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 incudes material previously published in IEEE Std 802 and IEEE Std 802.1AC.

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28 July 2021

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  - *IEEE Std 802.2™-1989 (reaffirmed 2003) was administratively withdrawn as an IEEE standard on 11 January 2011 in deference to the stabilized standard ISO/IEC 8802-2:1998 where the same material continues to be available.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 <u>interconnects two or more IEEE 802 ® networks that use the same data link layer (DLL) protocols </u>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   PSAP   PHY service access point
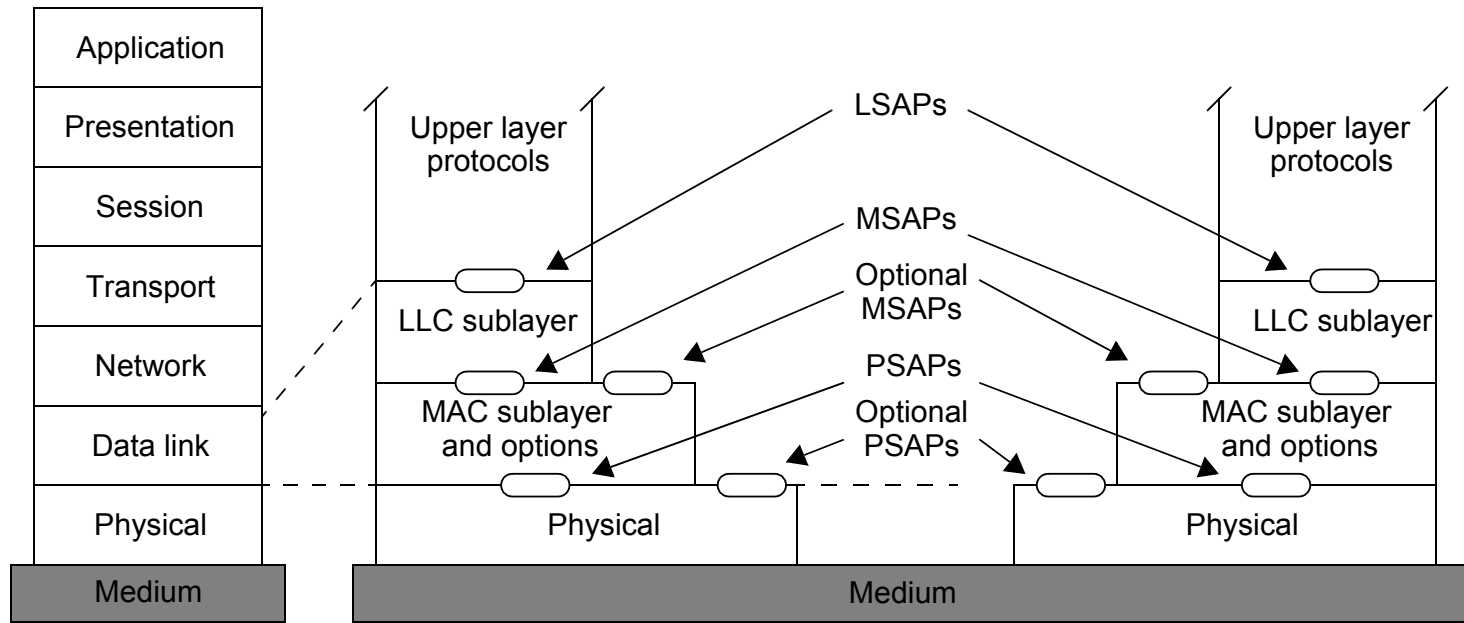LSAP   link service access point

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?

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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 prevents 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 Services

- 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:
  - Unacknowledged connectionless-mode
    - recovery and sequencing services are not provided
  - Connection-mode
    - sequenced delivery
  - Acknowledged connectionless-mode
    - sequenced delivery
- 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*
    - But "priority" is not part of the IEEE 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
- 802.2 accepts arbitrary data from the user and sends an LLC PDU to the MAC in a specified format
- IEEE Std 802 specifies format of MAC frames
  - But not how they get into that format
- In the absence of an LLC specification, the LL client essentially provides an 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 1042 ("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.
- Why doesn't IEEE 802 simply provide a transparent LL service to an arbitrary network client?

IEEE 802 should describe the IEEE 802 Service as a Transparent Link Layer Service

- 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