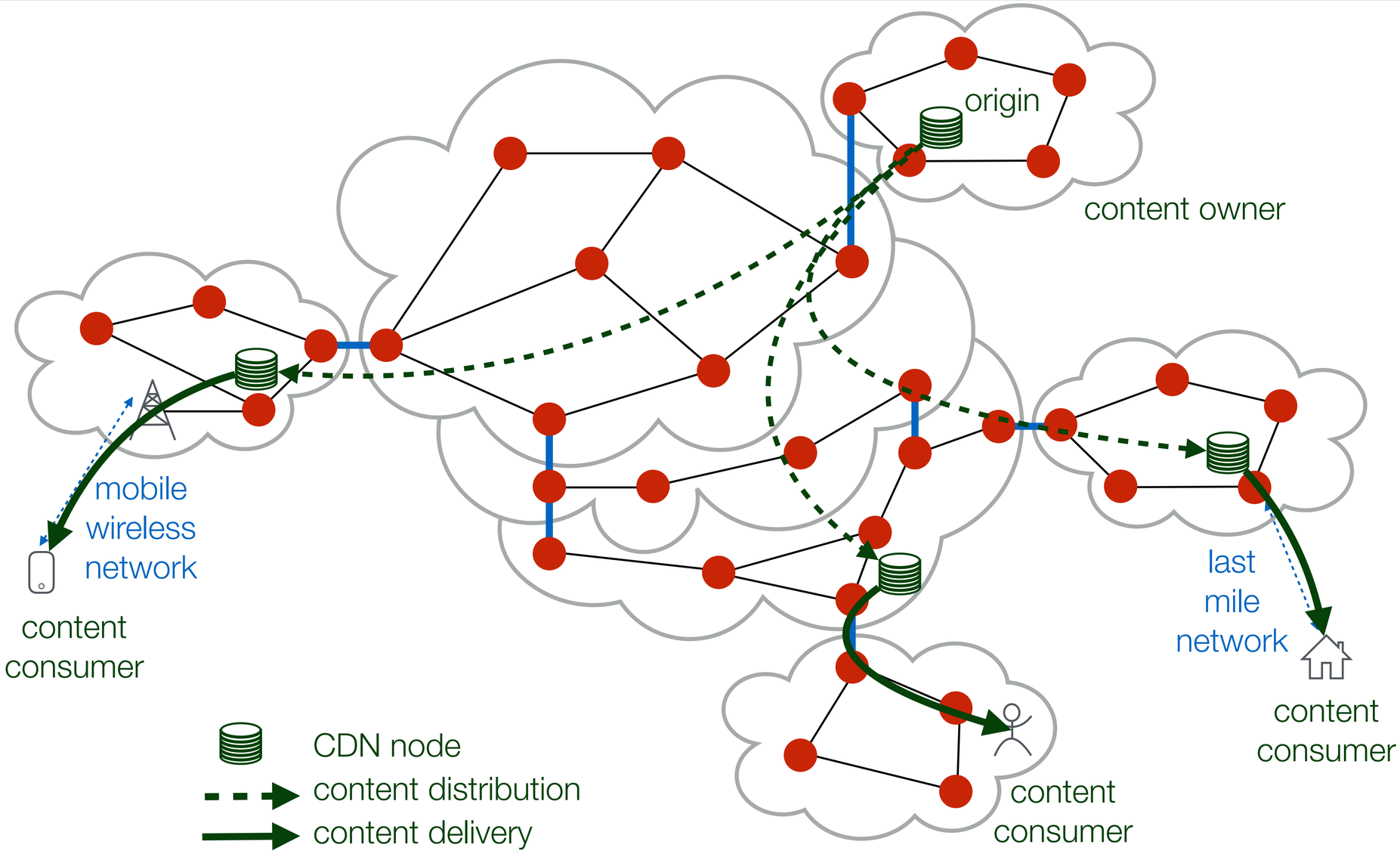
CS 725/825 & IT 725

Lecture 2

Basic Concepts

August 27, 2025

Content Delivery Network (CDN)

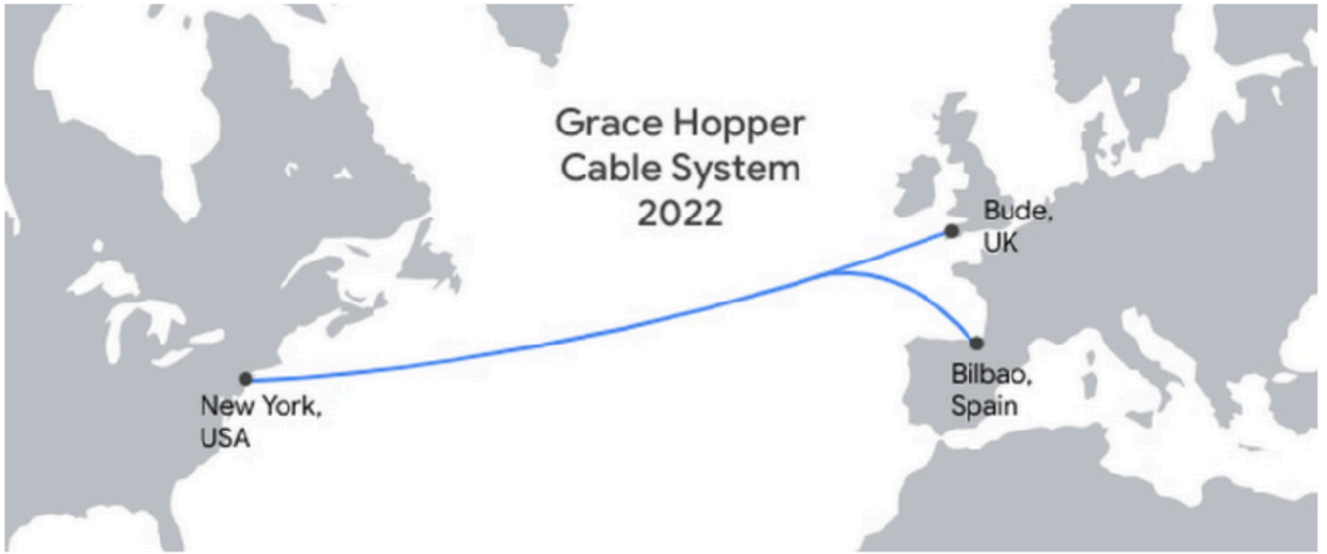


Our Grace Hopper subsea cable has landed in the UK

Sep 14, 2021 · 2 min read


Jayne Stowell
Strategic Negotiator, Global Infrastructure, Google Cloud

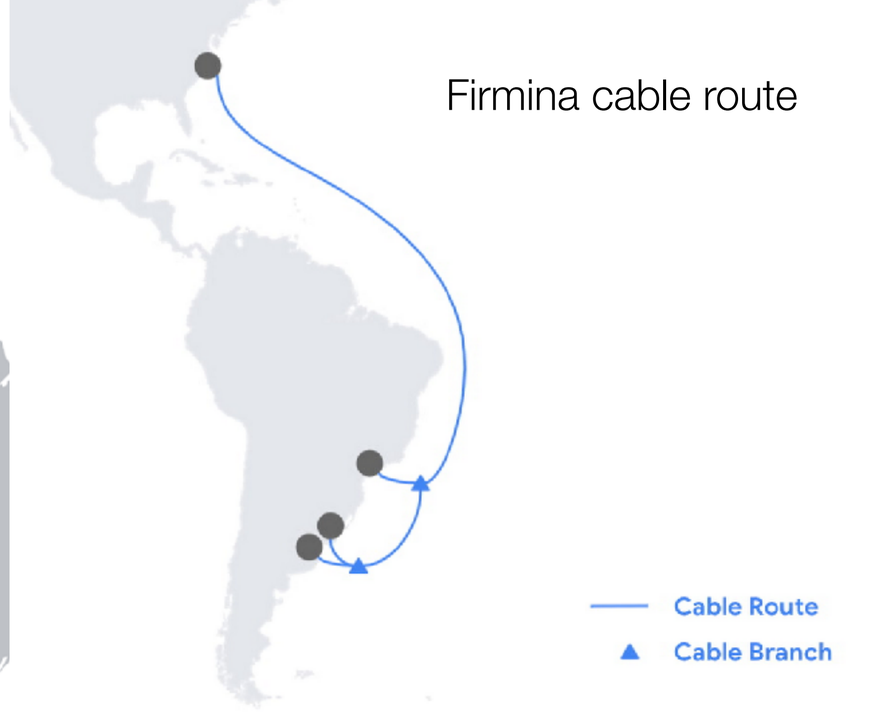
Share



Last year, we announced a new subsea cable — named Grace Hopper after the

Curie cable route

Firmina cable route



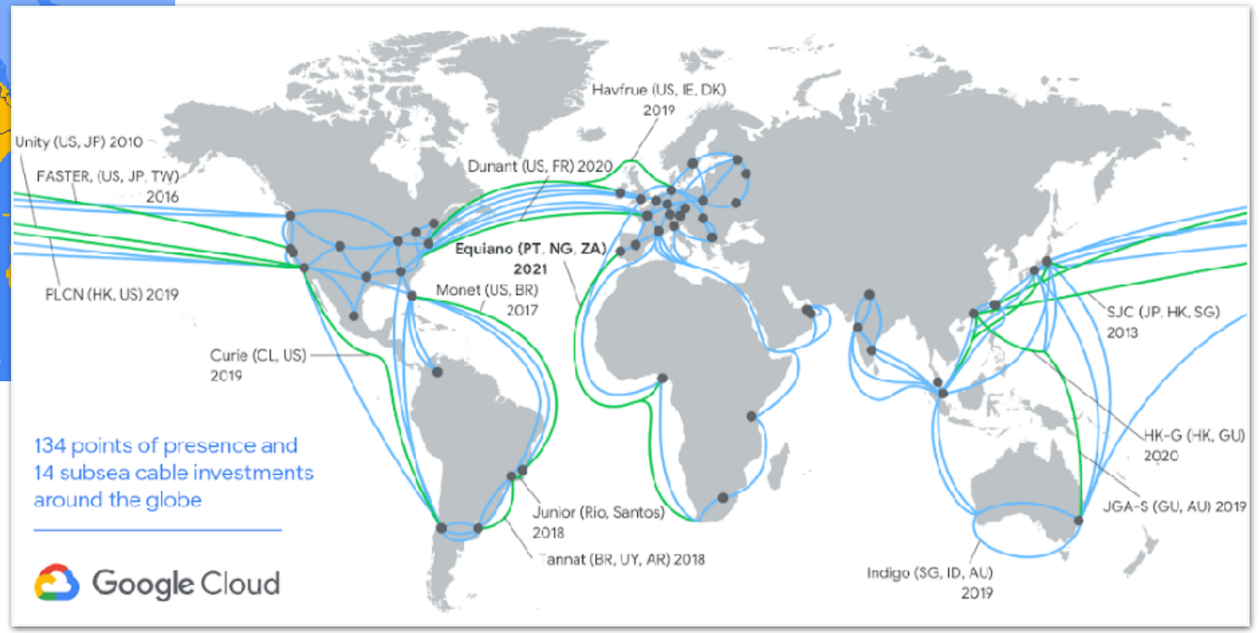


Image sources: Google Could Blog (https://cloud.google.com/blog/products/infrastructure/curie-subsea-cable-set-to-transmit-to-chile-with-a-pit-stop-to-panama https://cloud.google.com/blog/products/infrastructure/announcing-the-firmina-subsea-cable https://cloud.google.com/blog/products/infrastructure/introducing-equiano-a-subsea-cable-from-portugal-to-south-africa)

Other network categories

- Datacenter and Storage Networks
- Personal Area Network (PAN)
- Sensor networks, Internet of Things (IoT), Cyber-Physical Systems
- Mobile and Vehicular networks
- Home automation
- Industrial networking
- etc…

Basic Concepts

Basic Terms

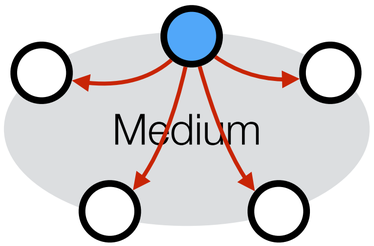
- Protocol
  - An agreement on how a communication is to proceed
- Packet (frame, message, datagram, cell, ...)
  - header, data (payload), trailer

- ?-cast
  - unicast, multicast, broadcast, anycast, ...
- Single hop vs. multihop

Communication medium types

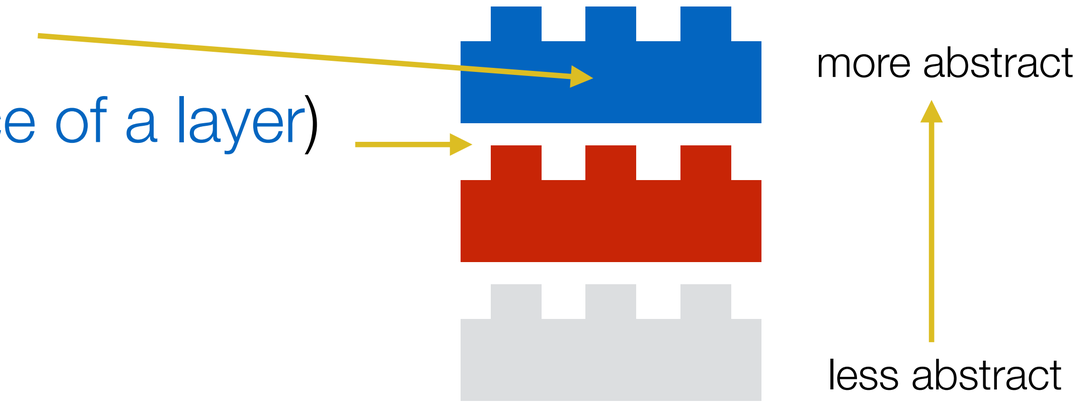
- Point to point
  - between two participants
  - simplex, duplex, full duplex
  - no need for addressing

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



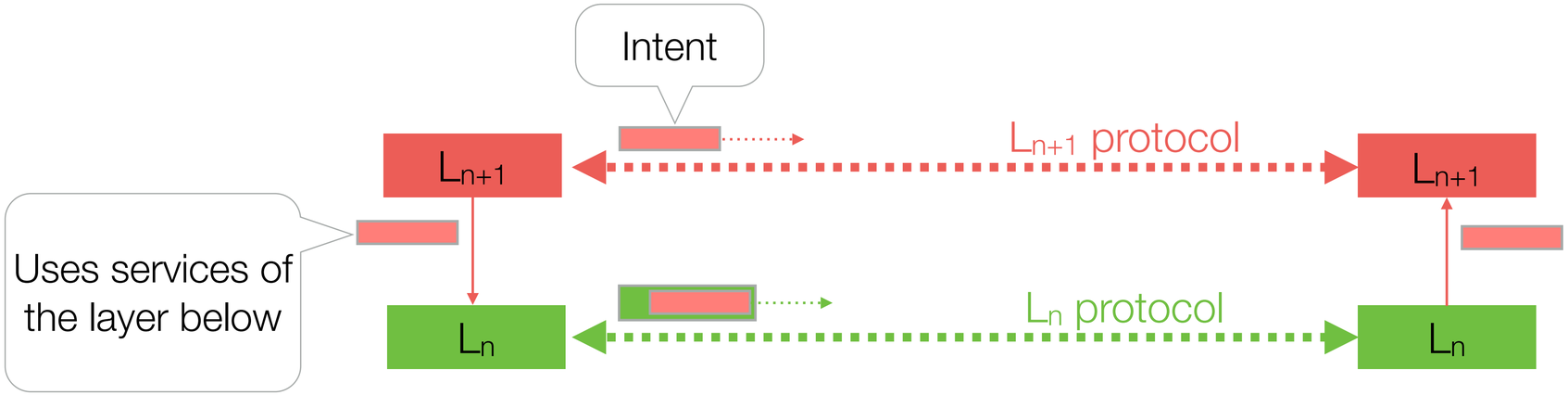
Layered models

- 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



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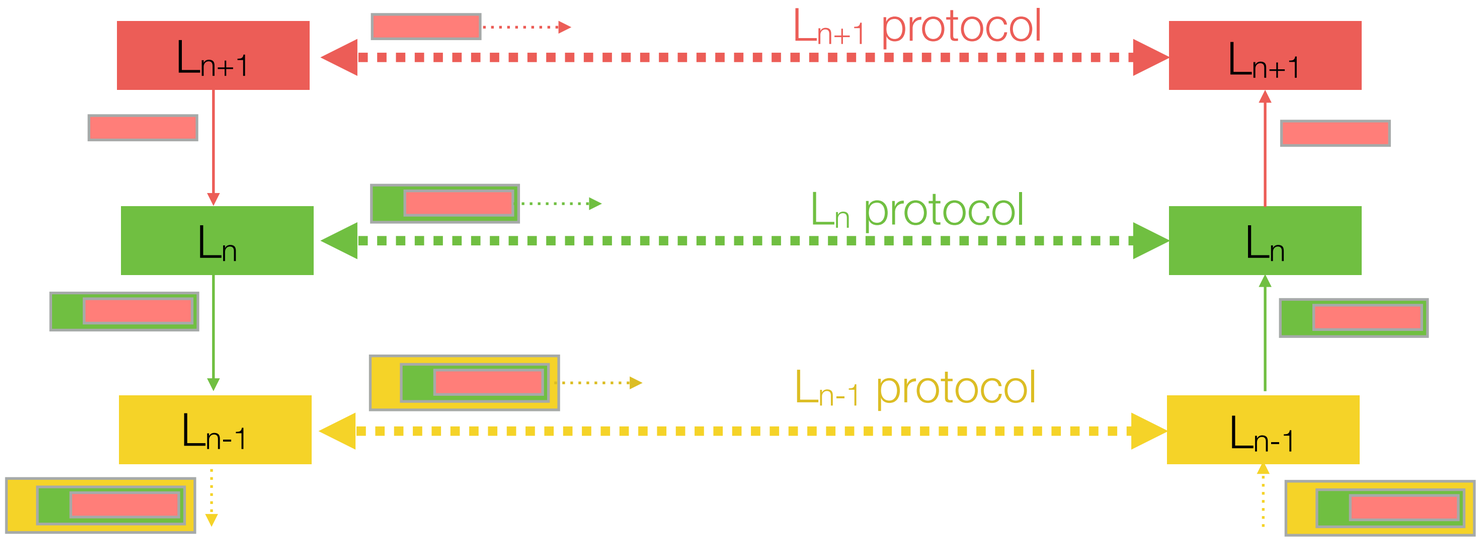
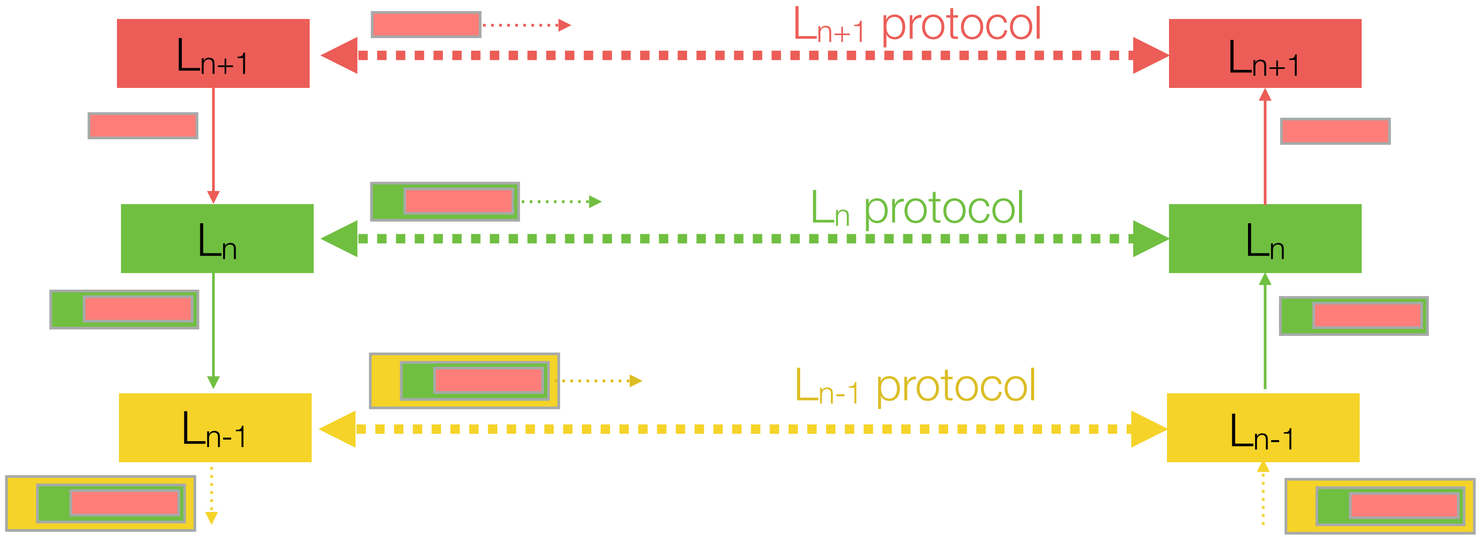
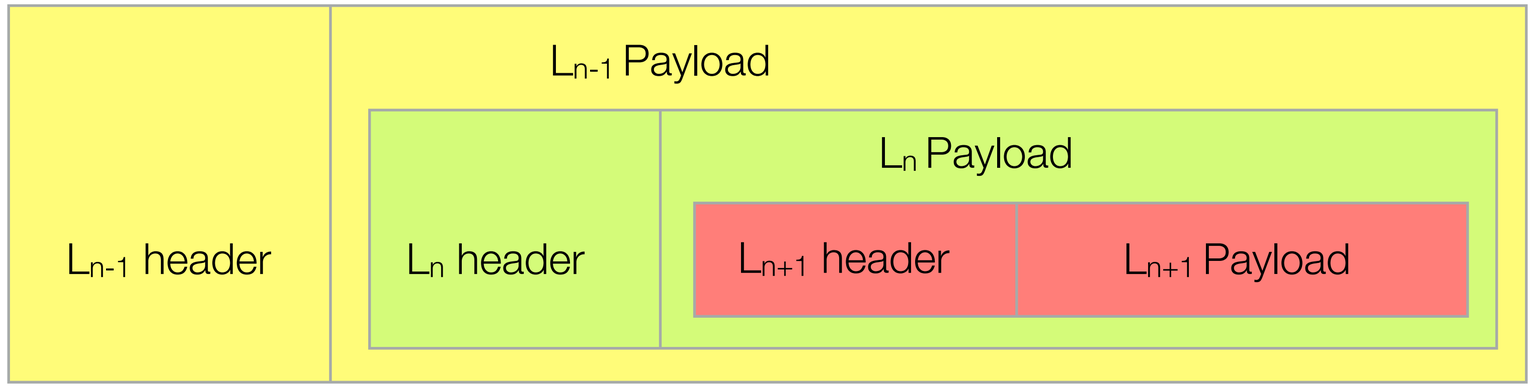


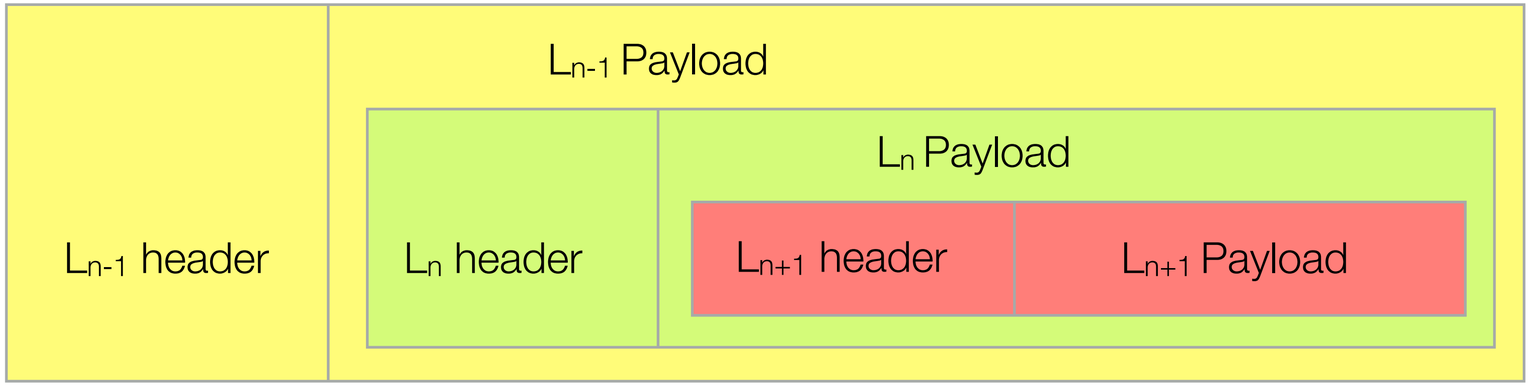
Protocol hierarchy





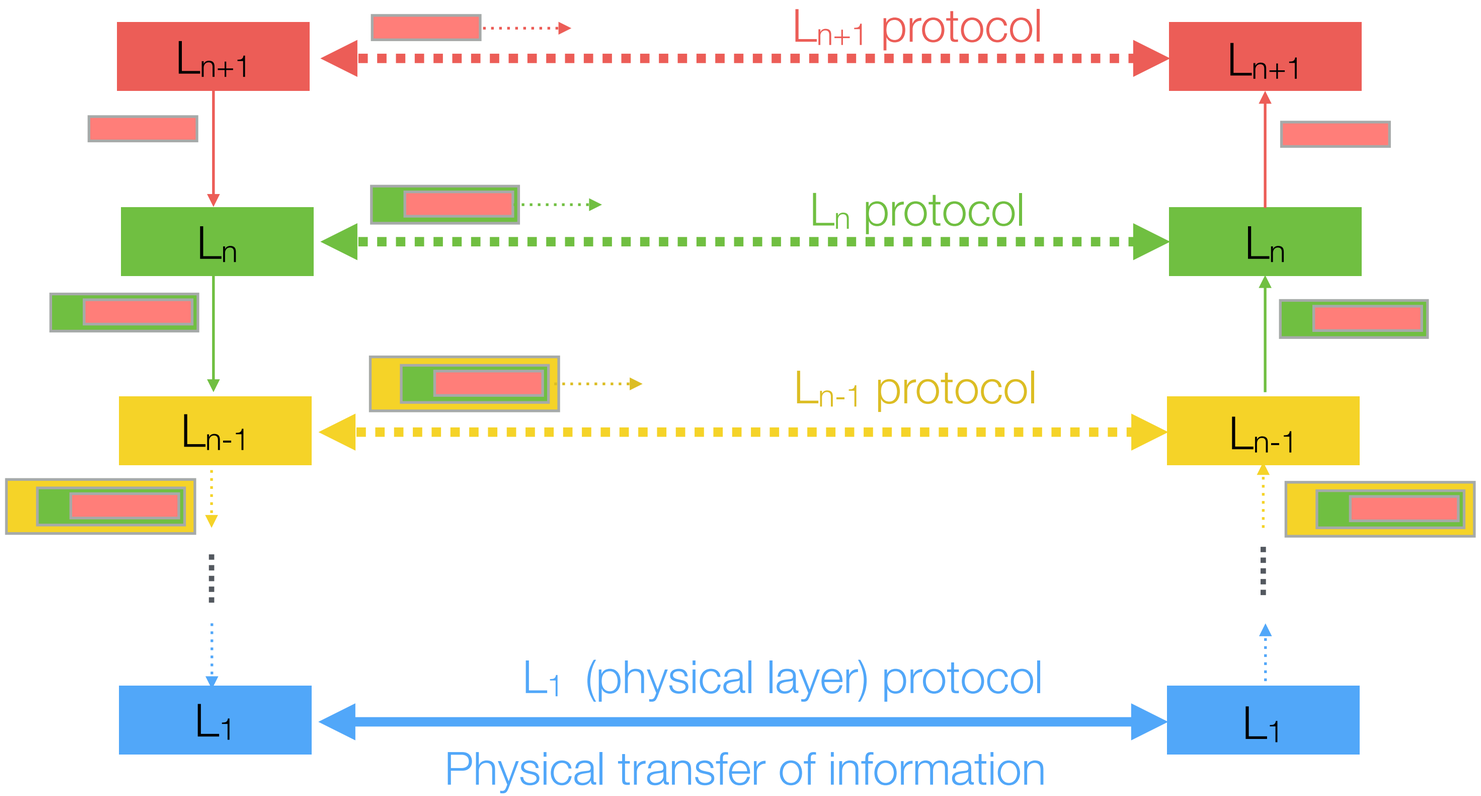
Protocol hierarchy

- Conceptual view



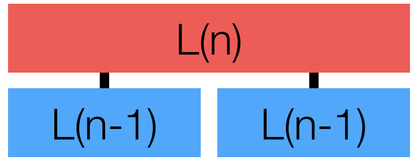
- Real protocol example

Protocol hierarchy

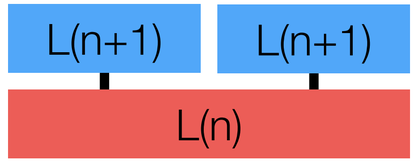


Multiple layer implementations

- 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
- L6 - Presentation
- L5 - Session
- L4 - Transport
- L3 - Network
- L2 - Link
- L1 - Physical

- L7 - Application

“security layer”

- L4 - Transport
- L3 - Network
- L1 & L2 - Link & 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.