CISC 434: Communication - 1

Communication
  - Layered Protocols
  - Types of Communications
  - Remote Procedure Call (RPC)
  - Message Oriented Communication
  - Stream-Oriented Communication
  - Multicast Communication
Some Basic Definitions

- OSI – Open System Interconnection
- Open system – a system ready to communicate with any other open system by using standard rules
- Protocols – formalized rules agreed by a group of computers to communicate over a network
- Layers – to divide the communication task so that each layer deals with specific aspect of communication
- Interface – each layer has an interface which consists of a set of operations that define the service of the layer for its users
Layered Protocols

Layers, interfaces, and protocols in the OSI model

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<table>
<thead>
<tr>
<th>Layer</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>Application protocol</td>
</tr>
<tr>
<td>Presentation</td>
<td>Presentation protocol</td>
</tr>
<tr>
<td>Session</td>
<td>Session protocol</td>
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<tr>
<td>Transport</td>
<td>Transport protocol</td>
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<tr>
<td>Network</td>
<td>Network protocol</td>
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<tr>
<td>Data link</td>
<td>Data link protocol</td>
</tr>
<tr>
<td>Physical</td>
<td>Physical protocol</td>
</tr>
</tbody>
</table>
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Network

A typical message on the network

- Data link layer header
- Network layer header
- Transport layer header
- Session layer header
- Presentation layer header
- Application layer header

Message

Bits that actually appear on the network

Data link layer trailer
Layers

- **Physical**
  - Standardizes electrical, mechanical, and signaling interfaces

- **Data Link**
  - Group the bits into units – frames
  - Put a special bit patterns on the start and end to mark a frame
  - Put a checksum by adding up all the bytes in the frame in a certain way
    - recomputed by the receiver to check the correctness of the frame

- **Network**
  - Routing – choosing the best path between two points
    - Connectionless protocol – Internet protocol (IP)
    - Connection-oriented protocol – virtual channel in ATM networks
Layers – contd.

- **Transport**
  - Deals with which packets have been sent, received, how many more the receiver has room to accept, which should be transmitted
  - Breaks a message into pieces, assigns each one a sequence number
  - Internet transport protocol
    - TCP (Transmission Control Protocol) – connection oriented, combination of TCP/IP, more reliable and overhead
    - UDP (Universal Datagram Protocol) – connectionless, just IP with slight modifications, less reliable and overhead

- **Session**
  - Provides dialogue control – tracks which party is currently talking
  - Provides synchronization facilities – useful for users to insert checkpoints into long transfers to utilize them in case of crash
Layers – contd.

**Presentation**
- The lower layers are concerned with transmitting bits reliably and efficiently, this layer is concerned with the meaning of bits.
- Define records in terms of fields (e.g., name, address).
- Sender notifies the receiver about record format – easier for communicating between machines with different internal representations.

**Application**
- Contains a collection of network applications – email, file transfer, terminal emulation, and others – File Transfer Protocol (FTP), Hyper Text Transfer Protocol (HTTP).
Types of Communication

- Viewing middleware as an intermediate (distributed) service in application-level communication
- Examples of high level middleware services – RPC, RMI, message queuing services, media transfer through streams
Persistence and Synchronicity In Communication

- **Transient Communication**
  - A message is stored by the communication system as long as the sending and receiving application are executing.
  - If the communication system (server) cannot deliver a message to the next server or receiver, the message will be discarded.
  - Used by the transport level communication – use store-and-forward routers – if a router cannot send to the next router, it just drops the message.
Persistent Communication – An Example

Persistent communication of letters (days of Pony Express)

Mail stored and sorted, to be sent out depending on destination and when pony and rider available
Persistence and Synchronicity in Communication

- Asynchronous Communication
  - The sender continues immediately after it has submitted its message for transmission

- Synchronous Communication
  - A sender may be blocked until the middleware notifies that it will take over transmission of the request
  - A sender may be blocked until its request has been delivered to the intended recipient
  - A sender may be blocked until its request has been fully processed (until the receiver returns a response)
General Organization of a Communication System

- Host (sender/receiver), Application, Operating system
Components Involved in a Communication System

- **Messaging interface**
  - Applications running on a host use an interface to the communication system for message transmissions

- **Communication network**
  - Host communicate through a network of communication servers

- **Communication server**
  - Responsible for passing and routing messages between hosts

- **Routing program**
  - Generates route for a message to reach a destination

- **Buffers**
  - Local or independent of communication hosts
Combinations of Persistence and Synchronicity

a) Persistent asynchronous
b) Persistent synchronous
c) Transient asynchronous
d) Receipt-based transient synchronous
e) Delivery-based transient synchronous
f) Response-based transient synchronous
Combinations of Persistence and Synchronicity – contd.

a) Persistent asynchronous communication – a message is either persistently stored in a buffer at the local host, or at the first communication server – electronic mail system.

b) Persistent synchronous communication.
Combinations of Persistence and Synchronicity – contd.

c) Transient asynchronous communication

d) Receipt-based transient synchronous communication
Combinations of Persistence and Synchronicity – contd.

e) Delivery-based transient synchronous communication

f) Response-based transient synchronous communication
Summary

- Layers, interfaces, and protocols in the OSI model
  - Layers
  - Middleware

- Types of Communications
  - Persistence
  - Synchronicity
  - Various combinations of the above two