

Lesson Module Status

- Slides – draft
- Properties - done
- Flashcards - NA
- 1st minute quiz – done
- Web Calendar summary – done
- Web book pages – done
- Commands – done
- Howtos – done
- Skills pacing - NA
- Lab – done
- Surveys and PW sheet copied – done
- Depot (VMs) – [done](#)
- Special – check VMware revert on Frodo and Celebrian – needed new snap



*Feel free to power on your station and login as:
user: cis 192
password: (on the whiteboard)*

CIS 192AB uses CCC-Confer

- Class meets every Thursday night:
 - 5:30PM to 9:35PM, Feb 11th to May 27th
- Attend in person or online
 - Option 1: Go to room 2501 on the Aptos Campus
 - Option 2: Attend class online (except 1st and final exam)
- Final exam on June 3rd
 - Room 2501 only

Attending class online www.cccconfer.org

HOME ABOUT US MEETINGS TRAINING CENTER PRODUCTS ARCHIVES SUPPORT CONTACT US

CCC Confer

Meet with Colleagues Without Leaving Your Office Using CCC Confer

Using Just Your Phone and Computer, You Can Meet with Anyone, Anywhere, Anytime. [Learn How](#)

MyConfer

PRESENTER/FACULTY SIGN UP!

PRESENTER/FACULTY LOG IN

PARTICIPANTS/STUDENTS LOG IN

Project Director's Corner

From the Desktop of Blaine Morrow

Tips, Blog & More

ONLINE TEACHING CONFERENCE 2010
June 16, 17, & 18
"Engaging every online student in lean and green times."

Meet & Confer

Use the phone and the Internet to meet, collaborate or train in real-time.

PARTICIPANT LOG IN

View Meet & Confer Archives

Office Hours

Faculty and students can interact using the phone and the internet for meetings, tutoring, counseling and more.

STUDENT LOG IN

View Office Hours Archives

Teach & Confer

Teach & Confer is a live interactive classroom to meet with your students.

STUDENT LOG IN

View Teach & Confer Archives

Call Confer

Here's a conference call service for those who just want to use the phone.

SCHEDULE CALL CONFER

Webinars

Webinars are web-based seminars. Using a phone and the internet, a broad audience can attend.

PARTICIPANT LOG IN

View Webinars Archives

ACCESSIBILITY This site is provided as a service to the administrators, staff and faculty of the California Community Colleges system. CCC Confer is funded by an e-conferencing grant from the California Community Colleges Chancellor's Office. PRIVACY

Attend any class online except for the 1st class and the final exam

- ❖ <http://www.cccconfer.org>
- ❖ Click the **Student Log In** button under the **Teach & Confer** logo

Attending class online www.cccconfer.org

MyConfer - Upcoming M... x

http://www.cccconfer.org/CCCC/MeetingSchedule.aspx?ShowType=Teach%20Confer

HOME ABOUT US MEETINGS TRAINING CENTER PRODUCTS ARCHIVES SUPPORT CONTACT US

CCC Confer

MEET & CONFER OFFICE HOURS **TEACH & CONFER** WEBINARS

Welcome to the CCC Confer Teach & Confer log-in page.

Date	Start Time	End Time	Name	Type
2/10/2010	7:30 PM	8:30 PM	James Gonzalez - MMST131 Web Design	Teach & Confer GO
2/10/2010	8:00 PM	9:00 PM	Karina Lawrence - Power Point Q and A Hour	Teach & Confer GO
2/10/2010	8:30 PM	12:30 AM	Mehdi Mirfatah - Online meeting	Teach & Confer GO
2/11/2010	9:00 AM	12:30 PM	Luis Flores - CSIT103 3147	Teach & Confer GO
2/11/2010	9:00 AM	1:30 PM	Norman Marten - PHSO M01	Teach & Confer GO
2/11/2010	9:00 AM	9:30 AM	Mehdi Mirfatah - Online meeting	Teach & Confer GO
2/11/2010	11:00 AM	12:00 PM	john gonder - Gonder 69 Lecture	Teach & Confer GO
2/11/2010	3:00 PM	4:00 PM	john gonder - Gonder 70 Lecture	Teach & Confer GO
2/11/2010	5:00 PM	9:00 PM	Julie Hoffman - Weekly Meeting Math 127 and Math 232	Teach & Confer GO
2/11/2010	5:00 PM	7:30 PM	Dennis Smith - Acct 111 - Cost Accounting	Teach & Confer GO
2/11/2010	5:00 PM	10:00 PM	Rich Simms - CIS 192AB Class	Teach & Confer GO
2/11/2010	5:30 PM	10:00 PM	Carol Wilksby - In 2007 Medical Quality Management	Teach & Confer GO
2/11/2010	6:00 PM	9:00 PM	Dennis Smith - Accounting 111	Teach & Confer GO
2/11/2010	6:00 PM	10:30 PM	Norman Marten - PHSO M01 nite class	Teach & Confer GO
2/11/2010	6:00 PM	8:00 PM	Cindy Moss - Math 120 and 200 Online	Teach & Confer GO
2/11/2010	6:00 PM	9:00 PM	Roger Powell - CCNA-Thursday	Teach & Confer GO
2/11/2010	6:30 PM	8:30 PM	Daniel Johnson - Intro to Flash	Teach & Confer GO
2/11/2010	7:00 PM	8:00 PM	Dawey Heinsma - Economic Jam Session With Economist	Teach & Confer GO
2/12/2010	9:00 AM	12:30 PM	Luis Flores - CSIT101 0329	Teach & Confer GO
2/12/2010	5:30 PM	7:30 PM	Kenny Lou - CIS 70A - Network Fundamentals	Teach & Confer GO

1 2 3 4 5 6 7 8 9 10 ...

ACCESSIBILITY This site is provided as a service to the administrators, staff and faculty of the California Community Colleges system. CCC Confer is funded by an e-conferencing grant from the California Community Colleges Chancellor's Office. PRIVACY

- ❖ For the current date locate:
Rich Simms – CIS 192AB Class
and click **GO**
- ❖ Dial-in number and passcode are on the handout
- ❖ You screen name should be your first and last name.
- ❖ For registered students only.

Group Mug Shots

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



Joe P.

Joe A.



Chris B.



Chuck



Rich



Ryan



Robert



John



Josh



Patrick



Chris H.



Lieven



Jack



Casady



Kay



Edwin



Julio



Jack



Drew



Bill



Aaron



Randall



Joe B.



Junious



Brynden

Class Activity
Log in to CCC Confer

- ❖ <http://www.cccconfer.org>
- ❖ Click the ***Student Log In*** button under the ***Teach & Confer*** logo
- ❖ For the current date locate:
Rich Simms – CIS 192AB Class
and click **GO**
- ❖ Dial-in number and passcode are on the handout

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/>

Introduction to TCP/IP and Network Access

Related Course Objectives

- Use basic network terminology to describe the five layers of the TCP/IP Reference Model, and describe at least one major function of each layer.
- Locate a specific Request For Comment (RFC) article on the Internet.
- Install the device drivers and configure the network interface card (NIC) of a Linux system so that it may join a network.

Agenda

- Introductions [A]
- Pre-requisites, Linux Market, IT Jobs, Infrastructure
- Baseline assessment [A]
- [A] How this class works [A], Housekeeping
- Equipment [A], Virtualization, VMware 101 [A] [A]
- Creating VMs [A], Cabling VMs, Taking VMs home
- Fun with Treebeard [A]
- SSH hopping [A]
- Network basics
- Standards
- NIC inventory [A], NIC drivers, Managing drivers [A]
- Configuring static IP (temp)
- Configuring gateway and DNS
- Configuring dynamic IP (temp)
- IPv6 usage
- Testing with ping
- Lab
- Wrap up



Introductions

Class Activity
Brief (**30 seconds**) Introductions

Go around the room starting with the instructor

1. Name
2. Brief summary of education/training
3. Brief summary of technical experience

Prerequisite Knowledge

CIS 81

Should have a high level understanding of the following:

IPv4 Addressing

Ethernet

Network stack (OSI layers)

Encapsulation

Subnetting

Utilities:

- Ping
- Wireshark

DNS

DHCP

NAT

Devices

- NICs
- Hubs
- Switches
- Routers

Routing

CIS 90

Should be comfortable with the following:

Navigating file tree

- ls, cd, pwd, find

File management

- cp, mv, rm, mkdir, rmdir

Edit configuration files

- vi

Working in a tty

- more, less, tty

Virtual terminals

- Ctrl-Alt-F1 ...

Getting info

- man, google

Miscellaneous

- ssh/Putty, su, chmod

Command line edits

- up arrow, tab

Showing file info

- cat, grep, head, tail, file, grep

Redirection

- >, >>, <, |



Linux Market

UNIX/Linux Overview

Server & PC markets

Servers

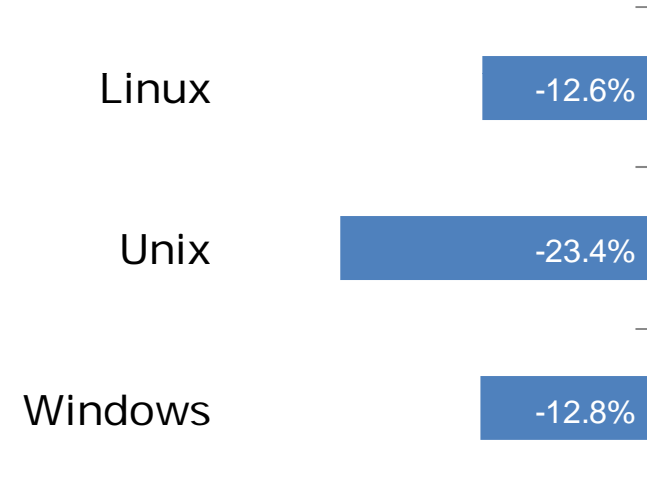
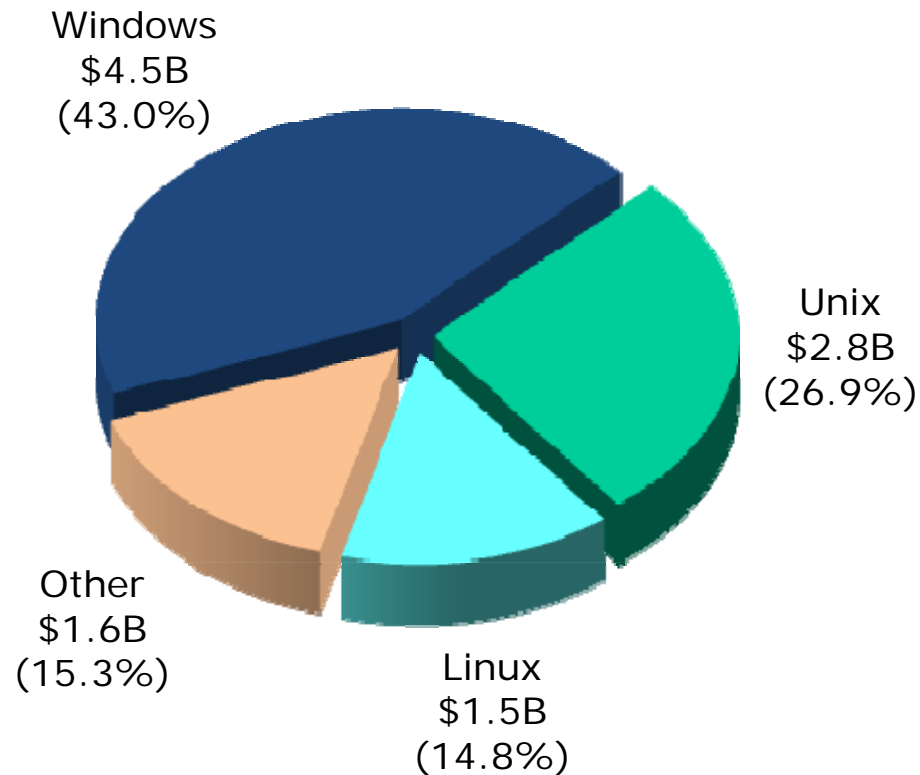
PC's



Worldwide Server Market

\$10.4B Server Revenue 3Q 2009

Year over Year Change



Source: IDC, Dec 2009

Linux distros mentioned by top server vendors

Server market share source: IDC 3Q09 report

Vendor	HP (30.9%)	IBM (31.8%)	Dell (13.5%)	Sun (7.5%)
RedHat Enterprise	✓	✓	✓	✓
Novell SUSE	✓	✓	✓	✓
Debian/GNU Linux	✓			
Oracle EL	✓	✓		✓
Asianux	✓	✓		
Ubuntu	✓		✓	✓
CentOs	✓			
Fedora	✓			

UNIX/Linux Overview - Desktops



Dec 2009¹

Operating Systems		
1	Windows XP	56.61%
2	Windows Vista	21.29%
3	Mac OS X	7.44%
4	Windows 7	6.80%
5	Linux	2.14%
6	Windows 2003	1.14%
7	iPhone OSX	0.64%
8	Windows 2000	0.50%
9	Windows 98	0.09%
10	Android	0.08%

Dec 2008²

Operating Systems		
1	Windows XP	72.17%
2	Windows Vista	13.44%
3	Mac OS X	5.24%
4	Linux	2.13%
5	Windows 2000	2.12%
6	Windows 2003	0.68%
7	Windows 98	0.55%
8	Windows ME	0.22%
9	SymbianOS	0.12%
10	WAP	0.04%

1-This report was generated 12/31/2009 based on the last 15,000 page views to each website tracked by W3Counter. W3Counter's sample currently includes 31,496 websites. The generation method was updated in July 2009 to ensure only visits during the month of the report are counted, resulting in a report that is more responsive to change.

2-This report was generated 12/31/2008 based on the last 53,892,847 unique visits to all tracked websites at that time. W3Counter's sample currently includes 19,174 websites. The last 25,000 page views to each website are analyzed to identify unique visits. Some visits may occur before the month of the report.

distrowatch.com

Top Ten Jan 2010

1. Ubuntu 9.10
2. Fedora 12 ↑
3. openSUSE 11.2 ↓
4. Debian 5.0
5. Mandriva 2010
6. Linux Mint 8
7. PCLinuxOS 2009.2
8. Slackware 13.0
9. Gentoo 10.1
10. CentOS 5.4
11. FreeBSD 8.0

Top Ten Jan 2009

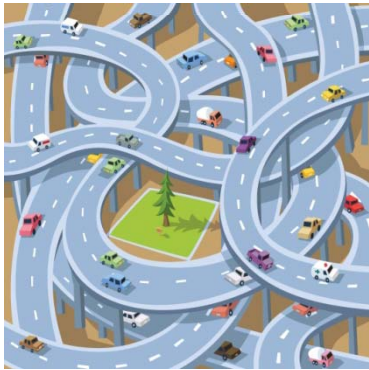
1. Ubuntu
2. openSUSE
3. Fedora
4. Debian
5. Mandriva
6. Linux Mint
7. PCLinuxOS
8. Slackware
9. Gentoo
10. CentOS
11. FreeBSD

CentOS is a clone distro of Red Hat Enterprise



IT Infrastructure

You use **Public Works Infrastructure** every time you drive, fly, turn on the lights or drink a glass of water



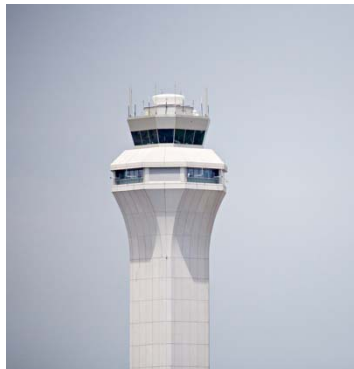
Roads



Water



Bridges

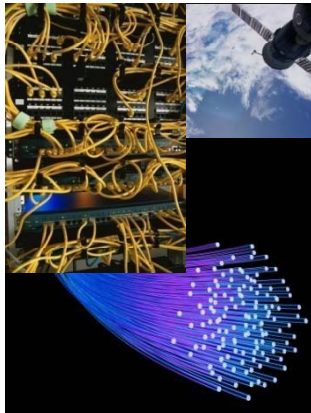


Airways



Power

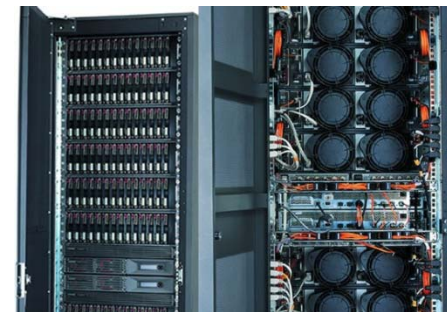
You use **IT Infrastructure** every time you send an email, surf the net or make an online purchase



Network



Servers



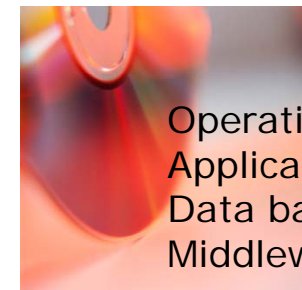
Storage



Desktops



Mobile



Operating Systems
Applications
Data bases
Middleware

Software



IT

(Information Technology)

Jobs

2009: The 10 hardest jobs to fill in the U.S. are:

1. Engineers
2. Nurses
3. Skilled/Manual Tradesmen
4. Teachers
5. Sales Representatives
6. Technicians
7. Drivers
8. IT Staff
9. Laborers
10. Machinist/Machine Operators

2008: The 10 hardest jobs to fill in the U.S. were:

1. Engineers
2. Machinists/Machine Operators
3. Skilled Manual Tradesmen
4. Technicians
5. Sales Representatives
6. Accounting & Finance Staff
7. Mechanics
8. Laborers
9. IT Staff
10. Production Operators

Even as thousands of IT jobs continue to be offshored each year, demand for software developers, systems engineers and network administrators is strong, according to the Manpower survey.

“One of the challenges that IT departments face is finding people who are well-rounded, can communicate with the lines of business and can manage,” says Melanie Holmes, a vice president at Manpower North America.

Source: Manpower Inc.

Baseline

CIS 192 will expand your knowledge and skills for deploying network based IT infrastructure

Some tools we will use:

- VMware virtual machines and networks
- Wireshark
- Putty
- New UNIX/Linux commands

Some infrastructure skills we will pick up:

- Adding and removing NIC drivers
- Configuring TCP/IP settings
- Configure routing protocols
- Configure PPP using a serial connection
- Access SMTP, POP and IMAP servers
- SSH tunneling
- Network troubleshooting
- Mount a remote directory
- Examining information in different network layers
- Automate the installation of a "bare-metal" computer with PXE
- Modifying firewall and SELinux settings

Some technologies we will deploy:

- Linux based router
- Firewalls
- Custom NAT
- DHCP server
- DNS server
- NFS server
- Samba server
- NIS server
- FTP server
- Web server

Class Activity
Baseline Knowledge Survey

Please browse to and complete the survey at:

<http://www.surveymonkey.com/s/KD7RDFW>

100% ANONYMOUS

The information gathered will be used to calibrate the lessons



How this Class Works

Class Activity (continued) Class Website

The screenshot shows a web browser window displaying the website <http://simms-teach.com/cis192home.php>. The page title is "Rich's Cabrillo College CIS Classes CIS 192 Home". The navigation menu includes "Home", "Resources", "Forums", "CIS Lab", and "CTC". On the left sidebar, there are buttons for "Login", "Flashcards", "Admin", and "CIS 192" (which is highlighted with a red box). Below the sidebar, there is a section for "CIS 192 Syllabus (Spring 2010) Section 66522" with sub-links for "Calendar" and "Grades" (both highlighted with red boxes). The main content area is titled "UNIX/Linux Network Administration (CIS 192)" and lists course details such as "Thursdays - 5:30PM to 9:35PM - Aptos Main Campus - Room 2501", "Open Lab - 4 hours & 5 minutes per week to be arranged - CTC or CIS Lab", and "Units: 4, prerequisites: CIS 81 and CIS 90, recommended: CIS 191". It also lists a required textbook: "Linux Administration Handbook (Second Edition)" by Evi Nemeth, Garth Snyder, Trent R. Hein, Prentice Hall PTR ISBN: 0131480049. A "Summary (from Cabrillo Schedule of Classes)" section states: "Build and monitor network infrastructures, and install, configure, and protect services on Linux TCP/IP networks." The "Course Description" section states: "Students will learn how network infrastructures are implemented on UNIX/Linux Systems. Emphasis is on the TCP/IP suite of protocols, with the course concentrating on the functionality of each layer of the TCP/IP Network Model, and the Linux commands and utilities used for administering the network. Students will also learn to install and configure network applications including DHCP, DNS, NFS, SAMBA, and web-based services such as FTP, HTTP and email. The course also covers firewalls and various WAN technologies including Virtual Private Networks and PPP."

1. Browse to:
`http://simms-teach.com`
3. Click on **CIS 192** on left panel to see the syllabus
4. Use links at top of content area to toggle between **Course Home, Calendar and Grades.**
5. The **syllabus** is on the Course Home page.



Course syllabus walkthrough

It is a good idea to read through the syllabus carefully to avoid any surprises and get a good idea how this course works.

We will cover some important syllabus highlights in the next several slides.

Weekly Cycle

<http://simms-teach.com>

Thursday

- "First Minute" Quiz
- Lecture on new material
- Class Activities
- Lab assignments due midnight

Use Forum to ask and answer questions



Calendar Page

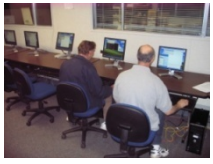
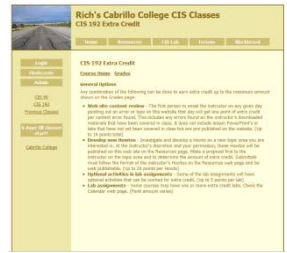


Friday
is grading day

Grades Page



Extra Credit Page



Work Lab Assignments for TBA portion of class (4 hours 5 min) in CIS Lab or CTC

Course outline and syllabus

Two important course policies to remember

In order to start classes on time, keep the class paced moving, keep my own sanity, and to avoid log jams at the end of the term:

- 1) No makeup's for missed quizzes***
- 2) Late work (Labs 1-10) will not be accepted***

If you have not completed a lab assignment, **please turn in what you have done for partial credit**

Don't worry though -- there are **ample extra credit opportunities** for students wanting or needing any extra points.

Course Calendar

Lesson # and Date

	7	3/25	<ul style="list-style-type: none"> • Details <p>Materials</p> <ul style="list-style-type: none"> • Presentation slides (download) <p>Assignment</p> <ul style="list-style-type: none"> • Lab 6 	8	Lab 5
			<p>Quiz 6</p> <p>Input/Output Processing</p> <ul style="list-style-type: none"> • stdin, stdout, stderr • Redirection • Filters and tees • Miscellaneous commands • Pipes 		
	8	4/1	<p>Materials</p> <ul style="list-style-type: none"> • Presentation slides (download) <p>Assignment</p> <ul style="list-style-type: none"> • Lab 7 	7	Lab 6 5 posts
	9	4/8	<p>Quiz 7</p> <p>Review</p> <p>Materials</p> <ul style="list-style-type: none"> • Presentation slides (download) <p>Assignment</p> <ul style="list-style-type: none"> • NA 		Lab 7
		4/15	Spring Break		
			Test #2		

First minute quiz

Lesson slides, feel free to download during class for local viewing

Lab Assignment

Test

What is due (by midnight of that class)

References to material in the textbook



Rich's Cabrillo College CIS Classes CIS 192 Grades

Home Resources Forums CI

CIS 192 How grading works

Monitor this page to track your progress in the course.

CIS 192 (Spring 2010) Grades [Course Home](#) [Calendar](#)

Points can be earned from the following activities:

- First minute quizzes - 30 points
- Final - 60 points
- Help forum participation - 80 points
- Tests - 90 points
- Lab assignments - 300 points

How your grade is determined:

A student can earn up to 560 total points doing the activities listed above. The number of points earned.

Percentage	Total Points	Letter Grade	Pass/No Pass
90% or higher	504 or higher	A	Pass
80% to 89.9%	448 to 503	B	Pass
70% to 79.9%	392 to 447	C	Pass
60% to 69.9%	336 to 391	D	No pass
0% to 59.9%	0 to 335	F	No pass

Your grade is based solely on the number of points you earn. It offers flexibility and gives you control.

Indicate on the class survey if you want to take the course for a grade or P/NP. You may change your mind later by contacting the instructor

For some flexibility, personal preferences or family emergencies there is an additional 90 points available of **extra credit** activities.

Use extra credit to earn additional points

Choice of Grade or Pass/No Pass

You indicate your grading choice on the Student Survey form passed out during the first class. You can verify your grading choice selection on the table below. Contact the instructor by email with any questions or to request a change in grading choice.

Recommendations

The instructor may provide letters of recommendation upon request. When writing a recommendation, the instructor will include both graded and non-graded areas of performance. Non-graded performance includes teamwork, helping others, quality, planning & organization skills, communication, motivation, and the desire to go above and beyond expectations. The forum is an excellent place to demonstrate teamwork and communication skills.

Don't forget to post! When racking up points the forum is "low hanging fruit"

Current Progress

Each student will be assigned a secret code name so they can monitor their progress on the table below. It is a good idea to check this table frequently and decide whether doing some extra credit activities would be beneficial.

Each student is assigned a secret LOR code name

Code Name	Grading Choice	Quizzes & Tests										Forum				Labs										Final	Extra Credit	Total	Grade			
		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
Max Points		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	30	60	90	560	
aragorn	Grade																															
arwen	P/NP																															

Contacting the instructor

- Use the forum for the fastest response on technical or class related questions.
- Use email for personal matters.
- Weekly office hours right before and after class (Th 4:45-5:30, 9:35-10) in room 2501
- The instructor will be available in the CIS Lab five hours (TBD) every week to help students with lab assignments or to better understand class material.
- Leave a message on voice mail if you have no network access. Checked rarely so don't expect a fast response.



CIS 192 - How this class Works

The TBA portion of this course is required

Requires spending on average of 4 hours and 5 minutes every week applying the skills learned during the lecture portion of the class.

Computer Lab locations



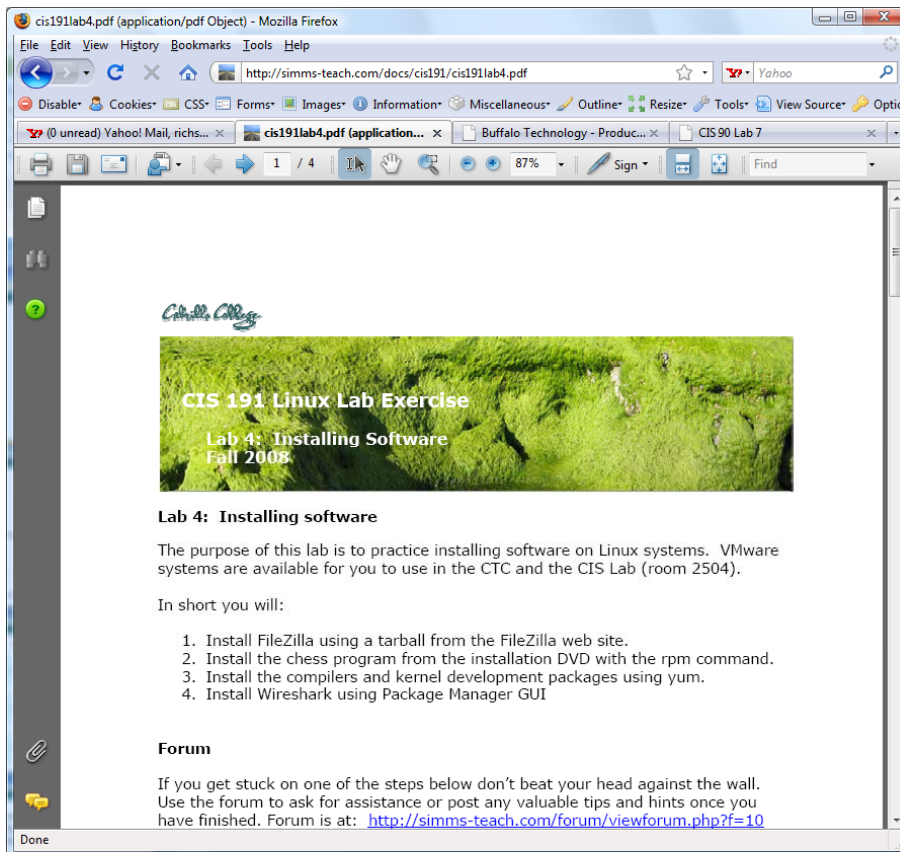
CIS Lab (room 2504)



CTC (building 1400)

CIS 192

Lab Assignments



Pearls of Wisdom:

- Don't wait till the last minute to start.
- The *slower* you go the *sooner* you will be finished.
- A few minutes reading the forum can save you hour(s).
- Line up materials, references, equipment and software ahead of time.
- Use Google when trouble-shooting
- **Late work is not accepted** so submit what you have for partial credit.

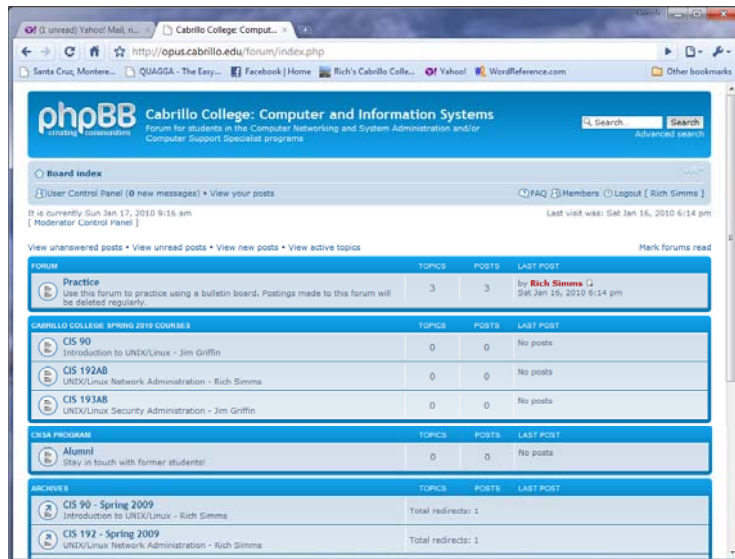
CIS 192

First Minute Quizzes



- The purpose of the quiz is to start each class on time
- 10 quizzes worth 3 points each
- Each quiz has three questions that are given out a week in advance.
- Prior to the actual quiz, students may work together and use the forum to discuss the answers.
- The quiz will start right at the beginning of class. They are closed book/notes/computer and no one may ask for or give assistance during the quiz.
- There are no makeups if you are late or miss class. Of course there are always ample extra credit opportunities!

Online Help Forum for Students



- Post questions and answers
- Share Linux information
- Post class notes for classmates who miss class
- Get clarifications
- Share Linux information



As an incentive to use the forum - students can earn 4 points per CIS 192 forum post (capped at 20 points for each ¼ of the course calendar)

CIS 192

Class Forum

Textbook

POSTREPLY ↩

Search this topic...

Search

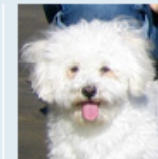
3 posts • Page 1 of 1

Textbook

by Benji Simms on Thu May 15, 2008 2:57 pm

What is the textbook for this course? I want to get it ahead of time and start reading through it.

Last edited by Benji Simms on Mon May 26, 2008 11:31 am, edited 1 time in total.



Benji Simms

Posts: 5
Joined: Thu May 15, 2008 2:40 pm



Rich Simms
Site Admin

Posts: 340
Joined: Thu May 15, 2008 1:44 pm



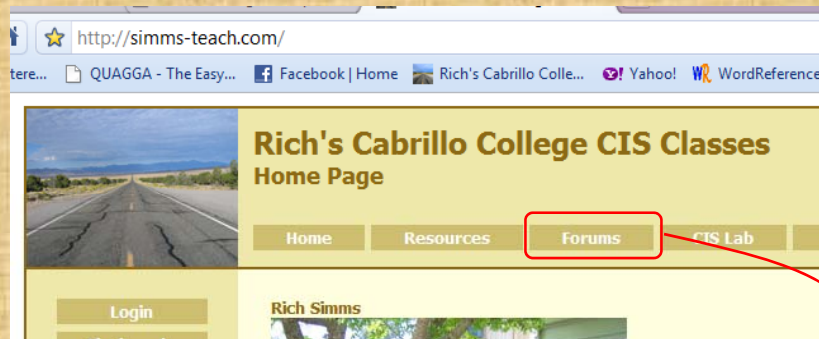
Benji Simms

Posts: 5
Joined: Thu May 15, 2008 2:40 pm

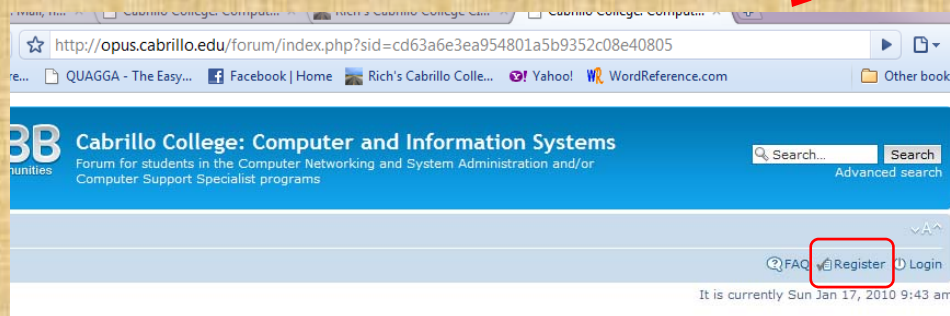
- Usernames cannot be anonymous and must be:
 - Your real **first** and **last** name separated by a **space** e.g. Rich Simms
 - Your username must match a name on the class roster otherwise the account will be deleted
- Uploading an avatar is optional. Identifying photos are preferred so students can get to know each other.

Class Activity Forum Registration

There is a Forums link on **simms-teach.com**



Or browse to **opus.cabrillo.edu /forum**



To Register:

1. Browse to the forum
2. Click on the Register link
3. Review and agree to terms
4. For your **Username** to be accepted it **must** be:
 - your **first and last name separated by a space**
e.g. Rich Simms
 - match a name on the class roster

Note: Anonymous or incomplete user account names will be deleted!

Housekeeping

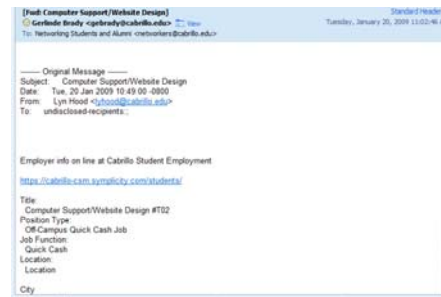
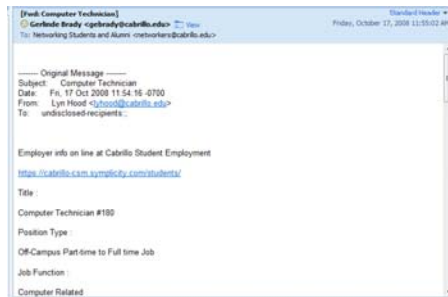
- Roll Call
- Add Slips
- Last day to add is 2/19
- CIS 180 - Capstone Class

See: <http://www.cabrillo.edu/~grollinson/>

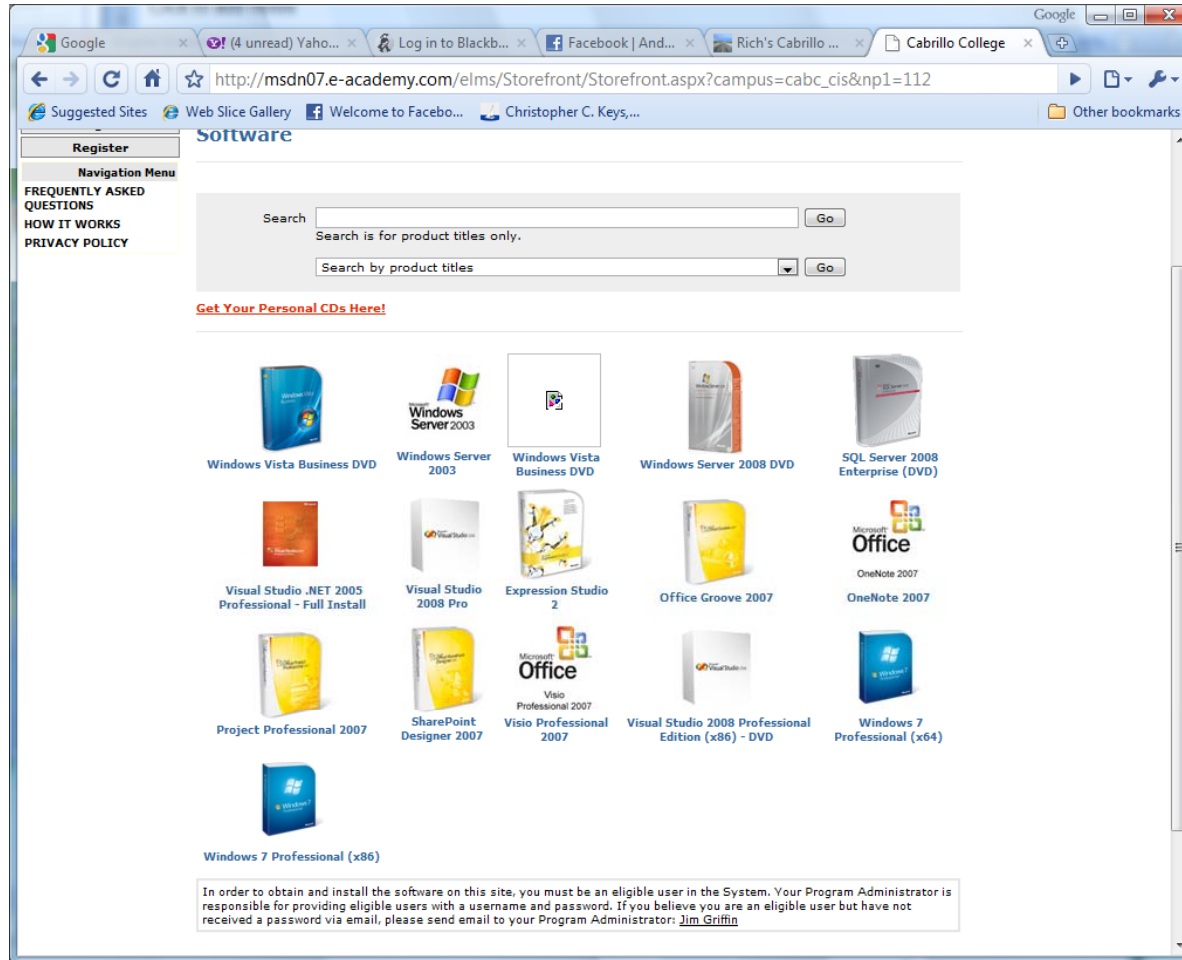
Cabrillo Networking Program Mailing list

Subscribe to (no subject or body):

- **networkers-subscribe@cabrillo.edu**
- Program information
- Certification information
- Career and job information
- Short-term classes, events, lectures, tours, etc.
- Surveys
- Networking info and links



MSDN Academic Alliance



- Microsoft software for students registered in a CIS or CS class at Cabrillo
- Available after registration is final (two weeks after first class)

Cabrillo GNU/Linux Users Group (CGLUG)

Come Alive!

From: Jim Griffin <jimg@Opus.cabrillo.edu> [Add to Contacts](#)

To: Cabrillo GNU/Linux Users Group <cglug@cabrillo.edu>

Hello CGLUG Community,

I am going to inject a little activity into the Cabrillo GNU/Linux user community by inviting my new Linux students to an event this Friday, Feb. 12, 2010 in Room 2504 (The networking lab) at 6:00 PM for a showing of the Revolution OS video and to help students install Linux on their laptops or at least VMware so they can run Linux. We'll see what kind of enthusiasm there is, and who knows - maybe the campus club will revitalize?

I'm looking forward to seeing some of you wizened wizards. Remember, that's Friday, February 12, on Cabrillo Campus - Room 2504. We can talk about whether this list serv is suiting our needs, or whether we want to create a forum to discuss and keep abreast of GNU/Linux issues. Till then!

Jim Griffin

Tomorrow at 6:00 PM if you are interested

Student Survey and Logins Sheet

UNIX/Linux Network Administration (CIS 192AB-66522)

Spring 2010 -- Student Survey

Student Information

- First Name: _____ Last Name: _____
- Date: _____ Email address: _____
- Grading choice: Pass/No pass Grade (choose one, you may change your mind later)
- CCC Confer will be used to record each class. There is a video cam option which may be used which could record student's faces. Do you give permission to post on the web any recordings that show your face? yes no

Computer Background

- Previous computer classes or training taken:

- Work or other experience using computers:

Home equipment

- Do you have a computer/phone headset (earphones & microphone)? yes no
- Do you have a computer with at least 2GB of RAM? yes no
- Do you have Internet access? no modem dsl/cable

Course Objectives

- What are you hoping to learn in this class?

- Other comments or special learning needs?

Logins and Passwords for CIS 192

Class Computer Stations (room 2501)

Username: _CIS 192_____ Password: _____

CCC Confer (<http://www.cccconfer.org>)

Dial-in: _888-886-3951_____ Passcode: _439080_____

192 Linux VMs:

Username: _cis192_____ Password: _____

Username: _root_____ Password: _____

Opus (opus.cabrillo.edu)

Username: _cis192_____ Password: _____

Username: _____ Password: _____

Help Forum (<http://opus.cabrillo.edu/forum/>)

Username: _____ Password: _____

CIS-Lab-xx Systems (Room 2504 and CTC):

Username: _CIS 192_____ Password: _____

Other:

System: _____ Username: _____ Password: _____

System: _____ Username: _____ Password: _____

System: _____ Username: _____ Password: _____

System: _____ Username: _____ Password: _____

Equipment

Assembling components into solutions



*Who likes
building
things?*



Assembling components into solutions



Servers and Clients



Routers



Rack



cables



Switches

If you like building things, you will like this course!

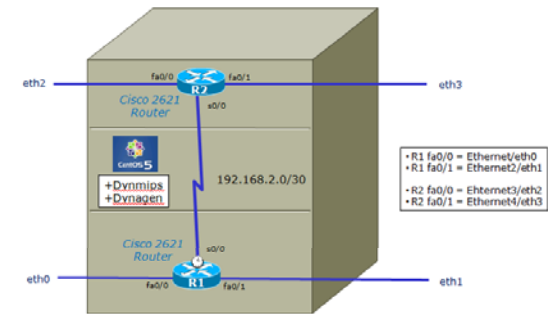
Assembling components into solutions



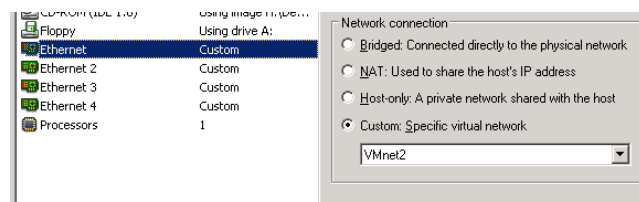
Systems
(using VMware Linux VMs)



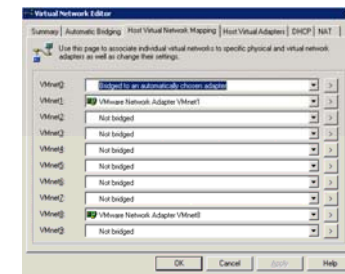
"Rack"
(Using one PC)



Routers
(Using Dynamips emulator on a Linux VM)



Cables
(using VM Ethernet Settings)



Switches
(Using VMnets as Hubs)

We will use virtual equipment in this course so every student has lots of building blocks to play with!

Meet the CIS 192 Systems



Arwen



eth0 eth1



Elrond



eth0 eth1



Celebrian



eth0 eth1



Legolas



eth0 eth1

4 CentOS 5.4
1 CentOS 5.3
2 Ubuntu 9.10
1 OpenSUSE 11.2
1 RH9
1 Fedora 12
1 Windows XP

*The servers
boot to run
level 3*

ethx = interface

Servers



Frodo



eth0



Sauron



eth0



Fang



eth0



William



Local Area
Connection



Treebeard



eth0 eth1



Nosmo



eth0 eth1



Sniffer

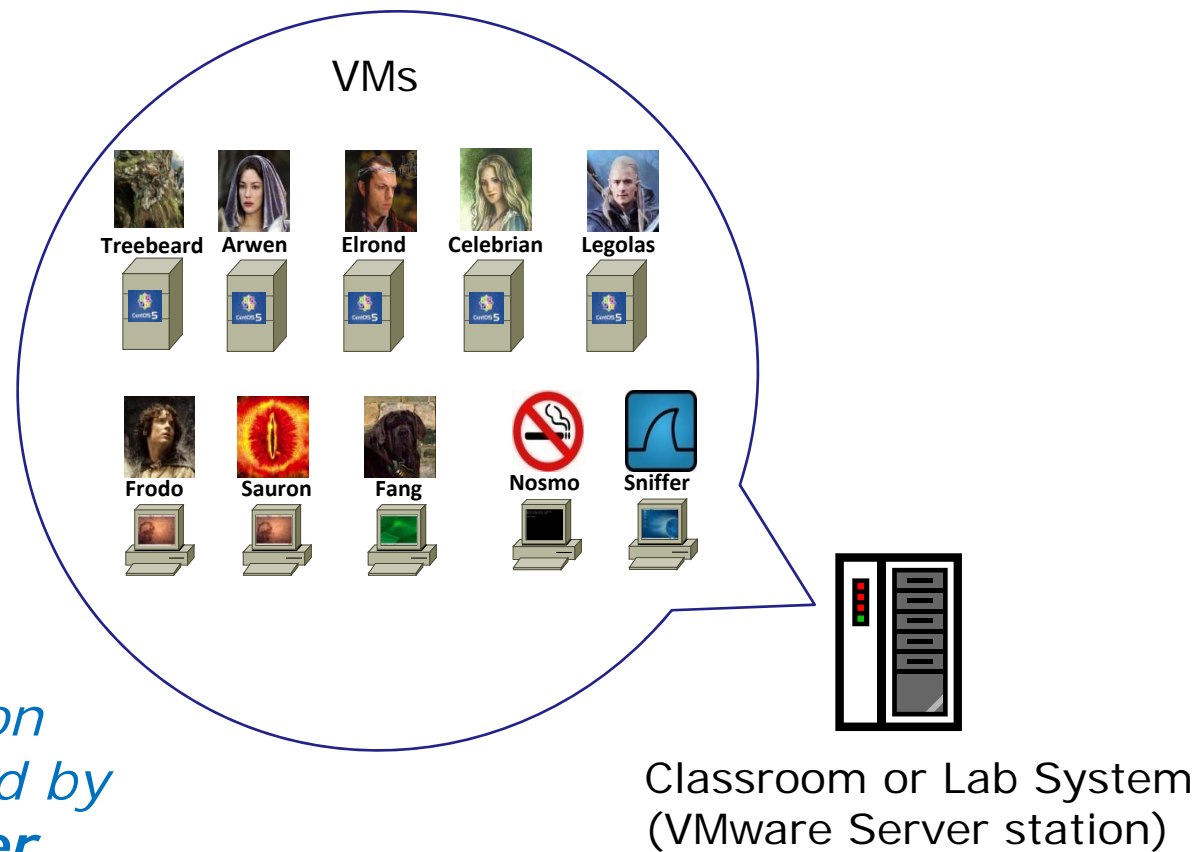


eth0
eth1
eth2
eth3

Clients

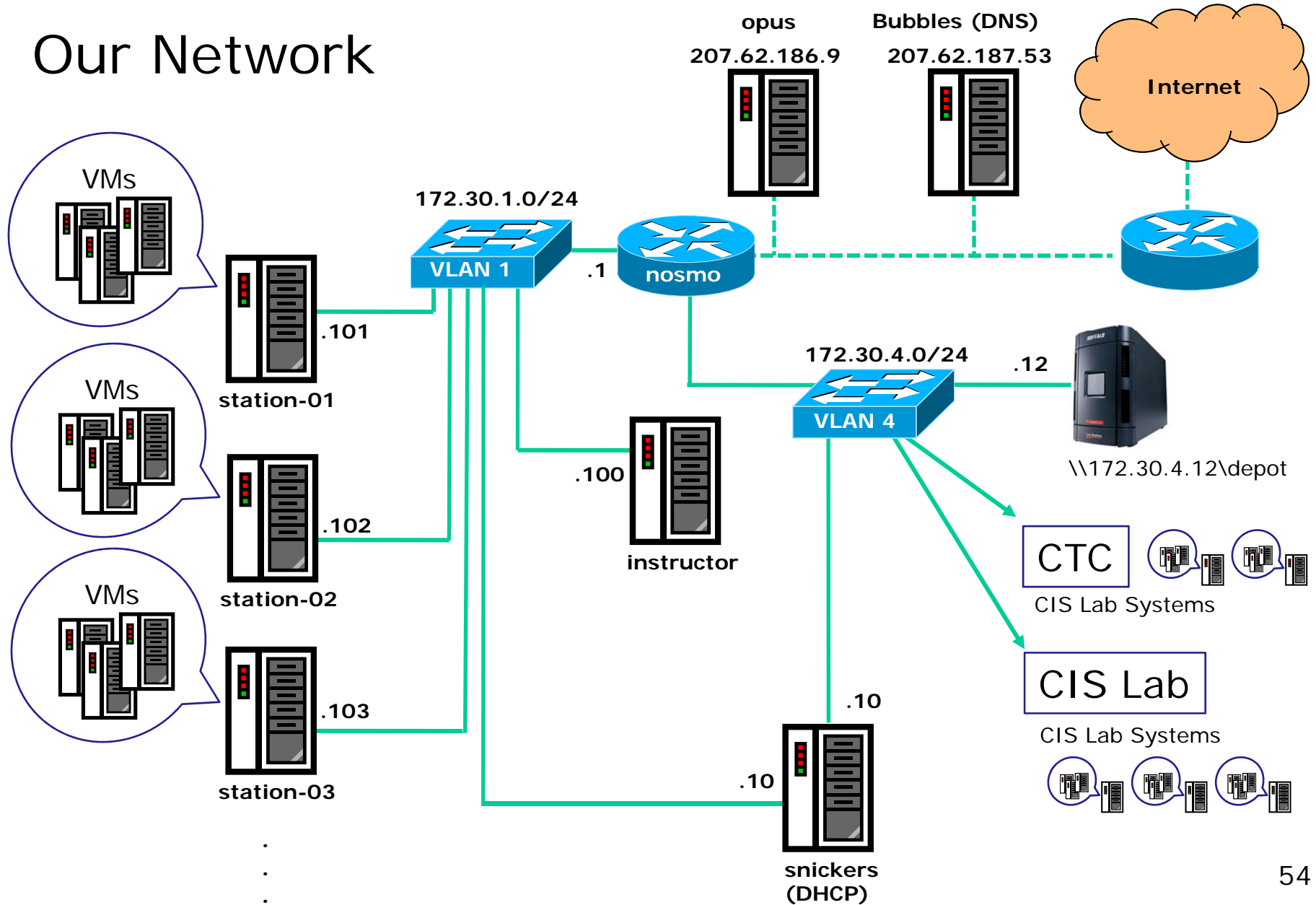
Special

*These systems are all **virtual machines** and they can be found on all the lab and classroom PCs.*



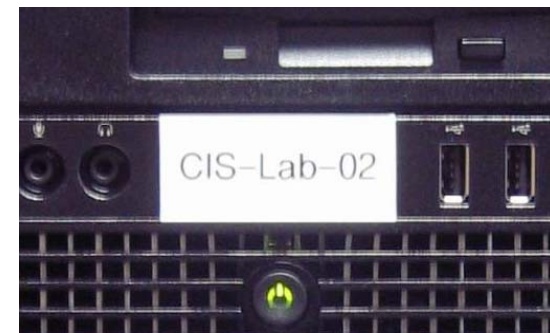
*The virtualization layer is provided by **VMware Server***

Our Network



Lab Resources CTC Building 1400

There are several **VMware Server stations** (labeled CIS-Lab-XX) in the corner with the Linux VMs for students to use at the CTC.

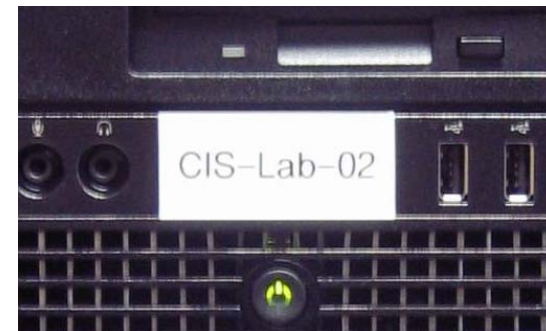


These systems are labeled as CIS-Lab-XX

Lab Resources

CIS Lab Room 2504

There are several **VMware Server stations** (labeled CIS-Lab-XX) along the wall in the CIS lab



These systems are labeled as CIS-Lab-XX

Hours posted at: <http://webhawks.org/~cislabs/>

Lab Resources

CIS Lab Room 2504

For real cabling practice, use the older PC's in the system pods. They have Trios switches for hard drive selection. Push in the second button *before* turning on the machine to run a local version of Red Hat Linux. Great way to practice your cabling skills.



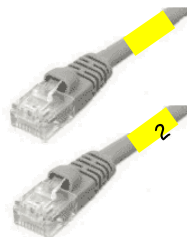
System Pod



**Windows
Client
(CIS 196)**

**Linux
(CIS 192)**

**Windows
Server
(CIS 196)**



2 NICs per server. Patch cables are color coded to match server:

- "2" indicates cable to 2nd NIC (eth1)
- Other cable goes to Intel NIC (eth0)

Hours posted at: <http://webhawks.org/~cislab/>

CIS Lab – Room 2504

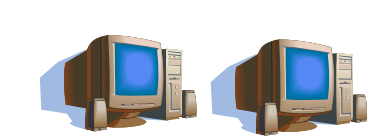
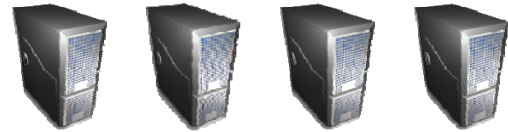
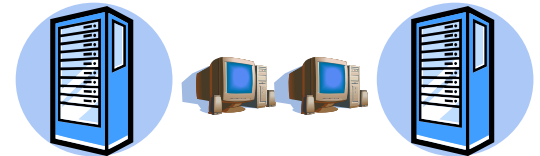
<http://webhawks.org/~cislabs/>



System Pod Student Project Pod



CIS 170 work area



Crash & Burn
Installation Systems

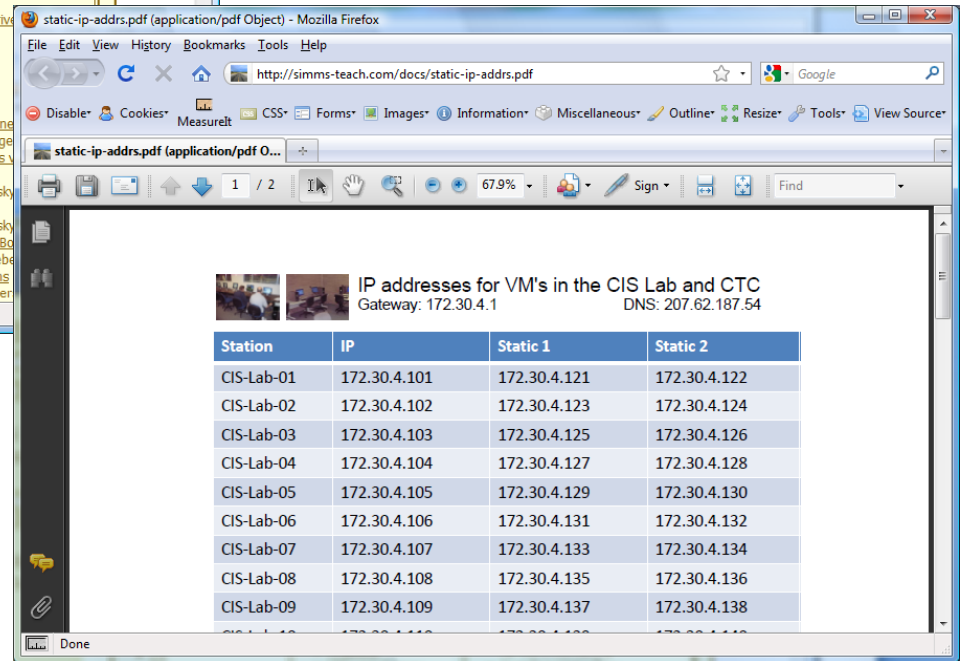
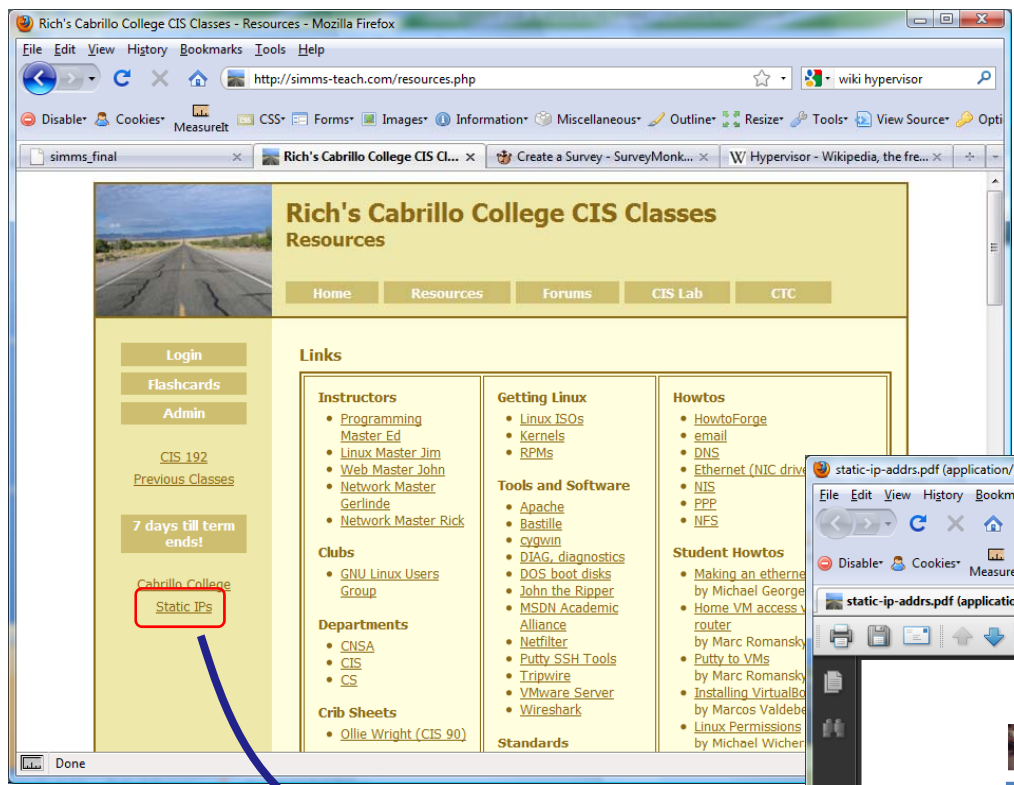


New VMware Stations (CIS-Lab-01 to CIS-Lab-06)

Static IP addresses are one click away:

Don't ruin your day with duplicate IP addresses!

Use the Static IP tables to find a unique IP address based on the station or pod you are using



Field Trip
CIS lab – Room 2504

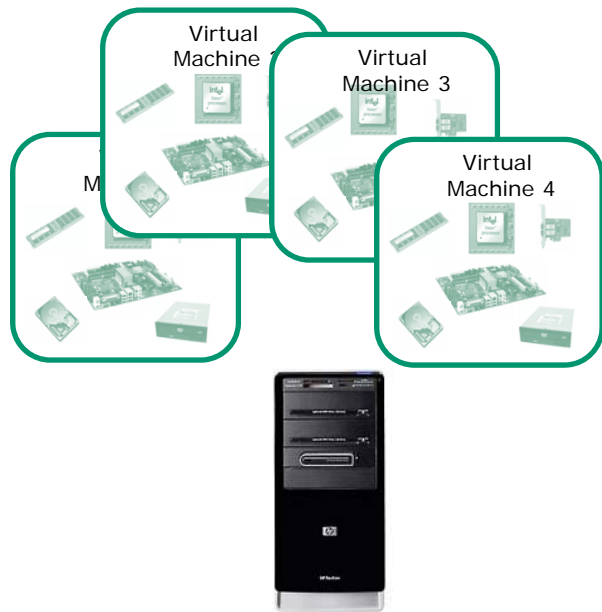




Virtualization

What is a virtual machine?

- **Virtual Machine Monitors** or **Hypervisors** allow a real computer to create and simulate multiple virtual computers.
- The simulated computers are called **virtual machines** or **VMs**.
- VMWare, MS Virtual Server, VirtualBox, Xen and KVM are all examples of **Hypervisors**.



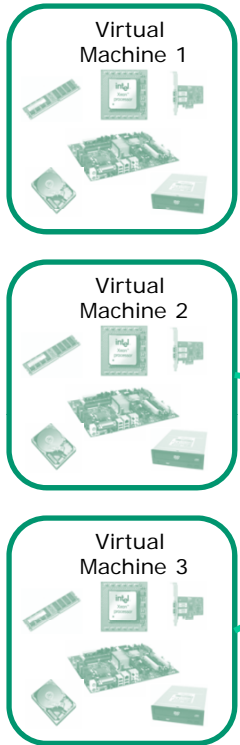
- You load an OS (operating system) and applications on a virtual machine just like you would any other computer.
- The OS and apps do not even know they are not running on a "real" computer.
- Over the network the virtual machines appear just like any other computer.



The EMH doctor on Star Trek Voyager was a simulation

Virtual Machines

*Multiple OS's on one computer
... running at the same time
... sharing the same physical hardware*

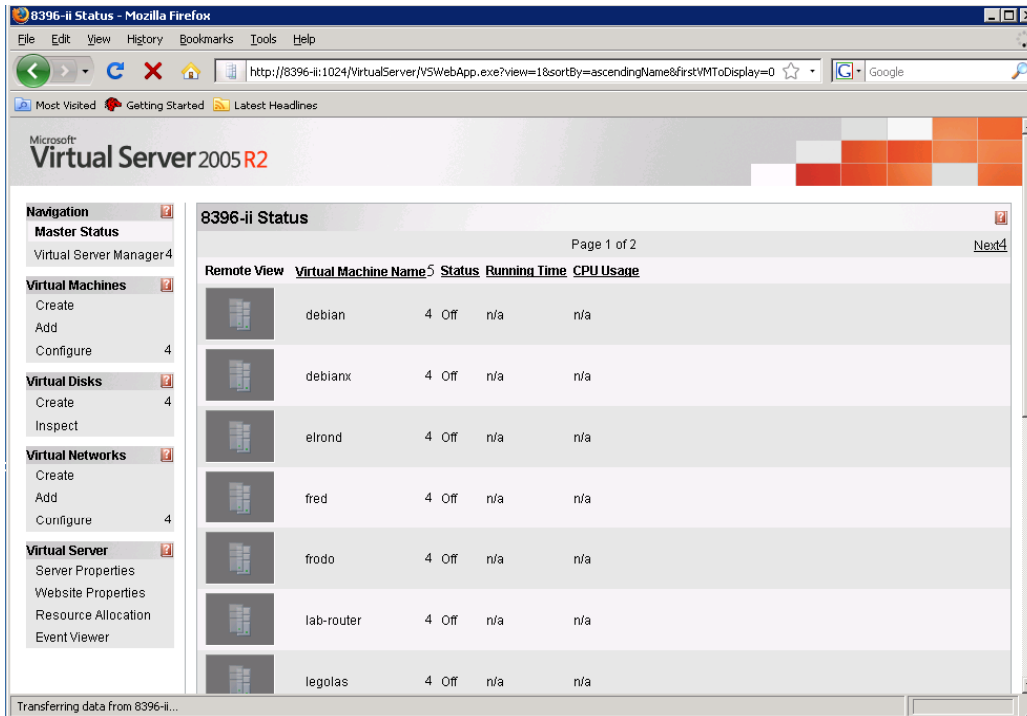


Benefits of virtualization:

- Rapidly and inexpensively bring a new computer online.
- Optimize performance by moving VMs between physical hosts.
- Run legacy apps on old OS's
- Test new OS's.
- Consolidate data center on fewer servers.
- Students can have their own personal computer lab.
- But, when the physical host goes down so do all the VMs!



Microsoft Virtual Server 2005



For Jim's CIS 192 I used MSVS to simulate each of the stations that used to be in the CIS Lab.

For Ed's CIS 165ph I used MSVS to installed Apache, PHP, MySql and PHPMyAdmin on a VM (XAMPP for Linux)

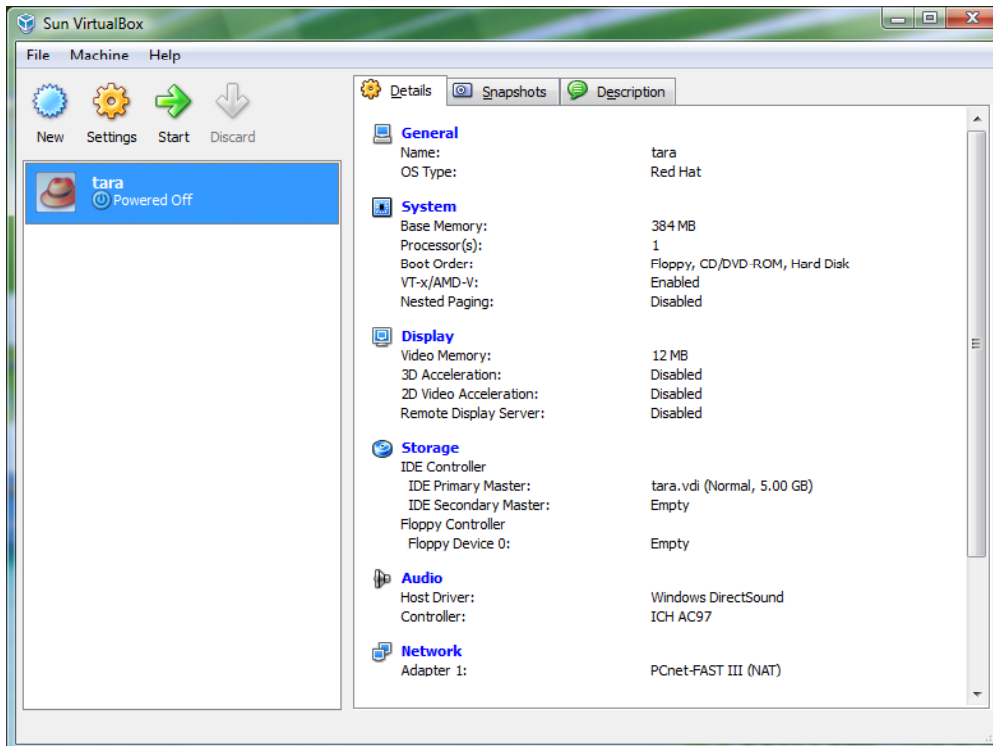
*Note: MS **Hyper-V** is the new CLI-based virtualization product going forward. It is part of Win Server 2008 and available stand-alone as a free download.*



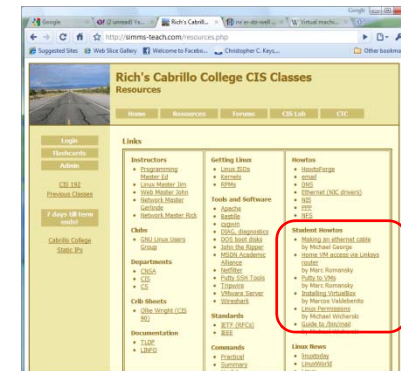
- ✓ Free download
- ✓ Multiple virtual networks
- ✓ Virtual serial ports

But ... I did have some initial video problems installing some Linux distros

Sun VirtualBox 3.1.4

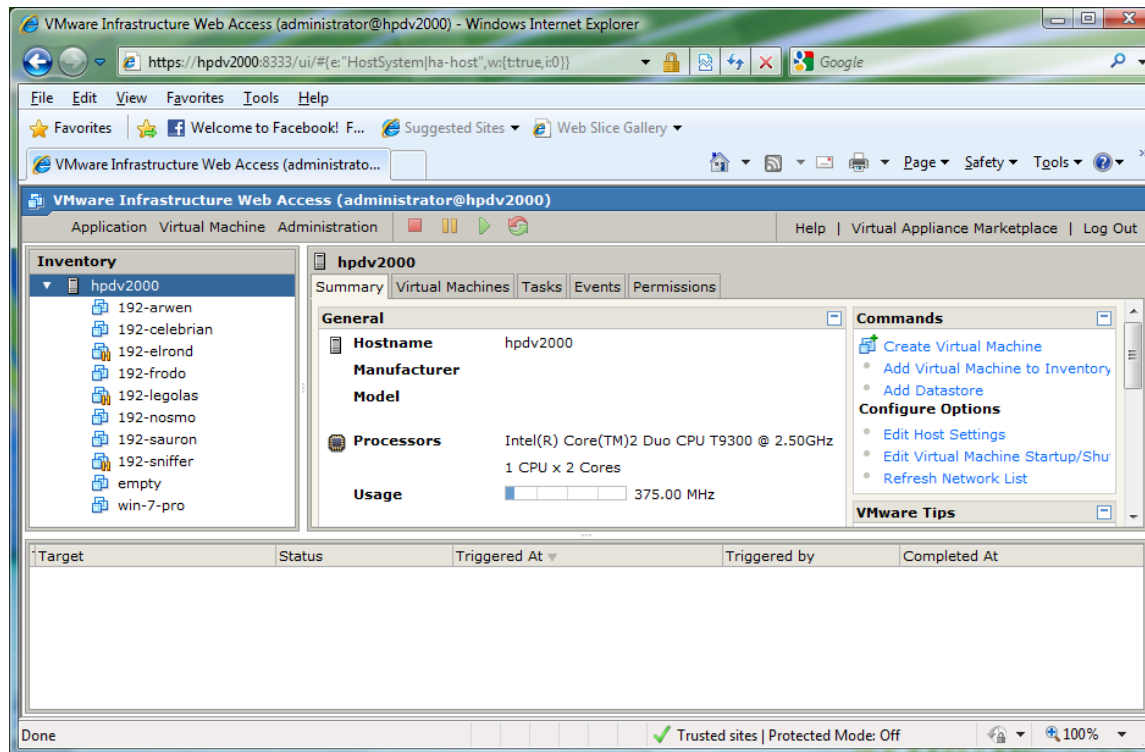


Marcos did a Howto on VirtualBox which is on the Resources page of the web site in the Student Howtos section



- ✓ Free download
- ✓ Virtual serial ports
- ✓ Has multiple internal networks
- ✓ Supported on Windows 7 (unlike VMware Server 1.x)

VMware Server 2.x



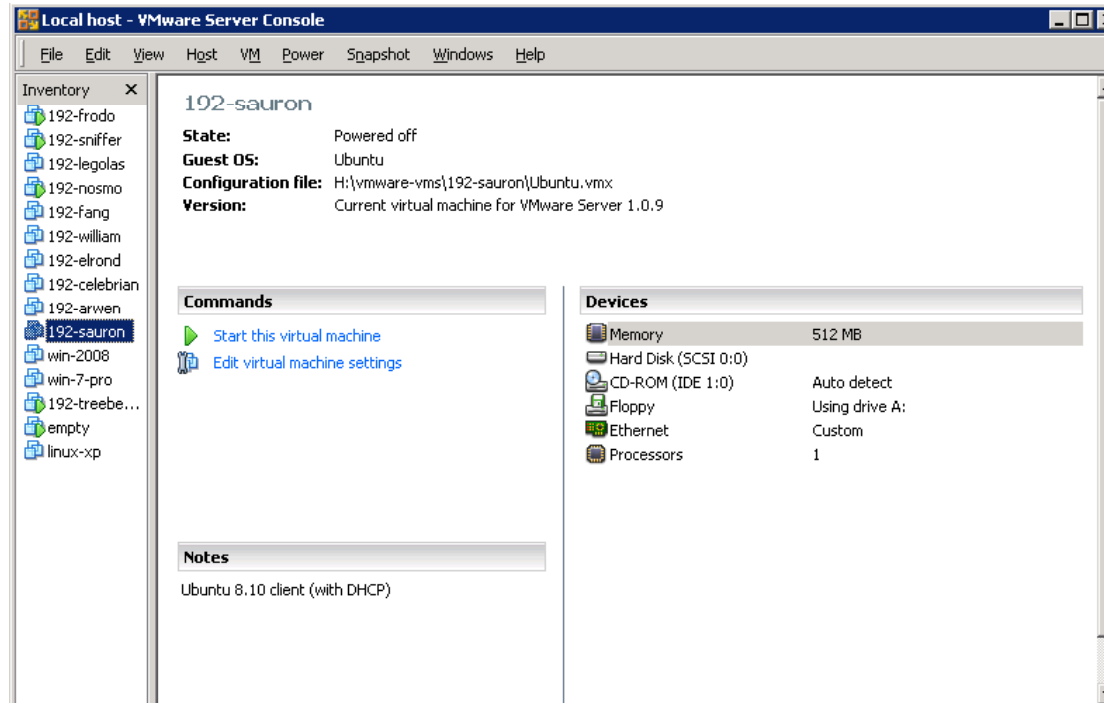
*I use this on my
Vista-64 notebook
computer (4GB RAM)*



- ✓ Free download
- ✓ Multiple virtual networks
- ✓ Virtual serial ports

but ... first-time install much more complicated than VMware Server 1.x

VMware Server 1.x



We use VMware Server in the classroom and lab



- ✓ Free download
- ✓ Multiple virtual networks
- ✓ Virtual serial ports

but ... not supported on Vista and on Windows 7. Must disable certificate checking on every boot-up

VMware ESXi



*This is a
"bare-metal"
hypervisor*

*It is not
installed on
another OS*

- ✓ Free download
- ✓ Multiple virtual networks
- ✓ Virtual serial ports

Looks very interesting!

Xen and KVM (Kernel-based Virtual Machine)

- Xen is a bare-metal hypervisor. It is the foundation for XenServer from Citrix
- KVM is a new serious alternative. Supported by Red Hat and Canonical (Ubuntu)

I haven't tried these two yet

- ✓ Free download
- ✓ Open source
- ? Multiple virtual networks
- ? Virtual serial ports

They both look very interesting!

The screenshot shows a web browser window with the URL <http://simms-teach.com/resources.php>. The page title is "Rich's Cabrillo College CIS Classes Resources". The "Resources" tab is highlighted with a red box. On the left sidebar, there are links for "Login", "Flashcards", "Admin", "CIS 192", "Previous Classes", "7 days till term ends!", and "Cabrillo College Static IPs". The main content area is titled "Links" and contains several sections:

- Instructors**
 - [Programming Master Ed](#)
 - [Linux Master Jim](#)
 - [Web Master John](#)
 - [Network Master Gerlinde](#)
 - [Network Master Rick](#)
- Clubs**
 - [GNU Linux Users Group](#)
- Departments**
 - [CNSA](#)
 - [CIS](#)
 - [CS](#)
- Crib Sheets**
 - [Ollie Wright \(CIS 90\)](#)
- Documentation**
 - [TLDP](#)
 - [LINFO](#)
- Getting Linux**
 - [Linux ISOs](#)
 - [Kernels](#)
 - [RPMs](#)
- Tools and Software**
 - [Apache](#)
 - [Bastille](#)
 - [cygwin](#)
 - [DIAG, diagnostics](#)
 - [DOS boot disks](#)
 - [John the Ripper](#)
 - [MSDN Academic Alliance](#)
 - [Netfilter](#)
 - [Putty SSH Tools](#)
 - [Tripwire](#)
 - [VMware Server](#)
 - [Wireshark](#)
- Standards**
 - [IETF \(RFCs\)](#)
 - [IEEE](#)
- Commands**
 - [Practical](#)
- Howtos**
 - [HowtoForge](#)
 - [email](#)
 - [DNS](#)
 - [Ethernet \(NIC drivers\)](#)
 - [NIS](#)
 - [PPP](#)
 - [NFS](#)
- Student Howtos**
 - [Making an ethernet cable](#) by Michael George
 - [Home VM access via Linksys router](#) by Marc Romansky
 - [Putty to VMs](#) by Marc Romansky
 - [Installing VirtualBox](#) by Marcos Valdebenito
 - [Linux Permissions](#) by Michael Wicherski
 - [Guide to /bin/mail](#) by Michael Wicherski
- Linux News**
 - [linuxtoday](#)

There is a link on the Resources Page for downloading VMware Server

Look in the Tools and Software section

Virtualization within virtualization

Dynamips and Dynagen

Options for learning to use a router

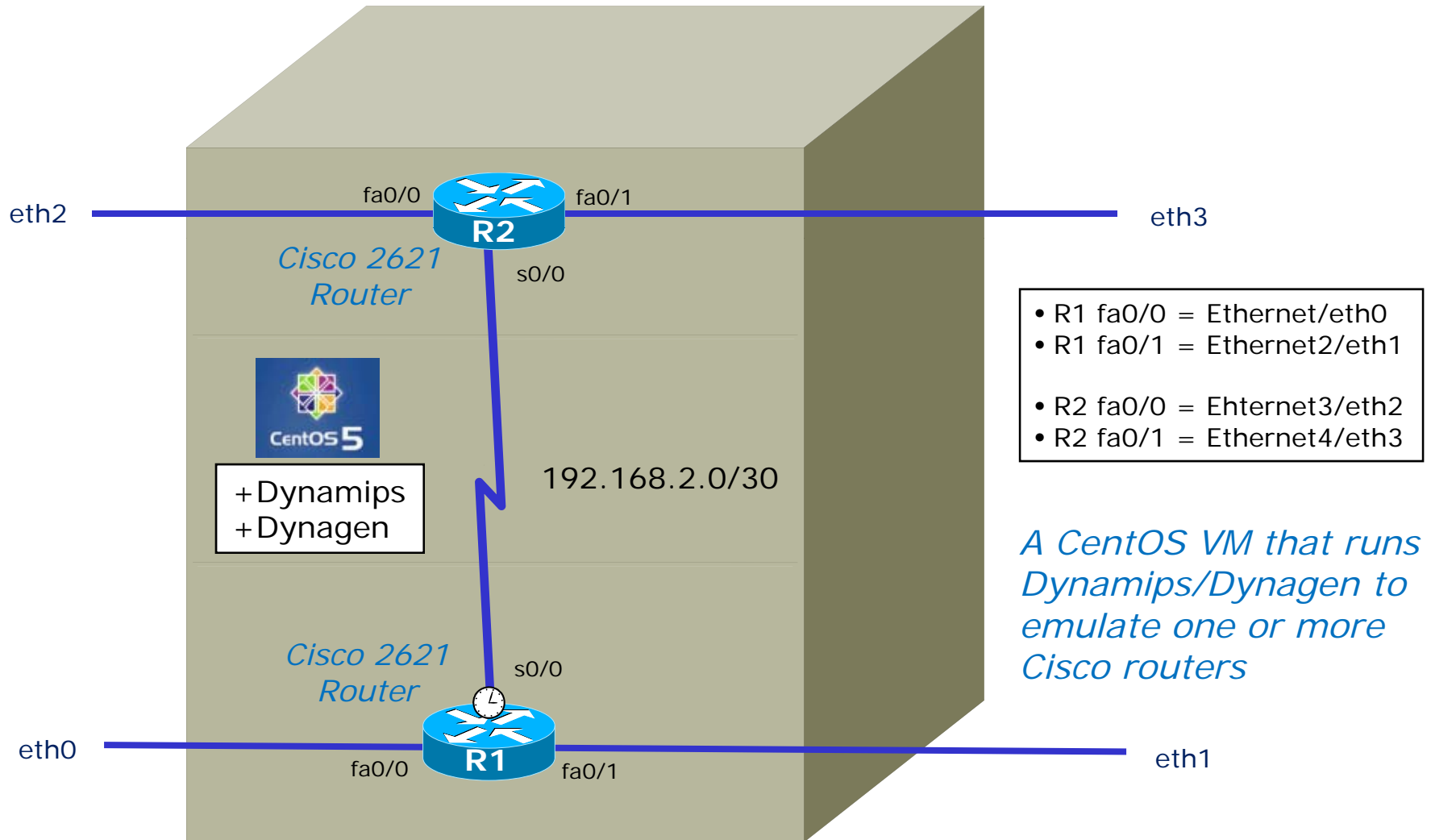
- A real router (hands on)
- Net Lab (remote access)
- Packet Tracer 5.2
- Dynamips/Dynagen emulator
 - on a real PC
 - on a VM

You can think of Dynamips/Dynagen as "VMware for routers." IOS runs on the emulator just like a Linux OS runs on a VM.

See the Dynamips/Dynagen tutorial at <http://dynagen.org/tutorial.htm>

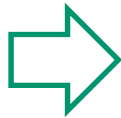
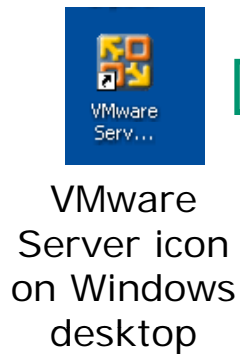
The Dual-c2621s VM

Located in: D:\cis192\My Virtual Machines\192-Dual-c2621s



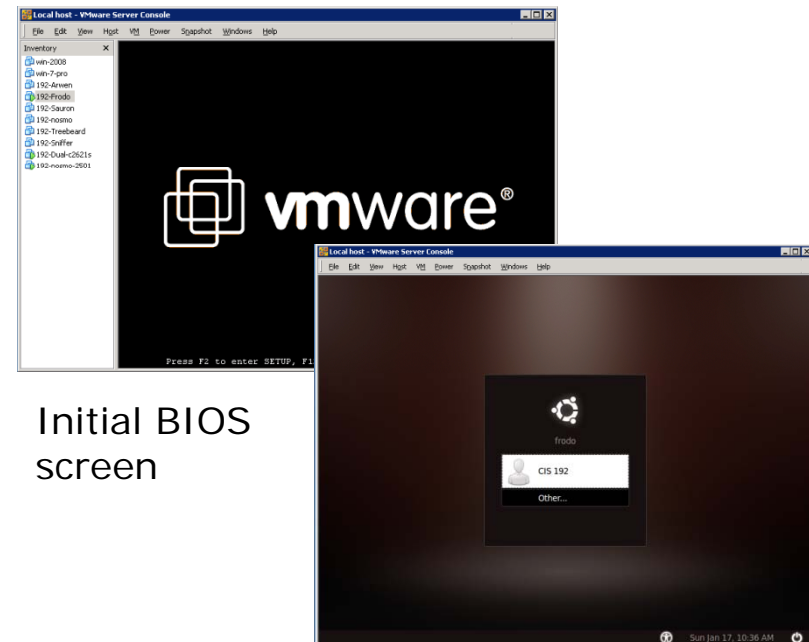
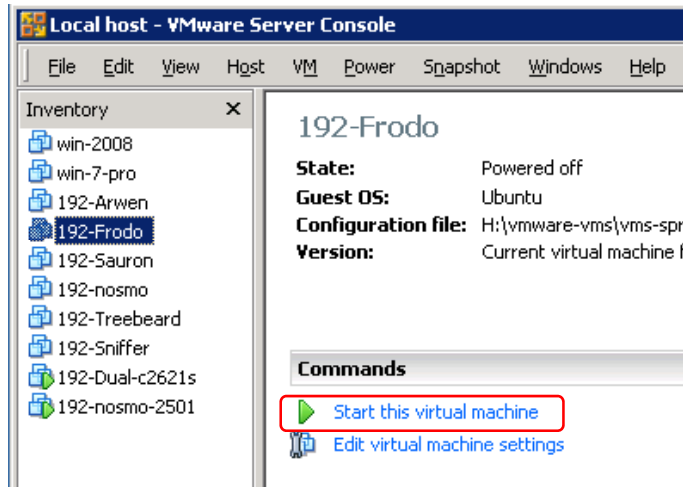
VMware 101

Power on a VM



Choose **Local host** to access local VMs.

Note: If you don't see this choice, wait a minute or two and try again. This can happen if you just booted up the PC and not all the VMware services have started up.



Initial BIOS
screen

Login after start-up is
complete

Select a VM, then **Power On** or
Start this virtual machine to start the VM

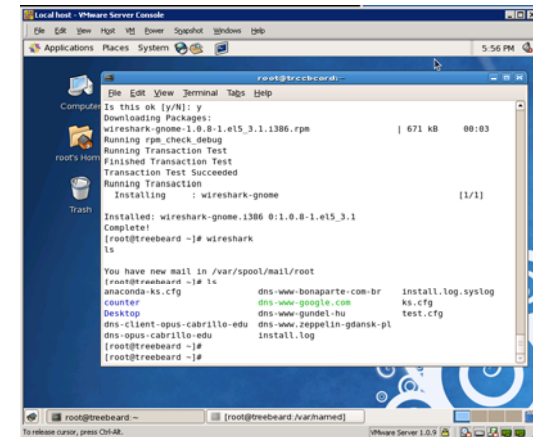
Keyboard and mouse

Which computer has the keyboard and mouse?

the Host?

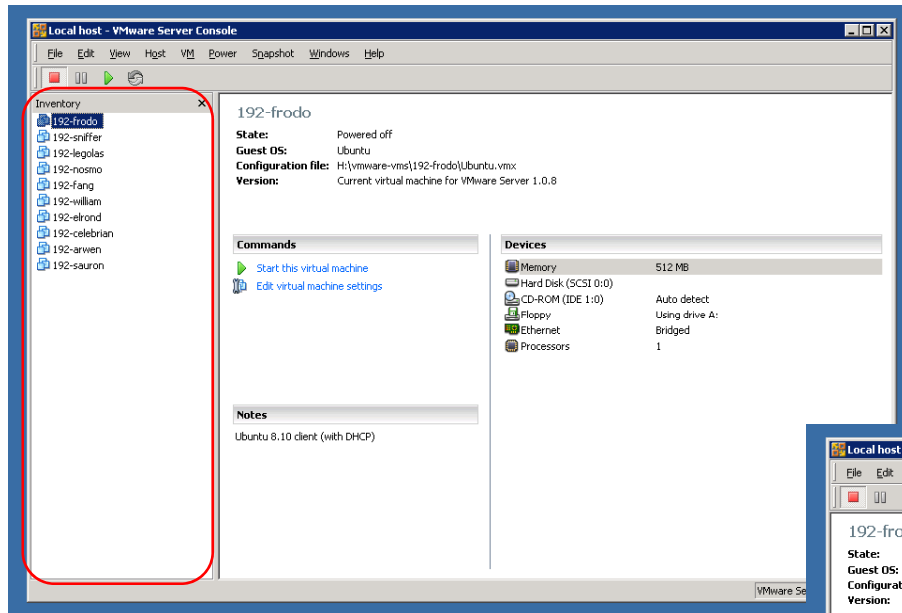


the VM?



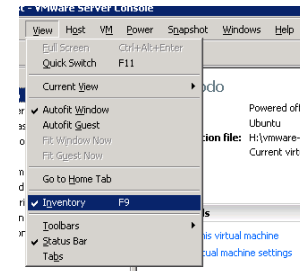
- **Click inside the VM** to let the VM use the keyboard/mouse
- Type **Ctrl-Alt** keys, at the same time, to release keyboard/mouse back to the host computer. See the hint on the lower left corner of the VM if you forget this.

Toggle Inventory View

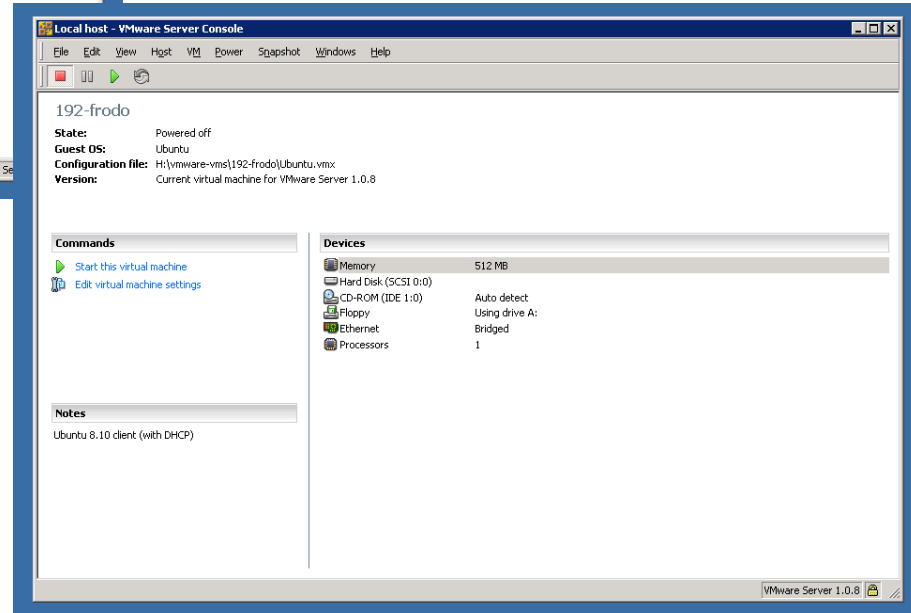


Inventory pane visible

The inventory pane shows available VMs that are available for use.

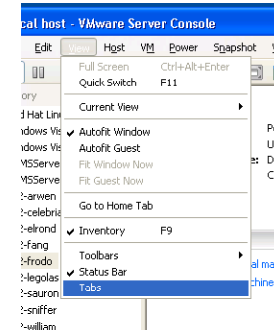
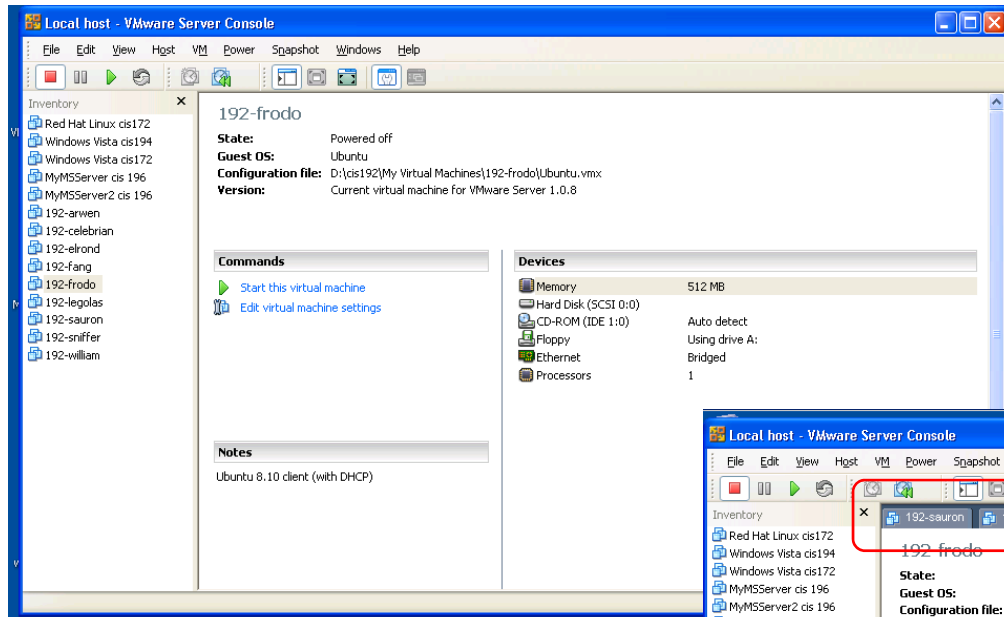


*Use:
View > Inventory
or F9
to toggle the
Inventory pane view*

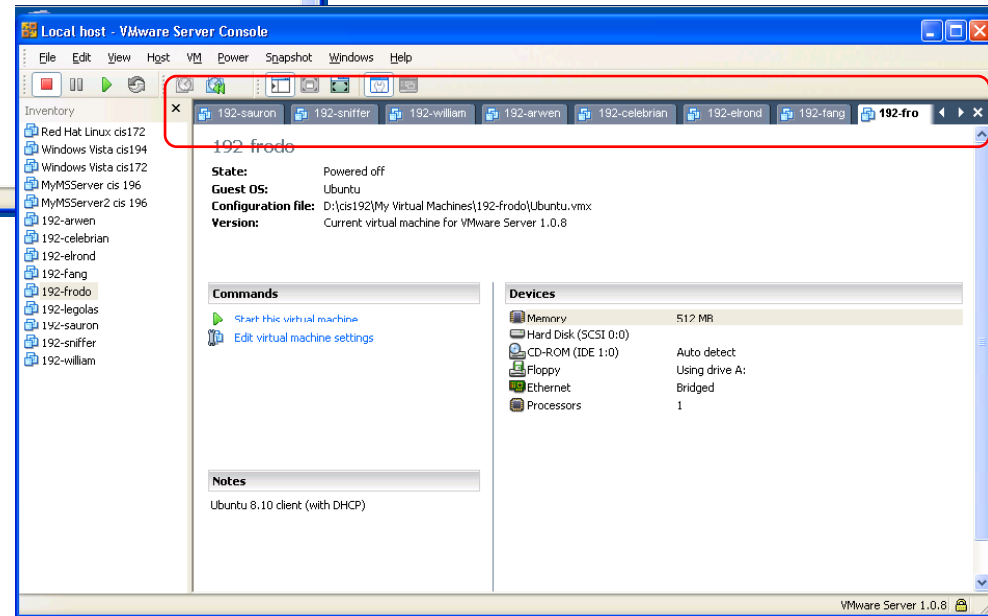


Inventory pane hidden

Toggle Tabs View

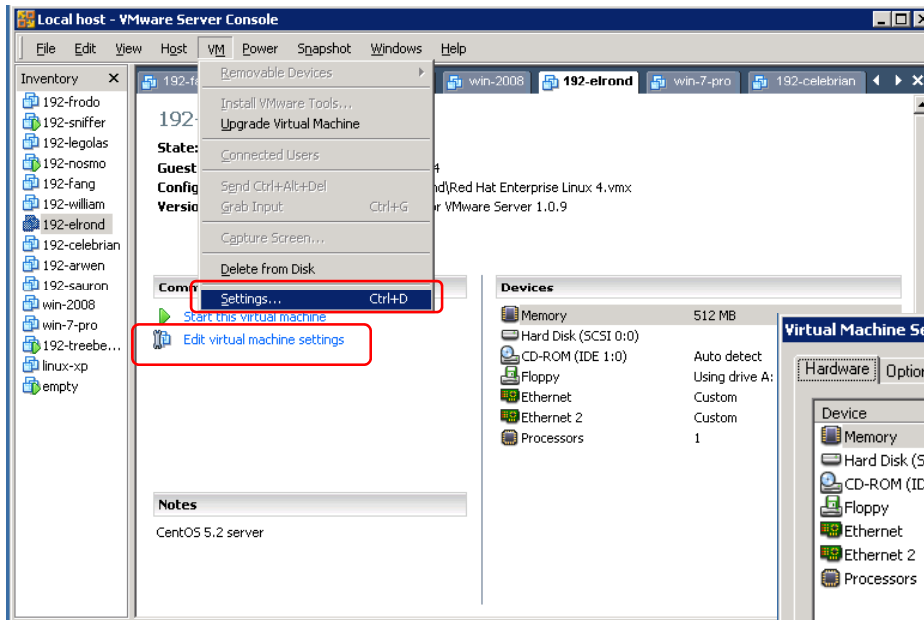


Use:
View > Tabs
to toggle

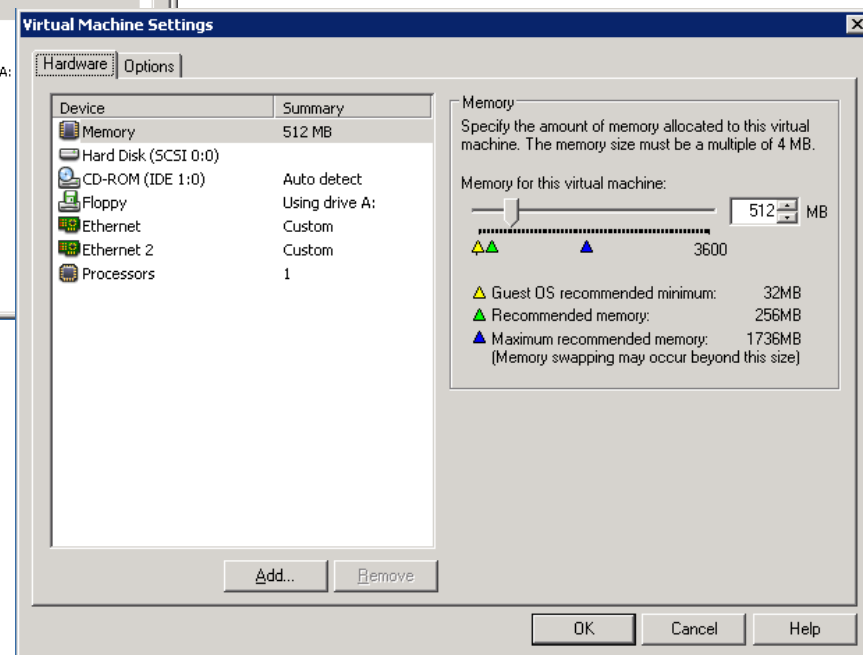


Disable Tabs if you need
more vertical screen real
estate

Configure VM Settings



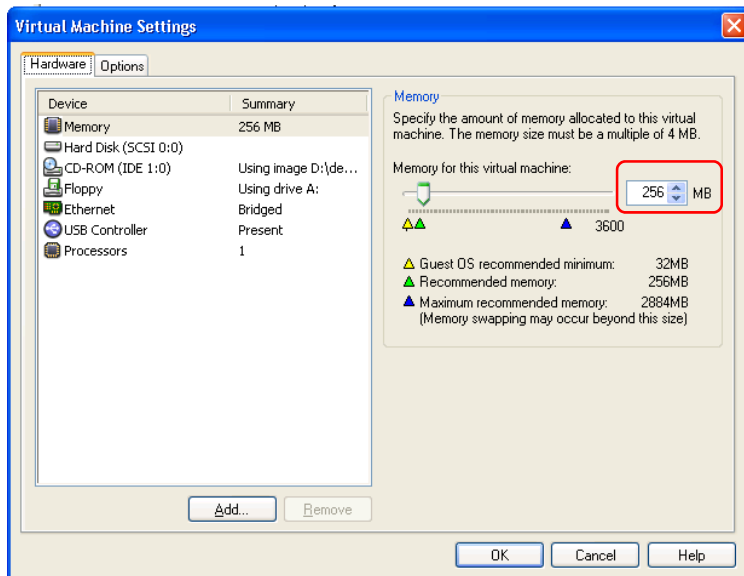
Use VM settings to show and adjust RAM, add more hardware, connect Ethernet interfaces, "load" CD's, etc.



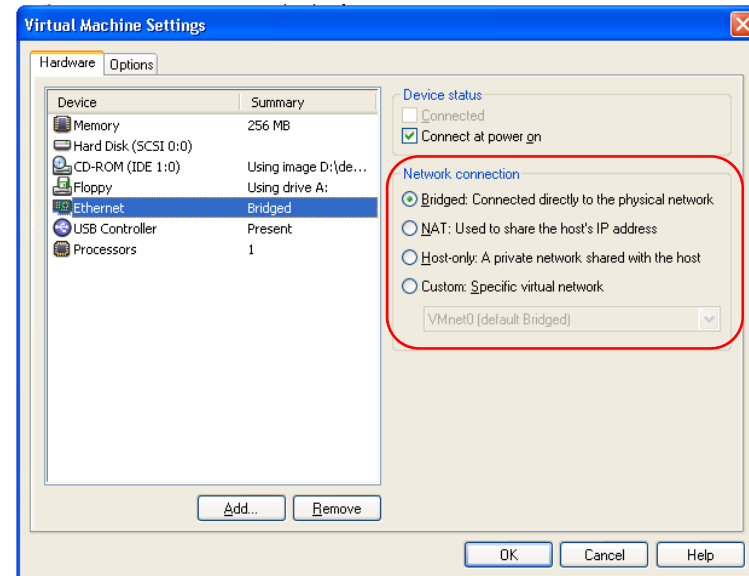
*Use:
VM > Settings ...
or Edit virtual machine settings
or right-click on VM in Inventory
list and choose Settings...*

VM Settings Dialog Box

VM Settings Dialog Box



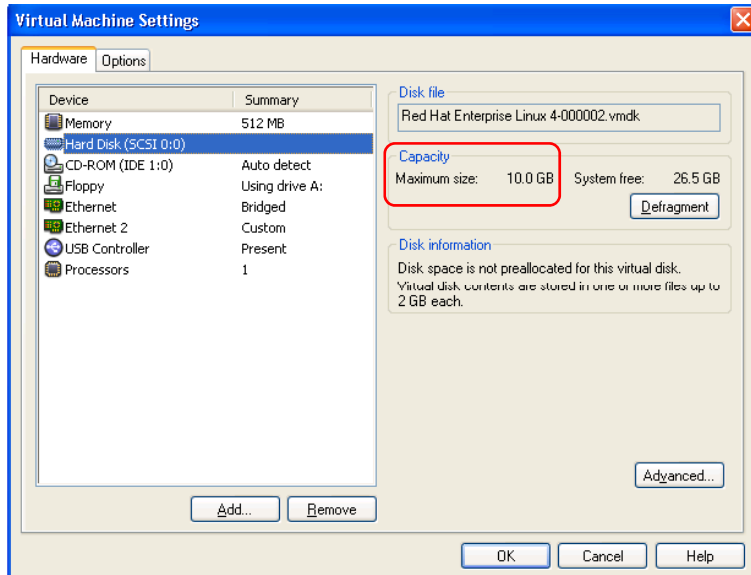
Showing RAM size



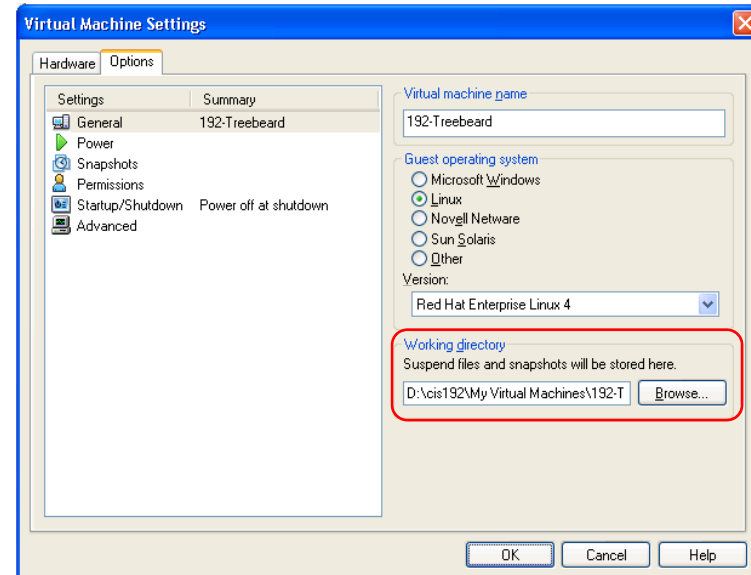
Showing NIC connection
(Bridged or specific VMnet)

Note: You will be using VM Settings to do the VM hardware inventory in Lab 1

VM Settings Dialog Box



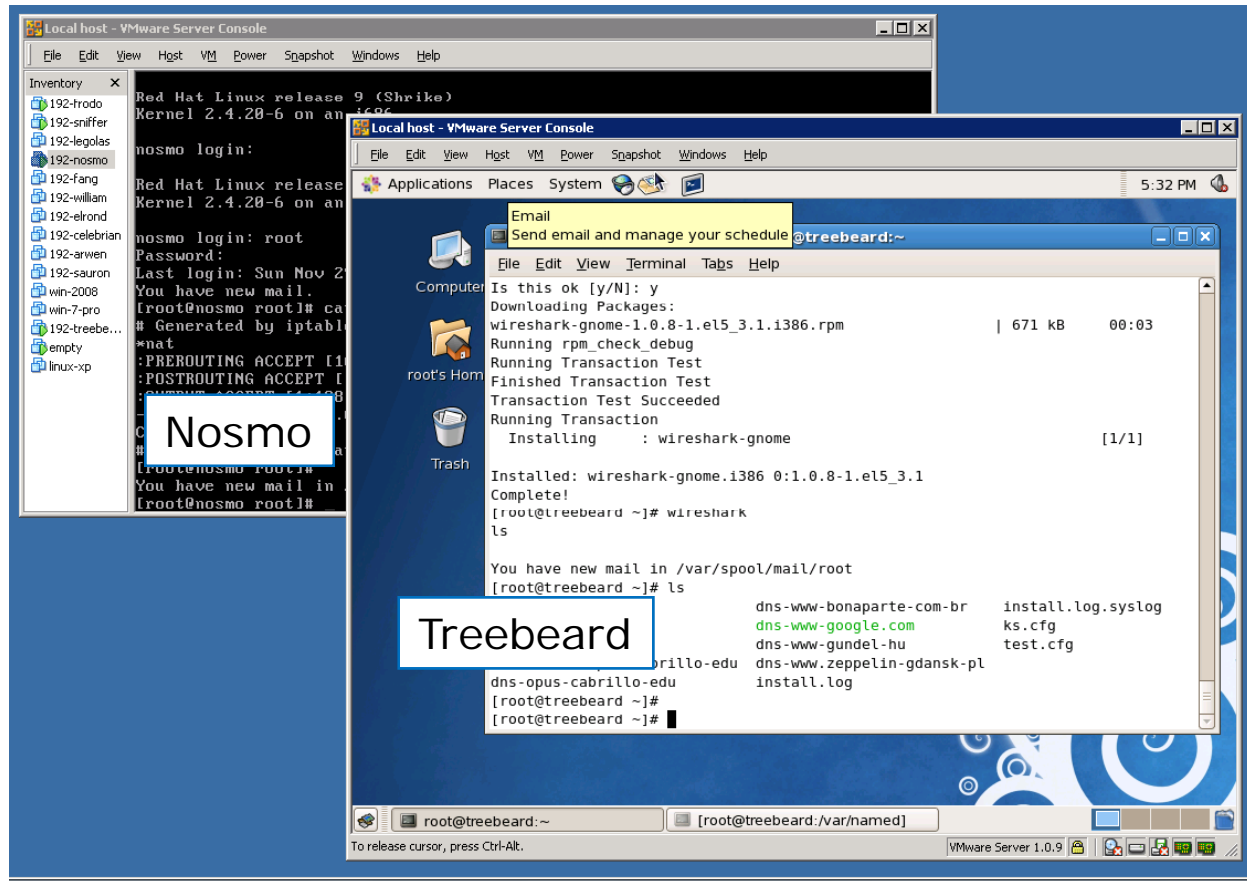
Showing hard drive capacity



Showing location of VM files on host VMware station

Note: You will be using VM Settings to do the VM hardware inventory in Lab 1

Multiple consoles

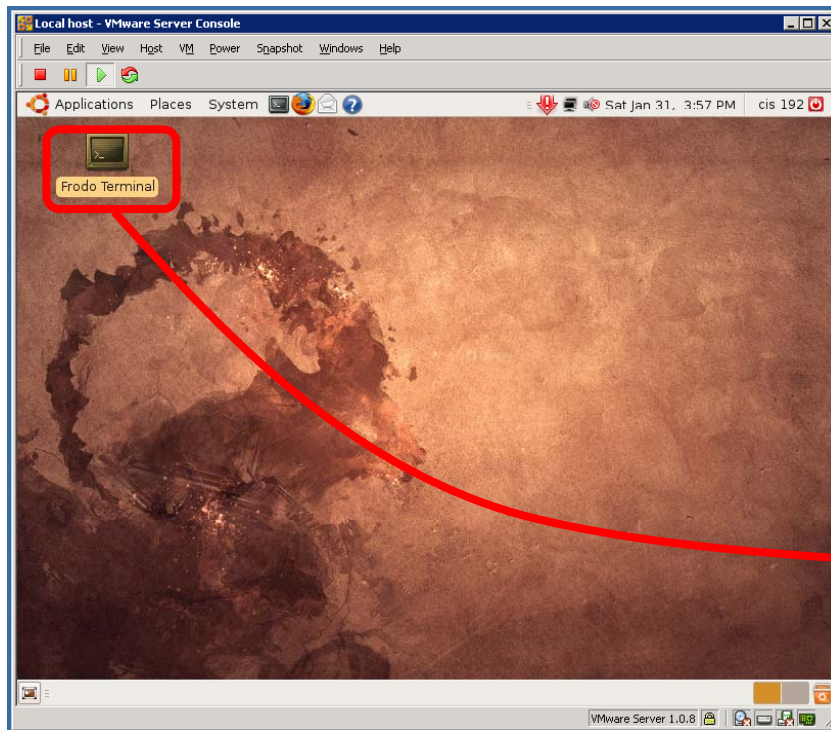


The Nosmo VM is shown in one console

The Treebeard VM is shown in a second console

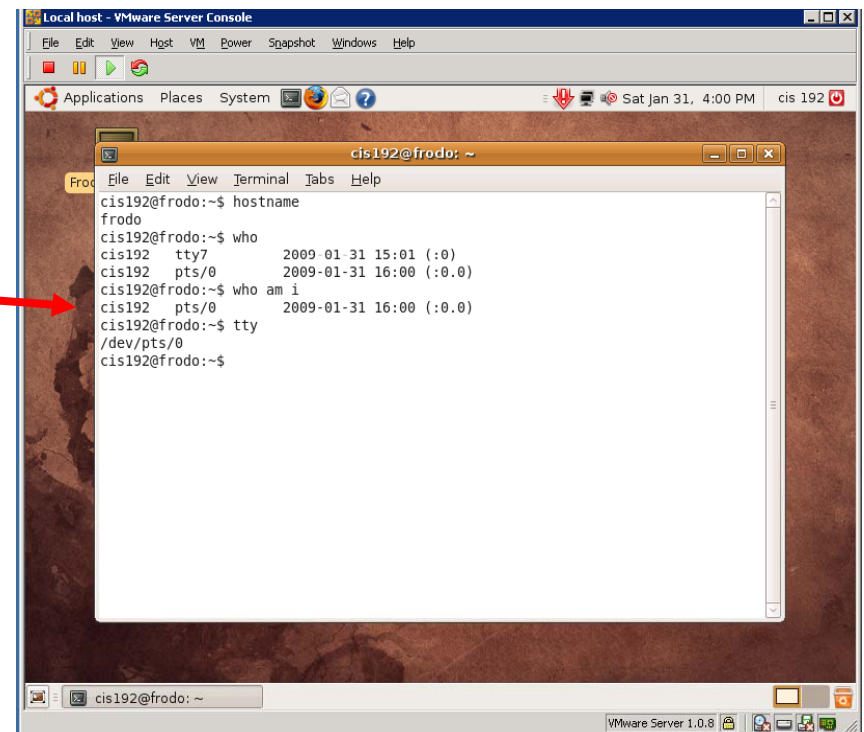
If your screen is big enough you may want to use a different console for each VM

Bringing up a graphical terminal



Open graphical terminal on Frodo by double clicking on icon

The Terminal program is also found under the Application menu of Gnome desktops



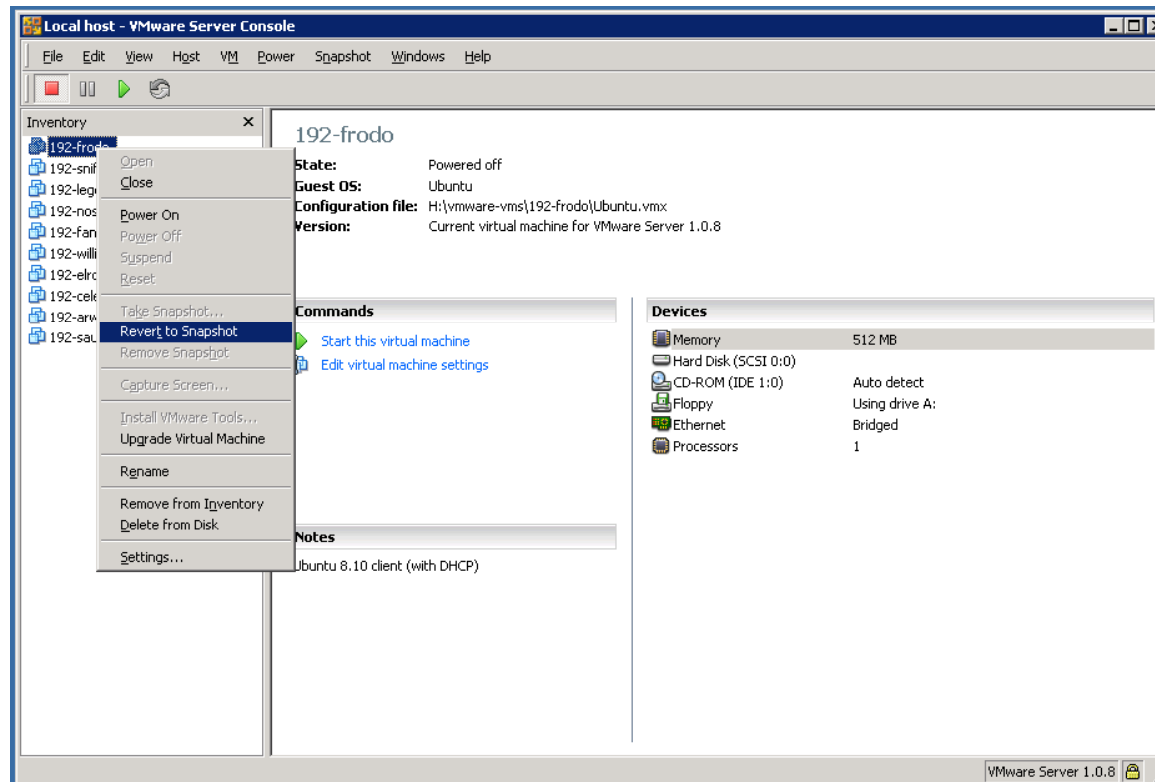
Type commands

Treat VMs as real computers

- Powering off a VM is the same as holding down the power button on a real computer. Any pending drive writes will be lost and open files may become corrupted.
- Shutting down your host VMware station before shutting down running VMs can also result in corrupted files for the same reason as above.
- The fastest way to shutdown Linux is to use: **init 0**
- Closing the VMware Server Console does not shut down the VM which will continue to run.

Always shutdown any running VMs when you are finished

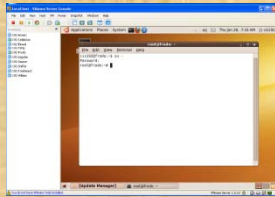
Revert to Snapshot



Revert to Snapshot will restore the VM back to its pristine state.

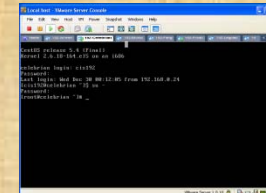


Very useful if you trash your system by mistake using your rootly powers!



Class Activity

Fire up Frodo and Celebrian



1. Explore the memory and Ethernet settings for the Frodo and Celebrian VMs (use **Edit virtual machine settings**)
2. Startup both Frodo and Celebrian VMs in two separate consoles.
3. Log in as **cis192** on both VMs,
4. On Celebrian, use **su -** to become root user.
5. On Frodo, start a graphical terminal and **su -** to become root user.
6. On Frodo, show the Inventory panel but no Tabs.
7. On Celebrian, show the Tabs but no Inventory panel.
8. Use the Inventory panels and Tabs to switch the two open consoles to a different VM.
9. Use **Ctrl-Alt-F1** on Frodo to get a virtual terminal and log in as root.
10. Shut down both VMs with **init 0**
11. After shutting down, revert both VMs back to their snapshots.

Click inside VM for it to capture the mouse, press Ctrl and Alt keys at the same time to release the mouse

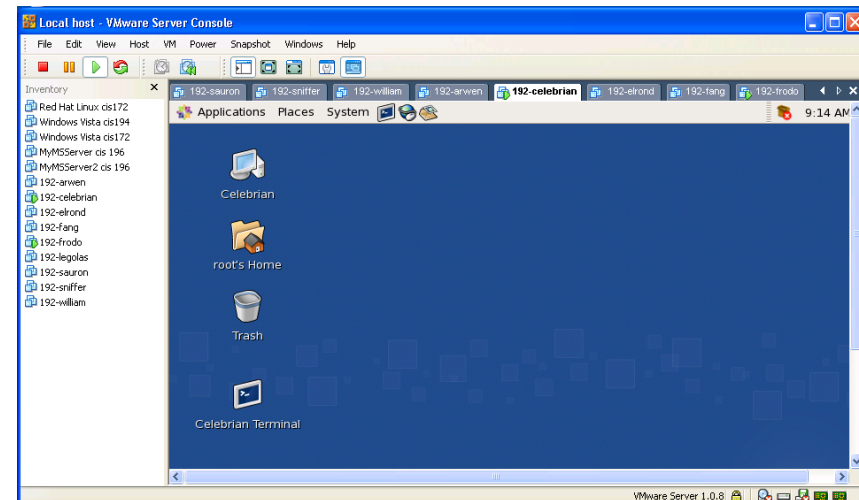
Changing run levels

```
192-sauron 192-sniffer 192-william 192-arwen 192-celebrian
CentOS release 5.2 (Final)
Kernel 2.6.18-92.1.22.el5 on an i686

celebrian login: root
Password:
Last login: Thu Feb  5 02:53:42 on tty1
[root@celebrian ~]# startx -
```

Most of the CentOS VMs are configured to boot up into runlevel 3.

startx or init 5 can be used to get to runlevel 5 (graphics)



Tangent: Run levels (learn more in CIS 191)

The screenshot shows a VMware Server Console window titled 'Local host - VMware Server Console'. On the left is an 'Inventory' pane listing various virtual machines. The main area displays a terminal window for the VM named '192-celebrian'. The terminal prompt is 'root@celebrian:~'. The user has executed the command 'cat /etc/inittab', and the output is displayed. The line 'id:3:initdefault:' is highlighted with a red rectangular box.

```

[root@celebrian ~]# cat /etc/inittab
#
# inittab      This file describes how the INIT process should set up
#              the system in a certain run-level.
#
# Author:      Miquel van Smoorenburg, <miquels@drinkel.nl.mugnet.org>
#              Modified for RHS Linux by Marc Ewing and Donnie Barnes
#
# Default runlevel. The runlevels used by RHS are:
# 0 - halt (Do NOT set initdefault to this)
# 1 - Single user mode
# 2 - Multiuser, without NFS (The same as 3, if you do not have networking)
# 3 - Full multiuser mode
# 4 - unused
# 5 - X11
# 6 - reboot (Do NOT set initdefault to this)
#
id:3:initdefault:

# System initialization.
si::sysinit:/etc/rc.d/rc.sysinit

l0:0:wait:/etc/rc.d/rc 0
    
```

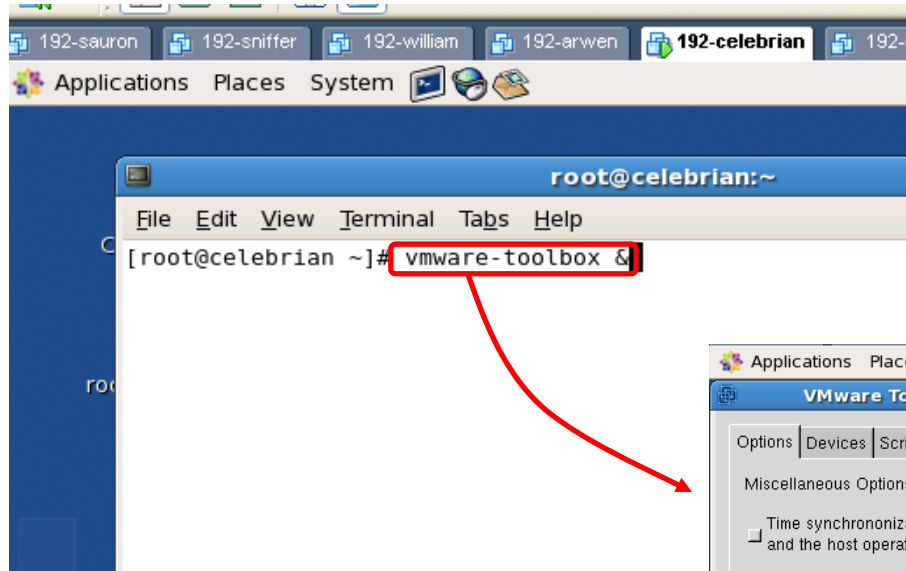
The initial run level is determined by a setting in /etc/inittab

Celebrian is configured to boot up into runlevel 3

Copy and paste between VM and host

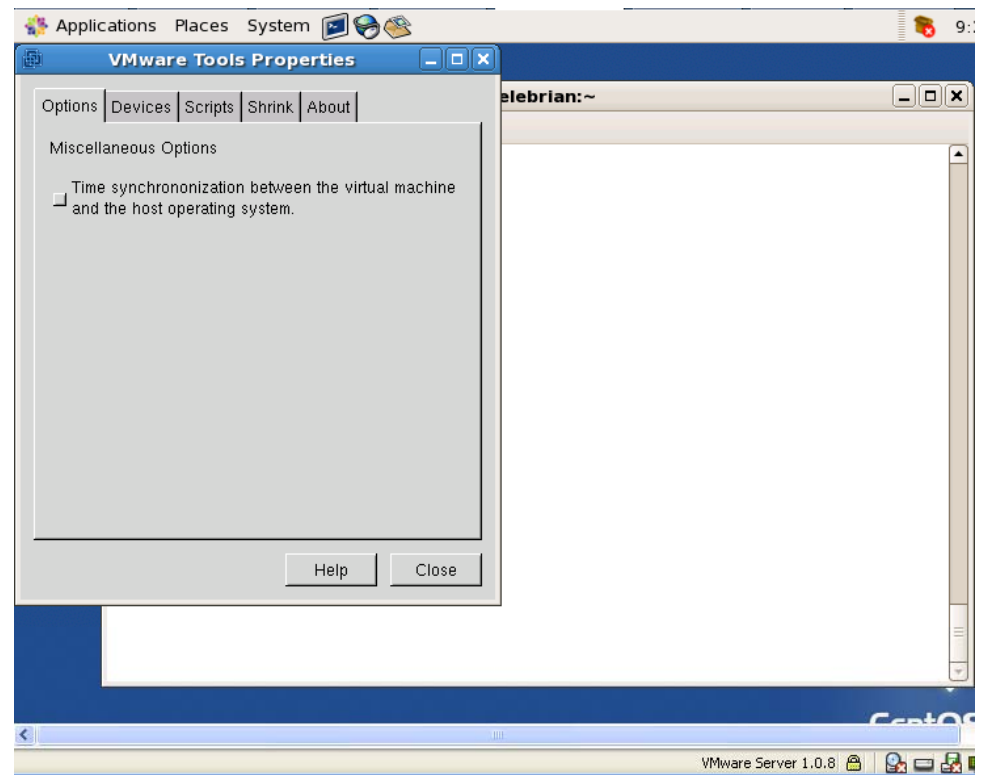
- Copy and paste between a virtual and host computer requires VMware Tools to be installed.
- VMware tools makes it easier to use and control VMs
- You only need to install VMware Tools on a VM once.
- After VMware Tools has been installed you must run a program called **vmware-toolbox** from the command line of a graphical terminal to enable copy & paste between systems.
- Append the command with a **&** so it runs in the background.

Copy and paste between VM and host



*Enter the
vmware-toolbox &
command*

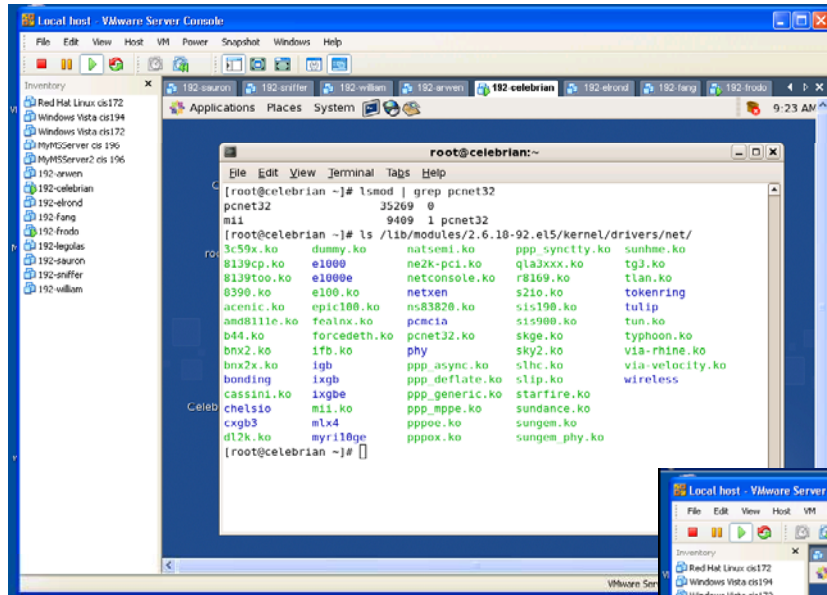
*Minimize the
resulting VMware
Tools Properties
box*



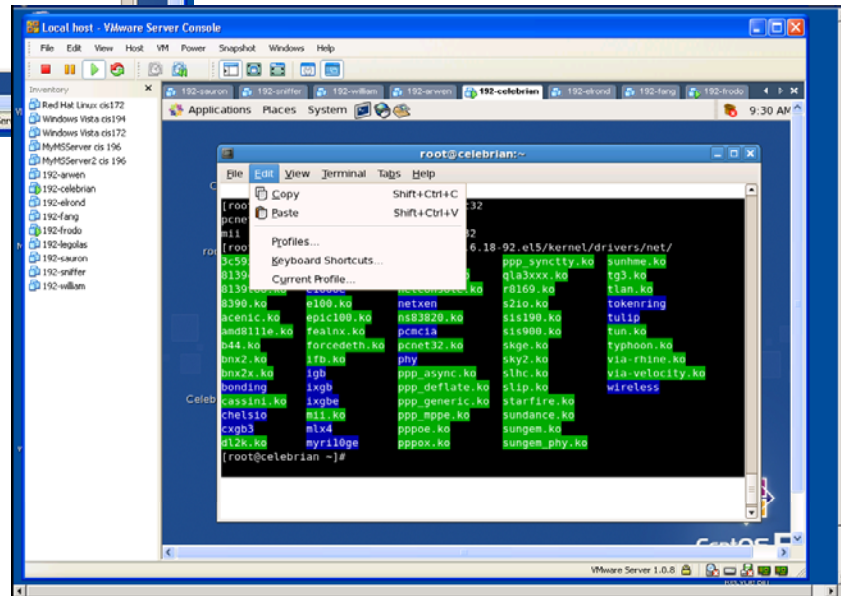
Copy and paste between VM and host

Type some example commands to test copy and paste with.

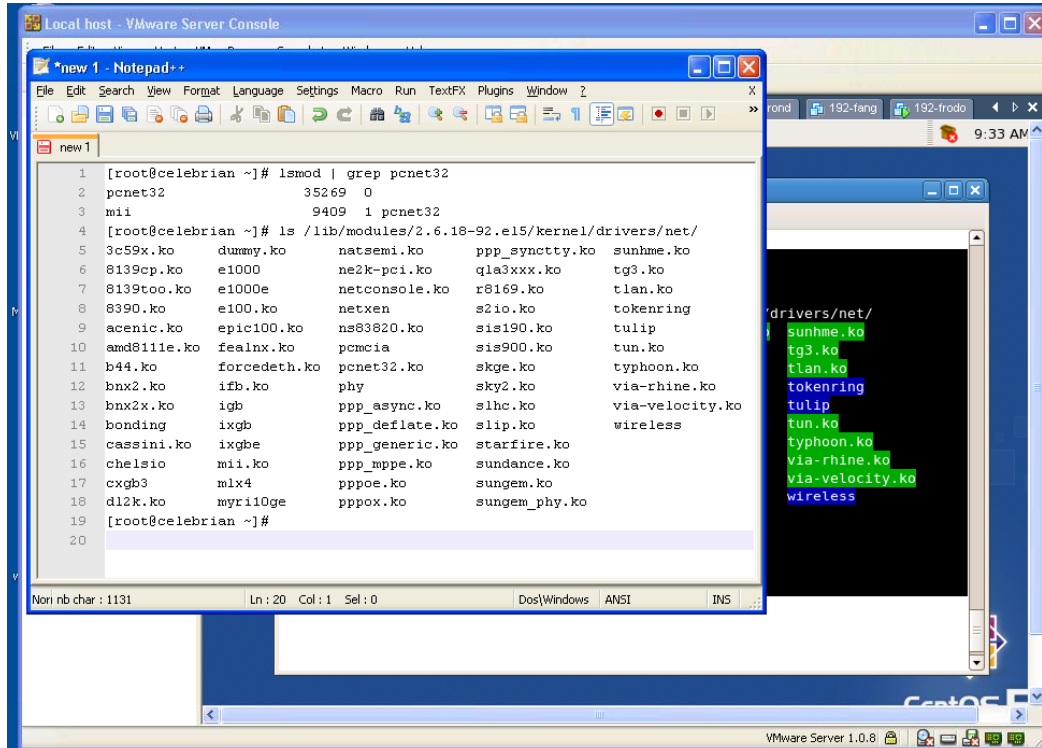
Note: These are commands we will be using in Lab 1.



Select the text and copy it to the Linux clipboard



Copy and paste between VM and host



Open a program like notepad or notepad++ on Windows and paste in the text

This is one way to exchange data with the Windows host. Putty (SSH), (p)scp and Filezilla (SFTP) are other methods we will learn later

Class Activity

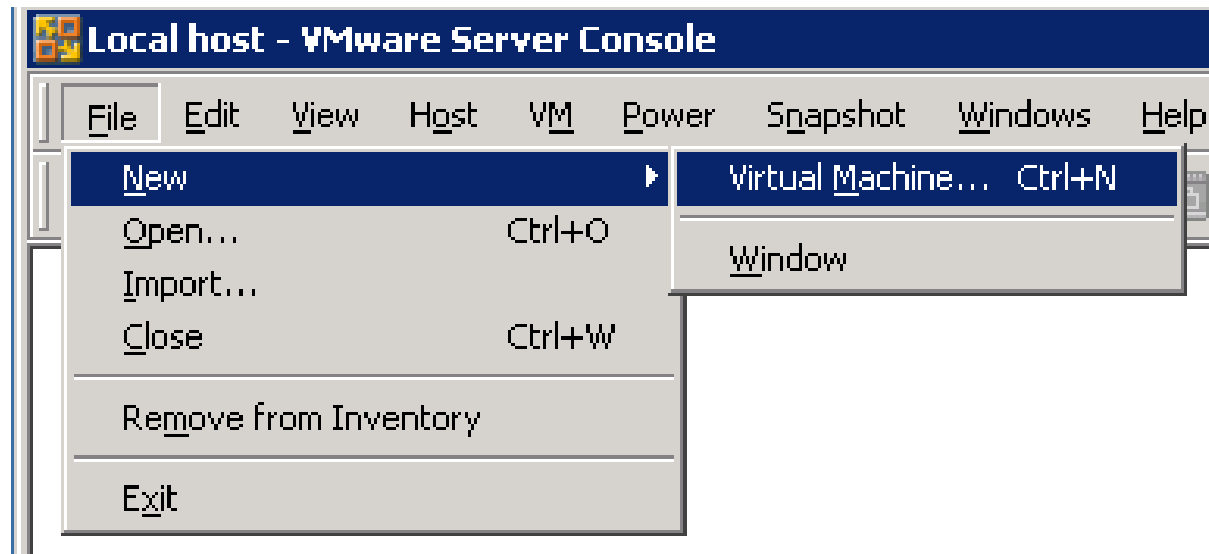
1. Start up **Celebrian** as **cis192** and **su** – to root.
2. Change Celebrian to run level 5 (use **startx**)
3. Start up a graphical terminal on **Celebrian**
4. Use **vmware-toolbox &** and then minimize the property box that pops up.
5. Type **lspci** and **lsmod** commands to list hardware devices and loaded kernel modules.
6. Start up notepad++ on your Windows station (pinned to your start menu).
7. Copy and paste the **lspci** and **lsmod** output on Celebrian into Notepad++ on Windows.

Creating VMs

Creating a new VM

VMware Server 1.08

We are going to make a brand new virtual computer with one CPU, a 5 GB SCSI drive and 512 MB of RAM



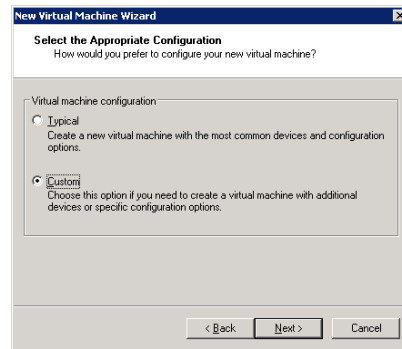
File > New > Virtual Machine

Don't try it yet, we will first walk through how its done then everyone will make one in the next activity

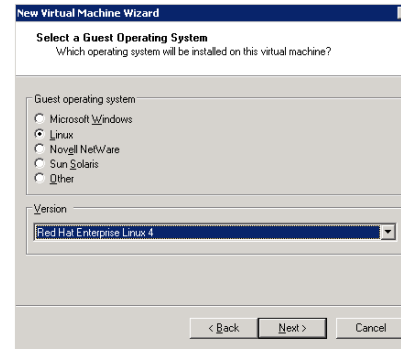
Creating a new VM VMware Server 1.x



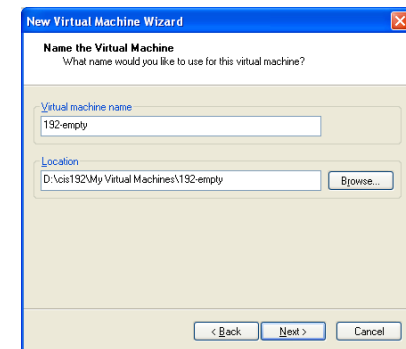
Next



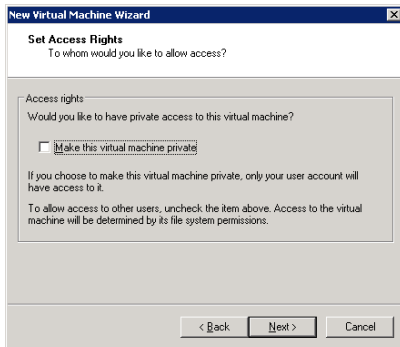
Custom



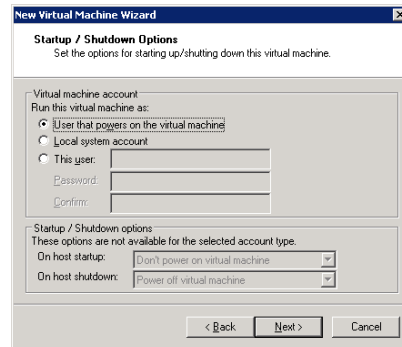
Linux
Red Hat Enterprise 4



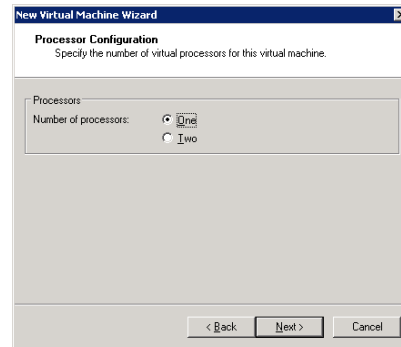
192-Empty
D:\cis192\My Virtual Machines\192-empty



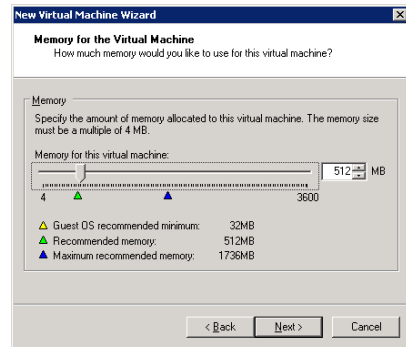
Not private



User that powers ...



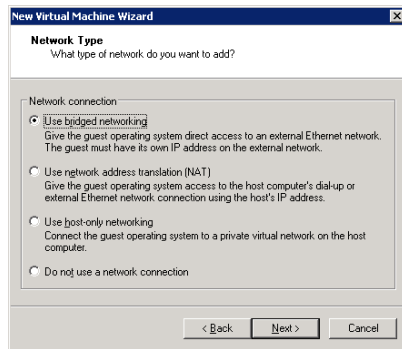
One



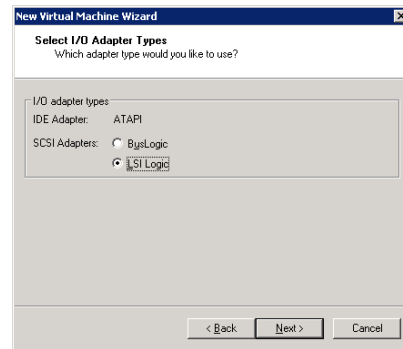
512 MB

Creating a new VM

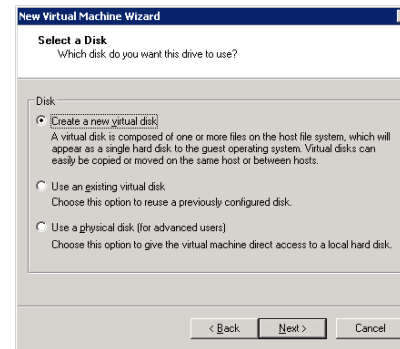
VMware Server 1.x



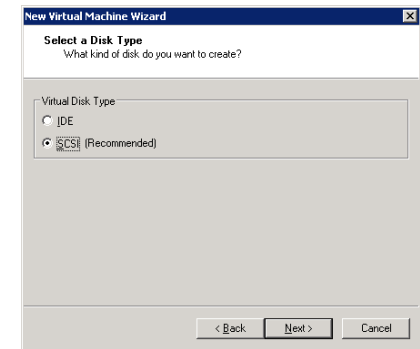
Bridged



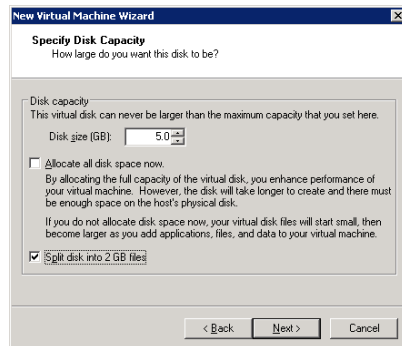
LSI Logic



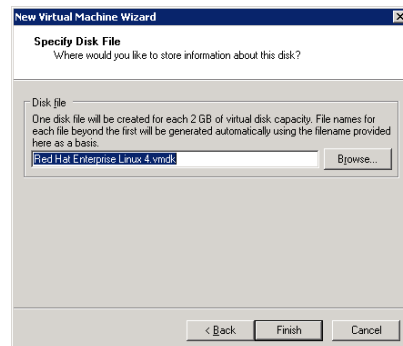
Create a new virtual disk



SCSI



5 GB
Don't allocate space now
Split into 2GB files

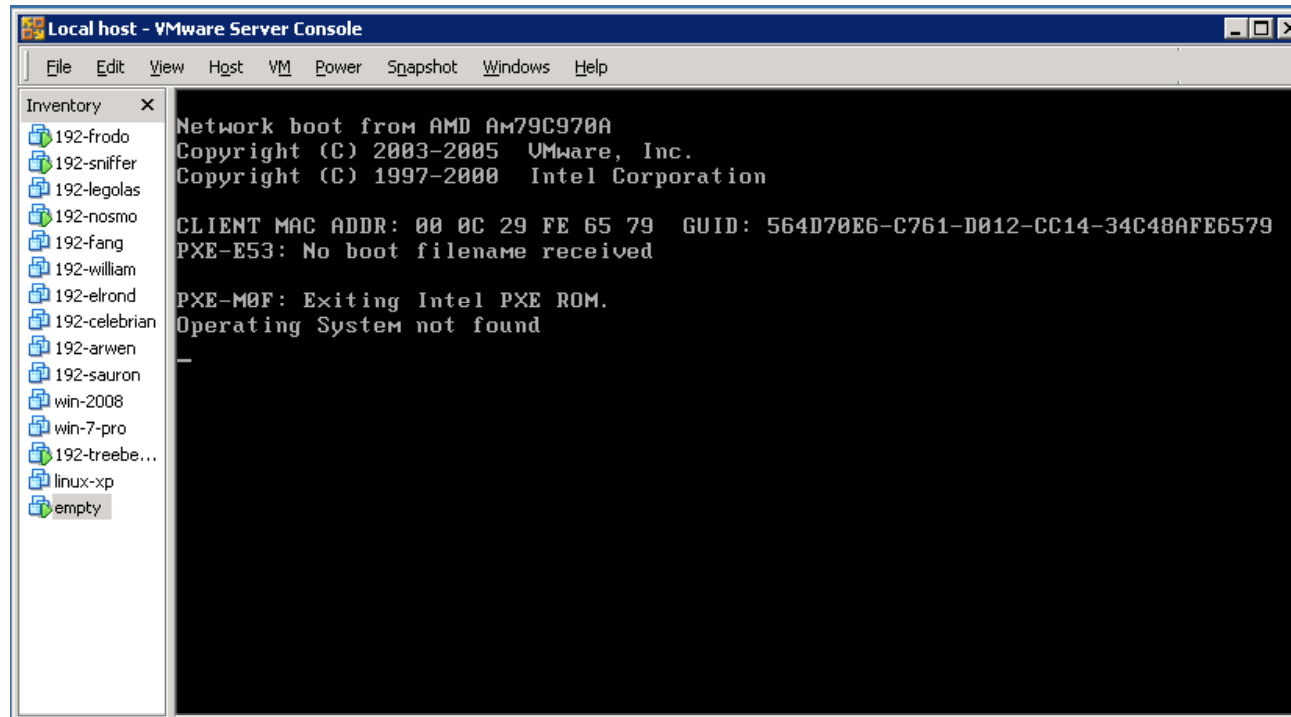


Red Hat Enterprise 4.vmdk

Creating a new VM

VMware Server 1.x

Powering on a new VM. Note the boot-up fails because there is no OS on the new hard drive.

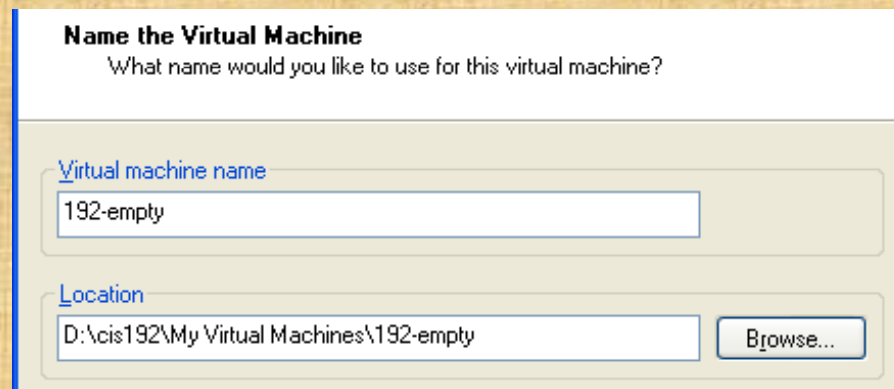


A computer without an Operating System installed is sometimes called a "bare-metal" computer

Class Activity – Make a computer

Now use the steps shown on the previous slides:

- 1) Create a new VM named **192-Empty** using the previous example exactly!
- 2) Don't take the default location for your new VM. Be sure you make it in the **D:\cis192\My Virtual Machines\192-empty** directory



Name the Virtual Machine
What name would you like to use for this virtual machine?

Virtual machine name
192-empty

Location
D:\cis192\My Virtual Machines\192-empty

- 3) Power it on when finished and observe what happens with a “bare metal” computer.
- 4) Power it off. We will use this VM again in another activity.

Cabling VMs

Cabling Devices on a Network



Desktop PC



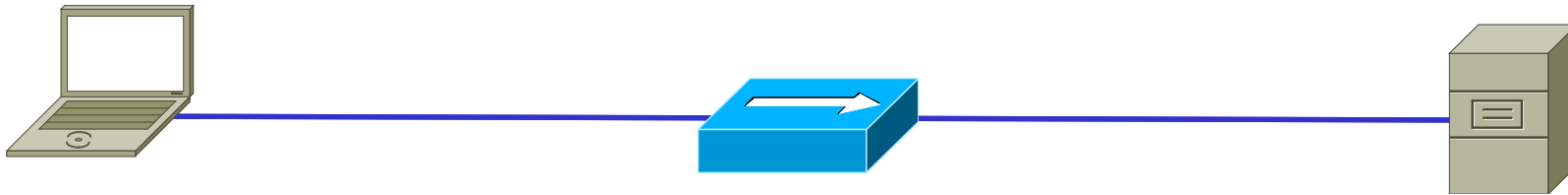
Switch



Router

Cabling a PC to a router using a switch

Cabling Devices on a Network



Notebook PC



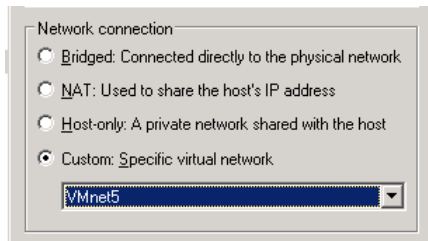
Hub



Server

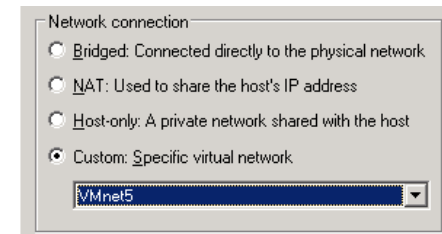
Cabling a PC to a Linux router using a hub

Cabling Devices on a Network



Network settings for the Ethernet device on the PC client VM

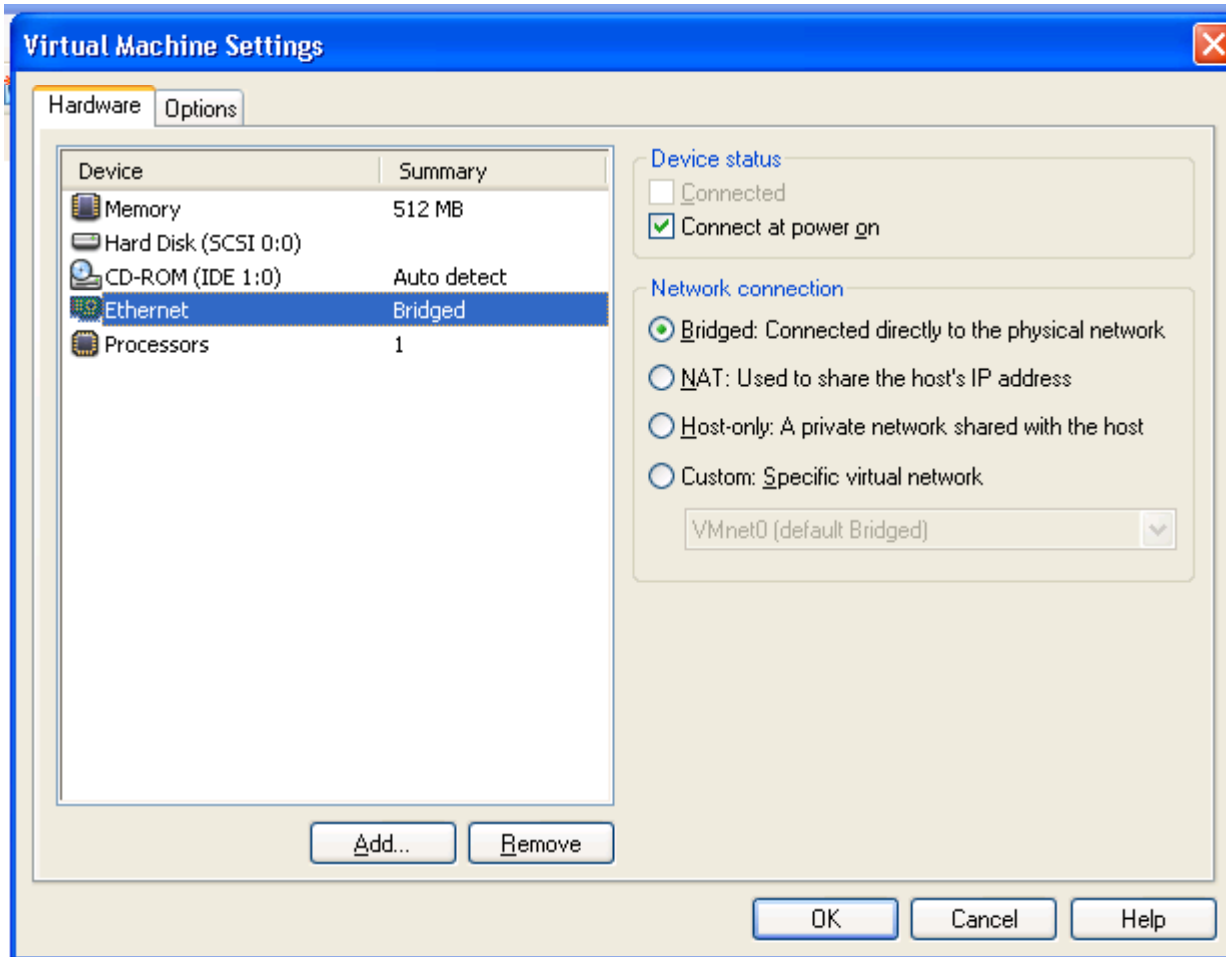
VMware provides multiple virtual networks. They function like virtual network hubs



Network settings for the first Ethernet device on the Linux router VM

Cabling a virtual PC to a virtual Linux router using a virtual hub

Cabling VMs



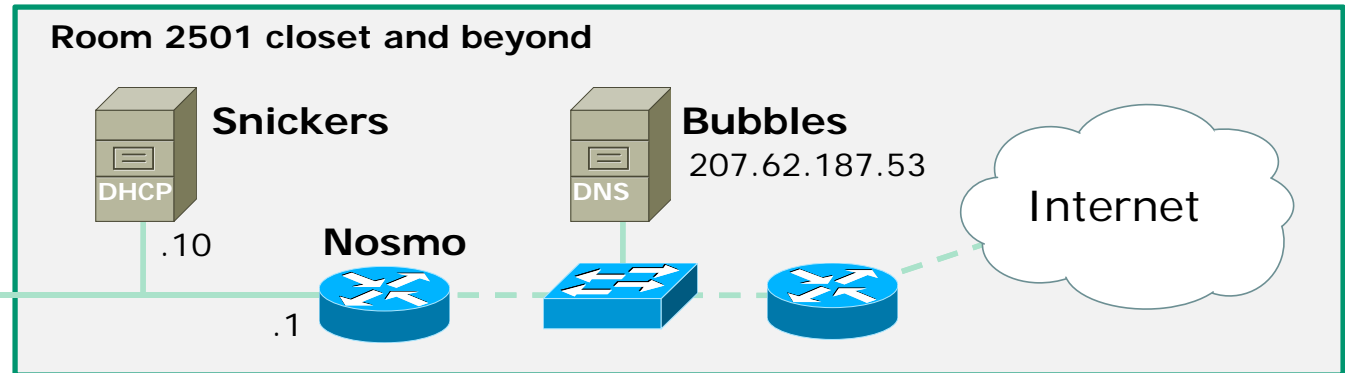
Cabling is done with the VM Settings for the Ethernet device (the NIC)

***Bridged** means the VM's NIC will use the host's physical NIC and be attached to the same network the host is. The virtual NIC will have its own MAC address.*

***VMnets** can be thought of as virtual hubs the VM can be cabled to.*

Cabling VMs – Example 1

Classroom



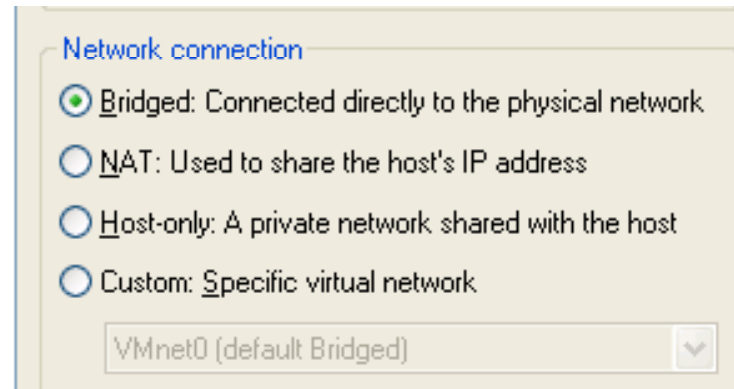
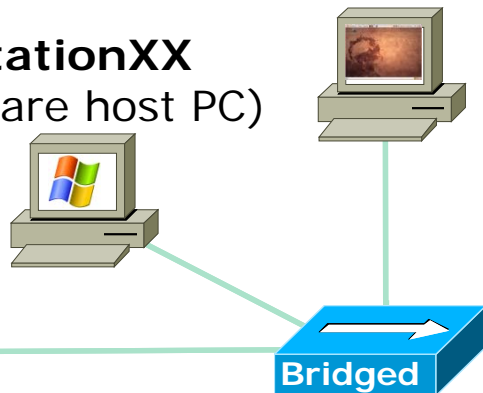
172.30.1.0 /24

A bridged network connection on a VM behaves as if the VM and the physical host computer are both plugged into the same imaginary hub.

In this example, both your Windows station and the Frodo VM are cabled to the classroom 172.30.1.0/24 network. They both have different MAC addresses.

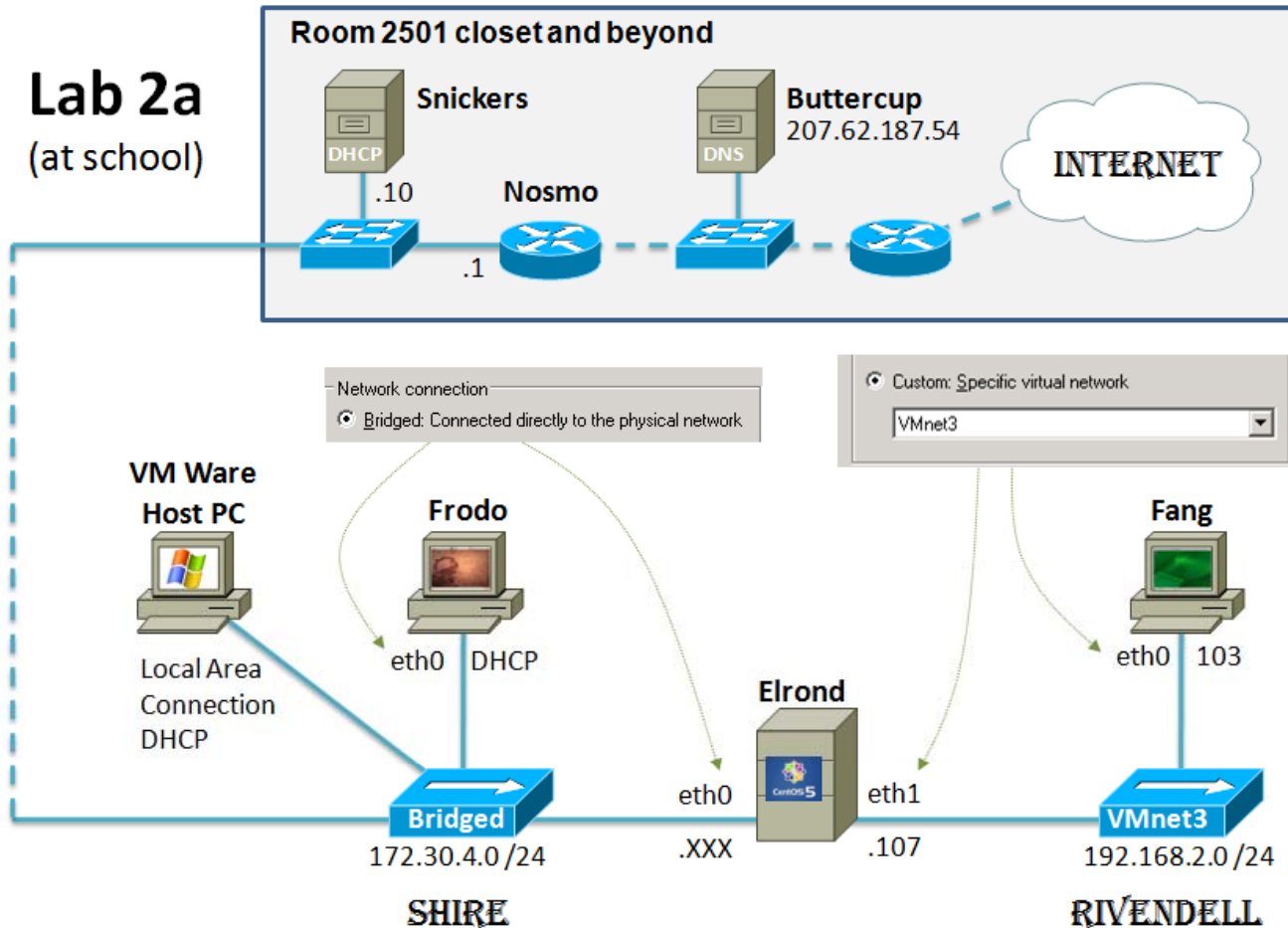
Frodo (a VM on StationXX)

StationXX (VMware host PC)



Cabling VMs – Example 2

Lab 2a (at school)



*Fang's NIC and Elrond's 2nd NIC are cabled to the Rivendell network. This is a **virtual network** using VMnet3.*

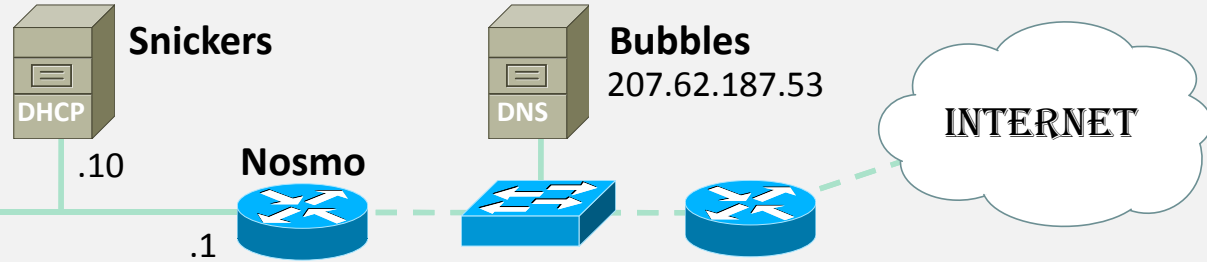
*Frodo and Elrond's 1st NIC are cabled to the Shire network (this is the physical network in the lab using a **bridged** connection)*

Lord of the Rings

- Tradition is behind naming the networks used in the labs that goes back to when Jim created this course.
- The **Shire** network will refer to the physical LAN in either the classroom or the lab.
- The **Rivendell** network will refer to the network that is one hop away.
- The **Mordor** network will refer to the network that is two hops away.
- These networks used to be three physical networks in Room 2504 complete with banners hanging from the ceiling. Now the Rivendell and Mordor networks are virtual.

CIS Lab and CTC

Room 2501 closet and beyond



VMware Station

SHIRE

172.30.4.0 /24

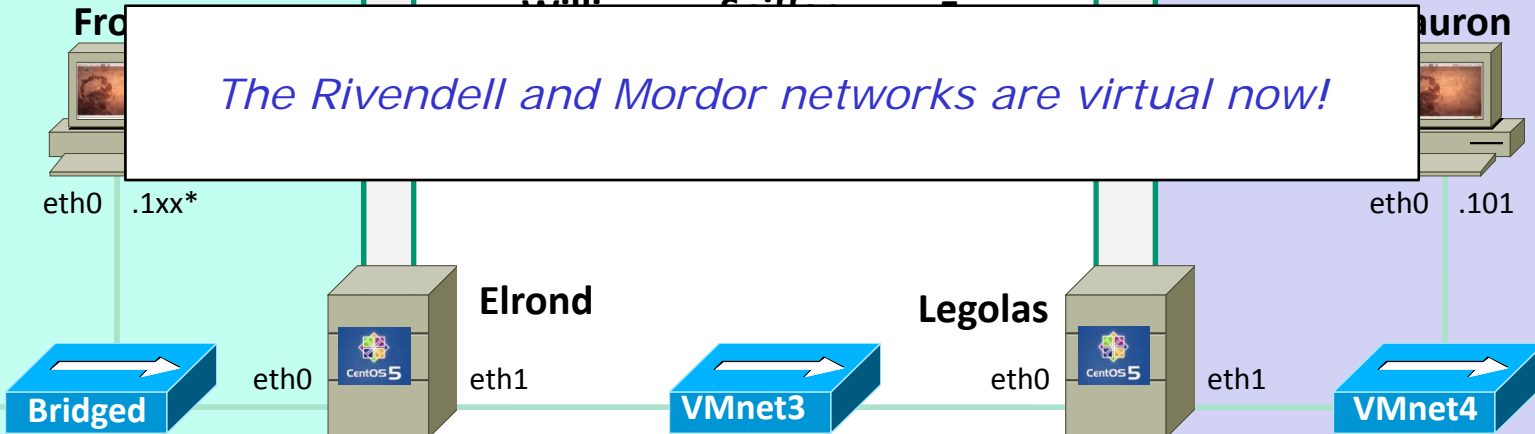
RIVENDELL

192.168.2.0 /24

MORDOR

192.168.3.0 /24

The Rivendell and Mordor networks are virtual now!



Taking VMs Home

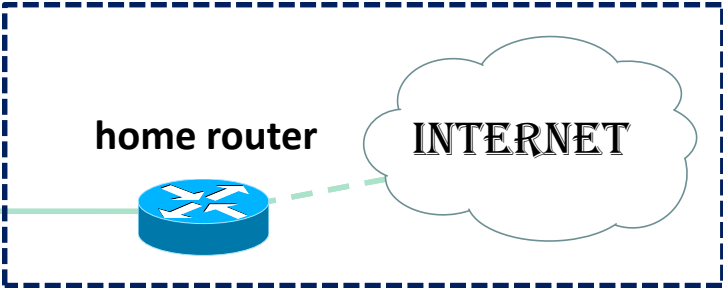
VMware Station

Nosmo*

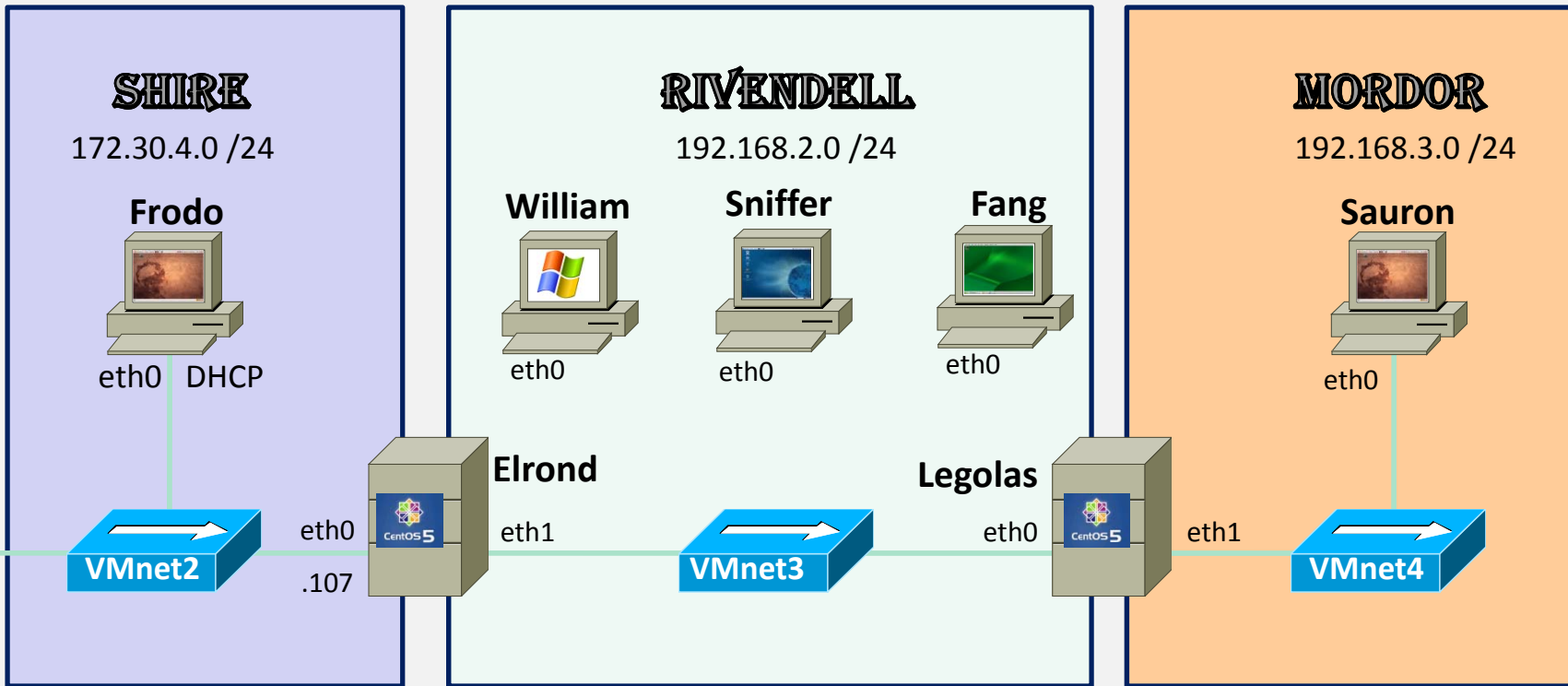


.1 .n

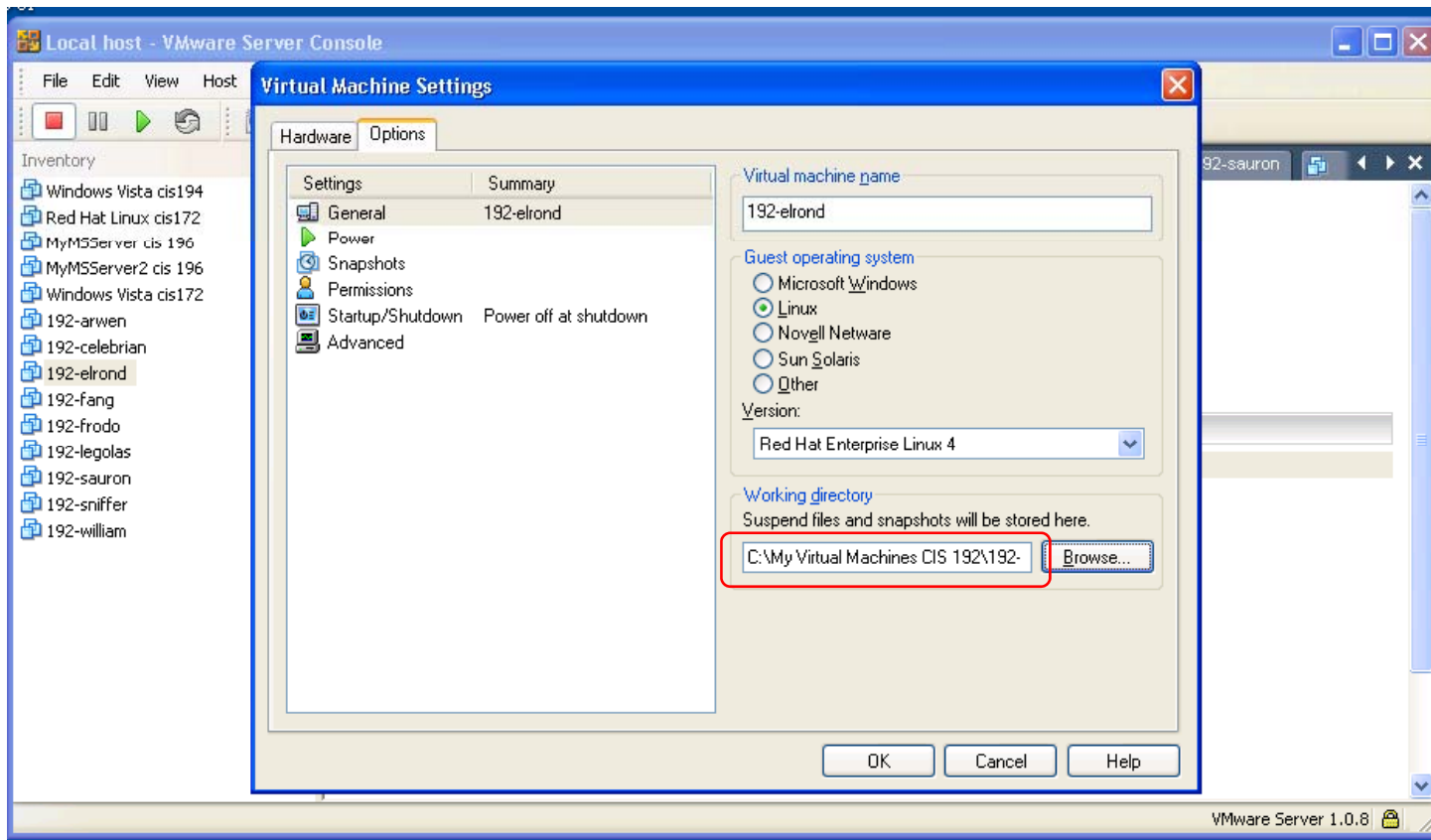
At Home



The nosmo VM can be used to replicate the CIS Lab network on home systems. *Don't use it at school though!* (duplicate IP address conflict with the real nosmo router)



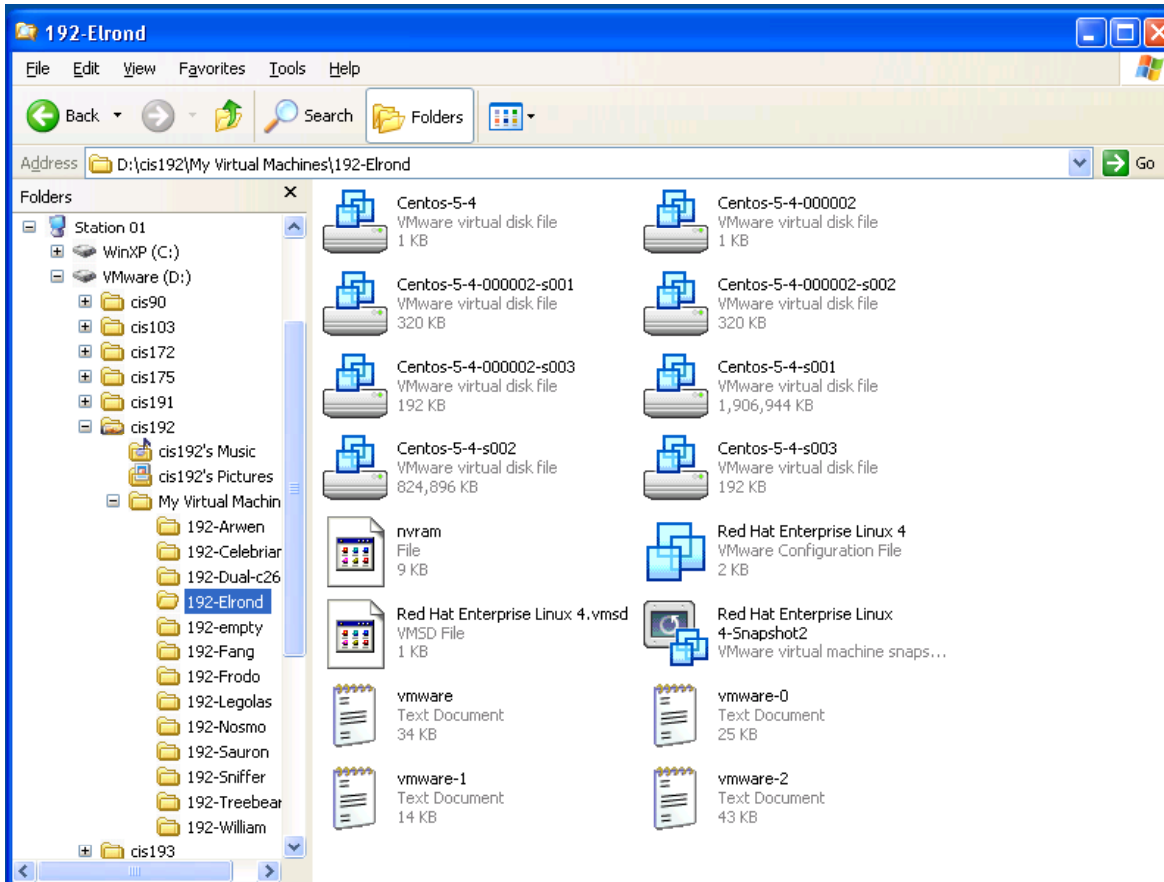
Copying a VM to another computer Locating the VM files



*Find the location of the VM you want to copy
using the Virtual Machine Setting dialog box*

Copying a VM to another computer Locating the VM files

D:\cis192\My Virtual Machines\



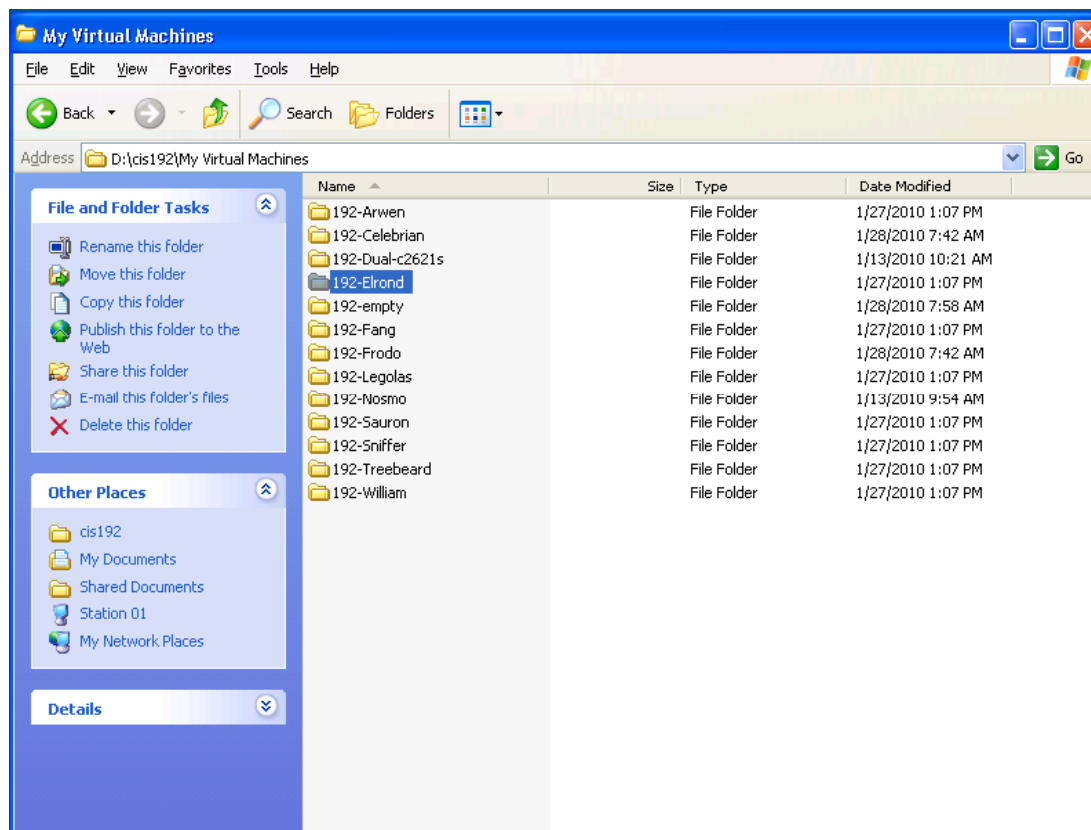
Copy the entire VM folder to your USB flash drive.

*For example, to bring home Elrond, you would copy the highlighted **192-Elrond** folder to your flash drive.*

Explorer view of Elrond on Station 01 in Room 2501 (2.6 GB when powered off)

Copying a VM to another computer Locating the VM files

D:\cis192\My Virtual Machines\



*For example to bring home Elrond, you would copy the highlighted **192-Elrond** folder to your flash drive.*

All VMs use about 40GB (when powered off)

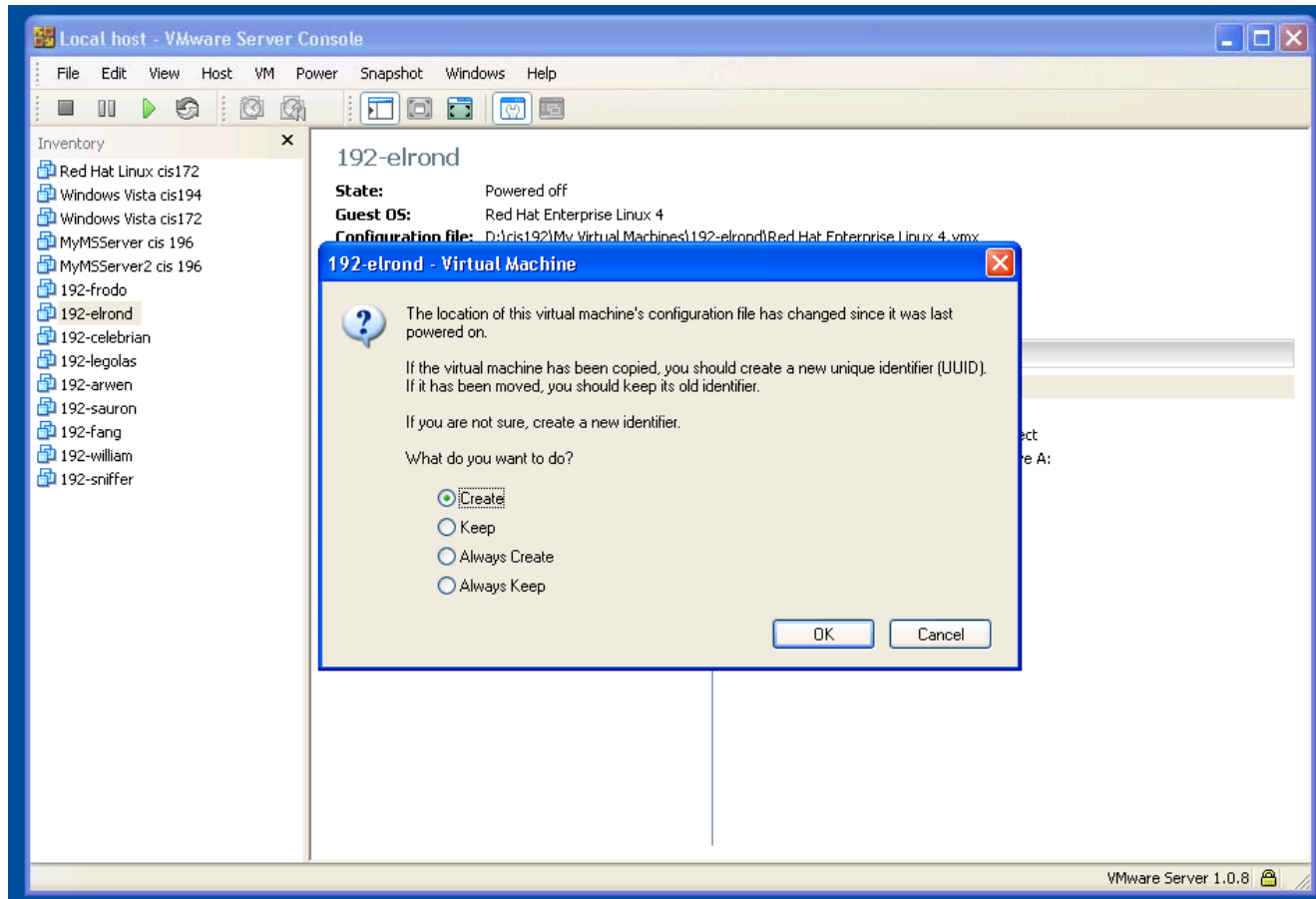
Elrond on Station 01 in Room 2501 (2.6 GB when powered off)

Copying a VM to another computer

On the home computer

- Install VMware Server
- Create a folder for your VMs or use the default My Virtual Machines folder.
- Copy the 192-Elrond folder from your USB flash drive to your home VM folder.
- Using the VMware Server Console
 - File > Open > Browse (to the .vmx configuration file inside the 192-elrond folder)
- Run the VM

Copying a VM to another computer



*You get prompted the first time you run a VM that has been transferred. Select **Create** so you get a new MAC address for your VM's interfaces.*

Howto for working at home

<http://simms-teach.com/howtos/202-working-at-home-nat.pdf>

Rich's Cabrillo College CIS Classes Resources

Home Resources Forums CIS Lab CTC

Links

Instructors

- Linux Master Jim
- Programming Master Ed
- Network Master Gerlinde
- Network Master Rick
- Web Master John
- Windows Master Gary

Getting Linux

- Linux ISOs
- Serials
- ROMs
- Tools and Software
- Aspirin
- Bestie
- cygwin
- DOS diagnostics
- DOS boot disks
- John the Ripper
- MSDN Academic Alliance
- netfilter
- Putty SSH Tools
- Trainers
- VMware Server
- Winshark

Howtos

- HowtoForge
- smail
- ONS
- Ethernet (NIC drivers)
- IPS
- NIS
- PPP
- Putty SSH keys
- rsd

Student Howtos

- Making an ethernet cable by Michael George
- Home VM access via Linksys router by Marc Romansky
- Putty to VMs by Marc Romansky
- Installing VirtualBox by Michael Wichercki
- Linux Permissions by Marcos Valdebenito
- Guide to /bin/mail by Michael Wichercki

Standards

- NET (RFCs)
- IEEE

Commands

- Practical
- Summary
- Useful
- vs.summary

Linux News

- linuxtoday
- linuxworld
- linux
- Linux Weekly News
- COMPUTERWORLD

Rich's Howtos

General

- Kernel update with yum (pdf)
- Make bootable pen drive using Fedora 9 (pdf)
- Make boot diagnostic floppy (pdf)
- Mount CD ISO and floppy image files with loopbacks
- OpenSUSE 11 custom root file system (pdf)
- Trouble City (pdf)
- Use Middle Earth VMs on Opus
- Using Linux at Cabrillo College

Installing Linux Distributions

- Dual boot DOS and Fedora 8 with VMware Tools (pdf)
- Dual boot DOS and Fedora 9 (pdf)
- Debian 4 installation at VM (pdf)
- Fedora 9 installation on VM (pdf)
- OpenSUSE 11 installation on VM (pdf)
- Install Ubuntu 8.04 into a new VM
- Ubuntu dual boot with Windows

Networks

- Basic network configuration

Partitions

- Partitions, File Systems and Mounts

Putty

- Installing PuTTY on Windows
- Configuring the appearance of PuTTY

Reference Implementations

- Windows XP and Linux
- SquirrelMail

VMware Server

- VM's - add USB controller (pdf)
- VM's - create a new one
- VM's - using virtual floppies
- Home Linux Networking Lab

From Jim Griffin's Linux Book Shelf

Introduction

- Linux User's Guide: Using the Command Line and GNOME with Red Hat Linux 9.0

Linux Howtos

Home Linux Networking Lab (202) - CIS 192 - Spring 2010

This Howto shows how to recreate the CIS Lab environment at home.

Supplies:

- A fast PC
 - 2 GB memory minimum
 - 50 GB free disk space minimum
- VMWare Server 1.08 or later
 - <http://www.vmware.com/products/server/>
- VMs (available in the CIS Lab)
 - Treebeard, Celebrian, Arwen, Frodo, Elrond, Sniffer, Legolas, Sauron, Fang and Noomi
- USB drive (to transport VMs from school to home)

Overview

Here is the network environment used in the CIS Lab and CTC:

CIS Lab and CTC

Room 201 closest and beyond

Switches: Sauron, Legolas, Frodo, Arwen, Celebrian, Treebeard

Internet

VMware Station

SHREE: 172.30.0.2/24 (Frodo, Sauron)

REYKJAVELL: 192.168.2.0/24 (William, Sniffer, Fang)

MOEDOR: 192.168.3.0/24 (Elrond, Legolas)

You may want to wait a few lessons before attempting this at home. It involves firewalls, NAT, DHCP, static routes and configuring permanent network settings.

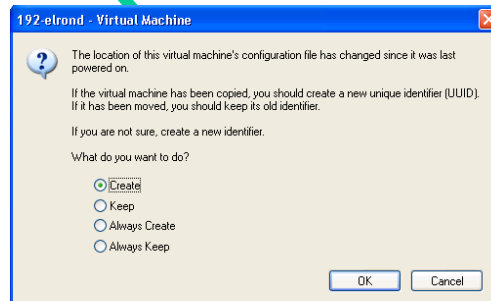
Some caveats regarding copying the 192 VMs

1. The Ubuntu and Fedora VMs may boot up with interfaces that don't start at eth0 because they use this file:
`/etc/udev/rules.d/70-persistent-net.rules`
 - You can ignore this, edit the file and delete the previous eth entries, or use my `/root/bin/init-network` script to fix.
2. The CentOS VM's `ifcfg-ethx` files are modified by VMware to use DHCP settings. This can result in long annoying timeouts during start up.
 - You can ignore this, edit the files and remove the dhcp settings, use my `/root/bin/init-network` script to fix or grab the latest version of the VMs on `\\172.30.4.12\depot`.

An unwanted VMware "feature"

Original VM at school

```
[root@legolas ~]# cat /etc/sysconfig/network-scripts/ifcfg-eth0
# Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE]
DEVICE=eth0
ONBOOT=no
HWADDR=00:0c:29:20:5c:c9
[root@legolas ~]# _
```



*Create makes a new MAC address. But it also **modifies the network settings** on the CentOS VMs!!*

After copy and **create**

Note: Keep the new MAC address but change the other settings back to the original if you want the copied VM to behave like it did at school. You can use the /root/bin/init-network script to do this.

```
[root@legolas ~]# cat /etc/sysconfig/network-scripts/ifcfg-eth0
# Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE]
DEVICE=eth0
ONBOOT=yes
BOOTPROTO=dhcp
HWADDR=00:0c:29:3c:d5:fc
[root@legolas ~]# _
```

Footnote: A modified version of the CentOS VMs are available on \\172.30.4.12\depot. The MAC addresses have been removed from the ifcfg-ethx files which seems to work around the problem.

Fun with Treebeard

Treebeard



Treebeard

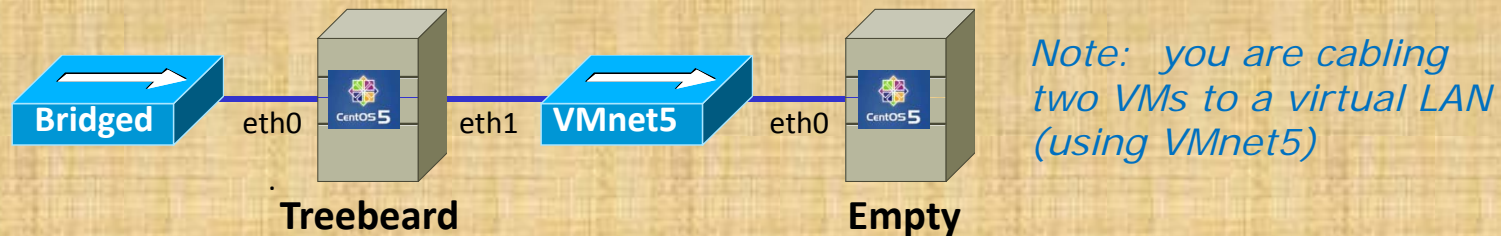
- Treebeard is a CentOS Linux server.
- It has been configured to provide TFTP, HTTP, DNS and DHCP services.
- The firewall has been modified so clients requests for these services will not be blocked.
- It has also been configured to do something else!

This is an example of the kinds of services we will learn to configure in this course.

Class Activity – Treebeard

Let see if we can figure the other service Treebeard provides!

- 1) Cable Treebeard and Empty as follows but don't power them on yet:



- 2) Power on **Treebeard** first! Wait till it is fully up and running.
- 3) We just created the **Empty** VM. It is a "bare-metal" PC without any OS or applications installed. The hard drive has not even been formatted yet. What should happen if we power it on?
- 4) Power on **Empty**. Take any default choices you are presented with.
- 5) What **the heck** just happened?

See: <http://simms-teach.com/howtos/201-pxe-install.pdf> to learn how to do this

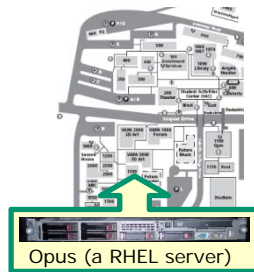
SSH Hopping

SSH (Secure Shell)

- SSH is a standard network protocol that lets data be exchanged securely (via authentication and encryption) by two computers on a network.
- On Linux and UNIX systems, SSH replaces Telnet for logging into remote system and issuing commands.
- SSH v2 is more secure than SSH v1. It is also incompatible.
- OpenSSH, found on most Linux distributions, is an open source implementation of SSH v2.
- On Linux, the **ssh** command is used to login and issue commands on another system. The **scp** command is used to securely copy files between systems.
- On Windows, the **Putty** software uses SSH. The Putty **pscp** command is the windows version of the Linux **scp** command.
- On Windows, **Filezilla** can copy files using SFTP which in turns uses SSH.

Telnet vs SSH (Secure Shell)

Remote computer



Sniffer view of a Telnet session

Telnet - all clear text

With telnet, everything is transferred in clear text over the network

Sniffer view of a SSH session

SSH - encrypted

With ssh, it is encrypted.

username
password
cat secret
exit



Local computer

SSH Hopping – Putty into first system

root@treebeard:~

```
[root@treebeard ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:ED:71:2A
          inet addr:192.168.0.20  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:feed:712a/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500
          RX packets:1303 errors:0 dropped:0 overruns:0
          TX packets:204 errors:0 dropped:0 overruns:0
          collisions:0 txqueuelen:1000
          RX bytes:212992 (208.0 KiB)  TX bytes:100000
          Interrupt:185 Base address:0x1400

[root@treebeard ~]#
```

Category:

- Session
 - Logging
- Terminal
 - Keyboard
 - Bell
 - Features
- Window
 - Appearance
 - Behaviour
 - Translation
 - Selection

Basic options for your PuTTY session

Specify the destination you want to connect to

Host Name (or IP address)	Port
192.168.0.20	22

Connection type:

Raw Telnet Rlogin SSH Serial

Load, save or delete a stored session

Saved Sessions

Load Save Delete

Always Never Only on clean exit

About Open Cancel

Putty into Treebeard using the IP address shown by ifconfig

SSH Hopping – ssh into next system

The screenshot shows a VMware Server Console window titled "Local host - VMware Server Console". On the left is an "Inventory" pane listing several VMs: win-2008, win-7-pro, 192-cisco-R1, 192-cisco-R2, 192-Elrond, 192-Treebeard, and 192-empty. The main console area shows a terminal session. The user is at the root of a VM named "seedling76". They run the command `ifconfig` on the `eth0` interface, which shows an IP address of `10.10.10.191`. A second terminal window is overlaid on top, showing the user logging in as root to a VM named "192-168.0.20", then running `ssh root@10.10.10.191` to hop to the "seedling76" VM. A red box highlights the IP address `10.10.10.191` in both the `ifconfig` output and the `ssh` command.

```
#logvol --fstype ext3 --name=LogVol00 --vgname=VolGroup00 --size=1024 --grow
%packages
@core
[root@seedling76 ~]# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:0C:29:B6:8B:B4
          inet addr:10.10.10.191  Bcast:10.10.10.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:feb6:8bb4/64  Scope:Link

login as: root
root@192.168.0.20's password:
Last login: Wed Dec 16 05:05:09 2009 from 192.168.0.24
[root@treebeard ~]# ssh root@10.10.10.191
root@10.10.10.191's password:
Last login: Thu Dec 31 01:02:53 2009 from 10.10.10.1
[root@seedling76 ~]#
```

*SSH into the Empty VM using the IP address from **ifconfig***

```
root@seedling76:~  
root@192.168.0.20's password:  
Last login: Wed Dec 16 05:05:09 2009 from 192.168.0.24  
[root@treebeard ~]# ssh root@10.10.10.191  
root@10.10.10.191's password:  
Last login: Thu Dec 31 01:02:53 2009 from 10.10.10.1  
[root@seedling76 ~]# cat anaconda-ks.cfg  
# Kickstart file automatically generated by anaconda.  
  
install  
url --url http://10.10.10.1/mirrors/CentOS-5.3-i386  
lang en_US.UTF-8  
keyboard us  
network --device eth0 --bootproto dhcp --hostname empty.localdomain  
rootpw --iscrypted $1$oePUsyvw$AqPrr7o4nHsq.ecY4TJsjl  
firewall --enabled --port=22:tcp --port=22:tcp  
authconfig --useshadow --enablemd5  
selinux --enforcing  
timezone --utc America/Los_Angeles  
bootloader --location=mbr --driveorder=sda  
# The following is the partition information you requested  
#cl  
#pa  
#pa  
#vo  
#lo  
--  
#lo  
#pa  
@cc  
[ro
```

```
Untitled - Notepad  
File Edit Format View Help  
[root@seedling76 ~]# cat anaconda-ks.cfg  
# Kickstart file automatically generated by anaconda.  
  
install  
url --url http://10.10.10.1/mirrors/CentOS-5.3-i386  
lang en_US.UTF-8  
keyboard us  
network --device eth0 --bootproto dhcp --hostname empty.localdomain  
rootpw --iscrypted $1$oePUsyvw$AqPrr7o4nHsq.ecY4TJsjl  
firewall --enabled --port=22:tcp --port=22:tcp  
authconfig --useshadow --enablemd5  
selinux --enforcing  
timezone --utc America/Los_Angeles  
bootloader --location=mbr --driveorder=sda  
# The following is the partition information you requested
```

Note: Putty copy & paste keys differ from MS Windows!

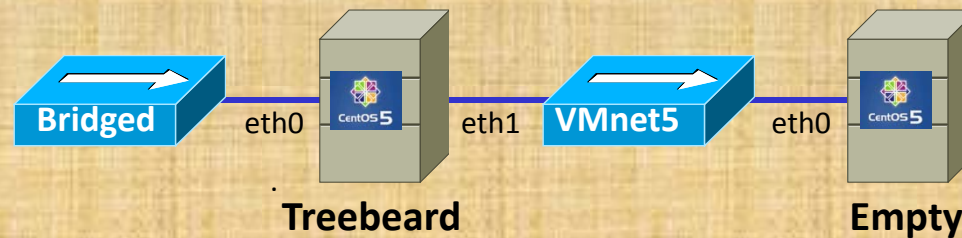
To copy to the clipboard - just select the text. The selected text is automatically put on the clipboard. Note, Ctrl-C does not do a copy, instead it sends an interrupt (SIGINT) to the current running program.

To paste from the clipboard – just click the right mouse key. Be careful as you may inadvertently paste unwanted clipboard contents into your Putty session!

Class Activity – SSH Hopping

Lets do some SSH hopping now!

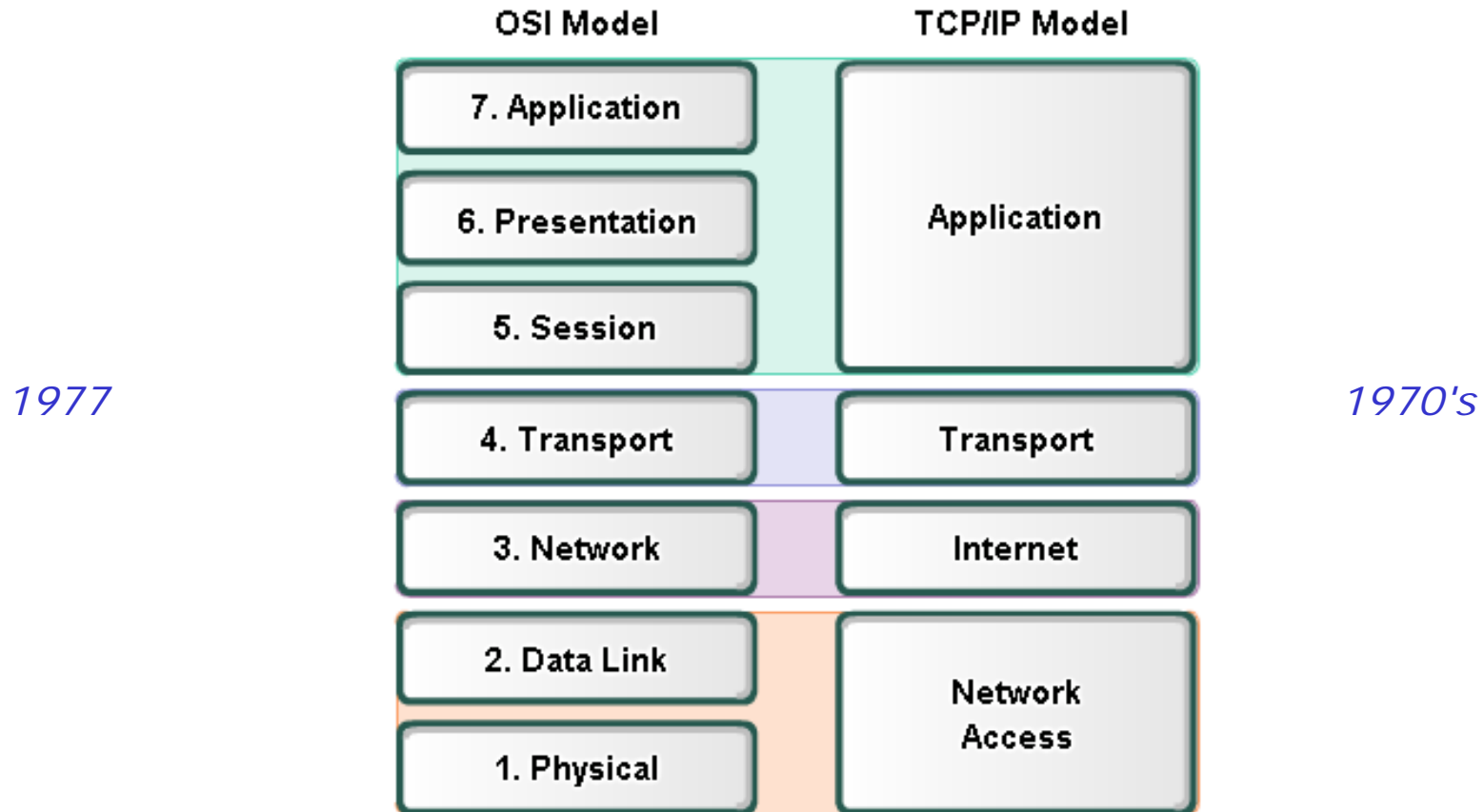
- 1) Use **ifconfig** to get the eth0 IP addresses on both Treebeard and Empty



- 2) Putty from your Windows station into Treebeard using its IP address
- 3) On Treebeard, **ssh** into the Empty VM using its IP address
- 4) **cat** the file **/root/anaconda-ks.cfg** on Empty
- 5) Select the output in Putty, then paste the contents of the clipboard into Notepad++ on Windows.

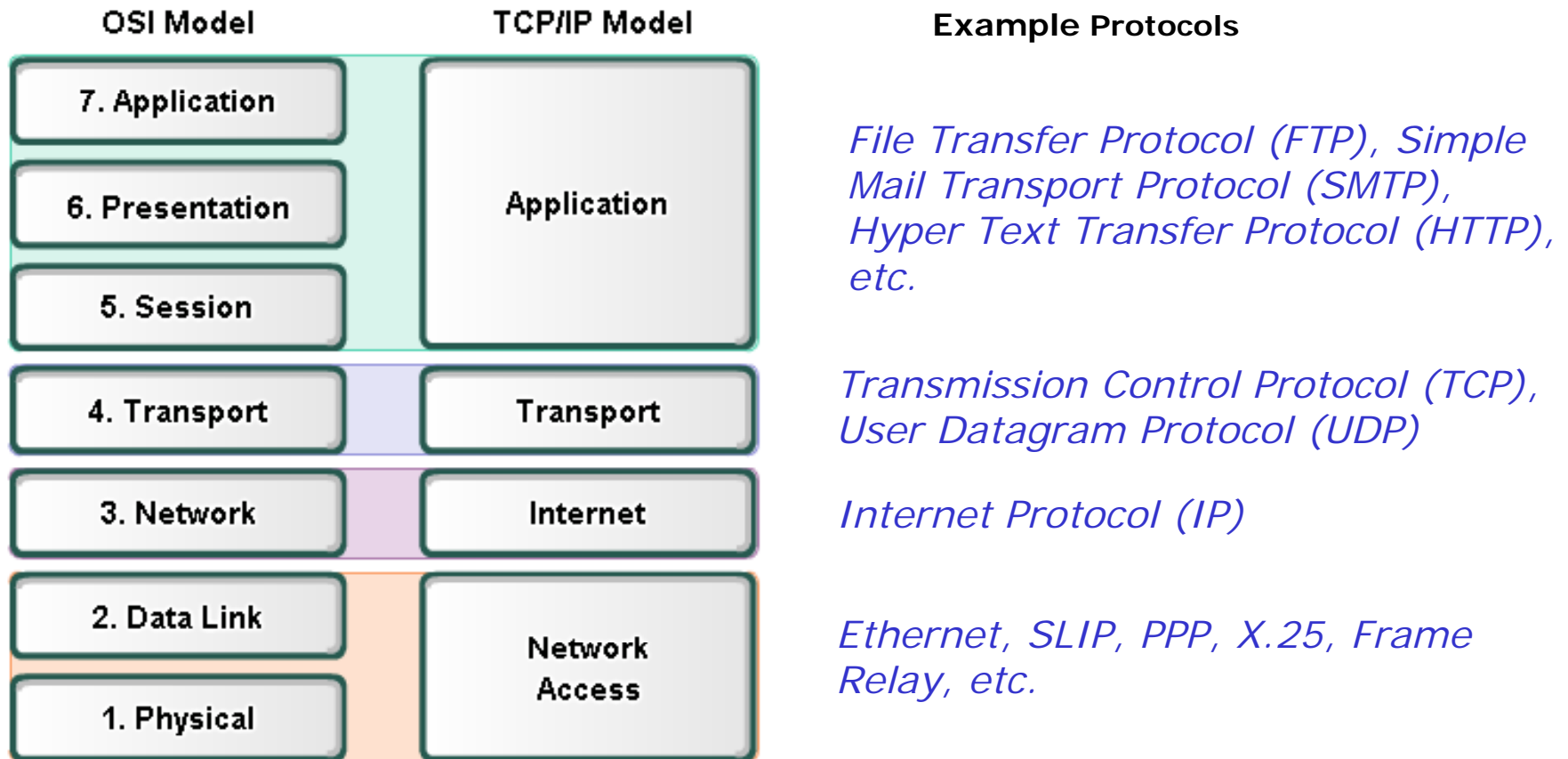
Network Basics

Protocol Reference Models



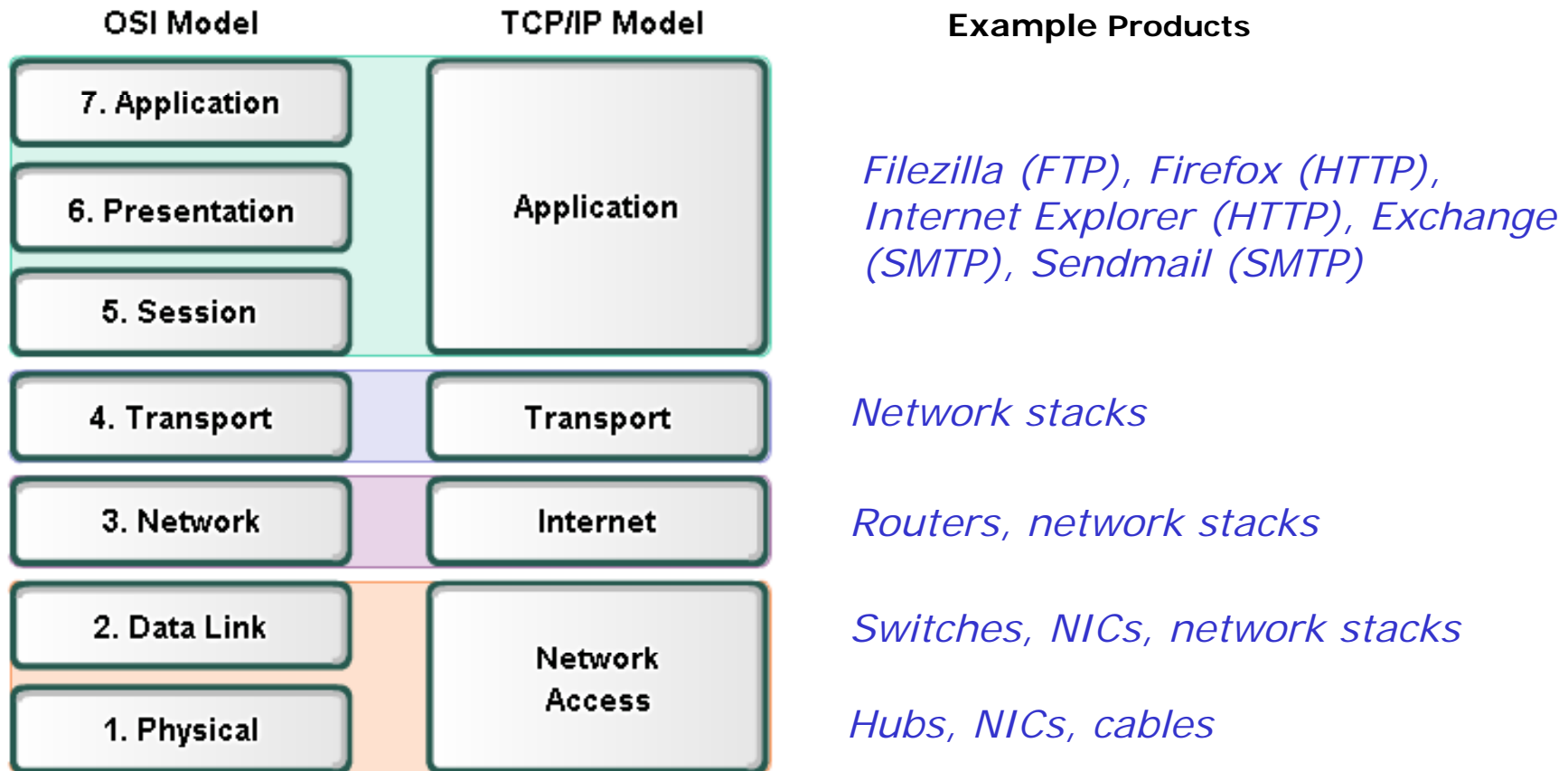
The **OSI** (Open Systems Interconnection) and **TCP/IP** models are define various **abstraction layers**. Each layer serves a different role in the overall communication process.

Protocol Reference Models



Showing how various **protocols** fit within the **OSI** and **TCP/IP** models. Each protocol is defined as a **standard** which enable multi-vendor solutions.

Protocol Reference Models



Each product must implement **standards** to enable multi-vendor **interoperability**.

Software implementations of network protocol layers are called **network stacks** and are built into OS's like Linux and Windows.


Reconciling the Layers

OSI	CIS 81	Nemeth Text	Wireshark	Source/ Destination	Unit	Devices
7 - Application	Application	Application	SSH, HTTP, DNS, RIP, Bootstrap (DHCP), SMB	An application program or service	Data	
6 - Presentation						
5 - Session						
4 - Transport	Transport	Transport	TCP/UDP	Port	Segment, Datagram	
3 - Network	Internet	Network	Internet Protocol	IP	Packet	Router
2 - Data link	Network Access	Link	Ethernet II	MAC	Ethernet Frame	Switch, NIC
1 - Physical		Physical	Frame	RJ-45 Jack	Bits	Hub, NIC, cables

The terminology for the different layers may change and blur a little depending on the textbook, product, or organization

Putting it all together – web server example

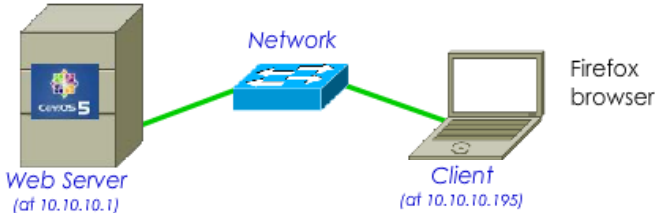
<http://simms-teach.com/animations/apache.html>



Linux Network Administration

Apache Web Server

How does a web server work?



Web Server (at 10.10.10.1)
Network
Client (at 10.10.10.195)
Firefox browser

Every time you surf the Internet you are connecting your computer (a client) to another computer (a server) somewhere on the **world wide web**. Each computer has a **unique IP address**. For this example the web server has an IP address of **10.10.10.1**.

Just about every client, whether it is a Mac, PC or Linux system, has one or more **web browsers** such as Firefox, IE or Safari installed.

Click the green arrow to continue

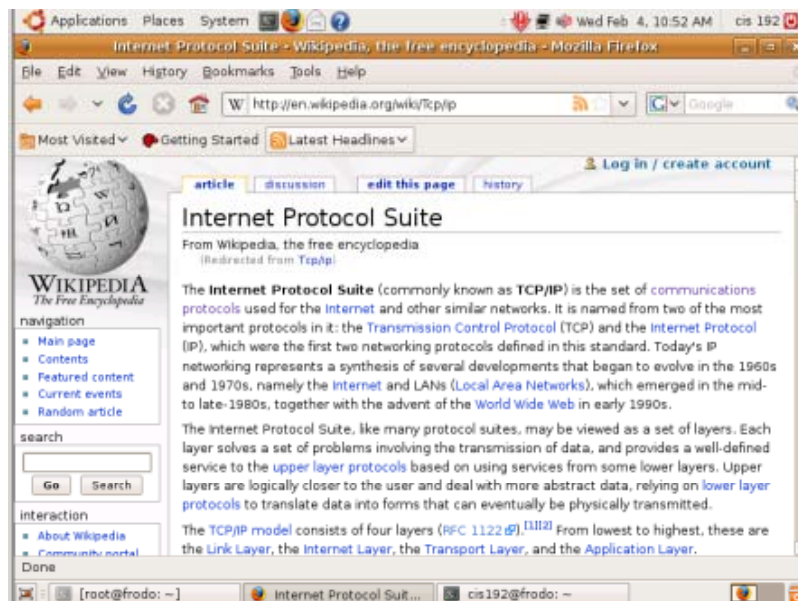
- > Stopping and starting the web service
- > Checking web server firewall allows incoming new traffic for port 80
- > Locating the Document Root using the httpd.conf file

Program - Official CIS 192AB Web Site - Contact

Let's start with a web server example to see how the network is used

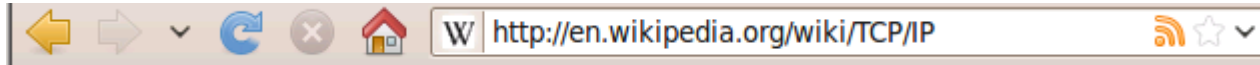
Deep dive into a single packet

*Now lets take a **deep dive** into a single network packet
... an "HTTP Get" sent from a browser to a web server*

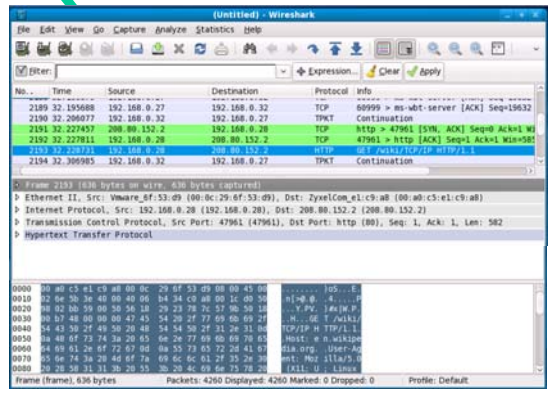
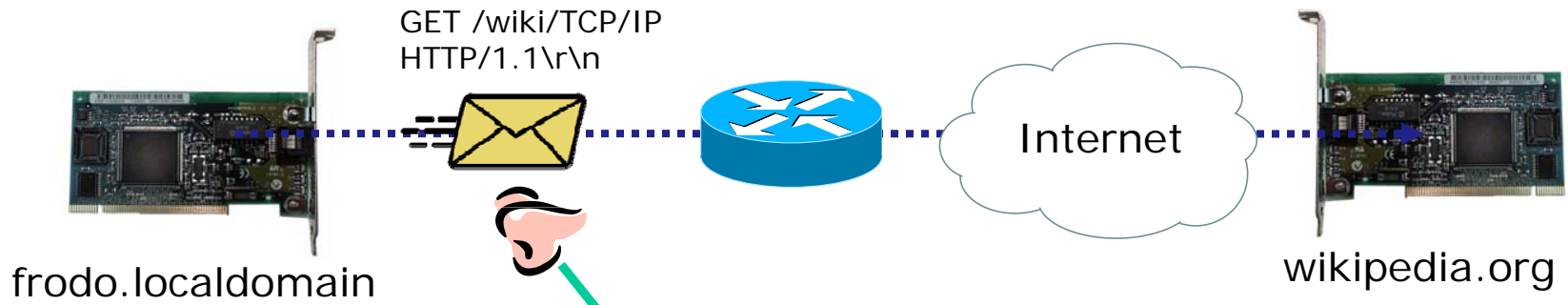


This example is based on using the Firefox browser on the Frodo VM at home to view a Wikipedia article on the Internet Protocol Suite

Deep dive into a single packet



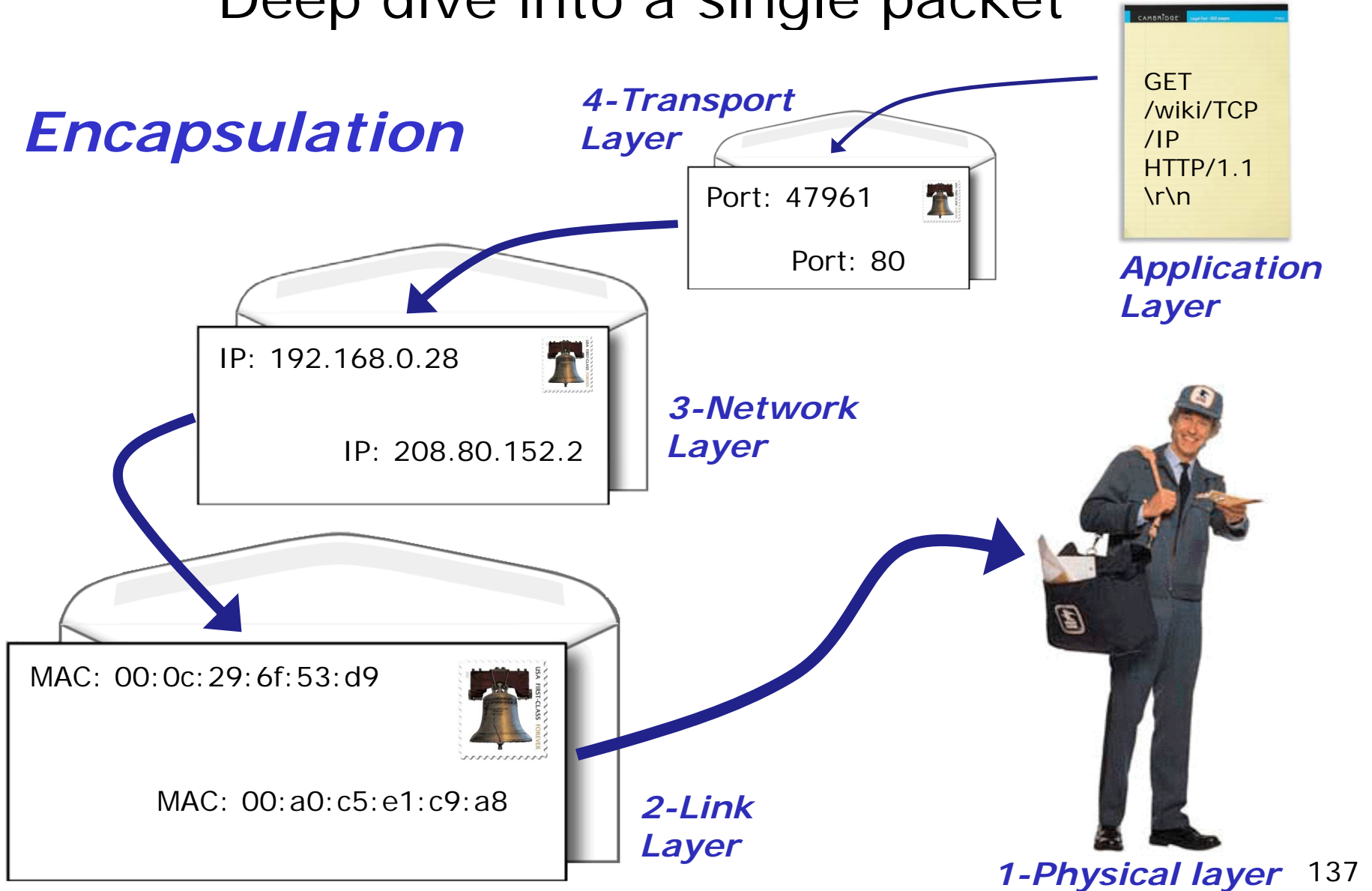
We will use a sniffer to look at the "HTTP GET" packet sent out the NIC card on the Frodo VM to the home router (and from there it is forwarded out to the Internet)



Note: The sniffer VM has four interfaces and Wireshark is installed. Wireshark is a sniffer program

Deep dive into a single packet

Encapsulation



Deep dive into a single packet

Note how Wireshark shows each layer for the selected HTTP GET packet

- 1-Physical →
- 2-Link →
- 3-Network →
- 4-Transport →
- Application →

The screenshot shows the Wireshark interface with the following details:

No.	Time	Source	Destination	Protocol	Info
2189	32.195688	192.168.0.27	192.168.0.32	TCP	60999 > ms-wbt-server [ACK] Seq=19632
2190	32.206077	192.168.0.32	192.168.0.27	TPKT	Continuation
2191	32.227457	208.80.152.2	192.168.0.28	TCP	http > 47961 [SYN, ACK] Seq=0 Ack=1 Win=582
2192	32.227811	192.168.0.28	208.80.152.2	TCP	47961 > http [ACK] Seq=1 Ack=1 Win=582
2193	32.228731	192.168.0.28	208.80.152.2	HTTP	GET /wiki/TCP/IP HTTP/1.1
2194	32.306985	192.168.0.32	192.168.0.27	TPKT	Continuation

Packet details for Frame 2193 (636 bytes on wire, 636 bytes captured):

- Ethernet II, Src: Vmware_6f:53:d9 (00:0c:29:6f:53:d9), Dst: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
- Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)
- Transmission Control Protocol, Src Port: 47961 (47961), Dst Port: http (80), Seq: 1, Ack: 1, Len: 582
- Hypertext Transfer Protocol

Packet bytes (hex and ASCII):

```

0000 00 a0 c5 e1 c9 a8 00 0c 29 6f 53 d9 08 00 45 00  ....oS...E.
0010 02 6e 5b 3e 40 00 40 06 b4 34 c0 a8 00 1c d0 50  .n[>@.@. .4....P
0020 98 02 bb 59 00 50 56 18 29 23 78 7c 57 9b 50 18  ...Y.PV. )#x|W.P.
0030 00 b7 48 00 00 00 47 45 54 20 2f 77 69 6b 69 2f  ..H...GE T /wiki/
0040 54 43 50 2f 49 50 20 48 54 54 50 2f 31 2e 31 0d  TCP/IP H TTP/1.1.
0050 0a 48 6f 73 74 3a 20 65 6e 2e 77 69 6b 69 70 65  .Host: e n.wikipe
0060 64 69 61 2e 6f 72 67 0d 0a 55 73 65 72 2d 41 67  dia.org. .User-Ag
0070 65 6e 74 3a 20 4d 6f 7a 69 6c 6c 61 2f 35 2e 30  ent: Moz illa/5.0
0080 20 28 58 31 31 3b 20 55 3b 20 4c 69 6e 75 78 20  (X11; U ; Linux
    
```

Deep dive into a single packet – Layer 1



*1-Physical
layer
expanded*

The screenshot shows the Wireshark interface with the following details for frame 2193:

No.	Time	Source	Destination	Protocol	Info
2191	32.227437	208.80.152.2	192.168.0.28	TCP	47961 > http [ACK] Seq=1 Ack=1 Win=585
2192	32.227811	192.168.0.28	208.80.152.2	TCP	47961 > http [ACK] Seq=1 Ack=1 Win=585
2193	32.228731	192.168.0.28	208.80.152.2	HTTP	GET /wiki/TCP/IP HTTP/1.1
2194	32.306985	192.168.0.32	192.168.0.27	TPKT	Continuation

Frame 2193 (636 bytes on wire, 636 bytes captured)

- Arrival Time: Feb 2, 2009 16:52:12.714354000
- [Time delta from previous captured frame: 0.000920000 seconds]
- [Time delta from previous displayed frame: 0.000920000 seconds]
- [Time since reference or first frame: 32.228731000 seconds]
- Frame Number: 2193
- Frame Length: 636 bytes
- Capture Length: 636 bytes
- [Frame is marked: False]
- [Protocols in frame: eth:ip:tcp:http]
- [Coloring Rule Name: HTTP]
- [Coloring Rule String: http || tcp.port == 80]

▶ Ethernet II, Src: Vmware_6f:53:d9 (00:0c:29:6f:53:d9), Dst: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
 ▶ Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)

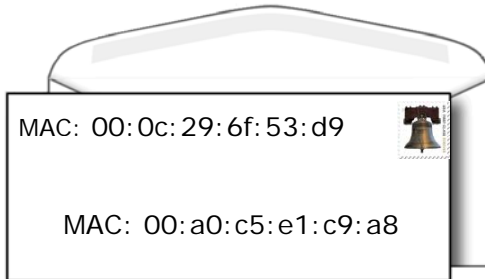
Hex dump (partial):

```

0000  00 a0 c5 e1 c9 a8 00 0c 29 6f 53 d9 08 00 45 00  ..... )oS...E.
0010  02 6e 5b 3e 40 00 40 06 b4 34 c0 a8 00 1c d0 50  .n[>@. .4....P
0020  98 02 bb 59 00 50 56 18 29 23 78 7c 57 9b 50 18  . .Y.PV. )#x|W.P.
0030  00 b7 48 00 00 00 47 45 54 20 2f 77 69 6b 69 2f  .H...GE T /wiki/
  
```

Frame (frame), 636 bytes Packets: 4260 Displayed: 4260 Marked: 0 Dropped: 0 Profile: Default

Deep dive into a single packet – Layer 2



*2-Link
layer
expanded*

(Untitled) - Wireshark

File Edit View Go Capture Analyze Statistics Help

Filter: + Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Info
2191	32.227497	208.80.152.2	192.168.0.28	TCP	47961 > http [ACK] Seq=1 Ack=1 Win=582
2192	32.227811	192.168.0.28	208.80.152.2	TCP	47961 > http [ACK] Seq=1 Ack=1 Win=582
2193	32.228731	192.168.0.28	208.80.152.2	HTTP	GET /wiki/TCP/IP HTTP/1.1
2194	32.306985	192.168.0.32	192.168.0.27	TPKT	Continuation

Frame 2193 (636 bytes on wire, 636 bytes captured)

- Ethernet II, Src: Vmware_6f:53:d9 (00:0c:29:6f:53:d9), Dst: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
 - Destination: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
 - Source: Vmware_6f:53:d9 (00:0c:29:6f:53:d9)
 - Type: IP (0x0800)
- Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)
- Transmission Control Protocol, Src Port: 47961 (47961), Dst Port: http (80), Seq: 1, Ack: 1, Len: 582
- Hypertext Transfer Protocol

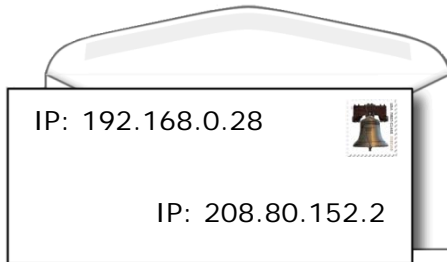
```

0000  00 a0 c5 e1 c9 a8 00 0c 29 6f 53 d9 08 00 45 00  ..... )oS...E.
0010  02 6e 5b 3e 40 00 40 06 b4 34 c0 a8 00 1c d0 50  .n[>@.@. .4....P
0020  98 02 bb 59 00 50 56 18 29 23 78 7c 57 9b 50 18  ..Y.PV. )#x|W.P.
0030  00 b7 48 00 00 00 47 45 54 20 2f 77 69 6b 69 2f  ..H...GE T /wiki/
    
```

Frame (frame), 636 bytes Packets: 4260 Displayed: 4260 Marked: 0 Dropped: 0 Profile: Default

*Note the use of **MAC addresses** in this layer. The first half of the MAC address identifies the NIC vendor.*

Deep dive into a single packet – Layer 3



*3-Network
layer
expanded*

No.	Time	Source	Destination	Protocol	Info
2191	32.227437	208.80.152.2	192.168.0.28	TCP	47901 [EST, ACK] Seq=0 Ack=1 Win=...
2192	32.227811	192.168.0.28	208.80.152.2	TCP	47961 > http [ACK] Seq=1 Ack=1 Win=585...
2193	32.228731	192.168.0.28	208.80.152.2	HTTP	GET /wiki/TCP/IP HTTP/1.1
2194	32.306985	192.168.0.32	192.168.0.27	TPKT	Continuation

Frame 2193 (636 bytes on wire, 636 bytes captured)

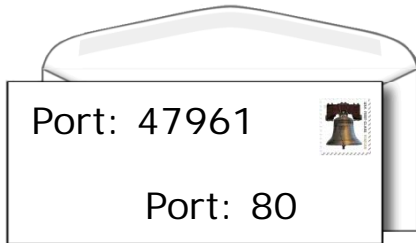
- Ethernet II, Src: Vmware_6f:53:d9 (00:0c:29:6f:53:d9), Dst: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
- Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)
 - Version: 4
 - Header length: 20 bytes
 - Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)
 - Total Length: 622
 - Identification: 0x5b3e (23358)
 - Flags: 0x04 (Don't Fragment)
 - Fragment offset: 0
 - Time to live: 64
 - Protocol: TCP (0x06)
 - Header checksum: 0xb434 [correct]
 - Source: 192.168.0.28 (192.168.0.28)

0000 00 a0 c5 e1 c9 a8 00 0c 29 6f 53 d9 08 00 45 00)oS...E.
 0010 02 6e 5b 3e 40 00 40 06 b4 34 c0 a8 00 1c d0 50 n[>@.@. .4....P
 0020 98 02 bb 59 00 50 56 18 29 23 78 7c 57 9b 50 18 ...Y.PV.)#x|W.P.
 0030 00 b7 48 00 00 00 47 45 54 20 2f 77 69 6b 69 2f ..H...GE T /wiki/

Frame (frame), 636 bytes Packets: 4260 Displayed: 4260 Marked: 0 Dropped: 0 Profile: Default

Note the use of IP addresses in this layer.

Deep dive into a single packet – Layer 4



*Transport
layer
expanded*

(Untitled) - Wireshark

File Edit View Go Capture Analyze Statistics Help

Restart the running live capture

No.	Time	Source	Destination	Protocol	Info
2191	32.227497	208.80.152.2	192.168.0.28	TCP	47961 > 47961 [FIN, ACK] Seq=0 Ack=1 Win=0 Len=0
2192	32.227811	192.168.0.28	208.80.152.2	TCP	47961 > http [ACK] Seq=1 Ack=1 Win=585 Len=0
2193	32.228731	192.168.0.28	208.80.152.2	HTTP	GET /wiki/TCP/IP HTTP/1.1
2194	32.306985	192.168.0.32	192.168.0.27	TPKT	Continuation

Frame 2193 (636 bytes on wire, 636 bytes captured)

- Ethernet II, Src: Vmware_6f:53:d9 (00:0c:29:6f:53:d9), Dst: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
- Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)
- Transmission Control Protocol, Src Port: 47961 (47961), Dst Port: http (80), Seq: 1, Ack: 1, Len: 582
 - Source port: 47961 (47961)
 - Destination port: http (80)
 - Sequence number: 1 (relative sequence number)
 - [Next sequence number: 583 (relative sequence number)]
 - Acknowledgement number: 1 (relative ack number)
 - Header length: 20 bytes
 - Flags: 0x18 (PSH,ACK)
 - Window size: 5856 (scaled)
 - Checksum: 0x4800 [correct]
 - Hypertext Transfer Protocol

0000 00 a0 c5 e1 c9 a8 00 0c 29 6f 53 d9 08 00 45 00)oS...E.
 0010 02 6e 5b 3e 40 00 40 06 b4 34 c0 a8 00 1c d0 50 .n[>@.@. .4....P
 0020 98 02 bb 59 00 50 56 18 29 23 78 7c 57 9b 50 18 ...Y.PV.)#x|W.P.
 0030 00 b7 48 00 00 00 47 45 54 20 2f 77 69 6b 69 2f ..H...GE T /wiki/

File: "/tmp/etherXXXXFIEWBH" 23... Packets: 4260 Displayed: 4260 Marked: 0 Dropped: 0 Profile: Default

*Note the use of **ports** in this layer. Port 80 is for web servers.*

Deep dive into a single packet – Application layer

```

GET
/wiki/TCP
/IP
HTTP/1.1
\r\n
    
```

*Application
layer
expanded*

The screenshot shows the Wireshark interface with the following details:

- Filter:** (empty)
- Packet List:**

No.	Time	Source	Destination	Protocol	Info
2191	32.227497	208.80.152.2	192.168.0.28	TCP	47961 > 47961 [STW, ACK] Seq=0 Ack=1 Win=...
2192	32.227811	192.168.0.28	208.80.152.2	TCP	47961 > http [ACK] Seq=1 Ack=1 Win=585...
2193	32.228731	192.168.0.28	208.80.152.2	HTTP	GET /wiki/TCP/IP HTTP/1.1
2194	32.306985	192.168.0.32	192.168.0.27	TPKT	Continuation
- Packet Details:**
 - Frame 2193 (636 bytes on wire, 636 bytes captured)
 - Ethernet II, Src: Vmware_6f:53:d9 (00:0c:29:6f:53:d9), Dst: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
 - Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)
 - Transmission Control Protocol, Src Port: 47961 (47961), Dst Port: http (80), Seq: 1, Ack: 1, Len: 582
 - Hypertext Transfer Protocol
 - GET /wiki/TCP/IP HTTP/1.1\r\n
 - Host: en.wikipedia.org\r\n
 - User-Agent: Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.9.0.3) Gecko/2008101315 Ubuntu/8.10 (intrepid) Firefox/3.0.1
 - Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8\r\n
 - Accept-Language: en-us,en;q=0.5\r\n
 - Accept-Encoding: gzip,deflate\r\n
 - Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7\r\n
 - Keep-Alive: 300\r\n
- Packet Bytes:**

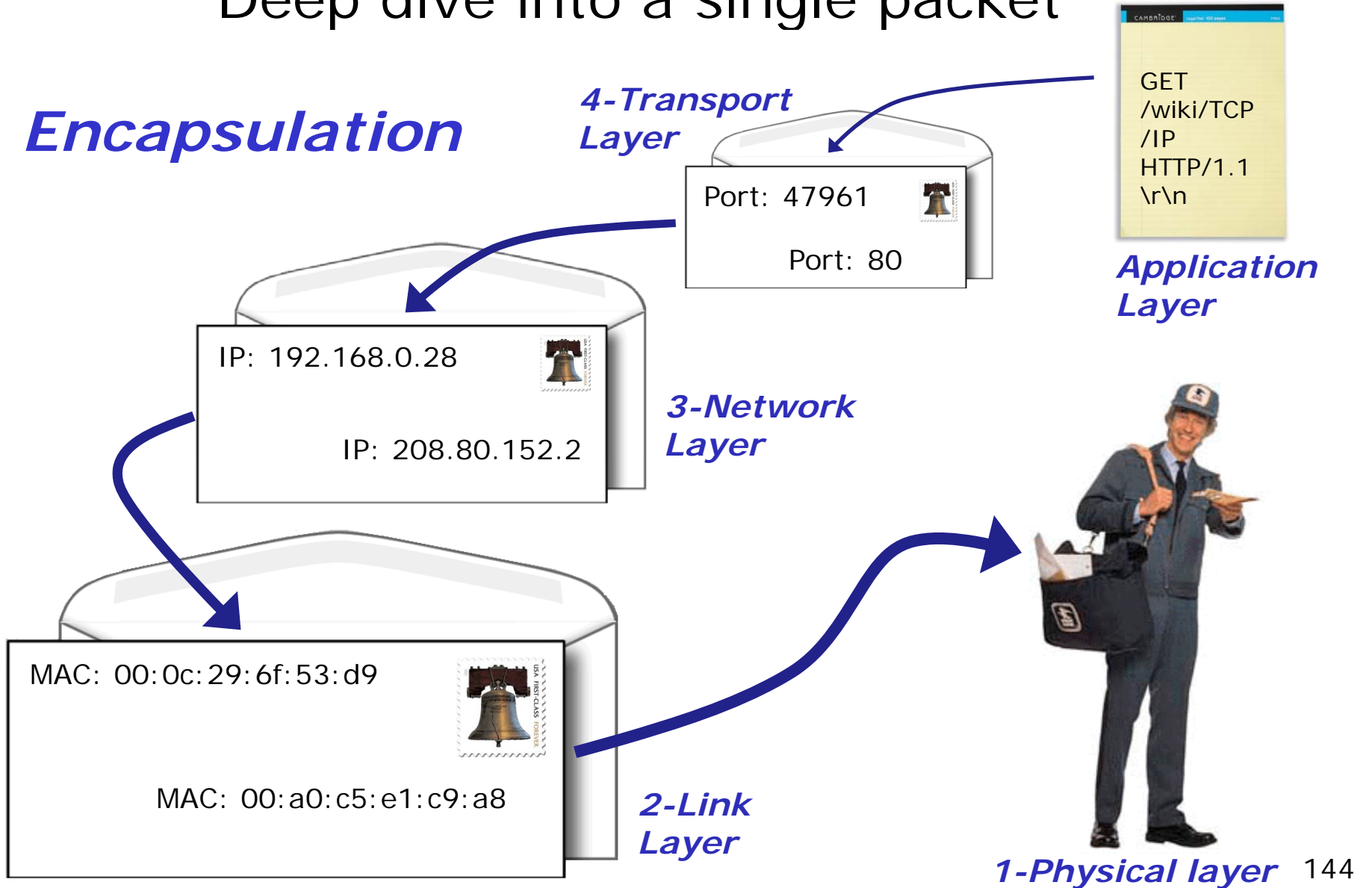
```

0000  00 a0 c5 e1 c9 a8 00 0c 29 6f 53 d9 08 00 45 00  ....oS...E.
0010  02 6e 5b 3e 40 00 40 06 b4 34 c0 a8 00 1c d0 50  .n[>@.@. .4....P
0020  98 02 bb 59 00 50 56 18 29 23 78 7c 57 9b 50 18  ...Y.PV. )#x|W.P.
0030  00 b7 48 00 00 00 47 45 54 20 2f 77 69 6b 69 2f  ..H...GE T /wiki/
    
```

At last we get to the actual request being sent to the web server application

Deep dive into a single packet

Encapsulation



Reconciling the TCP/IP Layers

OSI	CIS 81	Nemeth Text	Wireshark	Source/ Destination	Unit	Devices
7 - Application	Application	Application	SSH, HTTP, DNS, RIP, Bootstrap (DHCP), SMB	An application program or service	Data	
6 - Presentation						
5 - Session						
4 - Transport	Transport	Transport	TCP/UDP	Port	Segment, Datagram	
3 - Network	Internet	Network	Internet Protocol	IP	Packet	Router
2 - Data link	Network Access	Link	Ethernet II	MAC	Ethernet Frame	Switch, NIC
1 - Physical		Physical	Frame	RJ-45 Jack	Bits	Hub, NIC, cables

- *For all this to work standards are essential.*
- *Each layer uses a protocol that follows a standard.*
- *Network equipment providers and software vendors build to standards so everything can interoperate.*



Standards

Standards

- How do we get all this stuff to work together?
- How can multiple vendors products interoperate?

Answer: Standards

- IEEE – lower layer focus, e.g. Ethernet
- IETF – higher layer focus, e.g. HTTP protocol
- “Defacto” – vendor with market share sets, e.g. MS Word Doc

Standards IEEE

- Examples: 802.3 (Ethernet), 802.11 (WLAN)
- Search: **<http://ieeexplore.ieee.org/xpl/standards.jsp>**



Example: the active Ethernet standard 802.3-2005

Standards

IETF (Internet Engineering Task Force)

- Published as RFCs (Request for Comments)
- Examples: TCP, IP, HTTP, FTP, DNS, DHCP, SSH
- Status
 - Informational (e.g. RFC 1983 "Glossary")
 - Experimental
 - Best Current Practice
 - Standards Track
 - Proposed Standard
 - Draft Standard
 - Internet Standard
 - Historic
- RFC Search Engine: <http://www.rfc-editor.org/rfcsearch.html>

Standards

IETF (Internet Engineering Task Force)

Example: RFC 2131 for DHCP

Number	Title	Author or Ed.	Date	Format	More Info (Obs&Upd)	Status
RFC5223	Discovering Location-to-Service Translation (LoST) Servers Using the Dynamic Host Configuration Protocol (DHCP)	H. Schulzrinne, J. Polk, H. Tschofenig	August 2008	ASCII		PROPOSED STANDARD
RFC5192	DHCP Options for Protocol for Carrying Authentication for Network Access (PANA) Authentication Agents	L. Morand, A. Yegin, S. Kumar, S. Madanapalli	May 2008	ASCII		PROPOSED STANDARD

Network Working Group
Request for Comments: 2131
Obsoletes: 1541
Category: Standards Track

R. Droms
Bucknell University
March 1997

Dynamic Host Configuration Protocol

Status of this memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Abstract

The Dynamic Host Configuration Protocol (DHCP) provides a framework for passing configuration information to hosts on a TCP/IP network. DHCP is based on the Bootstrap Protocol (BOOTP) [7], adding the capability of automatic allocation of reusable network addresses and additional configuration options [19]. DHCP captures the behavior of BOOTP relay agents [7, 21], and DHCP participants can interoperate with BOOTP participants [9].

Table of Contents

- 1. Introduction. 2
- 1.1 Changes to RFC1541. 3
- 1.2 Related Work. 4
- 1.3 Problem definition and issues. 4

NIC Inventory

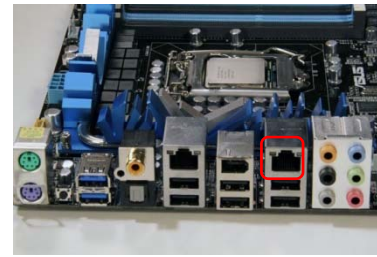
Connecting your Linux system to the Network

1. **Identify the NIC in your system (vendor and model)**
2. Locate a driver for your NIC
 - may be already available with your distro
 - may be available from NIC vendor
 - may be available from chipset vendor
 - may have get source and build (compile) it
3. Load the driver (**insmod** or **modprobe** command)
4. Bring up and configure the interface (ifconfig)

NIC (Network Interface Controller)



NIC card

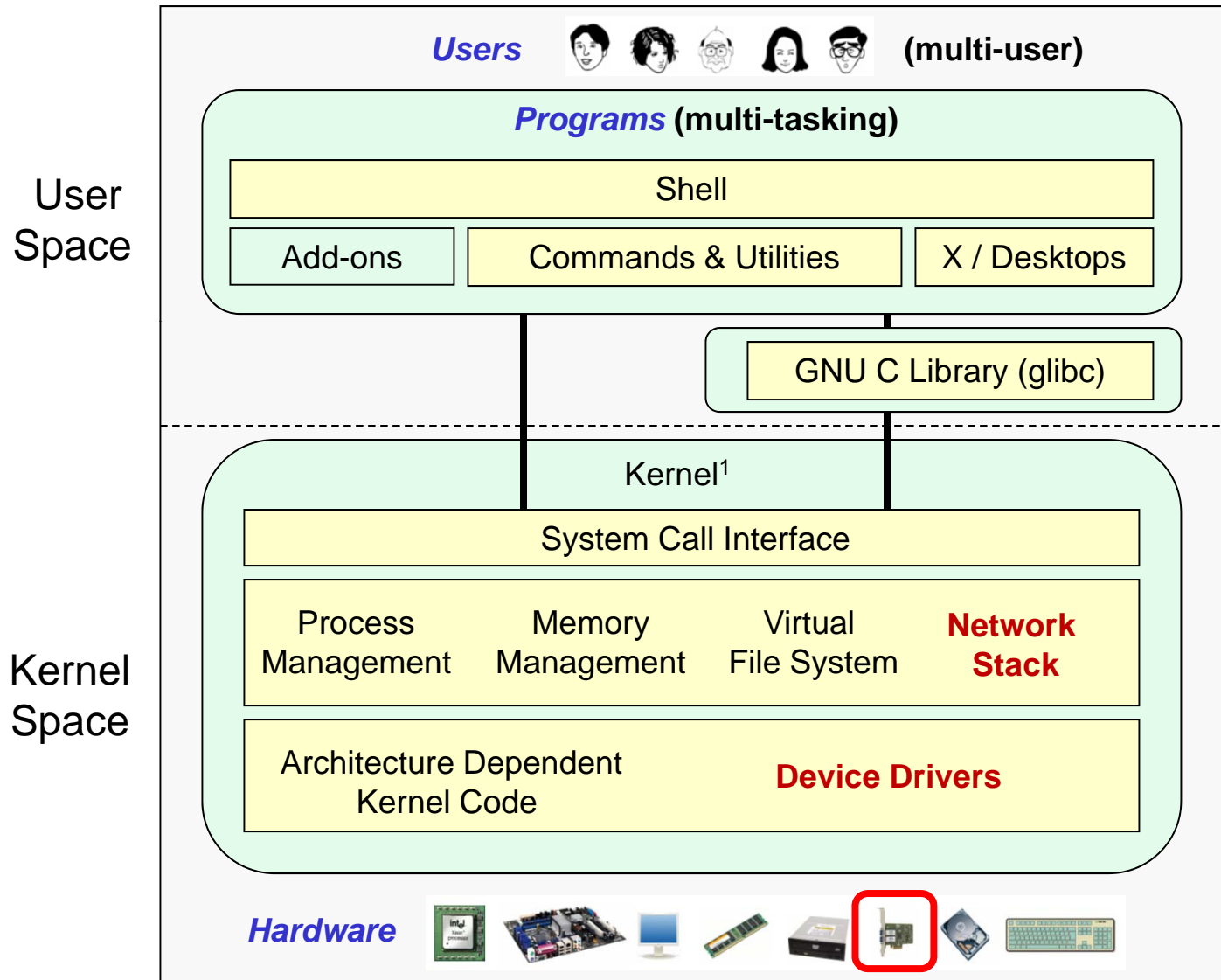


NIC on the motherboard

- The NIC is used by a computer to send and receive packets on the network.
- Most PC NICs are now part of the motherboard rather than a card.
- A NIC operates at the level 2 (Link Layer) and can send and receive Ethernet frames using MAC addresses.
- Multiple NICs allow a computer to be on multiple networks or they can be teamed for higher performance.
- On the Red Hat family, kudzu is used to probe for new hardware at boot time. If you install a second NIC after installation you will get prompted to configure it.



GNU/Linux Operating System Architecture

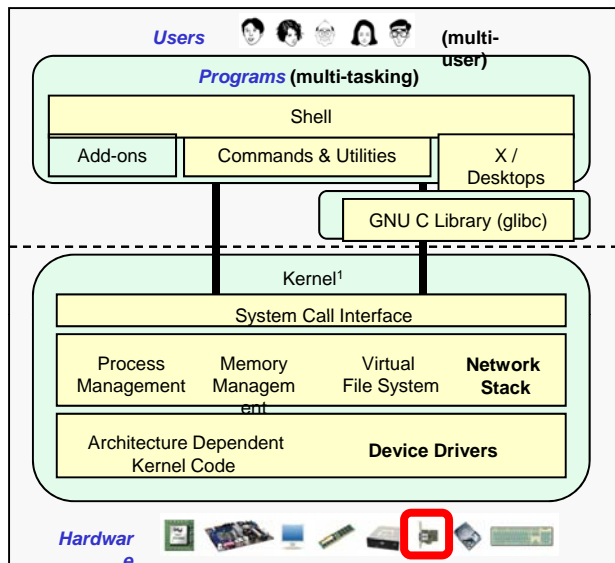


The network stack is implemented in the Linux kernel

NIC drivers are implemented as kernel modules than can be dynamically loaded and unloaded

¹See "Anatomy of the Linux kernel" by M. Tim Jones at <http://www-128.ibm.com/developerworks/linux/library/l-linux-kernel/>

NIC Hardware Inventory



How to determine what NIC you have:

- Use **lspci** to show PCI hardware on the computer.
- Use **dmesg** and look for NIC related information
- Use the web to check the technical specifications for your computer or mother board (assumes you have not made any NIC changes)

NIC Hardware Inventory



Using **lspci** command to show NIC information

```
[root@celebrian ~]# lspci
00:00.0 Host bridge: Intel Corporation 440BX/ZX/DX - 82443BX/ZX/DX Host bridge (rev 01)
00:01.0 PCI bridge: Intel Corporation 440BX/ZX/DX - 82443BX/ZX/DX AGP bridge (rev 01)
00:07.0 ISA bridge: Intel Corporation 82371AB/EB/MB PIIX4 ISA (rev 08)
00:07.1 IDE interface: Intel Corporation 82371AB/EB/MB PIIX4 IDE (rev 01)
00:07.3 Bridge: Intel Corporation 82371AB/EB/MB PIIX4 ACPI (rev 08)
00:0f.0 VGA compatible controller: VMware Inc Abstract SVGA II Adapter
00:10.0 SCSI storage controller: LSI Logic / Symbios Logic 53c1030 PCI-X Fusion-MPT Dual
  Ultra320 SCSI (rev 01)
00:11.0 Ethernet controller: Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE] (rev 10)
00:12.0 Ethernet controller: Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE] (rev 10)
[root@celebrian ~]#
```

The Celebrian VM has two AMD 79C970 NICs installed

NIC Hardware Inventory



Using **dmesg** to show NIC related information

```
[root@celebrian ~]# dmesg
```

```
< snipped >
```

```
hdc: ATAPI 1X CD-ROM drive, 32kB Cache, UDMA(33)
```

```
Uniform CD-ROM driver Revision: 3.20
```

```
pcnet32.c:v1.32 18.Mar.2006 tsbogend@alpha.franken.de
```

```
ACPI: PCI Interrupt 0000:00:11.0[A] -> GSI 18 (level, low) -> IRQ 177
```

```
pcnet32: PCnet/PCI II 79C970A at 0x1400, 00 0c 29 e5 48 fe assigned IRQ 177.
```

```
eth0: registered as PCnet/PCI II 79C970A
```

```
ACPI: PCI Interrupt 0000:00:12.0[A] -> GSI 19 (level, low) -> IRQ 185
```

```
pcnet32: PCnet/PCI II 79C970A at 0x1480, 00 0c 29 e5 48 08 assigned IRQ 185.
```

```
eth1: registered as PCnet/PCI II 79C970A
```

```
pcnet32: 2 cards_found.
```

```
piix4_smbus 0000:00:07.3: Found 0000:00:07.3 device
```

```
piix4_smbus 0000:00:07.3: Host SMBus controller not enabled!
```

```
input: PC Speaker as /class/input/input2
```

```
sd 0:0:0:0: Attached scsi generic sg0 type 0
```

```
Floppy drive(s): fd0 is 1.44M
```

```
< snipped >
```

*The pcnet32 driver is maintained
by Thomas Bogendörfer*

The Celebrian VM has two AMD 79C970 NICs installed

NIC Hardware Inventory



Use **dmesg** with **grep** to narrow down the output

```
[root@celebrian ~]# dmesg | grep eth0
```

```
eth0: registered as PCnet/PCI II 79C970A
```

```
eth0: link up
```

```
eth0: link up
```

```
eth0: no IPv6 routers present
```

```
[root@celebrian ~]# dmesg | grep net
```

```
audit: initializing netlink socket (disabled)
```

```
SELinux: Registering netfilter hooks
```

```
Initializing IPsec netlink socket
```

```
pcnet32.c:v1.32 18.Mar.2006 tsbogend@alpha.franken.de
```

```
pcnet32: PCnet/PCI II 79C970A at 0x1400, 00 0c 29 12 50 1e assigned IRQ 177.
```

```
eth0: registered as PCnet/PCI II 79C970A
```

```
pcnet32: PCnet/PCI II 79C970A at 0x1480, 00 0c 29 12 50 28 assigned IRQ 185.
```

```
eth1: registered as PCnet/PCI II 79C970A
```

```
pcnet32: 2 cards_found.
```

```
VMware vmxnet virtual NIC driver release 1.0.8 build-126538
```

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

The dmesg command with no options will show all the kernel messages in the kernel ring buffer. A good way to see bootup status.



NIC Hardware Inventory

Using the web to find NIC information

Example: An HP Pavilion a6750t uses a ASUS: IPIBL-LB (Benicia) motherboard which has a Realtek 8111C 10/100/1000 Mb/s (Gigabit Ethernet) Integrated LAN

Motherboard Specifications, IPIBL-LB (Benicia) - Mozilla Firefox

http://h10025.www1.hp.com/ewfrf/wc/document?docname=c01324212&lc=en&dlc=en&cc=us

Onboard LAN

- 1 Realtek 8111C 10/100/1000 Mb/s (Gigabit Ethernet) Integrated LAN

NOTE: Gigabit Ethernet is backwards compatible with 10/100 Mb/s network hardware.

Onboard audio

- Audio CODEC: ALC888S
- 7.1 channel high-definition audio

Onboard USB

- USB 2.0
- Twelve ports total
 - Four connectors on back panel
 - Six headers (four 1x4 and two 2x5 USB headers) support eight additional USB ports/devices

NOTE: Some USB ports may not be available externally for customer use. For more information, see model specifications.

Onboard 1394

- Type: IEEE 1394a 400Mb/s

Help us help you
This document:
» Was helpful
» Was not helpful
» Does not apply

Find: reverse Next Previous Highlight all Match case

Done

Class Activity NIC Inventory

1. Run Frodo and Celebrian if they are not already up and login as cis192 then **su -** to root.
2. Use the **lspci** command and locate the NIC hardware.
3. Use the **dmesg | more** command browse through the kernel bootup messages.
4. Narrow down the output with **dmesg | grep pcnet** and **dmesg | grep eth**
5. Try again with **dmesg | grep -i pcnet** (the **-i** option makes the search case insensitive)
6. How many NICs does Frodo have? How many does Celebrian have?
7. What NIC vendor is used on both VMs?

NIC Drivers

Connecting your Linux system to the Network

1. Identify the NIC in your system (vendor and model)

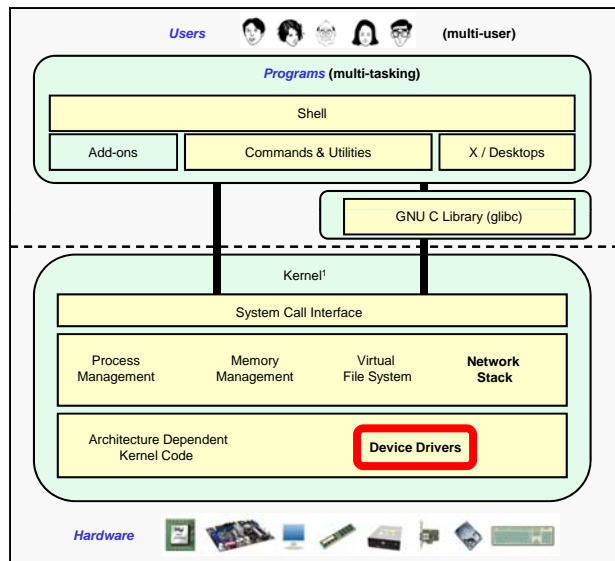
2. Locate a driver for your NIC

- may be already available with your distro
- may be available from NIC vendor
- may be available from chipset vendor
- may have get source and build (compile) it

3. Load the driver (**insmod** or **modprobe** command)

4. Bring up and configure the interface (ifconfig)

NIC Drivers



- The Linux kernel requires a specific driver to correctly use a specific vendors NIC hardware.
- Linux NIC drivers are implemented as **dynamic kernel modules**.
- Getting the right Linux NIC driver for your NIC can be **problematic**.
- 😊 Newer distributions are able to probe NIC hardware and automatically install the correct driver if they can recognize the NIC.
- ☹️ An older distribution may not recognize a newer NIC and you will have to manually locate, sometimes compile and install the correct NIC driver.

While there are hundreds of different NICs there are relatively few NIC chipsets many of which have Linux support

Locating NIC Drivers

- Newer distribution, older NICs – no problem, correct NIC driver is chosen automatically during installation. **/etc/modules.conf** (RH9) or **/etc/modprobe.conf** (CentOS 5) is updated with drivers to load at boot time.
- Check the computer or NIC vendors web site for NIC drivers. For example, HP supplies Linux drivers for many of its servers (but few of its desktops)
- Look in **/lib/modules/\$(uname -r)/kernel/drivers/net** directory. This has all the NIC drivers that have been compiled for your kernel. To choose the right one try **<http://tldp.org/HOWTO/Ethernet-HOWTO.html>**
- If the preceding methods have not worked you can always install an older NIC in your computer and use that until you find the correct driver for the newer NIC.
- Start googling, try **linux *nic-name* driver**. You may have to download source and compile a driver from the chipset vendor's site using their instructions.



NIC Drivers

Chipset vendor Downloads

97.) What are the Linux tg3, bnx2 and b44 drivers?

To better support users, Broadcom has been actively supporting, maintaining, and testing the in kernel Linux drivers for the NetXtreme, NetXtreme II, NetLink and 4401 product lines. The following is list of drivers supported for each product line:

- NetXtreme and NetLink - tg3
- NetXtreme II - bnx2
- 4401 - b44

Broadcom officially releases the Linux drivers as packages. The Linux driver packages released by Broadcom are based on the latest in-kernel drivers with some added compatibility code to make it backwards compatible with most 2.6 kernels and some 2.4 kernels (generally newer than 2.4.24). If you are using the latest upstream kernel from www.kernel.org, you generally do not need to download the Linux driver packages from Broadcom as the latest upstream kernel has the latest Linux driver patches.

For the NetXtreme and NetLink product lines, the tg3 driver is now the only Linux driver that Broadcom supports. Accordingly, Broadcom has discontinued support for the bcm5700 driver and no longer provides updates.

There are a few minor differences to be aware of if you are migrating from the bcm5700 driver to the tg3 driver. The tg3 driver does not support the Broadcom proprietary load balancing software module known as BASP. The Linux bonding driver and 802.1q driver provide similar functionalities and can be used with tg3. BASP will also be discontinued. The tg3 driver also does not support module parameters to configure the device (line speed, flow control, ring sizes, etc) but relies on standard Linux utilities such as ethtool. Other than these differences, the two drivers are very similar in terms of hardware support, robustness, and performance.

[Back to Top](#)

http://www.broadcom.com/support/ethernet_nic/downloaddrivers.php



NIC Drivers

Server vendor Downloads

HP ProLiant BL20p G4 Server series - Download drivers and software - HP Business Support Center - Mozilla Firefox

http://h20000.www2.hp.com/bizsupport/TechSupport/SoftwareIndex.jsp?lang=en&cc=us&prod=...

Search: [More options](#)

Business Support Center | All of HP United States

Download drivers and software

HP ProLiant BL20p G4 Server series

HP Passport Sign-in
User ID:
Password:

Register | Learn more... | Go

Tasks for my selected product

- Download drivers and software
- Troubleshoot a problem
- Setup, install, and configure
- Discover and use a product
- Perform regular maintenance
- Upgrade and migrate
- Recycle and dispose

Subscribe to driver and support alerts

Sign up now for customized driver, security, patch, and support email alerts. Only receive updates on products you specify or own when you want them.

Operating System: **Red Hat Enterprise Linux 5 Server (x86)**

By downloading, you agree to the terms and conditions of the [HP Software License Agreement](#).

Choose your software/driver language: English (American)

Quick jump to downloads by category...

- BIOS - System ROM
- Driver - Lights-Out Management
- Driver - Network

Find: reverse | Next | Previous | Highlight all | Match case

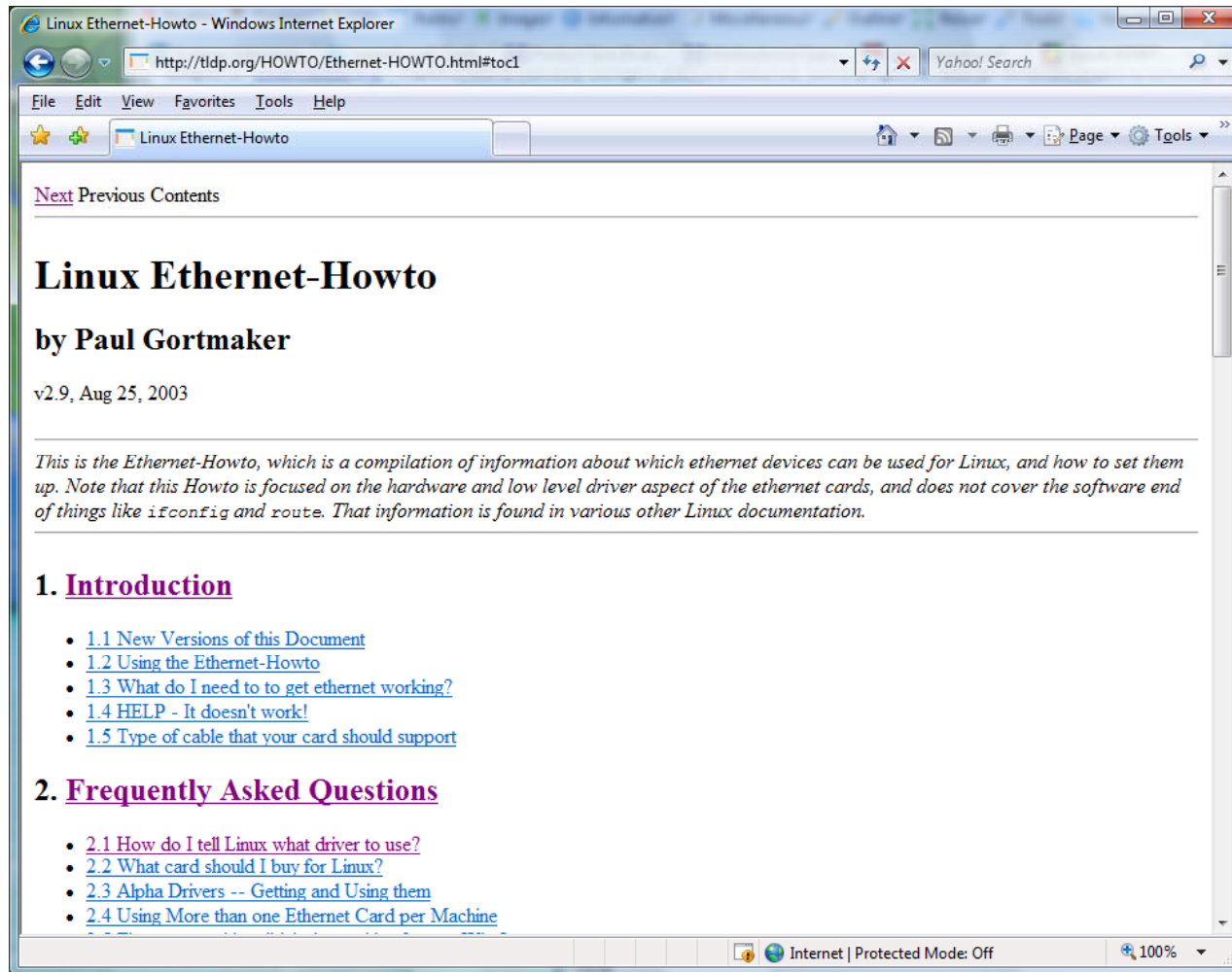
Driver - Network					
Description	Current version	Size (MB)	Estimated download time	Previous version	
HP NC-Series Broadcom 1Gb Multifunction Driver for Linux (multi-part download)	1.8.1c-1 (B) 14 Nov 2008			1.8.1c-1 11 Nov 2008	
Part 1		0.31	56K: <1m 512K: <1m		Download »
Part 2		0.008	56K: <1m 512K: <1m		Download »
HP NC-Series Broadcom TG3 Driver for Linux (multi-part download)	3.92n-1 11 Nov 2008			3.92e-3 7 Aug 2008	
Part 1		0.14	56K: <1m 512K: <1m		Download »
Part 2		0.011	56K: <1m 512K: <1m		Download »
HP NC-Series iSCSI Offload Driver for Linux (multi-part download)	1.3.6-1 11 Nov 2008			1.2.14-1 8 Jul 2008	
Part 1		0.1	56K: <1m 512K: <1m		Download »
Part 2		0.011	56K: <1m 512K: <1m		Download »
HP NC-Series iSCSI Offload Initiator Utilities for Red Hat Enterprise Linux 5 (multi-part download)	6.2.0.868-0.7c 8 Jul 2008			6.2.0.742-0.6b 18 Dec 2007	
Part 1		0.26	56K: <1m 512K: <1m		Download »
Part 2		0.005	56K: <1m 512K: <1m		Download »
HP NC-Series open-iscsi Boot Package for Linux (multi-part download)	1.1.2-0 8 Jul 2008			1.1.0-6 18 Dec 2007	

http://www.hp.com/#Support



NIC Drivers

<http://tldp.org/HOWTO/Ethernet-HOWTO.html>

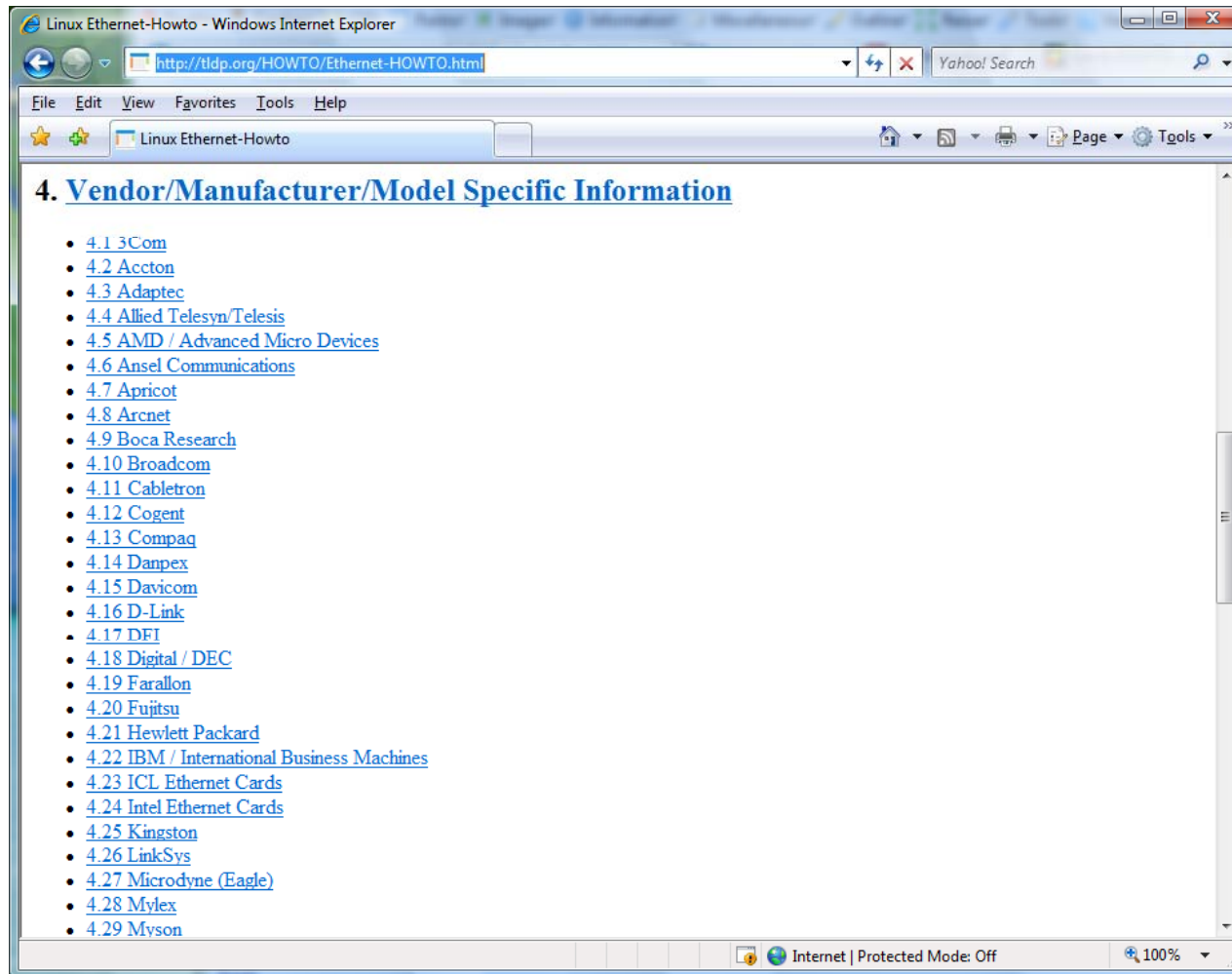


The TLDP web site has an Ethernet Howto that is extremely valuable when trying to find the correct NIC drivers

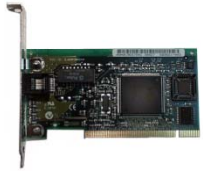


NIC Drivers

<http://tldp.org/HOWTO/Ethernet-HOWTO.html>



*See section 4 for
specific NICs*



NIC Drivers

<http://tldp.org/HOWTO/Ethernet-HOWTO.html>

*The AMD 79C970 on the Celebrian VM uses the **pcnet32** driver*

A screenshot of a Windows Internet Explorer browser window displaying the Linux Ethernet-Howto website. The browser's address bar shows the URL <http://tldp.org/HOWTO/Ethernet-HOWTO-4.html#ss4.5>. The page content includes a warning about kernel bugs, followed by sections for AMD 79C965 (PCnet-32), AMD 79C970/970A (PCnet-PCI), and AMD 79C971 (PCnet-FAST). The AMD 79C970/970A (PCnet-PCI) section is highlighted with a red rounded rectangle. The status for this chip is "Supported, Driver Name: pcnet32". The description states it is similar to the PCnet-32 but designed for PCI bus based systems. A note mentions a hardware problem with the Boca implementation on fast Pentium machines. Below this, the AMD 79C971 (PCnet-FAST) section is also visible, with status "Supported, Driver Name: pcnet32". The browser's status bar at the bottom shows "Done", "Internet | Protected Mode: Off", and "100%".

NIC Drivers



*NIC drivers are **kernel modules** and are kept in a specific directory so the kernel knows where to find them. Note, they were .o files in older distros.*

```
[root@celebrian ~]# uname -r
2.6.18-92.1.22.el5
```

```
[root@celebrian ~]# ls /lib/modules/$(uname -r)/kernel/drivers/net
```

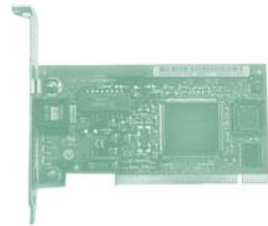
```
3c59x.ko      dummy.ko      natsemi.ko    ppp_synctty.ko  sunhme.ko
8139cp.ko    e1000         ne2k-pci.ko   qla3xxx.ko      tg3.ko
8139too.ko   e1000e        netconsole.ko r8169.ko         tlan.ko
8390.ko      e100.ko       netxen        s2io.ko         tokenring
acenic.ko    epic100.ko    ns83820.ko    sis190.ko       tulip
amd8111e.ko  fealnx.ko     pcmcia        sis900.ko       tun.ko
b44.ko       forcedeth.ko  pcnet32.ko    skge.ko         typhoon.ko
bnx2.ko      ifb.ko        phy           sky2.ko         via-rhine.ko
bnx2x.ko     igb           ppp_async.ko  slhc.ko         via-velocity.ko
bonding      ixgb          ppp_deflate.ko  slip.ko         wireless
cassini.ko   ixgbe        ppp_generic.ko  starfire.ko
chelsio      mii.ko        ppp_mppe.ko    sundance.ko
cxgb3        mlx4          pppoe.ko       sungem.ko
dl2k.ko      myri10ge     pppox.ko       sungem_phy.ko
```

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

```
[root@celebrian ~]# file /lib/modules/$(uname -r)/kernel/drivers/net/e100.ko
/lib/modules/2.6.18-92.1.22.el5/kernel/drivers/net/e100.ko: ELF 32-bit LSB relocatable,
  Intel 80386, version 1 (SYSV), not stripped
```

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

VMware Server Virtual Machines The Virtual NICs



Note: All the VMs have the same AMD 79c970 NICs which use the pcnet32 driver

Treebeard



eth0 eth1

Arwen



eth0 eth1

Elrond



eth0 eth1

Celebrian



eth0 eth1

Legolas



eth0 eth1

Servers

Frodo



eth0

Sauron



eth0

Fang



eth0

Nosmo



eth0

Sniffer



eth0
eth1
eth2
eth3

Clients

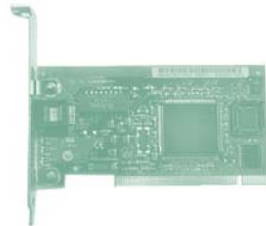
Special

Real NICs can be more challenging

System Pod



*Press middle button
to boot Linux*



*There are a variety on NICs on the
older systems in the System pods*

NIC	Linux Driver
Intel PRO 100 NIC	e100
D-Link NICs with RealTek 8129/8139 chipsets	8139too
3Com 3c905x NICs	3c59x
Lite-on Communications LNE 100TX cards with DEC chipsets	tulip
AMD 79c970 NIC (used in VMware VMs)	pcnet32

NIC Drivers



Some drivers that have been used with the PC's in the CIS Lab

```
[root@celebrian ~]# ls /lib/modules/$(uname -r)/kernel/drivers/net
```

```
3c59x.ko      dummy.ko      natsemi.ko    ppp_synctty.ko  sunhme.ko
8139cp.ko    e1000         ne2k-pci.ko   qla3xxx.ko      tg3.ko
8139too.ko   e1000e        netconsole.ko r8169.ko        tlan.ko
8390.ko      e100.ko       netxen        s2io.ko         tokenring
acenic.ko    epic100.ko    ns83820.ko    sis190.ko       tulip
amd8111e.ko  fealnx.ko     pcmcia        sis900.ko       tun.ko
b44.ko       forcedeth.ko  pcnet32.ko    skge.ko         typhoon.ko
bnx2.ko      ifb.ko        phy           sky2.ko         via-rhine.ko
bnx2x.ko     igb           ppp_async.ko  slhc.ko         via-velocity.ko
bonding      ixgb          ppp_deflate.ko  slip.ko         wireless
cassini.ko   ixgbe        ppp_generic.ko starfire.ko
chelsio     mii.ko        ppp_mppe.ko   sundance.ko
cxgb3       mlx4          pppoe.ko      sungem.ko
dl2k.ko     myri10ge     pppox.ko      sungem_phy.ko
[root@celebrian ~]#
```

NIC	Linux Driver
Intel PRO 100 NIC	e100
D-Link NICs with RealTek 8129/8139 chipsets	8139too
3Com 3c905x NICs	3c59x
Lite-on Communications LNE 100TX cards with DEC chipsets	tulip
AMD 79c970 NIC (used in VMware VMs)	pcnet32

Managing

(showing, installing, removing)

Drivers

Connecting your Linux system to the Network

1. Identify the NIC in your system (vendor and model)
2. Locate a driver for your NIC
 - may be already available with your distro
 - may be available from NIC vendor
 - may be available from chipset vendor
 - may have get source and build (compile) it
- 3. Load the driver (insmod or modprobe command)**
4. Bring up and configure the interface (ifconfig)

Commands for handling NIC drivers (kernel modules)

- To show available NIC drivers:
ls /lib/modules/\$(uname -r)/kernel/drivers/net
- To show loaded kernel modules including NIC drivers
lsmod
example: **lsmod | grep pcnet32** (show NIC drivers used on VMs)
- To remove (unload) a NIC driver
rmmmod driver
example: **rmmmod pcnet32** (removes pcnet32 VM NIC driver)
Do not specify the path or suffix (.ko) for drivers
- To insert (load) a NIC driver
insmod driver
modprobe driver
example: **modprobe pcnet32** (installs pcnet32 VM NIC driver)
modprobe is more intelligent and recommended over insmod

Commands for handling NIC drivers (kernel modules)

To show available NIC drivers:

ls /lib/modules/\$(uname -r)/kernel/drivers/net

```
Bluetooth: L2CAP ver 2.8
Bluetooth: L2CAP socket layer initialized
Bluetooth: RFCOMM socket layer initialized
Bluetooth: RFCOMM TTY layer initialized
Bluetooth: RFCOMM ver 1.8
Bluetooth: HIDP (Human Interface Emulation) ver 1.1
SELinux: initialized (dev autofs, type autofs), uses genfs_contexts
SELinux: initialized (dev autofs, type autofs), uses genfs_contexts
SELinux: initialized (dev autofs, type autofs), uses genfs_contexts
[root@elrond ~]# ls /lib/modules/2.6.18-92.el5/kernel/drivers/net/
3c59x.ko      dummy.ko      natsemi.ko    ppp_synctty.ko  sunhme.ko
8139cp.ko    e1000         ne2k-pci.ko   qla3xxx.ko      tg3.ko
8139too.ko   e1000e        netconsole.ko r8169.ko         tlan.ko
8390.ko      e100.ko       netxen        s2io.ko          tokenring
acenic.ko    epic100.ko    ns83820.ko    sis190.ko        tulip
amd8111e.ko fealnx.ko     pcmcia        sis900.ko        tun.ko
b44.ko       forcedeth.ko pcnet32.ko     skge.ko          typhoon.ko
bnx2.ko      ifb.ko        phy           sky2.ko          via-rhine.ko
bnx2x.ko     igb           ppp_async.ko  slhc.ko          via-velocity.ko
bonding      ixgb          ppp_deflate.ko slip.ko           wireless
cassini.ko   ixgbe        ppp_generic.ko starfire.ko
chelsio     mii.ko        ppp_mppe.ko   sundance.ko
cxgb3       mlx4          ppoe.ko       sungem.ko
dl2k.ko     myri10ge     pppox.ko      sungem_phy.ko
[root@elrond ~]#
```

*Use tab
completes!*

We are using the pcnet32 driver for the VM NICs

Commands for handling NIC drivers (kernel modules)

To show loaded kernel modules including NIC drivers

lsmod

example: **lsmod | grep pcnet32** (show NIC drivers used on VMs)

```
[root@elrond ~]# lsmod | head
Module                Size  Used by
autofs4               24517  2
hidp                  23105  2
rfcomm                42457  0
l2cap                 29505  10 hidp,rfcomm
bluetooth             53797  5 hidp,rfcomm,l2cap
vmxnet                15488  0
vmhgfs                44176  0
sunrpc                144893  1
ip_contrack_netbios_ns 6977  0
[root@elrond ~]# lsmod | grep pcnet32
pcnet32               35269  0
mii                   9409  1 pcnet32
[root@elrond ~]# _
```

This shows that the pcnet32 NIC driver is loaded and it uses the MII (Media Independent Interface) module

Commands for handling NIC drivers (kernel modules)

To remove (unload) a NIC driver

`rmmod driver`

```

root@frodo:~# lsmod | grep pcnet32
pcnet32          39684  0
mii              13440  1 pcnet32
root@frodo:~# rmmod pcnet32
root@frodo:~#
    
```

When you remove the NIC driver you will lose the network connection

Note: The pcnet32 driver is used for the NICs on the VMs

Class Activity - Managing NIC Drivers

1. Power on Frodo and Celebrian if they are not already up.
2. Login as cis192 then **su -** to root. Use a graphical terminal on Frodo.
3. Do a short listing of the NIC drivers on Frodo and Celebrian with:
ls /lib/modules/\$(uname -r)/kernel/drivers/net
Note: you can also type 2 then Tab key instead of \$(uname -r)
4. Pipe the output of the ls command above into **wc -l** and determine which distro includes the most NIC drivers on their standard installation.
5. On Frodo, locate the pcnet32 driver **pcnet32.ko**
6. On Frodo, check that the driver is loaded with **lsmod | grep pcnet32** then check the interface status with **ifconfig**
7. On Frodo, unload the NIC driver with **rmmod pcnet32**
8. On Frodo, check that the driver is unloaded with **lsmod | grep pcnet32** then check the interface status with **ifconfig eth0**
9. On Frodo, use **modprobe pcnet32** to reload the NIC driver again.
10. On Frodo, check that the driver is loaded again with **lsmod | grep pcnet32** then check the interface status with **ifconfig**
11. If you no longer have a IPv4 address use **dhclient**

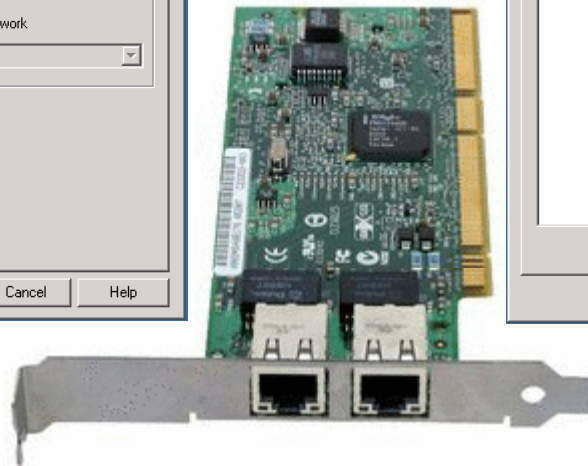
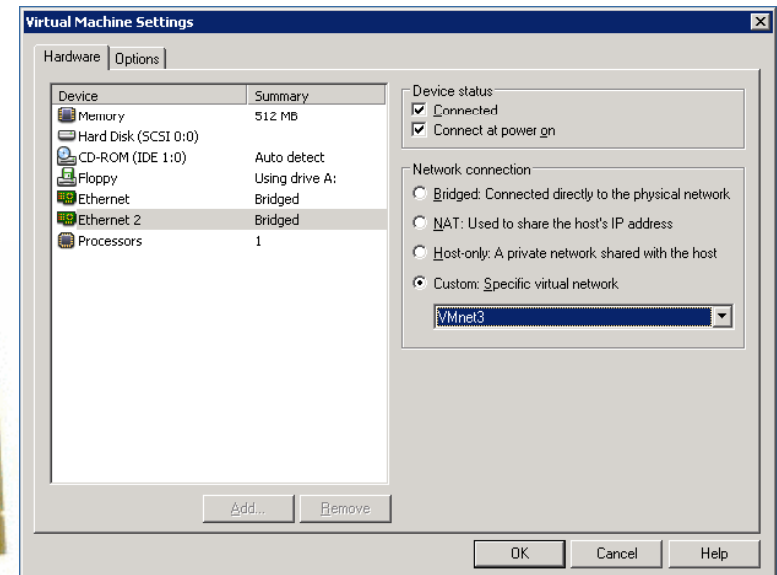
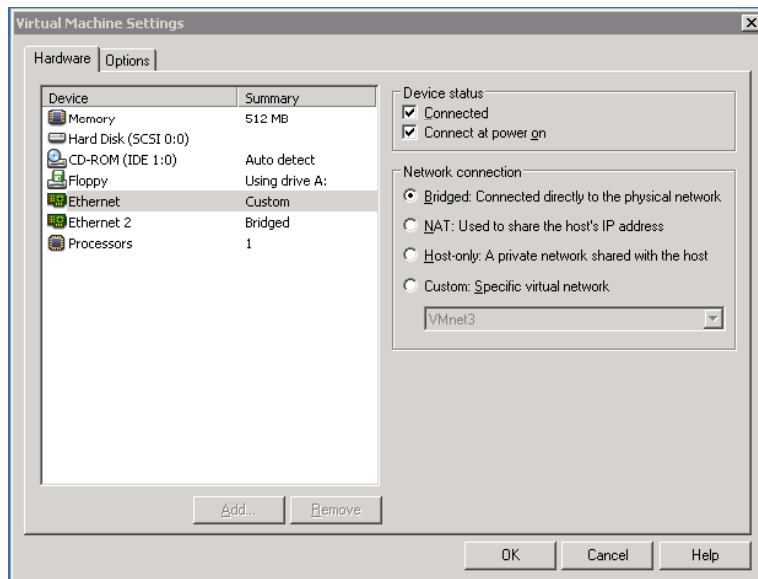
Configuring Static IP addresses (temporary)

Connecting your Linux system to the Network

1. Identify the NIC in your system (vendor and model)
2. Locate a driver for your NIC
 - may be already available with your distro
 - may be available from NIC vendor
 - may be available from chipset vendor
 - may have get source and build (compile) it
3. Load the driver (insmod or modprobe command)
4. **Bring up and configure the interface (ifconfig)**

Configuring a static IP address with ifconfig

Having two Ethernet adapters in your VM is the same as having two real adapters in a real physical computer



Ethernet = eth0

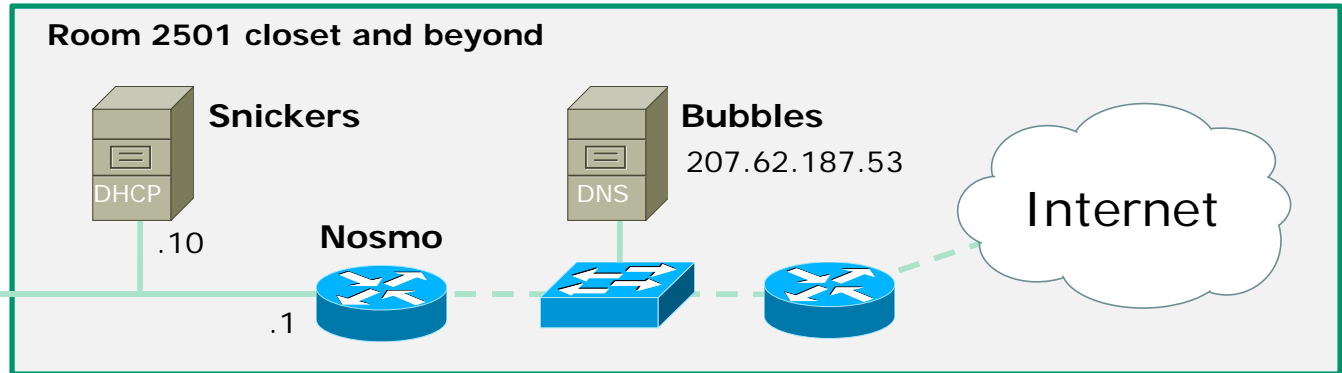
Ethernet2 = eth1

Linux will refer to the first adapter as eth0 and the second as eth1

Configuring a static IP address with ifconfig

**Classroom
Room 2501**

172.30.1.0 /24



**To avoid duplicate IP
address conflicts only use
the static IP addresses
assigned to your specific
VMware station**

StationXX
(VMware host PC)



eth0
.1xx



static-ip-address.pdf (application/pdf Object) - Mozilla Firefox

http://simms-teach.com/docs/static-ip-address.pdf

static-ip-address.pdf (application/pdf O...

1 / 2

67.9%

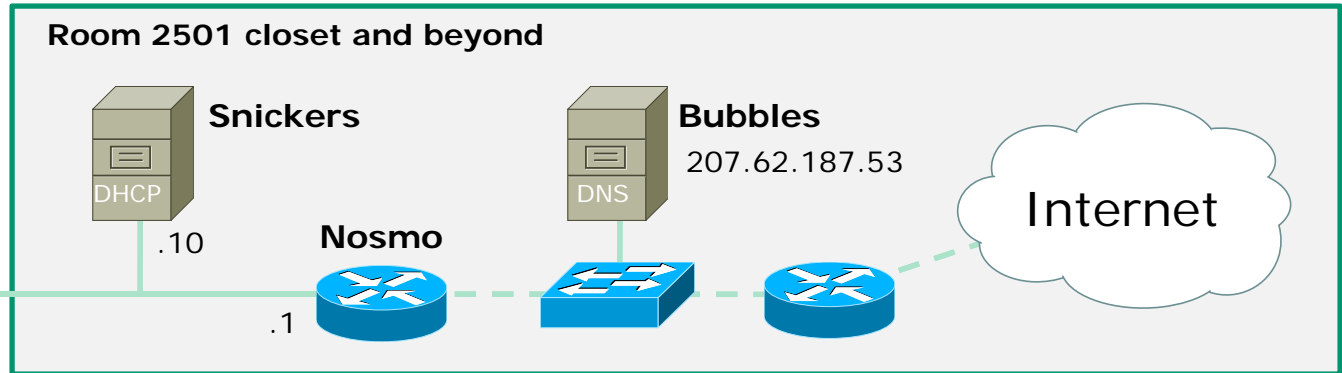
IP addresses for VM's in the CIS Lab and CTC
Gateway: 172.30.4.1 DNS: 207.62.187.54

Station	IP	Static 1	Static 2
CIS-Lab-01	172.30.4.101	172.30.4.121	172.30.4.122
CIS-Lab-02	172.30.4.102	172.30.4.123	172.30.4.124
CIS-Lab-03	172.30.4.103	172.30.4.125	172.30.4.126
CIS-Lab-04	172.30.4.104	172.30.4.127	172.30.4.128
CIS-Lab-05	172.30.4.105	172.30.4.129	172.30.4.130
CIS-Lab-06	172.30.4.106	172.30.4.131	172.30.4.132
CIS-Lab-07	172.30.4.107	172.30.4.133	172.30.4.134
CIS-Lab-08	172.30.4.108	172.30.4.135	172.30.4.136
CIS-Lab-09	172.30.4.109	172.30.4.137	172.30.4.138

Configuring a static IP address with ifconfig

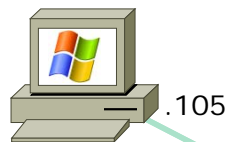
Classroom Room 2501

172.30.1.0 /24



For example, Station05 in the classroom is assigned 172.30.1.105 and 172.30.1.130 is available for use on one of the VMs.

Station05 (VMware host PC)



eth0
.130



IP addresses for VM's in the 2501 classroom

Station	IP	Static 1	Station	IP	Static 1
Instructor	172.30.1.100	172.30.1.125	Station-13	172.30.1.113	172.30.1.138
Station-01	172.30.1.101	172.30.1.126	Station-14	172.30.1.114	172.30.1.139
Station-02	172.30.1.102	172.30.1.127	Station-15	172.30.1.115	172.30.1.140
Station-03	172.30.1.103	172.30.1.128	Station-16	172.30.1.116	172.30.1.141
Station-04	172.30.1.104	172.30.1.129	Station-17	172.30.1.117	172.30.1.142
Station-05	172.30.1.105	172.30.1.130	Station-18	172.30.1.118	172.30.1.143
Station-06	172.30.1.106	172.30.1.131	Station-19	172.30.1.119	172.30.1.144
Station-07	172.30.1.107	172.30.1.132	Station-20	172.30.1.120	172.30.1.145
Station-08	172.30.1.108	172.30.1.133	Station-21	172.30.1.121	172.30.1.146
Station-09	172.30.1.109	172.30.1.134	Station-22	172.30.1.122	172.30.1.147
Station-10	172.30.1.110	172.30.1.135	Station-23	172.30.1.123	172.30.1.148
Station-11	172.30.1.111	172.30.1.136	Station-24	172.30.1.124	172.30.1.149
Station-12	172.30.1.112	172.30.1.137			

Configuring a static IP address with ifconfig

- To show all interfaces (and to show your IP address):
ifconfig
- To show the eth0 interface:
ifconfig eth0
- To set ip address and subnet mask:
ifconfig ethX xxx.xxx.xxx.xxx netmask xxx.xxx.xxx.xxx
or ifconfig ethX xxx.xxx.xxx.xxx/nn (where nn=prefix)
- To shut down an interface:
ifconfig ethX down
- To bring up an interface:
ifconfig ethX up

*Note: Configuring an IP address with **ifconfig** is temporary. It will last until the system is rebooted or the network service is restarted.*

Configuring a static IP address with ifconfig

The **ifconfig** command, with no arguments, will list all “up” interfaces

```
[root@elrond ~]# ifconfig
lo          Link encap:Local Loopback
            inet addr:127.0.0.1  Mask:255.0.0.0
            inet6 addr: ::1/128 Scope:Host
            UP LOOPBACK RUNNING  MTU:16436  Metric:1
            RX packets:8 errors:0 dropped:0 overruns:0 frame:0
            TX packets:8 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:0
            RX bytes:560 (560.0 b)  TX bytes:560 (560.0 b)

[root@elrond ~]# _
```

Network settings have been disabled on the CentOS VMs so you can practice setting them up. When you first power them on only the loopback “lo” interface is active.

Configuring a static IP address with ifconfig

To set ip address and subnet mask on Station 05 in the classroom:

ifconfig eth0 172.30.4.130 netmask 255.255.255.0

MAC address

IPv4 address

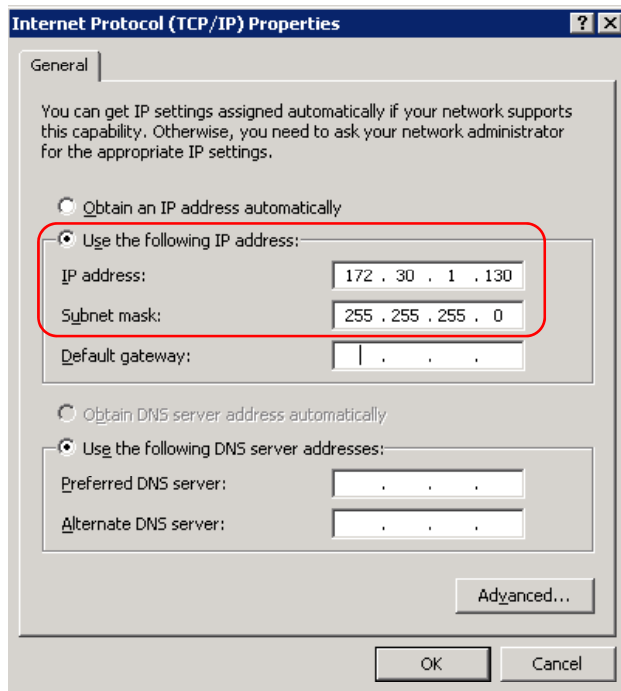
```
[root@elrond ~]# ifconfig eth0 172.30.1.130 netmask 255.255.255.0
[root@elrond ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:68:36:87
          inet addr:172.30.1.130  Bcast:172.30.1.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe68:3687/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:31 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 b)  TX bytes:7726 (7.5 KiB)
          Interrupt:177 Base address:0x1400
```

IPv6 address

Remember that 172.30.1.130 is only to be used on Station 5.

If every student configures their VM with the same static IP address there will be duplicate IP issues with the classroom network.

Configuring static IP and mask on other planets



Lan Area Connection on Windows XP

*One standard many
implementations!*

fa 0/0 on Cisco 2811 router

```
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int fa0/0
Router(config-if)#ip add 172.30.1.130 255.255.255.0
Router(config-if)#
```

Caveat: Root's environment has /sbin in path

To show all interfaces (and to show your IP address):

ifconfig

As root, your path includes /sbin

```
[root@benji ~]# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:0C:29:E6:2C:03
          inet addr:192.168.0.34  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fee6:2c03/64  Scope:Link
<snipped>
```

As non-root user your path does not include /sbin

```
[cis192@benji ~]$ ifconfig
-bash: ifconfig: command not found

[cis192@benji ~]$ /sbin/ifconfig
eth0      Link encap:Ethernet  HWaddr 00:0C:29:E6:2C:03
          inet addr:192.168.0.34  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fee6:2c03/64  Scope:Link
<snipped>
```

Configuring Gateway DNS

Configuring the gateway and DNS

- To show the routing table (including gateway)
route -n
- To set the gateway
route add default gw `xxx.xxx.xxx.xxx`
- To delete the gateway
route del default gw `xxx.xxx.xxx.xxx`
- To set the DNS server
edit **/etc/resolv.conf** and add:
nameserver `xxx.xxx.xxx.xxx`

Configuring the gateway and DNS

To set the default gateway

route add default gw `xxx.xxx.xxx.xxx`

```
[root@elrond ~]# route add default gw 172.30.1.1
[root@elrond ~]# route -n
Kernel IP routing table
Destination      Gateway          Genmask         Flags Metric Ref    Use Iface
172.30.1.0       0.0.0.0         255.255.255.0   U        0      0        0 eth0
0.0.0.0          172.30.1.1     0.0.0.0         UG       0      0        0 eth0
[root@elrond ~]#
```

After setting a new route it's a good idea to verify it using **route -n**

The routing table above has two entries:

- Packets destined for 172.30.1.0/24 are sent out the eth0 interface to the connected subnet
- All other packets are sent to the default gateway at 172.30.1.1

Configuring the gateway and DNS

To delete the default gateway

route delete default gw `xxx.xxx.xxx.xxx`

```
root@elrond ~]# route del default gw 172.30.1.1
root@elrond ~]# route -n
Kernel IP routing table
Destination      Gateway         Genmask        Flags Metric Ref    Use Iface
172.30.1.0       0.0.0.0        255.255.255.0 U          0    0      0 eth0
root@elrond ~]#
```

After changing a route it's a good idea to verify it using `route -n`

Configuring the gateway and DNS

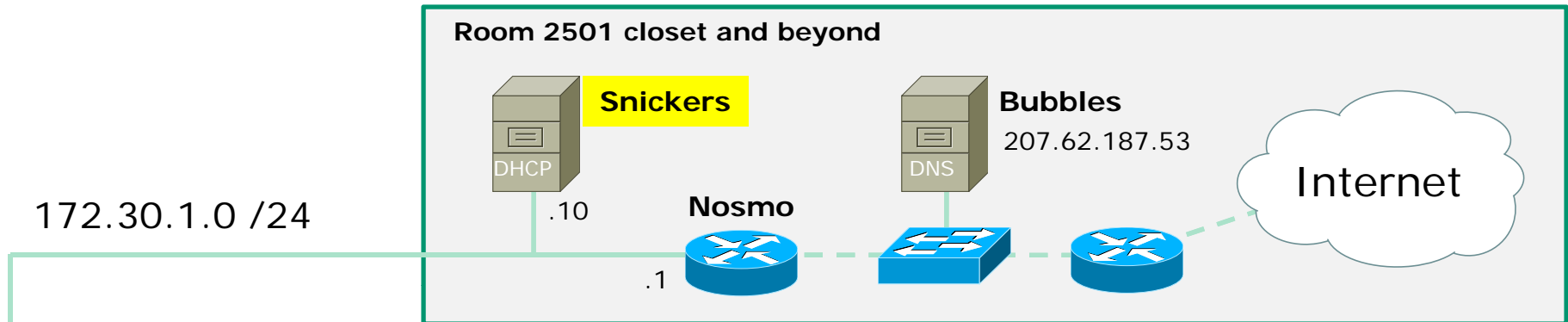
To set the DNS server edit **/etc/resolv.conf** and add:

```
nameserver xxx.xxx.xxx.xxx
```

```
[root@elrond ~]# cat /etc/resolv.conf
cat: /etc/resolv.conf: No such file or directory
[root@elrond ~]# echo nameserver 207.62.187.53 > /etc/resolv.conf
[root@elrond ~]# cat /etc/resolv.conf
nameserver 207.62.187.53
[root@elrond ~]# _
```

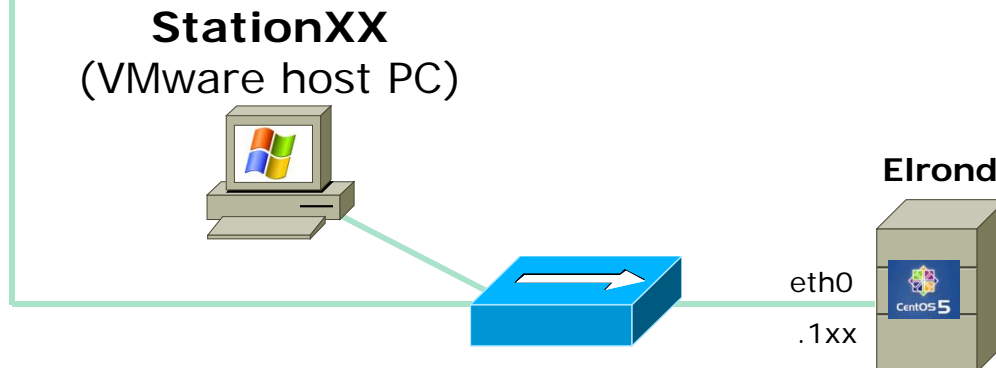
Configuring dynamic IP address (dhcp)

Configuring dynamic IP addresses



Snickers is a DHCP server that manages a pool of addresses (172.30.1.150 to 172.30.1.199) for room 2501.

It also manages a different pool of addresses (172.30.4.150 to 172.30.4.199) for CIS systems in the Lab and CTC.



Configuring dynamic IP addresses

- To request a dynamic IP address for eth0:
dhclient eth0
- To release a dynamic IP address:
dhclient -r eth0

Note: Specifying eth0 is not necessary for systems with a single NIC. However, all the CentOS systems used for this course have 2 NICs making it necessary to designate the specific interface

Configuring dynamic IP addresses

To get a dynamic IP address from a DHCP server:

dhclient eth0

```
[root@elrond ~]# dhclient eth0
Internet Systems Consortium DHCP Client V3.0.5-RedHat
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPP/eth0/00:0c:29:68:36:87
Sending on   LPP/eth0/00:0c:29:60:06:07
Sending on   Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 4
DHCPOFFER from 172.30.1.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 172.30.1.1
bound to 172.30.1.199 -- renewal in 10348 seconds.
[root@elrond ~]# _
```

I made this screen shot at home rather than at school ... how can you determine this by looking at the output above?

Configuring dynamic IP addresses

To release a dynamic IP address back to the DHCP server:

dhclient -r eth0

```
[root@elrond ~]# dhclient -r eth0
Internet Systems Consortium DHCP Client V3.0.5-RedHat
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/00:0c:29:68:36:87
Sending on   LPF/eth0/00:0c:29:68:36:87
Sending on   Socket/fallback
DHCPRELEASE on eth0 to 172.30.1.1 port 67
[root@elrond ~]#
```

We will learn more about DHCP and how to set up a DHCP server later in the course.



Testing

Testing Interface Settings

- Check IP address by pinging router or neighbor
ping `xxx.xxx.xxx.xxx`

At school, the nosmo router is at:

- *172.30.1.1 in the classroom*
- *172.30.4.1 in the lab*

- Check DNS by pinging hostname
ping google.com

Use Ctrl-C to stop pinging which will go on forever if you don't.

Commands for testing interfaces

Check settings by pinging the classroom router

ping 172.30.1.1

```
[root@elrond ~]# ping 172.30.1.1
PING 172.30.1.1 (172.30.1.1) 56(84) bytes of data.
64 bytes from 172.30.1.1: icmp_seq=1 ttl=64 time=5.81 ms
64 bytes from 172.30.1.1: icmp_seq=2 ttl=64 time=1.20 ms
64 bytes from 172.30.1.1: icmp_seq=3 ttl=64 time=1.31 ms
64 bytes from 172.30.1.1: icmp_seq=4 ttl=64 time=0.956 ms

--- 172.30.1.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3003ms
rtt min/avg/max/mdev = 0.956/2.322/5.813/2.019 ms
[root@elrond ~]#
```

Use Ctrl-C to stop pinging which will go on forever if you don't.

Commands for testing interfaces

Check settings by pinging the classroom router

ping 172.30.1.1

```
[root@elrond ~]# ping 172.30.1.1  
connect: Network is unreachable
```

The interface has not been configured with an IP address or a default route has not been set.

Commands for testing interfaces

Check DNS settings by pinging hostname

ping google.com

```
[root@elrond ~]# ping google.com
PING google.com (74.125.45.100) 56(84) bytes of data.
64 bytes from yx-in-f100.google.com (74.125.45.100): icmp_seq=1 ttl=235 time=48.4 ms
64 bytes from yx-in-f100.google.com (74.125.45.100): icmp_seq=2 ttl=235 time=44.4 ms
64 bytes from yx-in-f100.google.com (74.125.45.100): icmp_seq=3 ttl=235 time=44.9 ms
64 bytes from yx-in-f100.google.com (74.125.45.100): icmp_seq=4 ttl=235 time=44.4 ms

--- google.com ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3002ms
rtt min/avg/max/mdev = 44.478/45.605/48.464/1.676 ms
[root@elrond ~]# _
```

Use Ctrl-C to stop pinging which will go on forever if you don't.

Commands for testing interfaces

Check DNS settings by pinging hostname

ping google.com

```
[root@elrond ~]# ping google.com  
ping: unknown host google.com
```

The DNS name server has not been configured

IP addresses for VM's in the classroom

<http://simms-teach.com/docs/static-ip-addr.pdf>

Station	IP	Static 1
Instructor	172.30.1.100	172.30.1.125
Station-01	172.30.1.101	172.30.1.126
Station-02	172.30.1.102	172.30.1.127
Station-03	172.30.1.103	172.30.1.128
Station-04	172.30.1.104	172.30.1.129
Station-05	172.30.1.105	172.30.1.130
Station-06	172.30.1.106	172.30.1.131
Station-07	172.30.1.107	172.30.1.132
Station-08	172.30.1.108	172.30.1.133
Station-09	172.30.1.109	172.30.1.134
Station-10	172.30.1.110	172.30.1.135
Station-11	172.30.1.111	172.30.1.136
Station-12	172.30.1.112	172.30.1.137

Station	IP	Static 1
Station-13	172.30.1.113	172.30.1.138
Station-14	172.30.1.114	172.30.1.139
Station-15	172.30.1.115	172.30.1.140
Station-16	172.30.1.116	172.30.1.141
Station-17	172.30.1.117	172.30.1.142
Station-18	172.30.1.118	172.30.1.143
Station-19	172.30.1.119	172.30.1.144
Station-20	172.30.1.120	172.30.1.145
Station-21	172.30.1.121	172.30.1.146
Station-22	172.30.1.122	172.30.1.147
Station-23	172.30.1.123	172.30.1.148
Station-24	172.30.1.124	172.30.1.149



*Note **your** static IP address for **your** station to use in the next Class Activity*

Class Activity

Configuring Interface, default gateway and DNS

1. Power on **Celebrian** if it is not already on.
2. Configure eth0 with **your** static IP address (based on **your** station number) and subnet mask
ifconfig eth0 172.30.1.xxx netmask 255.255.255.0
3. Check it with **ifconfig eth0**
4. Configure your default gateway with:
route add default gw 172.30.1.1
5. Set up your DNS with:
echo nameserver 207.62.187.53 > /etc/resolv.conf
6. Test by pinging the router 172.30.1.1, google.com and your Windows station.
7. Bring the interface down with **ifconfig eth0 down** and see if you can still ping anything.
8. Use **dhclient eth0** and get a dynamic address. Can you ping your neighbor, Google and the router? Is your IP address the same your neighbor?

ipv6

Using IPv6 addresses in Linux

- IPv6 is a layer 3 protocol designed to replace IPv4
- The CentOS VMs for this course have the IPv6 module loaded into the kernel (**use `lsmod | grep ipv6`** to see it)
- IPv6 uses 128 bits to form an IP address as opposed to 32 bits in IPv4
- We will learn more about IPv4 and IPv6 later in the course.
- IPv4 IP address and mask do not need to be configured in order to use IPv6
- The loopback address for IPv6 is **`::1`**, for IPv4 it is **`127.0.0.1`**
- To ping yourself use **`ping6 ::1`**

Using IPv6 addresses in Linux – ping6

Elrond



lo

```

root@elrond ~]# ping6 ::1
PING ::1(::1) 56 data bytes
4 bytes from ::1: icmp_seq=0 ttl=64 time=0.330 ms
4 bytes from ::1: icmp_seq=1 ttl=64 time=0.265 ms

-- ::1 ping statistics ---
  packets transmitted, 2 received, 0% packet loss, time 1001ms
  tt min/avg/max/mdev = 0.265/0.297/0.330/0.036 ms, pipe 2
root@elrond ~]# ping 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
4 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=0.980 ms
4 bytes from 127.0.0.1: icmp_seq=2 ttl=64 time=0.095 ms

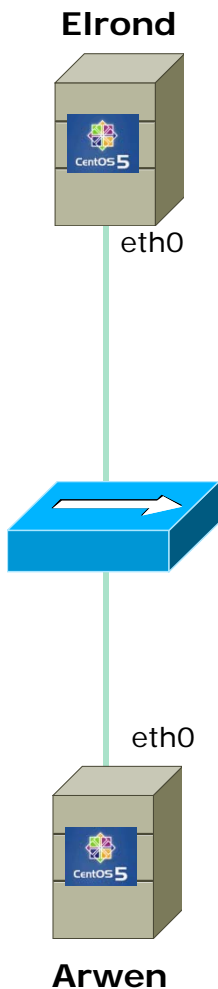
-- 127.0.0.1 ping statistics ---
  packets transmitted, 2 received, 0% packet loss, time 1000ms
  tt min/avg/max/mdev = 0.095/0.537/0.980/0.443 ms
root@elrond ~]#
    
```

The first ping uses an IPv6 loopback address.

The second ping uses the traditional IPv4 loopback address.

Loopback address are used to make network connections to local services. Packets stay local and are not sent out the NIC to the network.

Using IPv6 addresses in Linux – ping6



```
[root@elrond ~]# ping6 -I eth0 fe80::20c:29ff:fe4b:f5ce
PING fe80::20c:29ff:fe4b:f5ce(fe80::20c:29ff:fe4b:f5ce) from fe80::20c:29ff:fe68
:3687 eth0: 56 data bytes
64 bytes from fe80::20c:29ff:fe4b:f5ce: icmp_seq=0 ttl=64 time=2.30 ms
64 bytes from fe80::20c:29ff:fe4b:f5ce: icmp_seq=1 ttl=64 time=2.14 ms

--- fe80::20c:29ff:fe4b:f5ce ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1000ms
rtt min/avg/max/mdev = 2.141/2.223/2.306/0.095 ms, pipe 2
[root@elrond ~]# _
```

Note: the interface must be specified on the ping6 command

```
eth0  Link encap:Ethernet HWaddr 00:0C:29:4B:F5:CE
      inet6 addr: fe80::20c:29ff:fe4b:f5ce/64 Scope:Link
      UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
      RX packets:713 errors:0 dropped:0 overruns:0 frame:0
      TX packets:605 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:1000
      RX bytes:557922 (544.8 KiB) TX bytes:61674 (60.2 KiB)
      Interrupt:177 Base address:0x1400

[root@arwen ~]# _
```

Use the ifconfig command to see what the IPv6 address is

Using IPv6 addresses in Linux - ssh

Elrond



eth0

```
[root@elrond ~]# ssh fe80::20c:29ff:fe4b:f5ce%eth0
root@fe80::20c:29ff:fe4b:f5ce%eth0's password:
Last login: Mon Jan 25 23:30:16 2010 from fe80::20c:29ff:fe68:3687%eth0
[root@arwen ~]# _
```

Note: the interface must be specified on the ssh command



eth0



Arwen

```
eth0  Link encap:Ethernet HWaddr 00:0C:29:4B:F5:CE
      inet6 addr: fe80::20c:29ff:fe4b:f5ce/64 Scope:Link
      UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
      RX packets:713 errors:0 dropped:0 overruns:0 frame:0
      TX packets:605 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:1000
      RX bytes:557922 (544.8 KiB) TX bytes:61674 (60.2 KiB)
      Interrupt:177 Base address:0x1400

[root@arwen ~]# _
```

*Use the **ifconfig** command to see what the IPv6 address is*

Class Activity

IPv6

1. Power on **Frodo** and **Celebrian** if they are not on already using two different VMware consoles.
2. Their eth0 NICs should both be connected as **bridged**.
3. On Frodo, ping yourself using the loopback address with **ping6 ::1**
4. On Frodo, discover your IPv6 address using **ifconfig**
5. Position the smaller Celebrian console on top of the Frodo console so you can see Frodo's IPv6 address.
6. On Celebrian use **ping6 -I eth0 <insert Frodo's IPv6 address>** to ping Frodo using IPv6.
7. On Celebrian use **ssh cis192@ <insert Frodo's IPv6 address>%eth0** and login to Frodo.



Lab Assignment

Use the class calendar to get assignments and see due dates

Rich's Cabrillo College CIS Classes
CIS 192 Calendar

Home Resources Forums CIS Lab CTC

CIS 192 (Spring 2010) Course Calendar
Course Home Grades
(content subject to change)

Lesson	Date	Topics	Chapter	Due
1	2/11	<p>Introduction to Course, TCP/IP and Network Access</p> <ul style="list-style-type: none"> Linux market and jobs Understand how this course will work Equipment and resources Virtualization and VMware 101 skills Networking overview NIC drivers Configure network settings Test network connections Ping and SSH with IPv6 <p>Materials</p> <ul style="list-style-type: none"> Presentation slides (download) Apache web server example (show) Logins Sheet (download) Howto #129: Working at Home (download) <p>Assignment</p> <ul style="list-style-type: none"> Student survey (download) Lab 1 (Linux VMs) 	12,14	
2	2/18	<p>Quiz 1</p> <p>ARP and the Internet Layer</p> <ul style="list-style-type: none"> Review and use various tools for configuring an interface Understand how address resolution works Manage and track the arp cache Sniff packets on the network with tcpdump and Wireshark Understand the Internet layer (layer 3) and how addressing works Hop from system to system using SSH Understand how NAT/PAT works with private networks use several troubleshooting tools to diagnose problems <p>Materials</p> <ul style="list-style-type: none"> Presentation slides (download) IP address exercise (download) <p>Assignment</p> <ul style="list-style-type: none"> Lab 2 (Temp. NIC Config) 	12	<p>Student survey</p> <p>Lab 1</p>

CIS 192 Linux Lab Exercise
Lab 1: Exploring the Linux Network: VMs
Spring 2010

Lab 1: Exploring the Linux Network VMs

The purpose of this lab is to become familiar with resources available in the CIS Lab (room 2504) and the CTC. This includes using VMware Server and learning how to operate the CIS 192 Linux Networking VMs. This lab will also teach you some initial methods for exchanging textual information between the Windows host system, the VMs and the remote Opus server.

Supplies

- VMWare Server 1.08 or higher
- CIS 192 VMs: Elrond, Fang, Frodo, Sniffer and William
- Virtual networks: VMnet3 and VMnet4

How to submit your work for grading

- For each lab you will create a text file that gets turned in
- The **scp** (**pscp** on Windows) is used to copy your text file to a special turnin directory on Opus.
- It's a good idea to verify your **scp** copy worked!
- Labs must get turned in by midnight (Opus time) on the due date to get credit.
- Submit as many times as you wish up till the deadline.
- No points for late work. Its better to make a partial submittal before the deadline for partial credit.

How to submit your work for grading

Examples:

- Submit from Windows command line (Lab 1):

```
C:\>pscp lab1.txt cis192@opus.cabrillo.edu:lab1.simmsben
```

```
cis192@opus.cabrillo.edu's password:
```

```
C:\>
```

*Replace **simmsben** with your Opus logname. For the first lab can just use your last name since you won't have a logname yet.*

- Submit from Linux system (all other labs):

```
[root@arwen ~]$ scp lab2 cis192@opus.cabrillo.edu:lab2.simmsben
```

```
cis192@opus.cabrillo.edu's password:
```

```
lab1 100% 5 0.0KB/s 00:00
```

```
[root@arwen ~]$
```

- Check your submittal from Opus:

```
[simmsben@opus ~]$ ls /home/turnin/cis192
```

```
lab1.simmsben lab2.simmsben
```

```
[simmsben@opus ~]$
```

Some essentials for doing labs

The "I've tried everything and it still won't work" problem

- Use the forum to ask questions and to clarify things
- Review Lesson Powerpoints which usually have examples aimed at doing the lab assignments.
- Make a network diagram with all interfaces labeled. Confirm your configuration matches the diagram.
- Go back and methodically verify each step was completed. For example, if you modified `/etc/hosts` then `cat` it out and review your changes. If you set the default gateway, use `route -n` command to verify. If you configured an IP address, use **ifconfig** to verify.
- If your VM is completely "hosed": Use **Revert to snapshot** to restore to a pristine version.

Some essentials for doing labs

Some Tips

- Start early, doing labs at the last minute adds unnecessary time pressure.
- Its best if you fully understand each step as you do it. Use Google or refer back to Lesson slides to understand what you are doing.
- Keep a growing cheat sheet of commands and examples.
- Partner with another student – "two heads are better than one" (at least most of the time!)
- Use the forum to share specific tips you learned while doing a lab.

Some essentials for doing labs

- Becoming root:
 - `sudo command`
 - `SU -`
- To get command documentation:
 - `man command`
 - `google.com (linux xxxxxx command)`
- To try again for a DHCP address: `dhclient`
- Use Google to research an error message
 - Google *network is unreachable*

The - is very important as this gets you root's environment

Sometimes the systems in the lab time out before the IP address arrives from Snickers. Issue this command as root.

You will need to be the root user to do most labs. Be careful as root can do anything !!

Wrap

New commands:

dmesg
ifconfig
insmod
lsmod
lspci
modprobe
ping
ping6
rmmod
route
scp
ssh
su

New Files and Directories:

/etc/resolv.conf
/lib/modules/2.6.18-164.e15/kernel/drivers.net

VMware:

Revert to snapshot
vmware-toolbox &

Next Class

Assignment: Check Calendar Page on web site to see what is due next week.

Quiz questions for next class:

- What command would you use to remove (unload) the pcnet32 NIC driver?
- What command would you use to add 172.30.4.1 as the default gateway.
- At what OSI layer are IP addresses used?



Backup

Frodo and Celebrian VMs running on Windows VMware station

