Class announcements
- Database Assignment due date extended!
  - Wednesday May 25th
- Shiv out of town May 17 - 23
- Read Ch 19 and Akamai Case for Wednesday
- Student Presentations Wednesday
  - Michael Connare (News Article)
  - Shira Ben-Or (Akamai Case)

Distributed object management
by
David G. Messerschmitt
Distributed object management

Interoperability

Portability is not the emphasis

Interoperability requires:
- Common structure of data
- Common interpretation of data
- Agreement on protocols

Before and after

OMG process

Identify need
Request for proposals
Process to
- choose best
- or ask proposal advocates to work together

Which is most effective?

Industry de facto standard effort (CORBA)
or
Single vendor integrated solution (DCOM)?

CORBA vs DCOM

<table>
<thead>
<tr>
<th>CORBA</th>
<th>DCOM</th>
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<tbody>
<tr>
<td>• Integrate best ideas</td>
<td></td>
</tr>
<tr>
<td>• Multi-vendor support</td>
<td></td>
</tr>
<tr>
<td>• Cross-platform and language</td>
<td></td>
</tr>
<tr>
<td>• Fast, no consensus required</td>
<td></td>
</tr>
<tr>
<td>• No vendor interoperability issues</td>
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</table>
Two methods for application interaction

CORBA and DCOM
Exchange documents (XML)

What are their relative merits?

<table>
<thead>
<tr>
<th>CORBA vs XML</th>
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<tbody>
<tr>
<td><strong>CORBA</strong></td>
</tr>
<tr>
<td>• Natural OOP extension</td>
</tr>
<tr>
<td>• No document interpretation</td>
</tr>
<tr>
<td>• Good for back-and-forth protocols</td>
</tr>
<tr>
<td>Both have need for standardization of data or document interpretation</td>
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</tbody>
</table>

Are Java and CORBA competitive or complementary?
Both offer interoperability across different platforms
Java offers portability and transportability
CORBA offers heterogeneous language bindings
CORBA offers many services, metadata, etc.
Bottom line: they are complementary!
   (but some Java proponents may not agree)

Networks

What are some examples of communications networks?
- Public Telephone Network
- Internet
- LANs

What does a network do?

1) Transport packets from one host to another.
Network Architecture

- Network architectures are layered
- Each layer
  - uses the services of the layers below
  - To make more advanced services of layer above
- Allows layers to be designed independently
- We will talk about 3 layers next...

<table>
<thead>
<tr>
<th>Network</th>
<th>Link</th>
<th>Physical</th>
</tr>
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Physical Layer: Convey bits over a wire

Bits: 010110...

Physical Layer

- Other schemes for mapping a bit sequence to a physical sequence are possible.
  - These are called modulation schemes

Link Layer

- Make a Frame link out of a bit link
- Say we want to send 2 Frames with data
  - 01010101010111010 and 101010101011010
  - Concatenate them and send them as a sequence?
- Receiver could not tell where the new frame begins.
- Solution: insert a special sequence at the start of frame: 01111110

Network Layer

- A wants to send some data to C
  - Suppose A knows Cs address
  - A sends a packet towards C
Network Layer

Host A 128.114.60.200
Host B 128.114.60.201
Host C 128.114.60.202
Host D 128.114.60.203

A uses Link 1 to send to B
B looks at Packet Header and Routing Table
Decides to forward packet to link 2

Packet forwarding

Host B
Packet
Input link
Output link
Routing table

Want to allow multiple hosts to share a link

Back to Link Layer.. -- Ethernet

How do the hosts on this LAN identify each other?

Ethernet Continued

Each host (actually each interface)
- has a globally unique MAC address
- Cannot be changed

IP Addresses vs Mac Addresses

Hierarchical
- The beginning bits tell you which network the host is on
- Ex: UCSC addresses start with 128.114.X.X
- The last bits tell you which host of the network
Changeable
- Changes with location of Host
- 4 bytes
- Only 4.2 billion

Not Hierarchical
- Beginning bits tell nothing useful
- Not Changeable
- 6 bytes
- 281 Trillion
**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

**Ethernet Switch**

- Hub relays packets from incoming link to destination link only.
- Thus, parallel conversations possible.

**Link and Network Layers**

**OSI Layered Model of Networking**

<table>
<thead>
<tr>
<th>Application</th>
<th>Presentation</th>
<th>Session</th>
<th>Transport</th>
<th>Network</th>
<th>Link</th>
<th>Physical</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP</td>
<td>Internet Protocol (IP)</td>
<td>Ethernet, Wi-Fi, SONNET, ...</td>
<td>OFDM, QAM,...</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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.
Issues In Networking

Statistical Multiplexing
- Link shared in such a way that connections are not assigned fixed fraction of link.
- $A$ and $B$ unlikely to offer peak rate at the same time.
  - $\max(A + B) < \max(A) + \max(B)$

![Diagram of Statistical Multiplexing]

Statistical Multiplexing
- Because resources aren’t reserved. It’s possible offered load too high.
- Packets are put into a queue.
  - If offered load remains too high, queue will fill up and overflow.

![Diagram of Statistical Multiplexing]

Network Congestion

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

![Diagram of Network Congestion]

Questions to Address

- When networks are congested, certain sessions (source-destination pairs) need to reduce offered rates.
  - Who should reduce their rates, and by how much?
    - Everyone reduce by the same amount?
    - Those whose applications are more sensitive?
      - (Streaming Audio)
    - Those who pay less?

![Diagram of Congestion Control Methods]

Congestion control methods

- Over-provisioning of facilities (mitigation, not control)
- Network initiated
  - Network $\&$ source flow control, or
  - Source notification and policies, policing, or pricing incentives, or
  - Admission control for sessions
- Sources initiated
  - Source detects congestion (necessary resent packets is one method), and
  - Voluntary or mandatory policies

Examples of each?
Flow control vs Congestion Control

Receiver has to have a way to tell producer to slow down!