



CompTIA N +
Exam: N10-007

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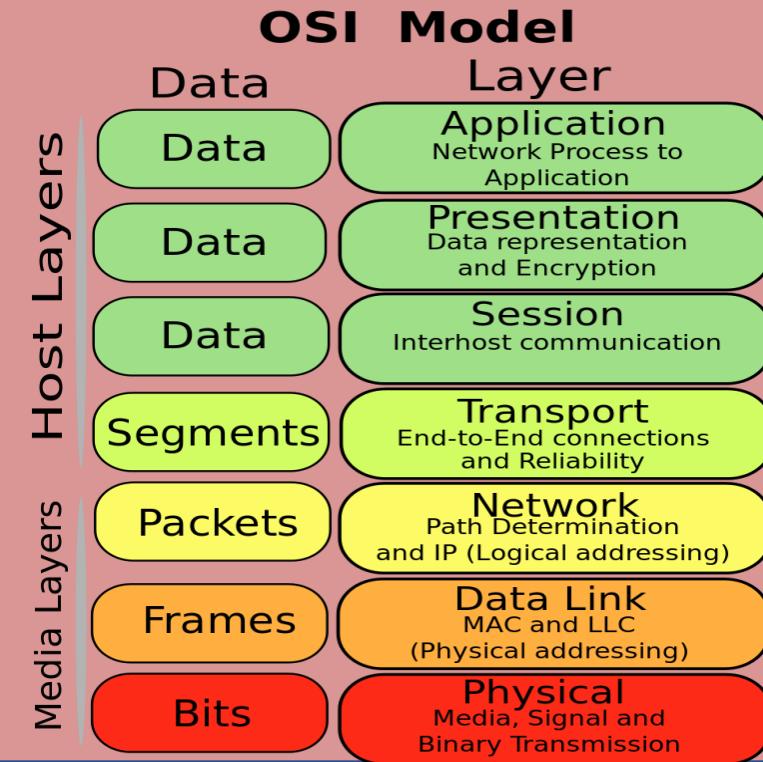
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Chapter- 2

Open System Interconnection (OSI Model)

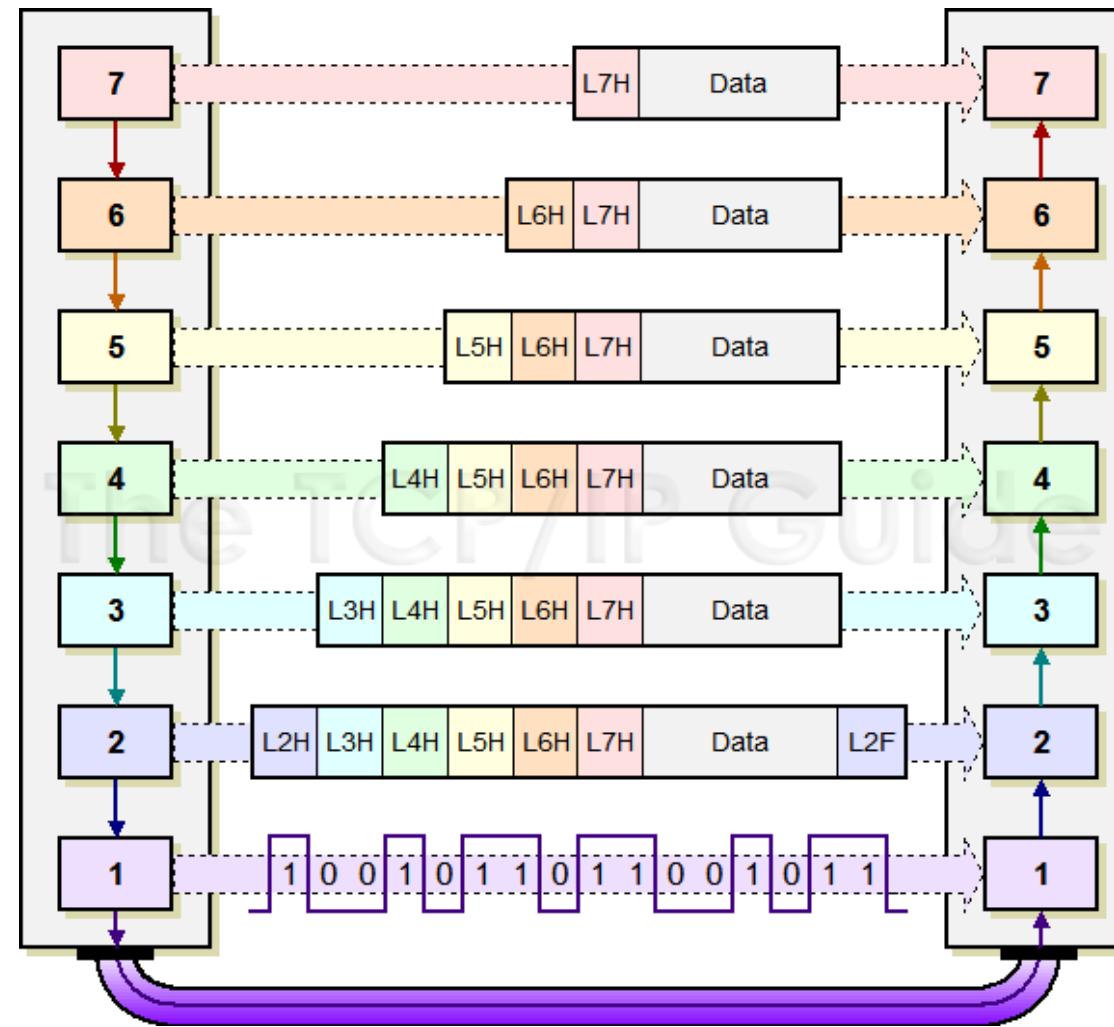
OSI Model Overview: 2-1



OSI Model Overview

- Developed in 1977 by the International Organization for Standardization (ISO)
- Called the OSI model or OSI stack
- Consists of 7 layers
- Useful in troubleshooting networks
- Serves as a reference model in networks

Data Types in OSI Model



Purpose of Reference Model

- Categorize functions of the network into particular layer(s)
- Compare technologies across different manufacturers
- By understanding its functions you can understand how best to communicate with that device



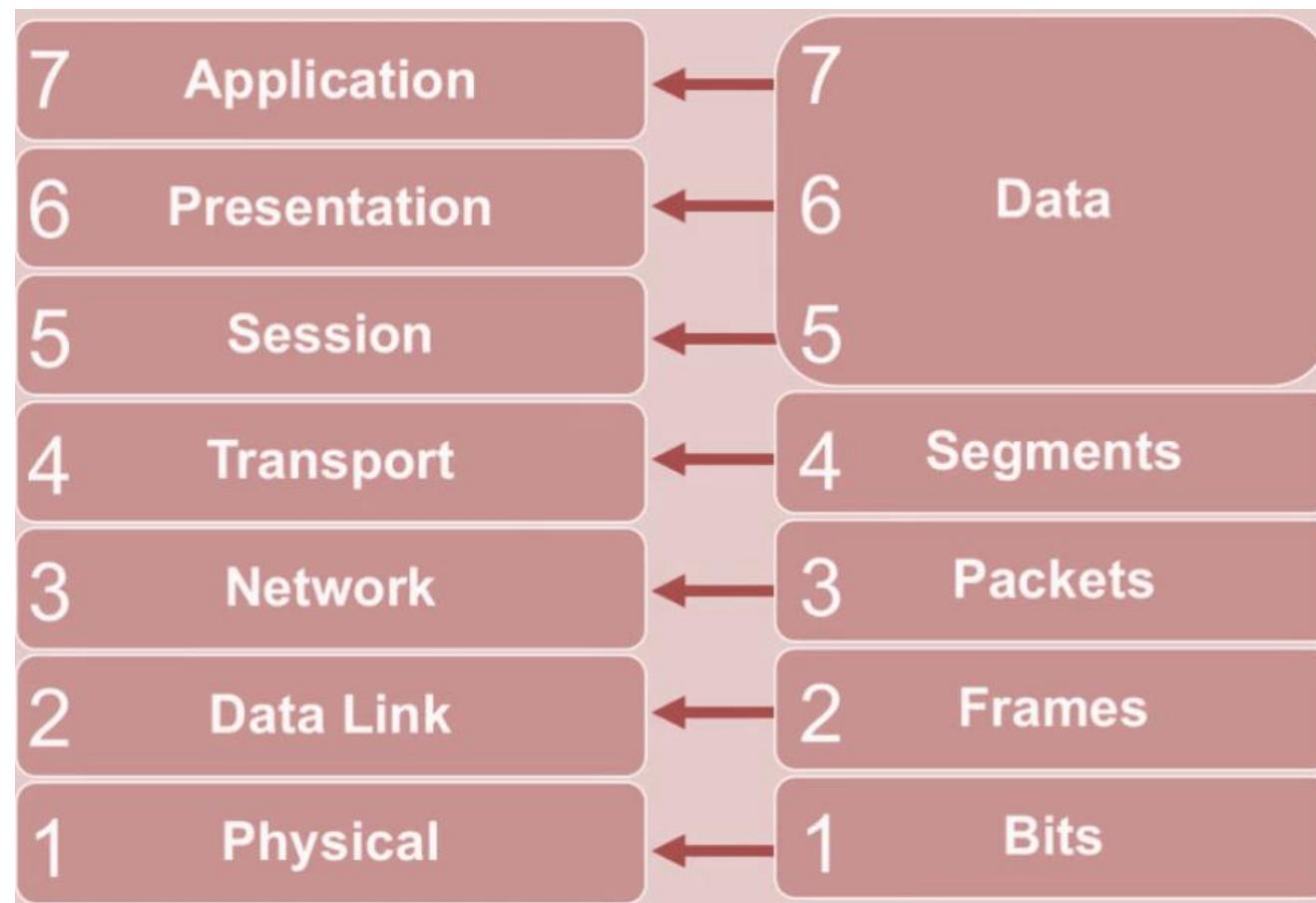
OSI Layers

All People Seems To Need Data Processing

Please Do Not Throw Sausage Pizza Away

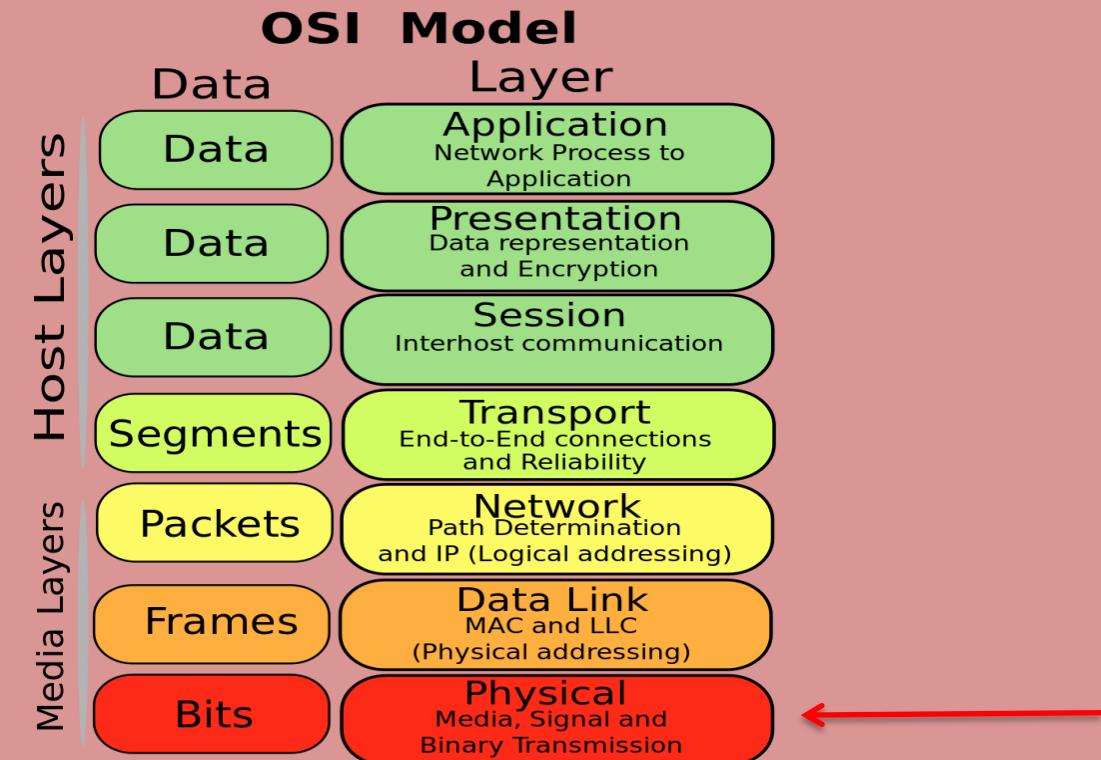


Data Types in OSI Model



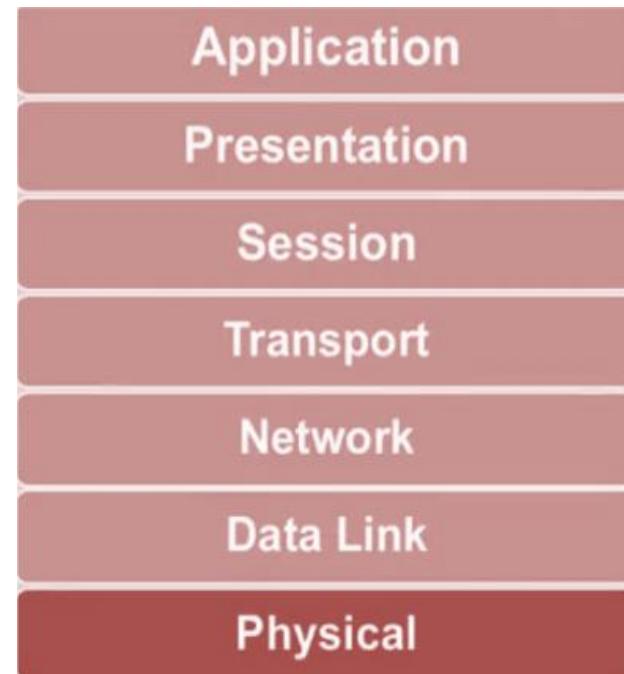
Don't Some People FBirthdays?

The Physical Layer: 2-2 Layer (1)



Layer1- Physical Layer

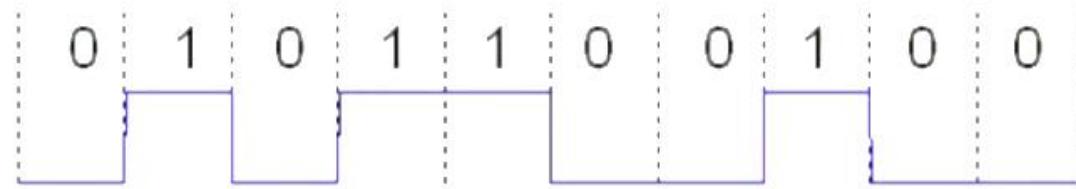
- Transmission of *bits* across the network
- Physical and electrical characteristics
- Characteristics:
 - How bits are represented on the medium
 - Wiring standards for connectors and jacks
 - Physical topology
 - Synchronizing bits
 - Bandwidth usage
 - Multiplexing strategy



Layer1- Physical Layer

How are bits represented on the medium?

- Electrical voltage (copper wiring) or light (fiber optics) represent 1's and 0's (bits)
- Current State
 - If 0 volts, then 0 is represented
 - If +/- 5 volts, then 1 is represented
- Transition Modulation
 - If it changed during the clock cycle, then a 1 is represented otherwise a 0



Layer1- Physical Layer

How are the cables wired?

- TIA/EIA-568-B is standard wiring for RJ-45 cables and ports
- Crossover cables use T-568A and T-568B
- Straight-thru cables typically use T-568B on both ends, but could use T-568A on both

Wiring standards will be addressed in-depth in the Ethernet module

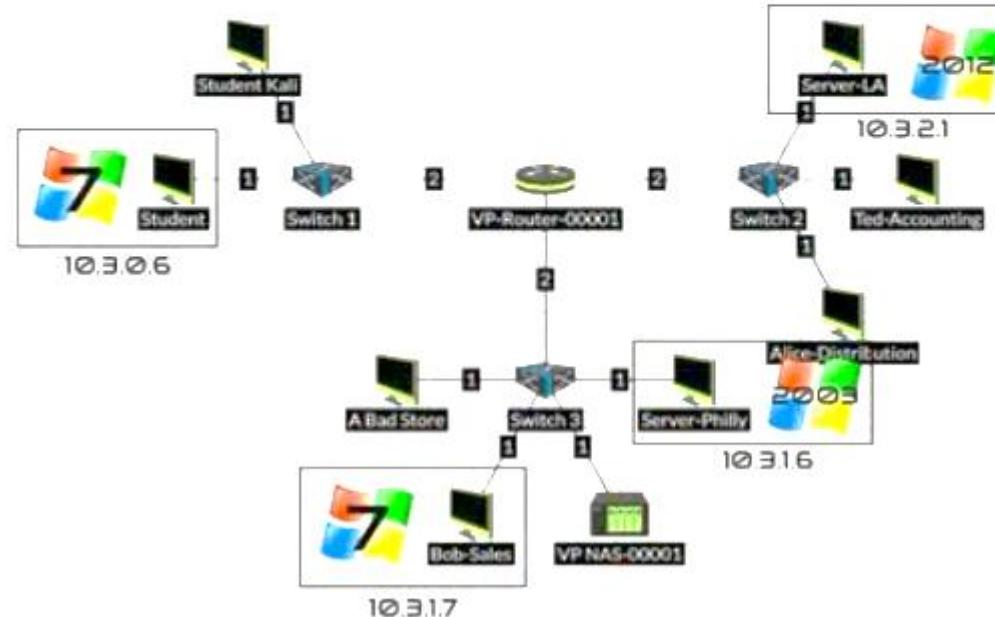
[Straight Through](#)
[Cross Over Cable](#)
[Page \(95\)](#)

Pin	Color
1	white/orange
2	orange
3	white/green
4	blue
5	white/blue
6	green
7	white/brown
8	brown

Layer1- Physical Layer

How are the cables connected?

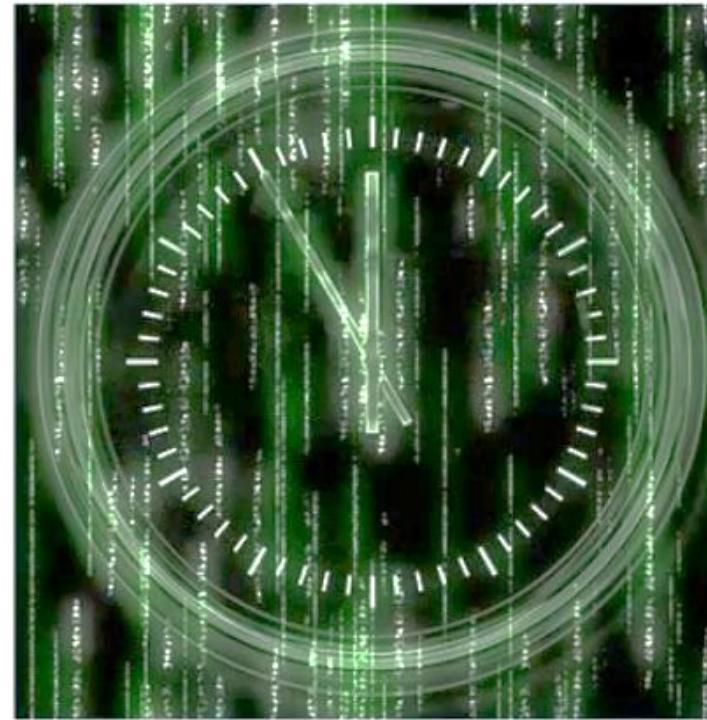
- Layer 1 devices view networks from a physical topology perspective
- Includes:
 - Bus
 - Ring
 - Star
 - Hub-and-Spoke
 - Full Mesh
 - Partial Mesh



Layer1- Physical Layer

How is communication synchronized?

- Asynchronous
 - Uses start bits and stop bits to indicate when transmissions occur from sender to receiver
- Synchronous
 - Uses a reference clock to coordinate the transmissions by both sender and receiver



Layer1- Physical Layer

How is bandwidth utilized?

- Broadband
 - Divides bandwidth into separate channels
 - Example:
 - Cable TV
- Baseband
 - Uses all available frequency on a medium (cable) to transmit data and uses a reference clock to coordinate the transmissions by both sender and receiver
 - Example:
 - Ethernet, Telephone call



Layer1- Physical Layer

How can we get more out of a limited network?

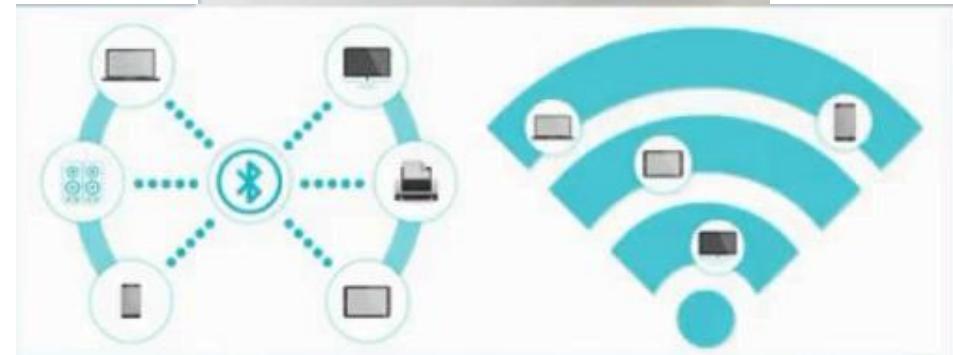
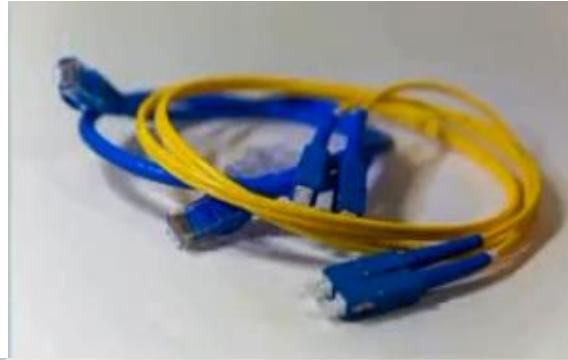
- Time-Division Multiplexing (TDM)
 - Each session takes turns, using time slots, to share the medium between all users (**Bathroom**)
- Statistical Time-Division Multiplexing (StatTDM)
 - More efficient version of TDM, it dynamically allocates time slots on an as-needed basis instead of statically assigning
- Frequency-Division Multiplexing (FDM):
 - Medium is divided into various channels based on frequencies and each session is transmitted over a different channel
 - Broadband

Layer1- Physical Layer

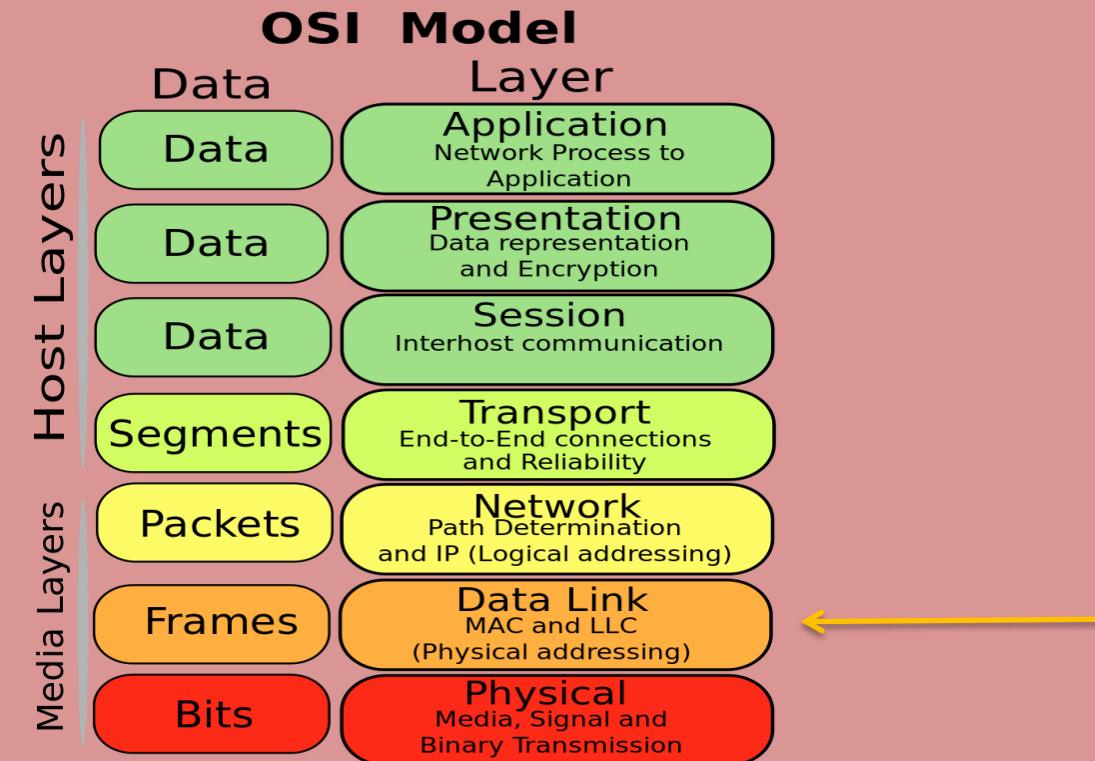
Examples at Layer-1

Stupid
Devices

- Cables
 - Ethernet
 - Fiber optic
- Radio frequencies
 - Wi-Fi
 - Bluetooth
- Infrastructure devices
 - Hubs
 - Wireless Access Points
 - Media Converters

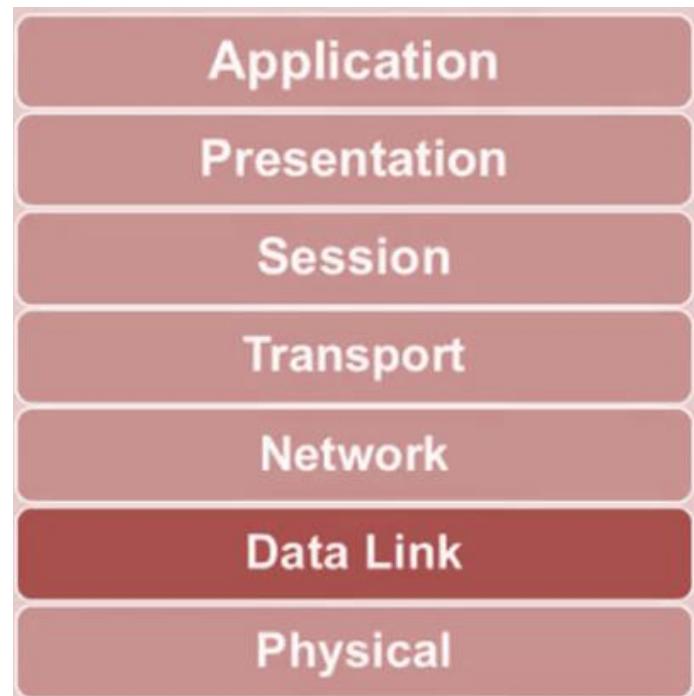


The Data Link Layer: 2-3 Layer (2)



Layer 2- Data Link Layer

- Packages data into frames and transmitting those frames on the network, performing error detection/correction, and uniquely identifying network devices with an address (MAC), and flow control
- MAC
 - Physical addressing
 - Logical topology
 - Method of Transmission
- LLC
 - Connection services
 - Synchronizing transmissions



Layer 2- Data Link Layer

Media Access Control (MAC)

- Physical addressing
 - Uses 48-bit address assigned to a network interface card (NIC) by manufacturer
 - First 24-bits is the vendor code
 - Second 24-bits is a unique value
- Logical topology
 - Layer 2 devices view networks logically
 - Ring, bus, star, mesh, hub-and-spoke, ...
- Method of transmission
 - Many devices are interconnected
 - Determines whose turn it is to transmit to prevent interference with other devices

3A:34:65:D2:51:F1

Layer 2- Data Link Layer

Logical Link Control (LLC)

- Provides connection services
- Acknowledgement of receipt of a message
- Flow control
 - Limits amount of data sender can send at one time to keep receiver from becoming overwhelmed
- Error control
 - Allows receiver to let sender know when an expected data frame wasn't received or was corrupted by using a checksum

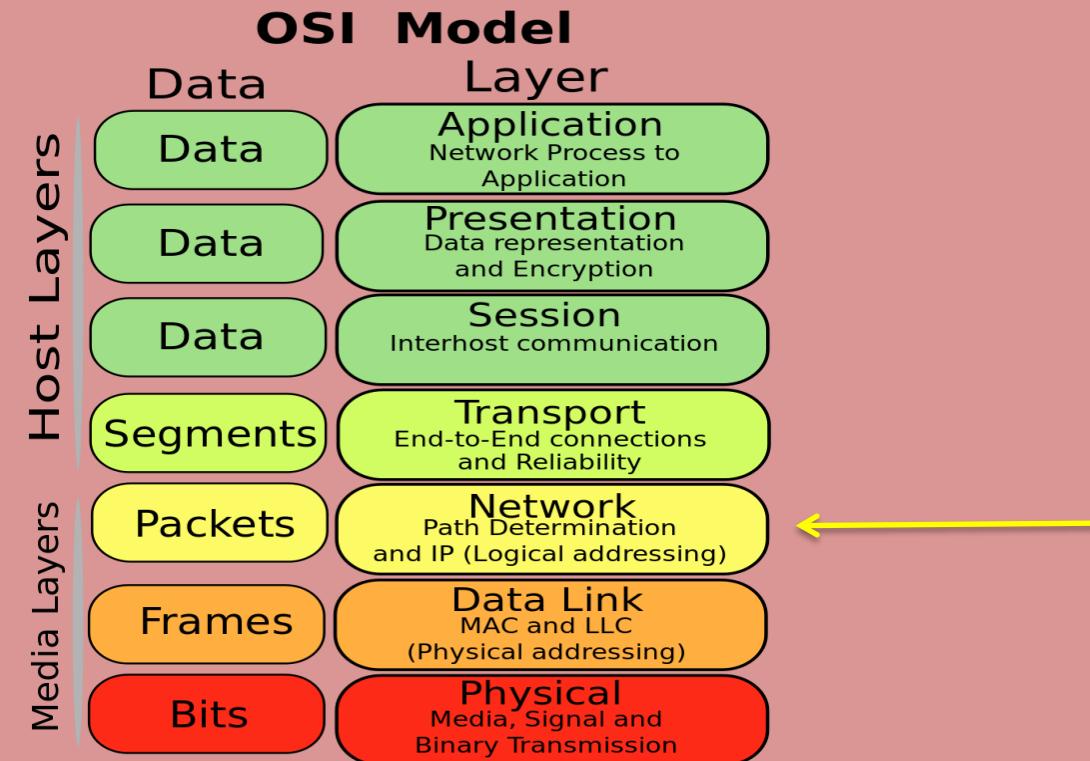
Layer 2- Data Link Layer

Examples at Layer 2

- NICs
- Bridges.
- Switches.

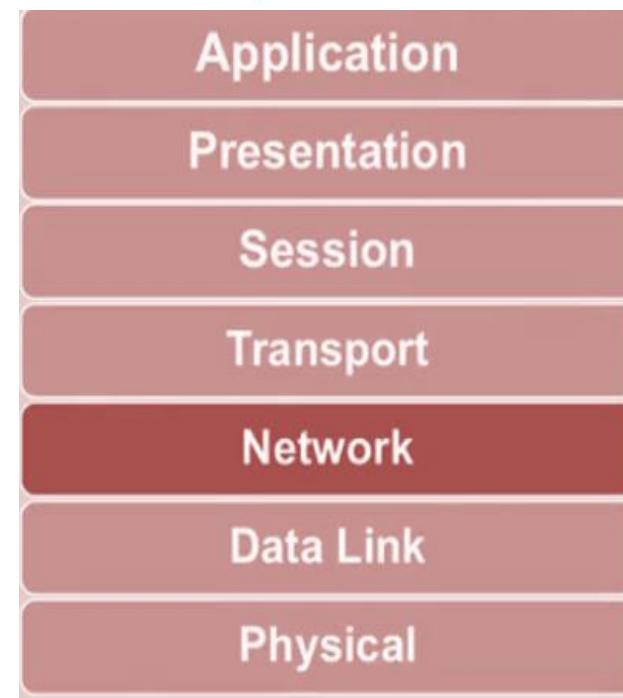


The Network Layer: 2-4 Layer (3)



Layer 3- Network Layer

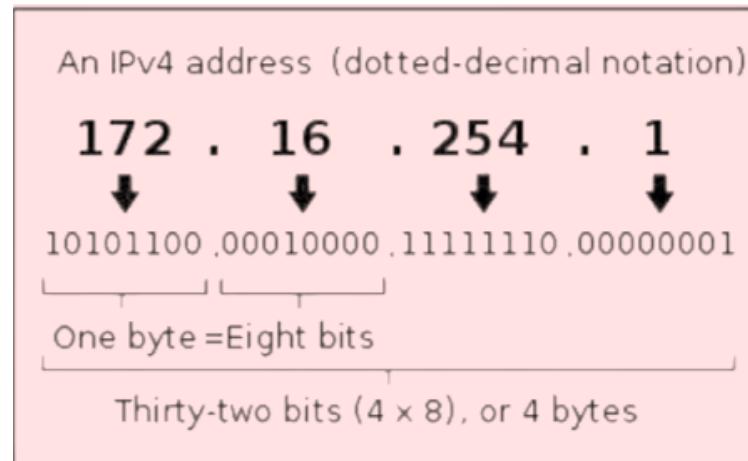
- Forwards traffic (routing) with logical address
 - Example: IP Address (IPv4 or IPv6)
- Logical addressing
- Switching
- Route discovery and selection
- Connection services
- Bandwidth usage
- Multiplexing strategy



Layer 3- Network Layer

Logical Address

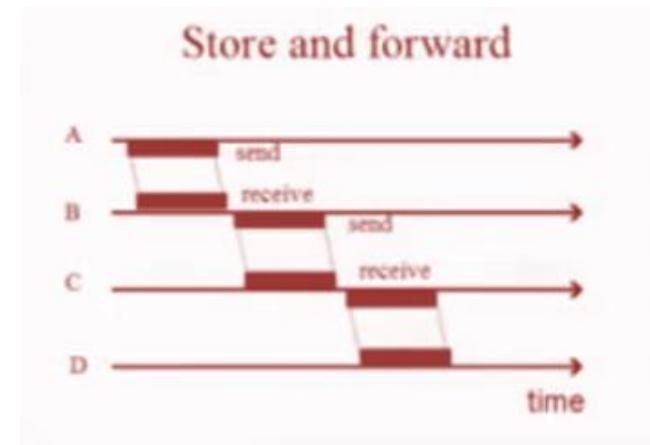
- Numerous routed protocols were used for logical addressing over the years:
 - AppleTalk
 - Internetwork Packet Exchange (IPX)
 - Internet Protocol (IP)
- Only Internet Protocol (IP) remains dominant
 - IP v4
 - IP v6



Layer 3- Network Layer

How Should data be forwarded or Routed?

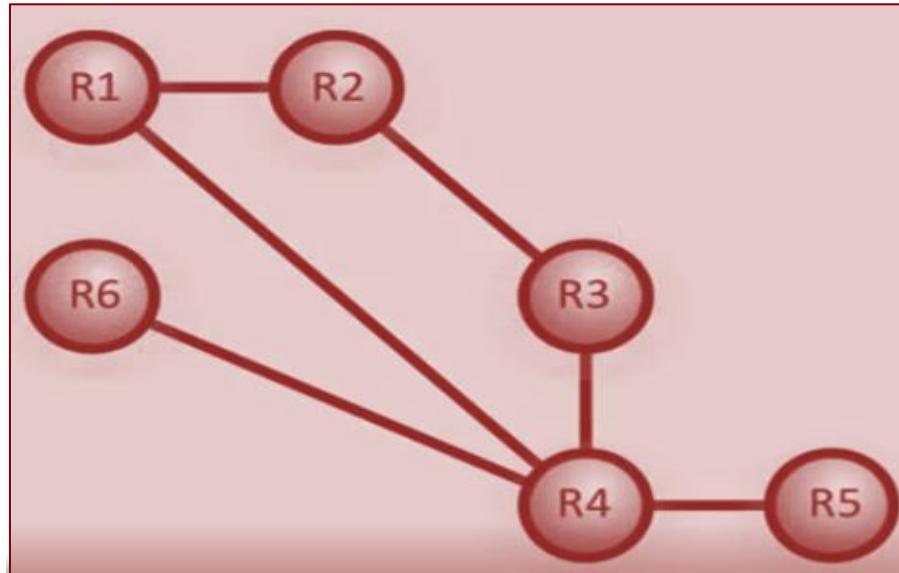
- Packet switching (known as *routing*)
 - Data is divided into packets and forwarded
- Circuit switching
 - Dedicated communication link is established between two devices
- Message switching
 - Data is divided into messages, similar to packet switching, except these messages may be stored then forwarded



Layer 3- Network Layer

Route Discovery and Selection

- Routers maintain a routing table to understand how to forward a packet based on destination IP address
- Manually configured as a static route or dynamically through a routing protocol
 - RIP
 - OSPF
 - EIGRP



Layer 3- Network Layer

Connection Services

- Layer 3 augment Layer 2 to improve reliability
- Flow control
 - Prevents sender from sending data faster than receiver can get it
- Packet reordering
 - Allows packets to be sent over multiple links and across multiple routes for faster service

Layer 3- Network Layer

Internet Control Message Protocol (ICMP)

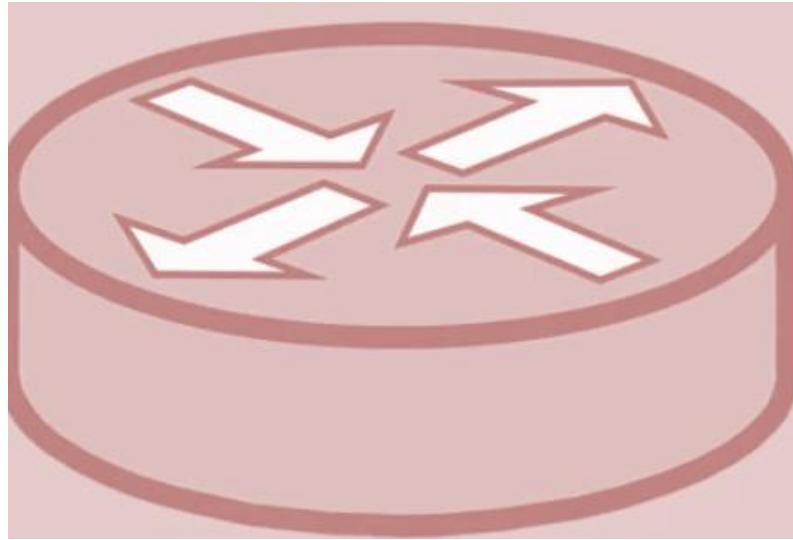
- Used to send error messages and operational information about an IP destination
- Not regularly used by end-user applications
- Used in troubleshooting (*ping* and *traceroute*)

```
$ ping -c 5 www.example.com
PING www.example.com (93.184.216.34): 56 data bytes
64 bytes from 93.184.216.34: icmp_seq=0 ttl=56 time=11.632 ms
64 bytes from 93.184.216.34: icmp_seq=1 ttl=56 time=11.726 ms
64 bytes from 93.184.216.34: icmp_seq=2 ttl=56 time=10.683 ms
64 bytes from 93.184.216.34: icmp_seq=3 ttl=56 time=9.674 ms
64 bytes from 93.184.216.34: icmp_seq=4 ttl=56 time=11.127 ms
```

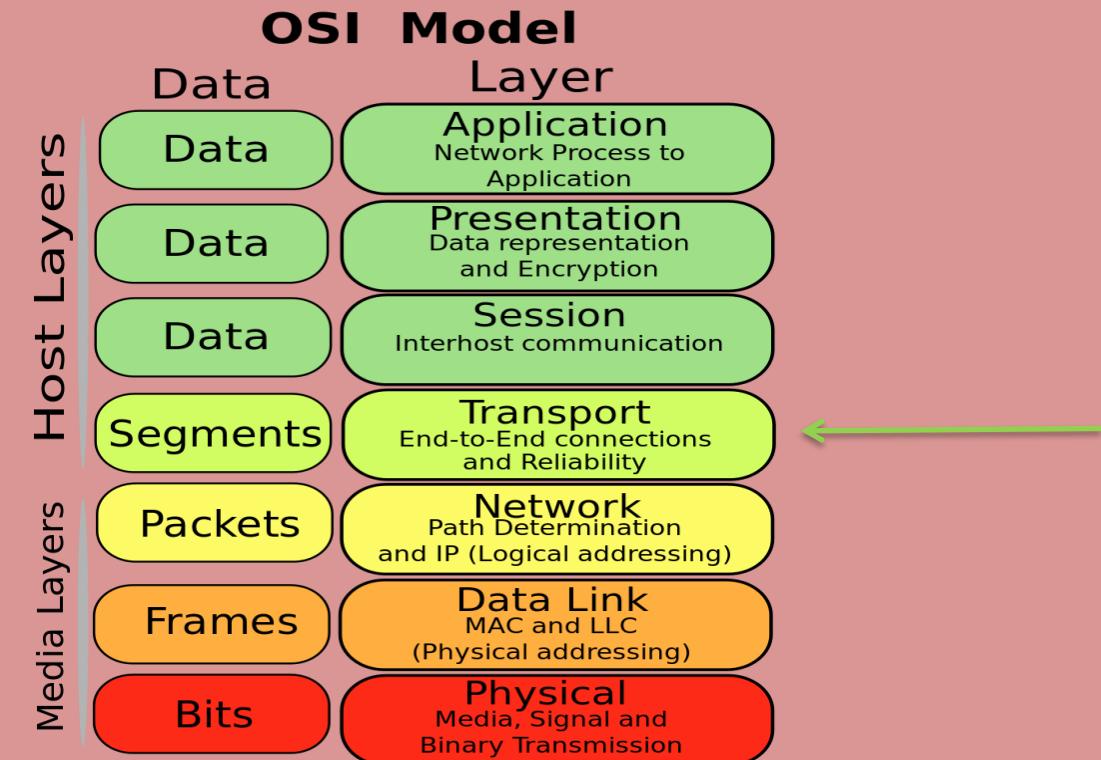
Layer 3- Network Layer

Examples at Layer 3

- Routers
- Multilayer switches
- IPv4 protocol
- IPv6 protocol
- Internet Control Message Protocol (ICMP)

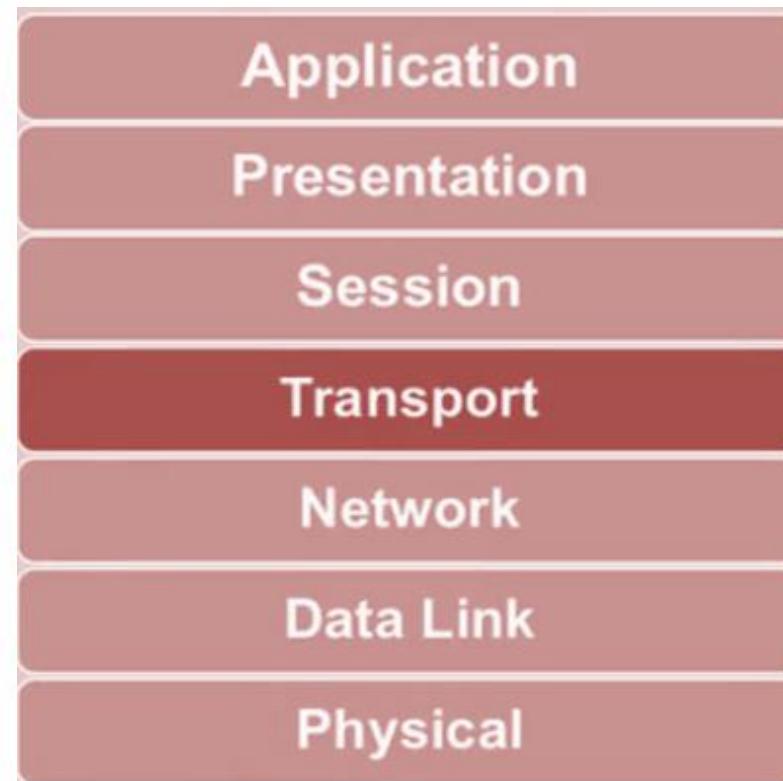


The Transport Layer: 2-5 Layer (4)



Layer 4- Transport Layer

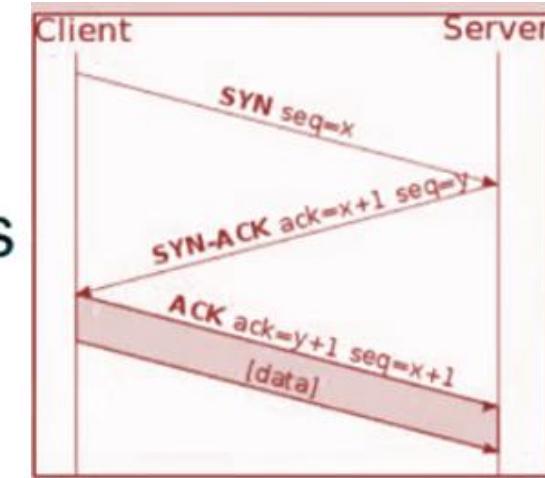
- Dividing line between upper and lower layers of the OSI model
- Data is sent as segments
- TCP/UDP
- Windowing
- Buffering



Layer 4- Transport Layer

TCP (Transmission Control Protocol)

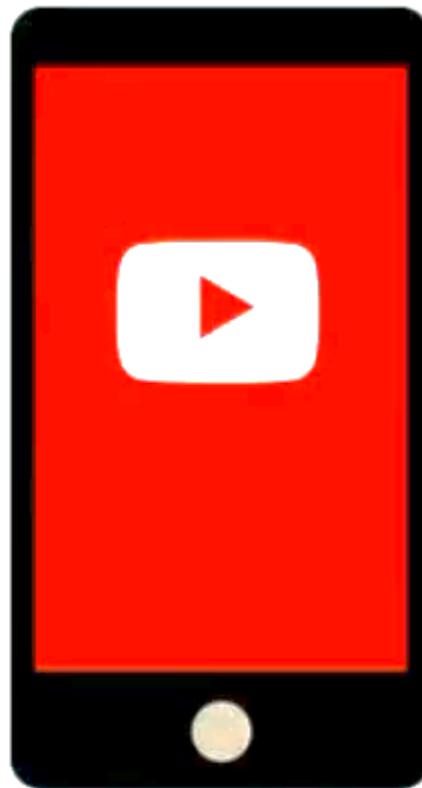
- Connection-oriented protocol
- Reliable transport of segments
 - If segment is dropped, protocol detects it and resends segment
- Acknowledgements received for successful communications
- Used for all network data that needs to be assured to get to its destination



Layer 4- Transport Layer

UDP (User Datagram Protocol)

- Connectionless protocol
- Unreliable transport of segments
 - If dropped, sender is unaware
- No retransmission
- Good for audio/video streaming
- Lower overhead for increased performance



Layer 4- Transport Layer

Wⁱn^do^wning

- Allows the clients to adjust the amount of data sent in each segment
- Continually adjusts to send more or less data per segment transmitted
 - Adjusts lower as number of retransmissions occur
 - Adjusts upwards as retransmissions are eliminated



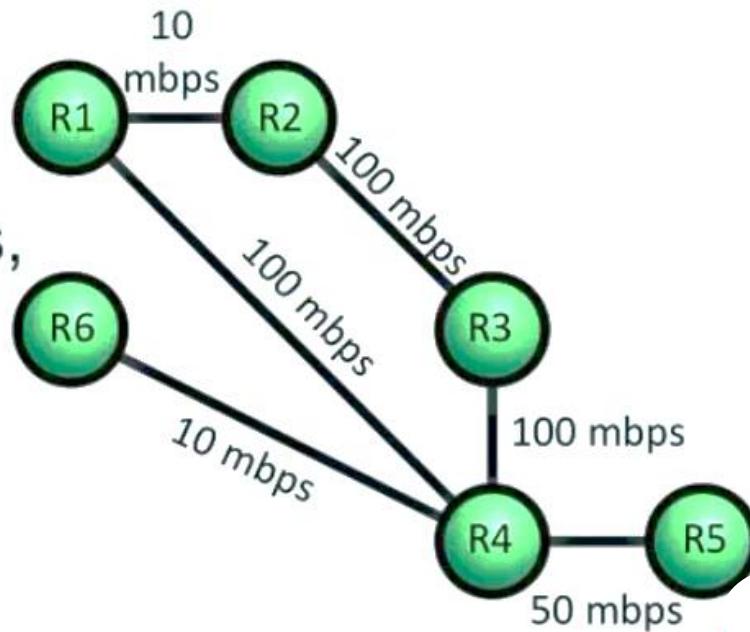
Layer 4- Transport Layer (TCP VS UDP)

TCP	UDP
Reliable	Unreliable
Connection-oriented	Connectionless
Segment retransmission and flow control through windowing	No windowing or retransmission
Segment sequencing	No sequencing
Acknowledge segments	No acknowledgement

Layer 4- Transport Layer

Buffering

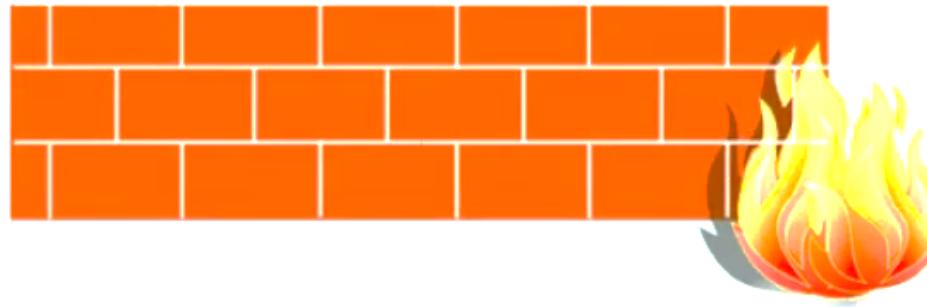
- Devices, such as routers, allocate memory to store segments if bandwidth isn't readily available
- When available, it transmits the contents of the buffer
- If the buffer overflows, segments will be dropped



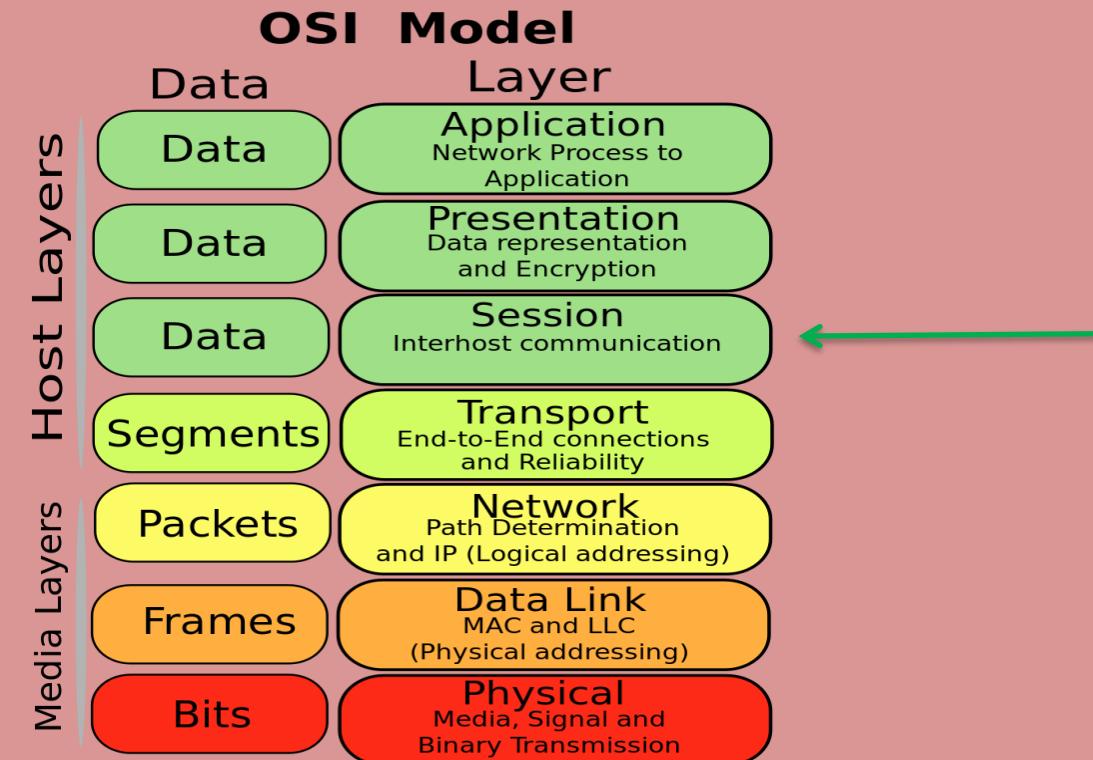
Layer 4- Transport Layer

Examples at Layer- 4

- TCP
- UDP
- WAN Accelerators
- Load Balancers
- Firewalls



The Session Layer: 2-6 Layer (5)



Layer 5- Session Layer

- Think of a session as a conversation that must be kept separate from others to prevent intermingling of the data
- Setting up sessions
- Maintaining sessions
- Tearing down sessions



Layer 5- Session Layer

Setting up Session

- Check user credentials
- Assign numbers to session to identify them
- Negotiate services needed for session
- Negotiate who begins sending data



Layer 5- Session Layer

Maintaining a Session

Maintaining a Session

- Transfer the data
- Reestablish a disconnected session
- Acknowledging receipt of data

Layer 5- Session Layer

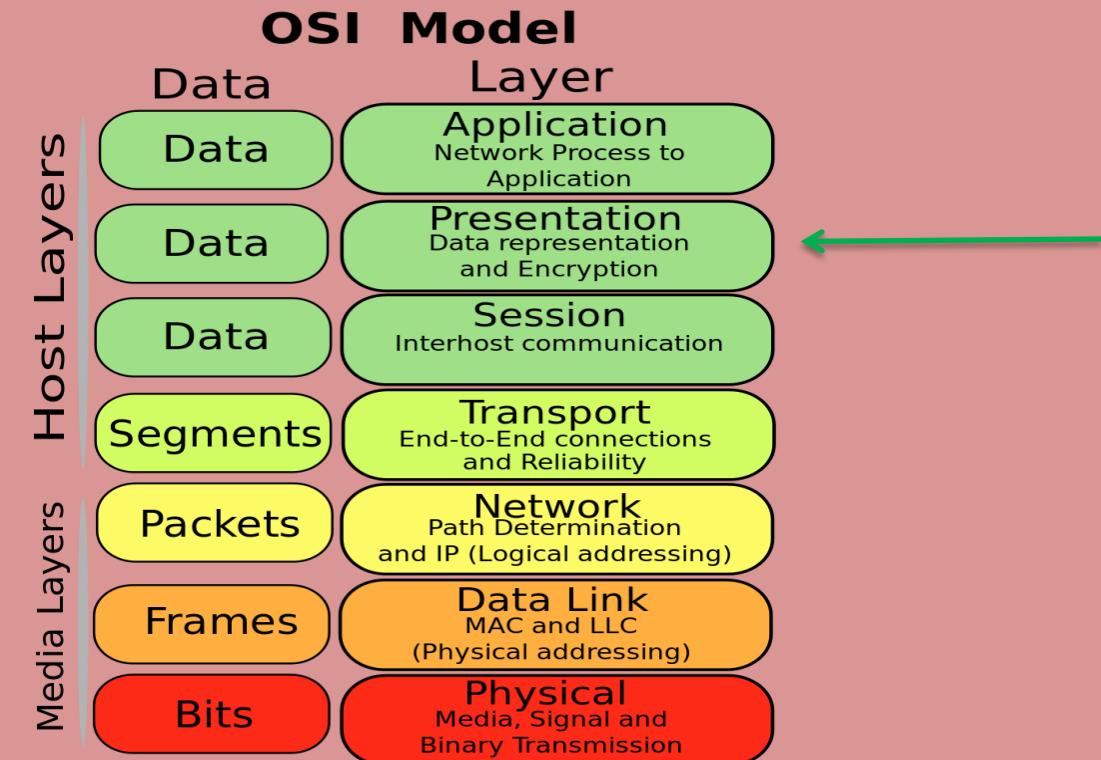
Examples at Layer 5

- H.323
 - Used to setup, maintain, and tear down a voice/video connection
- NetBIOS
 - Used by computers to share files over a network

Face Time- Skype

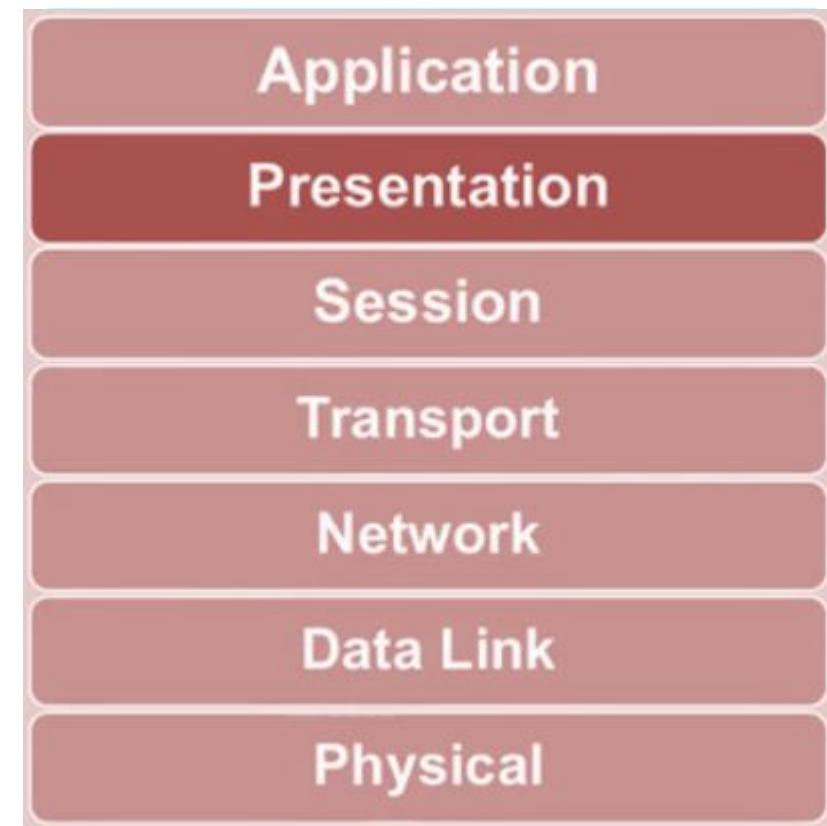
Which Operates over Real Time Protocol ([RTP](#)) using Port 1720 over [TCP](#).

The Presentation Layer: 2-7 Layer (6)



Layer 6- Presentation Layer

- Responsible for formatting the data exchanged and securing that data with proper encryption
- Functions
 - Data formatting
 - Encryption



Layer 6- Presentation Layer

Data Formatting

- Formats data for proper compatibility between devices
 - ASCII
 - GIF
 - JPG
- Ensures data is readable by receiving system
- Provides proper data structures
- Negotiates data transfer syntax for the Application Layer (Layer 7)

01000	.H.....
11011	.g.....
11000	...).P.
10011	.s....SS
10000	H-2.0-Op
01110	enSSH_5.
01001	9p1 Debi
01110	an-5ubur
	tu1.1..

Layer 6- Presentation Layer

Encryption

- Used to scramble the data in transit to keep it secure from prying eyes
- Provides confidentiality of data
- Example:
 - TLS to secure data between your PC and website



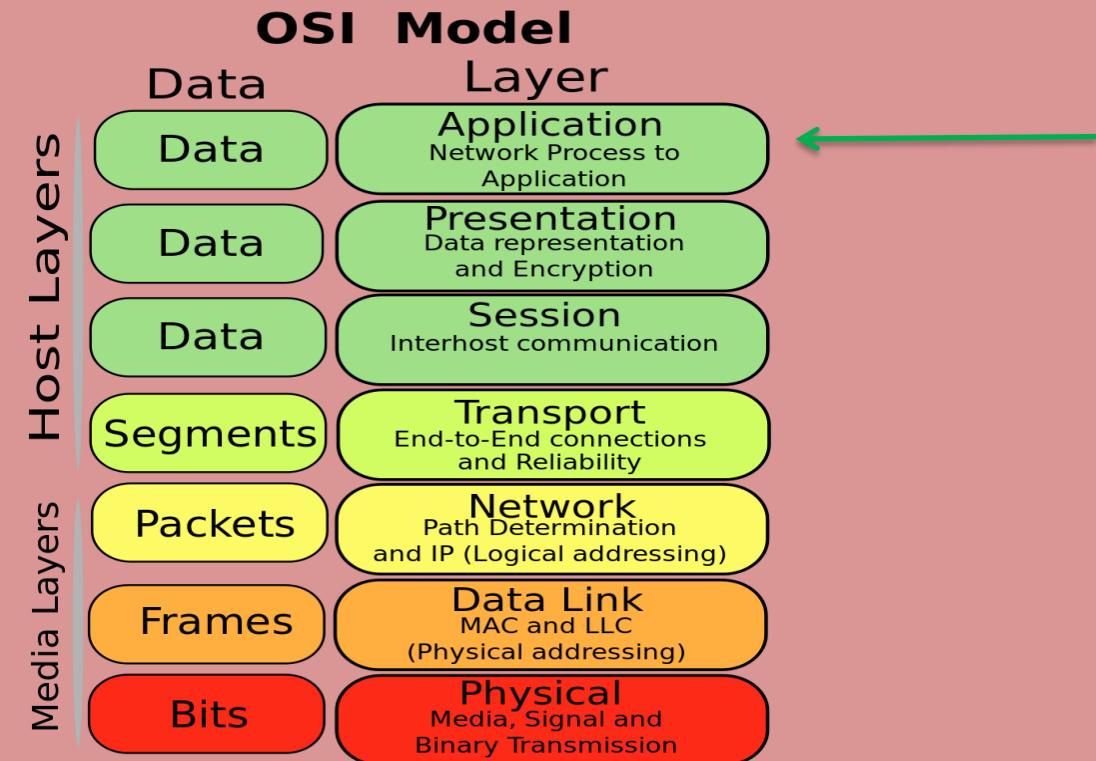
Layer 6- Presentation Layer

Examples at Layer 6

- HTML, XML, PHP, JavaScript, ...
- ASCII, EBCDIC, UNICODE, ...
- GIF, JPG, TIF, SVG, PNG, ...
- MPG, MOV, ...
- TLS, SSL, ...

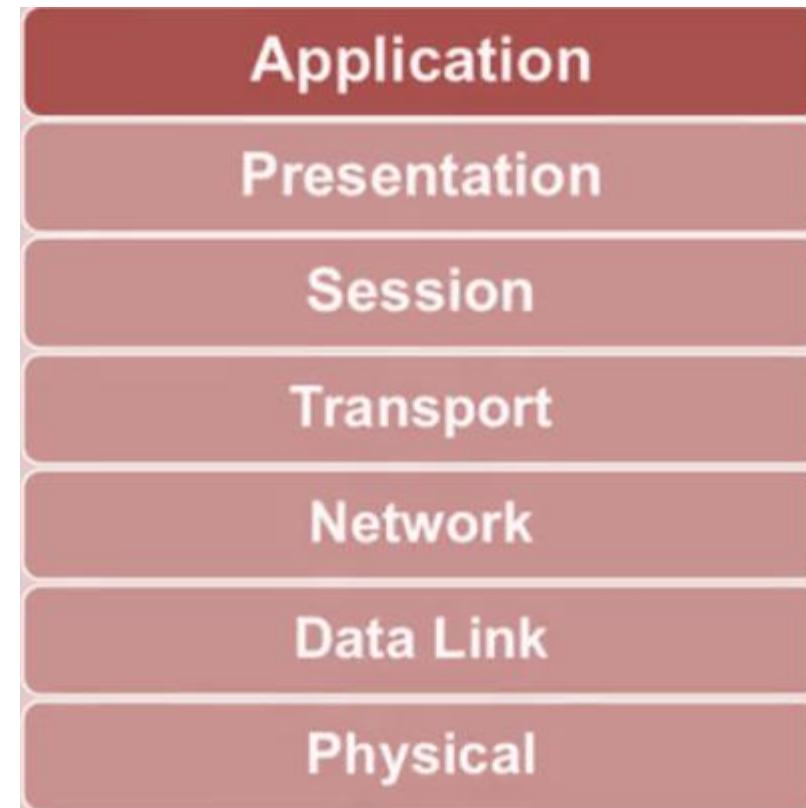


The Application Layer: 2-8 Layer (7)



Layer 7- Application Layer

- Provides application level services
 - Not Microsoft Word or Notepad
- Layer where the users communicate with the computer
- Functions:
 - Application services
 - Service advertisement



Layer 7- Application Layer

Application Services

- Application services unite communicating components from more than one network application

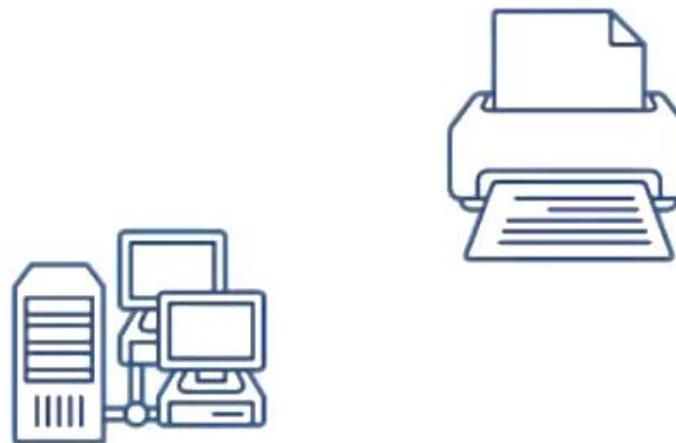
- Examples:
 - File transfers and file sharing
 - E-mail
 - Remote access
 - Network management activities
 - Client/server processes



Layer 7- Application Layer

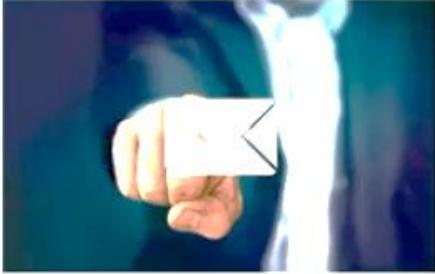
Service Advertisement

- Some applications send out announcements
 - States the services they offer on the network
 - Some centrally register with the Active Directory server instead
- Example:
 - Printers
 - File servers



Layer 7- Application Layer

Examples at Layer 7

- E-mail (POP3, IMAP, SMTP)
- Web Browsing (HTTP, HTTPS)
- Domain Name Service (DNS)
- File Transfer Protocol (FTP, FTPS)
- Remote Access (TELNET, SSH)
- Simple Network Management Protocol (SNMP)

Chapter 2- Questions:



Question#1:

Which of the following reside at the physical layer of the OSI model? (Select 2 answers)

A. IP address

B. Switch

C. Bit

D. Router

E. Network cabling

F. Frame

Question#2:

The application layer of the OSI model is also known as:

- A. Layer 1
- B. Layer 3
- C. Layer 6
- D. Layer 7

Question#3:

What are the characteristic components of the OSI data link layer? (Select 3 answers)

- A. MAC address
- B. Packet
- C. Switch
- D. Network cabling
- E. Router
- F. Frame

Question#4:

Layer 5 of the OSI model is also referred to as:

- A. Session layer
- B. Application layer
- C. Transport layer
- D. Presentation layer

Question#5:

Which of the answers listed below refer to the components that can be found at the OSI network layer? (Select 3 answers)

- A. Router
- B. Network cabling
- C. IP address
- D. TCP/UDP protocols
- E. Switch
- F. Packet

Question#6:

The term "Presentation layer" refers to:

- A. Layer 7 of the OSI model
- B. Layer 5 of the OSI model
- C. Layer 6 of the OSI model
- D. Layer 4 of the OSI model

Question#7:

Layer 2 of the OSI model is known as:

- A. Transport layer
- B. Network layer
- C. Data link layer
- D. Physical layer

Question#8:

Which of the following terms refers to the OSI network layer?

- A. Layer 2
- B. Layer 5
- C. Layer 3
- D. Layer 4

Question#9:

Which of the protocols listed below reside at the OSI transport layer? (Select 2 answers)

- A. UDP
- B. SSL/TLS
- C. ICMP
- D. TCP
- E. ATM

Question#10:

Which OSI layer assumes the responsibility for managing network connections between applications?

- A. Network layer
- B. Data link layer
- C. Application layer
- D. Session layer

Question#11:

Physical layer of the OSI model is also known as:

- A. Layer 2
- B. Layer 7
- C. Layer 1
- D. Layer 4

Question#12:

Layer 4 of the OSI model is also referred to as:

- A. Network layer
- B. Data link layer
- C. Session Layer
- D. Transport layer

Question#13:

Which of the following protocols reside at the application layer of the OSI model?
(Select 3 answers)

A. ATM

B. HTTP

C. FTP

D. IP

E. SMTP

F. TCP/UDP

Question#14:

In telecommunications, Protocol Data Unit (PDU) is a term used for describing a specific unit of data passed across a network.

- A. True
- B. False

Question#15:

Which of the statements listed below is not true?

- A. OSI physical layer PDU is the bit
- B. OSI data link layer PDU is the frame
- C. OSI network layer PDU is the packet
- D. OSI transport layer PDU is the segment
- E. PDUs between OSI session and application layers are referred to simply as the data
- F. All of the above statements are true

Question#16:

Character encoding, data compression and encryption/decryption take place at the:

- A. Application layer of the OSI model
- B. Presentation layer of the OSI model
- C. Session layer of the OSI model
- D. Transport layer of the OSI model

Question#17:

A dedicated communication channel used exclusively between two connected hosts is a characteristic feature of packet-switching networks.

- A. True.
- B. False.

Question#18:

Circuit-switching networks move data divided into small blocks over a shared connection.

- A. True.
- B. False.

Question#19:

The Open Systems Interconnection (OSI) model consists of:

- A. 7 Layers.
- B. 3 Layers.
- C. 9 Layers.
- D. 5 Layers.

Question#20:

In the OSI model, physical addressing takes place at the:

- A. Data link layer
- B. Layer 4
- C. Physical layer
- D. Session layer

Question#21:

What is the name of a data unit used at the OSI physical layer?

- A. Frame
- B. Segment
- C. Bit
- D. Packet

Question#22:

In the OSI model, Media Access Control (MAC) and Logical Link Control (LLC) sublayers are the components of:

- A. Session layer
- B. Data link layer
- C. Transport layer
- D. Network layer

Question#23:

User Datagram Protocol (UDP) resides at: (Select 2 answers)

A. Transport layer

B. Layer 3

C. Layer 4

D. Network layer

E. Layer 6

F. Data link layer

Question#24:

Which OSI layer is responsible for breaking up data into segments?

- A. Network layer
- B. Transport layer
- C. Presentation layer
- D. Data link layer

Question#25:

Transport layer resides between which two other layers of the OSI model?

- A. Network and Session
- B. Presentation and Application
- C. Physical and Network
- D. Physical and Data link

Question#26:

Routers operate at: (Select 2 answers)

- A. Physical layer of the OSI model
- B. Application layer of the OSI model
- C. Layer 3 of the OSI model
- D. Network layer of the OSI model
- E. Layer 5 of the OSI model

Question#27:

At which of the OSI layers IP addressing takes place?

- A. Layer 3
- B. Layer 1
- C. Layer 4
- D. Layer 6

Question#28:

Which of the following devices resides at the data link layer of the OSI model?

- A. Router
- B. Passive hub
- C. Ethernet switch
- D. Repeater

Question#29:

In the OSI model, Transmission Control Protocol (TCP) resides at: (Select 2 answers)

- A. Transport layer
- B. Layer 3
- C. Application layer
- D. Layer 4
- E. Network layer
- F. Layer 7

Question#30:

Which of following protocols reside(s) at the OSI network layer? (Select all that apply)

A. IPv4

B. UDP

C. IPsec

D. TCP

E. IPv6

F. ICMP

Question#31:

Which of the protocols listed below resides at the session layer of the OSI model?

- A. HTTP
- B. UDP
- C. IP
- D. SMTP
- E. PPTP

Question#32:

Internet Protocol Security (IPsec) resides at:

- A. Network layer of the OSI model
- B. Transport layer of the OSI model
- C. Session layer of the OSI model
- D. Presentation layer of the OSI model

End of Chapter (2)

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