NETWORK ADDRESS TRANSLATION (NAT)

NAT : Network Address Translation (NAT) is a method that remaps one IP address space into another by modifying the network address information in the IP header of packets. Most commonly, it allows devices on a private network to share a single public IP address when communicating with the internet.

How NAT works?

A NAT-enabled router, typically your home or office router, sits between your private local network and the public internet. It maintains a NAT table to track and manage all active connections.

* Outbound traffic: A device on your private network (e.g., 192.168.1.5) sends a request to a website.
* Packet translation: When the packet reaches the router, the NAT process replaces the device's private IP address with the router's public IP address.
* Port assignment: For each new connection, the router also assigns a unique source port number. It logs this translation (private IP and port to public IP and new port) in its NAT table.
* Internet communication: The packet, now with the router's public IP, is sent to the internet. The destination server sees all traffic from your network as coming from a single public IP address.
* Inbound traffic: When the server responds, it sends the packet back to the public IP address and port number that the router assigned.
* Packet routing: The router consults its NAT table, finds the corresponding private IP and port, and forwards the packet to the correct device on the private network.

Types of NAT :

1. Static NAT :

* Mapping: A one-to-one mapping between a single private IP address and a single public IP address.
* Use case: Typically used for devices that need to be accessible from the internet, like a web or email server, ensuring they are always reachable at the same public IP.

2. Dynamic NAT :

* Mapping: Maps private IP addresses to a pool of public IP addresses on a first-come, first-served basis.
* Use case: Used in corporate environments with multiple public IPs. If the public IP pool is exhausted, new connection requests are dropped until an address becomes free.

3. NAT Overload (or Port Address Translation / PAT) :

* Mapping: A many-to-one mapping that allows multiple private IP addresses to share a single public IP by using different port numbers.
* Use case: The most common type of NAT, used by nearly all home and small office networks. It is highly efficient for IPv4 address conservation.

4. Carrier-Grade NAT (CGNAT) :

* Mapping: A large-scale NAT used by internet service providers (ISPs) to translate private IPs at the carrier level.
* Use case: Allows ISPs to share a limited pool of public IPs among many customers, mitigating IPv4 exhaustion at scale.