



Lesson Module Status

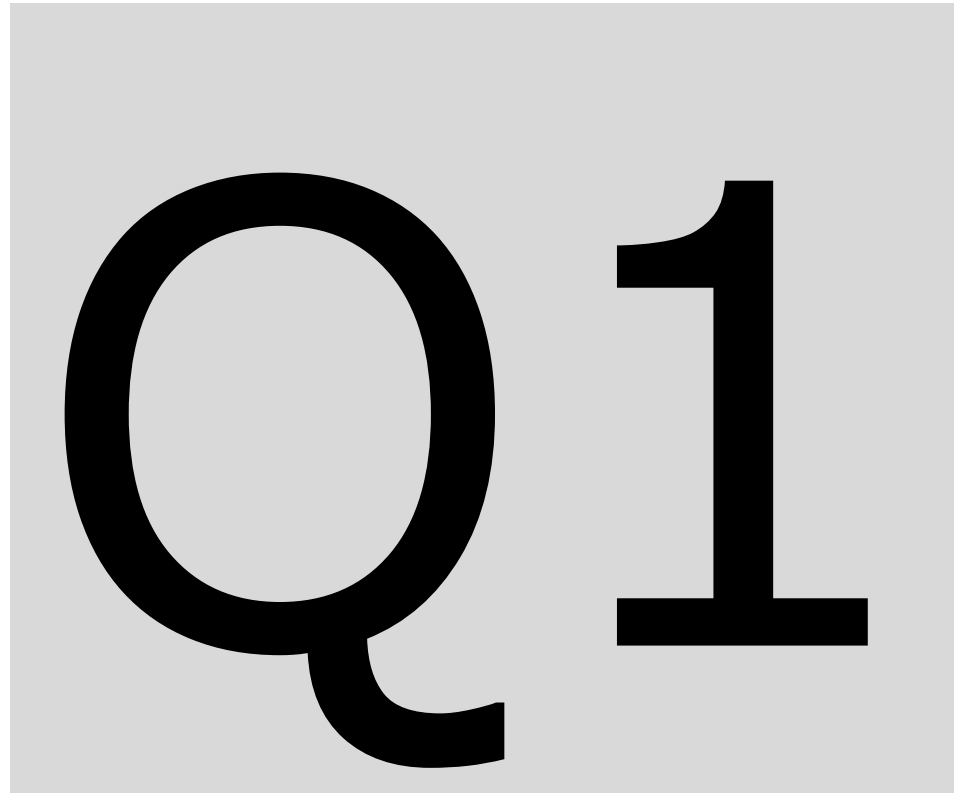
- Slides – draft
- Properties - done
- Flashcards -
- 1st minute quiz – done
- Web Calendar summary – done
- Web book pages – done
- Commands – done
- Howtos – done
- Surveys and PW sheet posted – done

- Lab tested – done
- Depot (Opus) – lab01 template - done
- Youtube Videos uploaded – done

- VM (Classroom PC) – done
- VMs (VLab) - done

- Headset charged –

- VTEA surveys -



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

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 gear
- Virtualization
- VMware 101

- Network Review
- Standards
- NIC inventory
- NIC Drivers
- UNIX/Linux commands

- Joining network (temp)
- Testing
- Dup IPs
- IPv6
- Lab assignment tips

- Q & A



*If you are in the physical classroom,
feel free to power on your station and login as:
user: cis192
password: (on the whiteboard)*

Course history and credits

Jim Griffin



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

Rick Graziani



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



Introductions

Class Activity
Brief (30 seconds) Introductions

Go around the room starting with the instructor

1. Preferred first name?
2. Where have you studied prior to Cabrillo?
3. Where do you work or worked previously?

CIS 192A uses CCC-Confer

- Class meets every Tuesday afternoon:
 - 1:00PM to 5:10PM, Oct 25th to Dec 13th
- Attend in person or online
 - Option 1: Go to room 2501 on the Aptos Campus
 - Option 2: Attend class online
- Final exam on Dec 13rd
 - Room 2501 or arrange with instructor

October 2011							November 2011							December 2011						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
25	26	27	28	29	30	1	30	31	1	2	3	4	5	27	28	29	30	1	2	3
2	3	4	5	6	7	8	6	7	8	9	10	11	12	4	5	6	7	8	9	10
9	10	11	12	13	14	15	13	14	15	16	17	18	19	11	12	13	14	15	16	17
16	17	18	19	20	21	22	20	21	22	23	24	25	26	18	19	20	21	22	23	24
23	24	25	26	27	28	29	27	28	29	30	1	2	3	25	26	27	28	29	30	31
30	31	1	2	3	4	5														



Prerequisite Knowledge

CIS 81

Should have a high level understanding of the following:

IPv4 Addressing

Ethernet

Network stack (OSI layers)

Encapsulation

Subnetting

Utilities:

- Ping
- Wireshark

DNS

DHCP

NAT

Devices

- NICs
- Hubs
- Switches
- Routers

Routing

CIS 90

Should be comfortable with the following:

Navigating file tree

- ls, cd, pwd, find

File management

- cp, mv, rm, mkdir, rmdir

Edit configuration files

- vi

Working in a tty

- more, less, tty

Virtual terminals

- Ctrl-Alt-F1 ...

Getting info

- man, google

Miscellaneous

- ssh/Putty, su, chmod, scp

Command line edits

- up arrow, tab

Showing file contents

- cat, grep, head, tail, file

Redirection

- >, >>, <, |



How this Class Works

Start here: <http://simms-teach.com/>

Rich's Cabrillo College CIS Classes Home Page

Home Resources Forums CIS Lab CTC

Login
Flashcards
Admin

[CIS 192A](#)
[Previous Classes](#)

46 days till CIS 192A starts!

[Cabrillo College](#)
[Web Advisor](#)
[CCC Confer](#)
[Static IPs](#)
[Quick Ref](#)
[Accessing VLab](#)

Rich Simms

Contact

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

Fall 2011 Linux Classes

- Introduction to UNIX/Linux (CIS 90) - [Jim Griffin](#) teaching
- UNIX/Linux System Administration (CIS 191AB) - [Jim Griffin](#) teaching
- UNIX/Linux Network Administration (CIS 192A) - Rich Simms teaching

Metal Sitemap Credits Earth

Class Exercise (class website)

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

First click on
CIS 192A on
left panel to see
syllabus

Rich's Cabrillo College CIS Classes
CIS 192A Home

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CIS 192A Syllabus (Fall 2011) Section 73604
Calendar Grades

UNIX/Linux Network Administration

- Tuesdays - 1:00PM to 5:10PM - 10/25 to 12/13:
 - Room 2501 Aptos Main Campus
 - Online in [CCC Confer Virtual Room](#)
- Open Lab - 4 hours & 5 minutes per week - To Be Arranged (TBA):
 - CIS Lab (Room 1403 in the CTC)
 - CIS VLAB for online distance education students
- Units: 2, prerequisites: CIS 81 and CIS 90, recommended: CIS 191
- Optional Textbook, available at the [Cabrillo College Bookstore](#):
 - [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

Summary (from Cabrillo Schedule of Classes)
Teaches building, monitoring and troubleshooting of a UNIX/Linux network.

Course Description
Students will learn how network infrastructures are implemented on UNIX/Linux Systems. Emphasis is on the TCP/IP suite of protocols, with the course concentrating on the functionality of

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

Class Activity Website navigation



The screenshot shows a website titled "Rich's Cabrillo College CIS Classes Home Page". The page has a navigation menu with links for Home, Resources, Forums, CIS Lab, and CTC. On the left side, there are buttons for Login, Flashcards, and Admin, along with links for CIS 192A, Previous Classes, and a countdown timer for CIS 192A starting in 46 days. Below these are links for Cabrillo College, Web Advisor, CCC Confer, Static IPs, Quick Ref, and Accessing VLab. The main content area features a photo of Rich Simms with four students and a dog, followed by contact information (Email: risimms@cabrillo.edu, Office hours: directory page) and a list of Fall 2011 Linux Classes: Introduction to UNIX/Linux (CIS 90) - Jim Griffin teaching, UNIX/Linux System Administration (CIS 191AB) - Jim Griffin teaching, and UNIX/Linux Network Administration (CIS 192A) - Rich Simms teaching. The footer includes links for Metal, Sitemap, W3C XHTML 1.0, W3C CSS, Credits, and Earth.


<http://simms-teach.com>

Make sure you can:

1. Get to the CIS 192A home page (syllabus)
2. Get to the Calendar page
3. Get to the Grades Page

http://simms-teach.com/cis192Acalendar.php

Attending class online



Rich's Cabrillo College CIS Classes

CIS 192A Calendar

[Home](#) [Resources](#) [Forum](#)

[Login](#)

[Flashcards](#)

[Admin](#)

[CIS 192A](#)

[Previous Classes](#)

46 days till CIS 192A starts!

[Cabrillo College Web Advisor](#)

[CCC Confer](#)

[Static IPs](#)

[Quick Ref](#)

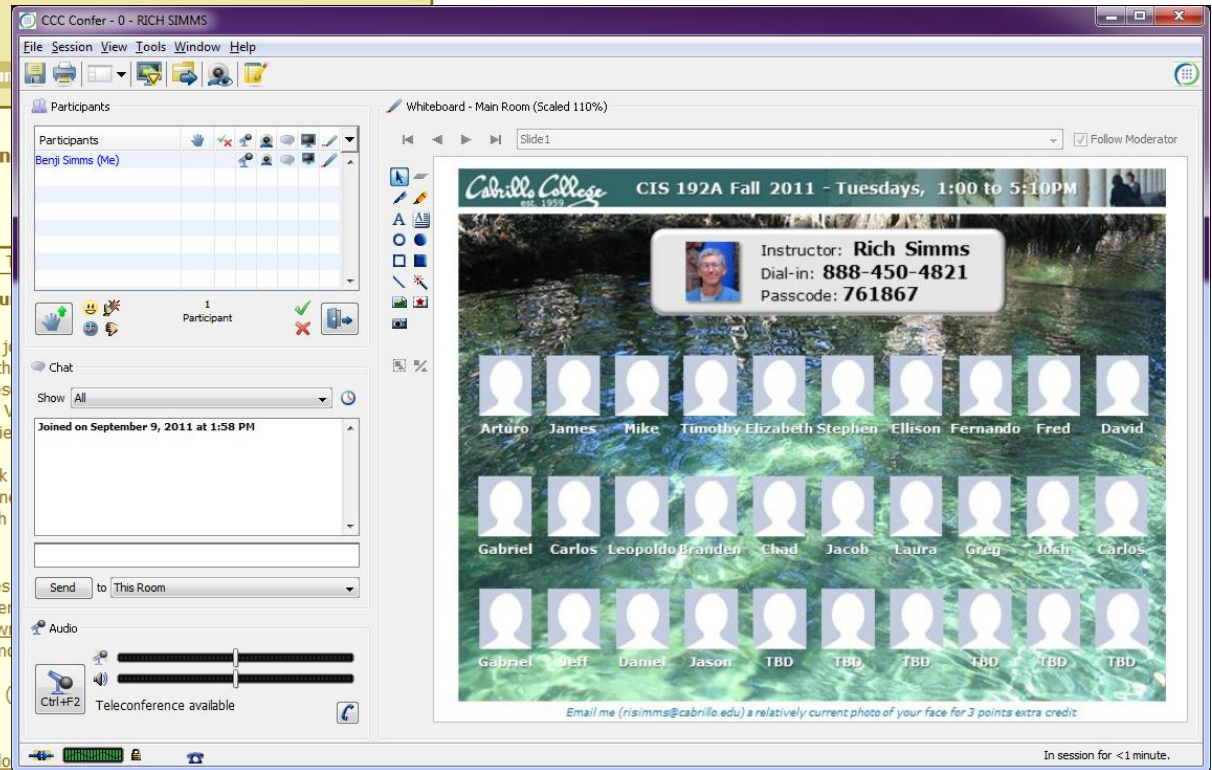
[Accessing VLab](#)

CIS 192A (Fall 2011) Course Calendar

[Course Home](#) [Grades](#)

(content subject to change)

Lesson	Date	Description
1	10/25	<p>Introduction to Course Access</p> <ul style="list-style-type: none"> Linux market and j Understand how th Equipment and res Virtualization and V Networking overvie NIC drivers Configure network Test network conn Ping and SSH with <p>Materials</p> <ul style="list-style-type: none"> Presentation slides Apache web server Logins Sheet (down) Howto #303: Remo (download) CIS VLab RDP file (<p>Assignment</p> <ul style="list-style-type: none"> Student survey (do Lab 1 (Linux VMs) <p>CCC Confer</p> <ul style="list-style-type: none"> Enter virtual classroom Class archives
	10/31	Last day to add CIS 192A
		Quiz 1



The screenshot shows the CCC Confer interface for a session titled "CCC Confer - 0 - RICH SIMMS". The interface includes a menu (File, Session, View, Tools, Window, Help), a Participants list (Benji Simms (Me)), a Chat window (showing "Joined on September 9, 2011 at 1:58 PM"), and an Audio control section. The main area displays a whiteboard with the course title "CIS 192A Fall 2011 - Tuesdays, 1:00 to 5:10PM" and instructor information: "Instructor: Rich Simms, Dial-in: 888-450-4821, Passcode: 761867". Below the whiteboard is a grid of participant avatars, with names like Arturo, James, Mike, Timothy, Elizabeth, Stephen, Ellison, Fernando, Fred, David, Gabriel, Carlos, Leopoldo, Branden, Chad, Jacob, Laura, Greg, Josh, Carlos, Gabriel, Jeff, Daniel, Jason, TBD, TBD, TBD, TBD, TBD, TBD. A red arrow points from the "Enter virtual classroom" link in the calendar page to the "CCC Confer" section of the interface.

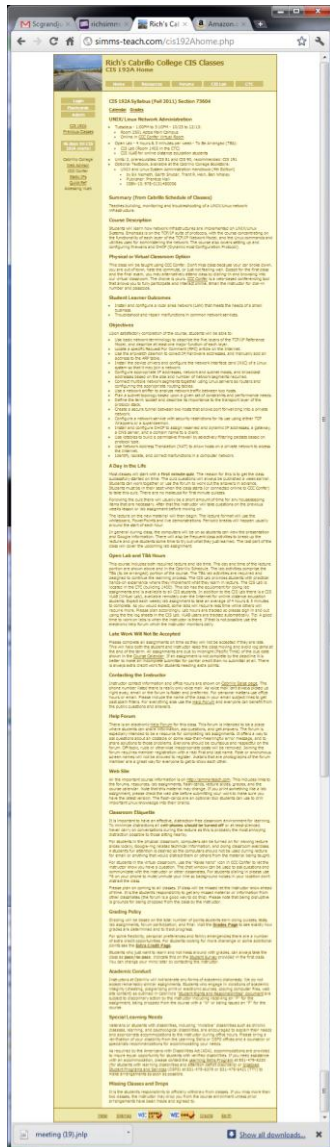
On the Calendar Page, just click on the link labelled "Enter Virtual Classroom" and follow instructions.

Class Activity Enter the Virtual Classroom

- **<http://simms-teach.com>**
- Click **CIS 192A** link on left panel
- Click **Calendar** link in content area
- Click **Enter Virtual Classroom** link in Lesson 1
- Download Java applet, run it and follow instructions
- Listen via your computer's speakers (delayed) and ask questions via chat window
- Or listen via toll-free dial-in number (no lag) and ask questions by speaking. Phone/computer headset with mike makes this an ideal solution for long distance live training.

Course syllabus

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



Weekly Cycle

<http://simms-teach.com>

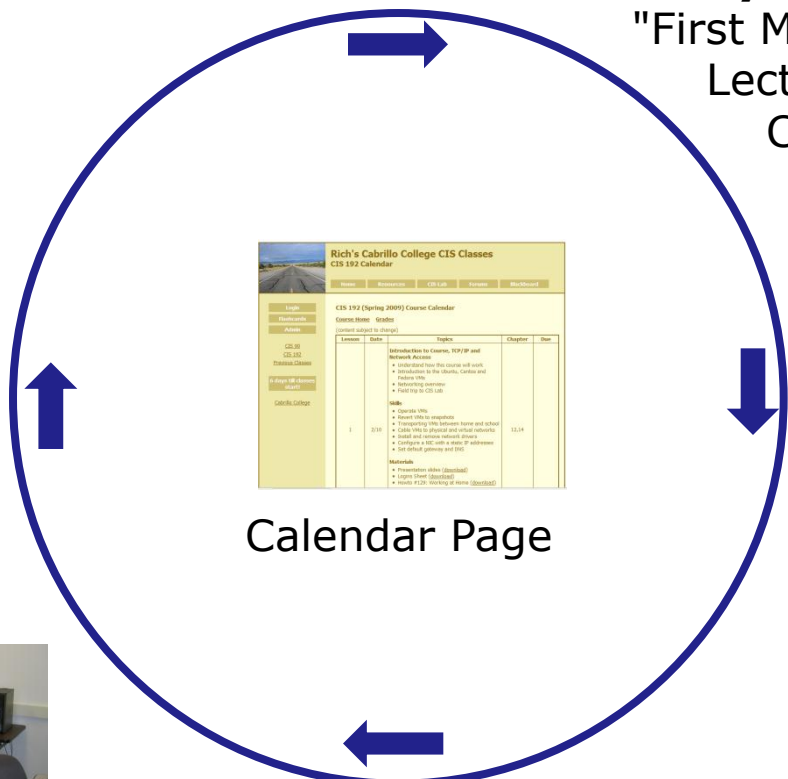
Tuesday

"First Minute" Quiz

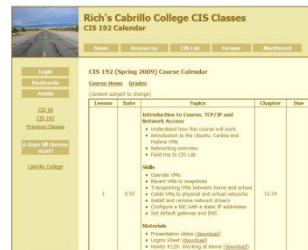
Lecture on new material

Class Activities

Lab assignments due midnight



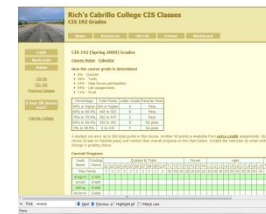
Use Forum to ask and answer questions



Calendar Page



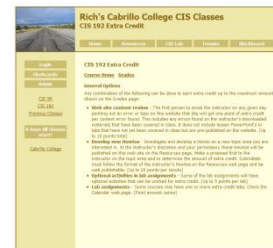
Wednesday
is grading day



Grades Page



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



Extra Credit Page

Course outline and syllabus

Two important course policies to remember

In order to start classes on time, stay on the tight schedule, keep my own sanity, and to avoid log jams at the end of the term:

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

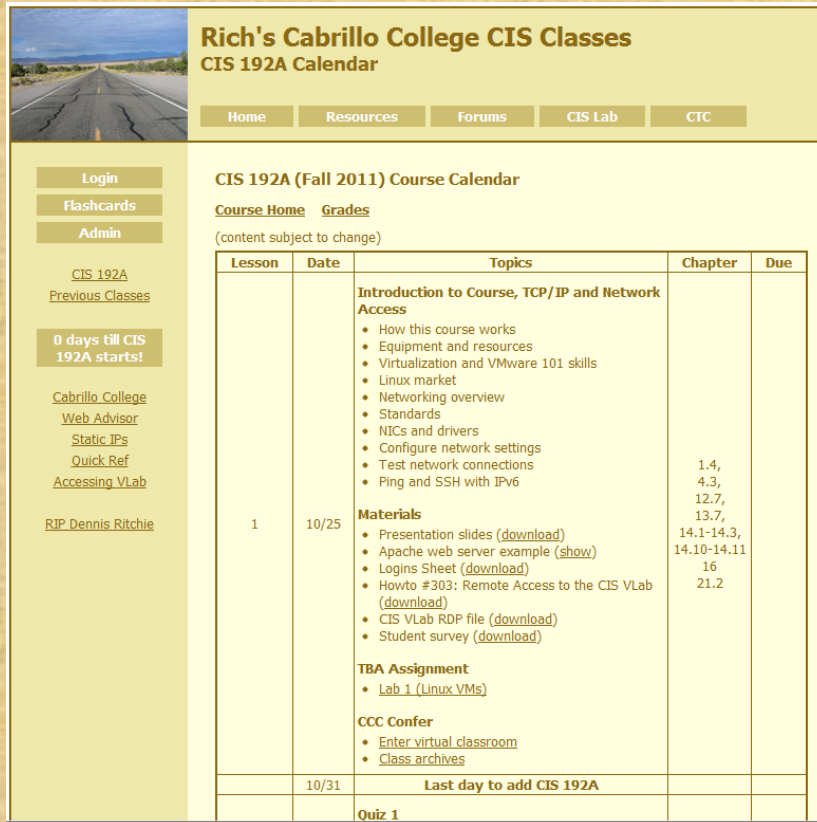
If you have not completed a lab assignment, **please turn in what you have done for partial credit**

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

Course Calendar

Lesson # and Date	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		References to material in the textbook
Lesson slides and additional materials			<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		TBA Lab assignment
First minute quiz		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 th 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) 	12	Student survey Lab 1	What is due by midnight on that date

Class Activity Website Calendar page



Rich's Cabrillo College CIS Classes
CIS 192A Calendar

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0 days till CIS 192A starts!

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[Accessing VLab](#)

RIP Dennis Ritchie

CIS 192A (Fall 2011) Course Calendar
[Course Home](#) [Grades](#)
 (content subject to change)

Lesson	Date	Topics	Chapter	Due
1	10/25	Introduction to Course, TCP/IP and Network Access <ul style="list-style-type: none"> How this course works Equipment and resources Virtualization and VMware 101 skills Linux market Networking overview Standards NICs and drivers Configure network settings Test network connections Ping and SSH with IPv6 Materials <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) TBA Assignment <ul style="list-style-type: none"> Lab 1 (Linux VMs) CCC Confer <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	
	10/31	Last day to add CIS 192A		
		Quiz 1		

<http://simms-teach.com>

Browse to the Calendar page

1. When is the first test?
2. When is the first quiz?
3. When is the last day to add?
4. When is Lab 3 due?
5. When will the firewall lab (Lab 5) be assigned?
6. What time does the final exam start?
7. When are the first five forum posts due?

CIS 192

How grading works

Monitor this page to track your progress in the course.

Rich's Cabrillo College CIS Classes CIS 192A Grades

Home Resources Forums CIS L

Login

Flashcards

Admin

CIS 192A

CIS 192A (Fall 2011) Grades

[Course Home](#) [Calendar](#)

How the course grade is determined

- 5% - Quizzes
- 9% - Tests
- 12% - Help forum participation
- 55% - TBA lab assignments
- 18% - Final

Percentage	Total Points	Letter Grade	Pass/No Pass
90% or higher	293 or higher	A	pass
80% to 89.9%	260 to 292	B	pass
70% to 79.9%	228 to 259	C	pass
60% to 69.9%	195 to 227	D	no pass
0% to 59.9%	0 to 194	F	no pass

For some flexibility, personal preferences or family emergencies there is an additional 60 points available of **extra credit** activities.

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					Forums						TBA Labs						Final	Extra Credit	Total	Grade
		Q1	Q2	Q3	Q4	Q5	T1	F1	F2	L1	L2	L3	L4	L5	L6							
	Max Points	3	3	3	3	3	30	20	20	30	30	30	30	30	30	30	60	60	325			
Arwen	Grade																					
Aragorn	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"

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

Each student is assigned a secret LOR code name

Contacting the instructor

- Use the forum for the fastest response to questions on class material or TBA lab assignments.
- Use email for personal matters.
- Weekly office hours on the mornings (Tuesdays 11:40-12:50) in room 2501
- The instructor will be available in the CIS Lab to help students with TBA lab assignments or class material. See schedule at: <http://webhawks.org/~cislabs>
- Leave a message on voice mail if you have no network access. Checked rarely so don't expect a fast response.



CIS 192 - How this class Works

The TBA portion of this course is required

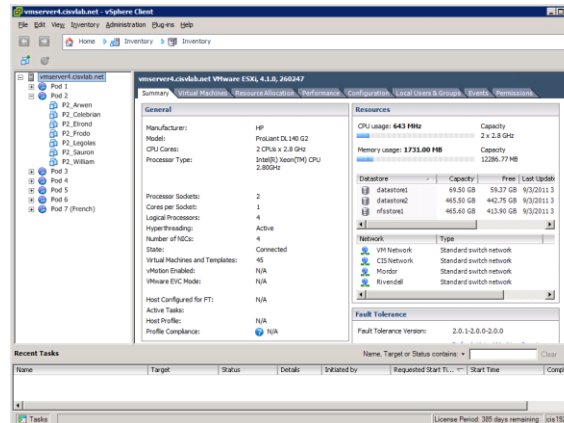
*Requires spending on average 4 hours and 5 minutes on **lab assignments** every week applying the skills learned during the lecture portion of the class.*

CIS Lab (in room 1403 of the CTC)



Please remember to always sign in and out on the log sheets!

CIS VLab (remote online access)



More on Grading

Lab Assignments (30 points each)

- Will be due at midnight (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 midnight 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 CTC and CIS lab. In addition the Linux Opus server and the CIS VLab may be accessed from anywhere over the Internet.

The TBA portion of this course requires spending on average 4 hours and 5 minutes every week applying the skills learned during the lecture portion of the class.

<http://simms-teach.com/cis90calendar.php>

1	10/25	<ul style="list-style-type: none"> • Ping and SSH with IPv6 <p>Materials</p> <ul style="list-style-type: none"> • Presentation slides (download) • Apache web server example (show) • Logins Sheet (download) • Howto #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 	12,14	
	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"> • Review and use various tools for configuring an interface • Understand how address resolution works • Manage and track the arp cache • Sniff packets on the network with tcpdump and Wireshark • Understand the Internet layer (layer 3) and how addressing works • Hop from system to system using SSH • Understand how NAT/PAT works with private networks • Use several troubleshooting tools to diagnose problems <p>Materials</p> <ul style="list-style-type: none"> • Presentation slides (download) 	12	<p>Student survey</p> <p>Lab 1</p>

Note: The first lab assignment and student survey is due by midnight of the next class meeting!

CIS 192

Lab Assignments



Pearls of Wisdom:

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

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 **1:00PM** 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 (30 points)

- Tests will be distributed by during the last half of the class.
- Full term courses like CIS 192AB or CIS 90 have three tests. Short term courses like 192A have one test.
- 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" you may continue to work on the test after class is over and turn it no later than midnight.

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.
- Full term courses like 192AB or 90 have four posting periods. Short courses like 192A have two posting periods.
- 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 midnight (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

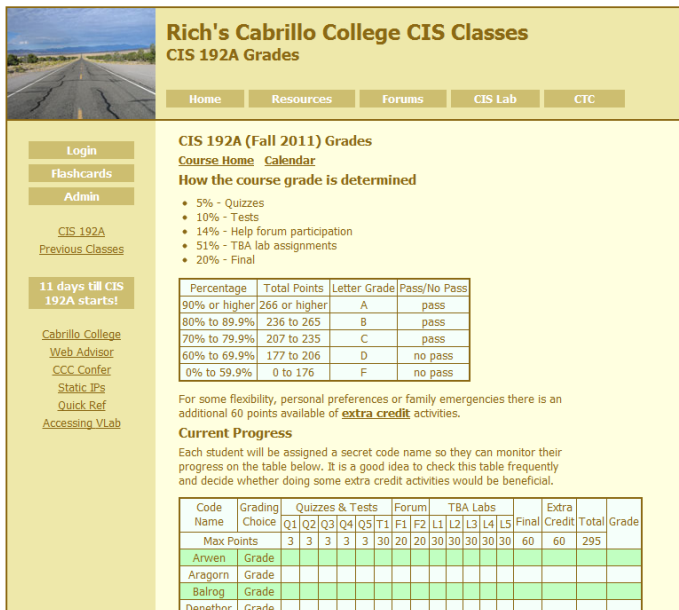
Extra credit

- 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 is a cap on extra credit points so plan carefully!**

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

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.



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CIS 192A Grades

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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

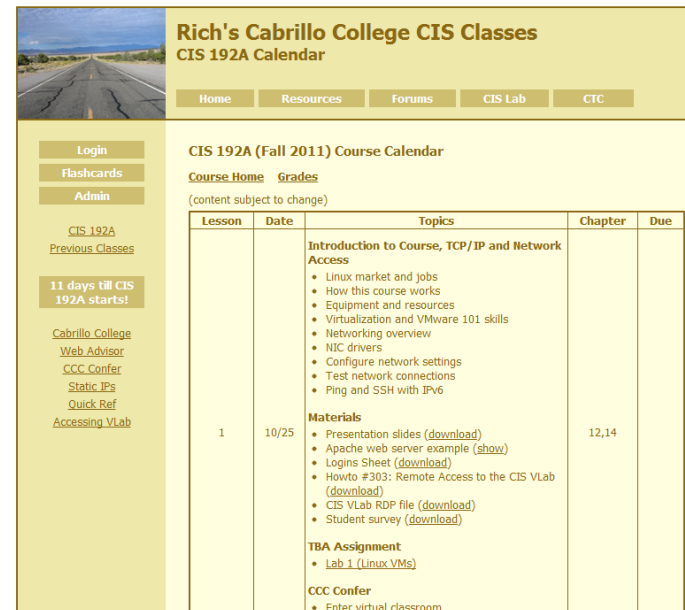
Percentage	Total Points	Letter Grade	Pass/No Pass
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80% to 89.9%	236 to 265	B	pass
70% to 79.9%	207 to 235	C	pass
60% to 69.9%	177 to 206	D	no pass
0% to 59.9%	0 to 176	F	no pass

For some flexibility, personal preferences or family emergencies there is an additional 60 points available of **extra credit** activities.

Current Progress

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Code Name	Grading Choice	Quizzes & Tests	Forum	TBA Labs	Final	Extra Credit	Total	Grade
		Q1 Q2 Q3 Q4 QS T1	F1 F2	L1 L2 L3 L4 L5	Final	60	60	295
Max Points	3	3 3 3 3 3	30 20	30 30 30 30 30	60	60	295	
Anwen	Grade							
Aragorn	Grade							
Balrog	Grade							
Denethor	Grade							



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CIS 192A Calendar

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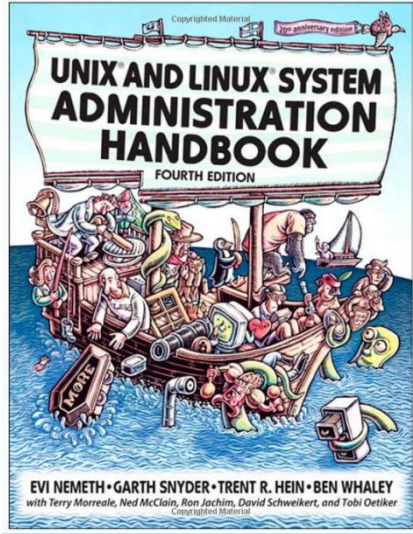
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CIS 192A (Fall 2011) Course Calendar
Course Home Grades

(content subject to change)

Lesson	Date	Topics	Chapter	Due
1	10/25	Introduction to Course, TCP/IP and Network Access <ul style="list-style-type: none"> • Linux market and jobs • How this course works • Equipment and resources • Virtualization and VMware 101 skills • Networking overview • NIC drivers • Configure network settings • Test network connections • Ping and SSH with IPV6 Materials <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) TBA Assignment <ul style="list-style-type: none"> • Lab 1 (Linux VMs) CCC Confer <ul style="list-style-type: none"> • Enter virtual classroom 	12,14	



Optional Textbook:

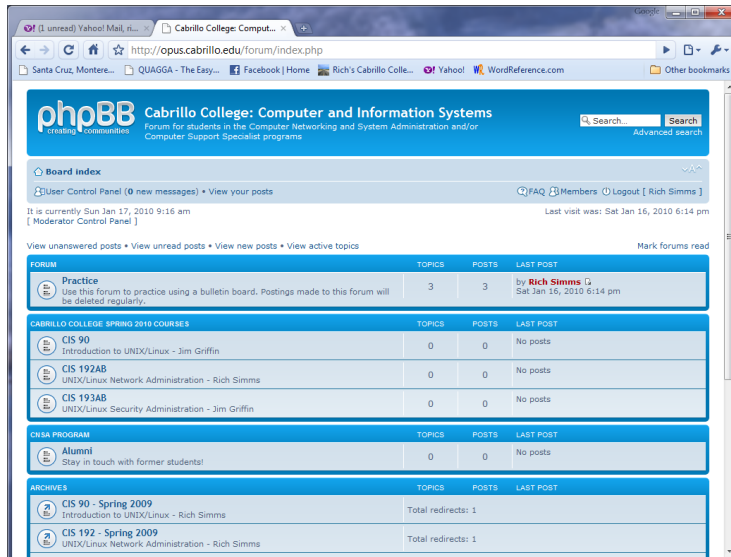
UNIX and Linux System Administration Handbook (4th Edition)

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



Help Forum

Online Help Forum



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



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

CIS 192

Class Forum

Textbook

POSTREPLY ↩

Search this topic...

Search

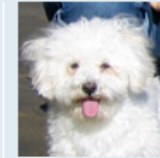
3 posts • Page 1 of 1

Textbook

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

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

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



Benji Simms

Posts: 5

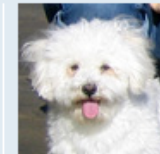
Joined: Thu May 15, 2008 2:40 pm



Rich Simms
Site Admin

Posts: 340

Joined: Thu May 15, 2008 1:44 pm



Benji Simms

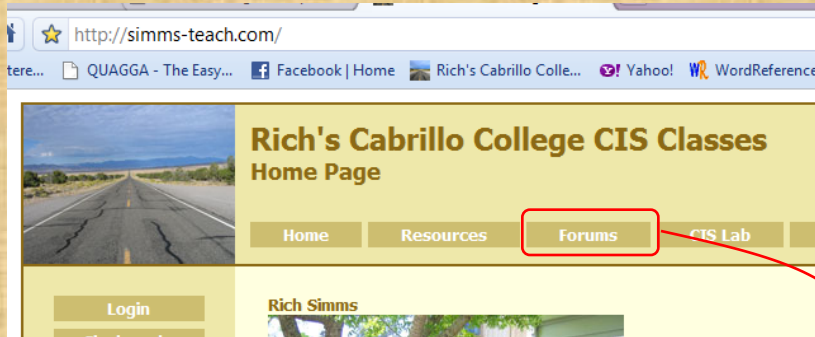
Posts: 5

Joined: Thu May 15, 2008 2:40 pm

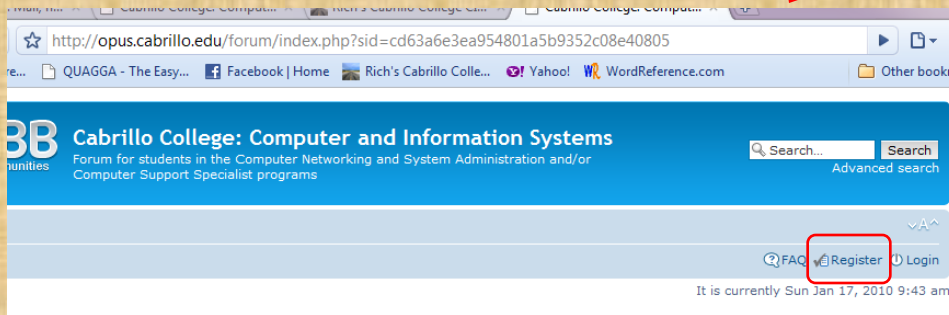
- Usernames cannot be anonymous and must be:
 - Your real **first** and **last** name separated by a **space** e.g. Rich Simms
 - Your username must match a name on the class roster otherwise the account will be deleted
- Uploading an avatar is optional. Identifying photos are preferred so students can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

Class Activity Forum Registration

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



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



To Register:

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

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



Housekeeping



- Roll Call



Turn Recording Off



James



Mike



Instructor: **Rich Simms**

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

Passcode: **761867**



Timothy



Elizabeth



Jacob G



Ellison



Mark



David



Gabriel P



Carlos R



Leandro



Leopoldo



Branden



Chad



Jacob S



Laura



Greg



Josh



Carlos V



Gabriel V



Jeff



Daniel



Jason



Thomas



Lars



Allstin



Geoffrey



Adriana



Christopher



Donovan



Alexander



TBD



TBD



TBD



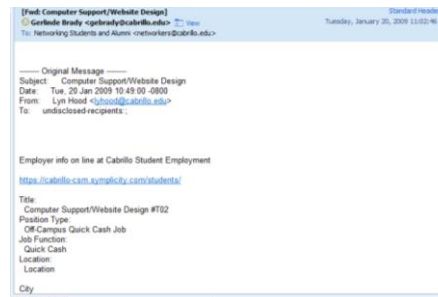
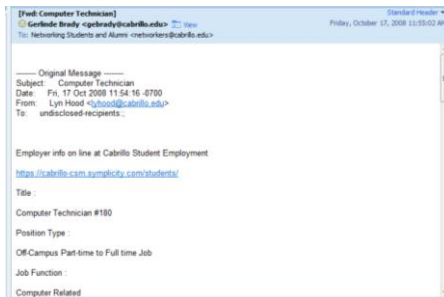
Turn Recording On

- Adds
- Last day to add is 10/31
- Classroom Perkins (VTEA) survey

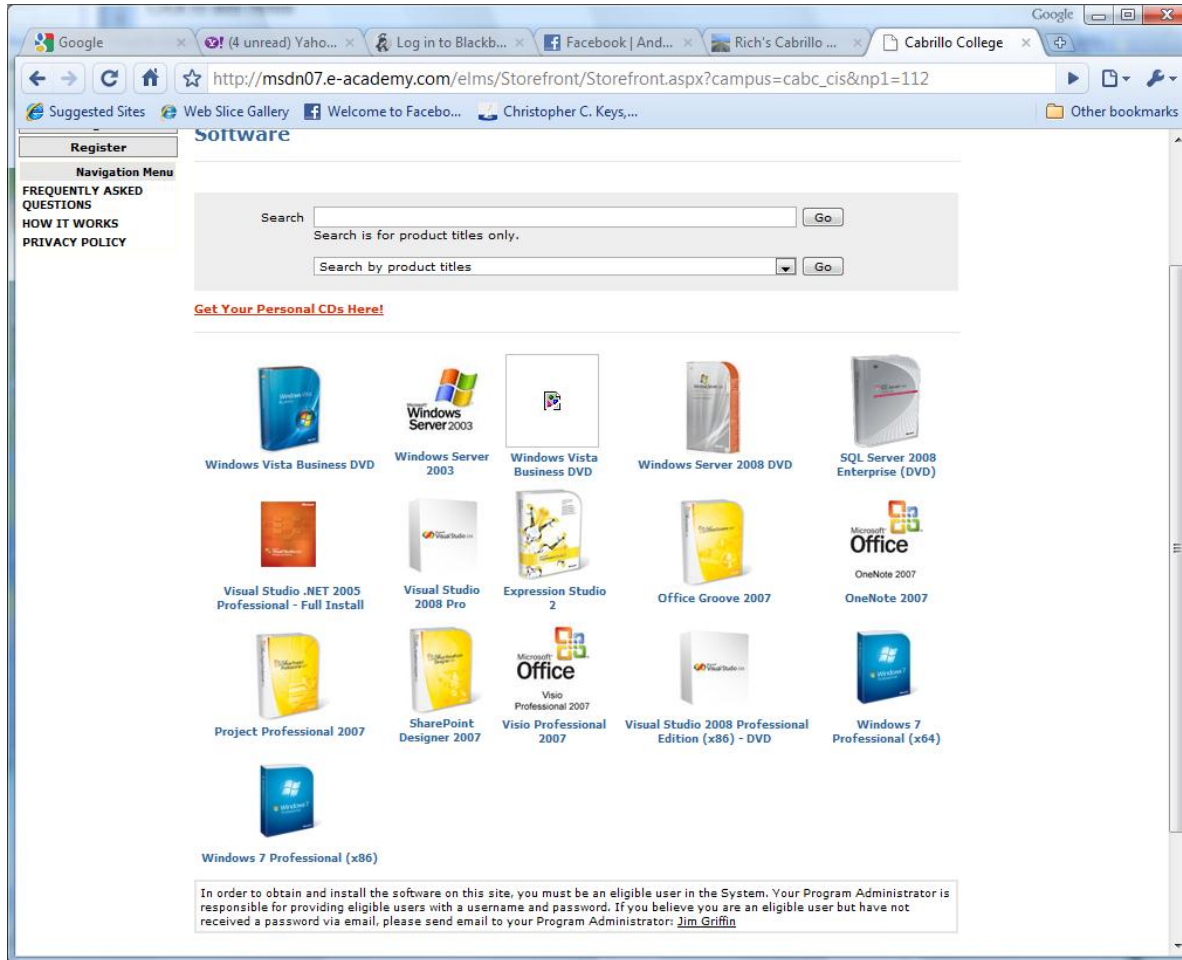
Cabrillo Networking Program Mailing list

Subscribe to (no subject or body):

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



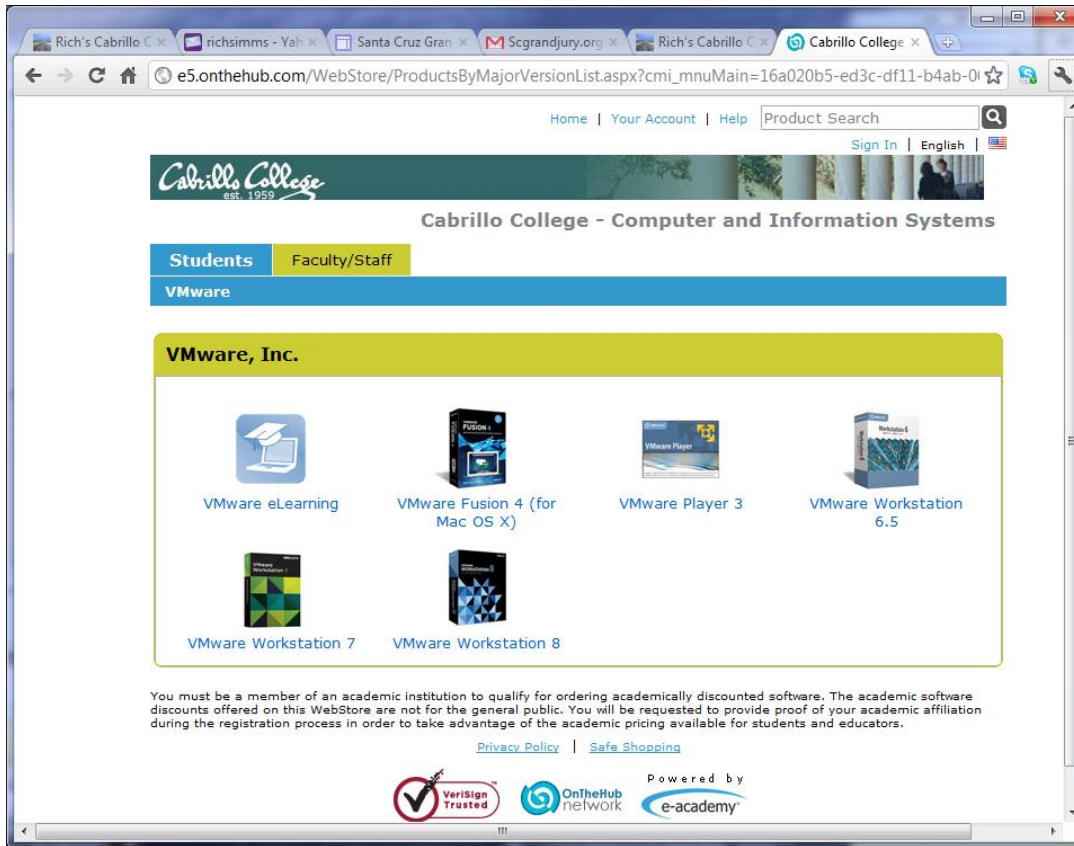
MSDN Academic Alliance



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

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

Student Survey and Logins Sheet

simms-teach x simms-teach x Cabrillo Coll x
simms-teach.com/docs/cis192/cis192survey

UNIX/Linux Network Administration (CIS 192A)
Fall 2011 -- Student Survey

Student Information

- First Name: _____ Last Name: _____
- Date: _____ Email address: _____
- Grading choice: Pass/No pass Grade (choose one, you may change your mind later)

Computer Background

- Previous computer classes or training taken:

- Work or other experience using computers:

Home equipment

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

Course Objectives

- What are you hoping to learn in this class?

- Other comments or special learning needs?

*Download, fill out and email to
risimms@cabrillo.edu*

Rich's l x simms x simms x Cabrill x
simms-teach.com/docs/cis192/logins-cis1

Logins and Passwords for CIS 192

Class Computer Stations (room 2501)
Username: _CIS 192 Password: _____

CIS-Lab-xx Systems (CIS Lab in the CTC):
Username: _CIS 192 Password: _____

CCC Confer (Phone audio)
Dial-in: _888-450-4821 Passcode: _761867

CIS-VLab (Remote Access):
Username: _____ Password: _____

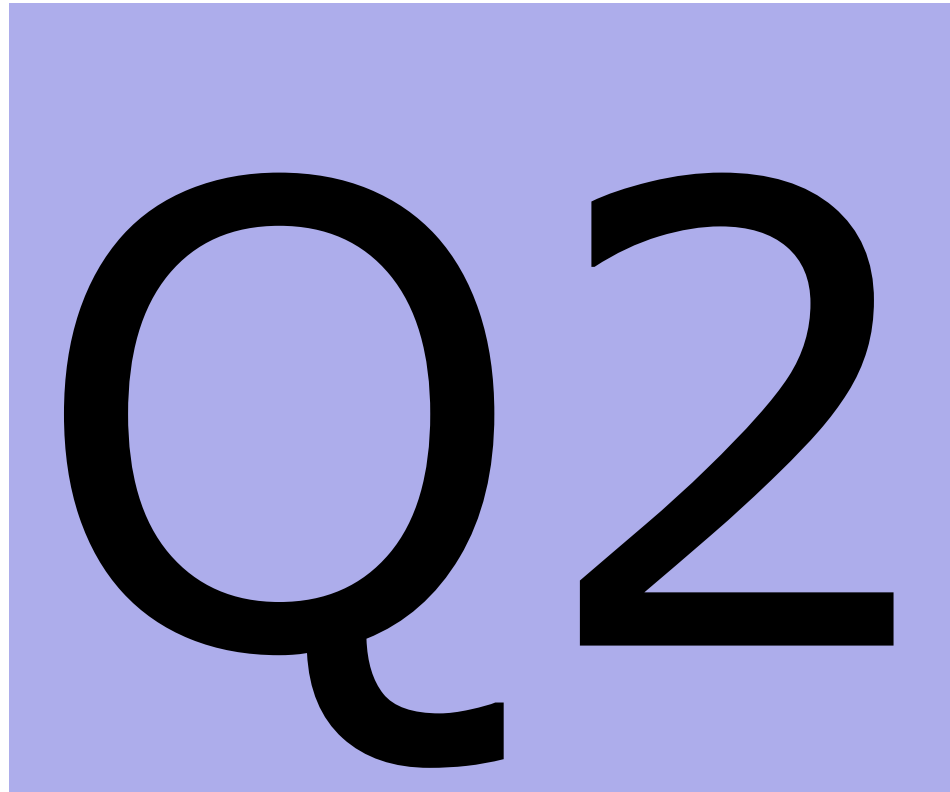
CIS-VLab (vmserver4 access):
Username: _cis192 Password: _____

192 Linux VMs:
Username: _cis192 Password: _____
Username: _root Password: _____

Opus (opus.cabrillo.edu)
Username: _cis192 Password: _____
Username: _____ Password: _____

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

*Download, fill out and keep for
your own records*

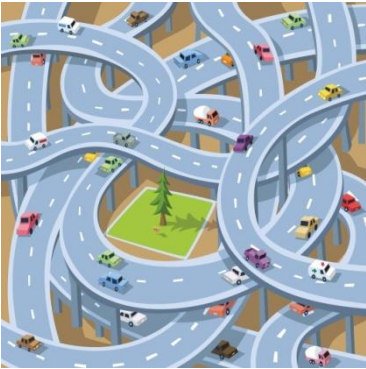


- UNIX/Linux market
- Equipment
- Login to Opus
- Login to CIS 192 VMs on school computers
- Login to CIS 192 VM remotely



UNIX/Linux Market

Public Works Infrastructure



Roads



Water



Bridges



Airways



Power



Telecommunications

IT (Information Technology) Infrastructure



Network



Servers



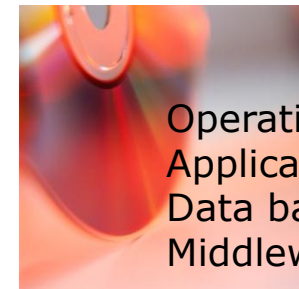
Storage



Desktops



Mobile



Operating Systems
Applications
Data bases
Middleware

Software

Computing Infrastructure Where UNIX/Linux is used

- Internet services – Web servers, DNS, DHCP, 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.
- Scientific applications and number-crunching
- Embedded in smartphones and other appliances

Operating Systems

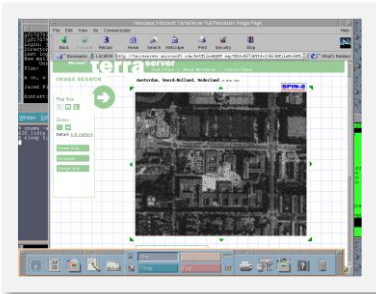
Various UNIX Based Products

SCO UNIX

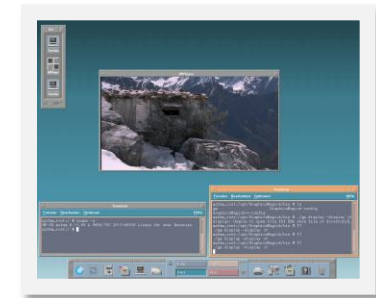


Berkeley
Software
Distribution

AIX



HP-UX



Solaris



Apple Mac OS X
and iOS



*The kernel is
UNIX based*

Operating Systems

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

Operating Systems

Embedding Linux in Products

Google Chrome OS
(coming soon)
for Netbooks and Tablets



Tivo



Buffalo
NAS storage



Android



MikroTik Routers



Operating Systems

Embedding UNIX in Products

Apple iOS



*The Apple iOS, like Mac OS X, runs on a UNIX like kernel
(Mach kernel + BSD components)*

Source: [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))

UNIX/Linux Overview

Server, PC, Smartphone markets

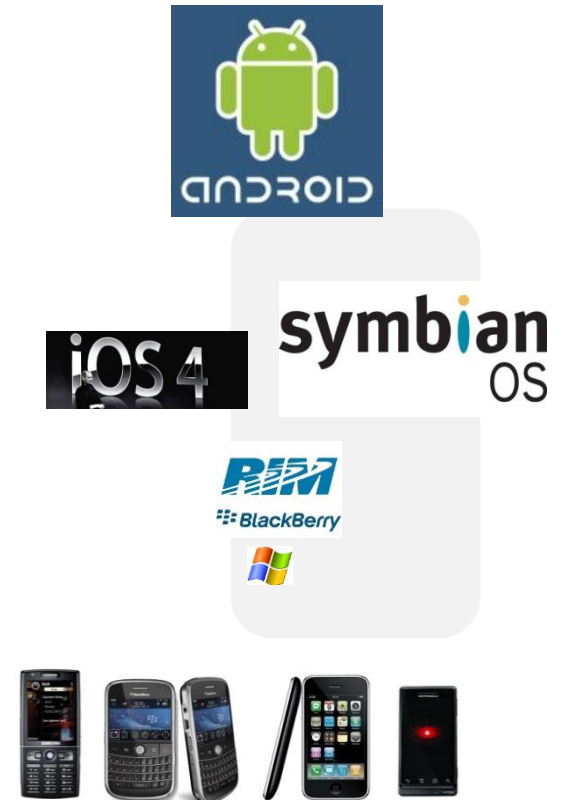
Servers



PC's



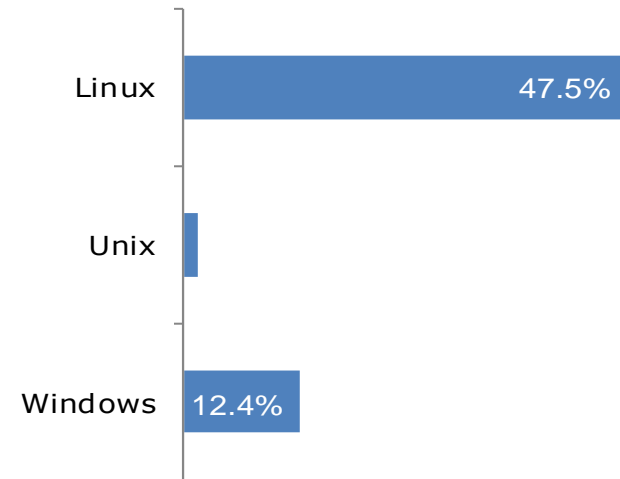
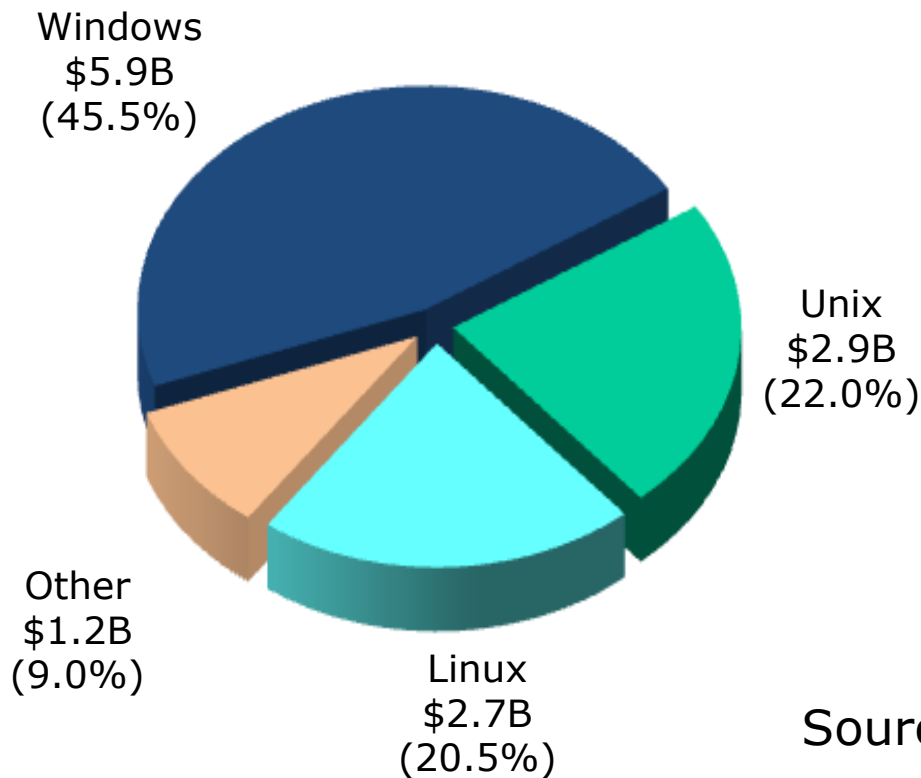
Smartphones



Worldwide Server Market

\$13.2B Server Revenue 2Q 2011

Year over Year Change



Source: IDC, Aug 2011

Worldwide "Ballpark" market for PCs

Website hits by OS

Jan 2009¹

Jul 2010²

Aug 2011³

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

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%

Operating Systems		
1	Windows XP	35.71%
2	Windows 7	33.77%
3	Windows Vista	10.34%
4	Apple OS X	8.69%
5	Apple iOS	2.88%
6	Linux	1.55%
7	Android	1.17%
8	BlackBerry	0.72%
9	SymbianOS	0.15%
10	Windows 2000	0.12%

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

2 - 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.

3-This report was generated 08/31/2011 based on the last 15,000 page views to each website tracked by W3Counter. W3Counter's sample currently includes 50,382 websites. The browser market share graph includes data from all versions of the named browser families, not only the top 10 as listed below.

Worldwide Smartphone Market

Table 2
Worldwide Smartphone Sales to End Users by Operating System in 2Q11
(Thousands of Units)


	Operating System	2Q11 Units	2Q11 Market Share (%)	2Q10 Units	2Q10 Market Share (%)
<i>Google</i>	Android ↑	46,775.9	43.4	10,652.7	17.2
<i>Nokia</i>	Symbian ↓	23,853.2	22.1	25,386.8	40.9
<i>Apple</i>	iOS ↑	19,628.8	18.2	8,743.0	14.1
<i>Blackberry</i>	Research In Motion ↓	12,652.3	11.7	11,628.8	18.7
<i>Samsung</i>	Bada ↑	2,055.8	1.9	577.0	0.9
	Microsoft ↓	1,723.8	1.6	3,058.8	4.9
	Others ↓	1,050.6	1.0	2,010.9	3.2
	Total	107,740.4	100.0	62,058.1	100.0

Source: Gartner (August 2011)

<http://www.gartner.com/it/page.jsp?id=1764714>
<http://www.mobiletechreview.com/smartphone.htm>

iso.linuxquestions.org

15 Most Popular Downloads

15 Most Downloaded Distribution Versions (last 30 Days)	 15 Most Downloaded Distributions (Ever)
1. Ubuntu 11.04 (4436)	1. Fedora
2. CentOS 5.5 (1193)	2. Mandriva
3. Damn Small Linux 4.4.10 (1116)	3. Red Hat Enterprise Linux
4. Slackware Linux 13.37 (689)	4. SUSE
5. Fedora 11 (607)	5. Ubuntu
6. Fedora 8 (603)	6. Damn Small Linux
7. CentOS 5.4 (602)	7. CentOS
8. Red Hat Linux 8.0 (Psyche) (577)	8. Linux XP
9. Ubuntu 10.04.3 (507)	9. Knoppix
10. openSUSE 10.2 Live DVD (495)	10. Debian
11. KNOPPIX 5.1.1 (466)	11. Slackware
12. Debian 3.0r2 (woody) (390)	12. MEPIS
13. Fedora 15 (378)	13. PCLinuxOS
14. MandrakeMove 9.2 (351)	14. Gentoo
15. openSUSE 10.3 Live (344)	15. Linspire

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



distrowatch.com

Top Ten Sep 2011

1. Ubuntu 11.04
2. Linux Mint 11
3. Fedora 15
4. Debian 6.0
5. openSUSE 11.4
6. Arch Linux 2011.08.19
7. PCLinuxOS 2010.12
8. CentOS 5.6
9. Mageia 1
10. Slackware 13.37
11. FreeBSD 8.2

Top Ten Jan 2010

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

Top Ten Jan 2009

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

CentOS is a clone distro of Red Hat Enterprise

Linux distros mentioned by top server vendors

Server market share source: IDC 2Q11 report

Vendor	IBM (30.5%)	HP (29.8%)	Dell (13.8%)	Oracle (7.2%)	Fujitsu (6.5%)
Red Hat Enterprise	✓	✓	✓	✓	✓
Novell SUSE	✓	✓	✓	✓	✓
Oracle Linux	✓	✓		✓	
Debian	✓	✓			✓
Asianux	✓	✓			
Ubuntu	✓	✓			✓
CentOS	✓	✓			
Fedora	✓	✓			
OpenSUSE	✓	✓			

For CIS 192 we will be using CentOS and Ubuntu VMs. Opus is a Red Hat Enterprise server. The Fang VM (for reserving VLab pods) is an openSUSE server. CentOS is built from Red Hat source code.

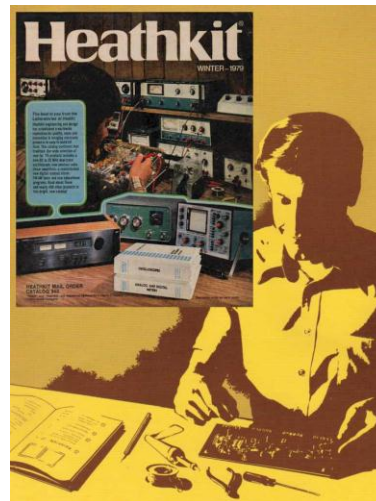


Equipment

Assembling components into solutions



*Who likes
building
things?*



Assembling components into solutions



Servers and Clients



Routers



Rack



cables



Switches

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

Assembling components into solutions



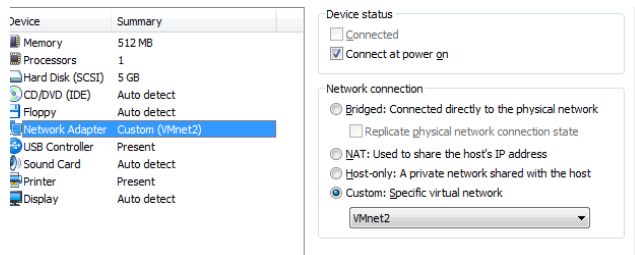
Servers and Clients
(using VMware VMs)



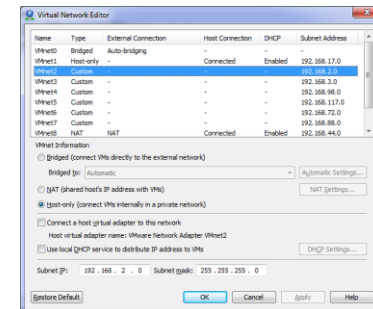
“Rack”
(Using one CIS Lab PC
or one VLab VMware
ESXi server)



Routers
(Using VMware Linux VMs)



Cables
(using VM Ethernet Settings)



Switches
(Using virtual networks)

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

Meet the CIS 192 Systems

Servers



Arwen



eth0 eth1



Elrond



eth0 eth1



Celebrian



eth0 eth1



Legolas



eth0 eth1



Opus



eth0

Clients



Frodo



eth0



Sauron



eth0



William



Local Area
Connection

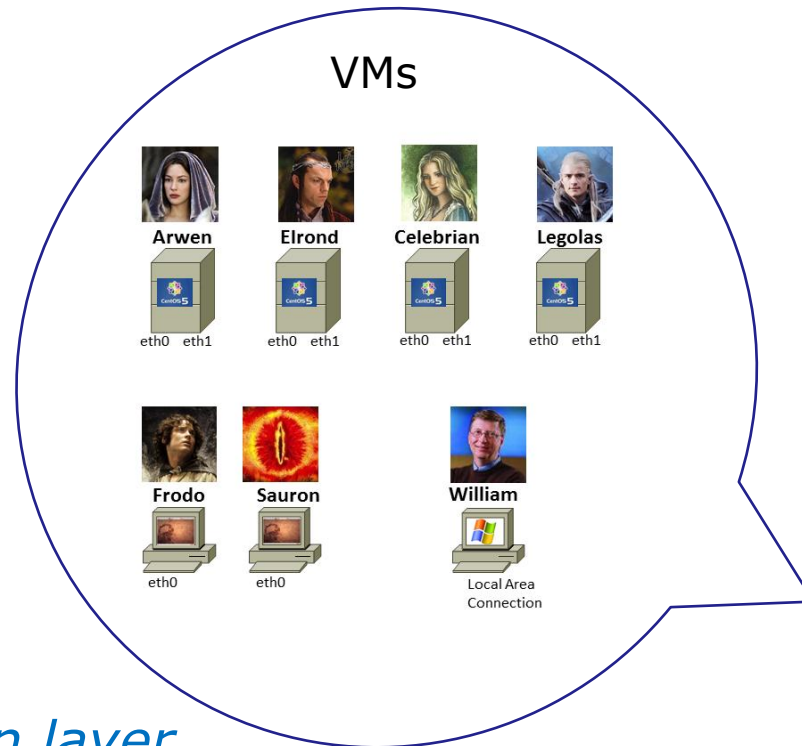


Fang



eth0

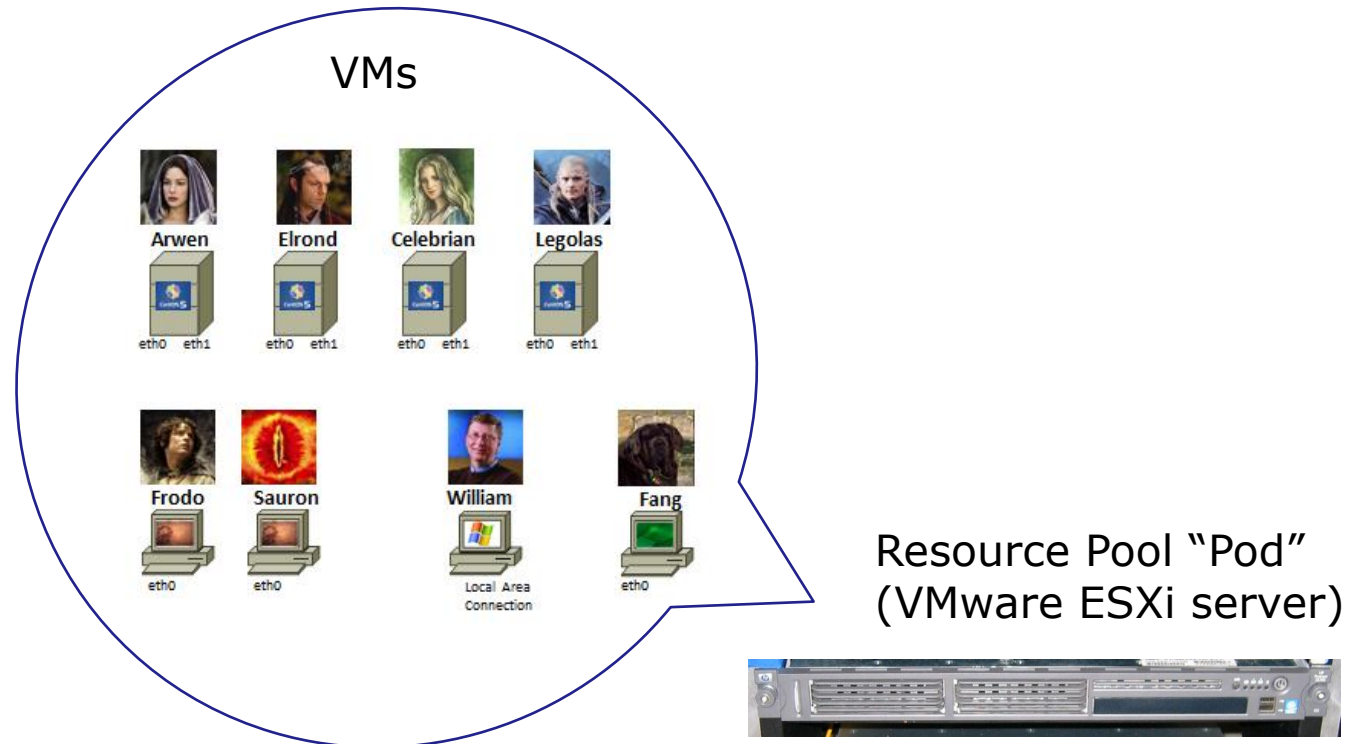
The VMs are located on each classroom and CIS Lab station (PC)



Classroom or Lab Stations
(VMware Workstation station)

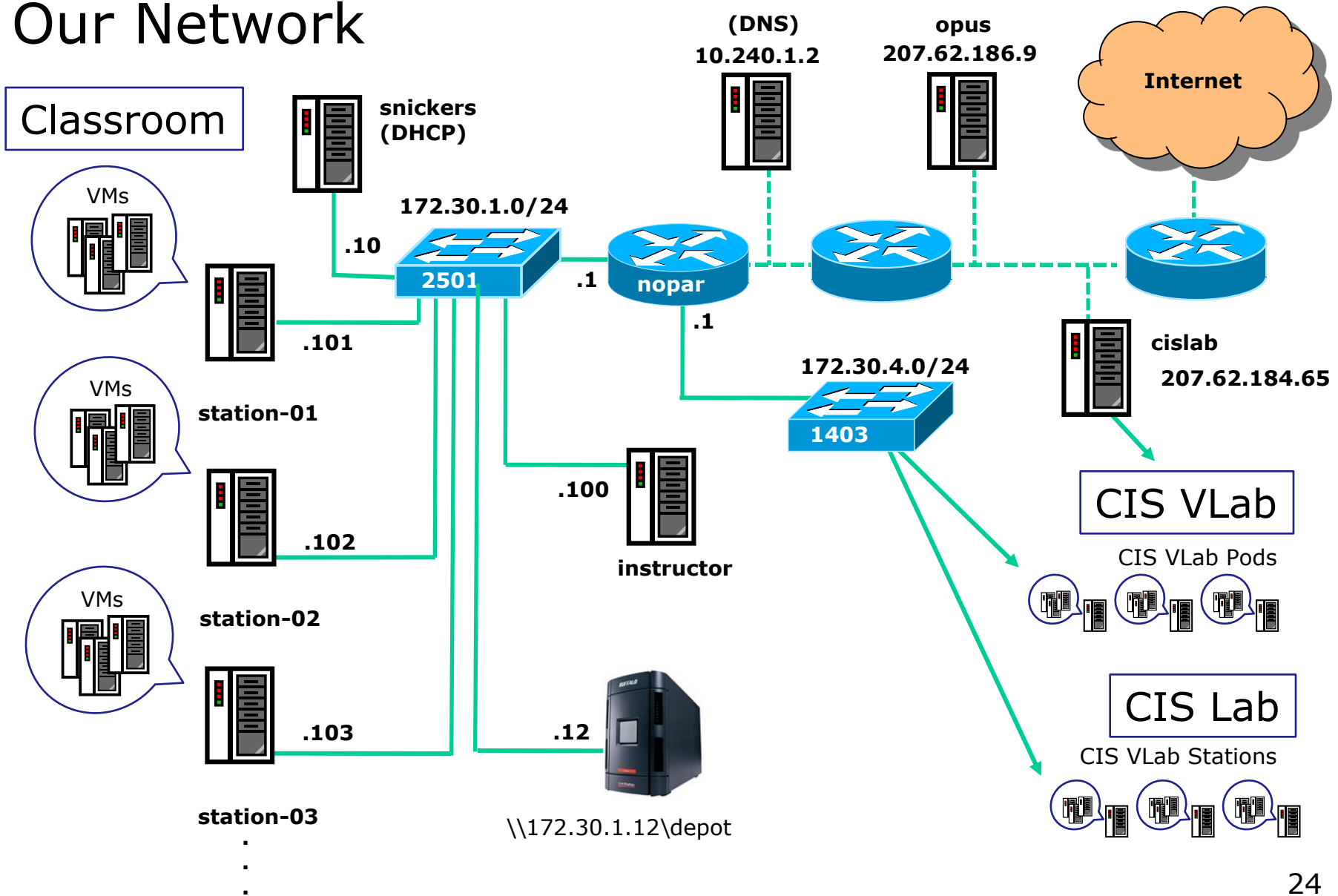
*The virtualization layer
is provided by **VMware
Workstation***

The VMs are also available remotely on a VLab server



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

Our Network



Lab Resources

CIS Lab (Room 1403 in CTC)

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

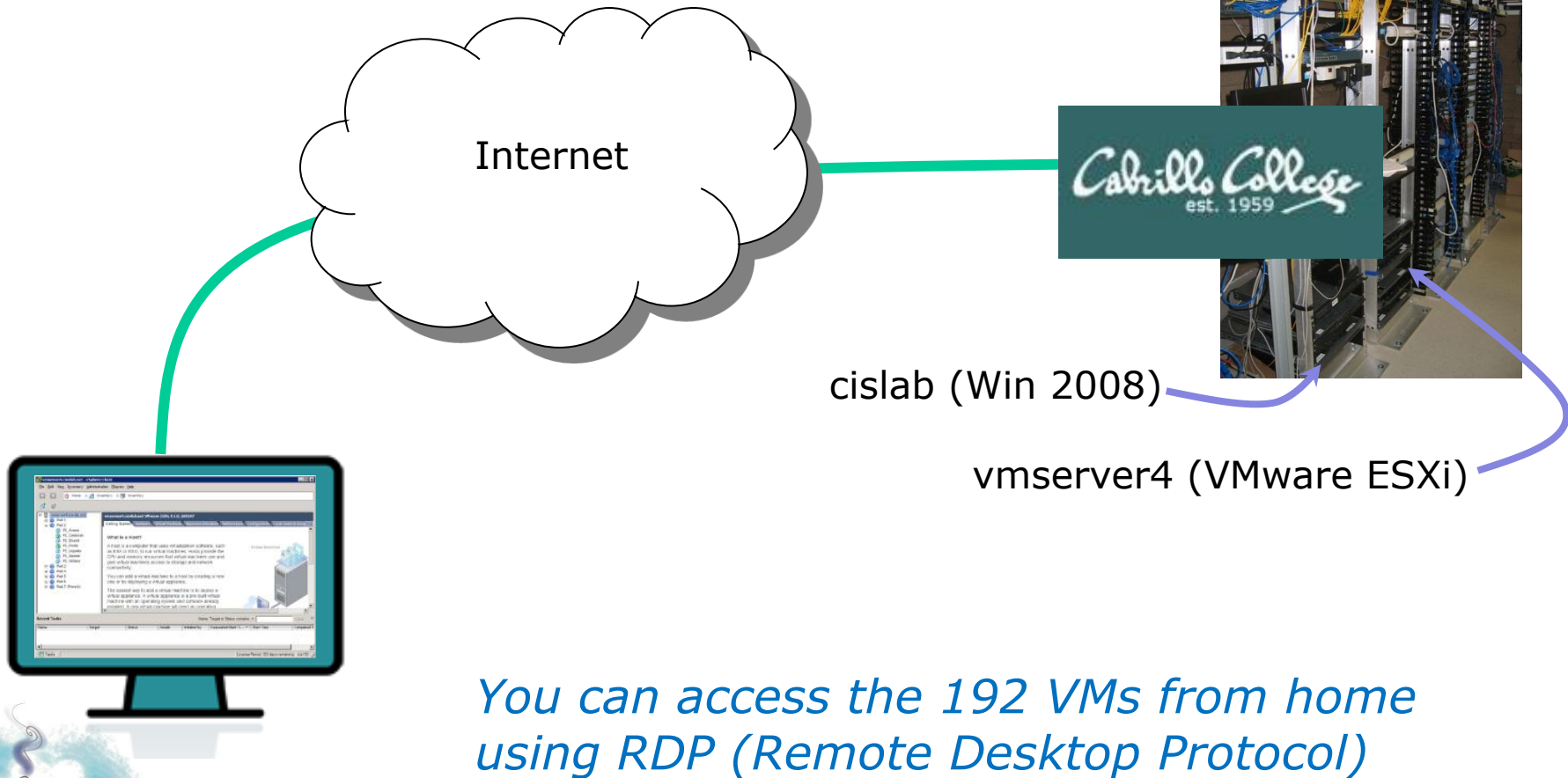


These systems are labeled as CIS-Lab-XX

Lab Resources

Remote Access to **CIS VLab**

Room 1403 on Aptos Campus



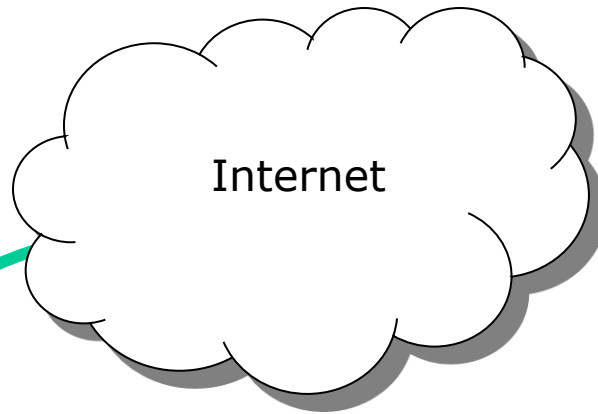
Lab Resources

Remote Access to **Opus**

Building 1200 on Aptos Campus



Red Hat Enterprise Linux Server



You can access the Opus server from home using SSH (Secure Shell protocol)



Opus

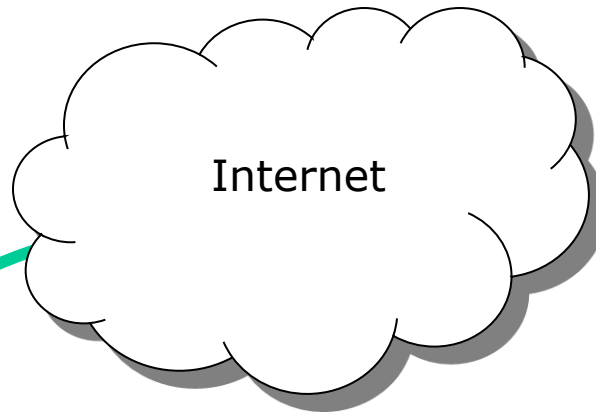
Lab Resources

Remote Access to **Opus**

Building 1200 on Aptos Campus



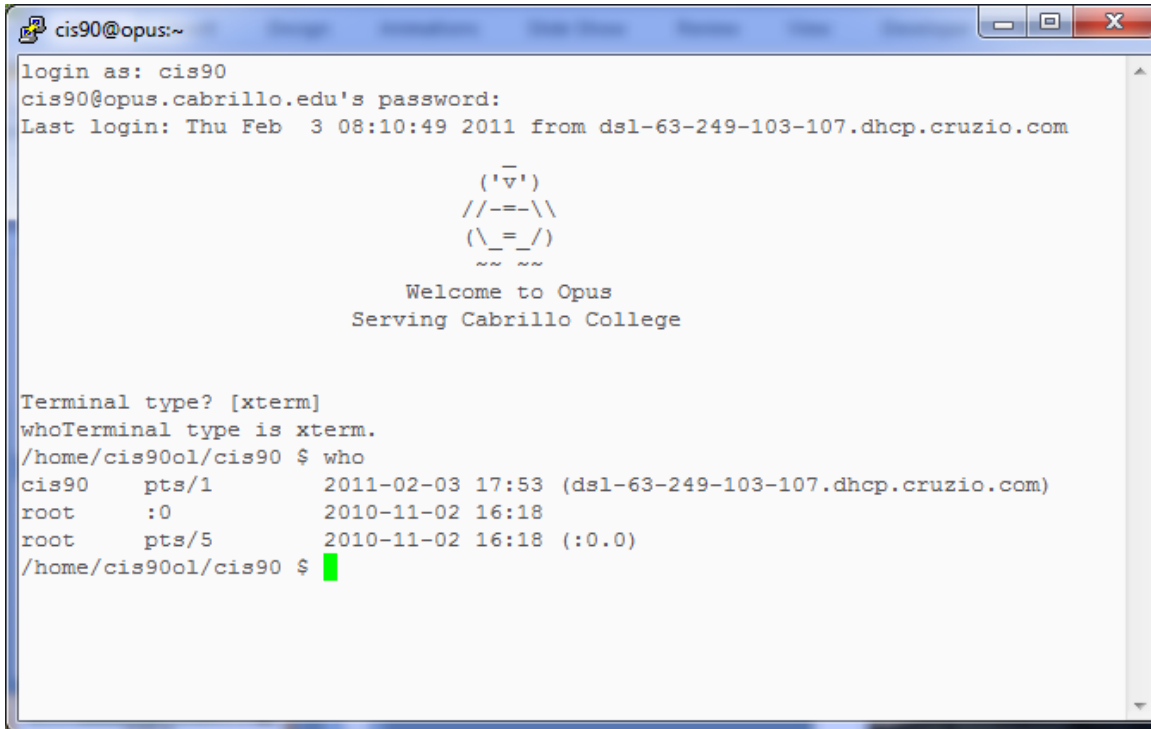
Red Hat Enterprise Linux Server



You can access the Opus server from home using SSH (Secure Shell protocol)



Online Lab Resources The Opus RHEL Server



```
login as: cis90
cis90@opus.cabrillo.edu's password:
Last login: Thu Feb  3 08:10:49 2011 from dsl-63-249-103-107.dhcp.cruzio.com

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

Welcome to Opus
Serving Cabrillo College

Terminal type? [xterm]
whoTerminal type is xterm.
/home/cis90ol/cis90 $ who
cis90 pts/1 2011-02-03 17:53 (dsl-63-249-103-107.dhcp.cruzio.com)
root :0 2010-11-02 16:18
root pts/5 2010-11-02 16:18 (:0.0)
/home/cis90ol/cis90 $
```

Students can remotely log into Opus, a Red Hat Enterprise Linux server located on campus.

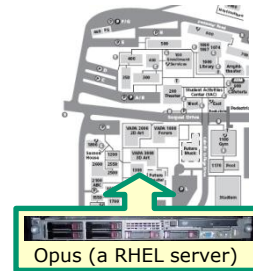
Students with Windows PC's will use Putty.

Students with Macs or Linux computers will use the ssh command from a terminal.

Note, all the lab assignments are submitted using Opus

Telnet vs SSH (Secure Shell)

Remote computer



SSH is a network protocol that enables secure connections between computers

Sniffer view of a Telnet session

Telnet - all clear text

Sniffer view of a SSH session

SSH - encrypted

username
password
cat secret
exit

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

With ssh, it is encrypted.



Local computer



Turn Recording Off

<http://simms-teach.com/docs/cis192/logins-cis192.pdf>

Student Survey and Logins Sheet

You will need your Opus
username and password
for the next activity

*You can use the logins sheet to
record your account information*

Logins and Passwords for CIS 192

Class Computer Stations (room 2501)
Username: Password:

CIS-Lab-XX Stations (CIS Lab in the CTC):
Username: Password:

CCC Confer (Phone audio)
Dial-in: Passcode:

CIS-VLab (cislab.cabrillo.edu):
Username: Password:

CIS-VLab (vmserver4):
Username: Password:

192 Linux VMs:
Username: Password:
Username: Password:

Opus (opus.cabrillo.edu)
Username: Password:
Username: Password:

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



Turn Recording On



Class Activity Logging into Opus

Live Opus Demo

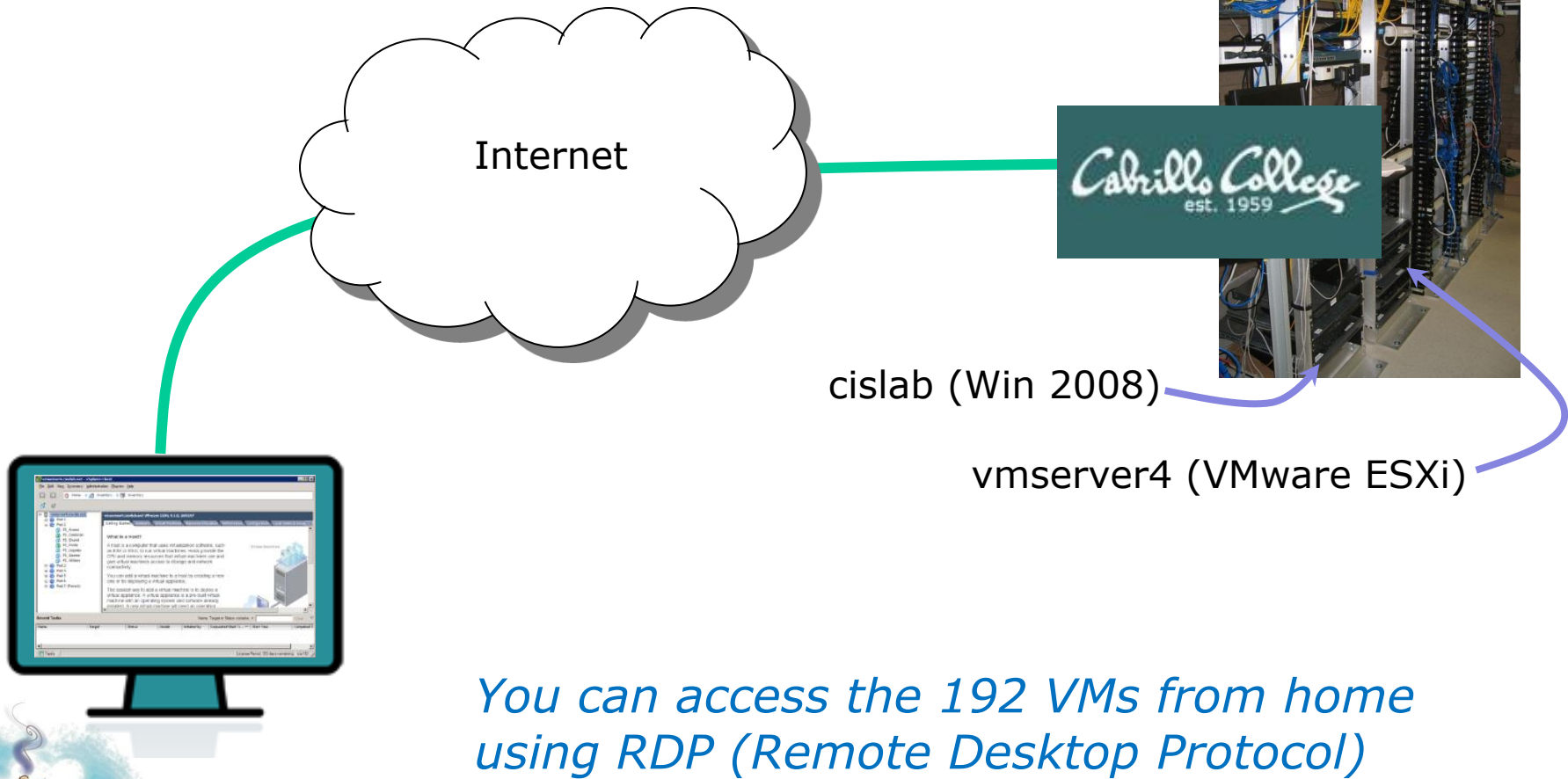


VLab

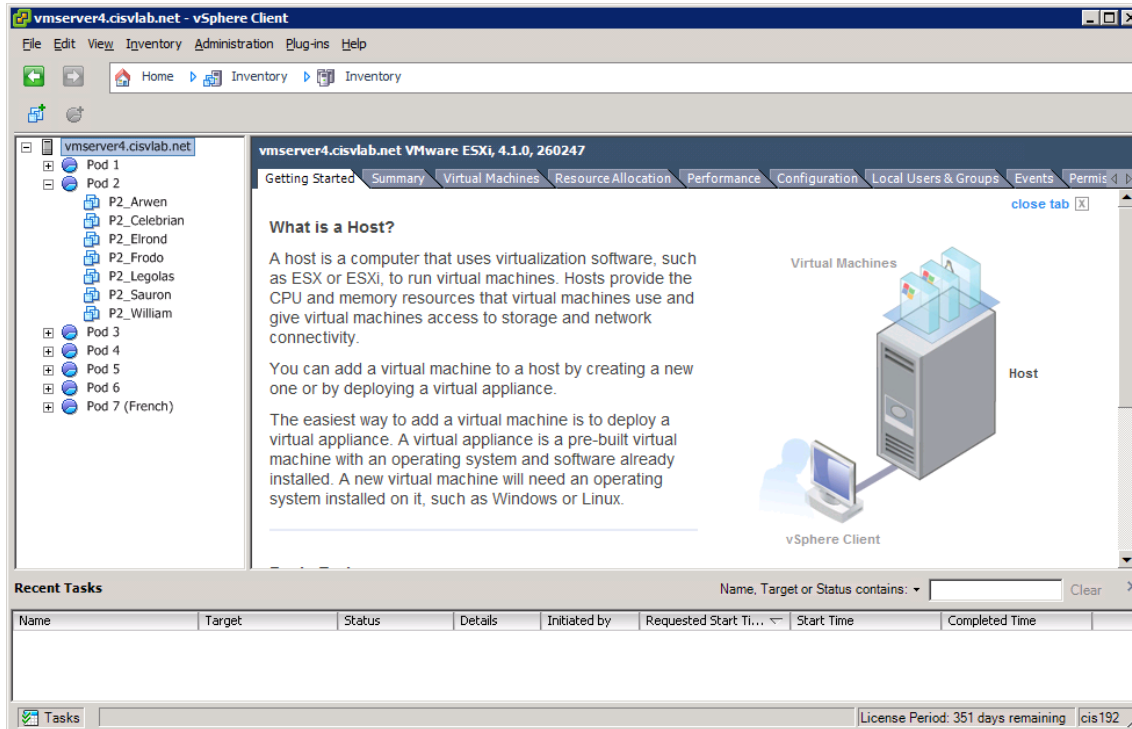
Lab Resources

Remote Access to CIS VLab

Room 1403 on Aptos Campus



Online Lab Resources CIS VLab



Students can remotely log into the CIS VLab

Students with Windows PC's need no additional software

Students with Macs will need to install CoRD

VMware vSphere Client connected to VMware ESxi server

Note, all lab assignments are done using the 192 VMs in the CIS Lab (room 1403) or remotely using VLab



Turn Recording Off

<http://simms-teach.com/docs/cis192/logins-cis192.pdf>

Student Survey and Logins Sheet

You will need your
username and
password for:

- CIS-Vlab
- vmserver4
- 192 Linux VMs

*You can use the logins sheet to
record your account information*

Logins and Passwords for CIS 192

Class Computer Stations (room 2501)
Username: Password:

CIS-Lab-XX Stations (CIS Lab in the CTC):
Username: Password:

CCC Confer (Phone audio)
Dial-in: Passcode:

CIS-VLab (cislab.cabrillo.edu):
Username: Password:

CIS-VLab (vmserver4):
Username: Password:

192 Linux VMs:
Username: Password:
Username: Password:

Opus (opus.cabrillo.edu)
Username: Password:
Username: Password:

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



Turn Recording On



Class Activity Logging into CIS Vlab

Live Demo



Classroom and CIS Lab Workstations

Lab Resources

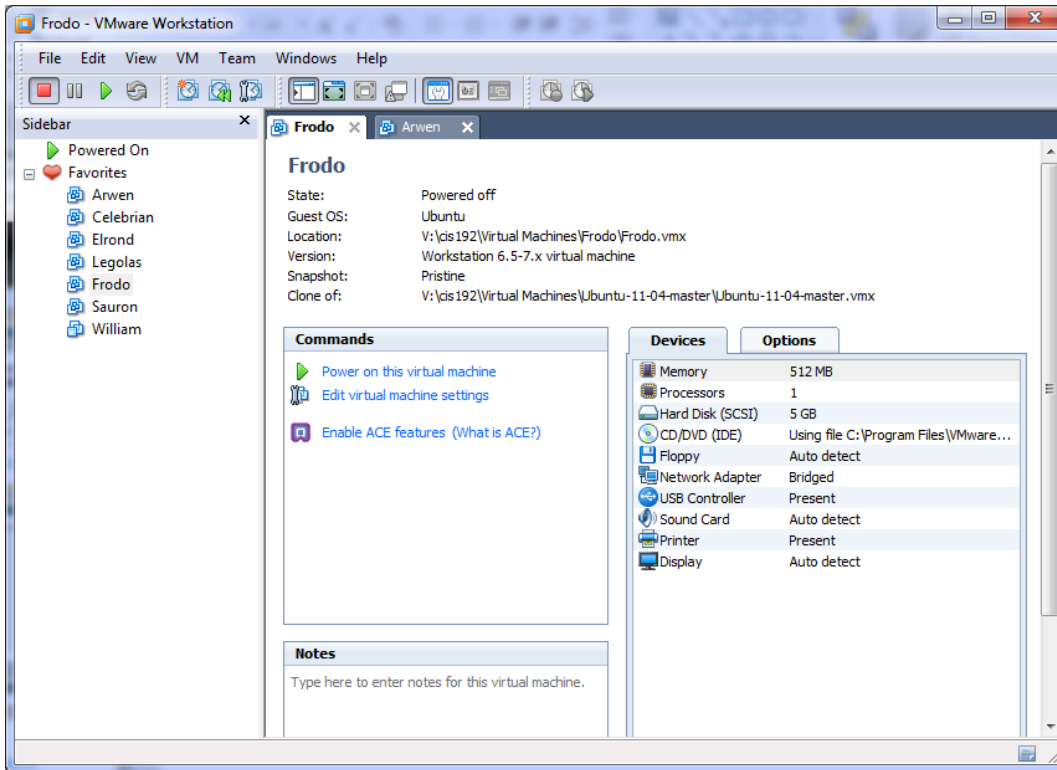
CIS Lab (Room 1403 in CTC)

There are VMware stations (labeled CIS-Lab-XX) along the back and side walls in the CIS lab



These stations are labeled as CIS-Lab-XX

CIS Lab Workstations



VMware Workstation

Each station in the classroom and CIS Lab has VMware Workstation installed

All the CIS 192 VMs are available

Instructors and lab assistants are available in the CIS Lab for help doing labs

Note, all lab assignments are done using the 192 VMs in the CIS Lab (room 1403) or remotely using VLab

<http://simms-teach.com/docs/cis192/logins-cis192.pdf>

Logins and Passwords for CIS 192

Class Computer Stations (room 2501)
Username: Password:

CIS-Lab-XX Stations (CIS Lab in the CTC):
Username: Password:

CCC Confer (Phone audio)
Dial-in: Passcode:

CIS-VLab (cislab.cabrillo.edu):
Username: Password:

CIS-VLab (vmserver4):
Username: Password:

192 Linux VMs:
Username: Password:
Username: Password:

Opus (opus.cabrillo.edu)
Username: Password:
Username: Password:

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

Student Survey and Logins Sheet

You will need your username and password for:

- Classroom stations
- CIS-Lab-XX stations
- 192 Linux VMs

You can use the logins sheet to record your account information

Class Activity
Using VMware Workstation VMs

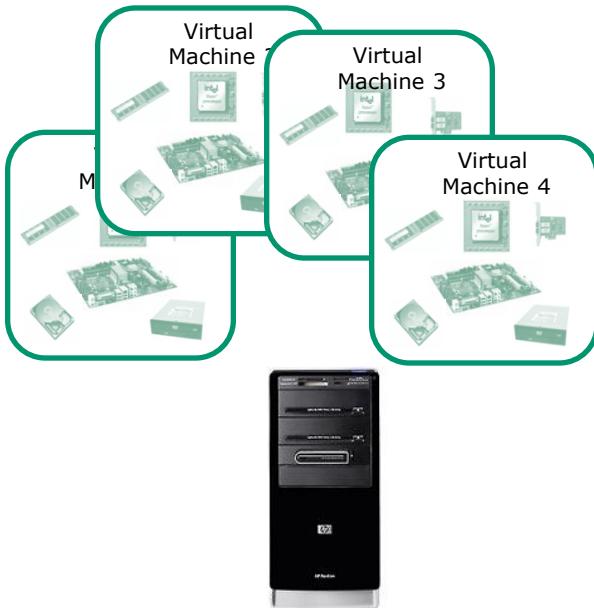
Live Demo



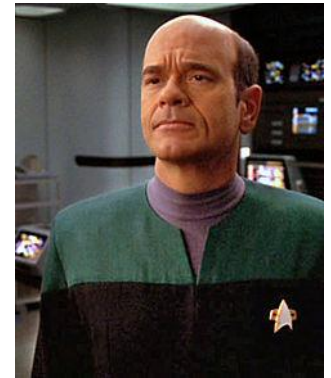
Virtualization

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**.



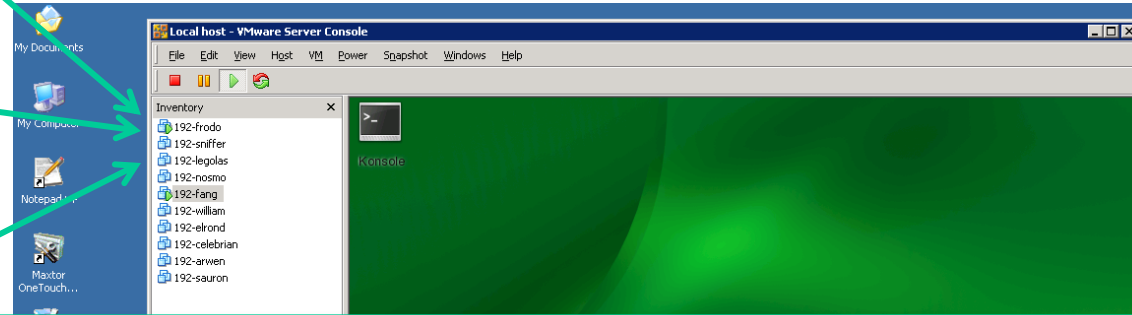
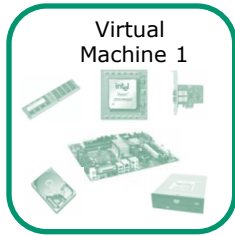
- You load an OS (operating system) and applications on a virtual machine just like you would any other computer.
- The OS and apps do not even know they are not running on a "real" computer.
- Over the network the virtual machines appear just like any other computer.



The EMH doctor on Star Trek Voyager was a simulation

Virtual Machines

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

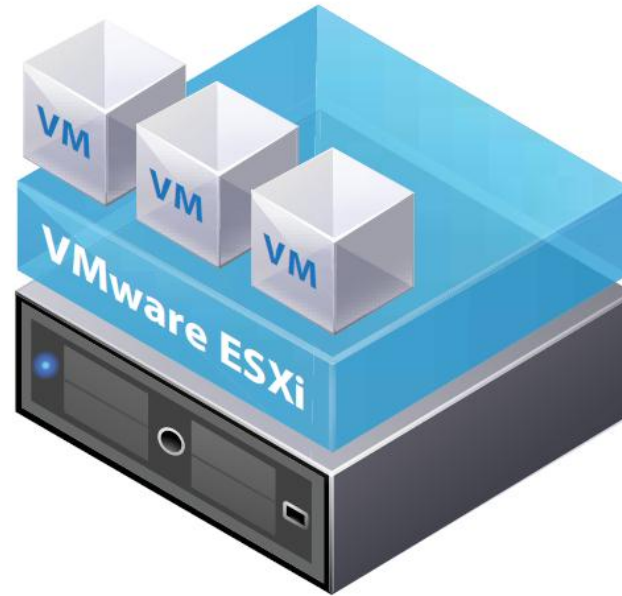


Benefits of virtualization:

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



VMware ESXi



*This is a
"bare-metal"
hypervisor*

*It is not
installed on
another OS*

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

Looks very interesting!

The screenshot shows a web browser window with the URL <http://simms-teach.com/resources.php>. The page title is "Rich's Cabrillo College CIS Classes Resources". The "Resources" tab is highlighted in red. The page content is organized into several sections:

- Navigation:** Home, Resources (highlighted), Forums, CIS Lab, CTC.
- Left Sidebar:** Login, Flashcards, Admin, CIS 192, Previous Classes, 7 days till term ends!, Cabrillo College, Static IPs.
- Links Section:**
 - Instructors:** Programming Master Ed, Linux Master Jim, Web Master John, Network Master Gerlinde, Network Master Rick.
 - Clubs:** GNU Linux Users Group.
 - Departments:** CNSA, CIS, CS.
 - Crib Sheets:** Ollie Wright (CIS 90).
 - Documentation:** TLDP, LINFO.
 - Getting Linux:** Linux ISOs, Kernels, RPMs.
 - Tools and Software:** Apache, Bastille, cygwin, DIAG, diagnostics, DOS boot disks, John the Ripper, MSDN Academic Alliance, Netfilter, Putty SSH Tools, Tripwire, **VMware Server** (highlighted), Wireshark.
 - Standards:** IETF (RFCs), IEEE.
 - Commands:** Practical.
 - Howtos:** HowtoForge, email, DNS, Ethernet (NIC drivers), NIS, PPP, NFS.
 - Student Howtos:** Making an ethernet cable by Michael George, Home VM access via Linksys router by Marc Romansky, Putty to VMs by Marc Romansky, Installing VirtualBox by Marcos Valdebenito, Linux Permissions by Michael Wicherski, Guide to /bin/mail by Michael Wicherski.
 - Linux News:** linuxtoday.

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

Look in the Tools and Software section

VMware 101

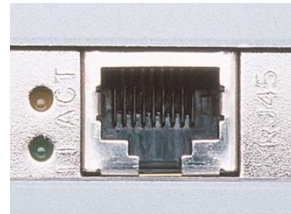
- Cabling
- Power on
- Move between
- Virtual Terminals
 - Shutdown



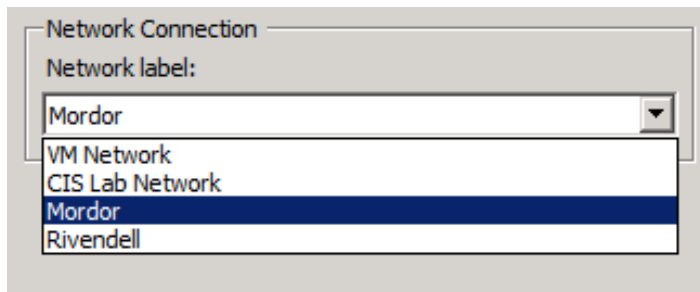
Cabling VMs

Physical and virtual cabling

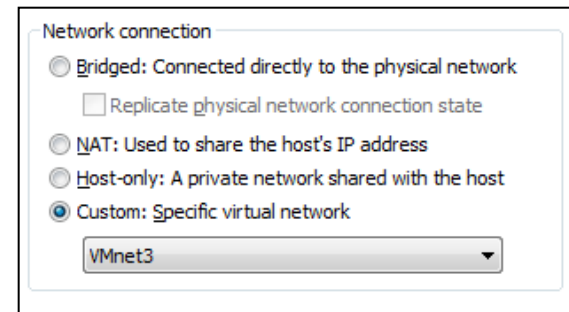
- In a physical environment we would connect Ethernet LAN cables between clients, servers, switches and routers.



- In a virtual environment cabling still must be done

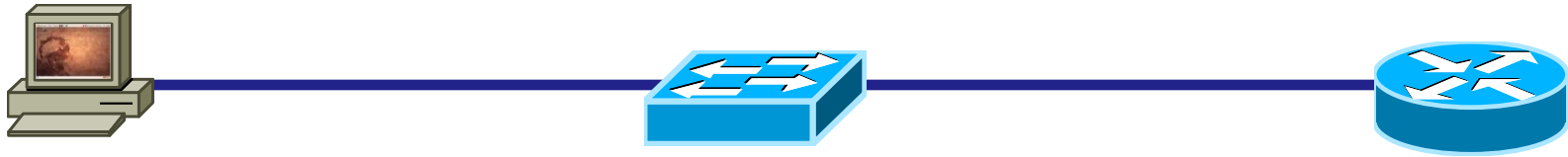


On VMware ESXi



On VMware Workstation

Cabling Devices on a Physical Network



Desktop PC



Switch



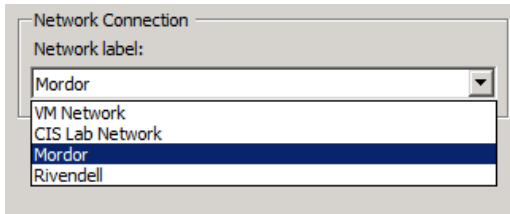
Router

Cabling a PC to a router using a switch

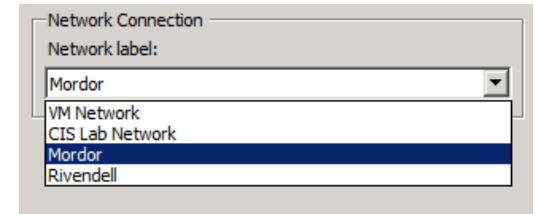
Cabling Devices on a Virtual Network



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



Network settings for the network adapter (NIC) on the client PC

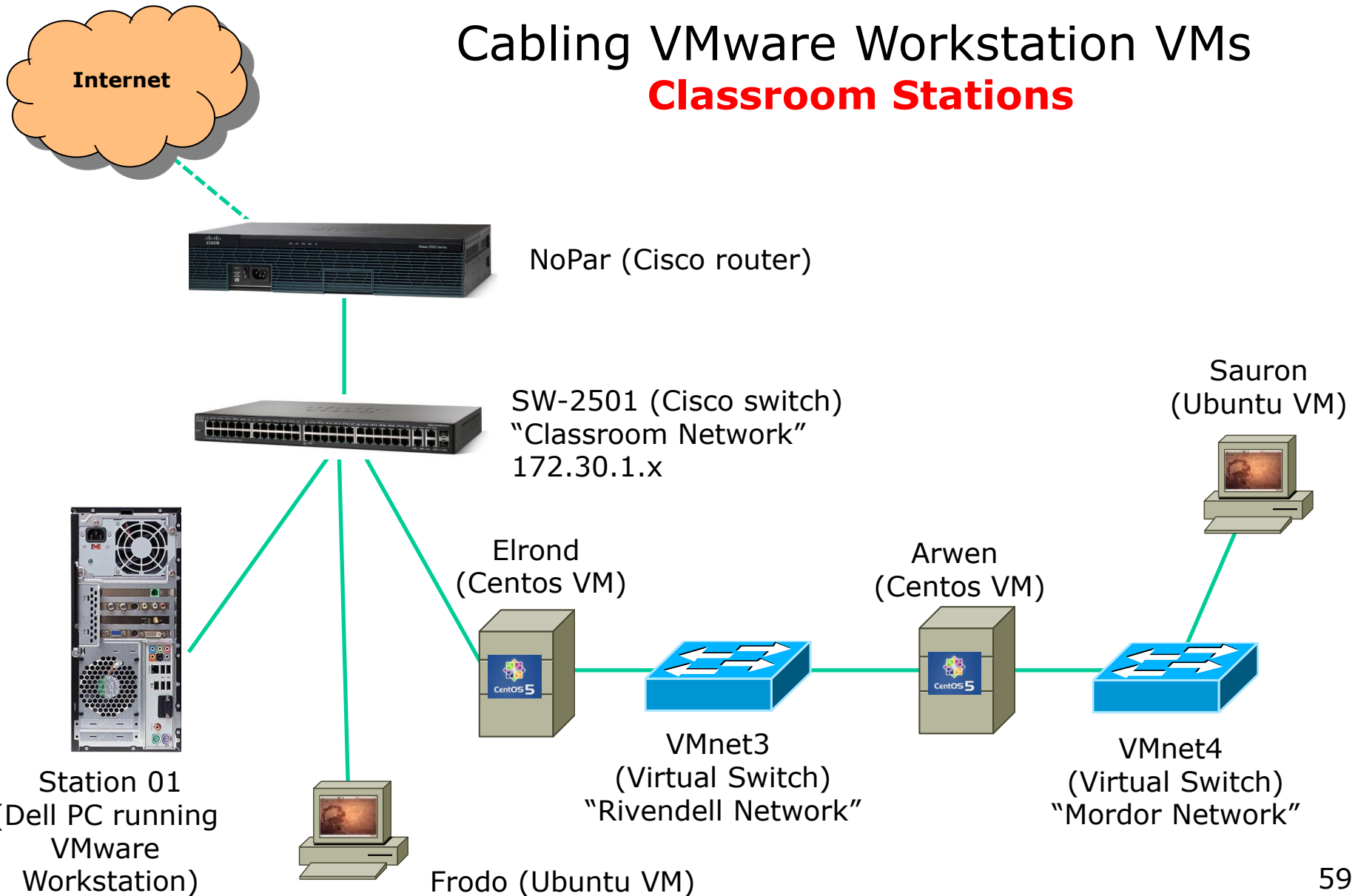


Network settings for the first network adapter (NIC) on the Linux router VM

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

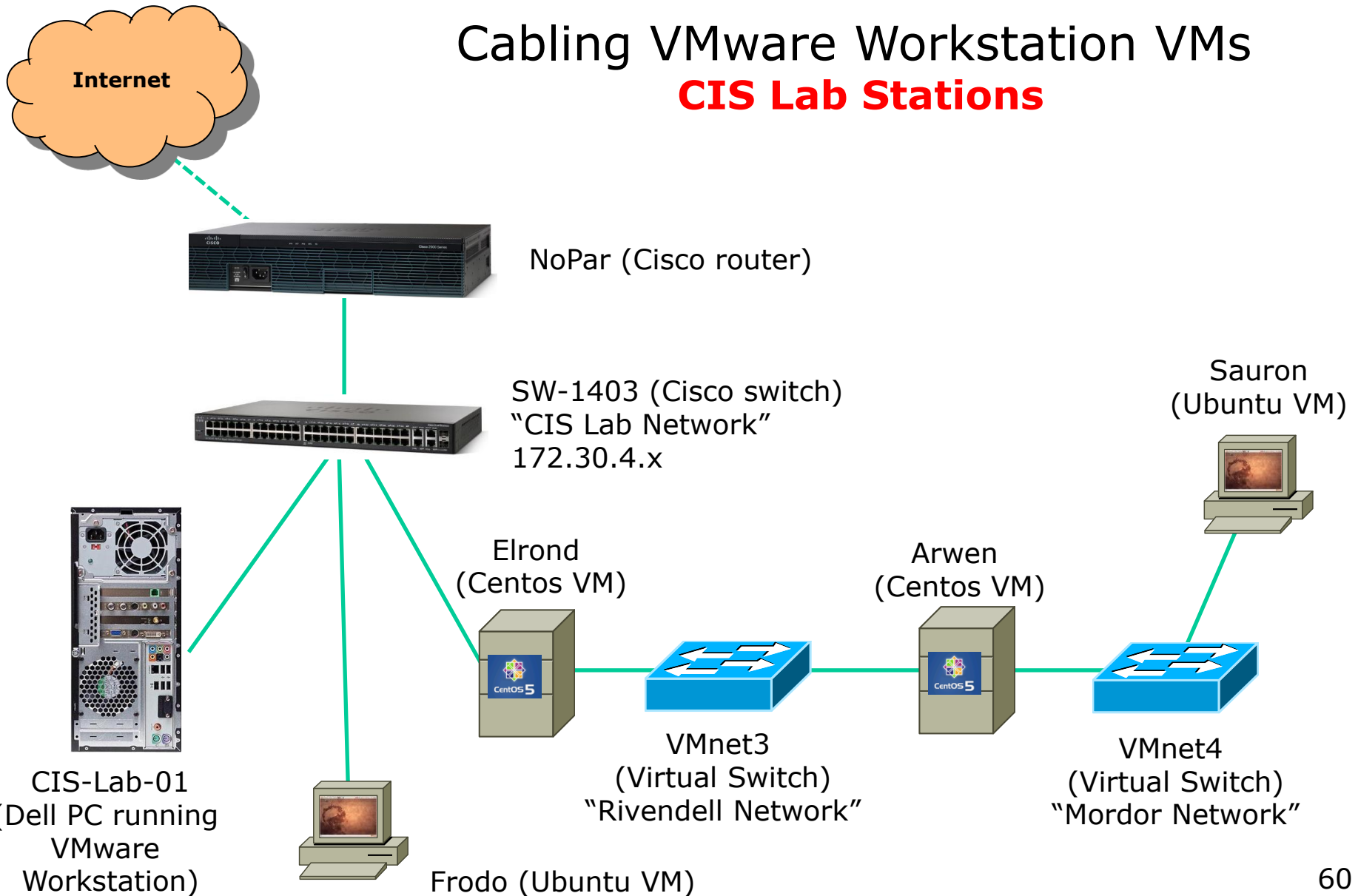
Cabling VMs VMware Workstation Example

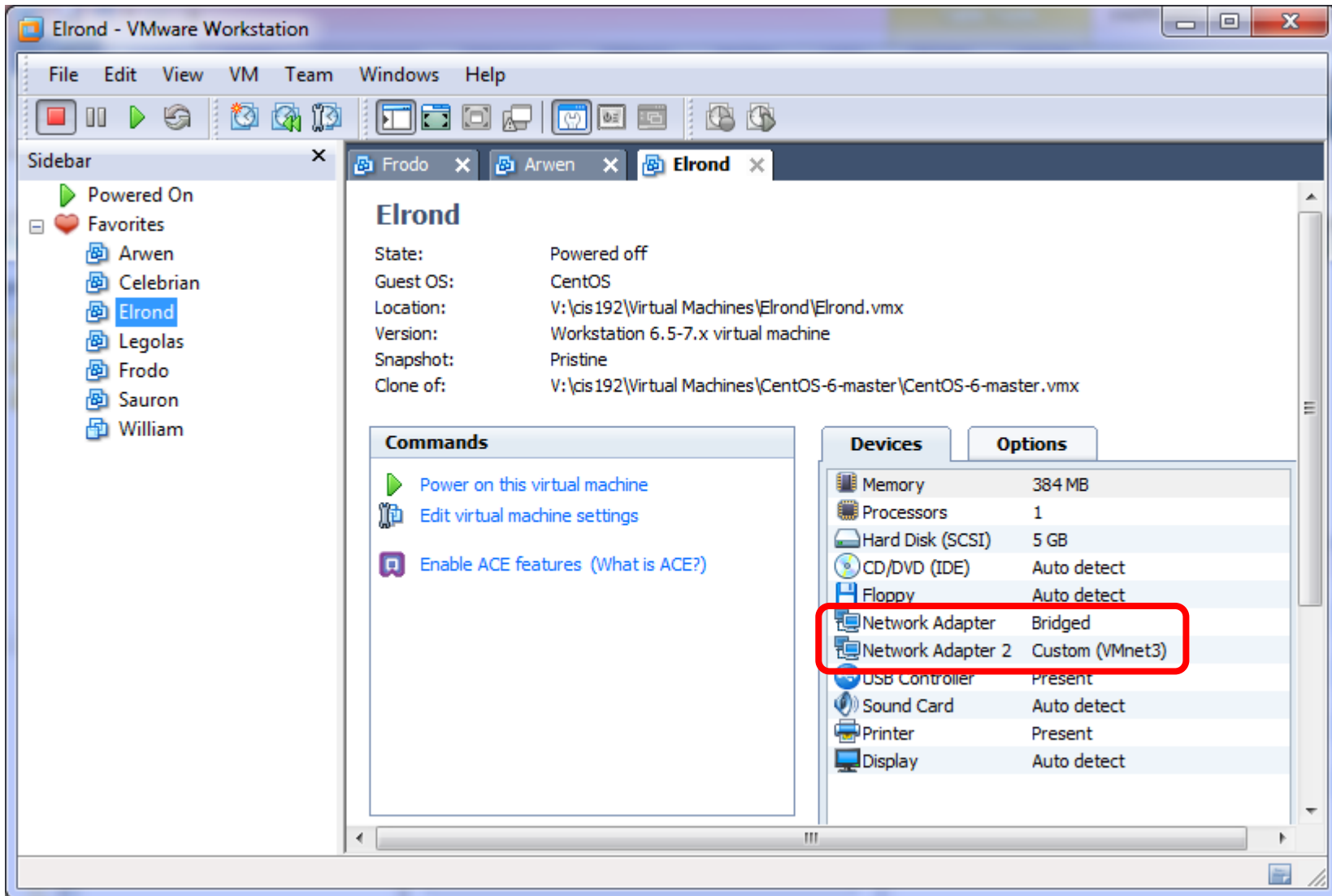
Cabling VMware Workstation VMs **Classroom Stations**



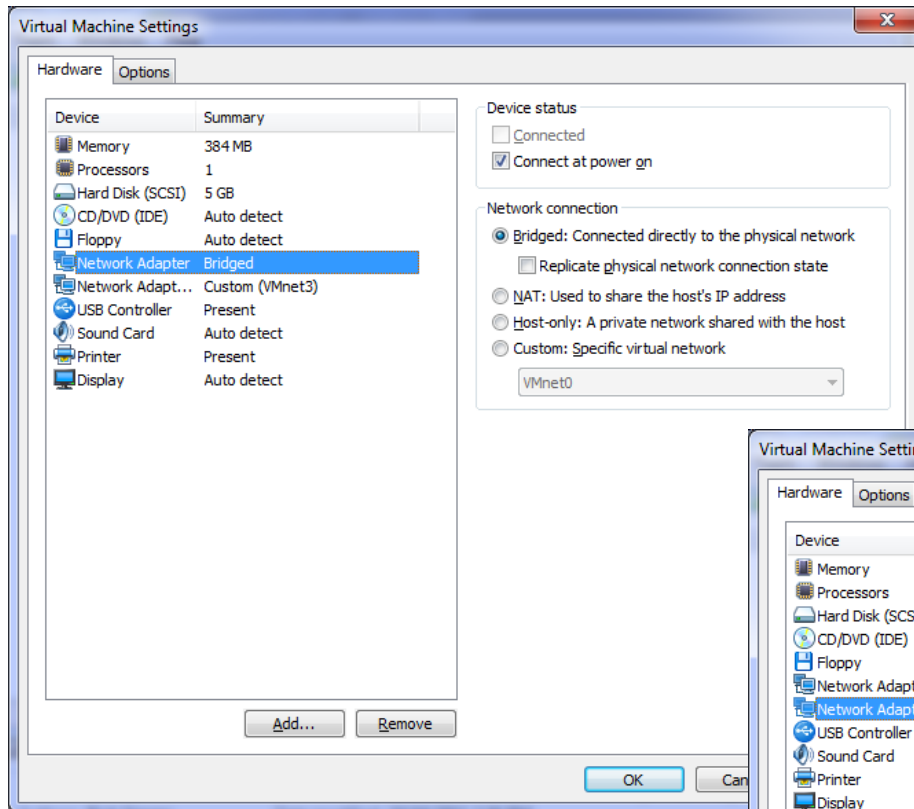
Cabling VMware Workstation VMs

CIS Lab Stations



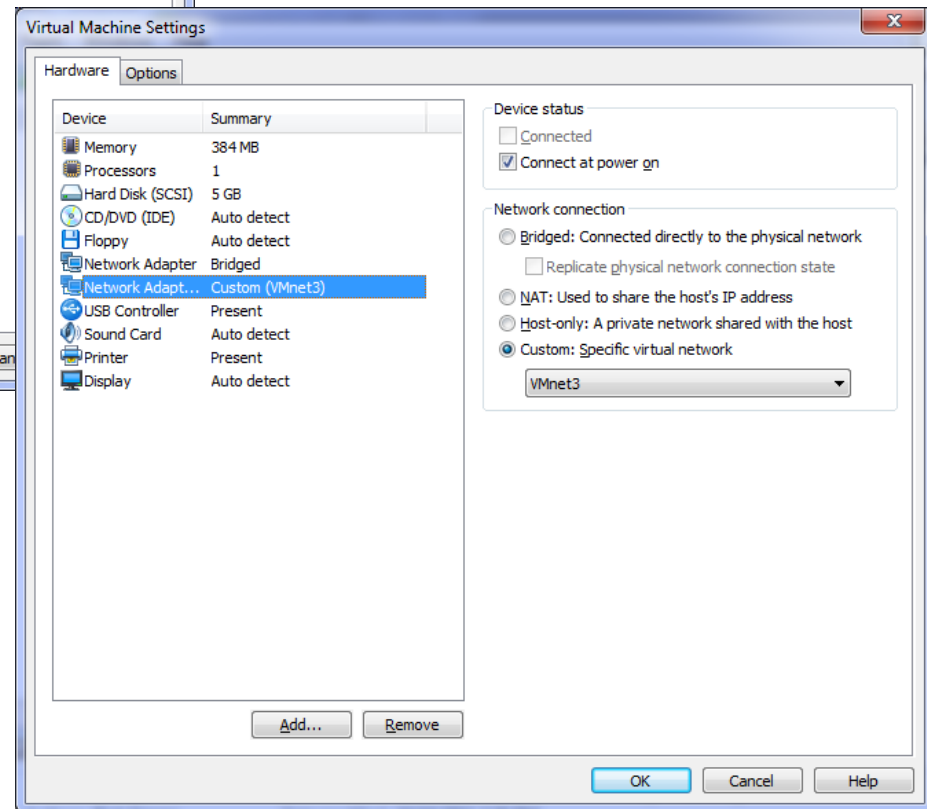


Elrond's network adaptors are cabled to the classroom or CIS Lab network (bridged) and the Rivendell network (vmnet3)

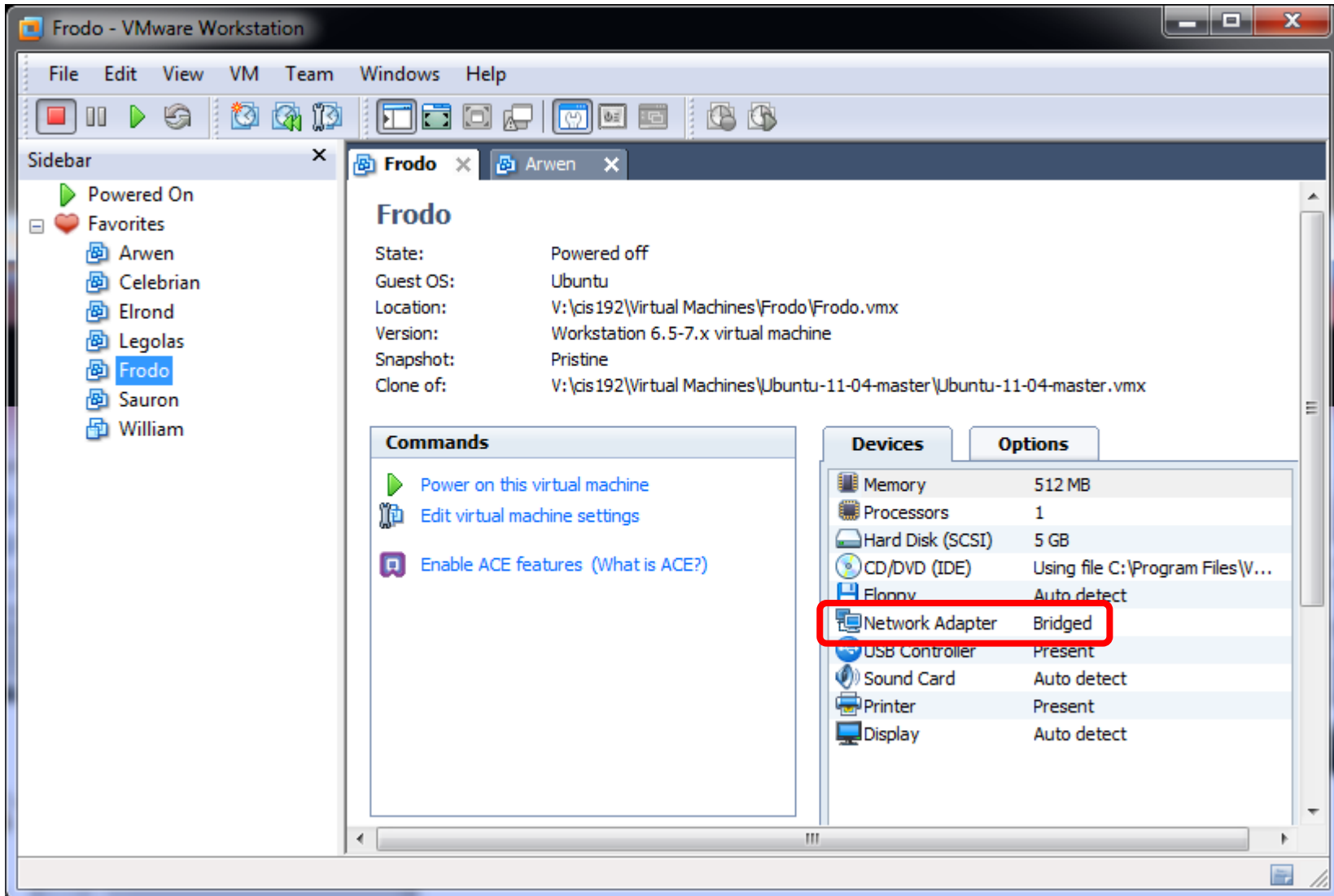


VMware Workstation

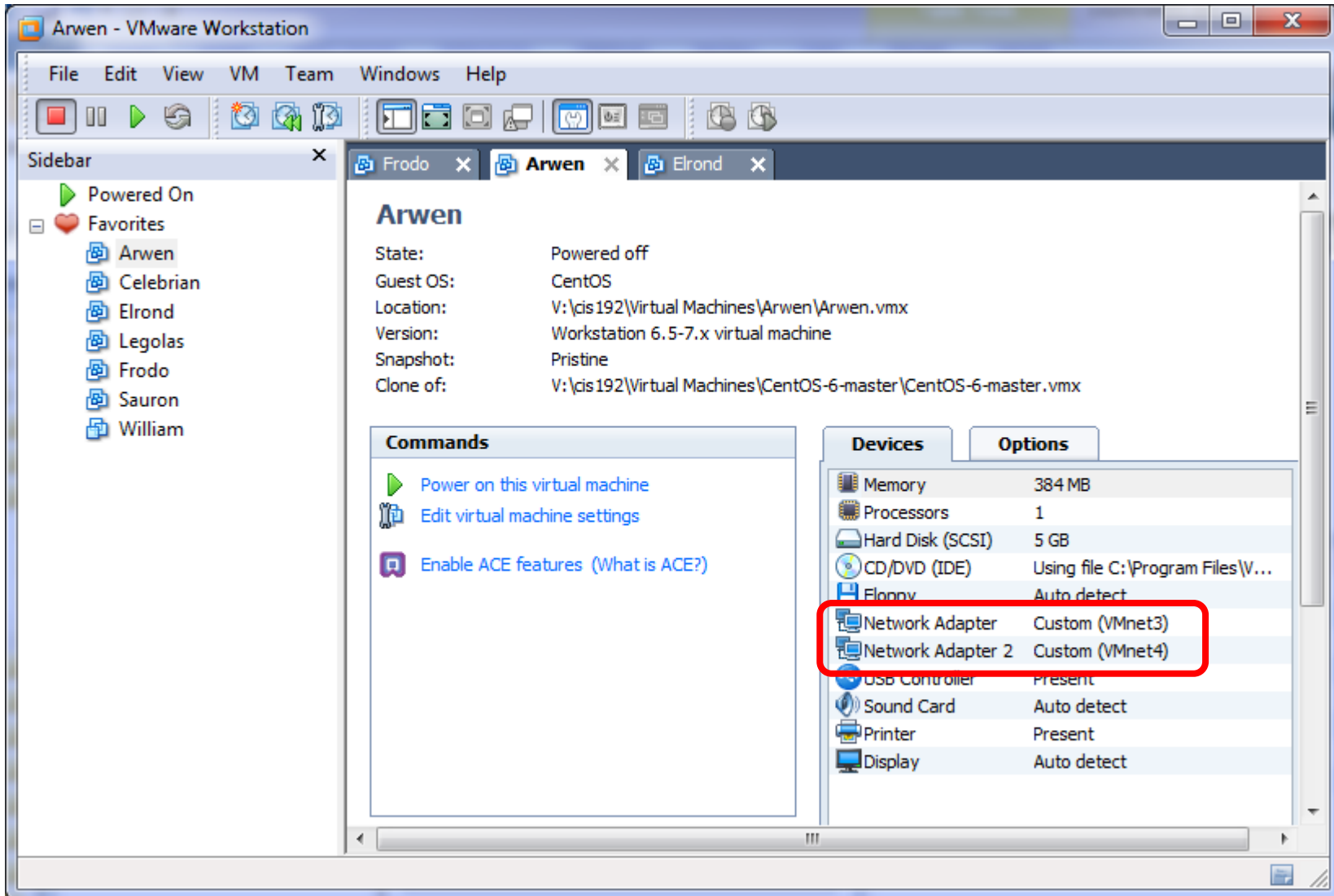
Use Edit Virtual Machine Settings to connect network adapters



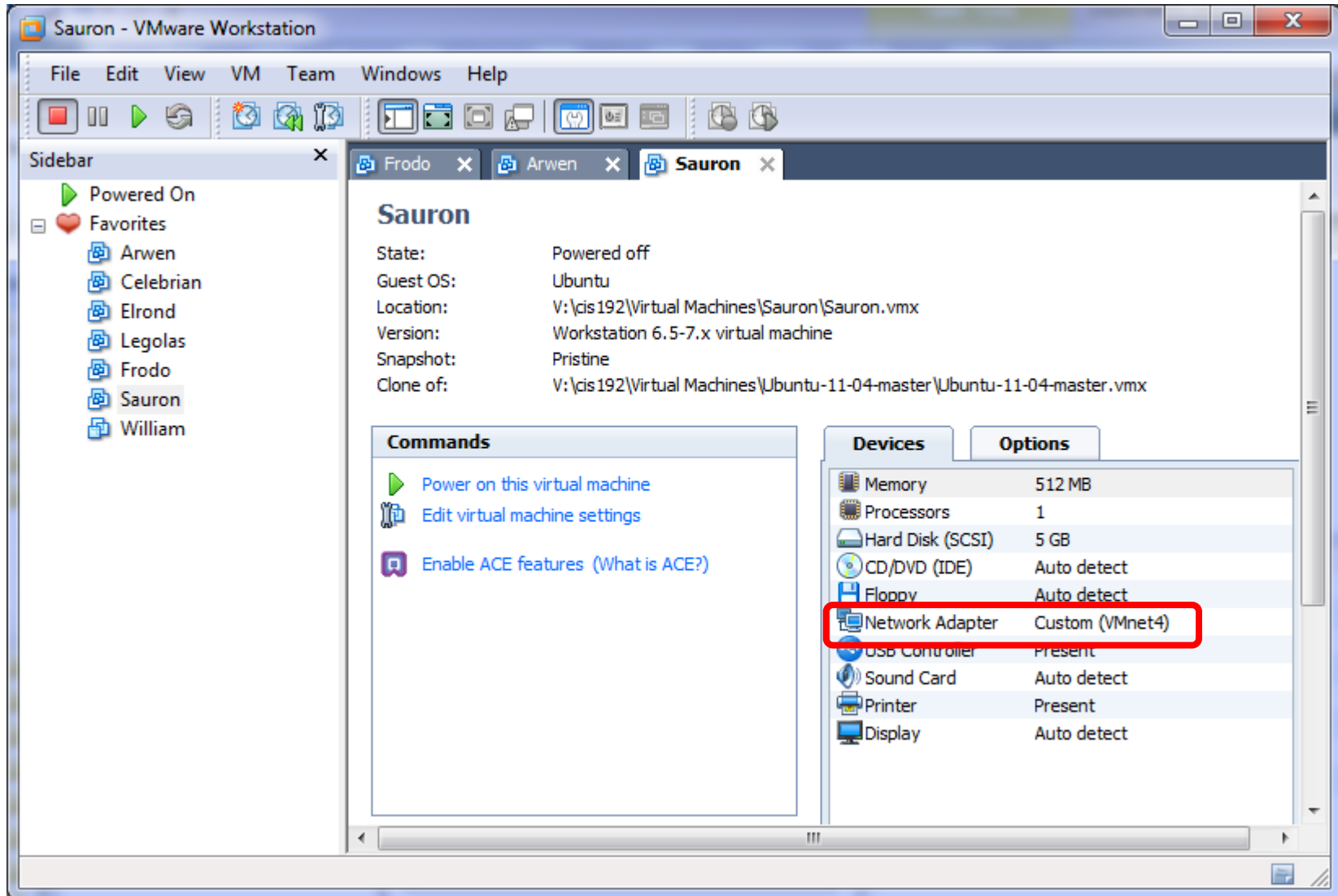
Elrond's network adaptors are cabled to the classroom or CIS Lab network (bridged) and the Rivendell network (vmnet3)



Frodo's network adaptor is cabled to the classroom or CIS Lab network (bridged)



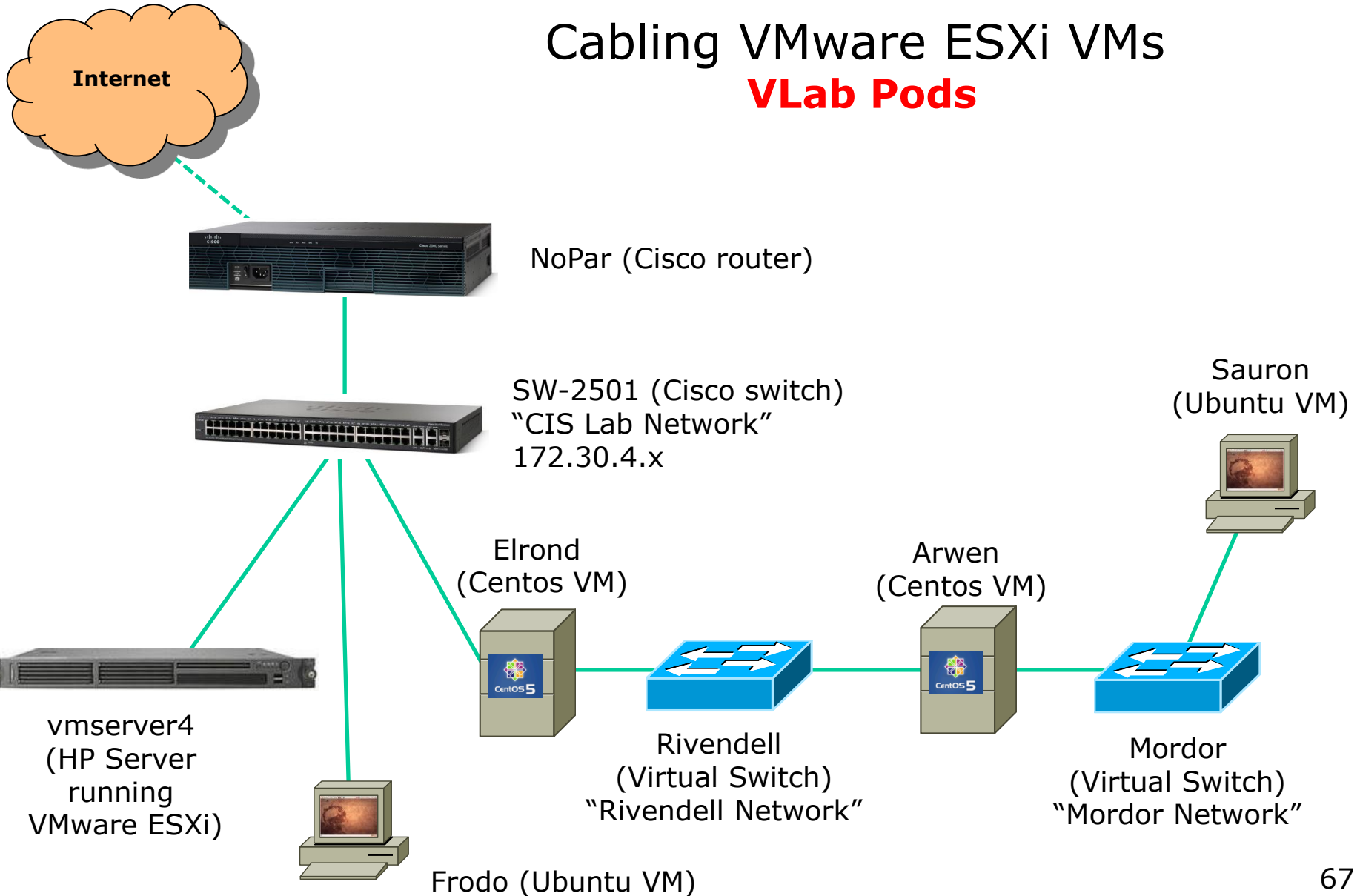
Legolas' network adaptors are cabled to the Rivendell network (vmnet3) and the Mordor network (vmnet4)



Sauron's network adaptor is cabled to the Mordor network (vmnet4)

Cabling VMs VMware ESXi Example

Cabling VMware ESXi VMs **VLab Pods**



vmserver4.cisvlab.net - vSphere Client

P1_Elrond - Virtual Machine Properties

Hardware | Options | Resources

Virtual Machine Version: 7

Show All Devices Add... Remove

Hardware	Summary
Memory	384 MB
CPUs	1
Video card	Video card
VMCI device	Restricted
SCSI controller 0	Paravirtual
Hard disk 1	Virtual Disk
CD/DVD Drive 1	/vmfs/volumes/3c36...
Network adapter 1	CIS Lab Network
Network adapter 2	Rivendell
Floppy drive 1	Client Device

Device Status

Connected

Connect at power on

Adapter Type

Current adapter: E1000

MAC Address

00:0c:29:fd:07:c7

Automatic Manual

Network Connection

Network label: CIS Lab Network

Help OK Cancel

Elrond's network adaptors are cabled to the CIS Lab network and the Rivendell network

vmserver4.cisvlab.net

P1_Frodo - Virtual Machine Properties

Hardware | Options | Resources

Virtual Machine Version: 7

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	[/vmfs/volumes/3c36
Network adapter 1	CIS Lab Network
Floppy drive 1	Client Device

Device Status

Connected
 Connect at power on

Adapter Type

Current adapter: VMXNET 3

MAC Address

00:0c:29:8d:4a:0d

Automatic Manual

Network Connection

Network label: CIS Lab Network

Help OK Cancel

Frodo's network adaptor is cabled to the CIS Lab network

vmserver4.cisvlab.net P1_Legolas - Virtual Machine Properties

Hardware Options Resources Virtual Machine Version: 7

Show All Devices Add... Remove

Hardware	Summary
Memory	384 MB
CPUs	1
Video card	Video card
VMCI device	Restricted
SCSI controller 0	Paravirtual
Hard disk 1	Virtual Disk
CD/DVD Drive 1	/vmfs/volumes/3c36...
Network adapter 1	Rivendell
Network adapter 2	Mordor
Floppy drive 1	Client Device

Device Status

Connected
 Connect at power on

Adapter Type

Current adapter: E1000

MAC Address

00:0c:29:13:98:d6

Automatic Manual

Network Connection

Network label: Rivendell

Help OK Cancel

Legolas' network adaptors are cabled to the Rivendell network and the Mordor network

vmserver4.cisvlab.net - v P1_Sauron - Virtual Machine Properties

File Edit View Inventory A Hardware Options Resources Virtual Machine Version: 7

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	/vmfs/volumes/3c36
Network adapter 1	Mordor
Floppy drive 1	Client Device

Device Status
 Connected
 Connect at power on

Adapter Type
Current adapter: VMXNET 3

MAC Address
00:0c:29:e7:f9:dd
 Automatic Manual

Network Connection
Network label:
Mordor

Recent Tasks

Name
Reconfigure virtual ma...
Reconfigure virtual ma...

Help OK Cancel

Sauron's network adaptor is cabled to the Mordor network

CRAZY Network Names

The crazy network names we use in this course

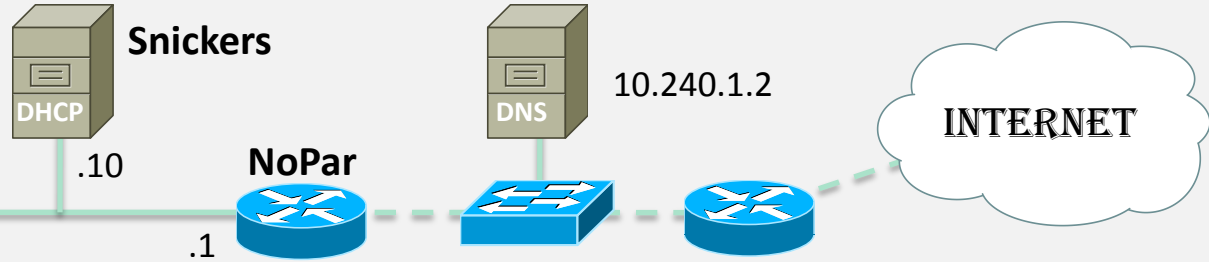
- Tradition is behind naming the networks used in the labs that goes back to when Jim created this course.
- The **Shire** network will refer to the physical LAN in either the classroom or the lab. On VMware Workstation we will use the **bridged** connection for this network.
- The **Rivendell** network will refer to the network that is one hop away. On VMware Workstation we will use **vmnet3** for this network.
- The **Mordor** network will refer to the network that is two hops away. On VMware Workstation we will use **vmnet4** for this network.

These networks used to be three physical networks in Room 2504, complete with banners hanging from the ceiling. The Rivendell and Mordor networks now are virtual.

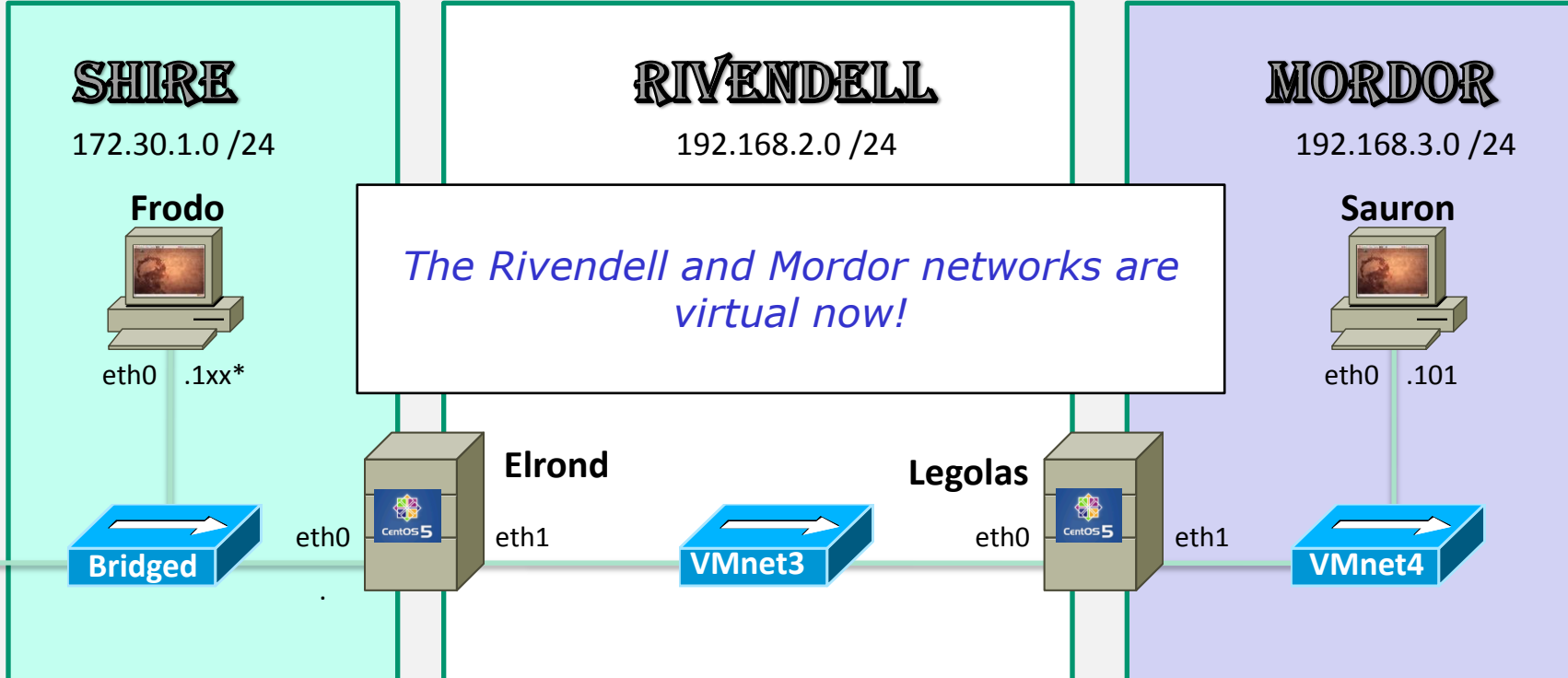
**CRAZY Network Names
being used in one of the
future lab assignments**

**Classroom
(VMware
Workstation)**

Room 2501 closet and beyond

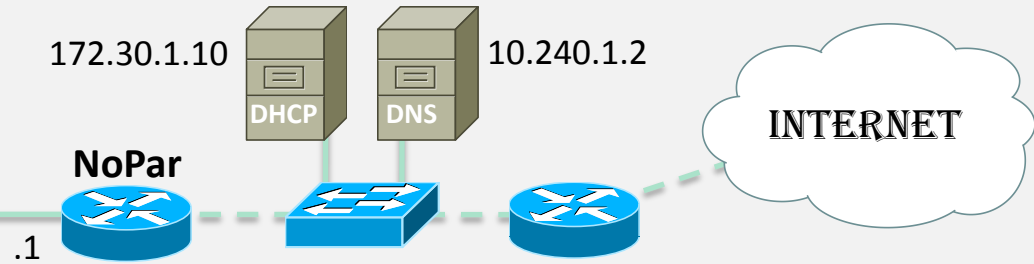


VMware Workstation

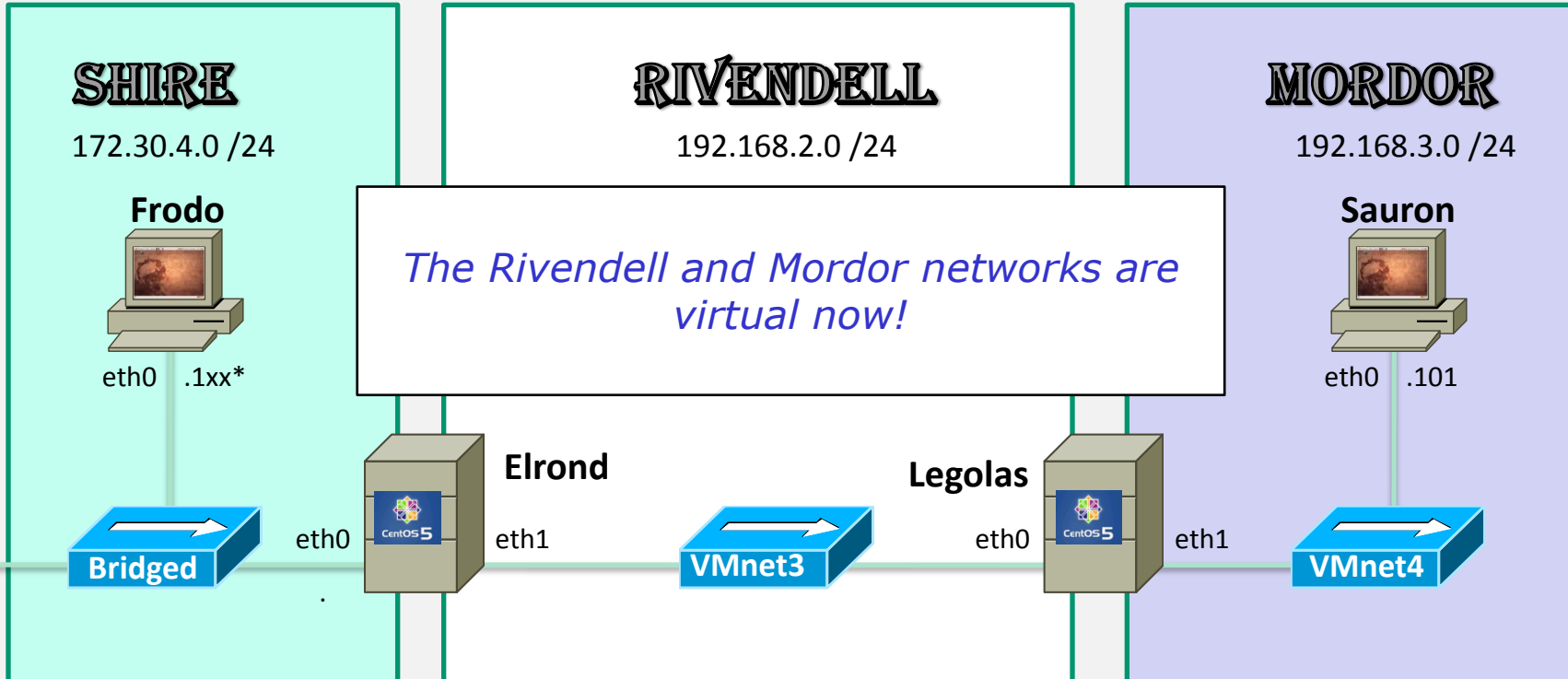


**CIS Lab
(VMware
Workstation)**

Room 2501 closet and beyond

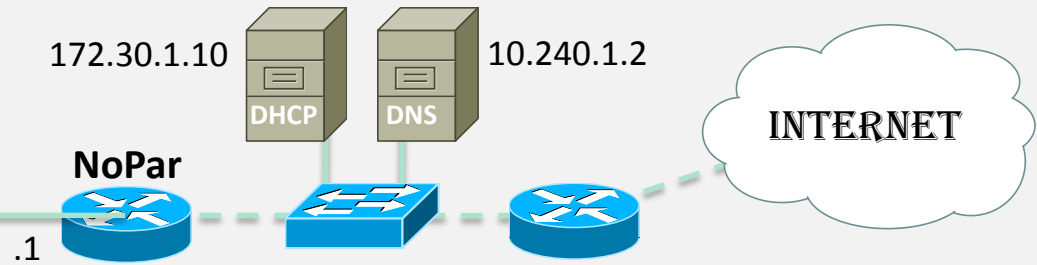


VMware Workstation

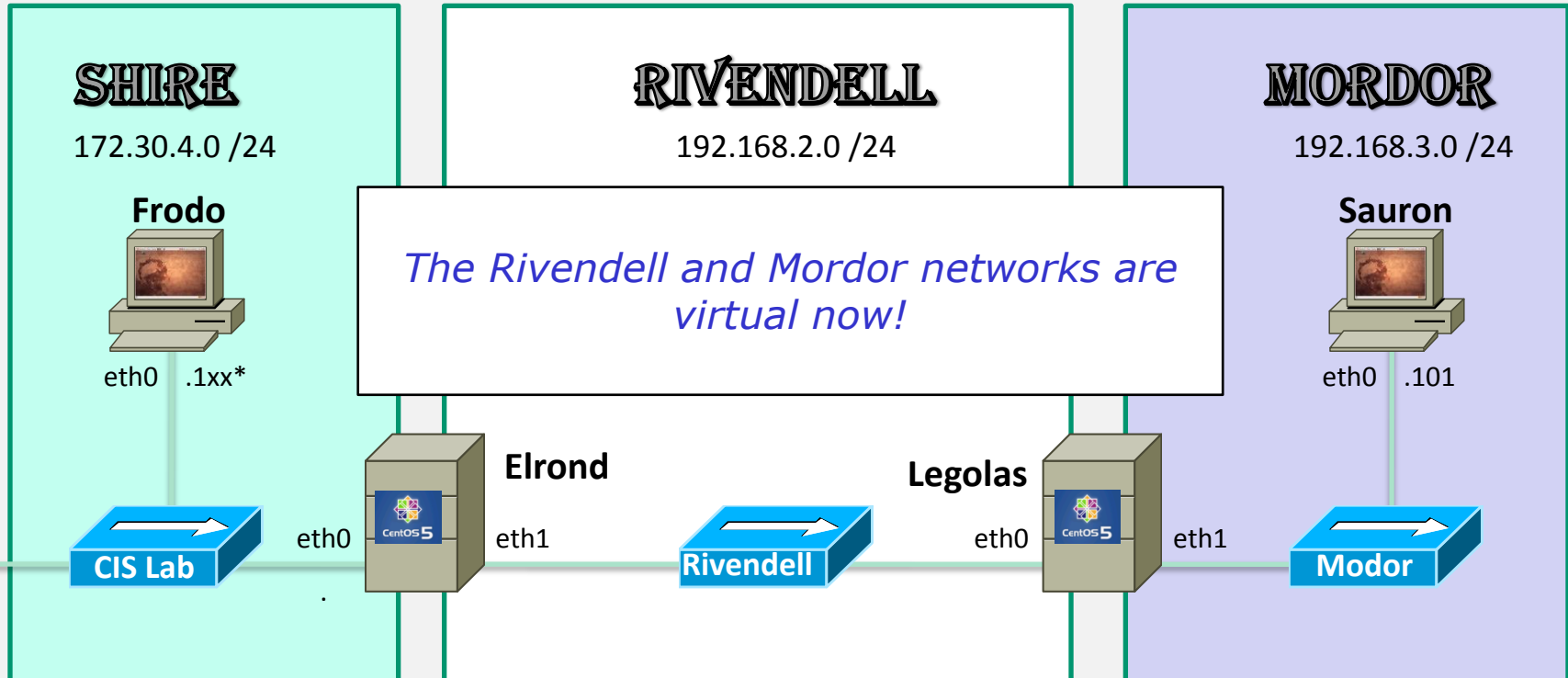


CIS VLab (VMware ESXi)

Room 2501 closet and beyond



VMware ESXi Pod





Class Activity Cabling VMs

Live Demo



Changing Virtual terminals

VMware VM Operations

Changing Virtual Terminals

The screenshot displays a VMware Workstation interface with three overlapping terminal windows. The background window, labeled 'tty7', shows the Ubuntu 11.04 desktop with a user login prompt. The middle window, labeled 'tty1', shows a terminal session with the prompt 'Ubuntu 11.04 frodo tty1' and the user 'frodo' logging in. The foreground window, labeled 'tty5', shows a terminal session with the prompt 'Ubuntu 11.04 frodo tty5' and the user 'frodo' logging in. A text box with a red border is overlaid on the 'tty5' window, containing the text: 'It can be very useful to have multiple login sessions on the same Linux VM. Virtual terminals is an easy way to do this.'

tty7

tty1

tty5



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.

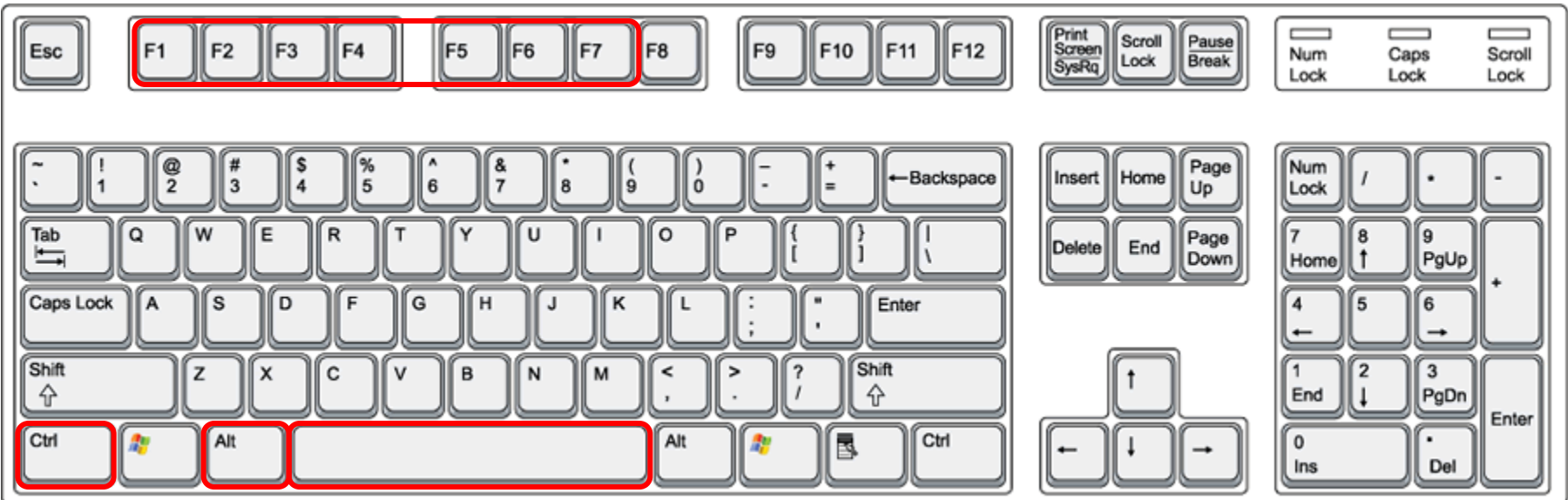
F7 is graphics mode for the Ubuntu VMs.

The Centos VMs do not have a graphics mode components installed (init 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

Live Demo

SSH Hopping

SSH (Secure Shell)

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

SSH Hopping – Putty into first system

root@treebeard:~

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

[root@treebeard ~]#
```

PuTTY Configuration

Category:

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

Basic options for your PuTTY session

Specify the destination you want to connect to

Host Name (or IP address) Port

Connection type:

Raw Telnet Rlogin SSH Serial

Load, save or delete a stored session

Saved Sessions

Always Never Only on clean exit

*Putty into Treebeard using the IP address shown by **ifconfig***

SSH Hopping – ssh into next system

The screenshot displays a VMware Server Console window titled "Local host - VMware Server Console". On the left, an "Inventory" pane lists several VMs: win-2008, win-7-pro, 192-cisco-R1, 192-cisco-R2, 192-Elrond, 192-Treebeard, and 192-empty. The main console area shows the following commands and output:

```
#logvol / --fstype ext3 --name=LogVol100 --vgname=VolGroup00 --size=1024 --grow
%packages
@core
[root@seedling76 ~]# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:0C:29:B6:8B:B4
          inet addr:10.10.10.191  Bcast:10.10.10.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:feb6:8bb4/64  Scope:Link
```

A smaller terminal window titled "root@seedling76:~" is overlaid on the main console, showing the following sequence of actions:

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

A red-bordered box highlights the text: *SSH into the Empty VM using the IP address from **ifconfig***



Class Activity SSH Hopping

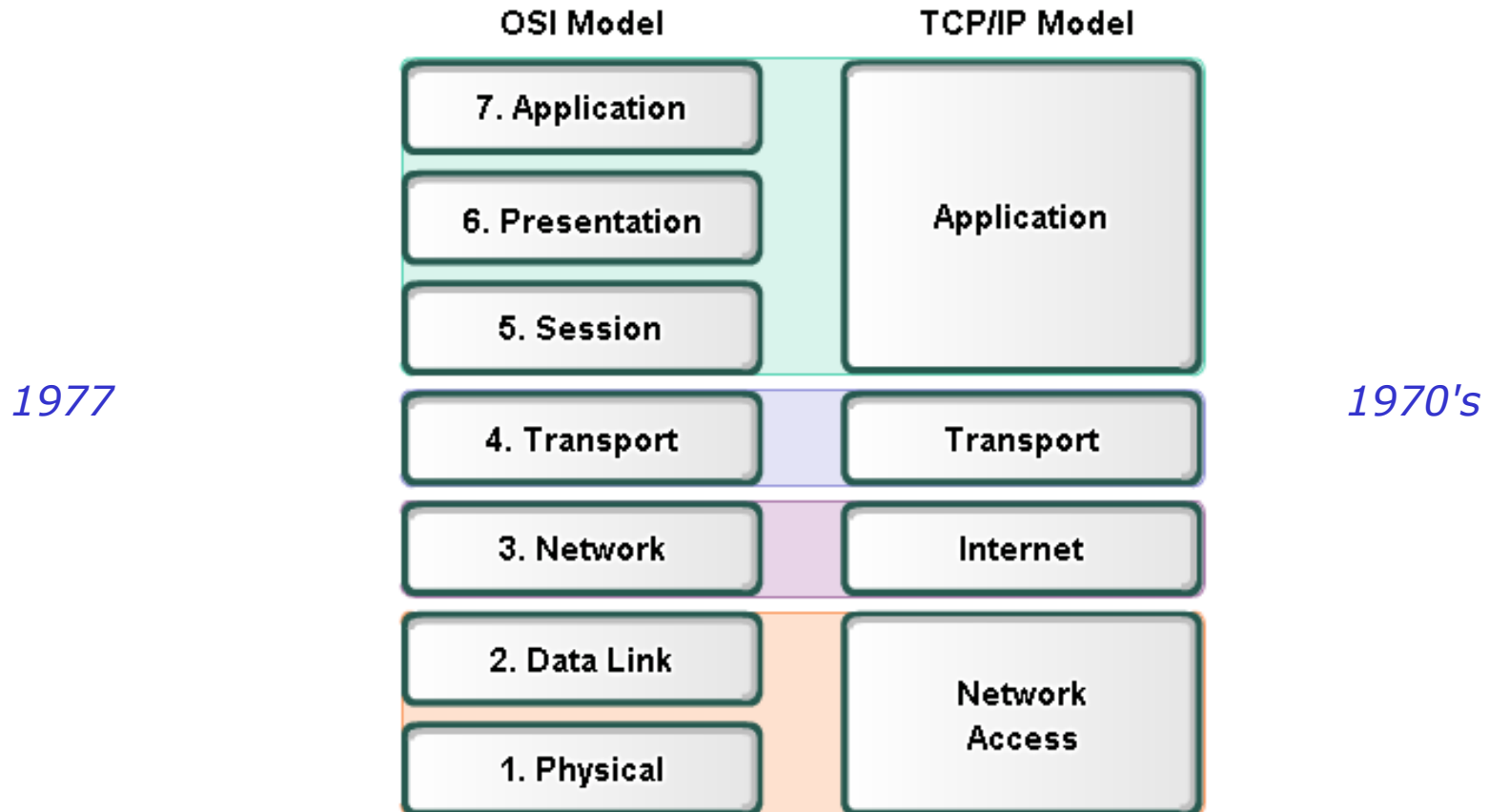
Live Demo

Q3

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

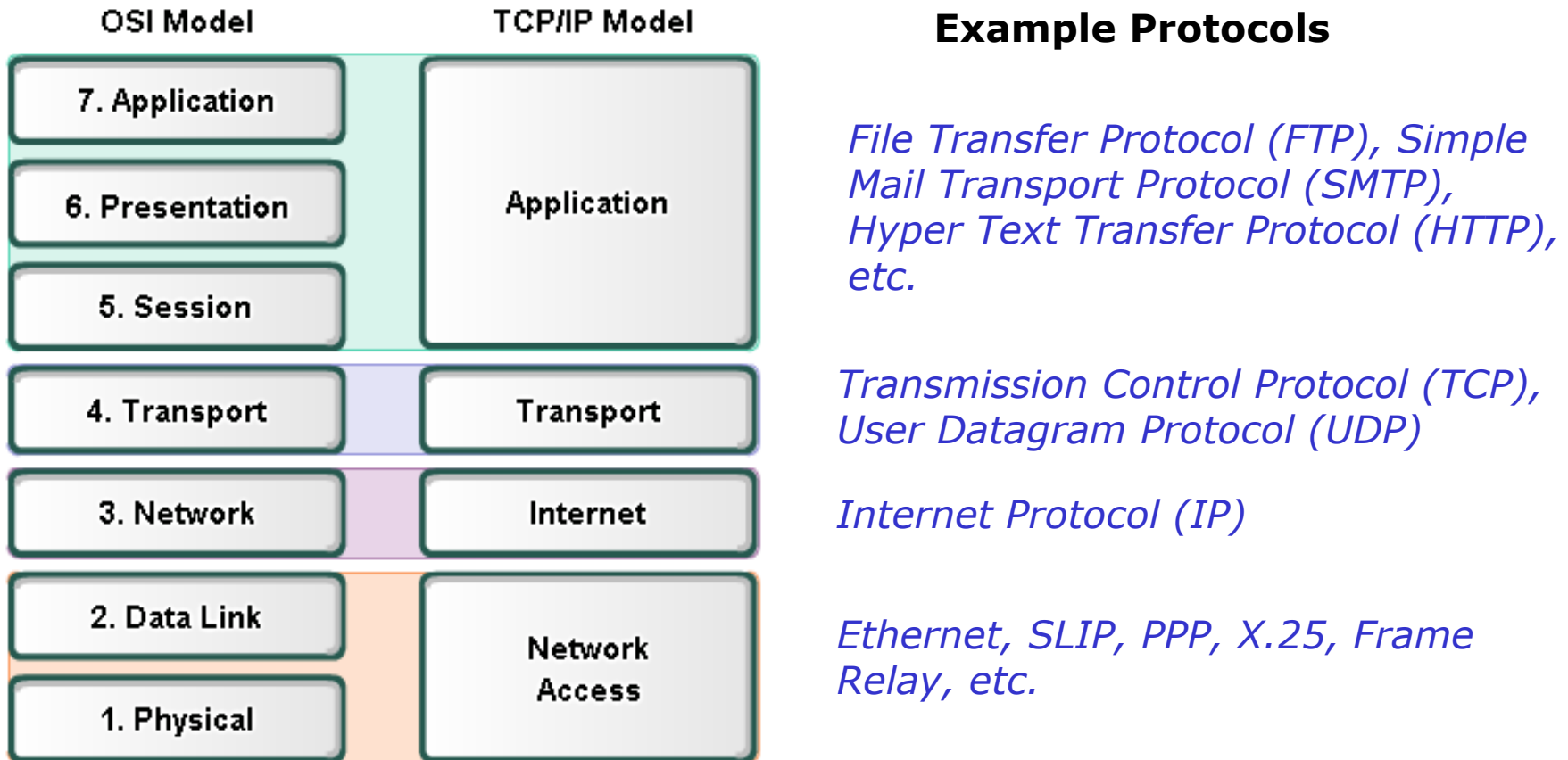
Network Basics

Protocol Reference Models



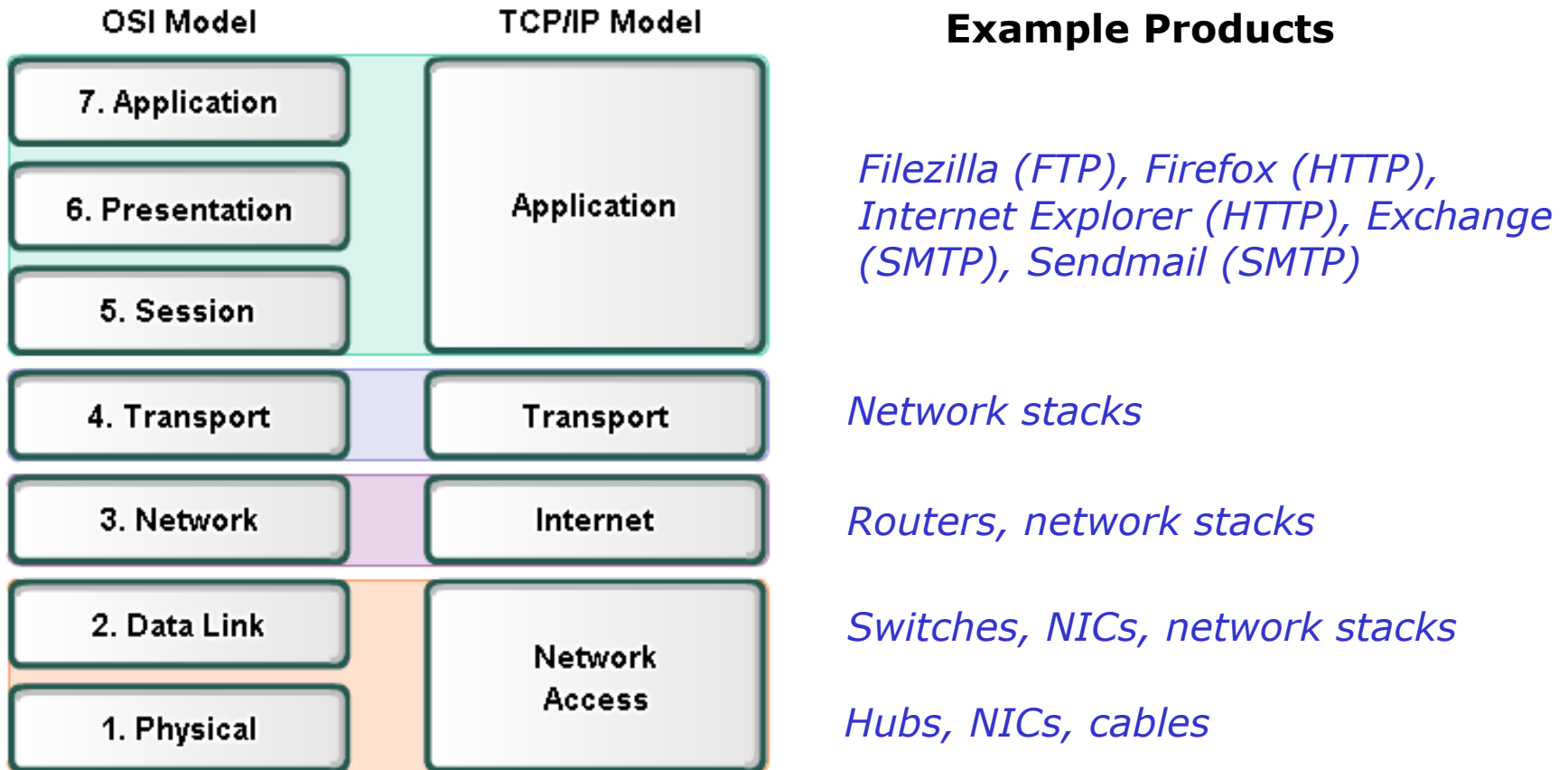
The **OSI** (Open Systems Interconnection) and **TCP/IP** models are define various **abstraction layers**. Each layer serves a different role in the overall communication process.

Protocol Reference Models



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

Protocol Reference Models



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

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

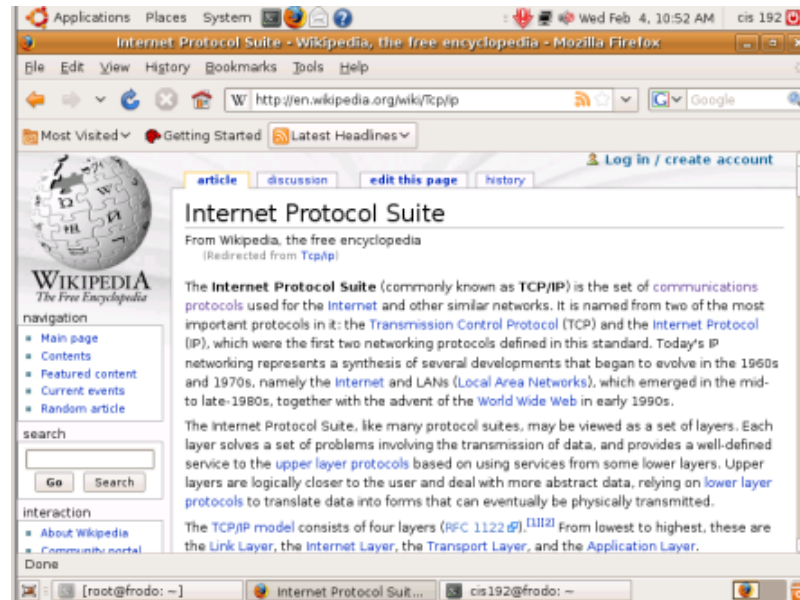
Reconciling the Layers

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

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

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

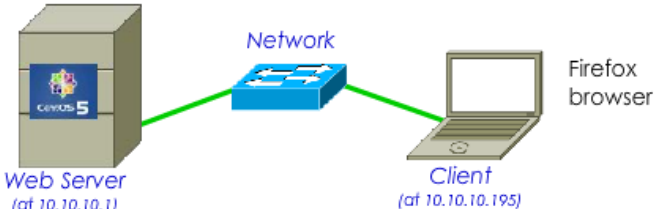
<http://simms-teach.com/animations/apache.html>



Linux Network Administration Apache Web Server

- Packet Forwarding
- DHCP
- DNS
- PXE
- Apache
- SSH Tunneling
- Routing Protocols
- Firewalls

How does a web server work?



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.

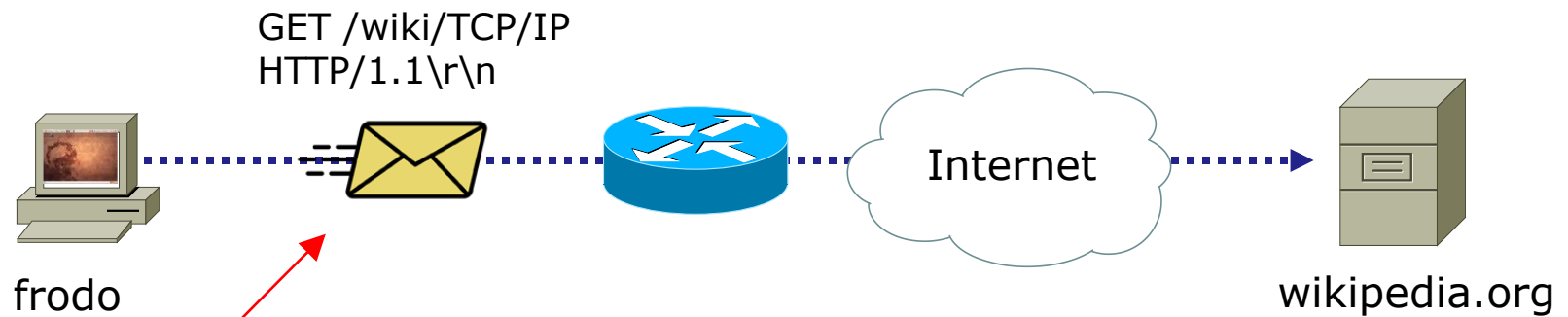
Click the green arrow to continue

- > 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

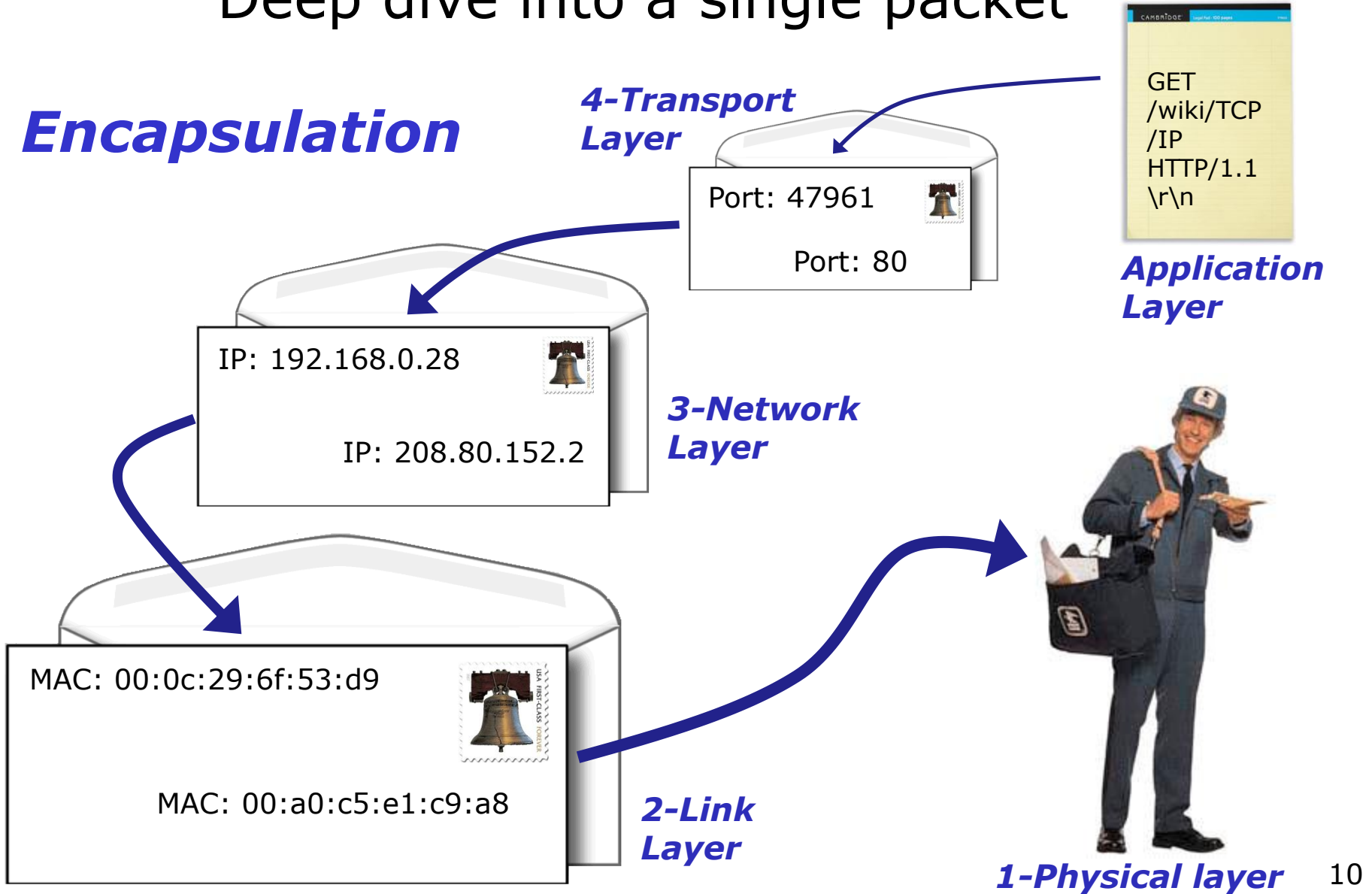
Deep dive into a single packet



*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

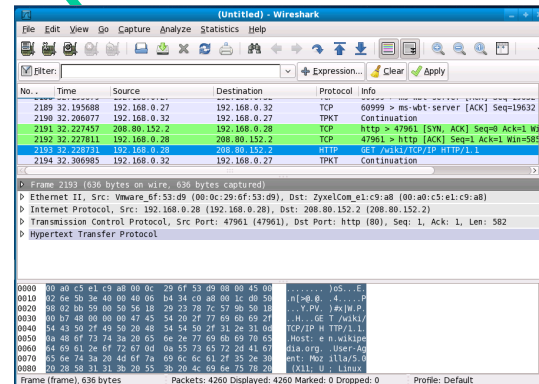
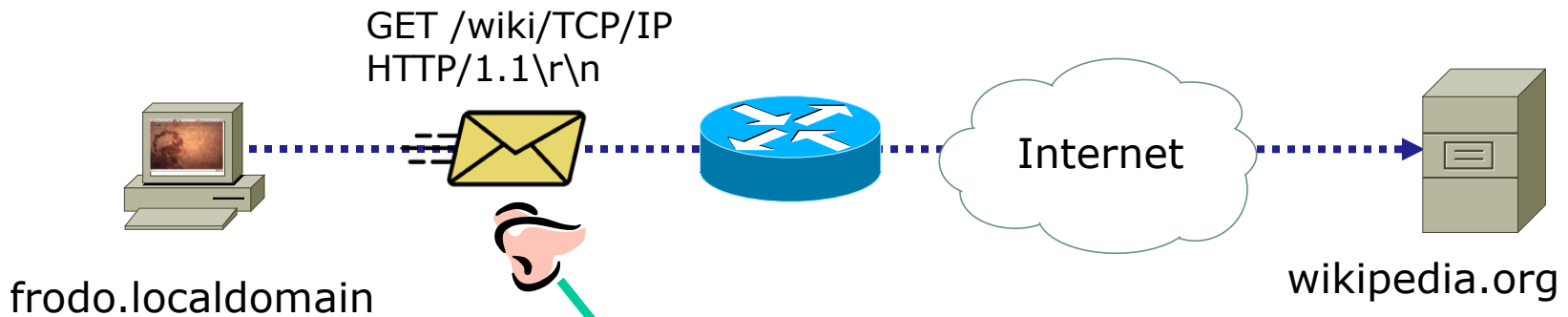
Encapsulation



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 the following packets:

No.	Time	Source	Destination	Protocol	Info
2189	32.195688	192.168.0.27	192.168.0.32	TCP	60999 > ms-wbt-server [ACK] Seq=19632
2190	32.206077	192.168.0.32	192.168.0.27	TPKT	Continuation
2191	32.227457	208.80.152.2	192.168.0.28	TCP	http > 47961 [SYN, ACK] Seq=0 Ack=1 Win=0 Len=0
2192	32.227811	192.168.0.28	208.80.152.2	TCP	47961 > http [ACK] Seq=1 Ack=1 Win=582 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

The selected packet (2193) is expanded in the packet details pane, showing 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, including the Ethernet II header, IP header, TCP header, and the HTTP GET request body.

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 [STW, ACK] Seq=0 Ack=1 Win=...
2192	32.227811	192.168.0.28	208.80.152.2	TCP	47961 > http [ACK] Seq=1 Ack=1 Win=585...
2193	32.228731	192.168.0.28	208.80.152.2	HTTP	GET /wiki/TCP/IP HTTP/1.1
2194	32.306985	192.168.0.32	192.168.0.27	TPKT	Continuation

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]

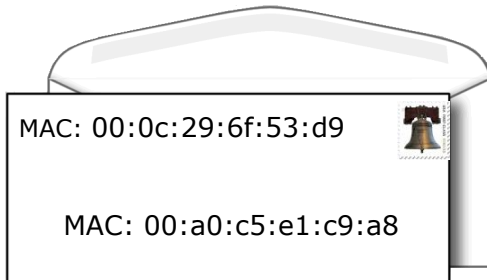
- Ethernet II, Src: Vmware_6f:53:d9 (00:0c:29:6f:53:d9), Dst: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
- Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)

```

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

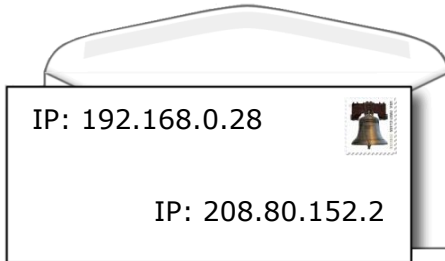
```

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*

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

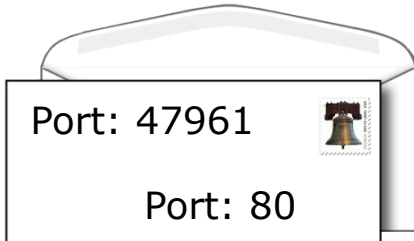
```

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	47961 > 47961 [ESTAB, 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)
- Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)
- Transmission Control Protocol, Src Port: 47961 (47961), Dst Port: http (80), Seq: 1, Ack: 1, Len: 582
 - Source port: 47961 (47961)
 - Destination port: http (80)
 - Sequence number: 1 (relative sequence number)
 - [Next sequence number: 583 (relative sequence number)]
 - Acknowledgement number: 1 (relative ack number)
 - Header length: 20 bytes
 - Flags: 0x18 (PSH, ACK)
 - Window size: 5856 (scaled)
 - Checksum: 0x4800 [correct]
 - Hypertext Transfer Protocol
 - 0000 00 a0 c5 e1 c9 a8 00 0c 29 6f 53 d9 08 00 45 00)oS...E.
 - 0010 02 6e 5b 3e 40 00 40 06 b4 34 c0 a8 00 1c d0 50 .n[>@.@. .4....P
 - 0020 98 02 bb 59 00 50 56 18 29 23 78 7c 57 9b 50 18 ...Y.PV.)#x|W.P.
 - 0030 00 b7 48 00 00 00 47 45 54 20 2f 77 69 6b 69 2f ..H...GE T /wiki/

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

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

Deep dive into a single packet – Application layer

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

*Application
layer
expanded*

The screenshot shows the Wireshark interface with a packet capture of an HTTP GET request. The packet list pane shows four packets, with packet 2193 selected. The packet details pane shows the expanded application layer for this packet, including the Hypertext Transfer Protocol section with the request line and various headers. The packet bytes pane shows the raw hex and ASCII data of the captured packet.

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\r\n
 - 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

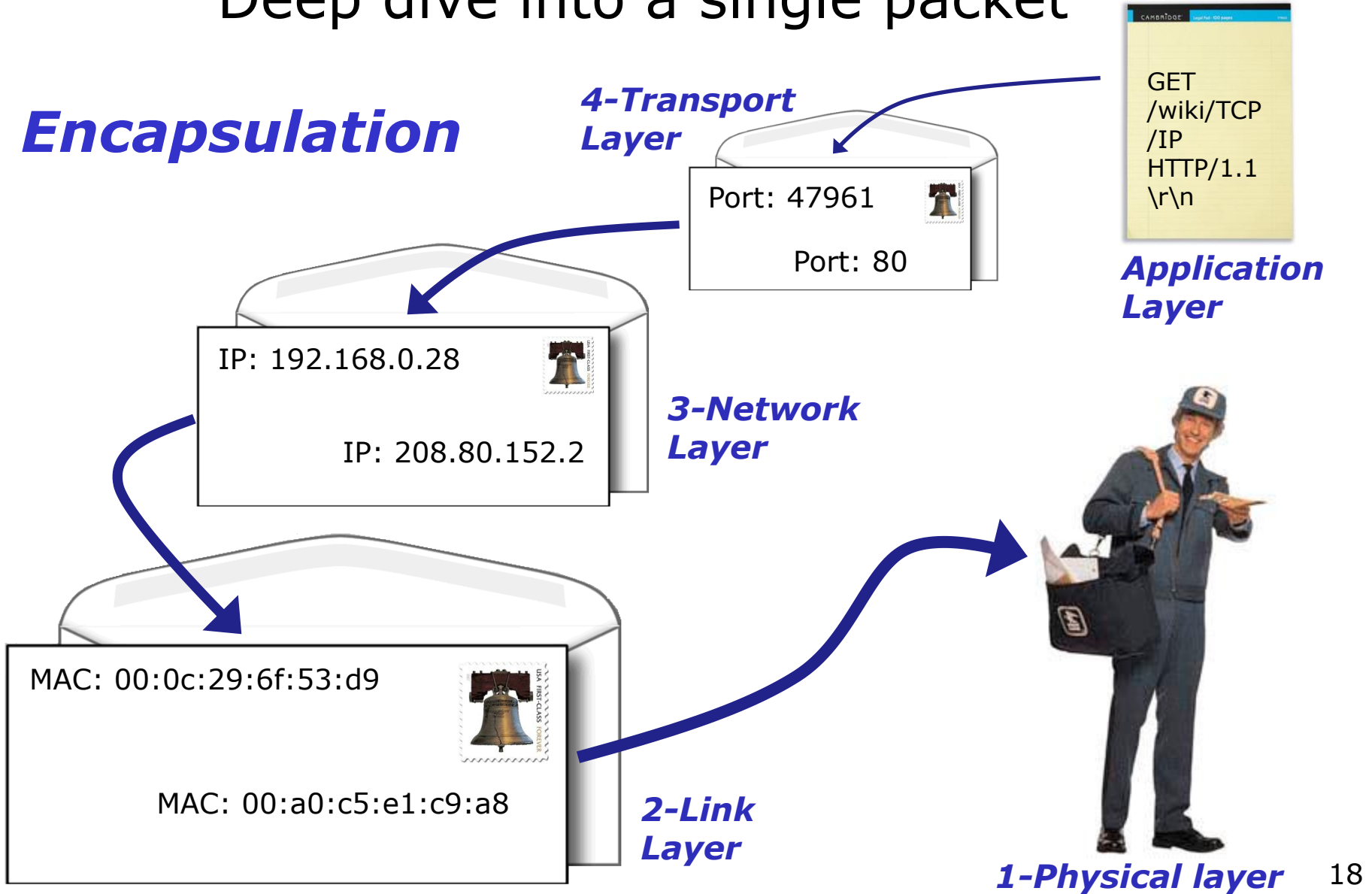
0000 00 a0 c5 e1 c9 a8 00 0c 29 6f 53 d9 08 00 45 00)oS...E.
 0010 02 6e 5b 3e 40 00 40 06 b4 34 c0 a8 00 1c d0 50 .n[>@.@. .4....P
 0020 98 02 bb 59 00 50 56 18 29 23 78 7c 57 9b 50 18 ...Y.PV.)#x|W.P.
 0030 00 b7 48 00 00 00 47 45 54 20 2f 77 69 6b 69 2f ..H...GE T /wiki/

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 18

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>**

The screenshot shows the IEEE Xplore Standards page. The browser address bar displays ieeexplore.ieee.org/xpl/standards.jsp. The page features a search bar with the IEEE logo and navigation tabs for 'Browse', 'My Settings', 'Cart', and 'Sign Out'. Under the 'Browse Standards' section, there are filters for 'By Number', 'By Subject', and 'By Subscription'. The 'Browse by Standard Range' section includes a grid of ranges: 0-99, 100-199, 200-299, 300-399, 400-499, 500-599, 600-699, 700-799, 800-899, 900-999, 1000-1099, 1100-1199, 1200-1299, 1300-1399, 1400-1499, 1500-1599, 1600-1699, and 1700->. There are also 'N', 'S', and 'Y' buttons. A 'Browse by Number or Keyword' search box is present. The 'Display Options' section includes 'Results Per Page' (set to 10) and checkboxes for 'Show Active Titles Only' and 'Show Redline Titles Only'. A 'WELCOME' message for Richard Simms (ID #92107045) is visible. The 'RECENTLY PUBLISHED' section lists three standards: 1. IEEE Std C37.20.7-2007 (Revision of IEEE Std C37.20.7-2001) - Redline; 2. IEEE Std C57.12.35-2007 (Revision of IEEE Std C57.12.35-1996) - Redline; 3. IEEE Std C57.13.1-2006. The page indicates '1343 Results Returned'.

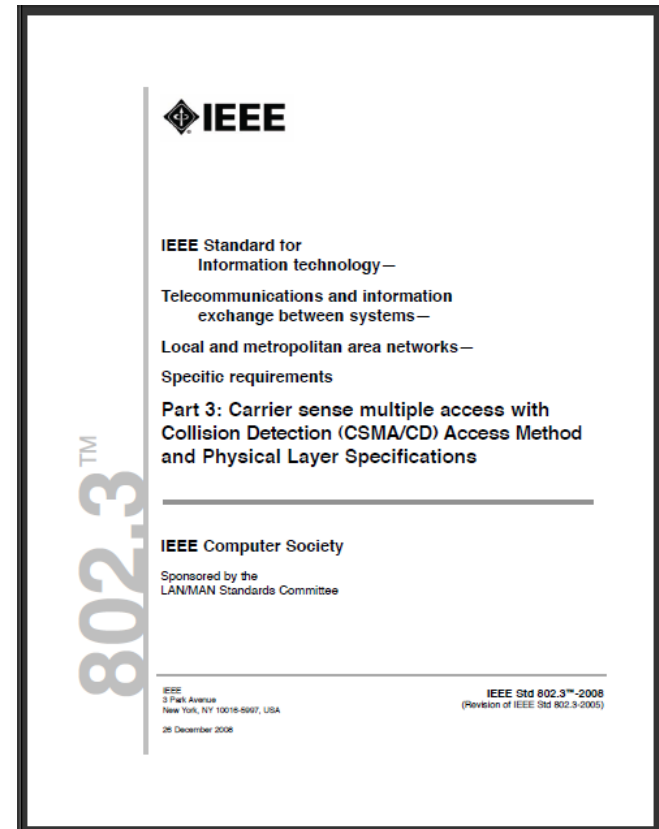
IEEE Standards

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)

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

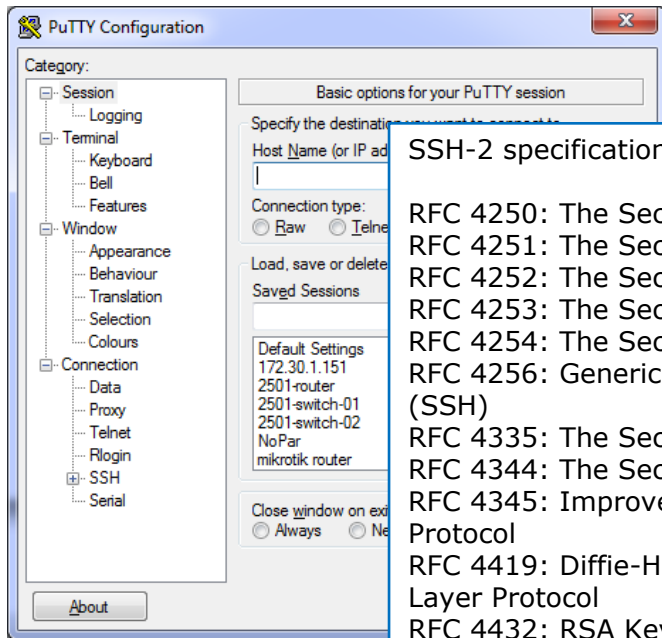
DHCP example

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

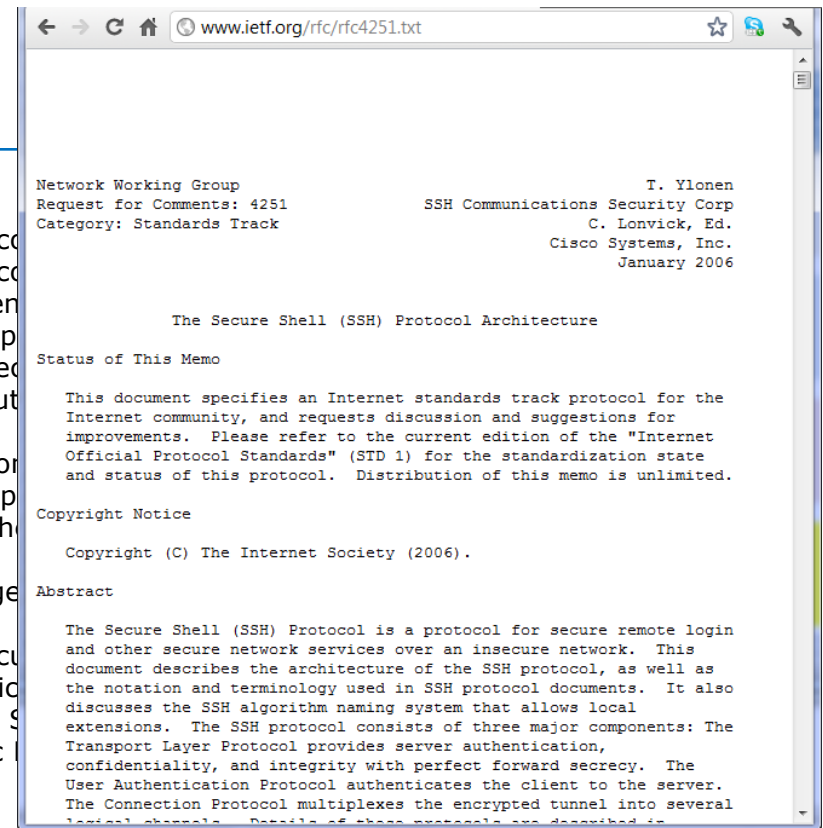
Standards

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 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

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
 - may be available from the vendor
 - may be available from a third party
 - may have to be downloaded and build (compile) it
3. Load the driver (insmod or modprobe command)
4. Bring up and configure the interface (ifconfig)

We will go through each of these four steps

NIC

aka

Network Interface Card
Network Interface Controller
Network Adapter
Ethernet Device

Connecting your Linux system to the Network

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

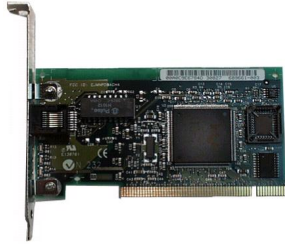
2. Locate a driver for your NIC

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

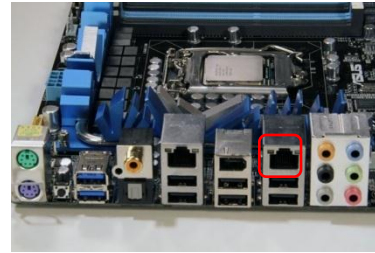
3. Load the driver (**insmod** or **modprobe** command)

4. Bring up and configure the interface (ifconfig)

NIC (Network Interface Card/Controller)



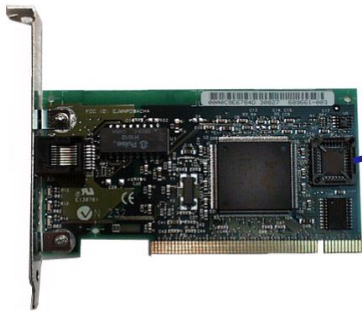
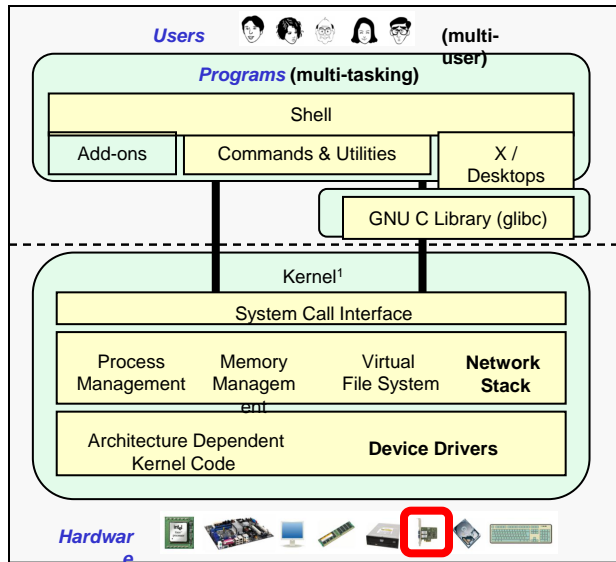
NIC card



NIC on the motherboard

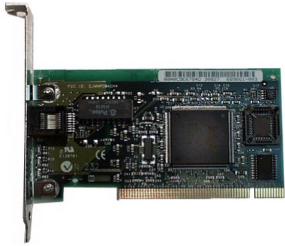
- The NIC is used by a computer to send and receive packets on the network.
- Most PC NICs are now part of the motherboard rather than a card.
- A NIC can operate at the level 2 (Link Layer) sending and receiving Ethernet frames based on MAC addresses.
- Multiple NICs allow a computer to be on multiple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

NIC Hardware Inventory



How to determine what NIC you have:

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



NIC Hardware Inventory

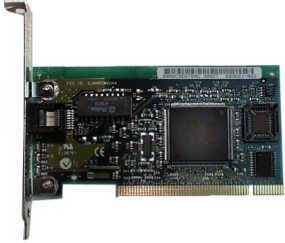
lspci command ... *on a classroom VM*

```
[root@celebrian ~]# lspci
00:00.0 Host bridge: Intel Corporation 440BX/ZX/DX - 82443BX/ZX/DX Host bridge (rev 01)
00:01.0 PCI bridge: Intel Corporation 440BX/ZX/DX - 82443BX/ZX/DX AGP bridge (rev 01)
00:07.0 ISA bridge: Intel Corporation 82371AB/EB/MB PIIX4 ISA (rev 08)
00:07.1 IDE interface: Intel Corporation 82371AB/EB/MB PIIX4 IDE (rev 01)
00:07.3 Bridge: Intel Corporation 82371AB/EB/MB PIIX4 ACPI (rev 08)
00:07.7 System peripheral: VMware Virtual Machine Communication Interface (rev 10)
00:0f.0 VGA compatible controller: VMware SVGA II Adapter
00:10.0 SCSI storage controller: LSI Logic / Symbios Logic 53c1030 PCI-X Fusion-MPT Dual
  Ultra320 SCSI (rev 01)
00:11.0 PCI bridge: VMware PCI bridge (rev 02)
00:15.0 PCI bridge: VMware PCI Express Root Port (rev 01)
< snipped >
00:18.7 PCI bridge: VMware PCI Express Root Port (rev 01)
02:00.0 USB Controller: Intel Corporation 82371AB/EB/MB PIIX4 USB
02:01.0 Ethernet controller: Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE] (rev 10)
02:02.0 Ethernet controller: Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE] (rev 10)
02:03.0 Multimedia audio controller: Ensoniq ES1371 [AudioPCI-97] (rev 02)
02:04.0 USB Controller: VMware USB2 EHCI Controller
[root@celebrian ~]#
```

*Interpretation: The Celebrian VM on a **classroom PC** has two NICs installed.*

The NIC vendor is AMD and the model is 79c970.

NIC Hardware Inventory



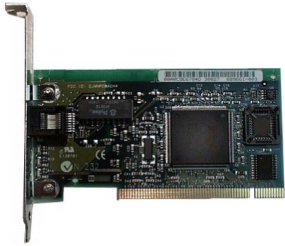
dmesg command ... *on a classroom VM*

```
[root@celebrian ~]# dmesg | grep net
Initializing cgroup subsys net_cls
audit: initializing netlink socket (disabled)
SELinux: Registering netfilter hooks
Initializing XFRM netlink socket
Initialzing network drop monitor service
VMware vmxnet virtual NIC driver
vmxnet 0000:02:01.0: PCI INT A -> GSI 19 (level, low) -> IRQ 19
Found vmxnet/PCI at 0x2024, irq 19.
vmxnet 0000:02:02.0: PCI INT A -> GSI 16 (level, low) -> IRQ 16
Found vmxnet/PCI at 0x20a4, irq 16.
pcnet32.c:v1.35 21.Apr.2008 tsbogend@alpha.franken.de
[root@celebrian ~]#
```

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

***dmesg** output may have useful messages regarding NIC and driver status during startup.*

*Note the 02:01 and 02:02 match the NICs in the previous **lspci** output.*



NIC Hardware Inventory

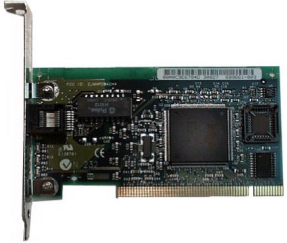
lspci command ... on VLab VM

```
[root@celebrian ~]# lspci
00:00.0 Host bridge: Intel Corporation 440BX/ZX/DX - 82443BX/ZX/DX Host bridge (rev 01)
00:01.0 PCI bridge: Intel Corporation 440BX/ZX/DX - 82443BX/ZX/DX AGP bridge (rev 01)
00:07.0 ISA bridge: Intel Corporation 82371AB/EB/MB PIIX4 ISA (rev 08)
00:07.1 IDE interface: Intel Corporation 82371AB/EB/MB PIIX4 IDE (rev 01)
00:07.3 Bridge: Intel Corporation 82371AB/EB/MB PIIX4 ACPI (rev 08)
00:07.7 System peripheral: VMware Virtual Machine Communication Interface (rev 10)
00:0f.0 VGA compatible controller: VMware SVGA II Adapter
00:11.0 PCI bridge: VMware PCI bridge (rev 02)
00:15.0 PCI bridge: VMware PCI Express Root Port (rev 01)
< snipped>
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)
03:00.0 Serial Attached SCSI controller: VMware PVSCSI SCSI Controller (rev
02)[root@celebrian ~]#
```

Interpretation: The Celebrian VM on the VLab VMware ESXi server has two NICs installed.

The NIC vendor is Intel and the NIC model is 8254EM.

NIC Hardware Inventory



dmesg command *... on VLab VM*

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

```
[root@celebrian ~]# dmesg | grep eth
e1000: eth0: e1000_probe: Intel(R) PRO/1000 Network Connection
e1000: eth1: e1000_probe: Intel(R) PRO/1000 Network Connection
e1000: eth0: e1000_set_tso: TSO is Enabled
e1000: eth1: e1000_set_tso: TSO is Enabled
e1000: eth0 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: None
eth0: no IPv6 routers present
[root@celebrian ~]#
```

***dmesg** output may have useful messages regarding NIC and driver status during startup.*



NIC Hardware Inventory

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

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

Onboard LAN

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

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

Onboard audio

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

Onboard USB

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

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

Onboard 1394

- Type: IEEE 1394a 400Mb/s

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

Find: reverse Next Previous Highlight all Match case

Done

Using the web to find NIC information

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

Class Activity NIC Inventory

1. Power on Frodo, login as cis192 then **sudo su -** to root.
2. Use the **lspci** command and locate the NIC hardware.
3. How many NICs does Frodo have?
4. What is the NIC vendor and model number?
5. Use the **dmesg | more** command browse through the kernel bootup messages.
6. Narrow down the output with
dmesg | grep net
or **dmesg | grep eth**

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)

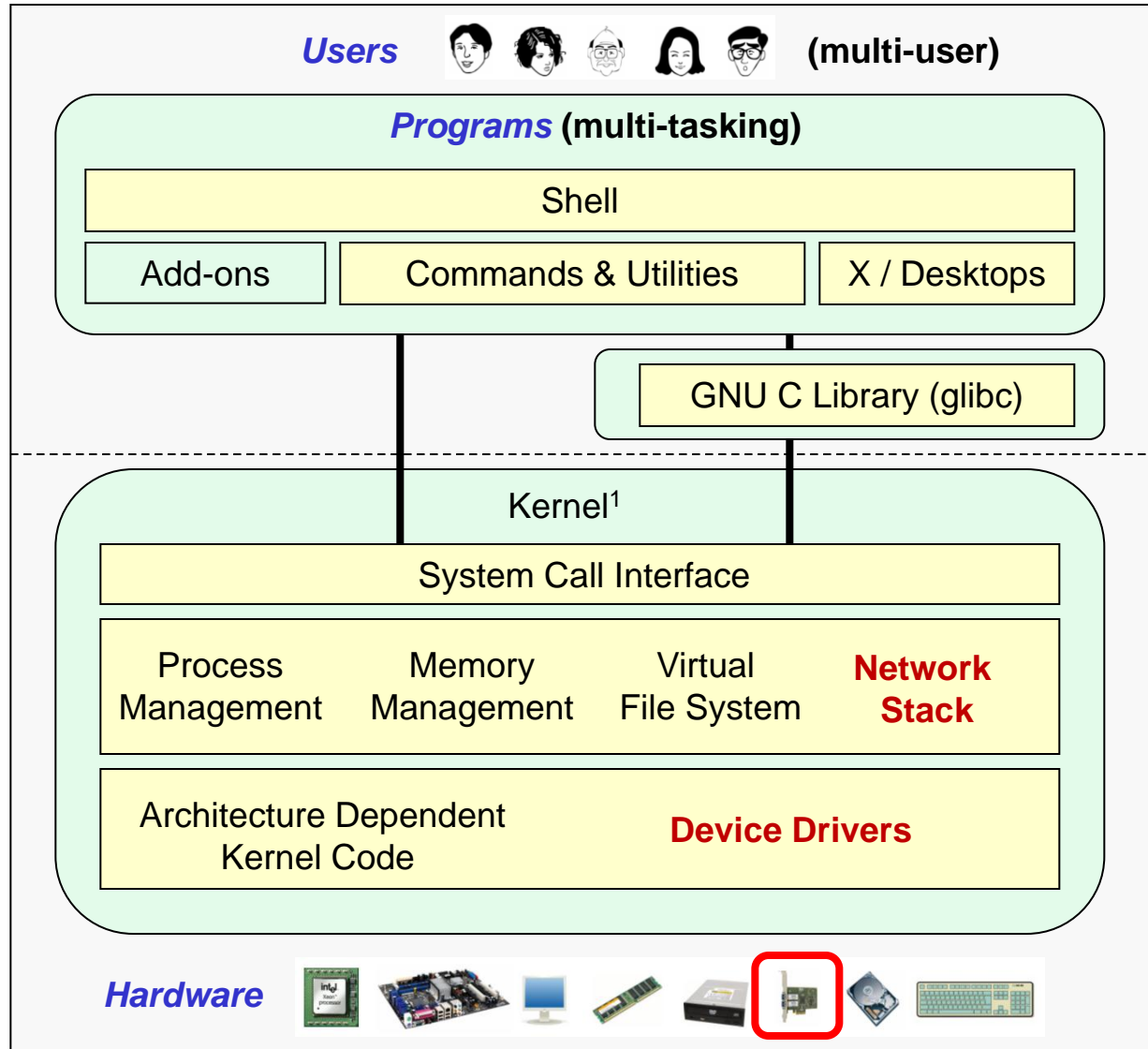


GNU/Linux Operating System Architecture



User Space

Kernel Space

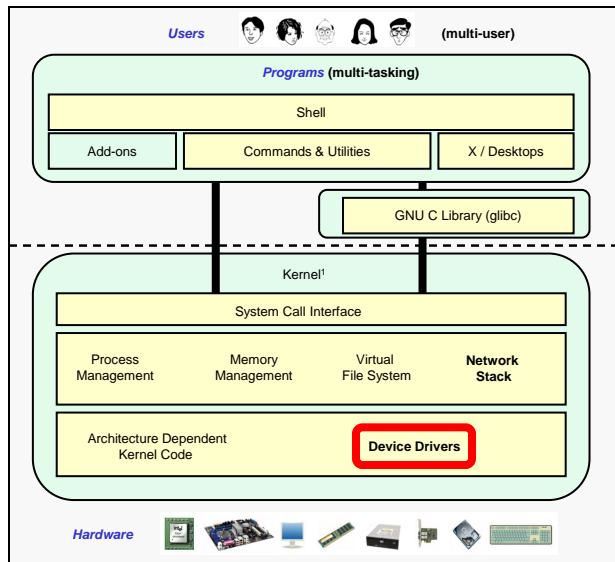


The network stack is implemented in the Linux kernel

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

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

NIC Drivers



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

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

Locating NIC Drivers

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

NIC Drivers

Chipset vendor Downloads



Broadcom Corporation - Download Drivers - Mozilla Firefox

File Edit View History Bookmarks Tools Help

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

Disable Cookies CSS Forms Images Information Miscellaneous Outline Resize Tools View Source Options

Home > Downloads & Support > Ethernet NIC > Download Drivers

Downloads & Support

- BLUETOOTH
- COMMUNICATIONS PROCESSORS
- ETHERNET NICs
- SEARCH SUPPORT
- CONTACT SUPPORT
- OTHER

Broadcom Ethernet NIC Driver Downloads

Below you will find the latest drivers for Broadcom's NetXtreme, NetXtreme II, NetLink and 4401 based Ethernet products.

[Click here](#) for information on the Linux tg3, bnx2 and b44 drivers.

Windows users, [click here](#) to determine the correct driver for your NIC.

NetXtreme I Desktop/Mobile

Download [drivers](#) for the following chipsets:
5702, 5705, 5751, 5752, 5753, 5754, 5755, 5756, 5761, 5764, 5782

NetXtreme I Server

Download [drivers](#) for the following chipsets:
5700, 5701, 5703, 5704, 5714, 5715, 5721, 5722, 5723, 5780

NetXtreme II 1 Gigabit Server

Download [drivers](#) for the following chipsets:
5706, 5708, 5709, 5716

NetXtreme II 10 Gigabit Server

Find: vmsd Next Previous Highlight all Match case

http://www.broadcom.com/support/ethernet_nic/faq_drivers.php#tg3

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

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

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

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

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

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

[Back to Top](#)

NIC Drivers

Server vendor Downloads



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

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

Search: [More options](#)

Business Support Center All of HP United States

Download drivers and software

HP ProLiant BL20p G4 Server series

HP Passport Sign-in
User ID:
Password:

Register [Learn more...](#) [Go](#)

Tasks for my selected product

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

Subscribe to driver and support alerts

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

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

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

Choose your software/driver language: English (American)

Quick jump to downloads by category...

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

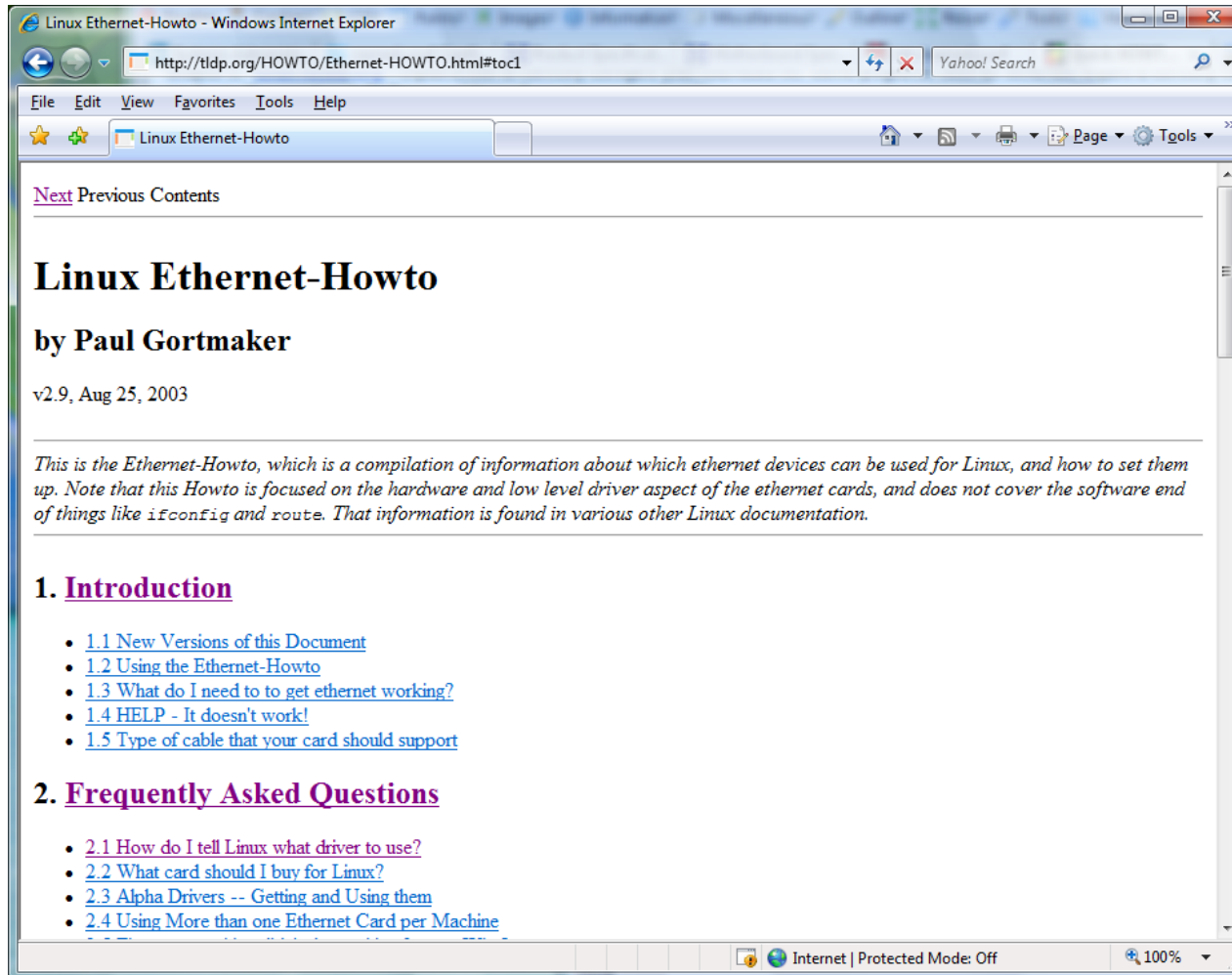
Find: reverse [Next](#) [Previous](#) [Highlight all](#) Match case

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

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

NIC Drivers

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



Linux Ethernet-Howto - Windows Internet Explorer

<http://tldp.org/HOWTO/Ethernet-HOWTO.html#toc1> Yahoo! Search

File Edit View Favorites Tools Help

Linux Ethernet-Howto

[Next](#) Previous Contents

Linux Ethernet-Howto

by Paul Gortmaker

v2.9, Aug 25, 2003

This is the Ethernet-Howto, which is a compilation of information about which ethernet devices can be used for Linux, and how to set them up. Note that this Howto is focused on the hardware and low level driver aspect of the ethernet cards, and does not cover the software end of things like `ifconfig` and `route`. That information is found in various other Linux documentation.

1. Introduction

- [1.1 New Versions of this Document](#)
- [1.2 Using the Ethernet-Howto](#)
- [1.3 What do I need to to get ethernet working?](#)
- [1.4 HELP - It doesn't work!](#)
- [1.5 Type of cable that your card should support](#)

2. Frequently Asked Questions

- [2.1 How do I tell Linux what driver to use?](#)
- [2.2 What card should I buy for Linux?](#)
- [2.3 Alpha Drivers -- Getting and Using them](#)
- [2.4 Using More than one Ethernet Card per Machine](#)

Internet | Protected Mode: Off 100%

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

NIC Drivers

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



*See section 4 for
specific NICs*

A screenshot of a Windows Internet Explorer browser window. The address bar shows the URL <http://tldp.org/HOWTO/Ethernet-HOWTO.html>. The page content is titled "4. Vendor/Manufacturer/Model Specific Information" and contains a list of 29 numbered links, each representing a different manufacturer or model of Network Interface Card (NIC). The links are: 4.1 3Com, 4.2 Accton, 4.3 Adaptec, 4.4 Allied Telesyn/Telesis, 4.5 AMD / Advanced Micro Devices, 4.6 Ansel Communications, 4.7 Apricot, 4.8 Arcnet, 4.9 Boca Research, 4.10 Broadcom, 4.11 Cabletron, 4.12 Cogent, 4.13 Compaq, 4.14 Danpex, 4.15 Davicom, 4.16 D-Link, 4.17 DFI, 4.18 Digital / DEC, 4.19 Farallon, 4.20 Fujitsu, 4.21 Hewlett Packard, 4.22 IBM / International Business Machines, 4.23 ICL Ethernet Cards, 4.24 Intel Ethernet Cards, 4.25 Kingston, 4.26 LinkSys, 4.27 Microdyne (Eagle), 4.28 Mylex, and 4.29 Myson. The browser's status bar at the bottom indicates "Internet | Protected Mode: Off" and "100%" zoom.



NIC Drivers

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

The `sis900.txt` file in 2.4 kernels states that "AM79C901 HomePNA PHY is not thoroughly tested, there may be some bugs in the "on the fly" change of transceiver." so you may want to check that if using a newer kernel.

AMD 79C965 (PCnet-32)

Status: Supported, Driver Name: pcnet32

This is the PCnet-32 -- a 32 bit bus-master version of the original LANCE chip for VL-bus and local bus systems. chip. While these chips can be operated with the standard `lance.c` driver, a 32 bit version (`pcnet32.c`) is also available that does not have to concern itself with any 16MB limitations associated with the ISA bus.

AMD 79C970/970A (PCnet-PCI)

Status: Supported, Driver Name: pcnet32

This is the PCnet-PCI -- similar to the PCnet-32, but designed for PCI bus based systems. Please see the above PCnet-32 information. This means that you need to build a kernel with PCI BIOS support enabled. The '970A adds full duplex support along with some other features to the original '970 design.

Note that the Boca implementation of the 79C970 fails on fast Pentium machines. This is a hardware problem, as it affects DOS users as well. See the Boca section for more details.

AMD 79C971 (PCnet-FAST)

Status: Supported, Driver Name: pcnet32

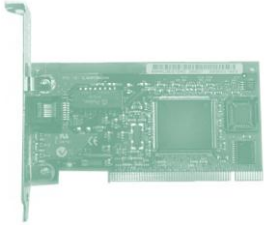
This is AMD's 100Mbit chip for PCI systems, which also supports full duplex operation. It was introduced in June 1996.

AMD 79C972 (PCnet-FAST+)

Status: Supported, Driver Name: pcnet32

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

CIS 192 VMs have Virtual NICs



Fortunately, you will not need to locate and install NIC drivers for the CIS 192 VMs. The drivers are automatically selected and loaded at startup.

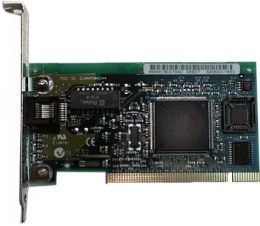
Servers



Clients



NIC Drivers



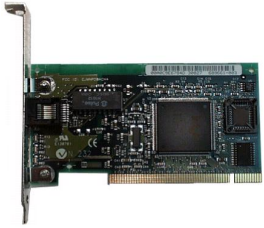
*Use the **lspci -k** command to see which driver was loaded for your NIC or NICs*

```
[root@celebrian ~]# lspci | grep -i Ethernet
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@celebrian ~]#

[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
< snipped >
[root@celebrian ~]#
```

NIC Drivers

NIC drivers are **kernel modules** and are kept in a specific directory so the kernel knows where to find them. They are kernel object files and named with a **.ko** suffix.



```
[root@celebrian ~]# ls /lib/modules/2.6.32-71.el6.i686/kernel/drivers/net/
```

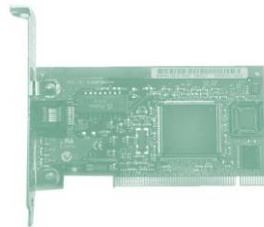
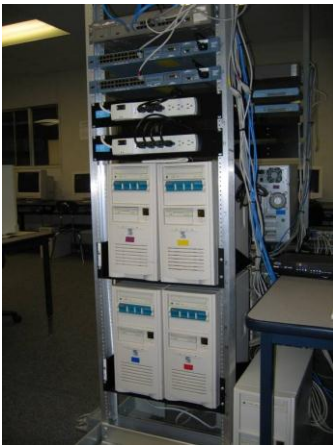
```
3c509.ko      cxgb4      macvlan.ko  pppol2tp.ko  sungem_phy.ko
3c59x.ko      dl2k.ko    macvtap.ko  pppox.ko     sunhme.ko
8139cp.ko     dnet.ko    mdio.ko     ppp_synctty.ko  tehuti.ko
8139too.ko    dummy.ko   mii.ko      qla3xxx.ko   tg3.ko
8390.ko       e1000     mlx4        qlge         tlan.ko
8390p.ko      e1000e    myri10ge   r6040.ko     tulip
acenic.ko     e100.ko   natsemi.ko r8169.ko     tun.ko
amd8111e.ko  enic      ne2k-pci.ko s2io.ko      typhoon.ko
atl1c        epic100.ko ne.ko       sc92031.ko   usb
atl1e        ethoc.ko  netconsole.ko sfc          veth.ko
atlx         ewrk3.ko  netxen     sis190.ko    via-rhine.ko
b44.ko       fealnx.ko niu.ko      sis900.ko    via-velocity.ko
benet        forcedeth.ko ns83820.ko skge.ko     virtio_net.ko
bnx2.ko      ifb.ko    pcmcia     sky2.ko      vmxnet3
bnx2x.ko     igb       pcnet32.ko slhc.ko     vxge
bonding      igbvf    phy        slip.ko      wan
can          ipg.ko   ppp_async.ko smc-ultra.ko wimax
cassini.ko   ixgb     ppp_deflate.ko smsc9420.ko wireless
chelsio     ixgbe    ppp_generic.ko starfire.ko xen-netfront.ko
cnic.ko     ixgbevff ppp_mppe.ko  sundance.ko
cxgb3       jme.ko   pppoe.ko    sungem.ko
[root@celebrian ~]#
```

The *e1000.ko* is in the *e1000* directory

Note, in older distros, these show as *.o* files

Real NICs in old gear can be more challenging

System Pod



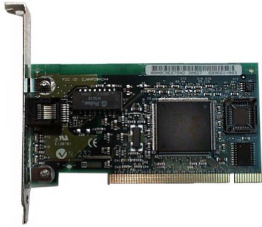
There are a variety on NICs on the older systems in the old CIS Lab system pods

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



Press middle button to boot Linux

Older Gear NIC Drivers



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

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

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



Managing 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)



Commands for handling NIC drivers (kernel modules)

- To show loaded kernel modules including NIC drivers

lsmod

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

- To remove (unload) a NIC driver

rmmmod *driver*

example: **rmmmod pcnet32** (removes pcnet32 VM NIC driver)

Do not specify the path or suffix (.ko) for drivers

- To insert (load) a NIC driver

insmod *driver*

modprobe *driver*

example: **modprobe pcnet32** (installs pcnet32 VM NIC driver)

modprobe is more intelligent and recommended over insmod



Driver Management Example

ifconfig

The screenshot shows a terminal window titled "P1_Arwen on vmserver4.cisvlab.net". The terminal output is as follows:

```
CentOS Linux release 6.0 (Final)
Kernel 2.6.32-71.el6.i686 on an i686

arwen login: root
Password:
Last login: Thu Sep  8 11:16:01 on tty1
[root@arwen ~]# 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)

[root@arwen ~]# _
```

After Arwen boots up is there any network connectivity?

ifconfig

```

P1_Arwen on vmserver4.cisvlab.net
File View VM
CentOS Linux release 6.0 (Final)
Kernel 2.6.32-71.el6.i686 on an i686

arwen login: root
Password:
Last login: Thu Sep  8 11:16:01 on tty1
[root@arwen ~]# 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)

[root@arwen ~]# _

```

*After Arwen boots up is there any network connectivity? **NO***

ifconfig eth0

```

P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:BB:23:97
          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@arwen ~]# _
    
```

To release cursor, press CTRL + ALT

Is the eth0 interface up or down?

ifconfig eth0

```

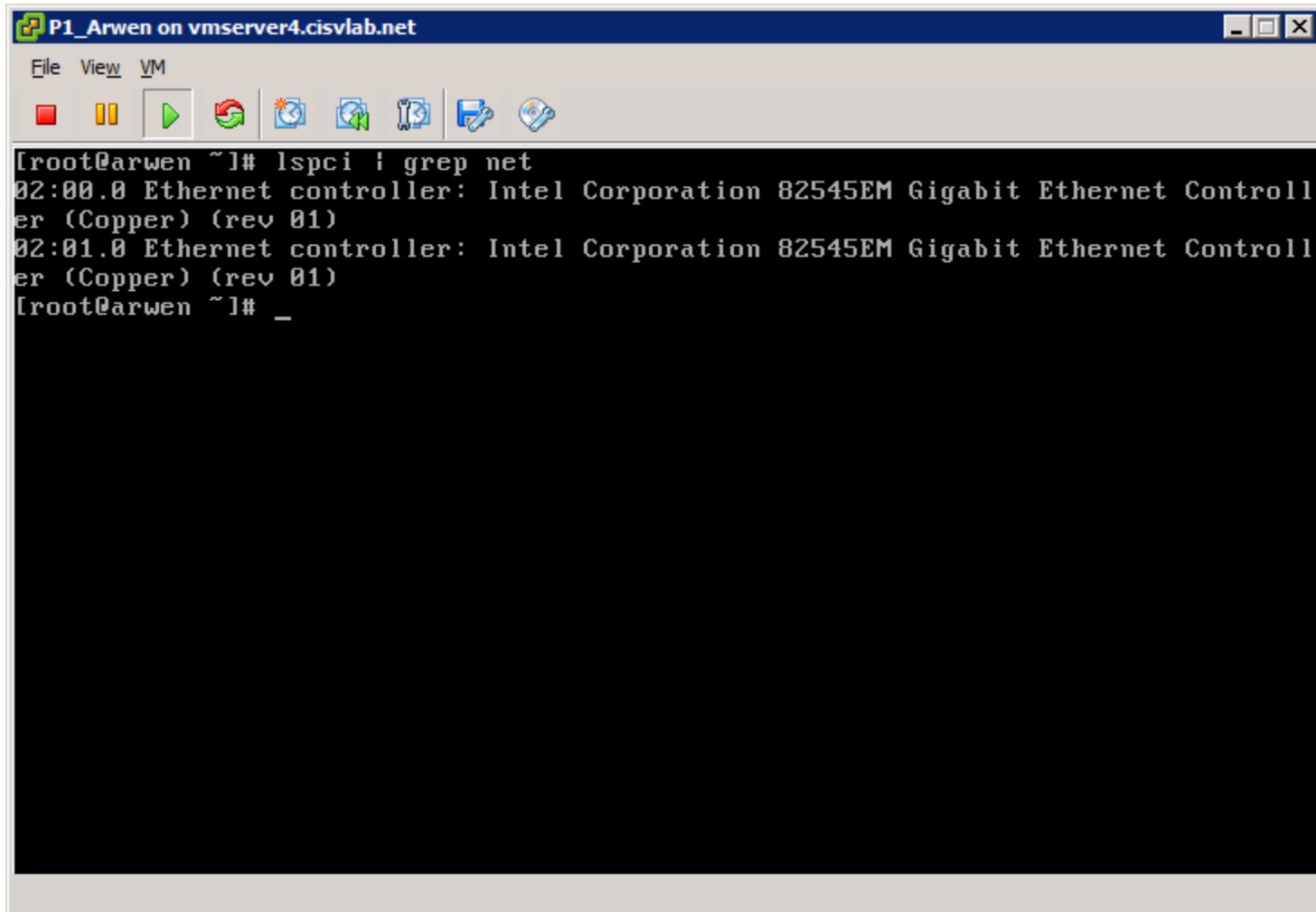
P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:BB:23:97
          BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)

[root@arwen ~]# _
    
```

To release cursor, press CTRL + ALT

*Is the eth0 interface up or down? **It's down***

lspci | grep net



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

```
[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?

lspci | grep net

The image shows a terminal window on a VM named 'P1_Arwen on vmserver4.cisvlab.net'. The terminal output of the command 'lspci | grep net' is as follows:

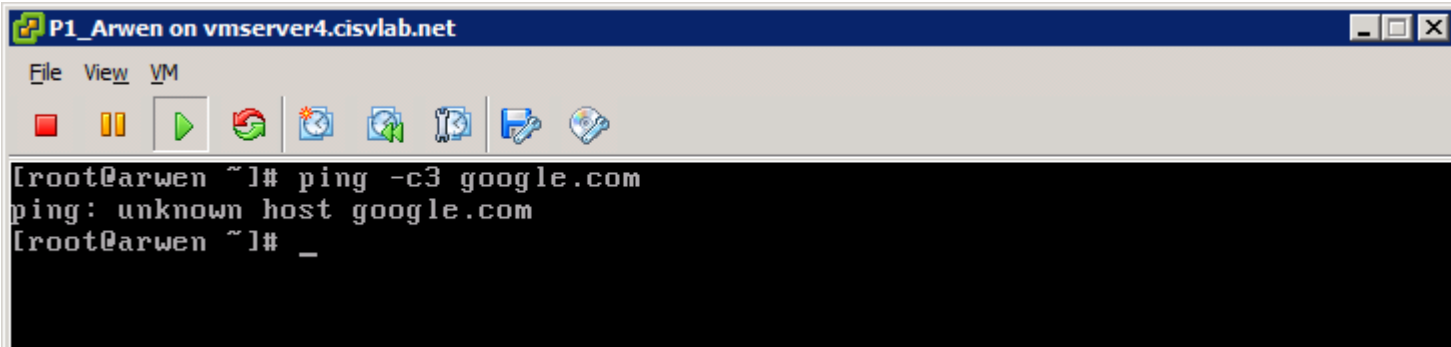
```
[root@arwen ~]# lspci | grep net
02:00.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
02:01.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
[root@arwen ~]# _
```

Overlaid on the terminal is a web browser window displaying the Intel product page for the Intel® 82545EM Gigabit Ethernet Controller. The page title is 'Intel® 82545EM Gigabit Ethernet Controller Overview'. The page content includes a navigation menu, a 'Products' sidebar, and a main text area describing the controller's features and specifications. A small image of the Intel 82545EM chip is also visible on the page.

How many NICs are on Arwen? **2**

What is the vendor and model number of the NICs? **Intel, 82545EM**

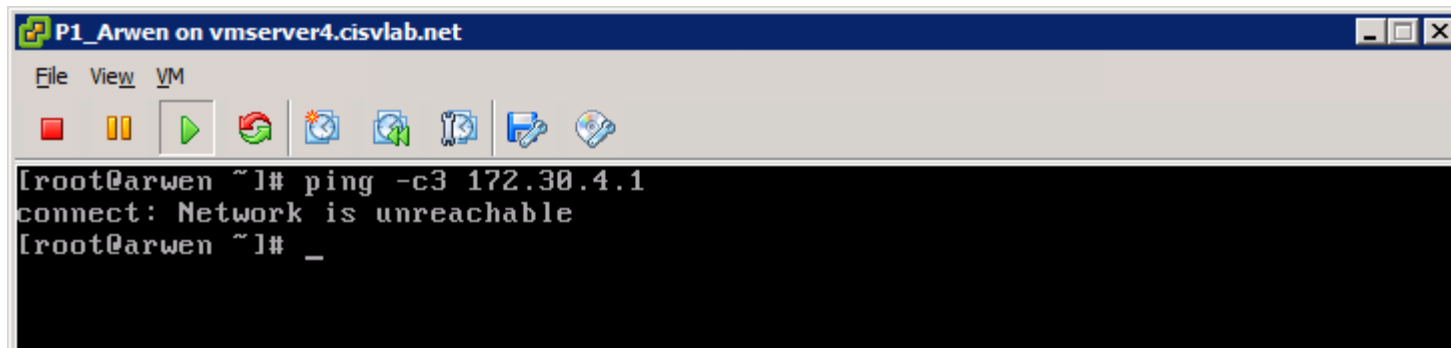
ping -c3 google.com



A screenshot of a terminal window titled "P1_Arwen on vmserver4.cisvlab.net". The window has a menu bar with "File", "View", and "VM" and a toolbar with various icons. The terminal text shows the command `ping -c3 google.com` being executed, resulting in the output `ping: unknown host google.com`. The prompt `[root@arwen ~]#` is visible at the beginning and end of the command line.

```
[root@arwen ~]# ping -c3 google.com
ping: unknown host google.com
[root@arwen ~]# _
```

ping -c3 172.30.4.1



A screenshot of a terminal window titled "P1_Arwen on vmserver4.cisvlab.net". The window has a menu bar with "File", "View", and "VM" and a toolbar with various icons. The terminal text shows the command `ping -c3 172.30.4.1` being executed, resulting in the output `connect: Network is unreachable`. The prompt `[root@arwen ~]#` is visible at the beginning and end of the command line.

```
[root@arwen ~]# ping -c3 172.30.4.1
connect: Network is unreachable
[root@arwen ~]# _
```

With no network connectivity can we ping a hostname on the Internet?

Can we ping a local IP address on the LAN?

ping -c3 google.com

The screenshot shows a terminal window titled "P1_Arwen on vmserver4.cisvlab.net". The terminal prompt is [root@arwen ~]#. The user enters the command ping -c3 google.com. The output is ping: unknown host google.com. The prompt returns to [root@arwen ~]#.

```
[root@arwen ~]# ping -c3 google.com
ping: unknown host google.com
[root@arwen ~]# _
```

ping -c3 172.30.4.1

The screenshot shows a terminal window titled "P1_Arwen on vmserver4.cisvlab.net". The terminal prompt is [root@arwen ~]#. The user enters the command ping -c3 172.30.4.1. The output is connect: Network is unreachable. The prompt returns to [root@arwen ~]#.

```
[root@arwen ~]# ping -c3 172.30.4.1
connect: Network is unreachable
[root@arwen ~]# _
```

*With no network connectivity can we ping a hostname on the Internet? **No***

*Can we ping a local IP address on the LAN? **No***

dhclient eth0

```

P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# dhclient eth0
[root@arwen ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:BB:23:97
          inet addr:172.30.4.164  Bcast:172.30.4.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:febb:2397/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:4  errors:0  dropped:0  overruns:0  frame:0
          TX packets:8  errors:0  dropped:0  overruns:0  carrier:0
          collisions:0  txqueuelen:1000
          RX bytes:812 (812.0 b)  TX bytes:1152 (1.1 KiB)

[root@arwen ~]# _

```

After requesting an IP address from a DHCP server for eth0 what IP address was assigned? Is the eth0 interface up or down?

dhclient eth0

```

P1_Arwen on vmserver4.cisvlab.net
File View VM
[root@arwen ~]# dhclient eth0
[root@arwen ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:BB:23:97
          inet addr:172.30.4.164  Bcast:172.30.4.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:febb:2397/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:4  errors:0  dropped:0  overruns:0  frame:0
          TX packets:8  errors:0  dropped:0  overruns:0  carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:812 (812.0 b)  TX bytes:1152 (1.1 KiB)

[root@arwen ~]# _
  
```

After requesting an IP address from a DHCP server for eth0 what IP address was assigned? **172.30.4.164** Is the eth0 interface up or down? **Up**

ping -c3 google.com

The screenshot shows a terminal window titled "P1_Arwen on vmserver4.cisvlab.net". The terminal output is as follows:

```
[root@arwen ~]# ping -c3 google.com
PING google.com (74.125.224.144) 56(84) bytes of data:
64 bytes from nuq04s09-in-f16.1e100.net (74.125.224.144): icmp_seq=1 ttl=54 time
=7.28 ms
64 bytes from nuq04s09-in-f16.1e100.net (74.125.224.144): icmp_seq=2 ttl=54 time
=6.93 ms
64 bytes from nuq04s09-in-f16.1e100.net (74.125.224.144): icmp_seq=3 ttl=54 time
=6.77 ms

--- google.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2010ms
rtt min/avg/max/mdev = 6.773/6.998/7.287/0.235 ms
[root@arwen ~]# _
```

Now that the eth0 interface is up and has an IP address can we ping a hostname on the Internet?

What did the -c3 option do on the ping command?

ping -c3 google.com

The screenshot shows a terminal window titled "P1_Arwen on vmserver4.cisvlab.net". The terminal output is as follows:

```
[root@arwen ~]# ping -c3 google.com
PING google.com (74.125.224.144) 56(84) bytes of data.
64 bytes from nuq04s09-in-f16.1e100.net (74.125.224.144): icmp_seq=1 ttl=54 time
=7.28 ms
64 bytes from nuq04s09-in-f16.1e100.net (74.125.224.144): icmp_seq=2 ttl=54 time
=6.93 ms
64 bytes from nuq04s09-in-f16.1e100.net (74.125.224.144): icmp_seq=3 ttl=54 time
=6.77 ms

--- google.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2010ms
rtt min/avg/max/mdev = 6.773/6.998/7.287/0.235 ms
[root@arwen ~]# _
```

Now that the eth0 interface is up and has an IP address can we ping a hostname on the Internet? **Yes**

What did the -c3 option do on the ping command? **3 pings only**



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 ~]# _
  
```

What driver is used for the Intel NICs?

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 ~]# _
  
```

What driver is used for the Intel NICs? **e1000**

What did the **-A3** option do on the **grep** command? **prints the matching line and the 3 lines after the matching line**

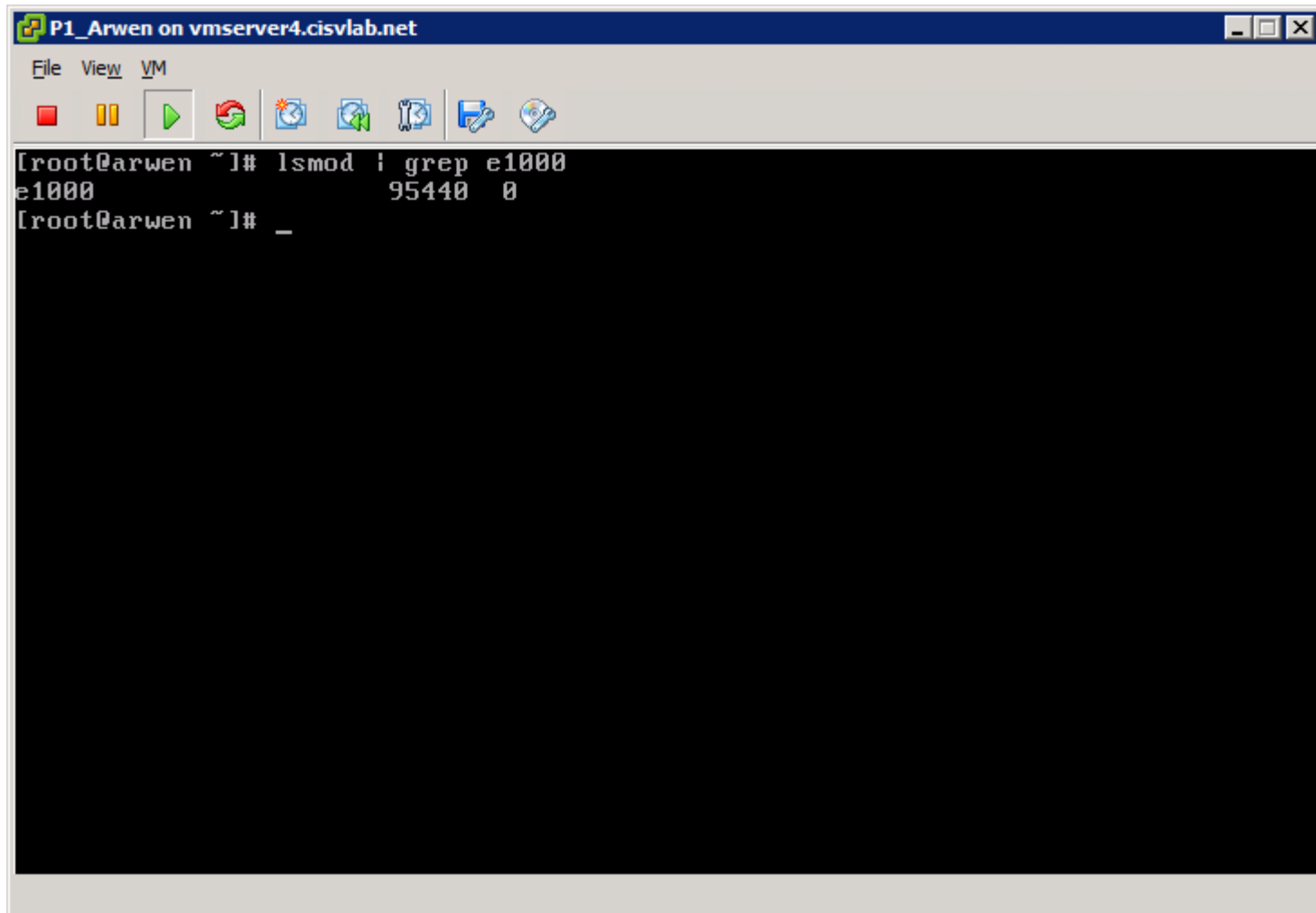


lsmod | grep e1000

```
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?

lsmod | grep e1000



The screenshot shows a terminal window titled "P1_Arwen on vmserver4.cisvlab.net". The terminal prompt is "[root@arwen ~]#". The user enters the command "lsmod | grep e1000". The output is "e1000 95440 0". The terminal prompt is then "[root@arwen ~]# _".

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

*Is the e1000 kernel module loaded and running? **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=0.714 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 ~]# _
  
```

What happened when the e1000 driver was unloaded on Arwen?

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=0.443 ms
64 bytes from 172.30.4.164: icmp_seq=114 ttl=64 time=0.443 ms
64 bytes from 172.30.4.164: icmp_seq=115 ttl=64 time=0.443 ms
64 bytes from 172.30.4.164: icmp_seq=116 ttl=64 time=0.443 ms
64 bytes from 172.30.4.164: icmp_seq=117 ttl=64 time=0.443 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 ~]# _
  
```

*What happened when the e1000 driver was unloaded on Arwen? **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
[red square] [yellow square] [green play button] [refresh] [power] [network] [printer] [help]

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
[red square] [yellow square] [green play button] [refresh] [power] [network] [printer] [help]

[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
[red] [yellow] [green] [refresh] [network] [power] [help] [undo] [redo]

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
[red] [yellow] [green] [refresh] [network] [power] [help] [undo] [redo]

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

Is the e1000 driver (a kernel module) loaded on Arwen? **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? Loaded the e1000 driver, then obtained an IP address and Arwen started to replying to ping requests again

Class Activity - Managing NIC Drivers

Live Demo

Remove a driver and add it back in

UNIX/Linux Commands



<p>> filename</p>	<p><i>filename</i> is created if it does not exist and emptied. Example: > output would empty the file named output or create it if it did not exist already.</p>
<p>command > filename</p>	<p><i>filename</i> is emptied, then the output of the command is redirected into <i>filename</i>. Example: ifconfig > output would save the output of the ifconfig command in a file named output.</p>
<p>command >> filename</p>	<p>Output of the command is appended to the end of <i>filename</i>. Example: route -n >> output would append the routing table to the end of the file named output.</p>



General Linux commands	
su -	To become root (superuser). The - is very important as it provides root's shell environment.
sudo su -	To become root on the Ubuntu VMs.

In CIS 90 you never logged in as root ... the all-powerful, super user!



<p>ssh <i>account@hostname</i></p> <p>ssh <i>account@ip-address</i></p>	<p>Login to a remote Linux computer on the network.</p> <p>Example: ssh cis192@172.30.4.153</p>
<p>ssh <i>account@hostname 'command'</i></p>	<p>Run a command on a remote system.</p> <p>Example: ssh root@172.30.4.164 'ifconfig' would run the ifconfig command on the remote system and show the output of the command on the local system.</p>
<p>scp <i>pathname account@host:pathname</i></p> <p>scp <i>account@host:pathname pathname</i></p>	<p>Copy files from one system to another.</p> <p>Example: scp output simben192@opus.cabrillo.edu: (above all on one line) would copy the local file named output to the user simben192's home directory on Opus.</p>

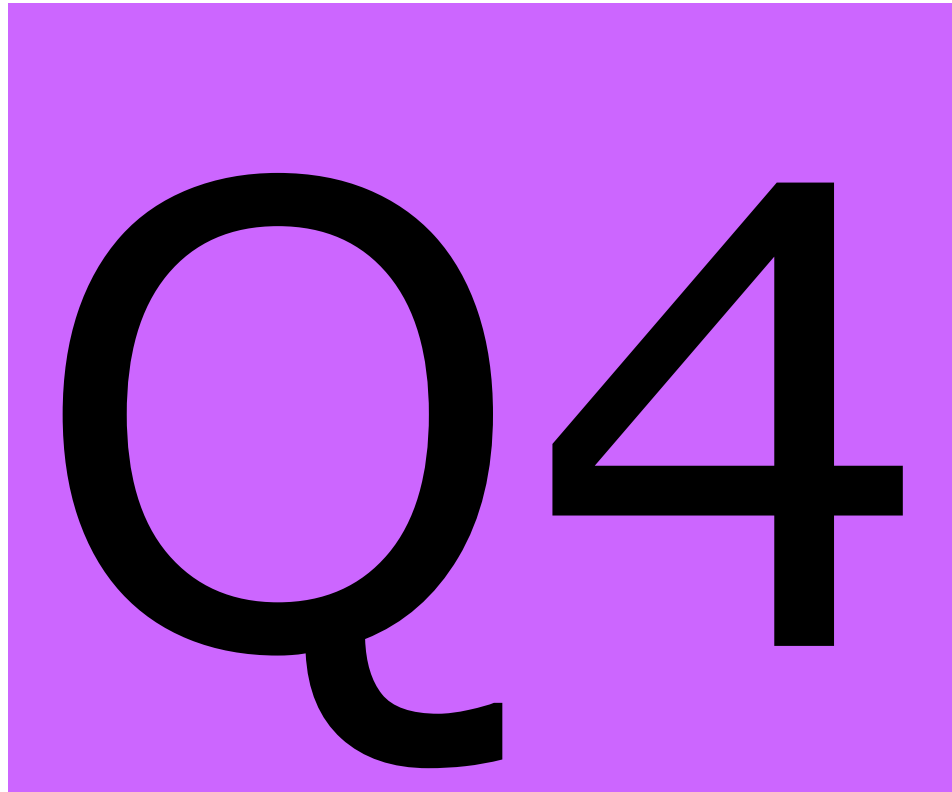


init 0

A fast way to gracefully shutdown a VM. You must be the root user to perform this command. Note: no warning is given to users that the system will be shut down.



yum provides <i>command</i>	Find the package containing the command or program to install
yum install <i>package</i>	Download and install the software package. Just specify the name of the package to get the correct version for your distribution. Examples: yum install traceroute yum install mtr





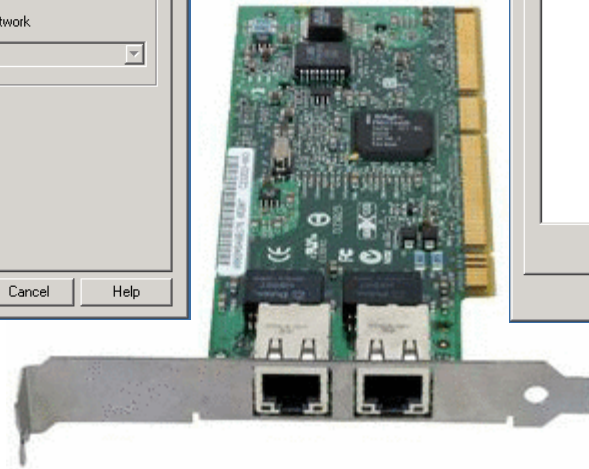
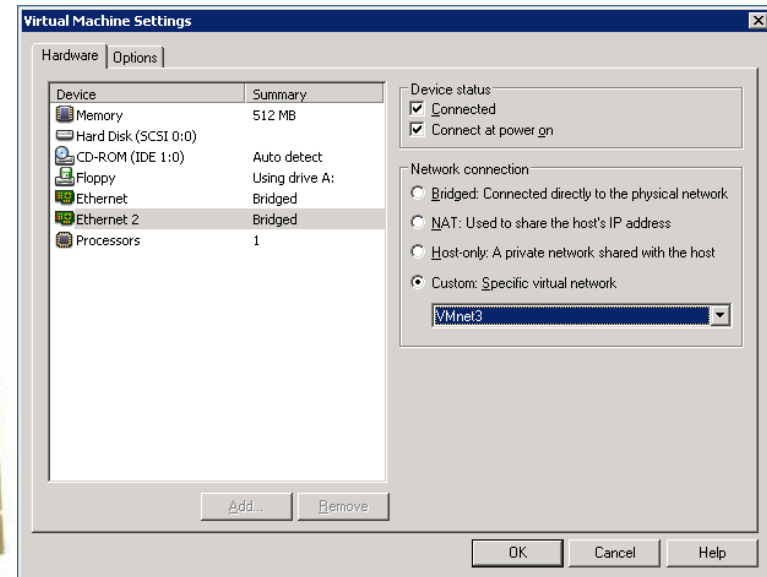
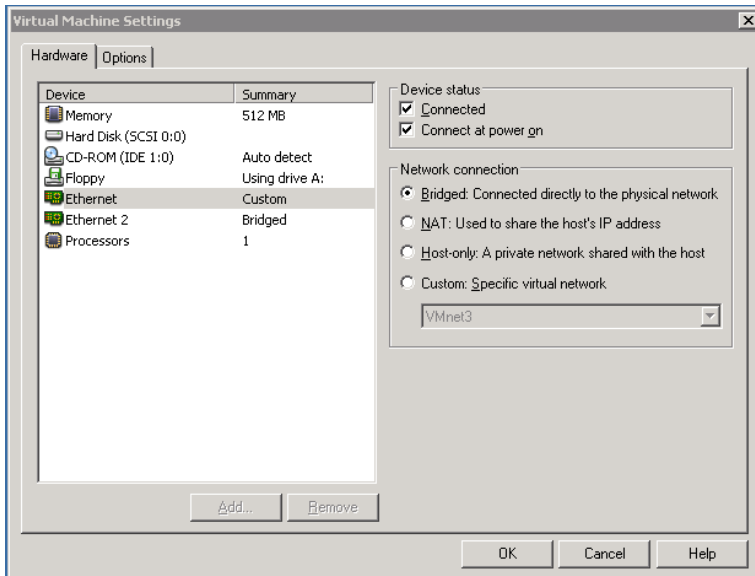
Joining the network continued ...

Connecting your Linux system to the Network

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

Configuring a static IP address with ifconfig

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



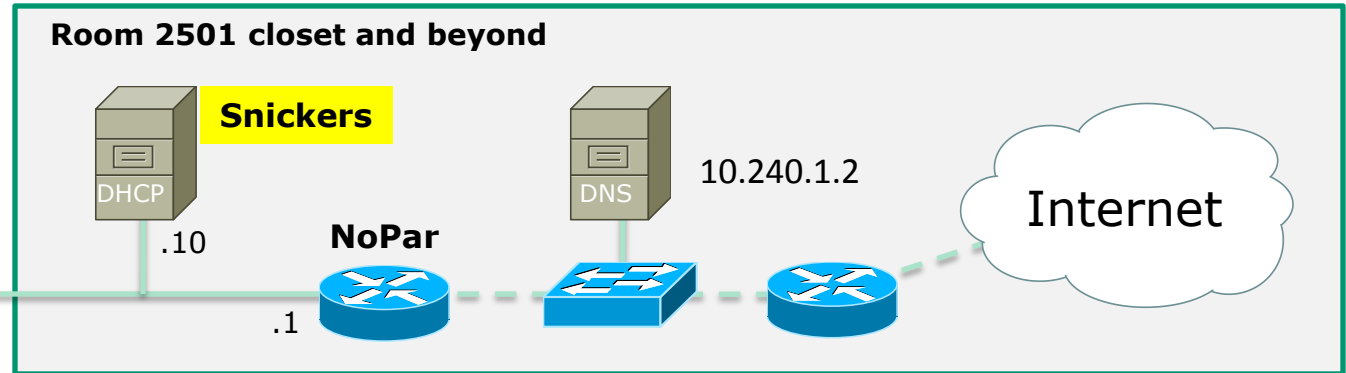
Ethernet = eth0

Ethernet2 = eth1

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

Configuring dynamic IP address (dhcp)

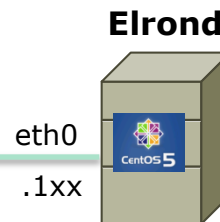
Configuring dynamic IP addresses



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 (172.30.4.150 to 172.30.4.199) for CIS systems in the CIS Lab and VLab.*

StationXX
(VMware host PC)



Configuring dynamic IP addresses

- To request a dynamic IP address for eth0:
dhclient eth0
- To release a dynamic IP address:
dhclient -r eth0
- To see what happened:
tail /var/log/messages

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

Initial state – system is not connected to network

ifconfig eth0

eth0 interface is down

```
[root@legolas ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:90:77:B4
          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)
```

route -n

No default gateway

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

cat /etc/resolv.conf

No DNS server configured

```
[root@legolas ~]# cat /etc/resolv.conf
[root@legolas ~]# _
```

Obtain IP address from DHCP server

dhclient eth0 *Request an IP address*

```
[root@legolas ~]# dhclient eth0
[root@legolas ~]#
[root@legolas ~]#
```

tail -6 /var/log/messages *Check the log to see what happened*

```
[root@legolas ~]# tail -6 /var/log/messages
Oct 20 09:27:31 legolas dhclient: DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 6
Oct 20 09:27:31 legolas dhclient: DHCPOFFER from 172.30.4.1
Oct 20 09:27:31 legolas dhclient: DHCPREQUEST on eth0 to 255.255.255.255 port 67
Oct 20 09:27:31 legolas dhclient: DHCPACK from 172.30.4.1
Oct 20 09:27:31 legolas NET[1454]: /sbin/dhclient-script : updated /etc/resolv.conf
Oct 20 09:27:32 legolas dhclient: bound to 172.30.4.150 -- renewal in 10951 seconds.
[root@legolas ~]#
```

ifconfig eth0 *eth0 interface is up and has IP address*

```
[root@legolas ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:90:77:B4
          inet addr: 172.30.4.150  Bcast:172.30.4.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe90:77b4/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:131 errors:0 dropped:0 overruns:0 frame:0
          TX packets:18 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:9187 (8.9 KiB)  TX bytes:2688 (2.6 KiB)

[root@legolas ~]# _
```

More than IP address is obtained

route -n

Default gateway set to 172.30.4.1

```
[root@legolas ~]# route -n
Kernel IP routing table
Destination      Gateway          Genmask         Flags Metric Ref    Use Iface
172.30.4.0       0.0.0.0         255.255.255.0   U        0      0      0 eth0
0.0.0.0          172.30.4.1     0.0.0.0         UG       0      0      0 eth0
```

cat /etc/resolv.conf

```
[root@legolas ~]# cat /etc/resolv.conf
; generated by /sbin/dhclient-script
search cisvlab.net
nameserver 192.168.0.8
nameserver 10.240.1.2
[root@legolas ~]#
```

Primary DNS server set to 192.168.0.8 and secondary DNS server set to 10.240.1.2

Release the IP address

dhclient -r eth0

```
[root@legolas ~]# dhclient -r eth0  
[root@legolas ~]#
```

Release the IP address

tail -2 /var/log/messages

Check the log to see what happened

```
[root@legolas ~]# tail -2 /var/log/messages  
Oct 20 09:29:42 legolas dhclient: DHCPRELEASE on eth0 to 172.30.1.10 port 67  
Oct 20 09:29:42 legolas NET[1484]: /sbin/dhclient-script : updated /etc/resolv.c  
onf  
[root@legolas ~]# _
```

ifconfig eth0

eth0 interface is down

```
[root@legolas ~]# ifconfig eth0  
eth0      Link encap:Ethernet  HWaddr 00:0C:29:90:77:B4  
          BROADCAST MULTICAST  MTU:1500  Metric:1  
          RX packets:114 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:10 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:7595 (7.4 KiB)  TX bytes:1536 (1.5 KiB)
```

Release the IP address

route -n

No default gateway

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

cat /etc/resolv.conf *No DNS servers*

```
[root@legolas ~]# cat /etc/resolv.conf
[root@legolas ~]#
```

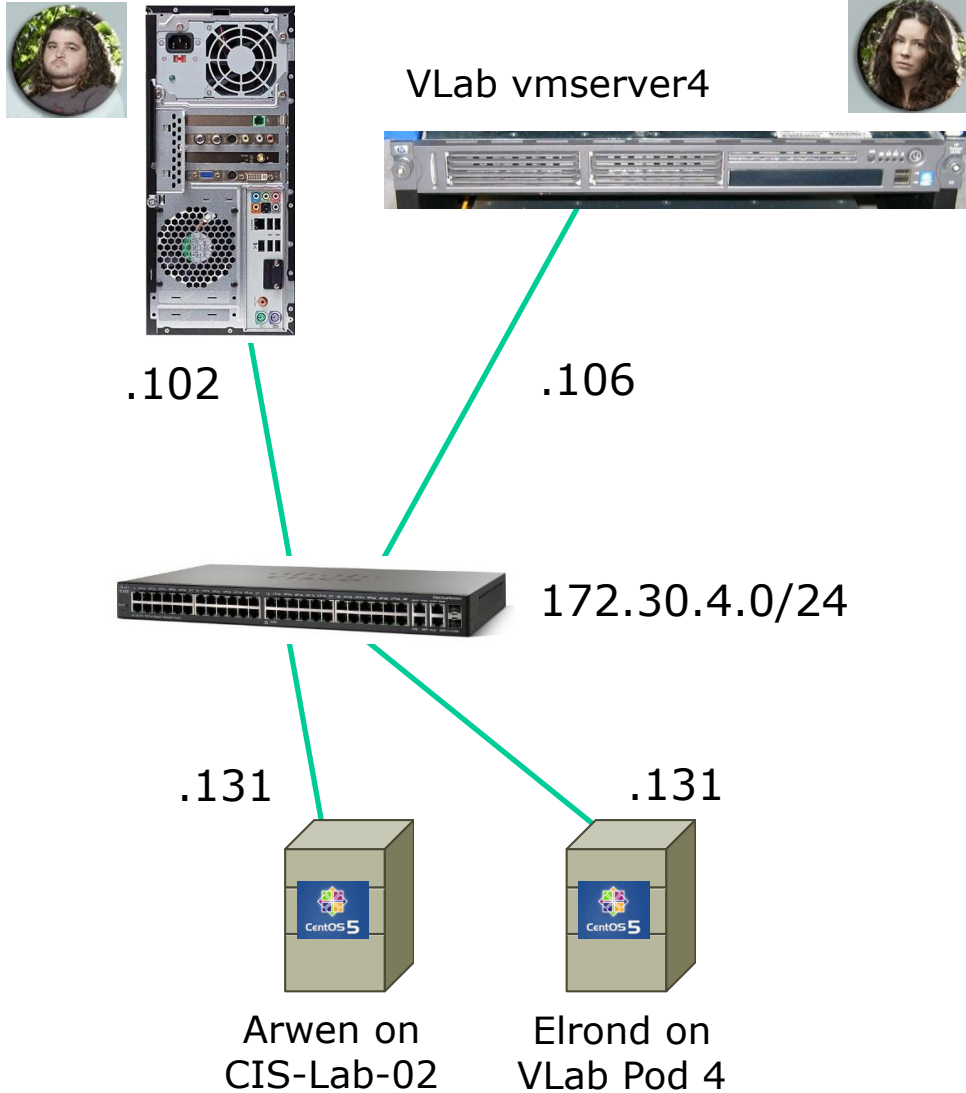
Class Activity
Obtain and release an IP address

Live Demo

Dup IPs

The classroom 172.30.1.0/24 and CIS Lab 172.30.4.0/24 networks have a limited number of IP addresses!

CIS-Lab-02



**Duplicate IP addresses =
TROUBLE !!**

Hugo is using local VMs on a CIS Lab workstation. He configures his Arwen VM eth0 interface to 172.30.4.131 and connects it to the Lab network.

Kate is remotely accessing Pod 4 in VLab from home. She configures her Elrond VM eth0 interface to 172.30.4.131 and connects it to the Lab network.

What will happen when Ben pings 172.30.4.131 on the Lab network?



IP Address Assignments for Classroom PCs (Room 2501)

Station	Station IP	Static 1	Static 2	Start	End
XX	172.30.1.	172.30.1.	172.30.1.	172.30.1.	172.30.1.
0	100	125	200	50	52
1	101	126	201	53	55
2	102	127	202	56	58
3	103	128	203	59	61
4	104	129	204	62	64
5	105	130	205	65	67
6	106	131	206	68	70
7	107	132	207	71	73
8	108	133	208	74	76
9	109	134	209	77	79
10	110	135	210	80	82
11	111	136	211	83	85
12	112	137	212	86	88
13	113	138	213	89	91
14	114	139	214	92	94
15	115	140	215	95	97
16	116	141	216	225	227
17	117	142	217	228	230
18	118	143	218	231	233
19	119	144	219	234	236
20	120	145	220	237	239
21	121	146	221	240	242
22	122	147	222	243	245
23	123	148	223	246	248
24	124	149	224	249	251

IP Address Assignments for Lab PCs (CIS Lab)

Station	Station IP	Static 1	Static 2	Start	End
CIS-Lab-	172.30.4.	172.30.4.	172.30.4.	172.30.4.	172.30.4.
1	101	121	122	50	54
2	102	123	124	55	59
3	103	125	126	60	64
4	104	127	128	65	69
5	105	129	130	70	74
6	106	131	132	75	79
7	107	133	134	80	84
8	108	135	136	85	89
9	109	137	138	90	94
10	110	139	140	95	99
11	111	141	142	200	204
12	112	143	144	205	209
Pod 1	145	146	210	214	
Pod 2	147	148	215	219	
Pod 3	149	245	220	224	
Pod 4	246	247	225	229	
Pod 5	248	249	230	234	
Pod 6	250	251	235	239	
Pod 7	252	253	240	244	

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

Only use static IPs assigned to the station you are using in the classroom or the lab!

IP Address Assignments for Classroom PCs (Room 2501)

Gateway: 172.30.1.1

172.30.1.1-49 (reserved)
172.30.1.150-199 (DHCP pool)

DNS: 192.168.0.8 and 10.240.1.2

Station	Station IP	Static		DHCP Pool	
		Static 1	Static 2	Start	End
XX	172.30.1.	172.30.1.	172.30.1.	172.30.1.	172.30.1.
0	100	125	200	50	52
1	101	126	201	53	55
2	102	127	202	56	58
3	103	128	203	59	61
4	104	129	204	62	64
5	105	130	205	65	67
6	106	131	206	68	70
7	107	132	207	71	73
8	108	133	208	74	76
9	109	134	209	77	79
10	110	135	210	80	82
11	111	136	211	83	85
12	112	137	212	86	88
13	113	138	213	89	91
14	114	139	214	92	94
15	115	140	215	95	97
16	116	141	216	225	227
17	117	142	217	228	230
18	118	143	218	231	233
19	119	144	219	234	236
20	120	145	220	237	239
21	121	146	221	240	242
22	122	147	222	243	245
23	123	148	223	246	248
24	124	149	224	249	251

What static IP addresses can be used by the student sitting at station 10 in the classroom?

IP Address Assignments for Classroom PCs (Room 2501)

Gateway: 172.30.1.1

172.30.1.1-49 (reserved)
172.30.1.150-199 (DHCP pool)

DNS: 192.168.0.8 and 10.240.1.2

Station	Station IP	Static		DHCP Pool	
		Static 1	Static 2	Start	End
XX	172.30.1.	172.30.1.	172.30.1.	172.30.1.	172.30.1.
0	100	125	200	50	52
1	101	126	201	53	55
2	102	127	202	56	58
3	103	128	203	59	61
4	104	129	204	62	64
5	105	130	205	65	67
6	106	131	206	68	70
7	107	132	207	71	73
8	108	133	208	74	76
9	109	134	209	77	79
10	110	135	210	80	82
11	111	136	211	83	85
12	112	137	212	86	88
13	113	138	213	89	91
14	114	139	214	92	94
15	115	140	215	95	97
16	116	141	216	225	227
17	117	142	217	228	230
18	118	143	218	231	233
19	119	144	219	234	236
20	120	145	220	237	239
21	121	146	221	240	242
22	122	147	222	243	245
23	123	148	223	246	248
24	124	149	224	249	251

What static IP addresses can be used by the student sitting at station 10 in the classroom?

172.30.1.135
or
172.30.1.210

IP Address Assignments for Lab PCs (CIS Lab)

172.30.4.1-49 (reserved)

172.30.4.150-199 (DHCP pool)

Gateway: 172.30.4.1

DNS: 192.168.0.8 and 10.240.1.2

Station	Station IP	Static		DHCP Pool	
		Static 1	Static 2	Start	End
CIS-Lab-	172.30.4.	172.30.4.	172.30.4.	172.30.4.	172.30.4.
1	101	121	122	50	54
2	102	123	124	55	59
3	103	125	126	60	64
4	104	127	128	65	69
5	105	129	130	70	74
6	106	131	132	75	79
7	107	133	134	80	84
8	108	135	136	85	89
9	109	137	138	90	94
10	110	139	140	95	99
11	111	141	142	200	204
12	112	143	144	205	209
Pod 1		145	146	210	214
Pod 2		147	148	215	219
Pod 3		149	245	220	224
Pod 4		246	247	225	229
Pod 5		248	249	230	234
Pod 6		250	251	235	230
Pod 7		252	253	240	244

What static IP addresses can be used by the student sitting at station CIS-Lab-06 in the CIS Lab?

IP Address Assignments for Lab PCs (CIS Lab)

172.30.4.1-49 (reserved)

172.30.4.150-199 (DHCP pool)

Gateway: 172.30.4.1

DNS: 192.168.0.8 and 10.240.1.2

Station	Station IP	Static		DHCP Pool	
		Static 1	Static 2	Start	End
CIS-Lab-	172.30.4.	172.30.4.	172.30.4.	172.30.4.	172.30.4.
1	101	121	122	50	54
2	102	123	124	55	59
3	103	125	126	60	64
4	104	127	128	65	69
5	105	129	130	70	74
6	106	131	132	75	79
7	107	133	134	80	84
8	108	135	136	85	89
9	109	137	138	90	94
10	110	139	140	95	99
11	111	141	142	200	204
12	112	143	144	205	209
Pod 1		145	146	210	214
Pod 2		147	148	215	219
Pod 3		149	245	220	224
Pod 4		246	247	225	229
Pod 5		248	249	230	234
Pod 6		250	251	235	230
Pod 7		252	253	240	244

What static IP addresses can be used by the student sitting at station CIS-Lab-06 in the CIS Lab?

172.30.4.131
or
172.30.4.132

IP Address Assignments for Lab PCs (CIS Lab)

172.30.4.1-49 (reserved)

172.30.4.150-199 (DHCP pool)

Gateway: 172.30.4.1

DNS: 192.168.0.8 and 10.240.1.2

Station	Station IP	Static		DHCP Pool	
		Static 1	Static 2	Start	End
CIS-Lab-	172.30.4.	172.30.4.	172.30.4.	172.30.4.	172.30.4.
1	101	121	122	50	54
2	102	123	124	55	59
3	103	125	126	60	64
4	104	127	128	65	69
5	105	129	130	70	74
6	106	131	132	75	79
7	107	133	134	80	84
8	108	135	136	85	89
9	109	137	138	90	94
10	110	139	140	95	99
11	111	141	142	200	204
12	112	143	144	205	209
Pod 1		145	146	210	214
Pod 2		147	148	215	219
Pod 3		149	245	220	224
Pod 4		246	247	225	229
Pod 5		248	249	230	234
Pod 6		250	251	235	230
Pod 7		252	253	240	244

What static IP addresses can be used by the student using Pod 2 in the CIS VLab?

IP Address Assignments for Lab PCs (CIS Lab)

172.30.4.1-49 (reserved)

172.30.4.150-199 (DHCP pool)

Gateway: 172.30.4.1

DNS: 192.168.0.8 and 10.240.1.2

Station	Station IP	Static		DHCP Pool	
		Static 1	Static 2	Start	End
CIS-Lab-	172.30.4.	172.30.4.	172.30.4.	172.30.4.	172.30.4.
1	101	121	122	50	54
2	102	123	124	55	59
3	103	125	126	60	64
4	104	127	128	65	69
5	105	129	130	70	74
6	106	131	132	75	79
7	107	133	134	80	84
8	108	135	136	85	89
9	109	137	138	90	94
10	110	139	140	95	99
11	111	141	142	200	204
12	112	143	144	205	209
Pod 1		145	146	210	214
Pod 2		147	148	215	219
Pod 3		149	245	220	224
Pod 4		246	247	225	229
Pod 5		248	249	230	234
Pod 6		250	251	235	230
Pod 7		252	253	240	244

What static IP addresses can be used by the student using Pod 2 in the CIS VLab?

172.30.4.147
or
172.30.4.148

CIS-Lab-02



.102

VLab vmserver4



172.30.4.0/24

.131



Arwen on
CIS-Lab-02

.131



Elrond on
VLab Pod 4

*What IP addresses
should Hugo and
Kate have used?*

CIS-Lab-02



.102



VLab vmserver4



172.30.4.0/24

.123
or .124

~~.131~~



Arwen on
CIS-Lab-02

~~.131~~



Elrond on
VLab Pod 4

.246
or .247

Hugo should have used:

*172.30.4.123 or
172.30.4.124*

and Kate should have used:

*172.30.4.246 or
172.30.4.247*

Configuring static IP address

Configuring a static IP address with ifconfig

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

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

Configuring a static IP address with ifconfig

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

ifconfig

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

[root@elrond ~]# _
```

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

Configuring a static IP address with ifconfig

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

ifconfig eth0 172.30.4.130 netmask 255.255.255.0

MAC address

IPv4 address

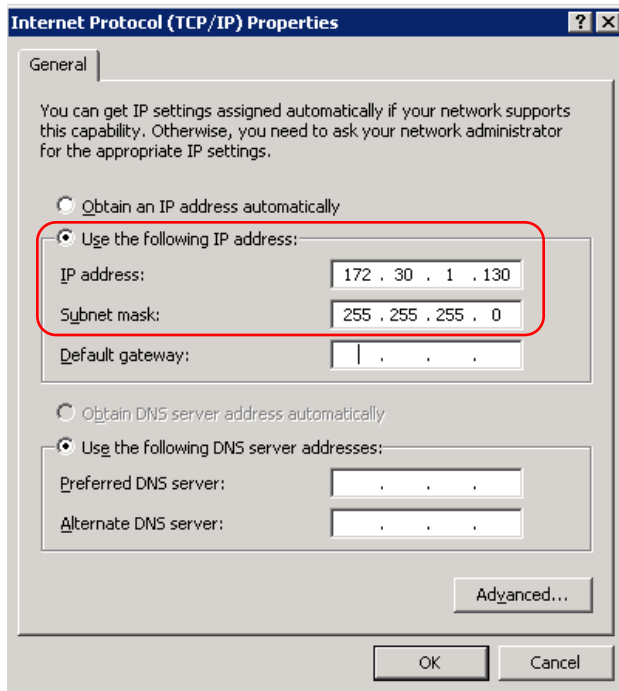
```
[root@elrond ~]# ifconfig eth0 172.30.1.130 netmask 255.255.255.0
[root@elrond ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:68:36:87
          inet addr:172.30.1.130  Bcast:172.30.1.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe68:3687/64 Scope:Link
         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

IPv6 address

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

*If every student configures their VM with the same static IP address there will be duplicate IP issues with the classroom network = **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 172.30.1.130 255.255.255.0
Router(config-if)#
```



Caveat: Root's environment has /sbin in path

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

ifconfig

As root, your path includes /sbin

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

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

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

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

Configuring Gateway DNS

Configuring the gateway and DNS

- To show the routing table (including gateway)
route -n
- To set the gateway
route add default gw `xxx.xxx.xxx.xxx`
- To delete the gateway
route del default gw `xxx.xxx.xxx.xxx`

Configuring the gateway and DNS

To set the default gateway

route add default gw xxx.xxx.xxx.xxx

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

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

The routing table above has two entries:

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

Configuring the gateway and DNS

To delete the default gateway

route del default gw xxx.xxx.xxx.xxx

```

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

```

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

Configuring the gateway and DNS

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

Configuring the gateway and DNS

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

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

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



Testing

Testing Interface Settings

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

At school, the nosmo router is at:

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

- Check DNS by pinging hostname
ping google.com

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

Commands for testing interfaces

Check settings by pinging the classroom router

ping 172.30.1.1

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

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

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

Commands for testing interfaces

Check settings by pinging the classroom router

ping 172.30.1.1

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

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

Commands for testing interfaces

Check DNS settings by pinging hostname

ping google.com

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

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

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

Commands for testing interfaces

Check DNS settings by pinging hostname

ping google.com

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

The DNS name server has not been configured

Class Activity

Configuring Interface, default gateway and DNS

1. Power on **Celebrian** if it is not already on.
2. Configure eth0 with **your** static IP address (based on **your** station number)
ifconfig eth0 172.30.1.xxx netmask 255.255.255.0
3. Check it with **ifconfig eth0**
4. Configure your default gateway with:
route add default gw 172.30.1.1
5. Set up your DNS with:
echo nameserver 10.240.1.2 > /etc/resolv.conf
6. Test by pinging the router 172.30.1.1, google.com and your Windows station.

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`**

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.



Lab Assignment

Use the class calendar to see all assignments and due dates

Rich's Cabrillo College CIS Classes
CIS 192A Calendar

Home Resources Forums CIS Lab CTC

Course Home Grades

(content subject to change)

Lesson	Date	Topics	Chapter	Due
1	10/25	Introduction to Course, TCP/IP and Network Access <ul style="list-style-type: none"> How this course works Equipment and resources Virtualization and VMware 101 skills Linux market Networking overview Standards NICs and drivers Configure network settings Test network connections Ping and SSH with IPv6 Materials <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) TBA Assignment <ul style="list-style-type: none"> Lab 1 (Linux VMs) CCC Center <ul style="list-style-type: none"> Enter virtual classroom Class archives 	12,14	
	10/31	Last day to add CIS 192A		
2	11/1	Quiz 1 ARP and the Internet Layer <ul style="list-style-type: none"> Permanent interface configuration Red Hat and Debian/Ubuntu files 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 Materials <ul style="list-style-type: none"> Presentation slides (download) IP address exercise (download) TBA Assignment <ul style="list-style-type: none"> Lab 2 (NIC Config) CCC Center <ul style="list-style-type: none"> Enter virtual classroom Class archives 	12	Student survey Lab 1

CIS 192 Linux Lab Exercise
Lab 1: Using the CIS Lab Resources
Fall 2011

Lab 1: Using the CIS Lab Resources

The purpose of this lab is to become familiar with some of CIS Lab resources and to start practicing some old and new Linux commands.

Resources

- The Opus server
- The CIS Student Forum
- CIS 192 VMs on stations CIS-Lab-01 to CIS-Lab-10 in the CIS Lab
- CIS 192 VMs in the CIS VLab

CIS 192 VMs

We will be using 7 Virtual Machines (VMs) for this course.

	CentOS	Ubuntu	Windows
VMs	Arwen	Frodo	William
	Celebrían	Sauron	
	Eilond		
	Legolas		

In the CIS Lab, VMware Workstation is used to operate these VMs. For the remotely accessed CIS VLab, VMware vSphere Client and ESXi are used to access duplicate VMs running on a VMware ESXi server.

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.

CIS Student Forum at

A phpBB forum, at <http://opus.cabrillo.edu/forum/viewforum.php?f=39>, 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 create a file named lab01 in your home directory on Opus. As you complete each step below you will record information in this lab01 file. When finished submit your work by copying your lab01 file into the instructors `turnin` directory.

Please refer to the Logins sheet you filled out in the first class for your various user accounts and passwords.

The Date

What is due by midnight (and not one minute later) on that date (Opus time)

How to submit your work for grading

- For each lab you will create a text file on Opus that gets submitted for grading.
- To submit, copy that text file to the /home/rsimms/turnin directory on Opus and name your file labxx.\$LOGNAME (where xx = the number of the lab).
- It's a good idea to verify your copy worked!
- Labs must get turned in by midnight (Opus time) on the due date to get credit.
- Submit as many times as you wish up till the deadline.
- No points for late work. 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/lab01.$LOGNAME
```

```
[simben192@opus ~]$
```

- Check your submittal from Opus:

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

```
lab01.simben192
```

```
[simben192@opus ~]$
```

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 Powerpoints which usually have examples aimed at doing the lab assignments.
- Make a network diagram with all interfaces labeled. Confirm your configuration matches the diagram.
- Go back and methodically verify each step was completed. For example, if you modified `/etc/hosts` then `cat` it out and review your changes. If you set the default gateway, use `route -n` command to verify. If you configured an IP address, use **ifconfig** to verify.
- Google unknown error messages you observe.
- Google any problems you are observing.

Some organization tips for doing labs

Some Tips

- Start early, doing labs at the last minute adds unnecessary time pressure and there may be no available equipment to use.
- 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.
- Keep a growing cheat sheet of commands and examples.
- Partner with another student – "two heads are better than one" (at least most of the time!)
- Use the forum to share specific tips you learned while doing a lab.

Static IP addresses are one click away:



Don't forget!

Don't ruin your day with duplicate IP addresses!

Rich's Cabrillo College CIS Classes
CIS 192A Calendar

Home Resources Forums CIS Lab CTC

Login
Flashcards
Admin

CIS 192A
Previous Classes

49 days till CIS 192A starts!

Cabrillo College
Web Advisor
CCC Confer
Static IPs
Quick Ref
Accessing Lab

CIS 192A (Fall 2011) Course Calendar
[Course Home](#) [Grades](#)
(content subject to change)

Lesson	Date	Topics	Chapter	Due
1	10/25	<p>Introduction to Course, TCP/IP and Network Access</p> <ul style="list-style-type: none"> Linux market and jobs Understand how this course will work Equipment and resources Virtualization and VMware 101 skills Networking overview NIC drivers Configure network settings Test network connections Ping and SSH with IPv6 <p>Materials</p> <ul style="list-style-type: none"> Presentation slides (download) Apache web server example (show) Logins Sheet (download) Howto #303: Remote Access to the C 		

Rich's Cabrillo College CIS | simms-teach.com/docs/sta | Cabrillo College: Computer

simms-teach.com/docs/static-ip-adrrs.pdf

IP Address Assignments for Lab PCs (CIS Lab)
172.30.4.1-49 (reserved)
172.30.4.150-199 (DHCP pool)
Gateway: 172.30.4.1
DNS: 192.168.0.8 and 10.240.1.2

Station	Station IP	Static		DHCP Pool	
		Static 1	Static 2	Start	End
CIS-Lab-	172.30.4.	172.30.4.	172.30.4.	172.30.4.	172.30.4.
1	101	121	122	50	54
2	102	123	124	55	59
3	103	125	126	60	64
4	104	127	128	65	69
5	105	129	130	70	74
6	106	131	132	75	79
7	107	133	134	80	84
8	108	135	136	85	89
9	109	137	138	90	94
10	110	139	140	95	99
11	111	141	142	200	204
12	112	143	144	205	209
Pod 1	145	146	147	210	214
Pod 2	147	148	149	215	219
Pod 3	149	245	246	220	224
Pod 4	246	247	248	225	229
Pod 5	248	249	250	230	234
Pod 6	250	251	252	235	239
Pod 7	252	253	254	240	244

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



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.

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