Lesson Module Checklist

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

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

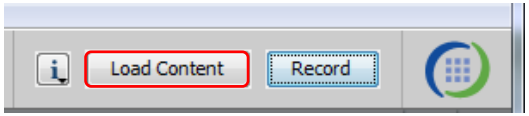
- Forum created and registration tested
- Opus accounts made and populated
- VLab VMs created and configured
- Surveys and PW sheet posted

- Rosters printed
- Add codes printed

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

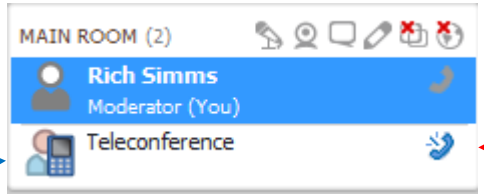
CCC Confer

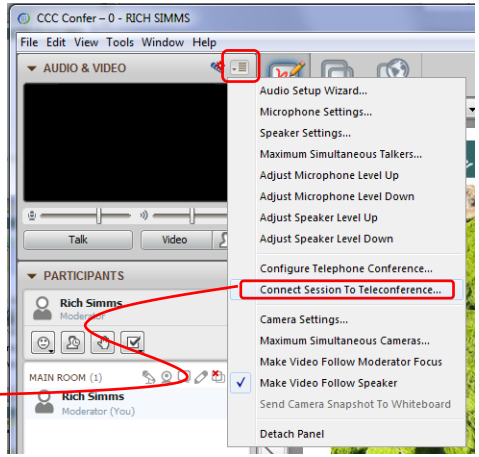
[ ] Preload White Board with *cis*lesson??*-WB*



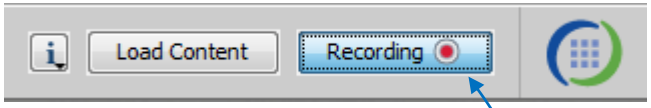
[ ] Connect session to Teleconference

Session now connected to teleconference





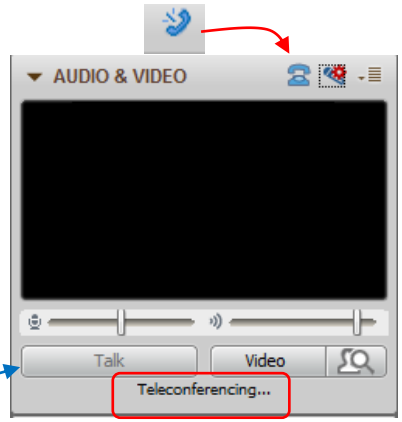
[ ] Is recording on?



Red dot means recording

[ ] Use teleconferencing, not mic

Should be greyed out

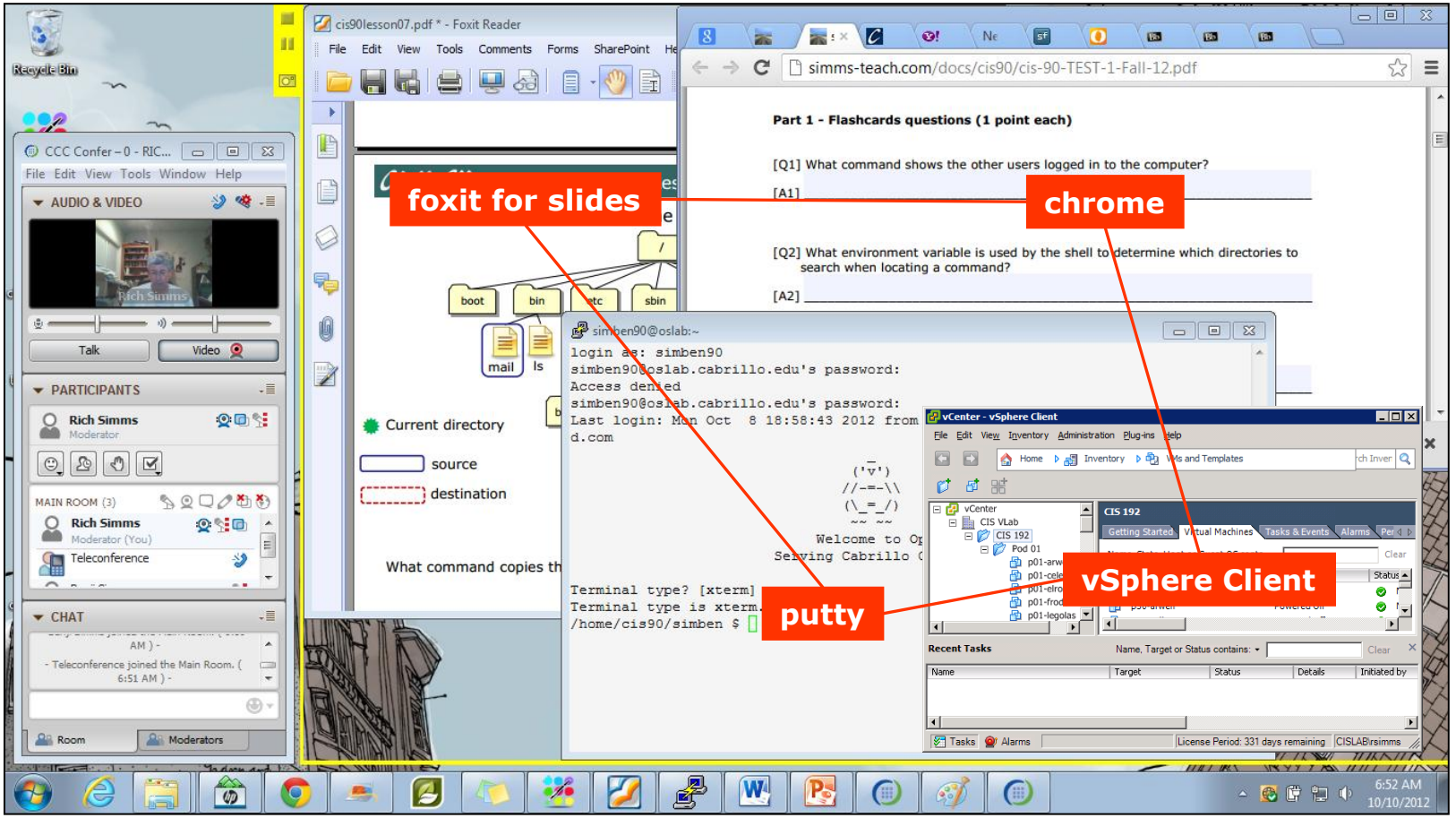


CCC Confer

Don't Forget

[ ] **Video (webcam) optional**

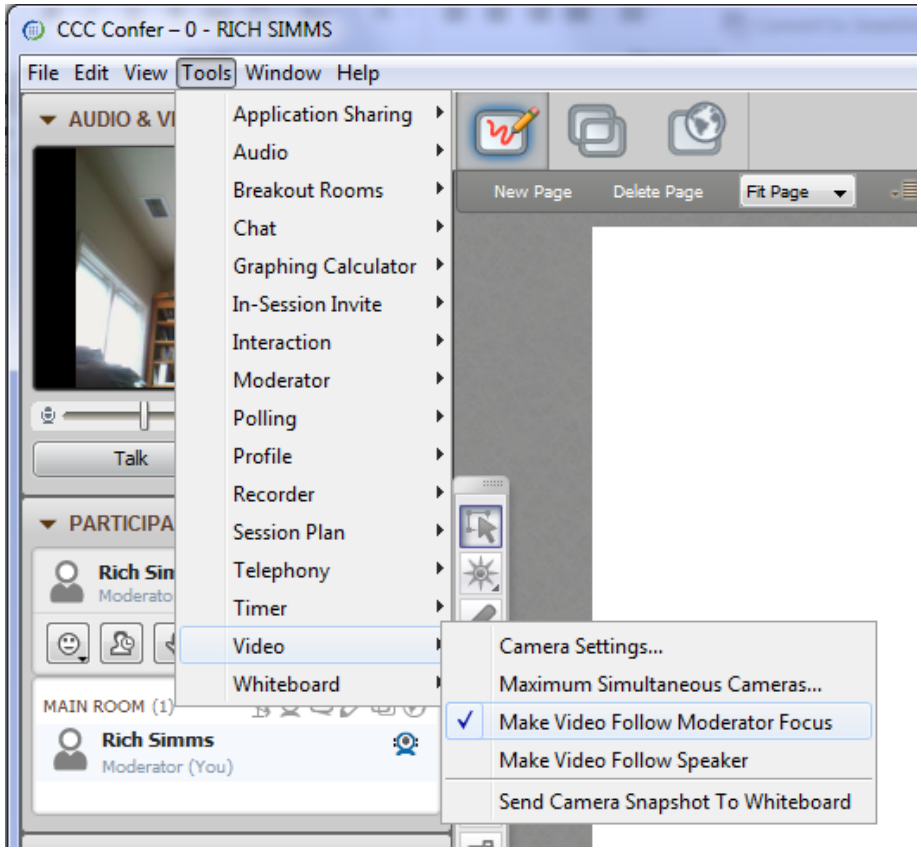
[ ] **layout and share apps**



CCC Confer

[ ] Video (webcam) optional

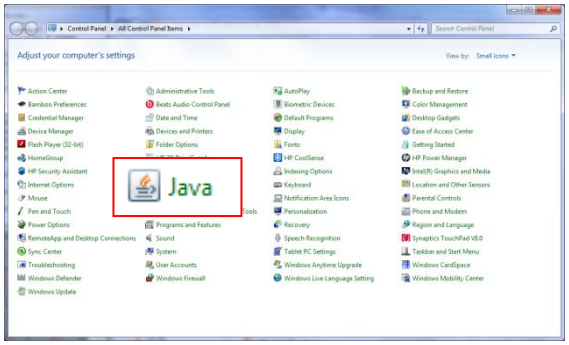
[ ] Follow moderator



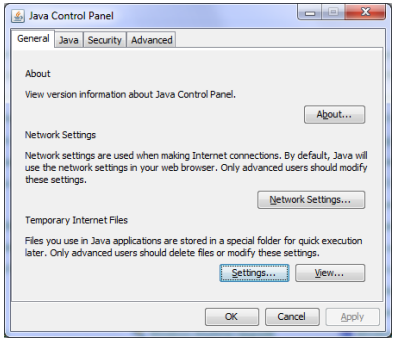
Universal Fix for CCC Confer:

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

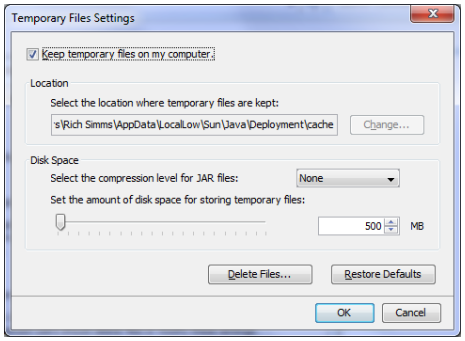
Control Panel (small icons)



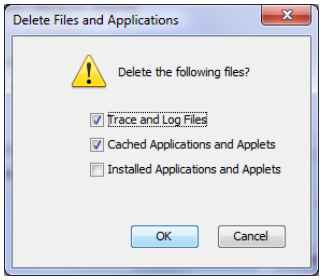
General Tab > Settings…



500MB cache size



Delete these



Google Java download

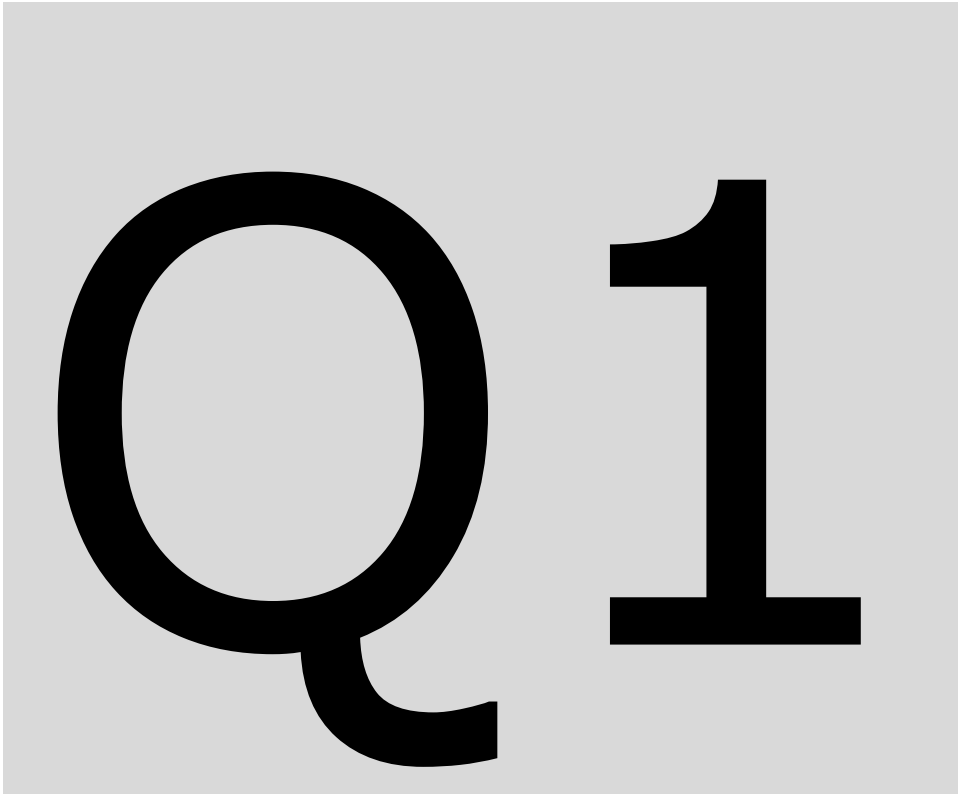
CIS 192AB - Lesson 1

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

Ahmed Solomon Sean Christopher Corey Bryan Shahram Tony David H. Donna

Stephanie David M. Evan Gabriel Elia Tajvia Carlos Adam Ben Laura

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



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

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

Introductions

Introductions and Credits

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

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

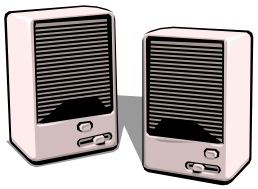
And huge thanks to:
- Rick Graziani for the use of his great network slides (http://cabrillo.edu/~rgraziani/)
- John Govsky for many teaching best practices: e.g. the First Minute quizzes, the online forum, and the point grading system (http://teacherjohn.com/)

Introduction to TCP/IP and Network Access

Related Course Objectives	Agenda
• 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.	• Introductions • CCC Confer • How this class works • Housekeeping • Linux Market • Lab resources • VMware 101 VLab, cabling, real estate • Superuser • Network Basics • NIC inventory • NIC Drivers • Configuring interfaces • Joining network (dhcp and static IP) • SSH hopping • Ping testing & troubleshooting • Command line sniffing • Dup IPs • IPv6

Virtual Classroom with CCC Confer

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

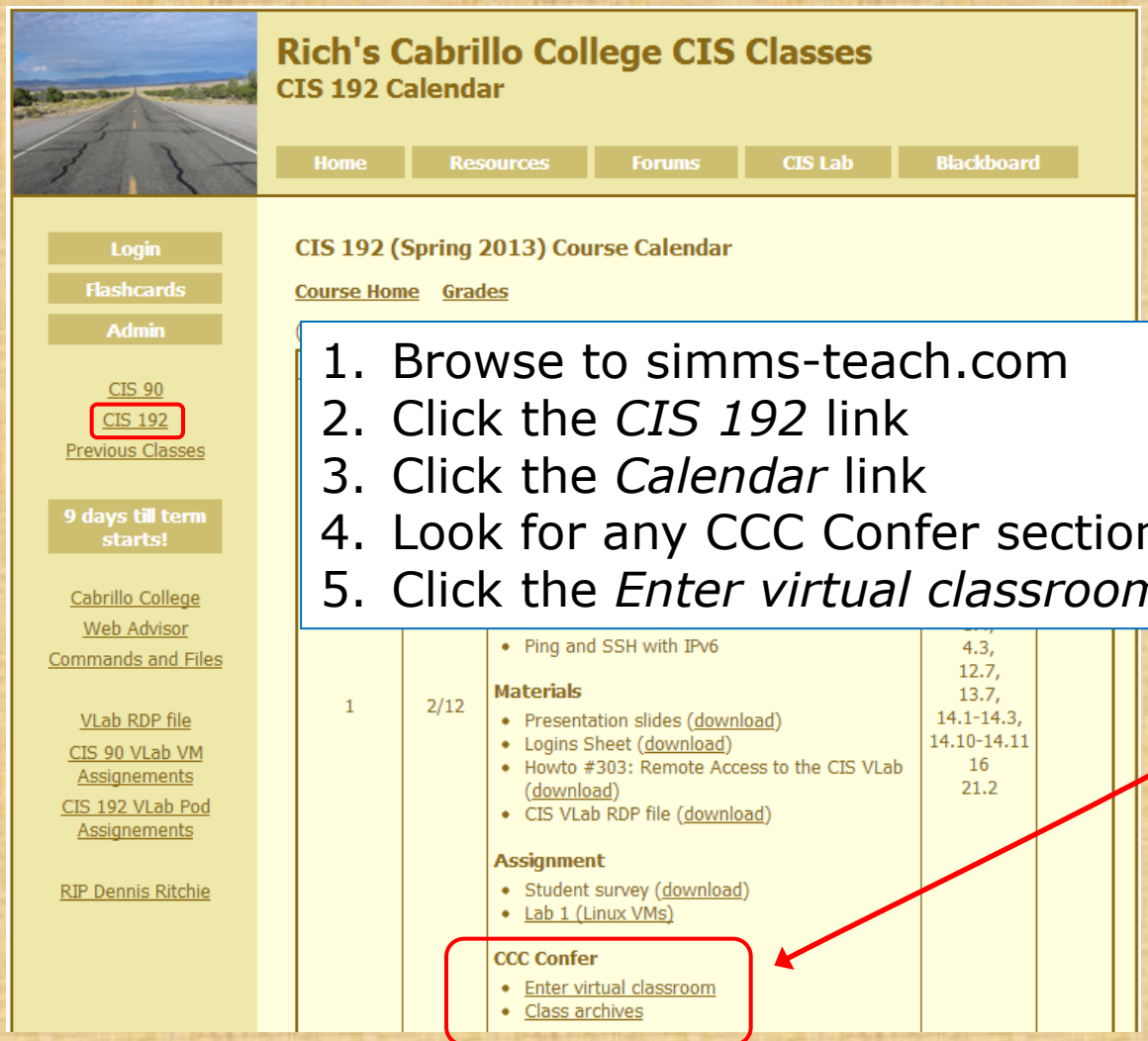


- Ask questions using the chat window or just speak if dialed in with your phone (or Skype)

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

Class Activity

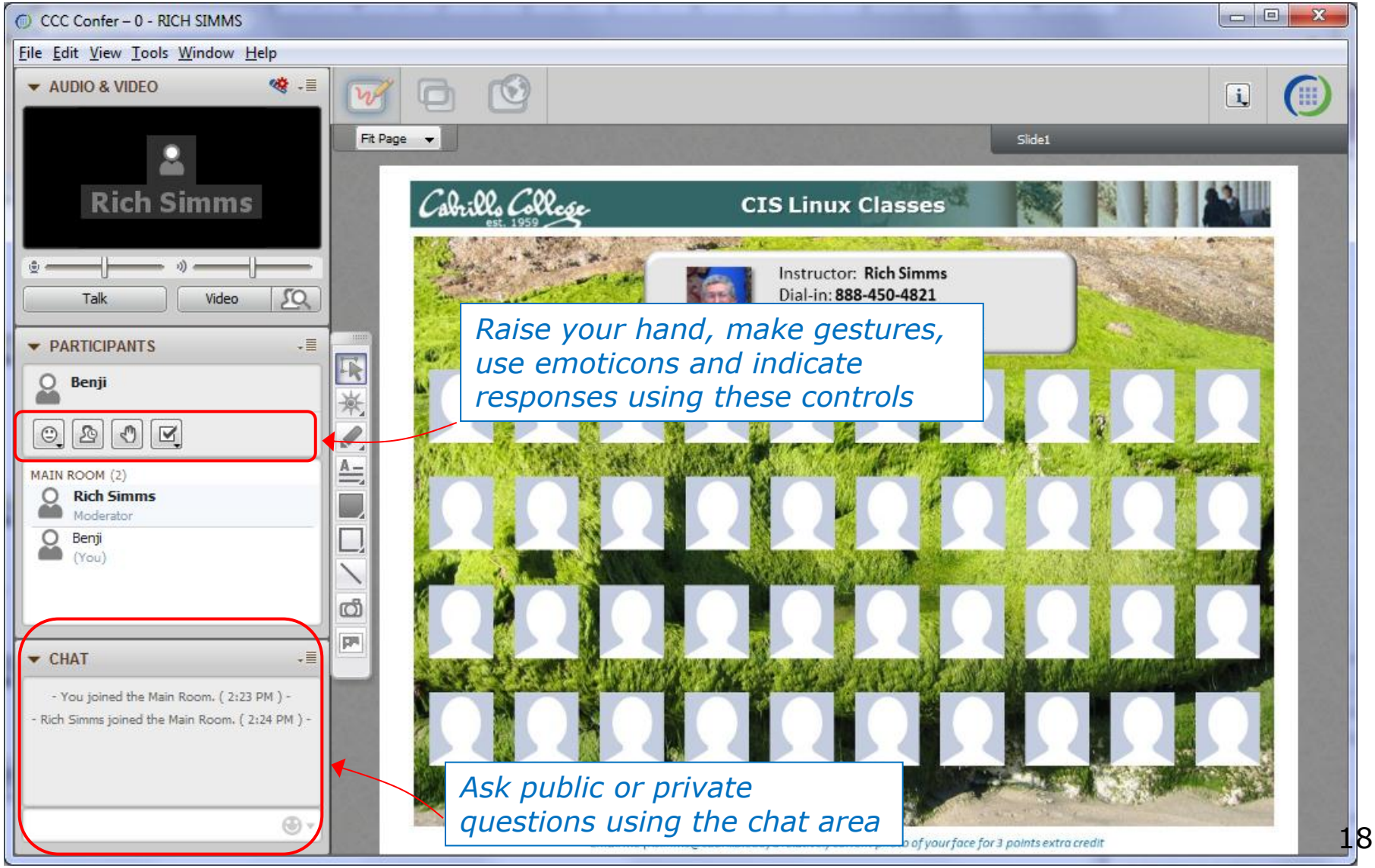
Enter the online virtual classroom



CCC Confer - Attending class online

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

CCC Confer - Attending class online



CCC Confer - Attending class online

When dialed in by phone you can use:

*0 Contact the operator for assistance.

*6 Mute/unmute your individual line with a private announcement.

Switch to preloaded whiteboard

Turn Recording On
Switch back to shared slides

Prerequisite Knowledge

CIS 81

Should have a high level understanding of the following:

IPv4 Addressing
Ethernet
Network stack (OSI layers)
Encapsulation
Subnetting
Utilities:
- Ping
- Wireshark

DNS
DHCP
NAT
Devices
- NICs
- Hubs
- Switches
- Routers

Routing

CIS 90

Should be comfortable with the following:

Navigating file tree
- ls, cd, pwd, find

File management
- cp, mv, rm, mkdir, rmdir

Edit configuration files
- vi

Working in a bare bones terminal
- more, less, tty, clear

Virtual terminals
- Ctrl-Alt-F1 …

Getting info
- man, google

Miscellaneous
- ssh/Putty, chmod, scp

Command line edits
- up arrow, tab

Showing file contents
- cat, grep, head, tail, file

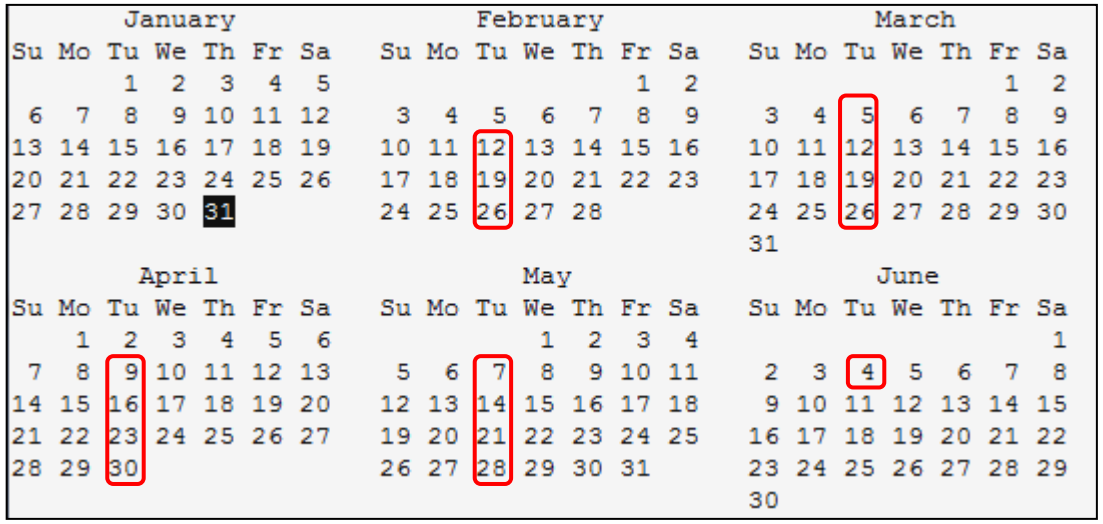
Redirection and pipes
- >,>>, < , |

How this Class Works

CIS 192AB
Spring 2013

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

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



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

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

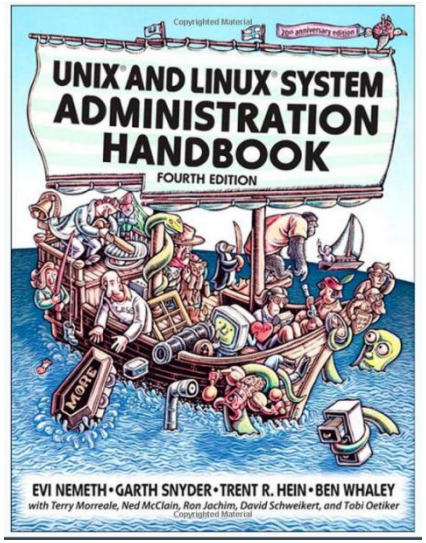
March						
Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

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

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

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

You may attend by either coming to room 2501 or remotely using CCC Confer



Required Textbook:

UNIX and Linux System Administration Handbook (4th Edition)

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

The typical week

http://simms-teach.com

Use Forum to ask and answer questions

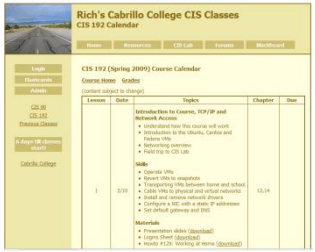
Tuesday

"First minute" quiz

Lecture on new lesson material

Class activities

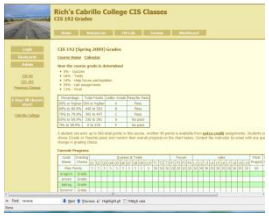
Previous week lab assignments due 11:59PM (Opus time)



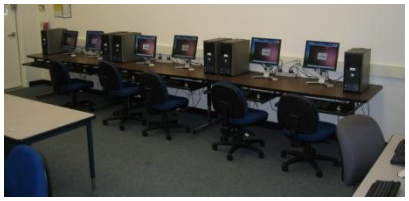
Calendar Page

Wednesday

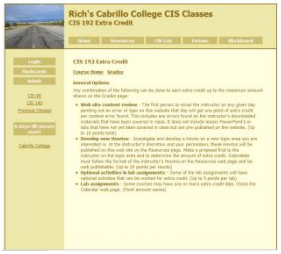
is grading day



Check progress on the Grades Page



Work Lab Assignments in the CIS Lab or from home



Check Extra Credit Page if you need some more points

Contacting the instructor

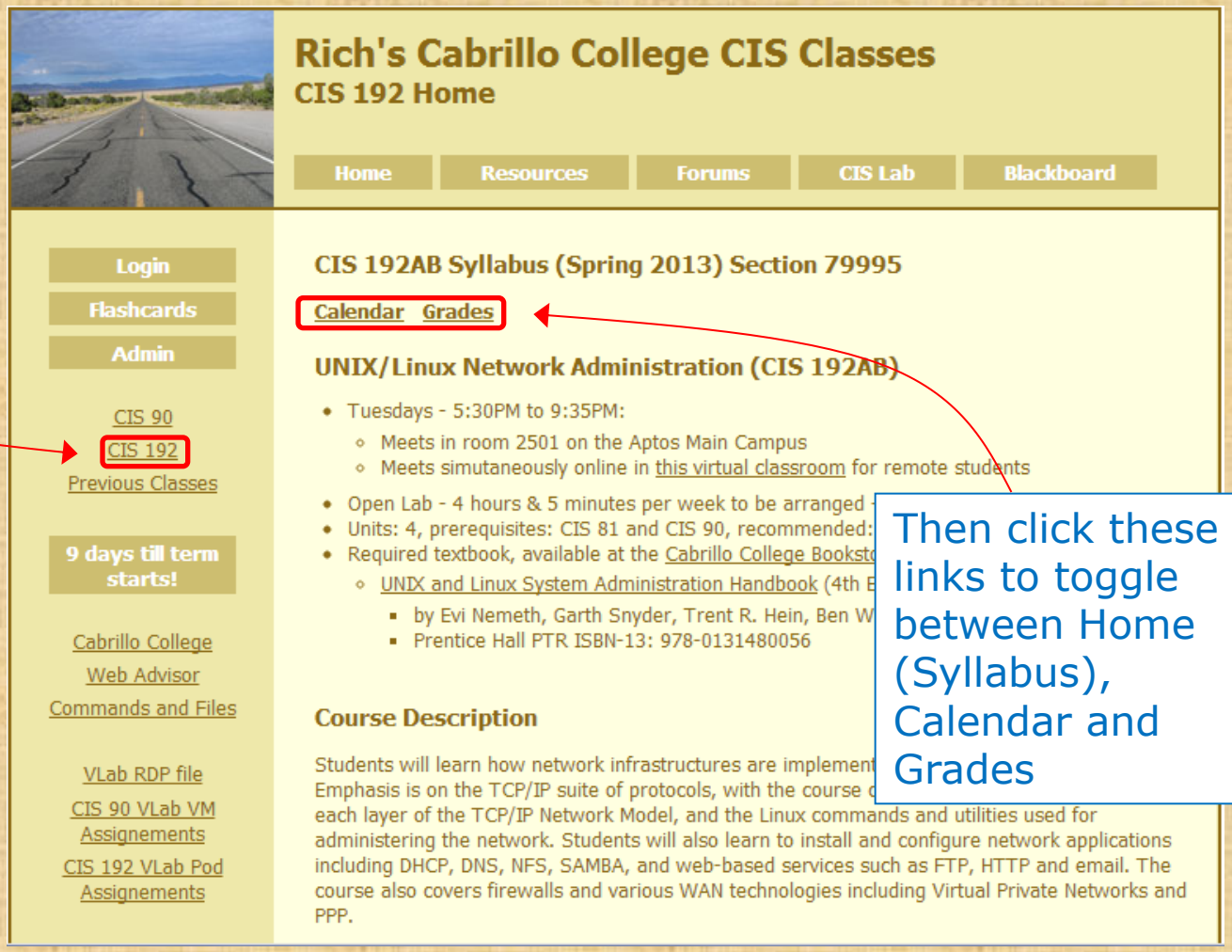
- Use the forum for the fastest response on technical or class related questions.
- Use email for personal matters only. If it's NOT personal I will most likely ask you to post your question on the forum and will answer it there instead so other students may benefit from the answer.
- Weekly office hours: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

- Avoid leaving a message on voice mail. Checked rarely so don't expect a fast response!

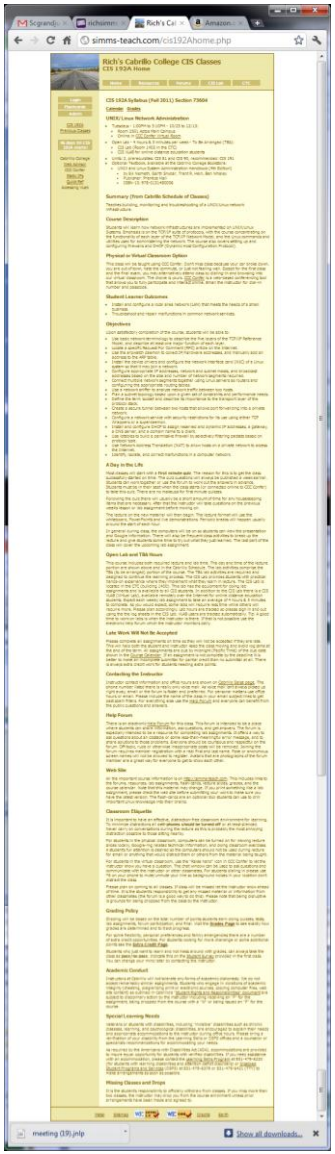
Class Exercise (class website)

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

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



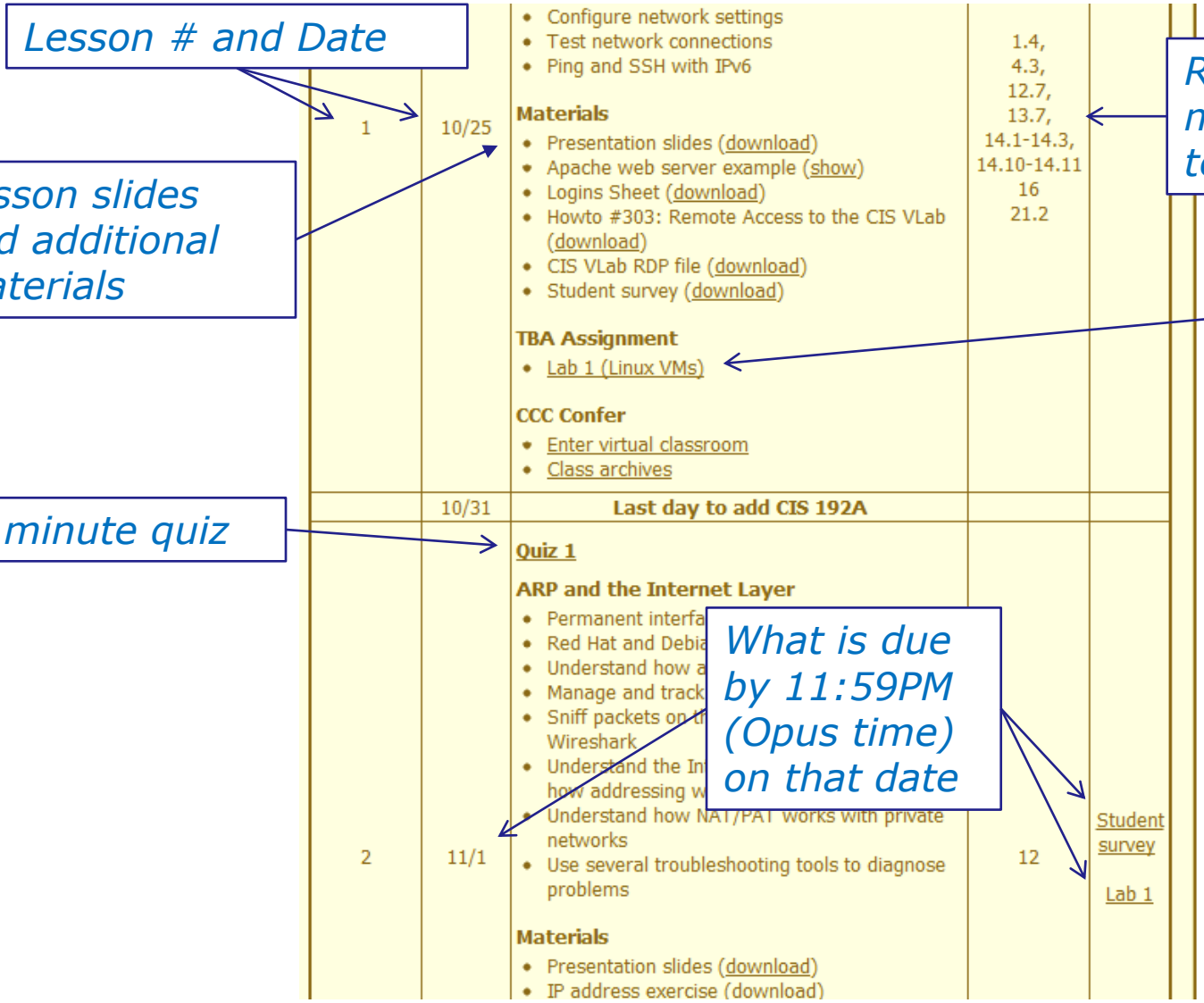
Then click these links to toggle between Home (Syllabus), Calendar and Grades



Course Syllabus
(on the CIS 192 home page)

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

Course Calendar



Course Grading

Monitor this page to track your progress in the course.

Rich's Cabrillo College CIS Classes
CIS 192 Grades

Home | Resources | Forums | CIS Lab | Blackboard

Admin

CIS 90
CIS 192
Previous Classes

9 days till term starts!

Cabrillo College
Web Advisor

CIS 192 (Spring 2013) Grades

Course Home Calendar

Points can be earned from the following activities:

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

How your grade is determined:

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

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

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

Choice of Grade or Pass/No Pass

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

Recommendations

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

Current Progress

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

Code Name	Grading Choice	Quizzes & Tests													Forum				Labs										Final	Extra Credit	Total	Grade
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	T1	T2	T3	F1	F2	F3	F4	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10				
Max Points		3	3	3	3	3	3	3	3	3	3	30	30	30	20	20	20	20	30	30	30	30	30	30	30	30	30	30	60	90	560	
Arwen	Grade																															

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

Use extra credit to earn additional points

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

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

Each student is assigned a secret LOR code name

More on Grading

Points can be earned from the following activities:

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0% to 59.9%	0 to 335	F	No pass

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

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

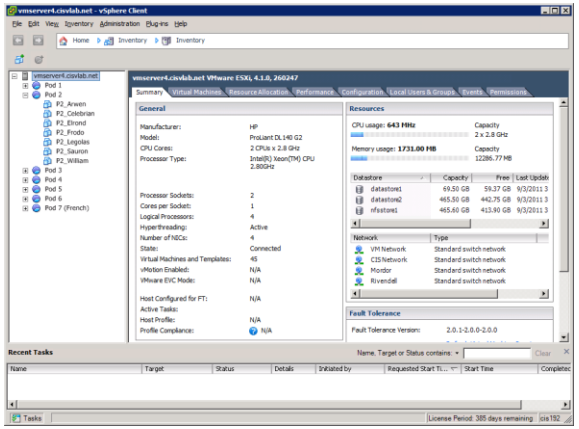
CIS 192 - How this class works

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)

CIS VLab (remote online access)



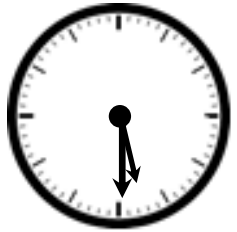
More on Grading

Lab Assignments (30 points each)

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

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

More on Grading



"First Minute" quizzes (3 points each)

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

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

More on Grading

Tests (3 tests, 30 points each)

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

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

More on Grading

Final Exam (60 points)

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

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

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

More on Grading

Forum Posts (20 points per posting period)

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

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

More on Grading

Extra credit (up to 90 points)

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

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

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

Course outline and syllabus

Please don't forget:

1) **No makeup's for missed quizzes**

2) **Late work (lab assignments) will not be accepted**

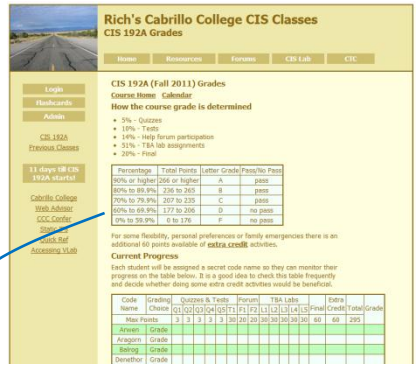
If you have not completed a lab assignment, **please turn in what you have done for partial credit**

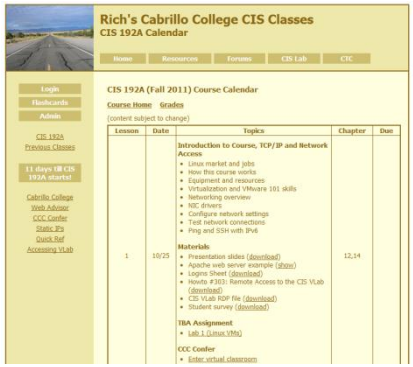
Don't panic though -- there are ample extra credit opportunities for students wanting or needing any extra points.

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

Final word on Grading

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



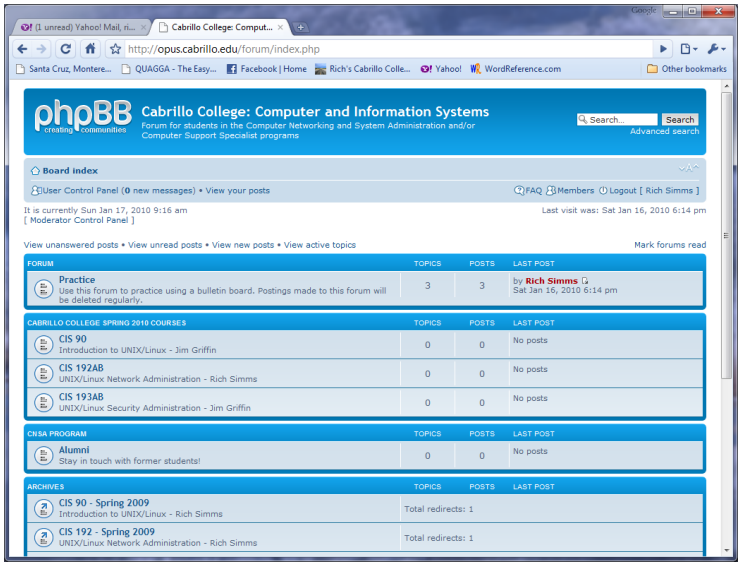


Percentage	Total Points	Letter Grade	Pass/No Pass
90% or higher	504 or higher	A	Pass
80% to 89.9%	448 to 503	B	Pass
70% to 79.9%	392 to 447	C	Pass
60% to 69.9%	336 to 391	D	No pass
0% to 59.9%	0 to 335	F	No pass

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

Help Forum

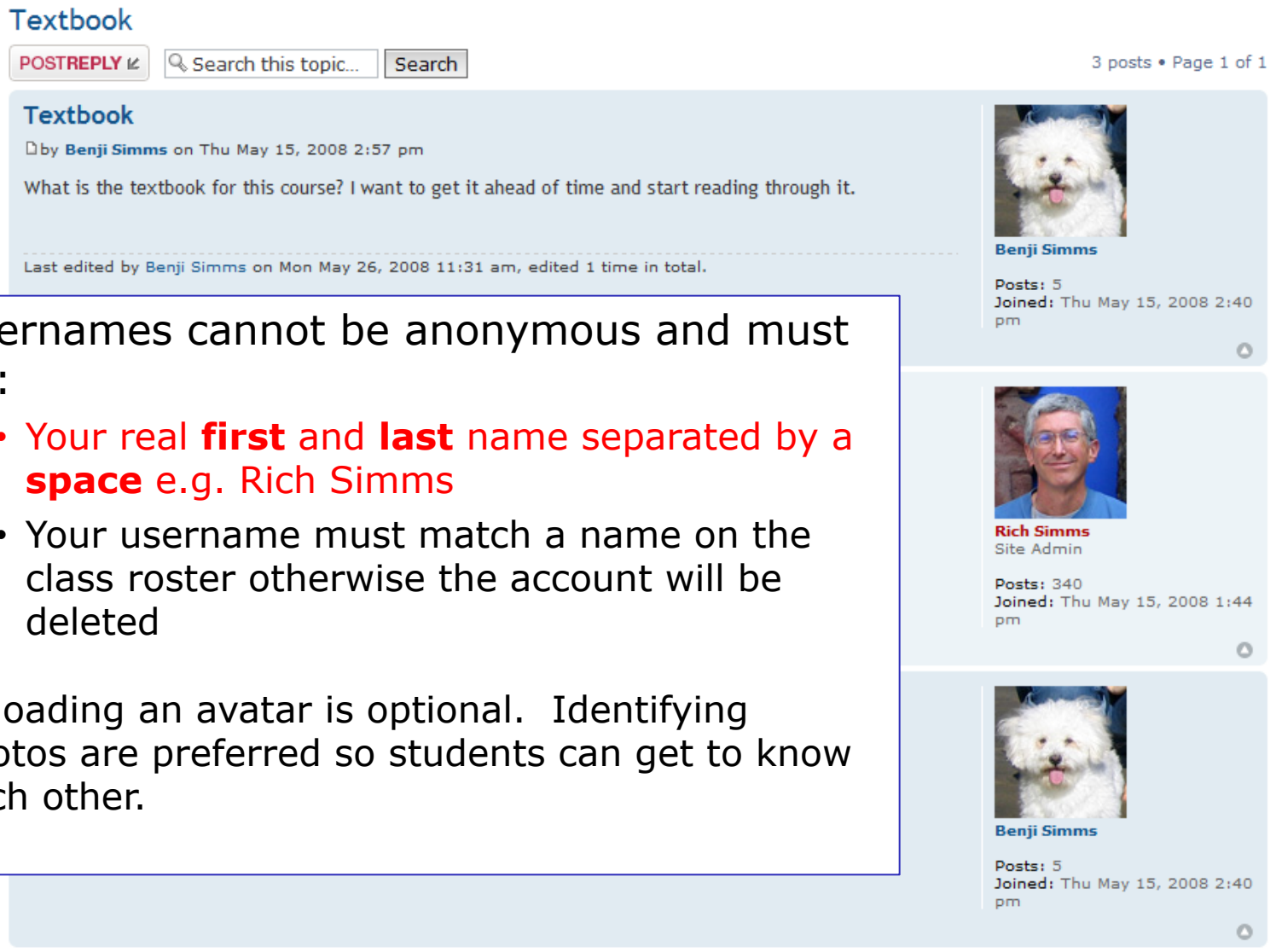
Online Help Forum



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

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

Class Forum



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

CIS 192
Class Forum

Optional, but handy is to subscribe to a forum.

After logging in:

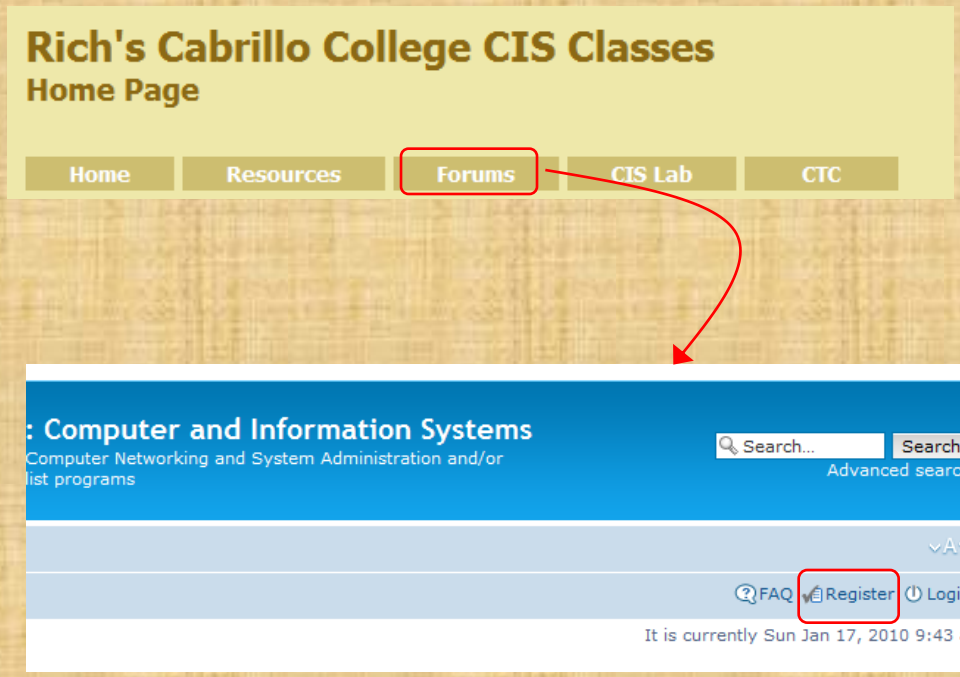
1. Go to the class forum.
2. Click the "Subscribe forum" box at the lower left. When subscribed you get email notifications when new posts are made.
3. To unsubscribe, click it again.

Unsubscribed looks like this

Subscribed looks like this

Class Activity
Forum Registration

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



To Register:

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

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

Housekeeping

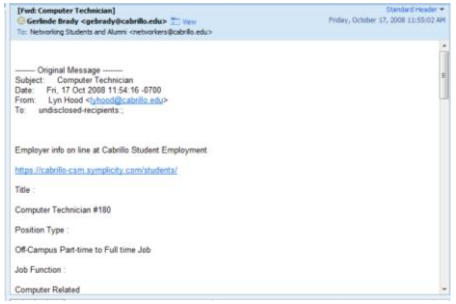
- Adds
- Last day to add is 2/23/2013

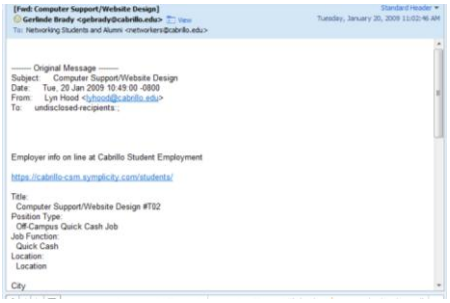
Cabrillo Networking Program Mailing list

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

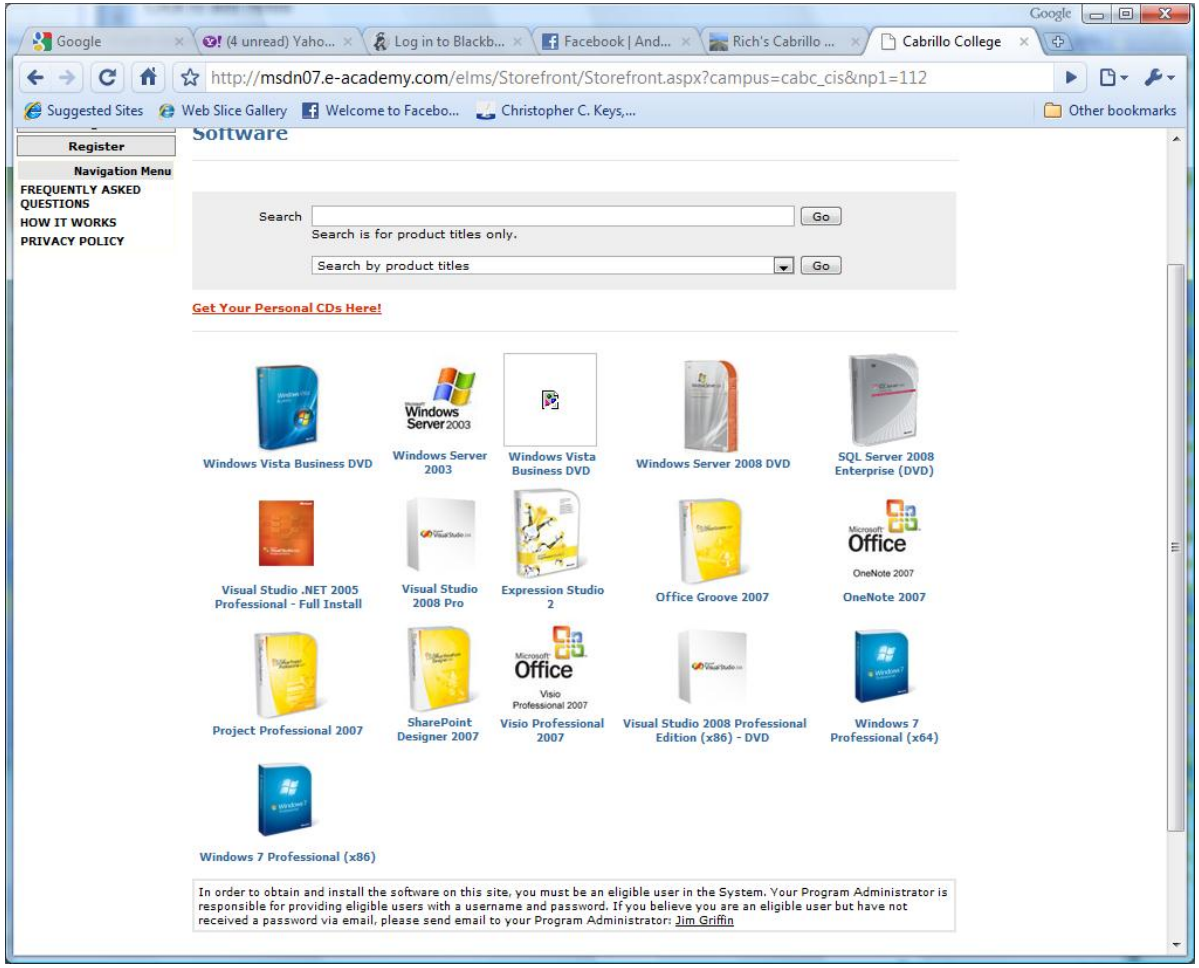
networkers-subscribe@cabrillo.edu

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





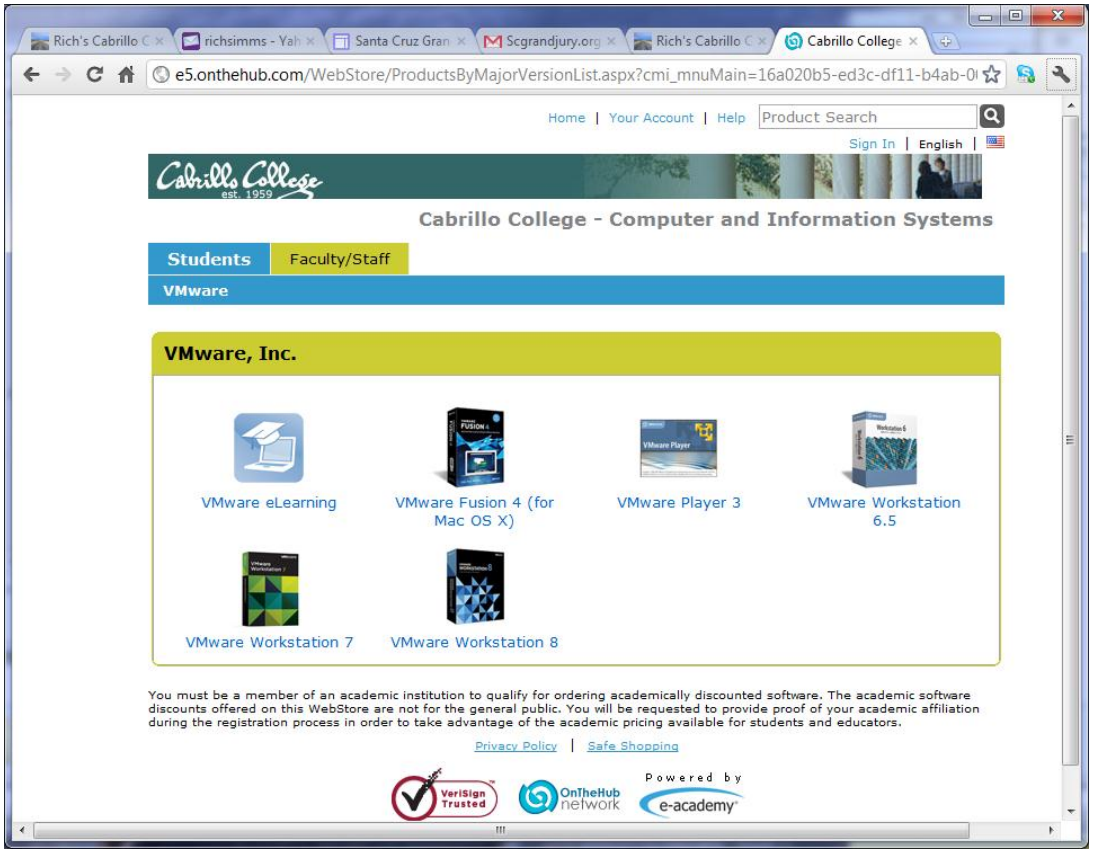
MSDN Academic Alliance



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

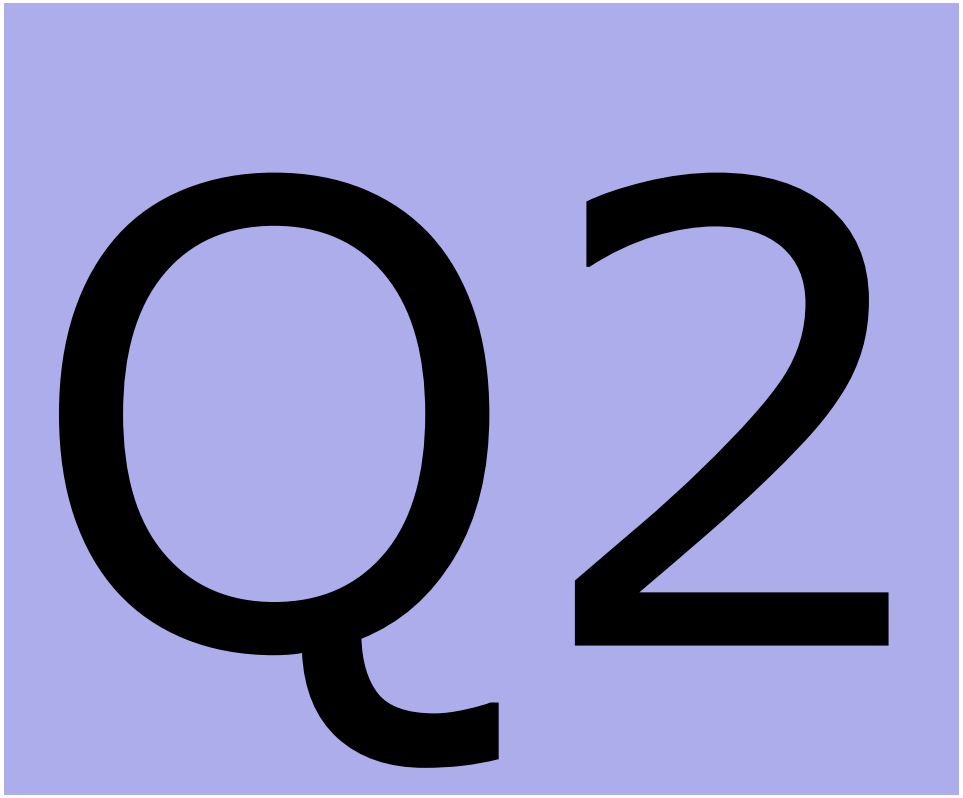
To get to this page, go to **http://simms-teach.com/resources** and click on the appropriate link in the Tools and Software section

VMware e-academy



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

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



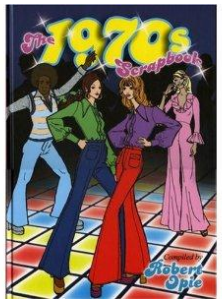
- UNIX/Linux market
- Equipment
- Login to Opus
- Login to CIS 192 VMs on school computers
- Login to CIS 192 VM remotely

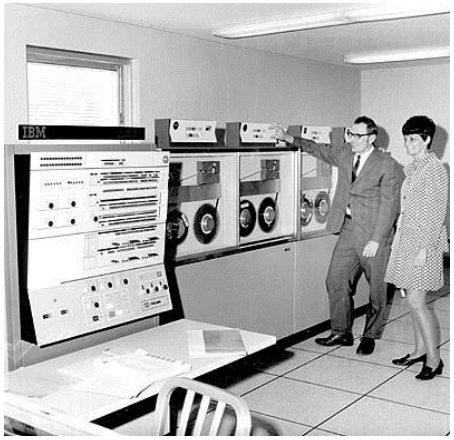
Why Study UNIX/Linux?

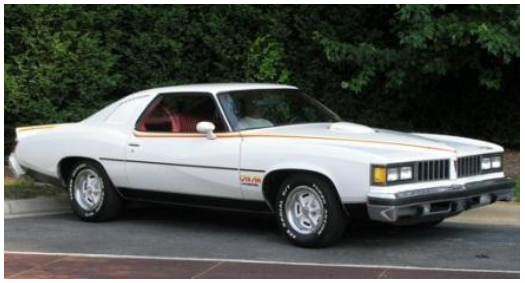
In 1971 Ken Thompson and Dennis Ritchie developed Unix at AT&T's Bell Labs

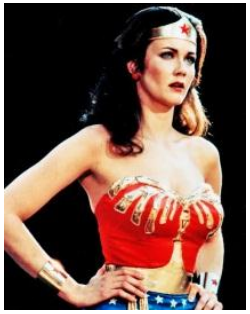
In 1971 Ken Thompson and Dennis Ritchie developed Unix at AT&T's Bell Labs

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









Heck NO !!

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

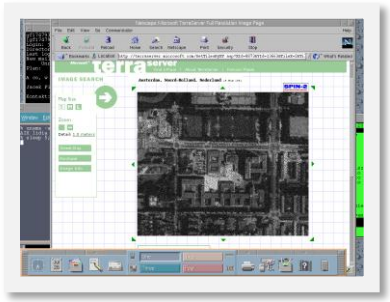
- Embedded in smartphones and many other appliances
- Internet services - Web, DNS, DHCP, Net News, Mail, etc.
- Enterprise and mission critical applications - Large databases, Enterprise Resource Management (ERM), Customer Relationship Management (CRM), data warehouse, manufacturing, supply chain management,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

Commercial UNIX Operating Systems

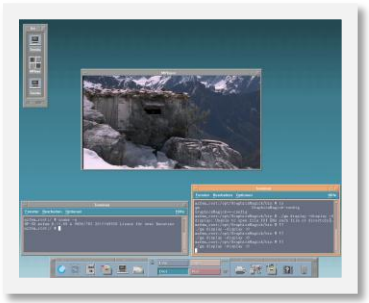
SCO UNIX

Berkeley Software Distribution

AIX



HP-UX



Solaris

Apple Mac OS X and iOS

The kernel is UNIX based

Various Linux Distributions

OpenSUSE

Red Hat Enterprise Linux

Fedora

Debian

CentOS

Ubuntu

Mandriva

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

Tux, the penguin, is the Linux kernel mascot

Embedded UNIX in Apple Products

Apple iOS

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

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

Embedded Linux (just a few)

Katana Robotic Arm

Linksys WRT-54GL

Tivo

Yamaha Disklavier Mark IV

Android

Some TomTom GPS models

Garmin Nuvi 5000

Buffalo NAS storage

Virgin America Personal Entertainment

MikroTik Routers

Google Chrome OS for Netbooks and Tablets

Raspberry Pi

http://www.linuxfordevices.com/c/a/Linux-For-Devices-Articles/The-Linux-Devices-Showcase/

The Open-Source Car

Summary: *Toyota is joining the Linux Foundation.*

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

Follow @sjvn

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

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

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

< snipped >

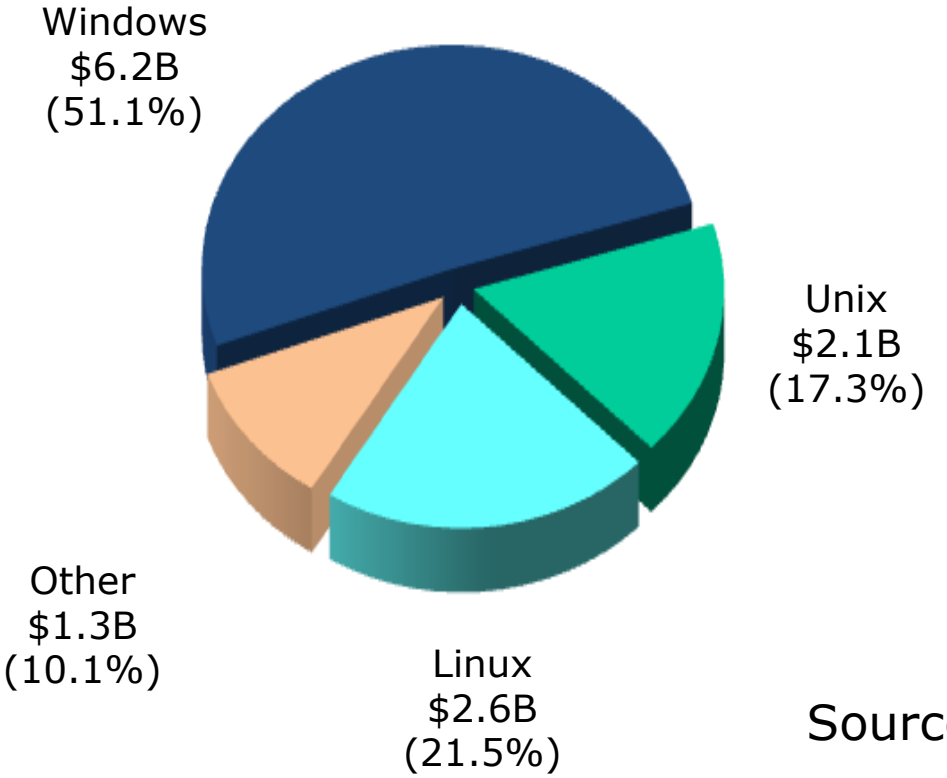
http://www.zdnet.com/blog/open-source/the-open-source-car/9193

Businesses and organizations that run on Linux

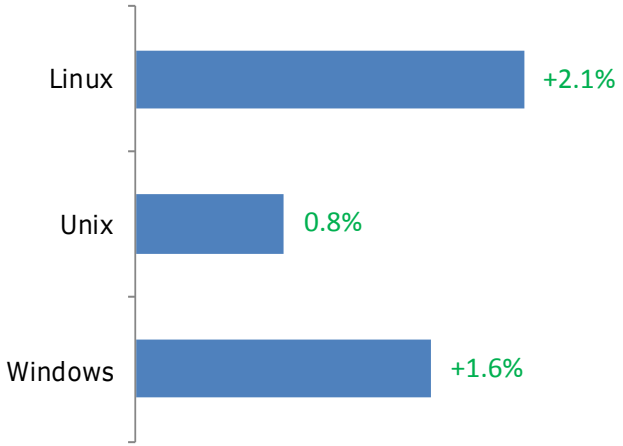
http://www.comparebusinessproducts.com/fyi/50-places-linux-running-you-might-not-expect


Worldwide Server Market

$12.2 Billion Server Revenue Q3 2012



Year over Year Change



Source: IDC, Nov 2012

http://www.idc.com/getdoc.jsp?containerId=prUS23808612#.UQx2eKVZW5I

Website hits by browser OS

Jul 2010[1]

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

6.9%

Dec 2011[2]

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

15.8%

Jan 2013[3]

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

22.8%

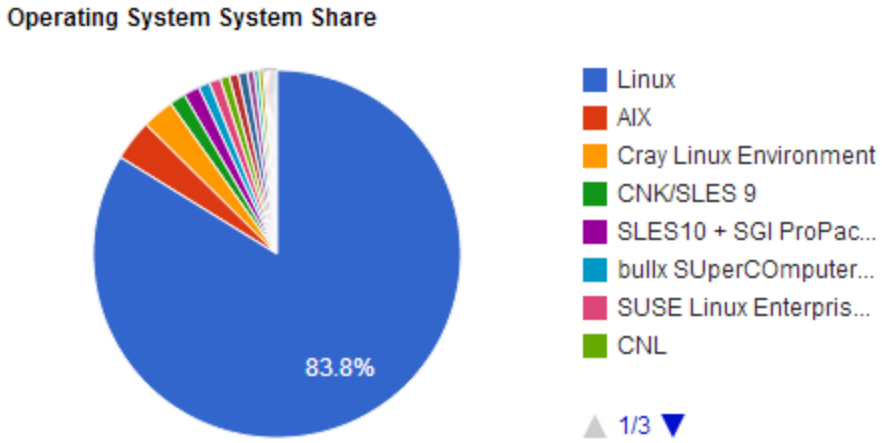
1-This report was generated 07/31/2010 based on the last 15,000 page views to each website tracked by W3Counter. W3Counter's sample currently includes 38,996 websites. The browser market share graph includes data from all versions of the named browser families, not only the top 10 as listed below.

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

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

W3Counter

source: http://www.w3counter.com/globalstats.php



Linux dominates the Supercomputer market

TOP500 NOVEMBER 2012

IBM iDataPlex in Canada

NASA Advanced Supercomputing (NAS) Facility

CERN

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

Source: http://www.top500.org/statistics/list/

iso.linuxquestions.org

15 Most Popular Linux Distro Downloads

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

Feb 1, 2013

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

Worldwide Smartphone Sales

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

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

Source: Gartner (November 2012)

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

Linux distros mentioned by top server vendors

Server market share source: IDC Q3 2012 report

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

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

Lab Resources

Meet the CIS 192 Systems

CIS 192 student pod VMs


Arwen


Elrond


Celebrian


Legolas

Opus

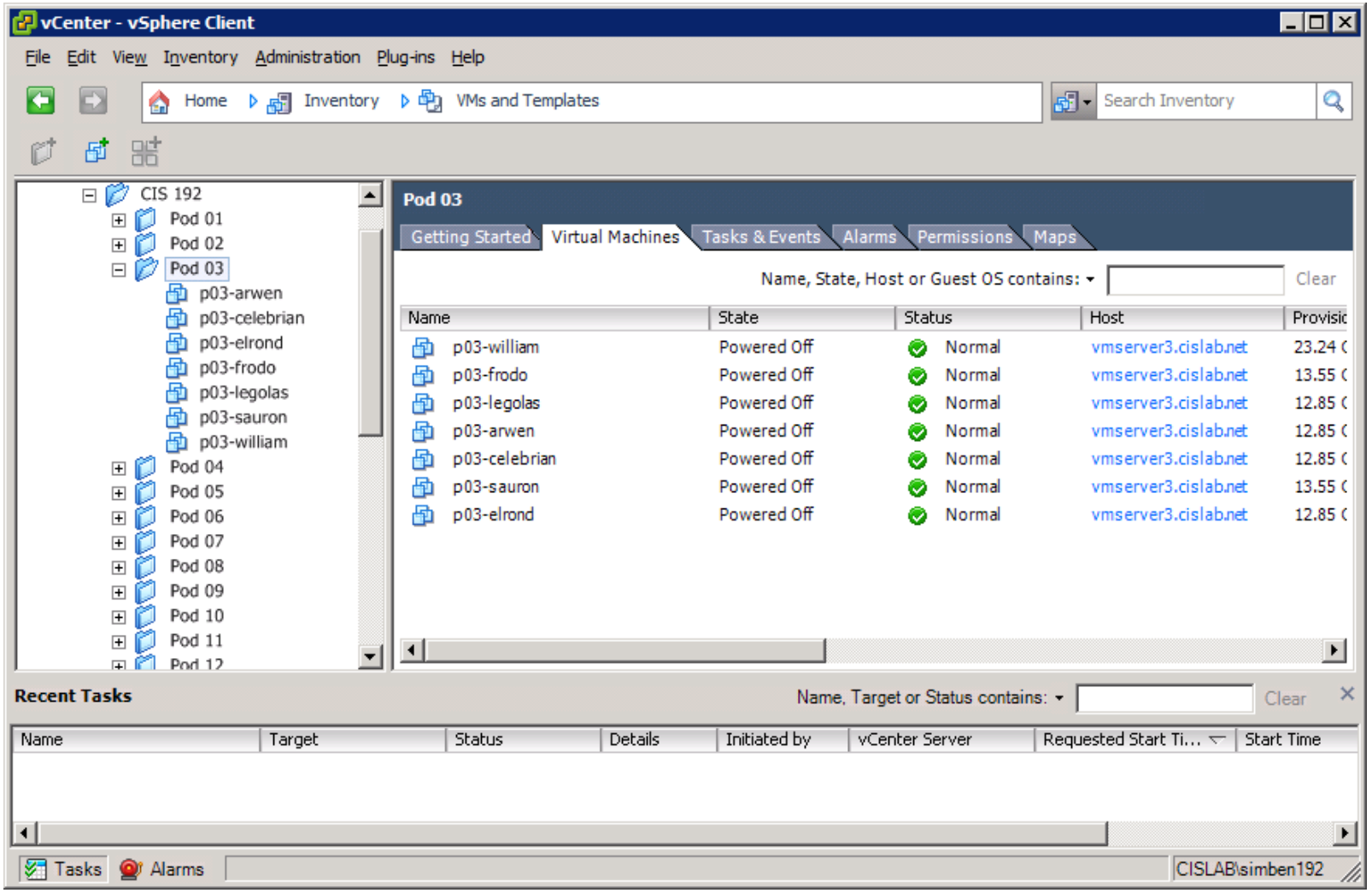

Frodo


Sauron

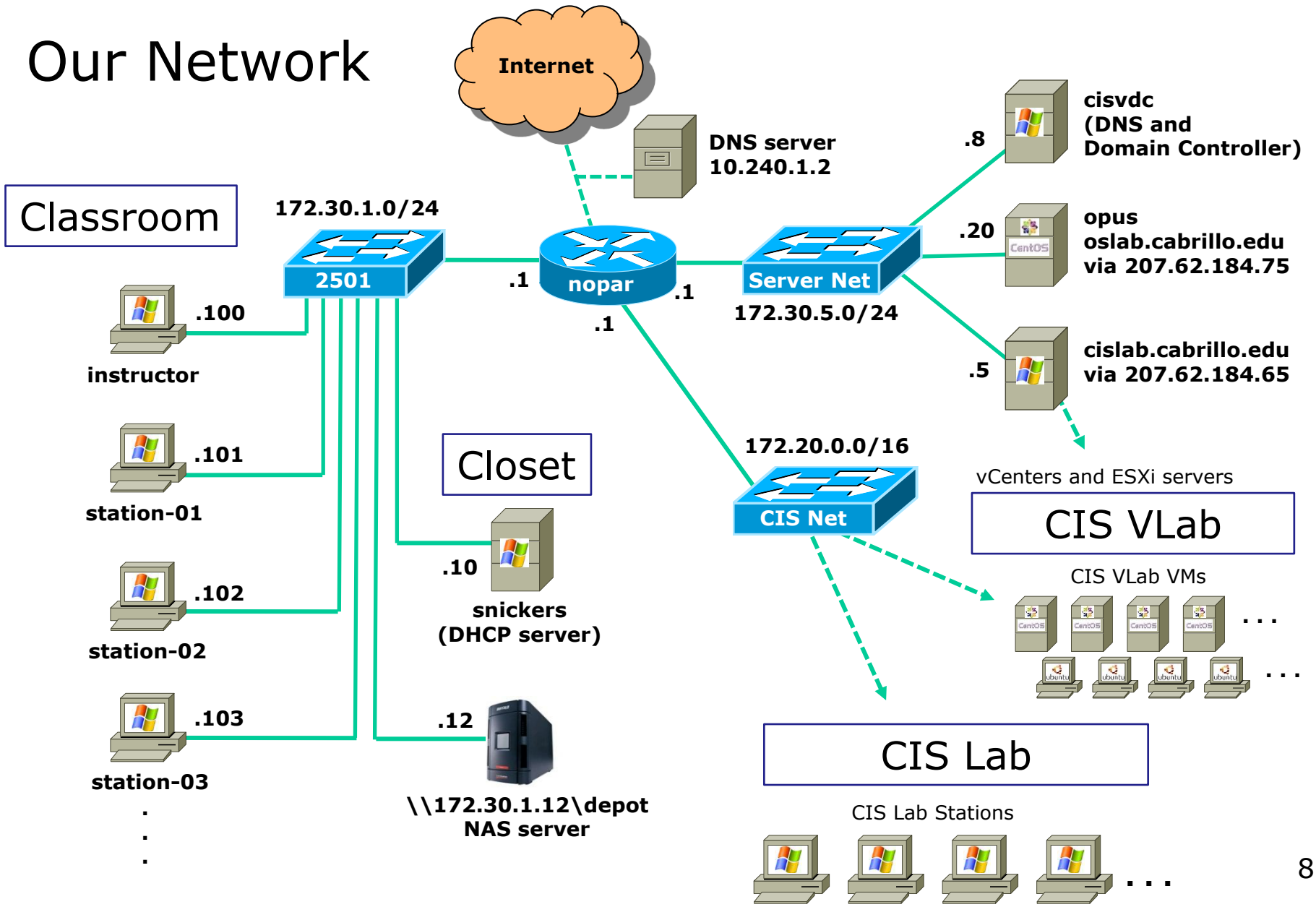

William

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

Showing CIS 192 Pod 3 in VLab

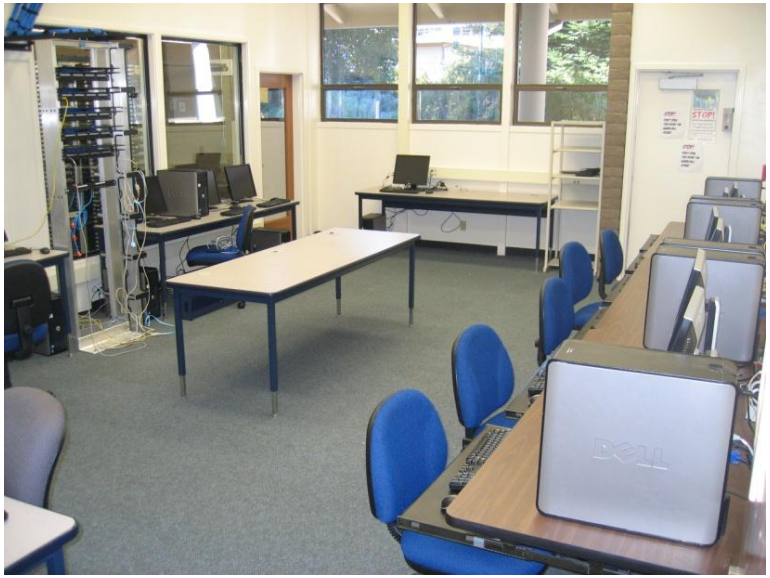


Our Network

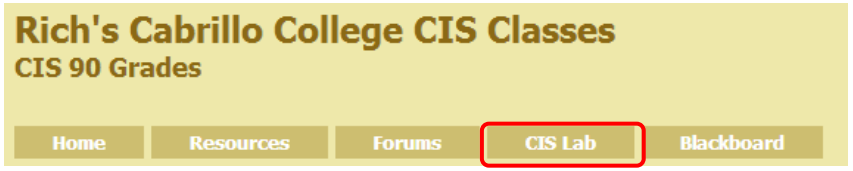

Internet
DNS server
10.240.1.2
cisvdc
(DNS and
Domain Controller)
.8
Classroom
172.30.1.0/24
2501
.1
nopar
.1
.1
Server Net
172.30.5.0/24
.20
opus
oslab.cabrillo.edu
via 207.62.184.75
.5
cislab.cabrillo.edu
via 207.62.184.65
.100
instructor
.101
station-01
.102
station-02
.103
station-03
Closet
.10
snickers
(DHCP server)
.12
\\172.30.1.12\depot
NAS server
172.20.0.0/16
CIS Net
vCenters and ESXi servers
CIS VLab
CIS VLab VMs
CIS Lab
CIS Lab Stations

The CIS Lab
CTC Building Room 1403

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



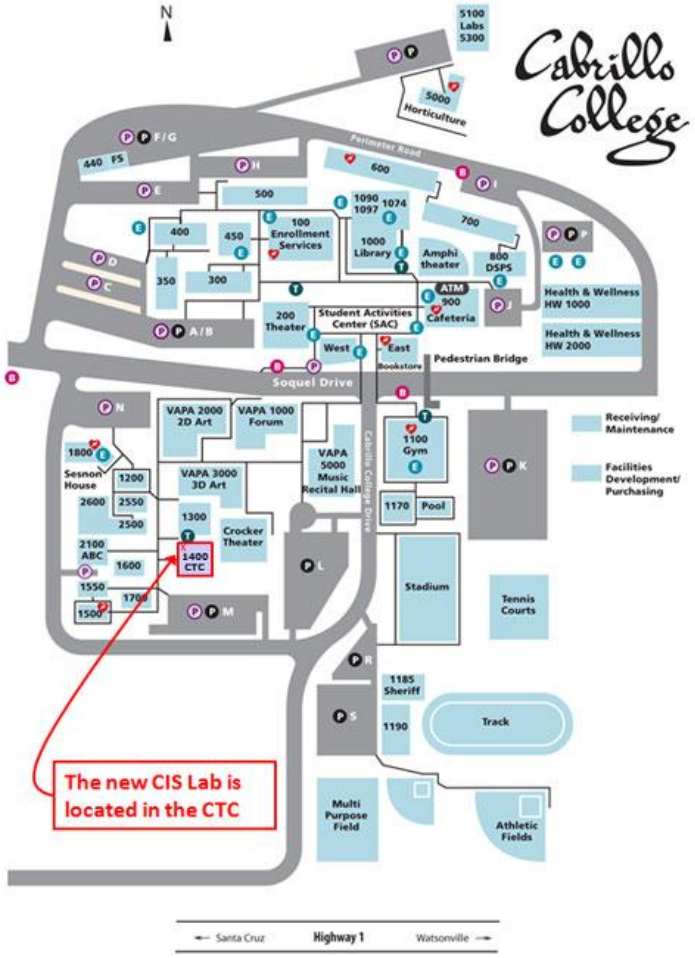
Instructors and lab assistants are available (see schedule) to help



Use this link to see the schedule and hours of operation

The CIS Lab

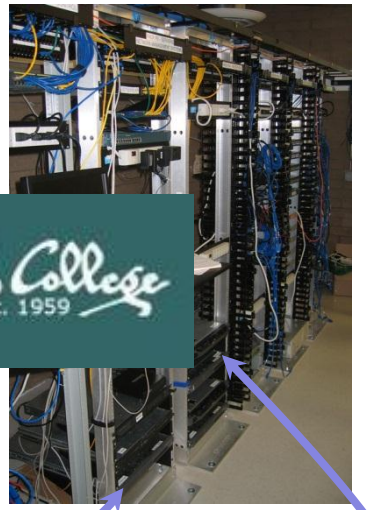
CTC Building Room 1403



Lab Resources

Remote Access to **CIS VLab**

Room 1403 on Aptos Campus

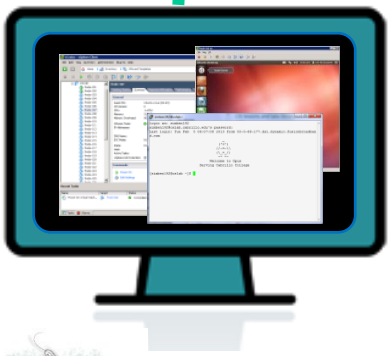


Internet

cislab (Win 2008)

vmware

vCenter (VMware appliance)
vmserver3 (VMware ESXi)



Home

School

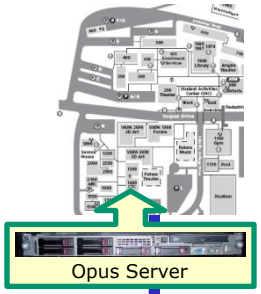
You can access the course VMs from school or home

Logging Into Opus via SSH

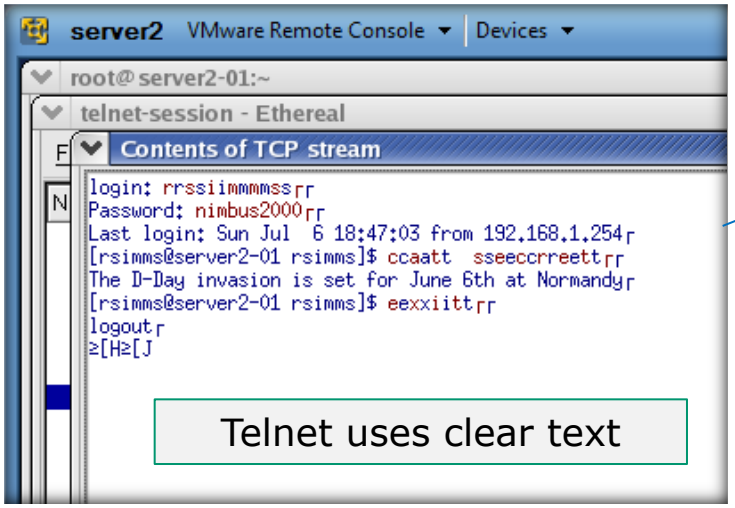
Picture credit:
http://www.cs.umd.edu/faq/ssh.html

SSH is a network protocol that enables secure connections between computers

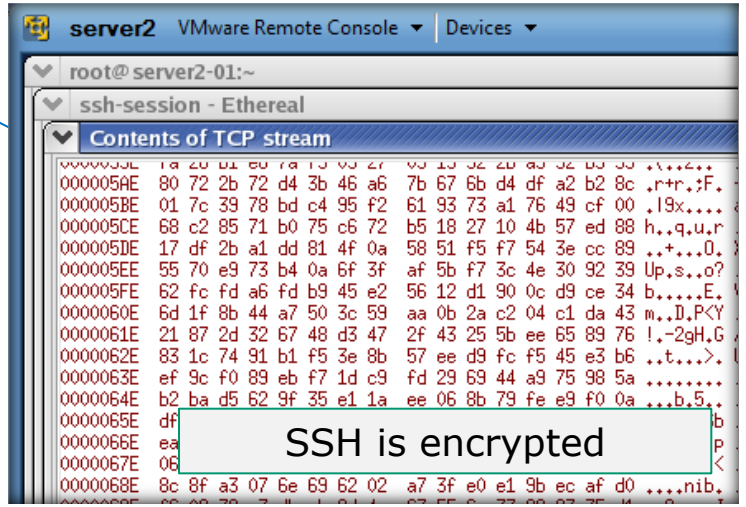
Remote Server



Sniffer view of a Telnet session



Sniffer view of a SSH session



Local computer

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

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

SSH connection to a UNIX/Linux Server

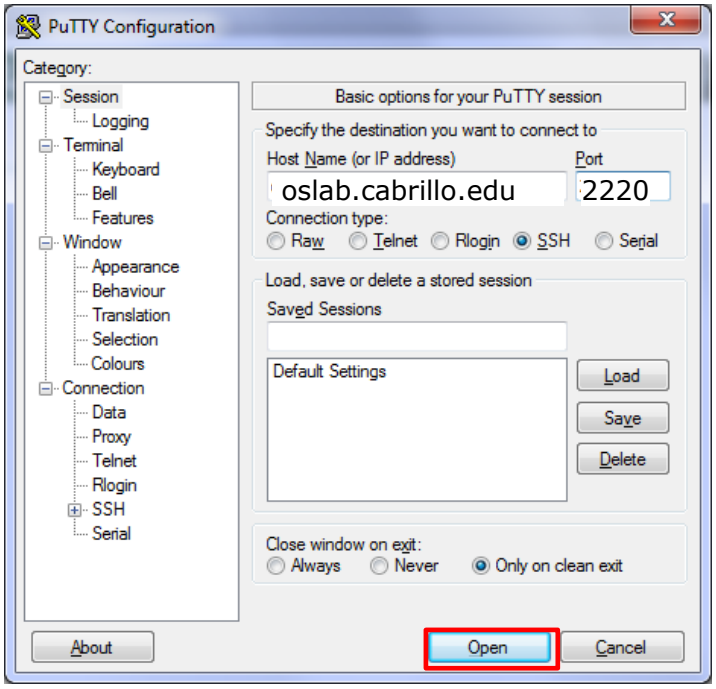
You need to know three things:

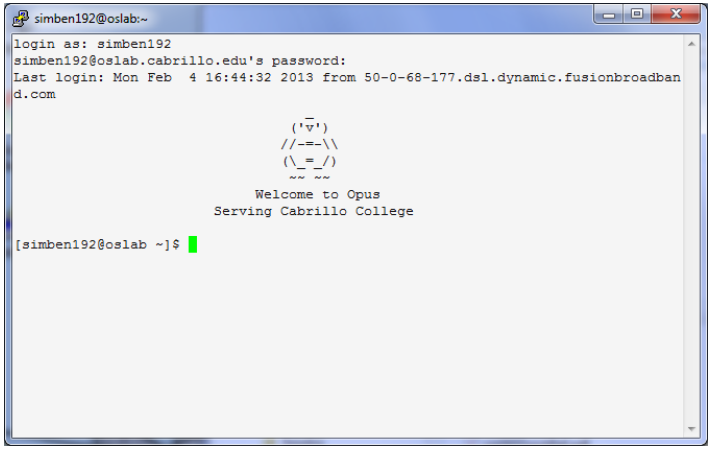
- The **hostname** of the remote server (must be a *fully qualified domain name* when going over the Internet)
- Your **login credentials** (username/password) on the remote server
- The **port number** the SSH service is listening on (the default is port 22)

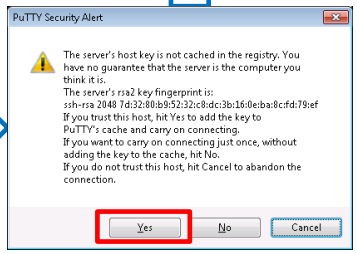
Logging into Opus from **home**

Opus

On Windows run Putty



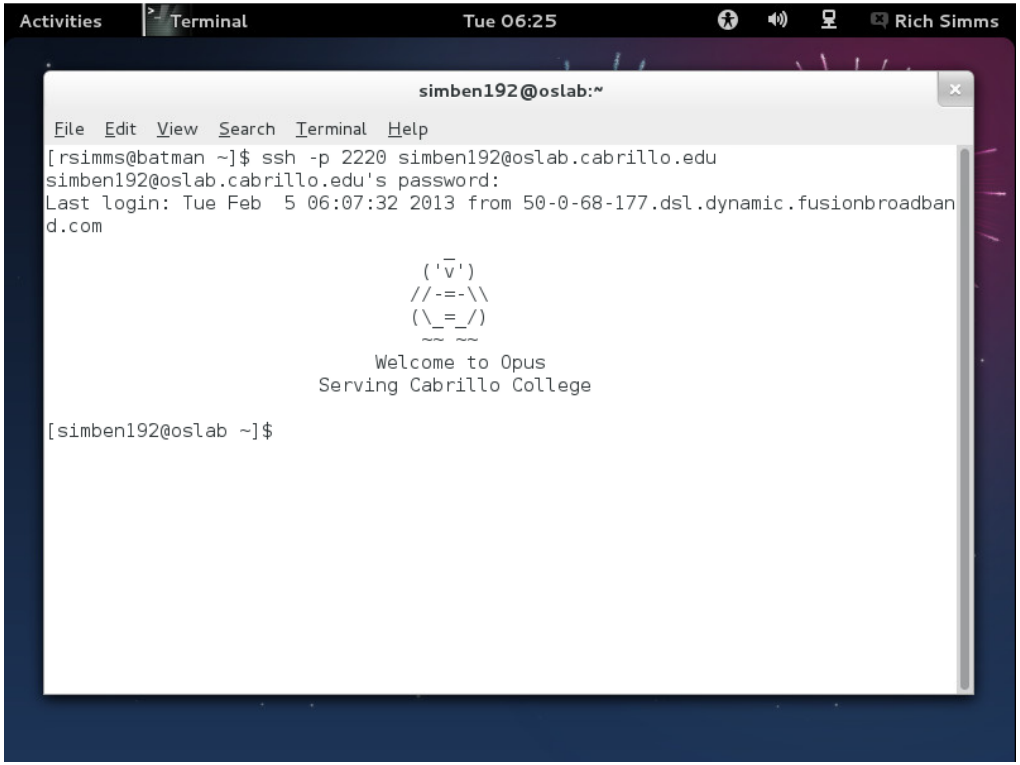




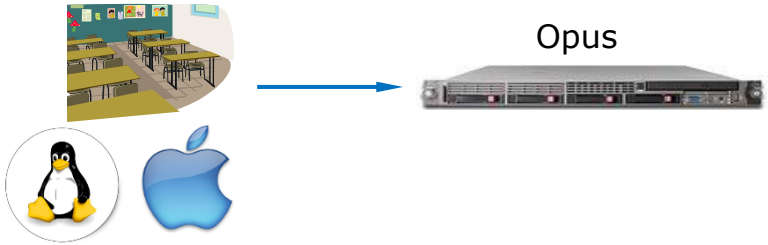
The first time a connection is made to a server this warning is displayed.

Logging into Opus from **home**

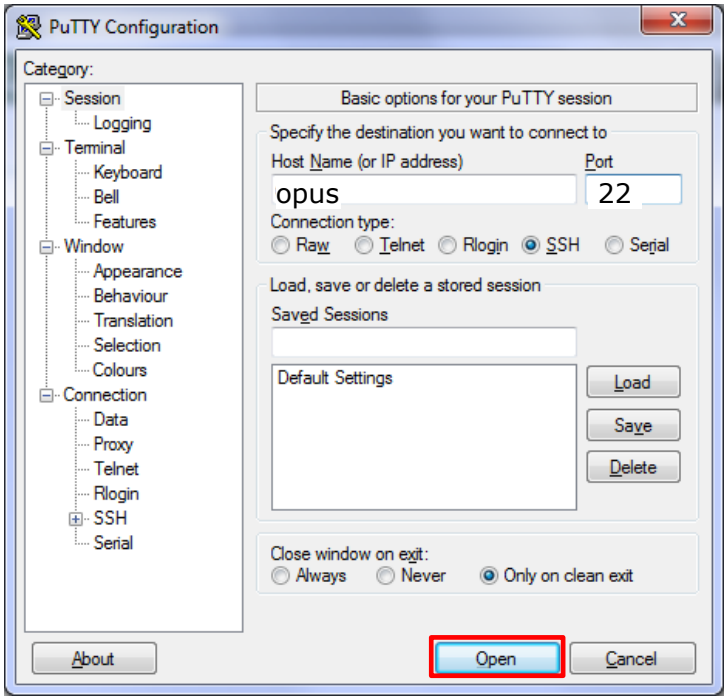
On a Mac or Linux terminal:
ssh -p 2220 *username*@oslab.cabrillo.edu



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



On Windows run Putty:



On a Mac or Linux terminal:

ssh *username*@**opus**

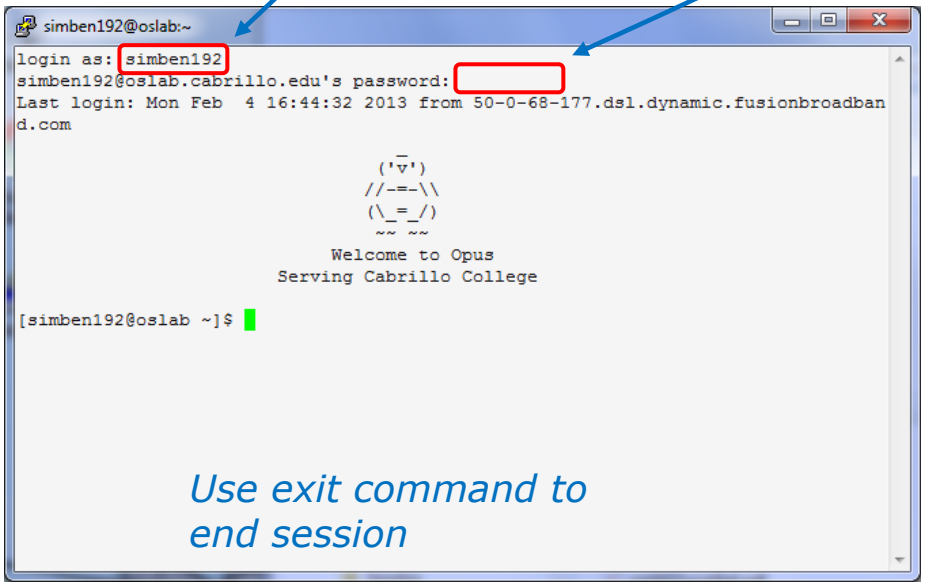
When connected to the CIS Lab network rather than the Cabrillo campus network you can just use "opus" as the hostname with port 22

Accessing Opus from a Windows PC using Putty

Log in with username and password

username

password
(not echoed)



Use exit command to end session

Class Activity

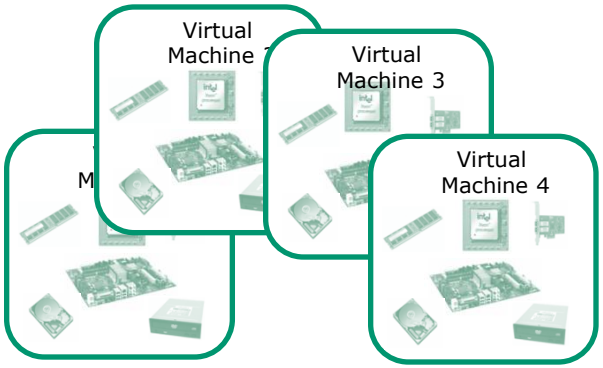
	Hostname	Port
Home or campus wireless network	oslab.cabrillo.edu	2220
Classroom or CIS Lab PCs	opus	22

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

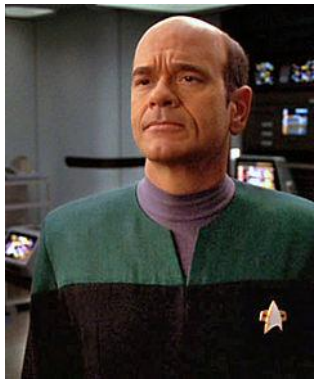
Virtualization

What is a virtual machine?

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



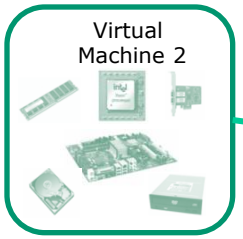
- You load an OS (operating system) and applications on a virtual machine just like you would any other computer.
- The OS and apps do not know they are not running on a "real" computer.
- Over the network a virtual machine appears just like any other computer.

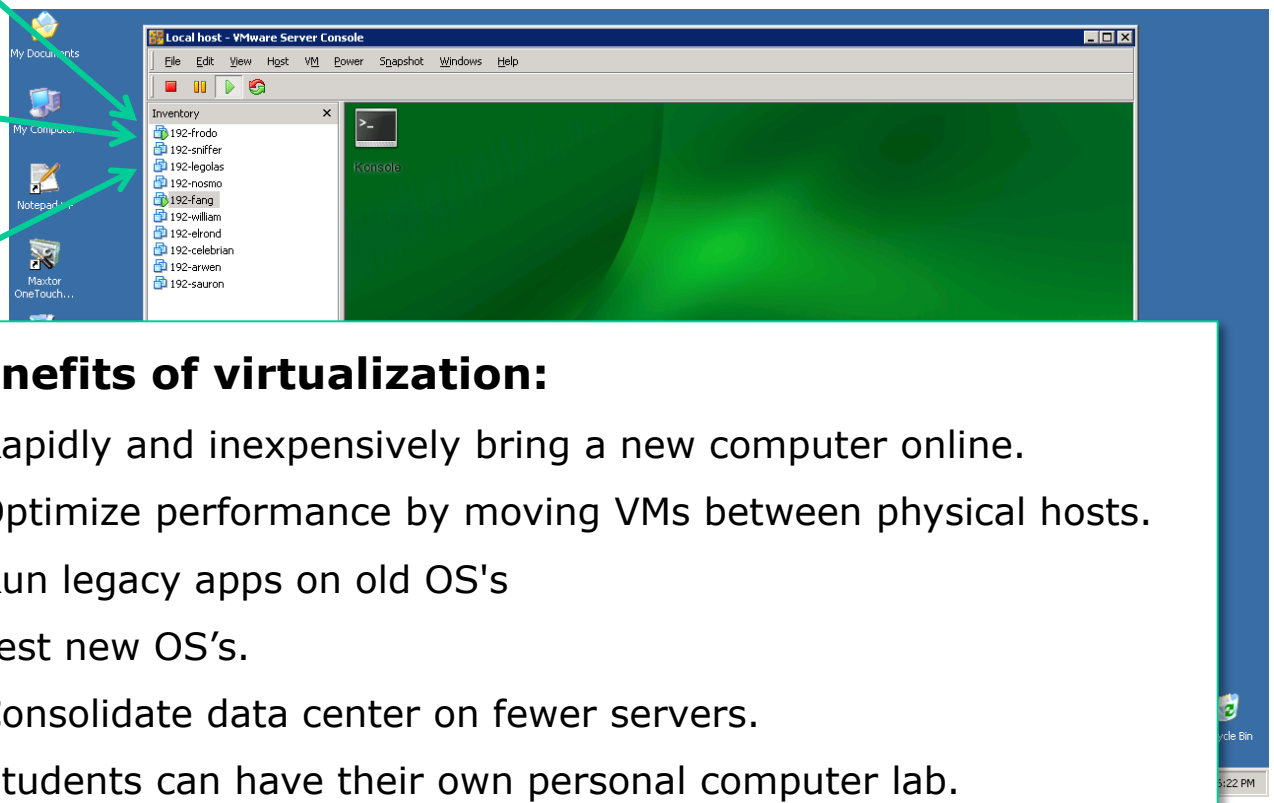


The EMH doctor on Star Trek Voyager was a simulation

Virtual Machines

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





Benefits of virtualization:

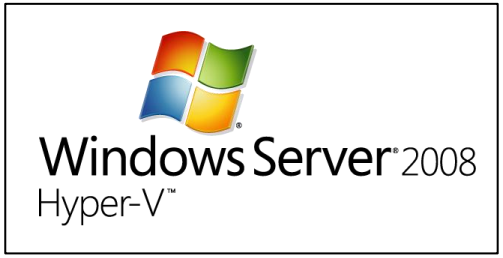
- Rapidly and inexpensively bring a new computer online.
- Optimize performance by moving VMs between physical hosts.
- Run legacy apps on old OS's
- Test new OS's.
- Consolidate data center on fewer servers.
- Students can have their own personal computer lab.
- But, when the physical host goes down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

Some of the virtualization product options for CIS Students

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

VMware ESXi and vSphere Client (Bare metal hypervisor)

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



Microsoft Hyper-V is available in Windows 2008 and 2012

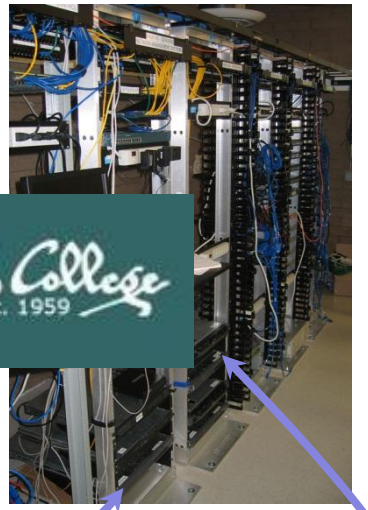
VirtualBox (for Windows, Mac, Linux or Solaris)

Using CIS VLab (Virtual Lab)

Lab Resources

Remote Access to **CIS VLab**

Room 1403 on Aptos Campus

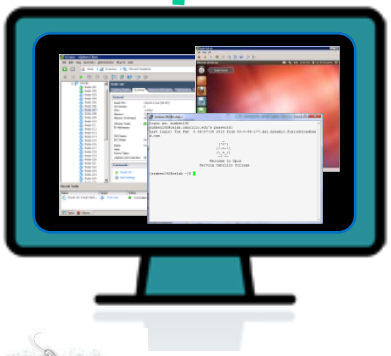


Internet

cislab (Win 2008)

vmware

vCenter (VMware appliance)
vmserver3 (VMware ESXi)

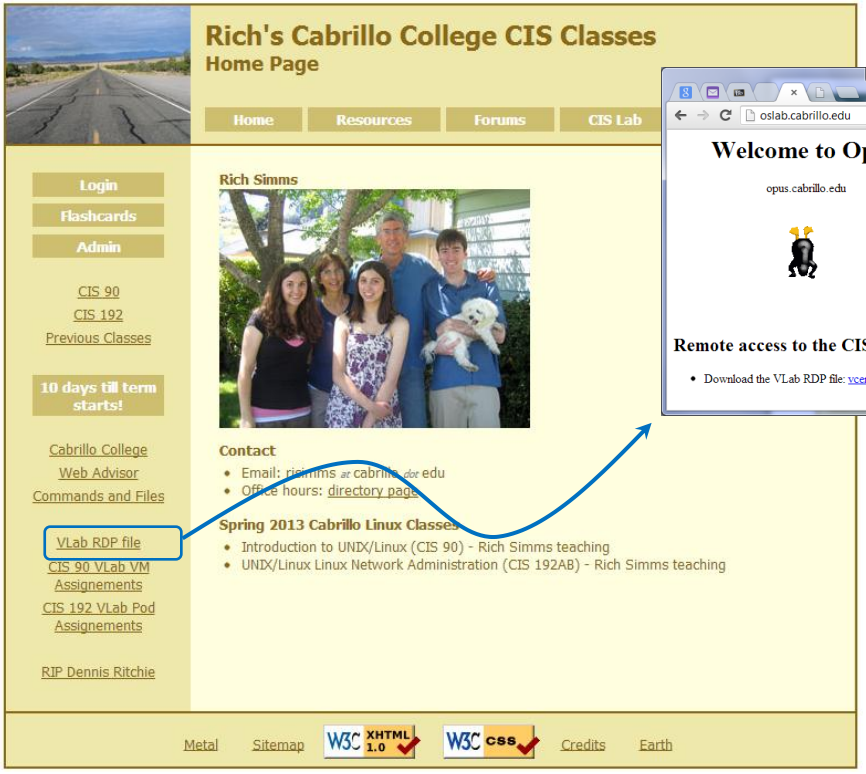


Home

School

You can access the course VMs from school or home

Getting to CIS VLab

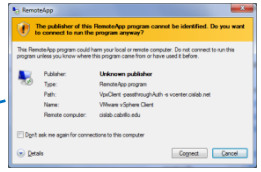


1

Open

Login

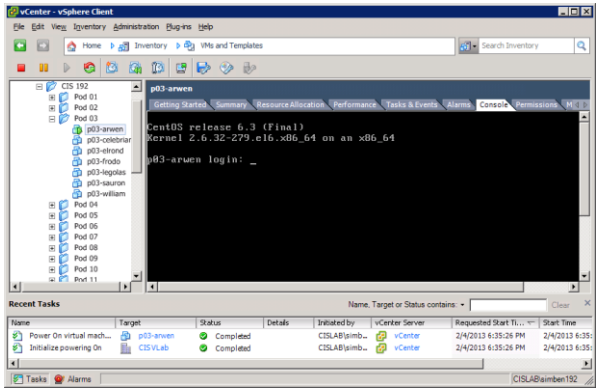
2



Connect

Ignore

Wait …

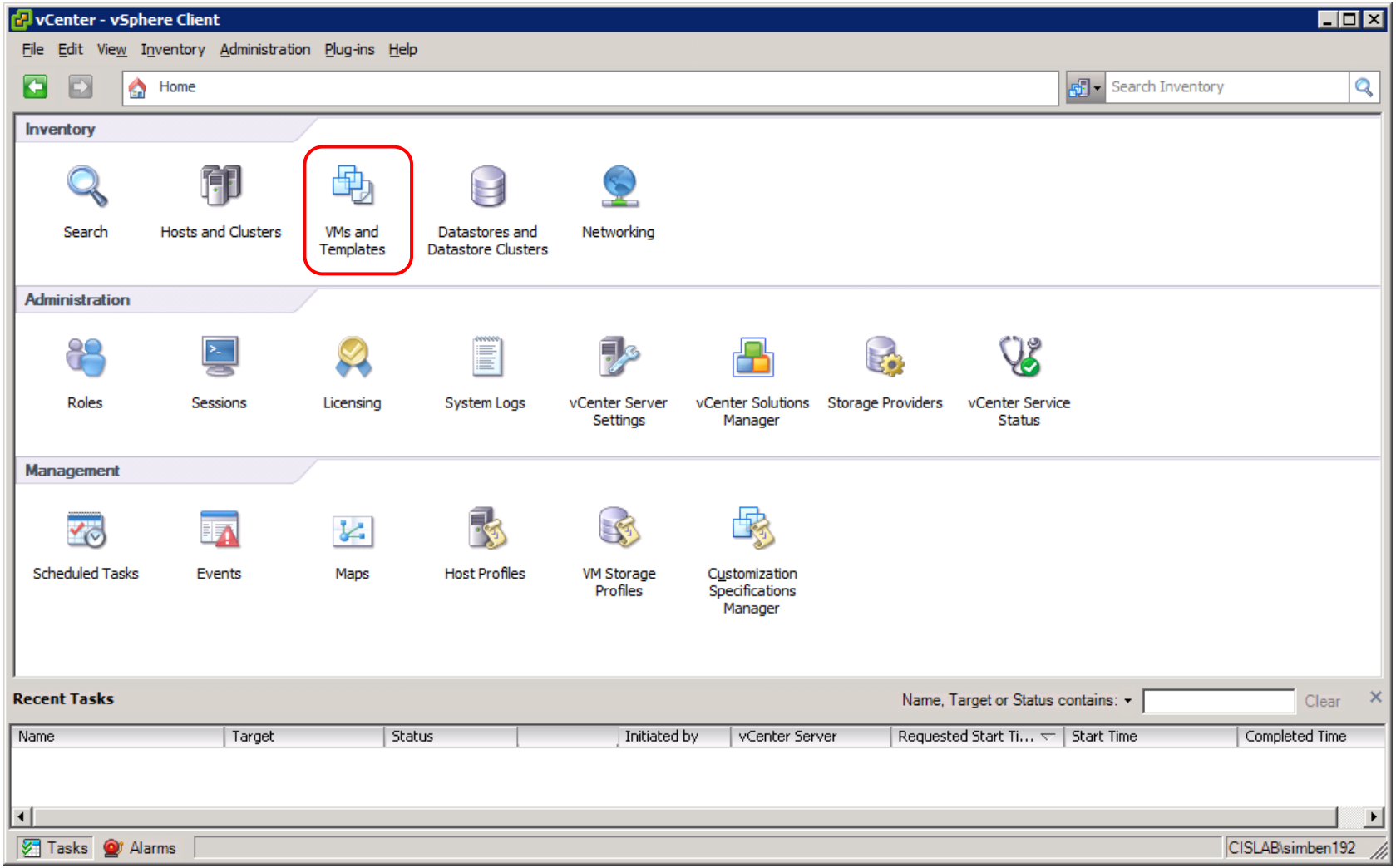


Locate and select your assigned pod

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

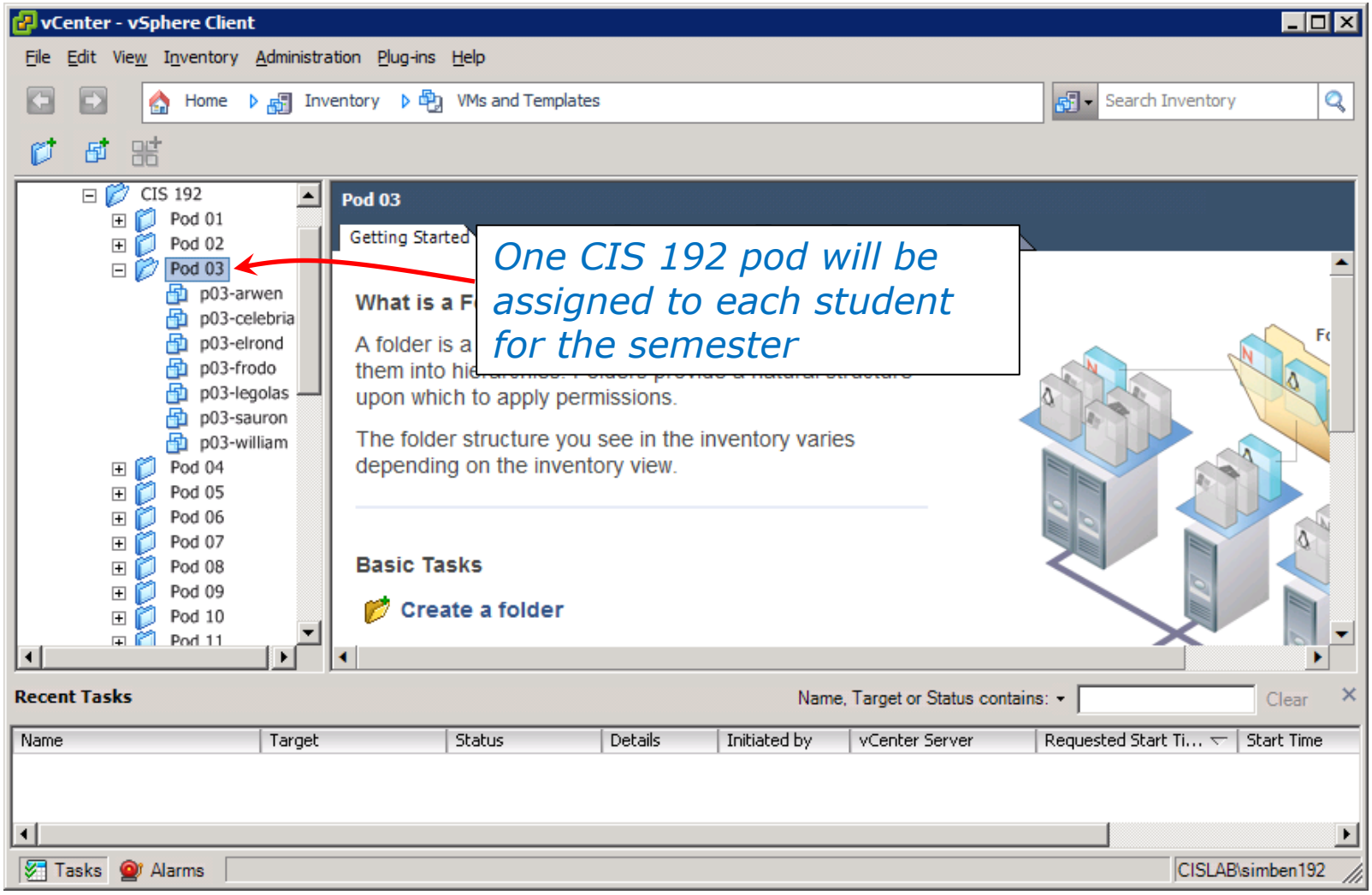
2) When entering your username and password you must preface your username with the "cislab\", for example Benji would use: cislab\simben192

CIS VLab Home View

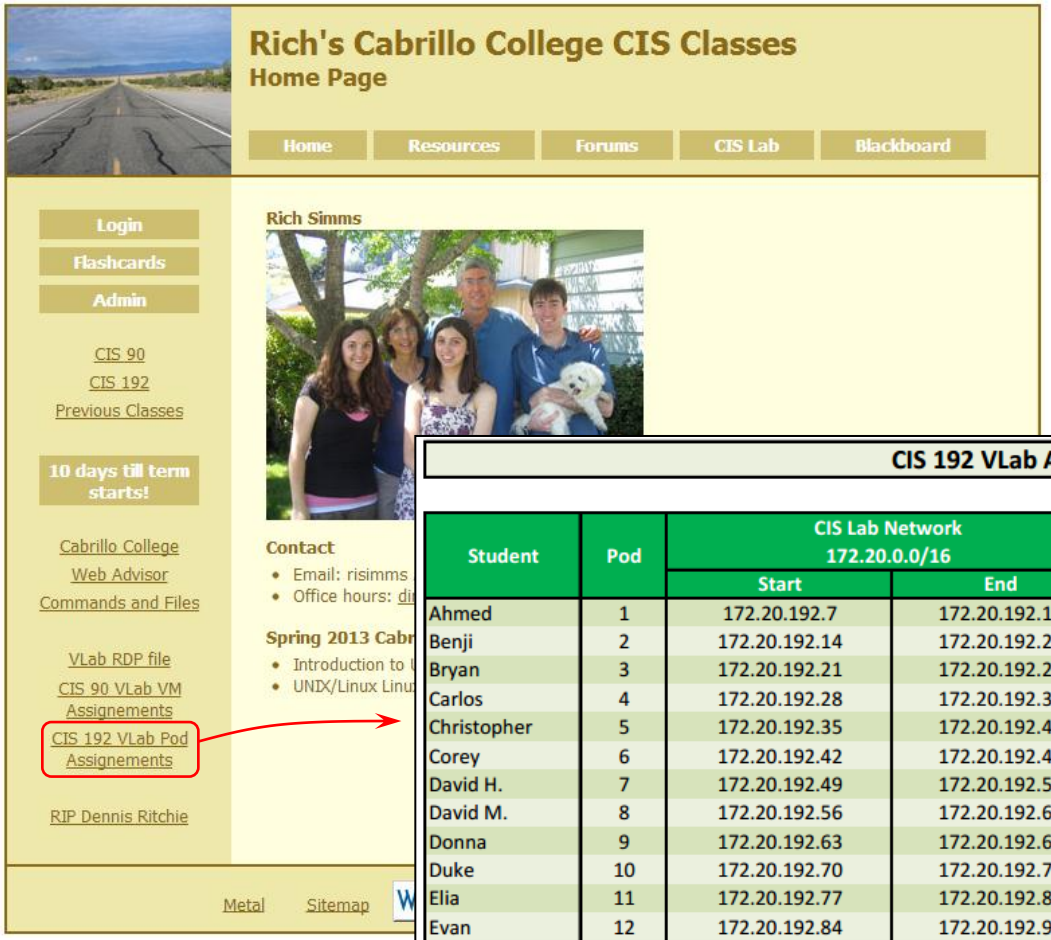


Click VMs and Templates to get to your course VMs

CIS Vlab VMs and Templates View



VMware vSphere Client



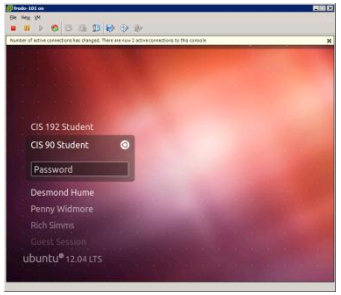
To see which CIS 192 pod is yours use the link on the class website

CIS 192 VLab Assignments

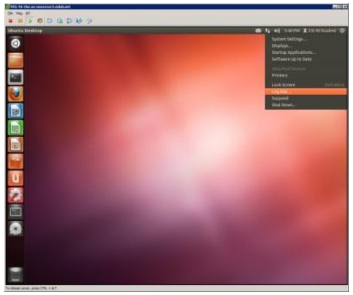
Student	Pod	CIS Lab Network 172.20.0.0/16		Virtual Switches		
		Start	End	Shire	Rivendell	Mordor
Ahmed	1	172.20.192.7	172.20.192.13	Shire-01	Rivendell-01	Mordor-01
Benji	2	172.20.192.14	172.20.192.20	Shire-02	Rivendell-02	Mordor-02
Bryan	3	172.20.192.21	172.20.192.27	Shire-03	Rivendell-03	Mordor-03
Carlos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

The Ubuntu VMs
(Frodo and Sauron)

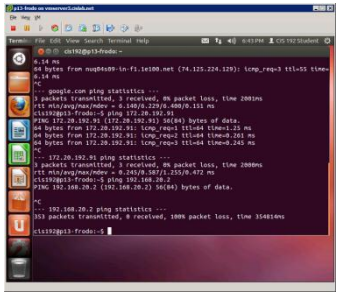
Log in as
CIS 192 Student (cis192)



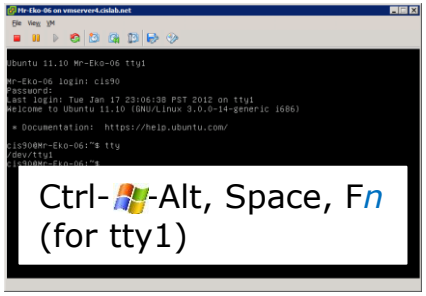
Shutdown using
 **> Shut Down…**



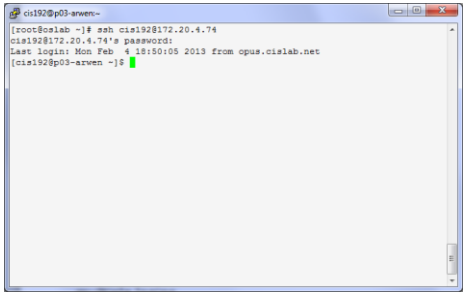
Use **Ctrl-Alt-t** to get a graphical terminal



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



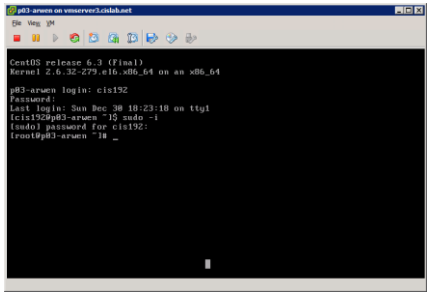
SSH to Opus, then to VM (after configuring IP address) for better terminal experience



The CentOS VMs

(Arwen, Celebrian, Elrond and Legolas)

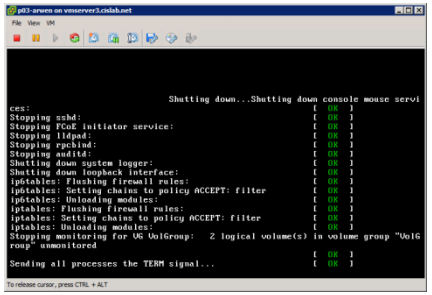
Log in as
cis192 or **root**



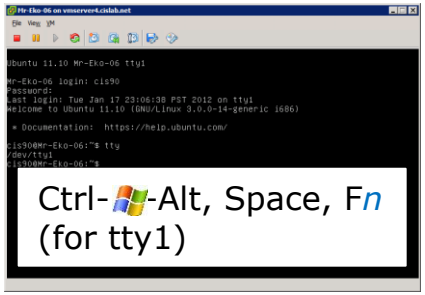
*Use **sudo -i** to become root*

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

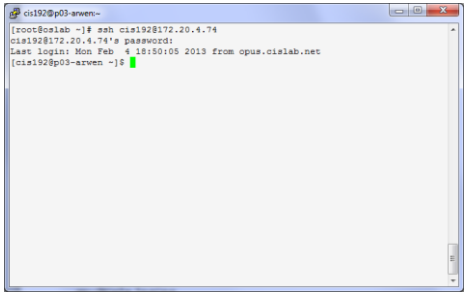
Shutdown using
init 0



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

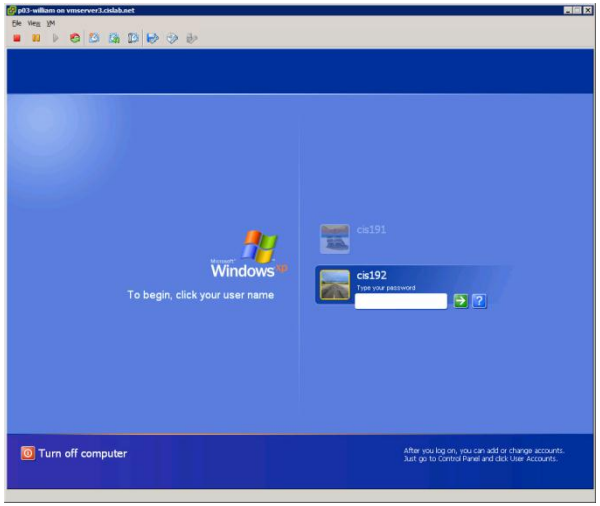


For better terminal experience, SSH to Opus, then to VM (after configuring IP address)

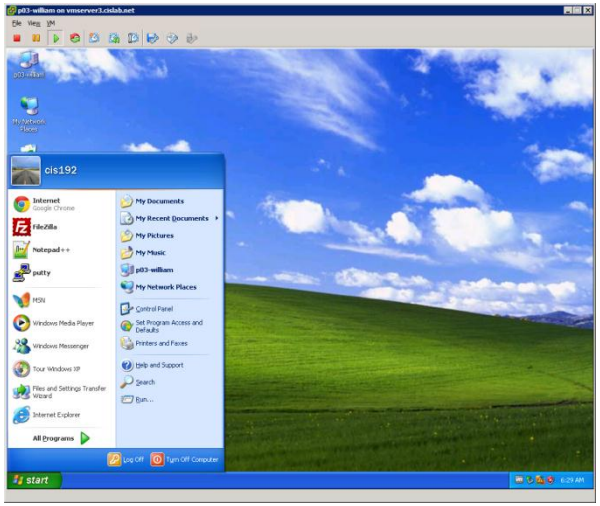


The CentOS VMs
(William)

Log in as **cis192**



Shutdown using
Start > Turn Off Computer



Class Activity

	CentOS	Ubuntu	Windows
VMs	Arwen	Frodo	William
	Celebrian	Sauron	
	Elrond		
	Legolas		

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

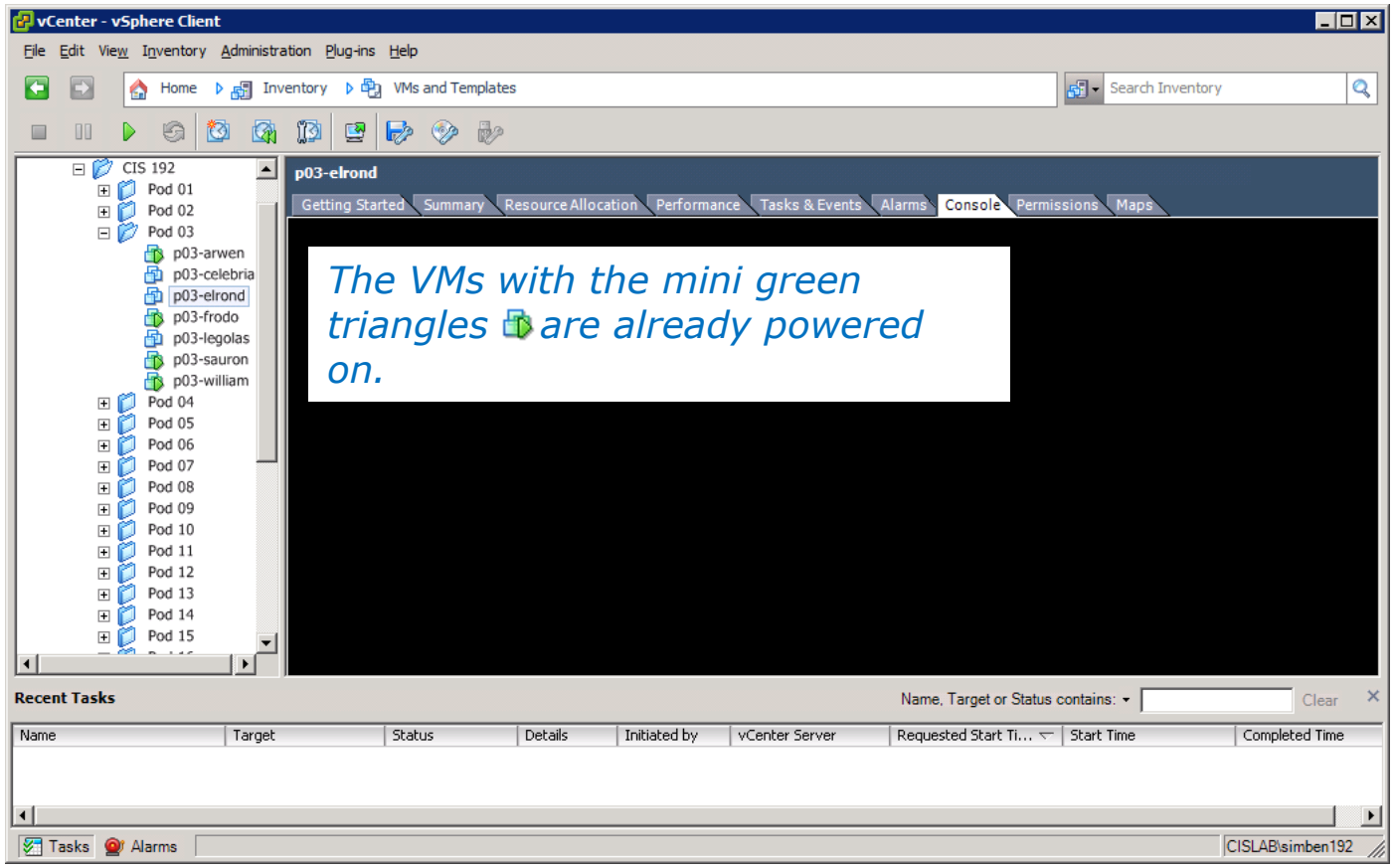
Power On
Becoming root
Restart
Shutdown

New commands for your toolbox

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

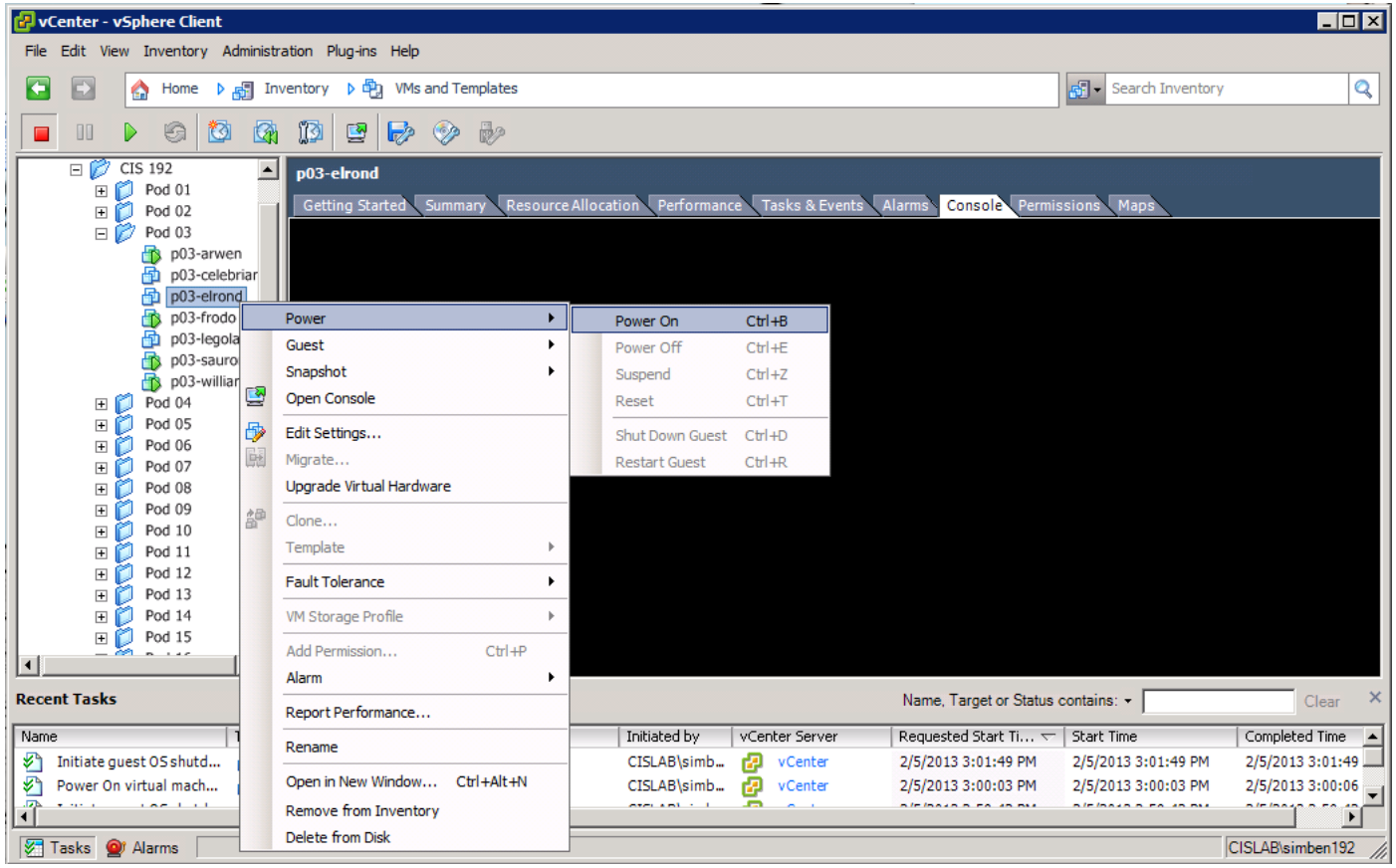
*The cis192 user has been added to the wheel group. The wheel group has been configured in the /etc/sudoers file to allow use of the **sudo -i** command*

VM Power Status



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

Powering On a VM



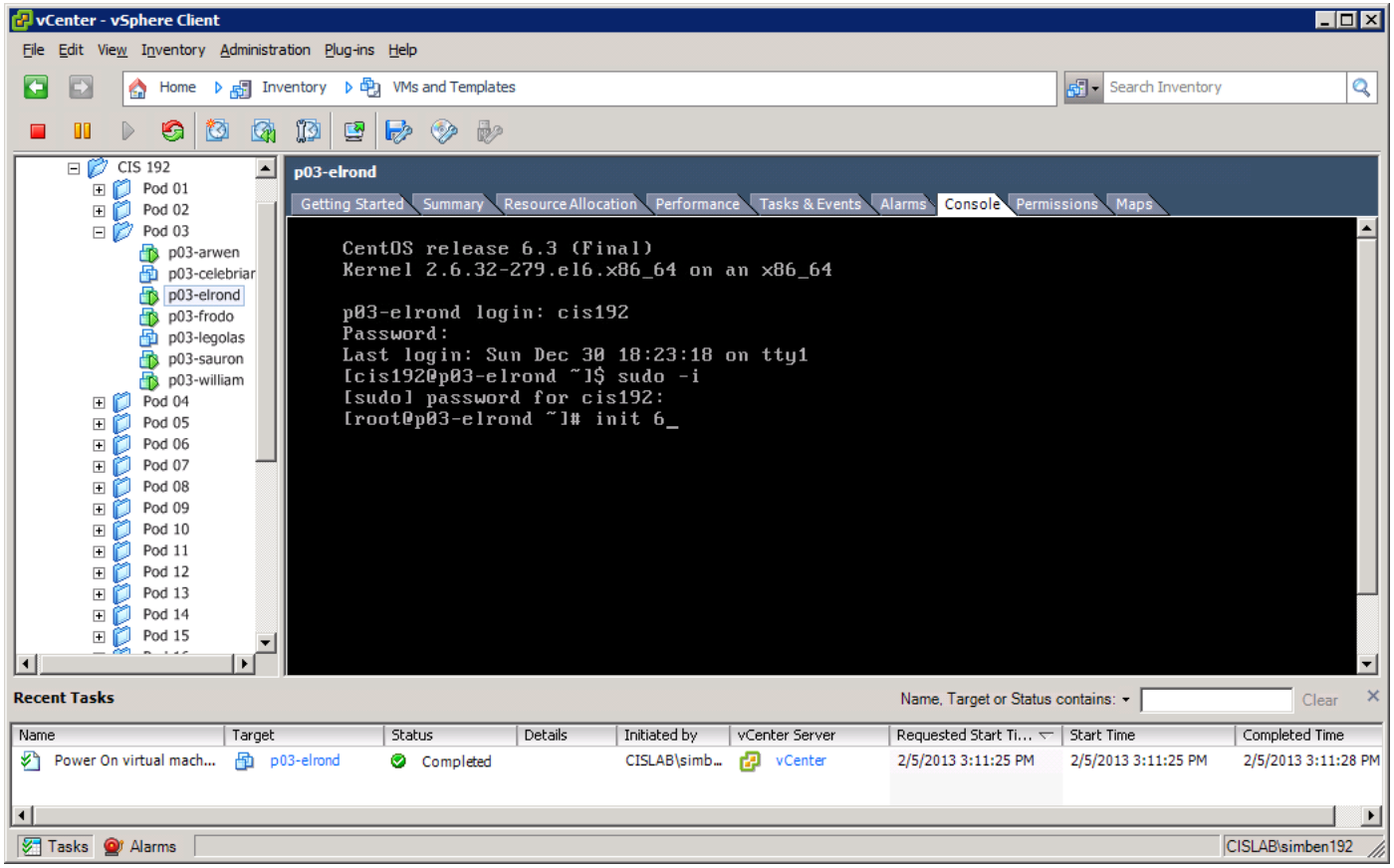
One way to Power On a VM is to select it in the left inventory panel then right click for Power, then Power On. Clicking the green "Play" icon from the tool bar or using Ctrl-B keystrokes will do the same thing.

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

Restarting a VM

sudo -i
init 6

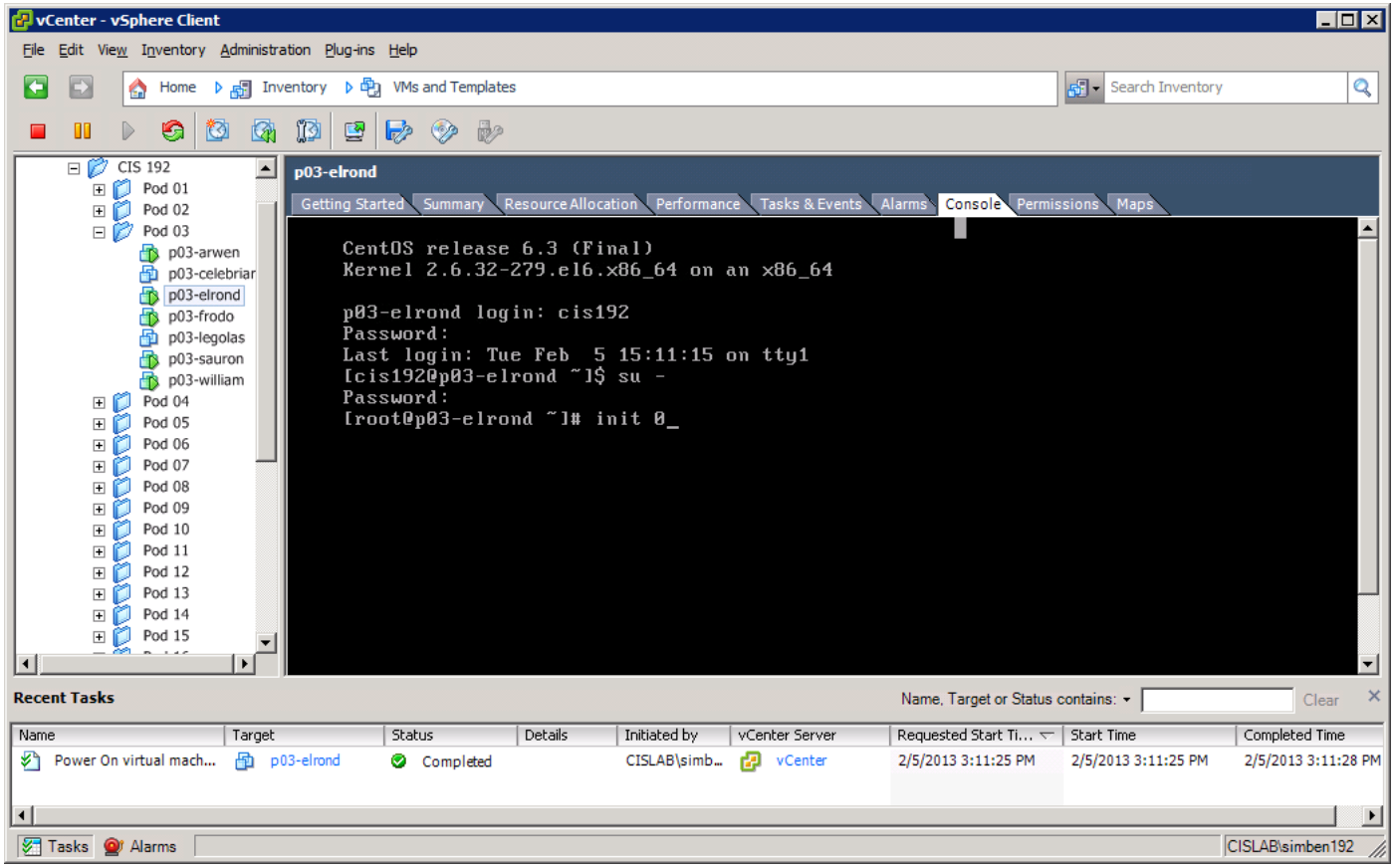
is a fast way to do a system restart



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

Shutting down a VM

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



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

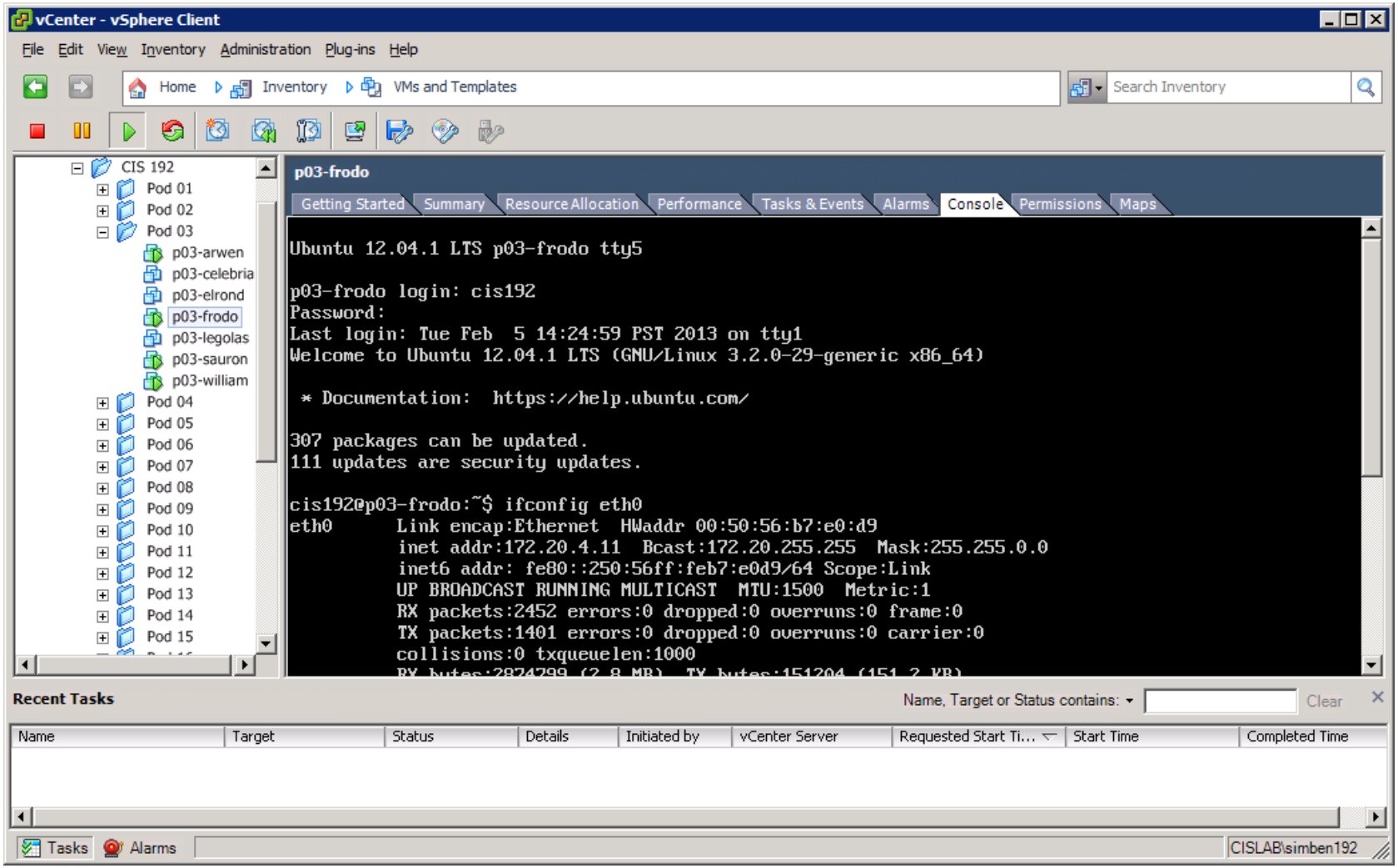
Class Activity
Using VMs

See if you can:

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

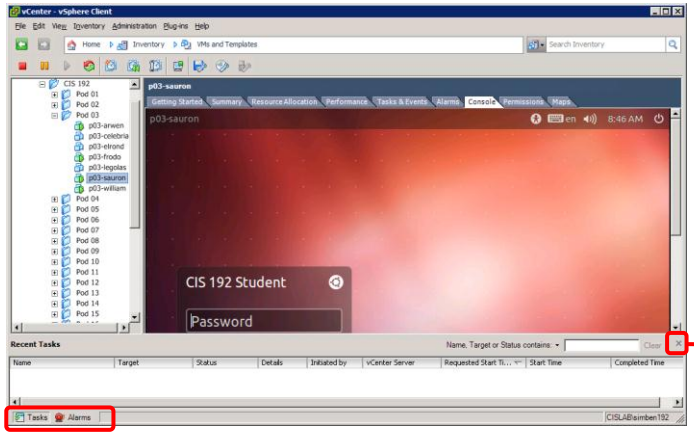
Managing Screen Real Estate

Default Console View



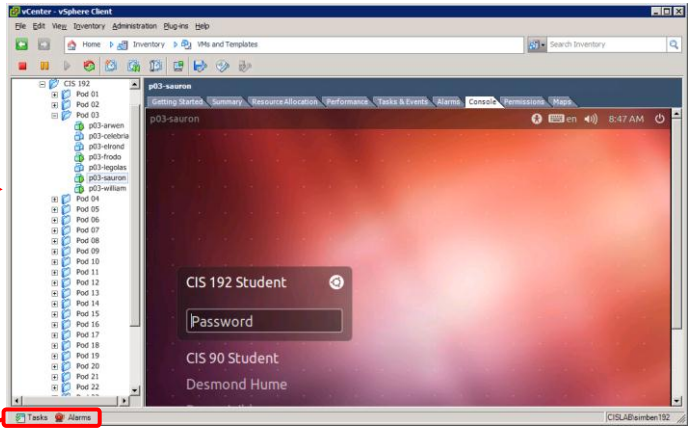
Use the console tab to view one VM at a time

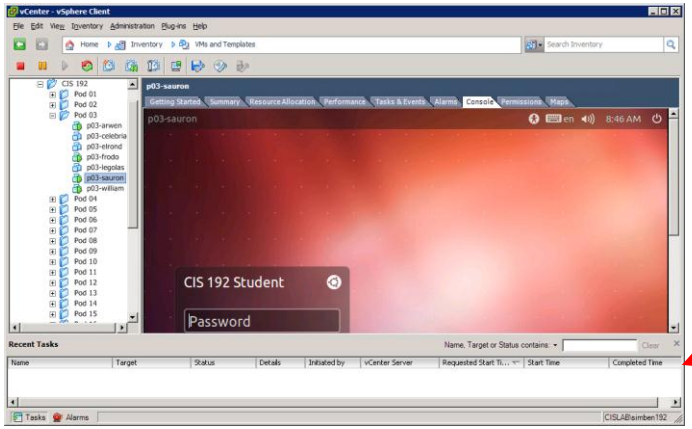
Better - remove Tasks/Alarms area



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

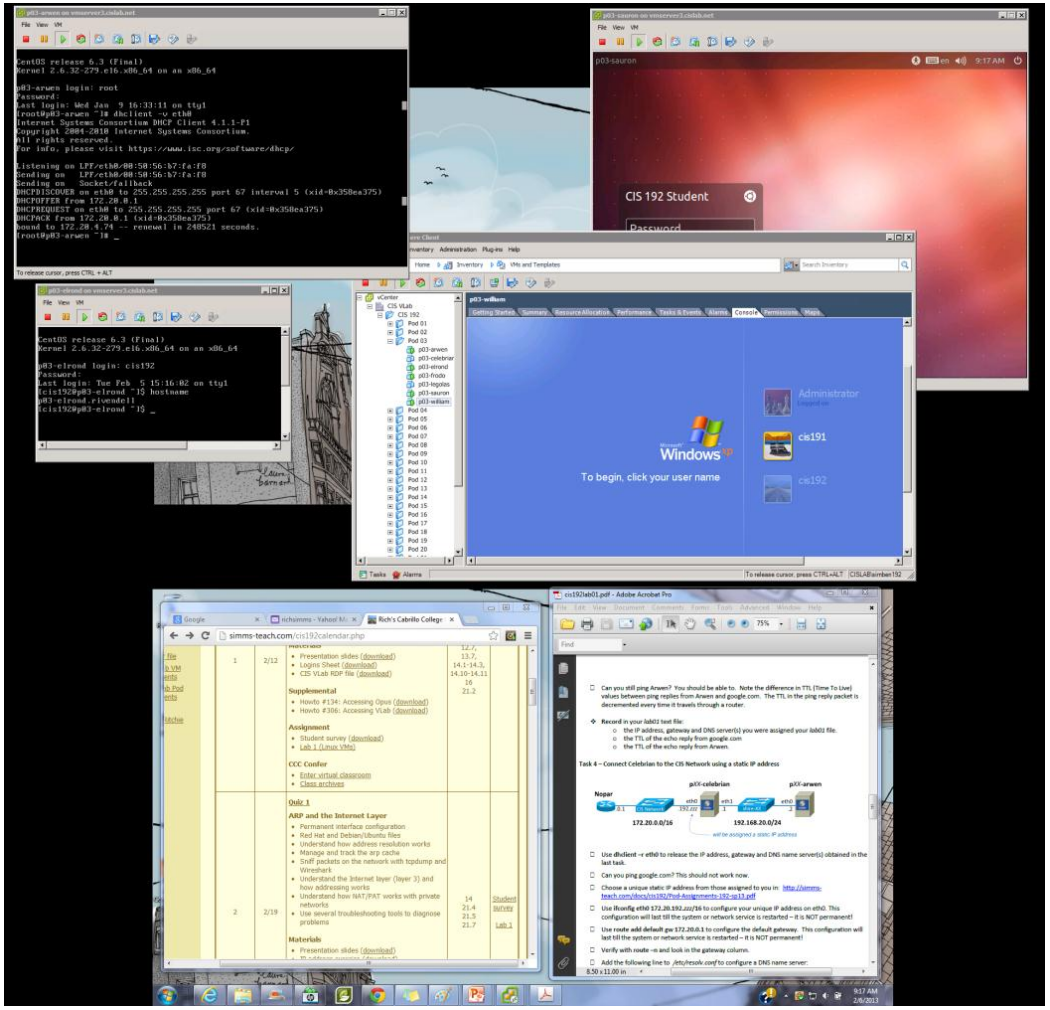
Remove the Tasks/Alarms area to see more of the VM





Restore the Tasks/Alarms area

Best - separate console windows

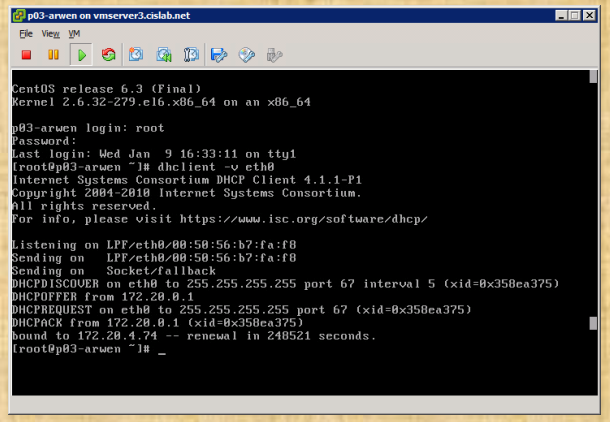


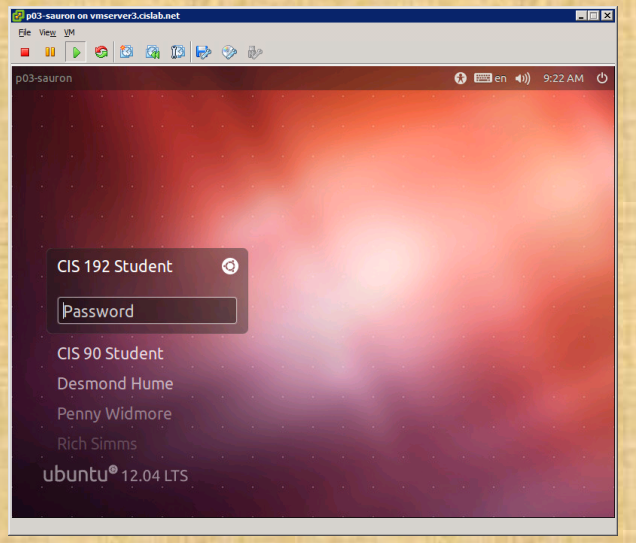
Working on a lab assignment with multiple VM consoles in view

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

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

Class Activity
Using VMs

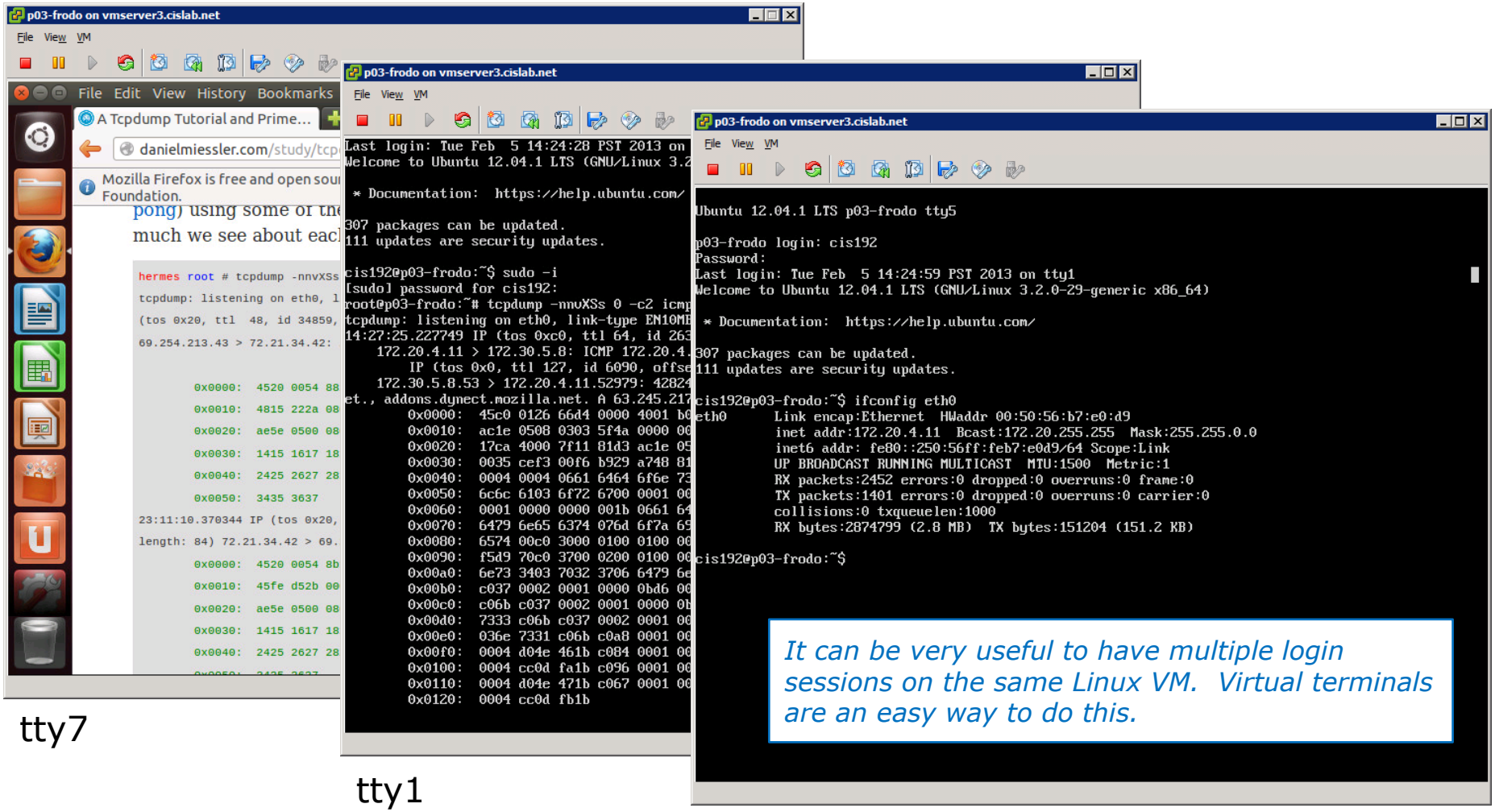




Select two or more of your VMs and open separate consoles for them

Changing Virtual terminals

VMware VM Operations
Changing Virtual Terminals



Changing Virtual Terminals on VMware Linux VMs

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

Pressing the ⊞ on some Windows keyboards may not be necessary

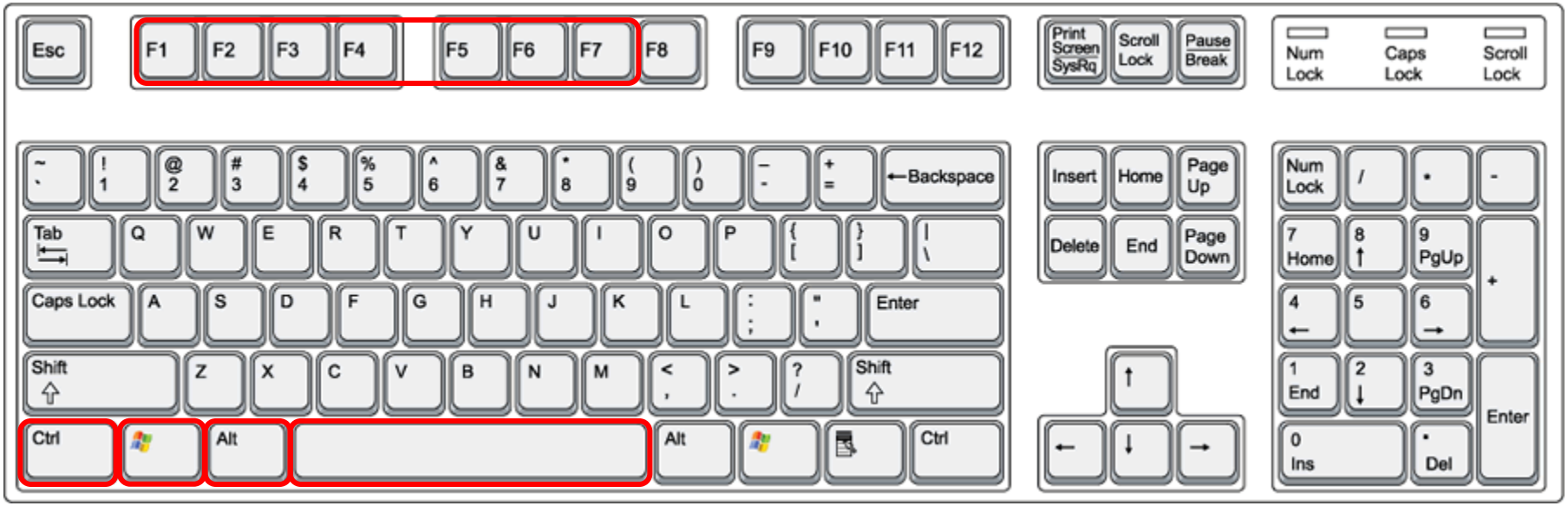
F7 is graphics mode for the Ubuntu VMs.

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

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

VMware VM Operations

Changing Virtual Terminals with a PC keyboard



On PC keyboard:

While holding down the **Ctrl-Alt** keys,
tap **Spacebar** then tap **F***N* key
(where *N*=1-7 to specify a function key)

VMware VM Operations

Changing Virtual Terminals with a Mac keyboard

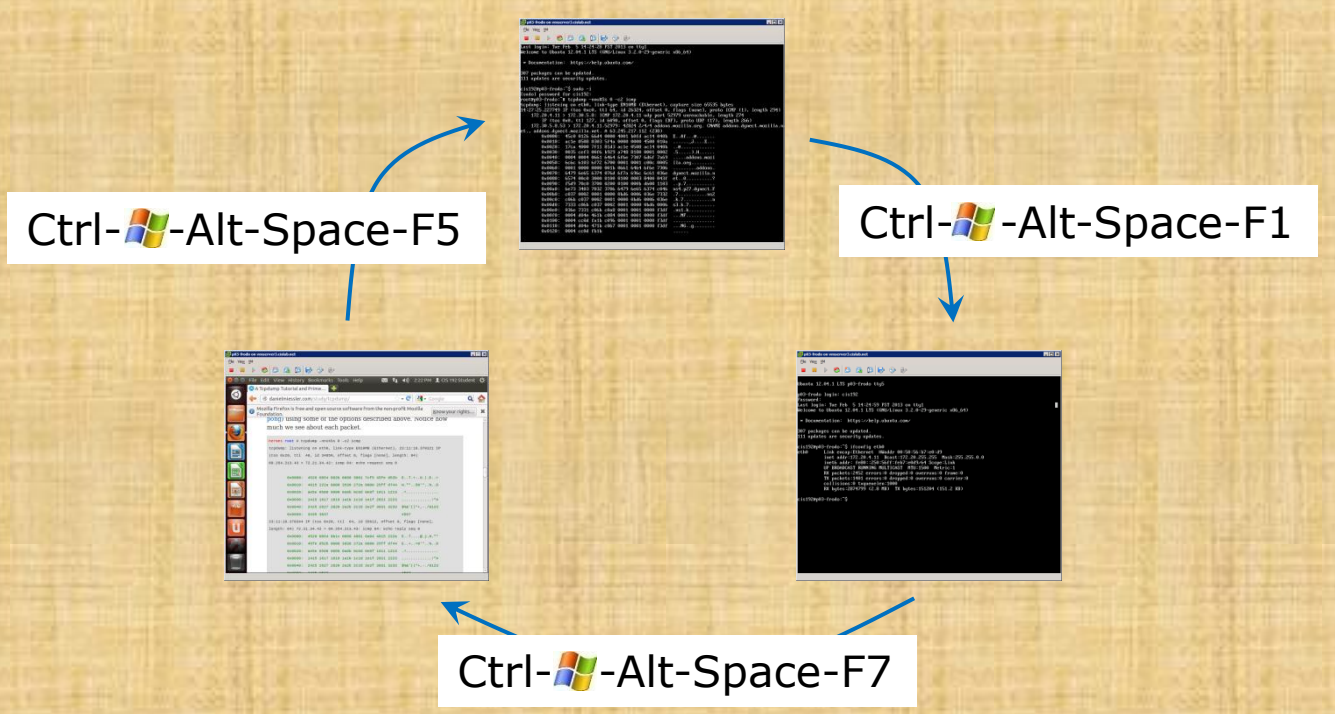
On Mac keyboard:

While holding down the **control-option** keys

tap **Spacebar** then tap **fn-F*N*** keys

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

Class Activity
Using VMs



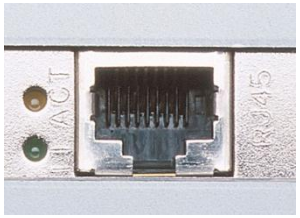
Frodo

See if you can change virtual terminals on your Frodo VM

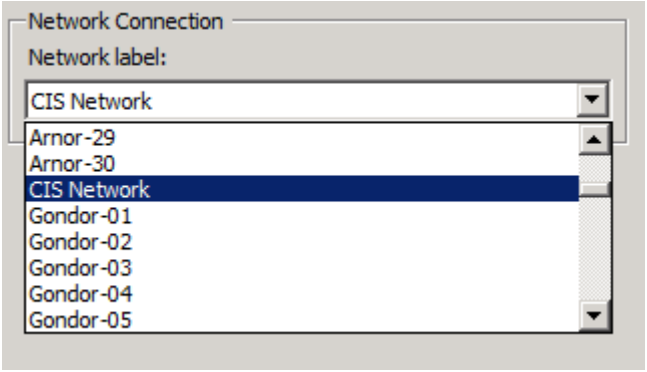
Cabling Virtual Equipment

Physical and virtual cabling

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

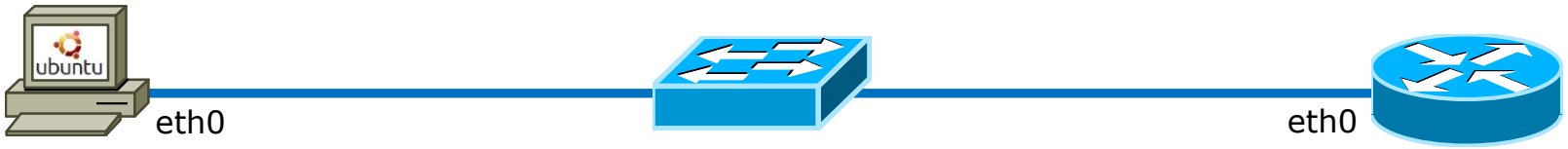


- In a virtual environment cabling still must be done



VMware ESXi

Cabling Devices on a Physical Network



Desktop PC

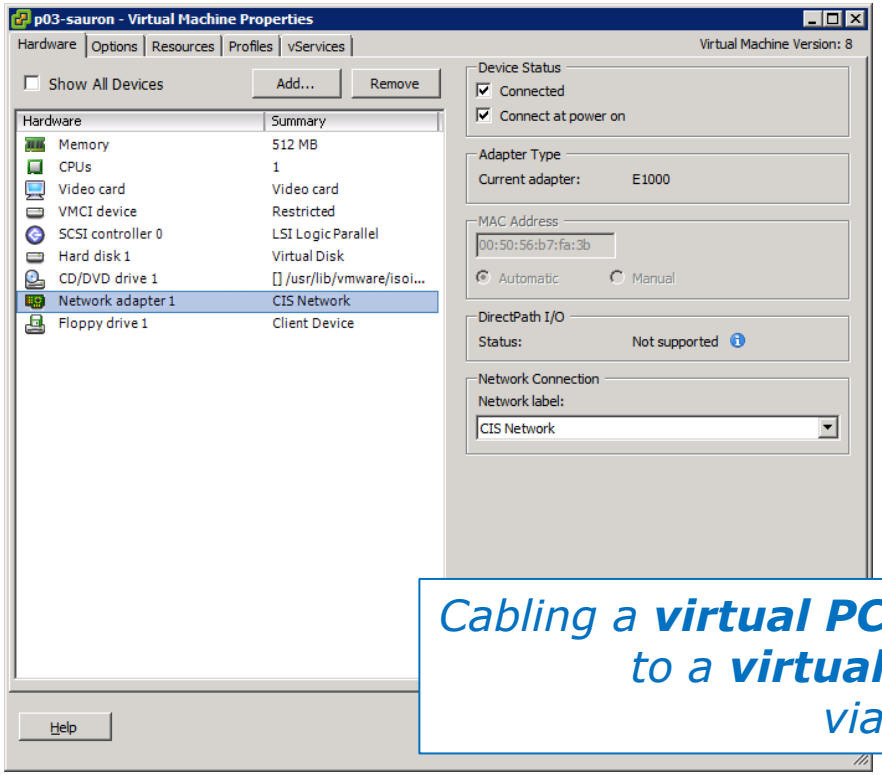
Switch

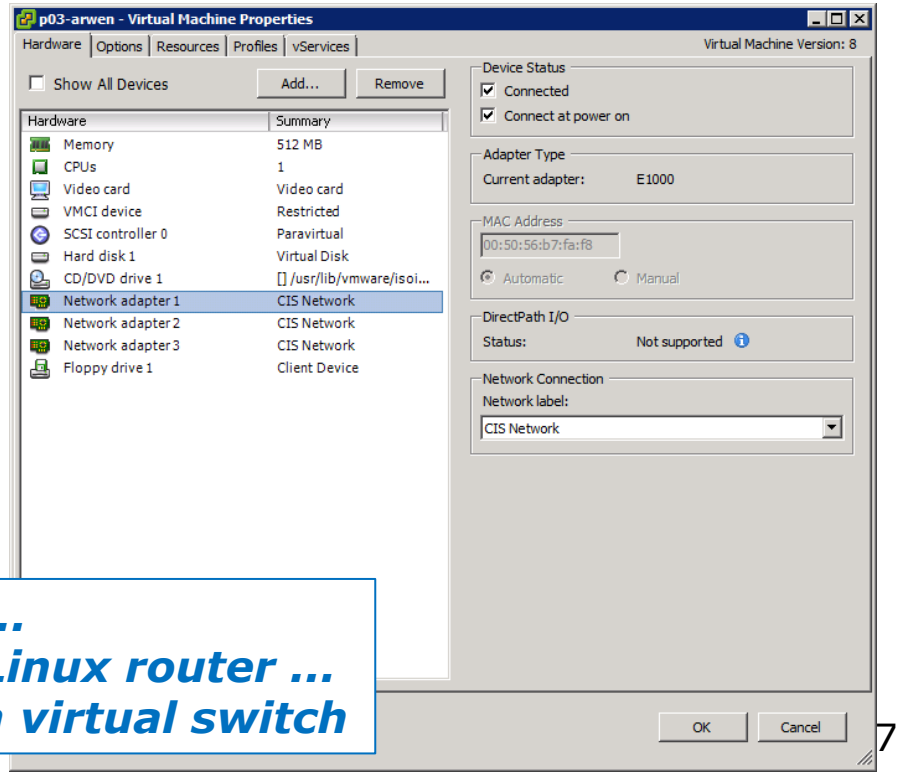
Router

Cabling a PC to a router via a switch

Cabling Devices on a Virtual Network

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

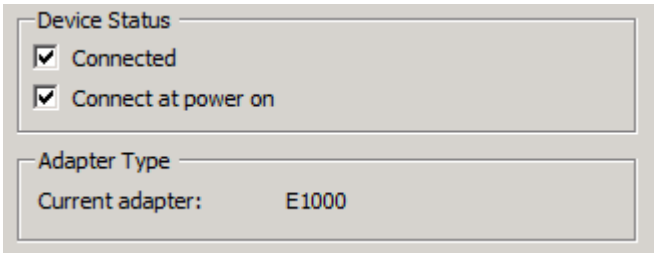


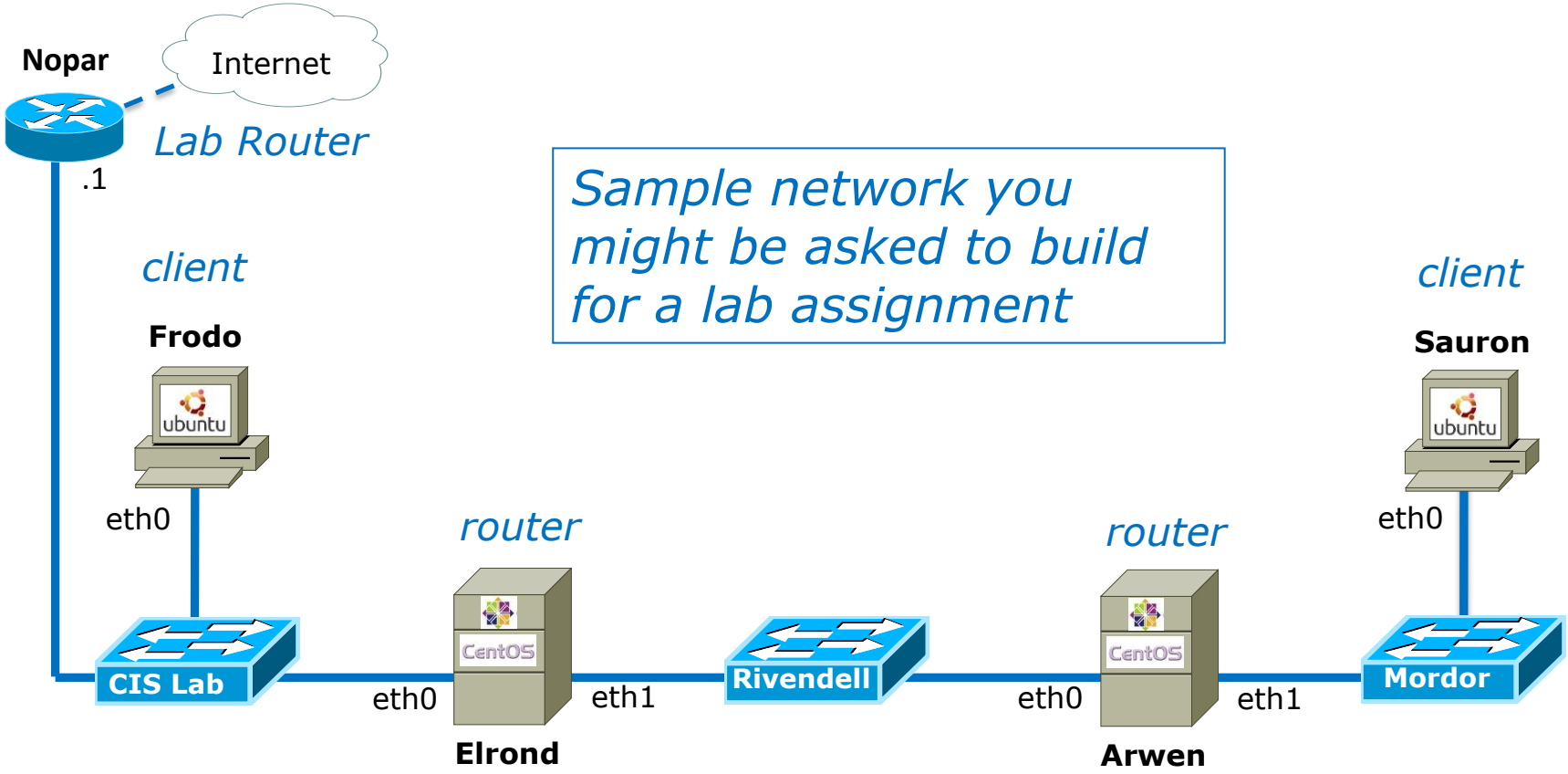


*Cabling a **virtual PC ...***
*to a **virtual Linux router ...***
*via a **virtual switch***

Connecting a cable to the NIC

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



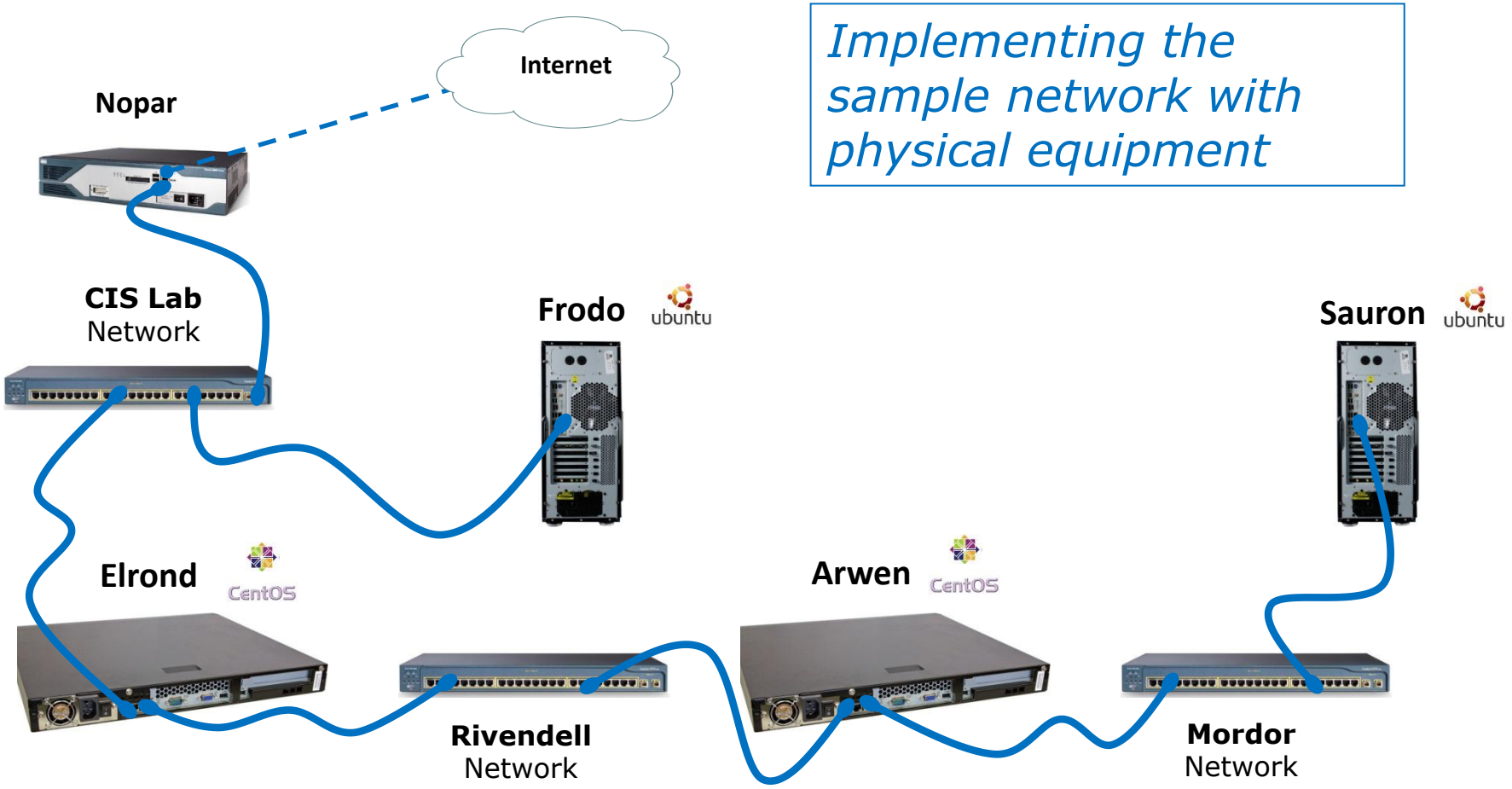


CIS LAB

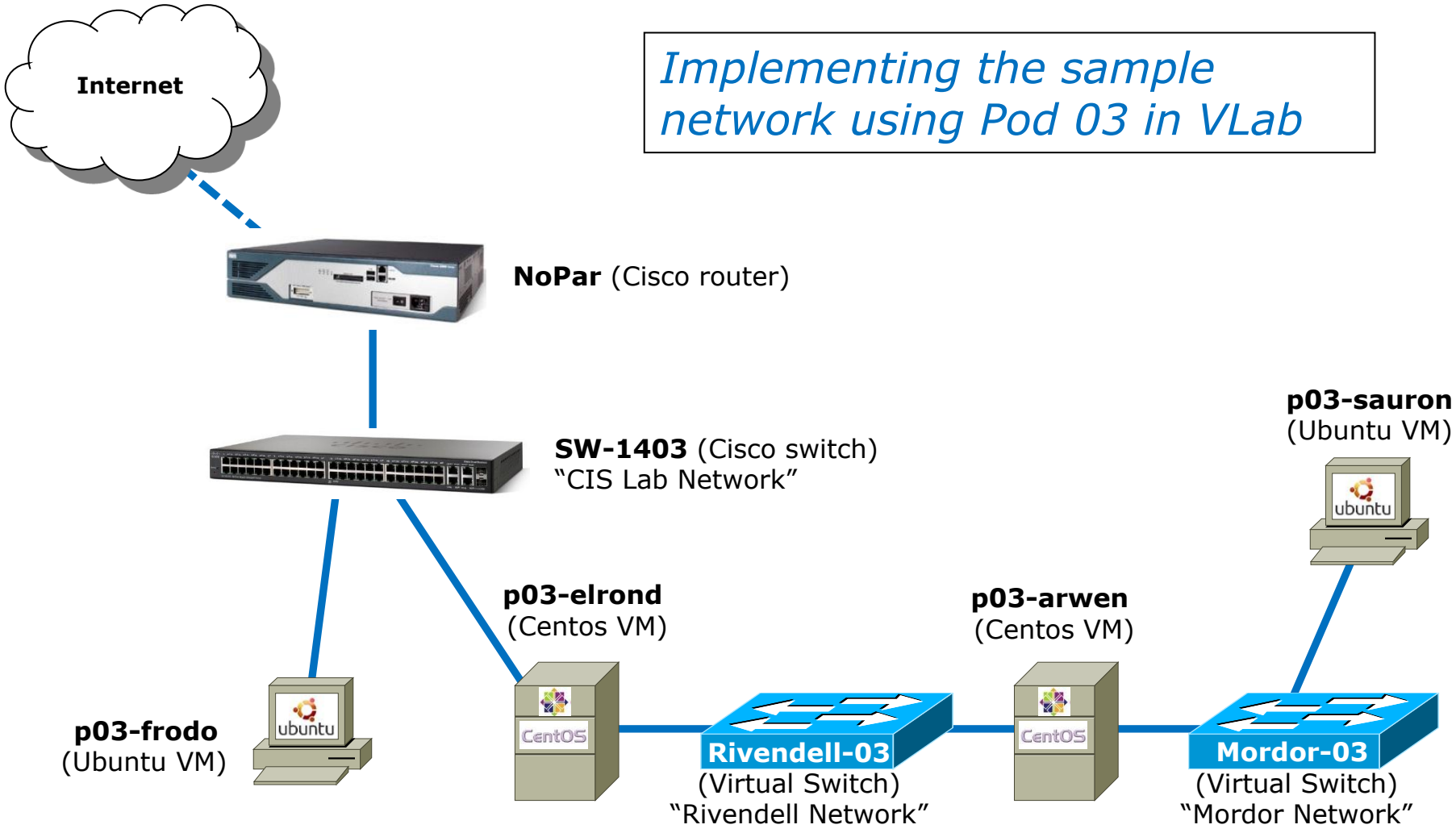
RIVENDELL

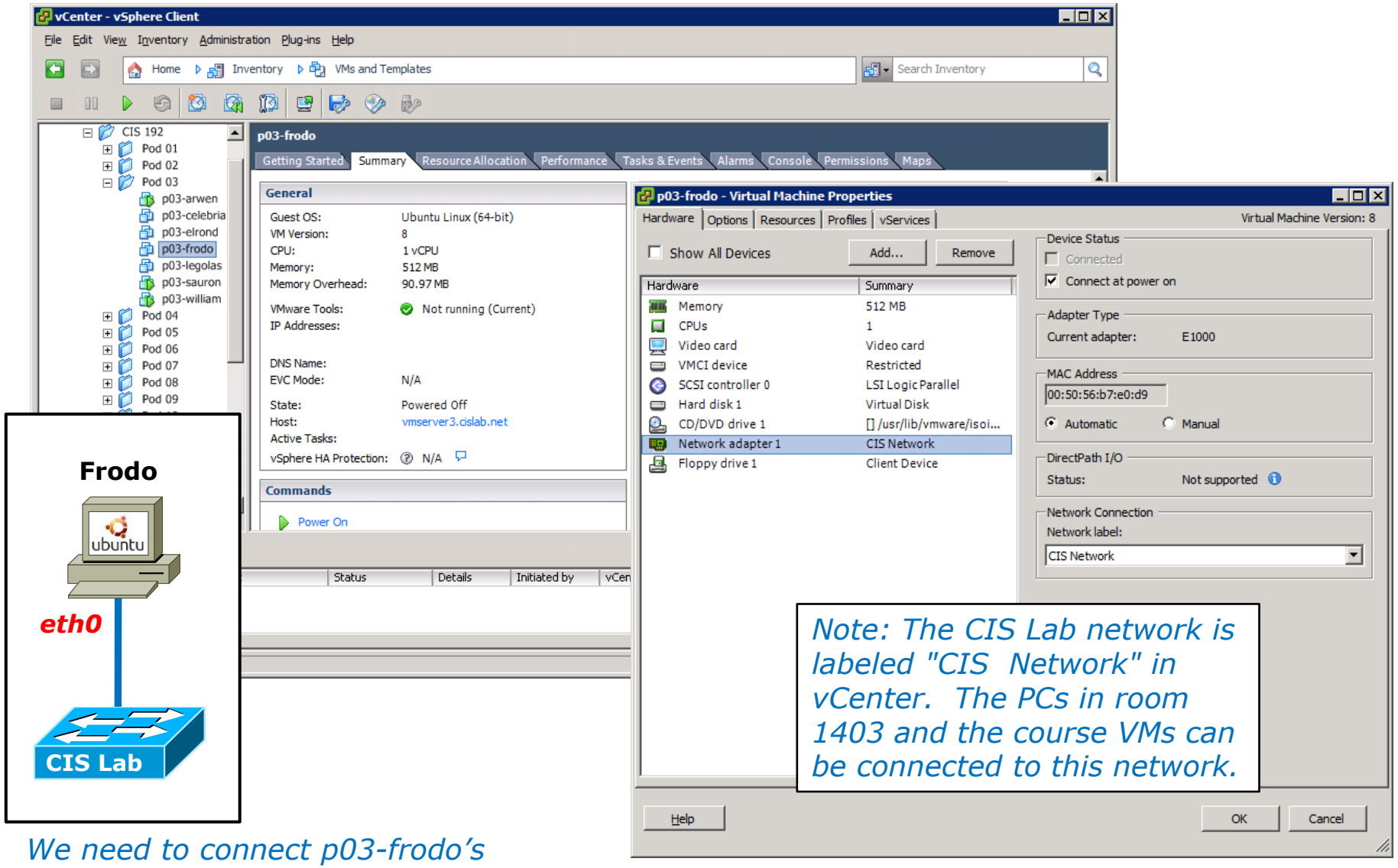
MORDOR

Implementing the sample network with physical equipment



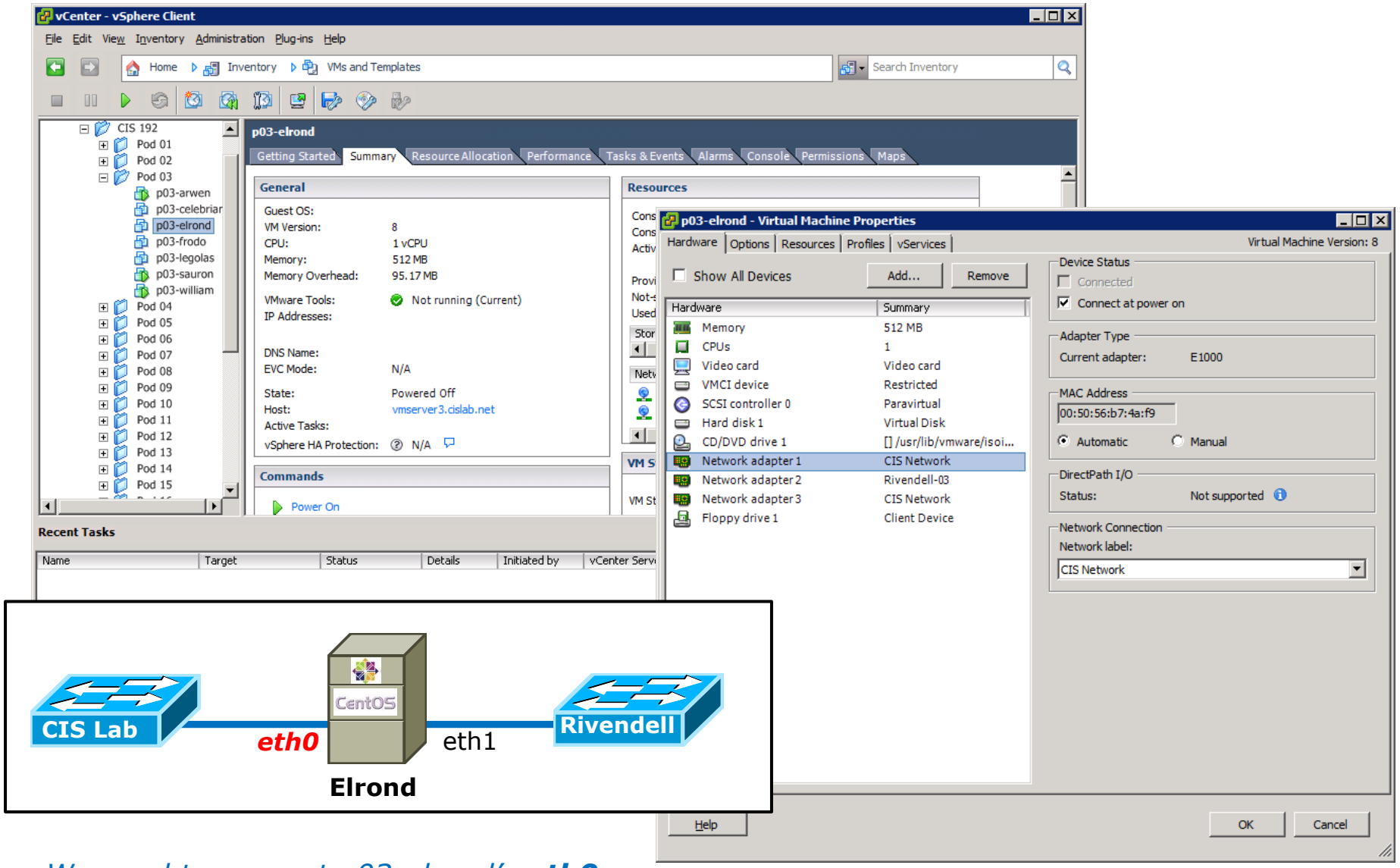
Implementing the sample network using Pod 03 in VLab



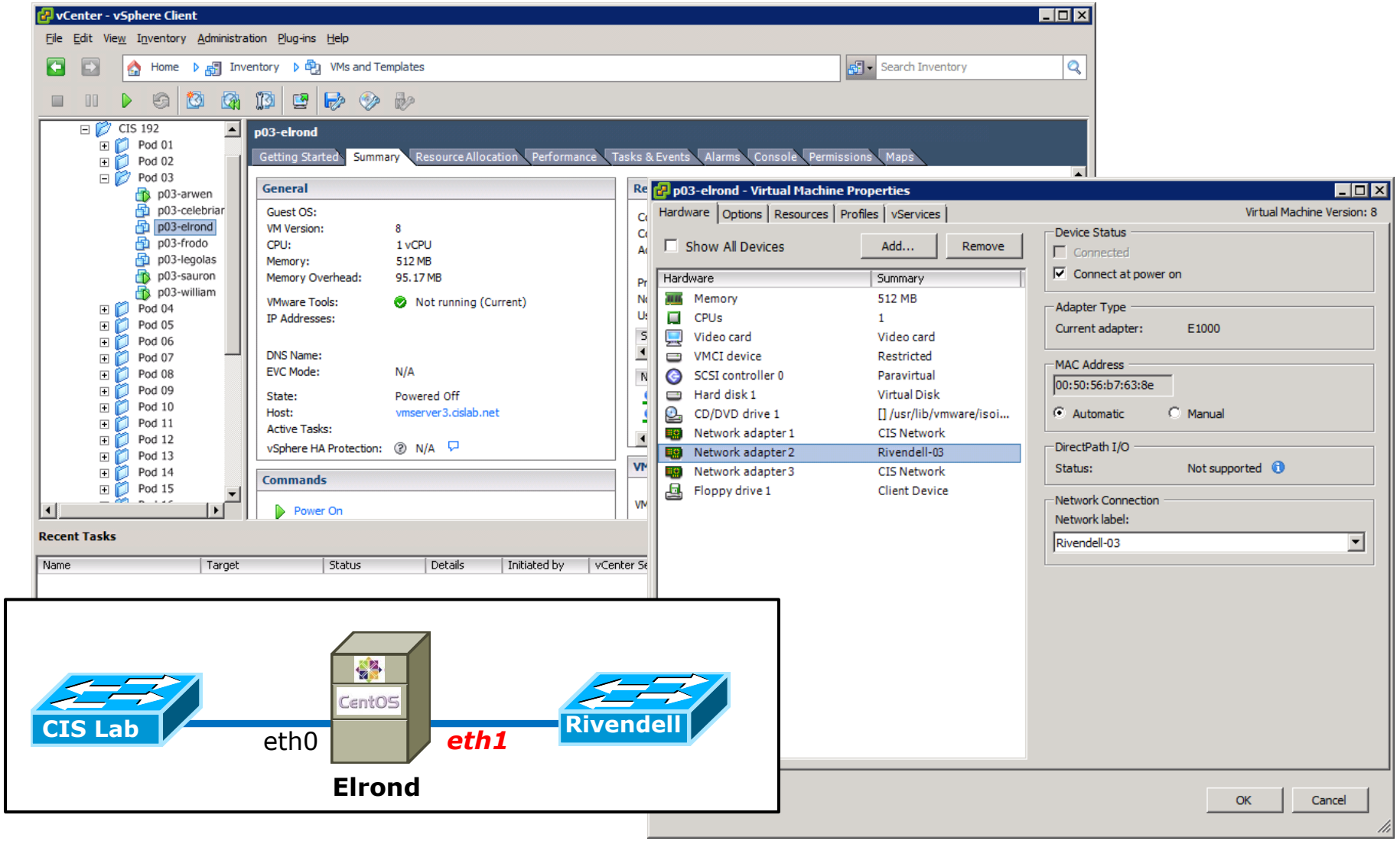


Note: The CIS Lab network is labeled "CIS Network" in vCenter. The PCs in room 1403 and the course VMs can be connected to this network.

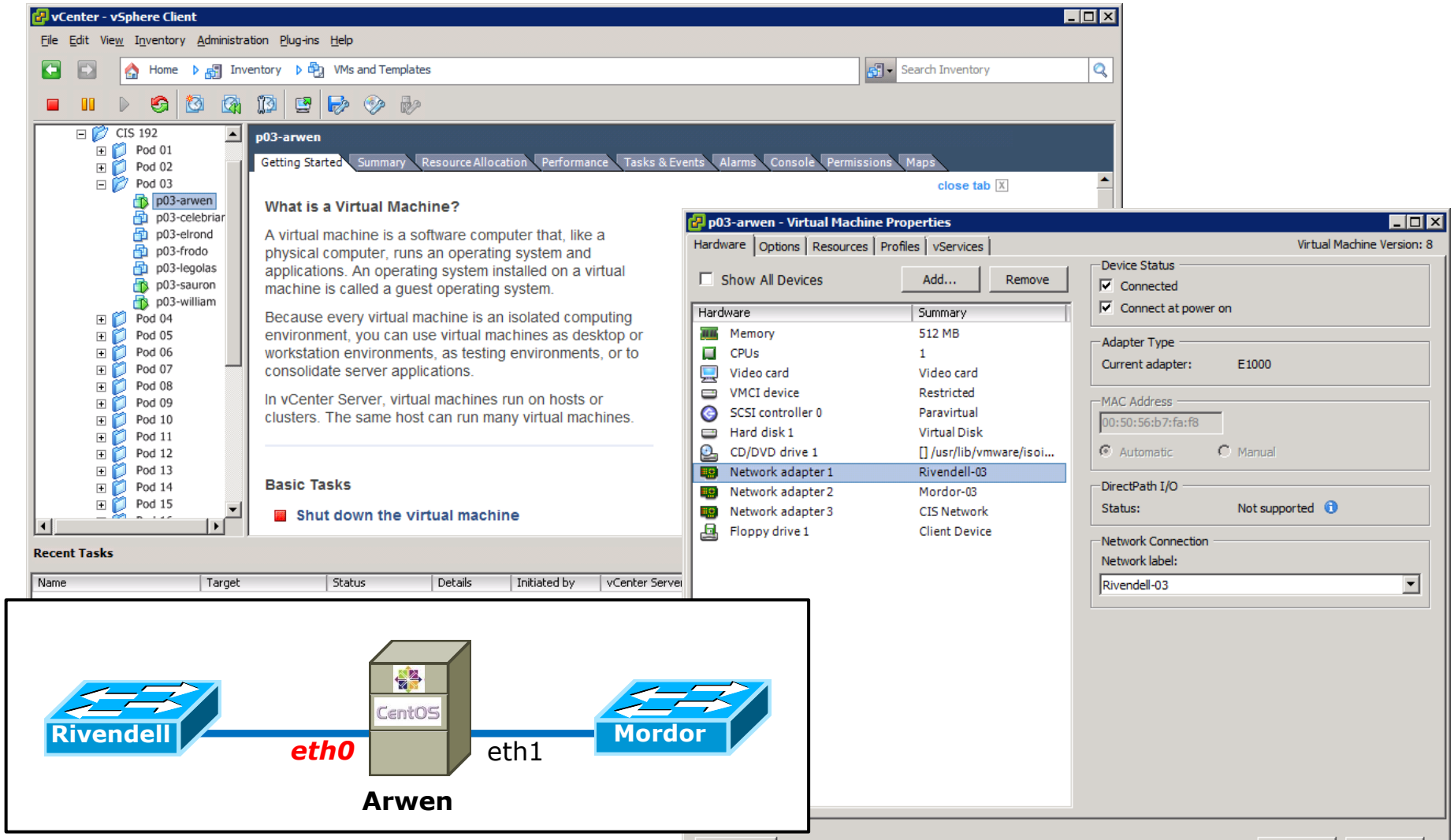
*We need to connect p03-frodo's **eth0** interface to the **CIS Lab Network***



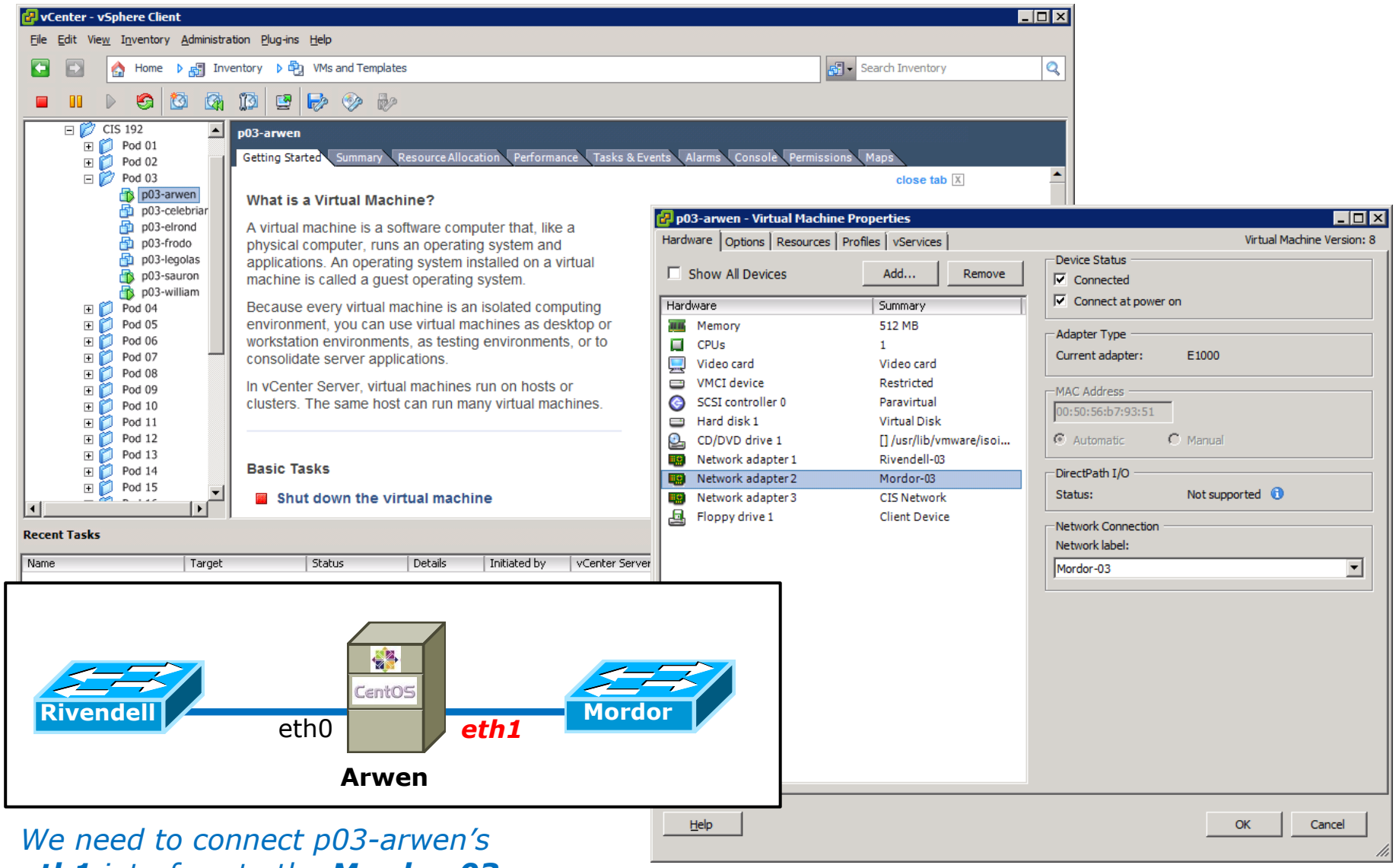
*We need to connect p03-elrond's **eth0** interface to the **CIS Lab Network***



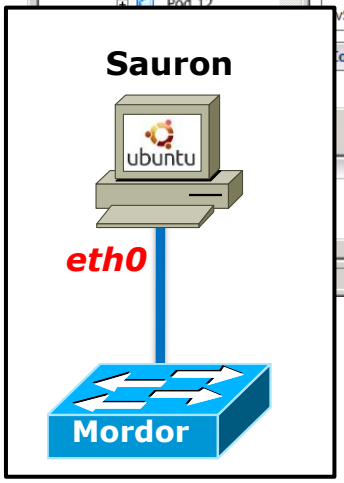
We need to connect p03-elrond's ***eth1*** *interface to the* ***Rivendell-03*** *Network*



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

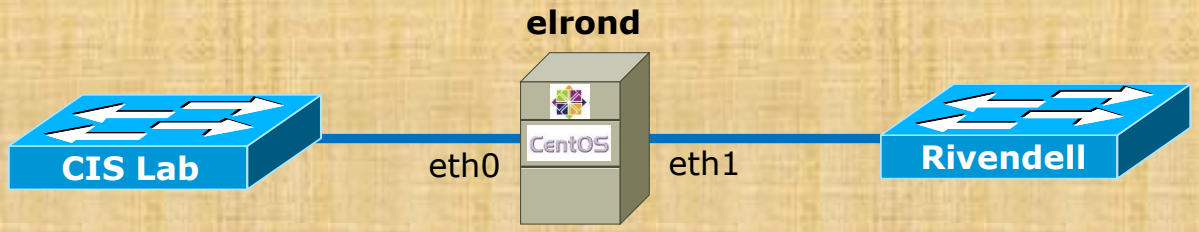


We need to connect p03-arwen's ***eth1*** *interface to the* ***Mordor-03*** *Network*

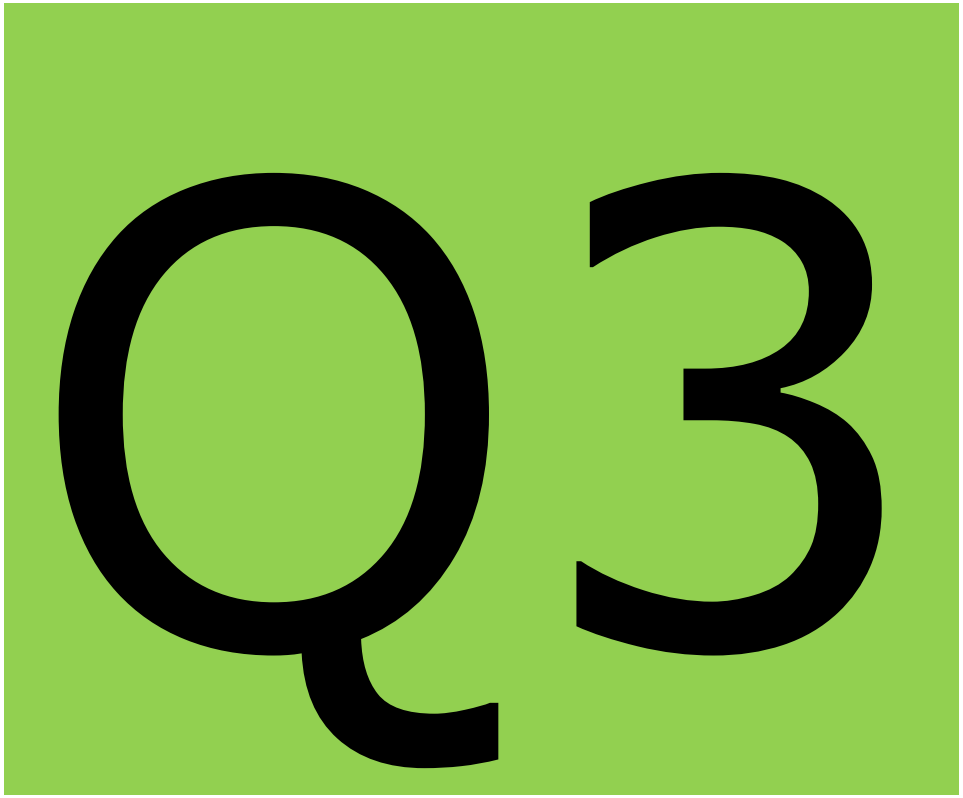


We need to connect p03-sauron's ***eth0*** *interface to the* ***Mordor-03*** *Network*

Class Activity
Cabling VMs



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

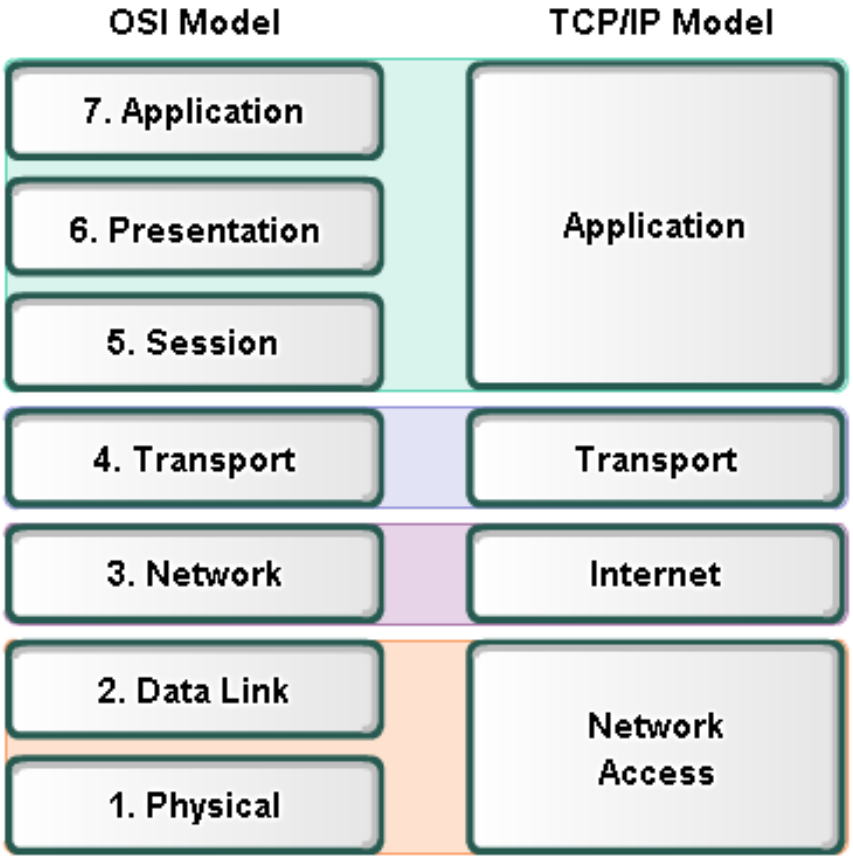


- Linux Review
- Network Review
- Standards
- NICs and drivers

Network Review

Protocol Reference Models

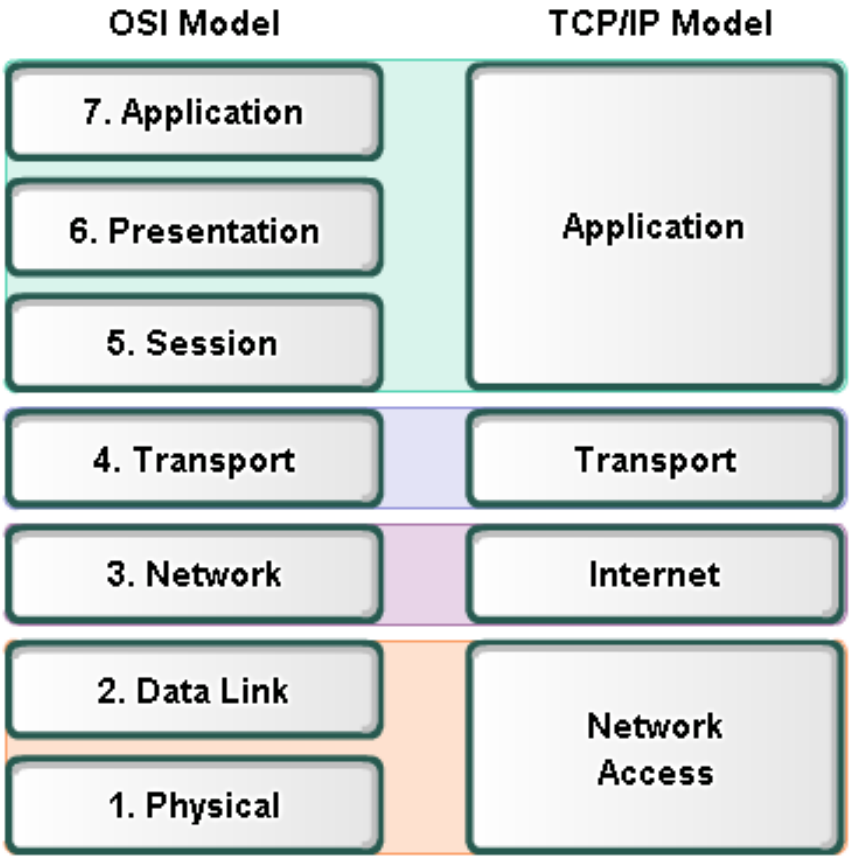
1977



1970's

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



Example Protocols

File Transfer Protocol (FTP), Simple Mail Transport Protocol (SMTP), Hyper Text Transfer Protocol (HTTP), etc.

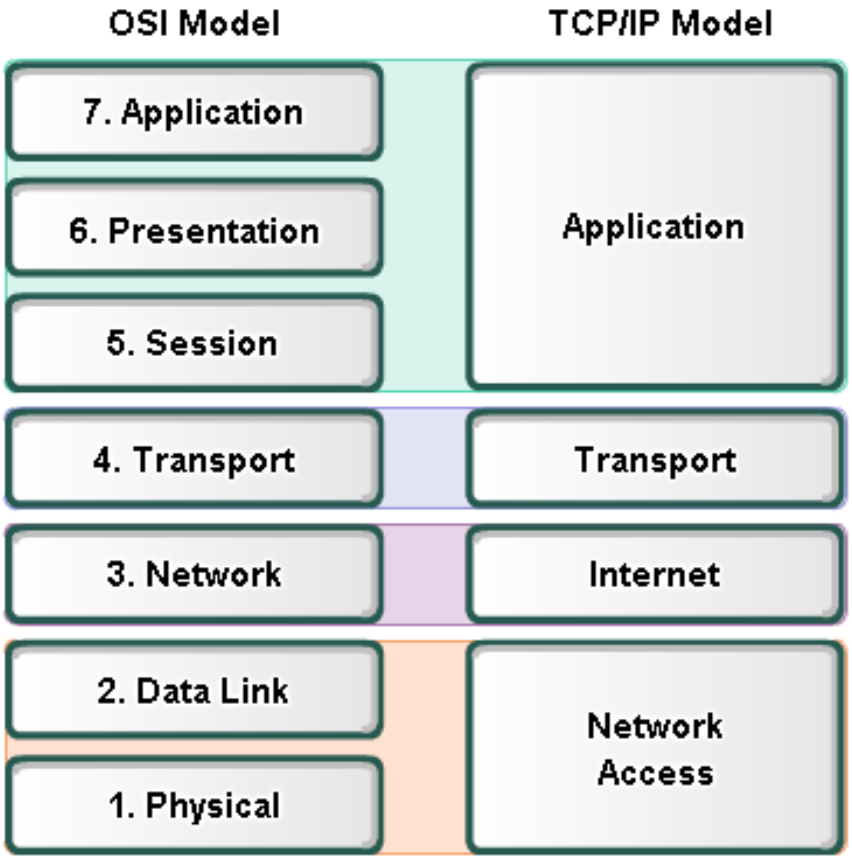
Transmission Control Protocol (TCP), User Datagram Protocol (UDP)

Internet Protocol (IP)

Ethernet, SLIP, PPP, X.25, Frame Relay, etc.

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



Example Products

Filezilla (FTP), Firefox (HTTP), Internet Explorer (HTTP), Exchange (SMTP), Sendmail (SMTP)

Network stacks

Routers, network stacks

Switches, NICs, network stacks

Hubs, NICs, cables

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

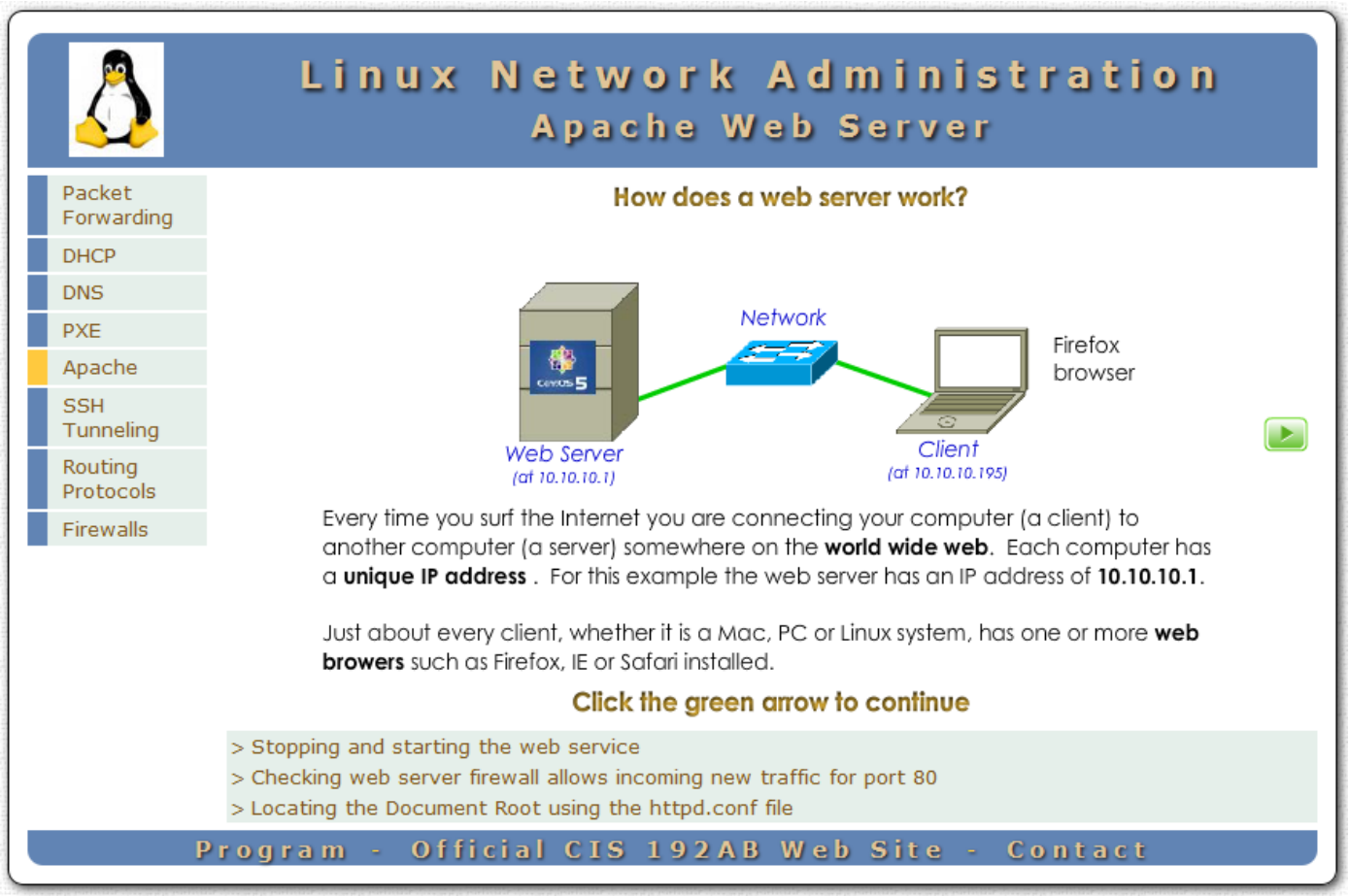
Deep dive into a single packet

*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

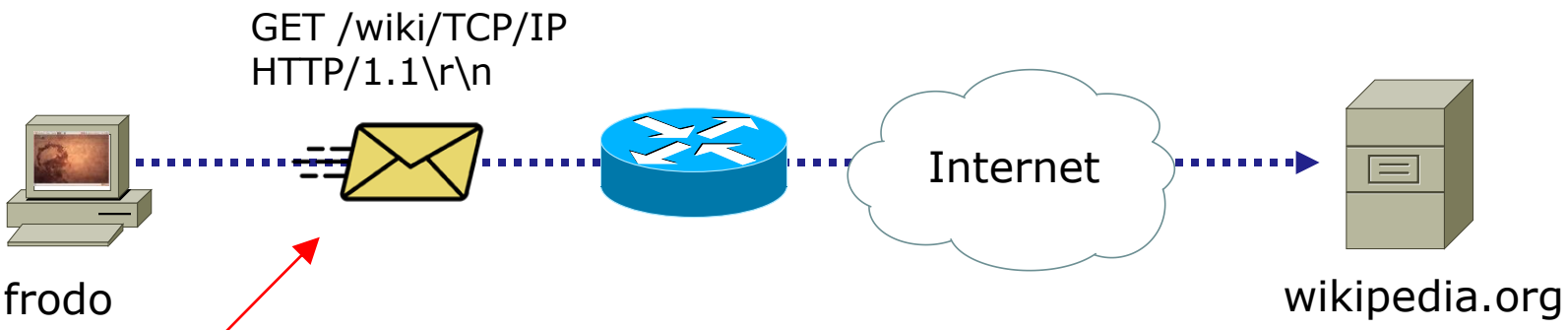
Putting it all together – web server example

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



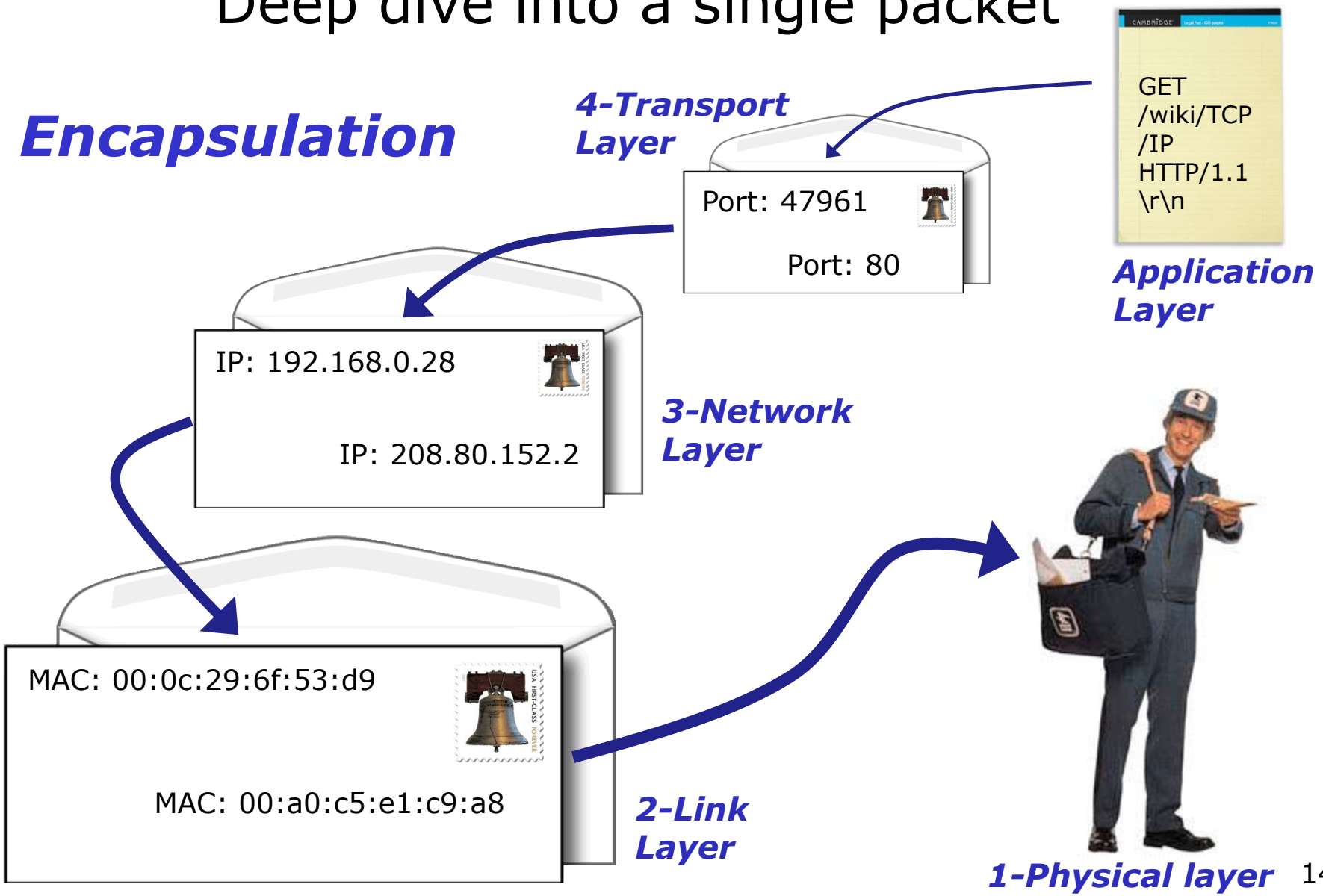
Let's start with a web server example to see how the network is used

Deep dive into a single packet



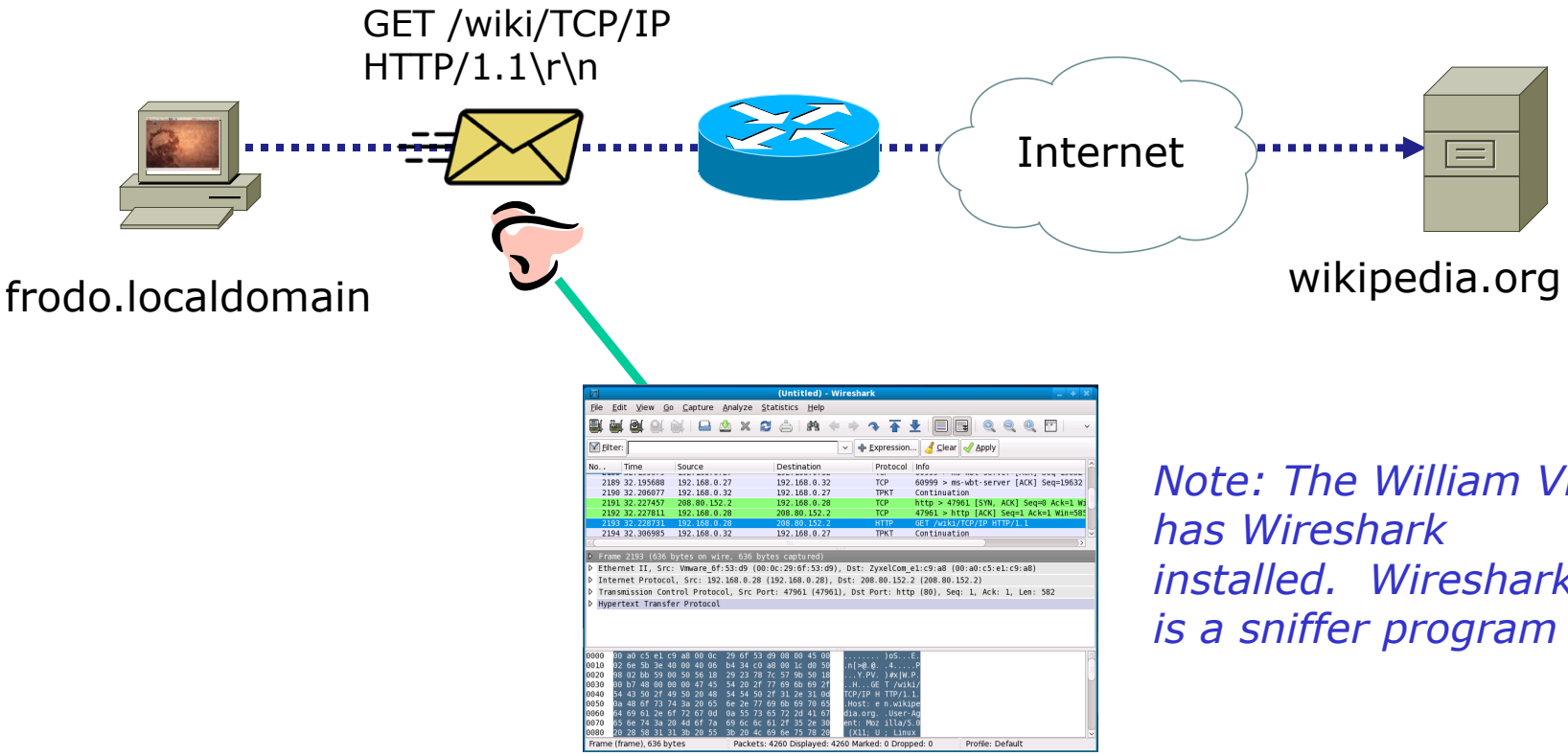
*The browser request for the wikipedia.org web page is **encapsulated** into an Ethernet frame that is sent to the default gateway router.*

Deep dive into a single packet



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)

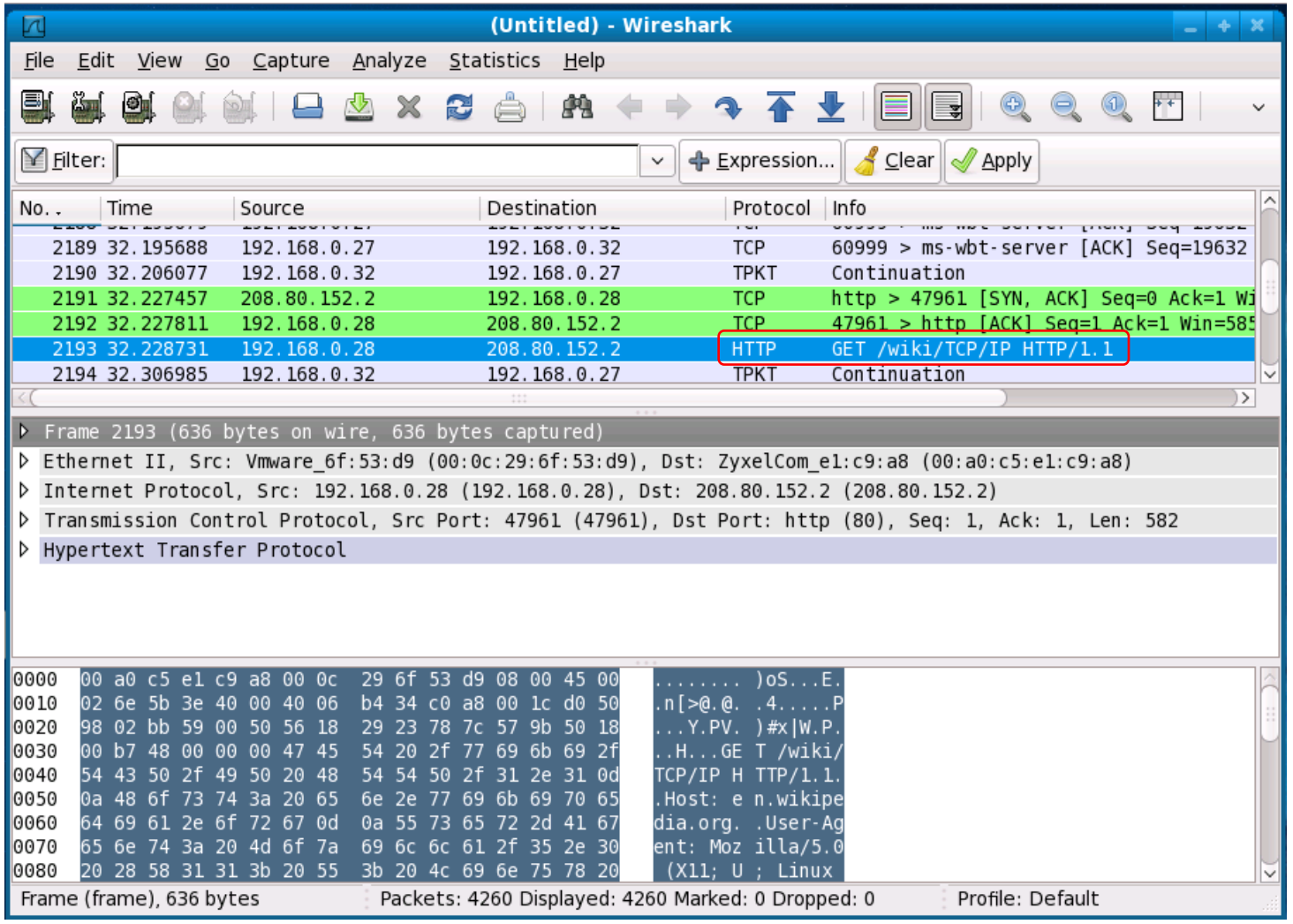


Note: The William VM has Wireshark installed. Wireshark is a sniffer program

Deep dive into a single packet

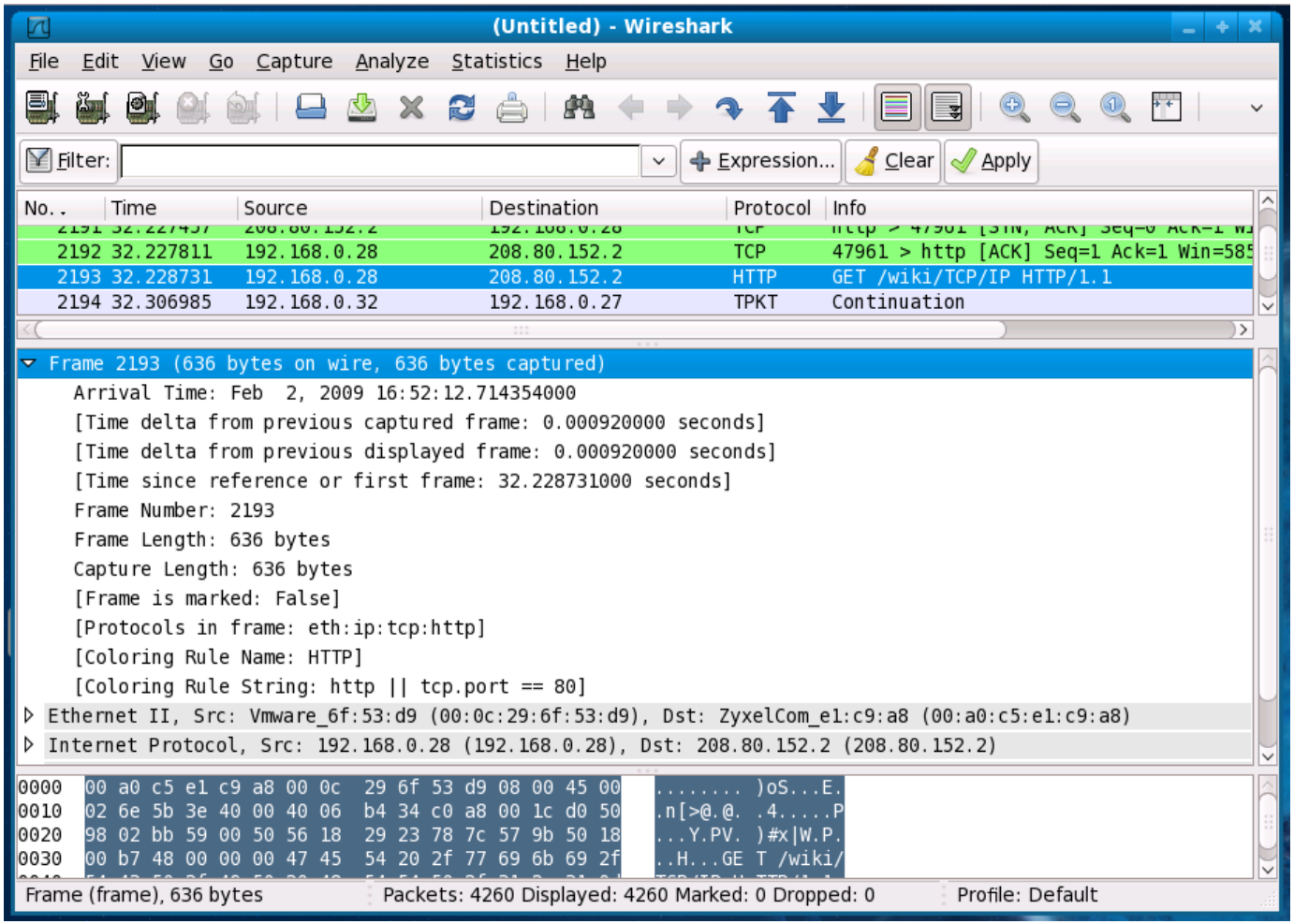
Note how Wireshark shows each layer for the selected HTTP GET packet

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

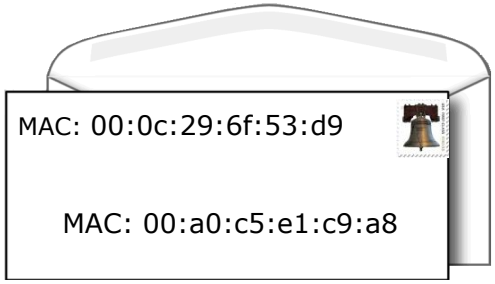


Deep dive into a single packet – Layer 1

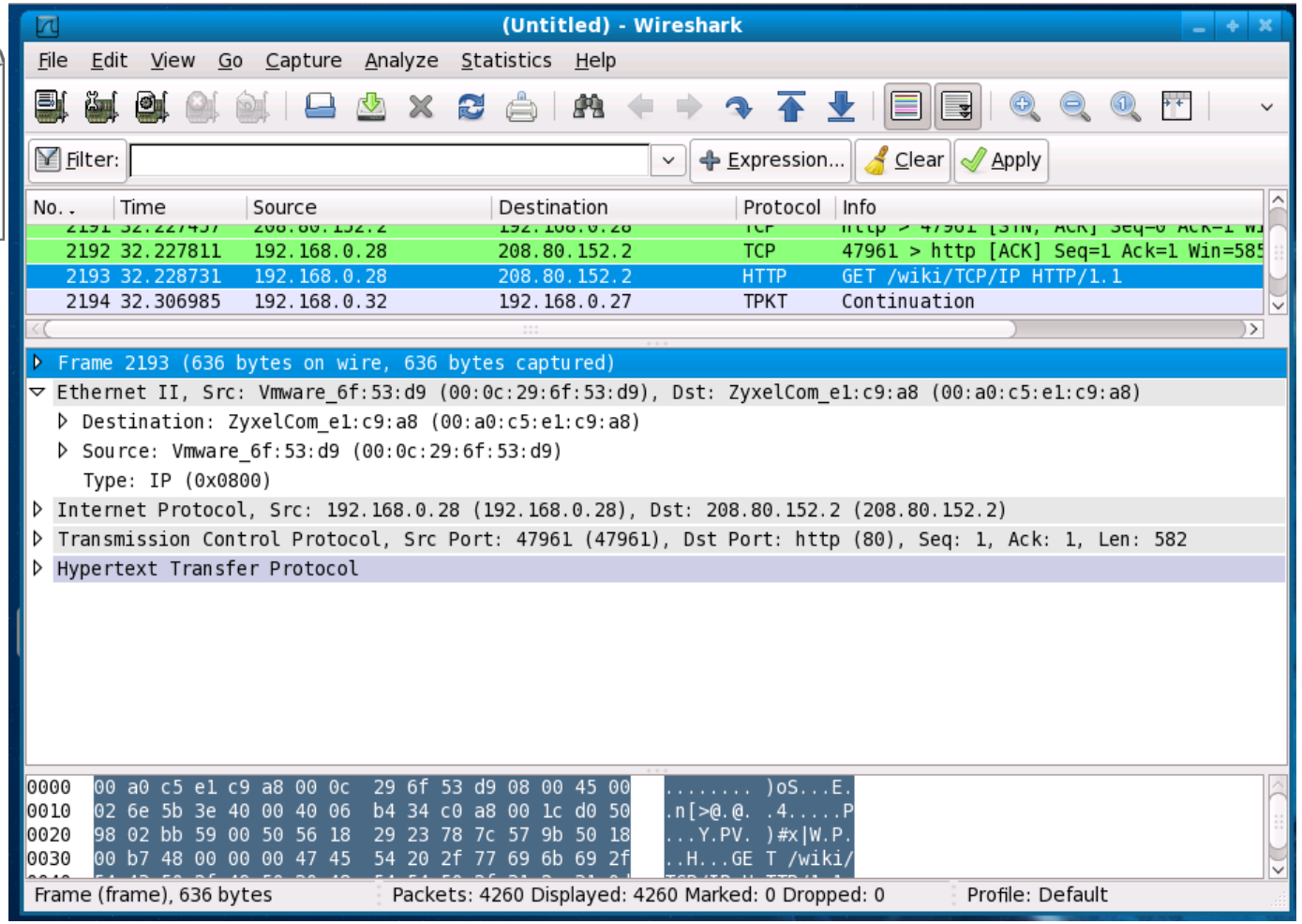
1-Physical layer expanded



Deep dive into a single packet – Layer 2

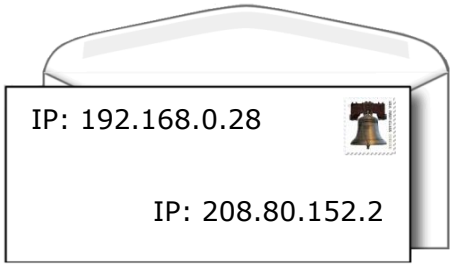


2-Link layer expanded



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

Deep dive into a single packet – Layer 3



3-Network layer expanded

Wireshark Network Analyzer
Wireshark traffic and network analyzer

File Edit View Go Capture

Filter: Expression... Clear Apply

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

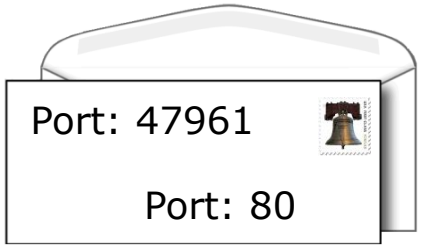
```
Frame 2193 (636 bytes on wire, 636 bytes captured)
Ethernet II, Src: Vmware_6f:53:d9 (00:0c:29:6f:53:d9), Dst: ZyxelCom_e1:c9:a8 (00:a0:c5:e1:c9:a8)
Internet Protocol, Src: 192.168.0.28 (192.168.0.28), Dst: 208.80.152.2 (208.80.152.2)
    Version: 4
    Header length: 20 bytes
  ▷ Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)
    Total Length: 622
    Identification: 0x5b3e (23358)
  ▷ Flags: 0x04 (Don't Fragment)
    Fragment offset: 0
    Time to live: 64
    Protocol: TCP (0x06)
  ▷ Header checksum: 0xb434 [correct]
    Source: 192.168.0.28 (192.168.0.28)
```

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

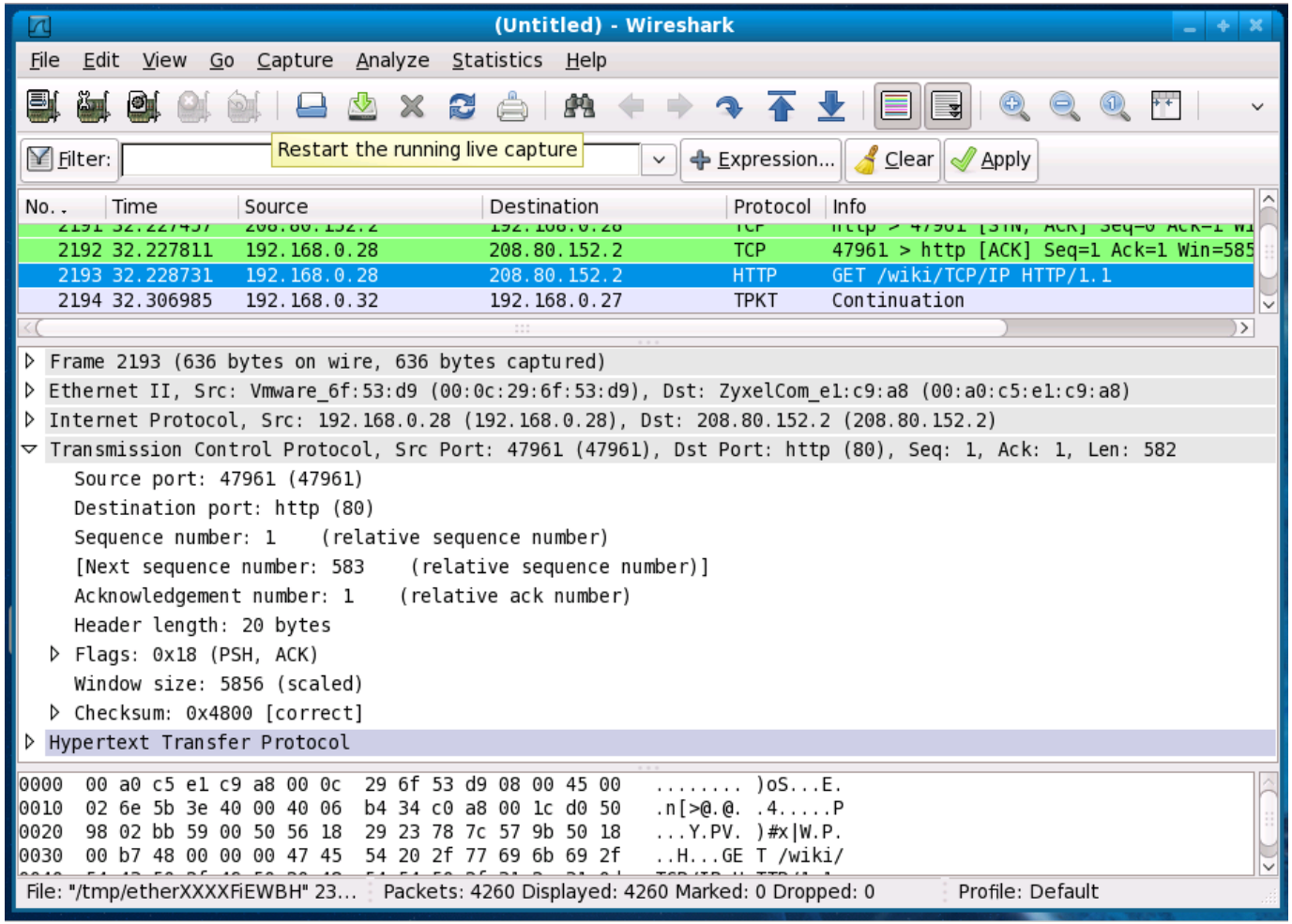
Frame (frame), 636 bytes | Packets: 4260 Displayed: 4260 Marked: 0 Dropped: 0 | Profile: Default

*Note the use of **IP addresses** in this layer.*

Deep dive into a single packet – Layer 4

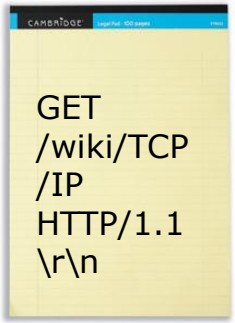


Transport layer expanded

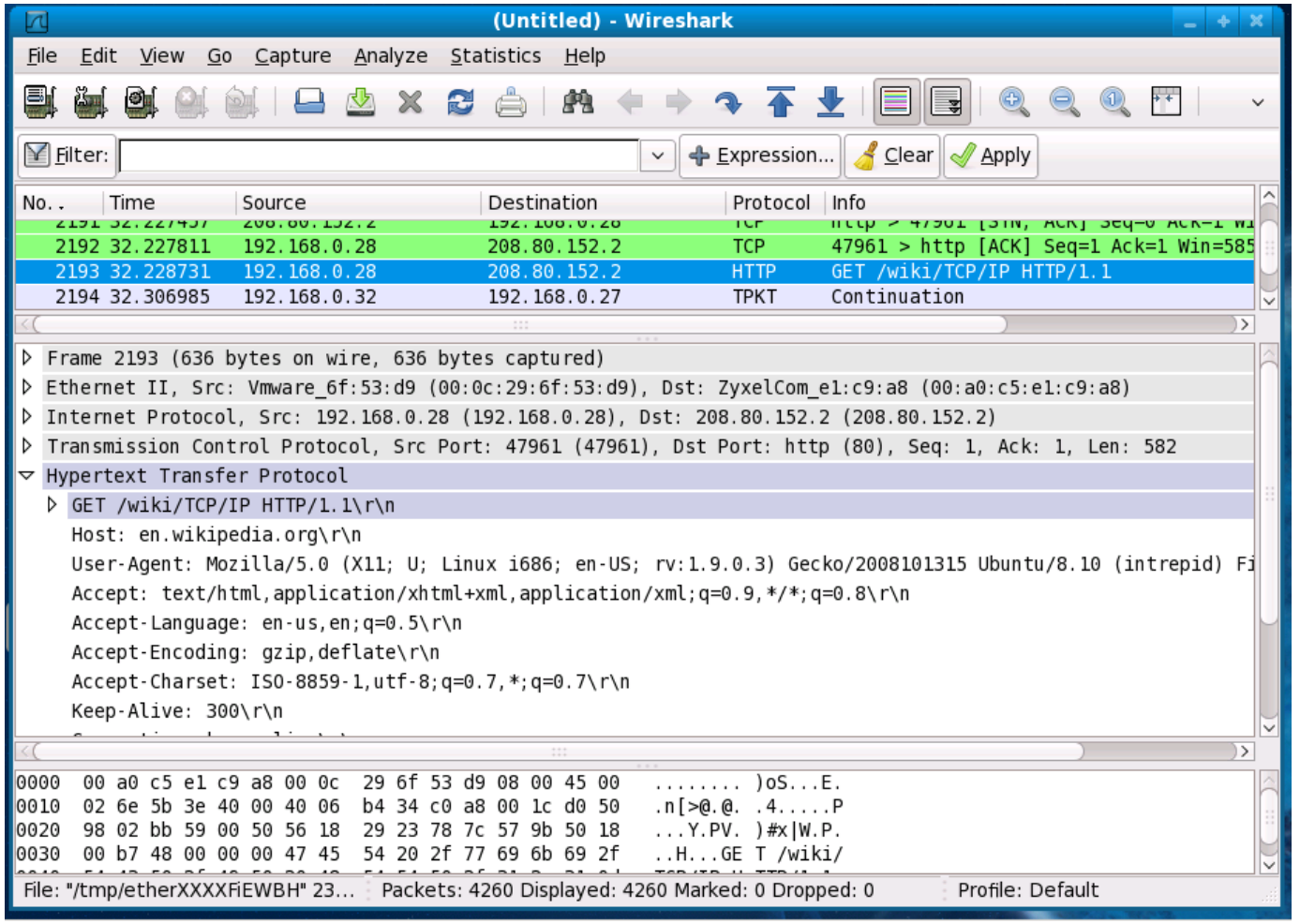


*Note the use of **ports** in this layer. Port 80 is for web servers.*

Deep dive into a single packet – Application layer

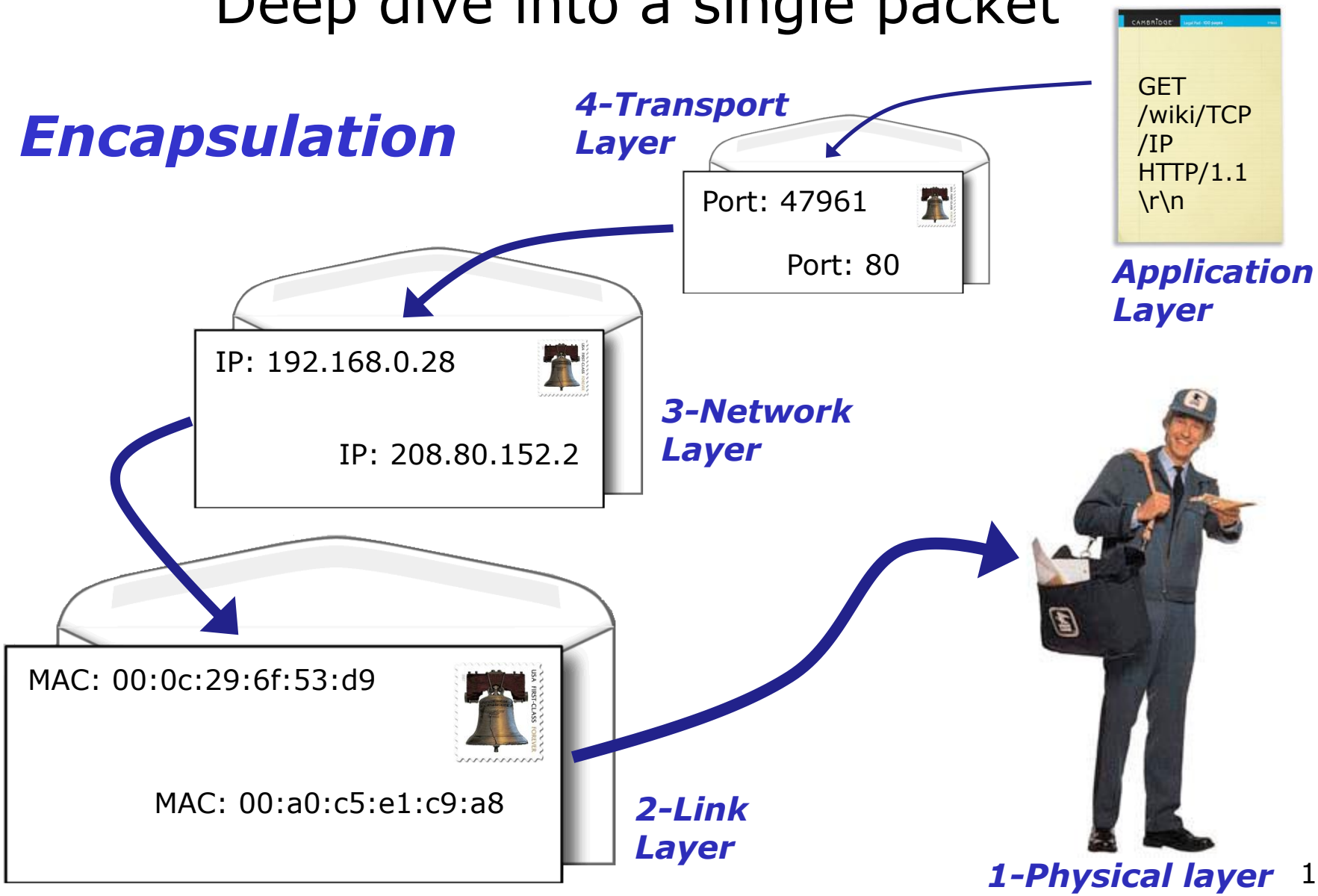


Application layer expanded



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

Deep dive into a single packet



Standards are needed

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

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

Standards

Standards

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

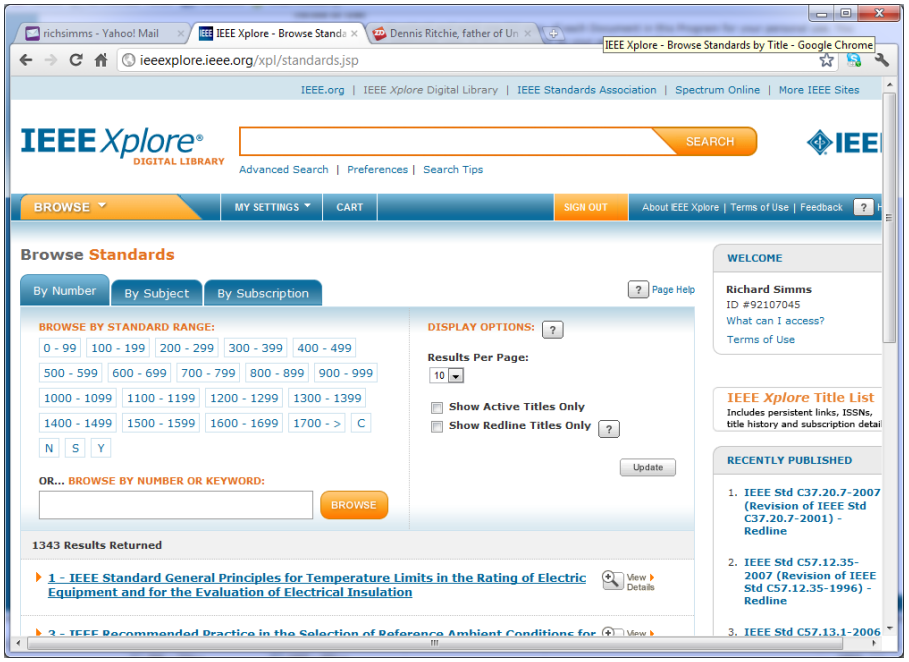
Answer: Standards

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

IEEE Standards

Institute of Electrical and Electronics Engineers

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

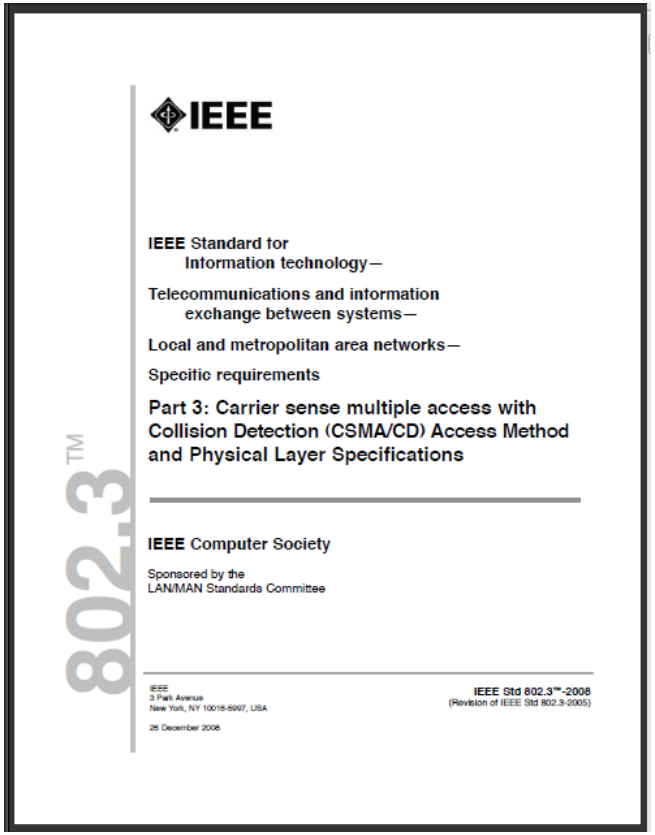


IEEE Standards

Institute of Electrical and Electronics Engineers

Example: Netgear Switch

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


IEEE

IEEE Standard for
Information technology—

Telecommunications and information
exchange between systems—

Local and metropolitan area networks—

Specific requirements

Part 3: Carrier sense multiple access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

802.3™

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
3 Park Avenue
New York, NY 10016-5997, USA

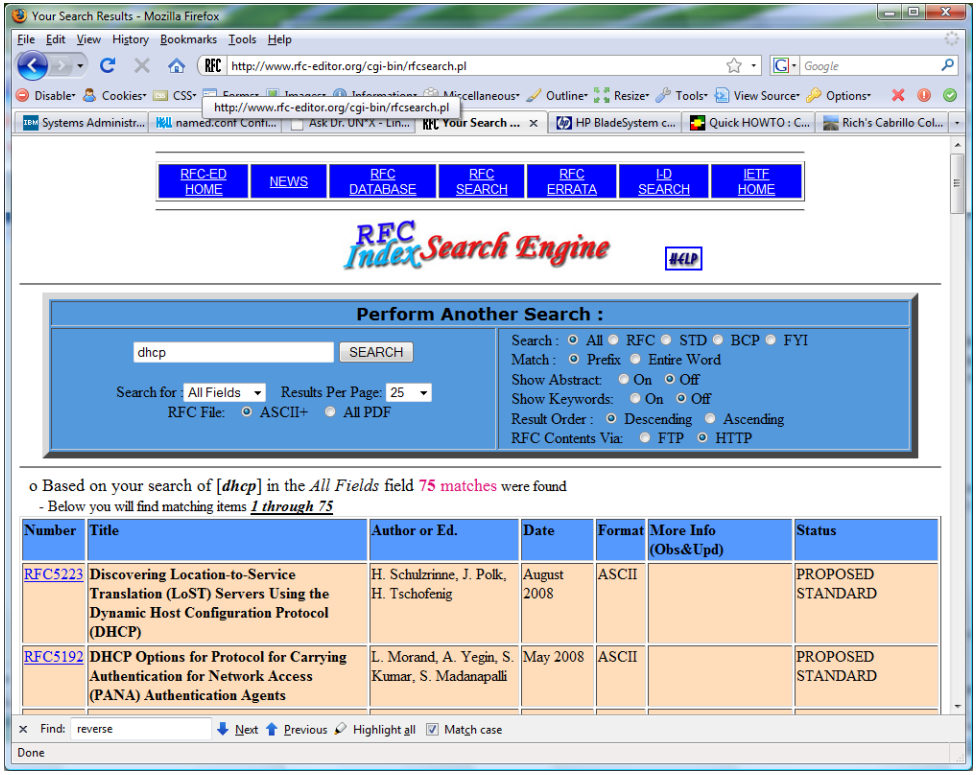
26 December 2008

IEEE Std 802.3™-2008
(Revision of IEEE Std 802.3-2005)

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)

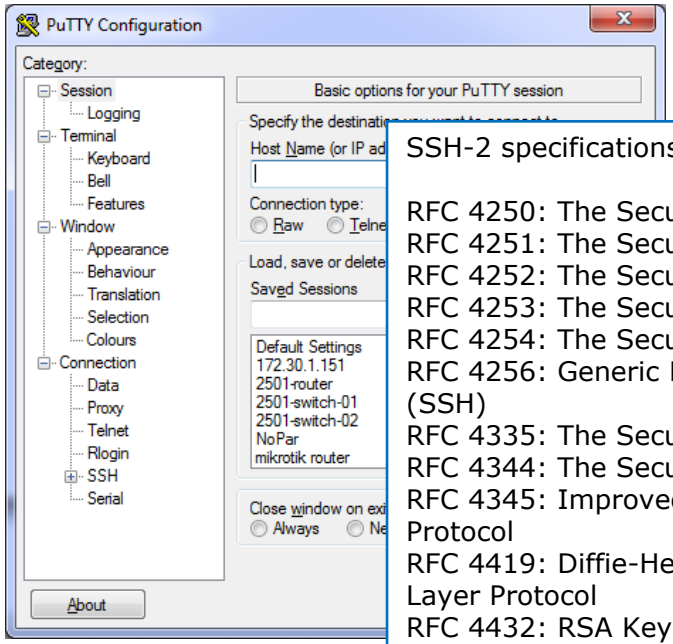


DHCP example

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

Standards
IETF (Internet Engineering Task Force)

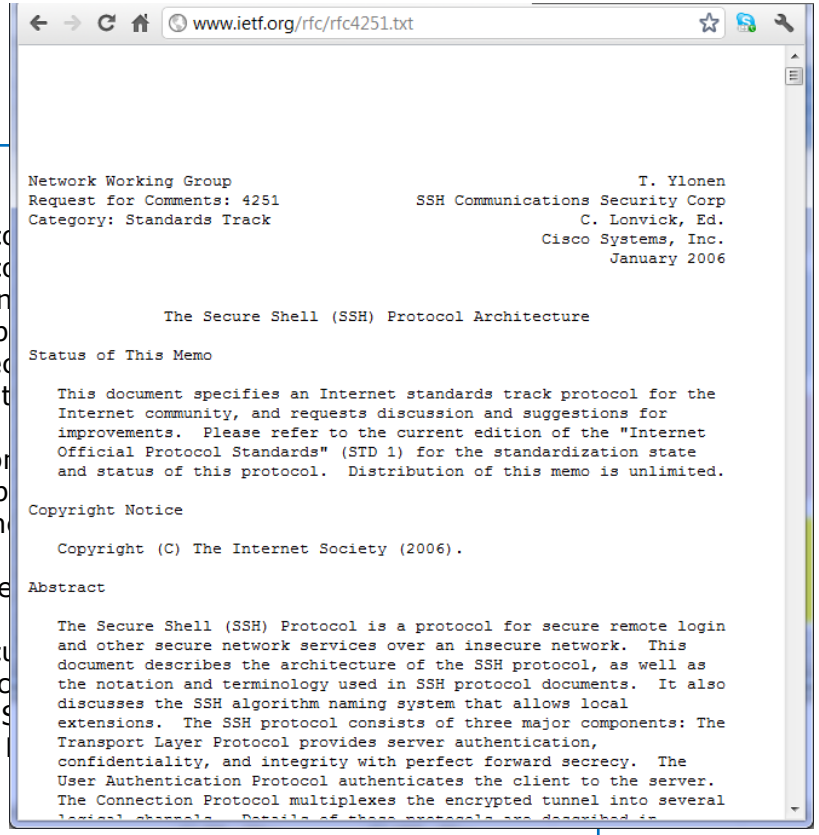
Example: PuTTY SSH software



SSH-2 specifications

RFC 4250: The Secure Shell (SSH) Protocol
RFC 4251: The Secure Shell (SSH) Protocol
RFC 4252: The Secure Shell (SSH) Authen
RFC 4253: The Secure Shell (SSH) Transp
RFC 4254: The Secure Shell (SSH) Connec
RFC 4256: Generic Message Exchange Aut
(SSH)
RFC 4335: The Secure Shell (SSH) Session
RFC 4344: The Secure Shell (SSH) Transp
RFC 4345: Improved Arcfour Modes for th
Protocol
RFC 4419: Diffie-Hellman Group Exchange
Layer Protocol
RFC 4432: RSA Key Exchange for the Secu
RFC 4462: Generic Security Service Applic
Authentication and Key Exchange for the S
RFC 4716: The Secure Shell (SSH) Public
IETF Secure Shell working group drafts:
filexfer
Independent drafts:
draft-miller-secsh-compression-delayed

RFC 4251 SSH Protocol Architecture



Joining the network

NIC Inventory

Connecting your Linux system to the Network

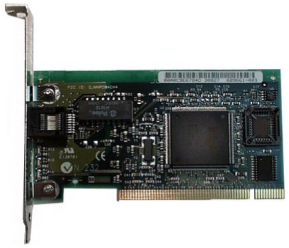
1. Identify the NIC(s) in your system (vendor and model)

2. Locate a driver for your NIC
   - may be already available with your distro
   - may be available from NIC vendor
   - may be available from chipset vendor
   - may have get source and build (compile) it

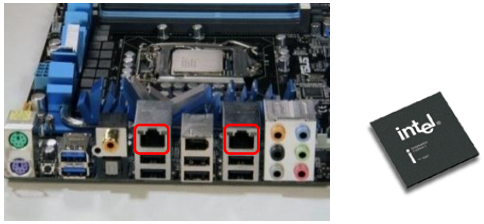
3. Load the driver (insmod or modprobe command)

4. Bring up and configure the interface (ifconfig)

What is a NIC?



NIC as accessory card



NIC chip on the motherboard

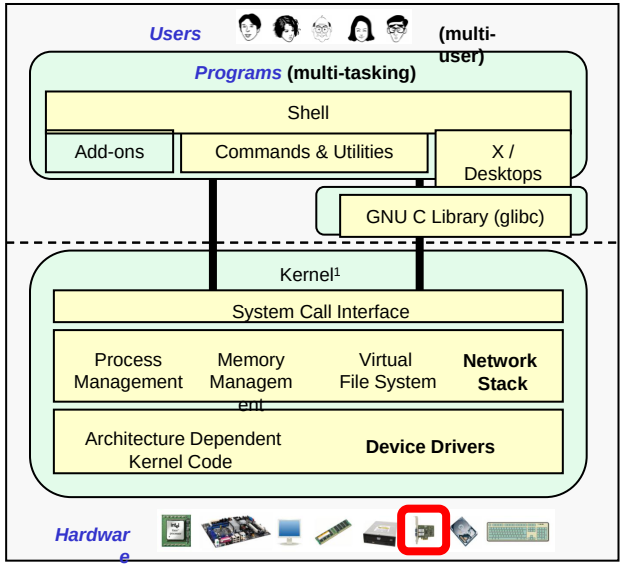
- The NIC (Network Interface Controller) is used by a computer to send and receive packets on the network.
- You will also hear NICs called *network adapters* or *Ethernet adapters.*
- Most PC NICs are now part of the motherboard rather than a card.
- A NIC can operate at the level 2 (Link Layer) sending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

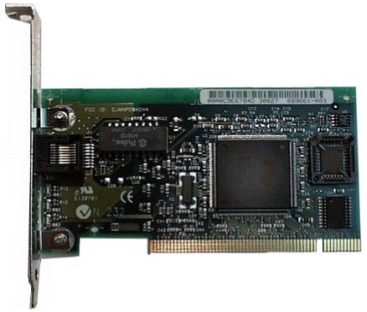
*New Linux distributions **automatically** probe hardware at system startup to identify the current NICs installed*

New commands for your toolbox

`lspci` *List the Ethernet controllers (and other devices)*

`dmesg` *Show boot messages which shows NIC initialization*





Manual NIC Hardware Inventory

lspci command *... on a pod VM*

```
[cis192@p03-celebrian ~]$ lspci
00:00.0 Host bridge: Intel Corporation 440BX/ZX/DX - 82443BX/ZX/DX Host bridge (rev 01)
00:01.0 PCI bridge: Intel Corporation 440BX/ZX/DX - 82443BX/ZX/DX AGP bridge (rev 01)
00:07.0 ISA bridge: Intel Corporation 82371AB/EB/MB PIIX4 ISA (rev 08)
00:07.1 IDE interface: Intel Corporation 82371AB/EB/MB PIIX4 IDE (rev 01)
00:07.3 Bridge: Intel Corporation 82371AB/EB/MB PIIX4 ACPI (rev 08)
00:07.7 System peripheral: VMware Virtual Machine Communication Interface (rev 10)
00:0f.0 VGA compatible controller: VMware SVGA II Adapter
< snipped >
00:18.6 PCI bridge: VMware PCI Express Root Port (rev 01)
00:18.7 PCI bridge: VMware PCI Express Root Port (rev 01)
02:00.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller
  (Copper) (rev 01)
02:01.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller
  (Copper) (rev 01)
02:02.0 Ethernet controller: Intel Corporation 82545EM  Gigabit Ethernet Controller
  (Copper) (rev 01)
03:00.0 Serial Attached SCSI controller: VMware PVSCSI SCSI Controller (rev 02)
[cis192@p03-celebrian ~]$
```

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

Manual NIC Hardware Inventory

dmesg command *... on a pod VM*

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

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

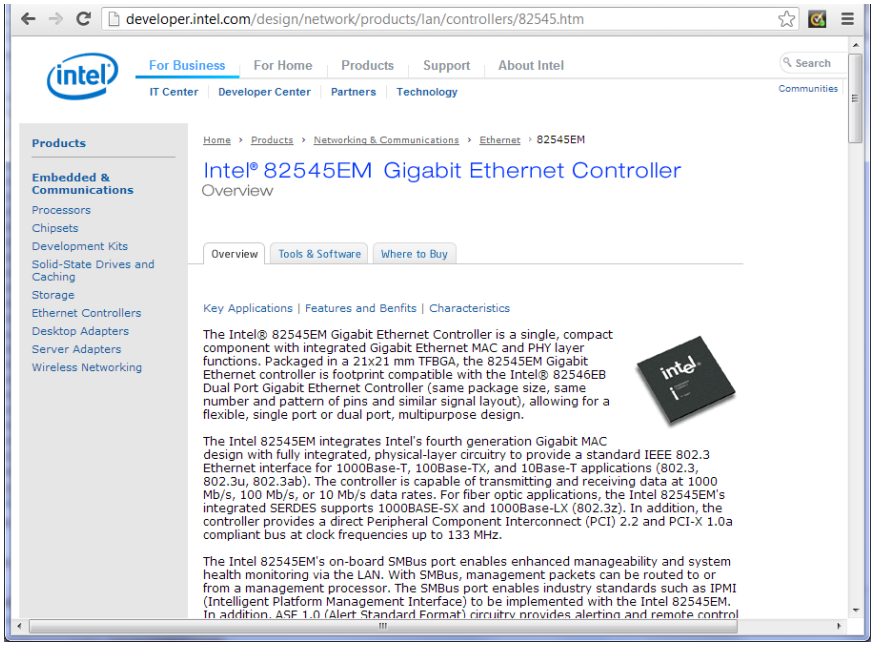
dmesg output often includes information on the NICs as the system boots up and drivers are loaded.

Google NIC for technical specifications

```
02:00.0 Ethernet controller: Intel Corporation 82545EM
Gigabit Ethernet Controller (Copper) (rev 01)
```

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

Specifications



Class Activity
NIC Inventory

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

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

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

Locating NIC Drivers

Connecting your Linux system to the Network

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

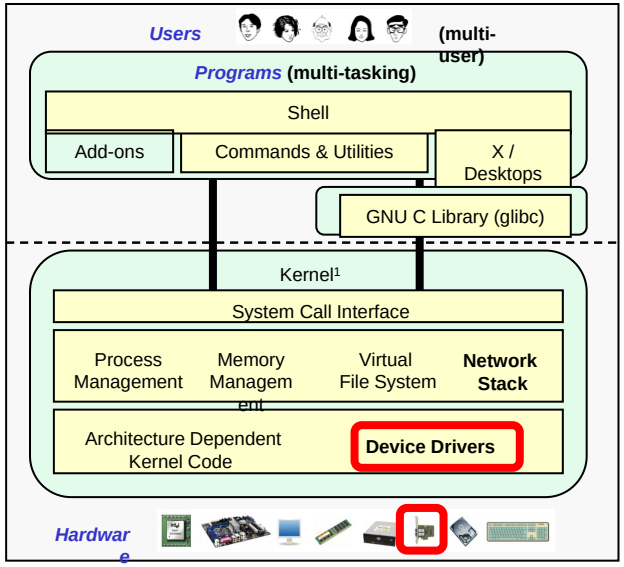
2. **Locate a driver for your NIC**
   - may be already available with your distro
   - may be available from NIC vendor
   - may be available from chipset vendor
   - may have get source and build (compile) it

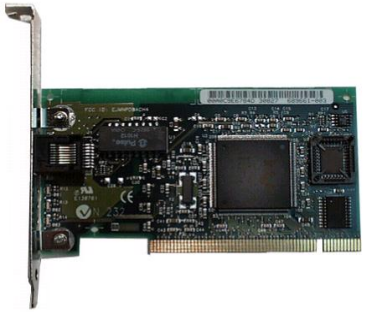
3. Load the driver (**insmod** or **modprobe** command)

4. Bring up and configure the interface (ifconfig)

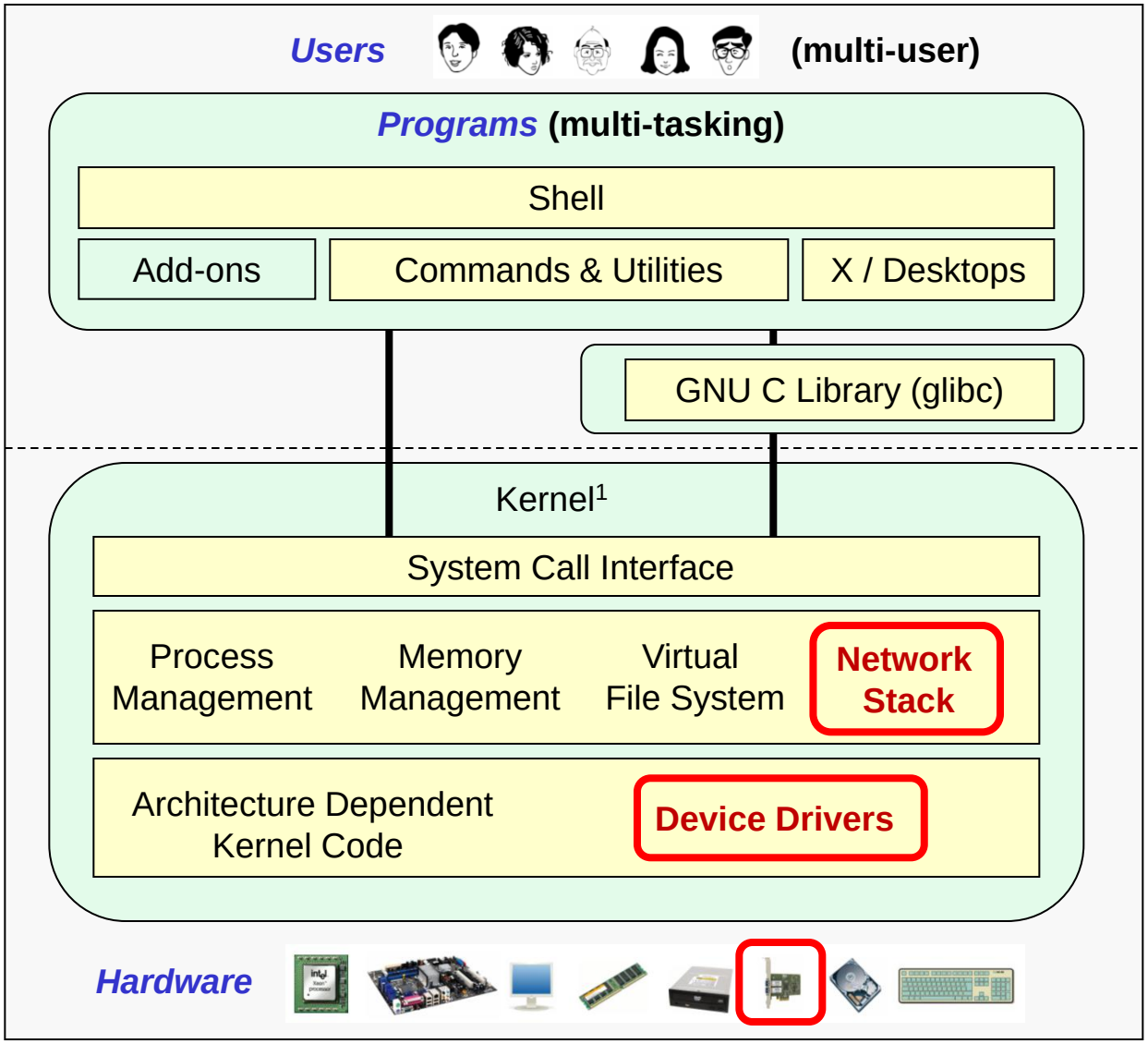
New commands for your toolbox

`lspci -k` *List the Ethernet controllers (and other devices) including names of kernel drivers*





What is a NIC driver?

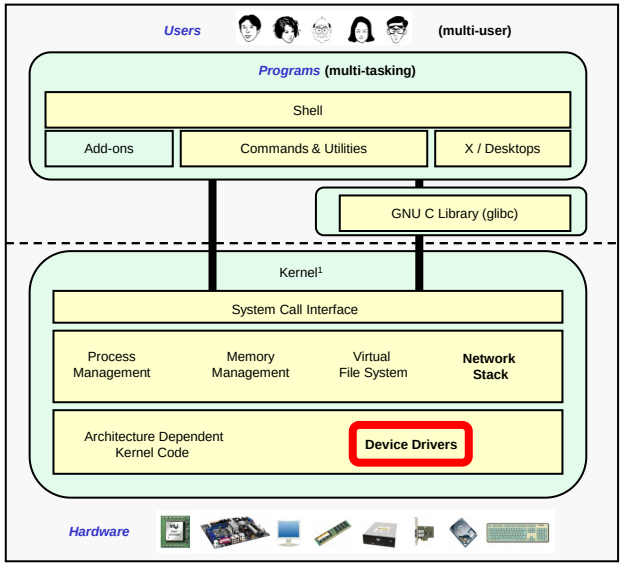


The network stack is implemented in the Linux kernel

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

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

NIC Drivers



- The Linux kernel requires a specific driver to correctly use a specific vendors NIC hardware.
- Linux NIC drivers are implemented as **dynamic kernel modules**.
- Getting the right Linux driver for your NIC can be **problematic:**

  ☺ Newer distributions are able to probe NIC hardware and automatically install the correct driver if they can recognize the NIC.

  ☹ An older distribution may not recognize a newer NIC and you will have to manually locate, sometimes compile and install the correct NIC driver.

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

The NIC drivers in your Linux distribution

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

```
[cis192@p03-celebrian ~]$ ls -F /lib/modules/2.6.32-279.el6.x86_64/kernel/drivers/net
3c59x.ko*     dl2k.ko*       mdio.ko*          ppp_synctty.ko*  tehuti.ko*
8139cp.ko*    dnet.ko*       mii.ko*           qla3xxx.ko*      tg3.ko*
8139too.ko*   dummy.ko*      mlx4/             qlcnic/          tlan.ko*
8390.ko*      e1000/         myri10ge/         qlge/            tulip/
acenic.ko*    e1000e/        natsemi.ko*       r6040.ko*        tun.ko*
amd8111e.ko*  e100.ko*       ne2k-pci.ko*      r8169.ko*        typhoon.ko*
atl1c/        enic/          netconsole.ko*    s2io.ko*         usb/
atl1e/        epic100.ko*    netxen/           sc92031.ko*      veth.ko*
atlx/         ethoc.ko*      niu.ko*           sfc/             via-rhine.ko*
b44.ko*       fealnx.ko*     ns83820.ko*       sis190.ko*       via-velocity.ko*
benet/        forcedeth.ko*  pch_gbe/          sis900.ko*       virtio_net.ko*
bna/          ifb.ko*        pcmcia/           skge.ko*         vmxnet3/
bnx2.ko*      igb/           pcnet32.ko*       sky2.ko*         vxge/
bnx2x/        igbvf/         phy/              slhc.ko*         wan/
bonding/      ipg.ko*        ppp_async.ko*     slip.ko*         wimax/
can/          ixgb/          ppp_deflate.ko*   smsc9420.ko*     wireless/
cassini.ko*   ixgbe/         ppp_generic.ko*   starfire.ko*     xen-netfront.ko*
chelsio/      ixgbevf/       ppp_mppe.ko*      sundance.ko*
cnic.ko*      jme.ko*        pppoe.ko*         sungem.ko*
cxgb3/        macvlan.ko*    pppol2tp.ko*      sungem_phy.ko*
cxgb4/        macvtap.ko*    pppox.ko*         sunhme.ko*
[cis192@p03-celebrian ~]$
```

Showing the driver loaded for a NIC

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

Shows the NICs on your system

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

Shows the drivers loaded for the NICs

Some Linux driver families

NIC	Linux Driver
Intel PRO 100 NIC	e100
Intel PRO 1000 NIC	e1000
D-Link NICs with RealTek 8129/8139 chipsets	8139too
3Com 3c905x NICs	3c59x
Lite-on Communications LNE 100TX cards with DEC chipsets	tulip
AMD 79c970 NIC	pcnet32

Managing Drivers

(showing, installing, removing)

Connecting your Linux system to the Network

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

2. Locate a driver for your NIC
   - may be already available with your distro
   - may be available from NIC vendor
   - may be available from chipset vendor
   - may have get source and build (compile) it

3. Load the driver (insmod or modprobe command)

4. Bring up and configure the interface (ifconfig)

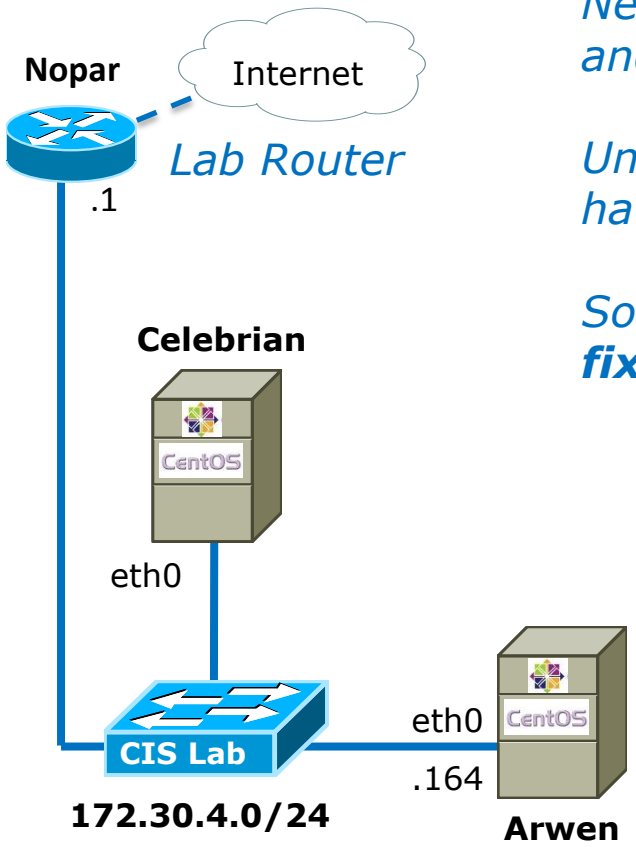
New commands for your toolbox

lsmod	*Show loaded kernel modules including NIC drivers*
rmmod *driver*	*Manually remove (unload) a NIC driver*
insmod *driver*	*To manually insert (load) a NIC driver (old way)*
modprobe *driver*	*To manually insert (load) a NIC driver (better way)*

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

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

Commands for managing NIC drivers



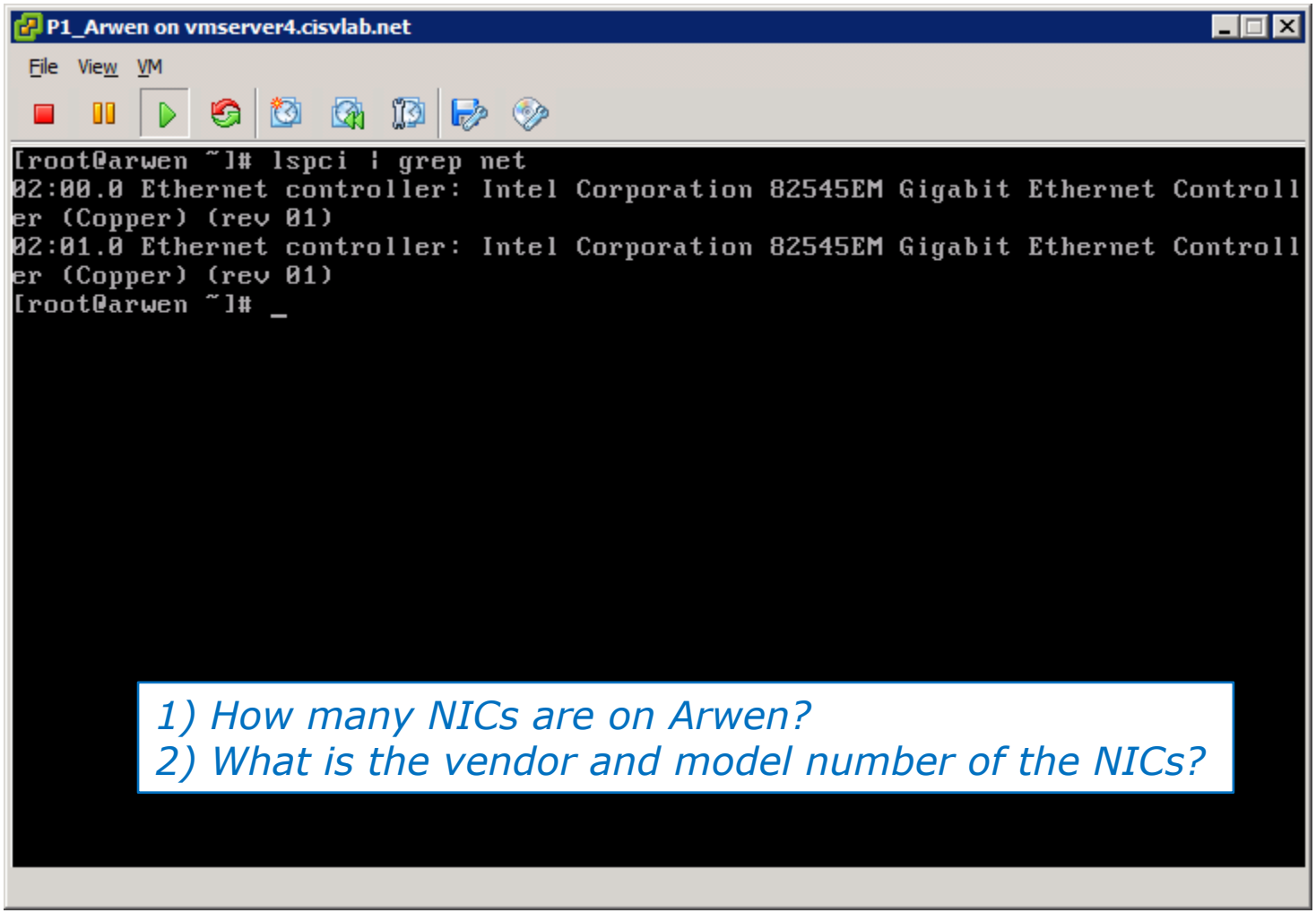
Newer Linux distributions automatically identify and load the correct NIC drivers for most NICs.

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

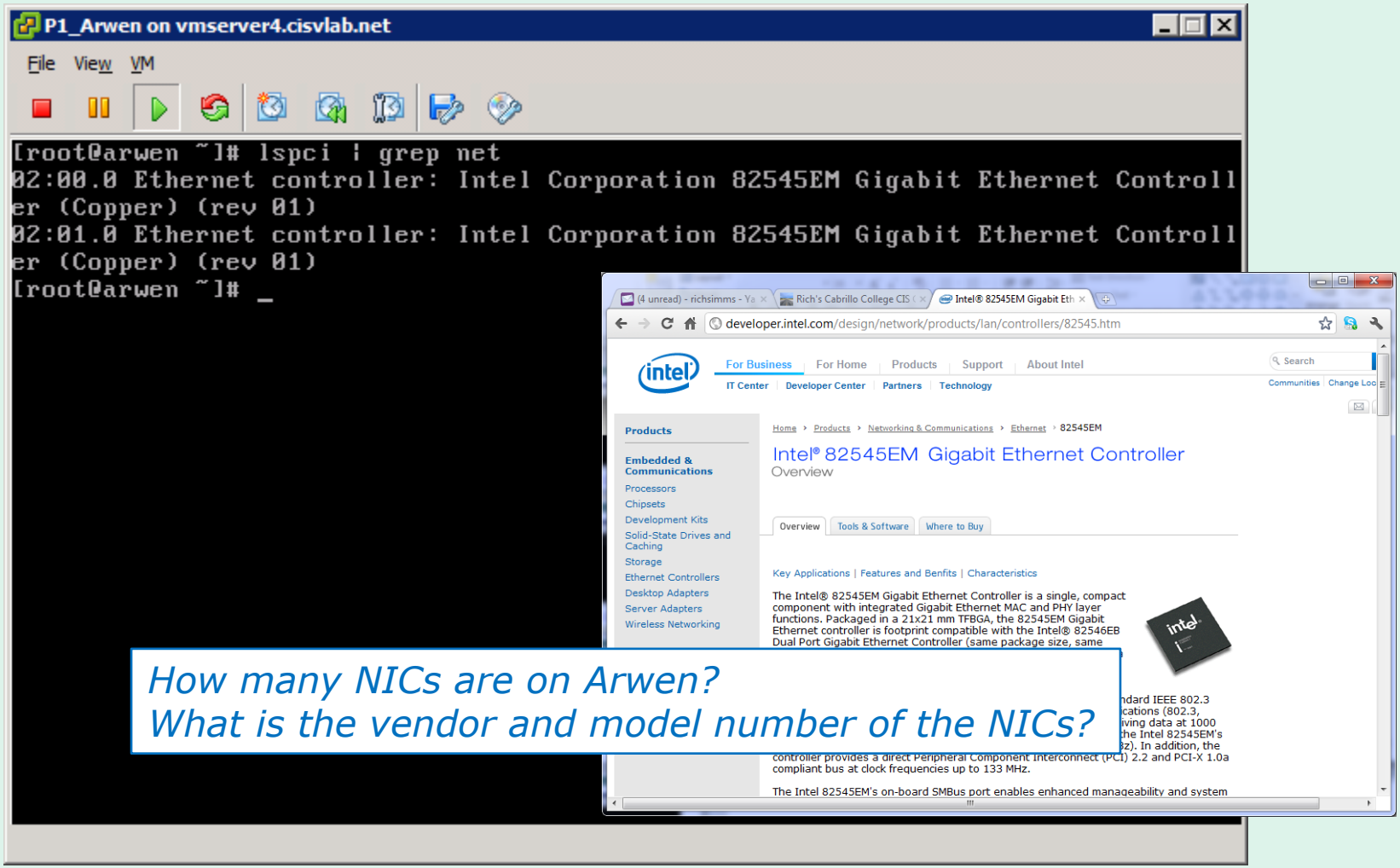
*So let's make a problem by first **breaking**, then **fixing** Arwen using the new commands.*

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

lspci | grep net



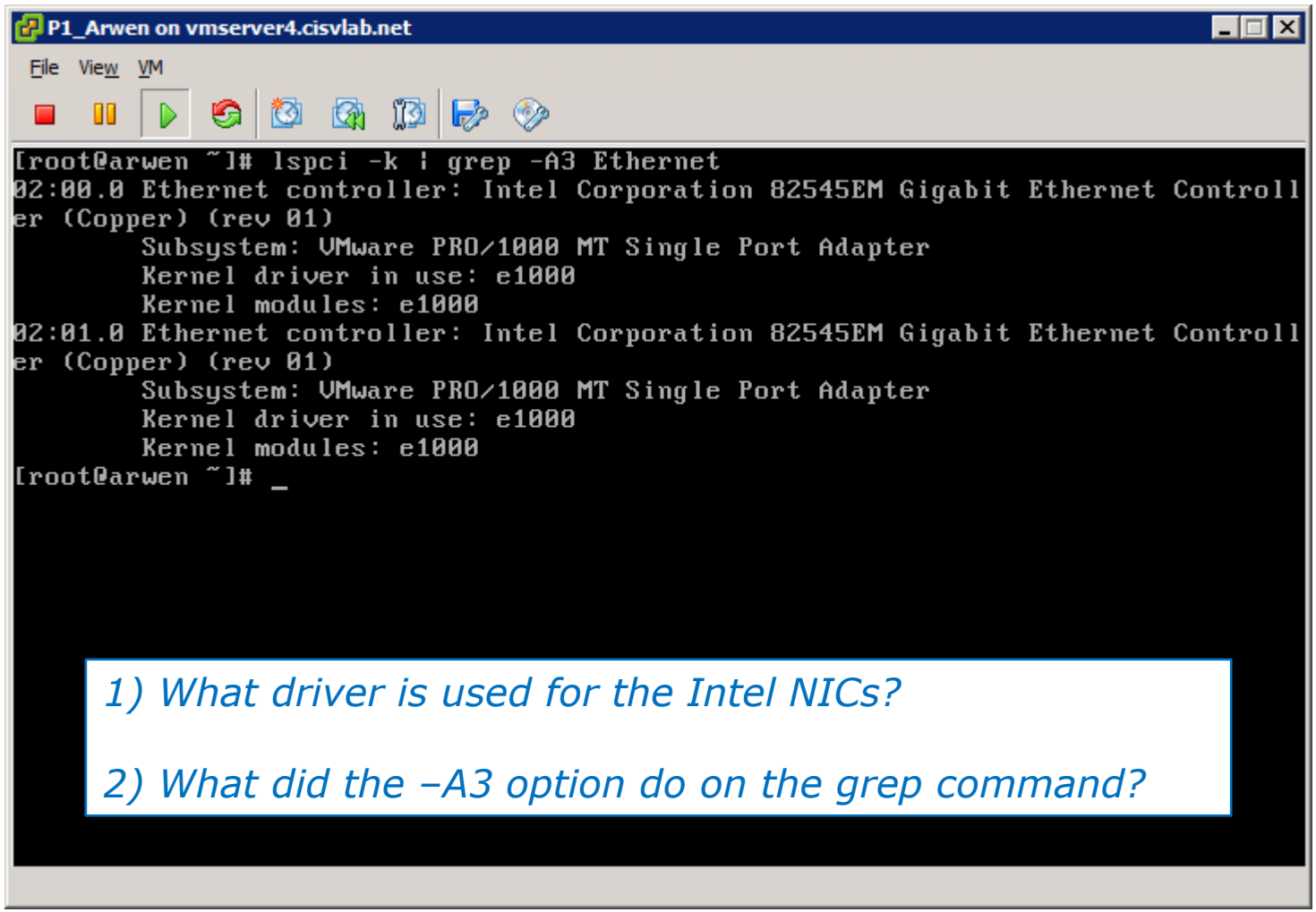
lspci | grep net



Answer 1: ***2***

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

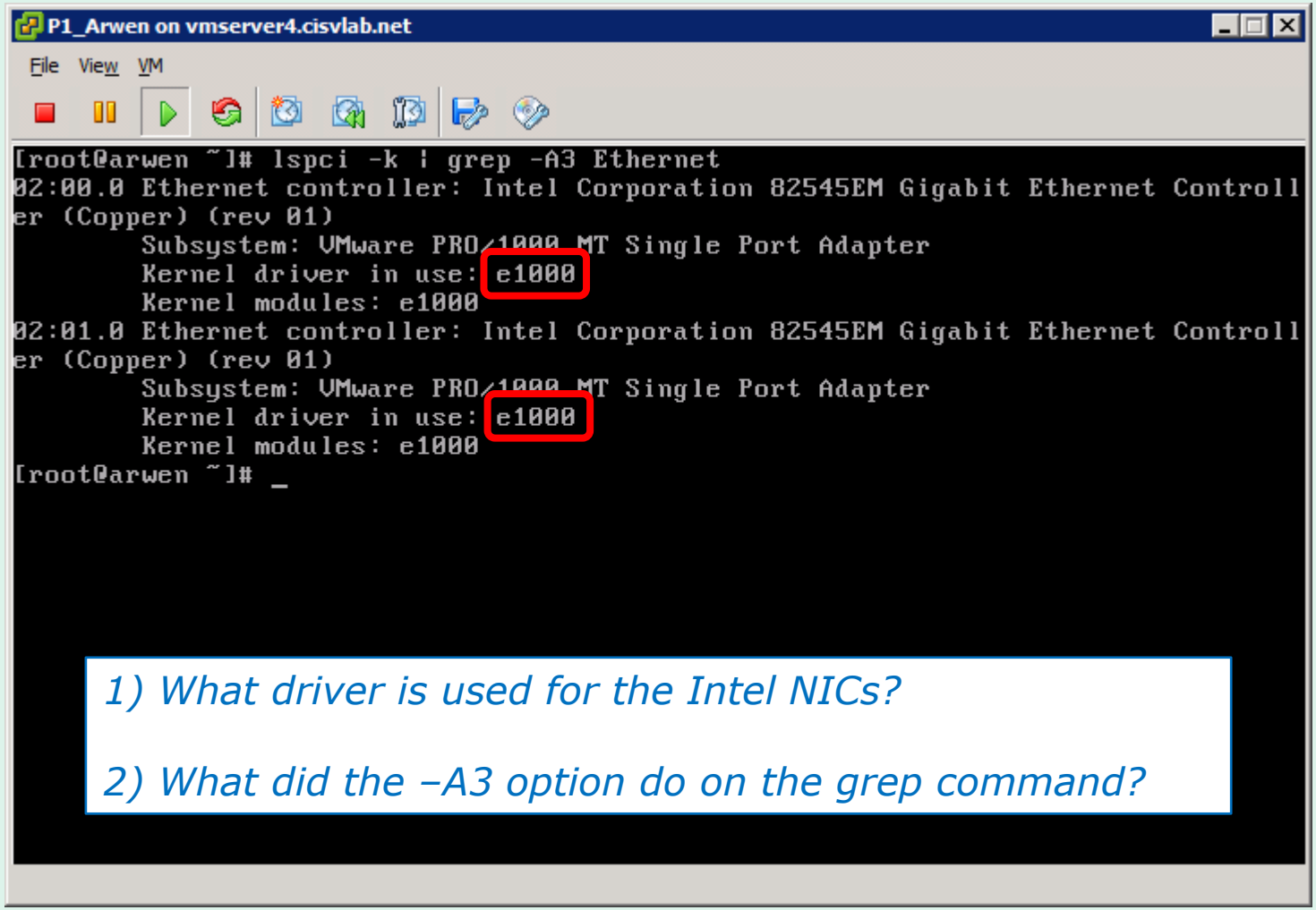
lspci –k | grep –A3 Ethernet



1) What driver is used for the Intel NICs?

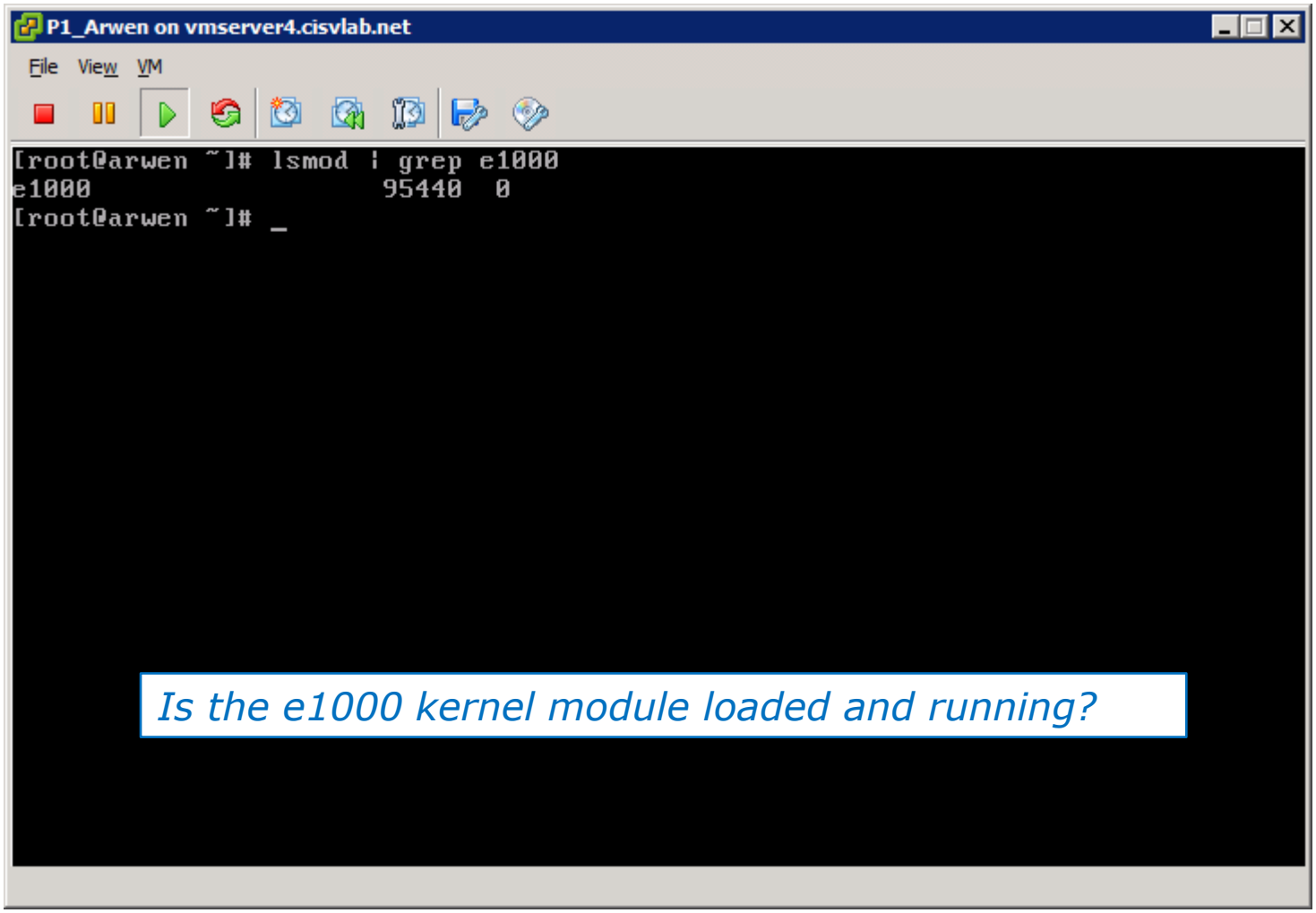
2) What did the –A3 option do on the grep command?

lspci –k | grep –A3 Ethernet

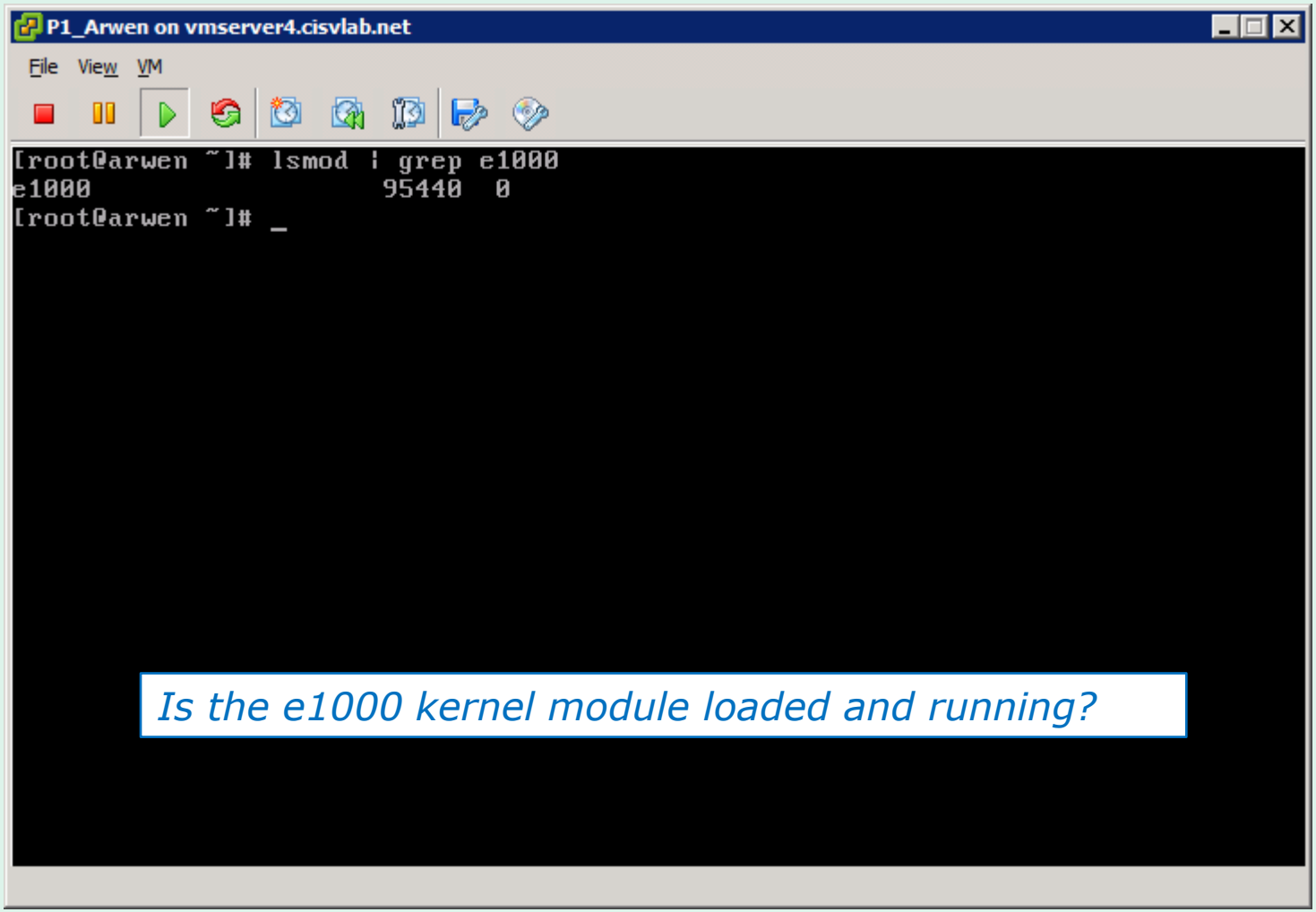


Answer 1: ***e1000***
Answer 2: ***prints the matching line and the 3 lines after it***

lsmod | grep e1000



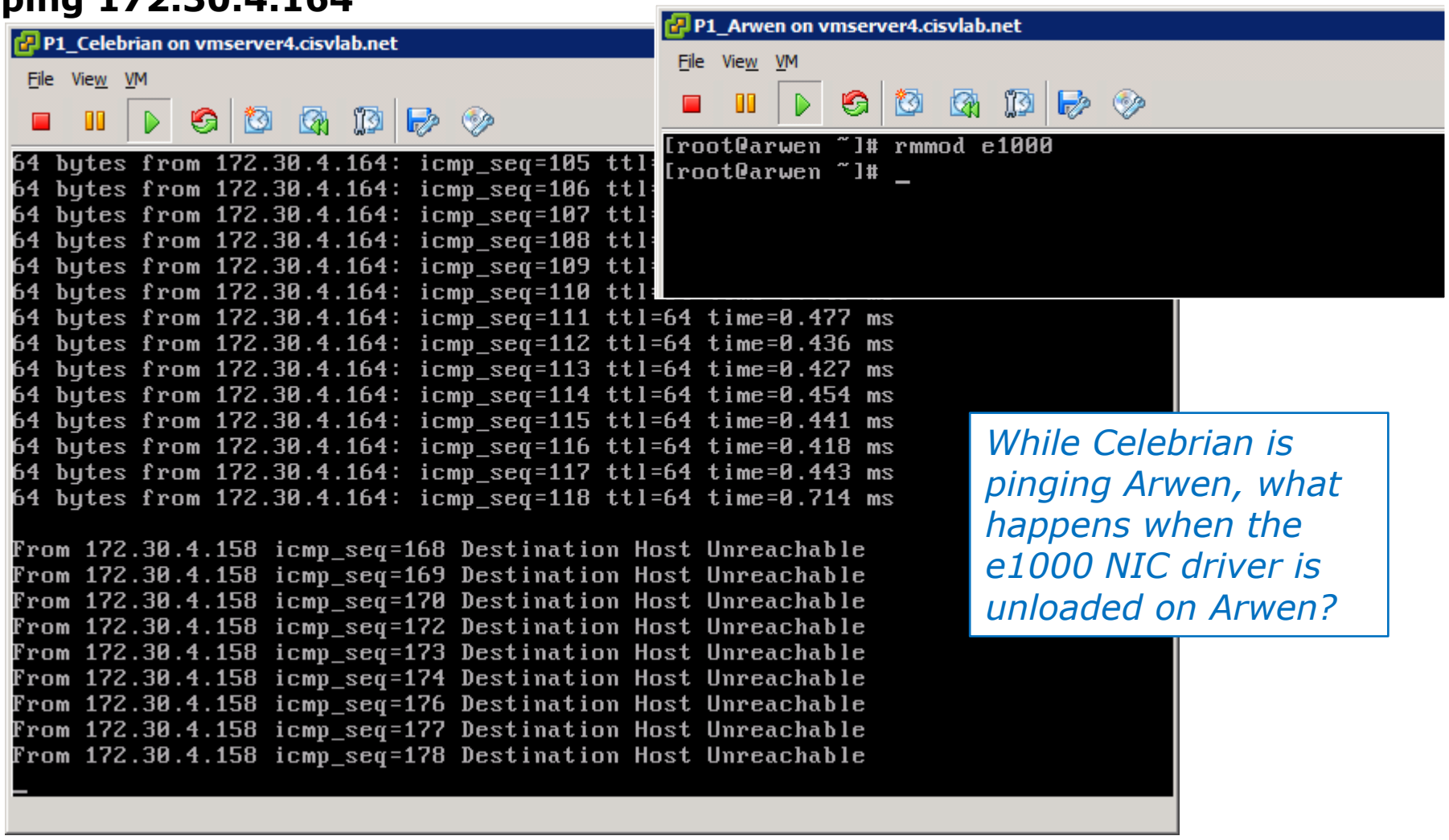
lsmod | grep e1000



Answer: ***Yes***

On Celebrian
ping 172.30.4.164

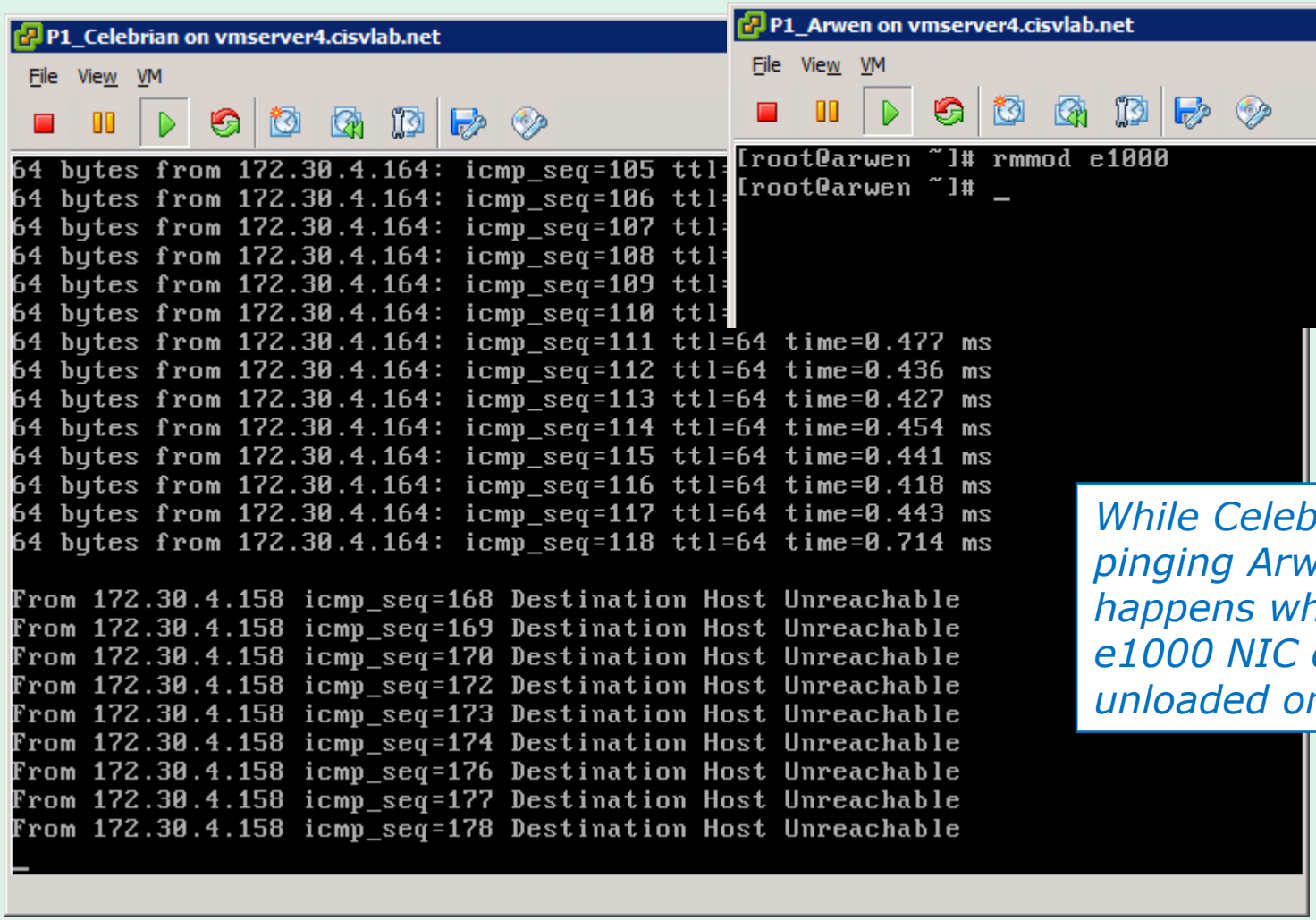
On Arwen
rmmod e1000



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

On Celebrian
ping 172.30.4.164

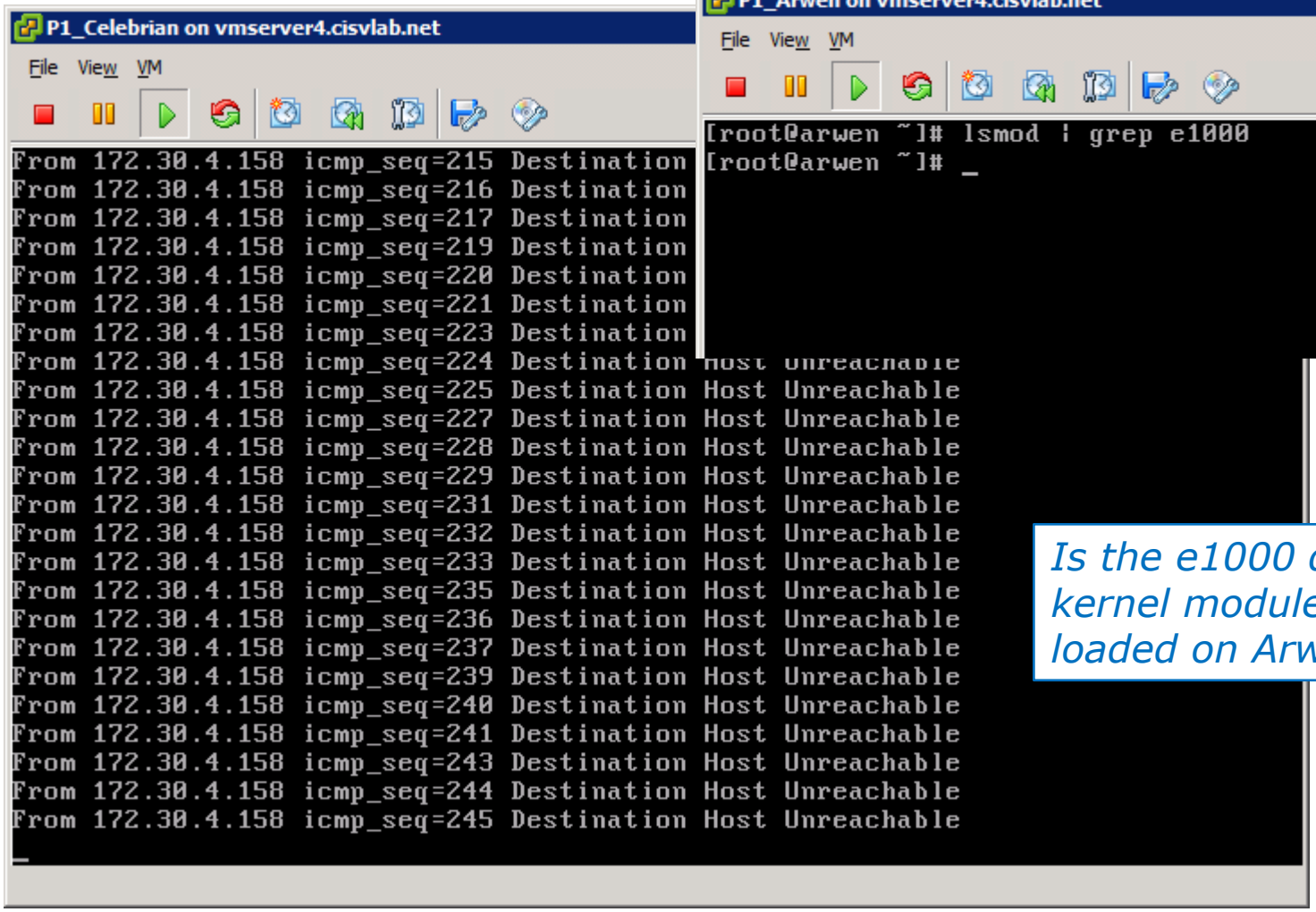
On Arwen
rmmod e1000



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

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

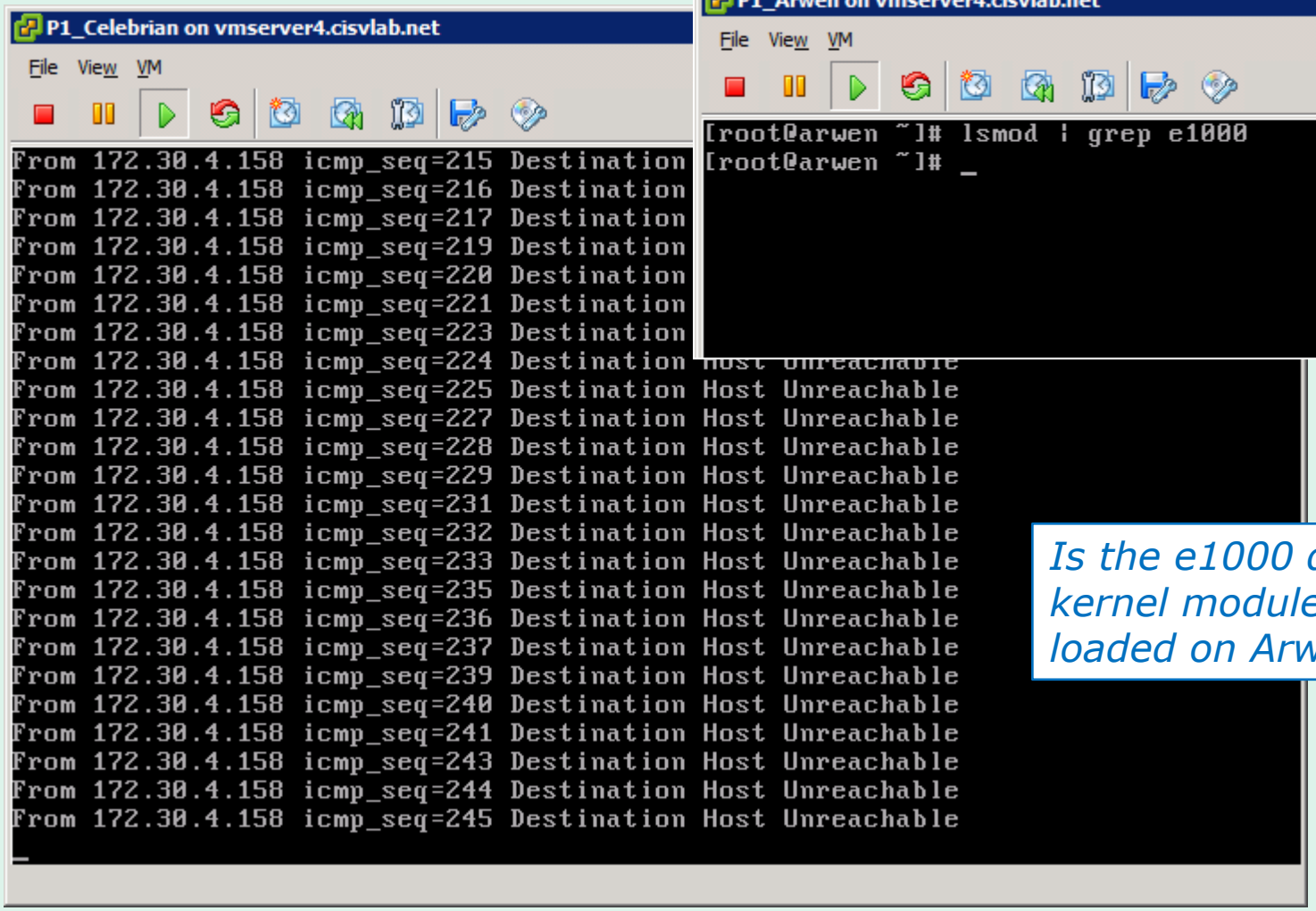
On Celebrian
ping 172.30.4.164



On Arwen
lsmod | grep e1000

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

On Celebrian
ping 172.30.4.164

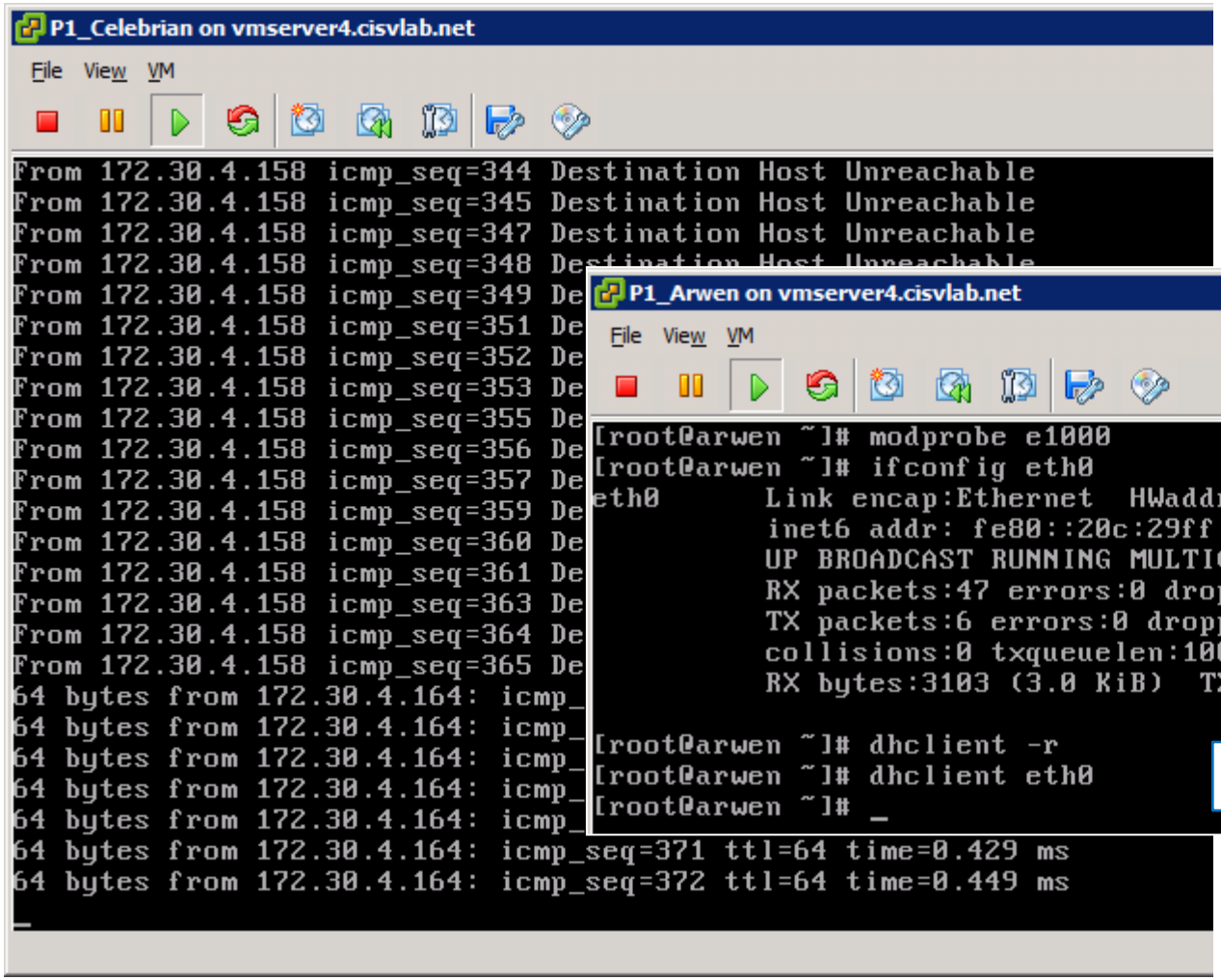


On Arwen
lsmod | grep e1000

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

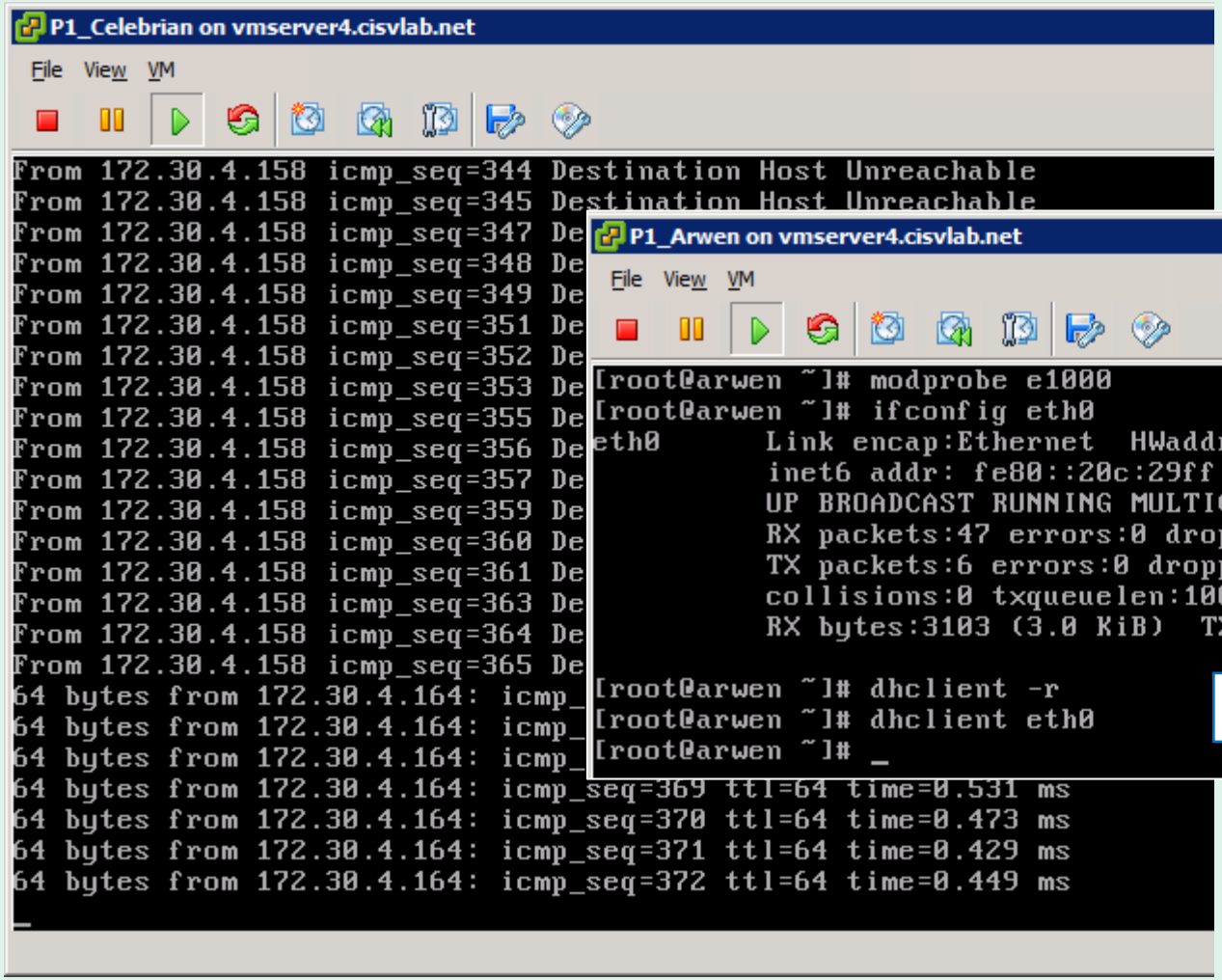
Answer: ***No***

On Celebrian
ping 172.30.4.164



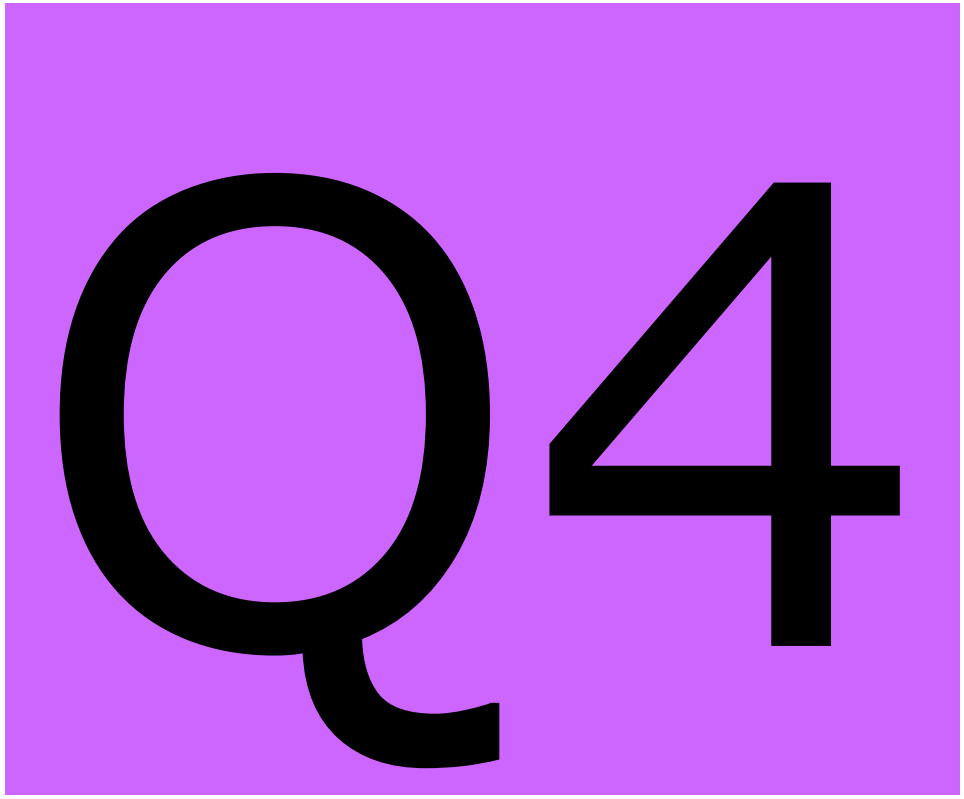
On Arwen:
modprobe e1000
ifconfig eth0
dhclient –r
dhclient eth0

On Celebrian
ping 172.30.4.164



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

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


Q4

Interface Configuration

Connecting your Linux system to the Network

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

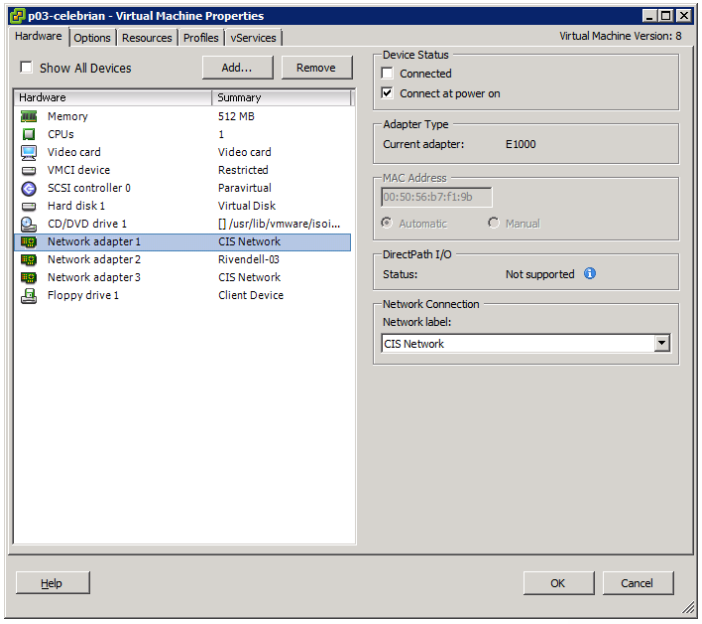
2. Locate a driver for your NIC
   - may be already available with your distro
   - may be available from NIC vendor
   - may be available from chipset vendor
   - may have get source and build (compile) it

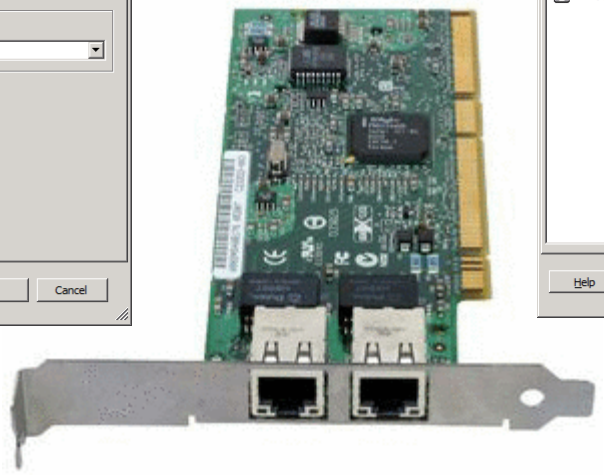
3. Load the driver (insmod or modprobe command)

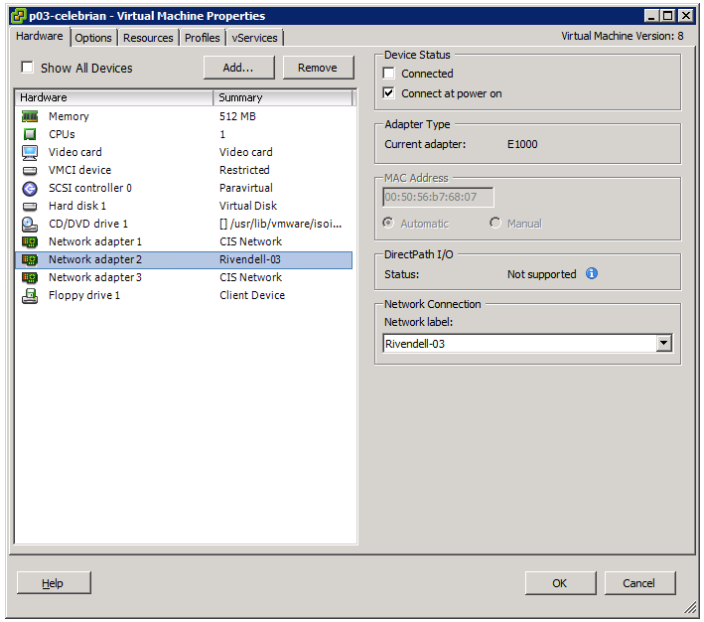
4. **Bring up and configure the interface (ifconfig)**

Configuring a static IP address with ifconfig

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





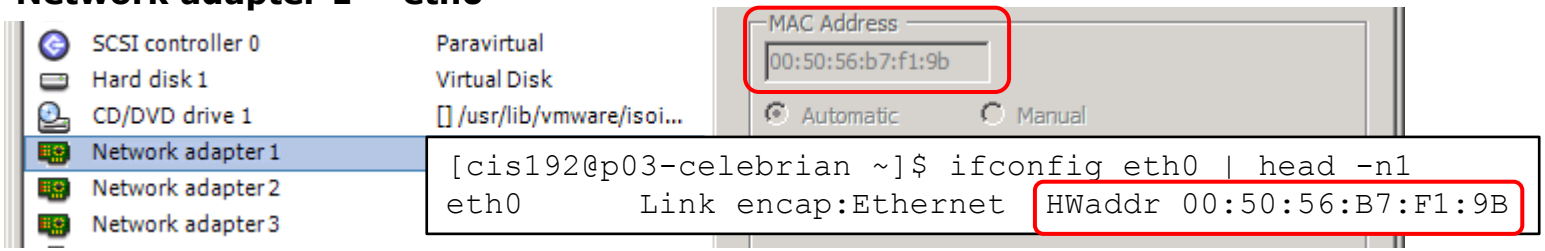


Network adapter 1 = eth0 Network adapter 2 = eth1

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

MAC addresses

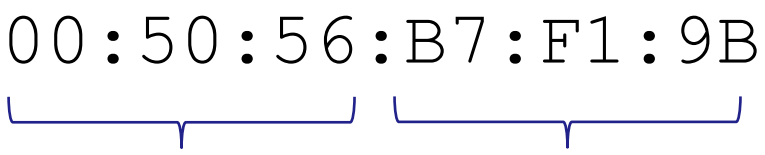
Network adapter 1 = eth0



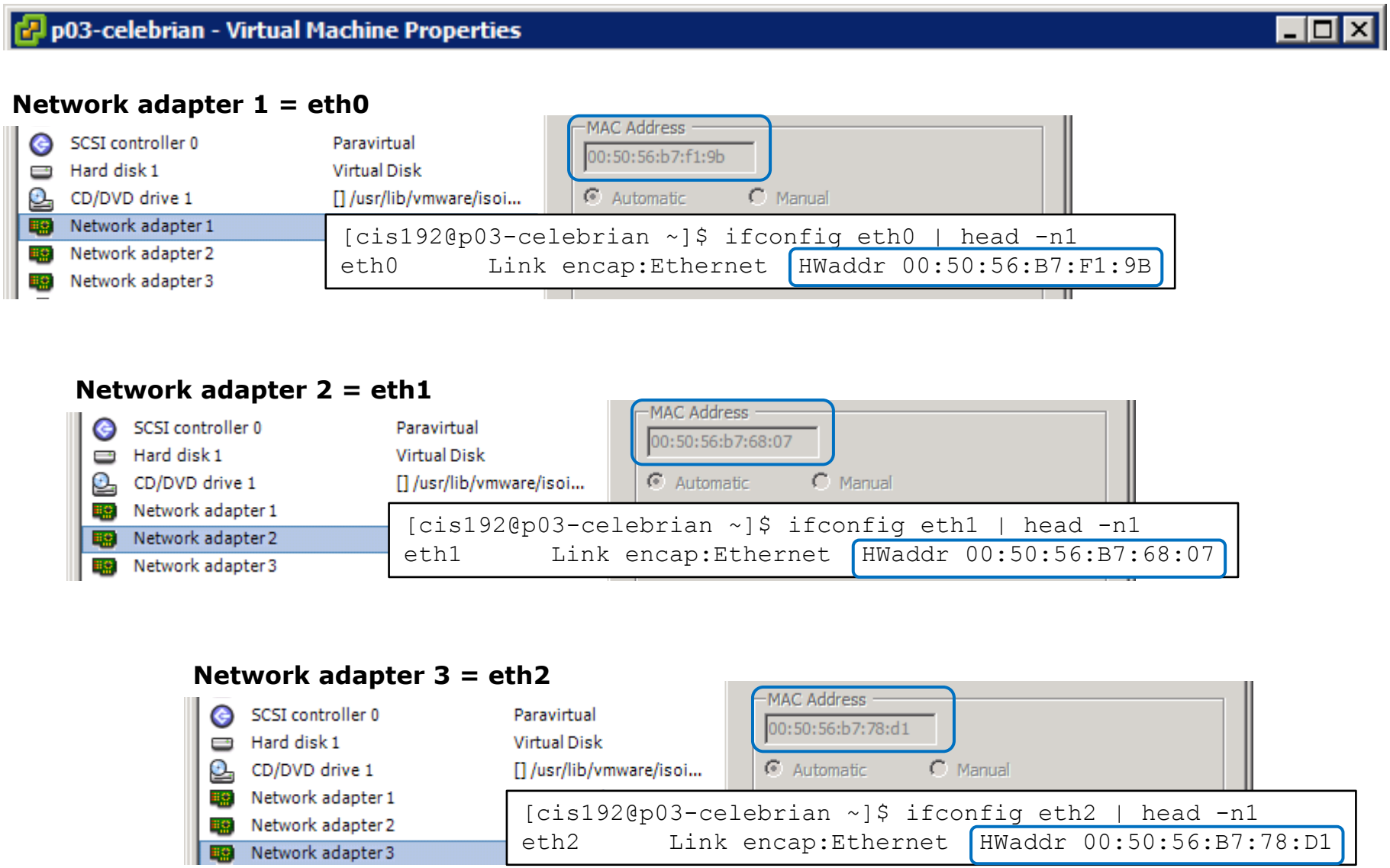
Every NIC has a unique MAC address.

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

Example MAC address



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



Showing how the VMware Network adapters correspond to Linux Ethernet interfaces

Network connectivity via DHCP

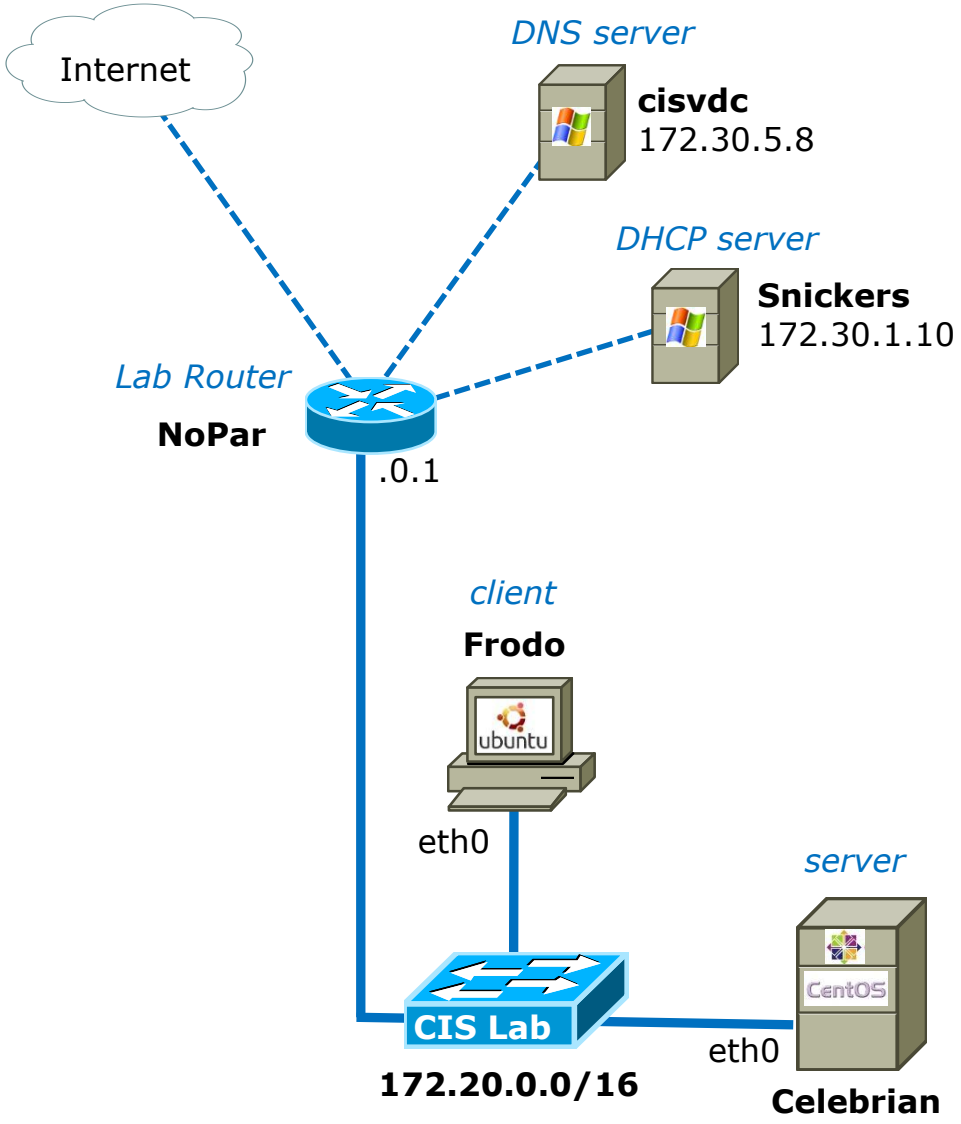
New commands for your toolbox

To obtain and release IP address:

`dhclient ethn`	*To request an IP address for an interface*
`dhclient -v ethn`	*Same but shows the addressed obtained*
`dhclient -r ethn`	*To release the IP address*
`tail /var/log/messages`	*To view related log messages*

To show network configuration:

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



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

Snickers *is a DHCP server in the 2501 closet*

- *It manages a pool of addresses (172.30.1.150 to 172.30.1.199) for room 2501.*
- *It also manages a different pool of addresses (172.20.4.11 to 172.20.9.254) for the systems in the CIS Lab.*

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

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

Check network connectivity status

Frodo

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

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

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

route -n *shows the default gateway is 172.20.0.1*

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

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

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

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

ping 172.20.0.1 -c2 *shows we have segment connectivity*

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

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

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

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

Celebrian

Check network connectivity status

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

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

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

Celebrian

How to manually obtain an IP address (and more)

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

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

dhclient -v eth0 *obtains an IPv4 address of 172.20.4.14*

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

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

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

route -n *shows the default gateway is 172.20.0.1*

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

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

Celebrian

Verify connectivity

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

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

ping 172.20.0.1 -c2
shows we have segment connectivity

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

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

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

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

Celebrian

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

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

dhclient -r eth0 *releases the IP address*

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

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

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

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

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

route -n *shows an empty routing table*

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

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

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

Celebrian

Check connectivity status

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

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

Celebrian now has no network connectivity

Network connectivity via static IP (temporary)

New commands for your toolbox

ifconfig eth*n* *xxx.xxx.xxx.xxx*/*pp*	*To set an IP address and subnet mask on an interface*
ifconfig eth*n* **down**	*To shut down an interface*
ifconfig eth*n* **up**	*To bring up an interface*

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

Configuring a static IP address with ifconfig

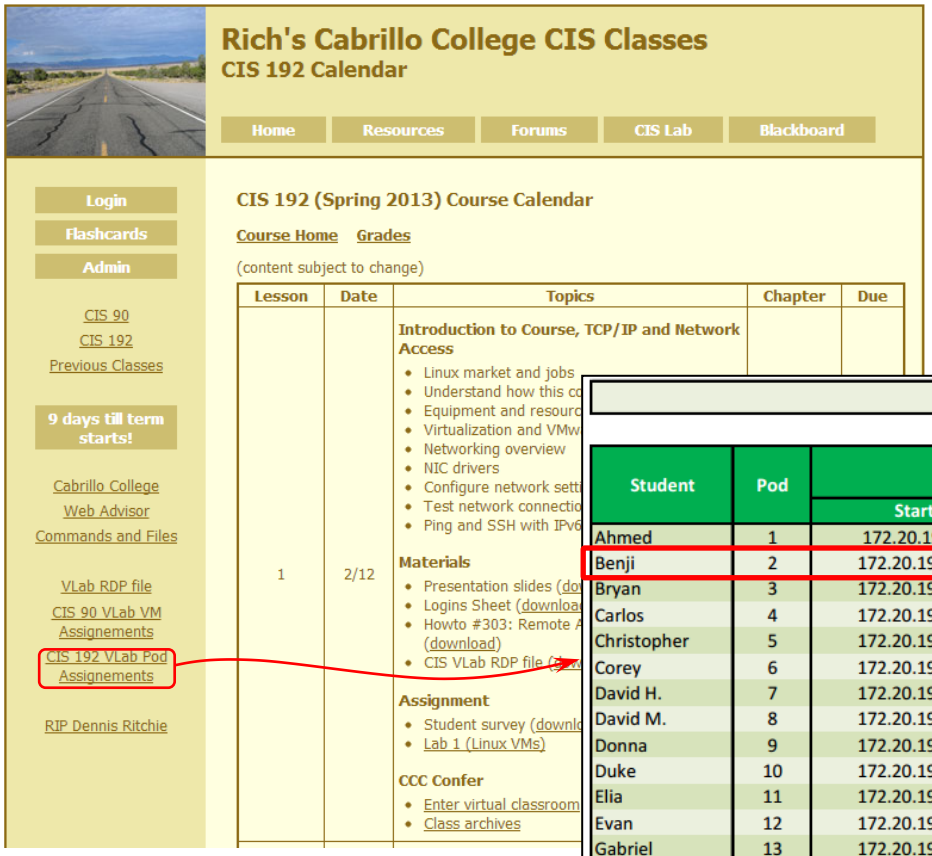
The **ifconfig** command, with no arguments, will list all "up" interfaces

```
[root@p03-celebrian ~]# ifconfig
lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
```

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

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

Select a UNIQUE IPv4 address



Select one of the IP addresses assigned to your pod.

For Benji this would be 172.20.192.14 through 172.20.192.20

CIS 192 VLab Assignments

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

Configuring a static IP address with ifconfig

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

ifconfig eth0 172.20.192.14/16

MAC address

IPv4 address

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

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

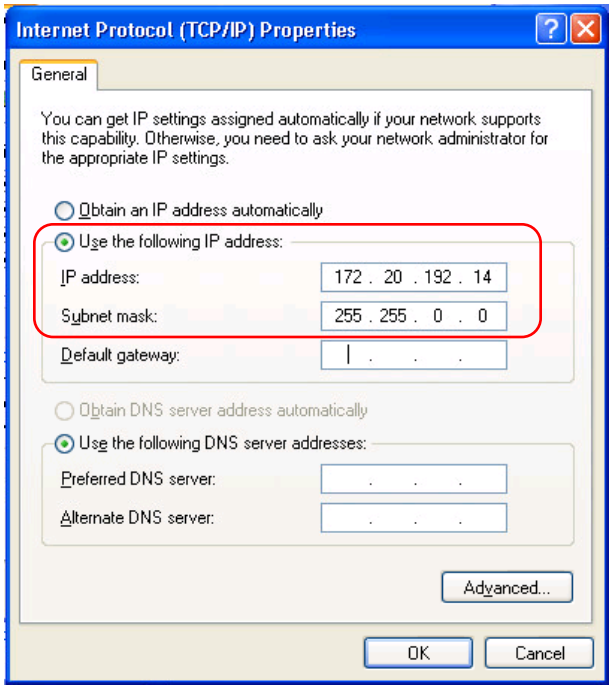
IPv6 link-local address

subnet mask

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

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

Configuring static IP and mask on other planets



Lan Area Connection on Windows XP

One standard …. many implementations!

fa 0/0 on Cisco 2811 router

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa0/0
Router(config-if)#ip add 172.20.192.14 255.255.255.0
Router(config-if)#
```

Caveat: Root's environment has /sbin in path

As root, your path includes /sbin

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

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

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


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

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

Configuring Gateway (temporary)

New commands for your toolbox

route add default gw *xxx.xxx.xxx.xxx*	*To set the default gateway*
route del default gw *xxx.xxx.xxx.xxx*	*To delete the default gateway*

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

Configuring the gateway

To set the default gateway

route add default gw 172.20.0.1
route -n

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

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

The routing table above has two routes:

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

Configuring the gateway

To delete the default gateway

route del default gw 172.20.0.1
route -n

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

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

The routing table above has one route:

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

Configuring DNS name servers

Configuring the gateway and DNS

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

```
search domain
nameserver xxx.xxx.xxx.xxx
nameserver xxx.xxx.xxx.xxx
```

string to append to short hostnames

primary name server

secondary name server (used only if primary is down)

Configuring the gateway and DNS

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

```
search cislab.net
nameserver 172.30.5.8
nameserver 10.240.1.2
```

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

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

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

The 172.30.5.8 is a CIS department DNS nameserver
The 10.240.1.2 is a campus DNS nameserver

Verify your DNS settings

```
[root@p03-celebrian ~]# ping vmserver3 -c2
PING vmserver3.cislab.net (192.168.0.13) 56(84) bytes of data.
64 bytes from vmserver3.cislab.net (192.168.0.13): icmp_seq=1 ttl=62 time=0.624
ms
64 bytes from vmserver3.cislab.net (192.168.0.13): icmp_seq=2 ttl=62 time=0.698
ms

--- vmserver3.cislab.net ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1002ms
rtt min/avg/max/mdev = 0.624/0.661/0.698/0.037 ms
[root@p03-celebrian ~]#
```

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

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

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

Internet hostnames are resolvable

Configuring hostname (temporary)

New commands for your toolbox

hostname	*Shows current hostname*
hostname *name*	*Sets the hostname to a new name*

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

Showing and changing the hostname

Shows the currently configured hostname

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

Sets a new hostname

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

Changes back to the original hostname

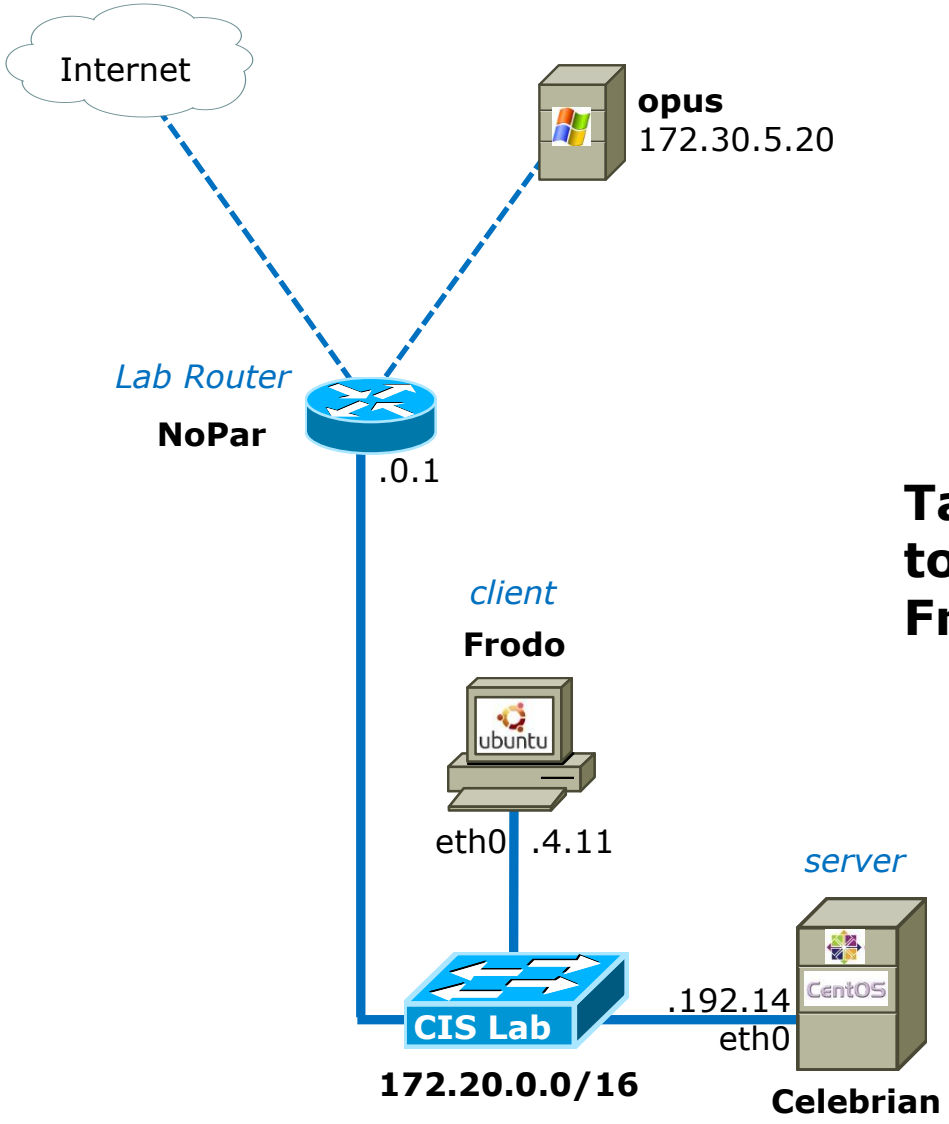
```
[root@p03-celebrian ~]# hostname p03-celebrian.rivendell
[root@p03-celebrian ~]# hostname
p03-celebrian.rivendell
```

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

SSH Hopping

SSH (Secure Shell)

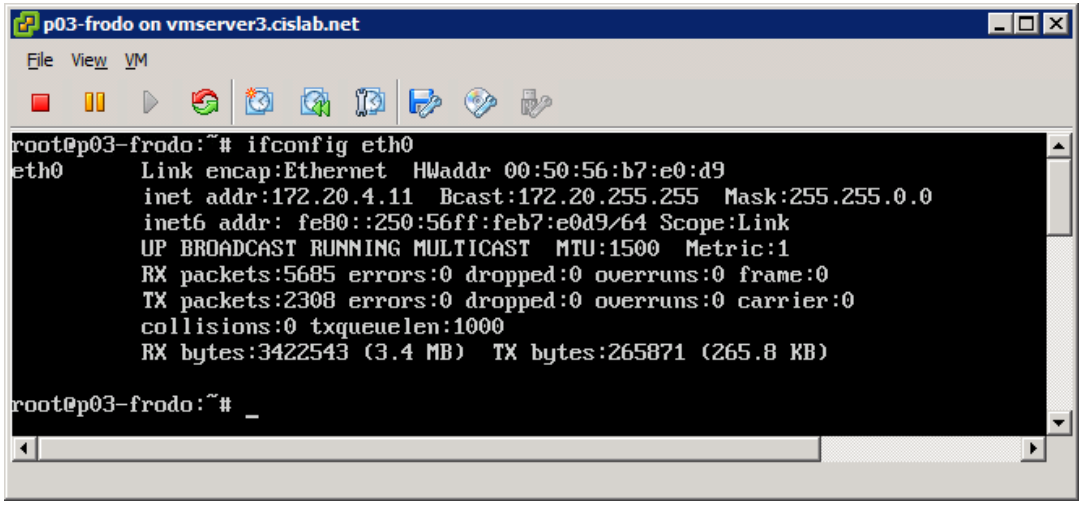
- SSH is a standard network protocol that lets data be exchanged securely (via authentication and encryption) by two computers on a network.
- On Linux and UNIX systems, SSH replaces Telnet for logging into remote system and issuing commands.
- SSH v2 is more secure than SSH v1. It is also incompatible.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



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

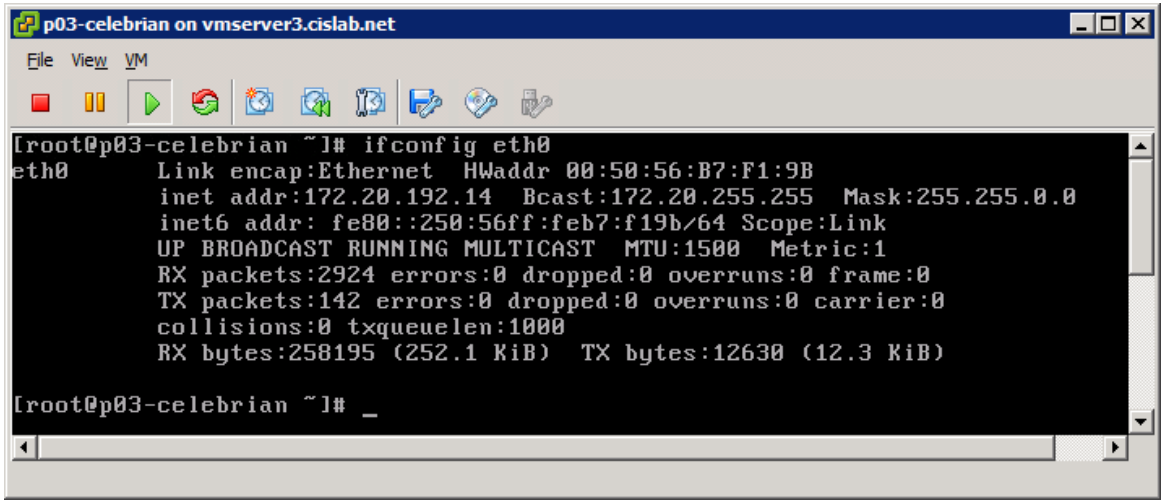
Celebrian *and* ***Frodo*** *in Pod 3 have joined the CIS Lab network and shown in the diagram.*

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

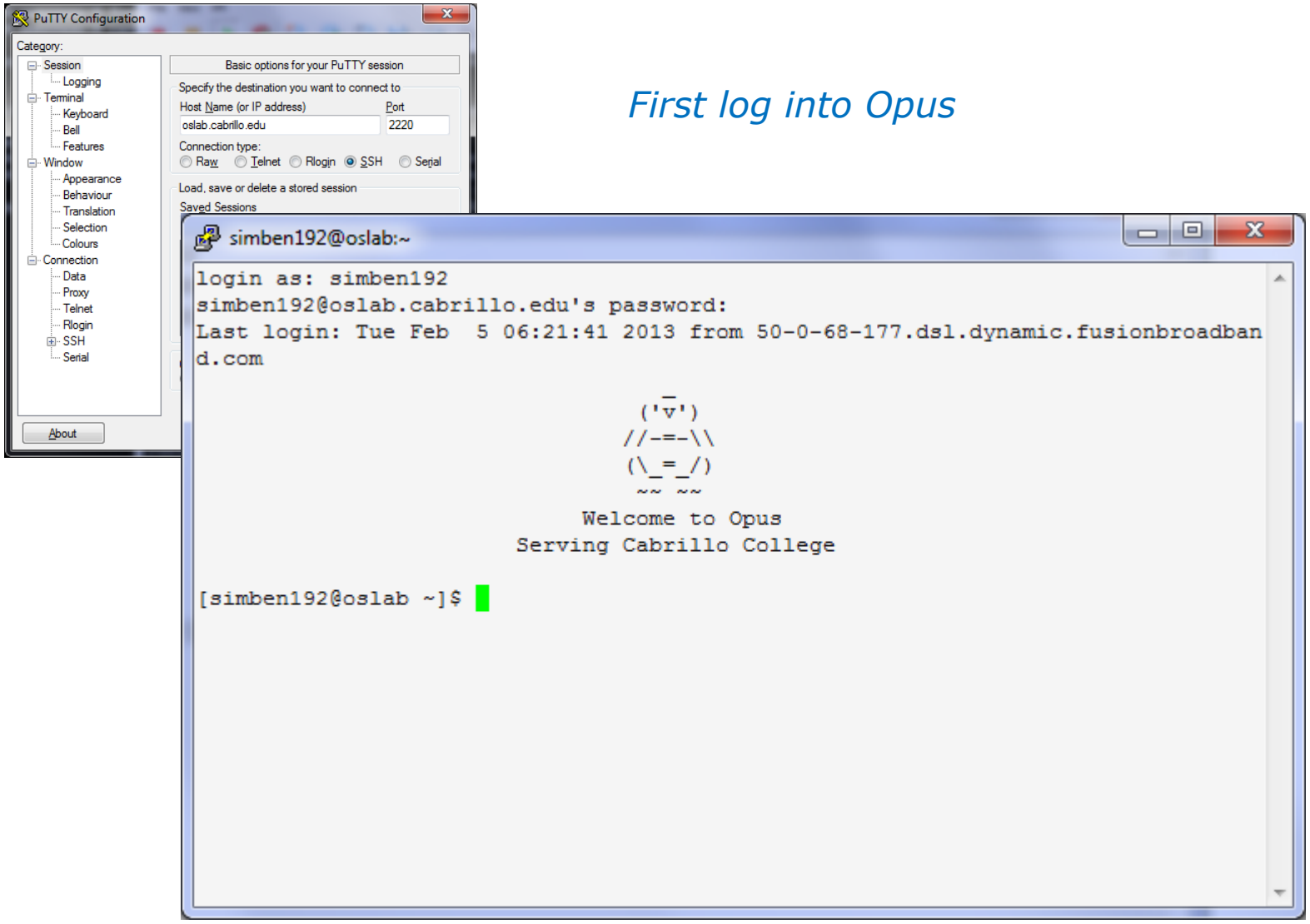


Frodo: 172.20.4.11

In VLab, confirm your IP addresses for Frodo and Celebrian

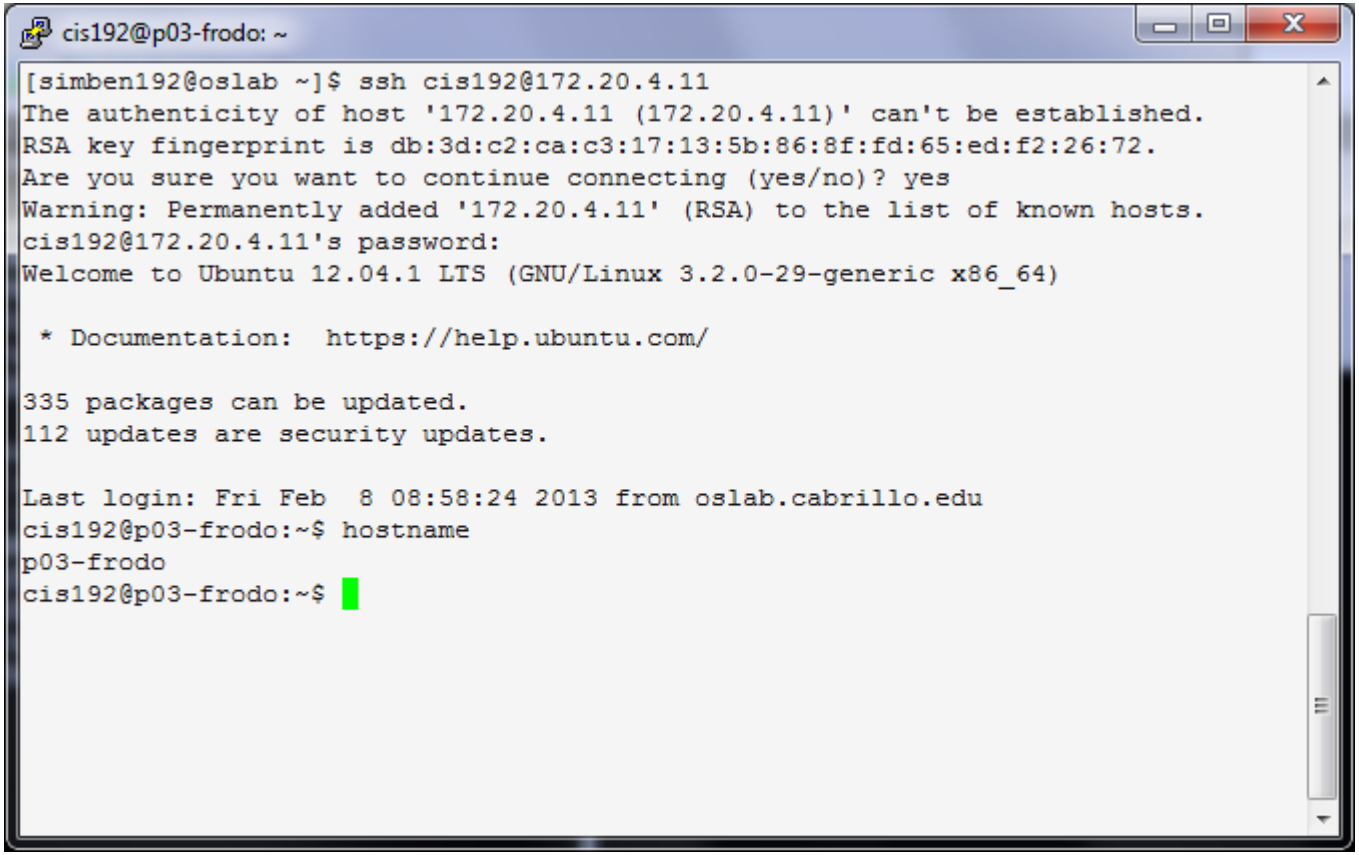


Celebrian: 172.20.192.14

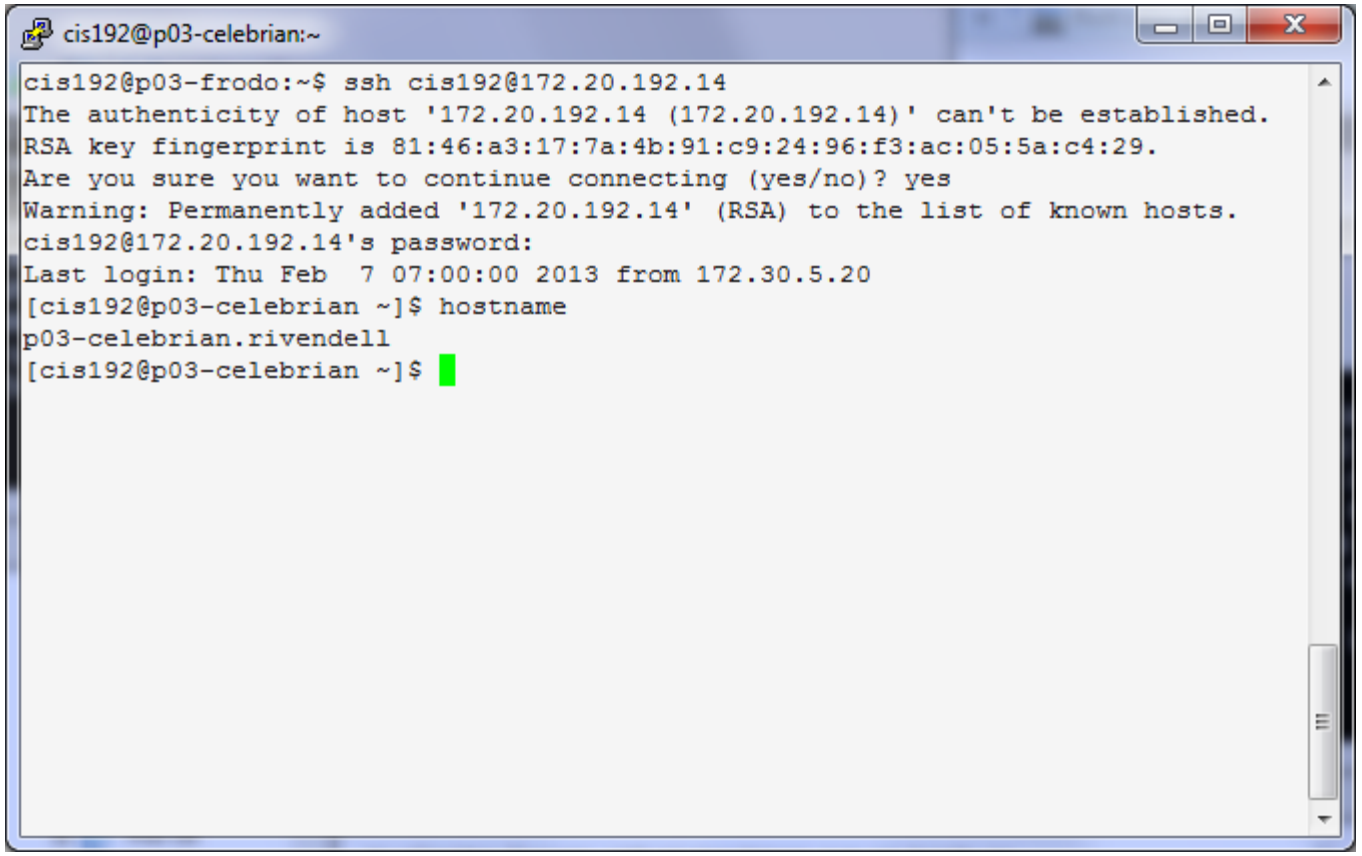


First log into Opus

From Opus, connect to Frodo

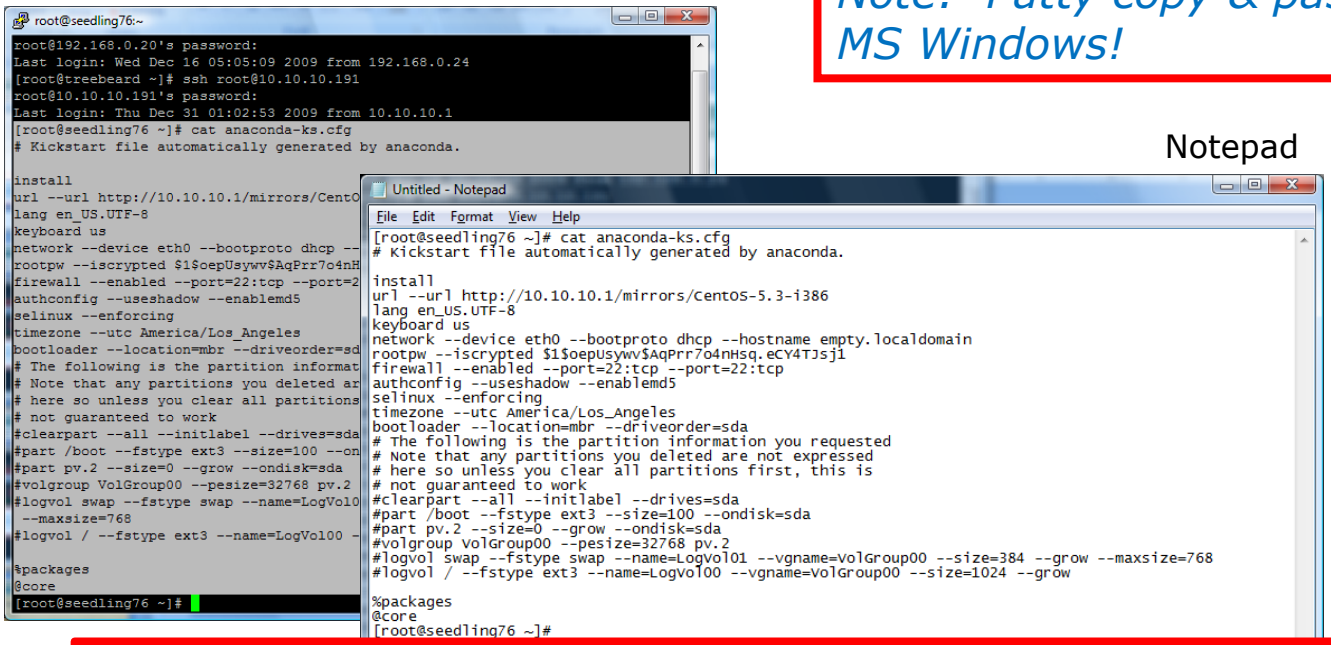


From Frodo, connect to Celebrian



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

Putty



Notepad

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

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

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

Ping testing and troubleshooting

New commands for your toolbox

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

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

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

Reach another host on the same segment?

Ping the lab router

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

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

Reach another host on the same segment?

Ping the lab router

ping 172.20.0.1

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

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

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

Reach another host on the same segment?

Ping another VM

ping 172.20.4.14

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

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

Reach another host on the same segment?

Ping another VM

ping 172.20.4.14

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

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

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

Reach a host on another network?

Ping the CIS department DNS server

ping 172.30.5.8

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

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

Reach a host on another network?

Ping the CIS department DNS server

ping 172.30.5.8

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

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

Reach a host on the Internet?

Ping Google

ping google.com

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

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

Reach a host on the Internet?

Ping Google

ping google.com

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

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

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

Ping Output

TTL (Time To Live)

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

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

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

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

RTT (Round Trip Time)

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

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

- RTT = Round Trip Time
- Measured in milliseconds

Long RTTs can indicate slow links and network congestion

Packet Loss

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

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

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

Command Line Sniffing

New commands for your toolbox

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

`tcpdump -n arp or ip and not port 22`

No DNS lookups, show only arp and IP packets and filter out ssh (port 22)

tcpdump is the command-line equivalent of wireshark and quite useful for trouble-shooting.

Celebrian pinging Frodo

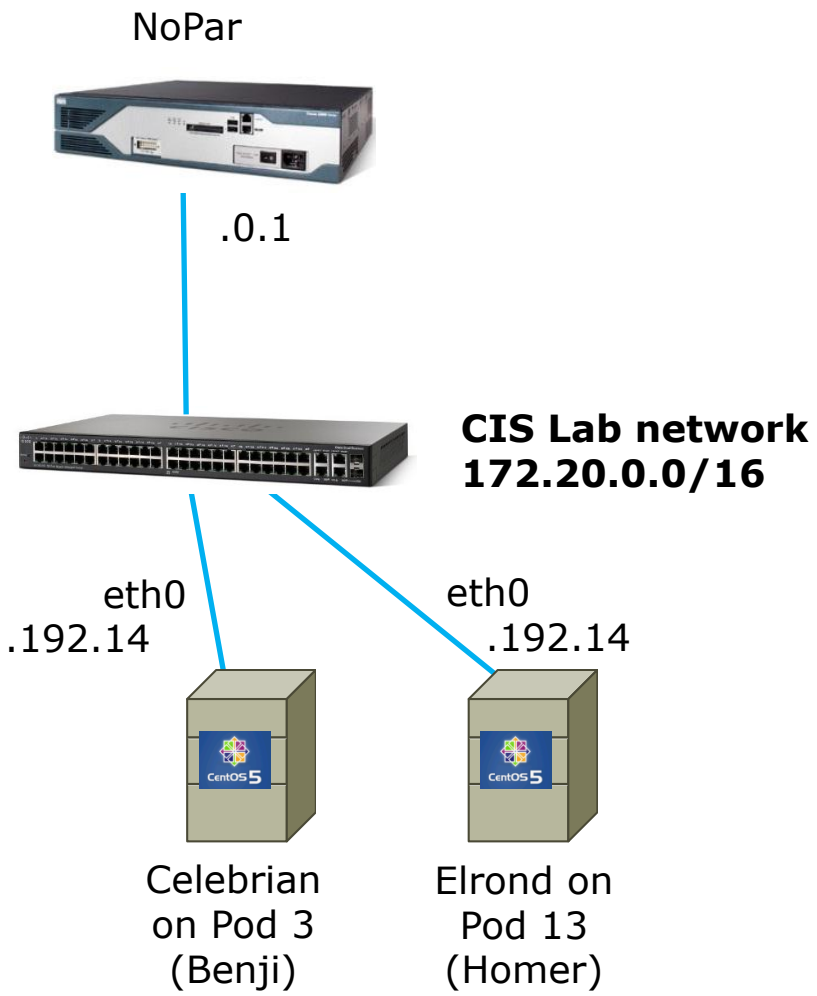
```
[root@p03-celebrian ~]# ping 172.20.4.11 -c2
PING 172.20.4.11 (172.20.4.11) 56(84) bytes of data.
64 bytes from 172.20.4.11: icmp_seq=1 ttl=64 time=1.65 ms
64 bytes from 172.20.4.11: icmp_seq=2 ttl=64 time=0.423 ms

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

Frodo getting pinged by Celebrian

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

Dup IPs

Duplicate IP addresses = TROUBLE !!



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

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

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

Duplicate IP addresses = TROUBLE !!

Celebrian

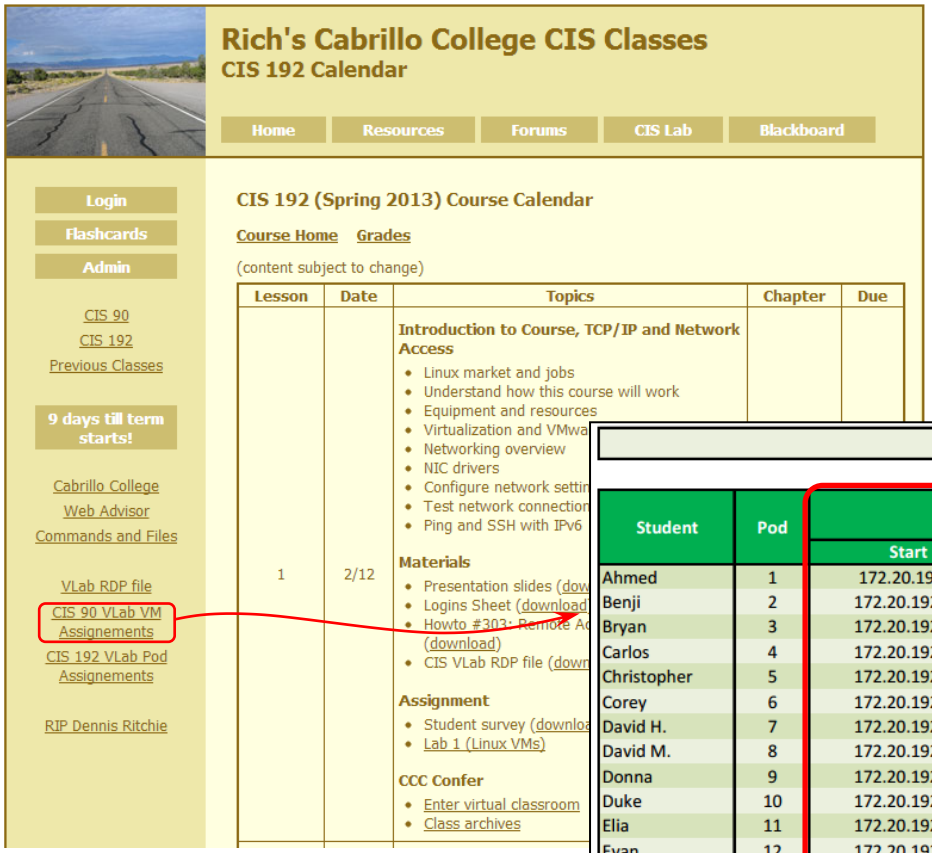
```
64 bytes from 172.20.0.1: icmp_seq=50133 ttl=255 time=0.443 ms
64 bytes from 172.20.0.1: icmp_seq=50134 ttl=255 time=0.430 ms
64 bytes from 172.20.0.1: icmp_seq=50135 ttl=255 time=0.434 ms
64 bytes from 172.20.0.1: icmp_seq=50136 ttl=255 time=0.434 ms
64 bytes from 172.20.0.1: icmp_seq=50137 ttl=255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

Elrond

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

Answer: Both will experience PACKET LOSS !!

Unique IP addresses =

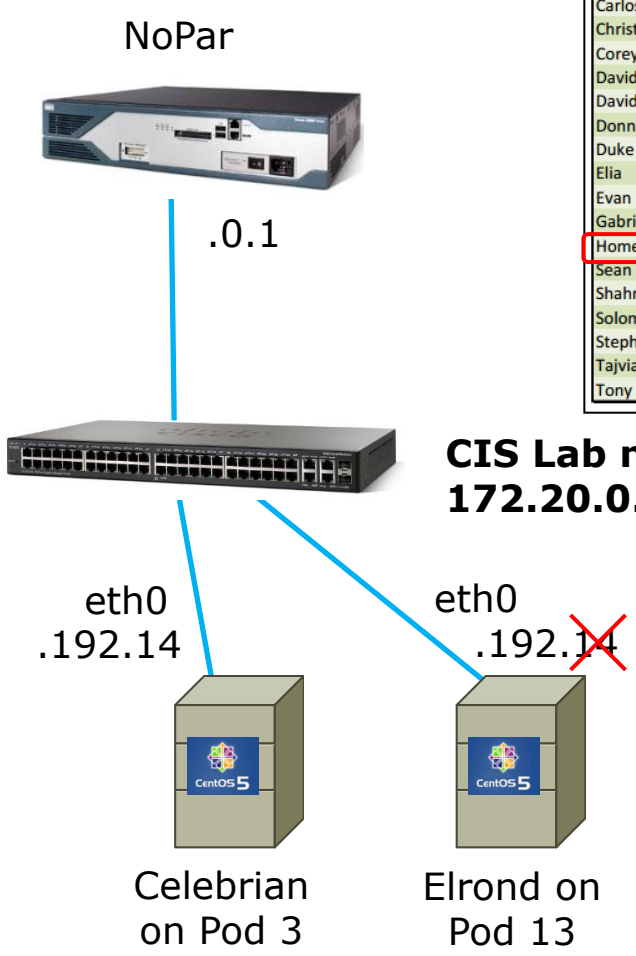


To avoid **TROUBLE**, use the Static IPs link on the website to select IP addresses.

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

CIS 192 VLab Assignments

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



CIS Lab network
172.20.0.0/16

CIS 192 VLab Assignments

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

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

172.20.192.91
172.20.192.92
172.20.192.93
172.20.192.94
172.20.192.95
172.20.192.96
172.20.192.97

ipv6

Using IPv6 addresses in Linux

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

New commands for your toolbox

```
ping6 -I eth0 ff02::1          IPv6 broadcast ping (via eth0)
ping6 -I eth0 2001:470:1f04:9b3::2   Ping an IPv6 address (via eth0)

ping6 ipv6.google.com          Ping an IPv6 hostname
ping6 -c2 ipv6.google.com      Ping an IPv6 hostname, only 2 times
```

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

IPv6 Broadcast Ping

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

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

Using IPv6 addresses in Linux – ping6

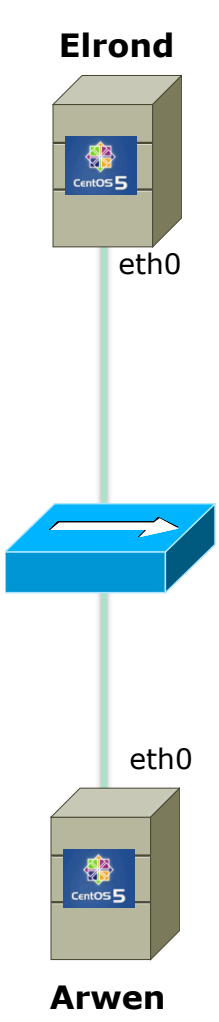

```
root@elrond ~]# ping6 ::1
ING ::1(::1) 56 data bytes
4 bytes from ::1: icmp_seq=0 ttl=64 time=0.330 ms
4 bytes from ::1: icmp_seq=1 ttl=64 time=0.265 ms

-- ::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
ING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
4 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=0.980 ms
4 bytes from 127.0.0.1: icmp_seq=2 ttl=64 time=0.095 ms

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

The first ping uses an IPv6 loopback address.

The second ping uses the traditional IPv4 loopback address.

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

Using IPv6 addresses in Linux – ping6



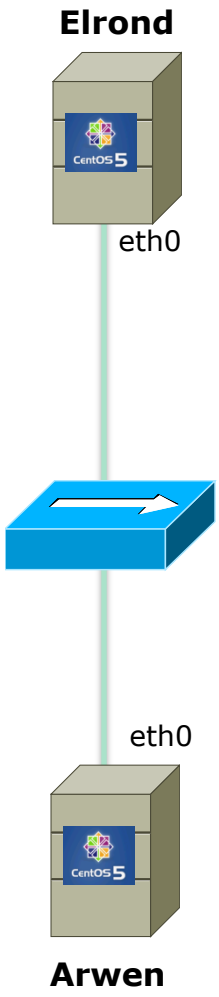

```
[root@elrond ~]# ping6 -I eth0 fe80::20c:29ff:fe4b:f5ce
PING fe80::20c:29ff:fe4b:f5ce(fe80::20c:29ff:fe4b:f5ce) from fe80::20c:29ff:fe68
:3687 eth0: 56 data bytes
64 bytes from fe80::20c:29ff:fe4b:f5ce: icmp_seq=0 ttl=64 time=2.30 ms
64 bytes from fe80::20c:29ff:fe4b:f5ce: icmp_seq=1 ttl=64 time=2.14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

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

Note: the interface must be specified on the ping6 command

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

[root@arwen ~]# _
```

*Use the **ifconfig** command to see what the ipV6 address is*

Using IPv6 addresses in Linux - ssh




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

[root@arwen ~]# _
```

*Use the **ifconfig** command to see what the ipV6 address is*

Class Activity
IPv6

1. Power on **Frodo** and **Celebrian** if they are not on already using two different VMware consoles.

2. Their eth0 NICs should both be connected as **bridged**.

3. On Frodo, ping yourself using the loopback address with **ping6 ::1**

4. On Frodo, discover your IPv6 address using **ifconfig**

5. Position the smaller Celebrian console on top of the Frodo console so you can see Frodo's IPv6 address.

6. On Celebrian use **ping6 –I eth0** <*insert Frodo's IPv6 address*> to ping Frodo using IPv6.

7. On Celebrian use **ssh cis192@**<*insert Frodo's IPv6 address*>**%eth0** and login to Frodo.

TBA Assignment

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

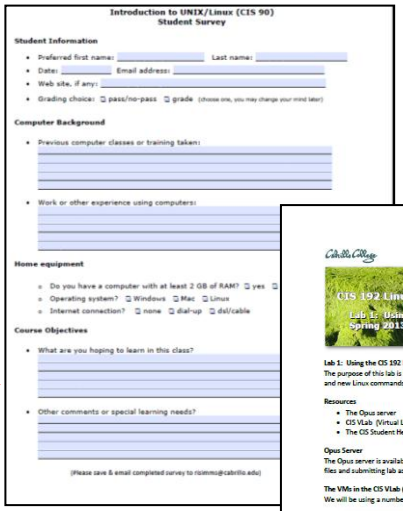
How to use the Calendar web page to get your work in on time

The assignment

The date

What is due on that date

Lesson	Date	Topics	Chapter	Due
1	2/12	**Introduction to Course, TCP/IP and Network Access** • Linux market and jobs • …derstand how this course will work • …ipment and resources • …ualization and VMware 101 skills • Networking overview • NIC drivers • Configure network settings • Test network connections • Ping and SSH with IPv6 **Materials** • Presentation slides (download) • Logins Sheet (download) • Howto #303: Remote Access to the CIS VLab (download) • CIS VLab RDP file (download) **Assignment** • Student survey (download) • Lab 1 (Linux VMs) **CCC Confer** • Enter virtual classroom • Class archives	1.4, 4.3, 12.7, 13.7, 14.1-14.3, 14.10-14.11 16 21.2	
2	2/19	**Quiz 1** **RP an…** • Perm… • Red… • 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** • Presentation slides (download) • IP address exercise (download)	14 21.4 21.5 21.7	Student survey Lab 1

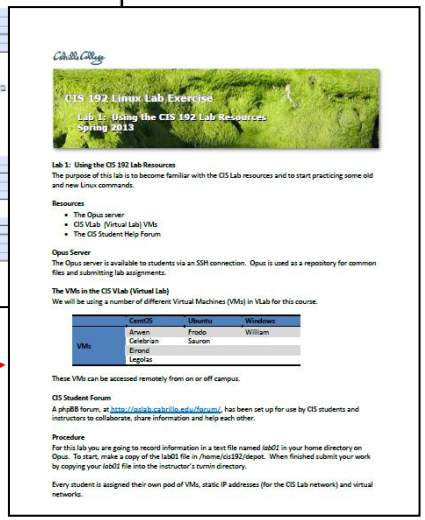

Introduction to UNIX/Linux (CIS 90)
Student Survey

Student Information

Computer Background

Home equipment

Course Objectives


CIS 192 Linux Lab Exercise

Lab 1: Using the CIS 192 Lab Resources

Spring 2013

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

How to submit your work for grading

- For each lab you will create a text file on Opus that gets submitted for grading.
- See the specific submittal instructions at the end of each lab.
- It’s a good idea to verify your copy worked!
- Labs must get turned in by 11:59PM (Opus time) on the due date to get credit.
- Submit as many times as you wish up till the deadline.
- No points for late work. It's better to make a partial submittal before the deadline for partial credit.

How to submit your work for grading

Examples:

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

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

- Check your submittal from Opus:

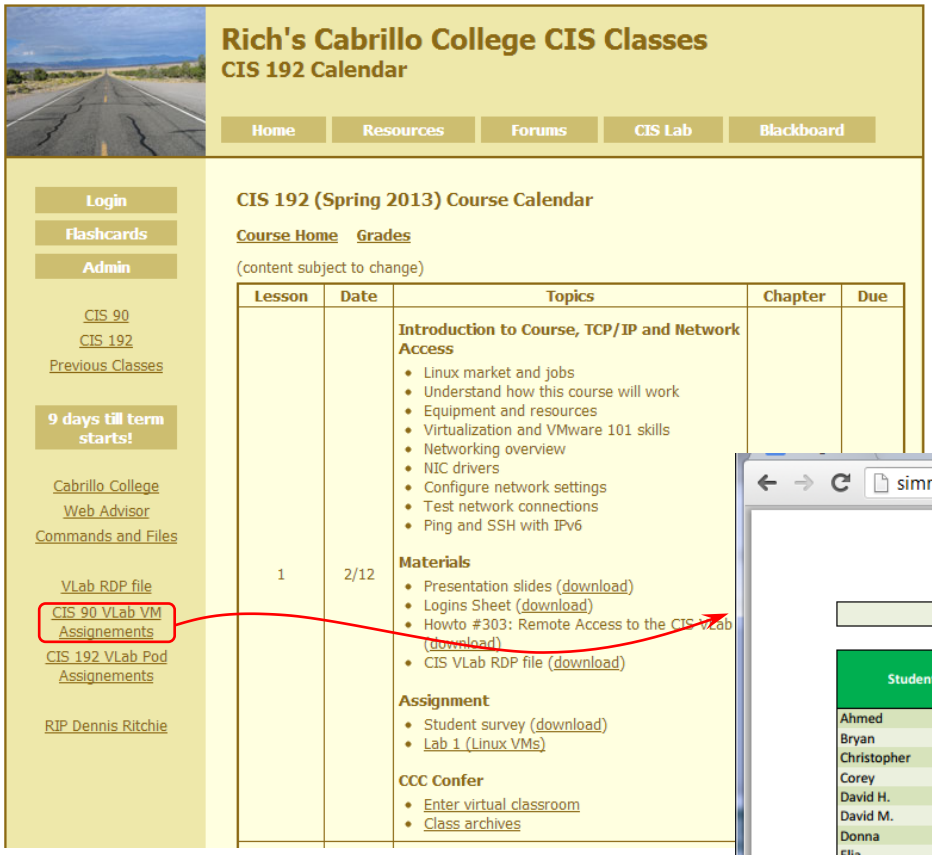
```
[simben192@opus ~]$ ls /home/rsimms/turnin/cis192
lab01.simben192
```

Some troubleshooting tips for doing labs

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

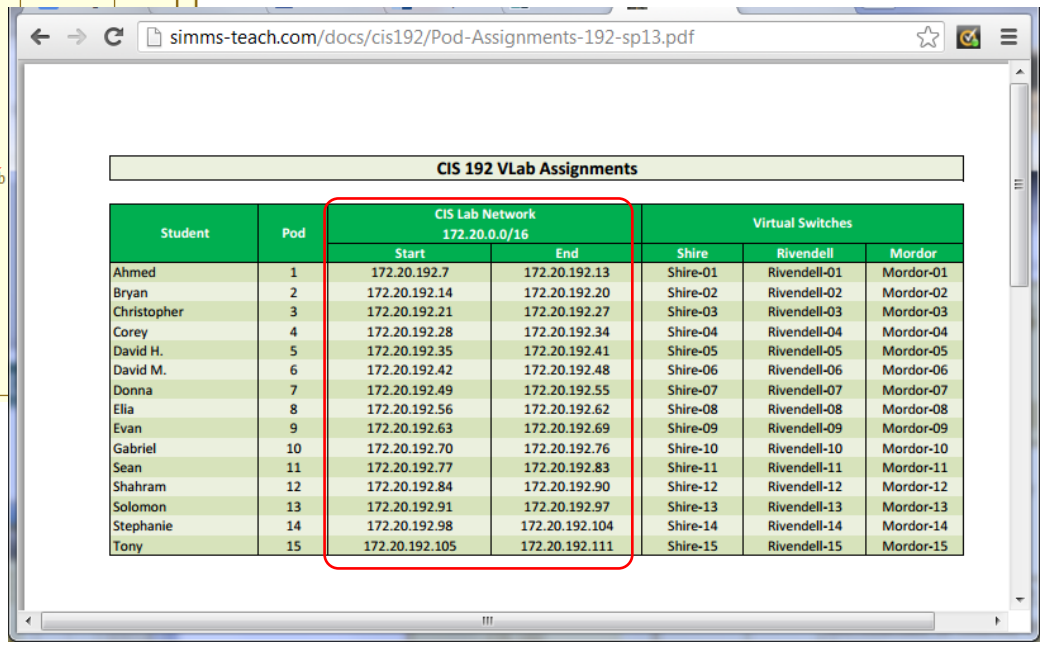
- Use the forum to ask questions and to clarify things.
- Review Lesson PowerPoint's which usually have examples aimed at doing the lab assignments.
- Make a network diagram with all interfaces labeled. Confirm your configuration matches the diagram.
- Go back and methodically verify each step was completed. For example, if you modified /etc/hosts then cat it out and review your changes. If you set the default gateway, use route –n command to verify. If you configured an IP address, use **ifconfig** to verify.
- Google problems or unknown error messages you observe.

Static IP addresses are one click away:



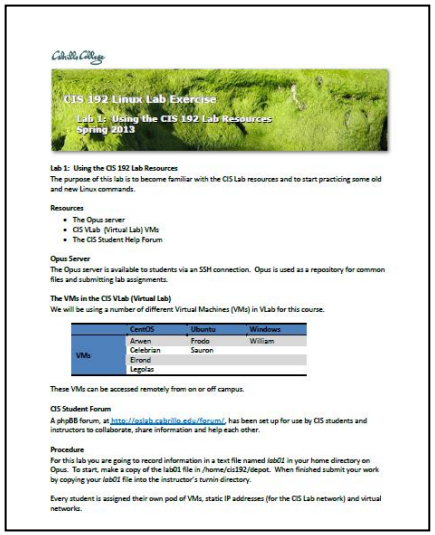
Don't forget!

Don't ruin your day with duplicate IP addresses!



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

Lab Assignments



Cabrillo College

CIS 192 Linux Lab Exercise

Lab 1: Using the CIS 192 Lab Resources
Spring 2013

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

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

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

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

	CentOS	Ubuntu	Windows
VMs	Aniven	Frodo	William
	Celebrian	Sauron	
	Elrond		
	Legolas		

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

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

Procedure
For this lab you are going to record information in a text file named *lab01* in your home directory on Opus. To start, make a copy of the lab01 file in /home/cis192/depot. When finished submit your work by copying your *lab01* file into the instructor's *turnin* directory.

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

Pearls of Wisdom:

- Don't wait till the last minute to start.
- The *slower* you go the *sooner* you will be finished.
- A few minutes reading the forum can save you hour(s).
- Line up materials, references, equipment and software ahead of time.
- It's best if you fully understand each step as you do it. Use Google or refer back to lesson slides to understand the commands you are using.
- Use Google when trouble-shooting
- Keep a growing cheat sheet of commands and examples.
- Partner with another student – "two heads are better than one" (at least most of the time!)
- Use the forum to collaborate and share specific tips you learned while doing a lab.
- Late work is not accepted so submit what you have for partial credit.

Wrap

New commands:

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

New Files and Directories:

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

Next Class

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

Lab 1 & Survey

Quiz questions for next class:

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

Backup