



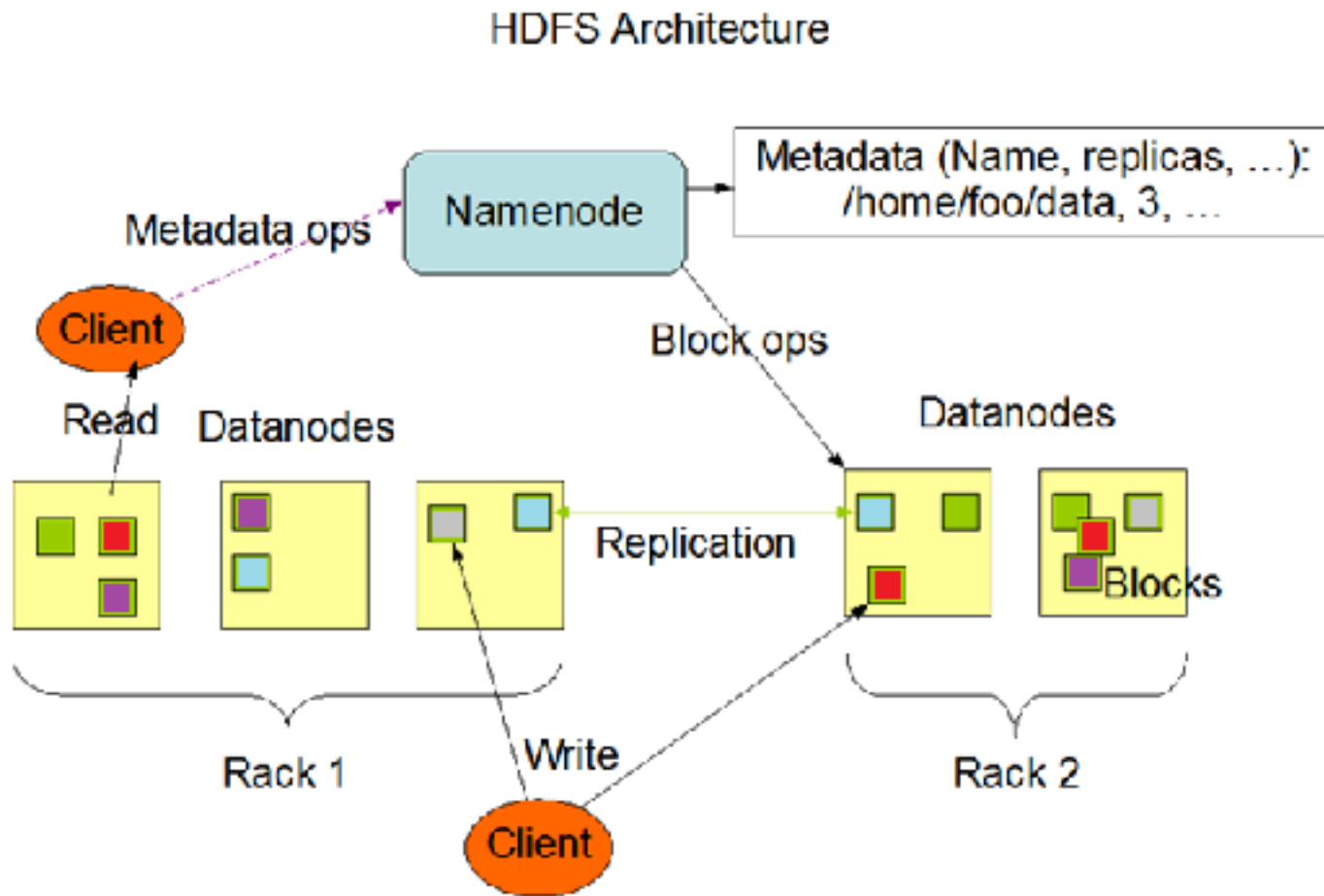
# HDFS

Hadoop Distributed File System

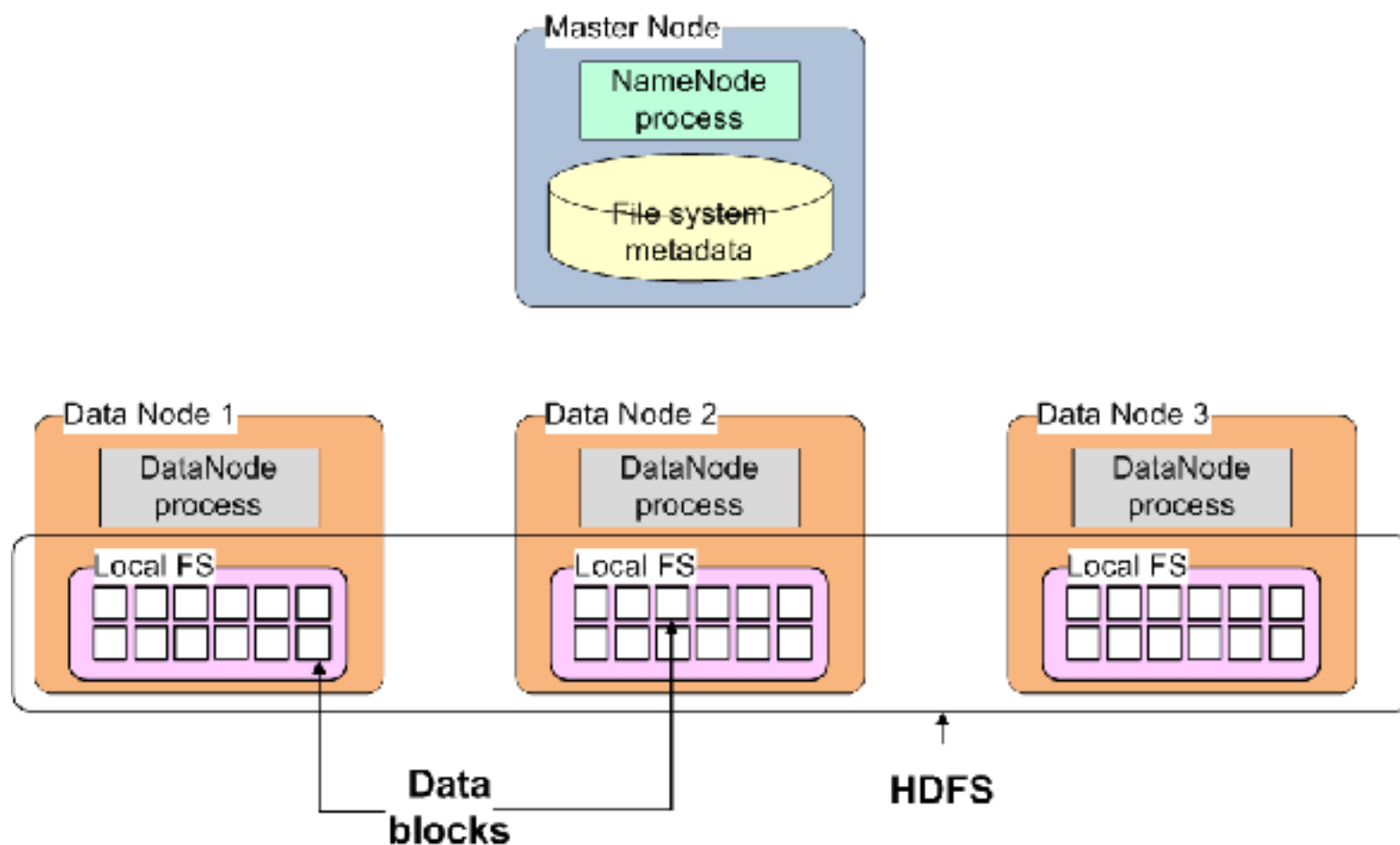
# История

- 2002 - запуск проекта Nutch
- 2003 - публикация с описанием GFS
- 2004 - создание NDFS (Nutch Distributed File System)
- 2004 - публикация Google и MapReduce
- 2005 - реализация MR в Nutch
- 2006 - выделение подпроекта Hadoop
- 2008 - выход Hadoop в лидеры ASF (Apache Software Foundation)

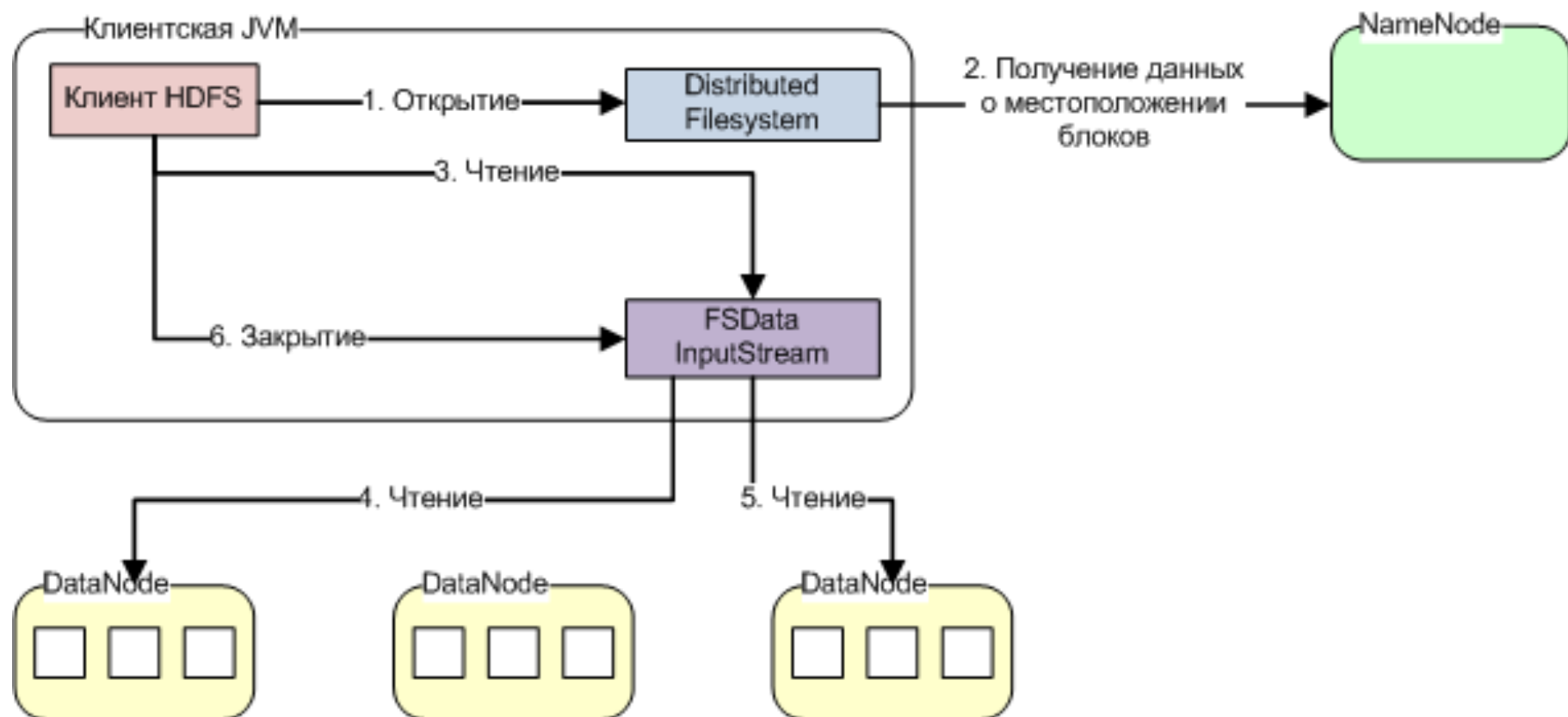
# Архитектура HDFS



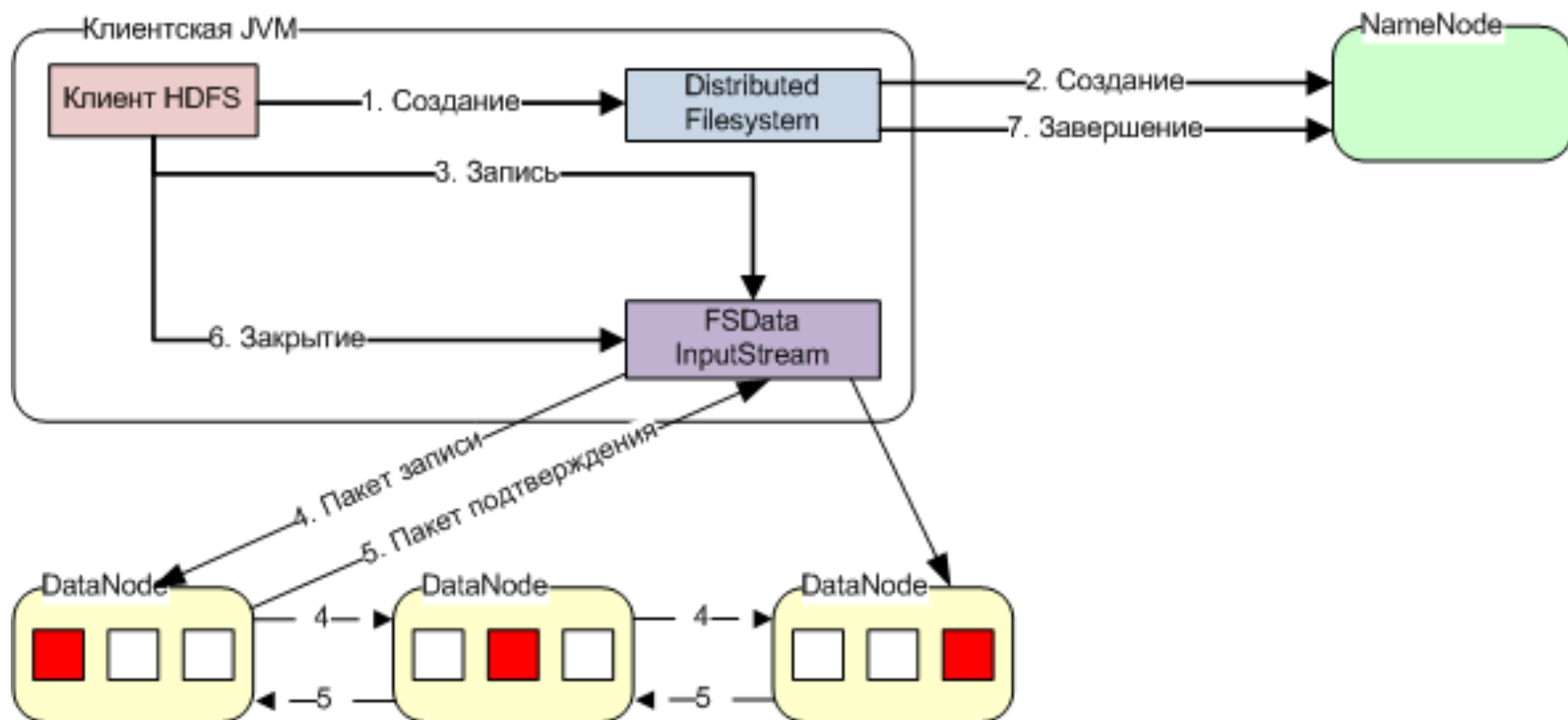
# Name Node



# Чтение HDFS



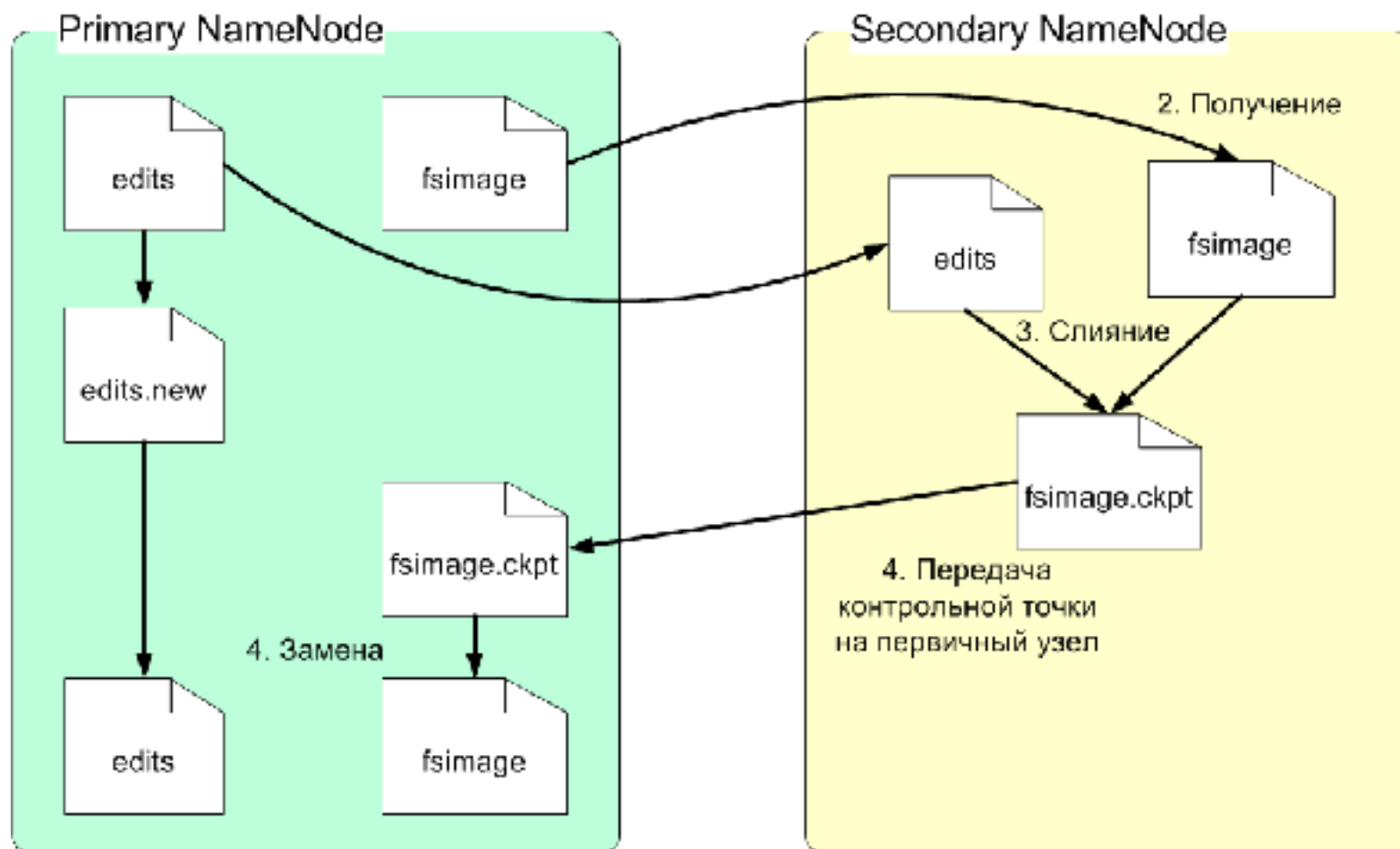
# Запись HDFS



# Name Node структура хранения

- `${dfs.name.dir}/`
  - VERSION (информация о версии HDFS)
  - edits (журнал изменений)
  - fsimage (контрольная точка метаданных)
  - fstime (время создания контрольной точки)

# Secondary Name Node





# Сведения о блоках файла

```
[root@hdp-15 ~]# hdfs fsck /user/hive/warehouse/big_cdr_parquet/000000_0 -files -blocks -locations
Connecting to namenode via http://hdp-7:50070
FSCK started by root (auth:SIMPLE) from /192.168.91.141 for path /user/hive/warehouse/big_cdr_parquet/000000_0
at Mon May 18 14:00:22 MSK 2015
/user/hive/warehouse/big_cdr_parquet/000000_0 1133129924 bytes, 9 block(s): OK
0. BP-1972162810-192.168.91.133-1428693610895:blk_1073747244_6432 len=134217728 repl=3
[192.168.91.141:50010, 192.168.91.139:50010, 192.168.91.133:50010]
1. BP-1972162810-192.168.91.133-1428693610895:blk_1073747245_6433 len=134217728 repl=3
[192.168.91.136:50010, 192.168.91.139:50010, 192.168.91.141:50010]
2. BP-1972162810-192.168.91.133-1428693610895:blk_1073747246_6434 len=134217728 repl=3
[192.168.91.142:50010, 192.168.91.136:50010, 192.168.91.141:50010]
3. BP-1972162810-192.168.91.133-1428693610895:blk_1073747247_6435 len=134217728 repl=3
[192.168.91.134:50010, 192.168.91.142:50010, 192.168.91.137:50010]
4. BP-1972162810-192.168.91.133-1428693610895:blk_1073747248_6436 len=134217728 repl=3
[192.168.91.135:50010, 192.168.91.133:50010, 192.168.91.137:50010]
5. BP-1972162810-192.168.91.133-1428693610895:blk_1073747249_6437 len=134217728 repl=3
[192.168.91.140:50010, 192.168.91.137:50010, 192.168.91.142:50010]
6. BP-1972162810-192.168.91.133-1428693610895:blk_1073747250_6438 len=134217728 repl=3
[192.168.91.142:50010, 192.168.91.139:50010, 192.168.91.141:50010]
7. BP-1972162810-192.168.91.133-1428693610895:blk_1073747251_6439 len=134217728 repl=3
[192.168.91.139:50010, 192.168.91.140:50010, 192.168.91.135:50010]
8. BP-1972162810-192.168.91.133-1428693610895:blk_1073747252_6440 len=59388100 repl=3 [192.168.91.141:50010,
192.168.91.137:50010, 192.168.91.135:50010]
```

# Сведения о блоках файла

Status: HEALTHY

Total size: 1133129924 B

Total dirs: 0

Total files: 1

Total symlinks: 0

Total blocks (validated): 9 (avg. block size 125903324 B)

Minimally replicated blocks: 9 (100.0 %)

Over-replicated blocks: 0 (0.0 %)

Under-replicated blocks: 0 (0.0 %)

Mis-replicated blocks: 0 (0.0 %)

Default replication factor: 3

Average block replication: 3.0

Corrupt blocks: 0

Missing replicas: 0 (0.0 %)

Number of data-nodes: 10

Number of racks: 1

FSCK ended at Mon May 18 14:00:22 MSK 2015 in 1 milliseconds

# Работа с HDFS (CLI)

Команда	Пример
<b>appendToFile</b>	<code>hdfs dfs -appendToFile localfile /user/hadoop/hadoopfile</code>
<b>cat</b>	<code>hdfs dfs -cat hdfs://nn1.example.com/file1</code>
<b>copyFromLocal</b> <b>copyToLocal</b>	<code>hdfs dfs -copyFromLocal localfile /user/hadoop/data/</code> <code>hdfs dfs -copyToLocal localfile /tmp/data/ localfile</code>
<b>cp</b>	<code>hdfs dfs -cp [-f] [-p   -p[topax]] URI [URI ...] &lt;dest&gt;</code>
<b>du</b>	<code>hdfs dfs -du -s /tmp/test.data</code>
<b>expunge</b>	<code>hdfs dfs -expunge</code>
<b>get</b> <b>getmerge</b>	<code>hdfs dfs -get /user/hadoop/file localfile</code> <code>hdfs dfs -getmerge &lt;src&gt; &lt;localdst&gt; [addnl]</code>
<b>ls</b>	<code>hdfs dfs -ls /user/hadoop/file1</code>
<b>mkdir</b>	<code>hdfs dfs -mkdir /user/hadoop/dir1 /user/hadoop/dir2</code>
<b>mv</b>	<code>hdfs dfs -mv /user/hadoop/file1 /user/hadoop/file2</code>

# Работа с HDFS (CLI)

Команда	Пример
<b>put</b>	<code>hdfs dfs -put localfile /user/hadoop/hadoopfile</code>
<b>rm</b>	<code>hdfs dfs -rm [-f] [-r -R] [-skipTrash] URI [URI ...]</code>
<b>tail</b>	<code>hdfs dfs -tail pathname</code>
<b>setrep</b>	<code>hdfs dfs -setrep [-R] [-w] &lt;numReplicas&gt; &lt;path&gt;</code>

# Права доступа

Команда	Пример
<b>chmod</b>	<code>chmod [-R] mode file</code>
<b>chgrp</b>	<code>chgrp [-R] group file ...</code>
<b>chown</b>	<code>chown [-R] [owner][:[group]] file ...</code>
<b>getfacl</b>	<code>hdfs dfs -getfacl /file</code> <code>hdfs dfs -getfacl -R /dir</code>
<b>setfacl</b>	<code>hdfs dfs -setfacl -m user:hadoop:rw- /file</code>

```
[root@hdp-15 ~]# hdfs dfs -ls /user/hive/000000_0
-rwxr-xr-x  3 hive hive 1133129924 2015-04-23 11:48 /user/hive/000000_0
```

# КВОТЫ

Команда	Пример
setQuota	hdfs dfsadmin -setQuota <N> <directory>...<directory>
clrQuota	hdfs dfsadmin -clrQuota <directory>...<directory>
setSpaceQuota	hdfs dfsadmin -setSpaceQuota <N> <directory>...<directory>
clrSpaceQuota	hdfs dfsadmin -clrSpaceQuota <directory>...<director>
count	hdfs dfs -count -q <directory>...<directory>

# КВОТЫ

```
[hdfs@hdp-15 ~]$ hdfs dfsadmin -setQuota 2 /tmp/tests
```

```
[hdfs@hdp-15 ~]$ hdfs dfs -count -q /tmp/tests
```

2	1	none	inf	1	0	0 /tmp/tests
---	---	------	-----	---	---	--------------

```
[hdfs@hdp-15 ~]$ hdfs dfs -count -q /tmp/tests/
```

2	1	none	inf	1	0	0 /tmp/tests
---	---	------	-----	---	---	--------------

```
[hdfs@hdp-15 ~]$ hdfs dfs -touchz /tmp/tests/test1
```

```
[hdfs@hdp-15 ~]$ hdfs dfs -count -q /tmp/tests/
```

2	0	none	inf	1	1	0 /tmp/tests
---	---	------	-----	---	---	--------------

```
[hdfs@hdp-15 ~]$ hdfs dfs -touchz /tmp/tests/test2
```

touchz: The NameSpace quota (directories and files) of directory /tmp/tests is exceeded: quota=2 file count=3

**-count -q:**

QUOTA	REMAINING_QUOTA	SPACE_QUOTA	REMAINING_SPACE_QUOTA
DIR_COUNT	FILE_COUNT	CONTENT_SIZE	FILE_NAME

# Стандартное API

- Основная библиотека: `hadoop-client`
- Пример:

```
private static void ImportDirToHiveTable(Path sourceDir, Path
targetDir) throws IOException {
    Configuration conf = new Configuration();
    FileSystem fs = FileSystem.get(conf);
    for (FileStatus fsts : fs.listStatus(sourceDir)) {
        FileUtil.copy(fs, fsts.getPath(), fs, targetDir, false, conf);
        logger.info(String.format("File %s copied to %s",
            fsts.getPath().getName(),
            targetDir.getName()));
    }
}
```



# Web API

Команда	
CREATE	Создание и запись данных в файл
APPEND	Дописывание файла
CONCAT	Объединение файлов
OPEN	Открытие и чтение файла
MKDIRS	Создание каталога
RENAME	Переименование файла/каталога
DELETE	Удаление файла/каталога
GETFILESTATUS	Получение информации о файле/каталоге
LISTSTATUS	Просмотр информации о каталоге
...	

# Web API (пример)

```
[root@hdp-15 ~]# curl -i "http://192.168.91.139:14000/webhdfs/v1/user/hive?  
op=LISTSTATUS&user.name=hdfs"
```

```
{"FileStatuses":  
  {"FileStatus":  
    [{  
      "pathSuffix":"user.csv",  
      "type":"FILE",  
      "length":22628,  
      "owner":"hive",  
      "group":"hive",  
      "permission":"644",  
      "accessTime":1429262046873,  
      "modificationTime":1429262048992,  
      "blockSize":134217728,  
      "replication":3  
    }]  
  }  
}
```

# Монтирование HDFS

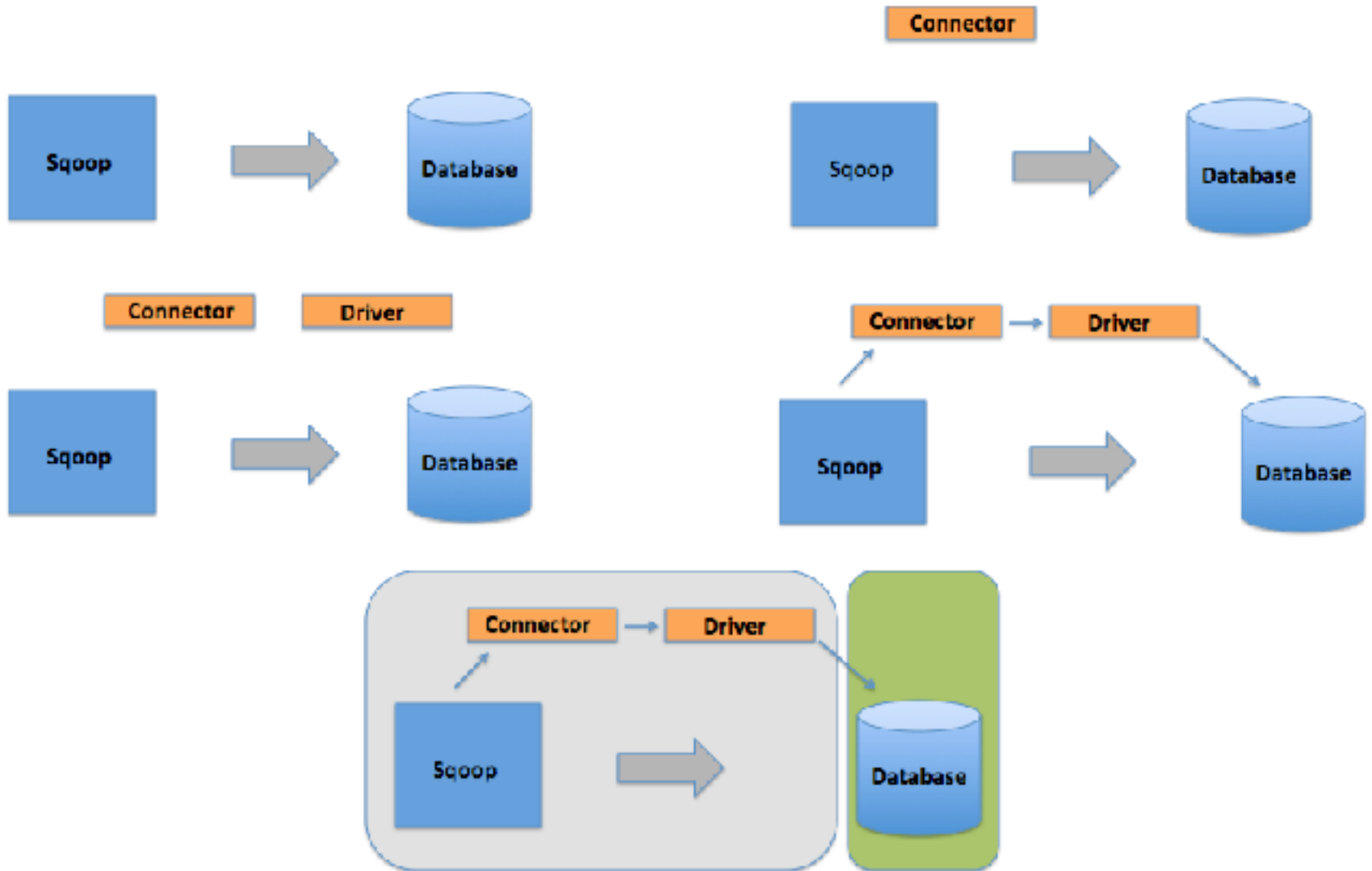
- FUSE (Filesystem in Userspace)
  - `sudo yum install hadoop-hdfs-fuse`
  - `mkdir -p <mount_point>`
  - `hadoop-fuse-dfs dfs://`  
`<NN_hostname>:<NN_port> <mount_point>`
- `export LIBHDFS_OPTS="-Xmx128m"`
- `/etc/fuse.conf` - файл конфигурации FUSE

# SQOOP

- Импорт данных из RDBMS
- Экспорт данных в RDBMS
- Вся БД / таблица / запрос
- Многопоточность
- Поддержка Hbase, Accumulo



# SQOOP



# SnakeBite (spotify.com)

- Написан на python
- Использует ProtoBuf (google.com)



```
wouter@foo:~$ time for i in {1..10}; do hadoop fs -ls / > /dev/n  
  
real    0m14.464s  
user    0m21.761s  
sys     0m1.140s  
  
wouter@foo:~$ time for i in {1..10}; do snakebite ls / > /dev/nu  
  
real    0m1.639s  
user    0m1.072s  
sys     0m0.160s
```

# Интеграция с Amazon s3

`$HADOOP_HOME/conf/hdfs-site.xml:`

```
<property>
```

```
    <name>fs.s3n.awsAccessKeyId</name>
```

```
    <value>AWS-ID</value>
```

```
</property>
```

```
<property>
```

```
    <name>fs.s3n.awsSecretAccessKey</name>
```

```
    <value>AWS-SECRET-KEY</value>
```

```
</property>
```

# Интеграция с Amazon s3

```
$ hadoop jar hadoop-*-examples.jar  
wordcount s3n://BUCKET-NAME/ s3n://  
BUCKET-NAME/DIRECTORY-NAME
```

*или*

```
$ hadoop jar hadoop-*-examples.jar  
wordcount s3n://AWS-ID: AWS-SECRET-  
KEY@BUCKET-NAME/ s3n:// AWS-ID: AWS-  
SECRET-KEY@BUCKET-NAME/DIRECTORY-  
NAME
```








# Hadoop в last.fm



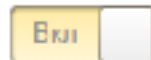
The screenshot shows the last.fm website interface. The top navigation bar includes links for Music, Videos, Radio, Events, and Charts, along with a search bar. The left sidebar contains links for Overview, Biography, Photos, Videos, and Albums. The main content area displays the track 'You Shook Me All Night Long (3:30)' by AC/DC. It includes a play button, a 'Top' button, and a 'Share' button. A message at the bottom states: 'We don't have a description for this track yet. [Want to help?](#)'

## Top Tracks

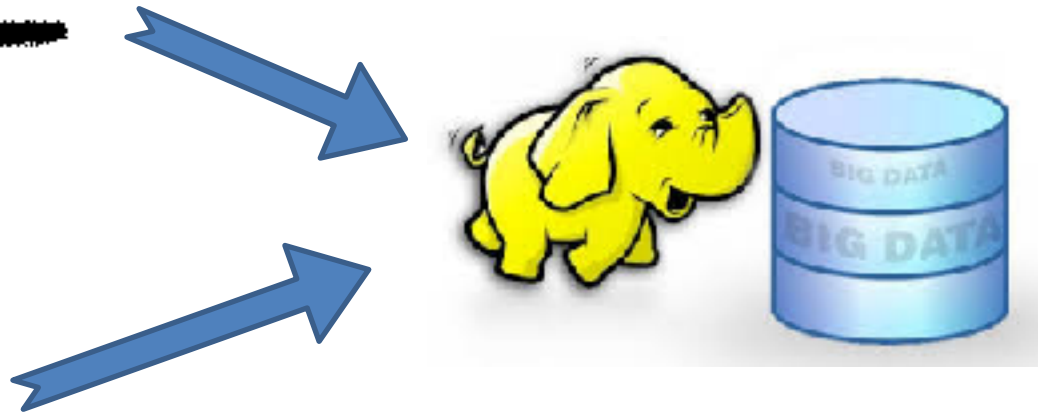
- **Coldplay – Viva la Vida**  
35,037 listeners  
64,360 plays
- **The Killers – Human**  
30,472 listeners  
60,450 plays
- **Kings of Leon – Sex on Fire**  
28,264 listeners  
78,192 plays
- **MGMT – Time to Pretend**  
26,774 listeners  
60,035 plays
- **MGMT – Kids**  
26,271 listeners  
67,090 plays

# Нadoop в last.fm

Скробблинг в last.fm

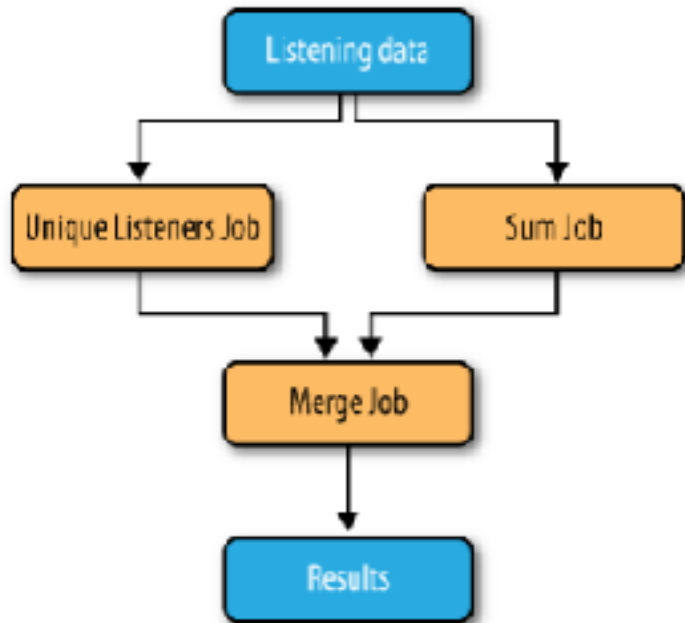


Ваш профиль. [REDACTED]  
Отвязать аккаунт



UserId	TrackId	Scrobble	Radio	Skip
111115	222	0	1	0
111113	225	1	0	0
111119	223	0	1	1
111115	225	1	0	0

# Hadoop B **last.fm**



TrackId	#listeners
IntWritable	IntWritable
222	1
223	1
225	2

TrackId	#listeners	#plays	#scrobbles	#radio	#skips
IntWritable	IntWritable	IntWritable	IntWritable	IntWritable	IntWritable
222	1	1	0	1	0
223	1	1	0	1	1
225	1	2	2	0	0

# Дополнительные материалы

- <http://hadoop.apache.org/docs/stable/>
- Hadoop. Подробное руководство
- <http://blog.cloudera.com/blog/>
- <http://hortonworks.com/blog/>

