LAYERING IN NETWORK DESIGN :- 31.01.06[1]

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Network Architecture Design

- Layered Architecture
  - design a network as layers, each of which provides some well-defined functionality implemented by hardware,software or combination of the two.
- Each layer implements groups of related functions.
- Each layer uses the services of the next lower layer,and provides services to the next higher layer.
- Interface of a layer- definition information and services provided by a layer to the next higher layer
- Specific implementation of a layer can be changed as long as the interface remains the same

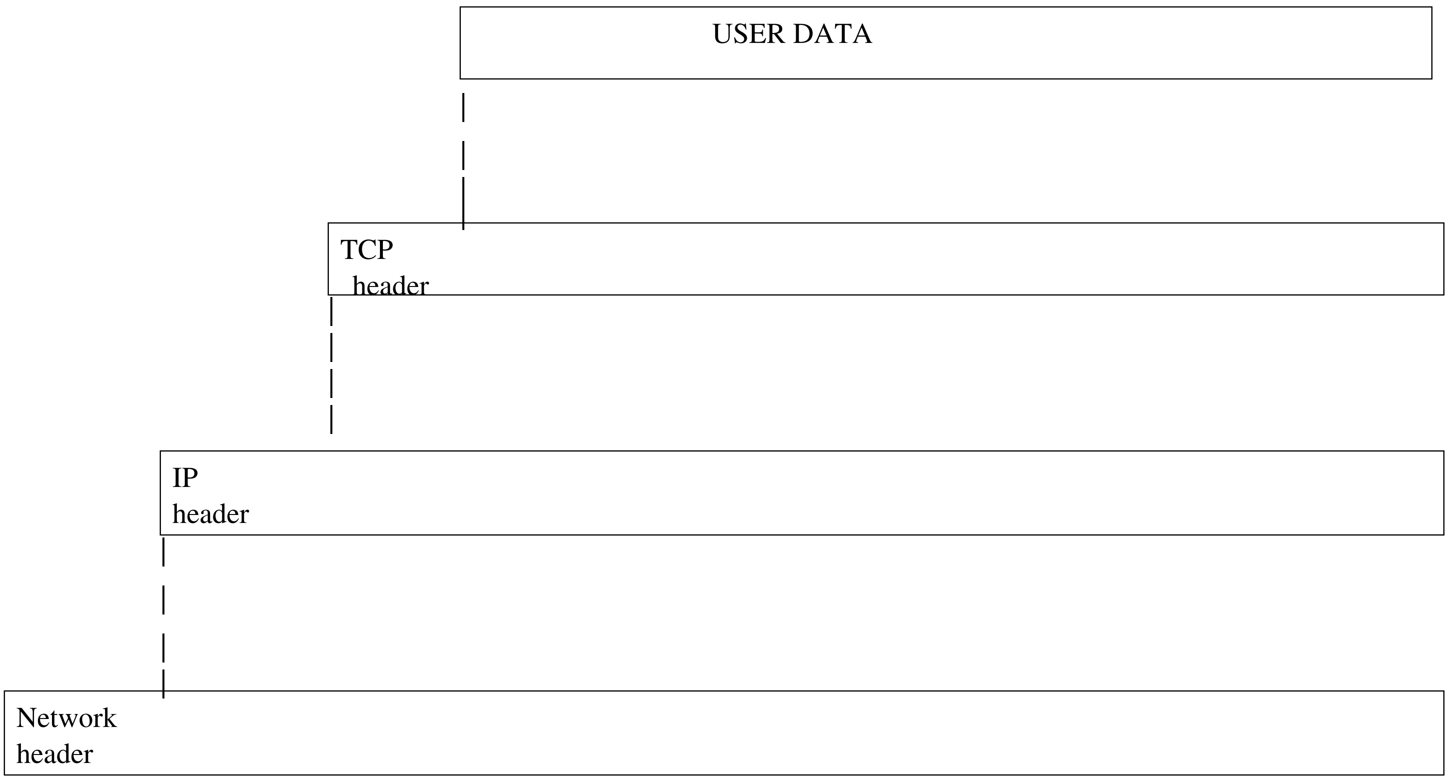
Example- ISO-OSI Model

- Seven Layers
- Physical Layer- handles actual transmission of signals over media. Specifies mechanical and electrical details.
- Data Link Layer- reliable(error-free),node-to-node delivery of bits.
- Network Layer- Source to destination delivery of a packet(a group of bits)possibly across multiple links-Routin; no reliability
- Transport Layer- end-to-end reliable delivery of entire message(not just packets)
- Session,Presentation,Application Layers

TCP/IP Suite

- Suite of protocols
- Five layers
  - Physical.Data Link, Network, Transport and Application
- Some layer may contain multiple protocols.Higher layer can use any of these protocols.
- Main protocols- TCP and UDP at the Transport Layer and IP at the Network Layer
- Other Protocols- ICMP,TELNET,Ftp,SNMP etc.

Encapsulation Example - TCP/IP



Number of Layers?

- Each layer takes data from higher layer,possibly breaks it up into smaller chunks, and adds its own header to each chunk

- More the no. of layers,more headers are added as the data goes downwards, more wastage.
- Too few layers - defeats the purpose of layering (isolating functionalityes in layers)itself

CURCUIT and PACKET SWITCHING

Switched Networks

- All machines in a network may not be directly connected to each other due to
  - large number
  - geographically far apart
- Long distance transmission done bye a network of switched nodes
- Ex. - Wide Area Networks(WAN)-network of machines spread over a large geographical area
- End devices or stations - devices that actually wants to communicate(ex.a PC,phone)
- Communication network - collection of nodes and connections
- Stations communicate using the communication network
- Data is switched from node to node until it reaches destination station
- Nodes not concerned with content of data
- Used to connect geographically distributed machines and networks into a single cohesive network.
- Two key switching techniques
  - Circuit Switching
  - Packet Switching

Circuit Switching

- Dedicated communication path between two stations
- Three phases
  - Establish - signaling to set up path
  - Transfer - transfer data, connection maintained
  - Disconnect - signalling to tear down connection
- Must have switching capacity and channel capacity to establish connection
- Needs to chose a path - routing
- Example - Public Telephone Network vspace1mm

- Advantages
  - once connected,transfer is fast(no routing needed after connection)
- Disadvantages
  - Inefficient : Channel capacity dedicated for duration of connection and If no data to be transmitted, capacity wasted.
  - Set up(connection) takes time
  - Fixed data rate - both ends must operate at same speed

Packet Switching

- Data are transmitted in short messages called packets(maximum packet size is defined)
- A dedicated connection between the two end nodes is not maintained
- Longer messaged broken up into smaller packets
- Each packet = data + control info (header)
  - control info usually conhtains routing info and other things
- Intermediate nodes buffer and then forward packets(store and forward)
- A nod-to-node link can be dynamically shared by namy packets

- DATAGRAM APPROACH
  - Each packet treated independently
  - Packets may follow different paths to the destination
  - May arrive out-of-order or get lost
  - Intermediate nodes need to decide where to forward packets(routing)
  - Up to receiver to re-order packets and recover missing packets

- VIRTUAL CIRCUIT APPROACH
  - Preplanned route established before any packets sent
  - Call request and call accept packets establish connection(handshaking)
  - Each packet contains a virtual circuit identifier instead of destination address
  - No routing decisions required for individual packets
  - Clear request packet is used to drop circuit
  - Not a dedicated path(unlike circuit switching, the links in a path may be shared between different virtual cicuits)

Virtual Circuits vs.Datagrams

- Virtual Circuits
  - Network can provide sequencing and error control
  - Packets are forwarded more quickly
    - No routing decisions to make
  - Less Reliable
    - Loss of a node loses all circuits through that node
- Datagram
  - No call setup phase : better if few packets
  - More flexible and reliable : Routing can be used to avoid congested parts of the network, loss of single node does not drop all packets

Advantages of Packet Switching

- Line Efficiency
  - single node to node link can be shared by many packets over time
  - Packets queued and transmitted as fast as possible
- Data rate conversion
  - Each station connects to the local node at its own speed
  - Nodes buffer data if required to equalize rates
- Packets are accepted evern when network is busy but delivery may slow down
- Priorities can be used