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MIPI ALLIANCE DEVELOPERS CONFERENCE

20-21 SEPTEMBER 2022

Dr. Gregor Sievers
dSPACE GmbH

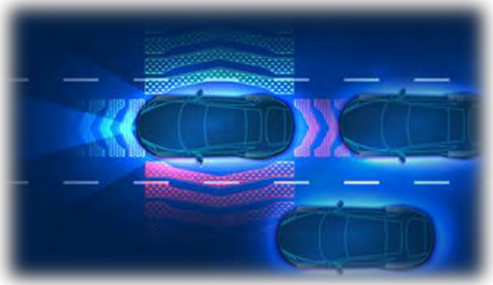
How to Engage in Data-Driven Development and Testing Using MIPI Automotive Sensor Interfaces

Agenda

- Autonomous Driving: Challenges
- Data Logging
- Data Ingestion
- Data Management
- Data Labeling
- Data Replay
- Conclusion

Autonomous Driving: Challenges

Ensure safety under all conditions!

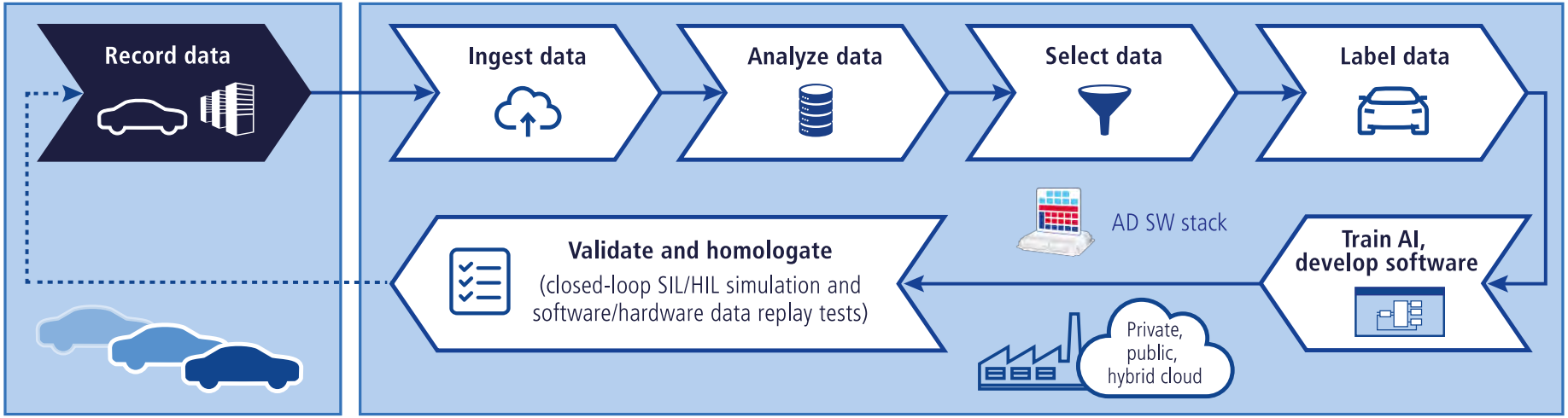


Dozens of environment sensors!

How to develop and test AI?

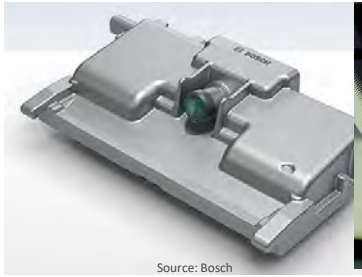
→ Data Driven Development

Data-Driven Development and Testing



Automotive Sensor Interfaces

Front Camera

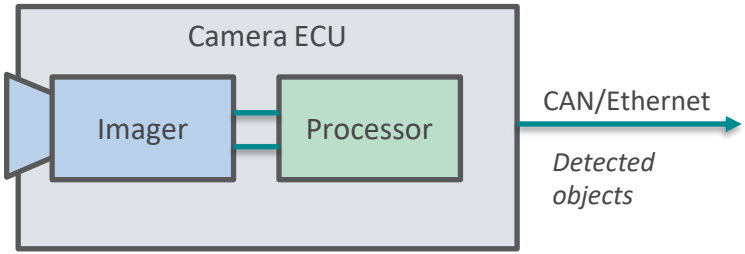

Source: Bosch

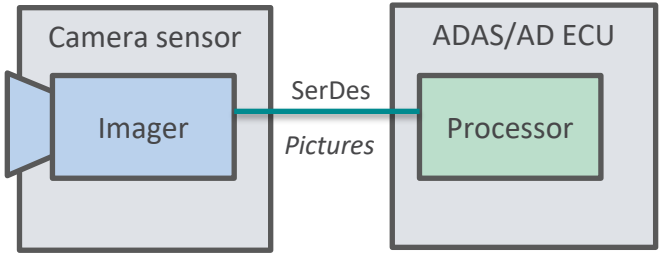

Source:
https://de.wikipedia.org/wiki/Spurhalteassistent#/media/Datei:Lane_Assist.jpg
CC BY-SA 3.0

Surround View Camera


Source: Continental

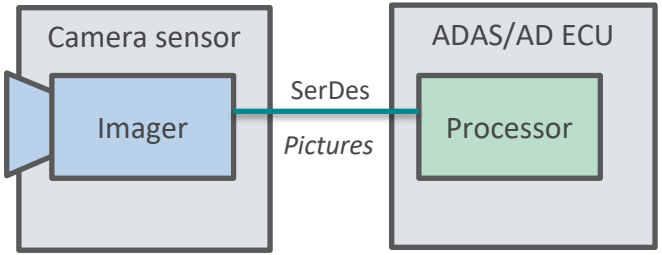

Source: https://ww.electrek.co/2019/05/29/honda-e-side-cameras/#



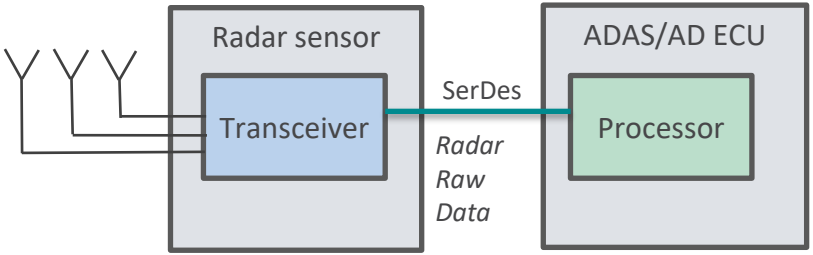


Automotive Sensor Interfaces

Driver & Occupant Monitoring



Radar & Lidar



Source: https://www.bosch-mobility-solutions.com/en/solutions/interior/interior-monitoring-systems/

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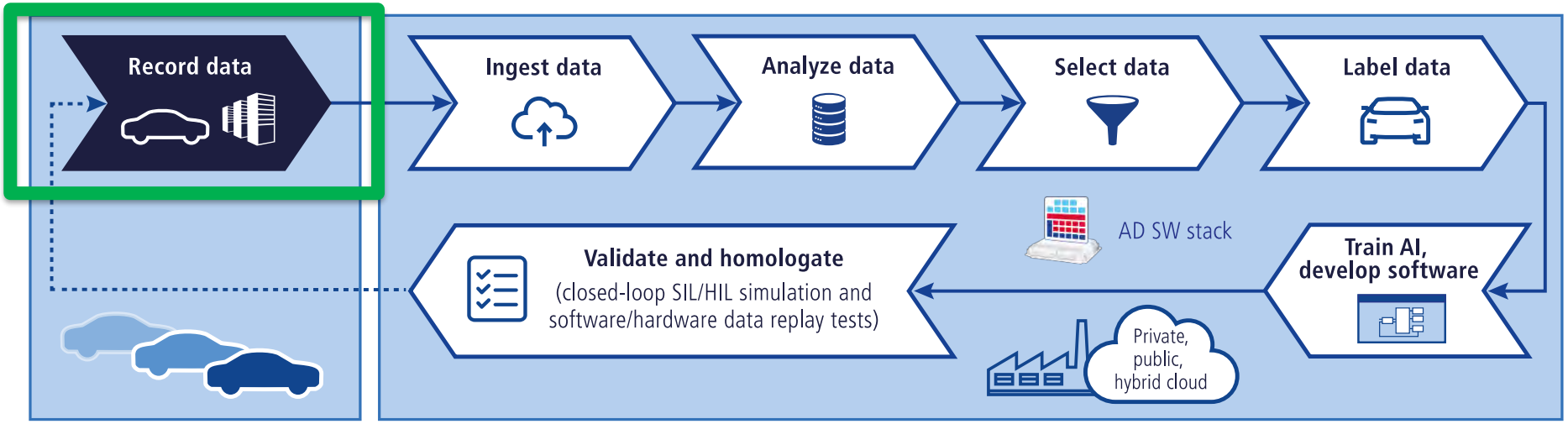
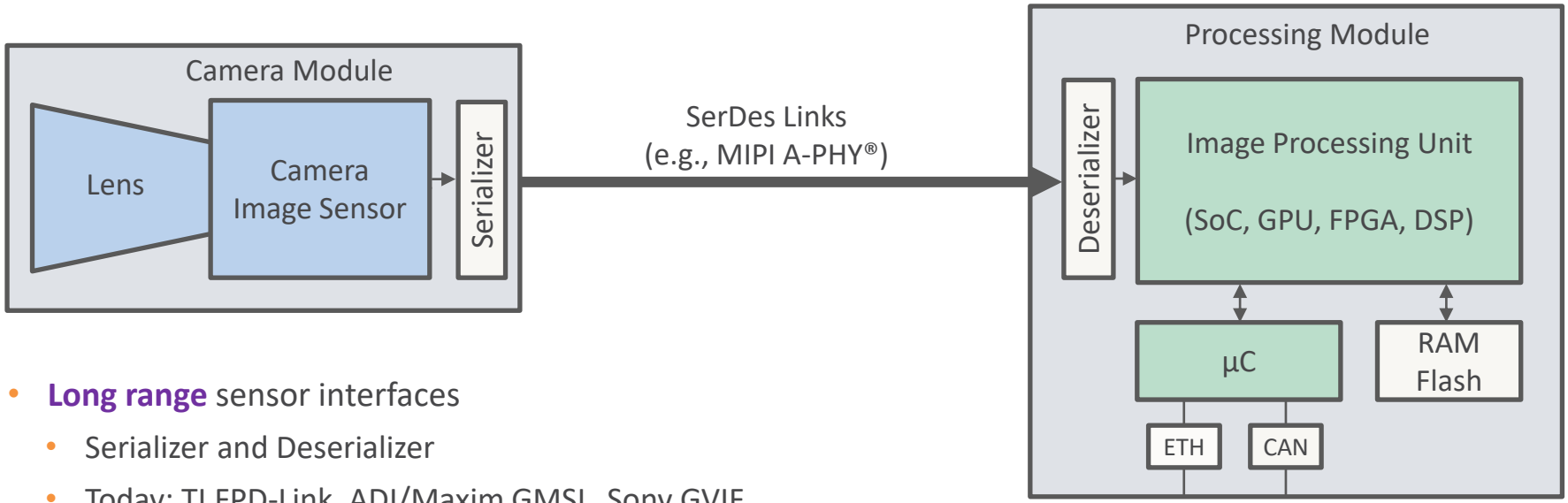
Data Logging

Data Logging

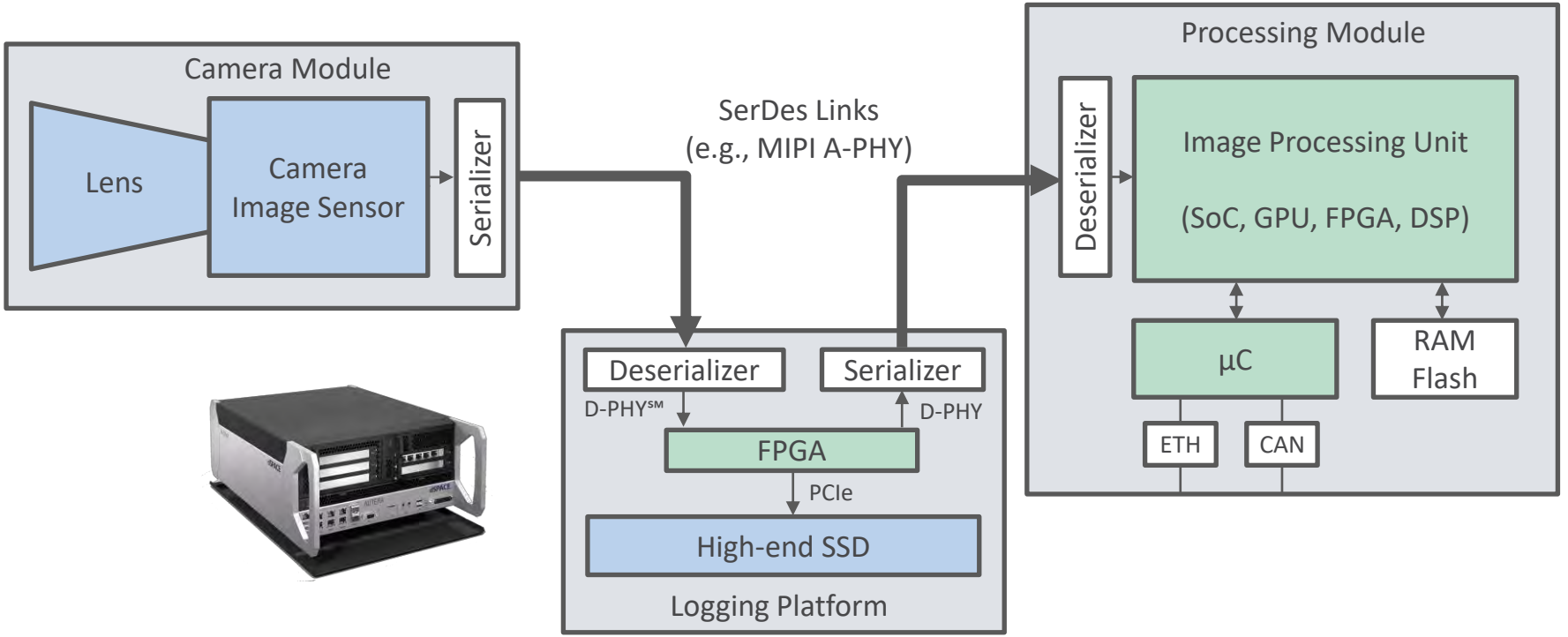


Automotive Surround View Cameras

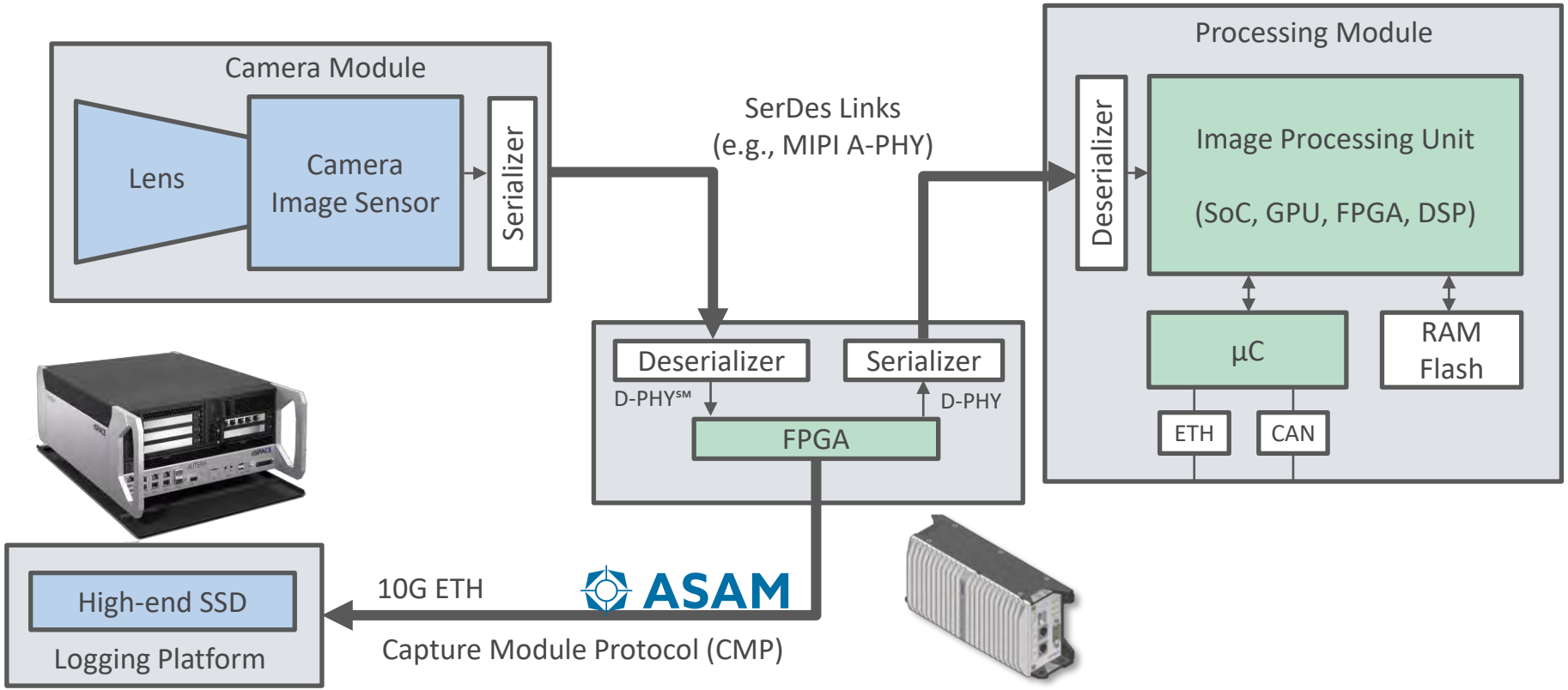


- **Long range** sensor interfaces
  - Serializer and Deserializer
  - Today: TI FPD-Link, ADI/Maxim GMSL, Sony GVIF
  - Future: MIPI A-PHY®

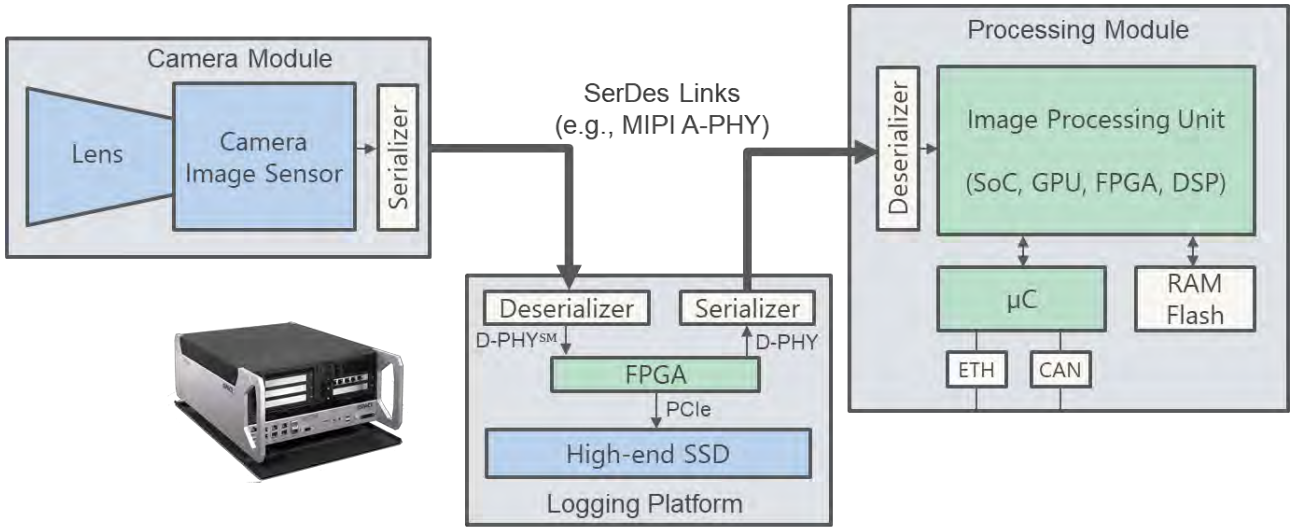
Surround View Camera: Data Logging



Surround View Camera: Data Logging



Data Logging: High Data Rates



Key takeaways

Challenges

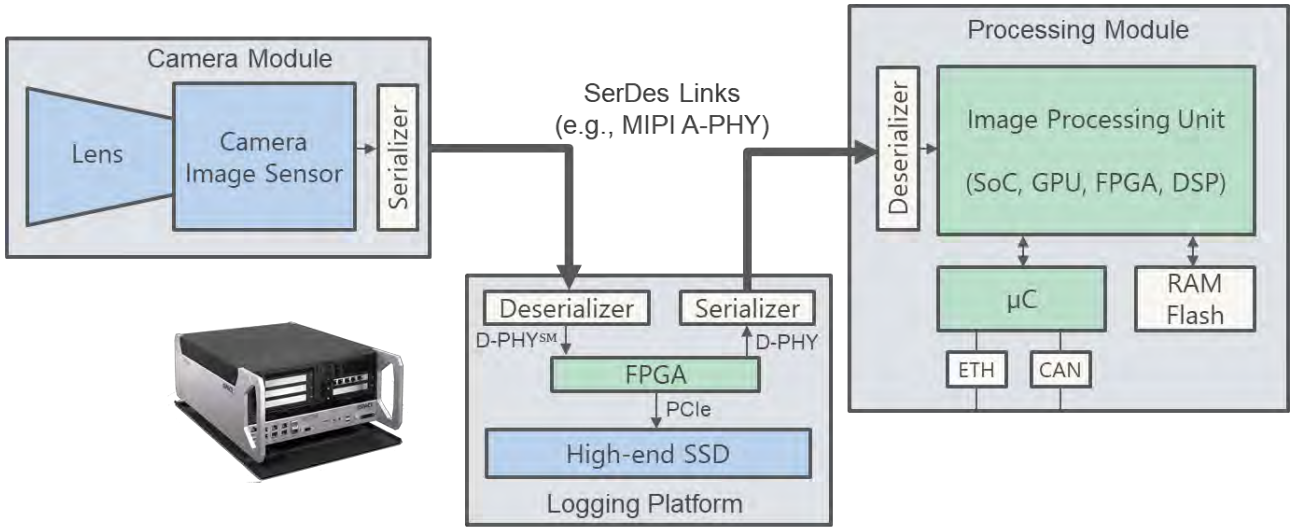
- High sensor data rates
  - Dozens Gbit/s per car
- Hundreds TB per day per car

Solution

- Large high-throughput SSDs
- Lossless data compression
  - In real-time
- Intelligent data selection
  - Redundancy reduction

MIPI MASS℠ – Challenges

Challenges for Data Driven Development



Key takeaways

Challenges

- Advanced safety and security functions
- Encryption & authentication

Solution 1

- Disable safety/security for testing
  - "HIL/testing mode"

Solution 2

- Implement MIPI MASS℠ in logging/testing hardware
- Requires keys from OEM/Tier1 suppliers

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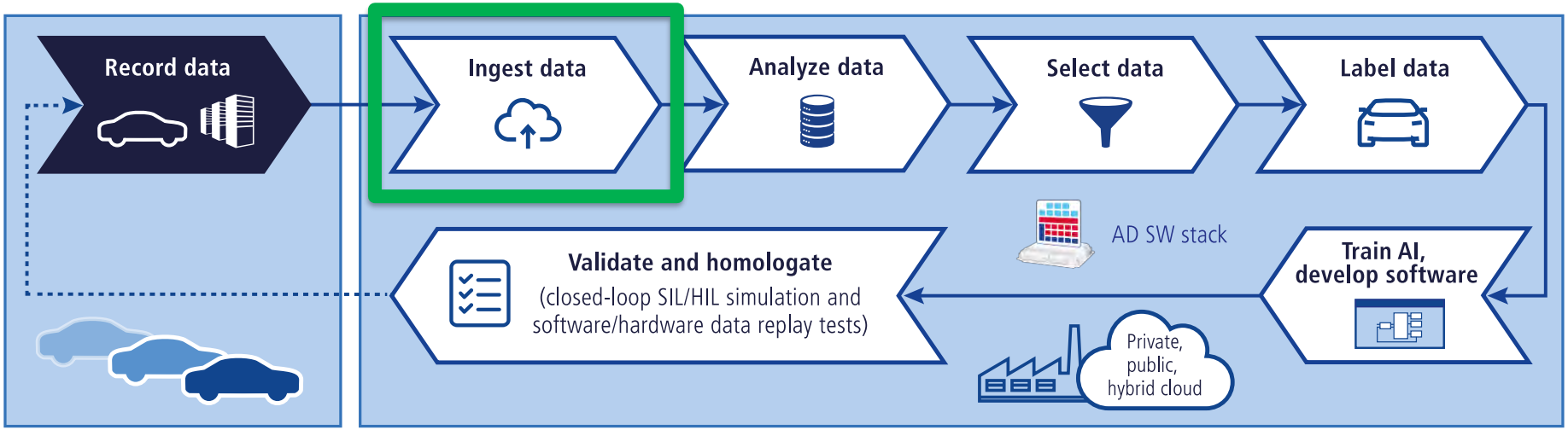
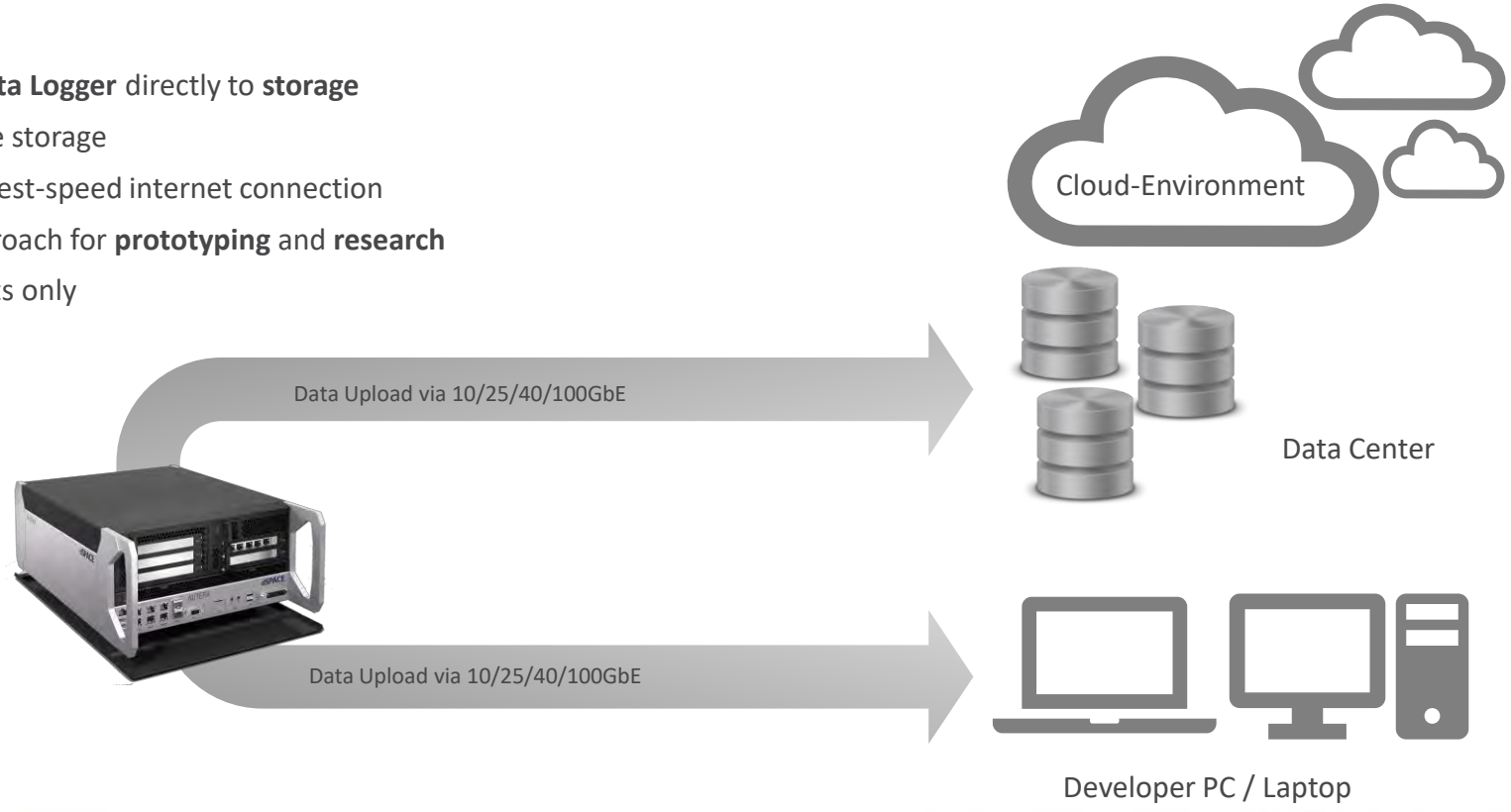
Data Ingestion

Data Ingestion



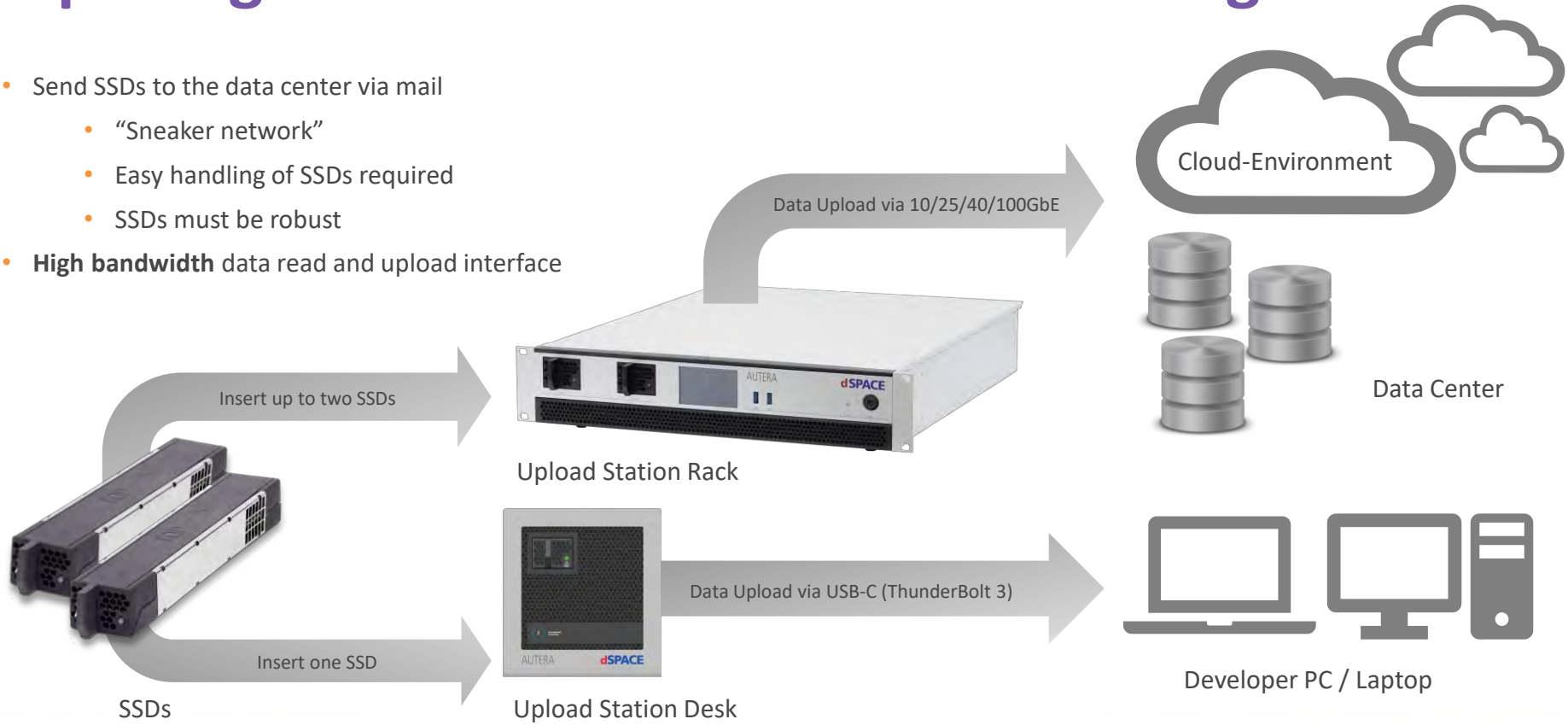
Opening the bottleneck with fast data ingestion

- Upload data from **Data Logger** directly to **storage**
  - Requires large storage
  - Requires highest-speed internet connection
- Straight forward approach for **prototyping** and **research**
  - Small data sets only



Opening the bottleneck with fast data ingestion

- Send SSDs to the data center via mail
  - "Sneaker network"
  - Easy handling of SSDs required
  - SSDs must be robust
- **High bandwidth** data read and upload interface



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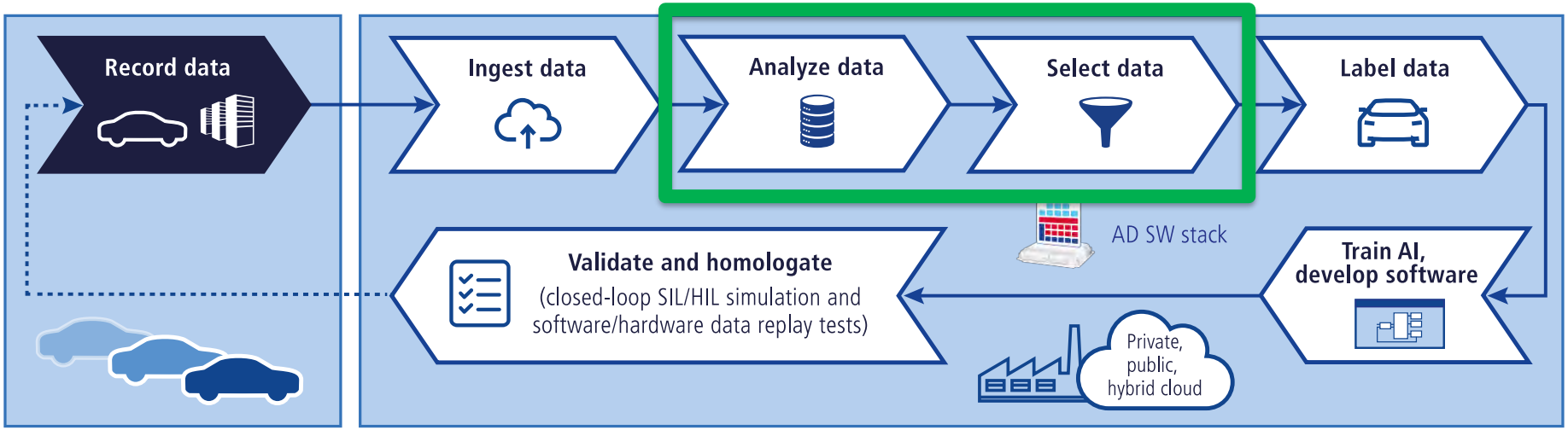
Data Management

Data Management



Data Management

Record data → Ingest data → ?

Data Consumers have **different needs**

Data Consumer

Collected data includes a lot of **useless data**

- Light & weather Conditions [Diverse]
- Traffic Participants [Diverse]
- Traffic participant position relative to the Ego Vehicle [Diverse]

→ Training Object Detection

- Video Duration >1 min
- Lane Count > 2 Lanes
- Traffic participant position relative to the Ego Vehicle [Diverse]

→ Validation of LKA

- Video Duration <= 1 min
- Traffic participant position relative to the Ego Vehicle [Front]

→ Validation of AEB

→ ....

Deliver the right data

Data Management

Record data → Ingest data → Analyze data → Select data → Data Consumer

Collected data includes a lot of **useless data**

- Light & weather Conditions [Diverse]
- Traffic Participants [Diverse]
- Traffic participant position relative to the Ego Vehicle [Diverse]

→ Training Object Detection

- Video Duration >1 min
- Lane Count > 2 Lanes
- Traffic participant position relative to the Ego Vehicle [Diverse]

→ Validation of LKA

- Video Duration <= 1 min
- Traffic participant position relative to the Ego Vehicle [Front]

→ Validation of AEB

→ ....

Deliver the right data

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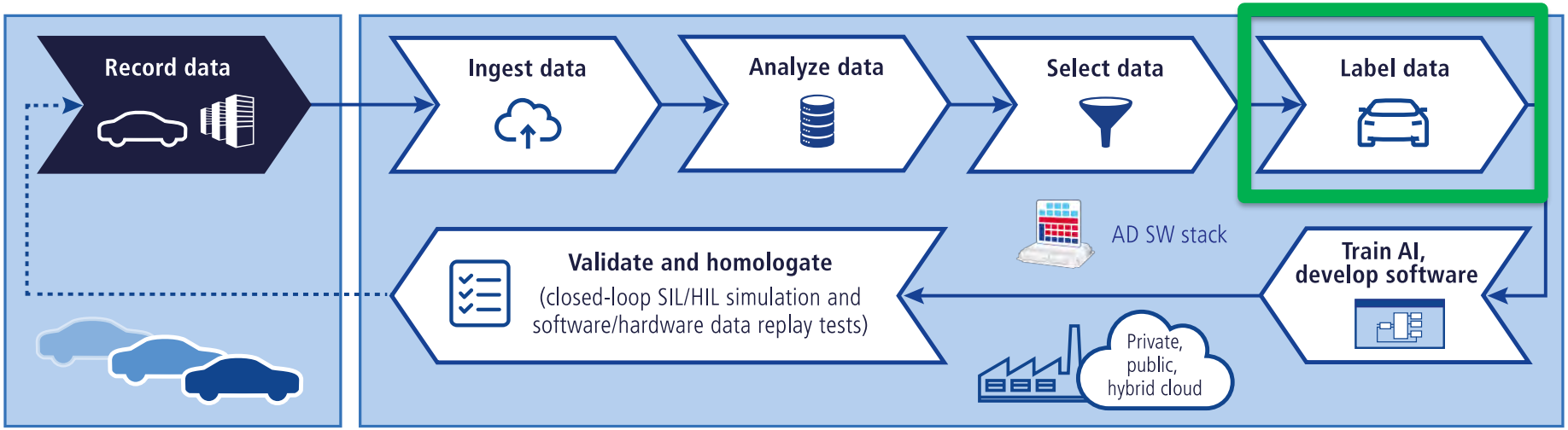
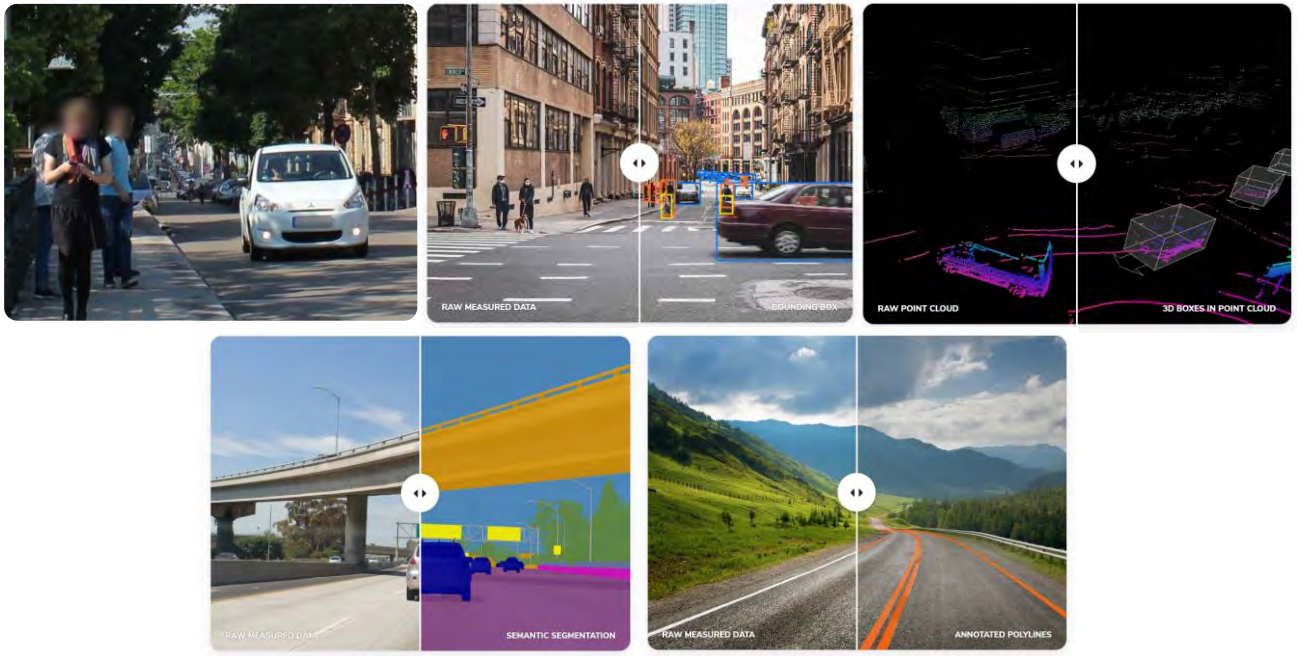
Data Labeling

Data Annotation & Labeling



Data Annotation & Labeling



Key takeaways

Anonymization
Anonymizes +99% of all identifiable faces and license plates.

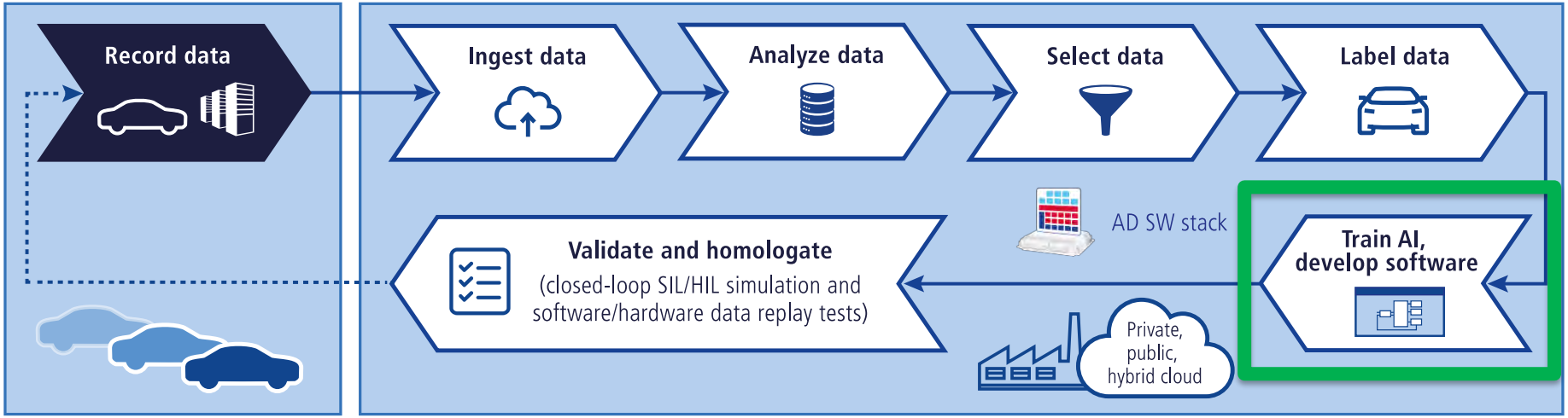
Compliance to international standards

AI-based labeling
2D/3D bounding boxes (videos/point clouds), semantic segmentation, 2D/3D polylines…

Manual annotations
Huge workforce of human annotators required.

Automated annotations
Cuts costs with ground truth generation >90% automated.

Data Annotation & Labeling



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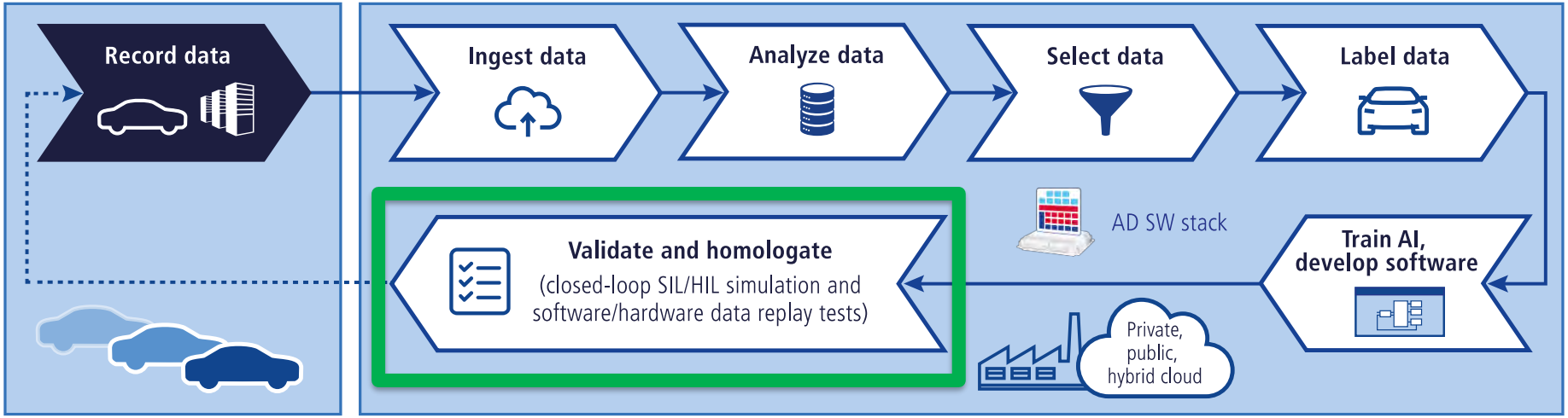
Data Replay

Data Replay



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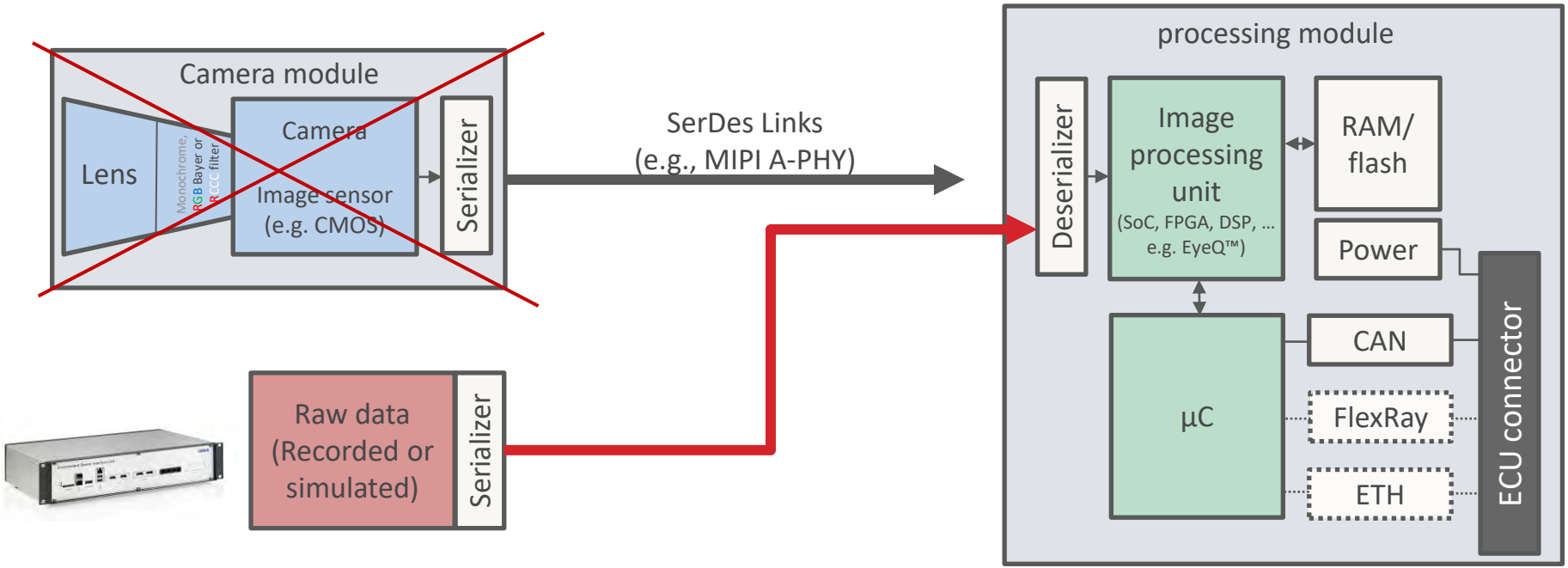

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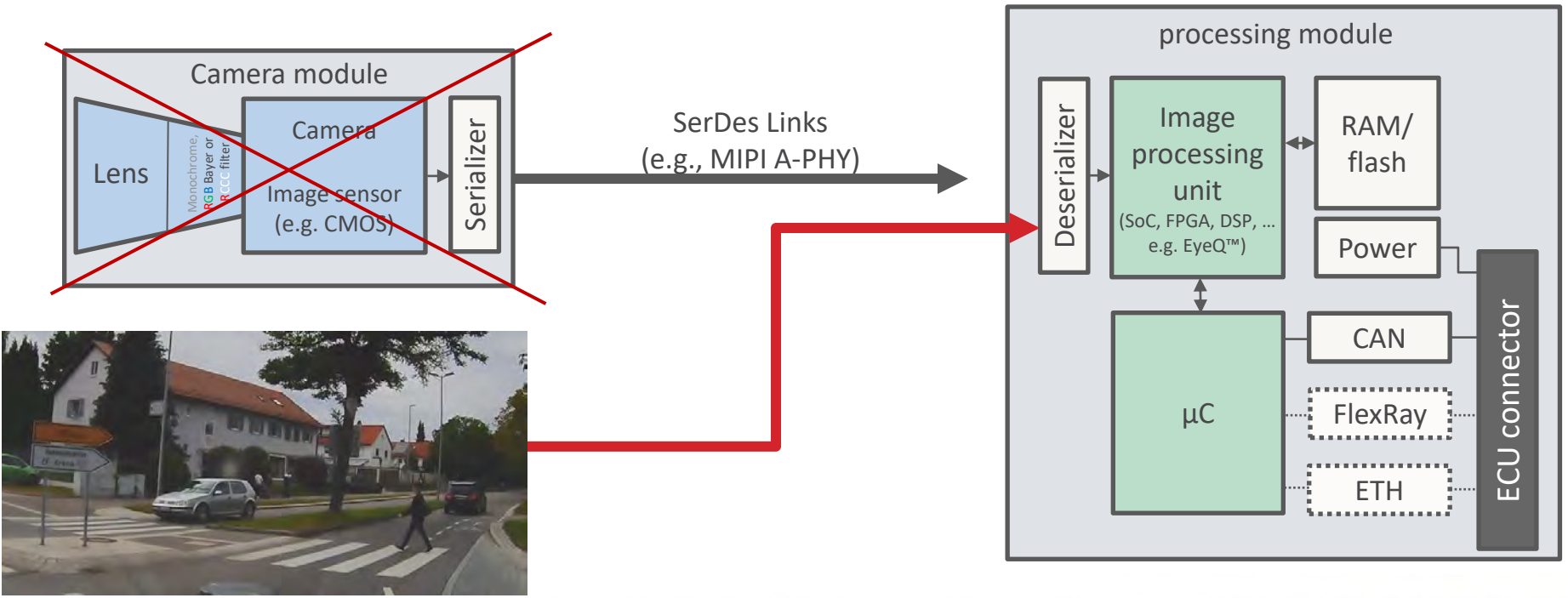

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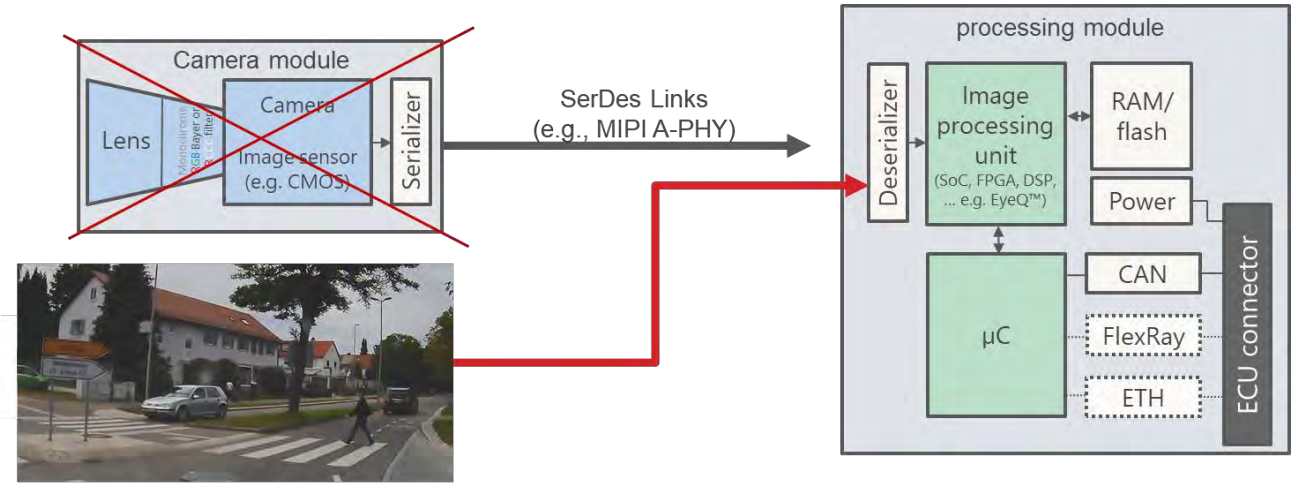

Key takeaways

Challenges

- Various sensor interfaces used today
- Even interface chips from same supplier are not 100% compatible
- I2C register configuration
- Synchronization of all ECU interfaces

Solution Today

- Modular hardware
- Highly configurable logging and simulation

Solution Tomorrow

- Standardized sensor interfaces
  - MIPI A-PHY
  - MIPI MASS℠

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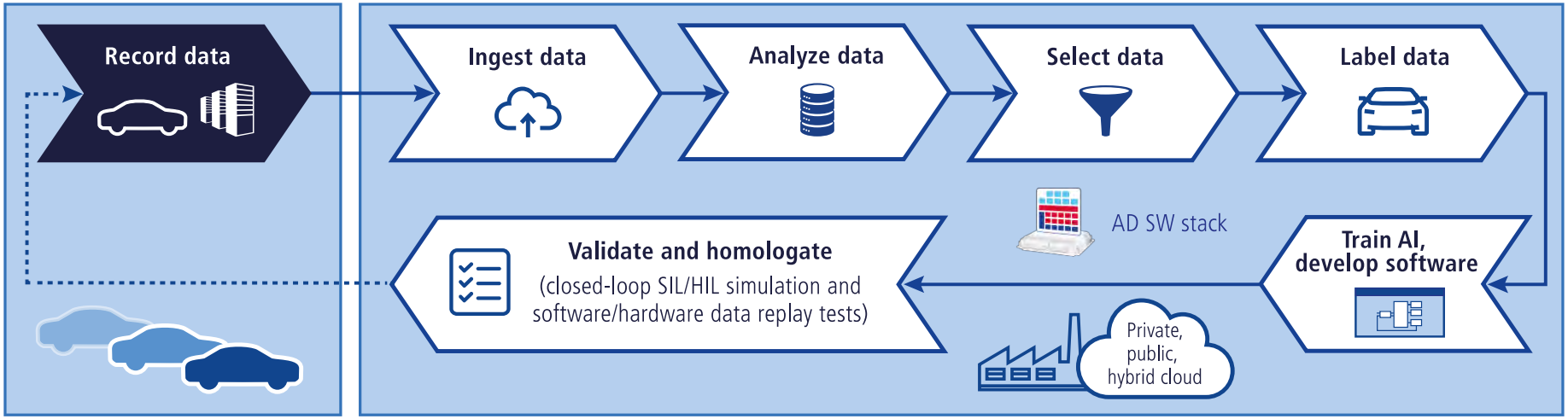
Conclusion

Conclusion

- Data is a key for Autonomous Driving
- Data Driven Development



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THANK YOU!

ADDITIONAL RESOURCES

- MIPI MASS℠

  https://www.mipi.org/introductory-guide-to-mass

- MIPI A-PHY®

  https://www.mipi.org/specifications/a-phy

- dSPACE Data Driven Development

  https://www.dspace.com/en/inc/home/applicationfields/comp/data_driven_development.cfm

- dSPACE Environment Sensor Interface Unit

  https://www.dspace.com/en/pub/home/products/special_solutions/esi_unit.cfm

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Q&A