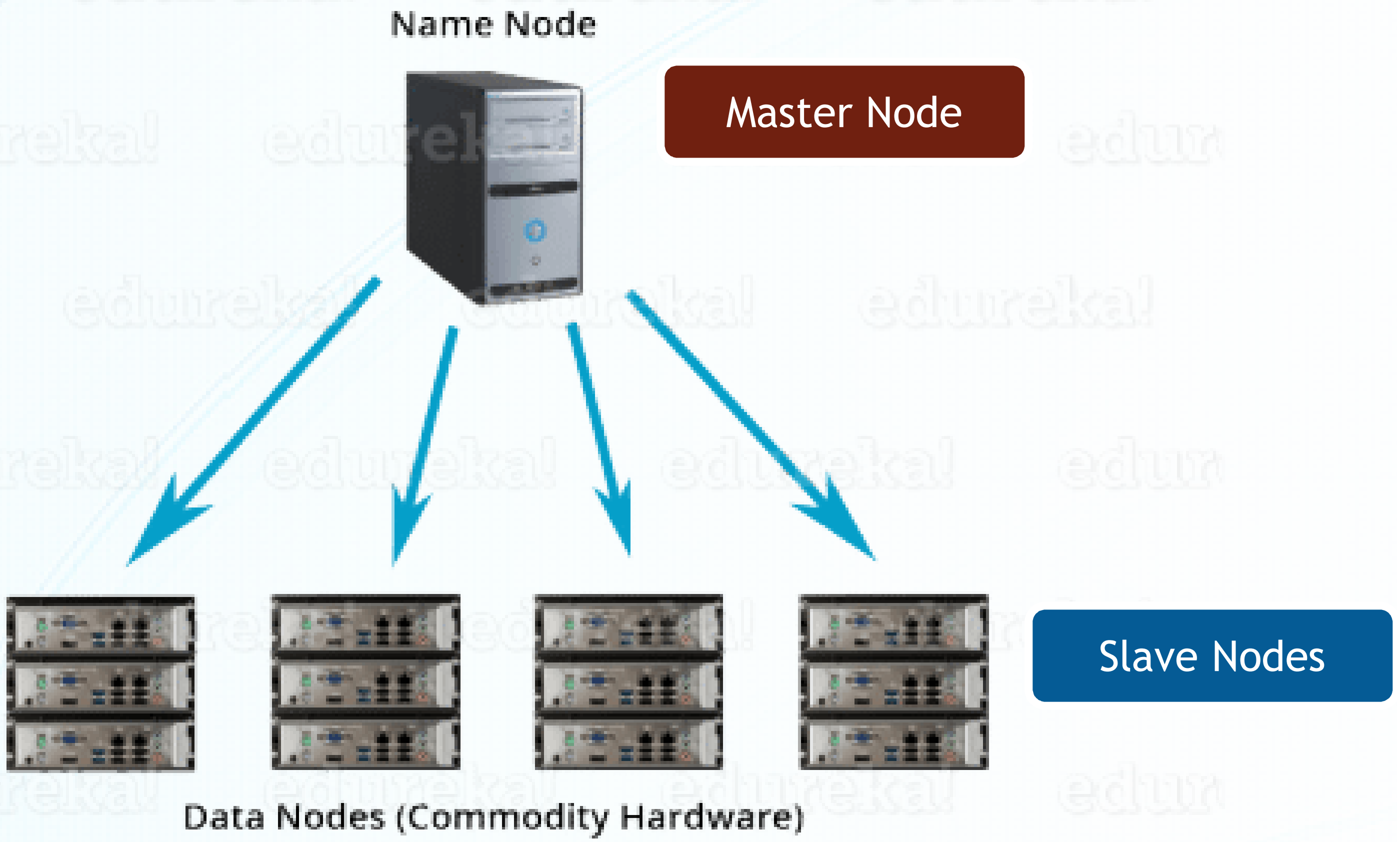
Streaming Data Access

Built for “Write-once Ready-many-times” pattern. Time to read the whole dataset is more important than the latency in reading the first record.

Commodity Hardware

Where chance of node failure is high.

Hadoop Master/Slave Architecture

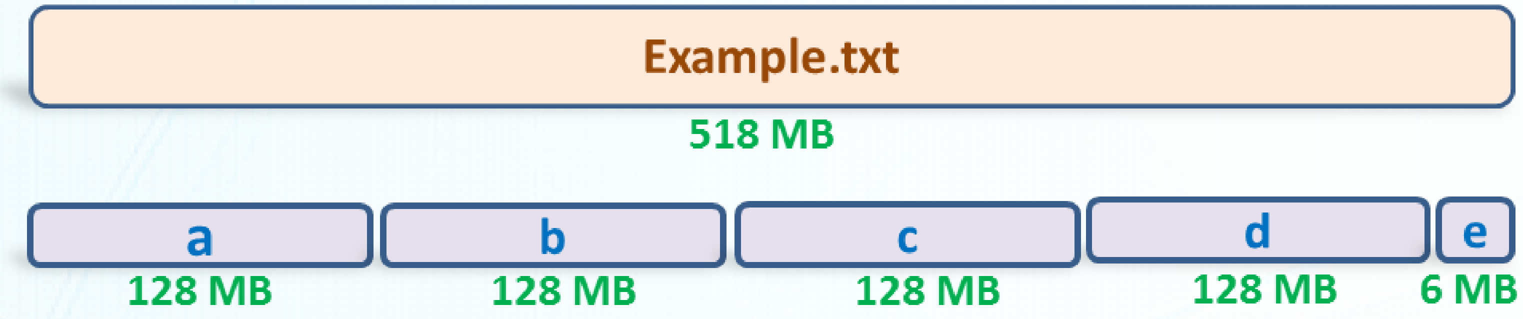


Blocks

- In HDFS, files are broken into blocks of 128MB and are distributed across various nodes in the cluster.

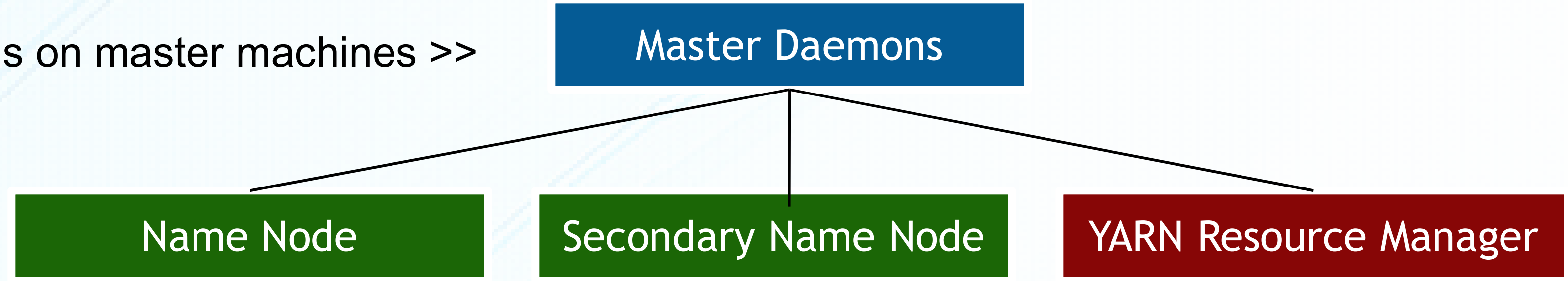
- Blocks are the basic unit of abstraction in HDFS

- **Advantages:**
  - a file can be larger than any single disk in the network
  - simplifies the storage subsystem
  - fits well with replication for providing fault tolerance and availability



Hadoop Daemon Processes

Runs on master machines >>



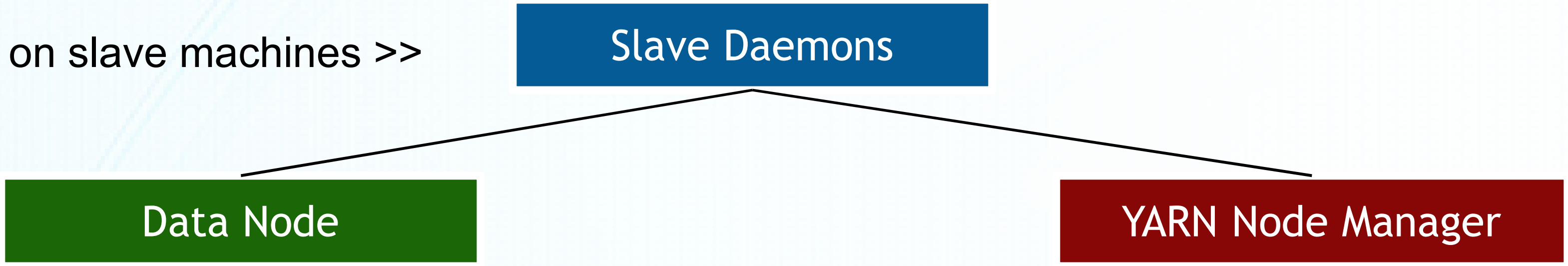
Master Daemons

Name Node

Secondary Name Node

YARN Resource Manager

Runs on slave machines >>



Slave Daemons

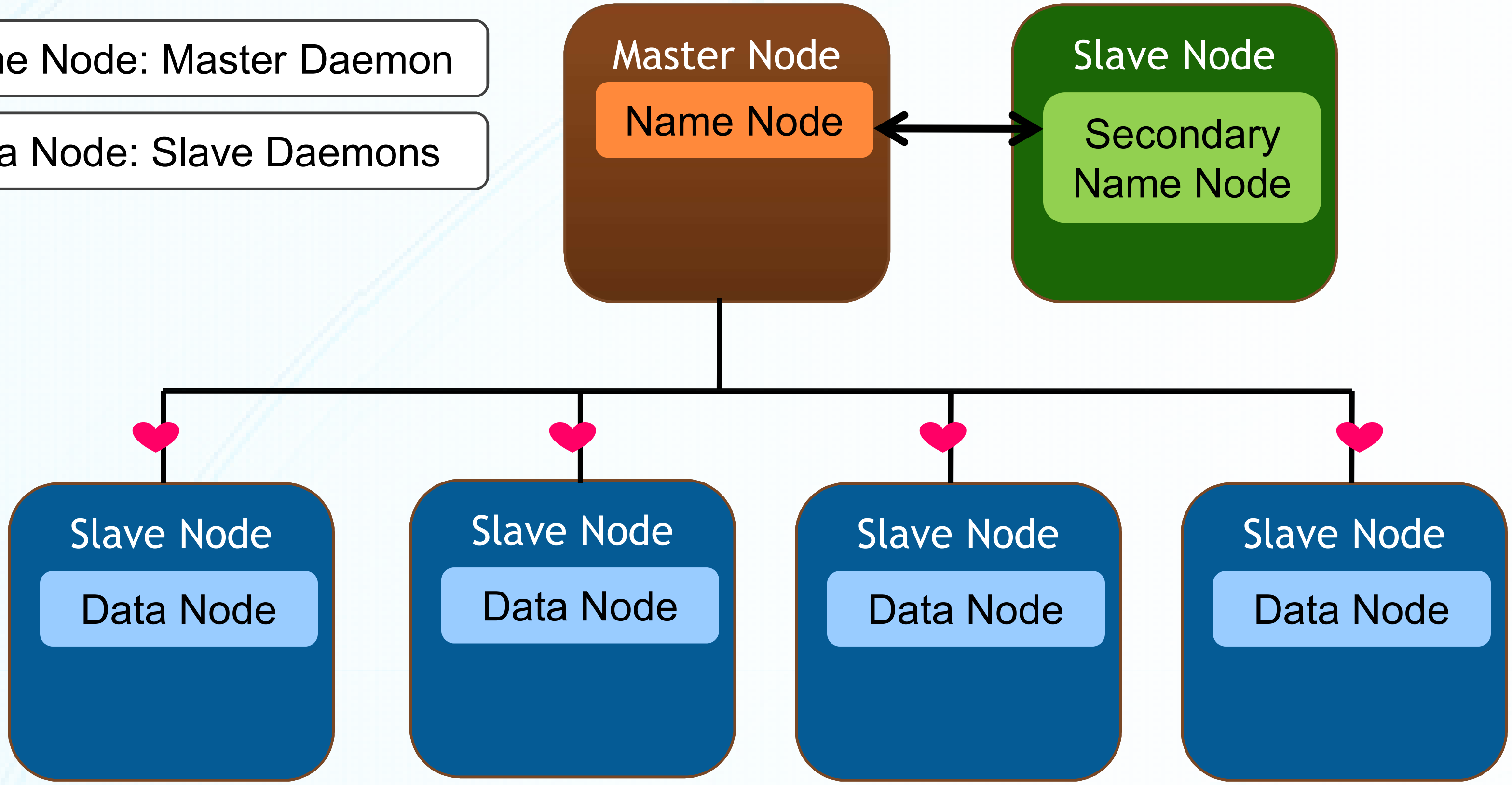
Data Node

YARN Node Manager

HDFS Storage Daemons

Name Node: Master Daemon

Data Node: Slave Daemons



Master Node

Name Node

Slave Node

Secondary Name Node

Slave Node

Data Node

Slave Node

Data Node

Slave Node

Data Node

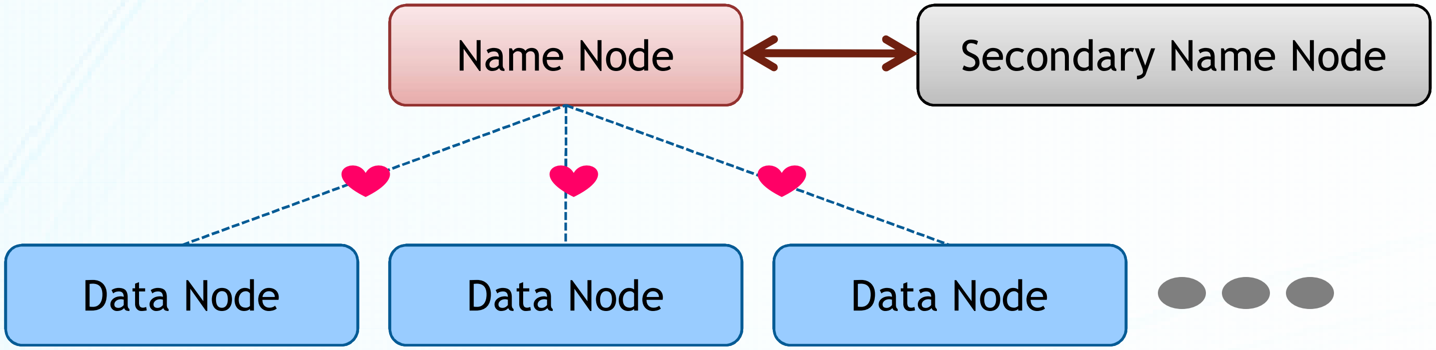
Slave Node

Data Node

Data Nodes communicate with Name Node through heartbeats ❤

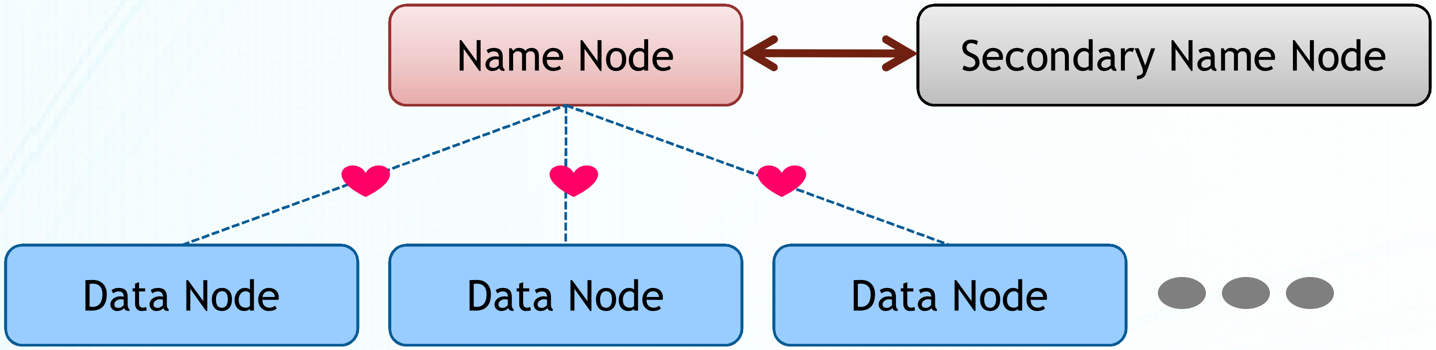
Name Node

- Name Node is the master daemon that maintains and manages Data Nodes
- Maintains meta data about data blocks such as location of blocks stored, size of the files, permissions, hierarchy etc in a file called **FsImage**.
- Receives heart-beat and block report from all Data Nodes.



Data Node

- These are slave daemons that runs on each slave machines
- Stores and manages actual data
- Serves Read and Write requests from the client
- Sends heartbeat to Name Node once every 3 sec.



FsImage & Edit Log Files

FsImage File

- FSImage file contains the complete state of the file system namespace since the start of the NameNode.
- Each node is an internal representation of a file or directory's metadata and contains such information as the file's replication level, modification and access times, access permissions, block size, and the blocks a file is made up of.
- For directories, the modification time, permissions, and quota metadata is stored.

EditLog File

- EditLog file is stored in-memory and records all incremental changes happening on HDFS and is periodically merged with FsImage during check-pointing process.

Secondary Name Node

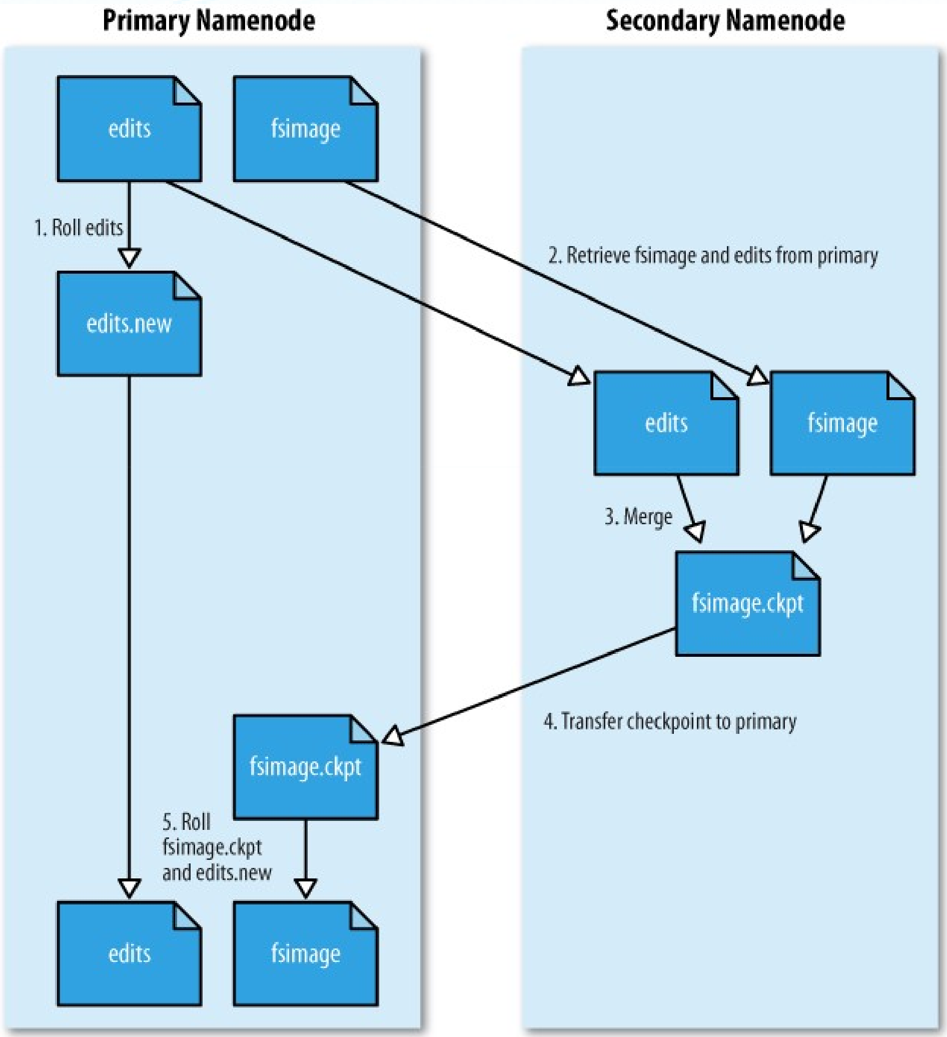
Check-pointing is the process of combining edit-logs with FsImage

SNN takes the responsibility of check-pointing, there by reducing load on Name Node

Allows faster fail-over as it prevents the edit-log from getting too huge.

Check-pointing happens periodically.

SNN is not a hot stand-by for NN. It just does metadata backup and is used to rebuild a failed NN



How is data stored in Data Nodes?

HFDS Blocks & Replication

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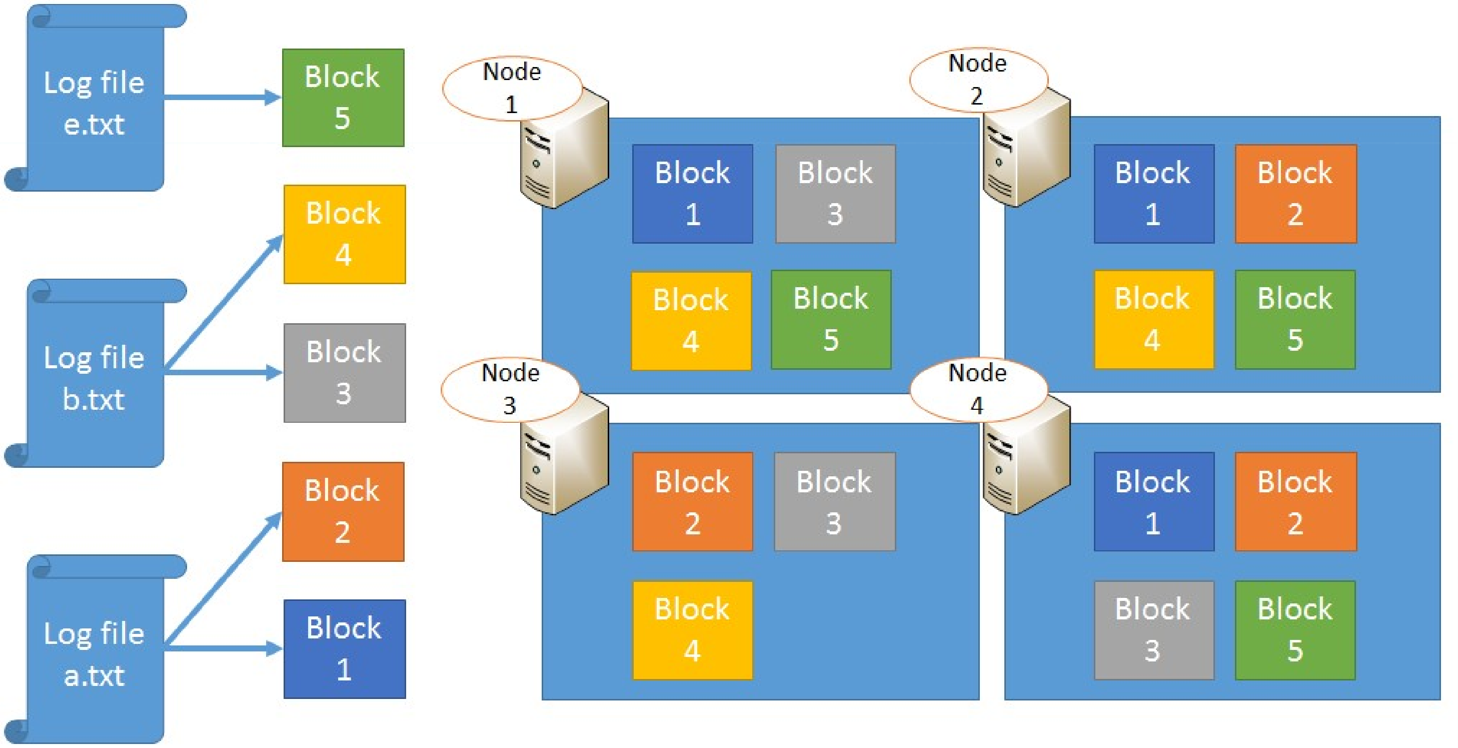
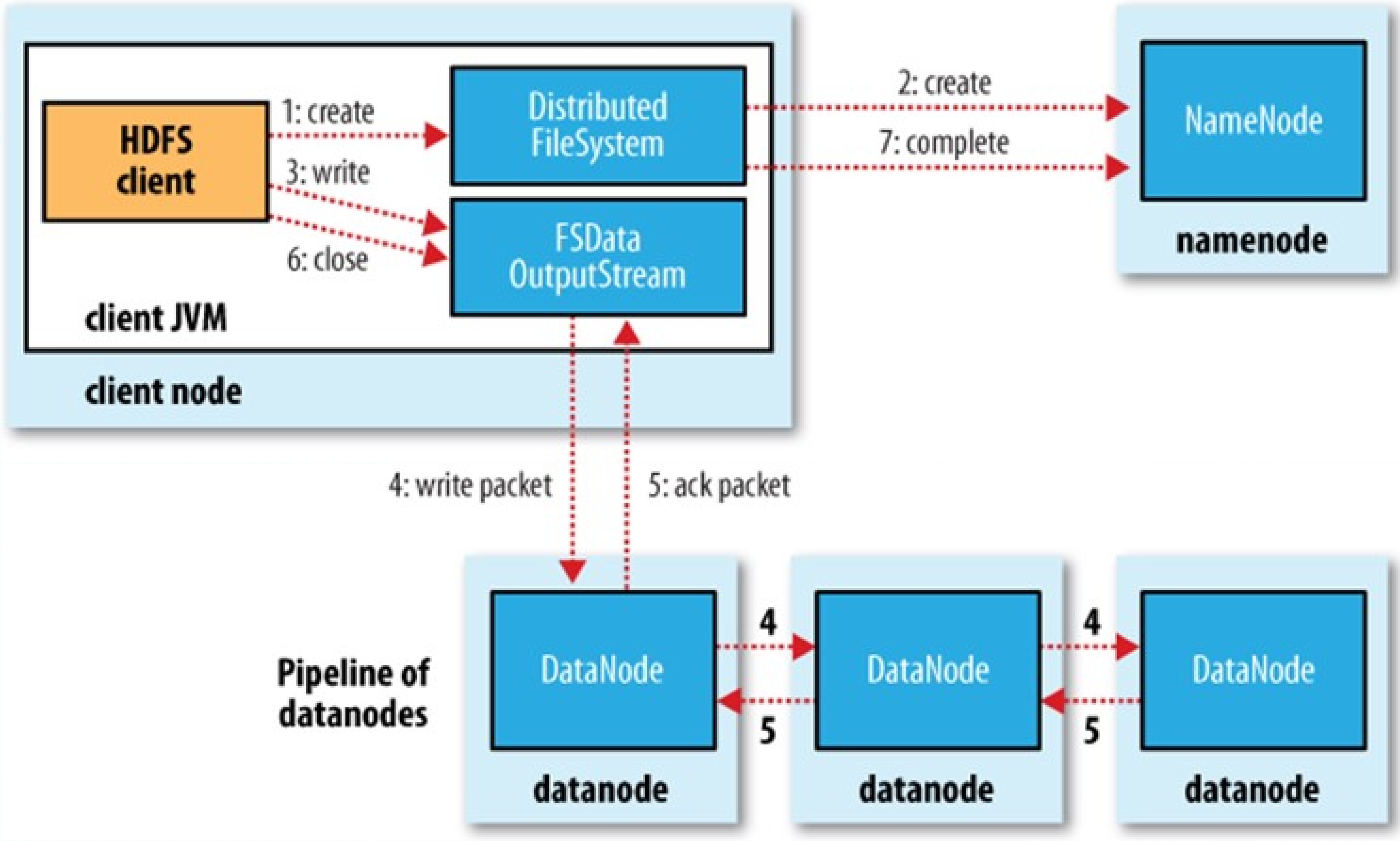
- HDFS is a block structured file system.
- Each file is stored on HDFS as blocks of 128MB (default)
- Each block is replicated 3x (default) to deal with Data Node failure



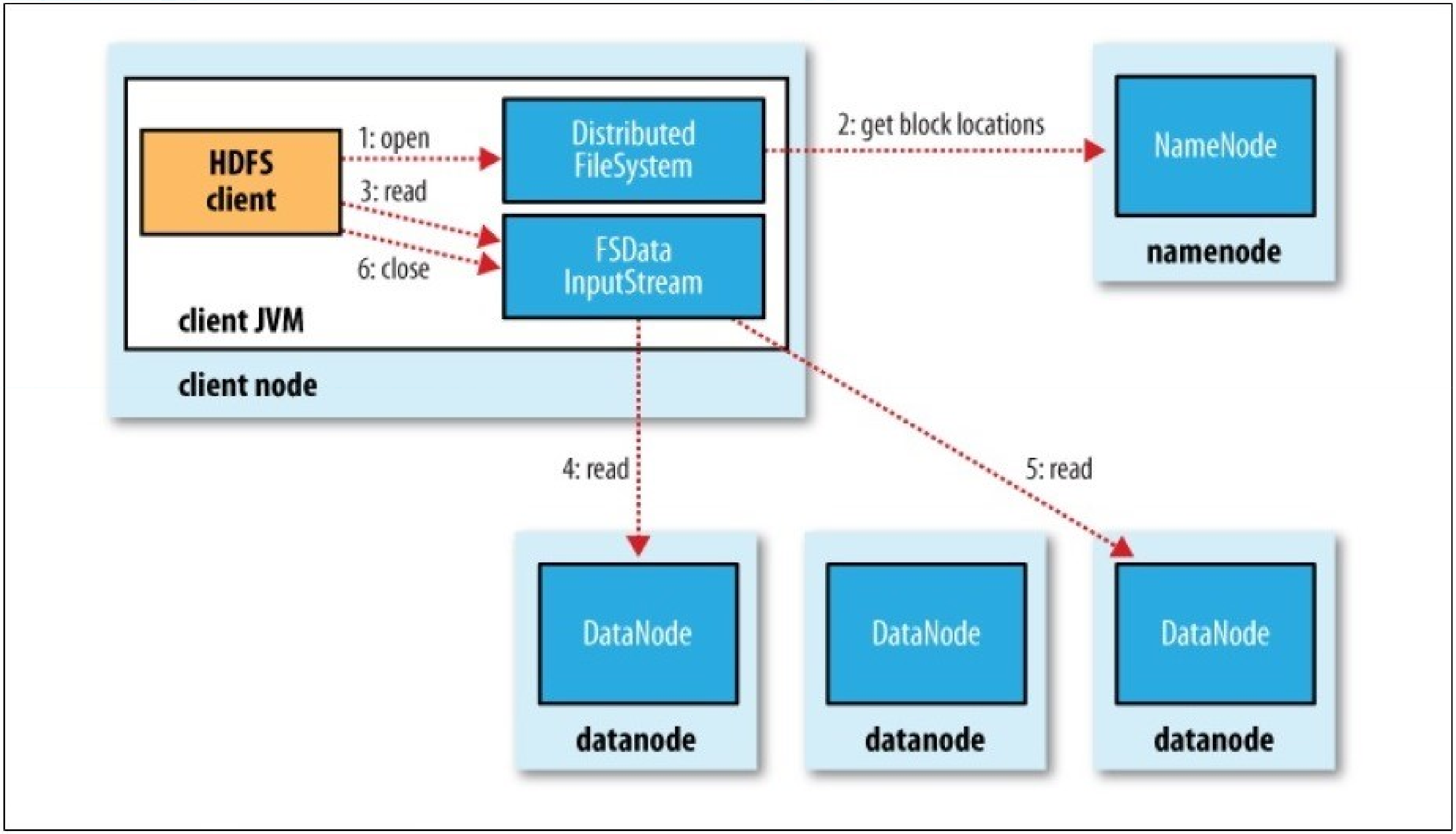
How are files written to and read from HDFS?

Anatomy of HDFS File Write

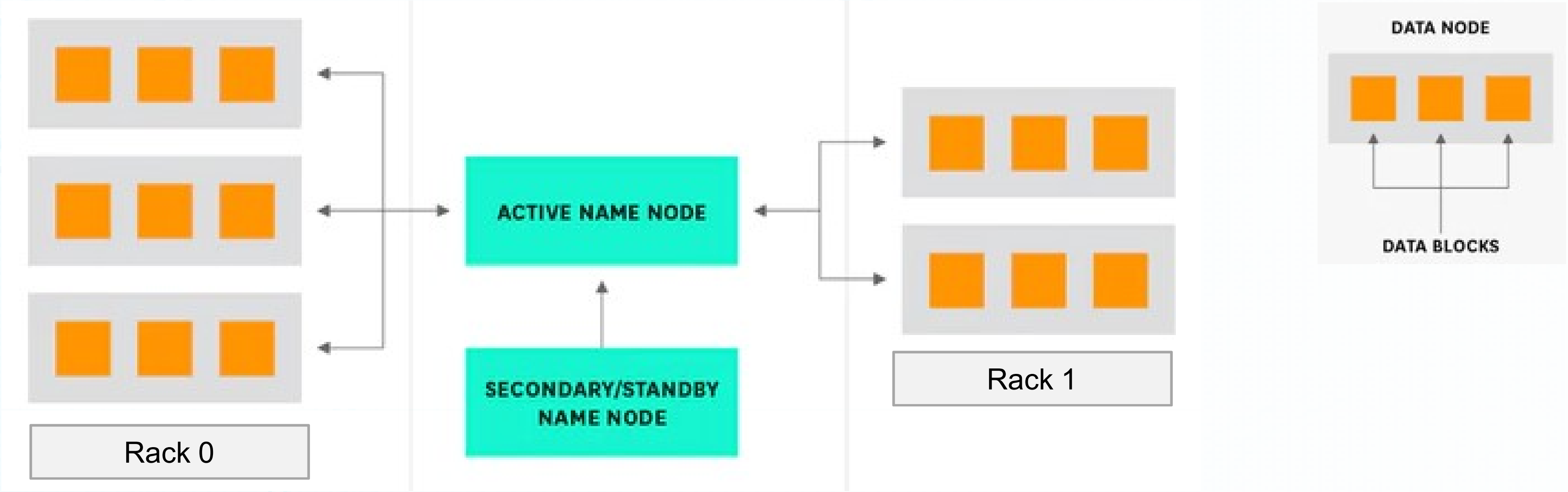


Replications are written sequentially. Blocks are written in parallel.

Anatomy of HDFS File Read

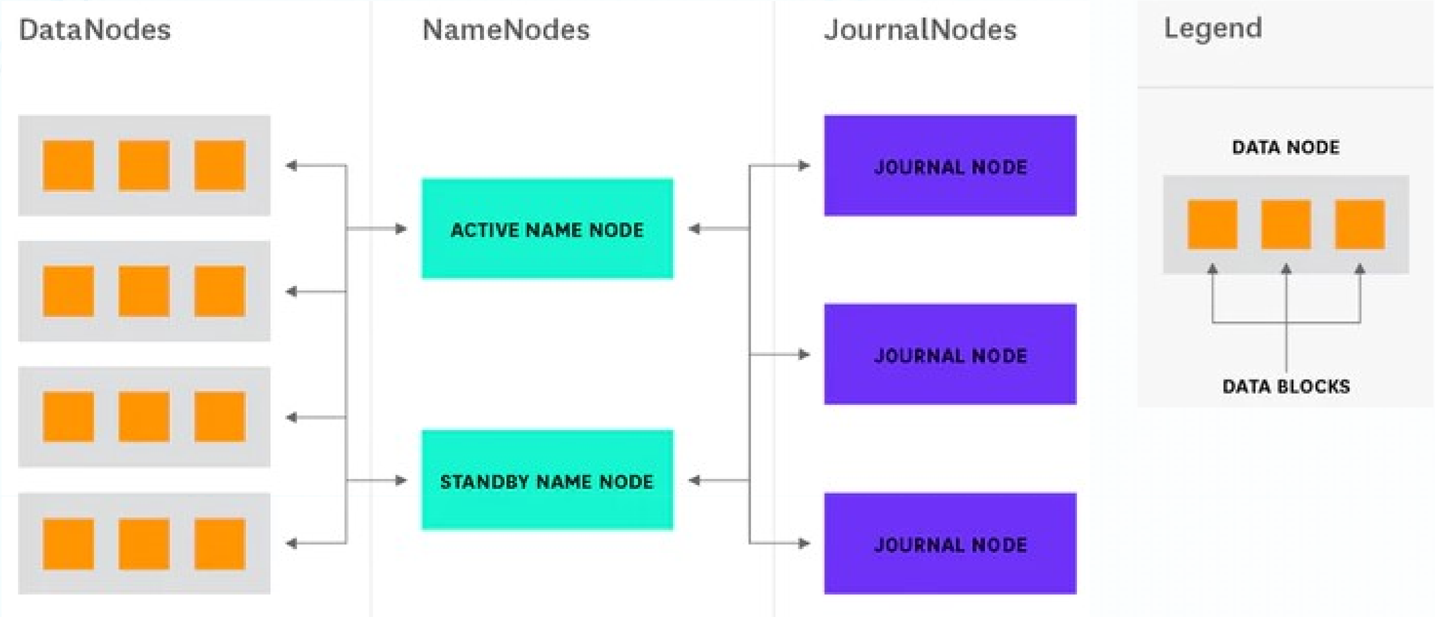


Hadoop Cluster Architecture with out HA



- In the early versions of Hadoop, NameNode was the ‘single point of failure’.
- SNN does not provide an alternative to NN, but only helps to quickly recover from NN failures. However, if NN is does the cluster experiences a downtime until it is restored.
- With Hadoop 2.0 and Standby NameNodes, a mechanism for true high availability was realized.

Hadoop Cluster Architecture with HA



- Standby NameNodes provide automatic failover if primary NameNode fails.

- Achieving high availability with Standby NameNodes requires shared storage between the primary and standbys (for the edit log).

- Though there are two options for the necessary shared storage - **NFS** and **Quorum Journal Manager(QJM -** only QJM is considered production-ready.

Name Node and QJM

- The QJM is a dedicated HDFS implementation, designed for the sole purpose of providing a highly available edit log, and is the recommended choice for most HDFS installations.

- Using QJM to maintain consistency of Active and Standby state requires that both nodes be able to communicate with a group of JournalNodes (JNs).

- When the Active node modifies the namespace, it logs a record of the change to a majority of JournalNodes. The StandbyNode watches the JNs for changes to the edit log and applies them to its own namespace.

Working with HDFS

Basic HDFS Commands

Help

```
$ hadoop fs -help
$ hdfs dfs -help
```

Basic File Operations

$ hadoop fs -mkdir *mydir*	Create directory
$ hadoop fs -rmdir *mydir*	Remove a directory
$ hadoop fs -ls	List files
$ hadoop fs -ls *specific_dir*	List files in a dir
$ hadoop fs -ls -R	Recursive listing
$ hadoop fs -cat *myfile*	Read the file content
$ hadoop fs -cp <source> <dist>	Copy file to a dir with in Hadoop
$ hadoop fs -mv <source> <dist>	Move a file within hadoop

Basic HDFS Commands

Basic File Operations

`$ hadoop fs -rm myfile`	Delete a file from Hadoop
`$ hadoop fs -rm -R mydir`	Delete files recursivly
`$ hadoop fs -chmod 777 myfile`	Change permission on a file/dir
`$ hadoop fs -chmod -R 777 mydir`	Change permissions recursively

Moving files between Linux & HDFS

`$ hadoop fs -copyFromLocal <src> <dist>`	Copy from Linux to HDFS
`$ hadoop fs -copyToLocal <src> <dist>`	Copy from HDFS to Linux
`$ hadoop fs -get <src> <dist>`	Copy from Linux to HDFS
`$ hadoop fs -put <src> <dist>`	Copy from HDFS to Linux
`$ hadoop fs -moveFromLocal <src> <dist>`	Move from Linux to HDFS

```
$ hadoop distcp -update hdfs://192.168.1.1/xxx  hdfs://192.168.1.2/yyy
```

TIME FOR QUESTIONS
12
1
2
3
4