Discussion 3: network with 100 nodes

Discussion Topic:

You are the network administrator for a small network with 100 nodes that include four servers (Domain controller, replica, data server, and webserver), a printer with mobile printing capability, and a VoIP phone system. The network address is 192.168.1.0, which is an IPv4 class C address with a capacity for 254 IP addresses. What would be your strategy for assigning addresses? Hint: consider ranges and pools.

My Post:

Hello Class,

In this discussion, we explore a scenario where a network administrator needs to assign IPv4 addresses within a small Class C network (192.168.1.0/24 with a subnet mask of 255.255.255.0, providing 254 usable addresses). The network comprises 100 nodes, including four servers (a domain controller, a replica, a data server, and a web server), a network printer, and a VoIP phone system.

Overview of the network

It is important before assigning IP addresses to devices to understand the purpose of each device and a plan for IP address allocation. This section analyses the provided Class C network scheme.

Subnet Mask: 255.255.255.0 (or /24) – This is the classful subnet mask for a Class C network.

Table 1

IP Address class

Address Class	Value in First Octet	Classful Mask (Dotted Decimal)	Classful Mask (Prefix Notation)
Class A	1–126	255.0.0.0	/8
Class B	128–191	255.255.0.0	/16
Class C	192–223	255.255.255.0	/24
Class D	224–239	—	—
Class E	240–255	—	—

Note: From "Lesson 5: IPv4 and IPv6 addresses. CompTIA Network+ Pearson N10-007 (Course & Labs) " by uCertify (2019).

Network Address: 192.168.1.0 – This is a private C class network see table below.

Table 2

Private IP Networks

Address Class	Address Range	Default Subnet Mask
Class A	10.0.0.0–10.255.255.255	255.0.0.0
Class B	172.16.0.0–172.31.255.255	255.255.0.0
Class B	169.254.0.0–169.254.255.255	255.255.0.0
Class C	192.168.0.0–192.168.255.255	255.255.255.0

Note: From "Lesson 5: IPv4 and IPv6 addresses. CompTIA Network+ Pearson N10-007 (Course & Labs) " by uCertify (2019).

Host IP Addresses

- Total Possible IP Addresses:
  The /24 subnet mask represents the first 24 bits of the IP address that are used to identify the network, the last 8 bits (32 total bits - 24 network bits = 8 host bits) are used to identify the host IP addresses.
  With 8 bits, you can have 2^8 (2 to the power of 8) or 256 IP address combinations.
  Therefore, there are 256 possible IP addresses within the 192.168.1.0/24 network.
- Reserved Addresses (Network and Broadcast):
  Network Address: the first possible address is reserved for the network address. It has all the bits set to 0. For this example, it is 192.168.1.0.
  Broadcast Address: The last possible address is reserved for the directed broadcast address. It address has all bits set to 1. For this example, it is 192.168.1.255.
- Host Usable IP Addresses:
  Since the network address and the broadcast address are reserved, they cannot be assigned to hosts.
  Therefore, the number of usable host IP addresses is 256 - 2 = 254.
  To calculate the total possible host IP addresses the following formula is used:
  2^h-2
  where h is the number of host bits in a subnet mask for example is:
  2^8-2 = 256 – 2 = 254
  See the table below.
  Table 3
  Usable Host IP Addresses

Address Class	Assignable IP Addresses
Class A	16,777,214 (2^{24}–2)
Class B	65,534 (2^{16}–2)
Class C	254 (2^8–2)

  Note: From "Lesson 5: IPv4 and IPv6 addresses. *CompTIA Network+ Pearson N10-007* (Course & Labs) " by uCertify (2019).

Number of Devices

100 nodes (4 servers, 1 printer, 1 VoIP system - assuming multiple phones, and the rest are workstations).

In summary:

- Network: 192.168.1.0/24
- Total IP Addresses: 256
- Network Address: 192.168.1.0
- Broadcast Address: 192.168.1.255
- Usable IP Addresses: 254 (from 192.168.1.1 to 192.168.1.254)

Specific Device IP Address Requirements

This section examines possible solutions to specific devices' IP Address requirements and proposed IP addressing schemes, by considering the device types and their roles within the network. The network needs to support servers, printers, a VoIP system, workstations, and mobile devices.

Servers typically require static IP addresses; this allows consistent access, enhances security, and simplifies management. It is especially important for the domain controller, which needs a fixed address for clients to connect reliably.

Printers can use dynamic IP addresses, however assigning a static IP address to the printer that has mobile printing capability ensures that mobile devices can consistently locate and connect to it.

VoIP Phone Systems require a set range of IP addresses to function correctly, for security reasons; it is also important that the allocated range is large enough to accommodate the number of phones and potential scaling.

Workstations, laptops, and mobile devices typically use dynamic IP addresses. This allows devices to automatically receive IP addresses from a DHCP server, providing flexibility to the user and reducing network administrative overhead.

Devises IP address Scheme

Now that the device IP address requirements have been defined, the device IP address scheme can be set by diving the network range into logical pools:

1. Network infrastructure devices (e.g., Router, Firewall, Default Gateway)
   192.168.1.1 – **192.168.1.9**
   These addresses are reserved for network infrastructure devices such as the default gateway (for example, 192.168.1.1) or a firewall appliance.
2. Servers (Domain Controller, Replica, Data Server, Web Server)
   192.168.1.10 – **192.168.1.14**
   Static IP addresses are assigned to the servers.
   Example:

- Domain Controller: 192.168.1.10
- Replica DC: 192.168.1.11
- Data Server: 192.168.1.12
- Web Server: 192.168.1.13

3. Network Printer(s)
   192.168.1.15 – **192.168.1.17**
   Static IP addresses to the printer and future printers.

4. VoIP phones
   192.168.1.18 – **192.168.1.39**
   This pool is used for VoIP phones.

5. DHCP Pool (Dynamic Addresses for Workstations, Laptops, Mobile Phones, etc.)
   192.168.1.40 – **192.168.1.200**
   It allows devices to receive addresses automatically, and the range can be adjusted in the DHCP server's configuration. This covers the 100 hosts and adds 60 extra addresses for mobile devices and scaling.

6. Reserved for scaling
   192.168.1.201 – **192.168.1.254**
   Keep a block of addresses for future needs, such as additional servers or equipment.

To summarize, this post explored the allocation of IP addresses within a small Class C network: 192.168.1.0/24 network. By understanding the scheme of the network, including its subnet mask, total and usable IP addresses, and the specific requirements of different devices, an IP addressing scheme was developed to accommodate the needs of the different types of devices and meet the requirements set by the given scenario.

-Alex

References:

uCertify. (2019). Lesson 5: IPv4 and IPv6 addresses. *CompTIA Network+ Pearson N10-007* (Course & Labs) [Computer software]. uCertify LLC. ISBN: 9781616910327