

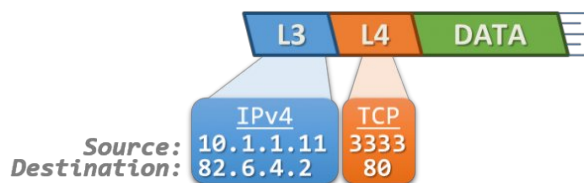
## NAT Terminology

### NAT Terminology

As [discussed before](#), Network Address Translation, or NAT, is a process that involves translating Private IP addresses into Public IP addresses. There are different operations within NAT and understanding each of them requires understanding NAT terminology.

#### NAT vs PAT

Network Address Translation and Port Address Translation differ by modifying different [headers in a data packet](#).



This article is a part of a [series](#) on [Network Address Translation \(NAT\)](#). Use the navigation boxes to view the rest of the articles.

#### Network Address Translation

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**Network Address Translation**, or **NAT**, implies a **translation of an IP address to another IP address**.

NAT in and of itself only affects the [L3 header](#), which in today's world will be the IPv4 header. While NAT can modify an IPv6 header as well, it really isn't common, as IPv6 was created in such a way to avoid the need for NAT altogether.

**Port Address Translation**, or **PAT**, implies a **translation of an IP address and Port to another IP address and Port**.

PAT affects *both* the L3 header and the [L4 header](#). Which means the IPv4 Header, as well as *either* the TCP or UDP header, will be modified.

You could consider PAT as a subset of NAT (i.e., Network Address Translation along with a Port translation), but there isn't really a common use case for a Port translation only without an accompanying IP address translation as well. Therefore, nearly every instance of a PAT will also typically include an IP address translation as well.

In summary, a NAT modifies *only* the L3 header, and a PAT modifies *both* the L3 and L4 header. Or, said another way, a NAT modifies only the IP, and a PAT modifies *both* the IP and Port.

#### Static vs Dynamic

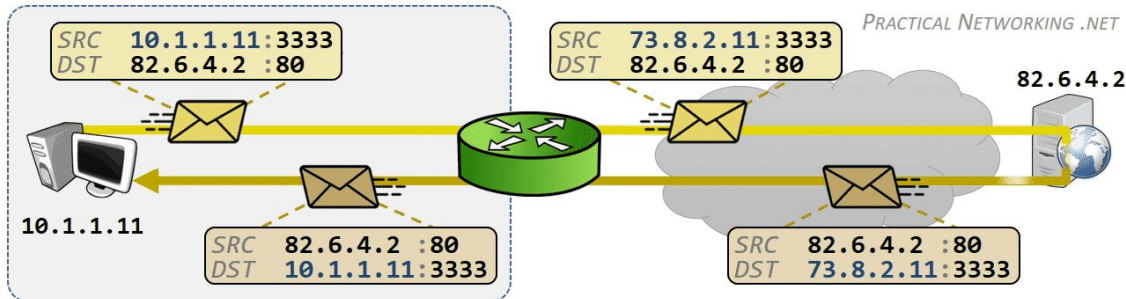
Both a NAT and a PAT can exist in two forms: Static or Dynamic. **These two terms designate whether the *post-translation attributes of the packet are explicitly defined*** by the administrator or determined by the translation device.

In either case, the *pre-translation* attributes are explicitly defined. This is how the NAT device knows which packets should be translated in the first place.

To help define the terms, we will look at an example of a Static translation and Dynamic translation below. The examples will use a **Router** as a NAT device, but many other devices can also perform address translation (Firewalls, Load Balancers, etc).

## Static Translations

In a **Static** translation, the **post-translation attributes are explicitly defined** by the administrator (IP address for a NAT, or IP:Port for a PAT). A Static translation implies the pre-translation IP or IP:Port will *permanently* map to the same, constant post-translation IP or IP:Port.



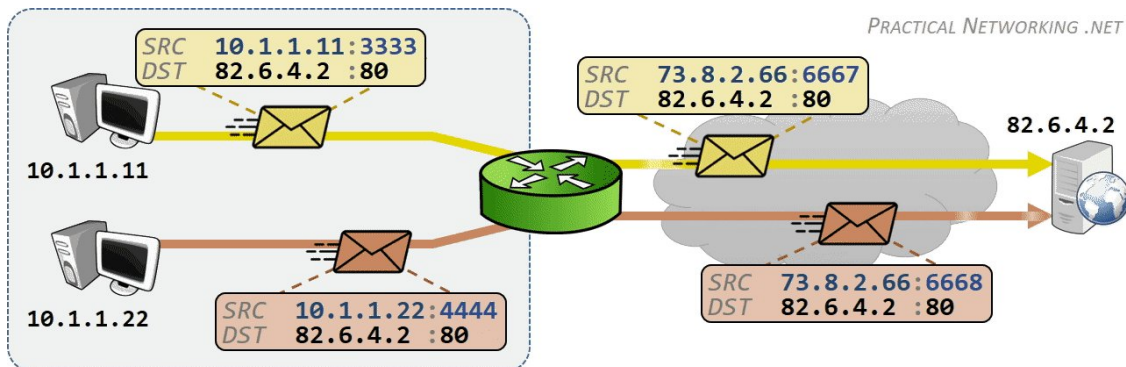
In this example, only the IP address is changing (NAT), and the mapping between pre-translation and post-translation is permanent (Static) – the IP address **10.1.1.11** will always be translated to **73.8.2.11** (and *vice versa*). Hence, this is an example of a **Static NAT**.

A **Static** mapping is sometimes referred to as a **One-to-One** translation – implying that in a Static translation, a single IP or IP:Port can only ever appear as another single IP or IP:Port.

## Dynamic Translations

In a **Dynamic** translation, the **post-translation attributes are selected by the router at the time that the packet is received** – the final post-translation attributes are not permanently mapped to pre-translation attributes.

Of course, the scope of post-translation attributes must be defined by the administrator, but the exact mapping is determined by the device, at the time the packet is received.



In this example, both the IP address and the Port are changing (which makes this a PAT), and the mapping between the pre-translation and post-translation is not explicitly defined by the administrator (which makes this a Dynamic translation). Hence, this is an example of a **Dynamic PAT**.

When the packet from **10.1.1.11** arrived on the Router, the Router chose a new source port of **6667**. When the packet from **10.1.1.22** arrived on the Router, the Router chose a new source port of **6668**. Both hosts are sharing the public IP address **73.8.2.66**.

There is no guarantee that the *next* connections initiated by either host will have port numbers of 6667 or 6668 – they will very likely be something else randomly chosen by the Router, at the time the next packet is received by the Router.

A **Dynamic** mapping is sometimes referred to as a **One-to-Many** or **Many-to-One** translation – implying that in a Dynamic translation, many addresses can appear as one, or one address can appear as many.

Both Static NAT and the Dynamic PAT will be explored in more detail in later articles in this series.

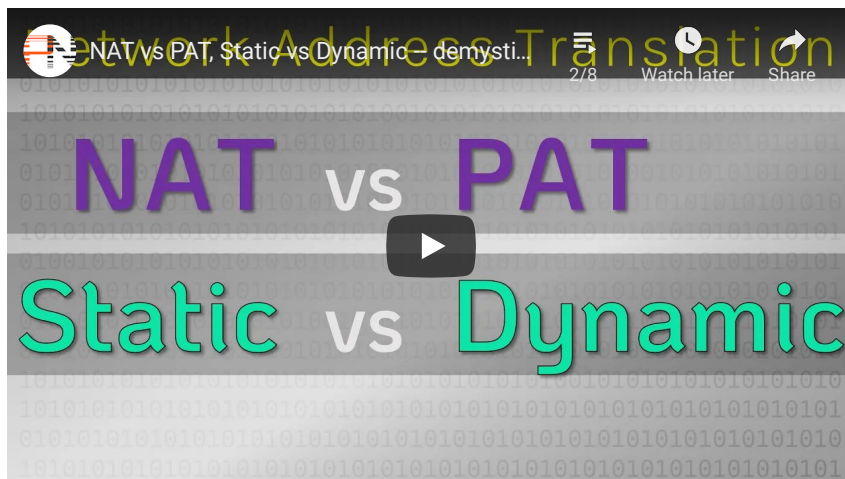
## Combining Terms

In total, we discussed two sets of two terms: **NAT and PAT**, and **Static and Dynamic**. When these are combined, they create four possible variants of Network Address Translation:

- **Static NAT**
- **Static PAT**
- **Dynamic PAT**
- **Dynamic NAT**

Each of the four combinations above account for every type of Network Address Translation that exists. They will also each be the subject of their own article in this series.

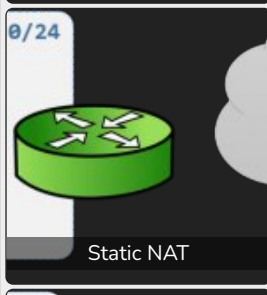
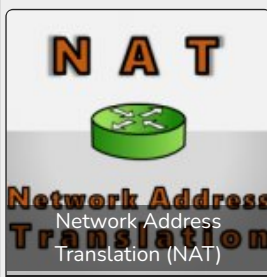
*Prefer video content to text? The majority of this article has been recorded and can be viewed on Youtube:*

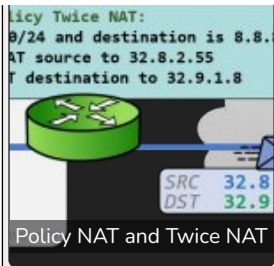


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Alex

🕒 3 years ago

Is the image illustrating dynamic NAT correct? It doesn't look like the router changes the ip or port although it says so in the text. Or am I misunderstanding something?

👍 0

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Alex

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Of course after posting I could see how I misinterpreted the image, never mind.

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Ed Harmoush (@ed) Author

🗨 Reply to Alex 🕒 3 years ago

Neither of these images are an illustration of Dynamic NAT. =) The [dedicated article on Dynamic NAT](#) has multiple illustrations though.

👍 0

➡ Reply

Mohsin Shafique

🕒 2 years ago

"You could consider PAT as a subset of NAT" wouldn't NAT be a subset of PAT because PAT also includes port translation at L4 which NAT does not?

👍 0

➡ Reply

Ed Harmoush (@ed) Author

🗨 Reply to Mohsin Shafique 🕒 11 months ago

This is probably just semantics. My reasoning was all translations affect the L3 header, and some also affect the L4 header. Meaning everything does at least a NAT, and some NAT's also do a PAT. Either way, the "subset" analogy is not significant, as long as you understand NAT is changing the L3 header, and PAT is

changing the L4 header (in addition to the L3 header).

👍 0    ➡ Reply

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