Telemedicine

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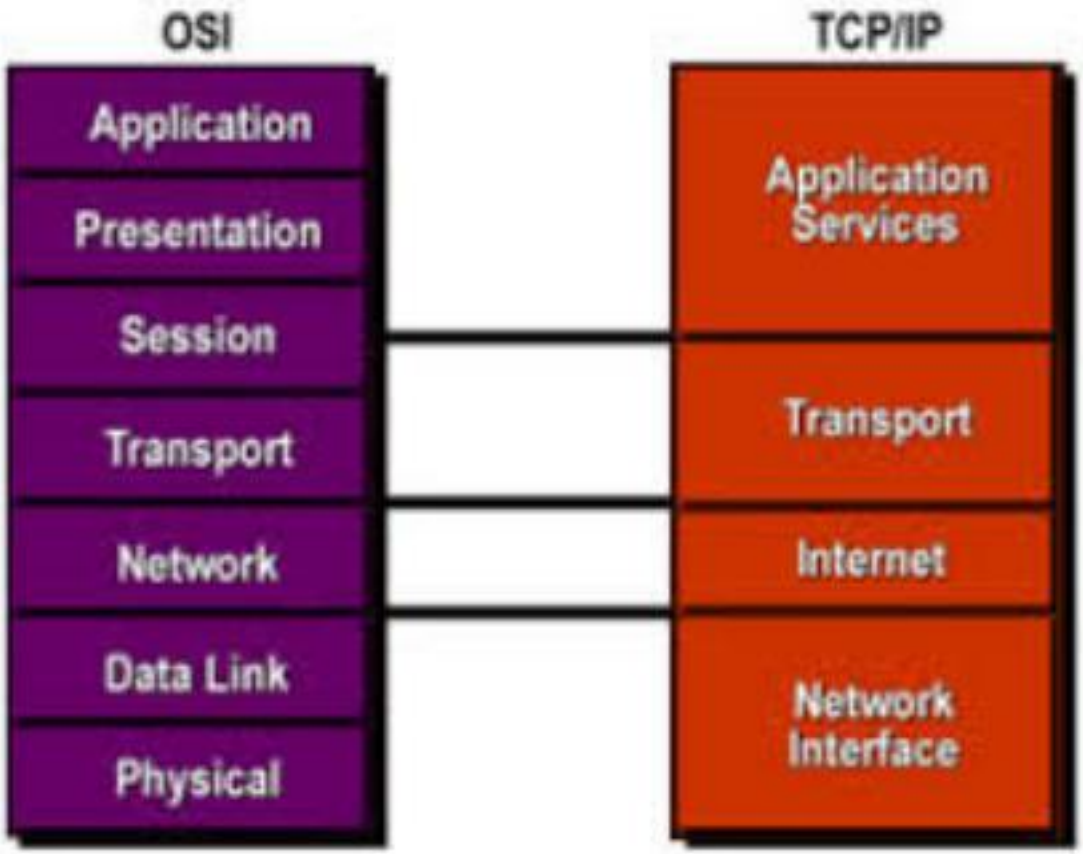
Class 16

Open Systems Interconnection model (OSI model)

- characterizes and standardizes the internal functions of a communication system by partitioning it into abstraction layers
- seven logical layers
- **A layer serves the layer above it and is served by the layer below it.**

OSI Model				
Layer		Data unit	Function[3]	Examples
Host layers	7. Application	Data	High-level APIs, including resource sharing, remote file access, directory services and virtual terminals	HTTP, FTP, SMTP
	6. Presentation		Translation of data between a networking service and an application; including character encoding, data compression and encryption/decryption	ASCII, EBCDIC, JPEG
	5. Session		Managing communication sessions, i.e. continuous exchange of information in the form of multiple back-and-forth transmissions between two nodes	RPC, PAP
	4. Transport	Segments	Reliable transmission of data segments between points on a network, including segmentation, acknowledgement and multiplexing	TCP, UDP, L2TP
Media layers	3. Network	Packet/Datagram	Structuring and managing a multi-node network, including addressing, routing and traffic control	IPv4, IPv6, IPsec, AppleTalk
	2. Data link	Bit/Frame	Reliable transmission of data frames between two nodes connected by a physical layer	PPP, IEEE 802.2
	1. Physical	Bit	Transmission and reception of raw bit streams over a physical medium	DSL, USB

OSI Model


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

Link Layer

- lowest layer in the Internet Protocol Suite
- commonly known as TCP/IP
- group of methods and communications protocols that only operate on the link that a host is physically connected to
- link is the physical and logical network component used to interconnect hosts or nodes in the network
- **link protocol** is a suite of methods and standards that operate only between adjacent network nodes of LAN and WAN
- combination of the data link layer and the physical layer in the Open Systems Interconnection(OSI) protocol stack

Internet layer

- group of internetworking methods, protocols, and specifications in the Internet protocol suite that are used to transport datagrams (packets) from the originating host across network boundaries
- connecting multiple networks with each other through gateways
- use IP-based packets
- Purpose:
  - For outgoing packets, select the next-hop host (gateway) and transmit the packet to this host by passing it to the appropriate link layer implementation;
  - For incoming packets, capture packets and pass the packet payload up to the appropriate transport layer protocol, if appropriate.
  - Provide error detection and diagnostic capability.
  - It is implemented in two versions, IPv4 and IPv6

Transport Layer

- provides end-to-end or host-to-host communication services for applications within a layered architecture of network components and protocols
- The transport layer provides services such as connection-oriented data stream support, reliability, flow control, and multiplexing.
- Transport layer services are conveyed to an application via a programming interface to the transport layer protocols
  - Multiplexing
  - Congestion avoidance

Application Layer

- abstraction layer that specifies the shared protocols and interface methods used by hosts in a communications network.
- standardizes communication and depends upon the underlying transport layer protocols to establish host-to-host data transfer channels

Packet switching vs Circuit switching

- Packet switching features delivery of variable bit rate data streams (sequences of packets) over a computer network which allocates transmission resources as needed using statistical multiplexing or dynamic bandwidth allocation techniques

- Packet switching contrasts with another principal networking paradigm, circuit switching, a method which sets up a limited number of dedicated connections of constant bit rate and constant delay between nodes for exclusive use during the communication session.

	Circuit Switching	Packet Switching
Dedicated "copper" path	Yes	No
Bandwidth available	Fixed	Dynamic
Potentially wasted bandwidth	Yes	No
Store-and-forward-transmission	No	Yes
Each packet follows the same route	Yes	No
Call setup	Required	Not required
When can congestion occur	At setup time	On every packet
Charging	Per minute	Per packet

Integrated Services Digital Network (ISDN)

- Set of communication standards for simultaneous digital transmission of voice, video, data, and other network services over the traditional circuits of the PSTN
- First defined in 1988
- Key feature: integrates speech and data on the same lines

- Several kinds of access interfaces to ISDN
  - Basic Rate Interface (BRI):
    - intended primarily for use in subscriber lines similar to those that have long been used for POTS
    - 2 bearer channels (B channels (primary data or voice communication is carried)) at 64 kbit/s each and 1 data channel (D channel (control **and** signalling information is carried)) at 16 kbit/s.
  - Primary Rate Interface (PRI),
    - 30 'B' channels of 64 kbit/s, one 'D' channel of 64 kbit/s and a timing and alarm channel of 64 kbit/s

Access through both circuit switch and packet switch N/W

- allow digital transmission of voice and data over ordinary telephone copper wires, resulting in potentially better voice quality
- circuit-switched connections (for either voice or data), and packet-switched connections (for data), in increments of 64 kilobit/s
- major market application for ISDN Internet access, where ISDN typically provides a maximum of 128 kbit/s in both upstream and downstream directions

- ISDN can be considered a suite of digital services existing on layers 1, 2, and 3 of the OSI model.
- In a videoconference, ISDN provides simultaneous voice, video, and text transmission between individual desktop videoconferencing systems and group (room) videoconferencing systems.

- Integrated services refers to ISDN's ability to deliver at minimum two simultaneous connections, in any combination of data, voice, video, and fax, over a single line.
- In ISDN, there are two types of channels, *B* (for "bearer") and *D* (for "data"). *B channels* are used for data (which may include voice), and *D channels* are intended for signaling and control (but can also be used for data).

- There are two ISDN implementations.
- Basic Rate Interface (BRI), also called basic rate access (BRA) — consists of two B channels, each with bandwidth of 64 kbit/s, and one D channel with a bandwidth of 16 kbit/s. Together these three channels can be designated as 2B+D.
- Primary Rate Interface (PRI)— contains a greater number of B channels and a D channel with a bandwidth of 64 kbit/s. The number of B channels for PRI varies according to the nation
- Broadband Integrated Services Digital Network (BISDN) is another ISDN implementation and it is able to manage different types of services at the same time. It is able to support transmission rates of 1.5 Mbps. B-ISDN requires fibre optic cables and is not widely available.

Asynchronous Transfer Mode (ATM)

- "a telecommunications concept defined by ANSI(American National Standards Institute) and ITU (International Telecommunication Union) **standards for carriage of a complete range of user traffic, including voice, data, and video signals**"

- It was designed for a network that must handle both traditional high-throughput data traffic (e.g., file transfers), and real-time, **low-latency (time delay between the cause and the effect of some physical change in the system being observed)** content such as voice and video

- The reference model for ATM approximately maps to the three lowest layers of the ISO-OSI reference model: network layer, data link layer, and physical layer.

- ATM is a core protocol of the public switched telephone network (PSTN) and Integrated Services Digital Network (ISDN)

- encodes data into small, fixed-sized packets (ISO-OSI frames) called cells.

- ATM uses asynchronous time-division multiplexing
  - method of transmitting and receiving independent signals over a common signal path by means of synchronized switches at each end of the transmission line so that each signal appears on the line only a fraction of time in an alternating pattern.

- ATM eventually became dominated by Internet Protocol (IP)

- ATM uses a connection-oriented model in which a virtual circuit must be established between two endpoints before the actual data exchange begins. These virtual circuits may be “permanent”, i.e. dedicated connections that are usually preconfigured by the service provider, or “switched”, i.e. set up on a per-call basis using signalling and disconnected when the call is terminated.