AVACS*
Automatic Verification and Analysis of Complex Systems

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*www.avacs.org
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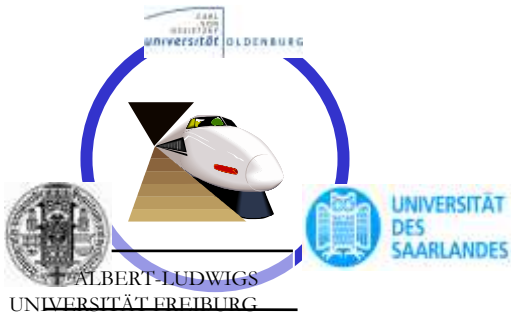
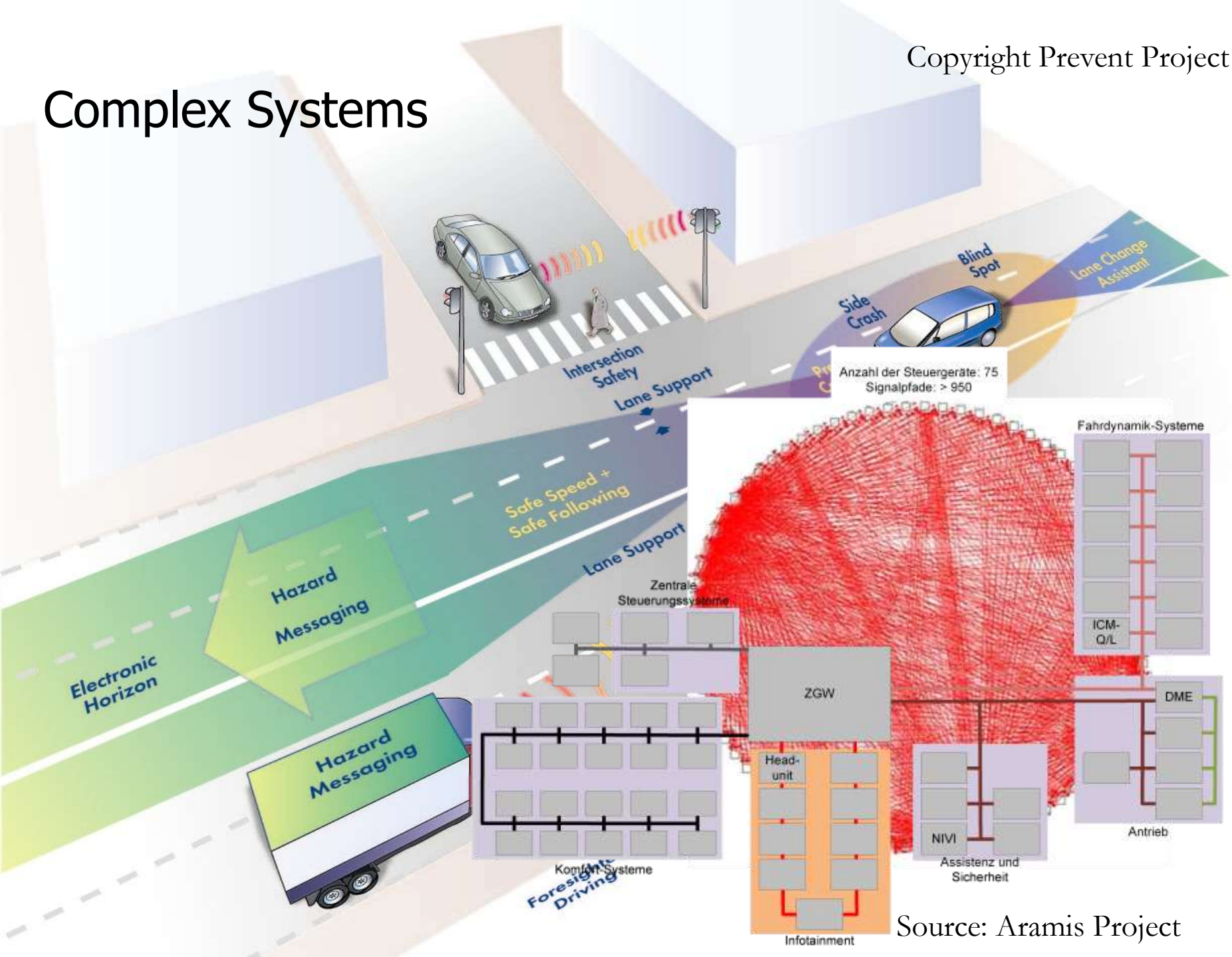


Complex Systems



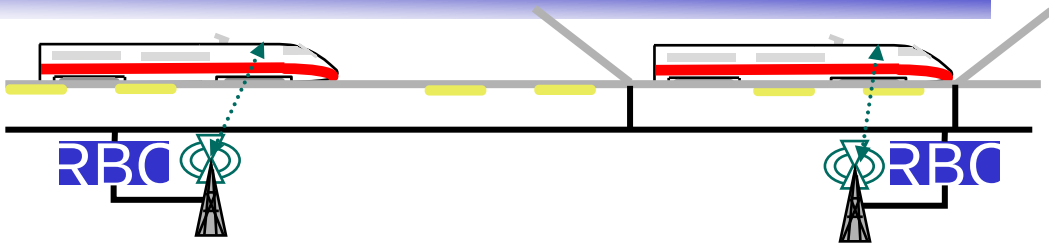
Source: Aramis Project

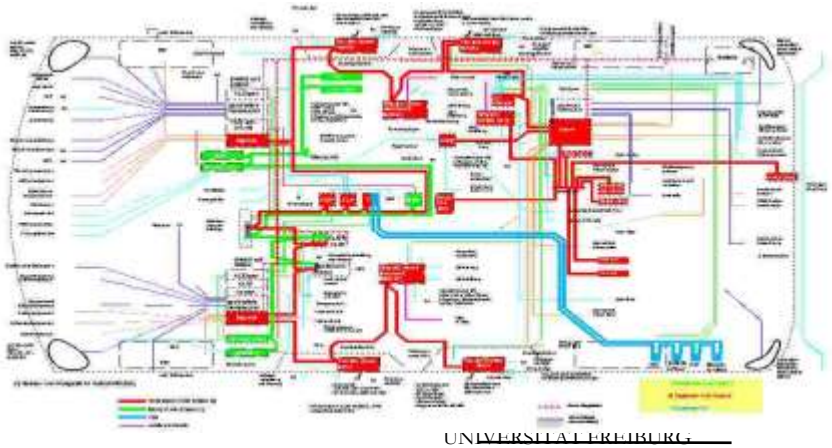
The Application Context

- Complex Embedded Systems are key enablers for safe flight and safe ground transportation
- Exponential growth in system complexity is a challenge for quality assurance
- AVACS contributes to meeting forthcoming requirements of pertinent safety standards on use of formal analysis methods
- Methods and tools cover large class of "cyber physical systems" seen to be highly relevant for addressing societal challenges (health, security, green mobility, ...)

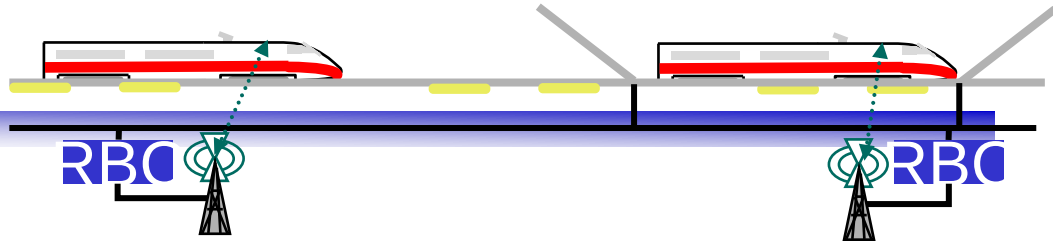
Automatic Verification of Complex Systems: Models

- Extremely Heterogeneous Model Space
  - Systems of Systems
  - ....
  - Cycle Accurate models of HW
- Comprehensive and Scalable Verification requires
  - Relating Models at different Design Levels
  - Identification of typical model characteristic



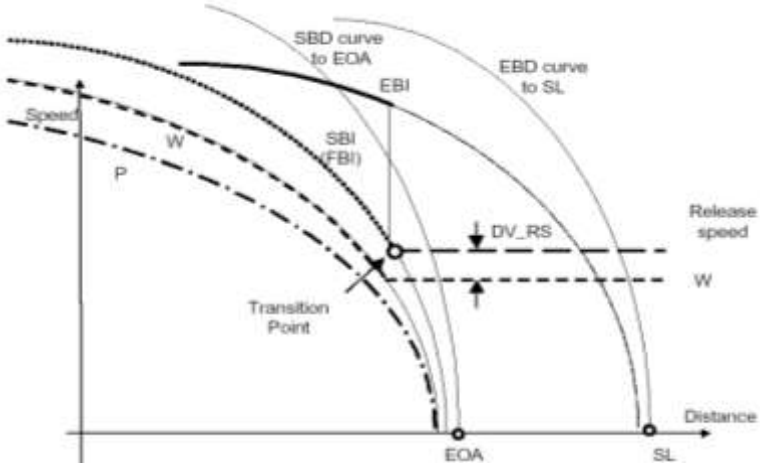


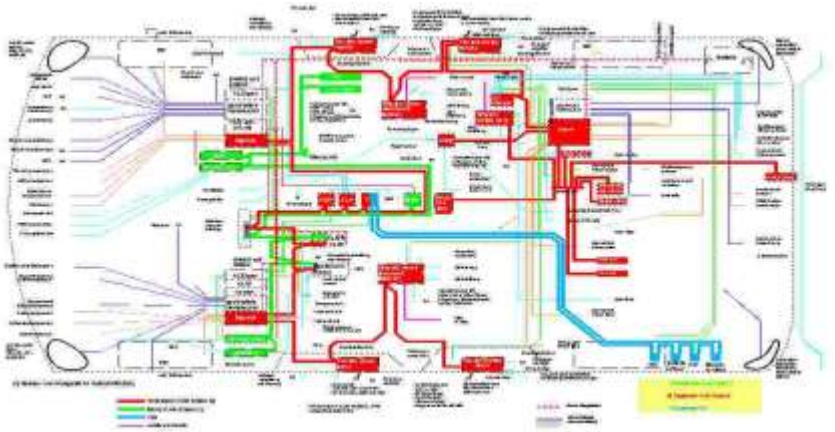
Requirements

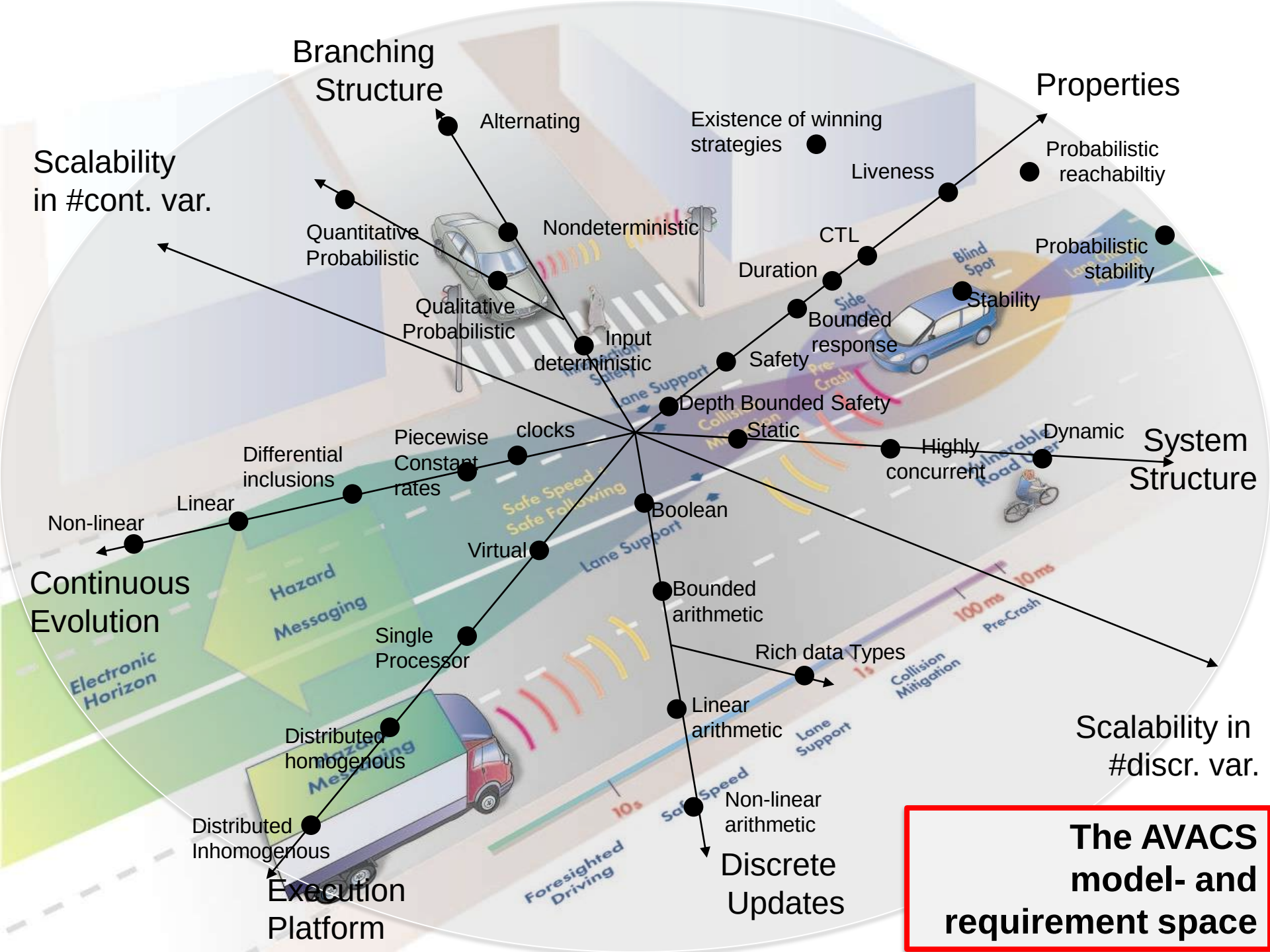


Heterogeneous Requirement Space

- Reliability
  - „probability of total a/c failure is less than 10^{-9} per flight hour“
- Coordination
  - “Crossing will grant access if secured”
- Local Control
  - “The train will never run faster than permitted speed”
  - “enforce brake profile”
- Real-Time
  - “When receiving unconditional emergency stop message the trair shall be tripped within 5 msec”
  - “Brake curve control task activated every 30 msecs”







The AVACS model- and requirement space

The AVACS Vision

To Cover the Model- and Requirement Space of Complex Safety Critical Systems

with Automatic Verification Methods

Giving Mathematical Evidence of Compliance of Models

To Dependability, Coordination, Control and Real-Time Requirements

AVACS Competence Layers

Complex Systems

Embedded Transportation Applications

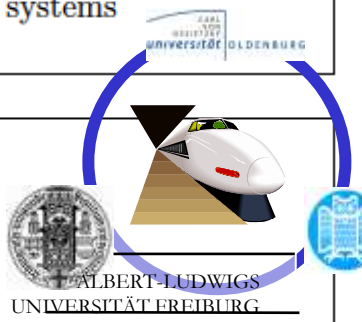
Models of Complex Systems

real-time – hybrid – distributed systems – system of systems

Combining V&A Technology

$(x_1 \wedge x_2 \wedge ...x_n$ for $s)$

$x_j \in$ V&A core technologies, $s \in$ systems



V&A Core Technologies

Abstraction – Decision Diagrams – Constraint Solving – Heuristic Search

Linear Programming – Model Checking – Lyapunov Method

Abstract Interpretation – SMT – Decision Procedures

Research Areas

R

Real-Time

H

Hybrid

S

Coarse Grain System Structure