A bit of history…

1980: Networks are an academic curiosity
1988: All networks wires are copper based
1988: Networks used by universities and large businesses
1996: Networks used by millions of people
2002: High bandwidth connections and information highways are common place
2050: ?
Who uses networks and why?

- **Companies**
  - Resource sharing
  - High reliability
  - Saving money

- **Individuals**
  - Access to remote information
  - Person to person communication
  - Interactive entertainment
  - Online shopping

**What A Network Does**

Provides communication that is
- Reliable
- Fair
- Efficient
- From one application to another

Automatically detects and corrects
- Data corruption
- Data loss
- Duplication
- Out-of-order delivery

Automatically finds optimal path from source to destination
Data Communications and Computer Networks

The Language of Computer Networks

WAN: Wide area network - a large network that encompasses parts of states, multiple states, countries, and the world

LAN: Local Area Network. Small, privately owned, localised network.

Data communications - the transfer of digital or analog data using digital or analog signals

Voice network - a network that transmits telephone signals

Data network - a network that transmits computer data

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Type of networks

- Broadcast (small localised)
  - One communication channel shared by all users
  - All messages received by all users
  - Users decode message target and discard useless messages
  - Some messages are addressed to all users / groups of users (multicast)

- Point to point (large, de-localised)
  - many connections between pairs of computers
Network topologies

The Big Picture of Network hardware

Networks are composed of many devices, including:

- workstations
- servers
- bridges
- routers
- hubs and switches
- nodes
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Examples

Figure 1-1
An overall view of the interconnection between local area networks and wide area networks

Figure 1-3
A microcomputer lab, showing the cabling that exits from the back of a computer and runs to a collection point of the LAN in the back of the room
Figure 1-4
A microcomputer sending data over a telephone line to an Internet service provider and into the Internet.

Figure 1-5
Two local area networks connected by a bridge.
Figure 1-6
Local area network to a wide area network connection

Figure 1-8
Example of a television company using a satellite system to broadcast television services into homes and businesses
A network is a combination of:

- hardware
- data communications
- protocols
- routing
- software
- services (applications)

How is it all organised and managed?
Network Architecture Models

• A reference model that describes the layers of hardware and software necessary to transmit data between two points

• Reference models are necessary to increase the likelihood that different components from different manufacturers will converse

• There are two models that are required learning: The OSI Model, and the Internet Model (TCP/IP model).
The Open Systems Interconnections (OSI) ISO seven layers Model:
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Physical layer:
handles the transmission of bits over a communications channel. Includes voltage levels, connectors, media choice, modulation techniques.

Data link layer:
responsible for taking the data and transforming it into a frame with header, control and address information, and error detection code.
**Data Communications and Computer Networks**

**Network architecture models**

**Network layer:**
- responsible for creating maintaining and ending network connections.
- Transfers a data packet from node to node within the network.

**Transport layer:**
- provides an end-to-end, error-free network connection. Makes sure the data arrives at the destination exactly as it left the source.

**Session layer:**
- responsible for establishing sessions between users.

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**Network architecture models**

**Presentation layer:**
- performs a series of miscellaneous functions necessary for presenting the data package properly to the sender or receiver

**Application layer:**
- where the application using the network resides. Common network applications include remote login, file transfer, e-mail, and web page browsing.
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Network architecture models

Figure 1-10: The network workers performing their jobs at each layer in the model.

Sending Process

Application layer
Application protocol

Presentation layer
Presentation protocol

Session layer
Session protocol

Transport layer
Transport protocol

Network layer
Network protocol

Data link layer
DH

Physical layer
Bits

Data

Receiving Process

Application layer
Application protocol

Presentation layer
Presentation protocol

Session layer
Session protocol

Transport layer
Transport protocol

Network layer
Network protocol

Data link layer
DH

Physical layer
Bits

Data

Actual data transmission path
The Internet Model (TCP/IP)

**Interface layer:**
equivalent to the OSI’s physical and data link layers

**Network layer:**
roughly equivalent to the OSI’s network layer

**Transport layer:**
performs same function as OSI transport layer

**Application layer:**
equivalent to the OSI’s presentation and application layers
Logical and physical connections

A logical connection is one that exists only in the software, while a physical connection is one that exists in the hardware.

Note that in a network architecture model, only the lowest layer contains a physical connection, while all higher layers contain logical connections.
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Our hybrid model

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Application layer</td>
</tr>
<tr>
<td>4</td>
<td>Transport layer</td>
</tr>
<tr>
<td>3</td>
<td>Network layer</td>
</tr>
<tr>
<td>2</td>
<td>Data link layer</td>
</tr>
<tr>
<td>1</td>
<td>Physical layer</td>
</tr>
</tbody>
</table>

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Network software

**CONNECTION-ORIENTED / CONNECTIONLESS SERVICES:**

**Connection oriented service** -
Like the phone system. The system establishes a connection, uses it, and closes it. Acts like a tube. Data comes out the other end in the same order as it goes in.
- Connection Setup
- Data Transfer
- Connection Termination

**Connectionless service** -
Like the post office. Each message has the entire address on it. Each message may follow a different route to its destination. Ordering not maintained.
- Data Transfer