Requirements, goals, and tasks of

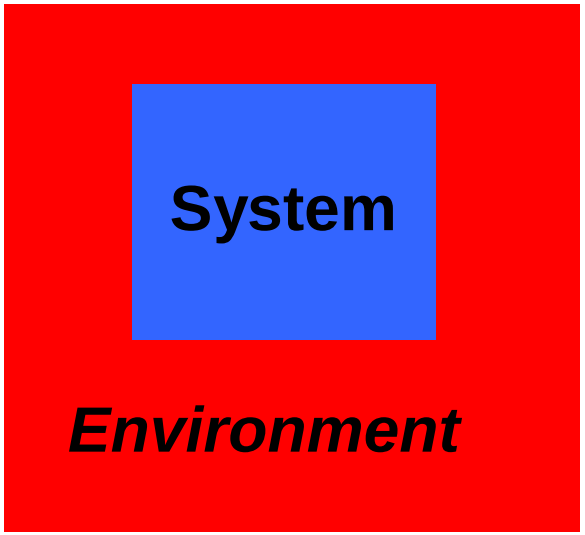
MSR Working Group

VHDL-AMS

Relationship between automotive manufacturer and supplier

- ***manufacturers** define system requirements and environment*

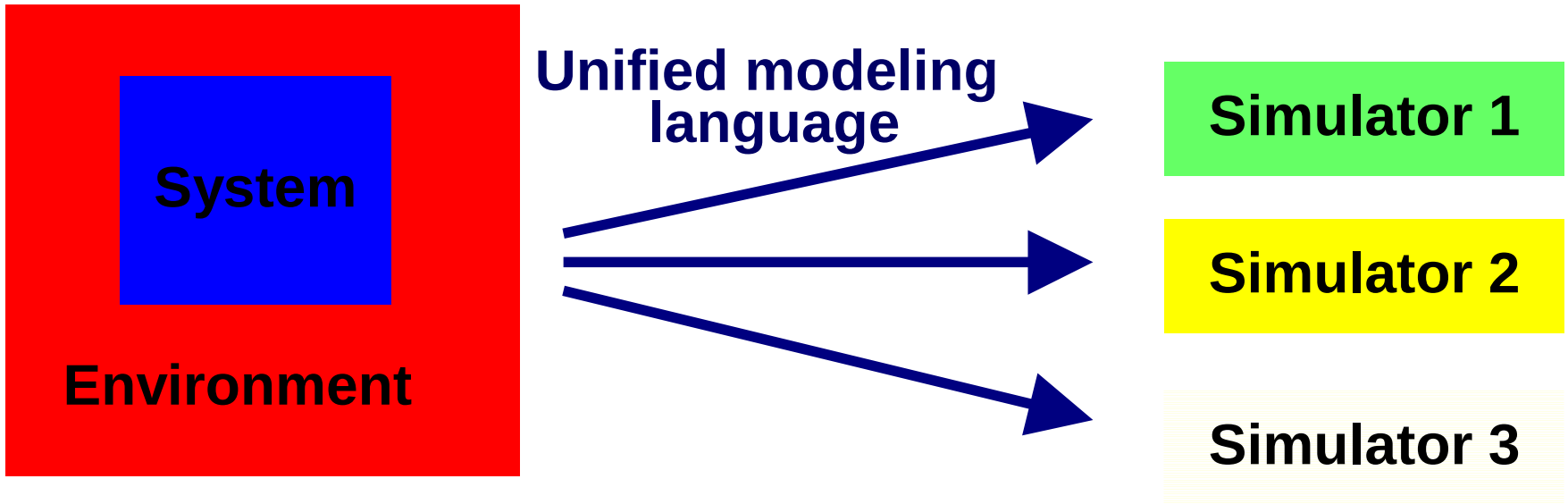
- ***suppliers** are responsible for system development (thermo control, ABS...)*



➔ *good cooperation between manufacturer and suppliers results in short and efficient development cycles*

Motivation

- *System design requires models for adaptation and simulation of system + environment*
- *Seamless design flow requires modeling language usable on all simulators to save cost for model development and tool purchase*



Founding of MSR-Working Group VHDL-AMS

- ***study about the usability of VHDL-AMS to describe the behavior of controller and plants in automotive applications (Dr. Ingrid Bausch-Gall, 1994)***

  ➔VHDL-AMS is suitable

- ***MSR defined VHDL-AMS as model exchange format***
- ***further activities have been stopped until first VHDL-AMS simulator would have been available***
- ***Adoption of VHDL-AMS as IEEE-Standard 1076.1 (March, 1999)***
- ***MSR Working Group VHDL-AMS has been founded in January 2000***

VHDL-AMS Working Group Partners

Audi AG

BMW AG

DaimlerChrysler AG

Hella KG

Porsche AG

Robert Bosch GmbH

Siemens AG

Volkswagen AG

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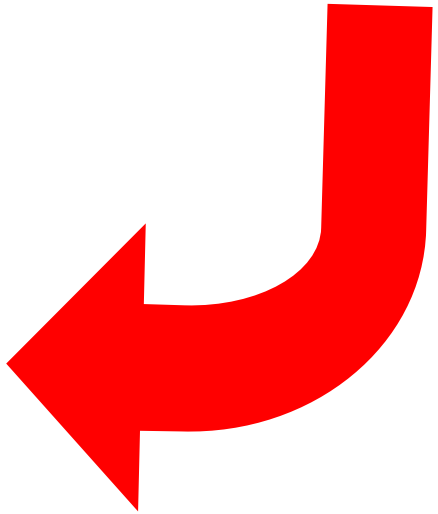
Web-Page: **http://www.msr-bg.org**

Goals of Working Group VHDL-AMS

- *Easy exchange of models between supplier and manufacturer*
- *Model compatibility between different simulators*

- *Development of a common model pool*
- *Building up cooperation with simulator companies*
- *VHDL-AMS as unified model exchange format*
- *Adaptation of VHDL-AMS for automotive applications*



Tasks

VHDL-AMS, Standard IEEE 1076.1

- ***VHDL is IEEE 1076 (VHSIC Hardware Description Language)***
- ***VHDL-AMS is extension for Analog and Mixed Signals***
- ***VHDL-AMS has means to describe:***
  - ***HW/SW systems***
  - ***physical plants (e.g. hydraulic valve, gear box)***
- ***Powerful tools are available***

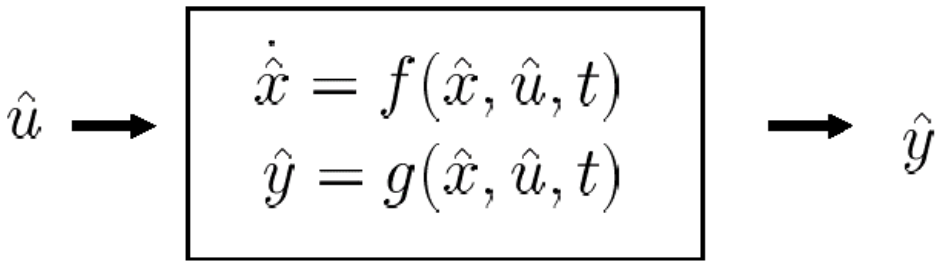
for more information: http://www.eda.org./vhdl-ams

VHDL-AMS Modeling Concepts

- ***Structural decomposition***
- ***Communication***
    - ***signal flow***
    - ***power bond***
- ***Analog***
    - ***Differential algebraic equations***
    - ***transfer functions***
- ***Event driven (time discrete)***
    - ***event driven communicating parallel processes***
- ***Analog - discrete (event driven) interaction***
    - ***threshold crossing***
    - ***break***

VHDL-AMS Subset for Real-Time (VHDL-AMS-RT)

Real-Time demands require



- ***block diagram modeling***
- ***no algebraic loops***
- ***predictable number of delta cycles***

Example of Real-Time Subset (VHDL-AMS-RT)

```
ARCHITECTURE  behaviour OF bouncing_ball IS
BEGIN
    pos'dot == vel;  -- announce discontinuity and reset velocity value
    BREAK vel => -vel WHEN NOT pos'above( 0.0);
    IF vel > 0.0 USE
      vel'dot == -g/m - vel** 2* air_res;
    else
      vel'dot == -g/m + vel** 2* air_res;
    END use;
END ARCHITECTURE;
```

Advantages of unified modeling with VHDL-AMS

- ***Readable documentation of discontinuous behavior***
- ***Facilitates model exchange***
- ***Facilitates model reuse***
- ***Facilitates tool substitution***
- ***Reduces training cost***
- ***Gives chance for niche products with solutions for partial problems***
- ***Competition will strengthen capabilities of the tools and will (hopefully) reduce tool cost***
- ***Modeling concepts have proper semantics***

Tasks of Working Group VHDL-AMS

- ***Development of model examples***
  - ***implementation of models in VHDL-AMS***
  - ***exchange of models including test bench and documentation***
  - ***exchange of experiences concerning simulation results of different tools (stability, computation time etc.)***
- ***Evaluation of tools for converting SPICE, MAST, … to VHDL-AMS***
- ***Definition of a subset of VHDL-AMS for Real-time applications (VHDL-AMS-RT) to model plants tool independently***
- ***Cooperation with tool developer (Avant!, ETAS, Mathworks, Mentor Graphics, …)***
- ***Building of an MSR library and package***