TIM 50 - Business Information Systems

Lecture 18

Instructor: Terry Allen
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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

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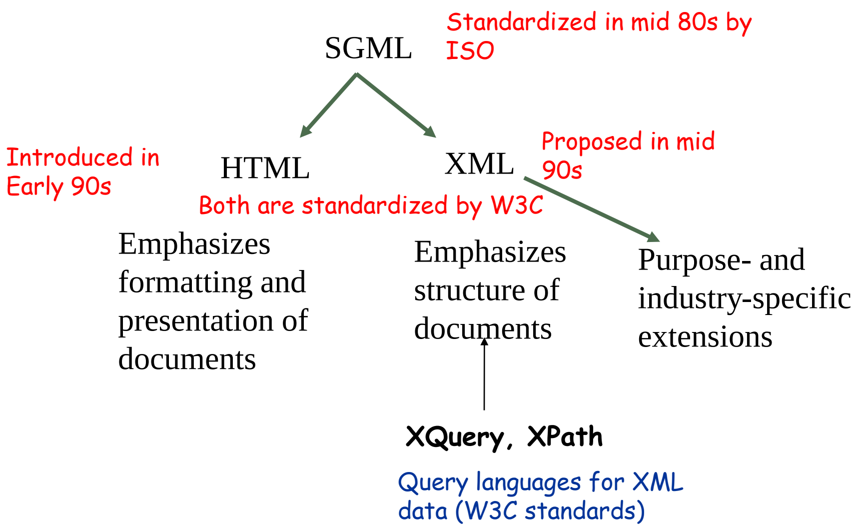
Documents and XML

- 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



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…

Network
Link
Physical

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
- 01010101010111010 and 101010101011010
- 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.

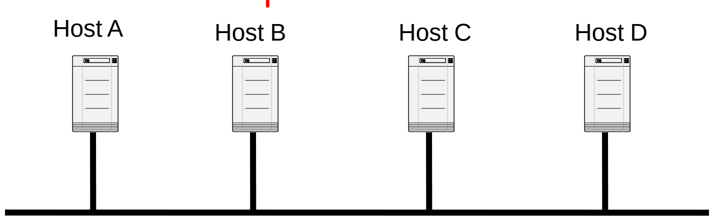
Error Detection

- ***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?

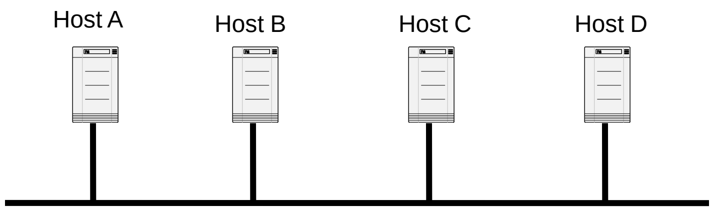
Don't transmit if you hear another host transmitting

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

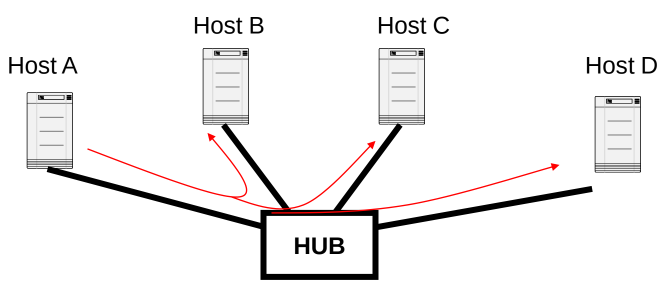
How do the hosts on this Ethernet identify each other?



Each host (actually each interface)

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

Ethernet Hub



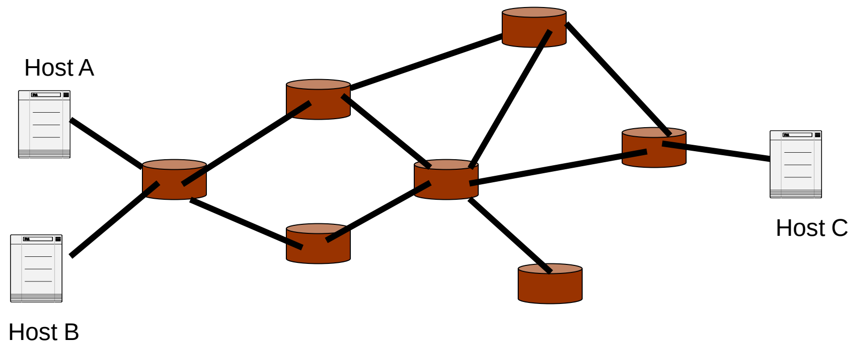
Hub broadcasts packets on a link to all others

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.

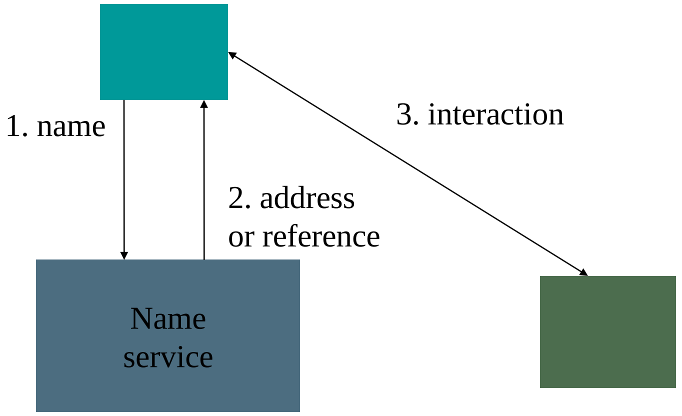
Recall: three ways of locating things(Ch.11)

Name
- "John Smith"

Address
- "1156 High St., Santa Cruz, CA"

Reference
- "Postmaster of UCSC, Santa Cruz, CA"

Name services



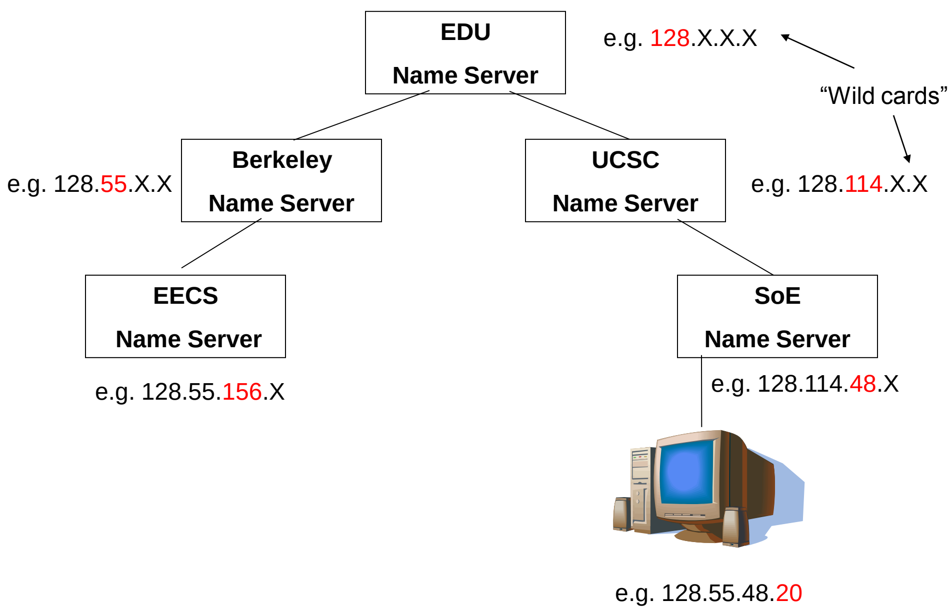
E.g. Map a host name (URL) to its IP address

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)

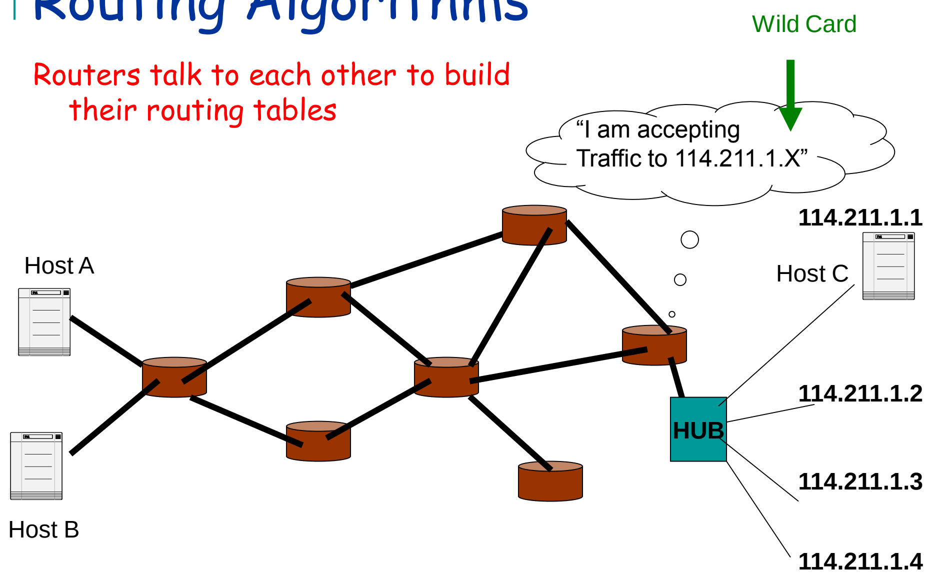
Routing

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

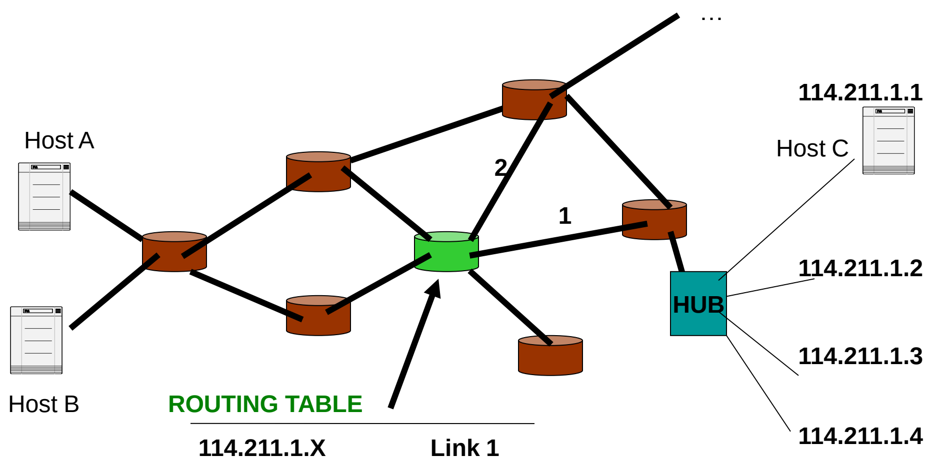
Packet forwarding
- Transmitting each packet on the appropriate output link
- Based on routing table

Routing Algorithms

Routers talk to each other to build their routing tables



Routing Table has Wild Cards

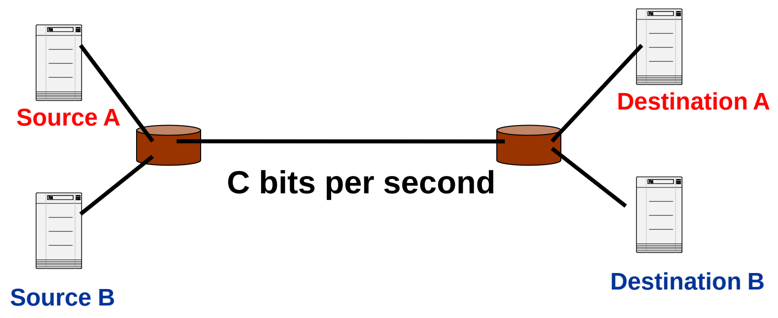


ROUTING TABLE

114.211.1.X	Link 1
200.261.19.X	Link 2

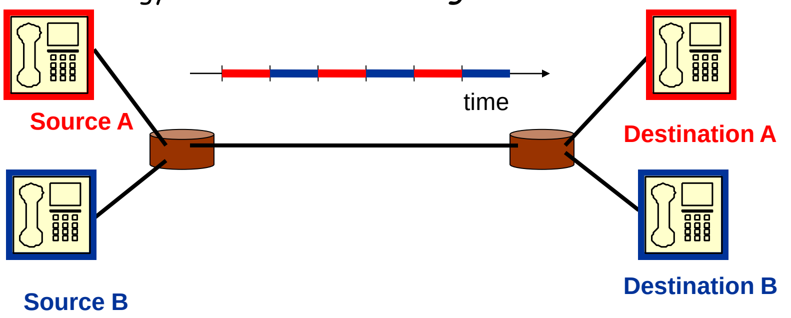
Issues In Networking

- 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.

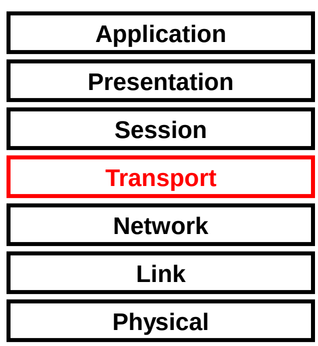
Transport Protocols

The Internet is unreliable

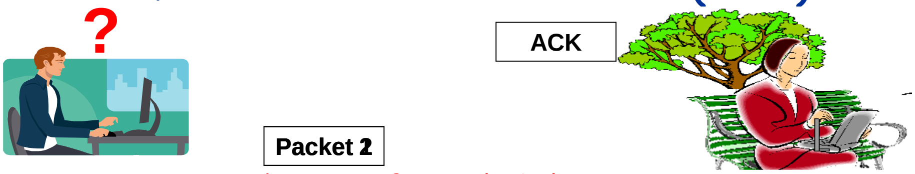
- It will make a “best effort” to get your packet to its destination

Packets can be lost because of

- Congestion
- Link errors
- Routing problems



Transmission Control Protocol (TCP)



Retransmit mechanism for reliability

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

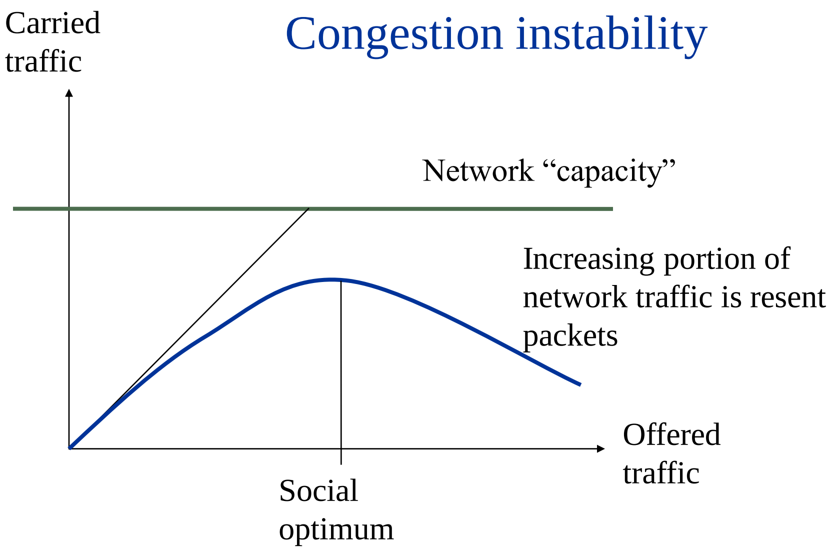
Congestion control

- 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:

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

$10^6 = 1000000$

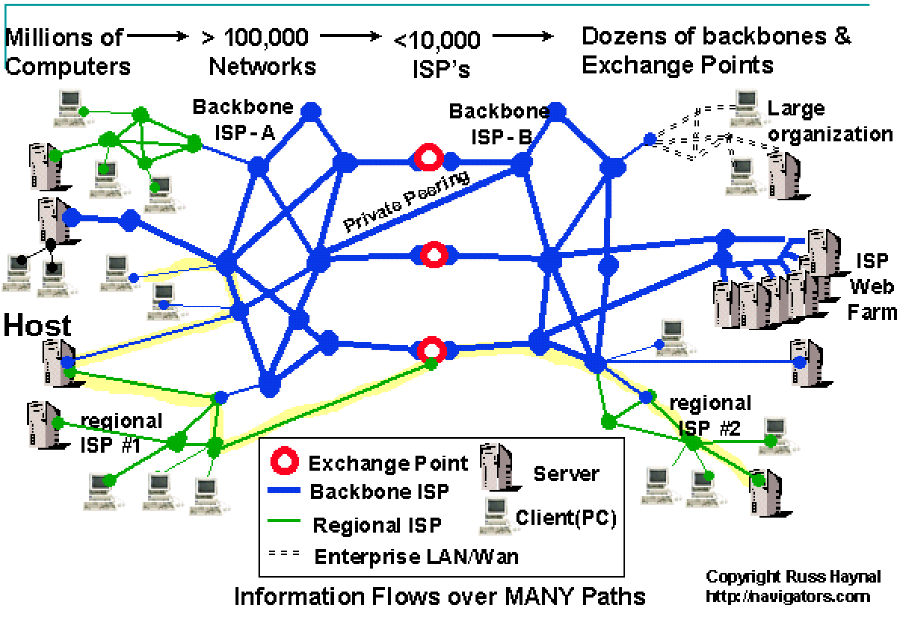
Computers count by base 2:

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

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