INFO 3605
Fundamentals of LAN Technologies
Lecture 14 - Analyzing Classful IPv4 Networks
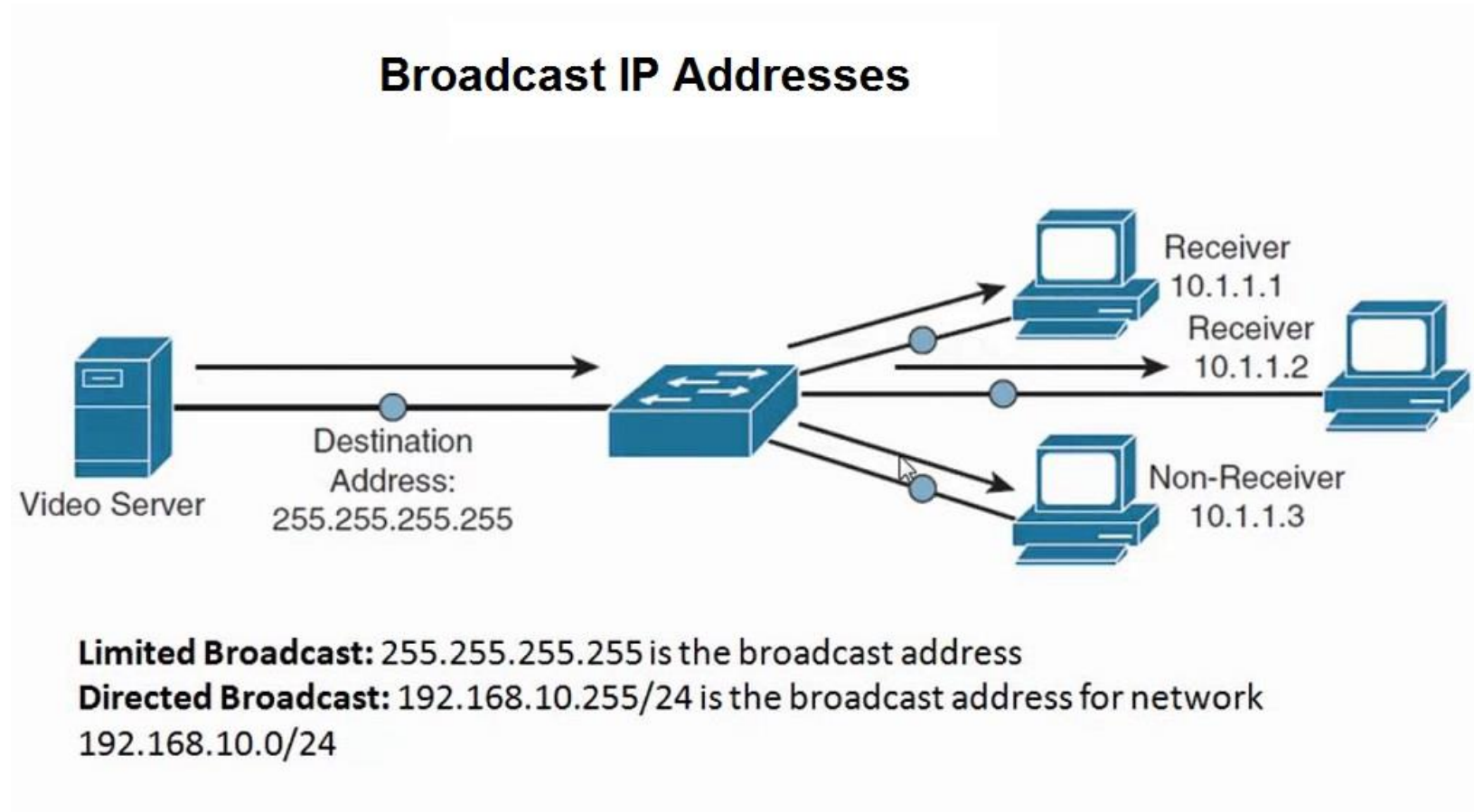
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Video Streaming inside your home network

- PlexServer can stream to all computers simultaneous using broadcast IP address.
- Saves bandwidth.

Broadcast IP Addresses

Video Server — Destination Address: 255.255.255.255

Receiver 10.1.1.1
Receiver 10.1.1.2
Non-Receiver 10.1.1.3

Limited Broadcast: 255.255.255.255 is the broadcast address
Directed Broadcast: 192.168.10.255/24 is the broadcast address for network 192.168.10.0/24

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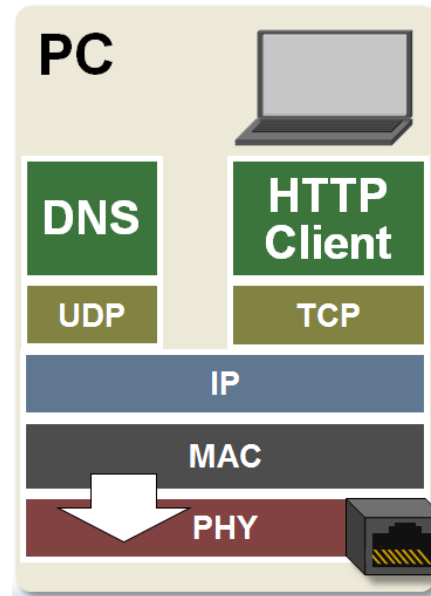
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Finding an IP address inside your home network

- What about finding an IP address?
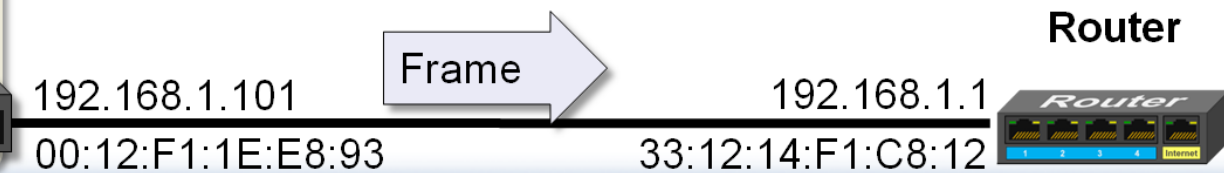
- ARP uses the broadcast at the Layer 2 (MAC/Frames Level)

  FF:FF:FF:FF:FF:FF

- Different from IP broadcast address.

IPv6 uses Neighbor Discovery Protocol (NDP) instead of ARP.

PC

DNS
HTTP Client
UDP
TCP
IP
MAC
PHY

Src MAC = 00:12:F1:1E:E8:93
Dst MAC = FF:FF:FF:FF:FF:FF
message = If your IP address is 192.168.1.1 send me your MAC address

Broadcast MAC address

Router

Frame

192.168.1.101
00:12:F1:1E:E8:93

192.168.1.1
33:12:14:F1:C8:12

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Objectives

- Configure, verify, and troubleshoot IPv4 addressing and subnetting

- Compare and contrast IPv4 address types:
  - Unicast
  - 1.9.b Broadcast

Quick Quiz

- Which of the following are not valid Class A network IDs? (Choose two answers.)

    a. 1.0.0.0

    b. 130.0.0.0

    c. 127.0.0.0

    d. 9.0.0.0

Quick Quiz

- Which of the following are not valid Class A network IDs? (Choose two answers.)

  a. 1.0.0.0

  b. 130.0.0.0

  c. 127.0.0.0

  d. 9.0.0.0

Quick Quiz

- Which of the following are not valid Class B network IDs?
  - a. 130.0.0.0
  - b. 191.255.0.0
  - c. 128.0.0.0
  - d. 150.255.0.0
  - e. All are valid Class B network IDs.

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Quick Quiz

- Which of the following are not valid Class B network IDs?

    a. 130.0.0.0

    b. 191.255.0.0

    c. 128.0.0.0

    d. 150.255.0.0

    e. All are valid Class B network IDs.

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Quick Quiz

- Which of the following are true about IP address 172.16.99.45's IP network? (Choose two answers.)

    a. The network ID is 172.0.0.0.

    b. The network is a Class B network.

    c. The default mask for the network is 255.255.255.0.

    d. The number of host bits in the unsubnetted network is 16.

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Classful Network Concepts

- What can be determines from the following IP address?
  - 10.4.5.99, 255.255.255.0
- Can determine the following facts:
  - Class (A, B, or C)
  - Default mask
  - Number of network octets/bits
  - Number of host octets/bits
  - Number of host addresses in the network
  - Network ID
  - Network broadcast address
  - First and last usable address in the network

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IPv4 Network Classes and Related Facts

- IP version 4 (IPv4) defines five address classes.

- Three of the classes, Classes A, B, and C, consist of unicast IP addresses.

- Unicast addresses identify a single host or interface so that the address uniquely identifies the device.

- Class D addresses serve as multicast addresses, so that one packet sent to a Class D multicast IPv4 address can actually be delivered to multiple hosts.

- Class E addresses were originally intended for experimentation.

IPv4 Network Classes and Related Facts

- IPv4 Address Classes Based on First Octet Values

Class	First Octet Values	Purpose
A	1–126	Unicast (large networks)
B	128–191	Unicast (medium-sized networks)
C	192–223	Unicast (small networks)
D	224–239	Multicast
E	240–255	Reserved (formerly experimental)

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IPv4 Network Classes and Related Facts

- Key Facts for Classes A, B, and C

	Class A	Class B	Class C
First octet range	1 – 126	128 – 191	192 – 223
Valid network numbers	1.0.0.0 – 126.0.0.0	128.0.0.0 – 191.255.0.0	192.0.0.0 – 223.255.255.0
Total networks	$2^7 - 2 = 126$	$2^{14} = 16{,}384$	$2^{21} = 2{,}097{,}152$
Hosts per network	$2^{24} - 2$	$2^{16} - 2$	$2^8 - 2$
Octets (bits) in network part	1 (8)	2 (16)	3 (24)
Octets (bits) in host part	3 (24)	2 (16)	1 (8)
Default mask	255.0.0.0	255.255.0.0	255.255.255.0

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The Number and Size of the Class A, B, and C Networks

- 126 Class A networks exist: network 1.0.0.0, 2.0.0.0, 3.0.0.0, and so on, up through network 126.0.0.0.
  - over 16 million host IP addresses per network

- 16,384 Class B networks exist.
  - over 65,000 hosts per network.

- There are more than 2 million Class C networks.
  - 254 hosts in each network.

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The Number and Size of the Class A, B, and C Networks

- Numbers and Sizes of Class A, B, and C Networks

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Address Formats

- The addresses in the classful network have a structure with two parts:
    - the network part (sometimes called the prefix) and
    - the host part.

- The addresses in the same network have the same values in the network part.

- The addresses in the same network have different values in the host part.

Address Formats

- Sizes (Bits) of the Network and Host Parts of Unsubnetted Classful Networks
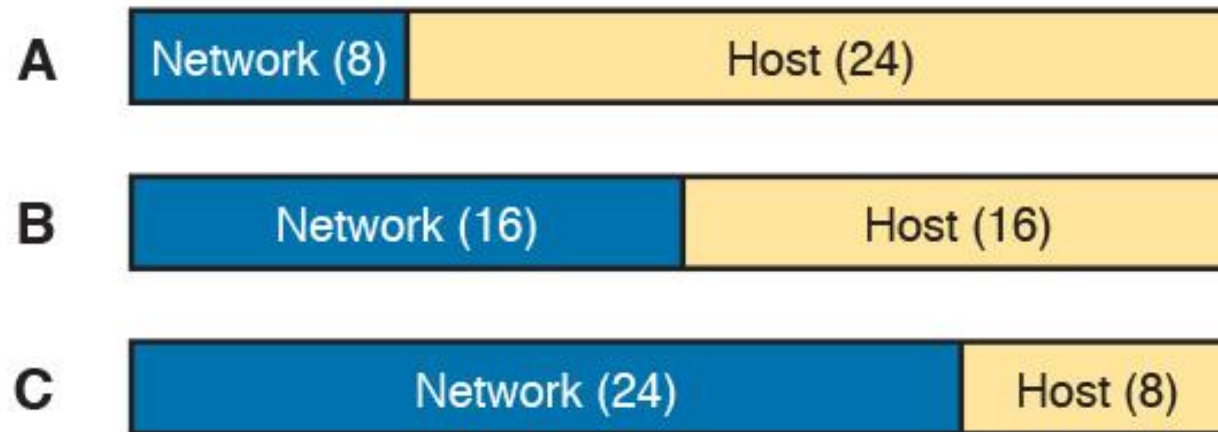
Default Masks

- Each network class has an associated default mask that defines the size of the network and host parts of an unsubnetted Class A, B, and C network.

- The mask lists binary 1s for the bits considered to be in the network part and binary 0s for the bits considered to be in the host part.

- Class A network 10.0.0.0 has a network part of the first single octet (8 bits) and a host part of last three octets (24 bits).
  - 11111111 00000000 00000000 00000000

Default Masks

- Default Masks for Classes A, B, and C

- Decimal 255 converts to the binary value 11111111.

- Decimal 0, converted to 8-bit binary, is 00000000.

A	Decimal	255	.	0	.	0	.	0
	Binary	11111111		00000000		00000000		00000000
	Concept	Network (8)			Host (24)		

B	Decimal	255	.	255	.	0	.	0
	Binary	11111111		11111111		0000000		00000000
	Concept	Network (16)				Host (16)	

C	Decimal	255	.	255	.	255	.	0
	Binary	11111111		11111111		11111111		00000000
	Concept	Network (24)					Host (8)

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Number of Hosts per Network

- With H host bits, 2^H unique combinations exist.

- The number of hosts in a network is not 2^H; instead, it is $2^H - 2$.

- Two of the addresses have been reserved for special purpose:
  - one for the network ID and
  - one for the network broadcast address

Deriving the Network ID and Related Numbers

- Each classful network has four key numbers that describe the network.

- You can derive these four numbers if you start with just one IP address in the network.

- The numbers are as follows:
    - Network number
    - First (numerically lowest) usable address
    - Last (numerically highest) usable address
    - Network broadcast address

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Deriving the Network ID and Related Numbers

- A network broadcast address is always the highest (last) number in the network.

- The highest (last) number usable as an IP address is the address that is simply one less than the network broadcast address.

Unusual Network IDs and Network Broadcast Addresses

- For Class A:

  - Class A network 0.0.0.0 was originally reserved for some broadcasting requirements, so all addresses that begin with 0 in the first octet are reserved.

  - Class A network 127.0.0.0 is still reserved because of a special address used in software testing, called the loopback address (127.0.0.1).

Unusual Network IDs and Network Broadcast Addresses

- For Class B:
  - Network numbers range from 128.0.0.0 to 191.255.0.0, for a total of 2^{14} networks.
  - The very first (lowest number) Class B network number (128.0.0.0) looks a little like a Class A network number, the first octet is 128, making it a Class B network with a two-octet network part (128.0).
  - The high end of the Class B range also might look strange at first glance (191.255.0.0), it's the highest of the valid Class B network numbers.
  - This network's broadcast address, 191.255.255.255, might look a little like a Class A broadcast address because of the three 255s at the end, but it is indeed the broadcast address of a Class B network.

Unusual Network IDs and Network Broadcast Addresses

- For Class C:
  - Class C network 192.0.0.0 looks a little like a Class A network because of the last three octets being 0, but first three octets belongs to class C.
  - Class C network 223.255.255.0, is another valid Class C network, consists of all addresses that begin with 223.255.255.

What have you learnt?

- Which of the following are true about IP address 192.168.6.7's IP network? (Choose two answers.)
  a. The network ID is 192.168.6.0.
  b. The network is a Class B network.
  c. The default mask for the network is 255.255.255.0.
  d. The number of host bits in the unsubnetted network is 16.

What have you learnt?

- Which of the following are true about IP address 192.168.6.7's IP network? (Choose two answers.)
  a. The network ID is 192.168.6.0.
  b. The network is a Class B network.
  c. The default mask for the network is 255.255.255.0.
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What have you learnt?

- Which of the following is a network broadcast address?
  - a. 10.1.255.255
  - b. 192.168.255.1
  - c. 224.1.1.255
  - d. 172.30.255.255

What have you learnt?

- Which of the following is a network broadcast address?
  - a. 10.1.255.255
  - b. 192.168.255.1
  - c. 224.1.1.255
  - d. 172.30.255.255

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Summary

- The address classes.

- Facts about Class A, B and C networks.

- Comparisons of network and host parts of addresses in the same classfull network.

- Default masks.

- Function to calculate the number of hosts per network.

- Steps to find information about a classfull network.

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End of Lecture 14, Further Reading, References

- Odom, Wendell. *CCENT/CCNA ICND1 100-105 official cert guide*. Indianapolis, IN: Cisco Press, 2016.

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