第 6 章 Hadoop HA 高可用

6.1 HA 概述

（1）所谓 HA（High Availablity），即高可用（7*24 小时不中断服务）。

（2）实现高可用最关键的策略是消除单点故障。HA 严格来说应该分成各个组件的 HA 机制：HDFS 的 HA 和 YARN 的 HA。

（3）NameNode 主要在以下两个方面影响 HDFS 集群

- NameNode 机器发生意外，如宕机，集群将无法使用，直到管理员重启
- NameNode 机器需要升级，包括软件、硬件升级，此时集群也将无法使用

HDFS HA 功能通过配置多个 NameNodes(Active/Standby)实现在集群中对 NameNode 的热备来解决上述问题。如果出现故障，如机器崩溃或机器需要升级维护，这时可通过此种方式将 NameNode 很快的切换到另外一台机器。

6.2 HDFS-HA 集群搭建

当前 HDFS 集群的规划

hadoop102	hadoop103	hadoop104
NameNode		Secondarynamenode
DataNode	DataNode	DataNode

HA 的主要目的是消除 namenode 的单点故障,需要将 hdfs 集群规划成以下模样

hadoop102	hadoop103	hadoop104
NameNode	NameNode	NameNode
DataNode	DataNode	DataNode

6.2.1 HDFS-HA 核心问题

1）怎么保证三台 namenode 的数据一致

a.Fsimage:让一台 nn 生成数据,让其他机器 nn 同步

b.Edits:需要引进新的模块 JournalNode 来保证 edtis 的文件的数据一致性

2）怎么让同时只有一台 nn 是 active，其他所有是 standby 的

a.手动分配

b.自动分配

3）2nn 在 ha 架构中并不存在，定期合并 fsimage 和 edtis 的活谁来干

由 standby 的 nn 来干

4）如果 nn 真的发生了问题，怎么让其他的 nn 上位干活

a.手动故障转移

b.自动故障转移

6.3 HDFS-HA 手动模式

6.3.1 环境准备

（1）修改 IP

（2）修改主机名及主机名和 IP 地址的映射

（3）关闭防火墙

（4）ssh 免密登录

（5）安装 JDK，配置环境变量等

6.3.2 规划集群

hadoop102	hadoop103	hadoop104
NameNode	NameNode	NameNode
JournalNode	JournalNode	JournalNode
DataNode	DataNode	DataNode

6.3.3 配置 HDFS-HA 集群

1）官方地址：http://hadoop.apache.org/

2）在 opt 目录下创建一个 ha 文件夹

```
[atguigu@hadoop102 ~]$ cd /opt
[atguigu@hadoop102 opt]$ sudo mkdir ha
[atguigu@hadoop102 opt]$ sudo chown atguigu:atguigu /opt/ha
```

3）将/opt/module/下的 hadoop-3.1.3 拷贝到/opt/ha 目录下（记得删除 data 和 log 目录）

```
[atguigu@hadoop102 opt]$ cp -r /opt/module/hadoop-3.1.3 /opt/ha/
```

4）配置 core-site.xml

```
<configuration>
<!-- 把多个 NameNode 的地址组装成一个集群 mycluster -->
  <property>
    <name>fs.defaultFS</name>
    <value>hdfs://mycluster</value>
  </property>
<!-- 指定 hadoop 运行时产生文件的存储目录 -->
  <property>
    <name>hadoop.tmp.dir</name>
    <value>/opt/ha/hadoop-3.1.3/data</value>
  </property>
</configuration>
```

5）配置 hdfs-site.xml

```
<configuration>
<!-- NameNode 数据存储目录 -->
  <property>
    <name>dfs.namenode.name.dir</name>
    <value>file://${hadoop.tmp.dir}/name</value>
  </property>
<!-- DataNode 数据存储目录 -->
  <property>
    <name>dfs.datanode.data.dir</name>
    <value>file://${hadoop.tmp.dir}/data</value>
  </property>
<!-- JournalNode 数据存储目录 -->
  <property>
    <name>dfs.journalnode.edits.dir</name>
    <value>${hadoop.tmp.dir}/jn</value>
  </property>
<!-- 完全分布式集群名称 -->
  <property>
    <name>dfs.nameservices</name>
    <value>mycluster</value>
  </property>
<!-- 集群中 NameNode 节点都有哪些 -->
  <property>
    <name>dfs.ha.namenodes.mycluster</name>
    <value>nn1,nn2,nn3</value>
  </property>
<!-- NameNode 的 RPC 通信地址 -->
  <property>
    <name>dfs.namenode.rpc-address.mycluster.nn1</name>
    <value>hadoop102:8020</value>
  </property>
  <property>
    <name>dfs.namenode.rpc-address.mycluster.nn2</name>
    <value>hadoop103:8020</value>
  </property>
  <property>
    <name>dfs.namenode.rpc-address.mycluster.nn3</name>
    <value>hadoop104:8020</value>
  </property>
<!-- NameNode 的 http 通信地址 -->
  <property>
    <name>dfs.namenode.http-address.mycluster.nn1</name>
    <value>hadoop102:9870</value>
  </property>
  <property>
    <name>dfs.namenode.http-address.mycluster.nn2</name>
    <value>hadoop103:9870</value>
  </property>
  <property>
    <name>dfs.namenode.http-address.mycluster.nn3</name>
    <value>hadoop104:9870</value>
  </property>
<!-- 指定 NameNode 元数据在 JournalNode 上的存放位置 -->
  <property>
     <name>dfs.namenode.shared.edits.dir</name>
     <value>qjournal://hadoop102:8485;hadoop103:8485;hadoop104:8485/mycluster</value>
  </property>
<!-- 访问代理类：client 用于确定哪个 NameNode 为 Active -->
  <property>
    <name>dfs.client.failover.proxy.provider.mycluster</name>
    <value>org.apache.hadoop.hdfs.server.namenode.ha.ConfiguredFailoverProxyProvider</value>
  </property>
<!-- 配置隔离机制，即同一时刻只能有一台服务器对外响应 -->
  <property>
    <name>dfs.ha.fencing.methods</name>
    <value>sshfence</value>
  </property>
<!-- 使用隔离机制时需要 ssh 秘钥登录-->
  <property>
    <name>dfs.ha.fencing.ssh.private-key-files</name>
    <value>/home/atguigu/.ssh/id_rsa</value>
  </property>
</configuration>
```

6）分发配置好的 hadoop 环境到其他节点

6.3.4 启动 HDFS-HA 集群

1）将 HADOOP_HOME 环境变量更改到 HA 目录(三台机器)

```
[atguigu@hadoop102 ~]$ sudo vim /etc/profile.d/my_env.sh
```

将 HADOOP_HOME 部分改为如下

```
#HADOOP_HOME
export HADOOP_HOME=/opt/ha/hadoop-3.1.3
export PATH=$PATH:$HADOOP_HOME/bin
export PATH=$PATH:$HADOOP_HOME/sbin
```

去三台机器上 source 环境变量

```
[atguigu@hadoop102 ~]$source /etc/profile
```

2）在各个 JournalNode 节点上，输入以下命令启动 journalnode 服务

```
[atguigu@hadoop102 ~]$ hdfs --daemon start journalnode
[atguigu@hadoop103 ~]$ hdfs --daemon start journalnode
[atguigu@hadoop104 ~]$ hdfs --daemon start journalnode
```

3）在[nn1]上，对其进行格式化，并启动

```
[atguigu@hadoop102 ~]$ hdfs namenode -format
[atguigu@hadoop102 ~]$ hdfs --daemon start namenode
```

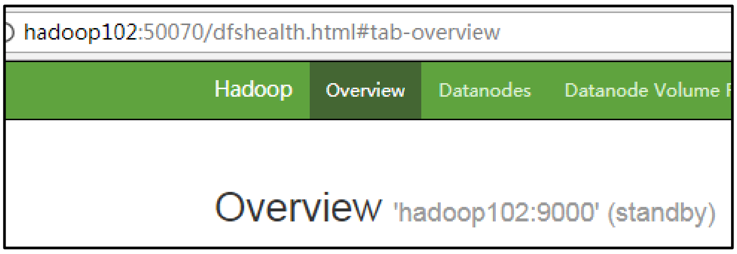
4）在[nn2]和[nn3]上，同步 nn1 的元数据信息

```
[atguigu@hadoop103 ~]$ hdfs namenode -bootstrapStandby
[atguigu@hadoop104 ~]$ hdfs namenode -bootstrapStandby
```

5）启动[nn2]和[nn3]

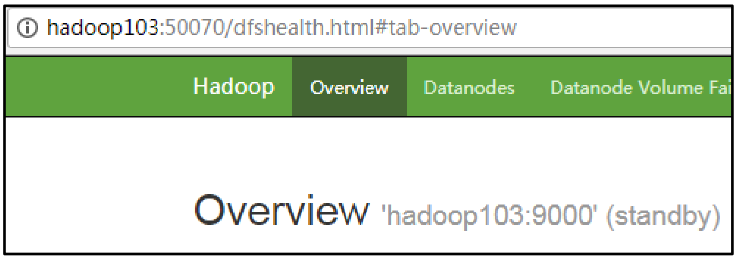
```
[atguigu@hadoop103 ~]$ hdfs --daemon start namenode
[atguigu@hadoop104 ~]$ hdfs --daemon start namenode
```

6）查看 web 页面显示


hadoop102:50070/dfshealth.html#tab-overview

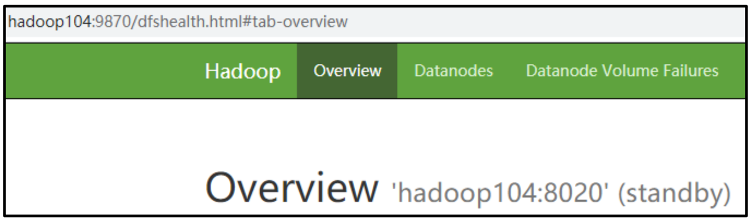
Overview 'hadoop102:9000' (standby)

图 hadoop102(standby)


hadoop103:50070/dfshealth.html#tab-overview

Overview 'hadoop103:9000' (standby)

图 hadoop103(standby)



hadoop104:9870/dfshealth.html#tab-overview

Overview 'hadoop104:8020' (standby)

图 hadoop104(standby)

7）在所有节点上，启动 datanode

```
[atguigu@hadoop102 ~]$ hdfs --daemon start datanode
[atguigu@hadoop103 ~]$ hdfs --daemon start datanode
[atguigu@hadoop104 ~]$ hdfs --daemon start datanode
```

8）将[nn1]切换为 Active

```
[atguigu@hadoop102 ~]$ hdfs haadmin -transitionToActive nn1
```

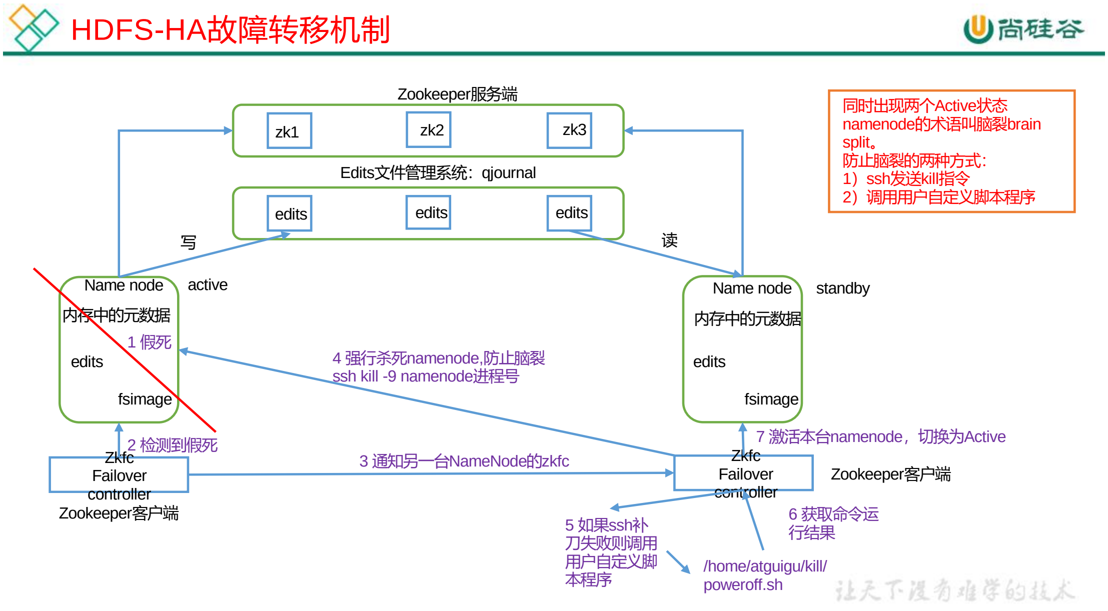
9）查看是否 Active

```
[atguigu@hadoop102 ~]$ hdfs haadmin -getServiceState nn1
```

6.4 HDFS-HA 自动模式

6.4.1 HDFS-HA 自动故障转移工作机制

自动故障转移为 HDFS 部署增加了两个新组件：ZooKeeper 和 ZKFailoverController（ZKFC）进程，如图所示。ZooKeeper 是维护少量协调数据，通知客户端这些数据的改变和监视客户端故障的高可用服务。



HDFS-HA故障转移机制

同时出现两个Active状态namenode的术语叫脑裂brain split。
防止脑裂的两种方式:
1）ssh发送kill指令
2）调用用户自定义脚本程序

6.4.2 HDFS-HA 自动故障转移的集群规划

hadoop102	hadoop103	hadoop104
NameNode	NameNode	NameNode
JournalNode	JournalNode	JournalNode
DataNode	DataNode	DataNode
Zookeeper	Zookeeper	Zookeeper
ZKFC	ZKFC	ZKFC

6.4.3 配置 HDFS-HA 自动故障转移

1）具体配置

（1）在 hdfs-site.xml 中增加

```
<!-- 启用 nn 故障自动转移 -->
<property>
    <name>dfs.ha.automatic-failover.enabled</name>
    <value>true</value>
</property>
```

（2）在 core-site.xml 文件中增加

```
<!-- 指定 zkfc 要连接的 zkServer 地址 -->
<property>
    <name>ha.zookeeper.quorum</name>
    <value>hadoop102:2181,hadoop103:2181,hadoop104:2181</value>
</property>
```

（3）修改后分发配置文件

```
[atguigu@hadoop102 etc]$ pwd
/opt/ha/hadoop-3.1.3/etc
[atguigu@hadoop102 etc]$ xsync hadoop/
```

2）启动

（1）关闭所有 HDFS 服务：

```
[atguigu@hadoop102 ~]$ stop-dfs.sh
```

（2）启动 Zookeeper 集群：

```
[atguigu@hadoop102 ~]$ zkServer.sh start
[atguigu@hadoop103 ~]$ zkServer.sh start
[atguigu@hadoop104 ~]$ zkServer.sh start
```

（3）启动 Zookeeper 以后，然后再初始化 HA 在 Zookeeper 中状态：

```
[atguigu@hadoop102 ~]$ hdfs zkfc -formatZK
```

（4）启动 HDFS 服务：

```
[atguigu@hadoop102 ~]$ start-dfs.sh
```

（5）可以去 zkCli.sh 客户端查看 Namenode 选举锁节点内容：

```
[zk: localhost:2181(CONNECTED) 7] get -s
/hadoop-ha/mycluster/ActiveStandbyElectorLock

    myclusternn2    hadoop103 �>(�>
cZxid = 0x10000000b
ctime = Tue Jul 14 17:00:13 CST 2020
mZxid = 0x10000000b
mtime = Tue Jul 14 17:00:13 CST 2020
pZxid = 0x10000000b
cversion = 0
dataVersion = 0
aclVersion = 0
ephemeralOwner = 0x40000da2eb70000
dataLength = 33
numChildren = 0
```

3）验证

（1）将 Active NameNode 进程 kill，查看网页端三台 Namenode 的状态变化

```
[atguigu@hadoop102 ~]$ kill -9 namenode 的进程 id
```

6.4.3 解决 NN 连接不上 JN 的问题

自动故障转移配置好以后，然后使用 start-dfs.sh 群起脚本启动 hdfs 集群，有可能会遇到 NameNode 起来一会后，进程自动关闭的问题。查看 NameNode 日志，报错信息如下：

```
2020-08-17 10:11:40,658 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop104/192.168.6.104:8485. Already tried 0 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:40,659 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop102/192.168.6.102:8485. Already tried 0 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:40,659 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop103/192.168.6.103:8485. Already tried 0 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:41,660 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop104/192.168.6.104:8485. Already tried 1 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:41,660 INFO org.apache.hadoop.ipc.Client: Retrying connect
```

```
to server: hadoop102/192.168.6.102:8485. Already tried 1 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:41,665 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop103/192.168.6.103:8485. Already tried 1 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:42,661 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop104/192.168.6.104:8485. Already tried 2 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:42,661 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop102/192.168.6.102:8485. Already tried 2 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:42,667 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop103/192.168.6.103:8485. Already tried 2 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:43,662 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop104/192.168.6.104:8485. Already tried 3 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:43,662 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop102/192.168.6.102:8485. Already tried 3 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:43,668 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop103/192.168.6.103:8485. Already tried 3 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:44,663 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop104/192.168.6.104:8485. Already tried 4 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:44,663 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop102/192.168.6.102:8485. Already tried 4 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:44,670 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop103/192.168.6.103:8485. Already tried 4 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:45,467 INFO
org.apache.hadoop.hdfs.qjournal.client.QuorumJournalManager: Waited 6001
```

```
ms (timeout=20000 ms) for a response for selectStreamingInputStreams. No
responses yet.
2020-08-17 10:11:45,664 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop102/192.168.6.102:8485. Already tried 5 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:45,664 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop104/192.168.6.104:8485. Already tried 5 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:45,672 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop103/192.168.6.103:8485. Already tried 5 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:46,469 INFO
org.apache.hadoop.hdfs.qjournal.client.QuorumJournalManager: Waited 7003
ms (timeout=20000 ms) for a response for selectStreamingInputStreams. No
responses yet.
2020-08-17 10:11:46,665 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop102/192.168.6.102:8485. Already tried 6 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:46,665 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop104/192.168.6.104:8485. Already tried 6 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:46,673 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop103/192.168.6.103:8485. Already tried 6 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:47,470 INFO
org.apache.hadoop.hdfs.qjournal.client.QuorumJournalManager: Waited 8004
ms (timeout=20000 ms) for a response for selectStreamingInputStreams. No
responses yet.
2020-08-17 10:11:47,666 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop102/192.168.6.102:8485. Already tried 7 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:47,667 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop104/192.168.6.104:8485. Already tried 7 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:47,674 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop103/192.168.6.103:8485. Already tried 7 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:48,471 INFO
org.apache.hadoop.hdfs.qjournal.client.QuorumJournalManager: Waited 9005
ms (timeout=20000 ms) for a response for selectStreamingInputStreams. No
responses yet.
2020-08-17 10:11:48,668 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop102/192.168.6.102:8485. Already tried 8 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:48,668 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop104/192.168.6.104:8485. Already tried 8 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:48,675 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop103/192.168.6.103:8485. Already tried 8 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:49,669 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop102/192.168.6.102:8485. Already tried 9 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:49,673 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop104/192.168.6.104:8485. Already tried 9 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:49,676 INFO org.apache.hadoop.ipc.Client: Retrying connect
to server: hadoop103/192.168.6.103:8485. Already tried 9 time(s); retry
policy is RetryUpToMaximumCountWithFixedSleep(maxRetries=10,
sleepTime=1000 MILLISECONDS)
2020-08-17 10:11:49,678 WARN
org.apache.hadoop.hdfs.server.namenode.FSEditLog: Unable to determine input
streams from QJM to [192.168.6.102:8485, 192.168.6.103:8485,
192.168.6.104:8485]. Skipping.
org.apache.hadoop.hdfs.qjournal.client.QuorumException: Got too many
exceptions to achieve quorum size 2/3. 3 exceptions thrown:
192.168.6.103:8485: Call From hadoop102/192.168.6.102 to hadoop103:8485
failed on connection exception: java.net.ConnectException: 拒绝连接; For more
details see:  http://wiki.apache.org/hadoop/ConnectionRefused
192.168.6.102:8485: Call From hadoop102/192.168.6.102 to hadoop102:8485
failed on connection exception: java.net.ConnectException: 拒绝连接; For more
details see:  http://wiki.apache.org/hadoop/ConnectionRefused
192.168.6.104:8485: Call From hadoop102/192.168.6.102 to hadoop104:8485
failed on connection exception: java.net.ConnectException: 拒绝连接; For more
details see:  http://wiki.apache.org/hadoop/ConnectionRefused
```

查看报错日志，可分析出报错原因是因为 NameNode 连接不上 JournalNode，而利用 jps 命令查看到三台 JN 都已经正常启动，为什么 NN 还是无法正常连接到 JN 呢？这是因为 start-dfs.sh 群起脚本默认的启动顺序是先启动 NN，再启动 DN，然后再启动 JN，并且默认的 rpc 连接参数是重试次数为 10，每次重试的间隔是 1s，也就是说启动完 NN 以后的 10s 中内，JN 还启动不起来，NN 就会报错了。

core-default.xml 里面有两个参数如下：

```
<!-- NN 连接 JN 重试次数，默认是 10 次 -->
<property>
  <name>ipc.client.connect.max.retries</name>
  <value>10</value>
</property>
<!-- 重试时间间隔，默认 1s -->
<property>
  <name>ipc.client.connect.retry.interval</name>
  <value>1000</value>
</property>
```

解决方案：遇到上述问题后，可以稍等片刻，等 JN 成功启动后，手动启动下三台 NN：

```
[atguigu@hadoop102 ~]$ hdfs --daemon start namenode
[atguigu@hadoop103 ~]$ hdfs --daemon start namenode
[atguigu@hadoop104 ~]$ hdfs --daemon start namenode
```

也可以在 core-site.xml 里面适当调大上面的两个参数：

```
<!-- NN 连接 JN 重试次数，默认是 10 次 -->
<property>
  <name>ipc.client.connect.max.retries</name>
  <value>20</value>
</property>
<!-- 重试时间间隔，默认 1s -->
<property>
  <name>ipc.client.connect.retry.interval</name>
  <value>5000</value>
</property>
```

6.5 YARN-HA 配置

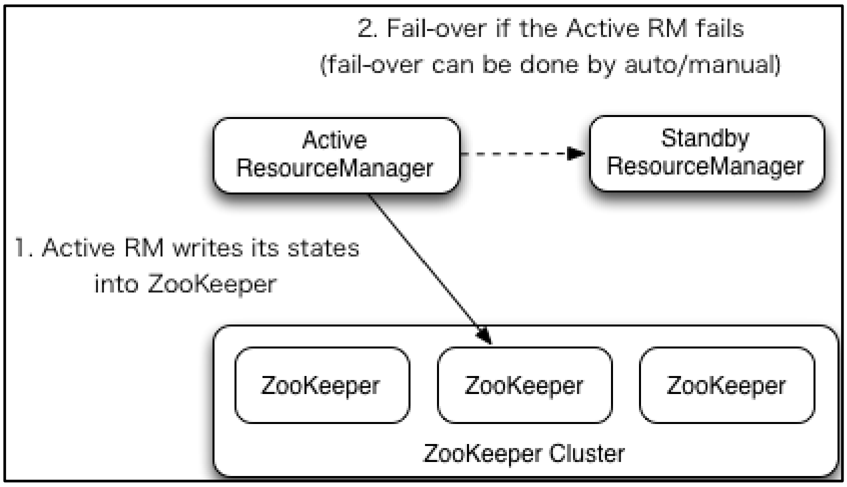
6.5.1 YARN-HA 工作机制

1）官方文档：

http://hadoop.apache.org/docs/r3.1.3/hadoop-yarn/hadoop-yarn-site/ResourceManagerHA.htm

1

2）YARN-HA 工作机制


2. Fail-over if the Active RM fails
(fail-over can be done by auto/manual)
Active ResourceManager
Standby ResourceManager
1. Active RM writes its states into ZooKeeper
ZooKeeper
ZooKeeper
ZooKeeper
ZooKeeper Cluster

6.5.2 配置 YARN-HA 集群

1）环境准备

（1）修改 IP

（2）修改主机名及主机名和 IP 地址的映射

（3）关闭防火墙

（4）ssh 免密登录

（5）安装 JDK，配置环境变量等

（6）配置 Zookeeper 集群

2）规划集群

hadoop102	hadoop103	hadoop104
ResourceManager	ResourceManager	ResourceManager
NodeManager	NodeManager	NodeManager
Zookeeper	Zookeeper	Zookeeper

3）核心问题

a .如果当前 active rm 挂了，其他 rm 怎么将其他 standby rm 上位

核心原理跟 hdfs 一样，利用了 zk 的临时节点

b. 当前 rm 上有很多的计算程序在等待运行,其他的 rm 怎么将这些程序接手过来接着跑

rm 会将当前的所有计算程序的状态存储在 zk 中,其他 rm 上位后会去读取，然后接着跑

4）具体配置

（1）yarn-site.xml

```
<configuration>

    <property>
        <name>yarn.nodemanager.aux-services</name>
        <value>mapreduce_shuffle</value>
    </property>

    <!-- 启用resourcemanager ha -->
    <property>
        <name>yarn.resourcemanager.ha.enabled</name>
        <value>true</value>
    </property>

    <!-- 声明两台resourcemanager的地址 -->
    <property>
        <name>yarn.resourcemanager.cluster-id</name>
        <value>cluster-yarn1</value>
    </property>
    <!--指定resourcemanager的逻辑列表-->
    <property>
        <name>yarn.resourcemanager.ha.rm-ids</name>
        <value>rm1,rm2,rm3</value>
    </property>
    <!-- ========== rm1的配置 ========== -->
    <!-- 指定rm1的主机名 -->
    <property>
        <name>yarn.resourcemanager.hostname.rm1</name>
        <value>hadoop102</value>
    </property>
    <!-- 指定rm1的web端地址 -->
    <property>
         <name>yarn.resourcemanager.webapp.address.rm1</name>
         <value>hadoop102:8088</value>
    </property>
    <!-- 指定rm1的内部通信地址 -->
    <property>
         <name>yarn.resourcemanager.address.rm1</name>
         <value>hadoop102:8032</value>
    </property>
    <!-- 指定AM向rm1申请资源的地址 -->
    <property>
    <name>yarn.resourcemanager.scheduler.address.rm1</name>
    <value>hadoop102:8030</value>
</property>
<!-- 指定供 NM 连接的地址 -->
<property>
    <name>yarn.resourcemanager.resource-tracker.address.rm1</name>
    <value>hadoop102:8031</value>
</property>
<!-- ========== rm2 的配置 ========== -->
<!-- 指定 rm2 的主机名 -->
<property>
   <name>yarn.resourcemanager.hostname.rm2</name>
   <value>hadoop103</value>
</property>
<property>
    <name>yarn.resourcemanager.webapp.address.rm2</name>
    <value>hadoop103:8088</value>
</property>
<property>
    <name>yarn.resourcemanager.address.rm2</name>
    <value>hadoop103:8032</value>
</property>
<property>
    <name>yarn.resourcemanager.scheduler.address.rm2</name>
    <value>hadoop103:8030</value>
</property>
<property>
    <name>yarn.resourcemanager.resource-tracker.address.rm2</name>
    <value>hadoop103:8031</value>
</property>
 <!-- ========== rm3 的配置 ========== -->
<!-- 指定 rm1 的主机名 -->
<property>
   <name>yarn.resourcemanager.hostname.rm3</name>
   <value>hadoop104</value>
</property>
<!-- 指定 rm1 的 web 端地址 -->
<property>
    <name>yarn.resourcemanager.webapp.address.rm3</name>
    <value>hadoop104:8088</value>
</property>
<!-- 指定 rm1 的内部通信地址 -->
<property>
    <name>yarn.resourcemanager.address.rm3</name>
```

```
        <value>hadoop104:8032</value>
    </property>
    <!-- 指定 AM 向 rm1 申请资源的地址 -->
    <property>
        <name>yarn.resourcemanager.scheduler.address.rm3</name>
        <value>hadoop104:8030</value>
    </property>
    <!-- 指定供 NM 连接的地址 -->
    <property>
        <name>yarn.resourcemanager.resource-tracker.address.rm3</name>
        <value>hadoop104:8031</value>
    </property>
    <!-- 指定 zookeeper 集群的地址 -->
    <property>
       <name>yarn.resourcemanager.zk-address</name>
       <value>hadoop102:2181,hadoop103:2181,hadoop104:2181</value>
    </property>

    <!-- 启用自动恢复 -->
    <property>
       <name>yarn.resourcemanager.recovery.enabled</name>
       <value>true</value>
    </property>

    <!-- 指定 resourcemanager 的状态信息存储在 zookeeper 集群 -->
    <property>
       <name>yarn.resourcemanager.store.class</name>
<value>org.apache.hadoop.yarn.server.resourcemanager.recovery.ZKRMStateSt
ore</value>
</property>
    <!-- 环境变量的继承 -->
    <property>
          <name>yarn.nodemanager.env-whitelist</name>

<value>JAVA_HOME,HADOOP_COMMON_HOME,HADOOP_HDFS_HOME,HADOOP_CONF_DIR,CLAS
SPATH_PREPEND_DISTCACHE,HADOOP_YARN_HOME,HADOOP_MAPRED_HOME</value>
    </property>

</configuration>
```

（2）同步更新其他节点的配置信息，分发配置文件

```
[atguigu@hadoop102 etc]$ xsync hadoop/
```

4）启动 YARN

（1）在 hadoop102 或者 hadoop103 中执行：

```
[atguigu@hadoop102 ~]$ start-yarn.sh
```

（2）查看服务状态

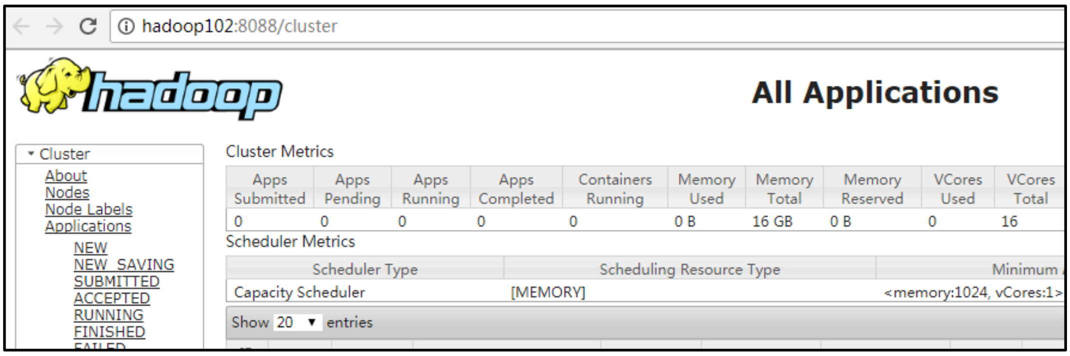
```
[atguigu@hadoop102 ~]$ yarn rmadmin -getServiceState rm1
```

（3）可以去 zkCli.sh 客户端查看 ResourceManager 选举锁节点内容：

```
[atguigu@hadoop102 ~]$ zkCli.sh
[zk: localhost:2181(CONNECTED) 16] get -s
/yarn-leader-election/cluster-yarn1/ActiveStandbyElectorLock

cluster-yarn1rm1
cZxid = 0x100000022
ctime = Tue Jul 14 17:06:44 CST 2020
mZxid = 0x100000022
mtime = Tue Jul 14 17:06:44 CST 2020
pZxid = 0x100000022
cversion = 0
dataVersion = 0
aclVersion = 0
ephemeralOwner = 0x30000da33080005
dataLength = 20
numChildren = 0
```

（4）web 端查看 hadoop102:8088 和 hadoop103:8088 的 YARN 的状态



hadoop102:8088/cluster

All Applications

Cluster Metrics

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Memory Total	Memory Reserved	VCores Used	VCores Total
0	0	0	0	0	0 B	16 GB	0 B	0	16

Scheduler Metrics

Scheduler Type	Scheduling Resource Type	Minimum
Capacity Scheduler	[MEMORY]	<memory:1024, vCores:1>

Show 20 entries

6.6 HADOOP HA 的最终规划

将整个 ha 搭建完成后,集群将形成以下模样

hadoop102	hadoop103	hadoop104
NameNode	NameNode	NameNode
JournalNode	JournalNode	JournalNode
DataNode	DataNode	DataNode
Zookeeper	Zookeeper	Zookeeper
ZKFC	ZKFC	ZKFC

ResourceManager	ResourceManager	ResourceManager
NodeManager	NodeManager	NodeManager