mipi alliance

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

How MASS Embeds Functional Safety Guided by the Requirements of ISO 26262

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Synopsys

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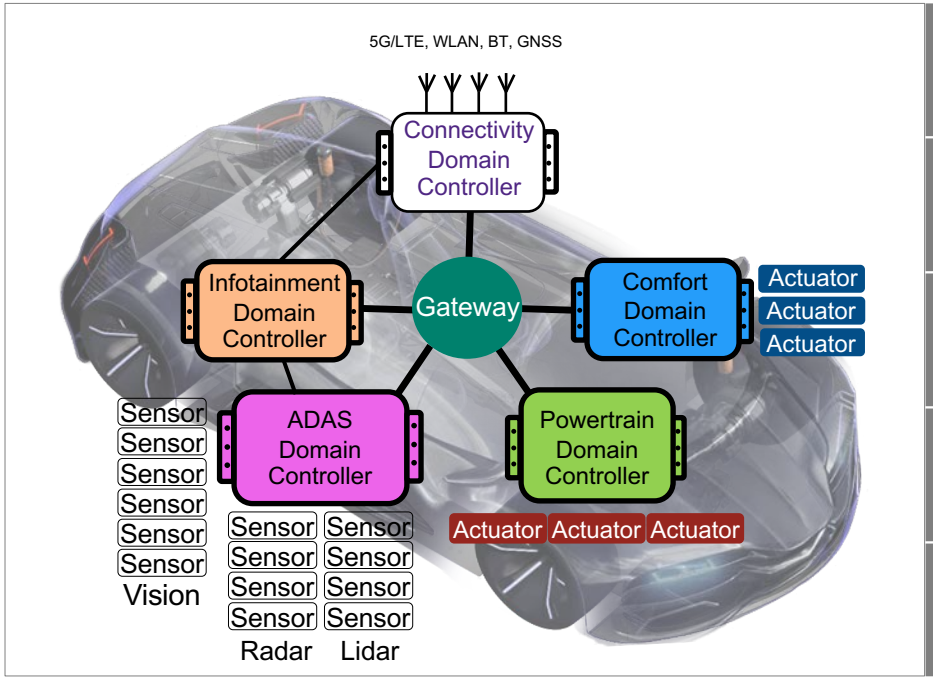
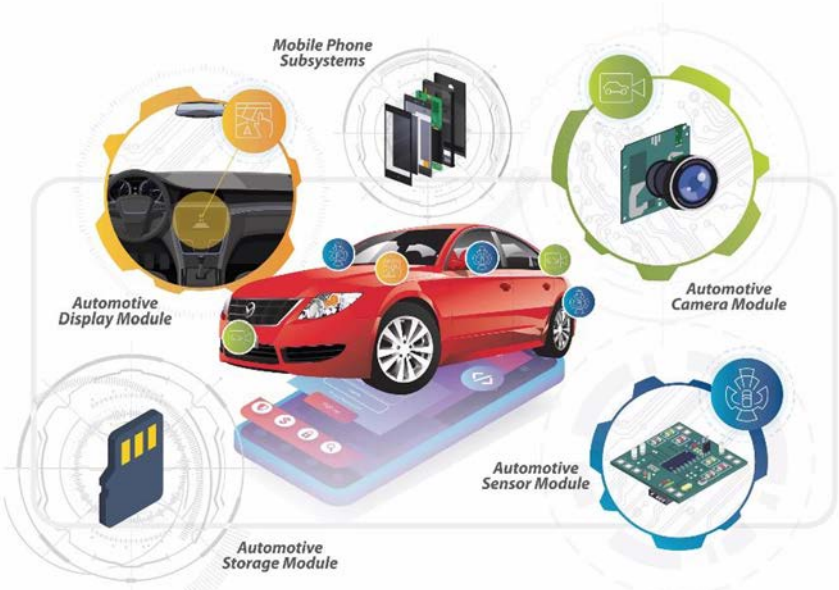
Trends & New Applications



- Transition from Distributed ECUs to centralized Domain Compute Modules
- New applications for ADAS, Infotainment, Connected Car & V2X
- Growing number & types of Sensors: Imaging, Lidar, Radar, Infra-Red
- System & SoC level Functional Safety and Reliably
- Requires High Performance FinFET Class Automotive SoCs

MIPI in Automotive



Cameras, displays, audio, sensors, storage, RFFE for 5G, Wi-Fi, Bluetooth, NFC

Reuse & extend well-proven protocols == reduced NRE/cost

Intra-box usage has been limited due to lack of native long-reach PHY

SPECIFICATIONS IN AUTOMOTIVE TODAY

Most MIPI interfaces are implemented as "*short reach*" (~15 to ~30cm+)

CSI-2
Camera Serial Interface protocol
Protocol for cameras, lidar, radar sensors

DSI-2
Display Serial Interface protocol
Protocol for smartphone, IoT and automotive displays

C-PHY SerDes
3-phase physical layer for CSI-2 & DSI-2
Short-reach physical layer for cameras and displays

D-PHY SerDes
Differential physical layer for CSI-2 & DSI-2
Short-reach physical layer for cameras and displays

I3C
Control and data bus protocol and interface
Sensor and general-purpose data and control interface within a module

RFFE
RF control protocol
Front-end control within a wireless module

UniPro for JEDEC UFS
Data transport protocol for UFS over M-PHY
Transport protocol for UFS storage

M-PHY SerDes for JEDEC UFS
Differential physical layer for UFS storage
Short-reach physical transport for UFS storage

A-PHY SerDes
***Long-reach** (up to 15m) asymmetrical physical layer (released Sep 2020)*

MIPI Automotive SerDes Solutions (MASS) in the Car

Electronic Control Unit (ECU)

- Advanced driver assistance system (ADAS) based on sensor feeds
- Produces display feeds

Sensors Examples

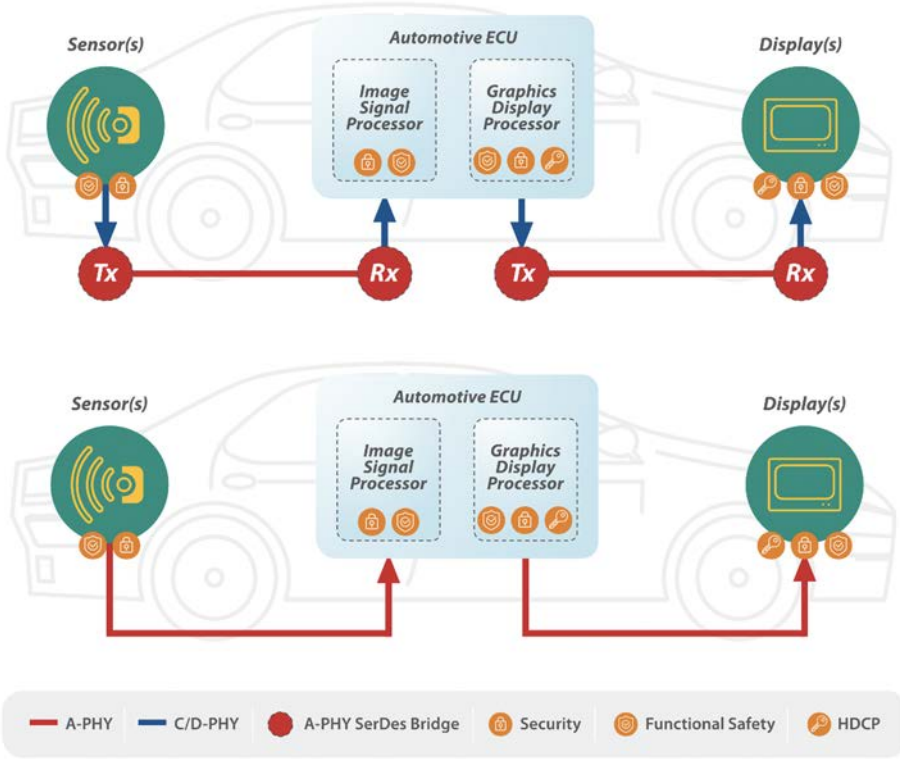
- Camera
- Lidar

Display Examples

- Dashboard
- Console
- Side view mirrors
- Entertainment

A-PHY (Bridges)

- Translates between short-range MIPI C-PHY / D-PHY & long-range MIPI A-PHY



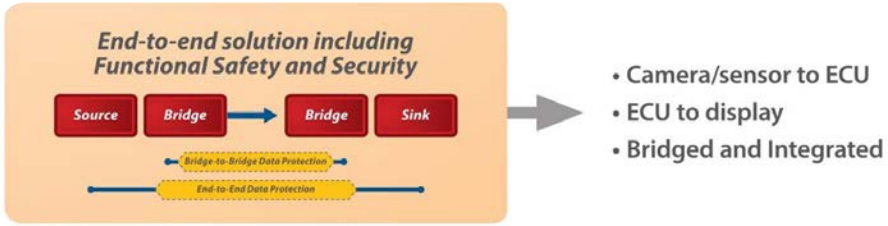
ISO26262-5 Annex D – Communications Bus

Annex D – Communication bus safety mechanisms:

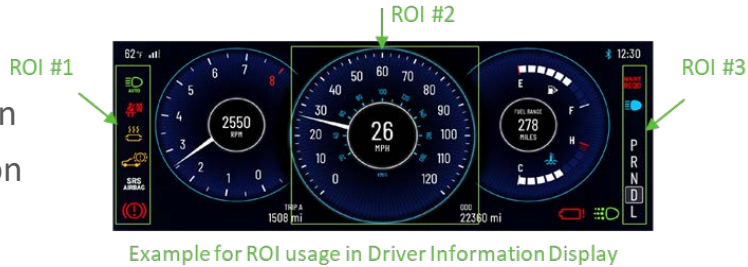
- One-bit hardware redundancy
- Multi-bit hardware redundancy
- Read back of sent message
- Complete hardware redundancy
- Inspection using test patterns
- Transmission redundancy
- Information redundancy
- Frame counter
- Timeout monitoring
- Combination of information redundancy, frame counter and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

Functional Safety – Service Extensions (CSE/DSE)

- **Flexible End-to-End Functional Safety and Security framework with SEP**
  - Packet based: per SEP
  - Frame based: per Video Frame
  - Regions of Interest: per ROI
  - With compression enabled/disabled



- **Example of FuSa Elements used**
  - CRCs with Hamming distance > 3 - detecting communication failure (bad payload)
    - SEP Header CRC + SEP Footer CRC
    - ROIs, Compression Slices / Columns etc.
  - Message Sequence Counter – detecting packet loss / duplication
  - Timeout Monitoring – detecting potential loss of communication
  - Test pattern generators (solid colors, color bar, tiles etc.)
  - Faults injection – checking error detection mechanisms



Example for ROI usage in Driver Information Display

MIPI CSI-2 Protocol with CSE

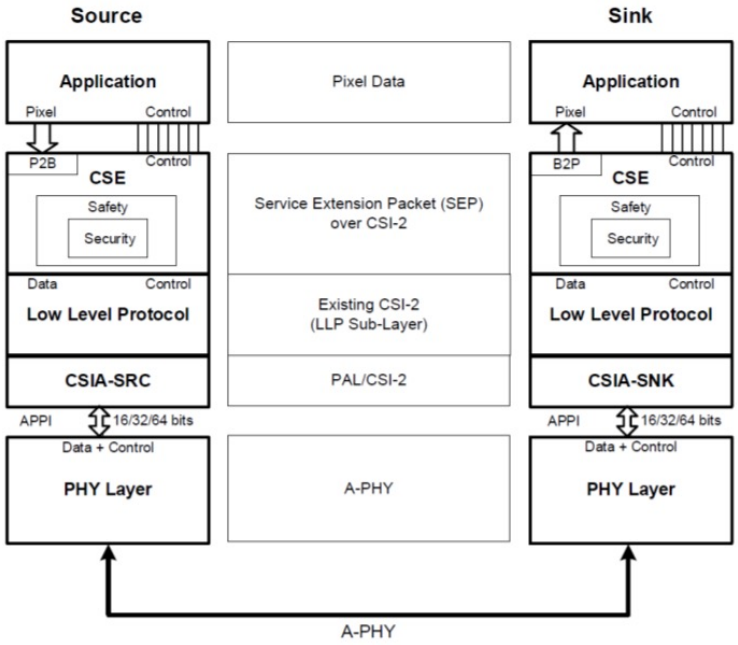


Figure 1 Layer Definitions for CSE Over A-PHY

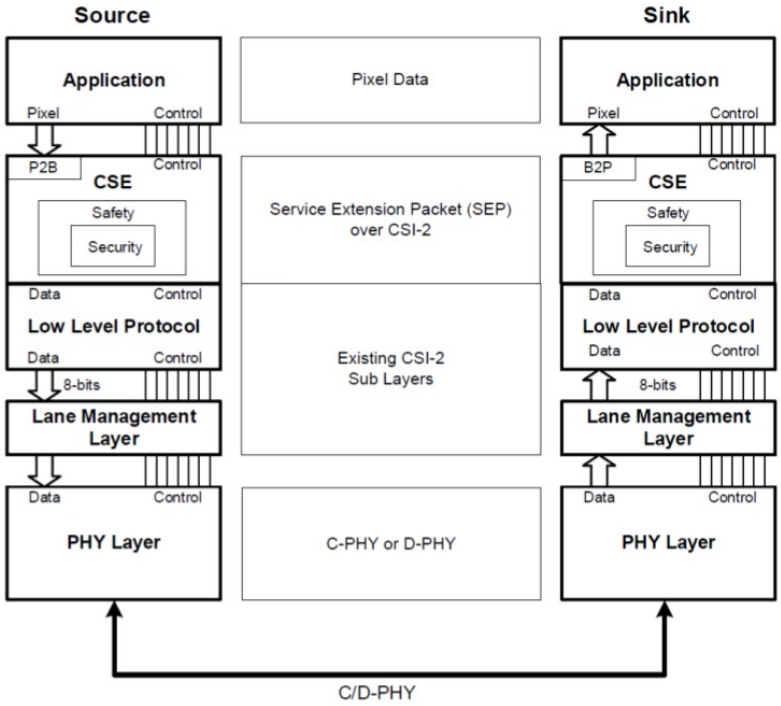


Figure 2 Layer Definitions for CSE Over C/D-PHY

Developing Systems & SoCs Meeting Automotive Requirements

Reduce Risk and Accelerate Qualification

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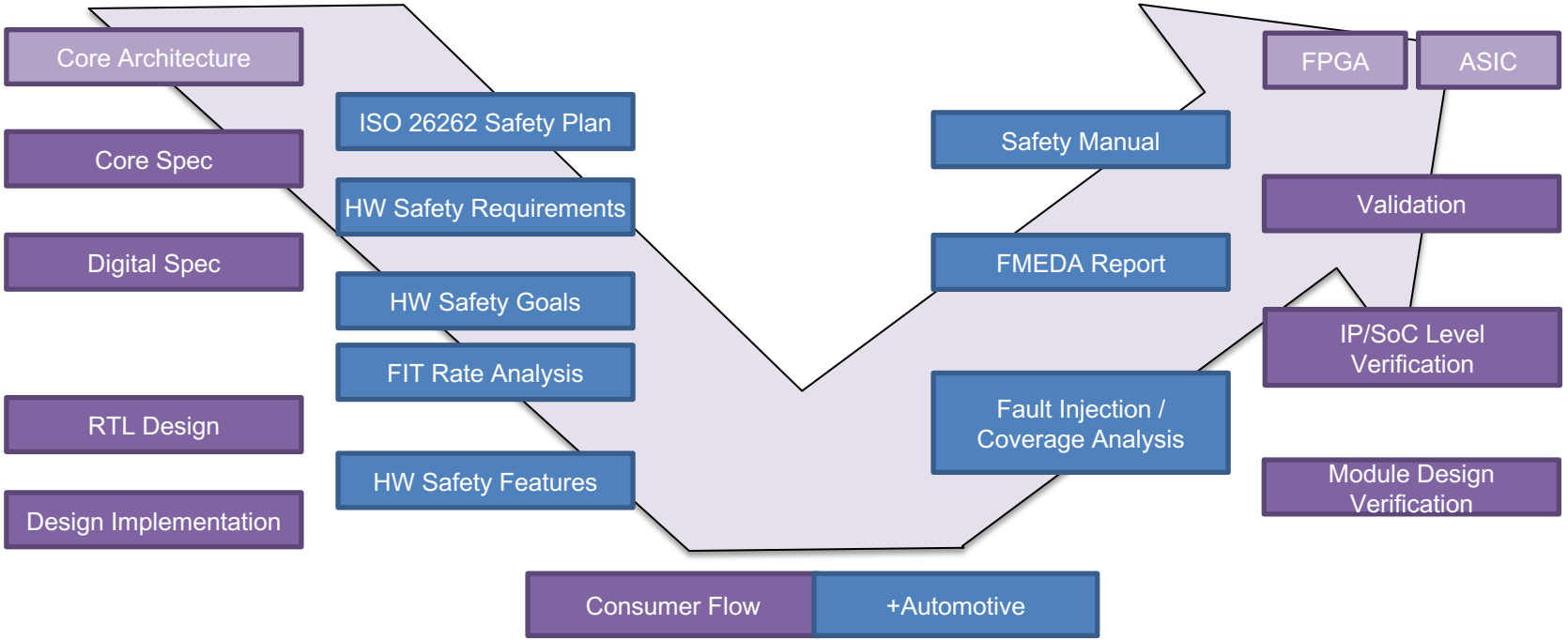
Temperature
Lifetime
Failure rate

Functional Safety	Accelerate ISO 26262 functional safety assessments to help ensure designers reach target ASIL levels
Reliability	Reduce risk & development time for AEC-Q100 qualification of SoCs
Quality	Meet quality levels required for automotive applications

Development Flows for ISO 26262 Functional Safety

Activities & Work Products for Automotive SoCs & IP



Automotive IP with FuSa Functionality

Synopsys Adds Specific Safety Mechanisms Functionality to DesignWare Automotive IP

Protection

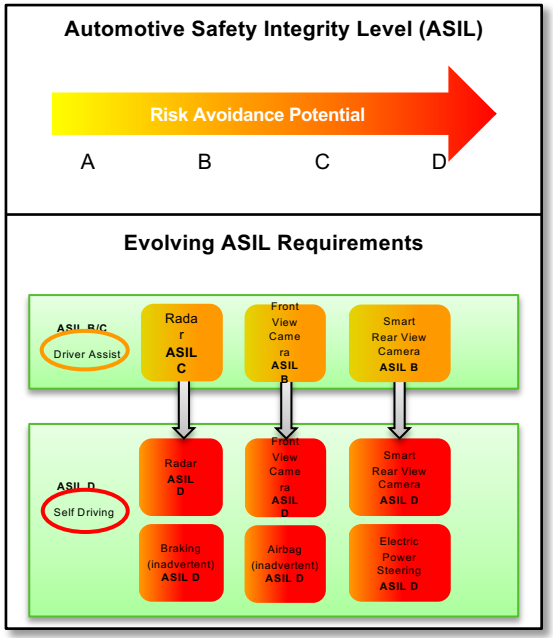
- User interface protection
- Buffer point protection
- Error detection codes
- Parity protection data
- Parity protection on configuration registers
- Memory protection
- Bad state protection/prevention

Redundancy

- Duplicate key modules
- Triplicate key modules

More…

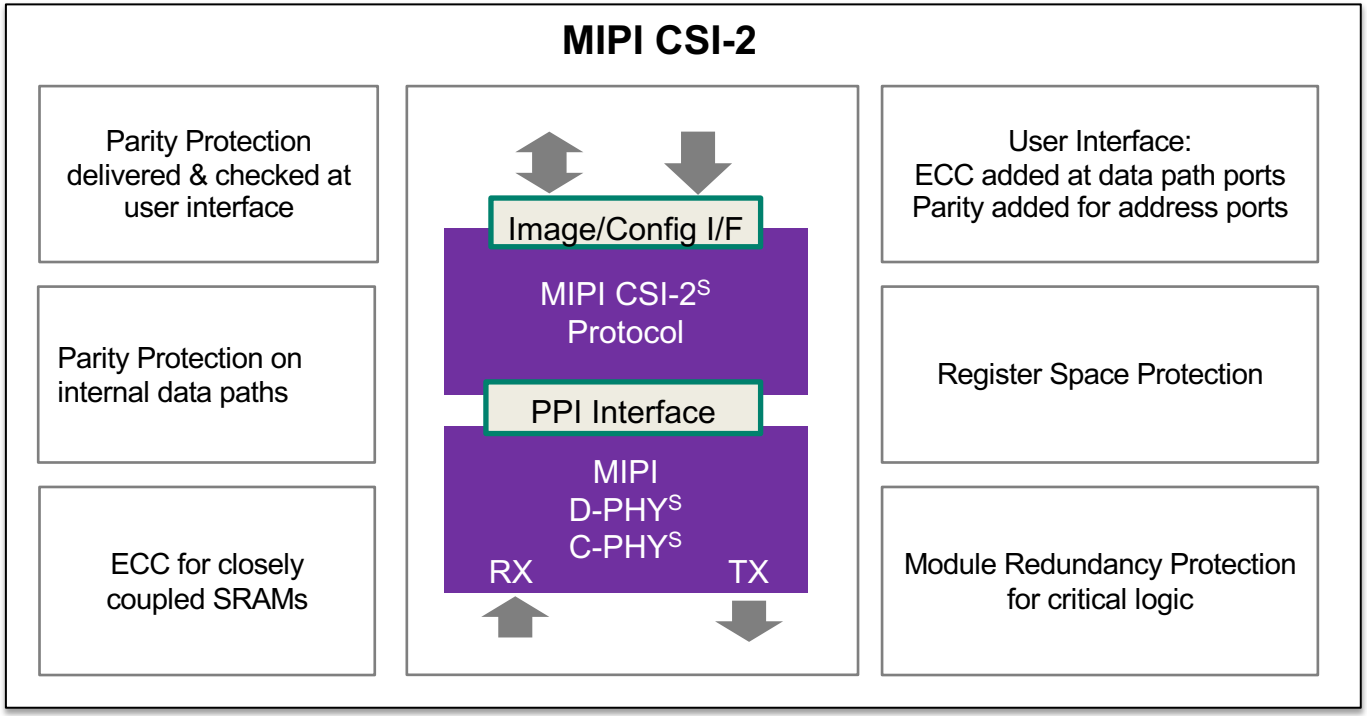
- Register concatenation
- Validity checking in key modules
- Dedicated interrupts for error reporting
- Processor Dual Core Lockstep support
- Processor user programmable watchdog timer



Note: Specific IP implements different range of safety features

Additional Safety Mechanisms to Meet ASIL B & Beyond

Example of an Automotive-Grade MIPI CSI-2 IP



- CSI-2 best-in-class example
- Safety Mechanisms to achieve ASIL B Random HW Fault metrics
- Each Safety Mechanism has an associated Reaction Time: Fault Handling Time Interval and Error Flag

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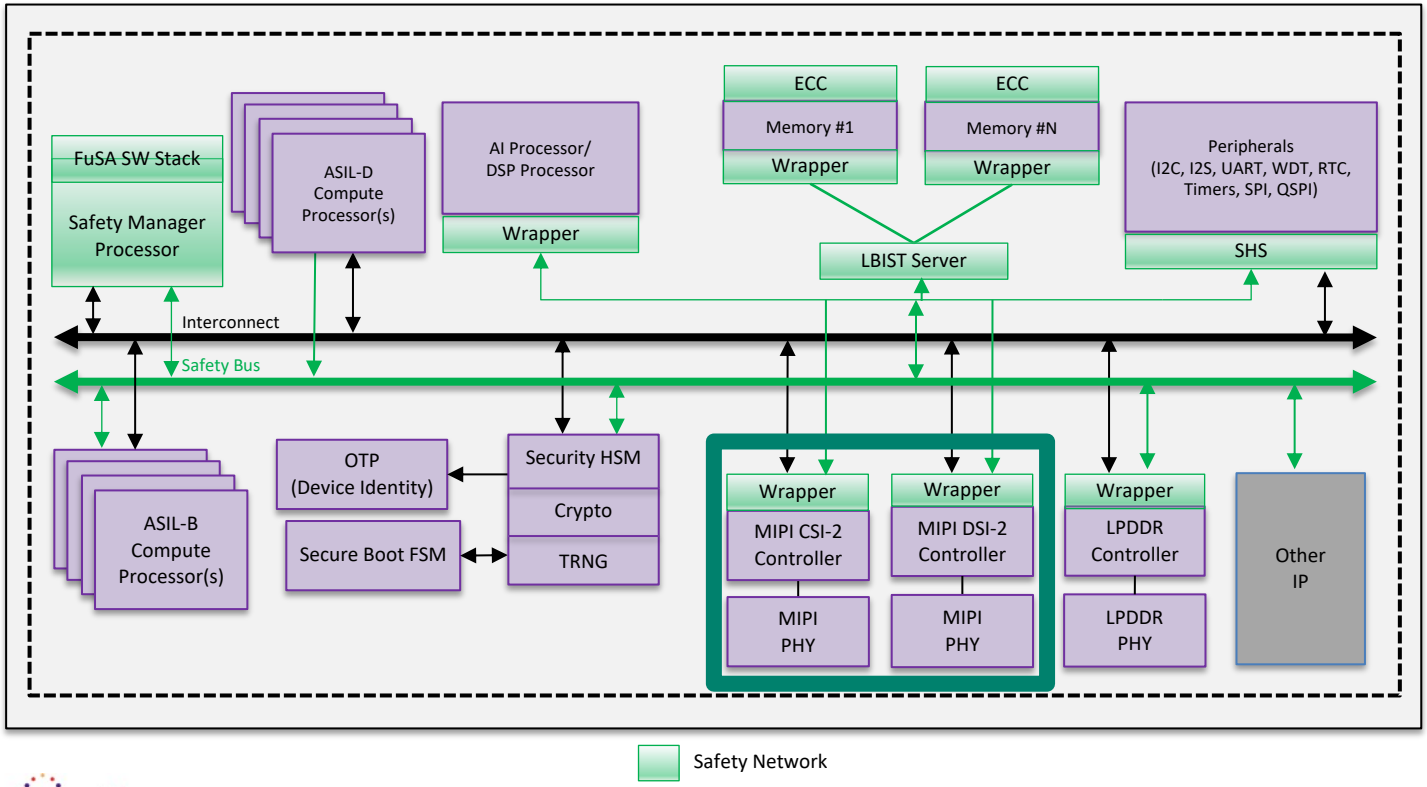
SGS TÜV SAAR ASIL B READY Functional Safety www.sgs-tuev-saar.com ASIL Random HW Faults ASIL Systematic in Progress

Safety Manager for SoC-Level Integration

Monitoring and Managing Functional Safety Capabilities

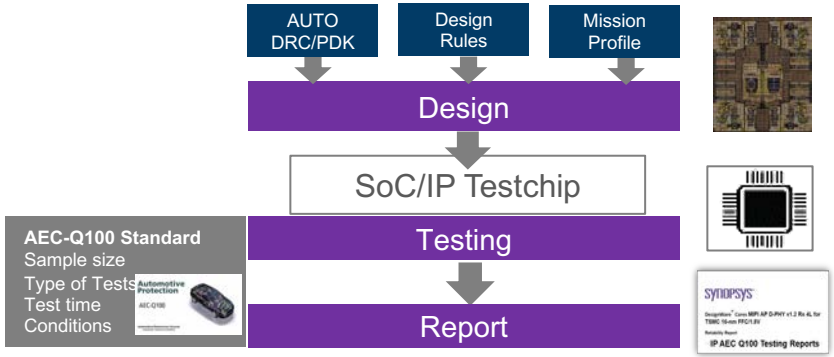


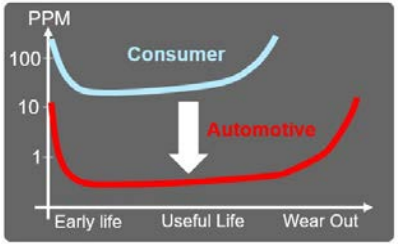
- Safety Manager monitors and manages all system failures and real-time faults; safe boot and mission-mode testing

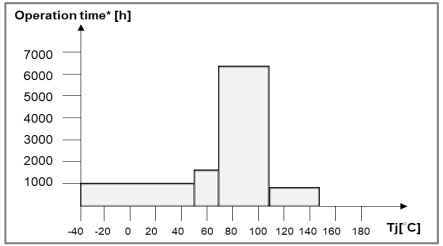
Need to Design for Reliability

Handling the Stringent Operating Conditions

- Environmental
- Temperature
- Noise
- Vibration
- Long term operation
- Field rate (targeting 0%)







Grade	Ambient Operating Temperature Range
0	-40°C to +150°C
1	-40°C to +125°C
2	-40°C to +105°C
3	-40°C to +85°C

AEC-Q100 Qualification						
Accelerated Lifetime Simulation Tests		Electrical Verification Tests				
HTOL	ELFR	ESD HBM	ESD CDM	IC Latch Up	E D	CHAR

Need for a Comprehensive Automotive-Grade MIPI IP

MIPI Automotive-Grade IP Package
22nm - 16nm - 7nm - 5nm

CSI-2 / DSI / DSI-2 Controllers

C-PHY / D-PHY

Safety	Reliability	Quality
• SAFETY MANUAL • FMEDA • FuSa CERTIFICATE • RANDOM • SYSTEMATIC • WORK PRODUCTS	• MISSION PROFILE • AUTO PDK/RULES • GRADE 2/1 • AEC-Q100 REPORT	• ISO 9001 QUALITY MANAGEMENT SYSTEM • QUALITY MANUAL

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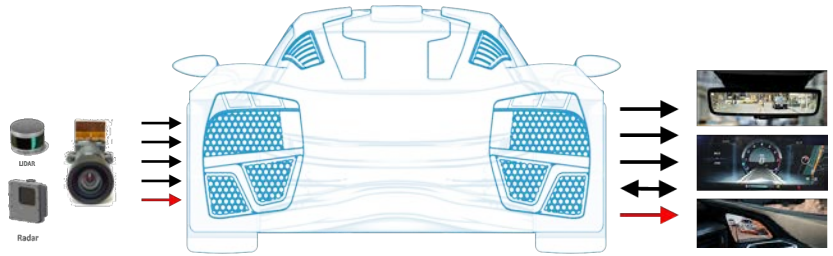
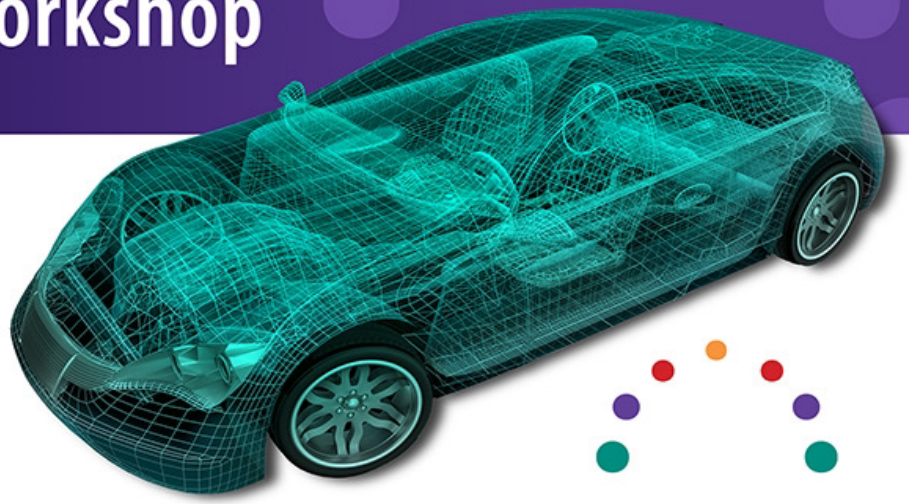
SGS TÜV SAAR ASIL B READY Functional Safety www.sgs-tuev-saar.com
ASIL Random HW Faults
ASIL Systematic in Progress

Automotive SoC
22nm - 16nm - 7nm - 5nm



MIPI Automotive Workshop

An in-depth look at the MIPI Automotive SerDes Solutions (MASS) framework



Q&A