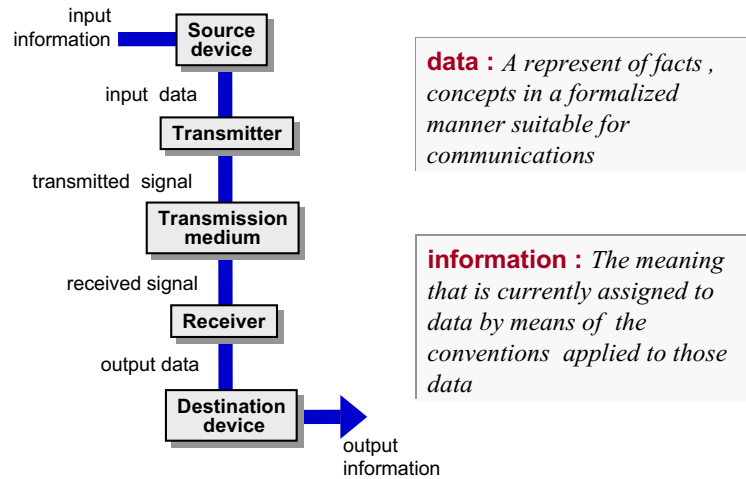


Data and Computer Communications

Surasak Sanguanpong
nguan@ku.ac.th
<http://www.cpe.ku.ac.th/~nguan>
Last updated: May 19, 1999

A Communications Model



Applied Network Research Group

Department of Computer Engineering, Kasetsart University

The fundamental purpose of data communications is to exchange information between two parties. The source device generate the data to be transmitted. The transmitter transform and encodes the input data into the appropriate form of signals that can be transmitted across the transmission medium. The receiver accepts the signal and converts it into a from that can be handled by the destination device.

Communication Tasks

- **Interfacing**
- **Signal generation**
- **Message formatting**

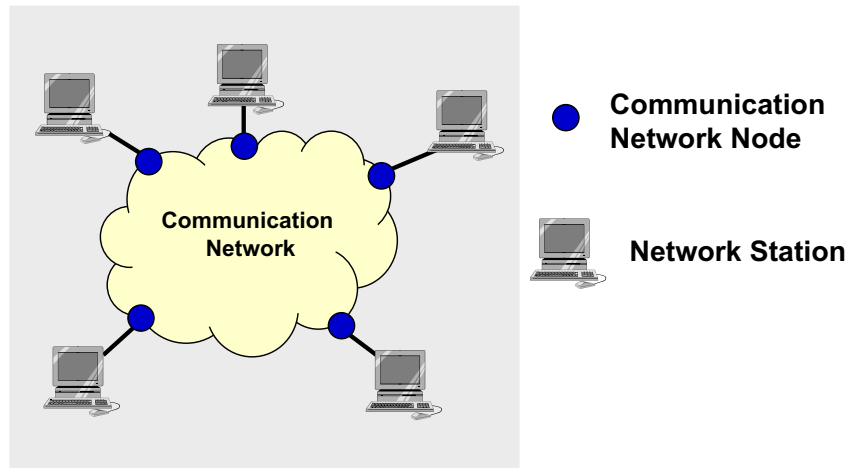
- **Addressing**
- **Flow control**
- **Routing**

- **Error detection**
- **Error correction**
- **Recovery**
- **Protection**

- **Transmission system utilization**
- **Exchange management**
- **System management**

Above lists are keys task that must be performed in a data communication system.

Data Communication Schematic



Applied Network Research Group

Department of Computer Engineering, Kasetsart University

Data communication takes place between two devices that are connected. It is impractical for any two devices to be directly, point-to-point connected because of :

- The devices are very far apart.
- Some device may require a link to many of the others.

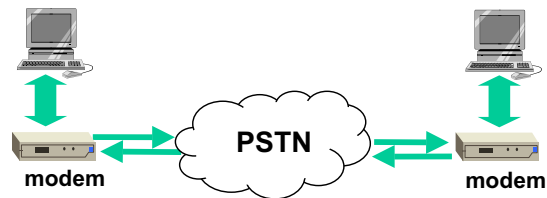
The solution is to attach each device to a network. The devices are known as *stations or network stations*. The stations may be computer or other communicating devices. Each station attaches to a *network node*, which performs communication tasks.

Data Communication Networks

- **Public Switched Telephone Network (PSTN)**
- **Local Area Network (LAN)**
- **Leased lines**
- **Public Switched Data Network (PSDN)**
- **Integrated Services Digital Network (ISDN)**

The type of data communication facility used is a function of the nature of the application, the number of computers involved, and their physical interface.

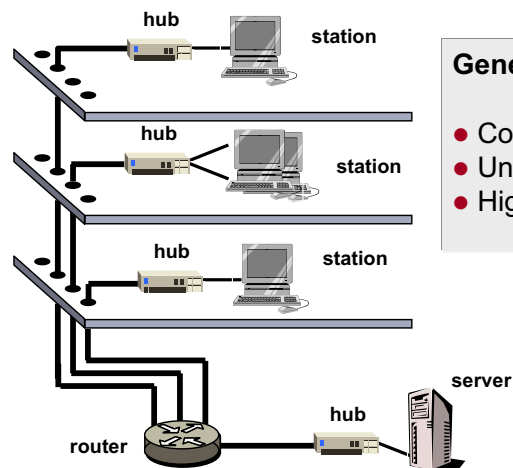
PSTN



- Distanced stations are connected via public carrier, normally telephone network.
- Modem is required to convert digital data to analog before transmitting to telephone line.
- The destination modem converts analog signal back to digital again.

Public carrier or *Public Switch Telephone Network* (PSTN) is normally used to connect distanced stations. This requires a device known as a *modem* (Modulator-Demodulator) to convert digital data to analog before transmitting to telephone line. The destination modem converts analog signal back to digital again.

LAN



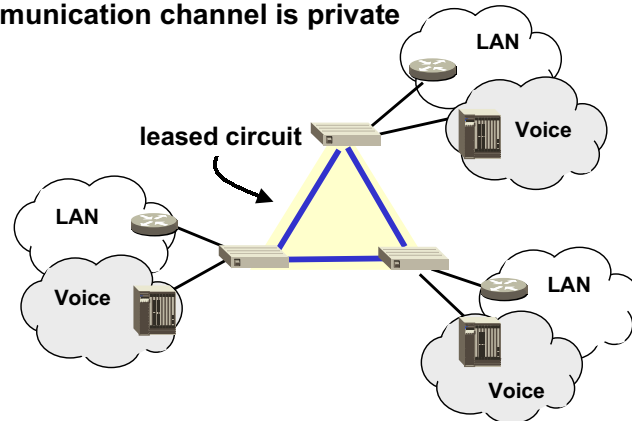
General Characteristics :

- Confined geographical area
- Under single management
- High data rate

Communications network that serves users within a confined area is known as a *Local Area Network* (LAN). Computers (server and workstations) are normally distributed around a single office or building, including network device like hub, bridge or router.

Leased Lines

- Lease public circuits to connect different sites
- Communication channel is private



Applied Network Research Group

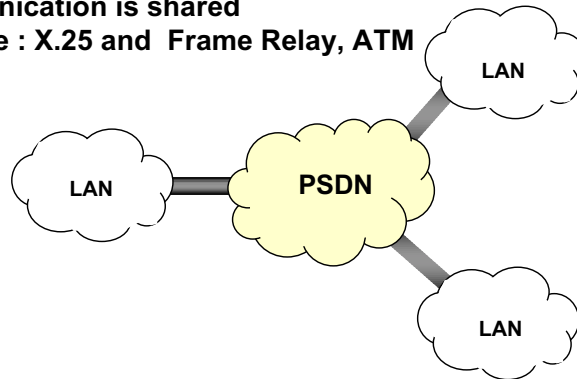
Department of Computer Engineering, Kasetsart University

Public carrier circuit have been normally used for connected computers in different sites,. The resulting network is known as a *Wide Area Network* (WAN). One approach is to lease transmission lines from the public carriers and install a private switching system at each site to create an *Enterprise Wide Private Network*. Such networks normally incorporate both voice and data communications.

The benefits are such as communication channel is private and online, several data transmission rate is provided from low speed to high speed.

PSDN

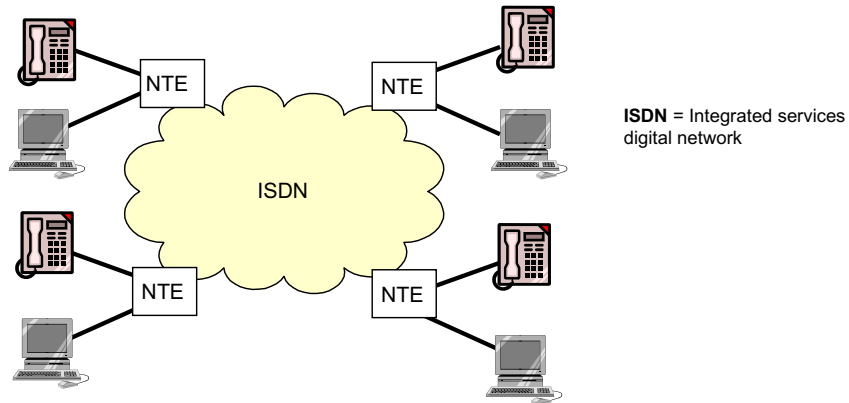
- PSDN is designed specifically for the transmission of data rather than voice
- Communication is shared
- Example : X.25 and Frame Relay, ATM



Telephone companies normally provide a public data service. Such networks is known as *Public Switch Data Network* (PSDN), like the PSTN, are now interconnected internationally and have been designed specifically for the transmission of data rather than voice. A network is public in the sense that many company share a switching network. A cost of this service is normally lower than a leased line.

ISDN

Using ISDN to carry both voice and data



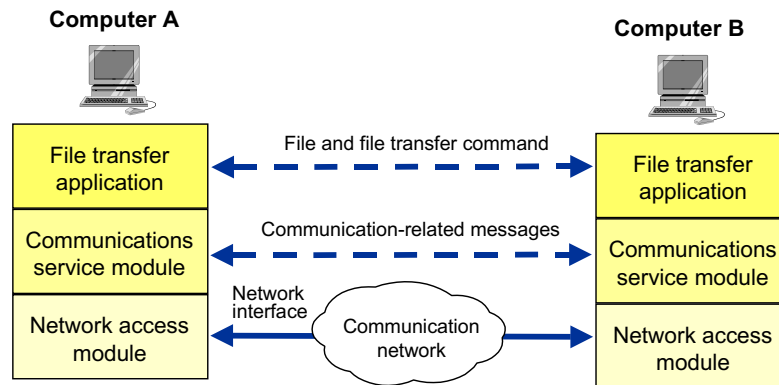
Applied Network Research Group

Department of Computer Engineering, Kasetsart University

Integrated Serviced Digital Networks (ISDN) is designed for transmitting voice, video and data over a digital line. ISDN services come in two forms :

- (1) BRI (Basic rate Interface) provides two 64Kbps channel plus a 16Kbps control channel (144 Kbps).
- (2) PRI (Primary rate Interface) provides twenty three (in North America) 64 Kbps channel and one 64 Kbps control channel (1.544 Mbps)

Computer Communication Architectures



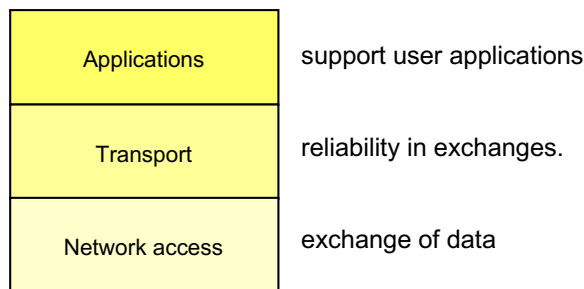
Applied Network Research Group

Department of Computer Engineering, Kasetsart University

Instead of a single module for performing communications, there is a structured set of modules that implements the communication function. That structure is referred to as a communications architecture.

Three-layers Model

- **Three-layers model involves three agents: applications, computers, and networks.**
- **Communication task can be organized into three relatively independent layers**



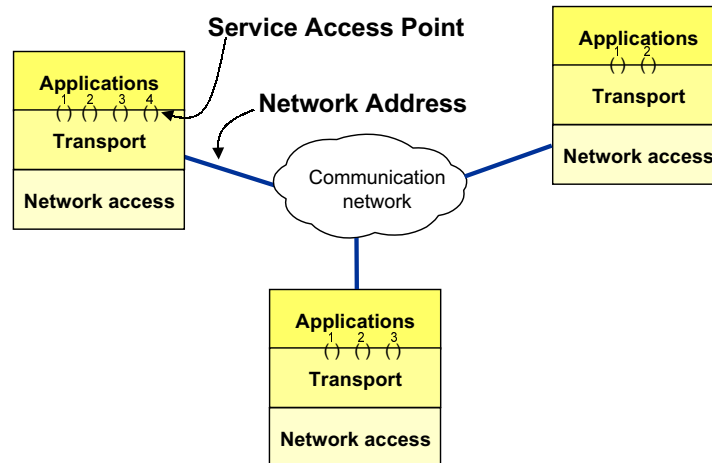
Communications can be said to involved three agents: applications, computers, and networks. Communication task can be organized into three relatively independent layers :

Network access : concern with the exchange of data between a computer and the attached network.

Transport : assured that the data arrive at the destination applications and in the same order. Also take care of reliability in exchanges.

Applications : support user applications.

Protocol Architectures and Networks

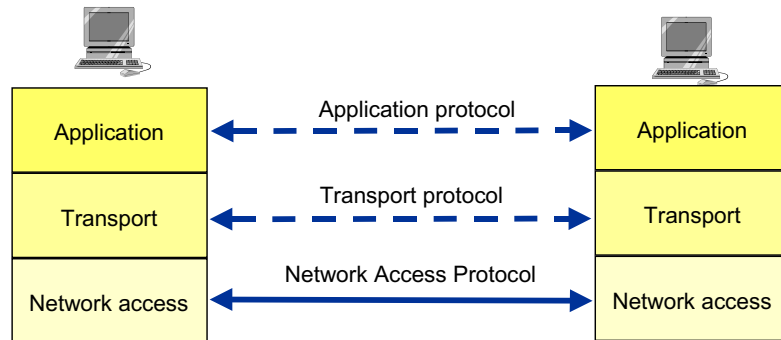


Applied Network Research Group

Department of Computer Engineering, Kasetsart University

Each computer on the network must have unique *network address* in order to deliver data to the proper destination. Each application must also have an software address that is unique within that computer to allow the transport layer to deliver data to the proper application. The latter addresses are known as *service access point* (SAP).

Protocol Layers



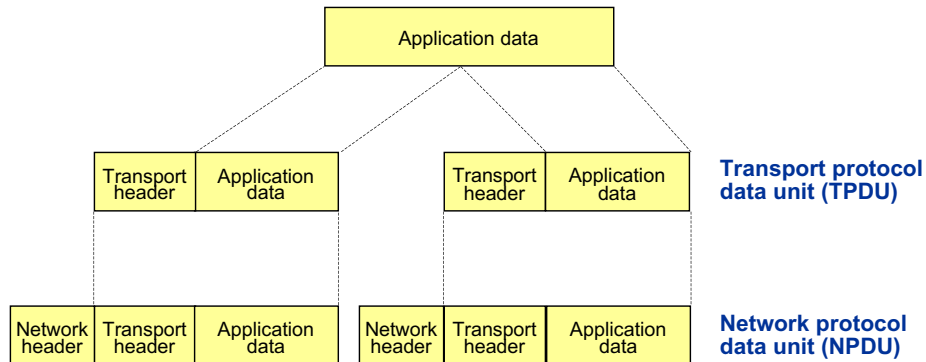
Applied Network Research Group

Department of Computer Engineering, Kasetsart University

Each layers has its own set of rules governing the way in which two entities cooperate to exchange data, called *protocol*.

A protocol specification details the control functions that may be performed, the format and control codes used to communicate those functions, and the procedures that two entities must follow.

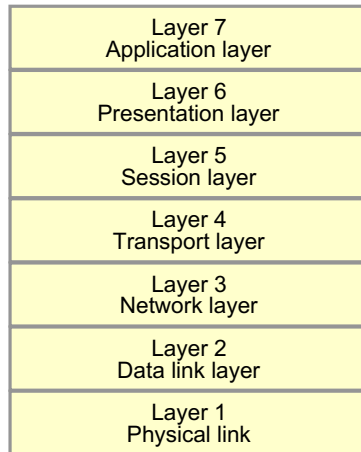
Protocol Data Unit



control info + data in each layer = protocol data unit (PDU)

To control communication operation, control information, as well as user data, must be transmitted. The sending application generates a block of data and passes this to the transport layer. The transport layer may break this block into smaller pieces to make it more manageable. To each of these pieces, the transport layer add a transport header to the front. The overall data (control + data) is then passed to the network access layer as the same manner.

OSI Reference Model



- **The Open Systems Interconnection (OSI) model was developed by the ISO as**
 - a model for computer communications architecture
 - a framework for developing protocols standards
- **OSI model consists of seven layers**

The OSI Layers

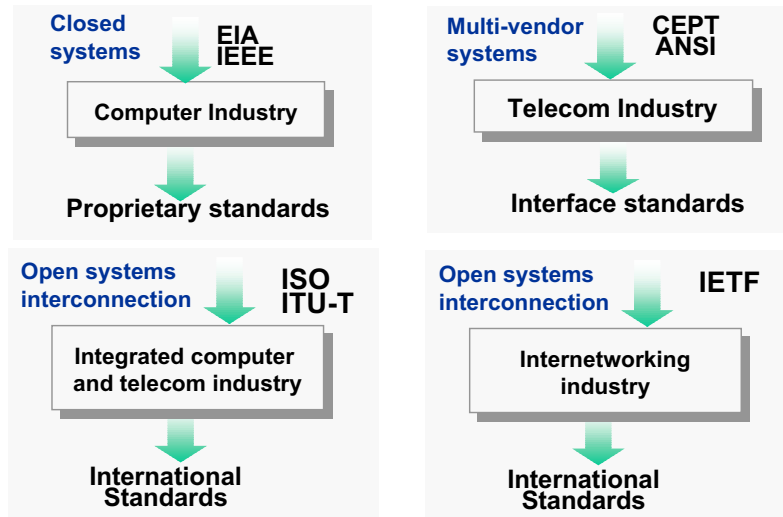
- 1. Physical** : Concerned with transmission raw bit stream over physical medium; deals with the mechanical, electrical, functional, and procedural interfaces, and the physical medium.
- 2. Data link** : Responsible for node to node validity and integrity of the transmissions; send block of data (frames) with the synchronization.
- 3. Network** : Provides upper layers with independence from the data transmission and switching technologies used to connect systems; establishes the route between the sender and receiver.
- 4. Transport** : Provides end-to-end error recovery and flow control.
- 5. Session** : Provides the coordination for communication between applications; establishes, manages, and terminates connections between cooperating applications.
- 6. Presentation** : Manages the way data is represented to the application processes from difference in data representation.
- 7. Application** : Defines the rules for gaining entrance into the communication system.

OSI and TCP/IP

OSI		TCP/IP
Application		Application
Presentation		
Session		
Transport		Transport
Network		Internet
Data Link		Network Access
Physical		Physical

TCP/IP protocol suite has served as the basis for the development of inter-operable communications standards. Nowadays, TCP/IP is the most widely used interoperable architecture, and the OSI is the “reference” standard model for classifying communications functions.

Standards Organizations



Applied Network Research Group

Department of Computer Engineering, Kasetsart University

Various organizations have been involved in the development or promotion of data and computer communications standards.