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EMI considerations and measurement

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(11/11/24)

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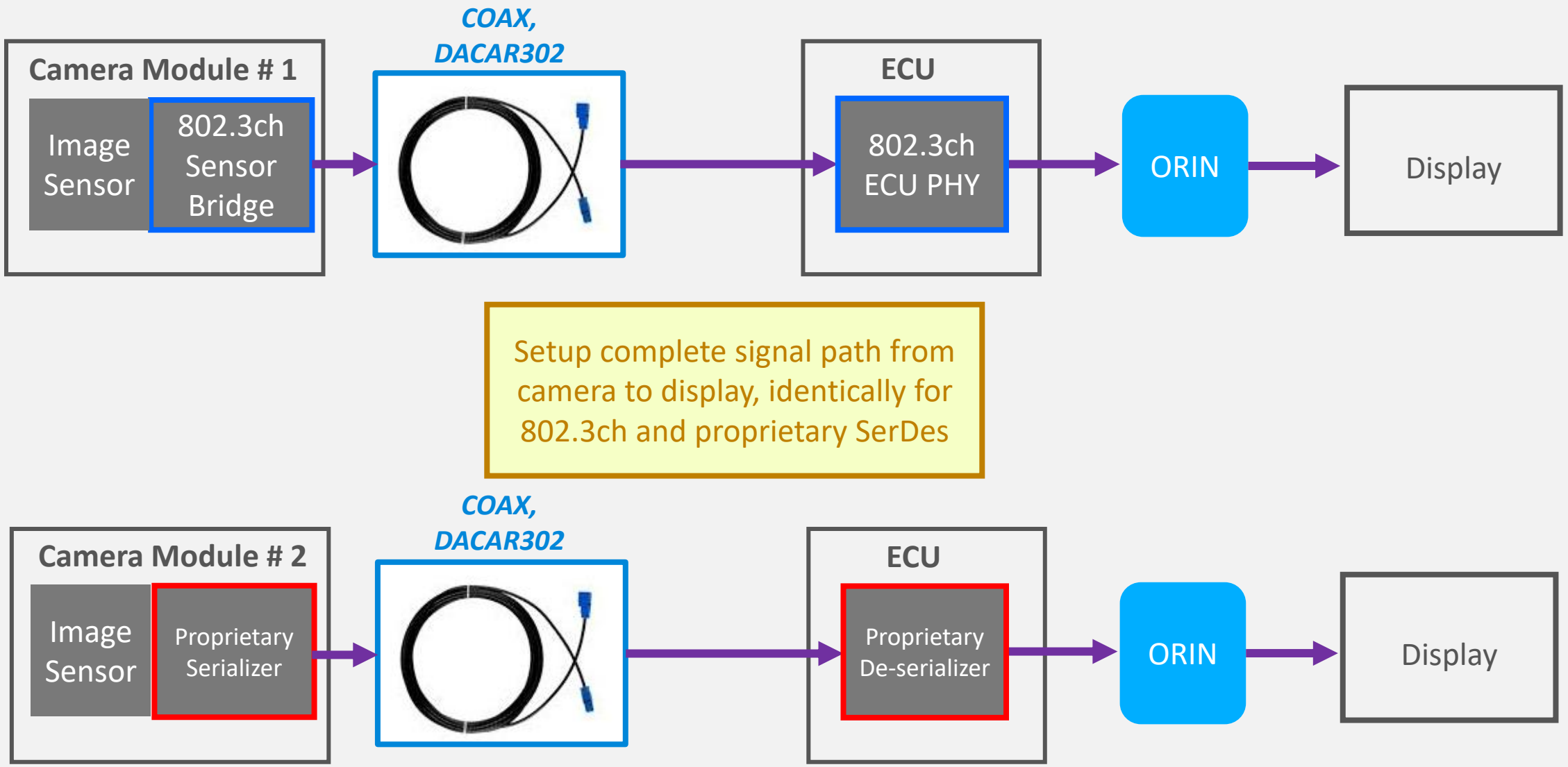
Agenda

- Motivation
- Measurement Setup
- Measurement Parameter Summary
- Measurement Result
- Conclusion

Motivation

- **EMI (Electromagnetic Interference)** has been mentioned to be an important factor for 802.3dm task group:
  - https://www.ieee802.org/3/dm/public/0524/Chini_Tazebay_3dm_01a_0524.pdf
  - https://www.ieee802.org/3/dm/public/0524/jonsson_etal_3dm_01_05_16_24.pdf
  - https://www.ieee802.org/3/dm/public/0724/jonsson_3dm_01_07_15_24.pdf
- There is currently a discussion regarding the modulation choice for 802.3dm. PAM4 802.3ch modulation downstream has been proposed by multiple individuals.
  - https://www.ieee802.org/3/dm/public/adhoc/101024/jonsson_3dm_01_10_10_24.pdf
  - https://www.ieee802.org/3/dm/public/0924/Lo_3dm_02_0924.pdf
  - https://www.ieee802.org/3/dm/public/0924/jonsson_3dm_01_09_15_24.pdf
  - https://www.ieee802.org/3/dm/public/0924/sedarat_3dm_202409.pdf
- There are considerable advantages to re-use ratified IEEE specification if possible.
- Concern has been expressed with using 802.3ch on Coax medium especially with respect to EMI performance.
- We would like to submit additional EMI measurement data to the task force to help informed decision making.

Setup



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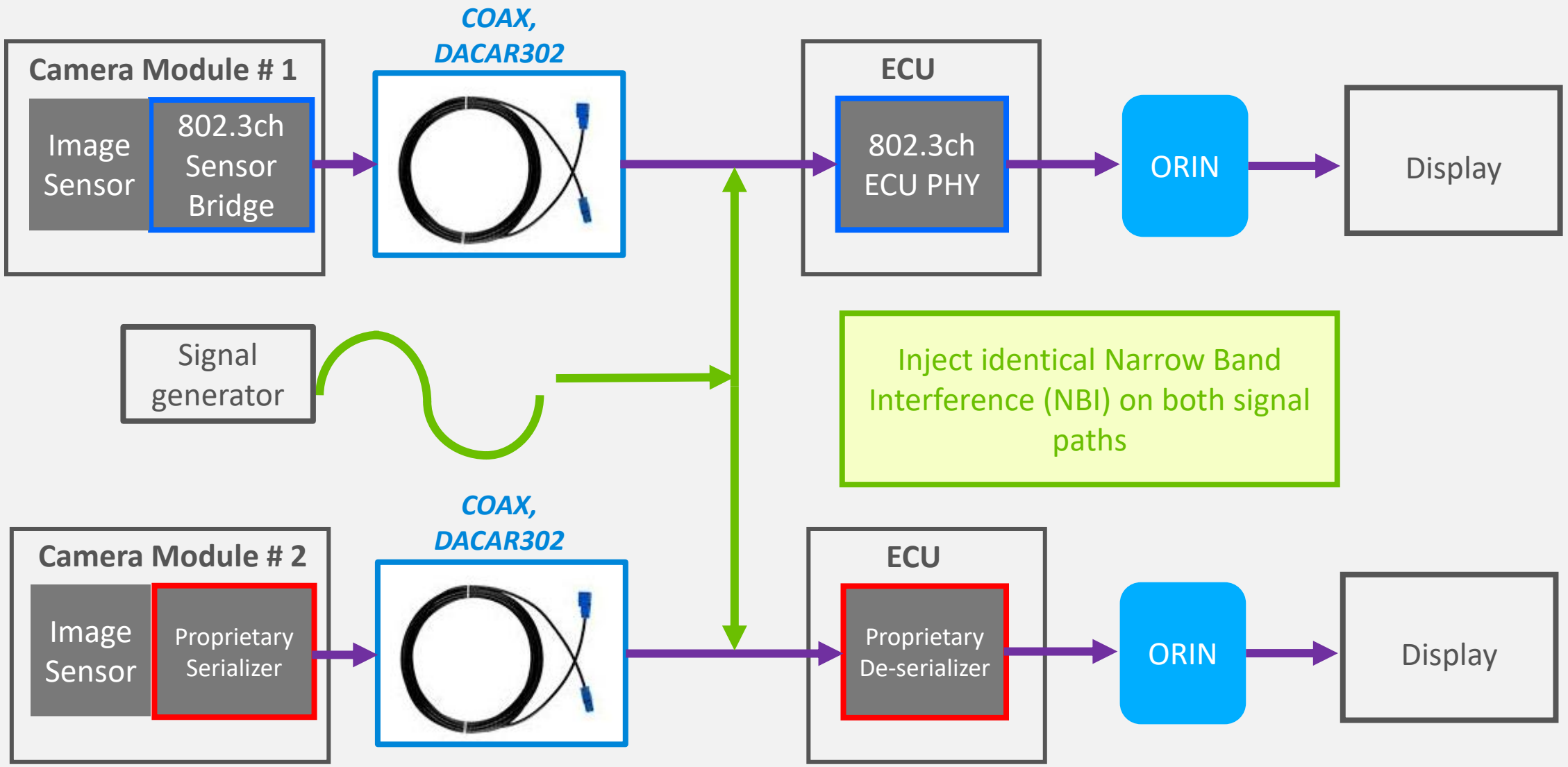
Setup



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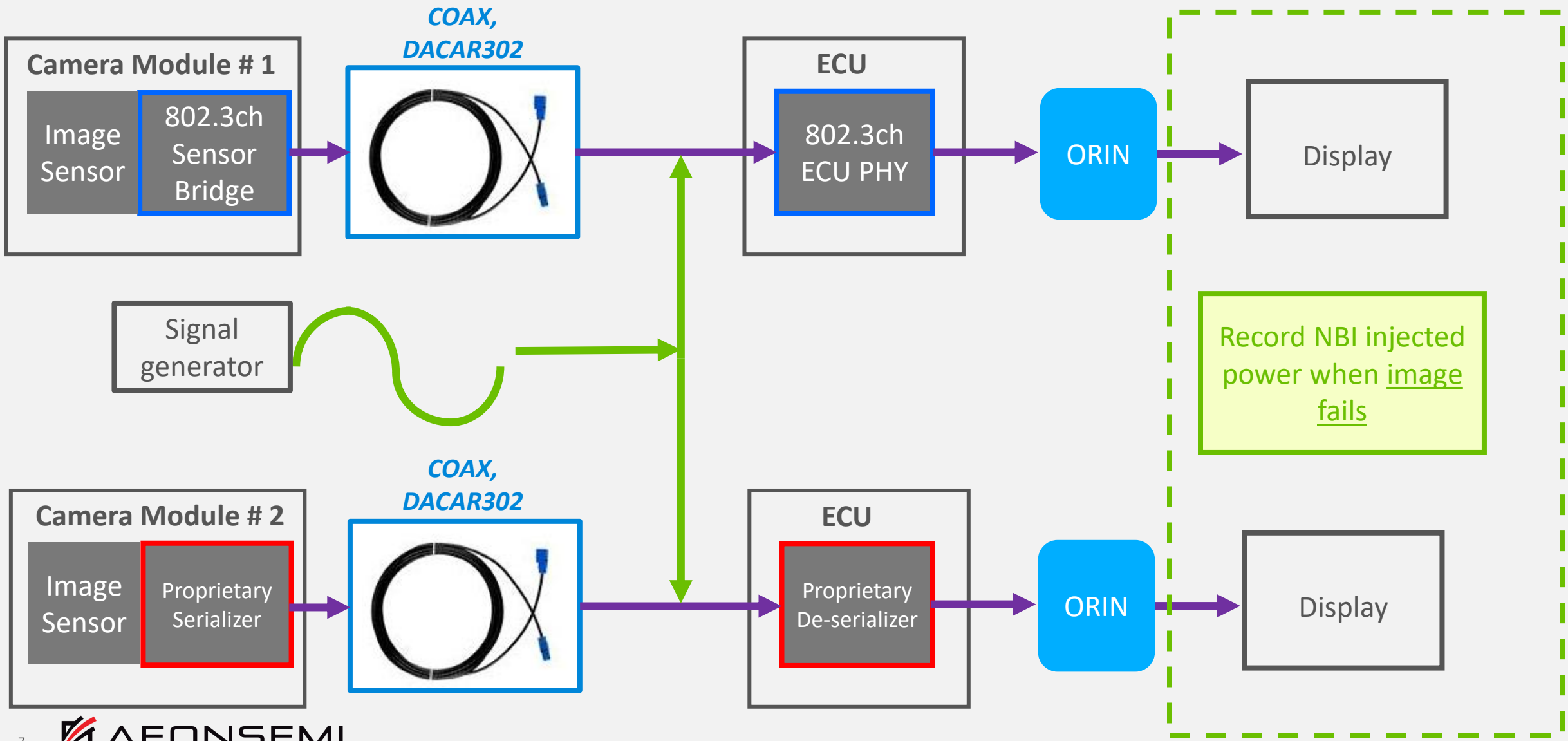
Measurement Output



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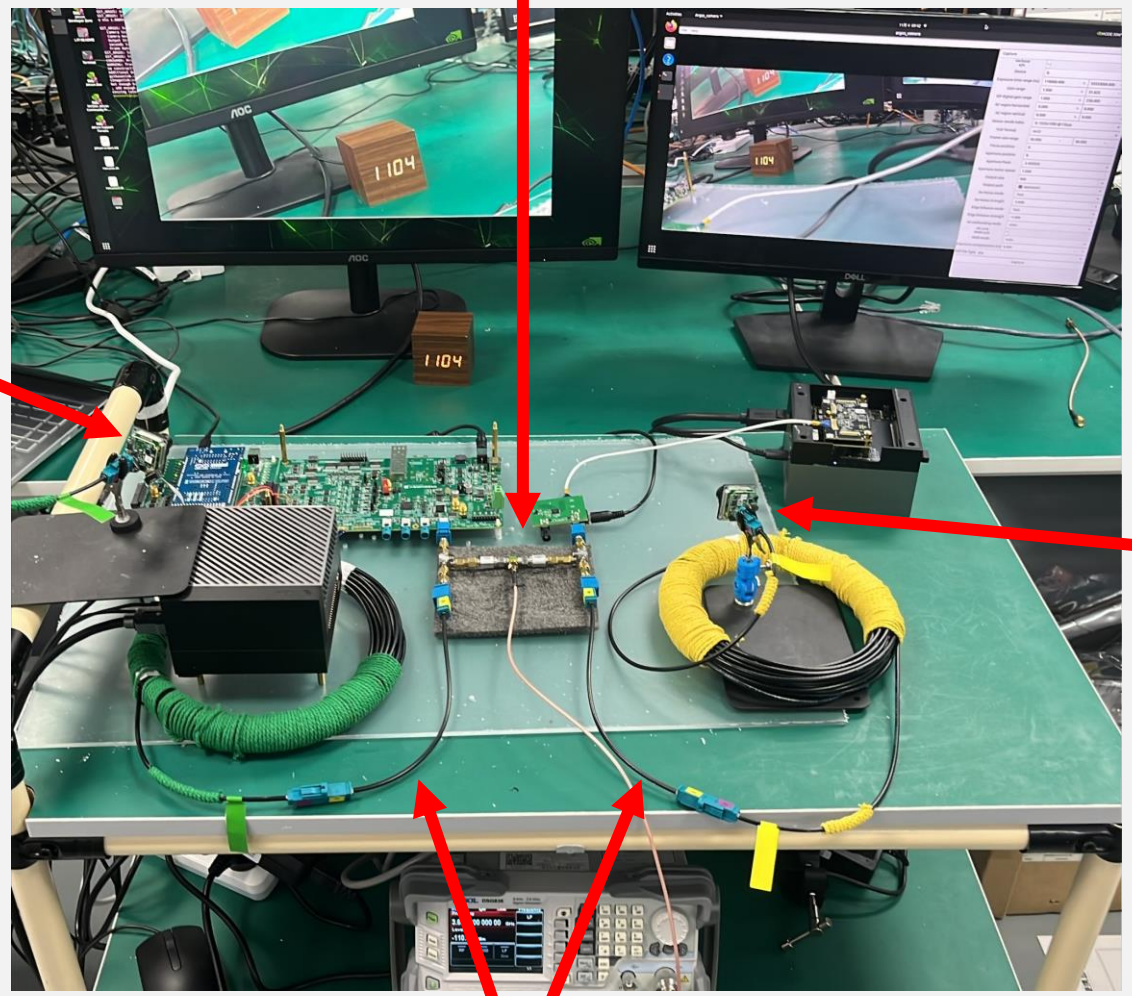
Measurement Lab Setup

- Used short 0.25m patch cable to match connector to injection apparatus.
- Probing at ECU DUT pin was done at multiple injected frequencies to confirm injected power was similar on both SerDes and 802.3ch signal path.



Summary Parameters

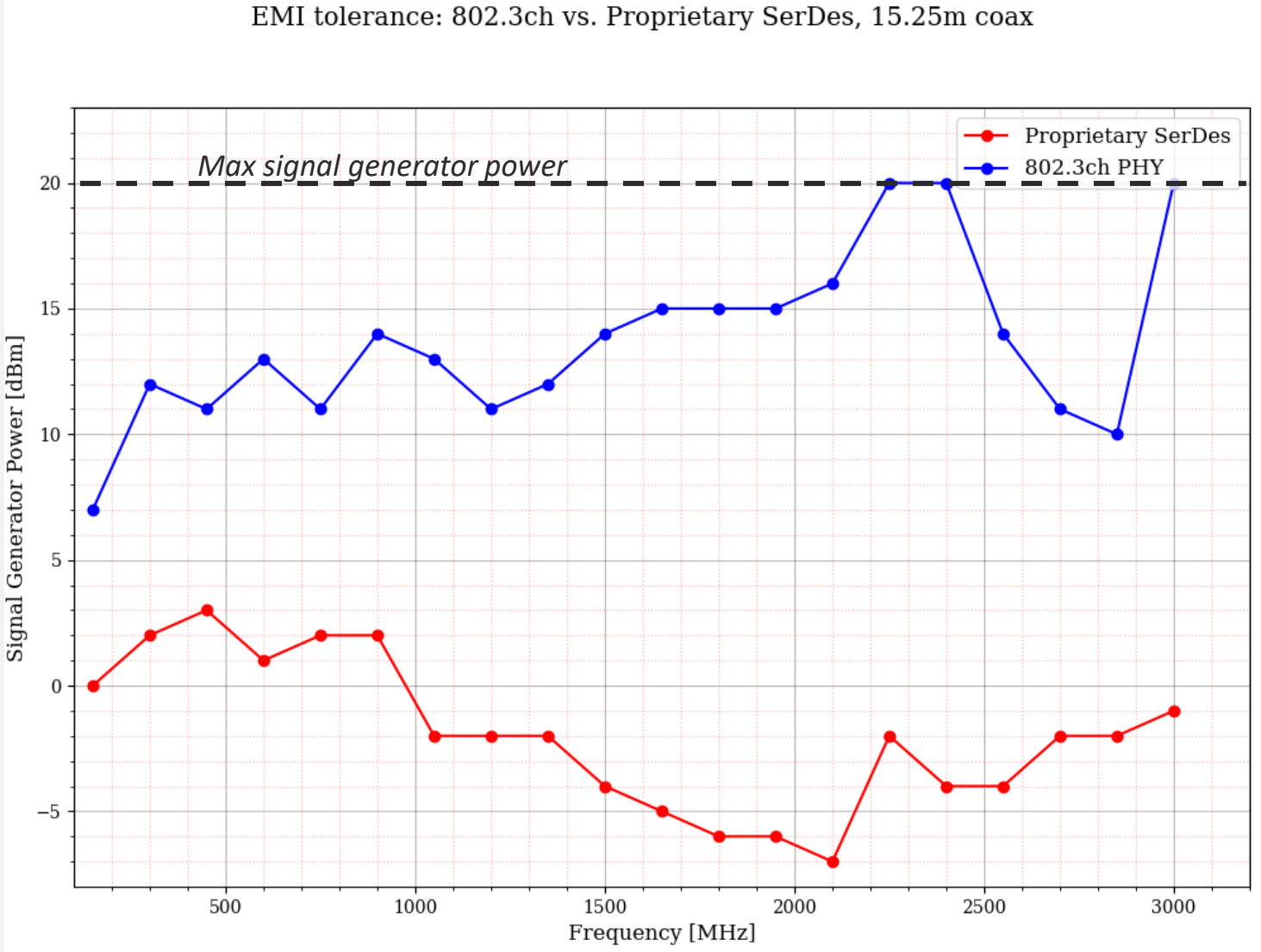
- 5Gpbs mode allows similar (payload) data rate comparison with proprietary SerDes solution.

Parameter	802.3ch	Proprietary SerDes
Camera module PoC	1 inductor	3 inductors
ECU PoC	1 inductor	3 inductors
Camera module Board	2cm x 2cm	
Downstream Maximum Payload	5Gbps	5.2Gbps
Upstream Payload	Control data	
Cable(s)	8.25m, 15.25m (Coax, DACAR 302)	
Frequency sweep	150MHz -> 3GHz	

Measurement Results: 15.25m coax

Better EMI tolerance

- Data clipped at 20dBm due to maximum signal generator output power reached
- The measurement allows for direct comparison between volume shipping SerDes and 802.3ch implementation.
- At 15.25m coax reach, 802.ch PHY implementation has much better EMI tolerance than incumbent SerDes implementation.



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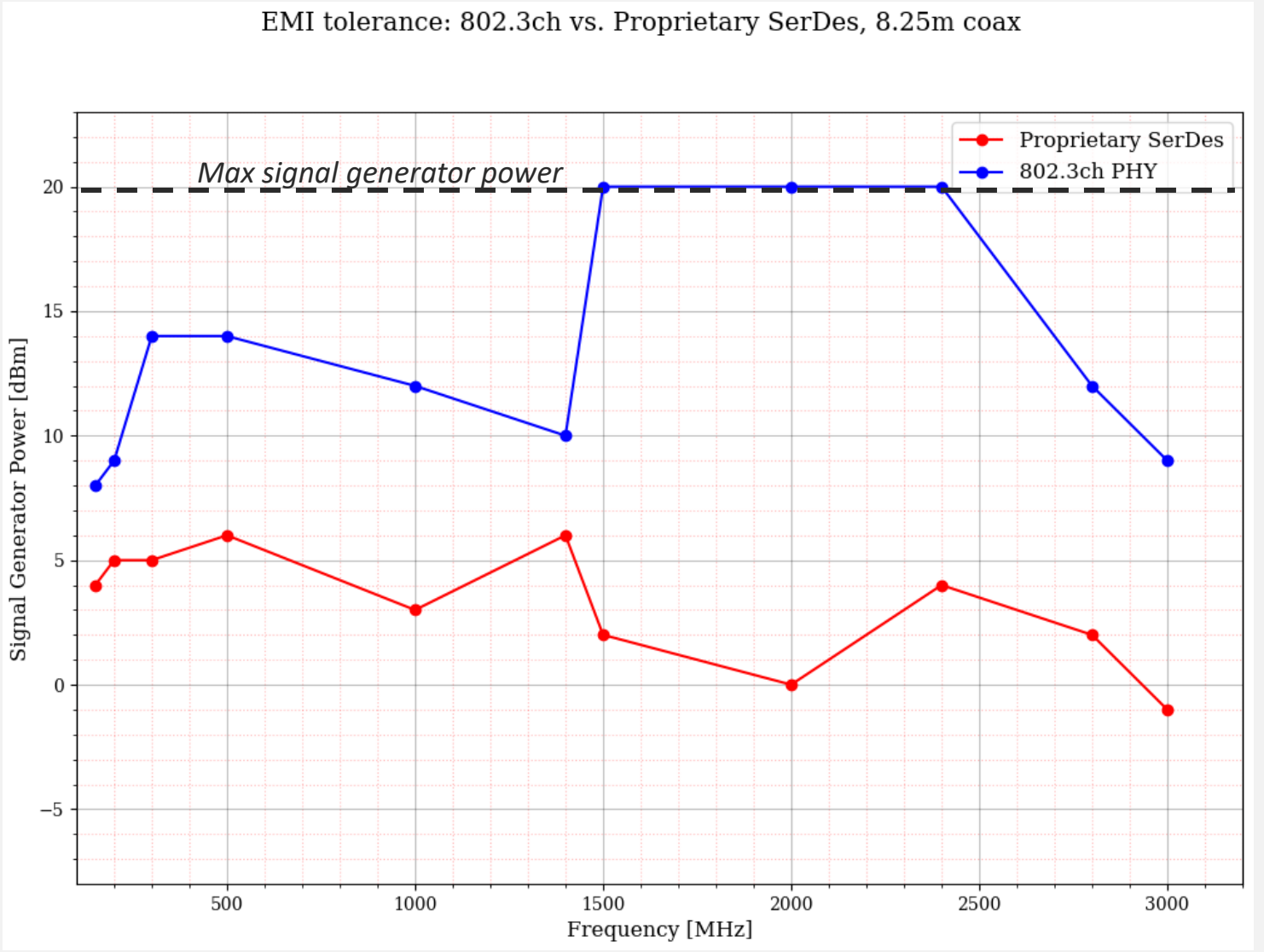
Measurement Results: 8.25m coax

Better EMI tolerance

- Repeat similar measurement at 8.25m reach



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Conclusion

- Data submitted to task group show 802.3ch silicon implementation is competitive in power and latency to proprietary incumbent SerDes
  - https://www.ieee802.org/3/dm/public/0924/Power_and_Latency_8023ch_Tran_09182024.pdf
  - https://www.ieee802.org/3/dm/public/0524/Evaluation%20of%20802.3ch_Tran_050142024a.pdf
- Additional measurement results show 802.3ch PHY outperforms incumbent proprietary SerDes on EMI tolerance as well.
  - How much more EMI tolerance is needed relative to incumbent solutions?
- Additional measurements can be made to provide more coverage/data points.