

524 Computer Networks

Section 1: Introduction to Course

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Sri Lanka Institute of Information
Technology - 2005

Course Outline – The Aim

- The course is design to establish the terminology and concepts of Computer Networks and the associated Communication environment.
- On the successful completion of the course, the student should be able to:
 - Understand and describe the concepts related to the different OSI layers.
 - Understand and describe the internal mechanisms of different network topologies and architectures and their relevance to data transmission system.



Course Outline

- Introduction
- Physical Layer
- Data Link Layer
- Network Layer
- Transport and Application Layers
- Security and other issues.



Text books

- Main text
 - Data Communications and Networking/3e
Behrouz A. Forouzan. Tata McGraw Hill, 2004
- Other text
 - Data and Computer Communications/7e
William Stallings, Pearson Education Inc. 2004



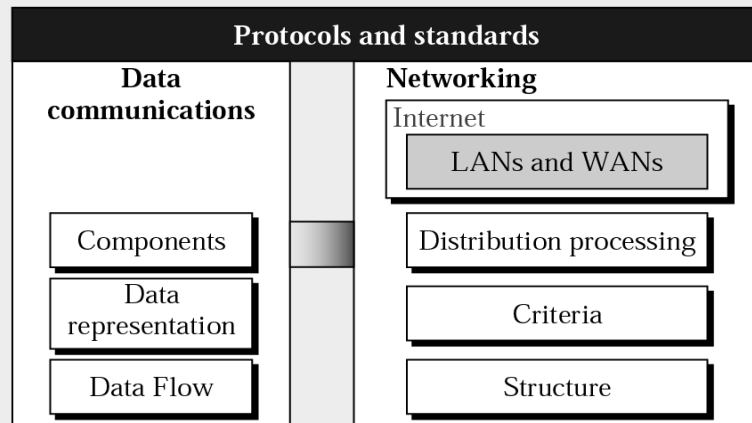
Grading Policy

- **Continuous Assessment - 50%**
 - Computer and self-study assignments - 30%
 - Mid-semester examination - 20%
- **End of Semester Examination - 50%**
 - One paper of 3hr duration



Overview

Network models

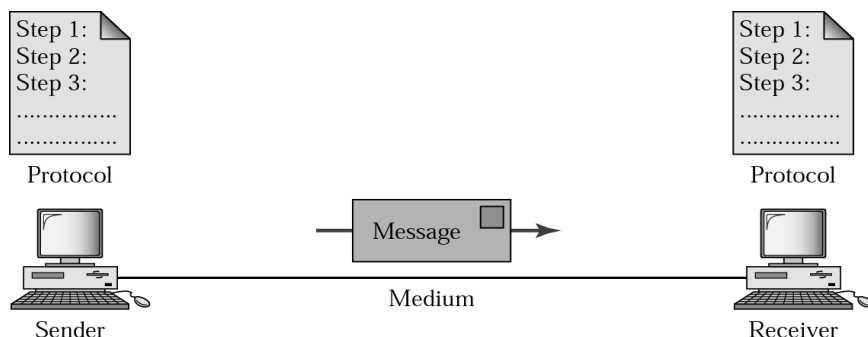


Data Communications

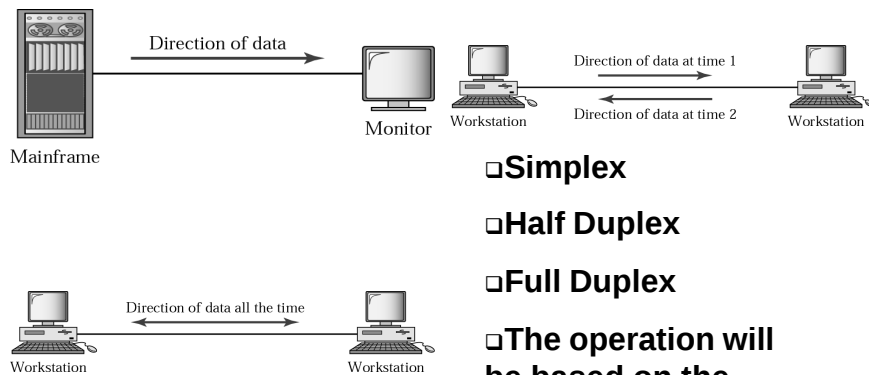
- Reliable transmission of information across a network.
- Uses hardware at Physical Layer level and Software at upper layers to implement a reliable communication.
- Performance Measures.
 - Delivery: o the correct destination.
 - Accuracy: no alterations
 - Timeliness: real-time data etc.



Components of a Data Com System



Direction of Information Flow



□ **Simplex**

□ **Half Duplex**

□ **Full Duplex**

□ **The operation will be based on the requirement.**

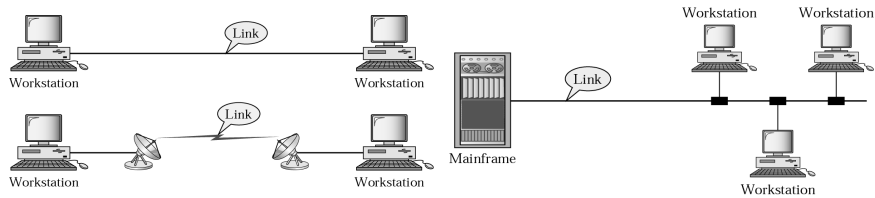


Networking

- A set of nodes (with devices) connected by a communication link.
- Criteria that has to be met by a network
 - Performance: transit time, response time, number of users, type of medium etc.
 - Reliability: failure frequency should be low.
 - Security: protecting from unauthorized access etc.
- Networks have structures.
 - Type of connection: Point to point, multi point.
 - Physical topology: star mesh etc.



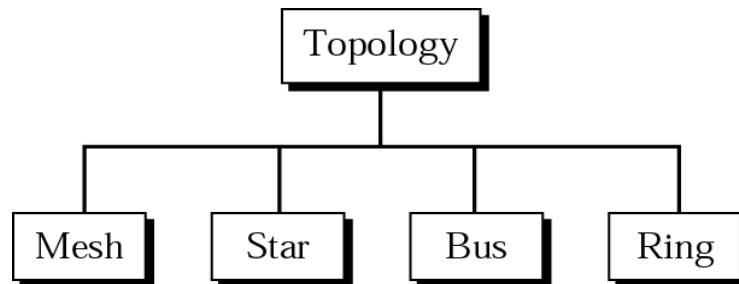
Types of Connections



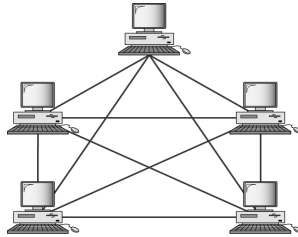
- Point to point provides a dedicated link between the sender and the receiver.
- Multipoint or multidrop shares the medium. Need to look at techniques of sharing etc. (MAC)



Physical Topology



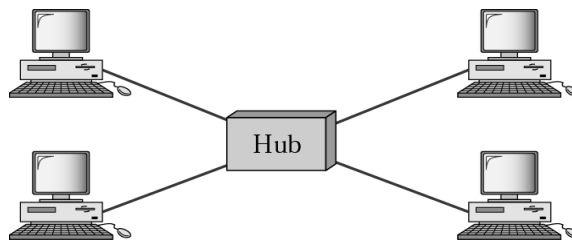
The Mesh Topology



- Dedicated point to point link to every other device. Hence high security for data. Each link is dedicated hence no congestion problems, also one link down does not mean the system fails.
- For n devices it has $n(n-1)/2$ channels to link and each device needs to have $(n-1)$ I/O ports to do this. Too expensive.



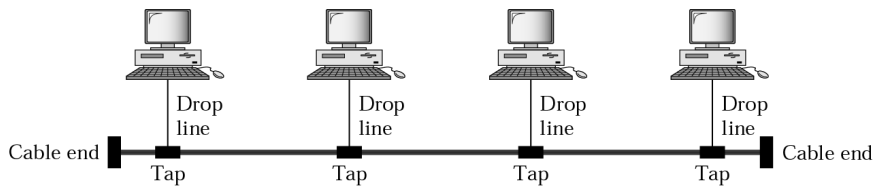
The Star Topology



- Less expensive compared to mesh since only one link and one I/O port is required to send data to a central location. Reconfiguration is easy. If one link fails the system does not fail
- If the hub fails, all fail. Link is through a central location hence no direct data transfer, less secure.



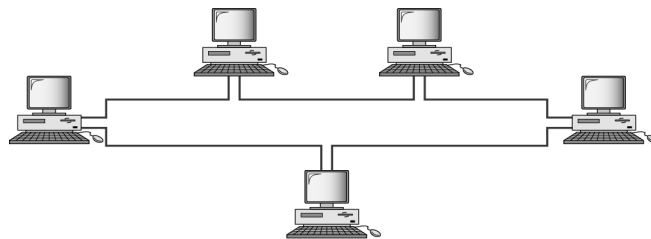
The Bus Topology



- Previous topologies were point to point. This is a multi point architecture. Used for backbones. Easy cabling. Optimal at the time of installation.
- The signal gets weaker as it travels down the backbone. Hence limited number of drop lines. Reconfiguration is impossible. Bus failure means system failure.



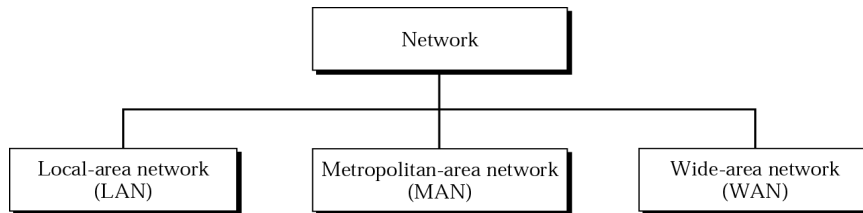
The Ring Topology



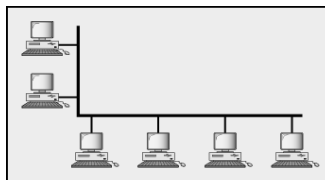
- Dedicated links with the two neighbors. Each device has a repeater and the signal travels only in one direction. Easy wiring.
- If the ring breaks, if the system is not configured properly the entire system fails.



Categories of Networks



The LAN

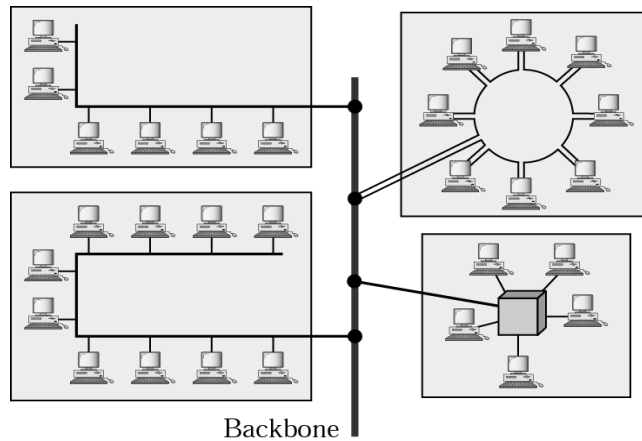


a. Single-building LAN

- Single building or several buildings in a private network.
- Media and topology is distinct. Generally only one type of media is used.
- Most common topologies are bus rings and star.



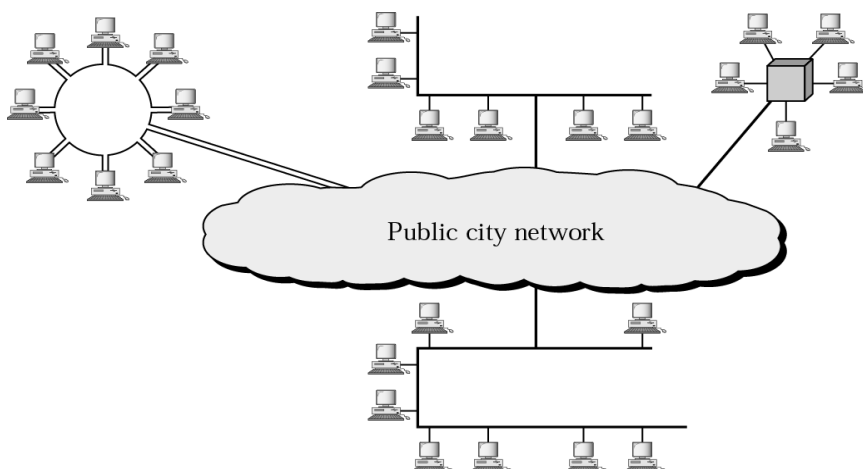
LAN With Backbone



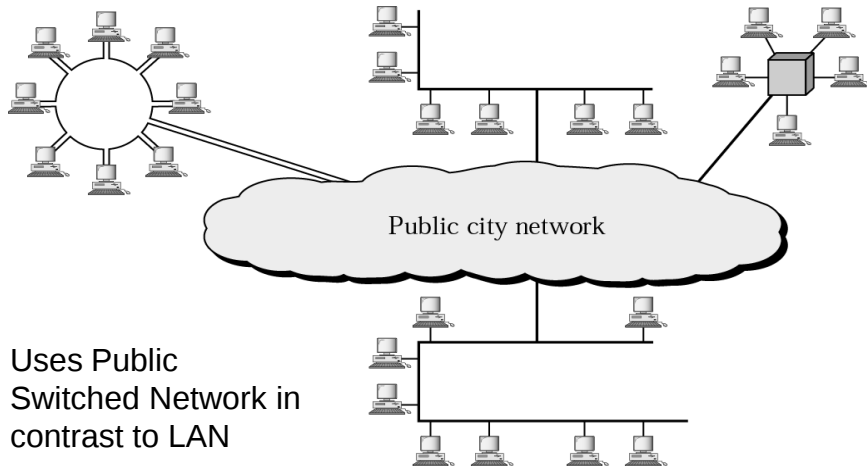
b. Multiple-building LAN



The MAN



The WAN



Uses Public
Switched Network in
contrast to LAN

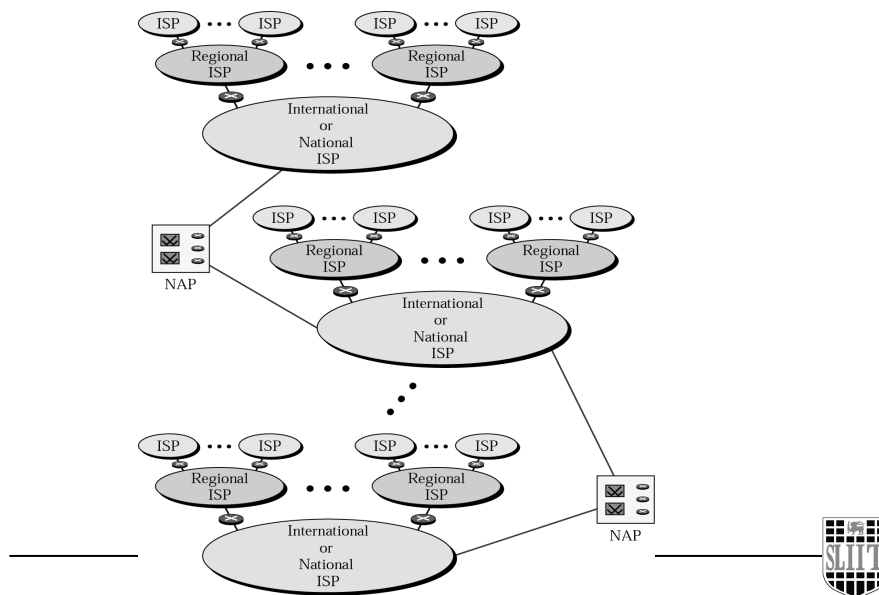


Extending the WAN

- WANs that are owned by a single company is often referred to as an enterprise network.
- When two or more WANs connect via public network it is referred to as internetwork or in short internet.
- TCP/IP is used as the protocol for internetworking.



The Internet

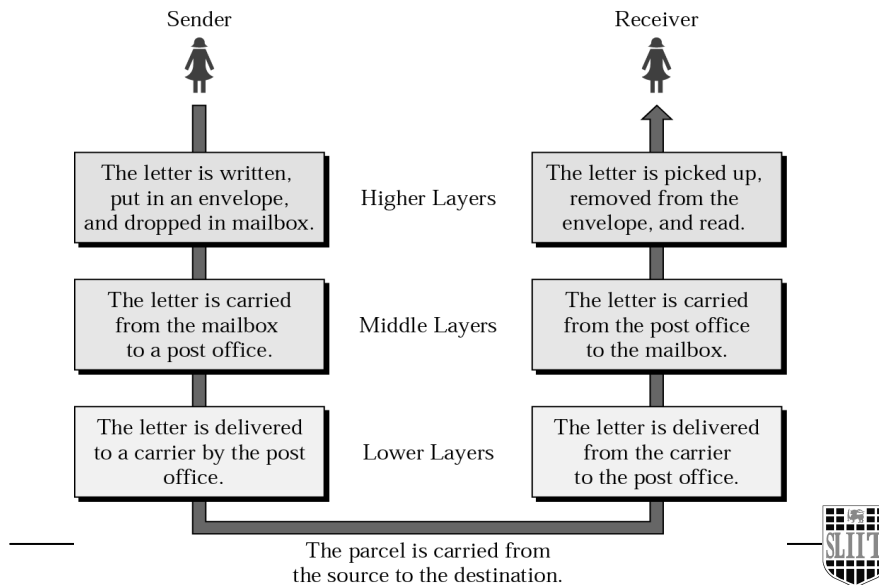


Network Models

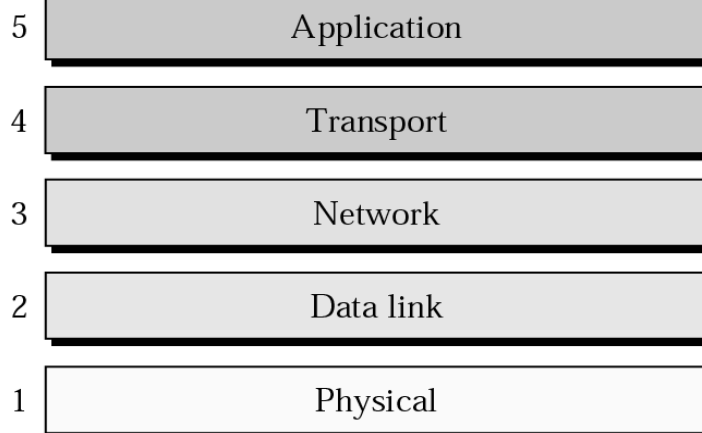
- The requirements of a model.
- To models we will be concentrating on.
 - The Internet Model
 - The OSI Model
- The layered model provides guidelines for the development of universally compatible networking protocols.



The Design of Layered Architecture



The Internet Model Layers

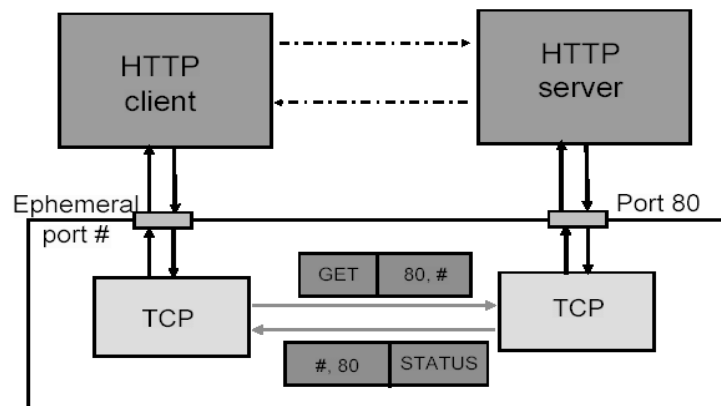


Layers, Services and Protocols

- The overall communications process between two or more machines connected across one or more networks is very complex
- **Layering** partitions related communications functions into groups that are manageable
- Each layer provides a **service** to the layer above
- Each layer operates according to a **protocol**



Example of HTTP Access



Protocols

- A *protocol* is a set of rules that governs how two or more communicating entities in a layer are to interact
- *Messages* that can be sent and received
- *Actions* that are to be taken when a certain event occurs, e.g. sending or receiving messages, expiry of timers
- **The purpose of a protocol is to provide a service to the layer above**

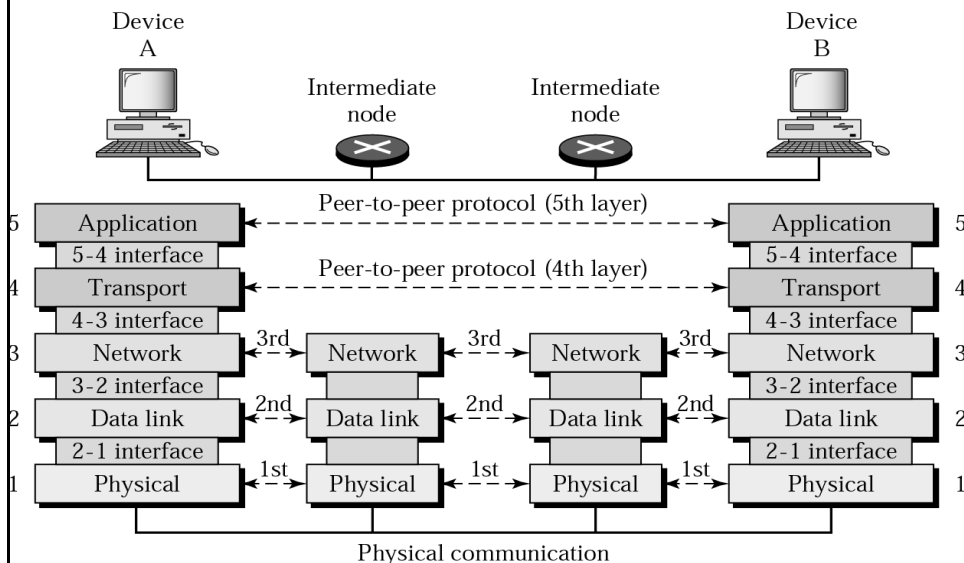


Why Layering?

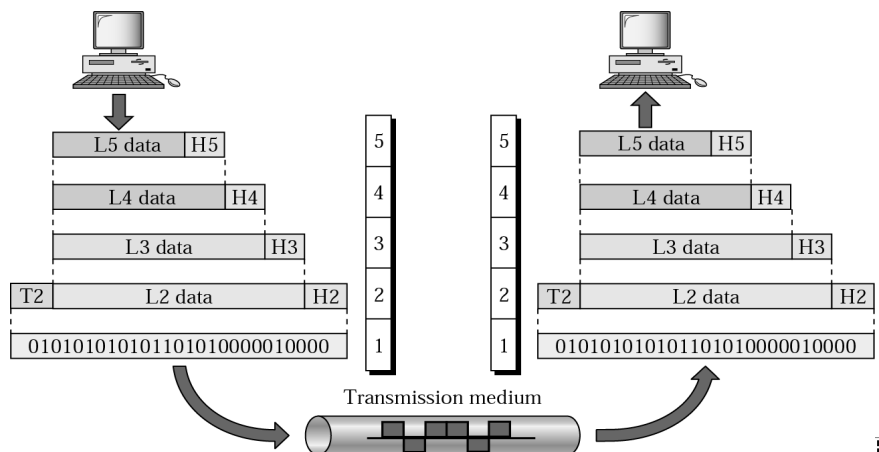
- **simplifies design, implementation, and testing by partitioning overall communications process into parts**
- **Protocol in each layer can be designed separately from those in other layers**
- **Protocol makes “calls” for services from layer below**
- **Layering provides flexibility for modifying and evolving protocols and services without having to change layers below**
- **Monolithic non-layered architectures are costly, inflexible, and soon obsolete**



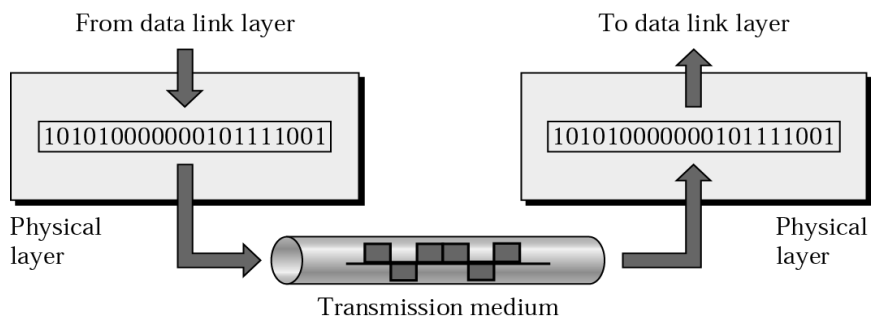
Peer to Peer Processes



Information Exchange using the Internet Model



The Physical layer

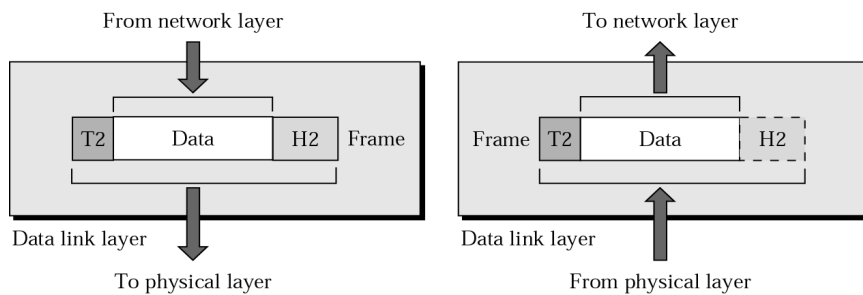


Physical Layer Functions

- Coordinates the functions required to transmit a bit stream over a physical medium.
- It deals with mechanical and electrical specifications of the interface and transmission media and defines the procedures and functions.
- Major duties include:
 - Physical characteristics of interfaces and media
 - Representation of bits.
 - Data rate.
 - Synchronization of bits.



The Data Link Layer

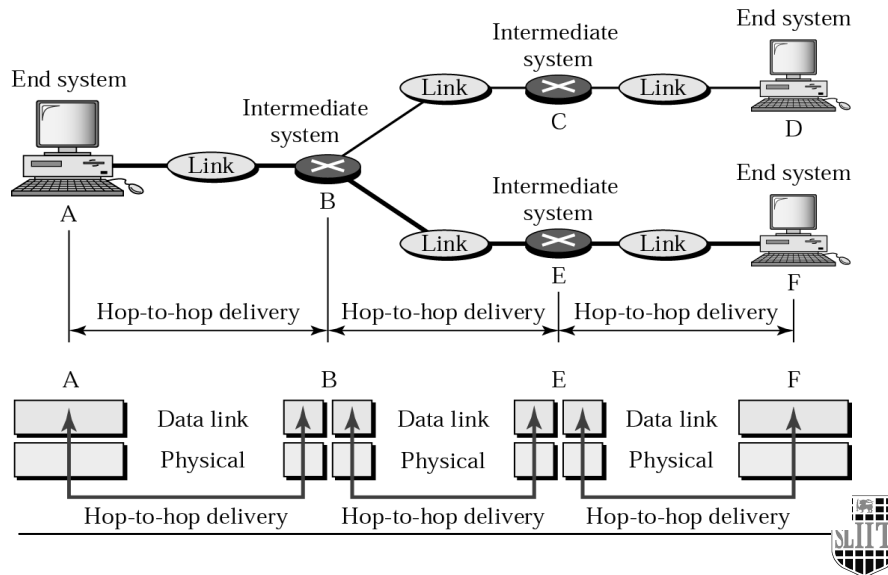


Data Link Layer Functions

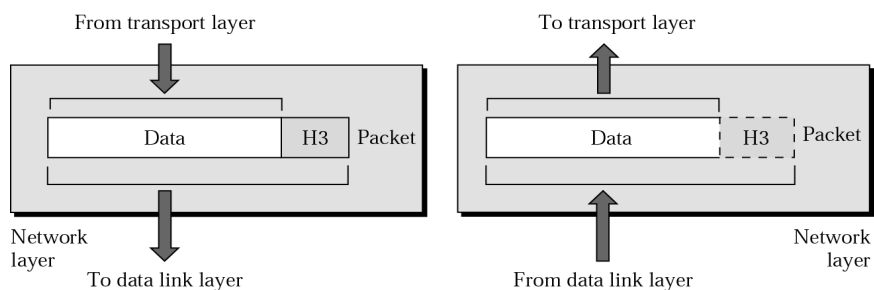
- The DLL is responsible for transmitting frames from one node to another. This is a hop to hop process.
- This layer makes the physical layer appear error free to the upper layer.
- The major duties included are
 - Framing
 - Physical addressing.
 - Flow and Error control
 - Access control



Illustration of a Hop-to-Hop Delivery



The Network Layer

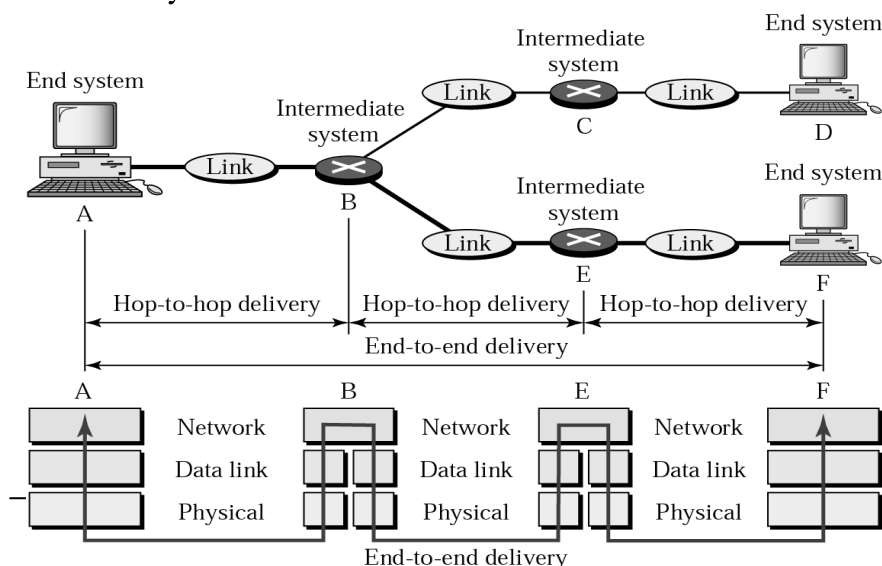


Network Layer Functions

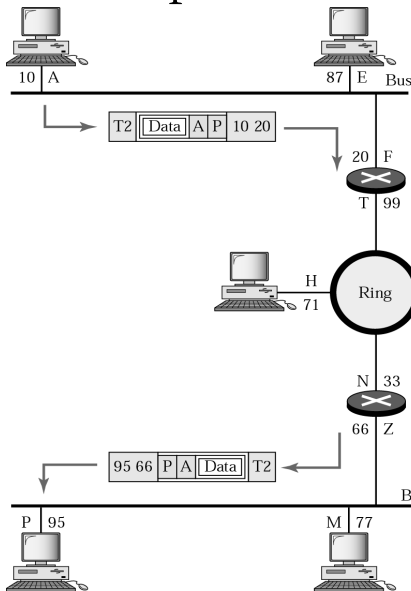
- The network layer is responsible for the delivery of packets from the original source to the final destination. This again is a hop to hop process.
- If the two systems are connected to the same link, there is no need of a network layer. Since we know where it has to be delivered.
- Addressing and routing are the major operations in this layer.



Illustration of Source to Destination Delivery of a Packet



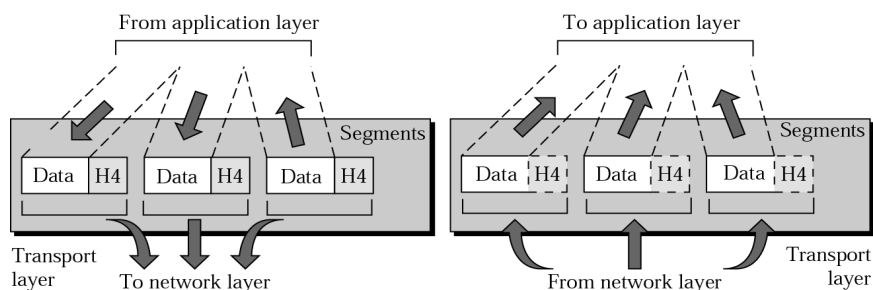
Example of Network Layer Functions



- Data is sent from a node with network address A and physical address 10, located on one LAN, to a node with a network address P and physical address 95, located on another LAN. The two devices are located on different networks, we cannot use physical addresses only; the physical addresses only have local jurisdiction. What we need here are universal addresses that can pass through the LAN boundaries.



The Transport Layer

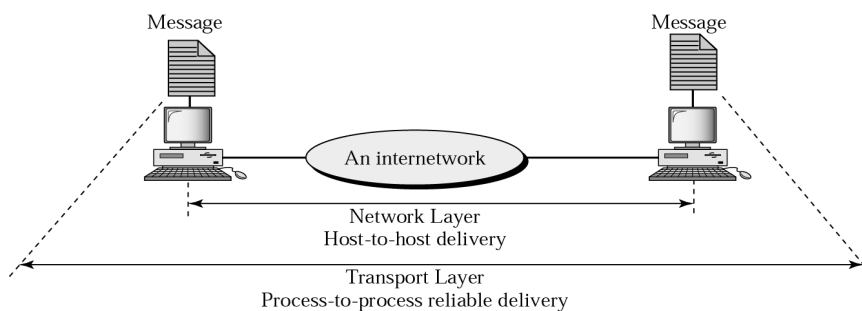


Transport Layer Functions

- The transport layer is responsible for delivery of a message from one process to another.
- This layer will over see that the whole message arrives intact and in order, overseeing both error and flow control at the process to process level. DLL did this same for packets and not the message. DLL did not assume any relation ship between the packets associated with a message.
- Major functions include: Port addressing, segmentation and reassembly, connection control, flow control, error control



Illustration of a Process to Process Delivery

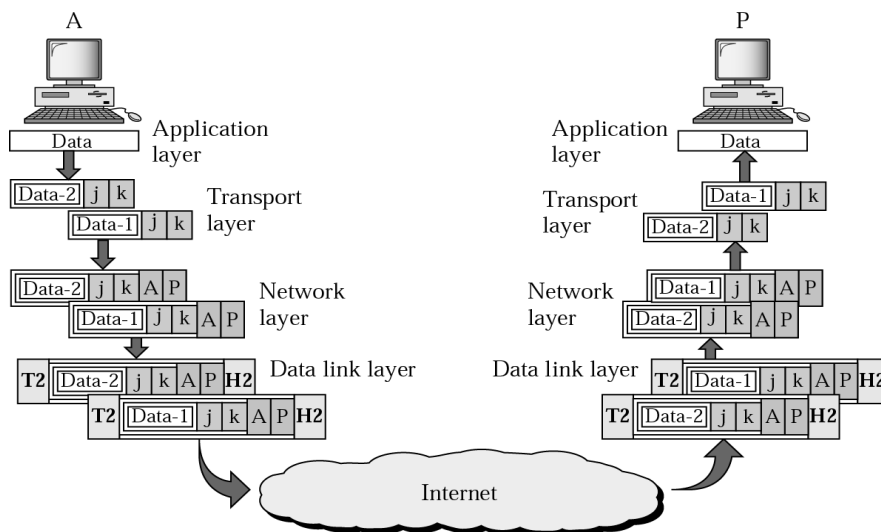


Example of Transport Layer Function

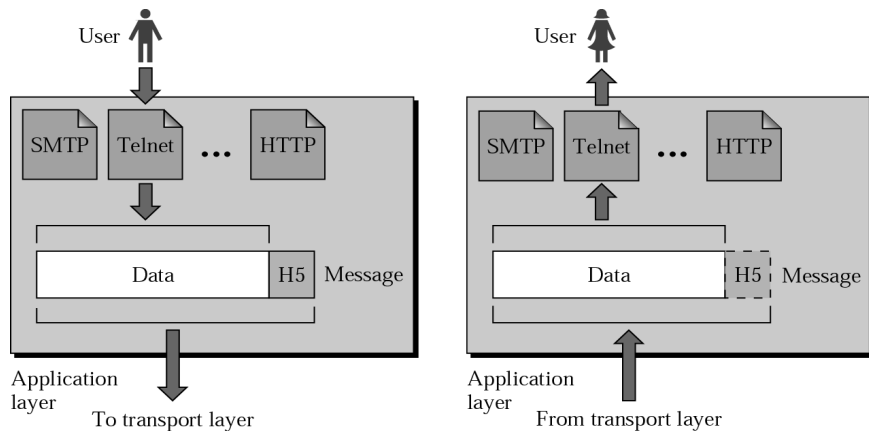
Data coming from the upper layers have port addresses j and k (j is the address of the sending process, and k is the address of the receiving process). Since the data size is larger than the network layer can handle, the data are split into two packets, each packet retaining the port addresses (j and k). Then in the network layer, network addresses (A and P) are added to each packet.



Example of Transport Layer Function



The Application Layer

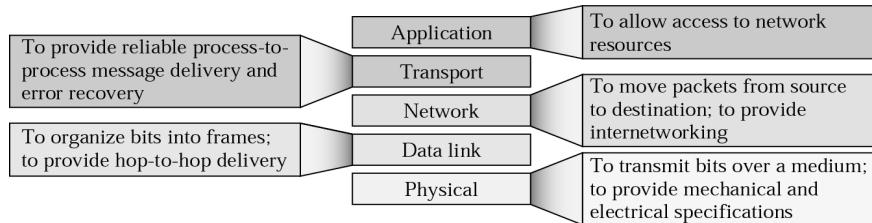


Application Layer Functions

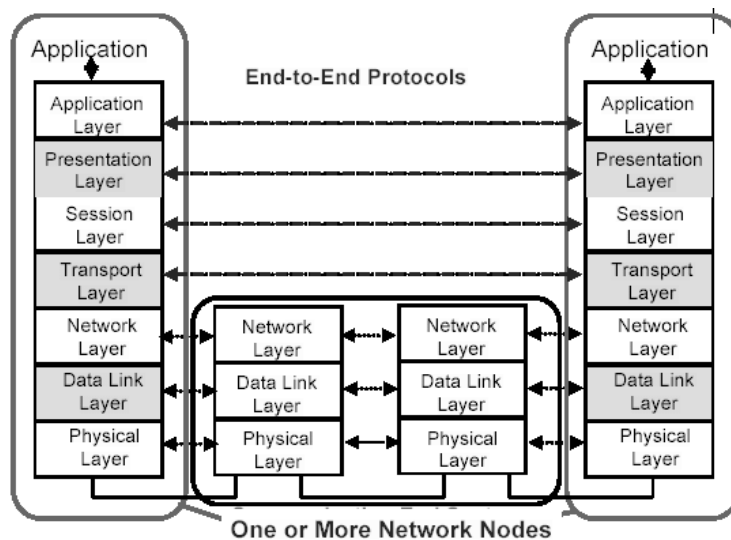
- The application layer is responsible for providing services to the user.
- Major duties are
 - Mail services
 - FTP access
 - Remote login
 - Accessing the WWW
 - Any other applications.



Summary of Layers in the Internet Model



The OSI Model



Headers and Trailers

