Hardware Address

- hardware address or physical address or media access (MAC) address - 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:

<table>
<thead>
<tr>
<th>Static</th>
<th>Manufacturer assigns permanent address.</th>
<th>Manufacturer ensures unique address.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic</td>
<td>Address assigned when computer boots.</td>
<td>Assigning scheme prevents conflicts.</td>
</tr>
<tr>
<td>Configurable</td>
<td>Address set by users.</td>
<td>Someone coordinates assignments.</td>
</tr>
</tbody>
</table>
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:
  - **Explicit frame type**: an identifying value is included in the frame to describe the contents.
  - **Implicit frame type**: 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 frame header followed by the frame data or payload.

- 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 Logical Link Control (LLC) SubNetwork Attachment Point (SNAP) 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:** snoopy