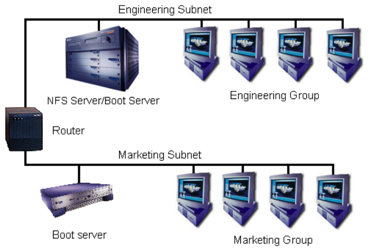
CSE 265:
System and Network Administration

- The Network File System
  - NFS Introduction
  - Server-side NFS
  - Client-side NFS
  - NFS Statistics with nfsstat
  - Dedicated NFS File Servers
  - Automatic Mounting

NFS: Network File System

- Allows systems to share filesystems with other computers
  - Clients mount network file systems just like local filesystems
- Originally designed to be transparent and stateless
- Consists of
  - A mounting protocol
  - Mount server
  - File service daemons
  - Diagnostic utilities



NFS

- Network File System
  - Version 2: slow (obsolete)
    - Originally released by Sun in 1985
  - Version 3: faster (common)
  - Version 4: security, locking (relatively new)
- Uses Sun's RPC (Remote Procedure Call) protocol (documented in RFC 1050, 1988)
  - Supports UDP or TCP for transport (v2,v3)
- File locking is worse under NFS v3 since servers are stateless

Magic cookies (NFS v2,v3)

- The server doesn't track which clients have mounted filesystems (stateless)
- Instead, the server discloses a secret/magic cookie that identifies the directory to the server on future access
  - Often the cookie is just the filesystem major and minor device IDs, plus directory inode
- Unmounting and remounting the actual filesystem on the server normally changes the cookie

Server-side NFS

- Servers “export” a directory to make it available to others
- Servers run two daemons (v2,v3)
  - rpc.mountd to handle mount requests
  - rpc.nfsd for actual file service
- Filesystems to be exported are in /etc/exports

```
# sample /etc/exports file
/               master(rw) trusty(rw,no_root_squash)
/projects       proj*.local.domain(rw)
/usr            *.local.domain(ro) @trusted(rw)
/home/joe       pc001(rw,all_squash,anonuid=150,anongid=100)
/pub            (ro,insecure,all_squash)
```

- Can modify and view exports using **exportfs**

Client-side NFS

- NFS filesystems are mounted much like local filesystems using **mount** hostname:directory
- Before mounting, filesystem must be exported
  - Check with **showmount** (v2,v3)

```
#showmount -e wume2
Export list for wume2:
/projects2 *.local.cse.lehigh.edu,davison
/projects1 *.local.cse.lehigh.edu,davison
```

- Use **umount** to unmount an NFS filesystem
  - Can't be unmounted while in use (just like local disks)
  - Use **lsof** to find processes with open files

Security and NFS

- Not originally designed for security!
- Access to NFS volumes is determined via /etc/exports
  - lists hostnames or IP addresses that have access
  - assumes clients will identify themselves correctly
- TCP wrappers/firewall can help protect service
- File-level access is managed according to UID, GID, and file permissions
  - Just as in local file systems

NFS Security Problems

- Users with given UID can access any file with that UID (even if different user)
  - Good reason for globally unique UID space!
- Root access on a client can access any file
- NFS typically uses option called “squashing root”
  - Makes incoming requests for UID 0 look like they came from some other user
  - Account named nobody is utilized
- Option all_squash does the same for all users

Dedicated NFS File Servers

- Dedicated NFS appliances are available
  - Network Appliance, EMC, HP, Oracle, etc.
- Features
  - Provide Network Attached Storage (NAS)
  - Optimized for file service
  - Can scale to lots of storage and users
  - Often provide service to both Unix and Windows clients
  - More reliable
    - simpler software, redundant hardware, RAID
  - Easy to administer
  - Often provide backup and checkpoint facilities

Mounting NFS filesystems

- Use **mount** for temporary mounts

```
# mount -o rw,hard,intr,bg server:/home /home
```

- /etc/fstab contains mounts for boot time

```
wume1:/home            /home            nfs   \
  intr,bg,rw 1 1
wume1:/var/spool/mail  /var/spool/mail  nfs   \
  intr,bg,rw 1 1
```

- Common options:
  - rw, ro, bg, hard, soft, intr, tcp, udp

Automatic Mounting

- Separate lines in /etc/fstab can be difficult in large networks
  - Maintaining /etc/fstab on more than a few dozen machines is tedious
  - Worse is when those machines mount from many hosts
- When an important host crashes, clients are crippled
  - Having a copy of the partition mountable elsewhere would be ideal
- An automounter mounts filesystems only when needed, and can work with replicated systems for redundancy

NFS Statistics and Utilities

- **nfsstat**

```
Server rpc stats:
calls       badcalls    badauth     badclnt     xdrcall
40996991    0           0           0           0
Server nfs v3:
null        getattr     setattr     lookup      access      readlink
2        0% 428484   1% 25913    0% 444794   1% 398283   0% 3174     0%
read        write       create      mkdir       symlink     mknod
10193400 24% 29048042 70% 69068    0% 695       0% 3110      0% 0         0%
remove      rmdir       rename      link        readdir     readdirplus
5014     0% 81       0% 103716   0% 0        0% 38649    0% 1625     0%
fsstat      fsinfo      pathconf    commit
853      0% 356      0% 0        0% 231730   0%
```

- **netstat**
  - General network statistics, may help debugging
- **showmount -a**
  - Shows all systems believed to have mounted filesystems

automount

- A background process that watches for requests for files within a specified directory
  - Uses autofs kernel-resident filesystem driver
  - Then mounts the requested filesystem
- /etc/init.d/autofs script is configured via /etc/auto.master

```
/misc /etc/auto.misc  --timeout=300
```

- Each mount point has separate map file (or script), listing all valid subdirectories and how to get them

automount example (misc)

```
# This is an automounter map and it has the following format
# key [ -mount-options-separated-by-comma ] location
# Details may be found in the autofs(5) manpage

cd              -fstype=iso9660,ro,nosuid,nodev :/dev/cdrom
brian-sun-windows       -fstype=smbfs,rw,noexec,username=brian,pass\
word=XYZ,uid=501,gid=501 ://gutenberg/brian

# the following entries are samples to pique your imagination
#linux        -ro,soft,intr         ftp.example.org:/pub/linux
#boot         -fstype=ext2          :/dev/hda1
#floppy       -fstype=auto          :/dev/fd0
```

```
% mount
/dev/mapper/VolGroup00-LogVol00 on / type ext3 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
/dev/sda2 on /boot type ext3 (rw)
tmpfs on /dev/shm type tmpfs (rw)
nfsd on /proc/fs/nfsd type nfsd (rw)
morning:/raid on /net/morning/raid type nfs
(rw,nosuid,nodev,hard,intr,addr=128.180.120.43)
```