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How to configure NFS on Linux

Contents [Hide]

Introduction (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h1-introduction>)

Scenario (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h2-scenario>)

Prerequisites (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h3-prerequisites>)

Server export file (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h4-server-export-file>)

Most common exports options (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h4-1-most-common-exports-options>)

Edit exports file (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h4-2-edit-exports-file>)

Restart NFS daemon (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h4-3-restart-nfs-daemon>)

Mount remote file system on client (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h5-mount-remote-file-system-on-client>)

Configure automount (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h6-configure-automount>)

Conclusion (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h7-conclusion>)

Appendix A (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h8-appendix-a>)

Turn off firewall on Redhat like systems: (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h8-1-turn-off-firewall-on-redhat-like-systems>)

Add iptables rules to allow NFS communication (<http://linuxconfig.org/how-to-configure-nfs-on-linux#h8-2-add-iptables-rules-to-allow-nfs-communication>)

1. Introduction

The Network File System is certainly one of the most widely used network services. Network file system (NFS) is based on the Remote procedure call (http://en.wikipedia.org/wiki/Remote_procedure_call) which allows the client to automatically mount remote file systems and therefore transparently provide an access to it as if the file system is local.

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2. Scenario

In this scenario we are going to export the file system from the an IP address 10.1.1.50 (NFS server) host and mount it on an a host with an IP address 10.1.1.55 (NFS Client). Both NFS server and NFS client will be running Ubuntu Linux.

At this point, we assume that the NFS service daemon is already installed on your system, including portmap daemon on which NFS setup depends.

If you have not done so yet simply install nfs-common package on both NFS client and NFS server using using apt-get tool.

```
# apt-get install nfs-common
```

The command above will fetch and install all support files common to NFS client and NFS server including portmap.

Additionally we need to install extra package on our NFS server side.

```
apt-get install nfs-kernel-server
```

This package is the actual NFS daemon listening on both UDP and TCP 2049 ports.

Execute rpcinfo -p to check correctness of your NFS installation and to actually confirm that NFS server is indeed running and accepting calls on a port 2049:

```
# rpcinfo -p | grep nfs
100003 2 udp 2049 nfs
100003 3 udp 2049 nfs
100003 4 udp 2049 nfs
100003 2 tcp 2049 nfs
100003 3 tcp 2049 nfs
100003 4 tcp 2049 nfs
```

Furthermore, before we start exporting and mounting NFS directories, your system needs to actually support network file system. To check whether your system supports NFS grep /proc/filesystems and search for nfs.

```
# cat /proc/filesystems | grep nfs
nodev nfs
nodev nfs4
```

If you do not see any output it means that NFS is not supported or the NFS module have not been loaded into your kernel. To load NFS module execute:

```
# modprobe nfs
```

When installed correctly, the NFS daemon should be now listening on both UDP and TCP 2049 port and portmap should be waiting for instructions on a port 111.

At this point you should have portmap listening on both NFS server and NFS client:

```
rpcinfo -p | grep portmap
100000 2 tcp 111 portmapper
100000 2 udp 111 portmapper
```

4. Server export file

4.1. Most common exports options

Here are the most common NFS export techniques and options:

/home/nfs/ 10.1.1.55(rw,sync)	export /home/nfs directory for host with an IP address 10.1.1.55 with read, write permissions, and synchronized mode
/home/nfs/ 10.1.1.0/24(ro,sync)	export /home/nfs directory for network 10.1.1.0 with netmask 255.255.255.0 with read only permissions and synchronized mode
/home/nfs/ 10.1.1.55(rw,sync) 10.1.1.10(ro,sync)	export /home/nfs directory for host with IP 10.1.1.55with read, write permissions, synchronized mode, and also export /home/nfs directory for another host with an IP address 10.1.1.10 with read only permissions and synchronized mode
/home/nfs/ 10.1.1.55(rw,sync,no_root_squash)	export /home/nfs directory for host with an IP address 10.1.1.55with read, write permissions, synchronized mode and the remote root user will be treated as a root and will be able to change any file and directory.
/home/nfs/ *(ro,sync)	export /home/nfs directory for any host with read only permissions and synchronized mode
/home/nfs/ *.linuxcareer.com(ro,sync)	export /home/nfs directory for any host within linuxconfig.org domain with a read only permission and synchronized mode
/home/nfs/ foobar(rw,sync)	export /home/nfs directory for hostname foobar with read, write permissions and synchronized mode

4.2. Edit exports file

Now that we have familiarized our selves with some NFS's export options we can define our first NFS export. Open up your favorite text editor, for example, vim and edit /etc/exports file by adding a line /home/nfs/ *(ro,sync) which will export /home/nfs directory for any host with read only permissions. Instead of text editor you can simply insert your NFS export line into /etc/exports file using echo command:

```
# echo '/home/nfs/ *(ro, sync)' > /etc/exports
# tail -1 /etc/exports
/home/nfs/ *(ro, sync)
```

Be sure that the directory you are about to export by NFS exists. You can also create a file inside the /home/nfs directory which will help you troubleshoot once you mount /home/nfs/ remotely.

```
# touch /home/nfs/nfs-test-file
```

4.3. Restart NFS daemon

Once you have edited `/etc/exports` file you need to restart your NFS daemon to apply any changes. Depending on your Linux distribution the restarting procedure of NFS may differ. Ubuntu and Debian users:

```
# /etc/init.d/nfs-kernel-server restart
```

Redhat and Fedora users

```
# /etc/init.d/nfs restart
```

If you later decide to add more NFS exports to the `/etc/exports` file, you will need to either restart NFS daemon or run command `exportfs`:

```
# exportfs -ra
```

5. Mount remote file system on client

First we need to create a mount point:

```
# mkdir /home/nfs_local
```

If you are sure that the NFS client and mount point are ready, you can run the `mount` command to mount exported NFS remote file system:

```
# mount 10.1.1.50:/home/nfs /home/nfs_local
```

In case that you need to specify a filesystem type you can do this by:

```
# mount -t nfs 10.1.1.50:/home/nfs /home/nfs_local
```

You may also get and an error message:

```
mount: mount to NFS server failed: timed out (retrying).
```

This may mean that your server supports higher NFS version and therefore you need to pass one extra argument to your `nfs` client `mount` command. In this example we use `nfs` version 3:

```
# mount -t nfs -o nfsvers=3 10.1.1.50:/home/nfs /home/nfs_local
```

In any case now you should be able to access a remote `/home/nfs` directory locally on your NFS client.

```
# ls /home/nfs_local/
nfs-test-file
# cd /home/nfs_local/
# ls
nfs-test-file
# touch test
touch: cannot touch `test': Read-only file system
```

The above output proves that a remote NFS export is mounted and that we can access it by navigating to a local `/home/nfs_local/` directory. Please notice that the touch command reports that the filesystem is mounted as read-only which was exactly our intention.

6. Configure automount

To make this completely transparent to end users, you can automount the NFS file system every time a user boots a Linux system, or you can also use PAM modules to mount once a user logs in with a proper username and password. In this situation just edit `/etc/fstab` to mount system automatically during a system boot. You can use your favorite editor and create new line like this within `/etc/fstab`:

```
10.1.1.50:/home/nfs /home/nfs_local/ nfs defaults 0 0
```

as before you also use echo command to do that:

```
# echo "10.1.1.50:/home/nfs /home/nfs_local/ nfs defaults 0 0" >> /etc/fstab
# tail -1 /etc/fstab
10.1.1.50:/home/nfs /home/nfs_local/ nfs defaults 0 0
```

7. Conclusion

The Network File System comes with tons of export options. What has been shown here, just barely scratches the surface of NFS. Please visit Linux NFS-HOWTO (<http://tldp.org/HOWTO/NFS-HOWTO/index.html>) hosted by linux documentation project or NFS homepage (<http://nfs.sourceforge.net/>) for more details.

8. Appendix A

Following section of this NFS tutorial is going to be devoted to RedHat and Fedora Linux systems which by default block all incoming traffic to a NFS server by engaging firewall using iptables rules. For this reason when the firewall is running on your NFS server, you might get this error when mounting NFS filesystem:

mount.nfs: mount to NFS server '10.1.1.13' failed: System Error: No route to host.

This error message has nothing to do with your NFS configuration, all what needs to be done is either turn off the firewall or add iptables rules to allow traffic on portmap port 111, nfs port 2049 and random ports for other nfs services.

There are two solutions to this problem: easy solution is to turn off the firewall completely and the right solution to add appropriate iptables rules.

8.1. Turn off firewall on Redhat like systems:

I would suggest this solution only for testing purposes of your NFS configuration. Enter the following command to stop firewall and clean up all iptables rules:

```
# service iptables stop
```

Now when your NFS settings are correct you should be able to mount nfs filesystem from you client machine.

8.2. Add iptables rules to allow NFS communication

This is a more complex but right solution to the above problem. First we need to set static port for nfs services such as rquotad, mountd, statd, and lockd by editing /etc/sysconfig/nfs file. Add or uncomment following lines in your /etc/sysconfig/nfs file:

```
LOCKD_TCPPOINT=32803  
LOCKD_UDPOINT=32769  
MOUNTD_PORT=892  
STATD_PORT=662
```

Restart you NFSD daemon with following commands:

```
# /etc/init.d/nfs restart  
# /etc/init.d/nfslock restart
```

Use rpcinfo command to confirm a validity of your new ports settings:

```
# rpcinfo -p localhost
```

The output should be similar to the one below:

```
program vers proto  port
100000    2    tcp    111  portmapper
100000    2    udp    111  portmapper
100011    1    udp    999  rquotad
100011    2    udp    999  rquotad
100011    1    tcp    1002 rquotad
100011    2    tcp    1002 rquotad
100003    2    udp    2049 nfs
100003    3    udp    2049 nfs
100003    4    udp    2049 nfs
100021    1    udp    32769 nlockmgr
100021    3    udp    32769 nlockmgr
100021    4    udp    32769 nlockmgr
100021    1    tcp    32803 nlockmgr
100021    3    tcp    32803 nlockmgr
100021    4    tcp    32803 nlockmgr
100003    2    tcp    2049 nfs
100003    3    tcp    2049 nfs
100003    4    tcp    2049 nfs
100005    1    udp    892  mountd
100005    1    tcp    892  mountd
100005    2    udp    892  mountd
100005    2    tcp    892  mountd
100005    3    udp    892  mountd
100005    3    tcp    892  mountd
100024    1    udp    662  status
100024    1    tcp    662  status
```

Save your current iptables rules into iptables-rules-orig.txt :

```
# iptables-save > iptables-rules-orig.txt
```

Create file called iptables-nfs-rules.txt with the following content:

```
*filter
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [2:200]
:RH-Firewall-1-INPUT - [0:0]
-A INPUT -j RH-Firewall-1-INPUT
-A FORWARD -j RH-Firewall-1-INPUT
-A RH-Firewall-1-INPUT -i lo -j ACCEPT
-A RH-Firewall-1-INPUT -p icmp -m icmp --icmp-type any -j ACCEPT
-A RH-Firewall-1-INPUT -p esp -j ACCEPT
-A RH-Firewall-1-INPUT -p ah -j ACCEPT
-A RH-Firewall-1-INPUT -d 224.0.0.251 -p udp -m udp --dport 5353 -j ACCEPT
-A RH-Firewall-1-INPUT -p udp -m udp --dport 631 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m tcp --dport 631 -j ACCEPT
-A RH-Firewall-1-INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m state --state NEW -m tcp --dport 2049 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m state --state NEW -m tcp --dport 22 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m state --state NEW -m tcp --dport 111 -j ACCEPT
-A RH-Firewall-1-INPUT -p udp -m state --state NEW -m udp --dport 111 -j ACCEPT
-A RH-Firewall-1-INPUT -p udp -m state --state NEW -m udp --dport 2049 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m state --state NEW -m tcp --dport 32769 -j ACCEPT
-A RH-Firewall-1-INPUT -p udp -m state --state NEW -m udp --dport 32769 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m state --state NEW -m tcp --dport 32803 -j ACCEPT
-A RH-Firewall-1-INPUT -p udp -m state --state NEW -m udp --dport 32803 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m state --state NEW -m tcp --dport 662 -j ACCEPT
-A RH-Firewall-1-INPUT -p udp -m state --state NEW -m udp --dport 662 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m state --state NEW -m tcp --dport 892 -j ACCEPT
-A RH-Firewall-1-INPUT -p udp -m state --state NEW -m udp --dport 892 -j ACCEPT
-A RH-Firewall-1-INPUT -j REJECT --reject-with icmp-host-prohibited
COMMIT
```

Apply new rules with iptables-restore, where the single argument will be an iptables-nfs-rules.txt file:

NOTE: this will create a new set of iptables rules. If you have already defined some iptables rules previously, you may want to edit iptables-rules-orig.txt and use it with iptables-restore command instead.

```
# iptables-restore iptables-nfs-rules.txt
```

Save these new rules, so you do not have to apply new rules for nfs daemon next time you restart your server:

```
# service iptables save
```

Now your server is ready to accept client nfs requests. Optionally, you may restart iptables rules / firewall with the following command:

```
# service iptables restart
```



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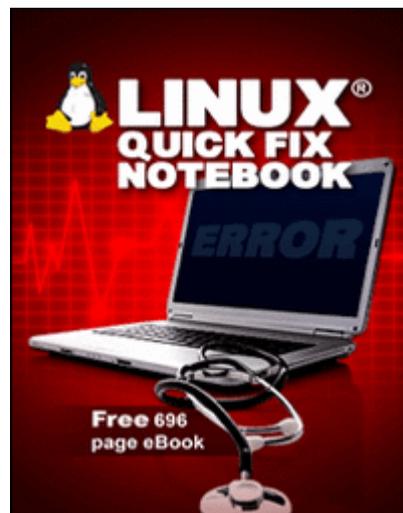


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