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COMPUTER NETWORKS (RCS – 601)

IP & SUBNET MASKING (PART 3) : NUMERICALS

NUMERICALS

A company is granted the site address 201.70.64.0 (class C). The company needs six subnets. Design the subnets.

Solution

The number of 1s in the default mask is 24 (class C).

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Solution (Continued)

The company needs six subnets. This number 6 is not a power of 2. The next number that is a power of 2 is 8 (2^3). We need 3 more 1s in the subnet mask. The total number of 1s in the subnet mask is 27 (24 + 3).

The total number of 0s is 5 (32 – 27). The mask is

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Solution (Continued)

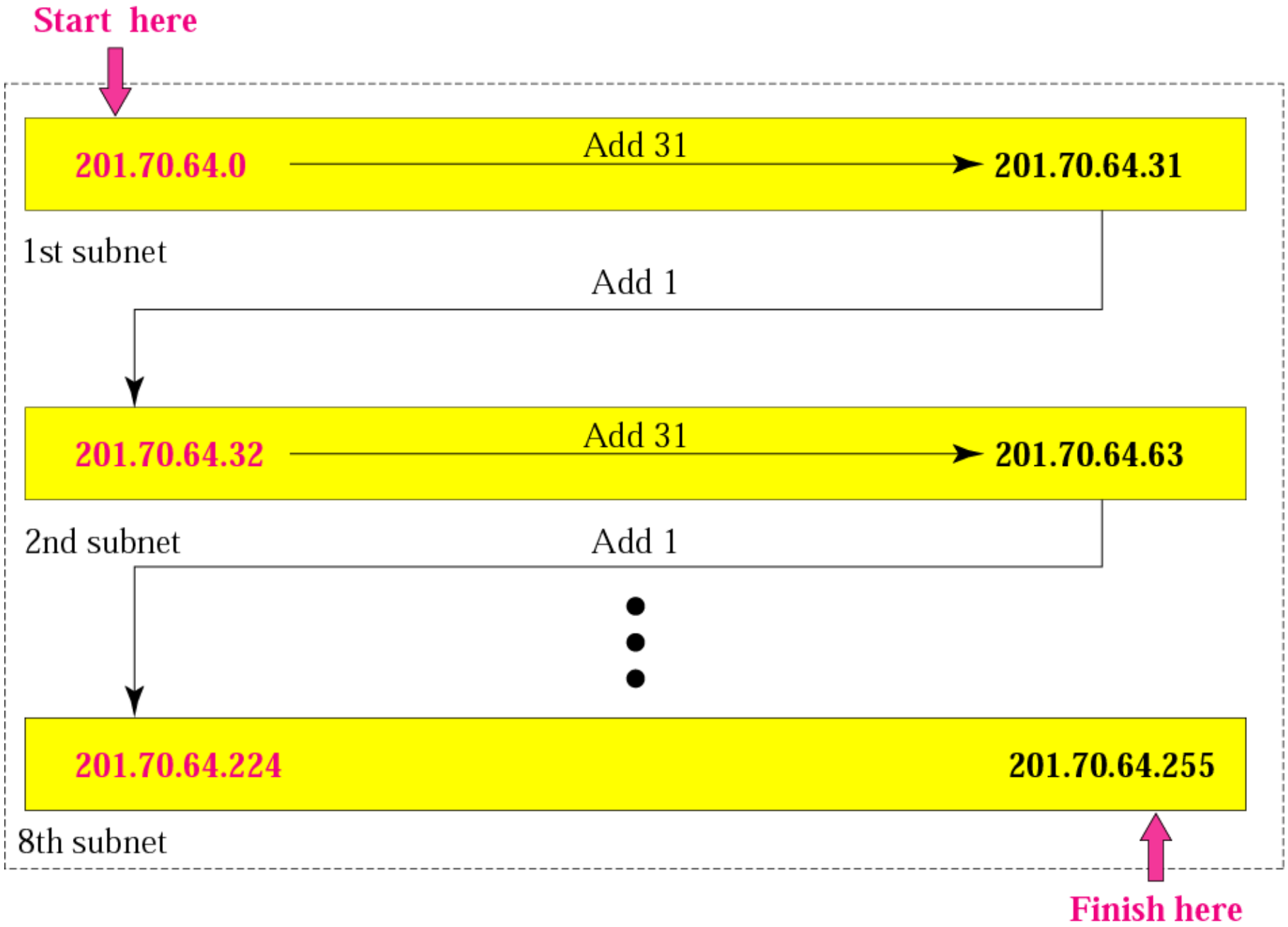
11111111 11111111 11111111 11100000

or

255.255.255.224

The number of subnets is 8.

The number of addresses in each subnet is 2^5 (5 is the number of 0s) or 32.


Start here
201.70.64.0
Add 31
201.70.64.31
1st subnet
Add 1
201.70.64.32
Add 31
201.70.64.63
2nd subnet
Add 1
201.70.64.224
201.70.64.255
8th subnet
Finish here

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Question

A small organization is given a block with the beginning address and the prefix length 205.16.37.24/29 (in slash notation). What is the range of the block?

Solution

The beginning address is 205.16.37.24. To find the last address we keep the first 29 bits and change the last 3 bits to 1s.

Beginning: 11001111 00010000 00100101 00011000
Ending : 11001111 00010000 00100101 00011111

There are only 8 addresses in this block.

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Question

What is the network address if one of the addresses is 167.199.170.82/27?

Solution

The prefix length is 27, which means that we must keep the first 27 bits as is and change the remaining bits (5) to 0s. The 5 bits affect only the last byte. The last byte is 01010010. Changing the last 5 bits to 0s, we get 01000000 or 64. The network address is 167.199.170.64/27.

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Question

An organization is granted the block 130.34.12.64/26. The organization needs to have four subnets. What are the subnet addresses and the range of addresses for each subnet?

Solution

The suffix length is 6. This means the total number of addresses in the block is 64 (2^6). If we create four subnets, each subnet will have 16 addresses.

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Solution (Continued)

Let us first find the subnet prefix (subnet mask). We need four subnets, which means we need to add two more 1s to the site prefix. **The subnet prefix is then /28.**

Subnet 1: 130.34.12.64/28 to 130.34.12.79/28.

Subnet 2 : 130.34.12.80/28 to 130.34.12.95/28.

Subnet 3: 130.34.12.96/28 to 130.34.12.111/28.

Subnet 4: 130.34.12.112/28 to 130.34.12.127/28.

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Question

A Corporation has been assigned the Class B network address 165.87.0.0. Company needs to divide the network into eight subnets. What subnet mask should be applied to the network to provide the most hosts per subnet?

a. 255.255.192.0
b. 255.255.224.0
c. 255.255.240.0
d. 255.255.248.0

Answer: 255.255.240.0

2^3-2 = 6 subnets
2^4-2 = 14 subnets
(2^16 - 2^4) -2 = 2^12 - 2 = 4094 hosts possible per subnet

Because 3 bits of subnetting will only yield 6 usable subnets (7 if ip subnet-zero is enabled), you will need to borrow another bit. To meet your minimum requirement of 8 subnets, and the maximum number of hosts per subnet, this Subnet mask will be correct: 255.255.240.0

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Question

If a class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?

Solution: The binary representation of subnet mask is 11111111.11111111.11111000.00000000. There are 21 bits set in subnet.

So 11 (32-21) bits are left for host ids.

Total possible values of host ids is 2^11 = 2048.

Out of these 2048 values, 2 addresses are reserved = 2046.

The address with all bits as 1 is reserved as broadcast address and address with all host id bits as 0 is used as network address of subnet.
In general, the number of addresses usable for addressing specific hosts in each network is always 2^N – 2 where N is the number of bits for host id.

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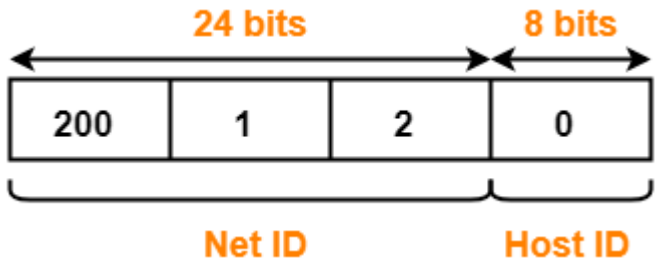
Question

Consider-

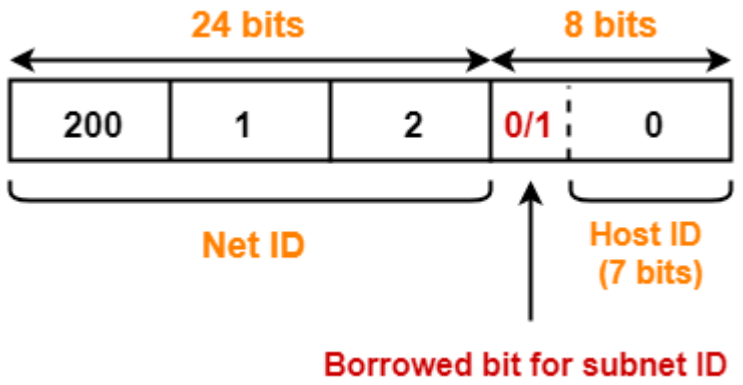
- We have a big single network having IP Address 200.1.2.0. We want to do subnetting and divide this network into 2 subnets.

Solution:

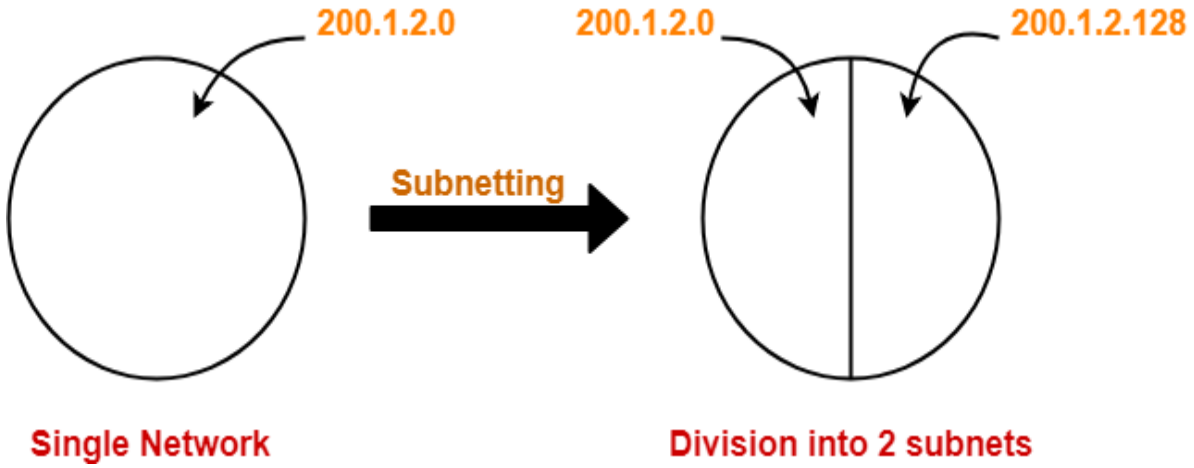
- Clearly, the given network belongs to class C.



- For creating two subnets and to represent their subnet IDs, we require 1 bit. So,
- We borrow one bit from the Host ID part.
- After borrowing one bit, Host ID part remains with only 7 bits.



- If borrowed bit = 0, then it represents the first subnet.
- If borrowed bit = 1, then it represents the second subnet.
- IP Address of the two subnets are-
- 200.1.2.**0**0000000 = 200.1.2.0
- 200.1.2.**1**0000000 = 200.1.2.128



- **For 1st Subnet-**

- IP Address of the subnet = 200.1.2.0
- Total number of IP Addresses = 2^7 = 128
- Total number of hosts that can be configured = 128 – 2 = 126
- Range of IP Addresses = [200.1.2.**0**0000000, 200.1.2.**0**1111111] = [200.1.2.0, 200.1.2.127]
- Direct Broadcast Address = 200.1.2.**0**1111111 = 200.1.2.127
- Limited Broadcast Address = 255.255.255.255

- **For 2nd Subnet-**

- IP Address of the subnet = 200.1.2.128
- Total number of IP Addresses = 2^7 = 128
- Total number of hosts that can be configured = 128 – 2 = 126
- Range of IP Addresses = [200.1.2.**1**0000000, 200.1.2.**1**1111111] = [200.1.2.128, 200.1.2.255]
- Direct Broadcast Address = 200.1.2.**1**1111111 = 200.1.2.255
- Limited Broadcast Address = 255.255.255.255

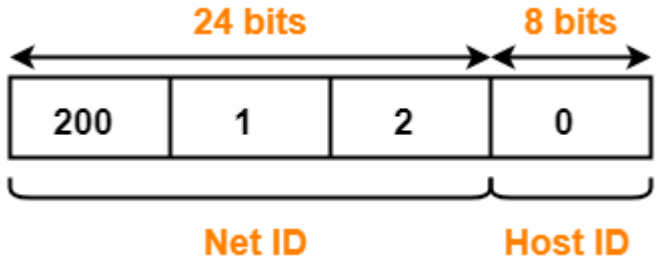
Question

Consider-

- We have a big single network having IP Address 200.1.2.0.
- We want to do subnetting and divide this network into 4 subnets.

Solution

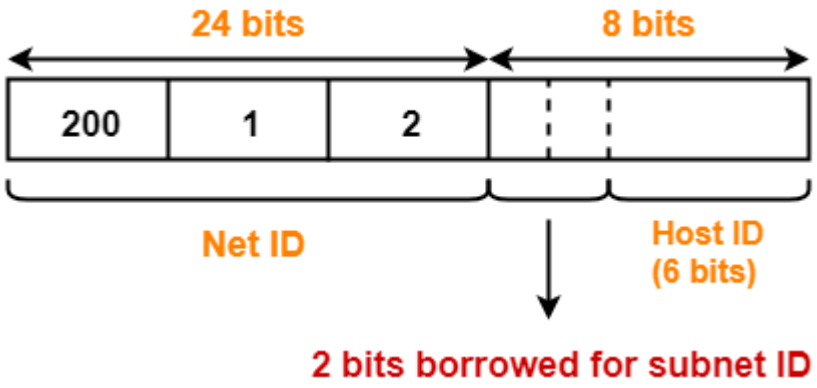
Clearly, the given network belongs to class C.



- For creating four subnets and to represent their subnet IDs, we require 2 bits.

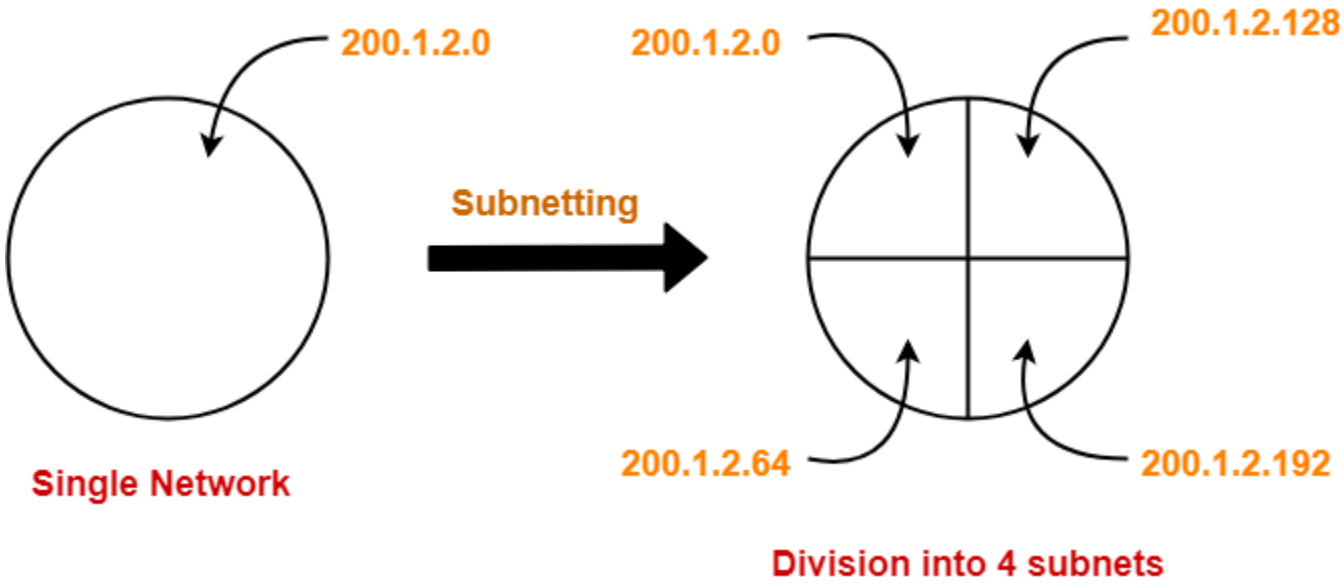
So,

- We borrow two bits from the Host ID part.
- After borrowing two bits, Host ID part remains with only 6 bits.



- If borrowed bits = 00, then it represents the 1st subnet.
- If borrowed bits = 01, then it represents the 2nd subnet.
- If borrowed bits = 10, then it represents the 3rd subnet.
- If borrowed bits = 11, then it represents the 4th subnet.

- IP Address of the four subnets are-
- 200.1.2.**00**000000 = 200.1.2.0
- 200.1.2.**01**000000 = 200.1.2.64
- 200.1.2.**10**000000 = 200.1.2.128
- 200.1.2.**11**000000 = 200.1.2.192


200.1.2.0
Single Network
Subnetting
200.1.2.0
200.1.2.128
200.1.2.64
200.1.2.192
Division into 4 subnets

- **For 1st Subnet-**

- IP Address of the subnet = 200.1.2.0
- Total number of IP Addresses = 2^6 = 64
- Total number of hosts that can be configured = 64 – 2 = 62
- Range of IP Addresses = [200.1.2.**00**000000, 200.1.2.**00**111111] = [200.1.2.0, 200.1.2.63]
- Direct Broadcast Address = 200.1.2.**00**111111 = 200.1.2.63
- Limited Broadcast Address = 255.255.255.255

- **For 2nd Subnet-**

- IP Address of the subnet = 200.1.2.64
- Total number of IP Addresses = 2^6 = 64
- Total number of hosts that can be configured = 64 – 2 = 62
- Range of IP Addresses = [200.1.2.**01**000000, 200.1.2.**01**111111] = [200.1.2.64, 200.1.2.127]
- Direct Broadcast Address = 200.1.2.**01**111111 = 200.1.2.127
- Limited Broadcast Address = 255.255.255.255

- **For 3rd Subnet-**

- IP Address of the subnet = 200.1.2.128
- Total number of IP Addresses = 2^6 = 64
- Total number of hosts that can be configured = 64 – 2 = 62
- Range of IP Addresses = [200.1.2.**10**000000, 200.1.2.**10**111111] = [200.1.2.128, 200.1.2.191]
- Direct Broadcast Address = 200.1.2.**10**111111 = 200.1.2.191
- Limited Broadcast Address = 255.255.255.255

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- **For 4th Subnet-**

- IP Address of the subnet = 200.1.2.192
- Total number of IP Addresses = 2^6 = 64
- Total number of hosts that can be configured = 64 – 2 = 62
- Range of IP Addresses = [200.1.2.**11**000000, 200.1.2.**11**111111] = [200.1.2.192, 200.1.2.255]
- Direct Broadcast Address = 200.1.2.**11**111111 = 200.1.2.255
- Limited Broadcast Address = 255.255.255.255

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Question

- Suppose a network with IP Address 192.16.0.0. is divided into 2 subnets, find number of hosts per subnet.

Also for the first subnet, find-

- Subnet Address
- First Host ID
- Last Host ID
- Broadcast Address

Solution:

- Given IP Address belongs to class C.
- So, 24 bits are reserved for the Net ID.
- The given network is divided into 2 subnets.
- So, 1 bit is borrowed from the host ID part for the subnet IDs.
- Then, Number of bits remaining for the Host ID = 7.
- Thus, Number of hosts per subnet = $2^7 = 128$.

For 1st Subnet-

- Subnet Address = First IP Address = 192.16.0.**0**0000000 = 172.16.0.0
- First Host ID = 192.16.0.**0**0000001 = 192.16.0.1
- Last Host ID = 192.16.0.**0**1111110 = 192.16.0.126
- Broadcast Address = Last IP Address = 192.16.0.**0**1111111 = 172.16.0.127

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Question

- What is **not true** about subnetting?
- It is applied for a single network
- It is used to improve security
- Bits are borrowed from network portion
- Bits are borrowed from Host portion

Clearly, Option (C) is correct.