VLSM and CIDR

Routing Protocols and Concepts – Chapter 6

Cisco | Networking Academy®
Mind Wide Open™

Objectives

- Compare and contrast classful and classless IP addressing.
- Review VLSM and explain the benefits of classless IP addressing.
- Describe the role of the Classless Inter-Domain Routing (CIDR) standard in making efficient use of scarce IPv4 addresses

Introduction

- Prior to 1981, IP addresses used only the first 8 bits to specify the network portion of the address
- In 1981, RFC 791 modified the IPv4 32-bit address to allow for three different classes
- IP address space was depleting rapidly

  the Internet Engineering Task Force (IETF) introduced Classless Inter-Domain Routing (CIDR)

  – CIDR uses Variable Length Subnet Masking (VLSM) to help conserve address space.

  -VLSM is simply subnetting a subnet

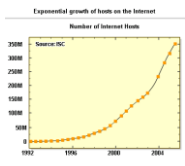
Classful and Classless IP Addressing

- Classful IP addressing
- As of January 2007, there are over 433 million hosts on internet
- Initiatives to conserve IPv4 address space include:

  -VLSM & CIDR notation (1993, RFC 1519)

  -Network Address Translation (1994, RFC 1631)

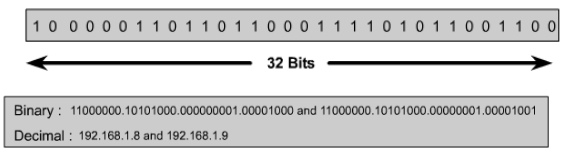
  -Private Addressing (1996, RFC 1918)



Classful and Classless IP Addressing

- The High Order Bits

  These are the leftmost bits in a 32 bit address



Classful and Classless IP Addressing

- Classes of IP addresses are identified by the decimal number of the 1st octet

  Class A address begin with a **0** bit

  Range of class A addresses = 0.0.0.0 to 127.255.255.255

  Class B address begin with a **1** bit and a **0** bit

  Range of class B addresses = 128.0.0.0 to 191.255.255.255

  Class C addresses begin with **two 1** bits & a **0** bit

  Range of class C addresses = 192.0.0.0 to 223.255.255.255.

High Order Bits

Class	High Order Bits	Start	End
Class A	0	0.0.0.0	127.255.255.255
Class B	10	128.0.0.0	191.255.255.255
Class C	110	192.0.0.0	223.255.255.255
Multicast	1110	224.0.0.0	239.255.255.255
Experimental	1111	240.0.0.0	255.255.255.255

Classful and Classless IP Addressing

- The IPv4 Classful Addressing Structure (RFC 790)

  An IP address has 2 parts:

  -The **network** portion

  Found on the **left** side of an IP address

  -The **host** portion

  Found on the **right** side of an IP address

Classful and Classless IP Addressing

Subnet Mask based on Class

	1st Octet	2st Octet	3st Octet	4st Octet	Subnet Mask
Class A	Network	Host	Host	Host	255.0.0.0 or /8
Class B	Network	Network	Host	Host	255.255.0.0 or /16
Class C	Network	Network	Network	Host	255.255.255.0 or /24

Number of Networks and Hosts per Network for Each Class

Address class	First Octet Range	Number of Possible Networks	Number of Host per Networks
Class A	0 to 127	128 (2 are reserved)	16,777,214
Class B	128 to 191	16,348	65,534
Class C	192 to 223	2,097,152	254

Classful and Classless IP Addressing

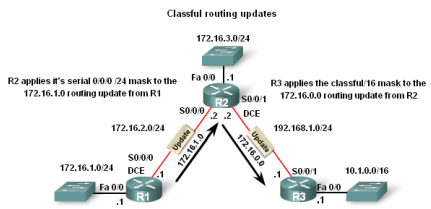
- **Purpose of a subnet mask**

  It is used to determine the network portion of an IP address

Classful and Classless IP Addressing

- Classful Routing Updates

  -Recall that classful routing protocols (i.e. RIPv1) do not send subnet masks in their routing updates
  The reason is that the Subnet mask is directly related to the network address



Classful and Classless IP Addressing

- Classless Inter-domain Routing (CIDR – RFC 1517)
  - Advantage of CIDR :

    -More efficient use of IPv4 address space

    -Route summarization
  - Requires subnet mask to be included in routing update because address class is meaningless

    Recall purpose of a subnet mask:

    -To determine the network and host portion of an IP address

Classful and Classless IP Addressing

- Classless IP Addressing
- CIDR & Route Summarization

  -Variable Length Subnet Masking (VLSM)

  -Allows a subnet to be further sub-netted according to individual needs

  -Prefix Aggregation a.k.a. Route Summarization

  -CIDR allows for routes to be summarized as a single route

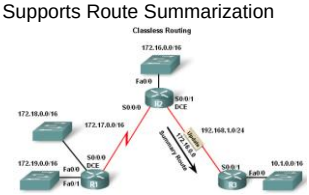
Classful and Classless IP Addressing

- Classless Routing Protocol
- Characteristics of classless routing protocols:

  -Routing updates include the subnet mask

  -Supports VLSM

  Supports Route Summarization



Classful and Classless IP Addressing

- Classless Routing Protocol

Routing Protocol	Routing updates Include subnet Mask	Supports VLSM	Ability to send Supernet routes
Classful	No	No	No
Classless	Yes	Yes	Yes

VLSM

- Classful routing

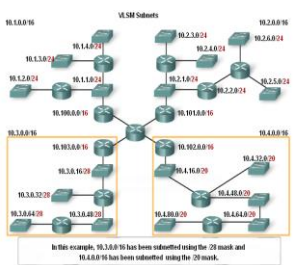
  -only allows for one subnet mask for all networks

- VLSM & classless routing

  -This is the process of subnetting a subnet

  -More than one subnet mask can be used

  -More efficient use of IP addresses as compared to classful IP addressing



VLSM

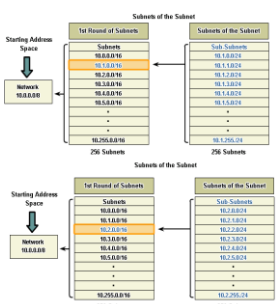
- **VLSM** – the process of sub-netting a subnet to fit your needs

  -**Example:**

  Subnet 10.1.0.0/**16**, 8 more bits are borrowed again, to create 256 subnets with a **/24** mask.

  -Mask allows for 254 host addresses per subnet

  -Subnets range from: 10.1.0.0 / 24 to 10.1.255.0 / 24



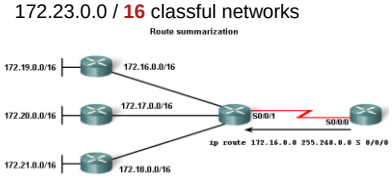
Classless Inter-Domain Routing (CIDR)

- Route summarization done by CIDR

  -Routes are summarized with masks that are less than that of the default classful mask

  -Example:

  172.16.0.0 / **13** is the summarized route for the 172.16.0.0 / **16** to 172.23.0.0 / **16** classful networks



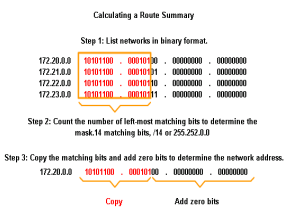
Classless Inter-Domain Routing (CIDR)

- Steps to calculate a route summary

  -List networks in binary format

  -Count number of left most matching bits to determine summary route's mask

  -Copy the matching bits and add zero bits to determine the summarized network address



Summary

- Classful IP addressing
  - IPv4 addresses have 2 parts:

    -Network portion found on left side of an IP address

    -Host portion found on right side of an IP address
  - Class A, B, & C addresses were designed to provide IP addresses for different sized organizations
  - The class of an IP address is determined by the decimal value found in the 1st octet
  - IP addresses are running out so the use of Classless Inter Domain Routing (CIDR) and Variable Length Subnet Mask (VLSM) are used to try and conserve address space

Summary

- Classful Routing Updates
  - –Subnet masks are not sent in routing updates
- Classless IP addressing
  - –Benefit of classless IP addressing
    - Can create additional network addresses using a subnet mask that fits your needs
  - –Uses Classless Interdomain Routing (CIDR)

Summary

- CIDR
  - Uses IP addresses more efficiently through use of VLSM
    - -VLSM is the process of subnetting a subnet
  - Allows for route summarization
    - -Route summarization is representing multiple contiguous routes with a single route

Summary

- Classless Routing Updates
  - Subnet masks are included in updates