

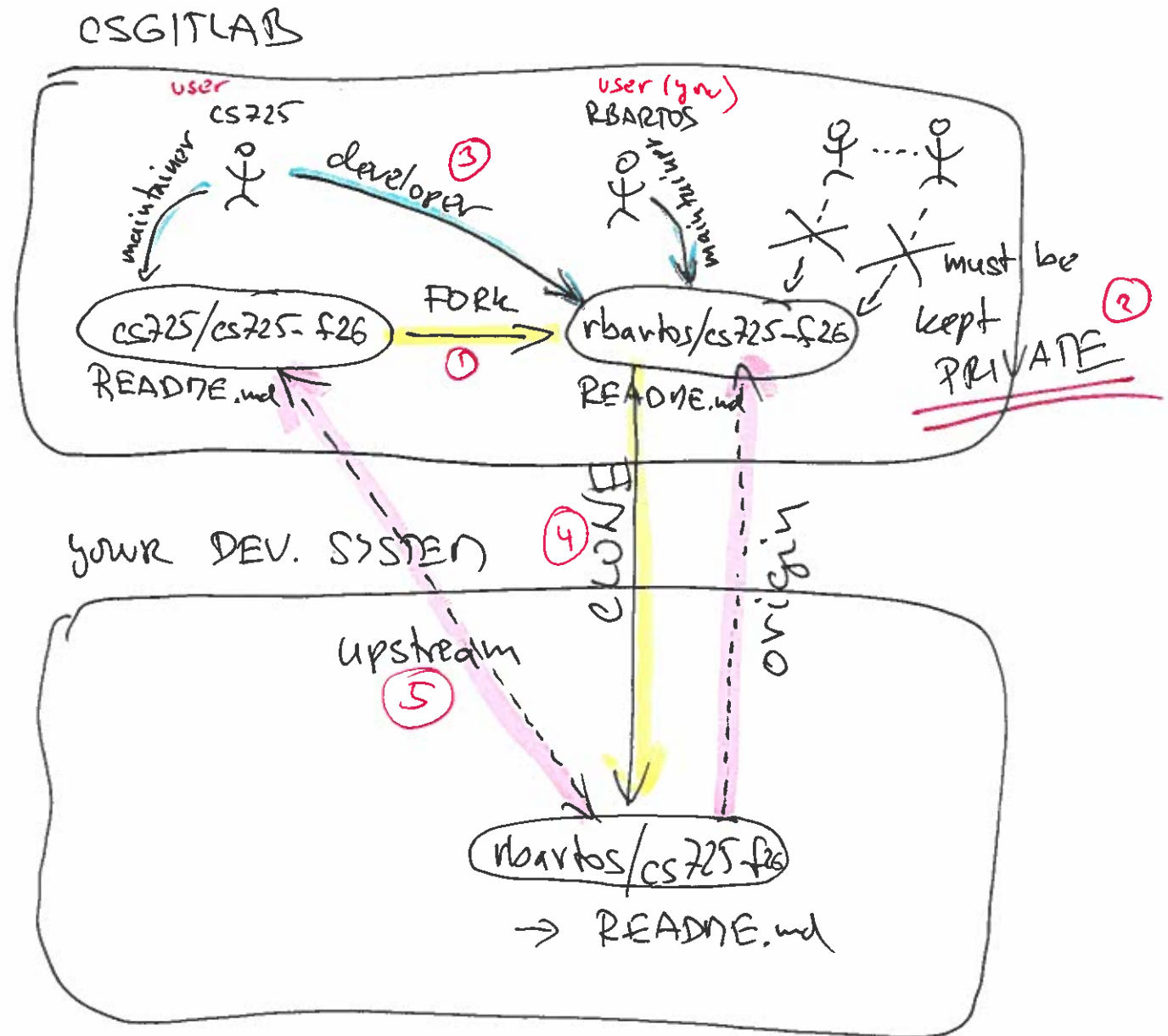
CS 725/825 & IT 725

Lecture 2

Basic Concepts

September 2, 2026

COURSE GITLAB SETUP



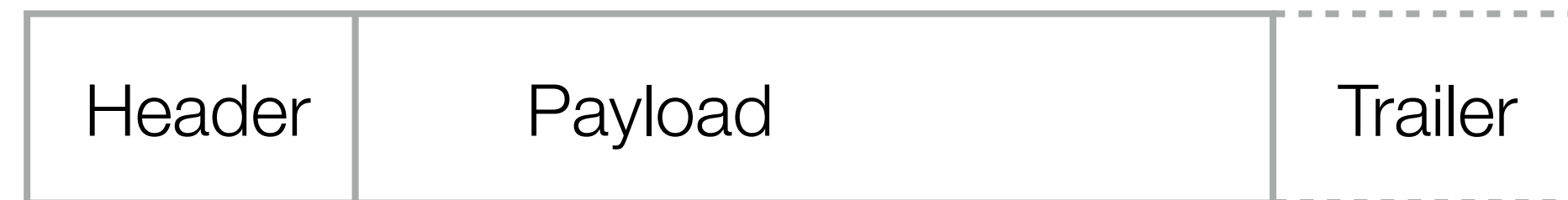
Basic Terms

► Protocol

- An agreement on how a communication is to proceed

► Packet (frame, message, datagram, cell,)

- header, data (payload), trailer



► ?-cast

- unicast, multicast, broadcast, anycast, ...

► Single hop vs. multihop

Communication medium types

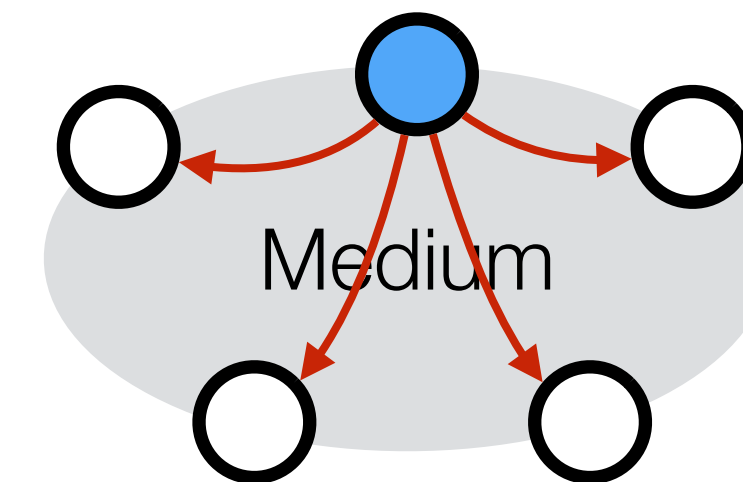
► Point to point

- between two participants
- simplex, duplex, full duplex
- no need for addressing



► Broadcast and select

- multiple nodes attached to a shared medium
- everyone hears every transmissions (*broadcast*)
- addresses needed to *select* transmission intended for a node



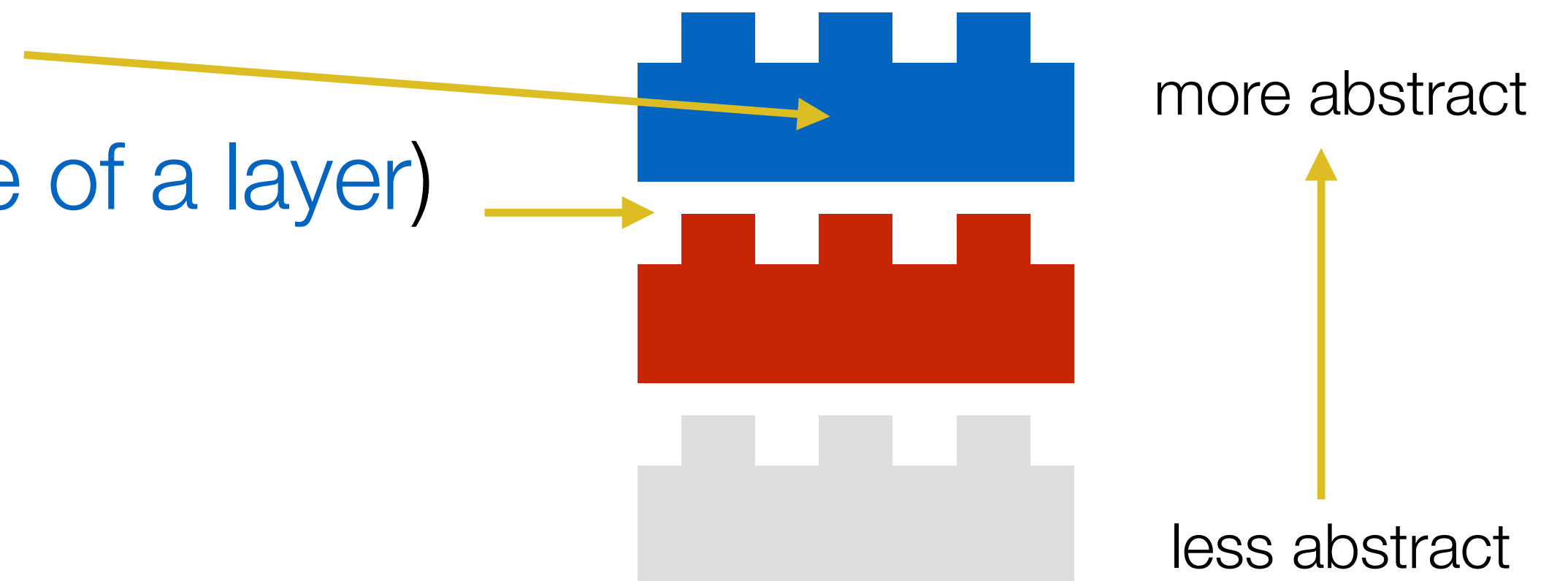
Layered models

► Motivation

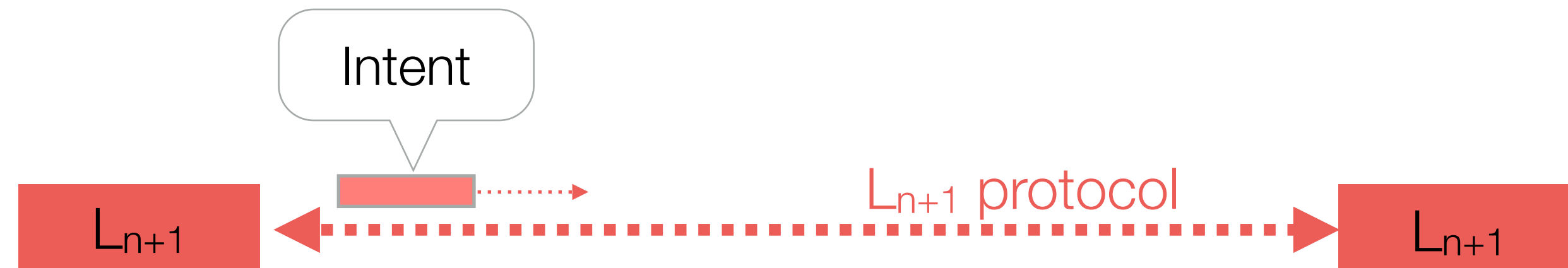
- networks require many different types of expertise
- need to mix-and-match

► Characteristics

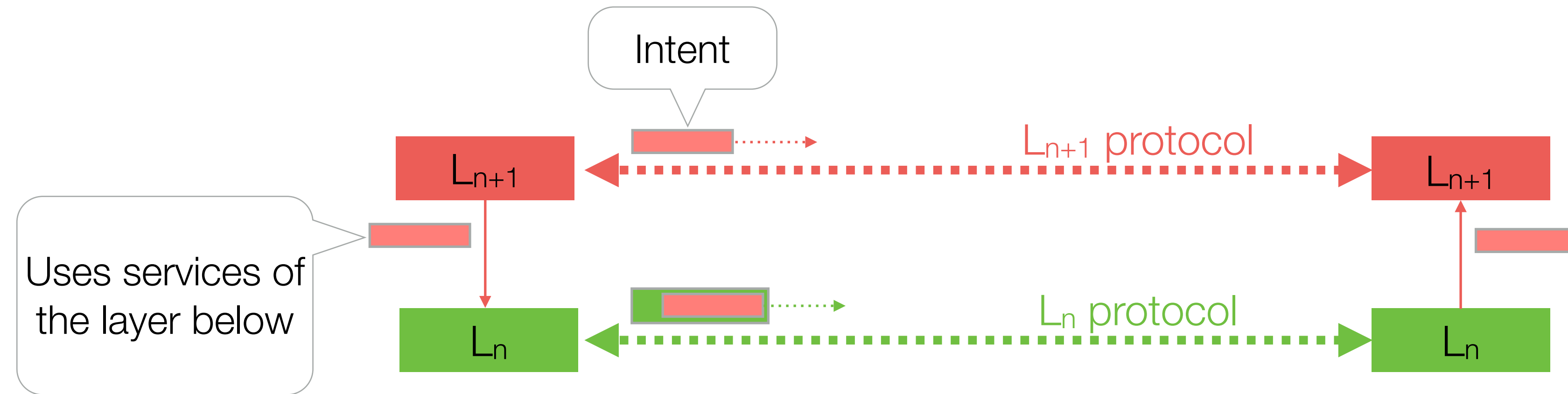
- black box functionality (abstraction)
- simple, well defined interfaces (*service of a layer*)
- vertically stacked



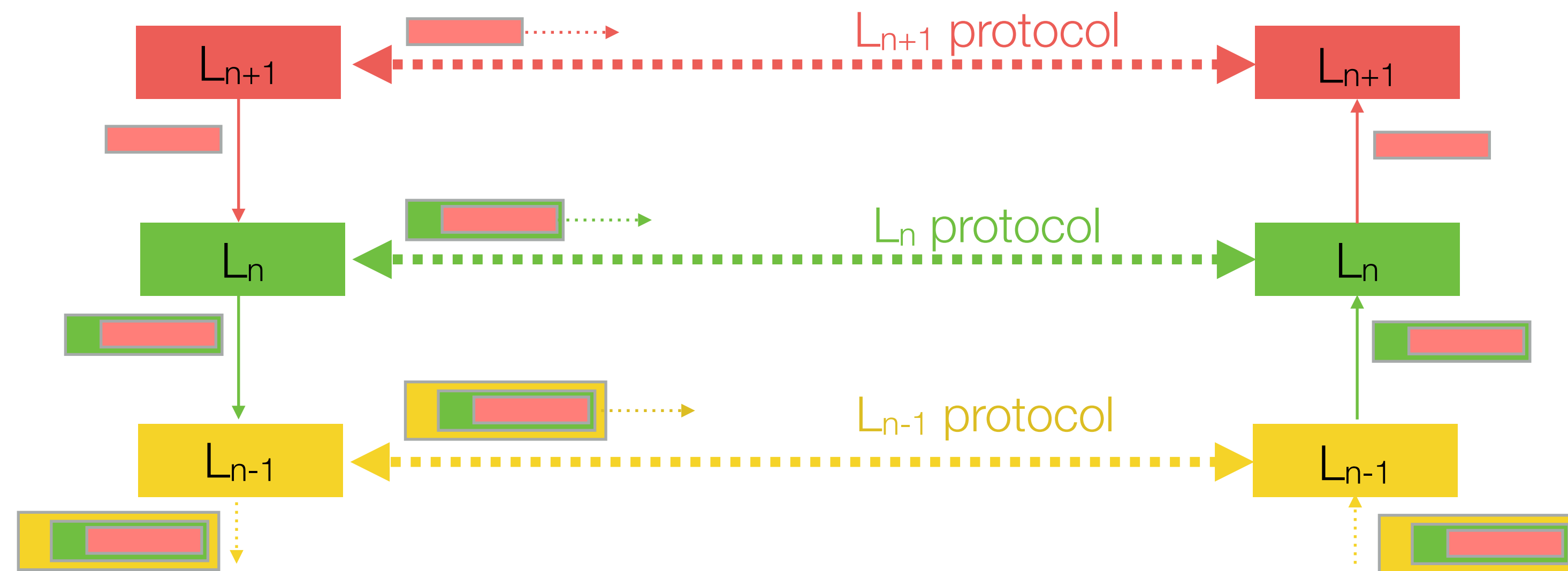
Protocol hierarchy



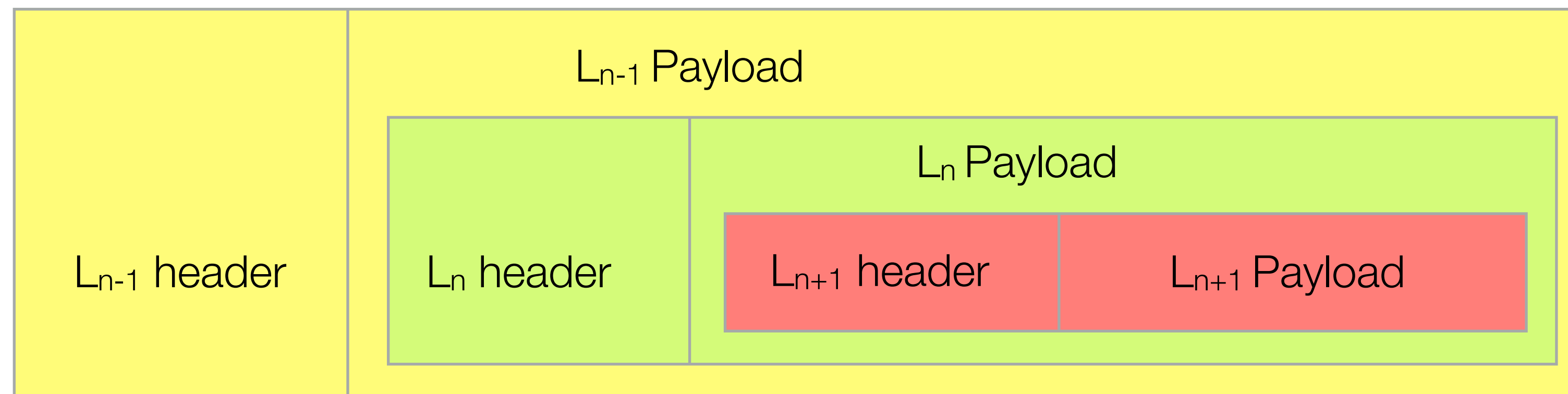
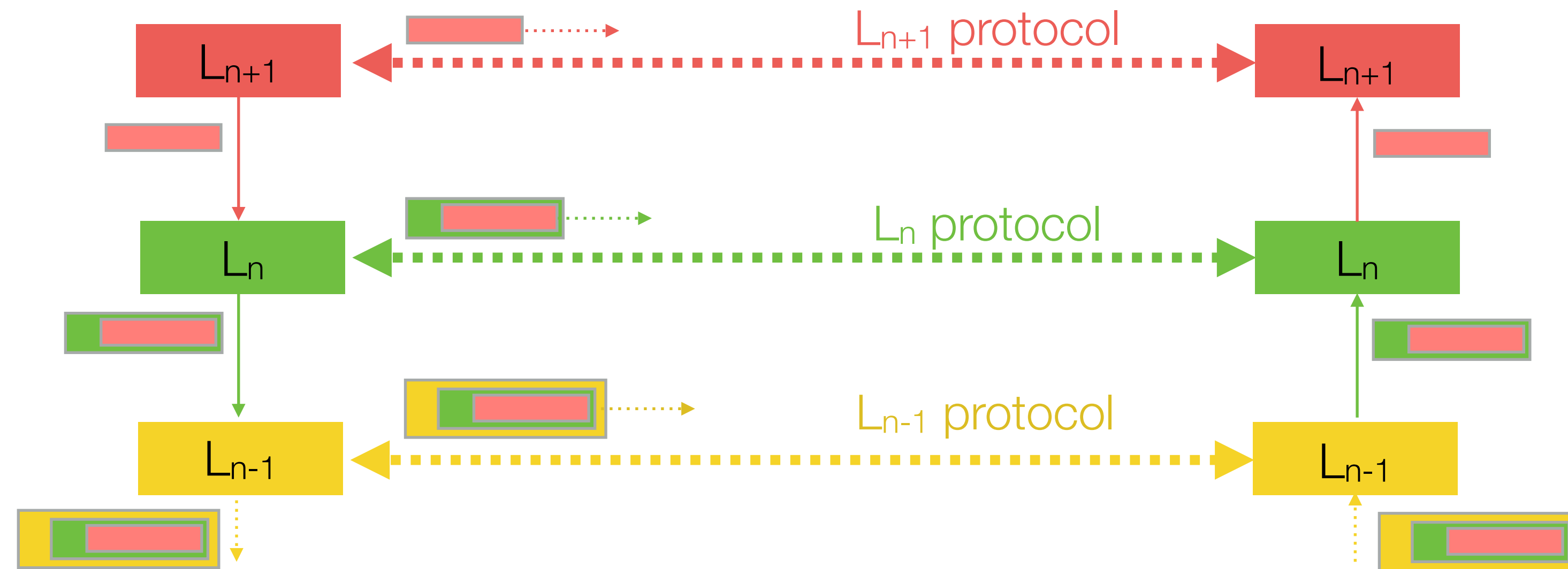
Protocol hierarchy



Protocol hierarchy

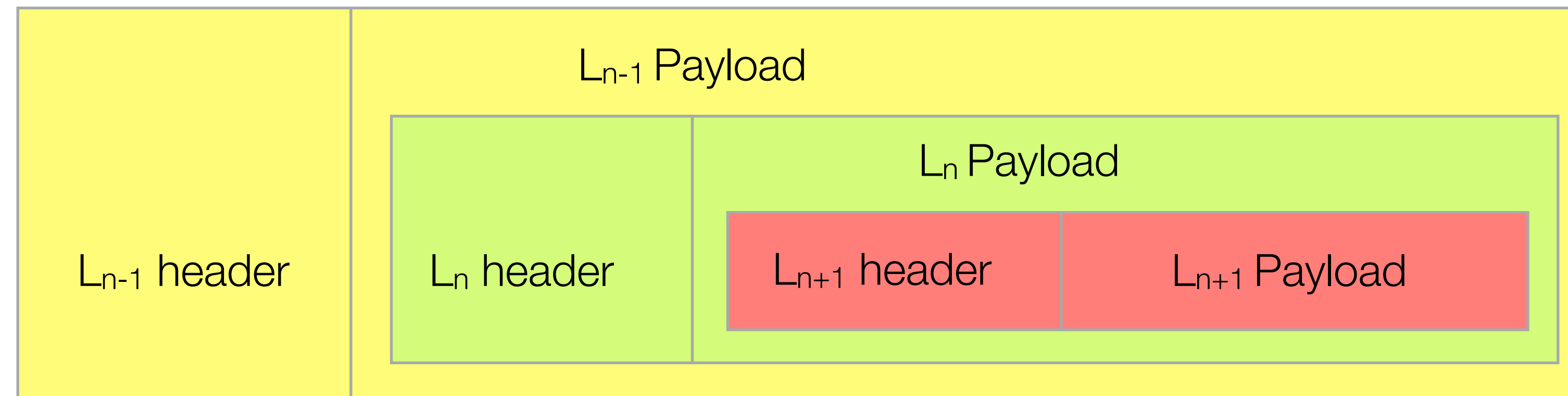


Protocol hierarchy



Protocol hierarchy

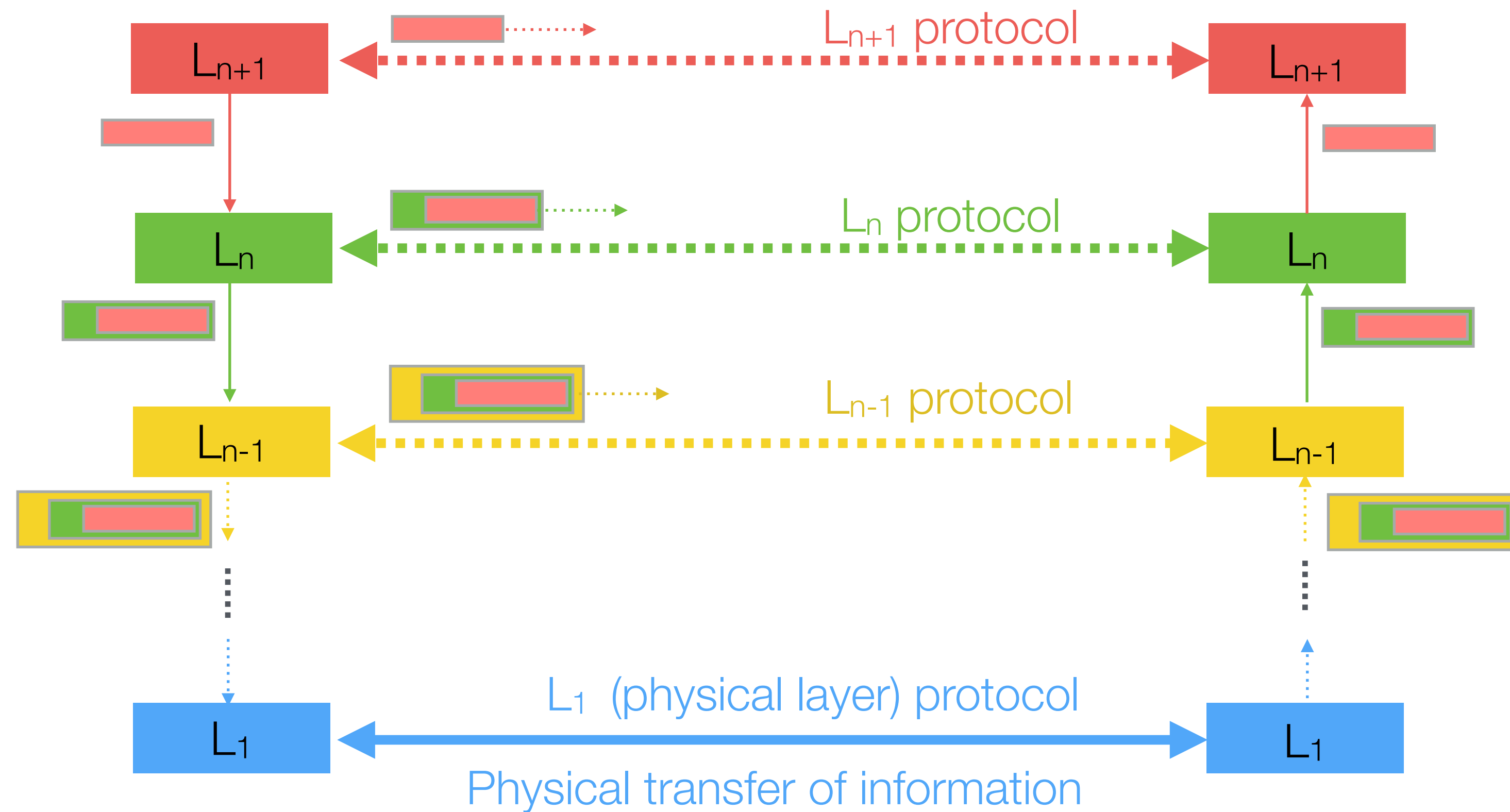
► Conceptual view



► Real protocol example



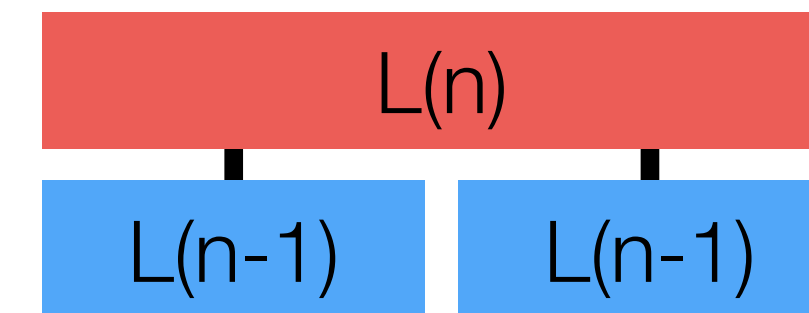
Protocol hierarchy



Multiple layer implementations

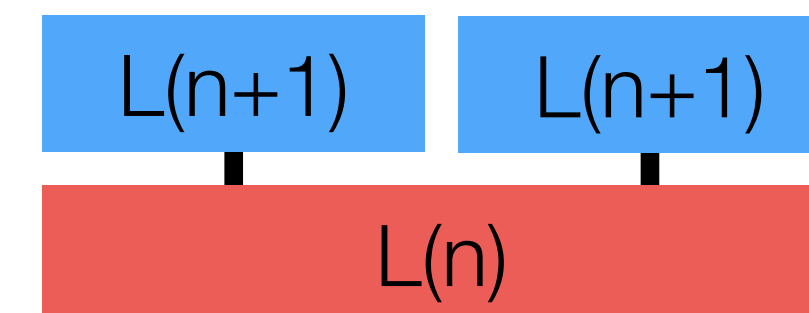
- ▶ Multiple lower layers

- Example: wired and wireless Ethernet



- ▶ Multiple higher layers

- Example: email and web



OSI 7-Layer Model

- ▶ L7 - **Application**
- ▶ L6 - **Presentation** - data representation
- ▶ L5 - **Session** - open/close/maintain session
- ▶ L4 - **Transport** - end-to-end error and flow control
- ▶ L3 - **Network** - end-to-end delivery (routing)
- ▶ L2 - **Link** - node-to-node delivery (single hop)
- ▶ L1 - **Physical** - send bits over a physical channel

“Internet” layers today

▶ L7 - Application

▶ L6 - Presentation

▶ L5 - Session

▶ L4 - Transport

▶ L3 - Network

▶ L2 - Link

▶ L1 - Physical

▶ L7 - Application

▶ L4 - Transport

▶ L3 - Network

▶ L1 & L2 - Link &
Physical

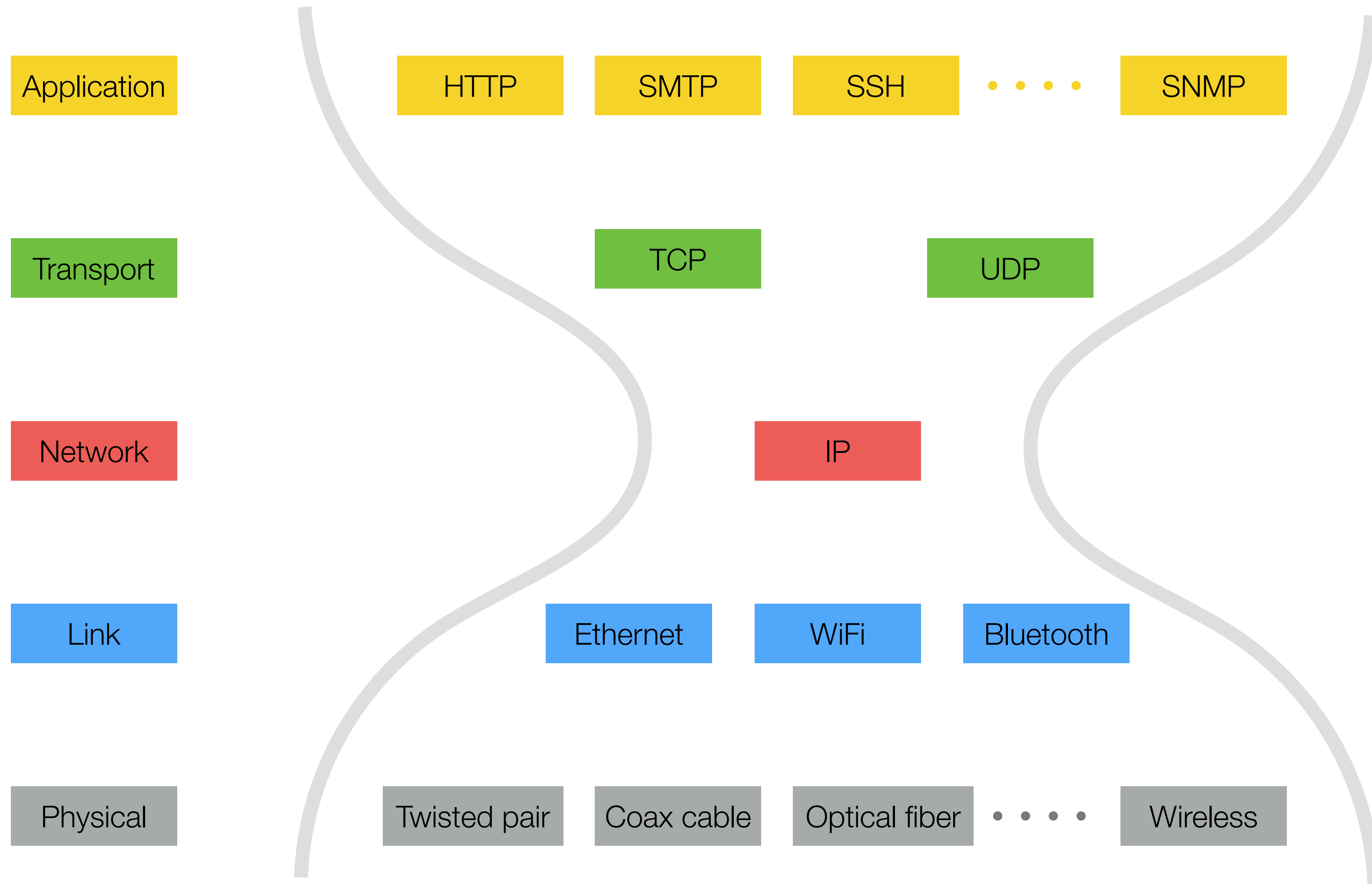
“Internet” layers today

- | | |
|---------------------|-----------------------------|
| ▶ L7 - Application | ▶ L7 - Application |
| ▶ L6 - Presentation | “security layer” |
| ▶ L5 - Session | ▶ L4 - Transport |
| ▶ L4 - Transport | |
| ▶ L3 - Network | ▶ L3 - Network |
| ▶ L2 - Link | ▶ L1 & L2 - Link & Physical |
| ▶ L1 - Physical | |

Internet protocol examples

- ▶ **Application** layer
 - HTTP/**HTTPS**, SMTP (email), streaming, messaging, etc.
- ▶ **Security** layer: **TLS** (a.k.a. SSL)
- ▶ **Transport** layer
 - **TCP**, UDP
- ▶ **Network** layer
 - IPv4, **IPv6**
- ▶ **Link & Physical** layer
 - Wired Ethernet, WiFi, etc.

Internet “Hourglass”



Protocols going forward

► QUIC and HTTP/3

- Enhanced HTTP over TLS 1.3 over UDP over IP ...
- Developed by Google and becoming widely deployed
- Design goal: reduction of transaction latency
- Implemented in the user space (application)