THE FULLY NETWORKED CAR

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"The best car safety device is a rear-view mirror with a cop in it ."

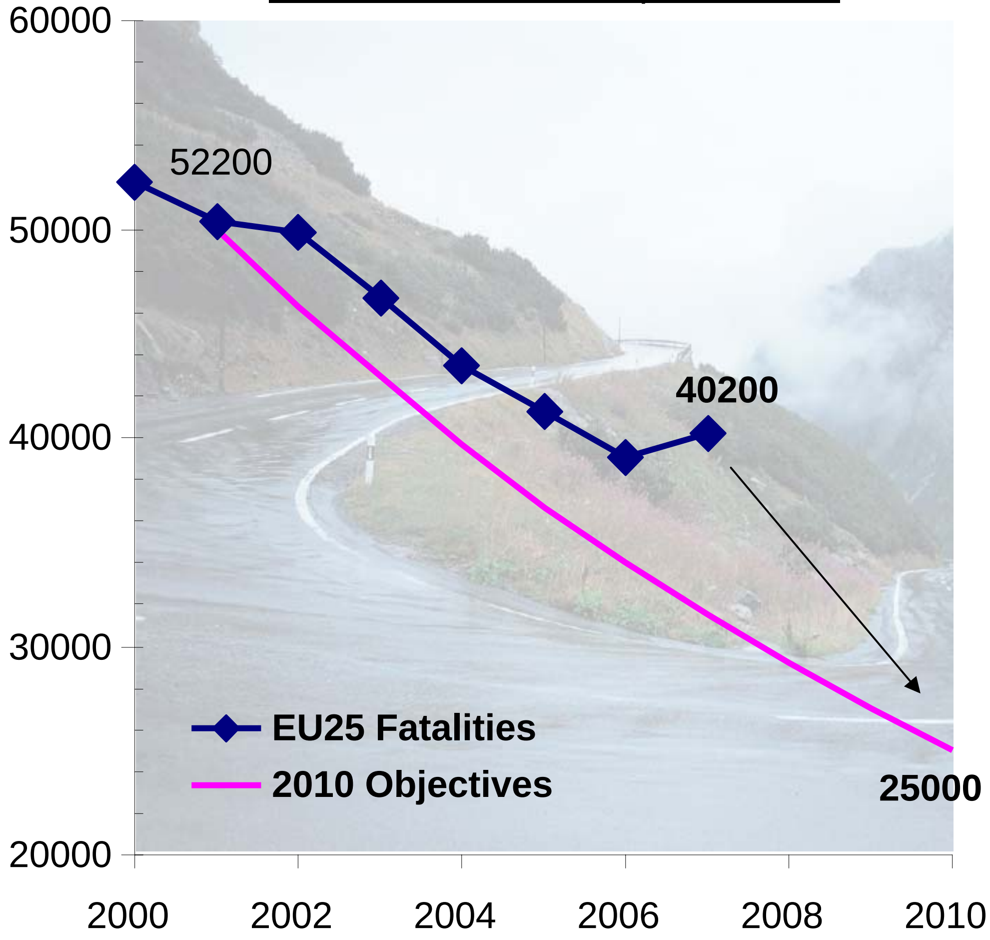
Dudley Moore (1935-2002)
English Actor

Overview

- Introduction: On the road to traffic safety - how far have we got today?
- More safety for the driver: active safety and driver assistance
- More safety around the car: environmental awareness, cognitive cars
- Inherent (functional) safety of automotive electronics
- Summary

Are we on track to meet the 2020 EU Goal ?

Total fatalities on European Roads



Source: EU CARE, EuroNCAP, EuroRAP

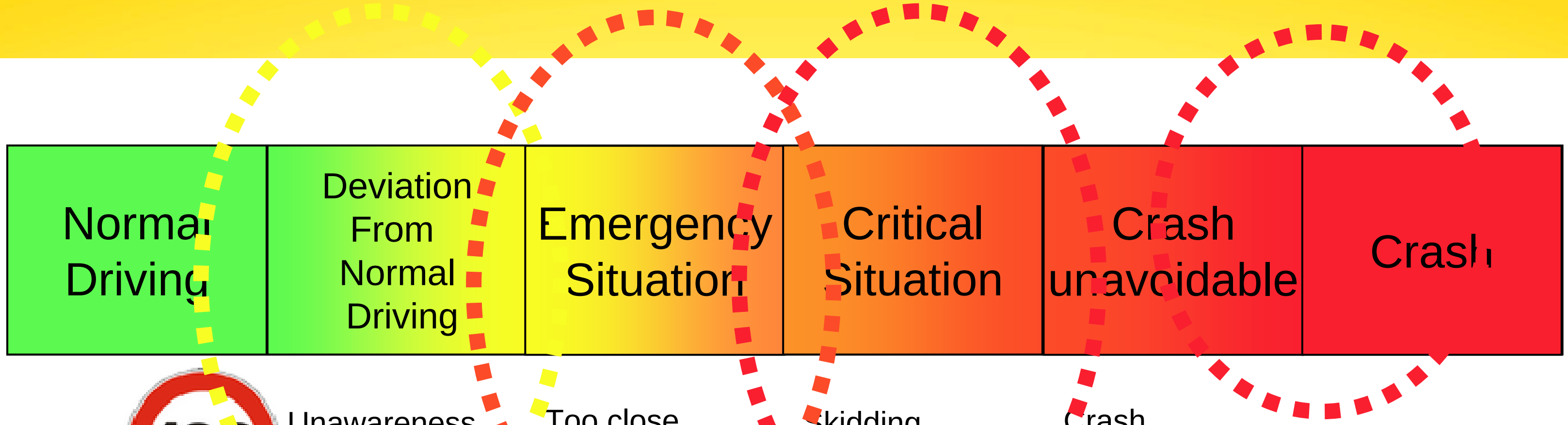
1990: 70900 fatilities
2000: 52200 fatalities
2007: 40200 fatalities, increasing !
2010: 25000 fatilities (goal)

Road fatalities are costing the European society 2% of GDP

Large difference in death rate per 100k inhabitants across Europe

Sweden	**4.9**	
UK	**5.6**	
Germany	**7.1**	**3x more risk**
France	**9.2**	
Italy	**9.6**	
Czech Republic	**13.5**	
Poland	**15**	

Crash Scenario



Unawareness
Lack of attention
Violation

Too close
Loss of traction
Unexpected event

Skidding
Loss of control

Crash
unavoidable

- ACC
- Smart Headlamp Control
- Night vision
- Park Assist

- Advanced Front Steering
- Lane Keep Assist
- Traffic Sign Recognition
- Drowsiness Monitor
- Blind spot detection

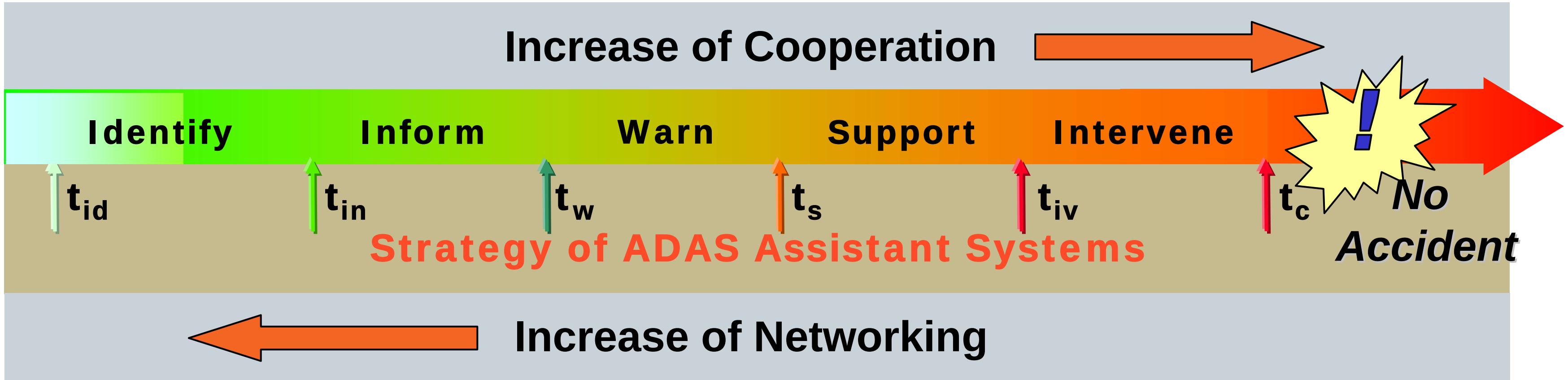
- ESC
- TCS
- Collision Avoidance

- ABS
- Brake Assist
- Pre-safe state

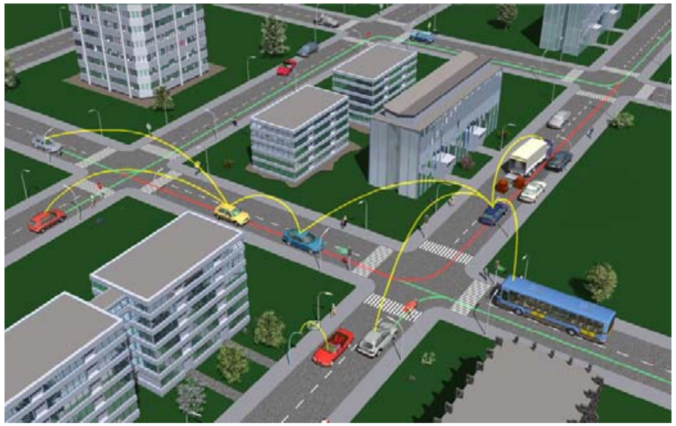
- Seatbelt
- Airbag
- Seat occupancy detection
- Pedestrian Protection
- eCall

Time of Introduction

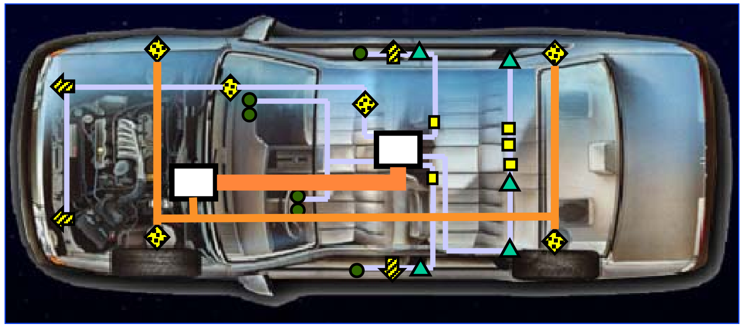
ADAS & Active Safety: Cooperation of Systems



- Surround sensing
- Infrastructure information
- Vehicle-2-vehicle collaboration



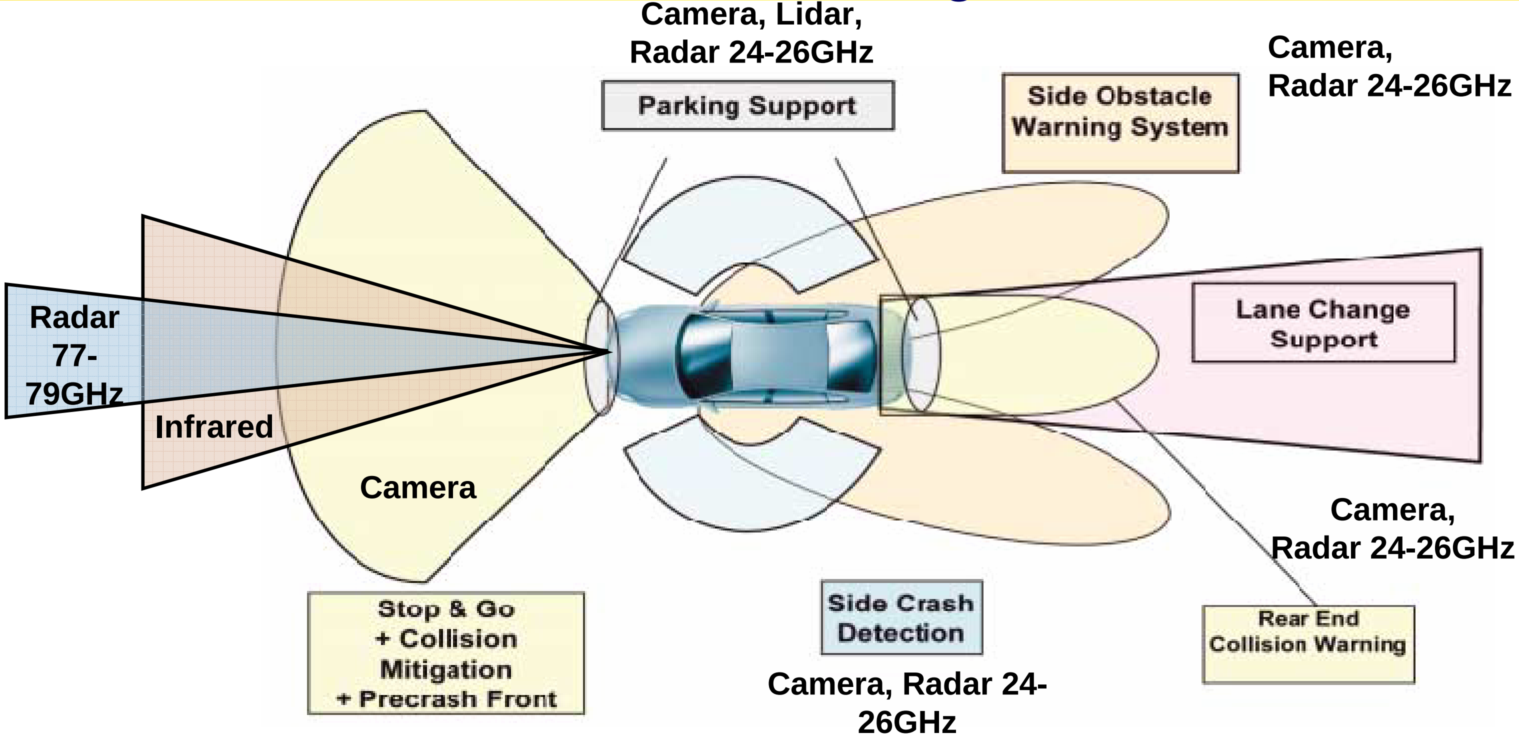
- Cross vehicle function collaboration
- Functional safety requirement



Environmental Awareness

- Car2car
  - Collaborative Safety
- Car2Infrastructure
  - Ecall
  - Toll collect, City Toll
  - Requirements: Global legislation, infrastructure investment
- Example Use Cases:
  - Road Feature Notification:
    - broad/unicast, range: 300m
  - Roadside Signage:
    - broadcast, range: 300m
  - Cooperative collision warning:
    - broadcast, range: 300m; safety relevant
  - Pre Crash Sensing:
    - unicast, range: 50m, safety critical

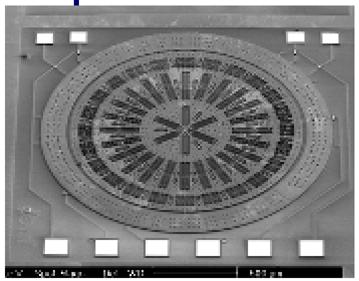
Advanced Driver Assistance Systems – Surround Sensing



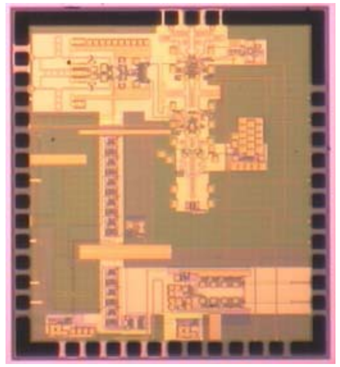
- Cameras can cover most of the applications and have the potential to become the preferred sensor for cost efficient systems
- Drawbacks of the camera sensor can be handled by sophisticated algorithms
- Several sensors will be used in the mid-term for redundancy reasons until the camera vision algorithms get robust and mature

ADAS & Active Safety: Enabling Technologies

- Active Safety
  - ESC: safety critical, inertial sensors (gyroscope), 200 Mips
  - Electronic Braking: safety critical, pressure sensors, 200 Mips
  - Integrated Chassis Management: safety critical, 300-500 Mips
  - Adaptive Suspension: safety critical, FlexRay, 200 Mips
  - Adaptive Steering: safety critcal, 50-100 Mips



- ADAS
  - Radar sensor: 77-79 GHz, 24-26GHz, SiGe:C technology
  - Radar signal processing: safety critical, 150 Mips
  - Camera signal processing:
    - Warning: safety relevant, 100-500 Mips
    - Intervention: safety critical, stereo vision, 1000-5000 Mips



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Functional Safety: Role of Standards

- Standards are emerging as a framework to establish metrics
  - IEC61508 (existing)
    - Safety lifecycle defined
    - Top down
    - Recommended & mandatory practices
  - ISO26262 (emerging)
    - Decomposition of safety from system to component level

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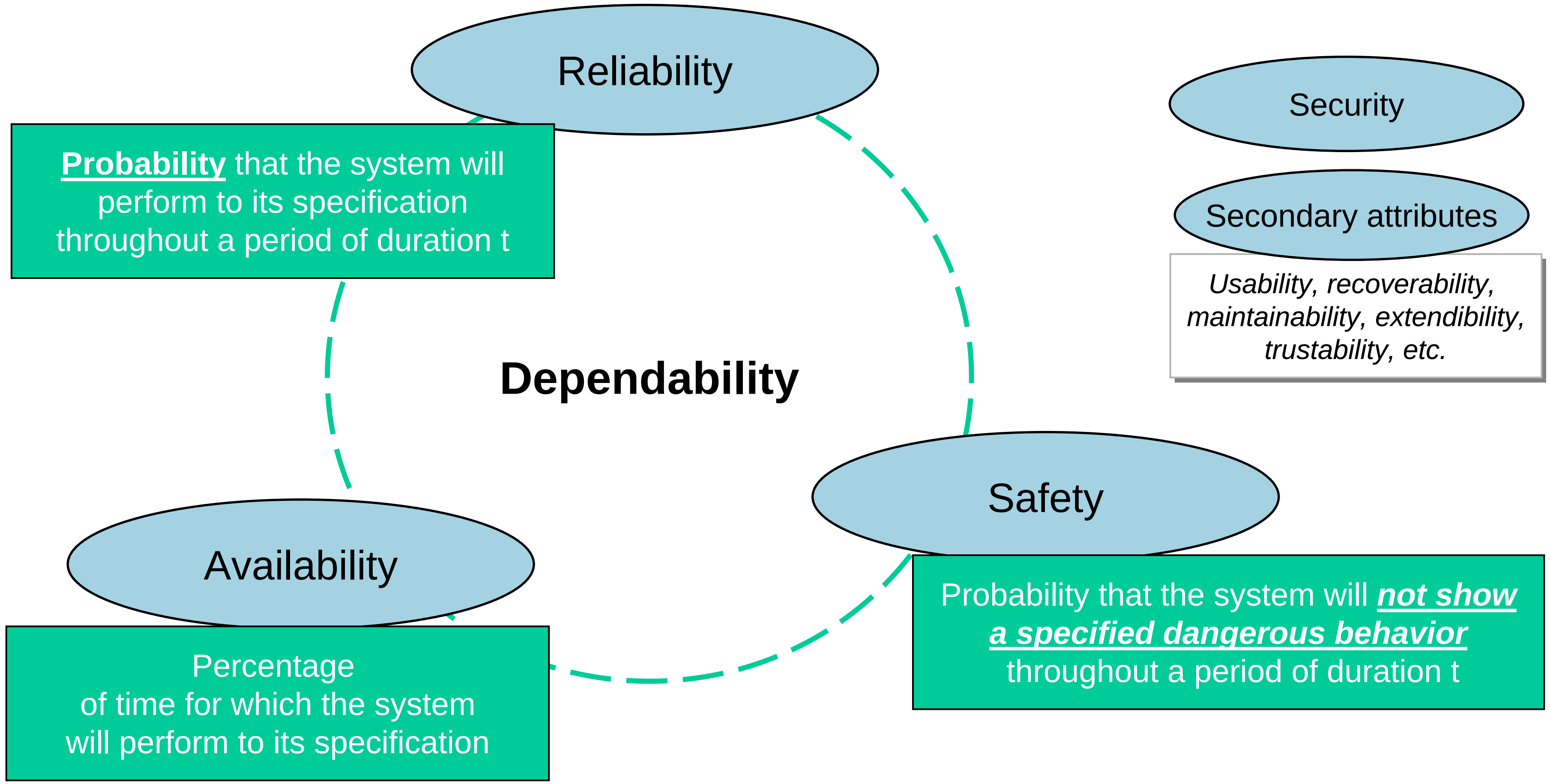
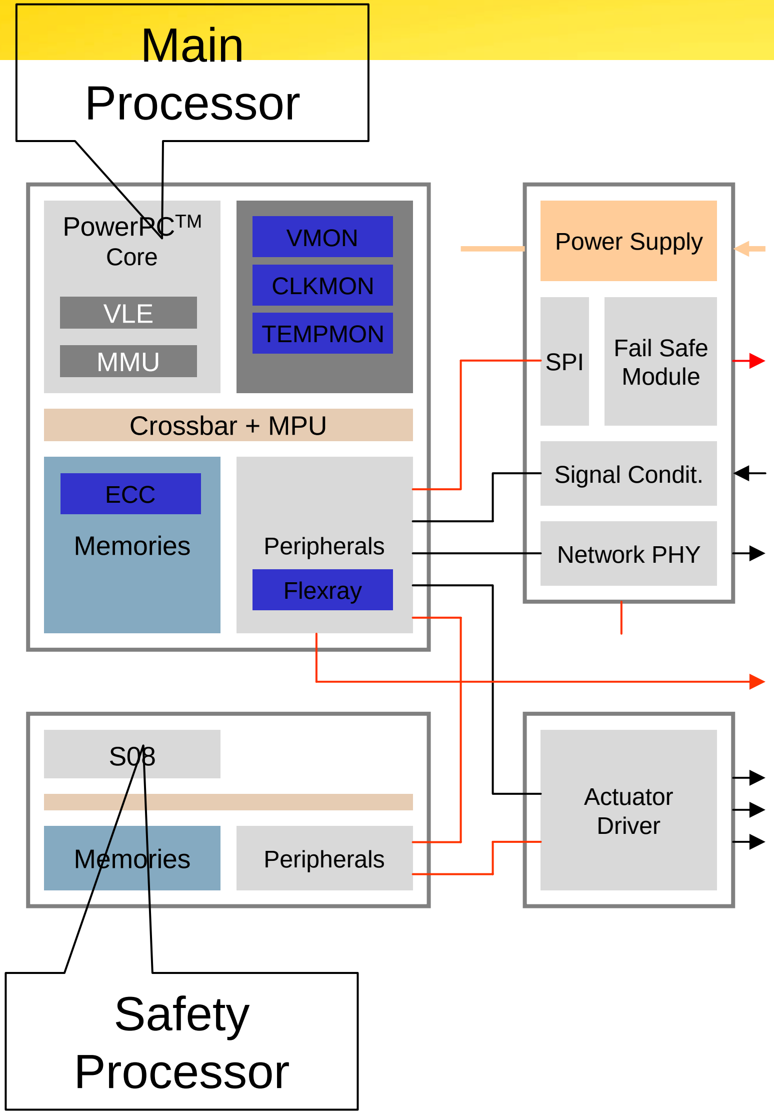
Safety in the Context of Dependability

Definitions according to IFIP WG10.4



Single Core Processor Safety Concept

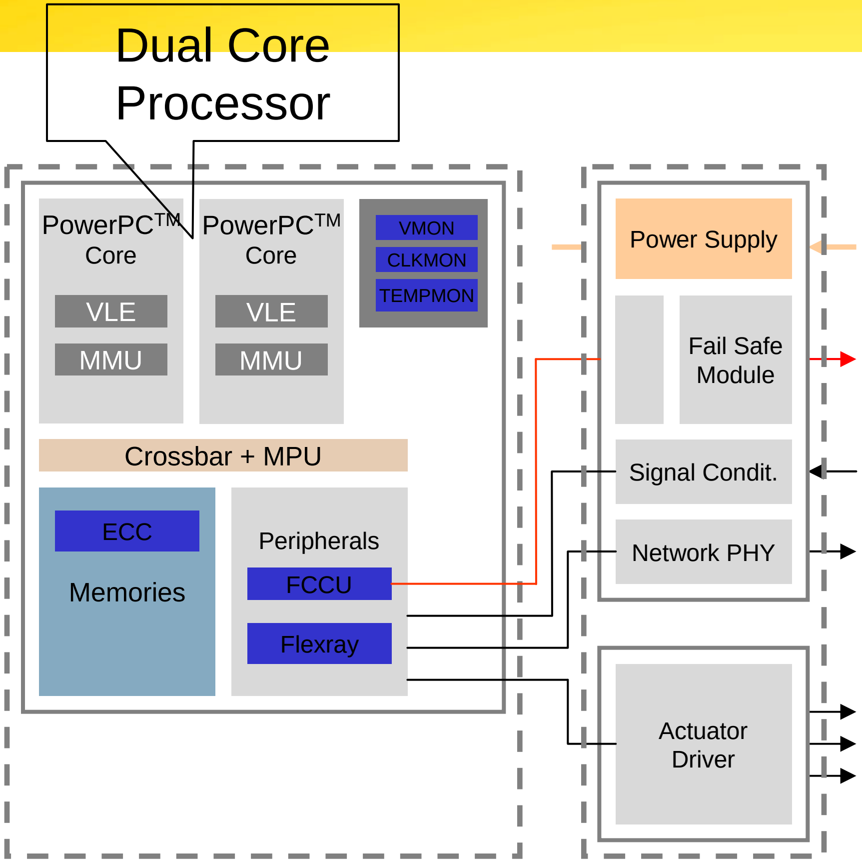


- Typical System Architecture
  - Discrete master/checker architecture
  - Main MCU for sensor/application processing and actuator control
  - Safety MCU for plausibility check and 2nd level actuator control
  - System basis chip integrating power supply, advanced watchdog and network physical layers
  - Application-specific actuator drivers
  - Self-test software package running on main MCU
- Advantages
  - Medium complexity
  - Early detection of permanent faults

Safety Features – Single Core & Asymmetric Dual Core Processors

Safety Feature	Use case
System Integration: Power Management Unit	**Supply voltage monitoring**
System Integration: Clock Monitor Unit	**Clock quality monitoring, self clocking**
Core: Core Self Test	**Detection of ‚sleeping' faults**
Error Detection: ECC on Flash and/or RAM	**Double error detection, single error correction**
Error Detection: Fault Collection and Control Unit	**Fault management**
Error Detection: Temperature sensor	**Die temperature indicator**
Architecture: Memory Management Unit	**Core based memory management**
Architecture: Memory Protection Unit	**Control of bus masters**
Redundancy: Second independent core	**Checker algorithms, code diversity**
Redundancy: Dual ADC	**Redundant measurements**
Redundancy: Dual timers	**Redundant measurements**
Communications: FlexRay	**Application backbone network, high-speed P2P**
Communications: Safety Port	**Clock-less protocol**

Symmetric Dual Core Processor Safety Concept



- Typical System Architecture
  - Main MCU with sphere of replication supporting:
    - Lockstep / non-lockstep dual core configuration
    - Redundancy of key elements such as cross-bar, DMA, interrupt controller & I/O bridge
  - System basis chip integrating power supply, advanced watchdog and network physical layers
  - Application-specific actuator drivers
  - Selftest software package running on main MCU

- Advantages
  - Low complexity
  - Early detection of transient faults
  - Early detection of permanent faults (Self test)
  - Availability

Safety Features – New Symmetric Dual Core Processor

Safety Feature	Use case
System Integration: Power Management Unit (PMU)	**Supply voltage monitoring (CMF)**
System Integration: Clock Monitor Unit (CMU)	**Clock quality monitoring, self clocking (CMF)**
Core: Core Self Test	**Detection of ‚sleeping' faults**
Error Detection: ECC on Flash **and** RAM	**Double error detection, single error correction**
Error Detection: Fault Collection and Control Unit (FCCU)	**Fault collection and management**
Error Detection: CRC Unit	**Protection of application data**
Redundancy: Dual ADC	**Redundant measurements & selftest**
Redundancy: Dual timers	**Redundant measurements**
Redundancy: Dual e200Core lockstep / non-lockstep	**Detection of transient faults**
Redundancy: Dual MMU, VLE, Cache	**Detection of transient faults**
Redundancy: Dual SWT, MCM, STM, INTC, eDMA	**Detection of transient faults**
Redundancy: RC Units at Gates to non redundant sphere	**Lockstep fault detection & signalling**
Redundancy: XBAR + Memory Protection Unit	**Detection of transient faults**
Redundancy: Dual Temp Sensor	**Die temperature measurement**
Communications: FlexRay	**Backbone application network, high-speed Point-to-Point**

Semiconductor: Making The Car Safer

Active safety systems will drive automotive electronics growth over the next decade

Sensor technology will enable cognition, making vehicles aware of their environment

Real-time Networks will enable the collaboration of electronic systems and enhance the overall functionality

The number of microcontrollers and **performance demands** will increase as systems integrate and add intelligence

Open system industry standards and collaboration will be critical to managing increasing vehicle complexity

Functional Safety capability will be required for intervening electronic systems

Responsibility of autonomous safety systems demand **zero defect** design methodologies

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Thank you for your attention.

Can I answer any Questions?

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