

Ethernet Basics

Ethernet Frame

PREAMBLE	DEST MAC	SOURCE MAC	ET	PAYLOAD 46-1500 BYTES	CRC
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Ethernet Frame consists of:

8 Byte PREAMBLE

6 Byte Destination MAC address

6 Byte Source MAC address

2 Byte Ethertype

46 - 1500 Bytes Payload

4 Bytes - 32 bit Ethernet CRC (or FCS)

There are other Enet frame formats but they are the minority

Preamble

64 bits (8 bytes) used as a synchronization aid on 10Mb Ethernet.

In 802.3 is defined as 7 bytes of preamble followed by a one byte Start Frame Delimiter (SFD)

Not needed on 100Mb or Gig Ethernet but is preserved for backward compatibility

The preamble is never included in packet length calculations or displayed on protocol captures.

It is included in bandwidth calculations (since it DOES take 64 bit times)

bit time

Bit Time - the time required to transmit one bit. Since 10BaseT Ethernet transmits 10Megabit or 10,000,000 bits per second.

Therefore the time required to transmit one bit is $1/10,000,000$ or 0.0000001 seconds (100 nS or 0.1 uS) per bit

Since 100Mb Ethernet is 10 times faster, the time for each bit is 10 times smaller.

One bit at 100Mb/s is 10nS or 0.01 uS (0.00000001 second)

For 1Gb the bit time is 1nS

MAC Addresses

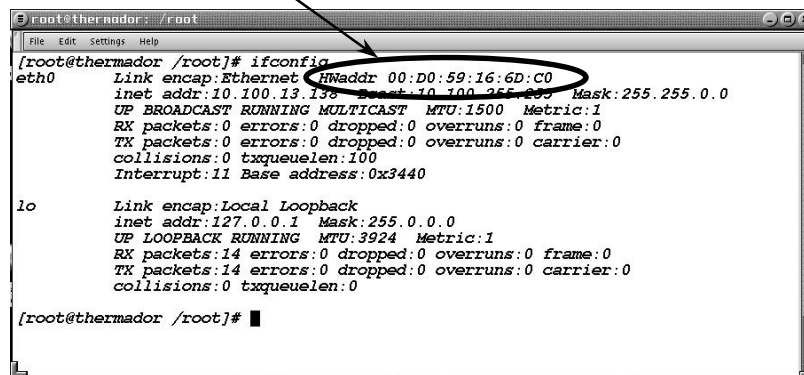
MAC address (also known as hardware address or physical address) is a 6 byte address assigned by the IEEE Standards Association and is unique for every Ethernet device ever manufactured.

The first three bytes are the OUI (Organizationally Unique Identifier) the second three bytes is a unique identifier assigned by the vendor



MAC Address

MAC Address of Ethernet NIC



A terminal window titled 'root@thermador: /root' showing the output of the 'ifconfig' command. The output for the 'eth0' interface is as follows:

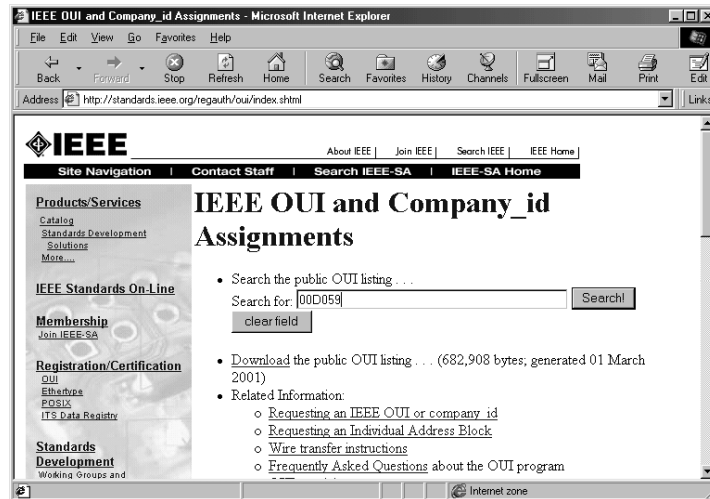
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[root@thermador /root]# ifconfig
eth0      Link encap:Ethernet HWaddr 00:D0:59:16:6D:C0
          inet addr:10.100.13.138 Bcast:10.100.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:100
          Interrupt:11 Base address:0x3440

lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:3924  Metric:1
          RX packets:14 errors:0 dropped:0 overruns:0 frame:0
          TX packets:14 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0

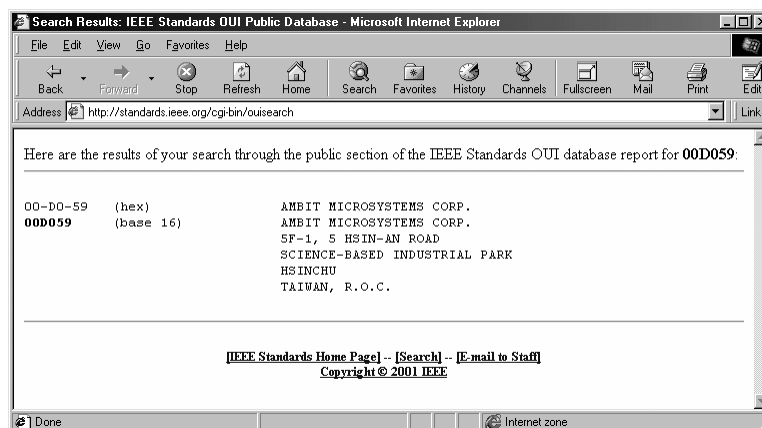
[root@thermador /root]#
```

An arrow points from the text 'MAC Address of Ethernet NIC' to the 'HWaddr' field in the terminal output, which is circled in red.

IEEE has the OUI codes...



Each 3 byte pattern is registered to an OEM



Special MAC Addresses

Broadcast:

A MAC with all bits set FF FF FF FF FF FF is a BROADCAST. It is received by all devices on the Ethernet segment

Multicast:

A MAC address with the least significant bit of the most significant byte set is a MULTICAST address.

01 00 00 00 00 00 00

Note: Ethernet frames are always displayed from most significant to least significant. In actual transmission, each byte is transmitted from least significant bit to most significant bit. Some RFCs reference this as “first bit transmitted”. Be aware.

Ethertype

The two bytes after the source MAC in Ethernet II are the EtherType

Identifies the type of frame:

0800 is IP

0806 is ARP

8137 is Novell IPX

8100 is VLAN

802.3 Ethernet uses these two bytes as a length field

How does a device know which the field refers to???

It depends on the value...

If the two bytes following the source MAC is equal to, or is greater than 1536 (0x0600 hex), it is an Ethertype

If the two bytes are less than 1536, it is a length

Since the maximum legal frame size is 1514 (1518 with VLAN tags), there's no chance of overlap.

Data (Payload)

Following the 14 bytes of Ethernet header will be between 46 and 1500 bytes of payload. This will give a minimum Ethernet frame of 64 bytes and a maximum of 1518 bytes

14 bytes header + 46 bytes payload + 4 bytes CRC = 64

14 bytes header + 1500 bytes payload + 4 bytes CRC = 1518

Frames with VLAN tags will be 4 bytes longer 1522 max.

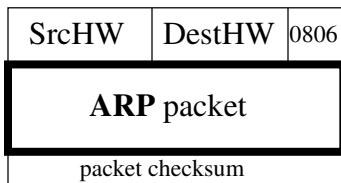
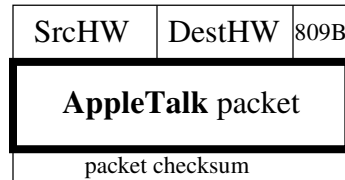
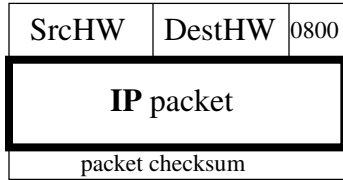
Basic Concepts

- To address a particular network node you must have the hardware MAC address
- If the destination MAC isn't right, it doesn't get there
- All higher level protocols sent over Ethernet are encapsulated in an Ethernet frame

Ethernet frame structure

Source HWaddress	Destination HWaddress	Type
Ethernet's Data Payload		
Packet Checksum		

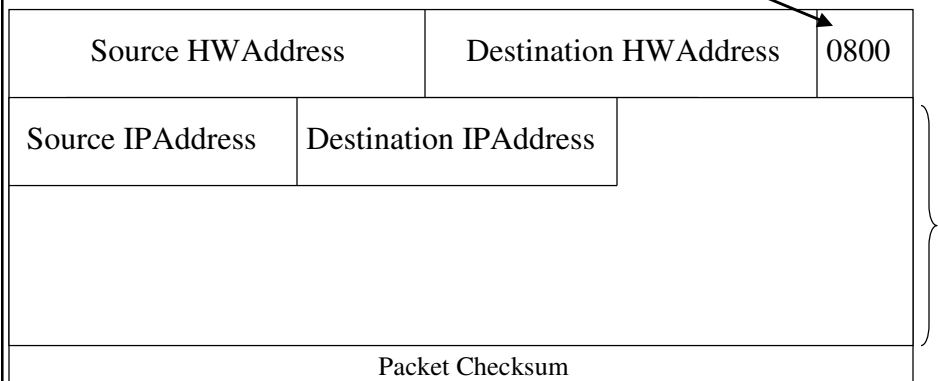
Ethernet types – type examples and their codes



... and many others

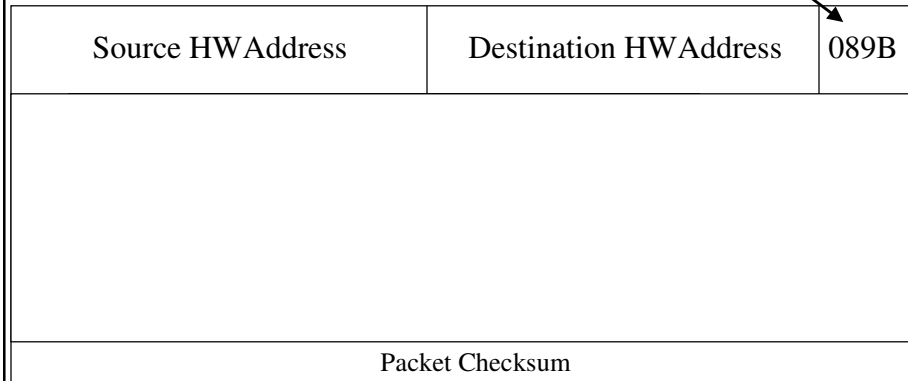
<http://www.iana.org/assignments/ethernet-numbers>

Ethernet carrying IP



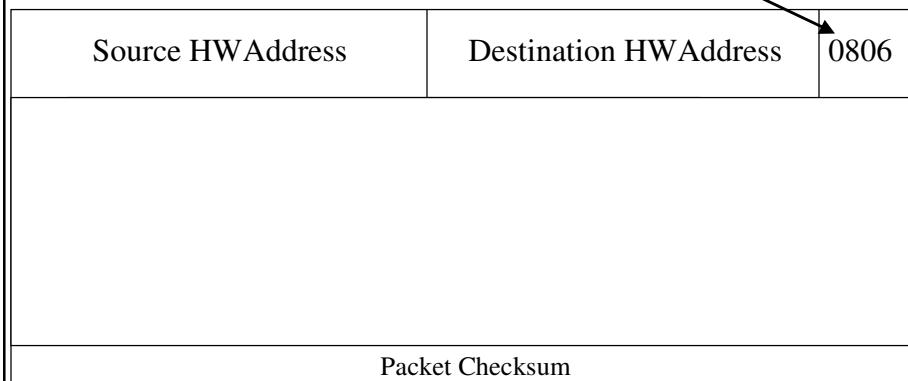
Ethernet's payload may be an IP packet

Ethernet carrying AppleTalk



Ethernet's payload may be an AppleTalk packet

Ethernet carrying ARP



Ethernet's payload may be an Address Resolution Protocol message