Proposed HLPDE Specification

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Abstract
This document proposes a detailed description of the higher layer protocol discrimination entity (HLPDE) of IEEE Std 802-2014 and thereby poses a detailed description of EPD and LPD. It is a followup to maint-Marks-hlpde-0919-redacted.pdf and maint-Marks-epd-lpd-0719-v02.

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Proposed HLPDE Specification

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2020-04-14
IEEE 802.1 Maintenance TG

Summary

- EtherType protocol discrimination (EPD) and LLC protocol discrimination (LPD) are discussed in IEEE Std 802, IEEE Std 802.1AC, and IEEE Std 802.1Q; IEEE Std 802.11 too.
- Overall, the descriptions are imprecise, inconsistent, and confusing.
- In general, aspects of EPD and LPD in IEEE Std 802 are out of line with the other standards. This contribution recommends the view of the other standards rather than of IEEE Std 802.
- IEEE Std 802 describes the EPD and LPD as HLPDE methods.
- A prior contribution <maint-Marks-hlpde-0919-redacted.pdf> said:
  - *The de facto LLC is the HLPDE. The root of the problem is that the HLPDE is not specified. It should possible to specify the HLPDE for clarification, without altering current understanding of the expected operation.*
- This contribution accordingly proposes to specify HLPDE.

High-level Summary of maint-Marks-epd-lpd-0719-v02.pdf

- Per IEEE Std 802, Ethernet supports EPD and LPD methods.
- Per IEEE Std 802.1AC, an EPD medium supports EPD and LPD methods; an LPD medium only LPD (in each case, using only one of the frame formats described in IEEE Std 802).
- Per the IEEE Std 802.1Q definitions, Ethernet supports EPD using Type encapsulation; Length encapsulation is neither EPD nor LPD. Per other parts of 802.1Q, a “Length/Type medium” supports Type-encapsulated EPD and Length-encapsulated LPD, as well as a method using LPD+EPD.
- In IEEE Std 802.11, EPD encoding supports both EPD and LPD methods.
- For networks without EtherTypes at the MAC layer, the situation is a bit more difficult to summarize.

HLPDE per IEEE Std 802.2014

The LLC sublayer contains a variety of entities, as illustrated in Figure 6.

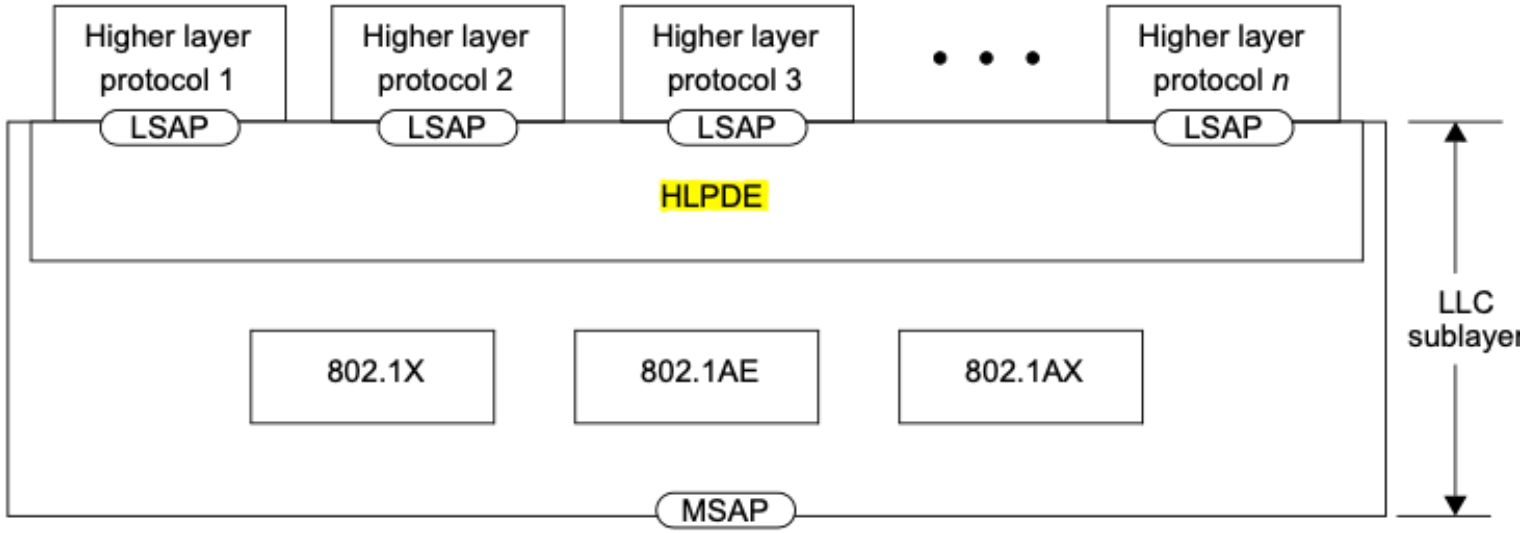


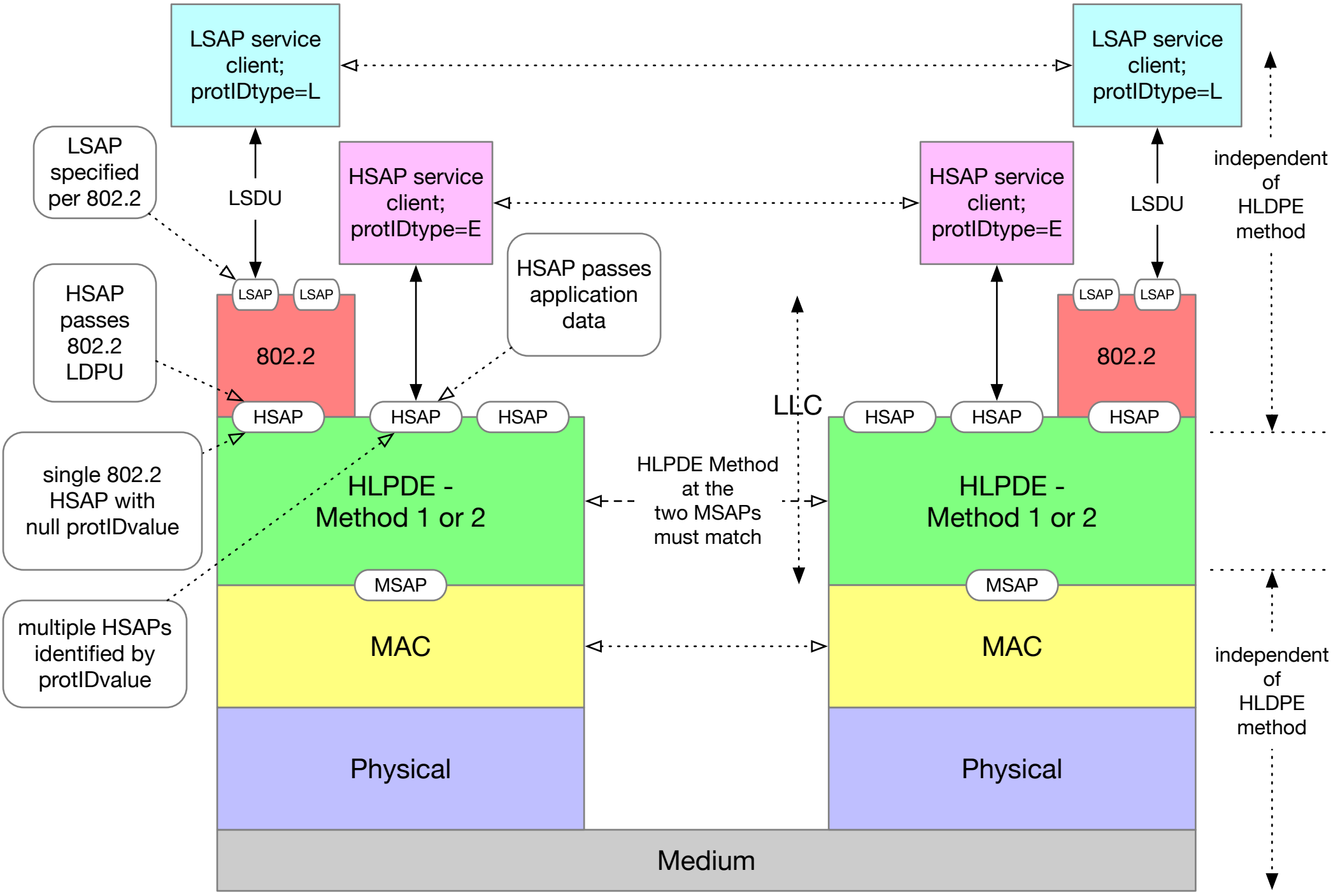
Figure 6—LLC sublayer in 802 RM

IEEE Std 802-2014:
The higher layer protocol discrimination entity (HLPDE) is used by the LLC sublayer to determine the higher layer protocol to which to deliver an LLC sublayer protocol data unit (PDU). Two methods may be used in the HLPDE. The two methods are:

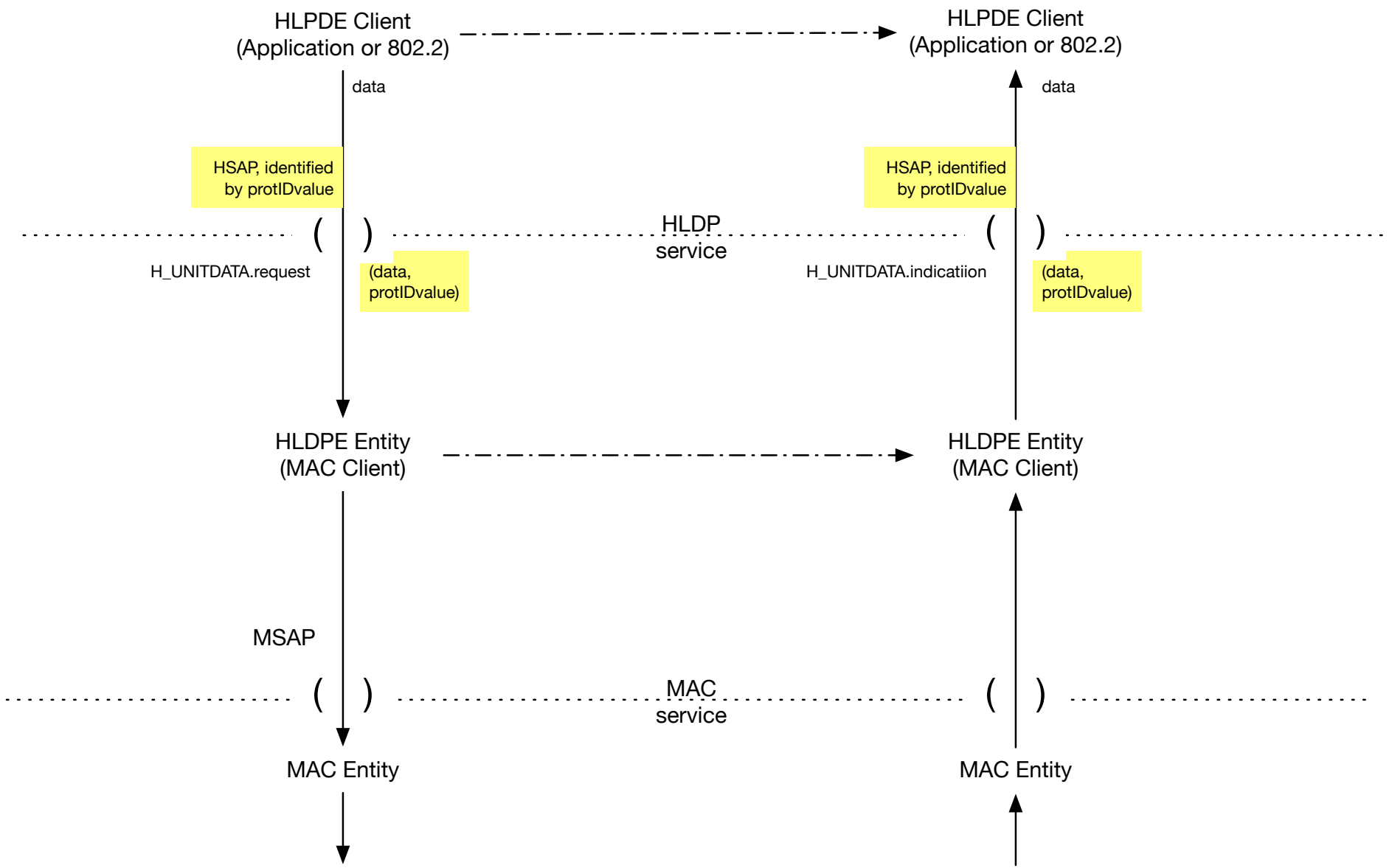
1) EtherType protocol discrimination (EPD), which uses the EtherType value made available to the LLC sublayer through the MSAP
2) LLC protocol discrimination (LPD), which uses the addresses defined in ISO/IEC 8802-2, including the Subnetwork Access Protocol (SNAP) format

- As discussed in prior contributions, the descriptions of EPD and LPD in IEEE Std 802-2014, 802.1AC, and 802.1Q are inconsistent.
- Since EPD and LPD are HLDPE methods, this contribution seeks to resolve the issues by developing a detailed description of the HLPDE.

HLPDE in the 802 Architecture



HSAP Service Primitives

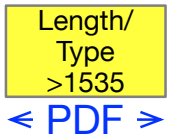


PDF Formats: protIDtype = E

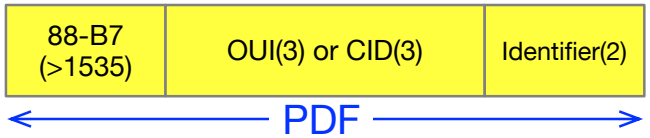
Protocol Discrimination Field (PDF) Format

Protocol Discrimination Field (PDF): contains protIDvalue

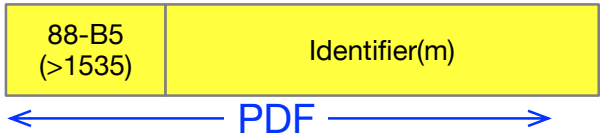
Pure EtherType



OUI Extended EtherType



Playpen EtherType



Playpen EtherType

Note: The destination HLPDE needs to identify only the protIDvalue length.

PDF Formats: protIDtype = L

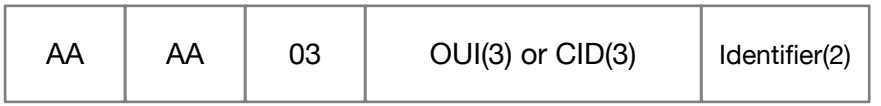
Note: This detail is provided for information only.

For protIDtype = L, protocol identification is embedded in the data, which is not exposed to HLPDE. The data is forwarded to 802.2 to resolve the protocol identification and identify the LSAP.

Other formats might be allowed but none need be listed.

DSAP/SSAP

SNAP/OUI



HLPDE Operation

- Multiple HSAPs identified by protIDvalue
  - The single 802.2 HSAP is identified by protIDvalue = <null> (protIDtype=L)
  - All other HSAPs (protIDtype=E) use non-null protIDvalue
- HSAP passes two parameters: (data, protIDvalue)
- HLPDE encodes the HSAP parameters (data, protIDvalue) into the MSAP msdu
  - the encoding format when protIDvalue = <null> is distinctive and identifiable
    - this allows for distinguishing protIDtype=L frames
- For msdu received from MSAP, HLPDE determines protIDtype from the encoding format
  - If protIDtype=L, the protocol identifier is embedded in the LPDU data field, which is not exposed to HLDPE. HLPDE passes data to the 802.2 HSAP, which is responsible for demultiplexing and forwarding to the correct LSAP per the protocol identifier
  - otherwise, protIDtype=E and HLPDE extracts (data, protIDvalue) from msdu
    - then forwards data to HSAP identified by protIDvalue

HLPDE Methods

•Two HLPDE Methods are supported.
  -Method 1: Length/Type
  -Method 2: LLC/SNAP

•The two Methods are different and incompatible, so the sender and receiver HLPDE must use matching methods.

•Both methods support both protIDtypes

encoding formats	**protIDtype: L**	**protIDtype: E**
Method 1: Length/Type (EPD)	Length	Type
Method 2: LLC/SNAP (LPD)	LLC	SNAP

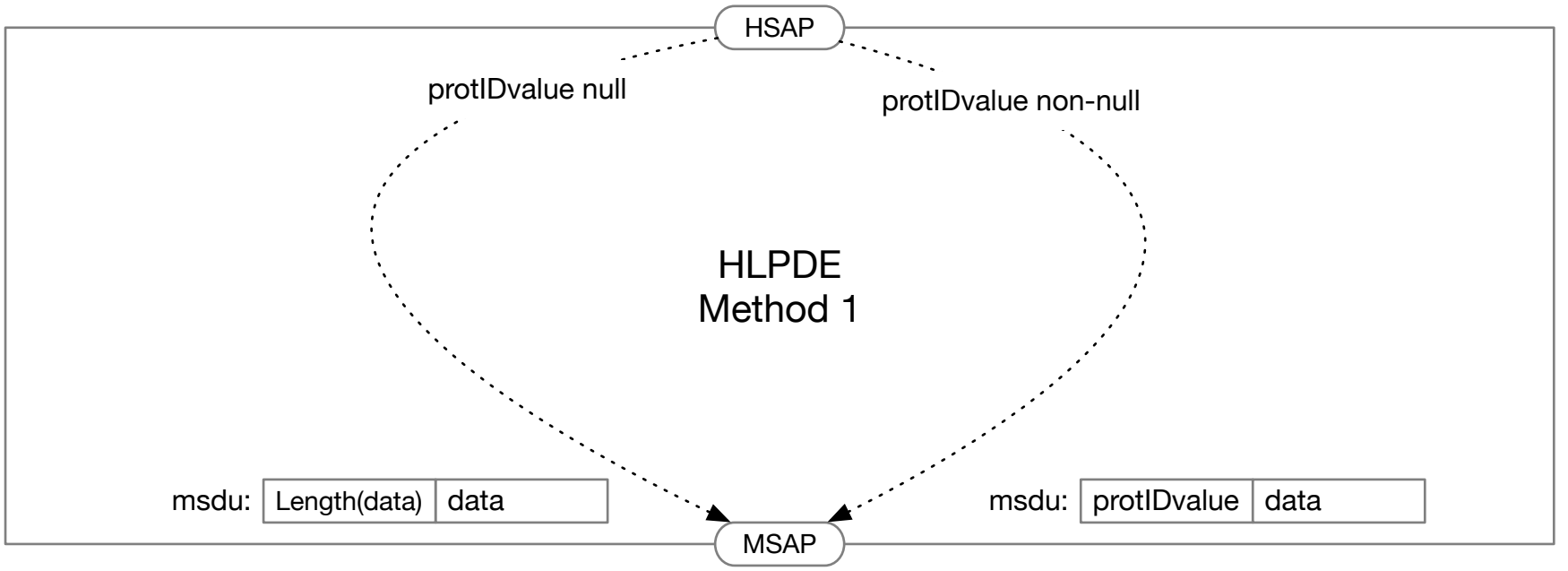
HLPDE Method 1 (Length/Type)

protIDtype = L

data:	data
protIDvalue:	<null>

protIDtype = E

data:	data	
protIDvalue:	Ethertype	extensions



Note: This requires the MAC to take the first byte of the msdu as the Length/Type field.

HLPDE Method 1 (Length/Type)

protIDtype	**protIDvalue** formats	**description**
L	<null>	
E	Ethertype(2) 88B7 | private(5) 88B5 | local(m) 88B6 | local(n)	assigned Ethertype value OUI extended Ethertype playpen Ethertype playpen Ethertype

Length/Type HLPDE - source

```
if protIDvalue = <null>
        Length(2) ← Length of data
        msdu ← Length(2) | data

else
        msdu ← protIDvalue | data
```

Length/Type HLPDE - destination

```
if first two bytes of msdu <1501 [protIDtype = L]
        Length(2) ← first two bytes of msdu
        data  ← msdu less first two bytes, trimmed to Length(2)*
        protIDvalue ← <null>

if first two bytes of msdu >1535 [protIDtype = E]
        protIDvalue ← first 2 bytes of msdu
        if protIDvalue = 88B7 then
                protIDvalue ← protIDvalue | next 5 bytes
        if protIDvalue = 88B5 then
                protIDvalue ← protIDvalue | next (m) bytes
        if protIDvalue = 88B6 then
                protIDvalue ← protIDvalue | next (n) bytes
        data ← msdu less first length(protIDvalue) bytes

pass data to HSAP at protIDvalue
```

*Note: It appears from IEEE Std 802.3 (Fig. 3-2) that the MAC passes up any padding up through the MSAP.

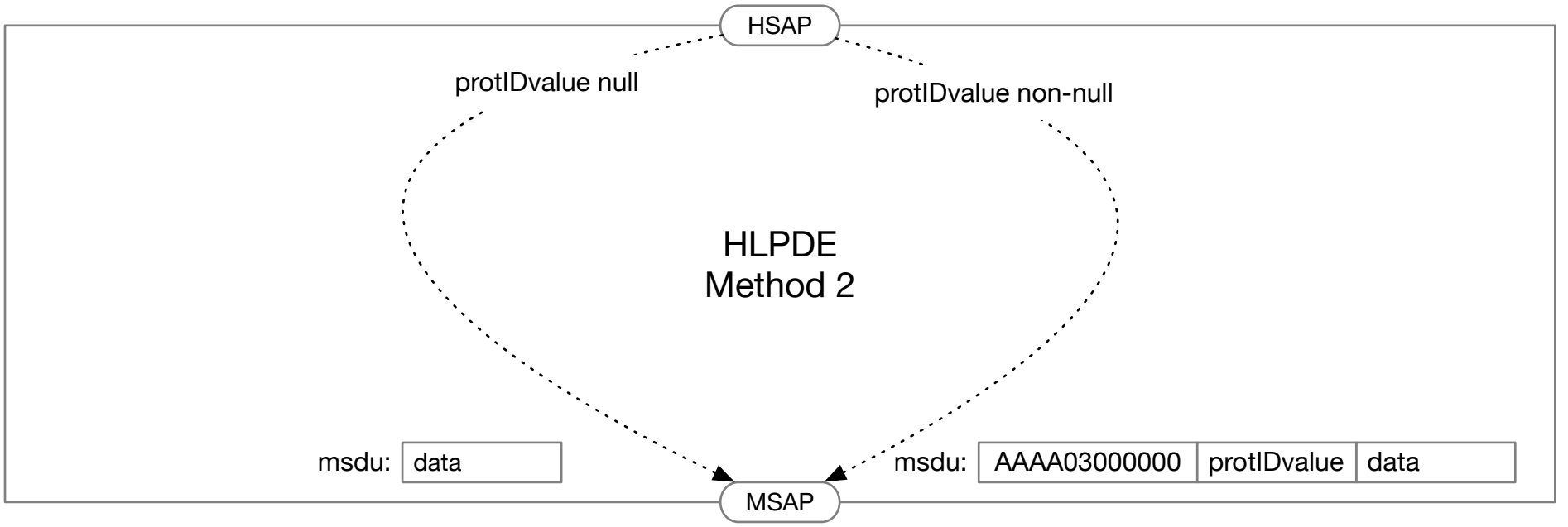
HLPDE Method 2 (LLC/SNAP)

protIDtype = L

data:	data
protIDvalue:	<null>

protIDtype = E

data:	data	
protIDvalue:	Ethertype	extensions



Note: Could have saved three bytes by assigning an LSAP identifier to Ethertype.
Instead of AAAA03000000, could have used EXEX03, where “EX” is the assigned Ethertype LSAP identifier.

HLPDE Method 2 (LLC/SNAP)

protIDtype	**protIDvalue** formats	**description**
L	<null>	
E	Ethertype(2) 88B7 | private(5) 88B5 | local(m) 88B6 | local(n)	assigned Ethertype value OUI extended Ethertype playpen Ethertype playpen Ethertype

LLC HLPDE - source

```
if protIDvalue = <null> [protIDtype = L]
        msdu ← data

else [protIDtype = E]
        msdu ← AAAA03000000(6) | protIDvalue | data
```

LLC HLPDE - destination

```
if msdu does not begin AAAA03000000 [protIDtype = L]
        data  ← msdu
        protIDvalue ← <null>

else [protIDtype = E]
        trim AAAA03000000 from start of msdu
        protIDvalue ← first 2 bytes of msdu
        if protIDvalue = 88B7 then
                protIDvalue ← protIDvalue | next 5 bytes
        if protIDvalue = 88B5 then
                protIDvalue ← protIDvalue | next (m) bytes
        if protIDvalue = 88B6 then
                protIDvalue ← protIDvalue | next (n) bytes
        data ← msdu less first length(protIDvalue) bytes

pass data to HSAP at protIDvalue
```

What are EPD and LPD?

IEEE Std 802-2014:
The higher layer protocol discrimination entity (HLPDE) is used by the LLC sublayer to determine the higher layer protocol to which to deliver an LLC sublayer protocol data unit (PDU). Two methods may be used in the HLPDE. The two methods are:

1) EtherType protocol discrimination (EPD), which uses the EtherType value made available to the LLC sublayer through the MSAP

2) LLC protocol discrimination (LPD), which uses the addresses defined in ISO/IEC 8802-2, including the Subnetwork Access Protocol (SNAP) format

- EPD is HLPDE Method 1 (Length/Type)
- LPD is HLPDE Method 2 (LLC/SNAP)

Note: This means that some text in IEEE Std 802-2014 is incorrect; e.g.:

- *IEEE Std 802.3™ is capable of natively representing the EtherType within its MAC frame format, which is used to support EPD. IEEE Std 802.3 also natively supports ISO/IEC 8802-2 LPD*

-802.3 supports HLPDE Method 1 (Type/Length or EPD), not LPD.

- *Protocol discrimination performed by the EPD method is based on EtherTypes*

-EPD supports both EtherType and other forms of protocol discrimination, including DSAP/SSAP

- *the value of the Type/Length field in the IEEE 802.3 MAC frame format directs the protocol parser into the LPD HLPDE if the value is less than 1536*

-802.3 is EPD only. If the Length/Type field is less than 1501, the field is directed to the 802.2 HSAP

- *This allows frames of both formats to be freely intermixed on a given IEEE 802 network and at a given station.*

-The HLPDE methods cannot be mixed. Frames of both protIDtypes can be intermixed.

- *… IEEE 802 networks that offer only the LPD function and not the EPD function in the LLC sublayer*

-The issue in the example is whether the sender knows the HLPDE used by the recipient.

Implications and Proposals

•This understanding implies that IEEE Std 802-2014 is substantially faulty regarding EPD and LPD.

•Some prior contributions, noting the discrepancy between
(a) IEEE Std 802-2014
(b) IEEE Stds 802.1AC, 802.1Q, and 802.11
took the view the IEEE Std 802-2014 was basically correct and needed only clarification.

•Based on the analysis herein, it appears that IEEE Stds 802.1AC, 802.1Q, and 802.11 are instead on the right track.

•**Proposals**
(1) IEEE Std 802 should be thoroughly revised, with a detailed description of the HLPDE
(2) IEEE Stds 802.1AC, 802.1Q, and 802.11 should be reviewed for consistency and clarified as necessary

Conclusion

- The standards are inconsistent.
- 802 is no longer reliant on the 802.2 LLC
- The root of the problem is that the HLPDE is not specified.
- It should possible to specify the HLPDE for clarification, without altering current understanding of the expected operation.
- This contribution proposes an HLPDE specification.

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