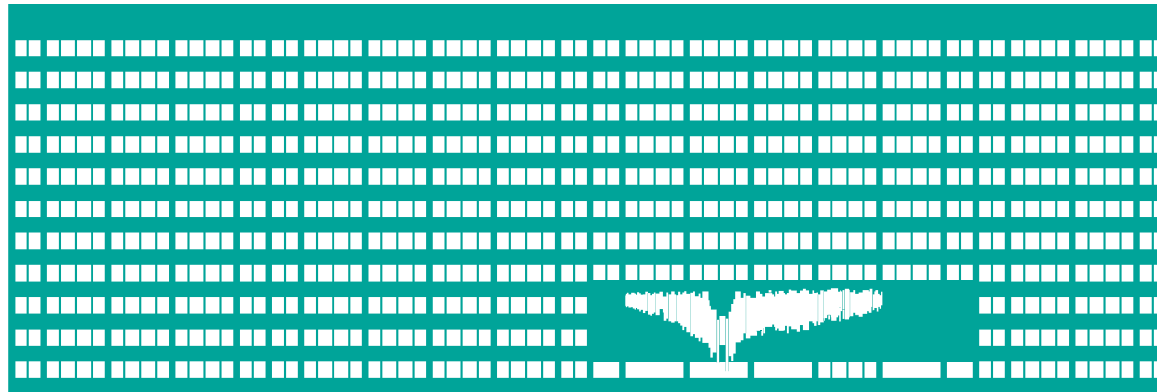# IEEE 802 Project
ISO 8802 Standards
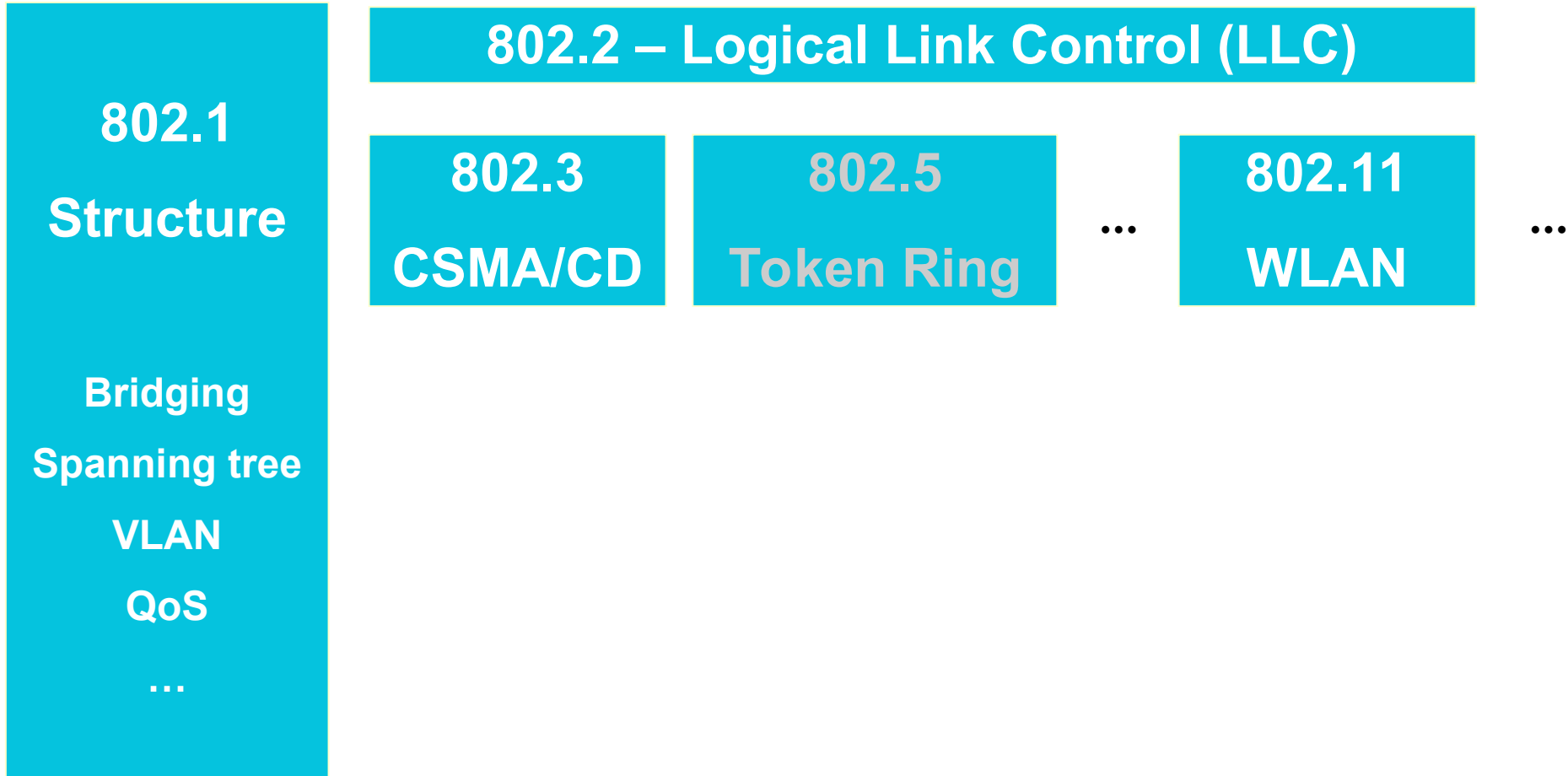
Computer Networks
Lecture 4

Standardization in LANs

- IEEE efforts to standardize the current state of LAN technologies (since 1982)
  - New specifications still evolve
  - Developed standards were accepted by ISO as ISO 8802 standard later (1987)

- Standardizes physical and link layer
  - The higher layers are implemented as software modules of LAN stations or routers in case of WANs

# Suite of IEEE 802 Recommendations

802.1 Structure
802.2 – Logical Link Control (LLC)

| 802.3 CSMA/CD | 802.5 Token Ring | ... | 802.11 WLAN | ... |

802.1

Structure

Bridging

Spanning tree

VLAN

QoS

…

IEEE 802.1 Recommendation

Defines mutual relationships between other standards (sublayering into MAC a LLC layers) and concepts common for all LAN LAN types

- Bridging principles, Spanning Tree protocol
  - Transparent bridges and source-route bridges)
  - 802.1d standard
- Virtual LANs (802.1q)
- Traffic priorization –QoS (802.1p)
- …

Relationship between IEEE 802 and OSI-RM
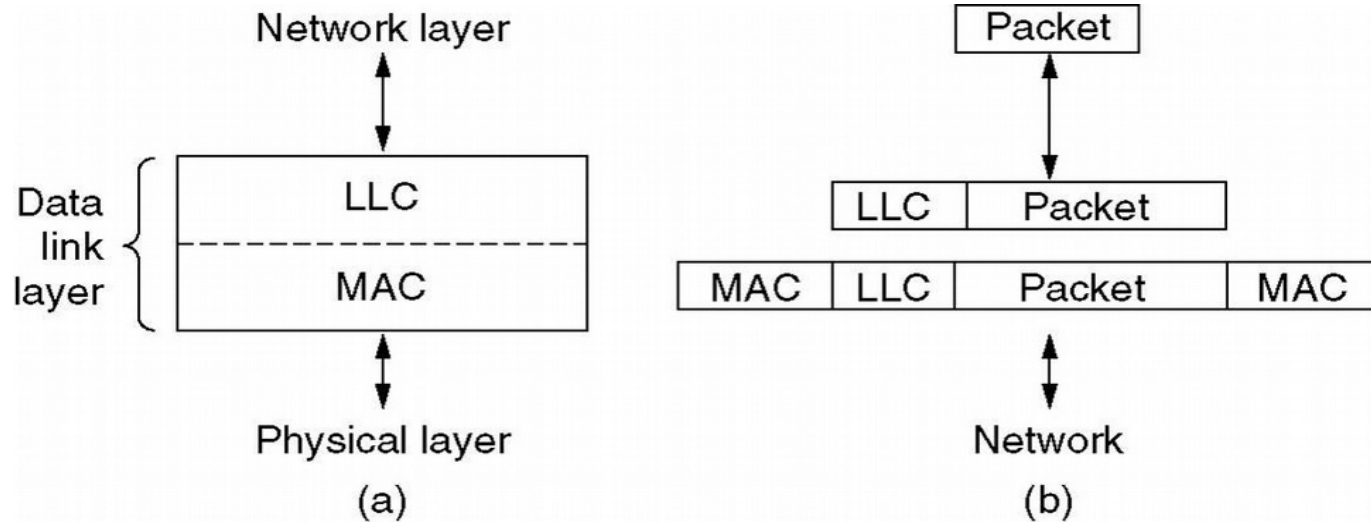
IEEE divides link layer into the following sublayers
- MAC (Media Access Control) – different for various network technologies
- LLC (Logical Link Control) – unifies all network technologies

MAC Sublayer

MAC Sublayer Standards for Current LAN types

Standards describe MAC sublayers

- 802.3 – CSMA/CD networks (Ethernet)
- 802.4 – Token Bus
- 802.5 – Token Ring
- 802.11 – wireless LANs (e.g. WiFi)
- 802.14 – HFC (Hybrid Fiber Coax), networks,
  - connects existing CaTV by optical backbone
- 802.15 – Wireless Personal Area Networks (WPAN)
  - e.g. Bluetooth
- 802.16 – Wireless WANs (e.g. WiMax)
- ...

Responsibilities of MAC Sublayer

- MAC access methods
- Frame formats
- Station addressing
- Error detection

MAC Addresses

- MAC address is assigned to each physical node in the network (station, router, …)
- Address length: 48 bits
  - Usually written as 6 HEXAdecimal double-colon separated digits
  - 16 bit addresses are also allowed, but only one address length can be permitted on a single LAN.
- First byte has special bits:
  - Lowest bit: unicast (0) / group (1) address.
  - 2nd lowest bit: globally unique (0) / locally assigned (1) address – almost always is set to 0, not 2.
- Globally unique address – 3 octets are manufacturer ID (ISO assigned), 3 octets (4-6) assigned by manufacturer
- All bits set to 1 – broadcast (FF:FF:FF:FF:FF:FF)
- All bits in address set to 0 – test and empty frames

MAC Frames

- Frames are transmitted by octets
  - sent to the medium from the lefmost octet (according to frame diagrams)

- Order of transmitted bits in each octet may differ:
  - the bit with lowest weight first (rightmost, LSB), e.g. IEEE 802.3
  - the bit with highest weight first (leftmost, MSB), e.g. IEEE 802.5

LLC Sublayer

(IEEE 802.2)

Responsibilities of LLC Sublayer

- Defines services provided to upper layers by any LAN technology (a common software interface)
  - Hides differences between individual LANs of 802 project

- Allows to address entities in scope of the network node (station, router)
  - SAP, Service Access Points

- Optional error control and flow control
  - Using error-control protocols

Implementation of LLC Sublayer

- Unified LLC frame format
  - Carried in different MAC frames

- LLC sublayer appends LLC header into MAC frames
  - LLC header is based on HDLC header

- Format and contents of LLC header do not depend on the LAN technology (MAC sublayer)

Services Provided by LLC Sublayer

1. Connectionless unacknowledged service
   - The most common one
   - No flow control and error control
   - Error detection and discarding of erroneous frames is accomplished by MAC sublayer
2. Connection-oriented service
   - Logical connection between remote entities (SAPs)
   - Error correction, flow control, frames numbering.
   - Equals to Extended Asynchronous Balanced Mode in HDLC
3. Connectionless acknowledged service
   - The least used one

Contents of the LLC Header

DSAP(1B), SSAP(1B), Control(1-2B), User data

Placed at the beginning of data part of MAC layer frame

- Destination Service Access Point (DSAP) – destination entity & Source Service Access Point (SSAP) – source entity
  - Identify partner processes on the source and destination machine (most often drivers of the upper layer of the protocol stack)
  - DSAP may contain broadcast and multicast addresses (not used in practice)
- Control fields may carry subset of HDLC commands