How It Works:
101: Naming, Addressing, Routing

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Agenda

- ⊙ Networking by Numbers
- ⊙ Naming
- ⊙ Addressing
- ⊙ Routing

Layer 0: Physical Realm

Wired
Copper
Fiber

VS

Wireless
Antenas

Layer 1 Example: Lambda on a fiber

⊙ Wave length on a fiber pair

⊙ Point-to-point

Layer 2 Example: WAN Fiber Path

- How to get fiber connectivity from A to B?
  - Can't always use a single, dedicated fiber
  - Interconnect multiple Layer 1 to create a fiber path from A to B

- Speed:
  - GE, 10GE, 25GE, 40GE, 100GE,...
  - Multiples of the above

Layer 3: Networking

- The world is NOT <u>flat</u>
- L2 domain == broadcast domain
- Need for topology isolation
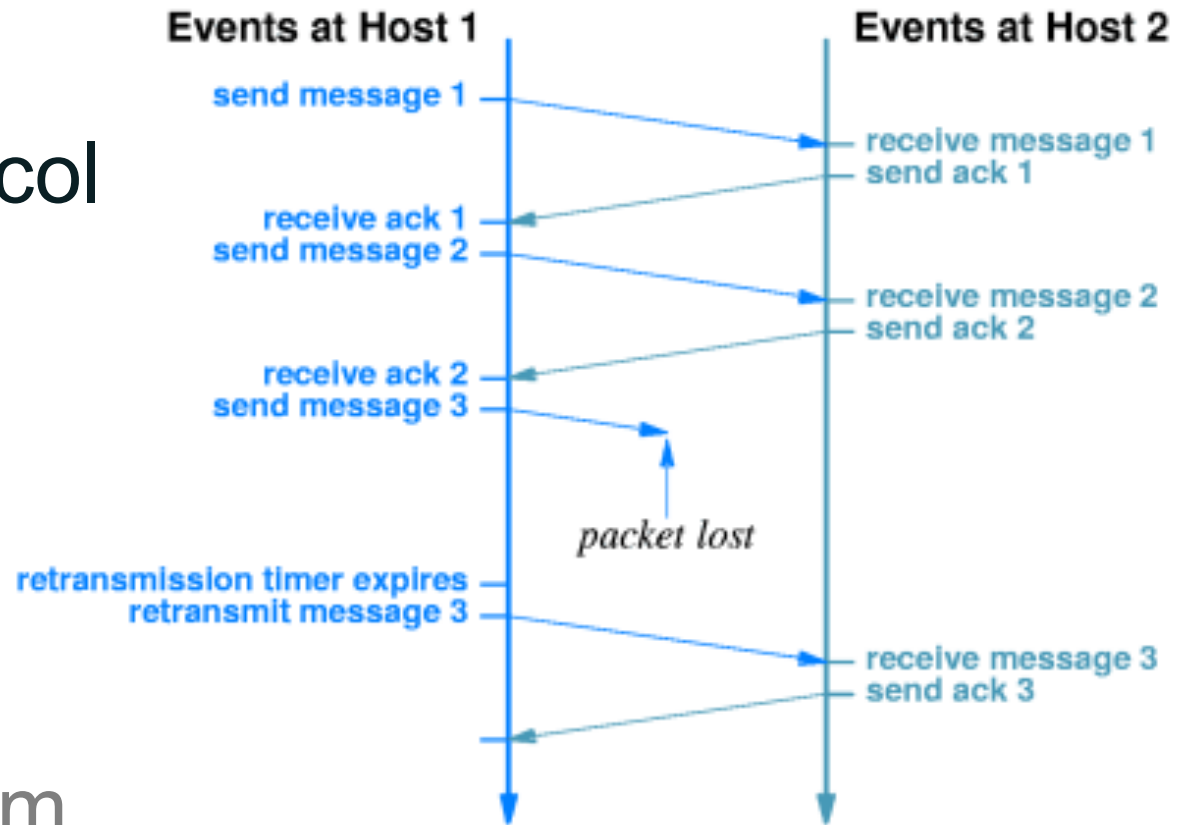- L3 interconnects L2 domains

Layer 3 == IP

IP: Internet Protocol

Layer 4: Transport

- **Transmission Control Protocol (TCP)**

Events at Host 1 | Events at Host 2

- send message 1 → receive message 1 / send ack 1
- receive ack 1 / send message 2 → receive message 2 / send ack 2
- receive ack 2 / send message 3 → *packet lost*
- retransmission timer expires / retransmit message 3 → receive message 3 / send ack 3

- User Datagram Protocol (UDP)

Layer 5: Session

- Real Time Streaming Protocol (RTSP)

Layer 6: Presentation

- In reverse chronological order:
  - JSON
  - XML
  - ASN.1
  - "fixed width"
  - "anything goes"

{"menu": {
    "id": "file",
     "value": "File",
     "popup": { "menuitem": [
            {"value": "New", "onclick":
                "CreateNewDoc()"},
            {"value": "Open", "onclick":
                "OpenDoc()"},
            {"value": "Close", "onclick":
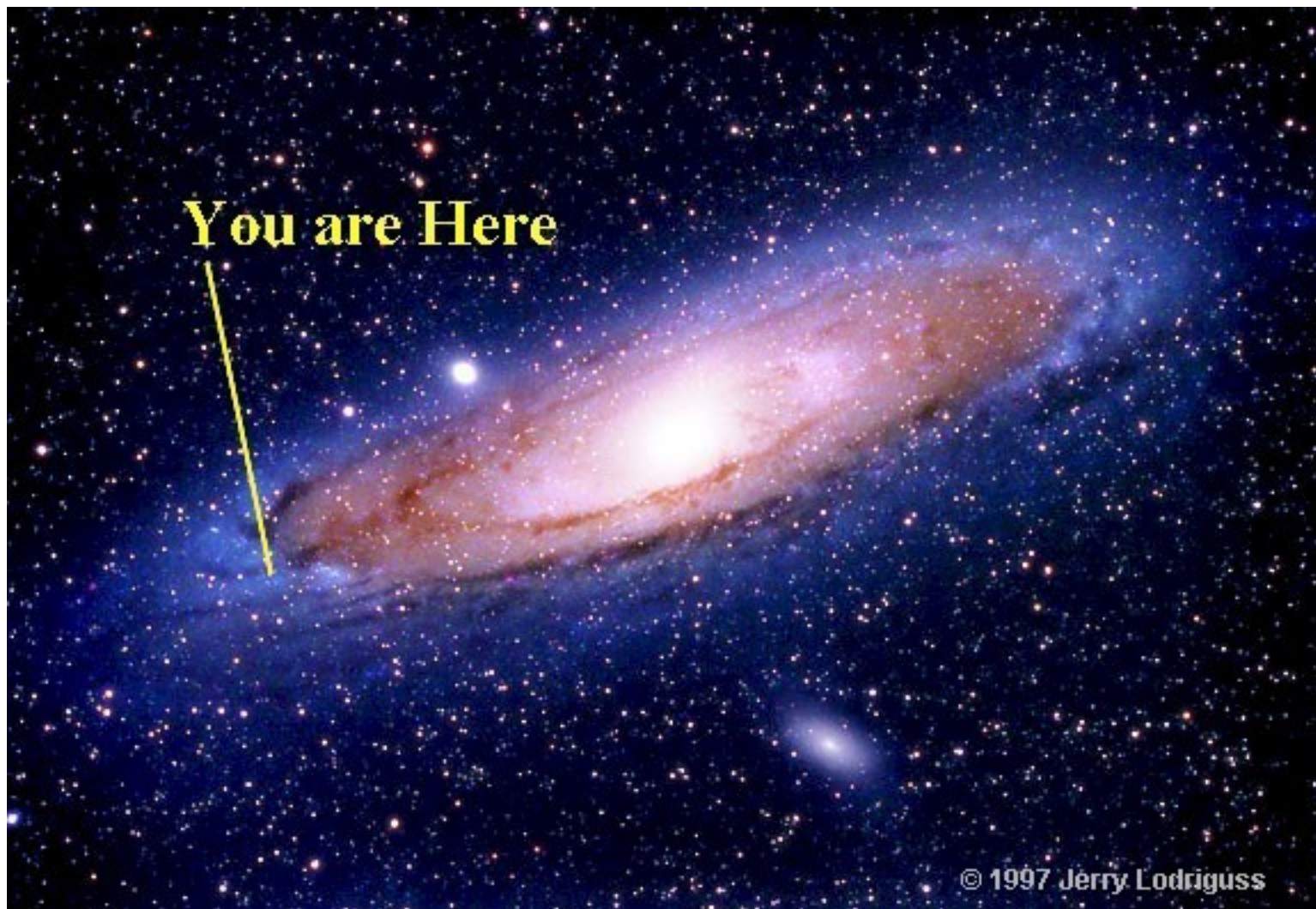   "CloseDoc()"}] } }}

L7: Applications

- Hypertext Transfer Protocol (HTTP)
- HTTP Secure (HTTPS)

Layer 8: Financial

Layer 9: Political

You are Here

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Naming

"Who is your dentist?"

What is a Name?

- Name |nām|
  - Noun
    - 1: A word or set of words by which a person, animal, place, or thing is known, addressed, or referred to: my name is Parsons, John Parsons | Köln is the German name for Cologne.
    - 2: A famous person: as usual, the big race will lure the top names.
      [in sing.] a reputation, especially a good one: he set up a school that gained a name for excellence.

→ If I know your name,
   I know 'who' you are

Name as a Handle

- "A word or set of words by which a person, animal, place, or thing is known…"
  - Having a name is only meaningful when other people know about it.
  - Knowing a name enables us to relate to it
    - We can talk –to– someone,
      or we can talk –about– someone.
  - Names can be passed from one party to another as a referral.

Here is the name of my dentist:

Names have Scopes

- Names need to be unique within a scope to avoid ambiguity
    - I'm the only Alain in my family
    - There were several Alains in my elementary classes, so teachers had to use a combination of first name/last name.

A name is Not Enough to Communicate

- Ok, I have your dentist name, but what is his address?

➔ Names must be mapped to a lower level identifier that will enable communication.

This process is called name resolution.

125, Root Canal rd, DC

CONTACT :
TEL :
NOTES :
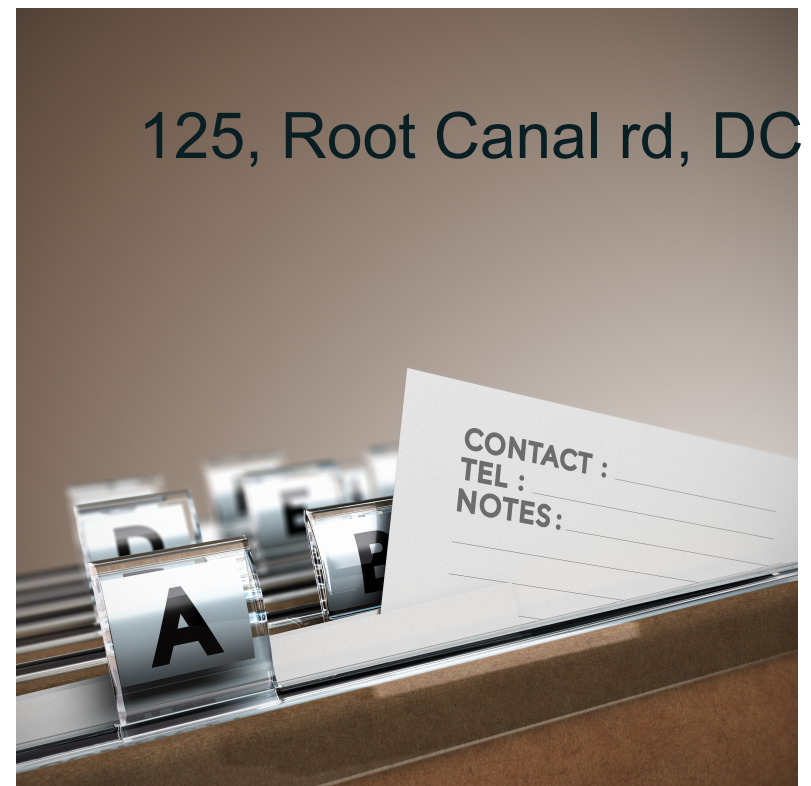
ADDRESSING

"Where is your dentist?"

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What is an Address?

- Address |əˈdres, ˈaˌdres|
  - Noun
    - The particulars of the place where someone lives or an organization is situated: they exchanged addresses and agreed to keep in touch

→ If I know your address,
   I know 'where' you are.

Address Structures

- A little detour: most famous address in DC: 1600 Pennsylvania Avenue NW, Washington, D.C. 20500-0003, USA

- Hierarchical structure:
  - USA
    - DC
      - NW
        » Pennsylvania Avenue
          - 1600

- Not always geographically organized
  - 1-800 (toll free) telephone numbers
  - Cell phone numbers
  - IP addresses

Addresses Have Scopes

- ## If you live in DC, all I need to tell you is:
    - ### 1600 Pennsylvania Avenue NW
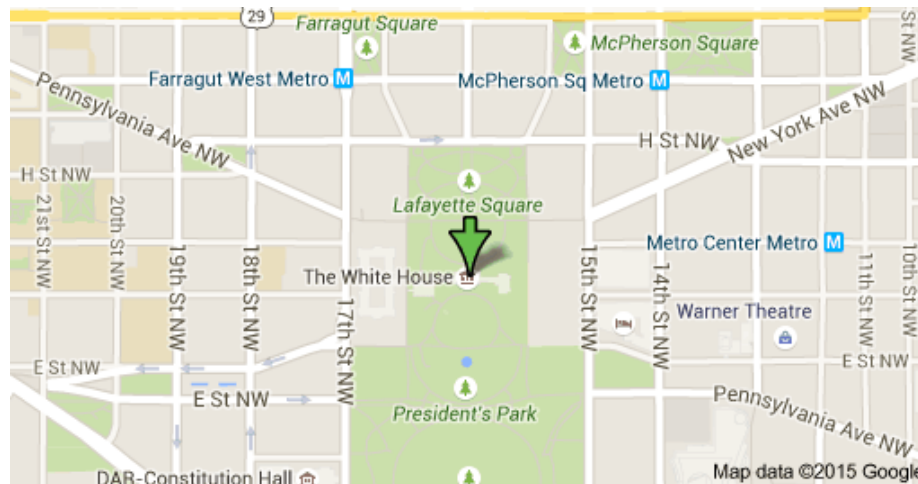
- ## If you live in Europe, you know that Paris is most probably in France. If you live in the US, you have 29 cities to choose from...

Address as a Handle

- ## Similar to names:
  - Addresses can be used directly
    - E.g., to send a postcard
  - Passed on to someone else as a reference

Here is the address of my dentist:
125, Root Canal rd, DC

An Address is Not Enough to Communicate

- You can send a postcard to 1600 Pennsylvania Avenue NW, Washington D.C. 20500 USA from anywhere in the world

- It would only arrive there because there is a postal system that will "route" the postcards through a number of mail hubs

- Now, How do I go to 125, Root Canal rd, DC?

POST Office

Routing
"How do I go to your dentist?"

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What is a Route?

- route |ro͞ot, rout|
  – Noun
  – A way or course taken in getting from a starting point to a destination: the most direct route is via Los Angeles

→ If I have a route for you,
   I know where to go.

Building Routes Before the Traffic Flows

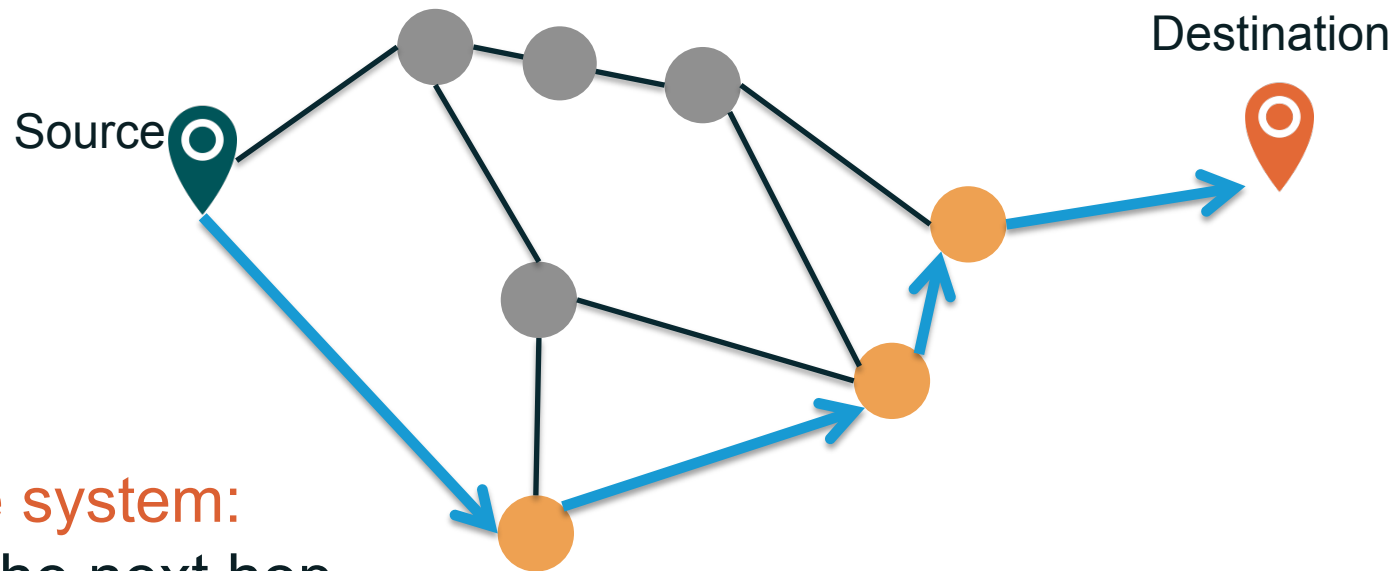Route announcements flow in the reverse direction from the future traffic:

Route announcement:
"You can reach this destination via me"
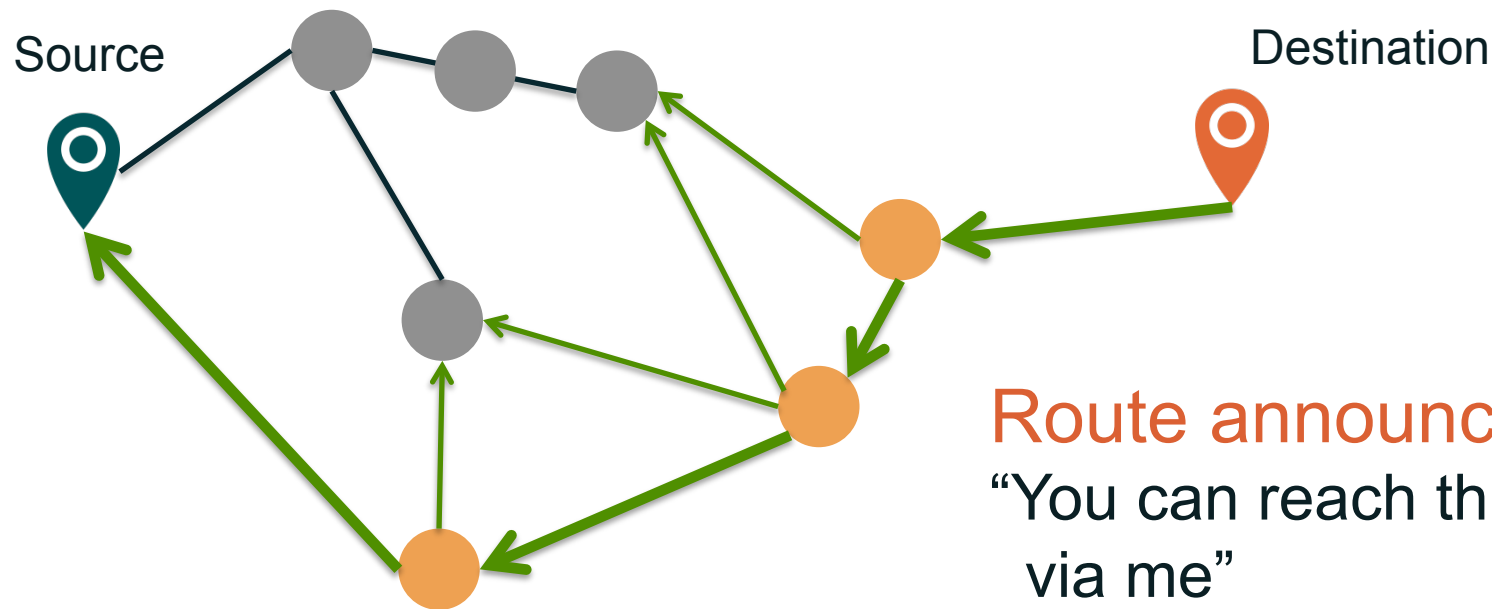
Cooperative system:
Previous hops re-announce routes

Sending Traffic Hop-by-Hop

Forwarding traffic happens hop-by-hop

→ If I have a route for your destination, I know the "next hop" to which I can deliver the packet.

Cooperative system:

We rely on the next hop to do the "right thing"

Conclusion
"You have arrived…"