

# Ethernet Basics

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## Ethernet Frame



Ethernet Frame consists of:

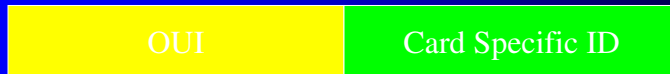
- 6 Byte Destination MAC address
- 6 Byte Source MAC address
- 2 Byte Ethertype
- 46 - 1500 Bytes Payload

*There are other ethernet frame formats but they are the minority*

# 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

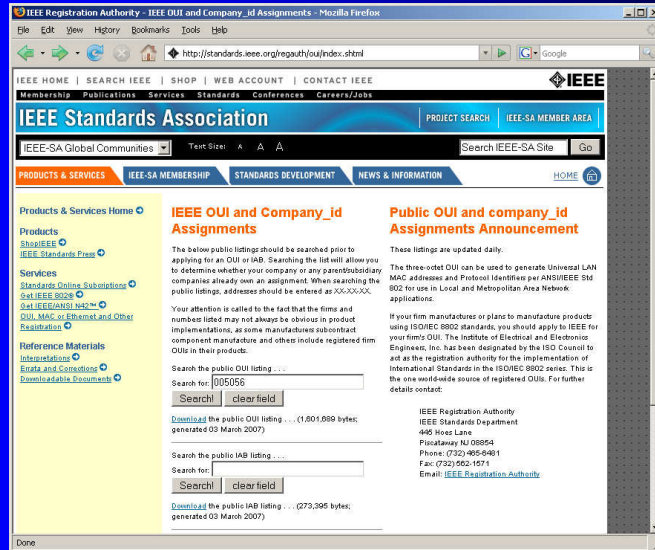
MAC Address of Ethernet NIC

```
[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

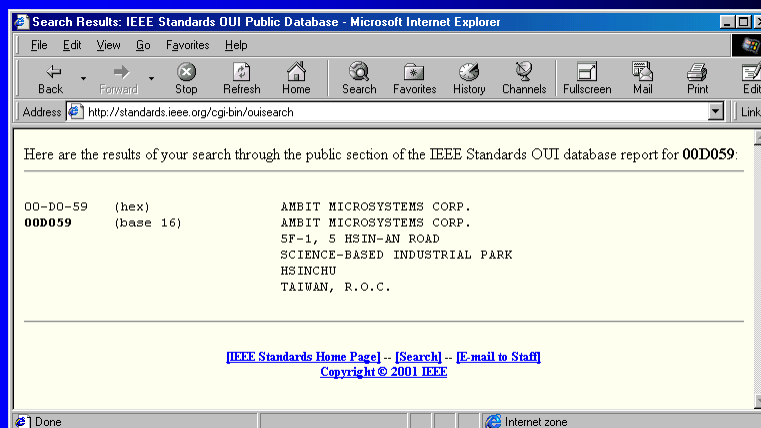
lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:3924  Metric:1
          RX packets:14 errors:0 dropped:0 overruns:0 frame:0
          TX packets:14 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0

[root@thermador: /root]#
```

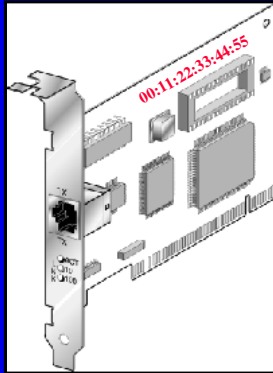
# IEEE has the OUI codes...



# Each 3 byte pattern is registered to an OEM



## Manufacturer burns MAC into NIC

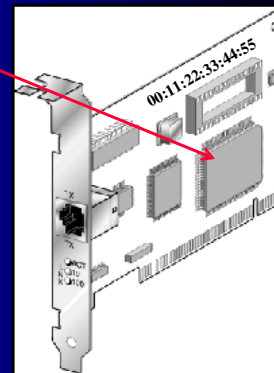
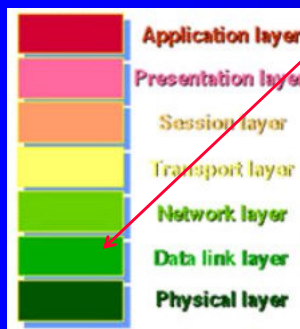


## MAC is used by ethernet software

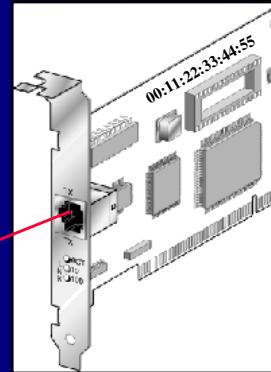
locus of ethernet software

conceptual

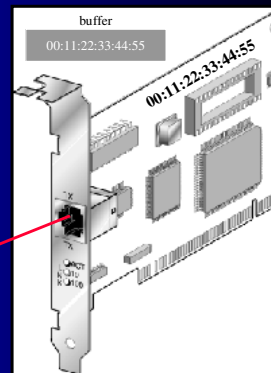
physical



ethernet makes frames,  
writes MAC into each as source



Buffers MAC –  
copies MAC to buffer, buffer to frame



## Spooing MAC –

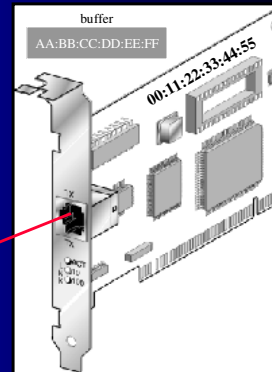
MAC is read-only, but buffer is read-write

```
ifconfig ethX hw ether AA:BB:CC:DD:EE:FF
```

or

```
ip link set ethX address AA:BB:CC:DD:EE:FF
```

writes the buffer



Spooed



## 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

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 Ether type

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???*

## Data (Payload)

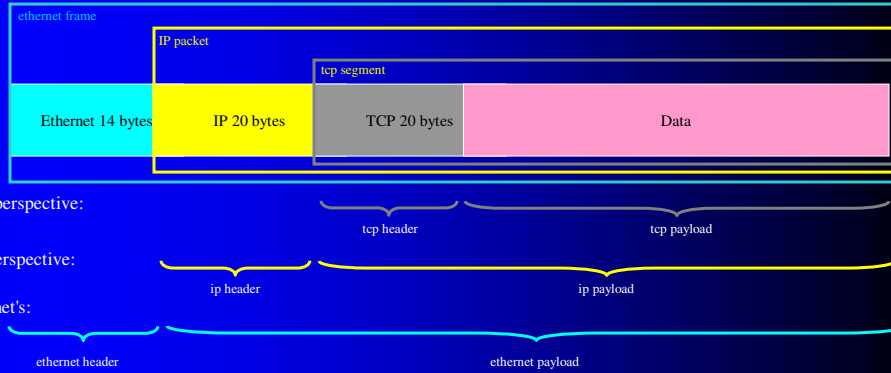
Following the 14 bytes of Ethernet header will be between 46 and 1500 bytes of payload. This will give a minimum Ethernet frame of 60 bytes and a maximum of 1514 bytes

14 bytes header + 46 bytes payload = 60

14 bytes header + 1500 bytes payload = 1514

# PDU Encapsulation

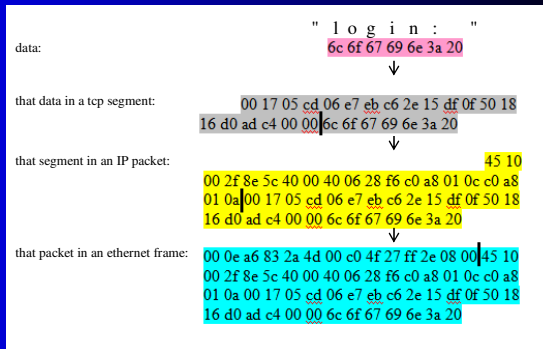
The “payload” portion of the ethernet frame usually contains the protocol information from higher layer PDUs such as IP and TCP



# Encapsulation: seen while using telnet

Frame 23: 61 bytes on wire (488 bits), 61 bytes captured (488 bits)  
 Ethernet II, Src: 00:c0:4f:27:ff:2e, Dst: 00:0e:a6:83:2a:4d  
 Internet Protocol Version 4, Src: 192.168.1.12, Dst: 192.168.1.10  
 Transmission Control Protocol, Src Port: 23, Dst Port: 1485, Seq: 123, Ack: 56, Len: 7  
 Telnet

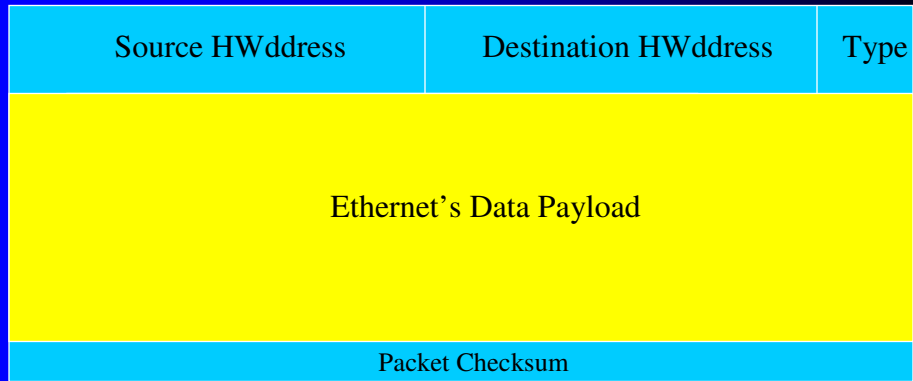
```
0000 00 0e a6 83 2a 4d 00 c0 4f 27 ff 2e 08 00 45 10  ....*M..O'....E.
0010 00 2f 8e 5c 40 00 40 06 28 f6 c0 a8 01 0c c0 a8  ..\@.@.(.....
0020 01 0a 00 17 05 cd 06 e7 eb c6 2e 15 df 0f 50 18  .....P.
0030 16 d0 ad c4 00 00 6c 6f 67 69 6e 3a 20  ....login:
```



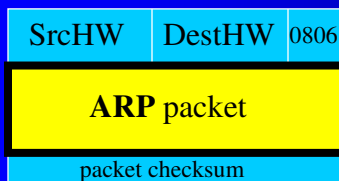
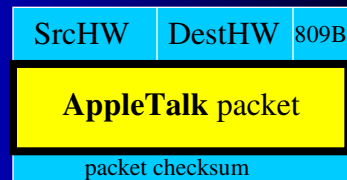
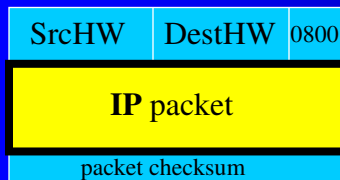




# Ethernet frame structure



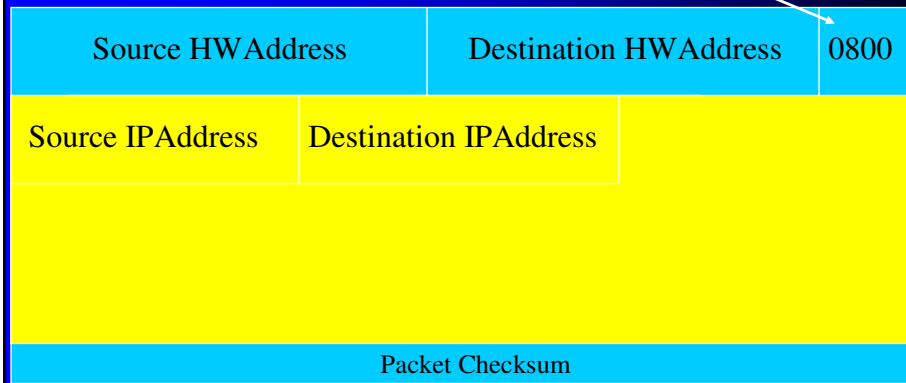
## Ethernet types – type examples and their codes



... and many others

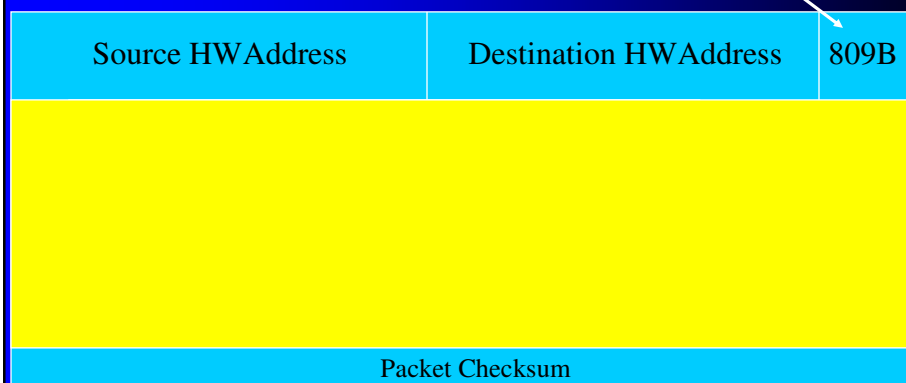
<http://www.iana.org/assignments/ieee-802-numbers/ieee-802-numbers.xml>

## Ethernet carrying IP



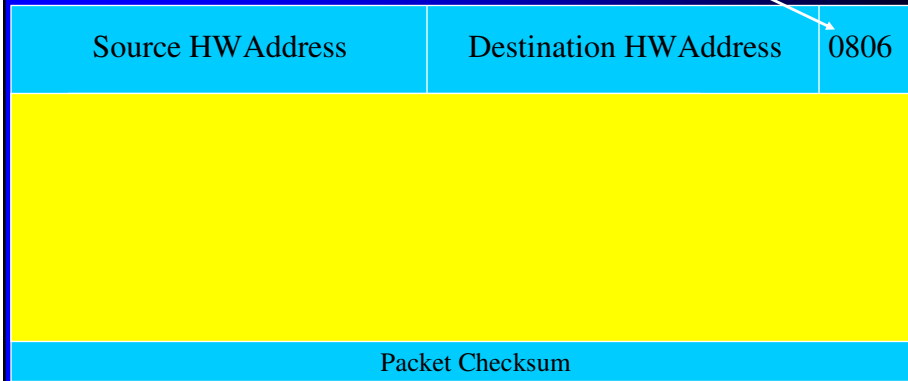
Ethernet's payload may be an IP packet

## Ethernet carrying AppleTalk



Ethernet's payload may be an AppleTalk packet

# Ethernet carrying ARP



Ethernet's payload may be an Address Resolution Protocol message