On adding 25Gbps to ISAAC text

Contribution to ISAAC Study Group

Ragnar Jonsson
Marvell

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Introduction

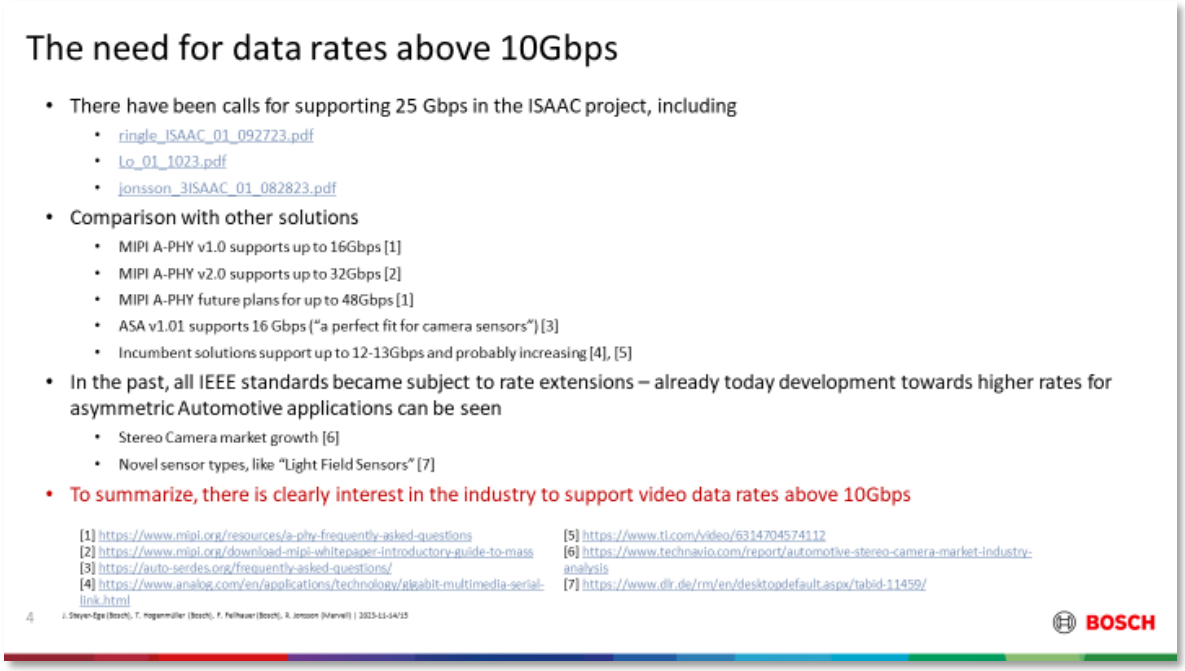
In this presentation we look into the effort and complexity of adding 25Gbps to ISAAC standard text:

- There is interest in supporting rates above 10Gbps
- It was previously stated that supporting 25Gbps would not significantly complicate the text or delay the project
- As an experiment, I have created an example text for how 25Gbps might be supported the ISAAC specification
- The text experiment shows that adding 25Gbps to the ISAAC standard can be relatively simple, **with less than 10% additional text**

Need for higher data rates

- The interest in data rates above 10Gbps was discussed in
  https://www.ieee802.org/3/ISAAC/public/1123/20231114_On_the_need_for_25Gbps_updated_post_presentation.pdf

- The primary argument against supporting 25Gbps in the ISAAC standard is that this may complicate the standard



The need for data rates above 10Gbps

- There have been calls for supporting 25 Gbps in the ISAAC project, including
  - ringle_ISAAC_01_092723.pdf
  - Lo_01_1023.pdf
  - jonsson_3ISAAC_01_082823.pdf
- Comparison with other solutions
  - MIPI A-PHY v1.0 supports up to 16Gbps [1]
  - MIPI A-PHY v2.0 supports up to 32Gbps [2]
  - MIPI A-PHY future plans for up to 48Gbps [1]
  - ASA v1.01 supports 16 Gbps ("a perfect fit for camera sensors") [3]
  - Incumbent solutions support up to 12-13Gbps and probably increasing [4], [5]
- In the past, all IEEE standards became subject to rate extensions – already today development towards higher rates for asymmetric Automotive applications can be seen
  - Stereo Camera market growth [6]
  - Novel sensor types, like "Light Field Sensors" [7]
- To summarize, there is clearly interest in the industry to support video data rates above 10Gbps

[1] https://www.mipi.org/resources/a-phy-frequently-asked-questions
[2] https://www.mipi.org/download-mipi-whitepaper-introductory-guide-to-mass
[3] https://auto-serdes.org/frequently-asked-questions/
[4] https://www.analog.com/en/applications/technology/gigabit-multimedia-serial-link.html
[5] https://www.ti.com/video/6314704574112
[6] https://www.technavio.com/report/automotive-stereo-camera-market-industry-analysis
[7] https://www.dlr.de/rm/en/desktopdefault.aspx/tabid-11459/

4 J. Steyer-Ege (Bosch), T. Hogenmiller (Bosch), F. Fellhauer (Bosch), R. Jonsson (Marvell) | 2023-11-14/15

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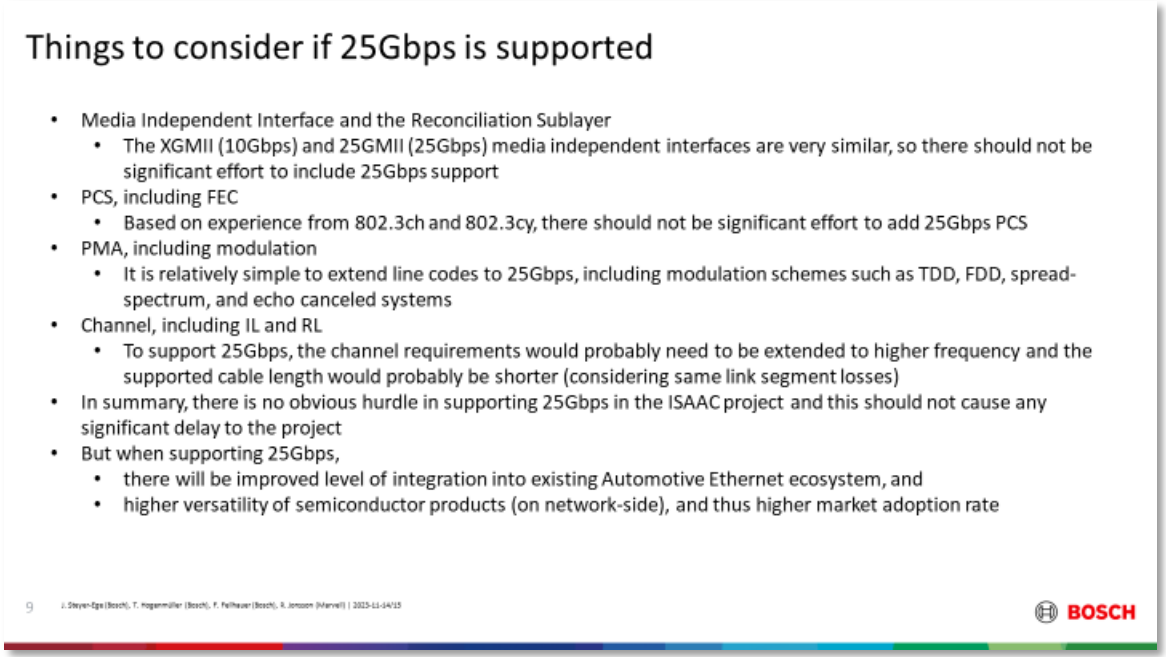
From: https://www.ieee802.org/3/ISAAC/public/1123/20231114_On_the_need_for_25Gbps_updated_post_presentation.pdf

There is clearly interest in the industry to support video data rates above 10Gbps

Motivation for this presentation

- This presentation is motivated by discussion about slide 9 of [On_the_need_for_25Gbps_updated_post_presentation.pdf]
- The presentation stated that adding 25Gbps was relatively small effort that should not cause significantly delay to the ISAAC project
- This statement was questioned by at least one participant in the discussion
- This presentation is intended to demonstrate the relative simplicity of adding 25Gbps



Things to consider if 25Gbps is supported

- Media Independent Interface and the Reconciliation Sublayer
  - The XGMII (10Gbps) and 25GMII (25Gbps) media independent interfaces are very similar, so there should not be significant effort to include 25Gbps support
- PCS, including FEC
  - Based on experience from 802.3ch and 802.3cy, there should not be significant effort to add 25Gbps PCS
- PMA, including modulation
  - It is relatively simple to extend line codes to 25Gbps, including modulation schemes such as TDD, FDD, spread-spectrum, and echo canceled systems
- Channel, including IL and RL
  - To support 25Gbps, the channel requirements would probably need to be extended to higher frequency and the supported cable length would probably be shorter (considering same link segment losses)
- In summary, there is no obvious hurdle in supporting 25Gbps in the ISAAC project and this should not cause any significant delay to the project
- But when supporting 25Gbps,
  - there will be improved level of integration into existing Automotive Ethernet ecosystem, and
  - higher versatility of semiconductor products (on network-side), and thus higher market adoption rate

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From: https://www.ieee802.org/3/ISAAC/public/1123/20231114_On_the_need_for_25Gbps_updated_post_presentation.pdf

Methodology of this presentation

I did a small experiment to analyze the effort of adding the 25Gbps data rate to standard text that already supports 2.5Gbps, 5Gbps, and 10Gbps:

- My example text is primarily based of the text in clause 149 (802.3ch)
- I updated the text to describe and asymmetric FDD based system with 2.5Gbps, 5Gbps, and 10Gbps in downstream, and 100Mbps upstream
- I then added support for 25Gbps to the text

My drafted text example was for an FDD system based on 802.3ch and 802.3cy, but similar example could have been generated based on the ASA text that has been liaised to 802.3

Example Text Changes

- The text examples on this slide are typical for what is needed to support 25Gbps in the ISAAC text
- All changes to the text to support 25Gbps are highlighted in **dark red**
- The text on the top right is mainly adding 25Gbps to the list of supported rates
- The text at the bottom right is an example of where the inclusion of 25Gbps is slightly more complicated

This text is for demonstration purposes only and should not be considered a text proposal

XXX. Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer, and baseband medium, asymmetric type 2.5G/100M-BASE-T1, 5G/100M-BASE-T1, 10G/100M-BASE-T1, and #25G/100M-BASE-T1

XXX.1 Overview

This clause defines asymmetric PHY with 100Mbps in one direction and 2.5Gbps, 5Gbps, 10Gbps, and #25Gbps, in the other direction. The 100Mbps PCS and PMA are defined in this sub clause, but the PCS and PMA for the high speed direction is defined in Clause 149 and Clause 165, with modifications described in this clause.

The type 2.5G/100M-BASE-T1, 5G/100M-BASE-T1, 10G/100M-BASE-T1, and #25G/100M-BASE-T1 Physical Coding Sublayer (PCS) as well as the 2.5G/100M-BASE-T1, 5G/100M-BASE-T1, 10G/100M-BASE-T1, and #25G/100M-BASE-T1 Physical Medium Attachment (PMA) sublayers. Together, the corresponding PCS and PMA sublayers comprise a 2.5G/100M-BASE-T1, 5G/100M-BASE-T1, 10G/100M-BASE-T1, or #25G/100M-BASE-T1 Physical Layer (PHY). Provided in this clause are functional and electrical specifications for the type 2.5G/100M-BASE-T1 PCS and PMA, 5G/100M-BASE-T1 PCS and PMA, 10G/100M-BASE-T1, and #25G/100M-BASE-T1 PCS and PMA.

XXX.5 PMA electrical specifications

The PMA electric specifications for 2.5G/100M-BASE-T1, 5G/100M-BASE-T1, and 10G/100M-BASE-T1 are as described in Clause 149.5 with the exceptions in this sub-clause.

The PMA electric specifications for #25G/100M-BASE-T1 are as described in Clause 165.5 with the exceptions in this sub-clause.

XXX.6 Management interface

2.5G/100M-BASE-T1, 5G/100M-BASE-T1, 10G/100M-BASE-T1, and #25G/100M-BASE-T1 make extensive use of the management functions that may be provided by the optional MDIO (Clause 45), and the communication and self-configuration functions provided by the optional Auto-Negotiation (Clause 98).

Key Observations from the Example Text Experiment

- The example text is primarily based of the text in clause 149 (802.3ch)
- Most of the text from clause 149 could be used for asymmetric FDD text with no or little change
- Most of the effort on updating the text was to support asymmetric operation
- The text for 25Gbps is **less than 10% of the overall text**
- Adding the 25Gbps text was **less than 2% of the overall effort**

Summary

- There is interest in having the ISAAC standard supporting data rates above 10Gbps, but some have concerns that this may complicate the standard
- The text experiment described in this presentation, evaluated the additional complexity and effort of supporting 25Gbps in the ISAAC standard
- This experiment shows that adding text to support 25Gbps will probably add **less than 10%** to the text and be **less than 2% to the effort**

Adding 25Gbps data rate will NOT overcomplicate the ISAAC text

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