Chapter 1
Introduction
A Communications Model

- **Source**
  - generates data to be transmitted

- **Transmitter**
  - Converts data into transmittable signals

- **Transmission System**
  - Carries data

- **Receiver**
  - Converts received signal into data

- **Destination**
  - Takes incoming data
Simplified Communications Model - Diagram

(a) General block diagram

(b) Example
## Communications Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission system utilization</td>
<td>Addressing</td>
</tr>
<tr>
<td>Interfacing</td>
<td>Routing</td>
</tr>
<tr>
<td>Signal generation</td>
<td>Recovery</td>
</tr>
<tr>
<td>Synchronization</td>
<td>Message formatting</td>
</tr>
<tr>
<td>Exchange management</td>
<td>Security</td>
</tr>
<tr>
<td>Error detection and correction</td>
<td>Network management</td>
</tr>
<tr>
<td>Flow control</td>
<td></td>
</tr>
</tbody>
</table>
Simplified Data Communications Model

1. Input information $m$
2. Input data $g(t)$
3. Transmitted signal $s(t)$
4. Received signal $r(t)$
5. Output data $g'(t)$
6. Output information $m'$
Networking

- Point to point communication not usually practical
  - Devices are too far apart
  - Large set of devices would need impractical number of connections
- Solution is a communications network
Simplified Network Model
Wide Area Networks

- Large geographical area
- Crossing public rights of way
- Rely in part on common carrier circuits
- Alternative technologies
  - Circuit switching
  - Packet switching
  - Frame relay
  - Asynchronous Transfer Mode (ATM)
Circuit Switching

- Dedicated communications path established for the duration of the conversation
- e.g. telephone network
Packet Switching

- Data sent out of sequence
- Small chunks (packets) of data at a time
- Packets passed from node to node between source and destination
- Used for terminal to computer and computer to computer communications
Frame Relay

- Packet switching systems have large overheads to compensate for errors
- Modern systems are more reliable
- Errors can be caught in end system
- Most overhead for error control is stripped out
Asynchronous Transfer Mode

- ATM
- Evolution of frame relay
- Little overhead for error control
- Fixed packet (called cell) length
- Anything from 10Mbps to Gbps
- Constant data rate using packet switching technique
Integrated Services Digital Network

- ISDN
- Designed to replace public telecom system
- Wide variety of services
- Entirely digital domain
Local Area Networks

- Smaller scope
  - Building or small campus
- Usually owned by same organization as attached devices
- Data rates much higher
- Usually broadcast systems
- Now some switched systems and ATM are being introduced
LAN Configurations

- **Switched**
  - Switched Ethernet
    - May be single or multiple switches
  - ATM LAN
  - Fibre Channel

- **Wireless**
  - Mobility
  - Ease of installation
Metropolitan Area Networks

- MAN
- Middle ground between LAN and WAN
- Private or public network
- High speed
- Large area
Protocols

- Used for communications between entities in a system
- Must speak the same language

Entities
- User applications
- e-mail facilities
- terminals

Systems
- Computer
- Terminal
- Remote sensor
Key Elements of a Protocol

- Syntax
  - Data formats
  - Signal levels

- Semantics
  - Control information
  - Error handling

- Timing
  - Speed matching
  - Sequencing
Protocol Architecture

- Task of communication broken up into modules
- For example file transfer could use three modules
  - File transfer application
  - Communication service module
  - Network access module
Simplified File Transfer Architecture
A Three Layer Model

- Network Access Layer
- Transport Layer
- Application Layer
Network Access Layer

- Exchange of data between the computer and the network
- Sending computer provides address of destination
- May invoke levels of service
- Dependent on type of network used (LAN, packet switched etc.)
Transport Layer

- Reliable data exchange
- Independent of network being used
- Independent of application
Application Layer

- Support for different user applications
- e.g. e-mail, file transfer
Addressing Requirements

- Two levels of addressing required
- Each computer needs unique network address
- Each application on a (multi-tasking) computer needs a unique address within the computer
  - The service access point or SAP
Protocol Architectures and Networks
Protocols in Simplified Architecture

Diagram showing the flow of data between two computers (Computer X and Computer Y) through Application, Transport, and Network access layers. The communication protocols are labeled as Application Protocol, Transport Protocol, and Network access protocols.
Protocol Data Units (PDU)

- At each layer, protocols are used to communicate.
- Control information is added to user data at each layer.
- Transport layer may fragment user data.
- Each fragment has a transport header added:
  - Destination SAP
  - Sequence number
  - Error detection code
- This gives a transport protocol data unit.
Network PDU

- Adds network header
  - network address for destination computer
  - Facilities requests
Operation of a Protocol Architecture
Standards

Required to allow for interoperability between equipment

Advantages
- Ensures a large market for equipment and software
- Allows products from different vendors to communicate

Disadvantages
- Freeze technology
- May be multiple standards for the same thing
Standards Organizations

- Internet Society
- ISO
- ITU-T (formally CCITT)
- ATM forum
Further Reading

- Web site for Stallings book
  - www.shore.net/~ws/DCC6e.html
- Web sites for IETF, IEEE, ITU-T, ISO
- Internet Requests for Comment (RFCs)
- Usenet News groups
  - comp.dcom.*
  - comp.protocols.tcp-ip
ΒΙΒΛΙΟΓΡΑΦΙΑ


