



Evolving or disrupting E/E architectures for autonomous vehicles?

Martin Törngren, Sagar Behere and Naveen Mohan

Division of **Mechatronics**, Industrial Engineering – **KTH**, Royal Institute of Technology, Stockholm

Joint work with several researchers at KTH, SP, Volvo cars and Scania



2016-09-23
FUSE final seminar

FUSE

ARCHER

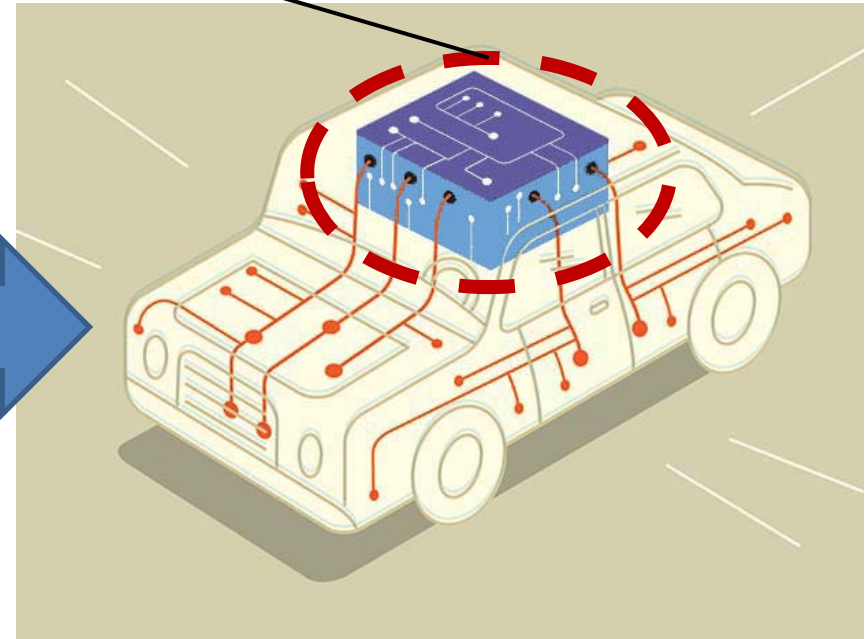
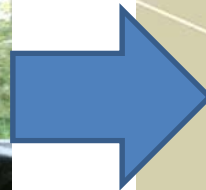
GCDC 2011 & 2016

Cices
Innovative Centre for Embedded Systems

 **CPSE Labs**

Architectural challenges and solutions for autonomous driving?

ADI – Autonomous Driving Intelligence



By Veronica538 (Own work)
[CC BY-SA 3.0 (<http://creativecommons.org/licenses/by-sa/3.0>) or
GFDL (<http://www.gnu.org/copyleft/fdl.html>)], via Wikimedia Commons

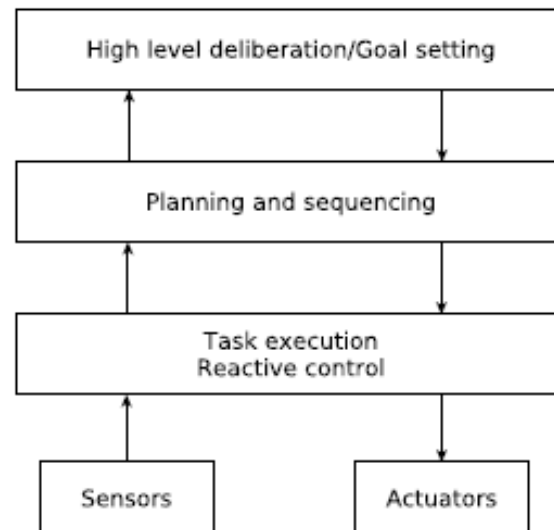
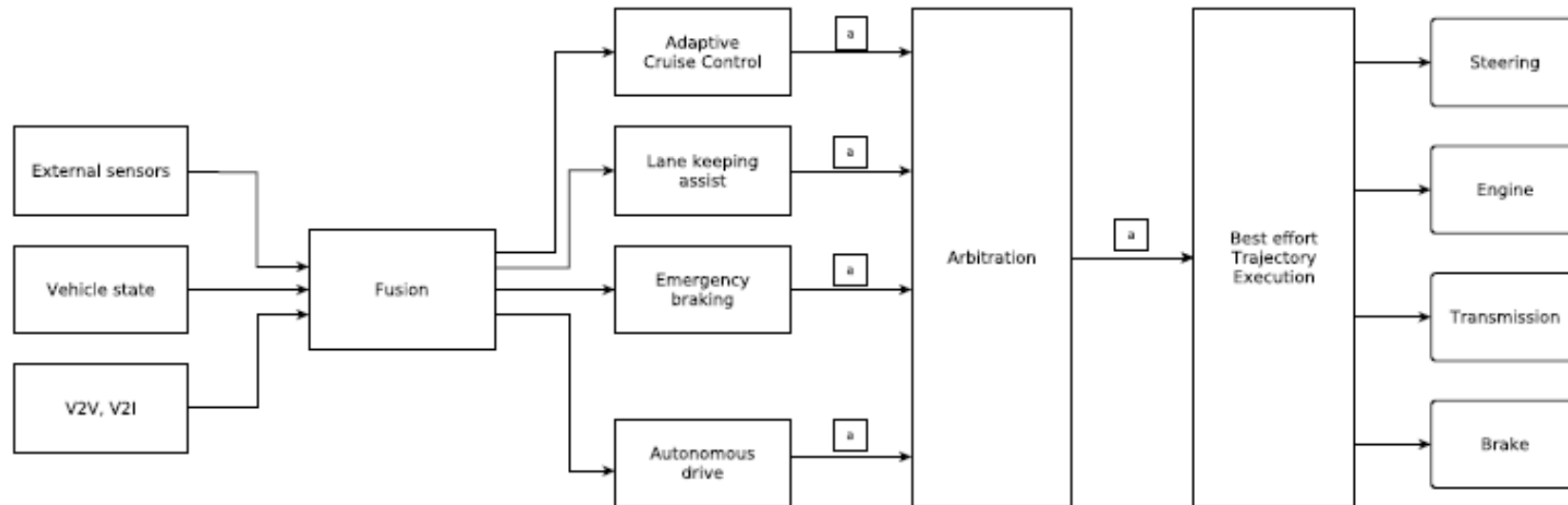
Illustration: Harry Campbell, IEEE Spectrum
<http://spectrum.ieee.org/cars-that-think/transportation/self-driving/nxps-bluebox-bids-to-be-the-brains-of-your-car>

Automotive melting pot

- Electrification and new power sources
- Connectivity and consumer electronics
- Servitization and DevOps
- Automation
 - Robotics and AI
 - System safety, security and dependability
 - Embedded and high performance computing
 - Systems and software engineering

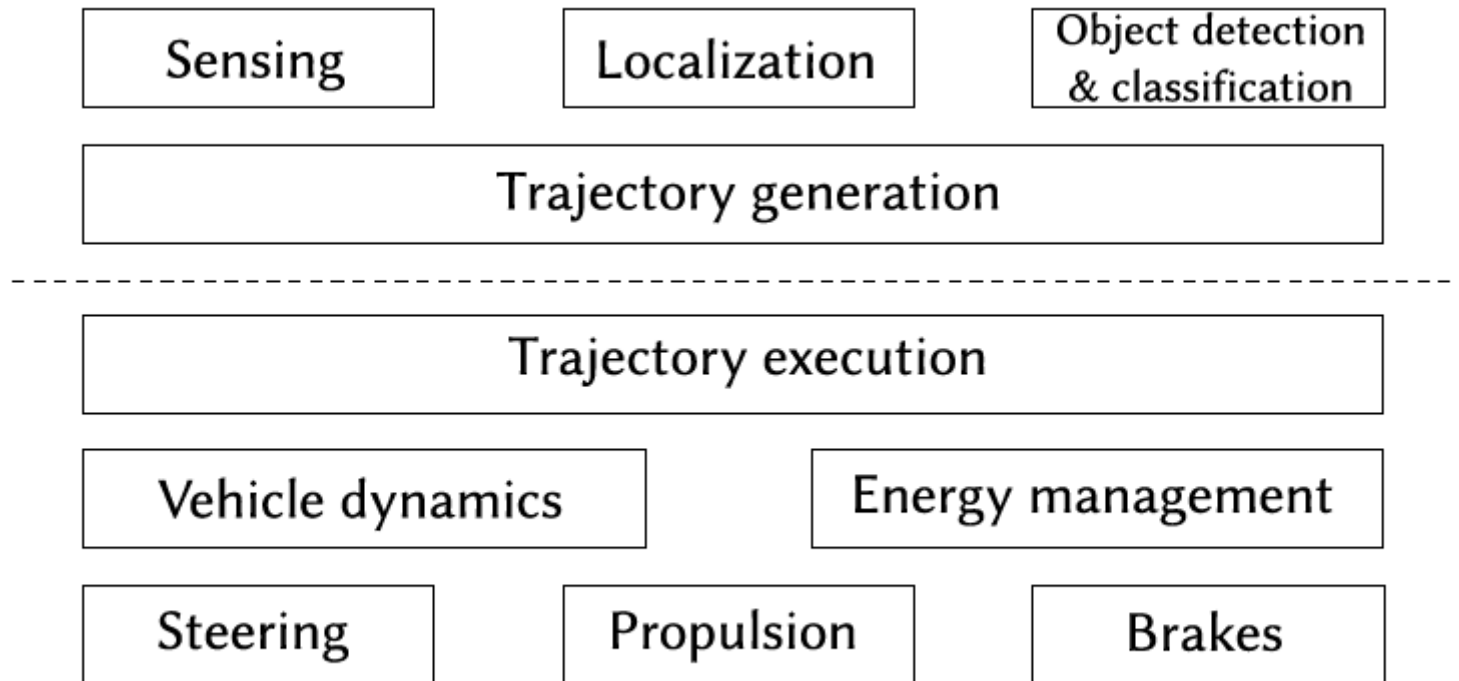


Architectural gap: current practice vs. state of the art



Courtesy of
Sagar Behere

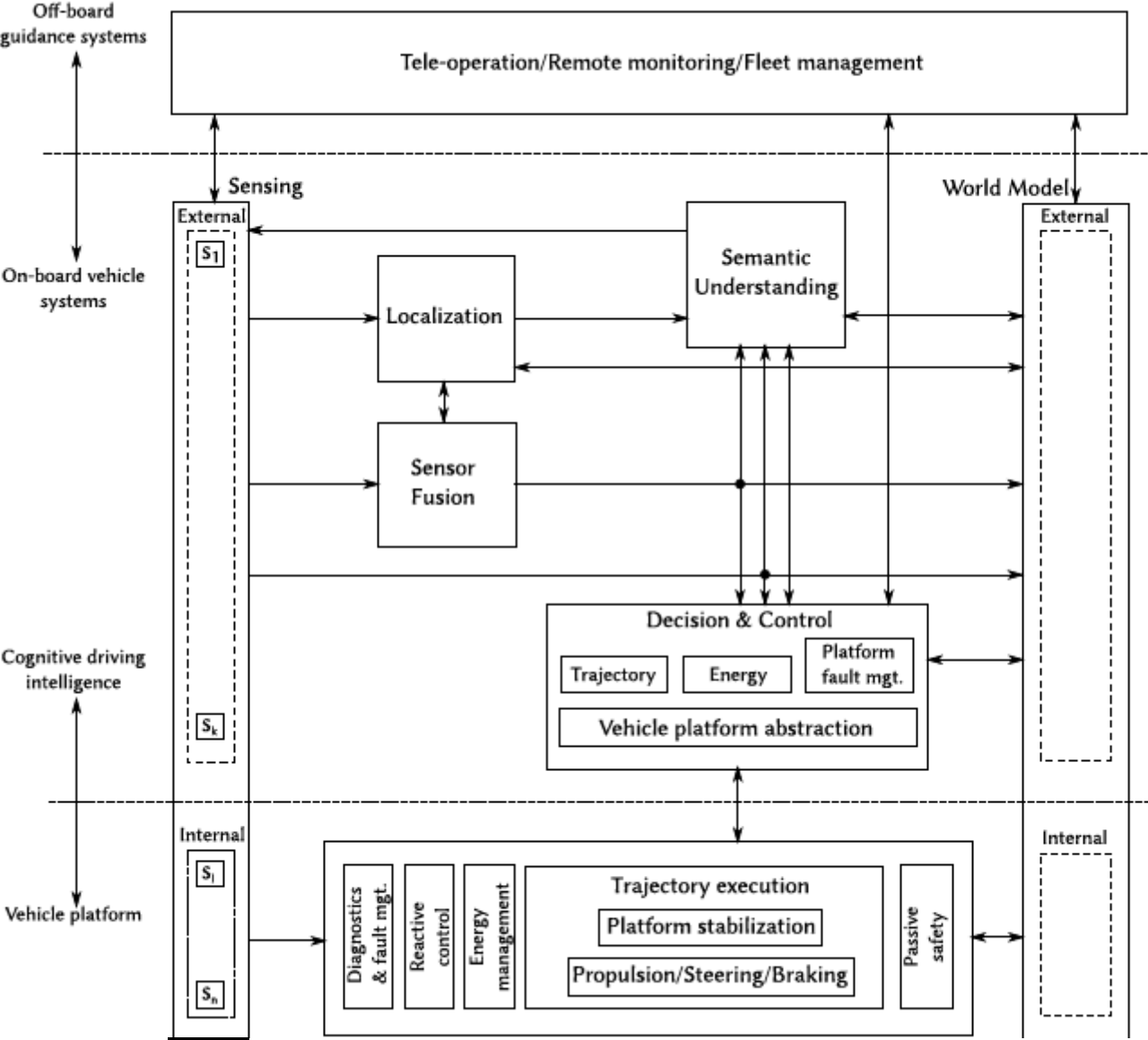
Autonomy: Basic functions



Assignment in space and time with considerations of

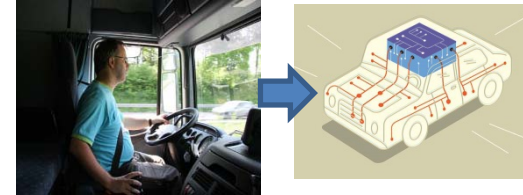
- Performance, Maintenance, Diagnostics
 - Evolving compute and communication platforms
- New requirements for various levels of autonomy
 - Safety, reliability, availability
- Product variants, evolution and business model
 - Legacy and reuse
- Methodology
 - Complexity (essential, accidental)
 - Verification and validation
 - Cost (initial, development, production, certification)

Reference architecture for aut. driving



See Sagar Behere PhD thesis for an elaboration

ADI related architectural questions!

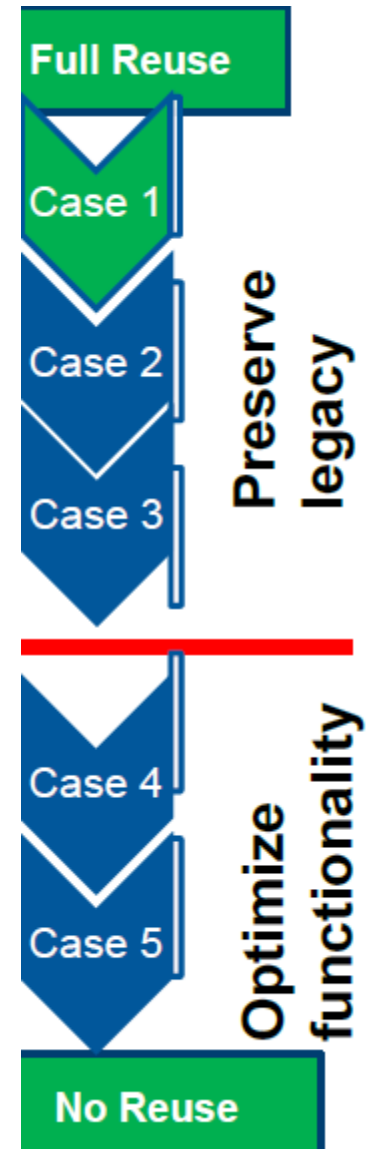


- New or evolutionary design?
 - How much legacy to preserve?
- Division between ADI and platform?
 - ADI modularization?
- From FS to FO! – Suitable architectural patterns?
- New compute and communication infrastructure
- Strategy related issues
 - Business case/model, time to market, level of automation, ...

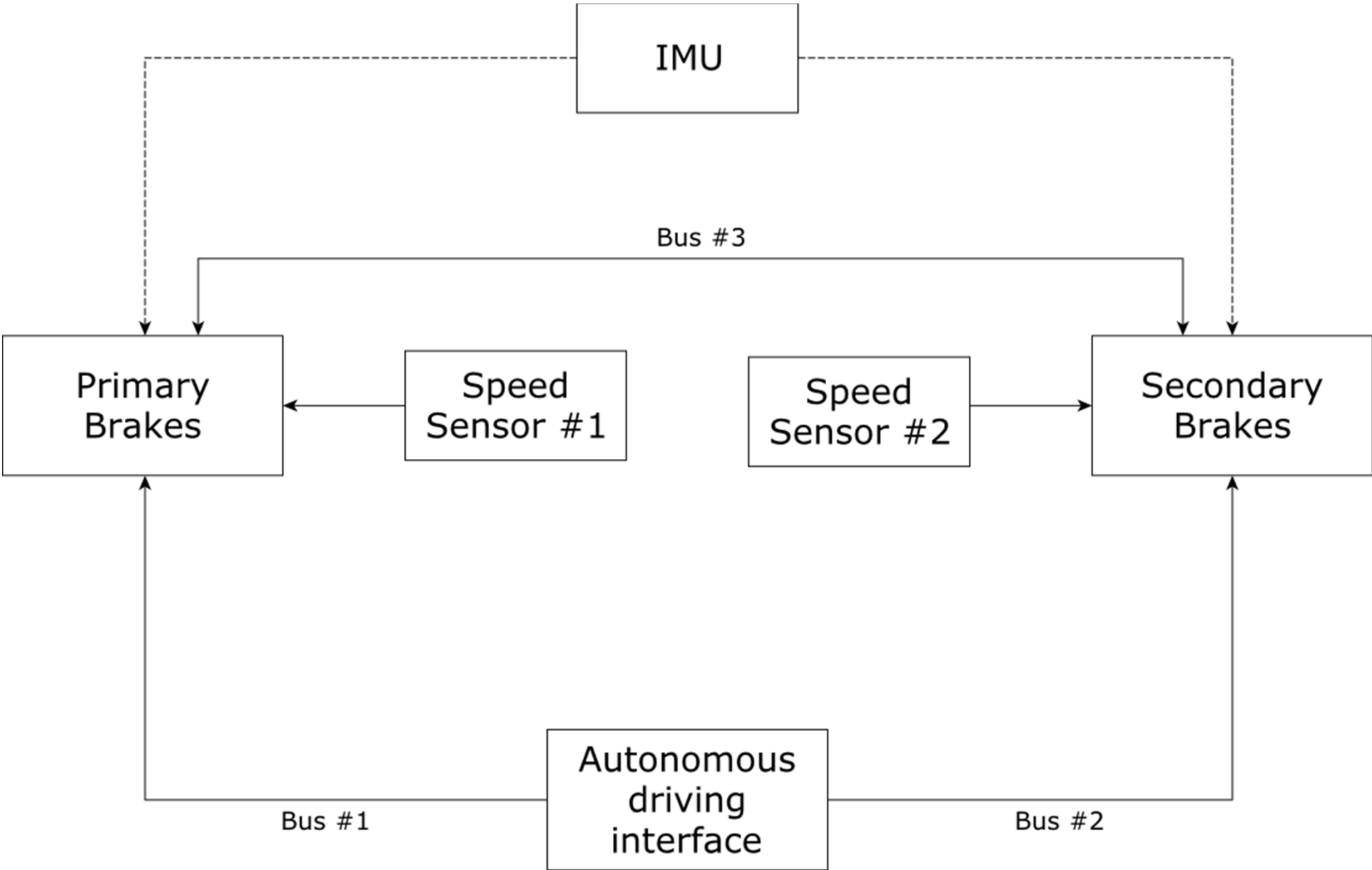
Alternatives for integrating the ADI onto a vehicle platform

- Span of options:
 - Robotics driver
 - Current prototype – attaching to CAN
 - Greater level of control and disabling controls
 - Changing the SW including allocation
 - Complete redesign

See Mohan et al.
for an elaboration
(WASA 2016)



Brake architecture pattern



Take aways!

- Evolutionary and Disrupting architectures!
 - Many “architetural drivers” including business cases
- Architectures will be of paramount importance!
 - Complexity, safety, availability, maintenance, cost, ...
 - New approaches needed and coming!
 - Limiting complexity & correctness by design (composability)
 - End to end deep learning
 - DevOps for CPS
- Partial solutions provided by the FUSE project
 - Problem analysis
 - Reference architectures and patterns
 - Supervisor patterns; Inherent redundancy
 - Towards a methodology

Spares

Cooperative reference architecture

