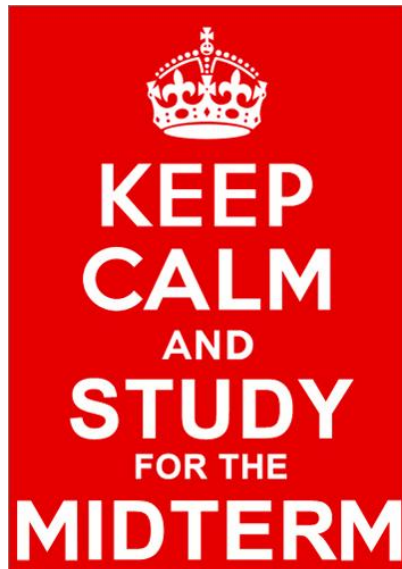


# ECE 356/COMPSI 356 Computer Network Architecture

## Midterm Review

Monday October 14th, 2019



## Midterm: Expectations

- Fundamental concepts
- Key algorithms / protocols

## Midterm Policy

- In class on Wednesday October 23<sup>rd</sup>, 1:25 PM – 2:40 PM
- Up to Wednesday October 16<sup>th</sup> lecture
- Closed book / notes
- No Internet
- Allowed:
  - A calculator
  - One two-sided hand-written page, written by you (letter-size)

## You Need to Know The Material Covered in Class

- Will not ask questions on material covered in the book but not in class
  - E.g., SONET framing, Bluetooth, message format in BGP
- Will ask questions on lecture materials not covered in the book. Materials not covered in the book includes:
  - Wireless channel properties
  - 5G communications
  - ICMP functionality
  - ...

5

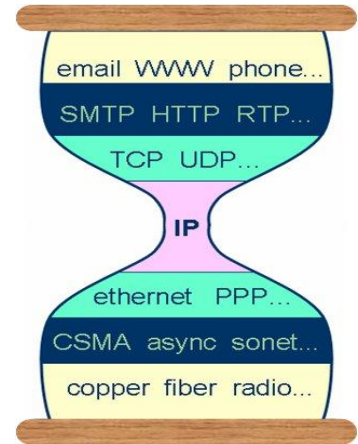
## Additional Study Materials

- HW1 solutions
- In-class quiz answers
  - Make sure you understand everything you did not get right
- Lab2 concepts and materials
  - If you are working in a group, please make sure to understand the parts done by your lab partner

6

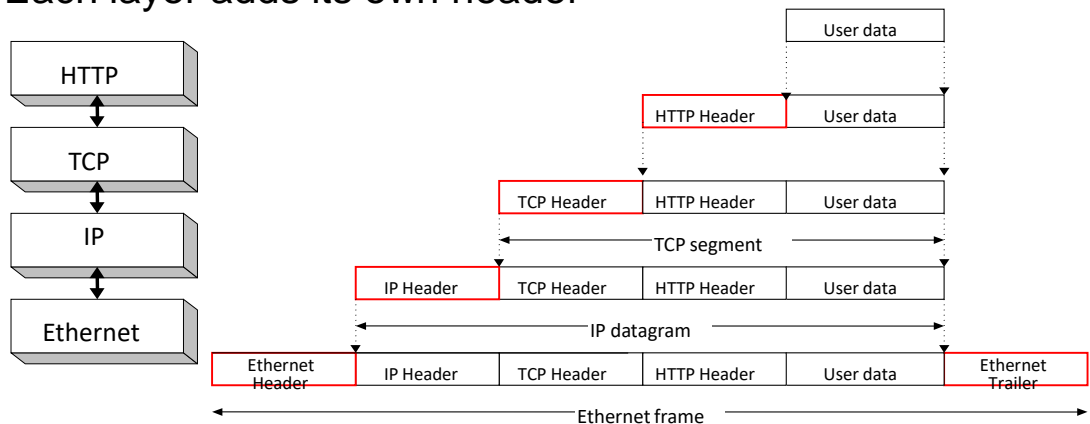
# What We've Learned: Network Architectures

- Basic concepts, Internet architecture
- Layering
- Protocol *peer* and *service* interfaces



## Encapsulation and Decapsulation on the Internet

- Each layer adds its own header



## What We've Learned: Hardware, Physical Layer, and Low-level Link Layer Functionality

- Covered by HW 1
- Different types of physical links
- Delay, bandwidth, throughput, delay-bandwidth product
- Shannon-Hartley channel capacity theorem
- Encoding, framing, error detection, reliable transmission

## What We've Learned: Ethernet

- Most successful LAN technology in the last 20 years
- Flat *unique* 6-byte address, e.g., C0:EE:FB:6D:8C:3D
  - Note how this is different from the IP address: no network prefix
- Multiple access on Ethernet: Carrier Sense Multiple Access with ***Collision Detection***
  - Sensing whether the channel is idle
  - Send jamming signal and wait after a collision
    - *Exponential backoff*: doubling the delay interval after each collision

## What We've Learned: Wireless Communications (1/3)

- Properties of wireless links
  - Much more complex than wired links
  - Attenuation, interference, multipath propagation
  - Signal to noise ratio, bit error rate

## What We've Learned: Wireless Communications (3/3)

- IEEE 802.11: ubiquitously used
  - Unlicensed spectrum bands, typically 2.4 GHz and 5 GHz
  - *Infrastructure* and *ad hoc* modes
  - Infrastructure mode AP-host relationships: hosts *associate* with access points
  - Multiple access: Carrier Sense Multiple Access with *Collision Avoidance*
    - Exchange control messages before transmitting information

## What We've Learned: Wireless Communications (3/3)

- Cellular communications & 5G
  - Uses *licensed spectrum*
  - Cellular technology *generations*
  - 5G: first cellular generation designed for a diverse set of connected devices
  - 5G's use of multiple frequency bands

## What We've Learned: Switching

- *Datagram* and *virtual circuit* switching
  - Datagram: connectionless
  - Virtual circuit: set up the connection state before sending packets
    - ATM is an example technology
- Ethernet switches
  - Learn forwarding tables
  - Form a spanning tree

## What We've Learned: IP Protocol (1/2)

- Delivering packets from a source to a destination across one or more IP networks
  - Addressing, routing
- Unreliable connection-less *best effort service (datagram service)*
- IP addressing
  - 32-bit globally unique identifier
  - *Network* and *host* part of the IP address
  - Classful vs. classless
  - CIDR notation, e.g., 128.143.137.144/24

## What We've Learned: IP Protocol (2/2)

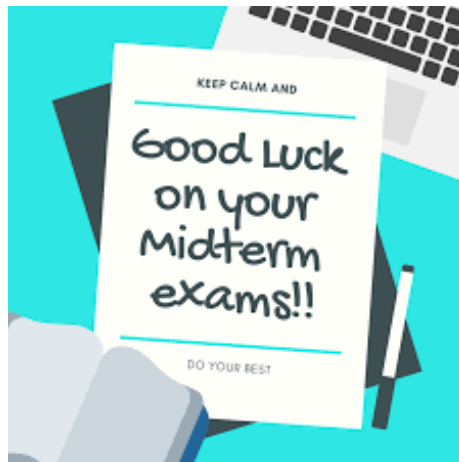
- Many details covered by Lab 2
- IP forwarding, longest prefix match
  - Routers forward according to network prefixes
- ARP
- ICMP



# What We've Learned: Routing

- See previous lecture for routing review materials

17



18