

TECHNO INTERNATIONAL NEW TOWN



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IPV4 ADDRESSES

IPv4, or Internet Protocol version 4, is the fourth version of the Internet Protocol, the communications protocol that provides an identification and location system for computers on networks. IPv4, or Internet Protocol version 4, is the fourth version of the Internet Protocol, the communications protocol that provides an identification and location system for computers on networks. However, the limited number of available addresses in IPv4 has led to the exhaustion of the IPv4 address space, prompting the development and adoption of IPv6 (Internet Protocol version 6) to accommodate the growing number of devices connected to the Internet.

It is the unique identifier used in the IP layer of the TCP/IP protocol suite to identify each device's connection to the Internet. A host's or router's connection to the Internet is defined by its 32-bit IPv4 address, which is unique and used worldwide. The IP address, not the host or router, is what identifies the connection because it could change if the device is relocated to a different network.

Representation technic

- **Classful Addressing**
- **Classless Addressing**

Classful Addressing

IPv4 classful addressing is an early addressing scheme that divided the available IP address space into three classes: Class A, Class B, and Class C. Each class had a fixed range of network and host bits, resulting in a predetermined number of networks and hosts per network.

CLASS A

For class A, out of these 32 bits, 8 are used for net ID generation, and the rest 24 are used for host ID generation. The range is .The very first bit is reserved as 0. So, the rest of the 31 bits are used to generate the IP addresses. So, the total number of IPs under class A is 2^{31} . And the number of the network ID is 2^{7-2} because out of 8 net id bits, we can only use 7, and the host ID is 2^{24-2}

because the number of the host id bit is 24 and the 2 is subtracted because Out of all the IPs, the very first and last IP is considered the reserved IP. The first bit (0.0.0.0) is considered the address of the current network, and the very last bit is considered the broadcasting IP address or loopback address. And the network mask is 255.0.0.0. As we all know, for masking, we need to convert all the net and subnet ids to 1 and all host ids to 0.

Class B

For class B, out of these 32 bits, 16 are used for net ID generation, and the rest 16 are used for host ID generation. The range is . The very first two bits are reserved as 1 and 0. So the rest of the 30 bits are used to generate the IP addresses. So, the total number of IPs under class A is 2^{30} . And the number of the network ID is 2^{14} because out of 16 net id bits, we can only use 14, and the number of the host ID is $2^{16}-2$ because the number of the host id bit is 16 and the 2 is subtracted because Out of all the IPs, the first IP (128.0.0.0) is considered the address of the current network, and the very last bit is considered the broadcasting IP address. And the network mask is 255.255.0.0. As we all know, for masking, we need to convert all the net and subnet ids to 1 and all host ids to 0.

Class C

For class C, out of these 32 bits, 24 are used for net ID generation, and the rest 8 are used for host ID generation. The range is: The very first three bits are reserved as 1, 1, and 0. So the rest of the 30 bits are used to generate the IP addresses. So, the total number of IPs under class A is 2^{29} . And the number of the network ID is 2^{21} because out of 24 net id bits, we can only use 21, and the number of the host ID is 2^8-2 because the number of the host id bit is 8 and the 2 is subtracted because Out of all the IPs, the first IP (192.0.0.0) is considered the address of the current network, and the very last bit is considered the broadcasting IP address. And the network mask is 255.255.255.0. As we all know, for masking, we need to convert all the net and subnet ids to 1 and all host ids to 0.

Class D & E

For classes D and E, we cannot divide the IP address as a net ID or host ID. So, we cannot identify the network mask. But for class D, the very first four bits are reserved as 1, 1, 1, and 0, and for class E, the very first four bits are reserved as

1, 1, 1, and 1. Class D IPs are reserved for multi-casting, and class E IPs are reserved for experimental and research purposes.

Limitations of classful IP addressing

1. Inefficient Address Space Utilization
2. Limited Address Space for Large and Small Networks
3. No Distinction Between Network and Host Bits
4. No Provision for Private Addressing
5. No Support for Variable-Length Subnetting

Classless Inter Domain Routing (CIDR)

The IP address allocation and routing technique known as Classless Inter-Domain Routing (CIDR) makes it possible to use IP addresses more effectively. The foundation of CIDR is the notion that, in contrast to the conventional method of allocating IP addresses, network prefixes can be used to route and allocate addresses.

The slash notation, which indicates the number of bits in the network prefix, is used to express CIDR addresses. As an illustration, 192.168.1.0/24 would be the representation of an IP address with the prefix length of 24 being 192.168.1.0. According to this format, the host identity is represented by the final 8 bits of the IP address, whereas the first 24 bits are the network prefix.

Advantages of CIDR

- **Efficient use of IP addresses:** Since the pool of accessible IPv4 addresses is getting less, CIDR makes it possible to use IP addresses more effectively.
- **Flexibility:** More flexible IP address allocation is made possible by CIDR, which is beneficial for businesses with intricate network requirements.
- **Better routing:** More effective IP traffic routing is made possible by CIDR, and this can improve network performance. Decreased administrative overhead: By making IP address and route management simpler, CIDR lowers administrative overhead.

- **Reduced administrative overhead:** By enabling more effective and flexible IP address allocation and routing, CIDR lowers administrative costs.

In conclusion, the CIDR technique of IP address allocation and routing enables improved IP traffic routing and more effective use of IP addresses. Compared to the conventional class-based addressing system, it offers a number of benefits, such as improved routing, decreased administrative burden, and increased flexibility.

Rules for forming CIDR Blocks:

- All IP addresses must be contiguous.
- Block size must be the power of 2 (2^n). If the size of the block is the power of 2, then it will be easy to divide the Network. Finding out the Block Id is very easy if the block size is of the power of 2.
- First IP address of the Block must be evenly divisible by the size of the block. In simple words, the least significant part should always start with zeroes in Host Id. Since all the least significant bits of Host Id is zero, then we can use it as Block Id part.

Example: Check whether 100.1.2.32 to 100.1.2.47 is a valid IP address block or not?

1. All the IP addresses are contiguous.
2. Total number of IP addresses in the Block = $16 = 2^4$.
3. 1st IP address: 100.1.2.00100000 Since, Host Id will contain last 4 bits and all the least significant 4 bits are zero. Hence, first IP address is evenly divisible by the size of the block.

All three rules are followed by this Block. Hence, it is a valid IP address block.

What is CIDR Subnetting?

An IP address space can be divided into smaller subnetworks using CIDR subnetting, which has none of the drawbacks of conventional subnetting techniques. Classes of IP addresses, such as Class A, Class B, and Class C, are the foundation of traditional subnetting. On the other hand, CIDR makes IP address distribution more effective and versatile. In order to subnet a network, you must comprehend the following fundamental ideas:

Network ID: The network ID is the portion of an IP address that identifies the network.

Host ID: The host ID is the portion of an IP address that identifies the device on the network.

Subnet mask: The subnet mask is a 32-bit number that divides an IP address into network and host portions. It determines which part of an IP address is the network ID and which part is the host ID.

Subnet: A subnet is a smaller network within a larger network that has its own unique network ID and host range.

How does CIDR work?

To identify which portion of an IP address is used for the network ID and which part is used for the host ID, CIDR subnetting employs a subnet mask. Utilizing bitwise operations on the IP address to extract the network ID, the subnet mask is expressed in binary notations.

What is a CIDR Subnetting?

The subnet mask in IP addresses can be represented in shorthand using CIDR notation. The forward slash (/) and the integer that represents the number of bits used for the network ID are appended to represent it. Since the network ID consists of 24 bits, the CIDR notation for a subnet mask of 255.255.255.0, for instance, is /24.

Subnets and IP address ranges are simpler to represent with CIDR notation. A network with the IP address range 192.168.0.0 - 192.168.255.255, for instance, can be written as 192.168.0.0/16, meaning that the network ID is used up to the first 16 bits.

Let's examine a few instances to demonstrate CIDR subnetting.

Example 1: Subnetting a Class C network

Suppose we have a Class C network with an IP address of 192.168.10.0 and a subnet mask of 255.255.255.0. We want to divide this network into four subnets.

Step 1: Determine the number of bits needed for the subnets. Four subnets require two bits, as $2^2 = 4$.

Step 2: Create a subnet mask with the required number of bits. In this case, we need a subnet mask of 255.255.255.192, which has the first 26 bits set to 1.

Step 3: Assign the subnets.

The first subnet has a network ID of **192.168.10.0/26**

The second subnet has a network ID of **192.168.10.64/26**

The third subnet has a network ID of **192.168.10.128/26**

The fourth subnet has a network ID of **192.168.10.192/26**.

How CIDR optimize the use of IPv4 address space and facilitate routing.

Variable-Length Subnet Masks (VLSM):

In classful addressing, the subnet masks were fixed based on the class of the network. CIDR introduces the concept of VLSM, allowing network administrators to use subnet masks of varying lengths.

With VLSM, organizations can allocate address space more efficiently by assigning larger subnets to networks that require more hosts and smaller subnets to networks with fewer hosts.

This flexibility helps prevent the wasteful allocation of IP addresses that was common in the classful system.

Address Aggregation:

CIDR enables address aggregation, also known as route summarization. This involves combining multiple contiguous IP address blocks into a single, more compact route advertisement.

Aggregating routes helps reduce the size of routing tables in routers and decreases the amount of information that needs to be exchanged between routers on the internet backbone.

Smaller routing tables result in faster and more efficient routing, reducing the overall load on the global internet infrastructure.

Prefix Notation:

CIDR uses prefix notation to represent IP address blocks. The notation specifies the network address followed by a slash ("/") and the number of bits in the subnet mask (e.g., 192.168.1.0/24).

This concise representation makes it easy to communicate address space allocations and routing information. It also simplifies the process of route summarization.

Efficient Address Utilization:

CIDR allows for more efficient utilization of IP address space by breaking free from the rigid class-based structure. It enables organizations to use only the necessary number of addresses for their specific requirements, reducing IP address wastage.

Scalability:

The CIDR addressing scheme enhances the scalability of the internet by accommodating the dynamic growth of networks and devices. It provides a scalable solution without the need for rigid class boundaries, allowing for better adaptation to changing network requirements.

Conclusion

In summary, CIDR optimizes the use of IPv4 address space by allowing for flexible subnetting and efficient address allocation. It also facilitates routing by promoting address aggregation, reducing the size of routing tables, and improving the overall scalability and efficiency of the global internet infrastructure. CIDR is a key technology that has contributed to the continued growth and sustainability of the internet.