5.4 SPECIAL ADDRESSES

In classful addressing some addresses were reserved for special purposes. The classless addressing scheme inherits some of these special addresses from classful addressing.

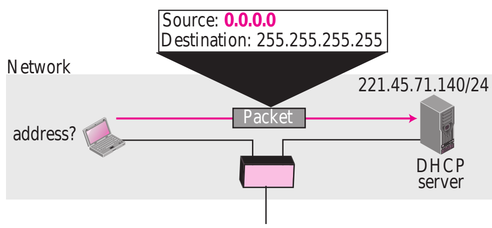
Special Blocks

Some blocks of addresses are reserved for special purposes.

All-Zeros Address

The block 0.0.0.0/32, which contains only one single address, is reserved for communication when a host needs to send an IPv4 packet but it does not know its own address. This is normally used by a host at bootstrap time when it does not know its IPv4 address. The host sends an IPv4 packet to a bootstrap server (called DHCP server as discussed in Chapter 18) using this address as the source address and a **limited broadcast address** as the destination address to find its own address (see Figure 5.35).

Figure 5.35 *Examples of using the all-zeros address*



All-Ones Address: Limited Broadcast Address

The block 255.255.255.255/32, which contains one single address, is reserved for limited broadcast address in the current network. A host that wants to send a message to every other host can use this address as a destination address in an IPv4 packet. However, a router will block a packet having this type of address to confine the broadcasting to the local network. In Figure 5.36, a host sends a datagram using a destination IPv4 address consisting of all 1s. All devices on this network receive and process this datagram.

Loopback Addresses

The block 127.0.0.0/8 is used for the **loopback address,** which is an address used to test the software on a machine. When this address is used, a packet never leaves the machine; it simply returns to the protocol software. It can be used to test the IPv4 software. For example, an application such as “ping” can send a packet with a loopback address as the destination address to see if the IPv4 software is capable of receiving and processing a packet. As another example, the loopback address can be used by a *client process* (a running application program) to send a message to a server process on the same machine. Note that this can be used only as a destination address in an IPv4 packet (see Figure 5.37).

Figure 5.36 *Example of limited broadcast address*

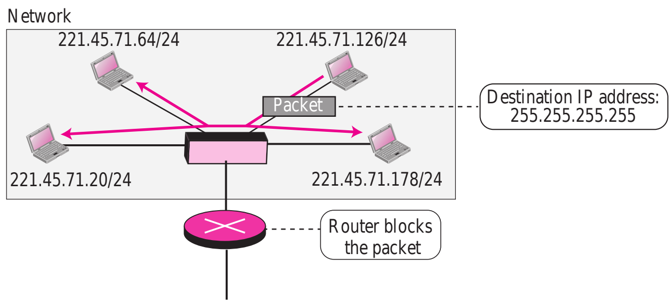
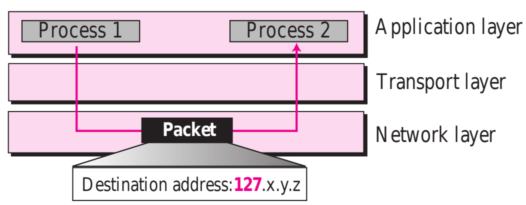


Figure 5.37 *Example of loopback address*



Private Addresses

A number of blocks are assigned for private use. They are not recognized globally. These blocks are depicted in Table 5.2. These addresses are used either in isolation or in connection with network address translation techniques (see NAT section later in this chapter).

Table 5.2 *Addresses for private networks*

Block	*Number of addresses*	*Block*	*Number of addresses*
10.0.0.0/8	16,777,216	192.168.0.0/16	65,536
172.16.0.0/12	1,047,584	169.254.0.0/16	65,536

Multicast Addresses

The block 224.0.0.0/4 is reserved for multicast communication. We discuss multicasting in Chapter 12 in detail.

Special Addresses in Each block

It is not mandatory, but it is recommended, that some addresses in a block be used for special addresses. These addresses are not assigned to any host. However, if a block (or subblock) is so small, we cannot afford to use part of the addresses as special addresses.

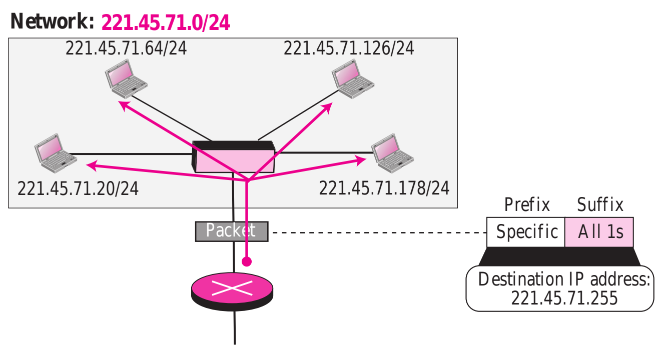
Network Address

We have already discussed network addresses. The first address (with the suffix set all to 0s) in a block defines the network address. It actually defines the network itself (cabling) and not any host in the network. Of course, the first address in a subnetwork is called the subnetwork address and plays the same role.

Direct Broadcast Address

The last address in a block or subblock (with the suffix set all to 1s) can be used as a **direct broadcast address.** This address is usually used by a router to send a packet to all hosts in a specific network. All hosts will accept a packet having this type of destination address. Note that this address can be used only as a destination address in an IPv4 packet. In Figure 5.38, the router sends a datagram using a destination IPv4 address with a suffix of all 1s. All devices on this network receive and process the datagram.

Figure 5.38 *Example of a direct broadcast address*



5.5 NAT

The distribution of addresses through ISPs has created a new problem. Assume that an ISP has granted a small range of addresses to a small business or a household. If the business grows or the household needs a larger range, the ISP may not be able to grant the demand because the addresses before and after the range may have already been allocated to other networks. In most situations, however, only a portion of computers in a small network need access to the Internet simultaneously. This means that the number of allocated addresses does not have to match the number of computers in the network. For example, assume a small business with 20 computers in which the maximum number of computers that access the Internet simultaneously is only 5. Most of the computers are either doing some task that does not need Internet access or communicating with each other. This small business can use the TCP/IP protocol for both internal and universal communication. The business can use 20 (or 25) addresses from the private block addresses discussed before for internal communication; five addresses for universal communication can be assigned by the ISP.

A technology that can provide the mapping between the private and universal addresses, and at the same time, support virtual private networks that we discuss in Chapter 30, is **network address translation (NAT).** The technology allows a site to use a set of private addresses for internal communication and a set of global Internet addresses