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Wireless LANs

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| Corrections to EPD and LPD Terminology |
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Abstract

This contribution proposes changes to IEEE P802.11-REVmd/D3.0 in order to correct the usage of EtherType protocol discrimination (EPD) and LLC protocol discrimination (LPD) terminology and align it with that of IEEE Std 802-2014.

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### Introduction

The current IEEE Std 802.11 revision project will be the first to roll up IEEE Std 802.11ak-2018 into the base. IEEE Std 802.11ak introduced the concepts of EtherType protocol discrimination (EPD) and LLC protocol discrimination (LPD) into IEEE Std 802.11, with reference to the terms as specified in IEEE Std 802-2014. However, the usage of these two terms in IEEE Std 802.11ak is inconsistent with the usage in IEEE Std 802-2014. The resulting specifications as represented in IEEE P802.11-REVmd/D3.0 are therefore confusing and difficult to understand; furthermore, critical normative information is absent. This contribution proposes changes to IEEE P802.11-REVmd/D3.0 in order to align the terminology with that of IEEE Std 802-2014 and identify the missing normative information.

### Background

Issues with EPD and LPD terminology have been discussed in the IEEE 802.1 Working Group [1,2,3,4]. The author has discussed these contributions, although not in full detail, with the IEEE 802.11 Architecture Standing Committee (ARC). A contribution to ARC of January 2020 [5] (later revised to [6], with the figures modified for clarity) pointed out specific issues in IEEE Std 802.11. Following discussion at an ARC meeting, ARC reported [7] that it “will continue to monitor 802.1’s work on this” and “We may consider updates to 802.11… Author (Roger Marks) will work off-line based on comments, and target something for REVmd’s ad hoc in Feb.”

### Problem Summary

In IEEE P802.11-REVmd/D3.0, EPD and LPD are not explicitly defined except by reference to IEEE Std 802 (see 4.3.29, “IEEE Std 802 describes the two LLC sublayer protocols: Ethertype protocol discrimination (EPD) and LLC protocol discrimination (LPD).” However, based on (informative) Annex M (“EPD and LPD headers and the integration function”), their meaning within IEEE P802.11-REVmd/D3.0 can be inferred. Annex M (M.1) states that “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,” and other parts of Annex 2 (e.g. Table M-1) are consistent with that view. However, this understanding of EPD and LPD is inconsistent with IEEE Std 802.

EPD encoding, as described in Annex M, describes the method used by Ethernet; the draft also refers directly (in 5.1.4) to “Ethernet frame format (EPD).” However, IEEE Std 802-2014 clearly states that Ethernet uses both EPD and LPD:

* *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)*

It also says:

* *For example, 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. This allows frames of both formats to be freely intermixed on a given IEEE 802 network and at a given station.* [Note: “1536” here can be read as “1501”, since behavior with values from 1501-1535, inclusive, is unspecified in IEEE Std 802.3.]

In other words, as described in IEEE Std 802-2014, Ethernet uses a Length/Type encoding; the Length/Type field is set to less than 1501 to indicate LPD and >1535 to indicate EPD.

The situation is illustrated by the following figure:

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Note that the terms “Length/Type Encoding” and “LLC Encoding” are not used in IEEE Std 802. However, this contribution proposes to introduce those terms in order to provide convenient alternative language for use in IEEE 802.11. The upper portion of the figure illustrates Length/Type Encoding as used in Ethernet but referred to in IEEE P802.11-REVmd/D3.0 as “EPD encoding” or “EPD format.” The figure shows why this terminology is problematic and confusing, since “EPD encoding” includes support for intermixed EPD and LPD frames. The lower portion of the figure illustrates LLC Encoding, which is consistent with what IEEE P802.11-REVmd/D3.0 calls “LPD encoding.” While LLC Encoding uses only LPD, not EPD, the term “LPD Encoding” should be avoided because this is only one of two different ways to encode with LPD within IEEE 802.11.

An additional critical problem with IEEE P802.11-REVmd/D3.0 is that the format of “EPD encoding,” even the format of the Length/Type field (or even its existence), is not specified normatively but only described by example in (informative) Annex M. A normative reference to IEEE Std 802 cannot solve the problem, because IEEE Std 802 does not specify the Length/Type field but only refers to how it is used in IEEE Std 802.3, where it is a specified MAC field. As stated in IEEE Std 802, EPD “uses the EtherType value made available to the LLC sublayer through the MSAP.” However, IEEE P802.11-REVmd/D3.0 describes the Length/Type field not as part of the MAC but as part of the MSDU and therefore part of an alternative 802.11-specific LLC that is in need of normative specification. For example, IEEE Std 802.3 specifies which values of the Length/Type field are used for EPD, which are used for LPD, and which are not used; it also specifies how the value of the field is set when it is a length. In IEEE P802.11-REVmd/D3.0, none of this information is normatively specified.

### Proposed Way Forward on Terminology

Contributions [5,6] suggest several possible way to address this issue, including doing nothing, changing IEEE Std 802 for consistency with IEEE P802.11-REVmd/D3.0, and other alternatives. This contribution is in line with the author’s understanding, based on the ARC discussion, that the preferred approach is to change the terminology in IEEE P802.11-REVmd so that EPD encoding is renamed “Length/Type (L/T) encoding” and “LPD encoding” is renamed “LLC encoding”. Note that the usage of the expression “Type/Length” in [5] is replaced in [6] by “Length/Type,” since the latter is the proper field name in IEEE Std 802.3.

# Proposed changes to P802.11REVmd/D3.0

***Change the following in subclause 2 (Normative references):***

ISO/IEC TR11802-5:1997, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Technical reports and guidelines—Part 5: Medium Access Control (MAC) Bridging of Ethernet V2.0 in Local Area Networks (previously known as IEEE Std 802.1H-1995 [B21]12).

***Change the following in subclause 3.1 (Definitions):***

**medium access control (MAC) service tuple**: The collection of a MAC service data unit (MSDU) along with the associated source address, destination addresses, priority, service class, optional set of service\_access\_point\_identifiers, and optional indication of whether the supplied MSDU uses (MDR2) Length/Type (L/T) encoding or logical link control (LLC) encoding, which are all passed as parameters across the MAC service access point (SAP) and are all except the service\_access\_point\_identifiers delivered across the distribution system between access points (APs), mesh gates, and the portal of an extended service set (ESS).(11ak)

***Add the following to subclause 3.1 (Definitions) in alphabetical order:***

Length/Type (L/T) encoding: an LLC encoding format using a two-octet Length/Type field at the start of the MSDU, allowing frames using LPD and those using EPD to be freely intermixed and discrimiated on the basis of the Length/Type field

logical link control (LLC) encoding: an LLC encoding format using only LPD for protocol discrimination

***Add the following to subclause 3.4 (Abbreviations and acronyms) in alphabetical order:***

L/T Length/Type

***Change the third paragraph of subclause 4.3.28.1 as follows:***

**4.3.28.1 General**

A GLK STA that starts a BSS uses membership selector values to set the BSS policy of requiring or not requiring general link or L/T encoding support for any STA that joins the BSS.

***Change subclause 4.3.29 as follows:***

**4.3.29 LLC and L/T Encoding(11ak)**

IEEE Std 802(#2677) describes two protocol discrimination methods: Ethertype protocol discrimination (EPD) and LLC protocol discrimination (LPD).

The higher-layer protocol is encoded using either LLC encoding, which uses LPD, or Length/Type (LT) encoding, which allows frames using LPD and those using EPD to be freely intermixed. L/T encoding uses a two-octet Length/Type field at the start of the MSDU. The value of the L/T field is set to less than 1501 to indicate that the MSDU uses EPD and that the value of the Length/Type field indicates an EtherType value. The value of the L/T field is set to greater than 1535 to indicate that the MSDU uses LPD. Other values of the L/T field are not used.

[*Contributor’s note: The text above is not a strict normative specification of the Length/Type field, and that would not belong in Clause 4. That normative specification should be elsewhere. Traditional LLC encoding need not be specified in the standard because the encoding is within the MSDU and is therefore part of the higher-layer IEEE 802.2 LLC protocol. EPD is also described in the draft as part of the LLC, with the encoding also embedded in the MSDU. However, such encoding is not specified in IEEE Std 802.2 or IEEE 802. Regarding Ethernet, IEEE Std 802 and IEEE Std 802.3 consider the EPD encoding to be within the MAC, and IEEE Std 802.3 accordingly specifies the details. However, since IEEE 802.11 prefers to describe it as within the LLC, it may be better to find another home for that description. One possibility is an revision of IEEE Std 802 that would describe a new variety of HLPDE that integrates EPD and LPD, based on a Type/Length field, into the LLC.*]

LLC encoding is the default for IEEE 802.11 MSDUs with the exception of the 5.9 GHz bands, where L/T encoding is used for the transmission of all MSDUs (see Annex E.2.3 and Annex E.2.4). While not the default, L/T encoding might be used in other bands when it is known that the addressed STAs and the transmitting STA support it.

An EPD STA is a STA that supports L/T encoded MSDUs. EPD STAs, other than those operating in the 5.9 GHz bands, indicate their support through a bit in the Capability Information field, DMG STA Capability Information field, and Relay Capabilities element. (#2227)An EPD STA, when transmitting a MPDU with an RA that is an individual address, uses L/T encoding if the recipient is an EPD STA; otherwise, such individually addressed transmissions use LLC encoding.

In an MPDU transmitted with a groupcast RA, the choice between LLC and L/T encoding of MSDUs in the MPDU is controlled by the policy of the BSS (see 5.1.4 (MSDU format)).

***Change subclause 5.1.4 as follows:***

**5.1.4 MSDU format**

Logical Link Control (LLC) sublayer entities use the MAC sublayer service to exchange PDUs with peer LLC sublayer entities. These PDUs are termed MAC sublayer SDUs (MSDUs) when sent to the MAC sublayer. One of two LLC sublayer protocol discrimination methods is used: LLC Protocol Discrimination (LPD) or EtherType Protocol Discrimination (EPD) (see IEEE Std 802). (11ak) Length/Type (L/T) encoding uses a two-octet Length/Type field to distinguish LPD and EPD frames. MSDUs are formatted in accordance with LLC or L/T encoding, as determined by the first condition below that is true. After a true condition has been found, subsequent conditions are ignored.

a) In the 5.9 GHz bands (see E.2.3 (5.9 GHz band in the United States (5.850–5.925 GHz)) and E.2.4 (5.9 GHz band in Europe (5.855–5.925 GHz))), useL/T encoding.

b) For OCB communications outside of the 5.9 GHz bands, use LLC encoding.

c) Within Data frames with (#2227)RAs that are individual addresses, if both the transmitter and receiver are EPD STAs, useL/T encoding.

d) Within Data frames with (#2227)RAs that are individual addresses, if either the transmitter or the receiver is not an EPD STA, useLLC encoding.

e) If the transmitting AP accepts(MDR2) association only from an EPD STA, useL/T encoding.

f) If the transmitting mesh STA peers(MDR2) only with an EPD mesh STA, useL/T encoding.

g) For all other cases, use LLC encoding.

When L/T encoding is used, in order to achieve interoperability, implementers are recommended to apply the procedures described in ISO/IEC TR11802-5:1997 (previously known as IEEE Std 802.1H-1995 [B21]), along with a selective translation table (STT) that handles a few specific network protocols, with specific attention to the operations required when passing MSDUs to or from LANs or operating system components that use L/T encoding. Note that such translations might be required in a STA.

[*Contributor’s note: In this paragraph, the proposal intentionally changes “LPD” not to “LLC encoding” but to “L/T encoding.” If the encoding is entirely LLC, then there is no need to apply 11802-5. 11802-5 applies when translating SNAP/EtherType frames to L/T encoding, addressing whether to use EPD or LPD for the resulting output frame. Per 11802-5, the output frame will use EPD except in special cases.]*

***Change the last paragraph of subclause 5.2.2 as follows:***

**5.2.2 GLK MAC data service specification(11ak)**

When GLK is in use, the MAC service primitives make use of the MSDU format parameter. In an MAUNITDATA.request primitive(MDR2), this parameter indicates whether the supplied MSDUuses LLC or L/T encoding. If the format is inappropriate for the transmission that carries this MSDU as described in 5.1.4 (MSDU format), the STA converts the format before transmission. In an MA-UNITDATA.indication primitive(MDR2), this parameter indicates the format of the received MSDU, which is determined as described in 5.1.4 (MSDU format). The MAC service user uses this information to parse the MSDU correctly.

[*Contributor’s note: Does this mechanism allow conveying the MSDU format parameter on a per-frame basis? Per the definition of “MAC service tuple,” the parameters “are all passed as parameters across the MAC service access point (SAP) and are all… delivered across the distribution system…”]*

***Change the last paragraph of subclause 5.2.2 as follows:***

**5.2.3.2 Semantics of the service primitive**

(11ak)The MSDU format parameter indicates the encoding, either LLC or L/T encoding, of the supplied MSDU. This parameter is null unless dot11GLKImplemented is true.

[*Contributor’s note: The added sentence (and in 5.2.4.2) reflects the statement in 5.2.2 that “When GLK is in use, the MAC service primitives make use of the MSDU format parameter.”*]

***Change the last paragraph of subclause 5.4.2 as follows:***

**5.2.4.2 Semantics of the service primitive**

(11ak)The MSDU format parameter indicates the encoding, either LLC or L/T encoding, of the received MSDU. This parameter is null unless dot11GLKImplemented is true.

***In subclause B.4.4.2 (MAC frames), change table entries as follows:***

(11ak)FT51 LLC-encodedMSDU 5.1.4 (MSDU format)

(11ak)FT52 L/T-encodedMSDU 5.1.4 (MSDU format), 11.52 (EPD operation(11ak))

(11ak)FR52 LLC-encodingMSDU 5.1.4 (MSDU format)

(11ak)FR53 L/T-encodedMSDU 5.1.4 (MSDU format), 11.52 (EPD operation(11ak))

***In subclause 9.4.2.3 (Supported Rates and BSS Membership Selectors element), change table 9-95 entry Value 124 as follows:***

124(11ak) EPD Indicates that support for L/T encoding is required in order to join the BSS that was the source of the Supported Rates and BSS Membership Selectors element or Extended Supported Rates and BSS Membership Selectors element containing this value.

***Change subclause 11.52 as follows:***

**11.52 EPD operation(11ak)**

A STA operating in the 5.9 GHz bands is an EPD STA and dot11EPDimplemented shall be set to true or not present. For an EPD STA not operating in the 5.9 GHz bands, dot11EPDImplemented shall be set to true. For a STA that is not an EPD STA, dot11EPDImplemented shall be set to false or not present. When an EPD STA is not operating in the 5.9 GHz bands, the EPD subfield is set to 1 in the Capability Information and DMG STA Capability Information fields.

The Supported Rates and BSS Membership Selectors or Extended Supported Rates and BSS Membership Selectors elements shall include the EPD selector if dot11EPDRequired is true.

See also 5.1.4 (MSDU format).

***Change the DESCRIPTION of MIB dot11EPDImplemented (p. 3857 l. 37) as follows:***

"When true, this attribute indicates a STA that supports the receipt and transmission of L/T-encodedMSDUs. When false, it indicates a STA that does not support L/T-encoded MSDUs. This is a capability variable."

***Change the DESCRIPTION of MIB dot11EPDRequired (p. 3857 l. 47) as follows:***

"When true, this attribute indicates a STA that will only associate, direct link, or peer with a STA supportingL/T-encoded MSDUs. When false, it indicates a STA that will associate, direct link, or peer with a STA that does not supportL/T-encoded MSDUs.

This is a control variable.

It is written by an external management entity. Changes take effect as soon as practical in the implementation."

***Change Annex A as follows:***

[B21] IEEE Std 802.1H™-1995, IEEE Standards for Local and metropolitan area networks–Recommended Practice for Media Access Control (MAC) Bridging of Ethernet V2.0 in IEEE 802 Local Area Networks [now known as ISO/IEC TR11802-5:1997; see Clause 2 (Normative references)].

***Change the last paragraph of subclause E.2.3 as follows:***

**E.2.3 5.9 GHz band in the United States (5.850–5.925 GHz)**

L/T encoding shall be used for transmission of all MSDUs.

***Change the last paragraph of subclause E.2.4 as follows:***

**E.2.4 5.9 GHz band in Europe (5.855–5.925 GHz)**

L/T encoding shall be used for transmission of all MSDUs.

***Change subclauses M.1, M.2, and M.3 of Annex M as follows:***

**Annex M**

(informative)

**L/T-encoded and LLC-encoded headers and the integration function(11ak)**

**M.1 Introduction**

(11ak)The purposes of this informative annex are to (1) guide the implementer of a non-GLK WLAN system that includes a portal that integrates the WLAN systems with a wired LAN, (2) clarify L/T-encoded and LLC-encoded headers including the case of A-MSDU subframes, and (3) clarify where and how L/T-encoded to LLC-encoded and LLC-encoded to L/T-encoded conversions are required.

(11ak) An L/T-encoded MSDU always starts with a Length/Type field that is either a 2‑octet length or a 2-octet Ethertype, while an LLC-encoded MSDU always starts with an LSAP octet. There is no indication in a Data frame as to whether L/T or LLC encoding is in use. A receiving STA uses the rules in 5.1.4 to determine the encoding of MSDUs it receives.

**M.2 Integration function header conversions(11ak)**

(11ak)Table M-1 (L/T-encoded and LLC-encoded MSDU headers(11ak)) illustrates L/T and LLC protocol header encodings. The encoding used within the DS is unspecified. If the DS has a portal, that portal provides the integration function. The integration function converts between the encoding used within the DS and that used in the non-IEEE-802.11 network with which the portal is connecting the DS. If the DS uses LLC encoding and the portal connects to a network that uses L/T encoding, for example IEEE Std 802.3, the integration function converts MSDUs exiting the DS from LLC to L/T encoding format (using EPD in nearly all cases, per ISO/IEC TR11802-5:1997) and those entering the DS from L/T to LLC encoding. (11ak)Conversion between and might also be required at any GLK STA unless the GLK STA will (MDR2)join only BSSs limited to STAs. If the GLK STA might receive or transmit Data frames containing MSDUs, it converts them to or from the MSDUs required by the Internal Sublayer Service SAPs provided by GLK STAs.

(11ak)Conversion between LLC encoding and L/T encoding is discussed in 5.1.4 (MSDU format) and IEEE Std 802.1AC.

**Table M-1—L/T-encoded and LLC-encoded MSDU headers(11ak)**

|  |  |  |
| --- | --- | --- |
| **Protocol** | **L/T-encoded MSDU Header** | **LLC-encoded MSDU Header** |
| BPDU | lengtha-42-42-03 | 42-42-03 |
| IPv4 | 08-00 | AA-AA-03-00-00-00-08-00 |
| IPv6 | 86-DD | AA-AA-03-00-00-00-86-DD |
| IP ARP | 08-06 | AA-AA-03-00-00-00-08-06 |
| IS-IS | lengtha-FE-FE-03 | FE-FE-03 |
| C-VLANb tagged IPv4 | 81-00-xy-zw-08-00 | AA-AA-03-00-00-00-81-00-xy-zw-08-00 |
| S-VLANc and C-VLANb tagged IPv6 | 88-A8-st-uv-81-00-xy-zw-86-DD | AA-AA-03-00-00-00-88-A8-st-uv-81-00-xy-zw-86-DD |
| a A 2-octet, big-endian, unsigned integer length in octets. b Assuming C-VLAN ID xy-zw. c Assuming S-VLAN ID st-uv. |  |  |

**M.3 A-MSDU subframes(11ak)**

(11ak)The formats of A-MSDU subframes are shown in 9.3.2.2 (Aggregate MSDU (A‑MSDU) format), specifically in Figure 9-68 (A‑MSDU structure), Figure 9-69 (Basic A‑MSDU subframe structure), and Figure 9-70 (A‑MSDU subframe structure for Mesh Data). These formats apply as shown regardless of whether the MSDU is L/T or LLC encoded.

(11ak)When the MSDU is L/T encoded, it always starts with a 2-octet Length/Type field, as shown in Table M-1. Thus, in the case where that 2-octet field is a length (indicated by its value considered as an unsigned field being less than or equal to 0x05DC) and the MSDU appears in an A-MSDU subframe, there will be two sequential length fields or, in the mesh data case, two length fields separated only by the Mesh Control field. Figure M-1 (L/T-encoded BPDU subframe(11ak)), Figure M-2 (L/T-encoded VLAN tagged IPv4 subframe(11ak)), and Figure M-3 (L/T-encoded VLAN tagged IS-IS subframe(11ak)) show basic A-MSDU subframes containing an L/T-encoded BPDU, an L/T-encoded VLAN tagged IPv4 packet, and an L/T-encoded VLAN tagged IS-IS PDU, respectively. In those figures, the arrowed line from each Length field goes to a curly bracket covering the data whose Length is in that length field.

**Figure M-1—L/T-encoded BPDU subframe(11ak)**

**Figure M-2—L/T-encoded VLAN tagged IPv4 subframe(11ak)**

**Figure M-3—L/T-encoded VLAN tagged IS-IS subframe(11ak)**

(11ak)When parsing an MSDU, if the default LLC encoding is used, the MSDU starts with an LSAP; if L/T encoding is used, the MSDU starts with a Length/Type field. Subclause 5.1.4 (MSDU format) specifies which encoding is used.

### Recommended further changes to P802.11REVmd/D3.0

Some uses of the term “EPD” are less likely to lead to problems, mainly because they are essentially arbitrary names of entities. The following are not here identified for replacement, though it is recommended that they be replaced for clarity:

* “EPD STA”
* “LPD/EPD” label in Figures 5-1, 5-2, and 5-7.
* EPD subfield bit (B13) in Figures 9-85 and 9-86 (“Capability Information field format”)
* EPD subfield bit (B62) in Figure 9-550 (“DMG STA Capability Information field format”)
* EPD selector feature (Value 124) in Table 9-95 (“BSS membership selector value encoding”)
* dot11EPDImplemented
* dot11EPDRequired

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