Address format

The **IEEE** manages DLL addresses, known as **MAC** addresses. Each node has a permanent 48–bit **MAC address** assigned to it by the manufacturer of the NIC. This address is stored in read–only memory and theoretically cannot be modified (but it can be spoofed[a]).

IEEE allows two formats for writing MAC addresses:

HH-HH-HH-HH-HH-HH

HH:HH:HH:HH:HH:HH

where H stands for a hexadecimal digit (0-F).

The address is supposed to be unique worldwide with the first 3 bytes indicating the the issuer of the address (this is called a Burn–In–Address). However, a skilled person may override a BIA address.

MAC addresses are used by Ethernet, wireless 802.11, Bluetooth and most other IEEE 802 networks.

[a] In hub– or star– Ethernet, the response to a spoofed frame is sent to the spoofing host, not to the victim.

Broadcast and Multicast

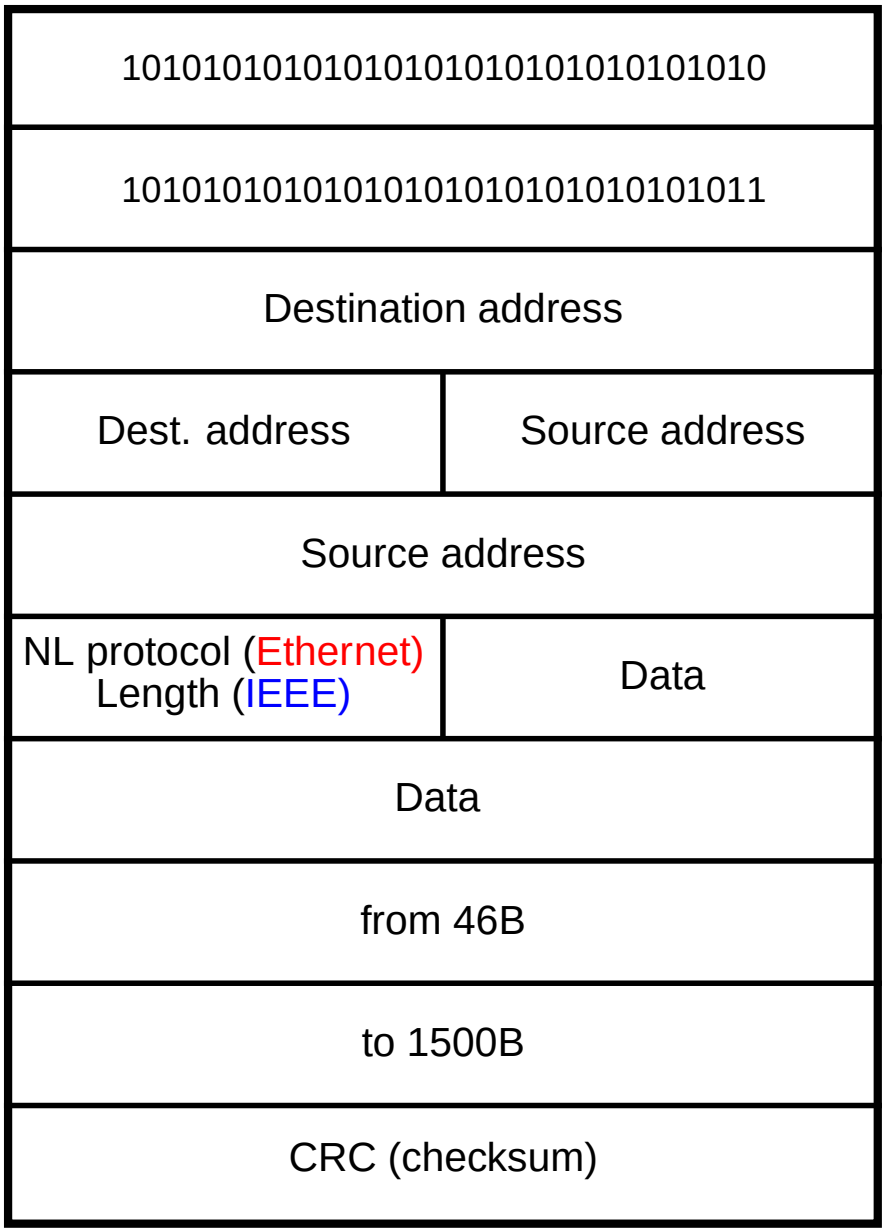
These two special cases are signalled by a special form of the first byte of the destination address.

Broadcast: destination address starts with **FF:**.

Multicast: destination address starts with an odd byte, i.e the first byte is **x1:**, **x3:**, **x5:**, etc. up to **xF:**, where **x** is any hex digit.

As a consequence, all unicast receivers have addresses with the first byte being even.

Frame format



Ethernet

Ethernet, the oldest modern local area network (1970s) exists in three variants:

- The original **bus** configuration running at 10Mb/s.
- A newer **star** configuration with a central **hub** running at 100Mb/s or 1Gb/s.
- A star configuration with a central **switch** which can run at any transmission rate (commercial versions run at 10 Gb/s but 100Gb/s are envisioned). Several switches can be attached to each other, this configuration is a WAN in some sense (it has only 2 layers: PL and DLL).

Broadcast bus

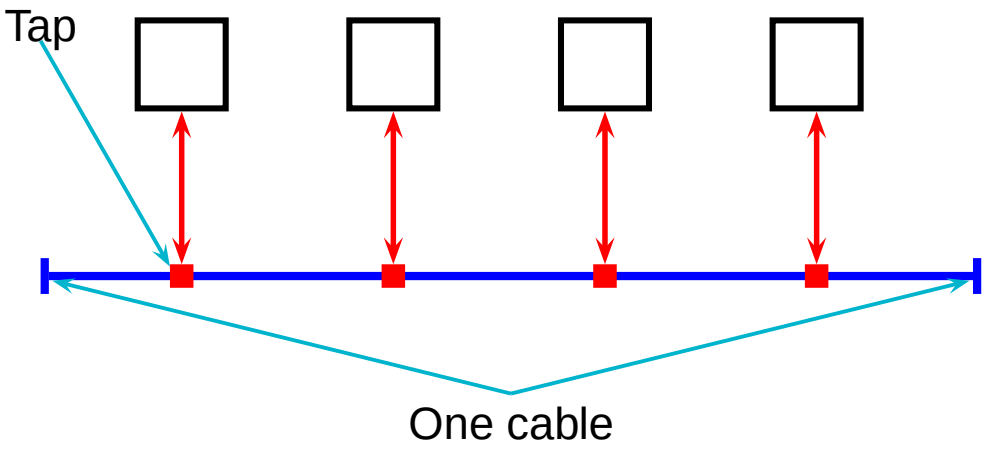
The traditional Ethernet versions were named according to a simple code:

10Base5	Thick coax	**5**00m	Broadcast cable
10Base2	Thin coax	**2**00m	P2P
10BaseT	Twisted pair	100m	P2P UTP
10BaseF	Fibre	2000m	P2P fibre

All of them used Manchester encoding. The coax versions were bi–directional (a single cable) while the UTP and fibre versions consisted of sets of two uni–directional cables, each set connecting a station to a central hub.

10Base5–Thicknet

Each segment was up to 500m long, but up to 5 segments could be connected with repeaters, giving a maximum length of 2500m (max length for CSMA/CD). Many stations can be connected to each segment but stations must be a multiple of 250cm apart.

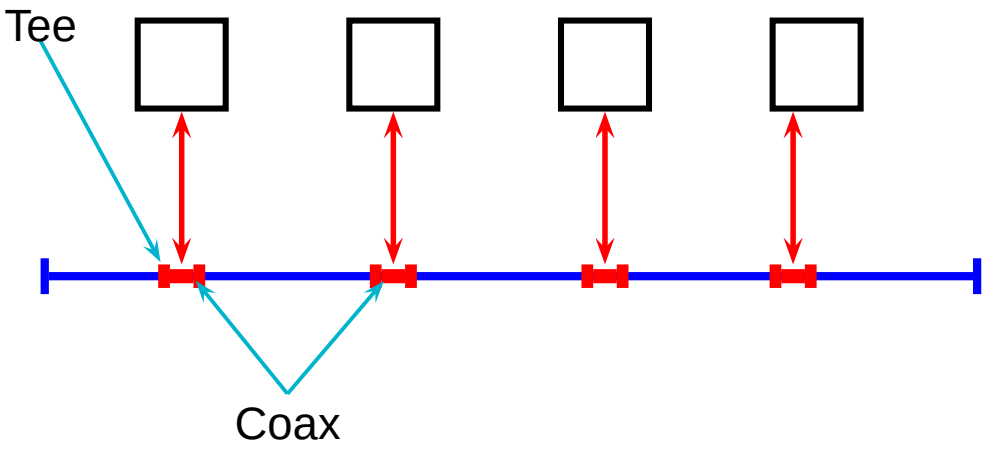


A **tap** is a passive transceiver (signal passes by through the tap unchanged).

Collisions occur in the cable and are passively witnessed by taps.

10Base2–Thinnet

Each segment connects a pair of stations; the segment's length is up to 185m. Segments can be combined to form a network that is as long as desired.

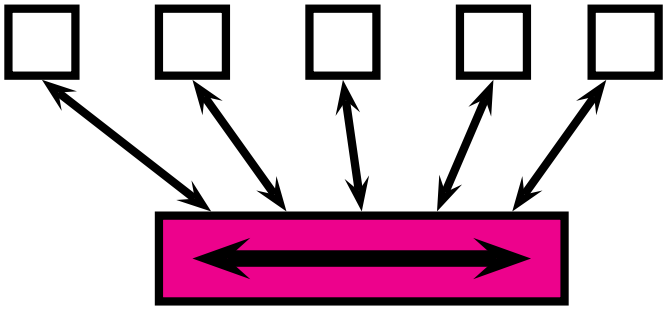


A BNC **tee** captures the signal and sends (all of it) to the station's NIC. The NIC has to regenerate the signal (note the reliability issue).

Collisions occur in the cable (harmless) and in the NIC interface when either both sides of the tee report input or when the signal level in one side of the tee is abnormal.

Hub–10Base-T

The coax cable is replaced by a **hub** which plays the same role. Collisions happen inside the hub (as opposed to the cable); they occur when two or more stations send signal to the hub at the same time.



In its simplest form, the hub relayed all of its input (from all ports) to all of its port (excluding the source port). Fancier variants exist.

Bridge

One extension of a hub was a device that would forward its inputs only selectively.

Originally meant as a fancy repeater (connecting two Ethernet 10Base5 segments), it evolved, eventually becoming an Ethernet **switch**.