Hardware Address

- <u>hardware address</u> or <u>physical address</u> or <u>media access (MAC) address</u> - an address assigned to a computer attached to a network.

- Each frame sent across a network includes the address of the sending computer (source address) and the address of the receiving computer (destination address).

LAN Hardware & Packet Filtering

- LAN hardware is separate and independent from a computer's CPU.

- The LAN interface handles all details of frame transmission and reception.

  - Adds source address and error detection codes to outgoing frames.

  - Checks destination address on incoming frames.

- If a frame's destination address matches, a copy of the frame is passed on to the computer.

- If a frame's destination address does not match, the frame is ignored.

- The network interface operates without using a computer's CPU.

Format of a Hardware Address

- Address depends on the LAN technology used.
- Examples.
- Hardware addresses must be unique on a LAN.
- Assignment of hardware addresses:

Static	Manufacturer assigns permanent address.	Manufacturer ensures unique address.
Dynamic	Address assigned when computer boots.	Assigning scheme prevents conflicts.
Config-urable	Address set by users.	Someone coordinates assignments.

Packet Contents

- The hardware addressing scheme allows a sender to identify a recipient of a packet, but it gives no information about a packet's contents.

- Two methods are used to identify a packet's contents:

  - <u>Explicit frame type</u>: an identifying value is included in the frame to describe the contents.

  - <u>Implicit frame type</u>: no identifying value is included; the receiver must infer the content type from the data itself.

Frame Headers & Formats

- Each LAN technology defines a frame format.

- Most modern standards specify a <u>frame header</u> followed by the frame data or <u>payload</u>.

- The size and format of a frame header are fixed. The size of the data area varies.

Example: Ethernet Frame Format

Preamble	**Allows receiver to synchronize with incoming signal**
Dest. Address	**Hardware address of recipient**
Source Address	**Hardware address of sender**
Frame Type	**Type of data carried in frame**
Data in Frame	**Frame's payload**
CRC	**CRC code**

- Since a hardware address consists of 6 hexadecimal numbers, there are $256^6 = 2.8 \times 10^{14}$ possible hardware addresses.

- The Ethernet standard specifies a header field of 48 bits for the recipient's hardware address. Note that $2^{48} = 256^6$.

- Although hardware addresses have to be unique only on a particular network, it's interesting that the Ethernet standard can accommodate all possible addresses.

Frames without Type Fields

- Some LAN technologies do not include a type field in the frame header.

- There are two ways around this:

  - The sender and receiver agree in advance to use a single data format. Too limiting and rarely done.

  - The sender and receiver agree to encode the data type in the first few bytes of the data field. The problem is what to include.

- Including a type field in the frame header means that the designers of the hardware technology decide what goes in the type field.

- If there is no frame type field, it's up to the software application designers to choose whatever they want for type values. Leads to nonstandardization and confusion.

- This is a job for a standards organization.

- Unfortunately, several organizations have come up with different standards.

- IEEE to the rescue! The IEEE 802.2 standard includes a specification known as a <u>Logical Link Control (LLC) SubNetwork Attachment Point (SNAP)</u> header.

Network Analyzer

- network analyzer or network monitor or network sniffer - a device or program that listens to a network and reports on traffic.

- A network analyzer...
  - can be used to examine network performance or to debug a network;
  - can report statistics such as capacity utilization distribution of frame size, collision rate, token circulation time, and so on;
  - can record and display specific frames to understand and debug packet transmissions;
  - can count frames of a specific type or size;
  - can display only frames from or to specific computers.

- **promiscuous mode** - a mode in which a computer accepts **all** frames.

- **A network analyzer places a computer with a network interface in promiscuous mode.**

- **Example**: snoop