**Topic: Media Access Control (MAC)**

Reading Time: 15 mins

**·        Note\* Highlight important/core points while reading**

·        Read the content and write the answers given in the document in your words, to get the solid grip on topic.

**Media Access Control (MAC) and MAC Addresses**

**Media Access Control (MAC)** refers to the set of rules and protocols that govern how devices on a network access and use the shared communication medium (such as cables or radio frequencies). The **MAC address** is a unique identifier assigned to a network interface card (NIC) for use in communication within a network segment. It operates at the **Data Link Layer (Layer 2)** of the OSI model.

**Working of MAC Address**

1.      **Definition of MAC Address**:

* A MAC address is a unique identifier that is embedded into the hardware of a NIC during manufacturing. It is used to identify devices on a local network.
* MAC addresses are 48-bits long (6 bytes) and are usually represented as 12 hexadecimal characters (e.g., 00:1A:2B:3C:4D:5E).

2.      **Format of MAC Address**:

* **First 3 Bytes (Organizationally Unique Identifier - OUI)**: These first 3 bytes are assigned to the manufacturer by the IEEE (Institute of Electrical and Electronics Engineers). They identify the device manufacturer.
* **Last 3 Bytes (NIC-Specific)**: The remaining 3 bytes are unique to the NIC itself, assigned by the manufacturer to ensure that each NIC has a unique MAC address.

3.      **Types of MAC Addresses**:

* **Unicast MAC Address**: Refers to a unique identifier assigned to a specific network device. Data sent to a unicast address is intended for one particular device.
* **Broadcast MAC Address**: A special MAC address (FF:FF:FF:FF:FF:FF) used to send data to all devices on the local network. Every device on the network listens for packets with this MAC address.
* **Multicast MAC Address**: A MAC address used to send data to a specific group of devices. Multicast addresses start with 01:00:5E and are used for group communication (e.g., streaming data to multiple devices at once).

4.      **Role of MAC Address in Communication**:

* MAC addresses are essential for proper packet delivery in local area networks (LANs). When data is transmitted over the network, the NIC examines the MAC address to determine if the packet is intended for it (unicast), all devices (broadcast), or a specific group (multicast).
* The MAC address is used in Ethernet frames, which are the data packets used by Ethernet to communicate over wired and wireless networks.

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| **Category** | **Description** |
| **Unicast MAC Address** | A unique MAC address assigned to a single device for communication between two devices. |
| **Broadcast MAC Address** | A special address (FF:FF:FF:FF:FF:FF) that sends data to all devices on the network segment. |
| **Multicast MAC Address** | A MAC address used for sending data to a specific group of devices rather than just one or all. |

**Benefits and Limitations of MAC Addressing**

**Benefits**:

* **Uniqueness**: MAC addresses are globally unique, which ensures no two devices on the same network have the same address.
* **Device Identification**: MAC addresses allow devices on a network to be reliably identified and communicate with each other.
* **Efficient Network Communication**: They allow for both unicast and broadcast communication, supporting various network configurations and traffic types.

**Limitations**:

* **Privacy Issues**: MAC addresses can be easily intercepted or spoofed, leading to security concerns in certain cases.
* **No Routing**: MAC addresses are used only within local networks and do not provide global routing. They are not suitable for communication across different networks.
* **Fixed Assignment**: The MAC address is typically fixed and cannot be changed, which may not be ideal in certain network configurations where changing the address is necessary.

**A-Rated Questions/Answers By Examiner**

**Q1**: **What is a MAC address, and where is it used?**

**Answer**: A MAC address is a unique identifier assigned to a network interface card (NIC). It is used to identify devices on a local network and facilitates data communication within that network.

**Q2**: **What are the main types of MAC addresses, and how do they differ?**

**Answer**: The main types of MAC addresses are:

* **Unicast**: A unique address for communication between two specific devices.
* **Broadcast**: A special address used to send data to all devices on the network.
* **Multicast**: An address used to send data to a specific group of devices.

**Q3**: **Explain the difference between unicast and broadcast MAC addresses.**

**Answer**: A **unicast MAC address** is a unique identifier assigned to a single device, ensuring that data is delivered to that specific device. A **broadcast MAC address** (FF:FF:FF:FF:FF:FF) is used to send data to all devices on the local network simultaneously.

**Q4**: **Why is a MAC address important for network communication?**

**Answer**: A MAC address is important because it uniquely identifies each device on a network. This ensures that data is correctly routed to the intended recipient device, enabling effective communication on local area networks (LANs).

**Q5**: **What is a limitation of MAC addressing in terms of privacy?**

**Answer**: A limitation of MAC addressing is that MAC addresses can be easily intercepted or spoofed, which can lead to security vulnerabilities or privacy concerns, especially in wireless networks.

### Write your Answers on your Notebook and Verify it on Next Screen

**Q6: What information is conveyed by the first three bytes of a MAC address, and who assigns them?**

**Q7: How do multicast MAC addresses function, and what is an example of their use?**

**Q8: Why are MAC addresses considered unsuitable for global network communication?**

**Q9: How does the MAC address help a NIC determine if an incoming data packet is relevant?**

**Q10: What challenges can arise from the fixed nature of MAC addresses in certain network configurations?**

**6. Answer**: The first three bytes of a MAC address are known as the Organizationally Unique Identifier (OUI), which identifies the manufacturer of the NIC. The IEEE assigns OUIs to manufacturers to ensure they are unique.

**7. Answer**: Multicast MAC addresses are used to send data to a specific group of devices within a network, rather than to a single device or all devices. They are commonly used in applications like streaming, where data is delivered to multiple devices simultaneously.

**8. Answer**: MAC addresses are designed for local network use only and do not support routing between different networks, which limits their use to within a local area network (LAN).

**9. Answer**: The NIC compares the destination MAC address in each incoming data packet to its own MAC address to determine if the packet is intended for it. If it’s a match, the NIC processes the packet; otherwise, it ignores it.

**10. Answer**: Since MAC addresses are usually fixed at the time of manufacture, they cannot be changed easily. This can be problematic in network configurations that require dynamic or temporary MAC addresses, such as in some virtualized or highly secure network setups.

### ****Kindly Write down your answers on your Note book and than verifiy it with answers given at the end****

1- A computer has both a media access control (MAC) address and an internet protocol (IP) address.

(a) Tick (3) one box to show which of the statements is correct about the MAC address.

**A**      It is assigned by the manufacturer.

**B**  It is assigned by a router.

**C**     It can be static or dynamic.

**D**    It is made up of three different parts.

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(b) An IP address can have an IPv4 or IPv6 format.

(i) Give an example of an IP address that has an IPv4 format.

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(ii) Give two characteristics of the IPv6 format.

1 ........................................................................................................................................ ...........................................................................................................................................

 2 ........................................................................................................................................ ........................................................................................................................................... [2]

2- Many devices have a Media Access Control (MAC) address.

Give three features of a MAC address.

Feature 1 .......................................................................................................................................... ..............................................................................................................................................

Feature 2 .......................................................................................................................................... ..............................................................................................................................................

Feature 3 .......................................................................................................................................... .......................................................................................................................................................... [3]