Announcements

Project Presentation Sample

- Title: Unified toast and computer mobile device

- Device that toasts bread as well as compute π to the n^{th} degree

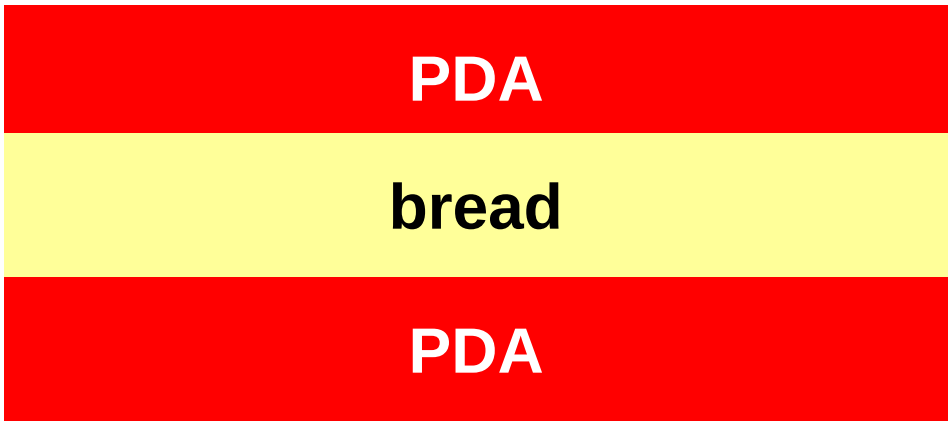
Motivation

- People need a mobile toaster to toast bread on the road

- Need compute power to compute pi
  - Computation consumes battery power which heats up the PDA

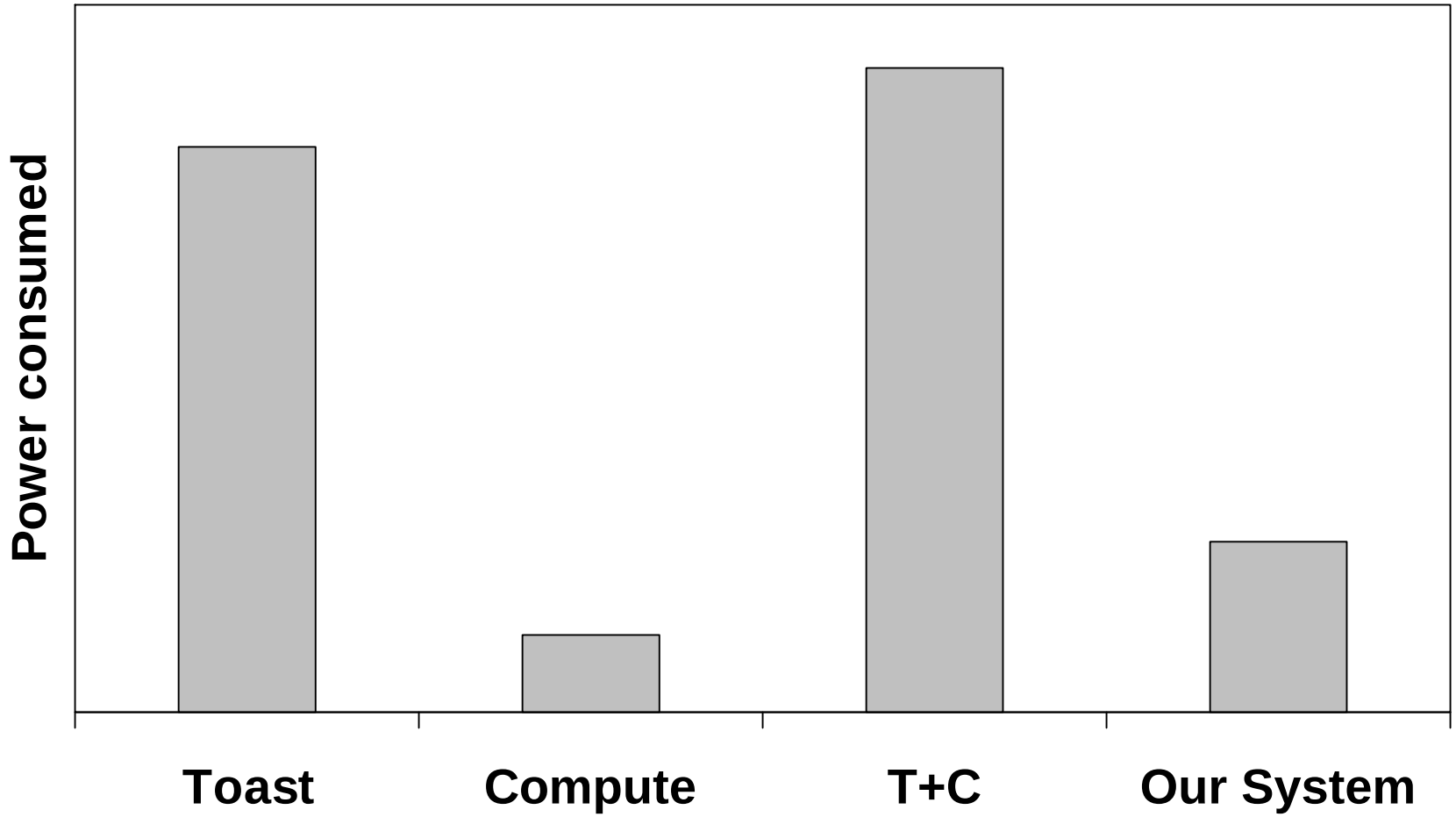
Approach

- We design an integrated system that harnesses the heat generated by the PDA to toast bread



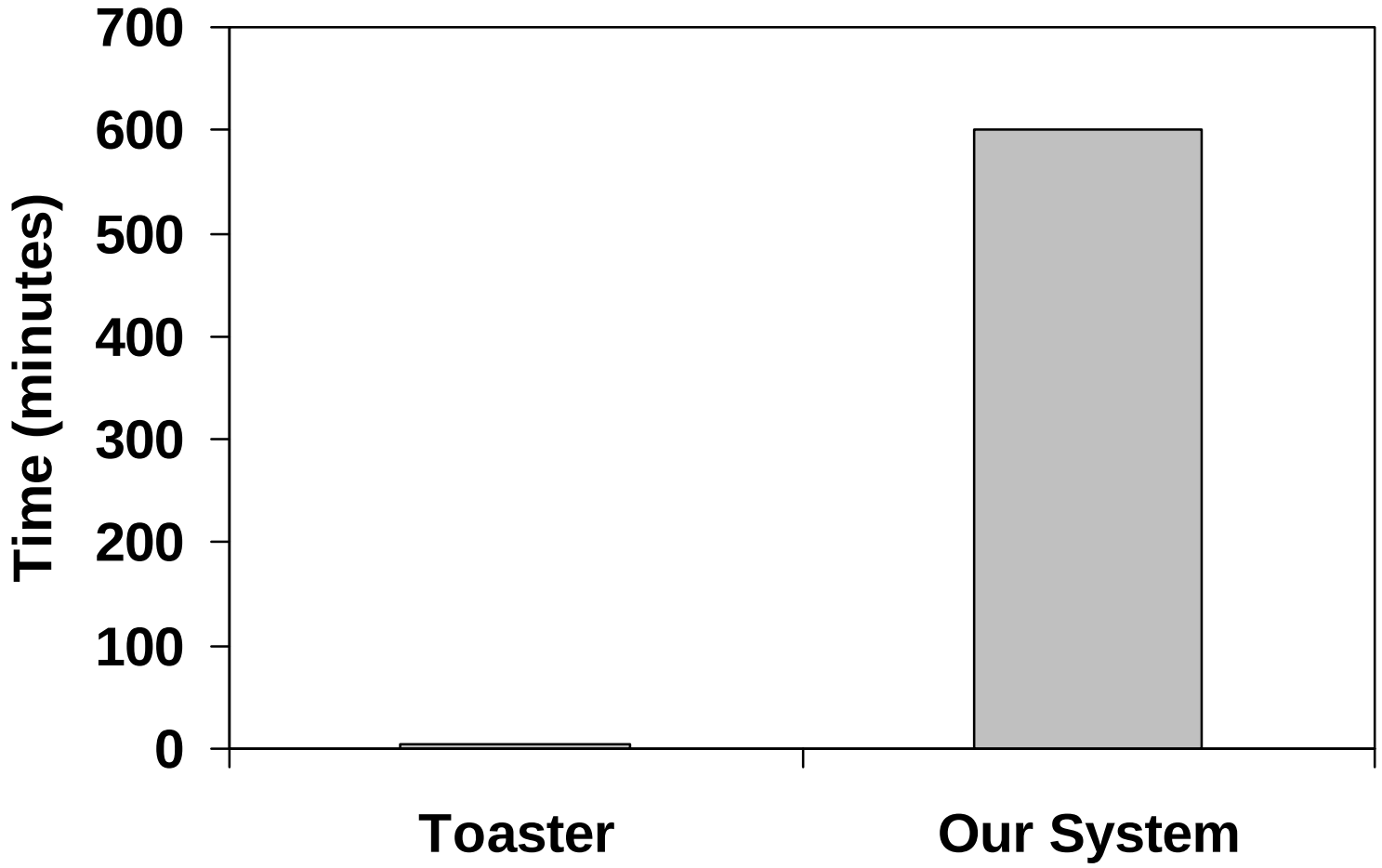
Results

- Energy consumption



Results

- Time to toast



Related Work

- Toaster+TV - Berkeley
- Toaster+Car Engine - MIT

Conclusions and Future work

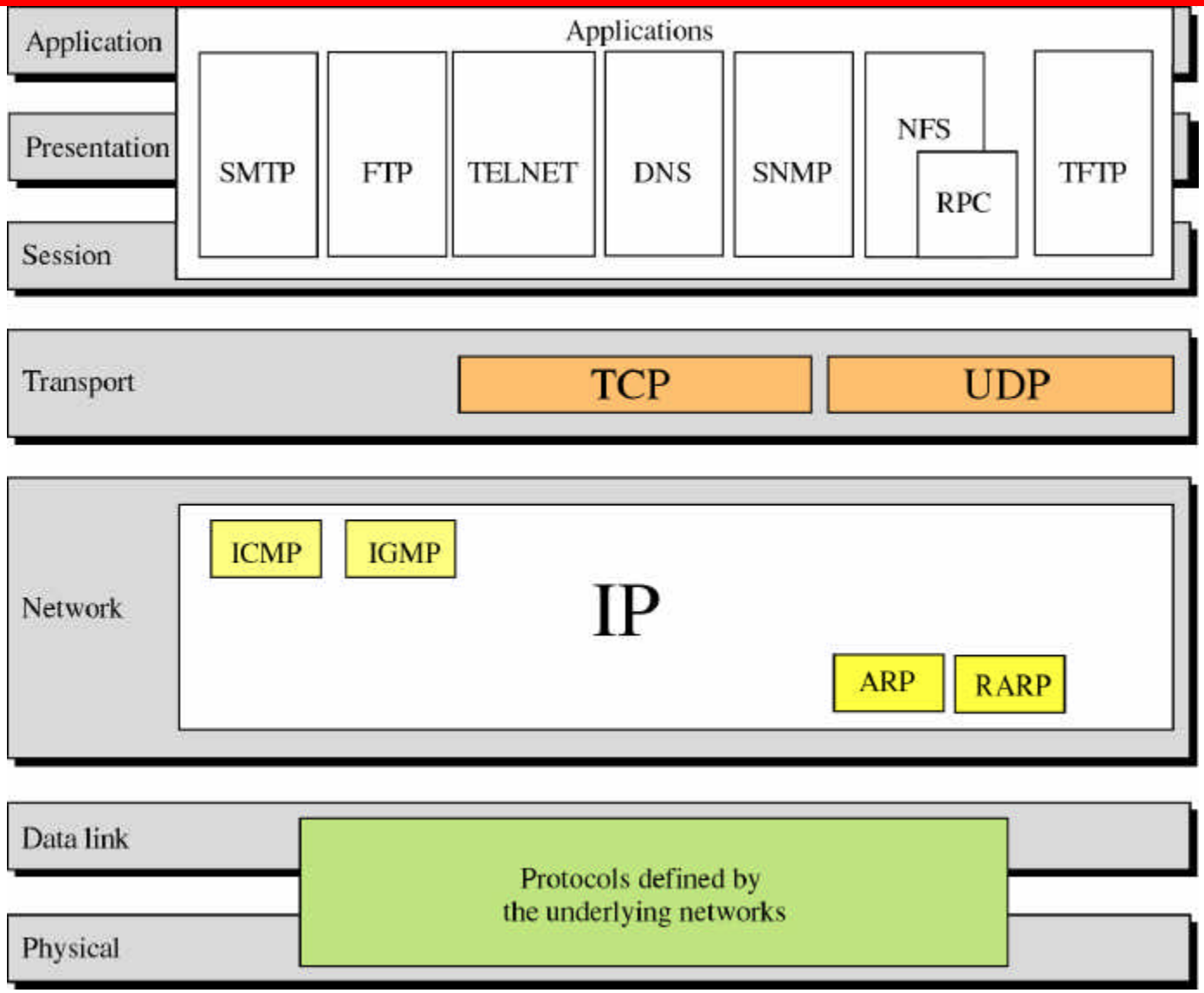
- Promising way to solve pi and toasting problem

- Future work:
  - Figure out a way to prevent molding as the bread toasts slowlllllllly

Outline

- Overview of IP
  - History of the Internet - http://www.davesite.com/webstation/net-history.shtml

OSI Model



Ethernet

10BaseT

OSI Model

- OSI Standardized before implemented
  - IETF philosophy: “We reject kings, presidents and voting. We believe in rough consensus and working code”
  - IETF requires two working/interoperable versions before considering a standard

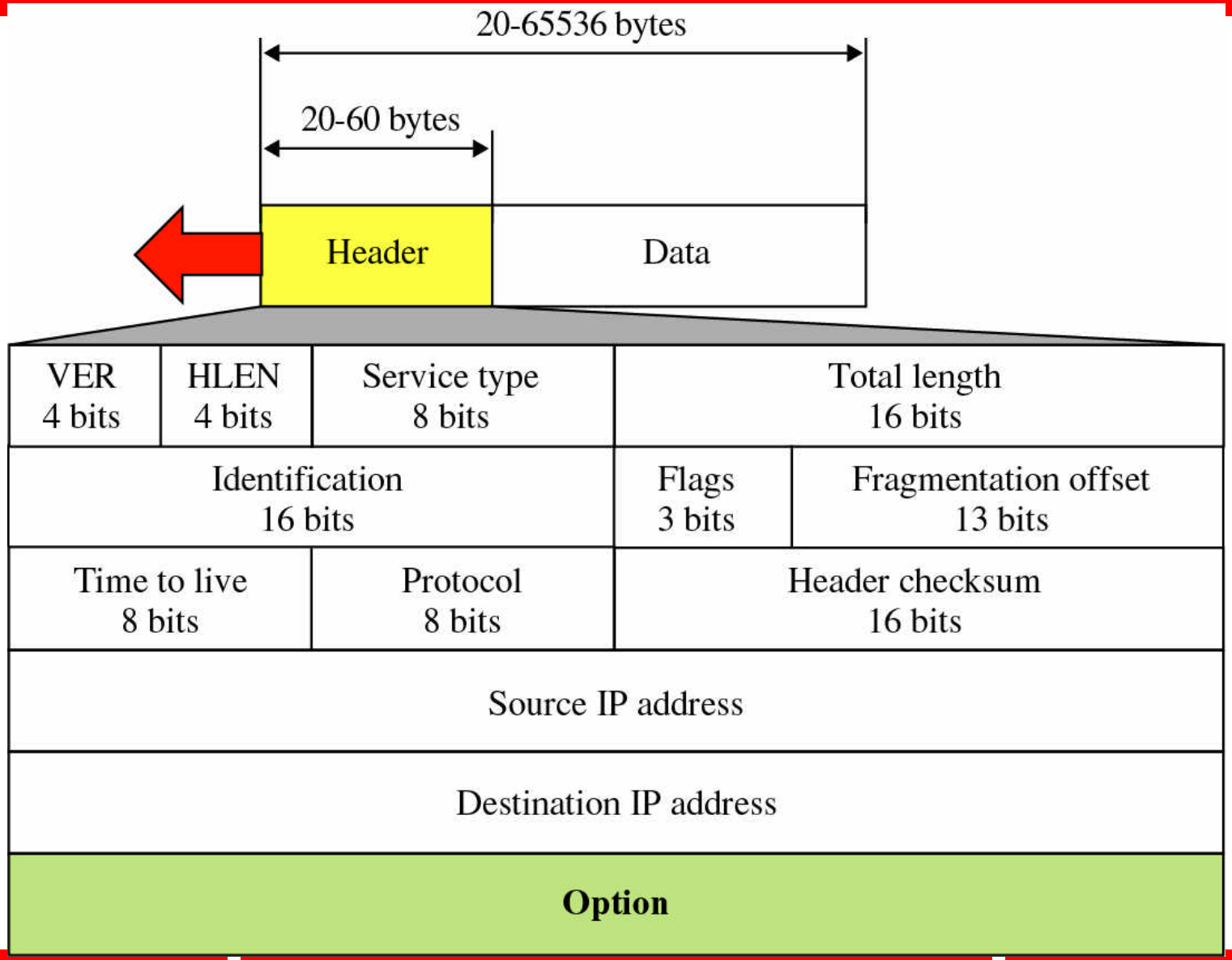
- Modular design, but some boundaries are arbitrary
  - Why seven layers?
  - What exactly is the session layer?
  - Much basic network functionality at multiple layers
    - Reliability, flow control, security

(courtesy Amin Vahdat @Duke)

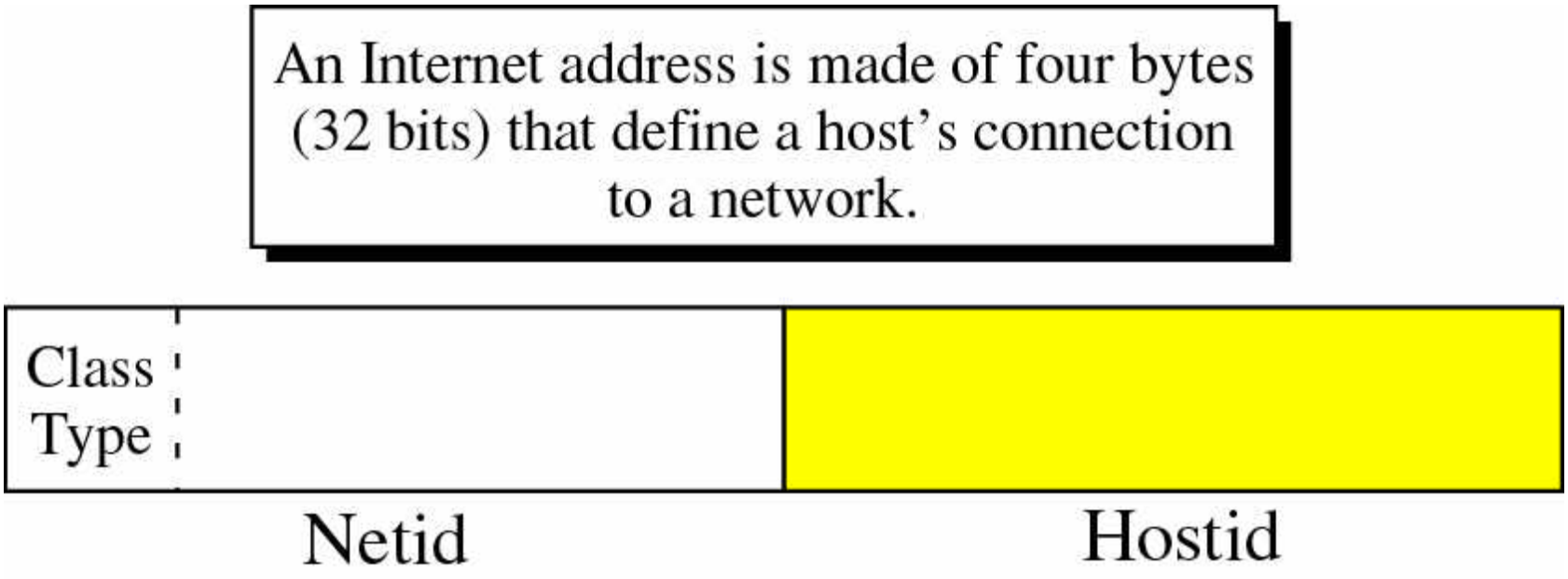
IP – The Internet Protocol

- Service mode: best effort
  - No guarantees about reliable, in-order, or error-free delivery
  - Enables IP to “run over anything”
- Fragmentation and Reassembly
  - Problem: networks have different maximum transmission units (MTUs)
    - Ethernet: 1500 bytes, FDDI: 4500 bytes, etc.
  - Communicating hosts may be on networks w/similar MTUs
    - But smaller MTU somewhere in the middle of the network
  - To maintain uniform host-to-host communication, IP must fragment and then reassemble packets
    - Input on 1500-byte MTU link, output on 500-byte MTU link

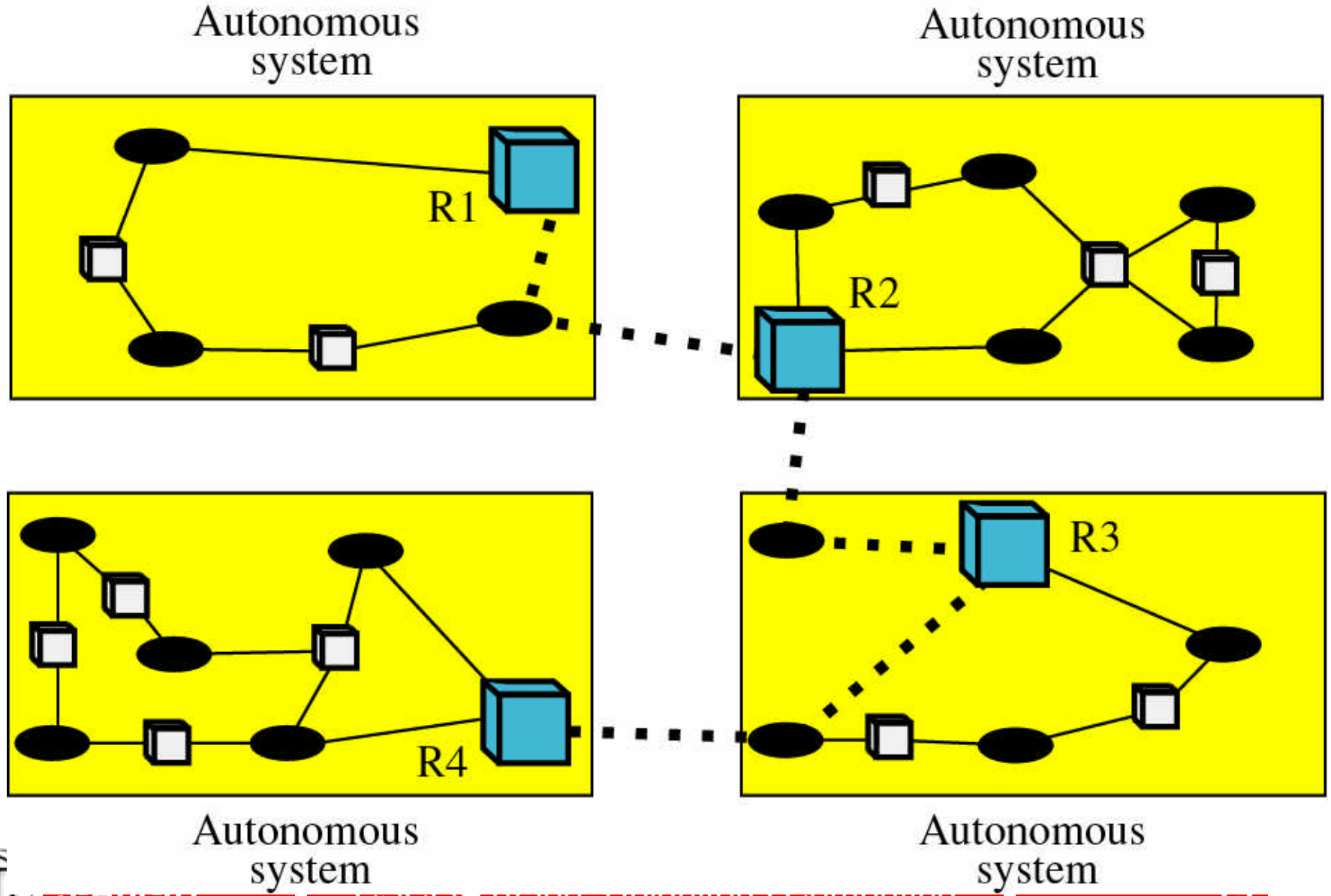
IP datagram


20-65536 bytes
20-60 bytes
Header
Data
VER
4 bits
HLEN
4 bits
Service type
8 bits
Total length
16 bits
Identification
16 bits
Flags
3 bits
Fragmentation offset
13 bits
Time to live
8 bits
Protocol
8 bits
Header checksum
16 bits
Source IP address
Destination IP address
Option

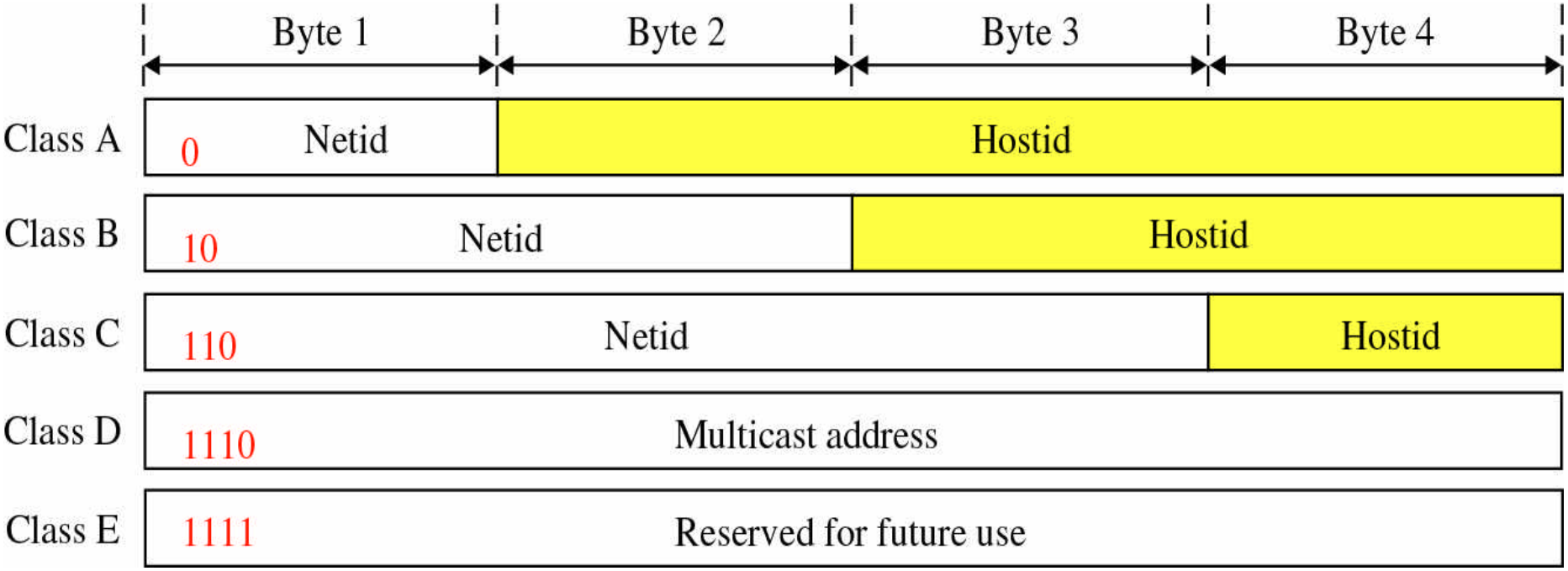
IP address



Routing datagrams



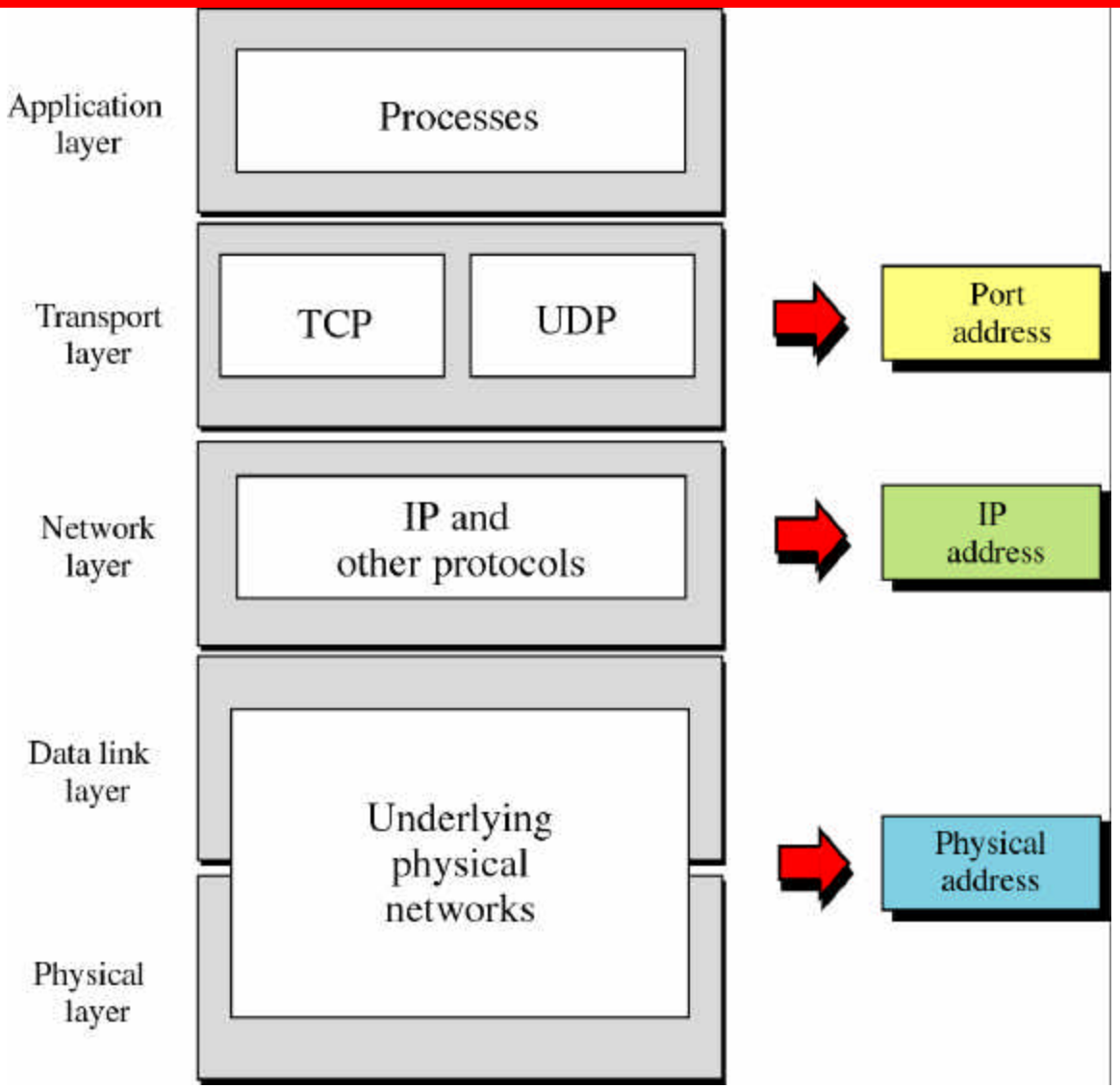
IP network classes



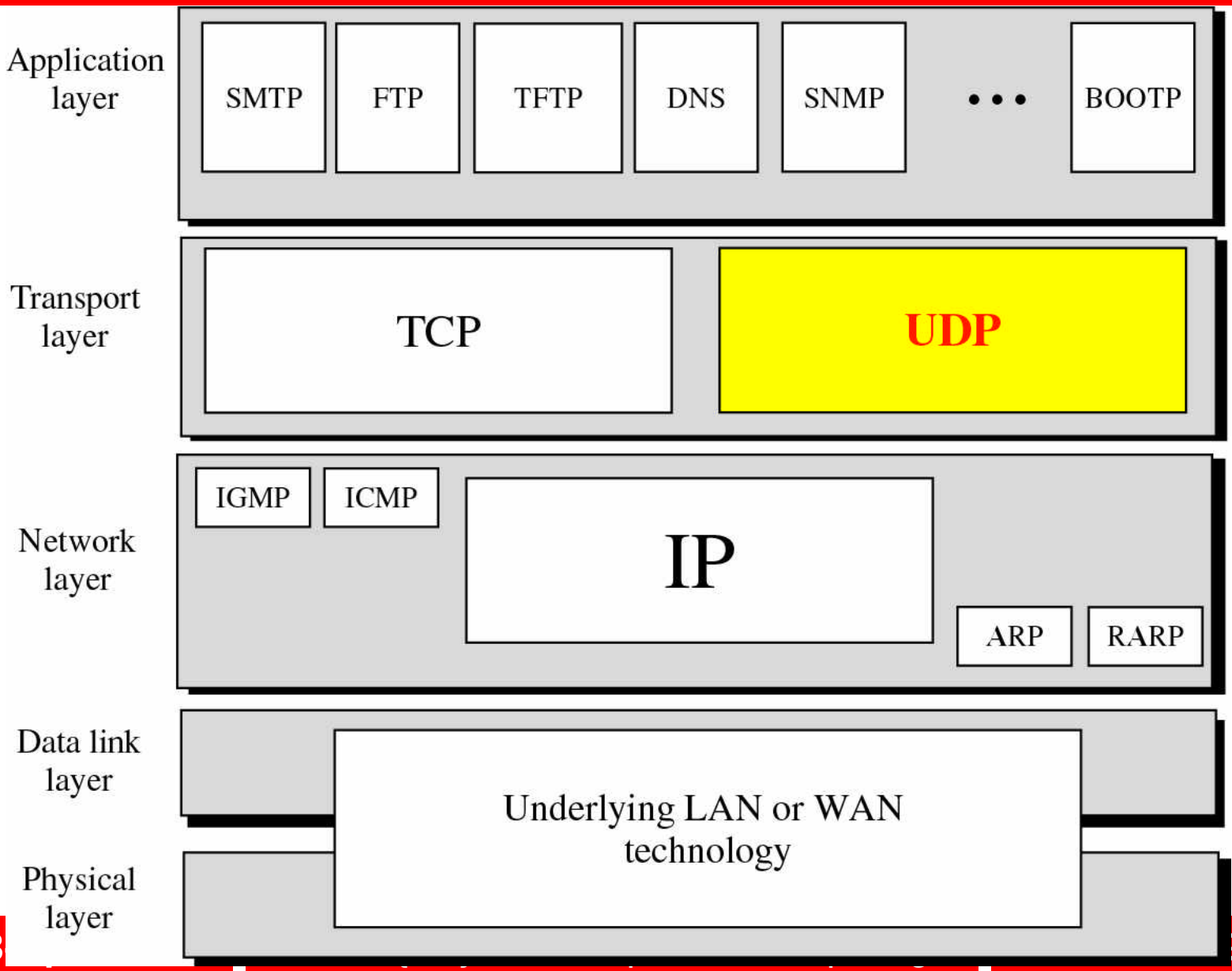
IP Address Issues

- We can run out
  - 4B IP addresses; 4B micros in 1997
  - Super nets and NATs are holding us
- We'll run out faster if sparsely allocated
  - Rigid structure causes internal fragmenting
  - E.g., assign a class C address to site with 2 computers
    - Waste 99% of assigned address space
- Need address aggregation to keep routing tables small
  - 2 million class C networks
  - Entry per network in IP forwarding tables
    - Scalability?

Addressing



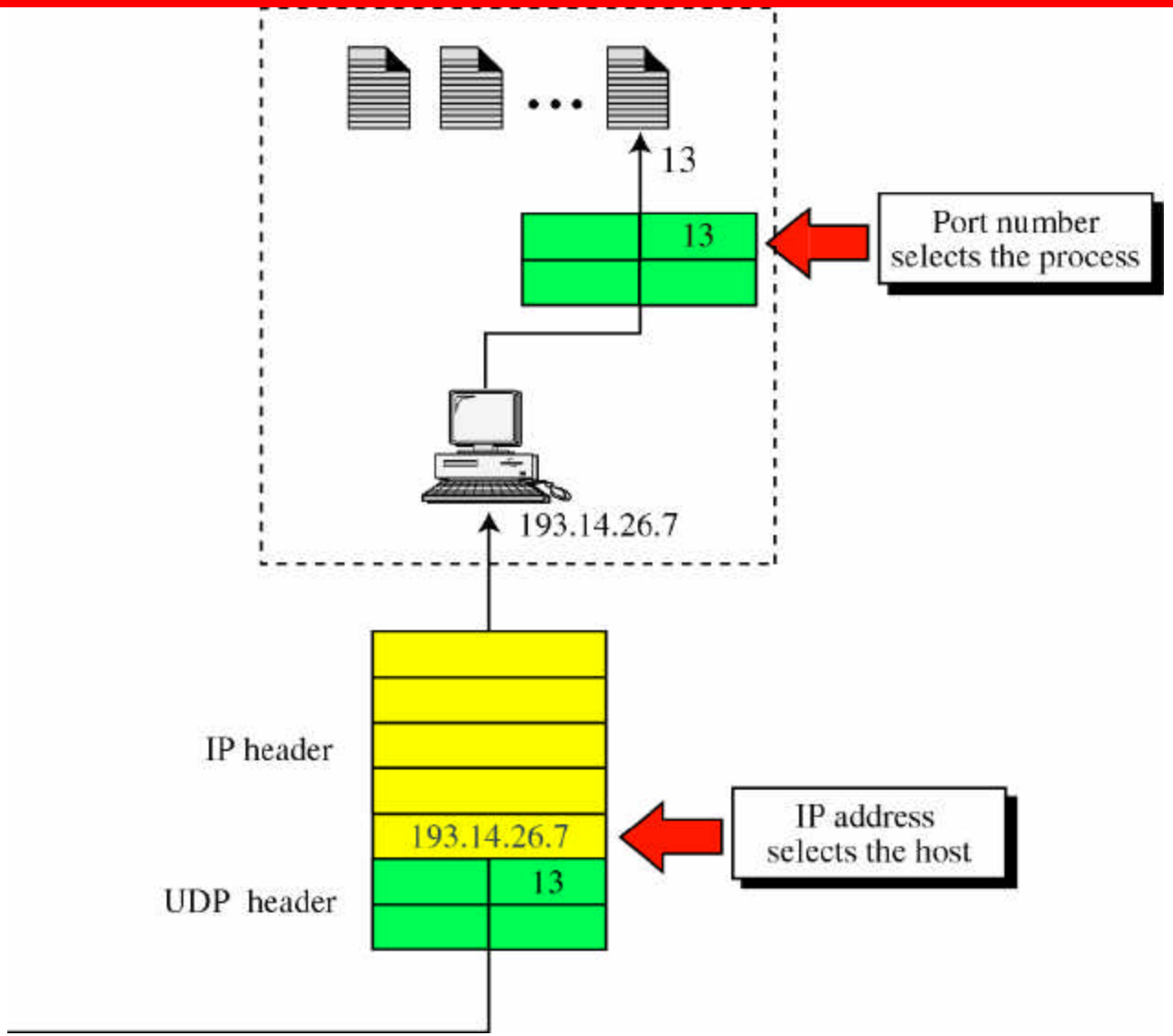
OSI in IP world



User Datagram Protocol (UDP)

- Simple demultiplexing
  - No guarantees about reliability, in-order delivery
- Thin veneer on top of IP adds src/dest port numbers
  - 16 bit port number allows for identification of 65536 unique communication endpoints per host
  - Note that a single process can utilize multiple ports
  - IP addr + port number uniquely identifies all Internet endpoints

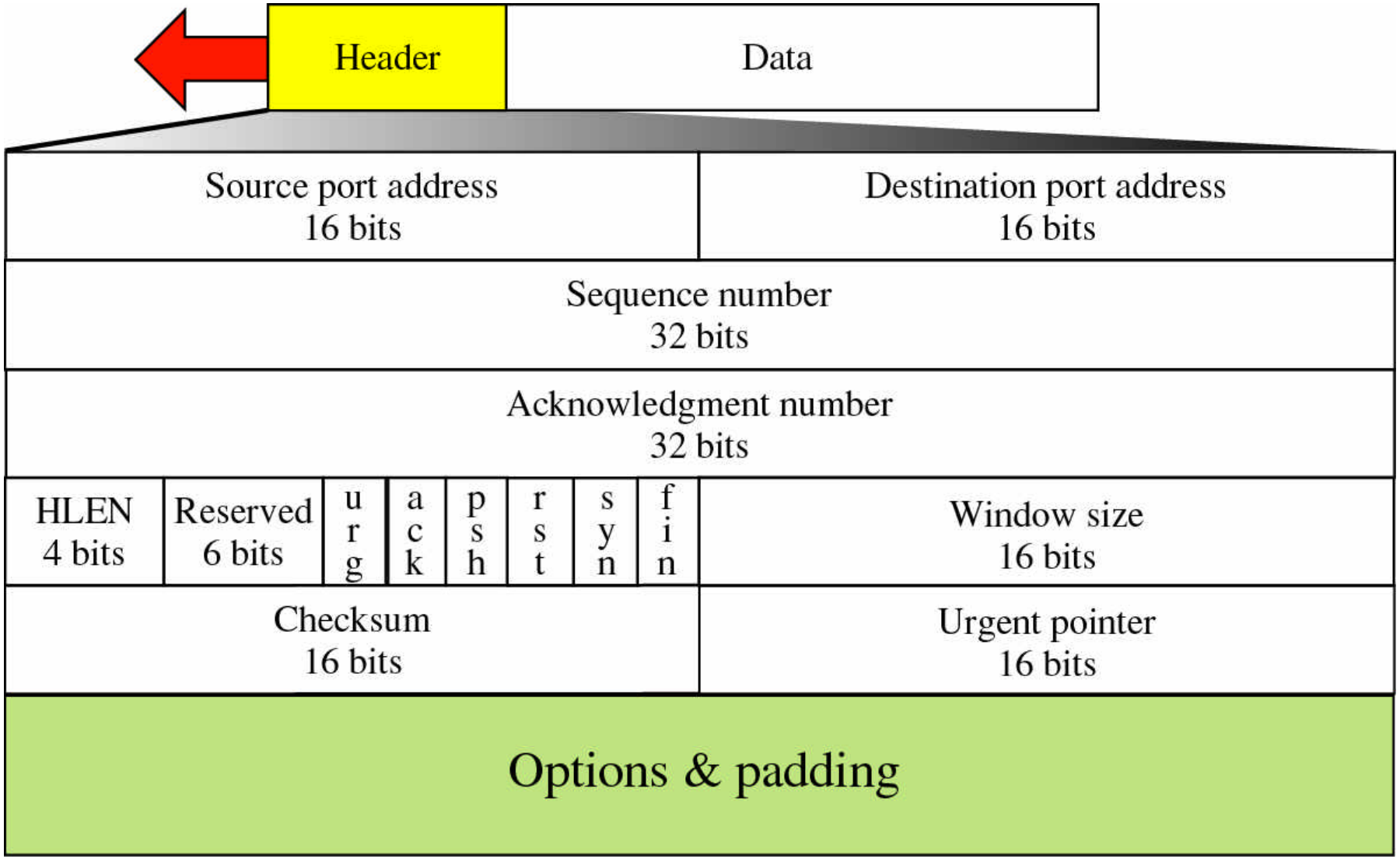
User Datagram Protocol (UDP)



Transmission Control Protocol (tcp)

- Reliable in-order delivery of byte stream
  - Full duplex (endpoints simultaneously send/receive)
  - e.g., single socket for web browser talking to web server
- Flow-control
  - To ensure that sender does not overrun receiver
  - Fast server talking to slow client
- Congestion control
  - Keep the sender from overrunning the network
  - Many simultaneous connections across routers (cross traffic)

TCP headers


Header
Data
Source port address
16 bits
Destination port address
16 bits
Sequence number
32 bits
Acknowledgment number
32 bits
HLEN
4 bits
Reserved
6 bits
urg
ack
psh
rst
syn
fin
Window size
16 bits
Checksum
16 bits
Urgent pointer
16 bits
Options & padding

Discussion