mipi alliance

IF IT'S NOT MIPI, IT'S NOT MOBILE

Enabling Automotive Displays Using MIPI Automotive SerDes Solutions (MASS)

James Goel

TSG Chair and Display WG Vice-Chair

19 May 2021

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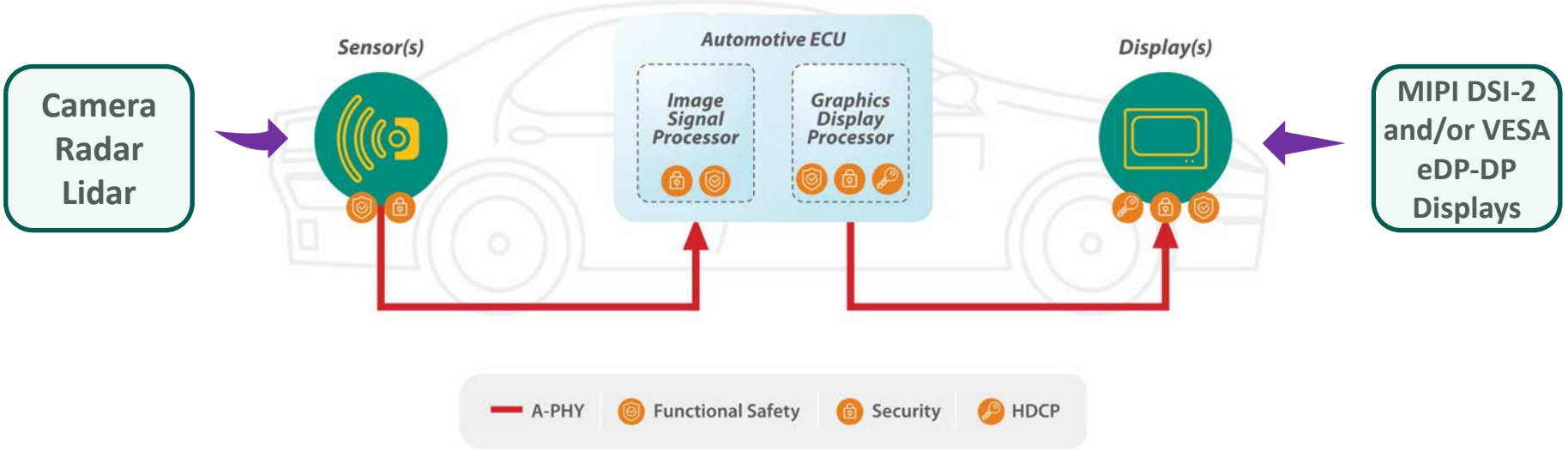
Table of Contents for MASS Displays Webinar

MIPI Automotive SerDes Solutions (MASS)

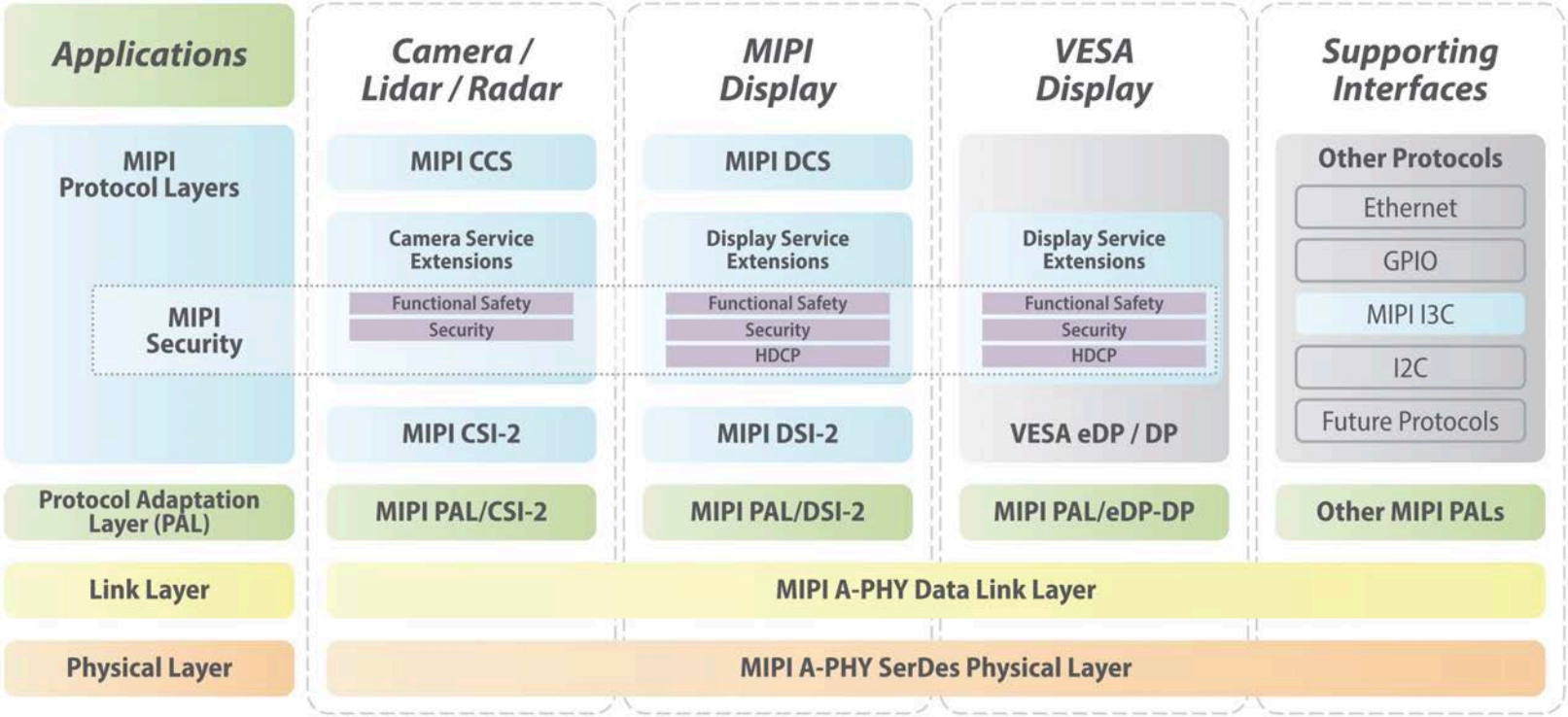
Vision for Full SerDes Integration



Sensor and display endpoints with integrated long-reach connectivity (integrated A-PHY SerDes) connect to the ECU without intermediate bridges. Application-level functional safety and security data protection. HDCP for protecting premium content.

MIPI Automotive SerDes Solutions (MASS)

A family of specifications



MASS Display Related Specifications (as of May 2021)

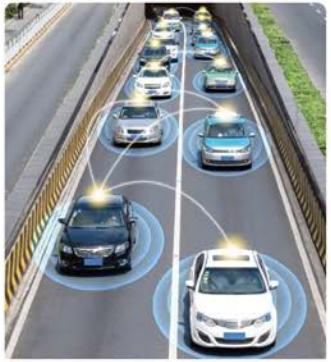
- **MIPI A-PHY℠ v1.0**
  - Automotive Physical SerDes Interface
  - Long-reach SerDes physical layer specification advancing ADAS, ADS, IVI and other automotive applications
- **MIPI Display Specifications**
  - DSI-2℠ v1.2 (v2.0 coming soon)
    - Display Serial Interface-2
  - DCS℠ v1.5
    - Display Command Set
- **New MIPI Display Functional Safety Enabling Specifications**
  - DSE℠ v1.0
    - Display Services Extension
  - MIPI PAL℠/DSI-2℠ v1.0
    - Protocol Adaptation Layer for Display Serial Interface-2
  - MIPI PAL℠/eDP-DP v1.0
    - Protocol Adaptation Layer for VESA embedded DisplayPort/DisplayPort

NOTE: Previous versions of existing specifications are also compatible with MASS

MASS Automotive Display Applications

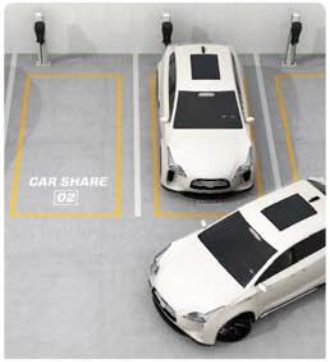
A Focus on Automotive Cabin

CASE – Driving Display Bandwidth



Connected

Automated



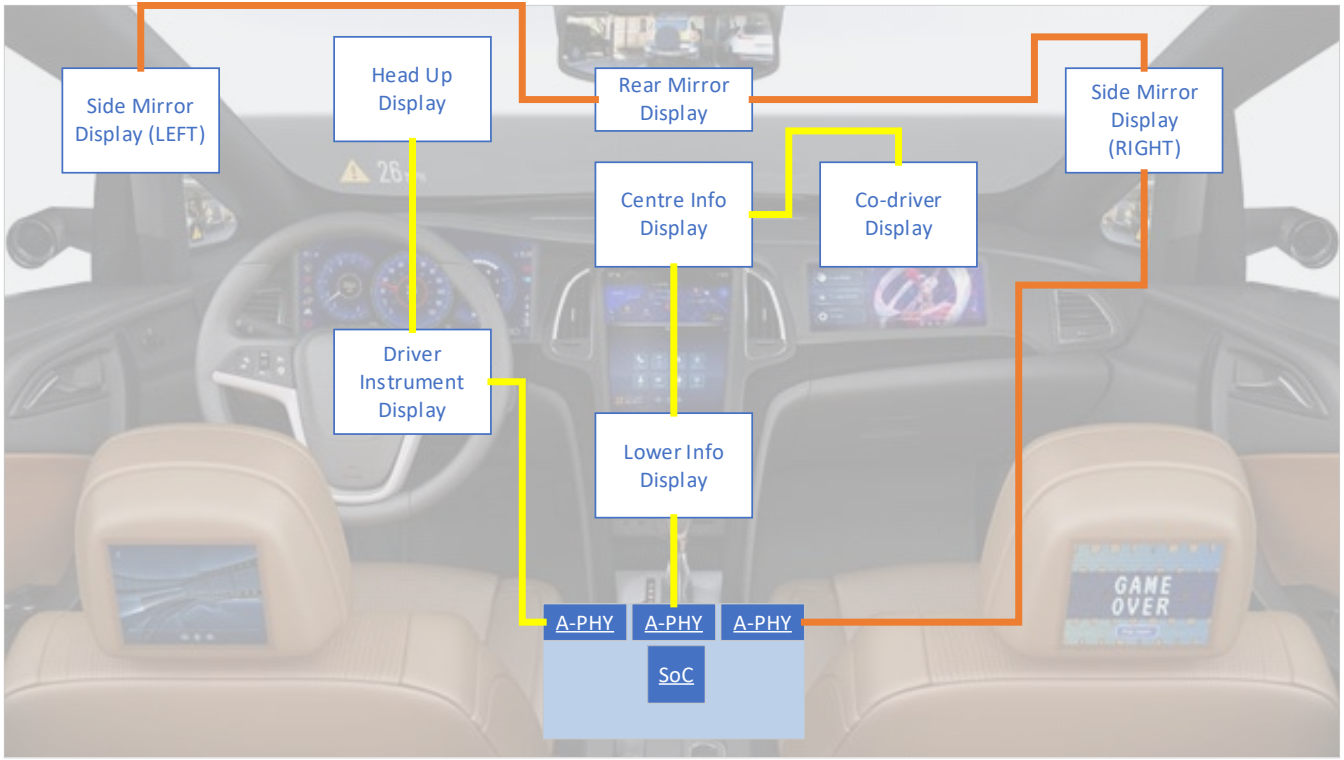
Shared

Electrified

Automotive Display Use-Case

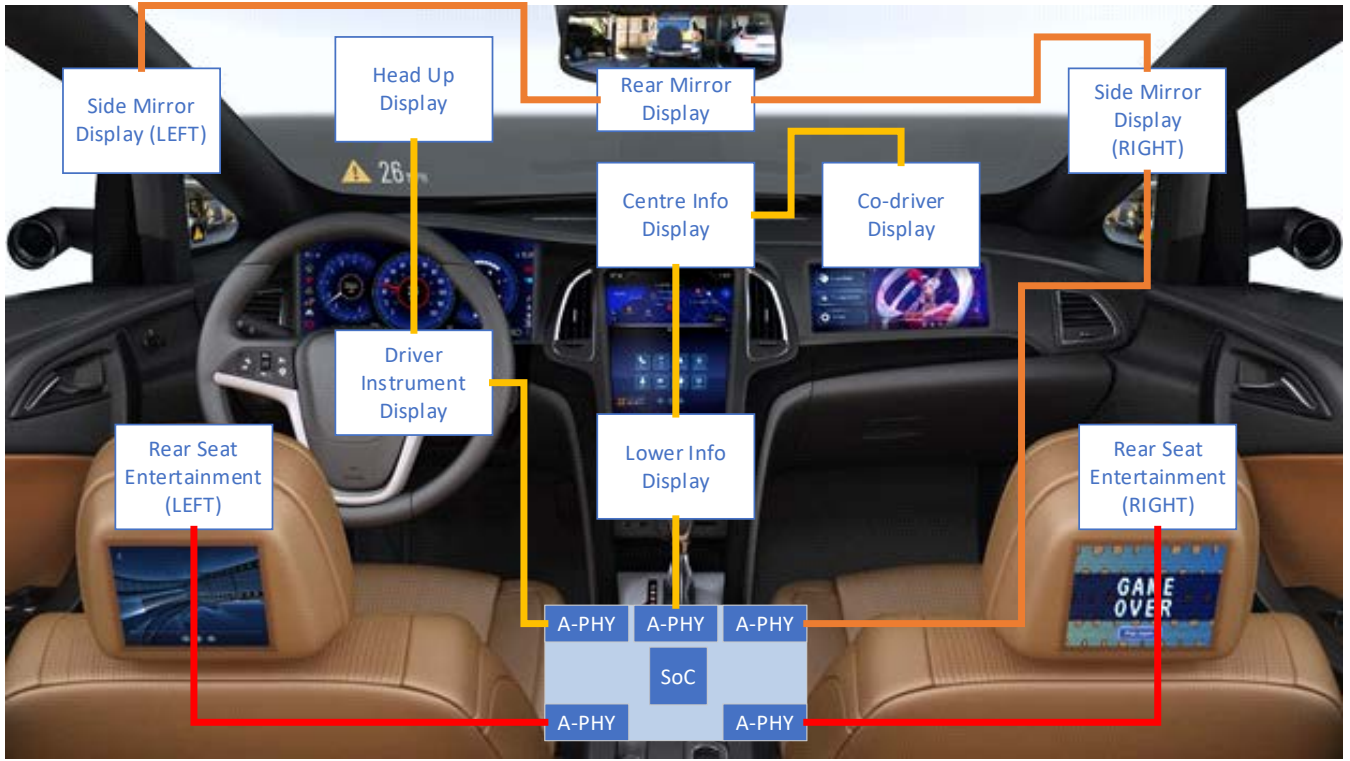
Automotive Display Use-Case

MASS Daisy Chain Application



MASS Point-to-Point Application

Automotive Display Use-Case



Modern Automotive Cockpit Displays

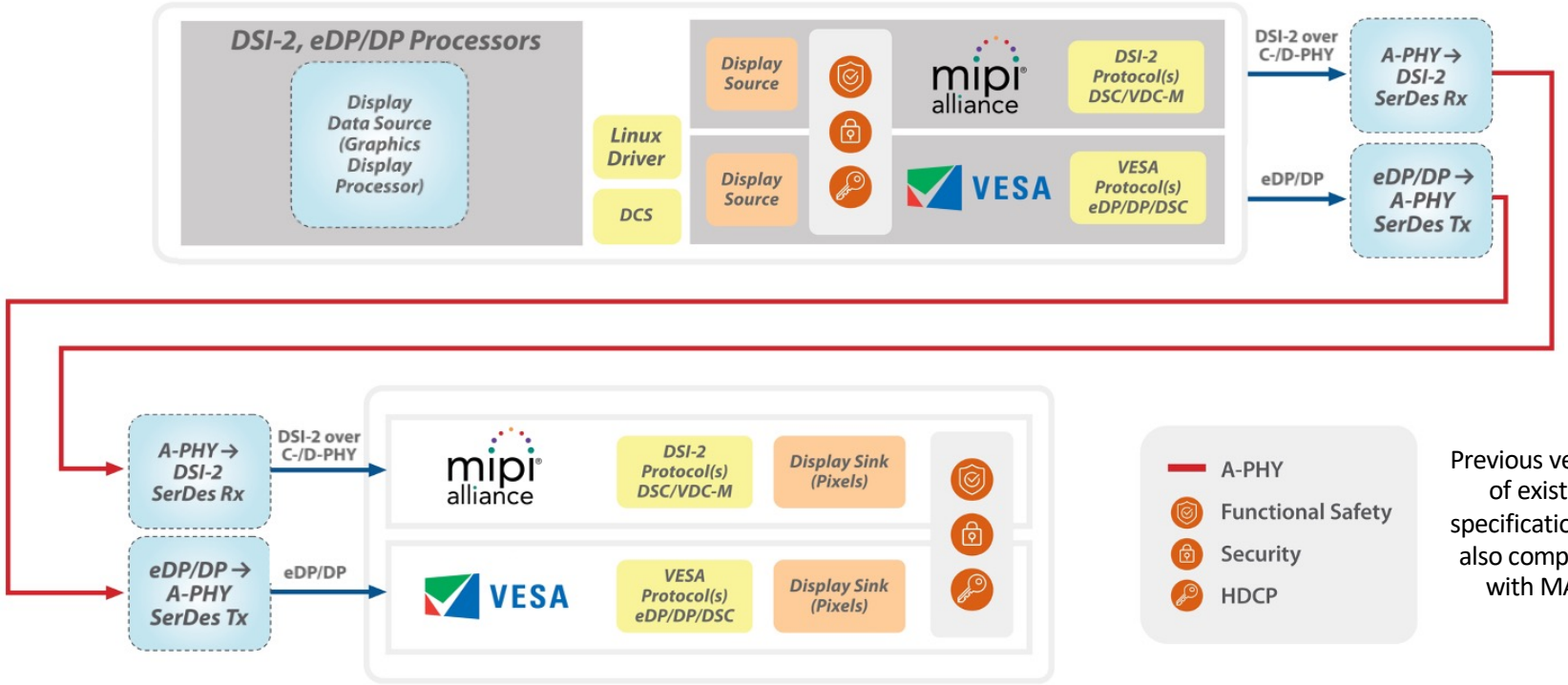
Display Type	Example Size (Inches)	Example Resolution
Left and Right-Side Mirror Displays	7”	1280x800
Driver Instrument Display (DID)	12.3”	3840x1440
Center Information Display (CID)	12.3”	3840x2160
Extended Co-Driver display (CDD)	12.3”	3840x2160
Lower Control Display	12.4”	3840x2160

MIPI A-PHY v1.0 – Gears and Profiles

- One rate/line-code/modulation per downlink gear
- Single uplink gear
- A-PHY Device supporting Gear N (i.e., N could be 1–5) shall support all lower gears.
- Two noise/performance profiles (with full inter-profile interoperability):
  - **Profile 1:** Optimized for low cost/power implementations for the lower gears with lower noise immunity and target BER of $<10^{-12}$
  - **Profile 2:** Optimized for vehicle lifespan, link robustness for all gears with high noise immunity and target PER of $<10^{-19}$

Downlink Gear Data Rate	*Modulation*	*Modulation Bandwidth* (GHz)	*Max Net App Data Rate* (Gbps)
G1 2 Gbps	NRZ-8B/10B	*1*	*1.5*
G2 4 Gbps	NRZ-8B/10B	*2*	*3*
G3 8 Gbps	PAM4	*2*	*7.2*
G4 12 Gbps	PAM8	*2*	*10.8*
G5 16 Gbps	PAM16	*2*	*14.4*
Uplink 100Mbps	NRZ-8B/10B	*0.05*	*55 Mbps*

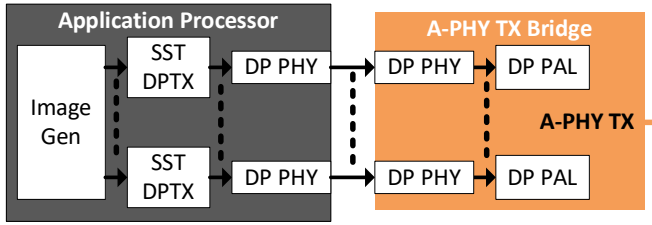
Focus on MASS Display



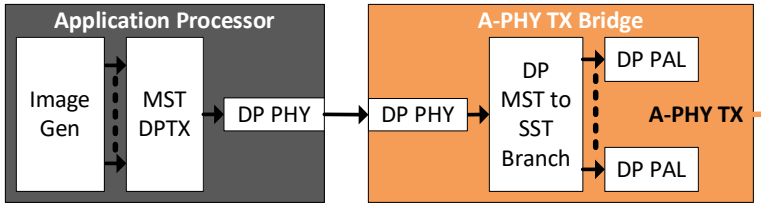
Previous versions of existing specifications are also compatible with MASS

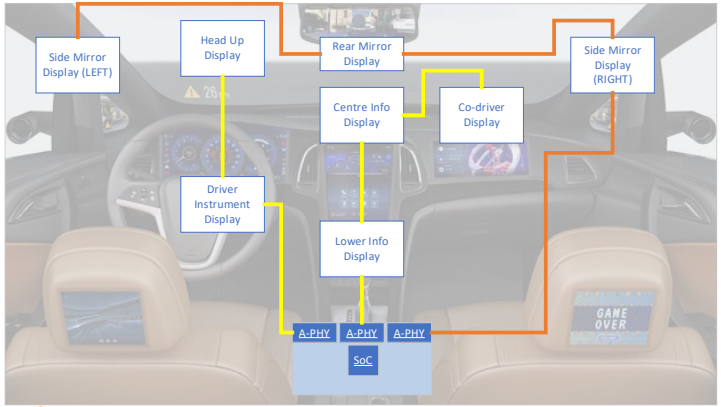
MIPI A-PHY℠ v1.0, DSI-2℠ v2.0, DCS℠ v1.5, DSE℠ v1.0
MIPI PAL℠/DSI-2℠ v1.0, MIPI PAL℠/eDP-DP v1.0, VESA DisplayPort 1.4a

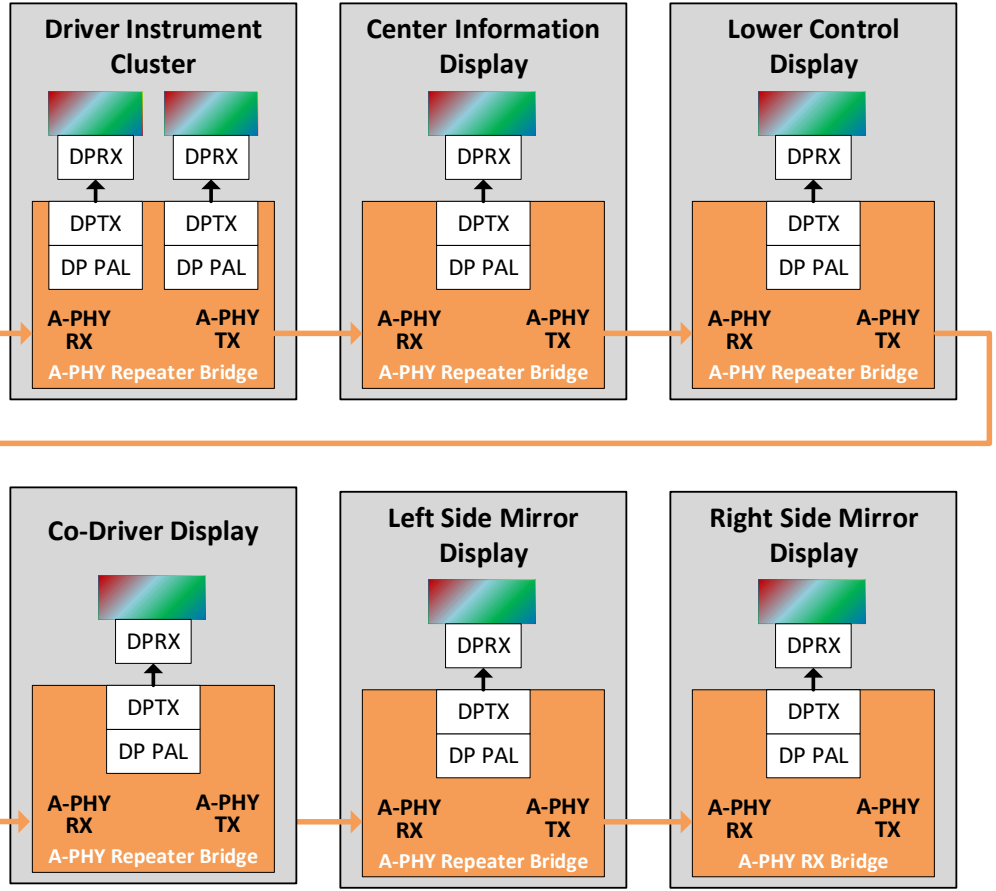
Use of Multiple SST DP Interfaces



Use of Singe MST DP Interface







Functional Safety for Automotive Displays

ISO26262:5 Product Development at the Hardware Level

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MASS Functional Safety Application

Digital Side Mirror Replacement

ISO26262 Part 5: Product development at the Hardware Level

- ISO26262 automotive functional safety standard
  - Reference for automotive safety lifecycle
  - Automotive-specific risk-based analysis for Automotive Safety Integrity Levels (ASILs)
  - Uses ASILs to specific applicable requirements
- Part 5: Hardware level
  - Specification of hardware safety requirements
  - Evaluation of safety goal violations due to random failures
  - ***Annex D: informative guidelines for appropriate safety mechanisms***

ISO26262-5 Annex D – Communications Bus


INTERNATIONAL STANDARD

ISO 26262-5

Second edition 2018-12

Road vehicles — Functional safety —

Part 5: Product development at the hardware level

Véhicules routiers — Sécurité fonctionnelle —

Partie 5: Développement du produit au niveau du matériel

Reference number ISO 26262-5:2018(E)

Annex D – Communication bus safety mechanisms:

- One-bit hardware redundancy
- Multi-bit hardware redundancy
- Read back of sent message
- Complete hardware redundancy
- Inspection using test patterns
- Transmission redundancy
- Information redundancy
- Frame counter
- Timeout monitoring
- Combination of information redundancy, frame counter and timeout monitoring

Adding Service Extensions Packets (SEPs)

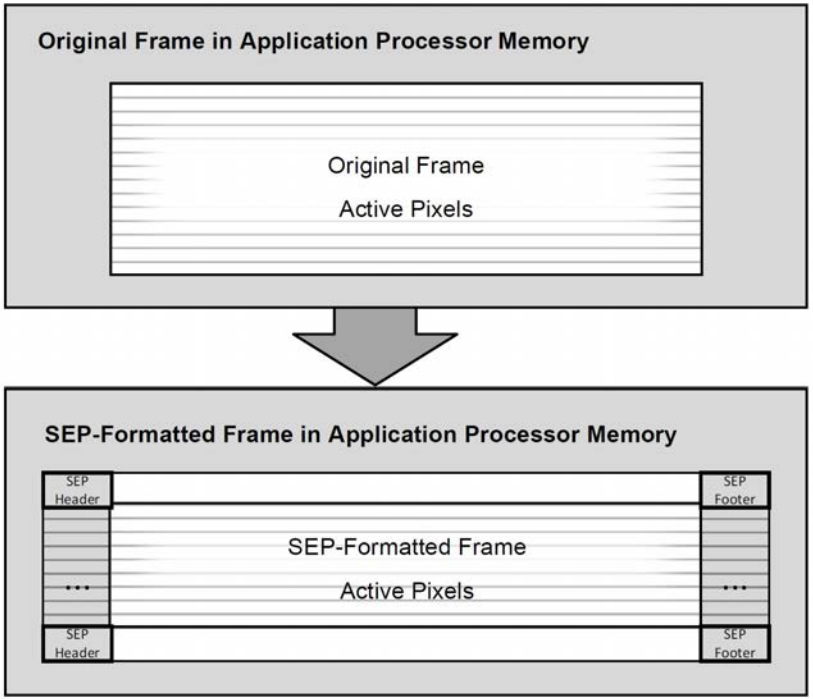


Figure 23 SEP Formatting in the Display Source

MIPI DSE℠ v1.0, MIPI PAL℠/DSI-2℠ v1.0

C.1 Converting DSI-2 Long and Short Packets to SEP

Figure 20 illustrates conversion from a DSI-2 Long Packet to SEP carried within DSI-2 Long Packet.

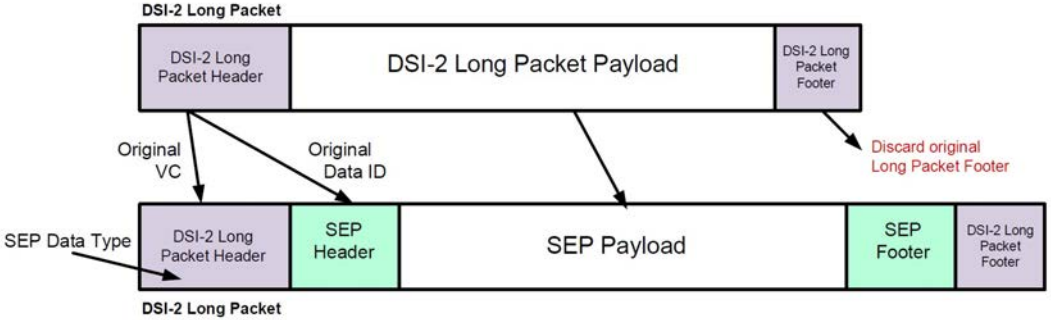


Figure 20 Converting DSI-2 Long Packet to SEP Within DSI-2 Long Packet

Figure 21 illustrates conversion from a DSI-2 Short Packet to SEP carried within DSI-2 Long Packet.

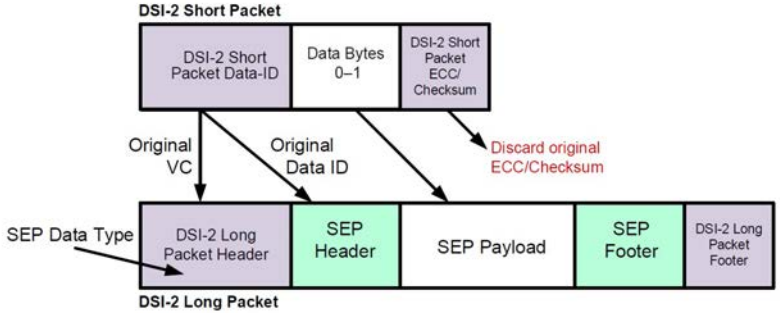


Figure 21 Converting DSI-2 Short Packet to SEP Within DSI-2 Long Packet

MASS Display Services Extension (DSE 1.0)
Services Extensions Protocol (SEP) Header and Footer

- eDT – extended Data Type
  - CSI, DSI
  - VESA eDP/DP
- Message Counter
- CRC-32
  - Hamming distance of 3 or more

Table 1 SEP Packet ePH Blocks: Overview

Bits	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ePH[0]	R	eVC							eDT								R	ePFEN	Reserved						ePHEN							
ePH[1]	Reserved																SEP Payload Length															
ePH[2]	Service Descriptor								Reserved								Message Counter															
ePH[3]	Reserved																															
ePH[4]	Reserved																															
ePH[5]	HDCP streamCtr[31..0]																															
ePH[6]	HDCP InputCtr[31..0]																															
ePH[7]	HDCP InputCtr[64.32]																															

Table 2 SEP Packet ePF Blocks: Overview

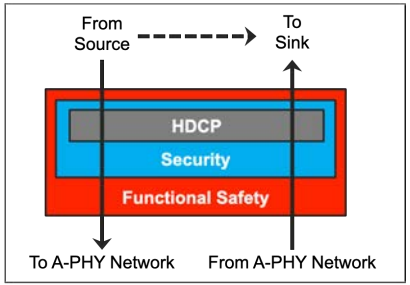
Bits	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ePF[1]	Reserved																															
ePF[0]	CRC-32																															

MASS Display Protocols

End-to-End Protocol Stack Up

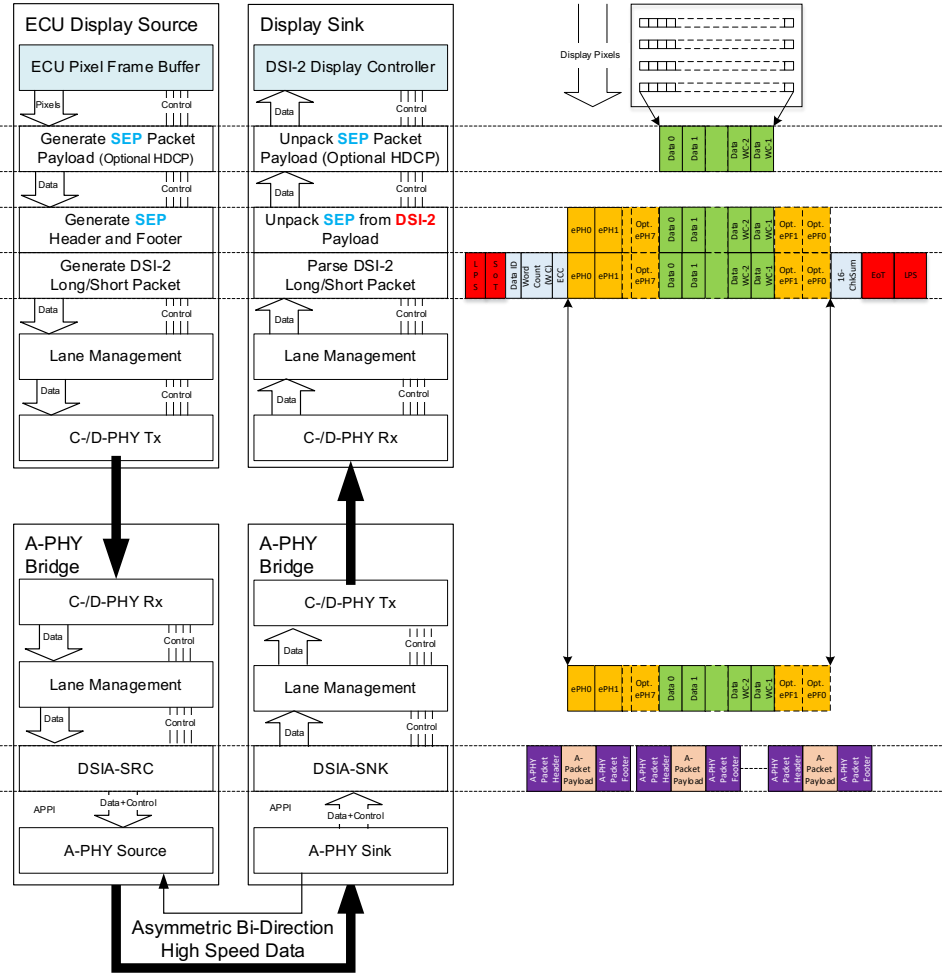
Incorporating Solutions for Data Protection

Bridge-to-Bridge Data Protection

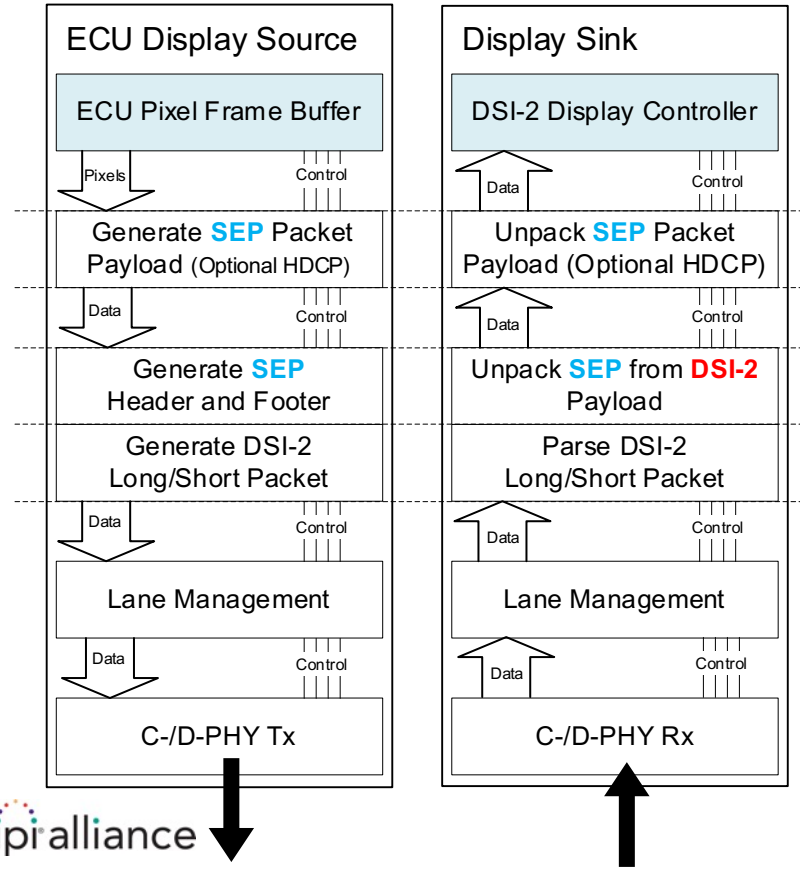


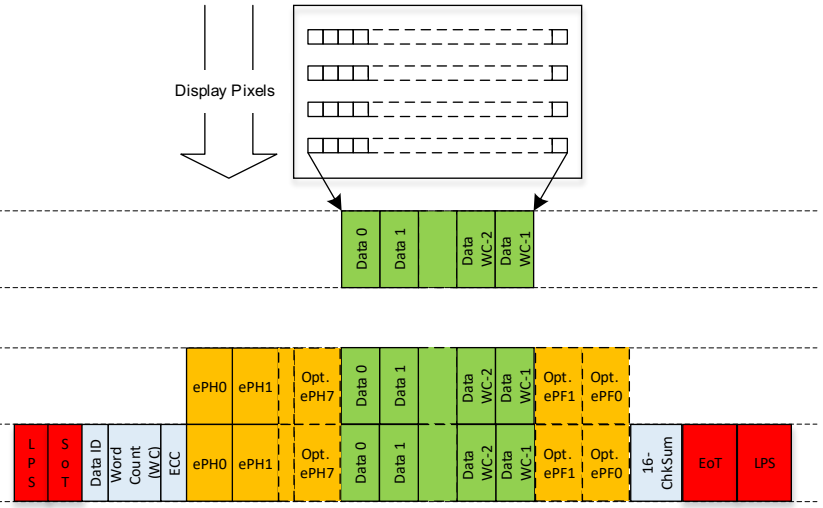
End-to-End Data Protection (Integrated SerDes)

Detailed Display Protocol Stack



ECU Display Source and Sink

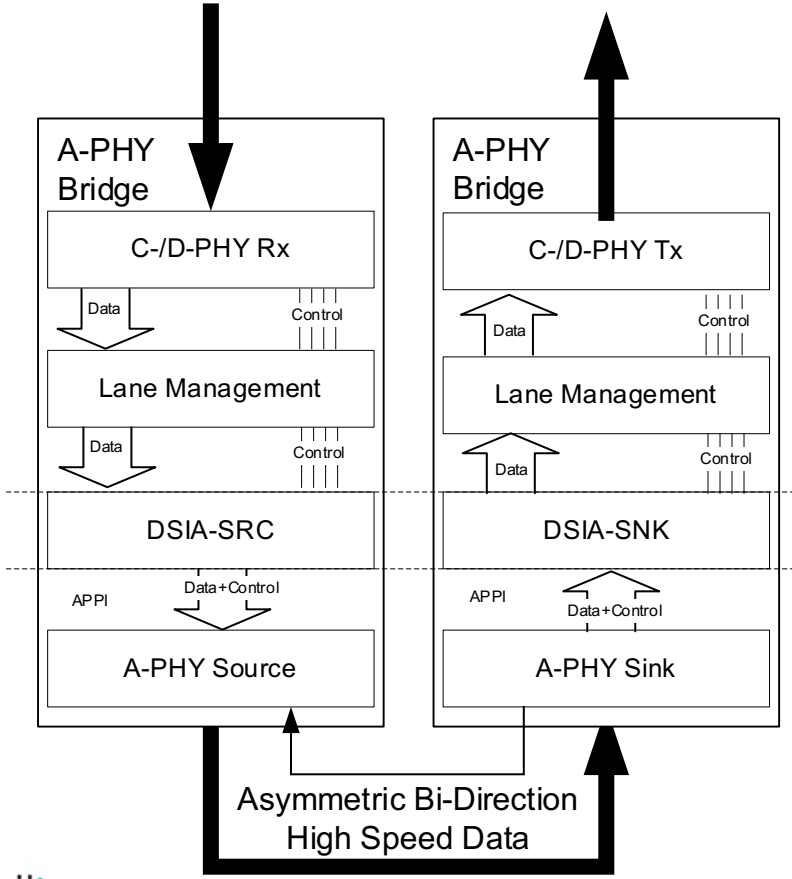


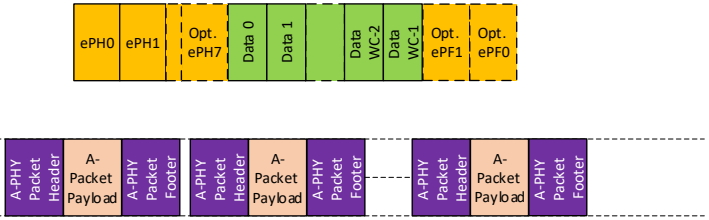


DSI-2℠ v2.0, DCS℠ v1.5, DSE℠ v1.0, MIPI PAL℠/DSI-2℠ v1.0, C-/D-PHY℠

Previous versions of existing specifications are also compatible with MASS

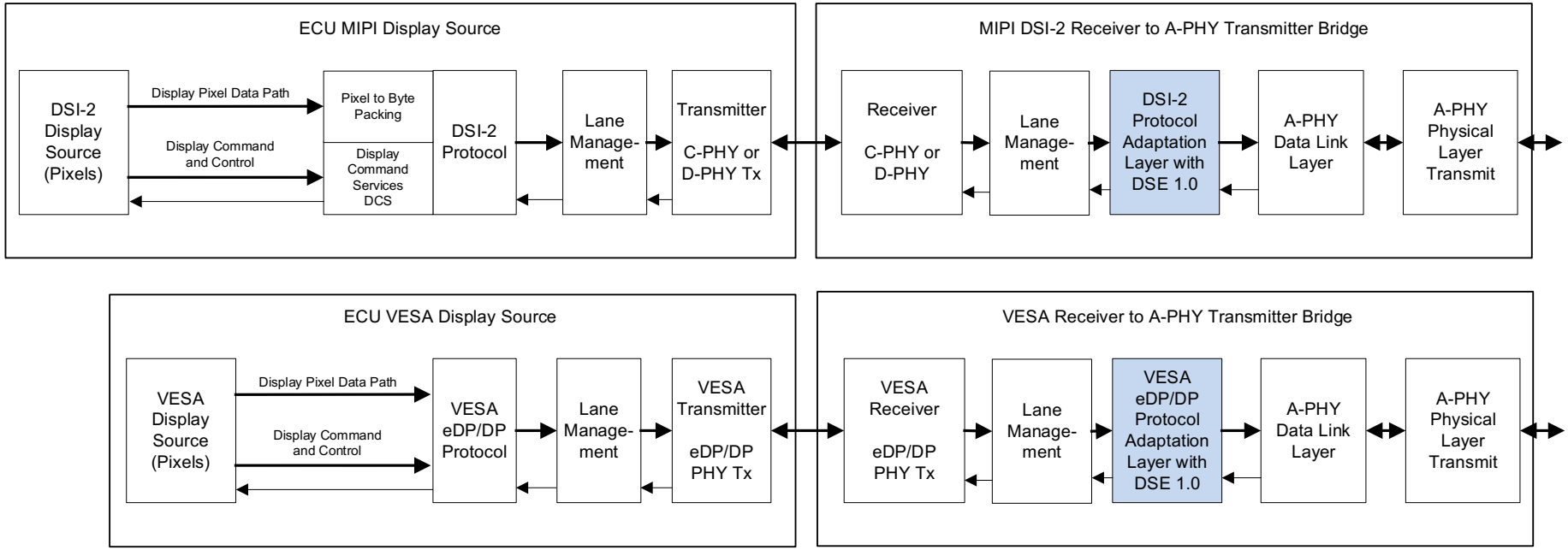
Detailed A-PHY Bridge PAL



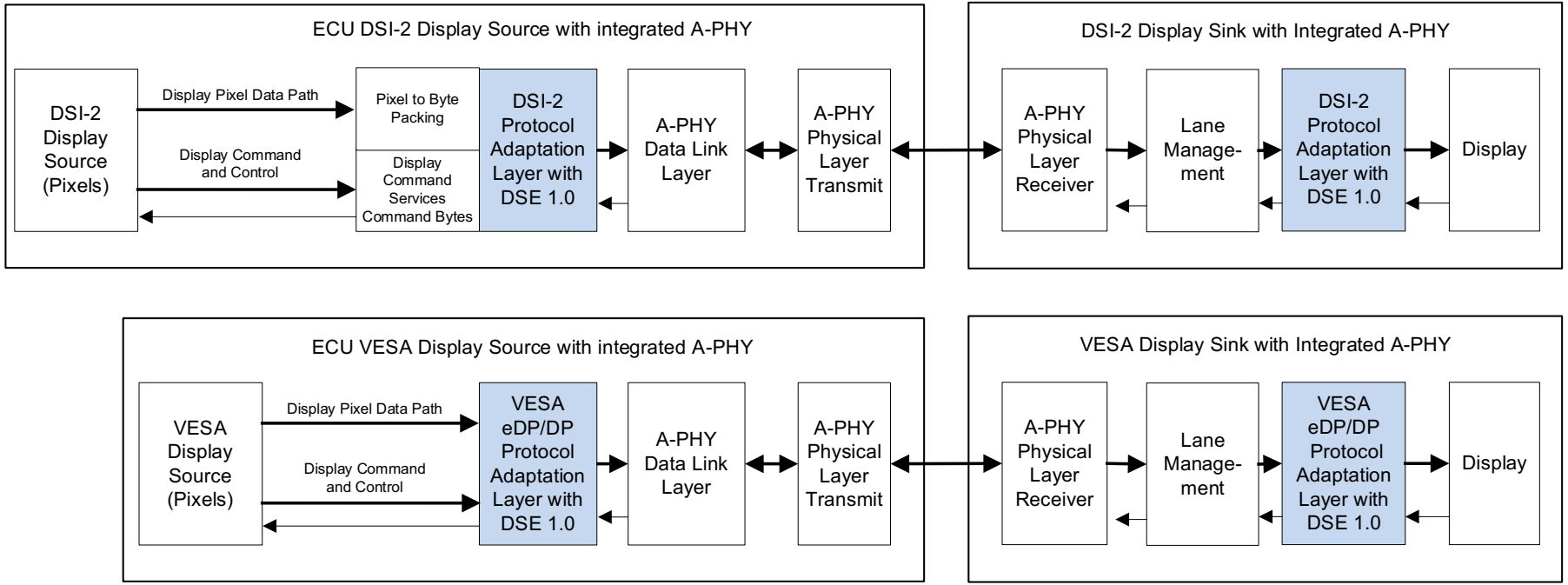


MIPI A-PHY℠ v1.0,
PAL℠/DSI-2℠ v1.0, C-/D-PHY℠

MASS Legacy ECUs with an External A-PHY Bridge



MASS New ECU with Fully Integrated A-PHY



Summary and Review

1. MASS Display Specifications (as of May 2021)
   - A-PHY 1.0, DCS and DSI-2, DSE PAL/DSI and PAL/eDP_DP
2. MASS Example Automotive Display Applications
   - Cabin displays with point-to-point and daisy-chain topologies
3. ISO26262-5: Functional Safety
   - Meeting safety goals using DSE CRC-32, Message ID and Time out
4. MASS Protocol Stack Up
   - DSI-2/DCS through DSE/PAL DSI-2 through A-PHY bridges
5. Display MASS Data Pipeline
   - External A-PHY Bridge
   - Integrated A-PHY solutions

Thanks for listening

MASS Display Stack **Press Release: Link**

Reach out to us: admin@mipi.org

