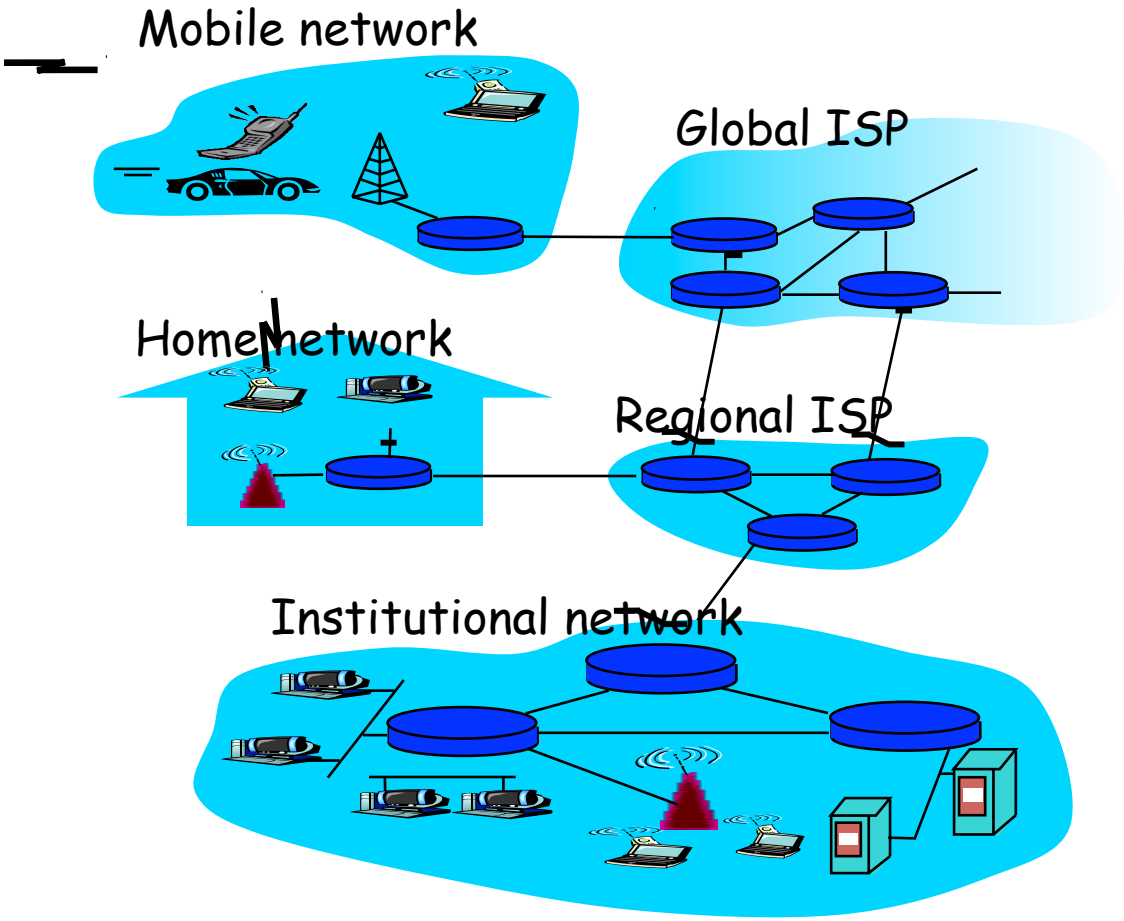
Architecture

Lecture 4

Layering – The protocol stack

Internet = network of networks

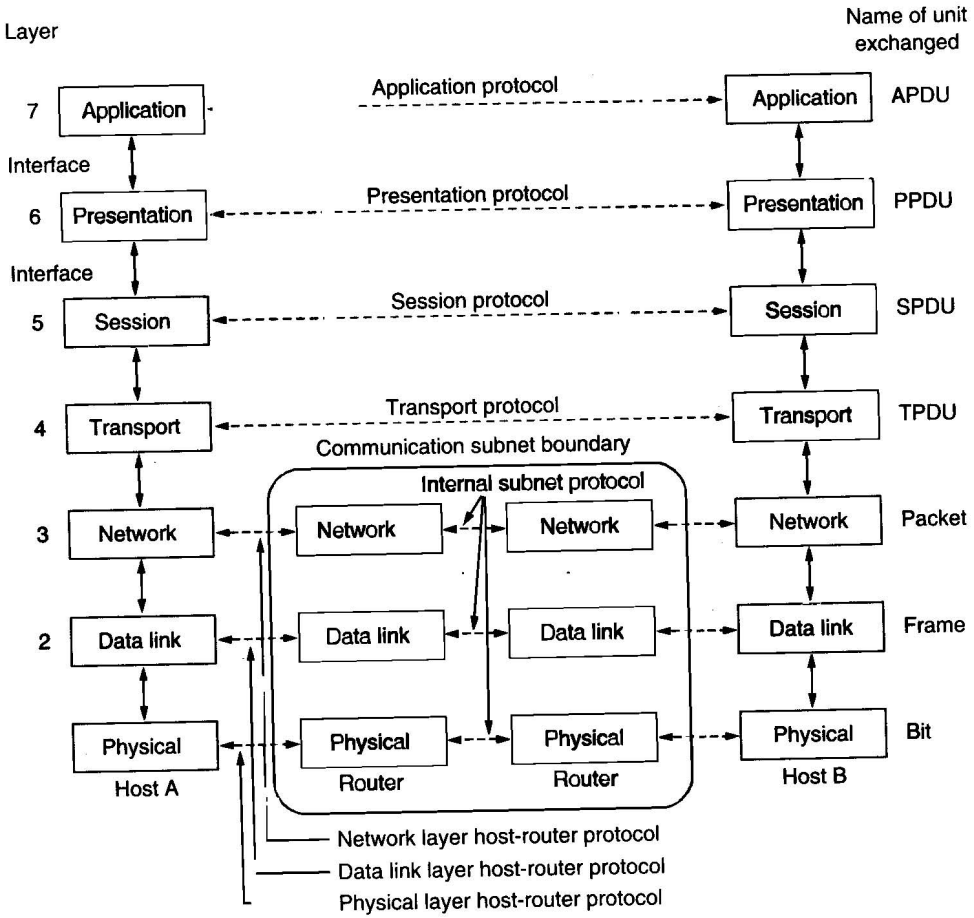


Kurose fig. 1.11

Layering

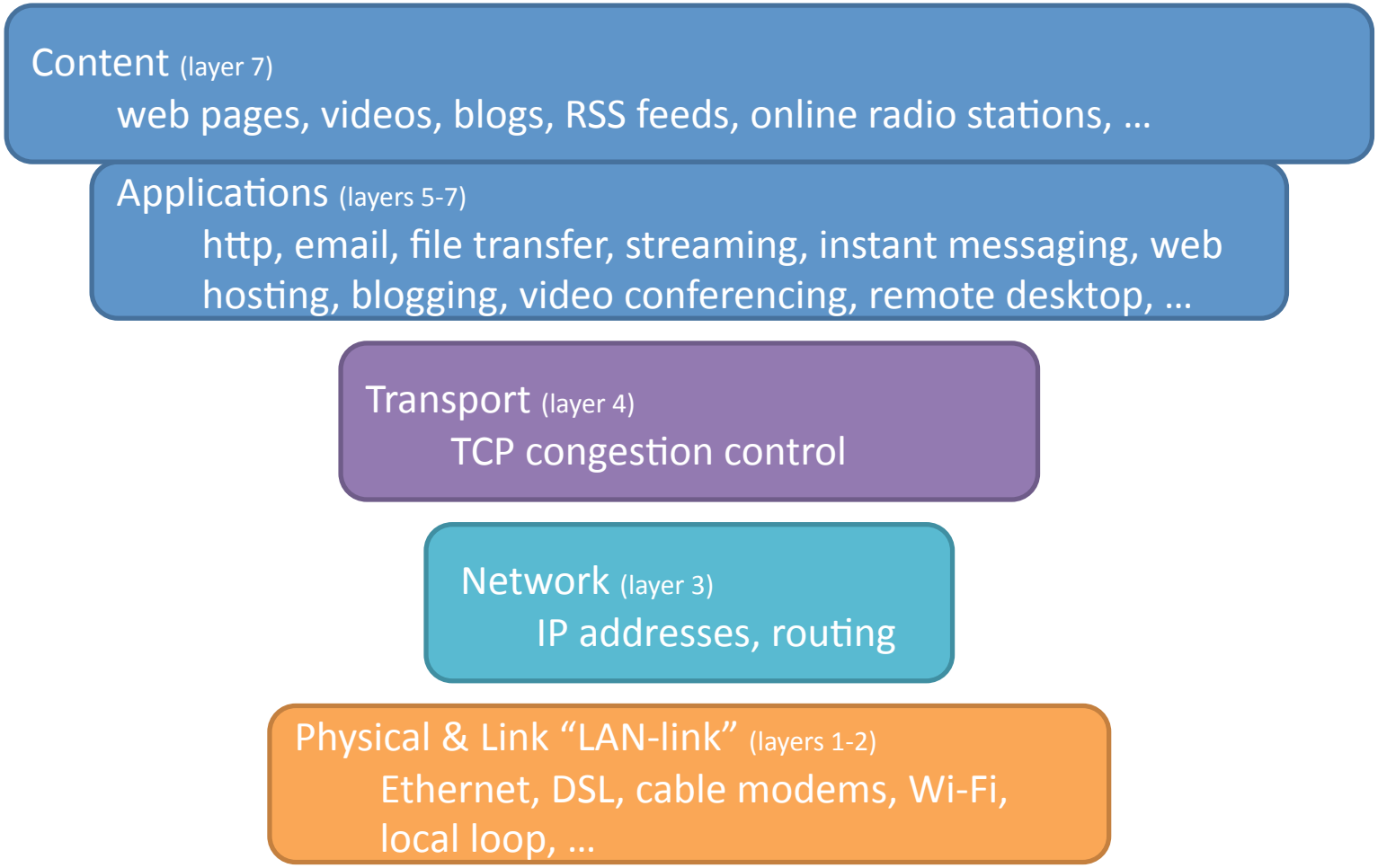
- Layers provide functionalities/services to the upper layers
- Some information exchange (e.g., failure reports)
- Not optimal!

OSI Layering Model



Tanenbaum fig. 1-16

Internet Layering



OSI layer 7: application

Implemented by hosts

- Applications
  - Browsers
  - Email programs
  - Media players
  - Etc, etc, etc …
- Protocols that support applications (type of messages, syntax)
  - www: http
  - email: pop, smtp, imap
  - ftp, telnet, …

OSI layer 4: transport

End-to-end control

- TCP (transmission control protocol)
  - Segmentation
  - Source and destination work together to decide pace (flow control)
  - Retransmit dropped packets (reliable)
  - Packet ordering
- UDP (user datagram protocol)

OSI layer 3: network

End-to-end packet forwarding

- Determine next router to send packet to
  - Addressing
  - Routing
- Receive packet and determine next router to send packet to
  - Queuing
  - Routing
  - Packet scheduling

OSI layer 2: link

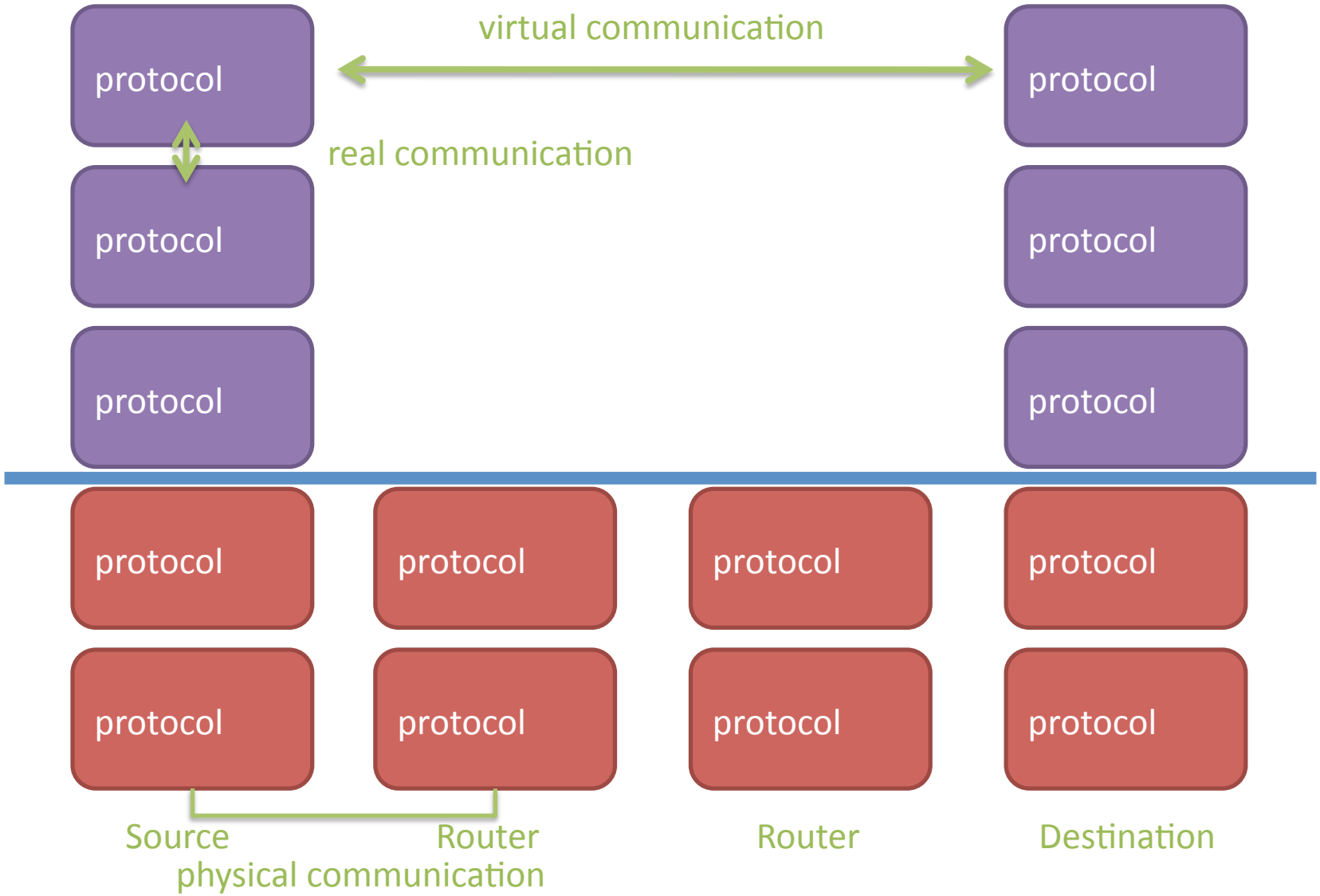
Link scale services

- Channel access, who gets to transmit when
- Framing
- Error detection
- Retransmission of corrupted packets

OSI layer 1: physical

- Bits to analog signal
  - Modulation
  - Depends on transmission medium, e.g. twisted pair, coax, fiber, wireless
- Analog signal to bits
  - Synchronization
  - Sampling
  - Challenges: delay, attenuation, dispersion, noise

Layering


virtual communication
protocol
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real communication
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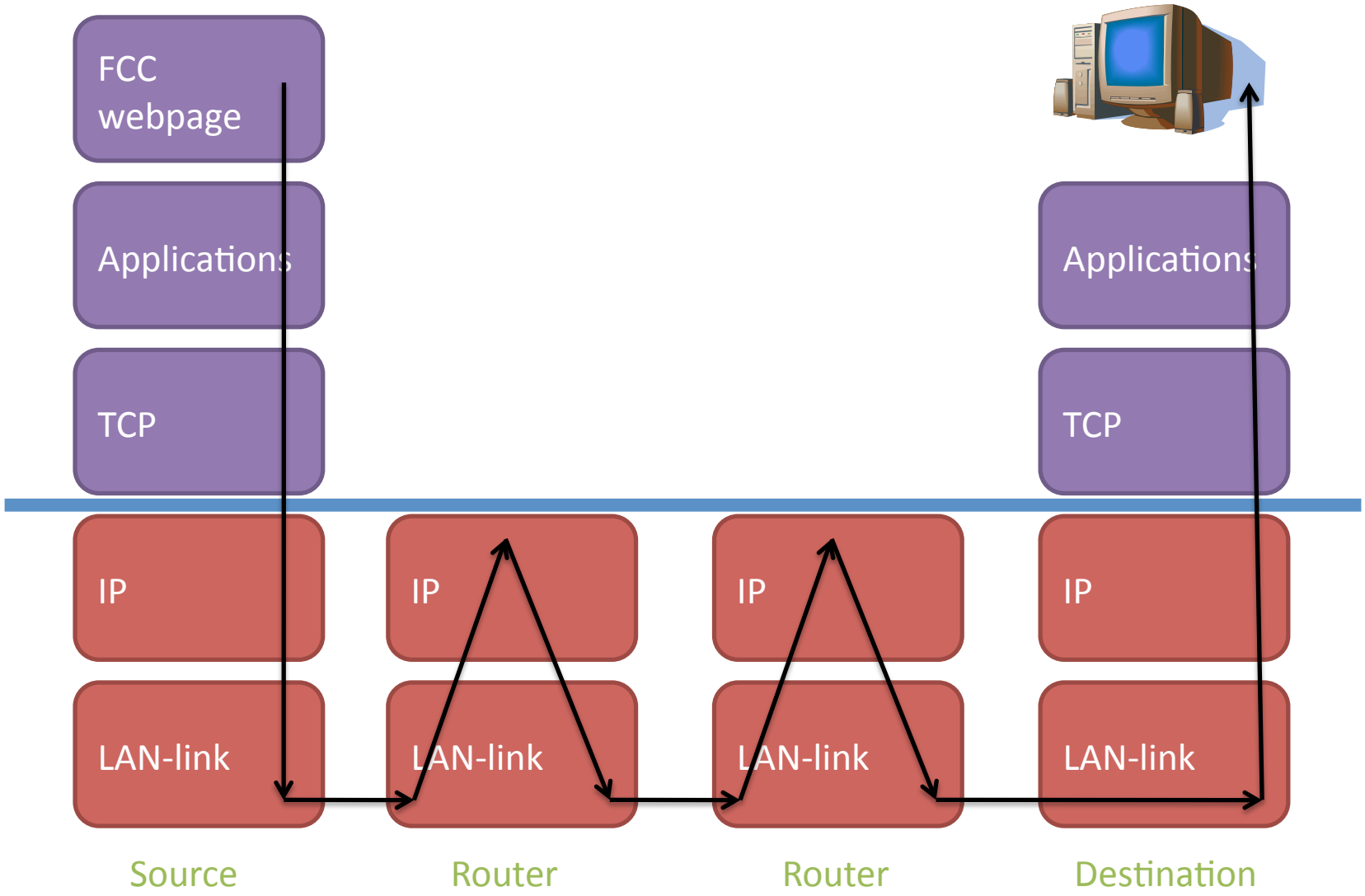
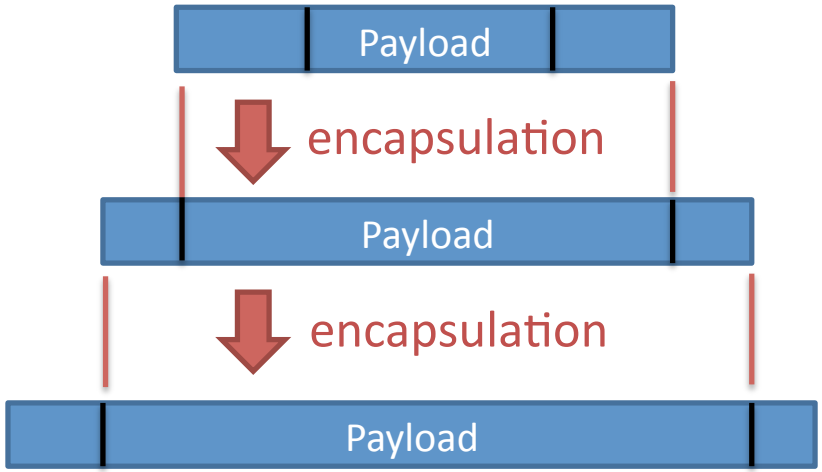
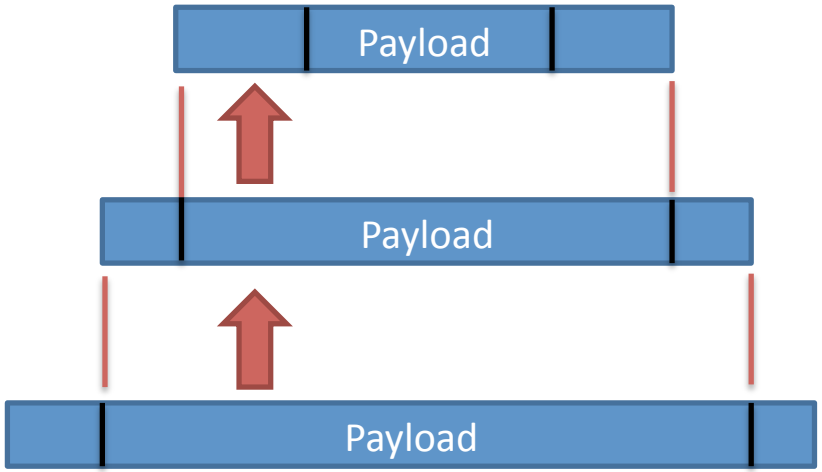
Source
Router
Router
Destination
physical communication

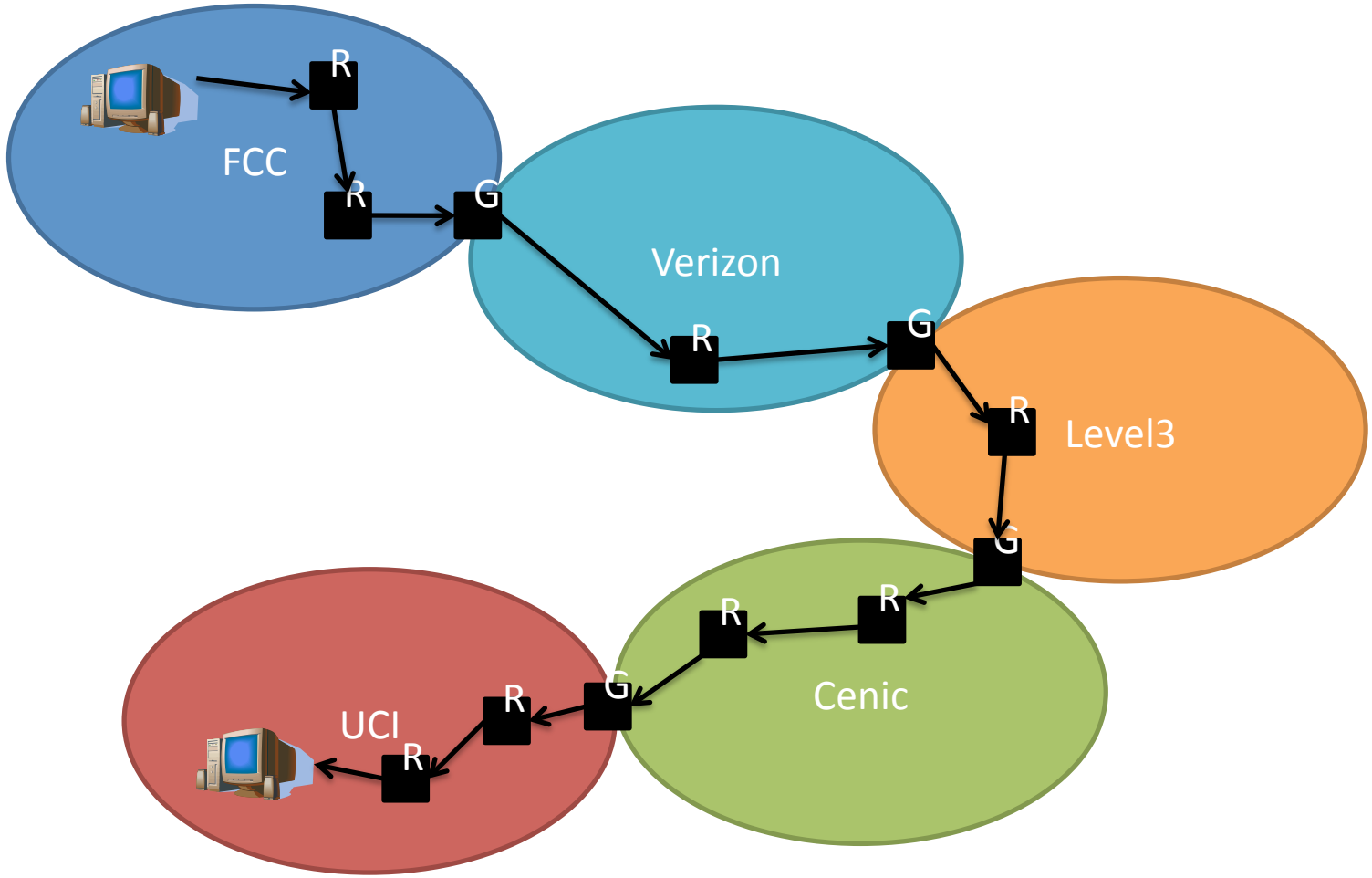
Layering + Peering



Packet format & layering



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