

IP Addressing and Subnetting IP Networks

Introduction to Networks v6.0



Chapter 8: Subnetting IP Networks

Pertemuan ke 8

Kompetensi Khusus

- Mahasiswa dapat melakukan konfigurasi alamat IPv4 dan IPv6 untuk menyediakan konektivitas dalam jaringan internet lingkup kecil dan menengah (C3)

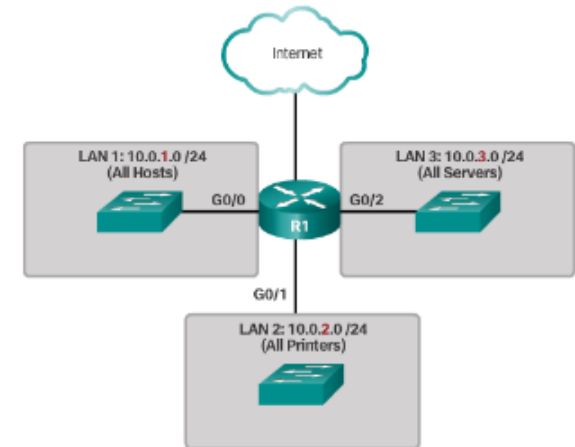
Materi:

1. IPv4 Network Addresses
2. IPv6 Network Addresses
3. Connectivity Verification
4. Subnetting an IPv4 Network
5. Addressing Schemes
6. Design Considerations for IPv6

1. Network Layer Protocols

1.1 Network Segmentation

- Broadcast Domains
 - Each router interface connects a broadcast domain.
 - Broadcasts are only propagated within its broadcast domain.
- Problems with Large Broadcast Domains
 - Slow network operations due to the significant amount of broadcast traffic.
 - Slow device operations because a device must accept and process each broadcast packet.
- Reasons for Subnetting
 - Solution: reduce the size of the network to create smaller broadcast domains.
 - Because each broadcast domain connects to a different router interface, each domain needs its own network address space.
 - The process of breaking an address range into smaller address spaces is called subnetting.
 - Network administrators can group devices into subnets that are determined by location, organizational unit or device type.



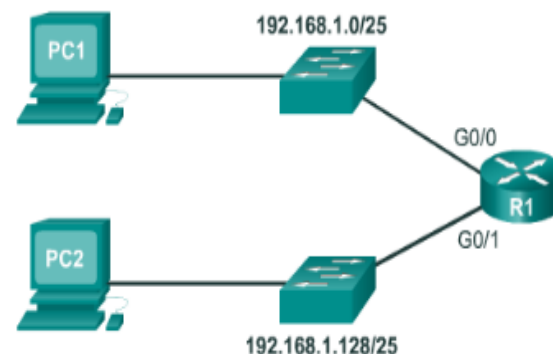
1.2 Subnetting an IPv4 Network

- Octet Boundaries
 - Subnets can be created based on octet boundaries.
(/8, /16 or /24)
- Subnetting on the Octet Boundary
 - Also known as IPv4 Classes.
 - Uses the octet boundaries to separate network from hosts.
- Classless Subnetting
 - Uses address bits to separate network from hosts.
 - Allows for much more flexibility.
- Classless Subnetting Example

Prefix Length	Subnet Mask	Subnet Mask in Binary (n = network, h = host)	# of subnets	# of hosts
/25	255.255.255.128	nnnnnnnn . nnnnnnnn . nnnnnnnn . nhhhhhhh 11111111 . 11111111 . 11111111 . 10000000	2	126

1.2 Subnetting an IPv4 Network

- Creating 2 Subnets
 - A subnet mask of /25 applied to 192.168.10.0, creates two equal subnets, each one with 126 hosts.
- Subnetting Formulas
 - Use 2^n , to calculate the number of subnets.
 - Use $2^h - 2$ to calculate the number of hosts.
 - n is the number allocated to the network portion of the address.
 - h is the number allocated to the host portion of the address.
- Creating 4 Subnets
 - A subnet mask of /26 applied to 192.168.10.0, creates four equal subnets, each one with 62 hosts.
 - $n = 2$ and therefore $2^2 = 4$.
 - $h = 6$ and therefore $2^6 - 2 = 62$.



1.3 Subnetting a /16 and /8 Prefix

- Creating Subnets with a /16 Prefix
 - A subnet mask of /16 applied to 172.16.32.0, creates a network with 65534 hosts.
 - A subnet mask of /18 applied to 172.16.32.0, creates 4 networks with 16382 hosts in each network.
 - A subnet mask of /22 applied to 172.16.32.0, creates 64 networks with 1022 hosts in each network.
- Creating 100 Subnets with a /16 Prefix
 - A subnet mask of /23 applied to 172.16.32.0, creates 128 networks with 510 hosts in each network
- Calculating the Hosts
 - Use $2^h - 2$ to calculate the number of hosts.
 - h is the number allocated to the host portion of the address.
- Creating 1000 Subnets with a /8 Prefix
 - A subnet mask of /18 applied to 20.0.0.0, creates 1024 networks with 16382 hosts in each network

1.4 Subnetting to Meet Requirements

- Subnetting Based on Host Requirements
 - Two considerations when planning subnets:
 - The number of host addresses required for each network.
 - The number of individual subnets needed.
- Subnetting Based on Network Requirements
 - Administrators may be asked to subnet an IP range to accommodate a specific number of networks.
 - Think of a company with 7 departments where each department must have its own subnetwork.
 - The number of hosts per subnet, while secondary, is also important.
- Network Requirement Example
 - Assume the range 200.42.98.0/24 was given to the administrator.
 - 7 subnets must be created.
 - Each department will have no more than 29 hosts.
 - A subnet mask of /27 applied to 200.42.98.0/24, creates 8 networks with 30 hosts in each network.

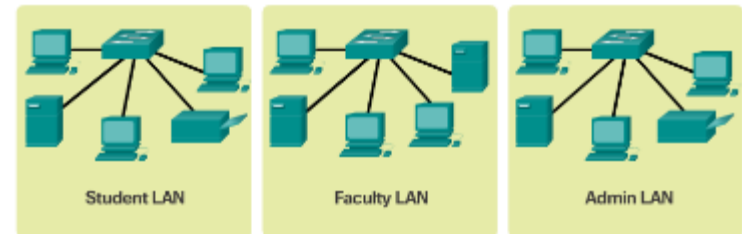
1.5 Benefits of Variable Length Subnet Masking

- Traditional Subnetting Wastes Addresses
 - Subnetting based on classes is not very flexible.
 - Results in wasted addresses.
- Variable Length Subnet Masks
 - By varying the mask, an administrator has more control.
 - Less waste.
- Basic VLSM
 - A subnet mask of /30 applied to 200.42.98.0, creates a network with 2 hosts in each network.
 - The network 200.42.98.0/30 would be a perfect match for a serial link.
- VLSM in Practice
 - Consider two routers connected by a Serial link:
 - RouterA would be 200.42.98.1/30 and RouterB would be 200.42.98.2/30.
 - 200.42.98.0/30 is the network address and 200.42.98.3/30 is the broadcast address.

2. Addressing Schemes

2.1 Structured Design

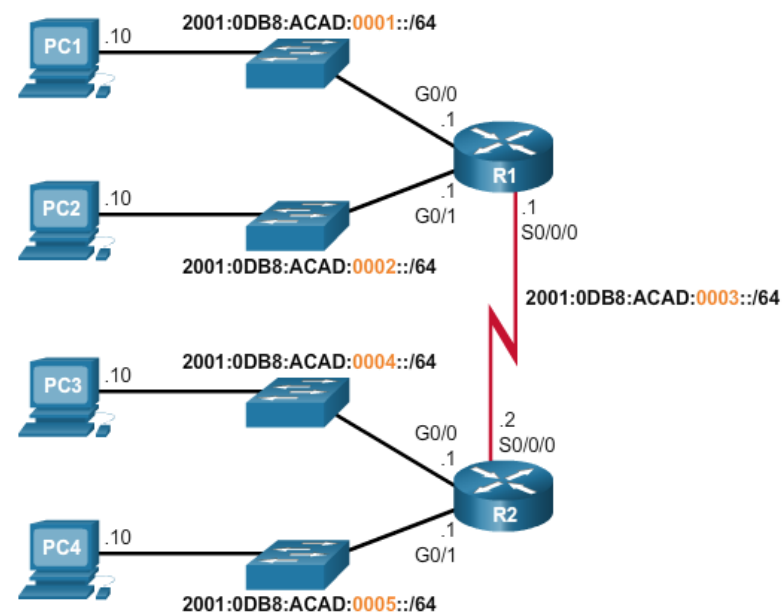
- Network Address Planning
 - Planning requires decisions on each subnet in terms of size, the number of hosts per subnet and how host addresses will be assigned.
- Planning to Address the Network
 - The Primary Planning Considerations are:
 - Prevent Duplication of Addresses
 - Monitor Security and Performance
 - Provide and Control Access
- Assigning Addresses to Devices
 - Different devices needs may also impact the addressing scheme.
 - Common devices are:
 - End user devices, servers, printers, network devices and gateways



3. Design Considerations for IPv6

3.1 Structured Design

- The IPv6 Global Unicast Address
 - The IPv6 global unicast address normally consists of a /48 global routing prefix, a 16 bit subnet ID, and a 64 bit interface ID.
- Subnetting Using Subnet ID
 - The subnet ID provides plenty subnets and host support in one subnet.
 - The subnet ID alone allows for creating up to 65,536 /64 subnets.
- IPv6 Subnet Allocation
 - Address waste is not a concern in IPv6.
 - Administrators can concentrate on designing a logical scheme to address the network.



Chapter Summary

Summary

- Implement an IPv4 addressing scheme to enable end-to-end connectivity in a small to medium-sized business network.
- Given a set of requirements, implement a VLSM addressing scheme to provide connectivity to end users in a small to medium-sized network.
- Explain design considerations for implementing IPv6 in a business network.

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