Pros and cons from the perspective of an individual affiliated with a car OEM

IEEE 802.3dm
November 13, 2024

Kirsten Matheus, BMW Group

Motivation

- A number of presentations shown in this TF and publicly at conferences have presented TDD, ASA-ML, or ASA-MLE as a very bad choice for automotive asymmetric high-speed communication.
- Some simulation results were used to back the statements made (and presented with honest conviction).
- At a car manufacturer such as BMW, there is no infrastructure in place to verify simulation results that relate to semiconductor implementations.
- Instead, as an individual affiliated with a car manufacturer, this author has to rely on experiences gained from real implementations. These are available for proprietary SerDes technologies, as well as TDD-based ASA-ML.
- This presentation discusses pros and cons based on the experience with these implementations.

Agenda

- Experiences with real implementations
- Pros and cons comparison items
  - Complexity
  - EMC performance
  - Timeline
  - Supplementing specifications/eco system
- Summary and conclusion

Real life implementations

- Since November 2022, BMW has publicly displayed various setups with TDD-based ASA-ML implementations.*)
- These included
  - ASA-ML implementations from four different silicon vendors
  - Imagers from four different imager suppliers
  - Camera implementations from minimum four suppliers
  - Live control of camera settings
  - Single serializers, single/quad deserializers, aggregation
  - Processing on two different SoC platforms
  - Different cable types and length
  - Power over coaxial power supply
  - Transmission over Ethernet backbone
  - Different displays

*) As a side product of the qualification work done for series production.

Real-life take-aways

The ASA-ML ICs have shown

- Competitive power consumption (in comparison with incumbents)
- Competitive complexity (in comparison with incumbents)
- Low effort power over circuitry
- Robust EMC performance.

- In not a single one of these implementations has latency ever come up as an issue.

- There is a growing eco-system.

Multi-vendor environment for ASA-ML*)**)

- **AVIVA Links**
- Broadcom
- **Jinglue Semiconductor (JLsemi)**
- Nanjing Rsemi Technology
- OMNIVISION
- Realtek
- ROHM
- Silicon Auto
- **Sony Semiconductor Solutions**
- **VSI, a Microchip company**

Those, who have presented unfavorable simulation results for TDD/ASA-ML/ASA-MLE are affiliated with three other companies.

Where is the disconnect?

*) ASA Successfully Establishes Multi-Vendor Market for Camera and Display Connectivity - Automotive Serdes Alliance (auto-serdes.org)

**) In bold, companies, who have publicly displayed their ASA-ML implementations

Complexity discussion limited to low-speed receiver

Simulation results for new ACT solution suggest it needs:

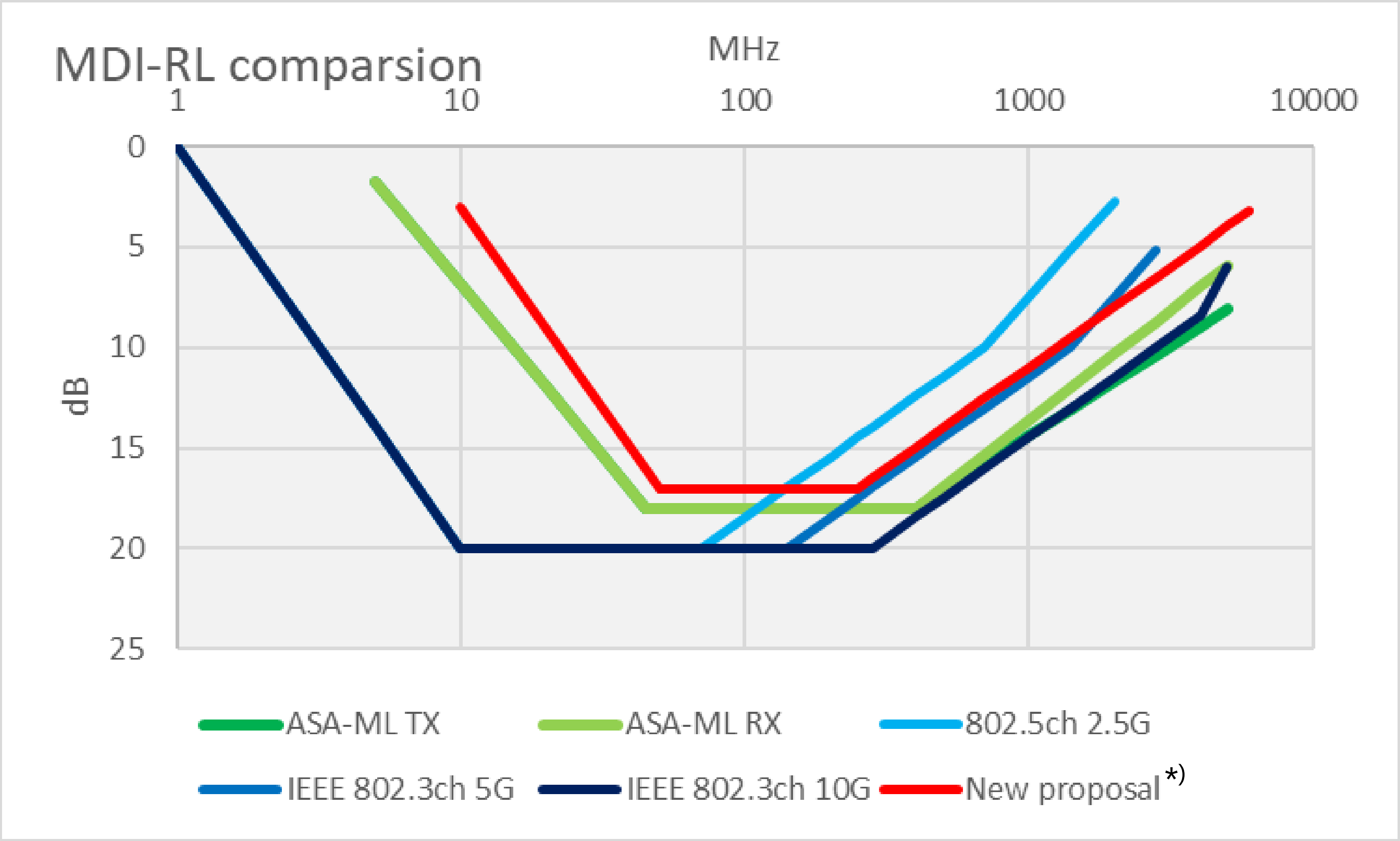
- No equalizer
- No echo canceller
- No crystal
- Very relaxed MDI-RL

Leading to a 4x smaller footprint than TDD/ASA-ML/ASA-MLE

Personal observations:

- Even 10BASE-T1S requires some processing, the dm uplink is 10 times faster.
- All incumbent solutions perform some echo cancelling.
- Crystal-less is a later optimization.
- 802.3ch requires more stringent MDI-RL.
- EMC robustness of TDD-based ASA-ML is proven with real implementations, whose complexity is competitive to the incumbents.
- How long before there is real-life proof for ACT?

MDI return loss comparison



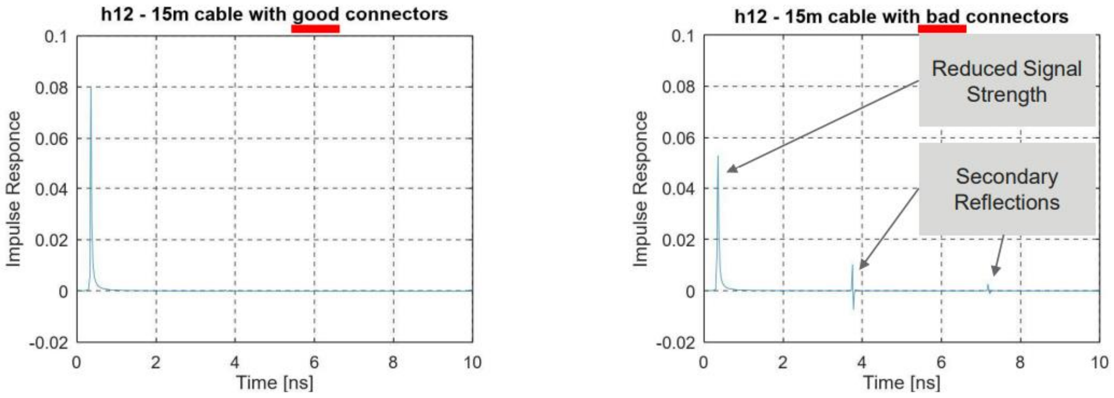
Why did 802.3ch extend to such a low frequency, if it could also work with significantly relaxed requirements?

*) https://ieee802.org/3/dm/public/0724/jonsson_houck_3dm_02_07_15_24.pdf

„Bad connector“ example

In https://www.ieee802.org/3/dm/public/0924/jonsson_3dm_02_09_15_24.pdf a bad connector example was given that would require a >300 tap equalizer to yield a reasonable BER in a TDD system without echo canceller.

Good vs Bad Connectors – Impulse Response



Bad connectors can cause secondary reflections that arrive after the main signal

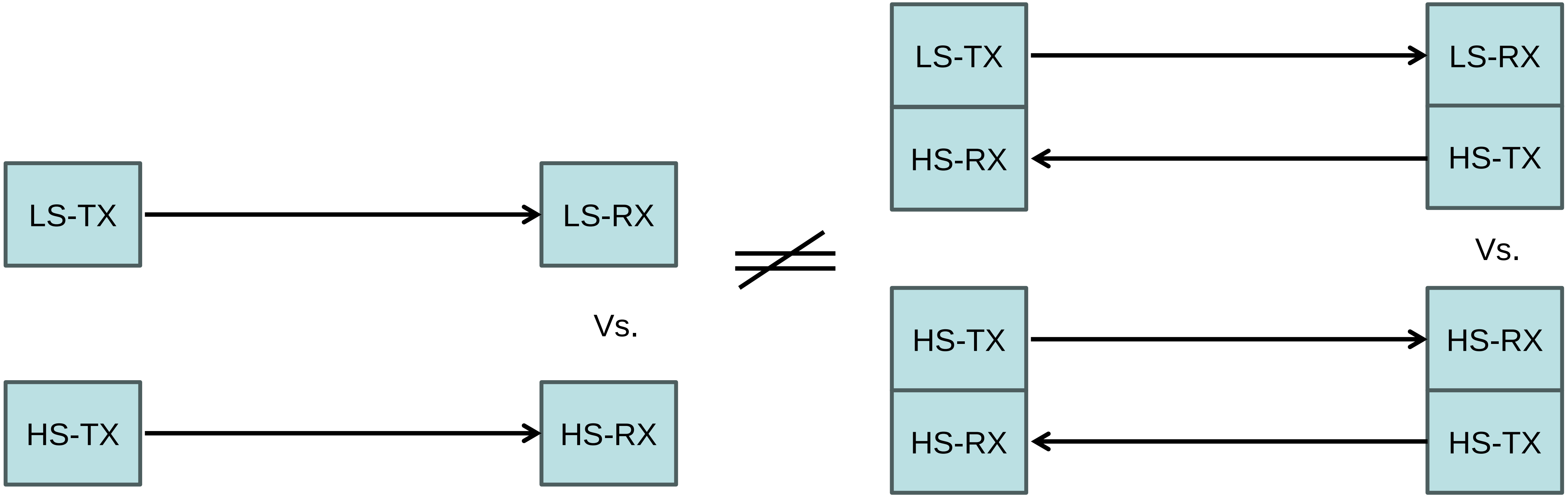
The author intended to test existing ASA-ML and IEEE 802.3ch solutions with a cable having the bad connector impulse response. It turned out that

- This cable does not exist
- If it existed it would not meet the limit lines
- State of the art floating tap equalizers may easily mitigate respective effects.

Comparison of complete transceiver

Most complexity comparisons seem to compare just a LS receiver with a HS receiver, which leads to unnecessarily unfavorable results.

The author expects that synergies between HS transmitter and HS receiver can be exploited if assessed in conjunction, mitigating some of the differences.



Example for required support specifications

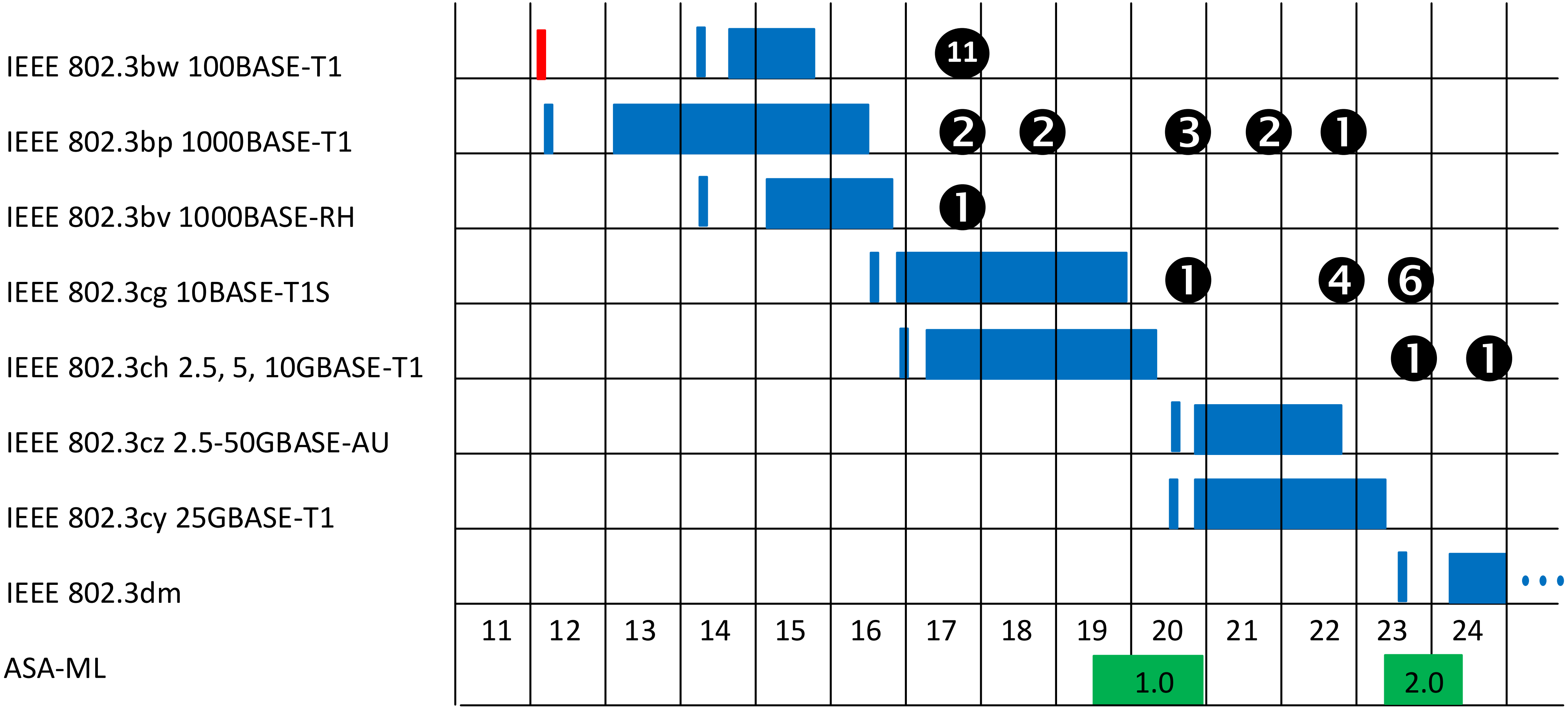
OPEN ALLIANCE

100Mbit/s specifications

- 100BASE-T1 System Implementation Specification
- 100BASE-T1 Advanced Diagnostic PHY features
- 100BASE-T1 Interoperability Test Suite
- 100BASE-T1 PHY Control Test Suite
- 100BASE-T1 Physical Coding Sublayer Test Suite
- 100BASE-T1 Channel and Component Requirements
- 100BASE-T1 Physical Media Attachment Test Suite
- 100BASE-T1 Sleep/Wake-up Specification
- 100BASE-T1 EMC Test Specification for Common Mode Chokes
- 100BASE-T1 EMC Test Specification for Transceivers
- 100BASE-T1 EMC Test Specification for ESD Suppression Devices

A similar set of specifications is developed for every single automotive Ethernet PHY

Supporting specs indicate maturity and timeline



❶ Number of supporting specifications published by the OPEN Alliance

ASA-ML eco-system beyond silicon suppliers

Supplementary specifications already in development

- EMC Test Specification for ASA-ML Transceivers
- ASA Channel and Components Test Specification
- ASA Interoperability Test Suite
- ASA Compliance Test Suite for PMA Electrical Tests
- ASA PHYC and PCS Test Specification

Directly reusable when same channel limit lines are adopted by IEEE 802.3dm

The more IEEE 802.3dm leverage, the more may be reused also from these specifications

Publicly announced active tool vendor involvement*)

- Bitifeye
- Keysight
- Rohde & Schwarz
- Teledyne-LeCroy

*) First ASA Plugfest for PMA Electrical CTS Demonstrates Reliability of ASA-ML Automotive High-speed Connectivity. - Automotive Serdes Alliance

Summary and conclusion.

- There is a disconnect between some of the simulation results presented in the TF and the experiences with real implementations made by the author.
- Either some of the assumptions made for the TDD/ASA-ML/ASA-MLE simulations are too pessimistic or the simulated disadvantages have significantly less impact in the real implementations.
- Timeline and reuse of the established eco-system speak for leveraging as much as possible from ASA-ML for IEEE 802.3dm.

Thank You!