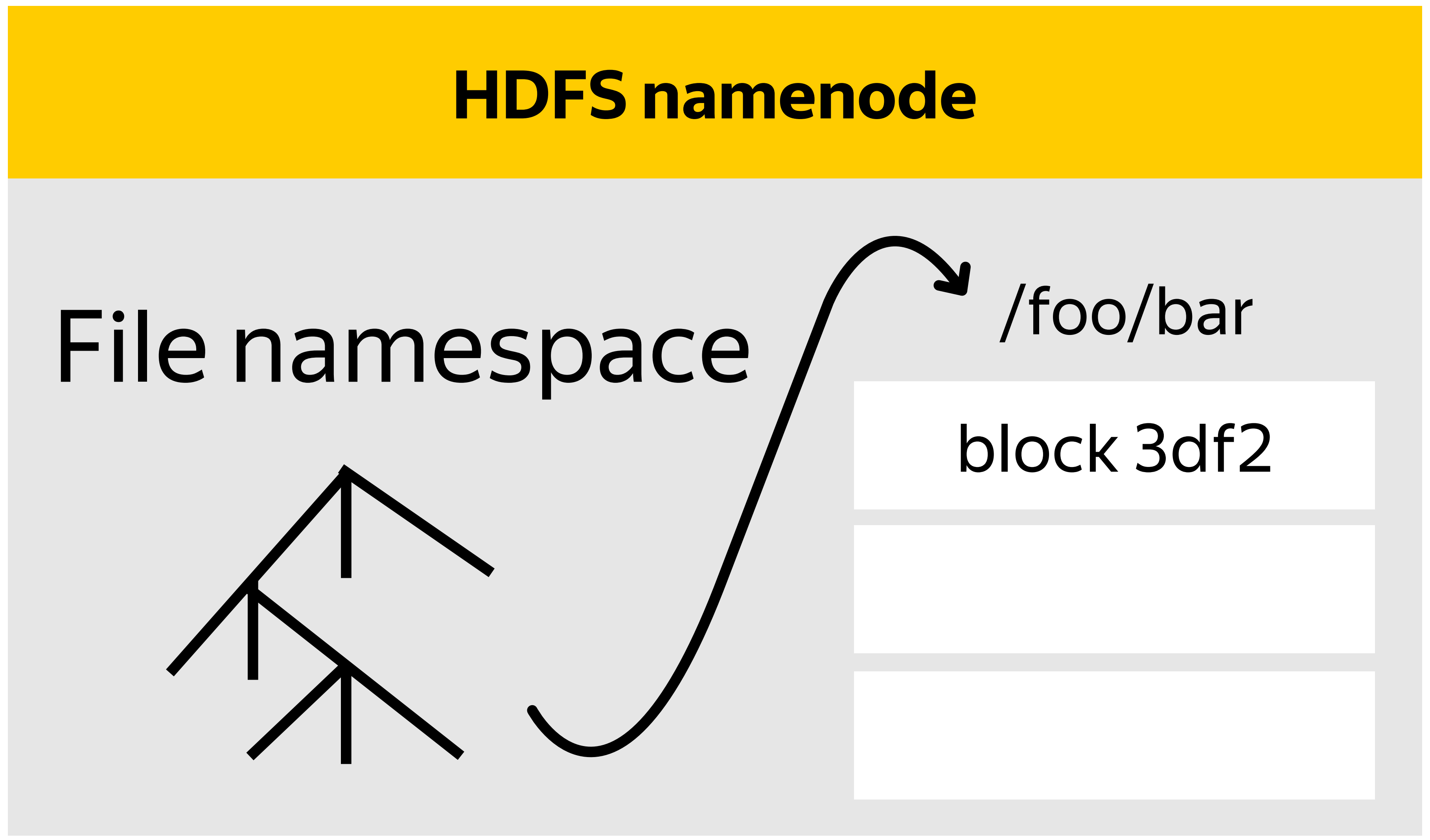
Yandex

# HDFS

Namenode Architecture

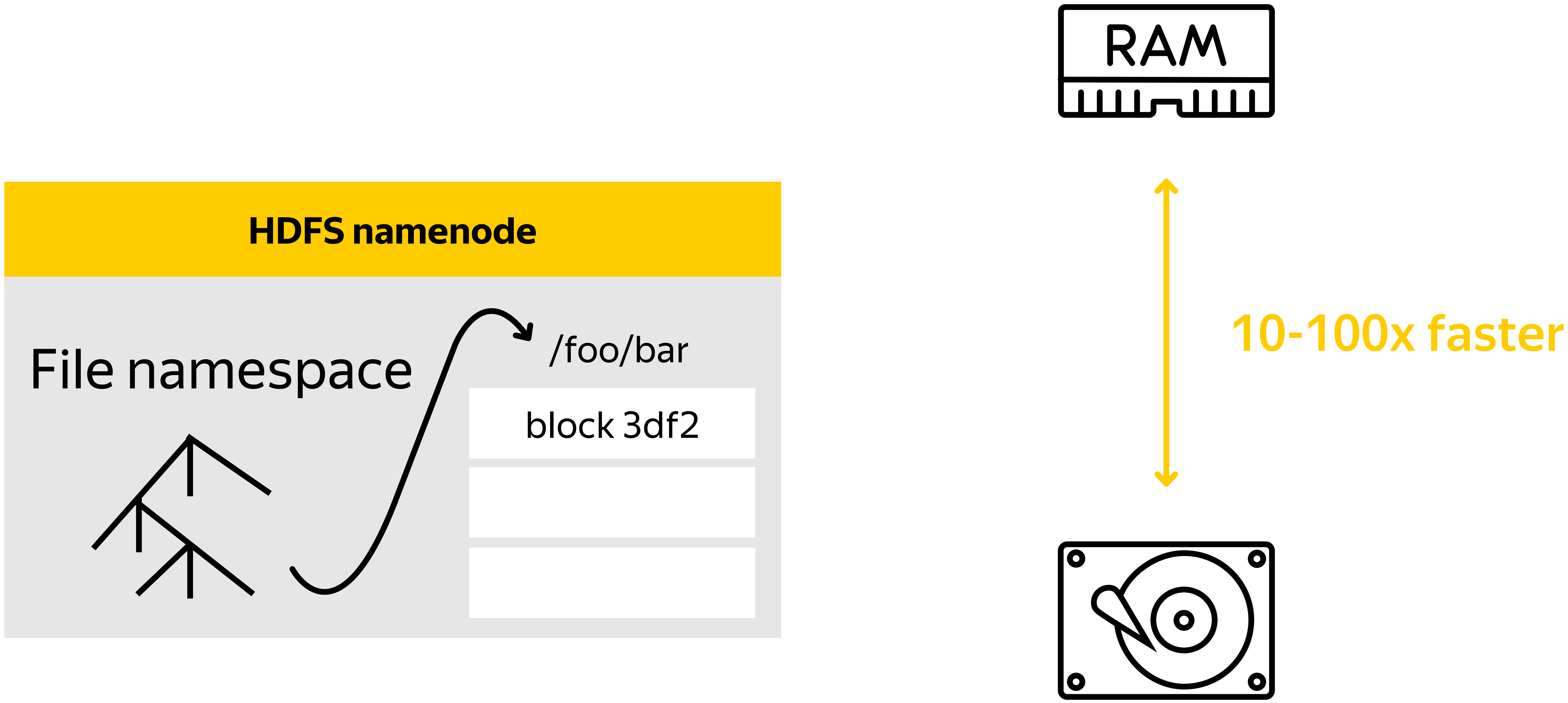


HDFS namenode

File namespace

/foo/bar

block 3df2



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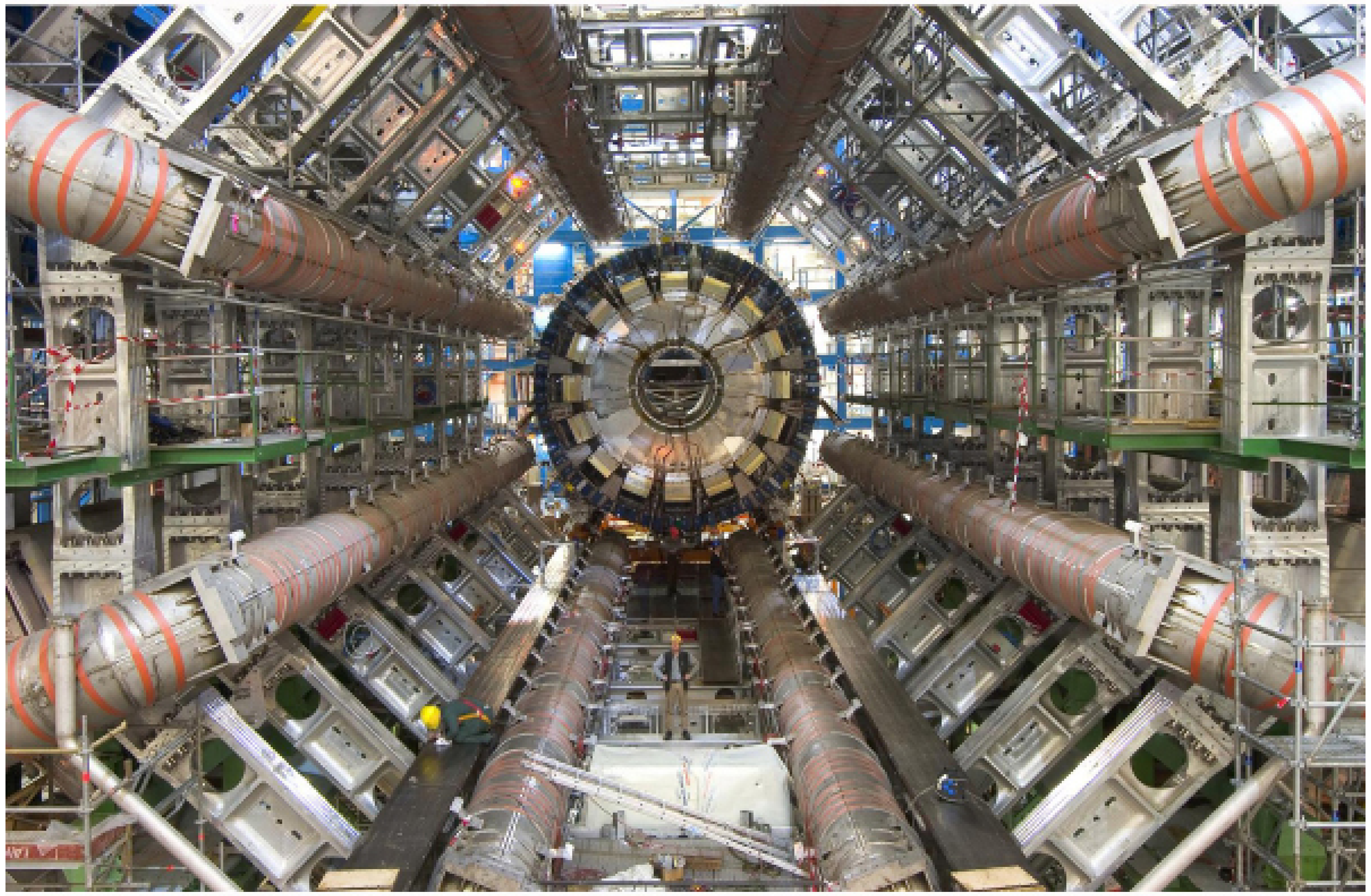
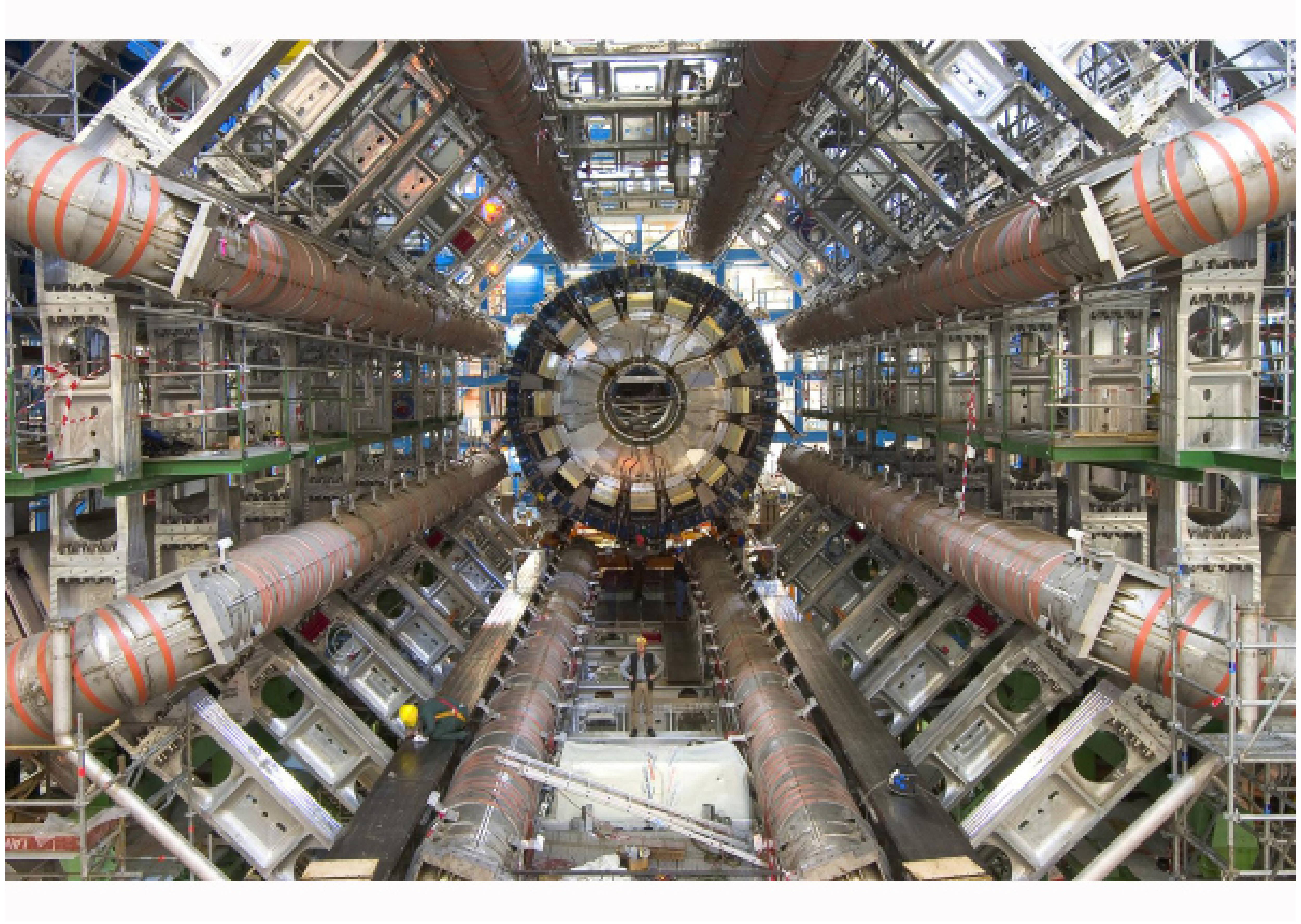
10-100x faster



1 year ~ 10 PB



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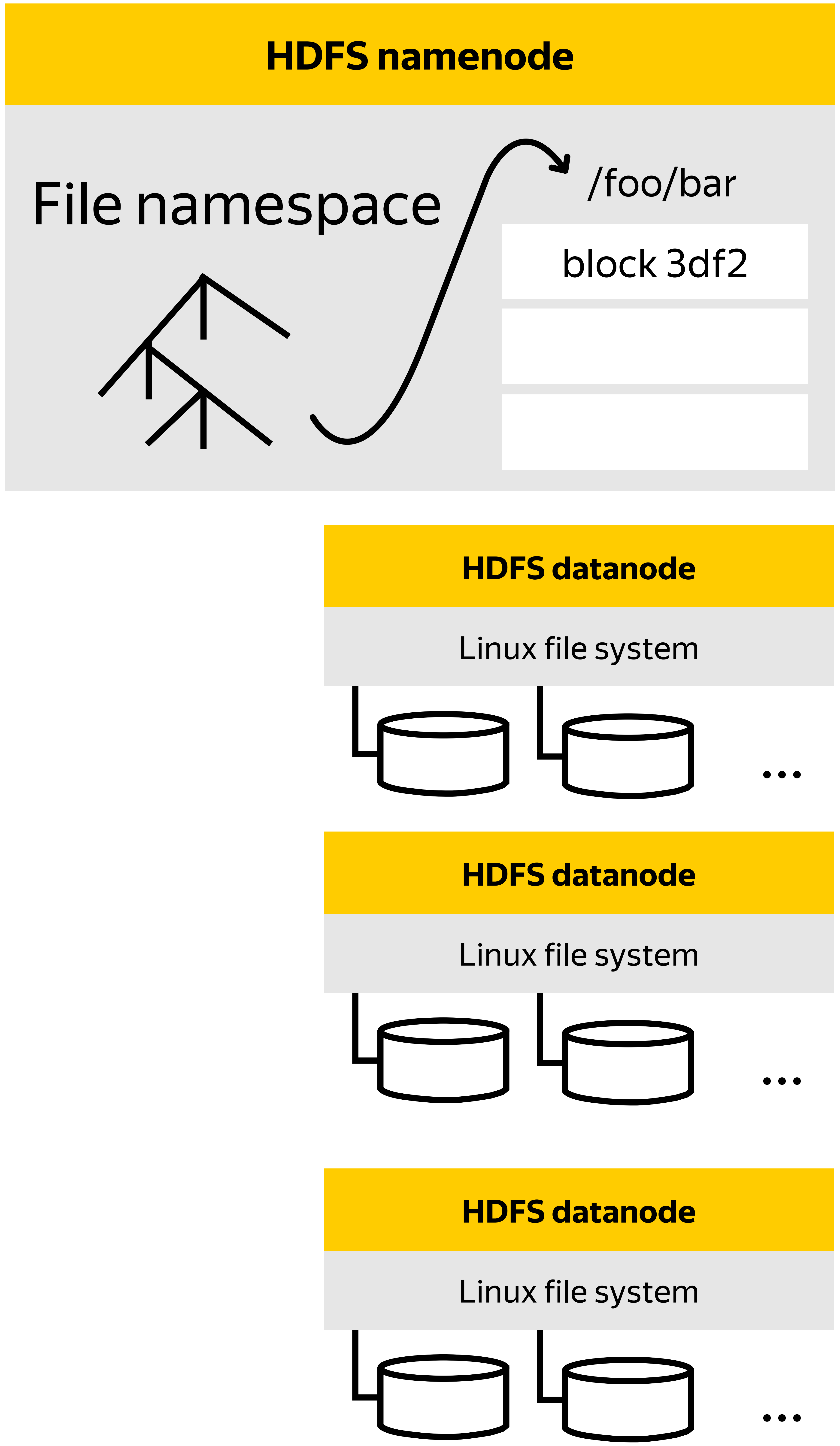

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HDFS datanode

Linux file system

...

HDFS datanode

Linux file system

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HDFS datanode

Linux file system

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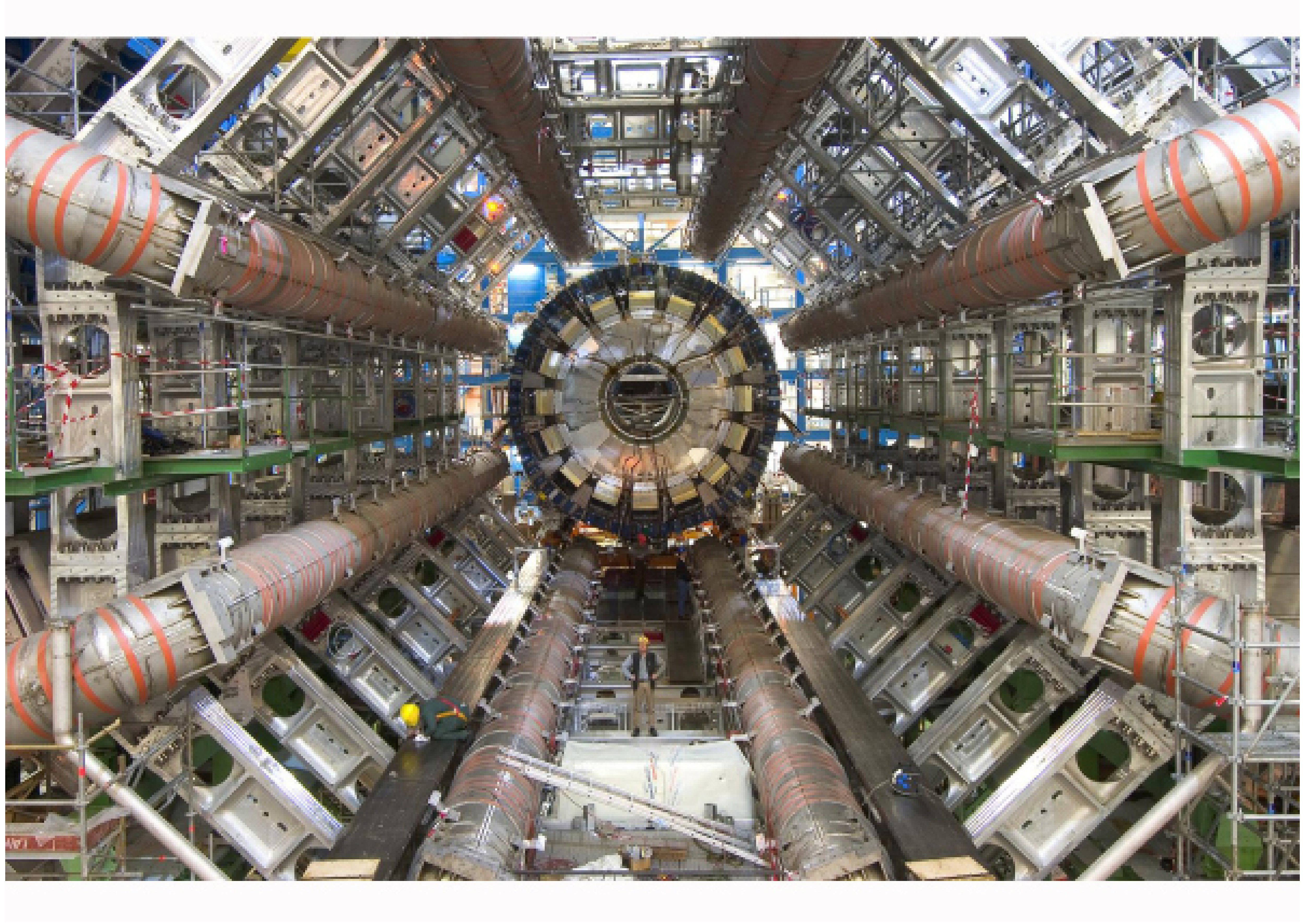
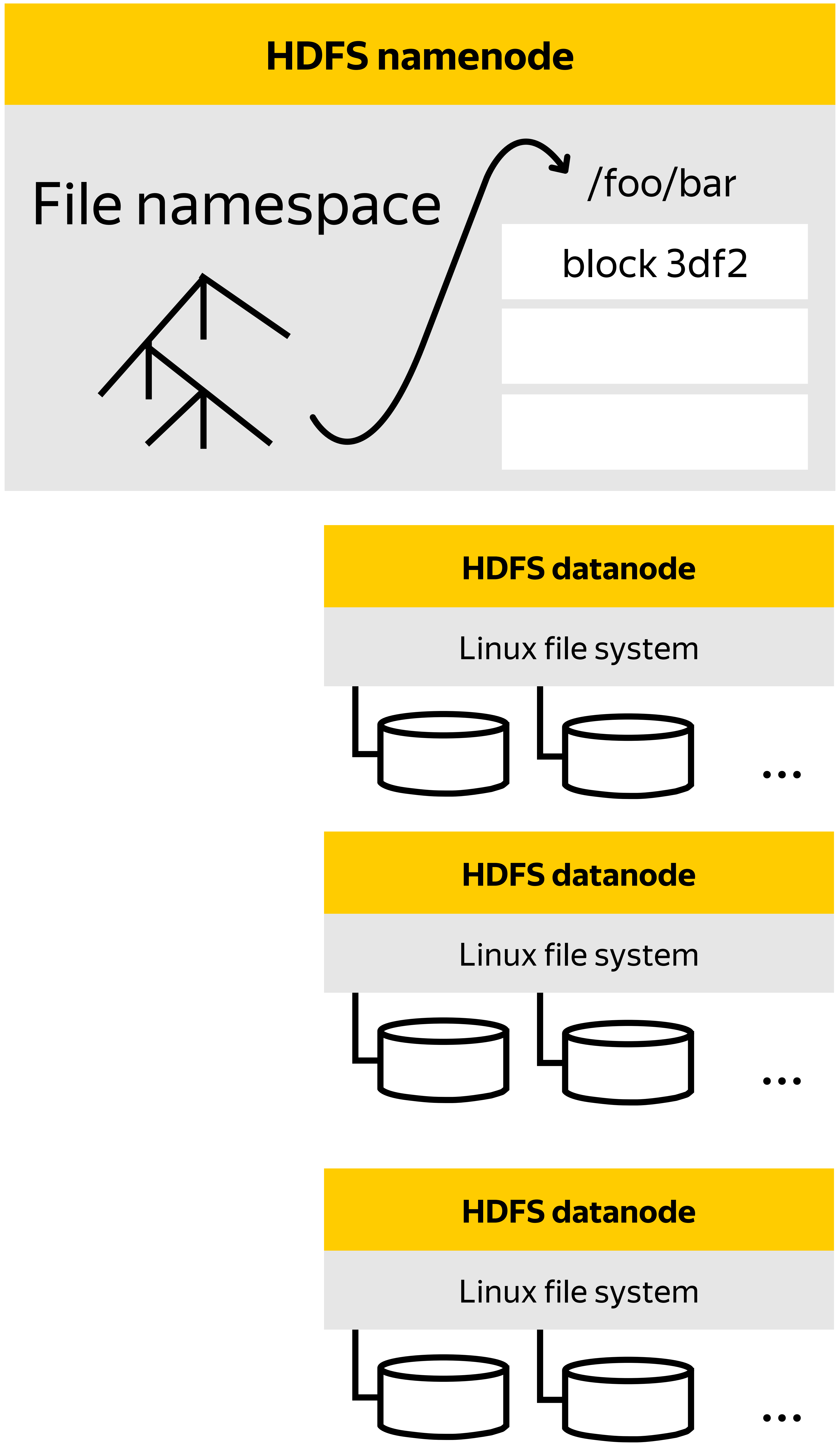


1 year ~ 10 PB

10 PB / 2 TB * 3 ~ 15 k



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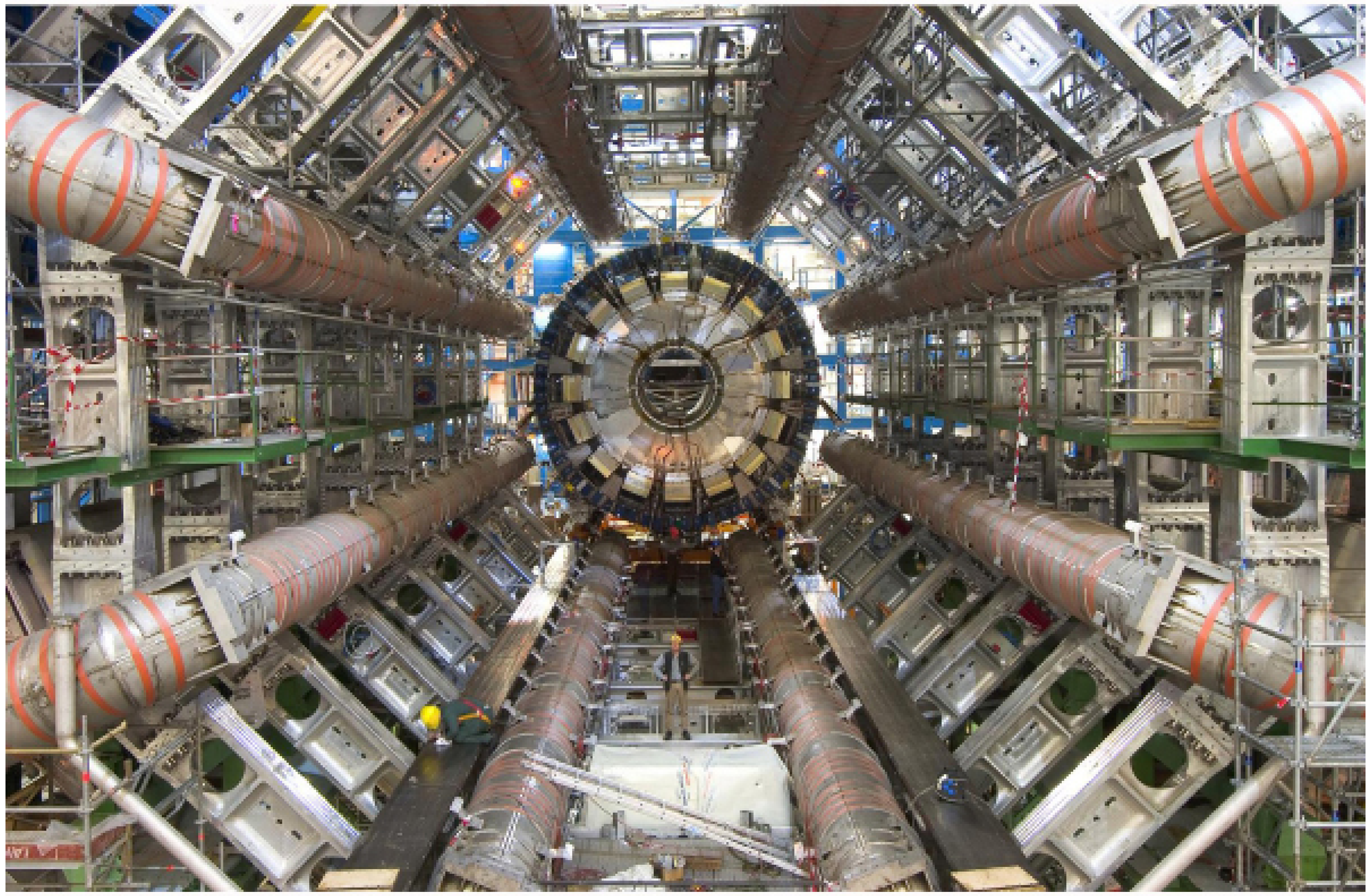

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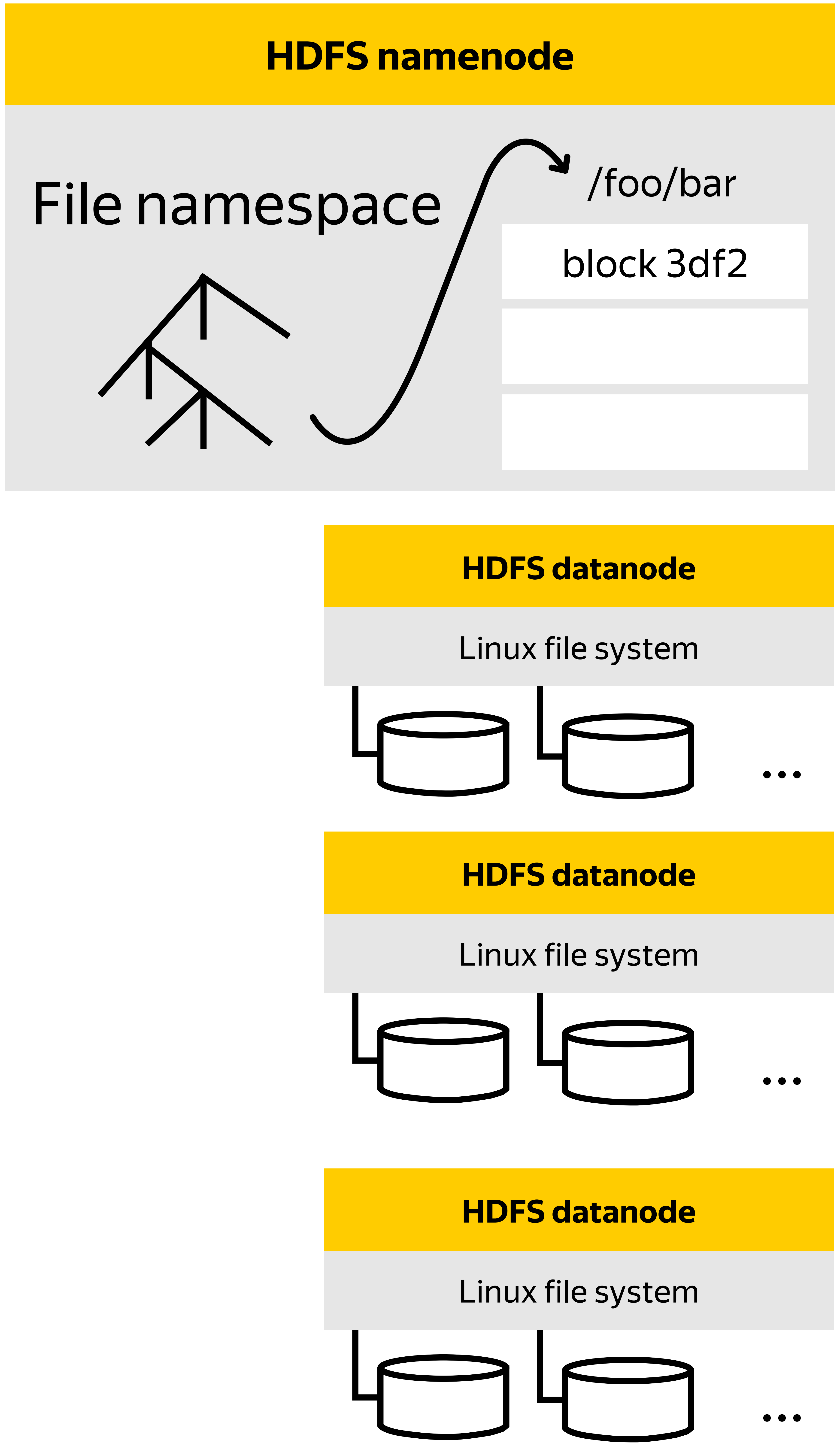
RAM ???



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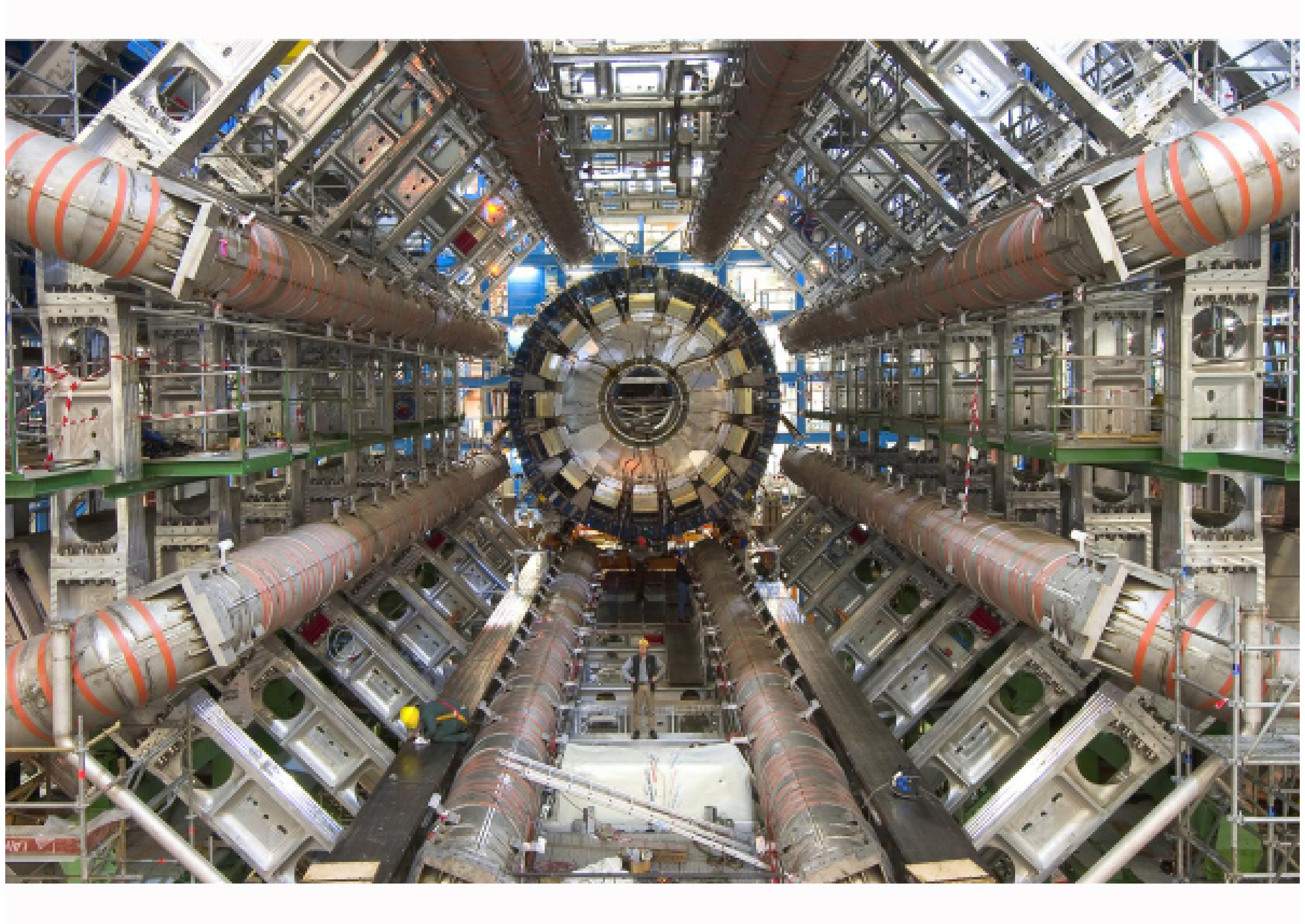

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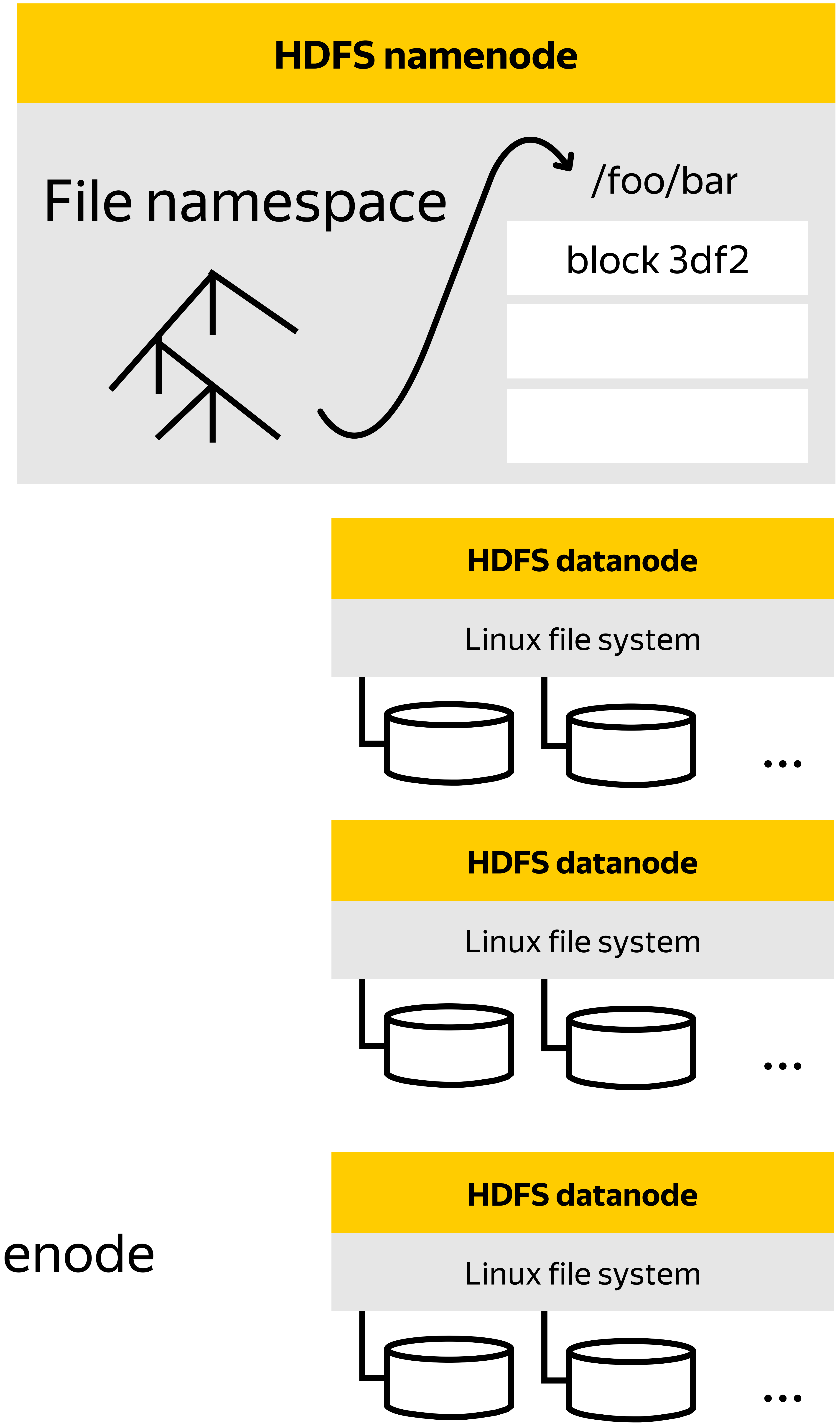
150 B - average block size on Namenode

https://issues.apache.org/jira/browse/HADOOP-1687



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Linux file system

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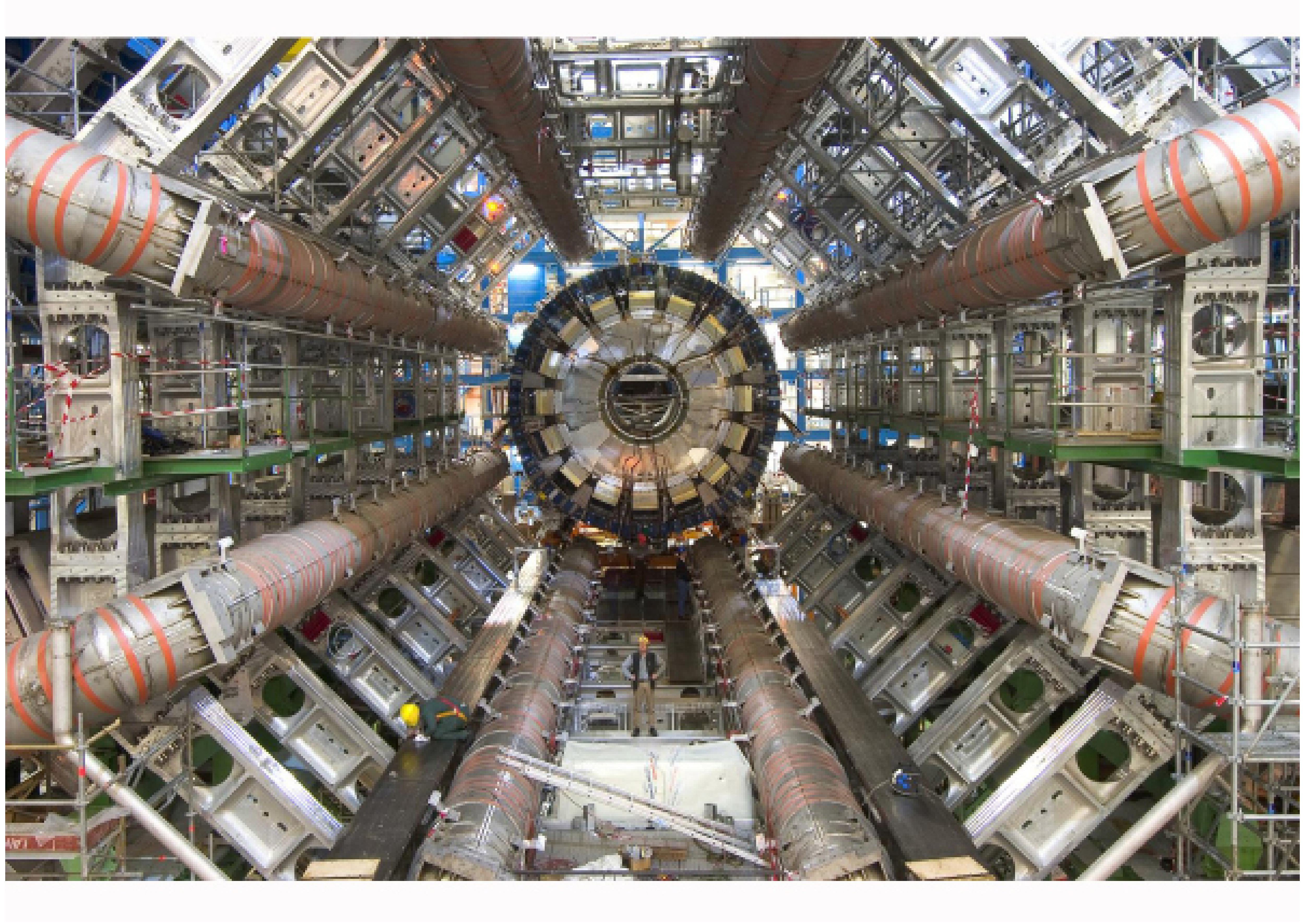

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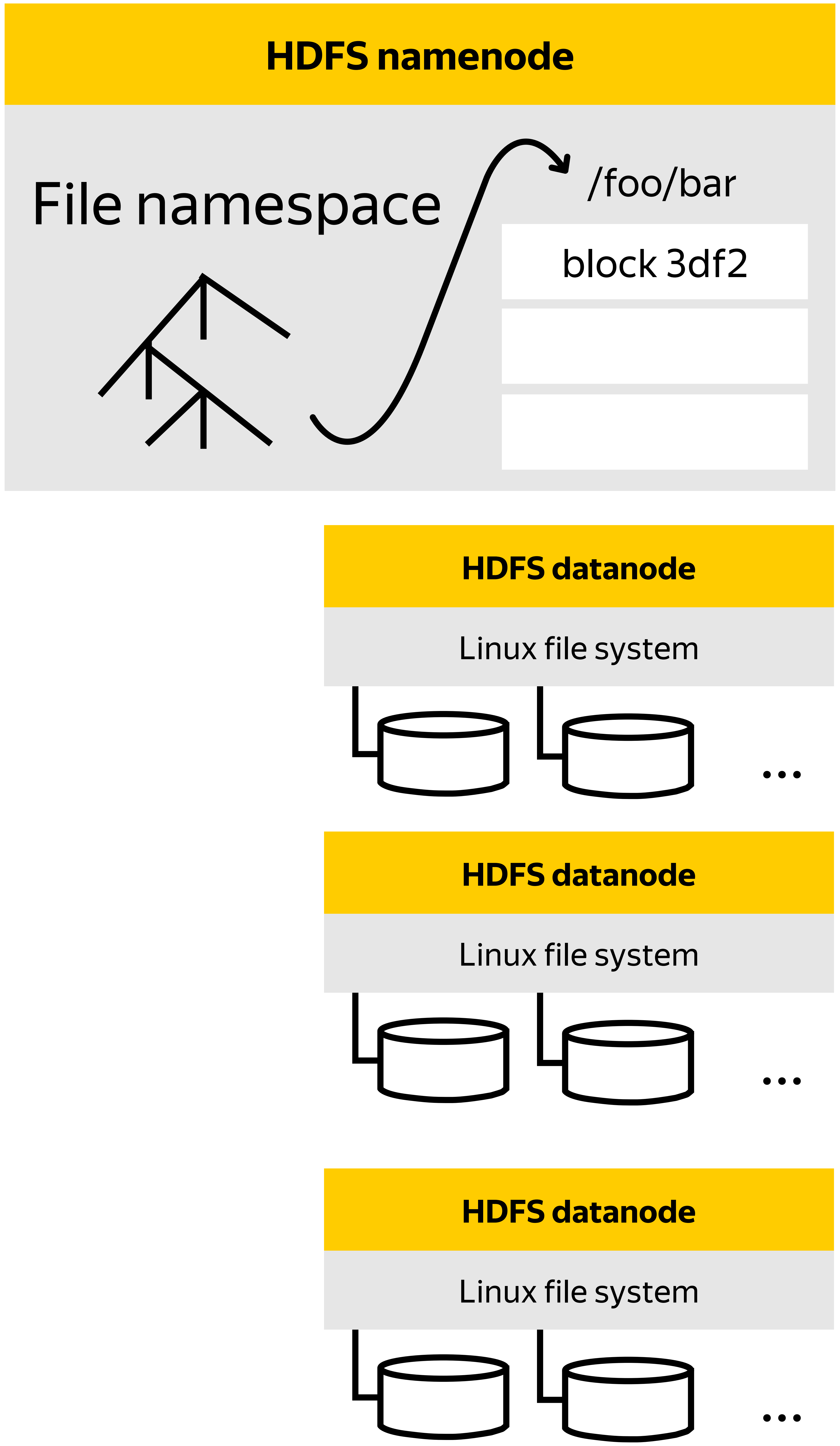
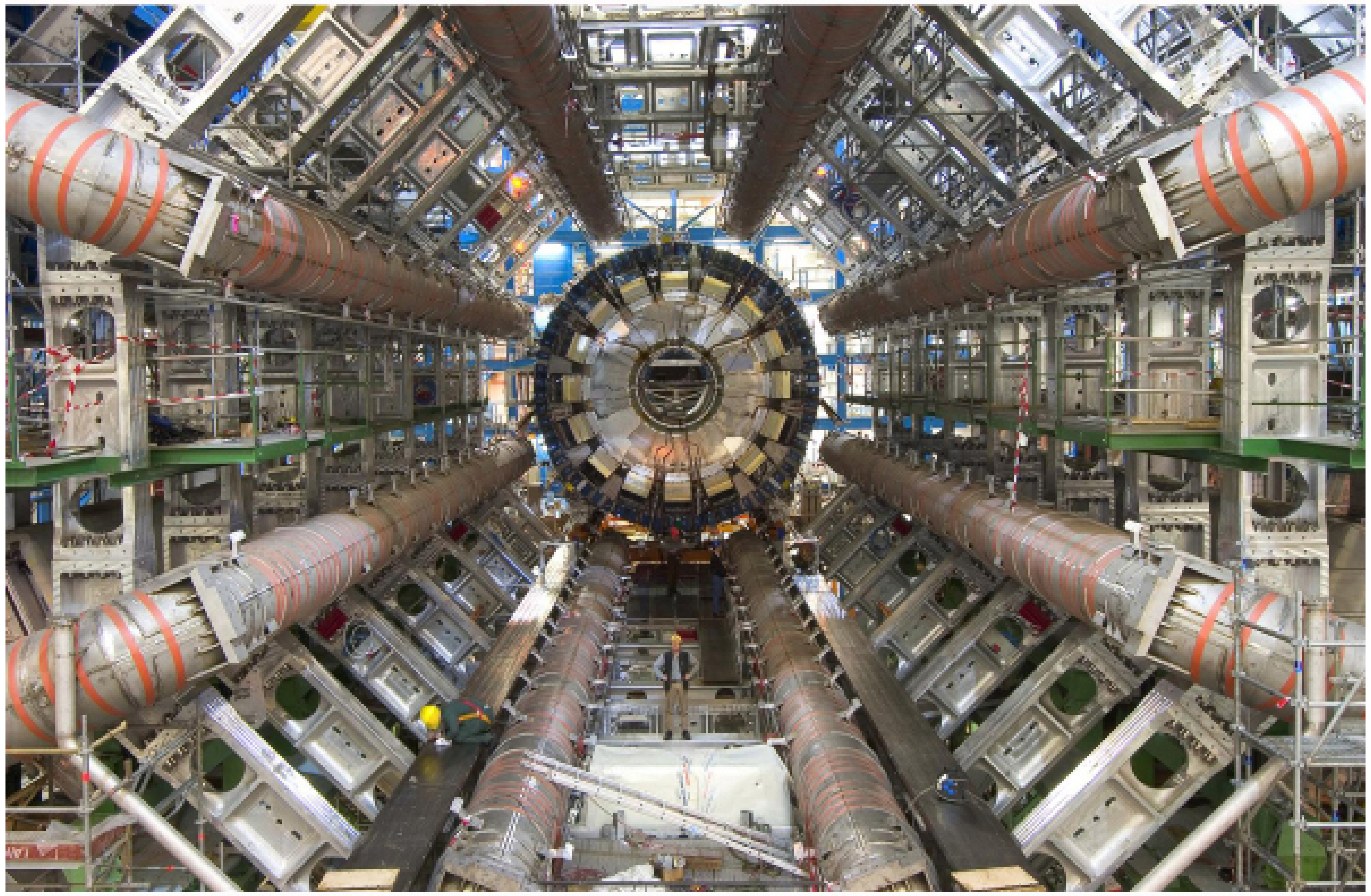
RAM

10 PB / 128 MB * 3 * 150 B ~ 35 GB





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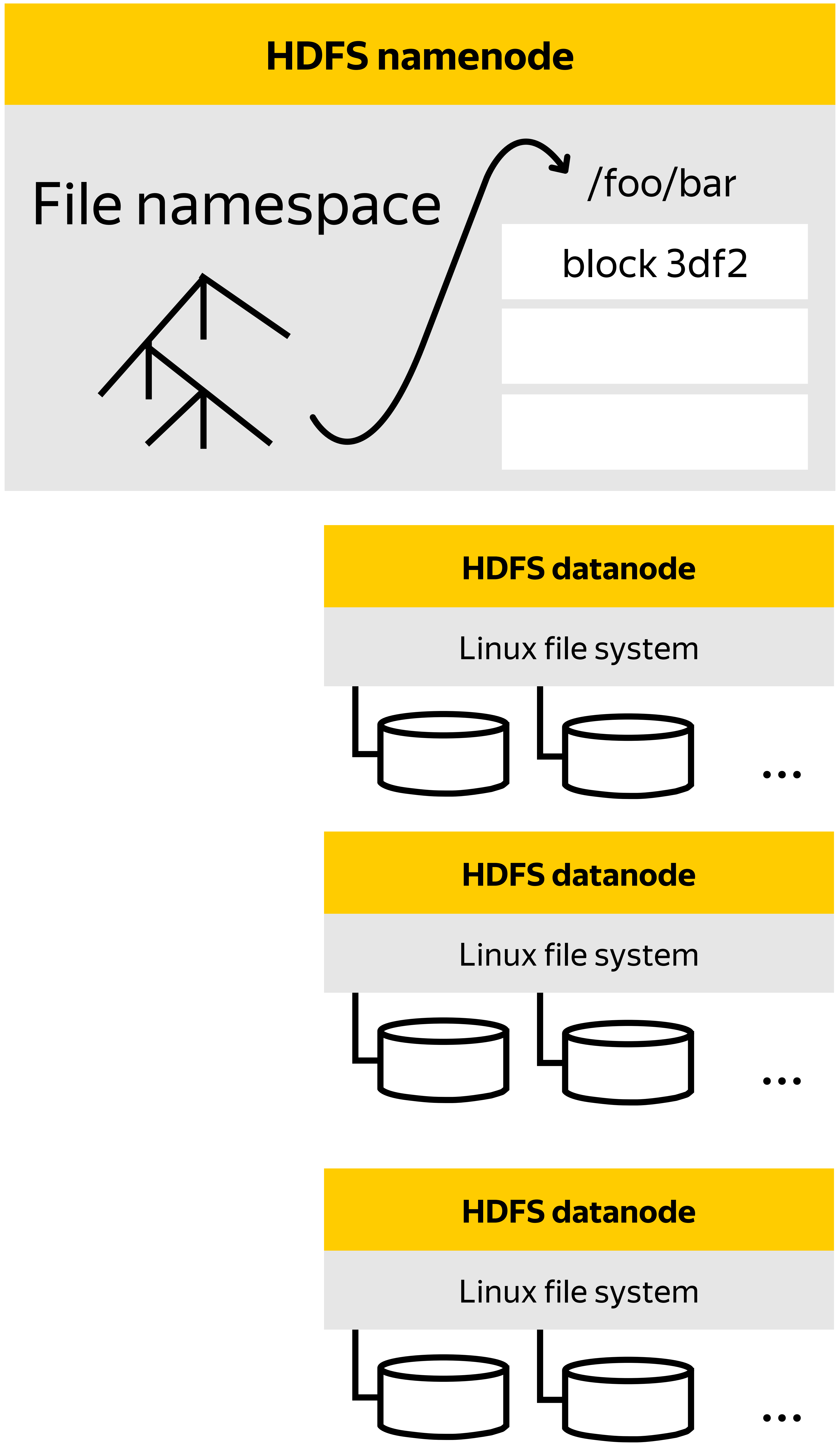
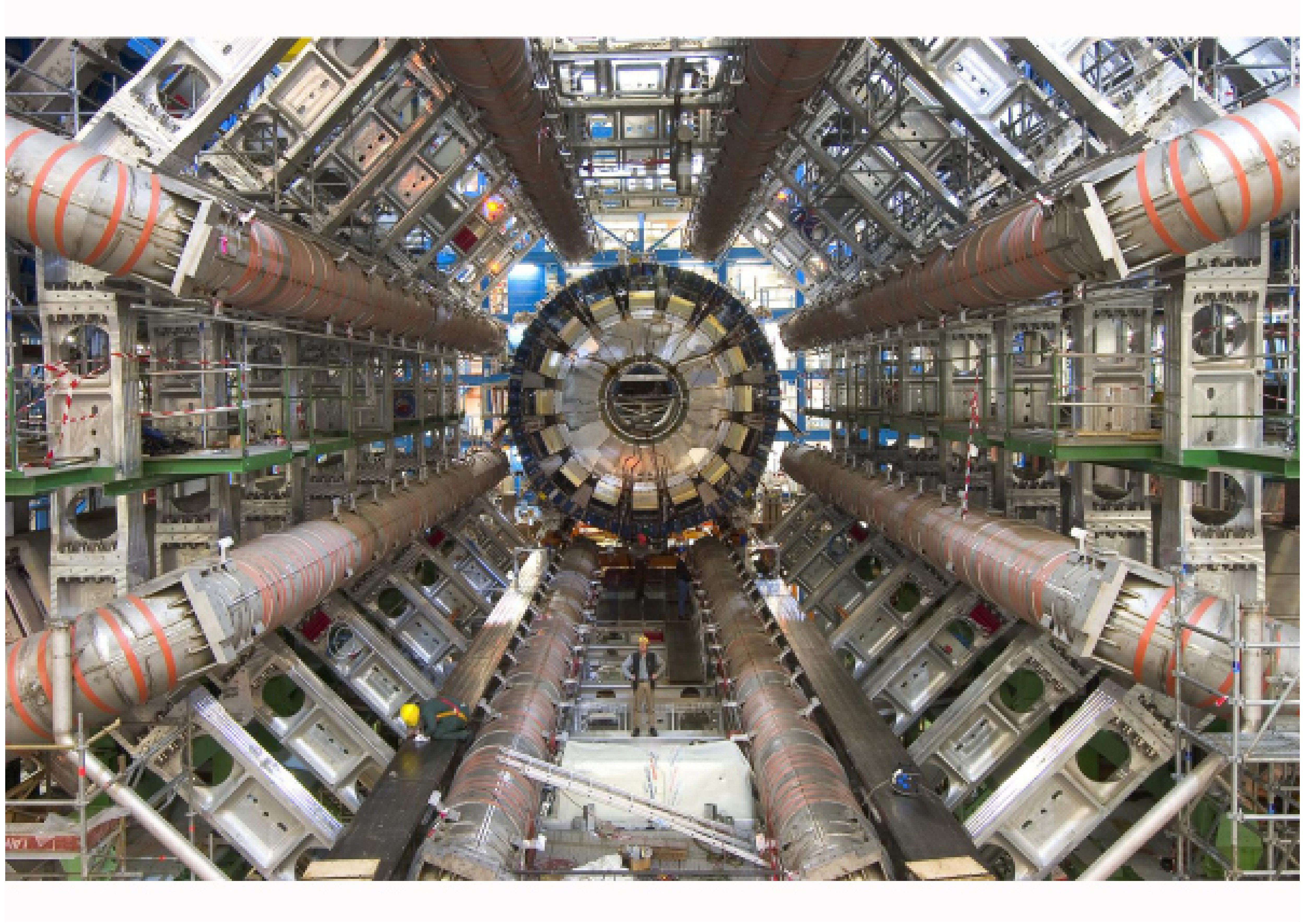
small files problem





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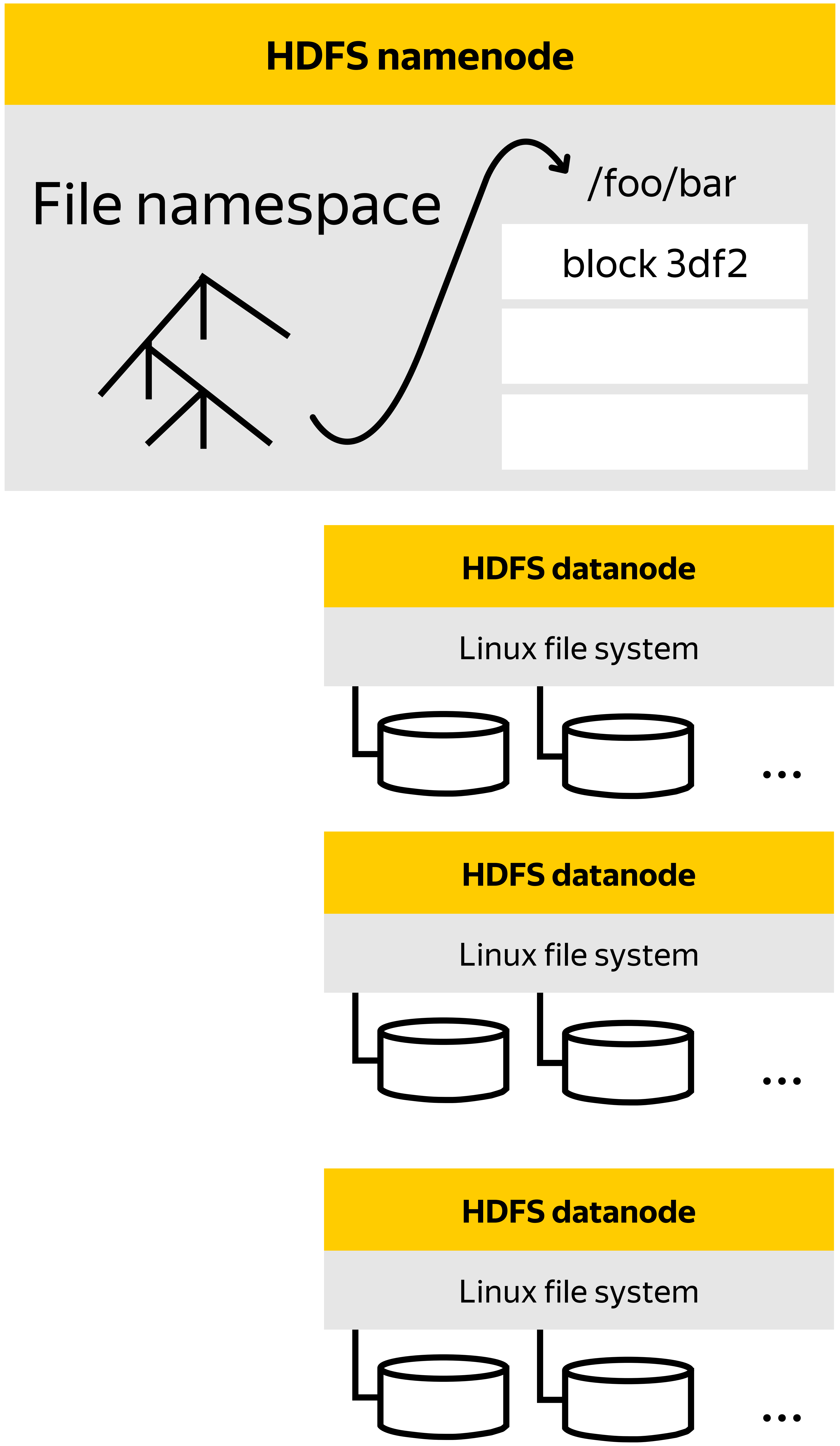
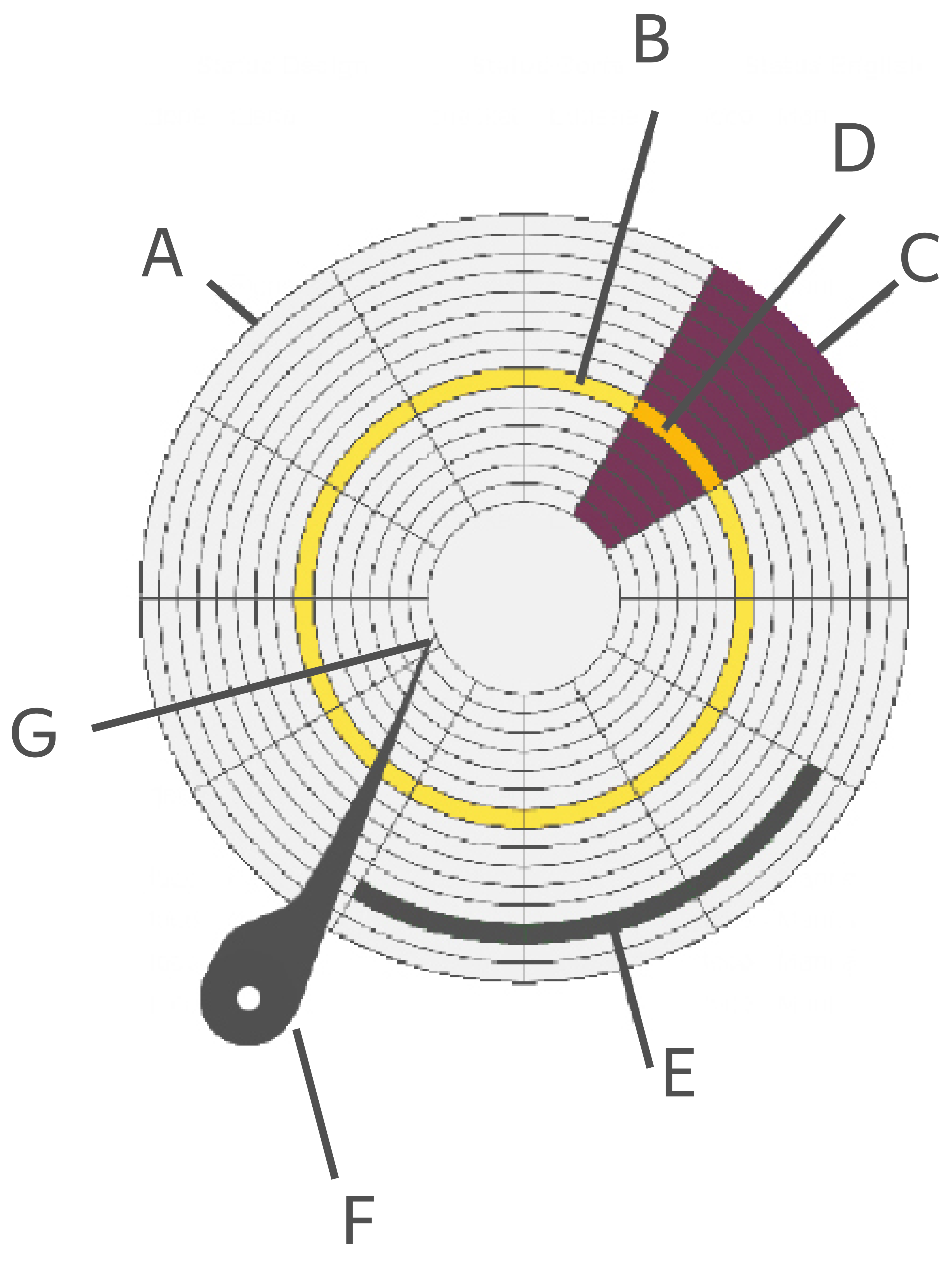
**default block size**

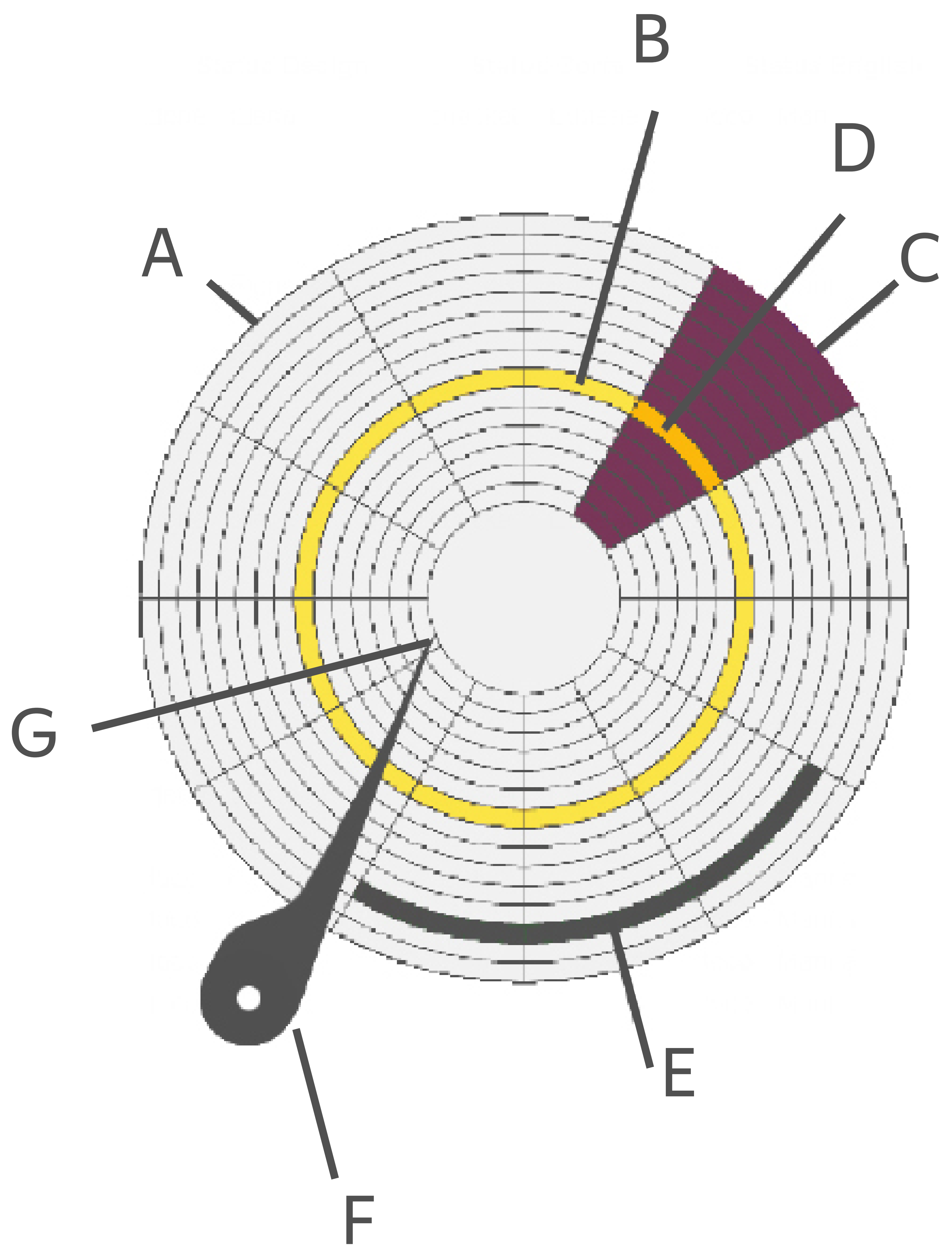


# Default Block Size



A — Platter
B — Track
C — Disk Sector
D — Track Sector
E — Cluster
F — Actuator Arm
G — Head

# Default Block Size

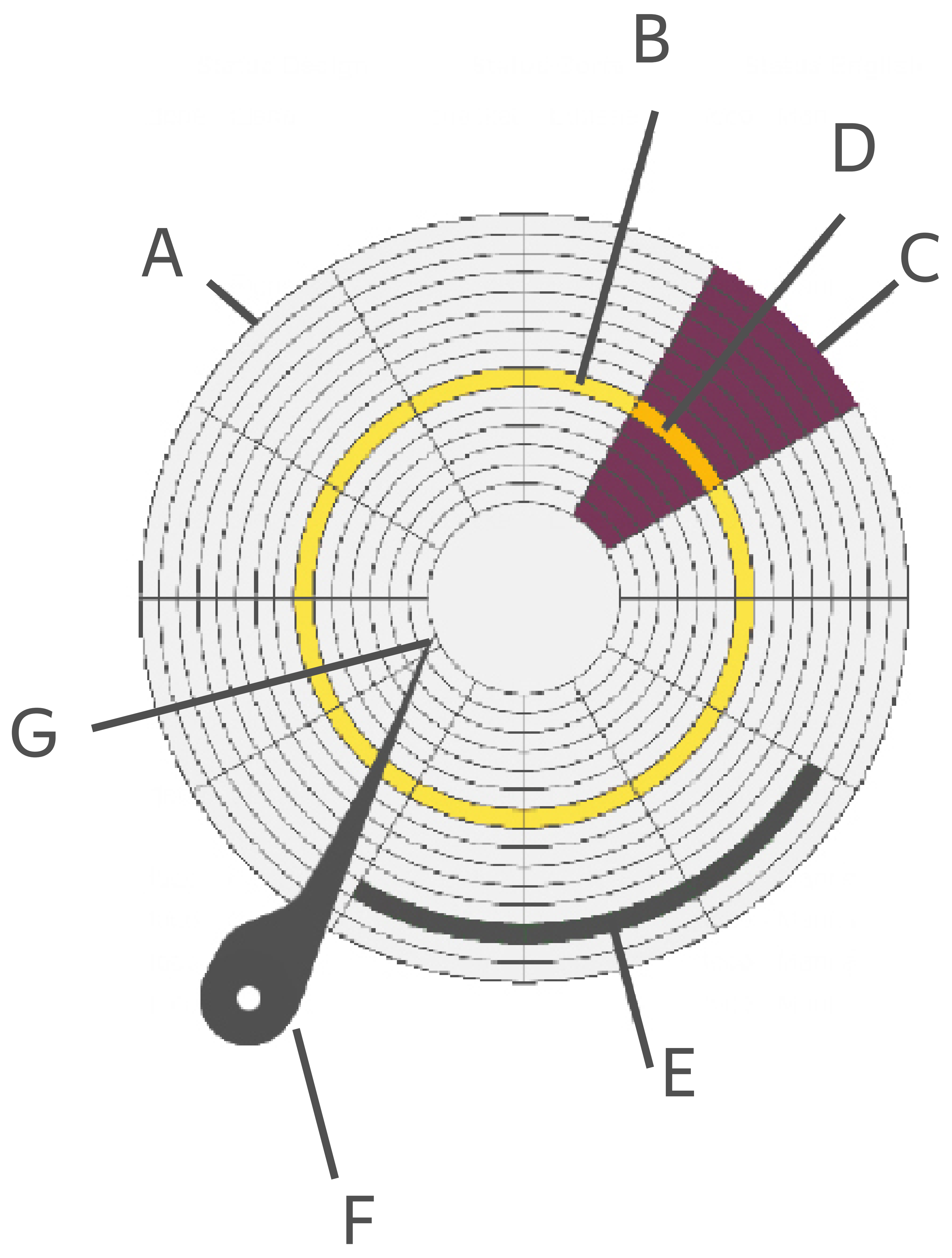


Samsung 940 PRO SSD:

* reading speed - 3.5 GB/sec

* 128 MB - 30-40 ms

# Default Block Size



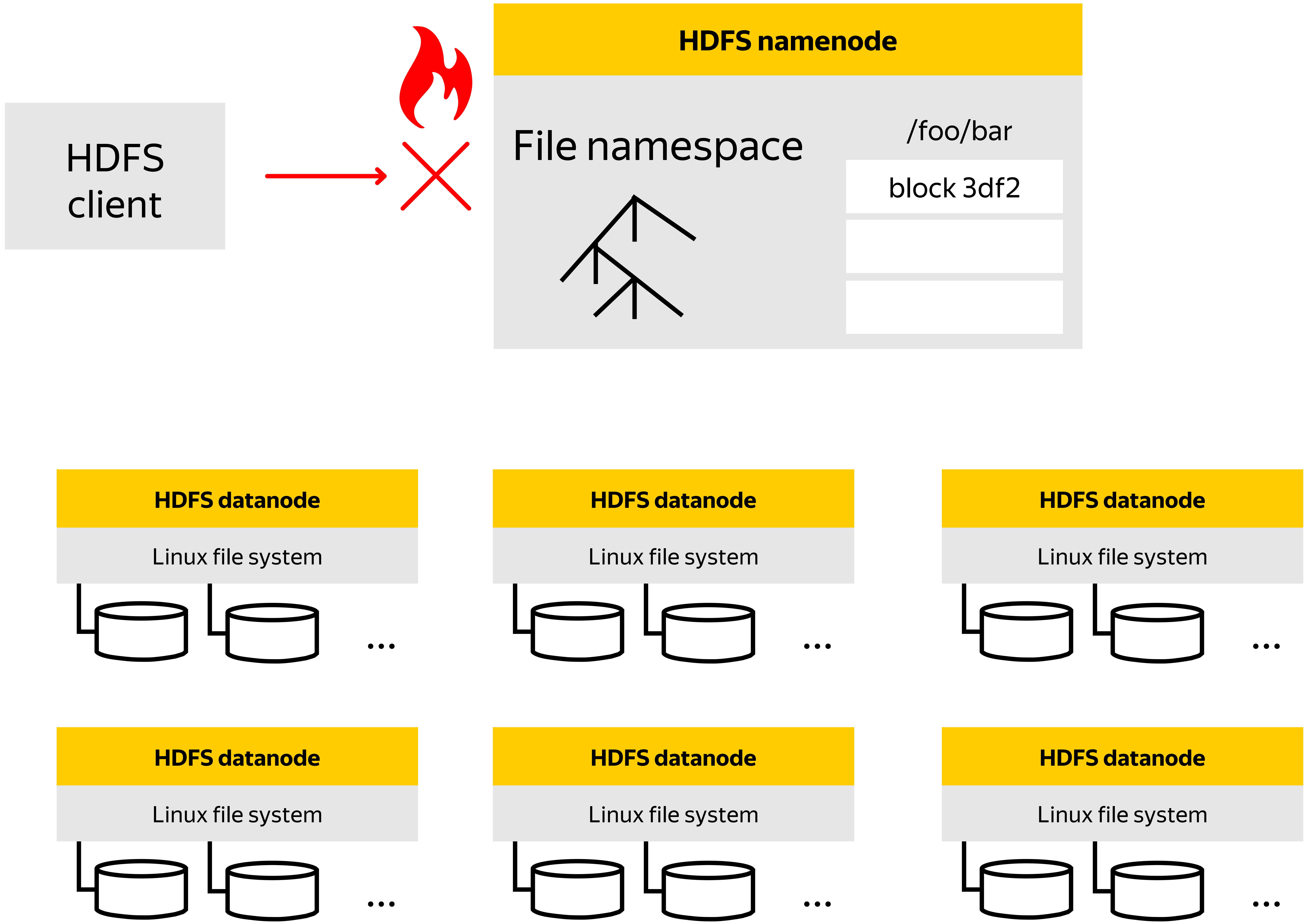
Samsung 940 PRO SSD:

* reading speed - 3.5 GB/sec

* 128 MB - 30-40 ms

seek time: 0.2-0.8 ms

1%


HDFS client
HDFS namenode
File namespace
/foo/bar
block 3df2
HDFS datanode
Linux file system
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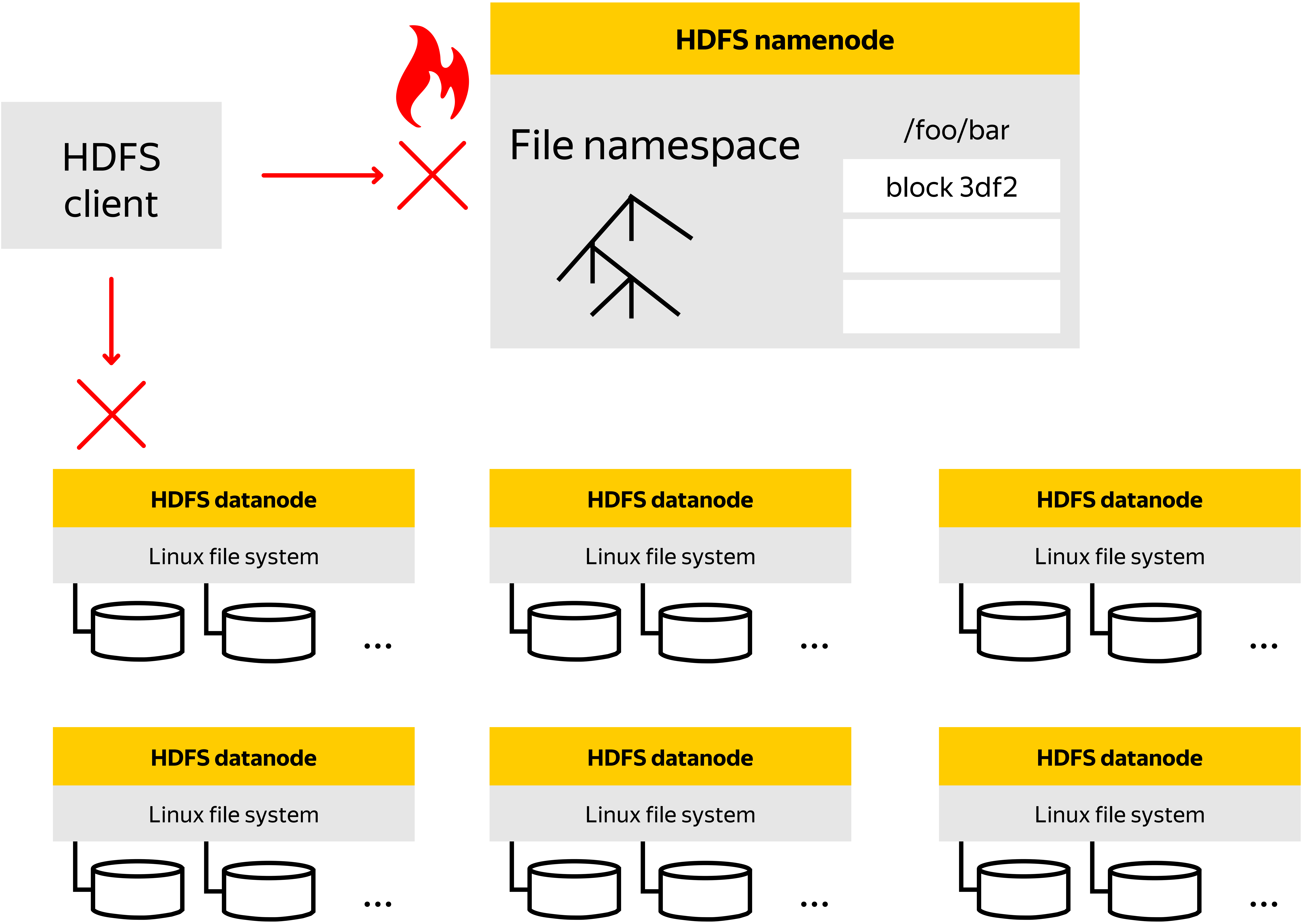
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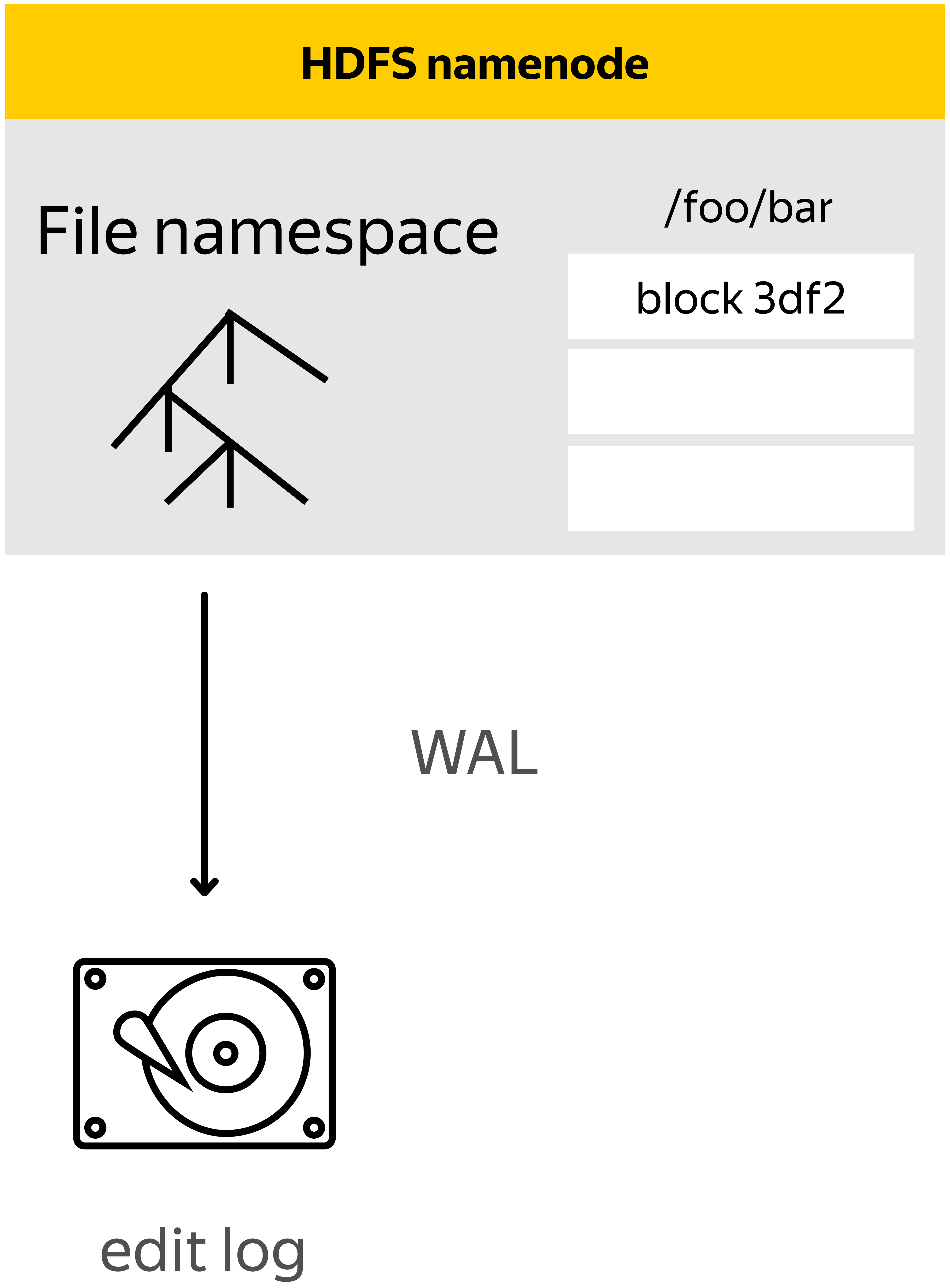

HDFS namenode

File namespace

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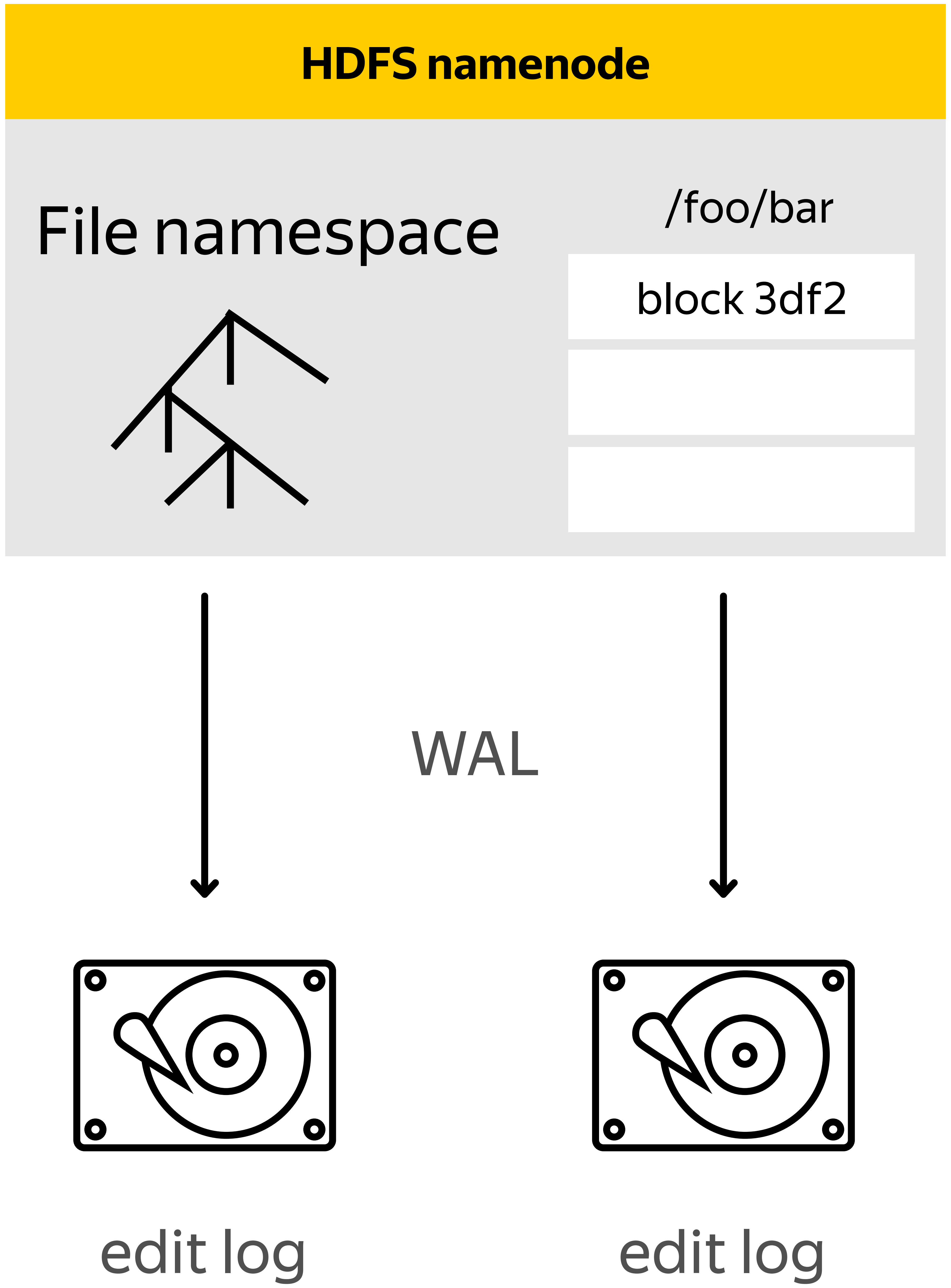
block 3df2

WAL

edit log



HDFS namenode

File namespace

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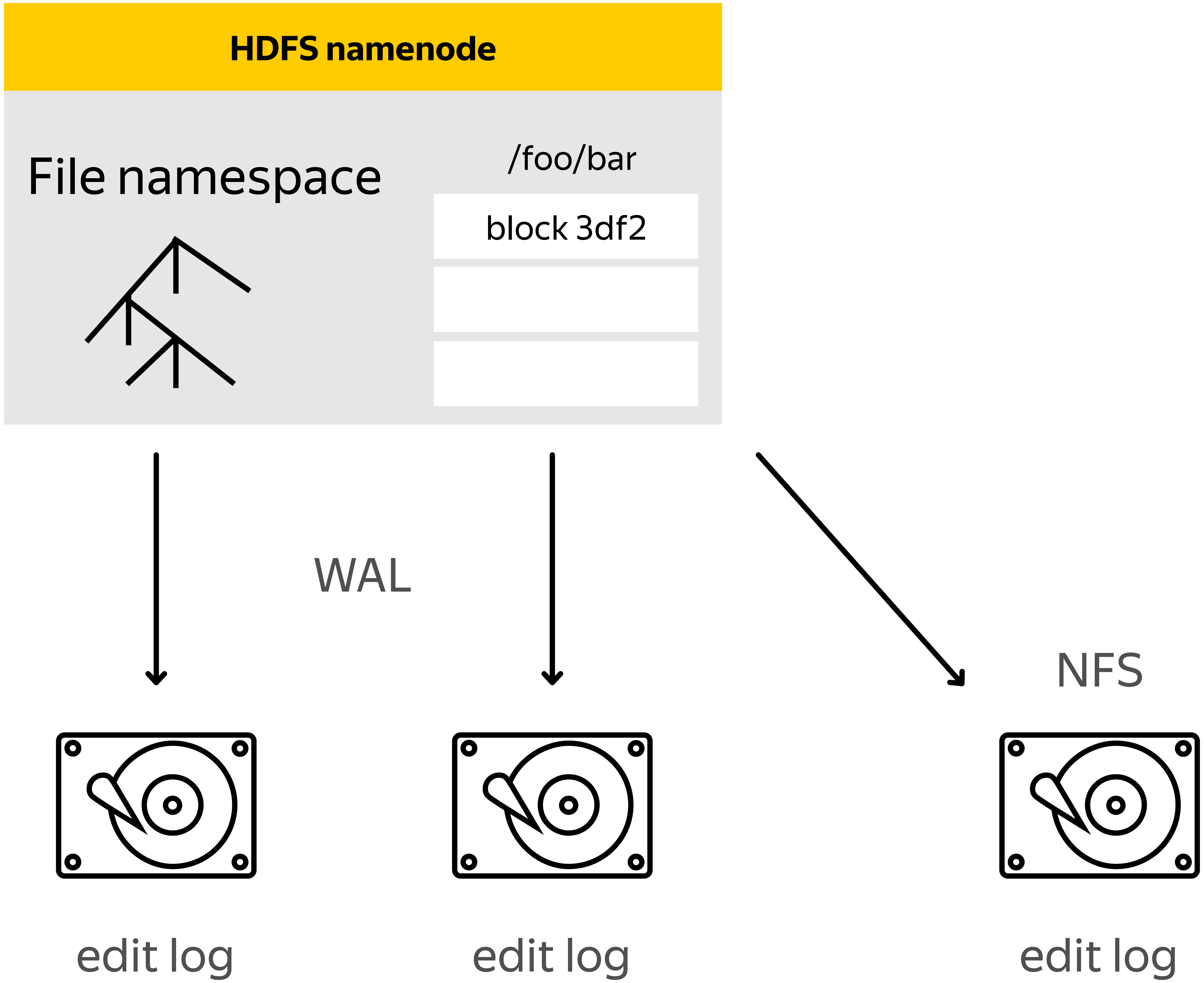
block 3df2

WAL

edit log

edit log



HDFS namenode

File namespace

/foo/bar

block 3df2

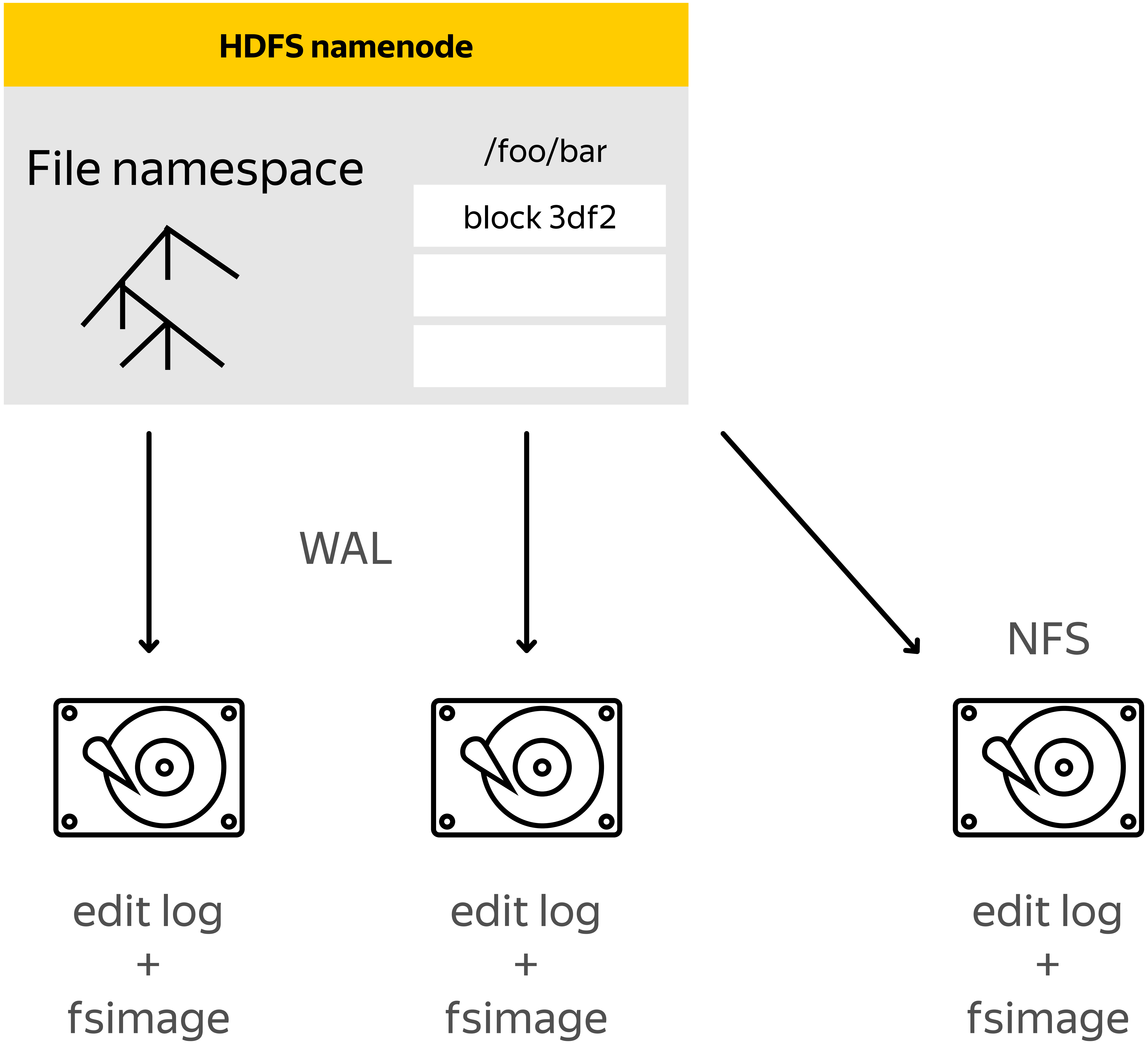
WAL

NFS

edit log

edit log

edit log



HDFS namenode

File namespace

/foo/bar

block 3df2

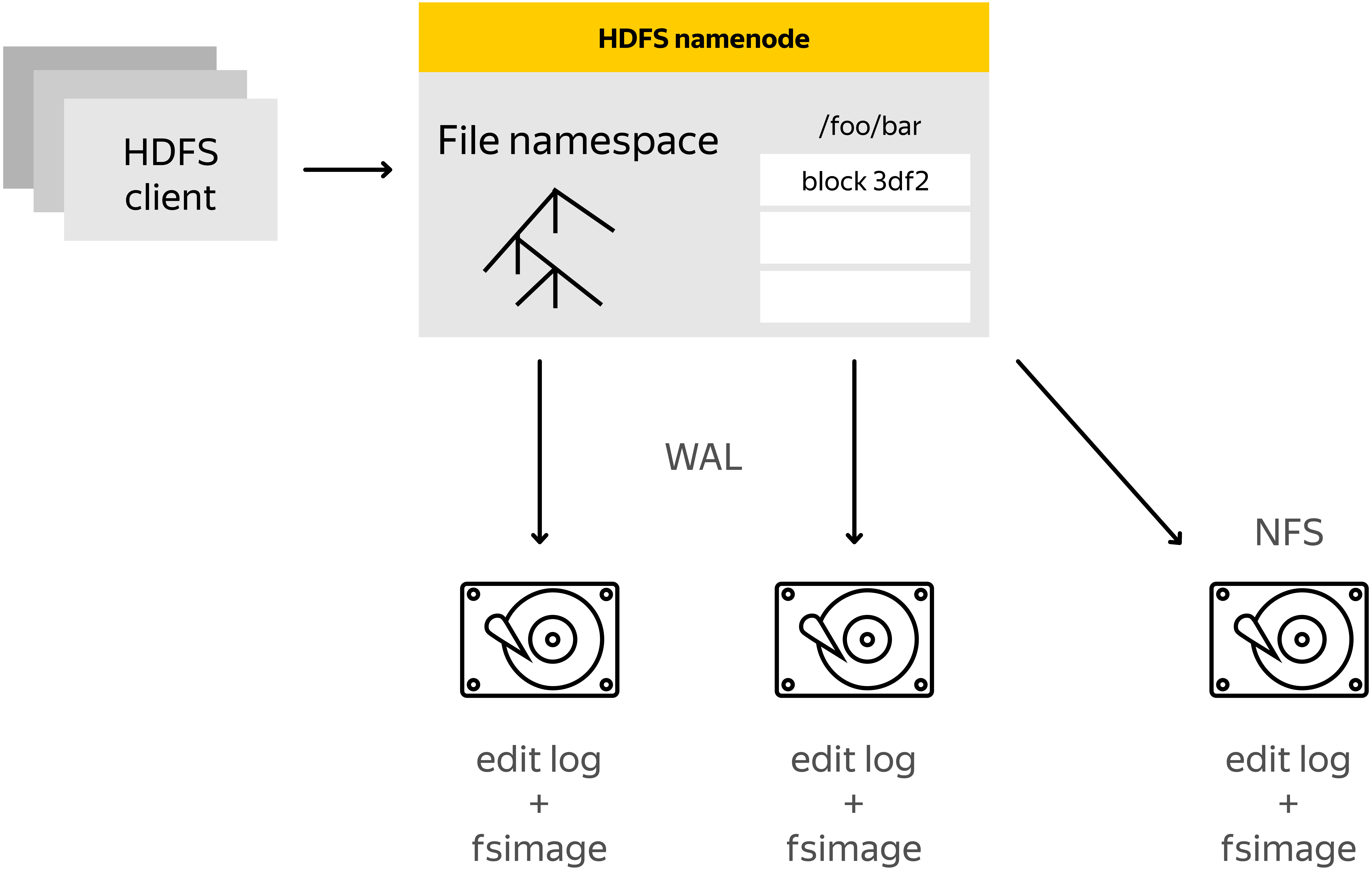
WAL

NFS

edit log
+
fsimage

edit log
+
fsimage

edit log
+
fsimage


HDFS client
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NFS
edit log + fsimage
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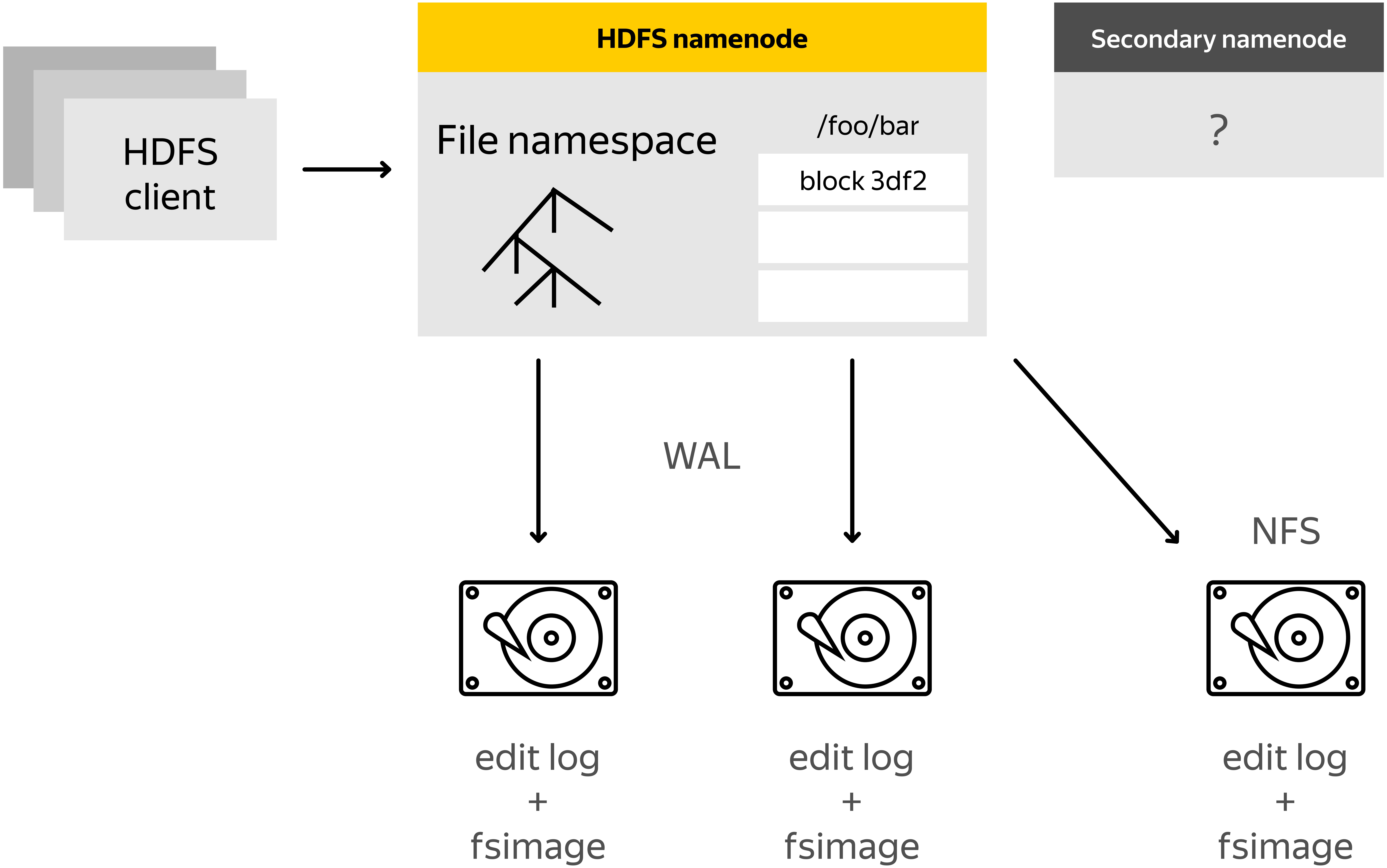


HDFS client

HDFS namenode

File namespace

/foo/bar

block 3df2

Secondary namenode

?

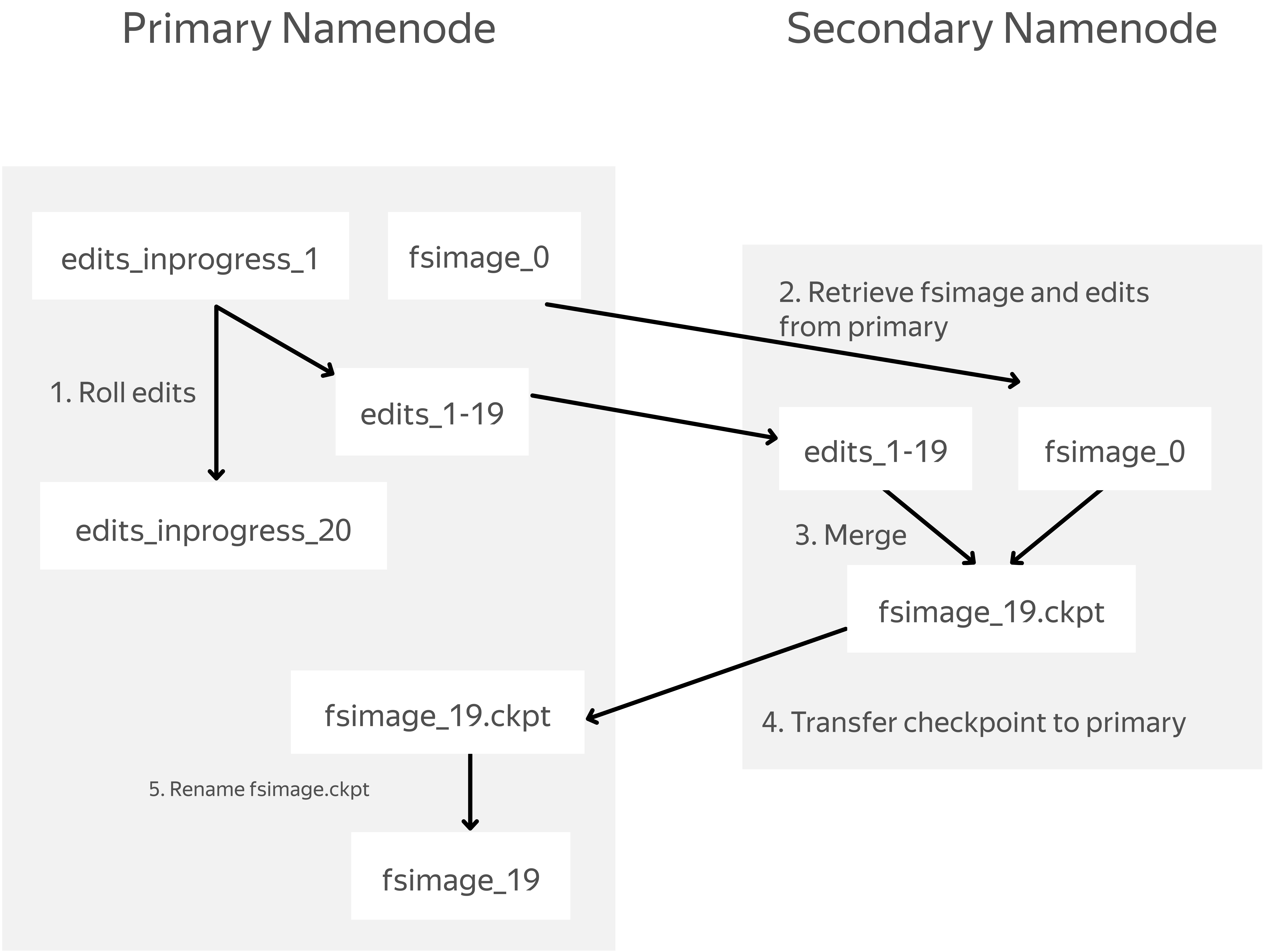
WAL

NFS

edit log
+
fsimage

edit log
+
fsimage

edit log
+
fsimage



Primary Namenode

Secondary Namenode

edits_inprogress_1

fsimage_0

1. Roll edits

edits_1-19

edits_inprogress_20

2. Retrieve fsimage and edits from primary

edits_1-19

fsimage_0

3. Merge

fsimage_19.ckpt

4. Transfer checkpoint to primary

fsimage_19.ckpt

5. Rename fsimage.ckpt

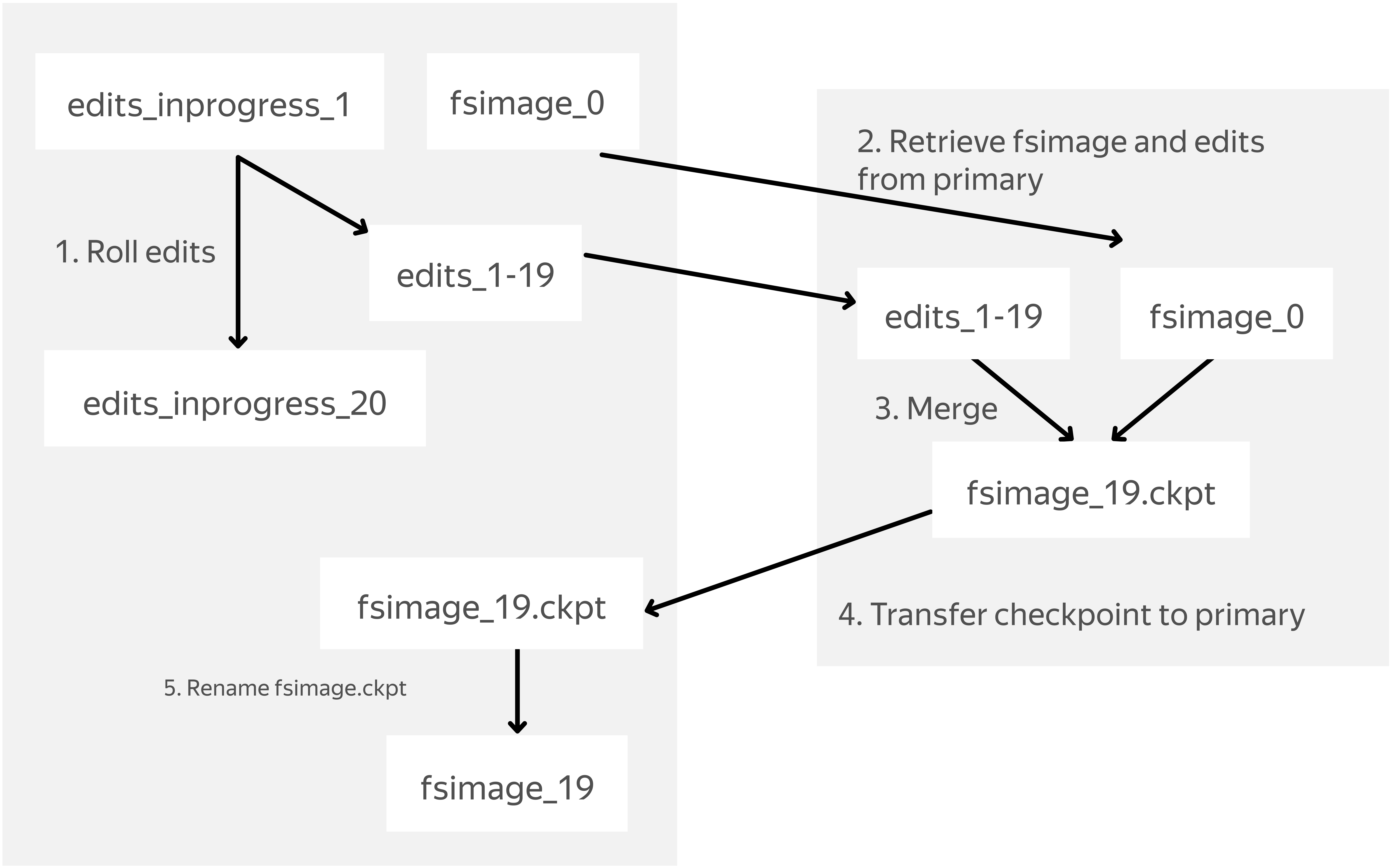
fsimage_19

Primary Namenode

Secondary Namenode

= Checkpoint Namenode

≠ Backup Node



edits_inprogress_1

fsimage_0

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edits_1-19

edits_inprogress_20

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edits_1-19

fsimage_0

3. Merge

fsimage_19.ckpt

4. Transfer checkpoint to primary

fsimage_19.ckpt

5. Rename fsimage.ckpt

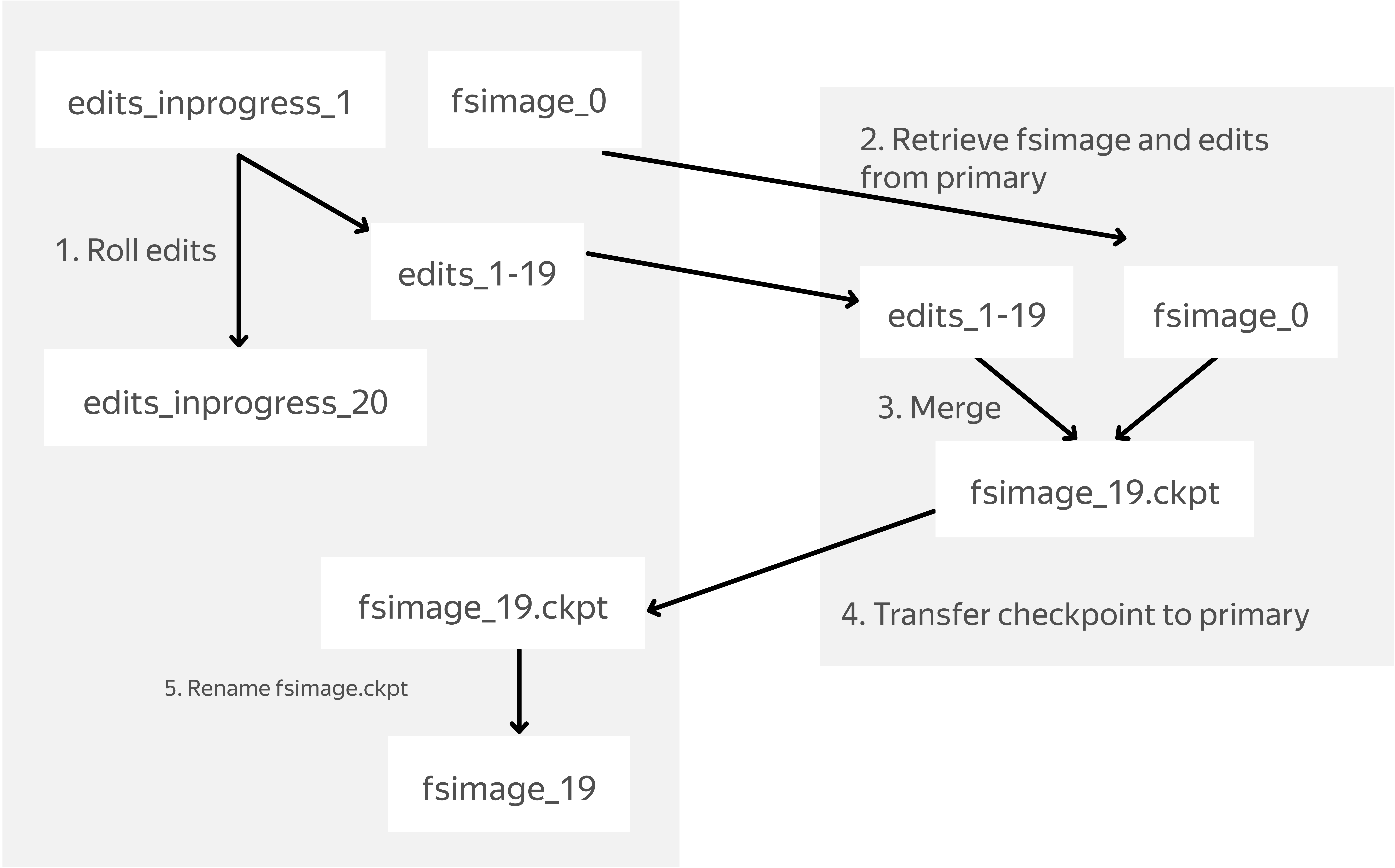
fsimage_19

## Primary Namenode

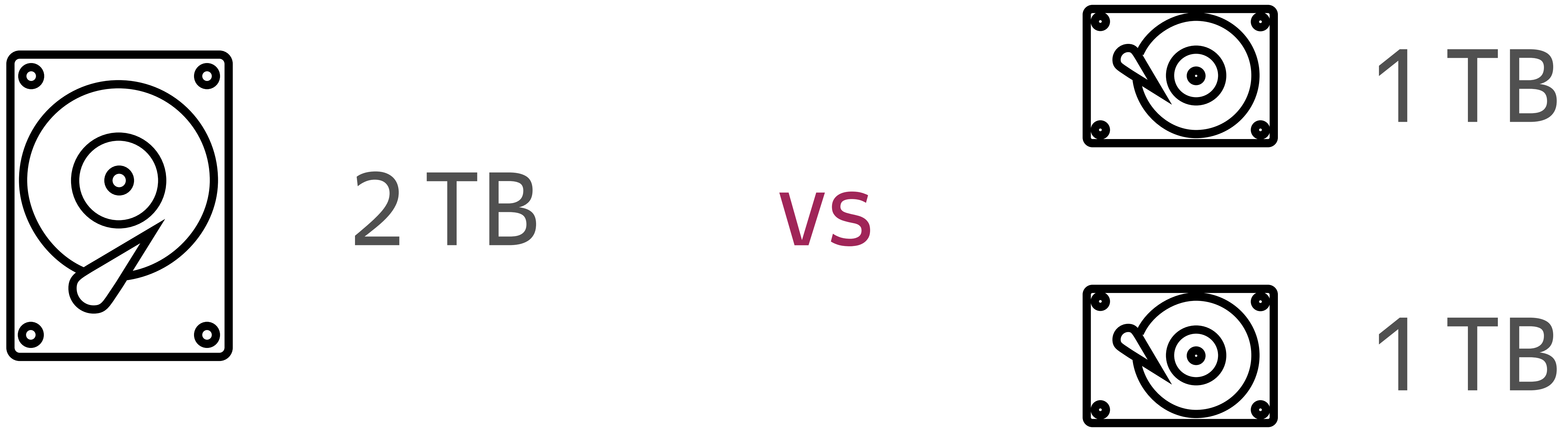
## Secondary Namenode

= Checkpoint Namenode

≠ Backup Node



https://issues.apache.org/jira/browse/HADOOP-4539



2 TB

vs

1 TB

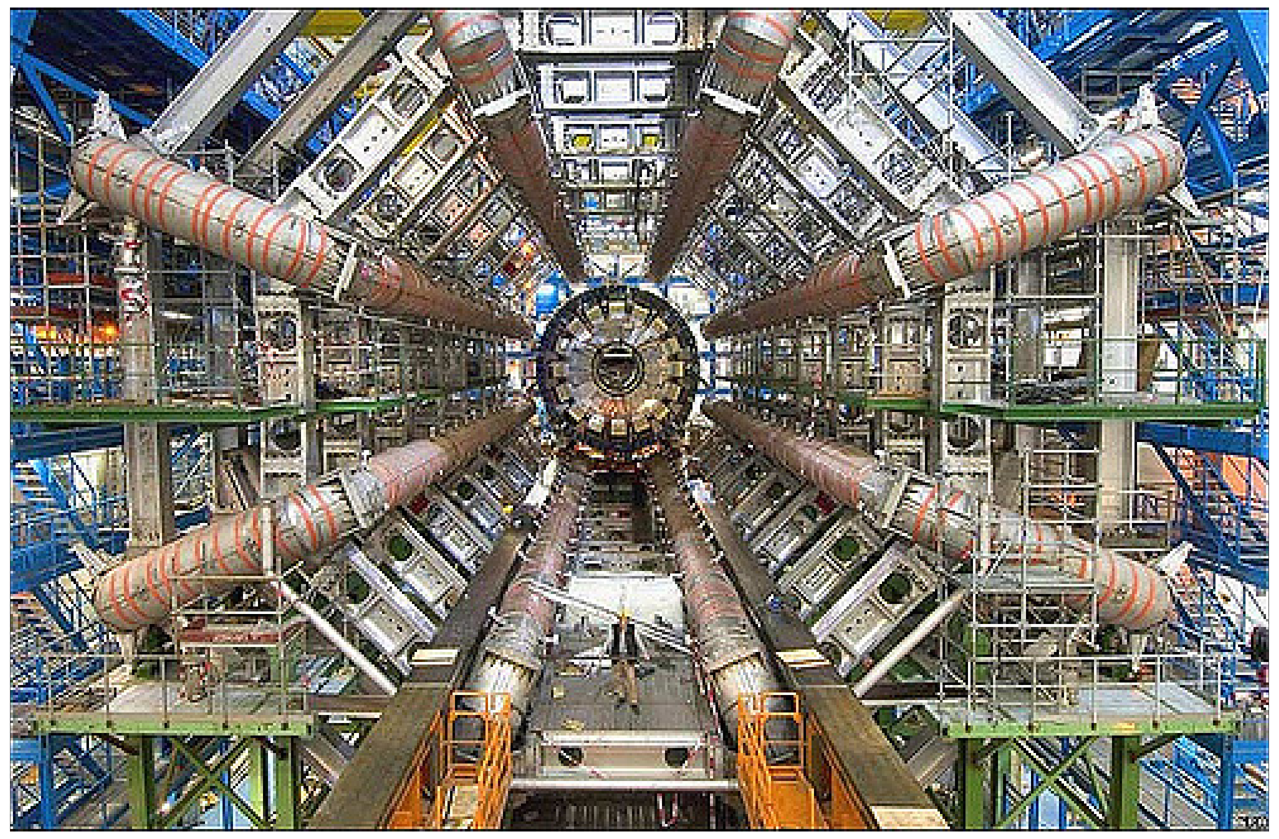
1 TB

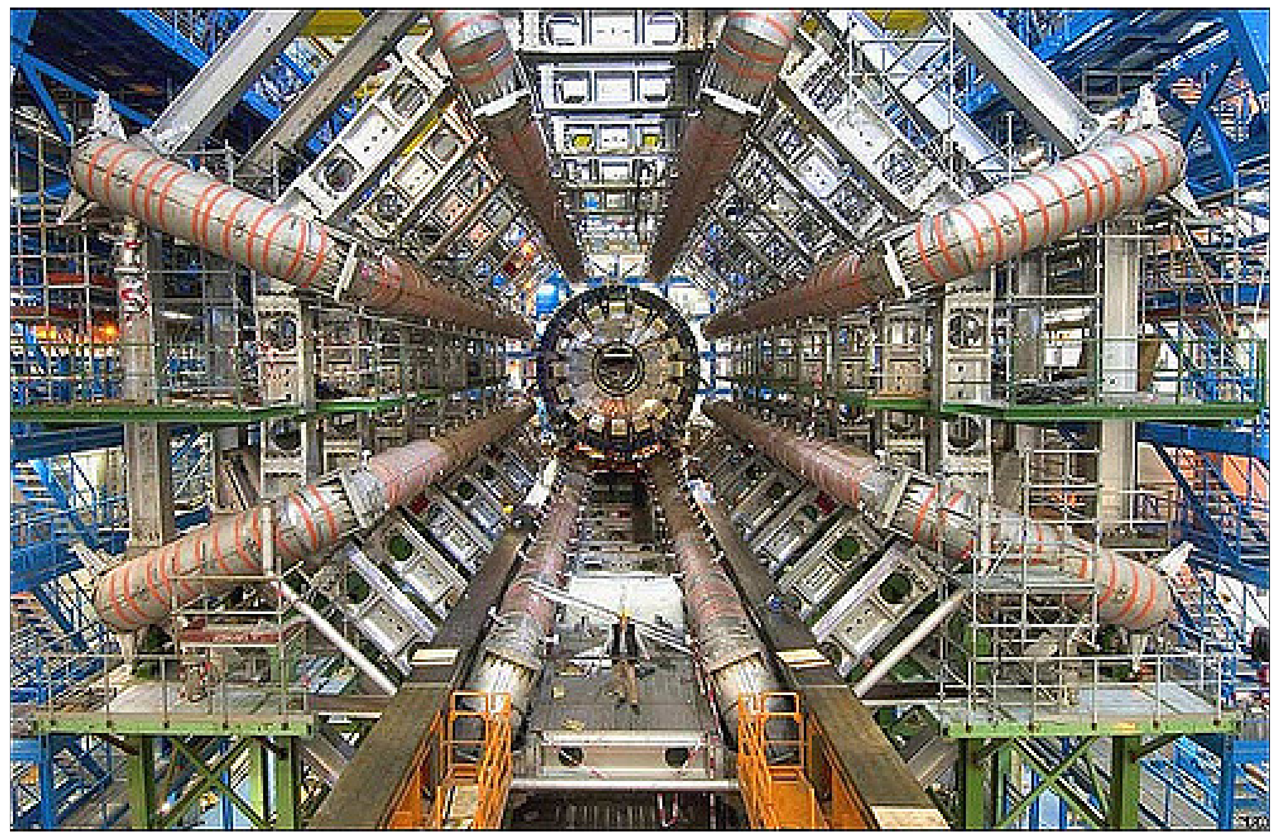
2 TB

vs

1 TB

1 TB





1 year ~ 10 PB

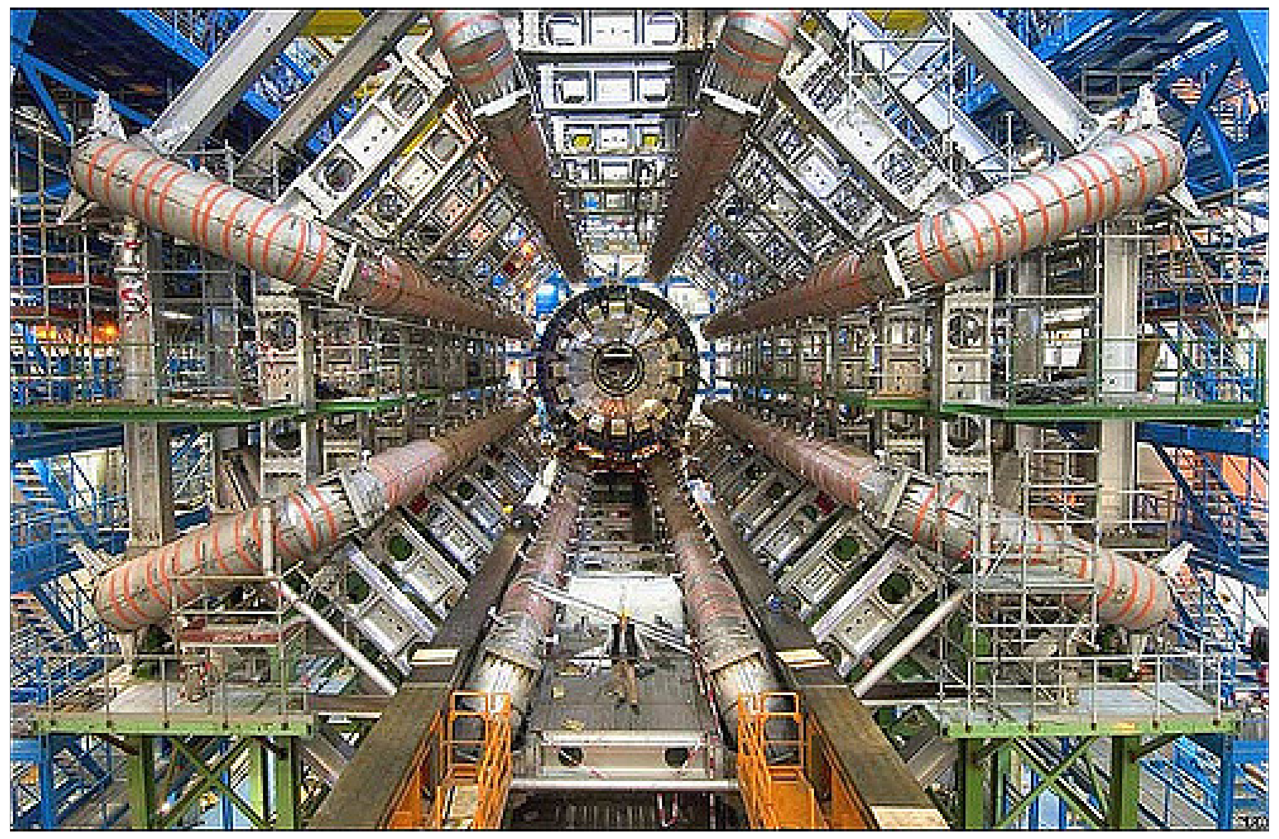
1 year ~ 5 PB + 5 PB

2 TB

vs

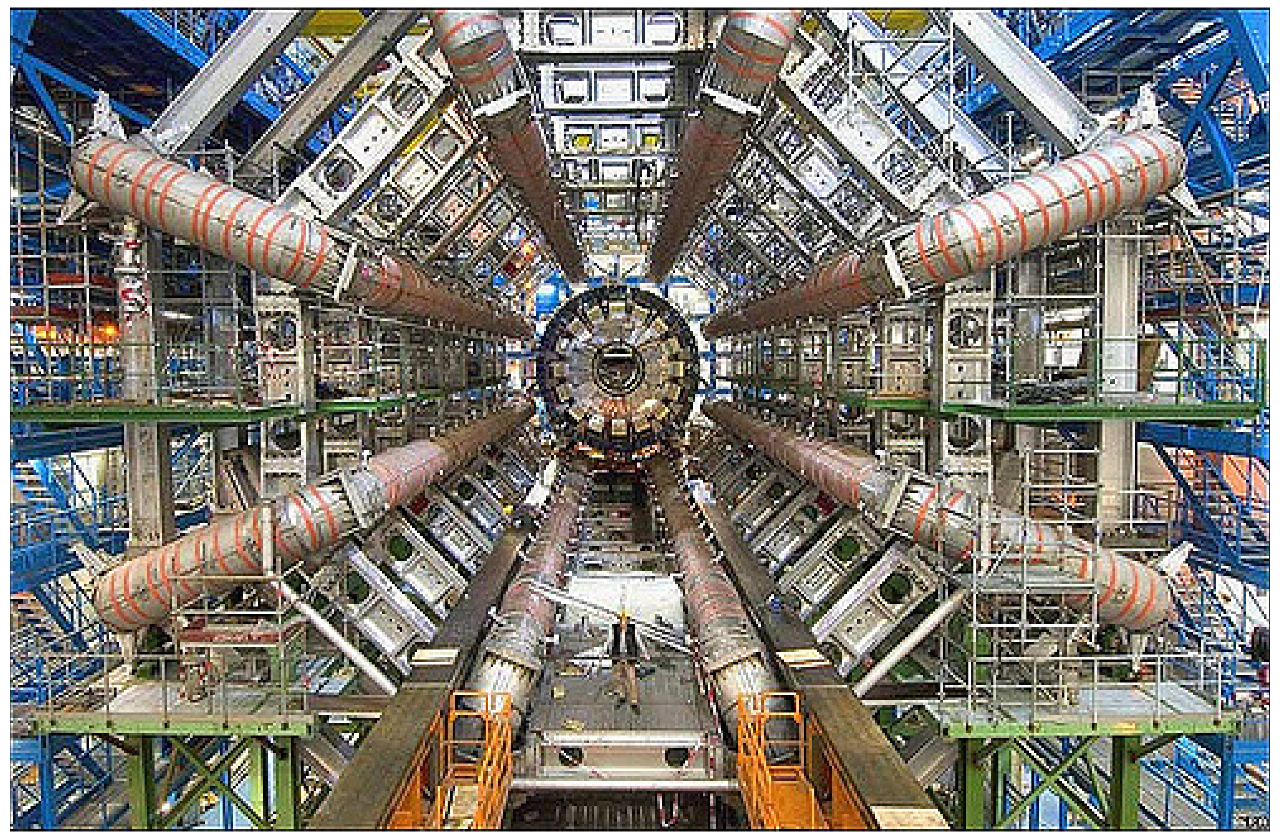
1 TB

1 TB



1 year ~ 10 PB

35 days



1 year ~ 5 PB + 5 PB

17.5 days

# Summary

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# Summary

- you can **explain and reason about** HDFS Namenode architecture (RAM; fsimage + edit log; block size)
- you can **estimate** required resources for a Hadoop cluster
- you can **explain** what small files problem is and where a bottleneck is
- you can **list differences** between different types of Namenodes (Secondary / Checkpoint / Backup)

**Big**DATAteam