Suggested PAR and CSD item wording

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Introduction

- This deck further refines the text presented earlier, hopefully to get agreement on PAR & CSD text.
- The 01a update incorporates wording from Dalmia_ISAAC_01_09142023.pdf on Technical Feasibility and Distinct Identity (Economic Feasibility is unchanged)

PAR

Key items: Scope, Need, and Stakeholders

Suggestion for PAR Scope

- Specify additions to and appropriate modifications of IEEE Std 802.3 to add:
  - Physical Layer specifications and management parameters for electrical media and operating conditions for applications in the automotive environment for operation up to 10 Gbps in one direction and up to 100 Mbps in the other direction,

  and
  - A protocol or sublayer for interfacing a physical layer device with different data rate capabilities in the transmit and receive directions to the existing 802.3 MAC with media independent interfaces at existing 802.3 rates.

- If this wording is acceptable, the key point is agreement on the lower-speed direction rate.
  - The CFI deck supports a value of up to 100 Mbps. (it seems we have agreement here)

Suggestion for need/stakeholders section

- **Need –** Automotive in-vehicle *and IoT* networks have begun a transition to Ethernet. Multigigabit links such as imaging sensors at end-nodes of the network where the backchannel is low bandwidth are important parts of this transition. These end-nodes are highly constrained on complexity and power consumption and converting them to Ethernet will require solutions specified for their operating conditions.
- **Stakeholders –** End-users, automotive Original Equipment Manufacturers (car makers) and Tier x automotive suppliers, system integrators, and providers of systems and components (e.g. 4K and 8K cameras, sensors, actuators, artificial intelligence (AI) processors, instruments, controllers, network infrastructure, user interfaces, and servers) for automotive *and IoT* applications.

Highlighted text to include IoT stakeholders for discussion among the study group
Dalmia and I agree, that IoT needs support from contributions, and I'll add it may need more definition
TF could leave IoT out without major issues.

CSDs

CSDs

- ✓ Managed Objects – project will contain objects
- ✓ Coexistence – not a wireless project
- Market Potential – Broad applicability, numerous vendors & users
  - Reference support of the CFI, can use reference presentations on applications
  - Wording is suggested to expansive application of asymmetry in IoT.
- Compatibility –
  - ✓ Compatible with the 802.3 MAC, Compliant with the 802 architecture
  - ✓ Need to double check asymmetric rate compatibility with 802.1 documents
- Economic/technical feasibility –
  - Presentations are being made to the study group this meeting.
  - Wording is proposed to reflect the fact we have multiple ways to get this done.

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.

- Broad Sets of Applicability:
  - Migration of cameras, displays, and other imaging sensors to an automotive ethernet network present an inherently asymmetric data stream with gigabit rates in one direction and a typically low-rate control plane in the other direction.
  - These applications are highly cost and power sensitive and benefit from optimization, requiring a targeted solution
  - Market-adjacent sensor applications will benefit from the standardization of protocols for interfacing natively asymmetric physical layers, as many sensors are asymmetric and similarly constrained to automotive cameras.
- Multiple vendors and numerous users:
  - At the call for interest, 70 individuals from 49 affiliations indicated they would support this project. These included automotive OEMs, automotive Tier 1, networking OEMs, silicon, infrastructure, cabling, connector, and test equipment experts.
  - Data presented at the CFI indicate a substantial automotive market potential, exceeding 1 billion ports in 2030, and with adjacent markets of more than 100 million ports.

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

- The proposed amendment will remain in conformance with IEEE Std 802, IEEE Std 802.1AC, and IEEE Std 802.1Q
- The proposed amendment will conform to existing IEEE 802.3 MAC specifications

- Notes:
  - wording has avoided the confusion on "full duplex",
  - Wording is minimal, to not make any detailed choices on the MAC beyond existing 802.3 MACs, and to avoid the term "PHY project" as this doesn't include the RS or any client work.

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.

- Distinct identity –
  - There are no reconciliation sublayers in IEEE Std 802.3 that support connecting PHYs with asymmetric data rate limitations to the MAC without an additional MAC control sublayer.
  - There are no IEEE 802.3 standards that support 1 gigabit or greater data rates in one direction, but are limited to 100 Mbps maximum data in the opposite direction.
- Notes:
  - Wording has been made more precise to exclude EPON, and to allow objectives of 1 Gb/s to be added without conflict.
  - Other clauses don't need to be specifically called out since we are commenting on the existing 802.3 standard and there are no similar ACTIVE projects.
  - Adopted Dalmia statement on PHY rates, it is cleaner, amended it to be broader (and still true) in case the project decides to pursue a 1Gbps downstream rate.
  - Dalmia suggestion to comment on how different PHYs produced by the proposed project might relate to each other isn't required by the CSD question (saying less is more)

Updates on Technical Feasibility

- Modified ‘proven operation’ to combine with Dalmia. Presentations aren’t ‘proven operationally’ but they can be used to extend the operational proof to asymmetry.
- Suggest leaving presentations on cabling out. PHY proposals have used proven cabling models from existing automotive media.
- Adopted Dalmia presentation language (without cabling) as the notion of multiple approaches will be dated and suggest the project may actually select multiple approaches to solve the same problem.

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.
- Transmission at multi-gigabit rates over electrical media has been proven technically and operationally at up to 25 Gb/s rates. Presentations have shown feasibility extends to asymmetric rates.
- Component vendors, including PHY vendors and systems subject matter experts have presented data on the feasibility of the necessary components for this project relevant to applications. Approaches which leverage existing technologies have been provided.
- 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.

- Ethernet interfaces in the target data rate range defined by this project will maintain a favorable cost-performance balance.
- The balance of costs between infrastructure and attached stations is not applicable to the automotive environment.
- The cost factors for Ethernet components and systems are well known. The proposed project may introduce new cost factors which can be quantified.
- Prior experience in the development of other physical layer specifications for Ethernet indicates that the specifications developed by this project will entail a reasonable cost for the resulting performance.
- The reduction in the number of legacy networks requiring specialized components, expertise, and gateways in the targeted markets will result in a significant drop in both installation and operational costs.
- Overall costs are minimized by introducing Ethernet network architecture, management, and software into the automotive environment.
- The use of asymmetric optimized physical layers will result in further reductions in power and cost, as well as operational simplicity.

Objectives

Generic Automotive Objectives

- Preserve the IEEE 802.3/Ethernet frame format at the MAC client service interface
- Preserve minimum and maximum frame size of the current IEEE 802.3 standard
- Support operation in automotive environments (e.g., EMC, temperature)
- Do not preclude meeting FCC and CISPR EMC requirements.

- Note – “support full-duplex” objective is dropped, as a review of specifications confirms that it is generally not seen in 802.3 projects with asymmetry.

Common objectives requiring a little discussion

- Do not preclude power delivery over the link segment
  - Do we need to say more? (would need contributions)
- Define optional startup procedure which enables the time from power_on=FALSE to a state capable of transmitting and receiving valid data to be less than 100 ms
  - Competition starts up faster than 100ms – do we need to too? (would need contributions)
- Suggest we leave these for later (post-Oct) discussion:
  - Support optional auto-negotiation
  - Support optional energy-efficient ethernet
  - Support for TSN elements (need to get specific)
  - Any latency requirement

Speeds and reach

- Define the performance characteristics of an automotive link segment supporting up to four inline connectors for at least 11m on both automotive coax and shielded balanced pair media and an electrical PHY to support up to 10 Gb/s point-to-point operation over this link segment in one direction and up to 100 Mb/s in the other direction over the link segment.

Notes:

- Reach taken from 802.3cy, as a reasonably justified number – others can be justified, but setting the number lower allows for longer reach to be pursued
- Presentations confirm coax & STP feasibility at data rates
- Presentations confirm multiple methods of reaching these goals

Reconcilation Sublayer

- Define a reconciliation sublayer (including any necessary client interfaces) to coordinate the PHY’s speed capabilities with the MAC’s operation

This is a generic suggestion for discussion

BACKUP / REFERENCE

Reconciliation Sublayer Comparison

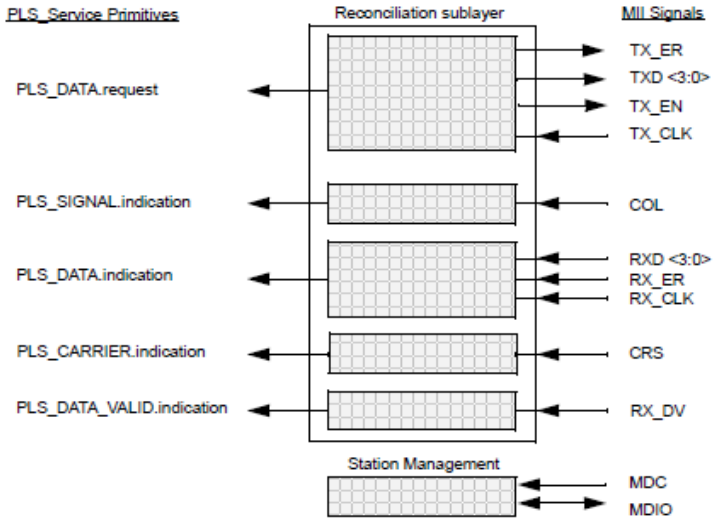


Figure 22–3—Reconciliation Sublayer (RS) inputs and outputs, and STA connections to MII

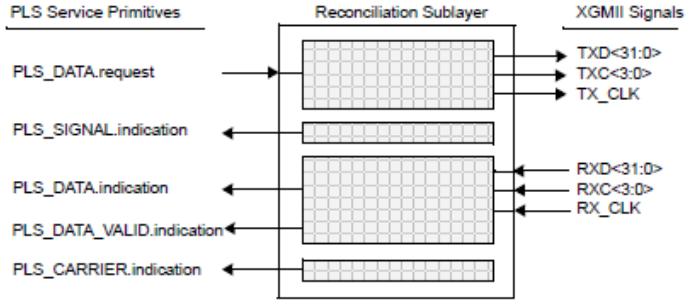


Figure 46–2—Reconciliation Sublayer (RS) inputs and outputs

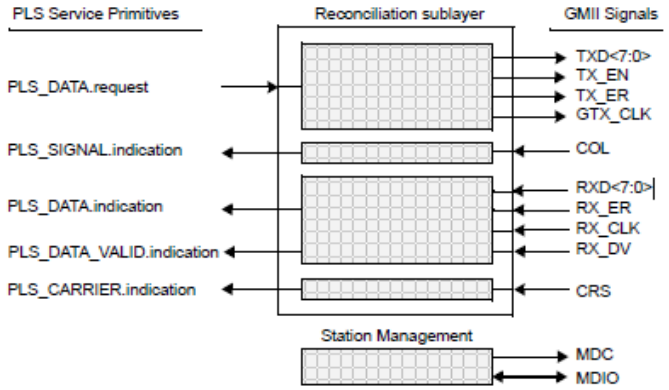
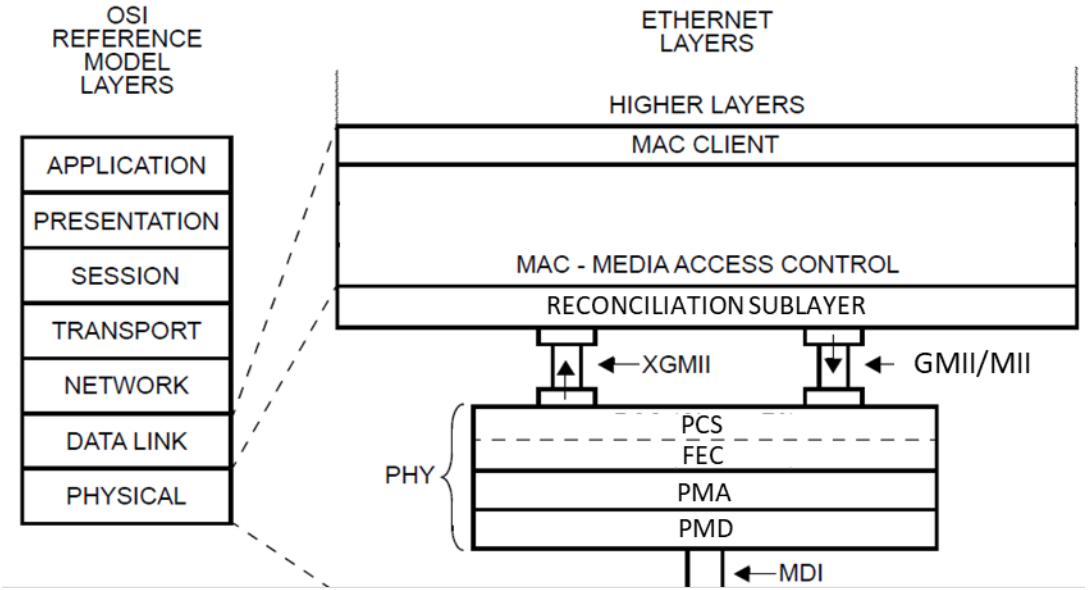


Figure 35–2—Reconciliation Sublayer (RS) inputs and outputs and STA connections to GMII

- Same primitives (driven by the MAC)
- Different Clocks
  - GMII, XGMII – clock goes in data direction (TX/RX)
  - MII – clock always comes from the PHY
- Different Control
  - MII, GMII – separate control signals
  - XGMII – encoded control sets
- Different Alignment
  - MII – nibble, GMII – byte, XGMII – 4 bytes

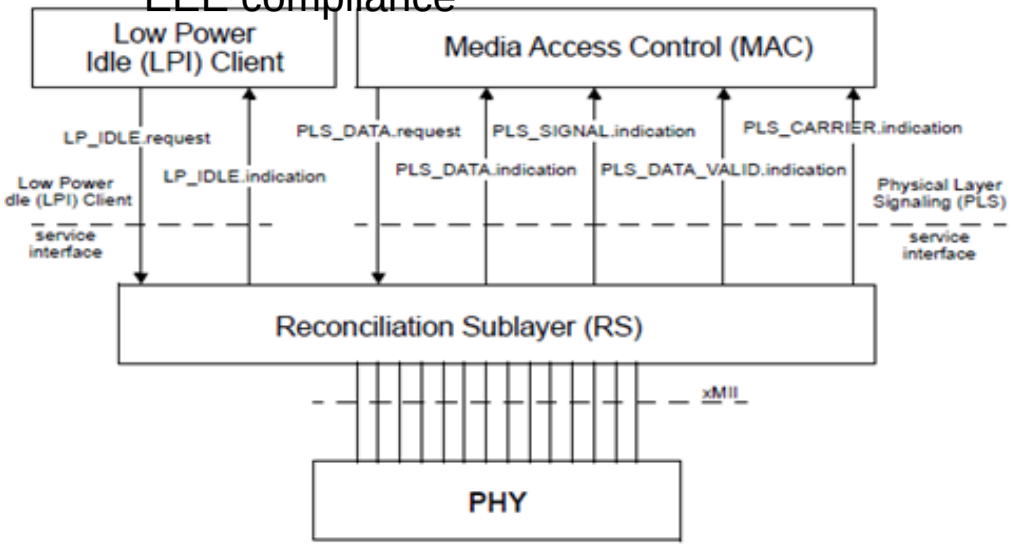
RS – Technical Feasibility
Two proven ways to limit rate towards a PHY

- "Dual Headed" RS, fixed rate (similar to EPON)
  - Needs definition (not just EPON, at least RS)
  - Fixes rates in specification



Source: IEEE Std 802.3-2022, Figure 56-5 (modified)

- Deferral/Client-driven RS (similar to EEE)
  - Operation based on primitives, flexible rates
  - Undefined client operation can't be relied on to interoperably defer MAC
  - Specifications on LPI client may impact existing EEE compliance



Source: IEEE Std 802.3-2022, Figure 78-1

THESE ARE ONLY 2 EXAMPLES – THERE ARE OTHER POSSIBILITIES