

become overrun and start discarding packets. We will see later that best-effort semantics form a key concept in the design of TCP/IP protocols.

2.5.4 48-Bit Ethernet MAC (Hardware) Addresses

IEEE defines a 48-bit MAC addressing scheme that is used with Ethernet and other network technologies. The abbreviation MAC stands for *Media Access Control*, and is used to clarify the purpose of the address. A MAC address is assigned to each network interface card. To insure uniqueness, an Ethernet hardware manufacturer must purchase a block of MAC addresses from IEEE and must assign one address to each NIC that is manufactured. The assignment means that no two hardware interfaces have the same Ethernet address.

Because each address is assigned to a hardware device, we sometimes use the term *hardware address* or *physical address*. For our purposes, we will use the terms interchangeably.

Note the following important property of a MAC address:

An Ethernet address is assigned to a network interface card, not to a computer; moving the interface card to a new computer or replacing an interface card that has failed changes a computer's Ethernet address.

Knowing that a change in hardware can change an Ethernet address explains why higher level protocols are designed to accommodate address changes.

The IEEE 48-bit MAC addressing scheme provides three types of addresses:

- *Unicast*
- *Broadcast*
- *Multicast*

A *unicast* address is a unique value assigned to a network interface card, as described above. If the destination address in a packet is a unicast address, the packet will be delivered to exactly one computer (or not delivered at all, if none of the computers on the network have the specified address).

A *broadcast address* consists of all 1s, and is reserved for transmitting to all stations simultaneously. When a switch receives a packet with all 1s in the destination address field, the switch delivers a copy of the packet to each computer connected to the switch except the sender.

A *multicast* address provides a limited form of broadcast in which a subset of the computers on a network agree to listen to a given multicast address. The set of participating computers is called a *multicast group*. The interface card on a computer must be configured to join a multicast group or the interface will ignore packets sent to the group. We will see that TCP/IP protocols use multicast and that IPv6 depends on multicast.