

## 2.2 NameNode, DataNode and the FileSystem Namespace

HDFS has a master/slave architecture. An HDFS cluster consists of a single NameNode, a master server that manages the file system namespace and regulates access to files by clients. In addition, there are a number of DataNodes, usually one per node in the cluster, which manage storage attached to the nodes that they run on. HDFS exposes a file system namespace and allows user data to be stored in files.

### NameNodes and DataNodes

Internally, a file is split into one or more blocks and these blocks are stored in a set of DataNodes. The NameNode executes file system namespace operations like opening, closing and renaming files and directories. It also determines the mapping of blocks to DataNodes. The DataNodes are responsible for serving read and write requests from the file system's clients. The DataNodes also perform block creation, deletion, and replication upon instruction from the NameNode.

HDFS Architecture

The NameNode and DataNode are pieces of software designed to run on commodity machines. These machines typically run a GNU/Linux OS. HDFS is built using the Java Programming Language; any machine that supports Java can run the NameNode or the DataNode software. Usage of the highly portable Java Language means that HDFS can be deployed on a wide range of machines. A typical deployment has a dedicated machine that runs only the NameNode software. Each of the other machines in the cluster runs one instance of the DataNode software. The architecture does not preclude running multiple DataNodes on the same Machine, but in a real deployment that is rarely the case.

The existence of a single NameNode in a cluster greatly simplifies the architecture of the system. The NameNode is arbitrator and repository for all HDFS metadata. The system is designed in such a way that user data never flows through the NameNode. (See figures: Data-read-in-HDFS and data-write-in-HDFS)

### The File System Namespace

HDFS supports a traditional hierarchical file organisation. A user or application can create directories and store files inside these directories. The file system namespace hierarchy is similar to most other existing file systems; one can create and remove files, move a file from one directory to another, or rename a file. HDFS does not support hard links or soft links. However, the HDFS architecture does not preclude implementing these features.

While HDFS follows naming conventions of the FileSystem, some paths and names (for example, .reserved and .snapshot) are reserved. Features such as transparent encryption and snapshot use reserved paths.

The NameNode maintains the filesystem namespace. Any change to the file system namespace or its properties is recorded by the NameNode. An application can specify the number of replicas of a file that should be maintained by HDFS. The number of copies of a file is called its replication factor. This information is stored by the NameNode.

**Sources:**

1. Main
2. HDFS Data flow