Outline

- Announcements
- Modularity and Layering (continued)
- Student Presentation
- More on Layering
- Student Presentation
- Components, Suppliers
Announcements

- Assignment 3 will be posted this week
  - Due November 14

- Database Assignment out this week on site
  - Due: November 21
  - Cut-off date: November 21 (30% penalty)
  - Deliverables:
    - *Hardcopy* of survey results & report
    - Report & MSAccess files via email

- Forum
  - You can participate in discussion topics
  - This will earn you extra participation points
Announcements

Forthcoming presentations

- **11/12**
  - Nataljia Robinett (Sun case study)

- **11/9**
  - Are you kidding?! That’s when we have our midterm!

Reading for Monday

- Messerchmitt Ch.7.2, 7.4.2 (pp.204-226)
- Messerchmitt Ch. 15
- MySQL Database Case
Quiz

1. What is a component?

2. Name the 3-tiers in the 3-tier architecture

3. Give 2 layers in a computer infrastructure
Another Interface Example: Automatic teller machine (ATM)

What is the interface between this machine and the customer?
Steps

1. Identify interface building blocks

2. Define available actions

3. Define, for each higher level function, a protocol
   - Single action or a finite sequence of actions
1. Interface building blocks

**Message on screen or printed**
- Menu of actions or returns from an action
- Touch selection of action

**Keypad**
- Input parameters to an action

**Card reader**
- Authentication, input parameters

**Money output slot**
- Returns money
2. ATM actions

A) Authentication
B) Account specification
C) Amount specification
A) Action: authentication

Parameters

- Identity (card in slot)
- Institution (card in slot)
- PIN (typed on keypad)

Internally, it contacts institution and matches against its database, institution noted for all subsequent actions (functionality)

Returns

- Screen message
  - "Invalid PIN", or
  - Menu of available actions
B) Action: specify_account

Parameters
- Account (touch screen from menu of choices)

Internally, choice noted for all subsequent actions (functionality)

Returns
- None
C) **Action**: amount

**Parameters**
- Dollars_and_cents (typed on keypad)

**Internally, amount noted**

**Returns**
- Success or failure (state dependent, for example for a withdraw failure when dollars_and_cents exceeds balance)
Protocol: cash_withdrawal

authentication → failure
choose objective → other objectives
account → no accounts
amount → balance exceeded!
Morgan Marie Hunt Bus Proj: Netflix
More on layering

by

David G. Messerschmitt
Interaction of layers

Layer above is a client of the layer below

Layer below as a server to the layer above

Each layer provides services to the layer above....

....by utilizing the services of the layer below and adding capability
Example 1

Bob sends a letter to Alice

US Postal Service → Bob

Envelope → Shipping Container

ABC Airlines

UK Royal Mail → Alice

Envelope

Shipping Container
Major layers

- Infrastructure
  - Network
  - Operating system
  - Middleware
  - Application frameworks and components
  - Applications
Layering builds capability incrementally by adding to what exists.
Data and information

Application
Deals with information

Assumes structure and interpretation

Infrastructure
Deals with data

Ignores structure and interpretation
Example 2

Web server 

Web page 

Web browser 

Screen 

HTML 

Application 

File 

Message 

Operating system 

File system 

Network 

Fragmentation 

Collection of packets 

Assembly
Package = file or message

Infrastructure deals with a package of data (non-standard terminology)

- collection of bits
- specified number and ordering

Infrastructure stores and communicates packages while maintaining data integrity

→ File for storage
→ Message for communication
Data integrity

- Nothing is lost/changed in the representation/recovery of information
- Retain the
  - values
  - order
  - number
  of bits in a package
- Also applies to more complicated forms of representation and data processing
  - E.g. Data Integrity in Databases
Example 3

HHC Server Application

Windows OS

Networking Infrastructure (Contains: TCP/IP, WiFi)

Passenger Information

HHC Client Application

Palm OS

Networking Infrastructure (Contains: TCP/IP, WiFi)

Collection of Packets
Example 3: Network Infrastructure Expanded

HHC Server Application

Windows OS

TCP transport layer

WiFi Link Layer

WiFi Physical Layer

Networking Infrastructure

Passenger Information

message

HHC Client Application

Palm OS

TCP transport layer

WiFi Link Layer

WiFi Physical Layer

Networking Infrastructure

Radio Signals

Packets

Packets
Example 4

HHC Server Application

Windows OS

Networking Infrastructure Layers within TCP/IP, WiFi

Collection of Packets

DBMS

Unix OS

Networking Infrastructure Layers within: TCP/IP, WiFi

HEADQUARTERS

Airline Dataserver

“Send me today’s flight information”
Data and information in layers

- The infrastructure should deal with data, or at most minimal structure and interpretation.
- The application adds additional structure and interpretation.
- This yields a separation of concerns.
Information in the infrastructure

- Sometimes it is appropriate for the infrastructure to assume structure and interpretation for data
  - to add capabilities widely useful to applications
  - to help applications deal with heterogeneous platforms, where representations differ

- Data types
Major layers - Review

Network
Operating system
Middleware
Application frameworks and components
Applications
Infrastructure
Operating system
Network
Student Presentations

- Warren Fung (Dell)
- Bryant Yang (Jawbone)
Components, Suppliers (cont’d)
Components (Examples?)

A component implementation is encapsulated (although often configurable)

Component: A subsystem purchased “as is” from an outside vendor

(Alternative – building your own subsystem)

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Supplier Types

- Three types of infrastructure/application suppliers:
  - Component Suppliers
  - Custom Subsystem Developers
  - System Integrators

- (Some suppliers are 2 or even 3 of above.)
Two ways to sell Software

**Product**
- Customer installed and operated
- Often (but not necessarily) sold or licensed at a fixed price

**Service**
- Functionality provided over a wide-area network
- Often (but not necessarily) sold by subscription

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Recall: Infrastructure and Applications

Infrastructure
- Equipment and/or software used by many applications

Applications
- Provide specific capabilities and features serving individual users.
Four possibilities (examples)

- **Product**
  - Microsoft Office
  - Microsoft Windows

- **Service**
  - Hotmail
  - Internet DNS (Domain Name System)

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Two types

- Bundled
  - An infrastructure provider bundles applications with their infrastructure
  - Example: AOL, telephony service providers

- Unbundled
  - A provider of an application service without providing an infrastructure service
  - Examples?
Examples of unbundled ASP model

- Web-based calendar (e.g. Yahoo, Google)
- Web-based email (e.g. Hotmail, Gmail)
- Web-based stock trading (e.g. Charles Schwab)
Application acquisition

Application

\{ Develop internally \}

Buy as product

Contract development

Product w/ customization

Software supplier

Outsource developer

Supplier, consultants
The changing industry structure
Stovepipe vs. Integrated Infrastructure

**Stovepipe Architecture**
---or---

**Turnkey Solution**

- Single supplier provides all encompassing solution
- (complete with infrastructure)

**Integrated Infrastructure**

Separate infrastructure that can support many applications

Application and Infrastructure

Application

Infrastructure

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From stovepipe to layering

Data
Voice
Video

Application-dependent infrastructure

Many applications

Integrated Infrastructure (Maybe broken into Additional layers.)

Application-independent
Stovepipe vs. Integrated Infrastructure

- What are some examples of each?

- What are the advantages of each approach?
Vertical Integration - Diversification

Two approaches for companies wishing to expand their product offerings

- A company is **vertically integrated** when it makes rather than buys the subsystems in its products.

- A **diversified** company produces products across different industry segments.

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Less Vertical Integration - More Diversification

Why do customers favor less vertical integration?

- Prefer competition amongst component suppliers
- Mix and match components
- Reduced lock in

Disadvantages??

- Customer needs to integrate components from different suppliers.

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Less Vertical Integration - More Diversification

Why do customers favor diversification?

- Reduce coordination costs by having to deal with fewer suppliers.

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