L2 Openflow
ONF & ITU Update

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HUAWEI

Agenda

- **ONF Support for L2 Openflow**
- **ITU-T SG15/Q2 Support for L2 openflow**
- **Using IEEE 1904.2 Channel**

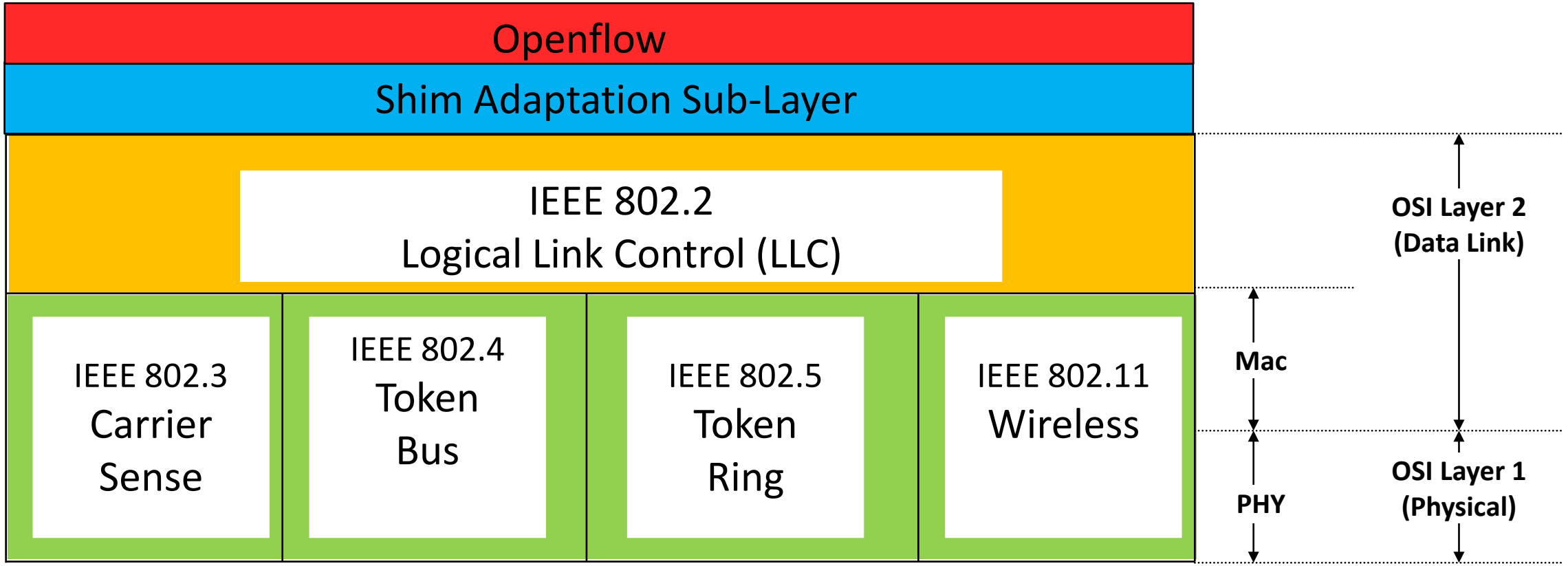
ONF L2 Openflow Support (1)

- **Openflow 1.3.5, which has been published in March 2015, decouples Openflow protocol from the underlying reliable transport.**
  - The full OpenFlow protocol can be used over an alternate transport protocol instead of TLS or TCP.
  - The main connection or a reliable auxiliary connection can be defined on an alternate transport protocol
- **Transport protocol should provide the following functionalities :**
  - Multiplexing multiple openflow connections between the openflow switch and multiple or the same openflow controller.
  - Reliability.
  - Ordered Delivery.
  - Segmentation and Assembly of openflow frames when the frame size exceed the link MTU.
  - Flow Control
  - Security

ONF L2 Openflow Support (2)

- An unreliable auxiliary connection can be defined on an alternate transport protocol only if this transport protocol provides multiplexing
- If the transport protocol can not meet these requirements, an adaptation layer must be used.
- Beyond those requirements, the mapping of OpenFlow messages to the alternate transport protocol is defined by the adaptation layer or the transport protocol and outside the scope of the openflow 1.3.5 specification.

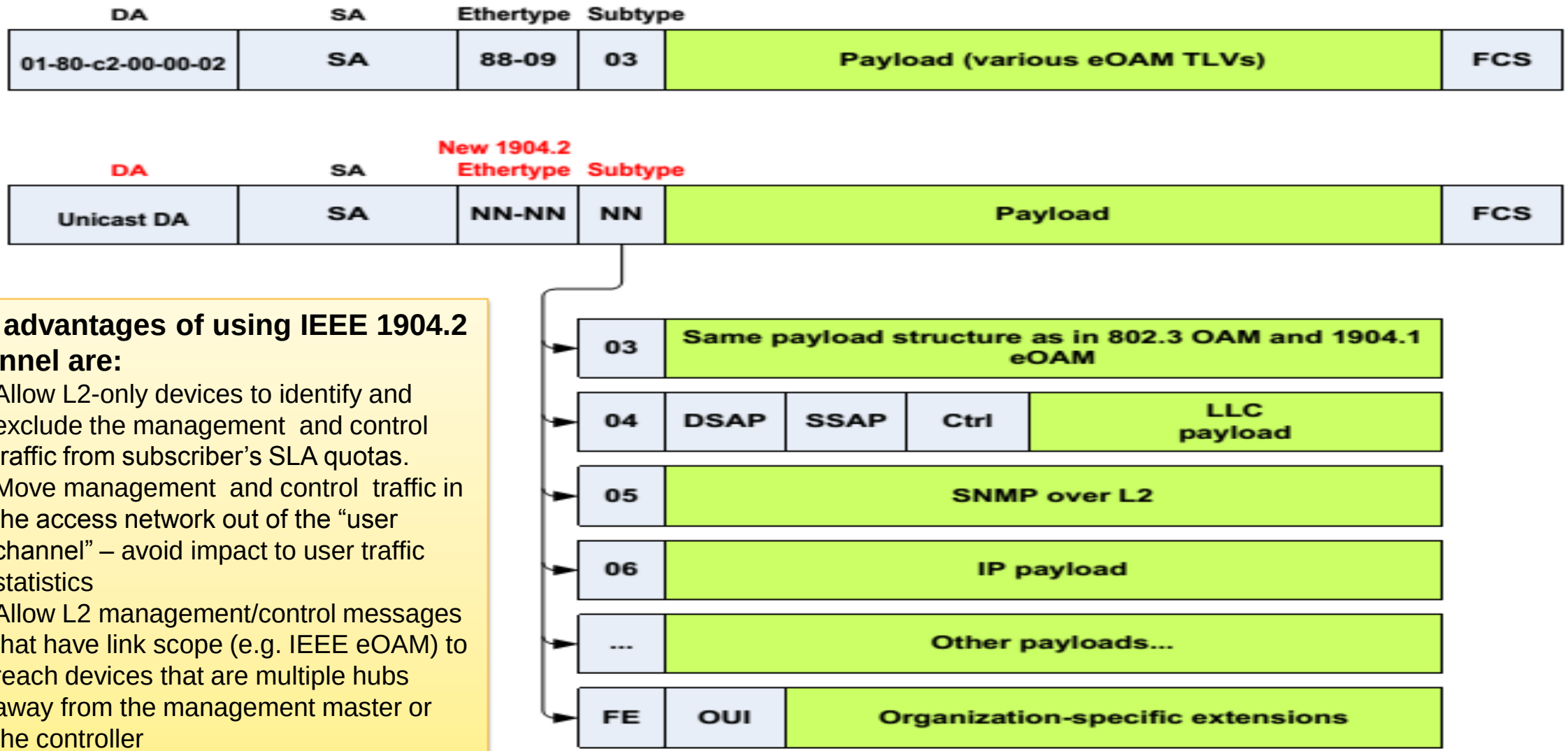
Using LLC Type 2 for Reliable L2 Communications



Using OMCI to Carry Openflow Messages in GPON

- **Huawei proposed in ITU-T SG15/Q2 using OMCI as a transport protocol for Openflow instead of extending it to provide another OpenFlow-like protocol.**
  - OMCI does not need to change to keep pace with frequent changes of OpenFlow.
  - Huawei proposed to add a new ME, *i.e. OpenFlow config data management Entity*, into current G.988 in order to support seamlessly transportation of OpenFlow packets in a PON system.
  - It is worth noting that similar Approach can be used with IEEE 802.3 OAM.
- **Huawei proposal has been accepted.**
- **The new OMCI spec (G.988 Amd2) with L2 Openflow support will be approved in February, 2016, and then will be published after that.**

Using IEEE 1904.2 Channel



The advantages of using IEEE 1904.2 Channel are:

1. Allow L2-only devices to identify and exclude the management and control traffic from subscriber's SLA quotas.
2. Move management and control traffic in the access network out of the "user channel" – avoid impact to user traffic statistics
3. Allow L2 management/control messages that have link scope (e.g. IEEE eOAM) to reach devices that are multiple hubs away from the management master or the controller

Thank You

Data Link Layer -- LLC

- Logical Link Control (LLC)
  - For IEEE 802, flow control, error control, and part of the framing duties are all brought together in this LLC sub-layer.
  - Framing is also performed in the MAC sub-layer.
  - The LLC provides a single data link control protocol for all IEEE LANs. (Contrast this with the MAC layer where we have different protocol versions for different LANs. See previous slide.)
  - The LLC makes the MAC sub-layer transparent.
  - Framing
    - LLC provides a PDU similar to HDLC

LLC Sublayer Connectionless Mode of Operation

- **The LLC sublayer standard, ISO/IEC 8802-2, describes two types of connection-less mode of operation for data communication between service access points:**
  - **Unacknowledged connectionless-mode (type 1),**
    - Information frames are exchanged between LLC entities without the need for the prior establishment of a logical link between peers. The LLC sublayer does not provide any acknowledgments for these LLC frames, nor does it provide any flow control or error recovery procedures.
    - LLC type 1 also provides a TEST function and an Exchange Identification (XID) function. The capability to act as responder for each of these functions is mandatory: This allows a station to check the functioning of the communication path between itself and any other station, to discover the existence of other stations, and to find out the LLC capabilities of other stations.
  - **Acknowledged connectionless-mode (type 3).**
    - With type 3 operation, information frames are exchanged between LLC entities without the need for the prior establishment of a logical link between peers. However, the frames are acknowledged to allow error recovery and proper ordering. Further, type 3 operation allows one station to poll another for data
    - This type has little or no commercial use.

LLC Sublayer Connection-mode of Operation

- **Connection-mode (type 2):**
  - A logical link is established between pairs of LLC entities prior to any exchange of information frames.
  - In the data transfer phase of operation, information frames are transmitted and delivered in sequence.
  - Error recovery using positive ACK and retransmission. F
  - low control using fixed-length sliding window of 8 frames are provided within the LLC sublayer.
- **Systems on the same IEEE 802.2 network may use 802.2 Type 2 communications after verifying that it is supported by both ends. This is accomplished using the 802.2 XID mechanism**

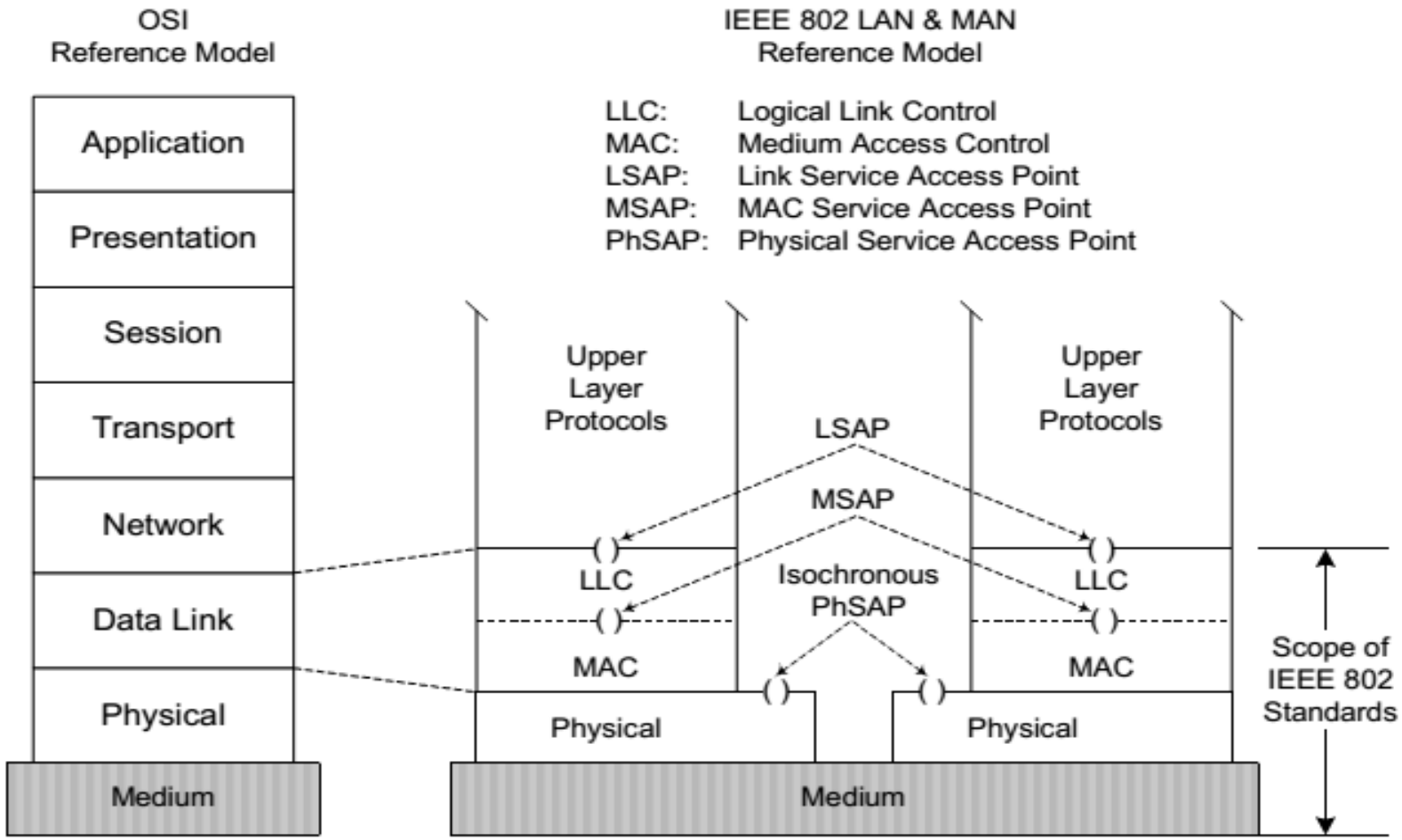
User Data Encapsulation

- **Type Field Encoding**
  - The length/type field (2 bytes) in the Ethernet frame contains a type value in the range of 0x600 to 0xFFFF indicating the higher-layer protocol that is being encapsulated.
  - The most common encapsulation used on Ethernet.
  - Ethertype values are registered with IEEE: http://standards.ieee.org/develop/regauth/ethertype/
  - Type field assignments are administered by the Registration Authority, IEEE Standards Department, P.O. Box 1331, 445 Hoes Lane, Piscataway, NJ 08855-1331, USA.
- **LLC Encoding**
  - The SSAP and DSAP identify the higher layer protocol.
  - The control field carries a value indicating the type of frame.
    - LLC type1 uses unnumbered Information and provides connectionless, best effort service.
    - LLC type 2 provides reliable, connection-oriented services.
  - SSAP/DSAP are allocated by IEEE-RA for a protocol which is a standard published by an internationally recognized standards organization, and has a potentially large field of application.

User Data Encapsulation (2)

- **Clients using Length Encapsulation and LLC can communicate among themselves, and Clients using Type Encapsulation can communicate among themselves on the same LAN.**
- **When Type Encapsulation is used LLC Protocol is not used and does not need to be present.**
- **If a device supports some clients that use Type Encapsulation and others that use Length Encapsulation, the MAC can demultiplex frames to both sets of clients simultaneously.**

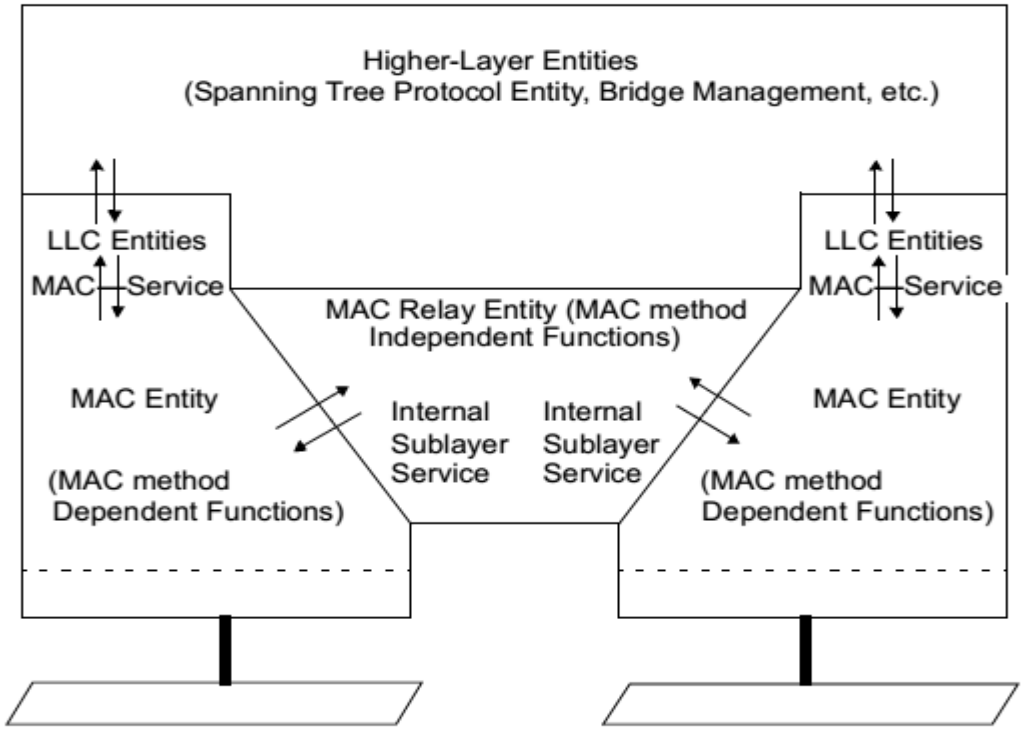
IEEE 802® Reference Model for End Station



IEEE 802.1D Bridge Architecture

M_UNITDATA.indication (
frame_type,
destination_address,
source_address,
mac_service_data_unit,
user_ priority,
frame_check_sequence
)

M_UNITDATA.request (
frame_type,
destination_address,
source_address,
mac_service_data_unit,
user_priority,
access_priority,
frame_check_sequence
)



❑ IEEE 802.1D Bridge shall Conform to IEEE Std 802.2 for the implementation of a class of LLC supporting Type 1 operation as required by 7.3 and 7.1.2. Each Bridge Port shall support the operation of LLC Type 1 procedures in order to support the operation of the Spanning Tree Protocol Entity. Bridge Ports may support other types of LLC procedures, which may be used by other protocols.
❑ A bridge processes protocols in the MAC sublayer and is functionally transparent to LLC and higher layer protocols. MAC frames are forwarded between access domains, or filtered (i.e., not forwarded to certain access domains), on the basis primarily of MAC addressing information

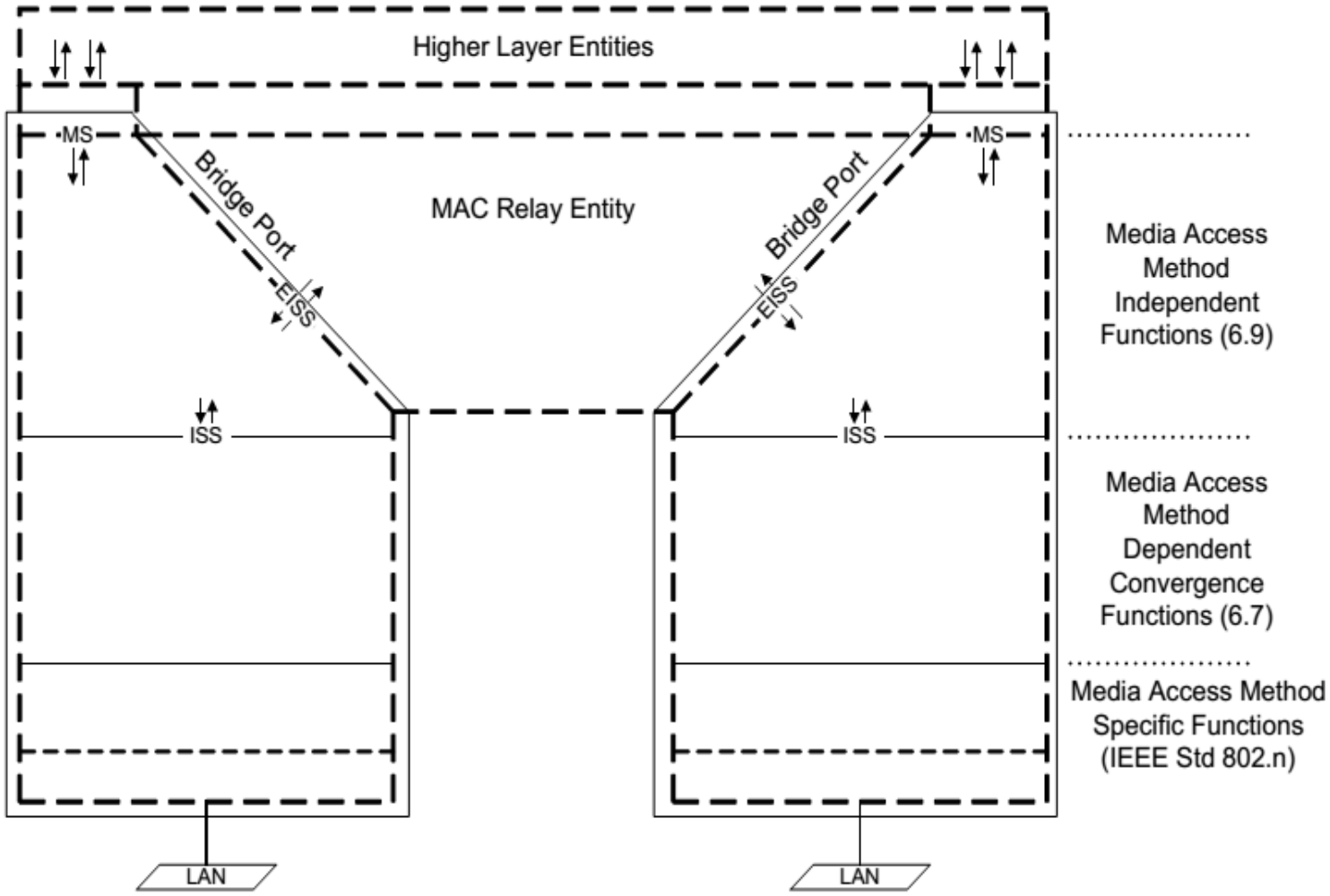
IEEE 802.1Q Bridge Architecture

EM_UNITDATA.indication

(
destination_address,
source_address,
mac_service_data_unit,
priority,
drop_eligible,
vlan_identifier,
frame_check_sequence,
service_access_point_identifier,
connection_identifier,
)

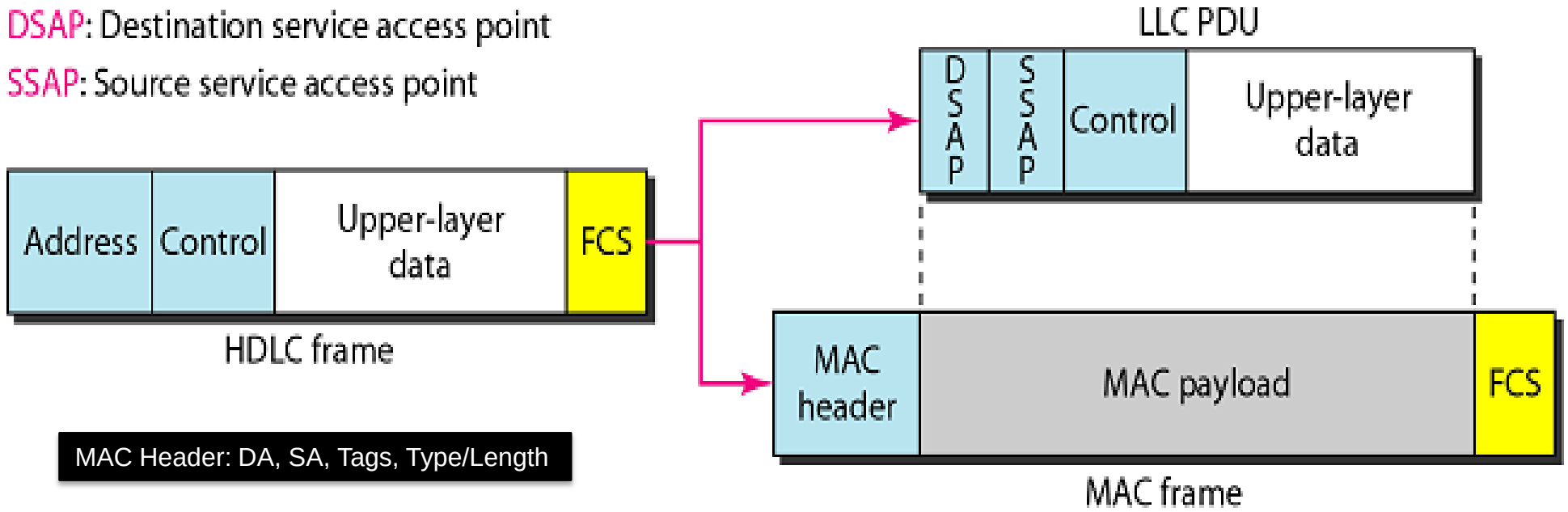
EM_UNITDATA.request

(
destination_address,
source_address,
mac_service_data_unit,
priority,
drop_eligible,
vlan_identifier,
frame_check_sequence,
service_access_point_identifier,
connection_identifier,
)

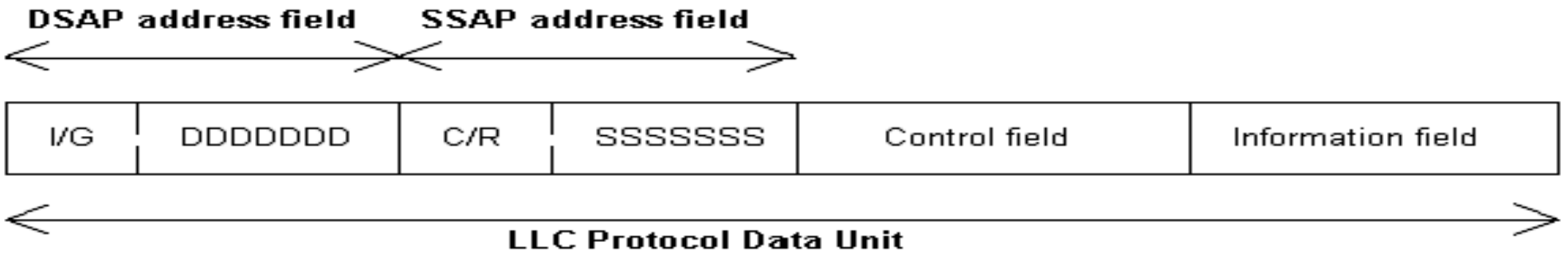


LLC Framing

- **The LLC header contains a control field like HDLC and is used for flow and error control.**
- **The two access point fields (DSAP and SSAP) define the upper layer protocol at the source and destination that uses LLC.**



LLC Address Fields



I/G = *Address type designation bit* (indicating individual or group *actual addresses*)

0 = Individual DSAP
1 = Group DSAP

C/R = The *command/response identifier bit*

0 = Command
1 = Response

The value of the C/R bit is set by the operation of the LLC protocol

D D D D D D D = Destination *actual address*
S S S S S S S = Source *actual address*

Note

i. A complete LLC PDU is shown so that the address fields can be seen in context.
ii. The leftmost bit of each field is the least significant bit.
iii. The Information field is not present in all LLC PDUs