Clarifying EPD and LPD

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Source:
Roger B. Marks Voice: +1 802 227 2253
EthAirNet Associates
roger@ethair.net

Norm Finn
Huawei Technologies Co. Ltd
nfinn@nfinnconsulting.com

Re: 802.1 Maintenance, related to IEEE Std 802-2014, IEEE Std 802.1AC-2016, and IEEE Std 802.1Q-2018
Venue:
802.1 Maintenance TG

Abstract:
This document addresses inconsistencies in the description of EtherType protocol discrimination (EPD) between IEEE Std 802-2014, IEEE Std 802.1AC-2016, and IEEE Std 802.1Q-2018.

Notice:
This document represents the current views of the authors only and is offered as a basis for discussion. More development is needed.

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Clarifying EPD and LPD

Roger B. Marks, EthAirNet Associates
Norm Finn, Huawei
2019-11-11
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.
- It's a problem for various reasons, particularly because new standards are supposed to support EPD, but we don't really know what that means.

Background Contributions

- R. Marks, “What are EPD and LPD?”
  maint-Marks-epd-lpd-0719-v02.pdf

- N Finn, “Why the EPD/LPD information in IEEE 802, IEEE 802.1AC, and 802.1Q must be fixed”
  maint-finn-epd-lpd-errors-0919-v02.pdf

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.

HPLDE in LLC

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

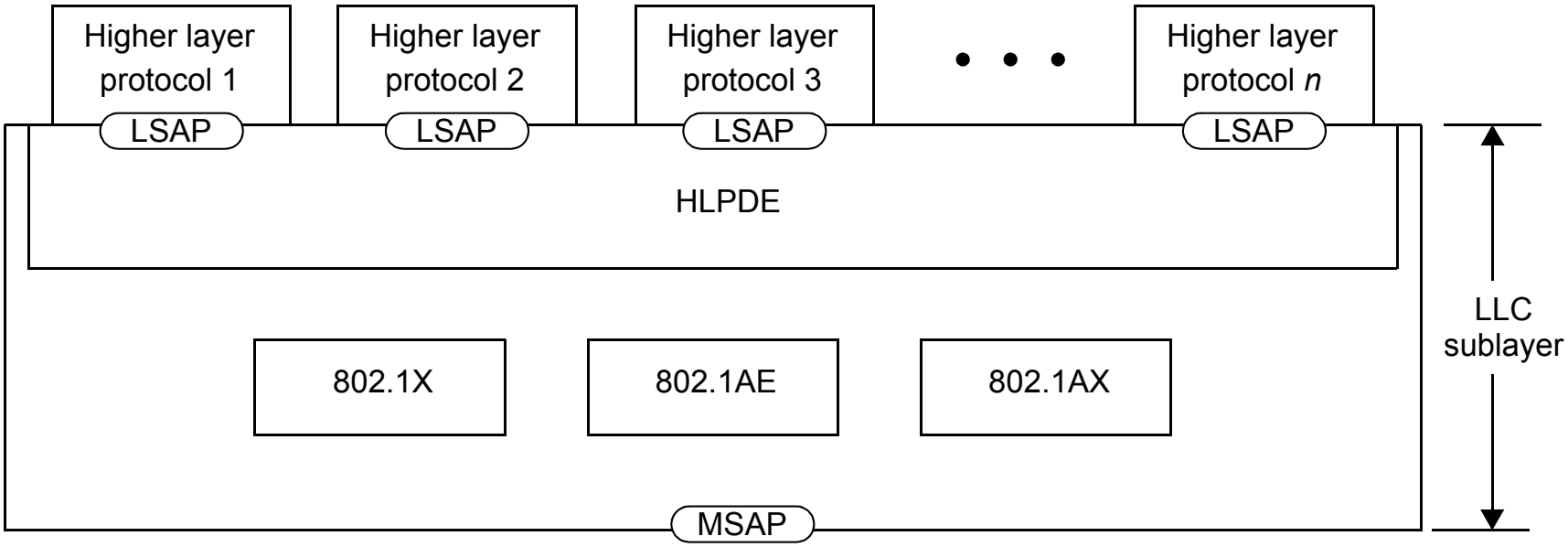

Figure 6—LLC sublayer in 802 RM

HLPDE in IEEE Std 802

In IEEE Std 802 (subclause 5.2.2), HLPDE is described generally, as part of the LLC, but not specified:

> *The higher layer protocol discrimination entity (HLPDE) is used by the LLC sublayer to determine the higher layer protocol ... Two methods may be used...*
>
> *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*
>
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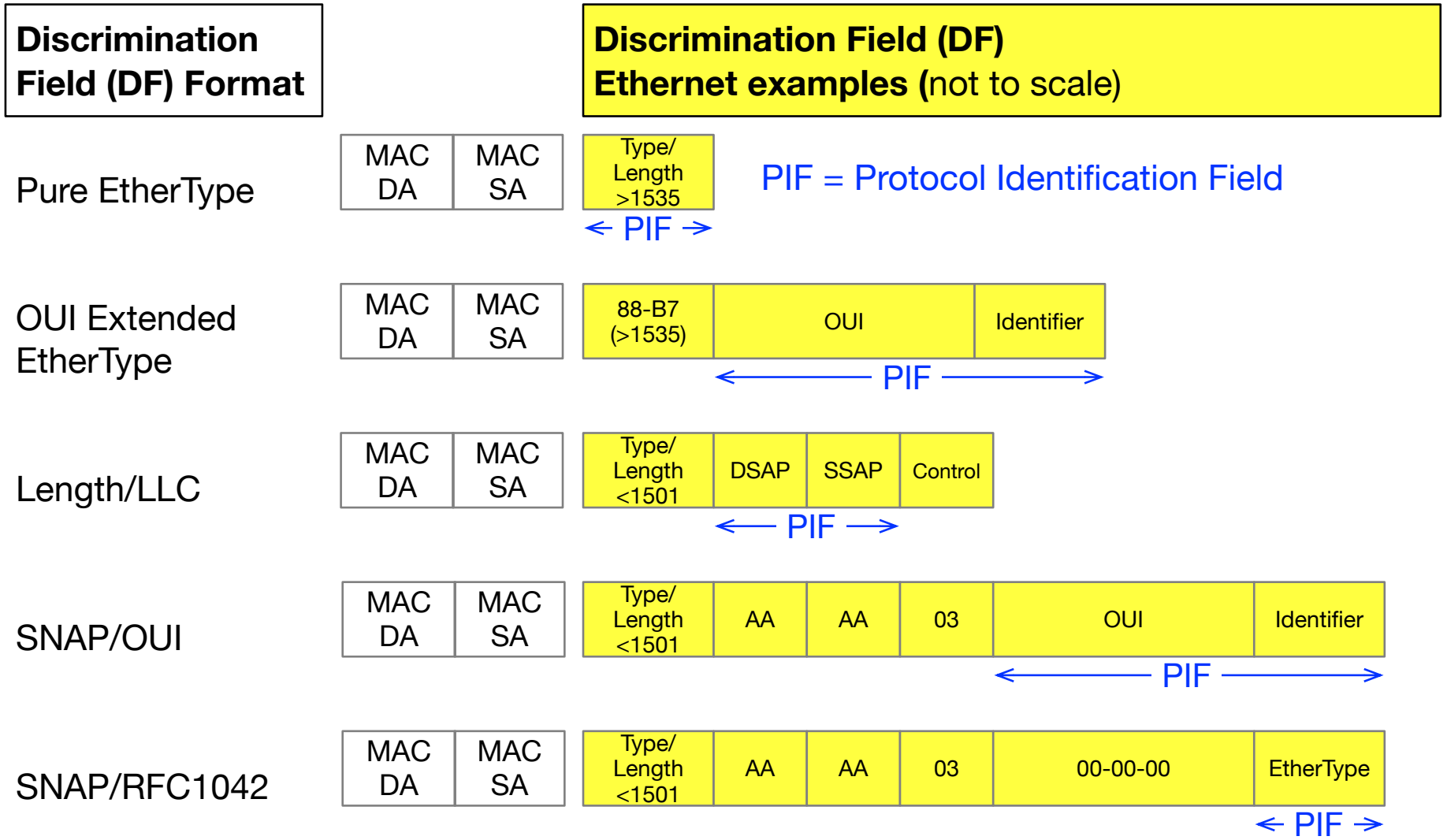
Protocol Identifier Types

per IEEE Std 802

1. Assigned per an IEEE RA registry
   A. DSAP/SSAP ("pure LLC," per 802.2)
   B. EtherType
2. Proprietary
   A. Local Experimental EtherType
   B. OUI Extended (OUI + 2 octets)

- LSAP is identified by (PIT, PIV)
  - PIT = Protocol Identifier Type, PIV = Protocol Identifier Value
- The protocol specifies the PIT and uses a suitable PIV.
- LLC/MAC must be enabled to communicate whatever the protocol specifies.

Protocol Identification Field (PIF) is embedded in the Discrimination Field (DF)

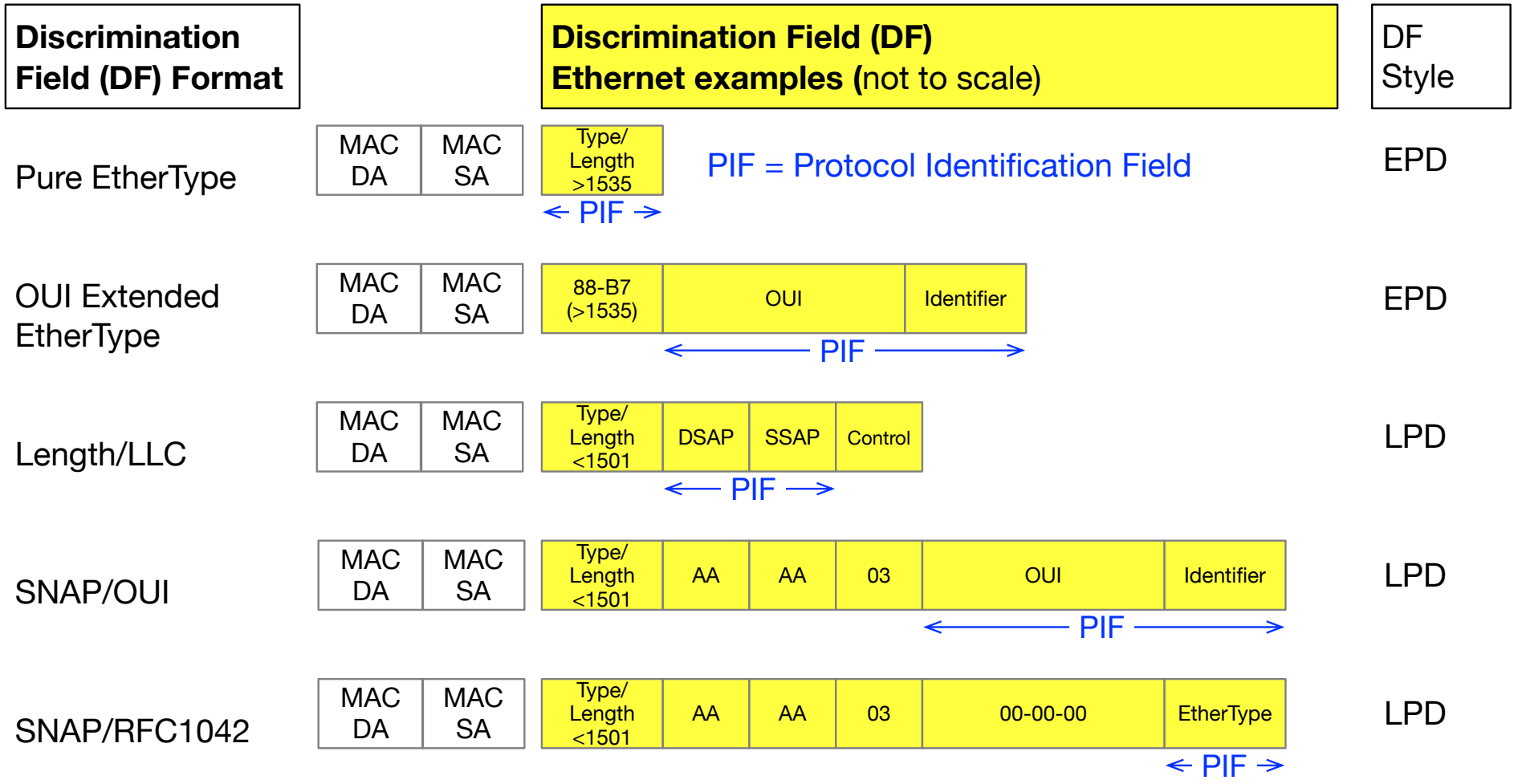


EPD and LPD, per IEEE Std 802

- *EPD… uses the EtherType value made available to the LLC sublayer through the MSAP*
- *LPD… uses the addresses defined in ISO/IEC 8802-2, including the Subnetwork Access Protocol (SNAP) format*
  - LLC using DSAP/SSAP is LPD
  - Note: SNAP carrying an EtherType is also LPD (uses 802.2 addresses)
- *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 natively supports ISO/IEC 8802-2 LPD (over a limited range of frame sizes)*
  - If the Type/Length field is <1501, then it represents a Length <1501 and we have LPD; this can include SNAP carrying an EtherType
- *In other IEEE 802 networks, such as for IEEE Std 802.11™, LPD is also achieved using SNAP*
- *…an LPD PDU…*
- ***In either of these techniques, the EtherType is effectively being used as a means of identifying an LSAP that provides LLC sublayer service to the protocol concerned.***

➢ EPD & LPD describe the Discrimination Field Style in the PDU, not the Protocol Identifier Type contained therein

Discrimination Format Styles: Ethernet Example

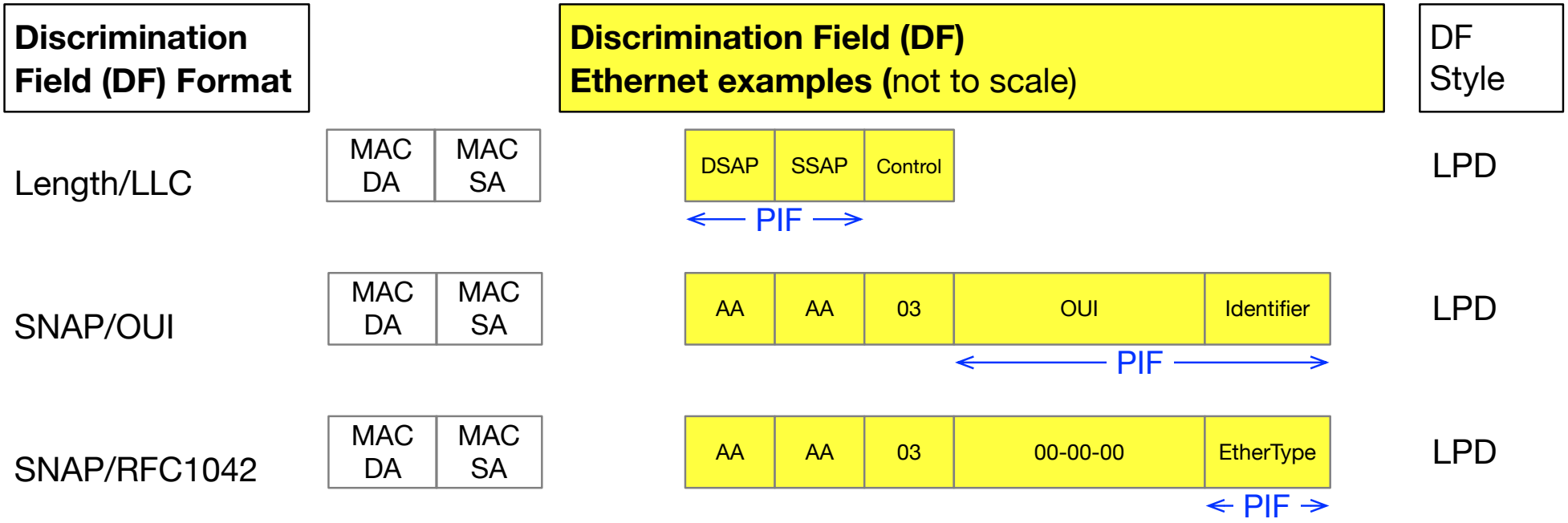


- Any DF Field with known DF Style can be parsed to identify DF Format, PIT, & PIV.
- If DF Style is indicated in the frame, mixed EPD and LPD frames are allowed.
- Ethernet indicates DF Style using the Type/Length field; alternate means are possible.

So, what are EPD and LPD?

- There is some confusion in the standards between EPD as (a) protocol identified by an EtherType; (b) an encoding method that supports both EtherType and DSAP/SSAP protocol types, and (c) a Type/Length encoding. The Discrimination Field (DF) is introduced here to help clarify this.
- Using Ethernet-based examples, we see that EPD and LPD are reflected in the style of Discrimination Field (DF); knowing the style, the DF can be parsed to determine the Protocol Identification Type and Protocol Identification Value.
- We need to also look at non-Ethernet examples.

Discrimination Format Styles: legacy 802.11 Example



- EPD DFs are not supported
- All frames use DF Style “LPD”.
- Any frame can be parsed to identify DF Format, PIT, & PIV.

Terminology Confusion

- In IEEE Std 802:
  - The legacy 802.11 case is identified with terms such as “IEEE 802 networks that offer only the LPD function” and “LPD-only IEEE 802 network.”
  - The Ethernet case is not named.
- In IEEE Std 802.11:
  - The legacy 802.11 case is called “LPD encoding”
  - The Ethernet case is called “EPD encoding”
  - 802.11 inaccurately attributes this terminology to IEEE 802 (“As specified in IEEE Std 802, EPD encoding always starts with a Length/Type field that is either a 2-octet length or a 2-octet Ethertype while LPD encoding always starts with an LSAP octet. There is no indication in a Data frame as to whether EPD or LPD MSDU encoding is in use.”)
- IEEE Std 802.1AC is close to 802.11:
  - an EPD medium supports EPD and LPD methods
  - an LPD medium only LPD
- Let’s propose terminology aligned with 802.11.

MAC Requirements

- MAC needs to support LLC (DSAP/SSAP) identifiers
  - EPD does not support these
  - therefore MAC must support LPD

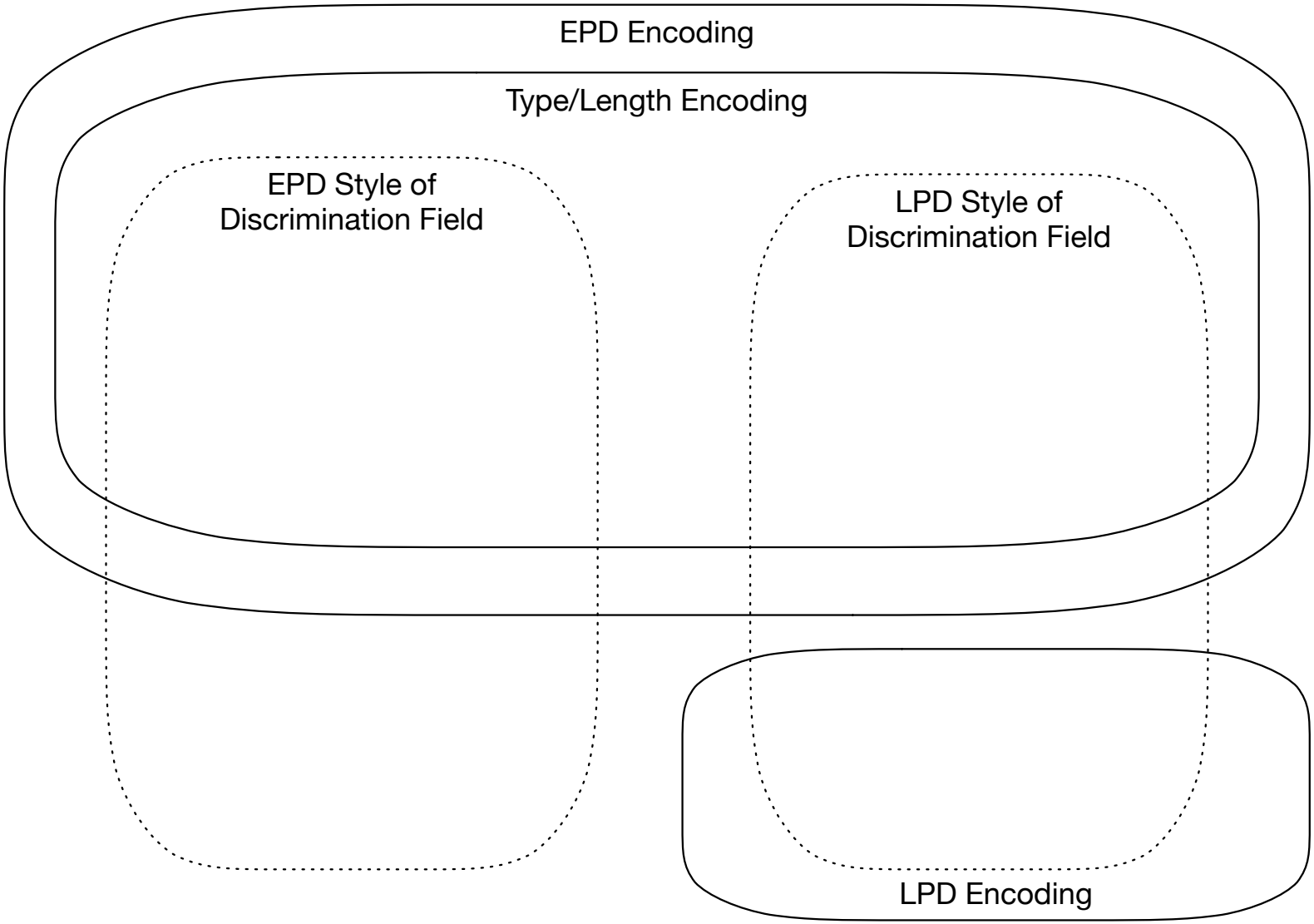
- MAC needs to support EtherType identifiers
  - It can do this with LPD
  - It can optionally EPD

- Going forward, MACs need to “support EPD.” This means:
  - Enabled to carry both EPD and LPD frames.
  - Enabled to differentiate EPD and LPD frames.

- Ethernet does this
  - Differentiates by Type/Length field encoding
  - At the IEEE 802 level, we shouldn’t care how the differentiation per frame is conveyed.

- So, MACs use either:
  - LPD encoding: supports LPD only
  - EPD encoding: supports LPD and EPD; differentiates EPD and LPD frames.

Rough Terminology Map



MSDU Formats and MAC Classes

Discrimination Field (DF) Format	PD Method	LPD Encoding	EPD Encoding
Pure EtherType	EPD	no	yes
OUI Extended EtherType	EPD	no	yes
LLC	LPD	yes	yes
SNAP/OUI	LPD	yes	yes
SNAP/RFC1042	LPD	yes	yes

Unification

- IEEE Std 802 says "*Two methods may be used in the HLPDE. The two methods are: … EPD and LPD*."
- Should we specify the HLPDE so that it uses one method, which includes EPD and LPD and a discriminator?
- Not an immediate concern.

Proposed Way Forward

Amend IEEE Std 802:

- Only minor changes; for example:
  - for clarity, describe EPD and LPD Encoding
  - subclause 9.4: “This subclause specifies the standard method for conveying Ethernet frames across IEEE 802 networks that offer only the LPD function and not the EPD function in the LLC sublayer.” should refer not to “Ethernet frames” but to EPD-formatted frames.
  - Review “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” [1501 might be better]
- Could amend within the expected PAR P802f
- P802f will be the third amendment, so a revision will follow

Revise IEEE Std 802.1AC and IEEE Std 802.1Q:

- Correct errors and align with IEEE Std 802.
- Update 802.11 WG, since IEEE Std 802.11 needs to be aligned