**IP Address**

An IP (Internet Protocol) address is a unique identifier assigned to each device connected to a network, enabling them to communicate with each other. An IP address helps locate and identify devices within a network.

**Structure of an IP Address**

Each IP address is composed of two parts:

1. **Network Part**: Identifies the specific network on which the device is located.
2. **Host Part**: Identifies the specific device (host) within that network.

IP addresses can be converted into binary numbers, consisting of 0s and 1s, which are used by computers to process and manage network data.

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|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Class** | Starting IP Address | Ending IP Address | Default Subnet Mask | Number of Networks | Number of Hosts per Network | Number of Hosts per Network |
| A | 0.0.0.0 | 127.255.255.255 | |  | | --- | |  |  |  | | --- | | 255.0.0.0 (/8) | | 128 | 16,777,214 | Large networks |
| B | 128.0.0.0 | |  | | --- | |  |  |  | | --- | | 191.255.255.255 | | 255.255.0.0 (/16) | 16,384 | 65,534 | Medium-sized networks |
| C | 192.0.0.0 | 223.255.255.255 | 255.255.255.0 (/24) | 2,097,152 | |  | | --- | |  |  |  | | --- | | 254 | | Small networks |
| D | 224.0.0.0 | |  | | --- | |  |  |  | | --- | | 239.255.255.255 | | |  | | --- | |  |  |  | | --- | | Not Applicable | | Not Applicable | Not Applicable | Multicast |
| E | 240.0.0.0 | 255.255.255.255 | |  | | --- | |  |  |  | | --- | | Not Applicable | | Not Applicable | Not Applicable | Experimental, Research |

* **Class A**: Supports large organizations with up to 16,777,214 hosts per network.
* **Class B**: Suitable for medium-sized networks with up to 65,534 hosts per network.
* **Class C**: Ideal for small networks with up to 254 hosts per network.
* **Class D**: Used for multicast groups, sending data to multiple specific devices.
* **Class E**: Reserved for experimental and research purposes.

### Eg:

### 192.168.59.24 ---- its have 4 octate

### 

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### IP Address Assignment Methods

1. **Static Assignment**: IP addresses are manually configured by an administrator. Suitable for devices that require a fixed IP address, like servers.
2. **Dynamic Assignment**: IP addresses are automatically assigned by a DHCP server. Ideal for large networks to reduce administrative workload.

### IPv4 and IPv6

#### IPv4

IPv4 addresses are 32-bit numbers, typically expressed in decimal format as four octets separated by periods (e.g., 192.168.1.1).

#### IPv6

IPv6 addresses are 128-bit numbers, expressed in hexadecimal format and separated by colons (e.g., 2041:0000:000F:0000:0000:0000:004B:131B). IPv6 addresses provide a vastly larger address space compared to IPv4.

**IPv6 Shortening Rules**:

1. **Omit Leading Zeros**: 2041:0000:000F:0000:0000:0000:004B:131B becomes 2041:0:F:0:0:0:4B:131B.
2. **Omit All-Zero Hexadecimals**: 2041:0000:000F:0000:0000:0000:004B:131B becomes 2041:0:F::4B:131B.
3. **Replace a Sequence of Four Zeros with a Single Zero**: 2041:0:000F::004B:131B becomes 2041:0:F::4B:131B.

**Types of IPv6 Addresses**:

* **Unicast**: One-to-one communication.
* **Multicast**: One-to-many communication.
* **Anycast**: One-to-nearest communication.

### Conclusion

Understanding IP addresses, their structure, and their classification is fundamental for managing network communication. The transition from IPv4 to IPv6 addresses the limitations of IPv4, providing a larger address space and improved network efficiency.