CS168: Discussion 4 - Routers II

Intro to the Internet
Spring 2025

Logistics

- HW1: Architecture
  - Deadline: Monday February 24
- Project 2: Distance-Vector Routing
  - Deadline: Tuesday February 28
- HW2: Routing
  - Deadline: Monday March 17

- Midterm on March 11, 7–9pm

Today's topics

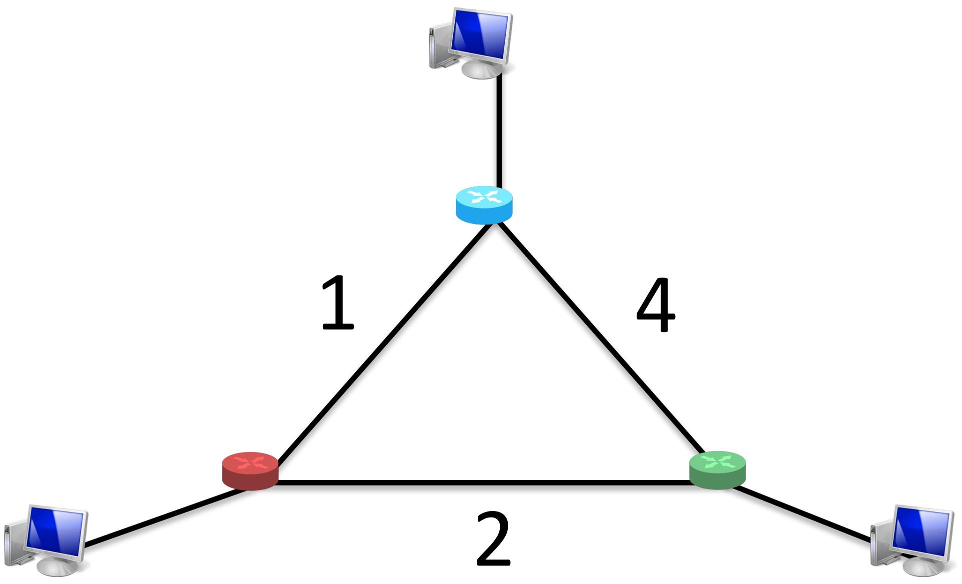
- link-state routing
- addressing

Link State Routing

Link State Routing

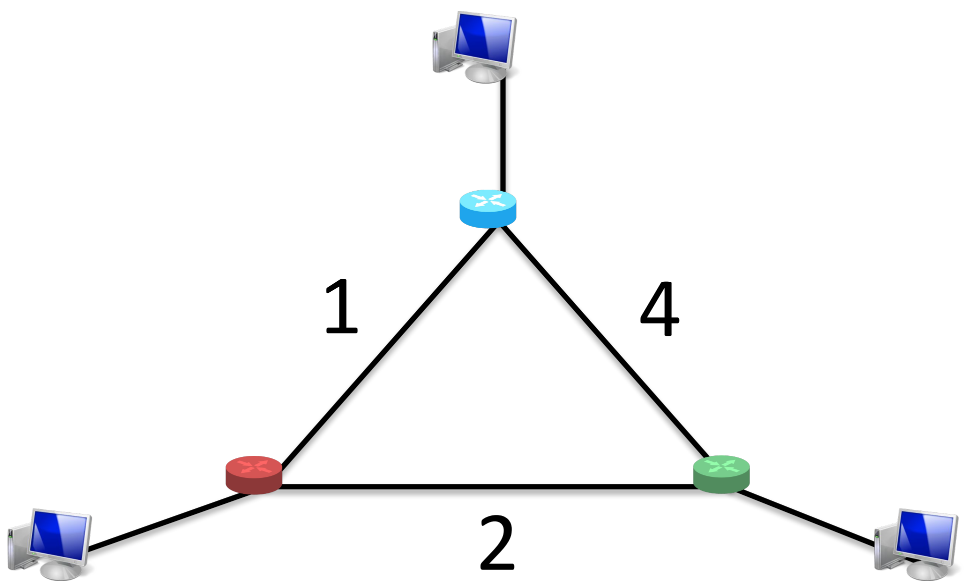
Each router knows its own local "link state":

- State of each link to its neighbor (up/down)
- Associated costs



Link State Routing

1. Router floods its link state to all other routers.
2. Each router learns global network topology
3. Then, computes shortest path themselves!
    - With Dijkstra's, etc



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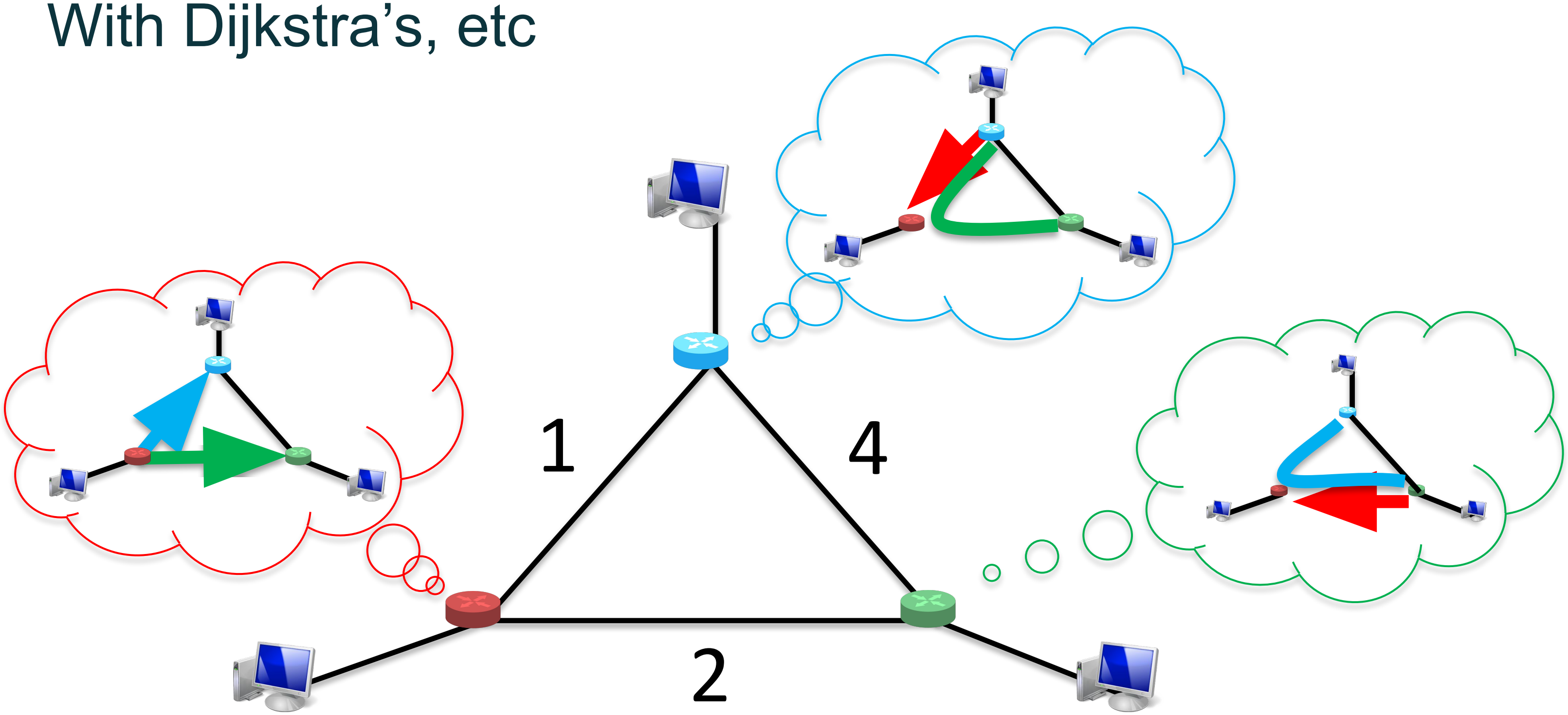


Distance Vector vs Link State

- Distance-Vector
  - Global computation (distributed across all nodes)
  - Only local data (local node plus whatever our neighbours told us).
- Link-State
  - Local computation
  - Using global data (from all parts of the network)

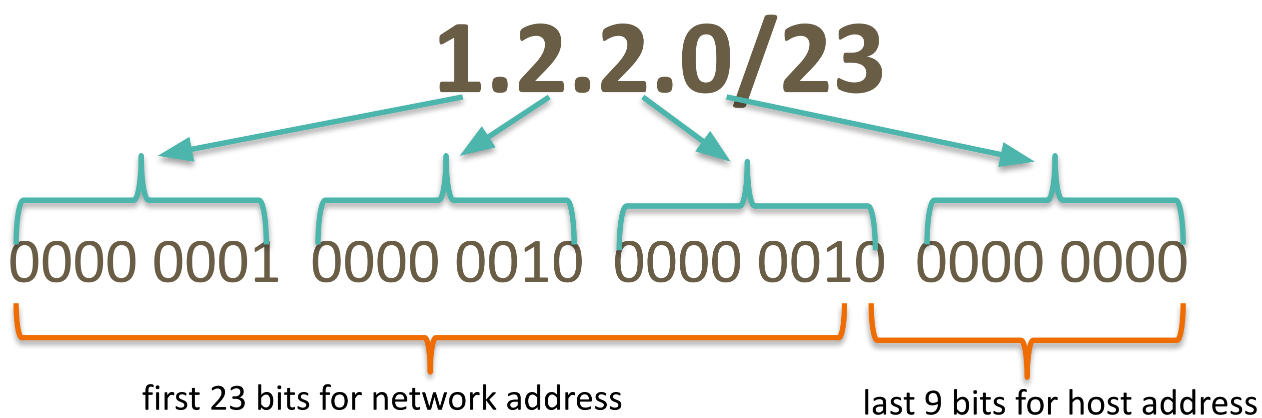
IP Addressing

Requirements of Addressing

- Scalable Routing
  - Minimize state exchange needed to create paths
- Efficient Forwarding
  - Small forwarding tables
  - Fast lookups
- Host must be able to recognize packet is for them
  - An end-to-end check on routing
  - L3: IP addresses (dynamically assigned)

IP Address

- 32 bits (for IPv4), split into 4 bytes, written in decimal (each decimal between 0 and 255)
- Network prefix: /<bits>
  - Size of network address, counting from the leftmost bit
  - Example: 1.2.2.0/23



Network prefixes (netmasks)

- Prefix dedicated to network address
- How can we tell if a host is in a network?
  - Check if the prefix matches!

Mask: 123.96.0.0/12

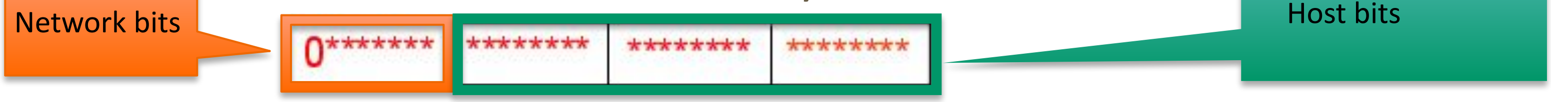
```
01111011 . 01100000 . 00000000 . 00000000
```

Addr: 123.100.42.6

```
01111011 . 01100100 . 00101010 . 00000110
```

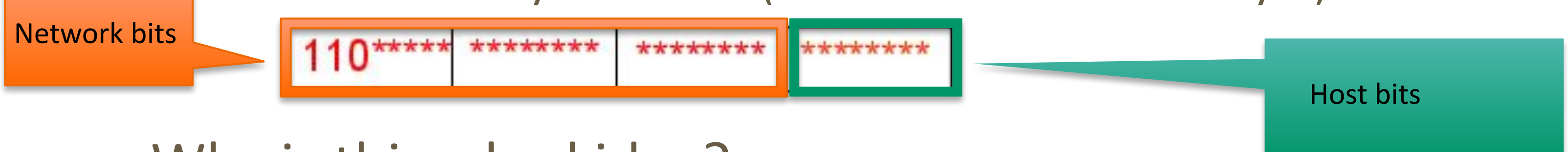
Classful Addressing

- Network classes:
  - A (/8): first 8 bits devoted to network
    - First bit is fixed to **0**.
    - first byte from 0 to 127
    - Can have ~16M hosts, only 2^7 = 128 nets.



  - B (/16): first 16 bits devoted to network (first byte from 128 to 191)
    - First two bits are fixed to **10**
    - Can have ~65K hosts, ~16K nets

  - C (/24): first 24 bits devoted to network (first byte from 192 to 223)
    - First three bits are fixed to **110**
    - Can have only 254 hosts (255 is reserved for last byte) ~2M nets



- Why is this a bad idea?

Very limited choices lead to waste of addresses

Classless Inter-Domain Routing (CIDR)

- Use two 32-bit numbers to represent a network
  - Network address = IP Address **bitwise AND** Subnet Mask
    - IP Address is 192.138.12.2
    - Subnet Mask is 255.248.0.0

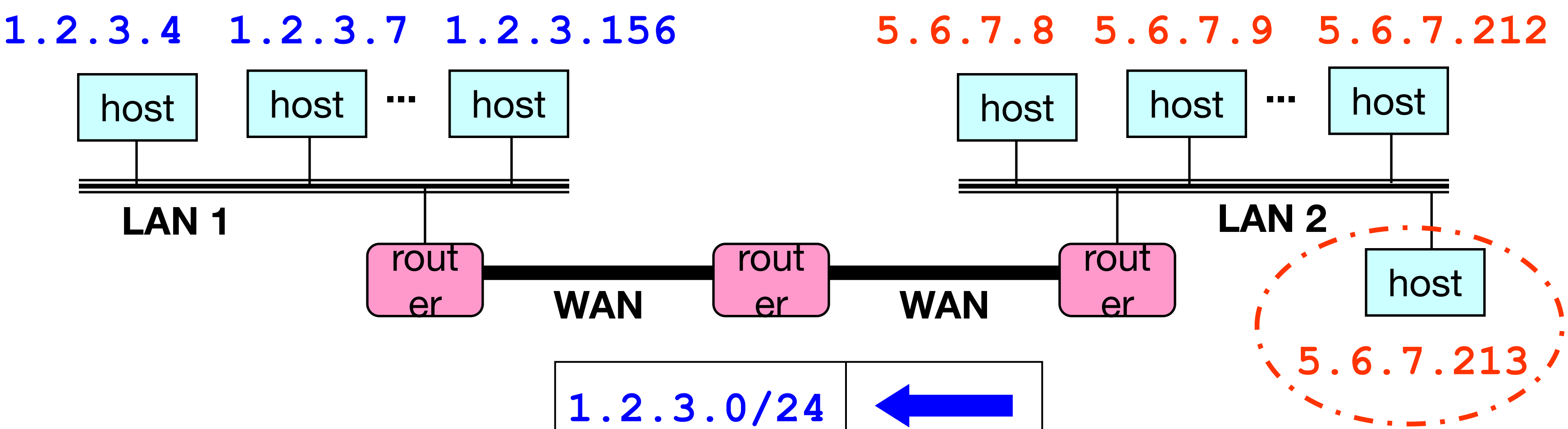
network address 192.136.0.0/13

IP Address	1100 0000 . 1000 1010 . 0000 1100 . 0000 0010
Subnet Mask	1111 1111 . 1111 1000 . 0000 0000 . 0000 0000

- Flexible division of bits:
  - More choices for the size of the network and hosts
- Offers better size routing table and efficient IP address space

Prefixes

- Easy to Add New Hosts
  - New host (5.6.7.213)
  - Forwarding table doesn't need to be updated!



1.2.3.0/24	←
5.6.7.0/24	→

forwarding table

Questions?

Feedback Form: https://tinyurl.com/cs168-sp25-dis