

SUSE Linux Enterprise High Availability Extension 15 SP4

使用 DRBD 和 Pacemaker 的 高度可用 NFS 储存

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此文档介绍了如何使用以下组件在双节点群集中设置高度可用的 NFS 储存：DRBD*（Distributed Replicated Block Device，分布式复制块设备）、LVM（Logical Volume Manager，逻辑卷管理器）和群集资源管理器 Pacemaker。

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1 使用情形

本文档将帮助您设置高度可用的 NFS 服务器。用于实现高度可用的 NFS 储存的群集具有以下属性：

- 两个节点：alice (IP: 192.168.1.1) 和 bob (IP: 192.168.1.2)，两者之间通过网络彼此相连。
- 两个浮动虚拟 IP 地址 (192.168.1.10 和 192.168.2.1)，这样无论服务在哪个物理节点上运行，客户端都可连接到服务。一个 IP 地址用于使用 Hawk2 进行群集管理，另一个 IP 地址专用于 NFS 导出。
- 一台共享储存设备，用作 SBD 屏蔽机制。可避免节点分裂的情况。
- 当活动的主机发生故障（**主动/被动**设置）时，资源从一个节点故障转移至另一个节点。
- 每台主机上的本地储存。使用 LVM 上的 DRBD 在主机之间同步数据。
- 通过 NFS 导出的文件系统。

安装并设置好基本的双节点群集后，再使用 NFS 的储存和群集资源对其进行扩展，即可获得一个高度可用的 NFS 储存服务器。

2 安装基本的双节点群集

继续前，您需要安装并设置一个基本的双节点群集。《Installation and Setup Quick Start》（安装和设置快速入门）中介绍了此任务。《Installation and Setup Quick Start》（安装和设置快速入门）介绍了如何使用 crm 外壳花费极少的精力设置群集。

3 创建 LVM 设备

LVM（**逻辑卷管理器**）支持在多个文件系统上灵活分配硬盘空间。

要准备供 LVM 使用的磁盘，请执行以下操作：

1. 创建 LVM 卷组，然后使用要用于 LVM 的相应设备替换 /dev/sdb1：

```
root # pvcreate /dev/sdb1
```

2. 创建包含此物理卷的 LVM 卷组 nfs:

```
root # vgcreate nfs /dev/sdb1
```

3. 在卷组 nfs 中创建一个或多个逻辑卷。下面的示例会创建一个名为 work 的 20 GB 逻辑卷:

```
root # lvcreate -n work -L 20G nfs
```

4. 激活卷组:

```
root # vgchange -ay nfs
```

成功执行上述步骤后，您的系统将会显示以下设备：/dev/VOLGROUP/LOGICAL_VOLUME。在本示例中，该设备为 /dev/nfs/work。

4 创建 DRBD 设备

本章介绍如何在 LVM 上设置 DRBD 设备。使用 LVM 作为 DRBD 后端的配置具有以下优点：

- 比在 DRBD 上使用 LVM 的配置更容易设置。
- 当需要调整 LVM 磁盘的大小或有更多磁盘添加到卷组时，管理起来更容易。

由于 LVM 卷组名为 nfs，DRBD 资源也会使用该名称。

4.1 创建 DRBD 配置

出于一致性原因，强烈建议您遵循以下建议：

- 为您的配置使用 /etc/drbd.d/ 目录。
- 根据资源的用途为文件命名。
- 将您的资源配置置于扩展名为 .res 的文件中。以下示例中使用 /etc/drbd.d/nfs.res 文件。

按如下所示继续：

过程 1：创建 DRBD 配置

1. 创建包含以下内容的 `/etc/drbd.d/nfs.res` 文件：

```
resource nfs {
    device /dev/drbd0; ❶
    disk   /dev/nfs/work; ❷
    meta-disk internal; ❸

    net {
        protocol C; ❹
        fencing resource-and-stonith;
    }

    handlers { ❺
        fence-peer "/usr/lib/drbd/crm-fence-peer.9.sh";
        after-resync-target "/usr/lib/drbd/crm-unfence-peer.9.sh";
        # ...
    }

    connection-mesh { ❻
        hosts      alice bob;
    }
    on alice { ❼
        address    192.168.1.1:7790;
        node-id    0;
    }
    on bob { ❼
        address    192.168.1.2:7790;
        node-id    1;
    }
}
```

- ❶ 应用程序预期要访问的 DRBD 设备。
- ❷ DRBD 用于储存实际数据的较低级别块设备。这是在第 3 节“创建 LVM 设备”中创建的 LVM 设备。
- ❸ 储存元数据格式的位置。使用 `internal` 的情况下，元数据将与用户数据一起储存在同一设备上。有关更多信息，请参见手册页。

- ④ 所指定要用于此连接的协议。如果是协议 C，则会将已到达所有磁盘（本地或远程）的写入操作视为完成。
- ⑤ 启用资源级别屏蔽。如果 DRBD 复制链路的连接中断，Pacemaker 会尝试将 DRBD 资源升级到另一个节点。在此过程中会调用脚本。有关更多信息，请参见《管理指南》，第 21 章 “DRBD”，第 21.6 节 “搭配使用资源级屏蔽与 STONITH”。
- ⑥ 定义网格的所有节点。hosts 参数包含共享相同 DRBD 设置的所有主机名。
- ⑦ 包含每个节点的 IP 地址和唯一标识符。

2. 打开 /etc/csync2/csync2.cfg 并检查是否存在以下两行：

```
include /etc/drbd.conf;  
include /etc/drbd.d/*.res;
```

如果不存在，请将这两行添加到文件中。

3. 将文件复制到其他节点上：

```
root # csync2 -xv
```

有关 Csync2 的信息，请参见《管理指南》，第 4 章 “使用 YaST 群集模块”，第 4.5 节 “将配置传输到所有节点”。

4.2 激活 DRBD 设备

准备好 DRBD 配置后，请执行以下操作：

1. 如果您在群集中使用防火墙，请在防火墙配置中打开端口 7790。
2. 如果是第一次执行此操作，请在两个节点（在本示例中为 alice 和 bob）上执行以下命令：

```
root # drbdadm create-md nfs  
root # drbdadm up nfs
```

此命令会初始化元数据储存并创建 /dev/drbd0 设备。

3. 如果所有节点上的 DRBD 设备的数据都相同，请跳过初始的重新同步过程。使用以下命令：

```
root # drbdadm new-current-uuid --clear-bitmap nfs/0
```

4. 将 alice 设为主节点：

```
root # drbdadm primary --force nfs
```

5. 检查 DRBD 状态：

```
root # drbdadm status nfs
```

此命令将返回以下消息：

```
nfs role:Primary
disk:UpToDate
alice role:Secondary
peer-disk:UpToDate
```

同步完成后，您便可访问块设备 /dev/drbd0 上的 DRBD 资源。将使用此设备来创建您的文件系统。有关 DRBD 的详细信息，请参见《管理指南》，第 21 章“DRBD”。

4.3 创建文件系统

完成第 4.2 节“激活 DRBD 设备”后，您应该能在 /dev/drbd0 上看到 DRBD 设备：

```
root # mkfs.ext3 /dev/drbd0
```

5 调整 Pacemaker 的配置

当原始节点恢复联机并位于群集中时，资源可能会故障回复到该节点。为防止资源故障回复到之前运行它的节点，或者要指定让该资源故障回复到其他节点，请更改其资源粘性值。可以在创建资源时或之后指定资源粘性。

要调整选项，请以 `root` 身份（或任何属于 `haclient` 组的非 `root` 用户身份）打开 `crm` 外壳并运行以下命令：

```
root # crm configure
crm(live)configure# rsc_defaults resource-stickiness="200"
crm(live)configure# commit
```

有关全局群集选项的详细信息，请参见《管理指南》，第 6 章“配置和管理基础”，第 6.2 节“仲裁判定”。

6 创建群集资源

下面几节介绍高度可用的 NFS 群集所需资源的配置。使用 `crm` 外壳来执行配置步骤。下面的列表列出了必要的群集资源：

群集资源概述

DRBD 原始资源和可升级克隆资源

这些资源用于复制数据。群集资源管理器认为有必要时，会将可升级克隆资源在主次角色之间切换。

NFS 内核服务器资源

使用此资源，Pacemaker 可确保 NFS 服务器守护程序始终可用。

NFS 导出

一或多个 NFS 导出，通常对应于文件系统。

示例 NFS 情形

- 下列配置示例假设 `192.168.2.1` 是用于为 `192.168.2.x/24` 子网中的客户端传递数据的 NFS 服务器的虚拟 IP 地址。
- 服务从 `/srv/nfs/work` 导出传递的数据。
- 在此导出目录中，群集将从 DRBD 设备 `/dev/drbd0` 挂载 `ext3` 文件系统。此 DRBD 设备位于名为 `nfs` 的 LVM 逻辑卷上。

6.1 DRBD 原始资源和可升级克隆资源

要配置这些资源，请从 `crm` 外壳运行以下命令：

```
crm(live)# configure
crm(live)configure# primitive drbd_nfs \
    ocf:linbit:drbd \
    params drbd_resource="nfs" \
    op monitor interval="15" role="Promoted" \
    op monitor interval="30" role="Unpromoted"
crm(live)configure# clone clone-drbd_nfs drbd_nfs \
    meta promotable="true" promoted-max="1" promoted-node-max="1" clone-max="2" \
    clone-node-max="1" notify="true"
crm(live)configure# commit
```

此命令会创建与 DRBD 资源 `nfs` 对应的 Pacemaker 可提升克隆资源。Pacemaker 现在应该会在两个节点上激活您的 DRBD 资源，并在其中一个节点上将该资源提升为主要角色。

使用 `crm status` 命令或运行 `drbdadm status` 检查群集的状态。

6.2 NFS 内核服务器资源

在 `crm` 外壳中，NFS 服务器守护程序的资源必须配置为 `systemd` 资源类型的克隆。

```
crm(live)configure# primitive nfsserver \
    systemd:nfs-server \
    op monitor interval="30s"
crm(live)configure# clone cl-nfsserver nfsserver \
    meta interleave=true
crm(live)configure# commit
```

提交此配置后，Pacemaker 应该就会在两个节点上启动 NFS 内核服务器进程。

6.3 文件系统资源

1. 按如下所示配置文件系统类型资源（但先**不要**提交此配置）：

```
crm(live)configure# primitive fs_work \
```

```
ocf:heartbeat:Filesystem \  
params device=/dev/drbd0 \  
    directory=/srv/nfs/work \  
    fstype=ext3 \  
op monitor interval="10s"
```

2. 将这些资源合并到一个 Pacemaker 资源组中：

```
crm(live)configure# group g-nfs fs_work
```

3. 添加以下约束，以确保该组在 DRBD 可提升克隆资源为主要角色的节点上启动：

```
crm(live)configure# order o-drbd_before_nfs Mandatory: \  
    clone-drbd_nfs:promote g-nfs:start  
crm(live)configure# colocation col-nfs_on_drbd inf: \  
    g-nfs clone-drbd_nfs:Promoted
```

4. 提交此配置：

```
crm(live)configure# commit
```

提交这些更改后，Pacemaker 会将 DRBD 设备挂载到同一节点上的 /srv/nfs/work。请使用 mount（或查看 /proc/mounts）确认这一点。

6.4 NFS 导出资源

当您的 DRBD、LVM 和文件系统资源正常工作时，继续使用用于管理 NFS 导出的资源。要创建高度可用的 NFS 导出资源，请使用 exportfs 资源类型。

要将 /srv/nfs/work 目录导出到客户端，请使用以下原始资源：

1. 使用以下命令创建 NFS 导出：

```
crm(live)configure# primitive exportfs_work \  
ocf:heartbeat:exportfs \  
params directory="/srv/nfs/work" \  
    options="rw,mountpoint" \  
    clientspec="192.168.2.0/24" \  
wait_for_leasetime_on_stop=true \  
op monitor interval="10s"
```

```
fsid=100 \  
op monitor interval="30s"
```

2. 创建这些资源后，将它们追加到现有的 `g-nfs` 资源组：

```
crm(live)configure# modgroup g-nfs add exportfs_work
```

3. 提交此配置：

```
crm(live)configure# commit
```

Pacemaker 将导出 NFS 虚拟根文件系统及两个其他导出。

4. 确认 NFS 导出设置正确：

```
root # exportfs -v  
/srv/nfs/work IP_ADDRESS_OF_CLIENT(OPTIONS)
```

6.5 NFS 导出的虚拟 IP 地址

初始安装会创建用于 Hawk2 的管理虚拟 IP 地址。虽然您也可将此 IP 地址用于 NFS 导出，但最好另外创建一个专用于 NFS 导出的 IP 地址。这样，以后便可更轻松地应用安全限制。在 `crm` 外壳中使用以下命令：

```
crm(live)configure# primitive vip_nfs IPAddr2 \  
    params ip=192.168.2.1 cidr_netmask=24 \  
    op monitor interval=10 timeout=20  
crm(live)configure# modgroup g-nfs add vip_nfs  
crm(live)configure# commit
```

7 使用 NFS 服务

本章概述如何从 NFS 客户端使用高度可用的 NFS 服务。

要连接到 NFS 服务，请务必使用**虚拟 IP 地址**来连接群集，而不要使用其中一个群集节点的网络接口上配置的物理 IP。出于兼容性原因，请使用服务器上 NFS 导出的**完整**路径。

最简单的形式是，使用如下所示的命令挂载 NFS 导出：

```
root # mount -t nfs 192.168.2.1:/srv/nfs/work /home/work
```

要配置特定传输协议 (proto) 和最大读取和写入请求大小 (rsize 和 wsize)，请使用以下命令：

```
root # mount -o rsize=32768,wsiz=32768 \
192.168.2.1:/srv/nfs/work /home/work
```


如果您需要与 NFS 版本 3 兼容，请在 -o 选项后添加值 vers=3。

要了解更多 NFS 挂载选项，请参见 nfs 手册页。

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