Group Members:

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Documentation of Advanced networking assignment

1. Purpose of subnetting:

Subnetting is a networking technique used to divide a larger IP network into smaller, more manageable subnetworks, or subnets. The primary purposes of subnetting are as follows:

- Efficient IP Address Allocation: This helps in allocating IP addresses more precisely after diving the larger networks into smaller networks
- Network Segmentation: this helps in network management and network traffic in the organization's departments

2. What is a subnet mask?

A subnet mask is a 32-bit numerical value used in IP (Internet Protocol) networking to define the boundaries of IP subnets. It works with an IP address to determine which part of the address identifies the network and which part identifies the host within that network.

A subnet mask consists of a series of binary ones (1s) followed by a series of binary zeros (0s). The ones in the mask indicate the network portion of the IP address, and the zeros indicate the host portion. When applied to an IP address using a process called "bitwise AND," the subnet mask extracts the network portion of the address.

3. What is the formula to calculate the number of subnets in a given subnet mask?

When finding all sunsets to be in a network we use this formula:

Number of Subnets = 2^(32 - Subnet Mask Length)

In this formula :

- 32: represents the total number of bits in an ipv4 address
- Subnet Mask length is the number of bits set to “1” in a subnet mask

4. What is the maximum number of hosts in a subnet with a subnet mask of 255.255.255.224?

Firstly we have 4 octets then 3 first ones are full, but what about the last one

To find the n of available hosts in the last host portion = (255-224)+1=32 hosts

Then **Maximum n of hosts in each subnet = 32-2=*30***

We subtracted 2 ips representing the network address and the broadcast address

5. What is the network address for the IP address 192.168.1.100/27?

Data given:

- **IP address: 192.168.1.100**
- **Ip address in binary: 11000000.10101000.00000001.01100100**
- **Subnet mask: /27 -> 255.255.255.224**

- **Subnet mask: 11111111.11111111.11111111.11100000**

Then to find the Net address we use AND bitwise operator:
Network address = IP address AND SubnetMask

11000000.10101000.00000001.01100100
AND
11111111.11111111.11111111.11100000

Which will give Network address in binary =
11000000.10101000.00000001.01100000

Thus Network address = 192.168.1.96

6. How many host bits and network bits are there in a subnet with a subnet mask of 255.255.255.128?

First of all, subnet mask in binary = 111111111.11111111.11111111.10000000

We know that host bits are non-zero bits in the host portion which are 7 bits

To means that there are ***7 host bits and 25 network bits in 255.255.255.128***

7. What is the broadcast address for the IP address 192.168.1.50/26?

Given data:

- IP address 192.168.1.50
- IP address in binary: 11000000.10101000.00000001.00110010
- Subnet mask: 255.255.255.192
- The subnet mask in binary: 11111111.11111111.11111111.11000000
- Inverted binary subnet mask:
  00000000.00000000.00000000.00111111

The formula for broadcast address = IP ADDRESS OR INVERTED-SUBNET MASK

Broadcast address =
11000000.10101000.00000001.00110010
OR
00000000.00000000.00000000.00111111

*Broadcast address in binary = 11000000.*10101000.00000001.00111111

Broadcast address in decimal = 192.168.1.63

8. How does subnetting help reduce network congestion?

- ***Segmentation of network traffic***: Subnetting divides a larger network into smaller subnets. Each subnet can host a specific group of devices or services, and traffic within a subnet remains localized. This segmentation prevents broadcast traffic and unnecessary data packets from overwhelming the entire network, reducing congestion.
- ***Efficient Use of IP Addresses***: Subnetting allows for the efficient allocation of IP addresses. Without subnetting, a single large network might waste IP addresses as not all devices require public IP addresses. Subnetting ensures that only the necessary devices are assigned IP addresses, reducing address exhaustion and the associated congestion.
- ***Isolation of Network Issues***: In a subnetted network, network issues or traffic spikes within one subnet are less likely to affect other subnets. Isolation can contain problems to a specific area of the network, preventing them from spreading and causing congestion across the entire network.
- ***Traffic Prioritization:*** Subnetting is used with QoS(Quality of Service). This means that the traffic is segmented in subnetting

depending on the priority type concerning certain criteria like time sensitivity.

9. You have sub-netted your class C network 192.168.1.0 with a subnet mask of 255.255.255.240. Please list the following: number of networks, number of hosts per network, the full range of the first three networks, and the usable address range from those first three networks.

Given data:

- **IP address: 192.168.1.0**
- **Subnet mask: 255.255.255.240(/28 in CIDR)**

Required:

- N of subnets
- N of hosts per subnet
- Details for the first 3 subnets

a. Number of subnets
   N of subnets = 2^(32- subnet mask length)=2^(32-28)=2^4 = 16
   N of subnets = 16 networks

b. Number of hosts per subnet
   Host bits = 4
   N of hosts = 2^(host bits)= 2^(4)= 16

   Precisely usable n of hosts as = 16-2 = 14

c. Full range of first 3 networks(subnets)
   i. Network 1
      - Network address: 192.168.1.0
      - Usable hosts range: 192.168.1.1-192.168.1.14
      - Broadcast address: 192.168.1.15

ii. Network 2

- Network address: 192.168.1.16
- Usable hosts range: 192.168.1.17-192.168.1.30
- Broadcast address: 192.168.1.31

iii. Network 3

- Network address: 192.168.1.32
- Usable hosts range: 192.168.1.33-192.168.1.46
- Broadcast address: 192.168.1.47

10. You have sub-netted your class C network 200.138.1.0 with a subnet mask of 255.255.255.252. Please list the following: number of networks, number of hosts per network, the full range of the first three networks, and the usable address range from those first three networks. Additionally, identify the broadcast addresses for each network.

Given data:

- **IP address:** 200.138.1.0
- **Subnet mask:**255.255.255.252**(/30 in CIDR)**

Required:

- N of subnets
- N of hosts per subnet
- Details for the first 3 subnets

d. Number of subnets
N of subnets = 2^(32- subnet mask length)=2^(32-30)=2^2 = 4
N of subnets = 4 networks

e. Number of hosts per subnet
   Host bits = 2
   N of hosts = 2^(host bits)= 2^(2)= 4

   Precisely usable n of hosts as = 4-2 = 2

f. Full range of first 3 networks(subnets)
   i. Network 1
      - Network address: 200.138.1.0
      - Usable hosts range:200.138.1.1-200.138.1.14
      - Broadcast address: 200.138.1.15

   ii. Network 2
      - Network address: 200.138.1.16
      - Usable hosts range: 200.138.1.17-200.138.1.30
      - Broadcast address:200.138.1.31

   iii. Network 3
      - Network address: 200.138.1.32
      - Usable hosts range: 200.138.1.33-200.138.1.46
      - Broadcast address: 200.138.1.47

11. What is the private IP address range for Class A, B, and C networks?

Full range of first 3 networks(subnets)

Class A

- Network address: **10.0.0.0**
- Subnet mask**: 255.0.0.0**
- Reserved IP range**: 10.0.0.0-10.255.255.255**
- Usable hosts range:**10.0.0.1-10.255.255.254**
- This range allows for over 16 million usable host addresses.

Class B

- Network address: **172.16.0.0-172.31.0.0**
- Subnet mask**: 255.240.0.0**
- Reserved IP range**: 172.16.0.0 to 172.31.255.255**
- Usable hosts range: **from 172.16.0.1 to 172.31.255.254**
- Each of the 16 Class B networks allows for over 65,000 usable host addresses.

Class C

- Network address: **192.168.0.0**
- Subnet mask**: 255.255.0.0**
- Reserved IP range**: 192.168.0.0 to 192.168.255.255**
- Usable hosts range:**192.168.0.1 to 192.168.255.254**
- This range allows for over 65,000 usable host addresses.

12. What is the difference between Private and Public IP addresses?

Public IP address: the IP address that is used to communicate outside the network.
This IP is mainly of two basic types namely:

- Dynamic IP address: these are the address that changes over time. After connecting the smartphone or computer to internet , the ISP provides the address

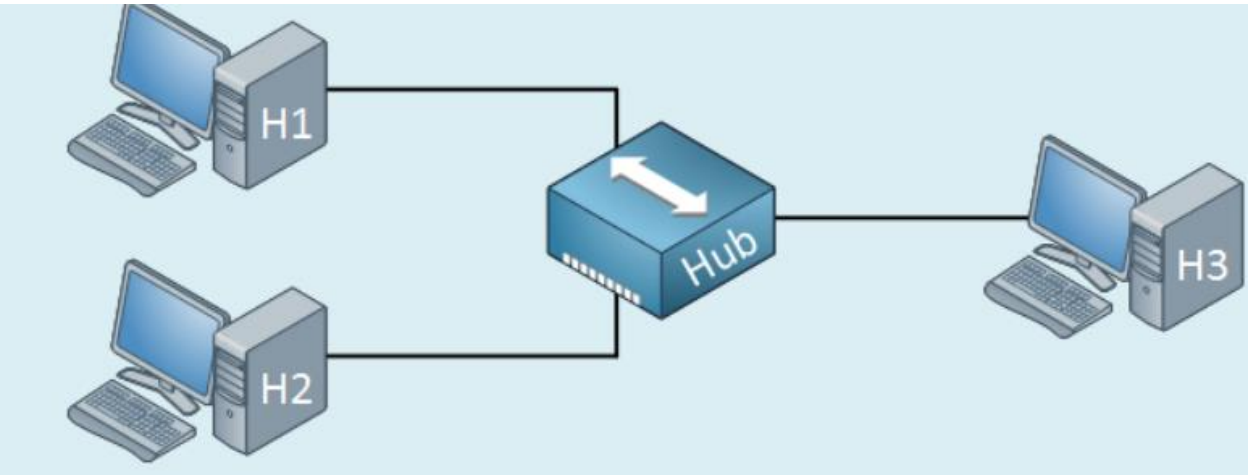
- Static IP address: they don't change over time. They are mostly used by the DNS-Servers

Private IP address: is the IP address that is used to communicate within the same network.It is mostly assigned by the router.

Public IP address	**Private IP address**
The scope of Private IP is local.	The scope of Private IP is global.
It is used to communicate within the network.	It is used to communicate outside the network.
Private IP addresses of the systems connected in a network differ uniformly.	Public IP may differ in a uniform or non-uniform manner.
It works only on LAN.	It is used to get internet service.
It is used to load the network operating system.	It is controlled by ISP.
It is available free of cost.	It is not free of cost.
Private IP can be known by entering "ipconfig" on the command prompt. Range: ● 10.0.0.0 – 10.255.255.255, ● 172.16.0.0 – 172.31.255.255, ● 192.168.0.0 – 192.168.255.255	Public IP can be known by searching "what is my ip" on Google. Range: Besides private IP addresses, the rest are public.
Example: 192.168.1.10	Example: 17.5.7.8
Private IP uses numeric code that is	Public IP uses a numeric code that

not unique and can be used again	is unique and cannot be used by other
Private IP addresses are secure	The public IP address has no security and is subjected to attack
Private IP addresses require NAT to communicate with devices	Public IP does not require a network translation

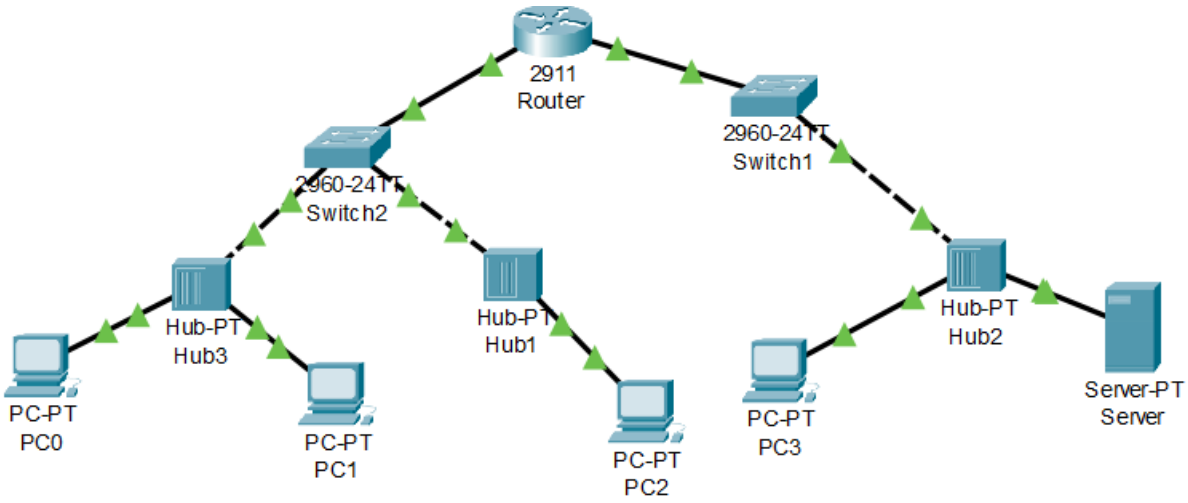
13. How many collision domains are in the below network where 3 PCs are connected to hub ports?



There is only 1 collision domain

This is because hub is not a collision domain separator all the devices connected to its port share the same collision domain.

14. How many broadcast domains and collision domains are available in the given network considering that the network has not been segmented into VLANs?



The above topology has 2 broadcast and 5 collision domains

Below is some info on how I got the above answer.

First of all
Broadcast domain: is the network segment where two devices can send the broadcast domain at the same time and then collision happens/occurs.

While

Collision domain: is the network segment where two devices can send a message to another device simultaneously any other device is trying to send a message too resulting in the collision in the same segment.

While in the network when going to explain these broadcast domain and collision domain we will need three main devices namely

- **Router**
- **Switch**
- **Hub**

a. **Hub**

This network device is also known as the multi-port repeater and this device can't segment the network into further networks. So when talking about the collision domain and broadcast domain don't separate any of the domains into further domains too. To mean in hub we have a single domain for both broadcast and collision.

b. Switch

This device is also known as a multi-port bridge which means that it can segment the network into further networks. But when it comes to the broadcast and collision domain, the switch is only capable of separating the collision domain as each port on it has its unique/own collision domain and continues with the single broadcast domain.

c. Router

This device can be called a dual separator as it can segment both collision and broadcast domains into further domains depending on the network involved. This means two or more networks linked together with a router each has its own broadcast and collision domain different from another network.

15. ***Below are the configuration commands for the required criteria***

a. Interface configurations on both router's interfaces

Firstly On all Routers

➢ Permit sudo privileges by

☐ enable

➢ Enter configurations terminal

configure terminal

On 1st Router

➢ Change the hostname

☐ hostname Router1

- ➢ Configure the first interface
  - ☐ interface GigabitEthernet0/0/0
  - ☐ ip address 192.0.2.1 255.255.255.0
- ➢ Save and up the connection
  - ☐ no shutdown
- ➢ Exit in interface-1 terminal
  - ☐ exit
- ➢ Configure the second interface
  - ☐ interface GigabitEthernet0/0/1
  - ☐ ip address 10.10.0.1 255.255.255.252
- ➢ Save and up the connection
  - ☐ no shutdown

For 2nd Router

- ➢ Change the hostname
  - ☐ hostname Router2
- ➢ Configure the first interface
  - ☐ interface GigabitEthernet0/0/0
  - ☐ ip address 10.10.0.2 255.255.255.252
- ➢ Save and up the connection
  - ☐ no shutdown
- ➢ Exit in interface-1 terminal
  - ☐ exit
- ➢ Configure the second interface
  - ☐ interface GigabitEthernet0/0/1
  - ☐ ip address 203.0.113.1 255.255.255.0
- ➢ Save and up the connection
  - ☐ no shutdown

b. DHCP configuration for both schools

On 1st Router

- ➢ Exclude default gateway
  - ☐ ip dhcp excluded-address 192.0.2.1
- ➢ Configure the pool named “School1”
  - ☐ ip dhcp pool School1
- ➢ Configure the default gateway for the pool
  - ☐ default-gateway 192.0.2.1
- ➢ Configure the network and its size(netmask)
  - ☐ network 192.0.2.0 255.255.255.0
- ➢ Exit in dhcp-conf terminal and conf terminal then save by writing to the memory
  - ☐ exit
  - ☐ wr

For 2nd Router

- ➢ Exclude default gateway
  - ☐ ip dhcp excluded-address 203.0.113.1
  - ☐ Ip dhcp excluded-address 203.0.113.2
- ➢ Configure the pool named “School2”
  - ☐ ip dhcp pool School2
- ➢ Configure default gateway for the pool
  - ☐ default-gateway 203.0.113.1
- ➢ Configure the network and its size(netmask)
  - ☐ network 203.0.113.0 255.255.255.0
- ➢ Exit in dhcp-conf terminal and conf terminal then save by writing to the memory
  - ☐ wr

c. Network static route configurations for both two networks(School1 and school2)

For 1st Router(Router1)

- ➢ Enter configure terminal
  - ☐ configure terminal

- ➢ Configure for the destination network and then valid next-hop address
  - ☐ ip route 203.0.113.0 255.255.255.0 10.10.0.2
- ➢ Exit the configure terminal and write to memory
  exit
  - ☐ wr
  - ☐

For 2nd Router(Router2)

- ➢ Enter configure terminal
  - ☐ configure terminal
- ➢ Configure for the destination network and then valid next-hop address
  - ☐ ip route 192.0.2.0 255.255.255.0 10.10.0.1
- ➢ Exit the configure terminal and write to memory
  - ☐ exit
  - ☐ wr

d. Floating static route on router Router2

On 2nd Router(Router2)

- ➢ Enter configure terminal
  - ☐ configure terminal
- ➢ Configure for the destination network and then valid next-hop address and then specify the administrative distance(AD) as the condition for this route to be used

  - ☐ ip route 192.0.2.0 255.255.255.0 10.10.0.1 92

  This means that the route will be used when all other routes with AD<92 are failed.

- ➢ Exit the configure terminal and write to memory
  - ☐ exit
  - ☐ wr

e. Default static route on router Router1

On 1st Router(Router1)

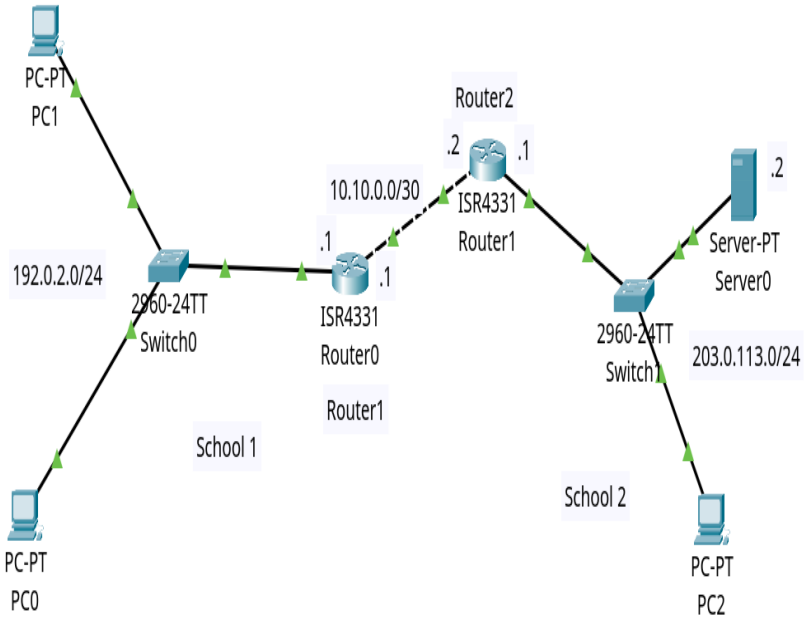
- ➢ Enter configure terminal
  - ☐ configure terminal
- ➢ Configure for the destination network(both IP and netmask) and then valid next-hop address

  - ☐ ip route 0.0.0.0 0.0.0.0 10.10.0.2

  This specifies that the packet going to any network in the same format as specified will be passing the specified next-hop address which is 10.10.0.2

- ➢ Exit the configure terminal and write to memory
  - ☐ exit
  - ☐ wr

- Cisco Packet's file for CYIZA Kenny Debrice



I'm CYIZA Kenny Debrice and from this exhibit

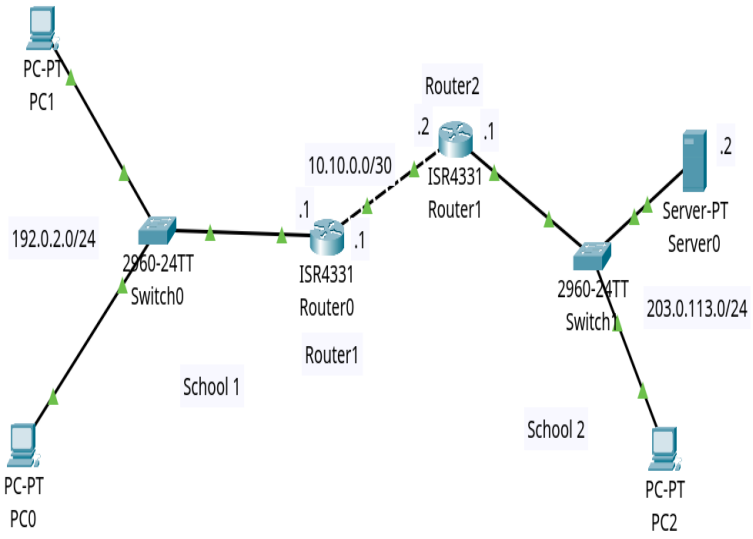
I've performed dhcp configuration on both networks given that
dhcp pool for 1st network is "School1" and dhcp poolname for 2nd network

Set network staitc route on both networks

Floating static route by defining the route with administrative distance
(to be used when other routes with efficient AD are down) on the Router2 ar

Default static rotue by using 0.0.0.0 0.0.0.0 then the valid next-hop address

- Cisco Packet's file for Uwimana Remy Chiessa



I'm Uwimana Remy Chiessa

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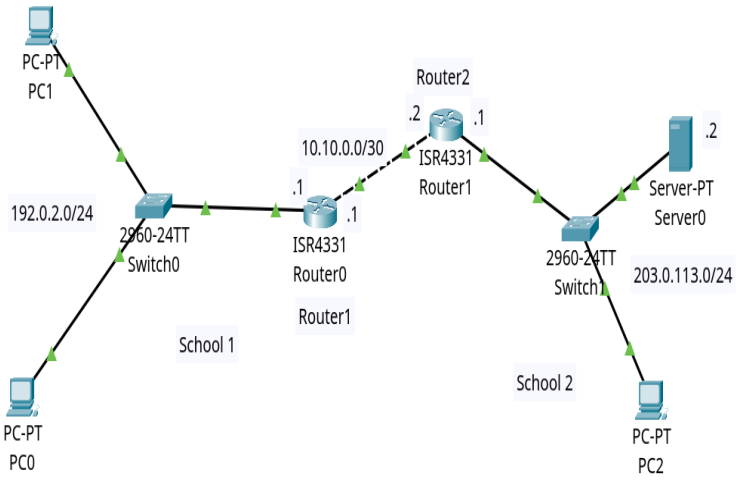
Default static rotue by using 0.0.0.0 0.0.0.0 then the valid next-hop address on Router 1

- Cisco Packet's file for Ishimwe Mugisha Benjamin



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