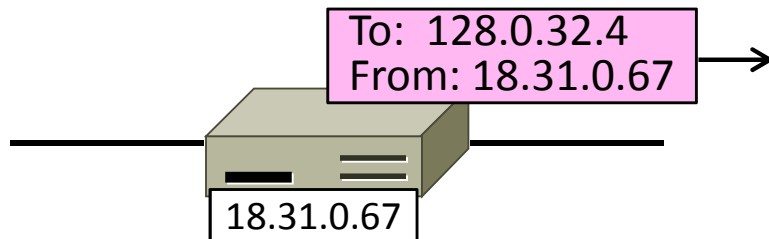# Computer Networks

IP Prefixes (§5.6.1-5.6.2)

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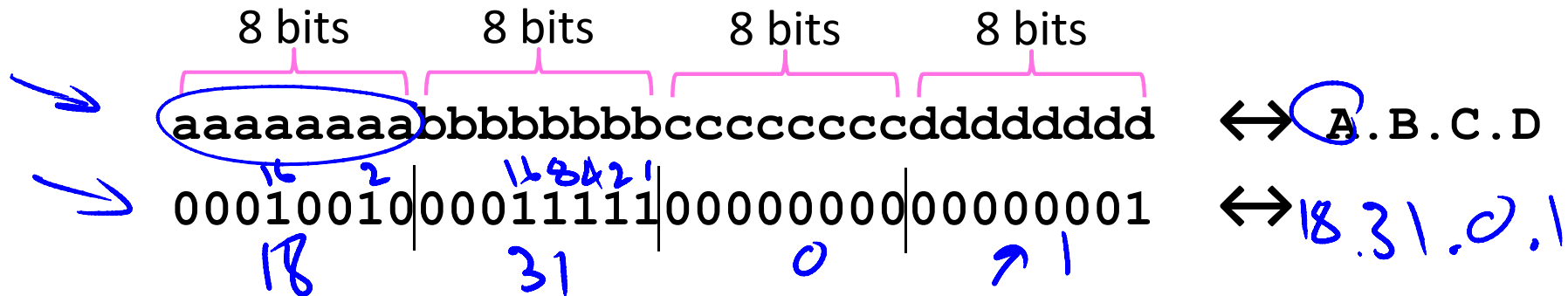
Topic

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

To: 128.0.32.4
From: 18.31.0.67

18.31.0.67

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 $4 \times 8 = 32$

8 bits	8 bits	8 bits	8 bits

aaaaaaaabbbbbbbbccccccccdddddddd ↔ A.B.C.D

00010010 00011111 00000000 00000001 ↔ 18.31.0.1

18   31   0   1

IP Prefixes – Modern

- Addresses are allocated in <u>blocks</u> called <u>prefixes</u>
  - Addresses in an L-bit prefix have the same top L bits
  - There are 2^{32-L} addresses aligned on 2^{32-L} boundary
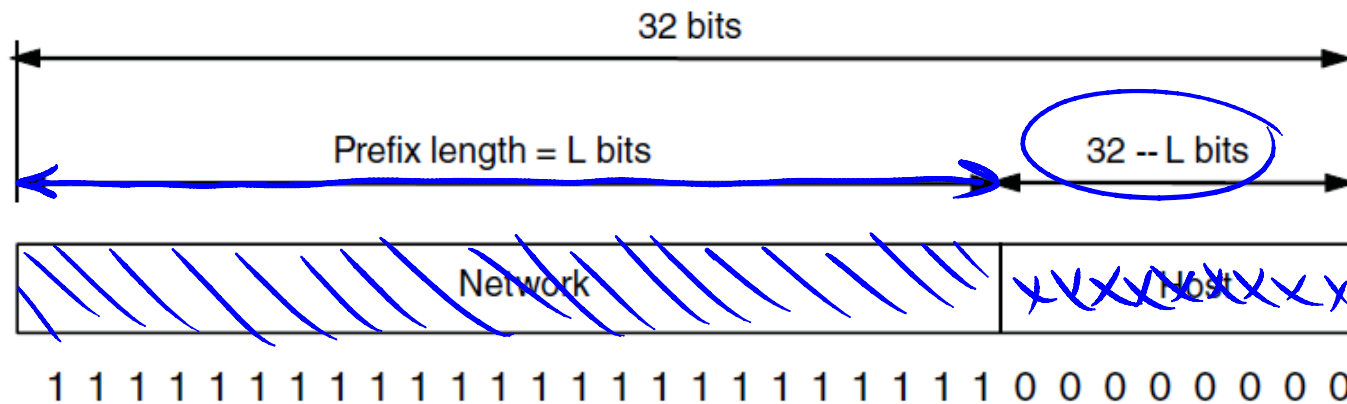
IP Prefixes (2)

- 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
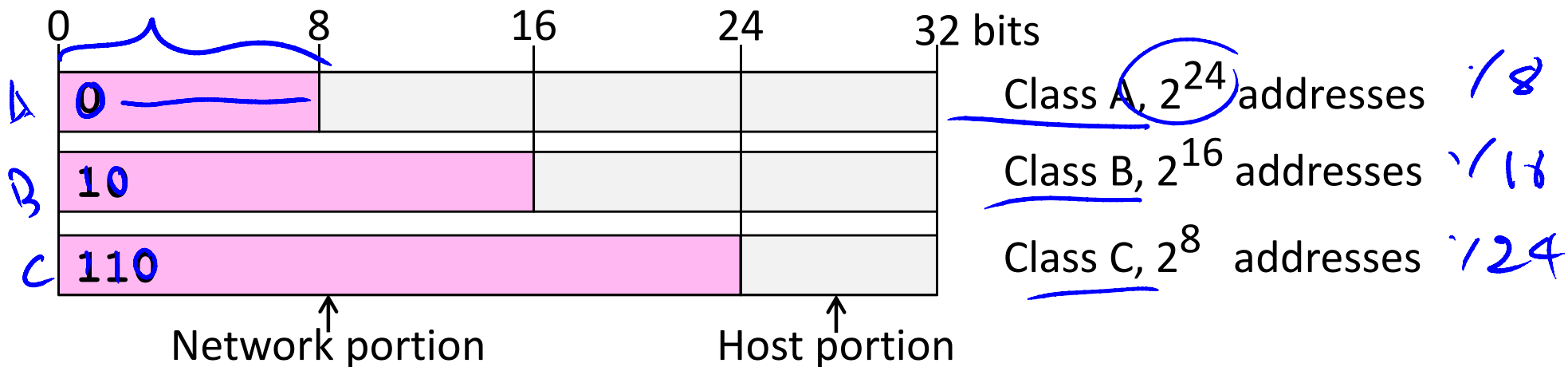128   13

IP Prefixes (3)

- <u>More specific</u> prefix
  – Has longer prefix, hence a <u>smaller number</u> of IP addresses
- <u>Less specific</u> prefix
  – Has shorter prefix, hence a <u>larger number</u> of IP addresses

Prefix length

| /0 | /8 | /16 | /24 | /32 |

2^{32} 2^{24} 2^{16} 2^{8} 2^{0} Addresses in prefix

Less specific   More specific
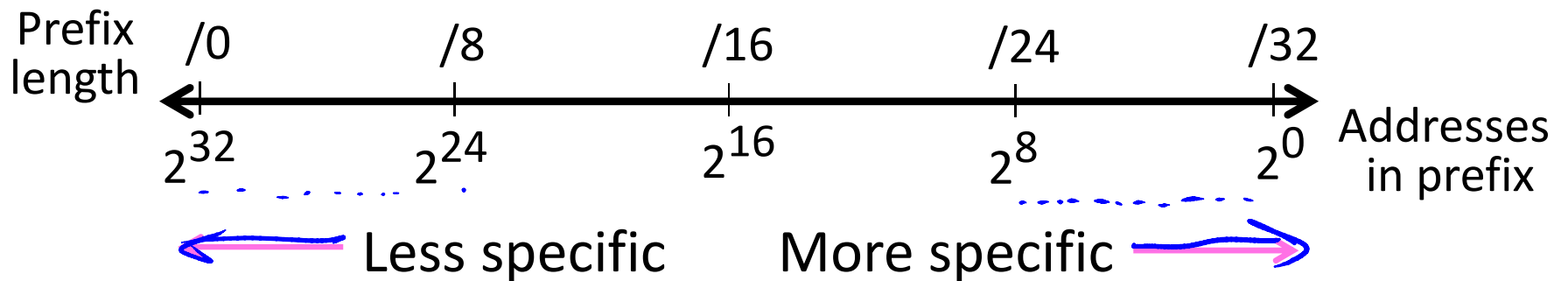
IP Address Classes – Historical

- 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

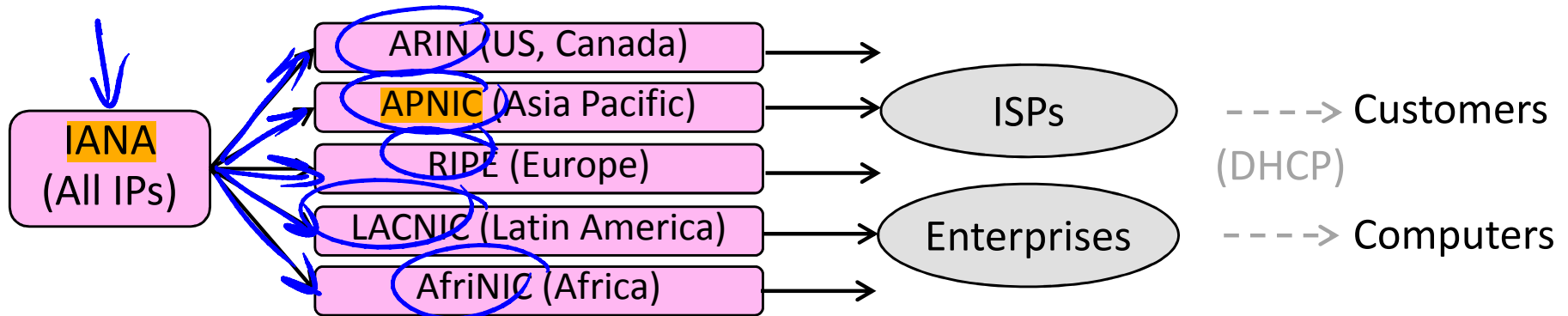| 0		8	16	24	32 bits	
A	**0**					Class A, 2^{24} addresses /8
B	**10**					Class B, 2^{16} addresses /16
C	**110**					Class C, 2^{8} addresses /24

Network portion → Host portion →

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)

IANA
(All IPs)

ARIN (US, Canada)
APNIC (Asia Pacific)
RIPE (Europe)
LACNIC (Latin America)
AfriNIC (Africa)

ISPs

Enterprises

- - - -> Customers
(DHCP)
- - - -> Computers

END