FPGA Applications for Automotive

FPGAs and SoCs are on the rise!

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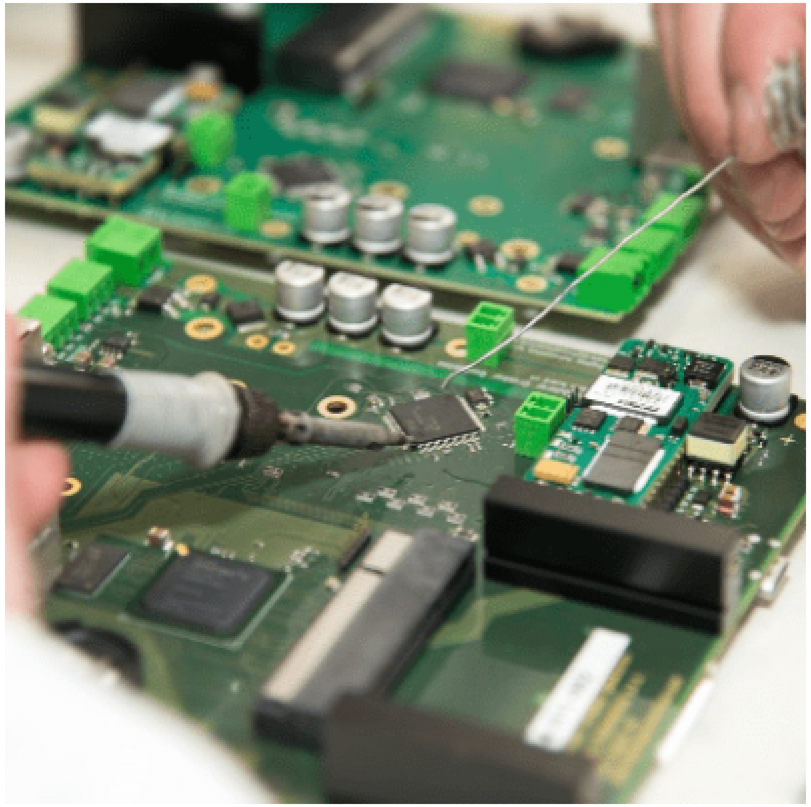
A Volkswagen Group Company

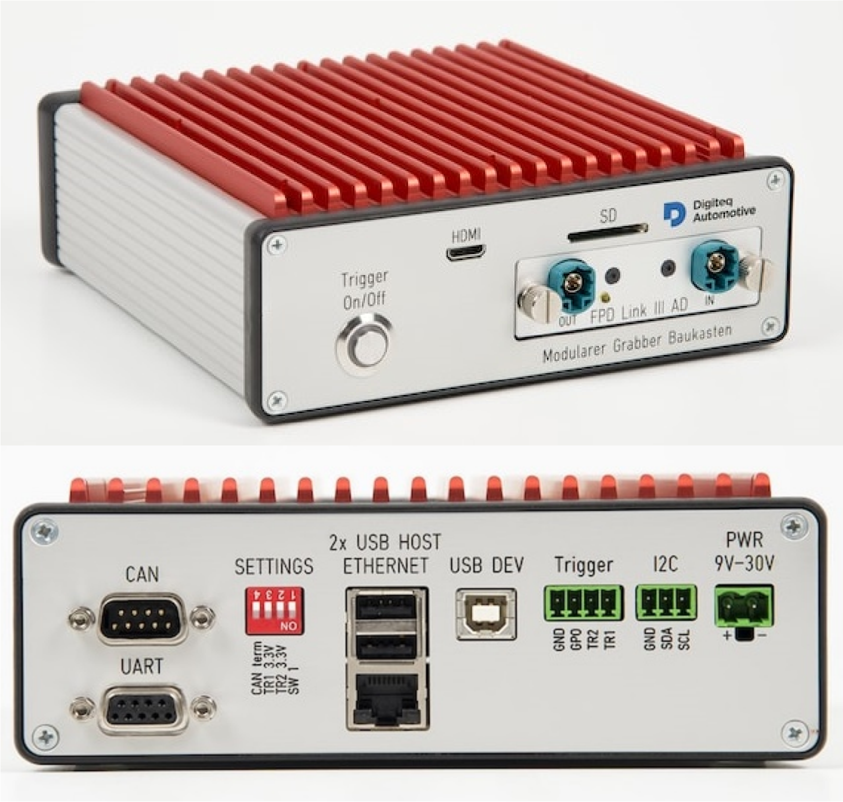
Introduction

- A typical automotive product uses the cheapest MCU (only that matters for a series of millions).
- When higher performance is required – choose an SoC (ARM Cortex-A family).
- The major disadvantage of MCUs/SoCs – a set of peripherals/functions is predetermined.
- FPGAs are great for projects which requires:
  - Flexibility to support future standards and interfaces,
  - Scalability to implement the desired number of interfaces/peripherals,
  - Cost-efficiency for low volume production (prototypes or test equipment).
- We would like to present some of our FPGA-based projects.



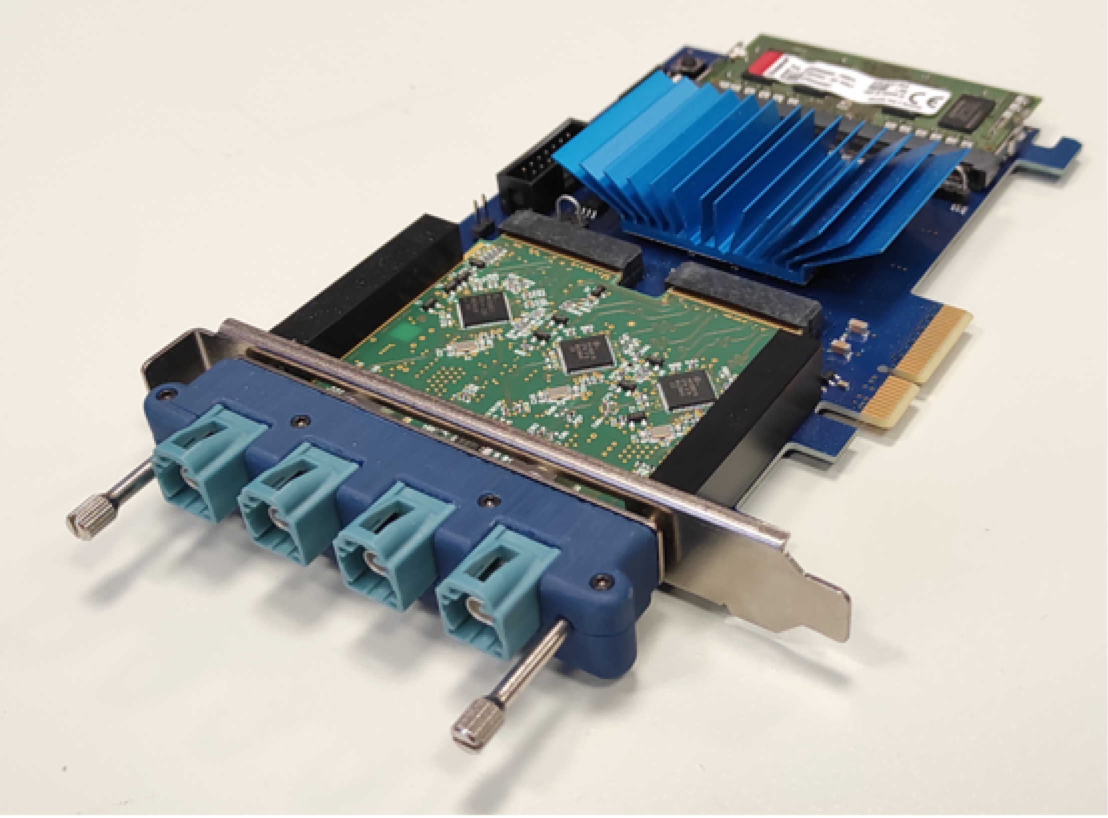
MGB (Modular Frame Grabber)

- Captures video/static frames w/o compression
- Acts as a pass-through device
- Streams video over Ethernet or HDMI
- Supports multiple automotive video interfaces via modules with an OpenLDI interface
- Spartan-6 implements an OpenLDI sink and frame buffer with a PCI Express link
- Quad-core ARM SoC provides video compression, HDMI output, and network services
- Disadvantage: only one video interface at the time, while a modern car has several displays



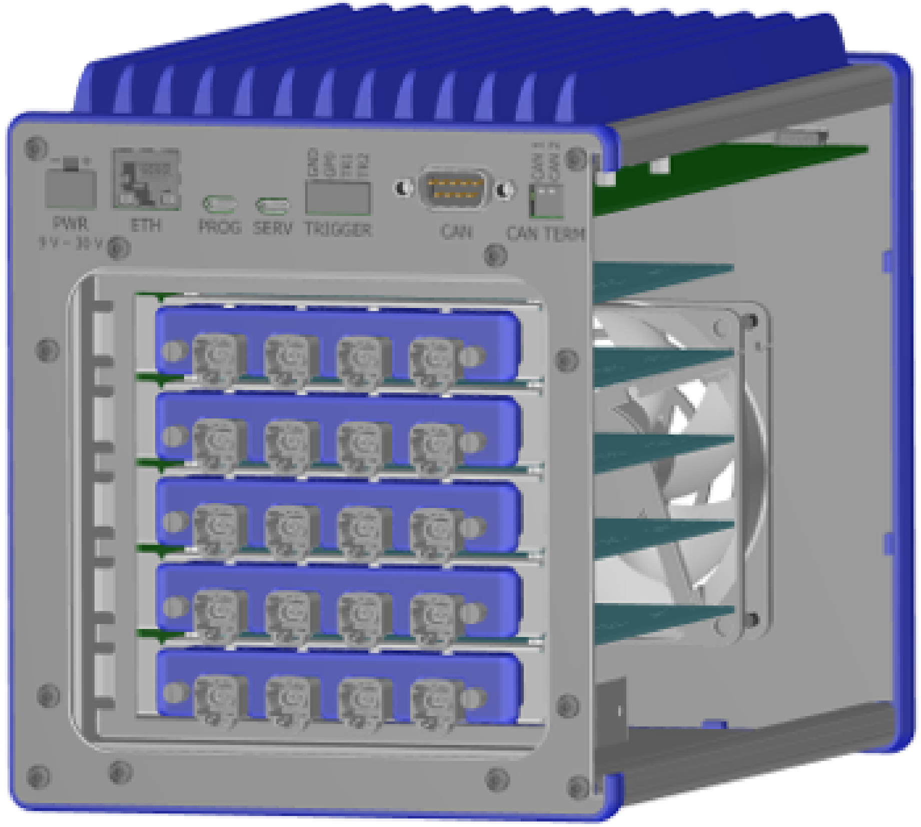
FrameGrabber 4

- The successor of the MGB uses Artix-7
- Also uses interchangeable interface modules
- Increased scalability, up to 4 sink/source OpenLDI interfaces + GTX lines for future use (DisplayPort)
- Faster and wider PCI Express interface
- A multi-stream DisplayPort 1.2 video source implementation is currently under development



FrameGrabber 4 Box

- The MGB on steroids!
- Up to 5 PCIe cards mean 20 video interfaces or more
- nVidia Jetson provides PCIe connectivity, video processing, and networking
- Intended for users who require a standalone device like the original MGB



A car-sharing project

- Specifications and implementation details are confidential except:
  - Certified Automotive product
  - „Low-volume“ project (means 1 million units by VW)
  - Based on Xilinx Zynq
    - FPGA implements CAN-FD & LIN interfaces
    - Processors are running a Linux distribution to handle user requests and to provide control

CANSim4 & CANSim5

- CAN simulator, which emulates car environment such as speed, dimming level, position, etc.
- CANSim4 is based on NXP MCU
- (Future) CANSim5 aims significantly higher:
  - Ability to run a full-size OS or RTOS
  - Networking support for remote operations
  - Doubling or tripling the number of interfaces (CAN-FD/LIN)
  - Flexibility to implement new standards with current hardware
  - Scalability to target the desired price (and set of functions) by modifying a BOM only
- Xilinx Zynq seems to be the ideal solution

Conclusion

- The presented uses-cases show:
  - FPGAs (usually paired with SoC) became common even in automotive domain
  - Such projects requires engineers capable of:
    - Designing and debugging electronics and PCBs on the lowest level
    - Proficient with MCUs, SoCs, and FPGAs
    - Proficient with programming baremetal/RTOS/Linux applications and/or drivers
    - Designing a system architecture
    - A bit of mechanical engineering
    - **Overall: our engineer is required to posses complex knowledge to deal with complex problems …**

Alternative definition of „*complex*“ engineering problem:

You got quite imaginary specifications and you are expected to develop and deliver a real product.

On the other hand, that is the exact moment when engineers can shine with their skills and creativity ☺

Disclaimer: This joke does not represent the opinions of Digiteq Automotive s.r.o.

Thank you for your attention!

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