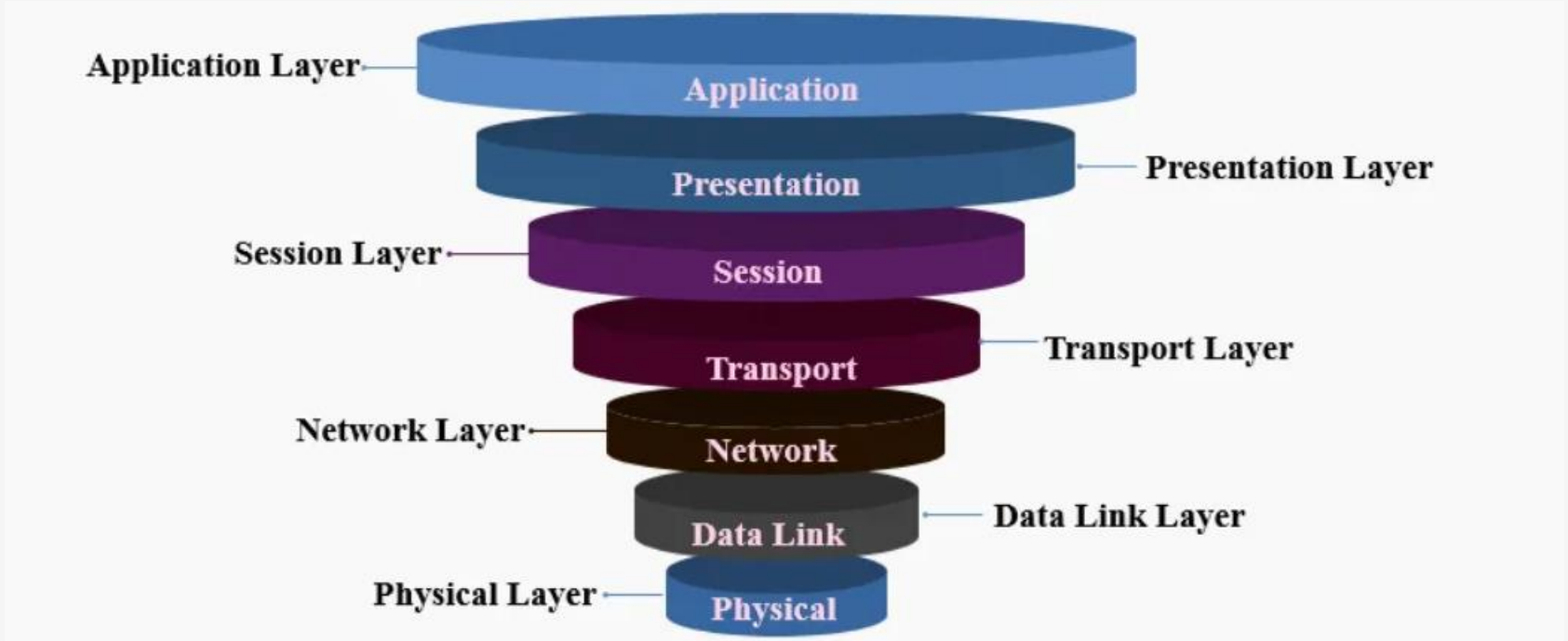
Conceptual Framework, Subnetting, and Static Routing

College of Engineering and Information Technology

Conceptual Framework

- Provides a structured approach to explain the interaction of networking devices.
- Helps to visualize how networks operate and isolate network problems.
- Explains the connectivity to understand the protocols and technology used in computer networks.
- In networking, we have two most common frameworks—OSI and TCP/IP model.

OSI Model


Application Layer
Application
Presentation
Presentation Layer
Session Layer
Session
Transport
Transport Layer
Network Layer
Network
Data Link
Data Link Layer
Physical Layer
Physical

OSI Layers

- **Physical Layer** – responsible for transmission and reception of unstructured raw data between a device. Handles data frames received from the Data Link layer into binary data bits of 1s and 0s.

- **Data Link Layer** - At the data link layer, directly connected nodes are used to perform node-to-node data transfer where data is packaged into frames. The data link layer encompasses two sub-layers of its own. The first, media access control (MAC), provides flow control and multiplexing for device transmissions over a network.

OSI Layers

- **Network Layer** – The network layer is responsible for receiving frames from the data link layer, and delivering them to their intended destinations among based on the addresses contained inside the frame.

  The network layer finds the destination by using logical addresses, such as IP (internet protocol). At this layer, routers are a crucial component used to quite literally route information where it needs to go between networks.

OSI Layers

- **Transport Layer** – The transport layer manages the delivery and error checking of data packets. This is where TCP(transmission control protocol) and UDP(user datagram protocol) takes place.

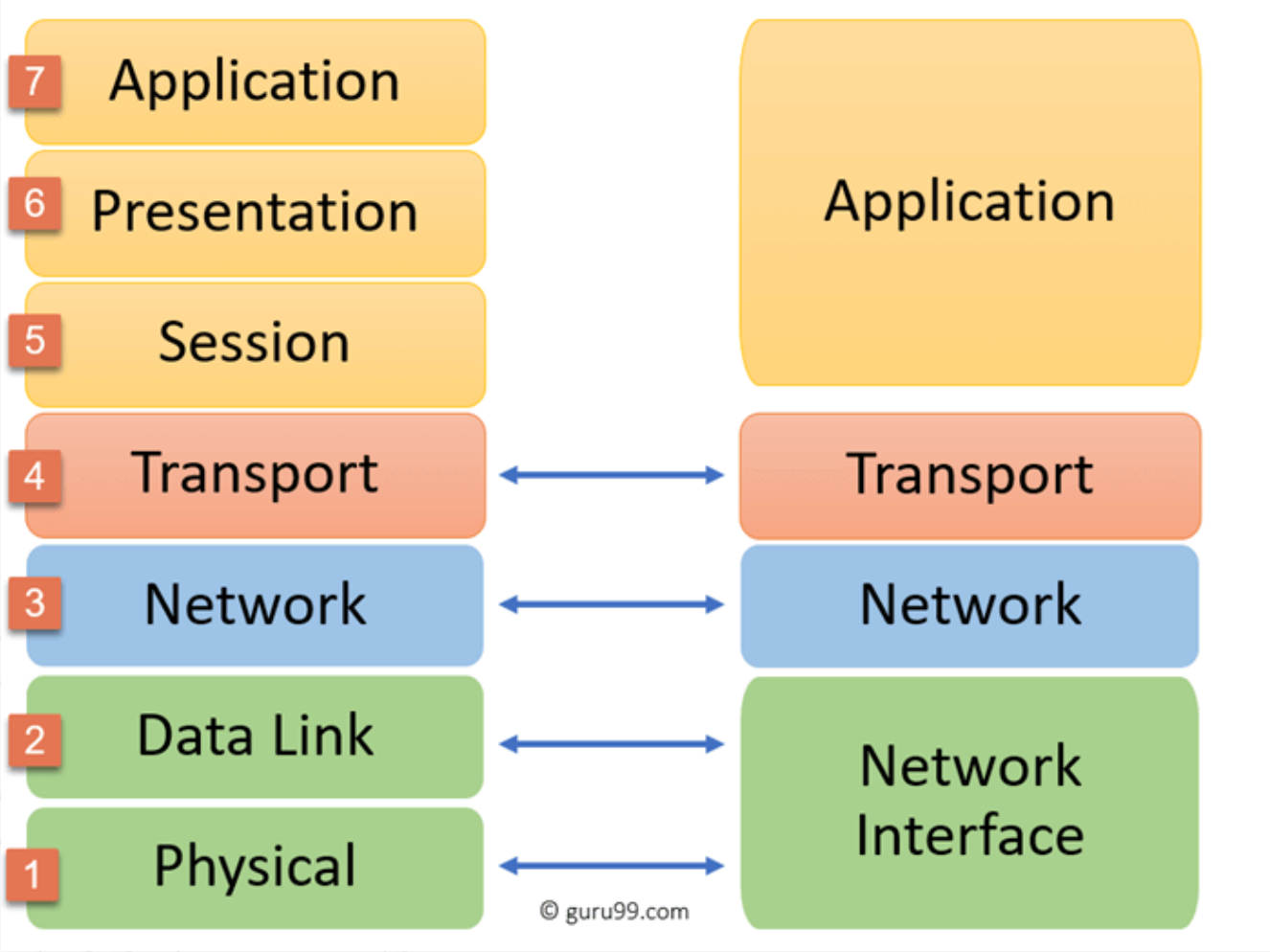
- **Session Layer** - session layer controls the conversations between different computers. A session or connection between machines is set up, managed, and determined at layer 5. Session layer services also include authentication and reconnections.

OSI Layers

- **Presentation Layer** - The presentation layer formats or translates data for the application layer based on the syntax or semantics that the application accepts. Because of this, it at times also called the syntax layer. This layer can also handle the encryption and decryption required by the application layer.

- **Application Layer** - At this layer, both the end user and the application layer interact directly with the software application.

OSI Model vs TCP/IP Model



TCP/IP Model vs OSI Model

- The TCP/IP model provides a practical approach, unlike the OSI model, which is more theoretical.
- The model divides the data into four (4) layers, where the data first goes into each of the layers in order to perform communication.

IP Subnetting

- In subnetting, we are making the mask longer than the default for the IP class.
- This creates sub-networks that allow for the efficient use of the address space.

Class C IP Subnetting

Subnet	1	2	4	8	16	32	64	128	256
Host	256	128	64	32	16	8	4	2	1
CID	/24	/25	/26	/27	/28	/29	/30	/31	/32
Mask	.0	.128	.192	.224	.240	.248	.252.	.254	.255

Problem

- Problem #1 – Create two(2) sub-network from 192.168.0.0 with at least 120 hosts each. Provide the network ID, range, broadcast address and the subnet mask.

  Requirements:
  -120 hosts
  -2 networks

Problem

Problem #1 – Create two(2) sub-networks from 192.168.0.0 with at least 120 hosts each. Provide the network ID, range, broadcast address and the subnet mask.

Requirements:

-120 hosts
-2 networks

Answer:

Network A
Network ID: 192.168.0.0
Range: 192.168.0.1-126
Broadcast: 192.168.1.127
Subnet Mask: 255.255.255.128

Network B
Network ID: 192.168.0.128
Range: 192.168.0.129-254
Broadcast: 192.168.1.255
Subnet Mask: 255.255.255.128

Problem

Problem #2 – Using 172.168.1.0 network ID, create sub-networks that consists of the ff:

Engineering: 60 users
Human Resources: 30 users
Customer Support: 10 users
Research and Development: 2 users

Problem

Problem #2 – Using 172.168.1.0 network, create sub-networks that consists of the ff:

Engineering: 60 users
Human Resources: 30 users
Customer Support: 10 users
Research and Development: 2 users

Answer:

Engineering Network (60 users)
Network ID: 172.168.1.0
Range: 172.168.1-62
Broadcast: 172.168.63
Subnet Mask: 255.255.255.192

Human Resources (30 users)
Network ID: 172.168.1.64
Range: 172.168.65-94
Broadcast: 172.168.1.95
Subnet Mask: 255.255.255.224

Customer Support (10 users)
Network ID: 172.168.1.96
Range: 172.168.1.97-110
Broadcast: 172.168.1.111
Subnet Mask: 255.255.255.240

Research and Development (2 users)
Network ID:172.168.1.112
Range: 172.168.1.113-114
Broadcast: 172.168.1.115
Subnet Mask: 255.255.255.252

Problem

Problem #2 – Using 172.168.1.0 network, create sub-networks that consists of the ff:

Engineering: 60 users
Human Resources: 30 users
Customer Support: 10 users
Research and Development: 2 users

Answer:

Engineering Network (60 users)
Network ID: 172.168.1.0
Range: 172.168.1.1-62
B – 172.168.1.63
Subnet Mask: 255.255.255.192

Human Resources (30 users)
Network ID: 172.168.1.64
Range: 172.168.1.65-94
Broadcast: 172.168.1.95
Subnet Mask: 255.255.255.244

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Customer Support (10 users)
Network ID: 172.168.1.96
Range: 172.168.1.97-110
Broadcast: 172.168.1.111
Subnet Mask: 255.255.255.240

Research and Development (2 users)
Network ID: 172.168.1.112
Range: 172.168.1.113-114
Broadcast: 172.168.1.115
Subnet Mask: 255.255.255.252

Problem

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Answer:

Engineering Network (60 users)
Network ID: 172.168.1.0
Range: 172.168.1.1-62
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Subnet Mask: 255.255.255.192

Human Resources (30 users)
Network ID: 172.168.1.64
Range: 172.168.1.65-94
Broadcast: 172.168.1.95
Subnet Mask: 255.255.255.224

Customer Support (10 users)
Network ID: 172.168.1.96
Range: 172.168.1.97-110
Broadcast: 172.168.1.111
Subnet Mask: 255.255.255.240

Research and Development (2 users)
Network ID: 172.168.1.112
Range: 172.168.1.113-114
Broadcast: 172.168.1.115
Subnet Mask: 255.255.255.252

SEATWORK

Problem #4 – Using 172.168.8.0 network ID, create sub-networks that consists of the ff:

Admin: 12 users
Registrar: 28users
Library: 55 users
Hostel Tropicana: 115 users

Admin
Network ID:
Range:
Broadcast:
Subnet Mask:

Registrar
Network ID:
Range:
Broadcast:
Subnet Mask:

Library
Network ID:
Range:
Broadcast:
Subnet Mask:

Hostel
Network ID:
Range:
Broadcast:
Subnet Mask:

SEATWORK

Problem #4 – Using 172.168.8.0 network ID, create sub-networks that consists of the ff:

Admin: 12 users
Registrar: Resources: 28 users
Library: 55 users
Hostel Tropicana: 115 users

Admin
Network ID: 172.168.8.0
Range: 172.168.8.1-14
Broadcast: 172.168.8.1-15
Subnet Mask: 255.255.255.240

Registrar
Network ID: 172.168.8.16
Range: 172.168.8.17-46
Broadcast: 172.168.8.47
Subnet Mask: 255.255.255.248

Library
Network ID: 172.168.8.48
Range: 172.168.8.49-110
Broadcast: 172.168.8.111
Subnet Mask: 255.255.255.252

Hostel
Network ID: 172.168.8.112
Range: 172.168.8.113-237
Broadcast: 172.168.8.112-238
Subnet Mask: 255.255.255.254

Class A, B, and C

	Public IP Range	Private IP Range	Subnet Mask	# of Networks	# of Hosts per Network
Class A	1.0.0.0 to 127.0.0.0	10.0.0.0 to 10.255.255.255	255.0.0.0	126	16,777,214
Class B	128.0.0.0 to 191.255.0.0	172.16.0.0 to 172.31.255.255	255.255.0.0	16,382	65,534
Class C	192.0.0.0 to 223.255.255.0	192.168.0.0 to 192.168.255.255	255.255.255.0	2,097,150	254

Class B IP Subnetting

et	1	2	4	8	16	32	64	128	256
	65536	3 2768	16384	8192	4096	2048	1024	512	256
	/16	/17	/18	/19	/20	/21	/22	/23	/24
et Mask	255.255.0.0	255.255.128.0	255.255.192.0	255.255.224.0	255.255.240.0	255.255.248.0	255.255.252.0	255.255.254.0	255.255.25

Problem

- Problem #5 – Create four(4) sub-networks from 172.16.0.0 with at least 15000 hosts each. Provide the network ID, range, broadcast address and the subnet mask.

  Requirements:

  -15000 hosts

  -4 networks

Problem

- Problem #5 – Create four(4) sub-networks from 172.16.0.0 with at least 15000 hosts each. Provide the network ID, range, broadcast address and the subnet mask.

Answer:

Network A
Network ID: 172.16.0.0
Range: 172.16.0.1-172.16.63. 254
Broadcast: 172.16.63.255
Subnet Mask: 255.255.192.0

Network B
Network ID: 172.16.64.0
Range: 172.16.64.1-172.16.127.254
Broadcast: 172.16.127.255
Subnet Mask: 255.255.192.0

Network C
Network ID: 172.16.128.0
Range:172.16.128.1-172.16.191.254
Broadcast: 172.16.191.255
Subnet Mask: 255.255.192.0

Network D
Network ID: 172.16.192.0
Range: 172.16.192.1-172.16.255.254
Broadcast: 172.16.255.255
Subnet Mask: 255.255.192.0

Seatwork

- Problem #6 – Create two(2) sub-networks from 172.16.0.0 with at least 2800 hosts each. Provide the network ID, range, broadcast address and the subnet mask.

Answer:

Network A
Network ID: 172.16.0.0
Range: 172.16.0.1-172.16.15.254
Broadcast: 172.16.15.255
Subnet Mask: 255.255.240.0

Network B
Network ID: 172.16.16.0
Range: 172.16.16.1-31.254
Broadcast: 172.16.31.255
Subnet Mask: 255.255.240.0

Problem

- Problem #6 – Create four(2) sub-networks from 172.16.0.0 with at least 2800 hosts each. Provide the network ID, range, broadcast address and the subnet mask.

Answer:

Network A
Network ID: 172.16.0.0
Range: 172.16.0.1-172.16.127.254
Broadcast: 172.16.127.255
Subnet Mask: 255.255.128.0

Network B
Network ID: 172.16.128.0
Range: 172.16.128.1-172.16.255.254
Broadcast: 172.16.255.255
Subnet Mask: 255.255.128.0

Seatwork

- Problem #6 – Create four(4) sub-networks from 172.16.0.0. Provide the network ID, range, broadcast address and the subnet mask.

Network 1 - 10,000 users
Network 2 – 7,500 users
Network 3 – 20,000 users
Network 4 –

Answer:

Network A
Network ID: 172.16.0.0
Range: 172.16.0.1-172.16.63.254
Broadcast: 172.16.63.255
Subnet Mask: 255.255.192.0

Network B
Network ID: 172.16.64.0
Range: 172.16.64.1-172.16.95.254
Broadcast: 172.16.95.255
Subnet Mask: 255.255.224.0

Network C
Network ID: 172.16.96.0
Range: 172.16.96.1-172.16.223.254
Broadcast: 172.16.223.255
Subnet Mask:255.255.128.0

Network D | 3,500
Network ID: 172.16.224.0
Range: 172.16.224.1-172.16.239.254
Broadcast: 172.16.239.255
Subnet Mask: 255.255.40.0

Seatwork

- Problem #6 – Create four(4) sub-networks from 172.16.0.0. Provide the network ID, range, broadcast address and the subnet mask.

Network 1 - 10,000 users
Network 2 – 7,500 users
Network 3 – 20,000 users
Network 4 –

Answer:

Network A
Network ID: 172.16.0.0
Range: 172.16.0.1-63.254
Broadcast: 172.16.63.255
Subnet Mask: 255.255.192.0

Network B
Network ID: 172.16.64.0
Range: 172.16.64.1-172.16.95.254
Broadcast: 172.16.95.255
Subnet Mask: 255.255.224.0

Network C
Network ID: 172.16.96.0
Range: 172.16.96.1-172.16.223.254
Broadcast: 172.16.223.255
Subnet Mask: 255.255.192.0

Network D | 3,500
Network ID: 172.16.224.0
Range: 172.16.224.1-172.16.239.254
Broadcast: 172.16.239.255
Subnet Mask: 255.255.240.0

Seatwork

- Problem #7 – Create four(4) sub-networks from 172.16.0.0. Provide the network ID, range, broadcast address and the subnet mask.

Network 1 - 50,780 users
Network 2 – 4,500 users
Network 3 – 30,000 users
Network 4 –

Answer:

Network A
Network ID:
Range:
Broadcast:
Subnet Mask:

Network B
Network ID:
Range:
Broadcast:
Subnet Mask:

Network C
Network ID:
Range:
Broadcast:
Subnet Mask:

Network D | 1,500
Network ID:
Range:
Broadcast:
Subnet Mask:

Seatwork

- Problem #7 – Create four(4) sub-networks from 172.16.0.0. Provide the network ID, range, broadcast address and the subnet mask.

Network 1 – 15,000 users
Network 2 – 4,500 users
Network 3 – 30,000 users
Network 4 –

Answer:

Network A
Network ID: 172.16.0.0
Range: 172.16.0.1-172.16.63.254
Broadcast: 172.16.63.255
Subnet Mask: 255.255.192.0

Network B
Network ID: 172.16.64.0
Range: 172.16.64.1-172.16.95.254
Broadcast: 172.16.95.255
Subnet Mask: 255.255.224.0

Network C
Network ID: 172.16.96.0
Range: 172.16.96.1-172.16.223.254
Broadcast: 172.16.223.255
Subnet Mask: 255.255.128.0

Network D | 1,500
Network ID: 172.16.224.0
Range: 172.16.224.1-172.16.232.254
Broadcast: 172.16.233.255
Subnet Mask: 255.255.248.0

Routing

- The term routing is used for taking a packet from one device and sending it through the network to another network.
- Router uses routing table to make decisions.
- Routing can be manually or dynamically configured.

Static Routing

- Static routing manually enter route information and uses
- simple routing algorithms and provides more security than dynamic routing.
- It does not handle failures in external networks well.

Configuration:

- ip route <destination network> <subnet mask> <next hop ip address>

Sources

- Forcepoint Cyber Edu. "OSI Model." Forcepoint Cyber Edu, https://www.forcepoint.com/cyber-edu/osi-model.