

ELLA: What is the IEEE 802 Link Layer Service?

Notice to WG Chair: This contribution is “previously published” per the IEEE SA Copyright Policy, as it includes material previously published in IEEE Std 802 and IEEE Std 802.1AC.

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Background

- On 22 July 2021, Nendica opened Study Item on Evolved Link Layer Architecture (ELLA), with the goal of producing, by the November 802 Plenary, an informal report documenting:
 - Summary of aspects missing from current IEEE 802 Architecture documentation
 - Potential benefits enabled by additional architectural details
 - Impact of new and evolving technologies on architecture
 - Architectural optimization in specific network environments
 - Possible standardization recommendations
- Issues were laid out in 802.1-21-0014-03-ICne

What is the 802 Link Layer?

- IEEE Std 802 says:
 - *The IEEE 802 standards emphasize the functionality of the lowest two layers of the OSI/RM, i.e., PHY and DLL [data link layer]*
 - *For the mandatory data services supported by all IEEE 802 networks, the DLL is structured as two sublayers, with the logical link control (LLC) sublayer, described in 5.2.2, operating over a MAC sublayer, described in 5.2.3.*
 - *IEEE Std 802.2™-1989 (reaffirmed 2003) was administratively withdrawn as an IEEE standard on 11 January 2011 in deference to the stabilized standard ISO/IEC 8802-2:1998 where the same material continues to be available. [note: it is a Normative Reference]*
 - *The MAC sublayer of the IEEE 802 RM exists between the PHY and the LLC sublayer to provide a service for the LLC sublayer.*
 - *bridge: A functional unit that interconnects two or more IEEE 802 ® networks that use the same data link layer (DLL) protocols above the medium access control (MAC) sublayer, but can use different MAC protocols. Forwarding and filtering decisions are made on the basis of layer 2 information.*
 - *end station: A functional unit in an IEEE 802 ® network that acts as a source of, and/or destination for, link layer data traffic carried on the network.*

What is the 802 Link Layer Service?

MSAP MAC service access point
LSAP link service access point

PSAP PHY service access point

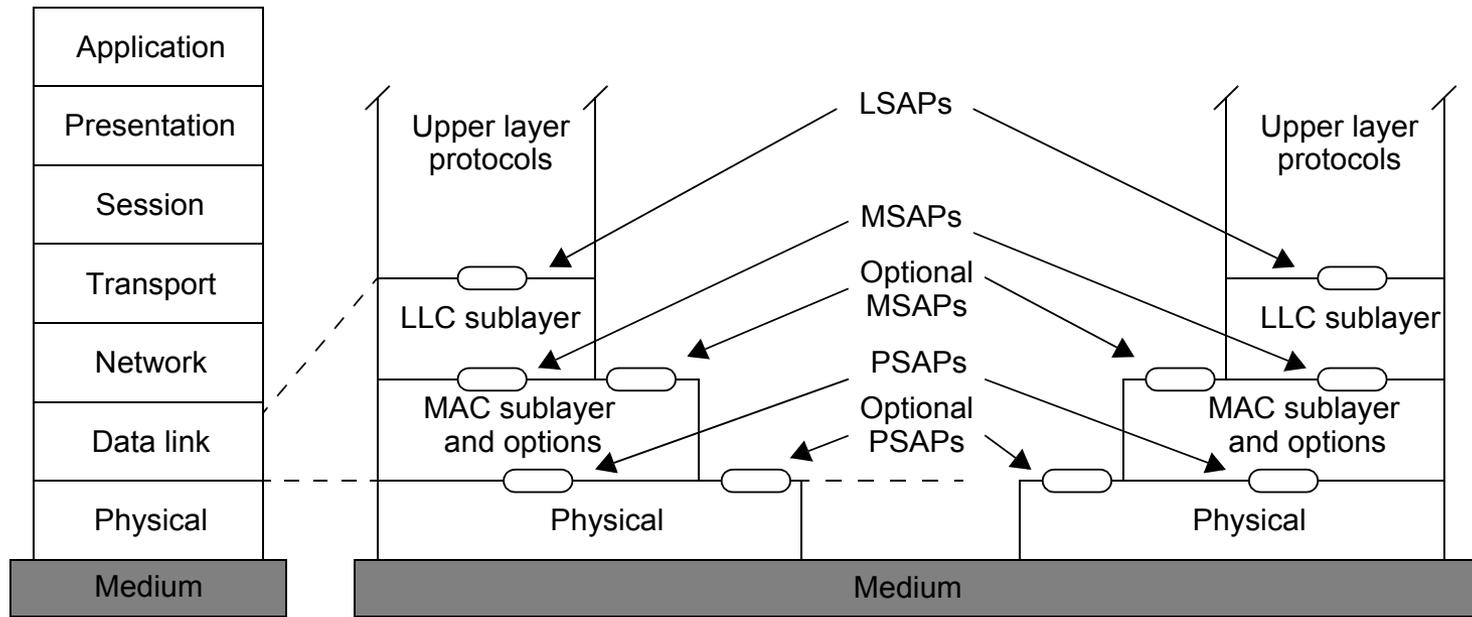


Figure 3—IEEE 802 RM for end stations

- IEEE Std 802 Fig 3 show link service access point (LSAP)
 - *One or more link service access points (LSAPs) provide interface ports to support one or more higher layer users above the LLC sublayer.*
- IEEE 802.1AC specifies the MAC Service, provided to the LLC.
- What specifies the 802 LL Service? In other words: what service does the IEEE 802 network provide to the upper layer client?

OSI Link Layer

- Open Systems Interconnection (OSI) specifies seven layers.
- ITU-T X.212 (OSI “Data Link Service [DLS] Definition”) describes the service provided by the DLS to the Network Layer, including:
 - Characterization of the service provided
 - Primitive actions and events, including:
 - parameters of the primitives
 - Sequences of actions and events
- Connectionless-mode and Connection-mode services are specified
- Abstract specification, but many details (body is 26 pages)

OSI Link Layer Service Characteristics

- ITU-T X.212 Data Link Service [DLS] behavior:
 - **Transfers DLS user data transparently, without restricting or interpreting the content or format of the data.**
 - Can prevent data loss, insertion, error (except in exceptional cases)
 - can prevent misordering (except in exceptional cases)
 - addressing is local
 - DLS user can request QoS characteristics
 - and more
- Connectionless-mode and Connection-mode services are specified
 - **Connectionless-mode: packets of limited length are sent transparently without a connection, with QoS selected per transmission**
 - Each packet is handled independently, unrelated to other packets
 - However, associations may be established between a pair of LSAPs
 - May discard, duplicate, or reorder packets
 - But, in some associations, the user will know that the service does not do these things
 - [Note: This is a bit confusing.]
 - **Connection-mode: preserves the packet sequence and boundaries**
 - Flow control included

802.2 LL Service Characteristics

- 802.2 describes LLC Service
 - Service to network includes services of LLC and lower layers
 - Also specifies requirements of MAC service provided to LLC
- per 802.2, three types of LLC Service:
 - Type 1: Unacknowledged connectionless-mode
 - The DL-UNITDATA request primitive is passed to the LLC sublayer to request that an LSDU be sent using unacknowledged connectionless-mode procedures. The DL-UNITDATA indication primitive is passed from the LLC sublayer to indicate the arrival of an LSDU.
 - DL-UNITDATA request (source_address, destination_address, data, priority)
 - The source_address and destination_address parameters specify the local and remote LSAPs involved in the data unit transfer. The destination_address may specify either an individual or group address. The data parameter specifies the link service data unit to be transferred by the data link layer entity. The priority parameter specifies the priority desired for the data unit transfer.
 - Type 2: Connection-mode
 - In-sequence delivery
 - Flow control
 - error recovery
 - Type 3: Acknowledged connectionless-mode

Reordering in the MAC Service

- Per 802.1AC, the MAC service is connectionless
 - *In general, the MAC Service provider can perform any or all of the following actions: Discard objects, Change the order of the objects*
 - *The MAC Service exhibits a negligible rate of the following: Object duplication, Reordering of objects for a given priority*
 - 802.1Q: “The MAC Service (IEEE Std 802.1AC) permits a negligible rate of reordering of frames with a given priority for a given combination of destination address, source address, and flow hash, if present, transmitted on a given VLAN.”
 - Note: priority, VLAN, flow hash are not included in IEEE Std 802 Architecture
 - *Awareness of the characteristics of the MAC Service provided, e.g., the rate at which objects can be discarded, duplicated, or misordered, is part of the MAC Service user’s a priori knowledge of the environment.*

Frame formatting

- Per OSI, the LL client provides arbitrary data that is not interpreted by the LL service provider (transparent service)
- 802.2 accepts arbitrary data from the user and sends an LLC PDU to the MAC in a specified format
- IEEE Std 802 provides many examples of MAC frame format
 - But does not detail which functionality put them into that format
- In the absence of an LLC specification, the LL client essentially assumes the LLC role, delivering a PDU that is formatted to the expectations of the MAC
 - and that format depends on the specific MAC
- See, for example:
 - RFC 1042 (“A Standard for the Transmission of IP Datagrams over IEEE 802 Networks”)
 - RFC 894 (“A Standard for the Transmission of IP Datagrams over Ethernet Networks”)
 - RFC 2464 (“Transmission of IPv6 Packets over Ethernet Networks”)
 - RFC 8691 (“Basic Support for IPv6 Networks Operating Outside the Context of a Basic Service Set over IEEE Std 802.11”) etc.

Should IEEE Std 802 Architecture describe the IEEE 802 Service as a Transparent Link Layer Service?

- Specify LL Service to network, to include services of LLC and lower layers
 - service should be transparent
- specify the network layer client expectations of the 802 LL Service
- specify how the network layer client establishes service conditions
- specify how this LLC interfaces to the MAC service
 - Details could be left to IEEE Std 802.1AC