

Network Address Translation (NAT)

by Sophia



WHAT'S COVERED

In this lesson, you will learn about network address translation, known as NAT.

Specifically, this lesson will cover the following:

1. Introduction to Network Address Translation (NAT)

1a. Advantages of NAT

2. Types of Network Address Translation

2a. Static NAT (SNAT)

2b. Dynamic NAT (DNAT)

2c. Port Address Translation (PAT)

3. NAT Names

4. How NAT Works

1. Introduction to Network Address Translation (NAT)

Similar to Classless Inter-Domain Routing (CIDR), the original intention for **Network Address Translation (NAT)** was to slow the depletion of available IP address space by allowing many private IP addresses to be represented by some smaller number of public IP addresses. Since then, it's been discovered that NAT is also a useful tool for network migrations and mergers, server load sharing, and creating "virtual servers." This lesson describes the basics of NAT functionality and the terminology common to NAT.



TERM TO KNOW

Network Address Translation (NAT)

A method of mapping an IP address onto another by modifying network address information in the IP header of packets while they are in transit across a traffic routing device.

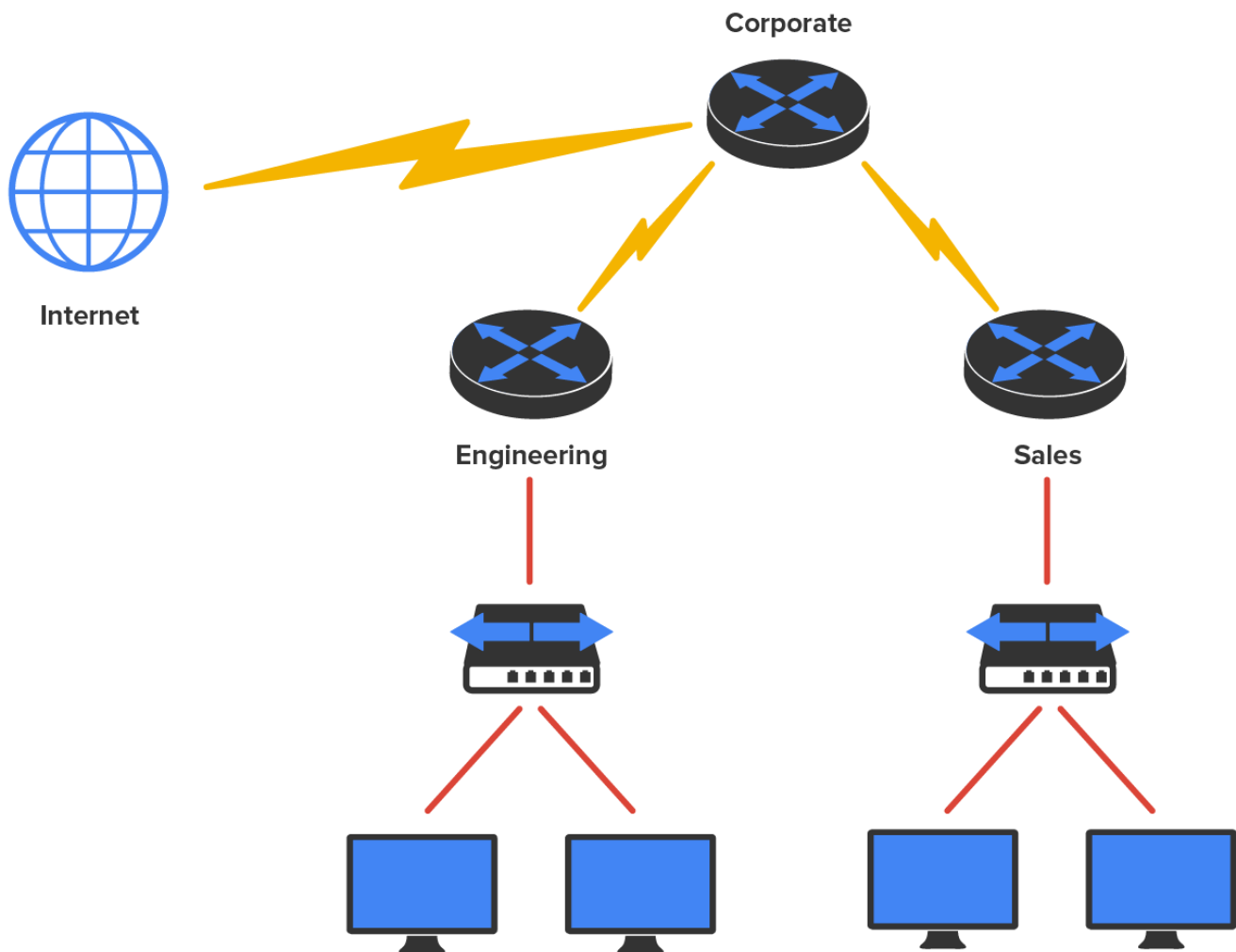
1a. Advantages of NAT

NAT has several benefits. One is that it decreases the sometimes overwhelming number of public IP addresses required in an organization's networking environment. It also comes in handy when two companies that have duplicate internal addressing schemes merge, or when an organization changes its ISP, and the networking manager doesn't want the hassle of changing the internal address scheme.

Consider using NAT in the following situations:

- You need to connect to the internet and your hosts don't have globally unique IP addresses.
- You change to a new ISP that requires you to renumber your network.
- You need to merge two intranets with duplicate addresses.

You typically use NAT on a border router. For an illustration of this, see the following figure, where NAT would be configured on the corporate router.



NAT has both advantages and disadvantages. See the table below for the pros and cons of using NAT.

Advantages

Conserves legally registered addresses.

Reduces address overlap occurrences.

Increases flexibility when connecting to the Internet.

Eliminates address renumbering as the network changes

Disadvantages

Translation introduces switching path delays.

Loss of end-to-end IP traceability.

Certain applications will not function with NAT enabled.

2. Types of Network Address Translation

This section introduces three types of NAT:

2a. Static NAT (SNAT)

Static NAT (SNAT) is designed to allow one-to-one mapping between local and global addresses. Keep in mind that the static version requires you to have one real internet IP address for every host on your network.



TERM TO KNOW

Static NAT (SNAT)

One-to-one mapping between local and global addresses.

2b. Dynamic NAT (DNAT)

Dynamic NAT (DNAT) enables you to map an unregistered IP address to a registered IP address from a pool of registered IP addresses. You don't have to statically configure your router to map an inside-to-outside address as you would using static NAT, but you do have to have enough real bona fide IP addresses for everyone who's going to be sending packets to and receiving them from the internet.



TERM TO KNOW

Dynamic NAT (DNAT)

Maps an unregistered IP address to a registered IP address from a pool of registered IP addresses.

2c. Port Address Translation (PAT)

Port Address Translation (PAT) is the most popular type of NAT configuration. PAT is a form of dynamic NAT that maps multiple unregistered IP addresses to a single registered IP address by using different Layer 4 port numbers. By using PAT, you get to have thousands of users connect to the internet using only one real global IP

address. PAT is the reason we haven't run out of valid IP addresses on the internet. PAT is what allows multiple devices to use your home internet connection simultaneously even though the router has just one IP address.



TERMS TO KNOW

Port Address Translation (PAT)

Enables multiple hosts to use the same global IP address to establish different external connections at the same time.

3. NAT Names

The names we use to describe the addresses used with NAT are pretty simple. Addresses used after NAT translations are called global addresses. These are usually the public addresses used on the internet, but remember, you don't need public addresses if you aren't going on the internet.

Local addresses are the ones we use before network translation. So, the **inside local address** is actually the private address (e.g., 192.168.10.10) of the sending host (e.g., a laptop) that is trying to get to the internet, while the **outside local address** is the address of the router (e.g., 104.18.41.229). The latter is usually a public address (web address, mail server, and so on) and is the gateway by which the packet leaves the local network on its way across the internet.

After translation, the inside local address is then called the **inside global address**, and the **outside global address** then becomes the name of the destination host. Check out the table below, which lists all these terms for a clear picture of the various names used with NAT.

Name	Meaning
Inside local	Name of the inside source address before translation
Outside local	Name of the destination host before translation
Inside global	Name of the inside host after translation
Outside global	Name of the outside destination host after translation



TERMS TO KNOW

Local Addresses

Addresses used before network translation; so, the inside local address is actually the private address.

Inside Local Address

Name of the inside source address before translation.

Outside Local Address

Name of the destination host before translation.

Inside Global Address

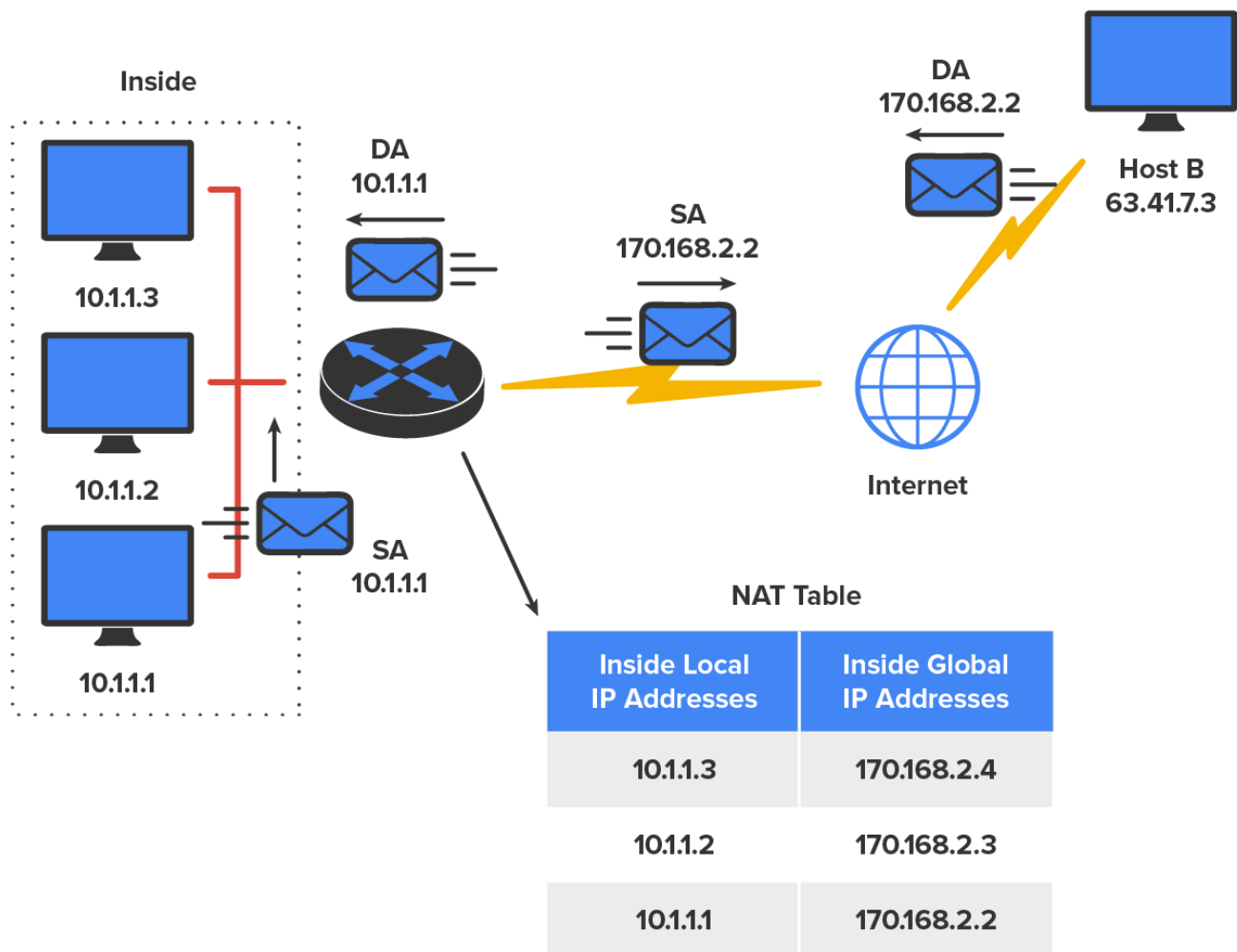
Name of the inside host after translation.

Outside Global Address

Name of the outside destination host after translation.

4. How NAT Works

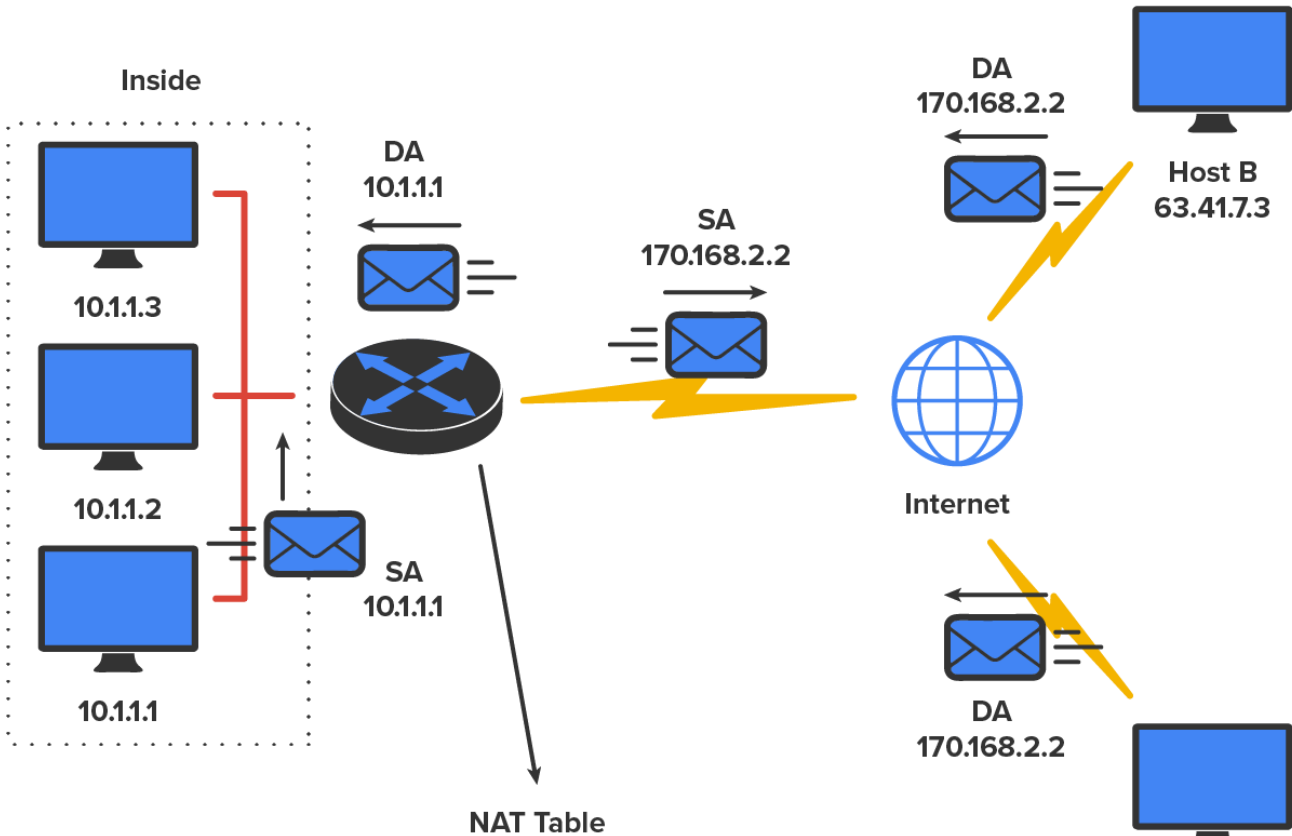
Now it is time to look at how this whole NAT thing works. The following diagram illustrates the basic translation of NAT.



In the example shown in the diagram above, host 10.1.1.1 sends an outbound packet to the border router configured with NAT. The router identifies the IP address as an inside local IP address destined for an outside network, translates the address, and documents the translation in the NAT table.

The packet is sent to the outside interface with the new translated source address. The external host returns the packet to the destination host, and the NAT router translates the inside global IP address back to the inside local IP address using the NAT table.

Let’s take a look at a more complex configuration using **NAT overloading**, or what is also referred to as PAT. The following diagram demonstrates how PAT works.



Protocol 10.1.1.1	Inside Local IP Addresses	Inside Global IP Addresses	Outside Global IP Addresses: Port
TCP	10.1.1.3:1492	170.168.2.2:1492	64.41.7.3:23
TCP	10.1.1.2:1723	170.168.2.2:1723	64.41.7.3:23
TCP	10.1.1.1:1024	170.168.2.2:1024	63.40.7.3:23

With PAT overloading, all inside hosts get translated to one single IP address. Take another look at the NAT table in the diagram above. In addition to the inside local IP address and outside global IP address, we now have port numbers. These port numbers help the router identify which host should receive the return traffic.

Port numbers are used at the transport layer to identify the local host in this example. If we had to use IP addresses to identify the source hosts, that would be called static NAT, and we would run out of addresses. PAT allows us to use the transport layer to identify the hosts, which in turn allows us to use up to 65,000 hosts with one real IP address.

One last thing: We've been discussing translating IP addresses using some type of network address translation. However, using a router or firewall, you can also perform **port forwarding**, which is translating the port number of a packet to a new destination. The destination may be a predetermined network port (using any IP protocol, but typically TCP or UDP ports) on a host within a private network behind a NAT router. Based on the received port number, a remote host can communicate to servers behind the NAT gateway to the local network.



TERMS TO KNOW

NAT Overload

Many-to-one mapping between local and global addresses.

Port Forwarding

Translating the port number of a packet to a new destination.



SUMMARY

In this lesson, you learned about **network address translation (NAT)**, including the **advantages of NAT**, the types of NAT such as static NAT (SNAT), dynamic NAT (DNAT), and NAT overloading using port address translation (PAT). You also learned about **NAT Names** and **how NAT works**.

Source: This content and supplemental material has been adapted from CompTIA Network+ Study Guide: Exam N10-007, 4th Edition. Source [Lammle: CompTIA Network+ Study Guide: Exam N10-007, 4th Edition - Instructor Companion Site \(wiley.com\)](#)



TERMS TO KNOW

Dynamic NAT (DNAT)

Maps an unregistered IP address to a registered IP address from a pool of registered IP addresses.

Inside Global Address

Name of the inside host after translation.

Inside Local Address

Name of the inside source address before translation.

Local Addresses

Addresses used before network translation; so, the inside local address is actually the private address.

NAT Overload

Many-to-one mapping between local and global addresses.

Network Address Translation (NAT)

A method of mapping an IP address onto another by modifying network address information in the IP header of packets while they are in transit across a traffic routing device.

Outside Global Address

Name of the outside destination host after translation.

Outside Local Address

Name of the destination host before translation.

Port Address Translation (PAT)

Enables multiple hosts to use the same global IP address to establish different external connections at the same time.

Port Forwarding

Translating the port number of a packet to a new destination.

Static NAT (SNAT)

One-to-one mapping between local and global addresses.