VIRTUAL PLATFORMS: FROM CONSUMER ELECTRONICS TO CRITICAL EMBEDDED SYSTEMS

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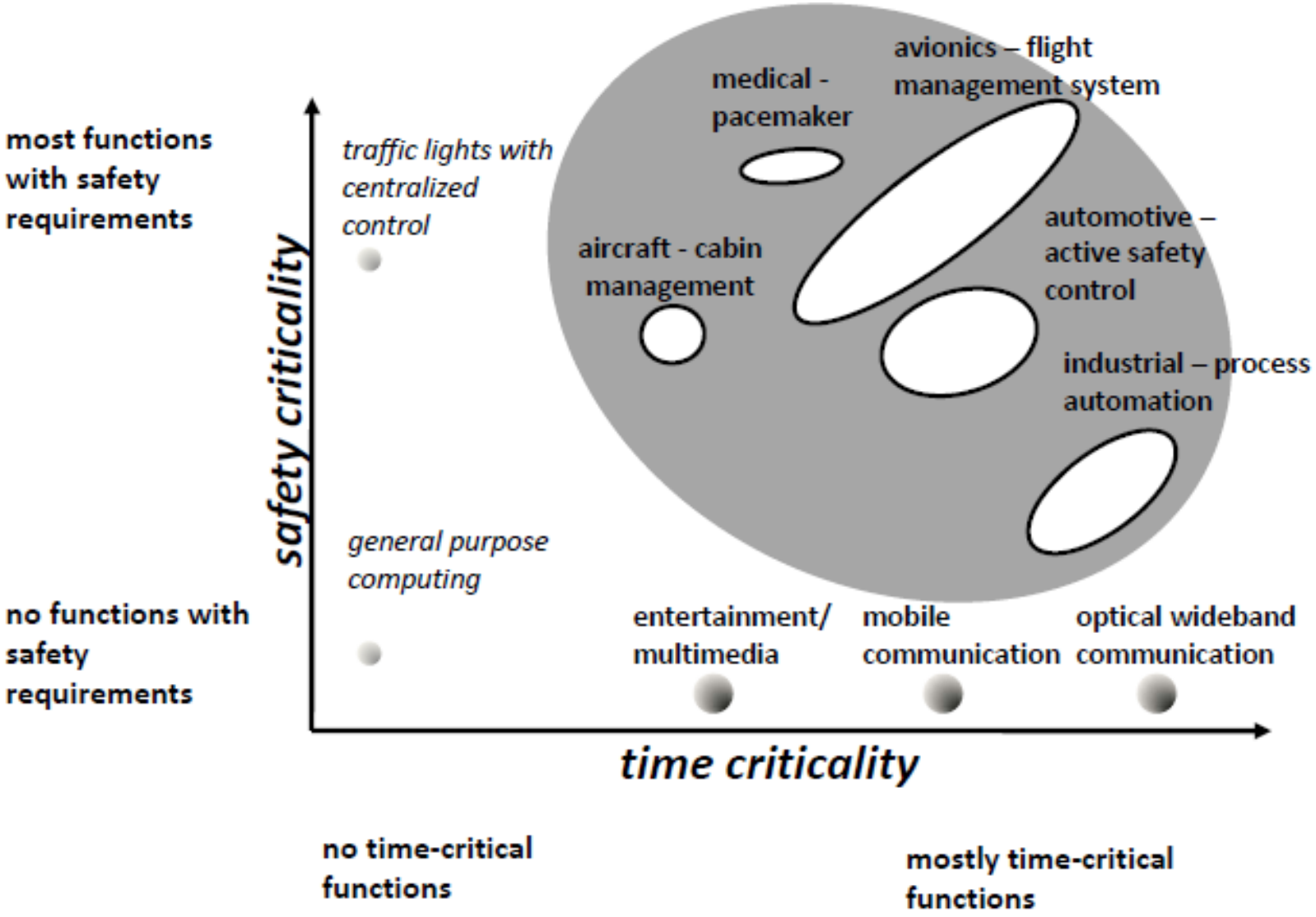
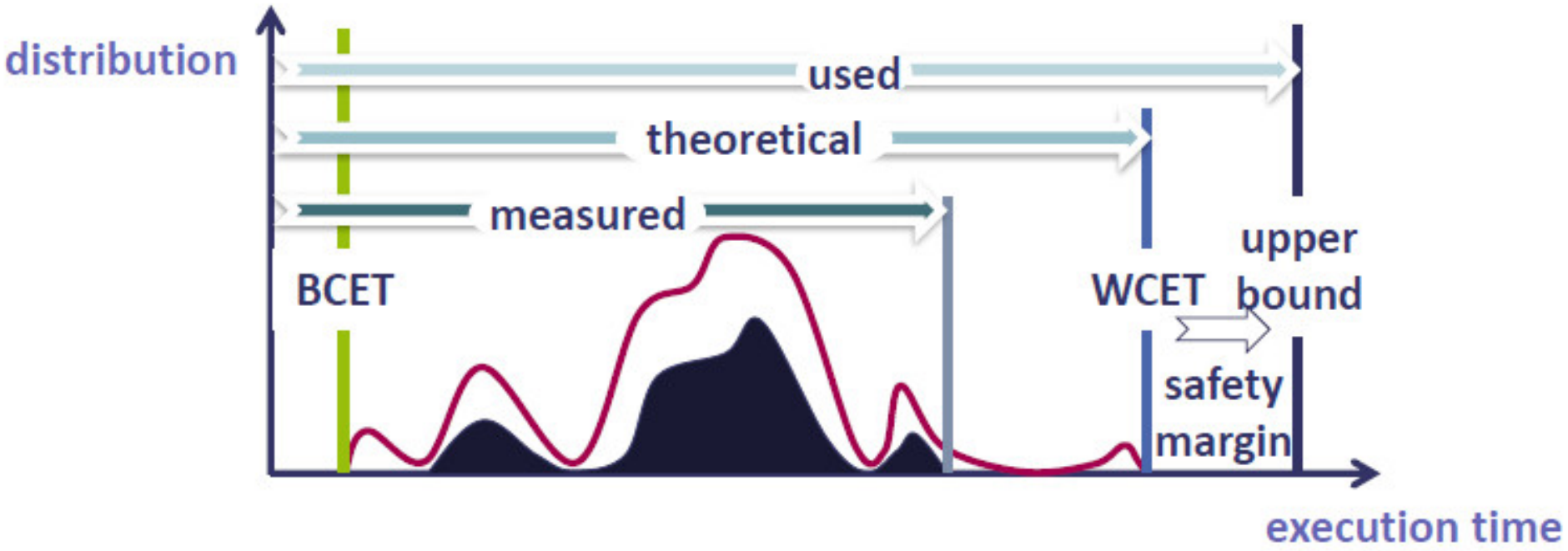
SAFETY-CRITICAL AND TIME CRITICAL APPLICATIONS (COURTESY ROLF ERNST)

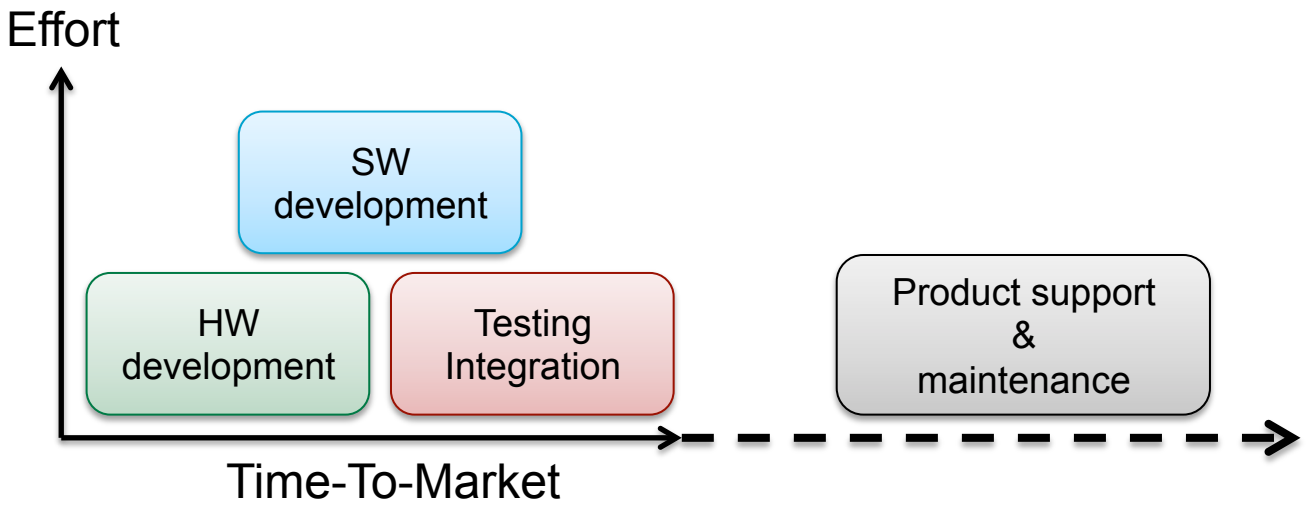


CHALLENGING NON-FUNCTIONAL REQUIREMENTS (COURTESY ARNAUD GRASSET)

PREDICTABILITY OF COMPLEX ARCHITECTURES

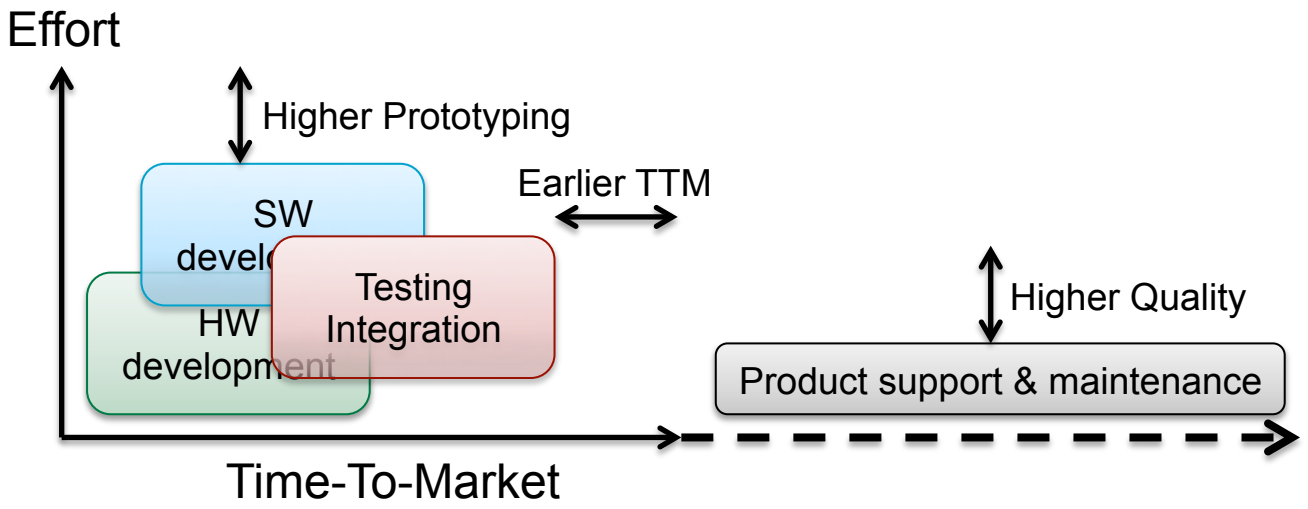


TRADITIONAL DESIGN AND VERIFICATION FLOW



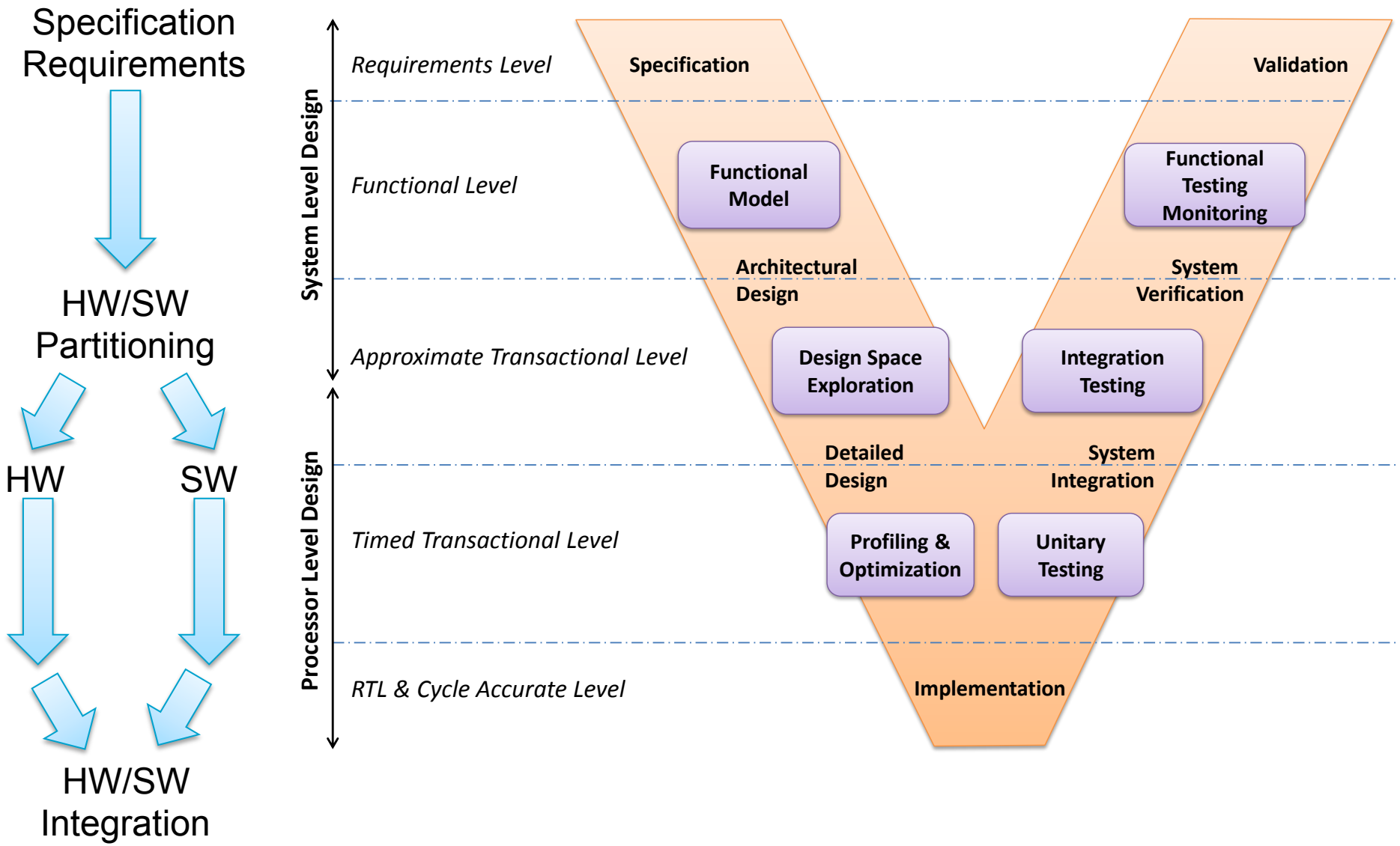
- HW/SW development & testing in a pipeline

VIRTUALIZED DESIGN AND VERIFICATION FLOW

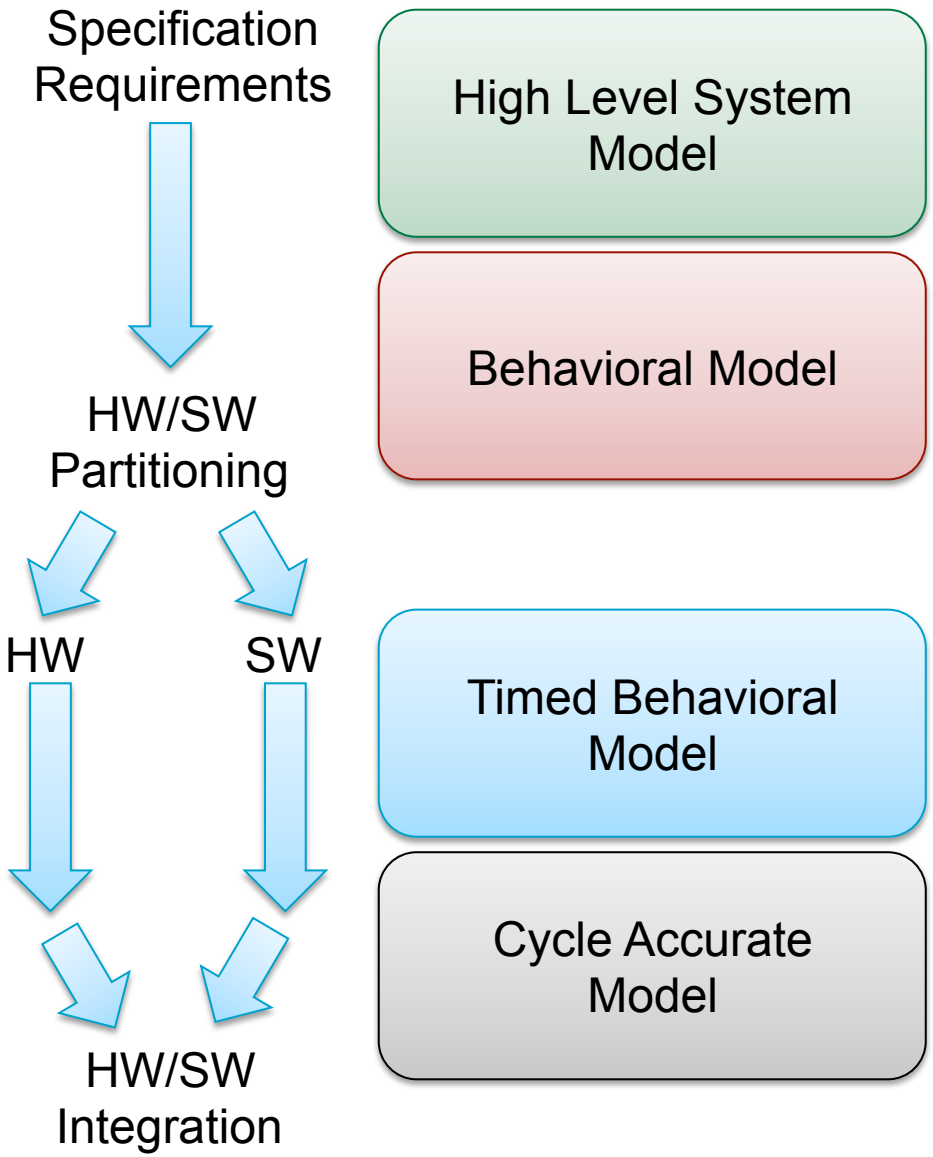


- Fusion of HW/SW development & Testing ➡ decreased TTM
- More competitive products
- Up to 6 months faster

EMBEDDED SYSTEM DESIGN FLOW



MODELING ABSTRACTION LEVELS



High Level System Model

Formal
- UML, SysML
- SDL
- AADL

Behavioral Model

Exécutable Spécification
- UML
- AADL
- Matlab
- Scilab
- Modelica
- Scade
- C/C++
- SystemC
- ArchC

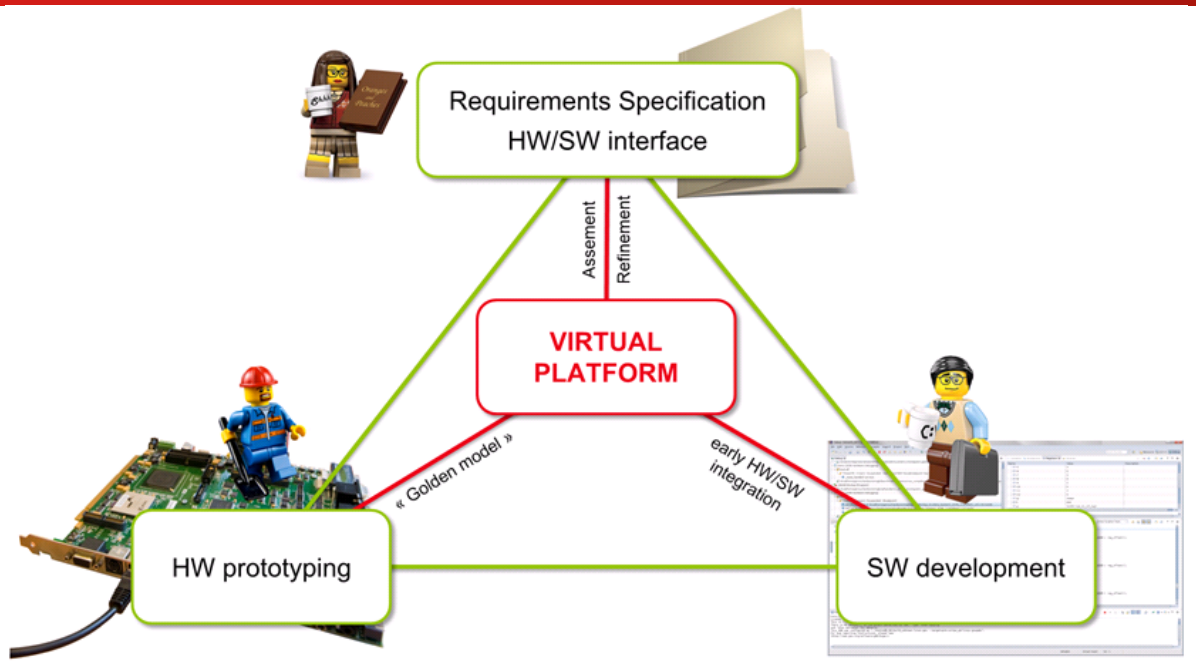
Timed Behavioral Model

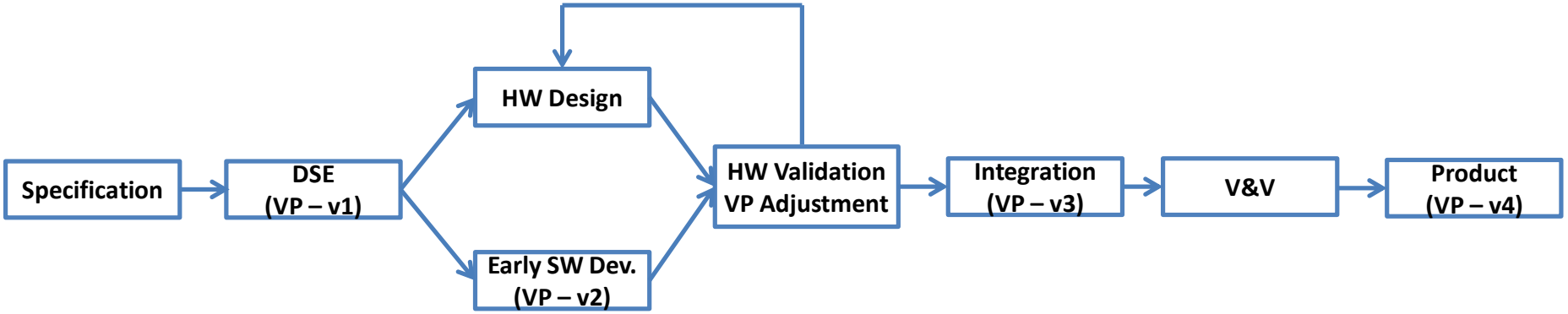
Approximated Timing Annotation
- C/C++
- SystemC
- ArchC

Cycle Accurate Model

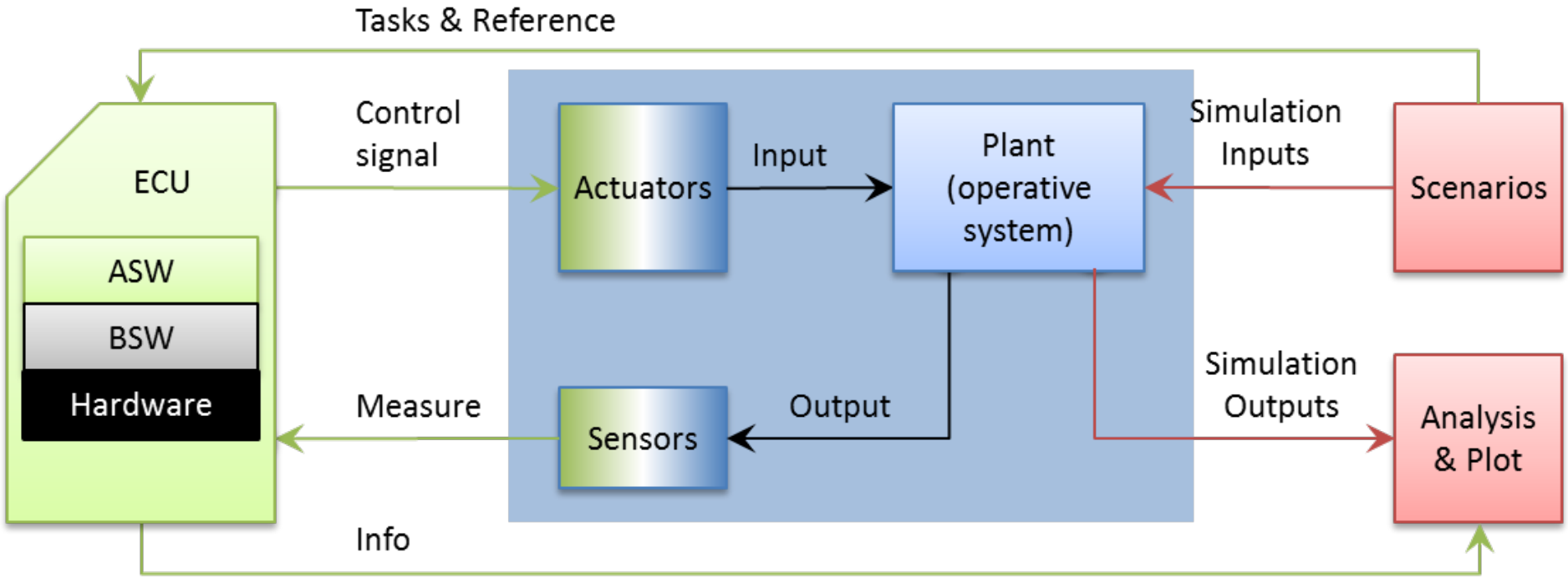
Accurate Timing
- SystemC
- VHDL
- Verilog
- AMS

SIMULATION WITHIN WORKFLOW





VIRTUAL TESTBED OF CONTROL LOOP



MODELING TRADEOFFS

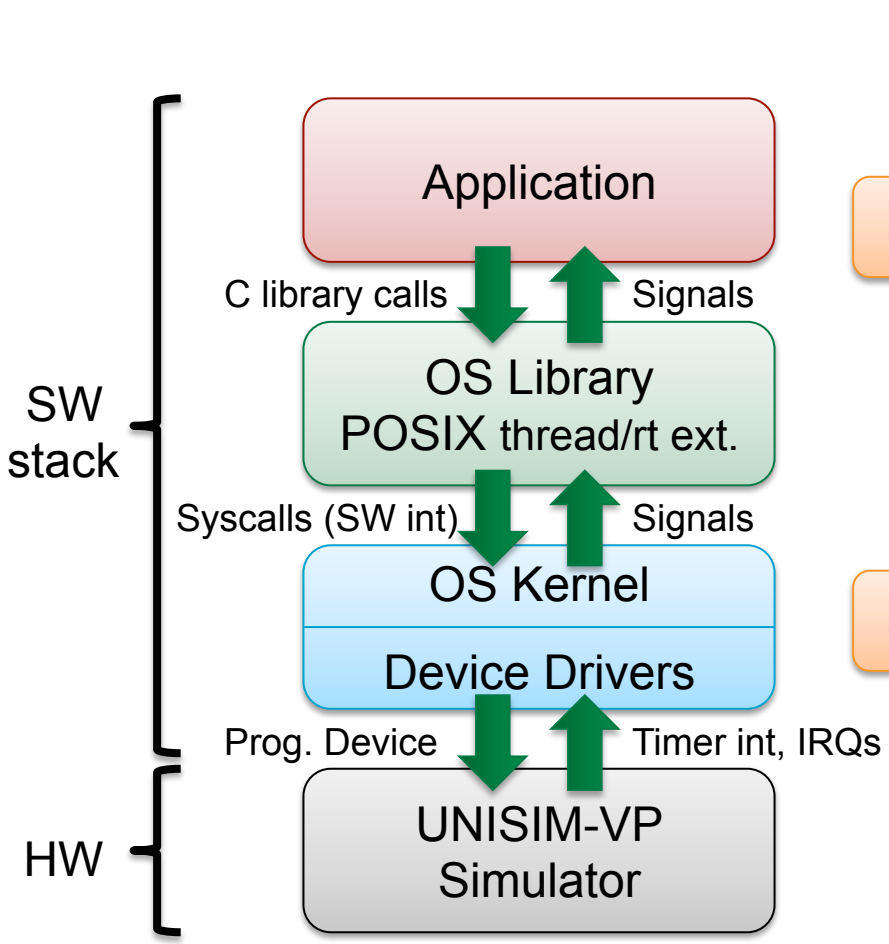
Design/Decision criterion

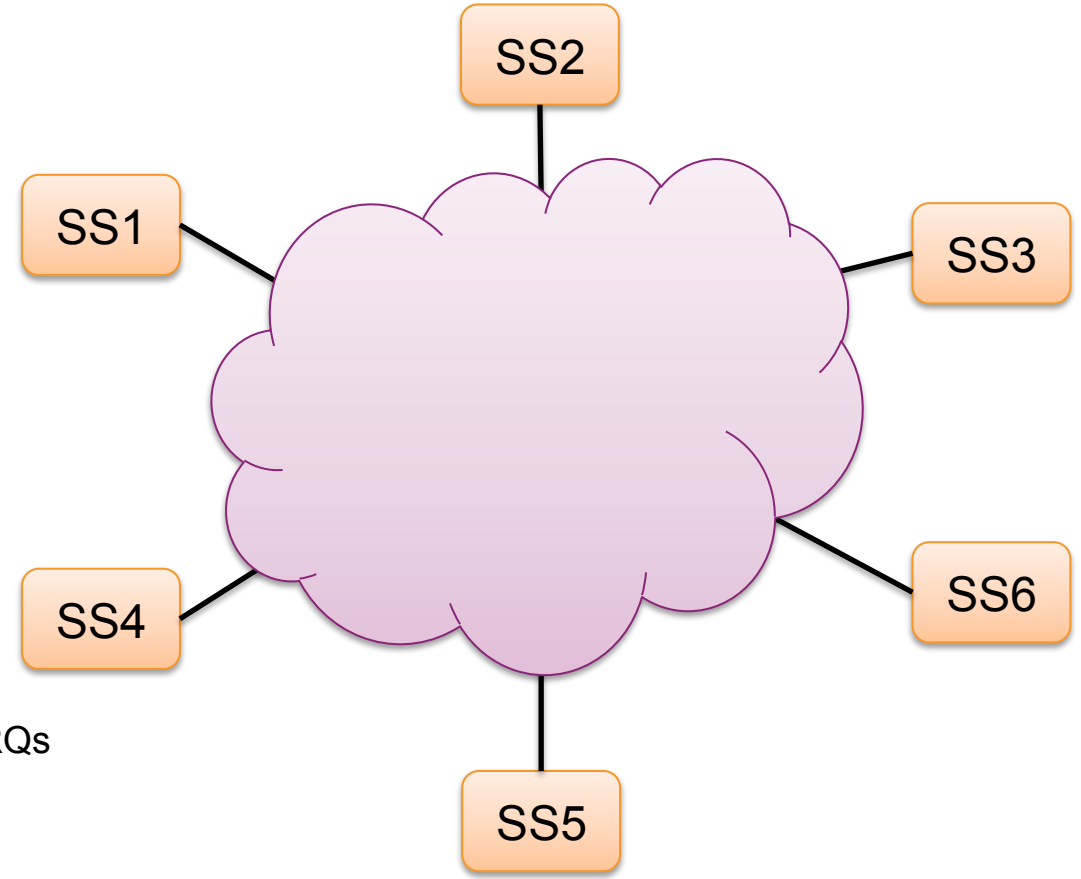
- **Level of detail/Precision/Representativeness**
- **Flexibility**
- **Speed**
- **Development cost**
- **Maintenance cost**

Impacts/Implications of modeling/technological choices

- **Speed impacts:**
  - Amount of tests
  - Quality of product because time budget for testing is limited
- **Low Level of Detail implies:**
  - High flexibility, high speed, low cost, low maintenance cost
  - But are key characteristics still captured? Is behavior still simulated?
  - Fortunately substitutes excel sheets by fast architectural exploration
- **High Level of Detail implies:**
  - high cost & maintenance cost
  - low flexibility
  - low speed

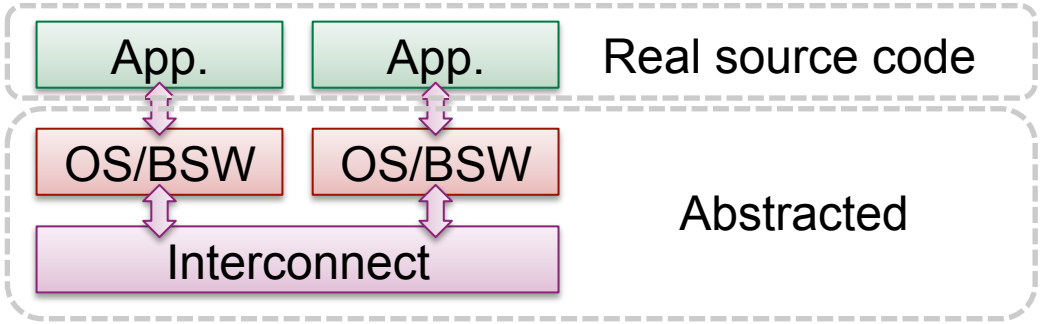
SIMULATION SCOPE



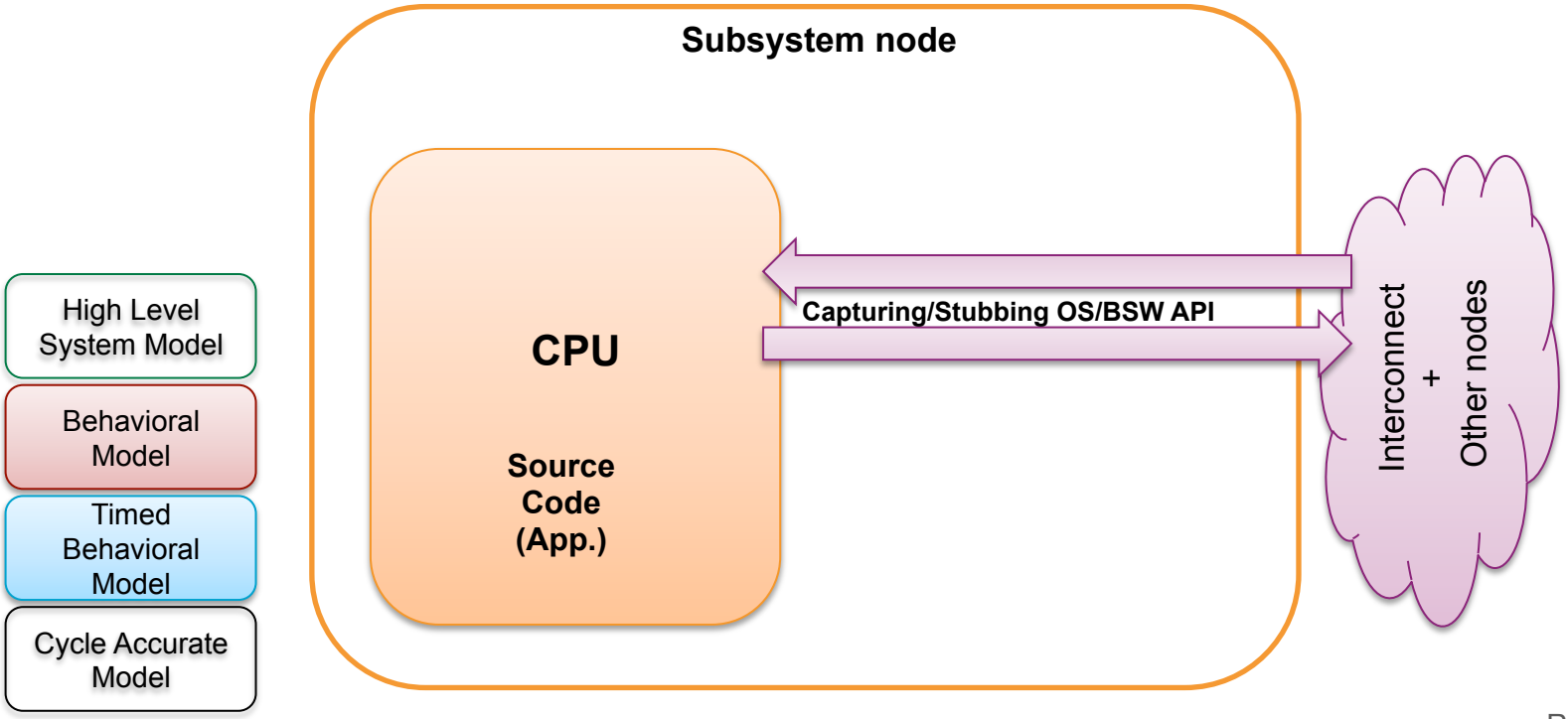


SIMULATION SCOPE – SIM2

User level:
Application source code



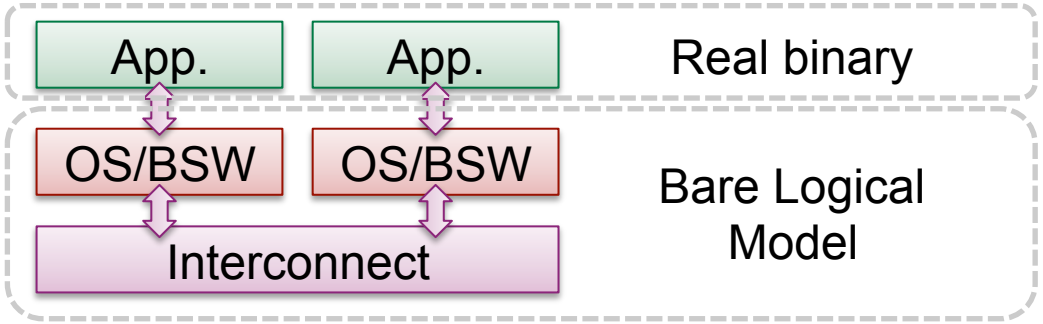
- Requires compiling target application using host compiler

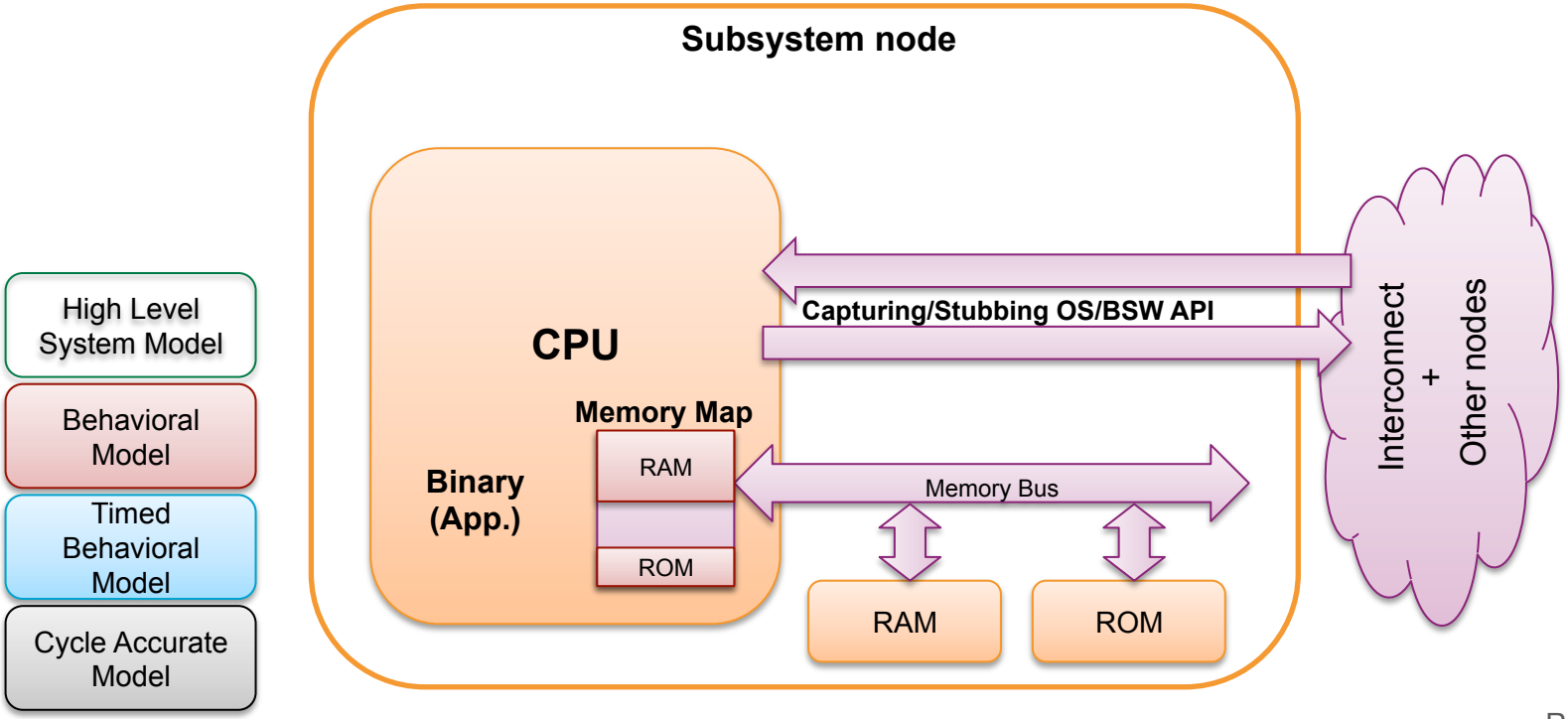


SIMULATION SCOPE – SIM3

User Level: Application Binary

- Requires an instruction set simulator



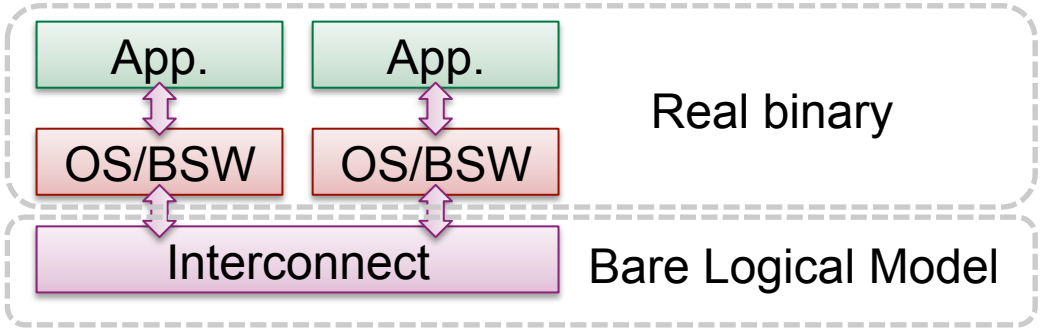


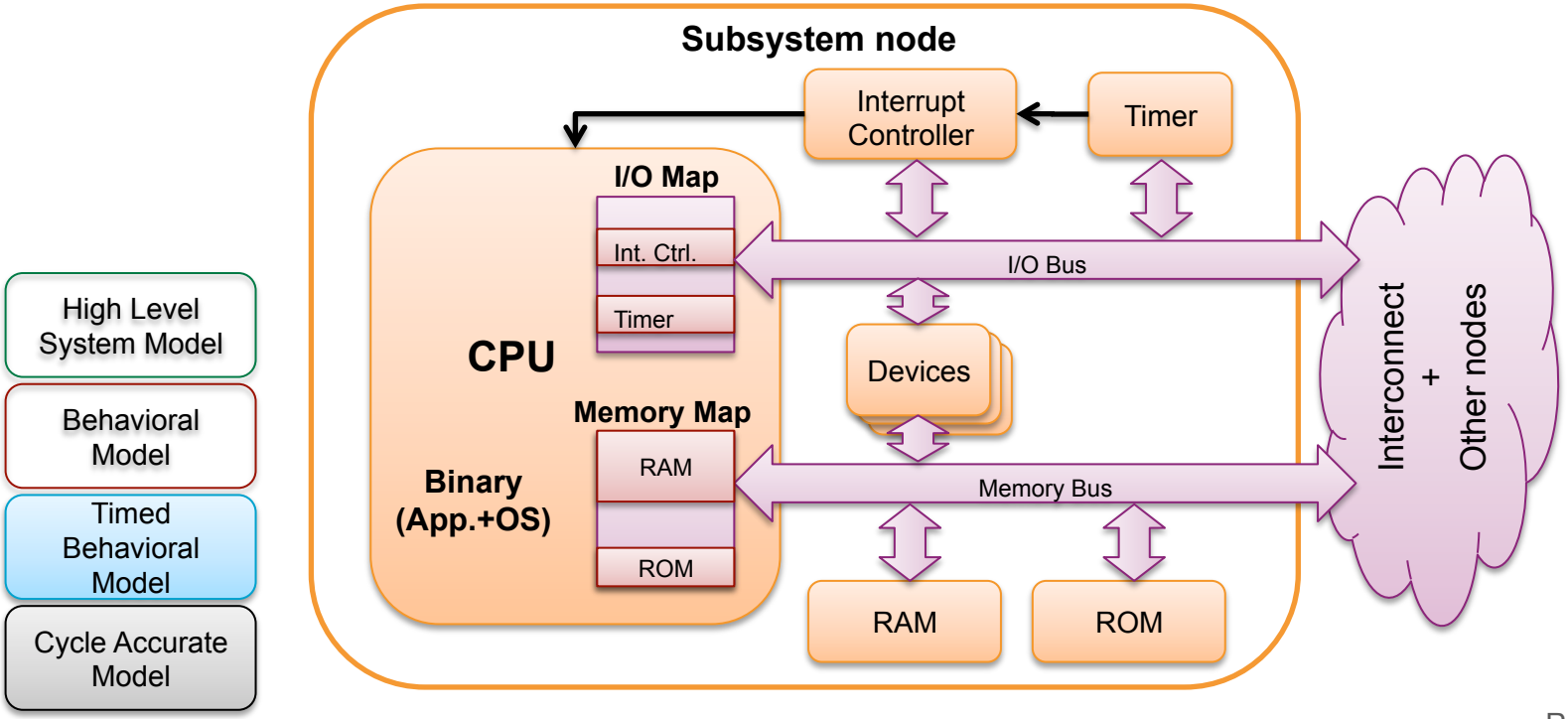
SIMULATION SCOPE – SIM4

Full system:

Application + OS binary

- Requires an instruction set simulator
- Requires simulation of peripherals



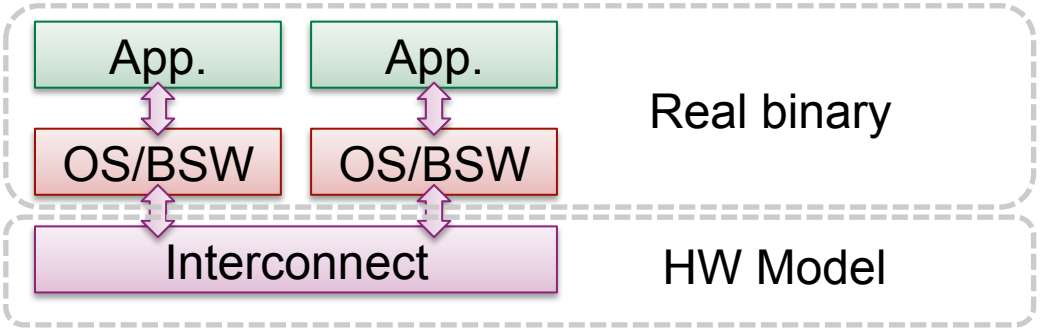


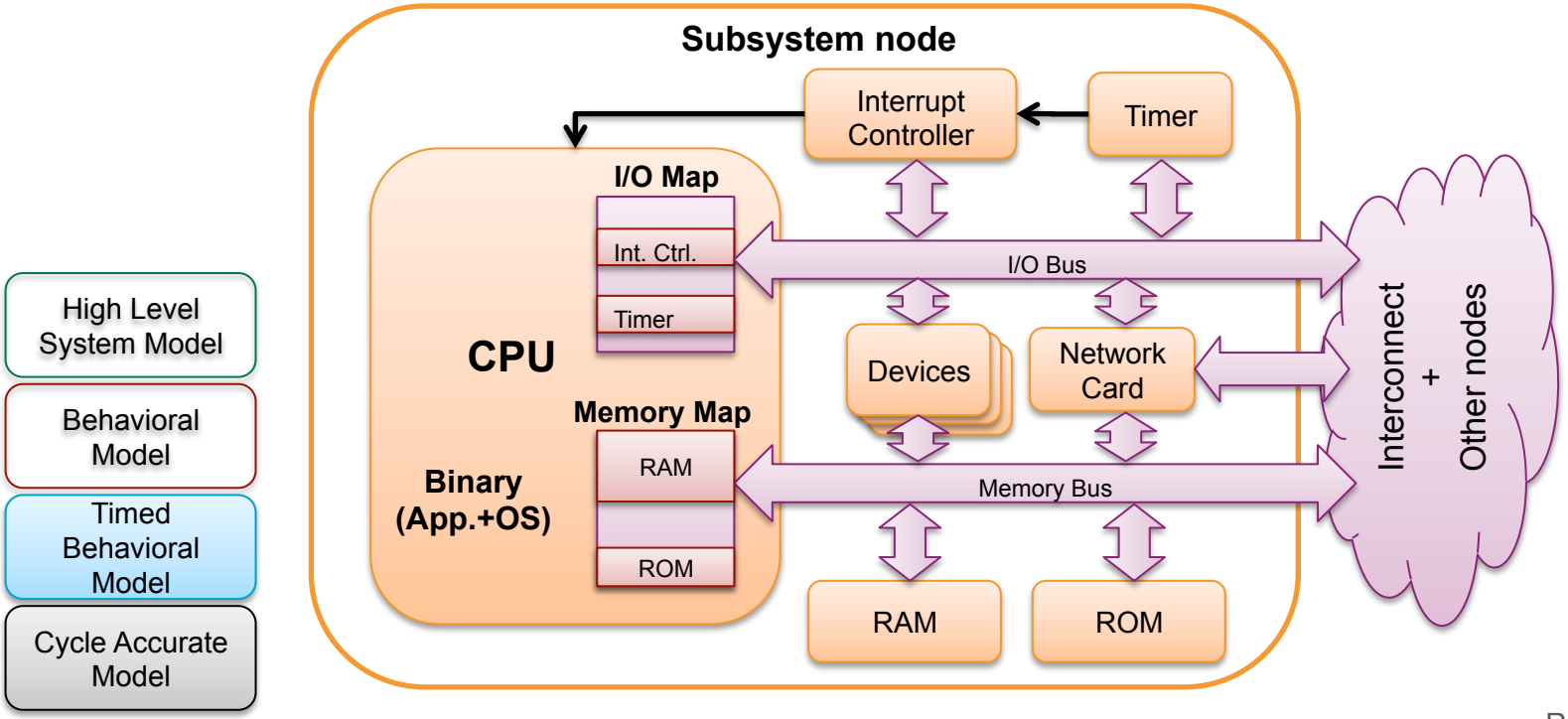
SIMULATION SCOPE – SIM5

Full system of system:

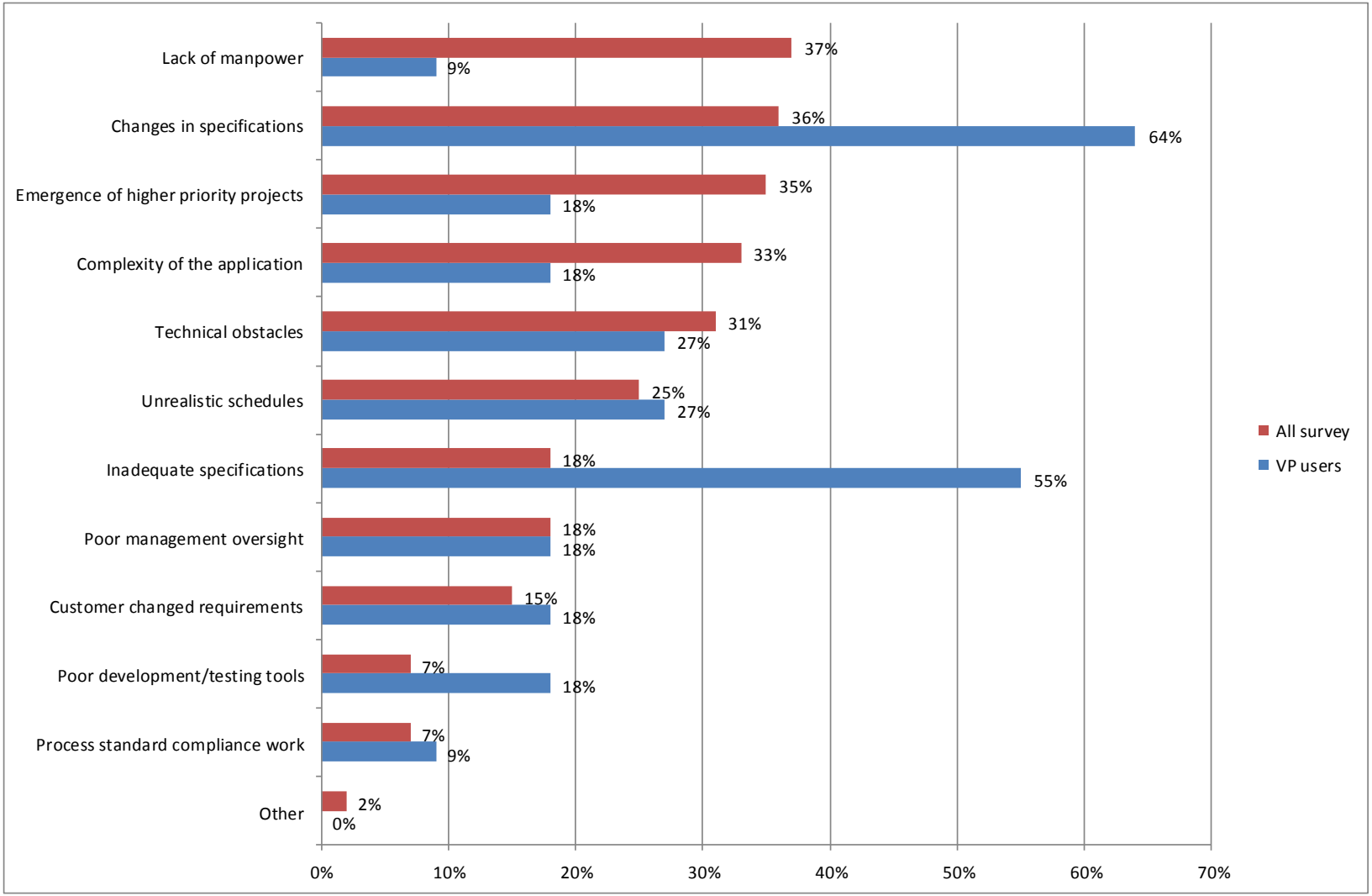
Application + OS binary

- Requires an instruction set simulator
- Requires simulation of peripherals
- Requires simulation of network adapters

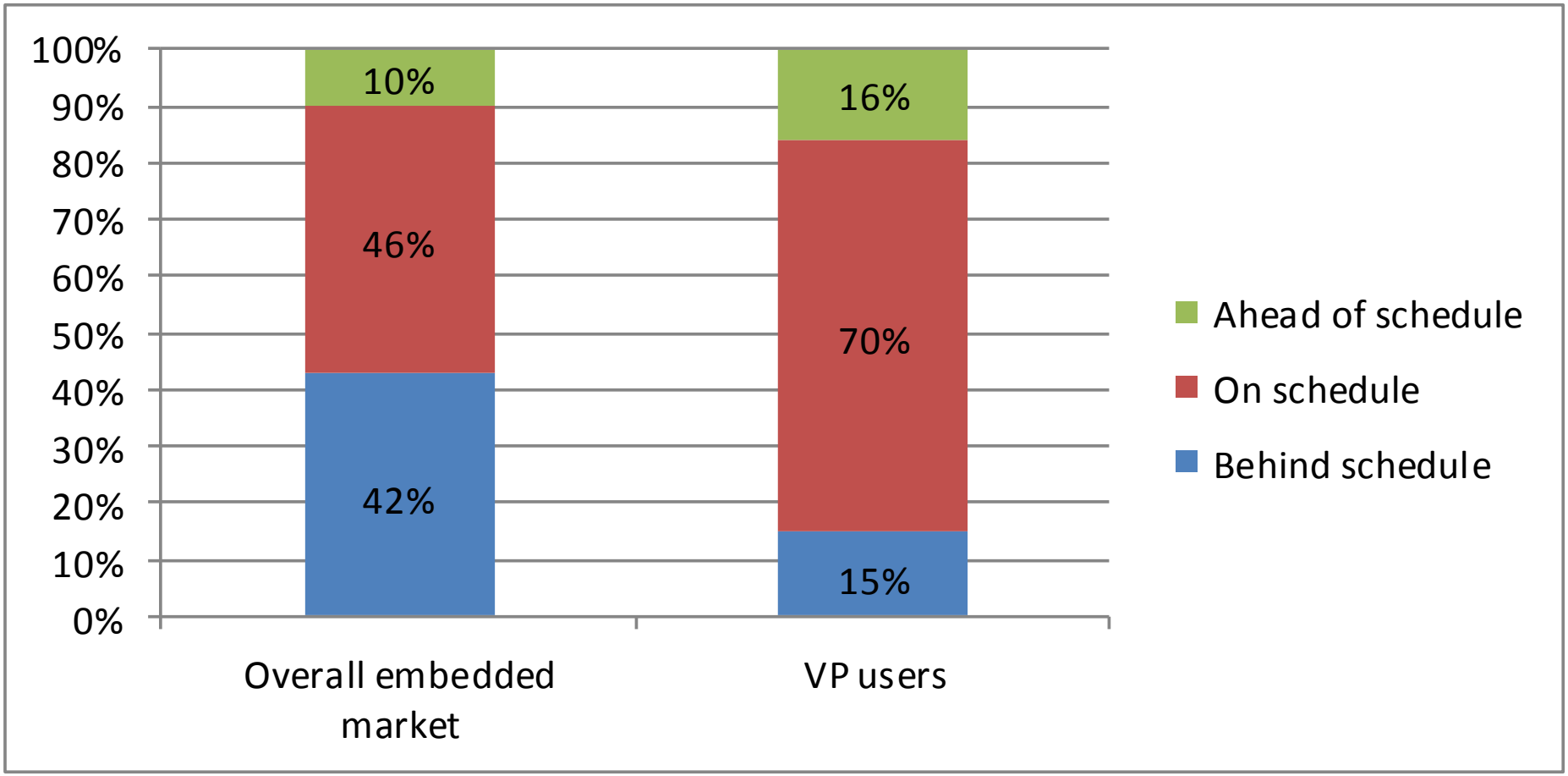




REASONS FOR DELAYS IN PROJECT SCHEDULE



COMPARISON OF OVERALL MARKET AND VIRTUAL PROTOTYPING SOLUTION (VPS) USERS



COMPETITIVE ADVANTAGES

- **Cheaper and Simplified deployment**
  - Less logistical problems (no physical constraints, no time-sharing on the board)
  - Easier injection of scenarios (nominal, faults)
  - Easier and extended means for system observation (traces)
- **Design, share and reuse**
  - Design space exploration
  - Golden/Reference model for HW/SW architects
  - Anticipated integration problems detection
- **Early System Validation**
  - Global validation of system at model level
  - Multi-level co-simulation {Matlab Simulink, Statemate Stateflow, VHDL-AMS, microcontrollers UNISIM-VP}
- **Automation of tests**
  - Shorter software updates to software validation cycles
  - Less hardware manipulations: Software engineer can spend time to increase quality and validation, not manipulation

WHAT IS BLOCKING ?

- **Current offers are not adapted to embedded systems integrators**
  - Target the semiconductor world (hardware prototyping and verification)
  - Few instrumentation capabilities for SW verification
  - Limited interoperability (models and tools)
  - Few catalogs / suppliers
- **Even if the scope is limited, there are still problems**
  - Development time and high cost
  - Difficulties to support in-house maintenance and upgrades of VP
  - Low ROI when product life cycle is short
  - Early availability of VP to maximize ROI
  - Unavailability of skilled manpower
- **No open-source solution that guarantees long term support to industrial**

WHAT WE SUGGEST

- **Creating a virtualization ecosystem suitable for system integrators and SMEs**
- **Sharing of development costs**
- **A participatory academic/industrial consortium ?**
  - To benefit to all stakeholders in the value chain
  - Reduce development costs of virtual platforms
  - Increase the availability of VPs
  - Influence the market of VPs
  - Will enable more R&D activities using/around virtual platforms

list
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QUESTIONS ?