

# Network Address Translation

## 1 Network Address Translation

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### 1.1 NAT Overview

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#### 1.1.1 Motivation Behind NAT

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- **IPv4 Address Shortage:** As Internet usage grows, public IPv4 addresses are becoming increasingly Limited.
- **Uneven Allocation:** Some regions face a severe shortage due to uneven distribution of addresses.
- **Transition Technologies:** Necessary to Save IPv4 addresses and enable continued internet connectivity.

#### 1.1.2 Public vs. Private IP Addresses

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- **Public IP Addresses:**
  - Managed by dedicated organizations.
  - Used for direct communication on the Internet.
- **Private IP Addresses:**
  - Can be assigned by anyone within internal networks.

- Not routable on the Internet.

### 1.1.2.1 Reserved Private IP Address Ranges

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Range	Class
10.0.0.0 – 10.255.255.255	Class A
172.16.0.0 – 172.31.255.255	Class B
192.168.0.0 – 192.168.255.255	Class C

### 1.1.3 NAT Implementation

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#### Note

NAT is a protocol for translating private IP addresses to public ones and vice versa.

NAT does provide a layer of obscurity which can complicate direct attacks from external entities on internal network devices.

#### 1.1.3.1 Typical NAT Scenarios:

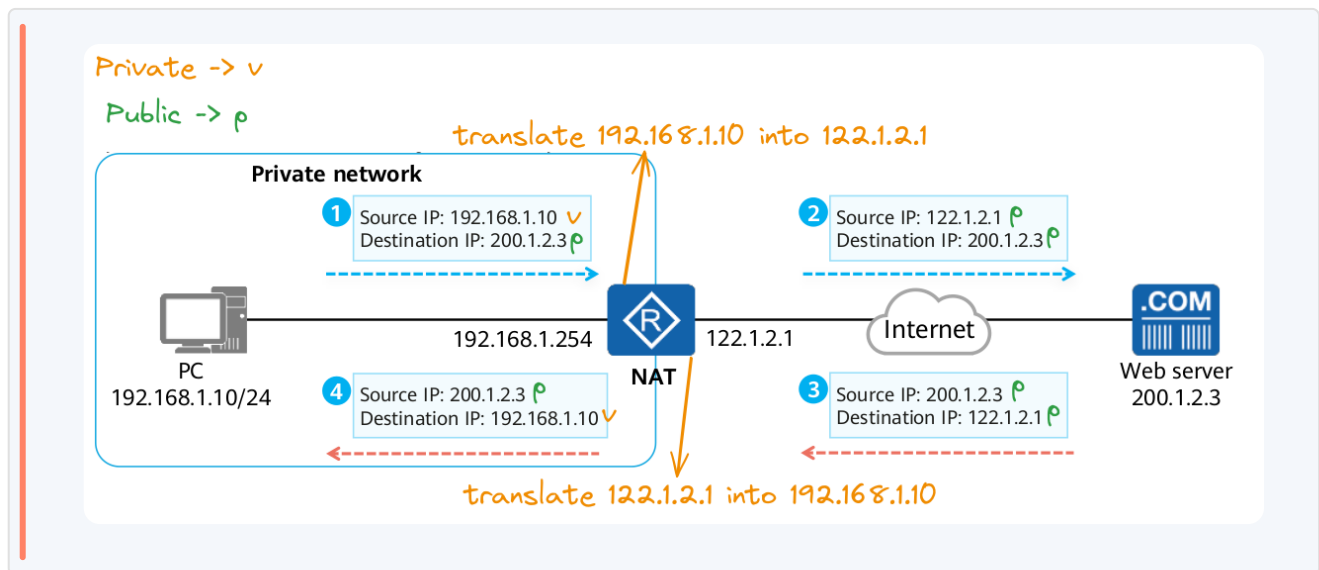
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1. **Internal to External:** Translates source private IP to a public IP for outbound traffic.
2. **External to Internal:** Translates destination public IP back to the original private IP for inbound traffic.

#### 1.1.3.2 How NAT Conserves IPv4 Addresses:

- **NAT + Private Addresses** : This combination significantly reduces the need for public IPv4 addresses by allowing multiple devices on a private network to share a single public address.

### 1.1.3.3 Example of NAT Process:



## 1.2 Static NAT

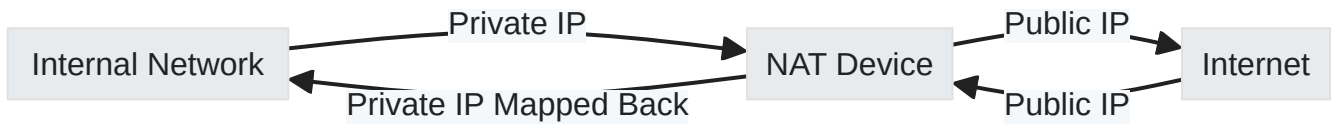
### 1.2.1 Static NAT Implementation

**Static Network Address Translation (NAT):** allows private IP addresses to be mapped to fixed public IP addresses, enabling bidirectional access between an internal host and the Internet.

Private Address	Public Address
192.168.1.1/24	122.1.2.1
192.168.1.2/24	122.1.2.2
192.168.1.3/24	122.1.2.3

### 1.2.1.1 Key Concepts

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### 1.2.2 Bidirectional Access

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- **Outgoing Traffic:** Private IP -> Public IP (Egress)
- **Incoming Traffic:** Public IP -> Private IP (Ingress)

### 1.2.3 Configuring Static NAT

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#### 1.2.3.1 Method 1: Interface View Configuration

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```
M↓ Markdown ↕
1 [Huawei-GigabitEthernet0/0/0] nat static global
  <public-address> inside <private-address>
```

#### 1.2.3.2 Method 2: System View Configuration

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```
M↓ Markdown ↕
1 [Huawei] nat static global <public-address> inside
  <private-address>
```

After configuring the above, enable static NAT on the specific interface:

```
M↓ Markdown ↕
```

## 1.3 Dynamic NAT

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### 1.3.1 Key Concepts of Dynamic NAT

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Dynamic NAT maps private IP addresses to a pool of public IP addresses. It efficiently utilizes public addresses by only assigning them when internal hosts require access to an external network.

Dynamic NAT does not translate port numbers. It uses a No-Port Address Translation (No-PAT) method.

1:1 mapping between public and private addresses.

Does not improve public address utilization since each private IP needs a unique public IP.

### 1.3.2 Benefits of Dynamic NAT

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- Efficient usage of public IP addresses.
- On-demand mapping reduces address waste.
- Supports multiple internal hosts with fewer public IPs.

### 1.3.3 How Dynamic NAT Works

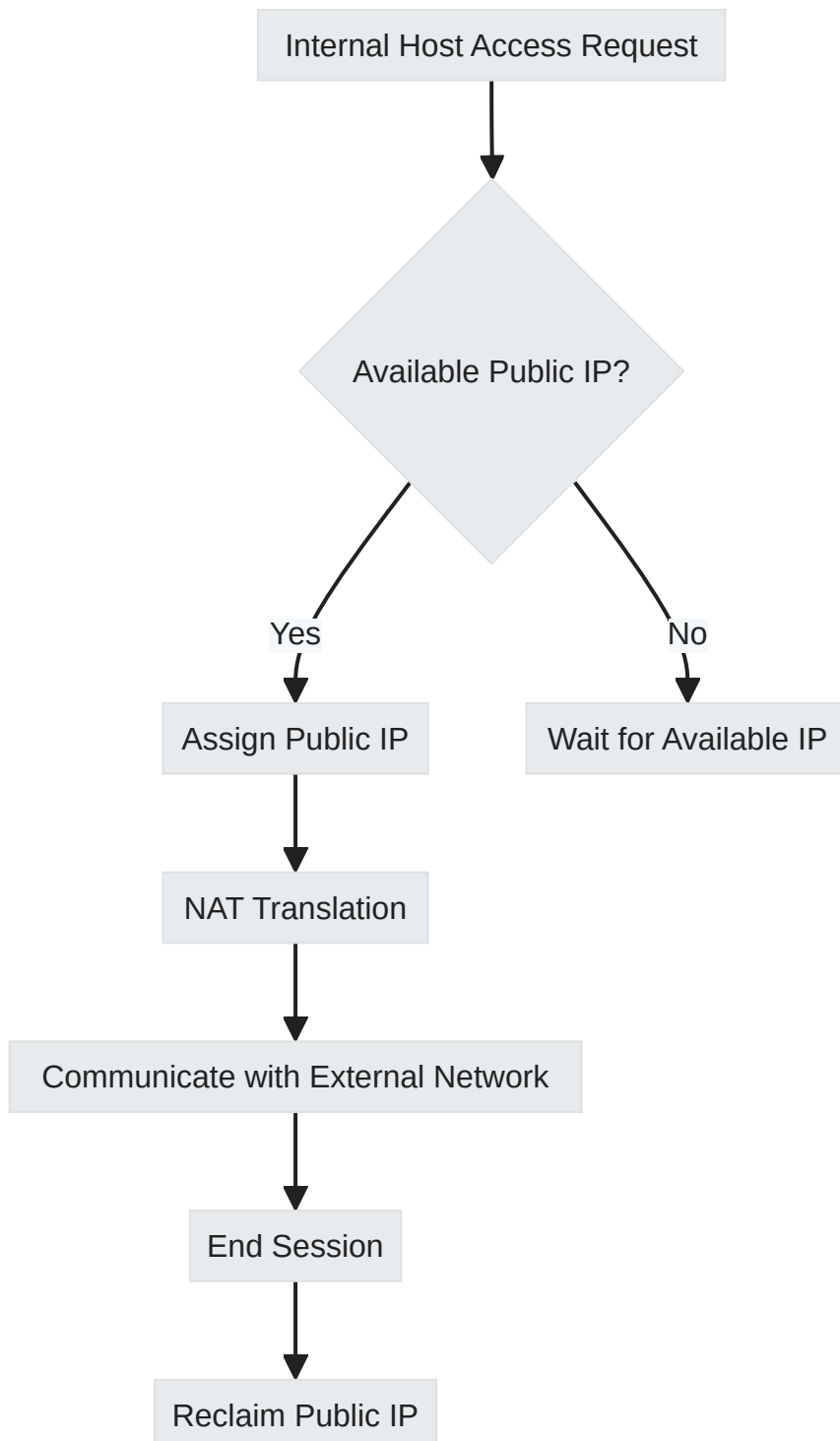
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1. **Mapping Request:** Internal host requests access to an external network.

2. **Address Assignment:** A free public IP from the pool is assigned to the host.
3. **Communication:** The internal host communicates using the assigned public IP.
4. **Session End:** Once done, the public IP is returned to the pool for future use.

### 1.3.4 Dynamic NAT Process

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## 1.3.5 Configuring Dynamic NAT

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### 1.3.5.1 Step 1: Create an Address Pool

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Create a range of public IP addresses that can be used for dynamic mapping.

```
M↓ Markdown ↕
1 [Huawei] nat address-group <group-index> <start-address> <end-address>
```

### 1.3.5.2 Step 2: Configure an ACL Rule for NAT

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Set up an Access Control List (ACL) that specifies which private addresses require dynamic NAT.

```
M↓ Markdown ↕
1 [Huawei] acl <number>
2 [Huawei-acl-basic-number] rule permit <source> <source-address> <source-wildcard>
```

### 1.3.5.3 Step 3: Configure Outbound NAT with Address Pool on Interface View

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Link the ACL rule with the address pool for dynamic NAT on the interface, optionally disabling port translation (no-pat).

```
M↓ Markdown ↕
1 [Huawei-GigabitEthernet0/0/0] nat outbound <acl-number> address-group <group-index> no-pat
```

# 1.4 NAPT and Easy IP

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## 1.4.1 Network Address and Port Translation (NAPT)


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- **Description:** NAPT translates both IP addresses and port numbers, allowing multiple internal hosts to share one public IP address.
- **Mapping:** 1:n mapping between public and private addresses.
- **Address Utilization:** Effectively improves public address utilization.

### 1.4.1.1 NAPT Implementation Steps

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1. Select an address from the pool and translate both the source IP address and port number.
2. Generate a temporary NAT mapping table with pre-translation(private) and post-translation(public) pairs.

 **Note**

NAPT enables multiple private IP addresses to map to a single public IP address through different port numbers.

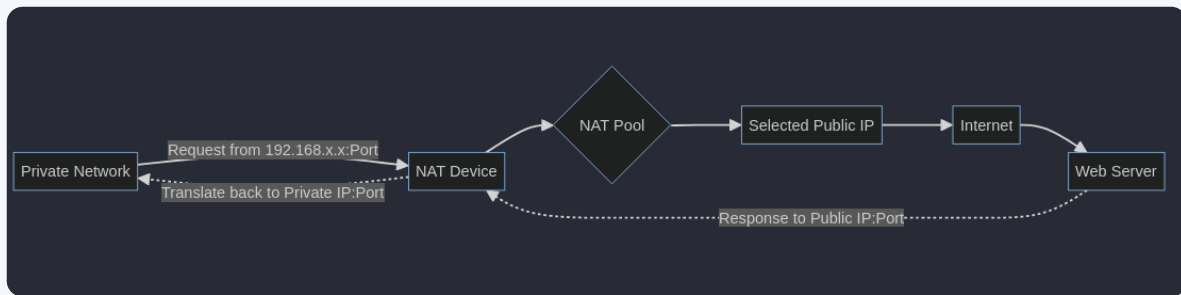
### 1.4.1.2 Example NAT Mapping Table

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Private IP Address:Port	Public IP Address:Port
192.168.1.1:10321	122.1.2.2:1025
192.168.1.2:17087	122.1.2.2:1026

### 1.4.1.3 NAPT Process





### 1.4.1.4 NAT Configuration

Link the ACL rule with the address pool for NATP on the interface with port translation.

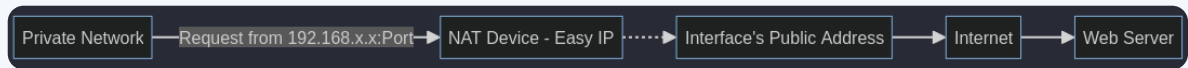
```
Markdown
1 [Huawei-GigabitEthernet0/0/0] nat outbound <acl-number>
  address-group <group-index>
```

## 1.4.2 Easy IP

- **Description:** Similar implementation as NATP but without an Specific address pool.
- **Interface Address:** Uses interface address as the public address for NAT translation.

### 1.4.2.1 Use Cases for Easy IP

- Suitable for scenarios where public IPs are not fixed or dynamically obtained through DHCP or PPPoE dial-up.



## 1.4.2.2 Configure Easy IP

Link the ACL rule with Easy IP on the interface

```
M↓ Markdown ↕  
1 [Huawei-GigabitEthernet0/0/0] nat outbound <acl-number>
```

## 1.5 NAT Server

### 1.5.1 Overview

NAT (Network Address Translation) Server is crucial for mapping an internal server's private IP and port to a public IP and port. This allows the internal server to provide services to the public network.



**Nat Server:** is NAT Functionality within Routers

### 1.5.2 Configuration Steps

#### 1.5.2.1 NAT Server Mapping Command



```
1 [R1-GigabitEthernet0/0/1]nat server protocol <protocol>
   global <public-address> <port-name> inside <private-
   address> <private-port>
```

- <protocol> :
  - tcp
- <port-name> :
  - www or 80