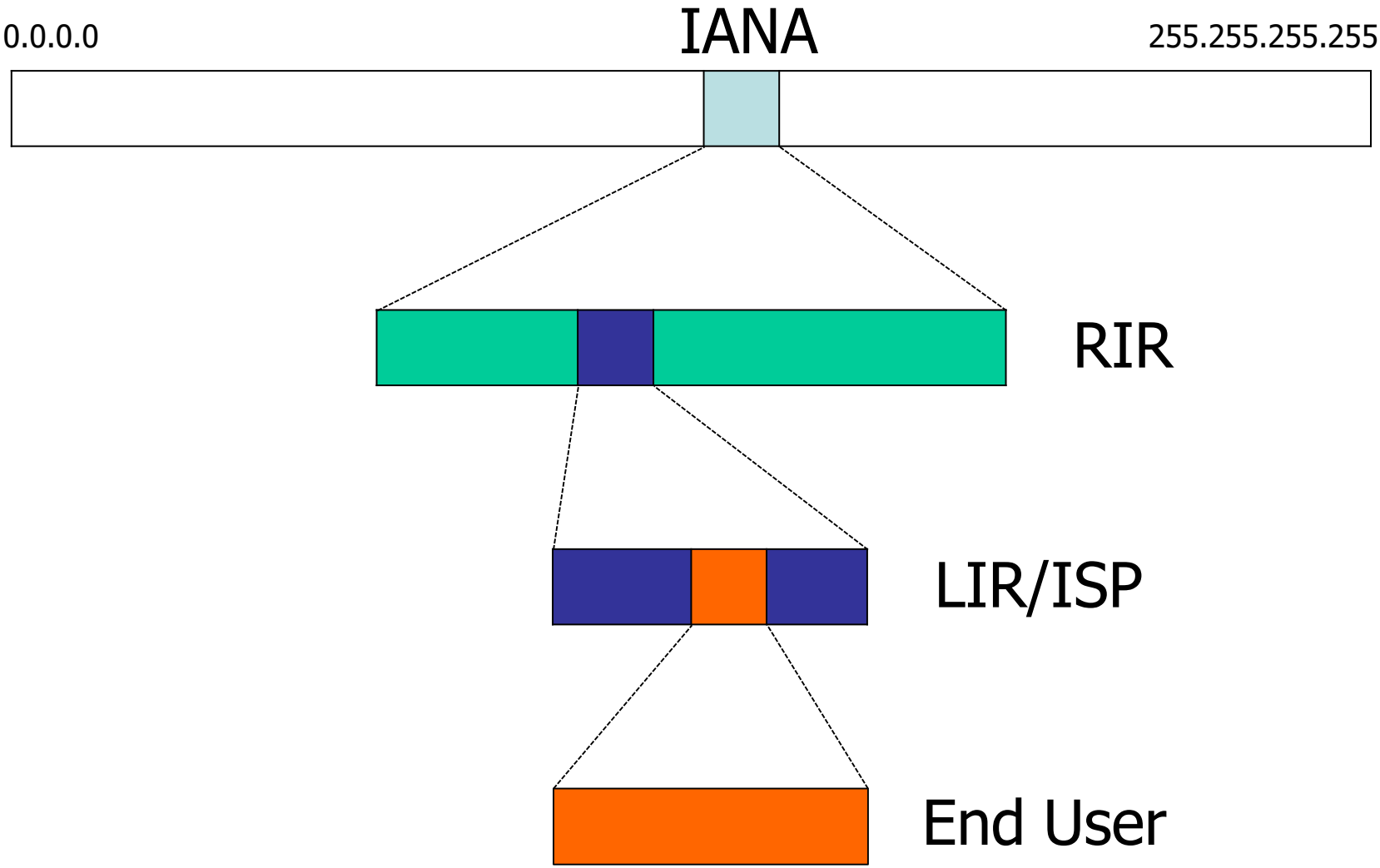
Boot Camp

IP Addressing

Day 1 – SS Track – SomNOG6

Hierarchical address allocation



IPv4 addresses

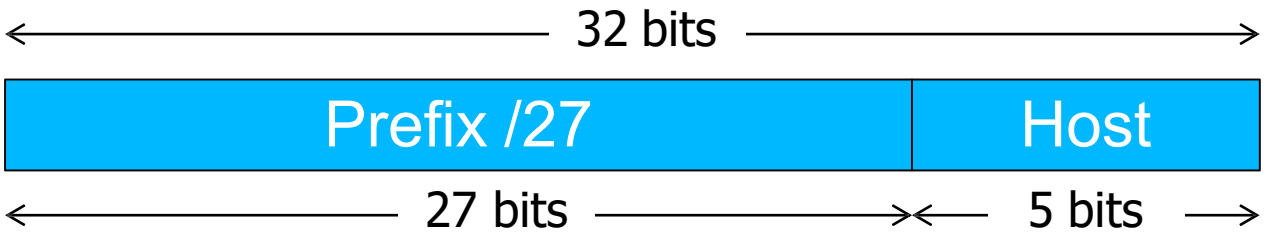
- 32-bit binary number
  - How many unique addresses in total?
- Conventionally represented as four dotted decimal octets

10000000110111111001110100010011

128 . 223 . 157 . 19

Can you explain why 00010011 = 19 in decimal?

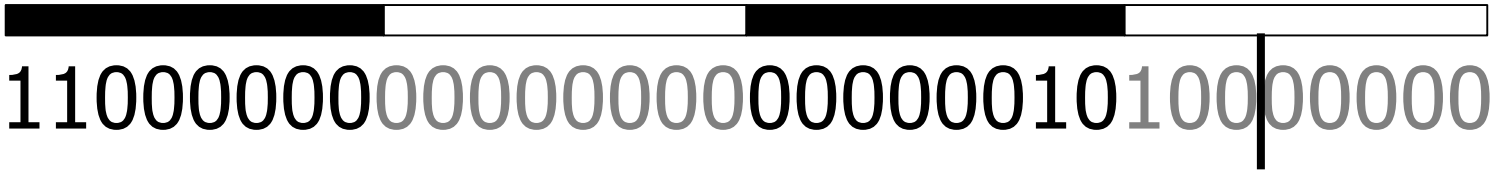
Prefixes



- A range of IP addresses is given as a prefix, e.g. 192.0.2.128/27
- In this example:
  - How many addresses are available?
  - What are the lowest and highest addresses?

Prefix calculation

192 . 0 . 2 . 128



11000000000000000000001010000000

Prefix length /27 ➔ First 27 bits are fixed

Lowest address:

11000000000000000000001010000000

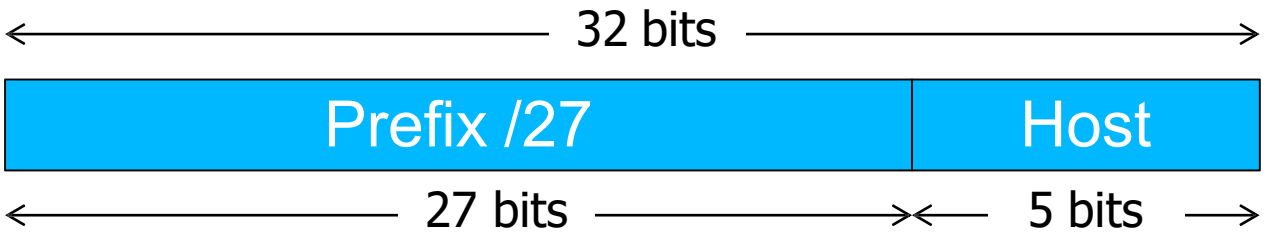
192 . 0 . 2 . 128

Highest address:

11000000000000000000001010011111

192 . 0 . 2 . 159

IPv4 “Golden Rules”



1. All hosts on the same L2 network must share the same prefix
2. All hosts with the same prefix have different host part
3. Host part of all-zeros and all-ones are reserved

Golden Rules for 192.0.2.128/27

- Lowest 192.0.2.128 = network address
- Highest 192.0.2.159 = broadcast address
- Usable: 192.0.2.129 to 192.0.2.158
- Number of usable addresses: 32 - 2 = 30

Exercises

- Network 10.10.10.0/25
  - How many addresses in total?
  - How many usable addresses?
  - What are the lowest and highest usable addresses?

- Network 10.10.20.0/22
  - How many addresses in total?
  - How many usable addresses?
  - What the the lowest and highest usable addresses?

An edge case

- How many usable addresses in a /30 prefix?
- What is this used for?
  - (Note: modern routers support /31 for this purpose to reduce IP address wastage)

Netmask

- Netmask is just an alternative (old) way of writing the prefix length
- A '1' for a prefix bit and '0' for a host bit
- Hence N x 1's followed by (32-N) x 0's

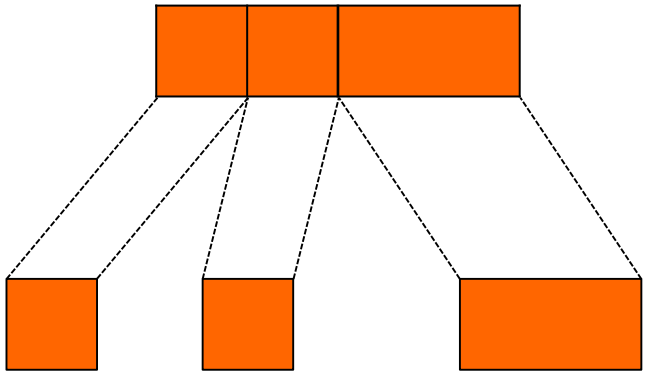
/27 =

11111111111111111111111111100000

255 . 255 . 255 . 224

Subnetting

- Since each L2 network needs its own prefix, then if you route more than one network you need to divide your allocation
- Ensure each prefix has enough IPs for the number of hosts on that network



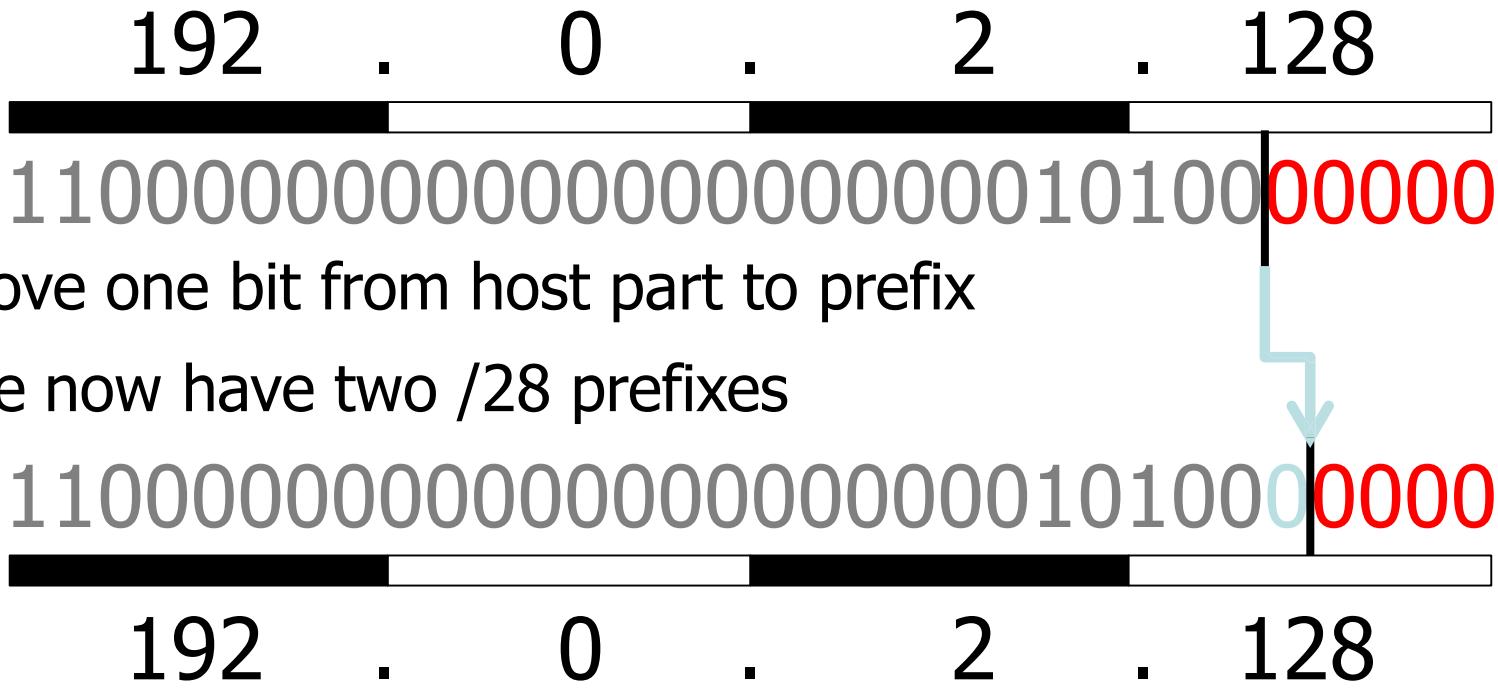
End User Allocation

Subnets

Subnetting Example

- You have been given 192.0.2.128/27
- However you want to build two Layer 2 networks and route between them
- The Golden Rules demand a different prefix for each network
- Let's split this address space into two equal-sized pieces

Subnetting /27

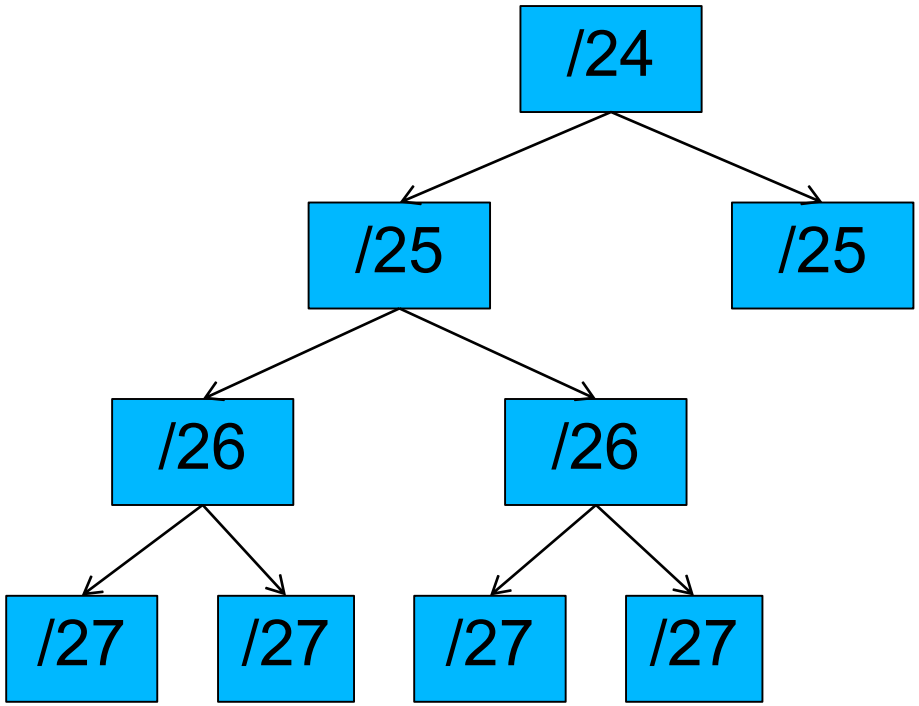


Check correctness

- Expand each new prefix into lowest and highest
- Ranges should not overlap
  - 192.0.2.128/28
    - Lowest (network) = 192.0.2.128
    - Highest (broadcast) = 192.0.2.143
  - 192.0.2.144/28
    - Lowest (network) = 192.0.2.144
    - Highest (broadcast) = 192.0.2.159
  - How many usable addresses now?

Aggregation tree

- Continue to divide prefixes as required
- Can visualize this as a tree



Questions on IPv4?