

Address	Subnet Address	Number of Subnets	Comments
10.5.22.5/8	255.0.0.0	0	This is the default Class A subnet address. The mask includes only the network portion of the address and provides no additional subnets.
10.5.22.5/16	255.255.0.0	254	This Class A subnet address has 16 bits of subnetting, but only the bits in the second octet (those beyond the default) contribute to the subnetting.
155.13.22.11/16	255.255.0.0	0	In this case, 16 bits are also used for subnetting, but because the default for a Class B address is 16 bits, no additional subnets are created.
155.13.10.11/26	255.255.255.192	1022	In this case, there is a total of 26 bits of subnetting, but the Class B address can use only 10 of them to create subnets. The result is the creation of 1024 subnets ($2^{10} - 2$).

How Routers Use Subnet Masks

	Network		Subnet	Host
172.16.2.160	10101100	00010000	00000010	10100000
255.255.255.192	11111111	11111111	11111111	11000000
	10101100	00010000	00000010	10000000
				128 192 224 240 248 252 254 255
Network Number	172	16	2	128

of this operation is that the host portion of the address is removed, and the router bases its decision on only the network portion of the address.

To determine an address's subnet, a router performs a logical AND operation with the IP address and subnet mask.

Recall that the host portion of the subnet mask is all 0s. The result

In the figure, the host bits are removed, and the network portion of the address is revealed. In this case, a 10-bit subnet address is used, and the network (subnet) number 172.16.2.128 is extracted.

Broadcast Addresses

Broadcast messages are sent to every host on the network. There are three kinds of broadcasts:

- **Directed broadcasts**—You can broadcast to all hosts within a subnet and to all subnets within a network. (170.34.2.255 sends a broadcast to all hosts in the 170.34.2.0 subnet.)
- **Flooded broadcasts (255.255.255.255)**—Local broadcasts within a subnet.
- You can also broadcast messages to all hosts on all subnets within a single network. (170.34.255.255 sends a broadcast to all subnets in the 170.34.0.0 network.)

Identifying Subnet Addresses

Given an IP address and subnet mask, you can identify the subnet address, broadcast address, first usable address, and last usable address using this method:

1. Write down the 32-bit address. Directly below that, write down the subnet mask.
2. Draw a vertical line just after the last 1 bit in the subnet mask.
3. Copy the portion of the IP address to the left of the line. Place all 0s for the remaining free spaces to the right. This is the subnet number.
4. Copy the portion of the IP address to the left of the line. Place all 1s for the remaining free spaces to the right. This is the broadcast address.
5. Copy the portion of the IP address to the left of the line. Place all 0s in the remaining free spaces until you reach the last free space. Place a 1 in that free space. This is your first usable address.
6. Copy the portion of the IP address to the left of the line. Place all 1s in the remaining free spaces until you reach the last free space. Place a 0 in that free space. This is your last usable address.

	174	24	4	176	
174.24.4.176	10101110	00011000	00000100	10110000	Host
255.255.255.192	11111111	11111111	11111111	11000000	Mask
174.24.4.128	10101110	00011000	00000100	10100000	Subnet
174.24.4.191	10101110	00011000	00000100	10111111	Broadcast
174.24.4.129	10101110	00011000	00000100	10100001	First
174.24.4.190	10101110	00011000	00000100	10111110	Last