

Network Address Translation (NAT)

What is NAT?

- The number of home users and small businesses that want to use the Internet is ever increasing. In the beginning, a user was connected to the Internet with a dial-up line, which means that she was connected for a specific period of time.
- An ISP with a block of addresses could dynamically assign an address to this user. An address was given to a user when it was needed.
- But the situation is different today. Home users and small businesses can be connected by an ADSL line or cable modem. In addition, many are not happy with one address; many have created small networks with several hosts and need an IP address for each host.
- With the shortage of addresses, this is a serious problem. A quick solution to this problem is called network address translation (NAT).

How NAT Works?

- NAT enables a user to have a large set of addresses internally and one address, or a small set of addresses, externally.
- The traffic inside can use the large set; the traffic outside, the small set.
- To separate the addresses used inside the home or business and the ones used for the Internet, the Internet authorities have reserved three sets of addresses as private addresses

Range of Private IP Address

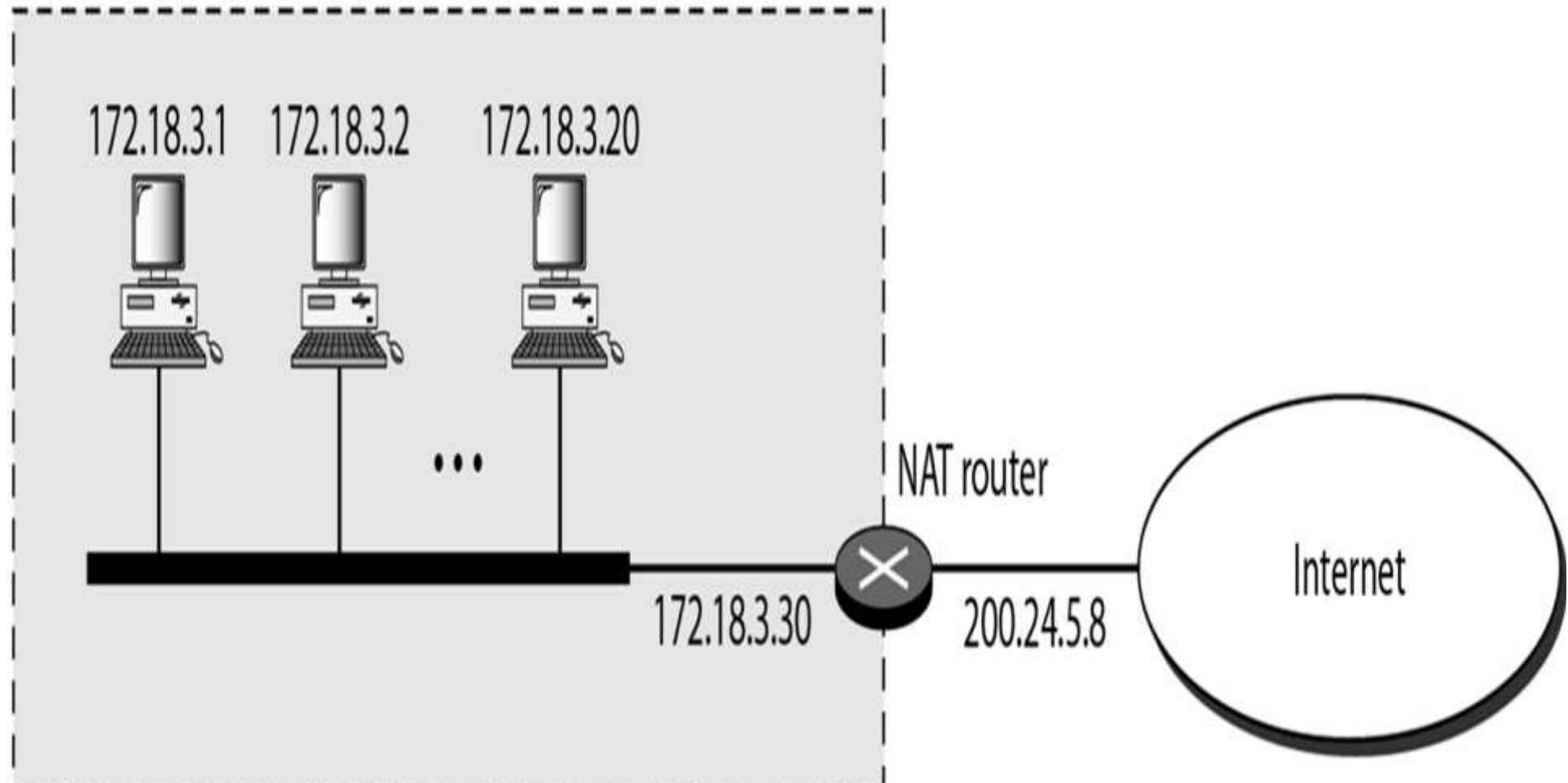
<i>Range</i>		<i>Total</i>
10.0.0.0	to 10.255.255.255	2^{24}
172.16.0.0	to 172.31.255.255	2^{20}
192.168.0.0	to 192.168.255.255	2^{16}

NAT

- Any organization can use an address out of this set without permission from the Internet authorities. Everyone knows that these reserved addresses are for private networks.
- They are unique inside the organization, but they are not unique globally.
- No router will forward a packet that has one of these addresses as the destination address.
- The site must have only one single connection to the global Internet through a router that runs the NAT software
- The router that connects the network to the global address uses one private address and one global address.
- The private network is transparent to the rest of the Internet; the rest of the Internet sees only the NAT router

Site using Private Addresses

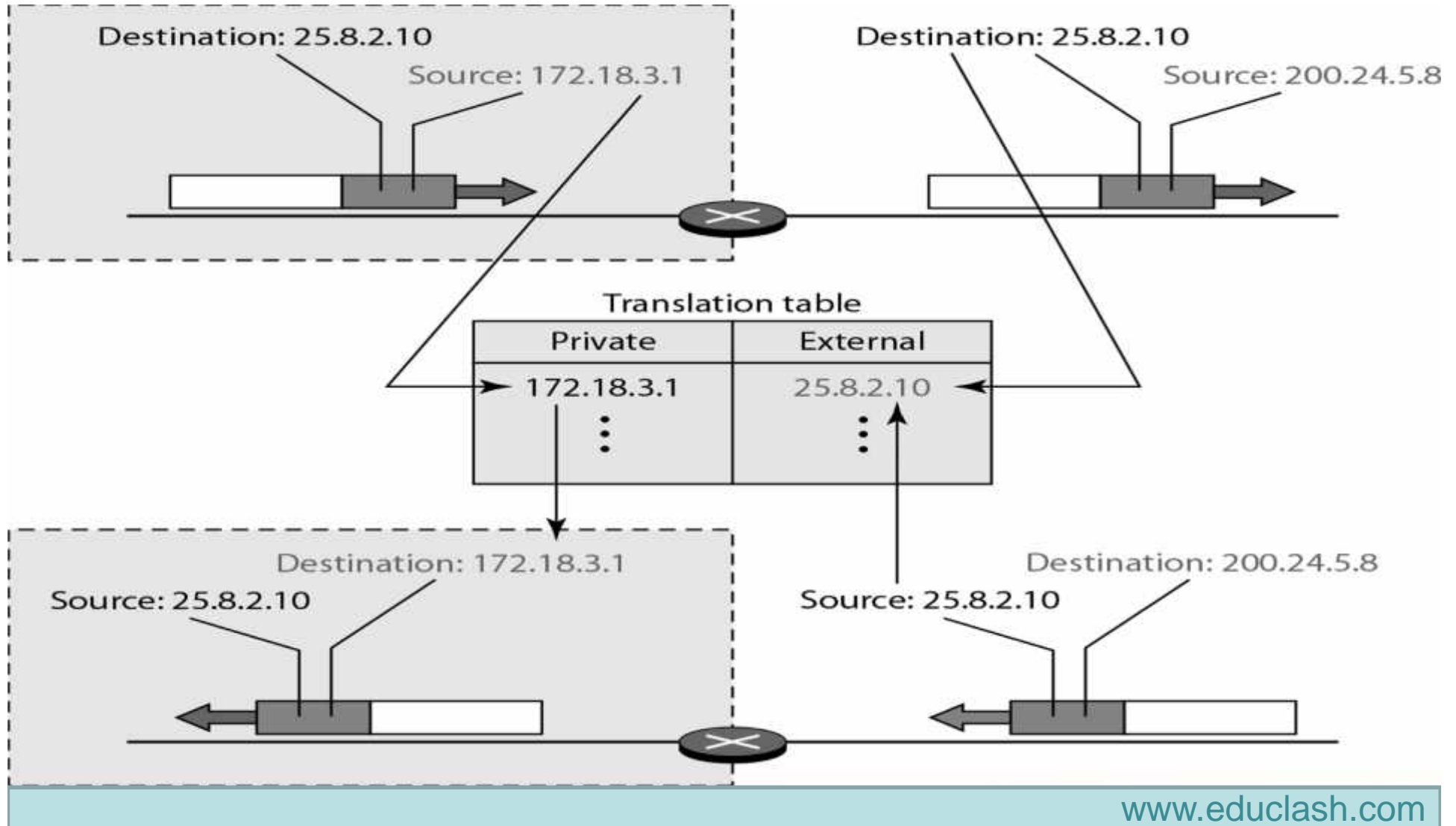
Site using private addresses



Inside to Outside – Easy. Outside to Inside – Difficult.

- **Using One IP Address:** In its simplest form, a translation table has only two columns: the private address and the external address (destination address of the packet).
- When the router translates the source address of the outgoing packet, it also makes note of the destination address-where the packet is going.
- When the response comes back from the destination, the router uses the source address of the packet (as the external address) to find the private address of the packet.

Translation Table



Translation Table

- In this strategy, communication must always be initiated by the private network. The NAT mechanism described requires that the private network start the communication. As we will see, NAT is used mostly by ISPs which assign one single address to a customer. The customer, however, may be a member of a private network that has many private addresses.
- In this case, communication with the Internet is always initiated from the customer site, using a client program such as HTTP, TELNET, or FTP to access the corresponding server program.
- A private network cannot run a server program for clients outside of its network if it is using NAT technology.

Translation Table

- **Using a Pool of IP Addresses:** Since the NAT router has only one global address, only one private network host can access the same external host. To remove this restriction, the NAT router uses a pool of global addresses.
- For example, instead of using only one global address (200.24.5.8), the NAT router can use four addresses (200.24.5.8, 200.24.5.9, 200.24.5.10, and 200.24.5.11).

NAT and ISP

- An ISP that serves dial-up customers can use NAT technology to conserve addresses. For example, suppose an ISP is granted 1000 addresses, but has 100,000 customers.
- Each of the customers is assigned a private network address. The ISP translates each of the 100,000 source addresses in outgoing packets to one of the 1000 global addresses; it translates the global destination address in incoming packets to the corresponding private address.

NAT and ISP

Figure 19.13 *An ISP and NAT*

