



Lesson Module Checklist

- Slides
- Flashcards
- 1st minute quiz
- Web Calendar summary
- Web book pages
- Commands
- Howtos

- Lab tested
- Opus – lab01 template in depot
- Youtube Videos uploaded

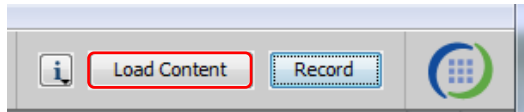
- Forum created and registration tested
- Opus accounts made and populated
- VLab VMs created and configured
- Surveys and PW sheet posted

- Rosters printed
- Add codes printed

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

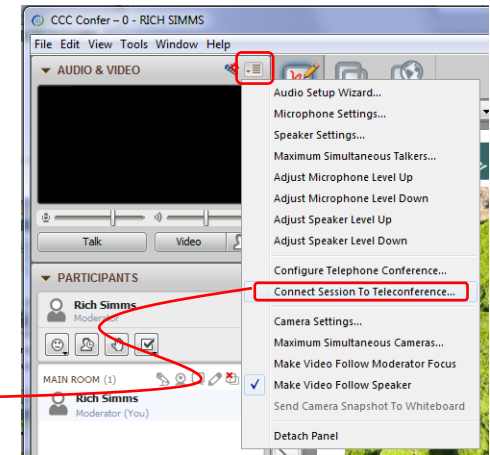
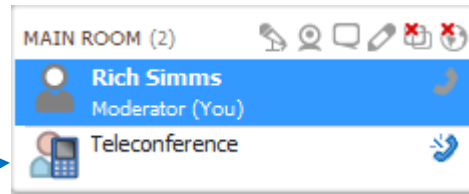


[] Preload White Board with *cis*lesson??*-WB*



[] Connect session to Teleconference

Session now connected to teleconference



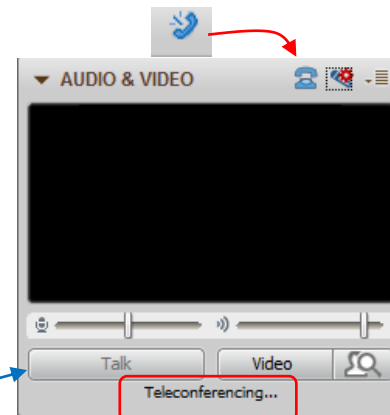
[] Is recording on?



Red dot means recording

[] Use teleconferencing, not mic

Should be greyed out





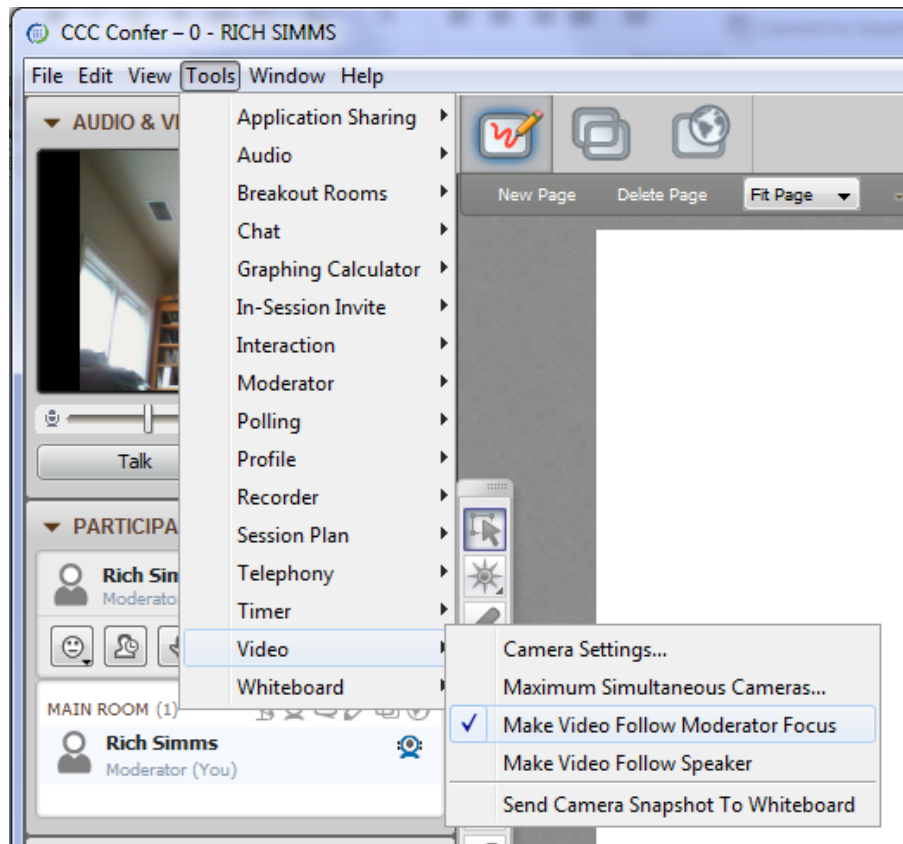
- [] Video (webcam) optional
- [] layout and share apps

The screenshot displays a Windows desktop environment with several applications open. On the left, the 'CCC Confer' application is visible, showing a video feed of Rich Simms and a list of participants. In the center, a 'Foxit Reader' window displays a PDF document titled 'cis90lesson07.pdf'. A red box labeled 'foxit for slides' points to the document. To the right, a 'Chrome' browser window shows a webpage from 'simms-teach.com' with flashcard questions. A red box labeled 'chrome' points to the browser. In the foreground, a 'putty' terminal window shows a login attempt for 'simben90' on 'oslab.cabrillo.edu', which is denied. A red box labeled 'putty' points to the terminal. In the background, the 'vSphere Client' window is open, showing a virtual machine named 'CIS 192'. A red box labeled 'vSphere Client' points to the VM. The desktop taskbar at the bottom shows icons for various applications, including Internet Explorer, File Explorer, and Microsoft Word. The system tray in the bottom right corner shows the date and time as 6:52 AM on 10/10/2012.



[] Video (webcam) optional

[] Follow moderator



Universal Fix for CCC Confer:

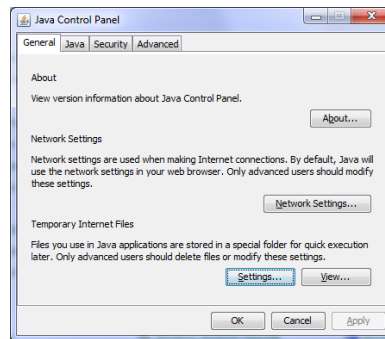
- 1) Shrink (500 MB) and delete Java cache
- 2) Uninstall and reinstall latest Java runtime



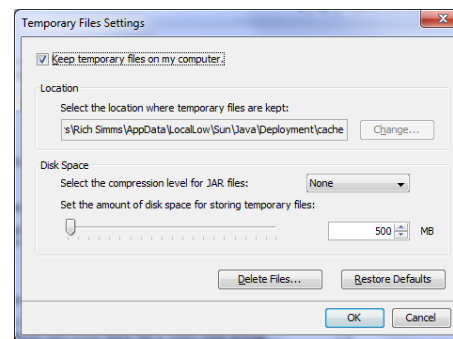
Control Panel (small icons)



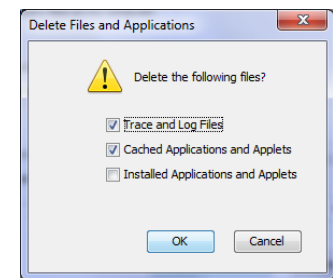
General Tab > Settings...



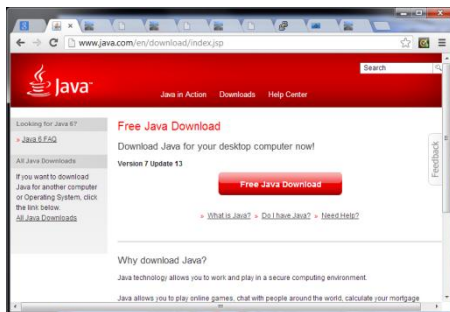
500MB cache size



Delete these



Google Java download





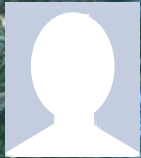
Instructor: **Rich Simms**

Dial-in: **888-450-4821**

Passcode: **761867**



Ahmed



Solomon



Sean



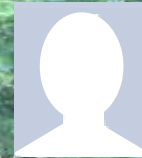
Christopher



Corey



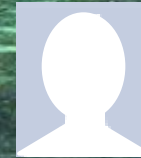
Bryan



Shahram



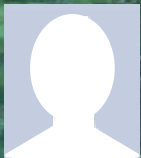
Tony



David H.



Donna



Stephanie



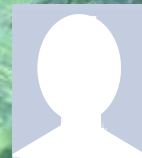
David M.



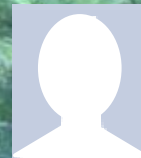
Evan



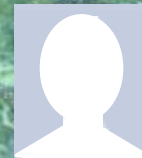
Gabriel



Elia



Tajvia



Carlos



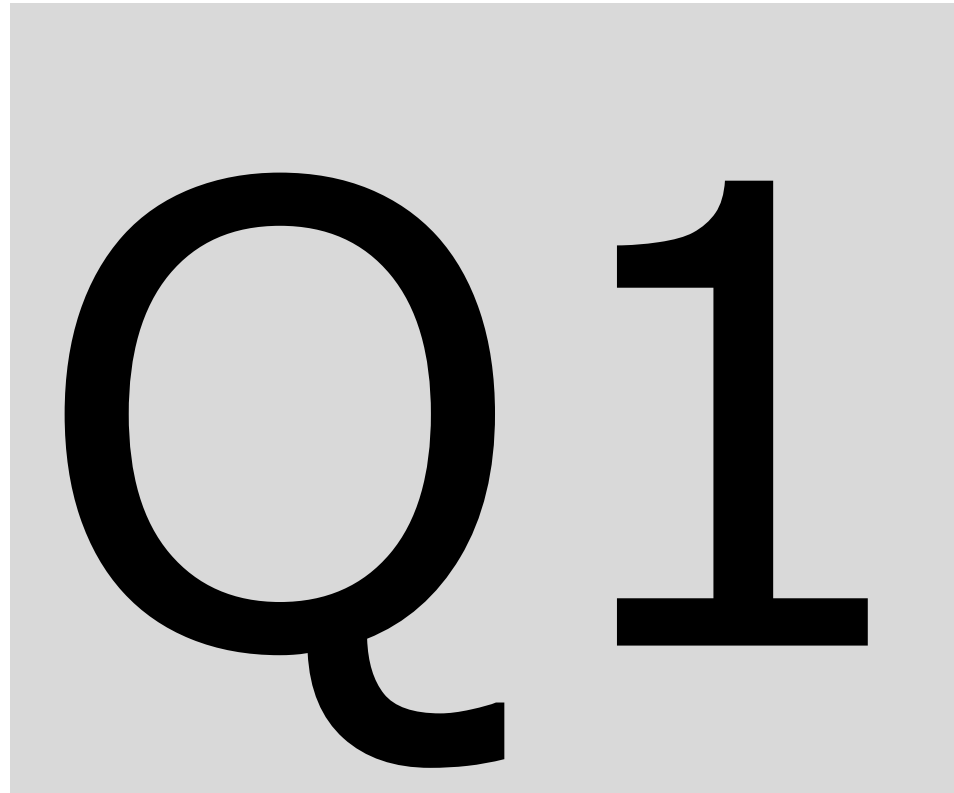
Adam



Ben



Laura



- Introductions
- Pre-requisites
- How this class works
- Housekeeping



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



Introductions

Introductions and Credits



Jim Griffin

- Jim created this Linux course
- Jim's site: <http://cabrillo.edu/~jgriffin/>



Rich Simms

- HP Alumnus
- Started teaching this course in 2008 when Jim went on sabbatical
- Rich's site: <http://simms-teach.com>

And huge thanks to:

- Rick Graziani for the use of his great network slides (<http://cabrillo.edu/~rgraziani/>)
- John Govsky for many teaching best practices: e.g. the First Minute quizzes, the online forum, and the point grading system (<http://teacherjohn.com/>)



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
- CCC Confer
- How this class works
- Housekeeping

- Linux Market
- Lab resources
- VMware 101 VLab, cabling, real estate
- Superuser

- Network Basics
- NIC inventory
- NIC Drivers
- Configuring interfaces

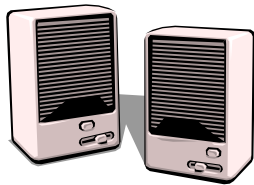
- Joining network (dhcp and static IP)
- SSH hopping
- Ping testing & troubleshooting
- Command line sniffing
- Dup IPs
- IPv6



Virtual Classroom with CCC Confer



- Listen using your computer's speakers/headset or with your phone using the dial-in number



- Ask questions using the chat window or just speak if dialed in with your phone (or Skype)

Dialing in by phone (or Skype) is best because you can ask and answer questions by speaking rather than use a chat window

Class Activity

Enter the online virtual classroom

Rich's Cabrillo College CIS Classes
CIS 192 Calendar

Home Resources Forums CIS Lab Blackboard

Login
Flashcards
Admin

CIS 90
CIS 192
Previous Classes

9 days till term starts!

Cabrillo College
Web Advisor
Commands and Files

VLab RDP file
CIS 90 VLab VM
Assignments
CIS 192 VLab Pod
Assignments

RIP Dennis Ritchie

CIS 192 (Spring 2013) Course Calendar
[Course Home](#) [Grades](#)

1	2/12	<ul style="list-style-type: none">Ping and SSH with IPv6 <p>Materials</p> <ul style="list-style-type: none">Presentation slides (download)Logins Sheet (download)Howto #303: Remote Access to the CIS VLab (download)CIS VLab RDP file (download) <p>Assignment</p> <ul style="list-style-type: none">Student survey (download)Lab 1 (Linux VMs) <p>CCC Confer</p> <ul style="list-style-type: none">Enter virtual classroomClass archives	4.3, 12.7, 13.7, 14.1-14.3, 14.10-14.11 16 21.2
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1. Browse to simms-teach.com
2. Click the *CIS 192* link
3. Click the *Calendar* link
4. Look for any CCC Confer section
5. Click the *Enter virtual classroom* link

CCC Confer - Attending class online



CCC Confer uses Java which requires a download and installation of the Java Runtime Environment from java.com (Oracle)

CCC Confer - Attending class online

The screenshot displays the CCC Confer application window titled "CCC Confer - 0 - RICH SIMMS". The interface includes a menu bar (File, Edit, View, Tools, Window, Help) and a toolbar with icons for drawing, erasing, and navigating. The main content area shows a slide titled "CIS Linux Classes" with the Cabrillo College logo and instructor information: "Instructor: Rich Simms" and "Dial-in: 888-450-4821". A grid of 40 white avatars is arranged on a green field background. A blue callout box points to the top row of avatars with the text: "Raise your hand, make gestures, use emoticons and indicate responses using these controls". On the left side, there is a control panel with sections for "AUDIO & VIDEO" (showing Rich Simms' video), "PARTICIPANTS" (listing Benji, Rich Simms as Moderator, and Benji as You), and "CHAT" (showing messages about joining the room). A red box highlights the interaction icons (smiley face, hand, etc.) in the Participants section, and another red box highlights the chat window. A second blue callout box points to the chat window with the text: "Ask public or private questions using the chat area".

CCC Confer - Attending class online

When dialed in by phone you can use:

- *0 Contact the operator for assistance.
- *6 Mute/unmute your individual line with a private announcement.



Switch to preloaded whiteboard



Turn Recording On
Switch back to shared slides



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 bare bones terminal

- more, less, tty, clear

Virtual terminals

- Ctrl-Alt-F1 ...

Getting info

- man, google

Miscellaneous

- ssh/Putty, chmod, scp

Command line edits

- up arrow, tab

Showing file contents

- cat, grep, head, tail, file

Redirection and pipes

- >, >>, <, |



How this Class Works

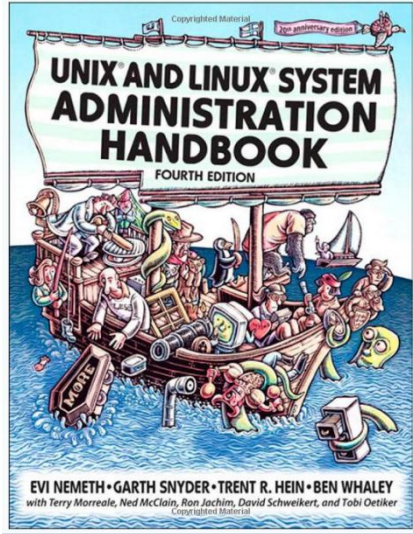
CIS 192AB

Spring 2013

Class meets in room **2501** and online every **Tuesday evening**:

- **5:30-9:35PM**, from **Feb 12th** to **May 28th**
- 15 lessons (class meetings) total
- Final exam at **5:30-8:20PM**, on **June 4th**

January							February							March						
Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5						1	2						1	2
6	7	8	9	10	11	12	3	4	5	6	7	8	9	3	4	5	6	7	8	9
13	14	15	16	17	18	19	10	11	12	13	14	15	16	10	11	12	13	14	15	16
20	21	22	23	24	25	26	17	18	19	20	21	22	23	17	18	19	20	21	22	23
27	28	29	30	31			24	25	26	27	28			24	25	26	27	28	29	30
														31						
April							May							June						
Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6				1	2	3	4							1
7	8	9	10	11	12	13	5	6	7	8	9	10	11	2	3	4	5	6	7	8
14	15	16	17	18	19	20	12	13	14	15	16	17	18	9	10	11	12	13	14	15
21	22	23	24	25	26	27	19	20	21	22	23	24	25	16	17	18	19	20	21	22
28	29	30					26	27	28	29	30	31		23	24	25	26	27	28	29
														30						



Required Textbook:

UNIX and Linux System Administration Handbook (4th Edition)

- By: Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley
- Publisher: Prentice Hall
- ISBN-13: 978-0131480056

The typical week
http://simms-teach.com

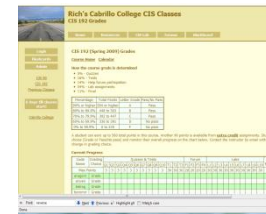
Tuesday

"First minute" quiz
Lecture on new lesson material
Class activities
Previous week lab assignments
due 11:59PM (Opus time)

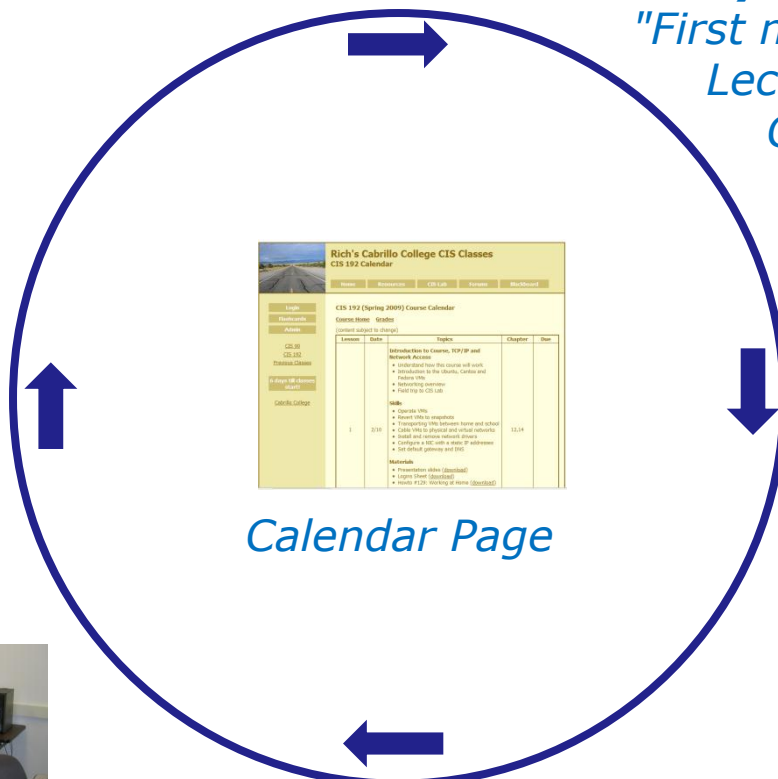
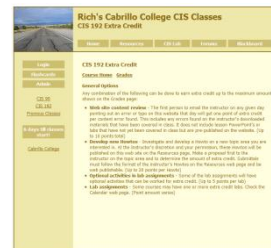


Wednesday
is grading day

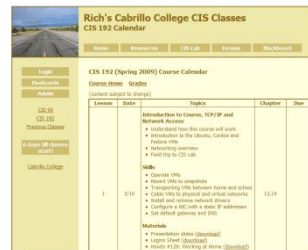
Check progress
on the Grades
Page



Check Extra Credit Page
if you need some more
points



Calendar Page



Use Forum to
ask and answer
questions



Work Lab Assignments
in the CIS Lab or from home

Contacting the instructor

- Use the forum for the fastest response on technical or class related questions.
- Use email for personal matters only. If it's NOT personal I will most likely ask you to post your question on the forum and will answer it there instead so other students may benefit from the answer.
- Weekly office hours:
<http://babyface.cabrillo.edu/salsa/listing.jsp?staffId=1426>
- Also available in the CIS Lab for help with lab assignments or class material:
<http://babyface.cabrillo.edu/salsa/listing.jsp?staffId=1426>
- Avoid leaving a message on voice mail. Checked rarely so don't expect a fast response!



Class Exercise (class website)

Please browse to: <http://simms-teach.com>

First click on
CIS 192 on left
panel to see
syllabus

Rich's Cabrillo College CIS Classes
CIS 192 Home

Home Resources Forums CIS Lab Blackboard

Login
Flashcards
Admin

CIS 90
CIS 192
Previous Classes

9 days till term starts!

[Cabrillo College Web Advisor](#)
[Commands and Files](#)
[VLab RDP file](#)
[CIS 90 VLab VM Assignments](#)
[CIS 192 VLab Pod Assignments](#)

CIS 192AB Syllabus (Spring 2013) Section 79995
[Calendar](#) [Grades](#)

UNIX/Linux Network Administration (CIS 192AB)

- Tuesdays - 5:30PM to 9:35PM:
 - Meets in room 2501 on the Aptos Main Campus
 - Meets simultaneously online in [this virtual classroom](#) for remote students
- Open Lab - 4 hours & 5 minutes per week to be arranged
- Units: 4, prerequisites: CIS 81 and CIS 90, recommended:
- Required textbook, available at the [Cabrillo College Bookstore](#)
 - [UNIX and Linux System Administration Handbook](#) (4th Edition)
 - by Evi Nemeth, Garth Snyder, Trent R. Hein, Ben W. Lippert, and David Korn
 - Prentice Hall PTR ISBN-13: 978-0131480056

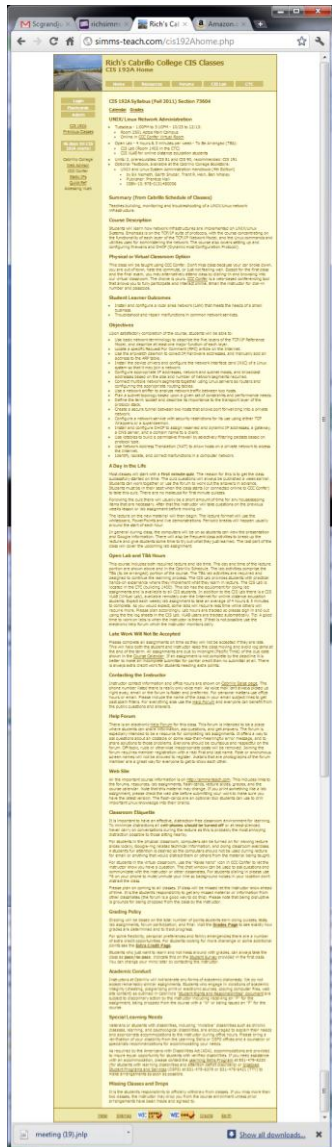
Course Description

Students will learn how network infrastructures are implemented and how to administer them. Emphasis is on the TCP/IP suite of protocols, with the course covering 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.

Then click these
links to toggle
between Home
(Syllabus),
Calendar and
Grades

Course Syllabus (on the CIS 192 home page)

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



Course Calendar

<i>Lesson # and Date</i>	1	10/25	<ul style="list-style-type: none"> Configure network settings Test network connections Ping and SSH with IPv6 	1.4, 4.3, 12.7, 13.7, 14.1-14.3, 14.10-14.11		<i>References to material in the textbook</i>
<i>Lesson slides and additional materials</i>			<p>Materials</p> <ul style="list-style-type: none"> Presentation slides (download) Apache web server example (show) Logins Sheet (download) Howto #303: Remote Access to the CIS VLab (download) CIS VLab RDP file (download) Student survey (download) <p>TBA Assignment</p> <ul style="list-style-type: none"> Lab 1 (Linux VMs) <p>CCC Confer</p> <ul style="list-style-type: none"> Enter virtual classroom Class archives 	16, 21.2		<i>TBA Lab assignment</i>
<i>First minute quiz</i>		10/31	Last day to add CIS 192A			
	2	11/1	<p>Quiz 1</p> <p>ARP and the Internet Layer</p> <ul style="list-style-type: none"> Permanent interfa Red Hat and Debia Understand how a Manage and track Sniff packets on t Wireshark Understand the In how addressing w 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) 	12	Student survey Lab 1	<i>What is due by 11:59PM (Opus time) on that date</i>

Course Grading

Monitor this page to track your progress in the course.

Rich's Cabrillo College CIS Classes CIS 192 Grades

Home Resources Forums CIS Lab Blackboard

CIS 192 (Spring 2013) Grades Course Home Calendar

Points can be earned from the following activities:

- First minute quizzes - 30 points (5%)
- Tests - 90 points (16%)
- Forum posts - 80 points (14%)
- Lab assignments - 300 points (54%)
- Final exam - 60 points (11%)

How your grade is determined:

A student can earn up to 560 total points doing the activities listed above. The course grade is based on 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

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

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 areas may include teamwork, leadership, quality, planning & organization skills, communication, documentation, motivation, and the desire to go above and beyond expectations. The forum is an excellent way to demonstrate teamwork and communication skills.

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.

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	20	30	30	30	30	30	30	30	30	30	30	60	90	560	
Arwen	Grade																															

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

Use extra credit to earn additional points

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

Your default grading choice will be a letter grade. This can be changed to Pass/No Pass by emailing a request to the instructor.

Each student is assigned a secret LOR code name

More on Grading

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0% to 59.9%	0 to 335	F	No pass

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

The student can decide the grade they want and how they want to earn it

CIS 192 - How this class works

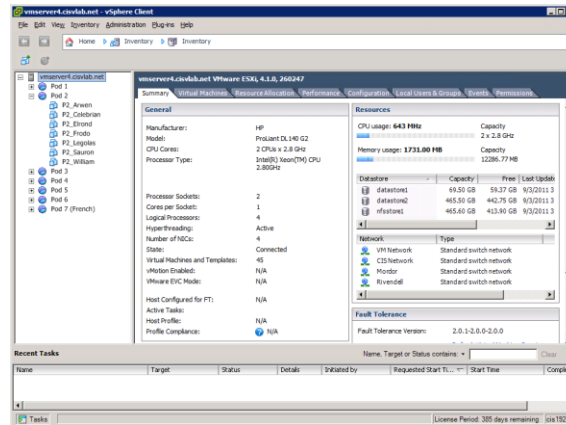
CIS Lab (in room 1403 of the CTC)



The TBA portion of this course is required

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

CIS VLab (remote online access)



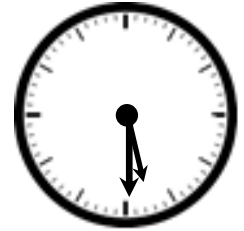
More on Grading

Lab Assignments (30 points each)

- Will be due at **11:59PM** (Opus time) on the date shown on the course Calendar. Each lab you submit is automatically time-stamped and the date be viewed by doing a long listing on the file.
- **Late work is not accepted.** There is no credit for any work turned in after the deadline. If you don't complete a lab assignment, please turn in what you have, by the due date, for partial credit.
- Students may work together and collaborate on labs but they must submit their own work to get credit.
- Lab resources, instructors, and assistants are available in the CIS lab. In addition the Linux Opus server and the CIS VLab may be accessed from anywhere over the Internet.

A lab assignment due at 11:59PM will get no credit if turned in one minute late at 12:00AM (midnight) the next day

More on Grading



"First Minute" quizzes (3 points each)

As an incentive to start class on time, 3 points are awarded for correctly answering 3 questions, in the correct order, at the very beginning of class.

- The quiz questions are shown on CCC Confer at **5:30PM** sharp.
- The quiz questions are given out in advance and students can use the forum to collaborate on answers prior to class.
- The **order of the questions** will not be known until the quiz is given! Emailed answers that are not in order will be marked as incorrect.
- Students may not give or ask others for assistance while taking a quiz.
- To take the quiz, students email the answers to the instructor.
- There are **no makeup's** for these quizzes and they **must be turned in within the first few minutes of class.**

More on Grading



Tests (3 tests, 30 points each)

- Tests will be distributed by during the last hour of the class.
- Tests are usually comprised of fill-in-the-blank type questions. Often you will have to use a Linux server to verify an answer.
- Tests are open notes, open book, and open computer.
- Tests are designed to take about an hour and be turned in at the end of class. To minimize "clock stress" on Test 1 and 2, you may continue to work on the test after class is over and turn it no later than 11:59PM.
- **Students may not give or ask others for assistance while taking a test.**

See the archived courses for an idea of what these tests are like

More on Grading



Final Exam (60 points)

- Students will deploy, configure and troubleshoot a network of Linux computers.
- There will be a list of network configuration specification tasks from which the student will choose a subset to implement for the exam.
- Final exams are open notes, open book, and open computer.

Students may not give or ask others for assistance while taking a final exam

See the archived courses for an idea of what these exams are like

More on Grading

Forum Posts (20 points per posting period)

- The end of each posting period is shown on the course calendar.
- Each post in the forum for this class is worth 4 points, up to 20 points maximum per period.
- The posts for the quarter will be due at **11:59PM** (Forum time) on the date shown on the course Calendar.
- Extra posts in one quarter do not carry over to the next quarter.
- Only posts in the forum for **this class** will be counted.

As far as earning points, forum posts are "low hanging fruit" !!

More on Grading

Extra credit (up to 90 points)

- You need to attend to a family emergency and can't turn in a lab assignment on time ... don't worry!
- Your schedule/commute doesn't allow you to take any of the "first minute" quizzes don't worry!
- You crash and burn on a test ... don't worry!
- You just don't like making forum posts ... don't worry!

There are ample extra credit opportunities which provide you with the flexibility to get the grade you want.

There is a cap on extra credit points so plan carefully!

Course outline and syllabus

Please don't forget:

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

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

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

A lab assignment due at 11:59PM will get no credit if turned in one minute late at 12:00AM (midnight) the next day

Final word on Grading

- You control your grade for this course!
- Use the Grades web page to plan for the grade you wish to receive and track your progress.
- Use the Calendar web page to see due dates for all assignments.

Rich's Cabrillo College CIS Classes
CIS 192A Grades

Home Resources Forums CIS Lab CTC

CIS 192A (Fall 2011) Grades
Course Home Calendar

How the course grade is determined

- 5% - Quizzes
- 10% - Tests
- 14% - Help Forum participation
- 51% - TBA lab assignments
- 20% - Final

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

Rich's Cabrillo College CIS Classes
CIS 192A Calendar

Home Resources Forums CIS Lab CTC

CIS 192A (Fall 2011) Course Calendar
Course Home Grades

(content subject to change)

Lesson	Date	Topics	Chapter	Due
		Introduction to Course, TCP/IP and Network Access		
		Linux market and jobs		
		How this course works		
		Equipment and resources		
		Virtualization and VMware 101 skills		
		Networking overview		
		NIC drivers		
		Configure network settings		
		Tail network connections		
		Ping and SSH with IPv6		
1	10/25	Materials		12:14
		• Presentation slides (download)		
		• Apache web server example (download)		
		• Logins sheet (download)		
		• Module P101: Remote Access to the CIS VLAB (download)		
		• CIS VLAB PDF file (download)		
		• Student survey (download)		
		VBA Assignment		
		• Lab 2: Linux (30%)		
		CCC Center		
		• Enter virtual classroom		

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

At the end of the course I use the table on the Grades web page to determine your grade



Help Forum

Online Help Forum

The screenshot shows the phpBB forum interface for Cabrillo College: Computer and Information Systems. The page includes a search bar, a board index, and a list of forum topics. The topics are organized into sections: Practice, Cabrillo College: Spring 2010 Courses, CIS 90, CIS 192AB, CIS 193AB, CIS 90 Program, Alumni, and Archives. Each topic has columns for the number of topics, posts, and the last post.

FORUM	TOPICS	POSTS	LAST POST
Practice Use this forum to practice using a bulletin board. Postings made to this forum will be deleted regularly.	3	3	by Rich Simms Sat Jan 16, 2010 6:14 pm
CABRILLO COLLEGE: SPRING 2010 COURSES			
CIS 90 Introduction to UNIX/Linux - Jim Griffin	0	0	No posts
CIS 192AB UNIX/Linux Network Administration - Rich Simms	0	0	No posts
CIS 193AB UNIX/Linux Security Administration - Jim Griffin	0	0	No posts
CIS 90 PROGRAM			
Alumni Stay in touch with former students!	0	0	No posts
ARCHIVES			
CIS 90 - Spring 2009 Introduction to UNIX/Linux - Rich Simms	Total redirects: 1		
CIS 192 - Spring 2009 UNIX/Linux Network Administration - Rich Simms	Total redirects: 1		

- Post questions and answers
- Collaborate on lab assignments
- Share UNIX/Linux information
- Post class notes for classmates who miss class
- Get clarifications
- Collaborate on quiz questions
- **Never post passwords!**



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

Class Forum

Textbook

POSTREPLY ↩

Search this topic...

Search

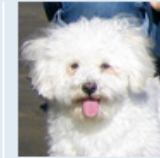
3 posts • Page 1 of 1

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

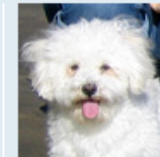
Joined: Thu May 15, 2008 2:40 pm



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.

CIS 192

Class Forum

Optional, but handy is to subscribe to a forum.

After logging in:

1. Go to the class forum.
2. Click the "Subscribe forum" box at the lower left. When subscribed you get email notifications when new posts are made.
3. To unsubscribe, click it again.

 Board index Subscribe forum

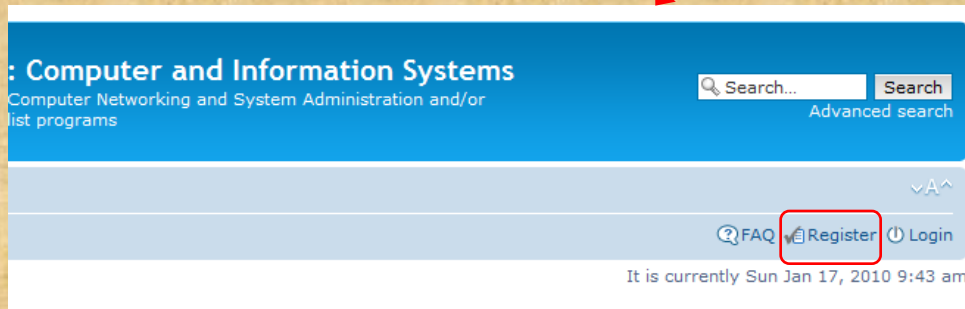
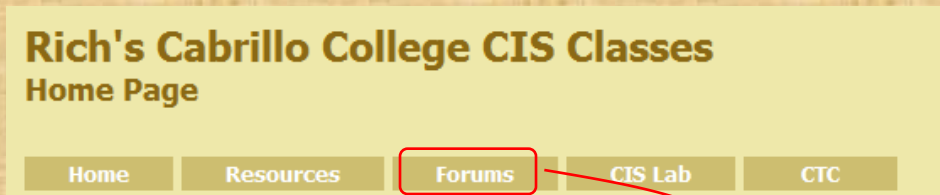
*Unsubscribed
looks like this*

 Board index Unsubscribe forum


*Subscribed
looks like this*

Class Activity Forum Registration

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



To Register:

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

Note: If you have already registered you don't need to do it again. If your username is incomplete or does not match a name of the class roster it will be modified or deleted by the instructor.



Housekeeping

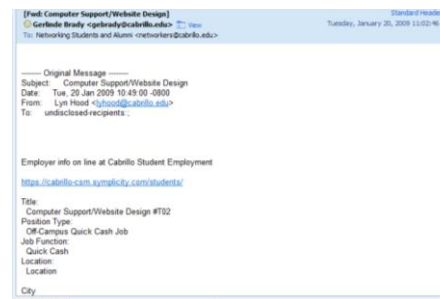
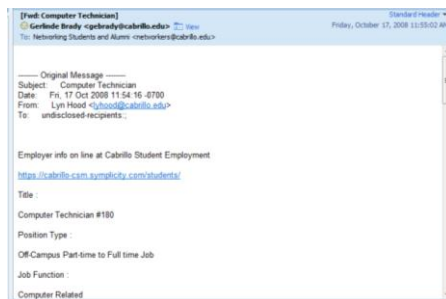
- Adds
- Last day to add is 2/23/2013

Cabrillo Networking Program Mailing list

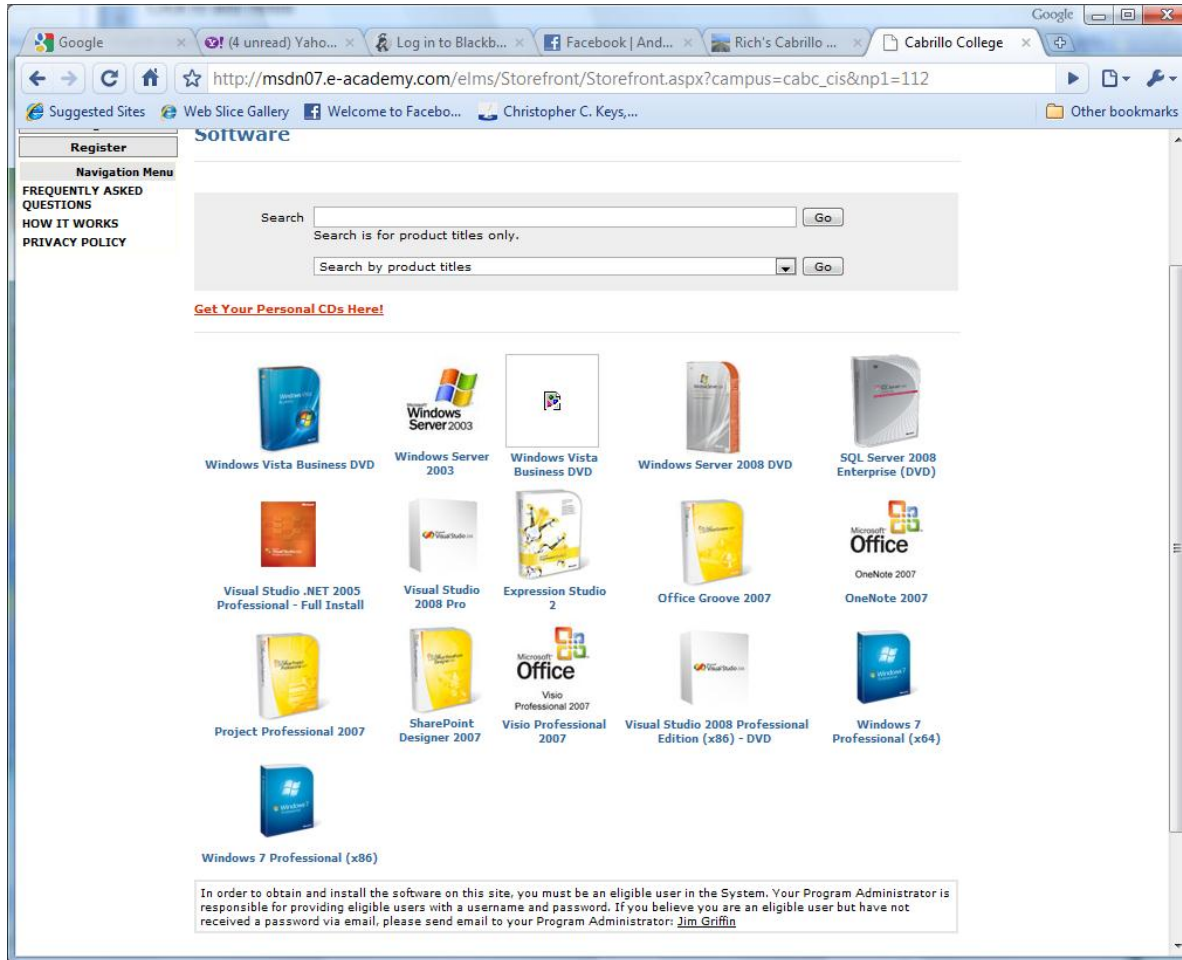
Subscribe by sending an email (no subject or body) to:

networkers-subscribe@cabrillo.edu

- Program information
- Certification information
- Career and job information
- Short-term classes, events, lectures, tours, etc.
- Surveys
- Networking info and links



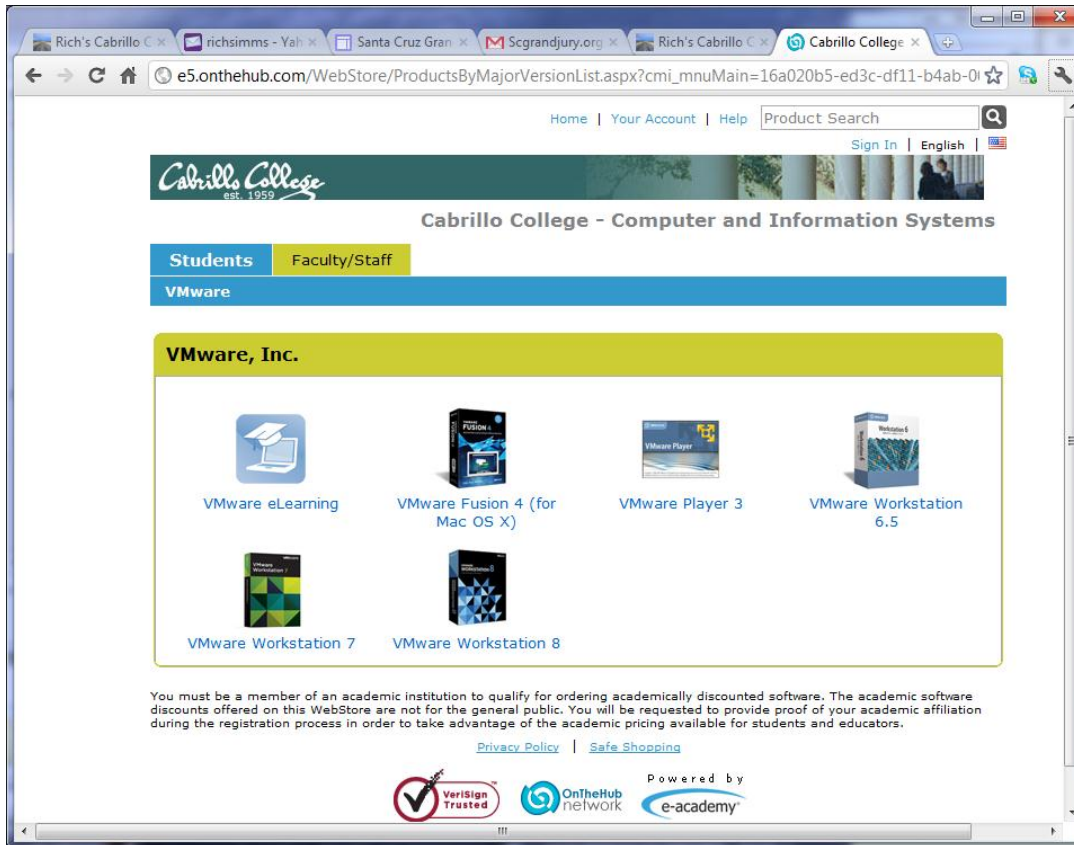
MSDN Academic Alliance



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

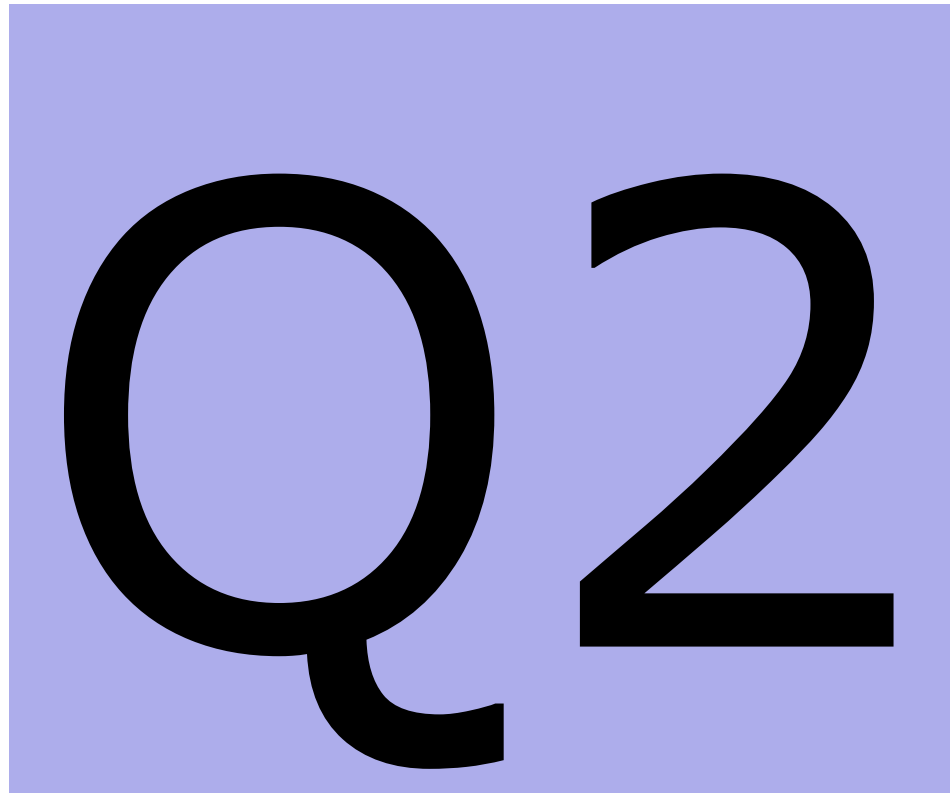
To get to this page, go to <http://simms-teach.com/resources> and click on the appropriate link in the Tools and Software section

VMware e-academy



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

To get to this page, go to <http://simms-teach.com/resources> and click on the appropriate link in the Tools and Software section



- UNIX/Linux market
- Equipment
- Login to Opus
- Login to CIS 192 VMs on school computers
- Login to CIS 192 VM remotely



Why Study UNIX/Linux?

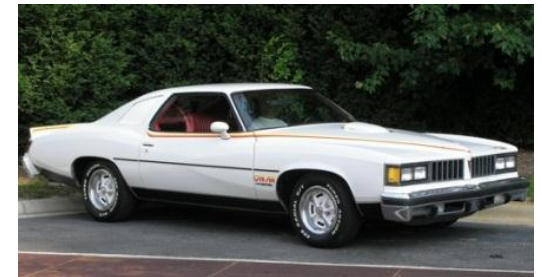
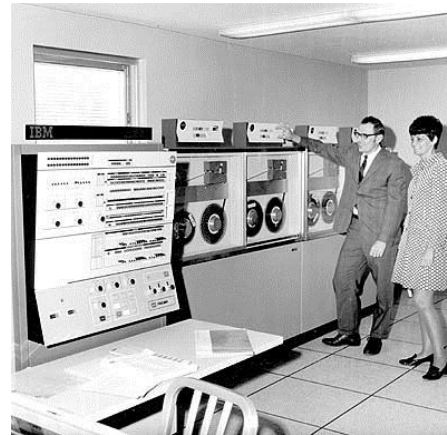
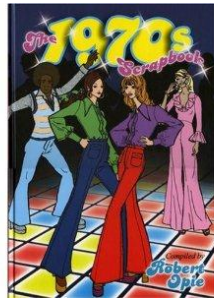
In 1971 Ken Thompson and
Dennis Ritchie developed
Unix at AT&T's Bell Labs

In 1971 Ken Thompson and Dennis Ritchie developed Unix at AT&T's Bell Labs



Bell Laboratories

Isn't UNIX/Linux an antique Operating System dating back to the early 70's that belongs in a museum?



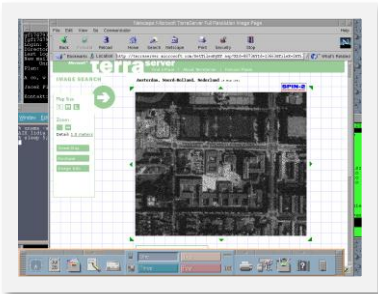
Heck NO !!

UNIX/Linux is widely used, constantly improved and growing fast!

- Embedded in smartphones and many other appliances
- Internet services - Web, DNS, DHCP, Net News, Mail, etc.
- Enterprise and mission critical applications - Large databases, Enterprise Resource Management (ERM), Customer Relationship Management (CRM), data warehouse, manufacturing, supply chain management, etc.
- Hollywood - feature animation, visual effects, rendering farms.
- Number-crunching super computers
- Companies like Google, Amazon, Facebook, PayPal, Yahoo etc. are using it to run their businesses on

Commercial UNIX Operating Systems

AIX

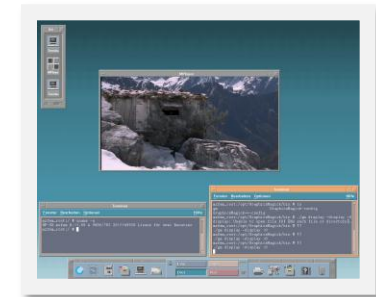


SCO UNIX



Berkeley
Software
Distribution

HP-UX



Solaris



Apple Mac OS X
and iOS



*The kernel is
UNIX based*

Various Linux Distributions

OpenSUSE



Red Hat Enterprise Linux



Fedora



Debian



CentOS



Ubuntu



Mandriva



*Note: A distribution is built by a company or organization. They start with the **Linux kernel** then add a custom mix of open source components. They may then add some of their own unique software to differentiate their distribution.*



Tux, the penguin, is the Linux kernel mascot

Embedded UNIX in Apple Products

Apple iOS



The Apple iOS, internally known as Darwin, like Mac OS X, runs on a UNIX like kernel (Mach kernel + BSD components)

Sources: [http://en.wikipedia.org/wiki/Darwin_\(operating_system\)](http://en.wikipedia.org/wiki/Darwin_(operating_system))
[http://en.wikipedia.org/wiki/IOS_\(Apple\)](http://en.wikipedia.org/wiki/IOS_(Apple))
<http://code.google.com/p/mobileterminal/>



Katana Robotic Arm

Embedded Linux (just a few)



Linksys WRT-54GL



Tivo



Yamaha Disklavier
Mark IV



Android



Some TomTom
GPS models



Garmin
Nuvi 5000



Buffalo
NAS storage



Virgin America
Personal
Entertainment



MikroTik Routers



Google Chrome OS
for Netbooks and Tablets



Raspberry Pi



The Open-Source Car

Summary: *Toyota is joining the Linux Foundation.*



By [Steven J. Vaughan-Nichols for Linux and Open Source](#) |
July 5, 2011 -- 10:13 GMT (03:13 PDT)

 Follow @sjvn

Besides a V6 as your engine, your car is very likely to soon be running Linux under the hood. [The Linux Foundation](#) will be announcing today that [Toyota](#) is joining the Foundation.



Some of you may be wondering, "What the heck is a car company doing joining the Linux Foundation?" The answer is easy. As the Foundation puts it, "A major shift is underway in the automotive industry. Car-makers are using new technologies to deliver on consumer expectations for the same connectivity in their cars as they've come to expect in their homes and offices. From dashboard computing to In-Vehicle-Infotainment (IVI), automobiles are becoming the latest wireless devices - on wheels."

And, what's one of the most popular systems for dashboard computing, heads-up driving displays and IVI? It's Linux, of course.

< *snipped* >

<http://www.zdnet.com/blog/open-source/the-open-source-car/9193>



Businesses and organizations that run on Linux



WIKIPEDIA
The Free Encyclopedia



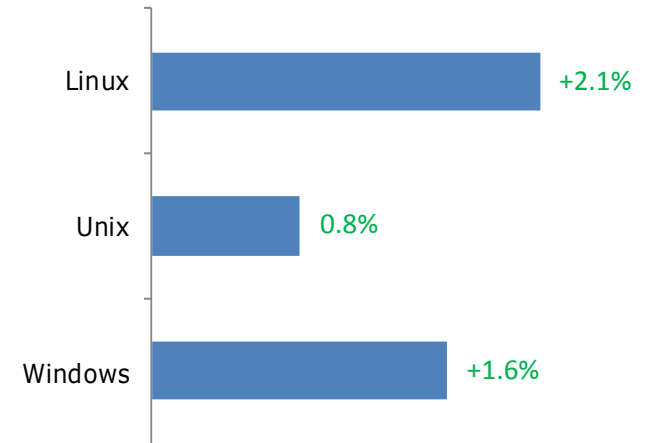
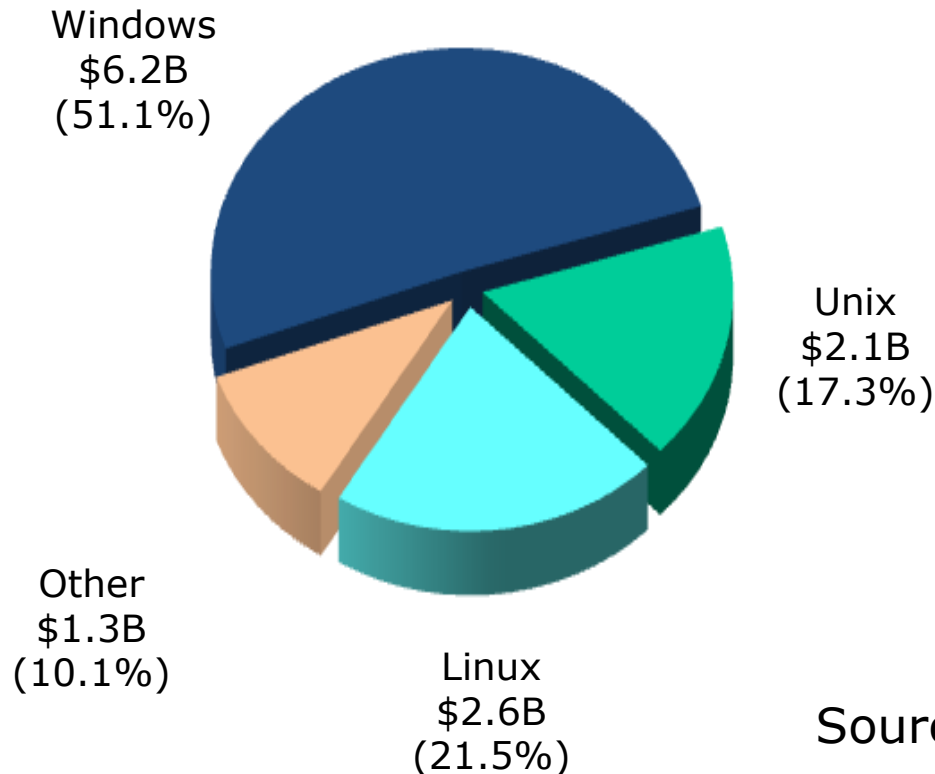


Worldwide Server Market



\$12.2 Billion Server Revenue Q3 2012

Year over Year Change



Source: IDC, Nov 2012

Website hits by browser OS

Jul 2010¹

Operating Systems		
1	Windows XP	48.17%
2	Windows 7	17.02%
3	Windows Vista	16.60%
4	Mac OS X	4.84%
5	Linux	1.45%
6	Windows 2003	1.02%
7	iPhone OSX	0.56%
8	Windows 2000	0.31%
9	WAP	0.12%
10	Android	0.08%

6.9%

Dec 2011²

Operating Systems		
1	Windows 7	37.60%
2	Windows XP	31.72%
3	Windows Vista	8.87%
4	Apple OS X	8.59%
5	Apple iOS	3.96%
6	Linux	1.64%
7	Android	1.64%
8	BlackBerry	0.68%
9	SymbianOS	0.23%
10	Windows 2000	0.09%

15.8%

Jan 2013³

Operating Systems		
1	Windows 7	44.13%
2	Windows XP	23.70%
3	iOS	8.79%
4	Apple OS X	8.52%
5	Windows Vista	5.48%
6	Android	3.75%
7	Windows 8	2.28%
8	Linux	1.74%
9	BlackBerry	0.61%
10	SymbianOS	0.23%

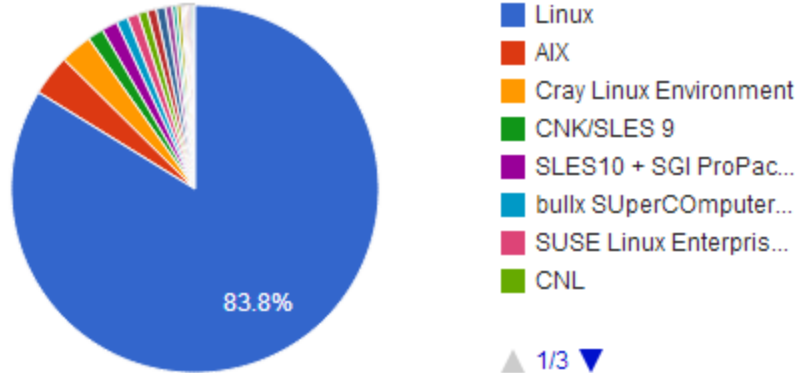
22.8%

1-This report was generated 07/31/2010 based on the last 15,000 page views to each website tracked by W3Counter. W3Counter's sample currently includes 38,996 websites. The browser market share graph includes data from all versions of the named browser families, not only the top 10 as listed below.

2-This report was generated 12/31/2011 based on the last 15,000 page views to each website tracked by W3Counter. W3Counter's sample currently includes 53,526 websites. The browser market share graph includes data from all versions of the named browser families, not only the top 10 as listed below.

3-This report was generated 01/31/2013 based on the last 15,000 page views to each website tracked by W3Counter. W3Counter's sample currently includes 63,187 websites. The browser market share graph includes data from all versions of the named browser families, not only the top 10 as listed below.

Operating System System Share



Linux dominates the Supercomputer market



IBM iDataPlex in Canada



NASA Advanced Supercomputing (NAS) Facility



CERN

Operating System	Count	System Share (%)	Rmax (GFlops)	Rpeak (GFlops)	Cores
Linux	419	83.8	124122700	177021632	12328716
AIX	18	3.6	4072666	5099712	182976
Cray Linux Environment	14	2.8	21742588	32301256	1034656
CNK/SLES 9	7	1.4	1453422	1749811	528384
SLES10 + SGI ProPack 5	7	1.4	960800	1096704	94208
bullx SUpErCOMputer Suite A.E.2.1	5	1	3241378	3961958	183424
SUSE Linux Enterprise Server 11	5	1	1624382	1921199	94752
CNL	4	0.8	453460	587565	60144
RHEL 6.2	4	0.8	1738900	2132582	102528
CentOS	4	0.8	955100	1182927	88928
Redhat Linux	3	0.6	311080	384785	42144
Windows HPC 2008	2	0.4	314300	460398	38028
RedHat Enterprise 5	2	0.4	177740	200271	17088
SUSE Linux	1	0.2	274800	308283	26304
RHEL 6.1	1	0.2	230600	340915	37056
Open Solaris	1	0.2	110600	121282	12032
Cell OS	1	0.2	81171	105830	5088
Windows Azure	1	0.2	151300	167731	8064
Super-UX	1	0.2	122400	131072	1280

iso.linuxquestions.org

15 Most Popular Linux Distro Downloads

15 Most Downloaded Distribution Versions (last 30 Days)	📡 15 Most Downloaded Distributions (Ever)
1. BackTrack 5 R3 (576742)	1. Fedora
2. CentOS 6.3 (81624)	2. Mandriva
3. FreeBSD 8.3 (12010)	3. Red Hat Enterprise Linux
4. BackTrack 5 R1 (8800)	4. SUSE
5. Oracle Linux 5 Update 7 (6246)	5. Ubuntu
6. BackTrack 5 R2 (3277)	6. CentOS
7. Linux Mint 13 "KDE" (3206)	7. Damn Small Linux
8. Ubuntu 12.10 (2737)	8. Linux XP
9. Damn Small Linux 4.4.10 (1714)	9. Knoppix
10. Zorin OS 5 "Educational" (1398)	10. Debian
11. Zenwalk Linux 7.2 (1295)	11. Slackware
12. Wifislax 4.3 (881)	12. PCLinuxOS
13. Fedora 18 (712)	13. MEPIS
14. KNOPPIX 7.0.4 (671)	14. Gentoo
15. KNOPPIX 5.1.1 (448)	15. Linux Mint

Feb 1, 2013

There are hundreds of Linux distributions. The one thing they have in common is they all use the Linux kernel.



Worldwide Smartphone Sales



**Worldwide Mobile Device Sales to End Users by Operating System in 3Q12
(Thousands of Units)**

Operating System	3Q12 Units	3Q12 Market Share (%)	3Q11 Units	3Q11 Market Share (%)
Google Android ↑	122,480.0	72.4	60,490.4	52.5
Apple iOS ↓	23,550.3	13.9	17,295.3	15.0
Blackberry Research In Motion ↓	8,946.8	5.3	12,701.1	11.0
Bada	5,054.7	3.0	2,478.5	2.2
Nokia Symbian ↓	4,404.9	2.6	19,500.1	16.9
Microsoft ↑	4,058.2	2.4	1,701.9	1.5
Others	683.7	0.4	1,018.1	0.9
Total	169,178.6	100.0	115,185.4	100.0

Source: Gartner (November 2012)

<http://www.gartner.com/newsroom/id/2237315>

Linux distros mentioned by top server vendors

Server market share source: IDC Q3 2012 report

Vendor	IBM (28.7%)	HP (27.3%)	Dell (17.1%)	Oracle (4.8%)	Fujitsu (3.8%)
Red Hat Enterprise	✓	✓	✓	✓	✓
Novell SUSE	✓	✓	✓	✓	✓
Oracle Linux	✓	✓	✓	✓	✓
Ubuntu	✓	✓	✓		✓
CentOS	✓	✓	✓		✓
Asianux	✓	✓	✓		✓
Debian	✓	✓			✓
Fedora	✓	✓			
OpenSUSE	✓	✓			

For CIS 192 we will be using CentOS and Ubuntu VMs. CentOS is built from Red Hat source code.



Lab Resources

Meet the CIS 192 Systems

CIS 192 student pod VMs



Arwen



Elrond



Celebrian



Legolas



Opus



Frodo



Sauron



William



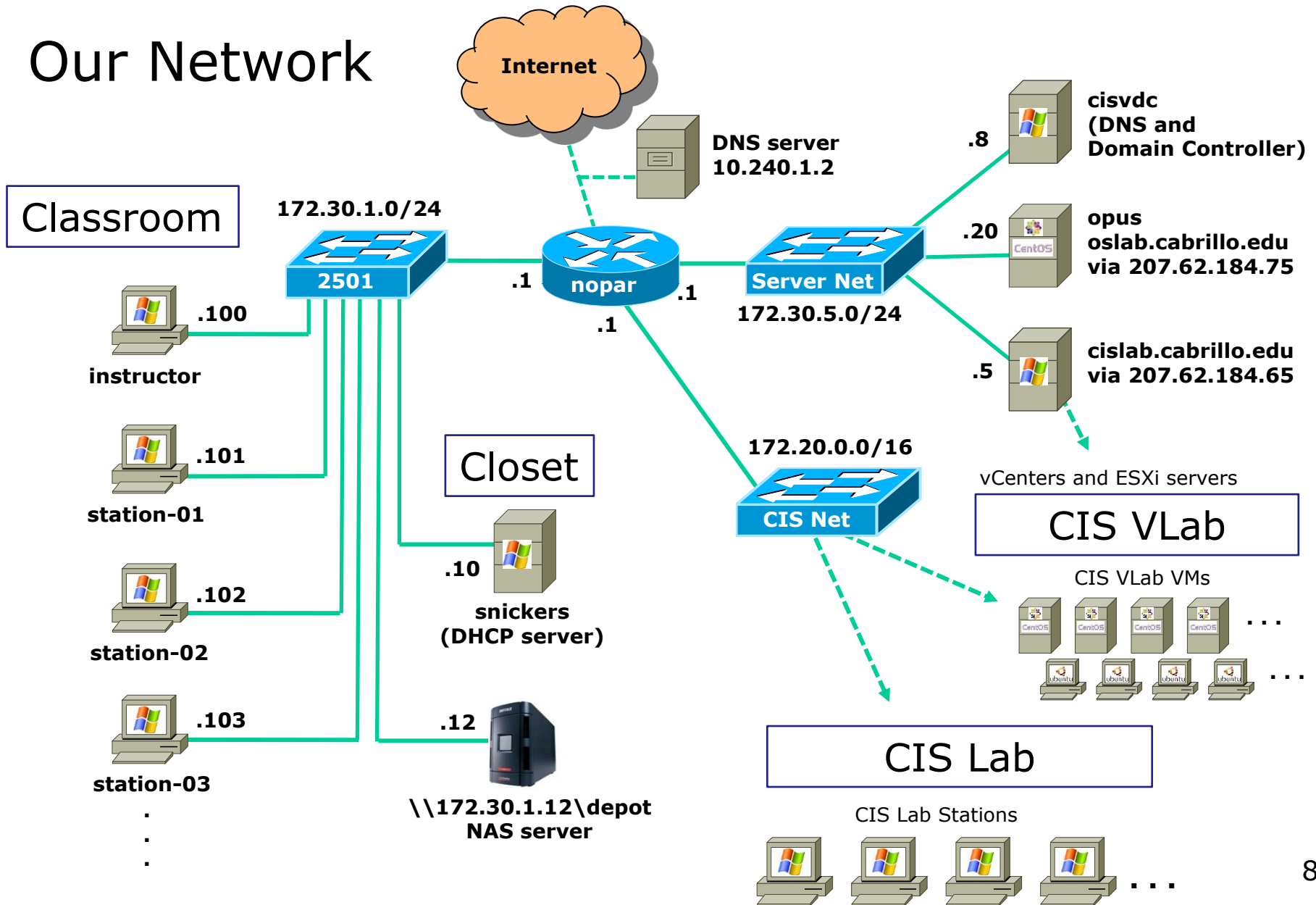
Each student is assigned a pod for their use over the semester

Showing CIS 192 Pod 3 in VLab

The screenshot shows the vCenter - vSphere Client interface. The left pane displays a tree view of the inventory, with 'CIS 192' expanded to show 'Pod 03'. The right pane shows the 'Pod 03' details, including a search bar and a table of virtual machines. The 'Recent Tasks' pane at the bottom is empty.

Name	State	Status	Host	Provisi...
p03-william	Powered Off	✓ Normal	vmserver3.cislab.net	23.24 C
p03-frodo	Powered Off	✓ Normal	vmserver3.cislab.net	13.55 C
p03-legolas	Powered Off	✓ Normal	vmserver3.cislab.net	12.85 C
p03-arwen	Powered Off	✓ Normal	vmserver3.cislab.net	12.85 C
p03-celebrían	Powered Off	✓ Normal	vmserver3.cislab.net	12.85 C
p03-sauron	Powered Off	✓ Normal	vmserver3.cislab.net	13.55 C
p03-elrond	Powered Off	✓ Normal	vmserver3.cislab.net	12.85 C

Our Network



The CIS Lab

CTC Building Room 1403

A lab for CIS students with all the equipment needed to complete lab assignments



Instructors and lab assistants are available (see schedule) to help

Rich's Cabrillo College CIS Classes
CIS 90 Grades

Home

Resources

Forums

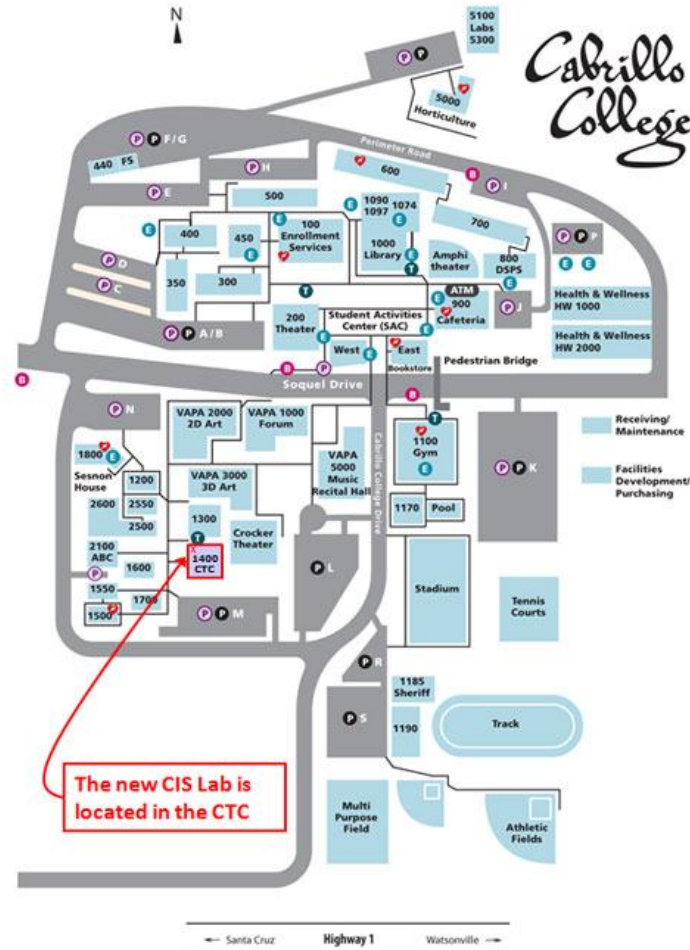
CIS Lab

Blackboard

Use this link to see the schedule and hours of operation

The CIS Lab

CTC Building Room 1403

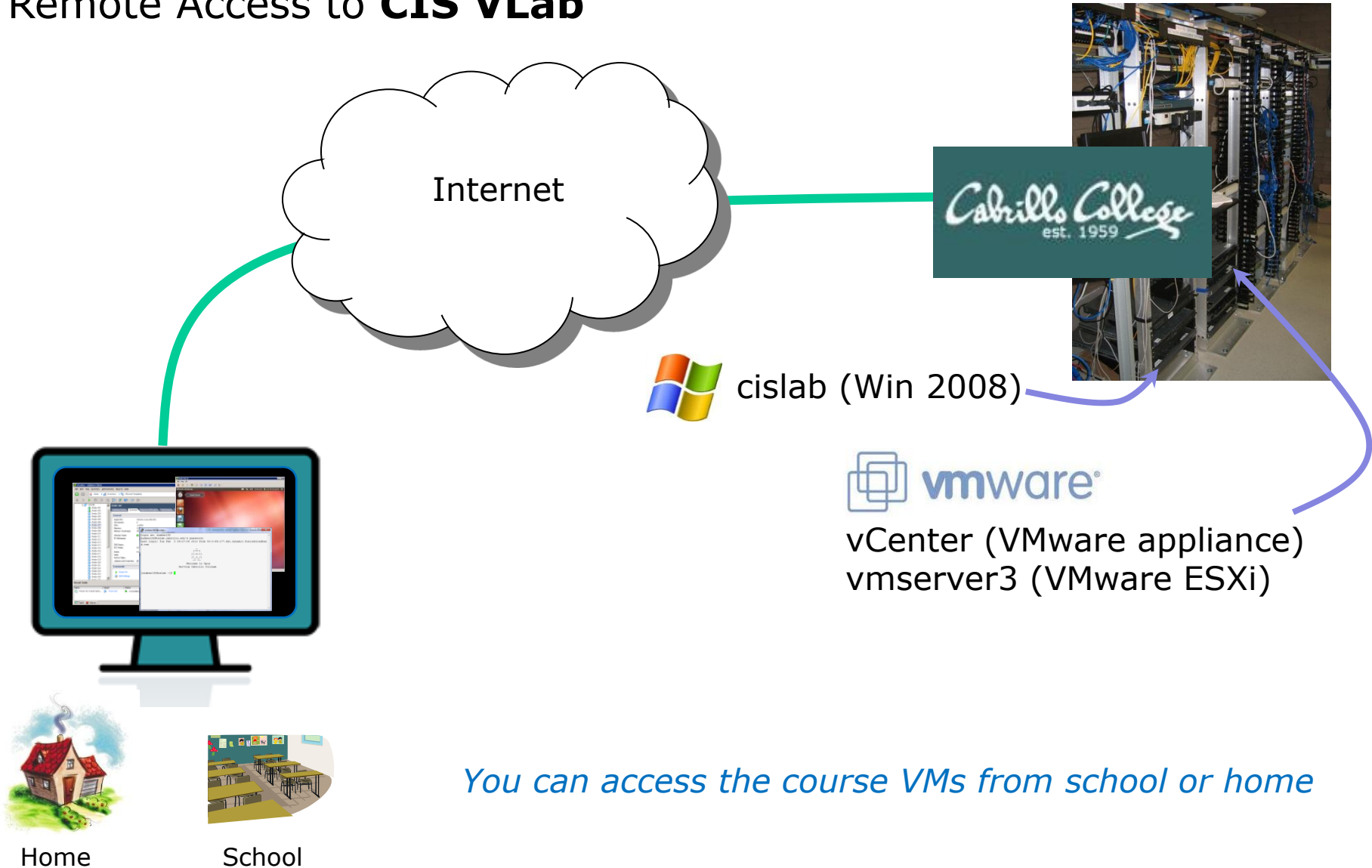




Lab Resources

Room 1403 on Aptos Campus

Remote Access to **CIS VLab**



You can access the course VMs from school or home

Logging Into Opus via SSH

Picture credit:
<http://www.cs.umd.edu/faq/ssh.html>



SSH is a network protocol that enables secure connections between computers

Remote Server



Sniffer view of a Telnet session

```

server2 VMware Remote Console | Devices
root@ server2-01:~
telnet-session - Ethereal
Contents of TCP stream
login: rssiimmmssr
Password: nimbus2000r
Last login: Sun Jul 6 18:47:03 from 192.168.1.254r
[rsimms@server2-01 rsimms]$ ccaatt sseeccrreett r
The D-Day invasion is set for June 6th at Normandyr
[rsimms@server2-01 rsimms]$ eexxiitt r
logout r
[H][J
    
```

Telnet uses clear text

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

Sniffer view of a SSH session

```

server2 VMware Remote Console | Devices
root@ server2-01:~
ssh-session - Ethereal
Contents of TCP stream
0000059E 1a 20 b1 e0 7a f3 93 2f 93 13 32 20 a3 32 b3 33 ...+...
000005AE 80 72 2b 72 d4 3b 46 a6 7b 67 6b d4 df a2 b2 8c ,r+r;F.
000005BE 01 7c 39 78 bd c4 95 f2 61 93 73 a1 76 49 cf 00 ,19x...
000005CE 68 c2 85 71 b0 75 c6 72 b5 18 27 10 4b 57 ed 88 h.,q.u.r
000005DE 17 df 2b a1 dd 81 4f 0a 58 51 f5 f7 54 3e cc 89 ...+...0.
000005EE 55 70 e9 73 b4 0a 6f 3f af 5b f7 3c 4e 30 92 39 Up,s..o?
000005FE 62 fc fd a6 fd b9 45 e2 56 12 d1 90 0c d9 ce 34 b.....E.
0000060E 6d 1f 8b 44 a7 50 3c 59 aa 0b 2a c2 04 c1 da 43 m..D,P<Y
0000061E 21 87 2d 32 67 48 d3 47 2f 43 25 5b ee 65 89 76 l.-2gH.G
0000062E 83 1c 74 91 b1 f5 3e 8b 57 ee d9 fc f5 45 e3 b6 ...t...>.
0000063E ef 9c f0 89 eb f7 1d c9 fd 29 69 44 a9 75 98 5a .....
0000064E b2 ba d5 62 9f 35 e1 1a ee 06 8b 79 fe e9 f0 0a ...b.5..
0000065E df .....
0000066E ea .....
0000067E 06 .....
0000068E 8c 8f a3 07 6e 69 62 02 a7 3f e0 e1 9b ec af d0 ...nib.
    
```

SSH is encrypted

With ssh, everything is encrypted. This is how we will access all remote systems in CIS 90.



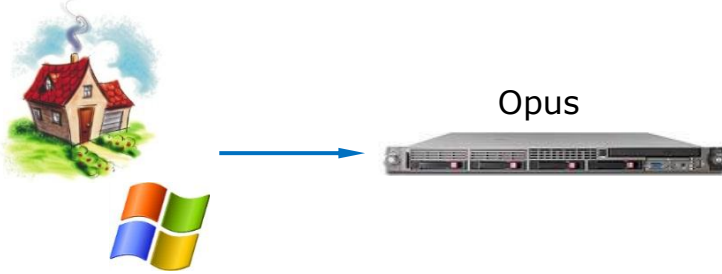
Local computer

SSH connection to a UNIX/Linux Server

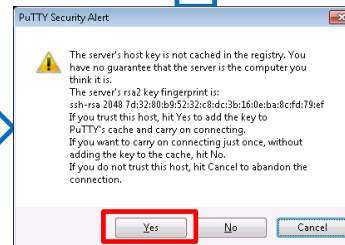
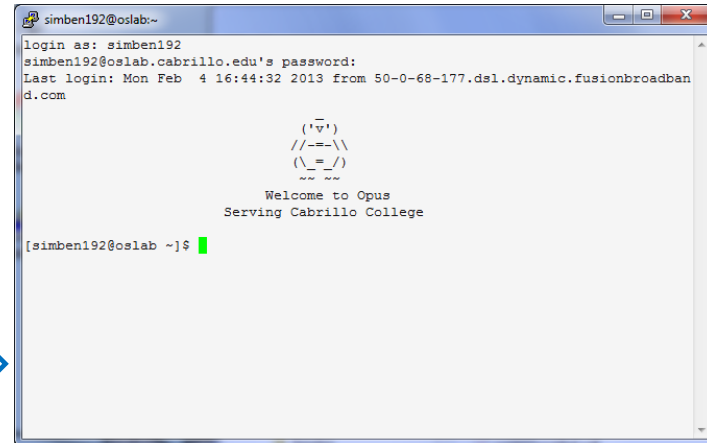
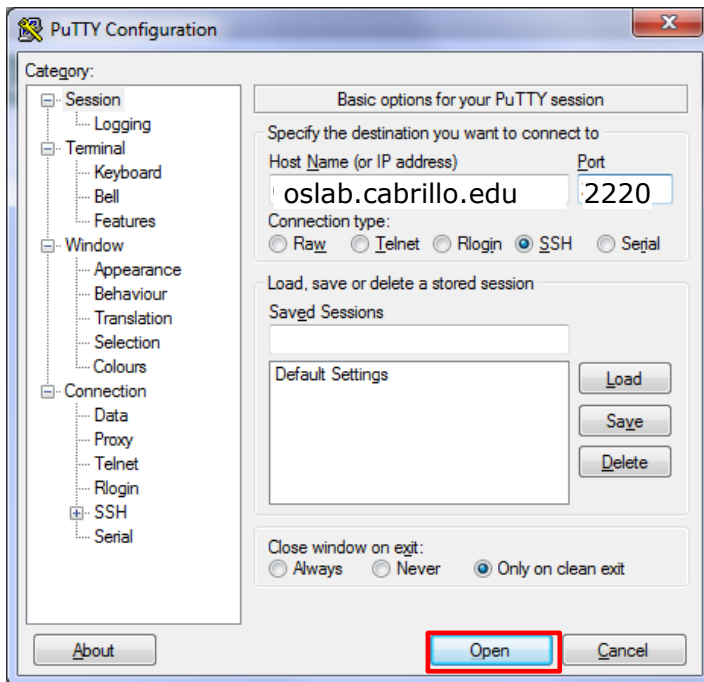
You need to know three things:

- The **hostname** of the remote server (must be a *fully qualified domain name* when going over the Internet)
- Your **login credentials** (username/password) on the remote server
- The **port number** the SSH service is listening on (the default is port 22)

Logging into Opus from **home**



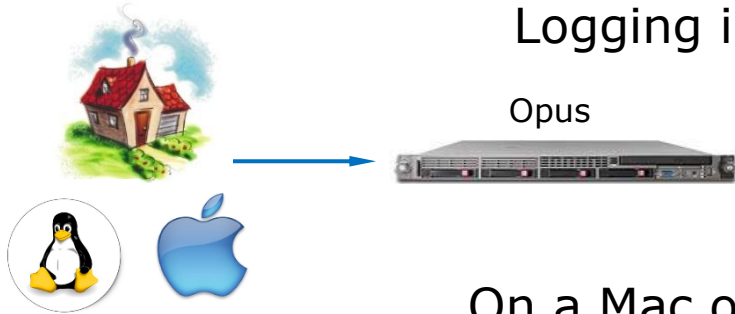
On Windows run Putty



The first time a connection is made to a server this warning is displayed.

Logging into Opus from **home**

Opus



On a Mac or Linux terminal:
ssh -p 2220 *username@oslab.cabrillo.edu*

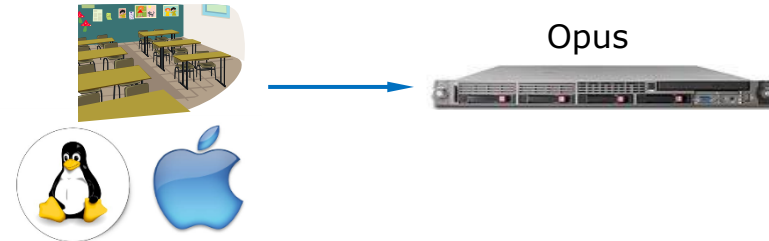
```
Activities Terminal Tue 06:25 Rich Simms
simben192@oslab:~
File Edit View Search Terminal Help
[rsimms@batman ~]$ ssh -p 2220 simben192@oslab.cabrillo.edu
simben192@oslab.cabrillo.edu's password:
Last login: Tue Feb 5 06:07:32 2013 from 50-0-68-177.dsl.dynamic.fusionbroadband.com

      ( 'v' )
     //--\\
    ( \_=/ )
     ~~~~

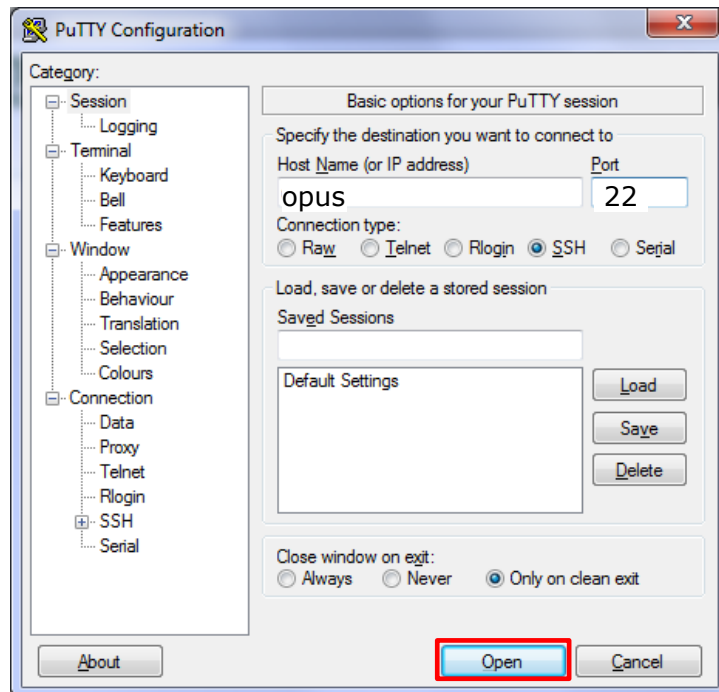
Welcome to Opus
Serving Cabrillo College

[simben192@oslab ~]$
```

Logging into Opus from **the classroom or CIS Lab**



On Windows run Putty:



On a Mac or Linux terminal:

ssh username@opus

When connected to the CIS Lab network rather than the Cabrillo campus network you can just use "opus" as the hostname with port 22

Accessing Opus from a Windows PC using Putty Log in with username and password

username

password
(not echoed)

```
simben192@oslab:~  
login as: simben192  
simben192@oslab.cabrillo.edu's password:  
Last login: Mon Feb 4 16:44:32 2013 from 50-0-68-177.dsl.dynamic.fusionbroadband.com  
  
      ( 'v' )  
    //--=\\  
   ( \\_=/ )  
    ~ ~ ~  
Welcome to Opus  
Serving Cabrillo College  
  
[simben192@oslab ~]$
```

*Use exit command to
end session*

Class Activity

	Hostname	Port
Home or campus wireless network	oslab.cabrillo.edu	2220
Classroom or CIS Lab PCs	opus	22

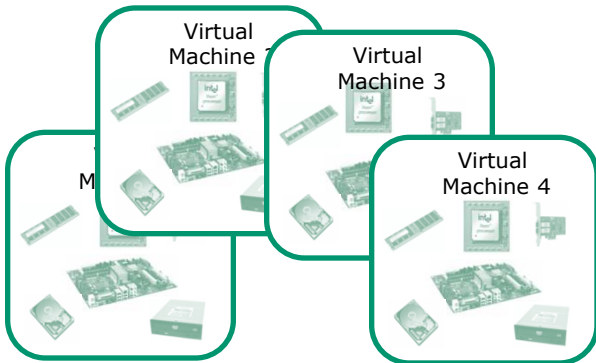
1. Use Putty (or a Mac terminal) and connect to Opus
2. Login using your unique username and password



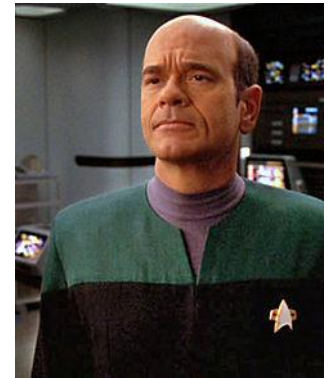
Virtualization

What is a virtual machine?

- **Virtualization software** 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 know they are not running on a “real” computer.
- Over the network a virtual machine appears just like any other computer.

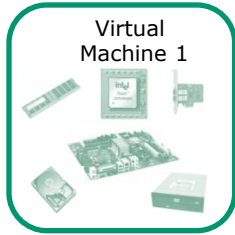


The EMH doctor on Star Trek Voyager was a simulation

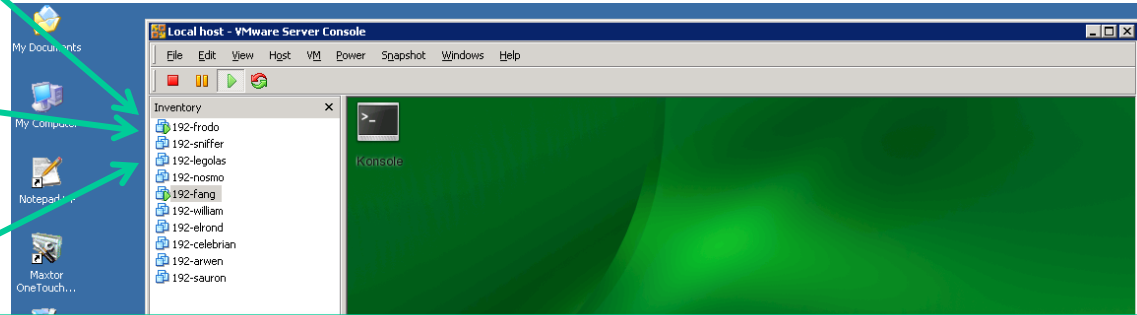


Virtual Machines

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



⋮

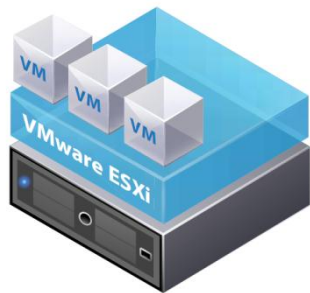


Benefits of virtualization:

- 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!

Some of the virtualization product options for CIS Students

See: <http://simms-teach.com/resources.php>



VMware ESXi and vSphere Client
(Bare metal hypervisor)



VMware Workstation (for Windows) or **Fusion** (for Mac)



Microsoft Hyper-V is available in Windows 2008 and 2012



VirtualBox (for Windows, Mac, Linux or Solaris)



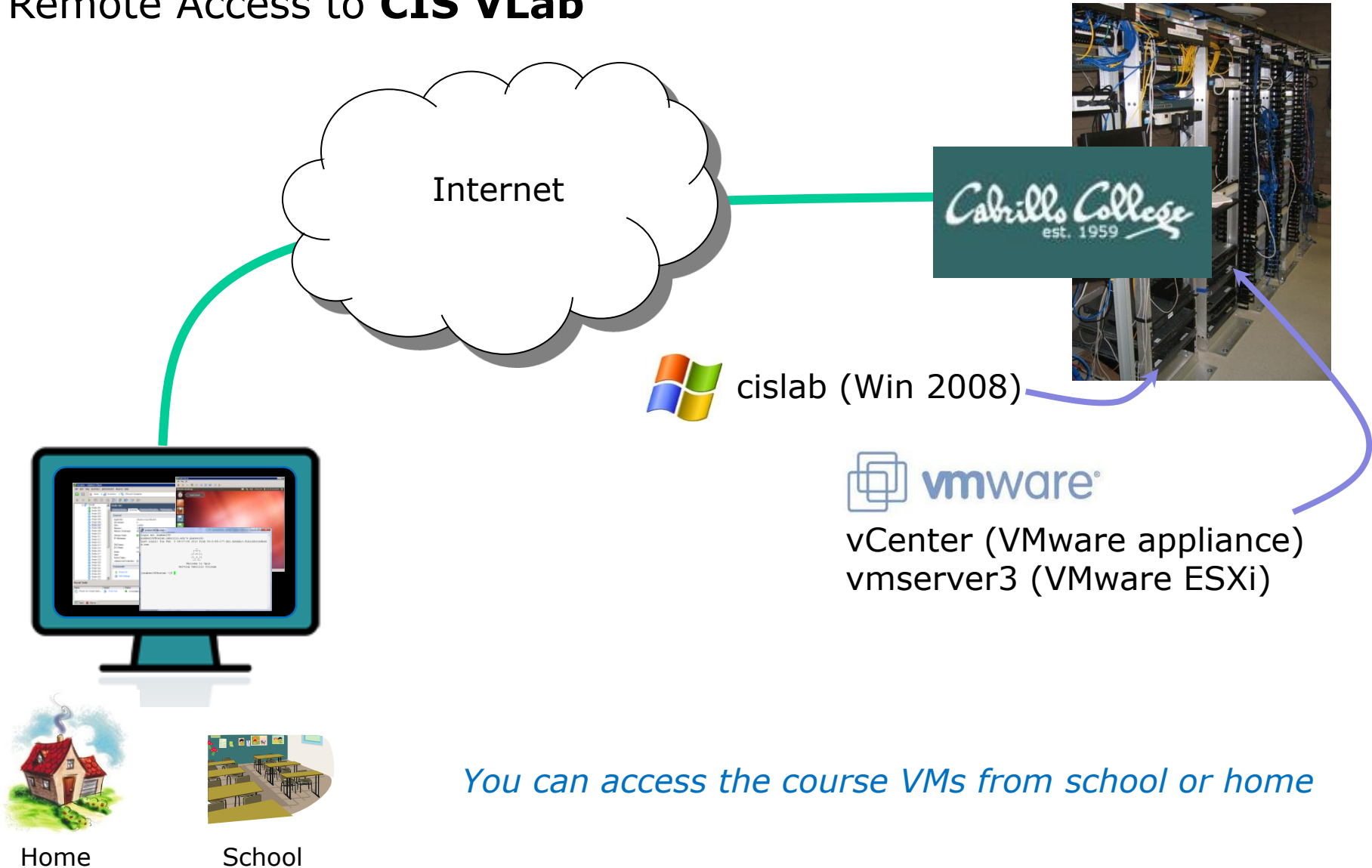
Using CIS VLab (Virtual Lab)



Lab Resources

Room 1403 on Aptos Campus

Remote Access to **CIS VLab**



You can access the course VMs from school or home

Getting to CIS VLab

Rich's Cabrillo College CIS Classes Home Page

Home Resources Forums CIS Lab

Login
Flashcards
Admin

CIS 90
CIS 192
Previous Classes

10 days till term starts!

Cabrillo College
Web Advisor
Commands and Files

VLab RDP file
CIS 90 VLab VM Assignments
CIS 192 VLab Pod Assignments

RJP Dennis Ritchie

Rich Simms

Contact

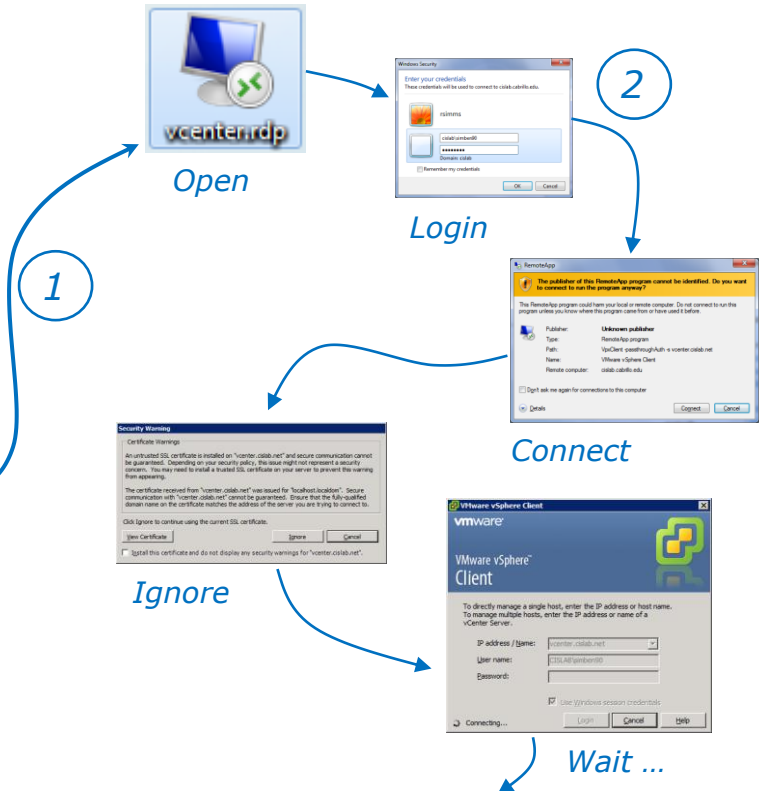
- Email: rsimms@cabrillo.edu
- Office hours: [directory page](#)

Spring 2013 Cabrillo Linux Classes

- Introduction to UNIX/Linux (CIS 90) - Rich Simms teaching
- UNIX/Linux Network Administration (CIS 192AB) - Rich Simms teaching

1) Download the `vcenter.rdp` file to your desktop and then open it to access VLab. Mac users will need to install CoRD.

2) When entering your username and password you must preface your username with the "cislabs", for example Benji would use: `cislabs\simben192`



vCenter - vSphere Client

Home Inventory Administration Upgrade Help Search Inventory

Hosts & Templates

Pod01
Pod02
Pod03
Pod04
Pod05
Pod06
Pod07
Pod08
Pod09
Pod10
Pod11

p03-arwen
p03-arwen
p03-astor
p03-ethond
p03-nodo
p03-nogates
p03-sauron
p03-william

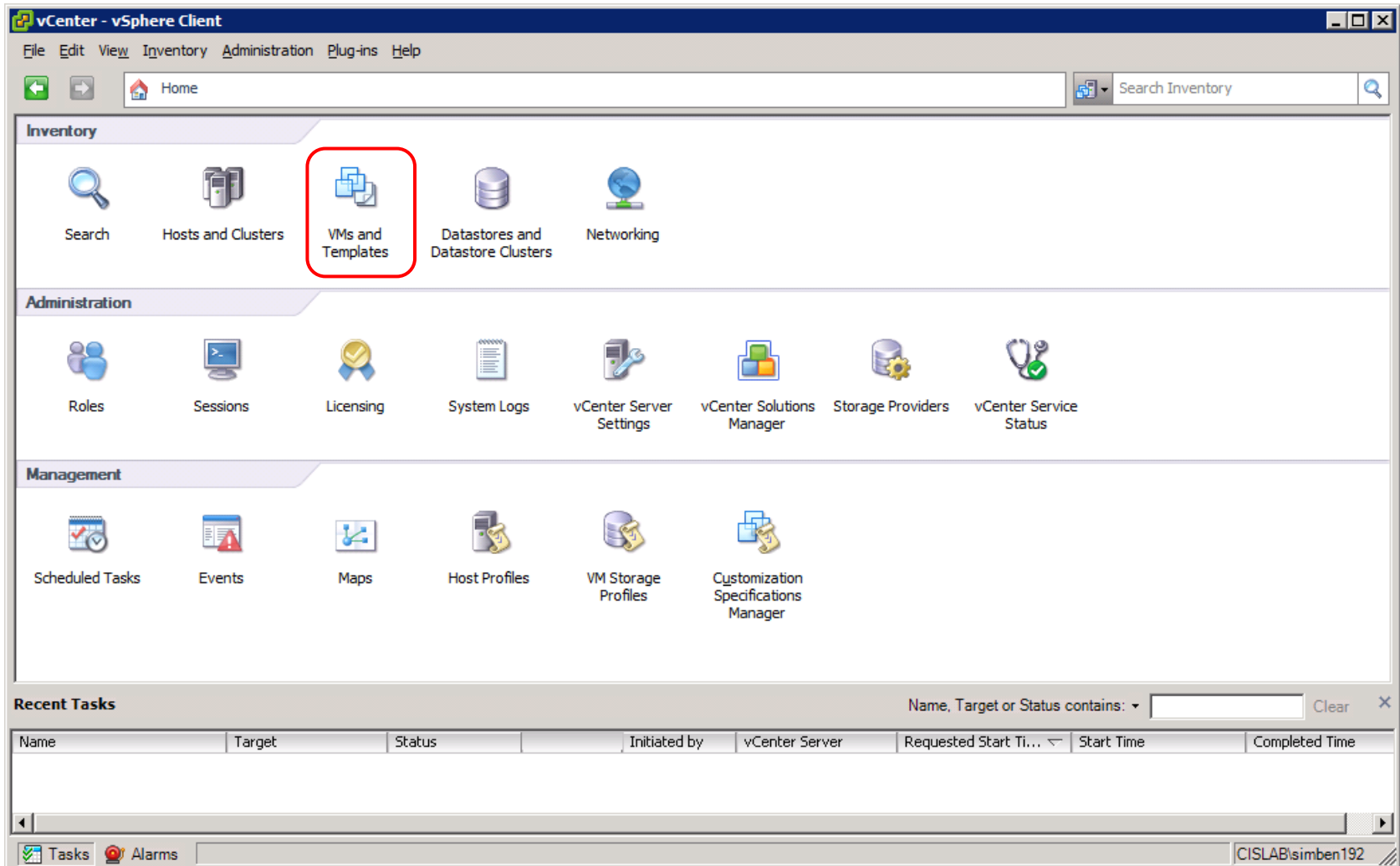
Getting Status Summary Resource Allocation Performance Tasks & Events Alarms Config Permissions

```
CentOS release 6.3 (Final)
Kernel 2.6.32-279.el6.x86_64 on an x86_64
p03-arwen login: _
```

Name	Target	Status	Details	Initiated by	Requested Start	Start Time
Power on virtual mach...	p03-arwen	Completed		vCenter Server	2/4/2013 6:35:26 PM	2/4/2013 6:35:26 PM
Initialize powering On	CISLAB	Completed		CISLAB\simben192	2/4/2013 6:35:26 PM	2/4/2013 6:35:26 PM

Locate and select your assigned pod

CIS VLab Home View



Click VMs and Templates to get to your course VMs

CIS Vlab VMs and Templates View

Getting Started

One CIS 192 pod will be assigned to each student for the semester

What is a Folder

A folder is a way to group objects into hierarchies. Folders provide a natural structure upon which to apply permissions.

The folder structure you see in the inventory varies depending on the inventory view.

Basic Tasks

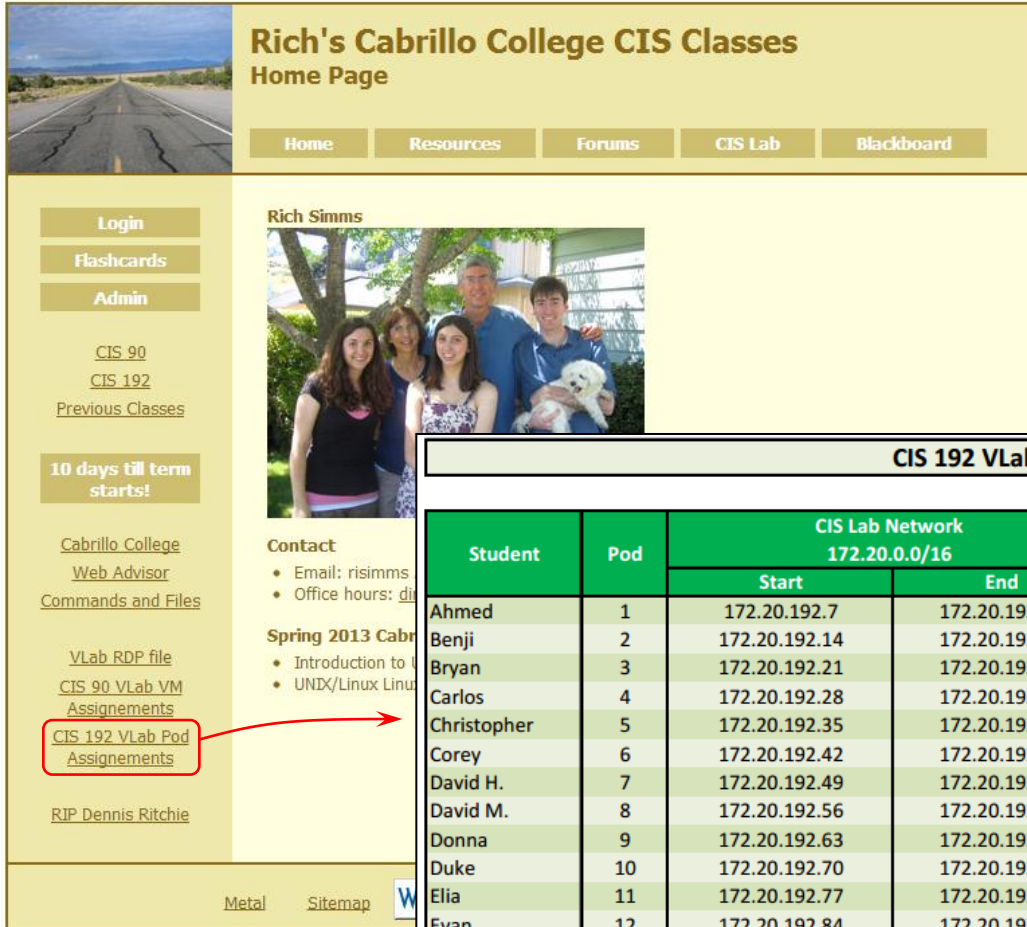
Create a folder

Recent Tasks

Name, Target or Status contains: Clear

Name	Target	Status	Details	Initiated by	vCenter Server	Requested Start Ti...	Start Time

Tasks Alarms CISLAB\simben192



Rich's Cabrillo College CIS Classes Home Page

Home Resources Forums CIS Lab Blackboard

Login
Flashcards
Admin


CIS 90
CIS 192
Previous Classes

10 days till term starts!

Cabrillo College
Web Advisor
Commands and Files

VLab RDP file
CIS 90 VLab VM Assignments
CIS 192 VLab Pod Assignments
RJP Dennis Ritchie

Rich Simms



Contact

- Email: risimms
- Office hours: di

Spring 2013 Cabr

- Introduction to
- UNIX/Linux Linu

Metal Sitemap

To see which CIS 192 pod is yours use the link on the class website

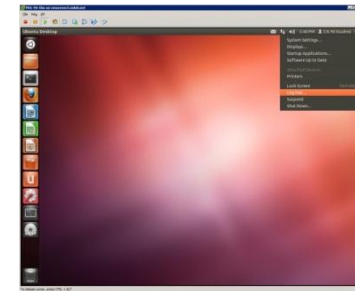
CIS 192 VLab Assignments						
Student	Pod	CIS Lab Network 172.20.0.0/16		Virtual Switches		
		Start	End	Shire	Rivendell	Mordor
Ahmed	1	172.20.192.7	172.20.192.13	Shire-01	Rivendell-01	Mordor-01
Benji	2	172.20.192.14	172.20.192.20	Shire-02	Rivendell-02	Mordor-02
Bryan	3	172.20.192.21	172.20.192.27	Shire-03	Rivendell-03	Mordor-03
Carlos	4	172.20.192.28	172.20.192.34	Shire-04	Rivendell-04	Mordor-04
Christopher	5	172.20.192.35	172.20.192.41	Shire-05	Rivendell-05	Mordor-05
Corey	6	172.20.192.42	172.20.192.48	Shire-06	Rivendell-06	Mordor-06
David H.	7	172.20.192.49	172.20.192.55	Shire-07	Rivendell-07	Mordor-07
David M.	8	172.20.192.56	172.20.192.62	Shire-08	Rivendell-08	Mordor-08
Donna	9	172.20.192.63	172.20.192.69	Shire-09	Rivendell-09	Mordor-09
Duke	10	172.20.192.70	172.20.192.76	Shire-10	Rivendell-10	Mordor-10
Elia	11	172.20.192.77	172.20.192.83	Shire-11	Rivendell-11	Mordor-11
Evan	12	172.20.192.84	172.20.192.90	Shire-12	Rivendell-12	Mordor-12
Gabriel	13	172.20.192.91	172.20.192.97	Shire-13	Rivendell-13	Mordor-13
Homer	14	172.20.192.98	172.20.192.104	Shire-14	Rivendell-14	Mordor-14
Sean	15	172.20.192.105	172.20.192.111	Shire-15	Rivendell-15	Mordor-15
Shahram	16	172.20.192.112	172.20.192.118	Shire-16	Rivendell-16	Mordor-16
Solomon	17	172.20.192.119	172.20.192.125	Shire-17	Rivendell-17	Mordor-17
Stephanie	18	172.20.192.126	172.20.192.132	Shire-18	Rivendell-18	Mordor-18
Tajvia	19	172.20.192.133	172.20.192.139	Shire-19	Rivendell-19	Mordor-19
Tony	20	172.20.192.140	172.20.192.146	Shire-20	Rivendell-20	Mordor-20

The Ubuntu VMs (Frodo and Sauron)

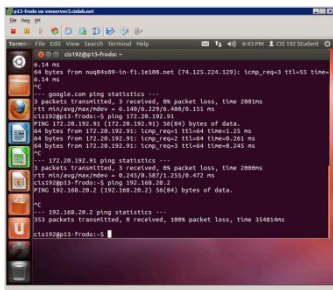
Log in as
CIS 192 Student (cis192)



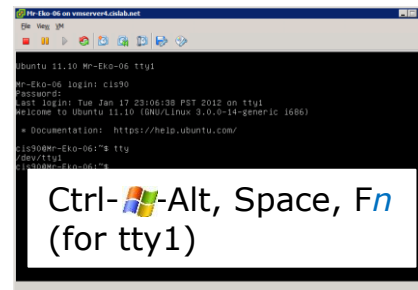
Shutdown using
 **> Shut Down...**



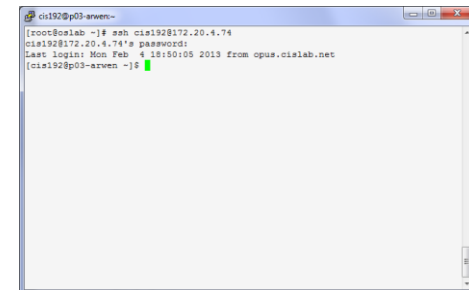
Use **Ctrl-Alt-t** to get a graphical terminal



Switch between virtual terminals for multiple logins (F1-F7)



SSH to Opus, then to VM (after configuring IP address) for better terminal experience



The CentOS VMs (Arwen, Celebrian, Elrond and Legolas)

Log in as
cis192 or **root**

Use *sudo -i* to become root



The CentOS VMs are configured
as run level 3 only (no graphical
desktop)

Shutdown using
init 0

```

p03-arwen on vmserver.cislab.net
[~]$ ssh
CentOS release 6.3 (Final)
Kernel 2.6.32-279.el6.x86_64 on an x86_64

p03-arwen login: cis192
Password:
Last login: Sun Dec 30 10:23:10 on tty1
cis192@p03-arwen:~$ sudo -i
[sudo] password for cis192:
root@p03-arwen:~#
    
```

```

p03-arwen on vmserver.cislab.net
[~]$ ssh
CentOS release 6.3 (Final)
Kernel 2.6.32-279.el6.x86_64 on an x86_64

p03-arwen login: cis192
Password:
Last login: Sun Dec 30 10:23:10 on tty1
cis192@p03-arwen:~$ sudo -i
[sudo] password for cis192:
root@p03-arwen:~#

root@p03-arwen:~# shutdown now
root@p03-arwen:~#

root@p03-arwen:~# init 0
root@p03-arwen:~#

Shutting down...Shutting down console mouse serv
ces:
Stopping sshd: [ OK ]
Stopping PCoA initiator service: [ OK ]
Stopping lldpad: [ OK ]
Stopping rchmd: [ OK ]
Stopping auditd: [ OK ]
Shutting down system logger: [ OK ]
Shutting down loopback interface: [ OK ]
iptables: Flushing iptables rules: [ OK ]
iptables: Setting chains to policy ACCEPT: filter [ OK ]
iptables: Unloading modules: [ OK ]
iptables: Flushing iptables rules: [ OK ]
iptables: Setting chains to policy ACCEPT: filter [ OK ]
iptables: Unloading modules: [ OK ]
Stopping monitoring for VG VolGroup: 2 logical volume(s) in volume group "VolG
rosp" unmonitored [ OK ]
Sending all processes the TERM signal... [ OK ]

To release cursor, press CTRL + ALT
    
```

Switch between virtual
terminals for multiple
logins (F1-F7)

```

f0r-eko-06 on vmserver.cislab.net
[~]$ ssh
Ubuntu 11.10 Natty Narwhal tty1
M-eko-06 login: cis90
Password:
Last login: Tue Jan 17 23:06:30 PST 2012 on tty1
Welcome to Ubuntu 11.10 (GNU/Linux 3.0.0-14-generic i686)

 * Documentation:  https://help.ubuntu.com/

cis90@M-eko-06:~$ ttty
/dev/tty1
cis90@M-eko-06:~$

Ctrl--Alt, Space, Fn
(for tty1)
    
```

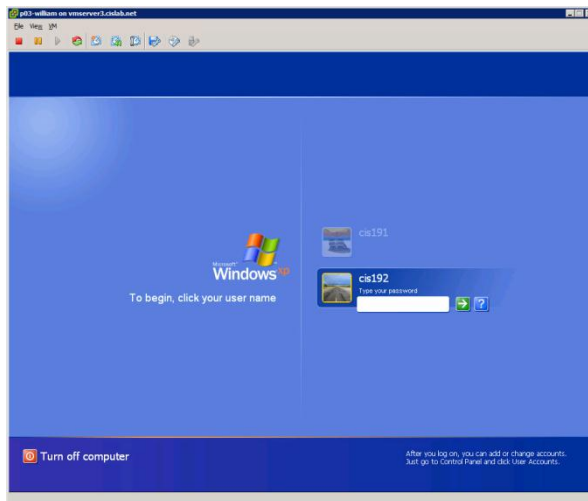
For better terminal
experience, SSH to Opus,
then to VM (after
configuring IP address)

```

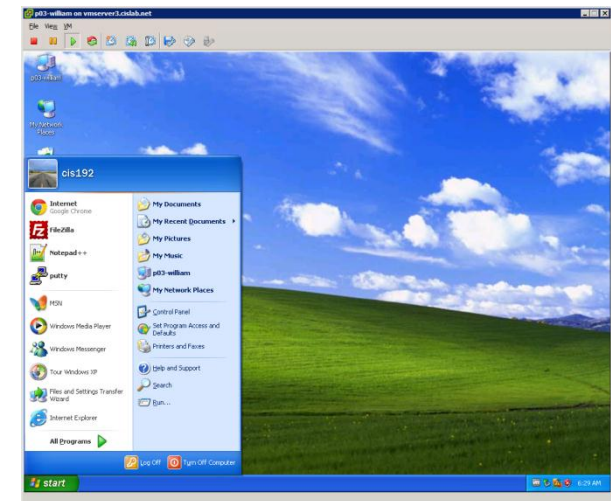
cis192@p03-arwen-
[root@celab ~]# ssh cis192@172.20.4.74
cis192@172.20.4.74's password:
Last login: Mon Feb  4 15:50:05 2013 from opus.cislab.net
[cis192@p03-arwen ~]$
    
```

The CentOS VMs (William)

Log in as **cis192**



Shutdown using
Start > Turn Off Computer



Class Activity

	CentOS	Ubuntu	Windows
VMs	Arwen	Frodo	William
	Celebrian	Sauron	
	Elrond		
	Legolas		

1. Log into VLab
2. Navigate to VMs and Templates
3. Identify and locate your pod
4. Select one of your VMs and explore the *Summary*, *Resource Allocation* and *Console* tabs on the vSphere Client

Power On Becoming root Restart Shutdown



New commands for your toolbox

- su -** *Become root (with root's environment) using root's password*
- sudo -i** *Become root using your password
(if user is configured in /etc/sudoers)*
- init 6** *Fast way to restart system - no warning to users*
- init 0** *Fast way to shutdown system - no warning to users*
- shutdown -r +n "message"** *Nicer way to restart in n minutes and users warned*
- shutdown -h +n "message"** *Nicer way to shutdown in n minutes and users warned*

*The cis192 user has been added to the wheel group. The wheel group has been configured in the /etc/sudoers file to allow use of the **sudo -i** command*

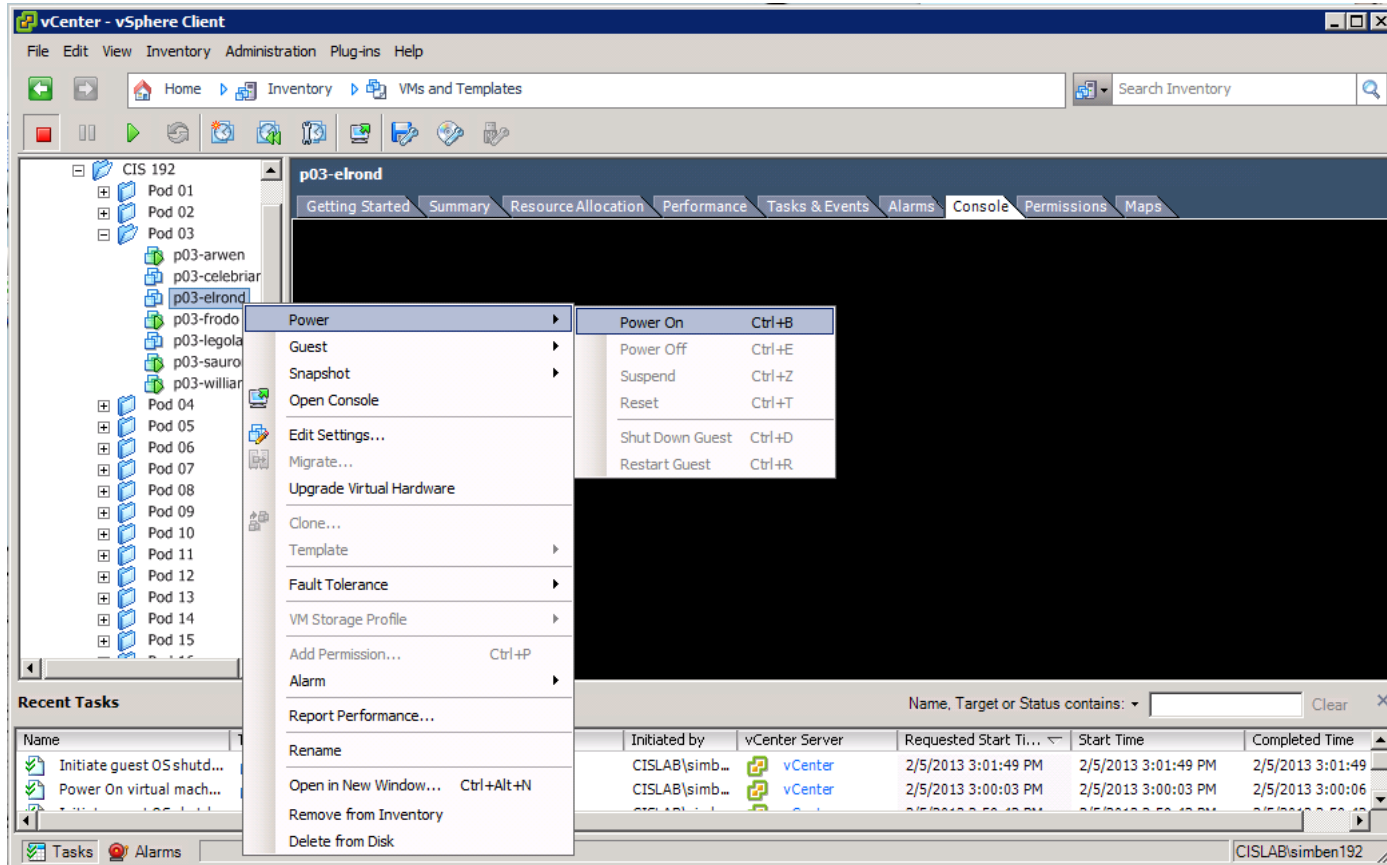
VM Power Status

The screenshot shows the vCenter - vSphere Client interface. The left pane displays a tree view of the inventory, including CIS 192, Pod 01 through Pod 15, and several VMs under Pod 03: p03-arwen, p03-celebria, p03-elrond, p03-frodo, p03-legolas, p03-sauron, and p03-william. The right pane shows the console for p03-elrond. A text box overlaid on the console reads: "The VMs with the mini green triangles are already powered on." Below the console is a "Recent Tasks" table.

Name	Target	Status	Details	Initiated by	vCenter Server	Requested Start Ti...	Start Time	Completed Time

In the example above the Arwen, Frodo, Sauron and William VMs in Pod 3 are powered up and running. Celebria, Elrond and Legolas are off.

Powering On a VM



One way to Power On a VM is to select it in the left inventory panel then right click for Power, then Power On. Clicking the green "Play" icon from the tool bar or using Ctrl-B keystrokes will do the same thing.

In the example above, the Elrond VM is getting Powered On.

Restarting a VM

sudo -i
init 6 *is a fast way to do a system restart*

The screenshot displays the vCenter vSphere Client interface. The left sidebar shows a tree view of the inventory, including a cluster named 'CIS 192' with multiple pods (Pod 01 to Pod 15) and several virtual machines (p03-arwen, p03-celebrar, p03-elrond, p03-frodo, p03-legolas, p03-sauron, p03-william). The main console window is open for VM 'p03-elrond', showing a terminal session where the user 'cis192' logs in and runs 'sudo -i' and 'init 6_'. Below the console, the 'Recent Tasks' table is visible, showing a task 'Power On virtual mach...' for target 'p03-elrond' with a status of 'Completed'.

Name	Target	Status	Details	Initiated by	vCenter Server	Requested Start Ti...	Start Time	Completed Time
Power On virtual mach...	p03-elrond	Completed		CISLAB\simb...	vCenter	2/5/2013 3:11:25 PM	2/5/2013 3:11:25 PM	2/5/2013 3:11:28 PM

*On a production systems don't use **init 6**, instead use something like:*
shutdown -r +25 "Save you work -- system will be restarted"

Shutting down a VM

**su -
init 0** *is a fast way to do shutdown*

The screenshot shows the vCenter vSphere Client interface. The left sidebar displays a tree view of the inventory, including 'CIS 192' and its sub-pods. The main console window shows the following text:

```
CentOS release 6.3 (Final)
Kernel 2.6.32-279.el6.x86_64 on an x86_64

p03-elrond login: cis192
Password:
Last login: Tue Feb  5 15:11:15 on tty1
[cis192@p03-elrond ~]# su -
Password:
[root@p03-elrond ~]# init 0_
```

Below the console, the 'Recent Tasks' section shows a table of operations:

Name	Target	Status	Details	Initiated by	vCenter Server	Requested Start Time	Start Time	Completed Time
Power On virtual mach...	p03-elrond	Completed		CISLAB\simben...	vCenter	2/5/2013 3:11:25 PM	2/5/2013 3:11:25 PM	2/5/2013 3:11:28 PM

shutdown -h +5 "Save your work -- system will shutdown" *is a nicer way*

Class Activity Using VMs

Celebrian



See if you can:

- Power on the Celebrian VM in your pod
- Become root (**su -** or **sudo -i**)
- Do a restart (**init 6**)



Managing Screen Real Estate

Default Console View

The screenshot shows the vCenter vSphere Client interface. The left sidebar displays a tree view of the inventory, with 'p03-frodo' selected under 'Pod 03'. The main window shows the 'Console' tab for the selected VM. The console output is as follows:

```

Ubuntu 12.04.1 LTS p03-frodo tty5

p03-frodo login: cis192
Password:
Last login: Tue Feb  5 14:24:59 PST 2013 on tty1
Welcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-29-generic x86_64)

 * Documentation:  https://help.ubuntu.com/

307 packages can be updated.
111 updates are security updates.

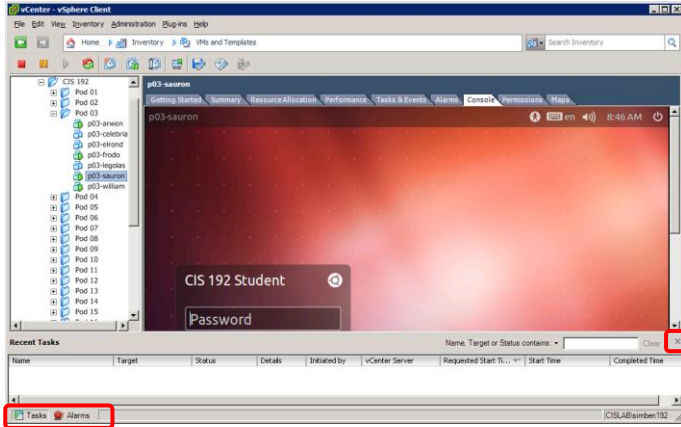
cis192@p03-frodo:~$ ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:50:56:b7:e0:d9
          inet addr:172.20.4.11  Bcast:172.20.255.255  Mask:255.255.0.0
          inet6 addr: fe80::250:56ff:feb7:e0d9/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2452 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1401 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:2824299 (2.8 MB)  TX bytes:151204 (151.2 KB)
    
```

At the bottom of the window, there is a 'Recent Tasks' table with the following columns: Name, Target, Status, Details, Initiated by, vCenter Server, Requested Start Time, Start Time, and Completed Time. The table is currently empty.

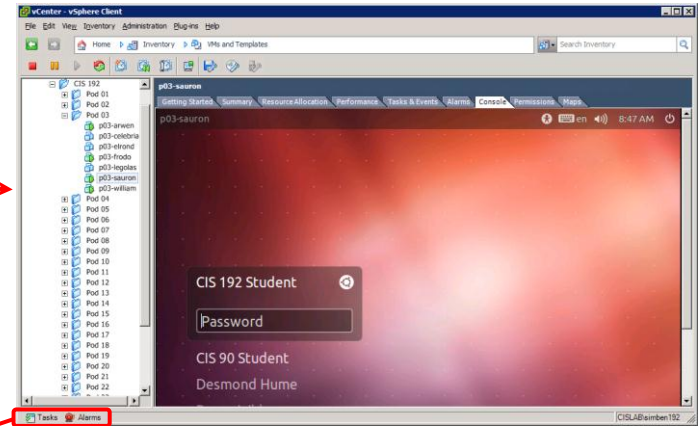
Use the console tab to view one VM at a time

Better - remove Tasks/Alarms area

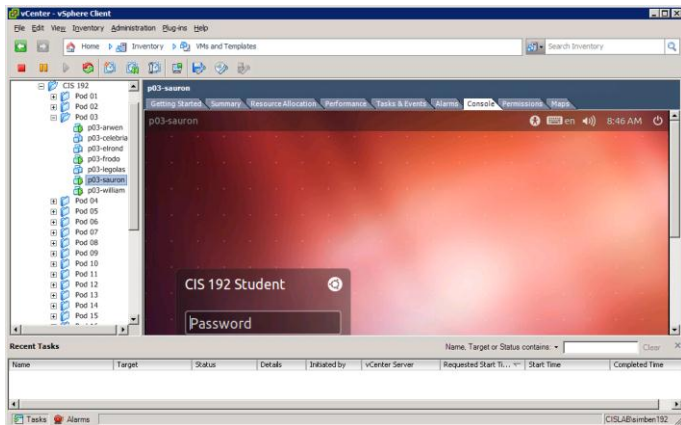
Remove the Tasks/Alarms area to see more of the VM



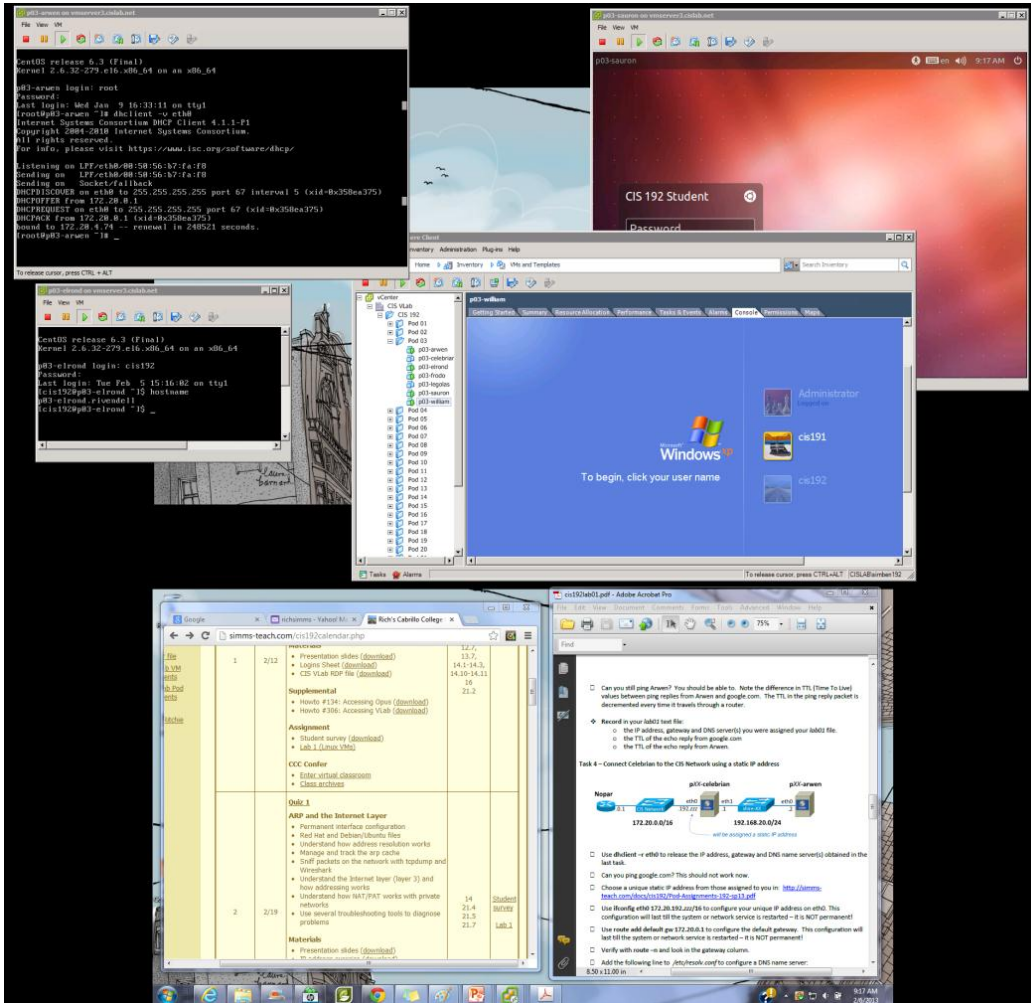
Click on Tasks or Alarms to toggle what is shown in this area



Restore the Tasks/Alarms area



Best - separate console windows

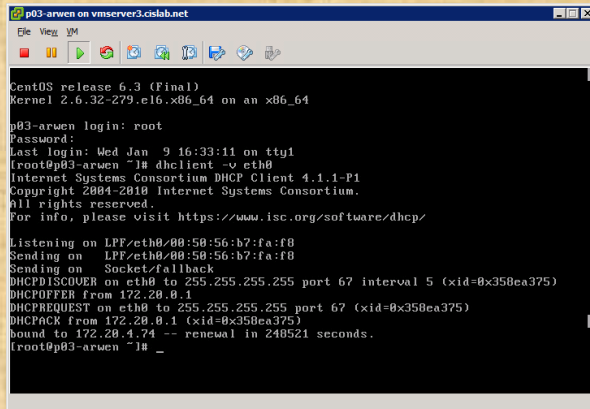


You can peel off multiple consoles and reposition them on your monitor(s).

Great way to work on multiple VMs at the same time while viewing a network diagram in a lab assignment.

Working on a lab assignment with multiple VM consoles in view

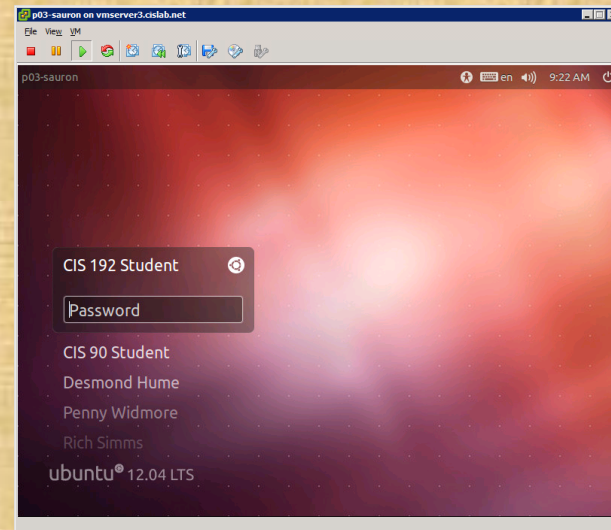
Class Activity Using VMs



```
p03-arwen on vmserver3.cislab.net
CentOS release 6.3 (Final)
Kernel 2.6.32-279.el6.x86_64 on an x86_64

p03-arwen login: root
Password:
Last login: Wed Jan  9 16:33:11 on tty1
[root@p03-arwen ~]# dhclient -v eth0
Internet Systems Consortium DHCP Client 4.1.1-P1
Copyright 2004-2010 Internet Systems Consortium.
All rights reserved.
For info, please visit https://www.isc.org/software/dhcp/

Listening on LPP/eth0/00:50:56:b7:fa:f8
Sending on LPP/eth0/00:50:56:b7:fa:f8
Sending on Socket/fallback
Sending on eth0 to 255.255.255.255 port 67 interval 5 (xid=0x358ea375)
DHCPOFFER from 172.20.0.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67 (xid=0x358ea375)
DHCPCACK from 172.20.0.1 (xid=0x358ea375)
bound to 172.20.4.74 -- renewal in 240521 seconds.
[root@p03-arwen ~]# _
```



Select two or more of your VMs and
open separate consoles for them

Changing Virtual terminals

VMware VM Operations

Changing Virtual Terminals

The image displays three overlapping VMware virtual terminal windows, each with a title bar that reads "p03-frodo on vmserver3.cislab.net".

- Left window (tty7):** Shows a Mozilla Firefox browser window. The address bar contains "danielmiessler.com/study/tcpdump". The page content includes a heading "A Tcpdump Tutorial and Prime..." and a paragraph starting with "ping) using some of the...". Below the text is a terminal window showing the output of a tcpdump command:


```
hermes root # tcpdump -nnvXs
tcpdump: listening on eth0, link-type EN10MB (0x00000000), capture length 65535 bytes
69.254.213.43 > 72.21.34.42:
0x0000: 4520 0054 88
0x0010: 4815 222a 08
0x0020: ae5e 0500 08
0x0030: 1415 1617 18
0x0040: 2425 2627 28
0x0050: 3435 3637
23:11:10.370344 IP (tos 0x20, length: 84) 72.21.34.42 > 69.254.213.42:
0x0000: 4520 0054 8b
0x0010: 45fe d52b 08
0x0020: ae5e 0500 08
0x0030: 1415 1617 18
0x0040: 2425 2627 28
0x0050: 3435 3637
```
- Middle window (tty1):** Shows a Linux terminal session. The user logs in as "cis192" and runs "sudo -i" to become root. The terminal output includes:



```
Last login: Tue Feb 5 14:24:28 PST 2013 on
Welcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-29-generic x86_64)
* Documentation: https://help.ubuntu.com/
307 packages can be updated.
111 updates are security updates.
cis192@p03-frodo:~$ sudo -i
[sudo] password for cis192:
root@p03-frodo:~# tcpdump -nnvXs 0 -c2 icmp
tcpdump: listening on eth0, link-type EN10MB (0x00000000), capture length 65535 bytes
14:27:25.227749 IP (tos 0xc0, ttl 64, id 263, len 60) 172.20.4.11 > 172.30.5.8: ICMP 172.20.4.11 > 172.30.5.8:53 > 172.20.4.11.52979: 42824
et., addons.dyndect.mozilla.net. A 63.245.217
0x0000: 45c0 0126 66d4 0000 4001 b0
0x0010: ac1e 0508 0303 5f4a 0000 00
0x0020: 17ca 4000 7f11 81d3 ac1e 05
0x0030: 0035 cef3 00f6 b929 a748 81
0x0040: 0004 0004 0661 6464 6f6e 73
0x0050: 6c6c 6103 6f72 6700 0001 00
0x0060: 0001 0000 0000 001b 0661 64
0x0070: 6479 6e65 6374 076d 6f7a 65
0x0080: 6574 00c0 3000 0100 0100 00
0x0090: f549 70c0 3700 0200 0100 00
0x00a0: 6e73 3403 7032 3706 6479 6e
0x00b0: c037 0002 0001 0000 0bd6 00
0x00c0: c06b c037 0002 0001 0000 0b
0x00d0: 7333 c06b c037 0002 0001 00
0x00e0: 036e 7331 c06b c0a8 0001 00
0x00f0: 0004 d04e 461b c084 0001 00
0x0100: 0004 cc0d fa1b c096 0001 00
0x0110: 0004 d04e 471b c067 0001 00
0x0120: 0004 cc0d fb1b
```
- Right window (tty5):** Shows a Linux terminal session. The user logs in as "cis192" and runs "ifconfig eth0" to view network interface details. The terminal output includes:



```
Ubuntu 12.04.1 LTS p03-frodo tty5
p03-frodo login: cis192
Password:
Last login: Tue Feb 5 14:24:59 PST 2013 on tty1
Welcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-29-generic x86_64)
* Documentation: https://help.ubuntu.com/
307 packages can be updated.
111 updates are security updates.
cis192@p03-frodo:~$ ifconfig eth0
eth0      Link encap:Ethernet HWaddr 00:50:56:b7:e0:d9
          inet addr:172.20.4.11 Bcast:172.20.255.255 Mask:255.255.0.0
          inet6 addr: fe80::250:56ff:feb7:e0d9/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:2452 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1401 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:2874799 (2.8 MB) TX bytes:151204 (151.2 KB)
cis192@p03-frodo:~$
```

It can be very useful to have multiple login sessions on the same Linux VM. Virtual terminals are an easy way to do this.



Changing Virtual Terminals on VMware Linux VMs

VMware operations	
On PC Keyboard:	While holding down the Ctrl-  -Alt keys, tap spacebar then tap f1, f2, ... or f7.
On Mac keyboard:	Hold down Control and Option keys, tap the spacebar, hold down fn key (in addition to Control and Option keys) and tap f1, f2, ... or f7.

Pressing the  on some Windows keyboards may not be necessary

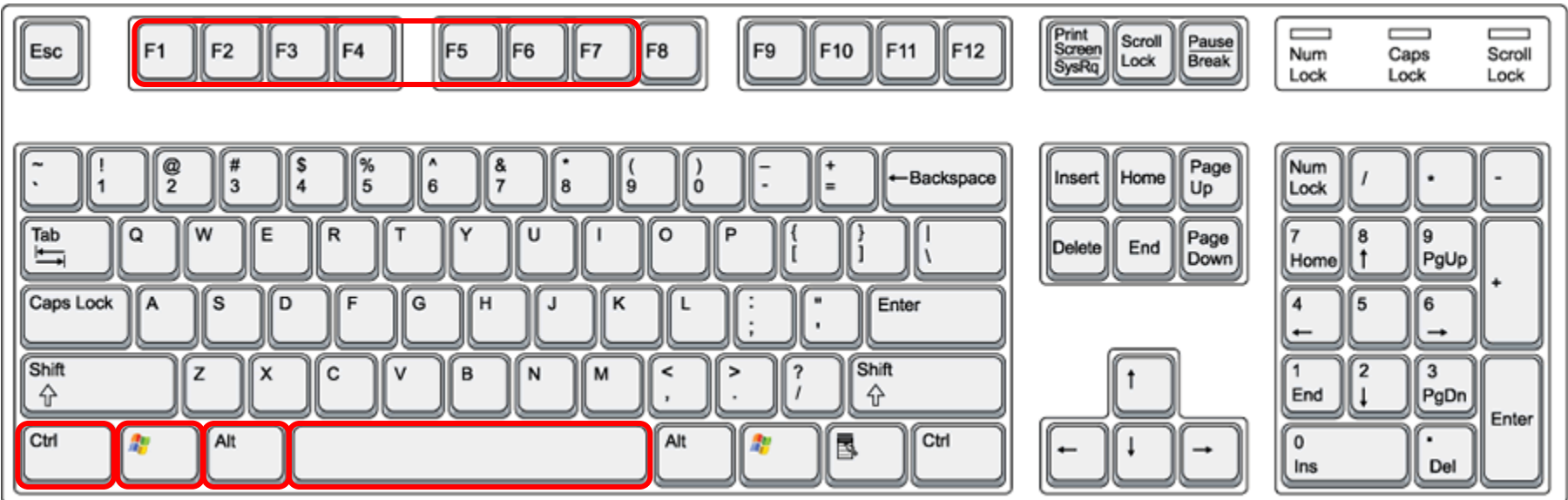
F7 is graphics mode for the Ubuntu VMs.

The Centos VMs do not have a graphics mode components installed (run level 3 only)

Note: the spacebar does not need to be tapped on a physical (non-VM) system. This is only required when changing virtual terminals on VMware VMs.

VMware VM Operations

Changing Virtual Terminals with a PC keyboard



On PC keyboard:

While holding down the **Ctrl-Alt** keys,
tap **Spacebar** then tap **FN** key

(where *N*=1-7 to specify a function key)

VMware VM Operations

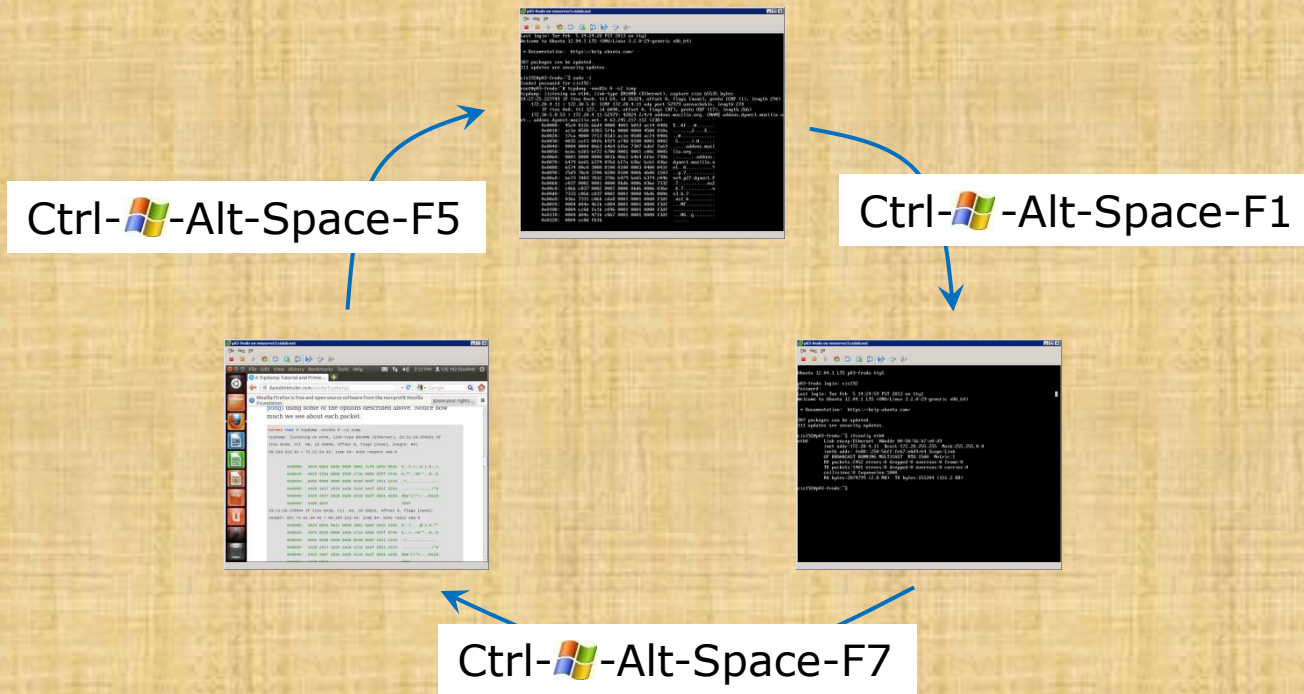
Changing Virtual Terminals with a Mac keyboard



On Mac keyboard:

While holding down the **control-option** keys
tap **Spacebar** then tap **fn-F N** keys
(where $N=1-7$ to specify a function key)

Class Activity Using VMs



Frodo



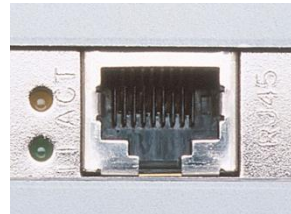
See if you can change virtual terminals on your Frodo VM



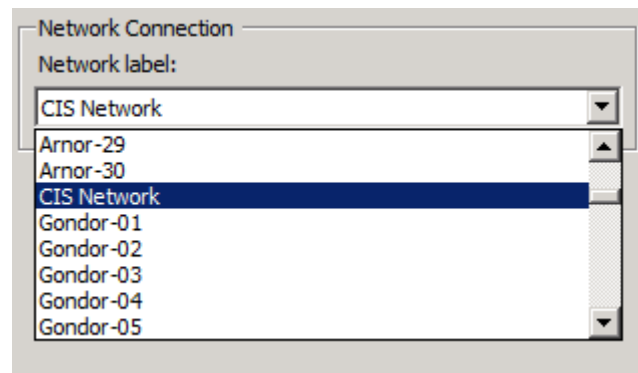
Cabling Virtual Equipment

Physical and virtual cabling

- In a physical environment we would connect Ethernet LAN cables between clients, servers, switches and routers.

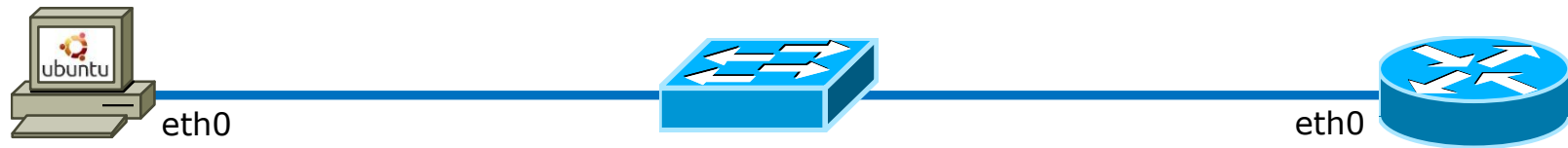


- In a virtual environment cabling still must be done



VMware ESXi

Cabling Devices on a Physical Network



Desktop PC



Switch



Router

Cabling a PC to a router via a switch

Cabling Devices on a Virtual Network

*VMware provides multiple virtual networks.
They function like virtual network switches*



p03-sauron - Virtual Machine Properties

Hardware | Options | Resources | Profiles | vServices | Virtual Machine Version: 8

Show All Devices Add... Remove

Hardware	Summary
Memory	512 MB
CPUs	1
Video card	Video card
VMCI device	Restricted
SCSI controller 0	LSI Logic Parallel
Hard disk 1	Virtual Disk
CD/DVD drive 1	/usr/lib/vmware/iso...
Network adapter 1	CIS Network
Floppy drive 1	Client Device

Device Status
 Connected
 Connect at power on

Adapter Type
 Current adapter: E1000

MAC Address

 Automatic Manual

DirectPath I/O
 Status: Not supported ⓘ

Network Connection
 Network label:

Help

p03-arwen - Virtual Machine Properties

Hardware | Options | Resources | Profiles | vServices | Virtual Machine Version: 8

Show All Devices Add... Remove

Hardware	Summary
Memory	512 MB
CPUs	1
Video card	Video card
VMCI device	Restricted
SCSI controller 0	Paravirtual
Hard disk 1	Virtual Disk
CD/DVD drive 1	/usr/lib/vmware/iso...
Network adapter 1	CIS Network
Network adapter 2	CIS Network
Network adapter 3	CIS Network
Floppy drive 1	Client Device

Device Status
 Connected
 Connect at power on

Adapter Type
 Current adapter: E1000

MAC Address

 Automatic Manual

DirectPath I/O
 Status: Not supported ⓘ

Network Connection
 Network label:

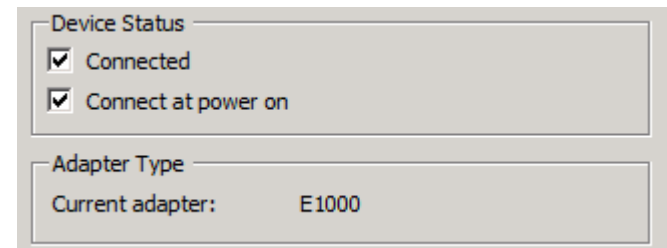
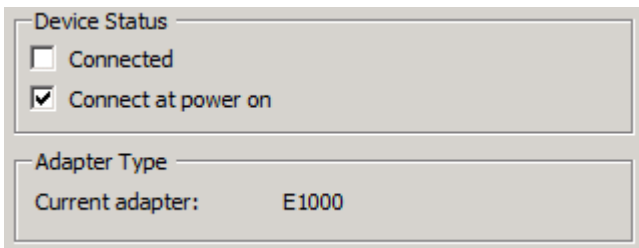
OK Cancel

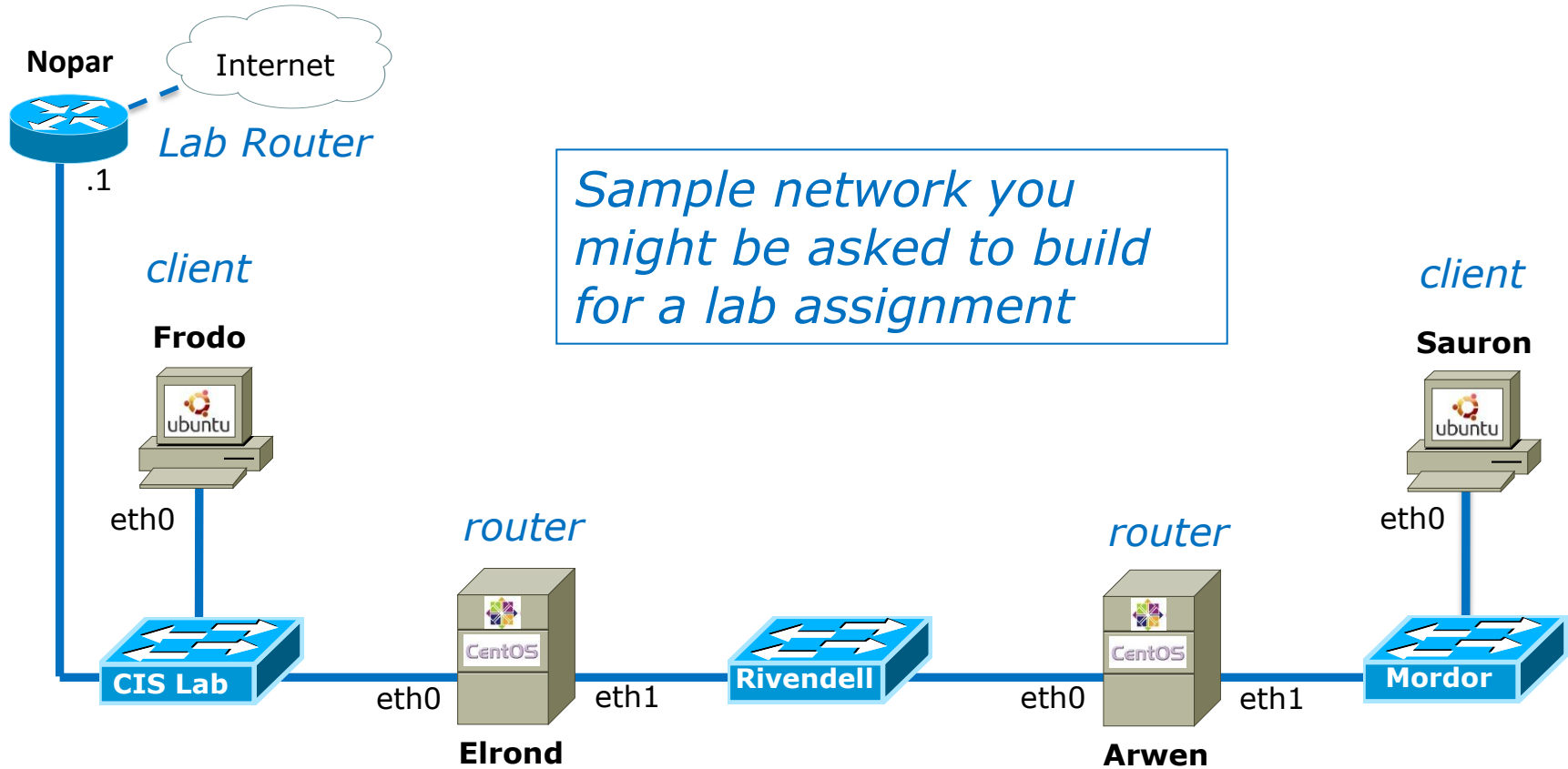
***Cabling a virtual PC ...
to a virtual Linux router ...
via a virtual switch***

Connecting a cable to the NIC



Connecting and disconnecting a cable is done by checking and unchecking "Connected" in the Device Status section of the Network Adapter settings





CIS LAB

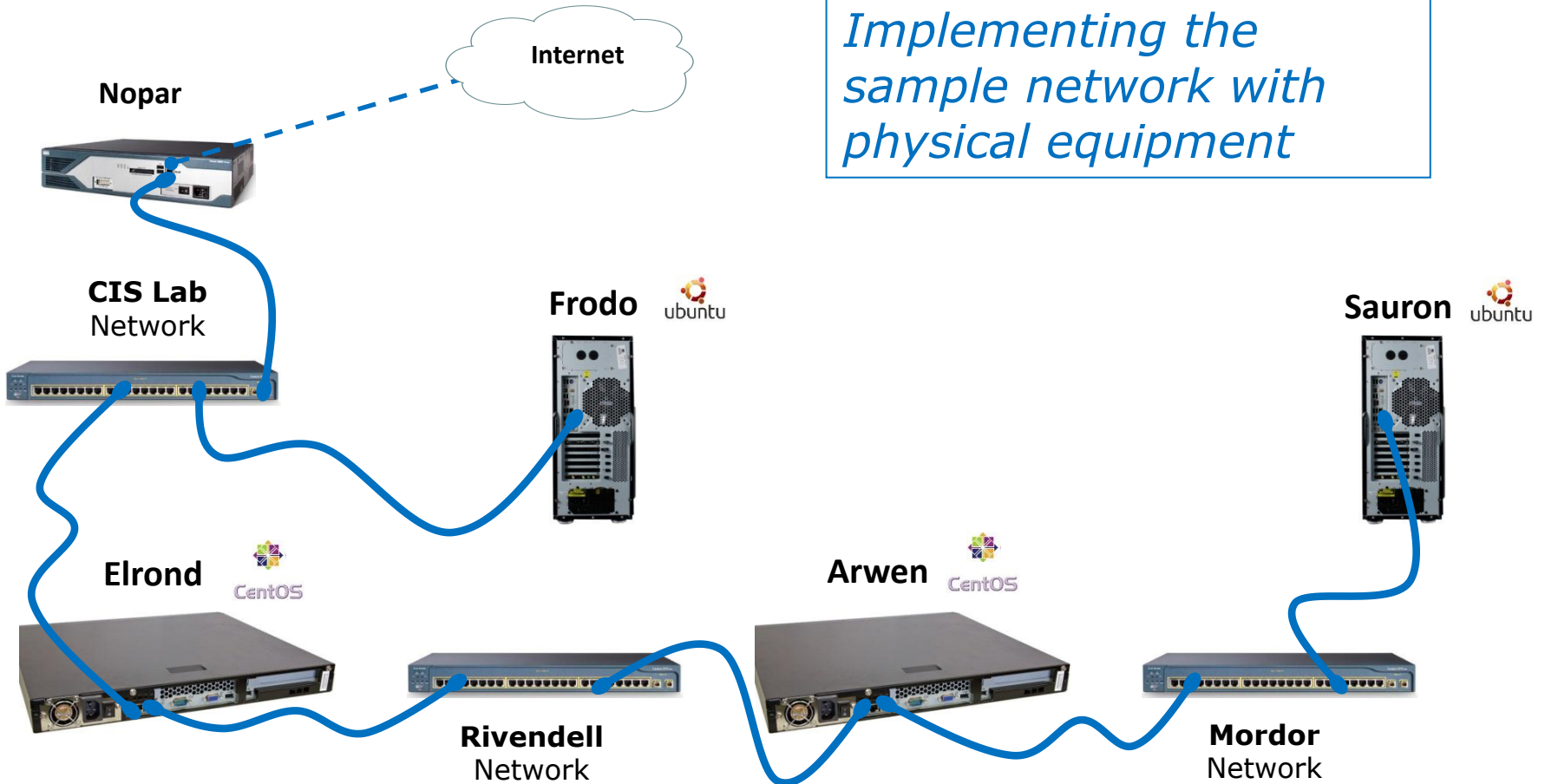


RIVENDELL

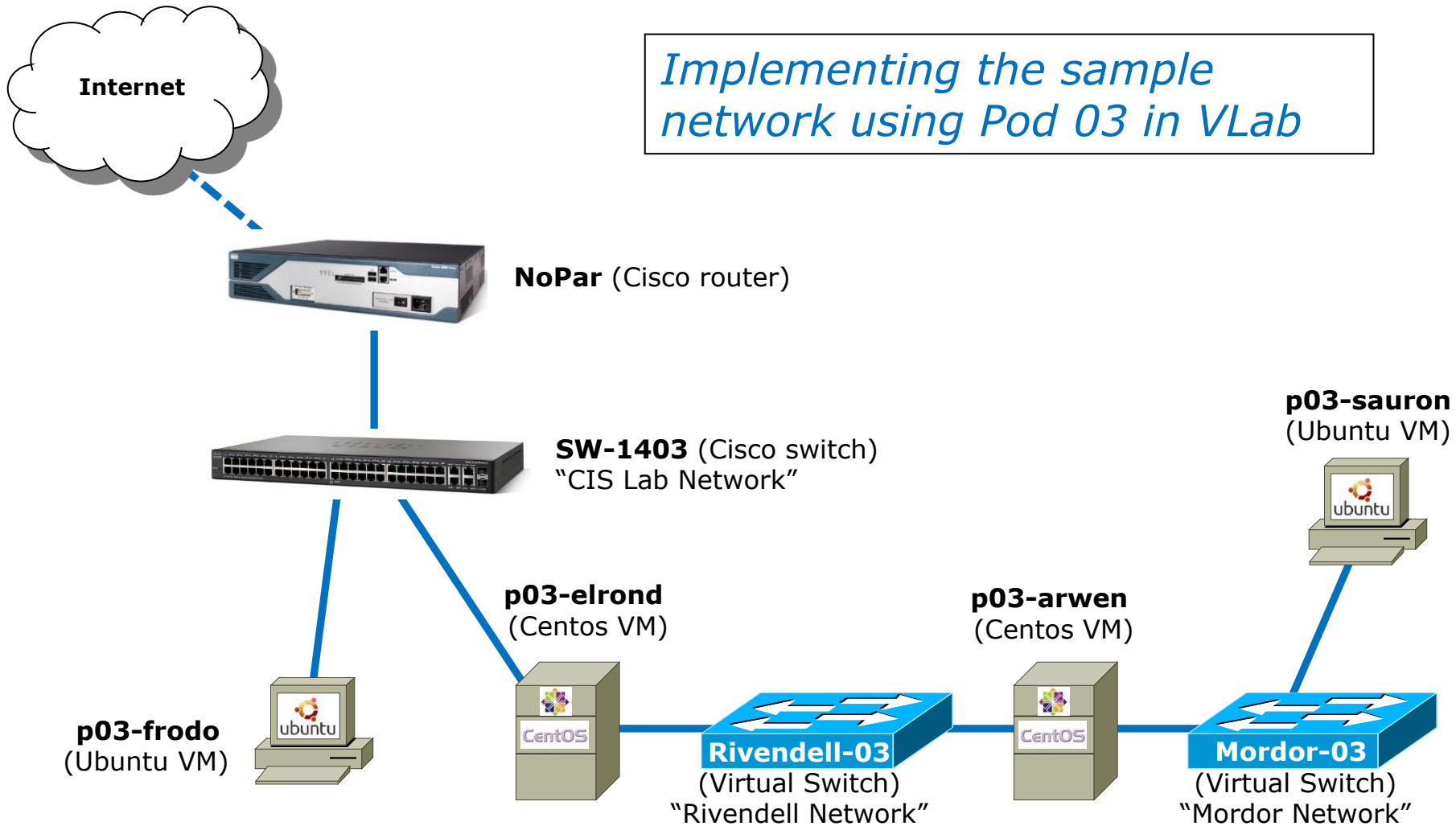


MORDOR

*Implementing the
sample network with
physical equipment*



Implementing the sample network using Pod 03 in VLab



The screenshot shows the vCenter vSphere Client interface. The left pane displays a tree view of the inventory, including 'CIS 192' and several pods. The main pane shows the 'Summary' tab for the VM 'p03-frodo'. The 'General' section lists details such as Guest OS (Ubuntu Linux (64-bit)), VM Version (8), CPU (1 vCPU), Memory (512 MB), and State (Powered Off). The 'Network adapter 1' is highlighted in the hardware list, and its properties are shown in the right pane, indicating it is connected to the 'CIS Network'. A diagram on the left illustrates the connection between the VM's 'eth0' interface and the 'CIS Lab' network. A note at the bottom right states: 'Note: The CIS Lab network is labeled "CIS Network" in vCenter. The PCs in room 1403 and the course VMs can be connected to this network.'

We need to connect p03-frodo's **eth0** interface to the **CIS Lab Network**

The screenshot displays the vCenter vSphere Client interface. The left pane shows a tree view of the inventory, including a pod named 'p03-elrond'. The main pane shows the 'Virtual Machine Properties' dialog for 'p03-elrond'. The 'Hardware' tab is selected, showing a list of devices. 'Network adapter 1' is highlighted, and its properties are shown on the right, including 'Device Status' (Connected), 'Adapter Type' (E1000), 'MAC Address' (00:50:56:b7:4a:f9), and 'Network Connection' (CIS Network).

The inset diagram illustrates a network topology. It shows three nodes: 'CIS Lab' (represented by a blue cube with arrows), 'Elrond' (represented by a server rack), and 'Rivendell' (represented by a blue cube with arrows). A red line connects 'CIS Lab' to 'Elrond' via an interface labeled 'eth0'. A blue line connects 'Elrond' to 'Rivendell' via an interface labeled 'eth1'.

We need to connect p03-elrond's **eth0** interface to the **CIS Lab Network**

The screenshot shows the vCenter vSphere Client interface. The main window displays the 'p03-elrond' virtual machine properties. The 'General' tab is active, showing details like Guest OS (CentOS), VM Version (8), CPU (1 vCPU), and Memory (512 MB). The 'Network adapter 2' is highlighted in the hardware list, showing it is connected to the 'Rivendell-03' network. Below the main window, a network diagram illustrates the connection between three components: 'CIS Lab' (represented by a blue cube with arrows), 'Elrond' (represented by a server rack labeled 'CentOS'), and 'Rivendell' (represented by another blue cube with arrows). A line connects 'CIS Lab' to 'Elrond' via an interface labeled 'eth0'. Another line connects 'Elrond' to 'Rivendell' via an interface labeled 'eth1'.

We need to connect *p03-elrond's eth1* interface to the **Rivendell-03** Network

vCenter - vSphere Client

File Edit View Inventory Administration Plug-ins Help

Home Inventory VMs and Templates Search Inventory

CIS 192

- Pod 01
- Pod 02
- Pod 03
 - p03-arwen**
 - p03-celebrar
 - p03-elrond
 - p03-frodo
 - p03-legolas
 - p03-sauron
 - p03-william
- Pod 04
- Pod 05
- Pod 06
- Pod 07
- Pod 08
- Pod 09
- Pod 10
- Pod 11
- Pod 12
- Pod 13
- Pod 14
- Pod 15

p03-arwen

Getting Started Summary Resource Allocation Performance Tasks & Events Alarms Console Permissions Maps

What is a Virtual Machine?

A virtual machine is a software computer that, like a physical computer, runs an operating system and applications. An operating system installed on a virtual machine is called a guest operating system.

Because every virtual machine is an isolated computing environment, you can use virtual machines as desktop or workstation environments, as testing environments, or to consolidate server applications.

In vCenter Server, virtual machines run on hosts or clusters. The same host can run many virtual machines.

Basic Tasks

- Shut down the virtual machine

Recent Tasks

Name	Target	Status	Details	Initiated by	vCenter Server

p03-arwen - Virtual Machine Properties

Hardware Options Resources Profiles vServices

Virtual Machine Version: 8

Show All Devices Add... Remove

Hardware	Summary
Memory	512 MB
CPUs	1
Video card	Video card
VMCI device	Restricted
SCSI controller 0	Paravirtual
Hard disk 1	Virtual Disk
CD/DVD drive 1	/usr/lib/vmware/iso...
Network adapter 1	Rivendell-03
Network adapter 2	Mordor-03
Network adapter 3	CIS Network
Floppy drive 1	Client Device

Device Status

- Connected
- Connect at power on

Adapter Type

Current adapter: E1000

MAC Address

00:50:56:b7:fa:f8

Automatic Manual

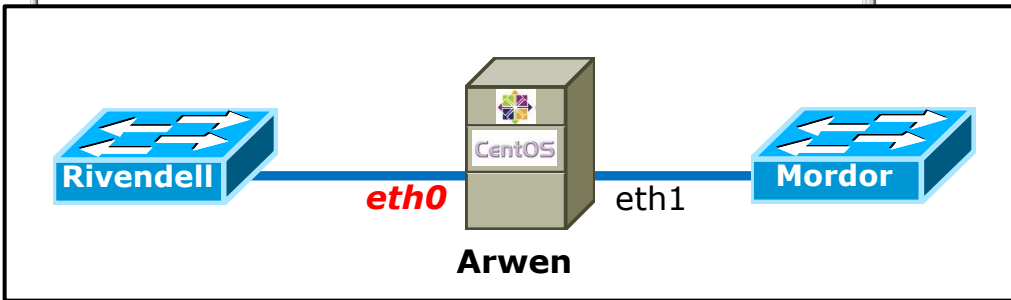
DirectPath I/O

Status: Not supported

Network Connection

Network label: Rivendell-03

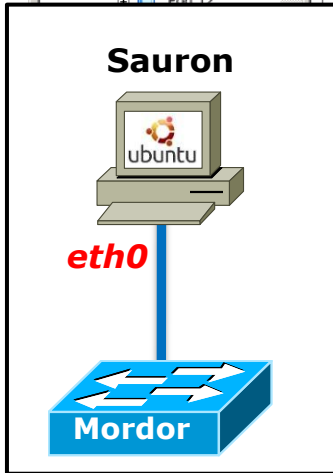
Help OK Cancel



We need to connect p03-arwen's **eth0** interface to the **Rivendell-03** Network

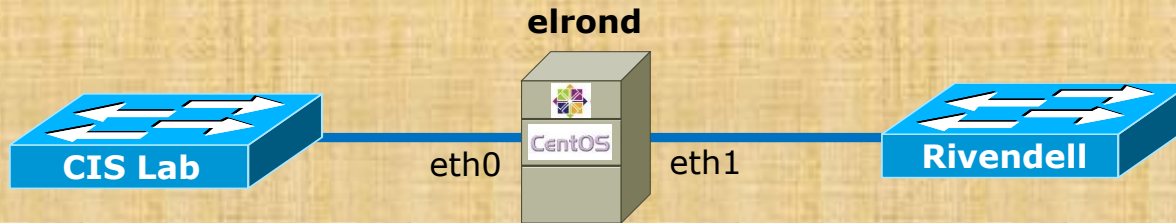
The screenshot shows the vCenter vSphere Client interface. The main window displays the 'p03-arwen' virtual machine properties. The 'Hardware' tab is active, showing a list of hardware components. The 'Network adapter 2' is selected, and its properties are shown on the right. The 'Device Status' is 'Connected', and the 'Current adapter' is 'E1000'. The 'MAC Address' is '00:50:56:b7:93:51'. The 'Network Connection' is set to 'Mordor-03'. Below the screenshot, a diagram illustrates the network topology. A central server labeled 'Arwen' has two network interfaces: 'eth0' connected to a switch labeled 'Rivendell' and 'eth1' connected to a switch labeled 'Mordor'.

We need to connect p03-arwen's **eth1** interface to the **Mordor-03** Network



We need to connect *p03-sauron's eth0* interface to the **Mordor-03** Network

Class Activity Cabling VMs



- Login to VLab
- Find your pod number *nn*
- Connect your *elrond-*nn** eth0 interface to connect to the CIS network
- Connect your *elrond-*nn** eth1 interface to the Rivendell-*nn* network

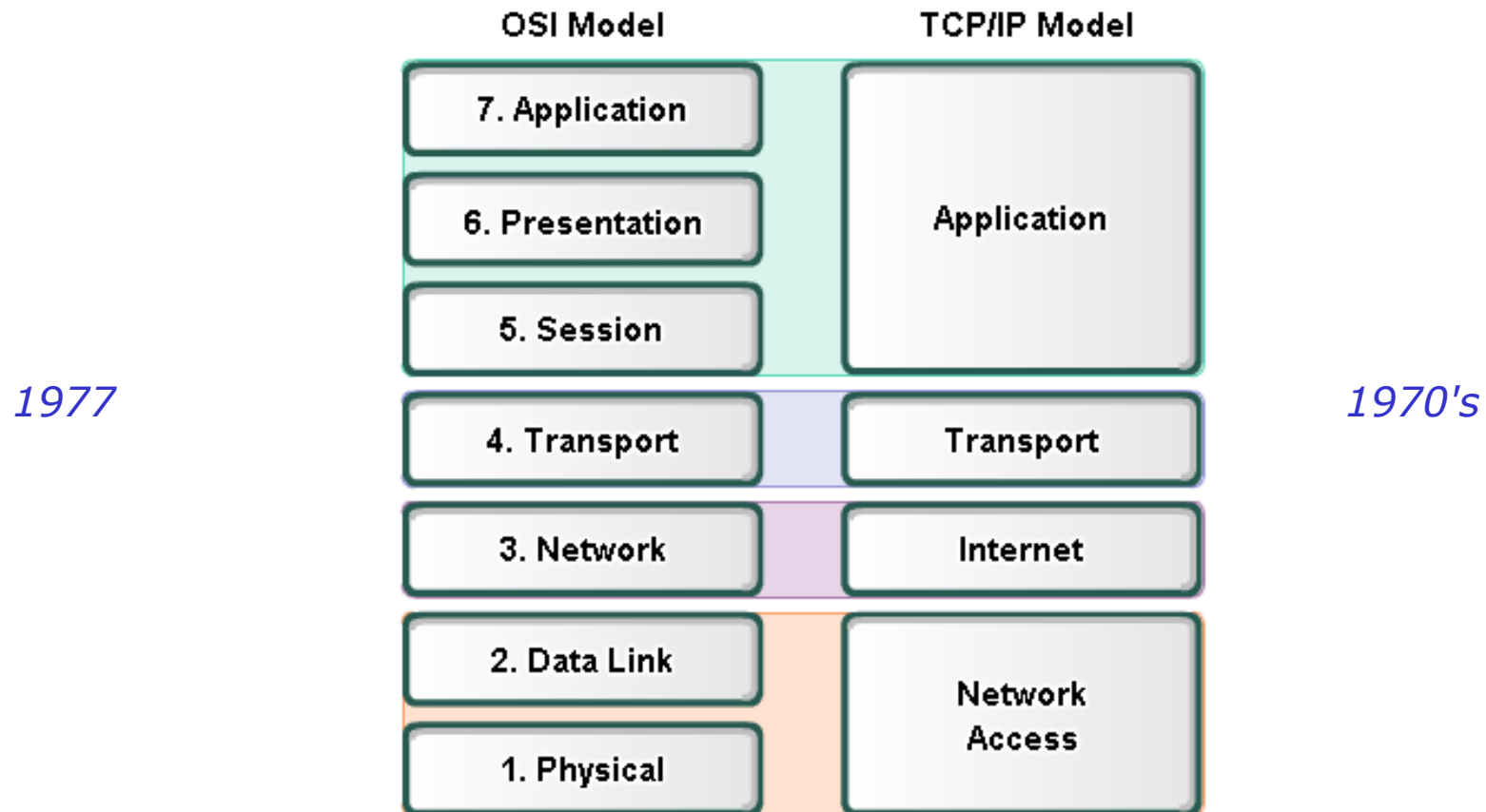
Q3

- Linux Review
- Network Review
- Standards
- NICs and drivers



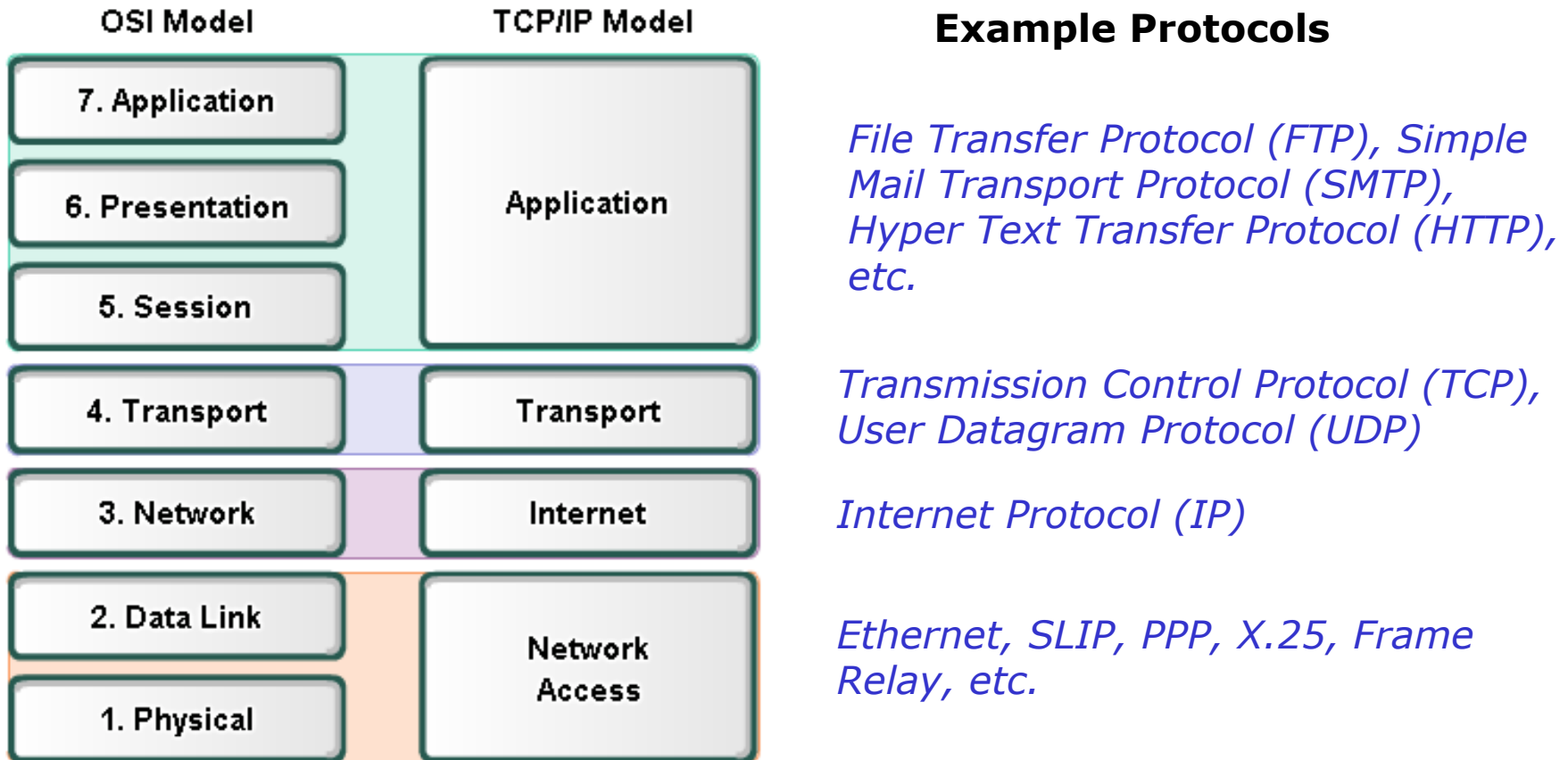
Network Review

Protocol Reference Models



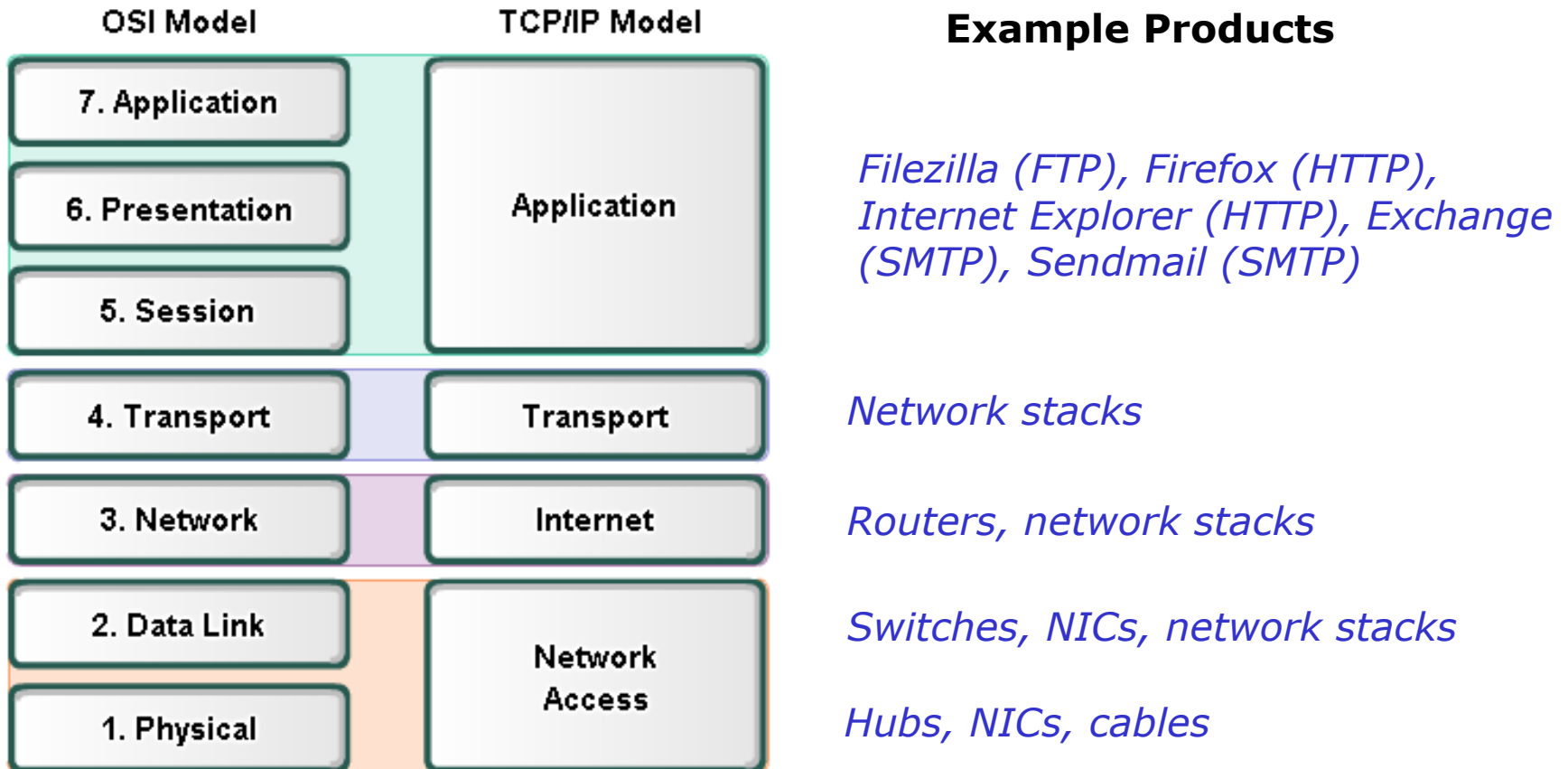
The **OSI** (Open Systems Interconnection) and **TCP/IP** models are define various **abstraction layers**. Each layer serves a different role in the overall communication process.

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.

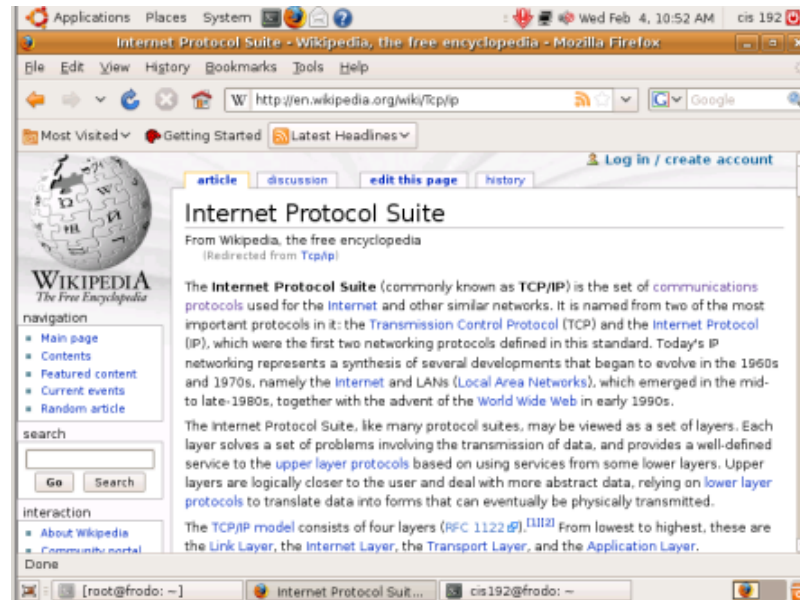
Reconciling the Layers

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

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

Putting it all together – web server example

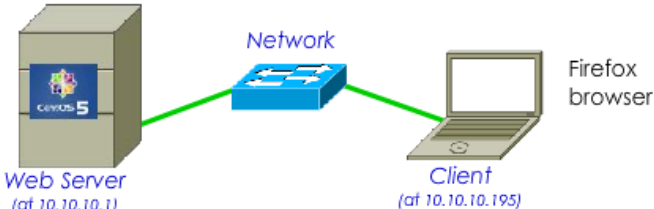
<http://simms-teach.com/animations/apache.html>



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.

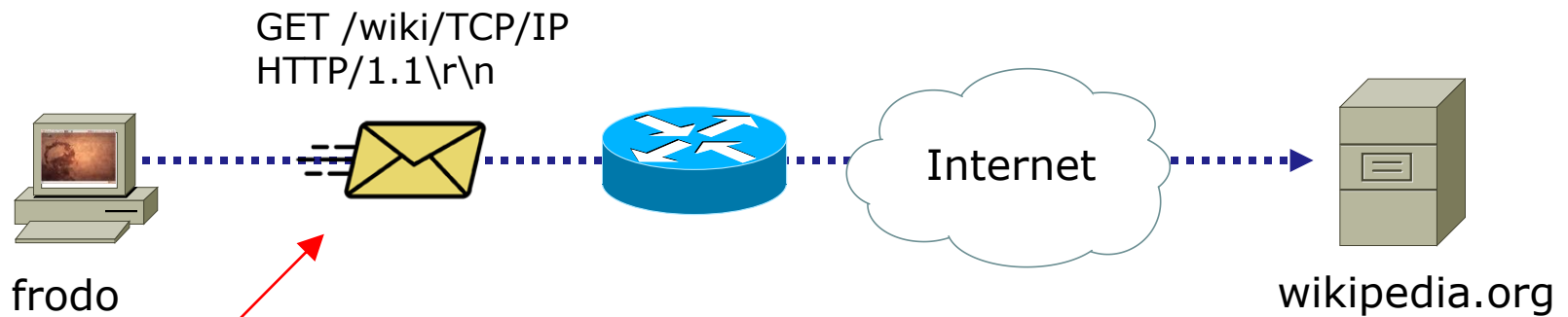
Click the green arrow to continue

- > 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

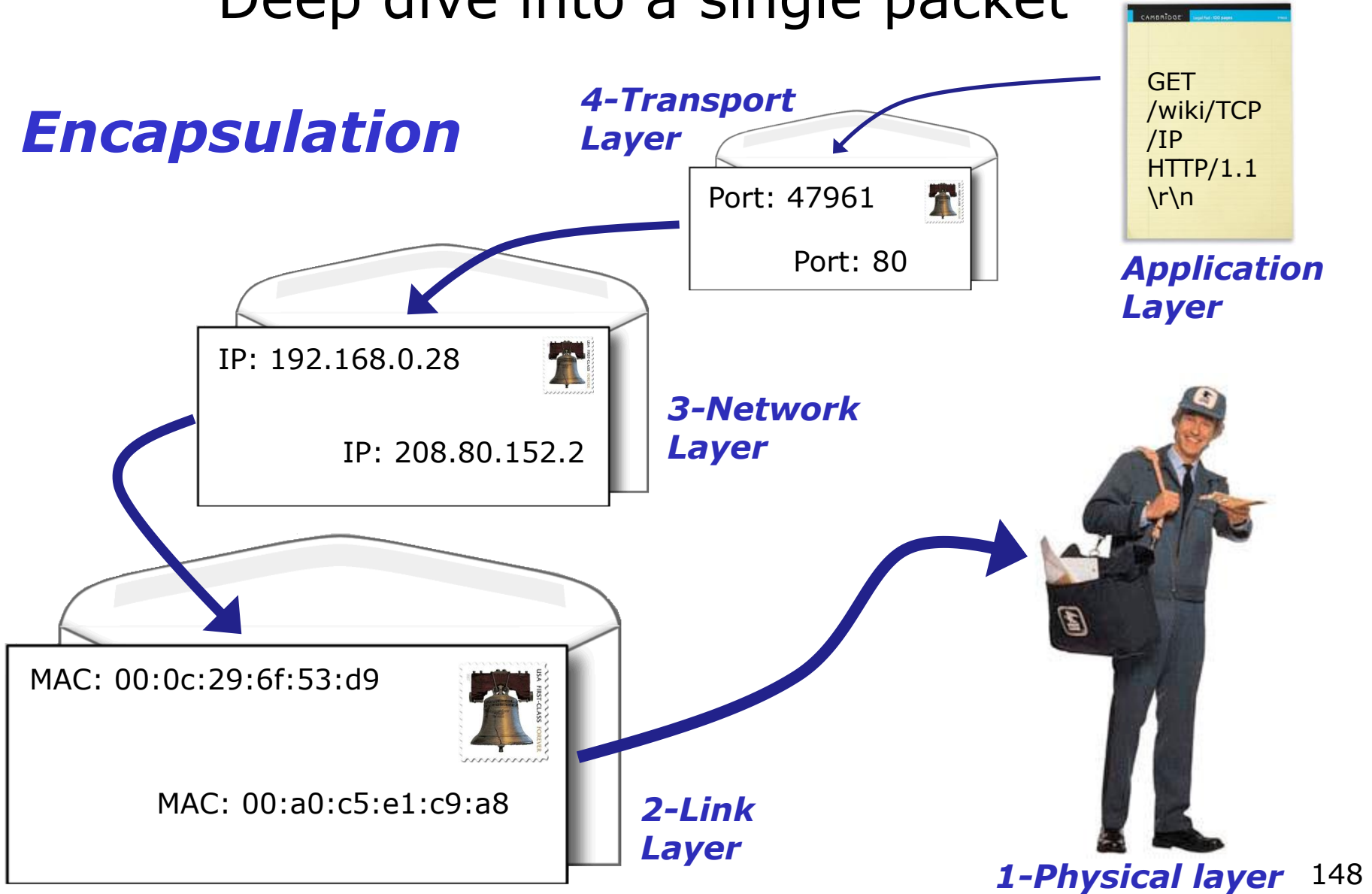
Deep dive into a single packet



*The browser request for the wikipedia.org web page is **encapsulated** into an Ethernet frame that is sent to the default gateway router.*

Deep dive into a single packet

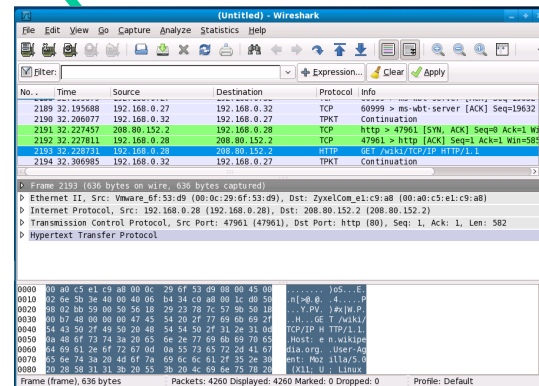
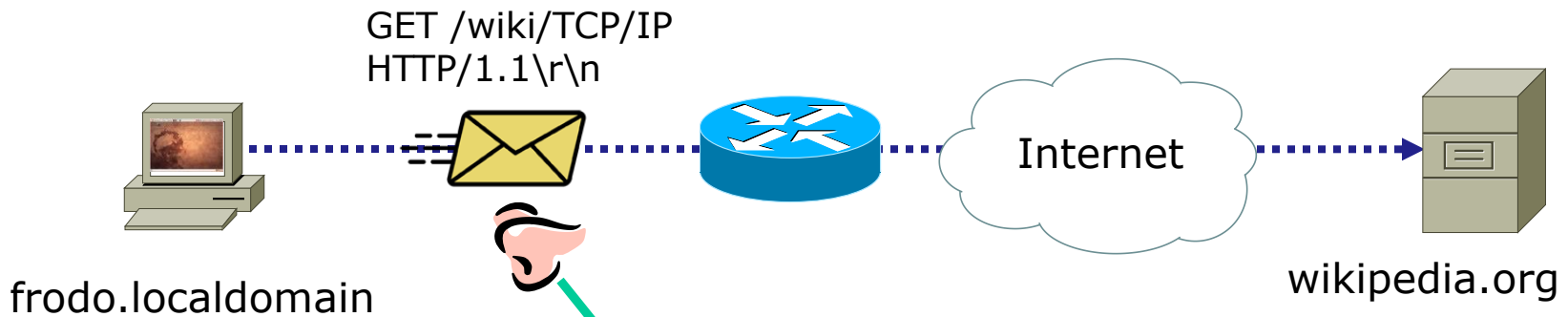
Encapsulation



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 William VM has Wireshark installed. Wireshark is a sniffer program

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 a packet capture. The packet list pane shows several packets, with packet 2193 selected and highlighted in blue. The details pane for packet 2193 shows the following layers:

- 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

The packet bytes pane shows the raw data of the packet, with the following hex and ASCII representation:

```

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
  
```

At the bottom of the interface, it shows: Frame (frame), 636 bytes | Packets: 4260 Displayed: 4260 Marked: 0 Dropped: 0 | Profile: Default

Deep dive into a single packet – Layer 1



*1-Physical
layer
expanded*

(Untitled) - Wireshark

File Edit View Go Capture Analyze Statistics Help

Filter: + Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Info
2191	32.227437	208.80.152.2	192.168.0.28	TCP	47961 > 47901 [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)

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]

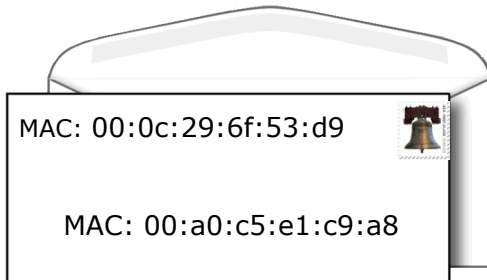
- Ethernet II, Src: Vmware_6f:53:d9 (00:0c:29:6f:53:d9), Dst: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
- Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)

```

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

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)

- 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

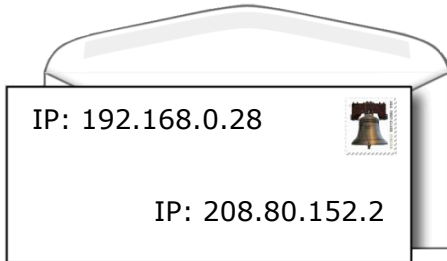
```

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*

Wireshark Network Analyzer

Filter: + Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Info
2191	32.227437	208.80.152.2	192.168.0.28	TCP	47961 [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)

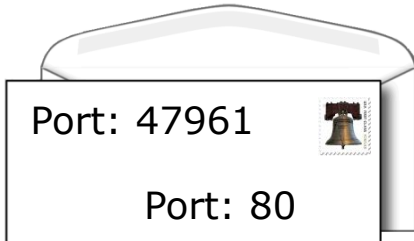
- Ethernet II, Src: Vmware_6f:53:d9 (00:0c:29:6f:53:d9), Dst: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
- Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)
 - Version: 4
 - Header length: 20 bytes
 - Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)
 - 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	32.227437	208.80.152.2	192.168.0.28	TCP	47901 > 47901 [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*

(Untitled) - Wireshark

File Edit View Go Capture Analyze Statistics Help

Filter: + Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Info
2191	32.227457	208.80.152.2	192.168.0.28	TCP	47961 > 47961 [STW, ACK] Seq=0 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)

- 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

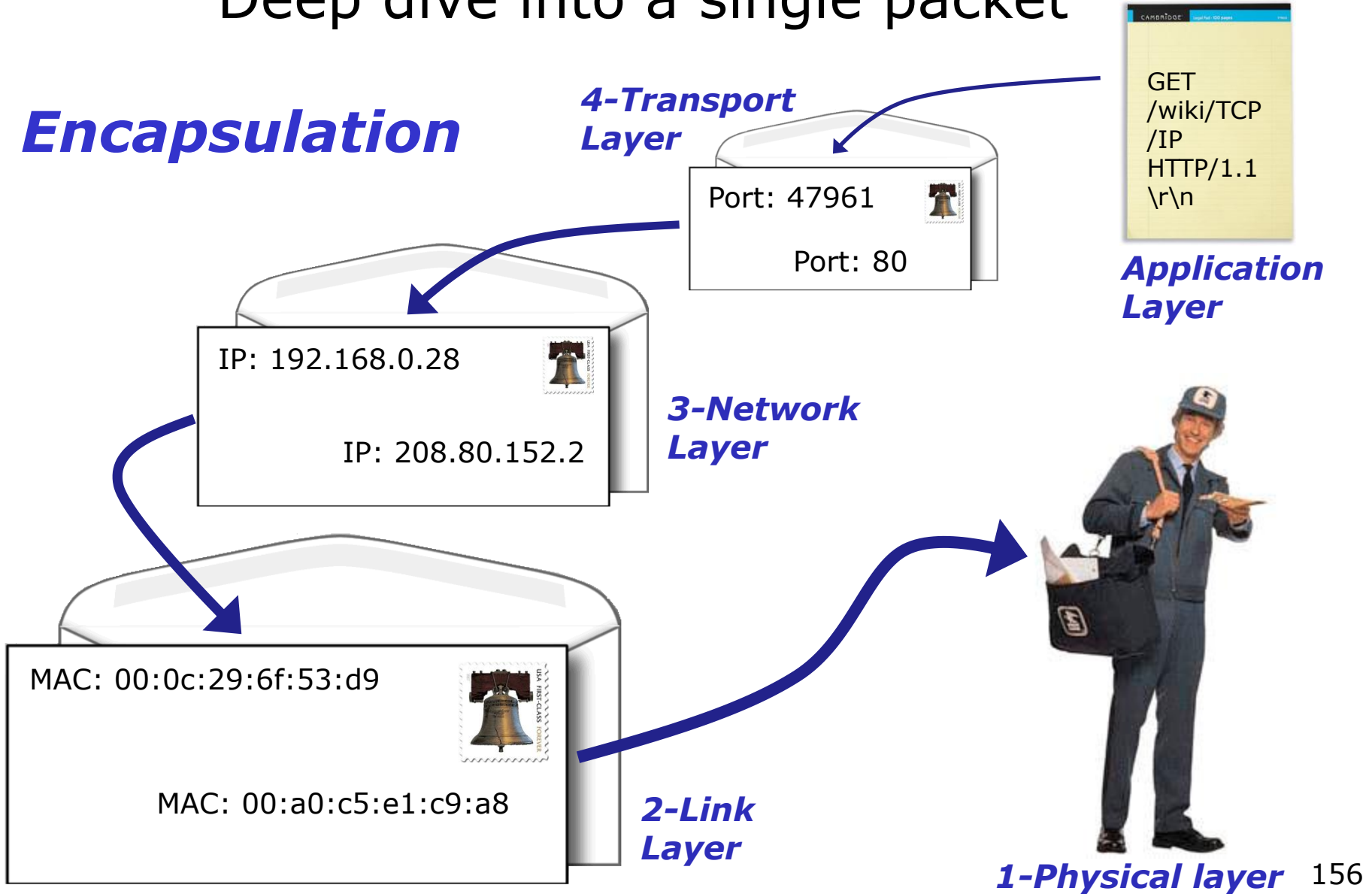
0000 00 a0 c5 e1 c9 a8 00 0c 29 6f 53 d9 08 00 45 00)oS...E.
 0010 02 6e 5b 3e 40 00 40 06 b4 34 c0 a8 00 1c d0 50 .n[>@.@. .4....P
 0020 98 02 bb 59 00 50 56 18 29 23 78 7c 57 9b 50 18 ...Y.PV.)#x|W.P.
 0030 00 b7 48 00 00 00 47 45 54 20 2f 77 69 6b 69 2f ..H...GE T /wiki/

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

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

Deep dive into a single packet

Encapsulation



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

Application Layer



1-Physical layer 156

Standards are needed

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?

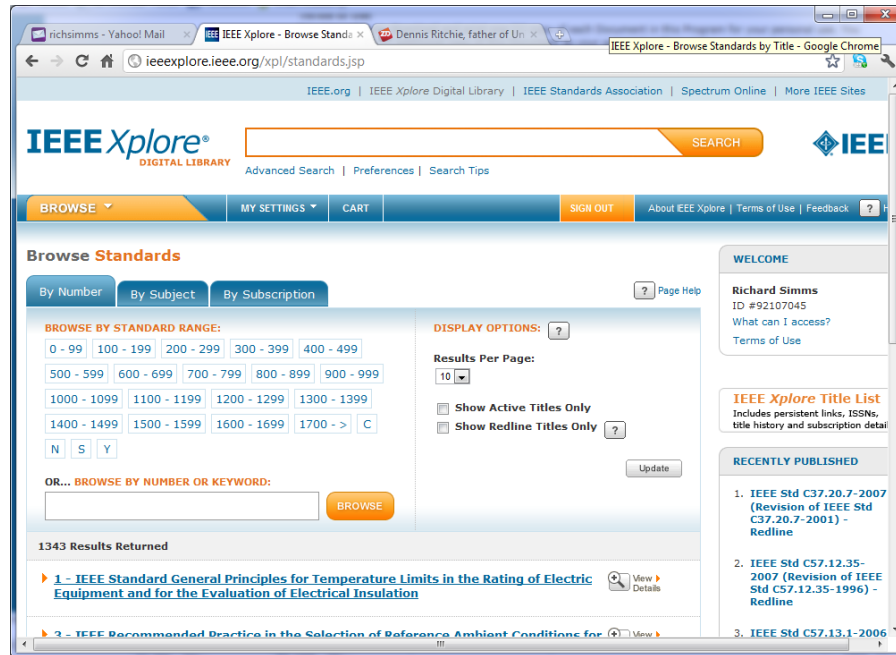
Answer: Standards

- **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, Adobe PDF

IEEE Standards

Institute of Electrical and Electronics Engineers

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



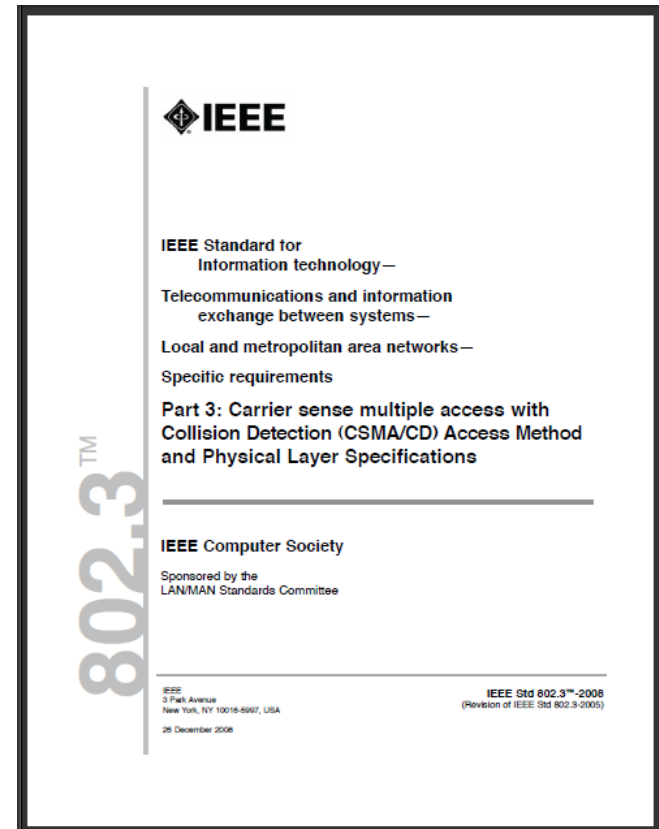
IEEE Standards

Institute of Electrical and Electronics Engineers

Example: Netgear Switch



- IEEE 802.3i 10BASE-T Ethernet
- IEEE 802.3u 100BASE-TX Fast Ethernet
- IEEE 802.3z 1000BASE-T Gigabit Ethernet
- IEEE 802.3x Full-duplex Flow Control
- IEEE 801.p priority tags



IETF Standards

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)

The screenshot shows a web browser window displaying the RFC Search Engine results for the search term 'dhcp'. The interface includes a navigation menu, a search form, and a table of results.

Perform Another Search :

Search for:

Search for: Results Per Page:

RFC File: ASCII+ All PDF

Search: All RFC STD BCP FYI
 Match: Prefix Entire Word
 Show Abstract: On Off
 Show Keywords: On Off
 Result Order: Descending Ascending
 RFC Contents Via: FTP HTTP

o Based on your search of [dhcp] in the All Fields field 75 matches were found
 - Below you will find matching items 1 through 75

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. Tschorefing	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

Find: reverse Highlight all Match case
 Done

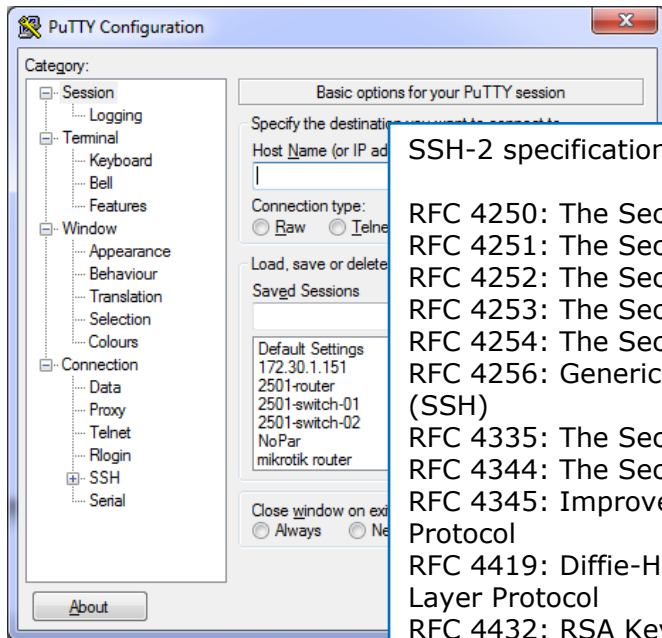
DHCP example

<http://www.rfc-editor.org/rfcsearch.html>

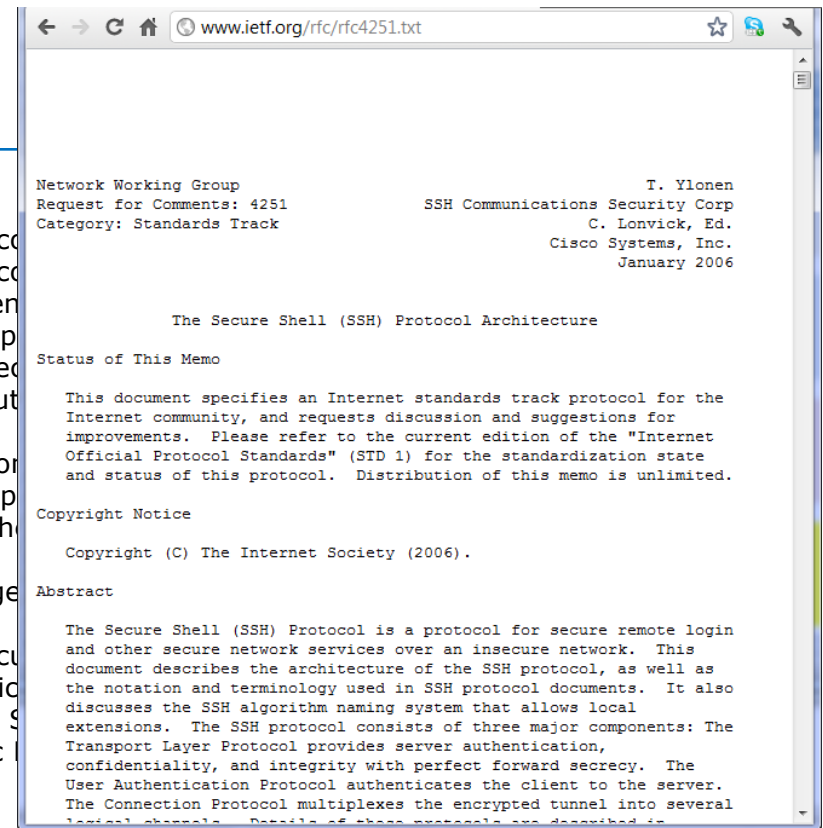
Standards

IETF (Internet Engineering Task Force)

Example: PuTTY SSH software



RFC 4251 SSH Protocol Architecture



SSH-2 specifications

- RFC 4250: The Secure Shell (SSH) Protocol
 - RFC 4251: The Secure Shell (SSH) Protocol Architecture
 - RFC 4252: The Secure Shell (SSH) Authentication Protocol
 - RFC 4253: The Secure Shell (SSH) Transport Layer Protocol
 - RFC 4254: The Secure Shell (SSH) Connection Protocol
 - RFC 4256: Generic Message Exchange Authentication Protocol (GEXAP)
 - RFC 4335: The Secure Shell (SSH) Session Protocol
 - RFC 4344: The Secure Shell (SSH) Transport Layer Protocol Extensions
 - RFC 4345: Improved Arcfour Modes for the Secure Shell (SSH) Protocol
 - RFC 4419: Diffie-Hellman Group Exchange Authentication Protocol
 - RFC 4432: RSA Key Exchange for the Secure Shell (SSH) Protocol
 - RFC 4462: Generic Security Service Application Specific Authentication and Key Exchange for the Secure Shell (SSH) Protocol
 - RFC 4716: The Secure Shell (SSH) Public Key Authentication Protocol
- IETF Secure Shell working group drafts:
filexfer
Independent drafts:
draft-miller-secsh-compression-delayed



Joining the network



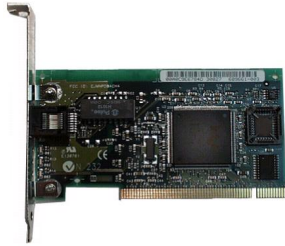
NIC Inventory



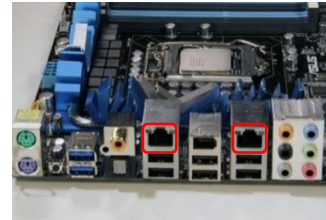
Connecting your Linux system to the Network

1. Identify the NIC(s) 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)

What is a NIC?



NIC as accessory card



NIC chip on the motherboard



- The NIC (Network Interface Controller) is used by a computer to send and receive packets on the network.
- You will also hear NICs called *network adapters* or *Ethernet adapters*.
- Most PC NICs are now part of the motherboard rather than a card.
- A NIC can operate at the level 2 (Link Layer) sending and receiving Ethernet frames based on MAC addresses.
- Multiple NICs allow a computer to be on multiple networks or they can be teamed for higher performance.

*New Linux distributions **automatically** probe hardware at system startup to identify the current NICs installed*



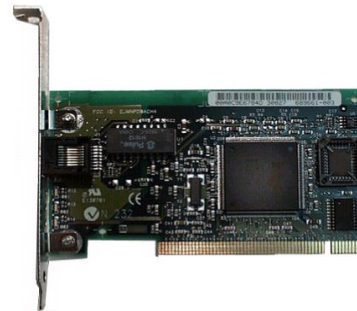
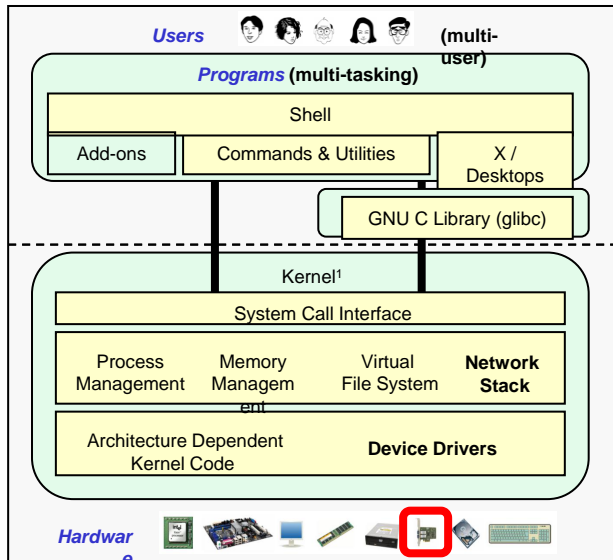
New commands for your toolbox

`lspci`

List the Ethernet controllers (and other devices)

`dmesg`

Show boot messages which shows NIC initialization



Manual NIC Hardware Inventory

lspci command ... on a pod VM

```
[cis192@p03-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)
00:07.7 System peripheral: VMware Virtual Machine Communication Interface (rev 10)
00:0f.0 VGA compatible controller: VMware SVGA II Adapter
< snipped >
00:18.6 PCI bridge: VMware PCI Express Root Port (rev 01)
00:18.7 PCI bridge: VMware PCI Express Root Port (rev 01)
02:00.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller
(Copper) (rev 01)
02:01.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller
(Copper) (rev 01)
02:02.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller
(Copper) (rev 01)
03:00.0 Serial Attached SCSI controller: VMware PVSCSI SCSI Controller (rev 02)
[cis192@p03-celebrian ~]$
```



Look for the string "Ethernet controller" and in this case the Celebrian VM on Pod 3 has three Intel 82545EM NICs installed.

Manual NIC Hardware Inventory

dmesg command *... on a pod VM*

Use grep to search dmesg output for strings like net, eth, int etc.

```
[root@celebrian ~]# dmesg | grep eth
e1000 0000:02:00.0: eth0: (PCI:66MHz:32-bit) 00:50:56:b7:f1:9b
e1000 0000:02:00.0: eth0: Intel(R) PRO/1000 Network Connection
e1000 0000:02:01.0: eth1: (PCI:66MHz:32-bit) 00:50:56:b7:68:07
e1000 0000:02:01.0: eth1: Intel(R) PRO/1000 Network Connection
e1000 0000:02:02.0: eth2: (PCI:66MHz:32-bit) 00:50:56:b7:78:d1
e1000 0000:02:02.0: eth2: Intel(R) PRO/1000 Network Connection
e1000: eth0 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: None
8021q: adding VLAN 0 to HW filter on device eth0
eth0: no IPv6 routers present
[cis192@p03-celebrian ~]$
```

dmesg output often includes information on the NICs as the system boots up and drivers are loaded.

Google NIC for technical specifications

```
02:00:0 Ethernet controller: Intel Corporation 82545EM  
Gigabit Ethernet Controller (Copper) (rev 01)
```

Use Google to help locate specs on your NICs based on lspci and dmesg output

Specifications

The screenshot shows the Intel Developer Center page for the Intel 82545EM Gigabit Ethernet Controller. The page includes a navigation menu with links for 'For Business', 'For Home', 'Products', 'Support', and 'About Intel'. The main content area features the product name 'Intel® 82545EM Gigabit Ethernet Controller' and an 'Overview' section. The text describes the controller as a single, compact component with integrated Gigabit Ethernet MAC and PHY layer functions. It also mentions key applications, features, and benefits, and provides technical specifications such as data rates and supported standards.

Class Activity NIC Inventory

```
[root@misterio ~]# lspci
00:00.0 Host bridge: Intel Corporation 440FX - 82441FX PMC [Natoma] (rev 02)
00:01.0 ISA bridge: Intel Corporation 82371SB PIIX3 ISA [Natoma/Triton II]
00:01.1 IDE interface: Intel Corporation 82371AB/EB/MB PIIX4 IDE (rev 01)
00:02.0 VGA compatible controller: InnoTek Systemberatung GmbH VirtualBox Graphics Adapter
00:03.0 Ethernet controller: Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE] (rev 10)
00:04.0 System peripheral: InnoTek Systemberatung GmbH VirtualBox Guest Service
00:05.0 Multimedia audio controller: Intel Corporation 82801AA AC'97 Audio Controller (rev 01)
00:06.0 USB controller: Apple Inc. KeyLargo/Intrepid USB
00:07.0 Bridge: Intel Corporation 82371AB/EB/MB PIIX4 ACPI (rev 08)
00:08.0 Ethernet controller: Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE] (rev 40)
00:09.0 Ethernet controller: Intel Corporation 82543GC Gigabit Ethernet Controller (Copper) (rev 02)
00:0a.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 02)
00:0d.0 SATA controller: Intel Corporation 82801HM/HEM (ICH8M/ICH8M-E) SATA Controller [AHCI mode] (rev 02)
[root@misterio ~]#
```

Use the CCC Confer Chat window to write your answers to these questions:

- 1) How many NICs are in this mystery system?
- 2) For each NIC, who is the vendor and what is the model number?



Locating 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)

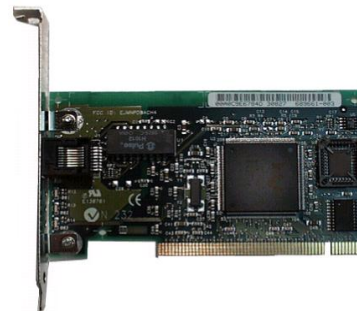
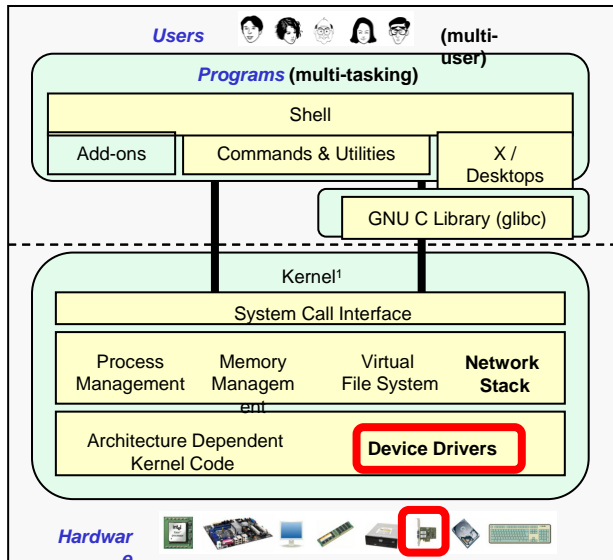
4. Bring up and configure the interface (ifconfig)



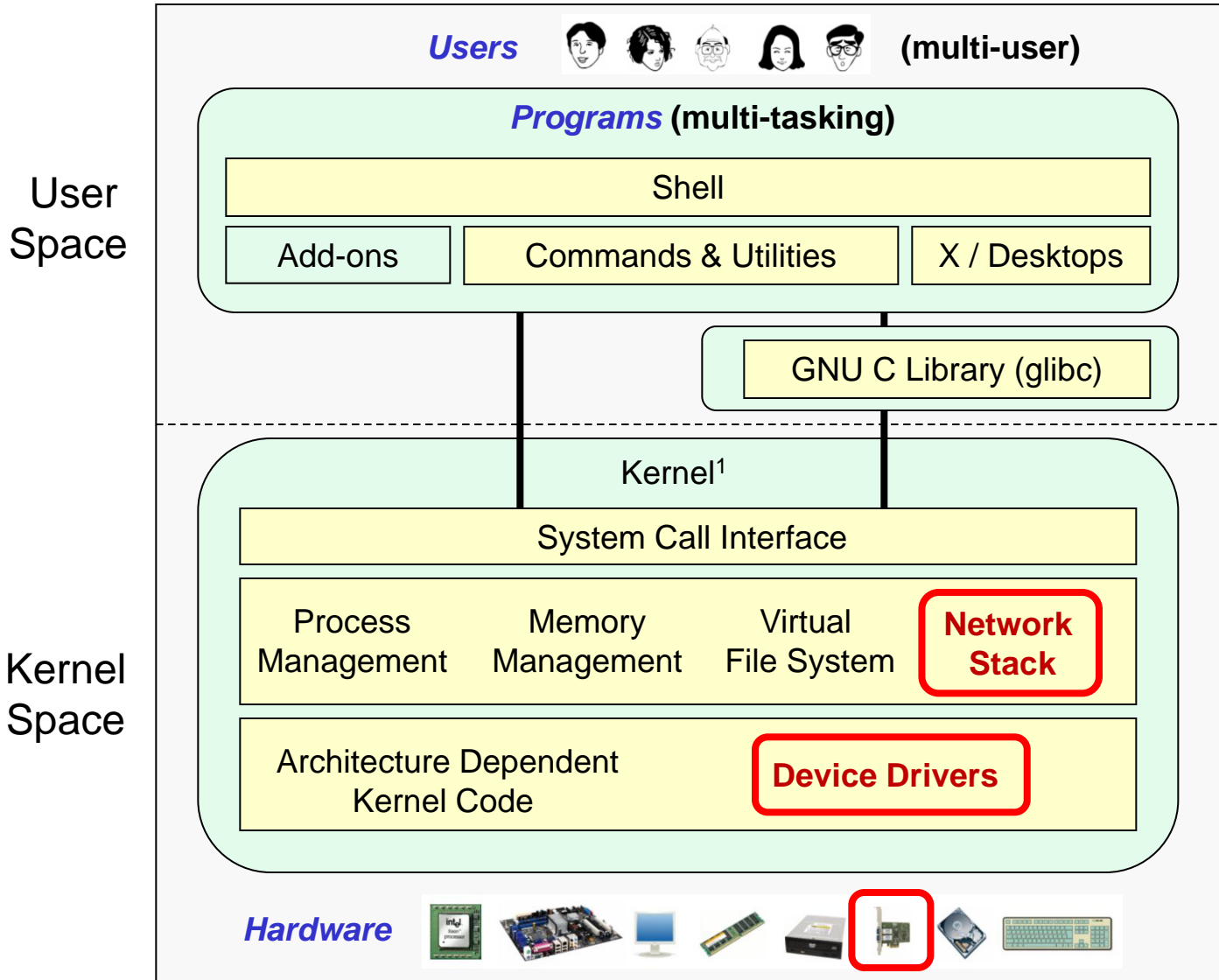
New commands for your toolbox

`lspci -k`

List the Ethernet controllers (and other devices) including names of kernel drivers



What is a NIC driver?

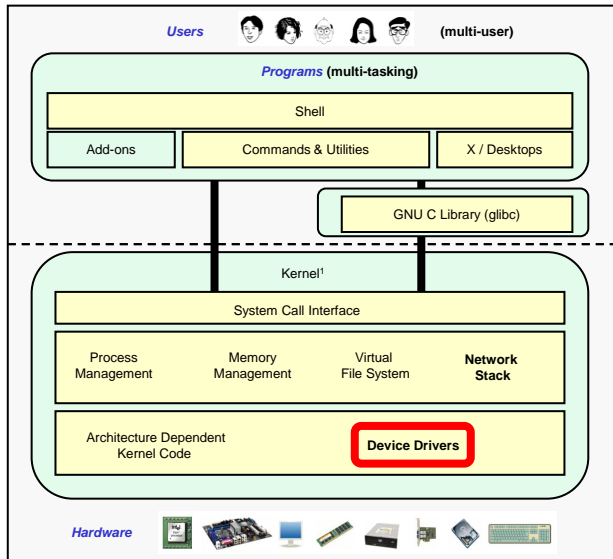


The network stack is implemented in the Linux kernel

NIC drivers are implemented as kernel modules that 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 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 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



The NIC drivers in your Linux distribution

These drivers, compiled to match your kernel, are located in the **/lib/modules/\$(uname -r)/kernel/drivers/net** directory.

```
[cis192@p03-celebrian ~]$ ls -F /lib/modules/2.6.32-279.el6.x86_64/kernel/drivers/net
3c59x.ko*      dl2k.ko*      mdio.ko*      ppp_synctty.ko*  tehuti.ko*
8139cp.ko*    dnet.ko*      mii.ko*       qla3xxx.ko*     tg3.ko*
8139too.ko*   dummy.ko*     mlx4/         qlcnic/         tlan.ko*
8390.ko*      e1000/        myri10ge/    qlge/           tulip/
acenic.ko*    e1000e/       natsemi.ko*  r6040.ko*       tun.ko*
amd8111e.ko*  e100.ko*      ne2k-pci.ko* r8169.ko*       typhoon.ko*
atl1c/        enic/         netconsole.ko* s2io.ko*        usb/
atl1e/        epic100.ko*   netxen/      sc92031.ko*     veth.ko*
atlx/        ethoc.ko*     niu.ko*      sfc/            via-rhine.ko*
b44.ko*      fealnx.ko*    ns83820.ko*  sis190.ko*      via-velocity.ko*
benet/        forcedeth.ko* pch_gbe/     sis900.ko*      virtio_net.ko*
bna/         ifb.ko*       pcmcia/      skge.ko*        vmxnet3/
bnx2.ko*      igb/          pcnets32.ko* sky2.ko*        vxge/
bnx2x/        igbvf/        phy/         slhc.ko*        wan/
bonding/      ipg.ko*       ppp_async.ko* slip.ko*        wimax/
can/          ixgb/         ppp_deflate.ko* smsc9420.ko*    wireless/
cassini.ko*   ixgbe/        ppp_generic.ko* starfire.ko*    xen-netfront.ko*
chelsio/     ixgbevfv/     ppp_mppe.ko*  sundance.ko*
cnic.ko*      jme.ko*       pppoe.ko*     sungem.ko*
cxgb3/        macvlan.ko*   pppol2tp.ko*  sungem_phy.ko*
cxgb4/        macvtap.ko*   ppox.ko*      sunhme.ko*
```



Showing the driver loaded for a NIC

```
[root@celebrian ~]# lspci | grep -i Ethernet
[cis192@p03-celebrian ~]$ lspci | grep Ether
02:00.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
02:01.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
02:02.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
[cis192@p03-celebrian ~]$
```

Shows the NICs on your system

```
[root@celebrian ~]# lspci -k
< snipped >
02:00.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
    Subsystem: VMware PRO/1000 MT Single Port Adapter
    Kernel driver in use: e1000
    Kernel modules: e1000
02:01.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
    Subsystem: VMware PRO/1000 MT Single Port Adapter
    Kernel driver in use: e1000
    Kernel modules: e1000
02:02.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
    Subsystem: VMware PRO/1000 MT Single Port Adapter
    Kernel driver in use: e1000
    Kernel modules: e1000
< snipped >
[root@celebrian ~]#
```

Shows the drivers loaded for the NICs

Some Linux driver families

NIC	Linux Driver
Intel PRO 100 NIC	e100
Intel PRO 1000 NIC	e1000
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	pcnet32



Managing Drivers

(showing, installing, removing)



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)



New commands for your toolbox

lsmod

Show loaded kernel modules including NIC drivers

rmmod *driver*

Manually remove (unload) a NIC driver

insmod *driver*

To manually insert (load) a NIC driver (old way)

modprobe *driver*

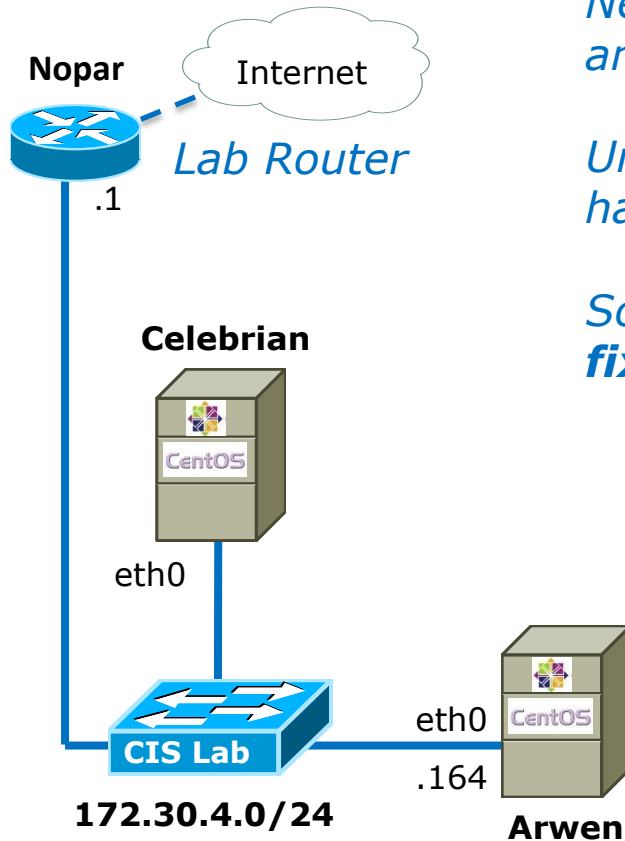
To manually insert (load) a NIC driver (better way)

Notes:

- 1) Do not specify the path or suffix (.ko) for drivers*
- 2) Note: modprobe is more intelligent and recommended over insmod for loading NIC drivers*

*Newer Linux distributions **automatically** identify and load the correct NIC drivers for most NICs*

Commands for managing NIC drivers



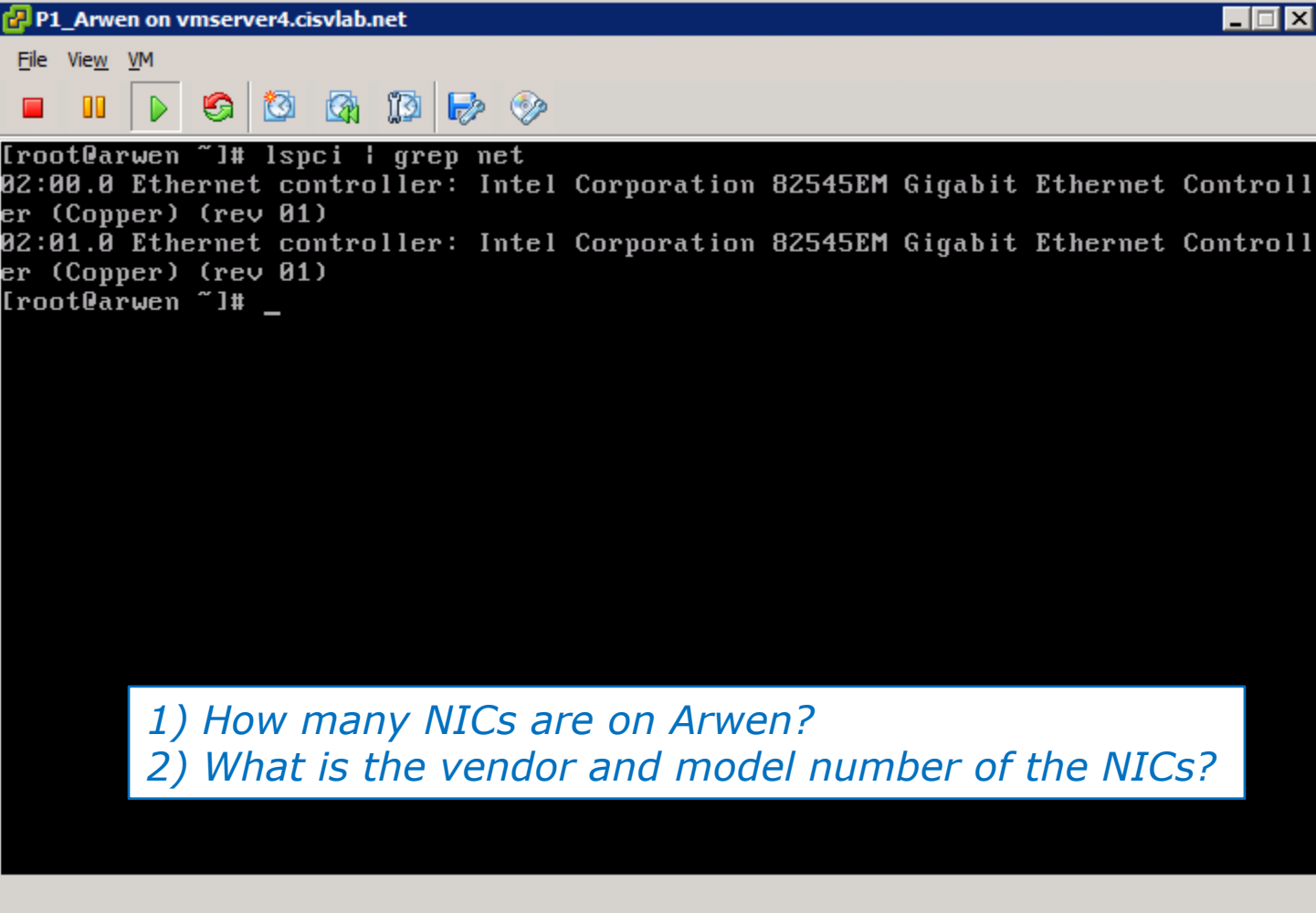
Newer Linux distributions automatically identify and load the correct NIC drivers for most NICs.

Unless you run into problems you usually don't have to use the driver management commands.

*So let's make a problem by first **breaking**, then **fixing** Arwen using the new commands.*

The example in the following slides shows how to use the driver management commands on Arwen (which is configured as shown here)

lspci | grep net



```
P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# lspci | grep net
02:00.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
02:01.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
[root@arwen ~]# _
```

- 1) How many NICs are on Arwen?
- 2) What is the vendor and model number of the NICs?

lspci | grep net

```

[root@arwen ~]# lspci | grep net
02:00.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
02:01.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
[root@arwen ~]# _
    
```

How many NICs are on Arwen?
What is the vendor and model number of the NICs?

Answer 1: 2

Answer 2: **Intel, model 82545EM**



lspci -k | grep -A3 Ethernet

```

P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# lspci -k | grep -A3 Ethernet
02:00.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
    Subsystem: VMware PRO/1000 MT Single Port Adapter
    Kernel driver in use: e1000
    Kernel modules: e1000
02:01.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
    Subsystem: VMware PRO/1000 MT Single Port Adapter
    Kernel driver in use: e1000
    Kernel modules: e1000
[root@arwen ~]# _

```

1) What driver is used for the Intel NICs?

2) What did the `-A3` option do on the `grep` command?



lspci -k | grep -A3 Ethernet

```

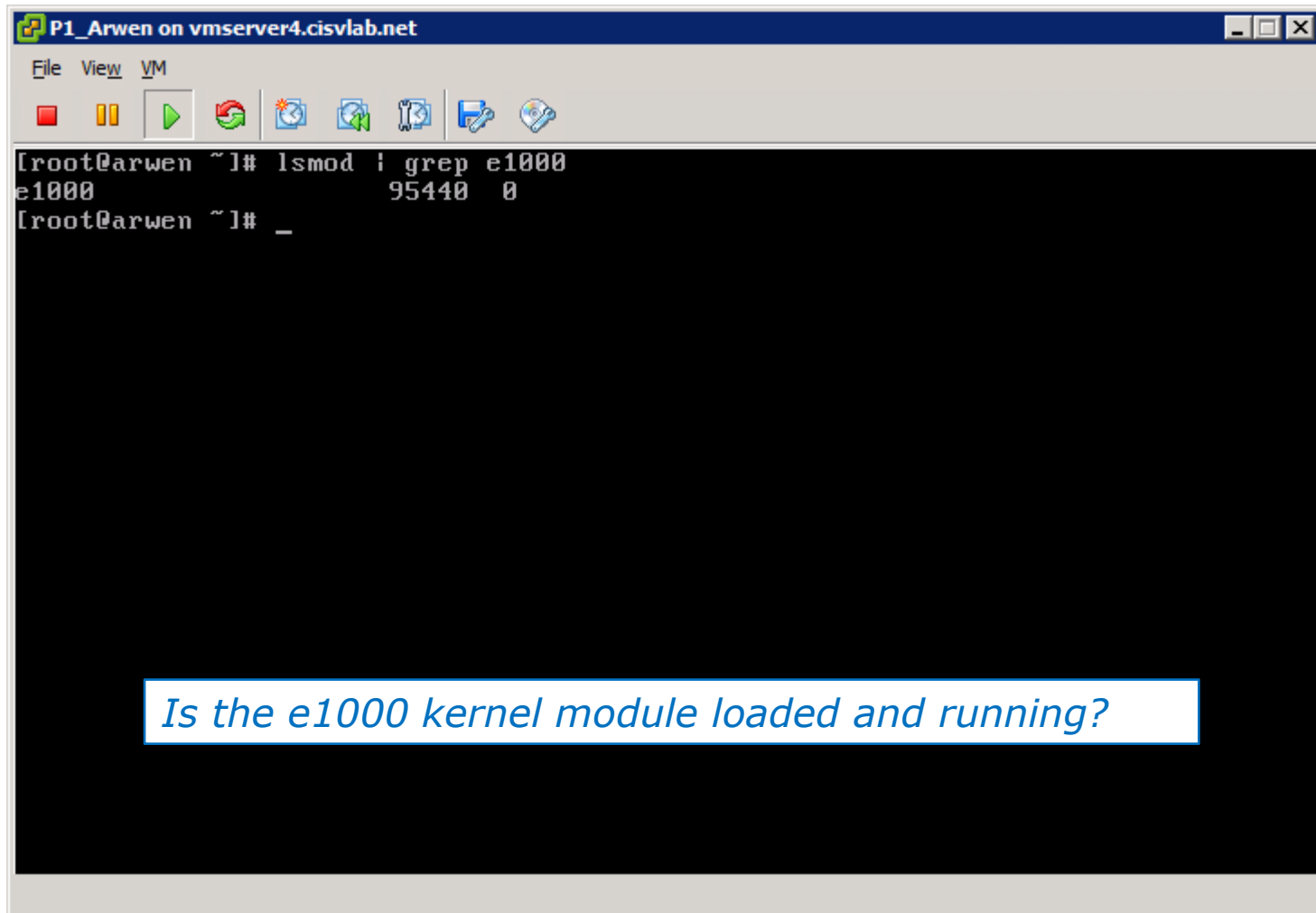
P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# lspci -k | grep -A3 Ethernet
02:00.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
Subsystem: VMware PRO/1000 MT Single Port Adapter
Kernel driver in use: e1000
Kernel modules: e1000
02:01.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
Subsystem: VMware PRO/1000 MT Single Port Adapter
Kernel driver in use: e1000
Kernel modules: e1000
[root@arwen ~]# _
  
```

- 1) *What driver is used for the Intel NICs?*
- 2) *What did the -A3 option do on the grep command?*

Answer 1: e1000

Answer 2: prints the matching line and the 3 lines after it

lsmod | grep e1000



The screenshot shows a terminal window titled "P1_Arwen on vmserver4.cisvlab.net". The terminal displays the command `lsmod | grep e1000` and its output:

```
[root@arwen ~]# lsmod | grep e1000
e1000                95440  0
[root@arwen ~]# _
```

Below the terminal output, a blue-bordered box contains the question: *Is the e1000 kernel module loaded and running?*



lsmod | grep e1000

```
P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# lsmod | grep e1000
e1000          95440  0
[root@arwen ~]# _
```

Is the e1000 kernel module loaded and running?

Answer: Yes

On Celebrian ping 172.30.4.164

On Arwen rmmod e1000

```

P1_Celebrian on vmserver4.cisvlab.net
File View VM
64 bytes from 172.30.4.164: icmp_seq=105 ttl=64 time=0.477 ms
64 bytes from 172.30.4.164: icmp_seq=106 ttl=64 time=0.436 ms
64 bytes from 172.30.4.164: icmp_seq=107 ttl=64 time=0.427 ms
64 bytes from 172.30.4.164: icmp_seq=108 ttl=64 time=0.454 ms
64 bytes from 172.30.4.164: icmp_seq=109 ttl=64 time=0.441 ms
64 bytes from 172.30.4.164: icmp_seq=110 ttl=64 time=0.418 ms
64 bytes from 172.30.4.164: icmp_seq=111 ttl=64 time=0.443 ms
64 bytes from 172.30.4.164: icmp_seq=112 ttl=64 time=0.443 ms
64 bytes from 172.30.4.164: icmp_seq=113 ttl=64 time=0.714 ms
64 bytes from 172.30.4.164: icmp_seq=114 ttl=64 time=0.714 ms
64 bytes from 172.30.4.164: icmp_seq=115 ttl=64 time=0.714 ms
64 bytes from 172.30.4.164: icmp_seq=116 ttl=64 time=0.714 ms
64 bytes from 172.30.4.164: icmp_seq=117 ttl=64 time=0.714 ms
64 bytes from 172.30.4.164: icmp_seq=118 ttl=64 time=0.714 ms
From 172.30.4.158 icmp_seq=168 Destination Host Unreachable
From 172.30.4.158 icmp_seq=169 Destination Host Unreachable
From 172.30.4.158 icmp_seq=170 Destination Host Unreachable
From 172.30.4.158 icmp_seq=172 Destination Host Unreachable
From 172.30.4.158 icmp_seq=173 Destination Host Unreachable
From 172.30.4.158 icmp_seq=174 Destination Host Unreachable
From 172.30.4.158 icmp_seq=176 Destination Host Unreachable
From 172.30.4.158 icmp_seq=177 Destination Host Unreachable
From 172.30.4.158 icmp_seq=178 Destination Host Unreachable

```

```

P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# rmmod e1000
[root@arwen ~]# _

```

While Celebrian is pinging Arwen, what happens when the e1000 NIC driver is unloaded on Arwen?

**On Celebrian
ping 172.30.4.164**

**On Arwen
rmmod e1000**

The image shows two terminal windows from a virtual machine environment. The left window, titled 'P1_Celebrian on vmserver4.cisvlab.net', displays a series of successful ping requests to 172.30.4.164 with varying TTL values and response times. The right window, titled 'P1_Arwen on vmserver4.cisvlab.net', shows the execution of the 'rmmod e1000' command, which unloads the network driver. Following this command, the left window shows a series of failed ping requests with the message 'Destination Host Unreachable'.

```

P1_Celebrian on vmserver4.cisvlab.net
File View VM
64 bytes from 172.30.4.164: icmp_seq=105 ttl=64 time=0.477 ms
64 bytes from 172.30.4.164: icmp_seq=106 ttl=64 time=0.436 ms
64 bytes from 172.30.4.164: icmp_seq=107 ttl=64 time=0.427 ms
64 bytes from 172.30.4.164: icmp_seq=108 ttl=64 time=0.454 ms
64 bytes from 172.30.4.164: icmp_seq=109 ttl=64 time=0.441 ms
64 bytes from 172.30.4.164: icmp_seq=110 ttl=64 time=0.418 ms
64 bytes from 172.30.4.164: icmp_seq=111 ttl=64 time=0.418 ms
64 bytes from 172.30.4.164: icmp_seq=112 ttl=64 time=0.443 ms
64 bytes from 172.30.4.164: icmp_seq=113 ttl=64 time=0.443 ms
64 bytes from 172.30.4.164: icmp_seq=114 ttl=64 time=0.714 ms
64 bytes from 172.30.4.164: icmp_seq=115 ttl=64 time=0.714 ms
64 bytes from 172.30.4.164: icmp_seq=116 ttl=64 time=0.714 ms
64 bytes from 172.30.4.164: icmp_seq=117 ttl=64 time=0.714 ms
64 bytes from 172.30.4.164: icmp_seq=118 ttl=64 time=0.714 ms
From 172.30.4.158 icmp_seq=168 Destination Host Unreachable
From 172.30.4.158 icmp_seq=169 Destination Host Unreachable
From 172.30.4.158 icmp_seq=170 Destination Host Unreachable
From 172.30.4.158 icmp_seq=172 Destination Host Unreachable
From 172.30.4.158 icmp_seq=173 Destination Host Unreachable
From 172.30.4.158 icmp_seq=174 Destination Host Unreachable
From 172.30.4.158 icmp_seq=176 Destination Host Unreachable
From 172.30.4.158 icmp_seq=177 Destination Host Unreachable
From 172.30.4.158 icmp_seq=178 Destination Host Unreachable

P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# rmmod e1000
[root@arwen ~]# _
    
```

While Celebrian is pinging Arwen, what happens when the e1000 NIC driver is unloaded on Arwen?

Answer: Arwen lost network connectivity and stopped responding to ping requests

On Celebrian
ping 172.30.4.164

```

P1_Celebrian on vmserver4.cisvlab.net
File View VM
From 172.30.4.158 icmp_seq=215 Destination Host Unreachable
From 172.30.4.158 icmp_seq=216 Destination Host Unreachable
From 172.30.4.158 icmp_seq=217 Destination Host Unreachable
From 172.30.4.158 icmp_seq=219 Destination Host Unreachable
From 172.30.4.158 icmp_seq=220 Destination Host Unreachable
From 172.30.4.158 icmp_seq=221 Destination Host Unreachable
From 172.30.4.158 icmp_seq=223 Destination Host Unreachable
From 172.30.4.158 icmp_seq=224 Destination Host Unreachable
From 172.30.4.158 icmp_seq=225 Destination Host Unreachable
From 172.30.4.158 icmp_seq=227 Destination Host Unreachable
From 172.30.4.158 icmp_seq=228 Destination Host Unreachable
From 172.30.4.158 icmp_seq=229 Destination Host Unreachable
From 172.30.4.158 icmp_seq=231 Destination Host Unreachable
From 172.30.4.158 icmp_seq=232 Destination Host Unreachable
From 172.30.4.158 icmp_seq=233 Destination Host Unreachable
From 172.30.4.158 icmp_seq=235 Destination Host Unreachable
From 172.30.4.158 icmp_seq=236 Destination Host Unreachable
From 172.30.4.158 icmp_seq=237 Destination Host Unreachable
From 172.30.4.158 icmp_seq=239 Destination Host Unreachable
From 172.30.4.158 icmp_seq=240 Destination Host Unreachable
From 172.30.4.158 icmp_seq=241 Destination Host Unreachable
From 172.30.4.158 icmp_seq=243 Destination Host Unreachable
From 172.30.4.158 icmp_seq=244 Destination Host Unreachable
From 172.30.4.158 icmp_seq=245 Destination Host Unreachable

```

On Arwen
lsmod | grep e1000

```

P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# lsmod | grep e1000
[root@arwen ~]# _

```

Is the e1000 driver (a kernel module) loaded on Arwen?

On Celebrian ping 172.30.4.164

```
P1_Celebrian on vmserver4.cisvlab.net
File View VM
From 172.30.4.158 icmp_seq=215 Destination Host Unreachable
From 172.30.4.158 icmp_seq=216 Destination Host Unreachable
From 172.30.4.158 icmp_seq=217 Destination Host Unreachable
From 172.30.4.158 icmp_seq=219 Destination Host Unreachable
From 172.30.4.158 icmp_seq=220 Destination Host Unreachable
From 172.30.4.158 icmp_seq=221 Destination Host Unreachable
From 172.30.4.158 icmp_seq=223 Destination Host Unreachable
From 172.30.4.158 icmp_seq=224 Destination Host Unreachable
From 172.30.4.158 icmp_seq=225 Destination Host Unreachable
From 172.30.4.158 icmp_seq=227 Destination Host Unreachable
From 172.30.4.158 icmp_seq=228 Destination Host Unreachable
From 172.30.4.158 icmp_seq=229 Destination Host Unreachable
From 172.30.4.158 icmp_seq=231 Destination Host Unreachable
From 172.30.4.158 icmp_seq=232 Destination Host Unreachable
From 172.30.4.158 icmp_seq=233 Destination Host Unreachable
From 172.30.4.158 icmp_seq=235 Destination Host Unreachable
From 172.30.4.158 icmp_seq=236 Destination Host Unreachable
From 172.30.4.158 icmp_seq=237 Destination Host Unreachable
From 172.30.4.158 icmp_seq=239 Destination Host Unreachable
From 172.30.4.158 icmp_seq=240 Destination Host Unreachable
From 172.30.4.158 icmp_seq=241 Destination Host Unreachable
From 172.30.4.158 icmp_seq=243 Destination Host Unreachable
From 172.30.4.158 icmp_seq=244 Destination Host Unreachable
From 172.30.4.158 icmp_seq=245 Destination Host Unreachable
```

On Arwen lsmod | grep e1000

```
P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# lsmod | grep e1000
[root@arwen ~]# _
```

Is the e1000 driver (a kernel module) loaded on Arwen?

Answer: No

On Celebrian ping 172.30.4.164

```

P1_Celebrian on vmserver4.cisvlab.net
File View VM
From 172.30.4.158 icmp_seq=344 Destination Host Unreachable
From 172.30.4.158 icmp_seq=345 Destination Host Unreachable
From 172.30.4.158 icmp_seq=347 Destination Host Unreachable
From 172.30.4.158 icmp_seq=348 Destination Host Unreachable
From 172.30.4.158 icmp_seq=349 De
From 172.30.4.158 icmp_seq=351 De
From 172.30.4.158 icmp_seq=352 De
From 172.30.4.158 icmp_seq=353 De
From 172.30.4.158 icmp_seq=355 De
From 172.30.4.158 icmp_seq=356 De
From 172.30.4.158 icmp_seq=357 De
From 172.30.4.158 icmp_seq=359 De
From 172.30.4.158 icmp_seq=360 De
From 172.30.4.158 icmp_seq=361 De
From 172.30.4.158 icmp_seq=363 De
From 172.30.4.158 icmp_seq=364 De
From 172.30.4.158 icmp_seq=365 De
64 bytes from 172.30.4.164: icmp_
64 bytes from 172.30.4.164: icmp_
64 bytes from 172.30.4.164: icmp_
64 bytes from 172.30.4.164: icmp_
64 bytes from 172.30.4.164: icmp_
64 bytes from 172.30.4.164: icmp_seq=371 ttl=64 time=0.429 ms
64 bytes from 172.30.4.164: icmp_seq=372 ttl=64 time=0.449 ms
_
    
```

On Arwen:
modprobe e1000
ifconfig eth0
dhclient -r
dhclient eth0

```

P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# modprobe e1000
[root@arwen ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:BB:23:97
          inet6 addr: fe80::20c:29ff:febb:2397/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:47 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3103 (3.0 KiB)  TX bytes:468 (468.0 b)

[root@arwen ~]# dhclient -r
[root@arwen ~]# dhclient eth0
[root@arwen ~]# _
    
```

What happened here?

**On Celebrian
ping 172.30.4.164**

```

P1_Celebrian on vmserver4.cisvlab.net
File View VM
From 172.30.4.158 icmp_seq=344 Destination Host Unreachable
From 172.30.4.158 icmp_seq=345 Destination Host Unreachable
From 172.30.4.158 icmp_seq=347 De
From 172.30.4.158 icmp_seq=348 De
From 172.30.4.158 icmp_seq=349 De
From 172.30.4.158 icmp_seq=351 De
From 172.30.4.158 icmp_seq=352 De
From 172.30.4.158 icmp_seq=353 De
From 172.30.4.158 icmp_seq=355 De
From 172.30.4.158 icmp_seq=356 De
From 172.30.4.158 icmp_seq=357 De
From 172.30.4.158 icmp_seq=359 De
From 172.30.4.158 icmp_seq=360 De
From 172.30.4.158 icmp_seq=361 De
From 172.30.4.158 icmp_seq=363 De
From 172.30.4.158 icmp_seq=364 De
From 172.30.4.158 icmp_seq=365 De
64 bytes from 172.30.4.164: icmp_
64 bytes from 172.30.4.164: icmp_
64 bytes from 172.30.4.164: icmp_
64 bytes from 172.30.4.164: icmp_seq=369 ttl=64 time=0.531 ms
64 bytes from 172.30.4.164: icmp_seq=370 ttl=64 time=0.473 ms
64 bytes from 172.30.4.164: icmp_seq=371 ttl=64 time=0.429 ms
64 bytes from 172.30.4.164: icmp_seq=372 ttl=64 time=0.449 ms
_
    
```

**On Arwen:
modprobe e1000
ifconfig eth0
dhclient -r
dhclient eth0**

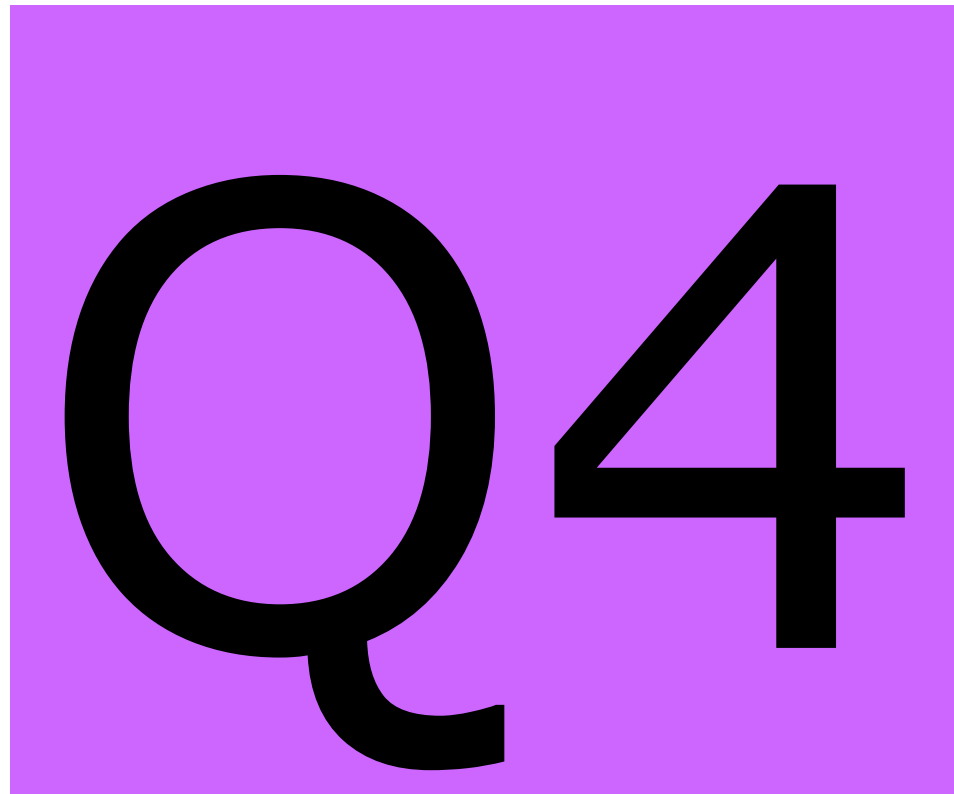
```

P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# modprobe e1000
[root@arwen ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:BB:23:97
          inet6 addr: fe80::20c:29ff:febb:2397/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:47 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3103 (3.0 KiB)  TX bytes:468 (468.0 b)

[root@arwen ~]# dhclient -r
[root@arwen ~]# dhclient eth0
[root@arwen ~]# _
    
```

What happened here?

Answer: Re-loaded the e1000 driver and re-obtained an IP address to get Arwen back in business again (more on dhclient later)



Interface Configuration

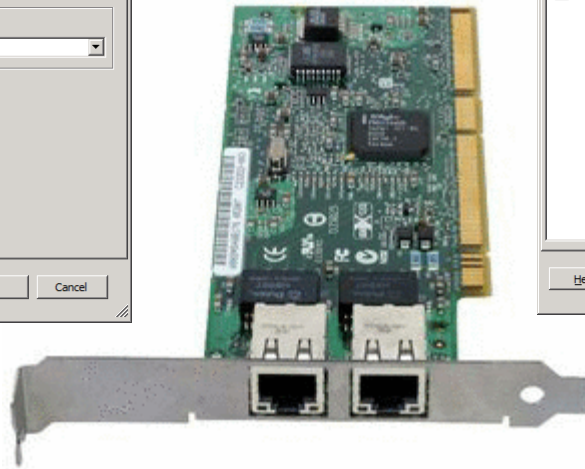
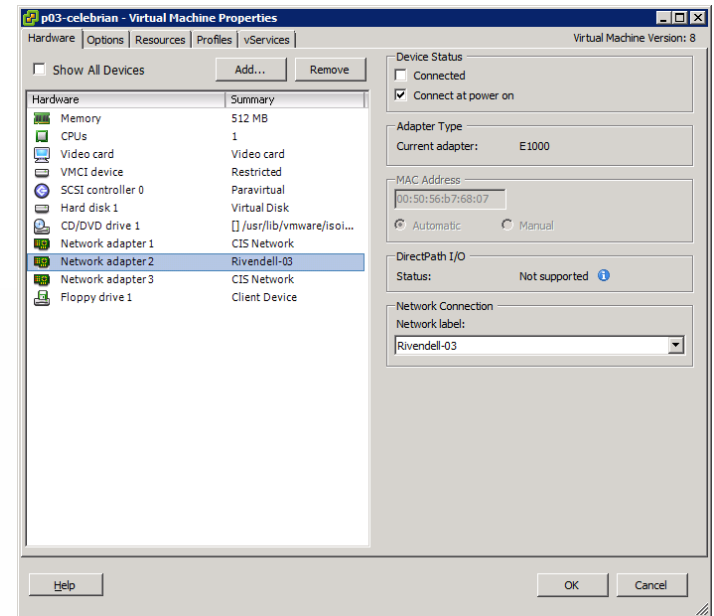
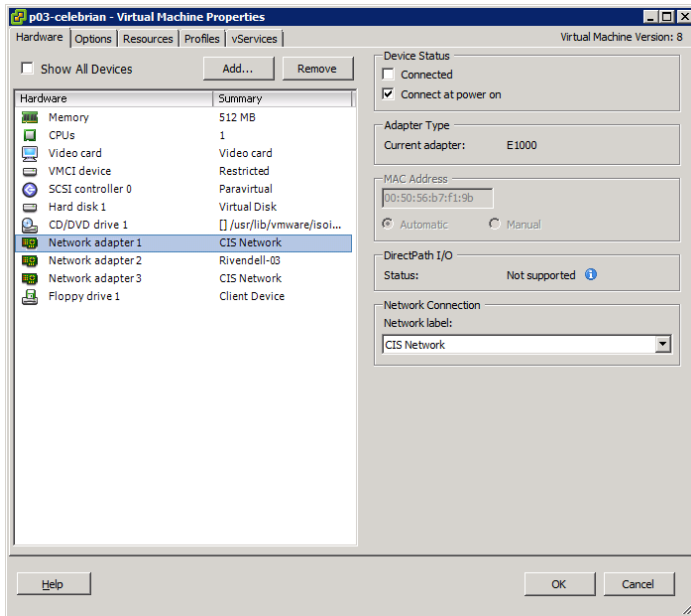


Connecting your Linux system to the Network

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



Network adapter 1 = eth0

Network adapter 2 = eth1

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

MAC addresses

Network adapter 1 = eth0

SCSI controller 0 Paravirtual
Hard disk 1 Virtual Disk
CD/DVD drive 1 [/usr/lib/vmware/isoi...
Network adapter 1 Automatic Manual
Network adapter 2
Network adapter 3

MAC Address
00:50:56:b7:f1:9b

```
[cis192@p03-celebrian ~]$ ifconfig eth0 | head -n1
eth0      Link encap:Ethernet  HWaddr 00:50:56:B7:F1:9B
```

Every NIC has a unique MAC address.

The first three bytes (24 bits) make up the OUI (Organizationally Unique Identifier). Network equipment vendors purchase an OUI from the IEEE Registration Authority then add another 24 bits, unique to their company, to form complete MAC addresses.

Example MAC address

00 : 50 : 56 : B7 : F1 : 9B



OUI

NIC specific

Sniffers like Wireshark and tcpdump use the OUI to identify the NIC vendor.

p03-celebrian - Virtual Machine Properties

Network adapter 1 = eth0

SCSI controller 0 Paravirtual
 Hard disk 1 Virtual Disk
 CD/DVD drive 1 [/usr/lib/vmware/isoi...
Network adapter 1 Automatic
 Network adapter 2 Manual
 Network adapter 3

MAC Address
00:50:56:b7:f1:9b

```
[cis192@p03-celebrian ~]$ ifconfig eth0 | head -n1
eth0      Link encap:Ethernet  HWaddr 00:50:56:B7:F1:9B
```

Network adapter 2 = eth1

SCSI controller 0 Paravirtual
 Hard disk 1 Virtual Disk
 CD/DVD drive 1 [/usr/lib/vmware/isoi...
 Network adapter 1 Automatic
Network adapter 2 Manual
 Network adapter 3

MAC Address
00:50:56:b7:68:07

```
[cis192@p03-celebrian ~]$ ifconfig eth1 | head -n1
eth1      Link encap:Ethernet  HWaddr 00:50:56:B7:68:07
```

Network adapter 3 = eth2

SCSI controller 0 Paravirtual
 Hard disk 1 Virtual Disk
 CD/DVD drive 1 [/usr/lib/vmware/isoi...
 Network adapter 1 Automatic
 Network adapter 2 Manual
Network adapter 3

MAC Address
00:50:56:b7:78:d1

```
[cis192@p03-celebrian ~]$ ifconfig eth2 | head -n1
eth2      Link encap:Ethernet  HWaddr 00:50:56:B7:78:D1
```



Network connectivity via DHCP



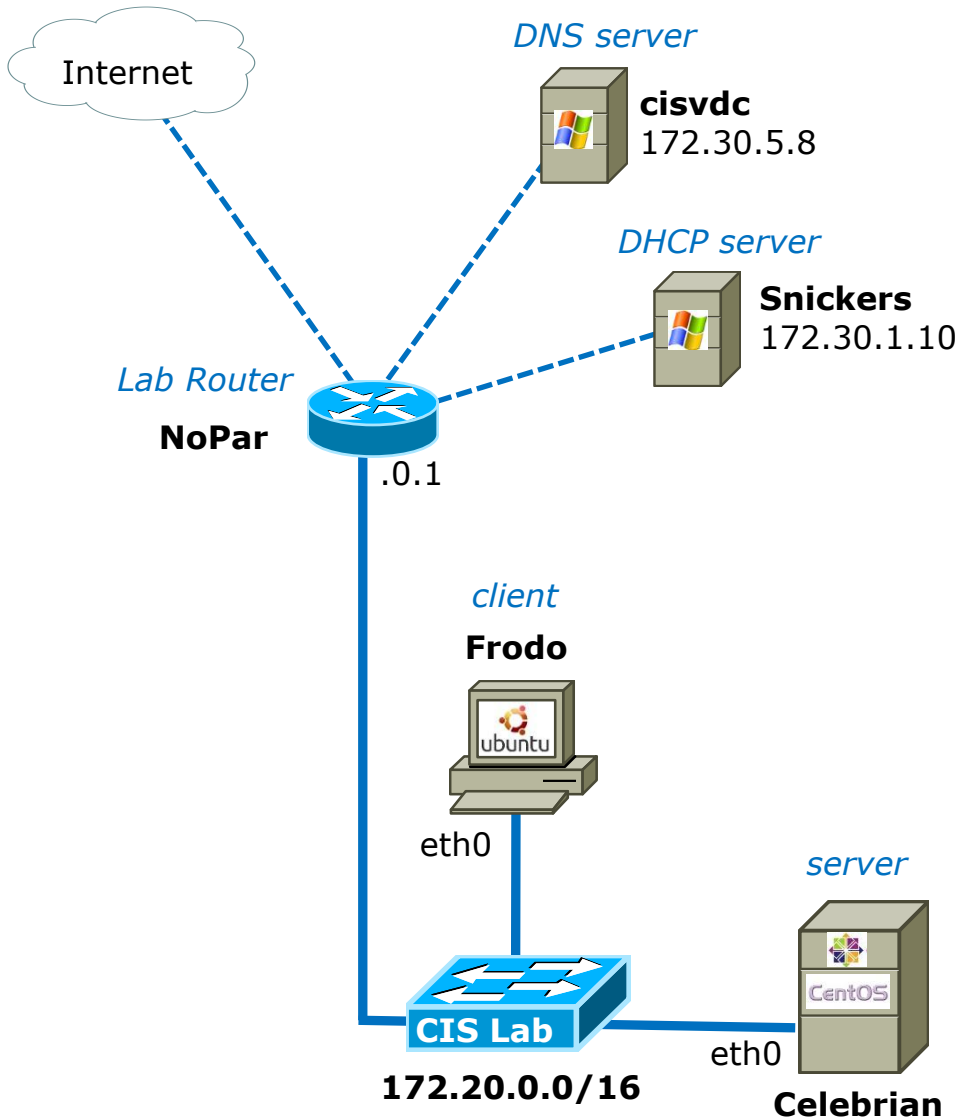
New commands for your toolbox

To obtain and release IP address:

<code>dhclient ethn</code>	<i>To request an IP address for an interface</i>
<code>dhclient -v ethn</code>	<i>Same but shows the address obtained</i>
<code>dhclient -r ethn</code>	<i>To release the IP address</i>
<code>tail /var/log/messages</code>	<i>To view related log messages</i>

To show network configuration:

<code>ifconfig</code>	<i>Show status of all interfaces</i>
<code>ifconfig ethn</code>	<i>Show single interface status</i>
<code>route -n</code>	<i>Show routing table (faster with no DNS lookups)</i>
<code>cat /etc/resolv.conf</code>	<i>Show DNS name servers</i>



cisvdc is a DNS server and the domain controller for the *cislab.net* domain

Snickers is a DHCP server in the 2501 closet

- It 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 (172.20.4.11 to 172.20.9.254) for the systems in the CIS Lab.

Frodo has been configured to use DHCP and will have network connectivity after it boots up.

Celebrian is not configured for network access and will have no connectivity when it boots up.



Frodo

Check network connectivity status

```
root@p03-frodo:~# ifconfig eth0
eth0      Link encan:Ethernet  HWaddr 00:50:56:b7:e0:d9
          inet addr:172.20.4.11  Bcast:172.20.255.255  Mask:255.255.0.0
          inet6 addr: fe80::250:56ff:feb7:e0d9/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:94 errors:0 dropped:0 overruns:0 frame:0
          TX packets:103 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:13481 (13.4 KB)  TX bytes:11926 (11.9 KB)
```

```
root@p03-frodo:~# route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         172.20.0.1     0.0.0.0         UG    0      0      0 eth0
169.254.0.0    0.0.0.0        255.255.0.0     U     1000   0      0 eth0
172.20.0.0     0.0.0.0        255.255.0.0     U      1      0      0 eth0
```

```
root@p03-frodo:~# cat /etc/resolv.conf
# Dynamic resolv.conf(5) file for glibc resolver(3) generated by resolvconf(8)
#     DO NOT EDIT THIS FILE BY HAND -- YOUR CHANGES WILL BE OVERWRITTEN
nameserver 127.0.0.1
search cislab.net
```

```
root@p03-frodo:~# ping 172.20.0.1 -c2
PING 172.20.0.1 (172.20.0.1) 56(84) bytes of data.
64 bytes from 172.20.0.1: icmp_req=1 ttl=255 time=0.512 ms
64 bytes from 172.20.0.1: icmp_req=2 ttl=255 time=0.480 ms

--- 172.20.0.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 0.480/0.496/0.512/0.016 ms
```

```
root@p03-frodo:~# ping google.com -c2
PING google.com (74.125.224.133) 56(84) bytes of data.
64 bytes from nuq04s09-in-f5.1e100.net (74.125.224.133): icmp_req=1 ttl=55 time=5.71 ms
64 bytes from nuq04s09-in-f5.1e100.net (74.125.224.133): icmp_req=2 ttl=55 time=5.38 ms

--- google.com ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 5.388/5.551/5.715/0.179 ms
```

ifconfig eth0 shows Frodo obtained a 172.20.4.11/16 IPv4 address and has a link-local IPv6 address. The eth0 interface is up.

route -n shows the default gateway is 172.20.0.1

cat /etc/resolv.conf shows that name service requests will resolved by a local service

ping 172.20.0.1 -c2 shows we have segment connectivity

ping google.com -c2 shows we have Internet connectivity and access to a name server

Frodo obtained the IPv4 address and gateway information from the DHCP server at startup.



Celebrian

Check network connectivity status

```
[root@p03-celebrian ~]#
[root@p03-celebrian ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:50:56:B7:F1:9B
          BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)

[root@p03-celebrian ~]# route -n
Kernel IP routing table
Destination        Gateway            Genmask           Flags Metric Ref    Use Iface
[root@p03-celebrian ~]# cat /etc/resolv.conf
[root@p03-celebrian ~]#
[root@p03-celebrian ~]# ping 172.20.0.1
connect: Network is unreachable
[root@p03-celebrian ~]#
[root@p03-celebrian ~]# ping google.com
ping: unknown host google.com
[root@p03-celebrian ~]# _
```

When Celebrian starts up it has **no network connectivity**. It does not have an IPv4 or IPv6 address. The eth0 interface is down. It has no default gateway set and no name servers configured.



Celebrian

How to manually obtain an IP address (and more)

```
[root@p03-celebrian ~]# dhclient -v eth0
Internet Systems Consortium DHCP Client 4.1.1-P1
Copyright 2004-2010 Internet Systems Consortium.
All rights reserved.
For info, please visit https://www.isc.org/software/dhcp/

Listening on LPF/eth0/00:50:56:b7:f1:9b
Sending on LPF/eth0/00:50:56:b7:f1:9b
Sending on Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 8 (xid=0x6844db11)
DHCPOFFER from 172.20.0.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67 (xid=0x6844db11)
DHCPCACK from 172.20.0.1 (xid=0x6844db11)
bound to 172.20.4.14 -- renewal in 201082 seconds.
```

dhclient -v eth0 obtains an IPv4 address of 172.20.4.14

```
[root@p03-celebrian ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:50:56:B7:F1:9B
          inet addr:172.20.4.14  Bcast:172.20.255.255  Mask:255.255.0.0
          inet6 addr: fe80::250:56ff:feb7:f19b/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:9 errors:0 dropped:0 overruns:0 frame:0
          TX packets:15 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1411 (1.3 KiB)  TX bytes:2046 (1.9 KiB)
```

ifconfig eth0 shows the eth0 interface is up and has both a IPv4 and a link-local IPv6 address.

```
[root@p03-celebrian ~]# route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
172.20.0.0 0.0.0.0 255.255.0.0 U 0 0 0 eth0
0.0.0.0 172.20.0.1 0.0.0.0 UG 0 0 0 eth0
```

route -n shows the default gateway is 172.20.0.1

```
[root@p03-celebrian ~]# cat /etc/resolv.conf
; generated by /sbin/dhclient-script
search cislabs.net rivendell
nameserver 172.30.5.8
nameserver 10.240.1.2
```

cat /etc/resolv.conf shows that name service requests will go to the CIS DNS server or the Cabrillo DNS server



Celebrian

Verify connectivity

```
[root@p03-celebrian ~]# ping 172.20.0.1 -c1
PING 172.20.0.1 (172.20.0.1) 56(84) bytes of data.
64 bytes from 172.20.0.1: icmp_seq=1 ttl=255 time=0.444 ms

--- 172.20.0.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.444/0.444/0.444/0.000 ms
[root@p03-celebrian ~]#
```

ping 172.20.0.1 -c2
shows we have segment connectivity

```
[root@p03-celebrian ~]# ping google.com -c1
PING google.com (74.125.224.133) 56(84) bytes of data.
64 bytes from nuq04s09-in-f5.1e100.net (74.125.224.133): icmp_seq=1 ttl=55 time=5.69 ms

--- google.com ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 9ms
rtt min/avg/max/mdev = 5.696/5.696/5.696/0.000 ms
[root@p03-celebrian ~]# _
```

ping google.com -c2
shows we have Internet connectivity and access to a name server

*Celebrian now has full network connectivity. However this is **not permanent** and will lose connectivity if the system or network service is restarted.*



Celebrian

How to release the IP address (and undo network settings)

```
[root@p03-celebrian ~]# dhclient -r eth0
```

dhclient -r eth0 *releases the IP address*

```
[root@p03-celebrian ~]# tail -n2 /var/log/messages
Feb 7 16:27:09 p03-celebrian dhclient[1830]: DHCPRELEASE on eth0 to 172.30.1.10
port 67 (xid=0xac9d64b)
Feb 7 16:27:10 p03-celebrian NET[1846]: /sbin/dhclient-script : updated /etc/resolv.conf
[root@p03-celebrian ~]# _
```

tail -n2 /var/log/messages *shows the release of the IP address back to Snickers in the system log*

```
[root@p03-celebrian ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:50:56:B7:F1:9B
          inet6 addr: fe80::250:56ff:feb7:f19b/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:119 errors:0 dropped:0 overruns:0 frame:0
          TX packets:43 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:13040 (12.7 KiB)  TX bytes:5877 (5.7 KiB)
```

ifconfig eth0 *shows the interface is still up but no longer has an IPv4 address*

```
[root@p03-celebrian ~]# route -n
Kernel IP routing table
Destination      Gateway          Genmask         Flags Metric Ref    Use Iface
[root@p03-celebrian ~]#
```

route -n *shows an empty routing table*

```
[root@p03-celebrian ~]# cat /etc/resolv.conf
[root@p03-celebrian ~]# _
```

cat /etc/resolv.conf *shows no nameservers*



Celebrian

Check connectivity status

```
[root@p03-celebrian ~]# ping 172.20.0.1 -c1  
connect: Network is unreachable  
[root@p03-celebrian ~]#
```

```
[root@p03-celebrian ~]# ping google.com -c1  
ping: unknown host google.com  
[root@p03-celebrian ~]# _
```

Celebrian now has no network connectivity



Network connectivity via static IP (temporary)



New commands for your toolbox

`ifconfig ethn xxx.xxx.xxx.xxx/pp` *To set an IP address and subnet mask on an interface*

`ifconfig ethn down` *To shut down an interface*

`ifconfig ethn up` *To bring up an interface*

*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@p03-celebrian ~]# 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:0 errors:0 dropped:0 overruns:0 frame:0
        TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:0
        RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
```

Network settings have not been configured on the CentOS VMs so you can practice setting them up. When you first power them on only the loopback “lo” interface is active.

The loopback interface is used to access network services that are running on the local system. Those packets don't have to be sent out on the network since they are destined for the local system.

Select a UNIQUE IPv4 address

Select one of the IP addresses assigned to your pod.

For Benji this would be 172.20.192.14 through 172.20.192.20

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9 days till term starts!

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[VLab RDP file](#)
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[CIS 192 VLab Pod Assignments](#)

RIP Dennis Ritchie

CIS 192 (Spring 2013) Course Calendar
[Course Home](#) [Grades](#)
(content subject to change)

Lesson	Date	Topics	Chapter	Due
		Introduction to Course, TCP/IP and Network Access <ul style="list-style-type: none"> Linux market and jobs Understand how this co Equipment and resourc Virtualization and VMW Networking overview NIC drivers Configure network sett Test network connecti Ping and SSH with IPv6 		
1	2/12	Materials <ul style="list-style-type: none"> Presentation slides (do Logins Sheet (download) Howto #303: Remote A (download) CIS VLab RDP file (down Assignment <ul style="list-style-type: none"> Student survey (downl Lab 1 (Linux VMs) CCC Confer <ul style="list-style-type: none"> Enter virtual classroom Class archives 		

CIS 192 VLab Assignments						
Student	Pod	CIS Lab Network 172.20.0.0/16		Virtual Switches		
		Start	End	Shire	Rivendell	Mordor
Ahmed	1	172.20.192.7	172.20.192.13	Shire-01	Rivendell-01	Mordor-01
Benji	2	172.20.192.14	172.20.192.20	Shire-02	Rivendell-02	Mordor-02
Bryan	3	172.20.192.21	172.20.192.27	Shire-03	Rivendell-03	Mordor-03
Carlos	4	172.20.192.28	172.20.192.34	Shire-04	Rivendell-04	Mordor-04
Christopher	5	172.20.192.35	172.20.192.41	Shire-05	Rivendell-05	Mordor-05
Corey	6	172.20.192.42	172.20.192.48	Shire-06	Rivendell-06	Mordor-06
David H.	7	172.20.192.49	172.20.192.55	Shire-07	Rivendell-07	Mordor-07
David M.	8	172.20.192.56	172.20.192.62	Shire-08	Rivendell-08	Mordor-08
Donna	9	172.20.192.63	172.20.192.69	Shire-09	Rivendell-09	Mordor-09
Duke	10	172.20.192.70	172.20.192.76	Shire-10	Rivendell-10	Mordor-10
Elia	11	172.20.192.77	172.20.192.83	Shire-11	Rivendell-11	Mordor-11
Evan	12	172.20.192.84	172.20.192.90	Shire-12	Rivendell-12	Mordor-12
Gabriel	13	172.20.192.91	172.20.192.97	Shire-13	Rivendell-13	Mordor-13
Homer	14	172.20.192.98	172.20.192.104	Shire-14	Rivendell-14	Mordor-14
Sean	15	172.20.192.105	172.20.192.111	Shire-15	Rivendell-15	Mordor-15
Shahram	16	172.20.192.112	172.20.192.118	Shire-16	Rivendell-16	Mordor-16
Solomon	17	172.20.192.119	172.20.192.125	Shire-17	Rivendell-17	Mordor-17
Stephanie	18	172.20.192.126	172.20.192.132	Shire-18	Rivendell-18	Mordor-18
Tajvia	19	172.20.192.133	172.20.192.139	Shire-19	Rivendell-19	Mordor-19
Tony	20	172.20.192.140	172.20.192.146	Shire-20	Rivendell-20	Mordor-20

Configuring a static IP address with ifconfig

To set an IP address and subnet mask on Celebrian in Pod 3:

ifconfig eth0 172.20.192.14/16

IPv4 address

MAC address

```
[root@p03-celebrian ~]# ifconfig eth0 172.20.192.14/16
[root@p03-celebrian ~]#
[root@p03-celebrian ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:50:56:B7:F1:9B
          inet addr:172.20.192.14  Bcast:172.20.255.255  Mask:255.255.0.0
          inet6 addr: fe80::250:56ff:feb7:f19b/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1 errors:0 dropped:0 overruns:0 frame:0
          TX packets:5 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:64 (64.0 b)  TX bytes:398 (398.0 b)

[root@p03-celebrian ~]# _
```

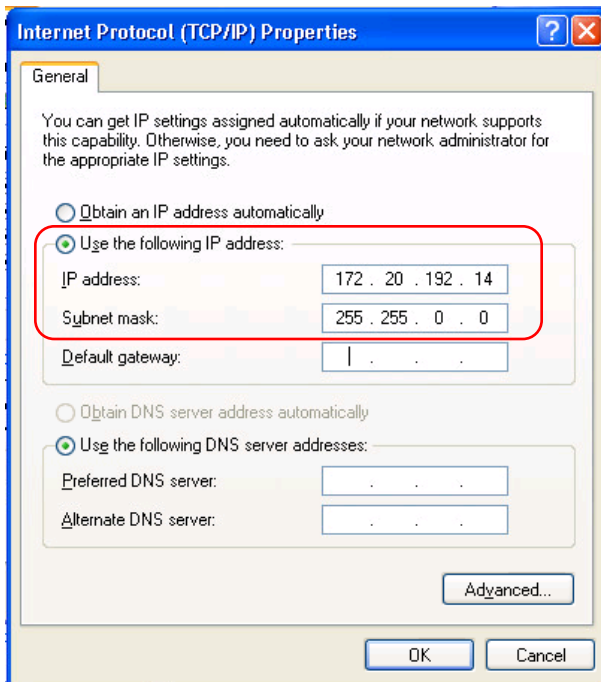
IPv6 link-local address

subnet mask

Remember that 172.20.192.14 is only to be used ion Pod 3.

*If every student configures their VM with the same static IP address there will be duplicate IP issues on the network which = **TROUBLE***

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 172.20.192.14 255.255.255.0
Router(config-if)#
```



Caveat: Root's environment has /sbin in path

As root, your path includes /sbin

```
[root@tachari ~]# 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>
```

Some non-root users may not have /sbin on their path

```
[homer@tachari ~]$ ifconfig
-bash: ifconfig: command not found

[homer@tachari ~]$ /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>
```

*If a command is not on your path then you must use
a full absolute pathname to it*



Configuring Gateway (temporary)



New commands for your toolbox

`route add default gw xxx.xxx.xxx.xxx` *To set the default gateway*

`route del default gw xxx.xxx.xxx.xxx` *To delete the default gateway*

Note: Configuring a route with this way is temporary. It will last until the system is rebooted or the network service is restarted.

Configuring the gateway

To set the default gateway

route add default gw 172.20.0.1
route -n

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

```
[root@p03-celebrian ~]# route add default gw 172.20.0.1
[root@p03-celebrian ~]#
[root@p03-celebrian ~]# route -n
Kernel IP routing table
Destination      Gateway          Genmask         Flags Metric Ref    Use Iface
172.20.0.0      0.0.0.0         255.255.0.0    U        0      0      0 eth0
0.0.0.0         172.20.0.1     0.0.0.0        UG       0      0      0 eth0
[root@p03-celebrian ~]# _
```

The routing table above has two routes:

- *Packets destined for 172.20.0.0/16 are sent out the eth0 interface to the connected subnet*
- *All other packets are sent to the default gateway at 172.20.0.1*

Configuring the gateway

To delete the default gateway

route del default gw 172.20.0.1
route -n

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

```
[root@p03-celebrian ~]# route del default gw 172.20.0.1
[root@p03-celebrian ~]#
[root@p03-celebrian ~]# route -n
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
172.20.0.0       0.0.0.0        255.255.0.0    U        0      0      0 eth0
[root@p03-celebrian ~]# _
```

The routing table above has one route:

- *Packets destined for 172.20.0.0/16 are sent out the eth0 interface to the connected subnet*



Configuring DNS name servers

Configuring the gateway and DNS

- To configure the DNS name servers edit **/etc/resolv.conf** and add:

search *domain*

*string to append to
short hostnames*

nameserver *xxx.xxx.xxx.xxx*

primary name server

nameserver *xxx.xxx.xxx.xxx*

*secondary name server
(used only if primary is
down)*

Configuring the gateway and DNS

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

```
search cislabs.net
nameserver 172.30.5.8
nameserver 10.240.1.2
```

```
[root@p03-celebrian ~]# cat /etc/resolv.conf
search cislabs.net
nameserver 172.30.5.8
nameserver 10.240.1.2
[root@p03-celebrian ~]# _
```

The "search" line will cause lookups to append cislabs.net to the hostname being resolved. User can then use short hostnames like opus instead of having to type opus.cislabs.net

The 172.30.5.8 is a CIS department DNS nameserver

The 10.240.1.2 is a campus DNS nameserver

Verify your DNS settings

```
[root@p03-celebrian ~]# ping vmserver3 -c2
PING vmserver3.cislab.net (192.168.0.13) 56(84) bytes of data.
64 bytes from vmserver3.cislab.net (192.168.0.13): icmp_seq=1 ttl=62 time=0.624
ms
64 bytes from vmserver3.cislab.net (192.168.0.13): icmp_seq=2 ttl=62 time=0.698
ms
--- vmserver3.cislab.net ping statistics ---
 2 packets transmitted, 2 received, 0% packet loss, time 1002ms
 rtt min/avg/max/mdev = 0.624/0.661/0.698/0.037 ms
[root@p03-celebrian ~]#
```

Local servers like vmserver3 automatically have .cislab.net" appended

```
[root@p03-celebrian ~]# ping google.com -c2
PING google.com (74.125.224.128) 56(84) bytes of data.
64 bytes from nuq04s09-in-f0.1e100.net (74.125.224.128): icmp_seq=1 ttl=55 time=
5.82 ms
64 bytes from nuq04s09-in-f0.1e100.net (74.125.224.128): icmp_seq=2 ttl=55 time=
5.55 ms

--- google.com ping statistics ---
 2 packets transmitted, 2 received, 0% packet loss, time 1007ms
 rtt min/avg/max/mdev = 5.557/5.691/5.826/0.154 ms
[root@p03-celebrian ~]# _
```

Internet hostnames are resolvable



Configuring hostname (temporary)



New commands for your toolbox

hostname

Shows current hostname

hostname *name*

Sets the hostname to a new name

Note: Configuring the hostname this way is temporary. It will last until the system is rebooted or the network service is restarted.

Showing and changing the hostname

Shows the currently configured hostname

```
[root@p03-celebrian ~]# hostname  
p03-celebrian.rivendell
```

Sets a new hostname

```
[root@p03-celebrian ~]# hostname Hugo  
[root@p03-celebrian ~]# hostname  
Hugo
```

Changes back to the original hostname

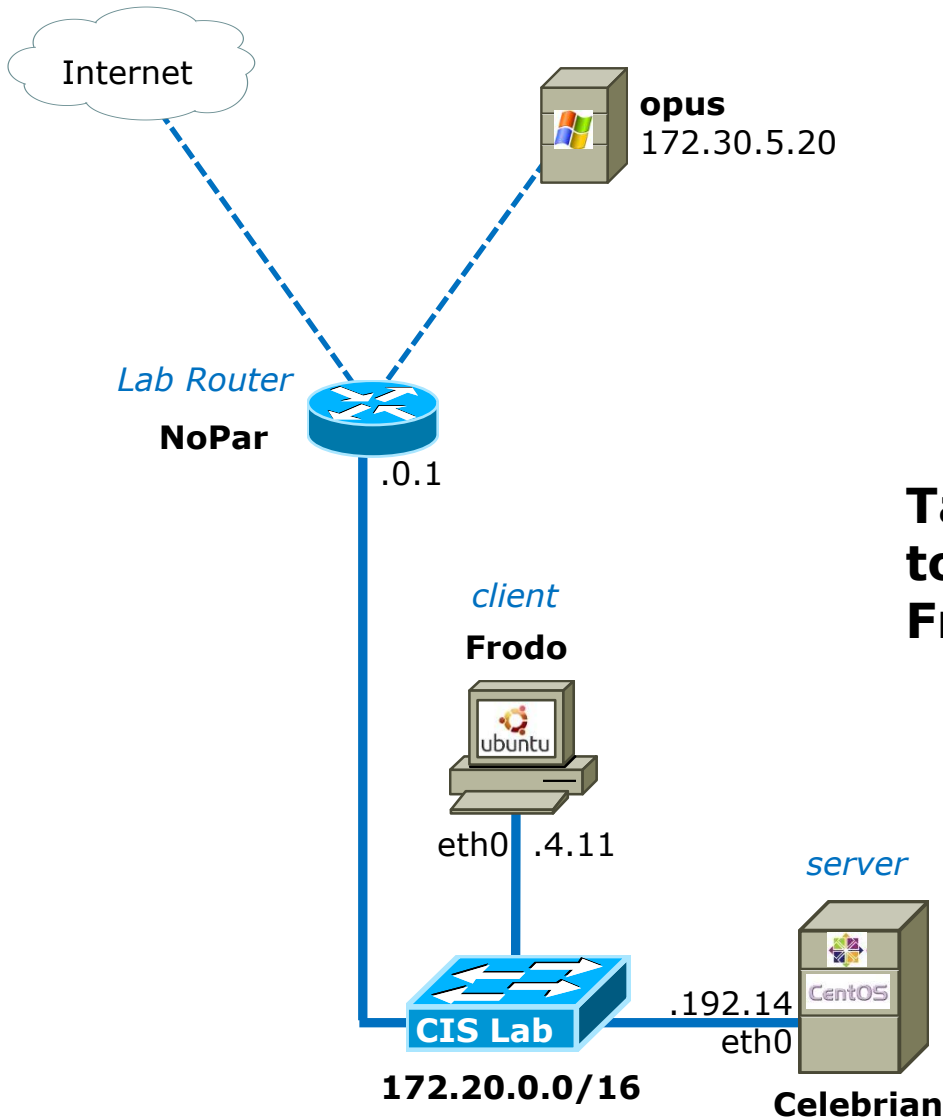
```
[root@p03-celebrian ~]# hostname p03-celebrian.rivendell  
[root@p03-celebrian ~]# hostname  
p03-celebrian.rivendell
```

Note: Configuring the hostname this way is temporary. It will last until the system is rebooted or the network service is restarted.

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.
- **Filezilla** can copy files using SFTP which in turns uses SSH.



Opus is our CIS student server. Anything sent to `oslab.cabrillo.edu` will actually go to NoPar which forwards port 2200 traffic to Opus.

Celebrian and *Frodo* in Pod 3 have joined the CIS Lab network and shown in the diagram.

Task: Use SSH from home to connect to Opus, then Frodo, and then Celebrian


```

root@p03-frodo:~# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:50:56:b7:e0:d9
          inet addr:172.20.4.11  Bcast:172.20.255.255  Mask:255.255.0.0
          inet6 addr: fe80::250:56ff:feb7:e0d9/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:5685 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2308 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3422543 (3.4 MB)  TX bytes:265871 (265.8 KB)

root@p03-frodo:~# _

```

Frodo: 172.20.4.11

In VLab, confirm your IP addresses for Frodo and Celebrian

```

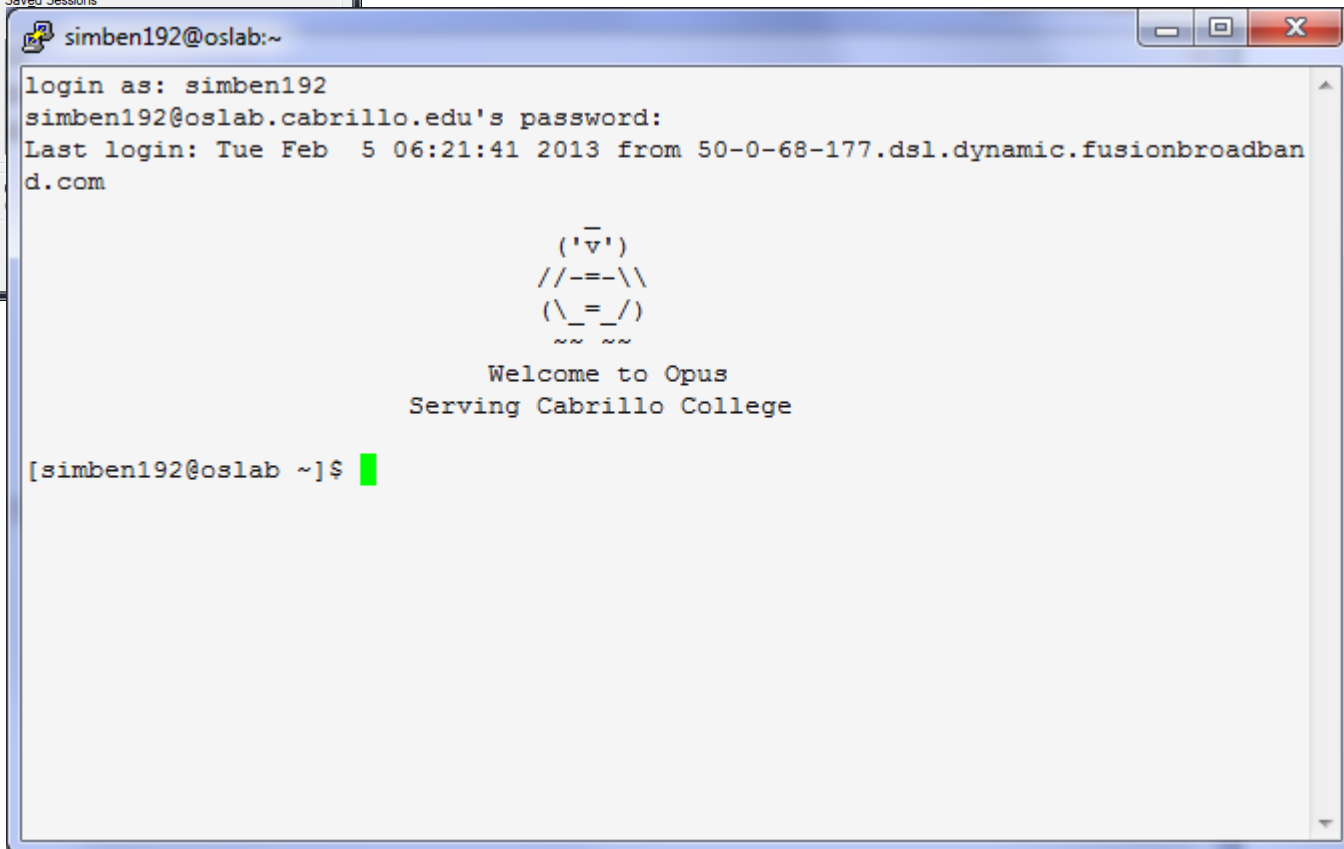
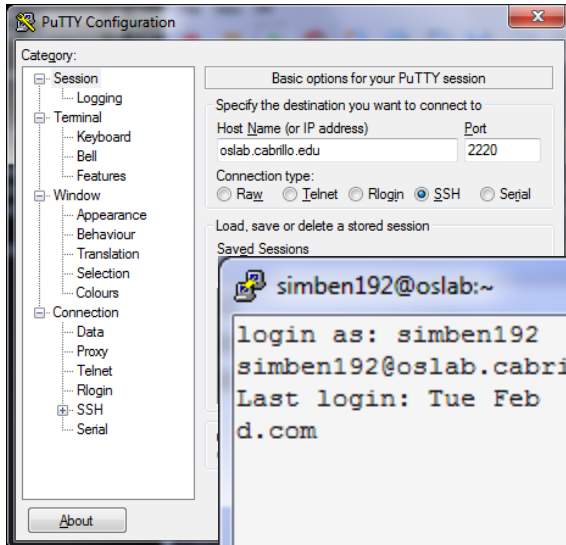
[root@p03-celebrian ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:50:56:B7:F1:9B
          inet addr:172.20.192.14  Bcast:172.20.255.255  Mask:255.255.0.0
          inet6 addr: fe80::250:56ff:feb7:f19b/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2924 errors:0 dropped:0 overruns:0 frame:0
          TX packets:142 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:258195 (252.1 KiB)  TX bytes:12630 (12.3 KiB)

[root@p03-celebrian ~]# _

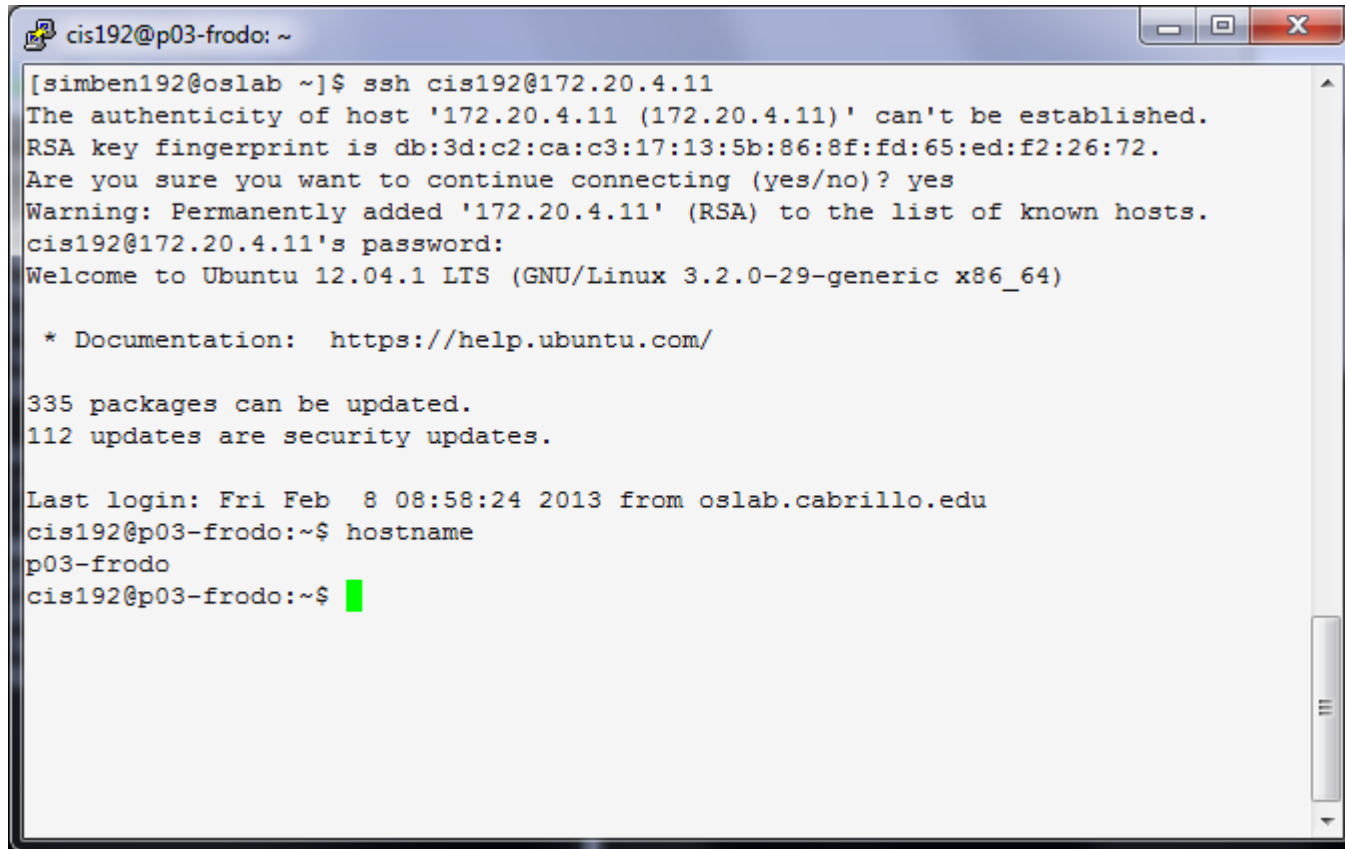
```

Celebrian: 172.20.192.14

First log into Opus



From Opus, connect to Frodo



```
cis192@p03-frodo: ~  
[simben192@oslab ~]$ ssh cis192@172.20.4.11  
The authenticity of host '172.20.4.11 (172.20.4.11)' can't be established.  
RSA key fingerprint is db:3d:c2:ca:c3:17:13:5b:86:8f:fd:65:ed:f2:26:72.  
Are you sure you want to continue connecting (yes/no)? yes  
Warning: Permanently added '172.20.4.11' (RSA) to the list of known hosts.  
cis192@172.20.4.11's password:  
Welcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-29-generic x86_64)  
  
* Documentation:  https://help.ubuntu.com/  
  
335 packages can be updated.  
112 updates are security updates.  
  
Last login: Fri Feb  8 08:58:24 2013 from oslab.cabrillo.edu  
cis192@p03-frodo:~$ hostname  
p03-frodo  
cis192@p03-frodo:~$ █
```

From Frodo, connect to Celebrian

```

cis192@p03-celebrian:~
cis192@p03-frodo:~$ ssh cis192@172.20.192.14
The authenticity of host '172.20.192.14 (172.20.192.14)' can't be established.
RSA key fingerprint is 81:46:a3:17:7a:4b:91:c9:24:96:f3:ac:05:5a:c4:29.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '172.20.192.14' (RSA) to the list of known hosts.
cis192@172.20.192.14's password:
Last login: Thu Feb  7 07:00:00 2013 from 172.30.5.20
[cis192@p03-celebrian ~]$ hostname
p03-celebrian.rivendell
[cis192@p03-celebrian ~]$ █
  
```

*To leave, successively use the **exit** command to back out of each system you connected via SSH into.*

Putty

```

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/CentO
lang en_US.UTF-8
keyboard us
network --device eth0 --bootproto dhcp --
rootpw --iscrypted $1$oePUsywv$AqPrr7o4nH
firewall --enabled --port=22:tcp --port=2
authconfig --useshadow --enablemd5
selinux --enforcing
timezone --utc America/Los_Angeles
bootloader --location=mbr --driveorder=sd
# The following is the partition informat
# Note that any partitions you deleted ar
# here so unless you clear all partitions
# not guaranteed to work
#clearpart --all --initlabel --drives=sda
#part /boot --fstype ext3 --size=100 --on
#part pv.2 --size=0 --grow --ondisk=sda
#volgroup VolGroup00 --pesize=32768 pv.2
#logvol swap --fstype swap --name=LogVol0
--maxsize=768
#logvol / --fstype ext3 --name=LogVol100
--maxsize=768

%packages
@core
[root@seedling76 ~]#
    
```

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

Notepad

```

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 $1$oePUsywv$AqPrr7o4nHsq.eCY4Tjsj1
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 that any partitions you deleted are not expressed
# here so unless you clear all partitions first, this is
# not guaranteed to work
#clearpart --all --initlabel --drives=sda
#part /boot --fstype ext3 --size=100 --ondisk=sda
#part pv.2 --size=0 --grow --ondisk=sda
#volgroup VolGroup00 --pesize=32768 pv.2
#logvol swap --fstype swap --name=LogVol01 --vgname=VolGroup00 --size=384 --grow --maxsize=768
#logvol / --fstype ext3 --name=LogVol100 --vgname=VolGroup00 --size=1024 --grow

%packages
@core
[root@seedling76 ~]#
    
```

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



Ping testing and troubleshooting



New commands for your toolbox

`ping xxx.xxx.xxx.xxx` *Ping an IPv4 address*
`ping hostname` *Ping a hostname (requires DNS server)*
`ping -c2 -I eth0 hostname` *Ping a hostname, only 2 times, via eth0*

Without the -c option pings go on forever. Use Ctrl-C to kill them.

The ping command can be used to check network connectivity. When troubleshooting, ping errors are very helpful in isolating problems.

Reach another host on the same segment?

Ping the lab router

```
[root@p03-celebrian ~]# ping 172.20.0.1
PING 172.20.0.1 (172.20.0.1) 56(84) bytes of data.
64 bytes from 172.20.0.1: icmp_seq=1 ttl=255 time=0.469 ms
64 bytes from 172.20.0.1: icmp_seq=2 ttl=255 time=0.467 ms
64 bytes from 172.20.0.1: icmp_seq=3 ttl=255 time=0.446 ms
^C
--- 172.20.0.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2528ms
rtt min/avg/max/mdev = 0.446/0.460/0.469/0.026 ms
[root@p03-celebrian ~]# _
```



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

Reach another host on the same segment?

Ping the lab router

ping 172.20.0.1

```
[root@p03-celebrian ~]# ping 172.20.0.1  
connect: Network is unreachable  
[root@p03-celebrian ~]# _
```



The "Network is unreachable" error means there is no route available to reach the device.

In this case the eth0 interface was not configured with an IP address.

Reach another host on the same segment?

Ping another VM

ping 172.20.4.14

```
[root@p03-celebrian ~]# ping 172.20.4.11
PING 172.20.4.11 (172.20.4.11) 56(84) bytes of data.
64 bytes from 172.20.4.11: icmp_seq=1 ttl=64 time=1.90 ms
64 bytes from 172.20.4.11: icmp_seq=2 ttl=64 time=0.292 ms
64 bytes from 172.20.4.11: icmp_seq=3 ttl=64 time=0.326 ms
^C
--- 172.20.4.11 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2372ms
rtt min/avg/max/mdev = 0.292/0.839/1.901/0.751 ms
[root@p03-celebrian ~]#
```



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

Reach another host on the same segment?

Ping another VM

ping 172.20.4.14

```
[root@p03-celebrian ~]# ping 172.20.4.11
PING 172.20.4.11 (172.20.4.11) 56(84) bytes of data.
From 172.20.4.14 icmp_seq=10 Destination Host Unreachable
From 172.20.4.14 icmp_seq=11 Destination Host Unreachable
From 172.20.4.14 icmp_seq=12 Destination Host Unreachable
^C
--- 172.20.4.11 ping statistics ---
15 packets transmitted, 0 received, +3 errors, 100% packet loss, time 14231ms
pipe 3
[root@p03-celebrian ~]# _
```



The "Destination Host Unreachable" error means you can reach the destination network but the host is down or offline.

In this case the destination VM lost network connectivity when its IP address was manually released.

Reach a host on another network?

Ping the CIS department DNS server

ping 172.30.5.8

```
[root@p03-celebrian ~]# ping 172.30.5.8
PING 172.30.5.8 (172.30.5.8) 56(84) bytes of data.
64 bytes from 172.30.5.8: icmp_seq=1 ttl=127 time=0.663 ms
64 bytes from 172.30.5.8: icmp_seq=2 ttl=127 time=0.633 ms
64 bytes from 172.30.5.8: icmp_seq=3 ttl=127 time=0.641 ms
^C
--- 172.30.5.8 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2513ms
rtt min/avg/max/mdev = 0.633/0.645/0.663/0.031 ms
[root@p03-celebrian ~]# _
```



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

Reach a host on another network?

Ping the CIS department DNS server

ping 172.30.5.8

```
[root@p03-celebrian ~]# ping 172.30.5.8  
connect: Network is unreachable  
[root@p03-celebrian ~]# _
```



The "Network is unreachable" error means there is no route available to reach the device. In this case the default gateway was not set.

Reach a host on the Internet?

Ping Google

ping google.com

```
[root@p03-celebrian ~]# ping google.com
PING google.com (74.125.224.137) 56(84) bytes of data:
64 bytes from nuq04s09-in-f9.1e100.net (74.125.224.137): icmp_seq=1 ttl=55 time=
6.25 ms
64 bytes from nuq04s09-in-f9.1e100.net (74.125.224.137): icmp_seq=2 ttl=55 time=
5.95 ms
64 bytes from nuq04s09-in-f9.1e100.net (74.125.224.137): icmp_seq=3 ttl=55 time=
5.90 ms
64 bytes from nuq04s09-in-f9.1e100.net (74.125.224.137): icmp_seq=4 ttl=55 time=
5.88 ms
^C
--- google.com ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3118ms
rtt min/avg/max/mdev = 5.889/5.998/6.254/0.176 ms
[root@p03-celebrian ~]# _
```



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

Reach a host on the Internet?

Ping Google

ping google.com

```
[root@p03-celebrian ~]# ping google.com  
ping: unknown host google.com  
[root@p03-celebrian ~]# _
```



The "unknown host" error message means the hostname was not resolvable to an IP address. It could be a mis-typed hostname or a name server could not be reached.

In this case the DNS name server were not configured in /etc/resolv.conf

Ping Output

TTL (Time To Live)

```
cis192@p03-frodo:~$ ping -c3 opus
PING opus.cislab.net (172.30.5.20) 56(84) bytes of data.
64 bytes from opus.cislab.net (172.30.5.20): icmp_req=1 ttl=63 time=0.489 ms
64 bytes from oslab.cabrillo.edu (172.30.5.20): icmp_req=2 ttl=63 time=0.652 ms
64 bytes from opus.cislab.net (172.30.5.20): icmp_req=3 ttl=63 time=0.640 ms

--- opus.cislab.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 0.489/0.593/0.652/0.079 ms
cis192@p03-frodo:~$
```

- TTL = Time to Live
- The initial TTL on the ping reply is set by the host being pinged
- Different OS's have different initial default TTLs
 - UNIX/Linux is usually 64
 - Windows is usually 128
 - Cisco is usually 255
- The TTL is decremented each time the IP packet goes through a router

Viewing the TTL gives clues to the OS being pinged and how far away it is (in router hops)

RTT (Round Trip Time)

```
cis192@p03-frodo:~$ ping -c3 cisvdc
PING cisvdc.cislab.net (172.30.5.8) 56(84) bytes of data.
64 bytes from cisvdc.cislab.net (172.30.5.8): icmp_req=1 ttl=127 time=0.537 ms
64 bytes from cisvdc.cislab.net (172.30.5.8): icmp_req=2 ttl=127 time=0.642 ms
64 bytes from cisvdc.cislab.net (172.30.5.8): icmp_req=3 ttl=127 time=0.675 ms

--- cisvdc.cislab.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 0.537/0.618/0.675/0.058 ms
cis192@p03-frodo:~$
```

- RTT = Round Trip Time
- Measured in milliseconds

*Long RTTs can
indicate slow links
and network
congestion*

Packet Loss

```
cis192@p03-frodo:~$ ping -c3 cisvdc
PING cisvdc.cislab.net (172.30.5.8) 56(84) bytes of data.
64 bytes from cisvdc.cislab.net (172.30.5.8): icmp_req=1 ttl=127 time=0.537 ms
64 bytes from cisvdc.cislab.net (172.30.5.8): icmp_req=2 ttl=127 time=0.642 ms
64 bytes from cisvdc.cislab.net (172.30.5.8): icmp_req=3 ttl=127 time=0.675 ms

--- cisvdc.cislab.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 0.537/0.618/0.675/0.058 ms
cis192@p03-frodo:~$
```

- Packet loss is the percentage of ping requests with no ping replies
- 100% packet loss indicates zero connectivity to target host
- Partial packet loss can indicate routing problems, duplicate IPs and other issues.

Command Line Sniffing



New commands for your toolbox

`tcpdump` *Display traffic*
`tcpdump -i eth0` *Display traffic on a specific interface*
`tcpdump -i eth0 -c 10 -n` *Display 10 packets then stop, no DNS lookups*

`tcpdump -n arp or ip and not port 22`
No DNS lookups, show only arp and IP packets and filter out ssh (port 22)

tcpdump is the command-line equivalent of Wireshark and quite useful for troubleshooting.

Celebrian pinging Frodo

```
[root@p03-celebrian ~]# ping 172.20.4.11 -c2
PING 172.20.4.11 (172.20.4.11) 56(84) bytes of data.
64 bytes from 172.20.4.11: icmp_seq=1 ttl=64 time=1.65 ms
64 bytes from 172.20.4.11: icmp_seq=2 ttl=64 time=0.423 ms

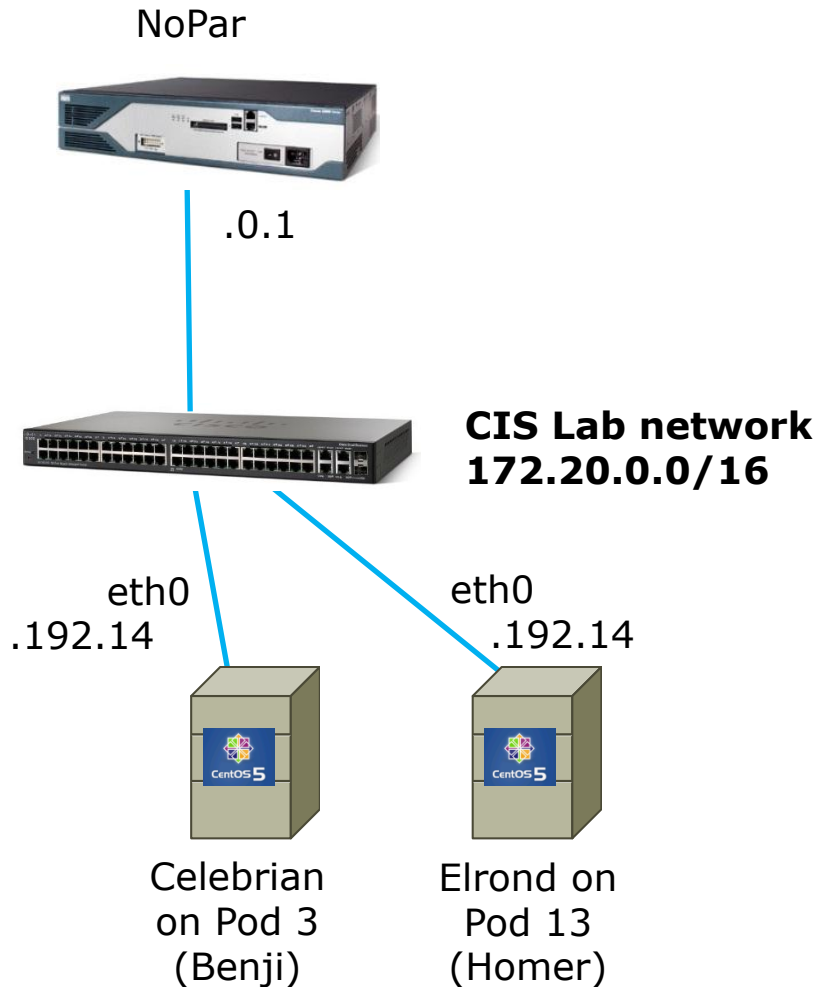
--- 172.20.4.11 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1002ms
rtt min/avg/max/mdev = 0.423/1.040/1.657/0.617 ms
[root@p03-celebrian ~]# _
```

Frodo getting pinged by Celebrian

```
root@p03-frodo:~# tcpdump -n arp or icmp
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth0, link-type EN10MB (Ethernet), capture size 65535 bytes
20:05:05.310931 ARP, Request who-has 172.20.4.11 tell 172.20.4.14, length 46
20:05:05.310950 ARP, Reply 172.20.4.11 is-at 00:50:56:b7:e0:d9, length 28
20:05:05.311153 IP 172.20.4.14 > 172.20.4.11: ICMP echo request, id 11528, seq 1, length 64
20:05:05.311171 IP 172.20.4.11 > 172.20.4.14: ICMP echo reply, id 11528, seq 1, length 64
20:05:06.311941 IP 172.20.4.14 > 172.20.4.11: ICMP echo request, id 11528, seq 2, length 64
20:05:06.311967 IP 172.20.4.11 > 172.20.4.14: ICMP echo reply, id 11528, seq 2, length 64
20:05:10.318498 ARP, Request who-has 172.20.4.14 tell 172.20.4.11, length 28
20:05:10.318828 ARP, Reply 172.20.4.14 is-at 00:50:56:b7:f1:9b, length 46
^C
8 packets captured
8 packets received by filter
0 packets dropped by kernel
root@p03-frodo:~# _
```

Dup IPs

Duplicate IP addresses = TROUBLE !!



Benji configures his Celebrian eth0 interface with an IP of 172.20.192.14.

Homer configures his Elrond eth0 interface with an IP address of 172.20.192.14.

What will happen when Benji and Homer both ping the NoPar router?

Duplicate IP addresses = TROUBLE !!

Celebrian

```
64 bytes from 172.20.0.1: icmp_seq=50133 ttl=255 time=0.443 ms
64 bytes from 172.20.0.1: icmp_seq=50134 ttl=255 time=0.430 ms
64 bytes from 172.20.0.1: icmp_seq=50135 ttl=255 time=0.434 ms
64 bytes from 172.20.0.1: icmp_seq=50136 ttl=255 time=0.434 ms
64 bytes from 172.20.0.1: icmp_seq=50137 ttl=255 time=0.402 ms
^C
--- 172.20.0.1 ping statistics ---
50137 packets transmitted, 25011 received, 50% packet loss, time 50136895ms
rtt min/avg/max/mdev = 0.327/0.471/67.614/0.883 ms
```

Elrond

```
64 bytes from 172.20.0.1: icmp_seq=50138 ttl=255 time=0.466 ms
64 bytes from 172.20.0.1: icmp_seq=50139 ttl=255 time=0.508 ms
64 bytes from 172.20.0.1: icmp_seq=50140 ttl=255 time=0.469 ms
64 bytes from 172.20.0.1: icmp_seq=50141 ttl=255 time=0.475 ms
64 bytes from 172.20.0.1: icmp_seq=50142 ttl=255 time=0.441 ms
^C
--- 172.20.0.1 ping statistics ---
50185 packets transmitted, 24421 received, 51% packet loss, time 50184883ms
rtt min/avg/max/mdev = 0.353/0.512/60.000/0.862 ms
```

Answer: Both will experience PACKET LOSS !!

Unique IP addresses =



To avoid **TROUBLE**, use the Static IPs link on the website to select IP addresses.

Only use the static IPs assigned to the pod and everyone will be 😊

Rich's Cabrillo College CIS Classes
CIS 192 Calendar

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CIS 192 (Spring 2013) Course Calendar

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(content subject to change)

Lesson	Date	Topics	Chapter	Due
1	2/12	<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 VMwa Networking overview NIC drivers Configure network settir Test network connectio Ping and SSH with IPv6 <p>Materials</p> <ul style="list-style-type: none"> Presentation slides (dow Logins Sheet (download Howto #303: Remote Ad (download) CIS VLab RDP file (downr <p>Assignment</p> <ul style="list-style-type: none"> Student survey (downlo Lab 1 (Linux VMs) <p>CCC Confer</p> <ul style="list-style-type: none"> Enter virtual classroom Class archives 		

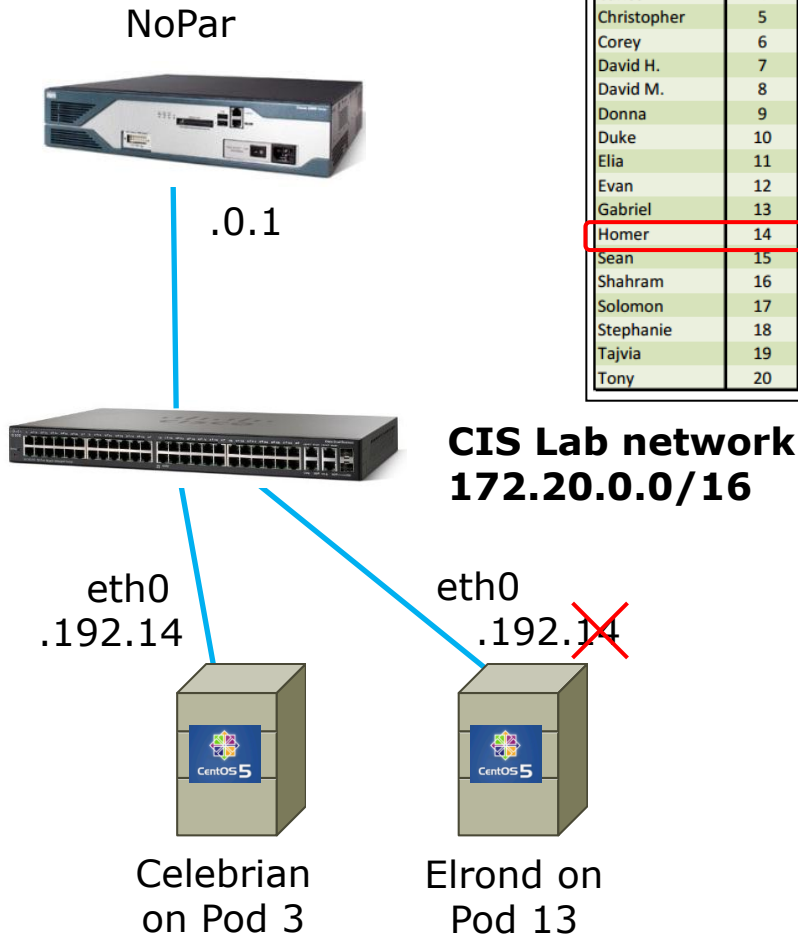
[VLab RDP file](#)

[CIS 90 VLab VM Assignments](#)

[CIS 192 VLab Pod Assignments](#)

[RIP Dennis Ritchie](#)

CIS 192 VLab Assignments						
Student	Pod	CIS Lab Network 172.20.0.0/16		Virtual Switches		
		Start	End	Shire	Rivendell	Mordor
Ahmed	1	172.20.192.7	172.20.192.13	Shire-01	Rivendell-01	Mordor-01
Benji	2	172.20.192.14	172.20.192.20	Shire-02	Rivendell-02	Mordor-02
Bryan	3	172.20.192.21	172.20.192.27	Shire-03	Rivendell-03	Mordor-03
Carlos	4	172.20.192.28	172.20.192.34	Shire-04	Rivendell-04	Mordor-04
Christopher	5	172.20.192.35	172.20.192.41	Shire-05	Rivendell-05	Mordor-05
Corey	6	172.20.192.42	172.20.192.48	Shire-06	Rivendell-06	Mordor-06
David H.	7	172.20.192.49	172.20.192.55	Shire-07	Rivendell-07	Mordor-07
David M.	8	172.20.192.56	172.20.192.62	Shire-08	Rivendell-08	Mordor-08
Donna	9	172.20.192.63	172.20.192.69	Shire-09	Rivendell-09	Mordor-09
Duke	10	172.20.192.70	172.20.192.76	Shire-10	Rivendell-10	Mordor-10
Elia	11	172.20.192.77	172.20.192.83	Shire-11	Rivendell-11	Mordor-11
Evan	12	172.20.192.84	172.20.192.90	Shire-12	Rivendell-12	Mordor-12
Gabriel	13	172.20.192.91	172.20.192.97	Shire-13	Rivendell-13	Mordor-13
Homer	14	172.20.192.98	172.20.192.104	Shire-14	Rivendell-14	Mordor-14
Sean	15	172.20.192.105	172.20.192.111	Shire-15	Rivendell-15	Mordor-15
Shahram	16	172.20.192.112	172.20.192.118	Shire-16	Rivendell-16	Mordor-16
Solomon	17	172.20.192.119	172.20.192.125	Shire-17	Rivendell-17	Mordor-17
Stephanie	18	172.20.192.126	172.20.192.132	Shire-18	Rivendell-18	Mordor-18
Tajvia	19	172.20.192.133	172.20.192.139	Shire-19	Rivendell-19	Mordor-19
Tony	20	172.20.192.140	172.20.192.146	Shire-20	Rivendell-20	Mordor-20



CIS 192 VLab Assignments						
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Carlos	4	172.20.192.28	172.20.192.34	Shire-04	Rivendell-04	Mordor-04
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Elia	11	172.20.192.77	172.20.192.83	Shire-11	Rivendell-11	Mordor-11
Evan	12	172.20.192.84	172.20.192.90	Shire-12	Rivendell-12	Mordor-12
Gabriel	13	172.20.192.91	172.20.192.97	Shire-13	Rivendell-13	Mordor-13
Homer	14	172.20.192.98	172.20.192.104	Shire-14	Rivendell-14	Mordor-14
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Shahram	16	172.20.192.112	172.20.192.118	Shire-16	Rivendell-16	Mordor-16
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Tajvia	19	172.20.192.133	172.20.192.139	Shire-19	Rivendell-19	Mordor-19
Tony	20	172.20.192.140	172.20.192.146	Shire-20	Rivendell-20	Mordor-20

Homer should have consulted the table and used one of the IP addresses assigned to him:

- 172.20.192.91
- 172.20.192.92
- 172.20.192.93
- 172.20.192.94
- 172.20.192.95
- 172.20.192.96
- 172.20.192.97

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
- 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**



New commands for your toolbox

```
ping6 -I eth0 ff02::1           IPv6 broadcast ping (via eth0)  
ping6 -I eth0 2001:470:1f04:9b3::2 Ping an IPv6 address (via eth0)  
  
ping6 ipv6.google.com          Ping an IPv6 hostname  
ping6 -c2 ipv6.google.com      Ping an IPv6 hostname, only 2 times
```

Without the -c option pings go on forever. Use Ctrl-C to kill them.

IPv6 Broadcast Ping

```

root@p03-frodo:~# ping6 -I eth0 ff02::1 -c2
PING ff02::1(ff02::1) from fe80::250:56ff:feb7:e0d9 eth0: 56 data bytes
64 bytes from fe80::250:56ff:feb7:e0d9: icmp_seq=1 ttl=64 time=0.043 ms
64 bytes from fe80::250:56ff:febd:227: icmp_seq=1 ttl=64 time=1.17 ms (DUP!)
64 bytes from fe80::250:56ff:febd:537e: icmp_seq=1 ttl=64 time=1.19 ms (DUP!)
64 bytes from fe80::250:56ff:febd:c4bb: icmp_seq=1 ttl=64 time=1.19 ms (DUP!)
64 bytes from fe80::250:56ff:febd:bd91: icmp_seq=1 ttl=64 time=1.20 ms (DUP!)
64 bytes from fe80::20c:29ff:fec5:b627: icmp_seq=1 ttl=64 time=1.20 ms (DUP!)
64 bytes from fe80::250:56ff:febd:cb20: icmp_seq=1 ttl=64 time=1.23 ms (DUP!)
64 bytes from fe80::250:56ff:febd:81fe: icmp_seq=1 ttl=64 time=1.28 ms (DUP!)
64 bytes from fe80::250:56ff:febd:2789: icmp_seq=1 ttl=64 time=1.29 ms (DUP!)
64 bytes from fe80::250:56ff:febd:994e: icmp_seq=1 ttl=64 time=1.33 ms (DUP!)
64 bytes from fe80::250:56ff:febd:6931: icmp_seq=1 ttl=64 time=1.44 ms (DUP!)
< snipped >
64 bytes from fe80::250:56ff:febd:fcab: icmp_seq=1 ttl=64 time=6.53 ms (DUP!)
64 bytes from fe80::250:56ff:febd:d21a: icmp_seq=1 ttl=64 time=6.54 ms (DUP!)
64 bytes from fe80::250:56ff:febd:cf44: icmp_seq=1 ttl=64 time=6.85 ms (DUP!)
64 bytes from fe80::250:56ff:febd:f61e: icmp_seq=1 ttl=64 time=6.95 ms (DUP!)
64 bytes from fe80::250:56ff:feb7:e0d9: icmp_seq=2 ttl=64 time=0.054 ms

--- ff02::1 ping statistics ---
2 packets transmitted, 2 received, +49 duplicates, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 0.043/3.255/6.959/1.905 ms
root@p03-frodo:~#

```

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

Elrond



eth0

```
[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



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

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.



TBA

Assignment

In addition to the lecture portion of this course you are expected to spend on average four hours and five minutes in the CIS VLab (Virtual Lab) each week practicing what you learned in the lecture.

How to use the Calendar web page to get your work in on time

Lesson	Date	Topics	Chapter	Due
1	2/12	<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) Logins Sheet (download) Howto #303: Remote Access to the CIS VLab (download) CIS VLab RDP file (download) <p>Assignment</p> <ul style="list-style-type: none"> Student survey (download) Lab 1 (Linux VMs) <p>CCC Confer</p> <ul style="list-style-type: none"> Enter virtual classroom Class archives 	1.4, 4.3, 12.7, 13.7, 14.1-14.3, 14.10-14.11, 16, 21.2	
2	2/19	<p>Quiz 1</p> <p>RP and Perm Red</p> <ul style="list-style-type: none"> 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 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) 	14, 21.4, 21.5, 21.7	<p>Student survey</p> <p>Lab 1</p>

The assignment

The date

What is due on that date

Introduction to UNIX/Linux (CIS 90)
Student Survey

Student Information

- Preferred first name: _____ Last name: _____
- Date: _____ Email address: _____
- Web site, if any: _____
- Grading choice: pass/no-pass grade (choose one, you may change your mind later)

Computer Background

- Previous computer classes or training taken: _____
- Work or other experience using computers: _____

Home equipment

- Do you have a computer with at least 2 GB of RAM? yes no
- Operating system? Windows Mac Linux
- Internet connection? none dial-up dial/cable

Course Objectives

- What are you hoping to learn in this class? _____
- Other comments or special learning needs? _____

(Please save & email completed survey to r192ab@cabrillo.edu)

Cabrillo College

CIS 192 Linux Lab Exercise
Lab 1: Using the CIS 192 Lab Resources
Spring 2013

Lab 1: Using the CIS 192 Lab Resources
The purpose of this lab is to become familiar with the CIS Lab resources and to start practicing some old and new Linux commands.

Resources

- The Opus server
- CIS VLab (Virtual Lab) VMs
- The CIS Student Help Forum

Opus Server
The Opus server is available to students via an SSH connection. Opus is used as a repository for common files and submitting lab assignments.

The VMs in the CIS VLab (Virtual Lab)
We will be using a number of different Virtual Machines (VMs) in VLab for this course.

VMs	CentOS	SUbuntu	Windows
	Arwen	Freddy	William
	Kathleen	Sauron	
	Erend	Legolas	

These VMs can be accessed remotely from on or off campus.

CIS Student Forum
A private forum, at <http://forum.cabrillo.edu/forum/>, has been set up for use by CIS students and instructors to collaborate, share information and help each other.

Procedure
For this lab you are going to record information in a text file named lab02 in your home directory on Opus. To start, make a copy of the lab02 file in /home/cis20/Opus. When finished submit your work by copying your lab02 file into the instructor's ramin directory.

Every student is assigned their own pod of VMs, static IP addresses (for the CIS Lab network) and virtual networks.

The student survey and Lab 1 are due by 11:59PM (Opus time) on 2/19

How to submit your work for grading

- For each lab you will create a text file on Opus that gets submitted for grading.
- See the specific submittal instructions at the end of each lab.
- It's a good idea to verify your copy worked!
- Labs must get turned in by 11:59PM (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. It's better to make a partial submittal before the deadline for partial credit.

How to submit your work for grading

Examples:

- Submit using **cp** command on Opus:

```
[simben192@opus ~]$ cp lab01 /home/rsimms/turnin/cis192/lab01.$LOGNAME
```

- Check your submittal from Opus:

```
[simben192@opus ~]$ ls /home/rsimms/turnin/cis192  
lab01.simben192
```

Some troubleshooting tips 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 PowerPoint's 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.
- Google problems or unknown error messages you observe.

Static IP addresses are one click away:

Rich's Cabrillo College CIS Classes
CIS 192 Calendar

Home Resources Forums CIS Lab Blackboard

Login
Flashcards
Admin

CIS 90
CIS 192
[Previous Classes](#)

9 days till term starts!

Cabrillo College
Web Advisor
Commands and Files

[VLab RDP file](#)
CIS 90 VLab VM Assignments
CIS 192 VLab Pod Assignments

RIP Dennis Ritchie

CIS 192 (Spring 2013) Course Calendar
[Course Home](#) [Grades](#)
(content subject to change)

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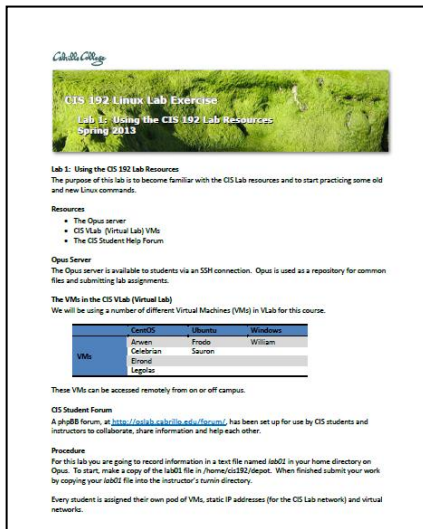
Don't forget!

Don't ruin your day with duplicate IP addresses!

simms-teach.com/docs/cis192/Pod-Assignments-192-sp13.pdf

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Tony	15	172.20.192.105	172.20.192.111	Shire-15	Rivendell-15	Mordor-15

For the shared CIS Lab network always use one of the static IP addresses assigned to your pod!



CIS 192 LINUX Lab Exercise
Lab 1: Using the CIS 192 Lab Resources
Spring 2013

Lab 1: Using the CIS 192 Lab Resources
The purpose of this lab is to become familiar with the CIS Lab resources and to start practicing some old and new Linux commands.

Resources

- The Opus server
- CIS VLab (Virtual Lab) VMs
- The CIS Student Help Forum

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The VMs in the CIS VLab (Virtual Lab)
We will be using a number of different Virtual Machines (VMs) in VLab for this course.

	CentOS	Ubuntu	Windows
VMs	Aileen Celebran Eronid Legator	Fredo Saunon	William

These VMs can be accessed remotely from on or off campus.

CIS Student Forum
A public forum, at <http://pub.cabrillo.edu/forum/>, has been set up for use by CIS students and instructors to collaborate, share information and help each other.

Procedure
For this lab you are going to record information in a text file named lab02 in your home directory on Opus. To start, make a copy of the lab02 file in /home/cis192/depot. When finished submit your work by copying your lab02 file into the instructor's home directory.

Every student is assigned their own pool of VMs, static IP addresses (for the CIS Lab network) and virtual networks.

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.
- It's best if you fully understand each step as you do it. Use Google or refer back to lesson slides to understand the commands you are using.
- Use Google when trouble-shooting
- 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 collaborate and share specific tips you learned while doing a lab.
- **Late work is not accepted** so submit what you have for partial credit.



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

Next Class

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

**Lab 1
& Survey**

Quiz questions for next class:

- What command would you use to remove (unload) the e1000 NIC driver?
- What command would you use to add 172.30.4.1 as the default gateway.
- What command would you use to show the MAC address on eth1?



Backup