ECE 405: Computer Networks

- Lecture 2 – Introduction

OUTLINE:

- Uses of Computer Networks ---------- **Sec. 1.1**
- Network Hardware---------- **Sec. 1.2**
- Network Software---------- **Sec. 1.3**

note, follow the yellow highlighted sentences in the textbook.

Uses of Computer Networks

1- Business Applications

- Most companies have a substantial number of computers.
- e-commerce: doing business electronically.
- There main concern is the resource sharing.
- Networks called VPNs (Virtual Private Networks) may be used to join the individual networks at different sites into one extended network.

• Server-Clint model: It is widely used and forms the basis of much network usage. The most popular realization is that of a Web application, in which the server generates Web pages based on its database in response to client requests.

Uses of Computer Networks

1- Business Applications

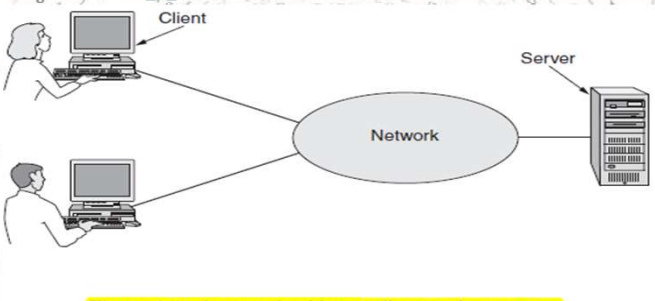


Figure 1-1. A network with two clients and one server.

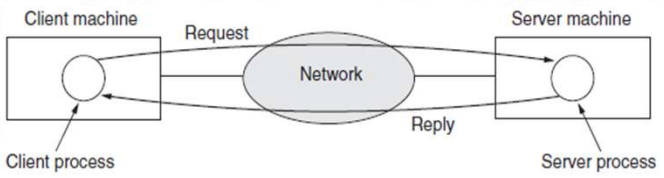


Figure 1-2. The client-server model involves requests and replies.

Uses of Computer Networks

2- Home Applications

- Much of this information is accessed using the client-server model, but there is different, popular model for accessing information that goes by the name of peer-to-peer communication, such as Bit-Torrent.

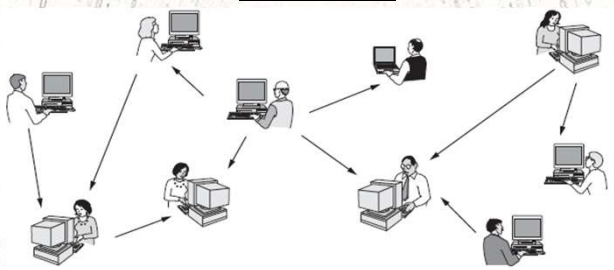


Figure 1-3. In a peer-to-peer system there are no fixed clients and servers.

- Power-Line Networks and RFID Technology.

Uses of Computer Networks

3- Mobile Users

- Cellular Networks and Mobile Hotspots.
- Fixed wireless vs. mobile wireless networks.

Wireless	Mobile	Typical applications
No	No	Desktop computers in offices
No	Yes	A notebook computer used in a hotel room
Yes	No	Networks in unwired buildings
Yes	Yes	Store inventory with a handheld computer

Figure 1-5. Combinations of wireless networks and mobile computing.

- NFC, Sensor Networks, and Wearable Technologies.

4- Social Users

- Profiling and Cookies.
- Botnet and Fishing ➔ CAPTCHA

Network Hardware

❖ NW hardware has two main dimensions:

1- Transmission topology; the link used for communication

a- Broadcast links.

b-Point-point links (unicast).

c- Multicasting.

2- Scale; distance is the metric for classification.

a- Personal Area Networks (PAN)

b- Local Area Network (LAN)

c- Metropolitan Area Networks (MAN)

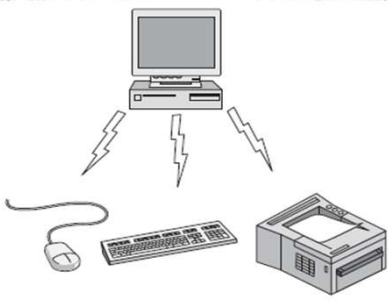
d- Wide Area Network (WAN)

e- Internetworks (Internet)

Network Hardware

a- Personal Area Networks (PAN)

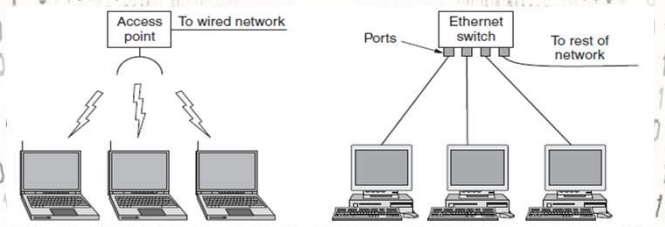
- communicate over the range of a person.
  A common example is a wireless network that connects a computer with its peripherals.
- Also, the master-slave Bluetooth Networks.



Network Hardware

b- Local Area Networks (LAN)

- **LAN is a privately owned network that operates within and nearby a single building.**
- **When LANs are used by companies, they are called enterprise networks.**
- **In Wireless LANs, every computer has a radio modem and an antenna that it uses to communicate with other computers. In most cases, each computer talks through the (Access Point), wireless router, or base station.**



Network Hardware

b- Local Area Networks (LAN)

- **There is a standard for wireless LANs called IEEE 802.11, popularly known as Wi-Fi.**
- **The topology of many wired LANs is built from point-to-point links. IEEE 802.3, popularly called Ethernet, is, by far, the most common type of wired LAN. The job of the switch is to relay packets between computers that are attached to it, using the address in each packet to determine which computer to send it to.**
- **Classical (original) Ethernet VS. Switched Ethernet.**
- **Static Allocation VS. Dynamic Allocation of Broadcast NWs.**

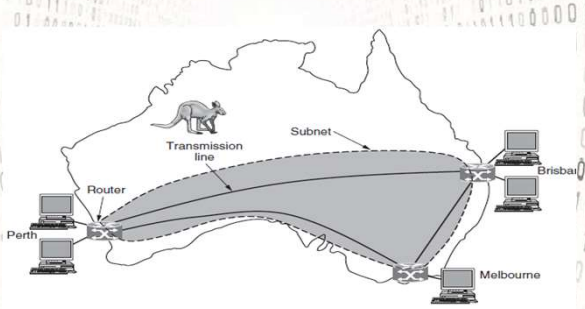
c- Metropolitan Area Networks (MAN)

- **It covers a city. The best-known examples of MANs are the cable television networks available in many cities.**

Network Hardware

d- Wide Area Networks (WAN)

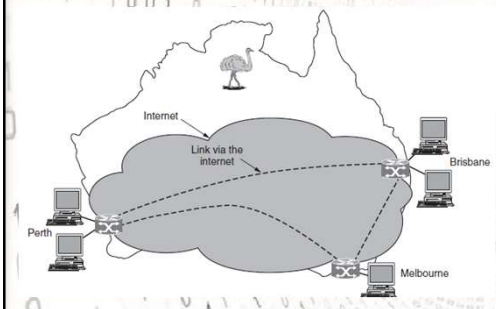
- It spans a large geographical area, often a country or continent.
- The WAN looks similar to a large wired LAN.
- In a WAN, the hosts and subnet are owned and operated by different people, where the term ‘‘subnet’’ is the collection of routers and communication lines that moved packets from the source host to the destination host.

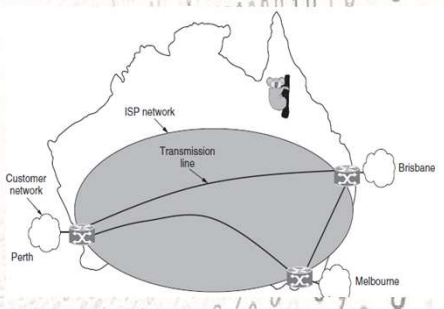


Network Hardware

d- Wide Area Networks (WAN)

- Routers in WAN will usually connect different kinds of networking technology. The networks inside the offices may be switched Ethernet, for example, while the long-distance transmission lines may be SONET links
- Dedicated WAN transmission (VPN) VS. ISP WAN transmission.





Network Software

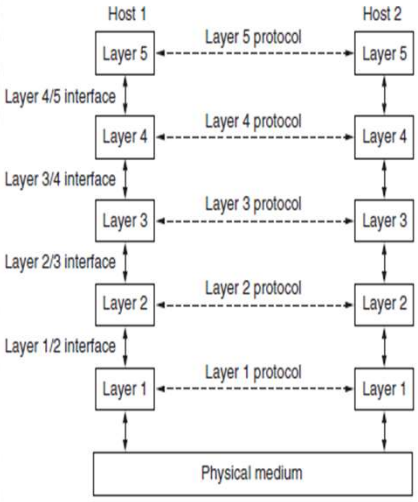
❖ Protocol hierarchies

- Networks are organized as a stack of **layers** or **levels**, each one built upon the one below it. The number of layers, the name of each layer, the contents of each layer, and the function of each layer differ from network to network.
- The purpose of each layer **is to offer certain services to the higher** layers while shielding those layers from the details of how the offered services are actually implemented.
- In a sense, each layer is a kind of virtual machine (black box), offering certain services to the layer above it.
- When **layer *n*** on one machine carries on a conversation with **layer *n*** on **another machine**, the rules and conventions used in this conversation are collectively known as the **layer *n* protocol**.
- Basically, a **protocol** is an agreement between the communicating parties on how communication is to proceed.

Network Software

❖ Protocol hierarchies

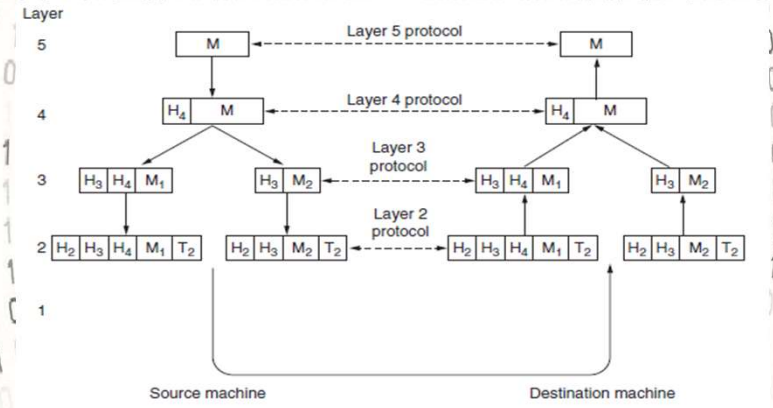
- For the five-layer network , the entities comprising the **corresponding layers on different machines are called peers**. The peers may be software processes, hardware devices, or even human beings.
- In other words, it is the peers that communicate by using the protocol to talk to each other.
- Each layer **passes** data and control information to the layer immediately **below it**.
- Between each pair of adjacent layers is an **interface.**



Network Software

❖ Protocol hierarchies

- A set of layers and protocols is called a **network architecture**.
- A list of the protocols used by a certain system, one protocol per layer, is called a **protocol stack**.



Network Software

❖ Design Issues for the Layers

- Some of the key design issues that occur in computer networks will come up in layer after layer, such as:

1. Reliability; by considering error detection, error correction, routing.
2. Scalable; by using addressing and naming.
3. Statistical Multiplexing; by considering resource allocation, flow control, Congestion control, quality of service, confidentiality, authentication, and integrity.

Network Software

❖ Connection-Oriented Versus Connectionless Service

Criteria	Connection-Oriented	Connection-Less
Connection	Prior connection needs to be established.	No prior connection is established.
Resource Allocation	Resources need to be allocated.	No prior allocation of resource is required.
Reliability	It ensures reliable transfer of data.	Reliability is not guaranteed as it is a best effort service.
Congestion	Congestion is not at all possible.	Congestion can occur likely.
Transfer mode	It can be implemented either using Circuit Switching or VCs.	It is implemented using Packet Switching.
Retransmission	It is possible to retransmit the lost data bits.	It is not possible.
Suitability	It is suitable for long and steady communication.	It is suitable for bursty transmissions.
Signaling	Connection is established through process of signaling.	There is no concept of signaling.
Packet travel	In this packets travel to their destination node in a sequential manner.	In this packets reach the destination in a random manner.
Delay	There is more delay in transfer of information, but once connection established faster delivery.	There is no delay due absence of connection establishment phase.

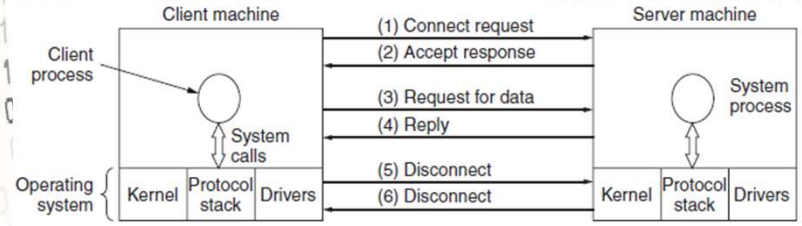
- Negotiation
- Packet
- Store-and-forward switching.
- Cut-through switching
- Acknowledgment
- Request-reply

Network Software

❖ Service Primitives

- A service is formally specified by a set of primitives (operations) available to user processes to access the service. These primitives tell the service to perform some action or report on an action taken by a peer entity.
- The primitives for connection-oriented service are different from those of connectionless service.

Primitive	Meaning
LISTEN	Block waiting for an incoming connection
CONNECT	Establish a connection with a waiting peer
ACCEPT	Accept an incoming connection from a peer
RECEIVE	Block waiting for an incoming message
SEND	Send a message to the peer
DISCONNECT	Terminate a connection



Network Software

❖ The Relationship of Services to Protocols

- A service is a set of primitives (operations) that a layer provides to the layer above it. The service defines what operations the layer is prepared to perform on behalf of its users, but it says nothing at all about **how** these operations are implemented.
- A protocol, is a set of rules governing the format of the messages that are exchanged by the peer entities within a layer. Entities use protocols to implement their service definitions.
- In contrast, protocols relate to the packets sent between peer entities on different machines.