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.

```
OUI  Card Specific ID
```

MAC Address

MAC Address of Ethernet NIC

```
[root@ethermapor /root]# ifconfig
eth0     Link encaps:Ethernet  Addr: 00:0F:06:16:60:C0
inet addr:10.100.13.171  Bcast:10.100.13.255  Mask:255.255.255.0
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:41  Base address 0xb400
lo     Link encap:Local Loopback
inet addr:127.0.0.1 Mask 255.0.0.0
UP LOOPBACK RUNNING  MTU:128 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
```

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

classical

physical
ethernet makes frames, writes MAC into each as source

Buffers MAC – copies MAC to buffer, buffer to frame
Spoofing 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

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??*

**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.
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

<table>
<thead>
<tr>
<th>Source HWaddress</th>
<th>Destination HWaddress</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ethernet’s Data Payload</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Packet Checksum</td>
</tr>
</tbody>
</table>

Note: The table above outlines the structure of an Ethernet frame, including fields such as Source HWaddress, Destination HWaddress, Type, Ethernet’s Data Payload, and Packet Checksum.
Ethernet types – type examples and their codes

- **IP packet**
  - SrcHW 0800
  - DestHW 0800
  - Packets checksum

- **AppleTalk packet**
  - SrcHW 809B
  - DestHW 809B
  - Packets checksum

- **ARP packet**
  - SrcHW 0806
  - DestHW 0806
  - Packets checksum

... and many others

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

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**Ethernet carrying IP**

- **Source HWAddress** 0800 **Destination HWAddress**
- **Source IPAddress**
- **Destination IPAddress**

Packet Checksum

Ethernet’s payload may be an IP packet
Ethernet carrying AppleTalk

Source HWAddress | Destination HWAddress | 809B

Packet Checksum

Ethernet’s payload may be an AppleTalk packet

Ethernet carrying ARP

Source HWAddress | Destination HWAddress | 0806

Packet Checksum

Ethernet’s payload may be an Address Resolution Protocol message