**How private and public IP work together to solve the problem of IP shortage?**

Private and public IP addresses work together through a process called Network Address Translation (NAT) to help mitigate the issue of IP address shortages.

**Private IP Addresses:**

* Scope: Used within private networks (e.g., home, office LAN).
* Range: These IP ranges are reserved for private use: 10.0.0.0 to 10.255.255.255, 172.16.0.0 to 172.31.255.255, and 192.168.0.0 to 192.168.255.255.
* Not Routable on the Internet: Private IPs cannot be directly accessed from the internet, which prevents conflicts between different networks using the same private IP ranges.

**Public IP Addresses:**

* Scope: Used on the public internet.
* Assigned by ISPs: Public IPs are unique and routable on the internet.
* Limited Supply: There is a finite number of public IP addresses available, leading to potential shortages.

**Network Address Translation (NAT):** NAT is a technique that enables devices on a private network to communicate with the wider internet using a single public IP address or a small pool of public IP addresses.

* Functionality: When a device with a private IP wants to access the internet, the NAT router changes the private IP address to a public IP address. It also keeps track of the outgoing request and maps it to the private IP address of the requesting device. When the response returns from the internet, the NAT router translates the public IP address back to the corresponding private IP address and forwards the response to the correct device.
* Benefits: Conservation of Public IP Addresses: Multiple devices within a private network can share a single public IP address.
* Security: NAT hides the internal network structure, making it harder for external entities to directly access private network devices.

This combination of private and public IP addresses, facilitated by NAT, helps address the problem of IP address shortages by allowing multiple devices to share a single public IP address, thereby reducing the number of public IPs required.