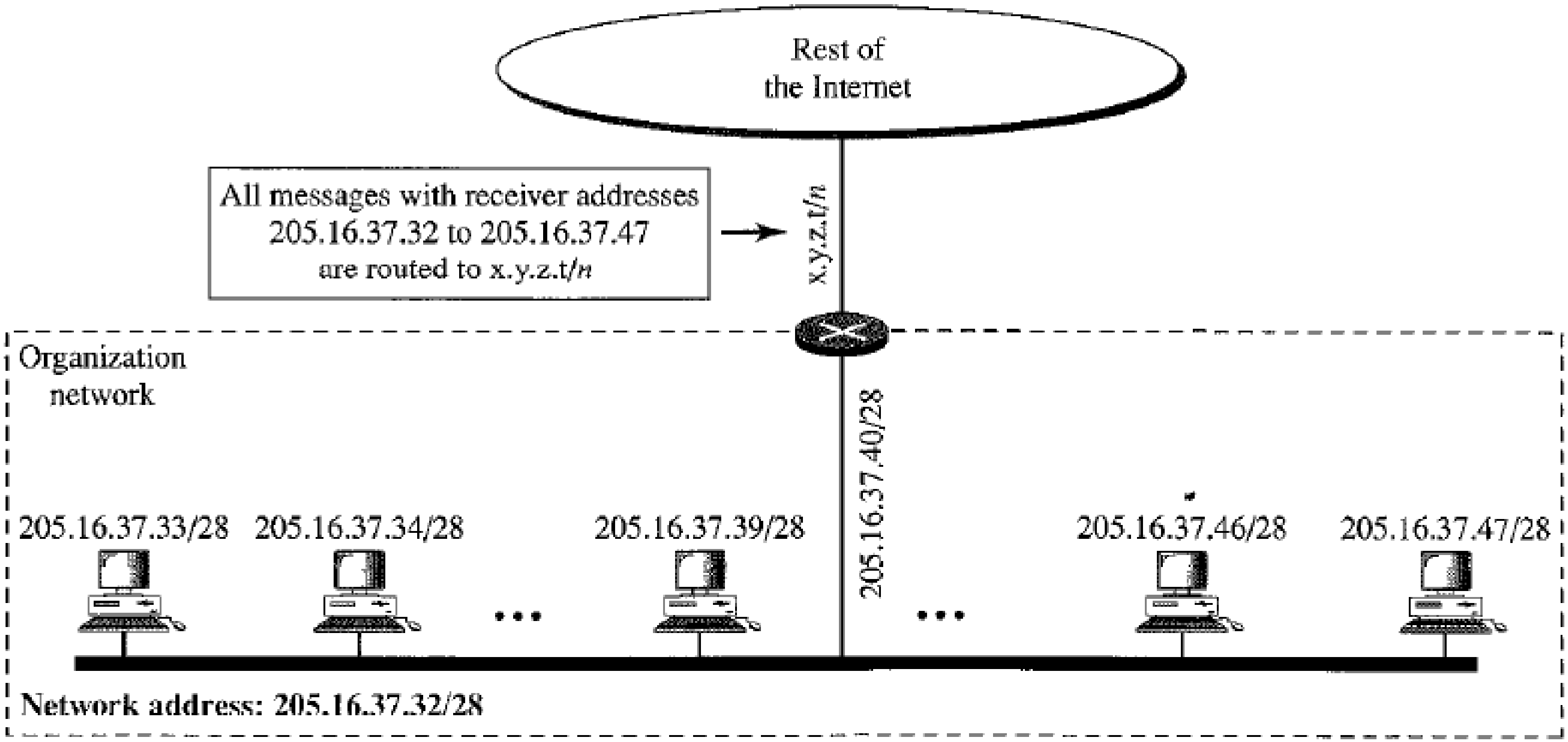
شبكات

Subnetting Addressing

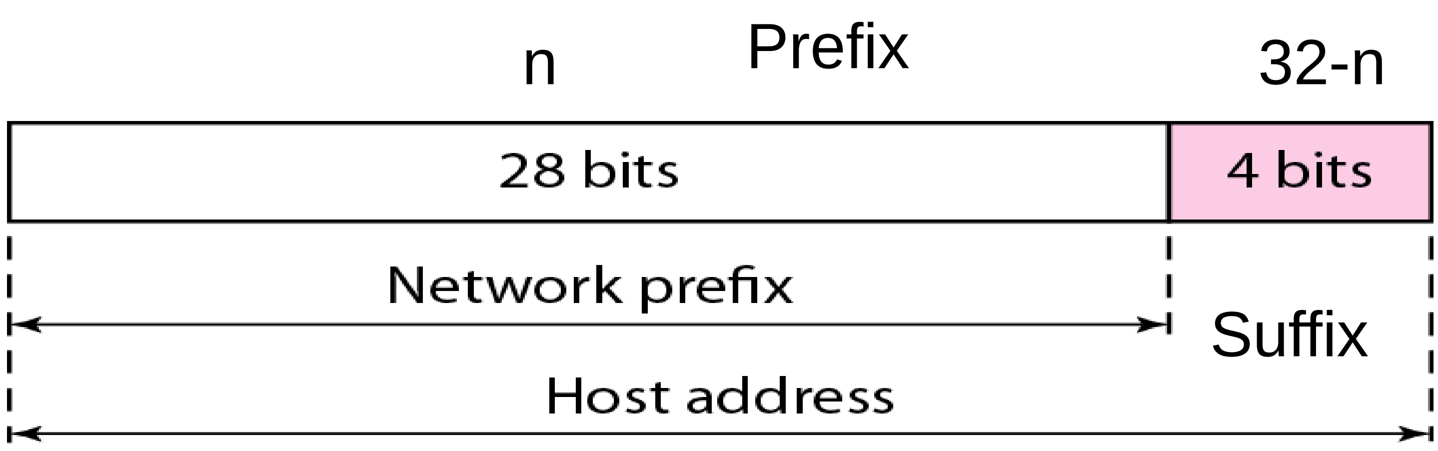
Network Addresses



The first address in a block is normally not assigned to any device; it is used as the network address that represents the organization to the rest of the world.

Two-Level Hierarchy: No Subnetting

An IP address can define only two levels of hierarchy when <u>not subnetted</u>. The *n* leftmost bits of the address *x.y.z.t/n* define the network; the 32 – *n* rightmost bits define the particular host to the network. The part of the address that defines the network is called the **<u>prefix</u>**; the part that defines the host is called the **<u>suffix</u>**.



Three-Levels of Hierarchy: Subnetting

An organization that is granted a large block of addresses may want to create clusters of networks (called subnets) and divide the addresses between the different subnets.

The organization, however, needs to create small sub blocks of addresses, each assigned to specific subnets. The organization has its own mask; each subnet must also have its own.

As an example, suppose an organization is given the block 17.12.14.0/26, which contains 64 addresses. The organization has three offices and needs to divide the addresses into three sub blocks of 32, 16, and 16 addresses. We can find the new masks by using the following arguments:

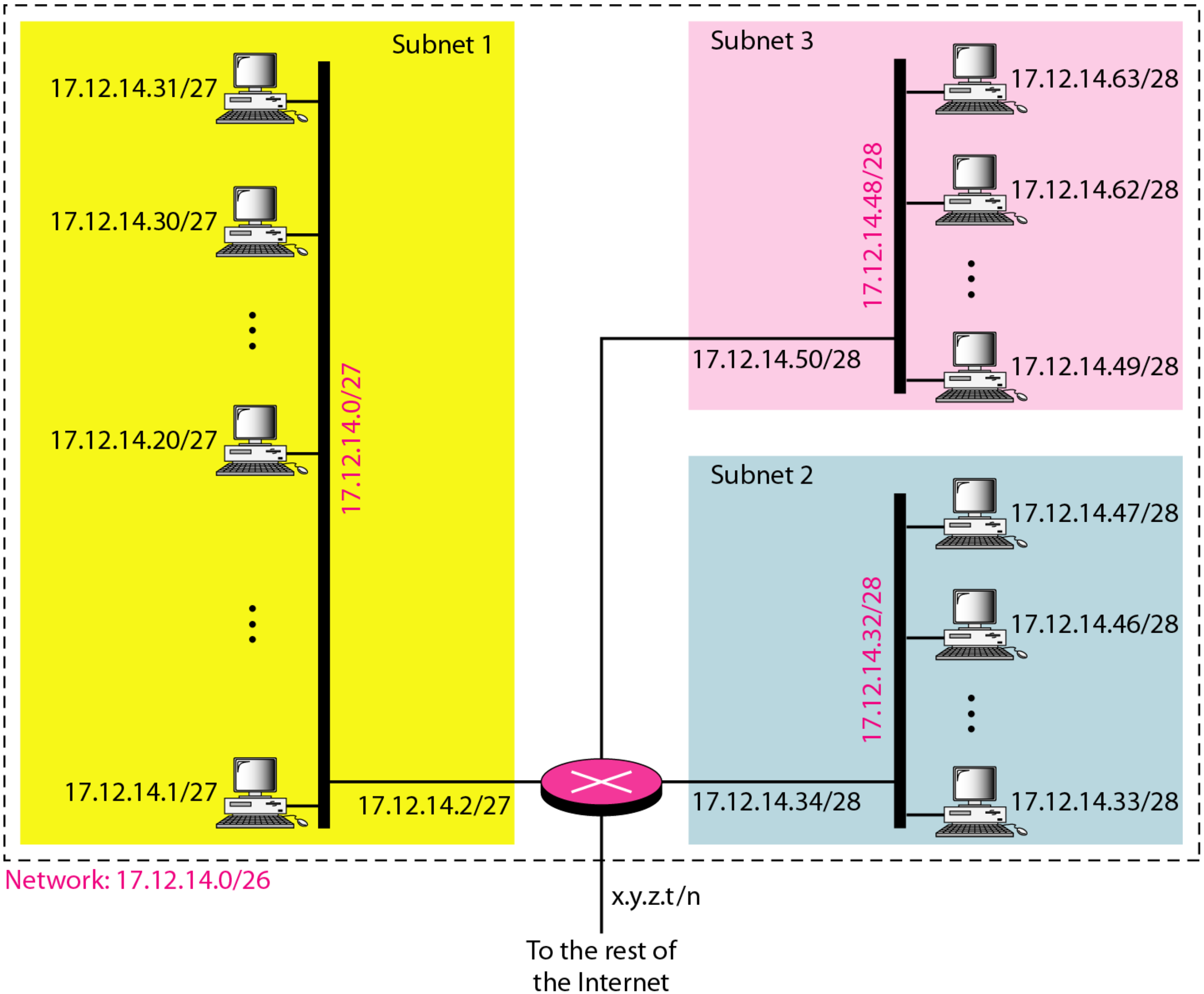
Find the mask for each subnet

1. Suppose the mask for the first subnet is n1, then 2^{32-n1} must be 32, which means that n1 =27.

2 . Suppose the mask for the second subnet is n2, then 2^{32-n2} must be 16, which means that n2 = 28.

3. Suppose the mask for the third subnet is n3, then 2^{32-n3} must be 16, which means that n3 =28.

Configuration and addresses in a subnetted network



Let us check to see if we can find the subnet addresses from one of the addresses in the subnet.

a. In subnet 1, the address 17.12.14.29/27 can give us the subnet address if we use the mask /27 because
Host: 00010001. 00001100. 00001110. 00011101
Mask:11111111 11111111 11111111 11100000 /27 (AND)
Subnet: 00010001 00001100 00001110 00000000 ....
(17.12.14.0)-(17.12.14.31)

b. **In subnet 2**, the address 17.12.14.45/28 can give us the subnet address if we use the mask /28 because
Host: 00010001 00001100 00001110 00101101
Mask:11111111 11111111 11111111 11110000 /28 (AND)
Subnet: 00010001 00001100 00001110 00100000 ....
(17.12.14.32)-(17.12.14.47)

c. **In subnet 3**, the address 17.12.14.50/28 can give us the subnet address if we use the mask /28 because

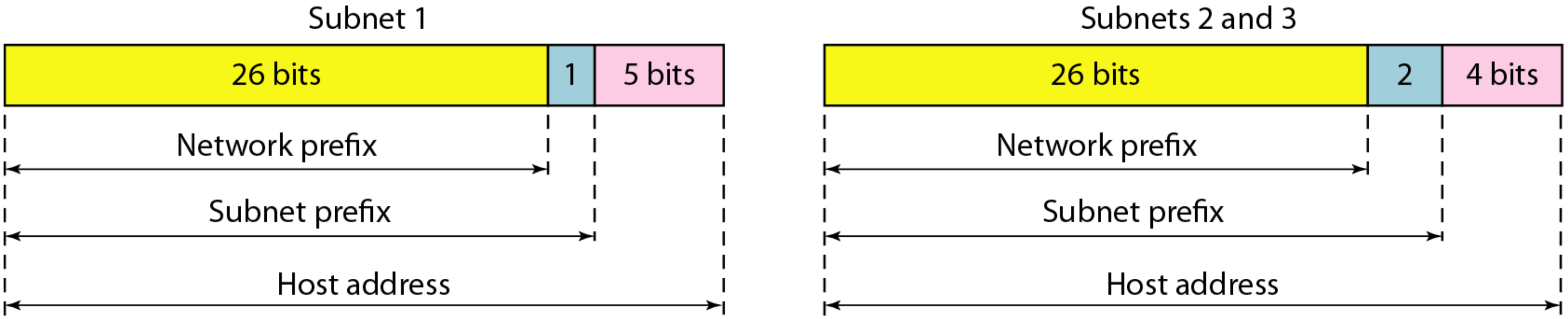
Host: 00010001 00001100 00001110 00110010

Mask:11111111 11111111 11111111 11110000 /28 (AND)

Subnet: 00010001 00001100 00001110 00110000 ....

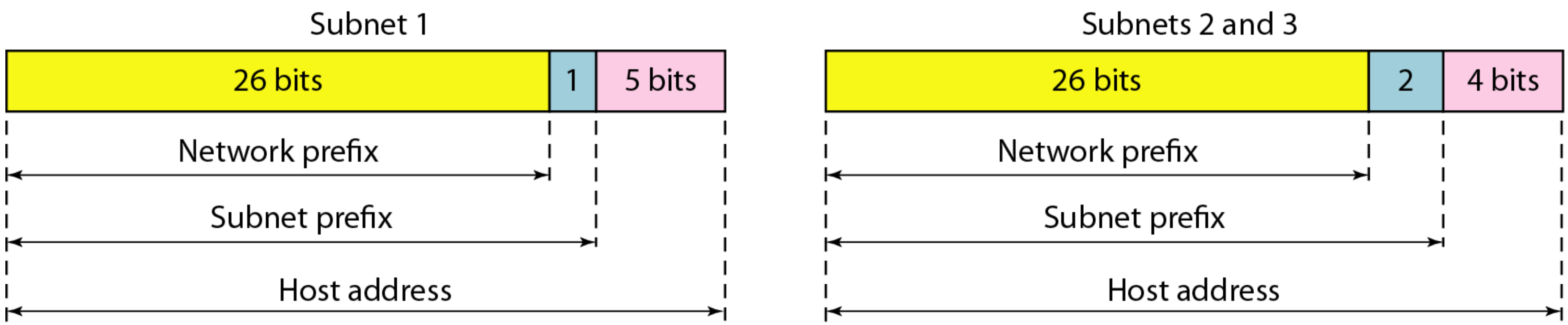
(17.12.14.48)-(17.12.14.63)

We can say that through subnetting, we have three levels of hierarchy.



Three-level hierarchy in an IPv4 address

Q/Analyze three – level of hierarchy as shown below for this network address 17.12.14.0/26 and draw the network diagram?



More Levels of Hierarchy

Large Block →Divide into →Small Blocks →Divide into→ Sub Blocks → Customers

National ISP → Regional ISP → Local ISP → Organization → Several Sub nets.

Address Allocation

How are the blocks allocated? The ultimate responsibility of address allocation is given to a global authority called the *Internet Corporation for Assigned Names and Numbers* (ICANN). However, ICANN does not normally allocate addresses to individual organizations. It assigns a large block of addresses to an ISP. Each ISP, in turn, divides its assigned block into smaller sub blocks and grants the sub blocks to its customers.

ICANN →National ISP → Regional ISP → Local ISP → Organization → Several Sub nets.

Example

An ISP is granted a block of addresses starting with 190.100.0.0/16 (65,536 addresses). The ISP needs to distribute these addresses to three groups of customers as follows:

a. The first group has 64 customers; each needs 256 addresses.
b. The second group has 128 customers; each needs 128 addresses.
c. The third group has 128 customers; each needs 64 addresses.

Design the sub blocks and find out how many addresses are still available after these allocations?

Solution

Figure below shows the situation.

Group 1

For this group, each customer needs 256 addresses. This means that 8 ($\log_2 256$) bits are needed to define each host. The prefix length is then 32 − 8 = 24. The addresses are (255.255.255.0) (255.255.0.0)

1st Customer:	*190.100.0.0/24*	*190.100.0.255/24*
2nd Customer:	*190.100.1.0/24*	*190.100.1.255/24*
. . .		
64th Customer:	*190.100.63.0/24*	*190.100.63.255/24*
Total = 64 × 256 = 16,384		

Group 2

For this group, each customer needs 128 addresses. This means that 7 ($\log_2 128$) bits are needed to define each host. The prefix length is then 32 − 7 = 25. The addresses are (255.255.255.128)

1st Customer:	*190.100.64.0/25*	*190.100.64.127/25*
2nd Customer:	*190.100.64.128/25*	*190.100.64.255/25*
. . .		
128th Customer:	*190.100.127.128/25*	*190.100.127.255/25*
Total = 128 × 128 = 16,384		

Group 3

For this group, each customer needs 64 addresses. This means that 6 ($\log_2 64$) bits are needed to each host. The prefix length is then $32 - 6 = 26$. The addresses are

1st Customer:	*190.100.128.0/26*	*190.100.128.63/26*
2nd Customer:	*190.100.128.64/26*	*190.100.128.127/26*
. . .		
128th Customer:	*190.100.159.192/26*	*190.100.159.255/26*
Total = 128 × 64 = 8192		

Number of granted addresses to the ISP: 65,536
Number of allocated addresses by the ISP: 40,960
Number of available addresses: 24,576

An example of address allocation and distribution by an ISP