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Full Stack Software Development

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Course: Basics of Networking

Lecture on: Network Models

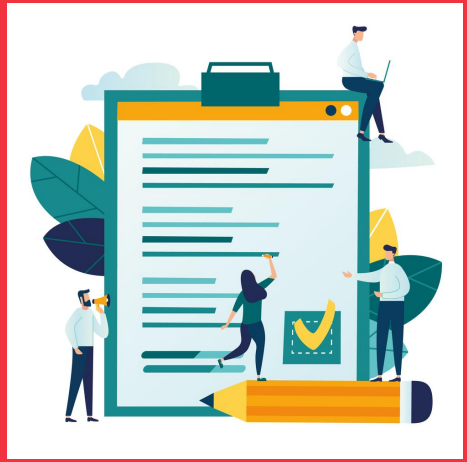
Instructor: Unnati Vora

In the Previous Class, We Covered...

- Basics of networking

Today's Agenda

- Network protocols and its need
- OSI model
- TCP/IP model
- HTTP and HTTPS



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Network Protocols and Their Need

NETWORK PROTOCOLS

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- Network protocols are a process of governing the exchange of information in an easy, reliable and secure way.
- A network protocol includes predefined rules and conventions for communication between the network and connected devices.
- Network protocols include identifying and establishing connections among devices.
- There are protocols for message acknowledgement and data compression as well.

NEED FOR NETWORK PROTOCOL

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- In the absence of protocols, devices cannot understand the electronic signals they send while communicating over network connections.
- Without a process, computers would not be capable of ‘talking’ to each other across the internet.
- Protocols aid computers identify themselves on the internet.
- Network protocols determine the packet format, type and size of the packets.
- They help to determine what happens when an error occurs and how to handle the error.

> Protocols are simply rules for communication. A violation of a protocol can lead to a breakdown in communication.

Poll 1 (15 Seconds)

Network protocols are a process of governing the exchange of information in an easy, reliable and secure way.

1. True
2. False

Poll 1 (Answer)

Network protocols are a process of governing the exchange of information in an easy, reliable and secure way.

1. **True**
2. False

PROTOCOL LAYERS

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- Network protocols work in layers, where the highest layer is what the user sees, and the lowest layer is the wire through which information traverses.
- These layers communicate efficiently and accurately with each other according to the set of rules.
- Layers divide the work done by a network.

PROTOCOL LAYERS

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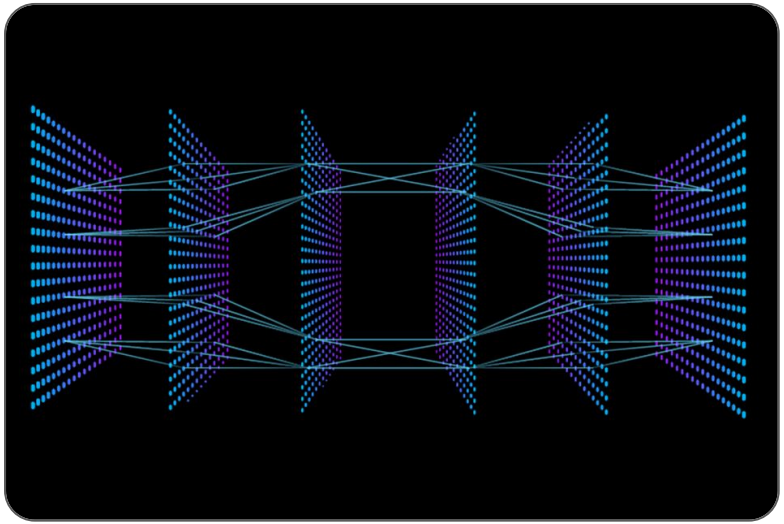
- A particular layer on a machine sends or receives precisely the same object that another machine's peer process sends or receives.
- Every layer acts in parallel with the same layer on other hosts.
- The primary purpose of a layered architecture is to divide the design into small pieces.
- Every layer adds to the lower layers' services so that the highest layer is provided with an entire set of services to manage communications and run distributed applications.



PROTOCOL LAYERS

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- For example, in an airline system, people are transported from the source to the airline's destination like a packet being shipped from the source host to the destination host on the internet.

- There is a ticketing function in an airline system at each end, a baggage function for ticketed passengers and a gate function for ticketed and baggage-checked passengers.

- An airline system has a layered architecture, making it easier to change the implementation of the layer's service.

PROTOCOL LAYERS

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- For example, if the gate functions change, the other layers would remain unchanged. Similarly, for large and complex systems that are updated continuously, the ability to change the implementation of service without affecting other system components is a significant advantage of layering.

- To reduce the design complexity, network designers organise protocols and the network hardware and software that implement the protocols in layers.

Poll 2 (15 Seconds)

Layers provide a division of the work done by a network.

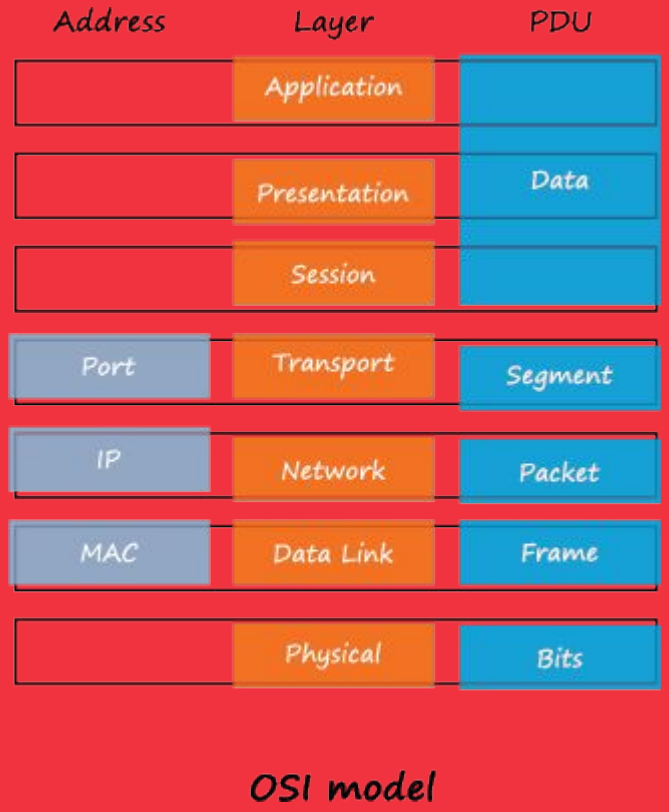
1. True
2. False

Poll 2 (Answer)

Layers provide a division of the work done by a network.

1. **True**
2. False

OSI Model


Address
Layer
PDU
Application
Presentation
Session
Data
Port
Transport
Segment
IP
Network
Packet
MAC
Data Link
Frame
Physical
Bits
OSI model

OSI MODEL

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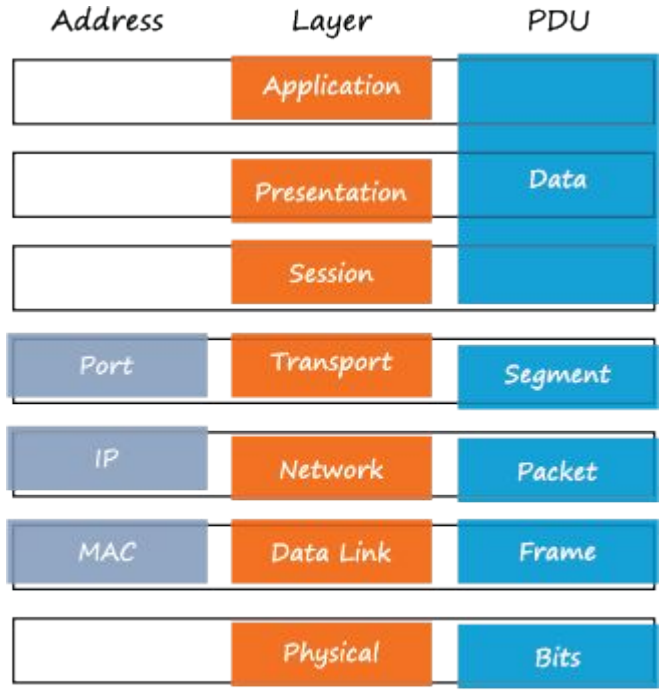
- The primary example of a layered set of protocols is the Open Systems Interconnection (OSI) reference model.

- While the information is transmitted between two networks, the data needs to travel down the seven OSI layers on the sending device and travel up the seven OSI layers on the receiving end.



OSI model

OSI MODEL

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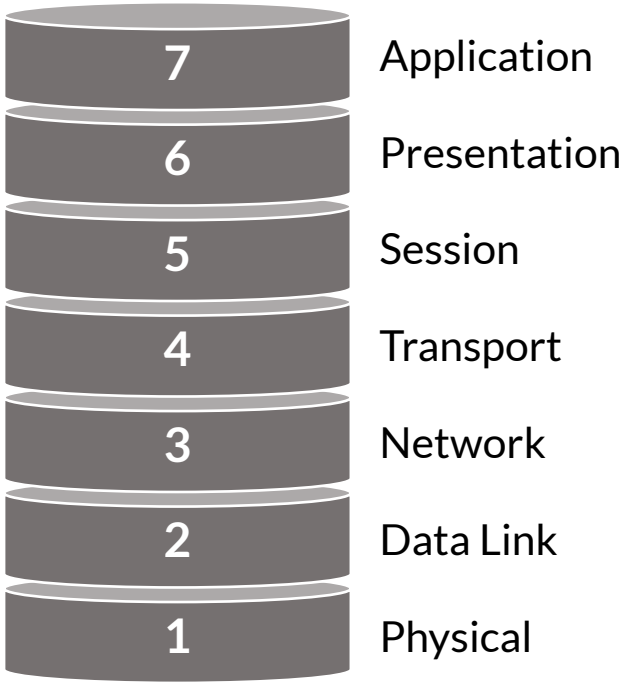
- The OSI model is used to describe the functions of a networking system.
- The OSI model characterises computing functions into a universal set of rules and requirements to support interoperability between various products and software.
- The OSI model consists of seven layers.



Physical Layer

- This layer includes physical equipment involved in the data transfer, such as cables.
- In this layer, data gets converted into a bitstream, a string of 0s and 1s.
- The physical layer of both the devices must agree on a signal convention to distinguish 1s from 0s on both the devices.

Data Link Layer

- The data link layer facilitates the data transfer between two devices, provided they are on the same network.
- It takes packets from the network layer and breaks them down into frames.
- Data link layer is responsible for flow control and error control in intra-communication.

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Network Layer

- This layer is responsible for facilitating data transfer between two separate networks.
- It breaks down the segments into smaller units called packets on the sender's device.
- It then reassembles the packets into segments on the receiver's device.
- It finds the best physical path for the data to reach its destination, and this process is known as routing.

Poll 3 (15 Seconds)

_____ breaks down the segments into smaller units called packets on the sender's device.

1. Physical layer
2. Data link layer
3. Network layer
4. None of the above

Poll 3 (Answer)

_____ breaks down the segments into smaller units called packets on the sender's device.

1. Physical layer
2. Data link layer
3. **Network layer**
4. None of the above

Transport Layer

- This layer is responsible for the end-to-end communication between two devices.
- It breaks down the data from the session layer into segments before sending it to the network layer.
- This layer reassembles the segments into data on the receiving device.
- This layer manages flow control and error control. Flow control determines an optimal transmission speed to match the speeds of the receiver's end and sender's end.

Session Layer

- This layer is responsible for opening and closing communication between two devices.
- The time between the opening and the closing of communication is known as a session.
- This layer ensures that the session stays open long enough to transfer all the data being exchanged.
- It synchronises data transfers with checkpoints.

Presentation Layer

- This layer is responsible for preparing data used by the application layer.
- It translates the incoming data into a syntax that the application layer can understand.
- This layer adds encryption at the sender's end and decodes the encryption at the receiver's end.
- It compresses the data that it receives from the application layer.

Application Layer

- It is the only layer that directly interfaces with the user.
- Software applications rely on this layer to initiate communications.
- This layer is responsible for the protocols and data manipulation that the software relies on.
- HTTP and Simple Mail Transfer Protocol (SMTP) are included in this layer.

Poll 4 (15 Seconds)

_____ adds encryption at the sender's end and decodes the encryption at the receiver's end.

1. Transport layer
2. Session layer
3. Presentation layer
4. Application layer

POLL 4 (ANSWER)

_____ adds encryption at the sender's end and decodes the encryption at the receiver's end.

1. Transport layer
2. Session layer
3. **Presentation layer**
4. Application layer

OSI MODEL

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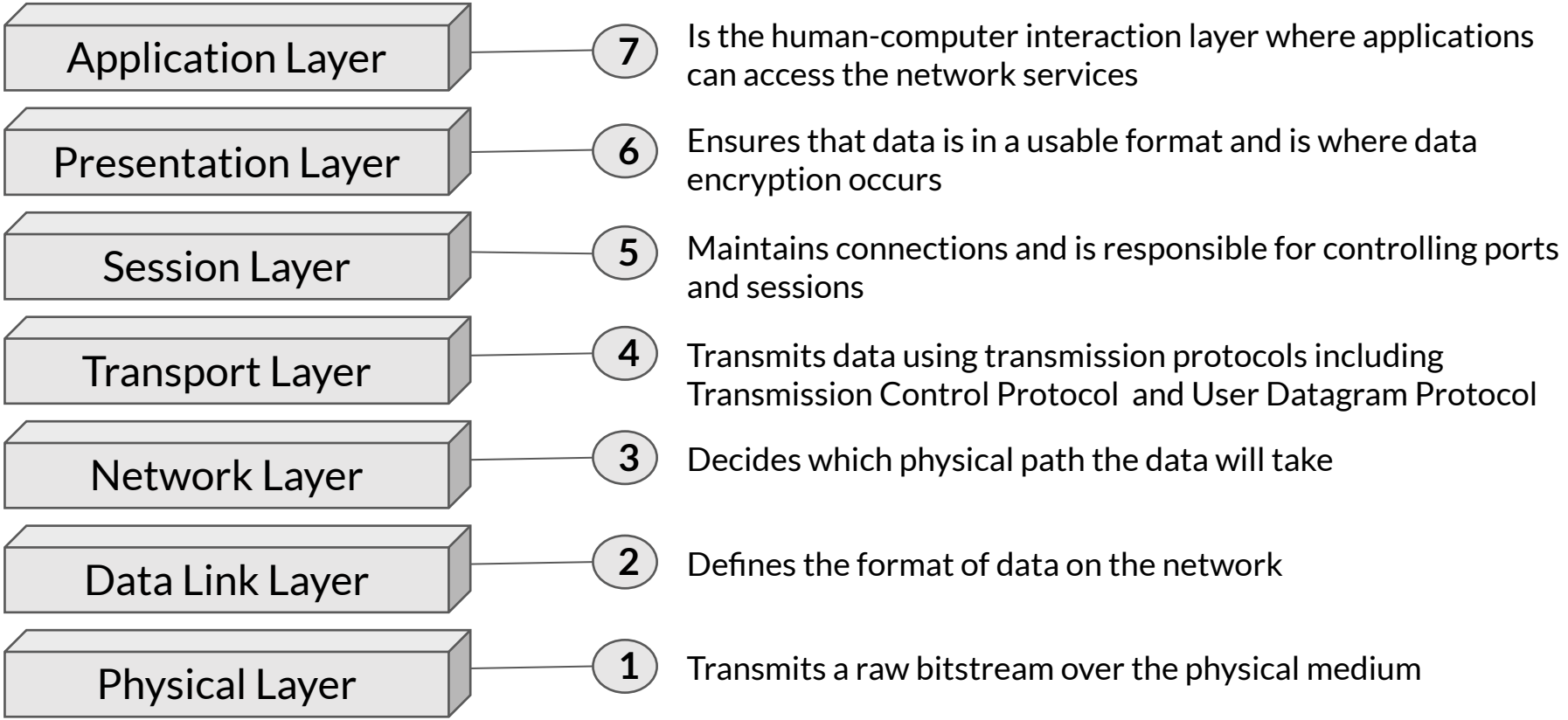

OSI MODEL

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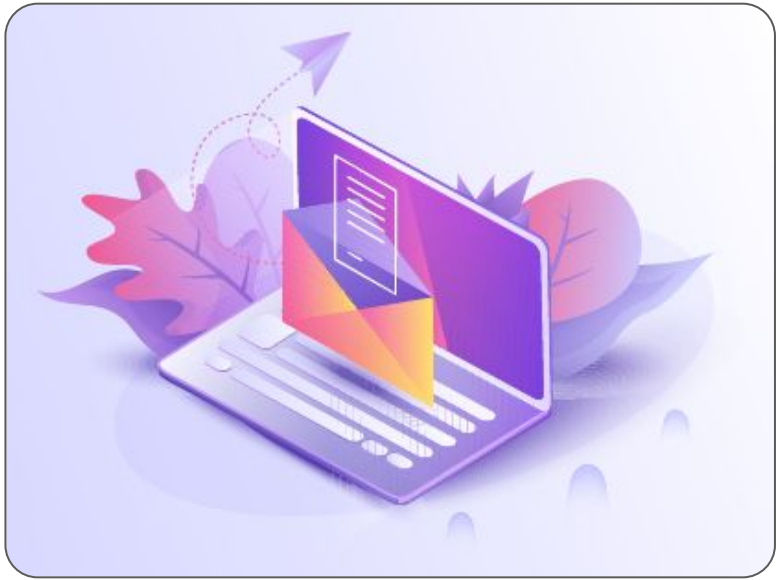
- For example, if a person sends an email to another, the email application will pass the email message over to the application layer, which will pick a protocol and pass the data along to the presentation layer.

- The presentation layer will then compress the data, and then, it will hit the session layer, which will initialise the communication session.



OSI MODEL

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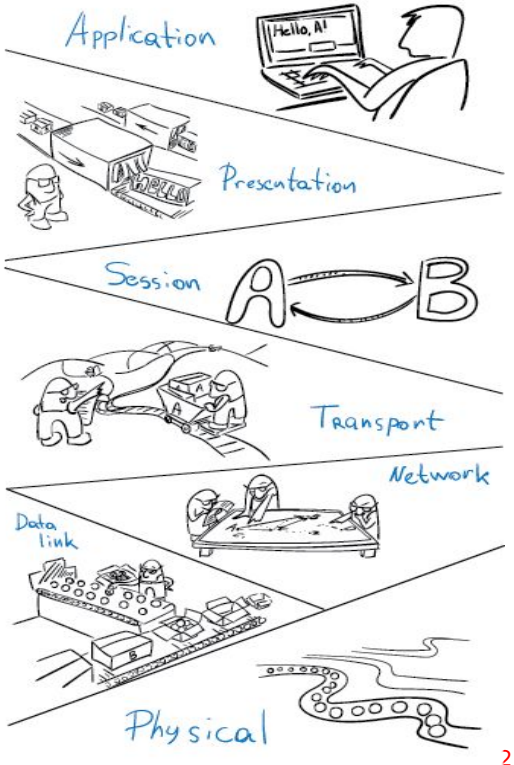
- The data will then hit the sender's transportation layer, where it will be segmented. Those segments will then be broken down into packets at the network layer, which will be further broken down into frames at the data link layer.

- The data link layer will then deliver those frames to the physical layer, which will send them through a physical medium such as a cable after converting them into a bitstream of 1s and 0s.



OSI MODEL

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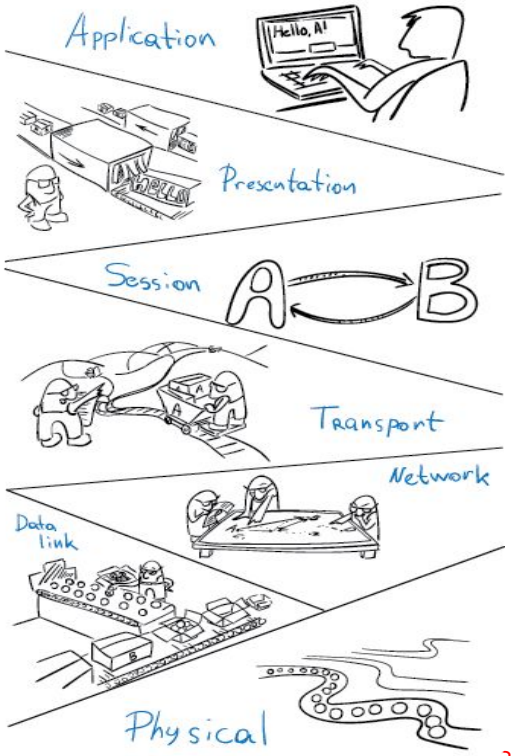
- Once the email reaches the receiver end computer through a physical medium such as a cable, the data will flow through the same layers but in an opposite order.
- First, the physical layer will convert the bitstream from 1s and 0s into frames, which will then be passed to the data link layer.
- The data link layer will then reassemble the frames into packets for the network layer.
- The network layer will then make segments out of the packets for the transport layer, which will reassemble the segments into one piece of data.



OSI MODEL

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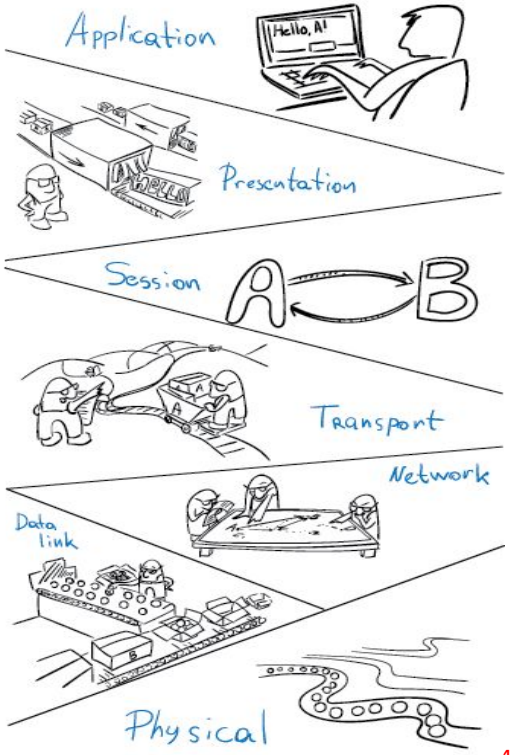
- The data will then flow into the receiver's session layer, which will then pass the data along to the presentation layer and end the communication session.
- The presentation layer will then remove the compression and pass the raw data to the application layer.
- The application layer will then feed the human-readable data along to the email software.



OSI MODEL

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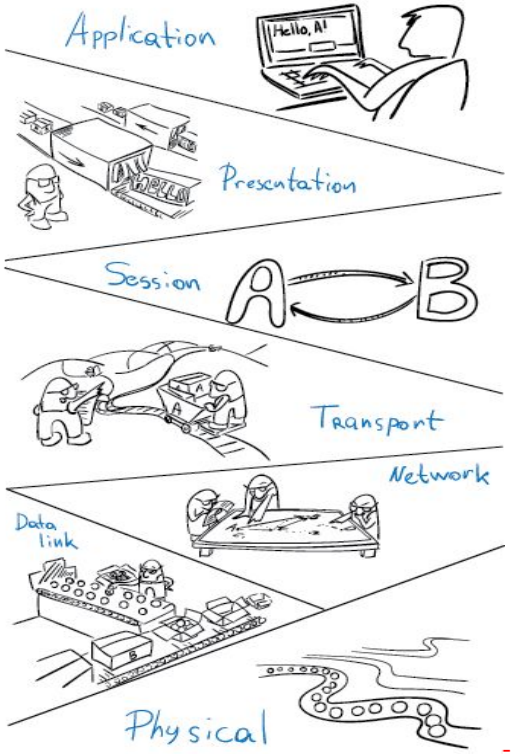
- The OSI model is a reference/logical model designed to describe the functions of the communication system.
- The OSI model helps the system divide the communication procedure into smaller, simpler components.



Poll 5 (15 Seconds)

_____ layer transmits data using transmission protocols, TCP and UDP.

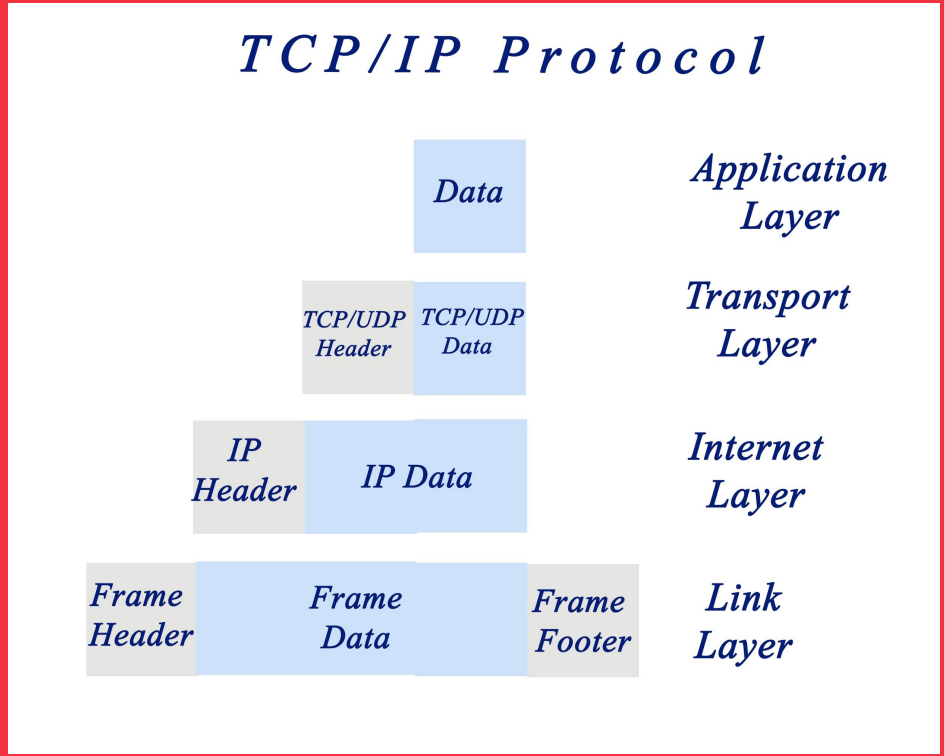
1. Transport layer
2. Session layer
3. Presentation layer
4. Application layer

Poll 5 (Answer)

_____ layer transmits data using transmission protocols, TCP and UDP.

1. **Transport layer**
2. Session layer
3. Presentation layer
4. Application layer

TCP/IP Model


TCP/IP Protocol
Data
Application Layer
TCP/UDP Header
TCP/UDP Data
Transport Layer
IP Header
IP Data
Internet Layer
Frame Header
Frame Data
Frame Footer
Link Layer

TCP/IP MODEL

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- The Transmission Control Protocol/ Internet Protocol (TCP/IP) model is based on standard protocols.
- It consists of four layers, unlike the OSI model that has seven layers.

> The TCP/IP model is a concise version of the OSI model.

TCP/IP MODEL

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Process/Application Layer

Host-to-Host/ Transport Layer

Internet Layer

Network Access/ Link Layer

Network Access Layer

- This layer is the combination of the data link layer and the physical layer of the OSI model.
- Hardware addressing the protocols present in this layer allows the physical transmission of data.
- It is the bottom-most layer of the TCP/IP model.
- It defines how the data should be sent physically through the network and is responsible for transmitting data between two devices provides they are on the same network.

Internet Layer

- The functions of this layer are similar to those of the OSI model network layer. It defines the protocols responsible for the logical transmission of data over the entire network.
- There are three protocols in this layer.
- IP stands for 'Internet Protocol' and is responsible for delivering packets from the source host to the destination host by looking at the packet headers' IP addresses.
- ICMP stands for Internet Control Message Protocol'.
- ICMP is encapsulated within IP datagrams responsible for providing the hosts with information about various network problems.
- ARP stands for Address Resolution Protocol'.
- ARP determines the hardware address of a host from a known IP address.

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Poll 6 (15 Seconds)

TCP/IP model consists of ___ layers, and OSI model has _____ layers.

1. seven, four
2. five, seven
3. seven, five
4. four, seven

Poll 6 (Answer)

TCP/IP model consists of ___ layers, and OSI model has _____ layers.

1. seven, four
2. five, seven
3. seven, five
4. **four, seven**

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Host-to-Host Layer

- It is analogous to the transport layer of the OSI model.
- It is responsible for end-to-end communication and error-free delivery of data.
- There are two main protocols present in host-to-host layer of TCP/IP model:
  - Transmission Control Protocol (TCP)
    - TCP is known to provide reliable and error-free communication between end systems.
    - It performs sequencing and segmentation of the data.
  - User Datagram Protocol (UDP).
    - UDP is a cost-effective protocol but has limited features.
    - Unlike TCP/IP, which is a connection-oriented protocol, UDP is connectionless.

Application Layer

- This layer performs the top three layers of the OSI model: application, presentation and session layer.
- It is responsible for node-to-node communication and controls user-interface specifications.
- Some of the layer protocols are HTTP, HTTPS, FTP, TFTP, Telnet, SSH, SMTP, SNMP, NTP, DNS, DHCP, NFS, X Window and LDP.

OSI VS TCP/IP MODEL

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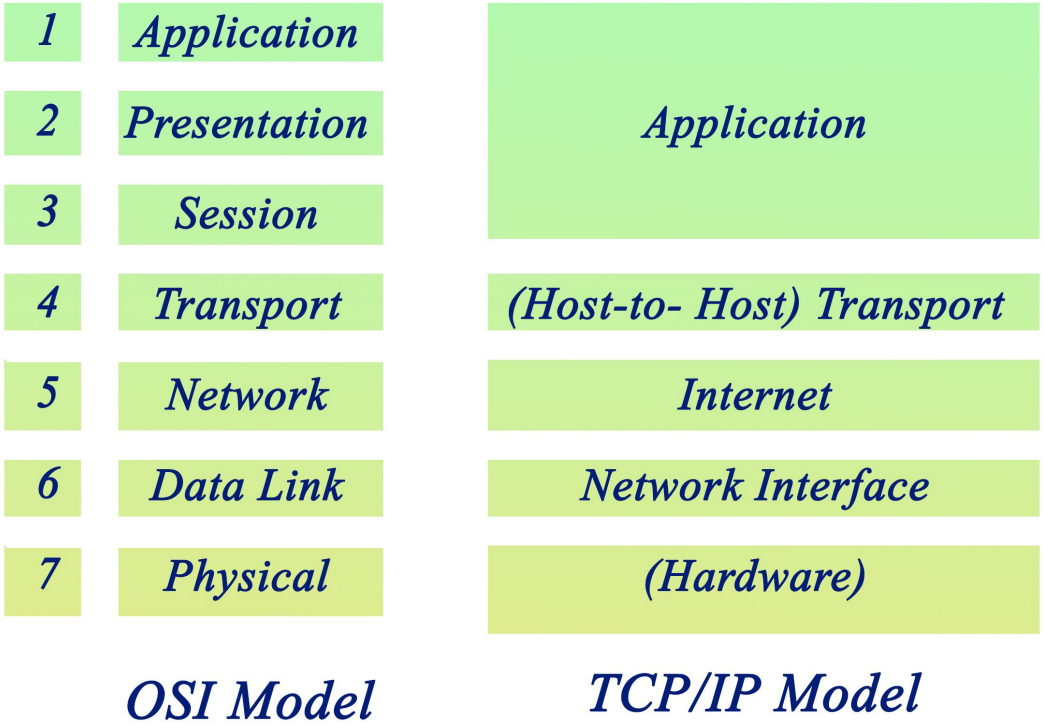


Poll 7 (15 Seconds)

TCP stands for:

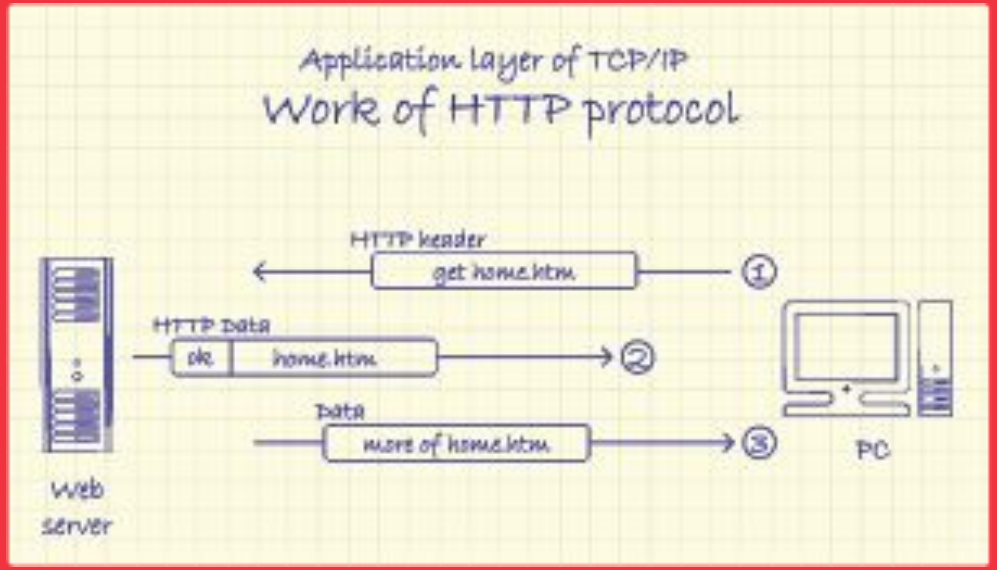
1. Transition Control Protocol
2. Transmit Control Protocol
3. Transmission Control Protocol
4. None of the above

Poll 7 (Answer)

TCP stands for:

1. Transition Control Protocol
2. Transmit Control Protocol
3. **Transmission Control Protocol**
4. None of the above

HTTP and HTTPS



HTTP AND HTTPS

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01	HTTP stands for ‘Hypertext Transfer Protocol’.
02	It is used by the World Wide Web to manage communications between web browsers and servers.
03	HTTPS stands for ‘HTTP-secure’.
04	HTTPS is efficient in cases where the browser needs to fill out forms, sign in and authenticate and carry out bank transactions.

HOW DOES A WEBSITE WORK?

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Have you ever wondered how a website works? Whenever a user types any web address, the desired page is loaded instantly.

- The web address you type is known as Uniform Resource Locator (URL).
- Then, the browser finds the page you requested with the help of cache, IP address and MAC address.
- Each URL will indicate a unique resource, and web servers handle the URL.
- The URL contains various parts such as protocol, domain name, port, path, parameters and anchor.

HOW DOES A WEBSITE WORK?

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Poll 8 (15 Seconds)

HTTP stands for:

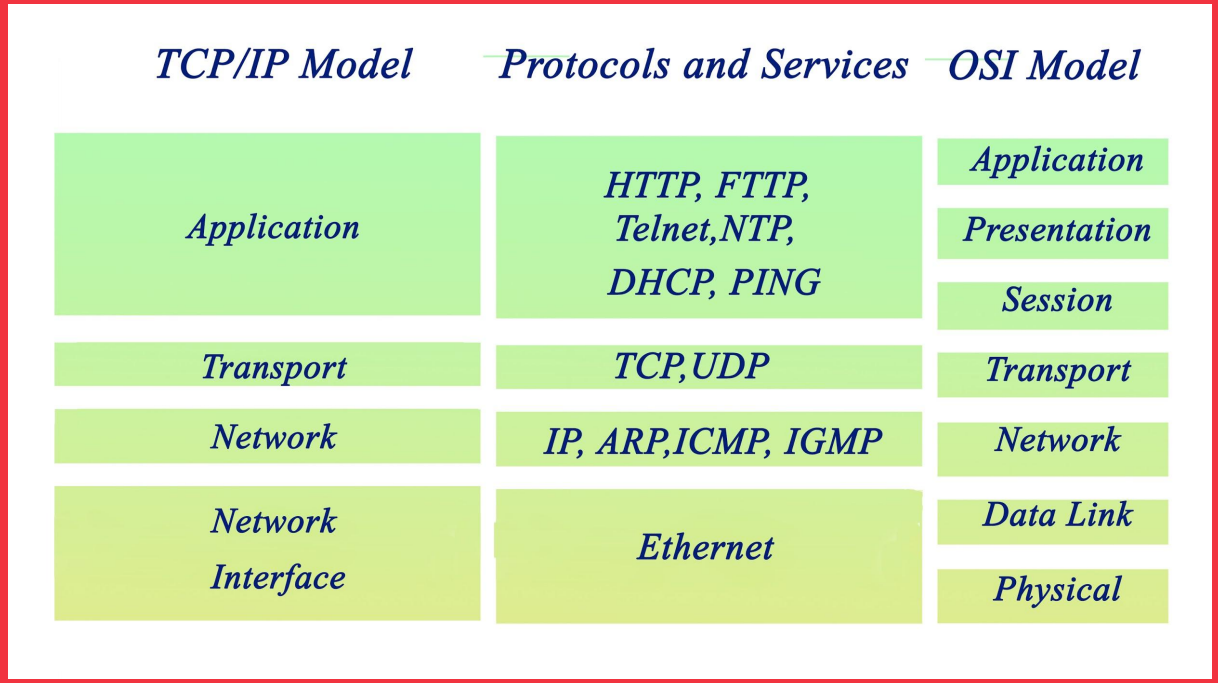
1. Hypertext Protocol
2. Hypertext Transfer Protocol
3. Hypertext Transport Protocol
4. Hypertext Presentation

Poll 8 (Answer)

HTTP stands for:

1. Hypertext Protocol
2. **Hypertext Transfer Protocol**
3. Hypertext Transport Protocol
4. Hypertext Presentation

Key Takeaways



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Thank You!