

Networking Basics 4: Ethernet

1. TCP/IP Introduction
2. Routing and Ports
3. TCP/IP Protocols
4. **Ethernet**
 - ethernet
 - **ARP**
5. DNS

Ethernet

Ethernet is the most commonly used physical networking technology for LANs.

Ethernet operates at the data link and physical network layers.

Each Ethernet device is identified by a **MAC (Media Access Control)** address:

- 48 bit number
- written in hex: AA:BB:CC:DD:EE:FF
- permanently burned into each Ethernet device (NIC)

Ethernet (contd.)

Ethernet sends data in **frames**:

- data/payload (e.g., IP datagram)
- destination and source MAC addresses
- error-detecting info (CRC)

Payload limits:

- standard is just 1500 bytes.
- IP datagrams larger than this must be **fragmented**
- **GigE** devices may support **jumbo frames** (up to 9000 bytes)

Maximum Transmission Unit (MTU):

the size in bytes of the largest data packets that can be transmitted over a network connection.

Ethernet (contd.)

Ethernet is actually a *family* of different wiring and signaling variants.

Twisted pair copper wire can handle four speeds:

- 10 Mbits/s (original 1980 spec speed)
- 100 Mbits/s, known as **Fast Ethernet**
- 1000 Mbits/s or 1 Gbits/s, **gigabit Ethernet** (GigE or GbE)
- 10000 Mbits/s or 10 Gbits/s, **10 gigabit Ethernet** (10 GigE or 10GbE or 10GE)

Ethernet (contd.)

The Ethernet connection between two devices can be **half duplex** or **full duplex**:

- **full duplex** means data can be simultaneously transmitted in both directions between two devices
- **half duplex** means data can be transmitted in only one direction at a time between two devices.
- most modern Fast Ethernet devices/cables support both
- GigE and up is full duplex only

Modern Ethernet devices typically support **autonegotiation**: allows connected devices to arrive at compatible settings for speed, duplex, and flow control.

Address Resolution Protocol (ARP)

ARP is the protocol that is used to convert IPv4 addresses to physical network addresses.

On the local physical network, hosts are known and addressed by a physical address (e.g, MAC address for Ethernet) rather than their IP address.

When we wish to send a packet to host x.y.z.w that is on the local network, the OS networking software must determine the physical address.

An OS maintains an IP to physical address mapping table, called the **ARP cache**.

ARP (contd.)

If the mapping for the desired IP address is not in the ARP cache, it must be determined:

1. host needing mapping sends *broadcast ARP Request frame* on the local network
2. machine that recognizes its IP address in the request sends back an ARP Reply containing its physical hardware address (e.g., MAC address)
3. mapping info is put into the ARP cache on requesting machine
4. info in the ARP cache is expired periodically to deal with network configuration changes