Al-Mustaqbal Univerity

College of Science

Intelligent Medical Systems Departement

Computer Networks - 3rd Class

جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

Lecture 4:

Designing IP Addressing in the Network

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Contents

- Converting IP Addresses Between Decimal and Binary.
- Determining an IP Address Class.
- Private and Public IPv4 Addresses.
- Subnet Mask.

Converting IP Addresses Between Decimal and Binary

- An IP address is a 32-bit, two-level hierarchical number.
- It is hierarchical because the first portion of the address represents the **network**, and the second portion of the address represents the **node (or host).**
- The 32 bits are grouped into four octets, with 8 bits per octet. The value of each octet ranges from 0 to 255 decimal, or 00000000 to 11111111 binary. IP addresses are usually written in dotted decimal notation, which means that each octet is written in decimal notation and dots are placed between the octets.

Converting IP Addresses Between Decimal and Binary

Value for Each Bit

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Converting From Binary to Decimal

0	1	0	0	0	0	0	1
128	64	32	16	8	4	2	1

0 + 64 + 0 + 0 + 0 + 0 + 0 + 1 = 65

Converting IP Addresses Between Decimal and Binary

- Examples: find the decimal addresses for the following binary addresses:

1) 00001010.00000001.00010111.00010011
2) 10101100 00010010 01000001 10101010
3) 11000000.10101000.00001110.00000110

Converting IP Addresses Between Decimal and Binary

- Examples: find the binary addresses for the following decimal addresses:

1) 10.1.23.19
2) 192.168.14.6
3) 172.18.65.170

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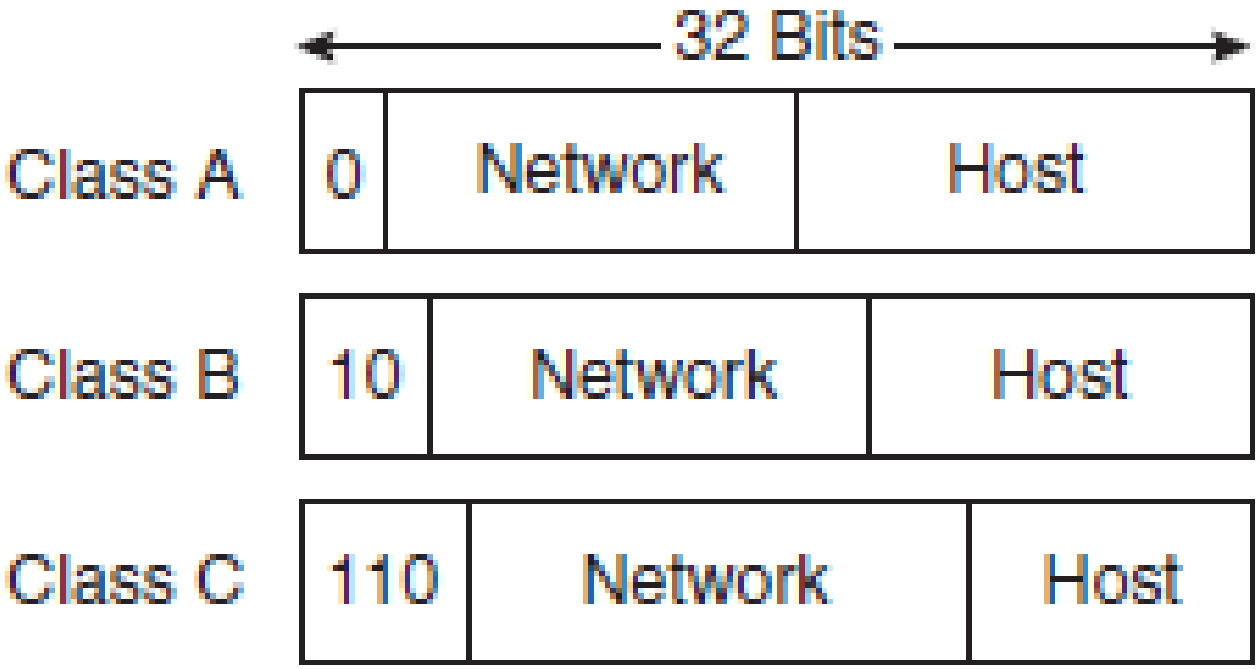
Determining an IP Address Class

- To accommodate large and small networks, the 32-bit IP addresses are segregated into Classes A through E.
- The first few bits of the first octet determine the class of an address; this then determines how many network bits and host bits are in the address.
- Each address class allows for a certain number of network addresses and a certain number of host addresses within a network.
- Using classes to denote which portion of the address represents the network number and which portion represents the node or host address is called classful addressing.

Determining an IP Address Class

- Determining an IP Address Class from the First Few Bits of an Address



Determining an IP Address Class

The following table shows the address format, the address range, the number of networks, and the number of hosts for each of the classes.

Class	Format	Address Range
A	N.H.H.H	1.0.0.0 to 126.0.0.0
B	N.N.H.H	128.0.0.0 to 191.255.0.0
C	N.N.N.H	192.0.0.0 to 223.255.255.0
D	Multicast	224.0.0.0 to 239.255.255.255
E	Experimental	240.0.0.0. to 254.255.255.255

NOTE The address 127.0.0.0 (any address starting with decimal 127) is reserved for loopback. 0.0.0.0 is also reserved and cannot be used to address devices.

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Private and Public IPv4 Addresses

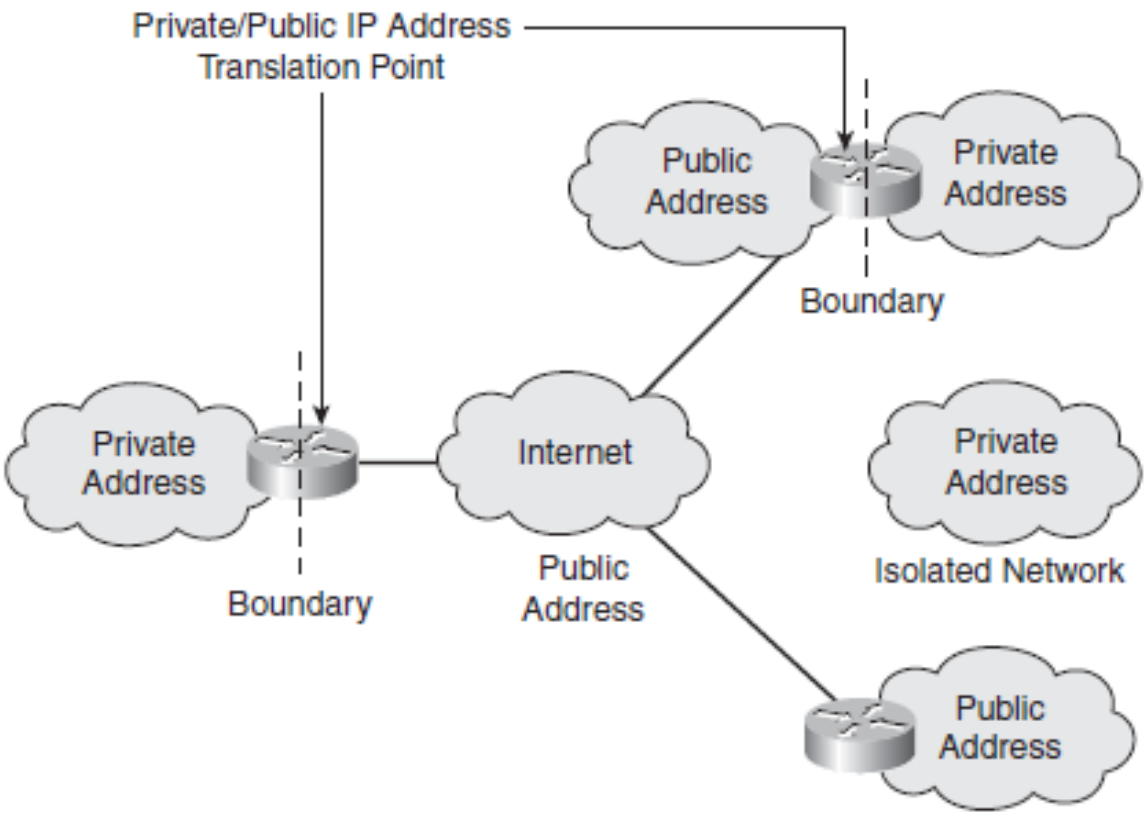
IP address space is divided into public and private spaces.

Private addresses are reserved IP addresses that are to be used only internally within a company's network, not on the Internet. Private addresses must therefore be mapped to a company's external registered address when sending anything on the Internet.

Public IP addresses are provided for external communication.

Private and Public IPv4 Addresses

- The following figure illustrates the use of private and public addresses in a network.



Private and Public IPv4 Addresses

RFC 1918, Address Allocation for Private Internets, defines the private IP addresses as follows:

10.0.0.0 to 10.255.255.255

172.16.0.0 to 172.31.255.255

192.168.0.0 to 192.168.255.255

The remaining addresses are public addresses..

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Subnet Masks

RFC 950, Internet Standard Subnetting Procedure, was written to address the IP address shortage.

It proposed a procedure, called subnet masking, for dividing Class A, B, and C addresses into smaller pieces, thereby increasing the number of possible networks.

The router does not determine the network portion of the address by looking at the value of the first octet; rather, it looks at the subnet mask that is associated with the address.

Subnet Masks

To create a subnet mask for an address, use a binary 1 for each bit that you want to represent the network or subnet portion of the address, and use a binary 0 for each bit that you want to represent the node portion of the address. Note that the 1s in the mask are contiguous. The default subnet masks for Class A, B, and C addresses are as shown in the following table:

Class	Subnetmask	
Class A	11111111.00000000.00000000.00000000	255.0.0.0
Class B	11111111.11111111.00000000.00000000	255.255.0.0
Class C	11111111.11111111.11111111.00000000	255.255.255.0

Subnet Masks

Using Prefixes to Represent a Subnet Mask

subnet masks identify the number of bits in an address that represent the network, subnet, and host portions of the address. Another way of indicating this information is to use a prefix.

A prefix is a slash (/) followed by a numeric value that is the number of bits in the network and subnet portion of the address. In other words, it is the number of contiguous 1s in the subnet mask.

For example, assume you are using a subnet mask of 255.255.255.0. The binary representation of this mask is 11111111.11111111.11111111.00000000, which is 24 1s followed by eight 0s. Thus, the prefix is /24, for the 24 bits of network and subnet information, (the number of 1s in the mask).

Subnet Masks

Using Prefixes to Represent a Subnet Mask

IP Address/Prefix	Subnet Mask in Decimal Subnet	Mask in Binary
192.168.112.0/12	255.240.0.0	11111111.11110000.00000000.00000000
172.16.0.0/16	255.255.0.0	11111111.11111111.00000000.00000000
10.1.1.0/27	255.255.255.224	11111111.11111111.11111111.11100000

Calculating a subnet Masks

*****The number of hosts available is calculated by the formula $2^h - 2$, where h is the number of bits in the host portion.**

In the host counting range, the all-0s bit pattern is reserved as the subnet identifier, and the all-1s bit pattern is reserved as a directed broadcast address, to reach all hosts on that subnet.

Calculating a subnet Masks

***Example:**

IP address= 192.168.0.1 /27

The Subnet Mask in Decimal : 255.255.255.224

In Binary: 11111111.11111111.11111111.11100000

:11000000.10101000.00000000.000{*****}⬅for hosts

Network address: 192.168.0.0

First host address: 192.168.0.1

Last host address: 192.168.0.30

Broadcast address: 192.168.0.31

Calculating a subnet Masks

***Example:

IP address = 192.168.16.0 /20

The Subnet Mask in Decimal: 255.255.240.0

In Binary: 11111111.11111111.11110000.00000000

IP address:11000000.10101000.0001{****.*********}⬅for hosts

Network address: 192.168.16.0

First host address: 192.168.16.1

Last host address: 192.168.31.254

Broadcast address: 192.168.31.255

Thank you