Networked Computing in B2B

- History predates Internet
- **Electronic Data Interchange** (EDI)
  - Exchange order information between firms involved in direct procurement
  - Originally done over private links
  - Only large firms could afford
  - Initially order and invoice
  - Existed since 70’s

Class Announcements

- Midterm 2/10
- Study guide posted

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**Key concept**

The key commodity manipulated by information technology is **information**.

To be manipulated in a computing/networking environment, information must be represented by data.

**What is information?**

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**Information**

From a user (human) perspective...

...recognizable patterns that influence you in some way (perspective, understanding, behavior...)

In the computing infrastructure, information has a somewhat different connotation as structure and interpretation added to data.

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**Data**

A bit is “0” or “1” — the atom of the information economy.

Data is a collection of bits, like

- “0101110111010110”
- “0000011”
- “11101110111011011101101101101010”

Note: the terms data and information are not always used consistently!

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**Representation**

- Take the place of the original
- Equivalent to, in the sense that the original can be reconstructed from its representation
- Often the original can only be approximately reconstructed, although it may be indistinguishable to the user
  - e.g. audio or video

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**ASCII**

<table>
<thead>
<tr>
<th>Character</th>
<th>Hex</th>
<th>Binary</th>
</tr>
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<tbody>
<tr>
<td><code>&lt;</code></td>
<td><code>x37</code></td>
<td>00110111</td>
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<tr>
<td><code>&gt;</code></td>
<td><code>x38</code></td>
<td>00111000</td>
</tr>
<tr>
<td><code>=&quot;</code></td>
<td><code>x39</code></td>
<td>00111001</td>
</tr>
<tr>
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<td><code>x3A</code></td>
<td>00111010</td>
</tr>
<tr>
<td><code>&gt;</code></td>
<td><code>x3B</code></td>
<td>00111011</td>
</tr>
<tr>
<td><code>&lt;</code></td>
<td><code>x3C</code></td>
<td>00111100</td>
</tr>
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<td><code>=&quot;</code></td>
<td><code>x3D</code></td>
<td>00111101</td>
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<td>00111111</td>
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<tr>
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<td>01000000</td>
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<tr>
<td><code>&lt;A&gt;</code></td>
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<td>01000001</td>
</tr>
<tr>
<td><code>&lt;B&gt;</code></td>
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<tr>
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<tr>
<td><code>&lt;D&gt;</code></td>
<td><code>x44</code></td>
<td>01000100</td>
</tr>
</tbody>
</table>

Note that this representation is not unique...

...this one happens to be a standard (ANSI X3.110-1983)

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**A picture**

This picture conveys information.

This information is represented in this computer, but how?
Expanding a small portion of the picture, we see that it is represented by square pixels…
….300 tall by 200 wide…. with a range of 256 intensities per pixel
300 • 200 • 8 bits = 480,000 bits (but it can be compressed)

A color picture can be represented by three monochrome images…
At the expense of three times as many bits

Terminology

Representation needs to be standardized

If the representation is not standardized, the information is garbled!

Regeneration

- Make a precise copy of the data (copy bit by bit)
- If you know the representation, this is equivalent to making a precise copy of the information
- Each such precise copy is called a generation
- process is called regeneration

Replication of information

Anything that can be regenerated can be replicated any number of times
This is a blessing and a curse
Analog information cannot be regenerated

We will never know exactly what the original of this Rembrandt looked like.

Discrete information can be regenerated

Regeneration can preserve data (but not its original physical form).

Replication of information requires knowledge of representation

Replication preserves the integrity of the data, but that is not sufficient.

Every .xxx DOS file is a representation.

Implications

Digitally represented information can be preserved over time or distance in its precise original form by occasional regeneration.
- digital library
- digital telephony

Replication of data is easy and cheap.

Implications (con’t)

- Replication of information requires knowledge of the structure and interpretation
  - Standardization or some other means
- Extreme supply economies of scale
- You can give away or sell and still retain
- Unauthorized replication or piracy relatively easy

Architecture

by

David G. Messerschmitt
What is Architecture?

How do you architect a solution?

A system is decomposed into interacting subsystems.

Each subsystem may have a similar internal decomposition.

Three elements of architecture:
- Decomposition
- Functionality
- Interaction
- Organization
- Responsibility
- Cooperation

System examples

Let’s quickly look at some system decomposition examples.
- Quick tour of information technology systems

Time sharing

- Point-to-point wire (no network)
- ASCII terminal (no graphics)
- Mainframe (database and application server)
Two-tier client/server

Three-tier client/server

System integration
1. Architecture
2. Subsystem implementation
3. System integration
   Bring together subsystems and make them achieve desired system functionality
   - Testing
   - Modifications often needed

Emergence
Subsystems are
- Specialized
- Have simple functionality
Higher-level system functionality arises from the interaction of subsystems
Called: Emergence
e.g. Airplane flies, but subsystems can’t

Why system decomposition?
- Divide and conquer approach to containing complexity
- Reuse
- Consonant with industry structure (unless system is to be supplied by one company)
- Others?

Networked computing infrastructure

by
David G. Messerschmitt
Layering

Example of Layering: networking

Software Layering

Operating system functions

Middleware Functions

What’s a database?
### A Database

<table>
<thead>
<tr>
<th>Year</th>
<th>City</th>
<th>Accommodation</th>
<th>Tourists</th>
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<tbody>
<tr>
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<td>Bed&amp;Breakfast</td>
<td>14</td>
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<tr>
<td>2002</td>
<td>Oakley</td>
<td>Resort</td>
<td>30</td>
</tr>
<tr>
<td>2002</td>
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<td>Bed&amp;Breakfast</td>
<td>200</td>
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<td>Camping</td>
<td>120000</td>
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<td>Bed&amp;Breakfast</td>
<td>3400</td>
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<tr>
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<td>Resort</td>
<td>210000</td>
</tr>
<tr>
<td>2002</td>
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<td>Bed&amp;Breakfast</td>
<td>3240</td>
</tr>
<tr>
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<td>Albany</td>
<td>Resort</td>
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</tr>
<tr>
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<td>Bed&amp;Breakfast</td>
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<tr>
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<td>Albany</td>
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</tr>
</tbody>
</table>

### Storage Middleware example: DBMS

- **Database Management System (DBMS)**
  - Manage Multiple databases
  - Allow multiple applications to access common databases
  - Implement standard data “lookup” (query) functions.

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### Client - Server Computing