Bosch IP TechDay 2024

CAN FD light Introduction

ME-IC/PRM-IP | March 14th, 2024

IP TechDay
We enable possibilities

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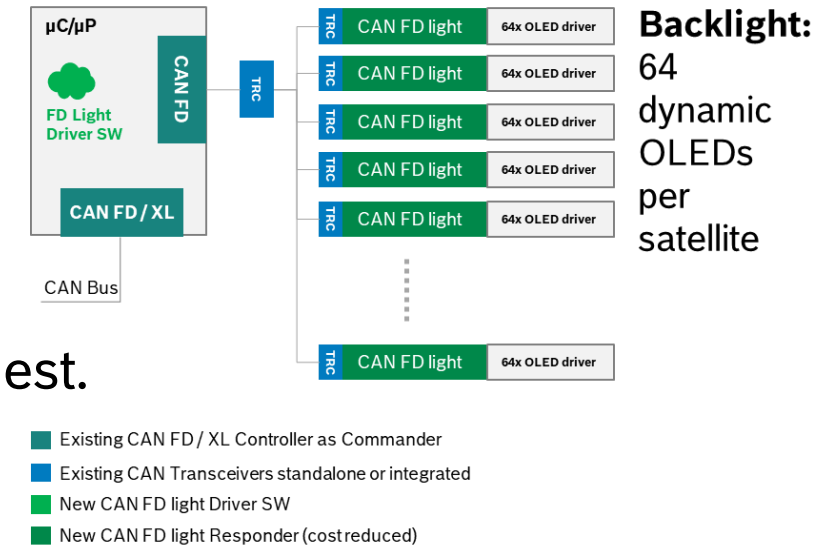
Agenda

- What is CAN FD light

1. Motivation and Advantage
2. Standardization and Availability
3. CAN FD light Overview
4. CAN FD light IP

CAN FD light
What is CAN FD light

- CAN FD light: Commander Responder Architecture
  - 1x Commander and multiple Responder
  - The CAN FD light Commander controls the entire communication.
    - Sends data to the Responder on the network and requests data from them.
  - The CAN FD light Responder answers to such a request.



- Simplified Protocol
  - CAN FD light uses a subset of the CAN FD protocol
    - No arbitration and no error frames are needed

1

CAN FD light
Motivation and Advantage

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CAN FD light
Motivation

CAN FD light … extending the CAN FD success story to new low end application domains

01 **Cost optimized solution for single Commander (master) – multi-Responder (slave) networks**

02 **Leverage benefits of existing and automotive proven CAN FD technology**

03 **Re-use of existing controllers and components on Commander (master) side**

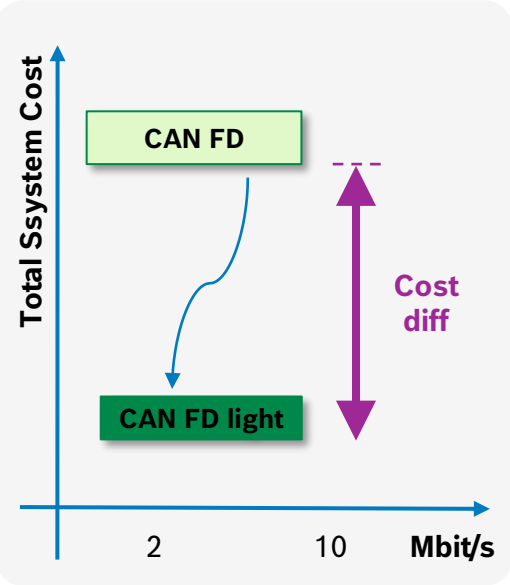
Existing CAN FD/XL controllers support CAN FD light Commander

04 **Lower cost Responder (MCU less)**

CAN FD light – Next Step in CAN Evolution

Advantages CAN FD light

- **Reduce Overall cost**
  - No accurate external crystal is needed, save 0.4$
  - Lower cost Receiver node as Monolithic device which include CAN Transceiver, CAN FD light Responder, state machine + analog for Sensor/Actuator
  - No SW update, lower cost of maintenance
  - Standardization
- **Reduce risk** trough Proven technology
  - Use of a subset of CAN FD
  - CAN Bus used in millions of cars
  - Robustness, Safety (CRC),
  - Use existing hardware, tools, cable and existing ECU (CAN FD and CAN XL controller) for the CAN FD light Commander *1



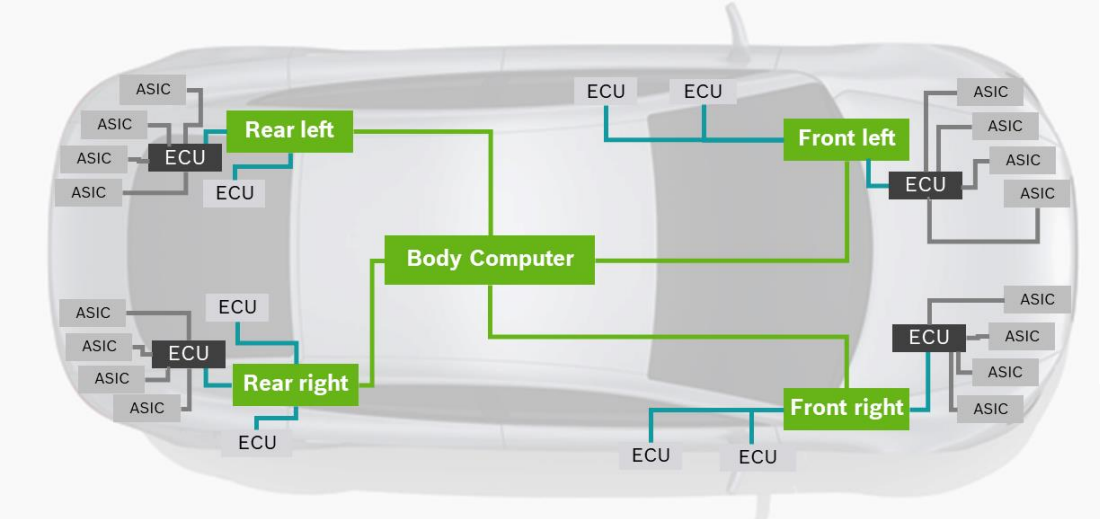
New possibilities

- Up to 8 Mbit/s *1 with up p to 64-byte packet data and

at low Cost and scalable (Transceiver, Pins, Cabling, ...)

*1 - CAN FD light with max 8Mbit/s need new CAN FD light Commander MCU
- with current Commander all existing CAN FD / XL commander
- 1Mbit/s w/ CAN FD Transceiver
- 2Mbit/s with CAN SIC Transceiver

CAN FD light
E/E-Architecture – Lighting Example



- Lighting ECU
  - Connected via P2P, e.g. UART to Lighting ECU

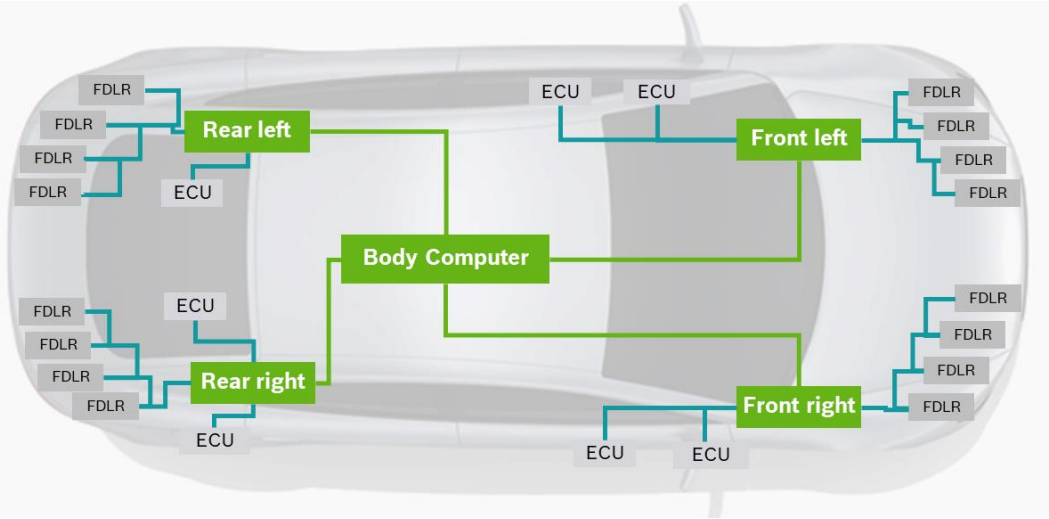
UART

CAN Bus

ECU Lighting ECU

CAN FD light

- reduces number of ECUs with CAN FD light responder and reduces overall complexity
- Example
  - Use of CAN FD light Responder to remove lighting ECU, cables connectors and reduce overall cost



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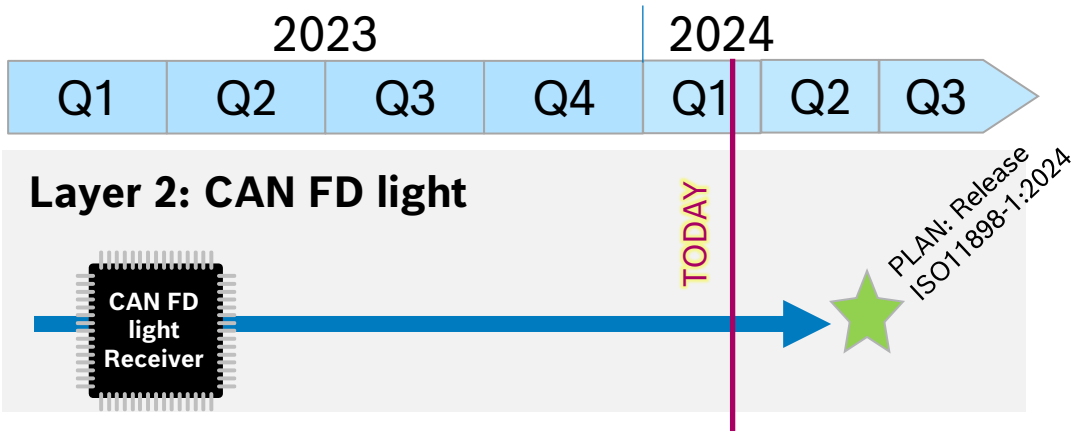
Standardization and Availability

CAN FD light – Next Step in CAN Evolution

Standardization Status CAN FD light Receiver

- **CiA 604-1: CAN FD light Protocol for responder nodes**
  [Published as Draft Specification Version 1.0.3, July 2023]
- CiA 604-2: CAN FD light Protocol Conformance Test Plan
  [In development]
- CiA 604-3: CAN FD light System Implementation
  [in development]



Step 1
Specification at CAN in Automation

Step 2
ISO Standardization

1:1 copy content into existing ISO documents

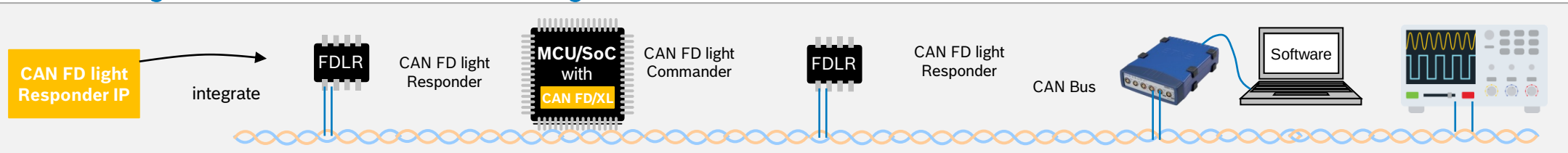
CAN FD light is described in ISO11898-1:2024 Annex A
[planned Release Q2/2024]
Since Dec 2023 release process started, no technical changes possible.

Transc eiver

Use all existing Transceiver in ISO11898-2:2015 and the new Transceiver in ISO11898-2:2024

CAN FD light – Next Step in CAN Evolution

ECO-System - Availability



CAN FD light Responder IPs (RTL)

- **Bosch: FDLR_CAN** [in development]
- **Bosch: FDLR_CAN** **Early Delivery FPGA version** [available]

CAN FD light Responder

- **ST microelectronics** L99LDLH32 multi-pixel driver with CAN FD light incl. CAN FD Transceiver [available]
- **Texas Instruments** TCAN5102 CAN FD light Responder [in development]
- **Company A,** [in development]
- **Company B,** [in development]

CAN FD light Commander

- **Use all existing CAN FD or CAN XL MCUs & SoCs** [available]
- **Texas Instruments** CAN FD light Commander w/ 8Mbit/s [in development]

CAN Transceiver

- **CAN High Speed**
- **CAN FD**
- **CAN SIC**
- **CAN SIX XL**
- **NXP, Bosch, Infineon, TI, Rohm Technologies, Microchip Technologies, Melexis Technology NV, onsemi, Analog Devices Inc./Maxim Integrated and much more …** [available]

Tooling / Software

- **Use all existing tools CAN analyzer / oscilloscope / Software from**
  - **Vector:** CANoe
  - **Keysight:**
  - **Teledyne LeCroy**
  - **Rohde & Schwarz**
  - **Pico Technology**
  - **And much more …**

  [available]

AUTOSAR: CAN FD supported [released & available]

For more information about other semiconductor products, please contact the respective company. For information specifically about TI CAN FD light products, you can reach out to Wes Ray at wes.ray@ti.com.

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CAN FD light
Overview

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CAN FD light
Concept Overview

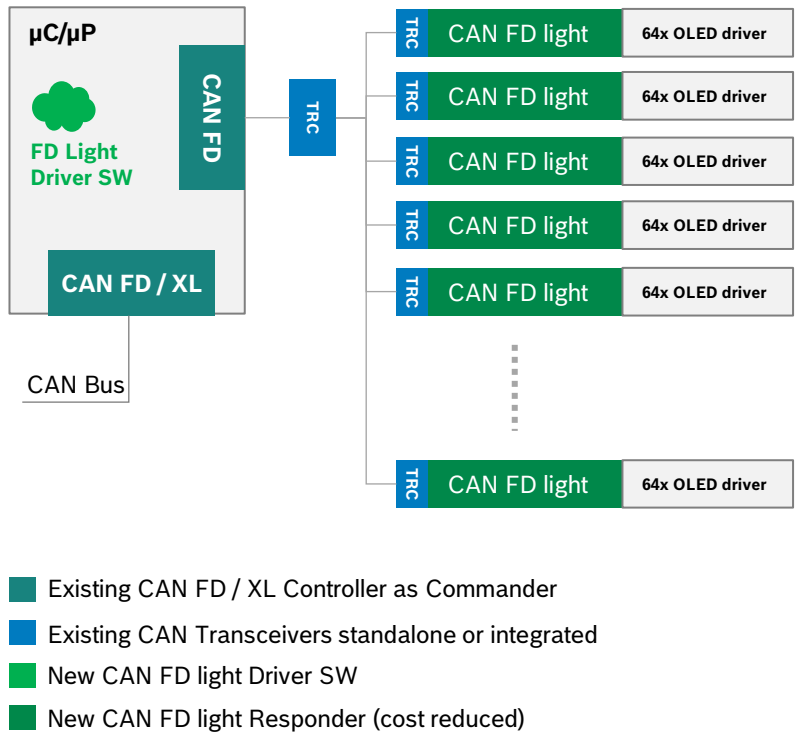
Single commander (master) – multi responder (slave) networks

COMMANDER (master)

- Standard CAN XL or CAN FD hardware controller [ISO11898-1:2015]
- Standard CAN/CAN FD Transceivers [ISO11898-2:2016]
- CAN FD light driver software

RESPONDER (slave)

- Monolithic integration in sensor or actuator or AFE
- No ECU or software required
- Simplified CAN FD controller logic
- No costly crystal or ceramic resonator required
- Standard CAN/CAN SIC Transceivers [ISO11898-2:2016]
- ASIL A/B/D or QM



Backlight: 64 dynamic OLEDs per satellite

CAN FD light
Build on proven CAN FD protocol

CAN FD light ...

A CAN FD PROTOCOL COMPATIBLE COMMUNICATION

01

02

03

CAN FD light is a cost-optimized sub-set of CAN FD

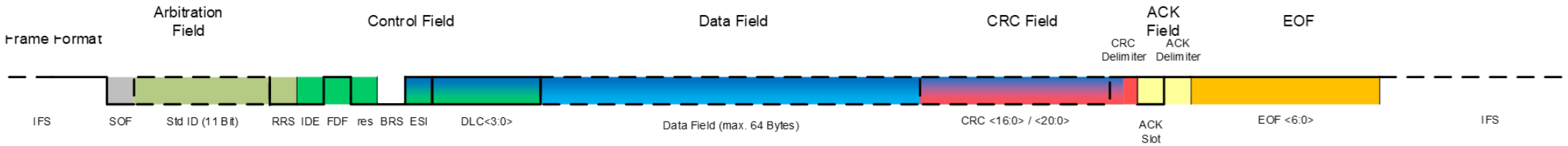
- Base identifier (11 bit) only
- FD Frames only (no Classical CAN Frame formats supported)
- BRS (Bit Rate Switch) = 0 only (one bit rate for the entire communication)

The CAN FD light protocol re-uses the CAN FD protocol frame format

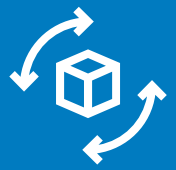
- Data length code – defining up to 64 byte of payload
- CRC Field – frame integrity protection
- Acknowledgement

The CAN FD light protocol don't need

- No Arbitration – due to strict communication flow
- No Error Frames – clearly identified data flow, no advertising errors needed



CAN FD light
Communication principles

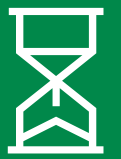


All communication initiated by the commander

- No arbitration or collision handling required
- High bandwidth utilization – no need to reserve bandwidth for high priority frames
- Addressing thru frame identifier (or first data field byte)

Support for Broadcast frames to address multiple actuators synchronously

- Single frame providing shared or individual information for multiple slaves at the same time
- No response from slave except of acknowledging



Support for Unicast frames – with or w/o response frame from slave

- Addressing individual slaves with dedicated control information or request for status/diagnosis response
- Well defined response time

CAN FD light

Addressing new application domains with low cost I/F

Automotive Lighting Internal and External

- Headlight and Taillight
- Interior Mood Lighting

Battery Management Network

- Battery Cell Controller with battery monitoring and balancing function

Actuator / Sensor

- Heating, ventilation, and air-conditioning (HVAC)
- Ultrasonic distance measurement
- Wiper / Body Electronics
- Other Sensor / Actuator

White goods

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CAN FD light IP
FDLR_CAN IP

FDL = CAN FD light

R = Responder

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FDLR_CAN IP
Timeline & Deliverables

Early Delivery Version (FPGA for AMD/Intel) available!

Revision 1.0.0

Planned Q4/24

Deliverables include:

- VHDL Source Code
- Module Integration Guide (designer's view)
- FMEDA
- Safety Manual (ISO 26262)
- Functional Safety assessment certificate
- Security Manual (ISO 21434)

Licensing conditions available at Bosch AE
Please see: https://www.bosch-semiconductors.com/ip-modules/can-protocol-license/

Revision 1.0.0

CAN FD light Conformance tested

depending on availability of CAN FD light CT

Planned for Q1/2025

Conformance Tested for CAN FD light

Thank you!

Gregor Sunderdiek, Product Manager