# ECE 435 – Network Engineering Lecture 1

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4 September 2018

# Introduction

- Distribute and go over syllabus
- Talk about the class.
  - Homeworks, 50%: 11 total, lowest dropped. Generally will be due on Thursday 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 compatibility reasons.

- Having an Ethernet cable might be good as well.

# Networking

In this class we will cover

- Computer Networks

- Computer Security

# 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.
  1Gbps might be fast, but what if 100ms latency?
- 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.

# 8th layer

- The user?

- Political? Financial? Government?
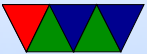
# Summary

| | 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 |

# Layering

- Why is it good?
  Abstraction. Easier to do one layer and do it right. Should the webserver be aware if it is serving over copper vs fiber?

- Counterpoint: 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