# Project IST 35102 OCERA

**Open Components for Embedded Real-Time Applications**

**Workpackage WP11 - Dissemination and Exploitation (WWW) Deliverable D11.1**


## Project Co-ordinator


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## Consortium

| | Participant name | Participant acronym |
|---|---|---|
| 1 | Universidad Politécnica de Valencia | UPVLC |
| 2. | Scuola Superiore S. Anna | SSSA |
| 3. | Czech Technical University in Prague | CTU |
| 4. | CEA/DRT/LIST/DTSI | CEA |
| 5. | Unicontrols | UC |
| 6. | MNIS | MNIS |
| 7. | Visual Tools S.A. | VT |

## Document version

| Release | Date | Reason of change |
|---|---|---|
| 1.0 | July, 25 | First release |

## INDEX

# 1. Project presentation

## 1.1 Project Objectives

The OCERA (Open Components for Embedded Real-time Applications) project is targeted at the improvement of embedded distributed computing systems for applications with real-time constraints. From the state of the art in real-time technology and after understanding each customer's needs, we will translate these into easy-to-use services of the highest quality and performance. Systems integrators today need to build larger, more sophisticated, more complex and powerful systems with less time, money and resources. For this reason, OCERA will provide more powerful and robust components.

The **Scientific and technological objectives** of the OCERA project are

- First, to create a library of free software components for the design of embedded real-time systems, targeted both to the industrial and to the academic world;
- Second, to contribute to improve the non-proprietary product Linux and to participate in the evolution of an open community standard, Linux.

The "open-source and free" development model shall be applied to a real-time embeddable kernel. The goal is to offer, in the form of open source component, features which are innovative in **scheduling**, in **resource management**, in **communication** and in **fault-tolerance**. Research areas of particular interest include these four aspects which are identified as key elements to provide guaranteed response times for real-time tasks and messages.

Recently, a tendency has emerged to integrate more software components in embedded systems, for example in automobile equipment, in mobile telecommunication, and so on. However, often the software development aspects are badly mastered, due to a misunderstanding of the real-time concepts. On the other hand, a good understanding of these concepts could greatly influence the competitiveness of the end product: in fact, a feasible and optimized implementation permits a better resource usage, and this in turn results in a cost reduction. The main quality of such a well-engineered software should lie in its capacity to support fast, easy-to-use, low-cost solutions, while guaranteeing, at the same time, a predefined quality of service.

The essential motivation of this project is built on the need for solutions which improve the productivity and the flexibility of development cycle and, at the same time, the predictability of the resulting system. Domains as telecommunications, monitoring, and control systems have strict requirements in terms of timing guarantee and reliability. Dedicated operating systems successfully address all these problems at the price of high development and maintenance costs and requiring a deep knowledge of the system.

The use of an open-source operating system, such as Real-Time Linux, could improve the development process in many ways. In particular, the model of development used in the open source community could be successfully applied to the design and implementation of real-time critical application, improving the reliability and the extensibility of the software components. Another justification for this choice lies in the

availability of many standard development tools (such as compilers, debuggers, profilers, etc.). It is important to note that, while from a development point of view the use of an open source operating systems can speed-up the development time, it does not prevent a commercial exploitation of the final application, as proved by some well-known success stories (such as Red-Hat, VA Linux Systems, etc.).

**The expected outcome of the OCERA project is the development of a comprehensive software architecture based on a high-performance distributed real-time operating system**. The software components, which will be the result of this project, will be portable (i.e. adaptable to several hardware configuration and operating systems), flexible (i.e. able to support a wide variety of application with different level of criticality) and configurable (i.e. scalable from a small embedded one to a full-featured general purpose operating system). The goal is to provide a modular solution for building real-time systems, including configurable real-time scheduler, resource manager, fault detection and so forth.

Another important objective is to prove the applicability and the interoperability of these software components by simulation, by integration and finally by tests on real applications. This is important in order to validate the final product. The integration of novel software components in Real-Time Linux will contribute not only to their validation on a real-world application but above all to their dissemination.

The tests on platforms will be performed to show the benefits in terms of both improved integration process and adequacy with strict requirements on safety and reliability of next generation applications. Three demonstrator systems, in the areas of process control, robotics and multimedia, will be chosen to validate the components and show that the proposed technology is flexible enough to span a large domain of applications.

It is also important to underline the fact that there is a wide community of academies and SMEs which have a deep knowledge of the Linux internals and support its development. Moreover, the industrial world is gaining confidence with Linux, as proved by the presence of several companies in the "club Linux" (Linéo, TimeSys, Lynx Real-Time Systems, etc). These companies are pushing the use of Linux as a base for embedded systems. In the heterogeneous scenario of the embedded systems market, Real-Time Linux is going to represent an effective alternative to the two common approaches: "in-house" and commercial.

The aim of OCERA project is to provide Linux with new real-time functionalities and permit embedded systems developers to access all the benefits that Linux has demonstrated in server and storage applications. From our research experience in real-time technology in one hand and the needs of industrial systems integrators in the other hand, we are able to define and develop sophisticated mechanisms and realize their integration.

Linux has become popular among the computing community, mainly because of its compliance to the POSIX standard which specifies the basic features and interfaces that UNIX-like operating systems should offer. Adhering to this standard means that code developed for Linux can be easily ported to other operating systems and vice-versa. All the OCERA components will be developed complying with the POSIX.4 standard which is becoming increasingly relevant in today's real-time computing systems. Thus the developed library will be compliant to any operating system that supports this standard.

We shall transfer to the industrial world a innovative real-time technology which lean on scientific results recognized and validated in a formal way. The software components will be open source, downloadable from a web site. The components which we shall make available will be selected so as to cover the widest possible application range, going from the most critical applications, generally with a strongly cyclic behaviour (military industry, avionic), to applications with different criticality degrees (mobile robotics with teleoperation via Internet), to non critical applications (multimedia, video on demand). This industrial transference offers to the Community an added value and contributes to EU policies giving to potential market models and techniques to be incorporated in their developments.

The market analysis will precisely define the customer's needs enabling the development of the best technological solution. Through the technology transfer mechanism, complete access and understanding of the source code will be provided. It concerns as well the sectors of high technology as the general public products. The potential market of the proposed components include platform developers, final users of embedded applications in a number of application fields interested in cost-effective solutions. Moreover, the availability of inexpensive, high performance processors and high-capacity memory chips has made it attractive to use distributed computing systems for real-time applications.

The embedded real-time systems market is expected to positively react to the availability of these solutions because the demand for predictability, fault-tolerance and high performance in communication will keep on rising every year. Embedded systems designers can use the library of software components for developing and supporting their own solutions. The library could also be used for R projects for it will be open source and easily customizable.

Finally, it is worth to mention the educational (and financial) interest of this library in high education. In a later phase, it will be possible to integrate the results of this project into a tool for training on embedded real-time systems, with practical application on real-time operating systems.

The project will be performed in three main phases:

- State of the art RTOS analysis and definition of the business cases;
- Software development with measurement of performance indicators and simulation
- Fields tests and validation of business
- Planning and execution of dissemination activities and training program for a proper take-up of the software components after completion of the project.

The broadcasting of the information for the public use of the library of components will be realized on the Web site of the OCERA project.

In summary, the partners will use their individual research experience in the domain of real-time (real-time scheduling for UPVLC, resource management for SSSA, fault-tolerance for CEA and communication for CTU) to collectively build an innovative product, which will consist of four major results:

- a set of free open-source components for real-time operating systems,

- a guide for implementing the components in a generic operating system,
- an improved version of Real-Time Linux provided by optional and selectable libraries offering new services.
- a set of three demonstrators in the areas of process control, robotics and multimedia, which prove the applicability and interoperability of the software components

## 1.2 Measurable and verifiable criteria

The project results can be evaluated with the following measurable and verifiable criteria:

- Functional software components will be created that are specifically aimed at improving timing performance and reliability of real-time systems, independently of the target operating system.
- The embedded real-time systems designed using OCERA components are expected to increase the predictability, fault-tolerance and high performance in communication.
- Currently, there are not industrial real-time operating system with two levels of scheduling that a system developed under OCERA can incorporate. The first level will provide a set of basic schedulers while the second one can include advanced schedulers allowing the design of applications incorporating imprecise computation or quality of service management.
- The inclusion of fault tolerant components will permit to develop safe critical applications providing facilities to handle exceptional situations.
- The definition of different modes in a real-time system is, currently, implemented at the application level. The incorporation of specific modes at the components level will facilitate the mode changes in an efficient and safe way. This functionality can not be found in any real time operating system.
- The OCERA components will be: adaptable to several hardware configuration, able to support a wide variety of application with different level of criticality and scalable from a small embedded one to a full-featured general purpose operating system.
- The project will make Europe more competitive in the field of embedded systems market since we will provide new real-time technologies and ensure their tranfer to the final user.

The above measures refer to qualitative aspects and new functionalities (further details can be found in section 5.Innovation). Some quantitative aspects will also be taken into account in order to evaluate the quality of the components, such as:

- overhead introduced by each set of components associated to a functionality
- RT-Linux and Linux footprints
- Kernel services response time

Where possible, the business case definitions/application specifications will include a quantification of targets for some of the above criteria; after the first phase of the project WP12 will in particular define evaluation and assessment criteria in more detail

## 2. Participant List

| Partic. Role | Partic. Id. | Partic. Name | Partic. Acronym | Country |
|---|---|---|---|---|
| CO | 1 | Universidad Politécnica de Valencia | UPVLC | E |
| CR | 2 | Scuola Superiore S. Anna | SSSA | I |
| CR | 3 | Czech Technical University in Prague | CTU | CZ |
| CR | 4 | CEA | CEA | FR |
| CR | 5 | UNICONTROLS | UC | CZ |
| CR | 6 | MNIS | MNIS | FR |
| CR | 7 | VISUAL TOOLS S.A. | VT | E |

## 3. Milestones and expected results

The expected outcome of the OCERA project is the implementation of a comprehensive software architecture based on a high-performance distributed real-time operating system. A library of free software components for the design of a high variety of embedded real-time systems to cover several classes of applications configures the basis of this architecture. The project will provide case studies, training documentation, details of the demonstrators and the software components through a web site.

The milestones are as follows:

**MS 1 (month 6)** : market analysis and architecture specification available;
**MS 2 (month 12)** : platform analysis completed and first OCERA components prototypes available;
**MS 3 (month 18)** : new functionalities defined and first step of component integration achieved;
**MS 4 (month 24)** : final version of components implemented; second step of integration achieved;
**MS 5 (month 30)** : Validation through application demonstrators done and technical support/training material available.

The OCERA components will provide Linux with the new real-time functionalities and will permit embedded system developers to access all these benefits. The project shall transfer to the industrial world an innovative realtime technology which leans on scientific results recognized and validated in a formal way. The components will be designed to cover the widest application range including fully critical systems, and systems with different criticality degrees.

# 4. Workplan

## 4.1 General description and overview of milestones

The consortium of the OCERA project is composed of seven organisations of four European countries as described in section 3. There are 4 research groups in charge of research and development activities and 3 partners are final users involved in aspects related to prospective, validation in real world applications and training.

The OCERA project, with a duration of 30 months, is articulated around 13 workpackages. The specifications for the development are defined in workpackage WP2 whose results enable to start workpackages WP4, WP5, WP6 and WP7, each specialized in one aspect of real-time technology and performed by the most competent partner laboratory in the consortium.

This project aims at reaching rapid production quality for the software components that will be developed. This implies extensive testing, verification and validation activities, performance evaluation and competition analysis. This is the reason why the development phase is performed in two steps.

1. As soon as the first step of development is achieved, the integration phase can start in workpackage WP8. This permits immediate exploitation of results. This means that at the middle of the project, one version of Real-time Linux supplied with a minimum set of functionalities will be made available
2. The second phase of development will start after the end of the second phase of the market analysis, with new needs. Its termination then conditions the start of the second phase of integration and the work of validation in WP9 which will have started before to make a preliminary analysis

All along the project interaction among will be carried out through periodic meetings, electronic mail, and the web site support. These activities are coordinated through WP11 and WP13.

The project Assessment and Evaluation is defined and supervised in WP12.

The main milestones of the project are:

**Milestone MS 1 (month 6)**

Initial studies (RTOS state of the art, market analysis and architecture specifications) (month 6)

Revised workplan (month 6)

**Milestone MS 2 (month 12)**

Platform analysis completed, Design of OCERA components completed (month 9)

First OCERA components prototype available (month 12)

**Milestone MS 3 (month 18)**

Second phase of market analysis completed (month 15)

Definition of new functionalities completed (month 15)

First step of integration completed (month 18)

**Milestone MS 4 (month 24)**

Final OCERA components prototype available (month 21)

Three Demonstrators - pilot protoypes implemented (month 24)

Second step of integration completed incl. configuration tool (month 24)

**Milestone MS 5 (month 30)**

Final OCERA system implemented (month 30)

Three Demonstrators -prototypes completed (month 30)

Final step of technical support and validation completed (month 30)

Evaluated results (month 30)

# 5. Web Site Specification and Initial Implementation

## 5.1 Web Objectives

The chapter deals with the OCERA web site specification, structure and design. The goals of the web site are:

1. To disseminate the achievements of the OCERA project and give the opportunity to know the technology and get the developments to the industry, academia and institutions. This dissemination will include public reports, scientific and industrial papers, software, user's and installation guides of OCERA components, examples, tutorials, and all the material needed to do possible the use of the developed technology.
2. To serve as common repository of the partners to facilitate the design, development and integration of the components.

From these goals the main functionalities provided by the web site are:

- Basic information about the project: Abstract, goals and expected results
- Information about the partners and their role in the project
- Publications of the project
- Dissemination activities: publications in conferences, seminars, industrial activities, etc.
- Documentation and development tools used by the partners
- Technical support provided by SourceForge web site to control the program versions, management tools and utilities
- Search facilities
- Private section to share the developments, internal and draft documentation, meeting minutes, meeting agendas, etc.

## 5.2 Web site structure

The following scheme shows the public web map :

| First level | Second level |
|---|---|
| Home | |
| Objectives | abstract<br>description of the work<br>project objectives<br>milestone<br>short presentation |
| Partners and roles | UPVLC |

| First level | Second level |
|---|---|
| | SSSA<br>CTU<br>CEA<br>UC<br>MNIS<br>VisualTools |
| Publications | Project deliverables<br>UPVLC<br>SSSA<br>CTU<br>CEA<br>UC<br>MNIS<br>VisualTools |
| Background | links to publications |
| Technical support | SourceForge web site link |
| Search | |

The SourceForge Technical support includes the following structure:

| First level | Second level |
|---|---|
| Summary | |
| Admin | |
| Forums | |
| Tracker | |
| Bugs | |
| Patches | |
| Tasks | |
| Docs | |
| Surveys | |
| News | |

| First level | Second level |
|---|---|
| CVS | |
| Files | |

The private section includes:

| First level | Second level |
|---|---|
| Private home | Annexes and CPFs Management<br>File editor<br>Public home page |
| Annexes and CPFs | Annexes<br>Document forms |
| Management | private deliverables management tasks |
| File Editor | |

## 5.3 Technical aspects

Server configuration:

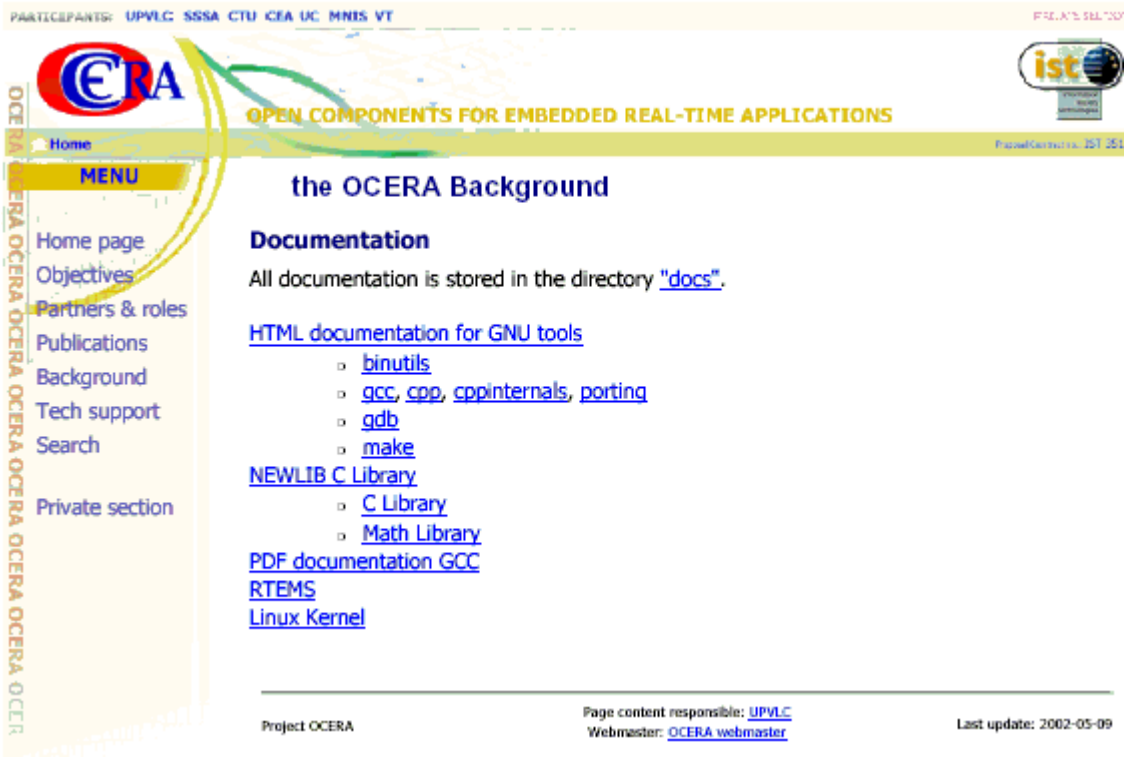
| | |
|---|---|
| Web site address: | http://www.ocera.org |
| IP address: | 158.42.50.124 |
| Web site language: | English |
| Script code language: | PHP, HTML |
| Web responsability: | CTU |
| Graphical design: | CTU - Jan Krákora |
| Script code language: | PHP, HTML |
| Web allocation: | UPVLC - Sergio Sáez |

## 5.4 Web snapshots

This section shows some snapshots from the OCERA and SourceForge web sites:


OCERA main page

Partners page




OCERA background page

**Project: OCERA: Summary**

Summary | Admin | Home Page | Forums | Tracker | Bugs | Support | Patches | Lists | Tasks | Docs | Surveys | News | CVS | Files |

The objectives of OCERA is the design and implementation of a library of free software components for the design of embedded real-time systems. These components will be used to create flexible, configurable, robust and portable embedded applications.

This project has not yet categorized itself in the Trove Software Map.

Project UNIX name: ocera
Registered: 2002-04-18 01:43
Activity Percentile (last week): 23.2877%
View project activity statistics

**Developer Info**

Project Admins:
adrianm
iripoll
mheras
ssaez

Developers:
17 [View Members]

**Latest File Releases**

| Package | Version | Date | Notes / Monitor | Download |
|---|---|---|---|---|
| **This Project Has Not Released Any Files** | | | | |

[View ALL Project Files]

**Public Areas**

Project Home Page

Tracker

- Bugs ( **0 open / 0 total** )
Bug Tracking System

- Support Requests ( **0 open / 0 total** )
Tech Support Tracking System

- Patches ( **0 open / 0 total** )
Patch Tracking System

**Latest News**

**CVS tree created**
*adrianm - 2002-07-10 01:55*
(0 Comments) [Read More/Comment]

**July 1st-2nd, 2002. First Technical Meeting**
*adrianm - 2002-07-10 01:51*
(0 Comments) [Read More/Comment]

**April 16-17 2002, Kickoff Meeting**
*adrianm - 2002-07-10 01:49*
(0 Comments) [Read More/Comment]

OCERA at SourceForge