



# Lecture (08)

## Internetwork Layer (2)

---

By:

**Dr. Ahmed ElShafee**

Dr. Ahmed ElShafee, ACU : Fall 2015, Networks I

## Agenda

---

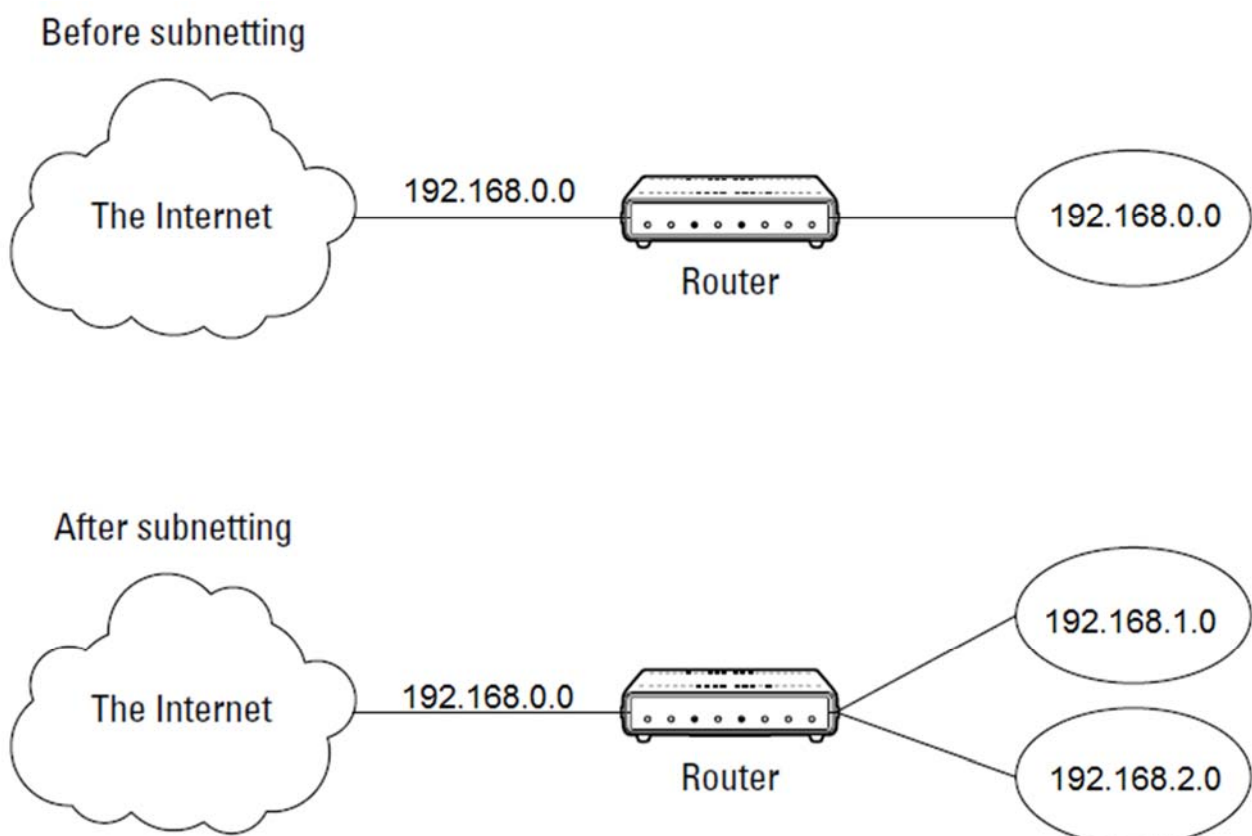
- Sub-netting
- Subnet masks

# Subnetting

- A *subnet* is a network that falls within a Class A, B, or C network.
- Subnets are created by using one or more of the Class A, B, or C host bits to extend the network ID.
- Thus, instead of the standard 8-, 16-, or 24-bit network ID, subnets can have network IDs of any length.
- Following Figure shows an example of a network before and after subnetting has been applied.
- In the unsubnetted network, the network has been assigned the Class B address 192.168.0.0.
- All the devices on this network must share the same broadcast domain.

٣

Dr. Ahmed ElShafee, ACU Fall 2013, Network I



٤

Dr. Ahmed ElShafee, ACU Fall 2013, Network I

- 
- In the second network, the first four bits of the host ID are used to divide the network into two small networks, identified as subnets 16 and 32.
  - To the outside world (that is, on the other side of the router), these two networks still appear to be a single network identified as 192.168.0.0.
  - For example, the outside world considers the device at 192.168.1.2 to belong to the 192.168.0.0 network.
  - As a result, a packet sent to this device will be delivered to the router at 192.168.0.0.
  - The router then considers the subnet portion of the host ID to decide whether to route the packet to subnet 1 or subnet 2.

◦

Dr. Ahmed ElShafee, ACU Fall 2013, Network I

---

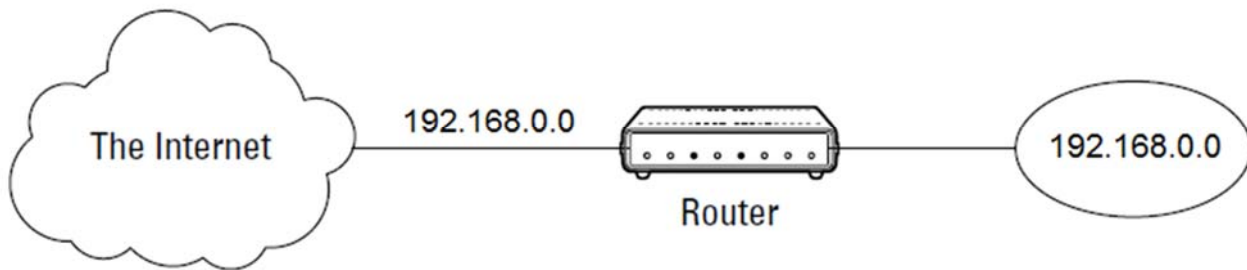
## Subnet masks

- 
- For subnetting to work, the router must be told which portion of the host ID should be used for the subnet network ID.
  - That is accomplished by using another 32-bit number, known as a *subnet mask*.
  - Those IP address bits that represent the network ID are represented by a 1 in the mask, and those bits that represent the host ID appear as a 0 in the mask.

7

Dr. Ahmed ElShafee, ACU Fall 2013, Network I

Before subnetting



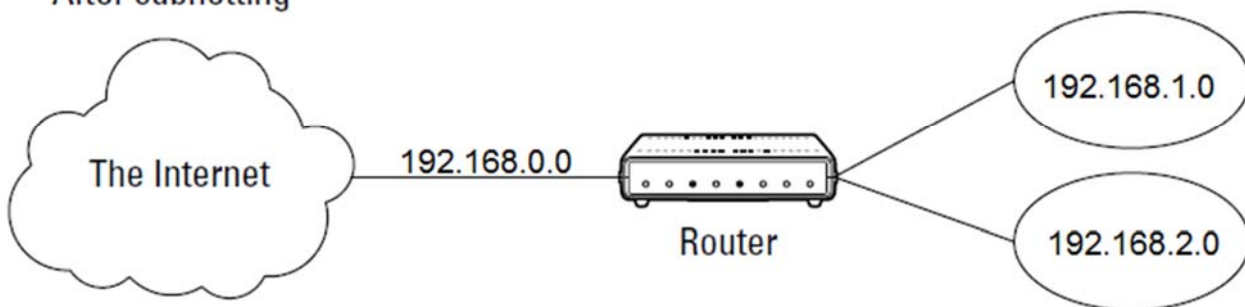
- Subnet mask here

<b>11111111</b>	<b>11111111</b>	<b>00000000</b>	<b>00000000</b>
255	255	0	0

Y

Dr. Ahmed ElShafee, ACU Fall 2013, Network I

After subnetting



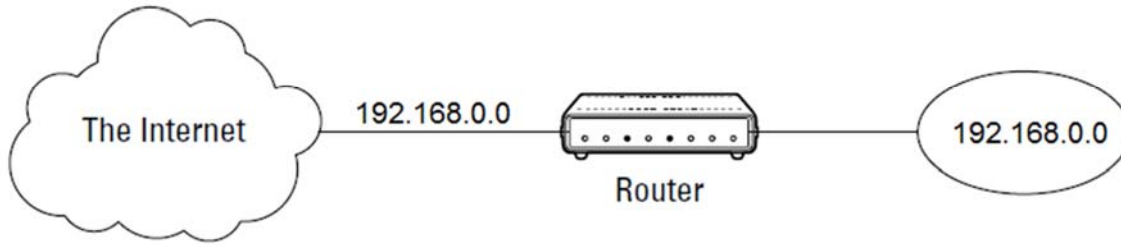
<b>Router</b>	<b>11111111</b>	<b>11111111</b>	<b>11111100</b>	<b>00000000</b>
	255	255	252	0

<b>PCs</b>	<b>11111111</b>	<b>11111111</b>	<b>11111100</b>	<b>00000000</b>
	255	255	252	0

A

Dr. Ahmed ElShafee, ACU Fall 2013, Network I

Before subnetting

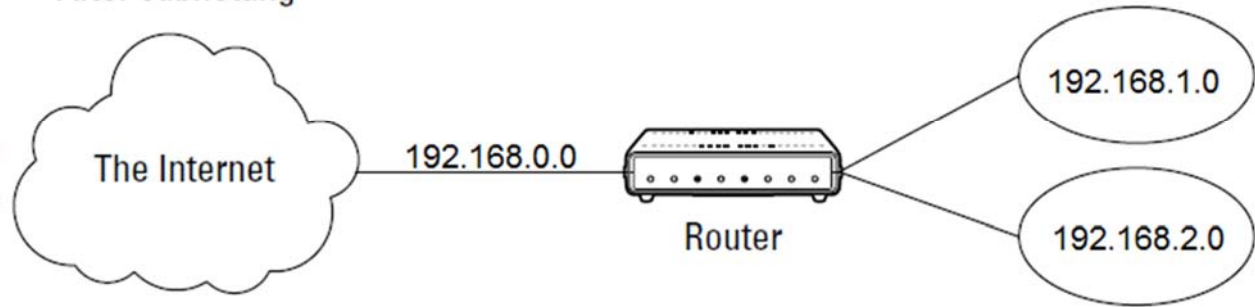


<b>Router</b>	<b>IP</b>	<b>192</b>	<b>168</b>	<b>0</b>	<b>1</b>
		11000000	10101000	00000000	00000001
	<b>Subnet Mask</b>	11111111	11111111	00000000	00000000
		255	255	0	0
<b>Network IP</b>	192	168	0	0	

<b>PC1</b>	<b>IP</b>	<b>192</b>	<b>168</b>	<b>0</b>	<b>2</b>
		11000000	10101000	00000000	00000010
	<b>Subnet Mask</b>	11111111	11111111	00000000	00000000
		255	255	0	0
<b>Network IP</b>	192	168	0	0	

Dr. Ahmed ElShafee, ACU Fall 2013, Network I

After subnetting



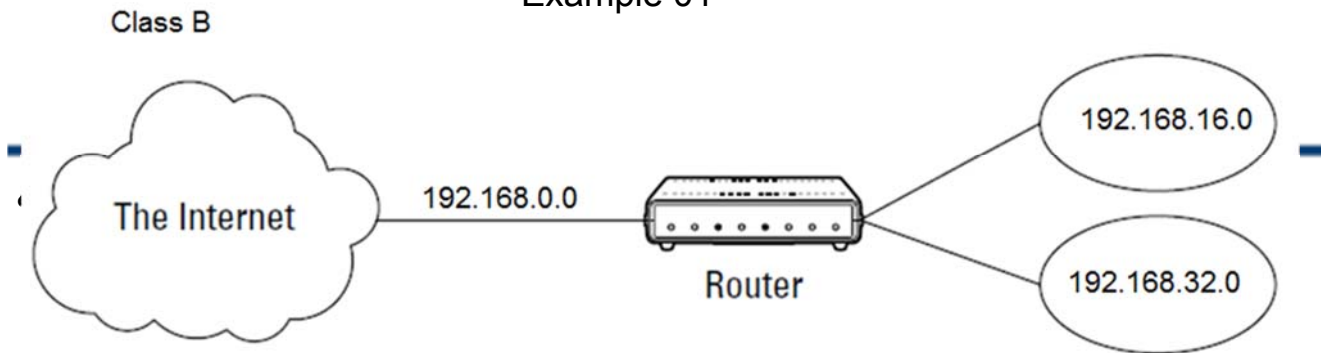
<b>Router</b>	<b>IP</b>	<b>192</b>	<b>168</b>	<b>0</b>	<b>1</b>
		11000000	10101000	00000000	00000001
	<b>Subnet Mask</b>	11111111	11111111	11111100	00000000
		255	255	252	0
<b>Network IP</b>	192	168	0	0	

<b>PC1</b>	<b>IP</b>	<b>192</b>	<b>168</b>	<b>1</b>	<b>1</b>
		11000000	10101000	00000001	00000001
	<b>Subnet Mask</b>	11111111	11111111	11111100	00000000
		255	255	252	0
<b>Network IP</b>	192	168	0	0	

Dr. Ahmed ElShafee, ACU Fall 2013, Network I

•PC2	IP	<b>192</b>	<b>168</b>	<b>2</b>	<b>1</b>
		11000000	10101000	00000010	00000001
	Subnet Mask	11111111	11111111	11111100	00000000
		255	255	252	0
	Network IP	192	168	0	0

### Example 01

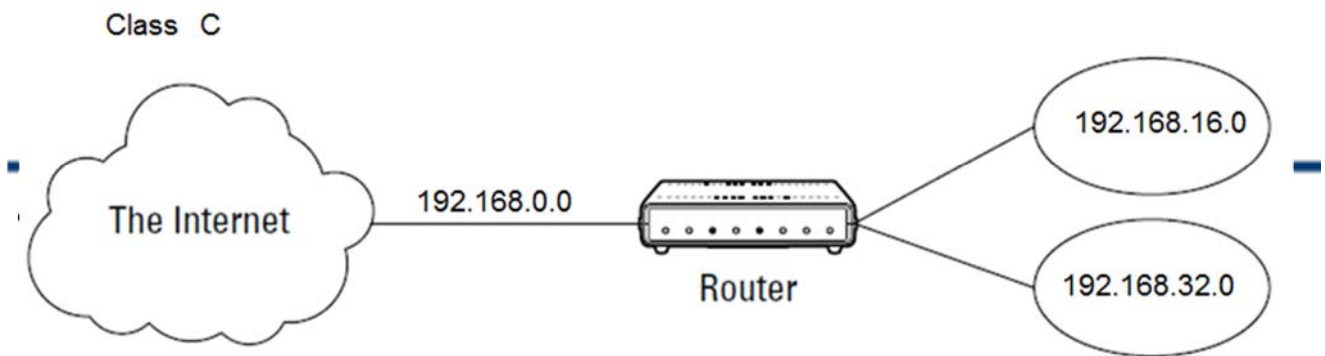


Router	IP	<b>192</b>	<b>168</b>	<b>0</b>	<b>1</b>
		11000000	10101000	00000000	00000001
	Subnet Mask	11111111	11111111	00000000	00000000
		255	255	0	0
	Network IP	192	168	0	0

PC1 in sub network 1	IP	<b>192</b>	<b>168</b>	<b>16</b>	<b>1</b>
		11000000	10101000	00010000	00000001
	Subnet Mask	11111111	11111111	00000000	00000000
		255	255	0	0
	Network IP	192	168	0	0



•PC2 PC1 in sub network 2	IP	<b>192</b>	<b>168</b>	<b>32</b>	<b>1</b>
		11000000	10101000	00100000	00000001
	Subnet Mask	11111111	11111111	00000000	00000000
		255	255	0	0
	Network IP	192	168	0	0

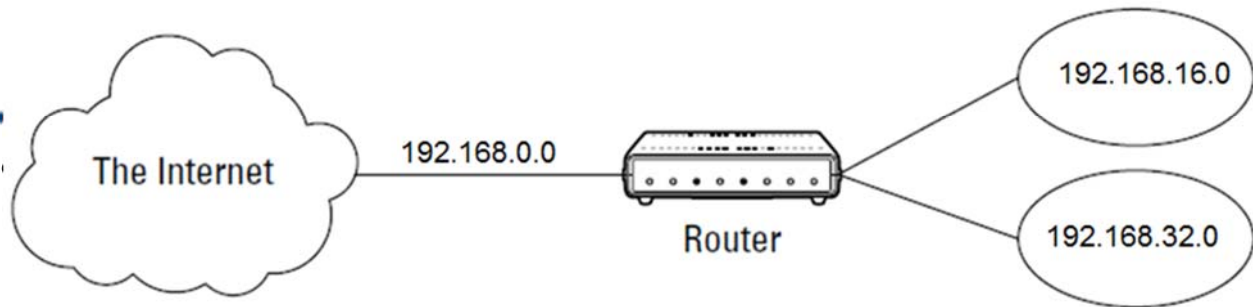


Router	IP	<b>192</b>	<b>168</b>	<b>0</b>	<b>1</b>
		11000000	10101000	00000000	00000001
	Subnet Mask	11111111	11111111	11111111	00000000
		255	255	255	0
	Network IP	192	168	0	0

PC1	IP	<b>192</b>	<b>168</b>	<b>16</b>	<b>1</b>
		11000000	10101000	00010000	00000001
	Subnet Mask	11111111	11111111	11111111	00000000
		255	255	255	0
	Network IP	192	168	16	0

PC2	IP	192	168	32	1
		11000000	10101000	00100000	00000001
	Subnet Mask	11111111	11111111	11111111	00000000
		255	255	255	0
	Network IP	192	168	32	0

### Subnetting



Router	IP	192	168	0	1
		11000000	10101000	00000000	00000001
	Subnet Mask	11111111	11111111	11000000	00000000
		255	255	192	0
	Network IP	192	168	0	0

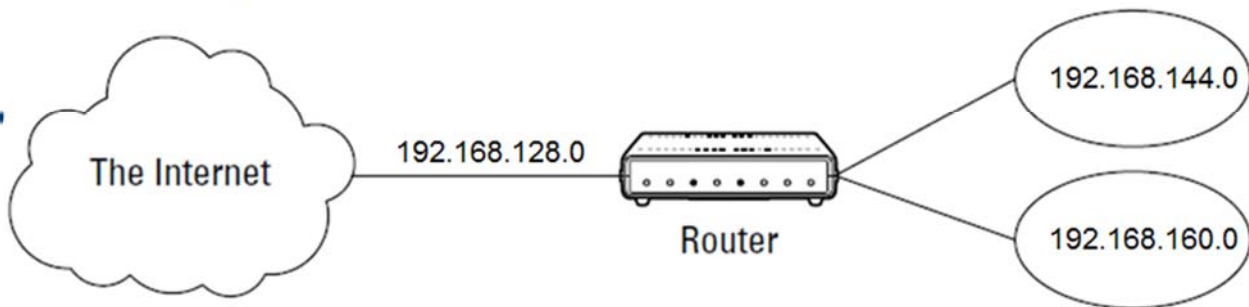
PC1	IP	192	168	16	1
		11000000	10101000	00010000	00000001
	Subnet Mask	11111111	11111111	11000000	00000000
		255	255	192	0
	Network IP	192	168	0	0



PC2	IP	192	168	32	1
		11000000	10101000	00100000	00000001
	Subnet Mask	11111111	11111111	11000000	00000000
		255	255	192	0
	Network IP	192	168	0	0

subnetting

### Example 02



Router	IP	192	168	128	1
		11000000	10101000	10000000	00000001
	Subnet Mask	11111111	11111111	11000000	00000000
		255	255	192	0
	Network IP	192	168	128	0

PC1 on sub network 1	IP	192	168	144	1
		11000000	10101000	10010000	00000001
	Subnet Mask	11111111	11111111	11000000	00000000
		255	255	192	0
	Network IP	192	168	128	0

<b>PC2 on sub network 2</b>	<b>IP</b>	<b>192</b>	<b>168</b>	<b>160</b>	<b>1</b>
		11000000	10101000	10100000	00000001
	<b>Subnet Mask</b>	11111111	11111111	11000000	00000000
		255	255	192	0
	<b>Network IP</b>	192	168	128	0

