SIXTH FRAMEWORK PROGRAMME
PRIORITY 2
Information Society Technologies IST

Contract for:

NETWORK OF EXCELLENCE

Up-date of the joint programme of activities M13 to M30

Project acronym: **HYCON**

Project full title: **Hybrid Control: Taming Heterogeneity and Complexity of Networked Embedded Systems**

Proposal/Contract no.: **511368**
Start date of contract: *15 September 2004* Duration: *4 years*

Francoise Lamnabhi-Lagarrigue, 06 April 2006

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05	**RUB**	Ruhr-Universität Bochum	**D**	Jan Lunze
06	**UNIDO**	Universität Dortmund	**D**	Sebastian Engell
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12	**UPAT**	University of Patras	**GR**	John Lygeros
13	**UAQ**	Università degli Studi dell'Aquila	**I**	Maria Domenica di Benedetto
14	**UNIPI**	Università di Pisa	**I**	Antonio Bicchi
15	**UNISI**	Università degli Studi di Siena	**I**	Alberto Bemporad
16	**PARADES**		**I**	Alberto Sangiovanni-Vincentelli
17	**TUE**	Technische Universiteit Eindhoven	**NL**	Maurice Heemels; Henk Nijmeijer
18	**UT**	Universiteit Twente	**NL**	Arjan van der Schaft
19	**TUD**	Technische Universiteit Delft	**NL**	Bart de Schutter
20	**KTH**	Royal Institute of Technology	**SE**	Karl Henrik Johansson
21	**ULIN**	Linköpings Universitet	**SE**	Lennart Ljung
22	**LTH**	Lund Institute of Technology	**SE**	Anders Rantzer
23	**UCAM**	University of Cambridge	**UK**	Jan Maciejowski
24	**RWTH**	Aachen University of Technology	**D**	Stefan Kowalewski
25	**UVA**	University of Valladolid	**E**	Cesar de Prada
26	**CNR**	Consiglio Nazionale delle Ricerche	**I**	Benedetto Piccoli
	LIGHT ASSOCIATION			
LA1	**UCB / CHESS**	University of California at Berkeley – Center for Hybrid and Embedded Software Systems	**USA**	Edward A. Lee Alberto Sangiovanni-Vincentelli Shankar Sastry
LA2	**UPENN**	University of Pennsylvania	**USA**	George Pappas Rajiv Alur
LA3	**ENSEEIT / IRIT**	Ecole Nationale Supérieure d'Electrotechnique, d'Electronique, d'Informatique, d'Hydraulique et des Télécommunications	**F**	Romain Dujol
LA4	**Univ. Bourgogne / LAAO**	Université de Bourgogne	**F**	Bernard Bonnard
LA5	**CNRS / VERIMAG**	Centre National de la Recherche Scientifique/	**F**	Oded Maler Paul Caspi Thao Dang
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9. Detailed joint programme of activities (JPA) – M13 to M30

9.1 Work package list /overview

WP Number	Workpackage title	Lead contractor No	Start month	End month	Deliverable Number
WP1	**Establishment of EIHS**	UNIPI-UNISI A. Bicchi – A. Bemporad	13	30	6
WP2	**Benchmarking**	US E. Camacho	13	30	4
WP3	**Tool integration**	UNIDO S. Engell	13	30	8
Total					**18**
WP4a	**Energy management**	ETHZ M. Morari	13	30	4
WP4b	**Industrial controls**	UNIDO-UMD S. Engell	13	30	4
WP4c	**Automotive control**	PARADES A. Balluchi A. Sangiovanni Vincentelli	13	30	4
WP4d	**Networked control**	UAQ- KTH F. Santucci K.H. Johansson	13	30	4
Total					**16**
WP5	**Knowledge management**	RUB J. Lunze	13	30	4
WP6	**Industrial bridging**	PARADES - ETHZ A. Sangiovanni Vincentelli - M. Morari	13	30	4
Total					**8**
WP7	**Administrative and financial management**	FIST E. Kohler J.de Macedo	13	30	2
WP8	**Assessment, evaluation and quality**	CNRS Lamnabhi-Lagarrigue J. Lygeros - K.H. Johansson	13	30	10
Total					**12**
TOTAL					**54**

9.2 Deliverables list

1-Nature: **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other
2-Dissemination: **PU** = Public,
PP = Restricted to other programme participants (including the Commission Services).
RE = Restricted to a group specified by the consortium (including the Commission Services).
CO = Confidential, only for members of the consortium (including the Commission Services).

Di.j.k = deliverable **k** of **task i.j** in the workpackage **WPi**

Deliverable number	Deliverable title ……..….Months	Milestones 3	4	5	6	7	8	9	20	21	22	23	24	25	26	27	28	29	30	1	2
INTEGRATING ACTIVITIES																					
D1.5.1	Ideal Profile of the Manager and Call for Applications issued by the Gov. Board	X																		R	PU
D1.6.1	Call for applications to EIHS Resident Scientist position issued			X																R	PU
D3.4.3	Free Modelica library for fast simulation of DAE and multi-rate controllers			X																	
D2.2.2	Documentation for Benchmark exercises M1 and I1				X															R	PU
D2.3.2	List of accepted experiments						X													R	PU
D1.7.1	ICO rules for Admissions, Enrolment, Requirements, Dissertation and Defence							X												R	PU
D3.6.1	Report: Requirements for an interchange format for nonlinear hybrid systems.								X												
D1.8.2	Second EIHS School on Hybrid Systems										X									R	PU
D3.3.2	Report on the relation between PWA systems and HA										X									R	PU
D3.3.3	Report on existing tools and methods for the identification of PWA systems												X							R	PU
D3.7.1	Report on tools for stochastic hybrid models and prospects for tool integration														X					R	PU
D1.7.2	Report on first year of ICO operations																		X	R	PU
D1.8.1	Report on first year of EIHS Teaching Activities																		X	R	PU
D2.4.2	Report on exercise results and analysis																		X	R	PU
D2.5.2	List of accepted benchmarks																		X	R	PU
D3.3.4	Definition of a simple benchmark model for hybrid identification																		X	R	PU
D3.6.2	Syntax and formal semantics of an initial version of the model interchange format																		X	R	PU
D3.7.2	Guidelines for the simulation of stochastic hybrid systems and stochastic approximation																		X	R	PU

JOINTLY EXECUTED RESEARCH																					
D4a.2.1	Draft Survey Report	X																		R	PU
D4d.2.2	Definition and description of the case studies				X															R	PU
D4a.3.1	Final Report						X													R	PU
D4d.3.1	First report on hybrid modelling and control for the case studies								X											R	PU
D4b.1.3	Verification results for 2 of the case studies in the area safety-related discrete control									X										R	PU
D4c.4.2	Proc. of the HYCON workshop "Automotive applications of hybrid systems"									X										R	PU
D4b.2.4	Application results for three of the case studies in the area 'large transitions'												X							R	PU
D4c.1.4	Preliminary report on Case study 1: Hybrid modeling of engines												X							R	PU
D4c.2.2	Preliminary report on Case study 2: Optimal and MPC in vehicle dynamics control												X							R	PU
D4c.3.2	Preliminary report on Case study 3: Platform-based design of an ECU												X							R	PU
D4a.5.2	Report on assessment of methods													X						R	PU
D4d.3.2	Final report on hybrid modelling and control for the case studies																X			R	PU
D4b.5.1	Considering safety issues in large transitions																		X	R	PU
D4b.6.1	Complexity reduction in controller synthesis for large transitions																		X	R	PU
D4a.7.1	Report on reviews' feedback, experimental verification plans																		X	R	PU
D4d.3.3	Plan for experimental validation																		X	R	PU
SPREADING																					
D5.1.3	Taxonomy available on the web for the NoE						X													O	PU
D5.4.5	Proceedings of the special session on hybrid systems at ECC-CDC						X													R	PU
D6.3.1	Programme definition including potential lecturers and outline of the lecture material								X											R	PU
D5.2.2	First version of the annotated bibliography available on the web												X							O	PU
D6.1.3	Report on industry affiliation and industry involvement at M24												X							R	PU
D6.2.2	Inventory of pilot projects – Release 2												X							R	PU
D6.5.1	IPR policy for Industrial Partner/Associate Agreements and IPR strategy - Release 2												X							R	PU
D5.2.6	Metadata generation tool (HYDRA) for authors																		X	O	PU
MANAGEMENT																					
D8.4.1	Updating of next 18 Months JPA work programme		X																	R	PU

D8.3.1	Report on the progress of the Gender action plan						X														**R**	**PU**
D8.2.1	JPA work analysis of deviation to original plans and recommendations						X														**R**	**PU**
D8.2.2	Report on the scientific and technical risk and recommendations						X														**R**	**PU**
D7.3.4	Activity report												X								**R**	**PU**
D7.2.2	Financial report and audit certificates												X								**R**	**PU**
D8.1.2	Report on dissemination activity and recommendations												X								**R**	**PU**
D8.5.2	Report on synergy actions with other projects												X								**R**	**PU**
D8.1.3	Periodic progress report												X								**R**	**PU**
D8.2.2	JPA work analysis of deviation to original plans and recommendations														X						**R**	**PU**
D8.4.2	Updating of next 18 Months JPA work programme														X						**R**	**PU**
D8.3.2	Report on the progress of the Gender action plan																		X		**R**	**PU**

9.3 Work package descriptions

WP1 – Establishment of the European Institute of Hybrid Systems

Work package number	1	Start date or starting event:						M13
Activity Type	Integrating activities							
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	0,7	3,2	2	2,75	1,2	2,7	0	2,5
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	ARADE
Person-months per participant	2,2	1,2	0	1	1,55	10,5	13	0,8
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	3,1	0	0,25	3,3	0	0	0	0
Participant id	UVA	CNR						
Person-months per participant	0	1,7						

Objectives

The establishment of a European Institute for Hybrid Systems (EIHS) which is expected to become a long-term internationally renowned focal point of multi-national, and multi-disciplinary research on hybrid systems. EIHS aims at promoting the education of students and researchers on hybrid systems. To strengthen the EIHS role, in particular with regard to the creation of a common background of knowledge among young investigators and students, through organized and harmonized teaching activities.

Description of work

Task 1.1: Review and Dynamic (re-)definition of the mission and structure.

Task 1.2: Definition of objective criteria for the choice of organizational structure.

Task 1.3: Choice of location of the EIHS - Collective decision on location(s). Definition of the rules for the sharing and common management of equipment, installations and infrastructure.

Task 1.4: Instituting the EIHS - Statute and Bylaws of the EIHS. Review and dynamic (re-)definition.

Task 1.5: Infrastructure set-up. Manager and staff hiring. Hiring of the manager of the institute and of the other initial staff members, setting up of the infrastructure (premises, facilities, computers, etc.).

Task 1.6: Operations Start - Call for applications for visiting resident researchers. Beginning of joint research activity at EIHS.

Task 1.7: International Curriculum Option (ICO) for Doctoral Studies in Hybrid Systems. Institutions entering th eICO convention will offer an integrated qualification for existing PhD courses in hybrid systems. Regulations for the I.C.O. will abide by each partner Institution's national legislation and own regulations. Additional specific regulations and criteria applying to the I.C.O., but not contradicting any of the above, will be agreed upon by the Institutions through an I.C.O. Board.

Task 1.8: Teaching Coordination and Summer Schools. Teaching activities towards undergraduate and Ph.D. students, Summer Schools, and continued education for industry and professionals will be organized in a coherent and synergistic way by an EIHS committee.

Deliverables

D1.5.1 Ideal Profile of the Manager and Call for Applications issued by the Gov. Board
D1.6.1 Call for applications to EIHS Resident Scientist position issued
D1.7.1 ICO Operational rules for Admissions, Enrolment, Requirements, Dissertation and Defence
D1.7.2 Report on first year of ICO operations
D1.8.1 Report on first year of EIHS Teaching Activities
D1.8.2 Second EIHS School on Hybrid Systems

Milestones

M1.1.2 Review of the mission and structure of the Institute.
M1.3.3 Decision by the Governing Board of the future common rules on utilisation of shared equipment, installations and infrastructure
M1.4.1 Adoption of Statute and Bylaws by the Governing Board
Applications filed for institution of EIHS as a legal entity
M1.5.1 Evaluation of applications and interviews by committee
M1.5.2 Hiring of the manager
M1.5.3 Review of Management Operations
M1.5.4 Location contracts signed for premises, infrastructure
M1.6.1 First set of resident scientists selected, start of work
M1.7.1 ICO Convention signed
M1.7.2 ICO Board nominated by Presidents, ICO operations start
M1.7.3 Review and decision on corrective actions on the ICO structure and rules
(including decisions on new associations).
M1.8.1 Committee for EIHS Teaching Activities and Summer School Coordination established
M1.8.2 Decision on corrective actions on EIHS Teaching Activities

Tasks and Deliverables – Milestones

	WP1 – Establishment of the European Institute of Hybrid Systems																		
N°	**Tasks**……Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1.1	Review and Dynamic (re-)definition of the mission and structure.																		
1.3	Choice of location of EIHS																		
1.4	Instituting the EIHS																		
1.5	Infrastructure set-up.																		
1.6	Operations Start																		
1.7	International Curriculum Option (ICO) for Doctoral Studies in Hybrid Systems																		
1.8	Teaching Activities Coordination and Summer Schools																		
N°	**Deliverables (D) / Milestones (M)**																		
M1.7.1	ICO Convention signed	X																	
M1.7.2	ICO Board nominated by Presidents, ICO operations start	X																	
D1.5.1	Ideal Profile of the Manager and Call for Applications issued by the Gov. Board	X																	
M1.3.3	Decision by the Governing Board of the future common rules on utilisation of shared equipment, installations and infrastructure			X															
M1.5.1	Evaluation of applications and interviews by committee			X															
D1.6.1	Call for applications to EIHS Resident Scientist position issued			X															
M1.4.1	Adoption of Statute and Bylaws by the Governing Board Applications filed for institution of EIHS as a legal entity				X														
M1.5.2	Hiring of the manager							X											
D1.7.1	ICO rules for Admissions, Enrolment, Requirements, Dissertation and Defence							X											
M1.8.1	Committee for EIHS Teaching Activities & Summer School Coordination established							X											

N°	**Tasks**.....Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
M1.5.4	Location contracts signed for premises, infrastructure							**X**											
M1.6.1	First set of resident scientists selected, start of work							**X**											
D1.8.2	Second EIHS School on Hybrid Systems										**X**								
M1.1.2	Review of the mission and structure of the Institute.												**X**						
M1.5.3	Review of Management Operations																		**X**
D1.7.2	Report on first year of ICO operations																		**X**
M1.7.3	Review and decision on corrective actions on the ICO structure and rules																		**X**
D1.8.1	Report on first year of EIHS Teaching Activities																		**X**
M1.8.2	Decision on corrective actions on EIHS Teaching Activities																		**X**

WP2 – Benchmarking

Work package number	2		Start date or starting event:					M13
Activity Type	Integrating activities							
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	0	1,5	0	7,6	1	8,1	0	0
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	ARADE
Person-months per participant	31,8	1,75	0	0	0	8,1	6,6	2,1
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	0	0	0	0	0	3	1,6	0
Participant id	UVA	CNR						
Person-months per participant	6,1	0						

Objectives

- Launching and carrying out benchmark exercises on two systems: a Solar Plant (I1) and an Idle Speed Control System (M1)
- Announcing a new call for benchmarks in December 2006.

Description of work

Task 2.2 – Preparation of benchmark cases (Solar plant (I1) and Idle Speed Control System (M1))
Preparation of the platforms and communication systems, model development, data collection for identification and test definition.

Task 2.3 - Implementation of Benchmark Exercises (first phase)
Announcing the call for the Solar Plant and Idle Speed Control System Benchmark, collecting proposals and selection of the accepted proposals. The proposals will be presented by Hycon partners and also by external candidates. An award to best experiments will be announced.

Task 2.4 - Implementation of Benchmark Exercises (second phase)
The selected proposals will be performed during this task. This task includes the scheduling of *experiment time* slots, the implementation of results by the proposers, the collecting and analysis of results and dissemination. A workshop to present the results and HYCON benchmark award will be organized.

Task 2.5. Call for new benchmarks
A new call for benchmarks will be announced in December 2006 in coordination with other WP. This task includes also the collection of proposals.

Deliverables

D2.2.2 - Documentation for Benchmark exercises M1 and I1
D2.3.2 - List of accepted experiments
D2.4.2 – Report on exercise results and analysis
D2.5.2 - List of accepted benchmarks

Milestones

M2.2.1 - Benchmark installation I1 and model M1 available for remote experimentation
M2.3.3 – HYCON award announce
M2.4.1 – Exercise proposals collected and analyzed
M2.4.2 – HYCON award decision
M2.5.1 - Benchmark proposals collected

Tasks and Deliverables - Milestones

	WP2 – Benchmarking																			
N°	**Tasks**……Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
2.2	2.2.1 Preparation of benchmark cases (Solar plant)																			
	2.2.2 Preparation of benchmark cases (Speed Control System)																			
2.3	Implementation of Benchmark Exercises (first phase)																			
2.4	Implementation of Benchmark Exercises (second phase)																			
2.5	Call for new benchmarks																			
N°	**Deliverables (D) / Milestones (M)**																			
M2.3.3	HYCON award announce			X																
M2.2.1	Benchmark installation I1 and model M1 available for remote experimentation				X															
D2.2.2	Documentation for Benchmark exercises M1 and I1				X															
D2.3.2	List of accepted experiments						X													
M2.4.1	Exercise proposals collected and analyzed																		X	
D2.4.2	Report on exercise results and analysis																		X	
M2.4.3	HYCON award decision																		X	
M2.5.1	Benchmark proposals collected																		X	
D2.5.2	List of accepted benchmarks																		X	

WP3 – Tool integration

Work package number	3	Start date or starting event:						M13
Activity Type	Integrating activities							
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	0	0	0	8	0	15,5	4	0
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	'ARADI
Person-months per participant	0	0	0	5,5	0	0	14	2,5
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	9,5	4	0	0	0,5	0	0	0
Participant id	UVA	CNR						
Person-months per participant	0	0						

Objectives: Continuous efforts towards the interoperability of tools

Description of work

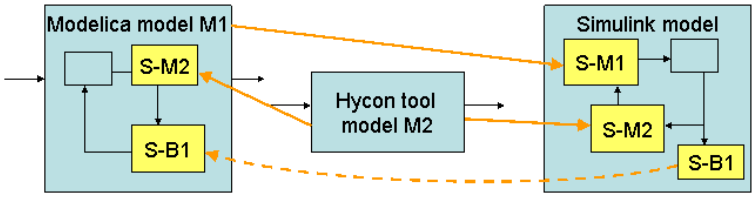
Task 3.1 – Tool Repository
The HYCON Tool Repository provides access to tools with a uniform description. It is to be maintained and extended with further tools beyond month 18. This requires some continuous effort for administration, adaptation, instruction of tool developers, and proactive requests for further tools. The HYCON Tool Repository will be documented such that it can be run and adapted by the EIHS.

Task 3.2 – HYCON Demonstrator Site
The Demonstrator Site allows checking out tools via web without license trouble. The actions within the months 13 to 18 will be done earlier than planned in the first proposal in order to gain momentum. After connecting a minimum number of 2 tools providing on-line experiments, further tools can be added consistently. The next step is a kick-off meeting with all participants, where the main concepts and the software developed until now will be presented. The HYCON Demonstrator Site will be documented such that it can be run and adapted by the EIHS.

Task 3.3 – Standard data format and toolboxes for switched linear dynamic systems
The first objective of WP3.3 is to define an interchange format based on PWA models (continuous-time, discrete-time, or discrete-event) in order to integrate tools that have been developed by HYCON partners. A second objective is to understand the connection between PWA models and hybrid automata (HA), in order to extend the integration to other tools based on HA, mainly for safety analysis / verification purposes. A third objective is to obtain piecewise affine approximations of nonlinear systems or PWA models from measured data. Thanks to the universal approximation properties of PWA maps, PWA models form a nonlinear black-box structure that is prepared to describe virtually any nonlinear dynamics. The goal of here is to develop tools for obtaining automatically piecewise affine systems in the format specified by WP3.3, starting from input/output/state data, either generated by simulating nonlinear models or measured from real plants. A longer term objective is to obtain PWA models from systems designed through the interchange format for nonlinear and non-deterministic systems.

Task 3.4 – Model sharing among simulation tools and component libraries
In this task a kind of co-simulation is realised contrary to the original proposal. At present, and in the near future, modelling and simulation frameworks for hybrid systems support a subset of modelling formalisms both on the continuous and on the discrete side. While it is possible to cast most problems into one of the representations offered by each tool, this may require a lot of effort if some part of a system has already been modelled using another formalism. Therefore possibilities to exchange subsystem models between different environments have been investigated. As a first step into this direction, it was planned to equip a number of tools with a *Modelica* interface to allow the exchange of modules that represent

subsystems in the form of (switched) continuous ODE or DAE systems. The second step planned was to define a joint interchange format for (timed) discrete event system blocks in a similar fashion such that several discrete formalisms can be mapped into this interchange format without a large model overhead and the models in the interchange format can be processed by simulation and analysis tools.
However, it appears to be more convenient to use the S-function block interface of Matlab Simulink. The new idea is to define this interface for Modelica/Dymola[1] such that it becomes possible to embed S-function blocks properly into a Modelica model. The other HYCON simulation tools such as Chi will have to generate S-function blocks from their models in order to be embedded in Modelica/Dymola. Hence, the full power of object-oriented equation-based modelling provided by Modelica as well as the many already existing Modelica component libraries for different domains can be combined with the specific strengths of other HYCON simulation tools.



This approach has several advantages compared to the former idea of the proposal:

- There are already tools that generate S-functions for simulation with Simulink (e.g. HSYDEL, the Hybrid Toolbox, the Multi parametric toolbox, as well as the Dymola export of Modelica models to Simulink)
- The S-functions can also be used together with Simulink without any trouble.
- Specific semantics of a certain tool need not to be translated into any exchange formalism, which certainly would raise a lot of difficult problems and would be a hard piece of work.
- Within the S-function wrapper, tool specific code can be used that is tailored to the particular structure of its problem area (e.g. code for higher index DAEs, chattering, etc.).
- S-functions should work also for complex discrete event models so that there is no need for additional efforts.
- We expect this approach to be realizable with reasonable efforts.

A minor drawback of this approach: The Modelica tool Dymola has an elaborated symbolic engine that generates very efficient simulation code from hybrid DAE models including automatic index reduction and many other techniques. It would be nice to make this available for the continuous parts of other simulation tools (e.g., Chi could use the Dymola preprocessing for its continuous parts). This is not possible in the S-function approach. Another drawback of this approach is that the simulation results may depend on the numerical solver that is used (fixed or variable step size, with or without event-detection, etc.). However this is a general problem of simulation tools.
Different lawyers attested that it is legal to use the S-function API without owning a Matlab license, i.e., it does not infringe copyrights or patents, as long we do not use original code from The MathWorks.

In addition, a free Modelica library for fast simulation of DAE and multi-rate controllers will be provided by the DLR: Simulation of complex dynamic systems with multi-rate digital controllers is time consuming because the sample times of the controllers inherently limit the step-size of the continuous plant and makes the simulation of this hybrid system usually very slow. Based on an available prototype, a free Modelica library will be provided that models a controller by blocks that are parameterized by their continuous behaviour. With a switch, the continuous blocks can be easily changed to discrete blocks. Information necessary to perform this transformation can be provided globally and also on a component basis (e.g. sample time, discretization method, quantization effects). It is now easy to use a continuous representation of the controller to get fast simulations (e.g. for optimization of controller parameters based on detailed plant models) and change to more detailed sampled models only when really necessary (e.g. to

[1] Modelica is a language for object-oriented modelling of physical systems. Dymola refers to a modelling and simulation tool processing Modelica models.

evaluate the designed controllers and for fine tuning).

Task3.5 – Co-simulation platform
The exchange of submodels between tools via an interchange format is necessarily limited to standard representations and will not cover the full descriptive power of the different formalisms used in different tools. E. g. Chi has a very powerful description language for the discrete elements of hybrid systems whereas advanced Modelica-based simulators provide effective algorithms for the solution of complex continuous dynamics built from a-causal subsystems. The main objective of this task is to make full use of the combined power of different tools and approaches. This goal is already achieved by the new approach used in task 3.4 (model sharing among simulation tools and component libraries), since it already embodies a kind of co-simulation. The only restriction is that it does not support by default a distributed computation on parallel computers (It is still possible to split a model into different parts computed on different machines.). The milestone M3.5.1, *Decision on the development of a co-simulation platform*, is already decided: the co-simulation platform is being developed within task 3.4

Task 3.6 – Model interchange format for nonlinear and nondeterministic hybrid systems
The interchange format that is being developed in task 3.3 is based on piecewise affine models and aims at connecting different tools for analysis, synthesis, optimization, simulation, etc. However, many tools use a class of hybrid systems that is more general than the PWA models so that they can not be mapped into the PWA format without loss of information, whereas the approach based on the S-function interface that is focused in WP3.4, supports a very broad class of hybrid systems, but is limited to simulation only. A second aspect of the S-function approach is that non-determinism has to be resolved within the generated blocks and cannot be handled by the computational model of Modelica/Dymola or Simulink.

Other interchange formats already exist. The HSIF format is a hybrid automaton network based interchange format. The interchange format developed in the COLUMBUS project aims to be very general, allowing transformations to and from the interchange format that preserve model structure including scoping, parallelism, and communication behaviour. This generality makes the definition of a formal semantics extremely difficult. Both interchange formats do not support general DAE systems of equations that are considered important for modelling complex physical systems..

The objective of this task is to provide an interchange format for the purpose of simulation, analysis and verification of models, including general DAE systems of equations (that may contain algebraic loops). To ensure that translations from models to the interchange format (and vice versa) preserve essential properties that can be verified, the semantics of the interchange format is formally defined. The purpose of the interchange format is not to preserve model structure such as scoping and parallelism. Because of the large number of different languages with different scoping, communication and synchronisation behaviour, this would make the interchange format too complex. Instead, parallel composition (including communication and synchronisation) should be eliminated in the target languages themselves. Such techniques are rapidly emerging. For hybrid automata, for instance, parallel composition is usually defined as a single automaton in terms of the cartesian product of the individual automata. Also in hybrid process algebras, techniques to eliminate parallel composition are becoming available.

Our aim is not to cover all languages, but a considerable subset of them. Different languages may each implement only a subset of the interchange format. We will start with a small set of essential primitives, based on hybrid automata. This set of primitives will be extended with among others general DAE systems of equations, urgent transitions, and a formal semantics will be provided.

Task 3.7 – Stochastic hybrid models

In many applications the exact timing of events is not known a priori and can not be concluded precisely from state variables, e. g. delays in communication networks, transportation and processing durations in manufacturing plants, failures of components etc. Besides the temporal uncertainty, there may be

variations with respect to model parameters and inputs such as the quality of chemical products, dimensions of work pieces, etc. Finally, the sequence of external events such as user commands and orderings may be uncertain. Generally, these effects can be modelled by timed discrete-event systems only. By adding more quantitative information expressed in probabilistic or statistical terms, stochastic models are obtained.

The work under Task 3.7 will start by an assessment of the state of the art for existing tools capable for dealing with stochastic hybrid systems. The starting point for this study will be recent successful projects on this topic in Europe. One such project is AMETIST (Advanced Methods for Timed Systems), where various extensions of the timed automata paradigm to a stochastic setting were studied. A language was developed with a formal semantics given in terms of Stochastic Timed Automata, a formalism that encompasses a number of well-known formalisms: labelled transitions system, probabilistic automata, timed automata, probabilistic timed automata, generalised semi-Markov processes, and Interactive Markov Chains, and more. A tool environment for model checking and discrete-event simulation has been developed. Optimization techniques based on mixed-integer programming were proposed for optimal control of stochastic hybrid systems within the HYCON consortium.

In the HYBRIDGE project (Distributed Control and Stochastic Analysis of Hybrid Systems Supporting Safety Critical Real-Time Systems Design) a methodology was developed to embed control system designs for safety critical operations within sound safety management systems such that the level of safety stays under control of humans.

Related work was also carried out under the FP5 project COLUMBUS, "Design of Embedded Controllers for Safety Critical Systems". Here the emphasis was on questions of reachability for stochastic hybrid systems and how the answers to these questions can be used to design controllers that meet probabilistic safety specification, primarily in automotive
and avionics applications.

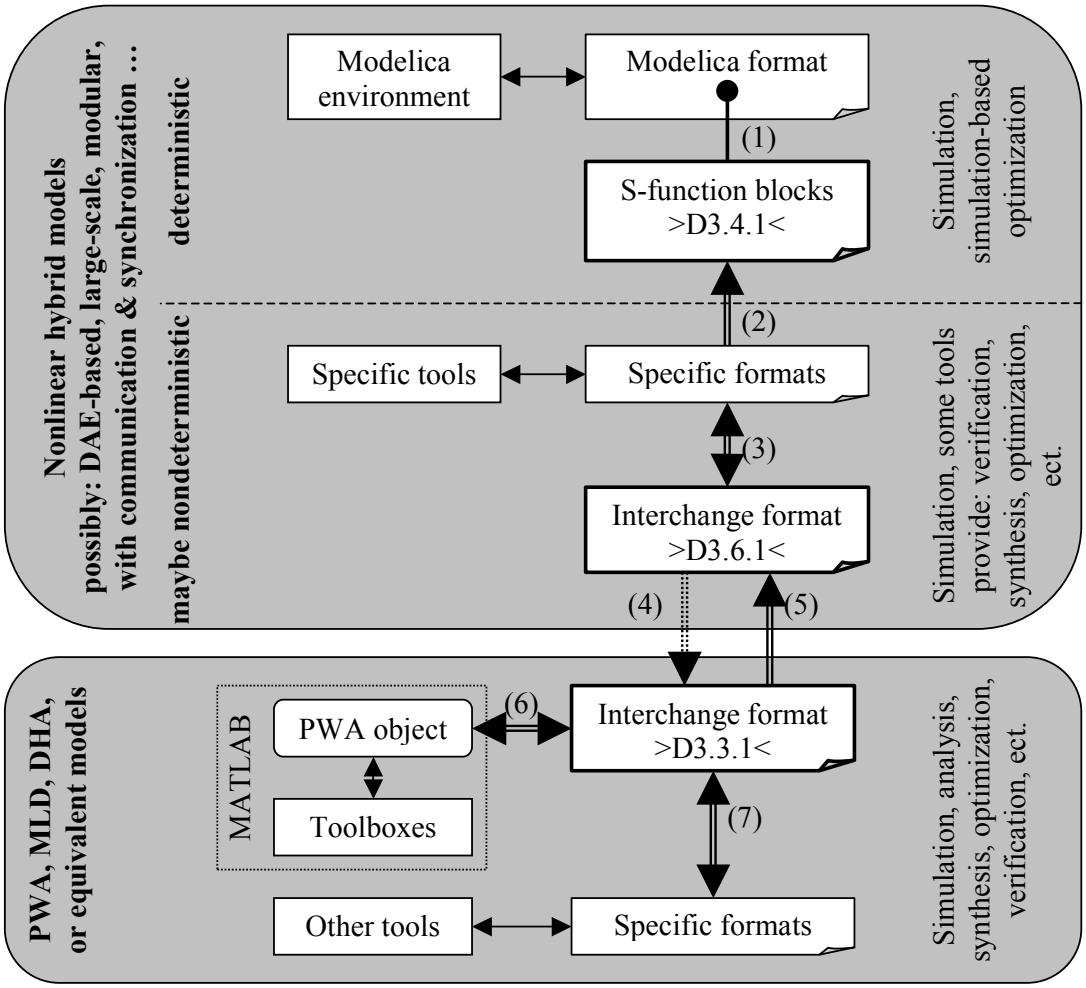
Related work on computational tools for stochastic hybrid systems has been carried out in the U.S.A., most notably as part of the CHARON effort at the University of Pennsylvania. The CHARON environment allows the modular modeling of stochastic hybrid systems and supports analysis functions such as simulation and model checking. Through the joint NSF/ITR - FP6/IST initiative the HYCON network of excellence will collaborate with the developers of CHARON, will incorporate any relevant CHARON findings in the results of Task 3.7 and will investigate the possible integration of the results of Task 3.7 and earlier European studies in the CHARON environment. The collaboration will be achieved by mutual visits of University of Pennsylvania researchers to the University of Siena and the University of Patras and vice versa; the visits will be supported by the NSF ITR-IST collaboration funds on the U.S. side and the HYCON network of excellence on the European side. The results of the collaboration will be documented in D3.7.1 and D3.7.2.

At a second stage the possibilities for integrating these tools with other tools of HYCON partners will be investigated. Given the fact that the variety of stochastic hybrid models is even greater than that of their deterministic counterparts it is likely to be too difficult to develop a general interchange format for this class of systems. Instead we will attempt to quantify the class of stochastic hybrid systems to which each tool is applicable and establish the common ground between tools.

In Task 3.7 we will also investigate the issues around stochastic hybrid simulation. We will survey algorithms capable of simulating different types of stochastic phenomena (diffusion processes, transition rates, stochastic discrete dynamics, forced transitions, etc.) and distill from them guidelines for the simulation of stochastic hybrid dynamics. We will then explore ways of extending existing hybrid systems simulation tools to incorporate these stochastic hybrid simulation guidelines. We will also investigate the use of Monte-Carlo simulation and other randomized methods for deriving probabilistic estimates of quantities such as reachability probabilities. Finally, we will develop strategies for

approximating deterministic and non-determinism hybrid systems by introducing random decisions, such as transition rates for situations where continuous evolution and discrete transitions are possible at the same time. This link will allow us to use the tools developed for stochastic hybrid system simulation to simulate non-deterministic systems, carry out efficient approximate analysis of non-deterministic systems using Monte-Carlo simulation, approximate Zeno systems by stochastic systems that are non-Zeno almost surely, etc.

Overview on Possibilities for Tool Integration developed in WP3



1) S-function blocks are embedded in Modelica models using S-function interface (is being realized in WP3.4).
2) Generation of S-function blocks from other sources, e.g., Chi, HYSDEL, etc. (is being realized in WP3.4)
3) Bidirectional translation into the interchange format supporting nonlinear non-deterministic models (to be realized in WP3.6).
4) Probably the most difficult translation, because the interchange format for nonlinear systems is more general than the PWA formalism. This could be realized after month 30, when both formats are completely defined.
5) This translation should not be very difficult and should be realized after month 30, when both formats are completely defined.
6) is being developed within WP3.3,
7) can be realized within the same task.

Deliverables

D3.3.2 - Report on the relation between PWA systems and HA
D3.3.3 - Report on existing tools and methods for the identification of PWA systems
D3.3.4 - Definition of a simple benchmark model for hybrid identification
D3.4.3 - Free Modelica library for fast simulation of DAE and multi-rate controllers (*Implementation of library, including demo examples*)
D3.6.1 - Report: Requirements for an interchange format for nonlinear hybrid systems (*Including the definition of simple benchmark models that show specific features that are to be supported*)
D3.6.2 - Report: Syntax and formal semantics of an initial version of the model interchange format (*The work done in MoBIES and COLUMBUS will be considered*)
D3.7.1 - Report on tools for stochastic hybrid models and prospects for tool integration
D3.7.2 - Guidelines for the simulation of stochastic hybrid systems and stochastic approximation

Milestones

M3.1.3 - 7 tools deposited
M3.2.2 - Demonstrator site infrastructure and web-portal operational (*Realization of the central web portal including a Matlab web-server and logging functionality with evaluation and feedback automation. Implementation of a graphical tool for defining test problems that are mapped automatically into the interchange format developed in WP3.3. Documentation of the Demonstrator Site such that it can be operated by the EIHS.*)
M3.2.3 - At least two tools connected to Demonstrator Site (*Implementation of the interface between tool and web, design of predefined online experiments, preparation of instructive material for visitors.*)
M3.3.2 - Standard model interface implemented in at least two tools (test version) (Implementation of the Matlab-based interfaces and evaluation of the interfaces using an example. Implementation of the interface of Matlab-PWA-Object and XML interchange format.)
M3.3.3 - Implementation of at least one identification tool
M3.4.2 - Implementation of the Dynamic Simulation Interfaces (test version)
M3.4.3 - Demonstration of the functioning of the Dynamic Simulation Interface (*Parts of a complex benchmark preferably taken from WP2 are modelled in different tools by the corresponding tool developers, connected together within Dymola using the Dynamic Simulation Interface, and the complete system is simulated*)
M3.7.1 - Decision on the integration path for WP3.3 and WP3.4

Tasks and Deliverables – Milestones M13-M18

AS PLANNED in ANNEX 1

	WP3 – Tool integration							
N°	**Tasks**……Months	13	14	15	16	17	18
3.1	Tool repository						
3.2	HYCON tool demonstrator site						
3.3	Standard data format and toolbox for switched linear systems						
3.4	Model sharing among tools						
3.5	Co-simulation platform						
N°	**Deliverables (D) / Milestones (M)**						
M3.3.2	Standard model interface implemented in 2 tool (test version)s			**X**			
M3.5.1	Decision on the development of a co-simulation platform			**X**			
M3.2.2	Demonstrator site infrastructure and web-portal operational						**X**
M3.4.2	Implementation of Modelica interfaces in tools (test version)						**X**
D3.4.2	Report: Definition and semantics of an interchange format for timed DES blocks						**X**
M3.1.3	7 tools deposited						**X**

UPDATED PLAN FOR M13-M18 and NEW PLANS FOR M19-M30

	WP3 – Tool Integration																		
N°	**Tasks**……Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
3.1	Tool repository																		
3.2	HYCON tool demonstrator site																		
3.3	Standard data format and toolbox for switched linear systems																		
3.4	Model sharing among tools																		
3.5	Co-simulation platform																		
3.6	Model interchange format for nonlinear and nondeterministic hybrid systems																		
3.7	Stochastic hybrid models																		
N°	**Deliverables (D) / Milestones (M)**	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
M3.3.2	Standard model interface implemented in at least two tools (test version)			X															
D3.4.3	Free Modelica library for fast simulation of DAE and multi-rate controllers			X															
M3.2.2	Demonstrator site infrastructure and web-portal operational			X															
M3.1.3	7 tools deposited						X												
M3.2.4	At least two tools connected to Demonstrator Site						X												
M3.4.2	Implementation of the Dynamic Simulation Interfaces (test version)						X												
D3.6.1	Report: Requirements for an interchange format for nonlinear hybrid systems.								X										
D3.3.2	Report on the relation between PWA systems and HA										X								
M3.4.3	Demonstration of the functioning of the Dynamic Simulation Interface										X								
D3.3.3	Report on existing tools and methods for the identification of PWA systems												X						
D3.7.1	Report on tools for stochastic hybrid models and prospects for tool integration														X				
D3.3.4	Definition of a simple benchmark model for hybrid identification																		X
M3.3.3	Implementation of at least one identification tool																		X
D3.6.2	Syntax and formal semantics of an initial version of the model interchange format																		X
M3.7.1	Decision on the integration path for WP3.3 and WP3.4																		X
D3.7.2	Guidelines for the simulation of stochastic hybrid systems and stochastic approximation																		X

WP4a – Energy management

Work package number	4a		Start date or starting event:					M13
Activity Type	Research activities							
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	0	6,5	0	21	0	0	0	0
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	ARADE
Person-months per participant	7	5	0	0	0	0	0	0
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	0	4,5	7	12	0	12,5	0	0
Participant id	UVA	CNR						
Person-months per participant	0	0						

Objectives

Overall Goal: Evaluate Hybrid System Concept and Tools for Problems related to the Generation, Transmission, and Conversion of Electric Energy.

Description of work

The workpackage is structured along three thematic areas (Modeling, Control of Power Generation and Transmission Systems, and Control of Power Electronics Systems, whose integration is essential for the effort to have any impact on the energy management problem. During the period M13 to M30, the partners will (i) complete the schedule they have committed to up to M18, (ii) engage in research activities for the development of hybrid control methods for the benchmarks they have defined, (iii) disseminate the preliminary results of their research efforts to receive feedback from the international scientific community, and (iv) plan the necessary steps for the experimental verification of their proposed solutions.

Task 4a.4 - Development of hybrid control methods for the proposed benchmarks

Task 4a.5 - Assess applicability of proposed solutions

Task 4a.6 - Disseminate preliminary results

Task 4a.7 - Plan experimental verification

Deliverables

D4a.2.1 Draft Survey Report
D4a.3.1 Final Report
D4a.5.2 Report on assessment of methods
D4a.7.1 Report on reviews' feedback, experimental verification plans

Milestones

M4a.3.1 Evaluation of task force progress
M4a.5.1 Group meeting with industrial critics
M4a.6.1 Submission to special conference session / special journal issue
M4a.6.2 Meeting with critics / discussion of reviewers' feedback, experimental verification plans

Tasks and Deliverables - Milestones

	WP4a – Energy management																		
N°	**Tasks**……..……Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4a.3	Conclude on plans for future activities																		
4a.4	Development of hybrid control methods for the proposed benchmarks																		
4a.5	Assess applicability of proposed solutions																		
4a.6	Disseminate preliminary results																		
4a.7	Plan experimental verification																		
N°	**Deliverables (D) / Milestones (M)**																		
D4a.2.1	Draft Survey Report	X																	
M4a.3.1	Evaluation of task force progress				X														
D4a.3.1	Final Report						X												
M4a.5.1	Group meeting with industrial critics												X						
D4a.5.2	Report on assessment of methods													X					
M4a.6.1	Submission to ACC / special journal issue														X				
M4a.6.2	Meeting with critics / discussion of review feedback, experimental verification plans																		X
D4a.7.1	Report on reviews' feedback, experimental verification plans																		X

WP4b – Industrial controls

Work package number	4b		Start date or starting event:					M13
Activity Type	Research activities							
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	0	0	8,5	0	0	21	0	8
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	ARADE
Person-months per participant	10,5	0	0	0	0	0	0	0
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	0	0	0	0	0	8,5	0	0
Participant id	UVA	CNR						
Person-months per participant	8,5	0						

Objectives

Based on the case studies developed in the first phase, the focus in the period M13 to M30 is to improve existing techniques for synthesizing and analyzing industrial hybrid controllers such that the challenges of industrial-size systems are better addressed. The following issues will be particularly emphasized:

- the analysis of hybrid control systems with respect to stability and the satisfaction of formal properties like safety and goal attainment;
- embedding safety-related restrictions into tools for performance optimization of industrial plants, including reconfiguration strategies for equipment malfunction;
- the reduction of complexity for the task of computing optimal control strategies by employing model approximation and abstraction.

Description of work

Task 4b.1 – Procedures for verification of safety-related discrete controls

Three different industrially relevant case studies have been developed within the first phase of HYCON (M1 to M12) within this strategic area: an avionic landing gear system (proposed by CNRS, motivated by an aircraft produced by Dassault aviation), a fuel cell system (US), and an evaporation system (UNIDO, in cooperation with Bayer Technology Services). While verification results for the landing gear system already exist and are documented, the further work within this task will focus on obtaining analysis results for the other two cases studies:

(a) Verification of the fuel cell system (Node: US)

In a first step, it is identified which of the existing verification tools are suited to solve the analysis task given in the problem description of the fuel cell system. Subsequently, the most appropriate tool is applied to check if safe operation can be ensured in all operation modes. (Node: US)

(b) Verification of the evaporation system (Node: UNIDO)

The objective of this case study is to show that a discrete controller prevents an evaporation system from reaching unsafe states (defined for pressure, temperature, and liquid levels) even in the case of malfunction of different actuators. UNIDO will apply its technique of counterexample-guided verification to obtain analysis results. Due to the size of the model, this application requires developing suitable strategies for model decomposition and (conservative) model simplification; this implies a link to the activities in task 4b.5.b.

(c) Assessment of the applicability of currently existing verification techniques (US, UNIDO)

Based on the experiences made in the tasks 4b.1.a and 4b.1.b, this activity aims at assessing the applicability of currently available techniques and drawing conclusions for necessary future developments. The outcome of this investigation will be summarized in a milestone report and also serves as a basis for the activities for task 4b.5.b.

Task 4b.2 – Control of large transitions in processing plants

A collection of six suitable cases studies were identified for this strategic area in the first phase: the end section of a sugar factory (proposed by UVA), a multi-tank pilot plant (UVA), a multi-product batch plant (UMD), a PVC production line (UCL together with Solvay), a multi-stage evaporator (UNIDO together with Bayer Technology Services), and an open plate reactor (LTH together with Alfa Laval AB). Initial results for generating (optimal) control strategies have been obtained so far mainly from those groups that have proposed the corresponding problem. In the upcoming phase, the objective for this task is to apply a larger set of techniques to the problems such that it can be concluded at the end for what particular industrial design problem a specific modeling format and solution approach is most appropriate. The problems are separated into two categories:

(a) The focus of these activities is on those case studies for which a complete hybrid model and a problem statement are available at this stage, and for which industrial relevance is obvious, i.e.:

- the multi-product batch plant,
- the PVC production line,
- and the multi-stage evaporator.

Different optimization-based approaches to control design will be applied to these case studies.

(b) Furthermore, different design techniques, which are not necessarily restricted to the optimal control of large transitions, will be investigated for the end section of a sugar factory, the multi-tank pilot plant, and the open plate reactor.

Task 4b.3 – Plans for the future

No new actions.

Task 4b.4 – Dissemination activities

The dissemination activities carried out so far (month 1 to 12), and the plans for the upcoming period are described in detail in the milestone report M.4b.4.1 (see the WP webpage). The core activities can be summarized as follows: publications on the case studies will be posted on the WP webpage and included in the publication database of WP5; one or two selected case studies will be included in the benchmark repository produced within WP2; it is planned to submit a special session on hybrid control techniques for industrial systems to the ADHS conference (Alghero, 2006); an industrial user day will be organized for mid of 2006; a special issue will be submitted to a suitable journal in the second half of 2006 to present different methods applied to one selected case study. In month 21, the dissemination activities are revised again with a focus to identify workshops or conferences at which the work of the WP should be presented in the period from month 22 to 30.

Task 4b.5 – Consideration of Plant Safety for Large Transitions in Processing Plants

This task aims at improving existing methods for designing controllers for large transitions with a particular focus on safety constraints. The activities are grouped into three areas:

Task 4b.5.a – Stability analysis

For some of the approaches applied in task 4.b.2, the investigation of stability of the controlled system is an open issue. UCL plans to obtain stability results for the PVC production line, UVA and US will work on a proof of stability for MPC approaches, and LTH will further develop techniques for robust stabilization and will apply them to the open plate reactor (see above).

Task 4b.5.b – Analysis of safety-related controllers by combining testing and verification

Motivated by the complexity of the verification task 4b.1.a/b, UNIDO and US aim at developing an analysis scheme that combines testing and verification. The idea is to first generate a suitable set of test cases with sufficient coverage of the state space and to identify potentially critical behaviors based on the test cases. In a second step, reachability analysis is applied only to those parts of the model for which step one has signalled behavior that may be critical with respect to a safe operation of the controlled system.

Task 4b.5.c – Reconfiguration strategies

Unsafe behavior of industrial plants often arises from the malfunction of specific pieces of equipment, e.g. that an actuator blocks in its current position. For the optimization-based control techniques applied in task 4.b.2, it is investigated under which conditions they still can generate safe control strategies if equipment malfunction occurs. In particular, it will be investigated exemplarily for one of the case studies of the area 'large transitions' under which conditions reconfigurations strategies can be found such that the original control goal (or a degraded version of it) can still be achieved.

Task 4b.6 – Complexity reduction for the computation of hybrid controllers for large transitions

The typical size of industrial plants limits the applicability of most techniques for generating (optimal) control strategies for large transitions such that only relative small parts of a plant can be considered at a time. This task aims at investigating approaches to better handle the complexity of industrial hybrid control problems. It will be studied, in particular, if algorithmically derived approximating or abstract models in combination with a step of model refinement can suffice in order generate (sub-)optimal control strategies.

Task 4b.7 – Workpackage Mangement

Deliverables

D4b.1.3 – Verification results for two of the case studies in the area 'safety-related discrete controls'

D4b.2.4 – Application results for three of the case studies in the area 'large transitions'

D4b.5.1 – Considering safety issues in large transitions

D4b.6.1 – Complexity reduction in controller synthesis for large transitions of processing plants

Milestones

M4b.1.4 – Assessment of the applicability of current verification techniques for industrial control

M4b.2.3 – Decision on the case studies to be included in the benchmark repository of WP2

M4b.4.2 – Plan for the dissemination activities in M22 to M30

Tasks and Deliverables - Milestones

	WP4b – Industrial controls																			
N°	**Tasks**……Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4b.1	Procedures for verification of safety related discrete controls																		
4b.2	Control of large transitions in processing plants																		
4b.3	Plans for the future																		
4b.4	Dissemination activities																		
4b.5	Techniques for ensuring a safe operation of industrial controlled systems																		
4b.6	Complexity reduction for the computation of hybrid controllers for large transitions of processing plants																		
N°	**Deliverables (D) / Milestones (M)**																		
D4b.1.3	Verification results for two of the case studies in the area safety-related discrete control									X									
M4b.2.3	Decision on the case studies to be included in the benchmark repository of WP2									X									
M4b.4.2	Plan for the dissemination activities in M22 to M30									X									
M4b.1.4	Assessment of the applicability of current verification techniques for industrial control												X						
D4b.2.4	Application results for three of the case studies in the area ‘large transitions’												X						
D4b.5.1	Considering safety issues in large transitions																		X
D4b.6.1	Complexity reduction in controller synthesis for large transitions																		X

WP4c – Automotive control WP4c – Automotive control

Work package number	4c		Start date or starting event:				M13
Activity Type	Research activities						
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	0	4,9	0	7,1	0	0	0	0
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	ARADE
Person-months per participant	0	0	2,9	2,4	7,9	7	6,4	11,3
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	9	0	3,4	5,7	0	16,1	4,1	8,1
Participant id	UVA	CNR						
Person-months per participant	0	1,3						

Objectives

The objective of this workpackage is to illustrate contributions to the improvement of design flows for embedded systems in the automotive industry that can be brought by the introduction of hybrid system modelling, analysis, synthesis and verification techniques.

Description of work

Task 4c.1: Hybrid models for automotive control

Due to the rich discrete-continuous interactions in automotive mechanical subsystems, hybrid modelling plays an important role in WP4c, as witnessed by the significant results obtained during the first year. Initially devoted mainly to HCCI and GDI engines modelling, this task has been extended to include spark ignition Multipoint Injection Engines, fuel consumption and energy management, exhaust after-treatment systems, powertrains, braking system and vehicle dynamics.
In particular, the partners will focus the activities within this task on
Case study 1: Hybrid modeling of engines
The experience gathered developing this case study will allow the partners to analyze advantages and difficulties encountered in hybrid modelling for automotive applications, provide motivations for new directions in hybrid system modelling techniques and clear indications for their fruitful introduction in industry.

Task 4c.2: Hybrid control in automotive applications

In the first year, the automotive control task covered a wide range of applications ranging from engine and vehicle dynamics control to efficient tail-pipe emission control. The application of hybrid design methodologies to automotive control problems will be further investigated. Optimal, switching, discrete-event and multi-rate approaches to controller design will be considered. In particular, research activities will be directed to
Case study 2: Optimal and MPC in vehicle dynamics control.
The resulting hybrid control algorithms will be compared with the standard ones employed in the industry in terms of performances, implementation requirements and calibration complexity. The quality of the proposed hybrid control strategies will be assessed by experimental results, either obtained using partners' test bed facilities or carried out by our industrial partners.

Task 4c.3: Design methodologies for embedded automotive control systems

Hybrid system analysis techniques allow designers to evaluate both the performances of the control algorithms at the functional level and the degradation due to their implementation on hw/sw platforms. Implementation platform evaluation will be obtained by introducing in the closed-loop model an abstract representation of the main effects due to the implementation and by analysing the behaviour for the resulting system. Exploration of the implementation parameters space will be performed to evaluate the trade-off between cost of the implementation platform and closed-loop performances. Combinations of randomized algorithms, formal analysis, and simulations will be used to sketch the critical scenarios at which the limits of performance of fault-tolerant controllers are reached. The proposed techniques will be evaluated in
Case study 3: Platform-based design of an ECU.

Task 4c.4 – Dissemination activities

Significant efforts will be devoted to dissemination of the results achieved in this workpackage among the industrial partners. Effective dissemination will be achieved by involving HYCON full and premium member automotive companies in the research activities. The second HYCON workshop on "Automotive applications of hybrid systems", scheduled in May 2006, will represent a major occasion for sharing the results and strengthening the collaborations with industry.

Deliverables

D4c.1.4 - Preliminary report on Case study 1: Hybrid modeling of engines
D4c.2.2 - Preliminary report on Case study 2: Optimal and MPC in vehicle dynamics control
D4c.3.2 - Preliminary report on Case study 3: Platform-based design of an ECU
D4c.4.2 - Proc. of the 2nd HYCON workshop "Automotive applications of hybrid systems"

Milestones

M4c.1.4 - Advantages achieved using hybrid modelling with respect to mean-value modelling
M4c.1.5 - Applicability of hybrid analysis and verification methodologies to automotive models
M4c.2.3 - Performance improvements using hybrid control design methodologies
M4c.2.4 - Industrial feasibility of hybrid control algorithms in automotive applications
M4c.3.2 - Criteria for the evaluation of different implementation platforms
M4c.3.3 - Hybrid approaches to automotive networked control design
M4c.4.2 - Feedbacks from the 2nd HYCON workshop "Automotive applications of hybrid systems"
M4c.4.3 - In depth look at the dissemination activities, recommendations for the future

Tasks and Deliverables – Milestones

	WP4c – Automotive control																		
N°	**Tasks**……Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4c.1	Hybrid models for automotive control																		
4c.2	Hybrid control in automotive applications																		
4c.3	Design methodologies for embedded automotive control systems																		
4c.4	Dissemination activities																		
N°	**Deliverables (D) / Milestones (M)**																		
M4c.1.4	Advantages achieved using hybrid modelling with respect to mean-value modelling						X												
M4c.2.3	Performance improvements using hybrid control design methodologies						X												
M4c.3.2	Criteria for the evaluation of different implementation platforms						X												
M4c.4.2	Feedbacks from the 2nd HYCON workshop "Automotive applications of hybrid systems"									X									
D4c.4.2	Proc. of the 2nd HYCON workshop "Automotive applications of hybrid systems"									X									
D4c.1.4	Preliminary report on Case study 1: Hybrid modeling of engines												X						
D4c.2.2	Preliminary report on Case study 2: Optimal and MPC in vehicle dynamics control												X						
D4c.3.2	Preliminary report on Case study 3: Platform-based design of an ECU												X						
M4c.4.3	In depth look at the dissemination activities, recommendations for the future												X						
M4c.1.5	Applicability of hybrid analysis and verification methodologies to automotive models																		X
M4c.2.4	Industrial feasibility of hybrid control algorithms in automotive applications																		X
M4c.3.3	Hybrid approaches to automotive networked control design																		X

WP4d – Networked Control

Work package number	4d		Start date or starting event:					M13
Activity Type	Research activities							
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	0	0	0	0	0	0	0	0
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	ARADE
Person-months per participant	0	0	0,5	8,5	20,1	12	10,5	4,8
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	0	0	0	13,5	10,5	1	0	0
Participant id	UVA	CNR						
Person-months per participant	0	4						

Objectives

The main objective of WP4d is on developing methodologies for hybrid modelling and design of control over wireless networks, with special motivation from wireless automation. The focus in the period M13-M30 will first be on a further refinement of the two case studies on networked control developed in the first phase, and then studies and evaluation of hybrid control tools applied to these problems. As part of the activities, initial planning will take place for experimental demonstrations relying on WP4d partners' available test-beds of wireless networked control systems.

Description of work

The work is organized in three tasks: Task 4d.2 is devoted to define and describe case studies for hybrid modelling and control in wireless networked systems. Task 4d.3 is focused on exploring and evaluating hybrid control tools for those case studies. Dissemination activities, including organization of workshops and conference sessions and industrial exposure of the results, take place within Task 4d.4.

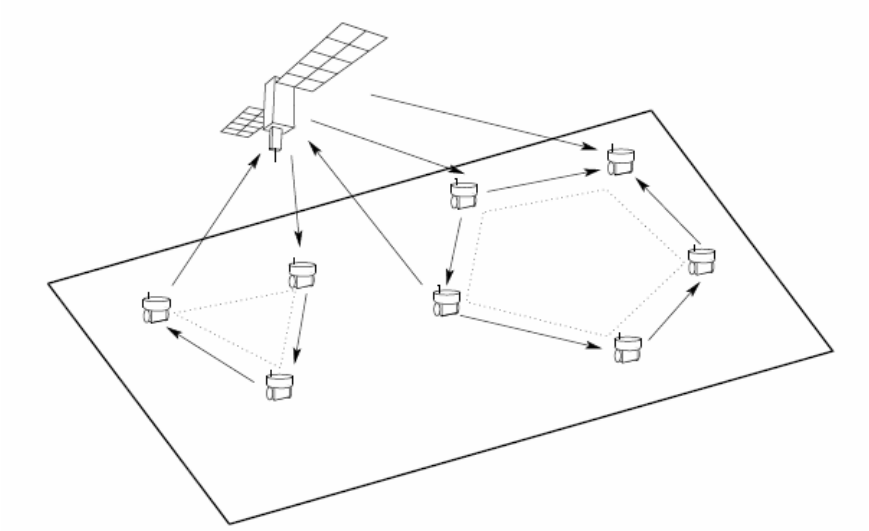
Task 4d.2 - Definition of case studies on hybrid modelling and control for networked control systems

Two case studies in the area of networked control over wireless networks will be studied. They are chosen based on the results of D4d.1.1 and D4d.1.2 and recommendations of the Industrial Advisory Board. The case studies are (a) Hybrid control of multi-robot systems over distributed wireless communication for industrial automation, and (b) Distributed and hybrid control of resources for control applications. The first case study is intended to model the collaborative behaviour of a multi-agent control system and explore hybrid systems tools to analyze performance limitations induced by the need of exchanging information across wireless links that have finite bandwidth and are not reliable. The second case study is devoted to a hybrid model of the joint behaviour of a monitoring/control application and the underlying wireless network: the goal is to achieve a meaningful (consistent) description of both components (application and network), so that management of radio resources can be tailored in an adaptive way to application requirements and application parameters can be tuned to the available network resources. A short description of the work planned for these case studies is provided in the following.

a) Hybrid control of multi-robot systems over distributed wireless communication for industrial automation This case study is on using hybrid control methodologies for distributed coordination of multi-robot systems, as illustrated in the figure below. Motivation for the study comes mainly from the development of new flexible manufacturing and control technologies for future industrial automation and robotics, but the research problem is quite generic and thus relevant in many areas of distributed control and networked synchronization.

Consider N identical mobile robots. The dynamics of each robot is governed by a control system \dot{x}_i=f_i(x_i,u_i), where x_i is the state of robot i and u_i the corresponding control. The objective is to achieve a desired multi-robot formation despite limited communication of the states between the robots. Examples of interesting formations are single point (rendezvous), line (platoon), lattice, and circle. Formations can be both stationary and moving; they can also be either fixed or changing over time. The communication topology is either given by a fixed graph or varying over time depending on the motion of the robots. An example of the latter is if robot i has a limited communication radius defining a neighborhood \mathcal{N}_i, such that robot j is in \mathcal{N}_i then robot i can use that state information in the control law u_i.

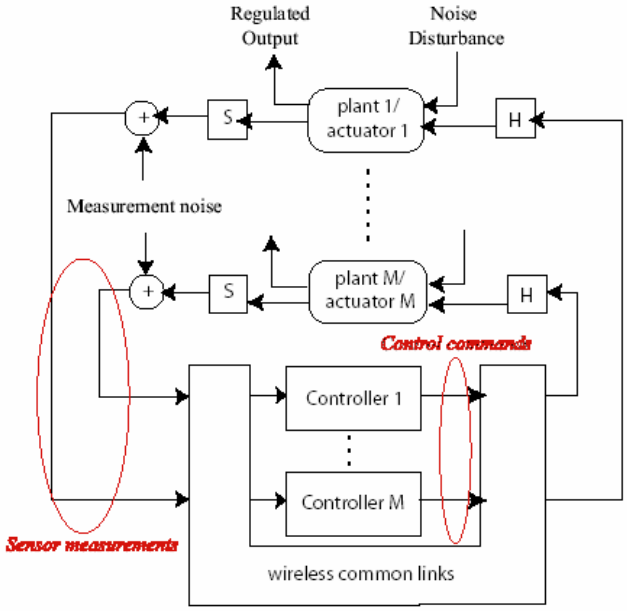
The proposed case study presents hybrid dynamics due to several reasons, e.g., (1) the communication topology is time-varying so the collaborative dynamics is switching depending on the current robot constellation; (2) the control strategy needs to switch between a set of discrete formations for the team of robot to efficiently pass obstacles etc.; and (3) the information communicated between robots is quantized. See D4d.1.2 for further background information on the case study.



b) Distributed and hybrid control of resources in wireless networks for control applications. This case study is focused on developing a hybrid dynamic model of resource allocation over wireless links, with particular focus on wireless sensor and actuator networks used in control applications. The explicit example that we address is represented by an adaptive framework for joint optimization of control performance (control over network) and network operations (control of networks) in a time-varying channel. A pictorial representation is provided in the figure below, where both measurements and commands are sent over shared wireless channels. Sound hybrid models that are able to capture the integration of the control application with the control of network resources is important for the progress of this case study.

This case study is inherently hybrid, e.g., (1) outage events in each wireless link determine

transitions among discrete states that represent network configuration at a macroscopic level; (2) at a further level of detail, a discrete component in the description of single link dynamics is represented by a finite set of channel capacities that can be made available for transporting information across the nodes of the distributed system; and (3) in many cases there are a set of control applications using a subset of the sensors and actuators, so the configuration will be switching over time. See D4d.1.1 and D4d.1.2 for further background information on the case study.



Task 4d.3 – Hybrid modeling and control for the proposed case studies

This task is devoted to the development and evaluation of hybrid control tools applied to the case studies defined in Task 4d.2. For case study (a) the focus will be on hybrid control methodologies for distributed coordination of multi-agent systems, while for case study (b) the focus will be on hybrid modeling for the integrated design of control and resource allocation algorithms for control applications utilizing wireless sensor networks. The work will essentially consist in theoretical advances that will be oriented to both improve control strategies under communication constraints and better modeling of characteristics of the wireless environment, especially statistics of outage events (rate of occurrence and duration), error control, multi-hop routing and energy efficiency issues. Fundamental constraints imposed by the control architecture, such as centralized vs decentralized and fixed vs switched, will be considered. Control over wireless links with explicit representation of limitations and imperfections of wireless networking (e.g., delays, link outages, delays, errors, multi-hop routing) will be studied. We focus in this phase on networking among homogeneous components. The research work includes the particular distributed control objectives given by coordination and consensus problems for multi-robot systems. Part of this task will explore cooperation with WP4c on application of wireless automation to automotive manufacturing. A plan for experimental validation will also be developed. Test-beds are under development by various partners and should be tuned to integrate and demonstrate the results of WP4d. This topic will be addressed within a project meeting that we intend to plan for detailed discussion of work on case studies, with involvement of WP4d IAB members.

Task 4d.4 – Dissemination activities

Efforts will be devoted to the dissemination activities as described in Section 6.2: GOLD System, Openness to other activities, Dissemination of knowledge, IPR. The dissemination plan includes the organization of a workshop on hybrid control using wireless sensor networks, to be held as a possible joint initiative with the NoE NEWCOM. The workshop is on invitation and no financial support is required from HYCON. An invited conference session will be organized in collaboration with the International Federation of Automatic Control Technical Committee on Networked Systems.

Deliverables

- D4d.2.2 – Definition and description of the case studies (M16)
- D4d.3.1 – First report on hybrid modelling and control for the case studies (M20)
- D4d.3.2 – Final report on hybrid modelling and control for the case studies (M29)
- D4d.3.3 – Plan for experimental validation (M30)

Milestones

M4d.3.1 – Internal meeting on case studies, test beds and industrial collaborations (M17)
M4d.3.2 – First assessment of hybrid modelling and control techniques for selected case studies (M18)
M4d.3.3 – Final assessment of hybrid modelling and control techniques for selected case studies and selection of further case studies for next phase (M30)
M4d.4.2 – Proposal for a workshop on control using wireless sensor networks (M21)
M4d.4.3 – Proposal for a conference session (M24)

Tasks and Deliverables - Milestones

	WP4d – Networked Control																			
N°	**Tasks**……Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4d.2	Definition of case studies on hybrid modelling and control for networked control systems																		
4d.3	Hybrid modeling and control for the proposed case studies																		
4d.4	Dissemination activities																		
N°	**Deliverables (D) / Milestones (M)**																		
D4d.2.2	Definition and description of the case studies				**X**														
M4d.3.1	Internal meeting on case studies, test beds and industrial collaborations					**X**													
M4d.3.2	First assessment of hybrid modelling and control techniques for selected case studies						**X**												
D4d.3.1	First report on hybrid modelling and control for the case studies								**X**										
M4d.4.2	Proposal for a workshop on control using wireless sensor networks									**X**									
M4d.4.3	Proposal for a conference session												**X**						
D4d.3.2	Final report on hybrid modelling and control for the case studies																**X**		
D4d.3.3	Plan for experimental validation																		**X**
M4d.3.3	Final assessment of hybrid modelling and control techniques for selected case studie and selection of further case studies for next phase																		**X**

WP5 – Knowledge management

Work package number	5		Start date or starting event:					M13
Activity Type	Spreading activities							
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	0	1,5	1,5	0	18,5	1,5	0	0
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	ARADE
Person-months per participant	1,5	2	0	1,5	2	1	1,5	0
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	3	4,5	0	0	0	0	0	1
Participant id	UVA	CNR						
Person-months per participant	2,5	0						

Objectives

With the creation of a common "language" in hybrid systems, the installation of a comprehensive knowledge source on hybrid systems and with the spread of excellence to young researchers and to groups outside the NoE, this work package contributes to the integration of the nodes within the network and the building of **durable structures of hybrid systems research** and has direct impacts on the future of hybrid systems research and application.

Description of work

This description of work reflects the modified task structure of WP5 compared to the first reporting period from M1-M12. The work package now contains three tasks and a parallel task for knowledge dessimination. The following description depicts the tasks of the period from month 13 to month 30 in detail.

Task 5.1 – Taxonomy of the domain of hybrid system

In this task a common "language" for the domain of hybrid systems will be developed. The approach requires the elaboration of taxonomy of hybrid systems, which will be used to classify and organize existing knowledge on hybrid systems. It will provide the basis for an effective retrieval of the documents in the annotated bibliography. The taxonomy will be published to the community of researchers of the NoE.

Task 5.2 – Annotated bibliography

The annotated bibliography will improve and simplify the access to relevant knowledge which is the key factor for the reinforcement of scientific and technological excellence across Europe. The annotated bibliography will provide a web-based interface for accessing systematically organized references, i.e. bibliographical data to journal articles and proceedings related to hybrid systems theory. The organization of the references will be executed according to the elaborated taxonomy (see task 5.1). The core objective of this task is to set up a shared technical infrastructure as well as to input a substantial number of relevant documents into the repository of the annotated bibliography.

Task 5.3 – Handbook of hybrid systems

A handbook of hybrid systems commonly written by the network partners should explain the main problems, ideas and methods for the analysis and design of hybrid systems. It results from the efforts made in other workpackages. Besides the main theoretical ideas, the specific problems encountered in different application areas will be described based on the results of the workpackages WP4x.

Task 5.4 – Dissemination activities

Knowledge acquired in hybrid systems has to be actively spread among researchers to pertain excellence. The activities of this task will open up complementary channels of knowledge transportation with respect to the infrastructure to be set up in tasks 5.1 through 5.3. As summer schools are a central dissemination activity of the network, the corresponding subtask and the deliverables have been moved to workpackage 1.

Deliverables

D5.1.3 – Taxonomy available on the web for the NoE
D5.2.2 – First version of the annotated bibliography available on the web
D5.2.6 – Metadata generation tool (HYDRA) for authors
D5.4.5 – Proceedings of the special session on hybrid systems at ECC-CDC

Milestones

M5.2.1 – Workshop for the discussion of the annotated bibliography
M5.2.3 – Survey of requirements regarding additional functionality of the annotated bibliography from the perspective of other HYCON WPs
M5.2.4 – On-line interface, which links the taxonomy to the metadata generator and the annotated bibliography, is available
M5.3.1 – Elaboration of the scope and structure of the hybrid systems handbook
M5.3.2 - Revised version of the handbook structure and list of tentative authors

Tasks and Deliverables – Milestones

	WP5 – Knowledge Management																		
N°	**Tasks**……Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
5.1	Taxonomy and glossary of the domain of hybrid system																		
5.2	Annotated bibliography																		
5.3	Handbook of hybrid systems																		
5.4	Dissemination activities																		
N°	**Deliverables (D) / Milestones (M)**																		
D5.1.3	Taxonomy available on the web for the NoE						X												
D5.4.5	Proceedings of the special session on hybrid systems at ECC-CDC						X												
M5.2.1	Workshop for the discussion of the annotated bibliography								X										
M5.3.1	Elaboration of the scope and structure of the hybrid systems handbook								X										
D5.2.2	First version of the annotated bibliography available on the web												X						
M5.2.4	On-line interface, which links the taxonomy to the metadata generator and the annotated bibliography, is available														X				
M5.2.3	Survey of requirements regarding additional functionality of the annotated bibliography from the perspective of other HYCON WPs															X			
M5.3.2	Revised version of the handbook structure and list of tentative authors															X			
D5.2.6	Metadata generation tool (HYDRA) for authors																		X

WP6 – Industrial bridging

Work package number	6		Start date or starting event:					M13
Activity Type	Spreading activities							
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	1,5	0	0	12,1	2	3,75	0	0
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	ARADE
Person-months per participant	0	0,9	0	0	3,4	2,4	0	10,8
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	0	0	0	1,3	0	1,7	2	1,9
Participant id	UVA	CNR						
Person-months per participant	0	0						

Objectives

Industrial participation is an important component of the NoE. The aim of this work package is to establish channels for effective long-term collaborations between Industry and Academia to refine and guide the hybrid system research pursued by the NoE and to introduce the proposed methodologies in industry. The bilateral collaboration will involve training programs managed by the academic team of the NoE, especially crafted for our industrial partners, test cases defined by industry, and software packages placed in the open domain to foster collaboration among the different constituencies of the NoE.

Description of work

This work package consists of the following tasks that articulate our view of industrial relations.

Task 6.1 – Engaging industrial partners and associates

The aim of this task is to increase the involvement of industry in the NoE, specifically for the application domains addressed in WP4. The objectives of this task are: to increase the number of industrial partners, to identify the specific needs and interests of each industrial partner, to guarantee that no industrial interest goes unanswered and that each contributor is participating in the most convenient form. These objectives will be pursued in strict collaboration with WP4, exploiting and reinforcing existing contacts as well as establishing new connections.

Based on the work carried out in year 1, industrial partner affiliations will be further extended increasing the number of connected companies, associated member companies, full member companies and premium member companies. Each company will receive information and will be invited to contribute to the NoE activities according to the chosen affiliation.

Every 6 months, the status of industry affiliation will be monitored and engagement strategies and industry involvement will be evaluated. Possible correcting actions will be identified and proposed. The industrial representatives most interested in having fruitful collaborations with the NoE will be invited to join the Industrial Advisory Board. At least a representative for each application domain addressed in WP4 will participate to the IAB. For each application area, an industrial committee will be set up collecting representatives from the HYCON affiliated companies. The committees will report to the IAB through their representatives.

The possibility of having industrial partners integrated in the Consortium, with the same responsibilities and benefits of other participants, will be evaluated on a case-by-case basis.

Task 6.2 – Identifying case studies and pilot projects

This task is devoted to soliciting connections with industry to assess the relevance of the NoE activities. Industries affiliation to HYCON will create the opportunity for opening new channels for effective long-term collaborations within the WP4 research program. Elbow-to-elbow collaboration cannot be equated to any other method for this task, since it guarantees high-bandwidth low-latency communication and favours a more effective integration. This task creates opportunities for industrial practitioners and researchers to come together and define research projects to develop in collaboration. The collaboration with industry on this task will produce inputs to both WP4 and WP2. The reports on pilot projects will be reviewed by the IAB.

Task 6.3 – Training programs

This task aims at the dissemination of hybrid systems methodologies in industry in a way that it is suitable for the background of the staff of research and development departments in industry. Activities will be carried out jointly with WP1. An Industrial Liaison board will superintend to training programs that are supported in part by the NoE and in part by the receiving industry, according to rules to be set up as an early deliverable of this NoE. A network of distinguished lecturers with competent lecturers and discussion partners will be set up in order to guarantee a higher quality effusion of this knowledge. The virtual library and the on-line handbook on hybrid systems developed within WP5 will be promoted in industry and will be instrumental in the dissemination activities.

Task 6.4 – Promoting open domain software

Software developed within the Jointly Executed Research will be published as it will be in open domain, as described in WP3, focusing on it the attention of both the industrial and academic scientific and engineering communities. Contacts between partners developing tools within WP3 and industries will be established, facilitating the presentation of the tools in industry by the partners and involving the industry in the evaluation of the tools.

Task 6.5 – Intellectual Property Rights management

The introduction of this task, specifically devoted to Intellectual Property Rights management, is motivated by the Consortium's awareness of the importance of acquiring correct behaviours in handling legal implications related to IPR (this activity was carried out within Task 6.1 in year 1).

The aim of this task is to support the NoE partners in handling IPR issues by implementing an operational project organisation for the identification of IPR relevant aspects, the subsequent intellectual protection and the dissemination of new inventions and discoveries.

This task will provide the partners with the necessary background and support on: strategies for knowledge protection, best practices and patent procedures and techniques, model contracts. The planned activities will be coordinated by the IPUDC (Intellectual Property Use and Dissemination Committee) and will help the negotiations with industry by providing good practices on protection techniques.

The Intellectual Property Rights policy for Industrial Partner/Associate Agreement defined in year 1 will be extended and updated taking into account the needs of the partners. A common IPR strategy model to network organisations and a guide on the Commission contract IPR rules will be proposed. Common model documents of agreements for property rights such as joint ownership of knowledge and Non-Disclosure Agreements will be defined.

Deliverables

D6.1.3 - Report on industry affiliation and industry involvement at M24
D6.2.2 - Inventory of pilot projects – Release 2
D6.3.1 - Programme definition including potential lecturers and outline of the lecture material
D6.5.1 - Intellectual Property Rights policy for Industrial Partner/Associate Agreements and common IPR strategy - Release 2

Milestones

M6.1.3 – Status of industry affiliation, evaluation of engagement strategy and industry involvement
M6.1.4 – Status of industry affiliation, evaluation of engagement strategy and industry involvement
M6.1.5 – Status of industry affiliation, evaluation of engagement strategy and industry involvement
M6.2.2 – Feedbacks from industrial partners on NoE deliverables
M6.3.1 – Definition of the aims and structure of the seminar programme
M6.3.2 – Status of NoE training programs
M6.4.1 – Distribution of the open domain software to industrial partners and associates
M6.4.2 – Feedbacks from industrial partners on NoE open domain software
M6.5.4 – Support to prepare the plan for use and dissemination of knowledge

Tasks and Deliverables - Milestones

	WP6 – Industrial bridging																		
N°	**Tasks**……Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
6.1	Engaging industrial partners and associates																		
6.2	Identifying case studies and pilot projects																		
6.3	Training programs																		
6.4	Promoting open domain software																		
6.5	Intellectual Property Rights management																		
N°	**Deliverables (D) / Milestones (M)**																		
M6.1.3	Status of industry affiliation, evaluation of engagement strategy and ind. involvement						X												
M6.3.1	Definition of the aims and structure of the seminar programme						X												
M6.2.2	Feedbacks from industrial partners on NoE deliverables						X												
D6.3.1	Programme definition including potential lecturers and outline of the lecture material								X										
M6.4.1	Distribution of the open domain software to industrial partners and associates								X										
M6.1.4	Status of industry affiliation, evaluation of engagement strategy and ind. involvement												X						
D6.1.3	Report on industry affiliation and industry involvement at M24												X						
D6.2.2	Inventory of pilot projects – Release 2												X						
D6.5.1	IPR policy for Industrial Partner/Associate Agreements and IPR strategy - Release 2												X						
M6.5.4	Support to prepare the plan for use and dissemination of knowledge												X						
M6.3.2	Status of NoE training programs																X		
M6.4.2	Feedbacks from industrial partners on NoE open domain software																X		
M6.1.5	Status of industry affiliation, evaluation of engagement strategy and ind. involvement																		X

WP7 – Project management

Work package number	**7**		**Start date or starting event:**					M13
Activity Type	Management activities							
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	9,05	6,6	0	0	0	0	0	0
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	ARADE
Person-months per participant	0	0	0	0	0	0	0	0,2
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	0	0	0	0	0	0	0	0
Participant id	UVA	CNR						
Person-months per participant	0	0						

Objectives

The aim of this workpackage is to establish the global framework of the Project and the setting up of the relevant structures and procedures for the performance defined in the JPA. Following the Consortium's rights and obligations under the Contract, this workpackages defines the Consortium's contractual, financial and technical management activities. In accordance to the provisions specified in the Contract and the Consortium Agreement, this workpackage shall allow to define, implement and control all the necessary and appropriate internal arrangements in order to ensure the efficient implementation and progress of the Project.

Description of work

Task 7.1 - Contractual / legal management

FIST is in charge of the management of the Contract, including:

- Constitution of the Consortium (signature of the Contract and administering the formalities to be completed by the Contractors)
- Administering the necessary and relevant formalities relating to the entry of new Contractors relating to the Contract and the Consortium Agreement
- Legal and administrative advisory services to the Contractors for the negotiation of the Contract and its amendments
- Editing of all contractual documents relating to the Contract following the provisions of the Consortium Agreement and the appropriate decision-taking instances of the Project
- Legal and administrative advisory services to the negotiation and maintenance of the Consortium Agreement and any internal agreements to be defined.
- Editing of all contractual documents relating to the Contract following the provisions of the Consortium Agreement and the appropriate decision-taking instances

Task 7.2 - Financial management

FIST realises the financial management, including:

- Receiving the financial contribution to the Project by the European Commission and distributing the fund following the appropriate provisions given by the appropriate Consortium Body
- Administering the Project's bank account, making it possible to determine at any time what portion of the Community funds has been paid to each Contractor for the purposes of the Project
- Reporting of the financial status of the Project
- Informing the Commission of the distribution of the funds and the date of transfers to the

Contractors
- Assisting the Contractors in preparing their cost statements: checking that costs are eligible according to the EC Contract and any relevant provisions to the Consortium Agreement.
- Obtaining audit certificates of the Contractors' financial statements (Eligible costs and Receipts) incurred up to the time when the final financial statement is submitted to the Commission)
- Obtaining any financial security such as bank guarantees when requested by the Commission

Task 7.3 - Technical and scientific Management
CNRS is in charge of **:**

- Checking the project progress against planned schedule
- Checking manpower consumption,
- Checking that milestones are met and deliverable properly produced
- Organizing of reviews and submission of deliverables and schedules.
- Organizing of information flow throughout the different bodies in the NoE.
- Keeping contact with the Project Officer and the Commission
- Defining the adapted tools and methods to be adopted by the Participants

Deliverables

D 7.2.2 - Financial reports and audit certificates
D 7.3.4 – Activity report

Milestones

M7.1.5. - Receiving the justification of resources deployed by each Contractor
M7.1.6. - Receiving form C financial statement from each Contractor
M7.2.7 – 2nd allocation of payments to the Contractors (according to 1st GB decision
M7.2.8 - Periodic payments to the Contractors
M7.2.9 - Reception and allocation of payments
M7.3.8 - Governing Boards: organisation, participation, minutes
M7.3.9 - Executive Committee meetings : organisation, participation
M7.3.10 - Executive Committee meetings : organisation, participation
M7.3.11 - Executive Committee meetings : organisation, participation
M7.3.12 - Negotiation of the update programm

Tasks and Deliverables - Milestones

	WP7 – Project management																		
N°	**Tasks**……Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
7.1	Contractual / legal management																		
7.2	Financial management																		
7.3	Project management																		
N°	**Deliverables (D) / Milestones (M)**																		
M7.2.2	2nd allocation of payments to the Contractors	X																	
M7.3.2	Governing Boards: organisation, participation, minutes			X															
M7.3.9	Executive Committee meetings : organisation, participation				X														
M7.2.8	Periodic payments to the Contractors						X												
M7.3.10	Executive Committee meetings : organisation, participation, minutes								X										
M7.1.5	Receiving the justification of resources deployed by each Contractor												X						
M7.1.6	Receiving form C financial statement from each Contractor												X						
M7.2.9	Reception and allocation of payments												X						
D7.3.4	Activity report												X						
D7.2.2	Financial report and audit certificates												X						
M7.3.12	Negotiation of the update programme												X						
M7.3.11	Executive Committee meetings : organisation, participation												X						

WP8 – Assessment, evaluation and quality

Work package number	8		Start date or starting event:				M13
Activity Type	Management activities						
Participant id	FIST	CNRS	UCL	ETHZ	RUB	UNIDO	DLR	UMD
Person-months per participant	0	18,25	0	2	2,5	2	0	0
Participant id	US	SUPELEC	INRIA	UPAT	UAQ	UNIPI	UNISI	ARADE
Person-months per participant	1	0	0	0	1	1	1,5	1
Participant id	TUE	UT	TUD	KTH	ULIN	LTH	UCAM	RWTH
Person-months per participant	1	0	0	2	0	0	0	0
Participant id	UVA	CNR						
Person-months per participant	0	0						

Objectives

The **Review and Assessment** of project results and progress towards the objectives will provide the necessary input to evaluate the activities and plan the NoE activities for the next period

Description of work

The NoE activities as a whole will be accessed in a early basis by a review of all its activities This will cover scientific, dissemination, management, legal, IPR, communication, educational and gender issue. The results achieved in the Joint Programme of Activities will be compared to the original plans and deviations analysed. A report will be issued with recommendation for next 18 months of work and a first version of the Joint Programme of activities for the next period of work will be presented in the Governing Board. This report will be discussed and a final version will be issued in order to rule the next year's network activities. HYCON will leverage work in other projects in the best possible way and will execute synergy actions with relevant projects. A special report will be devoted to the Gender action plan.

Task 8.1 - The documents reporting scientific, management, dissemination, legal, IPR, communications, and educational progress will be presented to the Advisory Committee for analysis and comment.

Task 8.2 - Analysis of the Joint Programme of Activities carried out during the period and its deviation to the original plans including recommendation for next period. Report on risk analysis.

Task 8.3 - Report on the progress of the Gender action plan

Task 8.4 - JPA work plan for the next 18 months

Task 8.5 - Synergy actions with other projects

Deliverables

D8.1.1 - Report on dissemination activity and recommendations
D8.2.1 - JPA work analysis of deviation to original plans and recommendations
D8.2.2 - Report on the scientific and technical risk and recommendations
D8.3.1 - Report on the progress of the Gender action plan
D8.4.1 - Updating of next 18 Months JPA work programme
D8.5.1 - Report on synergy actions with other projects

Milestones

M8.1.3 - Gathering of activity reports
M8.1.4 - List of network main achievements
M8.2.1 - Comparison Indicators, objectives and quality to access deviations
M8.3.2 - Decision for work programme amendments
M8.4.1 - Report on the standardisation issues and their future implementation
M8.4.3 - Decision as the utilisation of funding for the next period

Tasks and Deliverables – Milestones

	WP8 – Assessment, evaluation and quality																		
N°	**Tasks**……..…Months	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
8.1	Gathering information and reports																		
8.2	Updating of the JPA for the second project period																		
8.3	Work analysis of deviation to original plans and recommendations																		
8.4	JPA work plan for the next 18 months																		
8.5	On synergy actions with other projects																		
N°	**Deliverables (D) / Milestones (M)**																		
M8.3.2	Decision for work programme amendments	X																	
D8.2.1	JPA work analysis of deviation to original plans and recommendations		X																
D8.4.1	Updating of next 18 Months JPA work programme		X																
M8.2.1	Comparison Indicators, objectives and quality to access deviations			X															
M8.4.1	Report on the standardisation issues and their future implementation			X															
M8.4.3	Decision as the utilisation of funding for the next period			X															
D8.3.1	Report on the progress of the Gender action plan						X												
D8.2.2	Report on the scientific and technical risk and recommendations						X												
M8.1.3	Gathering of activity reports											X							
M8.1.4	List of network main achievements											X							
D8.1.2	Report on dissemination activity and recommendations												X						
D8.5.2	Report on synergy actions with other projects												X						
D8.1.3	Periodic progress report												X						
D8.2.2	JPA work analysis of deviation to original plans and recommendations														X				
D8.4.2	Updating of next 18 Months JPA work programme														X				
D8.3.2	Report on the progress of the Gender action plan																		X

10. Project resources and estimation of incurred eligible costs

10.1 Indicative Efforts full duration

Participant n°	Short name	ntegrating ıctivities	Jointly executed research activities	Spreading of excellence	Management activities	Total per participant (person/ months)
1	FIST	3		1	24	28
2	CNRS	21	32	7	26	86
3	UCL	5	21	2		28
4	ETHZ	20	68	18	2	108
5	RUB	8		44	2	54
6	UNIDO	51	40	17	2	110
7	DLR	9				9
8	UMD	9	18			27
9	US	54	29	11	2	96
10	SUPELEC	8	11	5		24
11	INRIA	2	9	2		13
12	UPAT	16	22	4	0	42
13	UAQ	10	50	8	2	70
14	UNIPI	34	26	14	2	76
15	UNISI	46	33	9	2	90
16	PARADES	8	35	20	2	65
17	TUE	26	28	8		62
18	UT	11	7	7		25
19	TUD	3	19	1		23
20	KTH	10	43	17	2	72
21	ULIN	5	12	10		27
22	LTH	2	73	2		77
23	UCAM	10	8	5		23
25	RWTH	5	10	6		21
26	UVA	14	8	5		27
27	CNR	3	12	2		17
Overall TOTAL efforts		393	614	225	68	1300

10.2 Indicative Efforts M13-M30

Indicative effort- M13 → M30

JPA	1 FIST	2 CNRS	3 UCL	4 ETHZ	5 RUB	6 UNID	7 DLR	8 UMD	9 US	10 SUP	11 INRIA	12 UPAT	13 UAQ	14 UNIPI	15 UNISI	16 PARA	17 TUE	18 UT	19 TUD	20 KTH	21 ULIN	22 LTH	23 UCAM	24 RWTH	25 UVA	26 CNR	
WP1	0,7	3,2	2	2,75	1,2	2,7	0	2,5	2,2	1,2	0	1	1,55	10,5	13	0,8	3,1	0	0,25	2,2	0	0	0	0	0	1,7	**52,55**
WP2	0	1,5	0	7,6	1	8,1	0	0	31,8	1,75	0	0	0	8,1	6,6	2,1	0	0	0	0	0	3	1,6	0	6,1	0	**79,25**
WP3	0	0	0	8	0	15,5	4	0	0	0	0	5,5	0	0	14	2,5	9,5	4	0	0	0,5	0	0	0	0	0	**63,5**
WP4a	0	6,5	0	21	0	0	0	0	7	5	0	0	0	0	0	0	0	4,5	7	8	0	12,5	0	0	0	0	**71,5**
WP4b	0	0	8,5	0	0	21	0	8	10,5	0	0	0	0	0	0	0	0	0	0	0	0	8,5	0	0	8,5	0	**65**
WP4c	0	4,9	0	7,1	0	0	0	0	0	0	2,9	2,4	7,9	7	6,4	11,3	9	0	3,4	3,8	0	16,1	4,1	8,1	0	1,3	**95,7**
WP4d	0	0	0	0	0	0	0	0	0	0	0,5	8,5	20,1	12	10,5	4,8	0	0	0	9	10,5	1	0	0	0	4	**80,9**
WP5	0	1,5	1,5	0	18,5	1,5	0	0	1,5	2	0	1,5	2	1	1,5	0	3	4,5	0	0	0	0	0	1	2,5	0	**43,5**
WP6	1,5	0	0	12,1	2	3,75	0	0	0	0,9	0	0	3,4	2,4	0	10,8	0	0	0	0,6	0	1,7	2	1,9	0	0	**43,05**
WP7	9,05	6,6	0	0	0	0	0	0	0	0	0	0	0	0	0	0,2	0	0	0	0	0	0	0	0	0	0	**15,85**
WP8	0	18,25	0	2	2,5	2	0	0	1	0	0	0	1	1	1,5	1	1	0	0	2	0	0	0	0	0	0	**33,25**
	11,25	**42,45**	**12**	**60,55**	**25,2**	**54,55**	**4**	**10,5**	**54**	**10,85**	**3,4**	**18,9**	**35,95**	**42**	**53,5**	**33,5**	**25,6**	**13**	**10,65**	**25,6**	**11**	**42,8**	**7,7**	**11**	**17,1**	**7**	**644,05**

10.4 Estimation of incurred eligible costs

10.4.1 Estimation of incurred eligible costs –18 months period, month 13-30

Participant n°	Participant short name	Cost model used	Estimated incurred eligible costs (detailed JPA for months 1-18)		Estimation of incurred eligible costs			Total receipts Month 13-30
					Joint Programme of Activities[2] (1) Month 13-30	Consortium Management Activities (2) Month 13-30	Total (3)=(1)+(2) Month 13-30	
1	FIST	FCF	Eligible costs	*Direct costs (a)*		35,214	35,214	
				of which subcontracting				
				Indirect costs (b)		7,043	7,043	
				Total eligible costs (a)+(b)		42,257	42,257	
			Requested EC contribution			42,257	42,257	
2	CNRS	FCF	Eligible costs	*Direct costs (a)*	109,178	17,380	126,558	
				of which subcontracting				
				Indirect costs (b)	21,835	3,476	25,311	
				Total eligible costs (a)+(b)	131,013	20,856	151,869	
			Requested EC contribution		100,000	20,856	120,856	
3	UCL	AC	Eligible costs	*Direct costs (a)*	23,394		23,394	
				of which subcontracting				
				Indirect costs (b)	4,679		4,679	
				Total eligible costs (a)+(b)	28,073		28,073	
			Requested EC contribution		28,073		28,073	
4	ETHZ	AC	Eligible costs	*Direct costs (a)*	136,372		136,372	
				of which subcontracting				
				Indirect costs (b)	27,274		27,274	
				Total eligible costs (a)+(b)	163,646		163,646	
			Requested EC contribution		163,646		163,646	
5	RUB	AC	Eligible costs	*Direct costs (a)*	90,931		90,931	
				of which subcontracting				
				Indirect costs (b)	18,186		18,186	
				Total eligible costs (a)+(b)	109,117		109,117	
			Requested EC contribution		109,117		109,117	

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6	UNIDO	AC	Eligible costs	*Direct costs (a)*	146,963		146,963	
				of which subcontracting				
				Indirect costs (b)	29,393		29,393	
				Total eligible costs (a)+(b)	176,356		176,356	
			Requested EC contribution		176,356		176,356	
7	DLR	FC	Eligible costs	*Direct costs (a)*	17,735		17,735	
				of which subcontracting				
				Indirect costs (b)	8,123		8,123	
				Total eligible costs (a)+(b)	25,858		25,858	
			Requested EC contribution		25,858		25,858	
8	UMD/TUB	AC	Eligible costs	*Direct costs (a)*	38,386		38,386	
				of which subcontracting				
				Indirect costs (b)	7,677		7,677	
				Total eligible costs (a)+(b)	46,063		46,063	
			Requested EC contribution		46,063		46,063	
9	US	AC	Eligible costs	*Direct costs (a)*	131,083		131,083	
				of which subcontracting				
				Indirect costs (b)	26,217		26,217	
				Total eligible costs (a)+(b)	157,300		157,300	
			Requested EC contribution		157,300		157,300	
10	SUPEL	FC	Eligible costs	*Direct costs (a)*	10,000		10,000	
				of which subcontracting				
				Indirect costs (b)	5,400		5,400	
				Total eligible costs (a)+(b)	15,400		15,400	
			Requested EC contribution		4,141		4,141	
11	INRIA	FC	Eligible costs	*Direct costs (a)*	3,714		3,714	
				of which subcontracting				
				Indirect costs (b)	2,972		2,972	
				Total eligible costs (a)+(b)	6,686		6,686	
			Requested EC contribution		6,686		6,686	
12	UPAT	AC	Eligible costs	*Direct costs (a)*	36,798		36,798	
				of which subcontracting				
				Indirect costs (b)	7,359		7,359	
				Total eligible costs (a)+(b)	44,157		44,157	
			Requested EC contribution		44,157		44,157	

13	UAQ	AC	Eligible costs	*Direct costs (a)*	68,737		68,737	
				of which subcontracting				
				Indirect costs (b)	13,747		13,747	
				Total eligible costs (a)+(b)	82,484		82,484	
			Requested EC contribution		82,484		82,484	
14	UNIPI	AC	Eligible costs	*Direct costs (a)*	147,713		147,713	
				of which subcontracting				
				Indirect costs (b)	29,542		29,542	
				Total eligible costs (a)+(b)	177,255		177,255	
			Requested EC contribution		177,255		177,255	
15	UNISI	AC	Eligible costs	*Direct costs (a)*	132,177		132,177	
				of which subcontracting				
				Indirect costs (b)	26,435		26,435	
				Total eligible costs (a)+(b)	158,612		158,612	
			Requested EC contribution		158,612		158,612	
16	PARA DE	FCF	Eligible costs	*Direct costs (a)*	100,000		100,000	
				of which subcontracting				
				Indirect costs (b)	20,000		20,000	
				Total eligible costs (a)+(b)	120,000		120,000	
			Requested EC contribution		97,326		97,326	
17	TUE	AC	Eligible costs	*Direct costs (a)*	55,125		55,125	
				of which subcontracting				
				Indirect costs (b)	11,025		11,025	
				Total eligible costs (a)+(b)	66,150		66,150	
			Requested EC contribution		66,150		66,150	
18	UT	FC	Eligible costs	*Direct costs (a)*	8,000		8,000	
				of which subcontracting				
				Indirect costs (b)	5,760		5,760	
				Total eligible costs (a)+(b)	13,760		13,760	
			Requested EC contribution		7,642		7,642	
19	TUD	AC	Eligible costs	*Direct costs (a)*	41,263		41,263	
				of which subcontracting				
				Indirect costs (b)	8,253		8,253	
				Total eligible costs (a)+(b)	49,516		49,516	
			Requested EC contribution		49,516		49,516	

20	KTH	AC	Eligible costs	*Direct costs (a)*	74,112		74,112	
				of which subcontracting				
				Indirect costs (b)	14,822		14,822	
				Total eligible costs (a)+(b)	88,934		88,934	
			Requested EC contribution		88,934		88,934	
21	ULIN	AC	Eligible costs	*Direct costs (a)*	22,453		22,453	
				of which subcontracting				
				Indirect costs (b)	4,491		4,491	
				Total eligible costs (a)+(b)	26,944		26,944	
			Requested EC contribution		26,944		26,944	
22	LTH	AC	Eligible costs	*Direct costs (a)*	78,116		78,944	
				of which subcontracting				
				Indirect costs (b)	15,623		15,623	
				Total eligible costs (a)+(b)	93,739		93,739	
			Requested EC contribution		93,739		93,739	
23	UCAM	AC	Eligible costs	*Direct costs (a)*	27,412		27,412	
				of which subcontracting				
				Indirect costs (b)	5,482		5,482	
				Total eligible costs (a)+(b)	32,894		32,894	
			Requested EC contribution		32,894		32,894	
24	RWTH	AC	Eligible costs	*Direct costs (a)*	30,250		30,250	
				of which subcontracting				
				Indirect costs (b)	6,050		6,050	
				Total eligible costs (a)+(b)	36,300		36,300	
			Requested EC contribution		36,300		36,300	
25	UVA	AC	Eligible costs	*Direct costs (a)*	21,450		21,450	
				of which subcontracting				
				Indirect costs (b)	4,290		4,290	
				Total eligible costs (a)+(b)	25,740		25,740	
			Requested EC contribution		25,740		25,740	
26	CNR	AC	Eligible costs	*Direct costs (a)*	17,417		17,417	
				of which subcontracting				
				Indirect costs (b)	3,483		3,483	
				Total eligible costs (a)+(b)	20,900		20,900	
			Requested EC contribution		20,900		20,900	

TOTAL (for months 13-30)	Total eligible costs	1,896,887	63,113	1,960,000
	Total requested EC contribution	1,825,832	63,113	1,888,945

10.4.2. Estimation of incurred eligible costs –full duration (48 months)

Participant n°	Participant short name	Cost model used	Estimated incurred eligible costs (whole duration of project))		Estimation of incurred eligible costs			Total receipts
					Joint Programme of Activities[3] (1)	Consortium Management Activities (2)	Total (3)=(1)+(2)	
1	FIST	FCF	Eligible costs	*Direct costs (a)*		100,000	100,000	
				of which subcontracting				
				Indirect costs (b)		20,000	20,000	
				Total eligible costs (a)+(b)		120,000	120,000	
			Requested EC contribution			120,000	120,000	
3	CNRS	FCF	Eligible costs	*Direct costs (a)*	270,000	116,667	376,667	
				of which subcontracting				
				Indirect costs (b)	54,000	23,333	75,333	
				Total eligible costs (a)+(b)	324,000	140,000	464,000	
			Requested EC contribution		270,000	140,000	410,000	
3	UCL	AC	Eligible costs	*Direct costs (a)*	70,833		70,833	
				of which subcontracting				
				Indirect costs (b)	14,167		14,167	
				Total eligible costs (a)+(b)	85,000		85,000	
			Requested EC contribution		85,000		85,000	
4	ETHZ	AC	Eligible costs	*Direct costs (a)*	400,000		400,000	
				of which subcontracting				
				Indirect costs (b)	80,000		80,000	
				Total eligible costs (a)+(b)	480,000		480,000	
			Requested EC contribution		480,000		480,000	
5	RUB	AC	Eligible costs	*Direct costs (a)*	200,000		200,000	
				of which subcontracting				
				Indirect costs (b)	40,000		40,000	
				Total eligible costs (a)+(b)	240,000		240,000	
			Requested EC contribution		240,000		240,000	

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6	UNIDO	AC	Eligible costs	*Direct costs (a)*	300,000		300,000	
				of which subcontracting				
				Indirect costs (b)	60,000		60,000	
				Total eligible costs (a)+(b)	360,000		360,000	
			Requested EC contribution		360,000		360,000	
7	DLR	FC	Eligible costs	*Direct costs (a)*	40,000		40,000	
				of which subcontracting				
				Indirect costs (b)	18,000		18,000	
				Total eligible costs (a)+(b)	58,000		58,000	
			Requested EC contribution		58,000		58,000	
8	UMD/TUB	AC	Eligible costs	*Direct costs (a)*	66,667		66,667	
				of which subcontracting				
				Indirect costs (b)	13,333		13,333	
				Total eligible costs (a)+(b)	80,000		80,000	
			Requested EC contribution		80,000		80,000	
9	US	AC	Eligible costs	*Direct costs (a)*	250,000		250,000	
				of which subcontracting				
				Indirect costs (b)	50,000		50,000	
				Total eligible costs (a)+(b)	300,000		300,000	
			Requested EC contribution		300,000		300,000	
10	SUPEL	FC	Eligible costs	*Direct costs (a)*	95,000		95,000	
				of which subcontracting				
				Indirect costs (b)	51,000		51,000	
				Total eligible costs (a)+(b)	146,000		146,000	
			Requested EC contribution		95,000		95,000	
11	INRIA	FC	Eligible costs	*Direct costs (a)*	47,000		47,000	
				of which subcontracting				
				Indirect costs (b)	38,000		38,000	
				Total eligible costs (a)+(b)	85,000		85,000	
			Requested EC contribution		85,000		85,000	
12	UOP	AC	Eligible costs	*Direct costs (a)*	75,000		75,000	
				of which subcontracting				
				Indirect costs (b)	15,000		15,000	
				Total eligible costs (a)+(b)	90,000		90,000	
			Requested EC contribution		90,000		90,000	

13	UAQ	AC	Eligible costs	*Direct costs (a)*	164,167		164,167	
				of which subcontracting				
				Indirect costs (b)	32,833		32,833	
				Total eligible costs (a)+(b)	197,000		197,000	
			Requested EC contribution		197,000		197,000	
14	UNIPI	AC	Eligible costs	*Direct costs (a)*	266,667		266,667	
				of which subcontracting				
				Indirect costs (b)	53,333		53,333	
				Total eligible costs (a)+(b)	320,000		320,000	
			Requested EC contribution		320,000		320,000	
15	UNISI	AC	Eligible costs	*Direct costs (a)*	270,833		270,833	
				of which subcontracting				
				Indirect costs (b)	54,167		54,167	
				Total eligible costs (a)+(b)	325,000		325,000	
			Requested EC contribution		325,000		325,000	
16	PARA DE	FCF	Eligible costs	*Direct costs (a)*	290,000		290,000	
				of which subcontracting				
				Indirect costs (b)	58,000		58,000	
				Total eligible costs (a)+(b)	348,000		348,000	
			Requested EC contribution		290,000		290,000	
17	TUE	AC	Eligible costs	*Direct costs (a)*	108,333		108,333	
				of which subcontracting				
				Indirect costs (b)	21,667		21,667	
				Total eligible costs (a)+(b)	130,000		130,000	
			Requested EC contribution		130,000		130,000	
18	UT	FC	Eligible costs	*Direct costs (a)*	93,000		93,000	
				of which subcontracting				
				Indirect costs (b)	67,000		67,000	
				Total eligible costs (a)+(b)	160,000		160,000	
			Requested EC contribution		80,000		80,000	
19	TUD	AC	Eligible costs	*Direct costs (a)*	91,667		91,667	
				of which subcontracting				
				Indirect costs (b)	18,333		18,333	
				Total eligible costs (a)+(b)	110,000		110,000	
			Requested EC contribution		110,000		110,000	

20	KTH	AC	Eligible costs	*Direct costs (a)*	229,167		229,167	
				of which subcontracting				
				Indirect costs (b)	45,883		45,883	
				Total eligible costs (a)+(b)	275,000		275,000	
			Requested EC contribution		275,000		275,000	
21	LIU	AC	Eligible costs	*Direct costs (a)*	66,667		66,667	
				of which subcontracting				
				Indirect costs (b)	13,333		13,333	
				Total eligible costs (a)+(b)	80,000		80,000	
			Requested EC contribution		80,000		80,000	
22	LTH	AC	Eligible costs	*Direct costs (a)*	166,667		166,667	
				of which subcontracting				
				Indirect costs (b)	33,333		33,333	
				Total eligible costs (a)+(b)	200,000		200,000	
			Requested EC contribution		200,000		200,000	
23	UCAM	AC	Eligible costs	*Direct costs (a)*	62,500		62,500	
				of which subcontracting				
				Indirect costs (b)	12,500		12,500	
				Total eligible costs (a)+(b)	75,000		75,000	
			Requested EC contribution		75,000		75,000	
24	RWTH	AC	Eligible costs	*Direct costs (a)*	41,667		41,667	
				of which subcontracting				
				Indirect costs (b)	8,333		8,333	
				Total eligible costs (a)+(b)	50,000		50,000	
			Requested EC contribution		50,000		50,000	
25	UVA	AC	Eligible costs	*Direct costs (a)*	29,167		29,167	
				of which subcontracting				
				Indirect costs (b)	5,833		5,833	
				Total eligible costs (a)+(b)	35,000		35,000	
			Requested EC contribution		35,000		35,000	
26	CNR	AC	Eligible costs	*Direct costs (a)*	24,167		24,167	
				of which subcontracting				
				Indirect costs (b)	4,833		4,833	
				Total eligible costs (a)+(b)	29,000		17,000	
			Requested EC contribution		29,000		17,000	

TOTAL (full duration)	Total eligible costs	4,583,000	260,000	4,843,000
	Total requested EC contribution	4,340,000	260,000	4,600,000

10.5. Estimated breakdown per workpackage (M13-30)

WP 1	**Eligible costs**	**EU contribution**
Personnel	190,000	170,000
Consumables	10,000	10,000
Total	200,000	180,000

WP 2	**Eligible costs**	**EU contribution**
Personnel	150,000	150,000
Consumables	20,000	10,000
Durable equipment	20,000	10,000
Total	190,000	170,000

WP 3	**Eligible costs**	**EU contribution**
Personnel	200,000	200,000
Consumables	25,000	15,000
Durable equipment	25,000	15,000
Total	250,000	230,000

WP 4a	**Eligible costs**	**EU contribution**
Personnel	170,000	160,000
Consumables	20,000	10,000
Durable equipment	20,000	10,000
Total	210,000	180,000

WP 4b	**Eligible costs**	**EU contribution**
Personnel	100,000	90,000
Consumables	20,000	15,000
Durable equipment	20,000	15,000
Total	140,000	120,000

WP 4c	**Eligible costs**	**EU contribution**
Personnel	250,000	230,000
Consumables	25,000	15,000
Durable equipment	25,000	15,000
Total	300,000	260,000

WP 4d	**Eligible costs**	**EU contribution**
Personnel	180,000	170,000
Consumables	15,000	10,000
Durable equipment	15,000	10,000
Total	210,000	190,000

WP 5	**Eligible costs**	**EU contribution**
Personnel	110,000	100,000
Consumables	20,000	10,000
Total	130,000	110,000

WP 6	**Eligible costs**	**EU contribution**
Personnel	170,000	150,000
Consumables	15,000	10,000
Total	185,000	160,000

WP 7	**Eligible costs**	**EU contribution**
Personnel	60,000	60,000
Consumables	15,000	15,000
Total	75,000	75,000

WP 8	**Eligible costs**	**EU contribution**
Personnel	40,000	40,000
Consumables	10,000	10,000
Total	50,000	50,000

All Workpackages	**Eligible costs**	**EU contribution**
Travel budget	150,000	140,000

All Workpackages	**Eligible costs**	**EU contribution**	**Registration fees**
Conference ECC-CDC (Participant n°9) - about 100 attendies	40,000	20,000	17,000
CTS- FAP courses (Participant n°2) - about 60 attendies	35,000	15,000	15,000

10.6 Infrastructure during phase 2

(identical to infrastructure of phase 1)

The consortium members bring into the NoE a significant amount of existing and projected funding (continuing at least for phase 1 of the JPA) from a range of national infrastructures, research programmes and initiatives. These tasks will be carried out by the nodes where the infrastructure is located under the supervision of the HYCON benchmark panel. The HYCON executive board will establish the composition of this panel. The benchmark test cases to be implemented during the first phase are:

- ETHZ (together with ABB) – The Voltage Stability Control Case Study: Two simplified models mimicking a typical Voltage stability problem occurring in a grid, developed for the IST-2001-33520 CC project

- RUB - HYBCELL: a model of a manufacturing cell that includes a heating process and, hence, has an intrinsic hybrid dynamics

- UNIDO – Test case for logic control design and implementation for a real laboratory plant (batch plant demonstrator). The tasks range from basic supervision to production scheduling.

- DLR - Rectifier circuit with 4 ideal diodes (demonstrates problems with under- and over-determined equations in certain switching modes occurring in intermediate iterations).
  - 6 degree of freedom robot with bearing friction and brakes in all 6 joints, where friction and brakes are modeled with varying degrees of freedom (demonstrates dynamic coupling of varying structure elements and overdetermined equations if friction and brake elements are both stuck on the same joint).

- US – Solar cooling system: 120 m^2 of solar collector's surface and 35 kW of cooling capacity, developed for the national funded project,"Instalacion piloto para control y supervision de la produccion de frio por energia solar", Adquisicion de infraestructura cientifico-tecnica dl programa national TAP.

- UPAT – An ESHED ROBOTEC industrial cell (consisting of 2 industrial robots, a CNC tool machine a vision system, driven by 5 PC's) and an EARNEST-X Sapri industrial robot arm. Both can be used to implement and test distributed control algorithms.

- PARADES - The Idle Speed Control Test Case: A detailed hybrid model of a 4-cylinder in-line engine in idle regime, developed for the IST-2001-33520 CC project.

- UCAM – A large scale, object oriented, stochastic, hybrid simulator for multiple aircraft flights, developed for project HYBRIDGE, IST-2001-32460. The simulator includes models for the aircraft dynamics, flight management system, flight plans and the weather.

A.1.5 List of researchers and PhD students

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	02
Participating organisation					
Organisation legal name	*Centre National de la Recherche Scientifique*				
Organisation short name	*CNRS*				
Internet homepage	http://www.cnrs.fr				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Lamnabhi-Lagarrigue	Françoise	DR	Female	I, R, S, M	CNRS
Chitour	Yacine	Professor	Male	I, R, S	Univ. Paris Sud
Loria	Antonio	CR	Male	I, R, S	CNRS
Ortega	Romeo	DR	Male	I, R, S	CNRS
Panteley	Elena	CR	Female	I, R, S	CNRS
Pasillas-Lepine	William	CR	Male	I, R, S	CNRS
Laghrouche	Salah	Post-Doc	Male	I, R, S	CNRS
Prieur	Christophe	CR	Male	I, R, S	CNRS
Demmou	Hamid	MC	Male	I, R, S	Univ.Paul-Sabatier
Vallette	Robert	DR	Male	I, R, S	CNRS
Daafouz	Jamal	Professor	Male	I, R, S	INPL
Riedinger	Pierre	MC	Male	I, R, S	INPL

List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Ait-Hammouda	Islem	PhD student	Male	I, R	CNRS
Chaillet	Antoine	PhD student	Male	I, R	CNRS
Burlion	Laurent	PhD Student	Male	I, R	CNRS
De Rinaldis	Alessandro	PhD student	Male	I, R	CNRS
Birouche	Abderazik	DEA	Male	I, R	INPL
Hetel	Laurentiu	DEA	Male	I, R	INPL
Patino	Diego	Master	Male	I, R	INPL
Garcia	Eloisa	PhD student	Female	I, R	CNRS

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**03**
Participating organisation					
Organisation legal name	*Université catholique de Louvain*				
Organisation short name	*UCL*				
Internet homepage	http://www.ucl.ac.be/				

List of RESEARCHERS to be integrated

Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Blondel	Vincent	Professor	M	I, R, S, M	UCL
Nesterov	Yurii	Professor	M	I, R	UCL
Sepulchre	Rodolphe	Professor	M	I, R, S	UCL
Bastin	Georges	Professor	M	I, R, S	UCL
Dochain	Denis	Professor	M	R, S	UCL
Pochet	Yves	Professor	M	R, S	UCL

List of DOCTORAL STUDENTS

Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Delvenne	Jean-Charles	PhD student	M	R	UCL
Baes	Michel	PhD student	M	R	UCL
Simeonova	Iliyana	PhD student	F	R	UCL
Ninove	Laure	PhD student	F	R	UCL
Hendrickx	Julien	PhD student	M	R	UCL
Germay	Christophe	PhD student	M	R	UCL
Stan	Guy-Bart	PhD student	M	R	UCL
Ronse	Renaud	PhD student	M	R	UCL

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**04**
Participating organisation					
Organisation legal name	*Swiss Federal Institute of Technology Zurich*				
Organisation short name	*ETHZ*				
Internet homepage	*http://* www.ee.ethz.ch				

List of RESEARCHERS to be integrated

Last name	**First name(s)**	**Professional Status** [1]	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)** [2 3]	**Legal name researcher's Employer** [4]
MORARI	Manfred	Prof.	M	I,R,S,M	ETHZ
SCHAUFELBERGER	Walter	Prof.	M	I, S	ETHZ
GLATTFELDER	Adolf	Prof.	M	R	ETHZ
FRÖHLICH	Klaus	Prof.	M	I, S	ETHZ
KOLAR	Johann	Prof.	M	NDI	ETHZ
KRAUS	Frantisek	Dr	M	R	ETHZ
LÖFBERG	Johan	Dr	M	R	ETHZ
PAPAFOTIOU	Georgios	Dr	M	I, R	ETHZ
PASETTI	Alessandro	Dr	M	NDI	ETHZ
ALLMELING	Jost	Dr	M	R	ETHZ
HAMMER	Wolfgang	Dr	M	R	ETHZ

List of DOCTORAL STUDENTS

Last name	**First name(s)**	**University degree**	**Gender: male or female**	**Connection with Joint Progr. of Activities (JPA)** [2 3]	**Organiser of course doctoral Student is enrolled in** [5]
BECCUTI	Andrea	MSc	M	R	ETHZ
CHRISTOPHERSEN	Frank	Dipl. Ing.	M	S, R	ETHZ
FOTIOU	Ioannis	Dipl. Ing.	M	R	ETHZ
KVASNICA	Michal	Dipl. Ing.	M	R	ETHZ
MÖBUS	Rainer	Dipl. Ing.	M	R	ETHZ
NIEDERBERGER	Dominik	Dipl. Ing.	M	I, R	ETHZ
NOLDE	Kristian	Dipl. Ing.	M	I, R	ETHZ
ROSTALSKI	Philipp	Dipl. Ing.	M	I, R	ETHZ
SAHIN	Akin	Msc	M	R	ETHZ
BERGER	Stefan	Dipl. Ing.	M	R	ETHZ
DEMIRAY	Turhan	MSc	M	R	ETHZ
FAVRE-PERROD	Patrick	Dipl. Ing.	M	R	ETHZ
GLANZMANN	Gabriela	Dipl. ing.	F	I, R	ETHZ
GRADER	Manfred	Dipl. Ing.	M	R	ETHZ
HINOW	Martin	Dipl. Ing.	M	R	ETHZ
KLÖCLK	Bernd	MSc	M	I, R	ETHZ
KRAUSE	Thilo	Dipl. Ing.	M	R	ETHZ
KRÜSI	Urs	Dipl. El. Ing.	M	R	ETHZ
ZHAO	Chuanhong	MSc	F	R	ETHZ
ZIMA	Marek	MSc	M	R	ETHZ

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	05
Participating organisation					
Organisation legal name	*Ruhr-Universität Bochum*				
Organisation short name	*RUB*				
Internet homepage	http://www.rub.de/atp				

List of RESEARCHERS to be integrated

Last name	First name(s)	Professional Status	Gender: Male or Female	Connection with Joint Progr. of Activities (JPA)	Legal name researcher's Employer
Lunze	Jan	Professor	m	I, R, S, M	RUB
Wenck	Florian	Researcher	m	I, R, S	RUB

List of DOCTORAL STUDENTS

Last name	First name(s)	University degree	Gender: male or female	Connection with Joint Progr. of Activities (JPA)	Organiser of course doctoral Student is enrolled in
Neidig	Jörg	Dipl.-Ing.	m	I, R,	RUB
Planchon	Philippe	Dipl.-Ing.	m	I, R,	RUB
Fritsch	Carsten	Dipl.-Ing.	m	I, R,	RUB
Schild	Axel	Dipl.-Ing.	m	I, R ,S ,M	RUB
Richter	Jan	Dipl.-Ing	m	I, R	RUB
De León Cantón	Plinie	M.Sc.	m	NDI	RUB

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**06**
Participating organisation					
Organisation legal name	*Universität Dortmund*				
Organisation short name	*UNIDO*				
Internet homepage	http://astwww.bci.uni-dortmund.de				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Engell	Sebastian	Professor, Head of Laboratory	M	I, R, S, M	UNIDO
Stursberg	Olaf	PostDoc, Group Leader	M	I, R, S	UNIDO
Remelhe	Manuel	Researcher	M	I, R	UNIDO
		r			

List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Lohmann	Sven	Dipl.-Ing.	M	R	Chem Eng. Dortmund
Tran	Thanh Ha	M.Sc.	M	R	Chem. Eng. Dortmund
Sonntag	Christian	Dipl.-Ing..	M	R	Chem. Eng. Dortmund

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**07**
Participating organisation					
Organisation legal name	*Deutsches Zentrum für Luft- und Raumfahrt*				
Organisation short name	*DLR*				
Internet homepage	*http://*				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Otter	Martin	Dr.-Ing.	Male	I	DLR
Schweiger	Christian	Dipl. – Ing.	Male	I	DLR

List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	8

Participating organisation

Organisation legal name	*Otto-von-Guericke Universitaet Magdeburg*
Organisation short name	*UNI MD*
Internet homepage	*http://ifatwww.et.uni-magdeburg.de/systemtheorie*

List of RESEARCHERS to be integrated

Last name	First name(s)	Professional Status [1]	Gender: Male or Female	Connection with Joint Progr. of Activities (JPA) [2 3]	Legal name researcher's Employer [4]
Raisch	Joerg	Professor	Male	I, R	UNI MD
Reissig	Gunther	Post-doc	Male	I, R	UNI MD
Azhmyakov	Vadim	Post-doc	Male	I, R	UNI MD

List of DOCTORAL STUDENTS

Last name	First name(s)	University degree	Gender: male or female	Connection with Joint Progr. of Activities (JPA) [2 3]	Organiser of course doctoral Student is enrolled in [5]
Li	Danjing	Master of Engineering	Female	I, R	UNI MD
Gromov	Dmitry	Dipl.-Ing.	Male	I, R	UNI MD
Conradi	Carsten	Dipl.-Ing.	Male	I, R	UNI MD
Geist	Stephanie	Dipl.-Ing.	Female	I, R	UNI MD

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**09**
Participating organisation					
Organisation legal name	*Universidad de Sevilla*				
Organisation short name	*US*				
Internet homepage	http://www.us.es				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status [1]**	**Gender : Male or Female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Legal name researcher's Employer [4]**
Camacho	Eduardo F.	Prof.	Male	WP2, WP1,WP4,WP5	Univ. de Sevilla
Bordons	Carlos	Assoc. Prof.	Male	WP1, WP2, WP4	Univ. de Sevilla
Ridao	Miguel Angel	Assoc. Prof.	Male	WP2, WP4	Univ. de Sevilla
Ruiz Arahal	Manuel	Assoc. Prof.	Male	WP2, WP4	Univ. de Sevilla
Alamo	Teodoro	Assoc. Prof.	Male	WP2, WP4	Univ. de Sevilla
Rodriguez	Daniel	Assist. Prof.	Male	WP2, WP4	Univ. de Sevilla
Limon	Daniel	Assist. Prof.	Male	WP2, WP4	Univ. de Sevilla
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender : male or female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Organiser of course doctoral Student is enrolled in [5]**
Dorado Navas	Fernando	Ind. Eng.	Male	WP2	Univ. of Seville
Zafra Cabeza	Ascencion	Comp Sci.	Female	WP2, WP4	Univ. of Seville
Nuñez Reyes	Amparo	Comp Sci.	Female	WP2, WP4	Univ. of Seville
Muñoz de la Peña	David	TelecomEng	Male	WP4	Univ. of Seville
Cepeda Caballos	Alfonso	Ind. Eng.	Male	WP4	Univ. of Seville
Alvarado Aldea	Ignacio	Ind. Eng.	Male	WP2	Univ. of Seville
Fiacchini	Mirko	Eng.	Male	Wp2, WP4	Univ. of Seville
Pontes Balanza	Beatriz	Comp. Sci.	Female	WP2, WP4	Univ. of Seville
Zanbrano	Darine	Chem. Eng	Female	WP2, WP4	Univ. los Andes (Venezuela)
Arce Rubio	Alicia	Ind. Eng.	Female	WP2,WP4	Univ. of Seville
del-Real Torres	Alejandro	Ind. Eng.	Male	WP2,WP4	Univ. of Seville

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**10**
Participating organisation					
Organisation legal name	*Ecole Supérieure d'Electricité*				
Organisation short name	*Supélec*				
Internet homepage	http://www.supelec.fr				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
GUEGUEN	Hervé	Prof.	M	I – S – R	Supélec
BUISSON	Jean	Prof.	M	I – S – R	Supélec
CORMERAIS	Hervé	Ass. Prof.	M	R	Supélec
RICHARD	Pierre-Yves	Ass. Prof.	M	NDI	Supélec
LEFEBVRE	Marie-Anne	Ss Prof	F	R	Supélec

List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
ZAINEA	Marius	DEA	M	R	Uni. Rennes Supélec
LEIRENS	Sylvain	DEA	M	R	Uni. Rennes Supélec
NASRI	Othman	DEA	M	R	Uni Rennes Supélec

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**11**
Participating organisation					
Organisation legal name	*Institut National de Recherche en Informatique et en Automatique*				
Organisation short name	*INRIA*				
Internet homepage	http://www.inria.fr				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Acary	Vincent	Chargé de Recherche 2c	Male	I,R	INRIA
Bernard	Olivier	Chargé de Recherche 1c	Male	R,S	INRIA
Brogliato	Bernard	Directeur de Recherche 2c	Male	I,R,S	INRIA
Ferrari-Trecate	Giancarlo	Chargé de Recherche 1c	Male	I,R,S	INRIA
Gouzé	Jean-Luc	Directeur de Recherche 2c	Male	R,S	INRIA
Sorine	Michel	Directeur de Recherche 2c	Male	R	INRIA
Wieber	Pierre-Brice	Chargé de Recherche 2c	Male	R	INRIA

List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Gati	Mehdi	PhD	Male	R	Univ. Paris Sud (Orsay)

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	12
Participating organisation					
Organisation legal name	*University of Patras*				
Organisation short name	*UPAT*				
Internet homepage	*http://www.upatras.gr*				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Koussoulas	Nikolaos	Professor, Head of Systems and Control Division	Male	IRS	UPAT
Lygeros	John	Professor	Male	IRSM	UPAT
Manesis	Stamatis	Professor	Male	IRS	UPAT
Tzes	Antony	Professor	Male	IRS	UPAT
Davrazos	Gregory	Postdoc	Male	IRS	UPAT
Djeridane	Badis	Postdoc	Male	IRS	UPAT
Nikolakopoulos	George	Postdoc	Male	IRS	UPAT

List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Arampatzis	Theodoros	Diploma	Male	IR	UPAT
Deligiannis	Vasilios	Diploma	Male	IR	UPAT
Diamantopoulou	Adamandia	Diploma	Female	IR	UPAT
Dritsas	Leonidas	Diploma	Male	IR	UPAT
Kobaios	Ioannis	Diploma	Male	IR	UPAT
Koutroumpas	Konstantinos	Diploma	Male	IR	UPAT
Limperopoulos	Ioannis	Diploma	Male	IR	UPAT
Panousopoulou	Athanasia	Diploma	Female	IR	UPAT
Terzakis	George	Diploma	Male	IR	UPAT
Tsoukalas	Athanasios	Diploma	Male	IR	UPAT

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**13**
Participating organisation					
Organisation legal name	*Università degli Studi di L'Aquila*				
Organisation short name	*UAQ*				
Internet homepage	*http://www.univaq.it*				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
De Santis	Elena	Ass. Professor	Female	I,R,S	University of L'Aquila
Di Benedetto	Maria Domenica	Professor	Female	I,R,S	University of L'Aquila
Di Benedetto	Maria Gabriella	Professor	Female	L,R	Univ. of Roma "La Sapienza"
Di Gennaro	Stefano	Ass. Professor	Male	R,S	University of L'Aquila
Graziosi	Fabio	Ass. Professor	Male	L,R	University of L'Aquila
Pratesi	Marco	Assistant Professor	Male	R,S	University of L'Aquila
Pola	Giordano	Post-doc	Male	R,S	University of L'Aquila
Giancola	Guerino	Post-doc	Male	R	University of Rome "La Sapienza"
Santucci	Fortunato	Ass. Professor	Male	L,R,S,M	University of L'Aquila
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Alesii	Roberto	Engineer	Male	R	University of L'Aquila
D'Innocenzo	Alessandro	Engineer	Male	R	University of L'Aquila
Di Renzo	Marco	Engineer	Male	L,R	University of L'Aquila
Domenicali	Daniele	Engineer	Male	R,S	University of Rome "La Sapienza"
De Nardis	Luca	Engineer	Male	R	University of Rome "La Sapienza"
Rinaldi	Claudia	Engineer	Female	R	University of L'Aquila
Tennina	Stefano	Engineer	Male	R	University of L'Aquila

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**14**
Participating organisation					
Organisation legal name	*Università degli Studi di Pisa*				
Organisation short name	*UNIPI*				
Internet homepage	http://www.piaggio.ccii.unipi.it				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Bicchi	Antonio	Professor	Male	IRSM	Università di Pisa
Balestrino	Aldo	Professor	Male	IRS	Università di Pisa
Innocenti	Mario	Professor	Male	RS	Università di Pisa
Caiti	Andrea	Professor	Male	IRS	Università di Pisa
Landi	Alberto	Professor	Male	IRS	Università di Pisa
Zini	Giancarlo	Professor	Male	IRS	Università di Pisa
Pollini	Lorenzo	Professor	Male	RS	Università di Pisa
Pallottino	Lucia	Post-Doc	Female	IRSM	Università di Pisa
Scilingo	Enzo Pasquale	Post-Doc	Male	IRS	Università di Pisa
Tonietti	Giovanni	Post-Doc	Male	RS	Università di Pisa
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Fontanelli	Daniele	Ph.D. Student	Male	RS	Università di Pisa
Scordio	Vincenzo Giovanni	Ph.D. Student	Male	RS	Università di Pisa
Sgambelluri	Nicola	Ph.D. Student	Male	RS	Università di Pisa
Danesi	Antonio	Ph.D. Student	Male	RS	Università di Pisa
Fagiolini	Adriano	Ph.D. Studnet	Male	RS	Università di Pisa
Sen	Soumen	Ph.D. Studnet	Male	RS	Università di Pisa

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	15
Participating organisation					
Organisation legal name	*Università degli Studi di Siena*				
Organisation short name	*UNISI*				
Internet homepage	*http://www.unisi.it*				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Bemporad	**Alberto**	Professor	Male	M,I,R,S	UNISI
Abrardo	Andrea	Professor	Male	I,R,S	UNISI
Agnetis	Alessandro	Professor	Male	I,R,S	UNISI
Bianchini	Gianni	Professor	Male	I,R,S	UNISI
Casini	Marco	Professor	Male	I,R,S	UNISI
Corona	Daniele	Post-doc	Male	R,S	Univ. of Cagliari
Giua	Alessandro	Professor	Male	I,R,S	Univ. of Cagliari
Nistri	Paolo	Professor	Male	M,I,R,S	UNISI
Paoletti	Simone	Post-doc	Male	I,R,S	UNISI
Papini	Duccio	Professor	Male	M,I,R,S	UNISI
Seatzu	Carla	Professor	Female	I,R,S	Univ. of Cagliari
Vicino	Antonio	Professor	Male	M,I,R,S	UNISI
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Alessio	Alessandro	Master	Male	I,R,S	UNISI
Ceccarelli	Nicola	Master	Male	R,S	UNISI
Di Cairano	Stefano	Master	Male	I,R,S	UNISI
Giorgetti	Nicolò	Master	Male	I,R,S	UNISI

Proposal Number		Proposal Acronym	HYCON	Participant number	**16**
Participating organisation					
Organisation legal name	*PARADES GEIE*				
Organisation short name	*PARADES*				
Internet homepage	http://www.parades.rm.cnr.it				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Sangiovanni-Vincentelli	Alberto	Scientific Director	M	I, R, S, M	
Ferrari	Alberto	Deputy Scientific Director	M	I, R, S	
Balluchi	Andrea	Research Scientist	M	I, R, S	
Murrieri	Pierpaolo	Research Scientist	M	I, R, S	
Benvenuti	Luca	Professor	M	I, R	University of Rome, "La Sapienza"
Villa	Tiziano	Professor	M	I, R	University of Udine (I)

List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Casagrande	Alberto	laurea	M	I, R	University of Udine (I)
Carloni	Marco	laurea	M	I, R	University of Bologna, (I)
a new phd student		laurea			University of Pisa, (I)

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**17**
Participating organisation					
Organisation legal name	*Technische Hogeschool Eindhoven*				
Organisation short name	*TUE*				
Internet homepage	*www.tue.nl*				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status [1]**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Legal name researcher's Employer [4]**
Nijmeijer	Henk	Prof	M	M,S, I (WP4c)	TUE
Van den Bosch	Paul	Prof	M	M, I (WP4b)	TUE
Heemels	Maurice	Dr	M	S	TUE
Van Beek	Bert	Dr	M	I, R (WP3)	TUE
Camlibel	Kanat	Dr	M	S (NDI)	TUE
Schiffeler	Ramon	MSc	M	R (WP3)	TUE
Klaasen	Tim	MSc	M	R (WP4c)	TUE
Juloski	Alexander	Dr	M	R (NDI)	TUE
Serrarens	Alex	Dr	M	R (NDI)	TUE
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: male or female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Organiser of course doctoral Student is enrolled in [5]**
Roset	Bas	MSc	M	NDI	TUE
Van Eeekelen	Joost	MSc	M	NDI	TUE
Koot	Michiel	MSc	M	NDI	TUE
Kessels	John	MSc	M	NDI	TUE

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**18**
Participating organisation					
Organisation legal name	*University of Twente*				
Organisation short name	*UT*				
Internet homepage	*www.utwente.nl*				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status [1]**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Legal name researcher's Employer [4]**
Brinksma	Ed	Professor	M		UT
Langerak	Romanus	Senior lecturere	M		UT
Polderman	Jan Willem	Associate Professor	M		UT
Van der Schaft	Arjan	Professor	M		UT
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: male or female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Organiser of course doctoral Student is enrolled in [5]**
Kordy	Piotr	MSc	M		UT
Krilavicius	Tomas	MSc	M		UT
Strubbe	Stefan	MSc	M		UT

Proposal Number 511368 Proposal Acronym HYCON Participant number **19**

Participating organisation

Organisation legal name Technische Universiteit Delft

Organisation short name TUD

Internet homepage http://www.tudelft.nl

List of RESEARCHERS to be integrated

Last name	First name(s)	Professional Status	Gender: Male or Female	Connection with Joint Progr. of Activities (JPA)	Legal name researcher's Employer
De Schutter	Bart	Assoc. prof.	Male	I, R, S	TUD
van den Boom	Ton	Assoc. prof.	Male	I, R, S	TUD
Hegyi	Andreas	postdoc	Male	M, R	TUD
Corona	Daniele	postdoc	Male	M, R	TUD

List of DOCTORAL STUDENTS

Last name	First name(s)	University degree	Gender: male or female	Connection with Joint Progr. of Activities (JPA)	Organiser of course doctoral Student is enrolled in
van Katwijk	Ronald	ir. (=MSc)	M	R	TUD
Negenborn	Rudy	ir. (=MSc)	M	R	TUD
IonNecoara	Ion	MSc	M	R	TUD
Gietelink	Olaf	MSc	M	M, R	TUD

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**20**
Participating organisation					
Organisation legal name	*Royal Institute of Technology*				
Organisation short name	*KTH*				
Internet homepage	http://www.kth.se				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Forsgren	Anders	Professor	Male	R	KTH
Hjalmarsson	Håkan	Professor	Male	R	KTH
Hu	Xiaoming	Professor	Male	R	KTH
Karlsson	Gunnar	Professor	Male	R	KTH
Lindquist	Anders	Professor	Male	I,R,S	KTH
Skoglund	Mikael	Professor	Male	R	KTH
Wahlberg	Bo	Professor	Male	R	KTH
Johansson	Karl Henrik	Assoc Prof	Male	I,R,S	KTH
Johansson	Mikael	Assoc Prof	Male	I,R,S	KTH
Jönsson	Ulf	Assoc Prof	Male	I,R,S	KTH
Fischione	Carlo	Postdoc	Male	R	KTH
Jansson	Henrik	Postdoc	Male	R	KTH
Rotkowitz	Michael	Postdoc	Male	R	KTH
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Almér	Stefan	MSc	Male	R	KTH
Bao	Lei	MSc	Female	R	KTH
Bengtsson	Per	MSc	Male	R	KTH
Flärdh	Oscar	MSc	Male	R	KTH
Gustavi	Tove	MSc	Female	R	KTH
Jacobsson	Krister	MSc	Male	R	KTH
Johansson	Björn	MSc	Male	R	KTH
Karlsson	Johan	MSc	Male	R	KTH
Lindhé	Magnus	MSc	Male	R	KTH
Lundqvist	Henrik	Lic	Male	R	KTH
Möller	Niels	MSc	Male	R	KTH
Pernestål	Anna	MSc	Female	R	KTH
Soldati	Pablo	MSc	Male	R	KTH
Speranzon	Alberto	Lic	Male	R	KTH
Strandemar	Katrin	MSc	Female	R	KTH

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**21**
Participating organisation					
Organisation legal name	*Linköping University*				
Organisation short name	*LIU*				
Internet homepage	*http://www.control.isy.liu.se*				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status [1]**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Legal name researcher's Employer [4]**
Ljung	Lennart	Professor	Male	S	LIU
Gunnarsson	Fredrik	Adj. Lecturer	Male	R,S	LIU
Roll	Jacob	Research Associate	Male	I,R	LIU
Gustafsson	Fredrik	Professor	Male	NDI	LIU
Glad	Torkel	Professor	Male	NDI	LIU
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: male or female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Organiser of course doctoral Student is enrolled in [5]**
Geijer-Lundin	Erik	MSc	Male	R,S	LIU
Törnqvist	David	MSc	Male	NDI	LIU
Eng	Frida	MSc	Female	NDI	LIU

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**22**
Participating organisation					
Organisation legal name	*LUNDS UNIVERSITET*				
Organisation short name	*LU*				
Internet homepage	http://www.lu.se				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Legal name researcher's Employer**
Rantzer	Anders	professor	male	I R S M	LU
Wittenmark	Björn	professor	male	I R S	LU
Johansson	Rolf	professor	male	I R S M	LU
Hagander	Per	Professor	male	I R S	LU
Robertsson	Anders	Post-doc	male	I R S	LU
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA)**	**Organiser of course doctoral Student is enrolled in**
Alriksson	Peter	MSc	male	I R S	LU
Nilsson	Oskar	MSc	male	I R S	LU
Wernrud	Andreas	MSc	male	I R S	LU
Haugwitz	Staffan	MSc	male	I R S	LU
Åkesson	Johan	MSc	male	I R S	LU
Solyom	Stefan	MSc	Male	I R S	LU

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	23
Participating organisation					
Organisation legal name	*The Chancellor, Master and Scholars of the University of Cambridge*				
Organisation short name	*UCAM*				
Internet homepage	http://www-control.eng.cam.ac.uk				

List of RESEARCHERS to be integrated

Last name	First name(s)	Professional Status	Gender: Male or Female	Connection with Joint Progr. of Activities (JPA)	Legal name researcher's Employer
Maciejowski	Jan	Head of Control Group	M	I R S	UCAM
Glover	Keith	Head of Engineering Department	M	I R S	UCAM
Vinnicombe	Glenn	Lecturer	M	I R S	UCAM
Kerrigan	Eric	Post-doc	M	I R S	UCAM
Goncalves	Jorge	Lecturer	M	IRS	UCAM
Lecchini-Visintini	Andrea	Post-doc	M	IRS	UCAM

List of DOCTORAL STUDENTS

Last name	First name(s)	University degree	Gender: male or female	Connection with Joint Progr. of Activities (JPA)	Organiser of course doctoral Student is enrolled in
Salinas-Varela	Adrian	MSc	M	IRS	UCAM

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**24**
Participating organisation					
Organisation legal name	*RWTH Aachen University*				
Organisation short name	*RWTH*				
Internet homepage	*www-i11.informatik.rwth-aachen.de*				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status [1]**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Legal name researcher's Employer [4]**
Kowalewski	Stefan	Professor	M	I, R, S	RWTH Aachen
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: male or female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Organiser of course doctoral Student is enrolled in [5]**
Salewski	Falk	Dipl.-Ing.	M	R	RWTH
Schlich	Bastian	Dipl.-Ing.	M	R	RWTH

Proposal Number		Proposal Acronym	HYCON	Participant number	25
Participating organisation					
Organisation legal name	*University of Valladolid*				
Organisation short name	*UVA*				
Internet homepage	*http://www.isa.cie.uva.es*				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status [1]**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Legal name researcher's Employer [4]**
Prada	Cesar de	Professor	M	IRM	UVA
Fuente	Mª Jesus	Assoc. Prof.	F	IR	UVA
Zamarreño	Jesus Mª	Assoc. Prof.	M	IR	UVA
Acebes	Luis F.	Assoc. Prof.	M	IR	UVA
Cristea	Smaranda	Assist. Prof.	F	IR	UVA
Gutierrez	Gloria	Assist. Prof.	F	IR	UVA
List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: male or female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Organiser of course doctoral Student is enrolled in [5]**
Sarabia	Daniel	Physics	M	RI	UVA
Merino	Alejandro	Chem Eng.	M	RI	UVA
Mazaeda	Rogelio	ComScience	M	RI	UVA
Rodriguez	Miguel	Electro. Eng.	M	R	UVA
Martín	Juan J.	Chem Eng.	M	RI	UVA

Proposal Number	511368	Proposal Acronym	HYCON	Participant number	**26**
Participating organisation					
Organisation legal name	*Istituto per le Applicazioni del Calcolo "Mauro Picone" - C.N.R.*				
Organisation short name	*C.N.R.*				
Internet homepage	*www.iac.cnr.it*				

List of RESEARCHERS to be integrated					
Last name	**First name(s)**	**Professional Status [1]**	**Gender: Male or Female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Legal name researcher's Employer [4]**
Piccoli	Benedetto	Research Director	Male	WP1 – WP4c WP4d	C.N.R.
Caramia	Massimiliano	Researcher	Male	WP1 – WP4c WP4d	C.N.R.
Vergni	Davide	Researcher	Male	WP1 – WP4c WP4d	C.N.R.

List of DOCTORAL STUDENTS					
Last name	**First name(s)**	**University degree**	**Gender: male or female**	**Connection with Joint Progr. of Activities (JPA) [2 3]**	**Organiser of course doctoral Student is enrolled in [5]**
Cascone	Nunzia	Bachelor	Female	WP1 – WP4c WP4d	University of Salerno
Rarita	Luigi	Bachelor	Male	WP1 – WP4c WP4d	University of Salerno
Manzo	Rosanna	Bachelor	Female	WP1 – WP4c WP4d	University of Salerno