Data Link Layer

Purpose of Layer 2
- Communication between end-devices (NIC to NIC)
- Allows upper layer protocols to access layer 1 media
- Encapsulates layer 3 packets (IPv4, IPv6) into Layer 2 frames
- Perform error detection & rejects corrupt frames

IEEE 802 LAN/MAN layer 2 sub layers → (1) Logical Link Control (LLC), (2) Media Access Control (MAC)

LLC responsibility : Communication between the networking software

MAC responsibility : Data encapsulation / Media Access Control

Providing Access to Media

4 basic layer 2 functions at each hop along the path →
(1) From network media, accepts a frame
(2) De-encapsulates the frame (packet)
(3) Re-encapsulates the packet (frame)
(4) Forward the new frame to next network segment

Layer 2 Protocols are defined by :
(1) IEEE
(2) ITU
(3) ISO
(4) ANSI

Topologies

(1) Physical Topology - shows physical connections

- how devices are interconnected

(2) Logical Topology - identifies virtual connections between devices using device interfaces and IP addressing schemes

WAN Topologies

(1) Point-to-Point : a permanent link between 2 endpoints
: simplest / most common

(2) Hub and spoke : a central site interconnects branch sites through point-to-point links
: similar to a star topology

(3) Mesh : requires every end system to be connected to every other end system
: provides high availability

LAN Topologies

Early Ethernet / Legacy Token Ring Topologies : (1) Bus - all end systems chained together and terminated on each end
(2) Ring - each end system is connected to its respective neighbors to form a ring

Present day : (3) Star / Extended Star Topology - easy to install
- very scalable
- easy to troubleshoot

Communication

(1) Half-duplex : On a shared medium. only allows one device to

send or receive at a time
: Used on WLANs and legacy bus topologies with ethernet hubs

(2) Full-duplex: On a shared medium, allows both devices to simultaneously transmit and receive
: Used on ethernet switches

Access Control Methods

Contention-based access → in half-duplex competing for medium

(1) CSMA/CD on legacy bus-topology ethernet
(2) CSMA/CA on wireless LANs

Controlled access

- Deterministic access: each node has its own time for the medium
- Used on legacy networks (Token Ring / ARCNET)

Data Link Frame

3 Parts: (1) Header
(2) Data
(3) Trailer

Layer 2 (MAC) Addresses

(1) Physical address
(2) Contained in frame header
(3) Only for local delivery of a frame on the link
(4) Updated by each device that forwards the frame

LAN/WAN frames

Logical topology and physical media determine layer 2 protocols:

(1) Ethernet

(2) 802.11 wireless
(3) Point-to-Point (PPP)
(4) High-level Data Link Control (HDLC)
(5) Frame Relay