ECE 435 – Network Engineering
Lecture 1

Vince Weaver

http://web.eece.maine.edu/~vweaver

vincent.weaver@maine.edu

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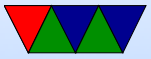
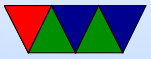
Introduction

- Distribute and go over syllabus
- Talk about the class.
  - Homeworks, 50%: 11 total, lowest dropped.
    Generally will be due on Wednesday by beginning of class. Will usually have at least a week to do them.
    Submission by e-mail, grades sent in response to that e-mail, if you don't like that let me know.
    Will send out e-mail when posted on website.
  - Midterm, 10%

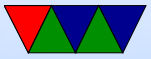


- Final, 15%
- Class participation, 5%
- Project, 20%: Involves using what we learn to do a networking-related project, with a final writeup and demo the last week of classes. More details as we get closer.

- Late work penalty
- Class notes will be posted on the website.

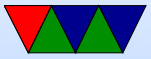


- Will involve some C coding, also a lot of Linux configuration and possibly serial ports and network connections
- Lab: no dedicated lab. Might involve some sort of setup where you have to come in and try some things out.

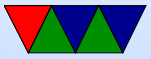


Hardware

- Will he helpful to have a device with ethernet that you can run tests on
- Raspberry Pi B+/2B/3B is great because if you mess things up you can just pop in a new SD card
- Laptop or desktop is fine too. It helps if it is running Linux. Although most TCP/IP stacks are similar for backwards compatability reasons.
- Having an ethernet cable might be good as well.

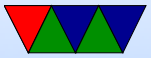


Networking



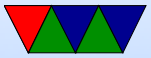
What is a Computer Network?

- A group of computers, connected to they can communicate
- Probably familiar with the Internet, which is a network of networks.



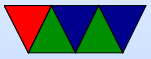
How can they be connected together?

- Wire (ethernet, telephone, powerlines)
- Fiber Optic
- Wirelessly: radio, microwave, infrared, laser
- Sound?



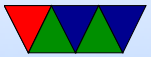
Why have networks?

- Resource sharing (printer, fileserver, etc.)
- Communication (e-mail, text messaging, video-conferencing, etc)
- Gaming
- Operating system/Security Updates



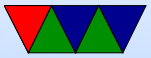
Why have network to your home?

- Accessing information (web-pages, etc)
- Entertainment (videos, gaming, web-pages, etc)
- Communication (e-mail, forums, video calls, phone calls)
- Shopping
- File sharing



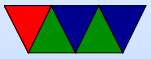
Network Problems

- Reliability
- Security
- Expense
- Speed
- Addressing (how to find a machine)
- Error correction
- Scalability
- Standards



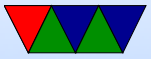
Network terms

- Client/Server
- Broadcast vs point-to-point
- Wide area network, local area network
- Bandwidth vs Latency. 100Mbps (100 mega-bits per second)
- Connection oriented vs packet based (Switched phone vs VOIP)
- Topology (star, ring, cube, mesh, hypercube)



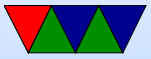
OSI Reference Model

ISO/OSI Open Systems Interconnection (1984)
ISO 7498
Many thought this would be the standard, but didn't end up that way
Everyone still talks about it anyway
Various layers each a new layer of abstraction.
Layers should be independent. Layering violations



1. Physical – **bits**: the raw bits. How 0 and 1 encoded, electrons or photons, etc.
   pins, volts, timing, frequency
   topology, how wires laid out
   bandwidth

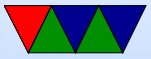
2. Data Link – **frames**: Transforms raw line to one that handles errors,
   breaks up data into frames, etc.
   Unique identity for each device on network
   Flow control, error handling



3. Network – **packets**: management of subnet. How packets routed from one network to another, addressing. (routing: what is routing?)

4. Transport – **end-to-end delivery**
   accepts a stream of bytes from above and make it suitable for the network layer.
   Gets back split up packets and turns it back into a total message.
   flow control, reliable delivery, error correction

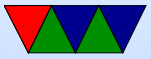
5. Session – allows different machines to have sessions



between them. session management, synchronization. Lets different apps share one connection to the network.

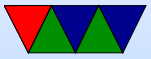
6. Presentation – syntax of data being transmitted. Char encoding, compression, encryption

7. Application – high level protocol, like webserver (http), ssh, etc.



	OSI	TCP/IP
7	Application	Application
6	Presentation	
5	Session	
4	Transport	Transport
3	Network	Internet
2	Data Link	Host-to-network
1	Physical	Host-to-network

RFC 3439: “Layering considered harmful”



Results

- OSI (theoretical) never caught on for various reasons
- TCP/IP (practical) did, but has its own limitations which we'll discuss later