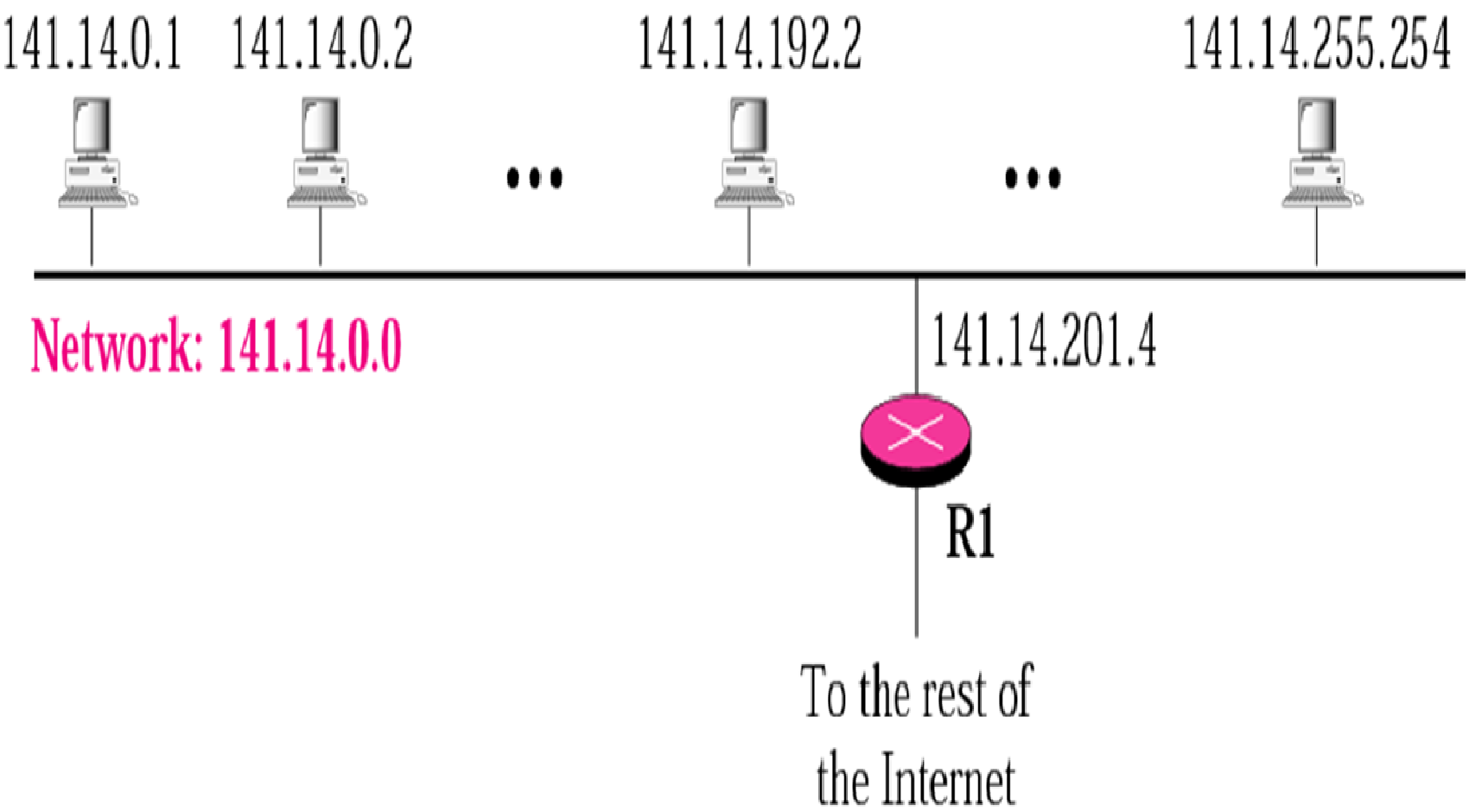
SUBNETTING

Network vs Host

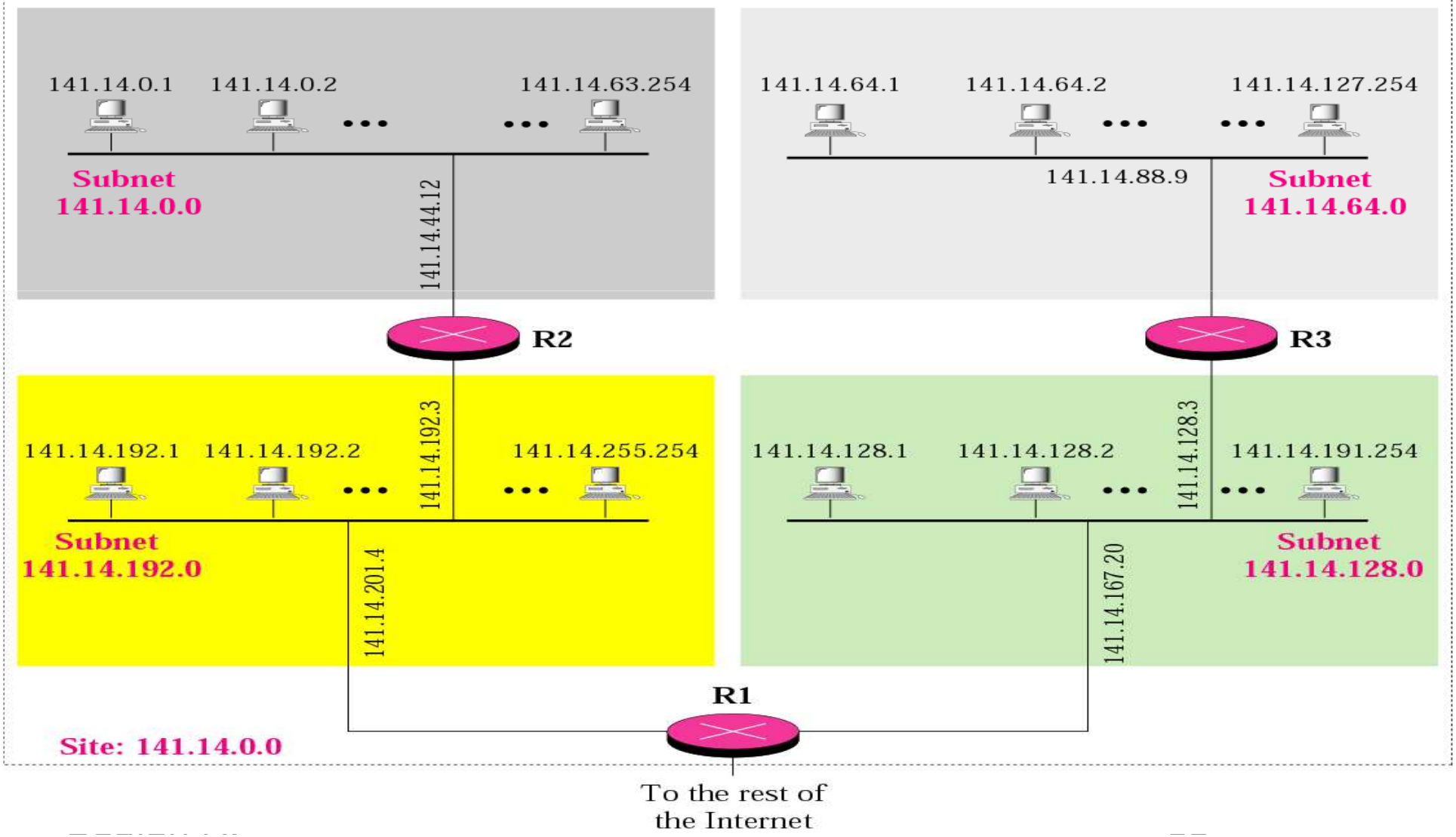
- IP addresses are designed with two levels of hierarchy:
  - 1 identifying the network it resides on
  - 1 identifying the host address on the network
- The Class of the address and the Default Mask determine which part belongs to the network address and which part belongs to the host address
- In classful addressing, a large part of the available addresses were wasted.

Network vs Host



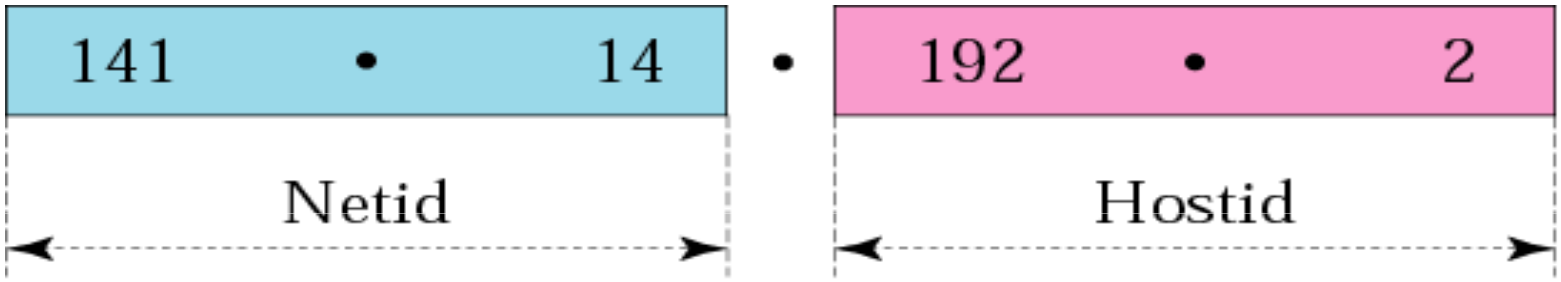
Subnetting

- A network with three levels of hierarchy .

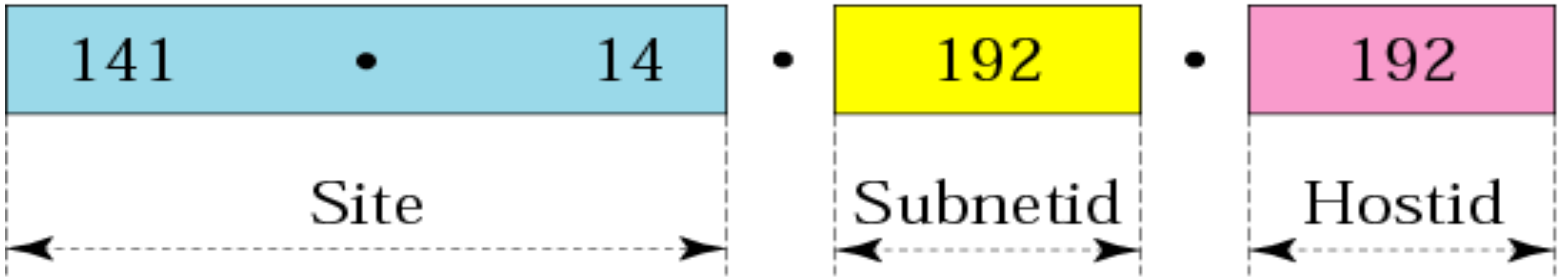


Subnetting

- Addresses in a network with and without subnetting (Class B)



a. Without subnetting



b. With subnetting

Default Mask

- Mask or a Default mask is a 32 bit number made of contiguous 1s followed by contiguous 0s
- Used to find the network address
- AND IP address with Default mask to get the network address

Class	*Binary*	*Dotted-Decimal*
A	11111111 00000000 00000000 00000000	255.0.0.0
B	11111111 11111111 00000000 00000000	255.255.0.0
C	11111111 11111111 11111111 00000000	255.255.255.0

Logical Bitwise AND Operation

- Consider The example
  - 140.179.240.200

- It's a Class B, so the Mask is:
  - 255.255.0.0

Logical Bitwise AND Operation

140.179.220.200 Class B address

255.255.0.0 Default Mask

In Binary:

10001100 10110011 11110000 11001000

11111111 11111111 00000000 00000000

10001100 10110011 00000000 00000000

By doing this, the computer has found that our Network Address is **140.179.0.0**

Another Example

Address → 206.15.143.89?

What class is it? Class C

What is the Default mask? 255.255.255.0

What is the Network Address? 206.15.143.0

What is the host portion of the address? 0.0.0.89

Subnetting

- Subnetting is a way of taking an existing class license and breaking it down to create more Network Addresses.
- This will always reduce the number of host addresses for a given network.
- Subnetting makes more efficient use of the address or addresses assigned to an organization.

How Does Subnetting Work?

- Additional bits can be added (changed from 0 to 1) to the subnet mask to further subnet, or breakdown, a network.

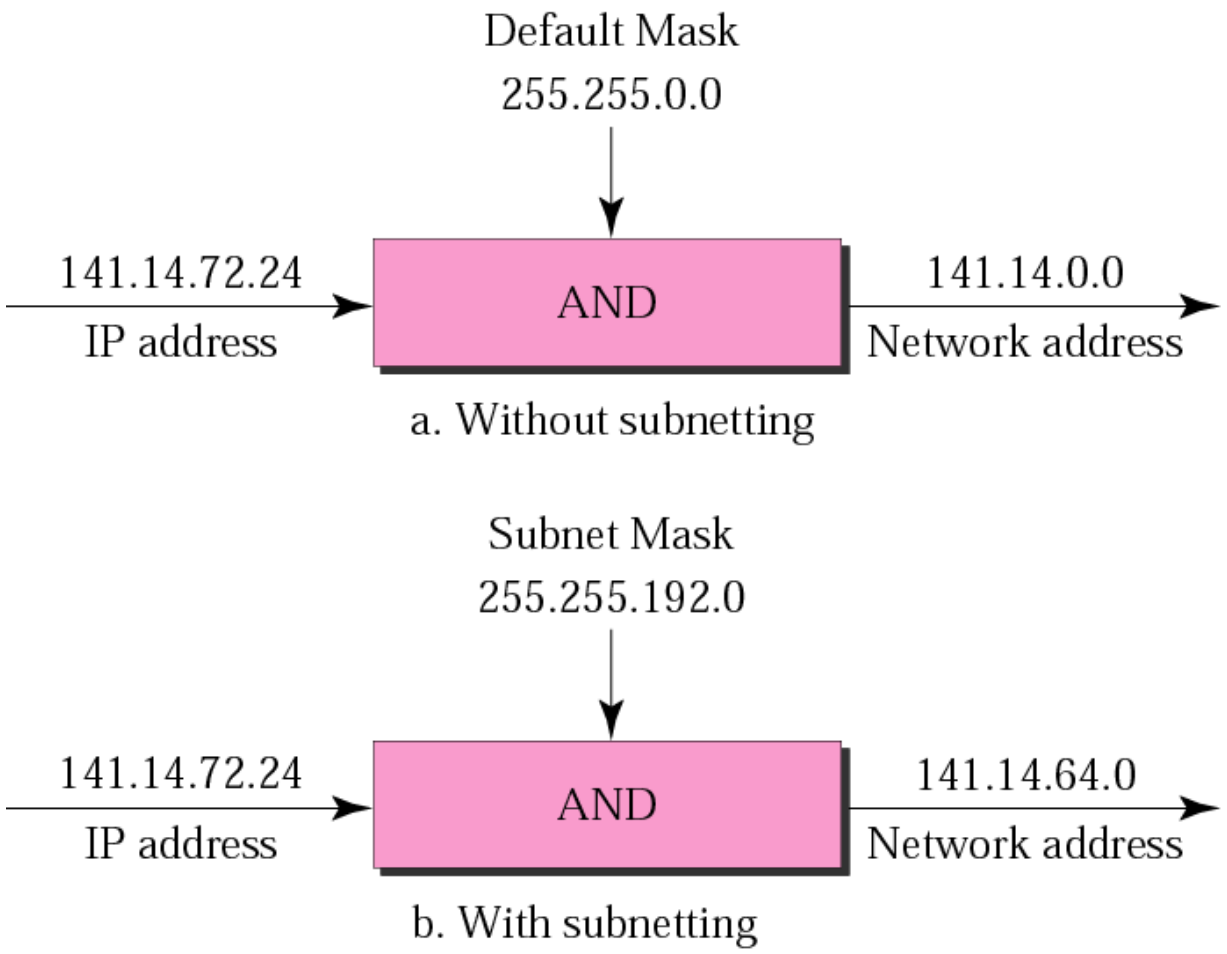
- When the *logical AND* is done by the computer, the result will give it a new Network (or Subnet) Address.

- Remember, an address of all "0"s or all "1"s cannot be used in the last octet (or host portion). All "0"s signify the Network Address and all "1"s signify the broadcast address

Subnet Mask

- Subnet mask is a 32 bit number made of contiguous 1s followed by contiguous 0s
- Used to find the subnet address
- AND IP address with Subnet mask to get the subnet address

Subnet Mask


Default Mask
255.255.0.0
141.14.72.24
IP address
AND
141.14.0.0
Network address
a. Without subnetting
Subnet Mask
255.255.192.0
141.14.72.24
IP address
AND
141.14.64.0
Network address
b. With subnetting

Example

- What is the subnetwork address if the destination address is 200.45.34.56 and the subnet mask is 255.255.240.0?

Solution

11001000 00101101 00100010 00111000

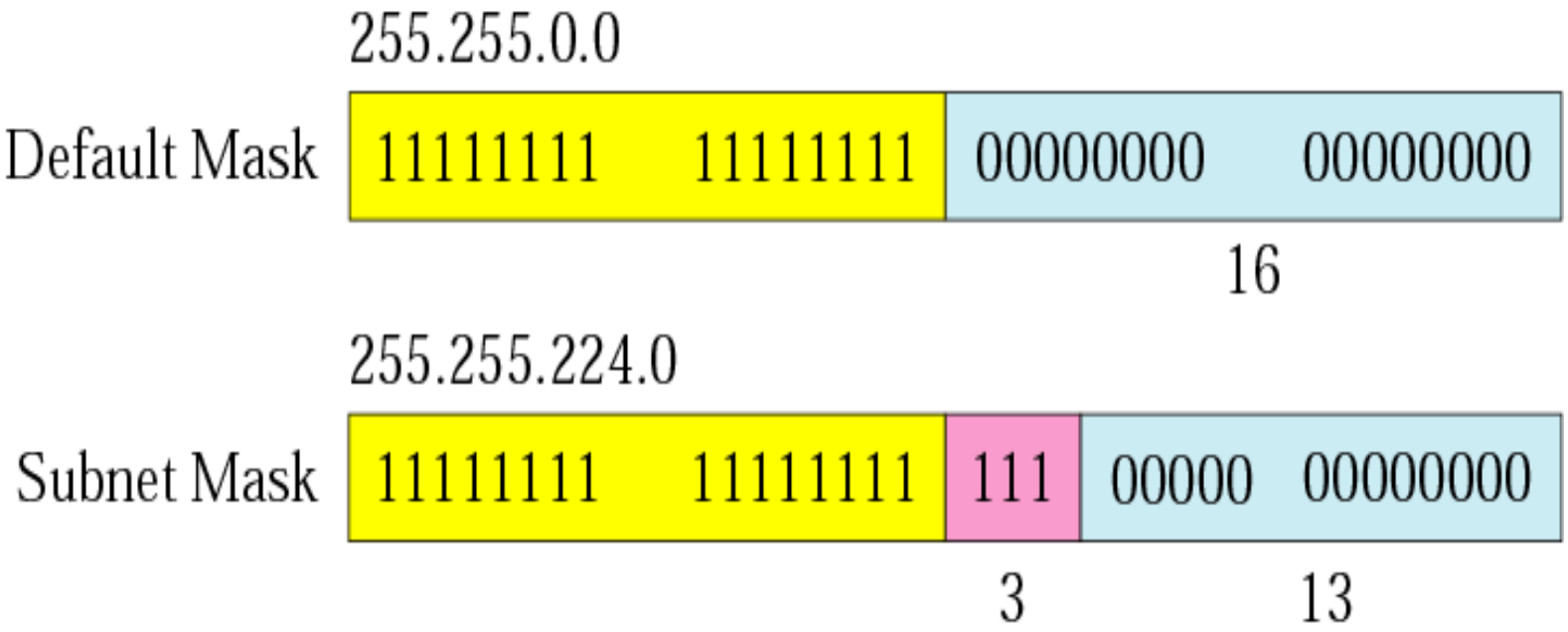
11111111 11111111 1111**0000** **00000000**

11001000 00101101 0010**0000** **00000000**

The subnetwork address is 200.45.32.0

Comparison of a default mask and a subnet mask

The number of subnets must be a power of 2.



Example

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

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

Example Cont…

- 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).

Example Cont…

- The mask is

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.

Example Cont…

- The six subnets are:

  201.70.64.0

  201.70.64.32

  201.70.64.64

  201.70.64.96

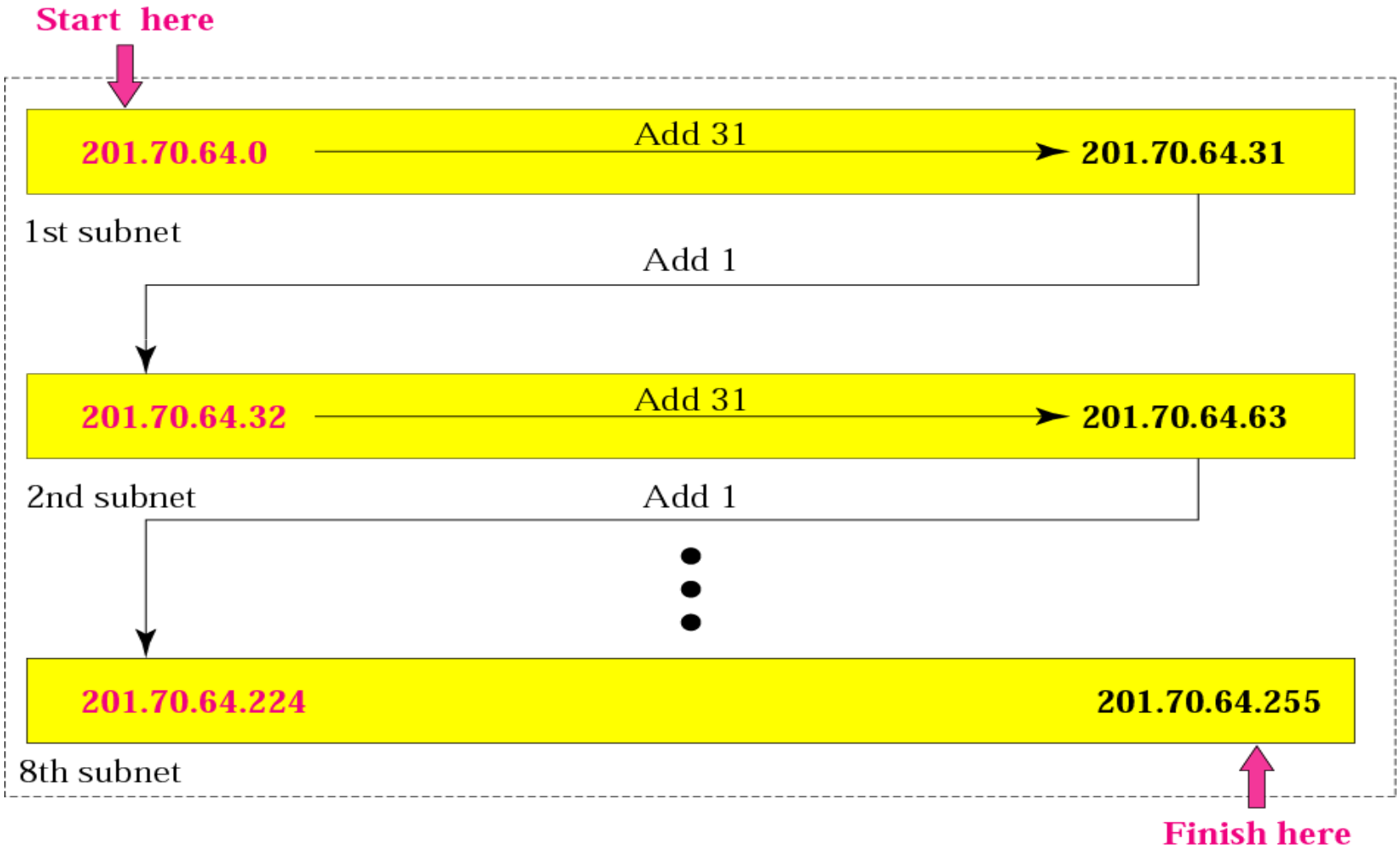
  201.70.64.128

  201.70.64.160

- The remaining 2 are unused

  201.70.64.192 201.70.64.224

Example Cont…



Another Example

- A company is granted the site address 181.56.0.0 (class B). The company needs 1000 subnets. Design the subnets.

- The number of 1s in the default mask is 16 (class B).

Another Example Cont…

- The company needs 1000 subnets.
- This number is not a power of 2.
- The next number that is a power of 2 is 1024 (2^{10}).
- We need 10 more 1s in the subnet mask.
- The total number of 1s in the subnet mask is 26 (16 + 10).
- The total number of 0s is 6 (32 - 26).

Another Example Cont…

- The mask is

  11111111 11111111 11111111 11000000

  or

  255.255.255.192

- The number of subnets is 1024.
- The number of addresses in each subnet is 2^6 (6 is the number of 0s) or 64.

Another Example Cont…