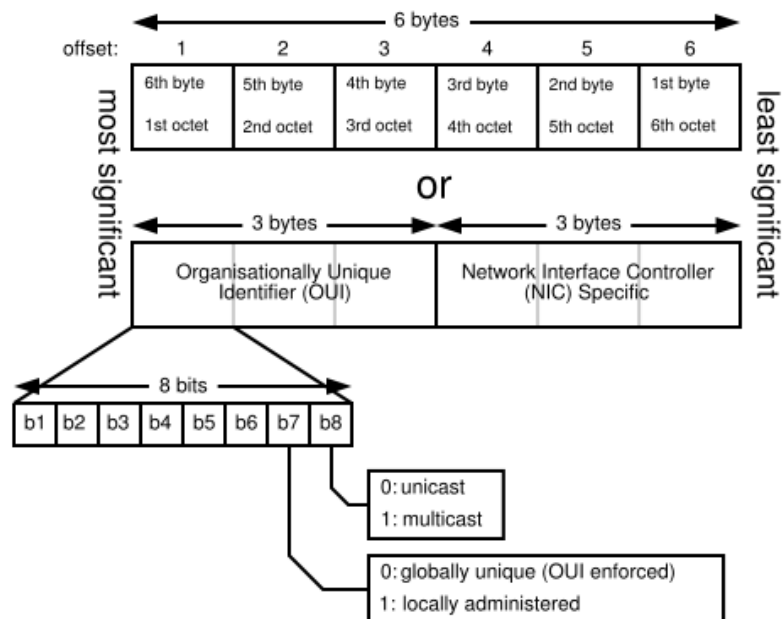


4.1 Address details



The original **IEEE 802** MAC address comes from the original **Xerox** Ethernet addressing scheme. This 48-bit address space contains potentially 2^{48} or 281,474,976,710,656 possible MAC addresses.

All three numbering systems use the same format and differ only in the length of the identifier. Addresses can either be "universally administered addresses" or "locally administered addresses."

A **universally administered address** is uniquely assigned to a device by its manufacturer; these are sometimes called "**burned-in addresses**." The first three **octets** (in transmission order) identify the organization that issued the identifier and are known as the **Organizationally Unique Identifier (OUI)**. The following three (MAC-48 and EUI-48) or five (EUI-64) octets are assigned by that organization in nearly any manner they please, subject to the constraint of uniqueness. The IEEE expects the MAC-48 space to be exhausted no sooner than the year **2100**; EUI-64s are not expected to run out in the foreseeable future.

A **locally administered address** is assigned to a device by a network administrator, overriding the burned-in address. Locally administered addresses do not contain OUIs.

Universally administered and locally administered addresses are distinguished by setting the second **least significant bit** of the most significant byte of the address. If the bit is 0, the address is universally administered. If it is 1, the address is locally administered. The bit is 0 in all OUIs. For example, 02-00-00-00-00-01, the most significant byte is 02h. The binary is **00000010** and the second least significant bit is 1. Therefore, it is a locally administered address.

If the least significant bit of the most significant byte is set to a 0, the packet is meant to reach only one receiving **NIC**. This is called **unicast**. If the least significant bit of the most significant byte is set to a 1, the packet is meant to be sent only once but still reach several NICs. This is called **multicast**.

MAC-48 and EUI-48 addresses are usually shown in **hexadecimal** format, with each octet separated by a dash or colon. An example of a MAC-48 address would be "00-08-74-4C-7F-1D". If you cross-reference the first three octets with **IEEE's** OUI assignments, you can see that this MAC address came from **Dell Computer** Corp. The last three octets represent the serial number assigned to the adapter by the manufacturer.

The following technologies use the MAC-48 identifier format:

- Ethernet
- 802.11 wireless networks
- Bluetooth
- IEEE 802.5 token ring
- Most other IEEE 802 networks
- FDDI
- ATM (switched virtual connections only, as part of an NSAP address)
- Fiber Channel and Serial Attached SCSI (as part of a World Wide Name)

The distinction between EUI-48 and MAC-48 identifiers is purely semantic: MAC-48 is used for network hardware; EUI-48 is used to identify other devices and software. (Thus, by definition, an EUI-48 is not in fact a "MAC address", although it is syntactically indistinguishable from one and assigned from the same numbering space.)

Note: The IEEE now considers the label MAC-48 to be an obsolete term which was previously used to refer to a specific type of EUI-48 identifier used to address hardware

interfaces within existing 802-based networking applications and should not be used in the future. Instead, the term EUI-48 should be used for this purpose.

EUI-64 identifiers are used in:

- FireWire
- IPv6 (as the low-order 64 bits of a unicast network address when temporary addresses are not being used)
- ZigBee / 802.15.4 wireless personal-area networks

The IEEE has built in several special address types to allow more than one **Network Interface Card** to be addressed at one time:

- Packets sent to the **broadcast address**, all one bits, are received by all stations on a **local area network**. In **hexadecimal** the broadcast address would be "FF:FF:FF:FF:FF:FF".
- Packets sent to a **multicast address** are received by all stations on a LAN that have been configured to receive packets sent to that address.
- **Functional addresses** identify one of more Token Ring NICs that provide a particular service, defined in **IEEE 802.5**.

These are "group addresses", as opposed to "individual addresses"; the least significant bit of the first octet of a MAC address distinguishes individual addresses from group addresses. That bit is set to 0 in individual addresses and 1 in group addresses. Group addresses, like individual addresses, can be universally administered or locally administered.

In addition, the EUI-64 numbering system encompasses both MAC-48 and EUI-48 identifiers by a simple translation mechanism. To convert a MAC-48 into an EUI-64, copy the OUI, append the two octets "FF-FF", and then copy the organization-specified part. To convert an EUI-48 into an EUI-64, the same process is used, but the sequence inserted is "FF-FE". In both cases, the process can be trivially reversed when necessary. Organizations issuing EUI-64s are cautioned against issuing identifiers that could be confused with these forms. The IEEE policy is to discourage new uses of 48-bit identifiers in favor of the EUI-64 system.

IPv6 one of the most prominent standards that uses EUI-64 applies these rules inconsistently. Due to an error in the appendix to the specification of IPv6 addressing, it is

standard practice to extend MAC-48 addresses (such as IEEE 802 MAC address) to EUI-64 using "FF-FE" rather than "FF-FF."

4.2 Individual Address Block

An **Individual Address Block** comprises a 24-bit **OUI** managed by the IEEE Registration Authority, followed by 12 IEEE-provided bits (identifying the organization), and 12 bits for the owner to assign to individual devices. An IAB is ideal for organizations requiring fewer than 4097 unique 48-bit numbers (EUI-48).

4.3 Printed Format

The standard (IEEE 802) format for printing MAC-48 addresses in human-readable media is six groups of two hexadecimal digits, separated by hyphens (-) in transmission order, e.g. 01-23-45-67-89-ab. This form is also commonly used for EUI-64. Other conventions include six groups of two separated by colons (:), e.g. 01:23:45:67:89:ab; or three groups of four hexadecimal digits separated by dots (.), e.g. 0123.4567.89ab; again in transmission order.