

Computer Networks

COSC 6377

Lecture 1

Spring 2019

January 14, 2019

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
- Willingness to catch up if you don't have these experiences

Structure

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

Homework

- Several short assignments
- Concepts and calculations
- Some hands-on (incl. programming) work
- Allowed to discuss with other students, but you should turn in your own hw
- Submit online

Project

- One project with intermediate checkpoints
- Build a networked system

- Possible to propose your own project
 - Strongly encouraged for PhD students
 - Talk to the instructor

Exams

- No final exam!
- Open notes
- In-class scheduling

Grades

Exams	40%
Homework	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
- 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: M 230-330

- TA: Nour Smaoui
- Office Hours: T 3-5

Communication

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

<http://www2.cs.uh.edu/~gnawali/courses/cosc6377-s19/>

Some Questions

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

Why are you taking this course?

What do you want to do?

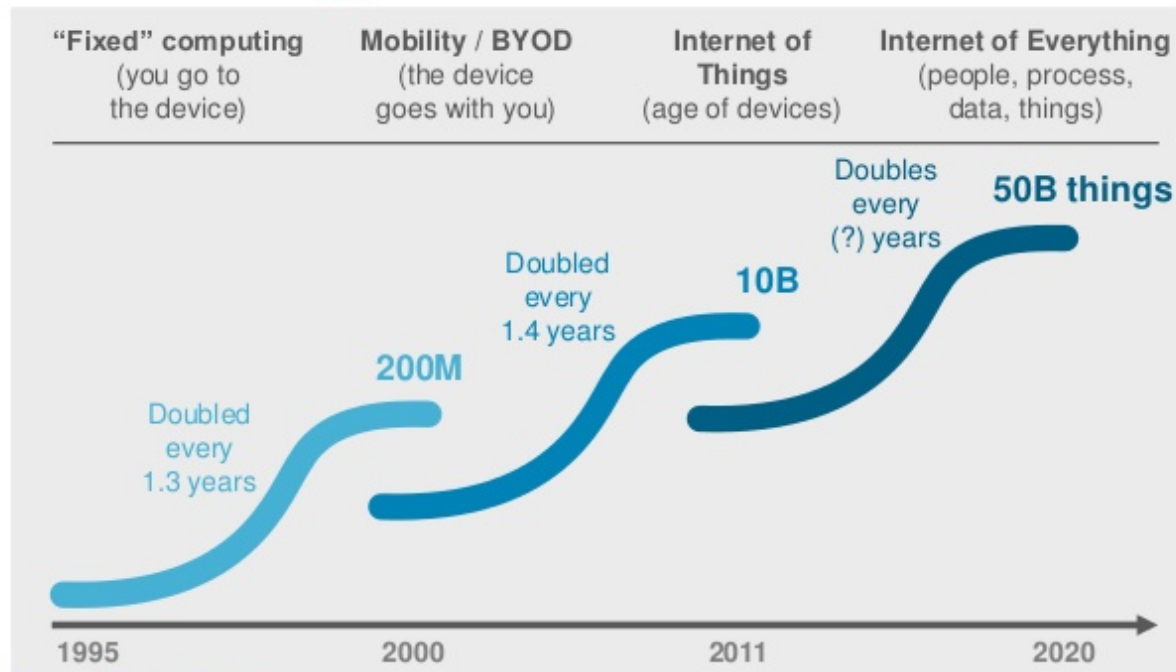
The Internet: An Exciting Time

- 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

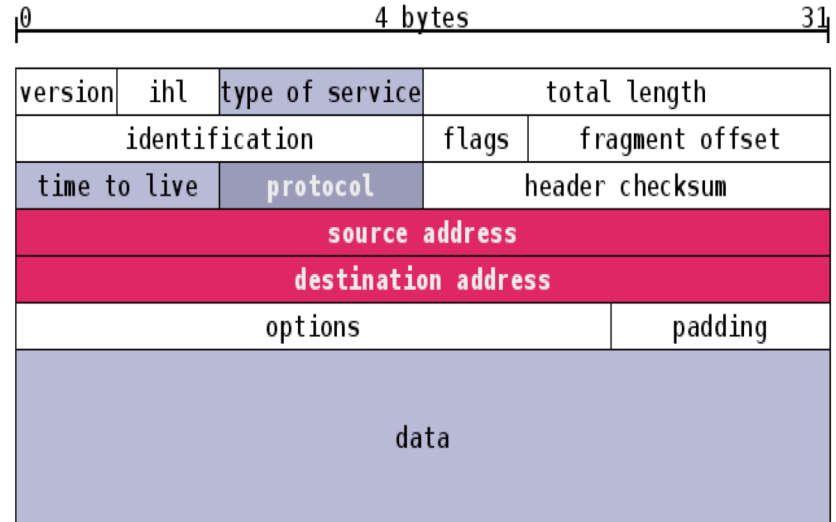
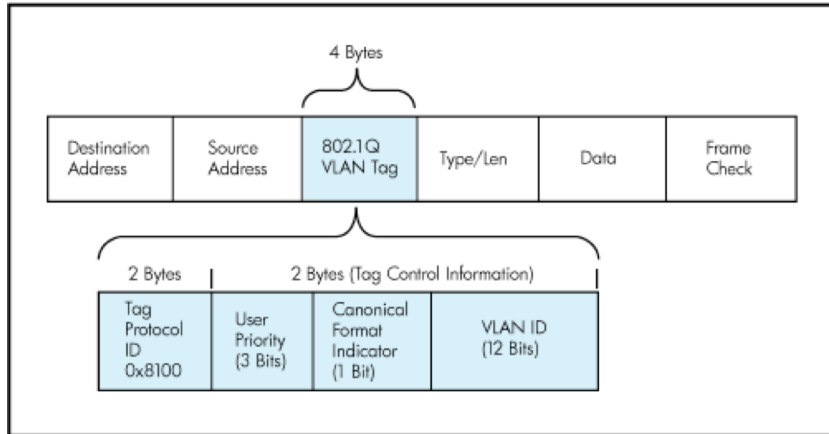
- Tangible, relates to reality
 - Can measure/build things
 - Can truly effect far-reaching change in the real world
- Inherently interdisciplinary
 - Well-motivated problems + rigorous solution techniques
 - Interplay with policy, economics, and social science
- Widely-understood impact
 - Can discuss technologies with your grandfather!

But, What *is* Networking?

A Plethora of Protocol Acronyms?

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

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
WAN accelerator
DNS server
Hub
Base station
Packet sniffer
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

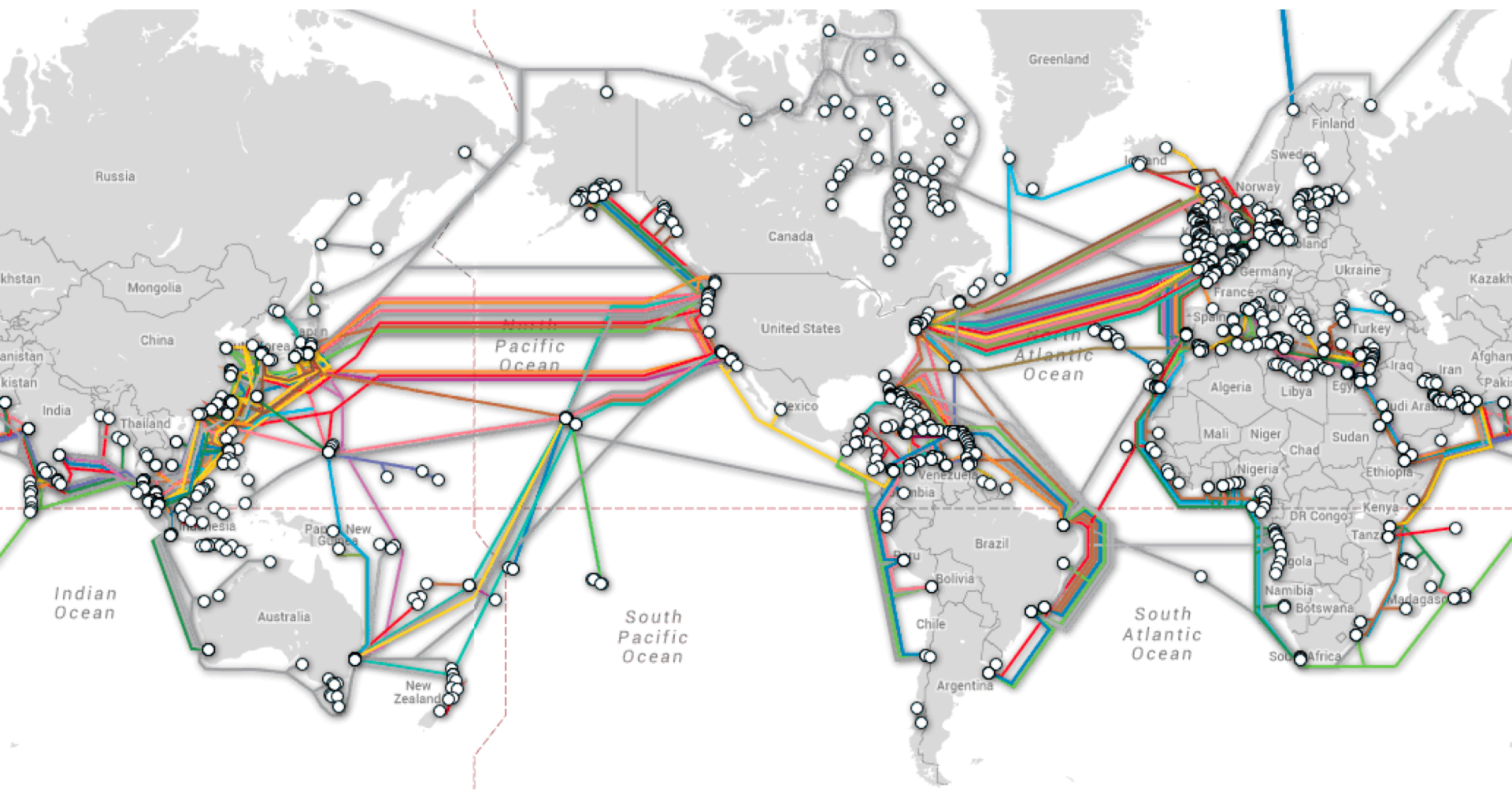
wireshark

dummysnet

mrtg

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

Or, What Will This Course *is* About



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

Nor does that...

We want to understand how the Internet works

Technical issues (protocols, architectures...)

Non-technical topics you will encounter
(net-neutrality, access, rights...)

Internet as human right?

Politics

Business

Free Internet Access

“1.5 million people access the Internet via Google's free Wi-Fi at 19 Indian railway stations”

mashable.com

Facebook also had Free Internet initiatives.

Types of things we will study

Internet Architecture

- 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

Congestion

- How to know how much traffic is being used for what purpose?
- How to ensure we can service the competing traffic demand sharing the infrastructure
- How to design applications to run “fast”

Reliability

- How reliable is the Internet?
- How can we measure different aspects of reliability in networking?
- What causes it to break?

Security

- How secure is the Internet?
- Security challenges in the Internet (DDoS, bots, etc.)
- Technologies to make Internet secure and their limitations
- How to make your application secure?

Back to the two questions

Why are you taking this course?

What do you want to do?

Project Ideas

- Study Wireless, Internet, ... adoption, use
- Extend existing technology
- Explore new and popular ideas
 - IoT
 - Blockchain
- Create impact using Internet or Wireless
 - Low-resource setting (edu, health, etc.)
 - Access to information

Plan for next four weeks

- Rapid review of undergraduate material
 - Understand how the basic building blocks work
- Watch lectures/read slides from COSC4377
 - Cover 3-5 lectures per week
- Discuss the material in the class
- Grab lectures from:
<http://www2.cs.uh.edu/~gnawali/courses/cosc4377-s12/>