0x01 Advanced Networking

Core Concepts

Welcome

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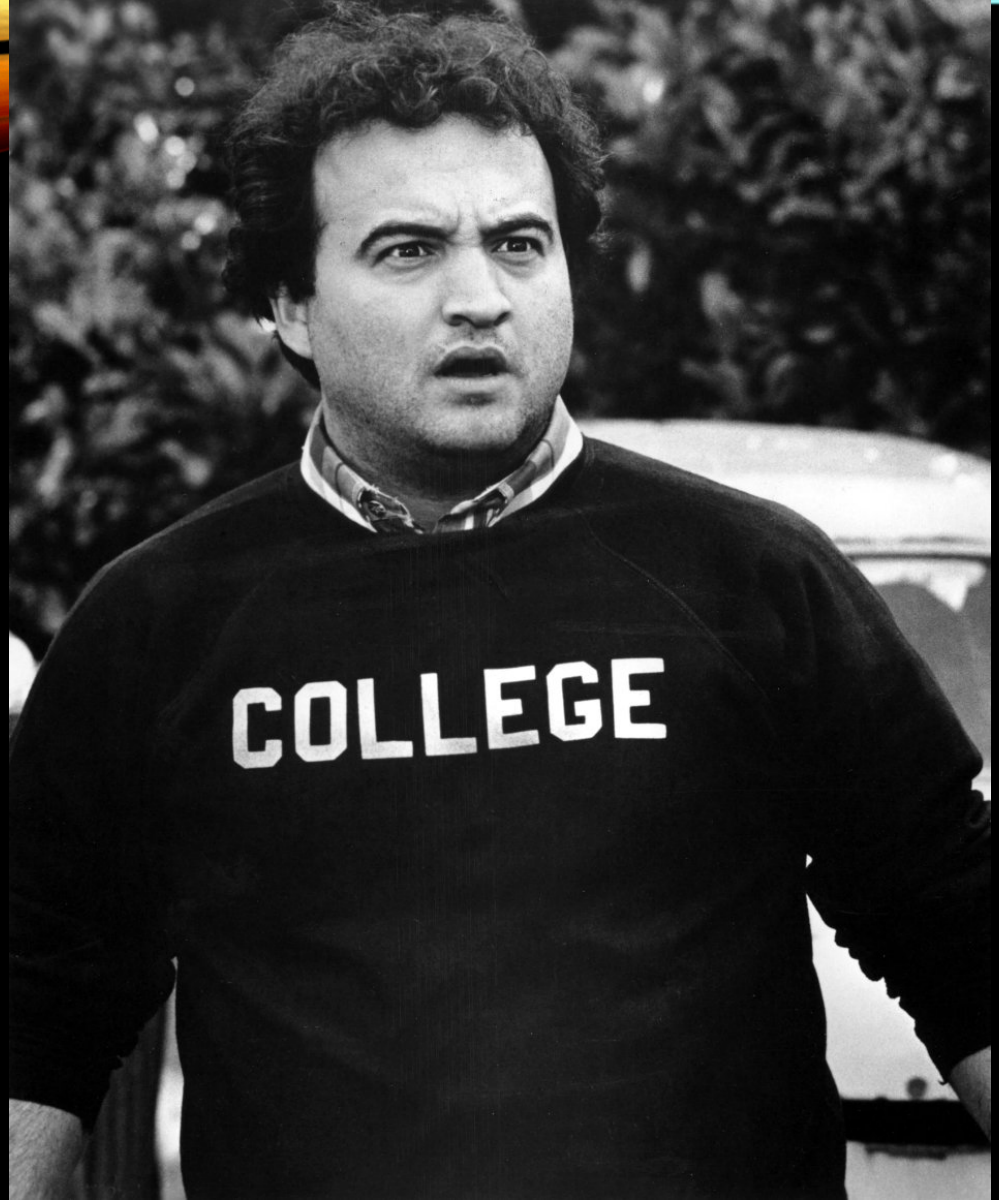
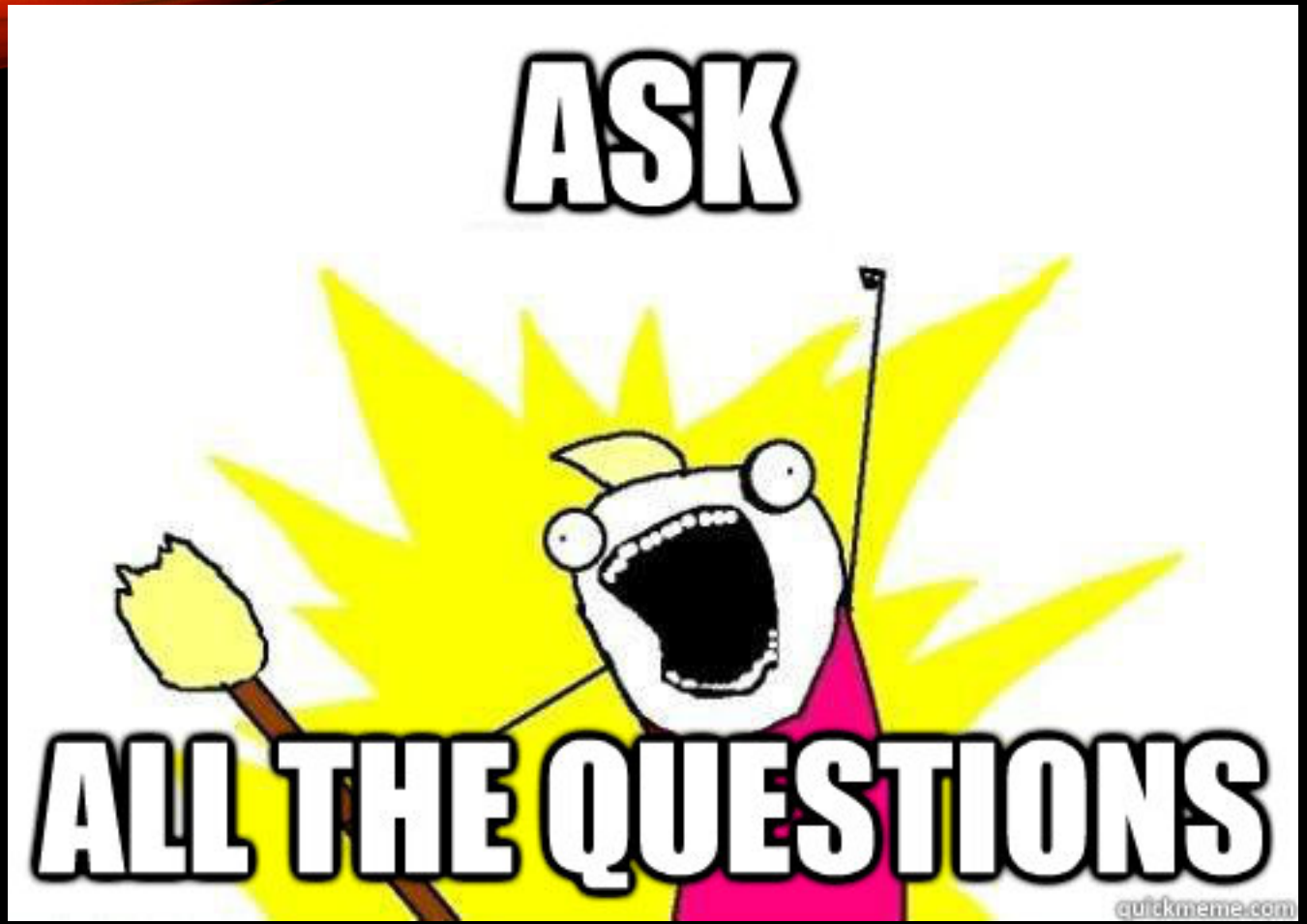

COLLEGE


147
Math Reception
145
144
Physics
140
141
Physics Prep
Advanced Chemistry
138
137
General Chemistry
116
119
118
131
129
127
120
Science Center
130
128
126
124
121
132
133
122
Office
Vending Machine
Auditorium
123
Entrance / Exit
114
113
Biology Research
110
111
109
Biology Lab
106
107
103
104
105
108
Biology Lab

50 minutes


ASK
ALL THE QUESTIONS
quickmeme.com

Week at a Glance

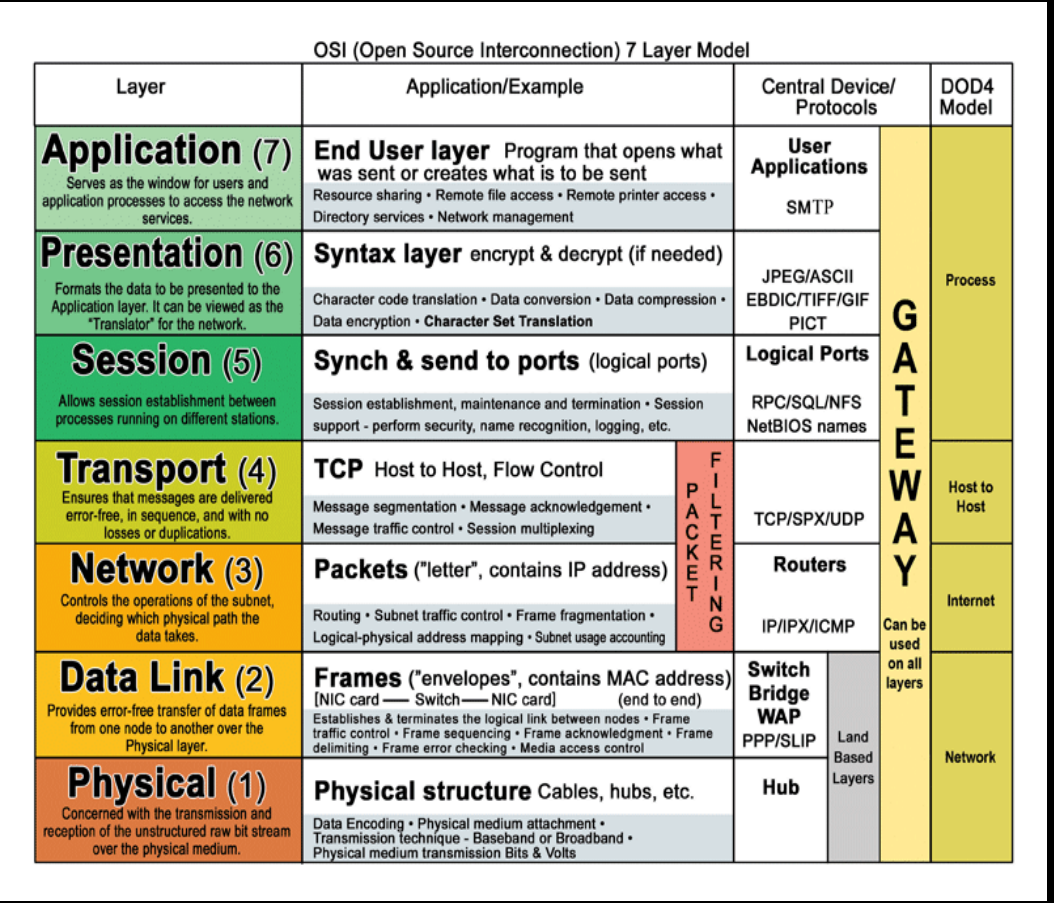
- Day 1 – Physical hardware, IP/MAC, Binary
- Day 2 – Subnetting 101, DHCP, DNS, Enterprise equipment
- Day 3 – Port scanning, TCP/UDP, SYN Flood
- Day 4 – ARP Poisoning, MITM attacks
- Day 5 – GenCyber Networking Olympics, Mom and Dad come back <3

What is a network?

- Allow us to connect to services and resources
  - HTTP(S), FTP, SSH, …
- This week should help you to understand why things work
  - What happens when you connect to a Wi-Fi network
  - What happens when you type www.google.com
  - What happens when you download a file

OSI Model

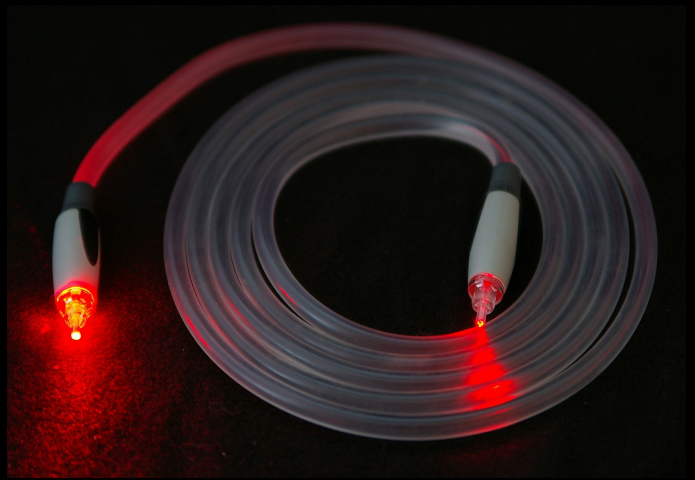
- (Open Systems Interconnection model)
- Standard conceptual model
- Telecomm or computer systems
- No representation of the underlying tech
- Help to understand how everything works together



Source: http://www.escotal.com/Images/Network%20parts/osi.gif

The First Layer

- Physical Layer
- All of the physical parts of a network are here
- We’re mostly concerned with:
  - Cables
  - Connectors

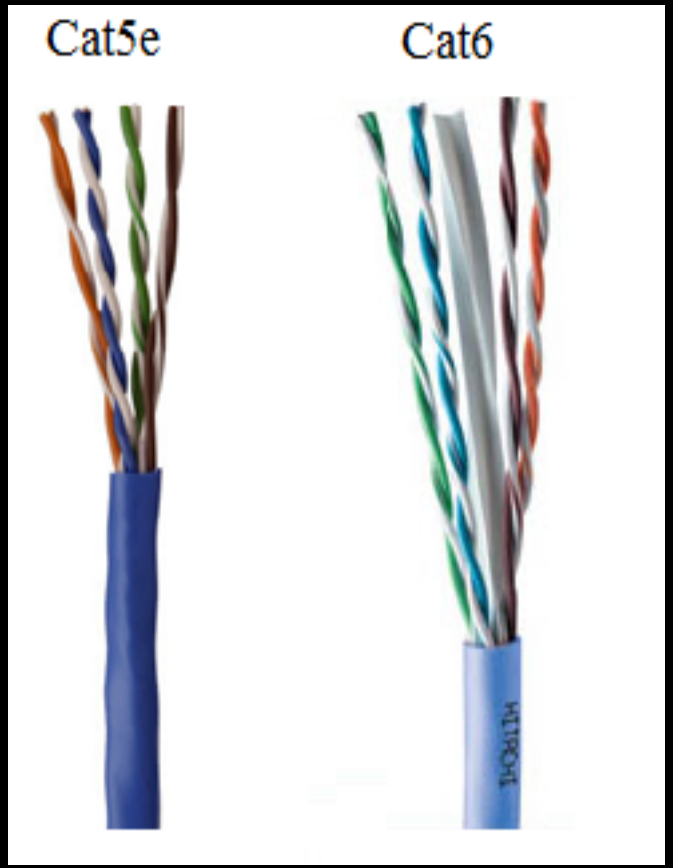


Cables

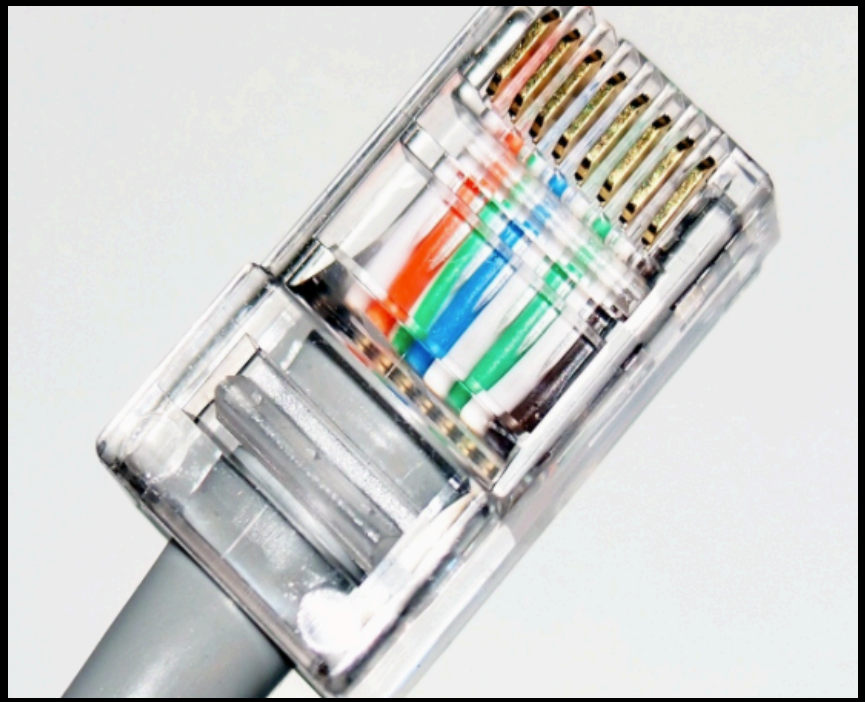
- **Fiber Optic**- Speed of Light!
- Runs HUGE distances
  - Actually crosses oceans
- www.submarinecablemap.com
- Current record speed: 255 Tb/s
  - That's 255,000 Gb/s
  - Or: 255,000,000 Mb/s

- **Twisted Pair**
  - Other Names: Cat5, Ethernet
- Fairly common/cheap
- 100 meters/328 feet max length
- Typical max speed: 10Gb/s

Cat 5e vs. Cat 6



Twisted Pair Cabling



Why are cables twisted?

- To eliminate crosstalk
- Crosstalk is essentially is where a signal transmitted on one channel is interfering with another transmission channel
- This can be eliminated or reduced by twisting the pairs of cabling together and separating out each pair

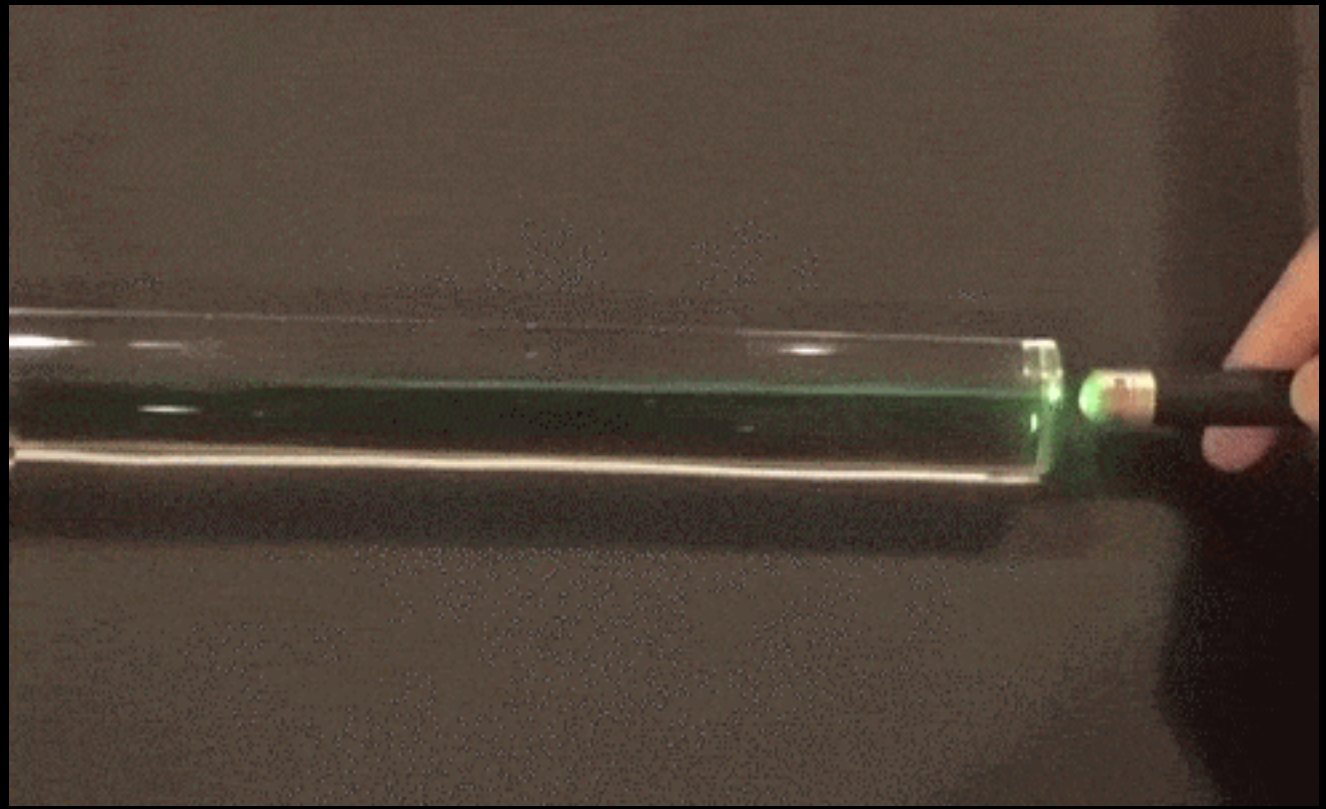
Multimode Fiber

- Light can be sent as regular light or with lasers
- Most multimode fiber uses LEDs
- Changes the angle of transmission down the core of the fiber cable
- Multiple reflection angles tend to disperse over long distances, so multimode fiber optic cables are used for relatively short distances
- A typical multimode network runs at 10, 100, or 1000 Mbps
- Distances for multi-mode runs generally top out at ~600 meters

Single Mode Fiber

- Uses Lasers
- High transfer rate
- Long distances
- Better choice if budget is not an issue

Fiber Cabling Demo



Network Interface Controller (NIC)

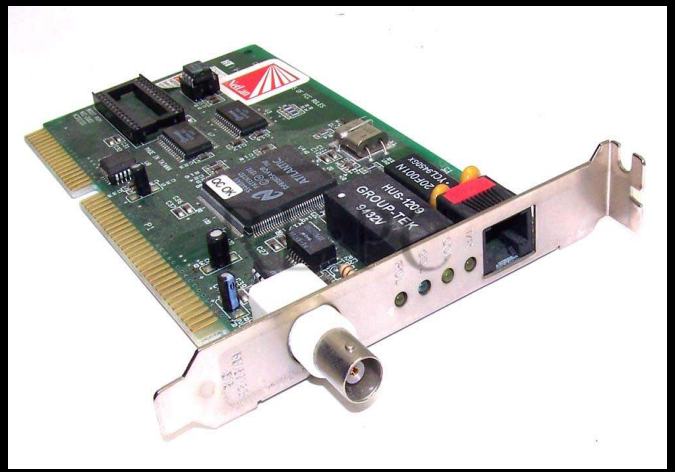
- What you plug your computer/device into for network access
  - Can also be wireless
- Uses physical (layer 1) and data link (layer 2) layers of OSI
- Provides a base for the full network protocol stacks
- Pretty much every computer you buy has one built in
  - Servers can have 4 or more (redundancy)

Activity: NIC

- How to find what network card and network you are using:

1. Click the Start Button and then click the "Programs" folder.
2. Next, click the "Accessories" and then the "System Information" folder.
3. Within the System Information window, click the + symbol next to Components.
4. Click the "+" next to "Network" and highlight "Adapter", in the right side of the window you should be able to locate complete information about the network card.

Legacy NICs



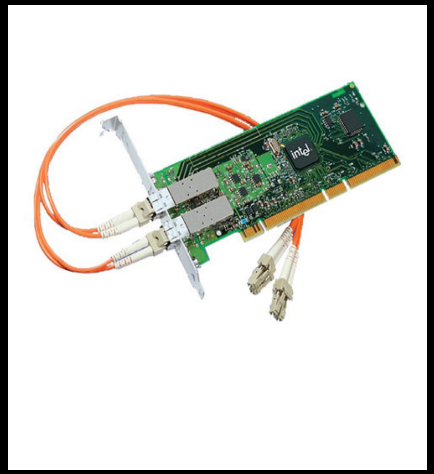
BNC and Ethernet NIC

56K NIC (dial-up)

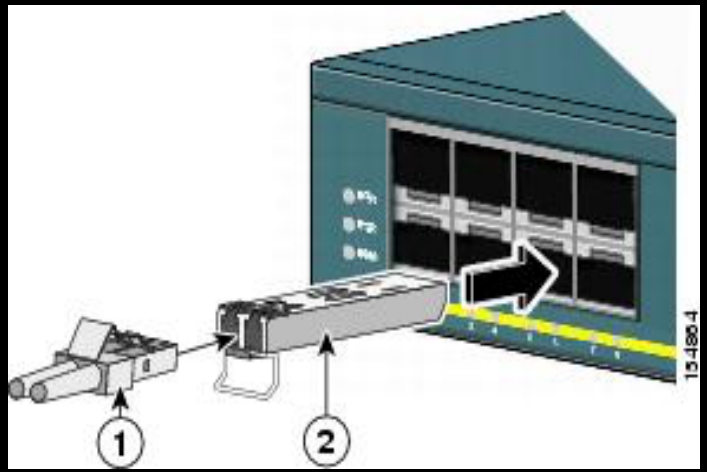
Token Ring

Modern NICs

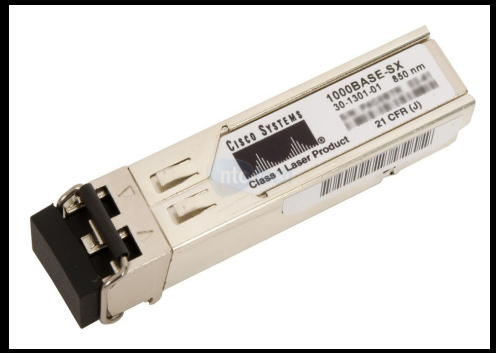
10/100/1000 NIC



Dual Fiber NIC



SFP into Switch



SFP

SFP

Media Converter

So Cables connect us… now what?

- Cables are our physical connection
- Allows signals to get sent and converted
- What do these signals looks like? It depends!
  - Could be Ethernet, USB, Bluetooth, Firewire, etc
  - We'll just focus on Ethernet

So What's Next?

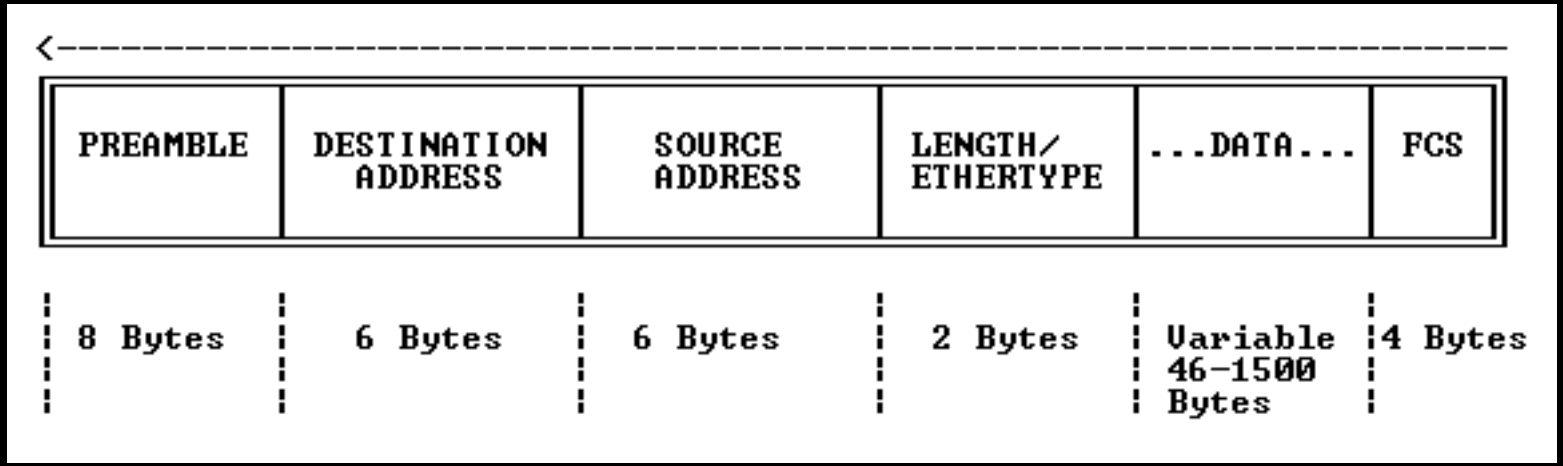
- Cables are our physical connection
- Allows signals to get sent and converted
- What do these signals looks like? It depends!
  - Could be Ethernet, USB, Bluetooth, Firewire, etc
  - We'll just focus on Ethernet

Layer 2- Ethernet

- We've converted our signal from the wire, what does it have?
- Ethernet Pieces:
  - Destination MAC Address
  - Source MAC Address
  - Length
  - Data

- What's a MAC Address?
  - Unique address
  - Every adapter has one
  - It "can't change"

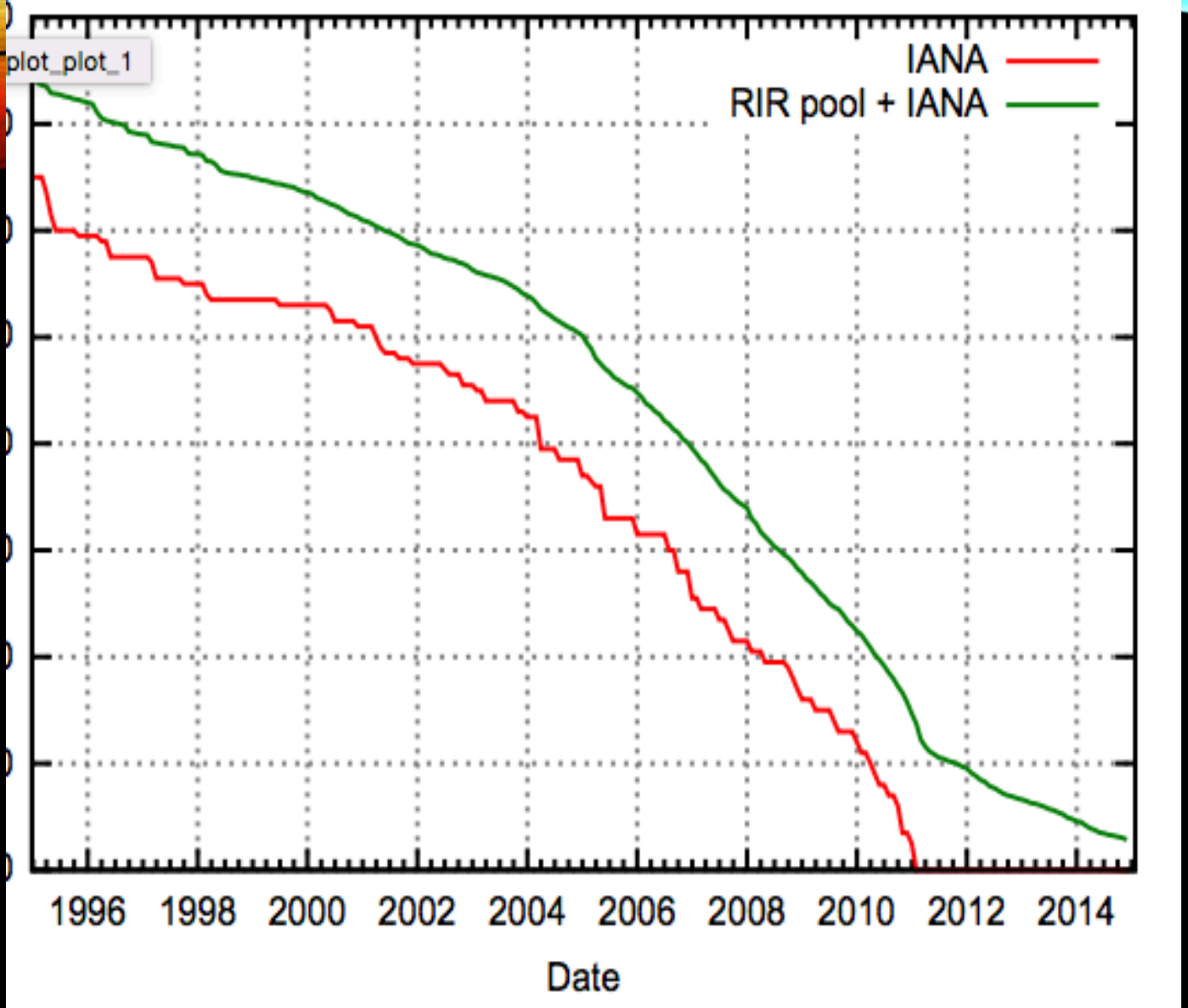
- Media Access Control
- Let's go find it!


PREAMBLE
DESTINATION ADDRESS
SOURCE ADDRESS
LENGTH/ ETHERTYPE
...DATA...
FCS
8 Bytes
6 Bytes
6 Bytes
2 Bytes
Variable 46-1500 Bytes
4 Bytes

Layer 3; One More Address!

- MAC address: Used to identify yourself to your neighbor
  - Kind of like your name; never changes even if you move
- IP Address: Used to identify yourself to the world
  - Changes as you move, just like your mailing address

- IPv4
  - 192.168.1.1
  - 4,294,967,296 addresses possible
- IPv6
  - 2001:0db8:85a3:0042:1000:8a2e:0370:7334
  - 3.4×10^{38} possible addresses


plot_plot_1
IANA
RIR pool + IANA
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Date

What does an IPv4 address consist of?

- Dotted-decimal notation, divide out octets
- 192.168.10.1

192	168	10	1
11000000	10101000	00001010	00000001

- How do the 0's and 1's create that number?

128	64	32	16	8	4	2	1
1	1	0	0	0	0	0	1

Activity: What are these in binary?

- 5
- 24
- 99
- 223
- 255

Activity: Find your IP address

- How do you find your IP?

Activity: Wireshark

Lets go look at some packets!