Workshop on advanced electronic solutions for high performance vehicle processors

18 May 2021 at 14h00

Virtual Workshop organised by EDM Forum & Hiper consortium

Agenda

14h00: HIPER: Introduction to collaborative research project on High Performance Vehicle Processors
Bart Vandevelde – imec

14h20: Advanced 3D printing solutions for advanced processor cooling

Part A: 3D printing technology
Willem Verleysen – Materialise

Part B: Simulation and characterisation of cooling performance of 3D printed heat sinks
Majid Nazemi – Materialise & Antonio Pappaterra – imec

15h10: Low melting point solder technology for advanced processor components
Ralph Lauwaert – Interflux Electronics

15h40: Final comments & questions

15h50: End

Q&A

Please use the “chat” box to ask your questions

Questions will be asked just after the talk

HIPER: Introduction to collaborative research project on High Performance Vehicle Processors

Speaker: Bart Vandevelde – imec – PPS/EA

Bart.Vandevelde@imec.be

Dissiemination activity with the HIPER project

- **HIPER**: High Performance Vehicle Computer and Communication System for Autonomous Driving
- Collaborative research program under PENTA-Eureka platform

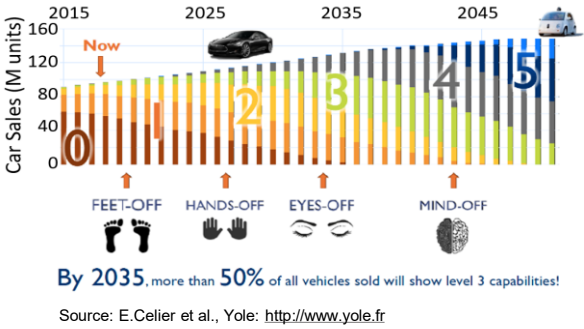
- Financial support through local funding agencies
  - Flanders: Vlaio

HiPer (High Performance Vehicle Computer and Communication System for Autonomous Driving)

Megatrend "Autonomous Vehicles"

$77 billion market potential in 2035 [2)]

Target: **zero** fatalities and **accidents** safety as well as ADAS technologies.



Source: E.Celier et al., Yole: http://www.yole.fr

80% of the top OEMs plan to build highly autonomous [1)]

Megatrend

Autonomous Driving

Robotaxis will become a **cheaper** mobility option than private vehicles in urban environments in 2030 [1)]

Transportation costs **-40%** per km [1)]

L4 share of new vehicles is expected to reach **17%** by 2035 in EU [1)]

Disruptive megatrends require **new core competencies**, new actions, and a new way of thinking [1)]

[1)] MCKINSEY RACE 2050 – A vision for the European automotive Industry

[2)] Boston Consulting Group

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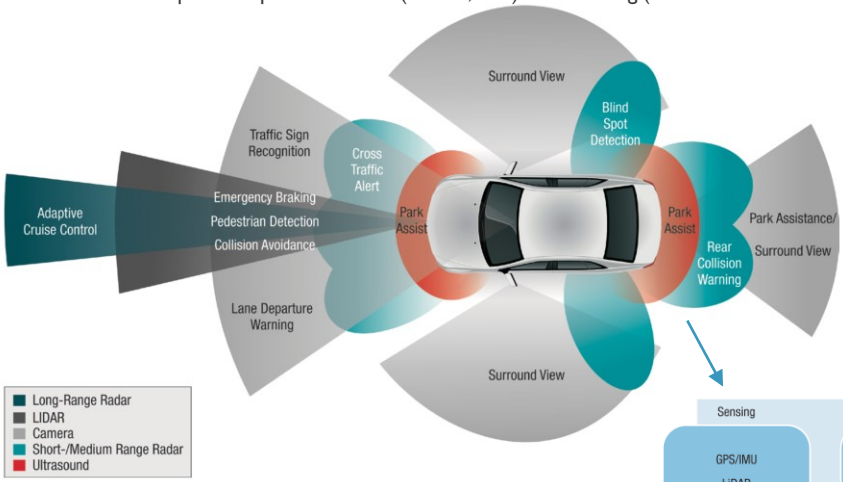
ADAS technologies

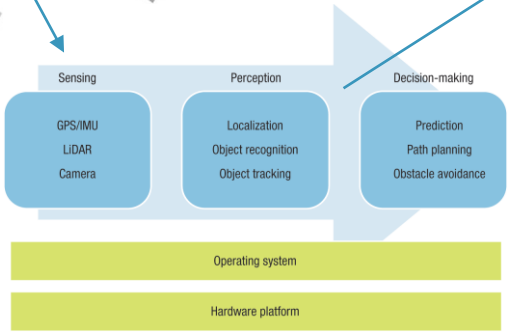
ADAS technologies

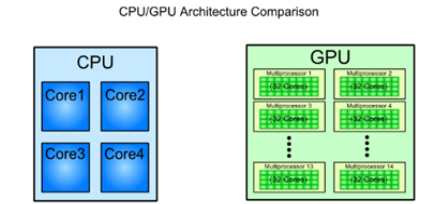
AD: From Sensing to Perception

- Autonomous driving requires high power GPUs to process the different real-time sensors data
- For safety backup emergency solutions are mandatory on the vehicle, increasing the number of electronic components
- The number of required chips & memories (DRAM, etc.) is increasing (in small volume boxes) → increasing power density



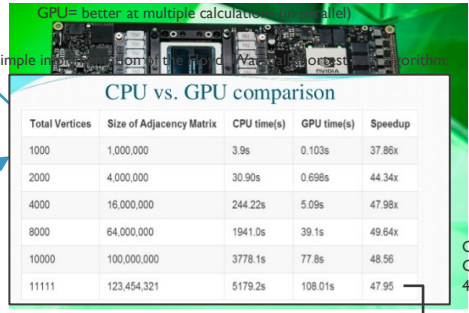
Long Range Radar: 250m
Lidar: 150m
Camera: 80m
Short/Medium Range Radar: 20m
Ultrasound: 2-4m





CPU= best at handling single calculations extremely quickly
GPU= better at multiple calculations (in parallel)

Simple in[illegible]om with the [illegible] Vacuum [illegible]orithm



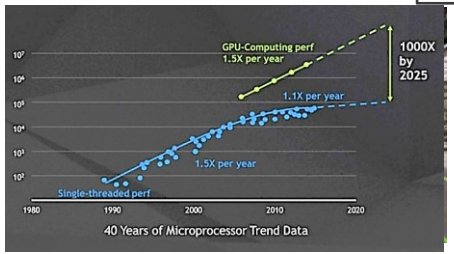
CPU vs. GPU comparison

Total Vertices	Size of Adjacency Matrix	CPU time(s)	GPU time(s)	Speedup
1000	1,000,000	3.9s	0.103s	37.86x
2000	4,000,000	30.90s	0.698s	44.34x
4000	16,000,000	244.22s	5.09s	47.98x
8000	64,000,000	1941.0s	39.1s	49.64x
10000	100,000,000	3778.1s	77.8s	48.56
11111	123,454,321	5179.2s	108.01s	47.95

On average GPU time is 45X faster!

Object Recognition → GPU

Computing performance projection:



Computer Architectures for Autonomous Driving, August 2017, pp. 18-25, vol. 50, Shaoshan Liu, Perceptln Jie Tang, South China University of Technology ,Zhe Zhang, Perceptln , Jean-Luc Gaudiot, University of California, Irvine

HiPer

High Performance Vehicle Computer and Communication System for Autonomous Driving

Trends

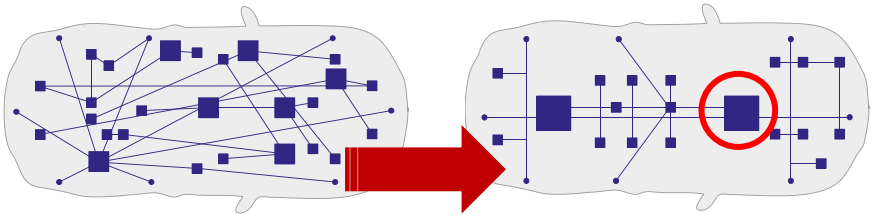
- Expansion of functional, autonomous driving functions thus E/E architecture change to central vehicle computers
- Shorter innovation cycles, digitalization
- Increase in driving ranges, operating time

Vehicle computers are the physical "heart" of the E/E architecture

In addition to the zone control units, a key to the cars of the future lies in new high-performance vehicle computers for bundling the functional software.
These are thus an important switch point for connected and automated driving.

E/E-Architektur

Paradigm shift from a domain-specific to a cross-domain and centralised E/E architecture with a few but very powerful vehicle computers instead of many individual ECUs.



Change in the E/E-architecture requires high-performance vehicle computers

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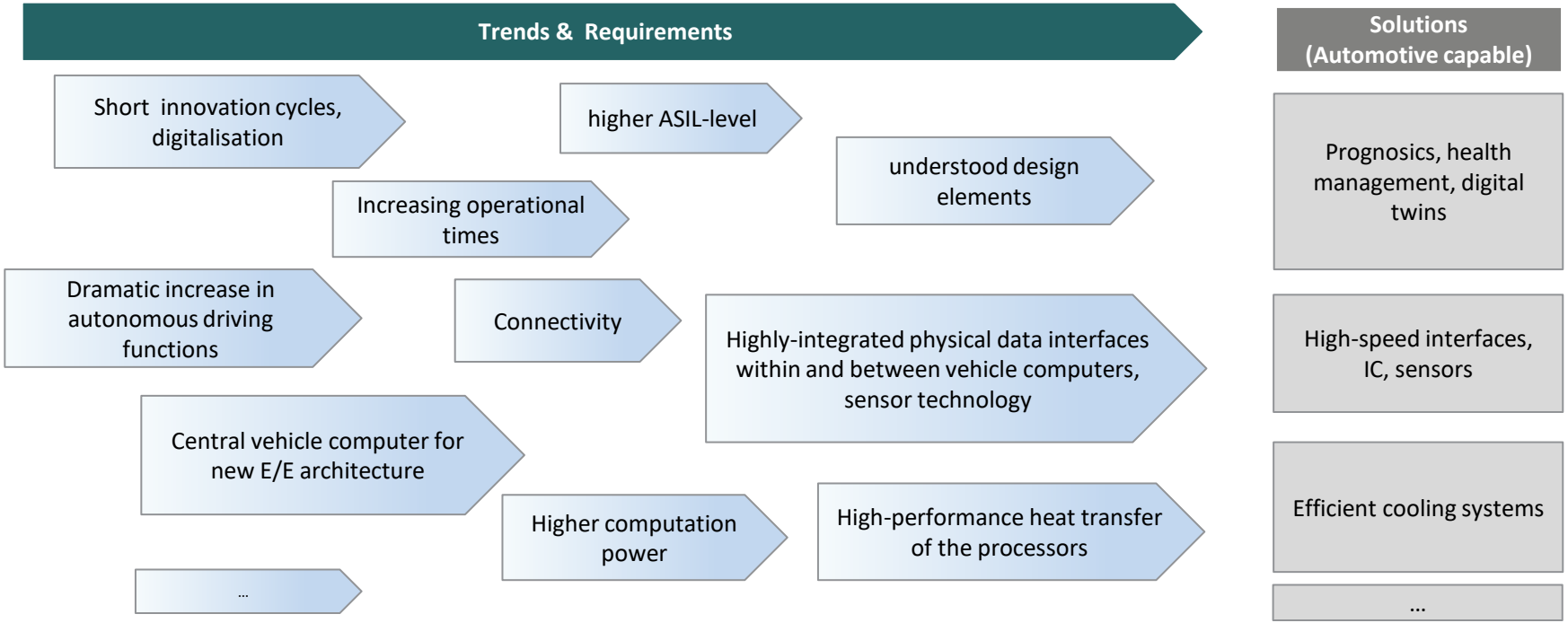
Trends & Requirements, challenges for VC



To realize innovative technology solutions for high-performance vehicle computers for autonoumous driving, public funded project HiPer was initiated

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Public funded Project HiPer (PENTA labelled)

PARTNERS

Advanced Packaging Center BV
Audi AG
Boschman Technologies BV
Chemnitzer Werkstoffmechanik GmbH
Delft University of Technology
Dynardo GmbH
Eindhoven University of Technology
Fastree3D BV
Fraunhofer Institute (ENAS)
Glück Industrie-Elektronik GmbH
IMEC
Interflux
Materialise
NXP Semiconductors
Robert Bosch GmbH
Technical University of Chemnitz

COUNTRIES INVOLVED

Germany
Netherlands
Belgium

Goals / Objectives

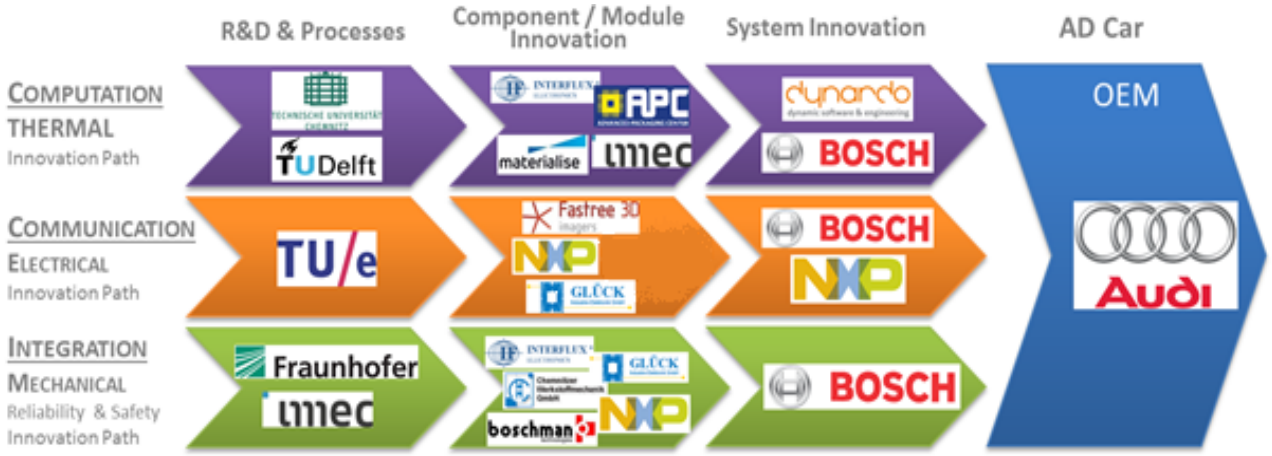
- Level 5 AD cars need much more computational power at highest functional safety level (**processors generate up to 300W**)
- Comprehensive perception of the surrounding environment in real-time: **deploying multiple** video/radar/lidar/ultrasonic **sensors**
- Final data fusion will be done in centralized HPVC units **with new connectors, wiring harness solutions and communication chips for higher data rates**
- **Reliability and functional safety** of AD electronic-systems must be increased

PROJECT DURATION

From 24/06/2019 to 23/06/2022

HiPer PENTA Review Meeting 19.06.2020

3 main technological pathes



Based on the main technological challenges 3 project pathes were established

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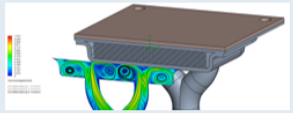
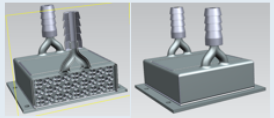
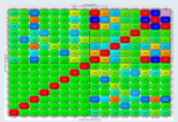
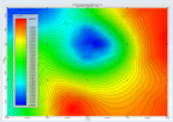
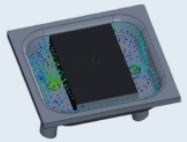
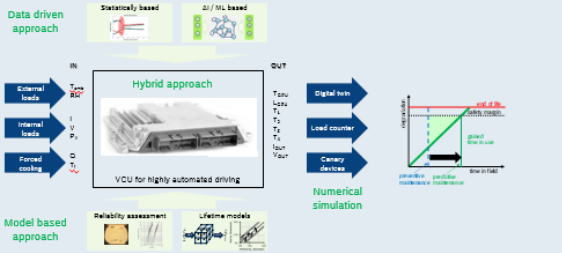
Build-up of demonstrators

Build-Up of 2 Demonstrators

1. Thermomechanical Demonstrator

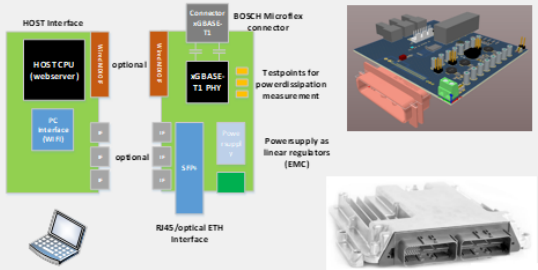






Cooling system concepts

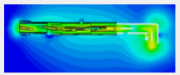
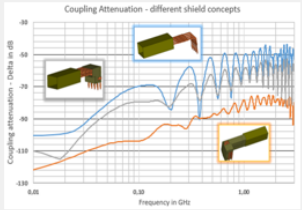


Thermomechanical mock up and prognostics and health management in demonstrator

2. Communication Demonstrator



High speed data connection from Radar, Lidar, Camera

High speed connector system integration into communication demonstrator

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