PAR Scope and Physical Layer Rates between 10 Gbps and 25 Gbps

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- Frank Wang, Realtek
- Peter Wu, Marvell

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Issues in the ISAAC Study Group

Many Points of Consensus:

- Support rates from the camera of: 2.5 Gb/s, 5 Gb/s, 10 Gb/s
- Support of both Coax & STP
- Support powering over the media
- Support rates to the camera of 100 Mb/s
- Support at least 15 m reach, 4 connectors on 2.5 Gb/s, 5 Gb/s, 10 Gb/s

Key Points of Discussion:

- Need and objectives for optional Auto-negotiation and EEE support
- Support for rates of 1 Gb/s from the camera
- Support for rates greater than 10 Gb/s (up to 25 Gb/s) from the camera

Of these, reaching closure on whether the PAR Scope allows rates greater than 10 Gb/s (and with what restrictions) is THE ONLY one in the critical path to becoming a Task Force!

Straw Poll #3 from November

Still no consensus on rates higher than 10 Gbps

Straw Poll #3:

I would support the following paths forward (Pick as many as you wish):

A. Include 25Gbps in the PAR and the Objectives

B. Include 25Gbps in Objectives, but PAR does not contain fixed rate limits for fast direction

C. Include 25Gbps in the PAR, but not the Objectives

D. Exclude 25Gbps from both the PAR and the Objectives

E. Abstain

Results: (from 58 total)

A: 26/58 = 45%

B: 24/58 = 41%

C: 21/58 = 36%

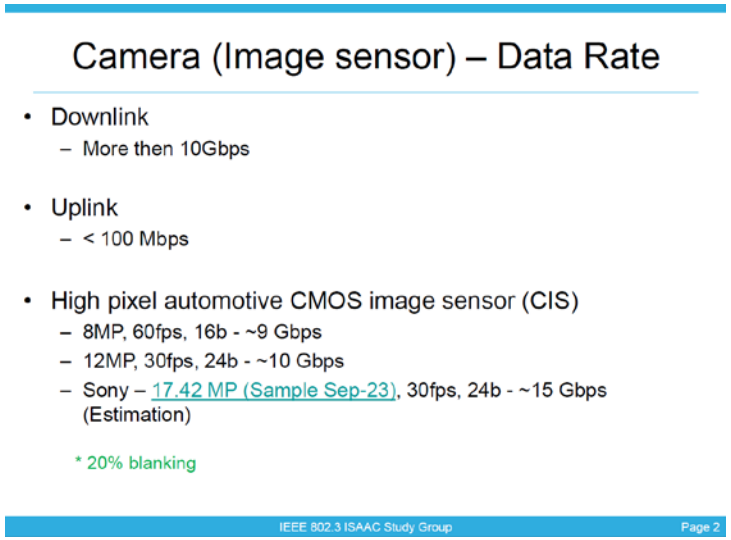
D: 17/58 = 29%

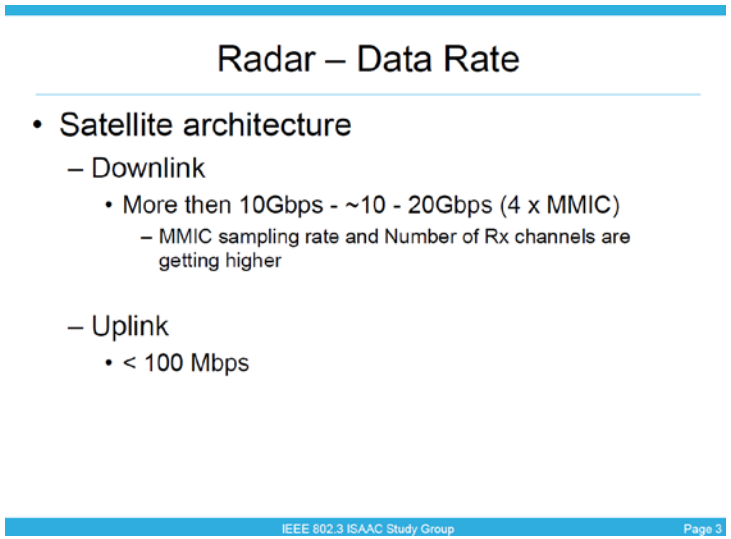
E: 13/58 = 22%

Not Asked – no fixed "fast direction" rate limit in the PAR, but no 25 Gbps objective

Interest in rates between 10 & 25 Gbps *(but not AT 25 Gbps)*

(ringle_ISAAC_01v4_092723.pdf)





Other solutions (e.g., MIPI or ASA) may serve this need with specified support for rates between 10 & 25 Gbps

< 25 Gbps, usually 12.5 to 15 Gbps

See, e.g., (steyer-ege) 20231114_On_the_need_for_25Gbps_updated_post_presentation.pdf, or (lasry) https://www.ieee802.org/3/ISAAC/email/msg00070.html

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Options Discussed

If the PAR Scope says “up to 10 Gb/s”
- Changes to XGMII would need to be written so as not to effect 25GMII (which is specified by reference to XGMII)
- Any changes to the 25GMII (and higher rate) would be out of scope
- Task Force cannot even discuss consideration of PHYs with rates greater than 10 Gb/s

If the PAR Scope says “up to 25 Gb/s”
- Changes to GMII, XGMII, and 25GMII would be in scope
- Task Force can consider PHYs with rates up to 25 Gb/s
- No commitment to producing a 25 Gb/s specification is made

If the PAR Scope has no upper rate limit
- Changes to all xMIIs (even to 50GMII) would be in scope
- Task Force can consider PHYs with any downstream rate

This presentation explores a new option to enable discussion of PHY rates between 10 and 25 Gbps

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Limits on what we can do

Study Group Charter

- 802.3 limit on what kinds of scope the study group can propose in a PAR
- “an electrical physical layer specification and related functionality of a client optimized for automotive end-node cameras”

PAR Scope

- Limits what the Task Force can put in a draft
- SA voters can reject a draft because it goes outside the PAR Scope

CSDs

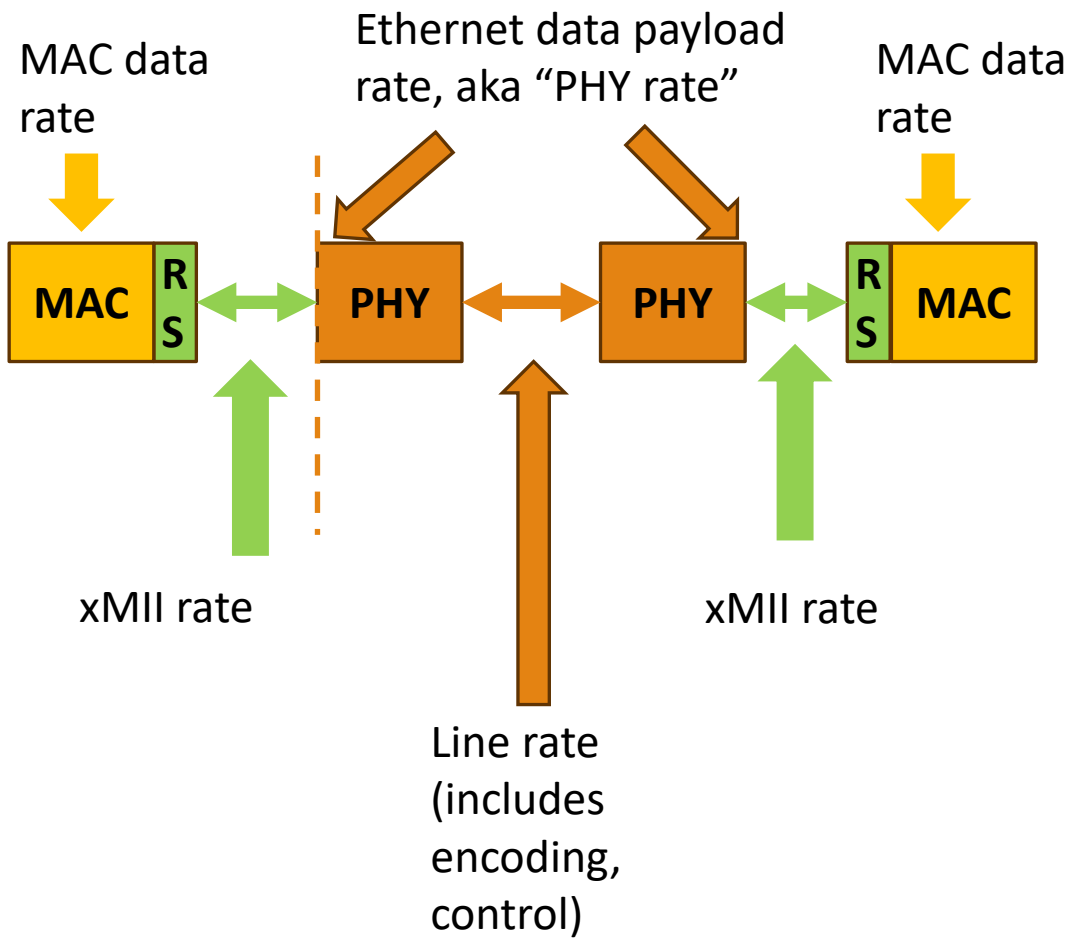
- Limits objectives to (Ethernet)-compatible, technically & economically feasible solutions, supported by multiple vendors and customers (Broad Market Potential)

The Study Group Charter limits us to Physical Layer – No new “MAC data rate”… meaning we can’t touch Clause 4.

What about PHYs > 10 Gb/s and < 25 Gb/s

Study Group charter only allows Physical Layer and associated client work – not MAC work

- Adding a new "MAC data rate" requires changes to Clause 4 – out of scope
- Adding "PHY rates" other than 25 Gbps would be In Scope
- Is a new xMII rate the same thing as the "MAC data rate" in Clause 4?



The “MAC data rate”

Mentioned in IEEE Std 802.3-2022 at 4.4.4.2 – but NOT a defined term.

Relates to parameters in Table 4-2

Table 4-2 lists various parameter values for the clause 4 MAC per “existing 802.3 rates”

- All the parameters between 2.5 Gb/s and 400 Gb/s are identical except for the fixed ipgstretchratio of 10 Gb/s (used for WIS)

BUT THE PRECISE MAC SPEC (4.2 & pascal code) IS RATELESS

What about the clock rate on the xMII?

The RS is physical layer (but not technically part of the “PHY”)

The RS defines an interface to the PHY (the xMII) and interfaces to the MAC via primitives

The “clock” speed of the xMII is PHYSICAL Layer

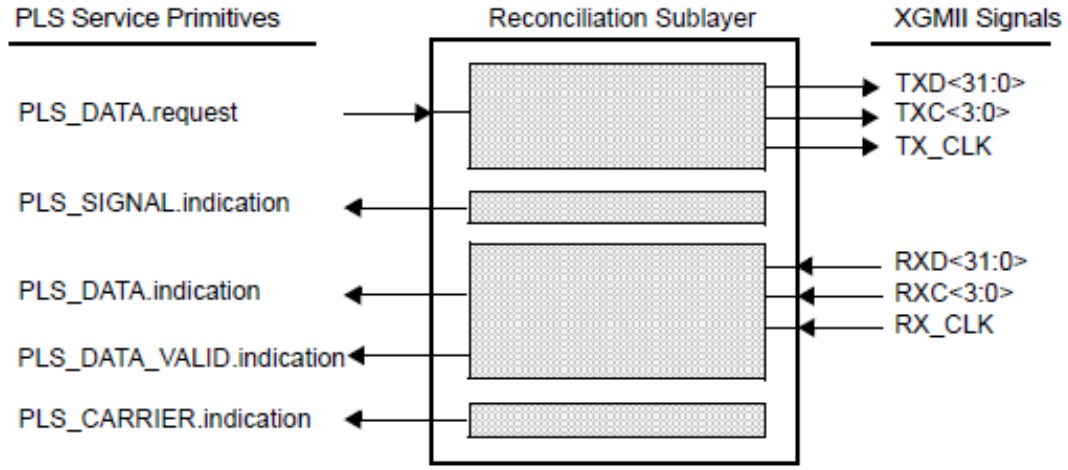


Figure 46–2—Reconciliation Sublayer (RS) inputs and outputs

Source: IEEE Std 802.3-2022

The primitives to the MAC are bitwise serial and instantaneous

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NOTE – separate implementations from specification

PLS_DATA.request(and indication) primitives are called from the rateless MAC

6.3.1.1 PLS_DATA.request

6.3.1.1.1 Function

This primitive defines the transfer of data from the MAC sublayer to the local PLS entity.

6.3.1.1.2 Semantics of the service primitive

The primitive shall provide the following parameters:

PLS_DATA.request (OUTPUT_UNIT)

The OUTPUT_UNIT parameter can take on one of three values: ONE, ZERO, or DATA_COMPLETE and represent a single data bit. The DATA_COMPLETE value signifies that the Media Access Control sublayer has no more data to output.

6.3.1.1.3 When generated

This primitive is generated by the MAC sublayer to request the transmission of a single data bit on the physical medium or to stop transmission.

6.3.1.1.4 Effect of receipt

The receipt of this primitive will cause the PLS entity to encode and transmit either a single data bit or to cease transmission.

Source: IEEE Std 802.3-2022

The RS transfers rateless primitives from the MAC to the PHY's rate-defined xMII

The RS specifies that multiple primitives are used to form the multi-bit words on the xMII side

- The RS Groups primitive requests into xMII transfers
- The RS does not specify the primitive timing

46.1.7.1 Mapping of PLS_DATA.request

46.1.7.1.1 Function

Map the primitive PLS_DATA.request to the XGMII signals TXD<31:0>, TXC<3:0>, and TX_CLK.

46.1.7.1.2 Semantics of the service primitive

PLS_DATA.request (OUTPUT_UNIT)

. . .

46.1.7.1.4 Effect of receipt

The OUTPUT_UNIT values are conveyed to the PHY by the signals TXD<31:0> and TXC<3:0> on each TX_CLK edge. Each PLS_DATA.request transaction shall be mapped to a TXD signal in sequence (TXD<0>, TXD<1>,... TXD<31>, TXD<0>) as described in 46.2. After 32 PLS_DATA.request transactions from the MAC sublayer (four octets of eight PLS_DATA.request transactions each), the RS requests transmission of 32 data bits by the PHY. The first octet of preamble shall be converted to a Start control character and aligned to lane 0. The TXD<31:0> and TXC<3:0> shall be generated by the RS for each 32 bit-times of the MAC sublayer.

Source: IEEE Std 802.3-2022 (emphasis added)

15 Gbps PAR Scope Proposal

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Possible Path Forward

As a Physical Layer project, we MAY specify an RS with an xMII at a rate between 10 Gbps and 25 Gbps, without specifying a new Ethernet rate

- Yes, I know, I have said otherwise in the past, but this is after careful review & consultation with experts
- We MIGHT want to say in the specification that the RS uses a particular column in Table 4-2, but that would be in the RS clause

No proposed Objective > 10 Gbps at this time.

Limit the data rate in the PAR scope at the MAC/PLS service interface.

Work to resolve what rates, if any are needed prior to May 2024 meeting (likely first Task Force or last study group meeting)

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Proposed 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 optimized for automotive end-node cameras supporting operation at video data rates up to ***15 Gbps*** in one direction and a lower data rate 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

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Thank you

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Alternative Wording

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 optimized for automotive end-node cameras for operation with data rates up to ***15 Gbps*** at the MAC/PLS service interface in one direction and with a lower data rate 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.

Note (not part of PAR scope) – We may wish to increase the 15 Gbps a little to give us a little margin in case 15 Gbps payload is a little too tight with protocol overhead (e.g., 16 or 17 – but the work should target 15 Gbps)

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Alternative Wording (2)

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 optimized for automotive end-node cameras for operation for the transfer of Ethernet frames at a rate of ***15 Gbps*** in one direction and with a lower data rate 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.