## Lesson Module Status

- Slides
- Whiteboard with 1st minute quiz

- Flashcards
- Web Calendar summary
- Web book pages
- Commands
- Howtos

- Printer, cable, cord, dhcp reservation
- NFS lab tested
- Lab template in depot

- Backup slides, Confer links, handouts on flash drive
- 9V backup battery for microphone

# Course history and credits

Jim Griffin

- Jim created the original version of this course
- Jim's site: http://cabrillo.edu/~jgriffin/

Rick Graziani

- Thanks to Rick Graziani for the use of some of his great network slides
- Rick's site: http://cabrillo.edu/~rgraziani/

Cabrillo College
est. 1959

# CIS 192 - Lesson 10

Instructor: **Rich Simms**
Dial-in: **888-450-4821**
Passcode: **761867**

Solomon

Sean C.

Chris

Corey

Bryan

Sean F.

Tony

David

Donna

Dave

Evan

Gabriel

Elia

Tajvia

Carlos

Adam

Ben

Laura

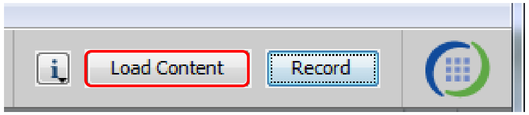
VMs for tonight

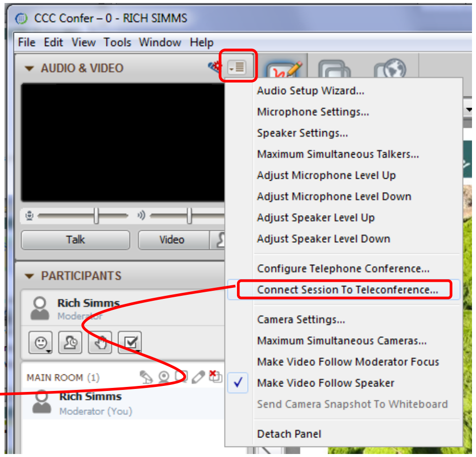
**Celebrian Arwen**

*Email me (risimms@cabrillo.edu) a relatively current photo of your face for 3 points extra credit*

CCC Confer

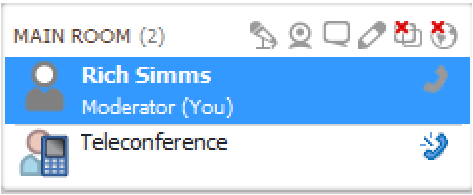
[ ] **Preload White Board with *cis*lesson??*-WB***



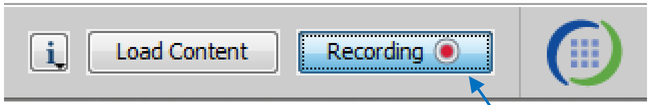

CCC Confer – 0 - RICH SIMMS
File Edit View Tools Window Help
AUDIO & VIDEO
Talk
Video
PARTICIPANTS
Rich Simms
Moderator
MAIN ROOM (1)
Rich Simms
Moderator (You)
Audio Setup Wizard...
Microphone Settings...
Speaker Settings...
Maximum Simultaneous Talkers...
Adjust Microphone Level Up
Adjust Microphone Level Down
Adjust Speaker Level Up
Adjust Speaker Level Down
Configure Telephone Conference...
Connect Session To Teleconference...
Camera Settings...
Maximum Simultaneous Cameras...
Make Video Follow Moderator Focus
Make Video Follow Speaker
Send Camera Snapshot To Whiteboard
Detach Panel

[ ] **Connect session to Teleconference**

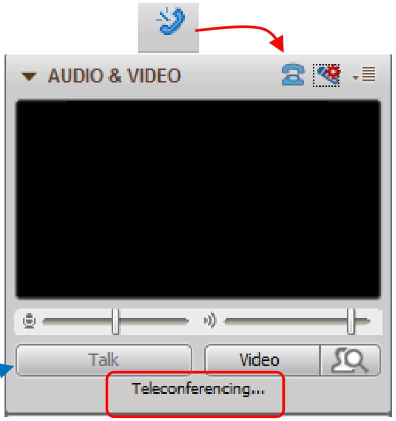
*Session now connected to teleconference*



[ ] **Is recording on?**



*Red dot means recording*

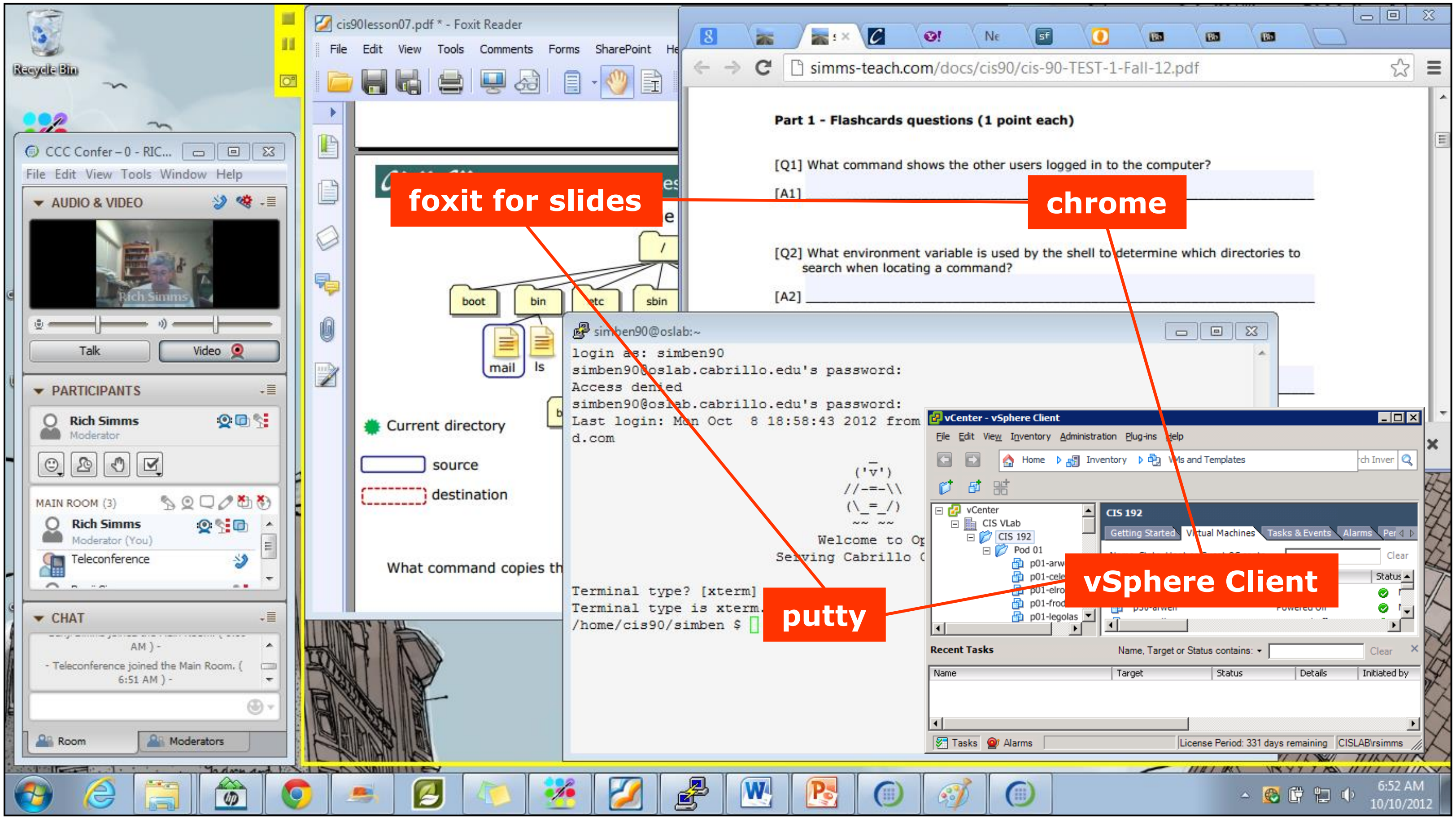


[ ] **Use teleconferencing, not mic**

*Should be greyed out*

[ ] Video (webcam) optional

[ ] layout and share apps



**Part 1 - Flashcards questions (1 point each)**

[Q1] What command shows the other users logged in to the computer?

[A1] ____________________________________________

[Q2] What environment variable is used by the shell to determine which directories to search when locating a command?

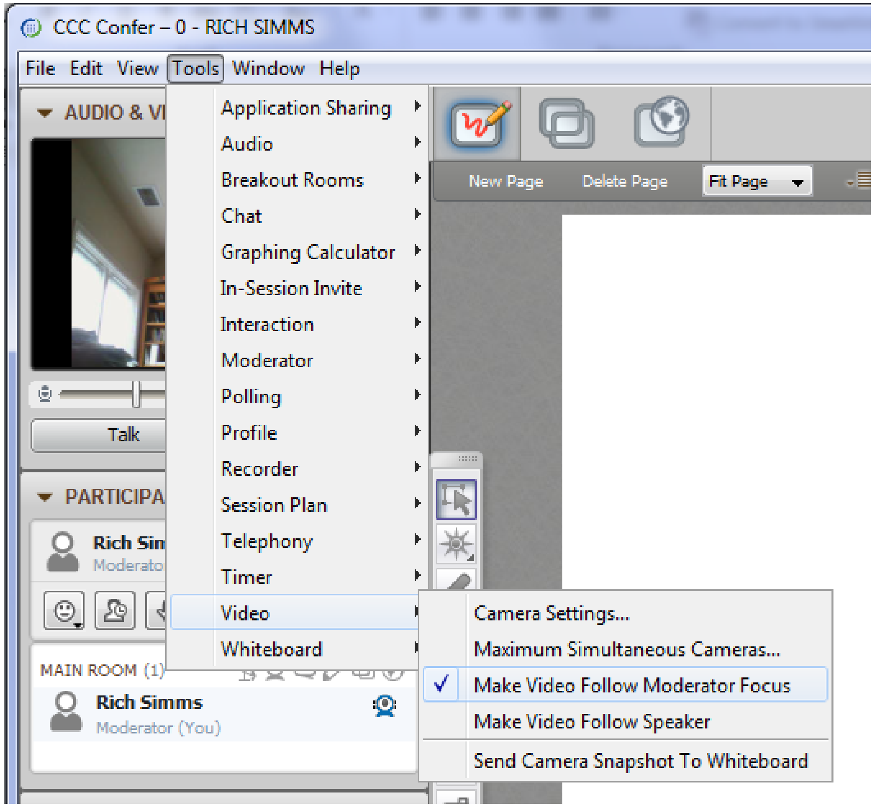
[A2] ____________________________________________

```
login as: simben90
simben90@oslab.cabrillo.edu's password:
Access denied
simben90@oslab.cabrillo.edu's password:
Last login: Mon Oct  8 18:58:43 2012 from
d.com

                                    ('v')
                                   //-=-\\
                                   (\_=_/)
                                    ~~ ~~
                              Welcome to Op
                           Serving Cabrillo C

Terminal type? [xterm]
Terminal type is xterm.
/home/cis90/simben $
```

[ ] Video (webcam) optional

[ ] Follow moderator

[ ] Double-click on postages stamps

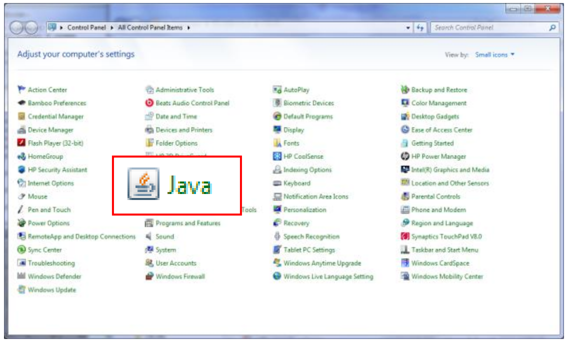


## Universal Fix for CCC Confer:

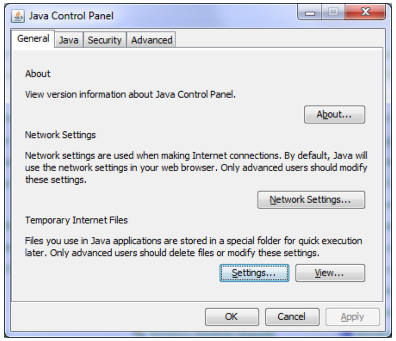
CCC Confer

1) Shrink (500 MB) and delete Java cache
2) Uninstall and reinstall latest Java runtime

Control Panel (small icons)



General Tab > Settings...



About

View version information about Java Control Panel.

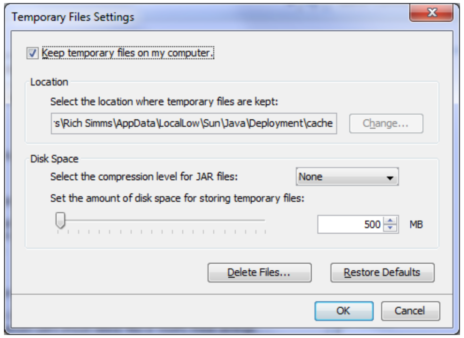
Network Settings

Network settings are used when making Internet connections. By default, Java will use the network settings in your web browser. Only advanced users should modify these settings.

Temporary Internet Files

Files you use in Java applications are stored in a special folder for quick execution later. Only advanced users should delete files or modify these settings.

500MB cache size



☑ Keep temporary files on my computer.

Location

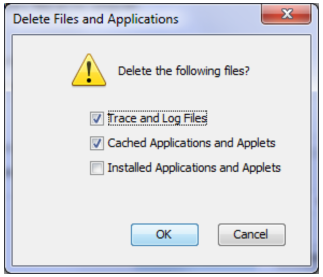
Select the location where temporary files are kept: s\Rich Simms\AppData\LocalLow\Sun\Java\Deployment\cache

Disk Space

Select the compression level for JAR files: None

Set the amount of disk space for storing temporary files: 500 MB

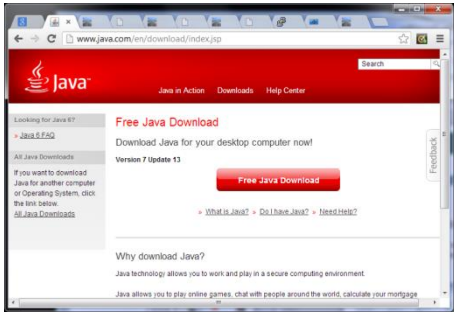
Delete these



Delete the following files?

☑ Trace and Log Files
☑ Cached Applications and Applets
□ Installed Applications and Applets

Google Java download



If you want to download Java for another computer or Operating System, click the link below.

Free Java Download

Download Java for your desktop computer now!

Version 7 Update 13

Why download Java?

Java technology allows you to work and play in a secure computing environment.

Java allows you to play online games, chat with people around the world, calculate your mortgage

# First Minute Quiz

Please answer these questions **in the order** shown:

Use CCC Confer White Board

**For credit email answers to:**
**`risimms@cabrillo.edu`**
**within the first few minutes of class**

# Network File System and Printing

| Objectives | Agenda |
|---|---|
| • Use NFS to share a directory of files on one machine with the other hosts on the same network. | • Quiz<br>• Questions on previous material<br>• Test 2 Results<br>• Housekeeping<br>• Mounting<br>• LVM sidetrack<br>• RPC and Port Mapper<br>• NFS<br>• Printing<br>• Lab X3 (NFS)<br>• Wrap |

# Questions

Lesson material?

Labs?

How this course works?

| | |
|---|---|
| Chinese Proverb | 他問一個問題，五分鐘是個傻子，他不問一個問題仍然是一個傻瓜永遠。<br>*He who asks a question is a fool for five minutes; he who does not ask a question remains a fool forever.* |

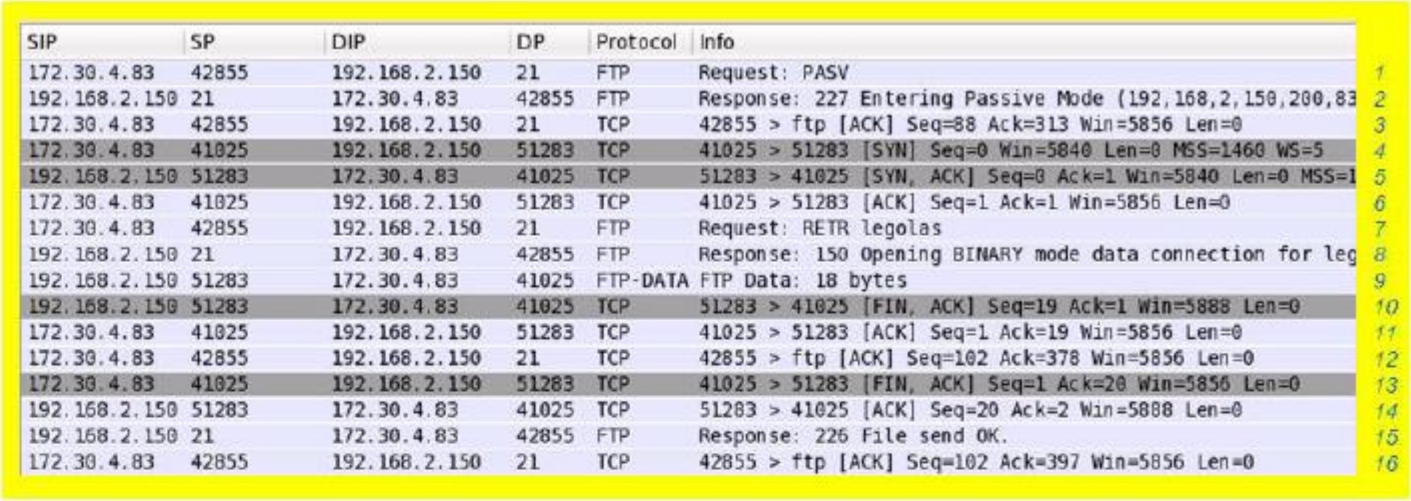
# Test 2 Results

# Test 2 Results

| | | |
|---|---|---|
| 1) | 10 | xxxxxxxxxx |
| 2) | 8 | xxxxxxxx |
| 3) | 3 | xxx |
| 4) | 6 | xxxxxx |
| 5) | 10 | xxxxxxxxxx |
| 6) | 4 | xxxx |
| 7) | 0 | |
| 8) | 8 | xxxxxxxx |
| 9) | 2 | xx |
| 10) | 5 | xxxxx |
| 11) | 9 | xxxxxxxxx |

*Histogram of incorrect answers*

Figure 1 - Wireshark capture of a FTP file copy

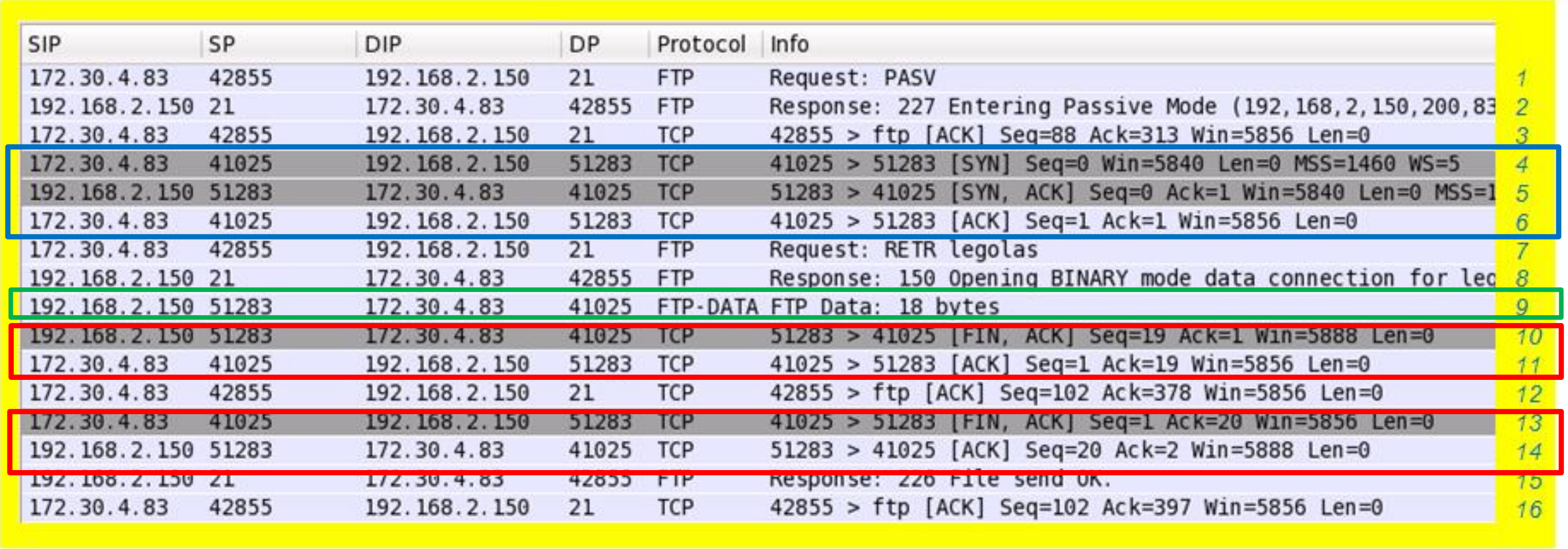


| SIP | SP | DIP | DP | Protocol | Info | |
|---|---|---|---|---|---|---|
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | FTP | Request: PASV | 1 |
| 192.168.2.150 | 21 | 172.30.4.83 | 42855 | FTP | Response: 227 Entering Passive Mode (192,168,2,150,200,83 | 2 |
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=88 Ack=313 Win=5856 Len=0 | 3 |
| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [SYN] Seq=0 Win=5840 Len=0 MSS=1460 WS=5 | 4 |
| 192.168.2.150 | 51283 | 172.30.4.83 | 41025 | TCP | 51283 > 41025 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1 | 5 |
| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [ACK] Seq=1 Ack=1 Win=5856 Len=0 | 6 |
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | FTP | Request: RETR legolas | 7 |
| 192.168.2.150 | 21 | 172.30.4.83 | 42855 | FTP | Response: 150 Opening BINARY mode data connection for leg | 8 |
| 192.168.2.150 | 51283 | 172.30.4.83 | 41025 | FTP-DATA | FTP Data: 18 bytes | 9 |
| 192.168.2.150 | 51283 | 172.30.4.83 | 41025 | TCP | 51283 > 41025 [FIN, ACK] Seq=19 Ack=1 Win=5888 Len=0 | 10 |
| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [ACK] Seq=1 Ack=19 Win=5856 Len=0 | 11 |
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=102 Ack=378 Win=5856 Len=0 | 12 |
| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [FIN, ACK] Seq=1 Ack=20 Win=5856 Len=0 | 13 |
| 192.168.2.150 | 51283 | 172.30.4.83 | 41025 | TCP | 51283 > 41025 [ACK] Seq=20 Ack=2 Win=5888 Len=0 | 14 |
| 192.168.2.150 | 21 | 172.30.4.83 | 42855 | FTP | Response: 226 File send OK. | 15 |
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=102 Ack=397 Win=5856 Len=0 | 16 |

1. Referring to figure 1 above and using the packet numbers on the right, which packets close the established connection used for the data transfer?

[A1] 10, 11, 13, 14 (not 12)

*See: Lesson 6 (More FTP Module) and Lesson 8 (TCP Connections module)*



| SIP | SP | DIP | DP | Protocol | Info | |
|---|---|---|---|---|---|---|
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | FTP | Request: PASV | 1 |
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| 192.168.2.150 | 51283 | 172.30.4.83 | 41025 | TCP | 51283 > 41025 [FIN, ACK] Seq=19 Ack=1 Win=5888 Len=0 | 10 |
| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [ACK] Seq=1 Ack=19 Win=5856 Len=0 | 11 |
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=102 Ack=378 Win=5856 Len=0 | 12 |
| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [FIN, ACK] Seq=1 Ack=20 Win=5856 Len=0 | 13 |
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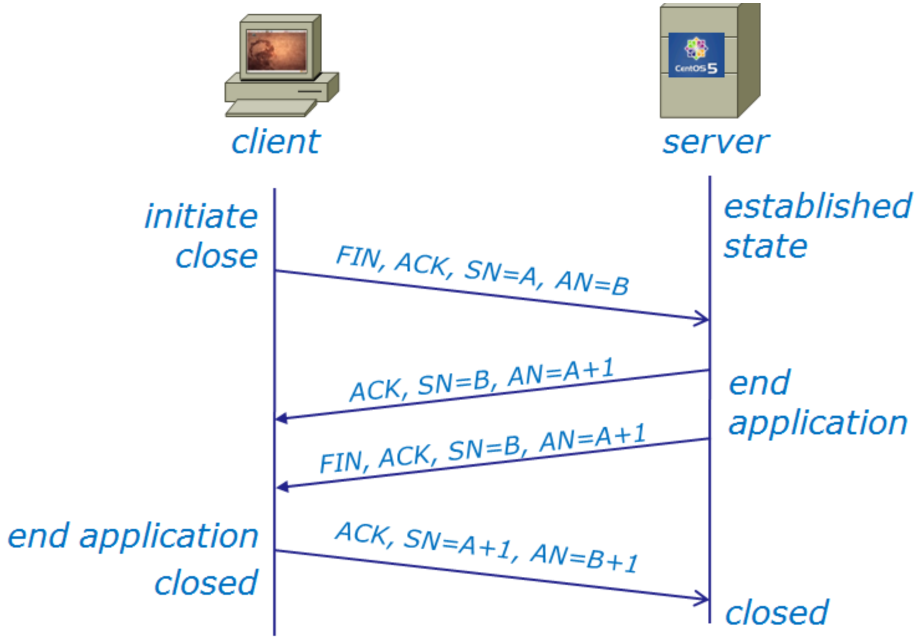
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=102 Ack=397 Win=5856 Len=0 | 16 |

*3 way handshake to* ***Open***

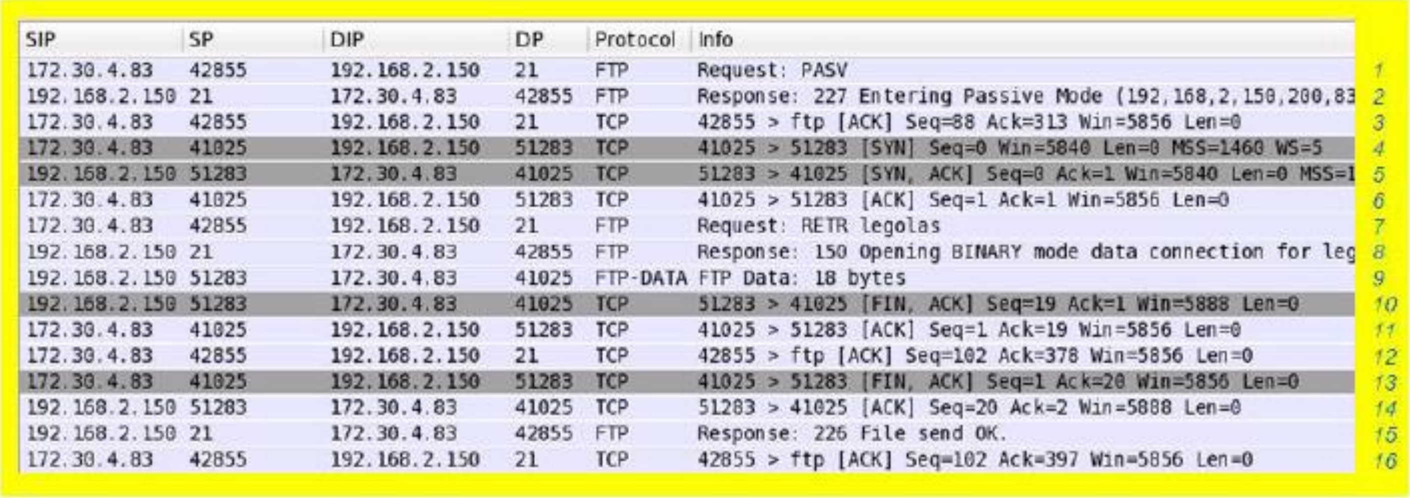
*Data* ***transfer***

*4 way handshake to* ***Close***



*Q1 answer - the packets that close the data transfer connection are 10,11,13, 14 (not 12)*

Figure 1 - Wireshark capture of a FTP file copy



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| 192.168.2.150 | 21 | 172.30.4.83 | 42855 | FTP | Response: 150 Opening BINARY mode data connection for leg | 8 |
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| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [ACK] Seq=1 Ack=19 Win=5856 Len=0 | 11 |
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=102 Ack=378 Win=5856 Len=0 | 12 |
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| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=102 Ack=397 Win=5856 Len=0 | 16 |

2. Referring to figure 1 above, what socket is used for the FTP data transfer?

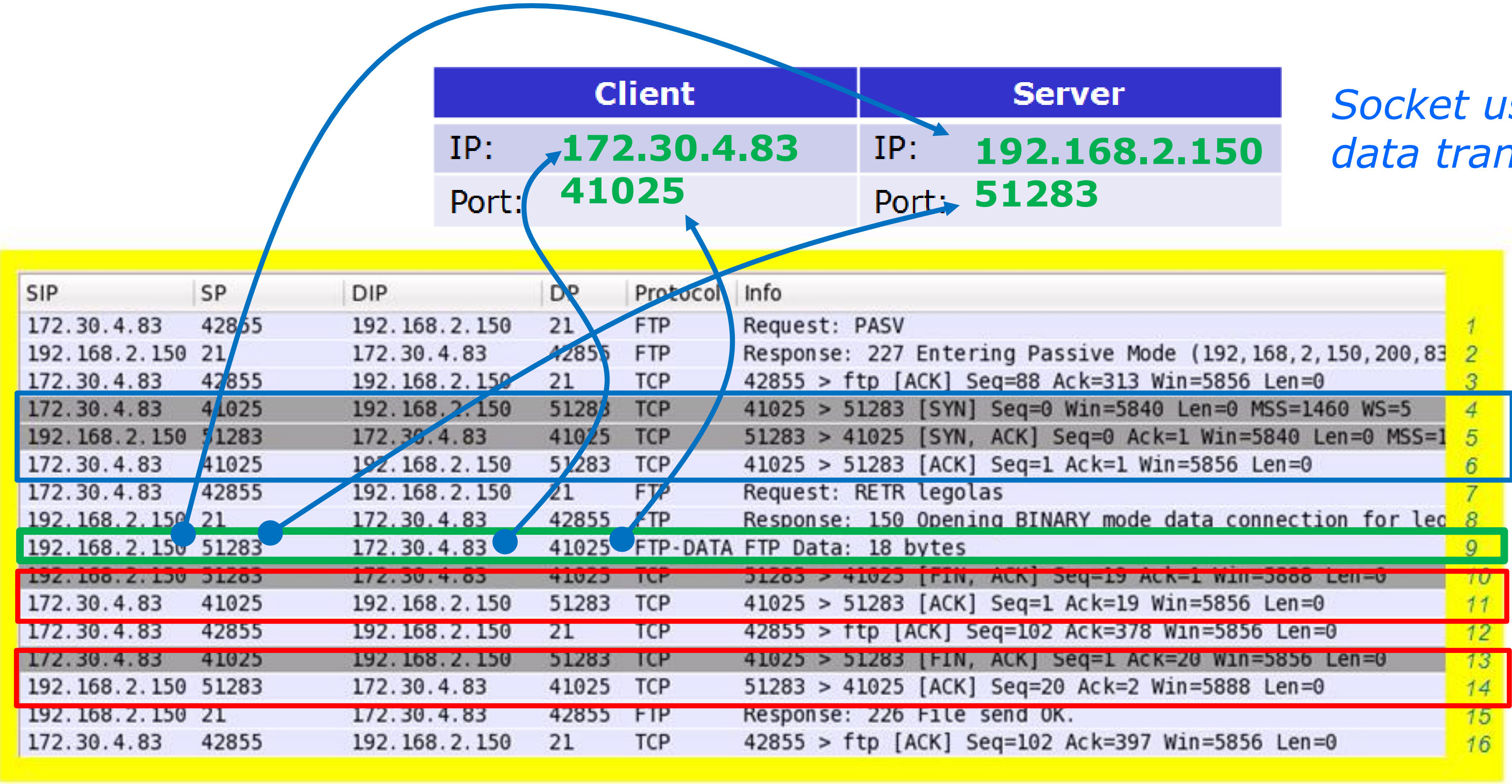
Client IP:
[A2a] 172.30.4.83

Client Port:
[A2b] 41025

Server IP:
[A2c] 192.168.2.150

Server Port:
[A2d] 51283

*See Lesson 6 (More FTP Module) and Lesson 8 (TCP Connections module)*



| Client | | Server | |
|---|---|---|---|
| IP: | 172.30.4.83 | IP: | 192.168.2.150 |
| Port: | 41025 | Port: | 51283 |

*Socket used for data transfer*

| SIP | SP | DIP | DP | Protocol | Info | |
|---|---|---|---|---|---|---|
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | FTP | Request: PASV | 1 |
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*3 way handshake to **Open***

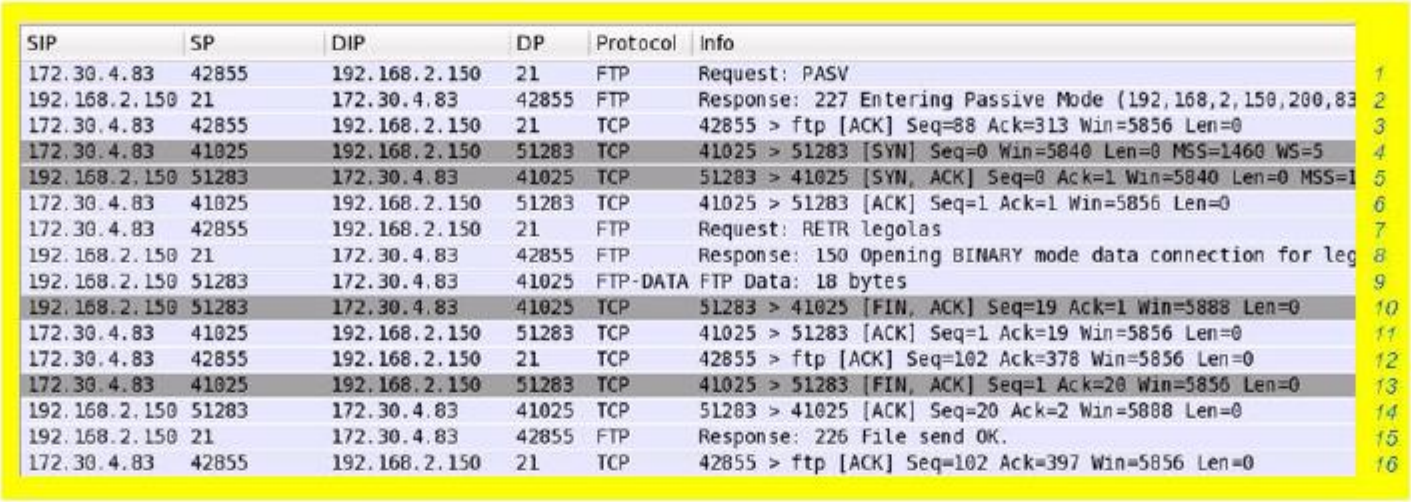
*Data **transfer***

*4 way handshake to **Close***

*Notes:*

- *FTP uses one socket for commands and another for data transfers*
- *To identify the server, look for the system using FTP ports 21 or 20*

Figure 1 - Wireshark capture of a FTP file copy



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|---|---|---|---|---|---|---|
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | FTP | Request: PASV | 1 |
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| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=102 Ack=397 Win=5856 Len=0 | 16 |

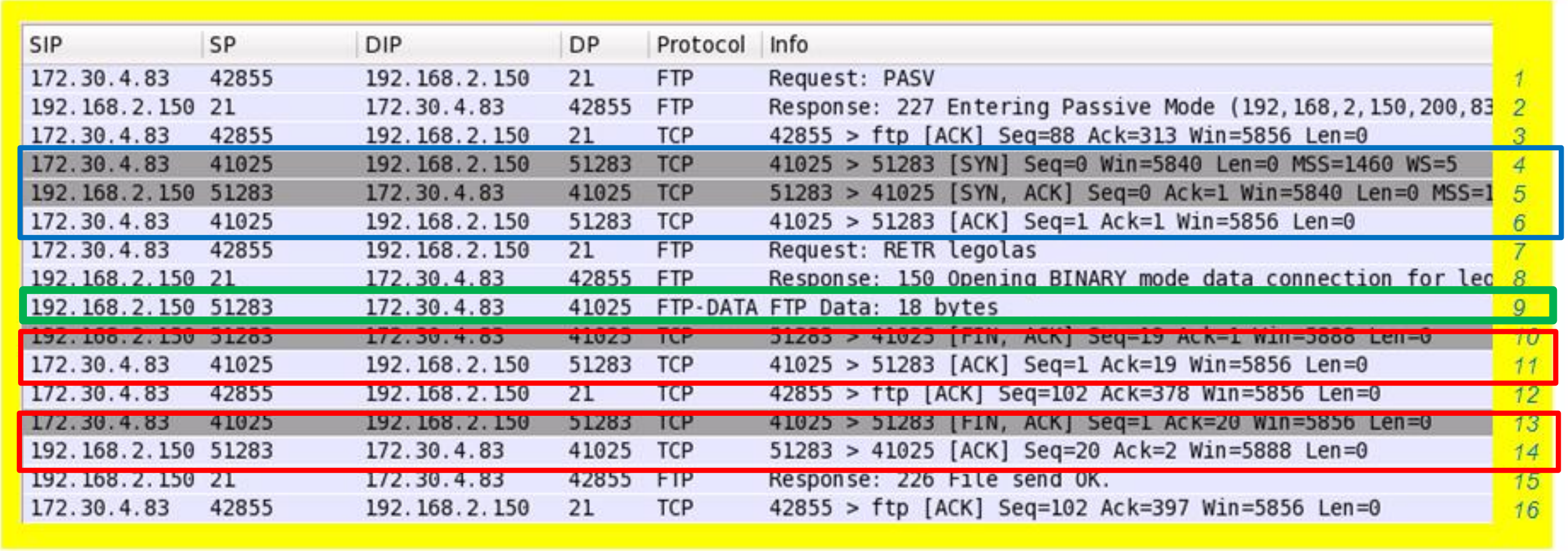
3. Refer to figure 1 above. Is the captured data transfer using active or passive mode? How do you know?

[A3] passive, because the client initiates the data transfer connection

*See Lesson 6 (More FTP Module)*

| Client | | Server | |
|---|---|---|---|
| IP: | 172.30.4.83 | IP: | 192.168.2.150 |
| Port: | 41025 | Port: | 51283 |

*Socket used for data transfer*



| SIP | SP | DIP | DP | Protocol | Info | |
|---|---|---|---|---|---|---|
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | FTP | Request: PASV | 1 |
| 192.168.2.150 | 21 | 172.30.4.83 | 42855 | FTP | Response: 227 Entering Passive Mode (192,168,2,150,200,83 | 2 |
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=88 Ack=313 Win=5856 Len=0 | 3 |
| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [SYN] Seq=0 Win=5840 Len=0 MSS=1460 WS=5 | 4 |
| 192.168.2.150 | 51283 | 172.30.4.83 | 41025 | TCP | 51283 > 41025 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1 | 5 |
| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [ACK] Seq=1 Ack=1 Win=5856 Len=0 | 6 |
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | FTP | Request: RETR legolas | 7 |
| 192.168.2.150 | 21 | 172.30.4.83 | 42855 | FTP | Response: 150 Opening BINARY mode data connection for leg | 8 |
| 192.168.2.150 | 51283 | 172.30.4.83 | 41025 | FTP-DATA | FTP Data: 18 bytes | 9 |
| 192.168.2.150 | 51283 | 172.30.4.83 | 41025 | TCP | 51283 > 41025 [FIN, ACK] Seq=19 Ack=1 Win=5888 Len=0 | 10 |
| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [ACK] Seq=1 Ack=19 Win=5856 Len=0 | 11 |
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=102 Ack=378 Win=5856 Len=0 | 12 |
| 172.30.4.83 | 41025 | 192.168.2.150 | 51283 | TCP | 41025 > 51283 [FIN, ACK] Seq=1 Ack=20 Win=5856 Len=0 | 13 |
| 192.168.2.150 | 51283 | 172.30.4.83 | 41025 | TCP | 51283 > 41025 [ACK] Seq=20 Ack=2 Win=5888 Len=0 | 14 |
| 192.168.2.150 | 21 | 172.30.4.83 | 42855 | FTP | Response: 226 File send OK. | 15 |
| 172.30.4.83 | 42855 | 192.168.2.150 | 21 | TCP | 42855 > ftp [ACK] Seq=102 Ack=397 Win=5856 Len=0 | 16 |

*3 way handshake to **Open***

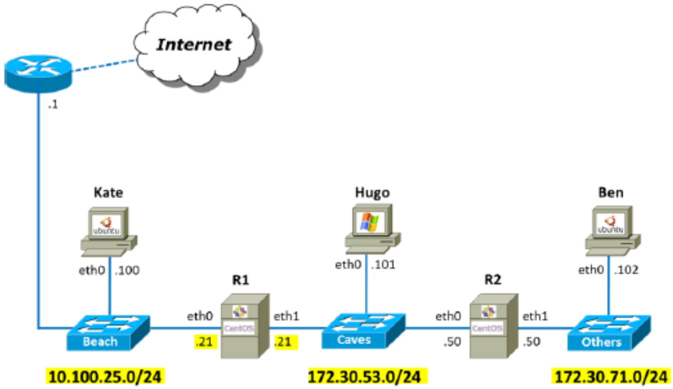
*Data **transfer***

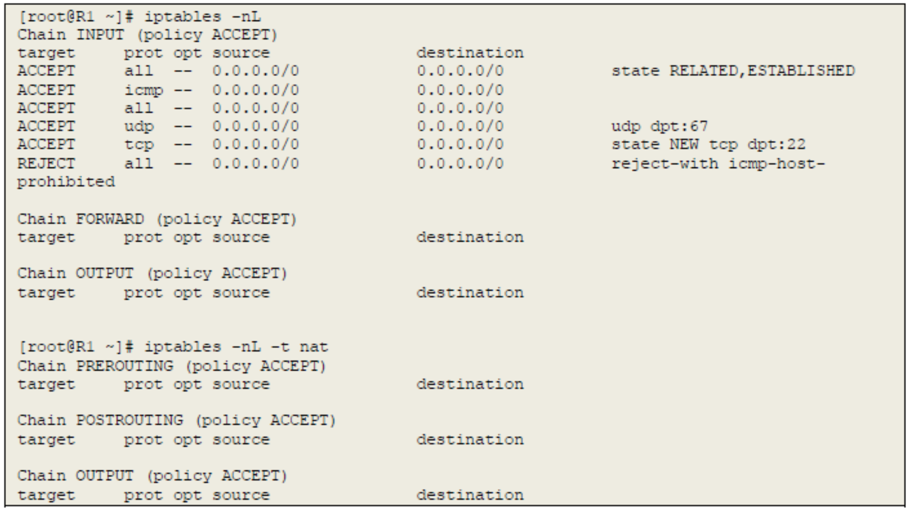
*4 way handshake to **Close***

*Notes:*

- *The FTP server is in **Passive mode because the client initiates the data connection** (3 way handshake) with the server.*

Figure 2 - Server R1 is providing gateway services for the Caves and Others networks





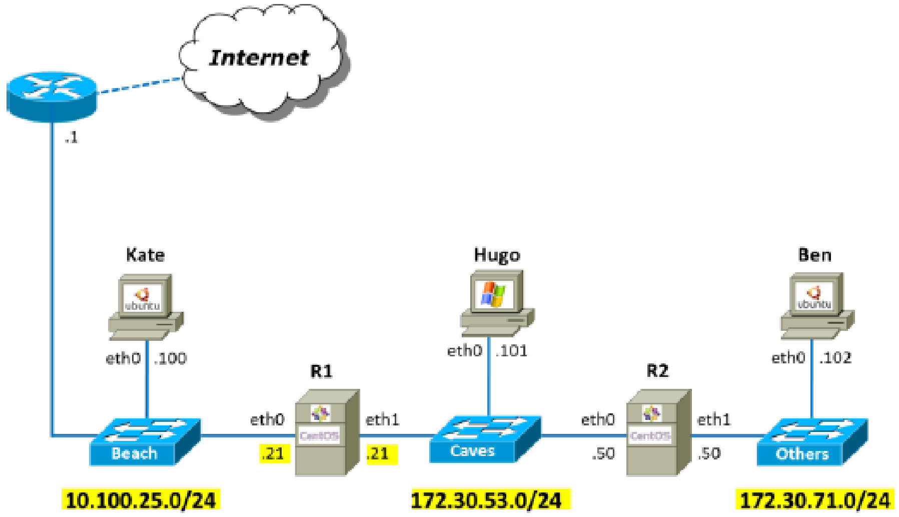
```
[root@R1 ~]# iptables -nL
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0           state RELATED,ESTABLISHED
ACCEPT     icmp --  0.0.0.0/0            0.0.0.0/0
ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0
ACCEPT     udp  --  0.0.0.0/0            0.0.0.0/0           udp dpt:67
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0           state NEW tcp dpt:22
REJECT     all  --  0.0.0.0/0            0.0.0.0/0           reject-with icmp-host-
prohibited

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination


[root@R1 ~]# iptables -nL -t nat
Chain PREROUTING (policy ACCEPT)
target     prot opt source               destination

Chain POSTROUTING (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
```

*See: Lesson 6 (slide 192) or Quick Reference Guide ("NAT Favorites")*

4. Referring to Figure 2, what iptables command on R1 would provide the Caves and Others networks with Internet access via MASQUERADE (not SNAT)?

[A4] iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE

Figure 2 - Server R1 is providing gateway services for the Caves and Others networks

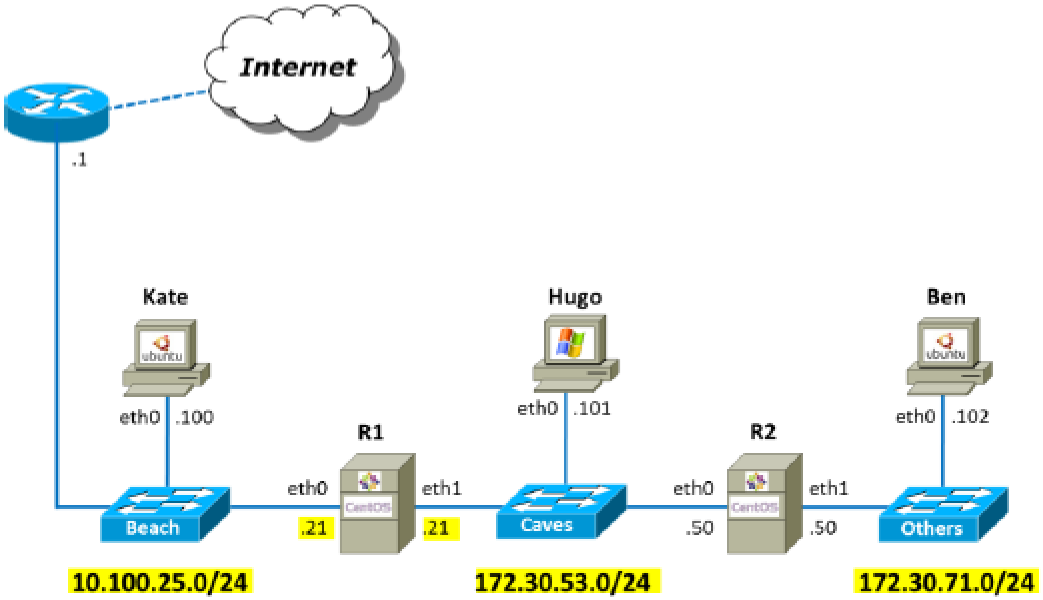


*See: Lesson 6 (NAT port forwarding module) or Quick Reference Guide ("NAT Favorites")*

5. Referring to Figure 2, what iptables command on R1 would forward HTTP (Hypertext Transfer Protocol) traffic arriving on its eth0 interface to Ben? (Hint: use DNAT)

[A5] iptables -t nat -A PREROUTING -i eth0 -p tcp -m tcp --dport 80 -j DNAT --to-destination 172.30.71.102

Figure 2 - Server R1 is providing gateway services for the Caves and Others networks

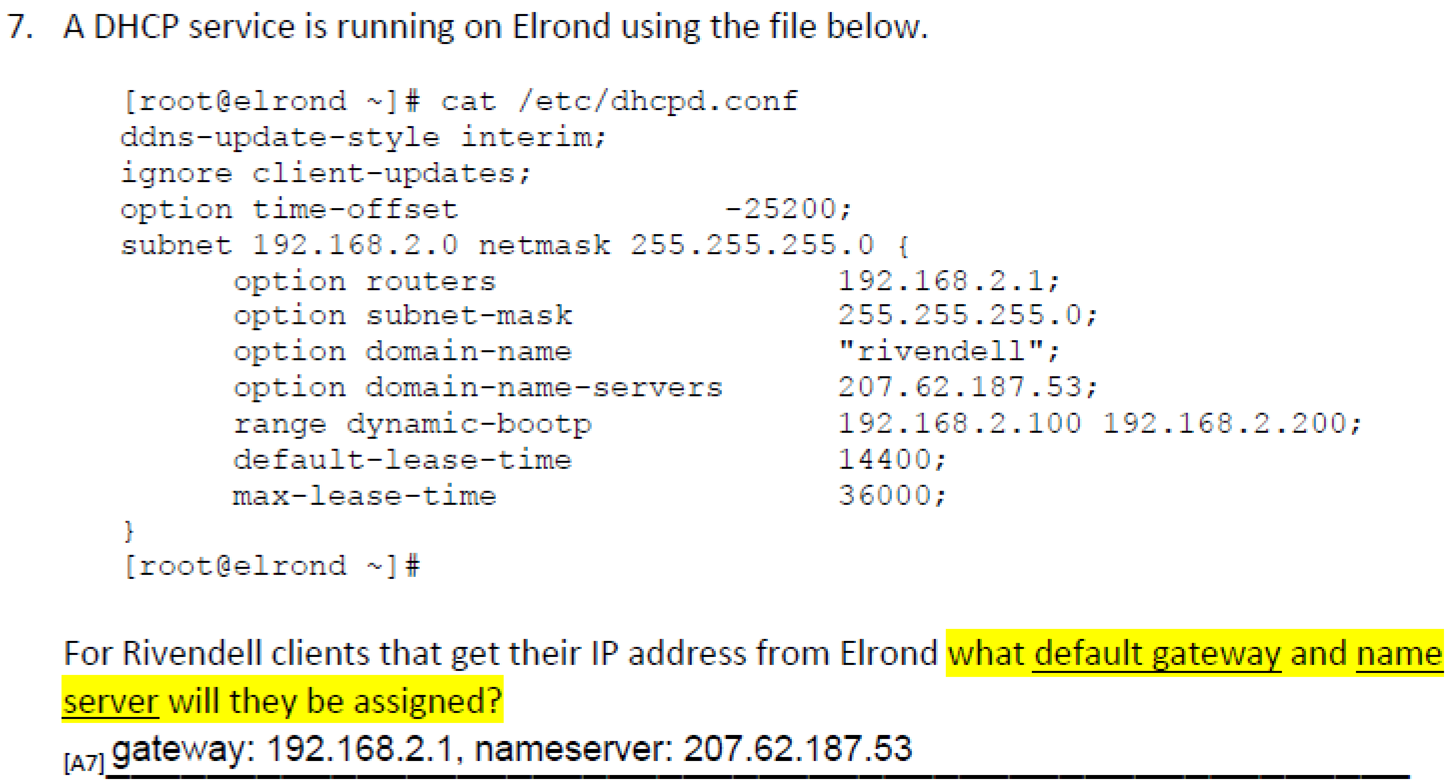


*See: Lesson 6 (sshd module)*

6. Referring to Figure 2, how would you configure TCP wrappers on Ben to only allow incoming SSH connections from hosts on the Caves network? (Answer by writing the lines you would add to the two files below)

/etc/hosts.allow: [A6a] sshd: 172.30.53.0/24

/etc/hosts.deny: [A6b] ALL: ALL



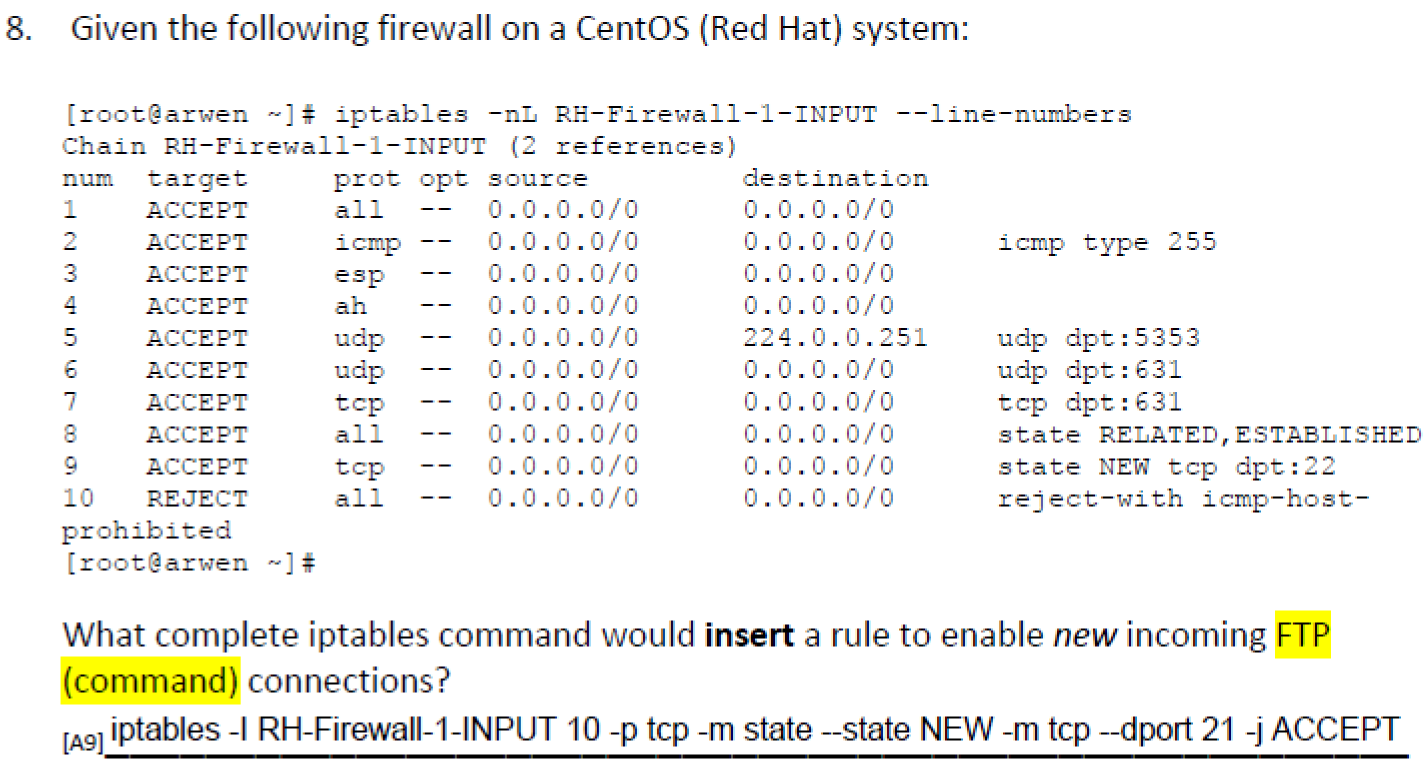
7. A DHCP service is running on Elrond using the file below.

```
[root@elrond ~]# cat /etc/dhcpd.conf
ddns-update-style interim;
ignore client-updates;
option time-offset              -25200;
subnet 192.168.2.0 netmask 255.255.255.0 {
      option routers                  192.168.2.1;
      option subnet-mask              255.255.255.0;
      option domain-name              "rivendell";
      option domain-name-servers      207.62.187.53;
      range dynamic-bootp             192.168.2.100 192.168.2.200;
      default-lease-time              14400;
      max-lease-time                  36000;
}
[root@elrond ~]#
```

For Rivendell clients that get their IP address from Elrond what default gateway and name server will they be assigned?

[A7] gateway: 192.168.2.1, nameserver: 207.62.187.53

*See Lesson 7 (DHCP module)*



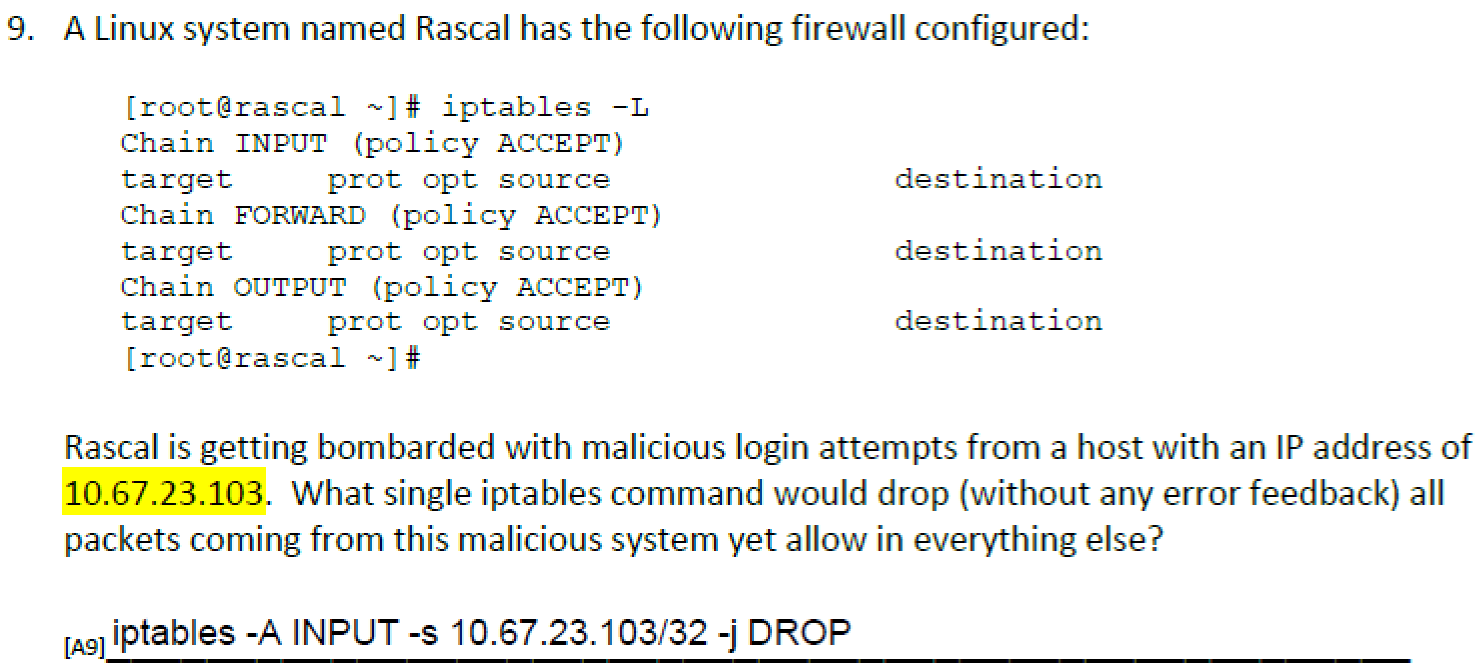
8. Given the following firewall on a CentOS (Red Hat) system:

```
[root@arwen ~]# iptables -nL RH-Firewall-1-INPUT --line-numbers
Chain RH-Firewall-1-INPUT (2 references)
num  target     prot opt source          destination
1    ACCEPT     all  --  0.0.0.0/0       0.0.0.0/0
2    ACCEPT     icmp --  0.0.0.0/0       0.0.0.0/0       icmp type 255
3    ACCEPT     esp  --  0.0.0.0/0       0.0.0.0/0
4    ACCEPT     ah   --  0.0.0.0/0       0.0.0.0/0
5    ACCEPT     udp  --  0.0.0.0/0       224.0.0.251     udp dpt:5353
6    ACCEPT     udp  --  0.0.0.0/0       0.0.0.0/0       udp dpt:631
7    ACCEPT     tcp  --  0.0.0.0/0       0.0.0.0/0       tcp dpt:631
8    ACCEPT     all  --  0.0.0.0/0       0.0.0.0/0       state RELATED,ESTABLISHED
9    ACCEPT     tcp  --  0.0.0.0/0       0.0.0.0/0       state NEW tcp dpt:22
10   REJECT     all  --  0.0.0.0/0       0.0.0.0/0       reject-with icmp-host-
prohibited
[root@arwen ~]#
```

What complete iptables command would **insert** a rule to enable *new* incoming FTP (command) connections?

[A9] iptables -I RH-Firewall-1-INPUT 10 -p tcp -m state --state NEW -m tcp --dport 21 -j ACCEPT

*See Lesson 5 (slide 115), Lesson 6 (Previous Red Hat Default module)*



9. A Linux system named Rascal has the following firewall configured:

```
[root@rascal ~]# iptables -L
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
Chain FORWARD (policy ACCEPT)
target     prot opt source               destination
Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
[root@rascal ~]#
```

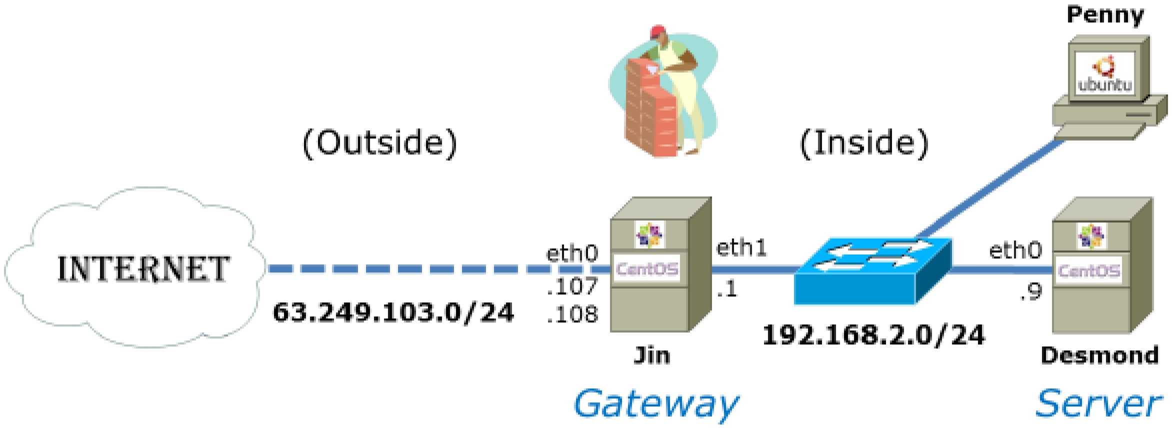
Rascal is getting bombarded with malicious login attempts from a host with an IP address of 10.67.23.103. What single iptables command would drop (without any error feedback) all packets coming from this malicious system yet allow in everything else?

[A9] iptables -A INPUT -s 10.67.23.103/32 -j DROP

*See Lesson 6 (slides 152-157)*

10. A network address translation service is set up on Jin for hosts on the private inside network, including Penny, using:

```
iptables -t nat -A PREROUTING -i eth0 -d 63.249.103.108 -j DNAT --to-destination 192.168.2.9
iptables -t nat -A POSTROUTING -o eth0 -s 192.168.2.9 -j SNAT --to-source 63.249.103.108
iptables -t nat -A POSTROUTING -o eth0 -s 192.168.2.0/24 -j SNAT --to-source 63.249.103.107
```



Imagine that Penny has made an ssh connection to the system, simms-teach.com, on the Internet. If you were to sniff the packets that simms-teach.com **receives** from Penny, what would the specific source and destination IP addresses be?

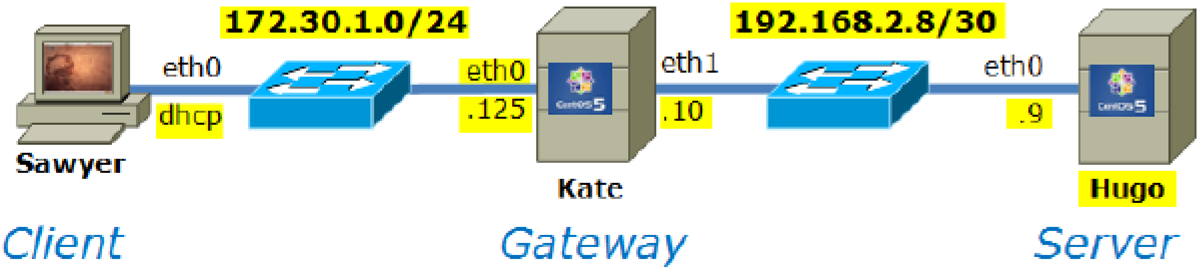
SIP: [A10a] 63.249.103.107

DIP: [A10b] 208.113.154.64

*See: Lesson 6 (slides 217-219) or Lab 5 and Lesson 1 (Ping Testing module)*

11. Extra Credit

Refer to the diagram below. Kate's firewall allows incoming new and established SSH connections from the outside. All other new connection attempts from the outside are blocked. A Telnet server is running on Hugo that can be accessed from all "inside" systems including Kate.



a) What command would set up SSH port forwarding (using an SSH tunnel) so that Sawyer could use its own port 8000 to access the Telnet server on Hugo? **and** b) once the port forwarding had been set up what second command on Sawyer would be used to make the actual connection to the Telnet server?

[11a] ssh -L 8000:192.168.2.9:23 172.30.1.125

[11b] telnet localhost 8000

*See: Lesson 6 (SSH Tunneling)*

# Housekeeping

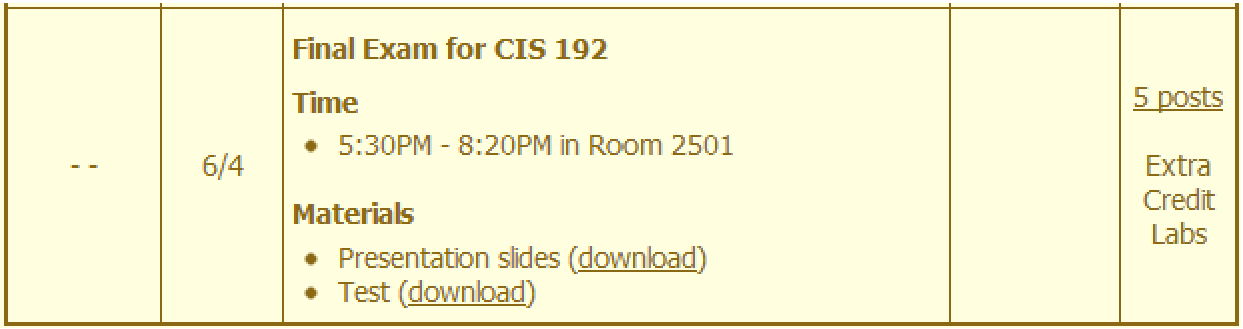
- Lab 7 (DNS) due 11:59PM tonight

- Extra credit labs available:
  - X1 Permanent NIC configuration (30 points)
  - X2 PPP (30 points)
  - X3 NFS (30 points)

- Guest student presentation tonight on WiFi Penetration

# Final Exam

- Timed test
- Open book, notes and computer
- You will be provided with a pristine exam pod
- There will be a number of tasks to implement
    - Some mandatory
    - Some optional
    - Some extra credit
    - Task specifications available one week in advance
- 60 points - the more tasks completed, the more points earned



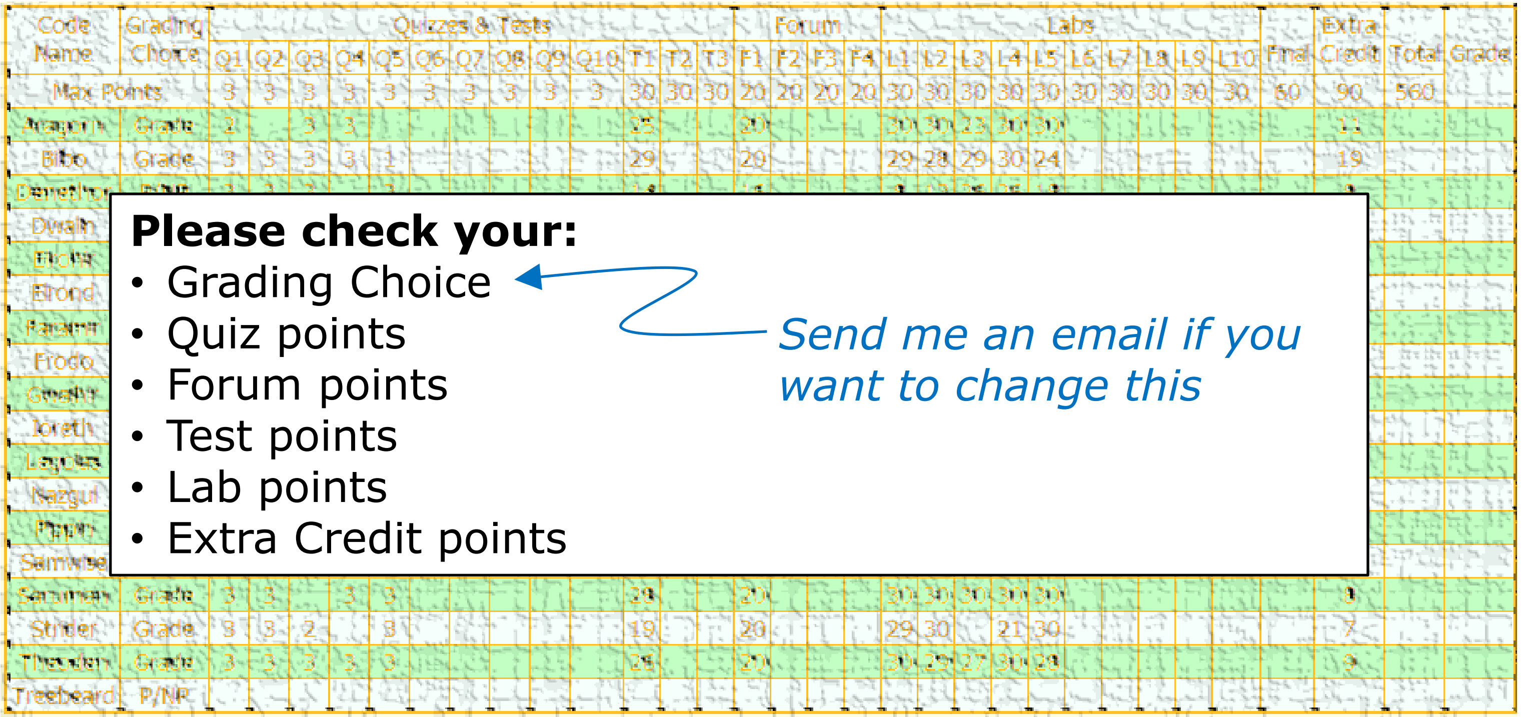
| | | | | |
|---|---|---|---|---|
| - - | 6/4 | **Final Exam for CIS 192**<br>**Time**<br>• 5:30PM - 8:20PM in Room 2501<br>**Materials**<br>• Presentation slides (download)<br>• Test (download) | | 5 posts<br>Extra Credit Labs |

# Extra Credit

- Note you can earn up to 90 points of extra credit (labs, typos, HowTos, etc.)
- 3 extra credit labs
- HowTos
  - Up to 20 points extra credit for a publishable HowTo document (will be published on the class website)
  - 10 points additional if you do a class presentation
  - Topics must be pre-approved with instructor

# Grades Web Page

**http://simms-teach.com/cis192grades.php**



| Code | Grading | Quizzes & Tests | | | | | | | | | | | | | Forum | | | | Labs | | | | | | | | | | | Extra | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Choice | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | T1 | T2 | T3 | F1 | F2 | F3 | F4 | L1 | L2 | L3 | L4 | L5 | L6 | L7 | L8 | L9 | L10 | Final | Credit | Total | Grade |
| Max Points | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 30 | 30 | 30 | 20 | 20 | 20 | 20 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 60 | 90 | 560 | |
| Aragorn | Grade | 2 | | 3 | 3 | | | | | | | 25 | | | 20 | | | | 30 | 30 | 23 | 30 | 30 | | | | | | | 11 | | |
| Bilbo | Grade | 3 | 3 | 3 | 3 | 1 | | | | | | 29 | | | 20 | | | | 29 | 28 | 29 | 30 | 24 | | | | | | | 19 | | |
| Denethor | P/NP | [illegible] | [illegible] | [illegible] | | [illegible] | | | | | | [illegible] | | | [illegible] | | | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | | | | | | [illegible] | | |
| Dwalin | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Elrohir | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Elrond | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Faramir | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Frodo | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gwaihir | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ioreth | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Legolas | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nazgul | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pippin | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Samwise | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Saruman | Grade | 3 | 3 | | 3 | 3 | | | | | | 28 | | | 20 | | | | 30 | 30 | 30 | 30 | 30 | | | | | | | 8 | | |
| Strider | Grade | 3 | 3 | 2 | | 3 | | | | | | 19 | | | 20 | | | | 29 | 30 | | 21 | 30 | | | | | | | 7 | | |
| Theoden | Grade | 3 | 3 | 3 | 3 | 3 | | | | | | 28 | | | 20 | | | | 30 | 29 | 27 | 30 | 28 | | | | | | | 9 | | |
| Treebeard | P/NP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Please check your:**

- Grading Choice
- Quiz points
- Forum points
- Test points
- Lab points
- Extra Credit points

*Send me an email if you want to change this*

*Don't know you secret LOR code name?*

*… then email me your student survey to get it!*

# Help with labs

**Like some help with labs?**

I’m in the CIS Lab Monday afternoons

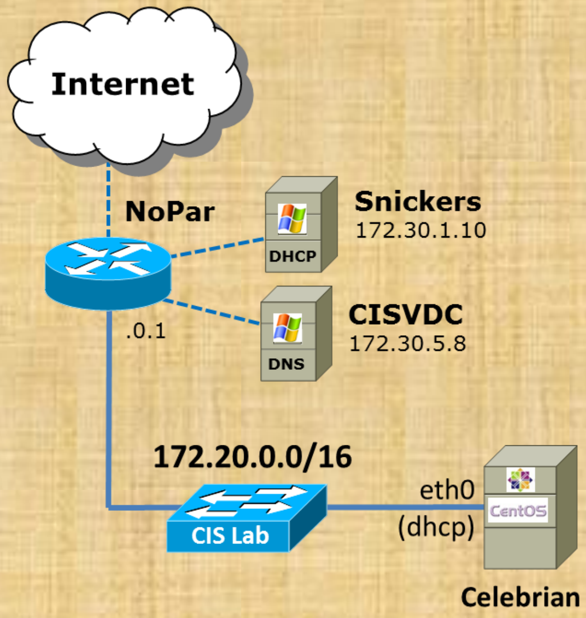
- See schedule at http://webhawks.org/~cislab/

or see me during office hours

or contact me to arrange another time online

# Warm-up

# Activity



Temporarily configure Celebrian as follows:

*Get a temporary IP address on eth0*
**dhclient -v eth0**

*Create a temporary static route to Pod 31*
**route add -net 192.168.31.0/24 gw 172.20.192.224**

*Append a line to /etc/hosts*
**192.168.31.50 nfs-depot-31**

*Test*
**ping nfs-depot-31**

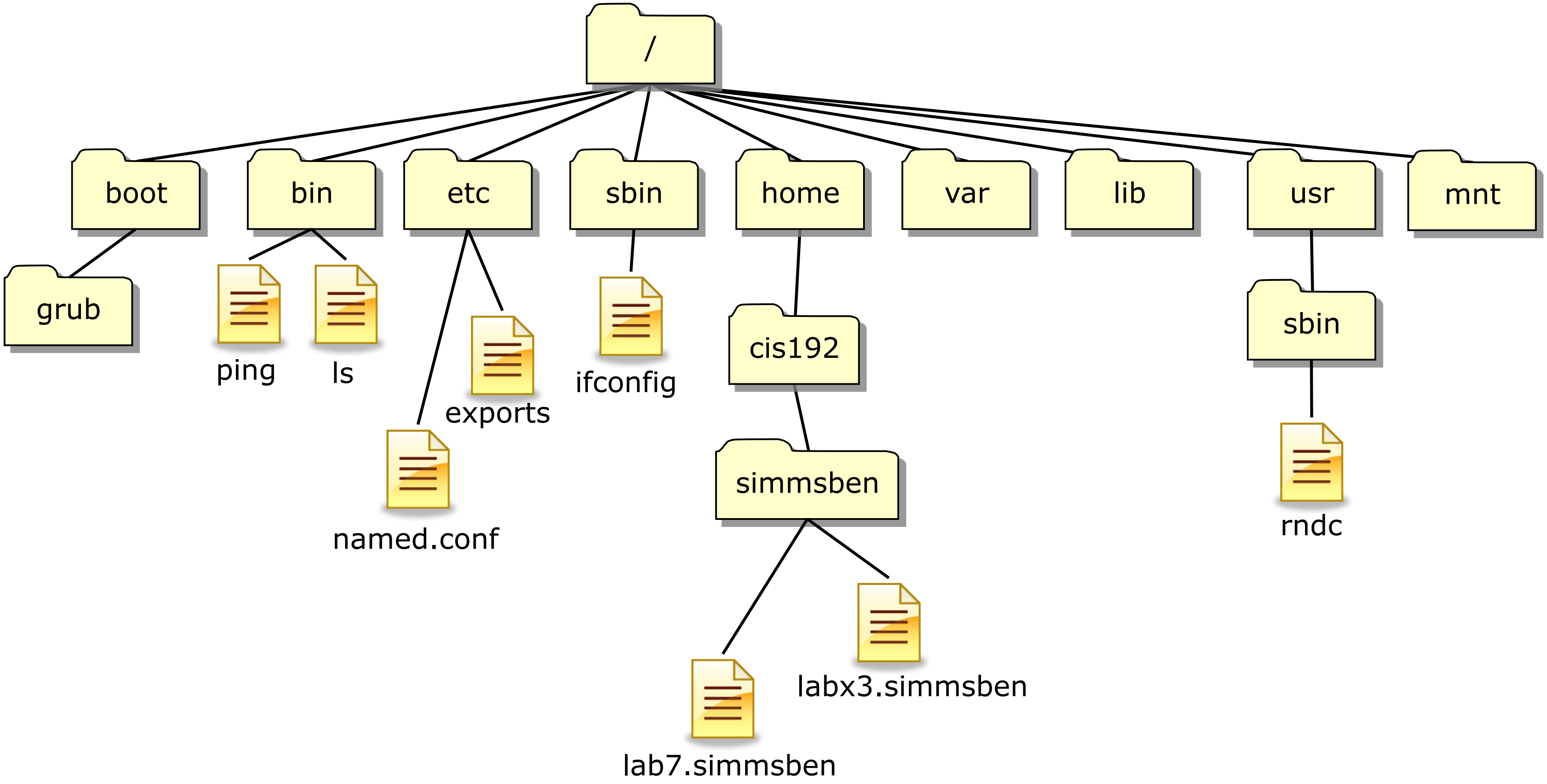
# Mounting File Systems

# Mounting File Systems

- The UNIX file tree offers a lot of flexibility in how it can be mapped to storage devices

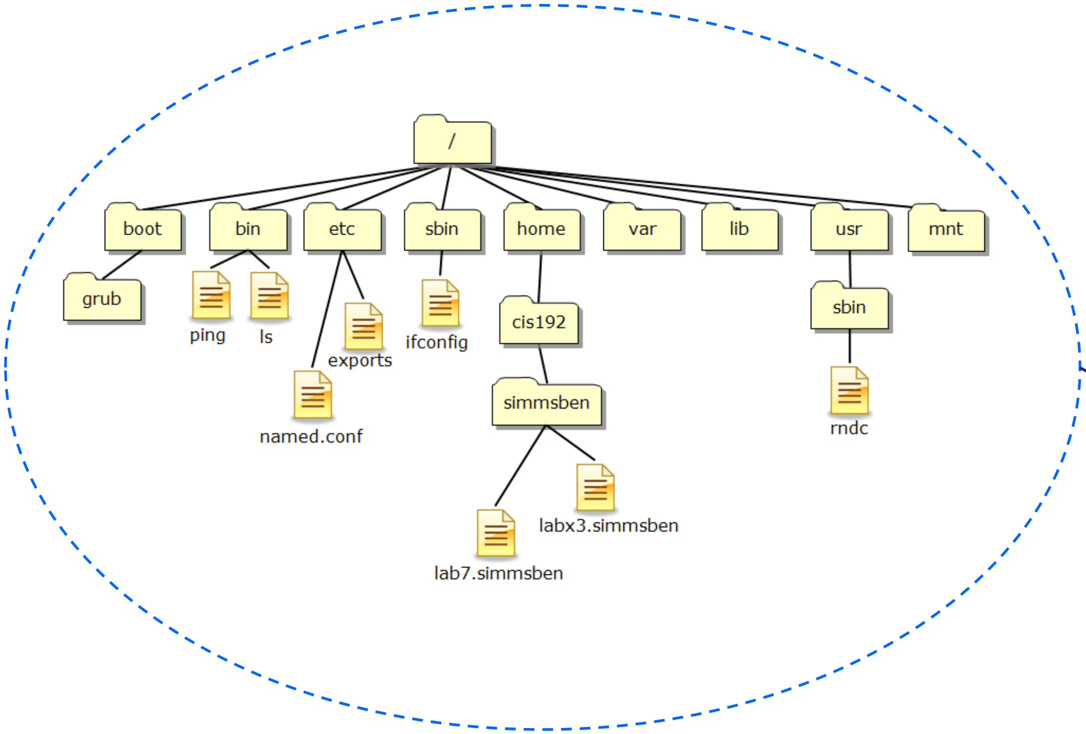
- The tree may span multiple partitions, kernel memory locations, multiple hard drives, optical drives, flash drives and even directories on other computers

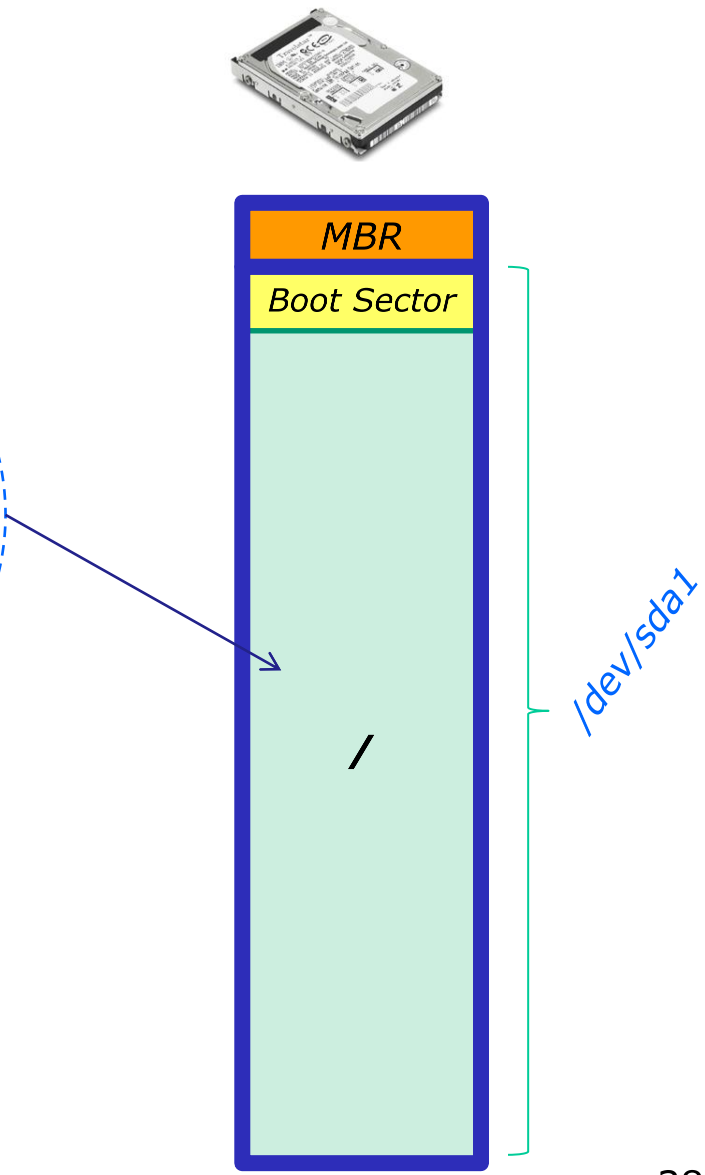
# Mounting File Systems



*A example UNIX file tree*

# Mounting File Systems

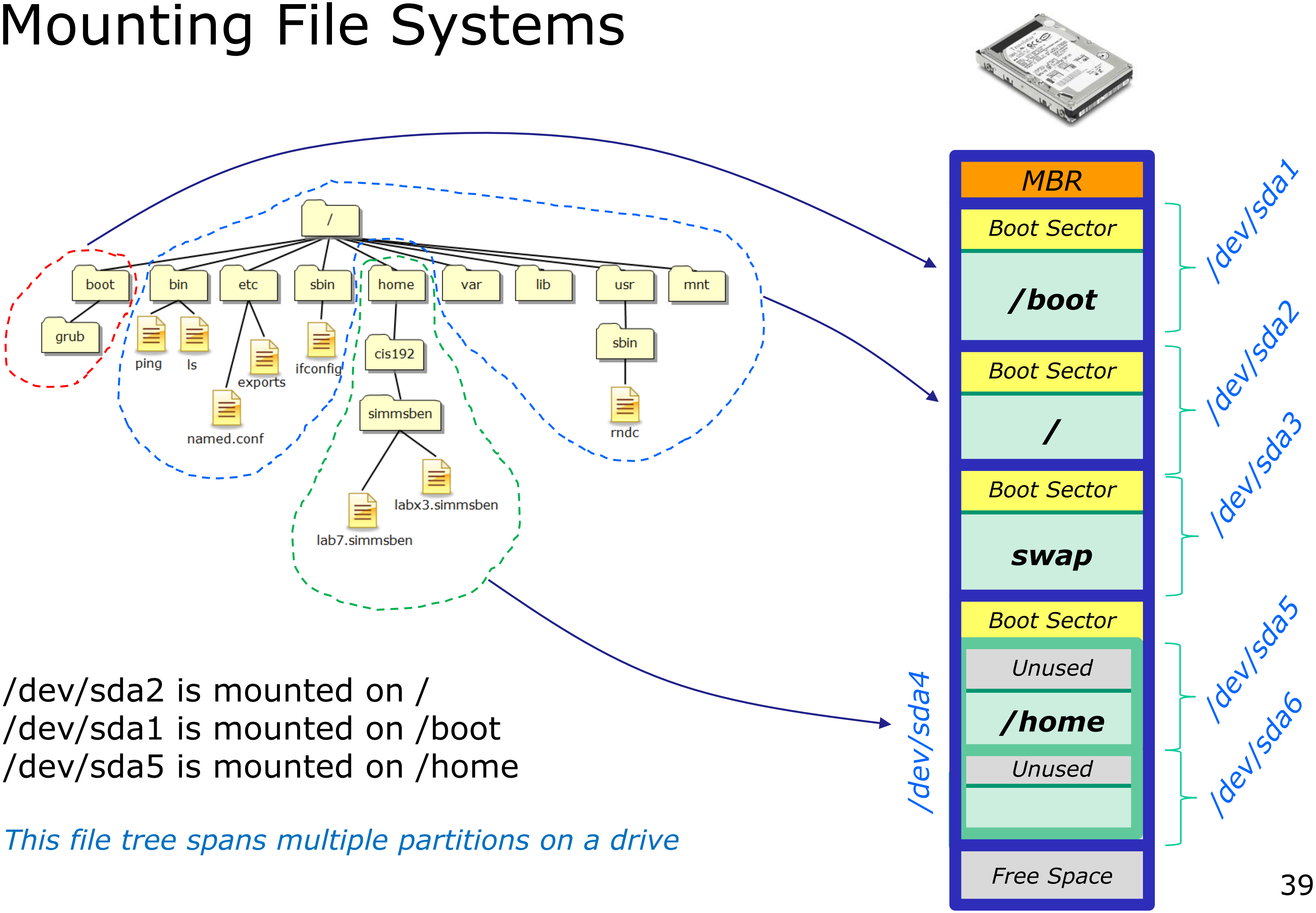




/dev/sda1 is mounted on /

*This file tree uses only one partition on a single drive*

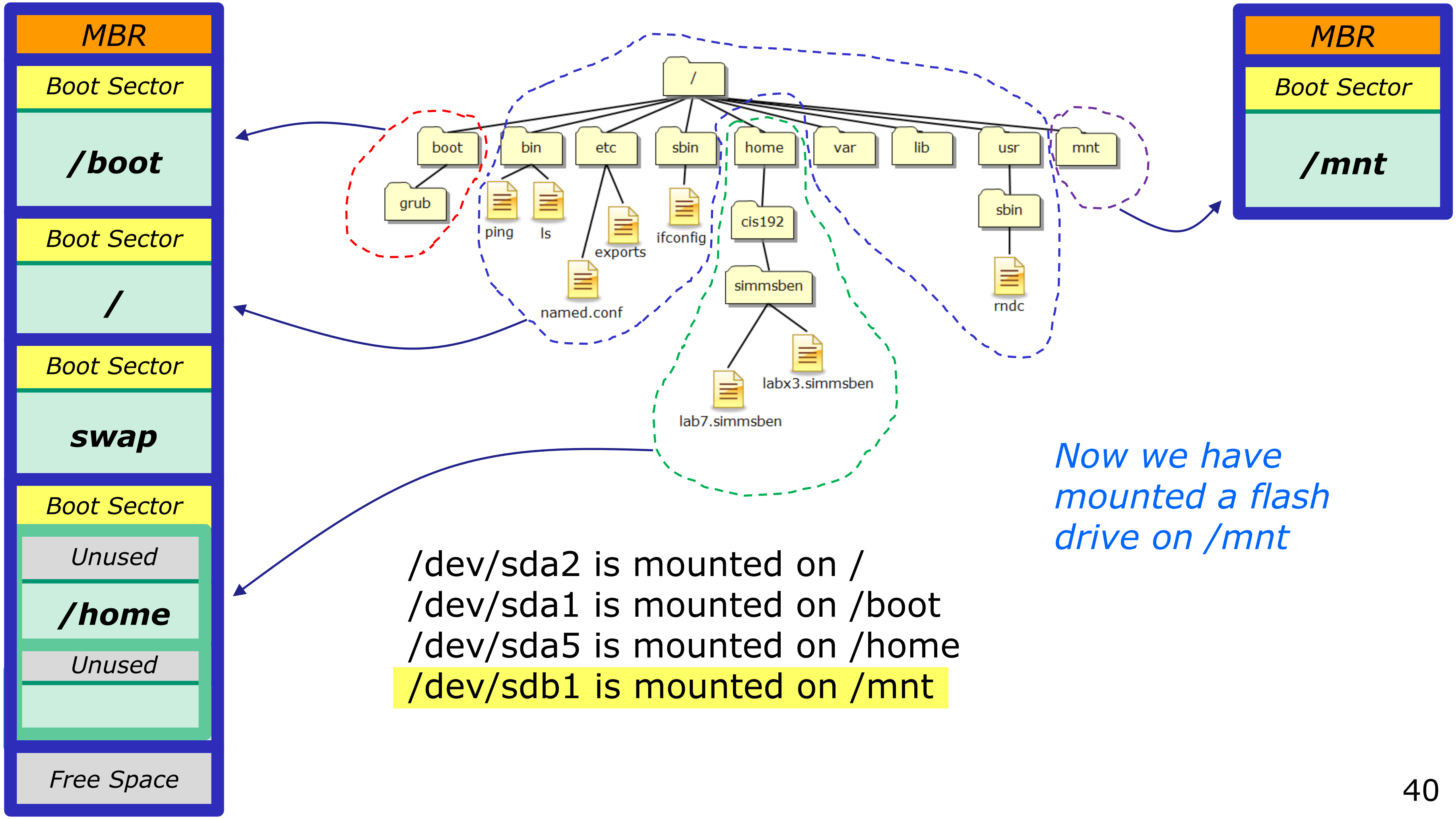
# Mounting File Systems



/dev/sda2 is mounted on /
/dev/sda1 is mounted on /boot
/dev/sda5 is mounted on /home

*This file tree spans multiple partitions on a drive*

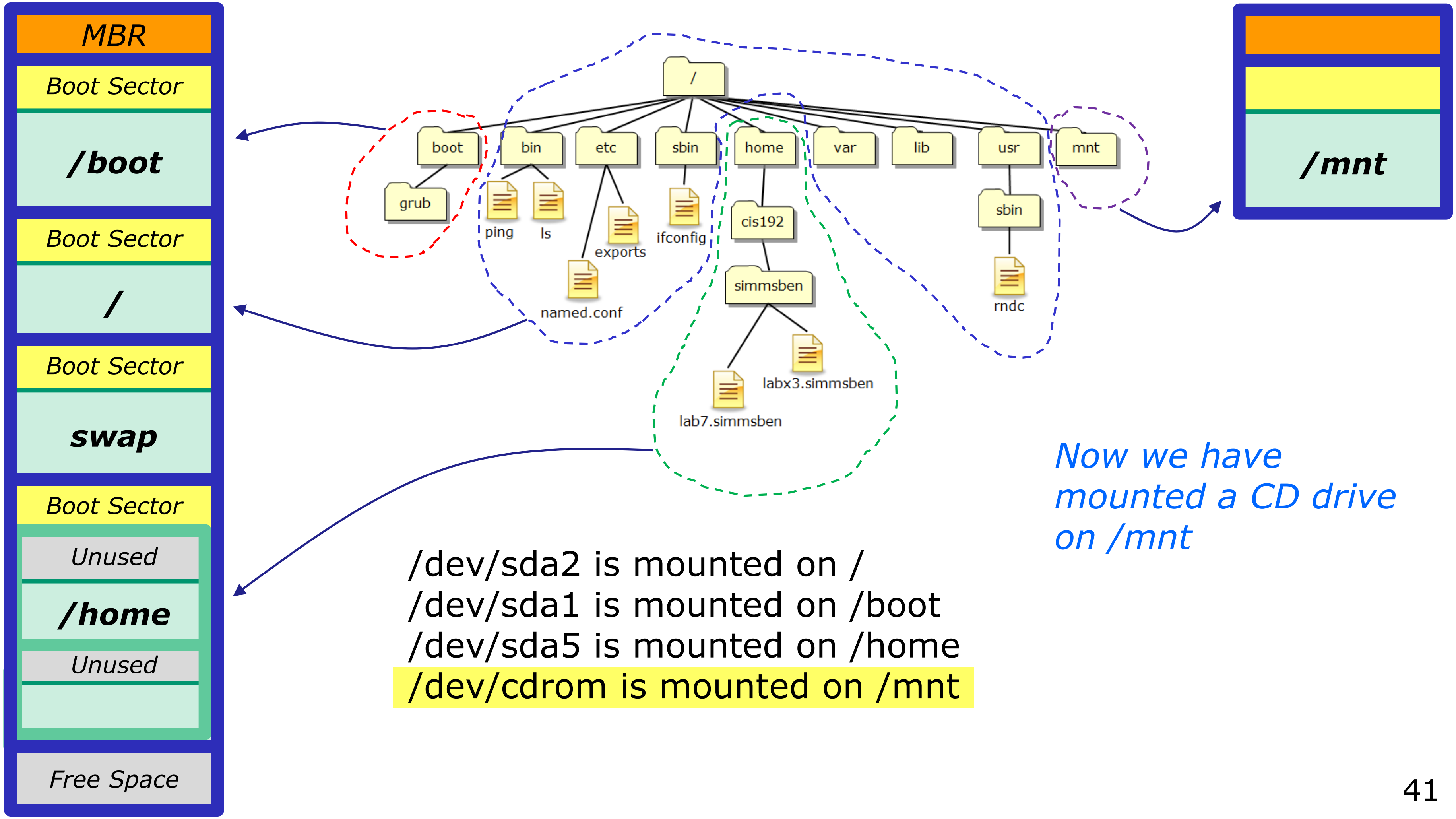
# Mounting File Systems



/dev/sda2 is mounted on /
/dev/sda1 is mounted on /boot
/dev/sda5 is mounted on /home
/dev/sdb1 is mounted on /mnt

*Now we have mounted a flash drive on /mnt*

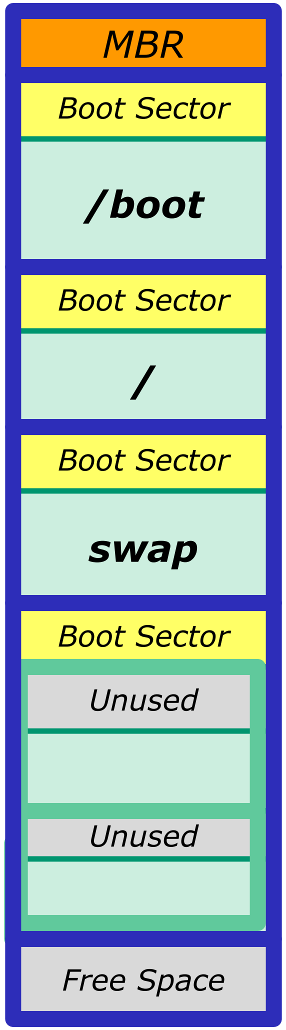
# Mounting File Systems

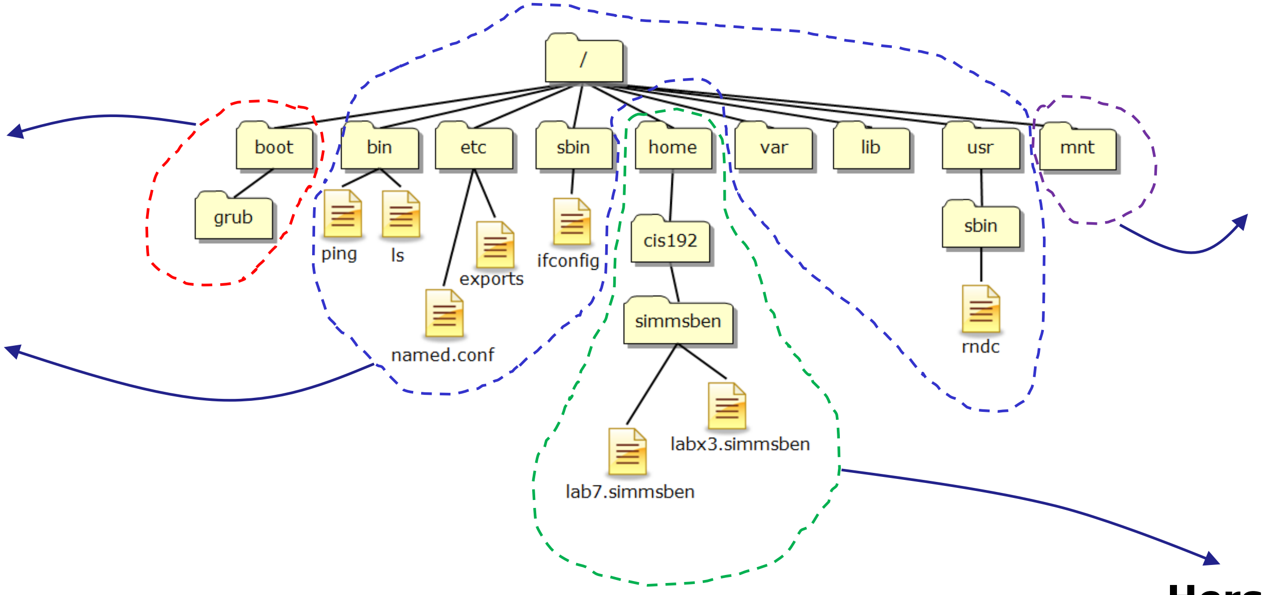


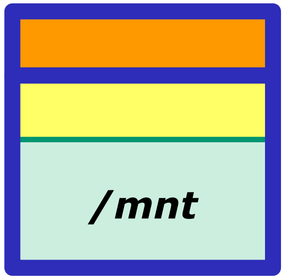
*Now we have mounted a CD drive on /mnt*

/dev/sda2 is mounted on /
/dev/sda1 is mounted on /boot
/dev/sda5 is mounted on /home
/dev/cdrom is mounted on /mnt

# Mounting File Systems







**Hershey:/home**

/dev/sda2 is mounted on /
/dev/sda1 is mounted on /boot
Hiro:/home is mounted on /home
/dev/cdrom is mounted on /mnt

*Now we have the /home directory of another system named Hershey (instead of the local drive partition) on /home*

# Mounting File Systems

## Mounting commands

- syntax: **mount** *device-file directory*
  - example: **mount /dev/cdrom /mnt**

    *Mount the CD on the /mnt directory*
  - example: **mount /dev/sdb1 /home**

    *Mount the 1st partition of the 2nd drive on the /home directory*
- syntax: **umount** ***device-file*** **|** ***directory***
  - example: **umount /mnt**

## Mount information

1. /etc/fstab *what to mount at boot time*
2. /etc/mtab *current mount status*

# Understanding mount command output

# Showing current mount status

On a rh9 VM

```
[root@rh9 root]# mount
/dev/sda2 on / type ext3 (rw)
none on /proc type proc (rw)
/dev/sda1 on /boot type ext2 (rw)
none on /dev/pts type devpts (rw,gid=5,mode=620)
/dev/sda5 on /home type ext3 (rw)
none on /dev/shm type tmpfs (rw)

[root@rh9 root]# cat /etc/mtab
/dev/sda2 / ext3 rw 0 0
none /proc proc rw 0 0
/dev/sda1 /boot ext2 rw 0 0
none /dev/pts devpts rw,gid=5,mode=620 0 0
/dev/sda5 /home ext3 rw 0 0
none /dev/shm tmpfs rw 0 0
[root@rh9 root]#
```

*The **mount** command without any arguments shows current mount status.*

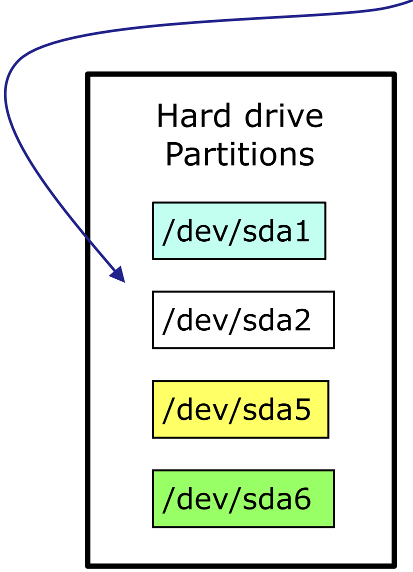
*Same info is in /etc/mtab*

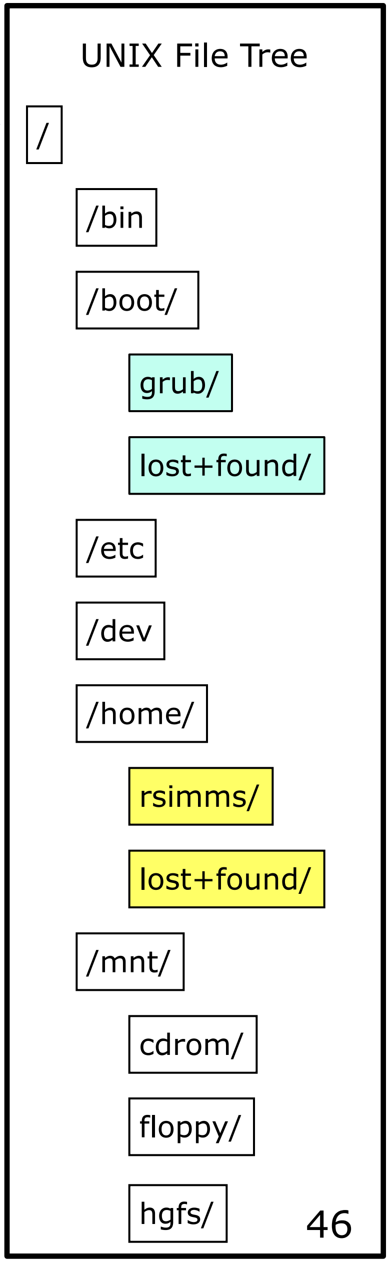
# Showing current mount status

On a rh9 VM

```
[root@rh9 root]# mount
/dev/sda2 on / type ext3 (rw)
none on /proc type proc (rw)
/dev/sda1 on /boot type ext2 (rw)
none on /dev/pts type devpts (rw,gid=5,mode=620)
/dev/sda5 on /home type ext3 (rw)
none on /dev/shm type tmpfs (rw)
```

*The second partition on the hard drive is mounted on the / directory in the UNIX file tree*





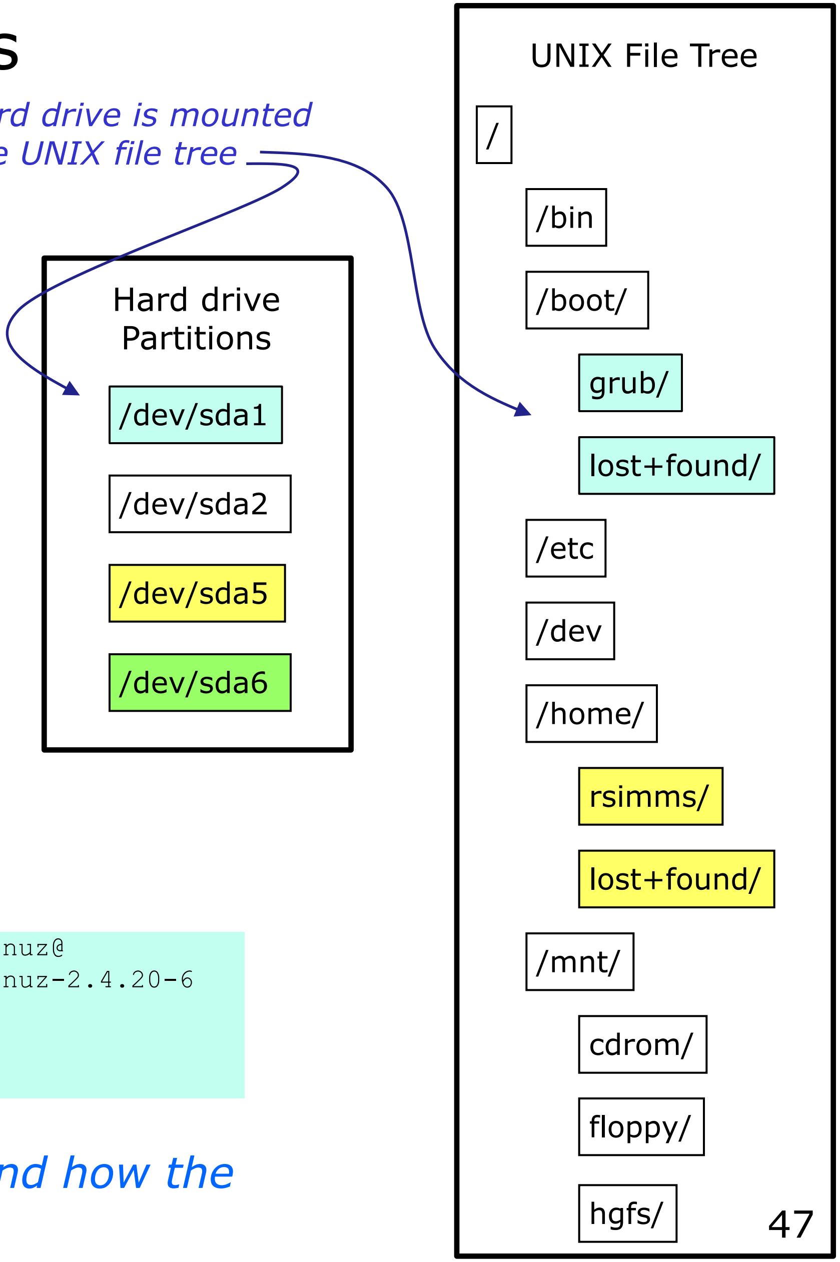
*Using mount command output to understand how the file tree maps to storage devices*

# Showing current mount status

On a rh9 VM

*The first partition on the hard drive is mounted on the /boot directory in the UNIX file tree*

```
[root@rh9 root]# mount
/dev/sda2 on / type ext3 (rw)
none on /proc type proc (rw)
/dev/sda1 on /boot type ext2 (rw)
none on /dev/pts type devpts (rw,gid=5,mode=620)
/dev/sda5 on /home type ext3 (rw)
none on /dev/shm type tmpfs (rw)
```



```
[root@rh9 root]# ls -F /boot
/boot:
boot.b             kernel.h       module-info-2.4.20-6  vmlinuz@
chain.b            lost+found/    os2_d.b               vmlinuz-2.4.20-6
config-2.4.20-6    message        System.map@
grub/              message.ja     System.map-2.4.20-6
initrd-2.4.20-6.img module-info@  vmlinux-2.4.20-6
```

*Using mount command output to understand how the file tree maps to storage devices*

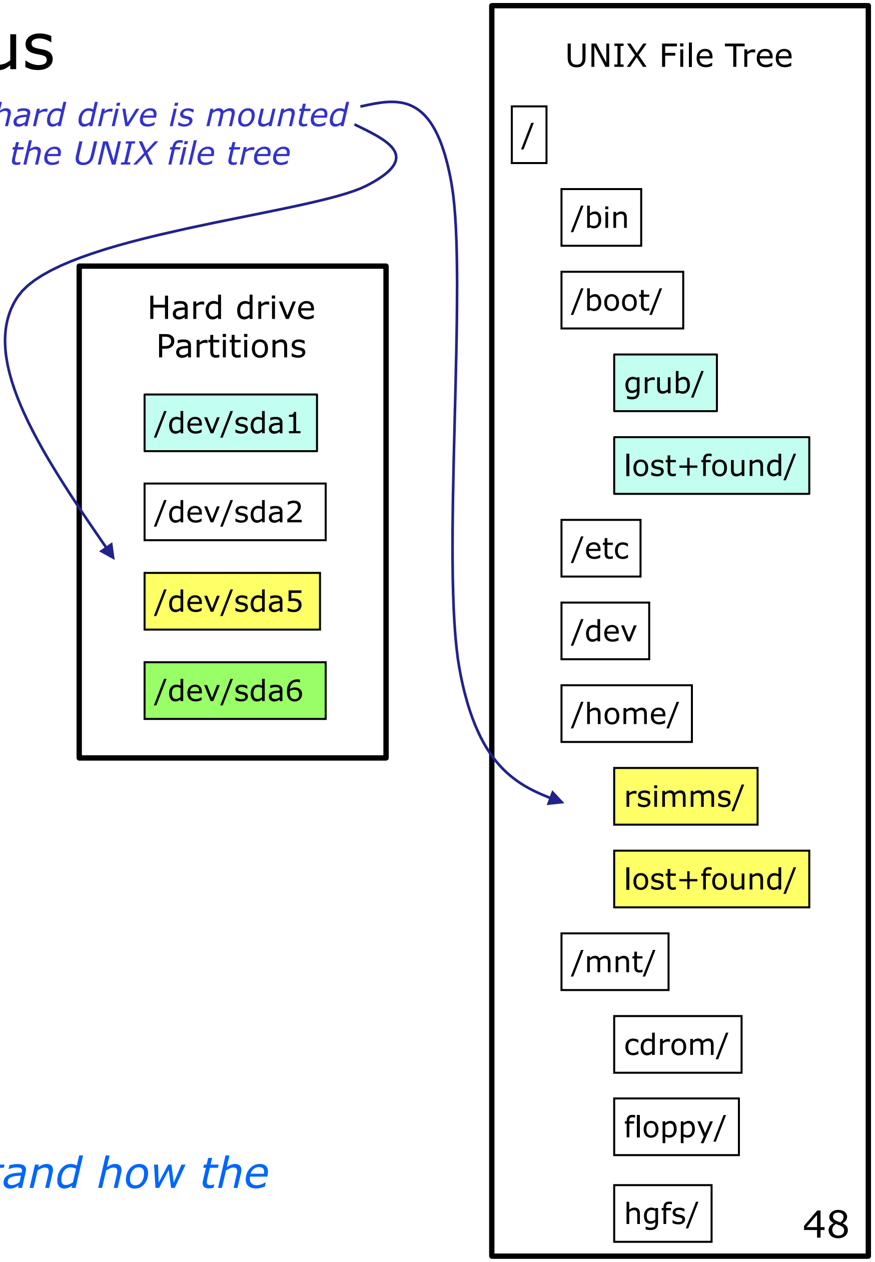
# Showing current mount status

On a rh9 VM

*The fifth partition on the hard drive is mounted on the /home directory in the UNIX file tree*

```
[root@rh9 root]# mount
/dev/sda2 on / type ext3 (rw)
none on /proc type proc (rw)
/dev/sda1 on /boot type ext2 (rw)
none on /dev/pts type devpts (rw,gid=5,mode=620)
/dev/sda5 on /home type ext3 (rw)
none on /dev/shm type tmpfs (rw)
```

```
[root@rh9 root]# ls -F /home

/home:
lost+found/  rsimms/
```



*Using mount command output to understand how the file tree maps to storage devices*

# The great cover-up

# Where did those files go?

# Showing current mount status

On a rh9 VM

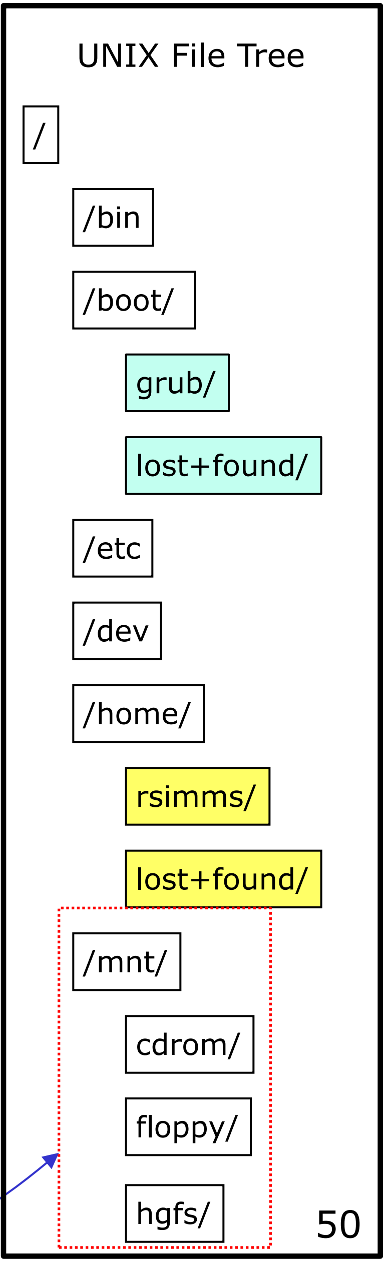
```
[root@rh9 root]# mount
/dev/sda2 on / type ext3 (rw)
none on /proc type proc (rw)
/dev/sda1 on /boot type ext2 (rw)
none on /dev/pts type devpts (rw,gid=5,mode=620)
/dev/sda5 on /home type ext3 (rw)
none on /dev/shm type tmpfs (rw)
```

```
[root@rh9 root]# ls -F /home /boot /mnt
/boot:
boot.b                  kernel.h      module-info-2.4.20-6  vmlinuz@
chain.b                 lost+found/   os2_d.b               vmlinuz-2.4.20-6
config-2.4.20-6         message       System.map@
grub/                   message.ja    System.map-2.4.20-6
initrd-2.4.20-6.img     module-info@  vmlinux-2.4.20-6

/home:
lost+found/  rsimms/

/mnt:
cdrom/  floppy/  hgfs/
```

*/dev/sda6 is **not** mounted yet, note contents of the /mnt directory*

Hard drive Partitions

- /dev/sda1
- /dev/sda2
- /dev/sda5
- /dev/sda6



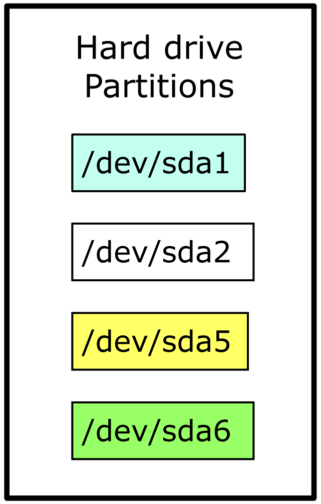
UNIX File Tree

```
/
    /bin
    /boot/
        grub/
        lost+found/
    /etc
    /dev
    /home/
        rsimms/
        lost+found/
    /mnt/
        cdrom/
        floppy/
        hgfs/
```

# Making and mounting a filesystem

On the rh9 VM

```
[root@rh9 root]# mkfs -t ext3 /dev/sda6
mke2fs 1.32 (09-Nov-2002)
Filesystem label=
OS type: Linux
Block size=1024 (log=0)
Fragment size=1024 (log=0)
26104 inodes, 104391 blocks
5219 blocks (5.00%) reserved for the super user
First data block=1
13 block groups
8192 blocks per group, 8192 fragments per group
2008 inodes per group
Superblock backups stored on blocks:
        8193, 24577, 40961, 57345, 73729

Writing inode tables: done
Creating journal (4096 blocks): done
Writing superblocks and filesystem accounting information: done

This filesystem will be automatically checked every 39 mounts or
180 days, whichever comes first.  Use tune2fs -c or -i to override.
```

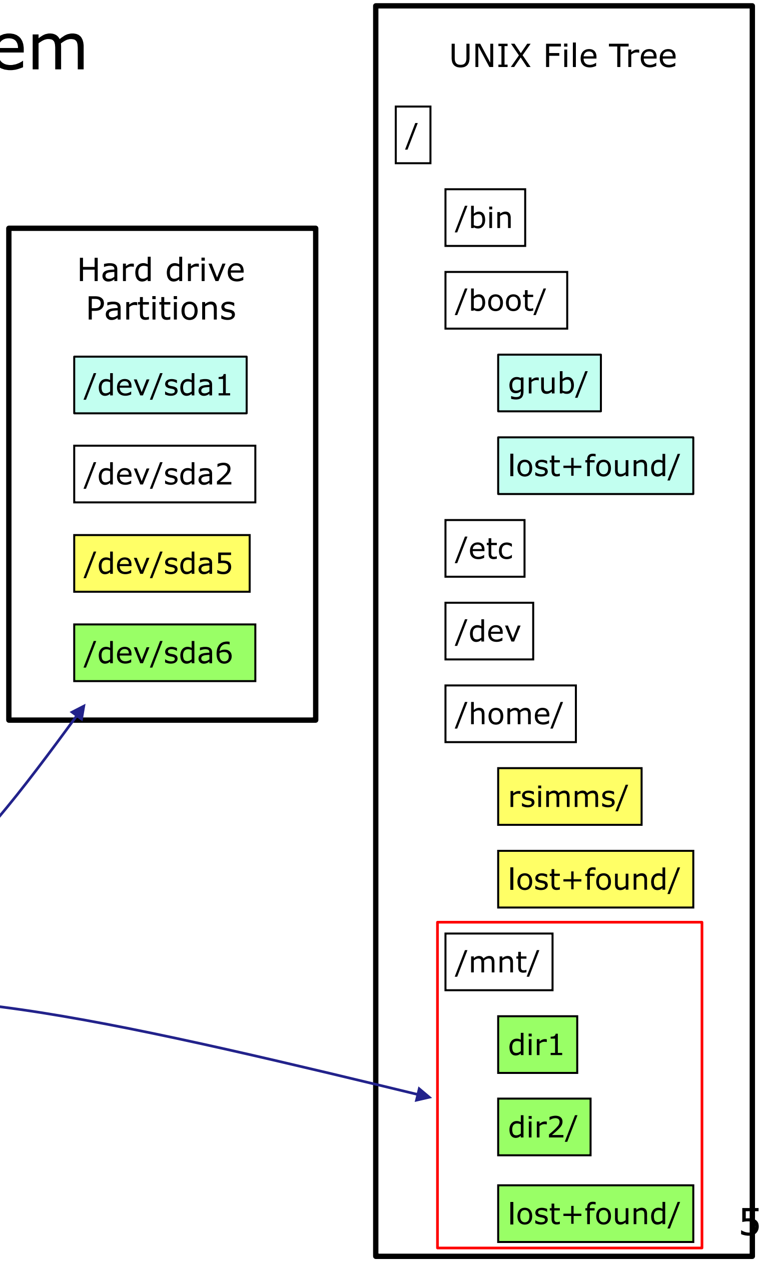


*Lets make a new ext3 filesystem on /dev/sda6*

# Making and mounting a filesystem

On the rh9 VM

```
[root@rh9 root]# mount /dev/sda6 /mnt
[root@rh9 root]# cd /mnt
[root@rh9 mnt]# mkdir dir1 dir2
[root@rh9 mnt]# ls
dir1  dir2  lost+found
[root@rh9 mnt]# cd
[root@rh9 root]# ls /mnt
dir1  dir2  lost+found
```



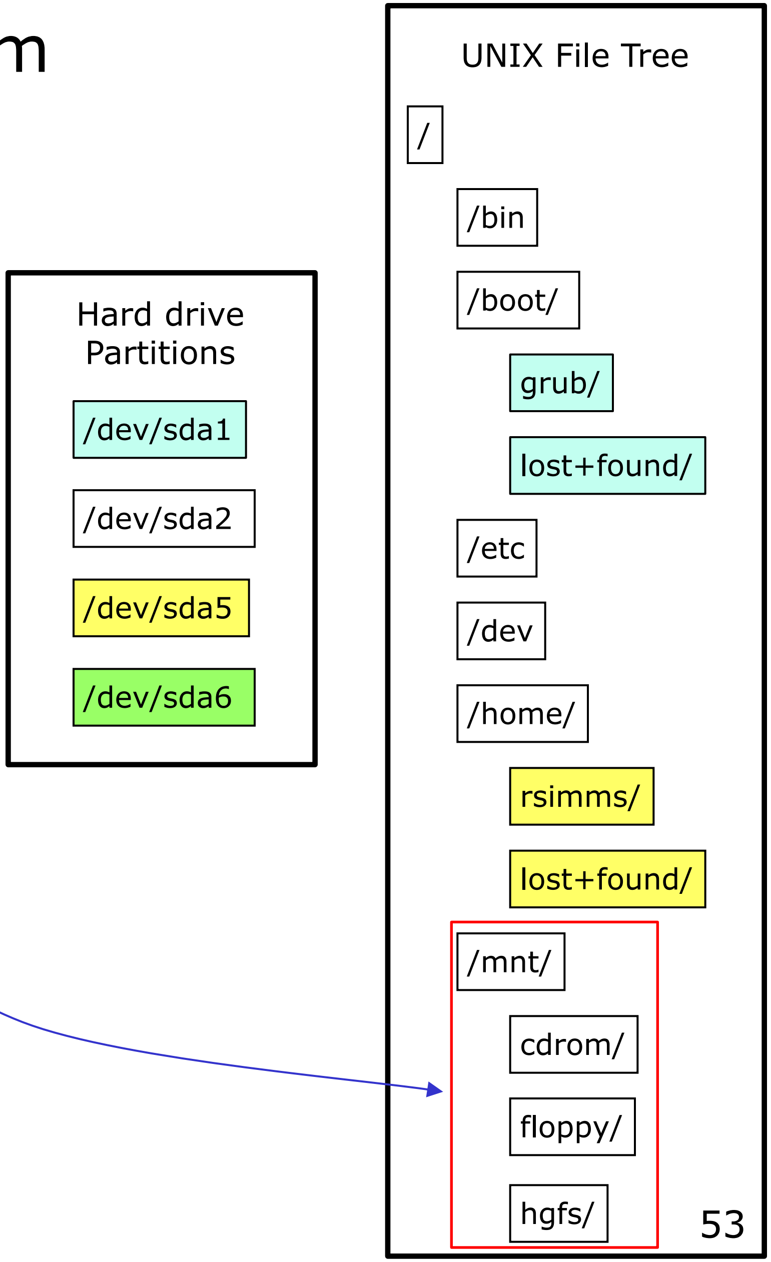
*Lets mount the new filesystem on **/mnt** and populate it with some example directories*

# Making and mounting a filesystem

On the rh9 VM

```
[root@rh9 root]# umount /mnt
[root@rh9 root]# ls /mnt
cdrom   floppy   hgfs
[root@rh9 root]#
```

*The umount command reverts the UNIX file tree back to the original directories*



Hard drive Partitions

/dev/sda1

/dev/sda2

/dev/sda5

/dev/sda6

UNIX File Tree

/

/bin

/boot/

grub/

lost+found/

/etc

/dev

/home/

rsimms/

lost+found/

/mnt/

cdrom/

floppy/

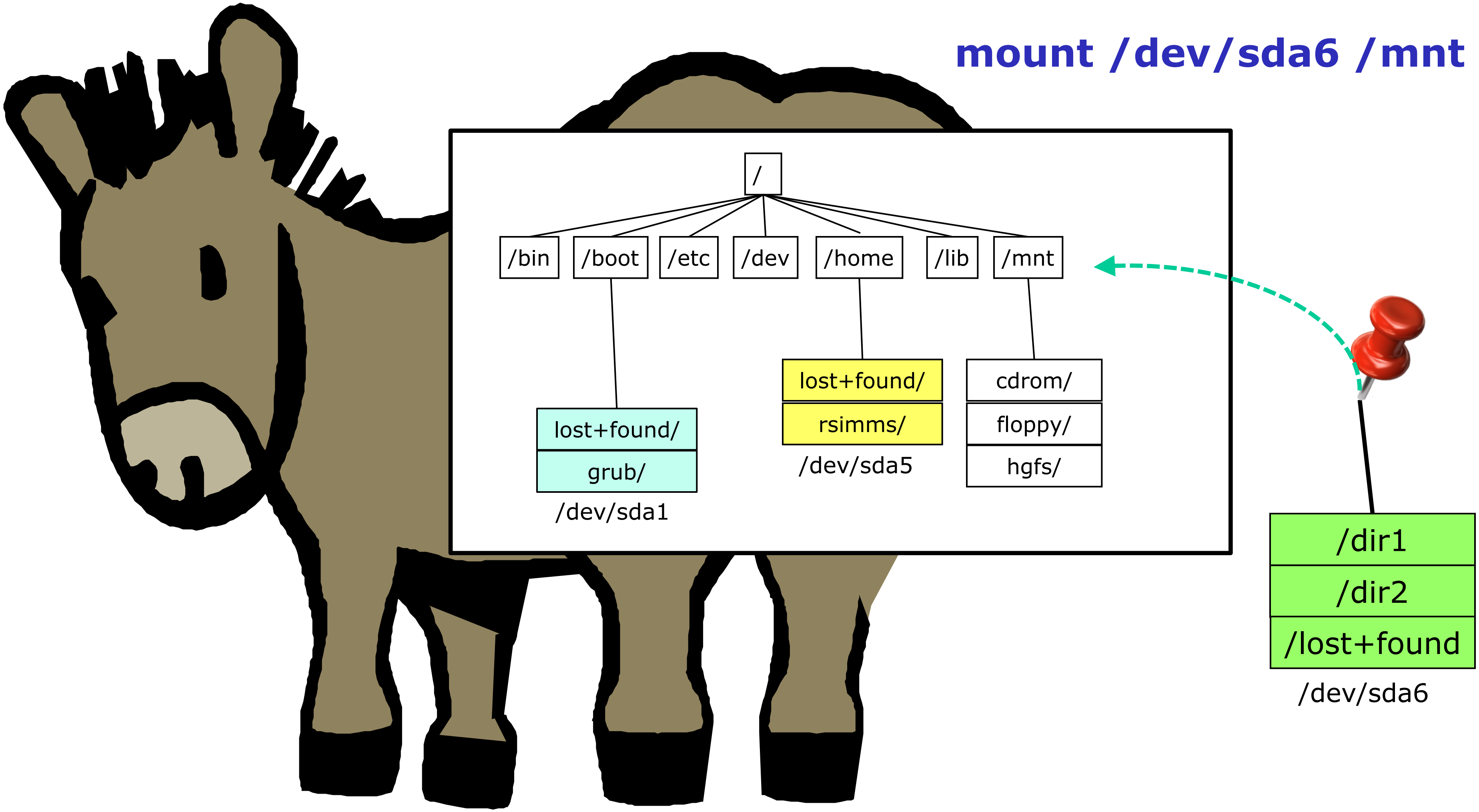
hgfs/

# Pin the tail on the donkey

# Mounting File Systems

## Like pinning the tail on the donkey

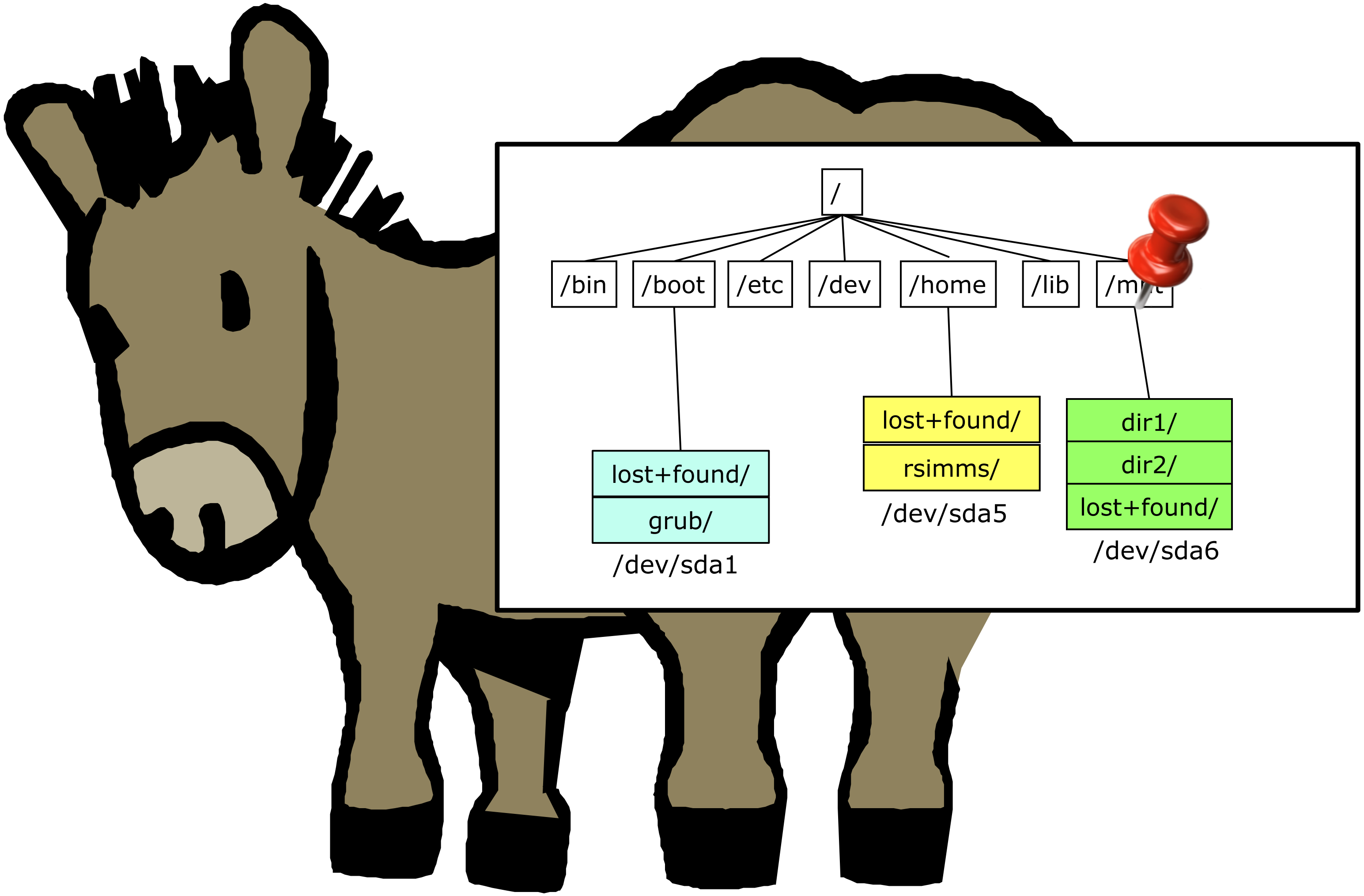
**mount /dev/sda6 /mnt**



*Initially the /mnt directory is mapped to files on /dev/sda2*

# Mounting File Systems

## Like pinning the tail on the donkey

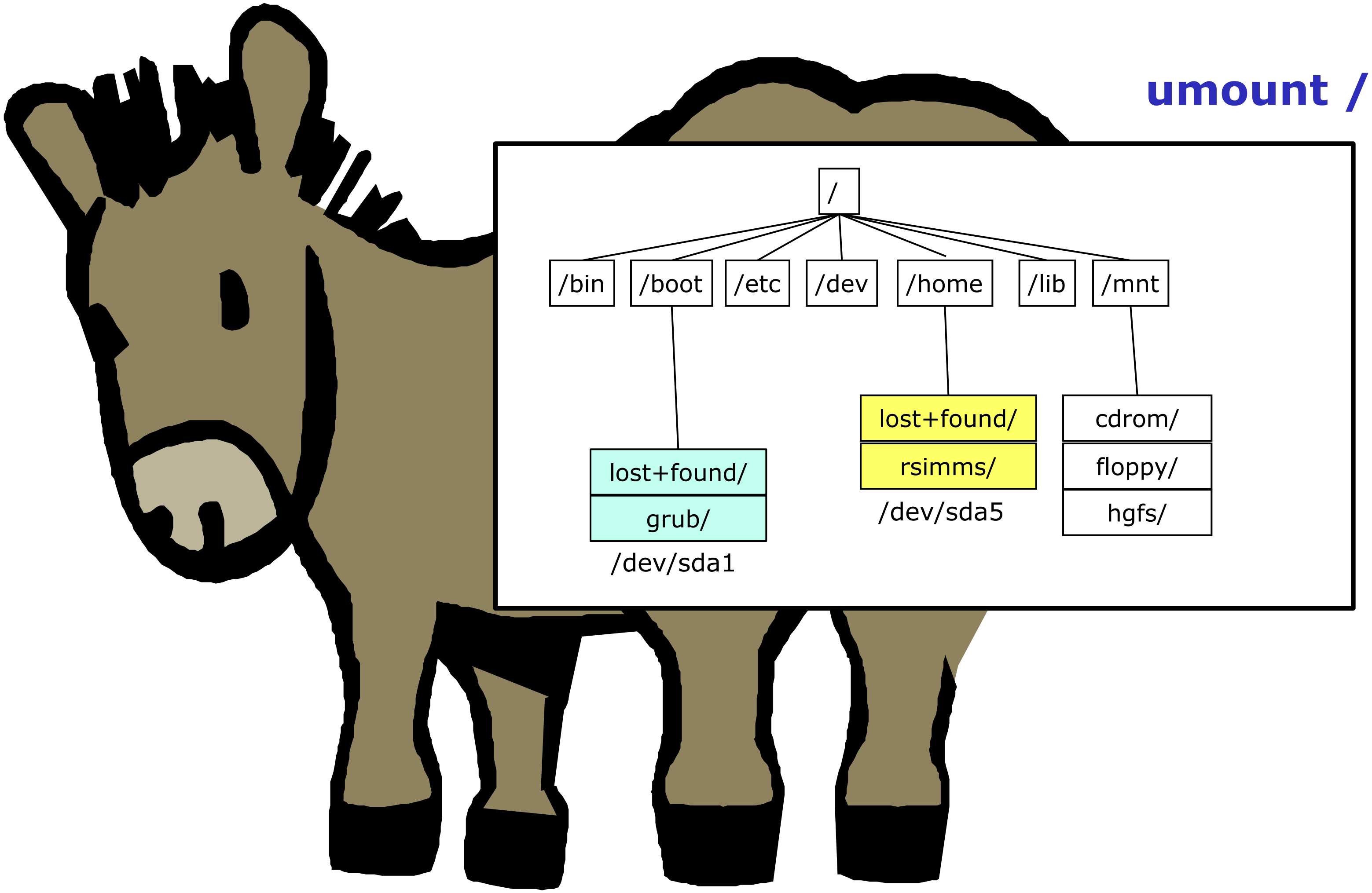


*After the mount command, /mnt is mapped to /dev/sda6 files*

# Mounting File Systems

## Like pinning the tail on the donkey

**umount /mnt**



/

/bin /boot /etc /dev /home /lib /mnt

lost+found/
grub/
/dev/sda1

lost+found/
rsimms/
/dev/sda5

cdrom/
floppy/
hgfs/

*After the umount command, /mnt is mapped back to files on /dev/sda2*

# Mounting File Systems

## Caveats

- Don’t mount a file system to a directory you are in.
- You can’t un-mount a file system you have cd’ed into:

```
[root@rh9 mnt]# umount /mnt
umount: /mnt: device is busy

[root@rh9 mnt]# cd
[root@rh9 root]# umount /mnt
[root@rh9 root]#
```

*Must cd out of the mounted directory before it can be unmounted*

# Mounting File Systems

## mount command and /etc/mtab

device | mount point | file system type | mount options | dump frequency | fsck pass

```
[root@rh9 root]# mount
/dev/sda2  on /          type  ext3    (rw)
none       on /proc      type  proc    (rw)
/dev/sda1  on /boot      type  ext2    (rw)
none       on /dev/pts   type  devpts  (rw,gid=5,mode=620)
/dev/sda5  on /home      type  ext3    (rw)
none       on /dev/shm   type  tmpfs   (rw)

[root@rh9 root]# cat /etc/mtab
/dev/sda2   /          ext3     rw                   0   0
none        /proc      proc     rw                   0   0
/dev/sda1   /boot      ext2     rw                   0   0
none        /dev/pts   devpts   rw,gid=5,mode=620    0   0
/dev/sda5   /home      ext3     rw                   0   0
none        /dev/shm   tmpfs    rw                   0   0
```

*Note: spaces added to output above for readability*

# Mounting File Systems
## /etc/fstab

*/etc/fstab is used to automatically mount file systems at boot time*

*Use **man fstab** for details*

*only 1's will be backed up by dump*

*fsck order, 0's not checked*

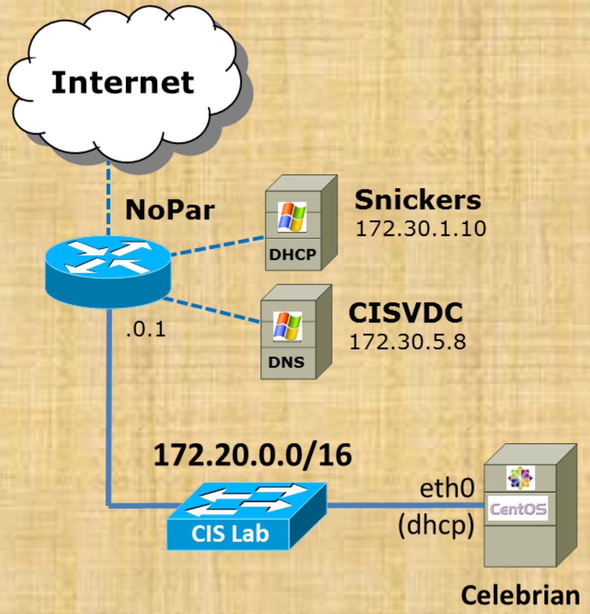
device | mount point | file system type | mount options | dump frequency | fsck pass

```
[root@rh9 root]# cat /etc/fstab
LABEL=/        /            ext3          defaults                 1  1
LABEL=/boot    /boot        ext2          defaults                 1  2
none           /dev/pts     devpts        gid=5,mode=620           0  0
LABEL=/home    /home        ext3          defaults                 1  2
none           /proc        proc          defaults                 0  0
none           /dev/shm     tmpfs         defaults                 0  0
/dev/sda3      swap         swap          defaults                 0  0
/dev/cdrom     /mnt/cdrom   udf,iso9660   noauto,owner,kudzu,ro    0  0
/dev/fd0       /mnt/floppy  auto          noauto,owner,kudzu       0  0
```

*Huh? So what the heck partition is LABEL=/? Use tune2fs to show volume names (labels)*

```
[root@rh9 root]# tune2fs -l /dev/sda1 | grep name
Filesystem volume name:   /boot
[root@rh9 root]# tune2fs -l /dev/sda2 | grep name
Filesystem volume name:   /
[root@rh9 root]# tune2fs -l /dev/sda5 | grep name
Filesystem volume name:   /home
[root@rh9 root]#
```

# Activity



On Celebrian:

- Issue **fdisk -l** (lower case L) to see partitions
- Issue **mount** command to see how partitions are mounted on UNIX file tree
- Review /etc/mtab
- Review /etc/fstab

```
[root@p02-celebrian ~]# fdisk -l

Disk /dev/sda: 6442 MB, 6442450944 bytes
199 heads, 62 sectors/track, 1019 cylinders
Units = cylinders of 12338 * 512 = 6317056 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x0002e028

   Device Boot      Start         End      Blocks   Id  System
/dev/sda1   *           1          84      512000   83  Linux
Partition 1 has different physical/logical beginnings (non-Linux?):
     phys=(0, 32, 33) logical=(0, 33, 3)
Partition 1 has different physical/logical endings:
     phys=(63, 221, 30) logical=(83, 32, 10)
Partition 1 does not end on cylinder boundary.
/dev/sda2              84        1020     5778432   8e  Linux LVM
Partition 2 has different physical/logical beginnings (non-Linux?):
     phys=(63, 221, 31) logical=(83, 32, 11)
Partition 2 has different physical/logical endings:
     phys=(783, 63, 48) logical=(1019, 169, 12)
Partition 2 does not end on cylinder boundary.

Disk /dev/mapper/VolGroup-lv_root: 4873 MB, 4873781248 bytes
255 heads, 63 sectors/track, 592 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x00000000


Disk /dev/mapper/VolGroup-lv_swap: 1040 MB, 1040187392 bytes
255 heads, 63 sectors/track, 126 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x00000000

[root@p02-celebrian ~]#
```

*Use fdisk -l to see how your disk is partitioned (CentOS 6.3 VMs)*

*Two logical volumes on /dev/sda2*

## *Use mount or /etc/mtab to see current mounts (CentOS 6.3 VMs)*

```
[root@p02-celebrian ~]# mount
/dev/mapper/VolGroup-lv_root on / type ext4 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
tmpfs on /dev/shm type tmpfs (rw,rootcontext="system_u:object_r:tmpfs_t:s0")
/dev/sda1 on /boot type ext4 (rw)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw)
```

*One of the logical volumes is mount on /*

*The first partition on the first scsi drive is mounted on /boot*

```
[root@p02-celebrian ~]# cat /etc/mtab
/dev/mapper/VolGroup-lv_root / ext4 rw 0 0
proc /proc proc rw 0 0
sysfs /sys sysfs rw 0 0
devpts /dev/pts devpts rw,gid=5,mode=620 0 0
tmpfs /dev/shm tmpfs rw,rootcontext="system_u:object_r:tmpfs_t:s0" 0 0
/dev/sda1 /boot ext4 rw 0 0
none /proc/sys/fs/binfmt_misc binfmt_misc rw 0 0
sunrpc /var/lib/nfs/rpc_pipefs rpc_pipefs rw 0 0
[root@p02-celebrian ~]#
```

## *Use mount or /etc/mtab to see current mounts (CentOS 6.3 VMs)*

```
[root@p02-celebrian ~]# mount
/dev/mapper/VolGroup-lv_root on / type ext4 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
tmpfs on /dev/shm type tmpfs (rw,rootcontext="system_u:object_r:tmpfs_t:s0")
/dev/sda1 on /boot type ext4 (rw)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw)
```

*Virtual filesystems (they exist only in RAM) also get mounted on the file tree*

```
[root@p02-celebrian ~]# cat /etc/mtab
/dev/mapper/VolGroup-lv_root / ext4 rw 0 0
proc /proc proc rw 0 0
sysfs /sys sysfs rw 0 0
devpts /dev/pts devpts rw,gid=5,mode=620 0 0
tmpfs /dev/shm tmpfs rw,rootcontext="system_u:object_r:tmpfs_t:s0" 0 0
/dev/sda1 /boot ext4 rw 0 0
none /proc/sys/fs/binfmt_misc binfmt_misc rw 0 0
sunrpc /var/lib/nfs/rpc_pipefs rpc_pipefs rw 0 0
```

## *Use /etc/fstab to configure what gets mounted at system startup (CentOS 6.3 VMs)*

*Note the swap logical volume is not mounted on the file tree. It's used as swap space and configured here*

```
[root@p02-celebrian ~]# cat /etc/fstab

#
# /etc/fstab
# Created by anaconda on Sun Dec 30 17:55:28 2012
#
# Accessible filesystems, by reference, are maintained under '/dev/disk'
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
#
/dev/mapper/VolGroup-lv_root /                       ext4    defaults        1 1
UUID=c57e1f48-d3cf-403a-803e-aeb0c28aba62 /boot                   ext4    defaults        1 2
/dev/mapper/VolGroup-lv_swap swap                    swap    defaults        0 0
tmpfs                   /dev/shm                tmpfs   defaults        0 0
devpts                  /dev/pts                devpts  gid=5,mode=620  0 0
sysfs                   /sys                    sysfs   defaults        0 0
proc                    /proc                   proc    defaults        0 0
[root@p02-celebrian ~]#
```

```
[root@p02-celebrian ~]# tune2fs -l /dev/sda1 | grep UUID
Filesystem UUID:          c57e1f48-d3cf-403a-803e-aeb0c28aba62
```

# LVM sidetrack

# Logical Volume Manager

```
[root@hiro ~]# fdisk -l

Disk /dev/sda: 5368 MB, 5368709120 bytes
255 heads, 63 sectors/track, 652 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/sda1   *           1          13      104391   83  Linux
/dev/sda2              14         652     5132767+  8e  Linux LVM
[root@hiro ~]#


[root@hiro ~]# 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/sda1 on /boot type ext3 (rw)
tmpfs on /dev/shm type tmpfs (rw)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw)
nfsd on /proc/fs/nfsd type nfsd (rw)
[root@hiro ~]#
```

*So what partition is this?*

*Where is /dev/sda2 mounted?*

# Logical Volume Manager

```
[root@hiro ~]# cat /etc/fstab
/dev/VolGroup00/LogVol00 /                        ext3    defaults        1 1
LABEL=/boot              /boot                    ext3    defaults        1 2
tmpfs                    /dev/shm                 tmpfs   defaults        0 0
devpts                   /dev/pts                 devpts  gid=5,mode=620  0 0
sysfs                    /sys                     sysfs   defaults        0 0
proc                     /proc                    proc    defaults        0 0
/dev/VolGroup00/LogVol01 swap                     swap    defaults        0 0
[root@hiro ~]#

[root@hiro ~]# tune2fs -l /dev/sda1 | grep volume
Filesystem volume name:   /boot
[root@hiro ~]#

[root@hiro ~]# tune2fs -l /dev/VolGroup00/LogVol00 | grep volume
Filesystem volume name:   <none>
[root@hiro ~]#
```

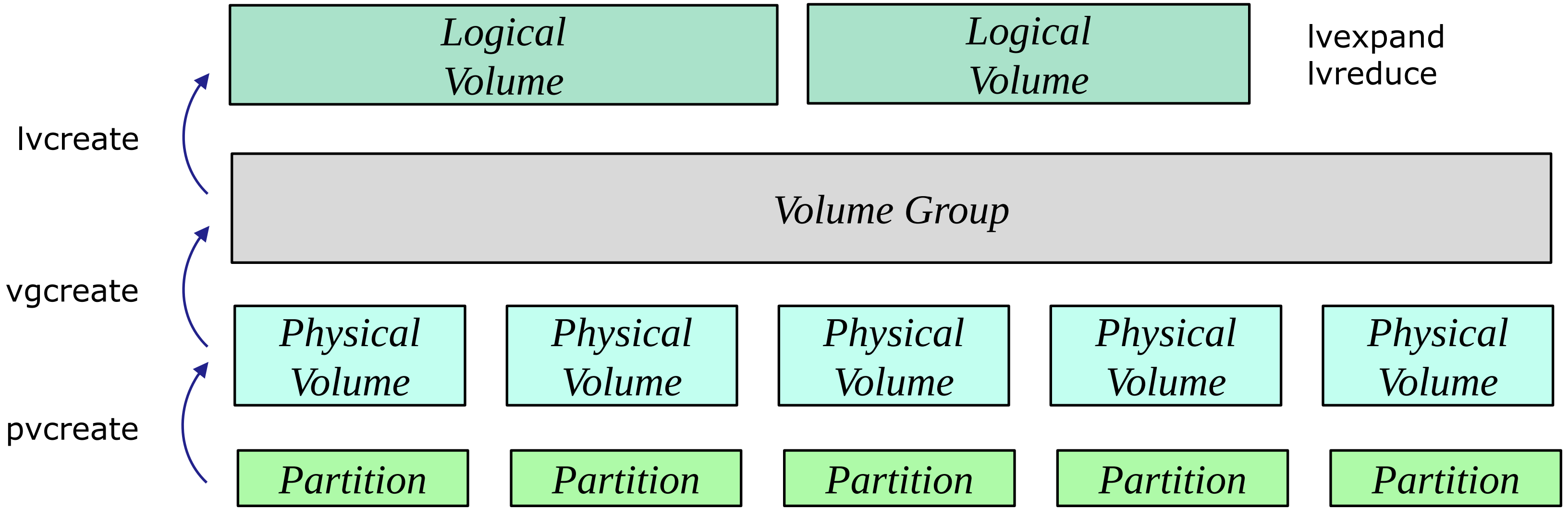
*The /boot labeled partition is /dev/sda1*

*dev/VolGroup00/LogVol10x are logical volumes created by LVM*

*Note, LVM is used with default installations of Centos and RHEL 5 and later.*

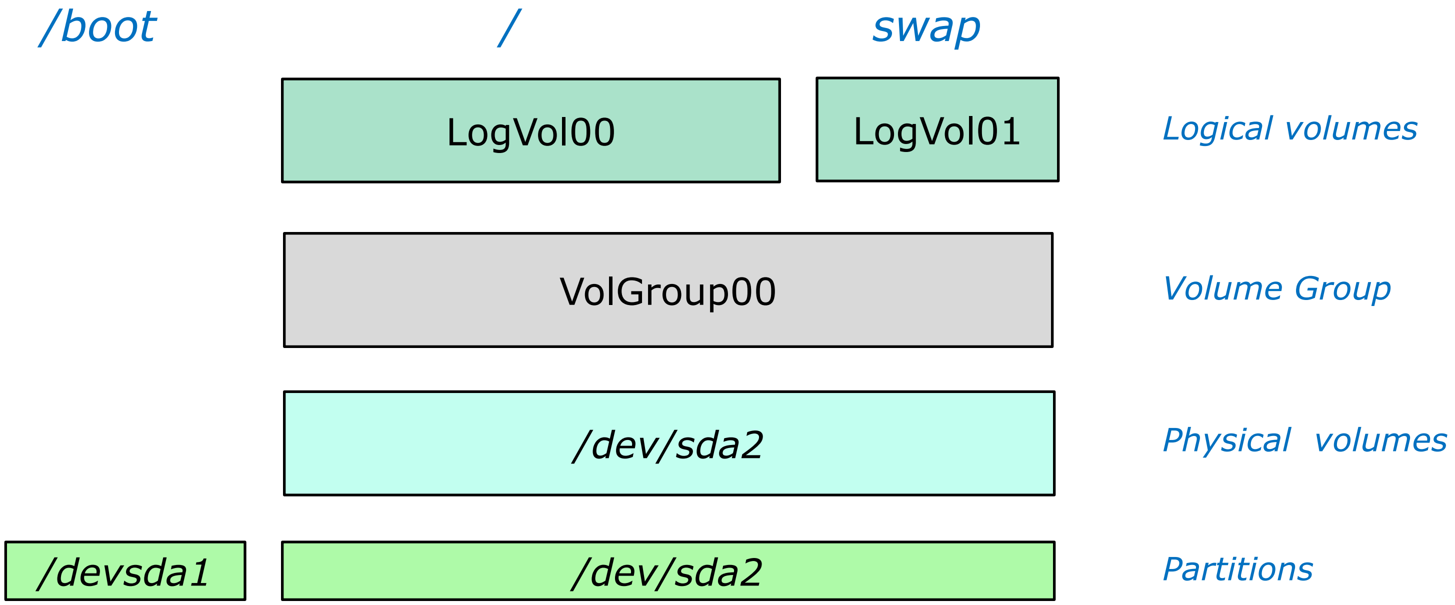
# Logical Volume Manager

- LVM lets you spread one or more logical volumes across one or more physical partitions.
- LVM provides more flexibility (with some additional complexity) for future changes.
- Logical volumes are very easy to resize compared to partitions.



# Logical Volume Manager

Arwen's Storage Allocation



*/boot* */* *swap*

LogVol00 LogVol01 *Logical volumes*

VolGroup00 *Volume Group*

*/dev/sda2* *Physical volumes*

*/devsda1* */dev/sda2* *Partitions*

# Logical Volume Manager

**LVM Commands:**

**pvscan -** shows physical volumes

**pvdisplay -** shows physical volume info

**vgscan** - scans for volume groups

**vgdisplay -** shows volume group info

**lvscan** - scans for logical volumes

**lvdisplay -** shows logical volume info

# Logical Volume Manager

```
[root@hiro ~]# pvscan
  PV /dev/sda2   VG VolGroup00   lvm2 [4.88 GB / 0    free]
  Total: 1 [4.88 GB] / in use: 1 [4.88 GB] / in no VG: 0 [0   ]
[root@hiro ~]#
```

*Physical volume information*

```
[root@hiro ~]# pvdisplay
  --- Physical volume ---
  PV Name               /dev/sda2
  VG Name               VolGroup00
  PV Size               4.89 GB / not usable 20.47 MB
  Allocatable           yes (but full)
  PE Size (KByte)       32768
  Total PE              156
  Free PE               0
  Allocated PE          156
  PV UUID               Hj6Fx7-Ars0-7MMp-voCc-0L92-uPgN-Q8s4xr

[root@hiro ~]#
```

*Note: /dev/sda2 is being used in the volume group VolGroup00*

**LVM Commands:**

**pvscan -** shows physical volumes
**pvdisplay -** shows physical volume info

# Logical Volume Manager

```
[root@hiro ~]# vgscan
  Reading all physical volumes.  This may take a while...
  Found volume group "VolGroup00" using metadata type lvm2
```

*Volume group scan*

```
[root@hiro ~]# vgdisplay
  --- Volume group ---
  VG Name               VolGroup00
  System ID
  Format                lvm2
  Metadata Areas        1
  Metadata Sequence No  3
  VG Access             read/write
  VG Status             resizable
  MAX LV                0
  Cur LV                2
  Open LV               2
  Max PV                0
  Cur PV                1
  Act PV                1
  VG Size               4.88 GB
  PE Size               32.00 MB
  Total PE              156
  Alloc PE / Size       156 / 4.88 GB
  Free  PE / Size       0 / 0
  VG UUID               fOKPku-aXsN-L1Ro-4yZo-Fi38-nA8R-zz41jT
```

*Volume group display*

```
[root@hiro ~]# lvscan
  ACTIVE            '/dev/VolGroup00/LogVol00' [3.88 GB] inherit
  ACTIVE            '/dev/VolGroup00/LogVol01' [1.00 GB] inherit
```

*Logical volume scan*

**LVM Commands:**

**vgscan** - scans for volume groups
**vgdisplay -** shows volume group info

**lvscan** - scans for logical volumes
**lvdisplay -** shows logical volume info

# Logical Volume Manager

```
[root@hiro ~]# lvdisplay
  --- Logical volume ---
  LV Name                /dev/VolGroup00/LogVol00
  VG Name                VolGroup00
  LV UUID                y275PJ-CqY7-vZ9f-gCod-X72l-HgWo-QwC4T7
  LV Write Access        read/write
  LV Status              available
  # open                 1
  LV Size                3.88 GB
  Current LE             124
  Segments               1
  Allocation             inherit
  Read ahead sectors     auto
  - currently set to     256
  Block device           253:0

  --- Logical volume ---
  LV Name                /dev/VolGroup00/LogVol01
  VG Name                VolGroup00
  LV UUID                xaOVc6-xP9C-wpT5-Ve2U-NA9p-Io9k-cPLQ4F
  LV Write Access        read/write
  LV Status              available
  # open                 1
  LV Size                1.00 GB
  Current LE             32
  Segments               1
  Allocation             inherit
  Read ahead sectors     auto
  - currently set to     256
  Block device           253:1
```

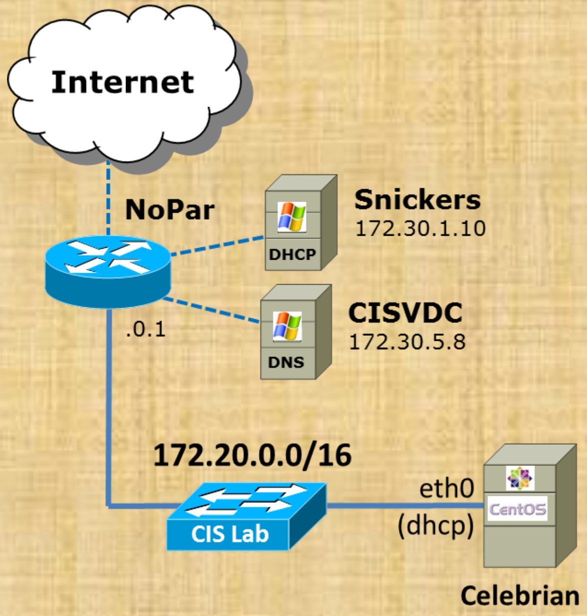
*Logical volume display*

*Mounted on /*

*Note, these logical volumes relate back to what we saw in /etc/fstab*

*Used as swap partition*

# Activity



Try some LVM commands on Celebrian

- **pvscan**
- **pvdisplay**
- **vgscan**
- **vgdisplay**
- **lvscan**
- **lvdisplay**

```
[root@p02-celebrian ~]# pvscan
  PV /dev/sda2   VG VolGroup   lvm2 [5.51 GiB / 0    free]
  Total: 1 [5.51 GiB] / in use: 1 [5.51 GiB] / in no VG: 0 [0   ]


[root@p02-celebrian ~]# pvdisplay
  --- Physical volume ---
  PV Name               /dev/sda2
  VG Name               VolGroup
  PV Size               5.51 GiB / not usable 3.00 MiB
  Allocatable           yes (but full)
  PE Size               4.00 MiB
  Total PE              1410
  Free PE               0
  Allocated PE          1410
  PV UUID               RJN1vC-RKk7-lk97-rtia-hYB0-qqib-KLRd6u
```

*Use pvscan and pvdisplay to show physical volumes being used for logical volumes*

```
[root@p02-celebrian ~]# vgscan
  Reading all physical volumes.  This may take a while...
  Found volume group "VolGroup" using metadata type lvm2


[root@p02-celebrian ~]# vgdisplay
  --- Volume group ---
  VG Name               VolGroup
  System ID
  Format                lvm2
  Metadata Areas        1
  Metadata Sequence No  3
  VG Access             read/write
  VG Status             resizable
  MAX LV                0
  Cur LV                2
  Open LV               2
  Max PV                0
  Cur PV                1
  Act PV                1
  VG Size               5.51 GiB
  PE Size               4.00 MiB
  Total PE              1410
  Alloc PE / Size       1410 / 5.51 GiB
  Free  PE / Size       0 / 0
  VG UUID               s2g6dw-6VNp-Owtl-F9A8-SbAZ-zKkh-Y1bmu5
```

*Use vgscan and vgdisplay to show volume groups being used for logical volumes*

```
[root@p02-celebrian ~]# lvscan
  ACTIVE            '/dev/VolGroup/lv_root' [4.54 GiB] inherit
  ACTIVE            '/dev/VolGroup/lv_swap' [992.00 MiB] inherit

[root@p02-celebrian ~]# lvdisplay
  --- Logical volume ---
  LV Path                /dev/VolGroup/lv_root
  LV Name                lv_root
  VG Name                VolGroup
  LV UUID                MH7j9J-9jwQ-B7WH-6Li2-SgAv-Ll4O-qcb3hf
  LV Write Access        read/write
  LV Creation host, time localhost.localdomain, 2012-12-30 17:55:01 -0800
  LV Status              available
  # open                 1
  LV Size                4.54 GiB
  Current LE             1162
  Segments               1
  Allocation             inherit
  Read ahead sectors     auto
  - currently set to     256
  Block device           253:0

  --- Logical volume ---
  LV Path                /dev/VolGroup/lv_swap
  LV Name                lv_swap
  VG Name                VolGroup
  LV UUID                XOqvYc-54Rj-9lOw-eP5i-YsLx-AEzk-eKBQIe
  LV Write Access        read/write
  LV Creation host, time localhost.localdomain, 2012-12-30 17:55:23 -0800
  LV Status              available
  # open                 1
  LV Size                992.00 MiB
  Current LE             248
  Segments               1
  Allocation             inherit
  Read ahead sectors     auto
  - currently set to     256
  Block device           253:1
```

*Use lvscan and lvdisplay to show logical volumes*

# RPC

# Remote Procedure Call

- In programming you use procedures (AKA functions) to encapsulate common functionality.
- Functions can be defined in the program or be available in a function library with can be linked statically or dynamically.
- The RPC (Remote Procedure Call) protocol is a way for a program to use a procedure on a remote system over the network.
- Services like NFS and NIS use this remote procedure call technology.
- A port mapper is used by RPC based programs to map a UDP or TCP port to a specific RPC program.
- Sun created the first popular implementation of RPC which is now called ONC (Open Network Computing) RPC.  See RFC 1831.

# NFS

# NFS

**What is NFS?**

- NFS is the Network File System.  It allows a system to mount a remote directory.

- Originally developed by Sun Microsystems in 1984

# NFS Overview

**The Network File System Components**

1. The *portmap* package

   NFS is designed around the Remote Procedure Call API and utilizes the portmap daemon for its operation. (Not required for NFS version 4)

2. The *nfs-utils* package has five components:
   - **rpc.nfsd** Primary NFS component. Handles all NFS requests, and provides the main engine for NFS to work.
   - **rpc.mountd** Handles permission evaluation before allowing the client to mount an export.
   - **rpc.quotad** Interfaces with the quota manager to ensure that client file system quotas are preserved.
   - **rpc.statd** Monitors UDP and TCP traffic during NFS operation. It reports crashes and reboots to the lock manager.
   - **rpc.lockd** Manages file-locking requests, and on crashed systems, this component provides lock recovery.

**3. Automount** is also included in the *nfs-utils* package, and is used for mounting NFS directories dynamically as they are accessed by users.

# NFS Overview

**Client-Server Operations**

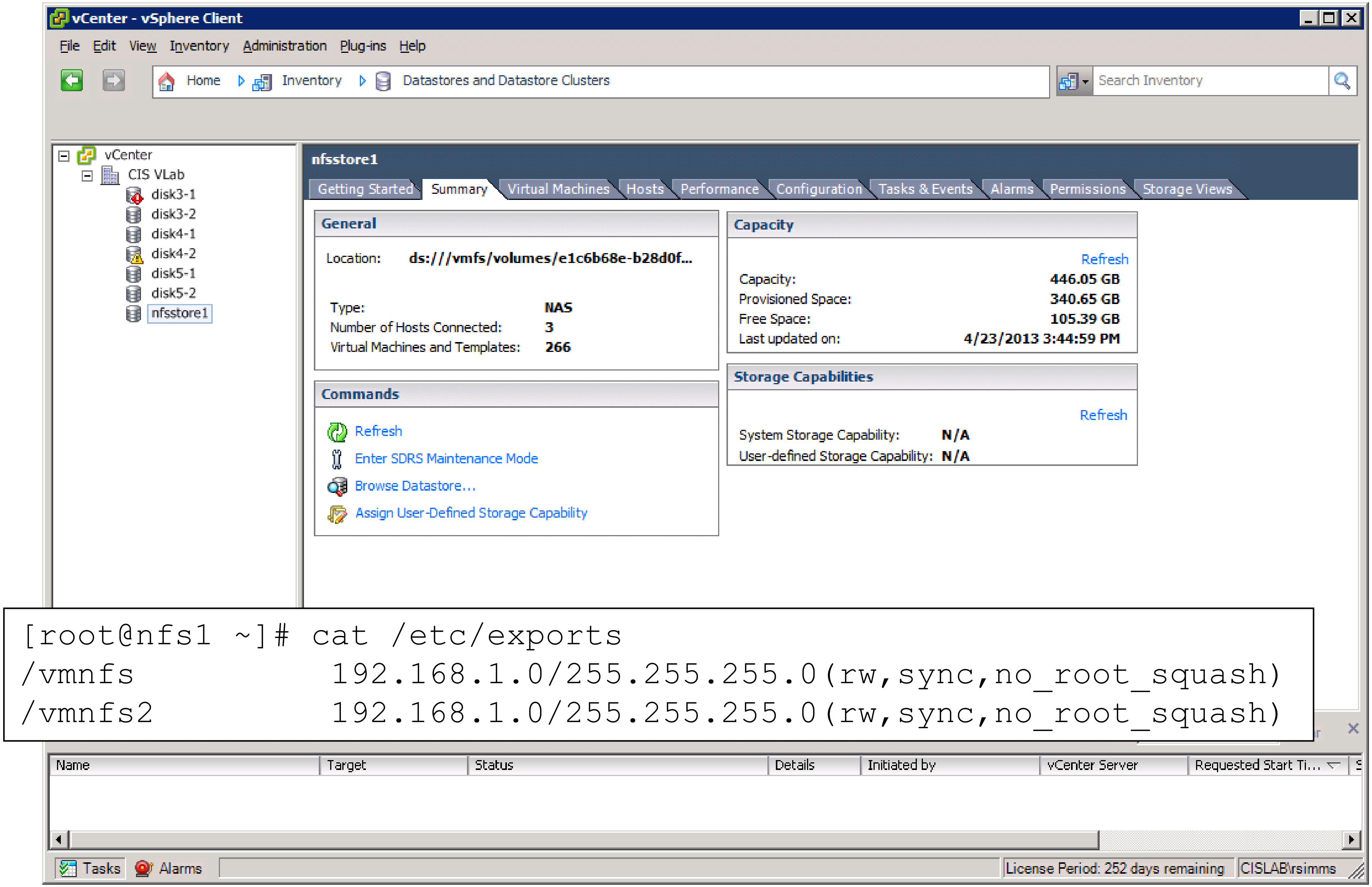
An NFS server, serving files and directories to remote clients, can be a client at the same time as it is serving.

- NFSv3 is capable of running over both UDP and TCP
- rpc.lockd and rpc.statd run on both the server and the client

*Implements NSM (Network Status Monitor) RPC protocol and provides reboot notification so locking can be updated when the NFS server crashes*

*Starts the NFS lock manager on kernels. Locking prevents more than one user accessing and modifying a file at the same time.*

# nfsstore1 in VLab



nfsstore1

General

Location: ds:///vmfs/volumes/e1c6b68e-b28d0f...

Type: NAS
Number of Hosts Connected: 3
Virtual Machines and Templates: 266

Commands

Capacity

Capacity: 446.05 GB
Provisioned Space: 340.65 GB
Free Space: 105.39 GB
Last updated on: 4/23/2013 3:44:59 PM

Storage Capabilities

System Storage Capability: N/A
User-defined Storage Capability: N/A

License Period: 252 days remaining | CISLAB\rsimms

```
[root@nfs1 ~]# cat /etc/exports
/vmnfs          192.168.1.0/255.255.255.0(rw,sync,no_root_squash)
/vmnfs2         192.168.1.0/255.255.255.0(rw,sync,no_root_squash)
```

# Using NFS

# NFS Example

nfs-depot-31

*NFS Server*

*This will be the “remote” system which is configured as a NFS server*

*Here is an example directory we want to share*

```
[root@nfs-depot-31 ~]# ls /depot
arwen.jpg                     hk.txt            lab03  labX3
benji-grail-600.jpg           holy-grail.jpg    lab04  legolas.jpg
bho.txt                       index.html        lab05  ptest01
celebrian.jpg                 iptables.default  lab06  remus-farm.jpg
distance-account-picture.jpg  jfk.txt           lab07  test01
elrond.jpg                    lab01             labX1
exam                          lab02             labX2
```

# NFS Example

**nfs-depot-31**

*NFS Server*

*Here is how you share this directory with others*

```
[root@nfs-depot-31 ~]# cat /etc/exports
/depot          *(ro,sync)
```

*Add a line to /etc/exports*

```
[root@nfs-depot-31 ~]# service nfs start
Starting NFS services:                                     [  OK  ]
Starting NFS mountd:                                       [  OK  ]
Stopping RPC idmapd:                                       [  OK  ]
Starting RPC idmapd:                                       [  OK  ]
Starting NFS daemon:                                       [  OK  ]
```

*Start the NFS services*

# NFS Example

**nfs-depot-31**

*NFS Server*

```
[root@nfs-depot-31 ~]# cat /etc/exports
/depot          *(ro,sync)
```

*Options, ro=read only, sync=writes data to disk instead of buffering*

*The hostnames that can mount it, *=all*

*The directory to export*

*This line defines the directory to be shared, who can access it, and how it is shared.*

# NFS Example

**nfs-depot-31**

*NFS Server*

```
[root@nfs-depot-31 ~]# ls /depot
arwen.jpg                     hk.txt            lab03  labX3
benji-grail-600.jpg           holy-grail.jpg    lab04  legolas.jpg
bho.txt                       index.html        lab05  ptest01
celebrian.jpg                 iptables.default  lab06  remus-farm.jpg
distance-account-picture.jpg  jfk.txt           lab07  test01
elrond.jpg                    lab01             labX1
exam                          lab02             labX2
```

## *Mount the remote directory on a local directory*

```
[root@p02-celebrian ~]# showmount -e nfs-depot-31
Export list for nfs-depot-31:
/depot      *
```

**Celebrian**

*NFS Client*

```
[root@p02-celebrian ~]# mkdir /depot
[root@p02-celebrian ~]# mount nfs-depot-31:/depot /depot
[root@p02-celebrian ~]# ls /depot
arwen.jpg                     hk.txt            lab03  labX3
benji-grail-600.jpg           holy-grail.jpg    lab04  legolas.jpg
bho.txt                       index.html        lab05  ptest01
celebrian.jpg                 iptables.default  lab06  remus-farm.jpg
distance-account-picture.jpg  jfk.txt           lab07  test01
elrond.jpg                    lab01             labX1
exam                          lab02             labX2
```

# NFS Example

**nfs-depot-31**

*NFS Server*

```
[root@nfs-depot-31 ~]# ls /depot
arwen.jpg                      hk.txt            lab03  labX3
benji-grail-600.jpg            holy-grail.jpg    lab04  legolas.jpg
bho.txt                        index.html        lab05  ptest01
celebrian.jpg                  iptables.default  lab06  remus-farm.jpg
distance-account-picture.jpg   jfk.txt           lab07  test01
elrond.jpg                     lab01             labX1
exam                           lab02             labX2
```

## *Show the NFS mount*

**Celebrian**

*NFS Client*

```
[root@p02-celebrian ~]# mount
/dev/mapper/VolGroup-lv_root on / type ext4 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
tmpfs on /dev/shm type tmpfs
(rw,rootcontext="system_u:object_r:tmpfs_t:s0")
/dev/sda1 on /boot type ext4 (rw)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw)
nfs-depot-31:/depot on /depot type nfs
(rw,vers=4,addr=192.168.31.50,clientaddr=172.20.4.71)
```

# NFS Example

**nfs-depot-31**

*NFS Server*

```
[root@nfs-depot-31 ~]# ls /depot
arwen.jpg                     hk.txt            lab03  labX3
benji-grail-600.jpg           holy-grail.jpg    lab04  legolas.jpg
bho.txt                       index.html        lab05  ptest01
celebrian.jpg                 iptables.default  lab06  remus-farm.jpg
distance-account-picture.jpg  jfk.txt           lab07  test01
elrond.jpg                    lab01             labX1
exam                          lab02             labX2
```

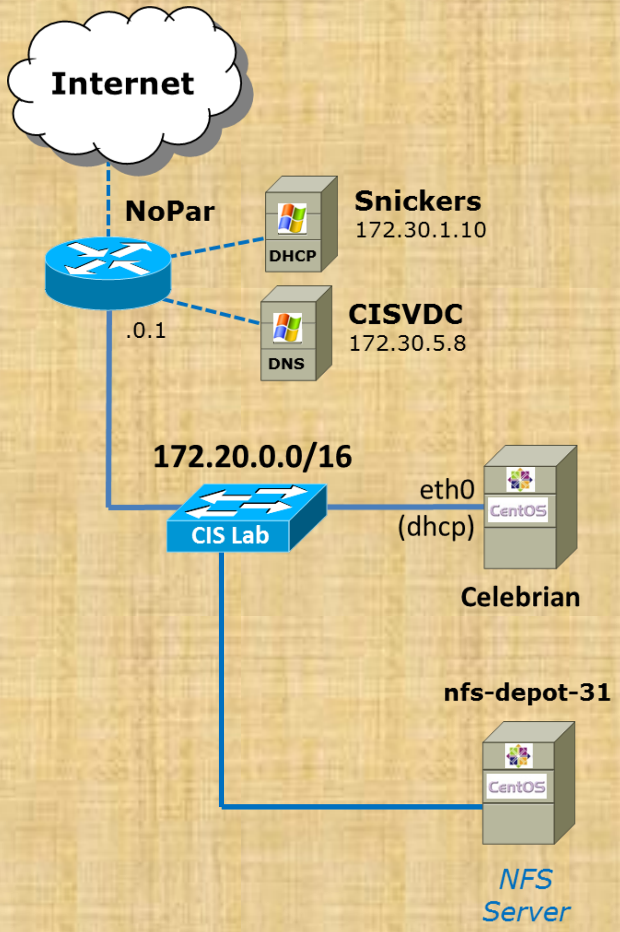
***Unmount the NFS directory when finished***

**Celebrian**

*NFS Client*

```
[root@p02-celebrian ~]# umount /depot
[root@p02-celebrian ~]# ls /depot
[root@p02-celebrian ~]#
```

# Activity



Try it on Celebrian:

```
mkdir /depot
mount nfs-depot-31:/depot /depot
ls /depot
mount
umount /depot
```

# Service Applications

**Steps to installing services**

1. Install software package using **yum**, **rpm, apt-get** or build from source code
2. Customize service’s configuration file
3. Modify the firewall to allow access to the service
4. Customize SELinux context settings to allow use
5. Start the service
6. Configure service to automatically start when system boots
7. Monitor and verify service is running
8. Troubleshoot as necessary
9. Monitor log files as appropriate
10. Configure additional security

# NFS

**Step 1** *Install software package using **yum**, **rpm** or build from source*

```
[root@nfs-depot-31 ~]# rpm -qa | grep nfs
nfs-utils-lib-1.1.5-4.el6.x86_64
nfs-utils-1.2.3-26.el6.x86_64
```

*Installed by default on Red Hat and CentOS.*

# NFS

## The Network File System Packages

```
[root@nfs-depot-31 ~]# rpm -qi nfs-utils
Name        : nfs-utils                    Relocations: (not relocatable)
Version     : 1.2.3                             Vendor: CentOS
Release     : 26.el6                        Build Date: Fri 22 Jun 2012 08:17:57 AM PDT
Install Date: Sun 30 Dec 2012 05:57:31 PM PST      Build Host: c6b9.bsys.dev.centos.org
Group       : System Environment/Daemons    Source RPM: nfs-utils-1.2.3-26.el6.src.rpm
Size        : 997655                           License: MIT and GPLv2 and GPLv2+ and BSD
Signature   : RSA/SHA1, Sun 24 Jun 2012 03:19:35 PM PDT, Key ID 0946fca2c105b9de
Packager    : CentOS BuildSystem <http://bugs.centos.org>
URL         : http://sourceforge.net/projects/nfs
Summary     : NFS utilities and supporting clients and daemons for the kernel NFS server
Description :
The nfs-utils package provides a daemon for the kernel NFS server and
related tools, which provides a much higher level of performance than the
traditional Linux NFS server used by most users.

This package also contains the showmount program.  Showmount queries the
mount daemon on a remote host for information about the NFS (Network File
System) server on the remote host.  For example, showmount can display the
clients which are mounted on that host.

This package also contains the mount.nfs and umount.nfs program.
[root@nfs-depot-31 ~]#
```

*nfs-utils: The NFS server programs*

# NFS

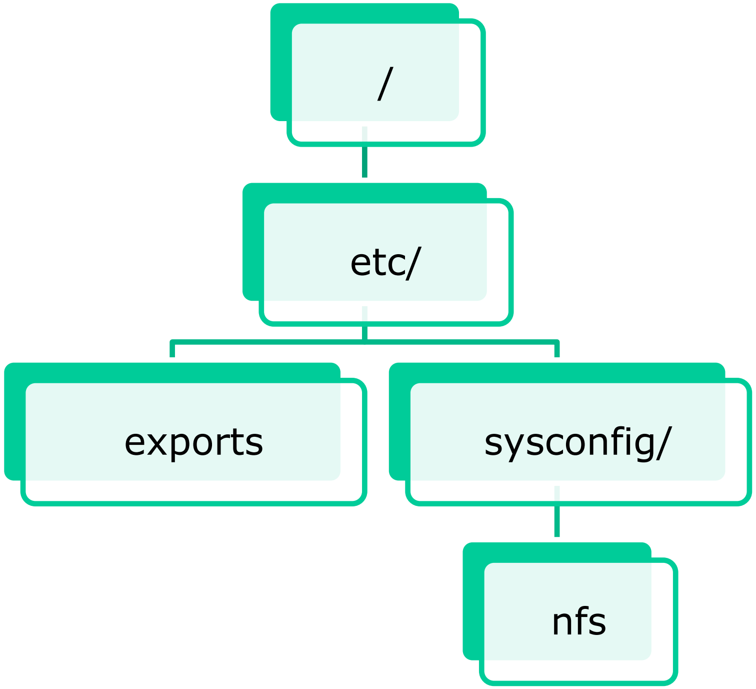
## The Network File System Packages

```
[root@nfs-depot-31 ~]# rpm -qi nfs-utils-lib
Name        : nfs-utils-lib                Relocations: (not relocatable)
Version     : 1.1.5                             Vendor: CentOS
Release     : 4.el6                         Build Date: Wed 07 Dec 2011 12:02:22 PM PST
Install Date: Sun 30 Dec 2012 05:57:30 PM PST      Build Host: c6b4.bsys.dev.centos.org
Group       : System Environment/Libraries   Source RPM: nfs-utils-lib-1.1.5-4.el6.src.rpm
Size        : 152918                           License: BSD
Signature   : RSA/SHA1, Thu 08 Dec 2011 12:43:47 PM PST, Key ID 0946fca2c105b9de
Packager    : CentOS BuildSystem <http://bugs.centos.org>
URL         : http://www.citi.umich.edu/projects/nfsv4/linux/
Summary     : Network File System Support Library
Description :
Support libraries that are needed by the commands and
daemons the nfs-utils rpm.
[root@nfs-depot-31 ~]#
```

*nfs-utils-lib: support library for the NFS programs*

# Installing and Configuring DNS service

**Step 2** Customize the configuration files



The *exports* file specifies directories and access controls for remote access by clients

The *nfs* files allows locking down ports for firewall control

# NFS

**Step 2** Customize service's configuration file

## /etc/exports

Syntax:

*directory to share* *who to share it with*

*absolute-directory-path [machine-specifier(option,options...)]...*

*no spaces (single argument)*

- Machine Specifiers
  - hostname
  - IP address
  - network addresses

- Options
  - ro, rw *read only, read-write (default)*
  - root_squash *squashes special root powers for UID 0 and GID 0, runs as nobody (default)*
  - no_root_squash *allows normal root access*
  - secure *allows remote access only from a privileged port (< 1024)*
  - insecure *allows access from any port*
  - sync *writes to disk are not buffered*

*See **man exports** for more details*

## Server-side NFS

*/etc/exports* file syntax:

*absolute-directory-path [machine-specifier(option,options...)]...*

/etc/exports file examples:

```
[root@hiro ~]# cat /etc/exports
/depot lab-01(rw) arwen(ro)
```

*exports depot directory to lab-01 (read-write) and to arwen (read only)*

```
[root@hiro ~]# cat /etc/exports
/depot 192.168.2.0/24(rw)
```

*exports depot directory all hosts on 192.168.2.0/24 network (read-write)*

```
[root@hiro ~]# cat /etc/exports
/depot 192.168.2.0/255.255.255.0(rw)
```

*same as above using netmask rather than prefix for network selection*

*These examples showing different ways to share*

## Server-side NFS

*Another /etc/exports example*

```
[root@hiro ~]# cat /etc/exports
/depot lab-01(rw) arwen(ro)
/home/cis192 192.168.2.0/24(rw,no_root_squash,sync)
/home/guest *(rw,sync)
```

*exports /depot directory to lab-01 (read-write) and to arwen (read only)*

*exports /home/cis192 to all hosts on 192.168.2.0/24 network as read-write, normal root access (dangerous) and replies are made after only disk writes have completed*

*exports /home/guest to all  as read-write and replies are made only after disk writes have completed*

*Use **exportfs -rv** or **service nfs restart** whenever you make changes to the /etc/exports file*

```
[root@hiro ~]# exportfs -rv
exporting lab-01:/depot
exporting arwen:/depot
exporting 192.168.2.0/24:/home/cis192
exporting *:/home/guest
```

# Server side NFS

**exportfs** - command to dynamically update exported files

Options:
-a *Exports or unexport all entries in the exports file.*
-r *Re-export all entries.*
-u client:[export] *Removes (unexport) from the specified host.*
-o options *Overrides NFS options in /etc/exports file.*
-v *Display output in verbose mode.*

Examples:
**exportfs -rv** (use after making changes to /etc/exports)

**exportfs -ua** (shuts down all exported directories)

# /etc/sysconfig/nfs

Lock down the ports used by NFS so we can configure a firewall for those ports. To do this, edit */etc/sysconfig/nfs* and uncomment the following lines:

```
#RQUOTAD_PORT=875
#LOCKD_TCPPORT=32803
#LOCKD_UDPPORT=32769
#MOUNTD_PORT=892
#STATD_PORT=662
#STATD_OUTGOING_PORT=2020
```

# Server side NFS

## **Step 3** *Firewall modifications*

**The following ports must be opened:**

port 111 TCP/UDP
port 2049 TCP
port 875 TCP/UDP
port 32803 TCP
port 32769 UDP
port 892 TCP/UDP
port 662 TCP/UDP

*Select ports in /etc/sysconfig/nfs*

*Example:*

```
[root@nfs-depot-31 ~]# cat /etc/sysconfig/iptables
# Firewall configuration written by system-config-firewall
# Manual customization of this file is not recommended.
*filter
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
-A INPUT -m state --state ESTABLISHED,RELATED -j ACCEPT
-A INPUT -p icmp -j ACCEPT
-A INPUT -i lo -j ACCEPT
-A INPUT -m state --state NEW -p udp --dport 111 -j ACCEPT
-A INPUT -m state --state NEW -p tcp --dport 111 -j ACCEPT
-A INPUT -m state --state NEW -p tcp --dport 2049 -j ACCEPT
-A INPUT -m state --state NEW -p tcp --dport 32803 -j ACCEPT
-A INPUT -m state --state NEW -p udp --dport 32769 -j ACCEPT
-A INPUT -m state --state NEW -p tcp --dport 892 -j ACCEPT
-A INPUT -m state --state NEW -p udp --dport 892 -j ACCEPT
-A INPUT -m state --state NEW -p tcp --dport 875 -j ACCEPT
-A INPUT -m state --state NEW -p udp --dport 875 -j ACCEPT
-A INPUT -m state --state NEW -p tcp --dport 662 -j ACCEPT
-A INPUT -m state --state NEW -p udp --dport 662 -j ACCEPT
-A INPUT -m state --state NEW -m tcp -p tcp --dport 22 -j ACCEPT
-A INPUT -j REJECT --reject-with icmp-host-prohibited
-A FORWARD -j REJECT --reject-with icmp-host-prohibited
COMMIT
```

# Server side NFS

## Step 4 SELinux

- By default, the appropriate SELinux booleans are set to allow NFS to operate in enforcing mode.

```
[root@nfs-depot-31 ~]# getsebool -a | grep nfs
allow_ftpd_use_nfs --> off
cobbler_use_nfs --> off
git_system_use_nfs --> off
httpd_use_nfs --> off
qemu_use_nfs --> on
rsync_use_nfs --> off
samba_share_nfs --> off
sanlock_use_nfs --> off
sge_use_nfs --> off
use_nfs_home_dirs --> on
virt_use_nfs --> off
xen_use_nfs --> off
```

# Server side NFS

**Step 5** Start service

```
[root@nfs-depot-31 ~]# service nfs start
Starting NFS services:                                     [  OK  ]
Starting NFS mountd:                                       [  OK  ]
Stopping RPC idmapd:                                       [  OK  ]
Starting RPC idmapd:                                       [  OK  ]
Starting NFS daemon:                                       [  OK  ]
```

# Server side NFS

If service is already running use the following to reread configuration files:

```
service named restart
```

or

```
exportfs -rv
```

# Server side NFS

**Step 6** Configure automatic service startup

To automatically start NFS service at system boot use:

```
[root@hiro ~]# chkconfig nfs on
[root@hiro ~]# chkconfig --list nfs
nfs             0:off   1:off   2:on    3:on    4:on    5:on    6:off
```

# Server side NFS

**Step 7** Monitor and verify service is running

## NFS service

```
[root@nfs-depot-31 ~]# service nfs status
rpc.svcgssd is stopped
rpc.mountd (pid 3127) is running...
nfsd (pid 3192 3191 3190 3189 3188 3187 3186 3185) is running...
[root@nfs-depot-31 ~]#
```

# Server side NFS

**Step 7** Monitor and verify service is running

## NFS processes

```
[root@nfs-depot-31 ~]# ps -ef | grep nfs
root      3183     2  0 12:54 ?        00:00:00 [nfsd4]
root      3184     2  0 12:54 ?        00:00:00 [nfsd4_callbacks]
root      3185     2  0 12:54 ?        00:00:00 [nfsd]
root      3186     2  0 12:54 ?        00:00:00 [nfsd]
root      3187     2  0 12:54 ?        00:00:00 [nfsd]
root      3188     2  0 12:54 ?        00:00:00 [nfsd]
root      3189     2  0 12:54 ?        00:00:00 [nfsd]
root      3190     2  0 12:54 ?        00:00:00 [nfsd]
root      3191     2  0 12:54 ?        00:00:00 [nfsd]
root      3192     2  0 12:54 ?        00:00:00 [nfsd]
root      3227  2709  0 12:56 pts/0    00:00:00 grep nfs

[root@nfs-depot-31 ~]# ps -ef | grep rpc
rpc       1320     1  0 Apr21 ?        00:00:00 rpcbind
rpcuser   1338     1  0 Apr21 ?        00:00:00 rpc.statd
root      1361     2  0 Apr21 ?        00:00:00 [rpciod/0]
root      3127     1  0 12:54 ?        00:00:00 rpc.mountd -p 892
root      3178     1  0 12:54 ?        00:00:00 rpc.idmapd
root      3229  2709  0 12:57 pts/0    00:00:00 grep rpc
```

# Server side NFS

**Step 7** Verify service is running

## netstat

```
[root@nfs-depot-31 ~]# netstat -tlnp
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address               Foreign Address             State       PID/Program
name
tcp        0      0 0.0.0.0:111                 0.0.0.0:*                   LISTEN      1320/rpcbind
tcp        0      0 0.0.0.0:22                  0.0.0.0:*                   LISTEN      1534/sshd
tcp        0      0 0.0.0.0:52214               0.0.0.0:*                   LISTEN      1338/rpc.statd
tcp        0      0 0.0.0.0:892                 0.0.0.0:*                   LISTEN      3127/rpc.mountd
tcp        0      0 0.0.0.0:2049                0.0.0.0:*                   LISTEN      -
tcp        0      0 0.0.0.0:32803               0.0.0.0:*                   LISTEN      -
tcp        0      0 :::111                      :::*                        LISTEN      1320/rpcbind
tcp        0      0 :::22                       :::*                        LISTEN      1534/sshd
tcp        0      0 :::55547                    :::*                        LISTEN      1338/rpc.statd
tcp        0      0 :::892                      :::*                        LISTEN      3127/rpc.mountd
tcp        0      0 :::2049                     :::*                        LISTEN      -
tcp        0      0 :::32803                    :::*                        LISTEN      -
[root@nfs-depot-31 ~]#
```

*Use **netstat -tl** command to see what port names your system is listening for requests on*

# Server side NFS

**Step 7** Verify service is running

## netstat

```
[root@nfs-depot-31 ~]# netstat -ulnp
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address               Foreign Address             State       PID/Program
name
udp        0      0 0.0.0.0:111                 0.0.0.0:*                               1320/rpcbind
udp        0      0 0.0.0.0:892                 0.0.0.0:*                               3127/rpc.mountd
udp        0      0 0.0.0.0:32769               0.0.0.0:*                               -
udp        0      0 0.0.0.0:2049                0.0.0.0:*                               -
udp        0      0 0.0.0.0:647                 0.0.0.0:*                               1320/rpcbind
udp        0      0 0.0.0.0:50956               0.0.0.0:*                               1338/rpc.statd
udp        0      0 0.0.0.0:666                 0.0.0.0:*                               1338/rpc.statd
udp        0      0 :::48236                    :::*                                    1338/rpc.statd
udp        0      0 :::111                      :::*                                    1320/rpcbind
udp        0      0 :::892                      :::*                                    3127/rpc.mountd
udp        0      0 :::32769                    :::*                                    -
udp        0      0 :::2049                     :::*                                    -
udp        0      0 :::647                      :::*                                    1320/rpcbind
```

*Use **netstat -tl** command to see what port names your system is listening for requests on*

**Step 8** Troubleshooting

```
[root@p02-celebrian ~]# mount nfs-depot-31:/depot /depot
```

*If no response, make sure nfs service has been started on nfs server and that all nfs configured ports are open in firewall*

# Server side NFS

**Step 9** Monitor log files

```
[root@nfs-depot-31 ~]# cat /var/log/messages | grep nfs | tail
Apr 23 12:50:54 nfs-depot-31 kernel: nfsd: last server has exited, flushing export
cache
Apr 23 12:50:54 nfs-depot-31 rpc.mountd[2800]: Caught signal 15, un-registering and
exiting.
Apr 23 12:50:55 nfs-depot-31 rpc.mountd[2984]: Version 1.2.3 starting
Apr 23 12:50:55 nfs-depot-31 kernel: NFSD: Using /var/lib/nfs/v4recovery as the NFSv4
state recovery directory
Apr 23 12:50:55 nfs-depot-31 kernel: NFSD: starting 90-second grace period
Apr 23 12:54:41 nfs-depot-31 kernel: nfsd: last server has exited, flushing export
cache
Apr 23 12:54:41 nfs-depot-31 rpc.mountd[2984]: Caught signal 15, un-registering and
exiting.
Apr 23 12:54:45 nfs-depot-31 rpc.mountd[3127]: Version 1.2.3 starting
Apr 23 12:54:45 nfs-depot-31 kernel: NFSD: Using /var/lib/nfs/v4recovery as the NFSv4
state recovery directory
Apr 23 12:54:45 nfs-depot-31 kernel: NFSD: starting 90-second grace period
[root@nfs-depot-31 ~]#
```

*Use **tail -f /var/log/messages** to monitor in real time*

# Server side NFS

**Step 10** Configure additional security

- Use consistent UIDs and GIDs across systems as account and group names are not used
- Set appropriate permissions
- Export only what you need to and only to those who need it.
- Use wildcards sparingly
- Protect your DNS server (avoid spoofing attacks)
- Protect portmap with TCP wrappers
- Use NSFv4 instead of earlier versions to authenticate users rather than client systems
- Take CIS 193!

# NFS Client

## Client-side NFS

Clients merely need to mount the exported directories to a local directory as if it were a file system.

- Syntax: **mount [-t nfs] [-*o options…] servername:export mountdir***

- Options:

| | |
|---|---|
| rw | *read-write (must be exported this way)* |
| hard | *if a NFS server goes down service will hang (blocked) till available again* |
| udp | *use UDP as the transport protocol (default)* |
| soft | *if a NFS server goes down service will return an error* |
| intr | *allows user to interrupt a blocked operation and return an error* |
| ro | *read-only* |
| tcp | *use TCP as the transport protocol* |

- showmount command

  **showmount -e *servername*** *shows the available exports*
  **showmount -a *servername*** *shows current exports being shared*

*See **man mount** and **man nfs** for more details*

# Client-side NFS

- NFS mount examples:

```
mount hiro:/depot /depot

mount -t nfs hiro:/depot /depot

mount -t nfs -o rw,hard,intr  hiro:/depot  /depot
```

- Using showmount command examples:

```
[root@lab-01 depot]# showmount -e hiro
Export list for hiro:
/home/guest   *
/home/cis192 192.168.2.0/24
/depot       arwen,lab-01
```

*Shows available exports*

## Client-side NFS

To automate mounting with /etc/fstab

- **Manual** mount:

```
[root@lab-01 ~]# mount -t nfs  hiro:/depot /depot
```

- **Automated** mount:

```
[root@lab-01 ~]# cat /etc/fstab
/dev/VolGroup00/LogVol00 /                       ext3    defaults        1 1
LABEL=/boot             /boot                    ext3    defaults        1 2
tmpfs                   /dev/shm                 tmpfs   defaults        0 0
devpts                  /dev/pts                 devpts  gid=5,mode=620  0 0
sysfs                   /sys                     sysfs   defaults        0 0
proc                    /proc                    proc    defaults        0 0
/dev/VolGroup00/LogVol01 swap                    swap    defaults        0 0
hiro:/depot             /depot                   nfs rw,addr=192.168.2.107 0 0
```

*One way to do this … do a manual mount and test the share. If satisfied, copy the line in /etc/mtab (current mounts) to /etc/fstab (mounts to perform at startup)*

# Printers

Two predominate types of printers

- Thermal inkjet technology
- Laser, drum, toner technology

So many ways to hook them up …

Now:
- Network
- USB
- Wireless (Bluetooth, IR)

Back then:
- Serial cable
- Parallel printer cable

# CUPS Installation

Linux printing commands

- The LP and LPRNG systems
  - **lpr** or **lp** copies the print job to the spool dir
  - **lpd** daemon checks the spool dir for jobs
  - Control and Data files are copied to the printer queue
  - **lpc** controls and configures lpd daemon
  - **lpq** queries the **lpd** daemon about print jobs
  - **lpstat** gives the status of the lp system
  - **cancel** or **lprm**
- The **C**ommon **U**NIX **P**rint **S**ystem
  - Uses modified versions of the same commands as LP by making use of symbolic links
  - Provides a web-based interface to the print system: *http://localhost:631*
  - Configuration files and drivers for CUPS printers are in */etc/cups*.
  - Print jobs are spooled as a pair of data and control files in */var/spool/cups*.

# CUPS Summary

**Step 1** **yum install cups** (if not already installed)

- Dependencies: cups-libs, poppler, poppler-util (poppler is used to make PDF documents)

**Step 2** Configuration files/tools:
Web GUI at http://localhost:631
or edit /etc/cups/printers.conf

**Step 3** Firewall: Open UDP 631 & TCP 631

**Step 4** SELinux: enforcing or permissive

**Step 5** **service cups start** (also **stop** and **restart**)

**Step 6** **chkconfig cups on** (or **off**)

**Step 7** Monitor or verify service is running:

```
service cups status
ps -ef | grep cupsd
netstat -tln | grep 631
netstat -uln | grep 631
```

Spool files in /var/spool/cups

**Step 8** Troubleshoot (check logs, firewall & network settings)

**Step 9** Log files: /var/log/cups/*

**Step 10** Additional security:
Remote access to web GUI must be enabled
http://www.cups.org/documentation.php/doc-1.4/security.html

# Default Red Hat Firewall

```
[root@elrond ~]# iptables -L -n
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
RH-Firewall-1-INPUT  all  --  0.0.0.0/0            0.0.0.0/0

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination
RH-Firewall-1-INPUT  all  --  0.0.0.0/0            0.0.0.0/0

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination

Chain RH-Firewall-1-INPUT (2 references)
target     prot opt source               destination
ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0
ACCEPT     icmp --  0.0.0.0/0            0.0.0.0/0           icmp type 255
ACCEPT     esp  --  0.0.0.0/0            0.0.0.0/0
ACCEPT     ah   --  0.0.0.0/0            0.0.0.0/0
ACCEPT     udp  --  0.0.0.0/0            224.0.0.251         udp dpt:5353
ACCEPT     udp  --  0.0.0.0/0            0.0.0.0/0           udp dpt:631
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0           tcp dpt:631
ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0           state RELATED,ESTABLISHED
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0           state NEW tcp dpt:22
REJECT     all  --  0.0.0.0/0            0.0.0.0/0           reject-with icmp-host-
prohibited
[root@elrond ~]#
```

*All UDP and TCP protocol traffic to port 631 is allowed.*

*This allows CUPS to listen for IPP (Internet Printing Protocol) requests.*

# Printer Configuration

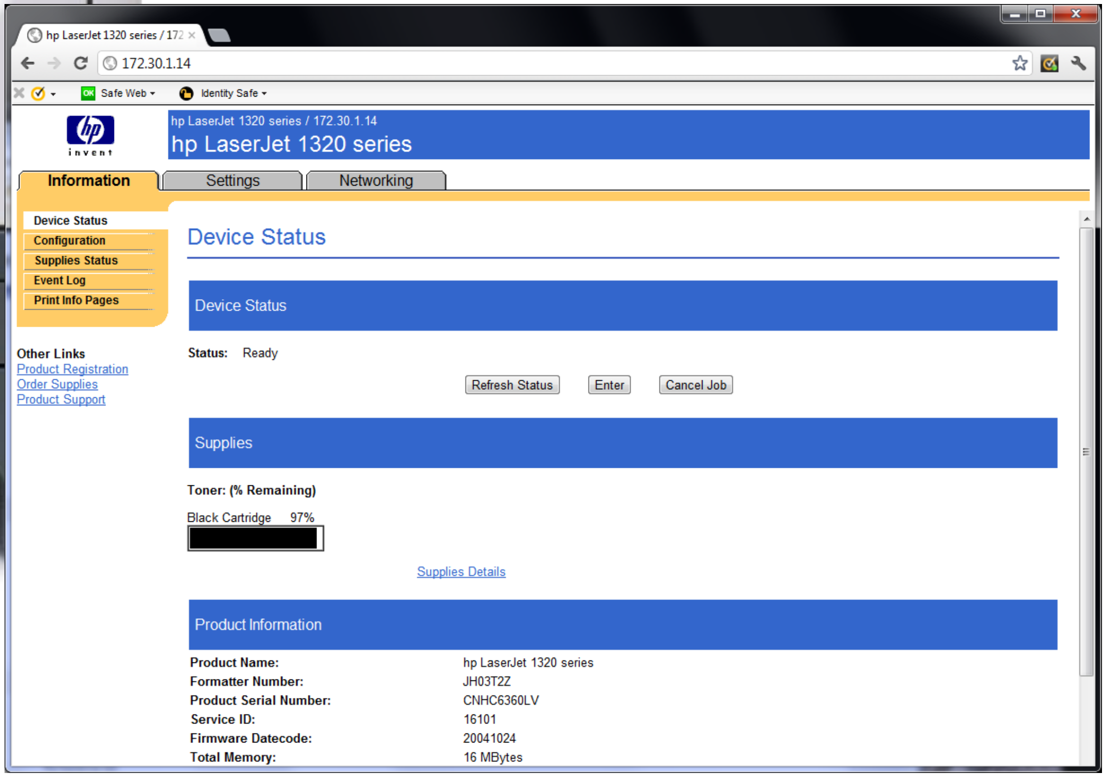
# CUPS

Example printer configuration

Printer: HP LaserJet 1320n
Connection: LAN

# CUPS

*The LaserJets have a web-based management utility*



hp LaserJet 1320 series / 172.30.1.14

hp LaserJet 1320 series

Other Links

Product Registration

Order Supplies

Product Support

Device Status

Device Status

**Status:** Ready

Supplies

**Toner: (% Remaining)**

Black Cartridge 97%

Supplies Details

Product Information

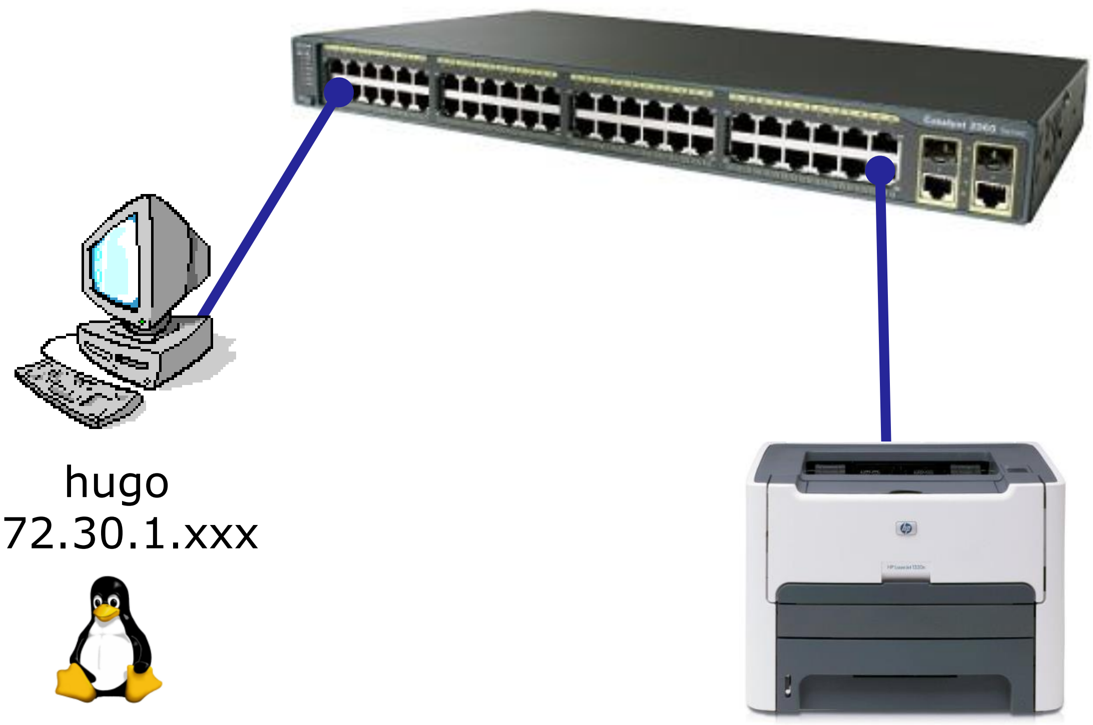
| | |
|---|---|
| **Product Name:** | hp LaserJet 1320 series |
| **Formatter Number:** | JH03T2Z |
| **Product Serial Number:** | CNHC6360LV |
| **Service ID:** | 16101 |
| **Firmware Datecode:** | 20041024 |
| **Total Memory:** | 16 MBytes |

*IP Address for this 1320n is 172.30.1.14*

# Add Printer

# CUPS

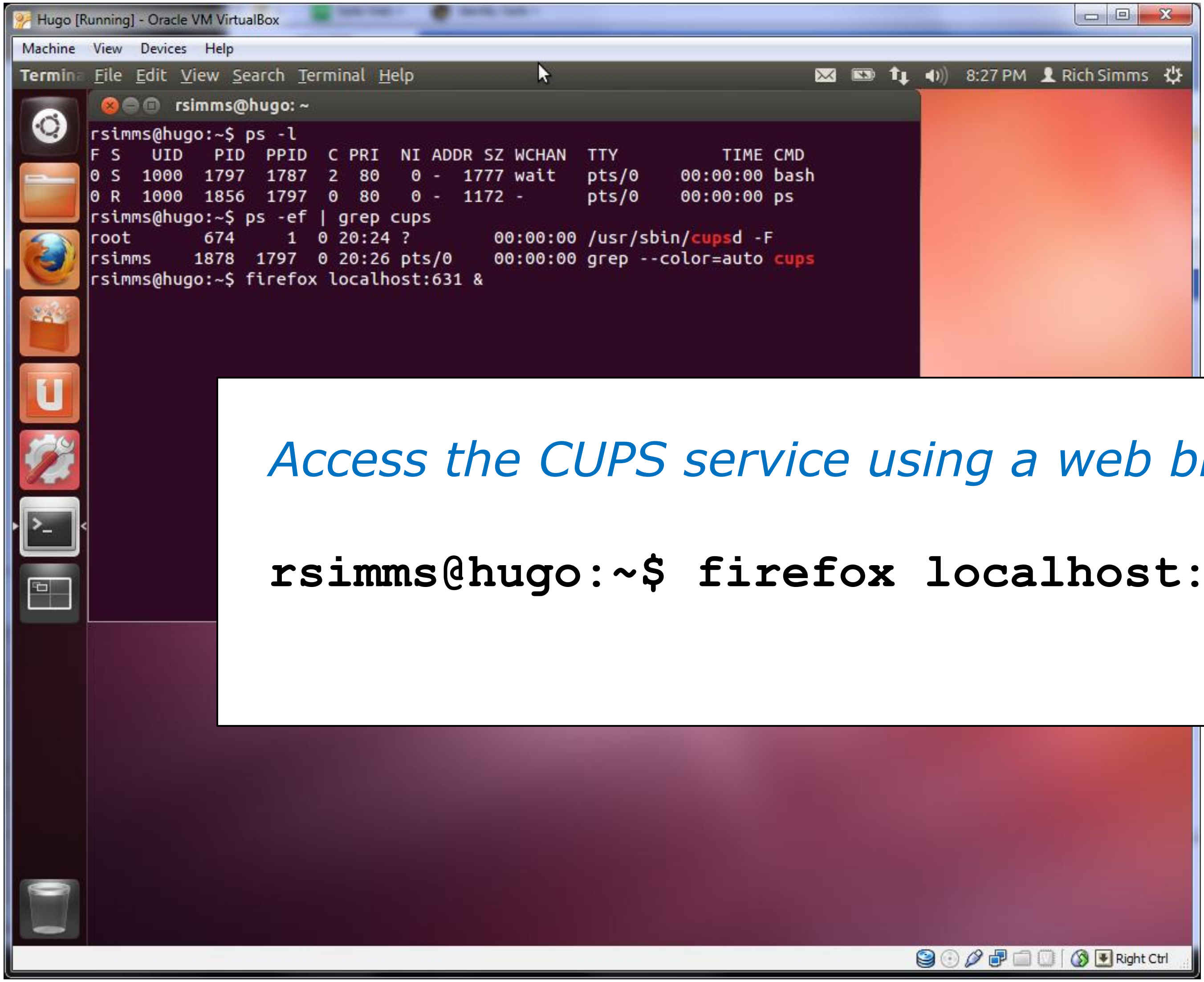
*This example will show how to add the HP 1320n as a networked printer.*



hugo
172.30.1.xxx

hp1320n
172.30.1.14

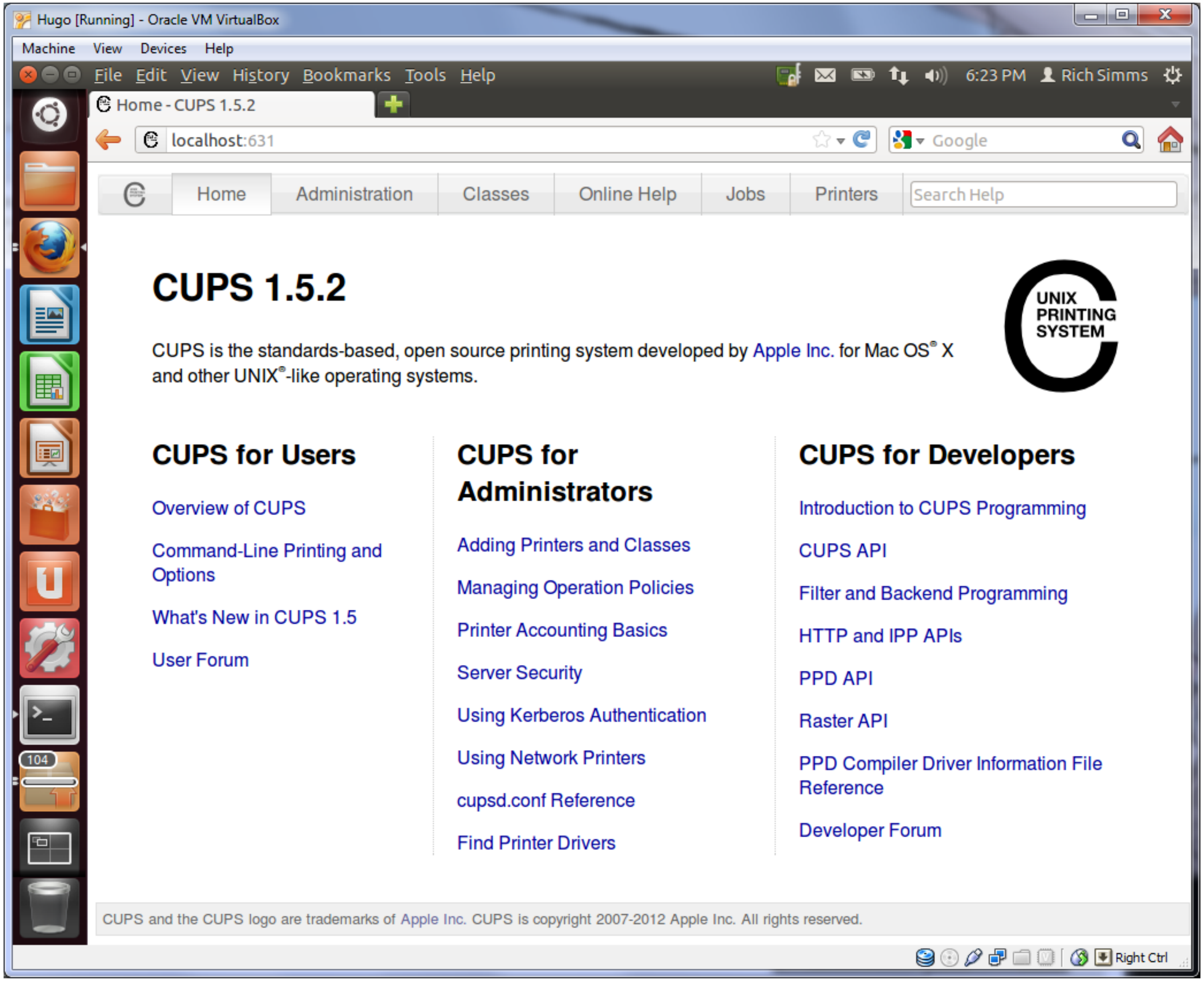
# CUPS


Hugo [Running] - Oracle VM VirtualBox
Machine View Devices Help
Terminal File Edit View Search Terminal Help
8:27 PM Rich Simms
rsimms@hugo: ~
Right Ctrl

```
rsimms@hugo:~$ ps -l
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S  1000  1797  1787  2  80   0 -  1777 wait   pts/0    00:00:00 bash
0 R  1000  1856  1797  0  80   0 -  1172 -      pts/0    00:00:00 ps
rsimms@hugo:~$ ps -ef | grep cups
root       674     1  0 20:24 ?        00:00:00 /usr/sbin/cupsd -F
rsimms    1878  1797  0 20:26 pts/0    00:00:00 grep --color=auto cups
rsimms@hugo:~$ firefox localhost:631 &
```

*Access the CUPS service using a web browser with*

```
rsimms@hugo:~$ firefox localhost:631 &
```



Hugo [Running] - Oracle VM VirtualBox
Machine View Devices Help
File Edit View History Bookmarks Tools Help
6:23 PM Rich Simms
Home - CUPS 1.5.2
localhost:631
Google
Home Administration Classes Online Help Jobs Printers
Search Help
UNIX PRINTING SYSTEM
Right Ctrl

# CUPS 1.5.2

CUPS is the standards-based, open source printing system developed by Apple Inc. for Mac OS® X and other UNIX®-like operating systems.

## CUPS for Users

- Overview of CUPS
- Command-Line Printing and Options
- What's New in CUPS 1.5
- User Forum

## CUPS for Administrators

- Adding Printers and Classes
- Managing Operation Policies
- Printer Accounting Basics
- Server Security
- Using Kerberos Authentication
- Using Network Printers
- cupsd.conf Reference
- Find Printer Drivers

## CUPS for Developers

- Introduction to CUPS Programming
- CUPS API
- Filter and Backend Programming
- HTTP and IPP APIs
- PPD API
- Raster API
- PPD Compiler Driver Information File Reference
- Developer Forum

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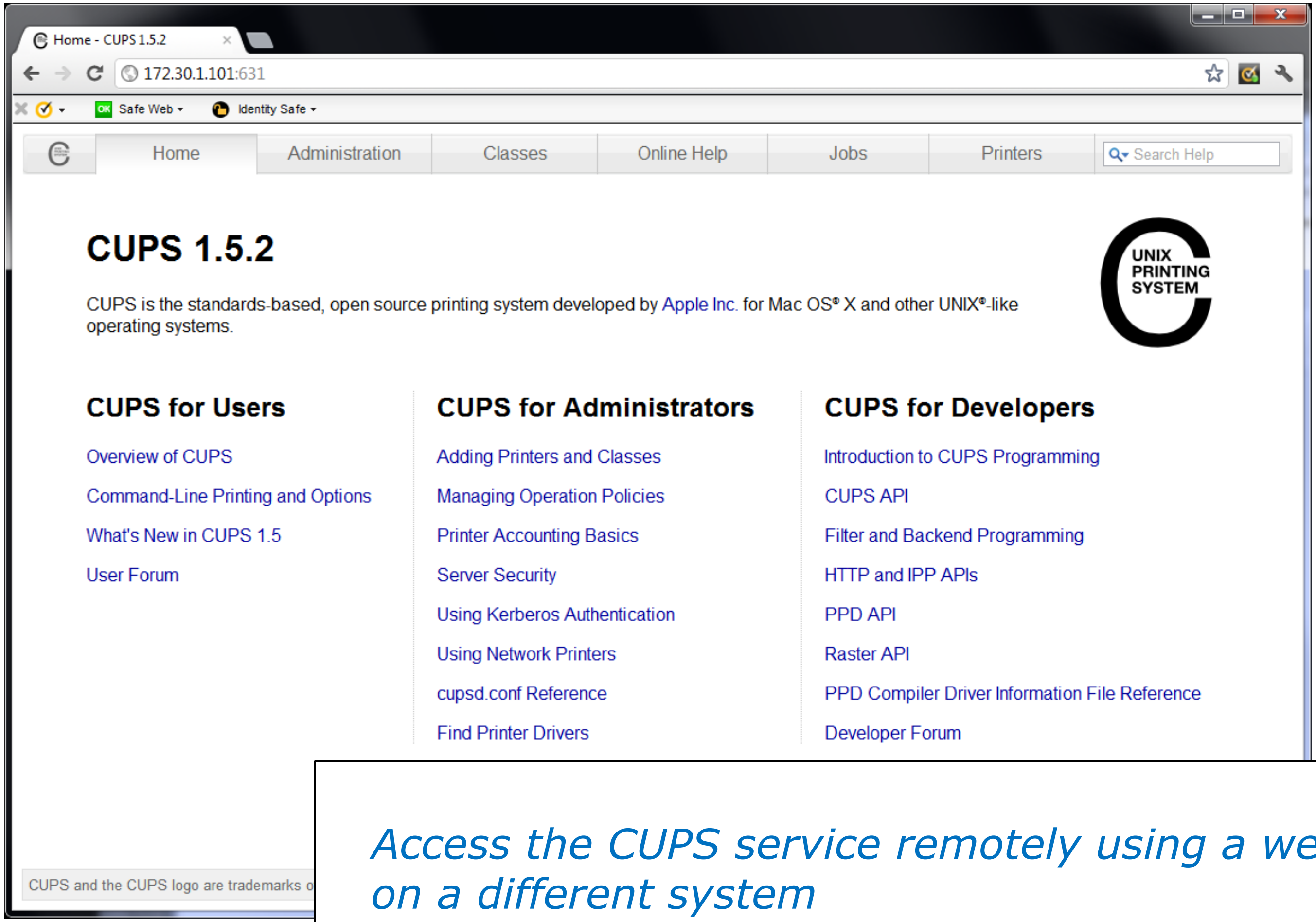


# CUPS 1.5.2

CUPS is the standards-based, open source printing system developed by Apple Inc. for Mac OS® X and other UNIX®-like operating systems.

## CUPS for Users

Overview of CUPS

Command-Line Printing and Options

What's New in CUPS 1.5

User Forum

## CUPS for Administrators

Adding Printers and Classes

Managing Operation Policies

Printer Accounting Basics

Server Security

Using Kerberos Authentication

Using Network Printers

cupsd.conf Reference

Find Printer Drivers

## CUPS for Developers

Introduction to CUPS Programming

CUPS API

Filter and Backend Programming

HTTP and IPP APIs

PPD API

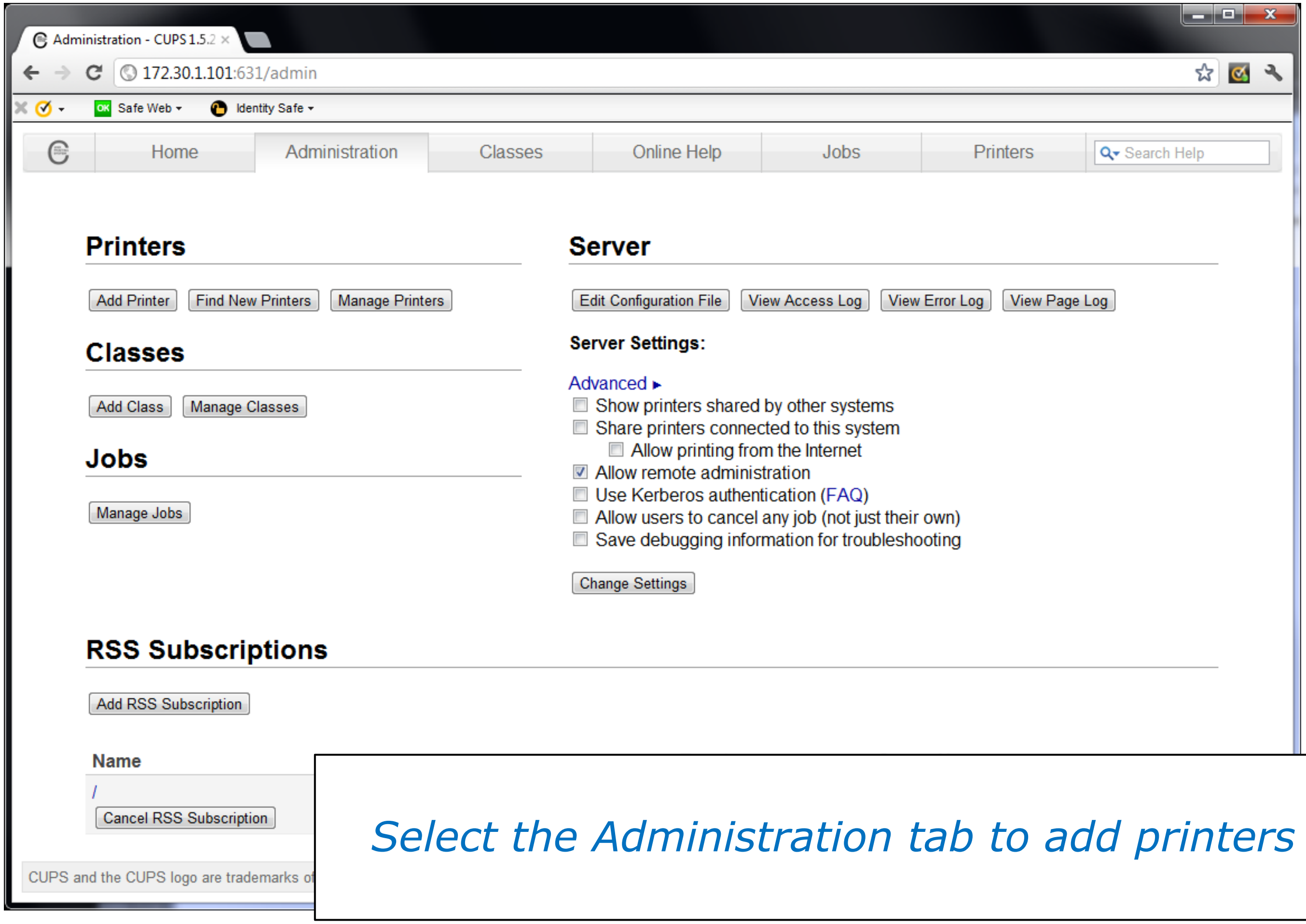
Raster API

PPD Compiler Driver Information File Reference

Developer Forum

CUPS and the CUPS logo are trademarks o

*Access the CUPS service remotely using a web browser on a different system*



## Printers

## Classes

## Jobs

## Server

**Server Settings:**

Advanced ▸

□ Show printers shared by other systems
□ Share printers connected to this system
□ Allow printing from the Internet
☑ Allow remote administration
□ Use Kerberos authentication (FAQ)
□ Allow users to cancel any job (not just their own)
□ Save debugging information for troubleshooting

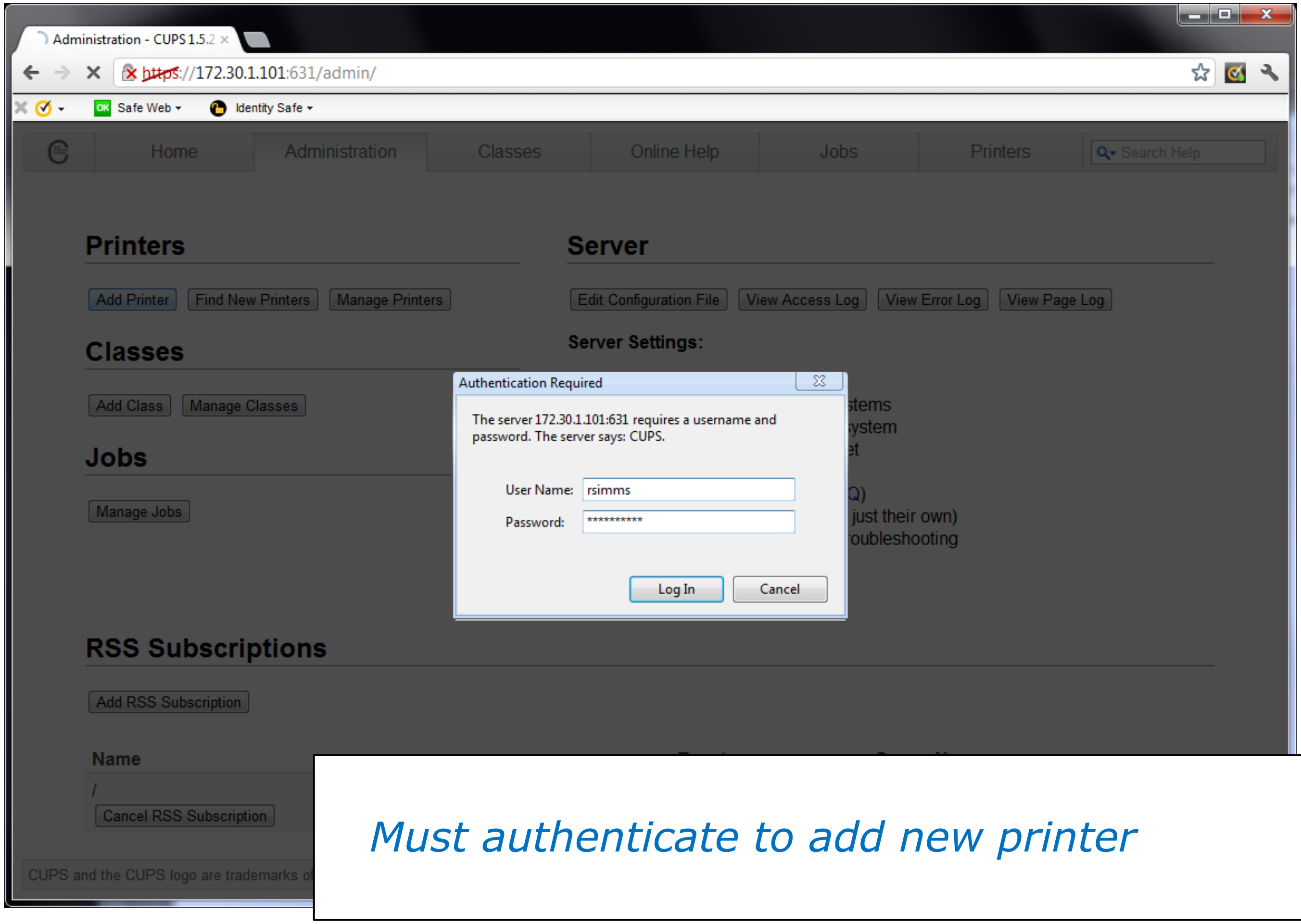
## RSS Subscriptions

**Name**

/

CUPS and the CUPS logo are trademarks of

*Select the Administration tab to add printers*



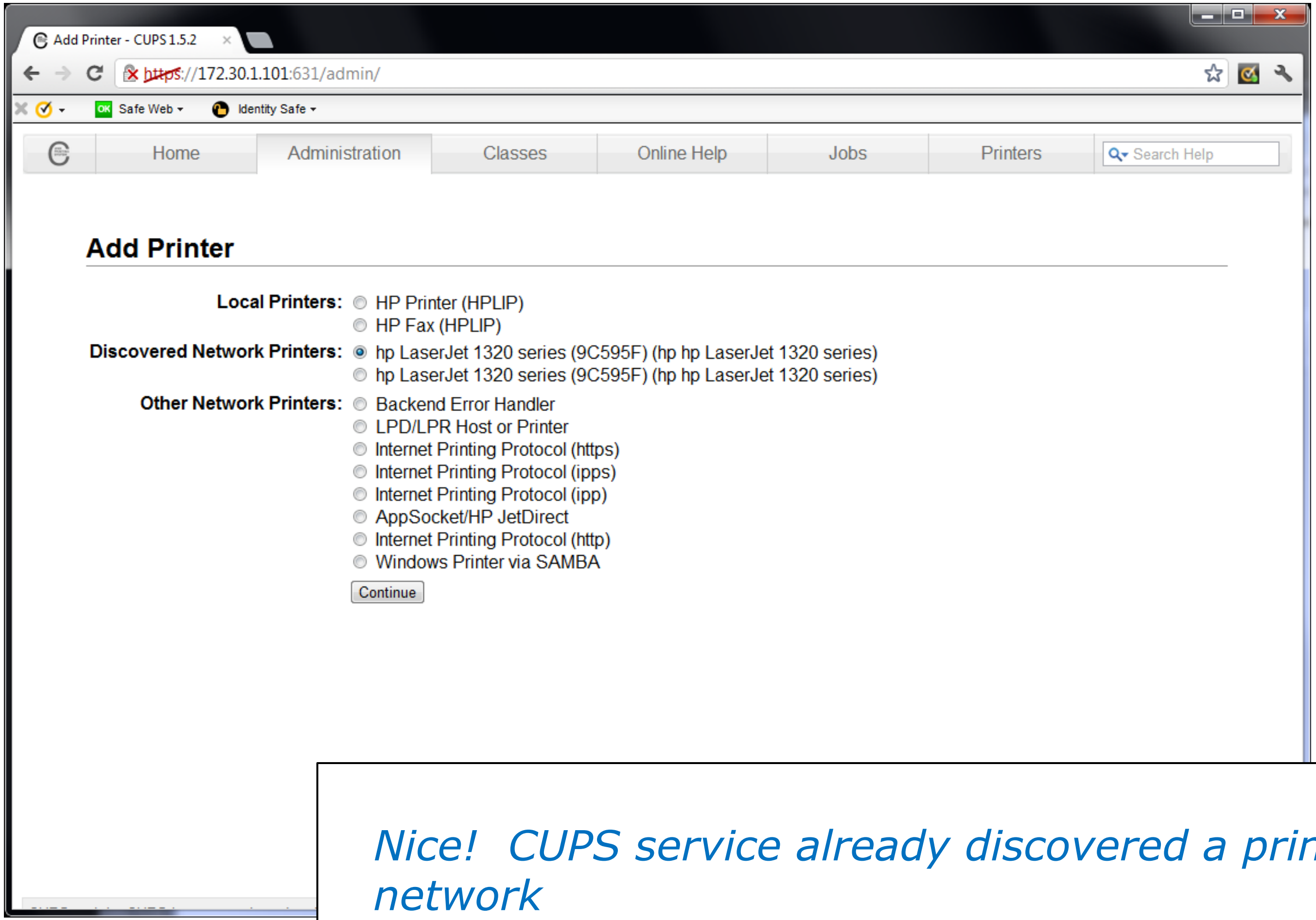
Authentication Required

The server 172.30.1.101:631 requires a username and password. The server says: CUPS.

User Name: rsimms

Password: ***********

*Must authenticate to add new printer*



## Add Printer

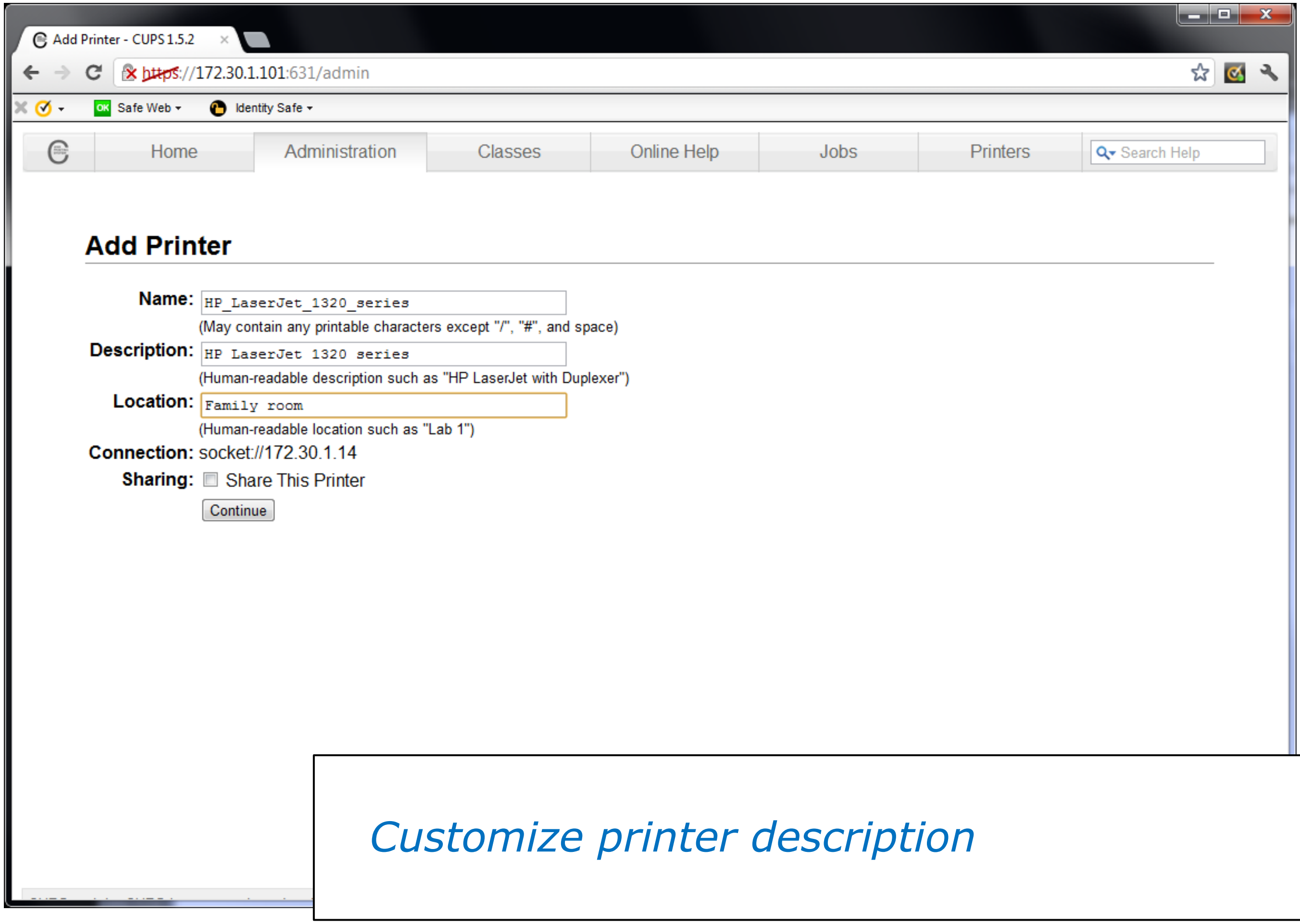
**Local Printers:**
○ HP Printer (HPLIP)
○ HP Fax (HPLIP)

**Discovered Network Printers:**
● hp LaserJet 1320 series (9C595F) (hp hp LaserJet 1320 series)
○ hp LaserJet 1320 series (9C595F) (hp hp LaserJet 1320 series)

**Other Network Printers:**
○ Backend Error Handler
○ LPD/LPR Host or Printer
○ Internet Printing Protocol (https)
○ Internet Printing Protocol (ipps)
○ Internet Printing Protocol (ipp)
○ AppSocket/HP JetDirect
○ Internet Printing Protocol (http)
○ Windows Printer via SAMBA

Continue

*Nice! CUPS service already discovered a printer on the network*



## Add Printer

**Name:** HP_LaserJet_1320_series
(May contain any printable characters except "/", "#", and space)

**Description:** HP LaserJet 1320 series
(Human-readable description such as "HP LaserJet with Duplexer")

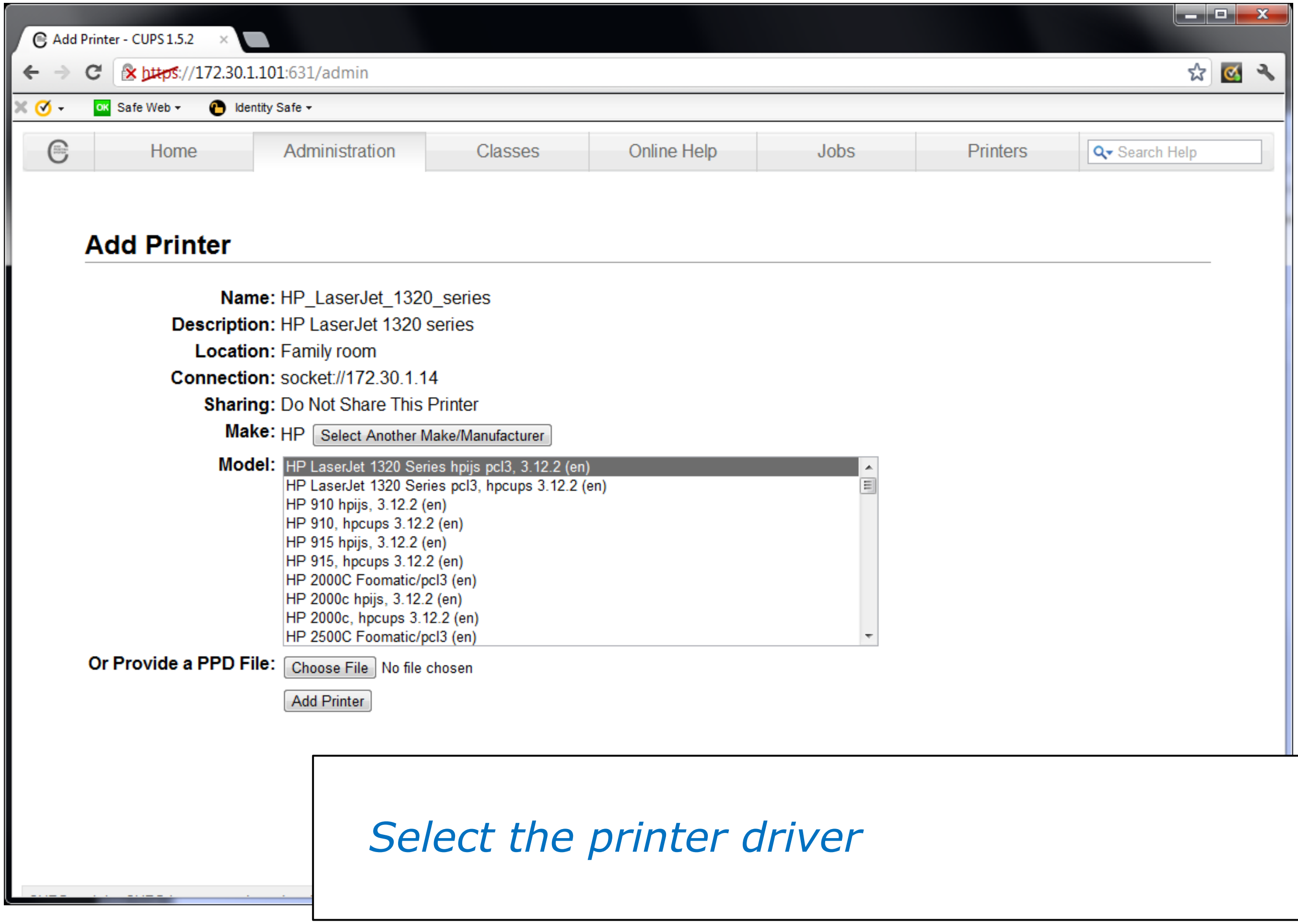
**Location:** Family room
(Human-readable location such as "Lab 1")

**Connection:** socket://172.30.1.14

**Sharing:** □ Share This Printer

Continue

*Customize printer description*



## Add Printer

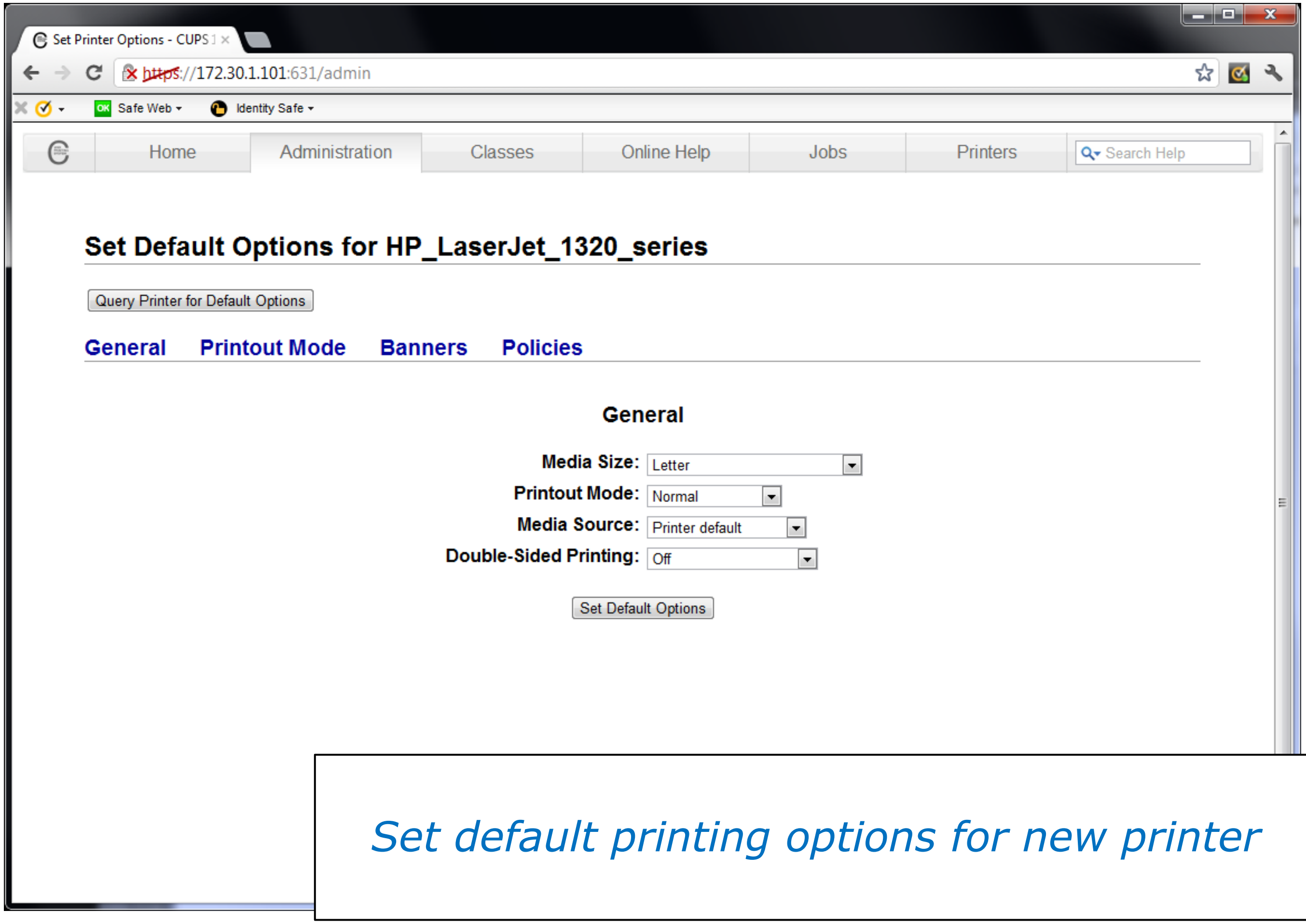
**Name:** HP_LaserJet_1320_series
**Description:** HP LaserJet 1320 series
**Location:** Family room
**Connection:** socket://172.30.1.14
**Sharing:** Do Not Share This Printer
**Make:** HP [Select Another Make/Manufacturer]
**Model:**

- HP LaserJet 1320 Series hpijs pcl3, 3.12.2 (en)
- HP LaserJet 1320 Series pcl3, hpcups 3.12.2 (en)
- HP 910 hpijs, 3.12.2 (en)
- HP 910, hpcups 3.12.2 (en)
- HP 915 hpijs, 3.12.2 (en)
- HP 915, hpcups 3.12.2 (en)
- HP 2000C Foomatic/pcl3 (en)
- HP 2000c hpijs, 3.12.2 (en)
- HP 2000c, hpcups 3.12.2 (en)
- HP 2500C Foomatic/pcl3 (en)

**Or Provide a PPD File:** [Choose File] No file chosen

[Add Printer]

*Select the printer driver*

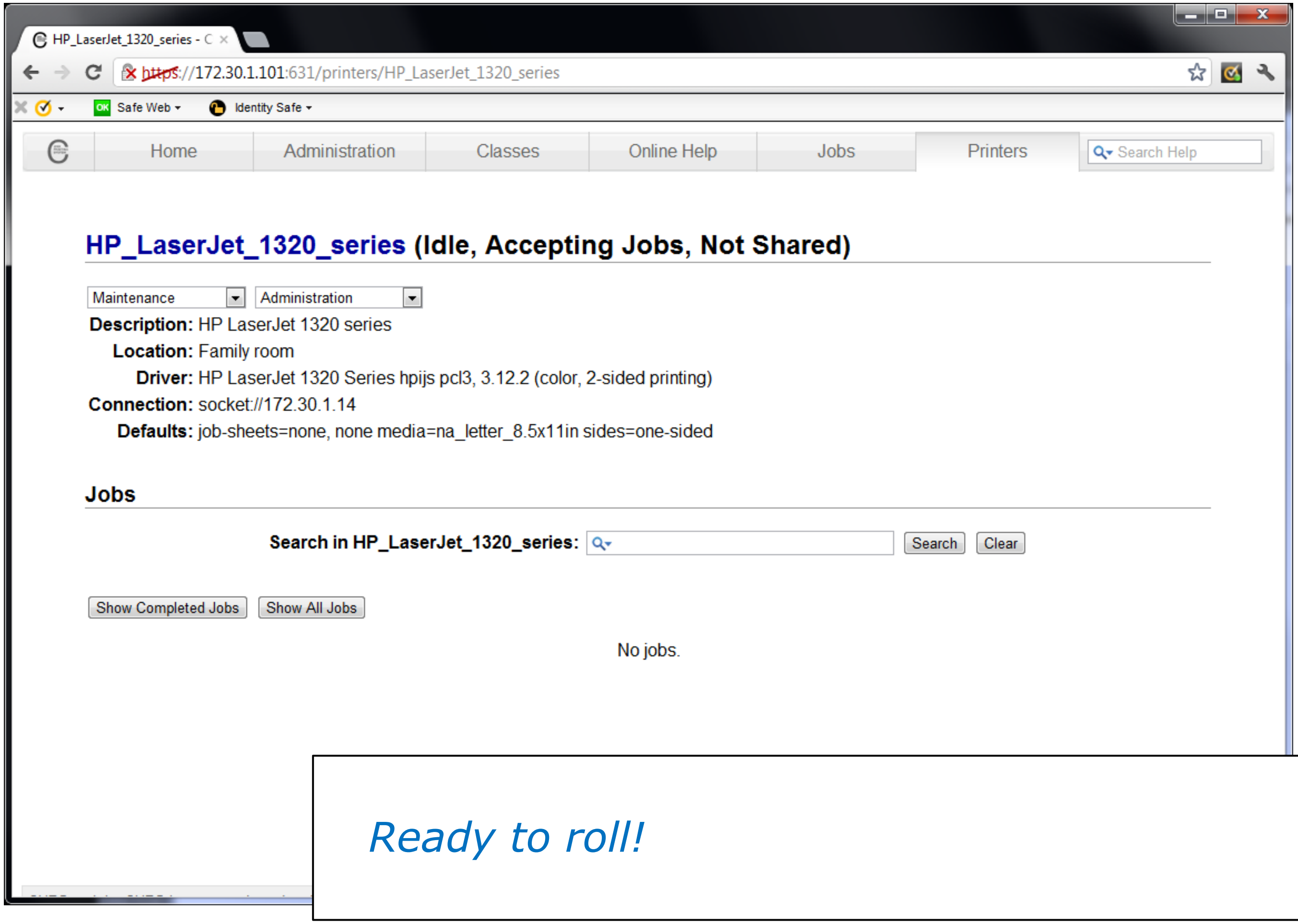


Set Default Options for HP_LaserJet_1320_series

General

Media Size: Letter
Printout Mode: Normal
Media Source: Printer default
Double-Sided Printing: Off

*Set default printing options for new printer*


HP_LaserJet_1320_series - C
https://172.30.1.101:631/printers/HP_LaserJet_1320_series
Safe Web
Identity Safe
Home
Administration
Classes
Online Help
Jobs
Printers
Search Help

## HP_LaserJet_1320_series (Idle, Accepting Jobs, Not Shared)

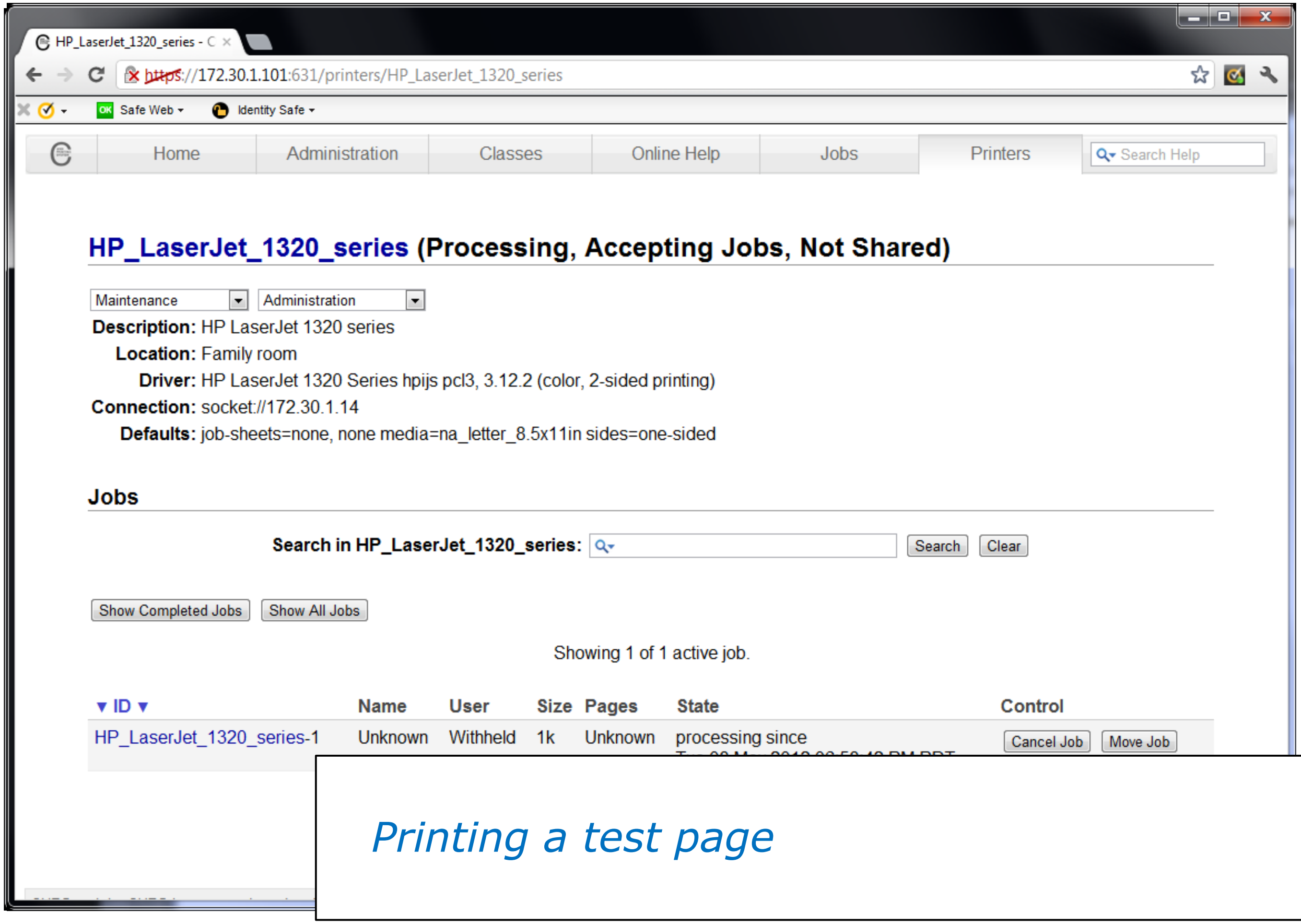
**Description:** HP LaserJet 1320 series
**Location:** Family room
**Driver:** HP LaserJet 1320 Series hpijs pcl3, 3.12.2 (color, 2-sided printing)
**Connection:** socket://172.30.1.14
**Defaults:** job-sheets=none, none media=na_letter_8.5x11in sides=one-sided

## Jobs

**Search in HP_LaserJet_1320_series:**

No jobs.

*Ready to roll!*



HP_LaserJet_1320_series - C
~~https~~://172.30.1.101:631/printers/HP_LaserJet_1320_series
Safe Web
Identity Safe
Home
Administration
Classes
Online Help
Jobs
Printers
Search Help

## HP_LaserJet_1320_series (Processing, Accepting Jobs, Not Shared)

Maintenance ▾ Administration ▾

**Description:** HP LaserJet 1320 series
**Location:** Family room
**Driver:** HP LaserJet 1320 Series hpijs pcl3, 3.12.2 (color, 2-sided printing)
**Connection:** socket://172.30.1.14
**Defaults:** job-sheets=none, none media=na_letter_8.5x11in sides=one-sided

### Jobs

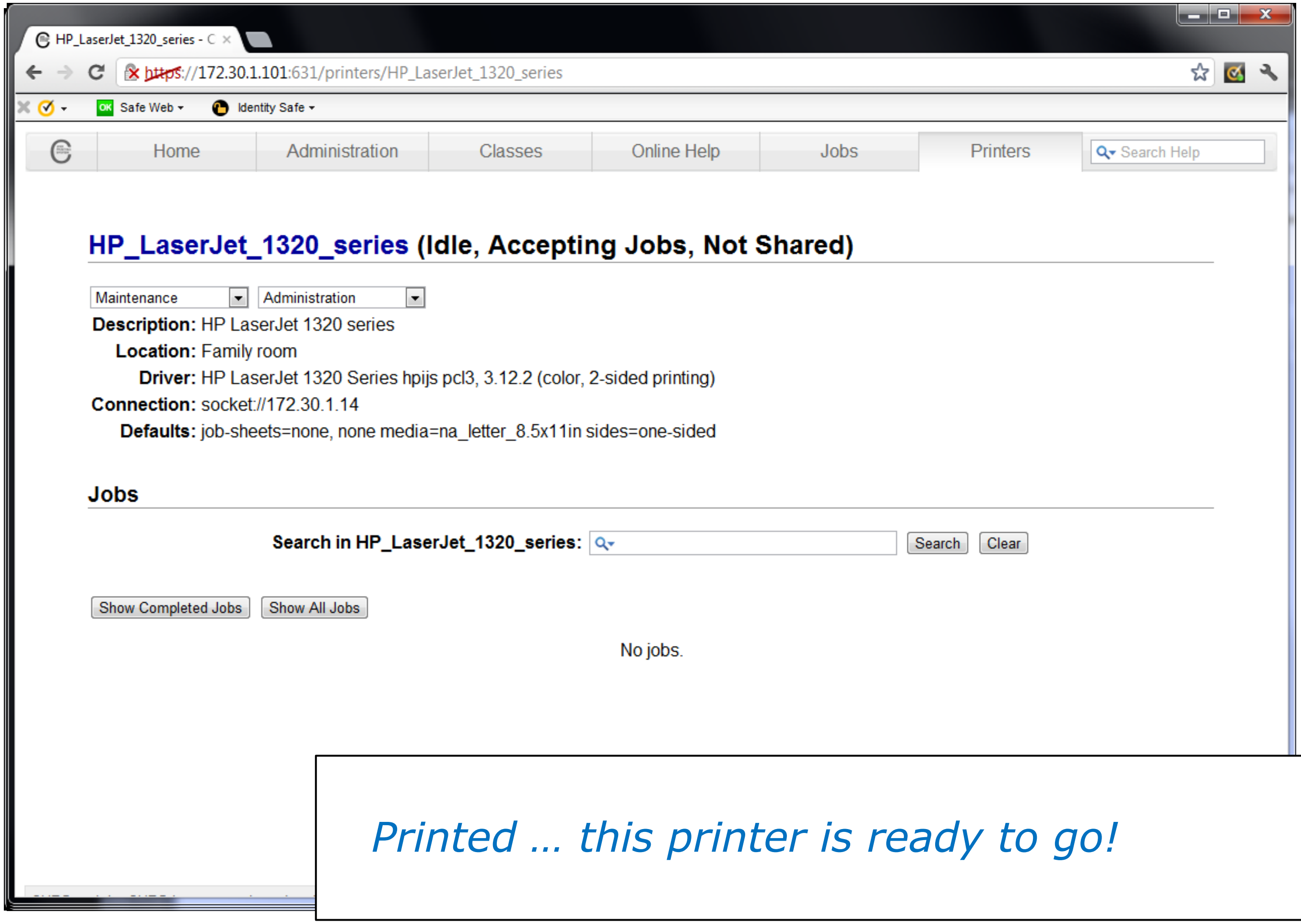
**Search in HP_LaserJet_1320_series:** [ ] Search Clear

Show Completed Jobs Show All Jobs

Showing 1 of 1 active job.

| ▼ ID ▼ | Name | User | Size | Pages | State | Control |
|---|---|---|---|---|---|---|
| HP_LaserJet_1320_series-1 | Unknown | Withheld | 1k | Unknown | processing since | Cancel Job Move Job |

*Printing a test page*



HP_LaserJet_1320_series - C
~~https~~://172.30.1.101:631/printers/HP_LaserJet_1320_series
Safe Web
Identity Safe
Home
Administration
Classes
Online Help
Jobs
Printers
Search Help

## HP_LaserJet_1320_series (Idle, Accepting Jobs, Not Shared)

**Description:** HP LaserJet 1320 series
**Location:** Family room
**Driver:** HP LaserJet 1320 Series hpijs pcl3, 3.12.2 (color, 2-sided printing)
**Connection:** socket://172.30.1.14
**Defaults:** job-sheets=none, none media=na_letter_8.5x11in sides=one-sided

### Jobs

**Search in HP_LaserJet_1320_series:**

No jobs.

*Printed … this printer is ready to go!*

# Printing in Linux

# Printing Commands

**ATT System V based print subsystem**

- lp (to print)
- lpstat (queue management)
- cancel (to remove jobs)

**BSD (Berkeley Software Distribution) based print subsystem**

- lpr (to print)
- lpq (queue management)
- lprm (to remove jobs)

**CUPS**

- Provides both System V and Berkeley based command-line interfaces
- Supports new Internet Printing Protocol
- Works with Samba

*BSD is a branch of UNIX developed at the University of California, Berkeley*

# CUPS

## lpstat command

*Use **lpstat** to show spooled print jobs, available and default printers*

```
rsimms@hugo:~$ lpstat

rsimms@hugo:~$ lpstat -p
printer HP_LaserJet_1320_series is idle.  enabled since Tue 08 May
2012 08:46:45 PM PDT

rsimms@hugo:~$ lpstat -p -d
printer HP_LaserJet_1320_series is idle.  enabled since Tue 08 May
2012 08:46:45 PM PDT
system default destination: HP_LaserJet_1320_series
```

*The –p option will show the available printers*

*The –d option will identify the default printer*

# CUPS

## lpstat command

*On Opus*

```
/home/cis90/simben $ lpstat -p -d
printer charlie disabled since Tue 26 Jan 2010 05:03:19 PM PST -
        I don't really exist
printer hplaser disabled since Tue 26 Jan 2010 04:58:14 PM PST -
        Out of paper
system default destination: charlie
```

*There are two “pretend” printers named charlie and hplaser on Opus*

# CUPS

## lp and lpr commands

*Use **lp** (or **lpr**) to print files*

```
/home/cis90/simben $ lp lab10
request id is hplaser-5 (1 file(s))

/home/cis90/simben $ lp -d hplaser lab10
request id is hplaser-6 (1 file(s))
```

*With **lp**, use the –d option to manually select a printer*

```
/home/cis90/simben $ lpr lab10

/home/cis90/simben $ lpr -P hplaser lab10
```

*With **lpr**, use the –P option to manually select a printer*

# CUPS

## lp and lpr commands

```
/home/cis90/simben $ echo "Print Me Quietly" | lpr -P hplaser
/home/cis90/simben $
```

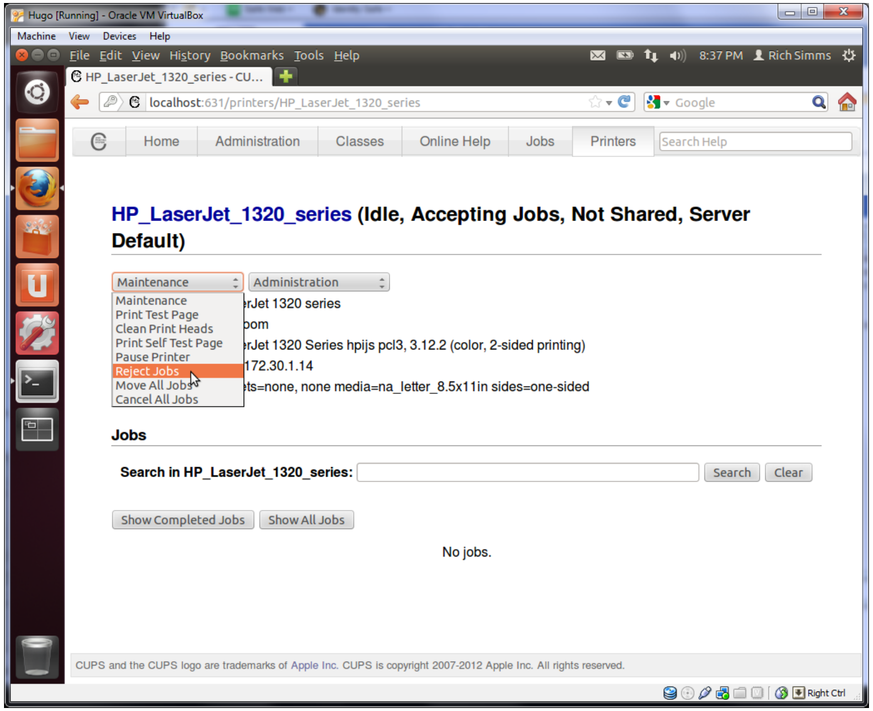
*Note that both lp and lpr will read from stdin.*

*This allows output from another command to be piped in*

# Managing Print Jobs

# CUPS

## Rejecting Jobs



**HP_LaserJet_1320_series (Idle, Accepting Jobs, Not Shared, Server Default)**

rJet 1320 series
oom
rJet 1320 Series hpijs pcl3, 3.12.2 (color, 2-sided printing)
172.30.1.14
ts=none, none media=na_letter_8.5x11in sides=one-sided

**Jobs**

**Search in HP_LaserJet_1320_series:**

No jobs.

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*Clicking the* Reject Jobs *selection on the web based utility will reject further jobs*

```
[root@benji ~]# lp myfile
lp: Destination "hp7550" is not accepting jobs.
[root@benji ~]#

[root@benji ~]# lpr myfile
lpr: Destination "hp7550" is not accepting jobs.
[root@benji ~]#
```

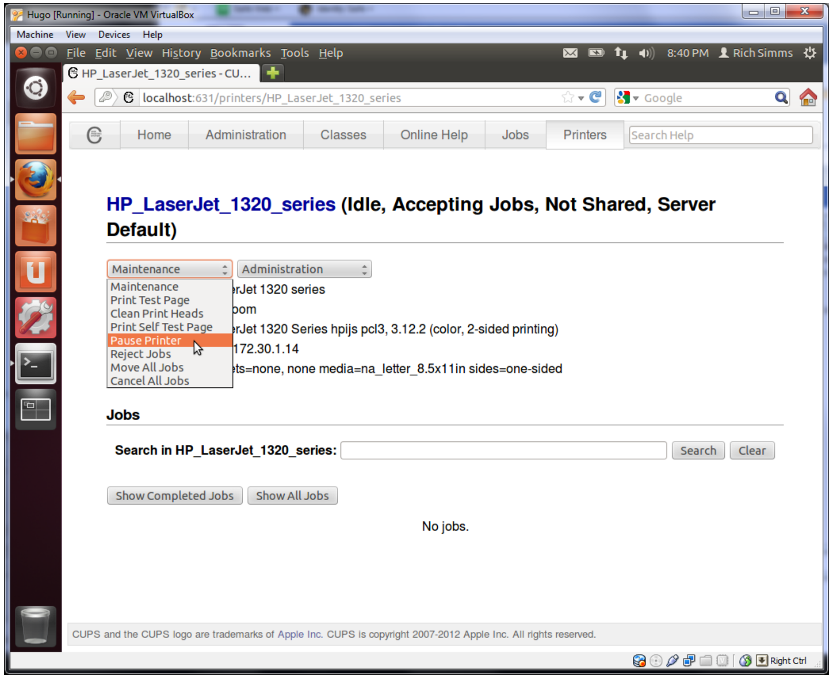
# CUPS

## Pausing the Printer

```
[root@benji ~]# lp myfile
request id is hp7550-22 (1 file(s))


[root@benji ~]# lpq
hp7550 is not ready
Rank     Owner   Job      File(s)
Total Size
1st      root    22       myfile
1024 bytes


[root@benji ~]# lpstat
hp7550-22                  root
1024    Sat 15 Nov 2008 12:20:23 PM
PST
```



localhost:631/printers/HP_LaserJet_1320_series

**HP_LaserJet_1320_series (Idle, Accepting Jobs, Not Shared, Server Default)**

…rJet 1320 series
…oom
…rJet 1320 Series hpijs pcl3, 3.12.2 (color, 2-sided printing)
…172.30.1.14
…ts=none, none media=na_letter_8.5x11in sides=one-sided

**Jobs**

Search in HP_LaserJet_1320_series:

No jobs.

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*Clicking the* **Pause Printer** *selection on the web based utility will still allow jobs to be spooled*

# CUPS

## Showing jobs waiting to print

```
[root@benji ~]# lpq
hp7550 is not ready
Rank    Owner   Job     File(s)
Total Size
1st     root    22      myfile
1024 bytes
2nd     root    23      myfile
1024 bytes
3rd     root    24      myfile
1024 bytes
4th     root    25      myfile
1024 bytes
```

*Use **lpq** or **lpstat** to show spooled print jobs*

```
[root@benji ~]# lpstat
hp7550-22               root              1024   Sat 15
Nov 2008 12:20:23 PM PST
hp7550-23               root              1024   Sat 15
Nov 2008 12:20:28 PM PST
hp7550-24               root              1024   Sat 15
Nov 2008 12:20:31 PM PST
hp7550-25               root              1024   Sat 15
Nov 2008 12:20:34 PM PST
```

# CUPS

## Removing/canceling pending print jobs

```
[root@benji ~]# lpq
hp7550 is not ready
Rank    Owner   Job     File(s)
Total Size
1st     root    22      myfile
1024 bytes
2nd     root    23      myfile
1024 bytes
3rd     root    24      myfile
1024 bytes
4th     root    25      myfile
1024 bytes

[root@benji ~]# cancel 22
[root@benji ~]# cancel 23
[root@benji ~]# lprm 24
[root@benji ~]# lprm 25

[root@benji ~]# lpq
hp7550 is not ready
no entries

[root@benji ~]# lpstat
[root@benji ~]#
```

*Use **cancel** or **lprm***
*to remove print jobs*

# Spool Files

# CUPS

## Spool files in /var/spool/cups

*When you print a new job, the response includes a number that can identify the spoolfile*

```
[root@benji ~]# lp myfile
request id is hp7550-27 (1 file(s))

[root@benji ~]# ls /var/spool/cups/
0000001b  c00009  c00012  c00015  c00018  c00021  c00024  c00027
c00001    c00010  c00013  c00016  c00019  c00022  c00025  d00027-001
c00008    c00011  c00014  c00017  c00020  c00023  c00026  tmp
[root@benji ~]#

[root@benji ~]# file /var/spool/cups/*27*
/var/spool/cups/c00027:     PDP-11 UNIX/RT ldp
/var/spool/cups/d00027-001: ASCII English text
[root@benji ~]#
```

*Spooled print files are kept in pairs, one control file and one data file, in /var/spool/cups*

# CUPS

## Spool file contents in /var/spool/cups

*Print job #27*

```
[root@benji ~]# ls /var/spool/cups/
0000001b  c00009  c00012  c00015  c00018  c00021  c00024  c00027
c00001    c00010  c00013  c00016  c00019  c00022  c00025  d00027-001
c00008    c00011  c00014  c00017  c00020  c00023  c00026  tmp
[root@benji ~]#


[root@benji ~]# cat /var/spool/cups/d00027-001
Hello There,
  How is it going.  Ready for some salsa?  Benji is getting ready for
the big trip.
-Rich
-[root@benji ~]# xxd -l 128 /var/spool/cups/c00027
-0000000: 0101 0002 0000 0001 0147 0012 6174 7472  .........G..attr
-0000010: 6962 7574 6573 2d63 6861 7273 6574 0005  ibutes-charset..
-0000020: 7574 662d 3848 001b 6174 7472 6962 7574  utf-8H..attribut
-0000030: 6573 2d6e 6174 7572 616c 2d6c 616e 6775  es-natural-langu
-0000040: 6167 6500 0565 6e2d 7573 0245 000b 7072  age..en-us.E..pr
-0000050: 696e 7465 722d 7572 6900 1f69 7070 3a2f  inter-uri..ipp:/
-0000060: 2f6c 6f63 616c 686f 7374 2f70 7269 6e74  /localhost/print
-0000070: 6572 732f 6870 3735 3530 4200 196a 6f62  ers/hp7550B..job
-[root@benji ~]#
```

*The data file is ascii and the control file is binary when printing a text file*

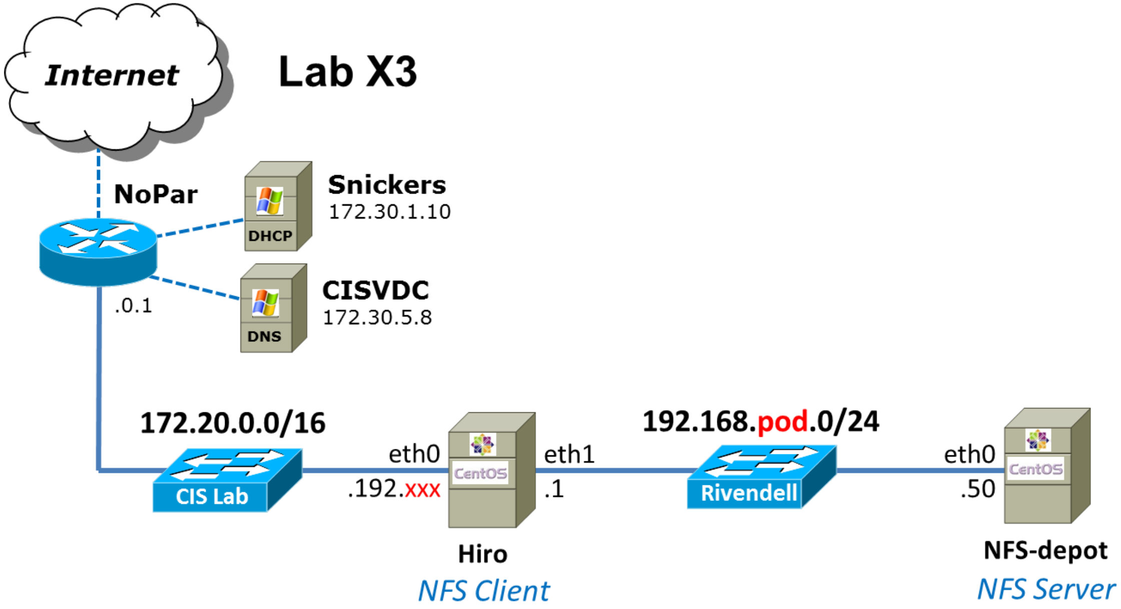
# Exercise: CUPS

- Run **service cups status** on Frodo
- Turn on the CUPS service  if off
- In graphics mode, browse to localhost:631
- Add a "fake" HP LaserJet 1320N and disable it.
- Practice printing to your fake printer.

# Lab X3

Lab X3 (NFS)

- More hostname changing practice
- Export two /home directories on NFS-depot
- Mount NFS-depot directories Hiro



Student
Presentation

# Wireless Penetration

-Ryan Schell

# Wrap

# References

RPC

- http://publib.boulder.ibm.com/infocenter/systems/index.jsp?topic=/com.ibm.aix.progcomm/doc/progcomc/rpc_portmap.htm

Port Mapper

- http://en.wikipedia.org/wiki/Portmap
- http://publib.boulder.ibm.com/infocenter/systems/index.jsp?topic=/com.ibm.aix.progcomm/doc/progcomc/rpc_portmap.htm

NFS

- http://www.cabrillo.edu/~jgriffin/CIS192/files/lesson11.html

- http://www.redhat.com/docs/manuals/enterprise/RHEL-3-Manual/ref-guide/s1-nfs-server-export.html
- http://blog.taragana.com/index.php/archive/full-disclosure-nis-security-hole-full-access-by-nis-client-root/
- http://www.redhat.com/docs/manuals/linux/RHL-7.3-Manual/custom-guide/s1-nfs-mount.html
- http://linux.about.com/library/cmd/blcmdl8_rpc.statd.htm

LVM

- http://advait.wordpress.com/2008/09/23/logical-volume-manager-and-logical-volumes-linux/
- http://www.linuxconfig.org/Linux_lvm_-_Logical_Volume_Manager
- http://blog.timc3.com/2006/03/19/lvm2-and-adding-disks/

# CIS 192 - Lesson 10

New commands, daemons:

mount
pvcreate, pvscan, pvdispaly
lvcreate, lvscan, lvdisplay
vgcreate, vgscan, vgdisplay

rpcinfo
netstat
showmount
exportfs

lp or lpr
convert
lpstat
lpq
cancel or lprm
lpoptions

Configuration files

/etc/exports
/etc/sysconfig/nfs
/etc/mtab
/etc/fstab
/var/spool/cups

# Next Class

Assignment: Check Calendar Page
http://simms-teach.com/cis192calendar.php

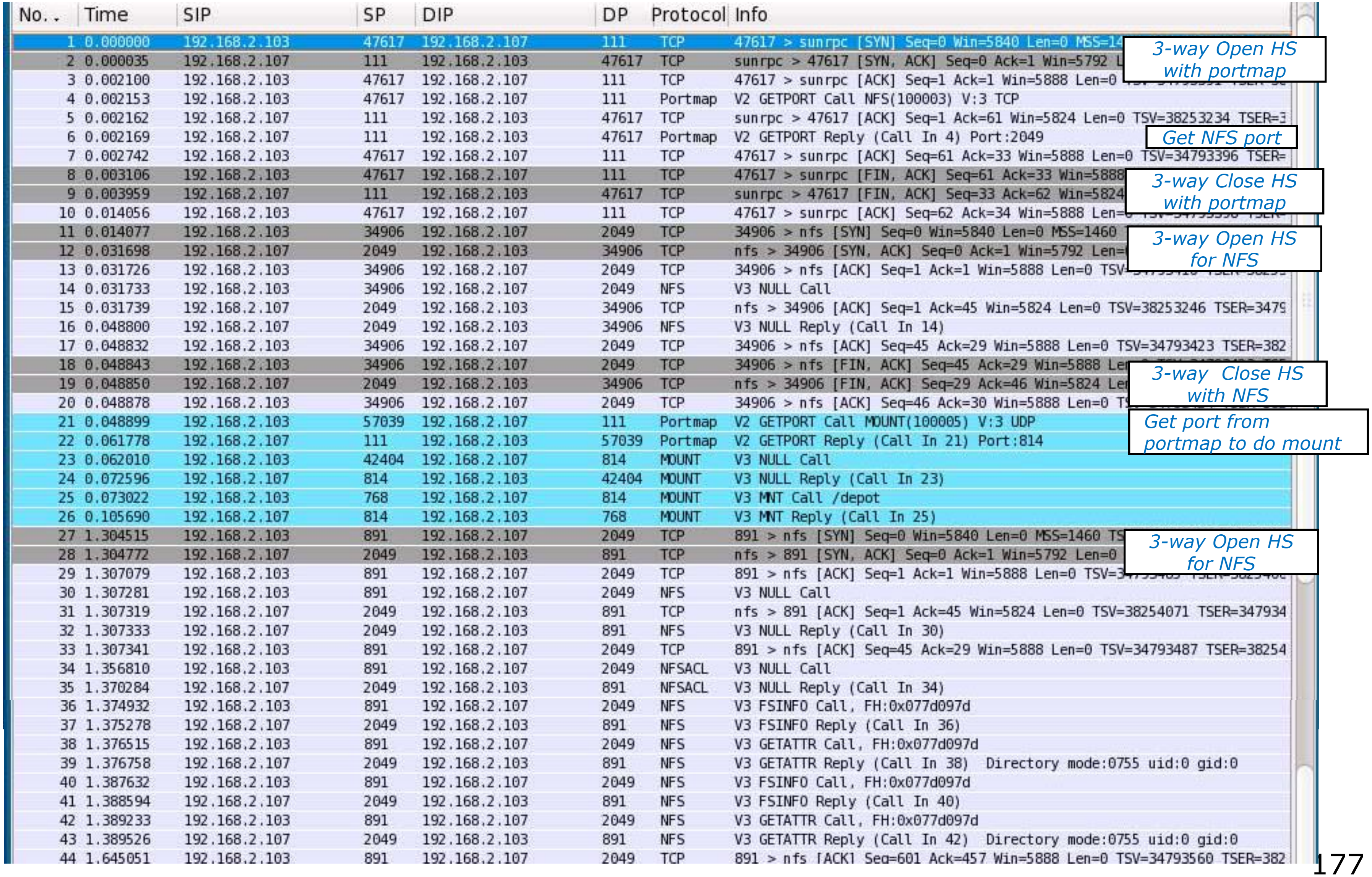
Lab X3 NFS
is available now

Quiz questions for next class:

- To configure an NFS server, what file must be edited to specify the directories to be shared ?
- In Linux/UNIX what does RPC stand for?
- What URL would be used to browse to the local CUPS web-based configuration utility?

# Backup

```
[root@arwen ~]# mount hiro:/depot /depot
```



| No. | Time | SIP | SP | DIP | DP | Protocol | Info |
|---|---|---|---|---|---|---|---|
| 1 | 0.000000 | 192.168.2.103 | 47617 | 192.168.2.107 | 111 | TCP | 47617 > sunrpc [SYN] Seq=0 Win=5840 Len=0 MSS=14 |
| 2 | 0.000035 | 192.168.2.107 | 111 | 192.168.2.103 | 47617 | TCP | sunrpc > 47617 [SYN, ACK] Seq=0 Ack=1 Win=5792 L |
| 3 | 0.002100 | 192.168.2.103 | 47617 | 192.168.2.107 | 111 | TCP | 47617 > sunrpc [ACK] Seq=1 Ack=1 Win=5888 Len=0 |
| 4 | 0.002153 | 192.168.2.103 | 47617 | 192.168.2.107 | 111 | Portmap | V2 GETPORT Call NFS(100003) V:3 TCP |
| 5 | 0.002162 | 192.168.2.107 | 111 | 192.168.2.103 | 47617 | TCP | sunrpc > 47617 [ACK] Seq=1 Ack=61 Win=5824 Len=0 TSV=38253234 TSER=3 |
| 6 | 0.002169 | 192.168.2.107 | 111 | 192.168.2.103 | 47617 | Portmap | V2 GETPORT Reply (Call In 4) Port:2049 |
| 7 | 0.002742 | 192.168.2.103 | 47617 | 192.168.2.107 | 111 | TCP | 47617 > sunrpc [ACK] Seq=61 Ack=33 Win=5888 Len=0 TSV=34793396 TSER= |
| 8 | 0.003106 | 192.168.2.103 | 47617 | 192.168.2.107 | 111 | TCP | 47617 > sunrpc [FIN, ACK] Seq=61 Ack=33 Win=5888 |
| 9 | 0.003959 | 192.168.2.107 | 111 | 192.168.2.103 | 47617 | TCP | sunrpc > 47617 [FIN, ACK] Seq=33 Ack=62 Win=5824 |
| 10 | 0.014056 | 192.168.2.103 | 47617 | 192.168.2.107 | 111 | TCP | 47617 > sunrpc [ACK] Seq=62 Ack=34 Win=5888 Len= |
| 11 | 0.014077 | 192.168.2.103 | 34906 | 192.168.2.107 | 2049 | TCP | 34906 > nfs [SYN] Seq=0 Win=5840 Len=0 MSS=1460 |
| 12 | 0.031698 | 192.168.2.107 | 2049 | 192.168.2.103 | 34906 | TCP | nfs > 34906 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len= |
| 13 | 0.031726 | 192.168.2.103 | 34906 | 192.168.2.107 | 2049 | TCP | 34906 > nfs [ACK] Seq=1 Ack=1 Win=5888 Len=0 TSV |
| 14 | 0.031733 | 192.168.2.103 | 34906 | 192.168.2.107 | 2049 | NFS | V3 NULL Call |
| 15 | 0.031739 | 192.168.2.107 | 2049 | 192.168.2.103 | 34906 | TCP | nfs > 34906 [ACK] Seq=1 Ack=45 Win=5824 Len=0 TSV=38253246 TSER=3479 |
| 16 | 0.048800 | 192.168.2.107 | 2049 | 192.168.2.103 | 34906 | NFS | V3 NULL Reply (Call In 14) |
| 17 | 0.048832 | 192.168.2.103 | 34906 | 192.168.2.107 | 2049 | TCP | 34906 > nfs [ACK] Seq=45 Ack=29 Win=5888 Len=0 TSV=34793423 TSER=382 |
| 18 | 0.048843 | 192.168.2.103 | 34906 | 192.168.2.107 | 2049 | TCP | 34906 > nfs [FIN, ACK] Seq=45 Ack=29 Win=5888 Le |
| 19 | 0.048850 | 192.168.2.107 | 2049 | 192.168.2.103 | 34906 | TCP | nfs > 34906 [FIN, ACK] Seq=29 Ack=46 Win=5824 Le |
| 20 | 0.048878 | 192.168.2.103 | 34906 | 192.168.2.107 | 2049 | TCP | 34906 > nfs [ACK] Seq=46 Ack=30 Win=5888 Len=0 T |
| 21 | 0.048899 | 192.168.2.103 | 57039 | 192.168.2.107 | 111 | Portmap | V2 GETPORT Call MOUNT(100005) V:3 UDP |
| 22 | 0.061778 | 192.168.2.107 | 111 | 192.168.2.103 | 57039 | Portmap | V2 GETPORT Reply (Call In 21) Port:814 |
| 23 | 0.062010 | 192.168.2.103 | 42404 | 192.168.2.107 | 814 | MOUNT | V3 NULL Call |
| 24 | 0.072596 | 192.168.2.107 | 814 | 192.168.2.103 | 42404 | MOUNT | V3 NULL Reply (Call In 23) |
| 25 | 0.073022 | 192.168.2.103 | 768 | 192.168.2.107 | 814 | MOUNT | V3 MNT Call /depot |
| 26 | 0.105690 | 192.168.2.107 | 814 | 192.168.2.103 | 768 | MOUNT | V3 MNT Reply (Call In 25) |
| 27 | 1.304515 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | TCP | 891 > nfs [SYN] Seq=0 Win=5840 Len=0 MSS=1460 TS |
| 28 | 1.304772 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | TCP | nfs > 891 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 |
| 29 | 1.307079 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | TCP | 891 > nfs [ACK] Seq=1 Ack=1 Win=5888 Len=0 TSV=3 |
| 30 | 1.307281 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | NFS | V3 NULL Call |
| 31 | 1.307319 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | TCP | nfs > 891 [ACK] Seq=1 Ack=45 Win=5824 Len=0 TSV=38254071 TSER=347934 |
| 32 | 1.307333 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | NFS | V3 NULL Reply (Call In 30) |
| 33 | 1.307341 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | TCP | 891 > nfs [ACK] Seq=45 Ack=29 Win=5888 Len=0 TSV=34793487 TSER=38254 |
| 34 | 1.356810 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | NFSACL | V3 NULL Call |
| 35 | 1.370284 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | NFSACL | V3 NULL Reply (Call In 34) |
| 36 | 1.374932 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | NFS | V3 FSINFO Call, FH:0x077d097d |
| 37 | 1.375278 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | NFS | V3 FSINFO Reply (Call In 36) |
| 38 | 1.376515 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | NFS | V3 GETATTR Call, FH:0x077d097d |
| 39 | 1.376758 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | NFS | V3 GETATTR Reply (Call In 38) Directory mode:0755 uid:0 gid:0 |
| 40 | 1.387632 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | NFS | V3 FSINFO Call, FH:0x077d097d |
| 41 | 1.388594 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | NFS | V3 FSINFO Reply (Call In 40) |
| 42 | 1.389233 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | NFS | V3 GETATTR Call, FH:0x077d097d |
| 43 | 1.389526 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | NFS | V3 GETATTR Reply (Call In 42) Directory mode:0755 uid:0 gid:0 |
| 44 | 1.645051 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | TCP | 891 > nfs [ACK] Seq=601 Ack=457 Win=5888 Len=0 TSV=34793560 TSER=382 |

3-way Open HS with portmap

Get NFS port

3-way Close HS with portmap

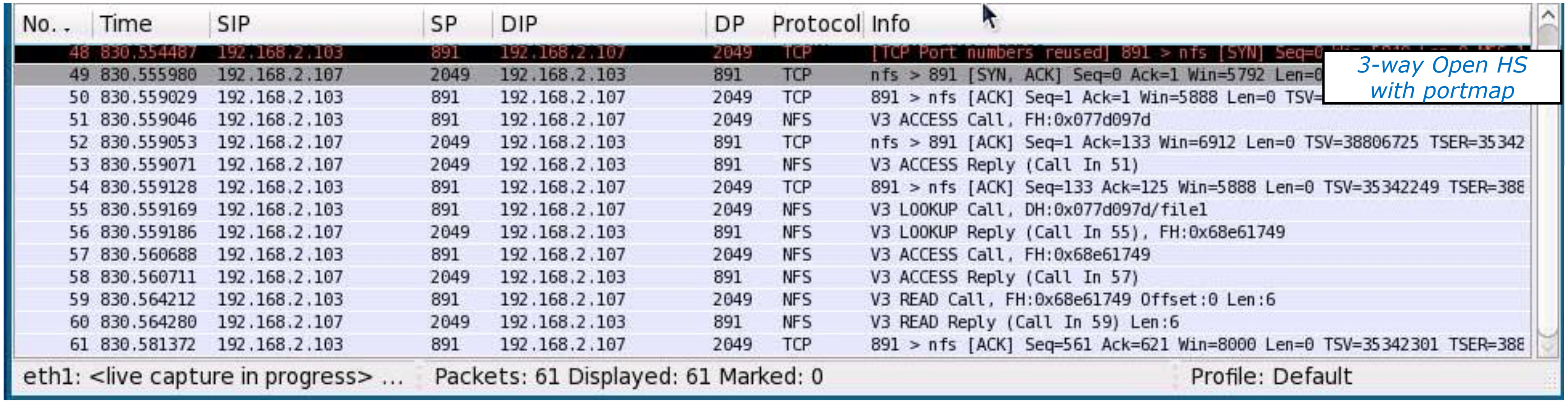
3-way Open HS for NFS

3-way Close HS with NFS

Get port from portmap to do mount

3-way Open HS for NFS

```
[root@arwen ~]# cat /depot/file1
file1
```



| No. | Time | SIP | SP | DIP | DP | Protocol | Info |
|---|---|---|---|---|---|---|---|
| 48 | 830.554487 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | TCP | [TCP Port numbers reused] 891 > nfs [SYN] Seq=0 |
| 49 | 830.555980 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | TCP | nfs > 891 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 |
| 50 | 830.559029 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | TCP | 891 > nfs [ACK] Seq=1 Ack=1 Win=5888 Len=0 TSV= |
| 51 | 830.559046 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | NFS | V3 ACCESS Call, FH:0x077d097d |
| 52 | 830.559053 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | TCP | nfs > 891 [ACK] Seq=1 Ack=133 Win=6912 Len=0 TSV=38806725 TSER=35342 |
| 53 | 830.559071 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | NFS | V3 ACCESS Reply (Call In 51) |
| 54 | 830.559128 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | TCP | 891 > nfs [ACK] Seq=133 Ack=125 Win=5888 Len=0 TSV=35342249 TSER=388 |
| 55 | 830.559169 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | NFS | V3 LOOKUP Call, DH:0x077d097d/file1 |
| 56 | 830.559186 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | NFS | V3 LOOKUP Reply (Call In 55), FH:0x68e61749 |
| 57 | 830.560688 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | NFS | V3 ACCESS Call, FH:0x68e61749 |
| 58 | 830.560711 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | NFS | V3 ACCESS Reply (Call In 57) |
| 59 | 830.564212 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | NFS | V3 READ Call, FH:0x68e61749 Offset:0 Len:6 |
| 60 | 830.564280 | 192.168.2.107 | 2049 | 192.168.2.103 | 891 | NFS | V3 READ Reply (Call In 59) Len:6 |
| 61 | 830.581372 | 192.168.2.103 | 891 | 192.168.2.107 | 2049 | TCP | 891 > nfs [ACK] Seq=561 Ack=621 Win=8000 Len=0 TSV=35342301 TSER=388 |

eth1: <live capture in progress> ... Packets: 61 Displayed: 61 Marked: 0 Profile: Default

*3-way Open HS with portmap*

| Client | | Server | |
|---|---|---|---|
| IP: | *192.168.2.103* | IP: | *192.168.2.107* |
| Port: | *891* | Port: | *2049* |