

IEEE 802.3 Ethernet Metadata Services Study Group Closing Report

David Ofelt
HPE
Bangkok, Thailand
2025-11-12

IEEE 802.3 Ethernet Metadata Services Study Group

Study Group information

Study Group Organization

David Ofelt, IEEE 802.3 Ethernet Metadata Services Study Group Chair

Gary Nicholl, IEEE 802.3 Ethernet Metadata Services Study Group Secretary

John D'Ambrosia, IEEE 802.3 Ethernet Metadata Services Unofficial Hot Spare Chair

Study Group charter

Move that the IEEE 802.3 Working Group request the formation of a Study Group to develop a Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for Ethernet Metadata Services.

Study Group web and reflector information

Reflector information: <http://www.ieee802.org/3/EMS/reflector.html>

Home page: <http://ieee802.org/3/EMS/index.html>

IEEE 802.3 Ethernet Metadata Services Study Group Activities this week

Met Wed AM1

Resolved comments against the PAR and CSD from 802.1 and 802.11

<https://mentor.ieee.org/802-ec/dcn/25/ec-25-0280-00-LMSC-responses-to-comments-received-on-ieee-p802-3dt-par-and-csd.pdf>

Approved the responses to the comments as well as the updates to the PAR and CSD

Current Documentation

PAR: <https://mentor.ieee.org/802-ec/dcn/25/ec-25-0218-01-LMSC-draft-ieee-p802-3dt-par.pdf>

CSD: <https://mentor.ieee.org/802-ec/dcn/25/ec-25-0219-01-LMSC-draft-ieee-p802-3dt-csd.pdf>

Objectives: https://www.ieee802.org/3/EMS/projdoc/objectives_ems_251022.pdf

802.1 Comments against the EMS PAR

2.1 Project Title

Does this project intend to define a service or does it intend to define a metadatabased mechanism in support of such service?

The title mentions metadata services, yet the scope does not elaborate on what those services are and 8.1 does not provide additional information.

Is the inclusion of “service” intended to reflect service access points in 802 and 802.1AC?

5.2.b Scope

Please revise the scope to make it bounded and clear.

With respect to item 1, it is not clear where the metadata would reside in an Ethernet packet. For distinct identity from IEEE 802.1 to be preserved, our expectation is that this metadata would not be part of the frame?

Is the metadata intended to be visible above the MAC sublayer?

Does the entire scope apply to 50Gb/s and above, or only point number 2?

Suggest adding more detail. The Broad Market Potential slide on page 4 of the CSD appears to denote that Link Layer Retry and Credit-Based Flow Control are the initial intended applications for this project. If that's the case, these should be included in the scope of the PAR, along with enough information to denote what they are and how they are used. If this is intended to be truly a generic service, that service has not been described in enough detail.

5.5 Need for the project

This section identifies potential opportunities but no specific need is included.

It is not clear what interoperable mechanisms are needed, which mechanisms they are, in what way they are interoperable, and in what way they relate to metadata services.

This is written in the future tense and can promise future action, which may not be true

802.1 Comments against the EMS CSD

Broad Market Potential Slide 4.

Please provide references to the specifications of the referenced technologies of Link Layer Retry and Credit-Based Flow Control.

Compatibility Slide 5.

How can it be ensured that other standards organizations and future projects which use this metadata maintain conformance with

IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q?

Insufficient technical information has been provided to determine conformance to IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q.

Distinct Identity Slide 6.

While it may be true that this is substantially different from other IEEE 802.3 specifications/solutions, metadata-based service exist throughout other IEEE 802 standards.

The distinct identity aspect of the proposed metadata is not clear. For instance, frame-encapsulated metadata already exists in tags (e.g., VLAN Tag, R-Tag, etc.) that have been specified by the IEEE 802.1 WG.

Technical Feasibility Slide 7.

Do metadata or metadata-based services introduce new attack vectors to 802 networks?

How do metadata or metadata-based services interact with security mechanisms such as MACsec? Are there other analogous mechanisms to secure this metadata?

802.11 Comments against the EMS PAR

PAR 6.1.2 – Why is RAC review not needed?

802.3 Reference Model

The RM for IEEE Std 802.3 is illustrated in Figure B.2.

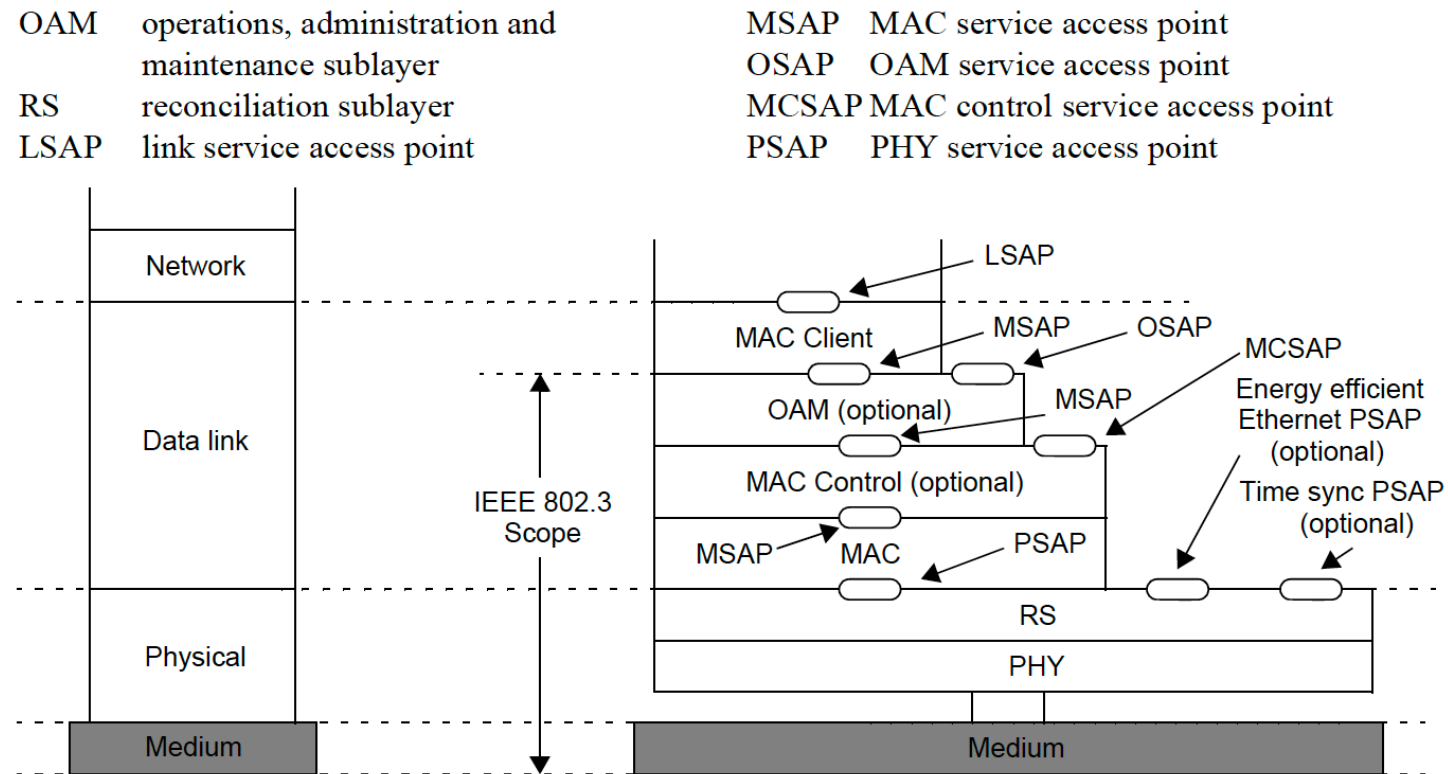


Figure B.2—The RM for IEEE 802.3 point-to-point stations

802.1 Comments against PAR 2.1

Comment:

2.1 Project Title

Does this project intend to define a service or does it intend to define a metadata-based mechanism in support of such service?

The title mentions metadata services, yet the scope does not elaborate on what those services are and 8.1 does not provide additional information.

Is the inclusion of “service” intended to reflect service access points in 802 and 802.1AC?

Proposed Response:

This is adding a physical layer service access point to the IEEE Std 802.3 and not to the IEEE Std 802.1AC. An update to the informative figures in IEEE Std 802-2024 may be submitted in the future to reflect this. We will clarify the scope to address these concerns (see slide 7).

802.1 Comments against PAR 5.2.b

Comment:

5.2.b Scope

Please revise the scope to make it bounded and clear.

With respect to item 1, it is not clear where the metadata would reside in an Ethernet packet. For distinct identity from IEEE 802.1 to be preserved, our expectation is that this metadata would not be part of the frame?

Is the metadata intended to be visible above the MAC sublayer?

Does the entire scope apply to 50Gb/s and above, or only point number 2?

Suggest adding more detail. The Broad Market Potential slide on page 4 of the CSD appears to denote that Link Layer Retry and Credit-Based Flow Control are the initial intended applications for this project. If that's the case, these should be included in the scope of the PAR, along with enough information to denote what they are and how they are used. If this is intended to be truly a generic service, that service has not been described in enough detail.

Proposed Response:

In order to make the scope bounded and clear, we proposed the following modifications:

5.2.b Scope of the project:

The scope of the project is the specification of additions and modifications to IEEE Std 802.3 to support the optional exchange of metadata through a physical layer service access point transferred:

- 1) In the preamble field of packets, or
- 2) In physical layer ordered sets, for MAC data rates greater than or equal to 50Gb/s, independent of packets

802.1 Comments against PAR 5.5

Comment:

5.5 Need for the project

This section identifies potential opportunities but no specific need is included.

It is not clear what interoperable mechanisms are needed, which mechanisms they are, in what way they are interoperable, and in what way they relate to metadata services.

This is written in the future tense and can promise future action, which may not be true

Proposed Response:

5.5 Need for the Project:

Multiple industry groups outside of IEEE 802 are defining features, such as Link Level Retry (LLR) and Credit-based Flow Control (CBFC) defined by the Ultra Ethernet Consortium, that require per-packet and packet-independent metadata transfers which are currently not supported by IEEE Std 802.3. An amendment to the IEEE Std 802.3 is needed to provide generic metadata transfer mechanisms through a physical layer service access point.

802.1 Comments against CSD Broad Market Potential

Comment:

Broad Market Potential Slide 4.

Please provide references to the specifications of the referenced technologies of Link Layer Retry and Credit-Based Flow Control.

Proposed Response:

Update the 2nd paragraph of the Broad Market Potential slide to be:

“””

Presentations have been submitted to the study group that illustrate the market adoption of Ethernet in AI/ML applications will be predicated on using metadata transfers to support features such as Link Layer Retry (LLR) and Credit-Based Flow Control (CBFC) defined by the Ultra Ethernet Consortium (see <https://ultraethernet.org>). The specification can currently be found at <https://ultraethernet.org/wp-content/uploads/sites/20/2025/10/UE-Specification-1.0.1.pdf>.

“””

802.1 Comments against Comments against CSD Compatibility & IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q?

Comment:

Compatibility Slide 5.

How can it be ensured that other standards organizations and future projects which use this metadata maintain conformance with

IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q?

Insufficient technical information has been provided to determine conformance to IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q.

Proposed Response:

We aren't changing the frame format, we aren't changing any of the existing service interfaces, we are adding a new optional physical layer service access point.

802.1 Comments against CSD Distinct Identity

Comment:

Distinct Identity Slide 6.

While it may be true that this is substantially different from other IEEE 802.3 specifications/solutions, metadata-based service exist throughout other IEEE 802 standards. The distinct identity aspect of the proposed metadata is not clear. For instance, frame-encapsulated metadata already exists in tags (e.g., VLAN Tag, R-Tag, etc.) that have been specified by the IEEE 802.1 WG.

Proposed Response:

We will add the following to the CSD distinct identity:

“””

This is the only project providing a physical layer service access point supporting per-packet metadata transfer mechanisms while adding no overhead to the packet, and also supporting packet-independent metadata transfers.

“””

802.1 Comments against CSD Technical Feasibility

Comment:

Technical Feasibility Slide 7.

Do metadata or metadata-based services introduce new attack vectors to 802 networks?
How do metadata or metadata-based services interact with security mechanisms such as MACsec? Are there other analogous mechanisms to secure this metadata?

Proposed Response:

This is transparent to MACsec. The new physical layer service access points will have similar exposure to attack vectors as existing physical layer service access points.

802.11 Comments against PAR 6.1.2

Comment:

PAR 6.1.2 – Why is RAC review not needed?

Proposed Response:

We are defining a protocol agnostic physical layer service access point, therefore a RAC review is not needed.

PAR

PAR item 2.1 – Project title

Project title: Standard for Ethernet Amendment:
Ethernet Metadata Services

Help text: The title of the base standard is uneditable. Please enter the amendment title in the text box. The title should be sufficiently unambiguous, understandable by NesCom member not from the society that submitted the PAR. All acronyms shall be spelled out in the title.

PAR item 4.2 and 4.3 Project dates

4.2 Expected Date of submission of draft to the IEEE-SA for Initial Standards Association Ballot:

Nov 2026

Help text: Enter the date the draft standard is planned to be submitted to IEEE-SA for Initial Standards Association Ballot.

4.3 Projected Completion Date for Submittal to RevCom:

Aug 2027

Help text: Enter the date the draft standard is planned to be submitted to RevCom for processing (not to exceed four years from the date of PAR submission). **It is suggested to allow at least six months after Initial Standards Association Ballot for the ballot process.** Cutoff dates for submitting draft standards to RevCom can be found in the yearly calendar located: <http://standards.ieee.org/about/sasb/meetings.html>.

PAR item 5.1 – Project participation

5.1 Approximate number of people expected to be actively involved in the development of this project:

40

Help text: This includes Working Group members, additional non-voting participants.

PAR item 5.2A – Standard scope

5.2A Scope of the complete standard:

This standard defines Ethernet local area, access and metropolitan area networks. Ethernet is specified at selected speeds of operation; and uses a common media access control (MAC) specification and management information base (MIB). The Carrier Sense Multiple Access with Collision Detection (CSMA/CD) MAC protocol specifies shared medium (half duplex) operation, as well as full duplex operation. Speed specific Media Independent Interfaces (MIIs) provide an architectural and optional implementation interface to selected Physical Layer entities (PHY). The Physical Layer encodes frames for transmission and decodes received frames with the modulation specified for the speed of operation, transmission medium and supported link length. Other specified capabilities include: control and management protocols, and the provision of power over selected twisted pair PHY types.

Help text: If this Amendment will change the scope statement of the complete document (base + Amendment), it can be edited and should be explained in the Additional Explanatory Notes field at the end of the PAR form. If this Amendment will not change the scope statement of the complete document the pre-populated text should be left as is.

PAR item 5.2B – Project scope

5.2B Scope of the Project:

~~The scope of the project is the specification of additions and modifications to IEEE Std 802.3 to support the optional exchange of metadata:~~

- ~~1) In Ethernet packets, or~~
- ~~2) Independent of Ethernet packets by Ethernet Physical layers that operate at MAC data rates of 50 Gb/s and above~~

The scope of the project is the specification of additions and modifications to IEEE Std 802.3 to support the optional exchange of metadata through a physical layer service access point transferred:

- 1) In the preamble field of packets, or
- 2) In physical layer ordered sets, for MAC data rates greater than or equal to 50Gb/s, independent of packets

Help text: State what the Amendment is changing or adding.

PAR item 5.3 – Project contingency

5.3 Is the completion of this standard contingent upon the completion of another standard (Yes or No)? If yes, please explain below:

No

5.3.1 If yes, please explain:

Help text: Your explanation should include how the standard is dependent upon the completion of another standard. Also, if applicable, why a PAR request is being submitted if the standard currently under development is not yet complete. The title and number of the standard which this project is contingent upon shall be included in the explanation.

PAR item 5.4 – Project purpose

5.4 Will the completed document (base + amendment) contain a purpose clause:

☐ Yes ☒ No

Note: IEEE Std 802.3 does not contain a Purpose Clause.

PAR item 5.5 – Project need

5.5 Need for the Project:

~~There is an opportunity for IEEE 802.3 to provide the industry with a generic set of interoperable mechanisms for per-packet and packet-independent metadata exchange. This will allow extensions to Ethernet to be defined by future IEEE 802.3 projects or other Standards Development Organizations (SDOs) for new or unforeseen features to meet evolving industry needs while maintaining the interoperability that makes Ethernet ubiquitous.~~

Multiple industry groups outside of IEEE 802 are defining features, such as Link Level Retry (LLR) and Credit-based Flow Control (CBFC) defined by the Ultra Ethernet Consortium, that require per-packet and packet-independent metadata transfers which are currently not supported by IEEE Std 802.3. An amendment to the IEEE Std 802.3 is needed to provide generic metadata transfer mechanisms through a physical layer service access point.

The need for the project details the specific problem that the standard will resolve and the benefit that users will gain by the publication of the standard. The need statement should be brief, no longer than a few sentences.

PAR item 5.6 – Stakeholders

5.6 Stakeholders for the Standard:

Stakeholders include users and producers of systems and components for applications needing metadata support, such as networks and compute clusters for artificial intelligence (AI) data centers, industrial, and building automation.

The stakeholders (e.g., telecom, medical, environmental) for the standard consist of any parties that have an interest in or may be impacted by the development of the standard.

PAR item 7.1 – Similar scope

7.1 Are there other standards or projects with a similar scope? (Yes or No)?

No

If yes, please explain:

Help text: Identify any standard(s) or project(s) of similar scope(s), both within or outside of the IEEE, and explain the need for an additional standard in this area.

For any standard(s) or project(s) of similar scope(s) add 'Project slide(s)'

To add: CTRL-M -> right click new slide -> Layout -> select 'Project' layout

PAR item 8.1 – Additional notes

Additional Explanatory Notes:

Item# 2.1, 5.2.b, 5.5, 5.6: The term “metadata” is defined by Merriam-Webster as “data that provides information about other data.” For IEEE 802.3 Ethernet, examples of “metadata” are:

- 1) Information about the data contained within a packet, or
- 2) Information about the Ethernet link and the data it is communicating.

If there is any further information that may assist NesCom in recommending approval for this project, include this information here. The title of any documents referenced in the PAR should be listed here.

IEEE 802.3 Ethernet Metadata Services Study Group

WG Motion - PAR

Move that the IEEE 802.3 Working Group approve the IEEE P802.3dt Ethernet Metadata Services PAR, in <https://mentor.ieee.org/802-ec/dcn/25/ec-25-0218-01-LMSC-draft-ieee-p802-3dt-par.pdf>

M: David Ofelt

S: Gary Nicholl

(Technical $\geq 75\%$)

CSD

Managed Objects

Describe the plan for developing a definition of managed objects. The plan shall specify one of the following:

- a) The definitions will be part of this project.
 - b) The definitions will be part of a different project and provide the plan for that project or anticipated future project.
 - c) The definitions will not be developed and explain why such definitions are not needed.
-
- The definition of protocol independent managed objects, to be included in Clause 30 of IEEE Std 802.3, will be part of this project.

Coexistence

A WG proposing a wireless project shall prepare a Coexistence Assessment (CA) document unless it is not applicable.

- a) Will the WG create a CA document as part of the WG balloting process as described in Clause 13? (yes/no)**
- b) If not, explain why the CA document is not applicable.**

- No. A CA document is not applicable because the proposed project is not a wireless project.

Broad Market Potential

Each proposed IEEE 802 LMSC standard shall have broad market potential. At a minimum, address the following areas:

- a) Broad sets of applicability.
- b) Multiple vendors and numerous users.

- With the rise of Artificial Intelligence (AI) and Machine Learning (ML) workloads, defining metadata service extensions for Ethernet will support a wide range of potential applications which will help Ethernet address markets such as, but not limited to, AI/ML.
- ~~Presentations have been submitted to the study group that illustrate the market adoption of Ethernet in AI/ML applications will be predicated on using metadata services to support features such as Layer Retry (LLR) and Credit-Based Flow Control (CBFC).~~
- Presentations have been submitted to the study group that illustrate the market adoption of Ethernet in AI/ML applications will be predicated on using metadata transfers to support features such as Link Layer Retry (LLR) and Credit-Based Flow Control (CBFC) defined by the Ultra Ethernet Consortium (see <https://ultraethernet.org>). The specification can currently be found at <https://ultraethernet.org/wp-content/uploads/sites/20/2025/10/UE-Specification-1.0.1.pdf>.
- Broad adoption will be enhanced by defining an extensible, interoperable approach to support metadata services for Ethernet.
- There has been wide attendance and participation in the study group by subject matter experts familiar with the needs of end users, equipment manufacturers and component suppliers. It is anticipated that there will be sufficient participation to effectively complete the standardization process.
- At the Call for Interest, held at the July 2025 Madrid Plenary, 40 individuals from 26 affiliations indicated they would support this project.

Compatibility

Each proposed IEEE 802 LMSC standard should be in conformance with IEEE Std 802, IEEE 802.1AC, and IEEE 802.1Q. If any variances in conformance emerge, they shall be thoroughly disclosed and reviewed with IEEE 802.1 WG prior to submitting a PAR to the Standards Committee.

a) Will the proposed standard comply with IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q?

b) If the answer to a) is “no”, supply the response from the IEEE 802.1 WG.

c) **Compatibility with IEEE Std 802.3**

d) **Conformance with the IEEE Std 802.3 MAC**

- As an amendment to IEEE Std 802.3 the proposed project shall comply with IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q.
- As an amendment to IEEE Std 802.3, the proposed project will conform to the full-duplex operating mode of the IEEE 802.3 MAC.
- By utilizing the existing IEEE Std 802.3 MAC protocol, this proposed amendment will maintain compatibility with the installed base of Ethernet nodes.
- The definition of protocol independent managed objects, to be included in Clause 30 of IEEE Std 802.3, will be part of this project.

Distinct Identity

Each proposed IEEE 802 LMSC standard shall provide evidence of a distinct identity. Identify standards and standards projects with similar scopes and for each one describe why the proposed project is substantially different.

Substantially different from other IEEE 802.3 specifications/solutions.

- The proposed amendment will be the first IEEE 802.3 standard to define metadata services.
- The proposed amendment to the existing IEEE 802.3 standard will be formatted as a collection of clauses, making it easy for the reader to select the relevant specification.
- This is the only project providing a physical layer service access point supporting per-packet metadata transfer mechanisms while adding no overhead to the packet, and also supporting packet-independent metadata transfers.

Technical Feasibility

Each proposed IEEE 802 LMSC standard shall provide evidence that the project is technically feasible within the time frame of the project. At a minimum, address the following items to demonstrate technical feasibility:

a) Demonstrated system feasibility.

b) Proven similar technology via testing, modeling, simulation, etc.

c) **Confidence in reliability.**

- The proposed project will build on the array of Ethernet component and system design experience, and the broad knowledge base of Ethernet network operation.
- System and component vendors have provided features using proprietary mechanisms similar to the metadata services to be defined by the proposed project.
- The reliability of Ethernet components and systems can be projected in the target environments with a high degree of confidence.

Economic Feasibility

Each proposed IEEE 802 LMSC standard shall provide evidence of economic feasibility. Demonstrate, as far as can reasonably be estimated, the economic feasibility of the proposed project for its intended applications. Among the areas that may be addressed in the cost for performance analysis are the following:

- a) Known cost factors.
- b) Balanced cost factors.
- c) Consideration of installation costs.
- d) Consideration of operational costs (e.g., energy consumption).
- e) Other areas, as appropriate.

- The cost factors for Ethernet components and systems are well known.
- The proposed project is not expected to alter these cost factors.
- Installation cost is expected to be not different than current installation cost.
- Network design, installation and maintenance costs are minimized by preserving network architecture, management, and software.
- In consideration of operational costs associated with power consumption, the project will have negligible impact.

IEEE 802.3 Ethernet Metadata Services Study Group

WG Motion - CSD

Move that the IEEE 802.3 Working Group approve the IEEE P802.3dt Ethernet Metadata Services CSD “Managed Objects”, “Coexistence”, “Broad Market Potential”, “Compatibility”, “Distinct Identity”, “Technical Feasibility”, and “Economic Feasibility” responses, as per <https://mentor.ieee.org/802-ec/dcn/25/ec-25-0219-01-LMSC-draft-ieee-p802-3dt-csd.pdf>

M: David Ofelt

S: Gary Nicholl

(Technical $\geq$ 75%)

OBJECTIVES

IEEE 802.3 Ethernet Metadata Services Study Group Draft Objectives

Adopted IEEE P802.3dt Objectives

Support full-duplex operation only

Preserve the IEEE 802.3/Ethernet frame format (see IEEE Std 802.3 subclause 3.1.1) at the MAC client service interface

Preserve the minimum and maximum Frame Size of the current IEEE 802.3 standard

Define an optional Per-packet metadata service

Define an optional Packet-independent metadata service, and associated modifications to the physical layers using the:

- 50GBASE-R PCS defined in Clause 133 *
- 100GBASE-R PCS defined in Clause 82, which use FECs defined in Clauses 91 and 161
- 200GBASE-R PCS defined in Clause 119
- 400GBASE-R PCS defined in Clause 119
- 800GBASE-R PCS defined in Clause 172
- 1.6TBASE-R PCS defined in Clause 175

16 Sep 2025 - Pending IEEE 802.3 WG Approval

* Adopted 22 Oct 2025 - Pending IEEE 802.3 WG Approval

IEEE 802.3 Ethernet Metadata Services Study Group

WG Motion - Objectives

Move that the IEEE 802.3 Working Group approve the IEEE P802.3dt Ethernet Metadata Services objectives, as per https://www.ieee802.org/3/EMS/projdoc/objectives_ems_251022.pdf

M: David Ofelt

S: Gary Nicholl

(Technical $\geq 75\%$)

IEEE 802.3 Ethernet Metadata Services Study Group

WG Motion – 1st Recharter Study Group

Move that the IEEE 802.3 Working Group request 1st rechartering of IEEE 802.3 Ethernet Metadata Services Study Group

Moved by David Ofelt on behalf of the study group
(By rule >50%)

Questions?

Thank you!