



Project IST 2001-37652 HRTC

Hard Real-time CORBA

Quarterly Management Report

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Consortium

	Participant name	Participant acronym
1	Universidad Politécnica de Madrid	UPM
2	Lund University	ULund
3	Technical University of Vienna	TUVienna
4	SCILabs Ingenieros S.L.	SCILabs

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1. OVERVIEW OF PROGRESS DURING PERIOD, STATUS, ACHIEVEMENTS, DELAYS, MILESTONES, PROBLEMS (IF ANY) AND CORRECTIVE ACTIONS

The project has not reached any milestone yet.

The official starting date of the project was 1 July 2002. Due to summer vacations the *de facto* starting point was 1 September 2002. As a result of this delay the entire project is currently delayed approx two months.

Work is progressing at a good pace since September 1 and we hope to be able to catch up part of this delay during M2-M6 using some of the effort not used during M0-M1 due to summer holidays.

Some deliverables have been rescheduled during this six month period due to this delay but we expect only a minor or no impact on project milestones. Some partners have incorporated more people to the project (Lund and UPM).

In the present status, all the partners share a common vision of the problem and have a clear understanding of the purpose and challenges of the testbeds. The equipment for the testbeds is being procured and installed. The contact with the OMG has been done with good results.

2. MAIN ACTIVITIES AND ACHIEVEMENTS – SCIENTIFIC AND TECHNICAL PERFORMANCE

2.1 WP1 – WP leader: ULund (Karl-Erik Årzén)

The activities in WP1 have been concentrated on networked control loops. In a networked control loop, the control loop is closed over a communication network. The sensing, control calculations, and actuation are located at separate nodes connected by a network. Measurement signals are sent from the sensors to the controller over the network and control signals are sent from the controller to the actuator over the network. The network generates communication delays. Depending on which protocol is used the delays are more or less deterministic. A survey has been performed where different approaches for handling network delays have been identified. This includes stability and control performance issues. The material was presented as a tutorial at the Vienna meeting.

The second activity that currently is being performed in WP1 is an investigation of the possibility to simulate networked control loops based on CORBA using IIOP on top of TCP. The environment that is being considered is TrueTime, a Simulink-based toolbox that allow co-simulation of control systems with real-time kernels and communication networks. The simulator currently supports simulation of a range of MAC protocols, including TDMA, Ethernet and CAN. If it can be extended to also simulate transport layers and the node-network interface, the simulator could play an important role in the project.

The third activity is the domain analysis of CORBA-based control systems. We have been studying design alternatives available from DCS vendors and technological alternatives in the field. Major issues in distributed process control –related to CORBA- to be addressed in the domain analysis and testbed have been identified. The work in this activity will lead to Deliverable 1.1

The work within WP1 suffers from the same delay as the rest of the project.

2.2 WP2 – WP leader: TUWien (Thomas Losert)

We have worked on D2.1 "Analysis of Protocols for Real-Time Control" which is a literature study regarding the available standards of communication protocols and their suitability for our purposes.

20 October 2002

In this workpackage we have prepared seminars on real-time CORBA, pluggable protocols for CORBA and time-triggered protocols which are the basis for our hard real-time protocols. From these seminars the key issue for hard real-time protocols (the notion of time) and its absence from the real-time CORBA specifications is being discussed in the consortium and that will be shown in the final specifications for the pluggable protocols. Although out of the scope of the project, also the need of fault tolerance in the broker appeared as a fundamental issue if it is to be used for critical systems.

Lund is working on using scheduled switched Ethernet as a transport layer for HRT-CORBA and Vienna is working on the use of a time-triggered, more deterministic transport.

In order to be prepared for the development phase regarding hard real-time time protocols a development environment has been set up to port the broker to the PowerPC platform. It is possible for the development environment to be modified depending on the tools and facilities provided by the TTTech equipment.

2.3 WP3 – WP leader: ULund (Klas Nilsson)

The work around the Robot Control Testbed (RCT) has been focused on finding the appropriate (for the purpose of the testbed)

- 1. network communication techniques considering the performance demands for robot servo control
- 2. embedded control processor boards
- 3. runtime platform suitable for execution of Hard RT software and providing integration with soft or non-RT software
- 4. investigation on how to provide a physically portable (that is virtual, for presentations and experiments at other sites) and executable specification/illustration of HRTC.
- 5. sensor-based (using external customer sensors) flexible control loops capturing the properties of component-based real-time networked control.

Here item 5 is the primary issue for which the other items form the basis. We have this far been able to establish: 1) Switched and scheduled RT Ethernet comprises the most suitable communication technique. 2) We will use PPC-G4 boards with PMC connections (from Motorola), plus dedicated processor types when motivated by local IO needs. 3) The RTAI ('European RT Linux') appears to be the most suitable RTOS, and porting of our RT control software has been started. 4) To provide availability of the testbed from a software point of view, some efforts are spent on Java-based IDL and virtual robots using Java3D. That work is mainly carried out in an adjacent project, but definitions of interfaces are carried out together with the HRTC efforts. 5) We have identified visual multi-camera servoing of robot motions as the best choice for testing component-based hard real-time control.

Presently, we are evaluating the possibilities to get HRTC solutions built into a commercially available camera hardware, as well as having ORBs also in the built-in servo control of the robot arm. The development is promising.

As CORBA experts SCILabs has contributed to this task defining what should the robot control testbed look like in order to be able to demonstrate the benefits of hard real-time CORBA in environment with hard timing constraints.

The complexity of the application in combination with the initially unknown properties of commercially available devices has implied that specifications of the testbed and interfaces have not been possible to determine without some procurement and initial prototyping. The first approach, to utilize TTP/C nodes, turned out not to be feasible considering the severe performance demands. Therefore, the final specifications in written form are delayed, since T3.1 to T3.4 in practice are carried out more interleaved than planned.

2.4 WP4 – WP leader: UPM (Manuel Rodríguez)

T4.1 PCT Requirements Specification: The testbed is not only centred in stringent timing constraints but also in scalability and interconnection of heterogeneous plant equipment in a hard/soft real-time environment. The work in this testbed has been focused towards analysing

and specifying an environment where an estimation of these benefits can be obtained. This means that the CORBA-based DCS implementation cases have been identified (in conjunction with task 1.1) and the derived requirements have been specified.

T4.2 PCT Design

The work in the design of the of the PCT has been focused in achieving the realizability of the experiments planned for the testbed based on available equipment. This means the selection of some critical components like the computing and communication equipment, plant and the commercial DCS to be used.

T4.3 PCT Procurement

Equipment necessary for the construction of the RCT has been specified, purchased and some has been already received (worksations, computing nodes for the cluster and hard real-time communication nodes).

2.5 WP5 - WP leader: SCILabs (Miguel Segarra)

WP 5 (Dissemination) is composed of five tasks but two of them are not due until later in the project (5.3 Publications and 5.5 Exploitation and Use Planning). Regarding the active tasks its status is the following:

T5.1 Dissemination Planning: The responsible for this task as shown in subsection 9.4.1 of Annex I is UPM. A draft version of the Dissemination Plan document is now available which includes contributions from all the partners. UPM issued a request for information to the partners in order to include in this document all the possible objectives for HRTC dissemination. The document gathers information on the dissemination activities to be carried out (OMG, industry and policy makers) as well as a description of the OMG process for specification adoption and a calendar of activities that can be selected for dissemination of HRTC.

T5.2 OMG Standardization: Responsible for this task is TUWien. One of the most important objectives of HRTC is to influence the CORBA community in order to obtain CORBA specifications for hard real-time. The Dissemination Plan collects the technical meetings of the OMG which are target for the standardisation activities of HRTC. The first of these meetings was the Helsinki (Finland) meeting held from September 30, 2002 to October 4, 2002. UPM and TUWien attended to the meeting as approved by the consortium in the 1st Plenary Meeting held in Vienna (Austria). As a first achievement from this activity, the proposal of establishing a working group on hard real-time was well received. The consortium has begun preliminary work to foster a "Control Systems Working Group" inside the OMG, key people has been contacted and more concrete tasks should arise from the Washington OMG Technical Meeting to be held in November. Additionally, a flyer was prepared for the OMG technical meeting in Helsinki explaining the objectives of the HRTC project.

T5.3 Publications: The leader for this task is Lund. This task is not due yet as there are no project results to be published.

T5.4 HRTC Web site: The leader for this task is UPM. A web site for HRTC has been published in a UPM's host and the <u>www.HardRealTimeCORBA.org</u> domain has been registered. The web site will evolve along with the project and it currently contains a public part and a private part for the partners. The project's site will be a place for exchange of project related documentation (for the private part) as more deliverables, reports, presentations and code are available and the place for public information of the project. It is foreseen to move the site from UPM to SCILabs' web server for faster access.

T5.5 Exploitation and Use Planning: The leader for this task is SCILabs. Although the start of this task is not due until month 5, SCILabs has already begun to contact some companies related to real-time developments to request if they are willing to answer a questionnaire and/or have an interview with us. The objective of this questionnaire is to find out additional needs they may have regarding hard real-time, to gather information on the use they make of

this type of tools, how do they develop their systems and to find out what are their choice tools for development.

2.6 WP6 – WP leader: UPM (Ricardo Sanz)

The management and coordination work has consisted mainly in the preparation of meetings, management documents and funds transfer.

As was commented at the very beginning, we have had not a very good start due to summer time but the project is progressing at a fast pace now.

The Kick-off Meeting (only the management committee) was organized in Barcelona in July as the only possible solution due to work and holidays constraints of the people involved (the IFAC World Congress was the context for this meeting).

From September 11th to September 13th the first Plenary Meeting has been held in Vienna. The main topics have been: a) tutorials to align knowledge about the major topics of this project: CORBA, process control, and real-time systems, b) clarification of testbeds and equipment selection¹ and c) organization of standardization and dissemination activities.

The task of project assessment has been delayed until M5 in order to gain more knowledge and receive initial inputs from people interested in the OMG Working Group on Control Systems.

3. KEY EVENTS DURING THE REPORTING PERIOD

Event	Dates/ Duration	Location	Purpose/Justification/Major Outcome (this section should be detailed, if appropriate)	Project Participants
Kick-off meeting	23/07/2002	Barcelona (Spain)	First meeting of the management committee in order to coordinate the project activities.	SCILabs (Segarra), UPM (Sanz), Lund(Arzen), TUWien (Kopetz)
1 st Plenary Meeting	11/09/2002 - 13/09/2002	Vienna (Austria)	First Plenary Meeting. Objectives: technology tutorials, hardware specification, robot and control testbeds definitions and, project procedures. Alignment of knowledge about CORBA, process control, and real-time systems	SCILabs (Segarra, Clavijo), UPM (Sanz, Galán, Rodríguez), Lund(Arzen, Nilsson, Anderson, Blomdell), TUWien (Kopetz, Losert, Obermeister)
OMG Technical Meeting	Sep. 29 - Oct. 4	Helsinki	Initial contacts to establish a "Control Systems Working Group" within the Real-Time, Embedded, and Specialized Systems Platform Task Force (RTESS PTF) of the OMG. The proposal is well received and a major contribution/activity is planned for the next OMG Meeting in Washington.	UPM (Sanz), TUWien (Losert)

3.1 Events directly related/funded by HRTC

3.2 Participation in other events (not funded by HRTC)

Event Dates/ Location			Purpose/Justification/Major Outcome	Project		
Duration			(this section should be detailed, if appropriate)	Participants		
IFAC World Congress	22/07/2002 - 26/07/2002	Barcelona (Spain)	Activities and contents of strong interest to HRTC. New organization of a working group on computing and control (Chairman Sanz, Co-	UPM(Sanz), Lund(Arzen)		

¹ Since this project has 1 year of duration and for minimizing delays because of waiting for the delivery of hardware the selection of hardware that is flexible enough to support the top candidates considered in D2.1 was considered an urgent topic.

		chairmen Arzen and Pereira)	
RTAS workshop	San Jose (USA)	Activities and contents of strong interest to HRTC.	Lund(Arzen)

4. LIST OF DELIVERABLES (INCL. THEIR STATUS)

ld	Deliverable Name	Lead	Original Due	Revised Due	Actual Date	Status of EC Review
D5.1	Dissemination Plan	UPM	M1/MS1	M3/MS1	M3	Pending
D6.1	Project Management Manual	UPM	M1/MS1	M3/MS1	M3	Pending
D3.1	RCT Requirements specification	ULUND	M2/MS1	M4/MS1		Pending
D4.1	PCT Requirements specification	UPM	M2/MS1	M4/MS1		Pending
D6.2	Evaluation Plan	UPM	M2/MS1	M4/MS1		Pending
D2.1	Protocols for Real-time Control	TUWien	M3/MS1	M5/MS1		Pending
D3.2	RCT Design	ULUND	M3/MS1	M5/MS1		Pending
D4.2	PCT Design	UPM	M3/MS1	M5/MS1		Pending
D6.3	Quarterly Report M3	UPM	M3/MS1	M5/MS1		Pending
D3.3	RCT Procurement	ULUND	M5/MS1	M6/MS1		Pending
D4.3	PCT Procurement	UPM	M5/MS1	M6/MS1		Pending
D1.1	CCS Domain Analysis	ULUND	M6/MS1	M6/MS1		Pending
D2.2	HRT Protocol Specification	SCILabs	M6/MS1	M6/MS1		Pending
D5.5	Draft Exploitation and Use Plan	SCILabs	M6/MS1	M6/MS1		Pending
D6.4	Periodic Report M6	UPM	M6/MS1	M6/MS1		Pending
D1.2	CCS Domain Architectures	UPM	M9/MS1	M9/MS2		Pending
D2.3	HRT Protocol	SCILabs	M9/MS2	M9/MS2		Pending
D3.4	Non HRTP RCT Implementation	ULUND	M9/MS2	M9/MS2		Pending
D4.4	Non HRTP PCT Implementation	UPM	M9/MS2	M9/MS2		Pending
D6.5	Quarterly Report M9	UPM	M9/MS2	M9/MS2		Pending
D3.5	HRTP RCT implementation	ULUND	M11/MS3	M11/MS3		Pending
D4.5	HRTP PCT implementation	UPM	M11/MS3	M11/MS3		Pending
D1.3	CCS Engineering Handbook	UPM	M12/MS3	M12/MS3		Pending
D3.6	RCT Testing	ULUND	M12/MS3	M12/MS3		Pending
D3.7	RCT Documentation	ULUND	M12/MS3	M12/MS3		Pending
D4.6	PCT Testing	UPM	M12/MS3	M12/MS3		Pending
D3.7	PCT Documentation	UPM	M12/MS3	M12/MS3		Pending
D5.4	HRTC Project Web Page	SCILabs	M12/MS3	M12/MS3		Pending
D5.6	Exploitation and Use Plan	SCILabs	M12/MS3	M12/MS3		Pending
D6.6	Periodic Report M12	UPM	M12/MS3	M12/MS3		Pending
D6.7	Project Evaluation Report	UPM	M12/MS3	M12/MS3		Pending
D6.8	Final Report	UPM	M12/MS3	M12/MS3		Pending

5. MANAGEMENT, CO-ORDINATION, RESOURCES

5.1 **Project Co-ordination and management activities/issues**

As this is a small project (in size and in time) the management committee has decided not to overload people with excessive management and coordination activities. During this period we have had two meetings and all the activity is coordinated by means of e-mail through two mail lists: management (only management committee) and general (both management and development).

The collaboration between partners is quite good and we have had no major problem during this period.

5.2 Project Workplan and proposed changes

This is the modified Gantt chart with the delay due to the commented problem. The proposed changes do not affect milestones, only delivery dates of initial deliverables.

ld	Nombre de tarea	Duración	Comienzo	1 01	02	03	04	05	06	07	08	09	10	11		12
1	1 CORBA Control Systems	260 d	lun 03/01/00	_		1										
2	1.1 CCS Domain Analysis	120 d	lun 03/01/00							_						
3	1.2 CCS Domain Architectures	75 d	lun 19/06/00													
4	1.3 CCS Engineering Process	140 d	lun 19/06/00						- *							
5	2 HRT Protocols	195 d	lun 03/01/00						_	-			Un I			
6	2.1 Protocols for Real-time Control	110 d	lun 03/01/00						ъ			Г				
7	2.2 HRT Pluggable CORBA Protocols	85 d	lun 05/06/00										h			
8	3 Test 1: Robot Control	230 d	lun 14/02/00						_	_		-	_			_
9	3.1 RCT Requirements specification	30 d	lun 14/02/00				և									
10	3.2 RCT Design	15 d	lun 27/03/00													
11	3.3 RCT Procurement	60 d	lun 13/03/00			r C										
12	3.4 Non HRTP RCT Implementation	135 d	lun 27/03/00			Ц							E.			
13	3.5 HRTP R CT implementation	40 d	lun 02/10/00												h	
14	3.6 RCT Testing	25 d	lun 27/11/00													
15	3.7 RCT Documentation	30 d	lun 20/11/00											1		
16	4 Test 2: Process Control	230 d	lun 14/02/00		\sim				_	-		-				_
17	4.1 PCT Requirements specification	30 d	lun 14/02/00				հ									
18	4.2 PCT Design	15 d	lun 27/03/00													
19	4.3 PCT Procurement	60 d	lun 13/03/00			r C										
20	4.4 Non HRTP PCT Implementation	135 d	lun 27/03/00			Ц							H			
21	4.5 HRTP PCT implementation	40 d	lun 02/10/00												h.	
22	4.6 PCT Testing	25 d	lun 27/11/00													
23	4.7 PCT Documentation	30 d	lun 20/11/00											1		
24	5 Dissemination	240 d	lun 31/01/00	1	<u>_</u>				_							_
25	5.1 Dissemination Planning	15 d	lun 31/01/00					-								
26	5.2 OMG Standardization	225 d	lun 21/02/00		Ľ.											
27	5.3 Publications	125 d	lun 10/07/00		1											
28	5.4 HRTC Web site	225 d	lun 21/02/00		Ľ											
29	5.5 Exploitation and Use Planning	170 d	lun 08/05/00													
30	6 Management	260 d	lun 03/01/00						_			-				_
31	6.1 Project Coordination and Reporting	260 d	lun 03/01/00													
32	6.2 Project Management	260 d	lun 03/01/00													
33	6.3 Project Assessment	260 d	lun 03/01/00													
34	6.4 Milestone 1: Domain Analysis	0 d	vie 30/06/00						X	30/0	5					
35	6.5 Milestone 2: HRT Protocols	0 d	sáb 30/09/00									Ļ	30/0	9		
36	6.6 Milestone 3: Final Results	0 d	dom 31/12/00													

5.3 List of items to be amended in Contract incl. Annex 1

5.3.1 Contract

No changes.

5.3.2 Annex 1 17/05/2002

We're using the Annex 1 as included in the HRTC contract: Annex 1 (IST-2001-37652) Version V1, 17/05/2002.

Only the due date of some deliverables has changed from what was specified in the contract.

	WP1 (PMs)	WP2 (PMs)	WP3 (PMs)	WP4 (PMs)	WP5 (PMs)	WP6 (PMs)	Total used in Reporting Period (PMs)	Planned Reporting Period (PMs)	Number of hours per month/ months per year	Total used accum. (PMs)	Total Planned in Annex 1 (PMs)
UPM	1	0	0.2	2	1	1.5	5.7	9.5	135/12	 5.7	46
ULUND	1.5	0.5	2	0	0	0.5	4.5	9.25	140/12	4.5	37
TU Vienna	0	1.34	0.13	0	0.465	0.645	2.58	3.375	133,33/12	2.58	13,5
SCILabs	0	1	0.5	0.5	0.75	0.25	3,00	4.875	140/12	 3,00	19
Total Used in Period	2.5	2.84	2.83	2.5	2.215	2.895	15.78				
Planned in Period	6	5	5	5	2,5	3,5		27			
	WP1	WP2	WP3	WP4	WP5	WP6					
	(PMs)	(PMs)	(PMs)	(PMs)	(PMs)	(PMs)					
Total used accumulated	2.5	2.84	2.83	2.5	2.215	2.895				15.78	
Total planned (Annex 1)	31	13	20	22	17.5	12					115.5

5.4 Effort consumption

Deviations from plan

The deviations from the plan are only due to the problem mentioned of initial reduced dedication due to summer holidays.

5.5 Summary of partner contributions during the reporting period

5.5.1 UPM

The activities of UPM have been focused in four activities: a) The domain analysis of CORBA-based control systems, where the major issues in distributed process control – related to CORBA- to be addressed in the testbed have been identified; b) Specification and design of the PCT c) the dissemination and standardization activities (mostly OMG related) and d) the management and coordination of the project.

5.5.2 ULUND

The main contributions from ULUND during this reporting period have concerned networked control loops, simulation of CORBA control systems, CCS domain analysis, robot testbed specification, and scheduled switched Ethernet as a deterministic plug-in transport layer in HRT-CORBA.

5.5.3 TUWien

TUWien has worked on the analysis of protocols for real-time control. Further they organized the HRTC Meeting in Vienna. In addition they attended the OMG Technical Meeting in Helsinki where the "Control Systems Working Group" could be established within the Real-Time, Embedded, and Specialized Systems Platform Task Force (RTESS PTF).

5.5.4 SCILabs

The main contributions in this reporting period are the elaboration of two seminars on realtime CORBA and pluggable CORBA protocols. Setting-up of a development environment for the broker (to be modified depending on the target hardware). SCILabs has provided expertise and feedback in the requirements specification of both testbeds and has led the Dissemination and Exploitation workpackage in which a dissemination plan has been produced, the OMG standardization process has begun, an informational flyer of the project has been elaborated and a first version of the project web site has been set up. Regarding the exploitation and use plan, SCILabs has begun to contact companies in the field to gather information.

5.6 Implementation of the previous Review Recommendations

There are no previous review and therefore no recommendations.

6. EXPLOITATION / TECHNOLOGY IMPLEMENTATION PLAN

SCILabs is contacting several companies in order to find out their interests in tools like a hard real-time broker and their current development practices for hard real-time. A questionnaire will be forwarded to each of these companies to collect the information. Afterwards, the compiled information will be used to prepare the D5.5 "Draft Exploitation and Use Plan" which is due at the end of the next quarter.