

IST-2001-37652 Hard Real-time CORBA

HRTC Evaluation Plan

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Reference Date Release Status IST37652/005 Deliverable D6.2 2003-2-23 2.0 Final Consortium

Partners

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Summary Sheet

IST Project 2001-37652 HRTC Hard Real-time CORBA

HRTC Evaluation Plan

Abstract:

This document is deliverable *D6.2 Evaluation Plan*. It describes how to perform the evaluation and assessment of the project in terms of expected results.

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Release Sheet (1)

Release:	0.1 Draft
Date:	2002/09/07
Scope	Initial version
Sheets	All
Release:	1.0 Final
Date:	2002/10/13
Scope	Final version
Sheets	All
Release:	1.1 Final
Date:	2002/12/23
Scope	Errors correction.
Sheets	7
Release:	2.0 Draft
Date:	2003/02/23
Scope	Inclusion of "quantitative" evaluation methods instead of questionnaire-based qualitative reviews as requested by the review team.
Sheets	All



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1 Introduction

1.1 Description of the document

This is HRTC deliverable D6.2 Evaluation Plan.

It describes the evaluation criteria and procedure for the HRTC project. This is done in relation to the project expected results as stated in section 2.3 of HRTC Contract Annex1.

1.2 Project objectives and scope

The long-term objectives of the project are focused in the advancement of the CORBA technology for distributed control systems.

The project will perform activities in domain analysis, implementation as well as specification fostering inside the OMG.

The concrete expected results that will serve as a basis for the assessment are described in the following section.

1.3 Expected project results

The planned final products of this project are described in the project technical annex:

- 1. Know-how in distributed real-time object-oriented control systems.
- 2. A pluggable real-time ORB protocol prototype.
- 3. A robot control testbed.
- 4. A process control testbed.
- 5. A specification process for CORBA-based control systems.

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2 References

2.1 Project Documents

HRTC Contract (Technical Annex) Document Number IST37652/001

2.2 OMG Documents

Discussion of the Object Management Architecture (OMA) Guide formal/00-06-41

TheCommonObject Request Broker: Architecture and Specification Version 3.0, July 2002 formal/02-06-01

Real-Time CORBA Specification Version 1.1, August 2002

formal/02-08-02

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3 Evaluation plan

3.1 Project Assessment and evaluation

Project assessment and evaluation will be done by focusing on the specific workpackages because their structure directly reflects the main products of the project (as described in section 1.3 *Expected project results*). See descriptions of workpackages 1-5 in the project technical annex.

For each workpackage the assessment/success criteria are different due to the different nature of the final result.

3.2 Evaluation procedure

The evaluation procedure will consist on the evaluation of each workpackage plus a summary evaluation of the project based on these partial evaluations.

The final summary evaluation will be included in the final report of the project.

3.3 WP1 Domain engineering

Success in this work can be determined by the quality of associated deliverables, being the most important a documented methodology to build CORBA-based control systems (the so called *CCS Engineering Handbook*).

3.3.1 Concrete Objectives

The objectives of WP1 is to identify the potential for using hard-real time CORBA in distributed control systems and and to identify the requirements that this poses on CORBA technology. The objectives is



further to provide analysis and simulation tools for CORBA, RT-CORBA and HRT-CORBA networked control loops.

3.3.2 Assessment criteria

The main assessment is the quality of the associated deliverables and the functionality, realism and user-friendliness of the analysis and simulation tools.

3.3.3 Evaluation procedure

For the text-based deliverables the main evaluation procedure will consist of a detailed review procedure. For the tool-based deliverables the evaluation procedure will consist of the execution of a series of networked control loop scenarios using the tools provided. The results will be evaluated with respect to functionality, realism and user-friendliness.

3.4 WP2 Real-time Protocols

Success will be demonstrated by the existence of a prototype of a software system that implements a CORBA pluggable real-time protocol over network infrastructure of higher predictability than conventional platforms for IIOP (typically TCP/IP over IEEE 802.3).

3.4.1 Concrete Objectives

Integration of a time-triggered transport protocol into the CORBA infrastructure. A time-triggered protocol provides a temporally predictable transport service with minimal jitter.

3.4.2 Assessment Criteria

The reduction of the end-to-end latency of the time-triggered transport service compared to conventional CORBA platforms.

3.4.3 Evaluation Procedure

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We will setup two testbeds of five nodes each, one containing a conventional Ethernet based transport mechanism and the other one a TTP/C based transport mechanism.

We will generate a typical periodic control workload and compare the jitter of two implementations, one time-triggered and the other event-triggered, on the two networks.

The analysis will take into account the differing bandwidth of the two networks.

3.5 WP3 Robot Control Testbed

Success will be demonstrated by the implementation of the robot control testbed and the realization of experiments on it.

3.5.1 Concrete objectives

The objectives of the RCT are to facilitate the evaluation of HRT CORBA techniques in a way that is relevant for industrial motion control applications. Technical aspects include communication, computing (realtime), connectivity (ORBs), and the achieved application performance depending on the performance of the platform.

Both the properties of CORBA and RT CORBA, using TCP/IP, and HRT CORBA using scheduled communication, should be possible to evaluate.

3.5.2 Assessment criteria

The primary criteria is if the RCT serves its purpose in terms of the concrete objectives and for the HRTC project as such. The robustness of the platform has to be such that experiments can be repeated, as required for an experimental verification in a scientific sense.

Monitoring facilities have to be sufficient to make experiments understandable and well documented without extra hardware. It is desirable to have a RCT that can be used to illustrate/explain the properties of CORBA and HRT CORBA, preferably in a spectacular way.



3.5.3 Evaluation procedure

The testbed is to be evaluated by a review investigating the following questions.

- 1. Experiments that have been performed and documented; Have the concrete objectives been met in terms of experimental possibilities.
- 2. Has the RCT contributed to any conclusions concerning useful or deficient techniques within the CORBA domain, applications, or control?
- 3. Is the testbed useful for demonstrations of CORBA features and limitations?

Availability of the simulation and soft RT parts in a virtual setting, *e.g.* to have a transportable testbed for demonstrations, is an extra plus.

3.6 WP4 Process Control Testbed

Success will be demonstrated by the implementation of the process control testbed and the realization of experiments on it.

3.6.1 Objectives

The main objective of the distributed process control testbed **is to identify requirements for distributed control systems and perform experiments in conditions of systems heterogeneity and legacy integration**. Experiments will be done using conventional IIOP and the new real-time protocol.

3.6.2 Assessment Criteria

The assessment criteria will be:

- n For the PCT Requirements deliverable: Contents evaluation
- n PCT Design deliverable: Contents evaluation
- n PCT implementation: The implemented PCT should be the one described in the PCT design.

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• PCT testing:

DCS Conventional

- Measure the behaviour of the control loop working under CORBA and comparison with a conventional control loop.
- Difficulties and requirements needed.

Legacy system

- Limitations of the integration and definition of what can be achieved (what functionality can be used of the legacy system).
- Measure of the behaviour of the integrated system
- Difficulties and Identification of new requirements
- Simulation and control
 - Behaviour of the control loop (timing properties)
 - Requirements identification
- Distributed simulation
 - Measure of the influence in the network and of the network.

SOE generation

- Limits of the experiment
- Measure of results, comparison of generated and recorded sequences of events.
- Requirements identification
- DCS New Transport
 - Limits of the implementation
 - Measure of the behaviour of the control loop working under RT CORBA (timing properties) and comparison with a conventional control loop.
 - Difficulties and requirements identification

Intensive traffic

- Measurement of the system performance as the system grows.
- Measurement of the system performance under dynamic loads.
- Difficulties and requirements identification

Concurrent access

- Measurement of the influence (system performance) and feasibility of multiple nodes accessing concurrently to a variable.
- Difficulties and requirements identification Heterogeneous networks



- Visibility of the nodes in different network segments.
- Measurement of performance (timing properties) operating over bridges.
- Difficulties and requirements identification

3.6.3 Evaluation Procedure

The evaluation of this WP4 has two parts, the first one is concerned with the initial documents of requirements and design. The work done should be qualitatively evaluated taking into account the objective of the workpackage.

The second one is concerned with the application of the previous work. Qualitative and some quantitative evaluations can be applied. The qualitative evaluation should be based on the ability to identify lacks and draw new requirements out of these configurations. A list describing these items should be elaborated for every test. The quantitative evaluation is related with the behaviour of the tests, most of it is related with time measurements in order to quantify how good or bad is the implementation regarding a conventional non CORBA and non RT implementation.

3.7 WP5 Dissemination

Success in this activity will be demonstrated by the existence of an specification process inside the OMG to deal with HRTC issues. This can be considered the overall success criteria of the project.

This activity is obviously subject to OMG policies, timing constraints and partnership. This means that the HRTC consortium will not be able to control but foster this work inside the OMG.

3.8 WP6 Management

Success in this workpackage will be demonstrated by the efficient use of the resources to achieve success in each workpackage as stated in previous sections. The evaluation will be obviously based in the level of success in each of the previous workpackages.



3.9 Evaluation agents

The evaluation of each workpackage will be done by the project managers of each partner involved in the workpackage by means of fulfilling a questionnaire.

The global evaluation will be performed by the General Project Manager and the Project Manager of the industrial partner.

If WP5 succeeds, external evaluations will be requested for the final evaluation of the project. The agents will be selected among the target audience of HRTC results (mainly people involved in OMG activities).

External agents will be provided with a specifically tailored questionnaire.