

Year 2 Review
Brussels, February 12, 2010

Cluster

Achievements and Perspectives :

Modeling and Validation

Cluster Leaders:

Kim G. Larsen, Aalborg University

Susanne Graf, Verimag

Core Teams (Modeling & Validation)

- **Kim Larsen (Aalborg – Denmark)**
 - *Timed automata based models. Performance analysis and synthesis.*
- **Susanne Graf (VERIMAG – France)**
 - *Component-based design. Extra-functional properties..*
- **Tom Henzinger (IST - Austria)**
 - *Rich Interfaces. Quantitative properties and resources.*
- **Alain Girault (INRIA - France)**
 - *Design and modeling for reliability of safety-critical embedded systems.*
- **Martin Törngren (KTH - Sweden)**
 - *Integrated models and validation.*
- **Christoph Kirsch (Salzburg - Austria)**
 - *Timing and reliability modeling.*
- **Bengt Jonsson (Uppsala - Sweden)**
 - *Component-based mod. & ver.*
- **Wang Yi (Uppsala - Sweden)**
 - *Resource modeling and timing analysis.*
- **Joseph Sifakis (VERIMAG - France)**
 - *Component-based design. Structural verification*
- **Sébastien Gérard (CEA LIST - France);**
 - *Model-based engineering, standard modeling.*
- **Jozef Hooman (ESI - Netherlands);**
 - *Quantitative modeling and testing.*
- **Boudewijn R. Haverkort (ESI, Netherlands)**
 - *Scientific Director of the ESI*
- **Werner Damm (OFFIS - Germany);**
 - *Component-based design and semantic foundation.*
- **Alberto Sangiovanni-Vincentelli (Trento - Italy)**
 - *Platform-based design.*

Affiliated Teams

- Henrik Lönn, Volvo Technology
- Jacques Pulou, France Telecom
- Albert Benveniste, INRIA Rennes
- Roderick Bloem, TU Graz
- Roberto Passerone, Uni Trento
- Koos Rooda, TU Eindhoven
- Paul van den Hof, TU Delft
- Tiziaqna Villa, Uni. Verona,
- Pierre Wolper, CFV, Belgium
- Yiannis Papadopolis, Uni. of Hull
- Ahmed Bouajjani, LIAFA
- Stavros Tripakis, Cadence Research Lab.
- Jean-Francois Raskin, CVF, Belgium
- Joost-Pieter Katoen, Aachen
- Holger Hermanns, U. of Saarland
- Christel Baier, Dresden
- Patricia Bouyer, Nicolas Markey, Philippe Schnoebelen, LSV Cachan
- Wil van der Aalst, TU Eindhoven
- Frits Vaandrager, Radboud U. Nijmegen

+ several industrial partners
at national levels.

Industrial Needs for Research in the Area

- Underlying hardware and networking trends
 - system/network-on-chip, multicore, sensor nets, wireless, etc.
- Trend towards model-based design
 - interaction of different models of computation and communication
 - automation of property-preserving model transformations
- Trend towards standardization and componentization
 - interfaces critical for component reuse
 - beyond functional characteristics of components:
timing, memory, power, reliability, security, etc.
- Gap between best-effort and critical systems engineering
 - optimization/average case vs. constraint satisfaction/worst-case

High-Level Objectives

- Establish a coherent **mathematically sound family** of design flows spanning the areas of computer science, control, and hardware based on model- and component-based theories, methods, and tools:
 - **model-based**, to achieve portability
 - **component-based**, to achieve scalability
 - **analyzable** (deterministic, ..), to achieve predictability
- Requires a new scientific foundation
 - new **abstractions** for computing as a physical, imperfect act
 - from boolean correctness to **quantitative robustness** measures: failure rate, life time, input tolerance, etc.
- Impact on **safety critical industries** (aerospace, automotive) as well as **high volume systems** (professional systems, consumer electronics).

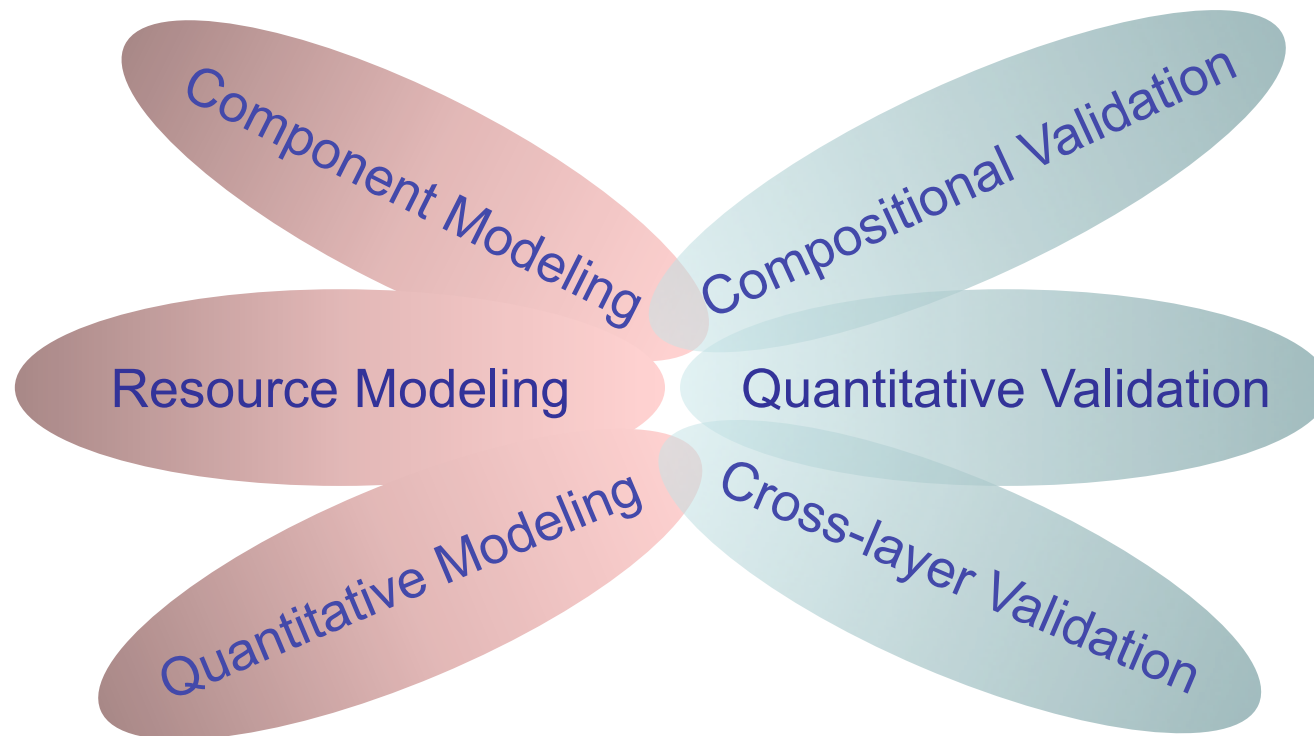
Overview of Cluster Activities

MODELING

Susanne Graf (VERIMAG)

VALIDATION

Kim G. Larsen (Aalborg)



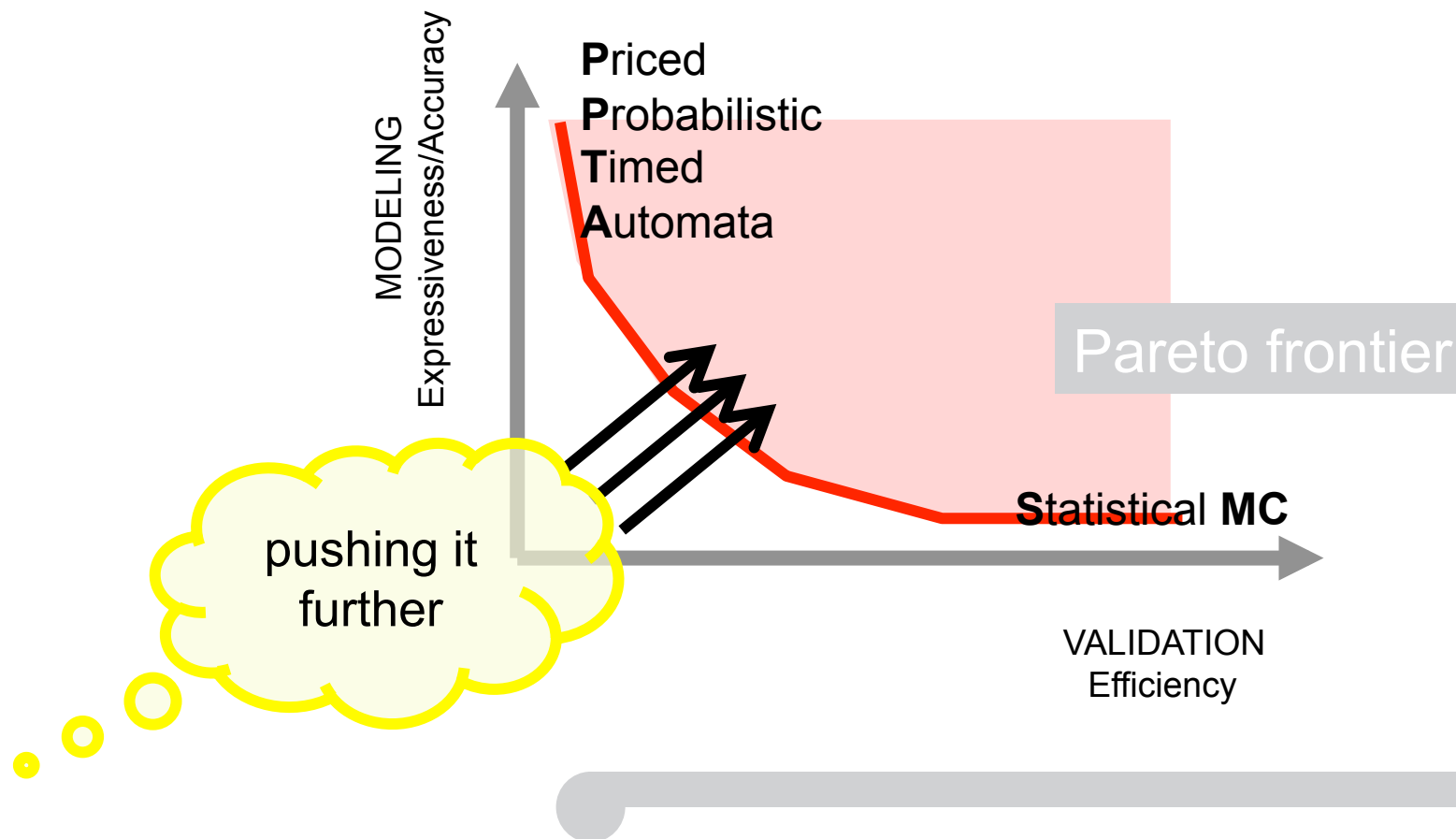
Overview of Cluster Activities

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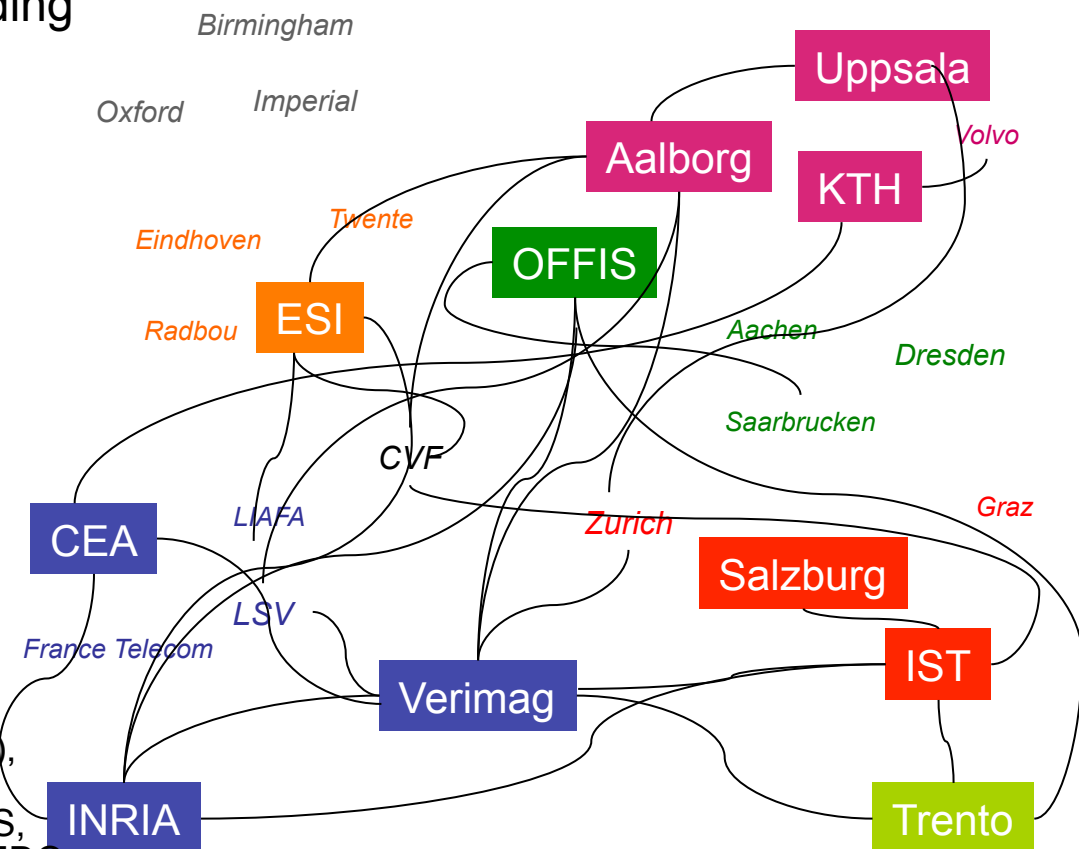
State of the Integration in Europe

- **Extensive collaboration** between partners of the cluster
- **Extensive collaboration** with leading research teams outside Europe.
- **Extensive interaction** with other communities
- **National Centers and projects**
 - CISS, ESI, ...
 - DaNES, DOTS, Testec, ICES, ...

- **FP7/ARTEMIS/ESF Projects**

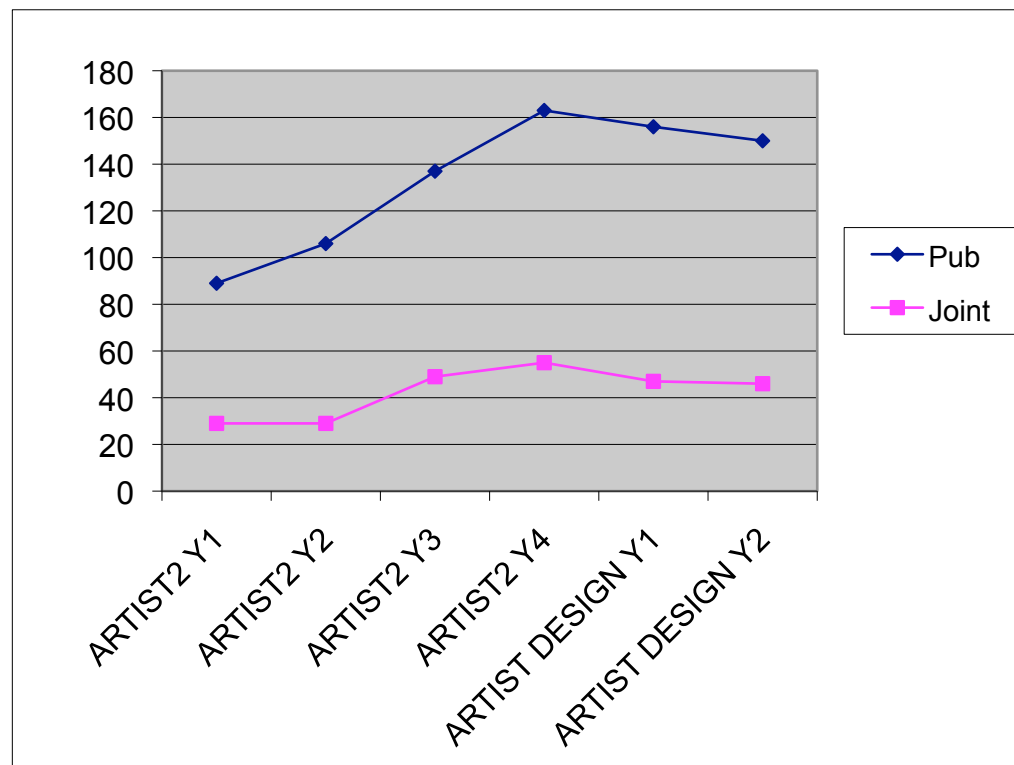
- Pro3D (STREP)
- SMECY (ARTEMIS)
- ACROSS (ARTEMIS)
- SYSMODEL (ARTEMIS)
- VERDE (ITEA)
- RECOMB (ARTEMIS)

and existing ones: QUASIMODO (STREP), MULTIFORM (STREP), COMBEST (STREP), GASICS, CESAR, GENESYS, ADAMS, ATTEST2, SPEEDS (IP), CREDO, PROSYD, ...



Building Excellence

- **150 publications**
(Y1 156)
- **46 joint publications**
(Y1 47)
- **2 Best Paper Awards**
RTSS09, MEMICS09
- High level of **dissemination**
through PhD schools and
industrial seminars (>40 keynote
presentations).
- **Strong impact**
on a number of important
international **conferences**
(CAV, TACAS, FORMATS,
EMSOF, CONCUR, ETAPS,
HSCC,..)
- **Transfer to industry**
long-term collaboration performed
by individual partners.
National centers and laboratories.



Building Excellence

Conferences and workshops organized

- ACM SIGPLAN/SIGBED Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES 2009)
- ACM/IEEE 12th Int. Conf. on Model Driven Engineering Languages and Systems – 2009
- 11th Int. Conference on Formal Engineering Methods - 2009
- 9th Int. Workshop on Runtime Verification – with CAV 2009
- 2nd Int. Workshop on Verification and Validation of Planning and Scheduling Systems – with CAV 2009
- **GASICS Worksh. on Games for Design, Verification & Synthesis – CAV 2009**
- 2nd Int. workshop on Model Based Architecting and Construction of Embedded Systems (ACES^{MB}) with MODELS 2009
- **MLQA, Models and Logics for Quantitative Analysis – with ETAPS 2009**
- QUANTLOG Workshop on Quantitative Logics – with ICALP 2009
- ArtistDesign Workshop on Embedded Systems in Healthcare 2009
- **2nd IEEE Int. workshop UML and Formal Methods – 2009**
- 4th Int. workshop on UML and AADL – 2009
- **Dagstuhl Seminar "Quantitative Models – Expressiveness and Analysis" - 2010**
- **Dagstuhl Seminar "Design and Validation of Embedded Systems" - 2009**
- EJCP (Ecole Jeunes Chercheurs en Programmation) – 2009
- **EMSOFT'09**
- **CAV'09**

Achievements Y2

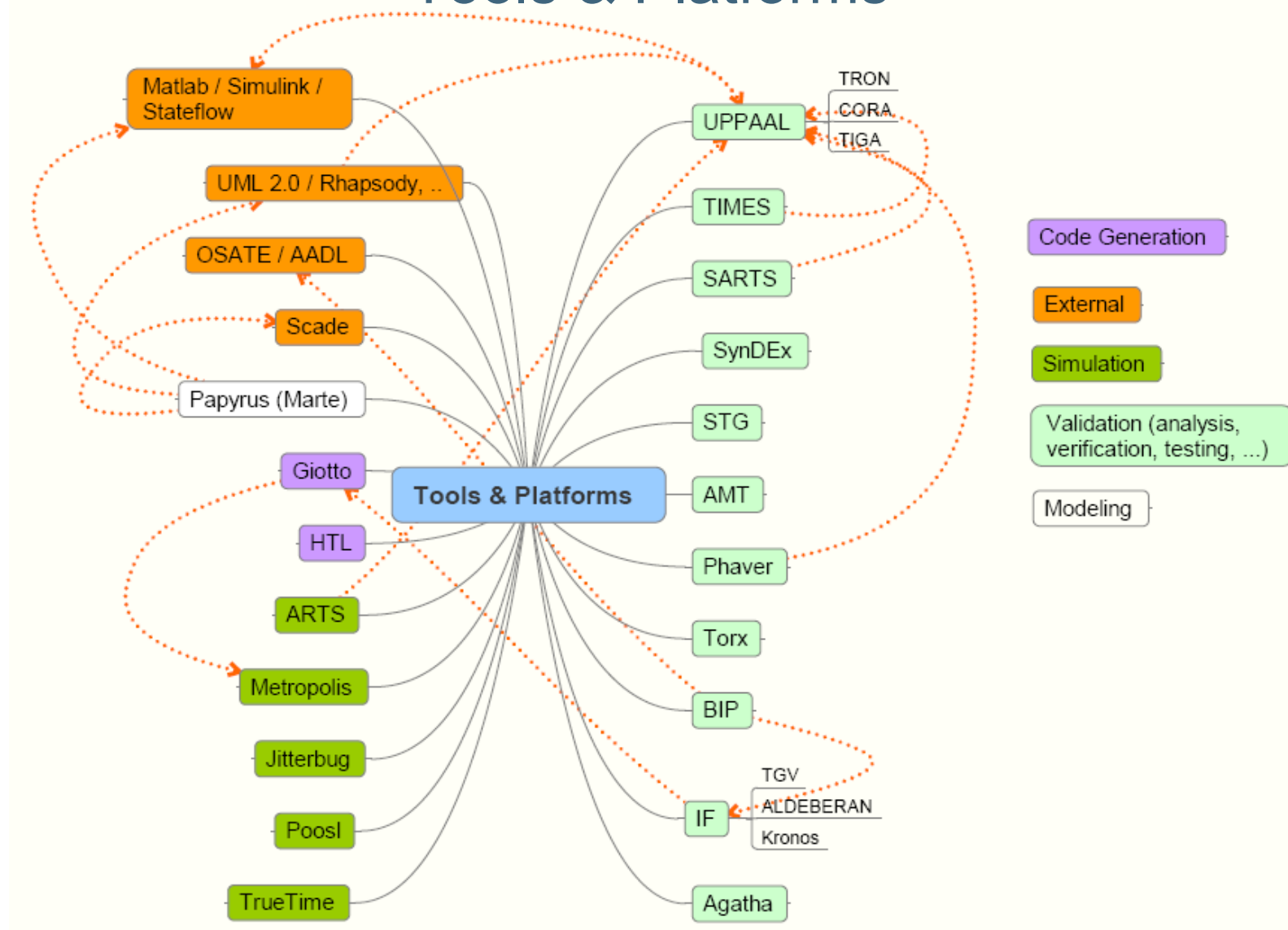
Modeling

- Component Modeling
 - Component-based design frameworks
 - Interfaces / contracts
 - Model transformations
 - Design platforms
- Resource Modeling
 - Middleware modeling
 - Transactional memories
 - Design-space exploration
 - Scheduling with multi-core
- Quantitative Modeling
 - Design frameworks for quantitative modeling
 - Quantitative models for energy efficiency
 - Modeling for robustness

Validation

- Compositional Validation
 - Time and stochastic models
 - Symbolic execution of heterogeneous systems
 - Safety, robustness and failure analysis
- Quantitative Validation
 - Schedulability and WCET for multiprocessor platforms
 - Tools for PTA
 - Extendable tools for hybrid systems
 - Techniques for Energy TA
- Cross-layer Validation
 - Controller synthesis from rich game models
 - Refinement checking
 - Temporal Logic, LSC -> Deterministic TA
 - Testing & diagnosability

Tools & Platforms



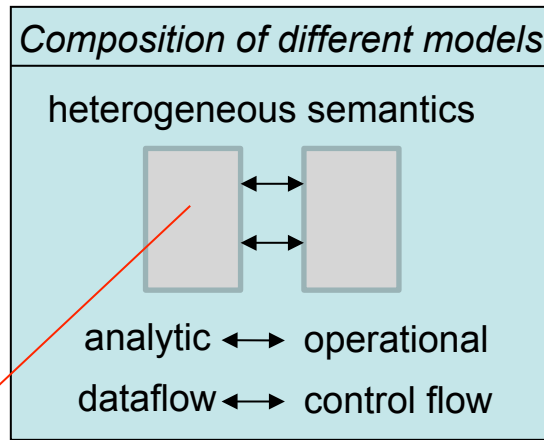


Scientific Highlight: Component-Based Design

COMBEST & SPEEDS

New Theory:

- encompassing heterogeneity
 - diff. interaction & computation models
 - analytical & operational models
- design for constructivity



Models of computation

LTTA	RTC	TA
BIP	LUSTRE	

Composing features

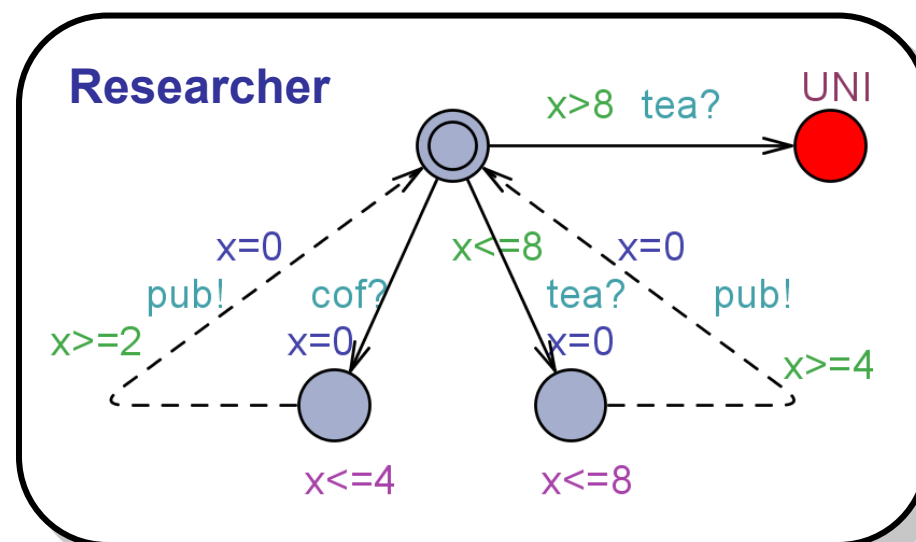
Contracts and interfaces
Fault analysis&robustness
Schedulability & hierarchy

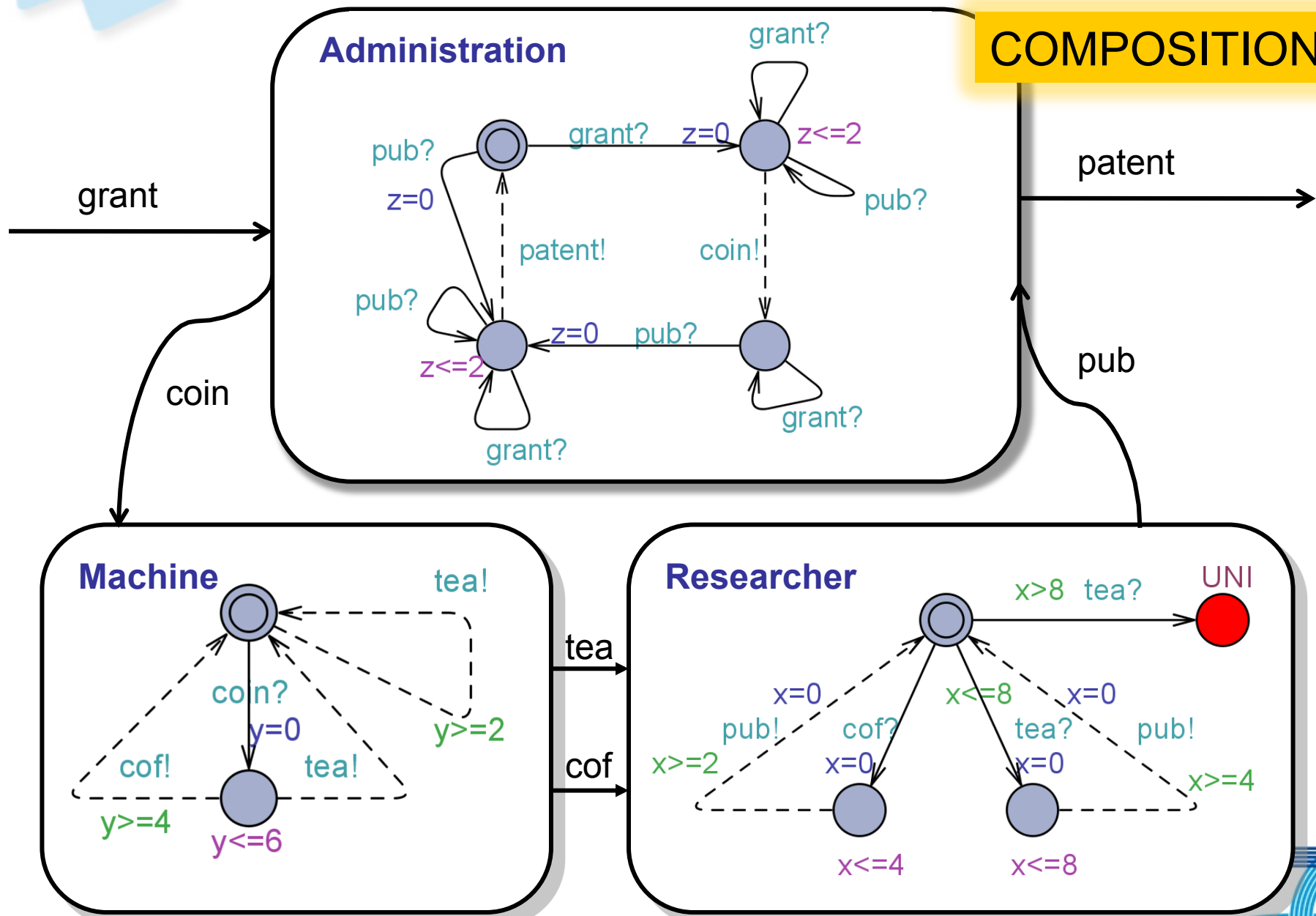
Theory

ARTIST DESIGN Partners:
 VERIMAG, TUBS, EPFL,
 ETHZ, TRENTO, INRIA,
 OFFIS, (PARADES)

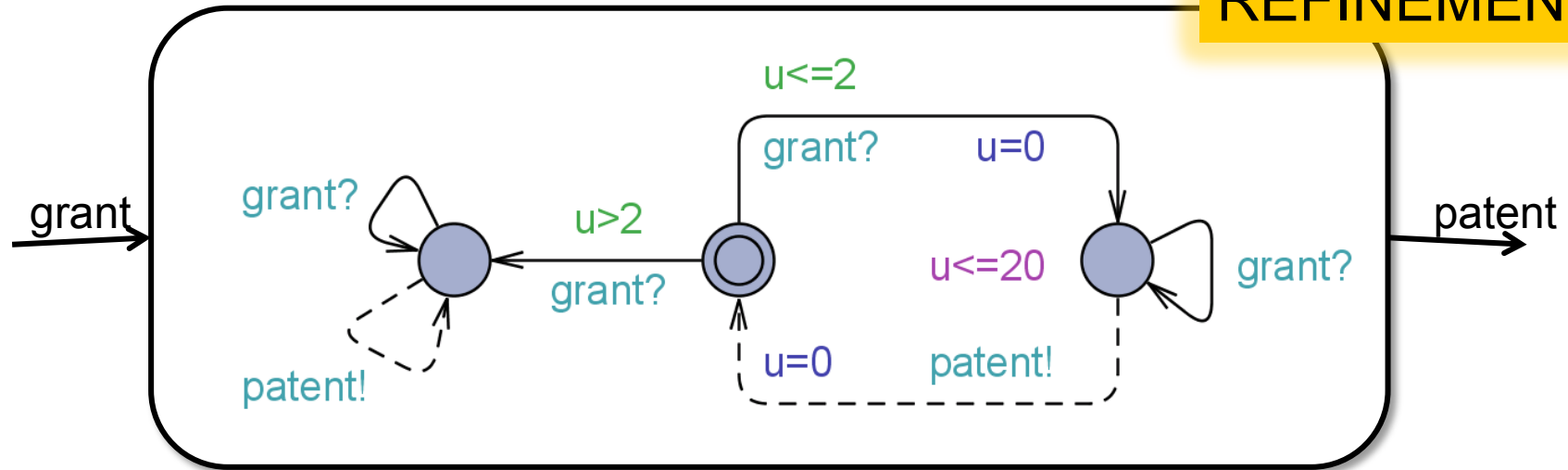
AALBORG

Env **Assumption**
Comp **Guarantees**

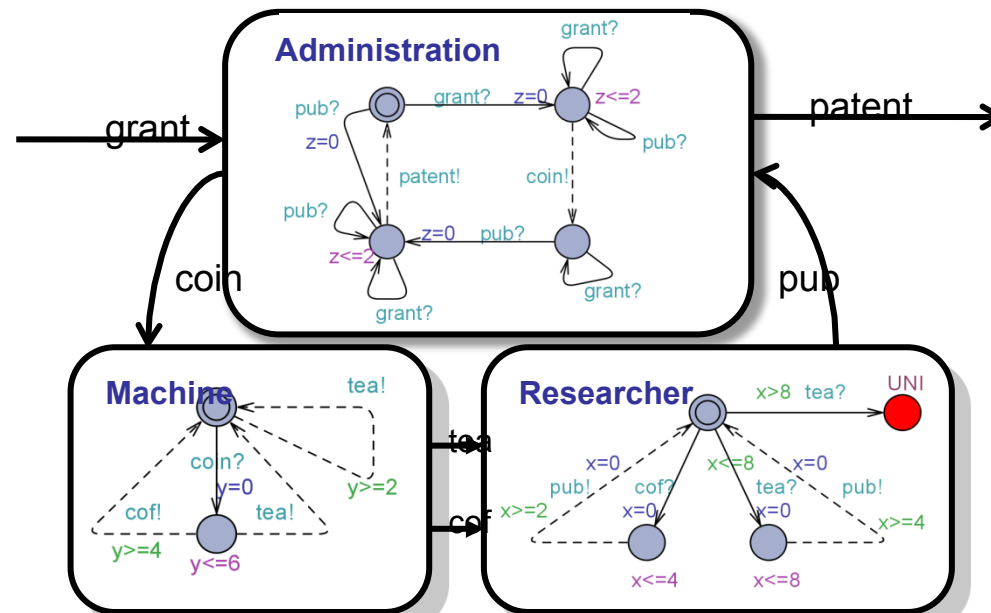




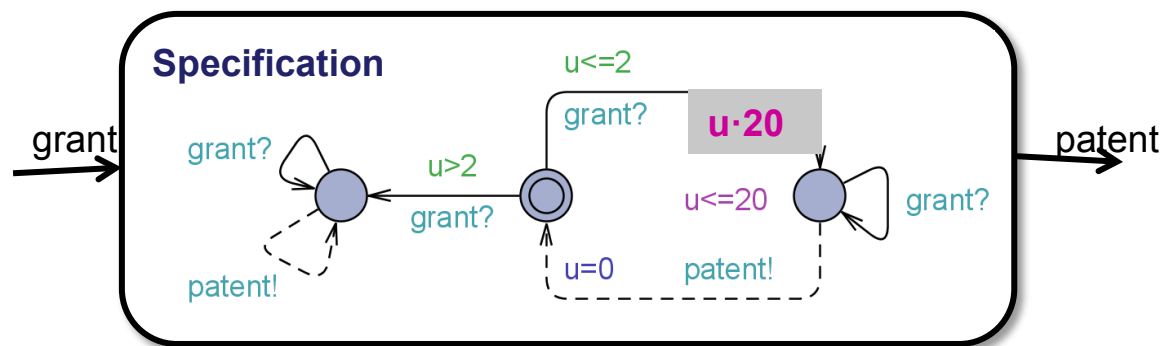
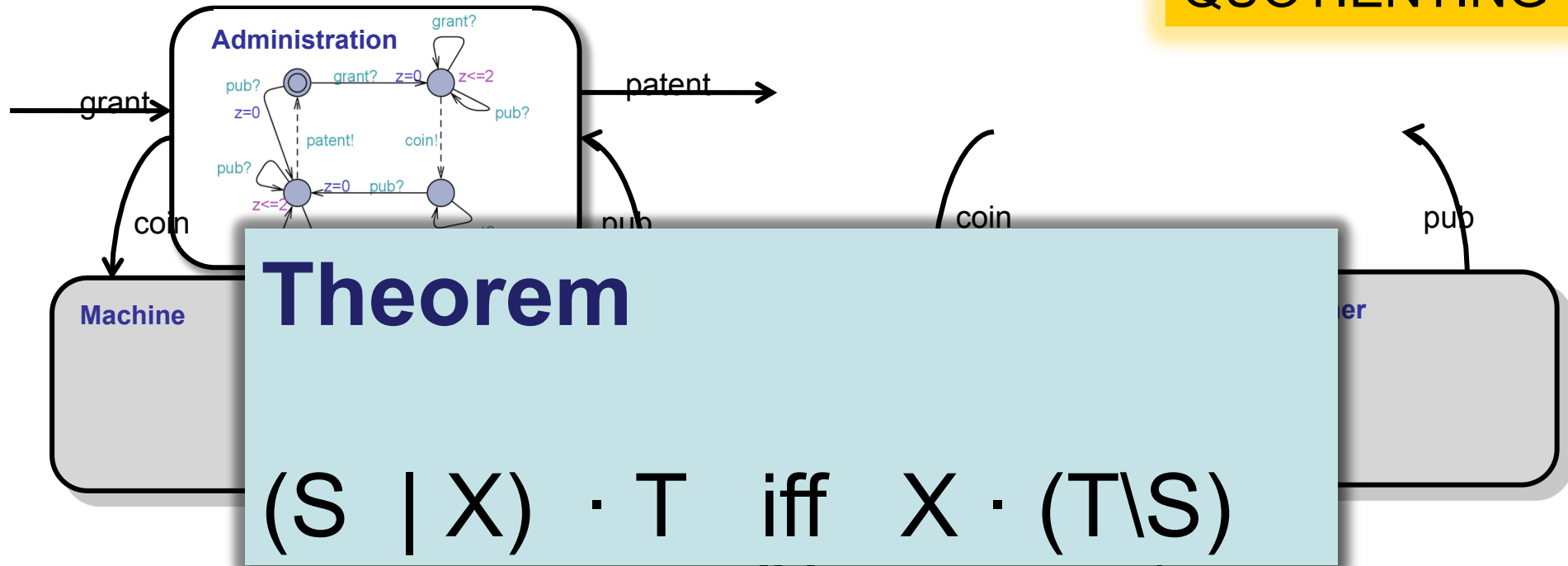
REFINEMENT



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QUOTIENTING



Spec \ Adm

- Several partners contributed (INRIA, VERIMAG, Aalborg, IST, TRENTO, ...)
- Available in tools



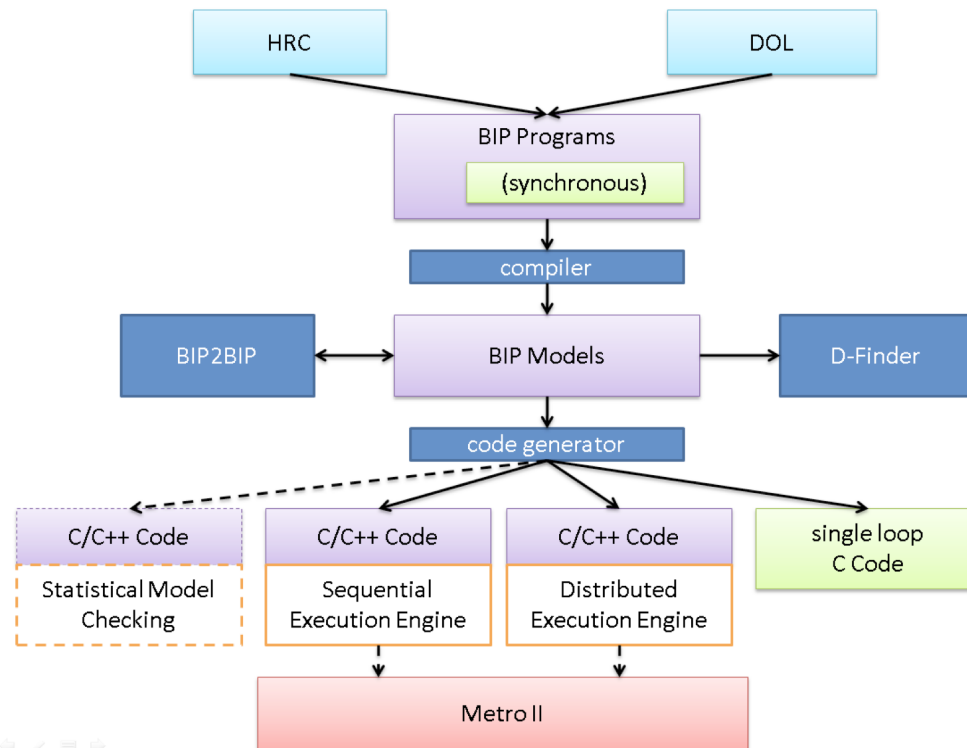
Scientific Highlight: Component-Based Design



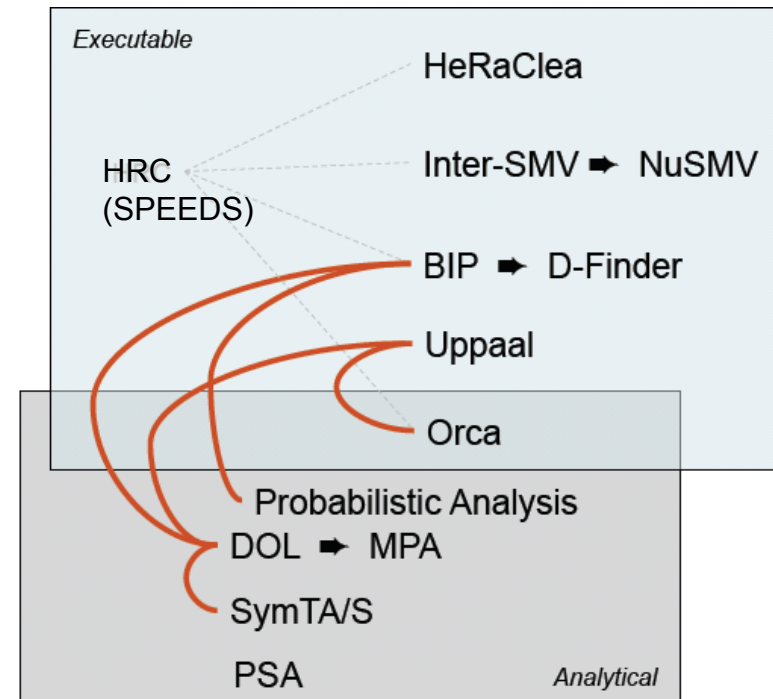
COMBEST & SPEEDS

Tool-chain:

- integration of state-of-the-art tools
- application to case studies



Tool integration



Scientific Highlight: Sensor Networks



Flower auction Flora Holland (Naaldwijk)

150.000 auction cars used to support logistic processes

An auction car costs approx. 650 Euro, paid by FH

A car is leased by an end-user (so-called "slotplaat")

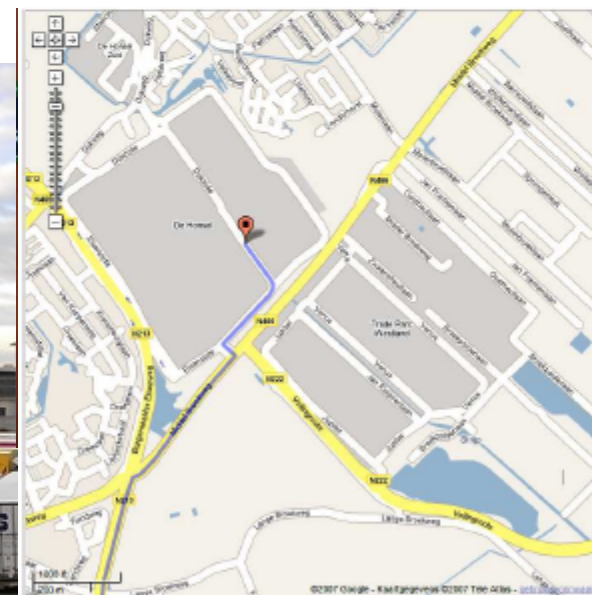
1% is lost or stolen each year, causing financial disputes

No overview: where is which car; when did it get there?

Flora Holland and Bloemenveiling Aalsmeer will merge;
logistic challenge + new standard auction car

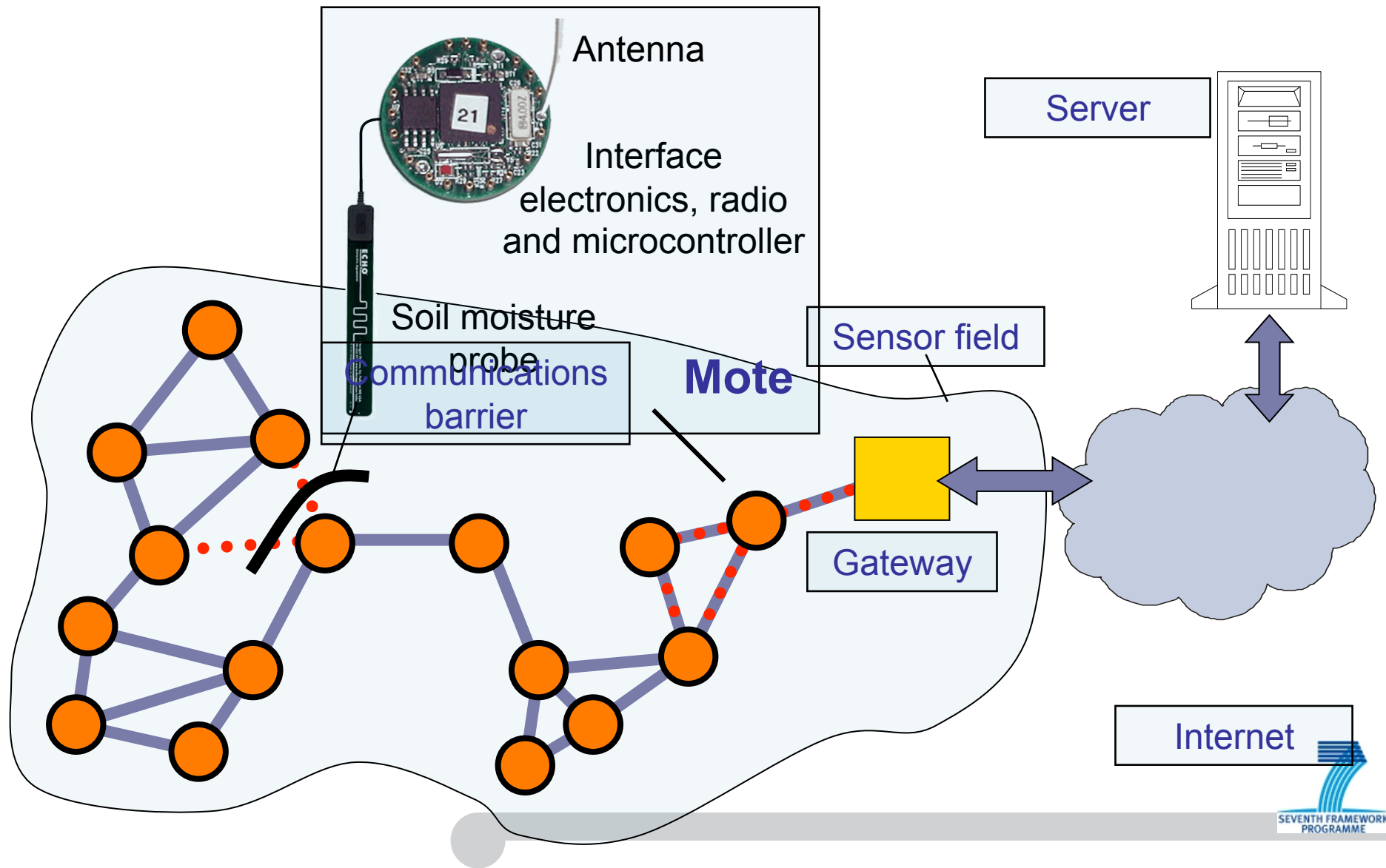


Quasimodo
CHESS 2.4 Ghz WSN

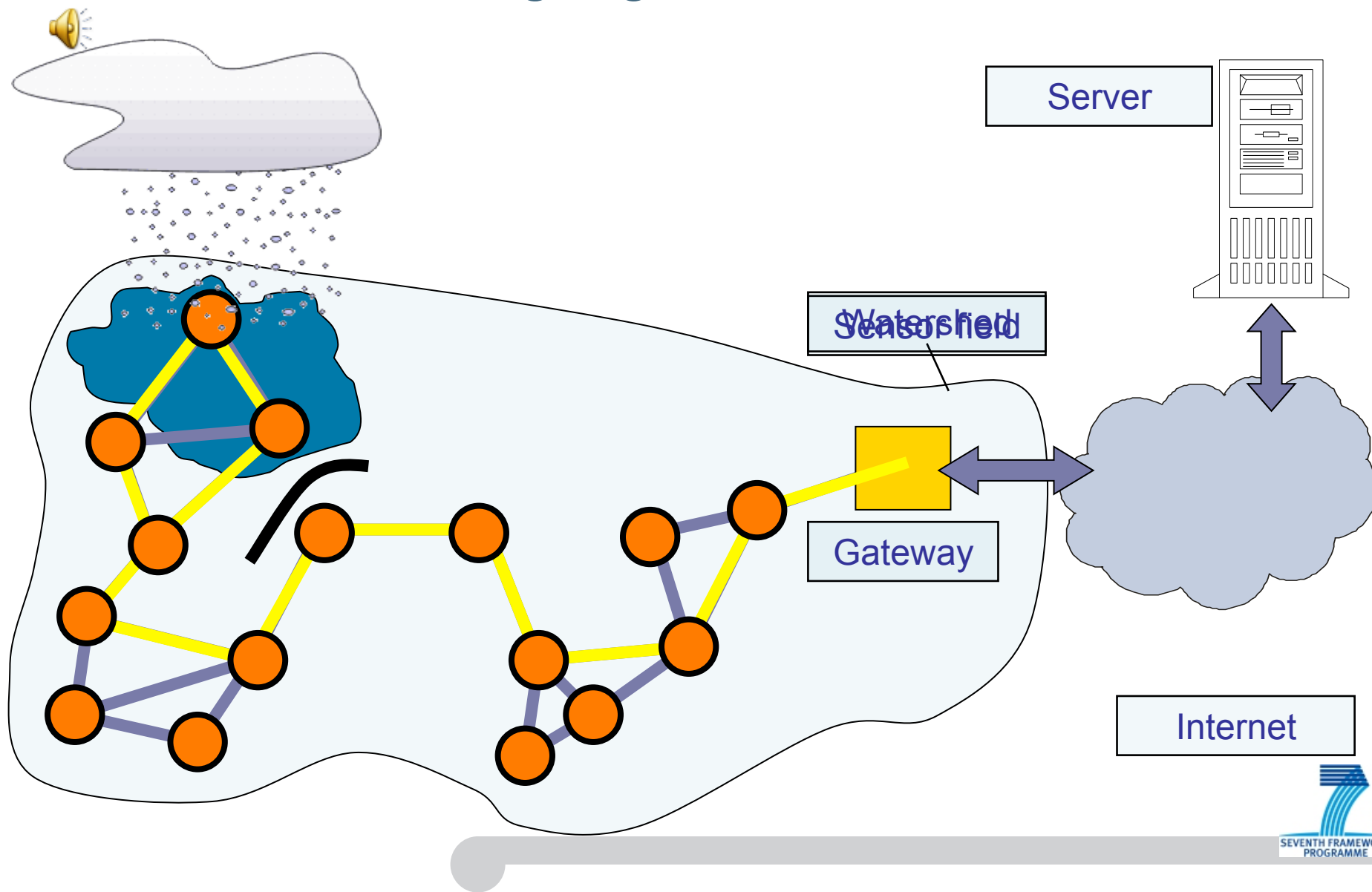


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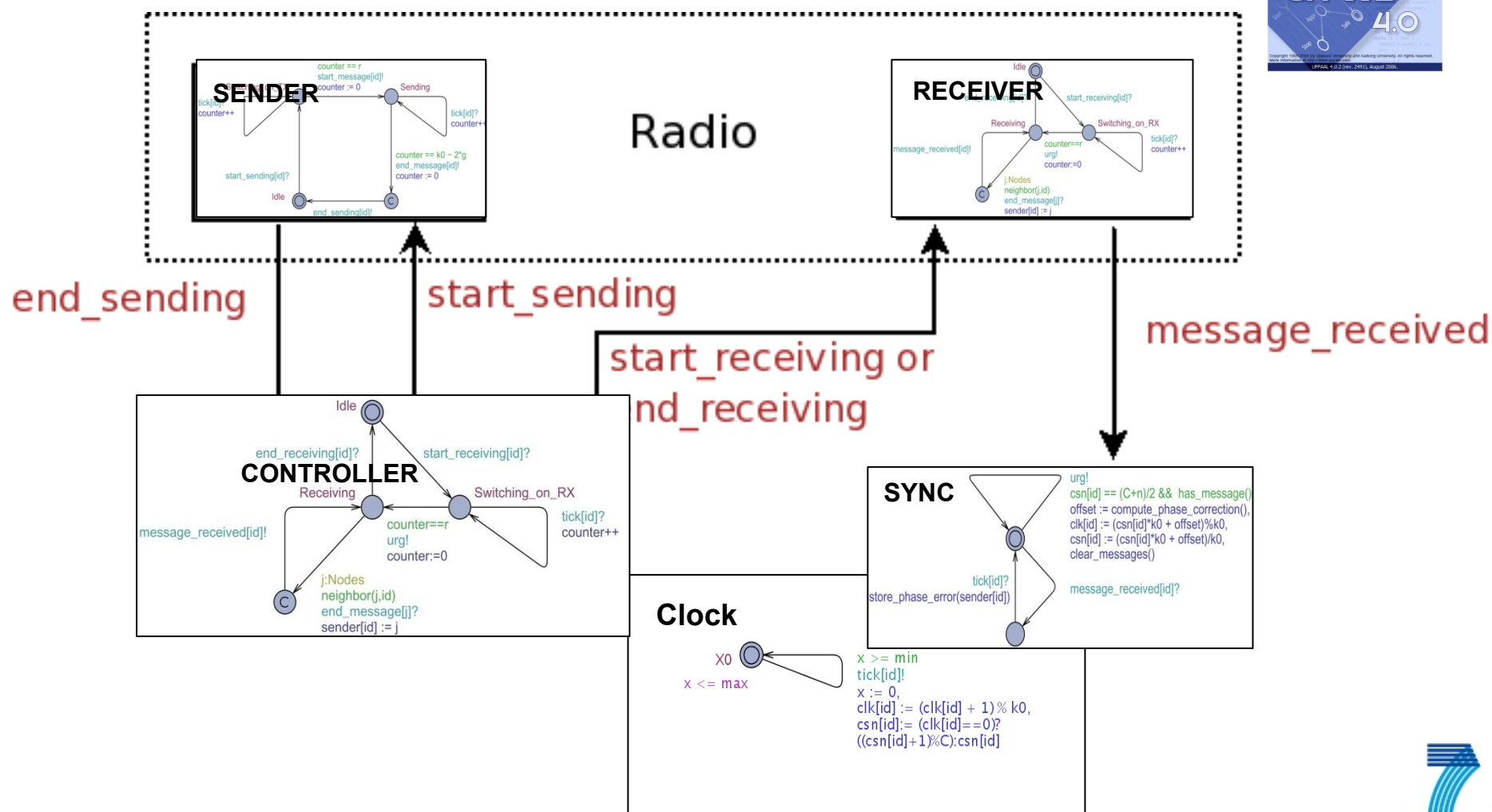
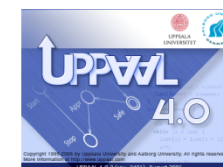
Scientific Highlight: Sensor Network



Scientific Highlight: Sensor Network

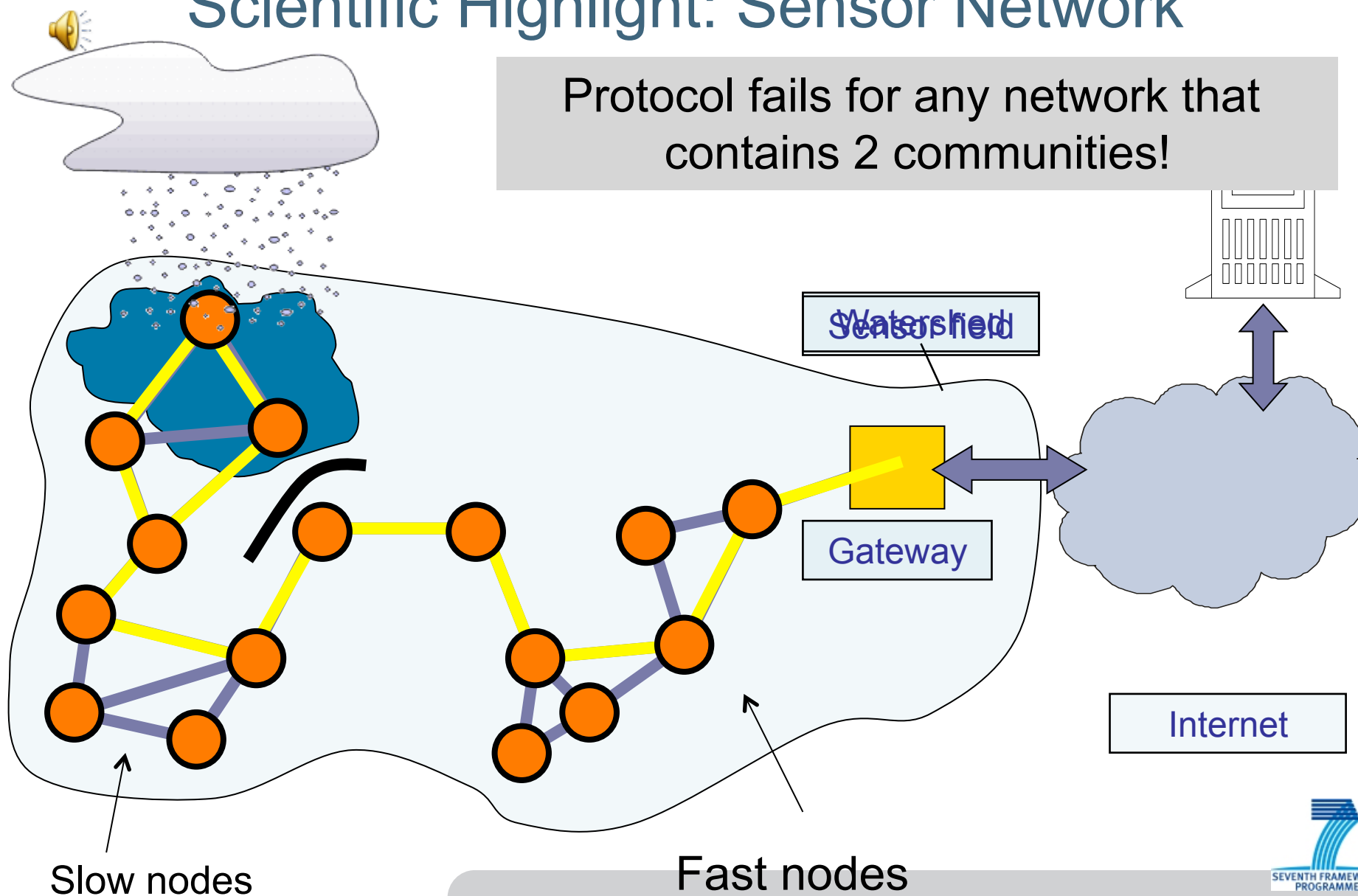


Scientific Highlight: Sensor Network

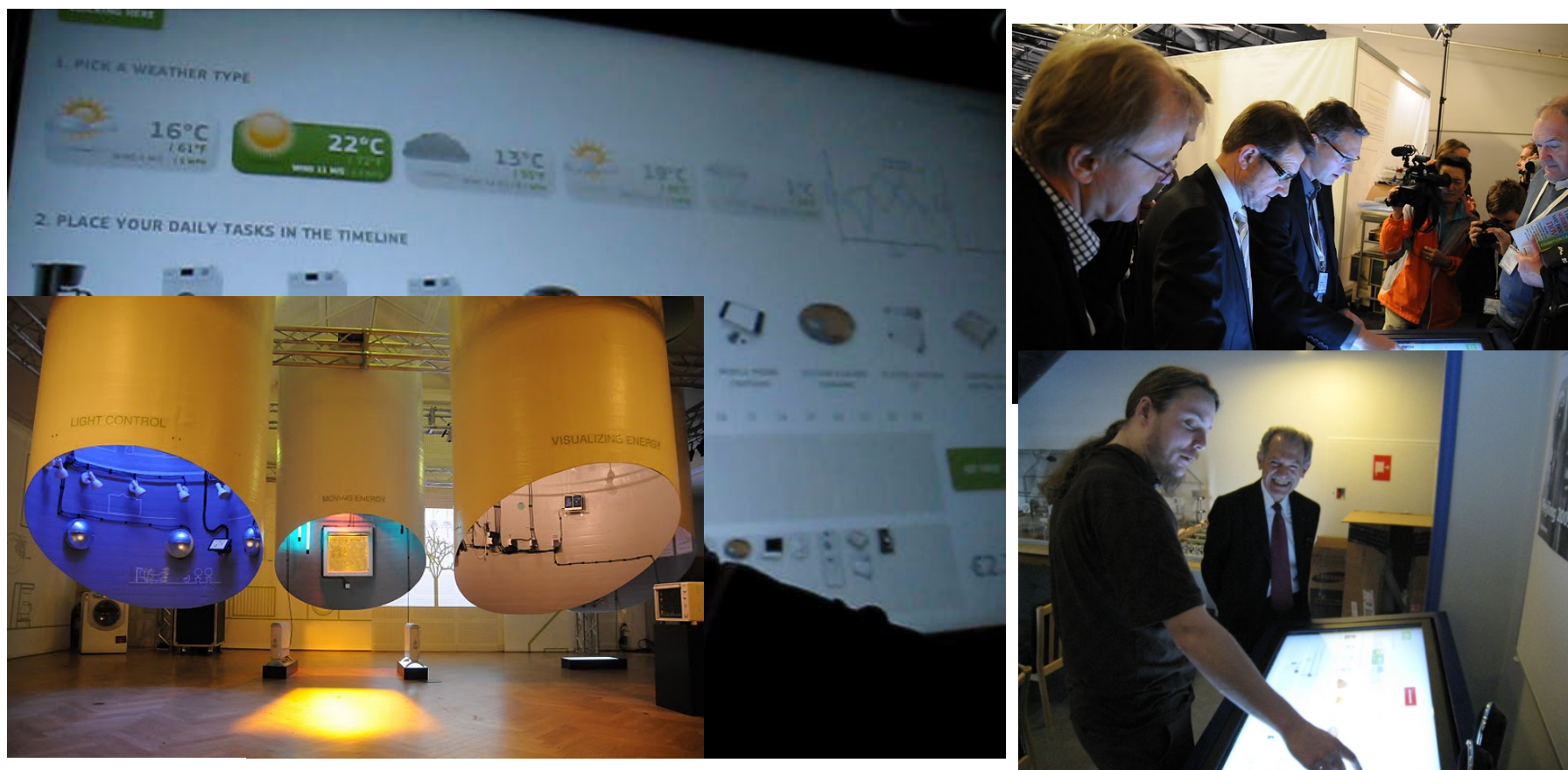


Scientific Highlight: Sensor Network

Protocol fails for any network that contains 2 communities!



Scientific Highlight: The Energy Aware House



 **INDESIT**

 **H. Jespersen & søn A/S**

 **EL**

 **SERVODAN**

 **Brunata**

 **WAVE ALLIANCE™**

 **DEVELCO PRODUCTS**

 **hummm®**

 **Kamstrup**

 **seluxit**

 **SEVENTH FRAMEWORK PROGRAMME**

Plans for Y3

- Develop and extend the results from Y1&Y2 along the six research directions.
- Continue demonstration of results by implementing tool-components.
- Increase industrial impact of cluster results (competences and tools).
 - Demonstrate maturity of method and tools by realistic applications.
 - Design flows and tool chains. (well on its way)
 - ...
- Increased focus on
 - Multi-core & MPSoC
 - Sensor networks
 - Low Power and Energy awareness

Plans for Y3

- MOVEP (Modeling and Verifying Parallel Processes): June 28-July 2, 2010, Aachen (Thierry Jeron)
- GASICS Worksh. on Games for Design, Verification & Synthesis – CONCUR 2010 (Kim G Larsen, Aalborg)
- EUROSYS, 2011 (Christoph Kirsch, Salzburg)
- 5th Summerschool on Modelbased Development of RT Embedded Systems, 2011.
- Reactive Modeling in Science & Engineering, May 6-7, 2010 (Tom Henzinger, IST)
- **CONCUR** (21st International Conference on Concurrency Theory), Paris, France, August 31-September 3, 2010 (Francois Laroussinie, LSV, Cachan)
- **FORMATS**: September 8-10, 2010, Vienna (Tom Henzinger, IST)
- **Cluster PhD School on Quantitative Model Checking** (March 2-5, 2010; Joost-Pieter Katoen, Kim G Larsen).

THE END