# Wide Area Networks (WANs)

WANs span a large geographical area; use services provided by public telephone/data networks; often consist of numerous interconnected nodes which route the data from source to destination. They have been implemented traditionally using Packet/Circuit Switching and, more recently using Frame relay and ATM networks.

Circuit-Switching

Virtual circuit established first

N3

N2

Source

N1

N4

N7

Destination

N6

Virtual Circuit – N1, N2, N7, N4, N5

N5

A dedicated communications path, consisting of sequence of physical links between nodes, is first established. Data then travels from source to destination along this path.

Packet-Switching

Nodes Ni are routers/switches

N5

N4

N6

N3

N2

Source

N1

N7

Destination

Data Packets

P5

P4

P3

P2

P1

P1 path – N1, N2, N3, N4, N5

P2 path – N1, N2, N3, N7, N5

P3 path – N1, N7, N5 (shortest)

P4 path – N1, N2, N7, N5

Data is broken into fixed length packets or data grams; each packet travels from source to destination by traversing a set of interconnected nodes (a path) within the network. The path is not pre-determined and could vary from packet to packet. There is no guaranteed delivery and the arrival order of the packets at the destination cannot be determined.

**Examples of WAN technologies:**

Frame-Relay

A variant application of the concept of packet switching is used where:

* The packets are of variable length and called “frames”
* Minimum error-detection is implemented at “frame” level since the modern telecommunication systems over which frame-relay operated have low error rates.

Frame-Relay increases end-user data rate to 2Mbps.

ATM (Asynchronous Transfer Mode or “Cell-Relay”)

Combines the idea of fixed-length packets (called “cells” in ATM context) from packet-switching, with the idea of a dedicated, dynamically assigned, virtual-circuit (from circuit-switching) which is used to transport the “cells” 53 bytes each from source to destination, at a constant user-determined data rate.

ISDN (Integrated Services Digital Network)

Supports voice and non-voice applications using limited set of standardized facilities. Only Narrowband ISDN built using 64Kbps channels is widely available as opposed to Broadband ISDN (proposed, but not fully implemented). Two types of access are supported:

Basic Access: 2 B-channels each 64Kbps, plus 1 D-channel (16Kbps) used for signaling. The B-channels may carry digital data, PCM-encoded digitized voice.

Primary Access: 23 B-channels, plus 1 D-channel (64Kbps) for signaling.

# Local Area Networks (LANs)

A multipoint network which is limited to a building or a small campus, it often connects devices to a broadcast network using a shared medium with no intermediate nodes. Each device’s transmission is received by all others. LANs support much higher data rates (~100Mbps) than WANs and operate mainly at the lower layers of the OSI Model. They may use Ethernet, Token-Ring, and FDDI technology. Token-Ring is a circular ring-shaped configuration proposed by IBM, but not widely used any more.

# Open Systems Interface (OSI) Reference Model

**OSI Model has been developed by International Standards Organization(ISO).**

The OSI model is a framework for computer communications architecture and for developing protocol standard. This model identifies 7 layers and the function associated with each layer so that new protocols may be developed to perform the functions of each layer.

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| TCP/IP | OSI | ***Hint****: Initial Letter of the Word below might help you remember………* |
| A  P  P  L  I  C  A  T  I  O  N  Layer | Application – provides users access to applications and distributed information services. | All |
| Presentation – makes network applications independent of the differences in the data representation (32/64 bit, ASCII/EBCDIC, Big Endian/Little Endian) | **P**eople |
| Session – provides framework and control structure for establishing, managing, terminating connections between remotely cooperating applications. | **S**eem |
| TRANSPORT  Layer  (TCP) | Transport ­­­­– provides capabilities for reliable transfer of data between end-points, including error recovery and flow-control. | **T**o |
| INTERNET  Layer  (IP) | Network – provides simplified mechanism to upper layers for establishing, maintaining, terminating connections between source and destination nodes, by transparently handling packet-level addressing and routing/switching mechanisms. | **N**eed |
| NETWORK ACCESS  Layer  (Ethernet, FDDI) | Datalink – provides mechanisms for reliable transfer of information across the physical link by sending “frames” of data with necessary synchronization, error-correction and congestion-control (CD) | **D**ata |
| PHYSICAL  Layer | Physical – deals with the electrical or optical characteristics of the physical medium which supports the transmission of an unstructured bit-stream. | **P**rocessing |