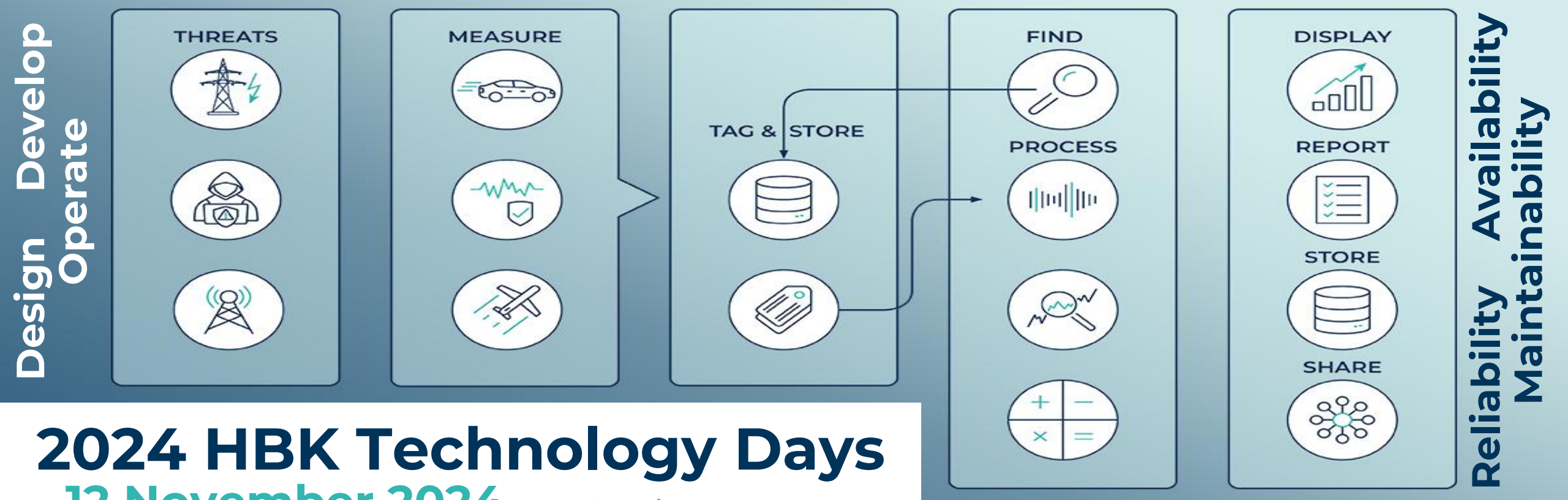




2024 HBK Technology Days

12 November 2024

Session 3: Vehicle Network Measurements



- Rapid Prototyping for ECU testing with FL3X Config for CAN, FlexRay and Automotive Ethernet

Christian Huschle,
STAR ELECTRONICS GmbH & Co. KG

Rapid Prototyping for ECU testing with FL3X Config for CAN, FlexRay and Automotive Ethernet

Abstract

- ECUs in modern vehicles exchange a lot of data between themselves during runtime. Especially in a software defined vehicle the individual ECU depends on incoming communication to perform its functionality as the sensors are not necessarily linked directly with the software feature using the measurement data.
- For several years it is standard that testing of such ECUs needs an environment around them to provide suitable data to get the DuT (device under test) in active mode. This is often done with a complete set of ECUs. However, using a simulation environment allows testing much earlier in a development phase and helps to minimize complexity of testing. Reducing complexity also means reducing costs.
- STAR ELECTRONICS provides a solution being in use at OEMs and their suppliers worldwide and focuses on rapid prototyping of RBS, gateway and signal manipulations.

Rapid Prototyping for ECU testing with FL3X Config for CAN, FlexRay and Automotive Ethernet

- ▲ About the presenter, Christian Huschle,
General Manager, STAR ELECTRONICS GmbH & Co. KG
 - Christian has an engineering diploma in Automation Technology as well as an MBA in General Management and was working at further European automotive suppliers (tier1 and technology specialists) in test centres and sales organizations. Before this, he has been working at several locations for Toyota Tsusho group companies in Europe and Japan being active for searching technology and products needed at Toyota group. During that time, he was participating in several consortia locally and worldwide for automotive industry and managed customer projects in Japan. Thus, working from different viewpoint in automotive area he is experienced in topics of conformance and certification testing, car communication, bus system specifications as well as Functional Safety.
 - Christian Huschle is working at STAR ELECTRONICS GmbH & Co. KG in Germany, a supplier of network equipment for the automotive industry and an engineering specialist in automotive bus systems. The company focusses on rapid prototyping and cost reduction of test environments for remaining bus simulation, gateway and signal manipulation. Data security is one of most important topics within this field of operation.

RAPID PROTOTYPING FOR ECU TESTING

Virtual and real environment



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Detailed product information can be found at:

www.flex-product.com



- » Introduction
- » Rapid prototyping by STAR®
- » Solutions for Gateway and ECU-Tests
- » FL3X Products
- » Virtual device
- » Replay
- » Technical background
- » STAR

INTRODUCTION

THE POWER OF SYNERGY

We provide **interdisciplinary solutions** from a single source that are customized to your needs.



INTRODUCTION

PRODUCTS for Rapid Prototyping

- » Bus interface
- » Rest bus simulation
- » Gateway
- » Signal manipulation
- » Visualization
- » Logging
- » Replay
- » For all OEMs



#10GBASE-T1

#5GBASE-T1

#2.5GBASE-T1

#1000BASE-T1

#100BASE-T1

#10BASE-T1S

#OABR

#CAN-FD

#CAN-SIC

#Ethernet

#FlexRay

#SPI

#LIN

#SENT

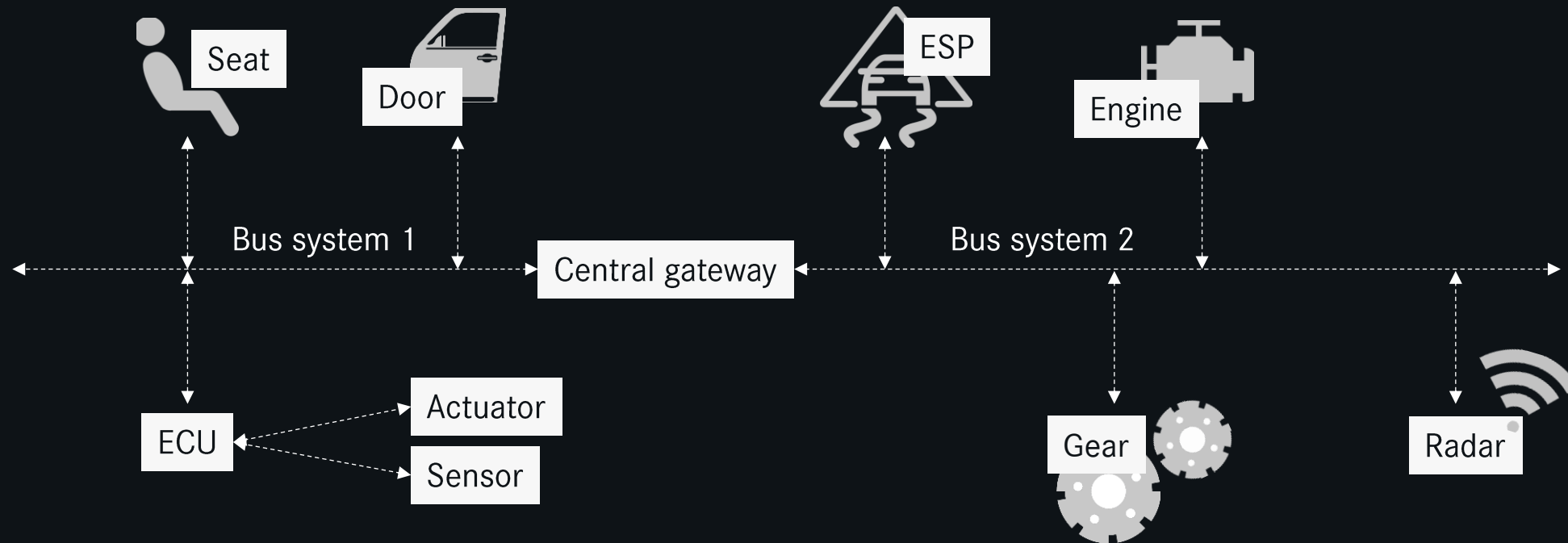
RAPID PROTOTYPING BY STAR®

THE BASICS: Car networking



RAPID PROTOTYPING BY STAR®

THE BASICS: Car networking



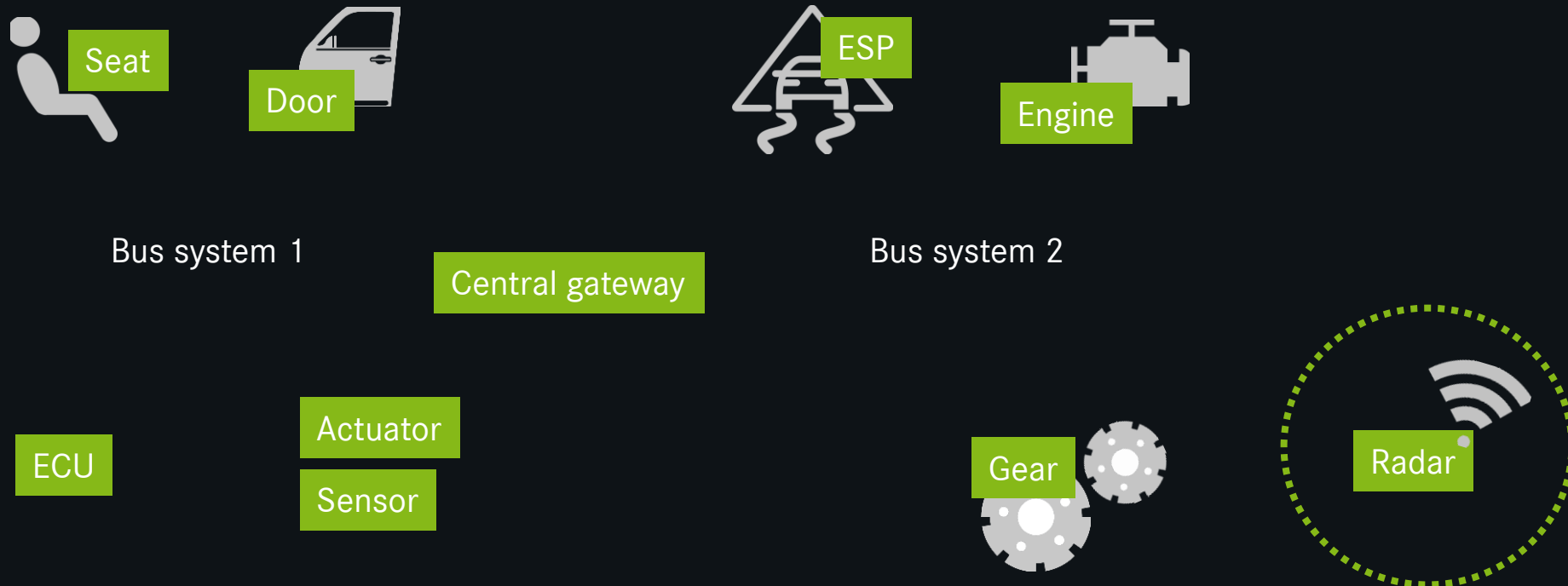
RAPID PROTOTYPING BY STAR®

THE TASK: Test of electronic control units



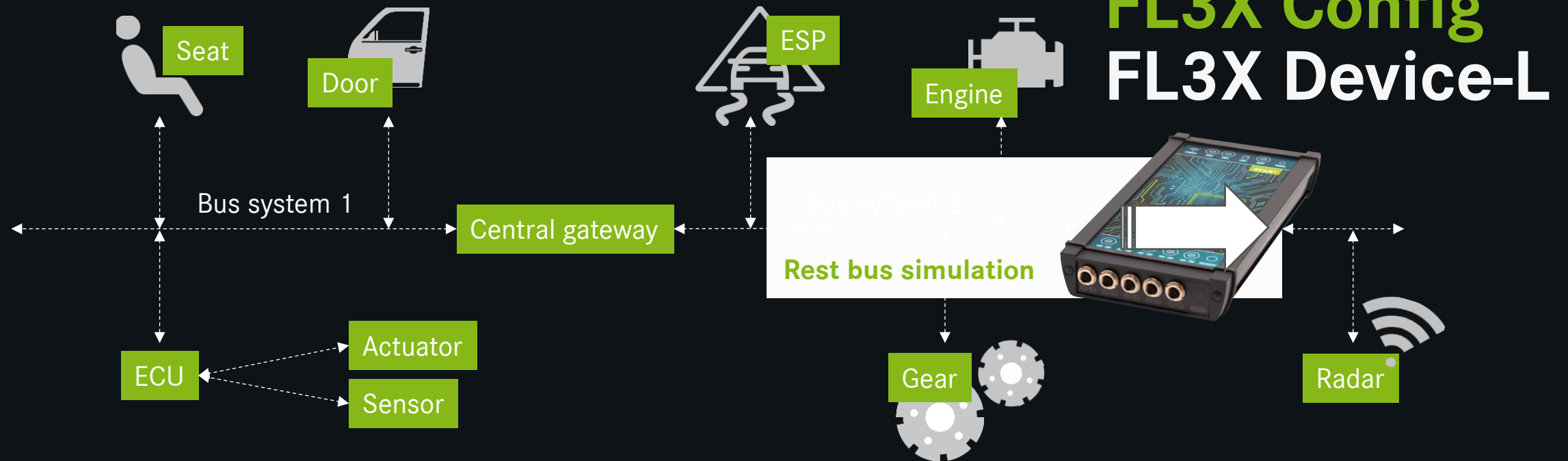
RAPID PROTOTYPING BY STAR®

THE TASK: Test of electronic control units



RAPID PROTOTYPING BY STAR®

THE SOLUTION: Rest bus simulation

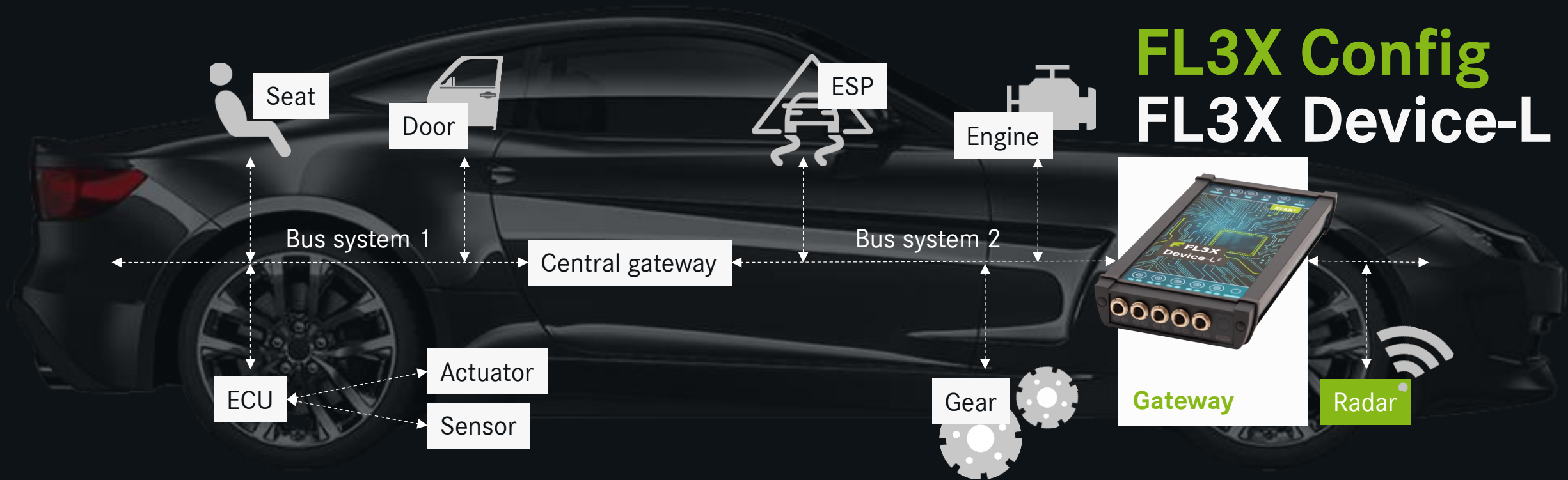


RAPID PROTOTYPING BY STAR®

THE SOLUTION: Gateway



FL3X Config FL3X Device-L



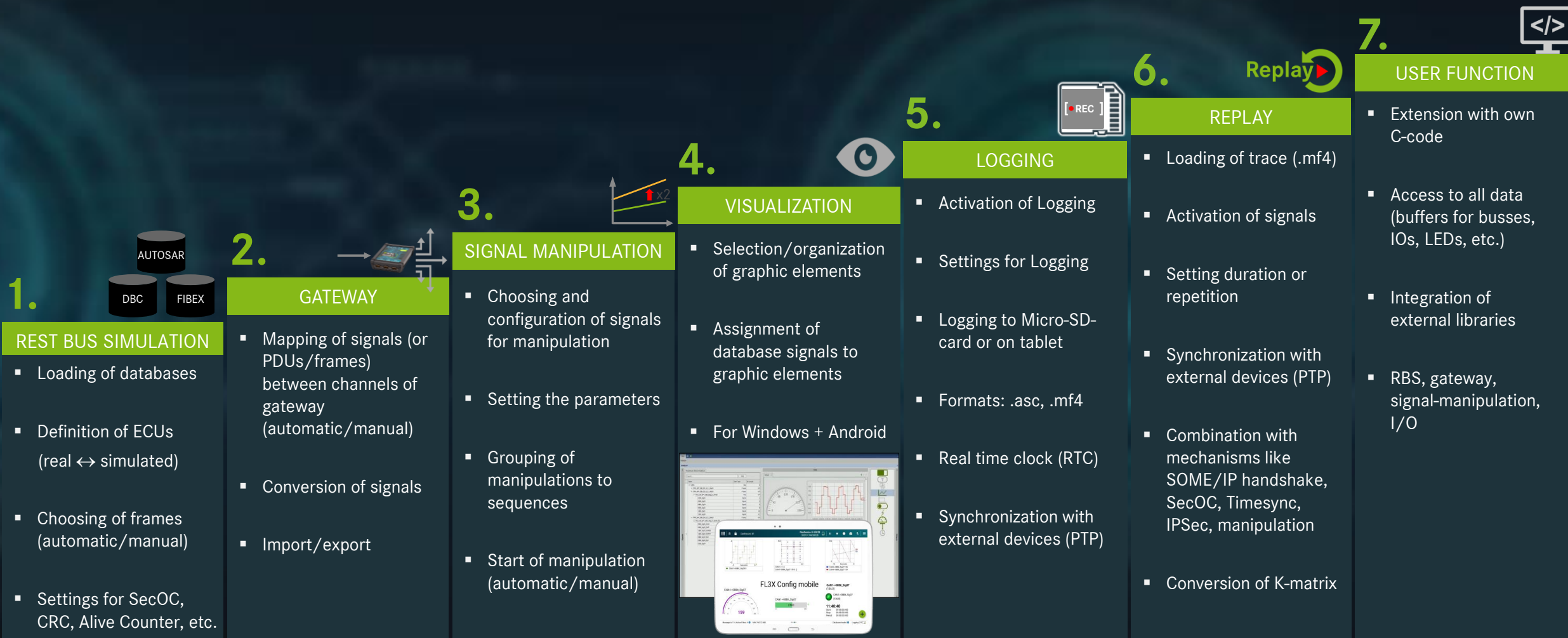
RAPID PROTOTYPING BY STAR®

THE RESULT: Fast Testability



SOLUTIONS FOR GATEWAY AND ECU-TESTS

RAPID PROTOTYPING ENVIRONMENT



Graphical User interface with integrated **drag&drop handling** and **automatic code generation**

SOLUTIONS FOR GATEWAY AND ECU-TESTS

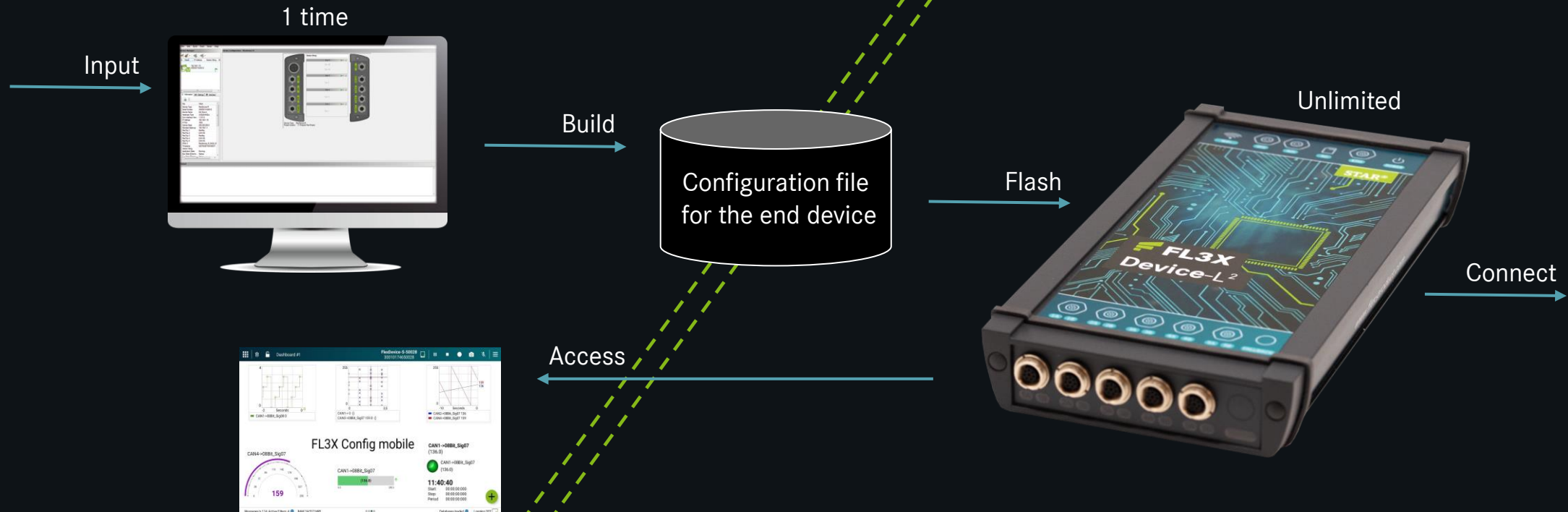
PROCESS with HW and SW

FL3X Config

Configuration software

FL3X Device / FL3X System

HW or Virtual Device



FL3X PRODUCTS

PRODUCT OVERVIEW

FL3X Device



FL3X System



FL3X Switch



FL3X Interface



FL3X Media



FL3X TAP





FL3X Device



FL3X Device-L

Connectors

- Ethernet (PC connection)
- WiFi
- Power 8-42V
- 4 x Digital IN/OUT
- 5 x Analog IN
- 2 x MicroSD-Slot (intern/extern)

LEDs

- Bus Status
- Power Status
- User defined

Sleep-Mode

- 5 mA current consumption

Reset

- Reset-Button

ARM Cortex A9

- 2 x 800 MHz
- FPGA

5 extension slots Physical Layer

- CAN-FD/HS (2 and 4 channels)
- Ethernet/100BASE-T1 (optional Switch)
- Ethernet/1000BASE-T1 (optional Switch)
- FlexRay (2 channels)
- LIN, SENT
- K-Line, UART, SPI

Housing

- IP20*
- -40 ... +85 °C
- 239 x 124 x 36 mm
- Plugs: M9



* IP67 on request



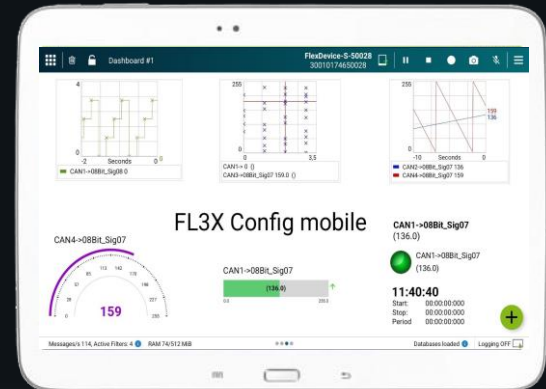
FL3X

- » Engineered and manufactured in Germany
- » Fair and flexible License model
- » Always up to date
- » Adaptable to your needs
- » Easy-to-use Soft- and Hardware

- » Changeable Physical Layer
- » Best price-performance ratio on the market
- » Several Software releases/year
- » Extended temperature range from -40°C to +70°C
- » Extensive accessories

FL3X PRODUCTS

USECASE: Battery storage and monitoring



VIRTUAL DEVICE

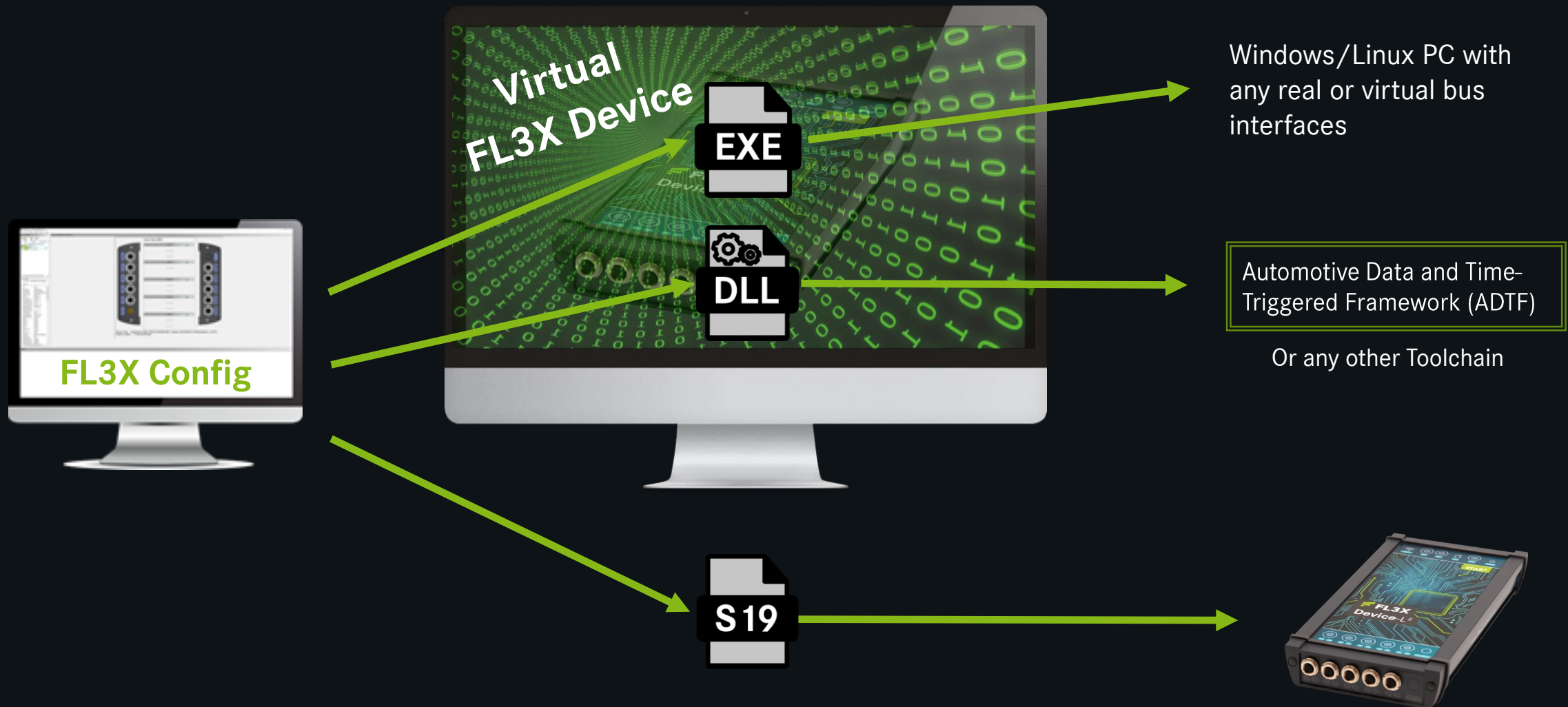
MEASUREMENT AND SIMULATION TOOLS

UseCase

Virtual FL3X Device



INTRODUCTION



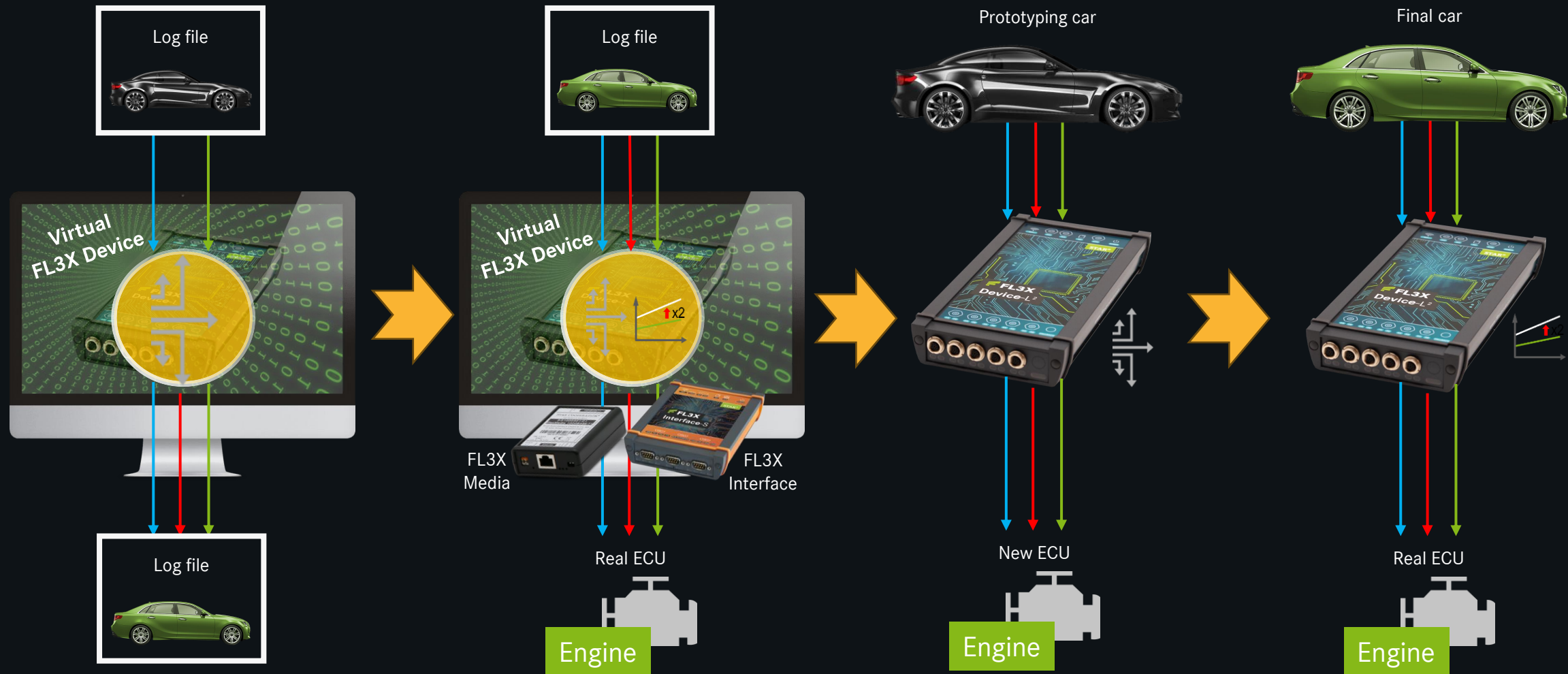
VIRTUAL DEVICE

BENEFITS

- » Virtual implementation from communication matrix X to communication matrix Y
- » Virtual Signal Manipulator
- » Virtual Gateway
- » FL3X Config projects are converted to virtual FL3X Device
- » C-Language DLL
- » Supports: CAN, ETH (including SOME/IP), FR, LIN
- » Integrable into various frameworks (e.g. ADTF)
- » Can be operated locally or in the cloud

VIRTUAL DEVICE

TESTING PROCESS IN PROGRESS



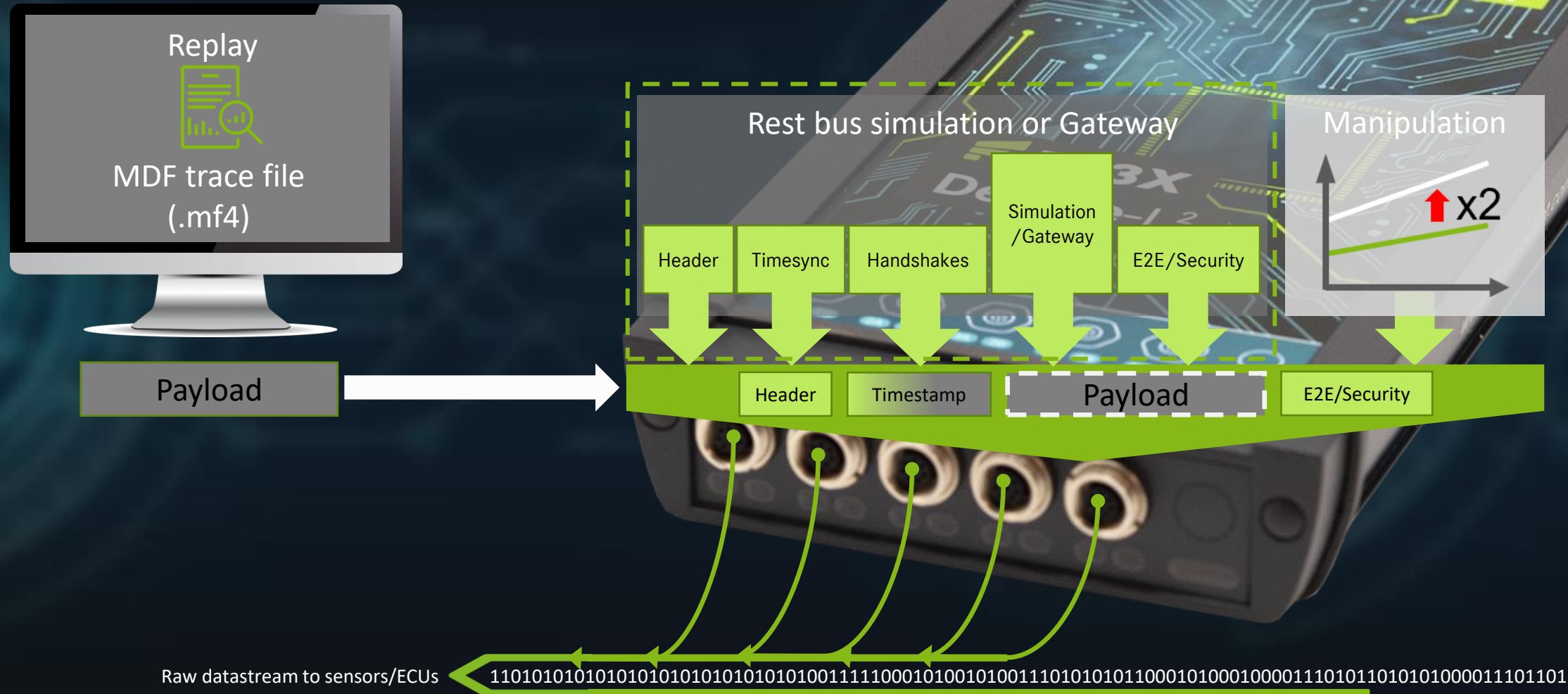
REPLAY USECASE



Replay



REPLAY SOLUTION



TECHNICAL BACKGROUND

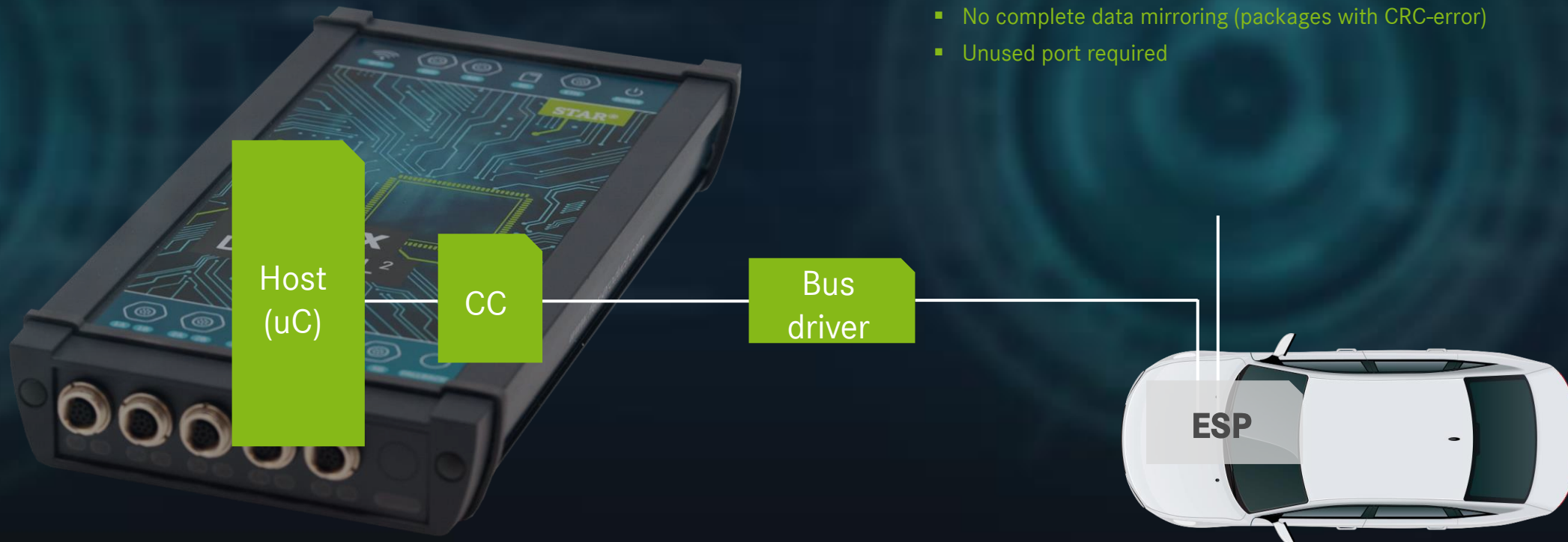
OABR: Existing switch as mirror-port

Advantages

- Simple connection
- Few measurement channels
- No additional latency

Disadvantages

- Additional (complex?) configuration of existing switch
- Additional stress of switch-processors (data loss?)
- Influencing switch timing unintended
- No complete data mirroring (packages with CRC-error)
- Unused port required



TECHNICAL BACKGROUND

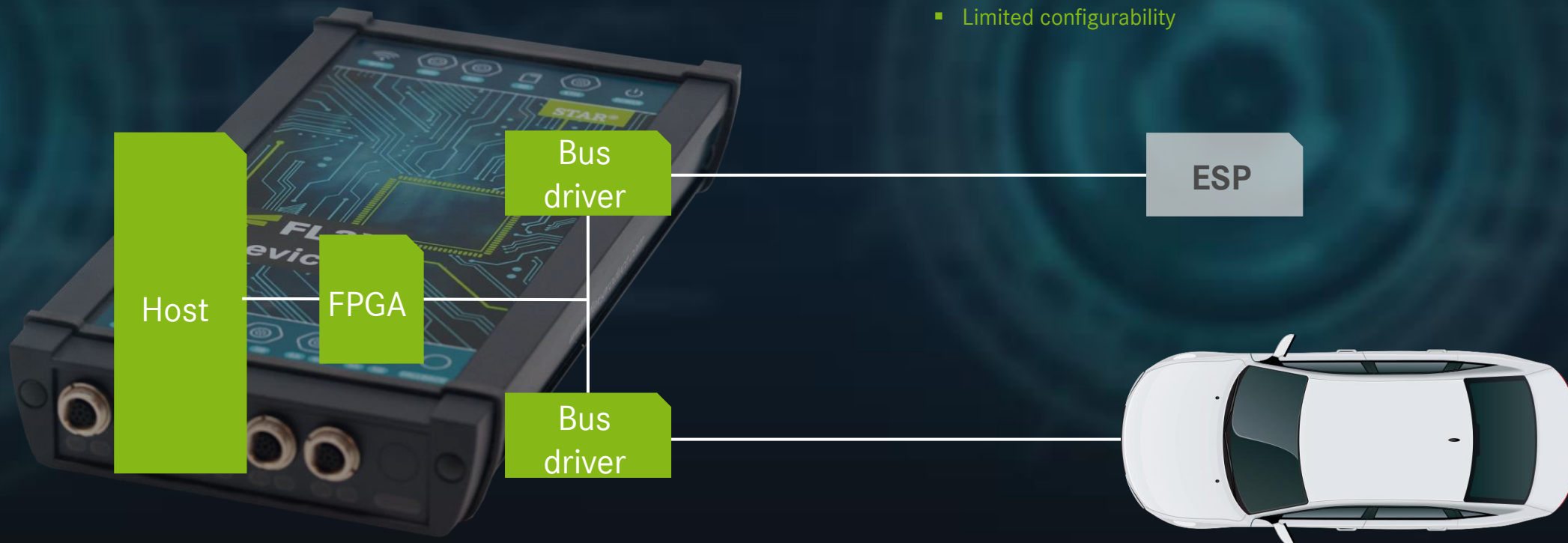
OABR: Tapping

Advantages

- Access to all data of connection definitely possible
- Simple configuration

Disadvantages

- Additional measurement channel required
- Propagation delay due to TAP
- Additional wiring (especially in case of several taps)
- Limited configurability



TECHNICAL BACKGROUND

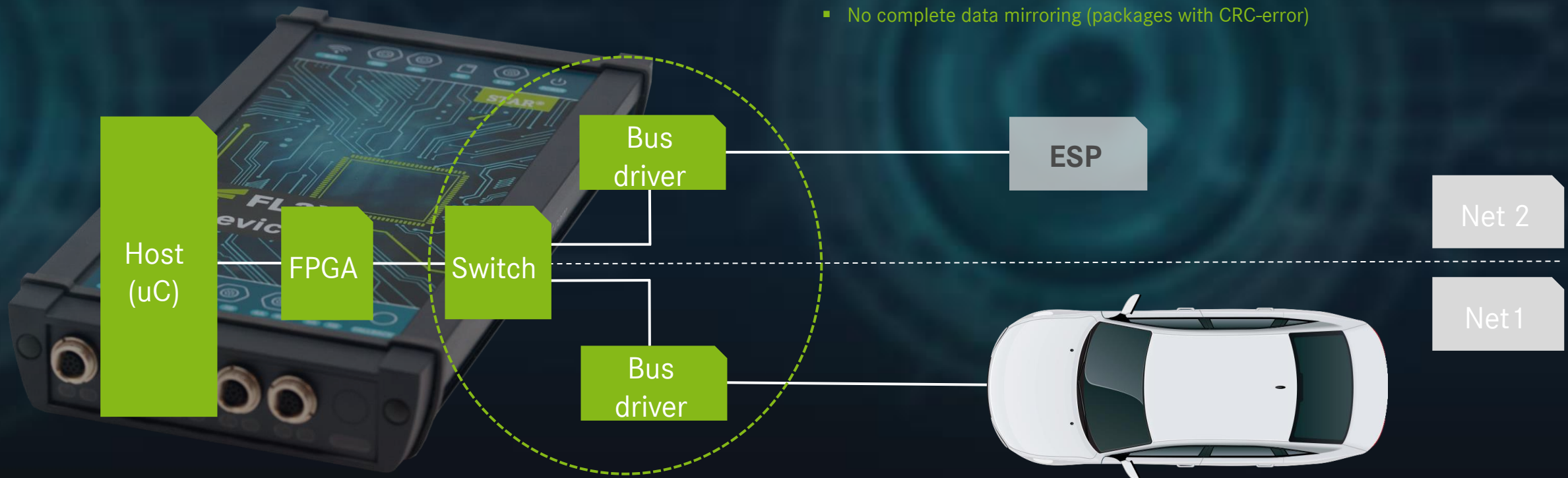
OABR: Measurement switch

Advantages

- Fully configurable
- Separation to independent sub-networks possible (data manipulation)

Disadvantages

- Additional measurement channel required
- Propagation delay due to switch
- Additional wiring (especially in case of several ports)
- No complete data mirroring (packages with CRC-error)



TECHNICAL BACKGROUND

OABR: Independent channels

Advantages

- Access to all data by micro controller
- Manipulation of any data possible
- Simple configuration

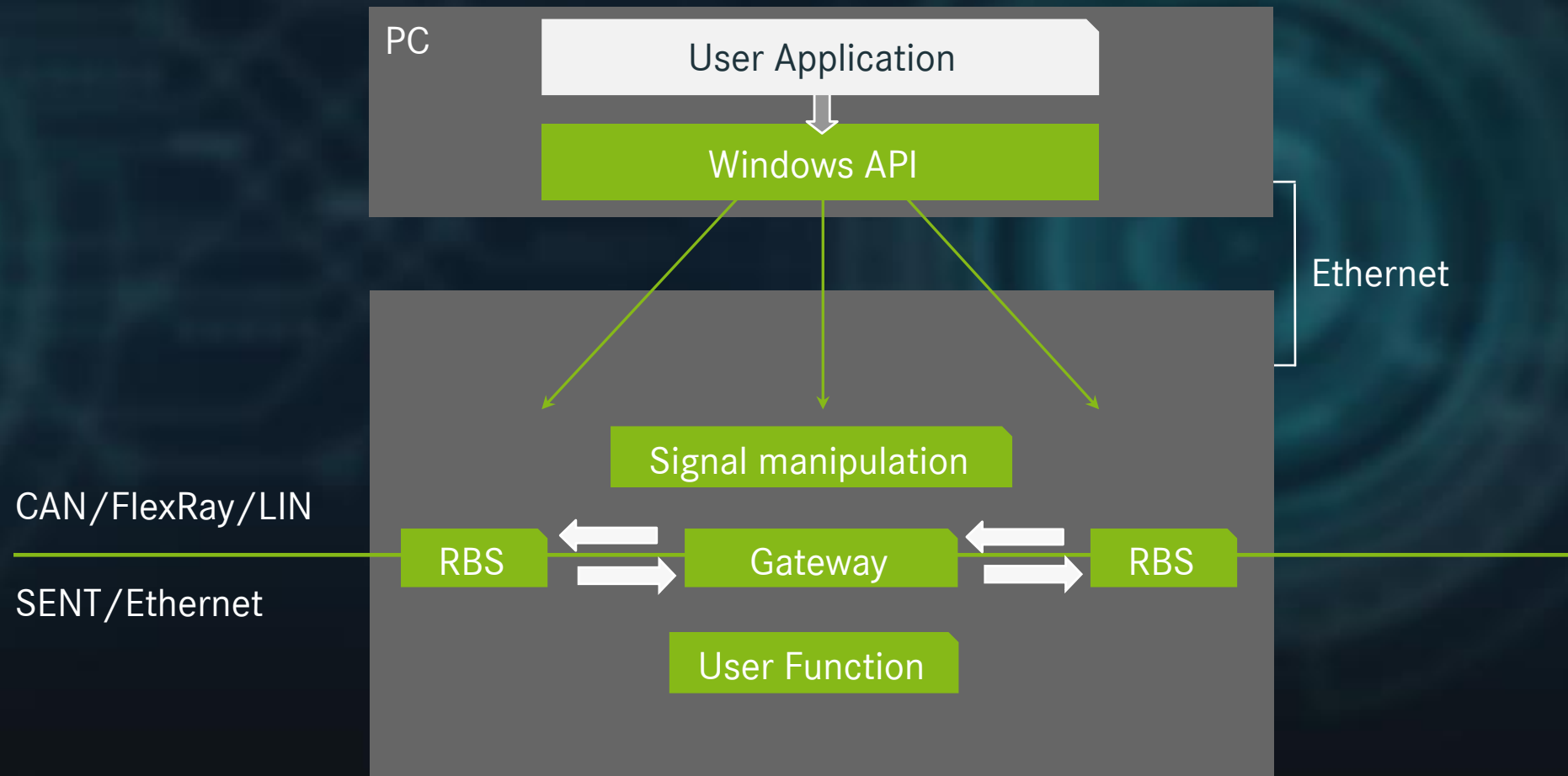
Disadvantages

- Requires two independent busses
- All communication going through micro controller
- Routing table required to forward data



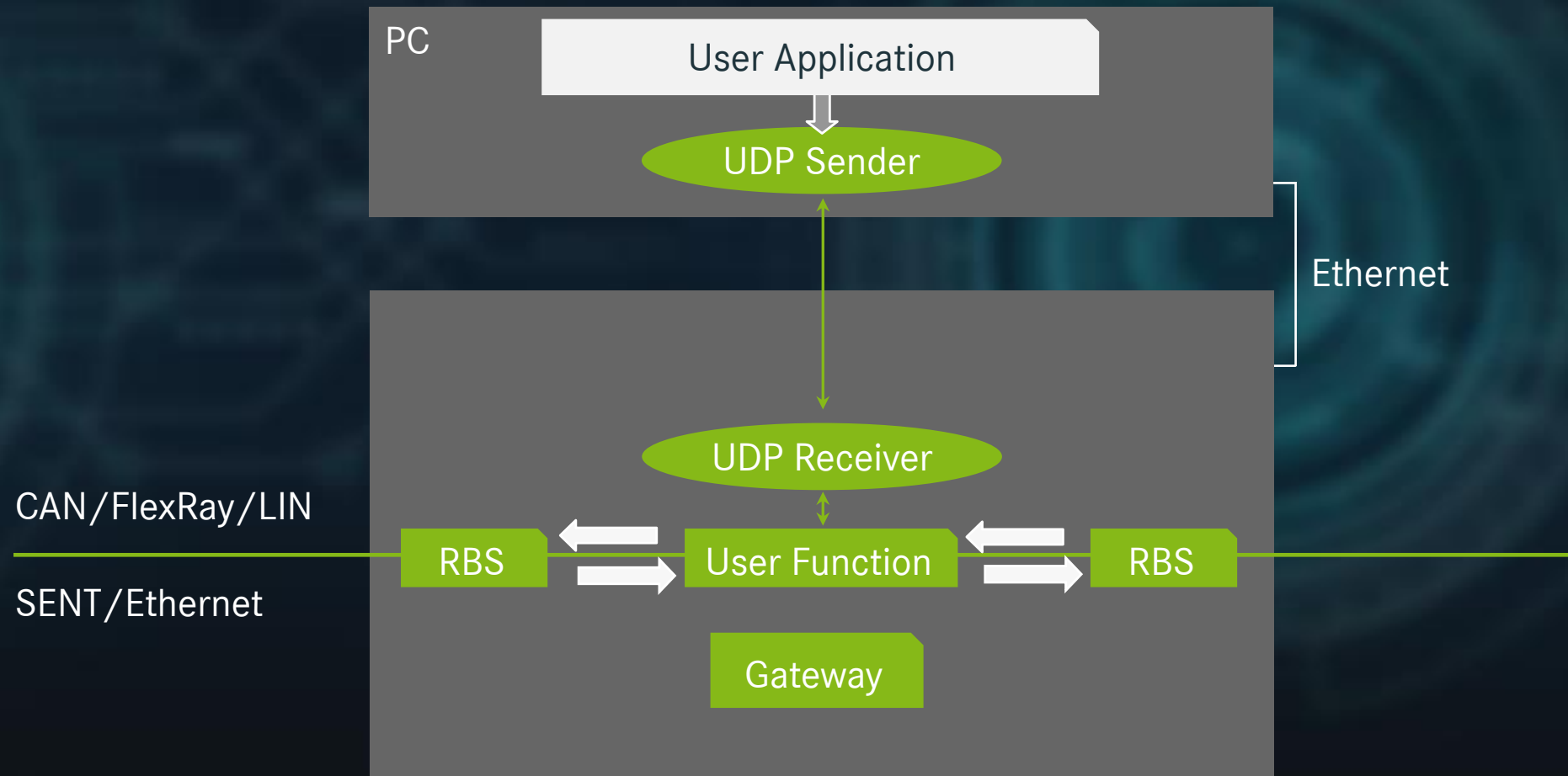
TECHNICAL BACKGROUND

TEST BOOTH: Control with Windows API



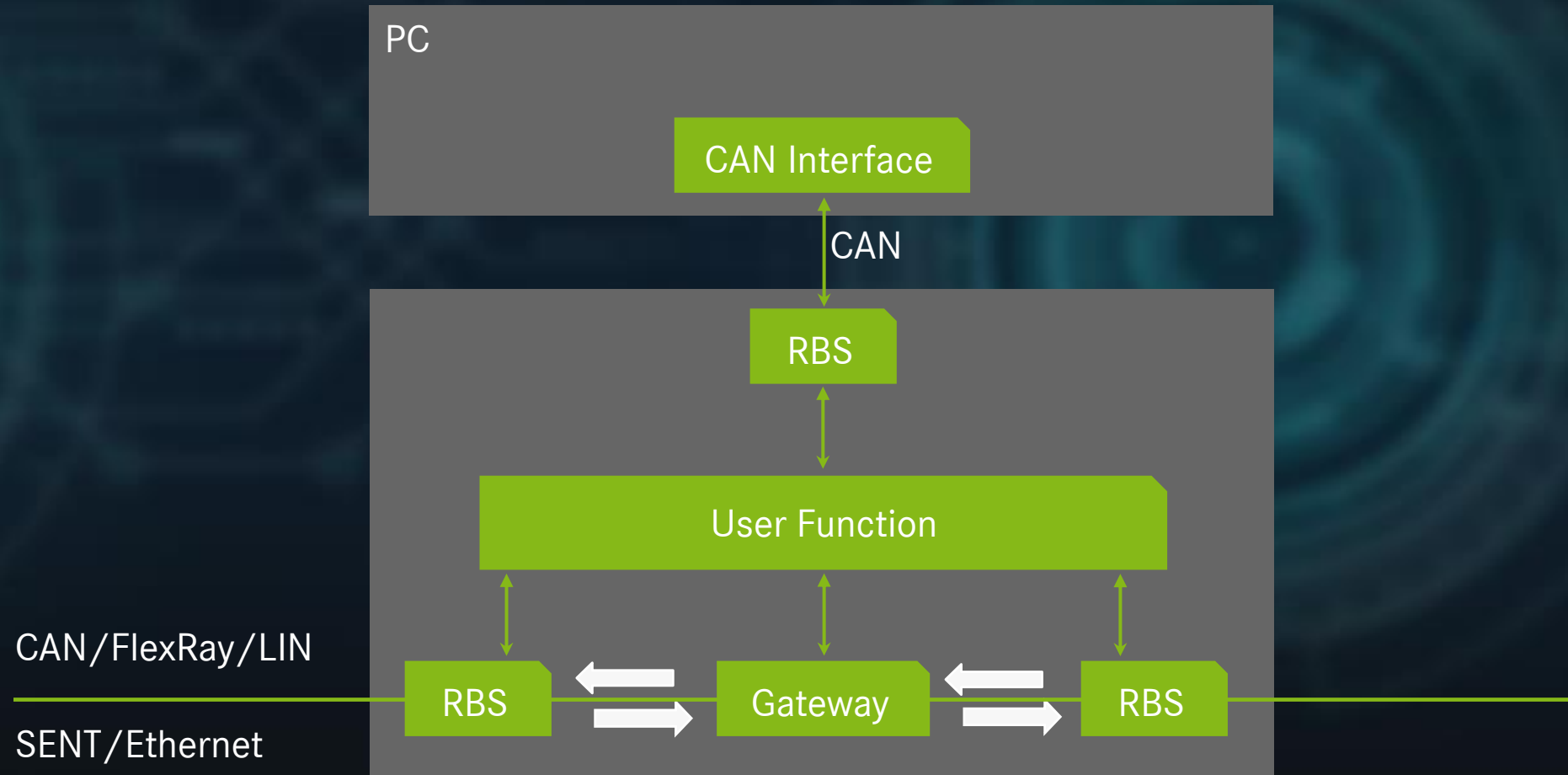
TECHNICAL BACKGROUND

TEST BOOTH: Exchange by Ethernet/UDP



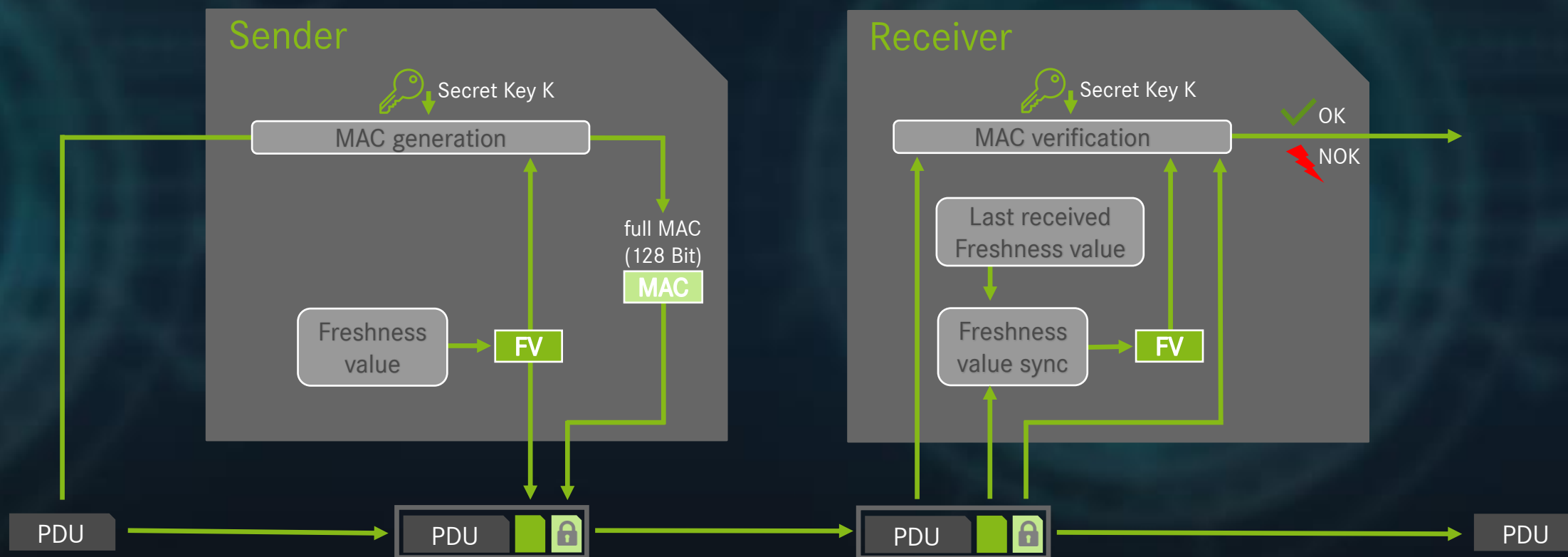
TECHNICAL BACKGROUND

TEST BOOTH: Control with CAN-Channel



TECHNICAL BACKGROUND

SECOC: Basics

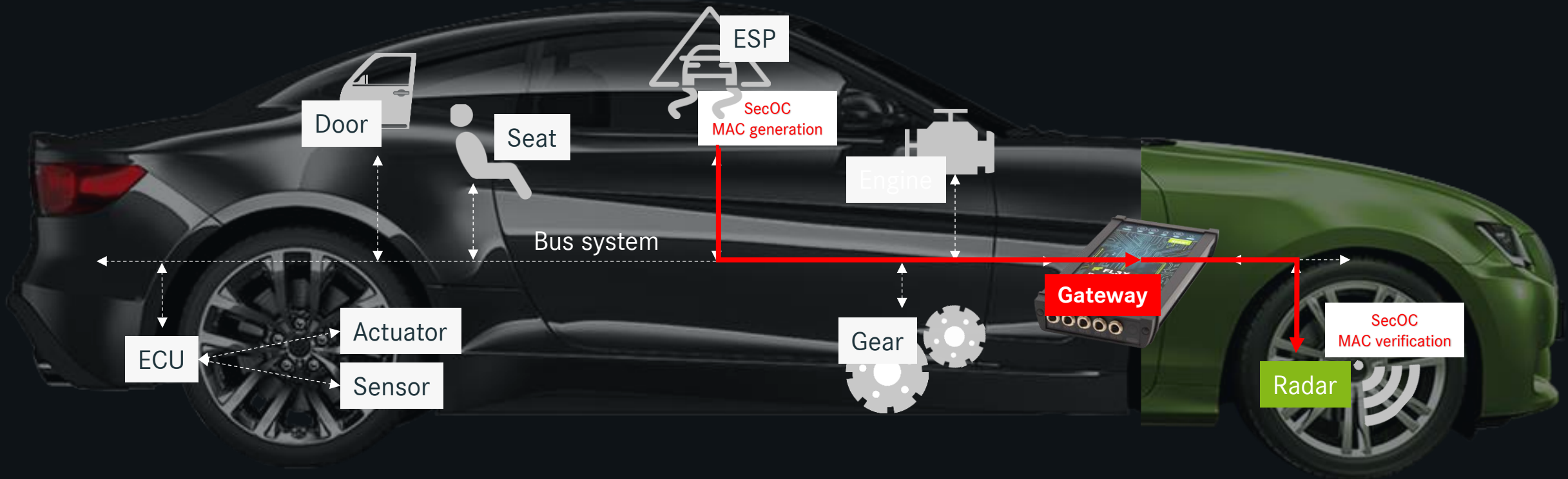


FV = Freshness Value

MAC = Message Authentication Code

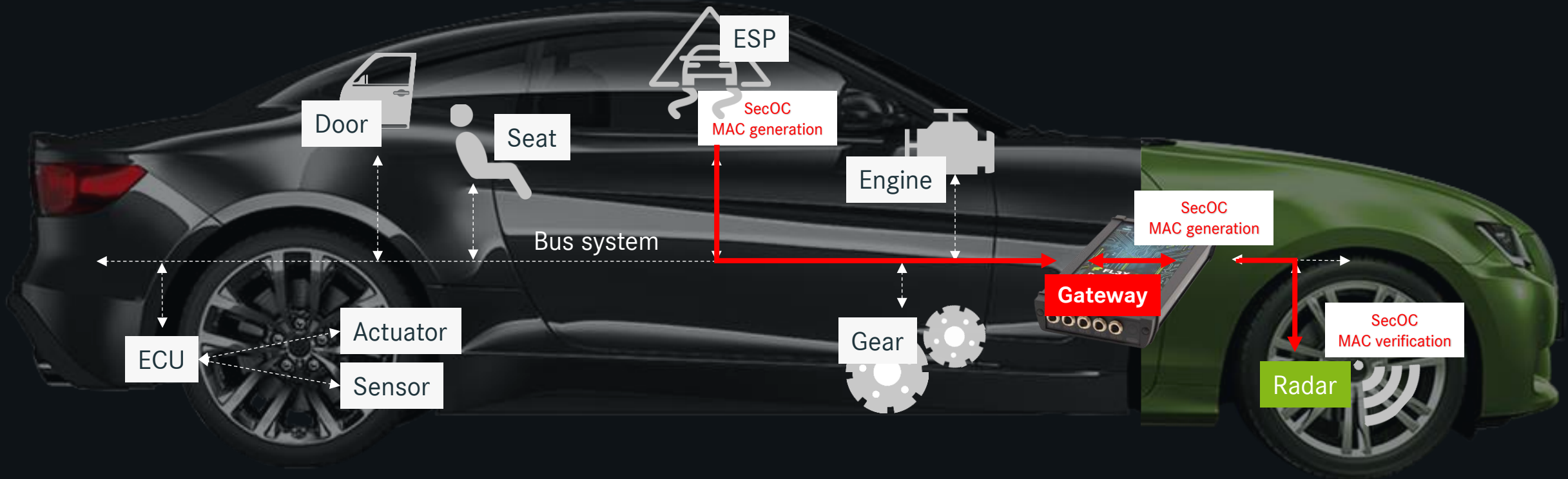
TECHNICAL BACKGROUND

SECOC: Handling of SecOC in general



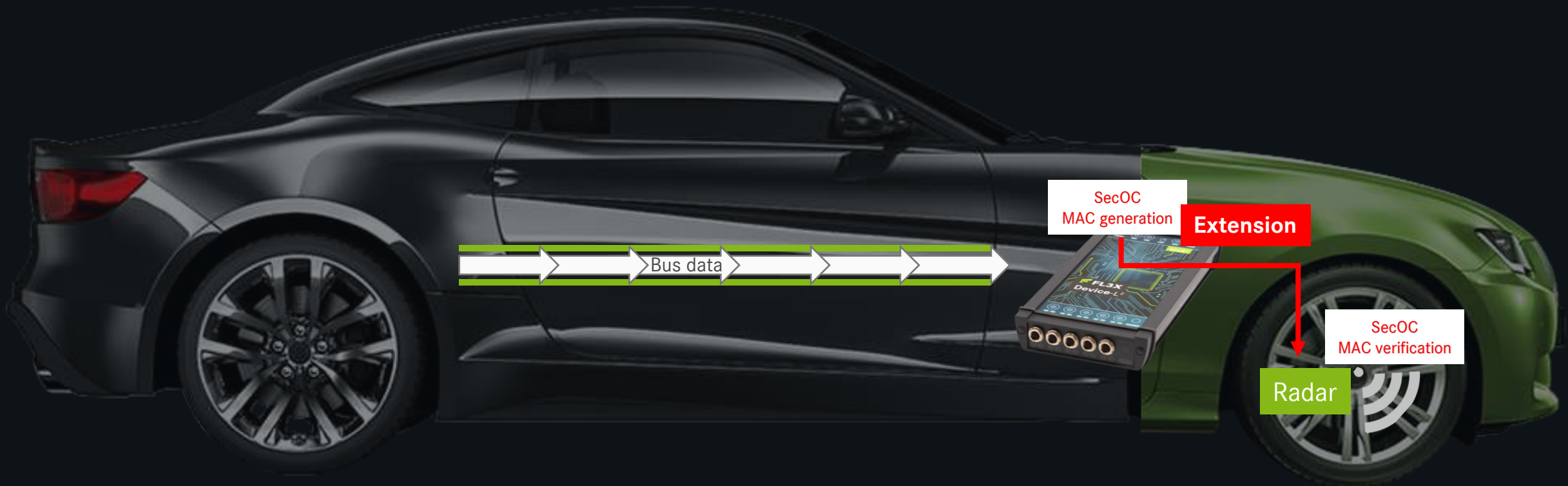
TECHNICAL BACKGROUND

SECOC: Handling with Manipulation / Re-Grouping



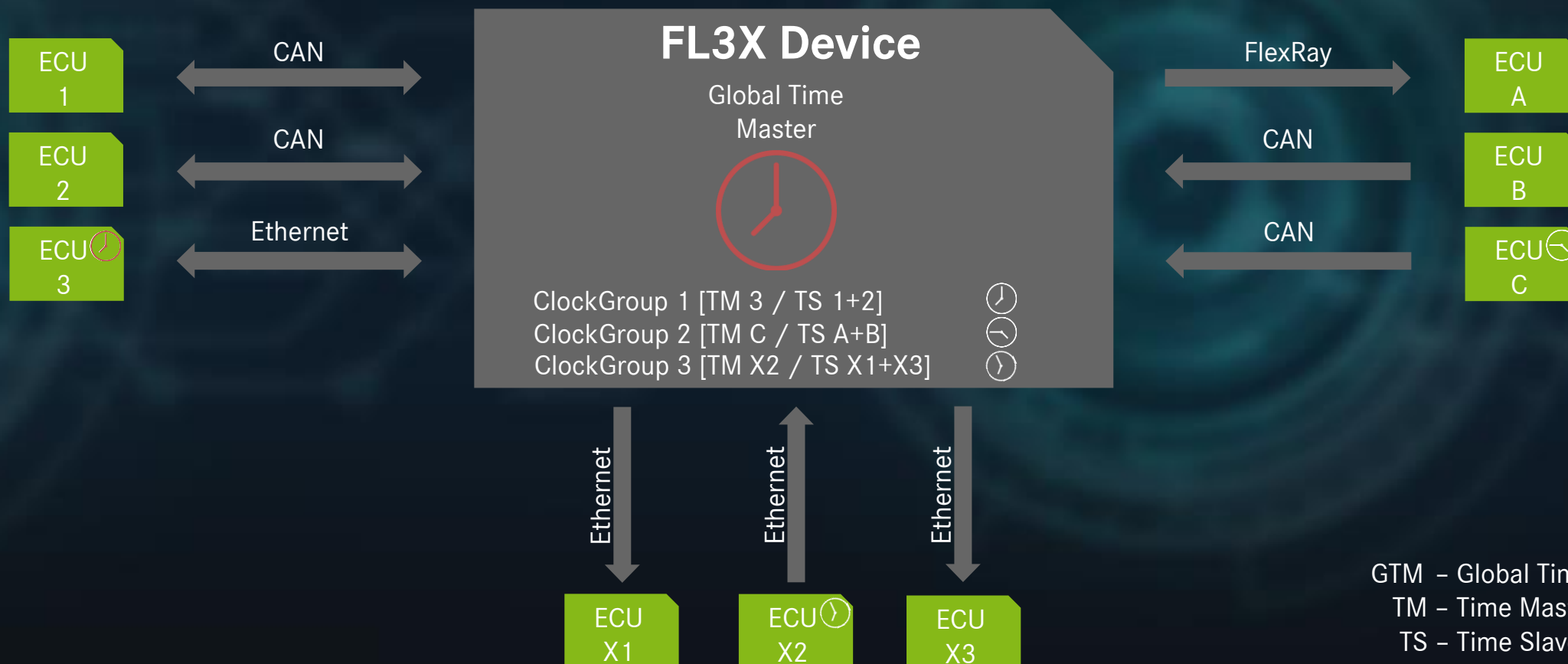
TECHNICAL BACKGROUND

SECOC: Handling of SecOC in car without SecOC



TECHNICAL BACKGROUND

END TO END PROTECTION: Time Master



Your advantages

- » Creation of RBS / gateways / signal manipulation with few clicks
 - » Extension for logging / visualization
 - » Economic license model
 - » Integration of new standards
 - » Flexible reaction to new requirements
- » All provided by one (tooling, realization, training)
- » Standardized but open platform for testing of Cyber Security

#Analyzing		#Gateway		#Interface		#Logging		#Rest Bus Simulation		#Signal Manipulation		#UserCode		#Visualisation	
#10GBASE-T1	#5GBASE-T1	#2.5GBASE-T1	#1000BASE-T1	#100BASE-T1	#10BASE-T1S	#OABR	#CAN-FD	#CAN-SIC	#Ethernet	#FlexRay	#SPI	#LIN	#SENT		

STAR COOPERATION®

LOCATIONS





Christian Huschle

General Manager Technology & Sales
STAR ELECTRONICS GmbH & Co. KG

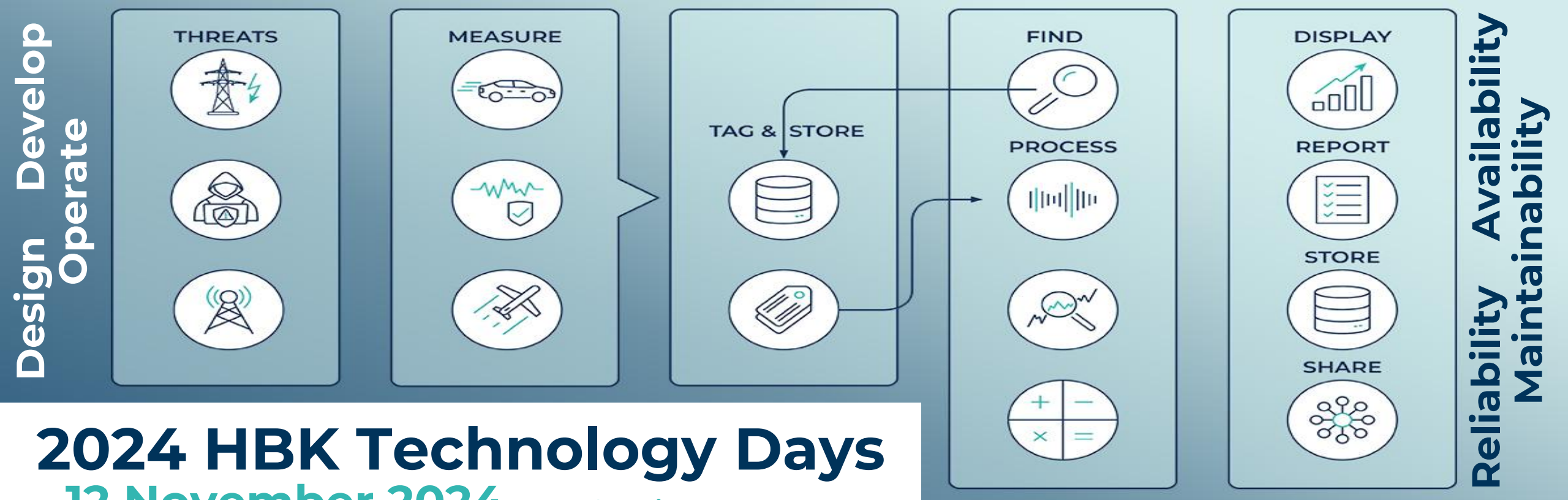
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Detailed product information can be found at:

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