

Assignment 4

Theory

1. IP Addressing Basics IPv4 and IPv6 Addressing

- IPv4 (Internet Protocol Version 4):
 - Uses a 32-bit addressing scheme
 - allows around 4.3 billion unique addresses
 - written in decimal format, separated by dots (For Ex: 192.168.1.1)
- IPv6 (Internet Protocol Version 6):
 - Uses a 128-bit addressing scheme
 - written in hexadecimal format, separated by colons (For Ex: 1011:09pa:00a2:0000:0000:9fe3:9102:4332).
- Public vs. Private IP Addresses
- Public IP Addresses:
 - Routable on the internet and assigned by ISPs (For Ex 8.8.8.8).
- Private IP Addresses:
 - Used within local networks and not routable on the internet. Their Address Ranges are: Class A: 10.0.0.0 – 10.255.255.255 Class B: 172.16.0.0 – 172.31.255.255 Class C: 192.168.0.0 – 192.168.255.255
- Subnet Masks
- A subnet mask defines the network and host portions of an IP address.
- For Ex: 255.255.0.0 indicates that the first two octets represent the network and the last two octet represents hosts.

2. Subnetting CIDR Notation and Its Role in Subnetting:

- CIDR: Classless Inter-Domain Routing
- A method to allocate IP addresses efficiently by eliminating the rigid class-based addressing system.
- Expressed using a suffix (For Ex: 192.168.1.0/24 means 24 bits for the network, 8 bits for hosts).
- Subnetting allows networks to be divided into smaller subnetworks, improving security and reducing IP wastage.
- Example: Splitting 192.168.1.0/24 into four subnets:
 - 192.168.1.0/26
 - 192.168.1.64/26
 - 192.168.1.128/26
 - 192.168.1.192/26

3. Supernetting Definition and Advantages:

- Supernetting: The process of combining multiple smaller networks into a larger one by modifying the subnet mask.
- Reduces the number of routing table entries, improving efficiency.
- Helps ISPs aggregate multiple customer networks. Real-World Applications:
 - Used in ISP route aggregation to reduce the number of advertised routes.
 - Helps in enterprise network management by consolidating multiple subnets.
- Example: Combining four /26 networks (192.168.1.0/26, 192.168.1.64/26, 192.168.1.128/26, 192.168.1.192/26) into a single /24 network (192.168.1.0/24). ## Practical

1. **Subnetting a Corporate Network** Departments:
 1. HR: 50 Hosts
 2. IT: 100 Hosts
 3. Finance: 30 Hosts Subnets Sizes Subnets Are Sized by Powers of 2. Therefore nearest power of 2 for each department. Subnets are determined by the formula: Subnet = 32 - Number of Bits
 4. HR: 64 [6 Bits, /26 Subnet]
 5. IT: 128 [7 Bits, /25 Subnet]
 6. Finance: 32 [5 Bits, /27 Subnet] Subnet Assignment: (Allocating Sequentially We Have)
2. IT (/25)
 - Network Address: 192.168.1.0/25
 - Broadcast Address: 192.168.1.127
 - Subnet Mask: 255.255.255.128
 - Usable IPs: 192.168.1.1 – 192.168.1.126
2. HR (/26)
 - Network Address: 192.168.1.128/26
 - Broadcast Address: 192.168.1.191
 - Subnet Mask: 255.255.255.192
 - Usable IPs: 192.168.1.129 – 192.168.1.190
3. Finance (/27)
 - Network Address: 192.168.1.192/27
 - Broadcast Address: 192.168.1.223
 - Subnet Mask: 255.255.255.224
 - Usable IPs: 192.168.1.193 – 192.168.1.222
2. Subnetting an ISP Network Supernetting combines multiple contiguous networks into a single network. This reduces the number of routing table entries, Thus improving efficiency. Given Networks:
 - 192.168.10.0/24
 - 192.168.11.0/24
 - 192.168.12.0/24
 - 192.168.13.0/24 Finding Common Bits in the Network Address Since the subnet is /24, the third octet changes and is relevant. Thus, we find common bits in the third octet. Given Values in 8 Bits:
 - 10 : 00001010
 - 11 : 00001011
 - 12 : 00001100
 - 13 : 00001101 We can See here, that only the last 6 bits remain constant. thus, to include all 4 networks we need a /22 Mask. (16 + 6 = 22) 16 for the first 2 octets, 6 for the 3rd one New Network addresses Since the new Subnet mask is /22, The Network Address 192.168.10.0/22 would cover all the four networks. Advantages

- For the router, it reduces the number of entries in the routing table. (from 4 /24 Entries to 1 /22)
 - The lower entry count improves efficiency and simplifies the network Management for Larger Networks.
3. Subnetting a University Network Departments:
 1. Engineering: 2,000 hosts
 2. Medical: 1,500 hosts
 3. Management: 1,000 hosts
 4. Library: 500 hosts
 5. Admin: 300 hosts

Subnets Sizes Subnets Are Sized by Powers of 2. Therefore nearest power of 2 for each department. Subnets are determined by the formula: Number of Bits are the nearest larger power of 2. Subnet = 32 - Number of Bits
 4. Engineering: 2048 [11 Bits, /21 Subnet]
 5. Medical: 2048 [11 Bits, /21 Subnet]
 6. Management: 1024 [10 Bits, /22 Subnet]
 7. Library: 512 [9 Bits, /23 Subnet]
 8. Admin: 512 [9 Bits, /23 Subnet] Subnet Assignment: (Allocating Sequentially We Have)
 9. Engineering (/21)
 - Network Address: 172.16.0.0/21
 - Broadcast Address: 172.16.7.255
 - Usable IPs: 172.16.0.1 – 172.16.7.254
 - Subnet Mask: 255.255.248.0
 2. Medical (/21)
 - Network Address: 172.16.8.0/21
 - Broadcast Address: 172.16.15.255
 - Usable IPs: 172.16.8.1 – 172.16.15.254
 - Subnet Mask: 255.255.248.0
 3. Management (/22)
 - Network Address: 172.16.16.0/22
 - Broadcast Address: 172.16.19.255
 - Usable IPs: 172.16.16.1 – 172.16.19.254
 - Subnet Mask: 255.255.252.0
 4. Library (/23)
 - Network Address: 172.16.20.0/23
 - Broadcast Address: 172.16.21.255
 - Usable IPs: 172.16.20.1 – 172.16.21.254
 - Subnet Mask: 255.255.254.0
 5. Admin (/23)
 - Network Address: 172.16.22.0/23

- Broadcast Address: 172.16.23.255
- Usable IPs: 172.16.22.1 – 172.16.23.254
- Subnet Mask: 255.255.254.0