

# NFS and Automounting

“Transparent access to files and directories on the network.”

CIS 68C2

UNIX Network Administration

Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

1

# NFS

## □ NFS – Network File System

- ✗ Shares directory trees across the network
  - ✗ Developed by Sun Microsystems
  - ✗ Supported on
    - ✗ all major UNIX's
    - ✗ PCs via PC NFS
    - ✗ Macs via Mac NFS
- ✗ File sharing means: *transparent access*
- ✗ Remote files & directories exist somewhere under /
  - ✗ UNIX commands have transparent access to remote files
  - ✗ No need to transfer files via **ftp**, **rcp**, etc.

“The poster child for everything that is or ever has been wrong with UNIX security”

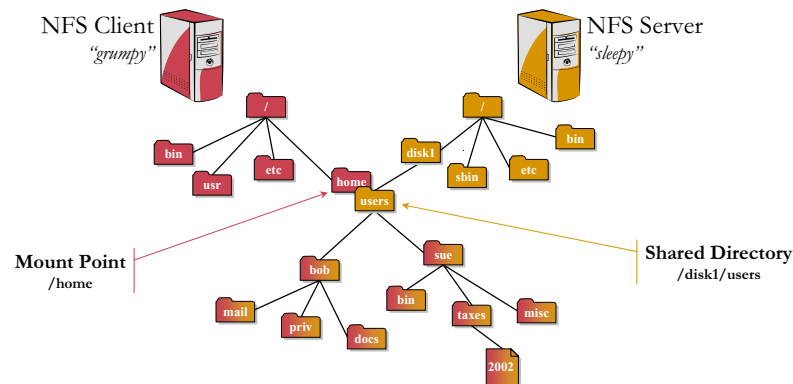
Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

2

# NFS

## □ *Sleepy's* shared files appear within *grumpy's* filesystem



Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

3

# NFS

## □ NFS

- ✗ Two versions of the NFS protocol exist
  - ✗ Version 2
  - ✗ Version 3
    - ✗ Much better performance; supports large files
    - ✗ Falls back to V2 protocol to interoperate w/V2 clients
- ✗ Runs over RPC, using TCP or UDP
- ✗ NFS has both client-side and server-side components
- ✗ Started from boot script /etc/init.d/nfs
  - ✗ Runlevel 3 or 5: /etc/rc[35].d/[SK]\*nfs

Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

4

# NFS

## □ NFS Daemons

- ✗ **nfsd**
  - ✗ Server-side component
  - ✗ Services NFS requests from clients
  - ✗ Several copies of the **nfsd** process is typical
    - ✗ **ps -ef** will show multiple processes or **nfsd N**
- ✗ **mountd** (or **rpc.mountd**)
  - ✗ Server-side component
  - ✗ Services filesystem **mount** requests from clients
- ✗ **quotad** (or **rpc.quotad**)
  - ✗ Supports client-side viewing of disk quotas
  - ✗ Generally considered obsolete, since large disks are cheap

Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

5

# NFS

## □ NFS Daemons

- ✗ **lockd** (or **rpc.lockd**)
  - ✗ Client-side and server-side components
  - ✗ Supports remote *file locking* requests
- ✗ **statd** (or **rpc.statd**)
  - ✗ Client-side and server-side components
  - ✗ Monitors NFS server status
  - ✗ Required for **lockd**
    - ✗ Removes unused locks not removed properly
- ✗ Remote file locking is problematic at best

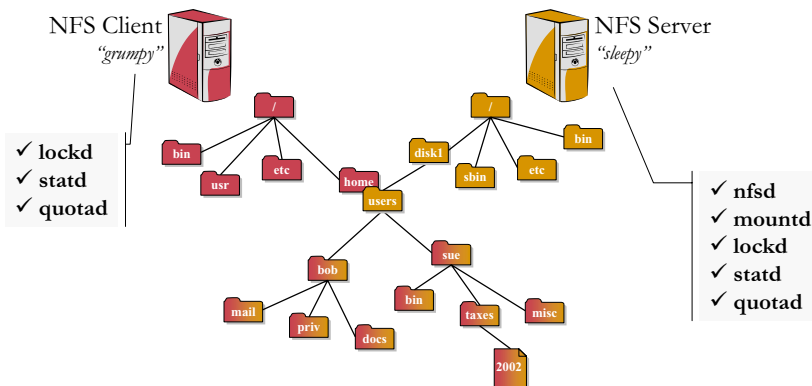
Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

6

# NFS

## □ NFS Daemons



Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

7

# NFS

## □ Sharing / Exporting

- ✗ Only entire directories trees can be shared
  - ✗ Cannot share individual files
  - ✗ All files and directories under exported directory are shared
- ✗ Directories are exported using **exportfs** command
  - ✗ Maintains the binary file **/var/lib/nfs/xtab**
    - ✗ Read by **mountd** when remote host requests access
    - ✗ Created from ASCII file **/etc/exports**
  - ✗ **-a** option exports all entries in **/etc/exports**
  - ✗ **-r** option synchronizes **xtab** and the kernel export table
    - ✗ Use after adding or deleting entries from **/etc/exports**

Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

8

# NFS

## □ /etc/exports

- ✗ Configuration table listing exported directories & options
- ✗ Syntax: *directory* [*host(option)*] ...

<i>directory</i>	The directory to be shared
<i>host</i>	The host(s) allowed to mount <i>directory</i> ; can be a hostname, * and ? wildcards, and IP network address(es)
<i>option</i>	Filesystem options (see: <i>man exports</i> )

```
$ cat /etc/exports
/usr/local          *(ro)
/usr/share/man      *(ro) bigcheese (rw,no_root_squash)
/                   bigcheese (rw,no_root_squash)
/project/src        *.eng.localdomain (rw)
/usr/src/redhat     @developers(ro)
/home/export        192.168.10.0/24 (rw,root_squash)
```

# NFS

## □ Mounting/Un-mounting NFS Filesystems

- ✗ Use **mount** command to mount an exported filesystem

- ✗ Syntax: **mount** *host.rmtdir localdir*

<i>host</i>	The hostname that is sharing <i>rmtdir</i>
<i>rmtdir</i>	Remote directory to be mounted locally May mount any sub-tree of <i>rmtdir</i>
<i>localdir</i>	Where <i>rmtdir</i> will be accessed locally

- ✗ **-a** option will mount all *auto* filesystems in /etc/fstab

- ✗ Use **umount** command to un-mount a filesystem

- ✗ Syntax: **umount** *host.rmtdir*

or **umount** *localdir*

# NFS

## □ NFS: UIDs & GIDs

- ✗ File/directory ownership is relative to NFS client

- ✗ NFS requires globally consistent user and group IDs

## □ NFS: UID 0 (root)

- ✗ UID 0 on NFS client would allow access to NFS files

- ✗ NFS provides mechanism to remap UID 0 to a safer UID

- ✗ **root\_squash** is default option in /etc/exports

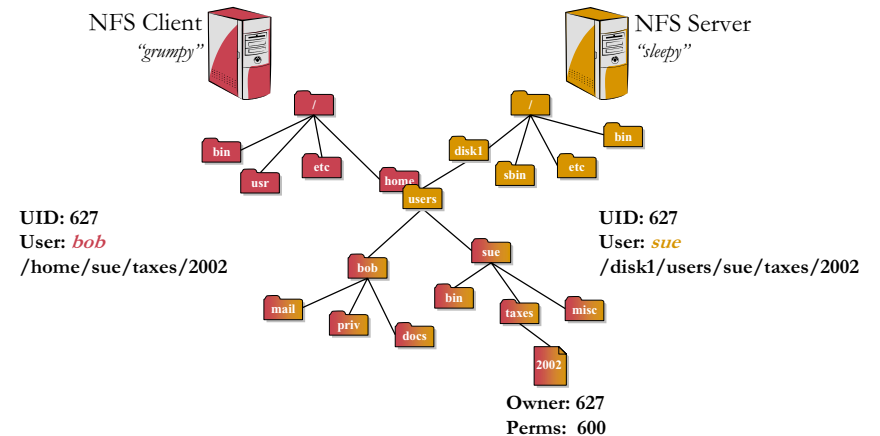
- ✗ Maps UID 0 to UID -2 for NFS activity

- ✗ Often there is an entry in /etc/passwd for this entry

- ✗ Account name **nobody**, **nfsnobody**, or **anonymous**

# NFS

## □ NFS: UIDs & GIDs



# NFS

- /etc/fstab
  - ✗ Filesystem mounting configuration table
  - ✗ Assists in boot-time mounting
  - ✗ Used for both local and network filesystems
  - ✗ Used by **mount** command
    - ✗ Unspecified arguments to **mount** are taken from /etc/fstab
  - ✗ Also used by **umount**, **fsck**, **dump**, and **swapon**
  - ✗ Order of /etc/fstab records matters
    - ✗ Read by commands top-to-bottom

# NFS

- /etc/fstab
  - ✗ Syntax: *filesystem mountpoint fstype options dump-level fsck-pass*
    - filesystem* Filesystem (or device) to be mounted
    - mountpoint* Where filesystem (or device) is to be accessed
    - fstype* Type of filesystem (i.e. nfs, ext2, iso9660, msdos)
    - options* Options supplied to mount command (see: man mount)
      - auto – will be mounted with mount –a command
    - dump-level* Level for dump command (set to 0 for NFS mounts)
    - fsck-pass* Determines relative order **fsck** will run on filesystem (set to 0 for NFS mounts)

# NFS

- /etc/fstab
  - ✗ Example

```
$ cat /etc/fstab
LABEL=/ / ext2 defaults 1 1
LABEL=/home /home ext2 defaults 1 2
/dev/cdrom /mnt/cdrom iso9660 noauto,owner,ro 0 0
/dev/cdrom1 /mnt/cdrom1 iso9660 noauto,owner,ro 0 0
/dev/fd0 /mnt/floppy auto noauto,owner 0 0
/dev/fd0 /mnt/floppyextfs ext2 noauto,owner 0 0
none /proc proc defaults 0 0
none /dev/pts devpts gid=5,mode=620 0 0
/dev/hde5 swap swap defaults 0 0
bambi:/usr/local /usr/local nfs auto,hard,intr,bg 0 0
doc:/usr/local/man /usr/local/man nfs auto,hard,intr,bg 0 0
goofy:/source /home/src nfs noauto,hard,intr,bg 0 0
```

# NFS

- NFS Diagnostics
  - ✗ **showmount** – information about exported filesystems
    - ✗ Syntax: **showmount options [ host ]**
    - ✗ **-e** option
      - ✗ Lists exported filesystems
    - ✗ **-a** option
      - ✗ Lists exported filesystems that have been mounted by some client
    - ✗ Optional *host* argument returns information relative to that host
  - ✗ **nfsstat** – NFS client/server statistics
    - ✗ Used for performance tuning and troubleshooting
  - ✗ Also **netstat -s** and **rpcinfo**

# Automounter

- Automounter
  - ✗ Mounting of filesystems happens auto-magically
    - ✗ Mounted when file/directories within filesystem are referenced
    - ✗ Un-mounted when unused
  - ✗ Two varieties of automounter for Linux:
    - ✗ **autofs**
      - ✗ Virtual filesystem implemented within the kernel
    - ✗ **amd**
      - ✗ User level program, runs on any UNIX platform
      - ✗ We will not be covering the **amd** automounter

# Automounter - autofs

- Automounter Components
  - ✗ **autofs**
    - ✗ Kernel-level virtual filesystem driver
  - ✗ **automount**
    - ✗ Daemon that assists kernel's **autofs** in mounting / un-mounting
    - ✗ One **automount** process per mount point
  - ✗ Configuration Files (Maps)
    - ✗ A master configuration file, and one or more second-level files
  - ✗ **/etc/init.d/autofs**
    - ✗ Script that processes the master configuration file
    - ✗ Takes single argument: **start, stop, restart, reload, status**
    - ✗ Don't confuse **autofs** kernel driver with **/etc/init.d/autofs**

# Automounter - autofs

- Configuration Files (also called *maps*)
  - ✗ **/etc/auto.master** - Master configuration file
    - ✗ The map of maps
    - ✗ Each entry refers to a second level configuration file
      - ✗ Except for Direct maps, which are unsupported in Linux
  - ✗ Second level configuration files (maps):
    - ✗ Indirect map
      - ✗ Used when there is a common leading prefix in automounted paths
    - ✗ Executable map
      - ✗ Used to run a program to run to generate automounter instructions

# Automounter - autofs

- Example
    - ✗ Indirect Maps
- /home/cis68c2/gumby/letter.txt**  
*map key relative path on mounted fs*
- 1) When a path begins with a directory listed in the master configuration file (called the *map* or *mountpoint*)...
  - 2) automounter refers to the map file listed here to see...
  - 3) if the next component of the path matches the item listed here (called the *key*), then...
  - 4) the filesystem listed here is mounted at the directory */map/key* and the path is now resolved.
- 
- | key     | Filesystem to mount          |
|---------|------------------------------|
| cis68c1 | geneva: /export/home/cis68c1 |
| cis68c2 | geneva: /export/home/cis68c2 |
| staff   | geneva: /export/home/staff   |
| sun4v   | sears: /export/tools.sun4v   |
| goofy   | goofy: /                     |
| bambi   | bambi: /                     |
| donald  | donald: /                    |
- Master Configuration Map**  
**/etc/auto.master**
- Map file**
- Indirect Maps**

## Automounter - autofs

- /etc/auto.master
  - ✗ Modifications to file are not noticed by automounter
    - ✗ Notify automounter with command: `/etc/init.d/autofs reload`
  - ✗ Syntax: `map mapfile options`

`map` Top-level mount directory (AKA: *mountpoint*)  
`mapfile` Name of map file to use for sub-directory resolution  
`options` Mounting options; cumulative with those in `mapfile`

```
$ cat /etc/auto.master
# Format of this file:
# map mapfile options
# For details of the format look at autofs(8).
/net /etc/auto.net --timeout=60
/home /etc/auto.home --timeout=300
/opt/tools /etc/auto.tools --timeout=300
```

Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

21

## Automounter - autofs

- Indirect Maps
  - ✗ Series of records, each indicating a directory beneath `map`, mounting options, and the filesystem to be mounted
  - ✗ Syntax: `key options location`

`key` Subdirectory under `map` – mount happens at `/map/key`  
`options` Mounting options, cumulative w/`auto.master`  
`location` Filesystem to be mounted; typically NFS mount but can be any mountable filesystem (local, samba, etc.)

```
$ cat /etc/auto.net
# Eg. When /net/goofy/XYZ is referenced, goofy:/ is mounted
# at /net/goofy and XYZ is resolved
goofy -rw,hard,intr goofy:/
bambi -rw,hard,intr bambi:/
donald -rw,hard,intr donald:/
```

Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

22

## Automounter - autofs

- Indirect Maps
  - ✗ Wildcards can be used to simplify mount mappings
    - \* As the `key` matches everything
    - & Refers to the `key` that was matched
  - ✗ Variables generalize system dependent mappings
    - ✗ See `autofs(5)` for list of built-in variables

```
$ cat /etc/auto.home
# Automounts goofy:/export/home/joe onto /home/joe
joe -rw,hard,nointr goofy:/export/home/&
# Automounts XXX:/home/XXX onto /home/XXX
* -rw,hard,nointr &:/home/&
$ cat /etc/auto.tools
# Automounts sears:/export/tools.$ARCH onto /opt/tools/$ARCH
$ARCH -rw,hard,nointr sears:/export/tools.$ARCH
```

Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

23

## Automounter - autofs

- Executable maps
  - ✗ Also called **program** maps
  - ✗ Allows scripting to generate more complex scenarios
  - ✗ If mapfile is an executable program, it is run when needed
    - ✗ The program is given one argument, the `key`
    - ✗ The program must return either:
      - ✗ One line of a map for use by the automounter
      - ✗ Nothing

Updated: 10/16/02

CIS68C2 UNIX Network Administration  
Copyright 2002 - Mike Cappella

24

### □ See Also

- ✗ O'Reilly's *Managing NFS and NIS*
- ✗ CIS8C1 Lecture 9
  - ✗ <http://cis68c1.mikecappella.com>
- ✗ *NFS HowTo*
  - ✗ <http://www.tldp.org/HOWTO/NFS-HOWTO/index.html>
- ✗ Man pages
  - ✗ nfsd(8) – NFS server process
  - ✗ mountd(8) – NFS mount daemon
  - ✗ exportfs(8) – management of NFS export list
  - ✗ nfsstat(8) – NFS / RPC statistics utility

### □ See Also

- ✗ Man pages (*continued*)
  - ✗ rpcinfo(8) – RPC information utility
  - ✗ fstab(5) – file system information table
  - ✗ autofs(5) – autofs configuration file format
  - ✗ autofs(8) – control script /etc/init.d/autofs
  - ✗ auto.master(5) – master configuration file format
  - ✗ automount(8) - configures mount points for autofs
  - ✗ mount(8) – the mount command (for mount options)