

# **Fundamental of Big Data Analytics**

**lec 03**

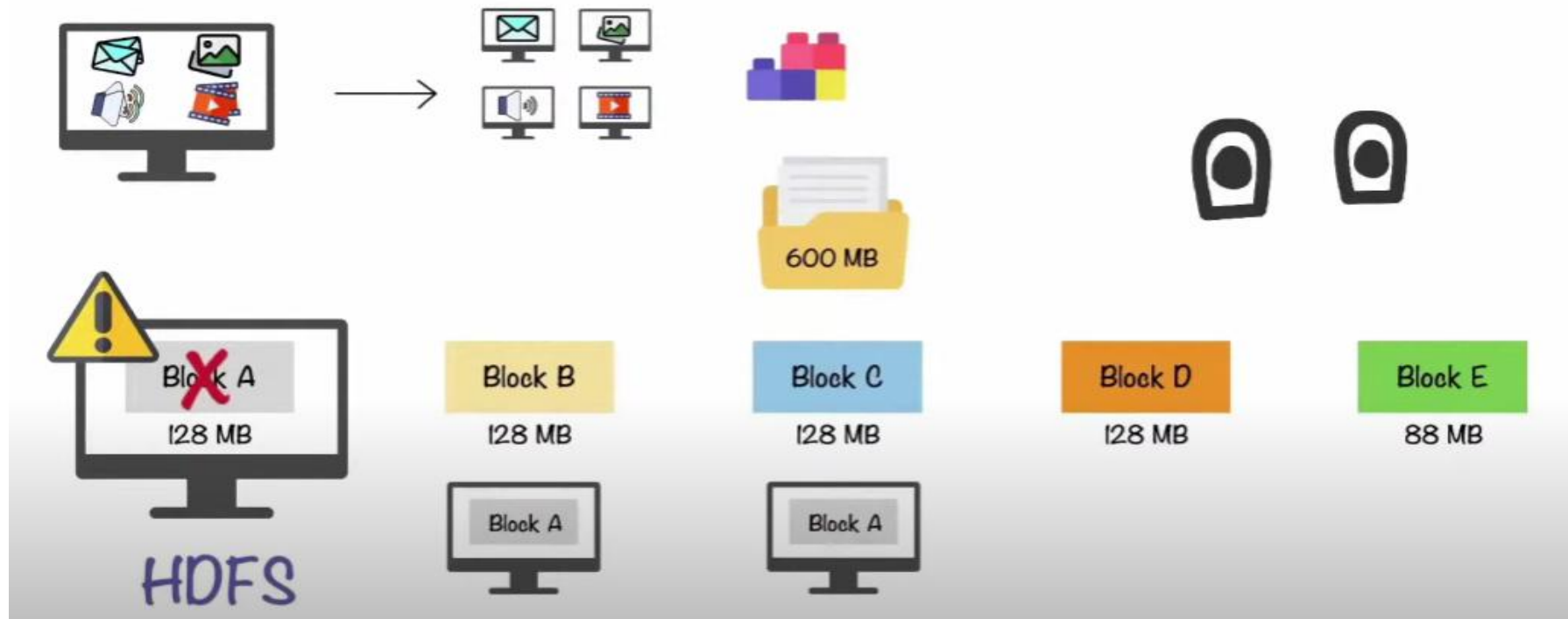
# Hadoop

- **Apache HDFS** or **Hadoop Distributed File System** is a **block-structured file system** where each file is divided into blocks of a pre-determined size.
- These blocks are stored across a cluster of one or several machines.
- Apache Hadoop HDFS Architecture follows a ***Master/Slave Architecture***
  - cluster comprises of a single **NameNode (Master node)**
  - all the other nodes are **DataNodes (Slave nodes)**

# Hadoop

- Hadoop consists of three components that are specifically designed to work on Big Data.
  - Storage Unit (HDFS)
  - Process data (MapReduce)
  - YARN

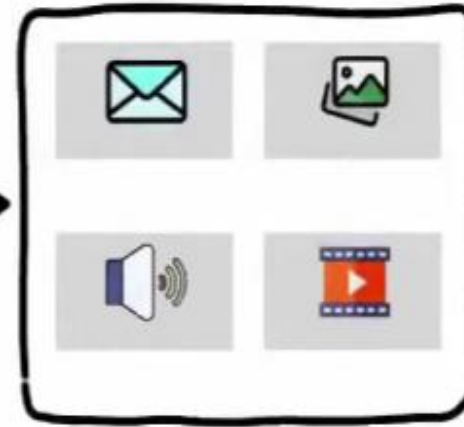
# HDFS



- HDFS makes copies of all data and stores it across multiple systems
- Data is not lost at any cost, even if one DataNode crashes, making HDFS fault tolerant.

# MapReduce

Traditional data processing method

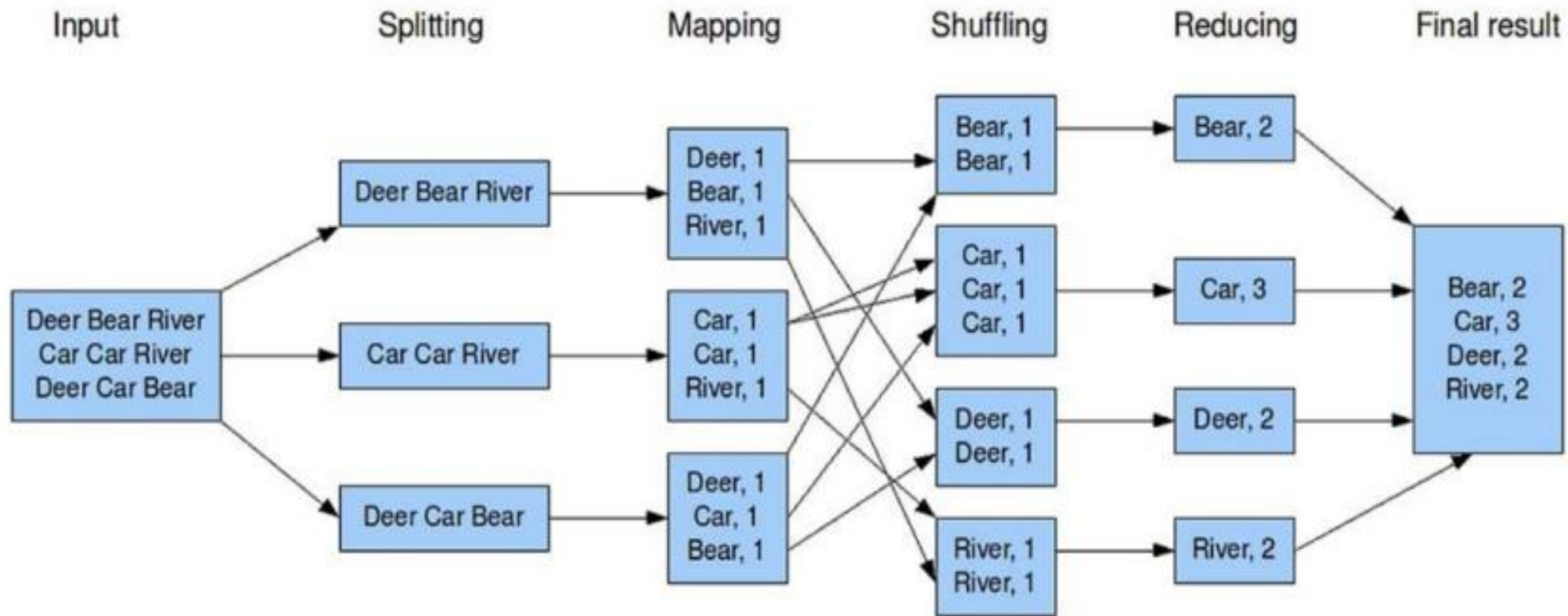


Final output

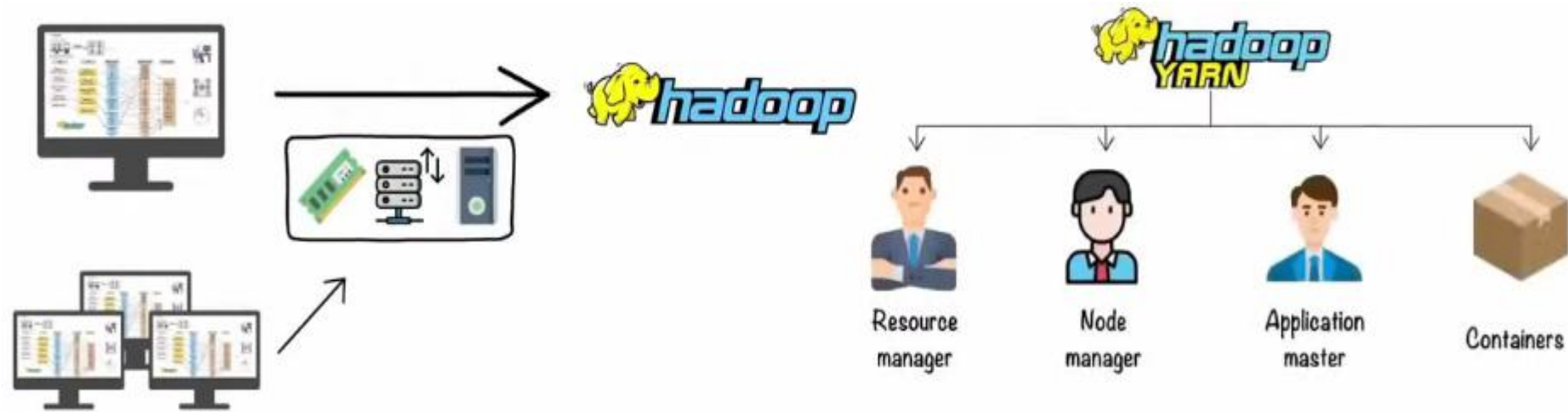


Processing large volumes of a variety of data

# Example: Word Count

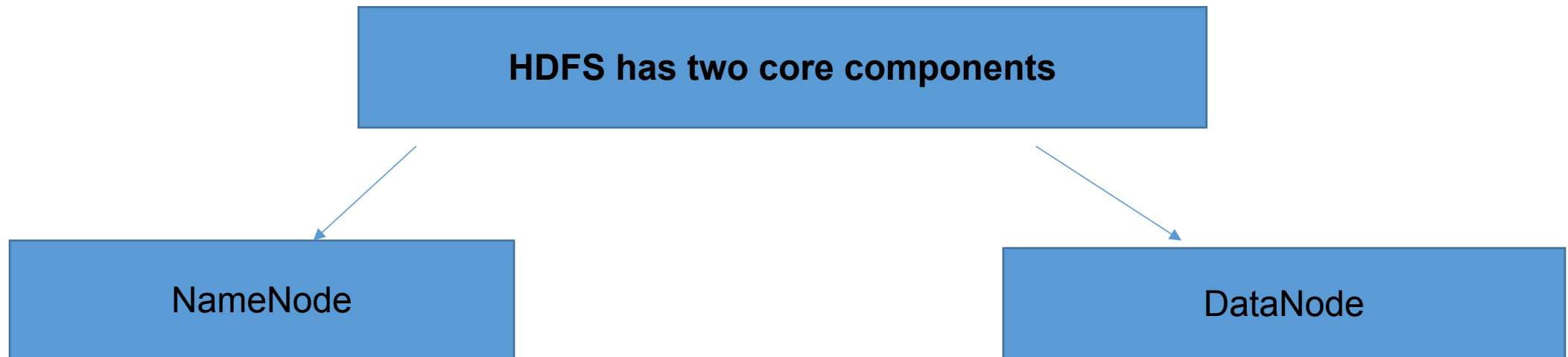


# YARN



# HDFS

- To store the massive data, data was divided and distributed among many individual databases.
- HDFS is a specially designed file system for storing huge dataset in commodity hardware.





# NameNode

- Is the master daemon.
- Only one active NameNode.
- Manages the DataNodes.
- Store all the metadata. MetaData gives information regarding the file location, block size and so on.

MetaData in HDFS is maintained by using two files

editlog

fsimage

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Keep track of recent  
changes made on  
HDFS  
ONLY recent changes  
are tracked here

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- Only one active NameNode.
- Manages the DataNodes.
- Store all the metadata. MetaData gives information regarding the file location, block size and so on.

MetaData in HDFS is maintained by using two files

editlog

fsimage

Keep track of every changes made on HDFS since the beginning

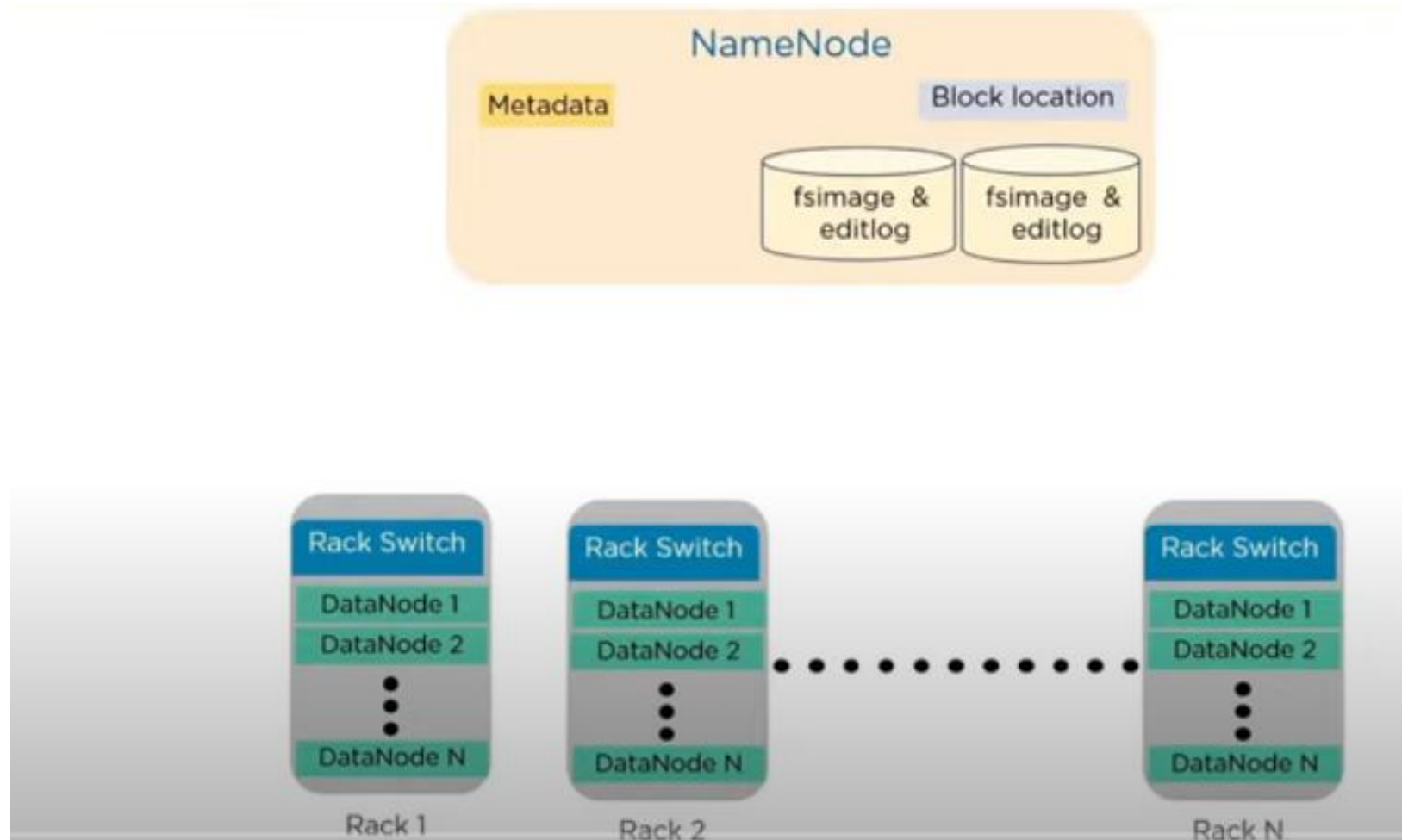


# DataNode

- DataNode is the slave daemon.
- There can be multiple DataNodes.
- Stores the actual data.

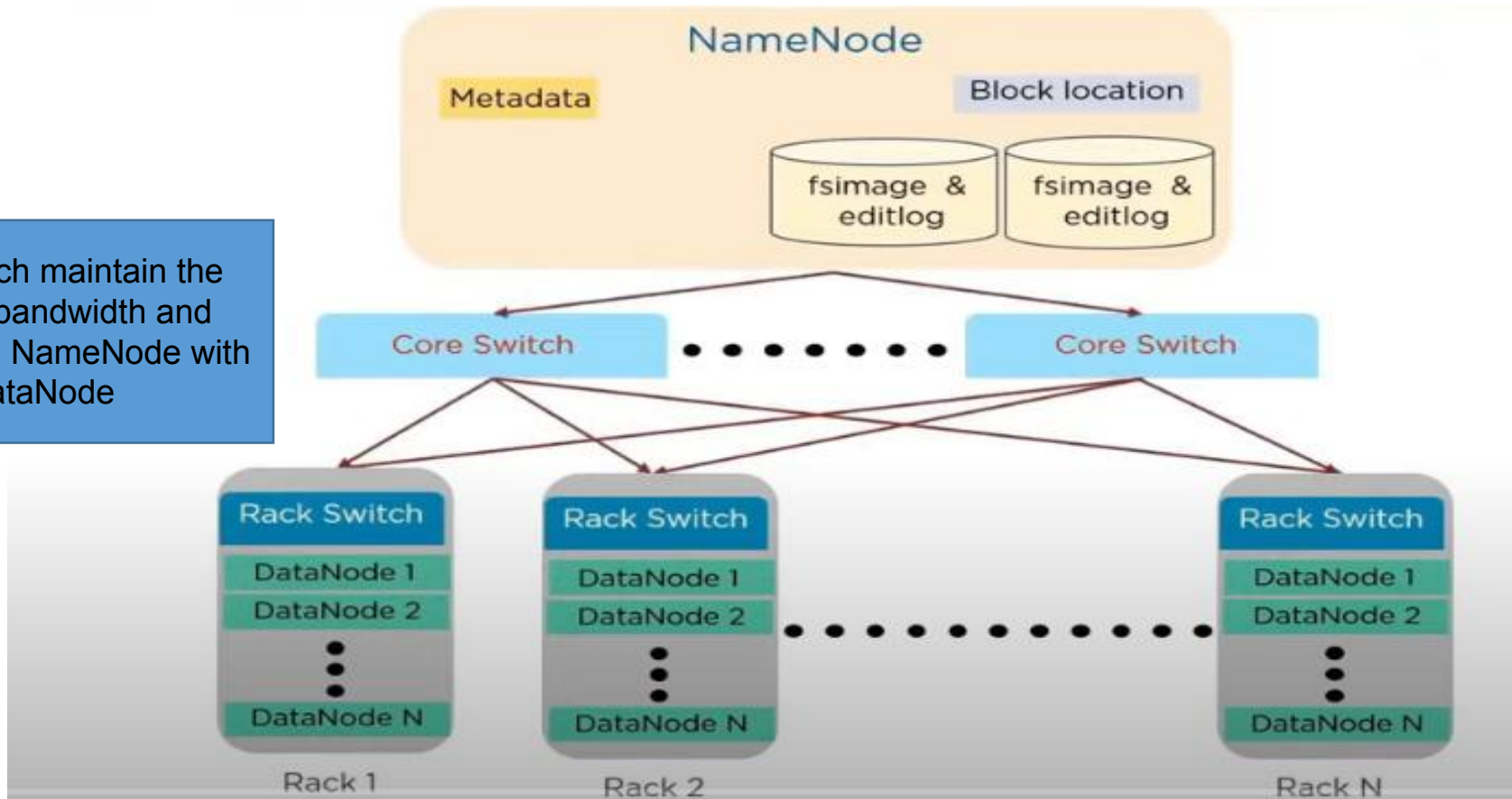
- The NameNode makes **all decisions** regarding **replication of blocks**.
- It **periodically receives** a **Heartbeat** and a **Blockreport** from each of the DataNodes in the cluster.
- **Heartbeat** implies that the each rack **DataNode is functioning properly**.
- A **Blockreport** contains a **list of all blocks on a DataNode**.

# HDFS Cluster architecture



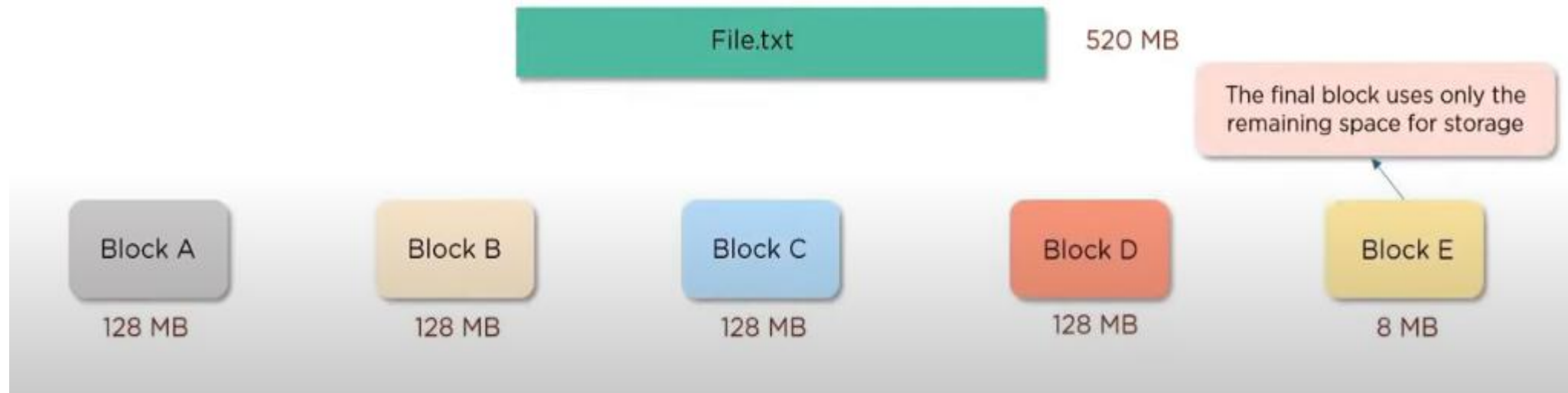
# HDFS Cluster architecture

Core switch maintain the network bandwidth and connect the NameNode with DataNode



# HDFS Data Blocks

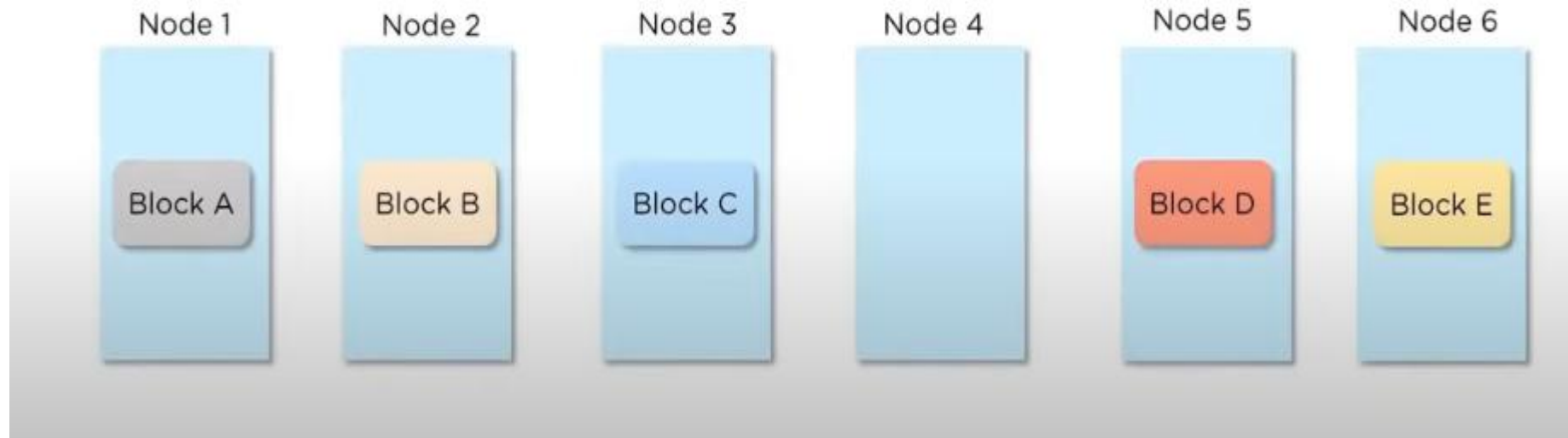
Now, let us look into how files are stored in HDFS





# DataNode failure

All the data blocks are stored in various DataNodes



Now, what happens when

Node 5 crashes?



Node 1

Block A

Node 2

Block B

Node 3

Block C

Node 4

Node 5



Block D

Node 6

Block E

Data is lost!

The data stored in Node 5 will be unavailable as there is no copy stored elsewhere



Node 1

Block A

Node 2

Block B

Node 3

Block C

Node 4

Node 5



Block D

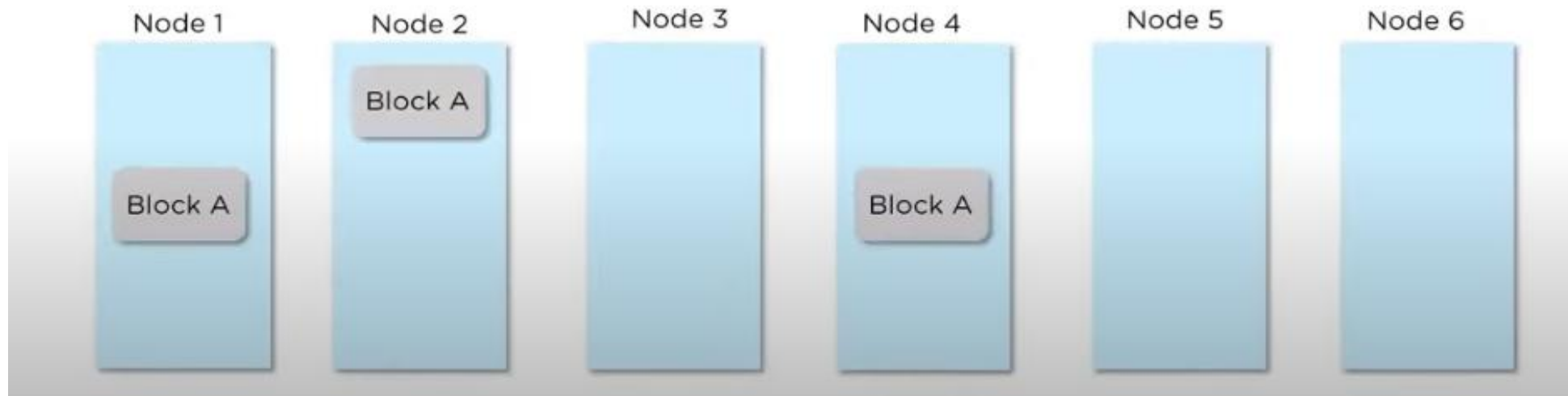
Node 6

Block E

# Replication

HDFS overcomes the issue of DataNode failure by creating copies of the data, this is known as the replication method

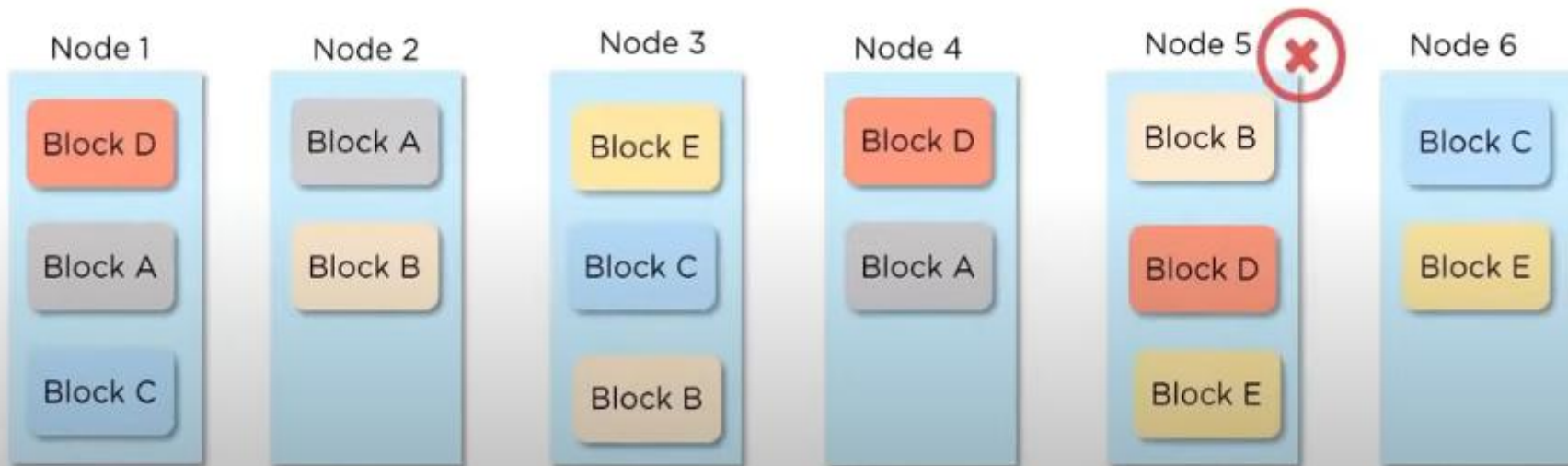
Data blocks are being replicated



Now, what happens when

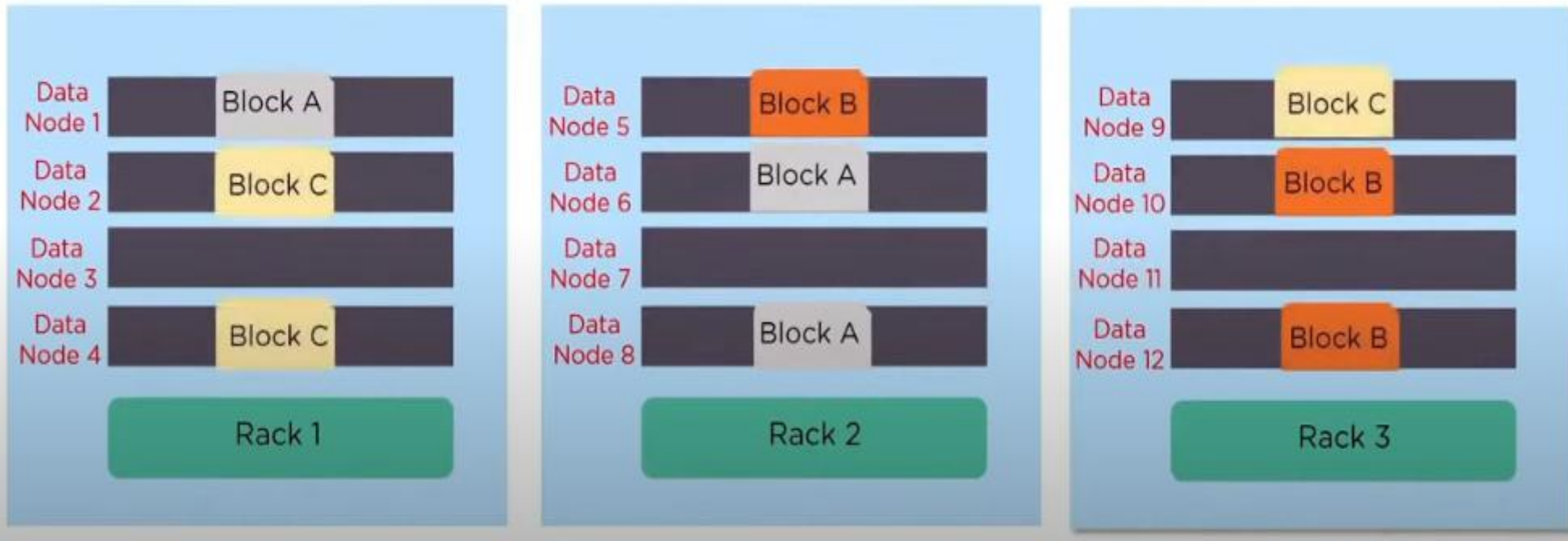
Node 5 crashes?

Will the data blocks B, D and E be lost?

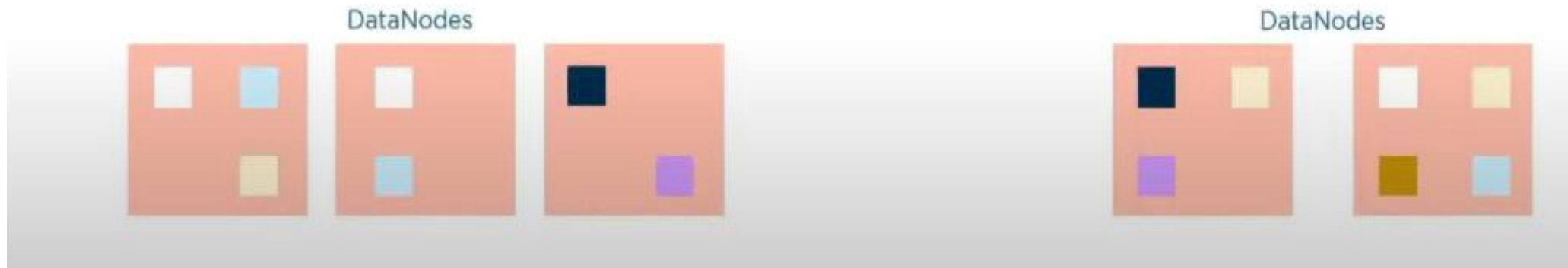


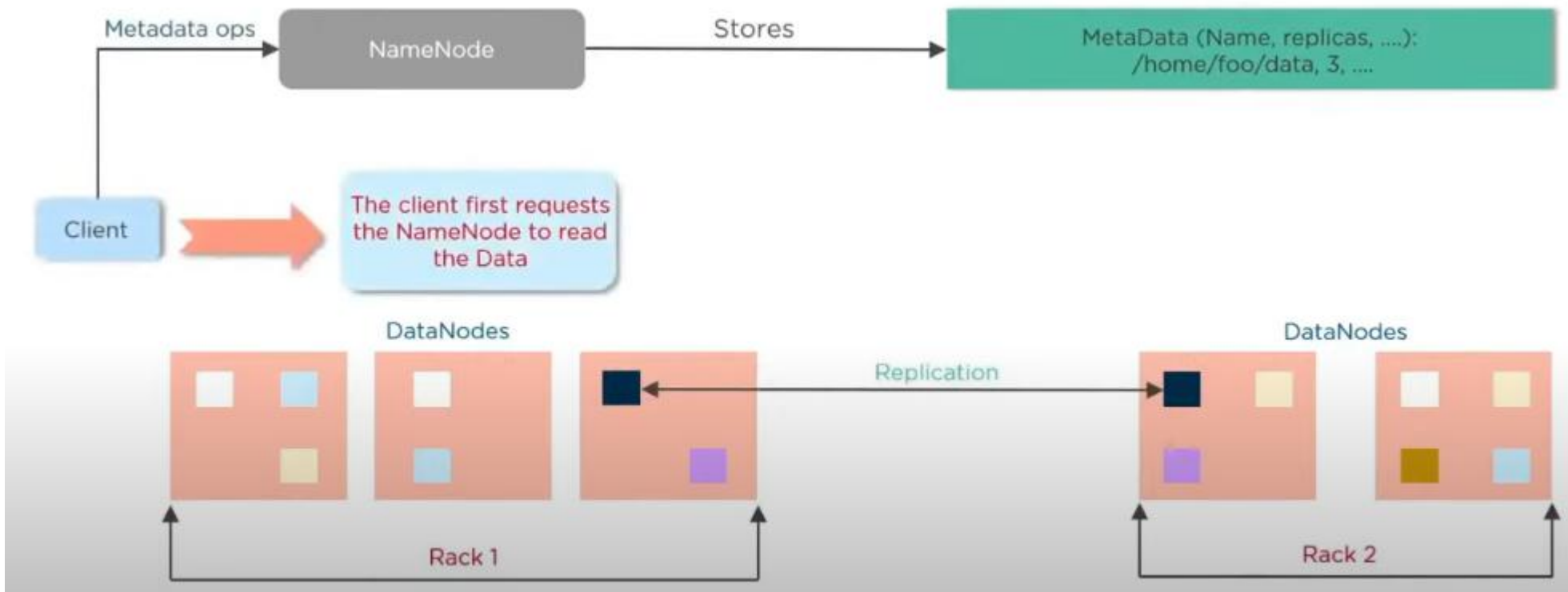
# Rack Awareness in HDFS

Rack is a collection of 30-40 DataNodes. Rack Awareness is a concept that helps to decide where a replica of the data block should be stored

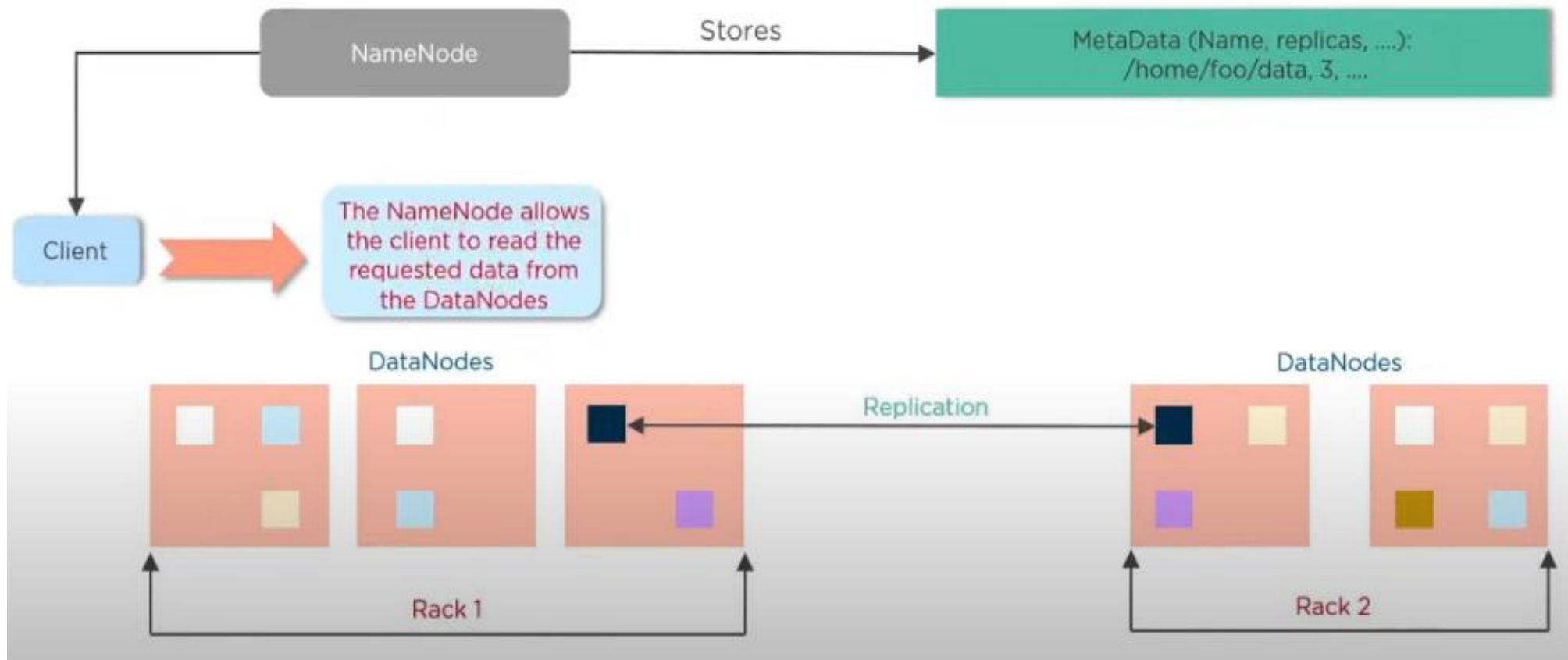


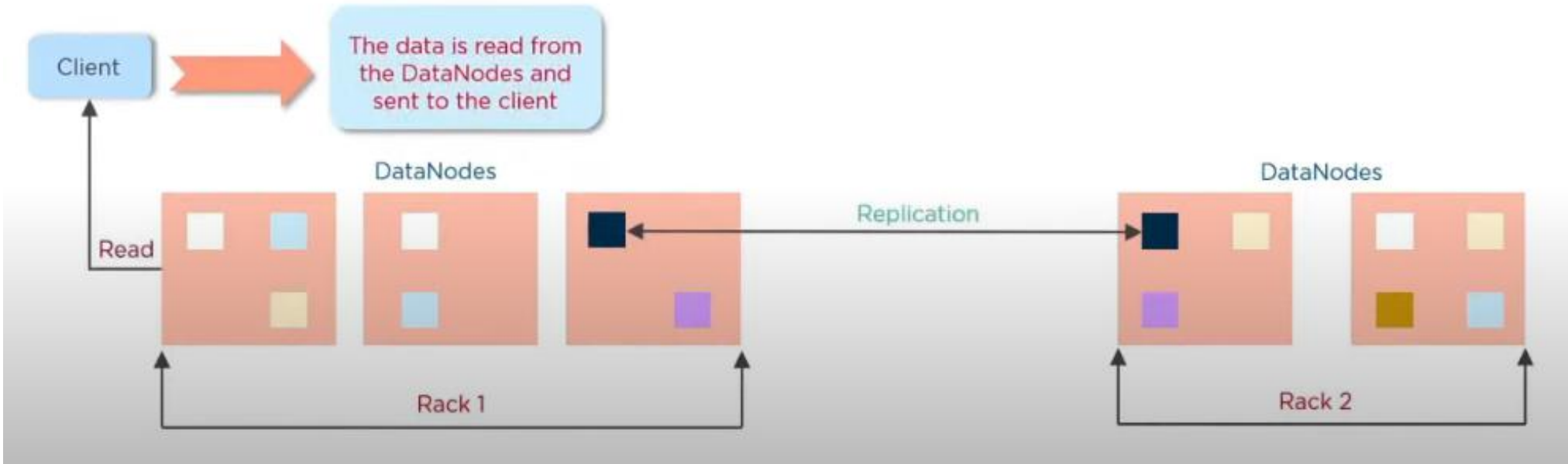
# HDFS architecture

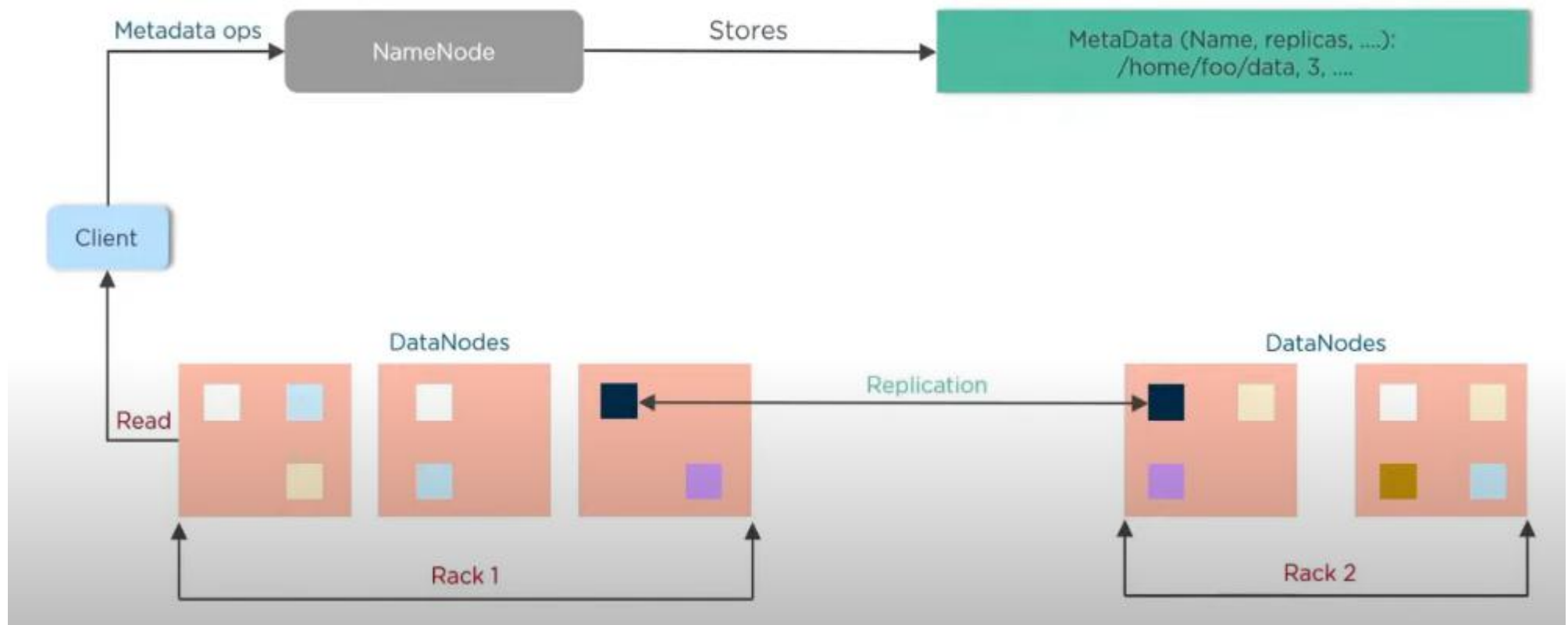






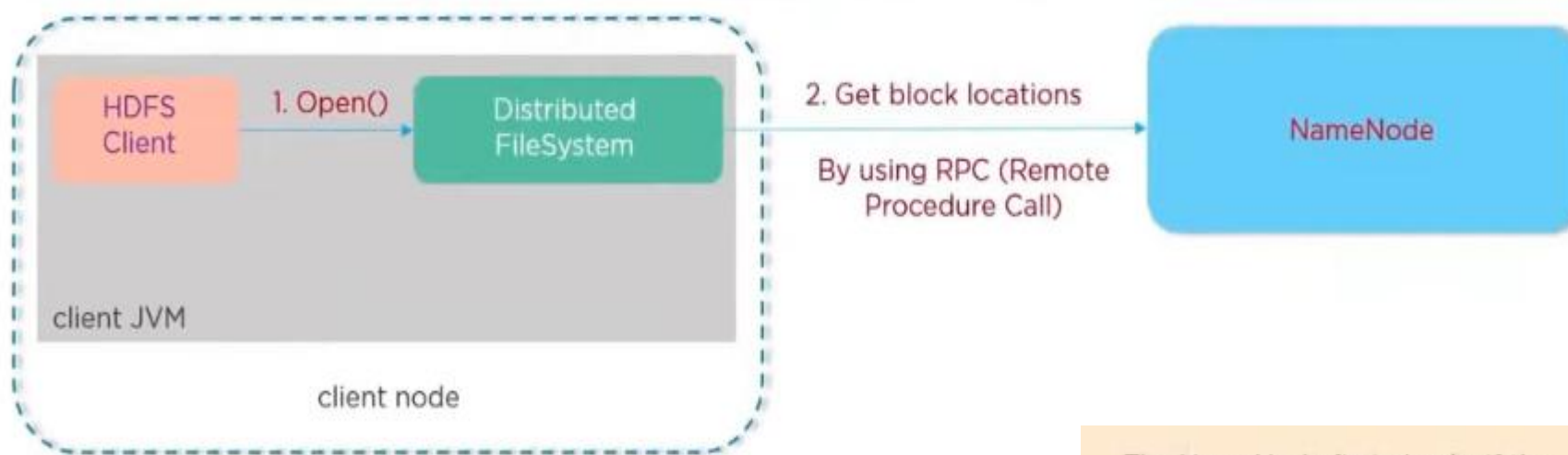






# HDFS read file Mechanism

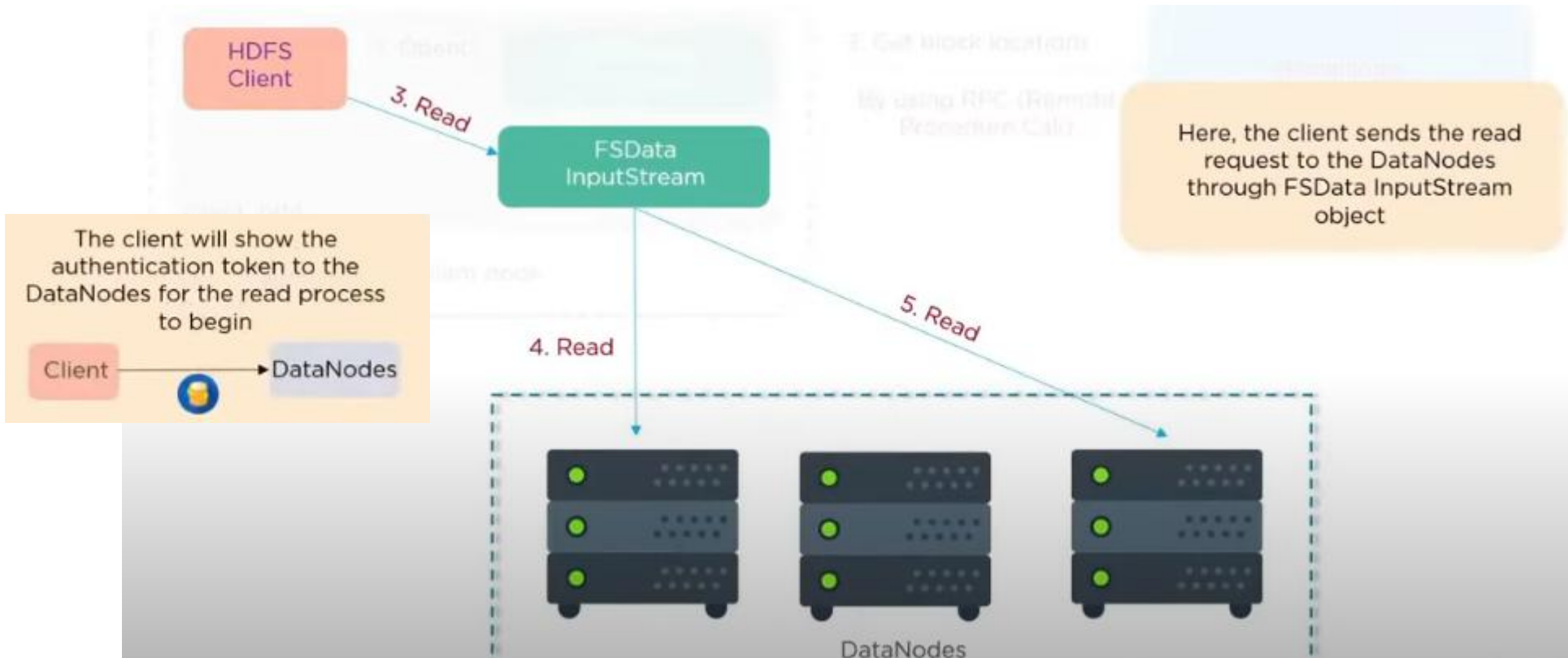


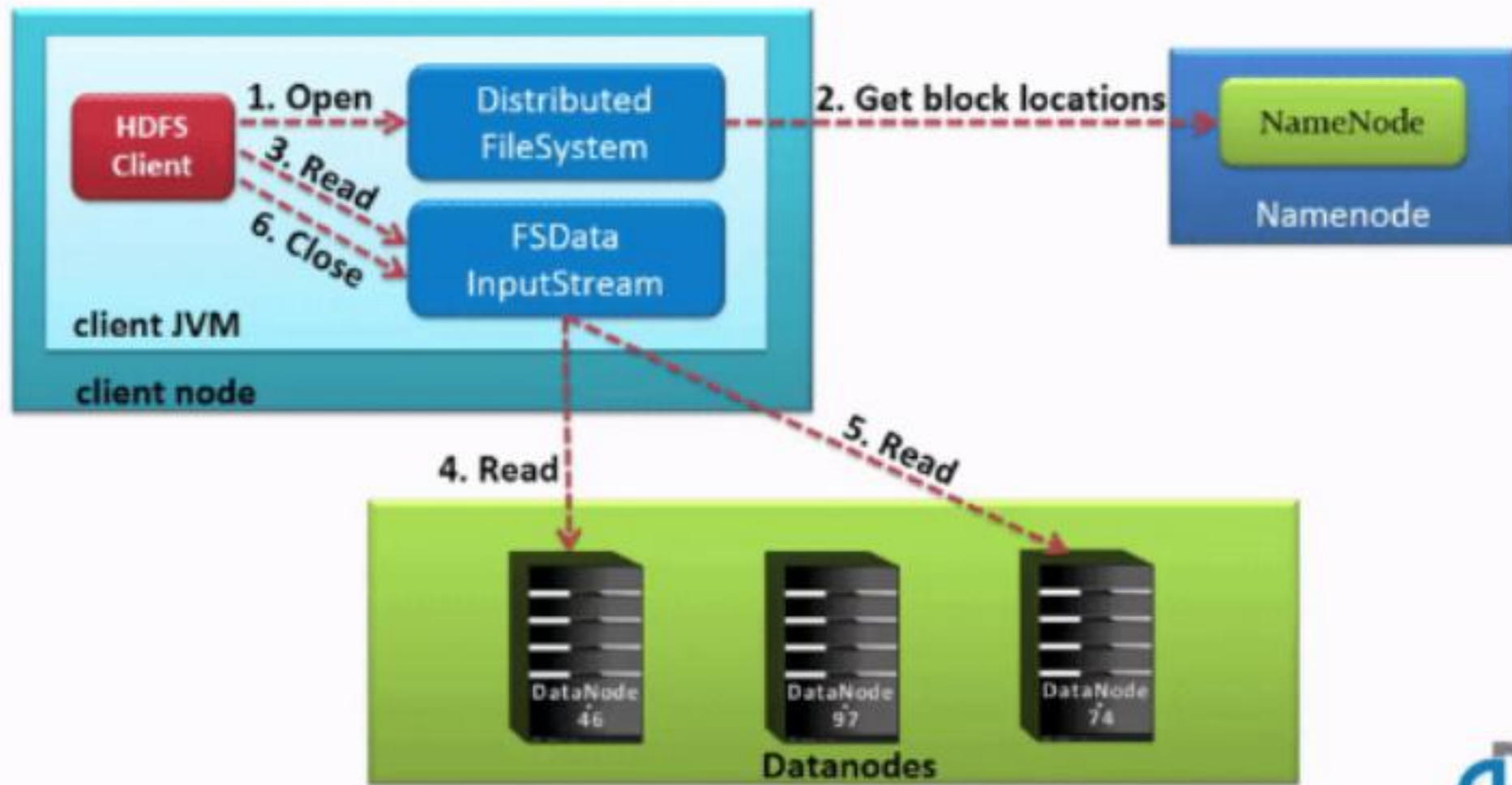


The NameNode first checks if the client is authorized to access the requested file

If yes, it then provides the block location & a token to the client which is shown to the slave for authentication







# HDFS write mechanism

