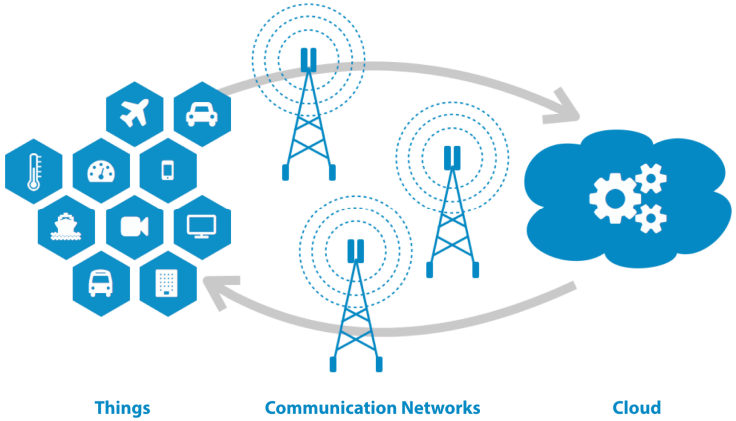
دانشگاه صنعتی همدان



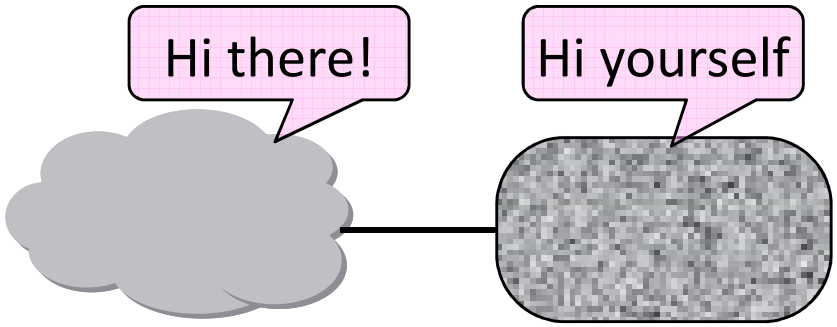
شبکه‌های کامپیوتری - مخابراتی

دکتر رجبی
نیمسال دوم سال تحصیلی ۹۹-۹۸
دانشگاه صنعتی همدان
گروه مهندسی برق و کامپیوتر

پروتکل IP

Topic

- How do we connect different networks together?
  - This is called internetworking
  - We'll look at how IP does it



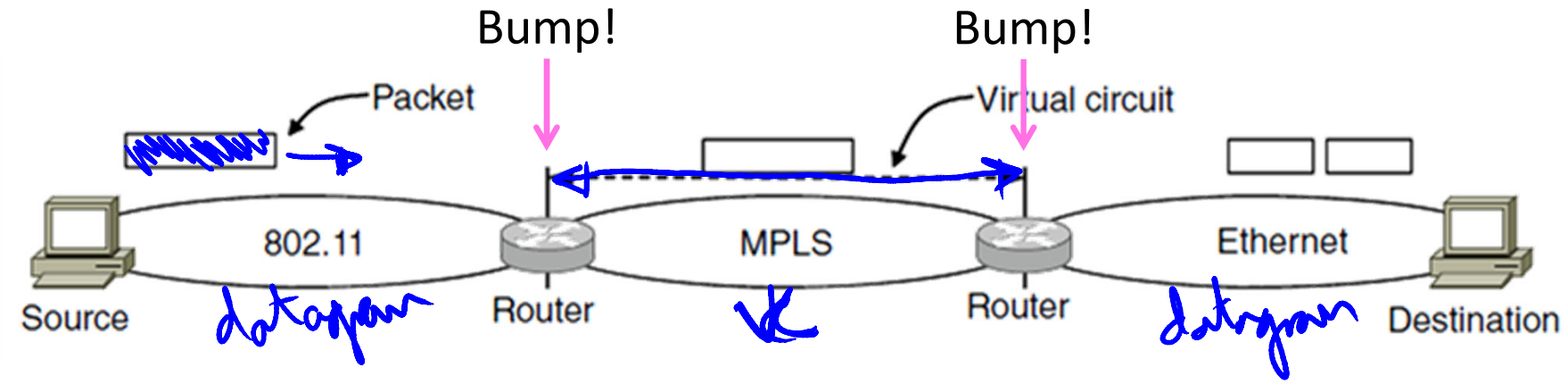
How Networks May Differ

- Basically, in a lot of ways:
  - Service model (datagrams, VCs)
  - Addressing (what kind)
  - QOS (priorities, no priorities)
  - Packet sizes
  - Security (whether encrypted)

- Internetworking hides the differences with a common protocol. (Uh oh.)

Connecting Datagram and VC networks

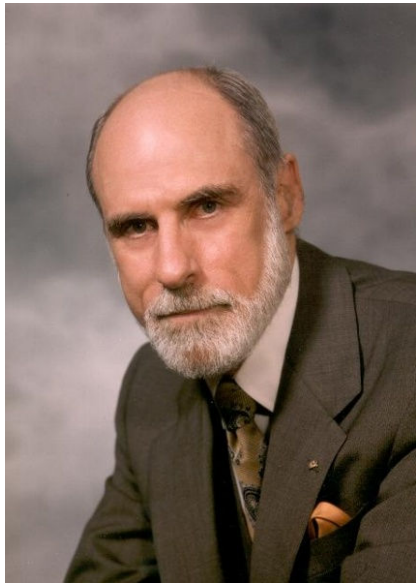
- An example to show that it's not so easy
  - Need to map destination address to a VC and vice-versa
  - A bit of a "road bump", e.g., might have to set up a VC



Internetworking – Cerf and Kahn

- Pioneered by Cerf and Kahn, the "fathers of the Internet"
  - In 1974, later led to TCP/IP
- Tackled the problems of interconnecting networks
  - Instead of mandating a single network technology

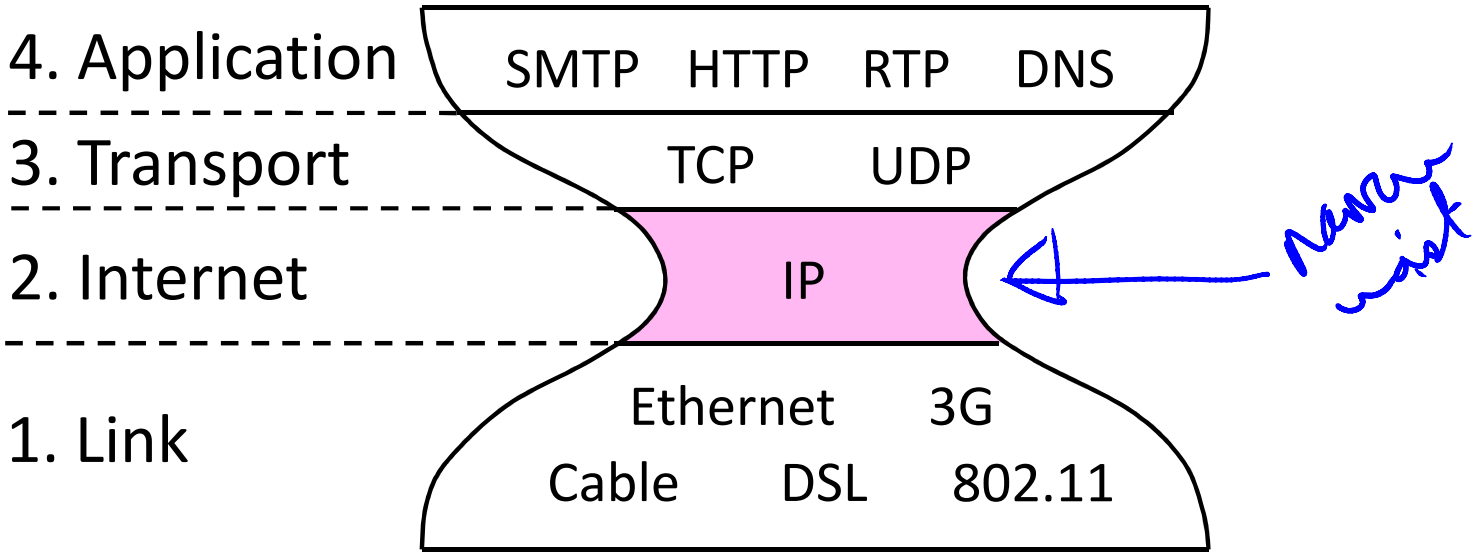
Vint Cerf



Bob Kahn

Internet Reference Model

- IP is the "narrow waist" of the Internet
  - Supports many different links below and apps above

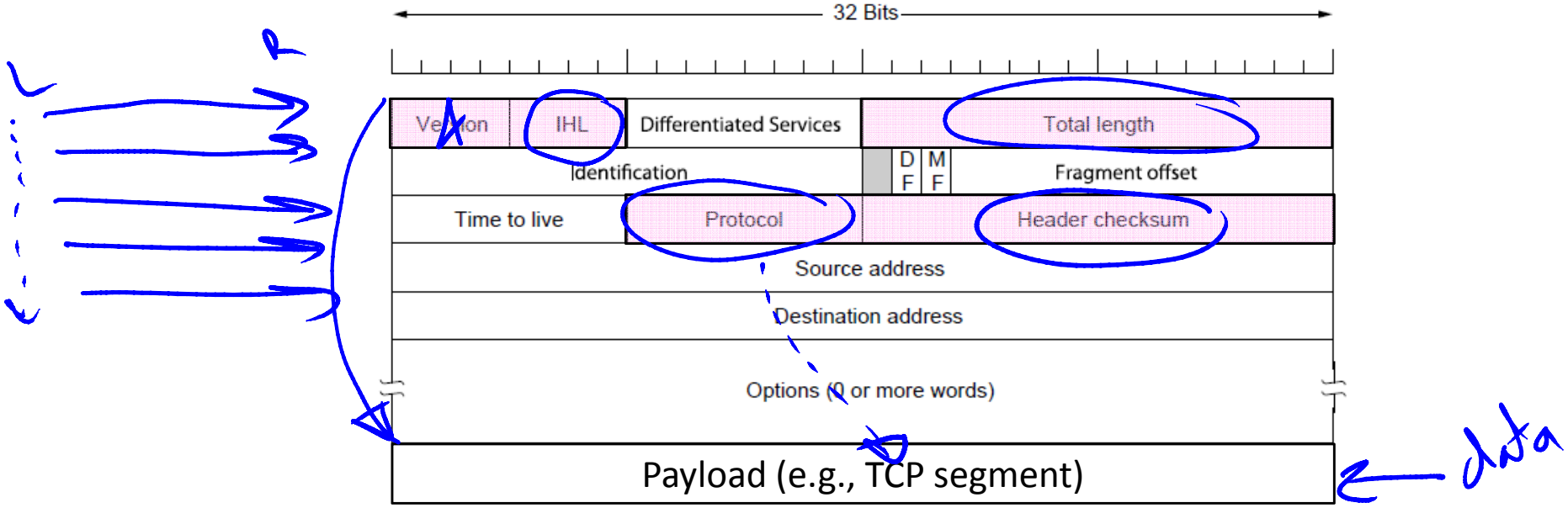


IP as a Lowest Common Denominator

- Suppose only some networks support QOS or security etc.
  - Difficult for internetwork to support
- Pushes IP to be a “lowest common denominator” protocol
  - Asks little of lower-layer networks
  - Gives little as a higher layer service

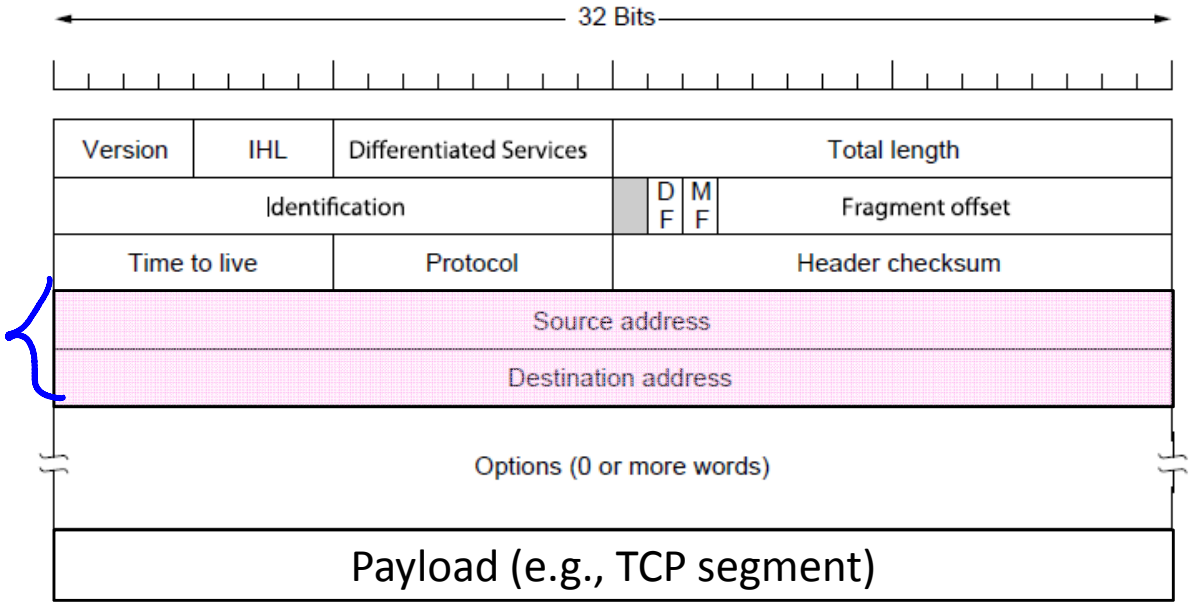
IPv4 (Internet Protocol)

- Various fields to meet straightforward needs
  - Version, Header (IHL) and Total length, Protocol, and Header Checksum



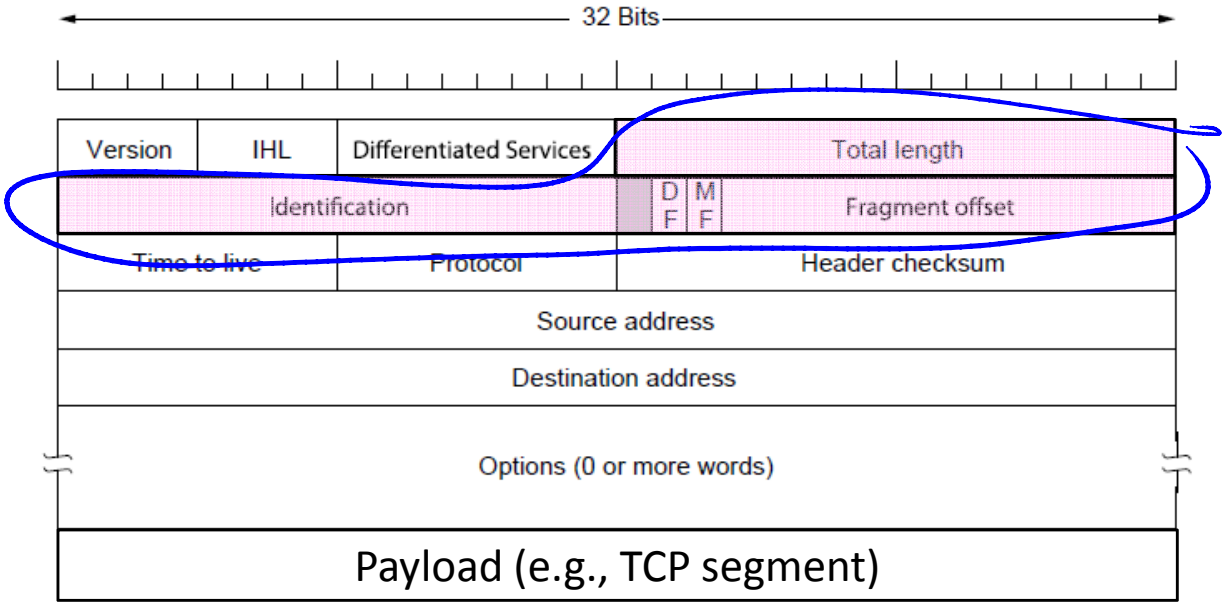
IPv4 (2)

- Network layer of the Internet, uses datagrams
  - Provides a layer of addressing above link addresses (next)



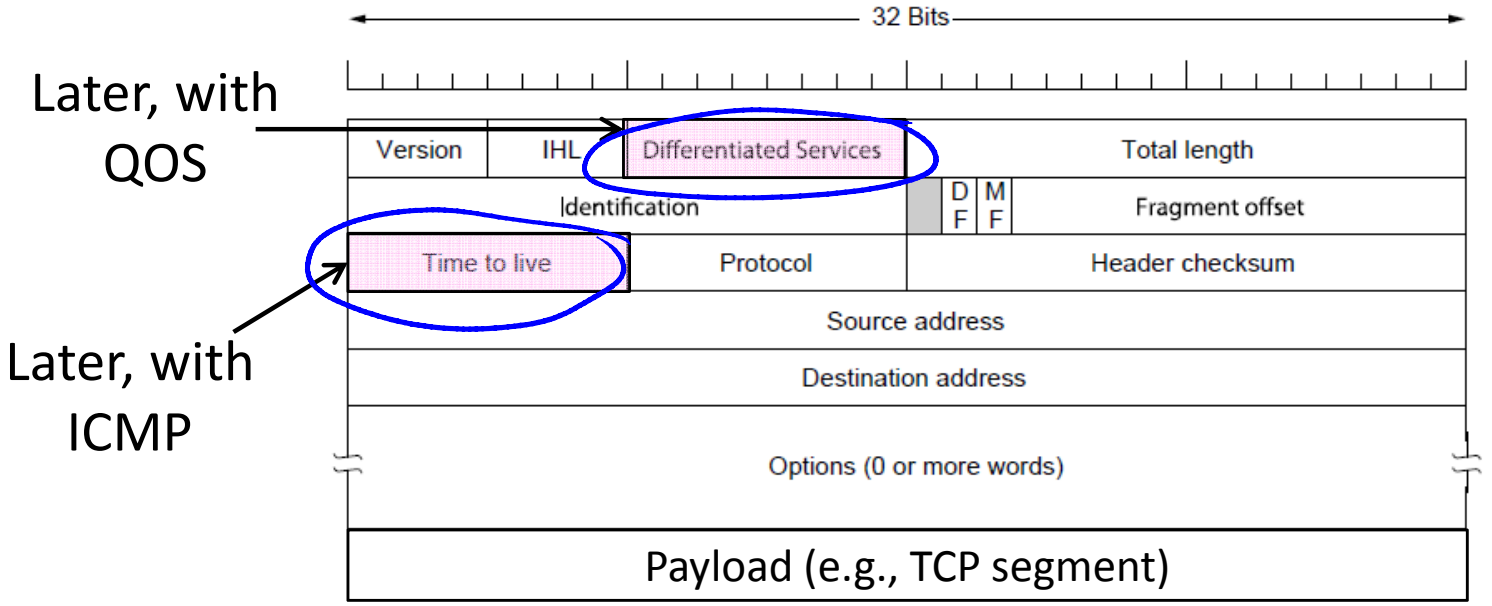
IPv4 (3)

- Some fields to handle packet size differences (later)
  - Identification, Fragment offset, Fragment control bits



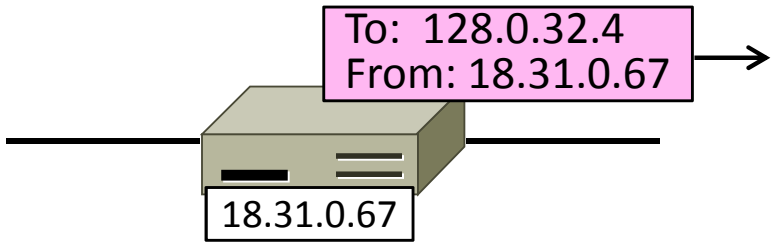
IPv4 (4)

- Other fields to meet other needs (later, later)
  - Differentiated Services, Time to live (TTL)



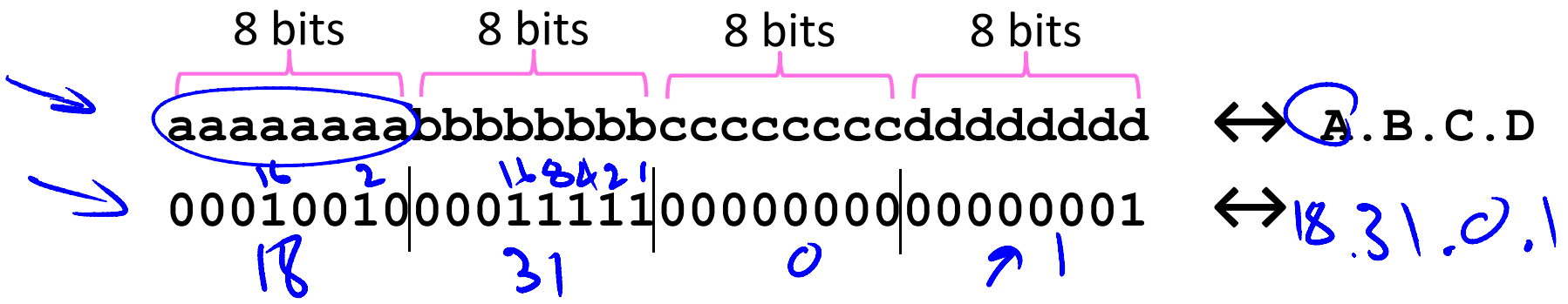
Topic

- What do IP addresses look like?
  - And IP prefixes, or blocks of addresses
  - (This is IPv4; we'll cover IPv6 later.)



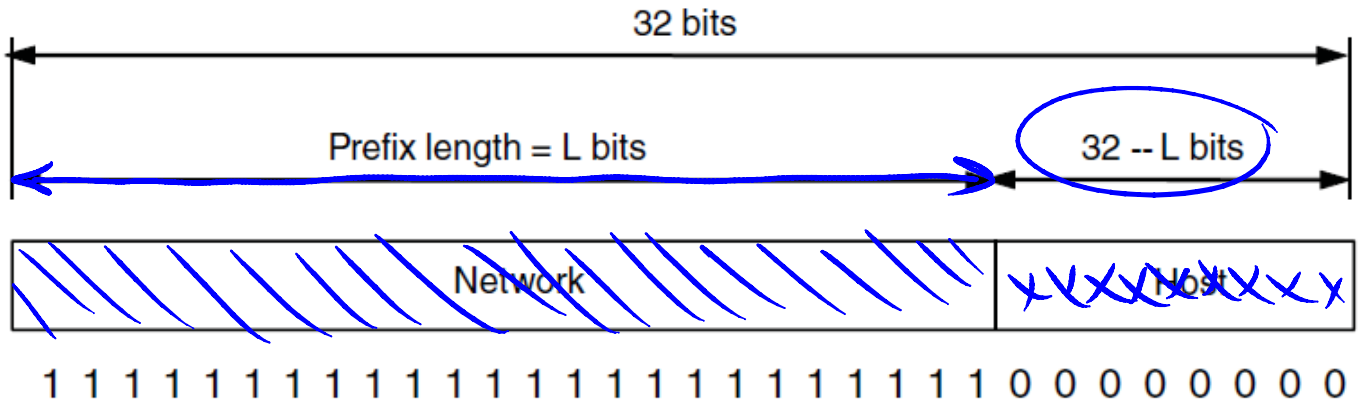
IP Addresses

- IPv4 uses 32-bit addresses
  - Later we'll see IPv6, which uses 128-bit addresses
- Written in "dotted quad" notation
  - Four 8-bit numbers separated by dots



IP Prefixes – Modern

- Addresses are allocated in blocks called prefixes
  - Addresses in an L-bit prefix have the same top L bits
  - There are 2^{32-L} addresses aligned on 2^{32-L} boundary



IP Prefixes (2)

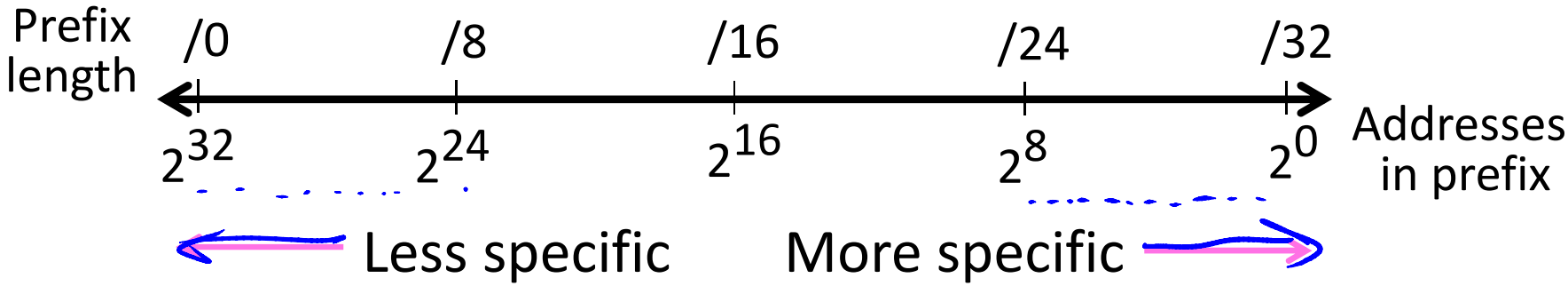
- Written in "IP address/length" notation
  - Address is lowest address in the prefix, length is prefix bits
  - E.g., 128.13.0.0/16 is 128.13.0.0 to 128.13.255.255
  - So a /24 ("slash 24") is 256 addresses, and a /32 is one address

00010010|00011111|00000000|xxxxxxxx ↔ 18.31.0.0/24

10000000|00001101|xxxxxxxx|xxxxxxxx ↔ 128.13.0.0/16

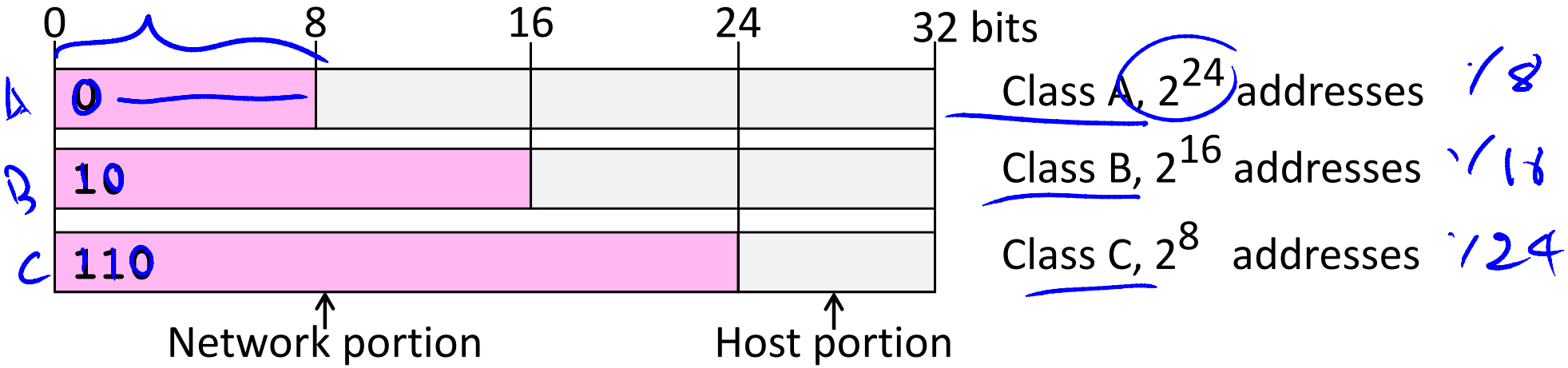
IP Prefixes (3)

- More specific prefix
  - Has longer prefix, hence a smaller number of IP addresses
- Less specific prefix
  - Has shorter prefix, hence a larger number of IP addresses



IP Address Classes – Historical

- Originally, IP addresses came in fixed size blocks with the class/size encoded in the high-order bits
  - They still do, but the classes are now ignored



Public / Private IP Addresses

- Public IP addresses, e.g., 18.31.0.1
  - Valid destination on the global Internet
  - Must be allocated to you before use »
  - Mostly exhausted … time for IPv6!
- Private IP addresses
  - Can be used freely within private networks (home, small company)
  - 10.0.0.0/8, 172.16.0.0/12, 192.168.0.0/16
  - Need public IP address(es) and NAT to connect to global Internet

Allocating Public IP Addresses

- Follows a hierarchical process
  - IANA delegates to regional bodies (RIRs)
  - RIRs delegate to companies in their region
  - Companies assign to their customers/computers (later, DHCP)