Public and Private IP addresses

1. Private IP Addresses

Private IP addresses are IP addresses used within a local network that are not routable on the public internet. They are reserved for use within private networks and are defined by specific address ranges.

Private IP Ranges:

- **10.0.0.0 to 10.255.255.255**
- **172.16.0.0 to 172.31.255.255**
- **192.168.0.0 to 192.168.255.255**

Characteristics:

- **Non-Routable**: These addresses are not visible or reachable from outside the local network.
- **Reuse**: The same private IP address ranges can be used in different private networks without conflict.

2. Public IP Addresses

Public IP addresses are assigned to devices that need to be reachable over the internet. These addresses are unique across the entire internet and are assigned by the Internet Assigned Numbers Authority (IANA) or regional internet registries.

Characteristics:

- **Global Uniqueness**: Each public IP address is unique across the internet.
- **Routing**: Public IP addresses are routable across the global internet, allowing devices to communicate with other devices outside their local network.

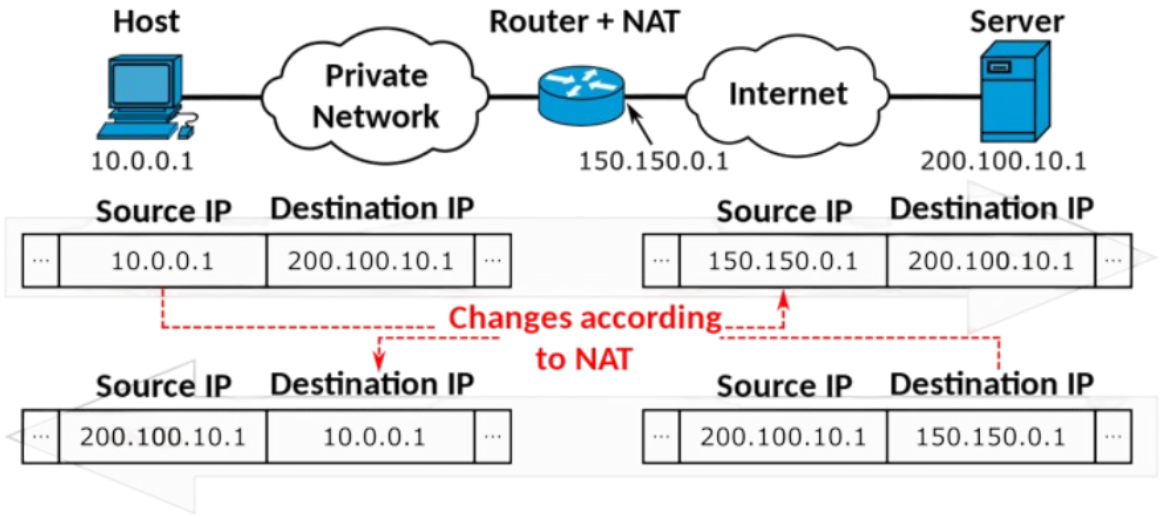
How Private and Public IP Addresses Work Together

Network Address Translation (NAT):

NAT is a technique used to map private IP addresses to a public IP address. This allows multiple devices on a local network to share a single public IP

address.

- **Private to Public**: When a device with a private IP address wants to access the internet, NAT translates the private IP address to a public IP address. This public IP address is used to route the traffic over the internet.
- **Public to Private**: When a response comes back from the internet, NAT translates the public IP address back to the appropriate private IP address so the response reaches the correct device on the local network.



Example:

1. **Request**: A device with a private IP address (e.g., 10.0.0.1) sends a request to access a website.
2. **NAT Translation**: The request is forwarded to the router, which performs NAT and replaces the private IP address with the router's public IP address(150.150.0.1)
3. **Internet**: The request is sent to the internet using the public IP address.
4. **Response**: The website responds to the public IP address.
5. **NAT Translation Back**: The router receives the response and uses NAT to translate the public IP address back to the private IP address (10.0.0.1) and forwards the response to the correct device.

IP Address scarcity solution:

IPv4: IPv4 address space is limited, with only about 4.3 billion addresses available. By using private IP addresses within local networks and NAT to share a single public IP address, the number of public IP addresses needed is greatly reduced. NAT allows multiple devices to use a single public IP address, conserving the number of public IP addresses needed.