

Chapter 5: The Data Link Layer

Our goals:

- ❑ understand principles behind data link layer services:
 - error detection, correction
 - sharing a broadcast channel: multiple access
 - link layer addressing
 - reliable data transfer, flow control: *done!*
- ❑ instantiation and implementation of various link layer technologies

Link Layer

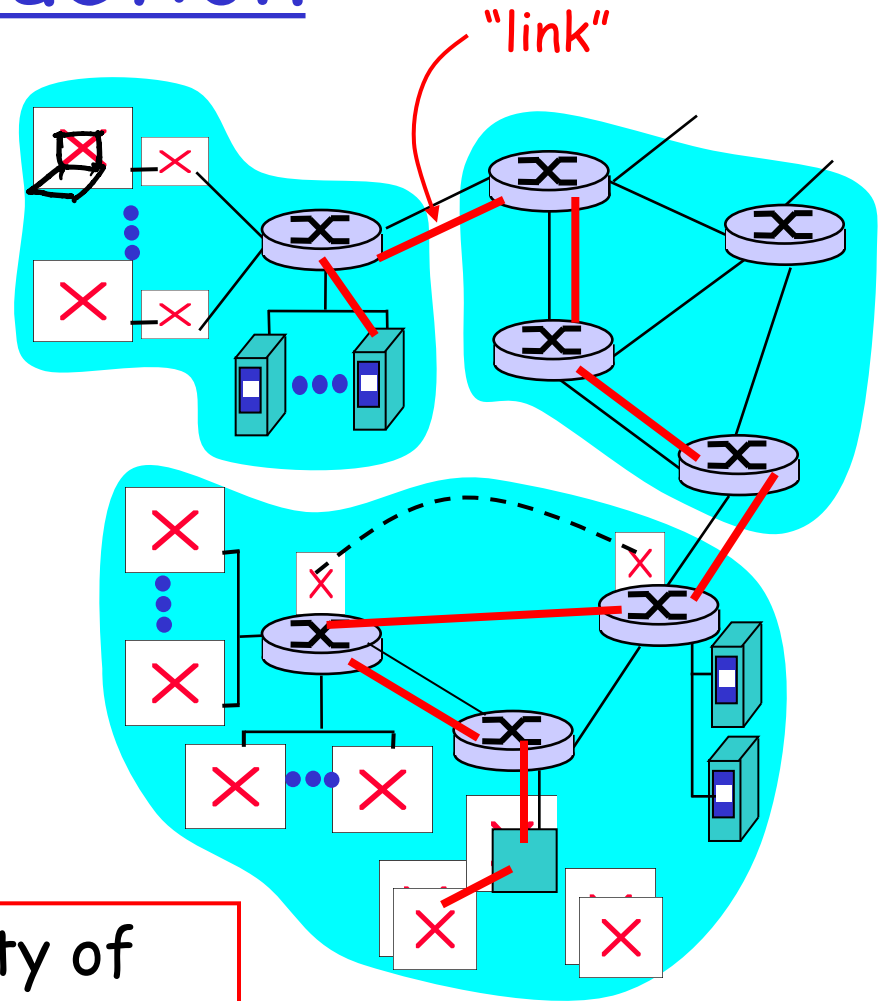
- 5.1 Introduction and services || 5%
- 5.2 Error detection and correction || 5%
- 5.3 Multiple access protocols || 65% Ethernet Wifi
- 5.4 Link-Layer Addressing || 10%
- 5.5 Ethernet
- 5.6 Hubs and switches || 15%
- 5.7 PPP

↓
wireless-

Link Layer: Introduction

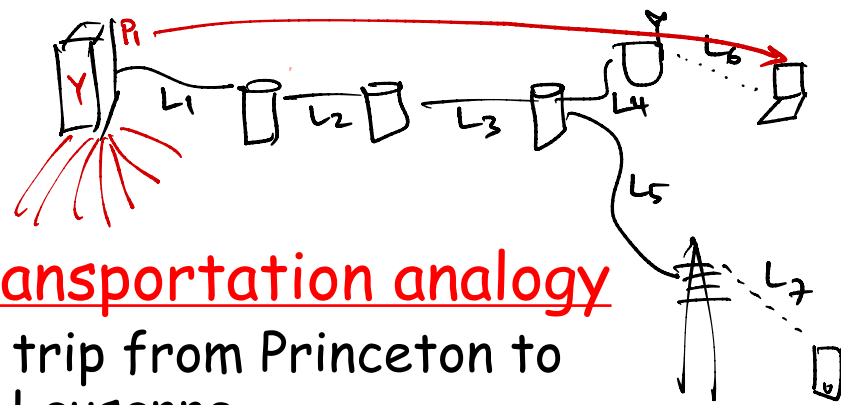
Some terminology:

- ❑ hosts and routers are **nodes**
- ❑ communication channels that connect adjacent nodes along communication path are **links**
 - wired links
 - wireless links
 - LANs
- ❑ layer-2 packet is a **frame**, encapsulates datagram



data-link layer has responsibility of transferring datagram from one node to adjacent node over a link

Link layer: context



- Datagram transferred by different link protocols over different links:

- e.g., Ethernet on first link, frame relay on intermediate links, 802.11 on last link

- Each link protocol provides different services

Traffic lights,
Airport control,
Platform scheduling,

transportation analogy

- trip from Princeton to Lausanne
 - limo: Princeton to JFK
 - plane: JFK to Geneva
 - train: Geneva to Lausanne
- tourist = **datagram**
- transport segment = **communication link**
- travel agent = **routing algorithm**
- transportation access = **link layer protocol**

Link Layer Services

❑ Framing, link access:

- encapsulate datagram into frame, adding header, trailer
- channel access if shared medium
- "MAC" addresses used in frame headers to identify source, dest
 - different from IP address!

*Medium
Access
Control.*

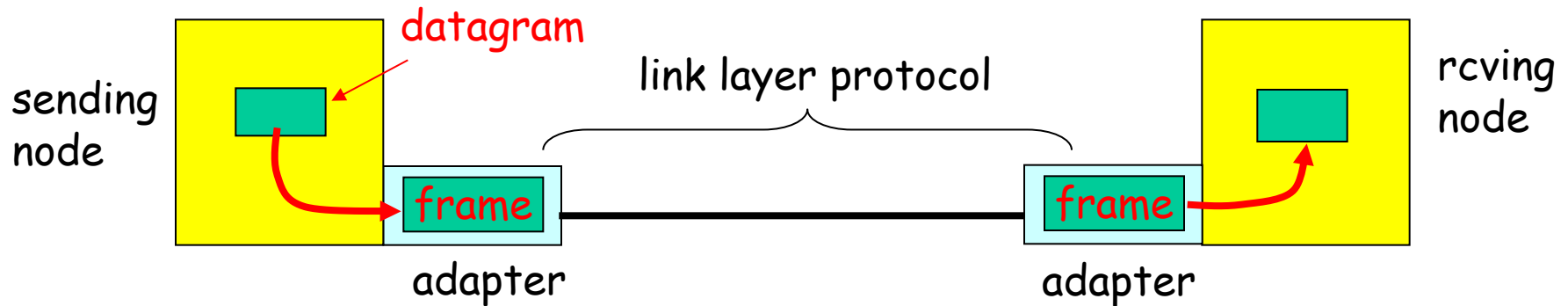
❑ Reliable delivery between adjacent nodes

- we learned how to do this already (chapter 3)!
- seldom used on low bit error link (fiber, some twisted pair)
- wireless links: high error rates
 - Q: why both link-level and end-end reliability?

Link Layer Services (more)

- ❑ *Flow Control:* ✓
 - pacing between adjacent sending and receiving nodes
- ❑ *Error Detection:*
 - errors caused by signal attenuation, noise.
 - receiver detects presence of errors:
 - signals sender for retransmission or drops frame
- ❑ *Error Correction:*
 - receiver identifies *and corrects* bit error(s) without resorting to retransmission
- ❑ *Half-duplex and full-duplex*
 - with half duplex, nodes at both ends of link can transmit, but not at same time

Adaptors Communicating



- ❑ link layer implemented in "adaptor" (aka NIC)
 - Ethernet card, PCMCIA card, 802.11 card
- ❑ sending side:
 - encapsulates datagram in a frame
 - adds error checking bits, rdt, flow control, etc.
- ❑ receiving side
 - looks for errors, rdt, flow control, etc
 - extracts datagram, passes to rcvng node
- ❑ adapter is semi-autonomous
- ❑ link & physical layers