Intro to CS
The nuts and bolts of the Internet

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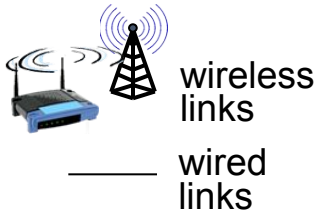
Some slides taken from: “Computer Networking: A Top Down Approach” by Kurose and Ross, Pearson/Addison Wesley April 2016

My Background

- First email circa 1988
- Streaming audio in 1995
- IRC chat in 1995
- Masters Degree in Telecommunications
- Employed as a network engineer during the peak of the Dot-Com era
- Primarily focused on protocol development and network access
- Avid “Among us” player!

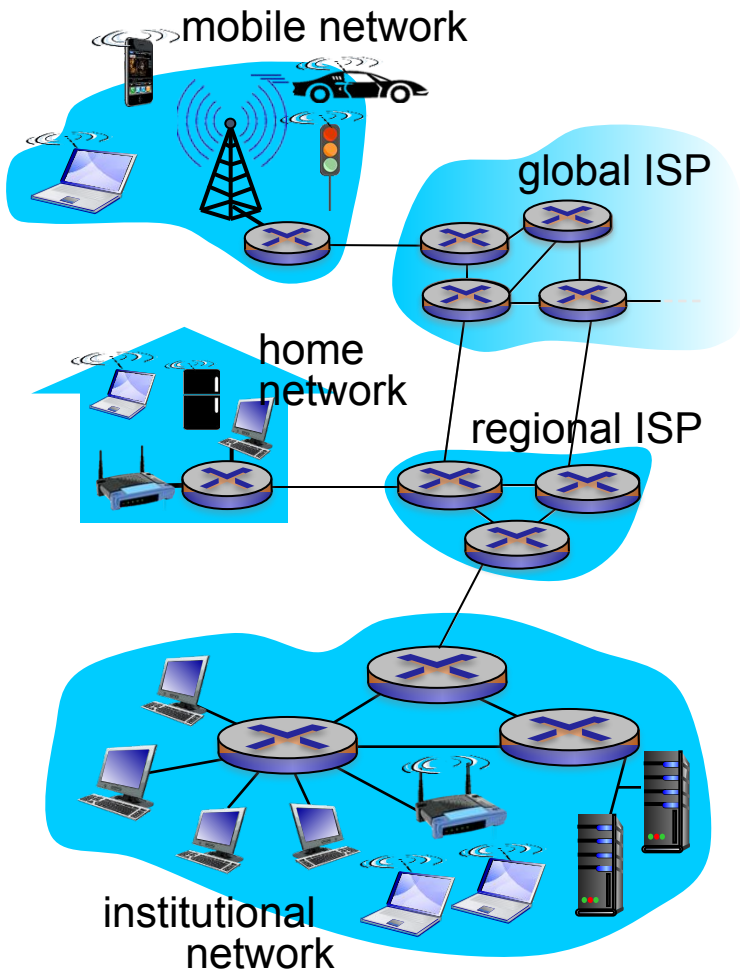
What's the Internet: "nuts and bolts" view

- billions of connected computing devices:
  - *hosts = end systems*
  - running *network apps*



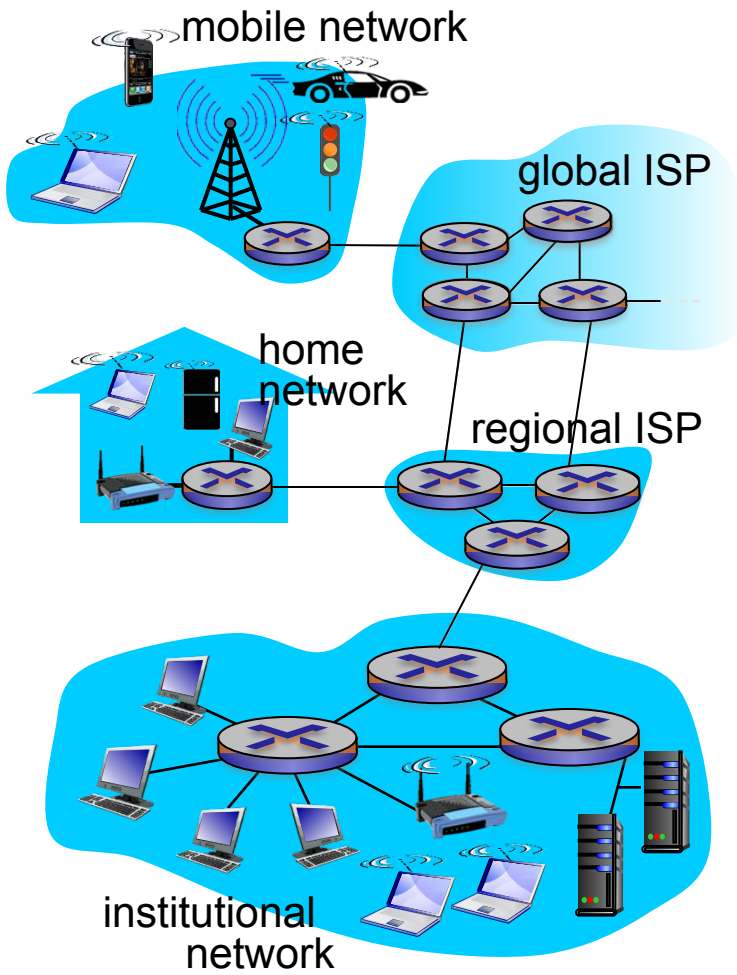
- *communication links*
  - fiber, copper, radio, satellite
  - transmission rate: *bandwidth*

- *packet switches:* forward packets (chunks of data)
  - *routers* and *switches*



What's the Internet: "nuts and bolts" view

- *Internet:* "network of networks"
  - Interconnected ISPs
- *protocols* control sending, receiving of messages
  - e.g., TCP, IP, HTTP, Skype, 802.11
- *Internet standards*
  - RFC: Request for comments
  - IETF: Internet Engineering Task Force

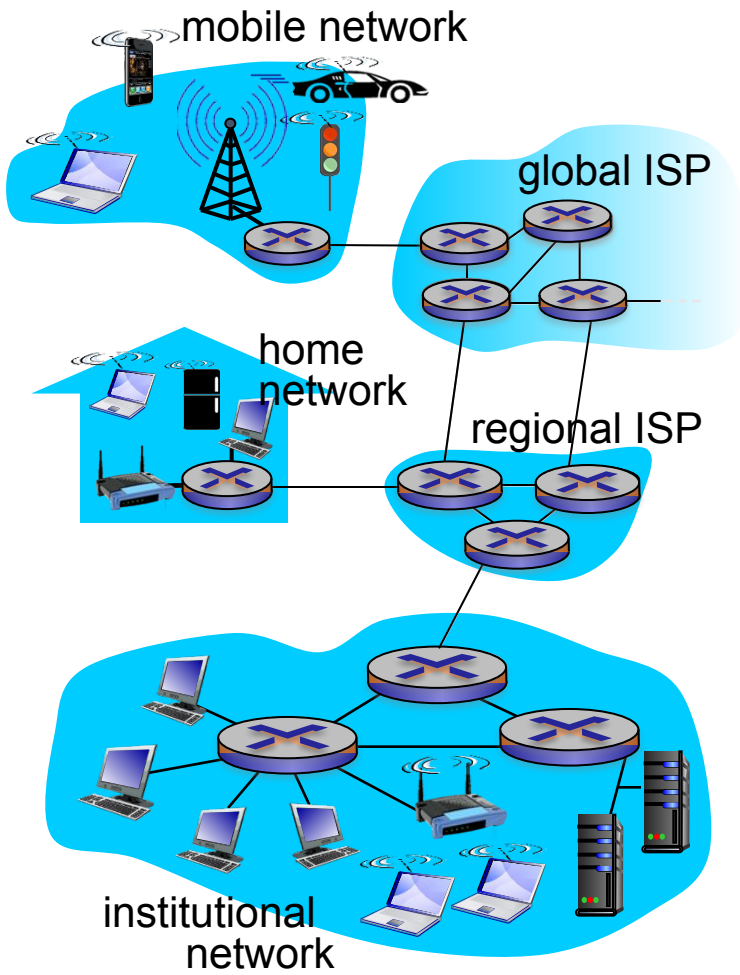


The Internet != The Web

- The Internet
  - a global network of interconnected devices
  - existed before the WWW (orthogonality issues)
  - carries a lot more than just www traffic
- The world wide web
  - originally designed to be a virtual construct of “linked” web pages.
  - Doesn’t exist in a reality

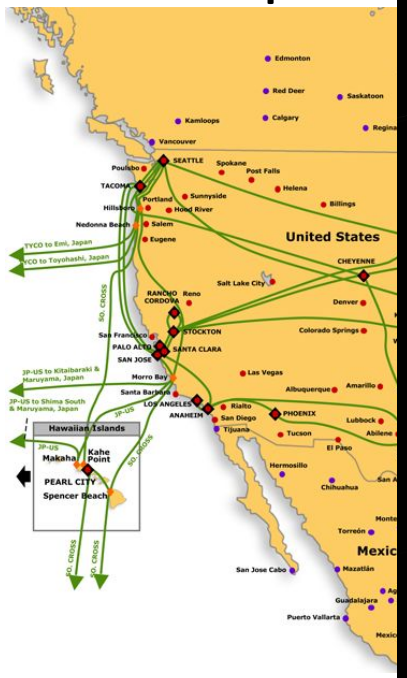
What's the Internet: a service view

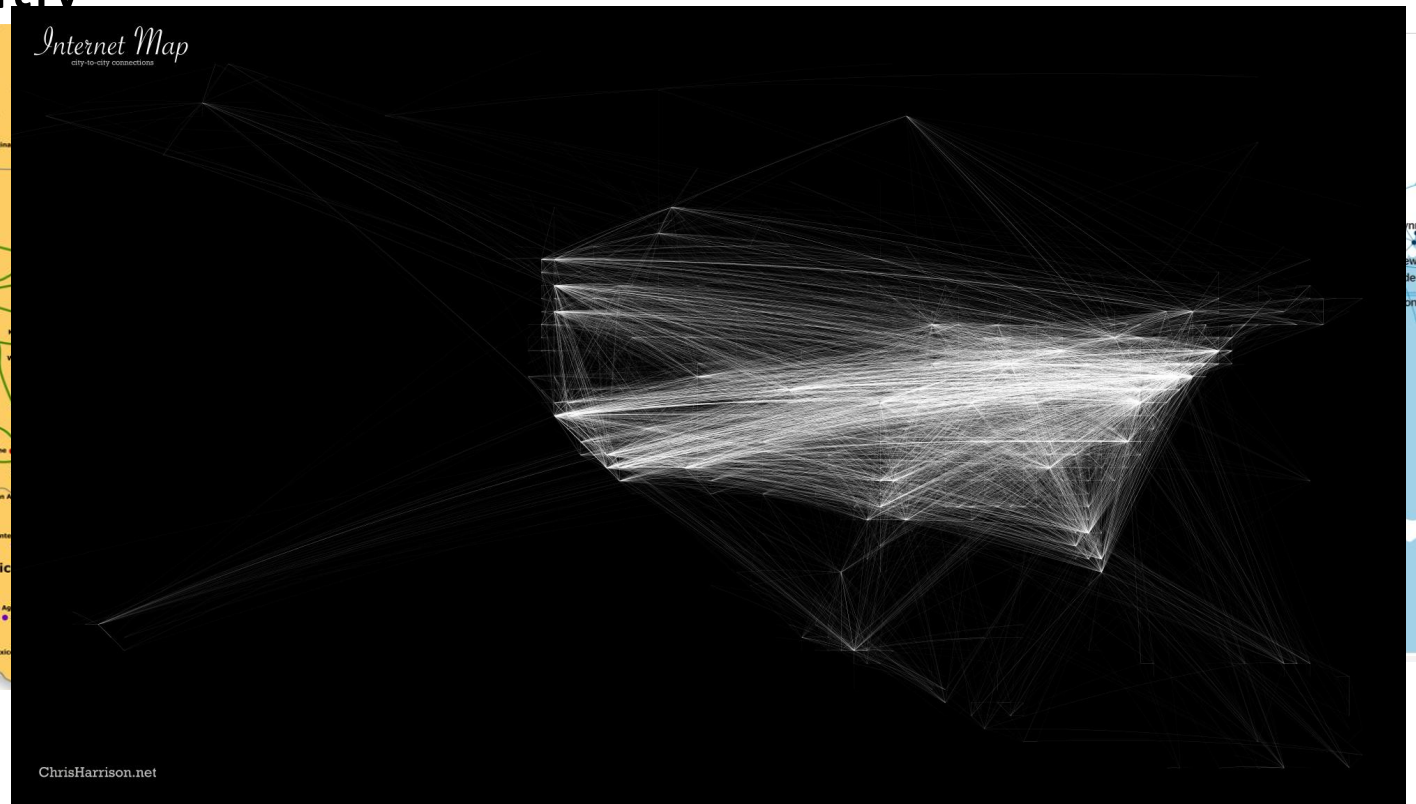
- *infrastructure that provides services to applications:*
  - Web, VoIP, email, games, e-commerce, social nets, …
- *provides programming interface to apps*
  - hooks that allow sending and receiving app programs to "connect" to Internet
  - provides service options, analogous to postal service



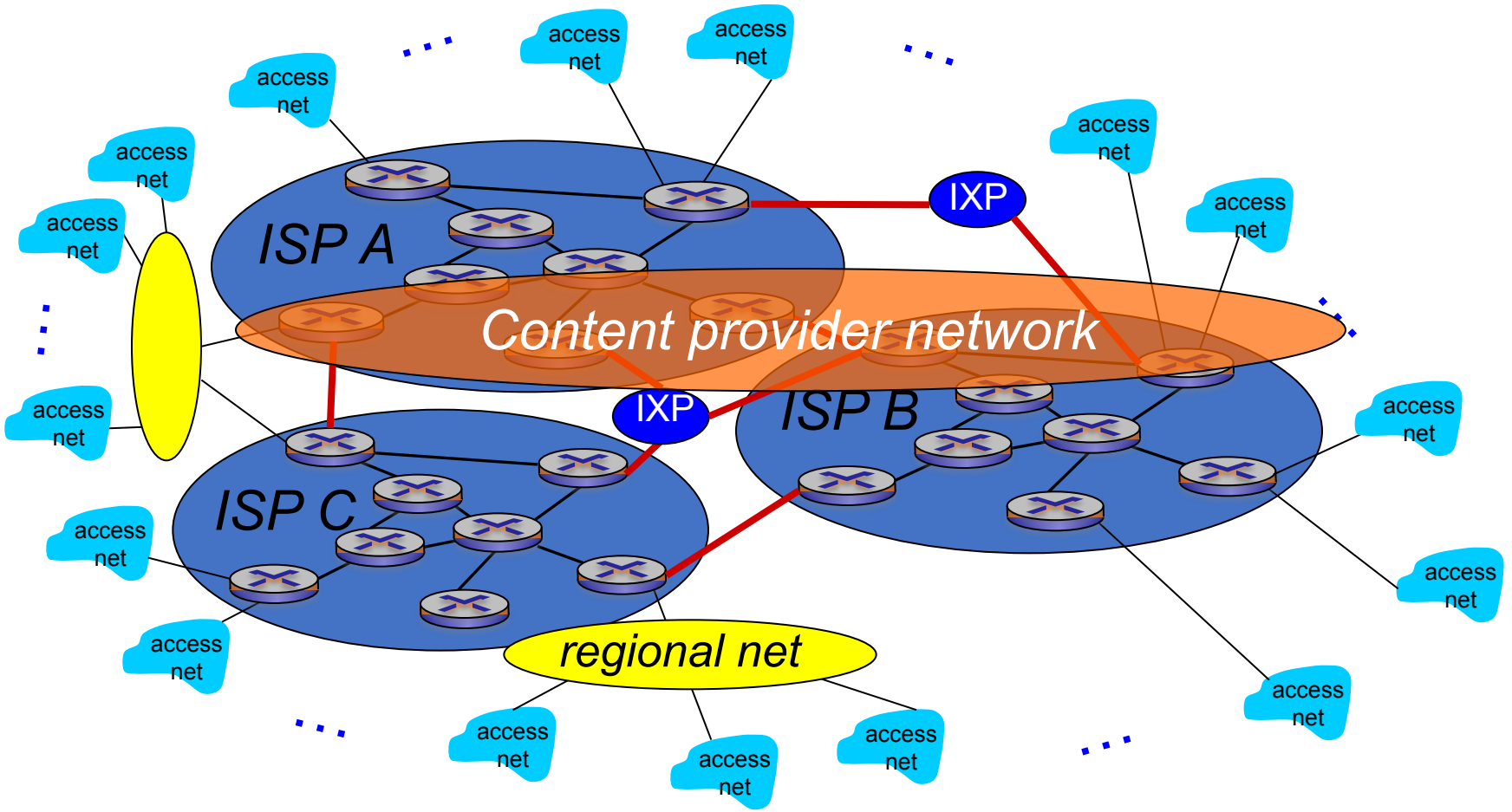
The Internet – A Physical view

- There isn't one view!
- Every individual network will have its own "map" and it will change frequently





The Internet – A Virtual view



What's a protocol?

human protocols:

- "what's the time?"
- "I have a question"
- introductions

… specific messages sent

… specific actions taken when messages received, or other events

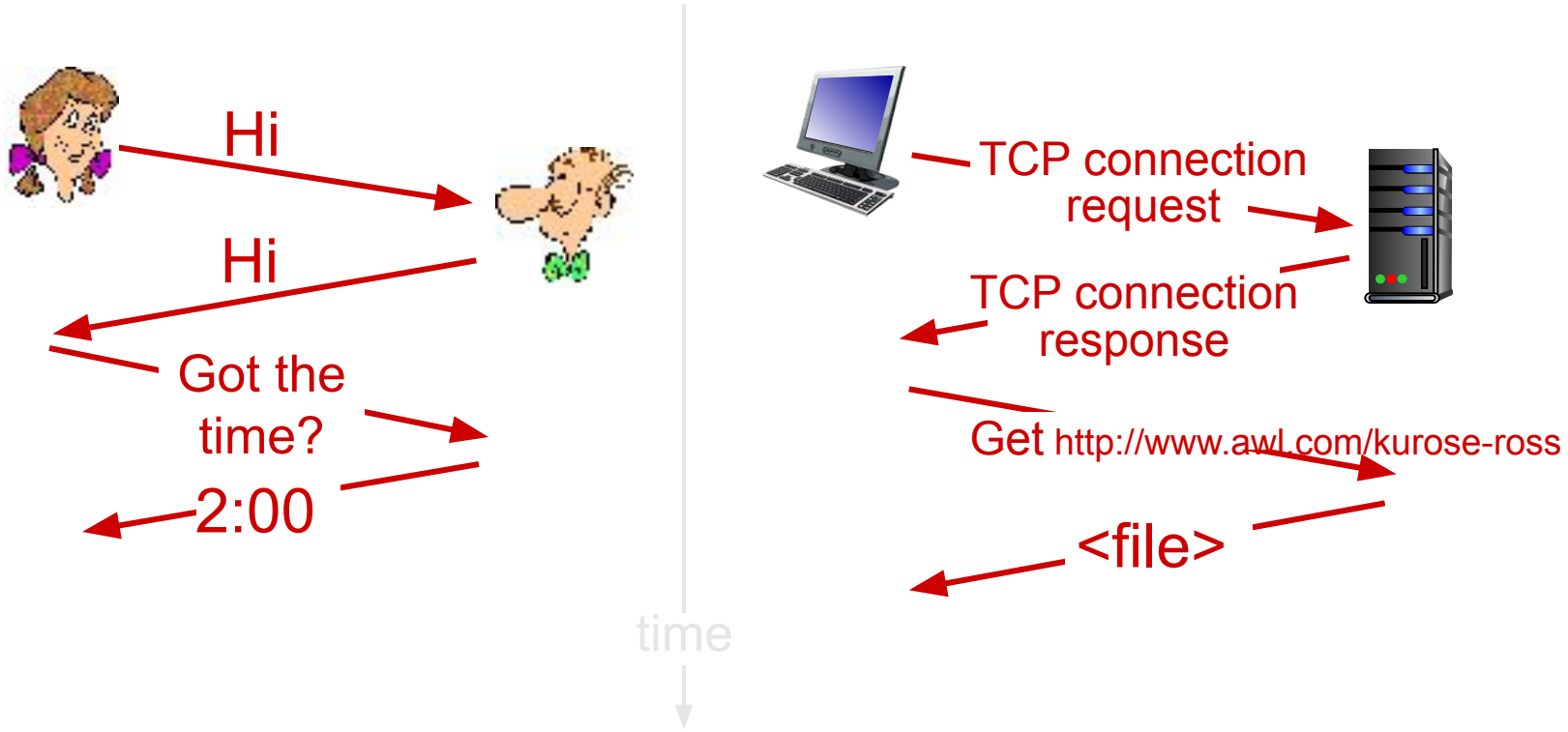
network protocols:

- machines rather than humans
- all communication activity in Internet governed by protocols

protocols define format, order of messages sent and received among network entities, and actions taken on message transmission, receipt

What's a protocol?

a human protocol and a computer network protocol:



Q: other human protocols?

What is a server

Does anyone know the time?

How did this USED to work?

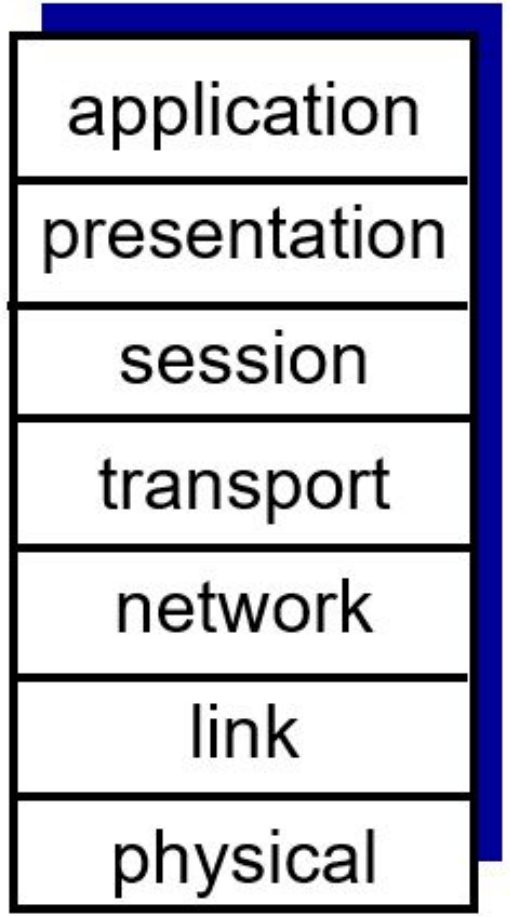
- The Plain Old Telephone System
  - A single copper wire used to be connected from your phone to the person you were calling.
  - To establish a call, you needed to speak to an operator
- Infrastructure was limited and EXPENSIVE!
- Over the years we found way to adapt, first eliminating operators, then multiplexing calls on that same single wire.

So what are we really talking about? NETOWRKING!

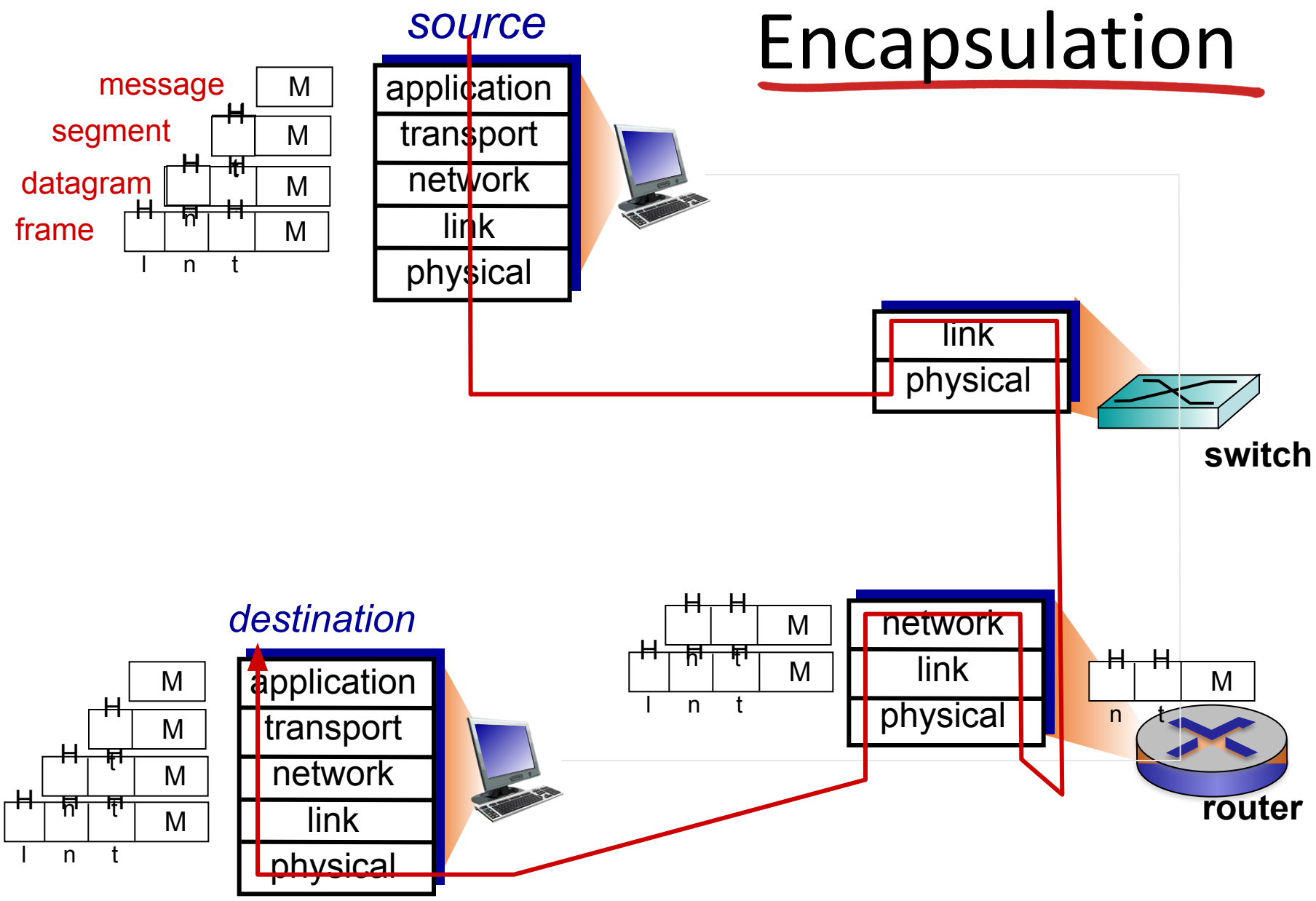
- Physical layer networking – Providing physical connectivity between devices
- Network layer networking – Providing the ability to find and route information on a global scale
- Application layer networking – Providing the ability to speak

OSI?

- The Open Systems Interconnect model was intended to allow changes to be made to one layer without impacting other layers.
- 7 Layers – like a cake from Brooklyn!
- Each layer encapsulates the information from the previous layer
- Today we use this as a reference model



Encapsulation



What is this TCP/IP that I keep hearing all about?

- TCP/IP is a suite of protocols which all Internet connected devices agree to support. These are BASIC protocols for connecting to the internet
- TCP is a transport control protocol for making “reliable” connections
- IP is a network layer protocol used for addressing devices globally
- IP Version 4 is the current standard
- Glacial speed migration to IP Version 6 is underway

What do I need to know?

- Without networks, computers today are pretty much useless!
- Networking involves a LOT of different disciplines
  - Physical infrastructure
  - Network routing
  - Application programming
  - Real-time systems
  - CyberSecurity

Why do I care?

- Imagine the current pandemic without an efficient way to communicate.
- Imagine your daily life without the Internet

What can I do?

- Write code for