Specification of multi-domain systems based on Matlab / Simulink

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Outline

- Special requirements at Bosch
- Our project goals
- Activities and results
- Introduction of a system example
- Summary and outlook

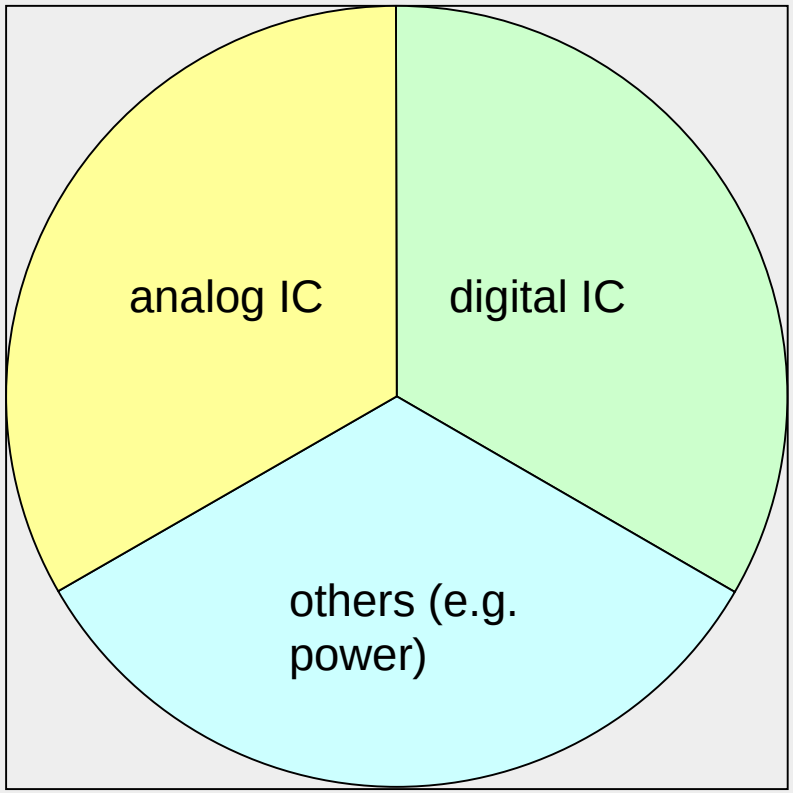
Specific requirements at Bosch Automotive Electronics division (1)

- Automotive sector:
  - most designs with extremly high demands on security and reliability
  - special environment
    - extreme temperatures
    - mechanical shock
    - electromagnetical fields
  - integration for reduction of
    - size
    - weight
    - costs

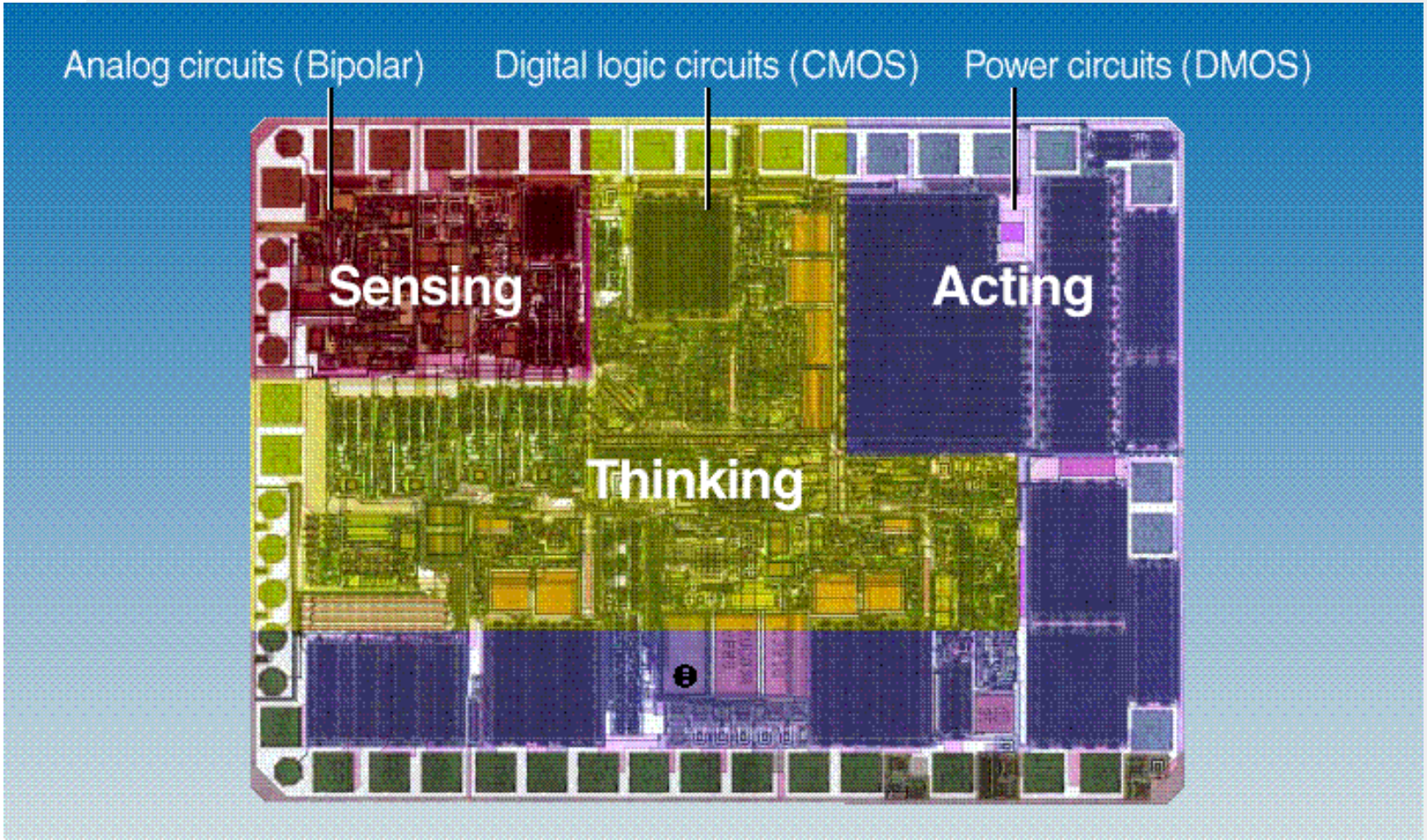
Specific requirements at Bosch Automotive Electronics division (2)

- ASICs to meet special requirements
- Mostly BCD processes
- Designs from various domains with a wide range of complexity
  - Sensor control (micromechanical, analog, digital)
  - Airbag control (analog, digital)
  - Video sensing (digital, SW)
  - DAB (digital, high complexity)

Distribution of semiconductor parts



Integration in Silicon



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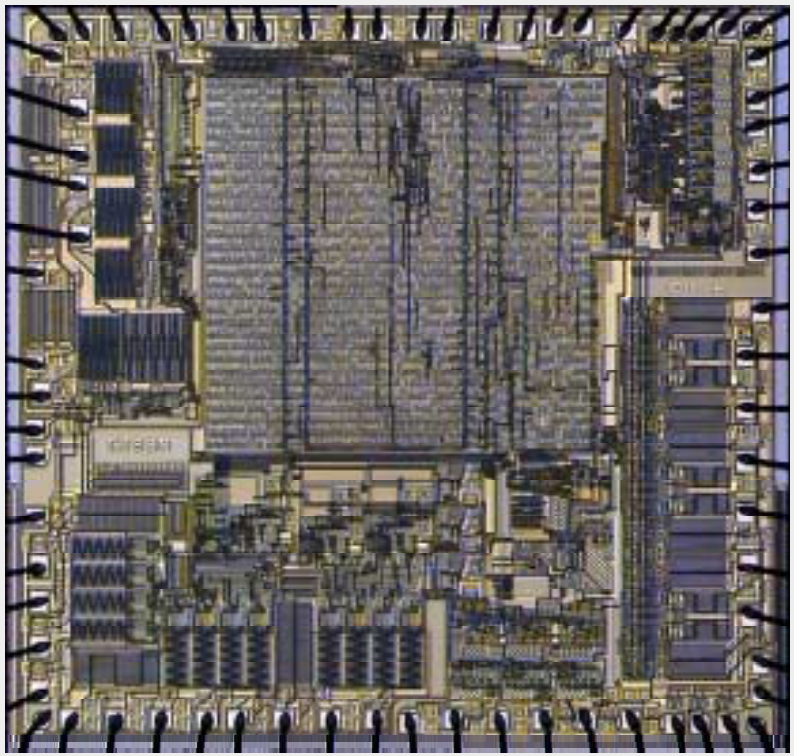
Control unit for fuel injection



Chip size	35 mm^2
Number of components:	**23 440**
Process:	BCD3

mixed process

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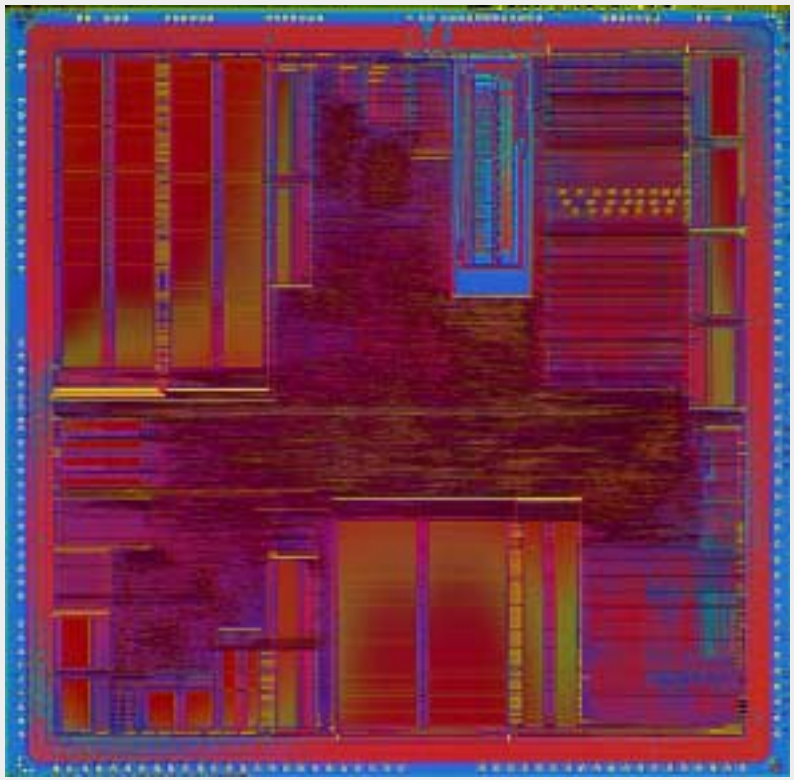
DAB-Fully Integrated Receiver Engine



Chip size:	81mm^2
Number of components:	**7.9 Mio**
Function:	DAB and FM on-chip
Process:	0.25µm, CMOS

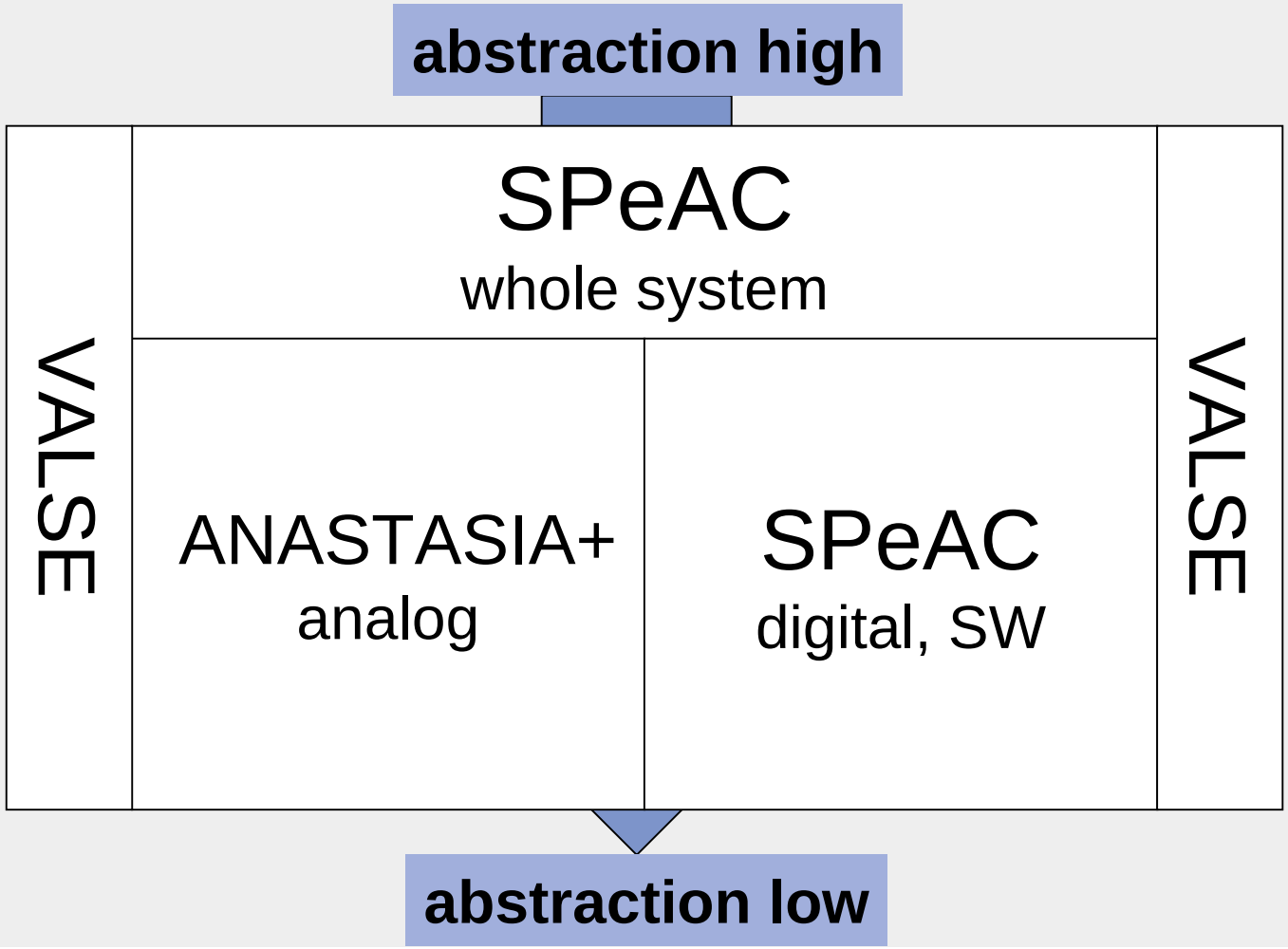
SPeAC project goals for Bosch

- Development and establishing of a digital system level design flow
- Closing the gap between specification an existing flows
- Better communication between ASIC designers and system designers
- Earlier detection of errors and misunderstanding
- More automatisation
- Better testability over domain borders

SPeAC Project structure at Bosch

- Coordination at dept. AE/DIC (A. Reutter)
- Subcontractors
  - Investigation tasks
  - Market overview
- Designers as active partners
  - Real world examples from involved departments
  - Correspondent for subcontractors
- PhD student
- Trainees, graduands
- AE/DIC staff

Bosch internal project cooperation



Major interests

- Co-Simulation of system model and implemented parts (e.g. Simulink - VHDL simulatior)
  - uniform description of all components at highest level
  - simulation over domain borders
  - simulation over abstraction levels
- Reuse of testbenches generated for system level model
  - complete verification environment over different abstraction levels
- Automatic VHDL generation from system level description
  - long term goal
  - „correctness by construction“

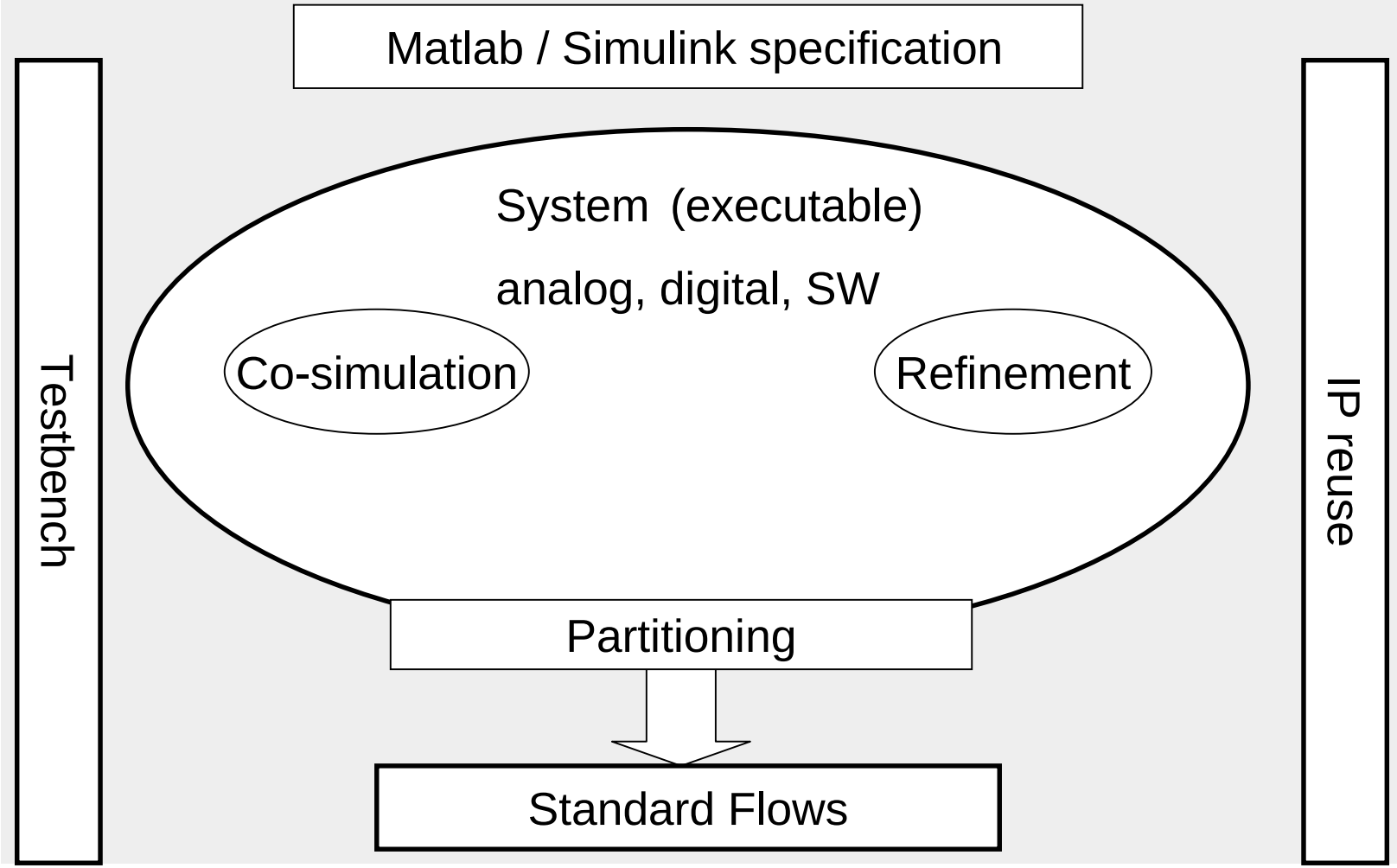
Current / done work (1)

- Investigation of languages for system level design
  - Theoretical concepts
  - Modeling of examples achieved from design departments
  - Subset for synthesis
  - options for design reuse
- Investigation of tools for system level design
  - usability
  - performance, stability
  - synthesis of modeled examples

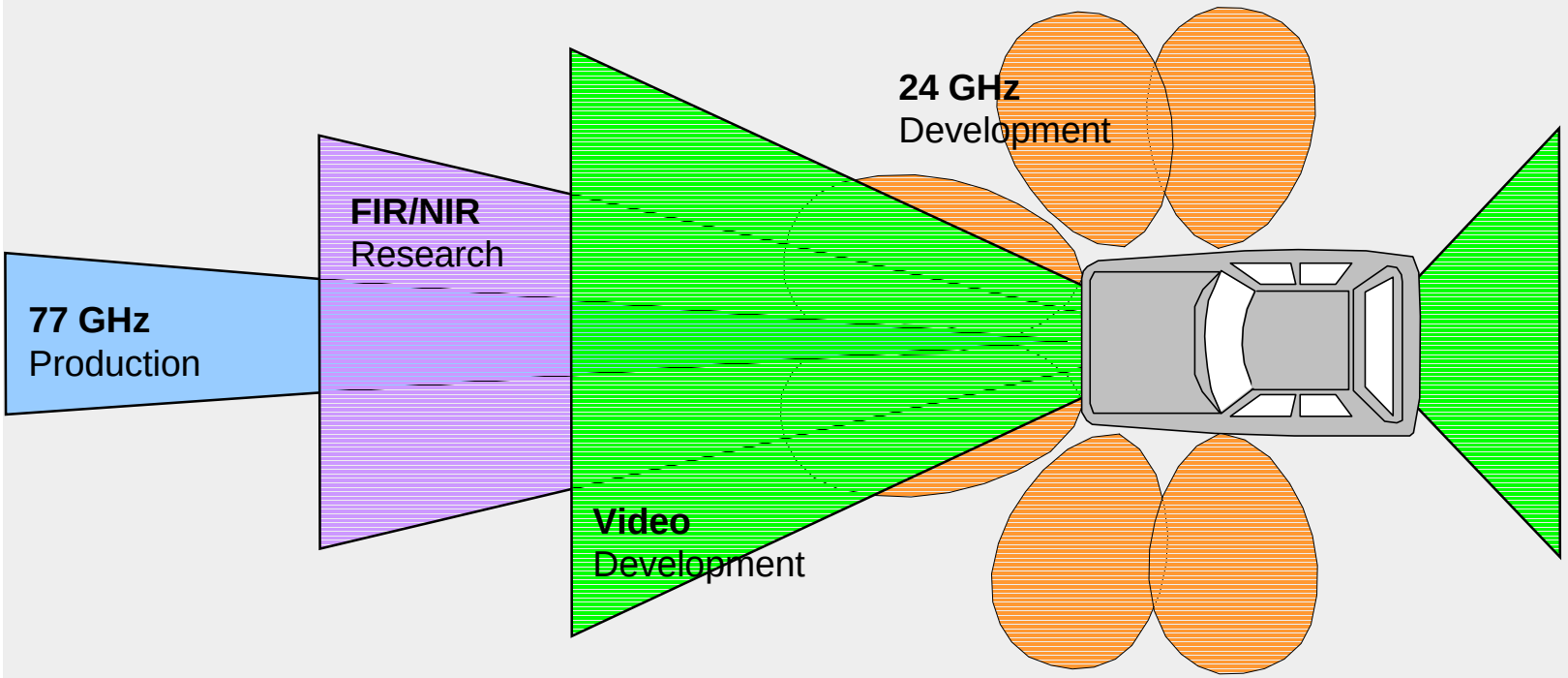
Current / done work (2)

- Elaboration of possible flow(s)
  - direct compilation from digital modules to VHDL
  - compilation of modules into an intermediate format like C-based languages
- Alternatives for co-simulation (e.g. Simulink-VHDL simulator)
  - Direct coupling: Simulink-Modelsim
  - Own master application which manages the simulators (e.g. SystemC application)
  - HW description with C derivate in RTL style
- Cooperation with The MathWorks
  - support from MathWorks developer
  - information exchange

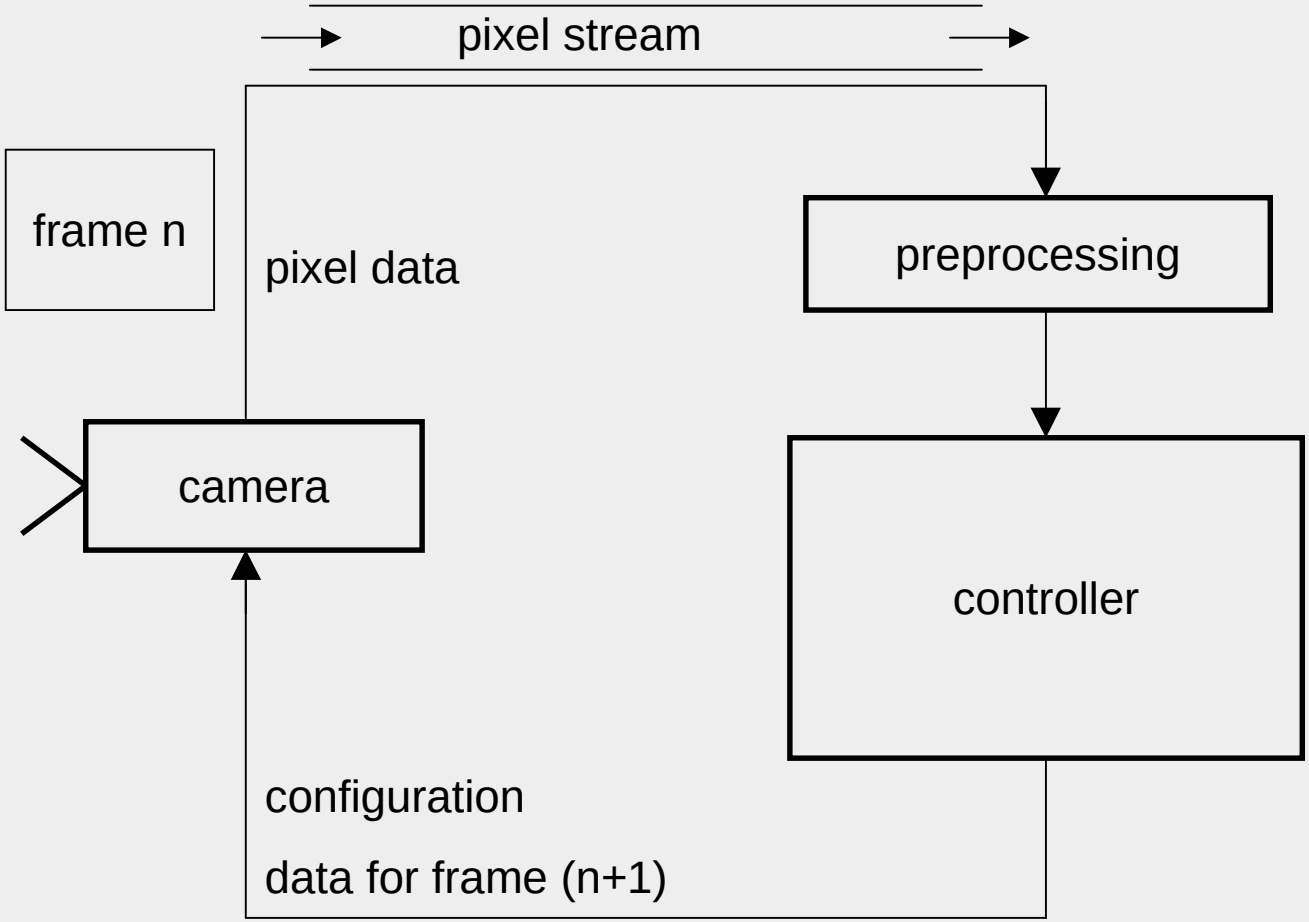
Matlab based system level design flow



Vehicle Surround Sensing



Working example: camera exposure control unit



Why this example?

- System example
  - not only digital HW, but:
  - Different domains: HW, SW
  - Not too complex
  - Availability of
    - Matlab model
    - C model untimed / timed
    - C model bit accurate
    - VHDL model / C model
- Prototype for the extension of digital flow

Summary and outlook

- Summary
  - Investigation of languages and tools
  - Elaboration of a prototypical flow
  - Evaluation of this flow with our example
  - Setup of a Simulink-VHDL cosimulation environment started:
- Next Steps
  - Establish a co-simulation environment
  - Elaboration of a testbench concept