

Computer Networks

COSC 6377

Lecture 1

Spring 2015

January 21, 2015

Course Goals

- Overview of the basics
- Principles and Philosophies
- Read research papers
- Hands-on experience with networked systems

Prerequisites

- Undergraduate level networking/OS course
- Some systems programming
- Familiar with Linux environment
- Access to a Linux environment
 - Use department server
 - Use your own machine

Structure

- Lectures
- Paper discussions
- Homeworks
- Project
- Exams
- Class participation

Homeworks

- 3-4 homeworks
- Concepts
- Calculations
- Some hands-on work
- Allowed to discuss with other students, but you should turn in your own writeup
- Submit through Moodle

Project

- One project with an intermediate checkpoint
- Build a networked system
- Possible to propose your own project
 - Strongly encouraged for PhD students
 - Talk to the instructor

Exams

- No final exam!
- The second exam will cover topics not covered by the first exam
- Open notes
- In-class scheduling

Grades

Exams	40%
Homeworks	15%
Project	40%
Class Participation	5%

- It is possible to get a C or lower grades
- No incompletes

Readings

- No required textbook
- Recommended texts
 - Computer Networks: A Systems Approach
 - Computer Networking: A Top-Down Approach
 - UNIX Network Programming
- Research papers
- Standards
- Wikipedia

Academic Honesty

- The work you turn in should be yours
- Acknowledge
 - Group discussions
 - Internet sources
- Plagiarism results in an F

Course Staff

- Instructor: Omprakash Gnawali
- Office Hours: TBD

- We may have pseudo TAs

Communication

- Send questions and answers to Piazza
- Emails MUST have COSC6377 in the subject
- Check course website and Piazza regularly

<http://www2.cs.uh.edu/~gnawali/courses/cosc6377-s14/>

Some Questions

- How difficult is this course?
- What is the workload?
- Will I learn anything useful?
- Any other questions?

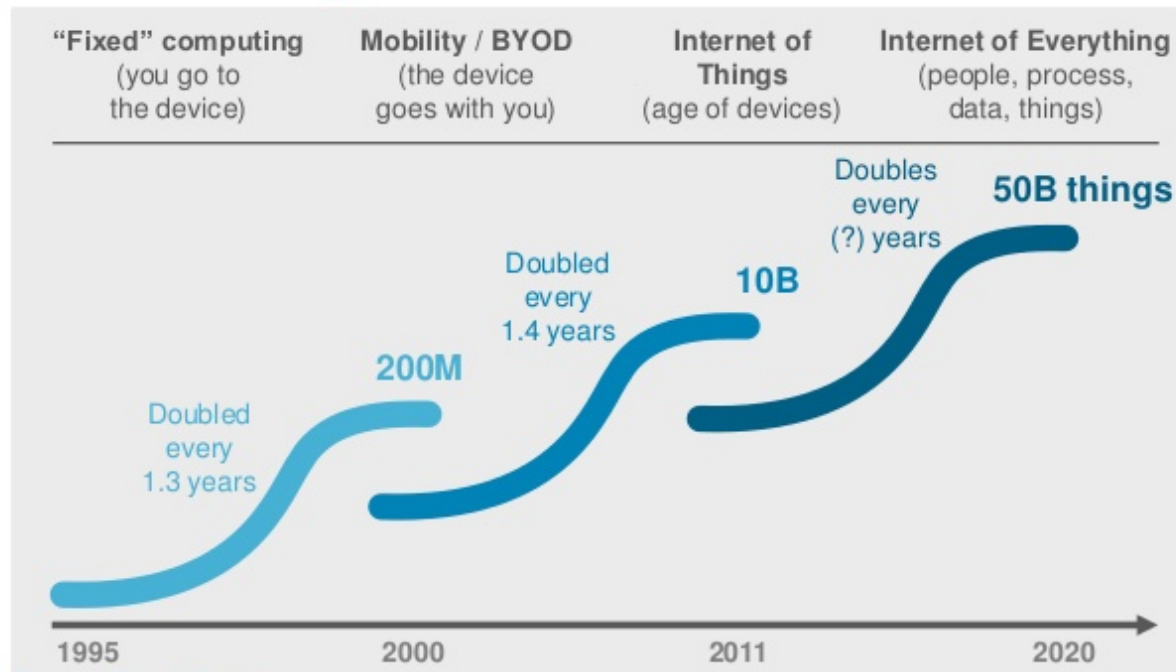
The Internet: An Exciting Time

- One of the most influential inventions
 - A research experiment that escaped from the lab
 - ... to be a global communications infrastructure
- Ever wider reach
 - Today: 3 billion+ users
 - Tomorrow: more users, computers, things, ...
- Near-constant innovation
 - Apps: Web, P2P, social networks, virtual worlds
 - Links: optics, WiFi, cellular, WiMax, ...

Transforming Everything

- The ways we do business
 - E-commerce, advertising, cloud computing, ...
- The way we have relationships
 - E-mail, IM, Facebook, virtual worlds, online dating
- How we think about law
 - Interstate commerce? National boundaries?
- The way we govern
 - E-voting and e-government
 - Censorship and wiretapping
- The way we fight
 - Cyber-attacks, including nation-state attacks

Internet Growth Occurring in Accelerating Waves



Source: Cisco IBSG, 2012

The Study of Networking is Cool

- Tangible, relates to reality
 - Can measure/build things
 - Can truly effect far-reaching change in the real world
- Inherently interdisciplinary
 - Well-motivated problems + rigorous solution techniques
 - Interplay with policy, economics, and social science
- Widely-read papers
 - Many of the most cited papers in CS are in networking

The Study of Networking is Cool

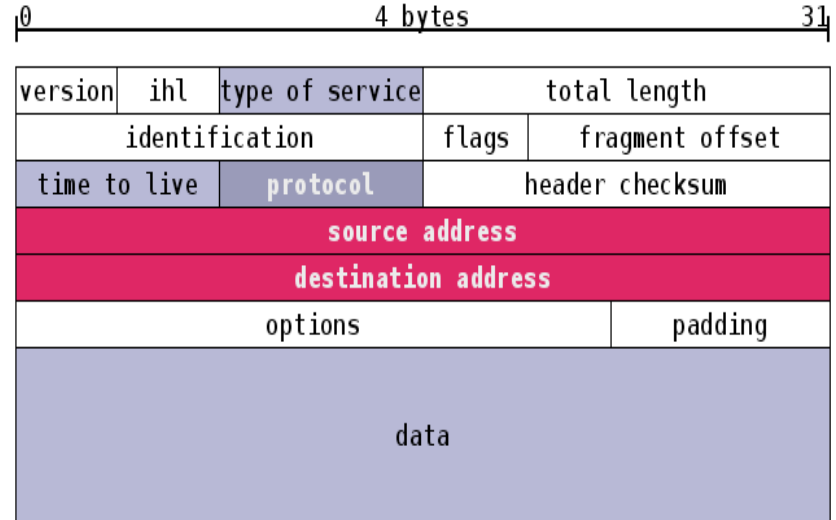
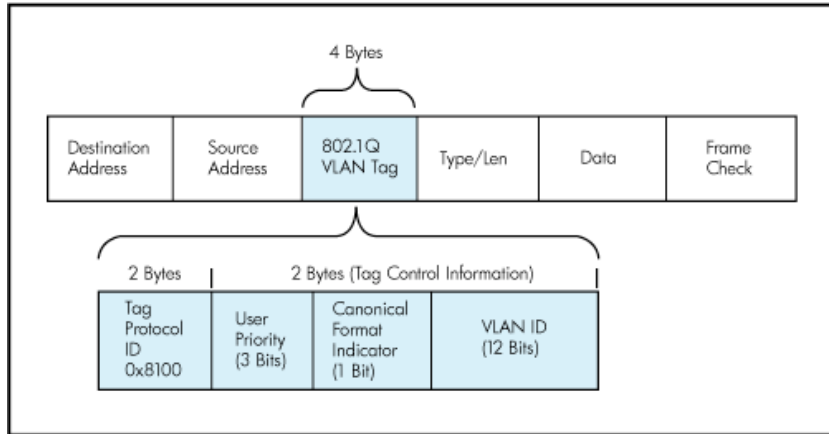
- Young, relatively immature field
 - Great if you like to make order out of chaos
 - Tremendous intellectual progress is still needed
 - *You* can help decide what networking really is
- Defining the problem is a big part of the challenge
 - Recognizing a need, formulating a well-defined problem
 - ... is at least as important as solving the problem...
- Lots of platforms for building your ideas
 - Programmability: Click, OpenFlow, NetFPGA
 - Routing software: Quagga, XORP, and Bird
 - Testbeds: Emulab, PlanetLab, Orbit, GENI, ...
 - Measurements: RouteViews, traceroute, Internet2, ...

But, What *is* Networking?

A Plethora of Protocol Acronyms?

SNMP WAP SIP PPP IPX MAC
LLDP FTP UDP ICMP IMAP IGMP HIP
OSPF RTP BGP HTTP ARP ECN
PIM RED BGP HTTP ARP ECN
RIP IP MPLS TCP RTCP
SMTP RTSP BFD CIDR
NNTP SACK TLS NAT STUN
DNS SACK SSH TLS NAT STUN
POP VLAN LISP VTP DHCP LDP

A Heap of Header Formats?



Source Port		Destination Port						
Sequence Number								
Acknowledgment Number								
Data Offset	Reserved	URG	ACK	PSH	RST	SYN	FIN	Window
Checksum				Urgent Pointer				
Options				Padding				

HTTP Response Header

Name	Value
HTTP Status Code: HTTP/1.1 200 OK	
Date:	Thu, 27 Mar 2008 13:37:17 GMT
Server:	Apache/2.0.55 (Ubuntu) PHP/5.1.2
Last-Modified:	Fri, 21 Mar 2008 13:57:30 GMT
Etag:	"358a4e4-56000-ddf5c680"
Accept-Ranges:	bytes
Content-Length:	352256
Connection:	close
Content-Type:	application/x-msdos-program

A Big Bunch of Boxes?

Router
Label Switched Router
Load balancer
Switch
Gateway
Scrubber
Repeater
Deep Packet Inspection
Intrusion Detection System
Bridge
Route Reflector
NAT
Firewall
DHCP server
Packet shaper
Hub
Packet sniffer
WAN accelerator
DNS server
Base station
Proxy

A Ton of Tools?

arpwatch

tcpdump

syslog

wget

traceroute

nslookup

trat

snort

nmap

whois

ipconfig

rancid

ntop

bro

dig

net-snmp

ping

iperf

NDT

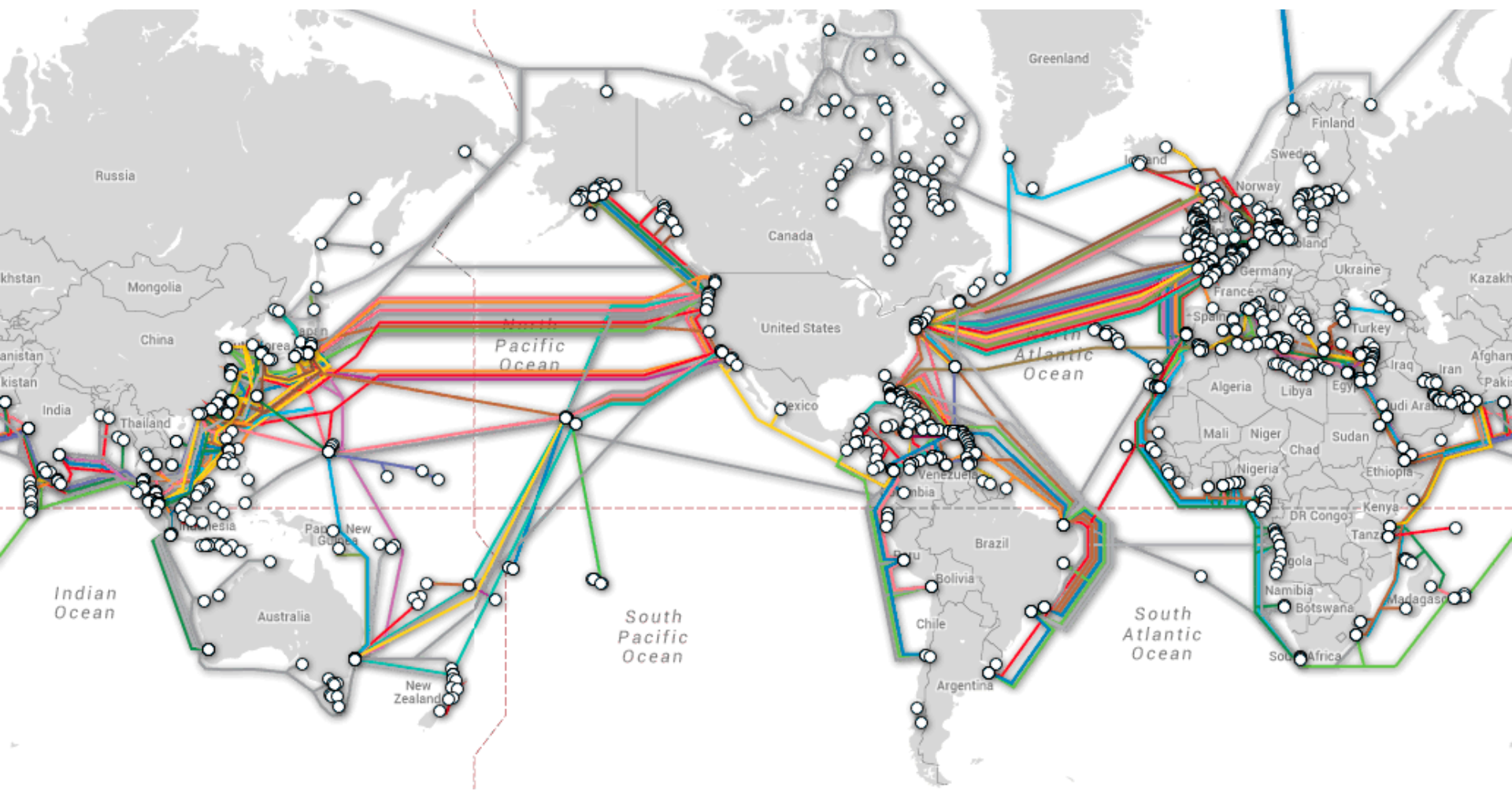
wireshark

dummysnet

mrtg

**But, That Doesn't Say What
Networking Really *Is***

Or, What Will This Course Be
About?



<http://www.submarinecablemap.com/>

One Take on Defining Networking

- How to
 - Design and manage *protocols*
 - That can be used and *combined in many ways*
 - To do *many things*
- Definition and placement of function
 - What to do, and where to do it
- The “division of labor”
 - Across multiple protocols and mechanisms
 - Across components (hosts, routers, administrators)
- Goal: search for general principles
 - Of protocol design, evaluation, and composition

Plan for next four weeks

- Review of undergraduate material
- Watch lectures/read slides from COSC4377
 - Cover approx. 5 lectures per week
- Discuss the material in the class
- Grab lectures from:
<http://www2.cs.uh.edu/~gnawali/courses/cosc4377-s12/>