Distributed Information Processing

5th Lecture

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Outline

- Communication
  - Layered Protocols
  - Middleware Protocols
  - Types of Communication
- Communication Methods
- Q&A
Message Passing Requirements

Agreements Needed at a Variety of Levels

- Meaning of the Bits Being Sent
  - Character coding: e.g., EBCDIC and ASCII
- Number of Volts for a 1-bit
- Indication of the Last Bit of the Message
- Detection of Damaged or Lost Messages
- Lengths of Numbers, Strings, and Others
- Representations

Agreements from the low-level details of bit transmission to the high-level details of how information is to be expressed
Layered Protocols

ISO OSI (Open Systems Interconnection) Reference Model

- Designed to Allow Open Systems to Communicate
  - Open system is prepared to communicate with any other by using standard rules that govern the format, contents, and meaning of messages
    - Protocols: such rules formalized
      - Connection oriented
      - Connectionless

- Useful for Understanding Computer Networks

Protocol Suite (or Stack)

- Collection of Protocols Used in a System
Illustration: Layered Protocols (1)

Layers, interfaces, and protocols in the OSI model

Tanenbaum & Van Steen, Distributed Systems: Principles and Paradigms, 2e, (c) 2007 Prentice-Hall, Inc. All rights reserved
Illustration: Layered Protocols (2)

A typical message as it appears on the network
Middleware Protocols

An adapted reference model for networked communication

Tanenbaum & Van Steen, Distributed Systems: Principles and Paradigms, 2e, (c) 2007 Prentice-Hall, Inc. All rights reserved
Types of Communication

- Synchronize at request submission
- Synchronize at request delivery
- Synchronize after processing by server

Client → Request → Server → Reply

Transmission interrupt
Storage facility

Viewing middleware as an intermediate (distributed) service in application-level communication

Persistent vs. Transient Communication
Asynchronous vs. Synchronous Communication
Communication Methods

- **RPC (Remote Procedure Call)**
  - Communication by Calling Remote Procedures
    - Definition of service interface
    - Lack of ability to create new object instances
    - Lack of support for remote object references

- **RMI (Remote Method Invocation)**
  - Communication by Calling Methods of a Remote Object
    - Implementation of a remote interface
    - Creation of new object instances
    - Support for remote object references
Communication Methods (Cont’d)

- **Socket**
  - Communication of Messages and Data between Processes
    - Use of a raw communication channel
    - Definition of a low-level message protocol
    - Definition of data transmission format

- **Distributed Event-Based Systems**
  - Communication via Event Subscription and Notification
    - Support for heterogeneity
    - Support for asynchronous communication
Middleware Approaches

- Location Transparency

Middleware layers

- Applications
- RMI, RPC and events
- Request reply protocol
- External data representation
- Operating System

Coulouris, Dollimore and Kindberg  Distributed Systems: Concepts and Design  Edn. 4  © Pearson Education 2005
Method Invocation

Local vs Remote Invocation
Distributed Object Model

A Remote Object and Its Remote Interface
Distributed Object Model (Cont’d)

- Instantiation of Remote Objects
RMI Components

- **Proxy**
  - Forwarding Messages to a Remote Object and Receiving the Reply
    - Making RMI transparent to clients

- **Dispatcher**
  - Receiving the Request and Selecting the Appropriate Skeleton Method

- **Skeleton**
  - Implementing Methods in the Remote Interface
    - Unmarshalling arguments and invoking the method
RMI Components (Cont’d)

Illustration

Translating between Local and Remote Object References and Creating Remote Object References
RPC Components

Illustration

client process

client stub procedure

Communication module

client program

Request

Reply

server process

server stub procedure

Communication module

dispatcher

service procedure

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