CS 4220: Computer Networks

Instructor: Xi Tan

Review

- Materials
  - Lectures, Homework assignments
- Topics
  - Chap 2 – The Application Layer
  - Chap 3 – The Transport Layer
  - Chap 4 – The Network Layer
  - Chap 5 – The Data Link Layer
  - Chap 6 – The Physical Layer and Wireless Access Network

- You are allowed to bring a US letter-sized cheat sheet (hand-written, front and back)

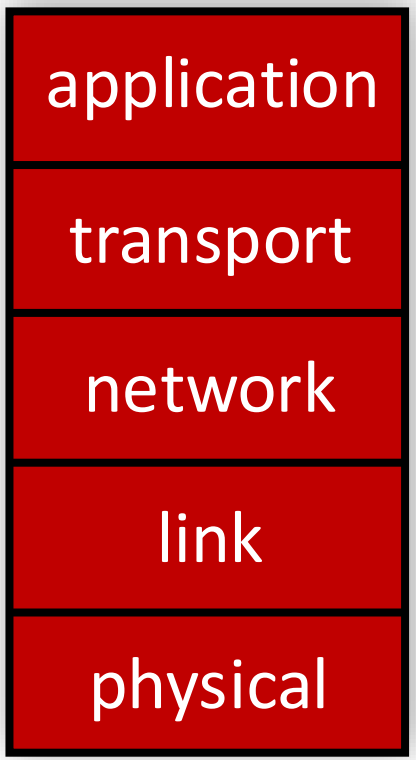
Review

- Type of questions
  - True/false questions
  - Multiple choice questions
  - Short answer questions
  - Other questions (calculation)

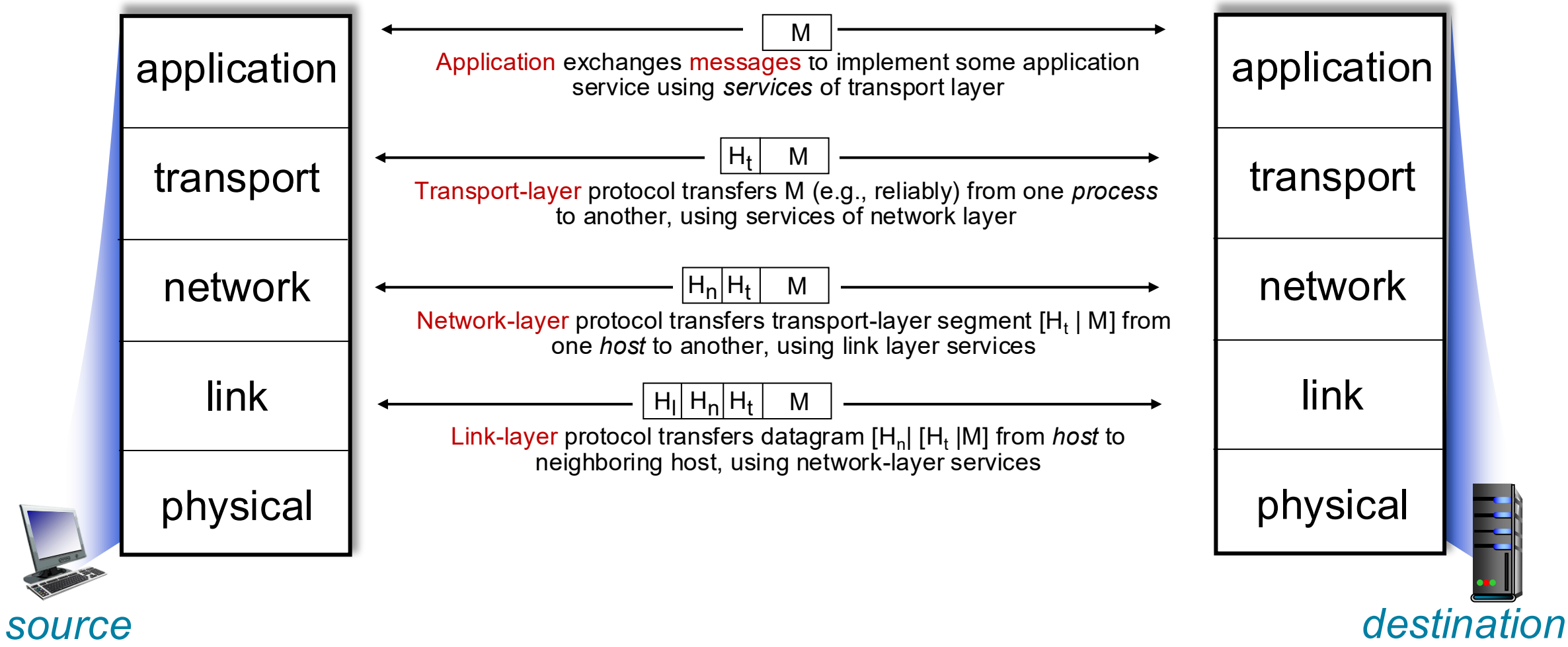
- Exam time:
  - Section **001** (class time: 4:45PM-6:00PM): 05/13 5:20 PM – 7:20 PM
  - Section **003** (class time: 12:15PM-1:30PM): 05/13 10:20 AM – 12:20 PM
- Exam location: Cybersecurity A107

Layered Internet protocol stack

- *application:* supporting network applications
  - HTTP, IMAP, SMTP, DNS
- *transport:* process-process data transfer
  - TCP, UDP
- *network:* routing of datagrams from source to destination
  - IP, routing protocols
- *link:* data transfer between neighboring network elements
  - Ethernet, 802.11 (WiFi), PPP
- *physical:* bits “on the wire”



Services, Layering and Encapsulation



Chap 2 – The Application layer

- Web
  - Non-persistent HTTP vs. persistent HTTP
- DNS
  - resolves high-level human readable names for computers to low-level IP addresses
  - iterative and recursive query

Chap 3 – The Transport layer

- Internet Protocols – UDP
- Internet Protocols – TCP
  - Connection establishment: How does the TCP protocol establish the connection?
  - Data transmission: How are the packets transmitted through the TCP connection? (TCP Client-Server Application)
  - TCP congestion control: additive increase multiplicative decrease (AIMD)
- The differences between UDP and TCP

Chap 4 – The Network layer

Data Plane

- ~~What's Inside a Router~~
- IP: the Internet Protocol
- ~~Generalized Forwarding~~
- ~~Internet Architecture~~

Control Plane

- Routing Algorithm
  - Link state (how the algorithm works)
  - Distance vector
- Intra-ISP routing: OSPF
- Routing Among ISPs: BGP
- SDN Control Plane
  - Advantages

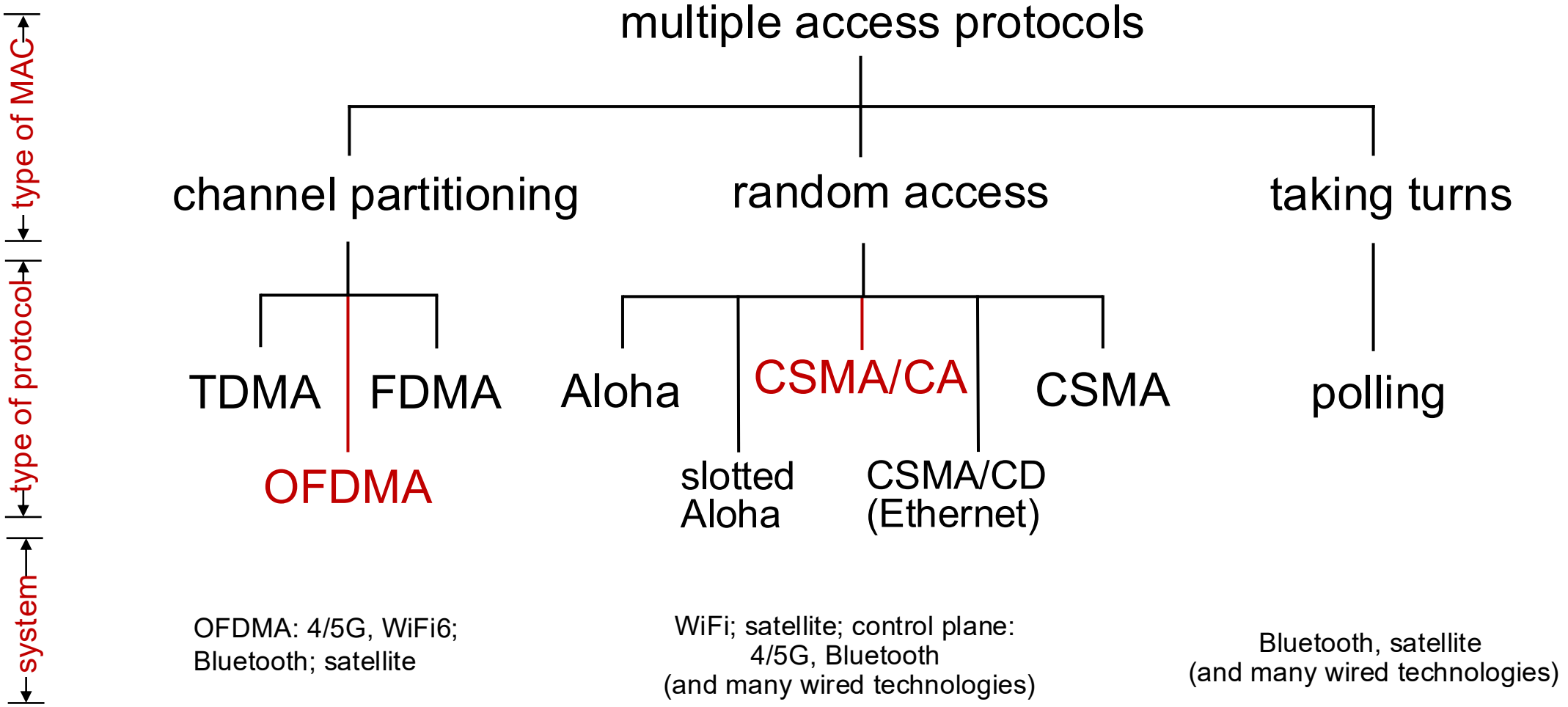
Chap 4 – The Network layer

- The Network Layer (IP) in the Internet
  - IP addressing
    - How to present an IP address?
    - Subnets
    - Longest prefix match
  - Internet Control Protocols
    - ICMP—The Internet Control Message Protocol
      - What does it use for?
    - ARP—The Address Resolution Protocol
      - How it is used in routing and delivery of IP datagrams
    - DHCP—The Dynamic Host Configuration Protocol
      - Works at the application layer

Chap 5 – The Data Link Layer

- Datalink Layer Services
  - Error detection and correction
    - Error detection
      - Parity bit (even and odd)
      - ~~Checksum~~
      - CRC: calculation
  - Physical addressing and ARP
    - A frame is the encapsulation of the header and trailer information with the packet
    - In the header, the source and destination MAC address are dealt
- Ethernet
  - Switch: functionalities, switch table, self-learning

Chap 6 –Wireless Access Network



Chap 6 –Wireless Access Network

- Sharing a wireless access channel: OFDMA, CSMA/CA
- Wireless LANs
  - Why we need CSMA/CA and how it works
  - Why we need VLANs?
- Bluetooth
  - Why we need the Bluetooth?
  - What is a piconet?
- Satellite
  - Applications

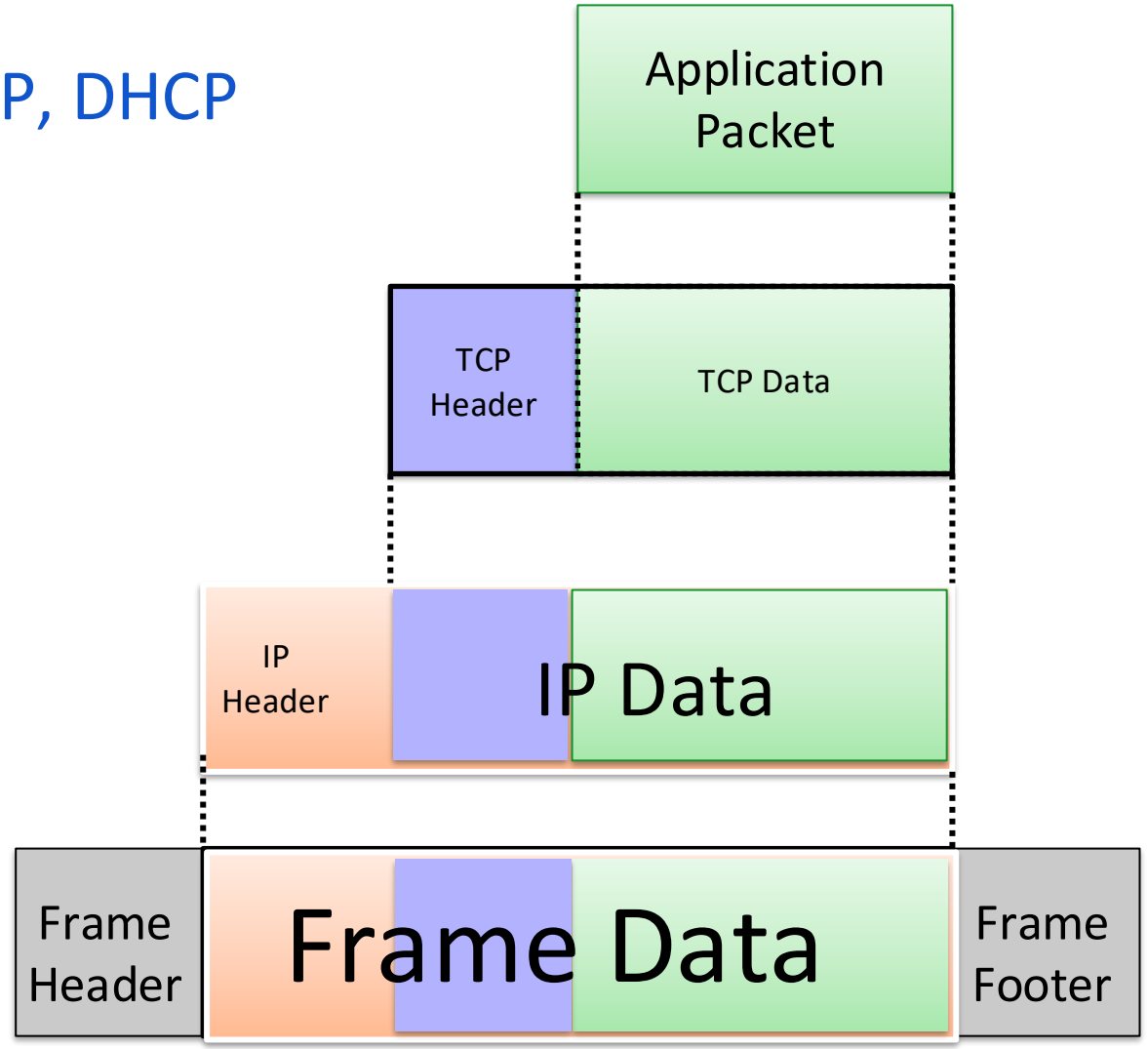
Internet Communication

DNS, SMTP, IMAP, DHCP

UDP, TCP

IP, ICMP

MAC, ARP, Ethernet, WiFi



Application Layer

Transport Layer

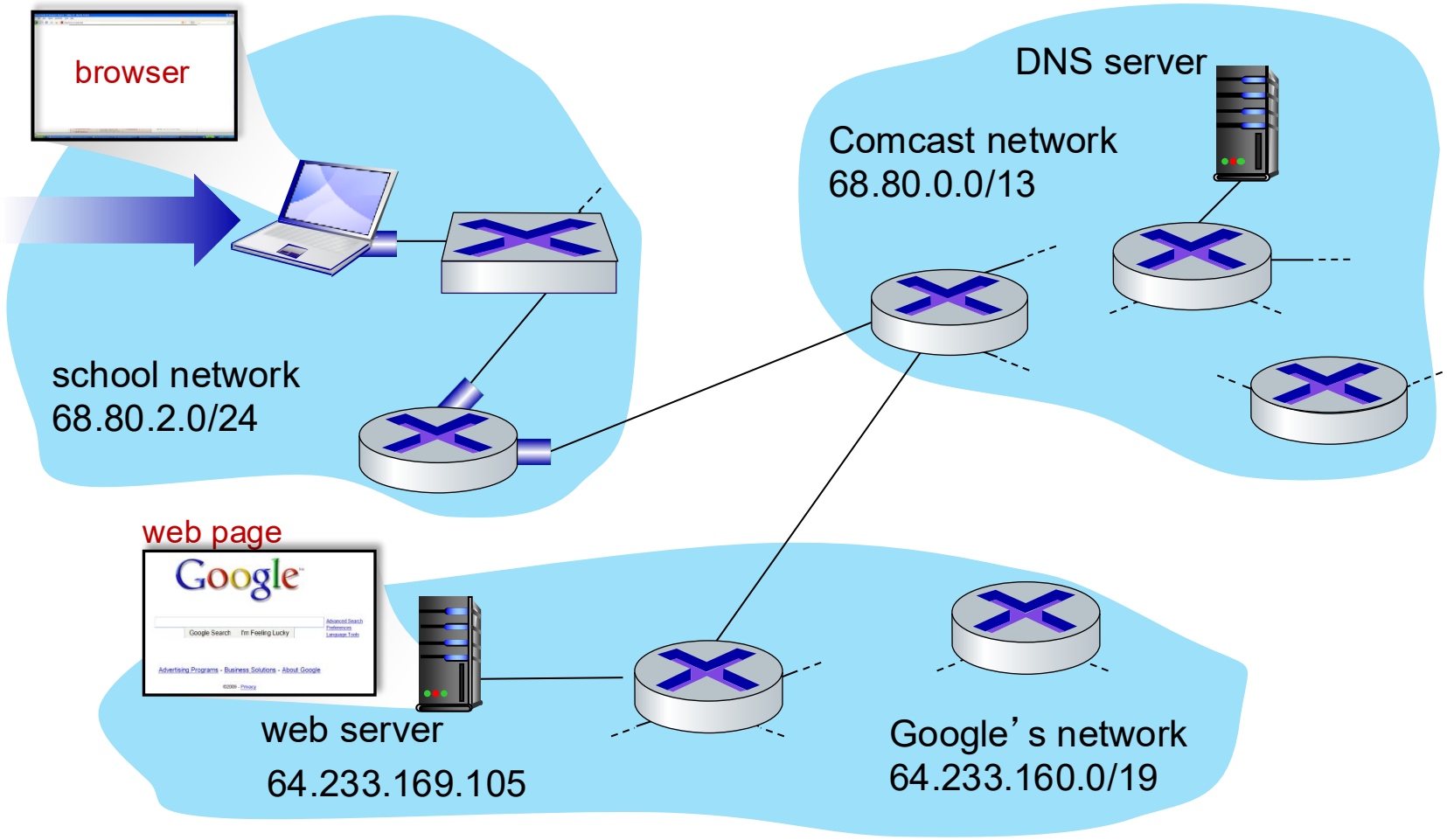
Network Layer

Link Layer

Synthesis: a day in the life of a web request

- application, transport, network, link
- putting-it-all-together: synthesis!
  - *goal:* identify, review, understand protocols (at all layers) involved in seemingly simple scenario: requesting www page
  - *scenario:* student connects laptop to campus network (Ethernet or WiFi), requests/receives www.google.com

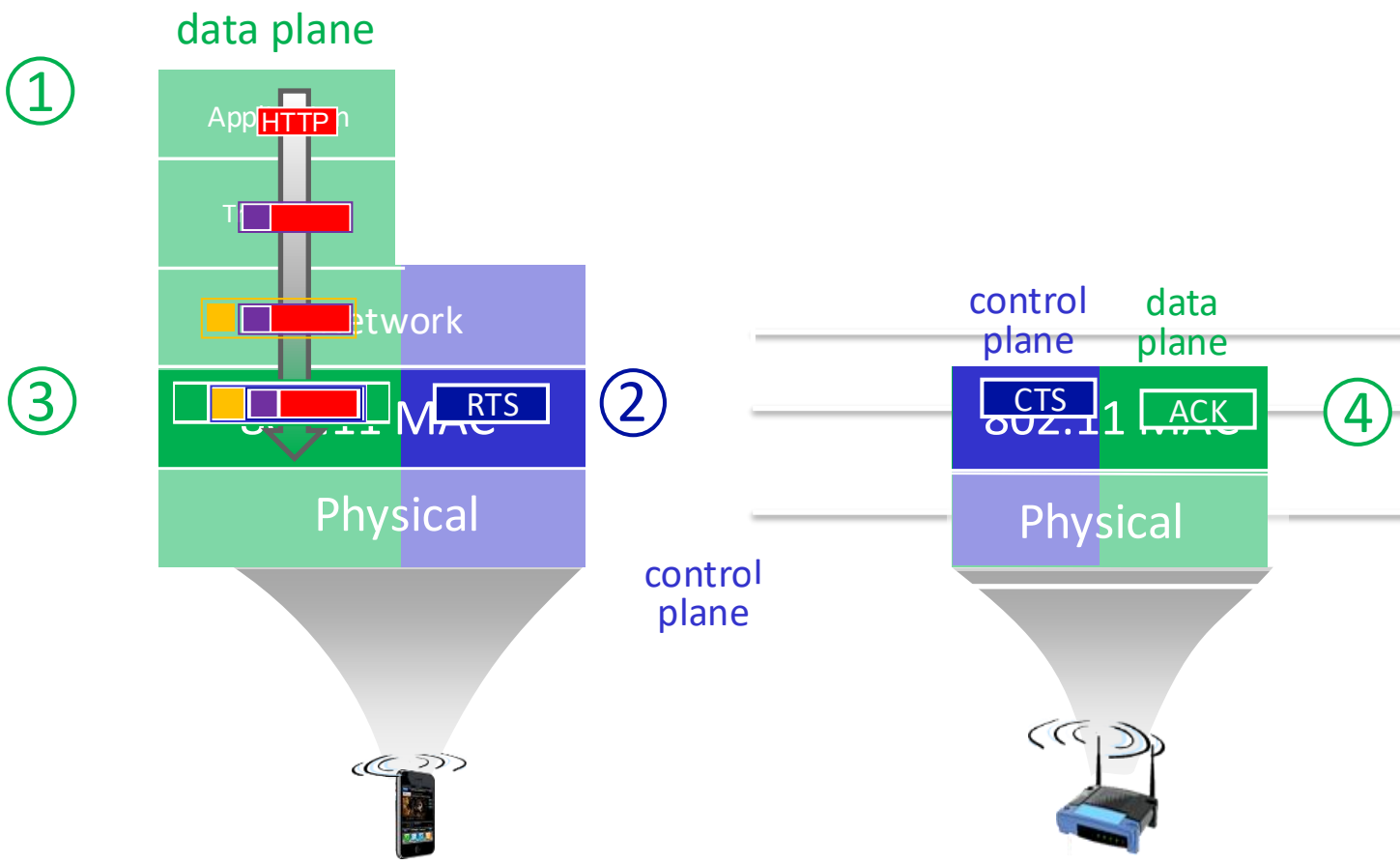
A day in the life: scenario



scenario:

- arriving mobile client attaches to network …
- requests web page: www.google.com

A day in the life* (WiFi)



1. HTTP/3 request in UDP segment, in IP datagram, into 802.11 frame. Enter, wait, MAC frame scheduling queue
2. Device sends RTS control frame (using CSMA/CA); AP responds with CTS.
3. Device sends DATA frame to AP. Buffers DATA frame
4. AP responds with ACK, device removes transmitted frame

AP can now forward frame to router

*https://gaia.cs.umass.edu/kurose_ross/videos/6/