TIM 50 - Business Information Systems

Lecture 18

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UC Santa Cruz

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Outline

- Announcements
- Markup Languages
- Networks
- Student Presentations
- Akamai Case

Announcements

- Reading
  - Messerschmitt Ch 10.1 -10.2
  - American Airlines

Markup languages

- Click to add text

Documents and XML

- Enterprises create/store/exchange documents
- When using DBMS, documents are stored in their entirety
  - BUT their internal structure is not visible
- The WWW as a communication medium
  - Non-traditional database
  - Billions of documents stored/exchanged
  - Need for identifying/processing documents' **internal structure**

Markup Languages

- A ***markup language*** describes the structure of a document
  - Based on tags
  - **Tags** denote structural elements like sections, subsections, figures, etc
- Internationally standardized, so application independent

Family lineage

SGML

Standardized in mid 80s by ISO

Introduced in Early 90s

HTML

XML

Proposed in mid 90s

Both are standardized by W3C

Emphasizes formatting and presentation of documents

Emphasizes structure of documents

Purpose- and industry-specific extensions

XQuery, XPath

Query languages for XML data (W3C standards)

Example: HTML

```
<html>
<h1>  Super Widget </h1>
<h2>  Widgets Incorporated</h2>
<em>   123456789  </em>
<br>
<p> $300</p>
</html>
```

Super Widget

Widgets Incorporated

123456789

$300

Networks

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What are some examples of communications networks?

- Public Telephone Network
- Internet
- LANs (Local Area Networks)

What does a network do?

- Transport data from one host to another
  - Host allocation
  - Routing
- Millions of users/applications/hosts share the same network
  - Resource sharing
  - Congestion control

Network Architecture

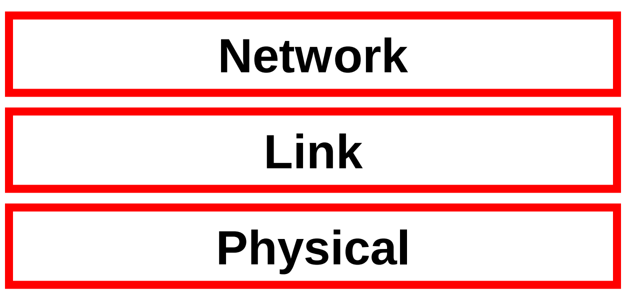
Network architectures are layered

Each layer

- uses the services of the layers below
- To offer more advanced services to layer above

Allows layers to be designed independently

We will talk about 3 layers next…



Link Layer

- Make a ***Frame*** link out of a bit link
  - Instead of endless sequence of 1s and 0s, we want distinct “packages” of data that are separate from each other
- Say we want to send 2 Frames with data
  - 010101010101111010 and 10101010101011010
  - Concatenate them and send them as a sequence?
- How can the receiver tell where the new frame begins?

- Solution: insert a special sequence at the start of frame: for example: 01111110

Link Layer (cont'd)

Also does error detection/correction

- Insert extra information the helps the receiver to determine if the data has been corrupted.
- Example: parity bit
  - Sender adds a 1 or zero to end of data so number of ones is always odd
    - 10011 or 10000
  - If receiver counts an even number of ones, than it knows the data was corrupted.

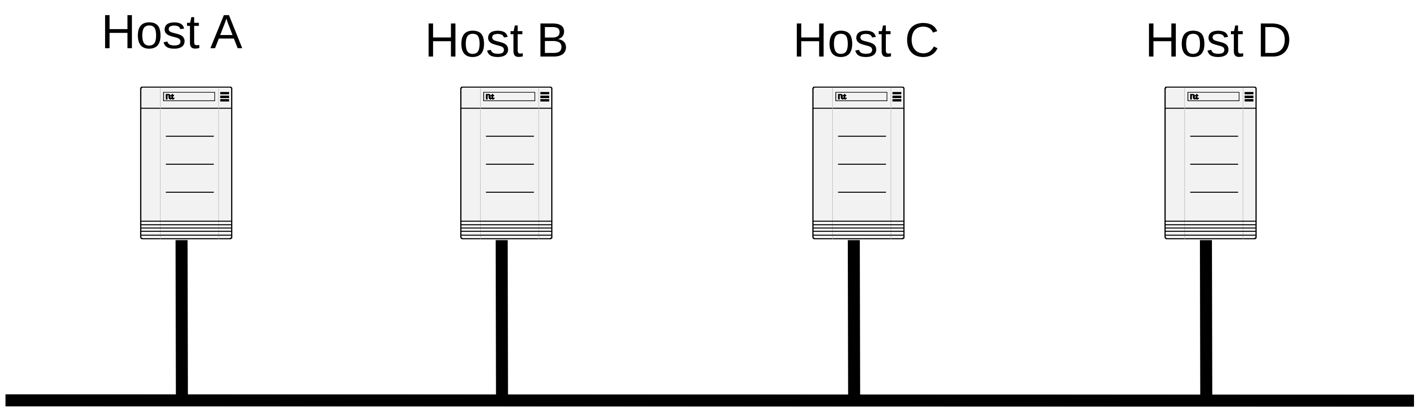
Error Detection

- ***Simple parity*** bit scheme problem?
  - Cannot detect if two or any even number of bits were modi
    fied during the transmission.

- ***CRC (for cyclic redundancy code)***: more sophisticated error detection code
  - sending node: calculates the CRC bits (typically 32 bits) from the previous bits in the packet
  - receiving node: performs the same calculation and compares the result with the error detection bits in the packet;
  - if they diff
    er, the receiving node knows that some error occurred and itdiscards the corrupted packet.

More Link Layer.. -- Ethernet

Want to allow multiple hosts to *share a link*



How do they avoid talking at the same time?

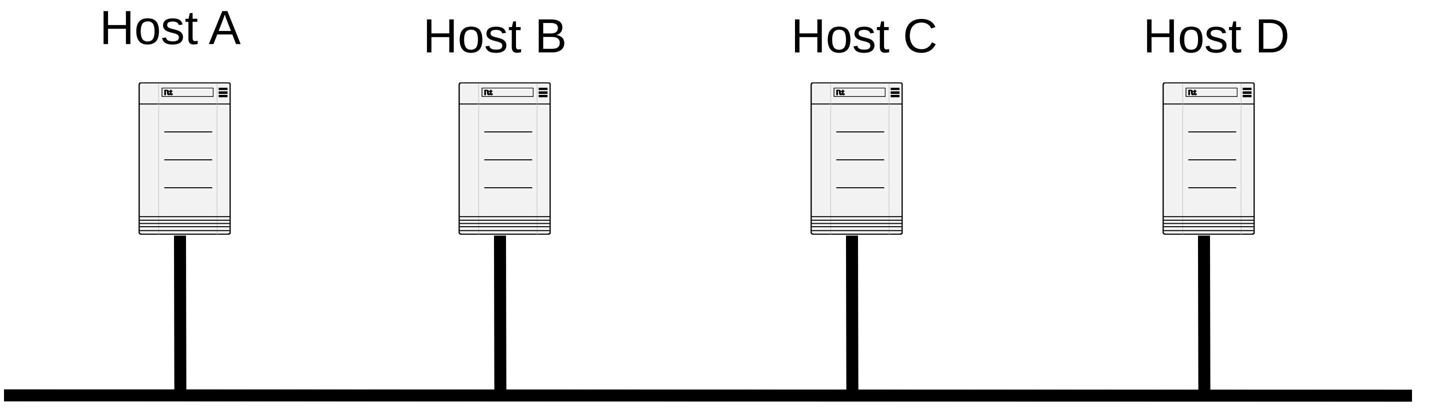
Don't transmit if you hear another host transmitting

If there is a collision, stop wait a random amount of time, and try again

This is a **Medium Access Control (MAC)** Protocol

Ethernet Continued

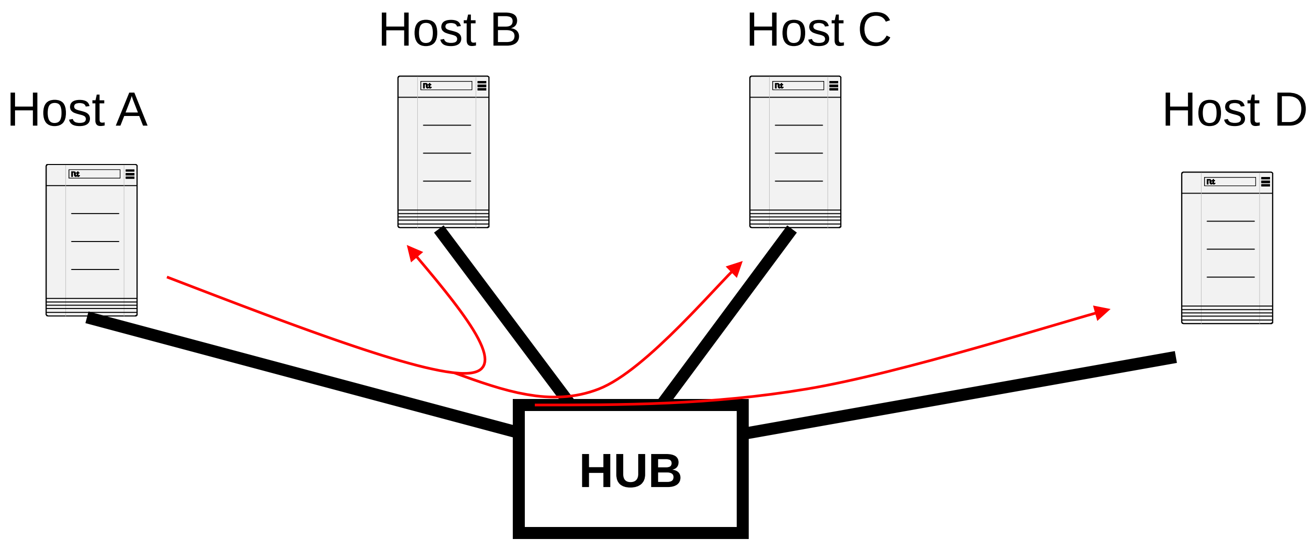
How do the hosts on this Ethernet identify each other?



Each host (actually each interface)

- has a globally unique *MAC address*
- Cannot be changed

Ethernet Hub



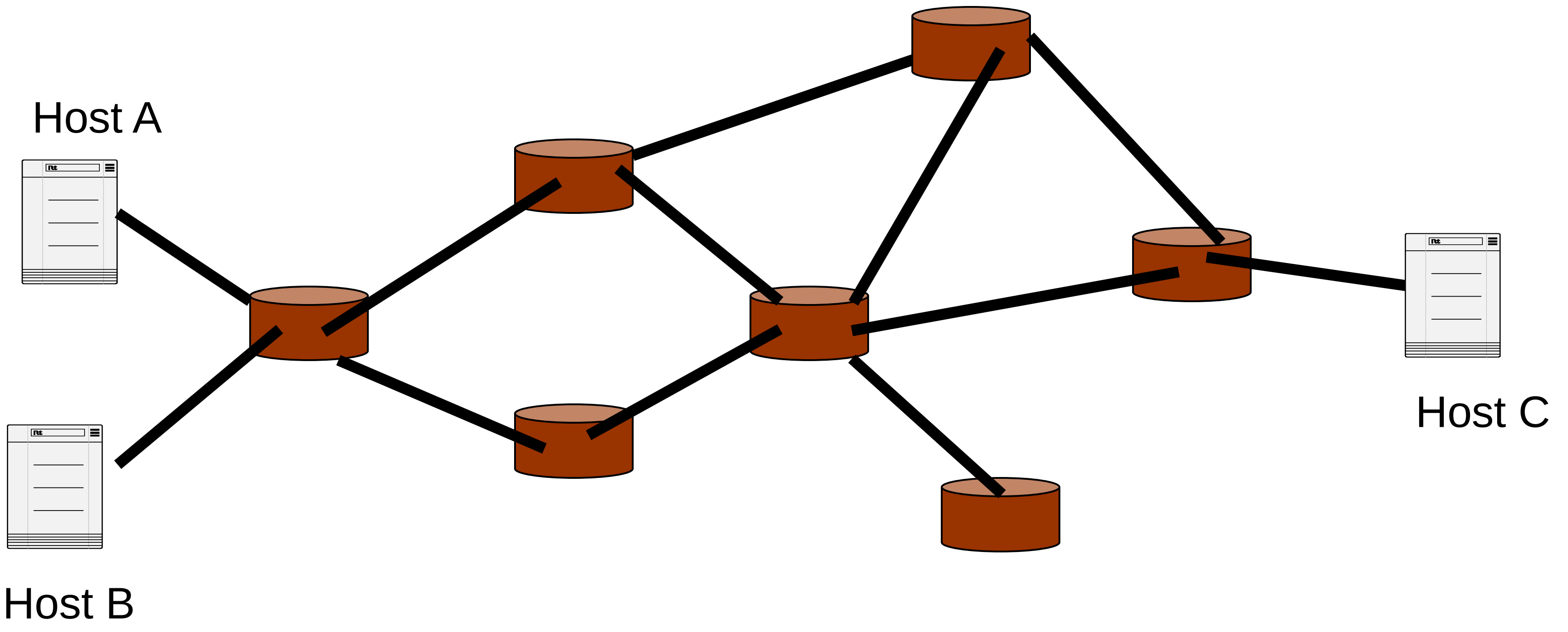
Hub broadcasts packets on a link to all others

As if all hosts connected to single link

- We say it is a Single collision domain

Only one host can talk at a time

Routing in the Internet

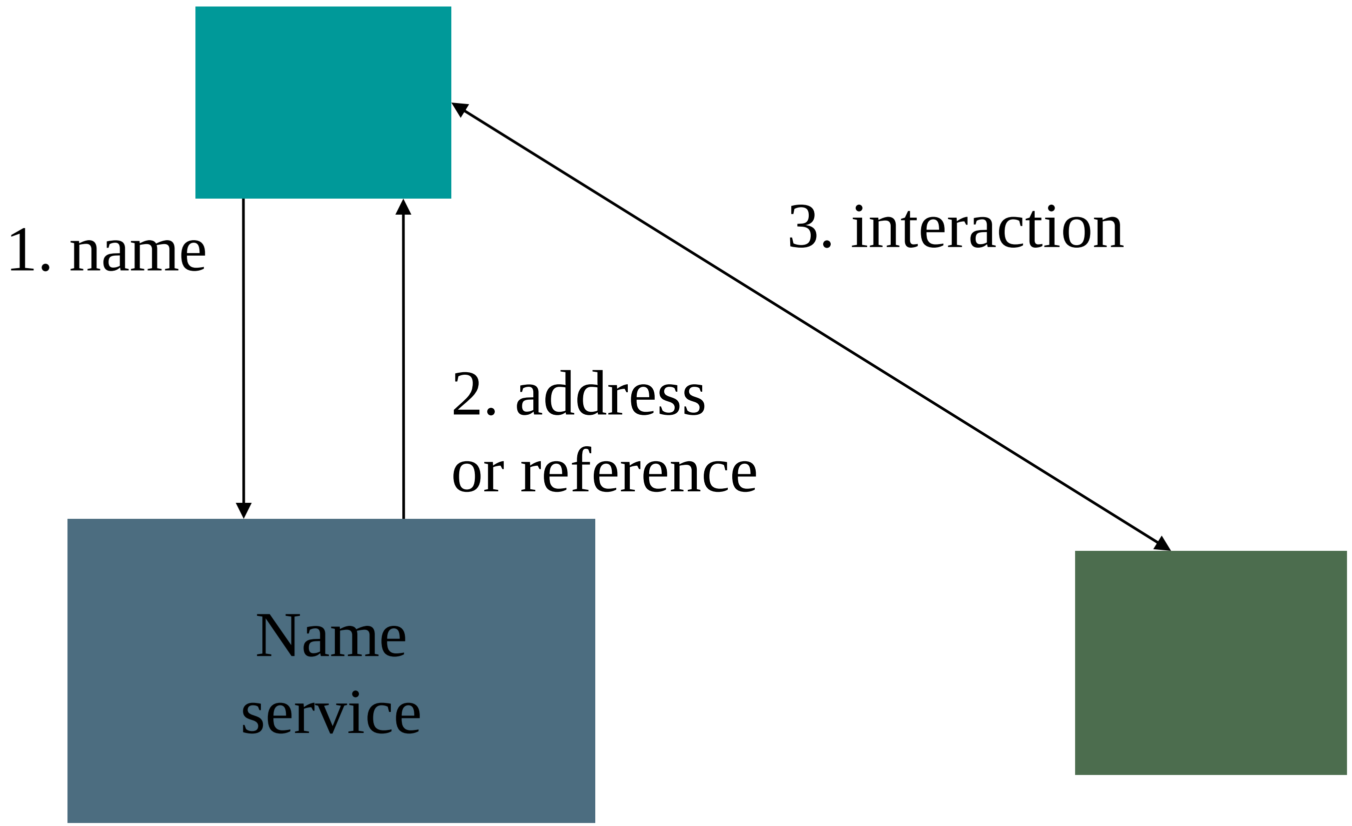


Many feasible paths from source to destination.

Recall: three ways of locating things(Ch.11)

- Name
  - "John Smith"
- Address
  - "1156 High St., Santa Cruz, CA"
- Reference
  - "Postmaster of UCSC, Santa Cruz, CA"

Name services



E.g. Map a host name (URL) to its IP address

Domain Names

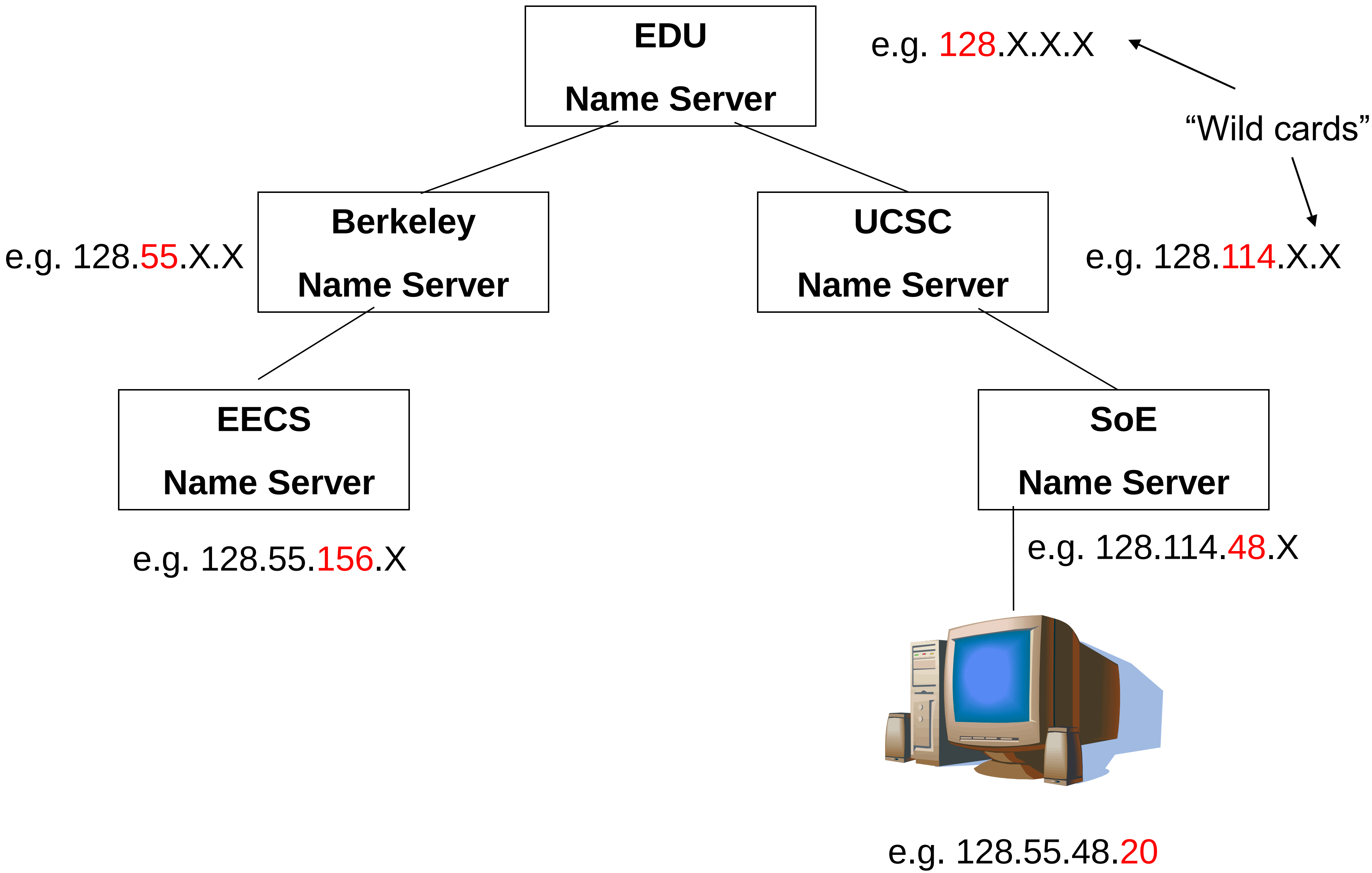
IP addresses are inconvenient for people

- e.g. 128.55.156.273
- 32 bits hard to remember
- 128 bits very hard to remember

Domain names

- e.g. argus.eecs.berkeley.edu
- Easier to remember than IP addresses
- However, we need some way of mapping domain names to IP addresses.

Domain Name System (DNS)



Hierarchy in Addresses vs. Names

Addresses hierarchical in topology

- Maximize "wild cards" and distribute address administration

Names hierarchical in administration

- Single administered organizations often distributed topologically (e.g. ibm.com)

Routing

Routing

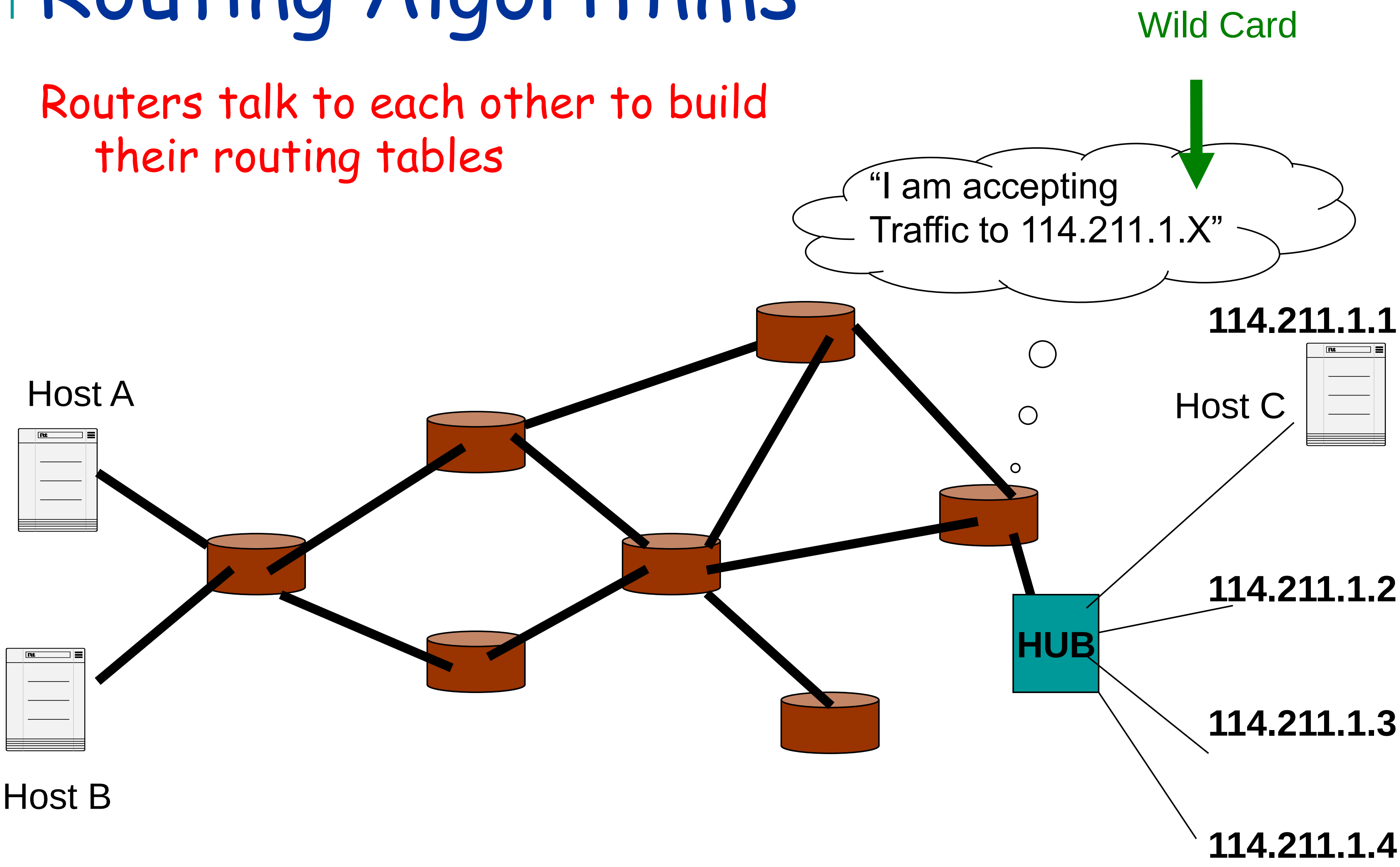
- Updating the routing table
- Objective: each packet gets closer to destination

Packet forwarding

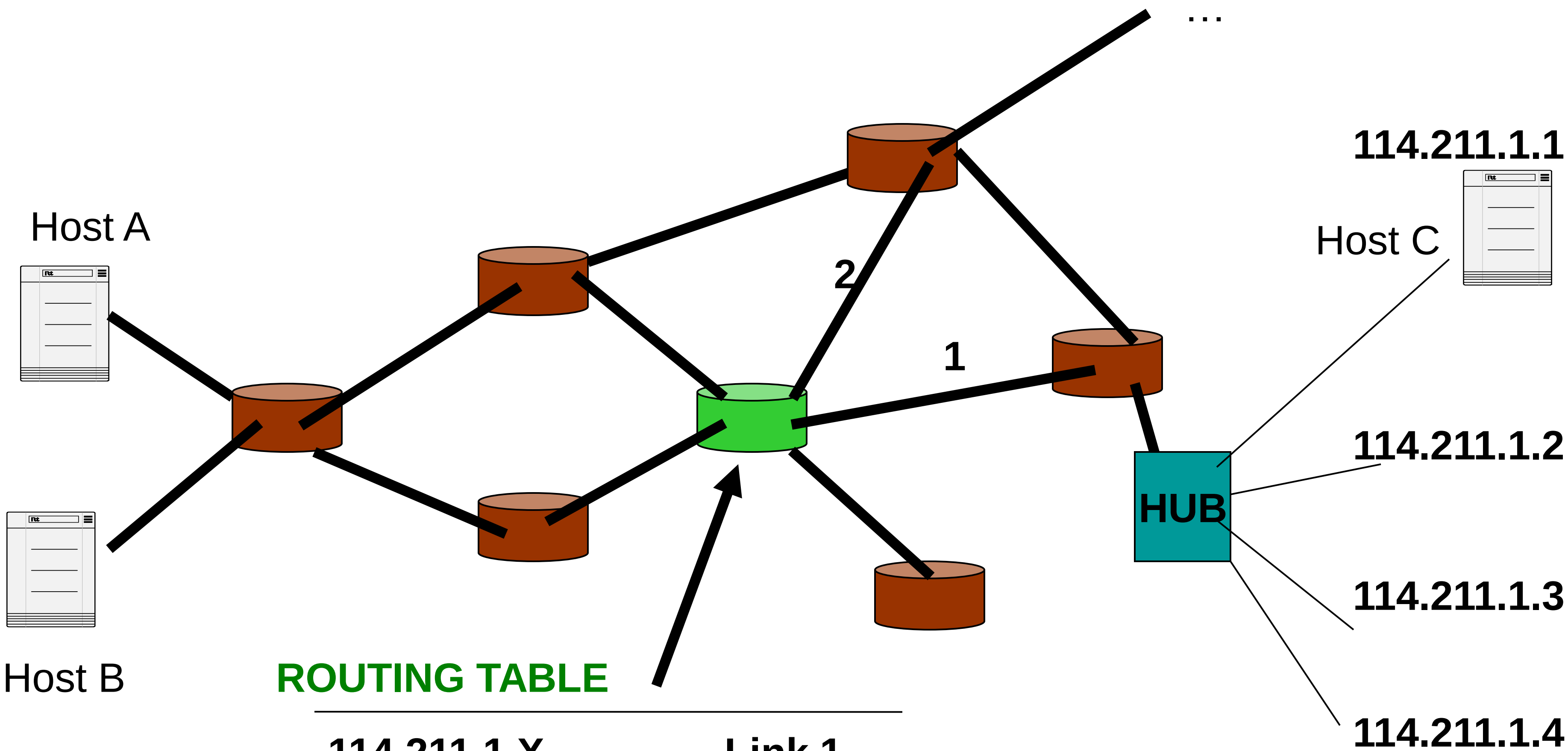
- Transmitting each packet on the appropriate output link
- Based on routing table

Routing Algorithms

Routers talk to each other to build their routing tables



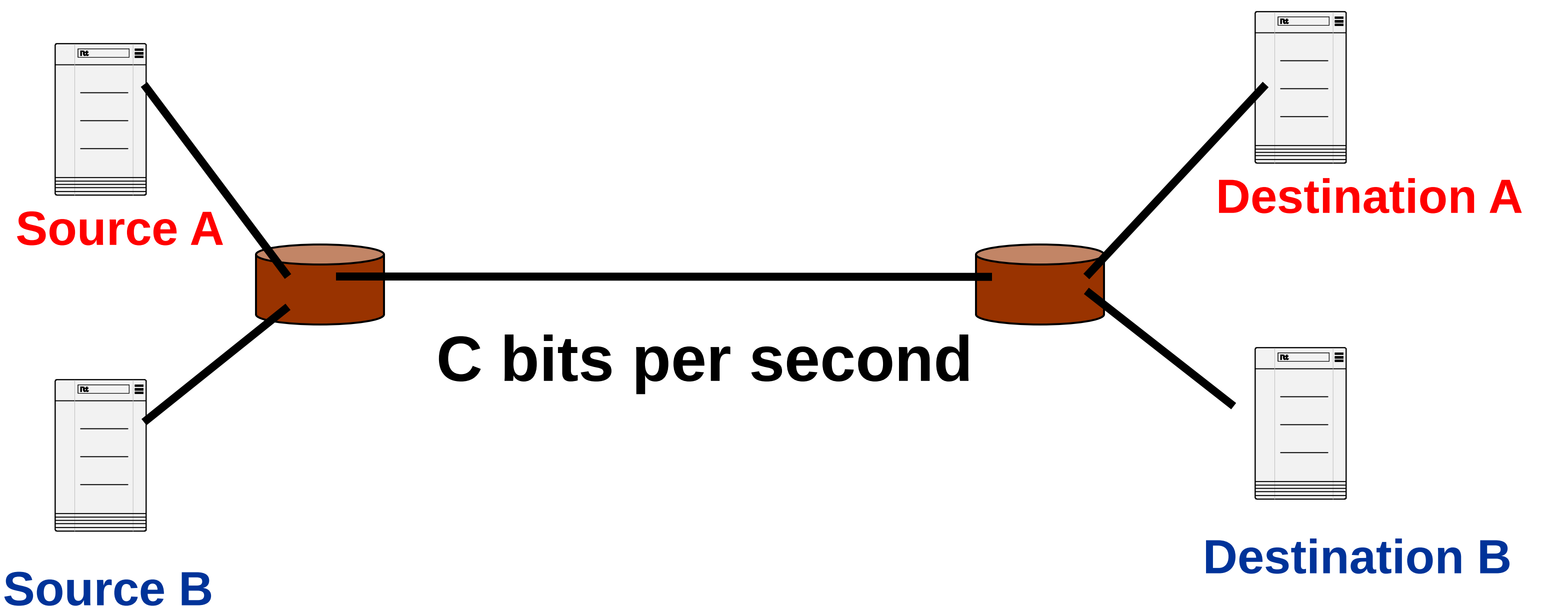
Routing Table has Wild Cards



114.211.1.X	Link 1
200.261.19.X	Link 2

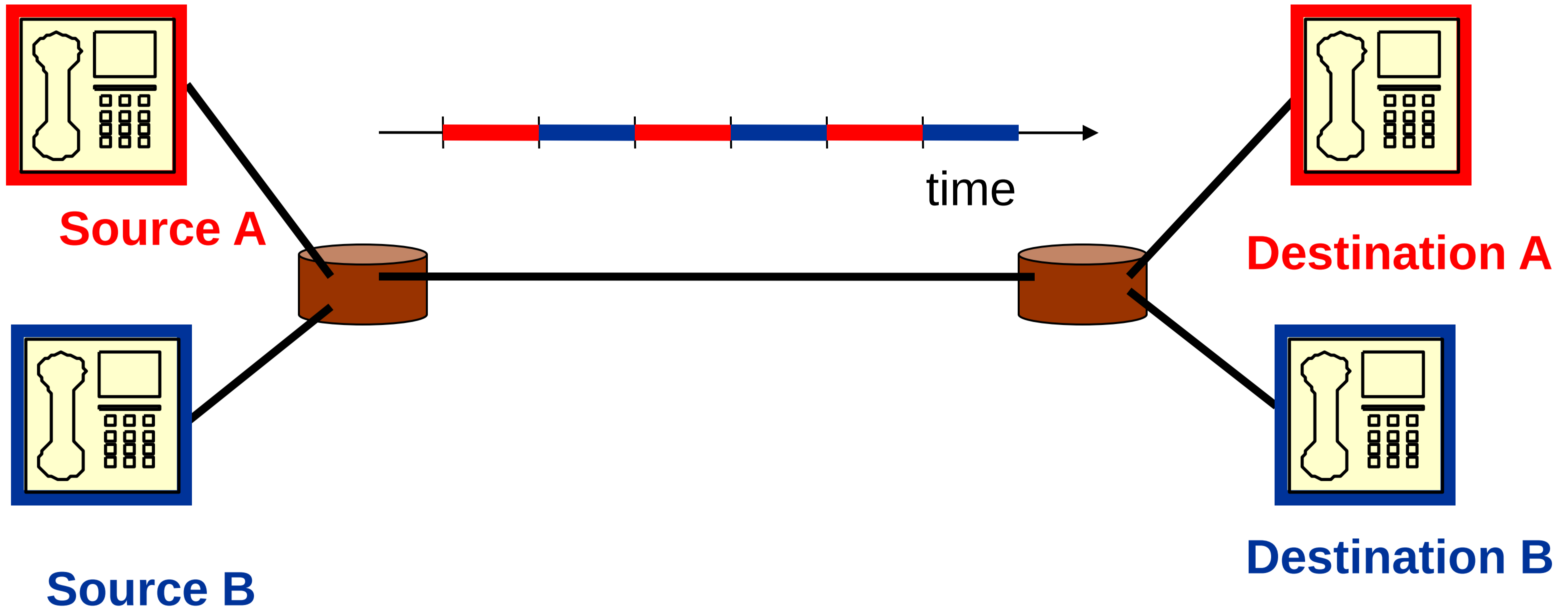
Issues In Networking

- Sharing of Limited Resources
  - How Should A and B share a link with limited bit rate?



Issues In Networking

- Time Division Multiplexing
  - gives each connection the use of the link a fixed fraction of time
  - Fixed fraction of resources reserved for each connection
  - Technology called ***circuit switching***.



- Problem
  - When A is silent, A's fraction of link goes unused.

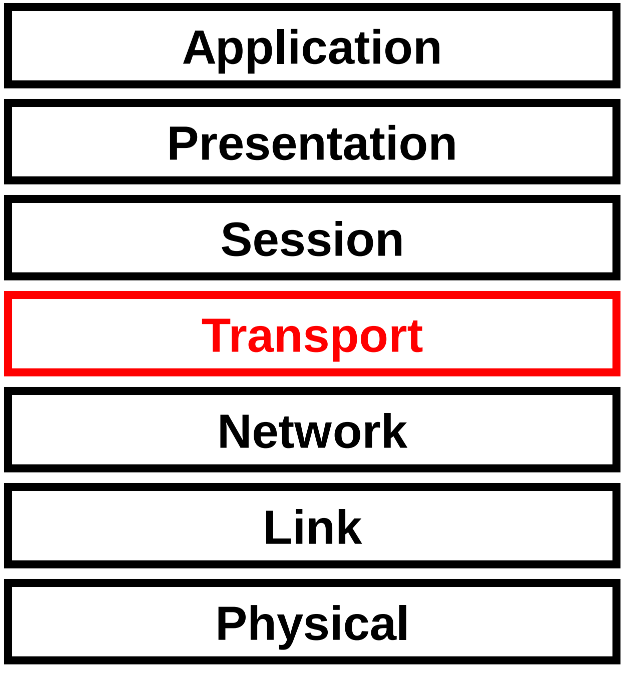
Transport Protocols

The Internet is unreliable

- It will make a “best effort” to get your packet to its destination

Packets can be lost because of

- Congestion
- Link errors
- Routing problems



Transmission Control Protocol (TCP)

Packet 2

ACK

Retransmit mechanism for reliability

- Receiver sends acknowledgements to sender
- If a packet is lost, source fails to get ACK, and then retransmits.

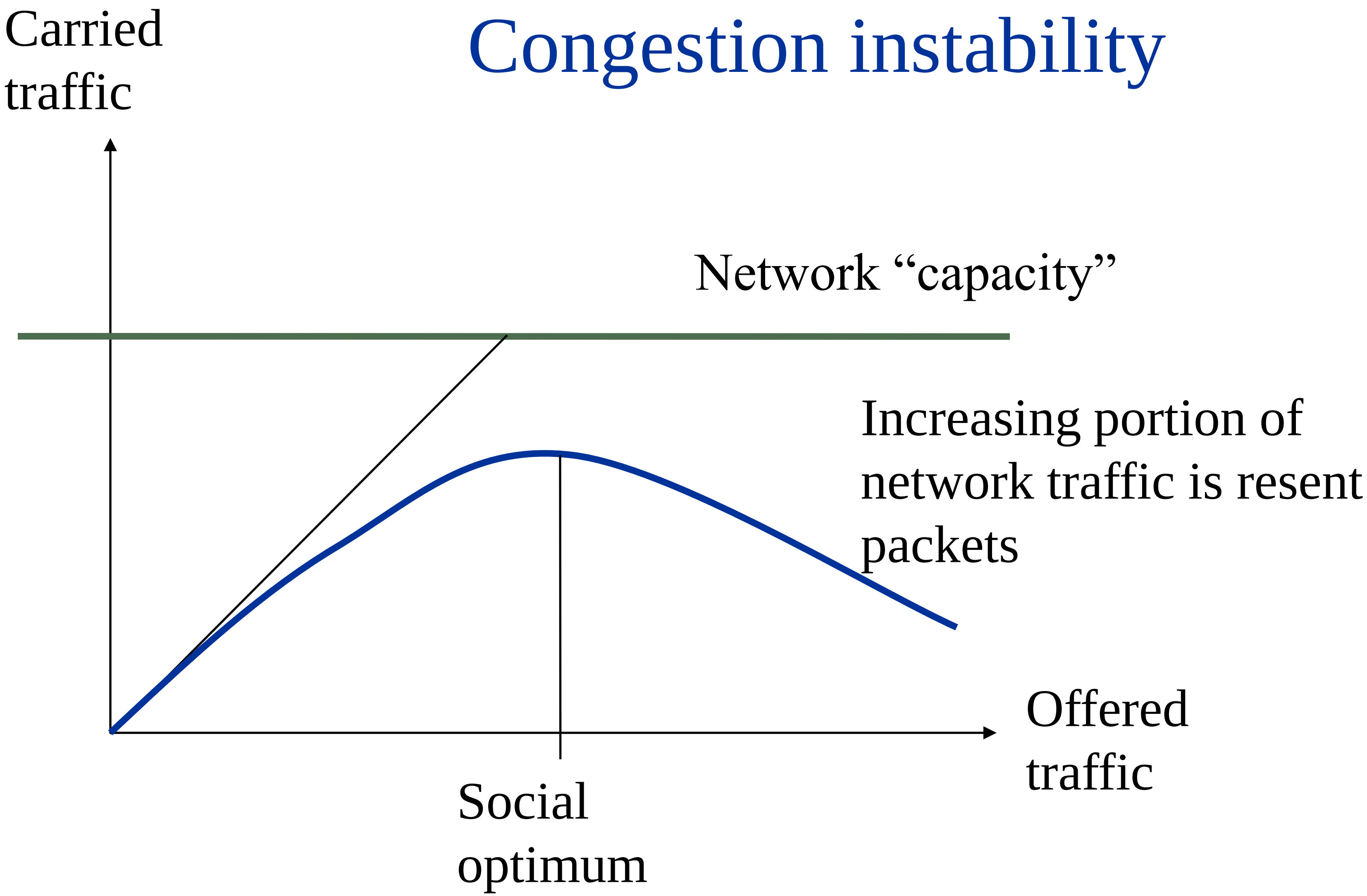
Congestion control

- If congestion perceived (by lost packets)
- Source reduces its send rate
  - When loss, sender reduces send rate by half
  - Otherwise slowly increases

Network congestion

- Traffic can overload links
  - Failure of statistical multiplexing
- Congestion must be limited in some fashion

Congestion instability



Congestion Control

When networks are congested, certain sessions (Source-destination pairs) should reduce offered rates.

- Today all TCP sessions slow down when they detect packet losses.
- UDP sessions do not slow down.

What are some alternative strategies?

- Have those whose applications aren't as sensitive slow down more?
  - How would we know which are less sensitive

kb, mb and others...

We count in base 10 by powers of 10:

$10^1 = 10$, $10^2 = 10*10 = 100$, $10^3 = 10*10*10 = 1000$,

$10^6 = 1000000$

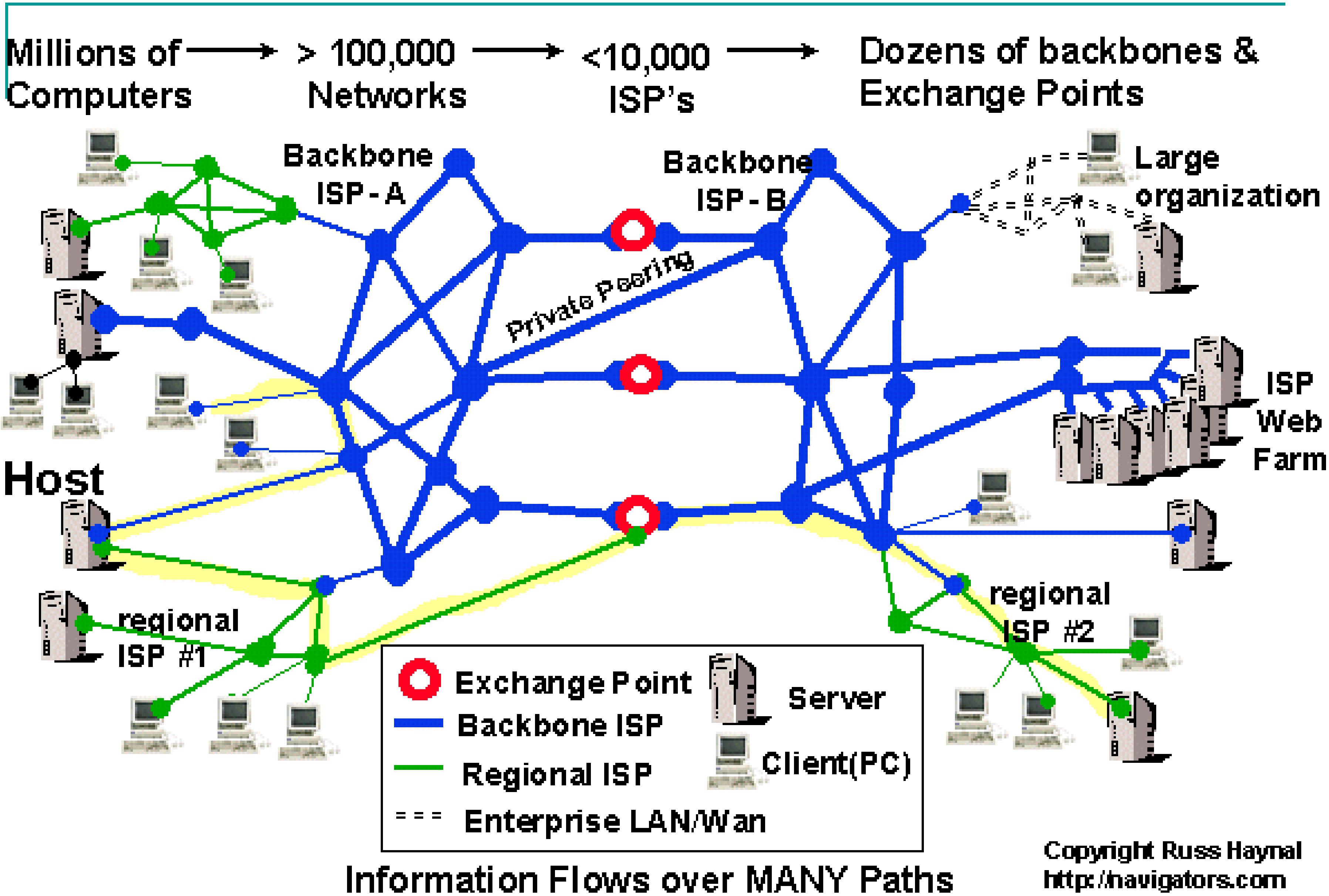
Computers count by base 2:

$2^1 = 2$, $2^2 = 2*2 = 4$, $2^3 = 2*2*2 = 8$, $2^{10} = 1024$, $2^{20} = 1048576$

So in computers, the following units are used:

Unit	**Equivalent**
1 kilobyte (KB)	1,024 bytes
1 megabyte (MB)	1,048,576 bytes (1,024*1,024)
1 gigabyte (GB)	1,073,741,824 bytes
1 terabyte (TB)	1,099,511,627,776 bytes
1 petabyte (PB)	1,125,899,906,842,624 bytes

Akamai Case (cont'd)



Source: www.navigators.com

Bottlenecks in the Internet architecture

- First mile
  - -Web and application server performance
  - -Router and Switch capacity.
- Backbone
  - -Many routers for data to go through (17 to 20 routers)
- Peering
  - -Dumping traffic on other NSPs
- Last mile
  - -IAP's router or modem capacity
  - -Limited transmission rates
  - -Older computers

2 major problems:

- **loss of packets (information)**
- **slow connections**

Freeflow

- Deployed in 1999
- Akamai Infrastructure
  - 13000 servers in 954 networks by 2001
- Customers
  - Large Commercial Websites

Competition

- Hosting firms (substitute)
  - Exodus
- Other CDNs
  - Sandpiper, Adero, Mirror Image
- Content Alliances
  - Akamai's competitors banded together to share networks

Akamai Case

- How did Akamai differentiate from its competitors after the dot-com recession of 2000?
- Was it a successful move? Was it a costly decision for Akamai? Why?

2001 Market Changes

Bad

- Dot-coms bust
- Customers leave
  - "churn rate goes to 22% per quarter"

Good

- Hosting firms go bust (exodus)
- Some CDN competitors go bust.
- Competing CDN alliances mired in problems

EdgeSuite

- Assemble and Present dynamic pages at edges rather than just deliver heavy objects
- Pricing - higher than old service
- Soon EdgeSuite dominated revenue