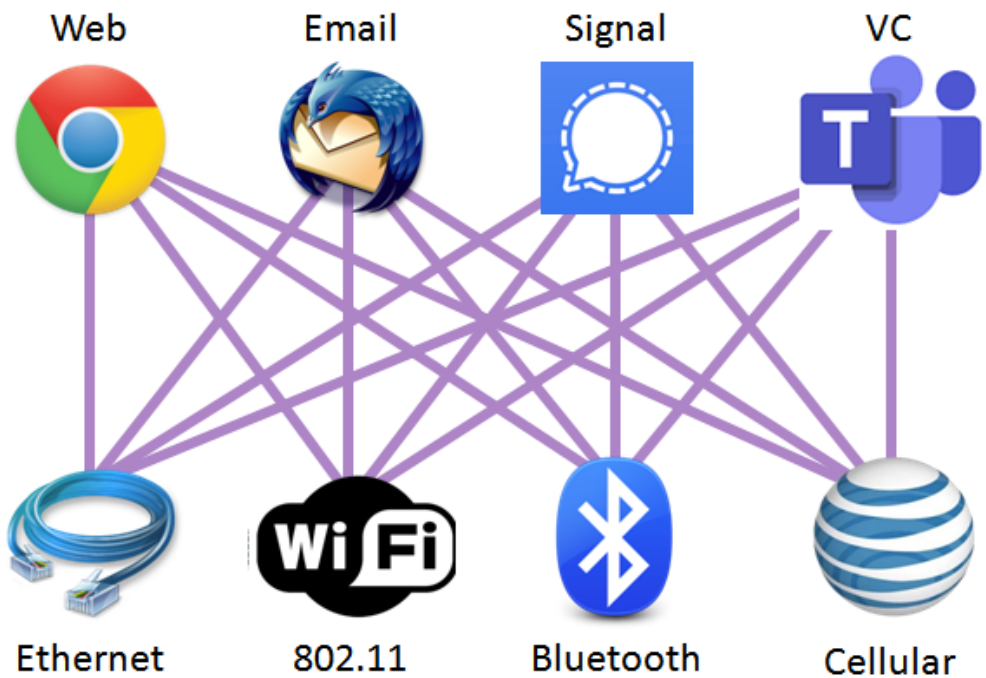
22AIE204 Introduction to Computer Networks

OSI Model

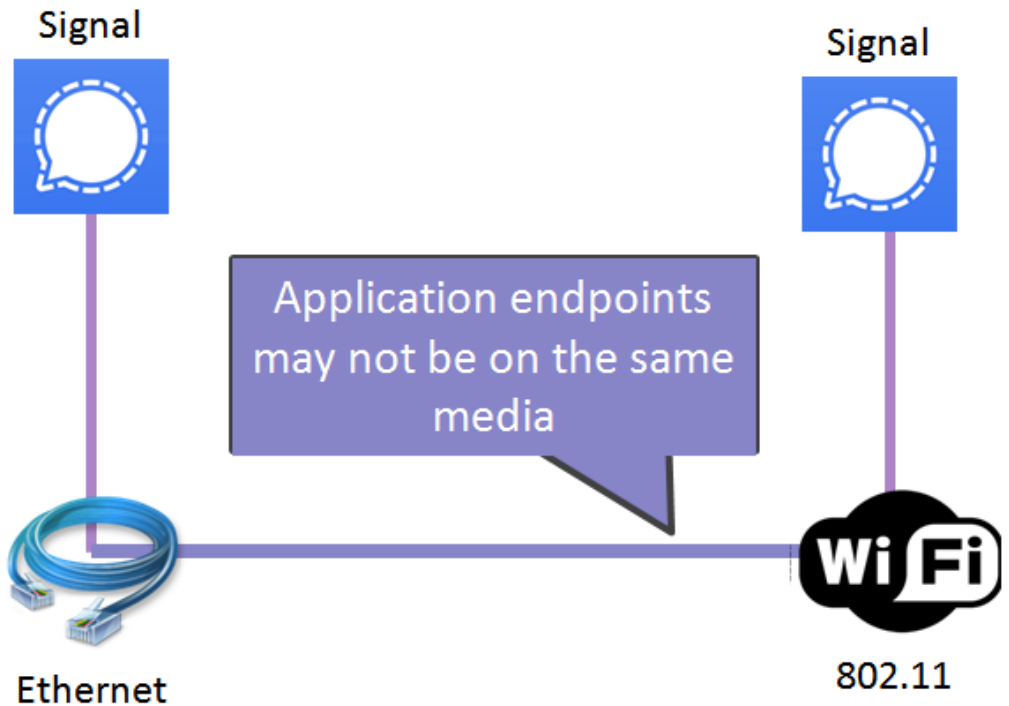
Challenges in organizing the network functions

- Applications should run on devices irrespective of the mode of access such as Ethernet cables, WiFi, cellular networks,etc



Challenges in organizing the network functions

- Applications should be accessible on devices irrespective of the mode of access such as Ethernet cables, WiFi, cellular networks,etc
- same application can be connected over wired to wireless medium



Challenges in organizing the network functions

- Applications should run on devices irrespective of the mode of access such as Ethernet cables, WiFi, cellular networks,etc
- Same application can be connected over wired to wireless medium
- Ensure reliable data transfer
- Scale the network

Open Systems Interconnection (OSI) Model

- It is a reference model for any two systems in the network to communicate with each other
  - facilitates the data transfer between application programs through the network
  - In 1984, it was approved as an international standard for communications architecture.
- The challenges in data transfer between end devices over a network is organized into smaller and more manageable functions.
  - layers in the model.

OSI Model

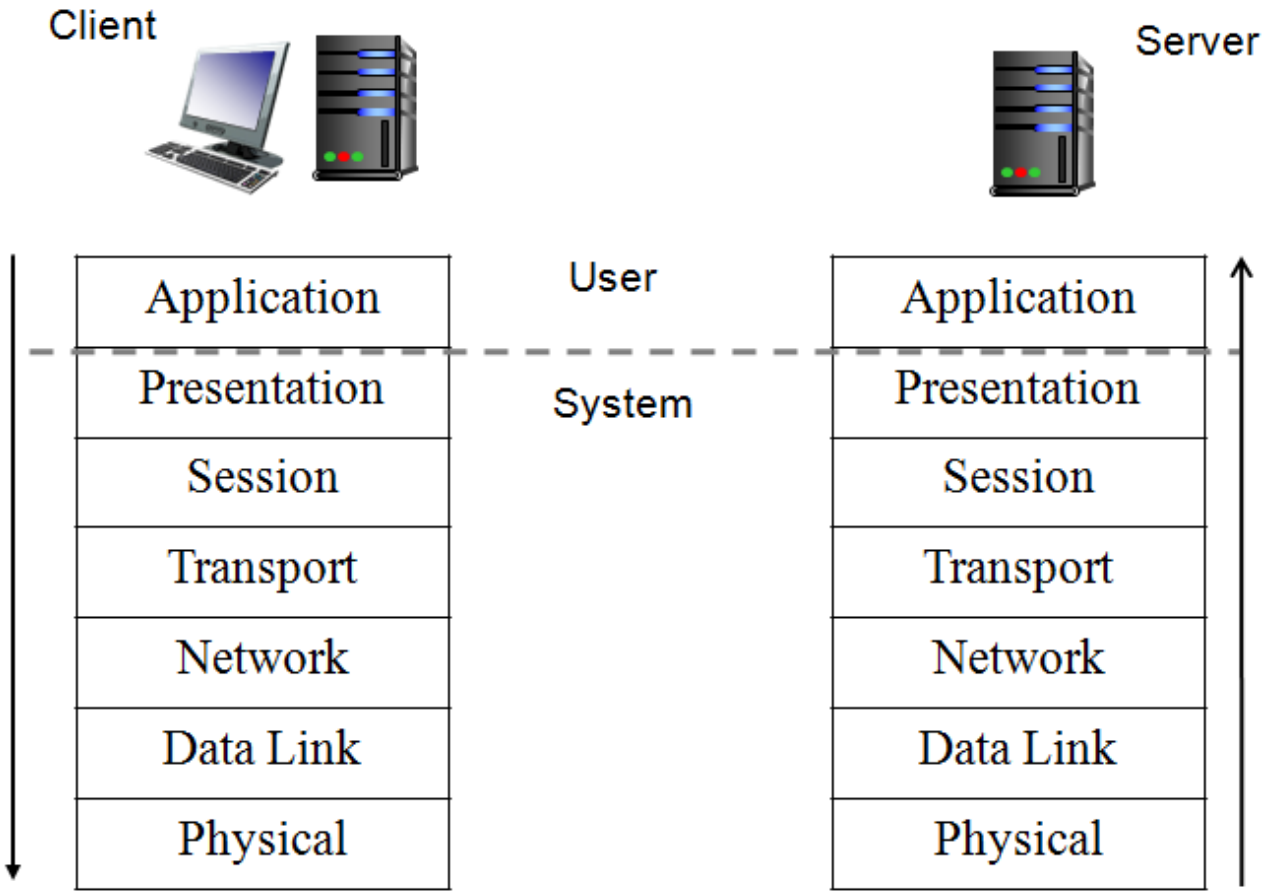


Figure: Client to server communication based on OSI model

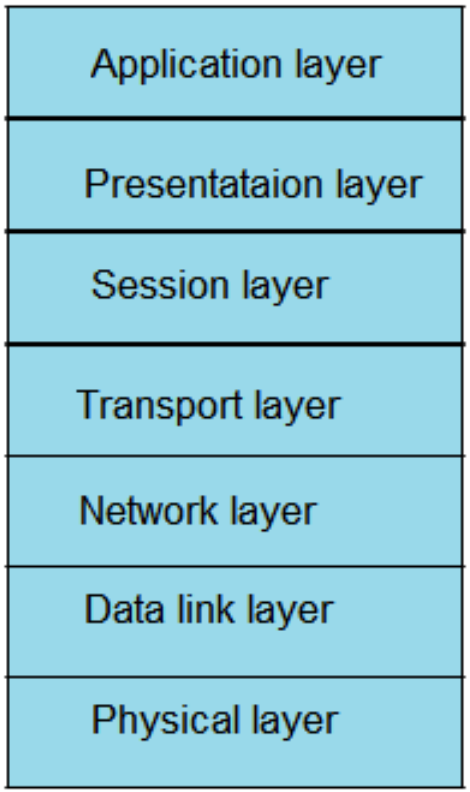
OSI Model

- The process of breaking up the functions or tasks of networking into layers reduces complexity.
- Each layer provides a service to the layer above it in the protocol specification.
- Each layer communicates with the same layer's software or hardware on other computers.
- The lower 4 layers (transport, network, data link and physical Layers) are concerned with the flow of data from end to end through the network.
- The upper four layers of the OSI model (application, presentation and session) are orientated more toward services to the applications.

Layer Features

- Service to the layer above
  - What does this layer do?
- Interface
  - data and network information being passed down to layer below at the sender or passed up to the layer above at the receiver
  - How do you access this layer?
- Protocol
  - How is this layer implemented?
  - a set of rules used to exchange information in the given layer

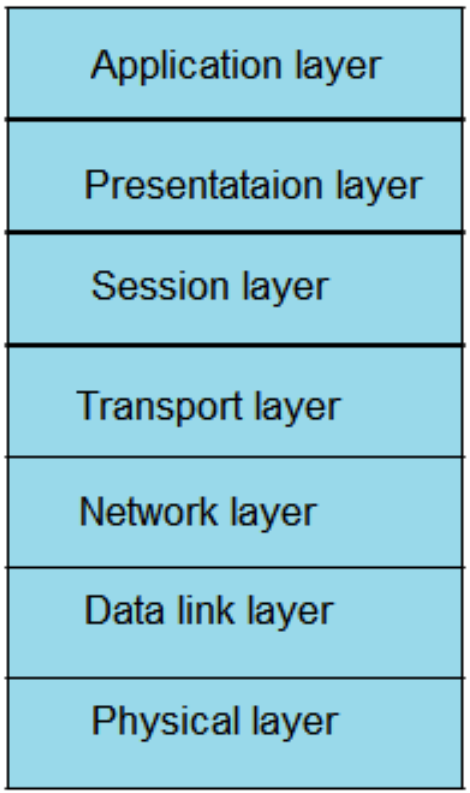
Physical Layer



- Service
  - Move information between two systems connected by a physical link
- Specifies how to send one bit
  - Encoding scheme for one bit
  - Voltage levels
  - Timing of signals
- Examples: coaxial cable, fiber optics, radio frequency transmitters

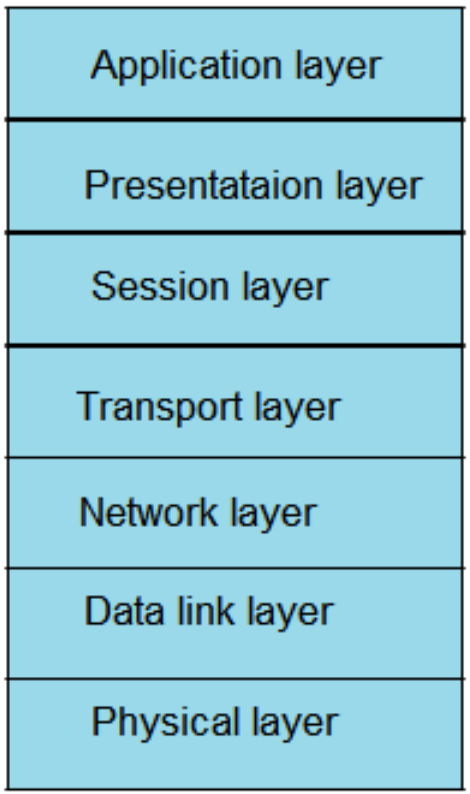
Data Link Layer

Data link layer attempts to provide reliable communication over the physical layer interface.



- Service
  - Data framing: boundaries between packets
  - Media access control (MAC)
  - Per-hop reliability and flow-control
- Send one packet between two hosts connected to the same media
  - Physical addressing (e.g. MAC address)
- Examples: Ethernet, Wifi, DOCSIS

Network Layer

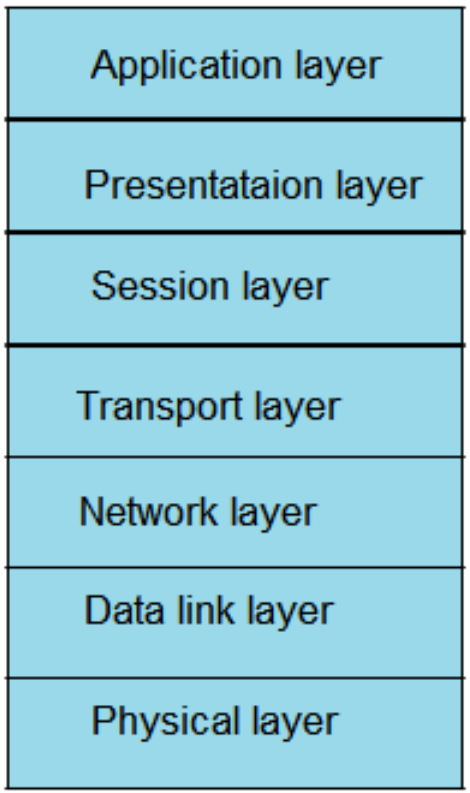


- Service
  - Deliver packets across the network through best path
  - Handle fragmentation/reassembly
  - Packet scheduling
- Send one packet to a specific destination
  - globally unique IP addresses
  - maintain routing tables
- Example: Internet Protocol (IP): IPv4, IPv6

* routing tables - the best path from one router to others routers are computed and tabulated

Transport Layer

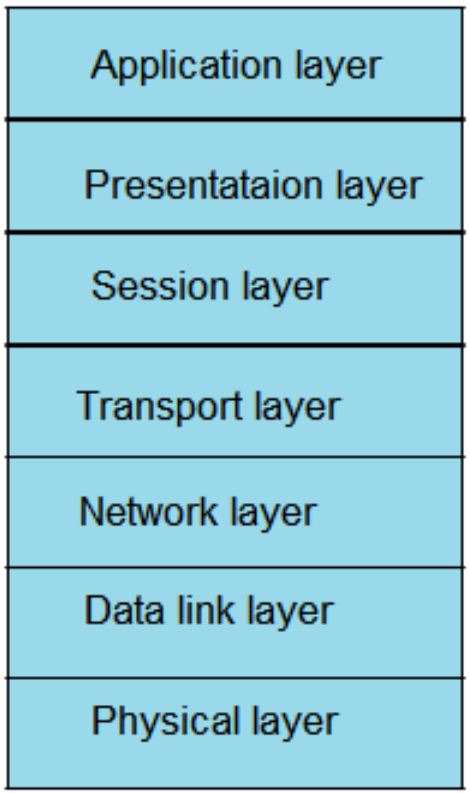
It provides a reliable mechanism for the exchange of data between two processes in different end devices.



- Service
  - Multiplexing/demultiplexing
  - Congestion control
  - Reliable, in-order delivery
  - connection less/connection oriented service
- Send message to a destination
  - Port numbers
  - Reliability/error correction
  - Flow-control information
- Examples: UDP, TCP

Session Layer

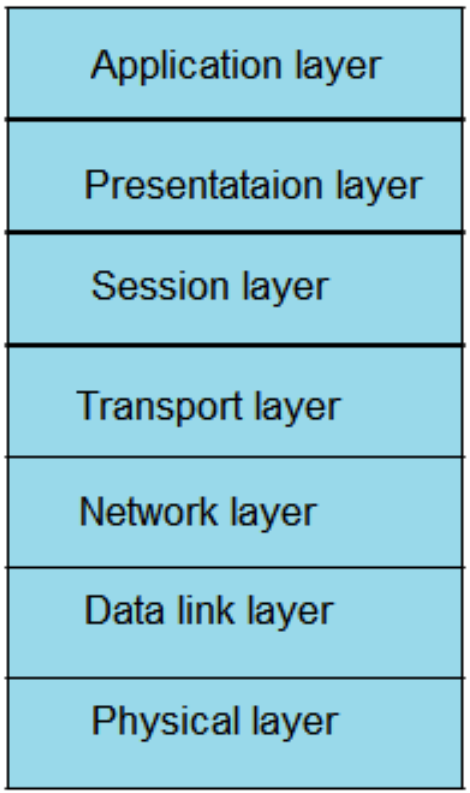
It defines how to start, control and end conversations (called sessions) between applications.



- Service
  - Access management
  - Synchronize the end devices
  - log-in or password validation
- Checkpoints
  - if there is a session break, the data transfer is resumed based on the checkpoints

Presentation Layer

It defines the format in which the data is to be exchanged between the two communicating end devices

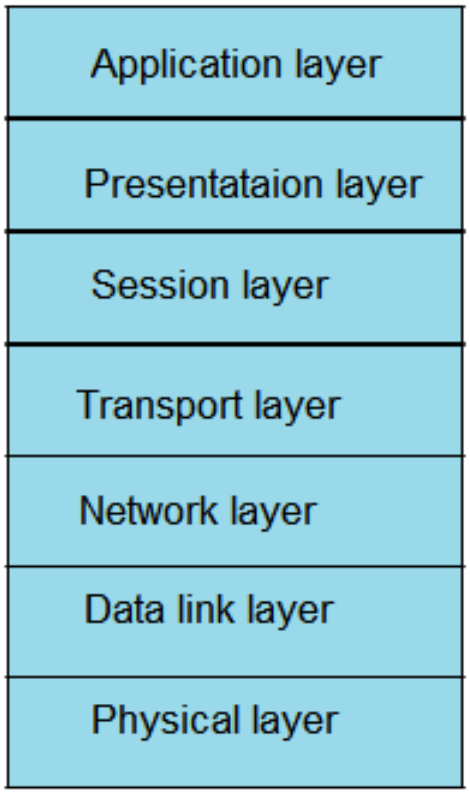


- Service
  - Convert data between different representations
  - E.g. big endian to little endian
  - E.g. Ascii to Unicode
- Implementation
  - Define data formats
  - Apply transformation rules

Application Layer

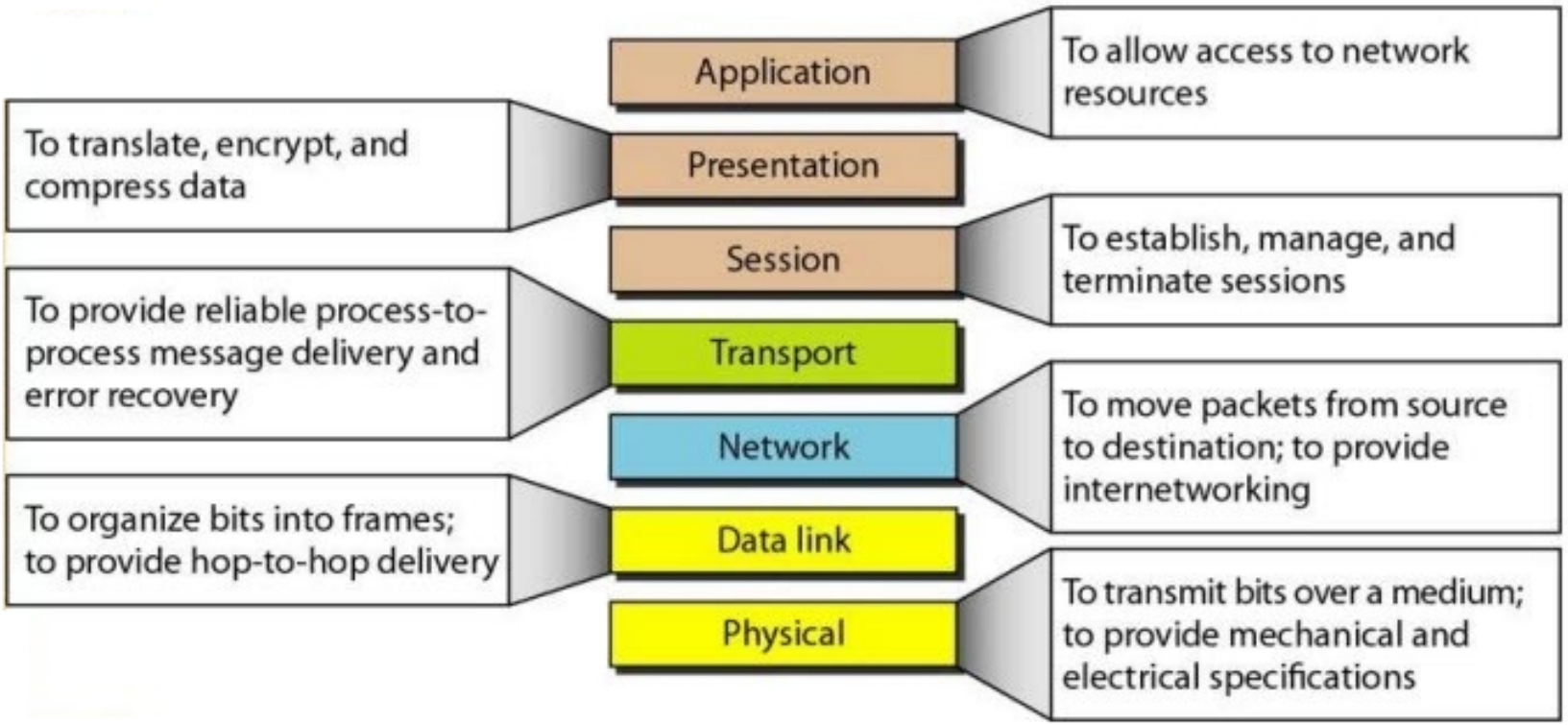
- Application layer interacts with application programs and is the highest level of OSI model.
- Application layer contains management functions to support distributed applications.
- Examples of application layer are applications such as file transfer, electronic mail, remote login etc.

Layer Architecture



- Data is encapsulated with the necessary protocol information as it moves down the layers before network transit.
- Network layers follow a set of rules, called protocol.
- The protocol defines the format of the data being exchanged, and the control and timing for the handshake between layers.

OSI Reference Model: 7 Layers



Source: https://www.router-switch.com/faq/network-layers-in-osi-model-features-of-osi.html

Questions

- Which layer is responsible for delivering data units from one node to the next without errors?
- Which layer ensures interoperability between communicating devices through transformation of data into a mutually agreed upon format.
- Which layer is responsible for correct data delivery to the application, if there is more than one application running in the user end device, which ?
- The address unique to a device is _____ ?

Questions?