

CS 725/825 & IT 725

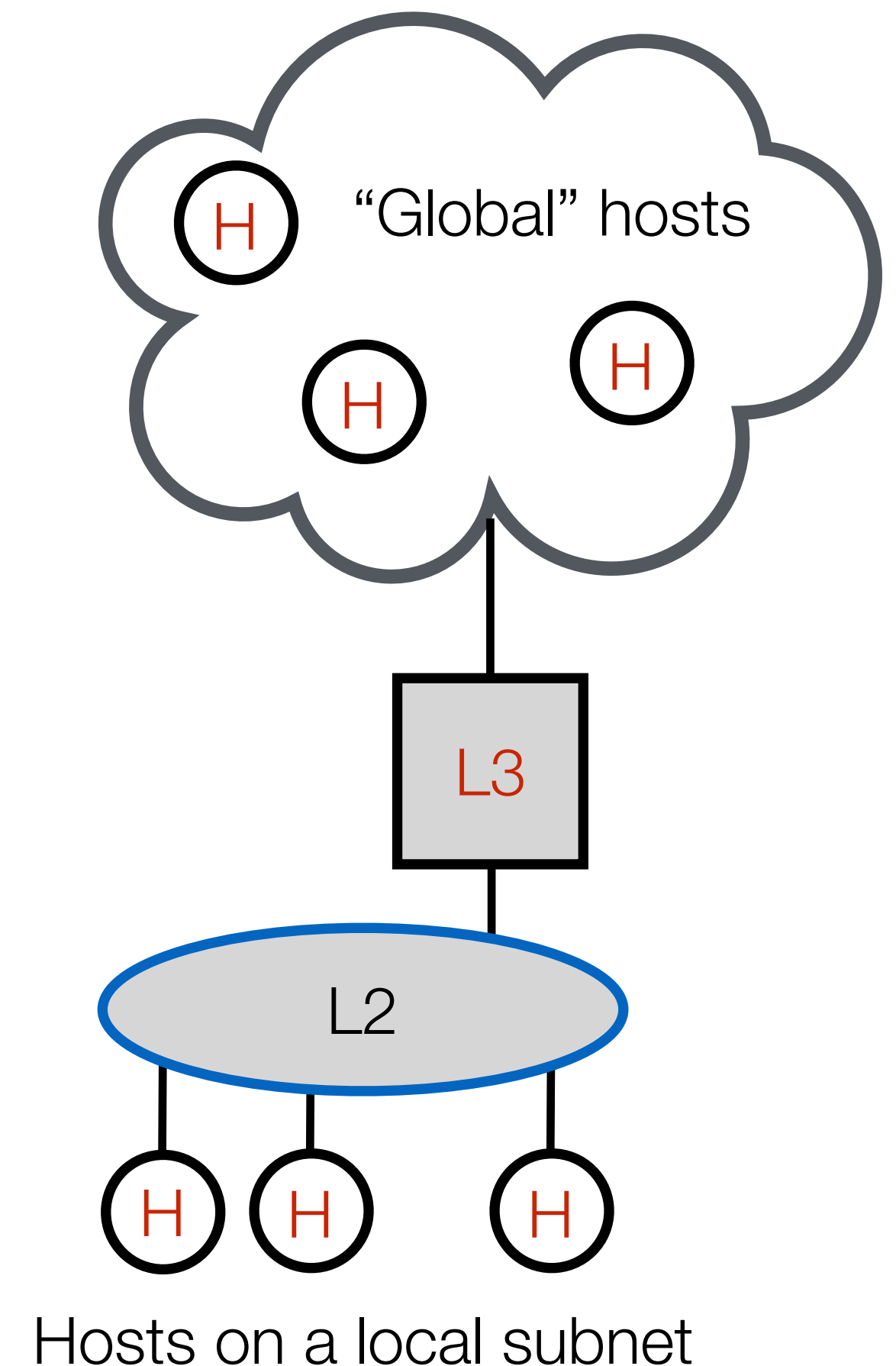
Lecture 5

Networking Fundamentals

September 21, 2026

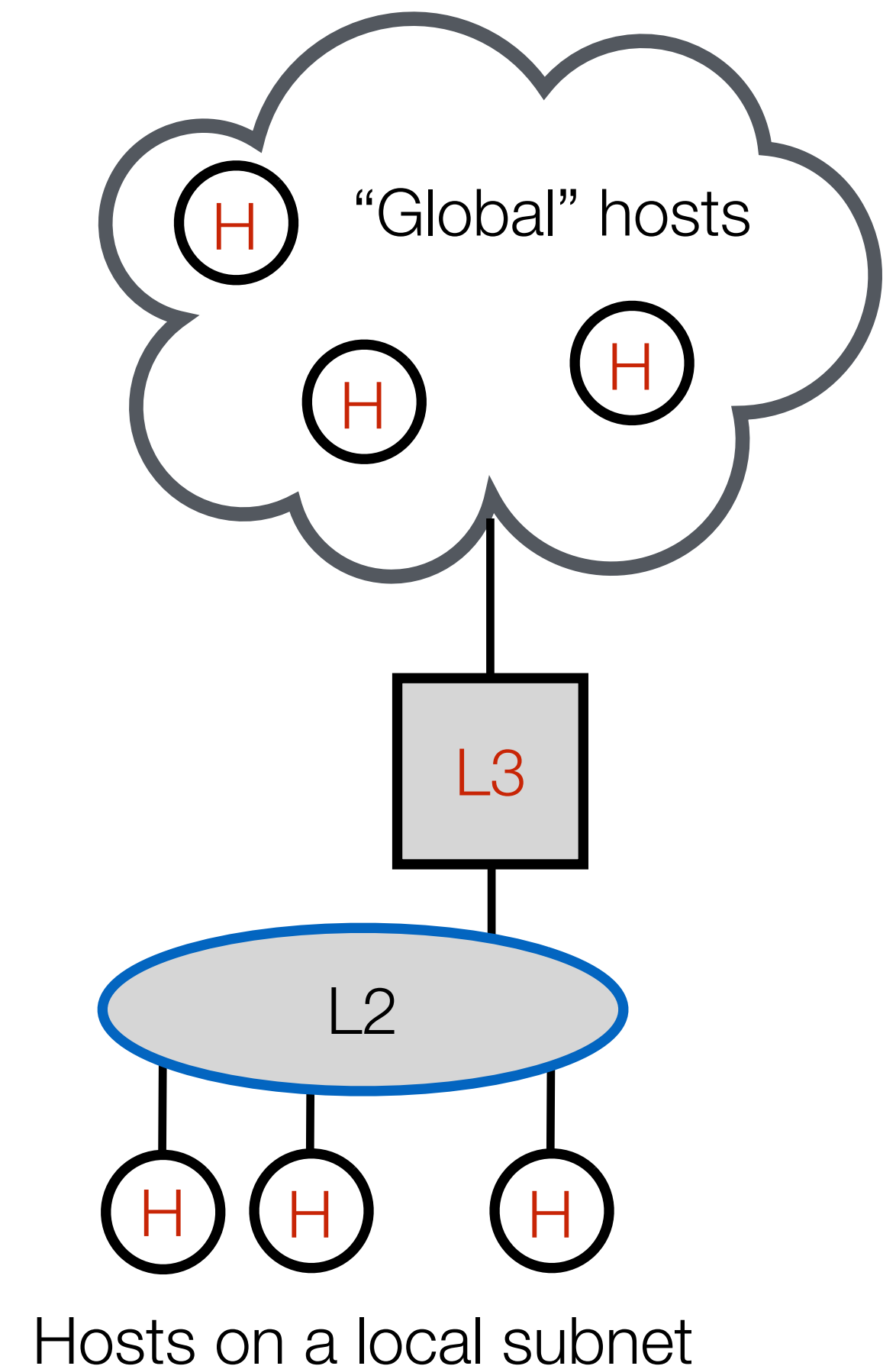
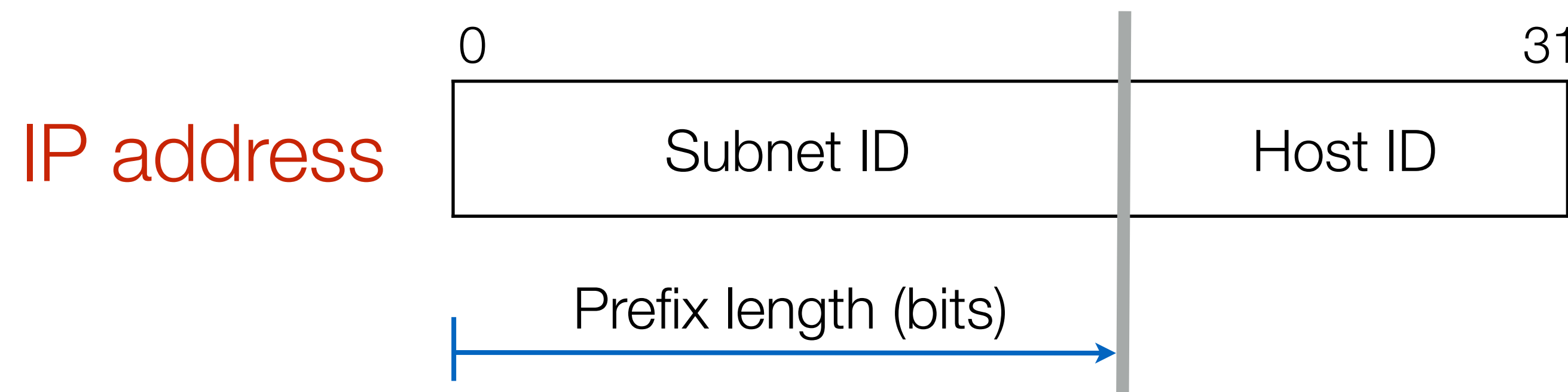
Subnetting

- ▶ **Problem:** deciding whether an IP address belongs to a specific **subset** of IP addresses
- ▶ **Solution:** nodes on a subnet (and only those) have IP addresses within a specific **range**



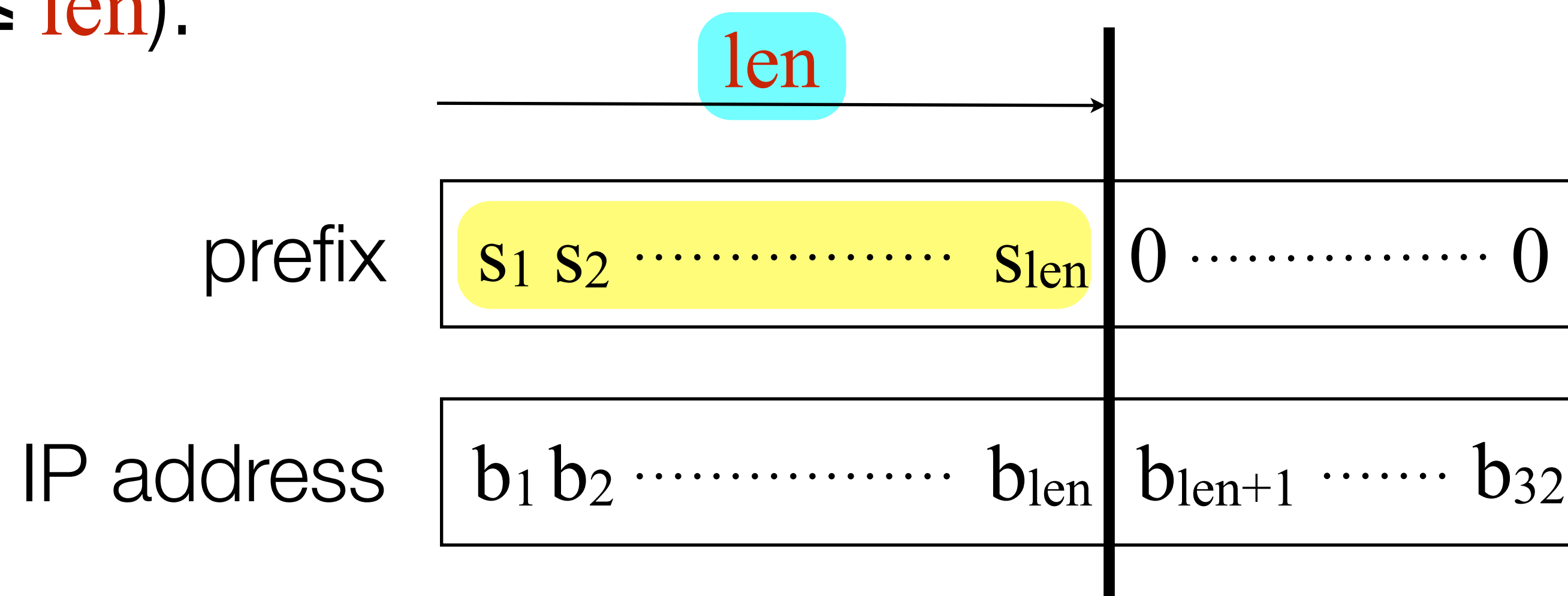
Subnetting

- ▶ **Problem:** deciding whether an IP address belongs to a specific **subset** of IP addresses
- ▶ **Solution:** nodes on a subnet (and only those) have IP addresses within a specific **range**
- ▶ Simplifying HW implementation: **subnets** (ranges of IP addresses that can be placed only in a specific, constrained way):



IP Prefix

- ▶ specifies a range of consecutive IP addresses
- ▶ consists of a *subnet id* and a *length* (*len*)
e.g., 132.177.4.0/22
- ▶ An IP address belongs to a range specified by a prefix if its first *len* bits are equal to those in the *subnet id* ($s_i = b_i$ for all $i \leq \text{len}$):



Example questions

- ▶ Range of 132.177.4.0/24?
- ▶ Prefix for range 132.177.0.0 → 132.177.255.255?

Example questions

- ▶ Range of 132.177.4.0/24?
132.177.4.0 → 132.177.4.255
- ▶ Prefix for range 132.177.0.0 → 132.177.255.255?
132.177.0.0/16

Example questions

- ▶ Range of 132.177.4.0/26?
- ▶ Prefix for range 132.177.2.192 → 132.177.2.223?

Example questions

- ▶ Range of 132.177.4.0/26?
132.177.4.0 → 132.177.4.63
- ▶ Prefix for range 132.177.2.192 → 132.177.2.223?
132.177.2.192/27

Combining prefixes

132.177.0.0/24

Range 132.177.0.0 - 132.177.0.255

132.177.1.0/24

Range 132.177.1.0 - 132.177.1.255

Combining prefixes

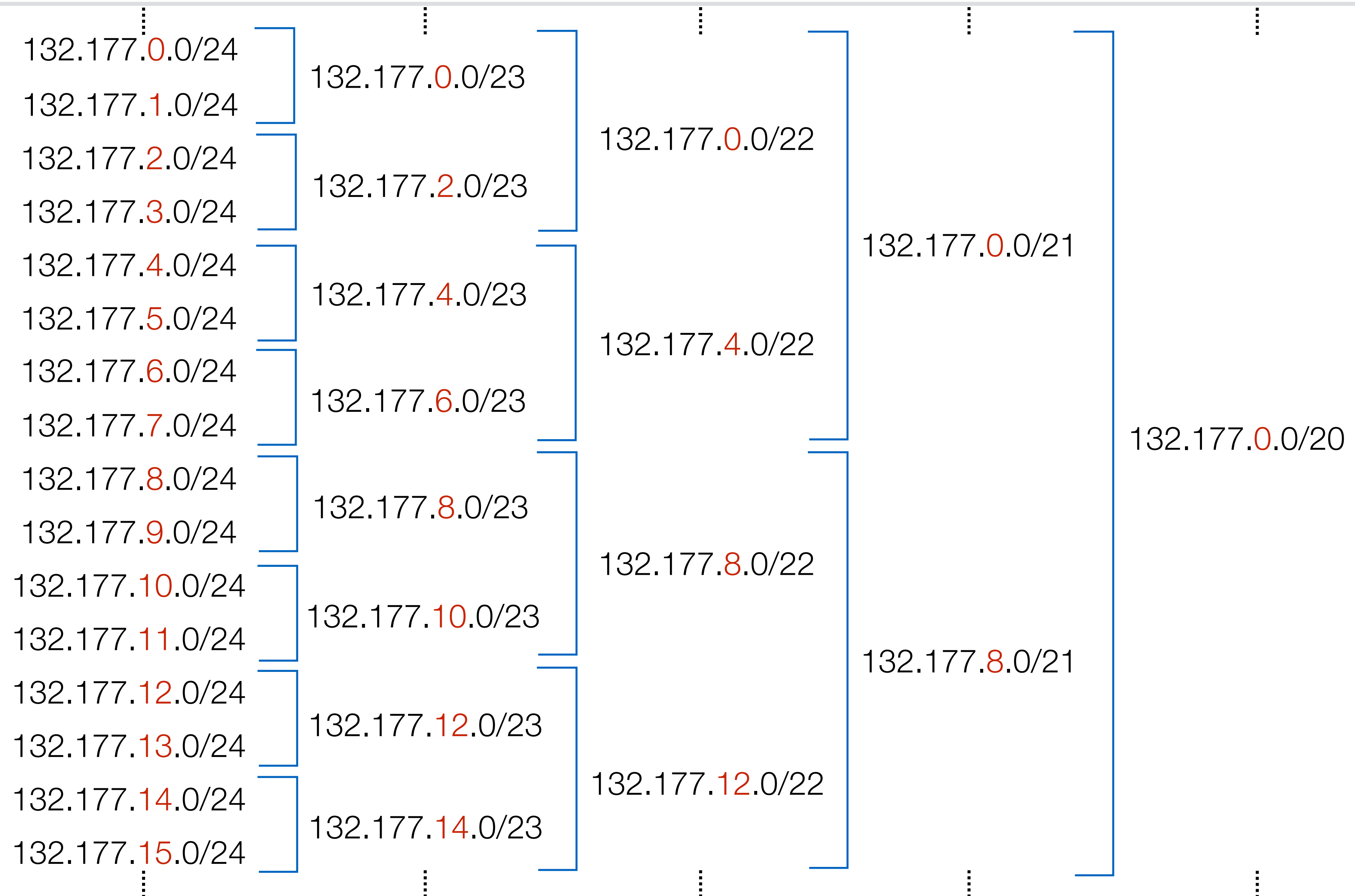
132.177.0.0/24
132.177.1.0/24



132.177.0.0/23

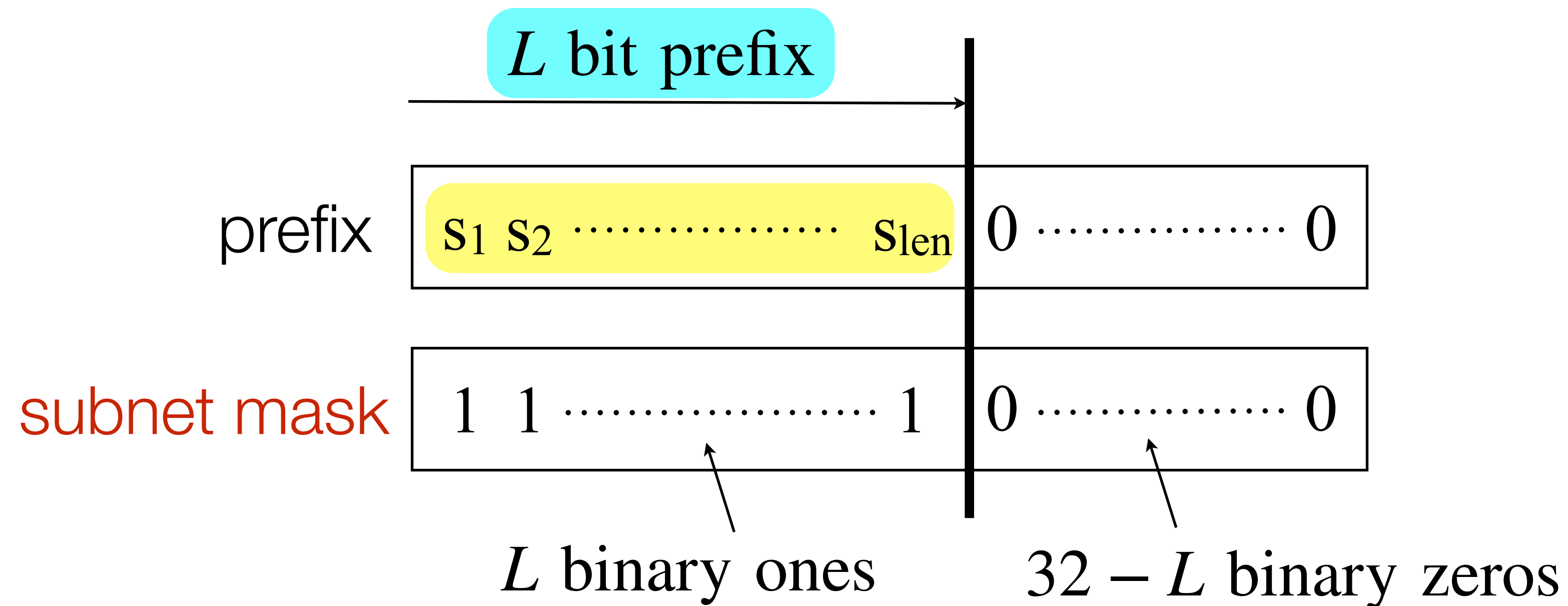
Range 132.177.0.0 - 132.177.1.255

Combining prefixes



Subnet Mask

- ▶ Another way to specify **prefix length**
- ▶ A 32 bit, IP address-like value whose binary representation has binary ones in bits corresponding to the subnet id bits.



Subnet Mask Representation

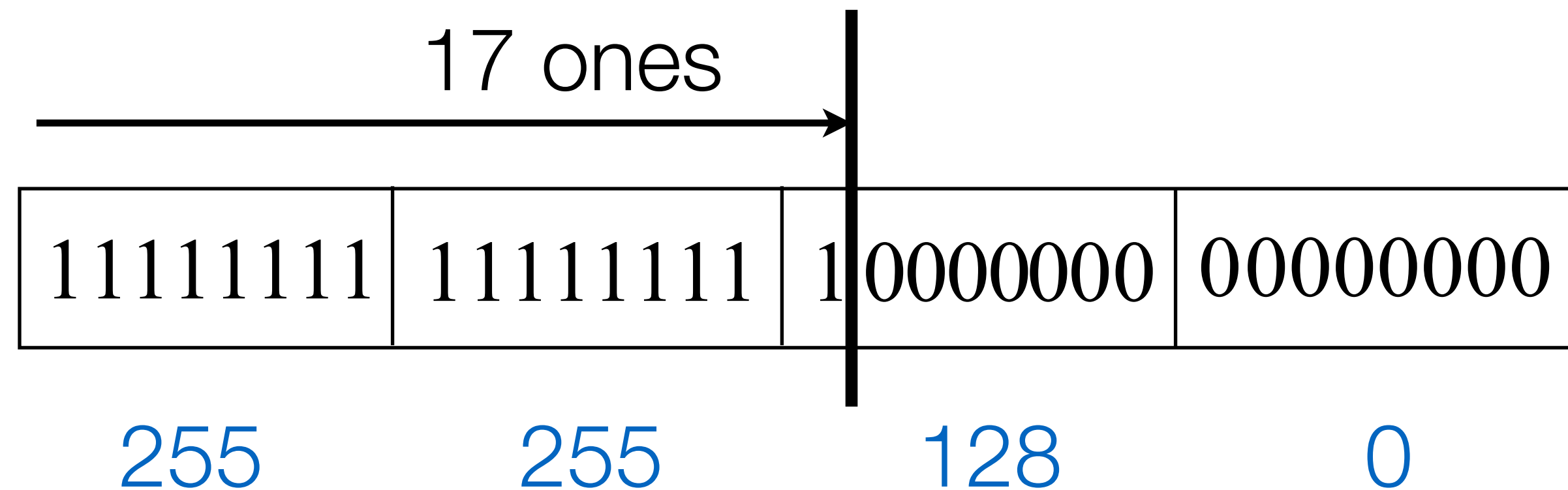
- ▶ Typically represented using *decimal dotted notation*:
255.255.0.0
- ▶ Subnet length and subnet mask (netmask) are for all practical purposes equivalent:

132.177.4.0 with netmask 255.255.255.0

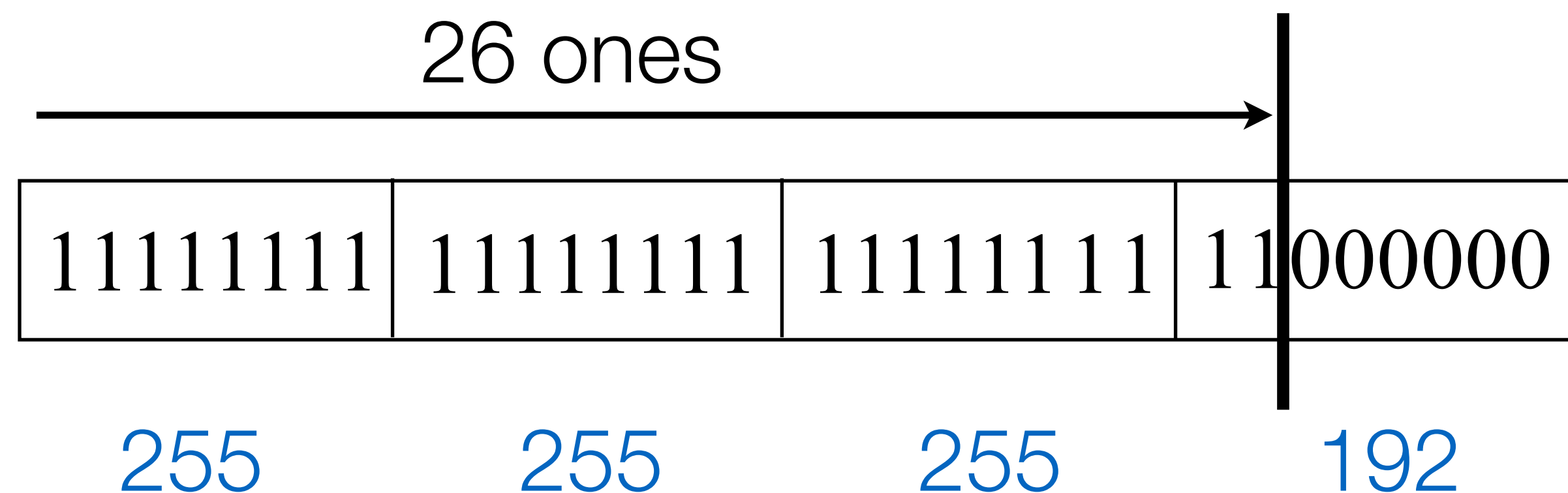
is equivalent to 132.177.4.0 /24

Example questions

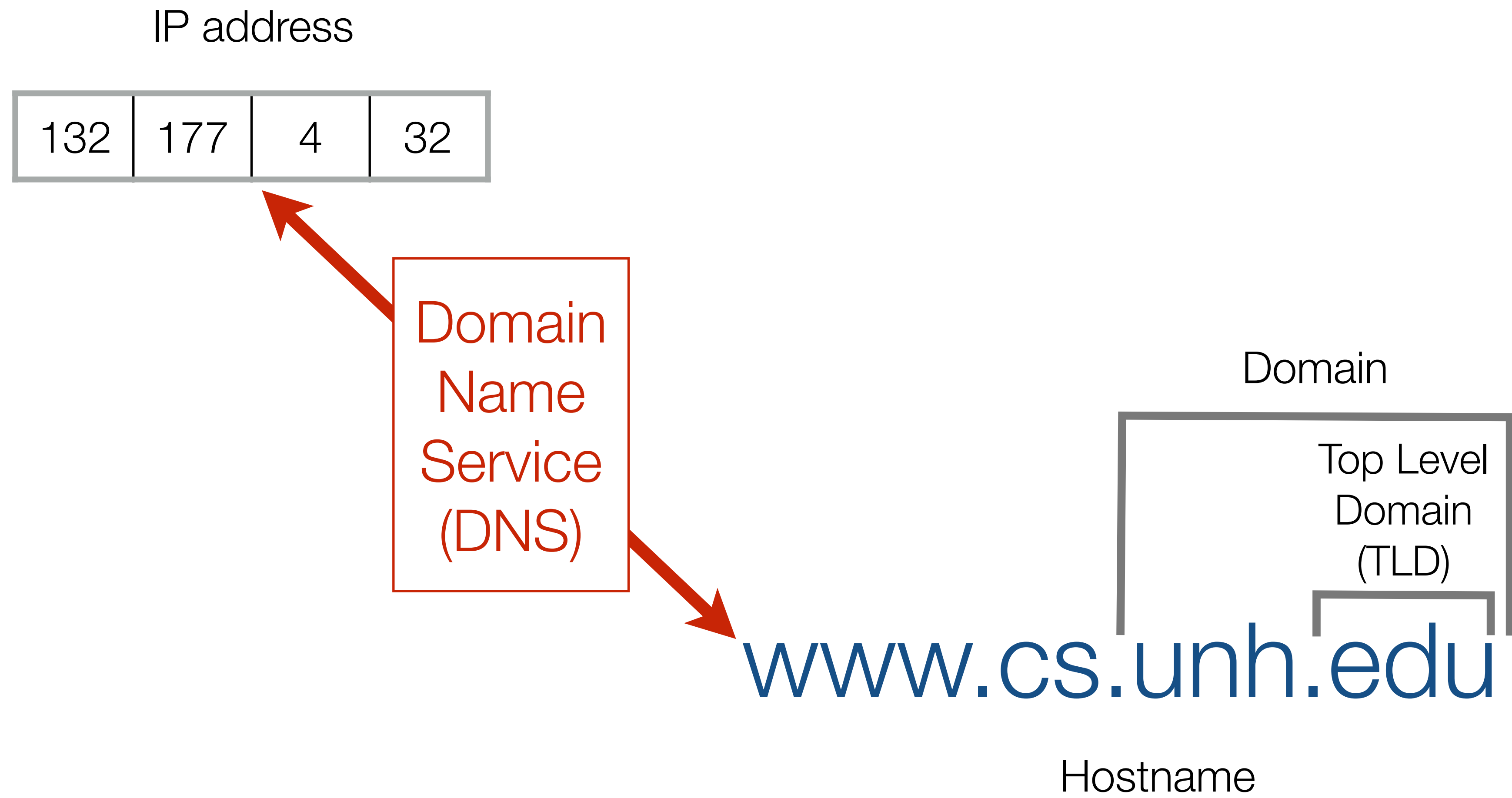
- Subnet mask for prefix length /17?



- Prefix length for subnet mask 255.255.255.192?



Domain Name Service



Domain Name Service

- ▶ Mapping between hostnames and IP addresses:
 - one-to-one, one-to-many, many-to-one, or many-to-many?
 - mapping in both directions
- ▶ Possible solutions:
 - centralized database
 - fully distributed database

Domain Name Service

- ▶ Distributed, redundant, hierarchical database
 - ownership
 - characteristics of the organization (.com, .org, ...)
 - geography (.uk, .cn, .nh.us)
- ▶ Query delegation:
 - recursive
 - iterative (non-recursive)