

Collaborative Platform for Universities, Foster Clubs and Scientists in Aerospace Research*

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Abstract

Communication is an essential element in our lives. The Internet has become part of our everyday life connecting everybody, everywhere and anytime. This is obviously changing the way people work and interact. People want to collaborate with team partners from wherever and whenever necessary.

This paper presents the collaborative platform for an innovating project (called PERSEUS¹ – Student Project in European Space Research for Universities and Scientists) in the domain of small size satellites. The participants of this project come from a large variety of technical and non-technical domains. Thus, the need for a tool to ease their cooperation and coordination of multiple disciplinary analyses is obvious.

1. Introduction

Space agencies have always attached a great importance to their relations with universities. For instance, common activities have been developed between these partners. In France, annual launching campaigns of experimental rockets have been carried out for several years under the aegis of the CNES (French National Space Agency) and the association Planet Sciences.

These campaigns demonstrate that creativity and the imagination of the young people have very few limits and thus validate the idea that by

¹ The PERSEUS Project is financed by the CNES (French National Space Agency)

offering them technical and financial supports, and an adequate technical framing, challenges can be taken up.

In the past, this has been demonstrated by the launching of several satellites designed and built by young members of clubs.

Thus, the existence of a network of a very active aerospace clubs shows that France can pass at a higher speed in this field of *collaboration* already developed in other countries (ex. the California University in CALVEIN project, the RVT at the Tokyo University).

2. The PERSEUS Project

Today, we cannot imagine the world of the space activity disconnected from that of the higher education. In France and Europe, the relations between industrialists, researchers and students have always existed.

PERSEUS project aims at entrusting to the academic and the research world, the design and the development of a launching system for nano-satellites, with a framing of professionals from the space sector. Over several years, students and researchers, supported by a network of experts, are being mobilized together to design and produce an operational launcher of small size satellites (nano satellites) [1].

PERSEUS differs from the more conventional similar projects by the will to develop innovating technologies, and by its federator character. PERSEUS programme's main ideas are [2]:

- Stimulating the imagination and creativity of future graduates
- Involving school or university laboratories

- Involving small and medium-sized businesses from outside the space sector: technology transfer
- Promoting the emulation generated by the involvement of multiple teams

For the students, this is also a single opportunity to experiment a hands-on activity and to invest themselves completely in experimental activities. PERSEUS aims at sensitizing the students with the space techniques, mainly in the field of the launchers, but the types of work are much diversified:

- System studies
- Subsystem and technological studies
- Experiments, ground or in-flight testing
- Economic studies
- Project management, programming, methods

It is not a question of a simple specific experiment, but well of a true teaching and technological challenge, carrying important stakes. For the CNES, the initiative goes in the 2 directions. The creativity of these young people will make it possible to release from new tracks of technological innovations "which should be able to be" transposable with the commercial launchers. This project especially proposes them to take part in a multi-field human adventure leading to a concrete realization.

3. PERSEUS Collaborative Platform

The PERSEUS collaborative platform, called Perseus Portal ("Portail Perseus"), has been designed by the National Institute of Communications (INT) and the CNES, as a tool of collaboration and communication between the universities and industrial partners within the framework of the Perseus project. This platform consists of a secure network and software infrastructure which will allow collaborative work between the entities.

The Perseus Portal is presented as a Web interface towards a system which offers various functionalities through two access levels: the first level is the free access Public Portal, the second is the community level based on an identification access.

The Public Portal is a tool for publication of information on the research projects and programs. It is accessible to the public without identification, by using a normal Internet access. The Portal makes it possible to a Net surfer to

understand what the Perseus project is and how to take part in it. It is also used for recruitment of the new participants.

As we said, the community level is not public. It is protected (user name and password for every participant) and it allows the real work between the participants in the program through the functionalities:

1. File Manager - share files of the project between the actors of the project
2. Mailing lists - management of mailing lists associated with the project
3. Twiki Tool for collaborative drafting - collaborative drafting between members of the project (whom we call twiki [3] because of the tool used)
4. Wiki encyclopedic - A collaborative written encyclopedia (using the Twiki tool) with the goal to create a base of knowledge by domain of research or by subject in the space field.
5. News of the project (visible on the web Public Portal)
6. Calendar of the project
7. Address book of the project

The tools integrated into the Perseus Portal are widely in use in the open source and academic communities and thus the role of INT is to adapt them to the use of the aerospace community.

4. Toward a scalable platform

One of the most innovating aspects of this platform compared to the other existing ones is its optimization in order to ensure an optimal quality of service to the partners of the PERSEUS project. INT has proposed a technical solution which consists in integrating both hardware and software solutions.

The PERSEUS collaborative platform will allow many institutions to work altogether and as a consequence a very large number of requests will be received by the platform, and some time in very short period of time. In spite of the power of current processors, it appears that a single processor server could hardly support the load induced by an intensive use.

A first solution would consist in using an SMP-based server platform (with four or even eight processors sharing a single memory). However, in addition to the weak scalability of such a solution, the cost of the hardware limits its use seriously.

A second solution would consist in using a cluster of PCs-based architecture. A cluster of PCs is a collection of standard PCs connected altogether by a dedicated network and managed as a single entity. The main advantages of this solution are: first, the use of low-cost hardware as all components are standard ones, and second, its great scalability. However, as opposed to the first solution, the memory within a cluster of PCs is distributed on each PC composing the machine (which is not the case in an SMP-based server where as single memory is shared by all the processors).

When considering the second solution, the view of the cluster of PCs can be provided in two different ways to the application:

1. The cluster of PCs is seen as a group of intrinsically independent PCs. In this case, it becomes necessary to rewrite a part of the application in order to take advantage of the all the resources of the platform.
2. The cluster of PCs is seen as a unified system similar to an SMP-based server. In this case, the use of the distributed resources is made completely transparent to the application. Typical resources unified in this way are the processors (they all are accessible from all the nodes of the platform without extra need of communications), the memory (all independent physical memories can be used from any nodes of the cluster transparently), the disks (all independent disks can be used from any nodes of the cluster transparently, even when a process migrates from one node to another one).

The second way of viewing the cluster platform is far the best solution for the PERSEUS project as it will not require rewriting any piece of code. However, we first need to determine whether the available solutions are able to cope with the inherent problems of a collaborative platform.

Available solutions for unifying resources in clusters of PCs are of two different natures. The first solutions are dealing with a single resource only. This is the case of Distributed Shared Memory (DSM) systems for the unification of the memory (SAM [4], Delphi [5]) and systems able to manage large sets of disks (like MosixFS [6], PVFS [7]). The second solutions are dealing with the system as a whole and are called Single System Image (SSI) systems (Mosix [8], OpenSSI [9], Kerrighed [10], Genesis [11]). Very few systems of this nature are available (and even

more, very few are mature ones). In the scope of the PERSEUS project, we decided to perform tests using the Kerrighed solution, considering it is at present the most stable solution.

5. Conclusions

This paper presents the Perseus collaborative platform which is the result of the student's and researcher's needs of exchanging and sharing information.

The Perseus Portal aims at bringing good practices taken from the collaborative software development to aerospace scientific communities. In that sense, the Perseus Portal integrates tools that are widely in use in the open source and academic communities and adapt them to the use of the aerospace community.

In the first phase of this project, considering the reduced number of participants, we proposed to implement the first technical solution, based on a bi-processor server. Nevertheless, the second solution is by far the best solution for the PERSEUS project as it will not require rewriting any piece of code. However, we first need to determine whether the available solutions are able to cope with the inherent problems of a collaborative platform.

Acknowledgments

We want to thank Raymond Bec and Kevin De Groote from the French National Space Agency for this project proposal.

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