



Network of Excellence
Thematic Priority 2

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HYCON

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

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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)	

Executive summary

This report briefly summarizes a list of the inventory that the Networks of Excellence has at its disposal from all of the partners. The inventory is organized in three categories, Equipment, Infrastructure, and Installations.

Equipment consists of all moveable instruments including computers, computer equipment, computer software and workstations as well as individual laboratory tools.

Infrastructure comprises the actual property of the Institution that is designated to carry out specific activities. Examples of infrastructure are offices, laboratory space, meeting rooms and libraries.

Installations are systems that are set up within the framework of the infrastructure. They can be added or removed. Examples of these would be wired and wireless computer networks and laboratory experiment apparatuses.

Enumerated below are the equipment, infrastructures and installations, listed by Institution, available to the Networks of Excellence. A list with the inventory subdivided per partner is also appended.

Inventory by Type

Equipment

Workstations with standard office applications and printers	Windows	All
	Linux	ETHZ, UNIPI, UNISI, UNIQ, TUD
Mathematical Tools	Matlab	CNRS-CRAN, CNRS-LASS, CNRS-LSS, ETHZ, SUPELEC, UNIPI, UNISI, TUD, KTH, UNIQ
	Mathematica	ETHZ
	Maple V.	ETHZ, KTH
Simulation Software	ILOG	ETHZ
	CPLEX	ETHZ, UDortmund, UNISI
	NAG	ETHZ, UDortmund
	GAMS	UDortmund
	gPROMS	UDortmund
	DYMOLA	UDortmund, SUPELEC
	Scade	SUPELEC
	PSpice	ETHZ
	Visual Studio	UNIPI
	LabView	UNIPI
	Xpress-MP solver	UNISI
	Mosek	KTH
	Opnet	UNIQ
	Omnet++	UNIQ
	TOSSIM	UNIQ
Protel	ETHZ, UNIPI	
Didactic Experiments	Helicopter model	RUB
	Inverted pendulum: 1 axis	RUB, UNIPI
	Gyro pendulum	RUB
	Hovering magnetic ball	RUB

Specific Laboratory Tools	A/D and D/A converters	UNIQ
	Batch plant and evaporator	UDortmund
	Bora with flywheel/cvt	TUE
	Crash test rig	TUE
	Chromatographic SMB Plant controlled by Siemens PCS7 Control system	Udortmund
	Demonstrator for batch plant scheduling controlled by PFCS7 control system	Udortmund
	Electro-mechanical actuator testbench	DLR
	Flat plank tyre tester	TUE
Specific Laboratory Tools	Flexible Manufacturing Cell Model (hybrid control experiment and diagnosis)	RUB
	Flexible production line	UMagdeburg
	Helmet test rig	TUE
	Model railway	UMagdeburg
	Multiproduct batch plant	UMagdeburg
	Networked three tank experiment for diagnosis of quantised systems	RUB
	Optically accessible 1-cyl HD diesel engine	TUE
	Optically accessible 1-cyl gasoline engine (Rotax 600cc)	TUE
	Pneumatic power-generator model	RUB
	10 Polymerisation reactor controlled by ABB Freelance DCS	UDortmund
	Reactive Distillation Column controlled by PC-based MiniDCS	UDortmund
	Steer-by-wire testbench	DLR
	Stereo visualization environment	DLR
	Tyre drums	TUE
	Tyre measuring hub	TUE
	Various cars	TUE
	Various power train test rigs	TUE
	Phantom, Delta, Haptic devices	UNIFI
	UNIFI SoftArm, VSA-1, Scorbot	UNIFI
	Lightweight robotic manipulator arm: 4 joints for continuous control	UNIFI
Industrial robot for controller development	RUB	
Koala and other vehicles	UNIFI	

Sensor Networks	MIB600	
	Wireless Measurement System, MICA2: 3rd Generation, Tiny, Wireless Smart Sensors, TinyOS	UNIQ
	Wireless Measurement System, MICAz: 2.4 GHz, IEEE 802.15.4 compliant; Tiny	UNIQ
	MTS101 Basic Sensor Board compatible with MICA, MICA2 and MICAz	UNIQ
	Environmental Monitoring Board: MTS310 Multi Sensor Board Light, Temperature; Microphone, Sounder; Tone Detection Circuit; 2-Axis Accelerometer; 2-Axis Magnetometer; Compatible with MICA, MICA2 and MICAz	UNIQ
	14 Tmote Sky and associated software	UNIQ
	25 Telos motes and associated software for sensor network applications	UNIFI
	Pcmcia GPRS Merlin G 201,4+2, MS10, antenna-Versione BULK; Modem GPRS CC2400DK C.I. RF tx rx2400 MHZ (Development Kit) The CC2400 single-chip RF transceiver using unlicensed 2.4 GHz frequency band	KTH
Embedded Programming	4 PSoC Development Tool solutions with in-circuit emulator	UNIFI
	Starter kit FPGA Anadigm is a programmable analog arrays (FPAA) P160 Analog Module Kit Memec Analog Module P160 compatible system board with A/D and D/A converters	UNIQ
	FPGA development platform	UNIQ
	Memec Virtex-4 LC Development Kit	UNIQ
	FPAA Anadigm starter kit	UNIQ
	P160 Analog Module Kit	UNIQ

Infrastructure

Administrative facilities	Offices	CNRS-CRAN, CNRS-LSS, RUB, UDortmund, UMagdeburg, SUPELEC, UNIQ, UNIFI
	Meeting rooms	CNRS-CRAN, CNRS-LASS, CNRS-LSS, RUB, UNIFI
	Seminar rooms	CNRS-LASS, CNRS-LSS, RUB
	Computer pools	RUB
Laboratories	Automatic Control Laboratory: laboratory of the Department of Information Technology and Electrical Engineering of the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland with 2 experimental rooms and 2 rooms for visitors	ETHZ
	Four laboratories	RUB
	Research laboratory of Center of Excellence DEWS; Research laboratory of telecommunications	UNIQ
	One control laboratory and one robotic and automation laboratory	UNIFI
	Two laboratories- one on Via Roma and one in via Tommaso Pendola	UNISI
	Automotive laboratory	TUE
	One laboratory with a wide variety of lab processes including water tanks, gyros, helicopters and pendubots	KTH
Libraries	One library	CNRS-CRAN
	2000 books and a collection of journals totalling 350 subscriptions some of which date back to the creation of the lab	CNRS-LASS
	Supelec and Université Paris-Sud	CNRS-LSS
	Library of the Automatic Control Laboratory- access to 3000 books and 21 journals; Library of the Department of Information Technology and Electrical Engineering- access to 7000 books and 295 journals; Main ETHZ library-access to 6.4 items including 7400 on-line journals; Library of the University of Zurich-access to a total of 4.8 million items	ETHZ
	One library- access to 11.000 books on electrical engineering and subscription to 24 journals	RUB
	One library- literature on Hybrid systems and control; various journals; access to ScienceDirect	SUPELEC
	The University System in Pisa (comprised of the Università di Pisa, the Scuola Normale Superiore and Scuola S. Anna) offers a vast library system, with specialized and general interest books. Also available are state-of-the-art on-line book and journal retrieval software for reference finding.	UNIFI
Other amenities	Restaurants	CNRS-CRAN, CNRS-LASS, CNRS-LSS, SUPELEC
	Student residence	CNRS-CRAN, CNRS-LASS, CNRS-LSS, UMagdeburg
Staff	450 Peronnel	CNRS-LASS
	Technical staff with 10 people	RUB, UNIFI
	Scientific staff with 9 people	RUB, UNIFI

Installations

Computer Networks	several servers for Internet presence	RUB
	one computer network	UDortmund
	Cluster of 40 Linux computers	DLR
	Sun servers and Linux based workstations	UMagdeburg
	Secure Internet and Ethernet	SUPELEC
Wireless networks	<p>France Telecom's researchers are undertaking a life-size trial of mesh WiFi technology on the Supélec campus in the Paris region. As a real alternative to bring wireless broadband to public mobile or home access, mesh WiFi represents a major stake for temporary events. This technology is also especially suitable for the coverage of airports, shopping centres, parks and limited but dense urban zones (metropolitan networks), since it is a solution that can be rolled out faster and at a lower cost. Through this experimental network developed by France Telecom's R&D, almost 400 users with WiFi portable PCs will have access to Supélec's internal network as well as the Internet. At Supélec, this network access facilitates exchange between users through the Information System, while maintaining a high security level. The trial should draw to a close at the end of December 2006.</p>	CNRS-LSS, SUPELEC
Sensor networks	based on a web service, local or remote (wired or wireless via GPRS) access to the sensor network is provided. A running (on-line) interactive demo will soon be available	UNIQ
Manufacturing facilities	machine shop, chemical laboratory, micro fabrication facilities	UNIFI
Online experiments	<p>As well as fast internet connection and other facilities for researchers, the institution offers the innovative "Automatic Control Telelab" (http://www.dii.unisi.it/~control/act/faq.php) that supports real-time configuration and observation of experiments. The telelab also supports playback access to acquired data from remote computer linked to a collection site through the Internet. The offered online experiments are: Control of the angle of a DC motor, Control of the speed of a DC motor, Control of the water level in a tank, Control of the water flow, Control of a magnetic levitation system, Control of a 2 DOF Helicopter and Control of a LEGO Mobile Robot.</p>	UNISI

Inventory by Partner Institution

Equipment

	France Innovation Scientifique et Transfert (France)
Workstations, Printers	CNRS-CRAN (France)
Workstations, MATLAB, printers library containing 2,000 books (with a planned increase of about 1000 books per year) and a collection of journals totalling 355 subscriptions some of which date back to the creation of the lab. Also, some 12,000 books are distributed throughout the lab.	CNRS- LASS (France)
	Université Catholique de Louvain (Belgium)
<p><u>Hardware:</u> In terms of personal computers and printing equipment, the hardware needs of the laboratory are covered by the Informatic Support Group (ISG) of the Department on a supply-and-demand basis. Moreover, 4 computers running on a Linux environment are available through the network for heavy computations.</p> <p><u>Software:</u> The software inventory of IfA contains all the standard office applications and electronic typography packages, communications software, and programming language environments. Moreover, the scientific software that is available on demand covers various aspects of electrical engineering, ranging from electric circuit simulation (e.g. PSpice) to design packages like Protel. However, given the research interests of the HYCON NoE, the available software tools in the following areas are of particular importance: Mathematical tools for control engineers: MATLAB, Mathematica, Maple V. Linear, non-linear and mixed-integer optimization (ILOG CPLEX, NAG, GAMS). Library of the Automatic Control Laboratory: Direct access to 3000 books and 21 journals</p> <ul style="list-style-type: none"> ▪ Library of the Department of Information Technology and Electrical Engineering: Direct access to 7000 books and 295 journals. ▪ Main Library of the ETH: Access to a total of 6.4 million items, including 7400 journals available online. ▪ Library of the University of Zurich: Access to a total of 4.8 million items. 	Swiss Federal Institute of Technology (Switzerland)
<p>14 - Computer Pool PC-Windows XP 1 Helicopter model 1 Networked Three Tank experiment: used for diagnosis of quantised systems 1 Flexible Manufacturing Cell Model: used for hybrid control experiments and diagnosis 1 Flexible Process Plant (VERA): 8 containers, 80 actuators (disc. And continuous), 60 Sensors, Industry orient automation concept 1 Lightweight robotic manipulator arm: 4 joints, used for continuous control 1 Inverted Pendulum: 1 axis 1 Gyro Pendulum 1 Pneumatic power-generator model 1 Hovering magnetic ball: used for student labs 5 Several other small experiments: used for student labs Library: approx 11000 books on electrical engineering and subscription to 24 journals</p>	Ruhr-Universität Bochum (Germany)
<p>Reactive Distillation Column controlled by PC-based MiniDCS Chromatographic SMB Plant controlled by Siemens PCS7 Control System 10 l Polymerisation Reactor controlled by ABB Freelance DCS Experiments using the above equipment must be carefully planned well ahead of time - the installations may also serve as case studies for process automation Demonstrator for Batch Plant Scheduling controlled by PCS7 Control System Lab Experiment: Batch Plant, including the famous evaporator PCs</p>	Universität Dortmund (Germany)
<p>Industrial robot for controller development Electro-mechanical actuator testbench Steer-by-wire testbench Stereo visualization environment</p>	Deutsches Zentrum für Luft und Raumfahrt (Germany)

<p>Experimental equipment with hybrid character Detailed information on the experimental equipment will be provided later on. modern computer network (sun servers & linux based workstations) providing sufficient computational facilities for potential visitors</p> <ol style="list-style-type: none"> 1. Multiproduct batch plant 2. Model railway 3. Flexible production line 	<p>Otto-von-Guericke- Universität Magdeburg (Germany)</p>
	<p>Universidad de Sevilla (Spain)</p>
<p>PC Workstation computation tools (Matlab*, Simulink*, ...) simulator (Dymola*) specification and verification tool (Scade*) printers * use of software may be restricted to specific activities according to license agreement</p> <p>Literature on Hybrid Systems and Control Journals access to ScienceDirect</p>	<p>SUPELEC (France)</p>
	<p>INRIA (France)</p>
	<p>University of Patras (Greece)</p>
<ol style="list-style-type: none"> 1) - PC and Workstations as components of the software lab 2) - Sensor network components from Xbow, with following details <ul style="list-style-type: none"> - " The Stargate is a powerful Linux based single board computer with Compact Flash, PCMCIA, Ethernet, USB Host, and additional interface. " - "MIB - Programming and Interface Boards. The MIB600 Ethernet Interface board delivers a LAN data interface and Mote programming. " - "Wireless Measurement System, MICA2: 3rd Generation, Tiny, Wireless Smart Sensors, TinyOS " - "MIB - Programming and Interface Boards" <p>Wireless Measurement System, MICAz: 2.4 GHz, IEEE 802.15.4 compliant ;Tiny, Wireless Measurement System "Antennas Available for MICA2/MICAz boards in each frequency" "MTS101 Basic Sensor Board Light Sensor, Temperature Sensor Bread Board Area Compatible with MICA, MICA2 and MICAz" ENVIRONMENTAL MONITORING BOARD "MTS310 Multi Sensor Board Light, Temperature ; Microphone, Sounder; Tone Detection Circuit; 2-Axis Accelerometer; 2-Axis Magnetometer; Compatible with MICA, MICA2 and MICAz "Pcmcia GPRS Merlin G201, 4+2, MS10, antenna-Versione BULK; Modem GPRS CC2400DK C.I. RF tx rx2400 MHZ (Development Kit) CC2400DK Development Kit. The CC2400 Single-Chip RF transceiver using unlicensed 2.4GHz frequency band.</p> 3) – FPGA development platform Starter Kit FPGA Virtex 4 Memec The Memec Virtex-4 LC Development Kit is evaluation board for Virtex-4 platform Starter Kit FPAAs Anadigm Is a programmable analog arrays (FPAAs) P160 Analog Module Kit Memec Analog Module P160 compatible system board with A/D and D/A converters - SW tools for computation and simulation: MATLAB with various toolbox, Opnet, Omnet++, TOSSIM, ... 	<p>Università degli Studi dell'Aquila (Italy)</p>

Seven computers, fully SW enabled (incl. comprehensive MATLAB licenses etc.) 2 haptic devices 3 robot arms Wheeled vehicles Custom design experimental systems	Università di Pisa (Italy)
The partner institution has 5 fully equipped personal computers at the disposal of the NoE. Both operating systems Windows XP and Linux are available. The computers include the required software for research on hybrid systems: Matlab 7.0 (and toolboxes), Cplex, TeX editors,... The following licenses are available for use: 10 full floating licenses of CPLEX solver 10 full licenses of Xpress-MP solver	Università degli Studi di Siena (Italy)
Three (3) desks equipped with a workstation and installed software.	PARADES (Italy)
Bora with flywheel/cvt Crash test rig Helmet test rig Flat plank tyre tester tyre drums tyre measuring hub various power train test rigs Optically accessible 1-cyl HD diesel engine Optically accessible 1-cyl gasoline engine (Rotax 600cc) various cars	Technische Universiteit Eindhoven (Netherlands)
Standard computer equipment	Universiteit Twente (Netherlands)
Workstation with Linux or Windows desktop PC (Matlab, simulink, etc.)	Technische Universiteit Delft (Netherlands)
Laptops and computers with state-of-the art software for Scientific computation (Matlab, Maple, Mosek, etc.) 25 Telos motes and associated software for sensor network applications	Royal Institute of Technology (Sweden)
	Linköpings Universitet (Sweden)
	Lund Institute of Technology (Sweden)
	University of Cambridge (United Kingdom)

Infrastructure

	France Innovation Scientifique et Transfert (France)
Offices, meeting rooms, library, Restaurants, Student residence	CNRS-CRAN (France)
2 meeting rooms 1 seminar room 1 restaurant: 1 student residence The "Laboratory of Analysis and Architecture of Systems" (LAAS) totals 450 persons and uses 11,400 sq. m. of facilities.	CNRS- LASS (France)
2 offices equipped with phones and Internet connections 2 Libraries: SUPELEC and Université Paris-Sud 1 meeting room 1 seminar room 2 restaurants : SUPELEC and Université Paris-Sud 1 student residence	CNRS- LSS
	Université Catholique de Louvain (Belgium)
The Automatic Control Laboratory (Institut für Automatik, IfA) is a laboratory of the	Swiss Federal Institute

<p>Department of Information Technology and Electrical Engineering of the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland.</p> <p>The Automatic Control Laboratory is located in the ETL building, part of the ETH Zentrum installation. Apart from a number of fully equipped offices, the Laboratory infrastructure also contains 2 rooms for visitors (with a total capacity of 10 people) and 2 lab rooms available for experiments.</p> <p>Libraries: Library of the Automatic Control Laboratory Library of the Department of Information Technology and Electrical Engineering: Main Library of the ETH Library of the University of Zurich</p>	<p>of Technology (Switzerland)</p>
<p>University has a good connection to highway and public transportation Several cafeteria on campus and in the surroundings Office Space: 15 rooms 1 Computer Pool 1 Library 4 Laboratories Seminar room with 40 seats Meeting room with approx 30 seats</p>	<p>Ruhr-Universität Bochum (Germany)</p>
<p>Office Space, Coffeemaker</p>	<p>Universität Dortmund (Germany)</p>
	<p>Deutsches Zentrum für Luft und Raumfahrt (Germany)</p>
<p>Office space for 15 researchers, including 2 visitors (for short or long term stays) Visitors can be hosted in the university's guest house.</p>	<p>Otto-von-Guericke- Universität Magdeburg (Germany)</p>
	<p>Universidad de Sevilla (Spain)</p>
<p>Offices: 1 for faculty 4 for students 2 offices equipped with phones and internet connections 2 Libraries: SUPELEC and Université Paris-Sud 1 meeting room 1 seminar room 2 restaurants: SUPELEC and Université Paris-Sud 1 student residence</p>	<p>SUPELEC (France)</p>
	<p>INRIA (France)</p>
	<p>University of Patras (Greece)</p>
<ul style="list-style-type: none"> - Research laboratory of Center of Excellence DEWS - Research laboratory of telecommunications - Office space for 2 Ph.D. Students and 1 professor 	<p>Università degli Studi dell'Aquila (Italy)</p>
<p>One laboratory One office room and one workstation both equipped with high bandwidth Internet, phone and fax connectivity. There is one meeting room available for such briefings and open discussions. Available for use in this room is an LCD projector and a computer. Libraries:</p>	<p>Università di Pisa (Italy)</p>
<p>Two major labs are at disposal of the NoE: one located at Via Roma and one sited in via Tommaso Pendola. Most of people working on hybrid systems perform their work in Via Roma where personal computers are offered to the NoE. The telelab as well as other facilities for 'more applied' research are found in via Tommaso Pendola.</p>	<p>Università degli Studi di Siena (Italy)</p>
<p>None</p>	<p>PARADES (Italy)</p>
<p>Automotive lab</p>	<p>Technische Universiteit Eindhoven (Netherlands)</p>
<p>None</p>	<p>Universiteit Twente (Netherlands)</p>

None	Technische Universiteit Delft (Netherlands)
An extensive lab, with a wide variety of labprocesses, including watertanks, gyros, helicopters and pendubots.	Royal Institute of Technology (Sweden)
	Linköpings Universitet (Sweden)
	Lund Institute of Technology (Sweden)
	University of Cambridge (United Kingdom)

Installations

	France Innovation Scientifique et Transfert (France)
	CNRS-CRAN (France)
	CNRS- LASS (France)
Mesh WiFi technology : France Telecom's researchers are undertaking a life-size trial of mesh WiFi technology on the Supélec campus in the Paris region. As a real alternative to bring wireless broadband to public mobile or home access, mesh WiFi represents a major stake for temporary events. This technology is also especially suitable for the coverage of airports, shopping centres, parks and limited but dense urban zones (metropolitan networks), since it is a solution that can be rolled out faster and at a lower cost. Through this experimental network developed by France Telecom's R&D, almost 400 users with WiFi portable PCs will have access to Supélec's internal network as well as the Internet. At Supélec, this network access facilitates exchange between users through the Information System, while maintaining a high security level. The trial should draw to a close at the end of December 2006.	CNRS- LSS
	Université Catholique de Louvain (Belgium)
	Swiss Federal Institute of Technology (Switzerland)
Technical staff with 10 people Scientific staff with 9 people Several Servers for Internet presence	Ruhr-Universität Bochum (Germany)
Computer Network	Universität Dortmund (Germany)
Cluster of 40 Linux computers for parallel simulations	Deutsches Zentrum für Luft und Raumfahrt

	(Germany)
Modern computer network (sun servers & Linux based workstations) providing sufficient computational facilities for potential visitors	Otto-von-Guericke-Universität Magdeburg (Germany)
	Universidad de Sevilla (Spain)
Internet secure connection Ethernet Mesh WiFi tried at Supélec: Through this experimental network developed by France Telecom's R&D, almost 400 users with WiFi portable PCs will have access to Supélec's internal network as well as the Internet. At Supélec, this network access facilitates exchange between users through the Information System, while maintaining a high security level. The trial should draw to a close at the end of December 2006.	SUPELEC (France)
	INRIA (France)
	University of Patras (Greece)
- Sensor network platform: based on a web service, local or remote (wired or wireless via GPRS) access to the sensor network is provided. A running (on-line) interactive demo will be soon made available	Università degli Studi dell'Aquila (Italy)
Machine-shop, electronics, optic and fiber-optic measurement and testing instruments, a chemical laboratory, micro fabrication facilities	Università di Pisa (Italy)
As well as fast internet connection and other facilities for researchers, the institution offers the innovative "Automatic Control Telelab" (http://www.dii.unisi.it/~control/act/faq.php) that supports real-time configuration and observation of experiments. The telelab also supports playback access to acquired data from remote computer linked to a collection site through the Internet. The offered online experiments are: Control of the angle of a DC motor, Control of the speed of a DC motor, Control of the water level in a tank, Control of the water flow, Control of a magnetic levitation system, Control of a 2 DOF Helicopter and Control of a LEGO Mobile Robot.	Università degli Studi di Siena (Italy)
None	PARADES (Italy)
See equipment	Technische Universiteit Eindhoven (Netherlands)
None	Universiteit Twente (Netherlands)
None	Technische Universiteit Delft (Netherlands)
A wide variety of lab processes, including water tanks, gyros, helicopters and pendubots.	Royal Institute of Technology (Sweden)
	Linköpings Universitet (Sweden)
	Lund Institute of Technology

	(Sweden)
	University of Cambridge (United Kingdom)