IP ADDRESSING

BY-21071A12D5

WHAT IS IP ADDRESS:

An IP address, or Internet Protocol address, is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication. It serves two main purposes: identifying the host or network interface and providing the location of the host in the network.

In essence, an IP address acts as a unique identifier, much like a home address in the physical world, ensuring that data reaches its intended recipient in the vast network of interconnected devices.

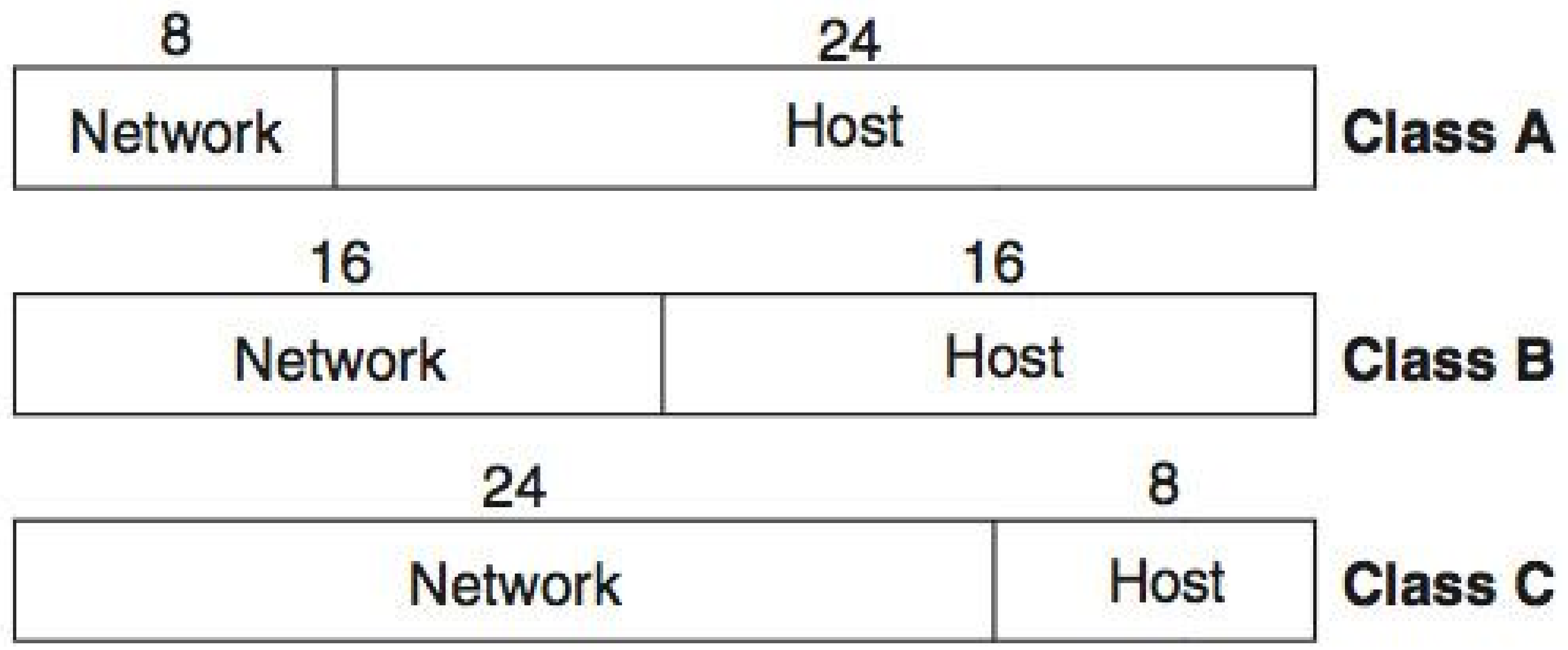
WHY IP ADDRESS?

IP addresses are essential for uniquely identifying each device in a network. The IP protocol is employed to assign these addresses, utilizing two methods: IPv4 and IPv6. IPv4 uses a 32-bit format, while IPv6 employs a 128-bit format. The use of these methods ensures that every device connected to the network receives a unique identifier, facilitating seamless communication and data transfer. IPv4 addresses were the initial standard but faced limitations due to the depletion of available addresses, prompting the introduction of IPv6. This 128-bit format in IPv6 allows for a vastly expanded address space, accommodating the ever-growing number of devices connected to the internet. Both IPv4 and IPv6 are integral to the process of assigning identifiers, contributing to efficient data routing and communication across diverse networks.

INTRODUCTION TO IPV4 ADDRESS

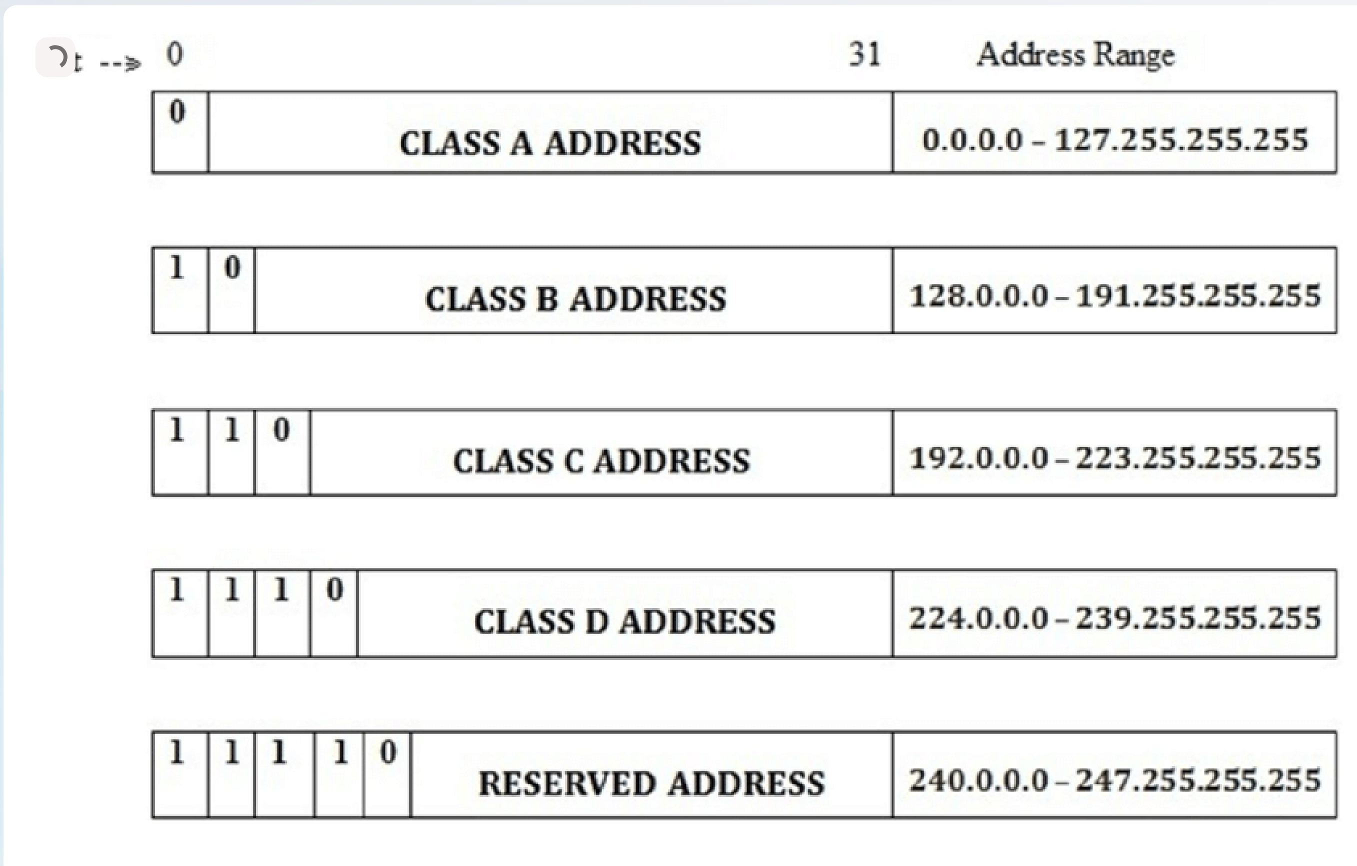
IPv4 is a widely used method for assigning IP addresses, consisting of four parts separated by dots. Each part ranges from 0 to 255 as decimal numbers. These numbers are then converted into 8-bit binary format, resulting in a 32-bit length for the IPv4 address. The addressing system includes five classes: A, B, C, D, and E.

IPv4 addresses are divided into five classes, each with its own range. In Class A, the first 8 bits represent the network ID, leaving 24 bits for the host ID. Class B allocates the first 16 bits to the network ID and the remaining 16 bits for the host ID. Class C designates the initial 24 bits for the network ID and the last 8 bits for the host ID. Classes D and E serve specialized purposes: D for multicasting and E for research and experiments.

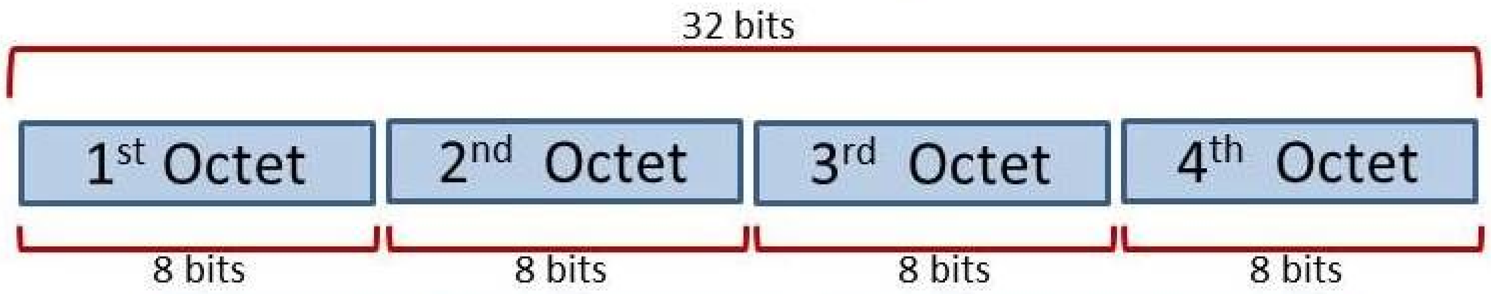

8
24
Network
Host
Class A
16
16
Network
Host
Class B
24
8
Network
Host
Class C

IDENTIFYING IPV4 CLASSES:

To uniquely identify each class, specific patterns are followed in their binary representation. Class A starts with 0, Class B with 10, Class C with 110, Class D with 1110, and Class E with 1111. These patterns distinguish the various classes, ensuring proper allocation of bits for network and host IDs.



IP Version 4 Addressing Structure



Classes of IP	1st Octet range	Default Subnet Mask
Class A	0-127	255.0.0.0
Class B	128-191	255.255.0.0
Class C	192-223	255.255.255.0
Class D	224-239	------------------
Class E	240-255	------------------

DISADVANTAGE OF IPV4 ADDRESS:

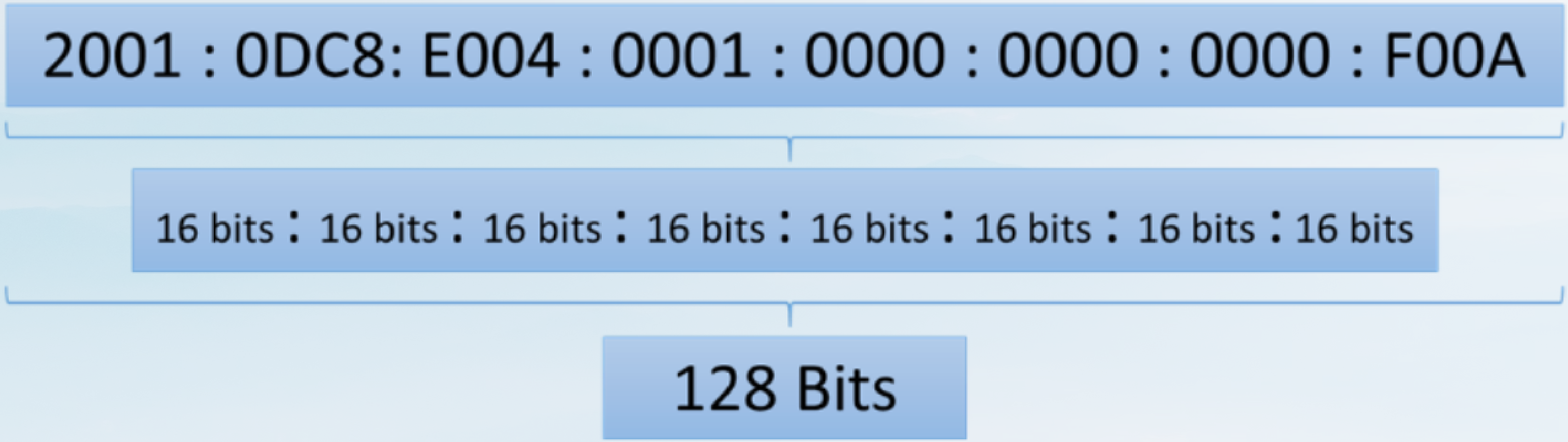
Despite its prevalence, IPv4 encounters limitations in addressing the surging demand for connected devices. With the ability to generate addresses for only 2^32 devices, it falls short in meeting the escalating needs of our interconnected world. This scarcity of available addresses necessitates the evolution towards a more resilient addressing system. Recognizing this imperative, the development and adoption of IPv6 emerge as a strategic response. IPv6 presents a significantly expanded address space, strategically designed to accommodate the ever-growing demand for unique IP addresses in our increasingly connected global network.

INTRODUCTION TO IPV6:

IPv6 marks a significant leap forward in IP address assignment, showcasing a robust advancement compared to IPv4. Its distinctive feature lies in the adoption of a hexadecimal format, a departure from IPv4's decimal-based system. In IPv6, addresses are structured into 8 parts, each consisting of 16 bits. This shift from IPv4's four-part structure to IPv6's 8-part composition results in a substantial increase in address length, now totaling 128 bits. The integration of a hexadecimal format not only contributes to the efficiency of address representation but also significantly expands the capacity of the addressing system, paving the way for the increasing demands of our interconnected world.

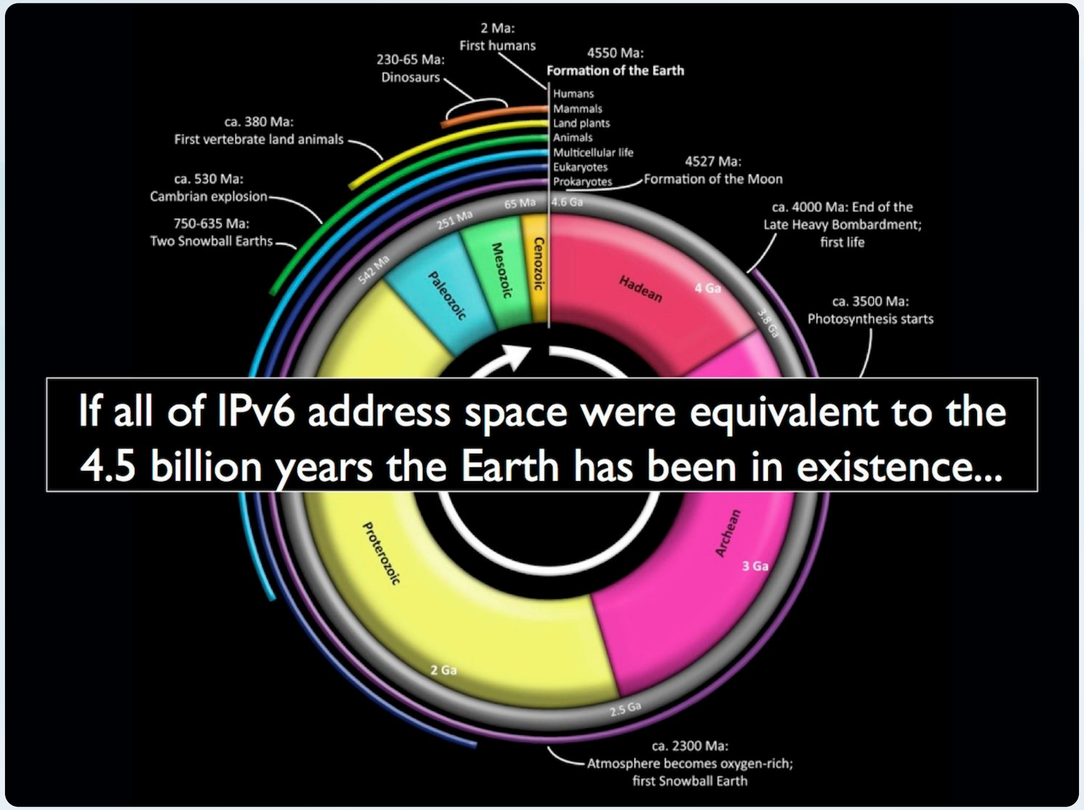
IPV6 ADDRESS STRUCTURE:

IPv6's address structure is characterized by its use of hexadecimal notation and 8 parts of 16 bits each. The 128-bit length of the IPv6 address provides a significantly larger address space compared to IPv4. This expanded capacity enables IPv6 to accommodate an astounding 2^128 devices, offering a vast pool of unique addresses for the growing number of connected devices.



ADDRESSING CAPACITY OF IPV6:

The power of IPv6 lies in its exceptional addressing capacity. With the ability to accommodate up to 2^128 devices, it surpasses the limitations of IPv4 by an enormous margin. To illustrate, envision assigning an IP address to every grain of sand in the Sahara Desert; even after such an exhaustive scenario, IPv6 would still have an abundance of addresses available. This vast address space ensures the scalability and future-proofing of IPv6 in the face of the ever-expanding landscape of connected devices.



CONTINUED USE OF IPV4:

IPv4, despite its limitations, remains widely utilized in networking. Its addressing system, consisting of four parts with each part comprising 8 bits, results in a 32-bit address. While IPv4 is challenged by a finite address space, the familiarity, and compatibility with existing infrastructure have contributed to its continued prevalence. The majority of devices worldwide still rely on IPv4, and its simplicity has facilitated a smooth transition into more advanced technologies. However, the ever-growing number of connected devices has prompted the exploration and adoption of IPv6 to address the limitations posed by the finite IPv4 address pool.

Property	IPv4	IPv6
Address size and network size	32 bits, network size 8-30 bits	128 bits, network size 64 bits
Packet header size	20-60 bytes	40 bytes
Header-level extension	limited number of small IP options	unlimited number of IPv6 extension headers
Fragmentation	sender or any intermediate router allowed to fragment	only sender may fragment
Control protocols	mixture of non-IP (ARP), ICMP, and other protocols	all control protocols based on ICMPv6
Minimum allowed MTU	576 bytes	1280 bytes
Path MTU discovery	optional, not widely used	strongly recommended
Address assignment	usually one address per host	usually multiple addresses per interface
Address types	use of unicast, multicast, and broadcast address types	broadcast addressing no longer used, use of unicast, multicast and anycast address types
Address configuration	devices configured manually or with host configuration protocols like DHCP	devices configure themselves independently using stateless address autoconfiguration (SLAAC) or use DHCP

SUMMARY:

IPv4, with its 32-bit address structure, has been a foundational element in networking, but its limited address space (2^32) faces challenges in accommodating the growing number of connected devices. The introduction of IPv6 offers a robust solution, utilizing a hexadecimal format and an extended 128-bit address length, capable of accommodating an astounding 2^128 devices. IPv6's efficiency and expansive capacity make it a compelling choice for the future of networking. Despite IPv6's advancements, IPv4 persists due to its familiarity and compatibility with existing infrastructure. Both addressing systems coexist, but the escalating demand for unique addresses is steering the transition towards IPv6. The contrasting structures and capacities of IPv4 and IPv6 highlight the evolving landscape of IP addressing in the ever-expanding realm of connected devices.