

# SYSTEM INTEGRATION *for* VALUE-ADDED SERVICES IN E-LEARNING

In modern Open Source LMS landscape, there is a wide availability of different products, each one with their qualities, but also with their peculiarities. In our experience, none of the available Open Source LMS suit perfectly the needs of our end users. To achieve the best user experience – students and teachers in our context – the adopted strategy was to integrate different services into the main LMS, rather than developing new features into it.

The main advantage of a distributed system like the one proposed is reusability and scalability:

- The services are not tightly coupled to the Main LMS, so it can be substituted with minor effort.
- Every single service function can be run in separated servers.
- The additional services are shared between different LMS installations, leading to cost optimization and reduced administration time.
- We are able to move an overloaded service to a single dedicated machine, or a most powerful one, with a minimum impact on the continuity of service of the main LMS.

By integrating different, specific software components we achieved the goals of high scalability and reliability towards a plug-in driven architecture; furthermore, developed user interfaces are fully integrated into the LMS graphical theme, hiding the underlying complexity to the end user – all this with minimal impact on the LMS core code. The main results achieved so far is the maximizing of user satisfaction in their experience with our e-learning services; as this is only a first release of the framework we are planning to develop more and improved features. The feedback received from users has been positive so far confirming the validity of our work.

*Authors*

Pier Giuseppe Rossi

pg.rossi@unimc.it

Lorenzo Maurizi

lorenzo.maurizi@unimc.it

Simone Carletti

simone.carletti@unimc.it

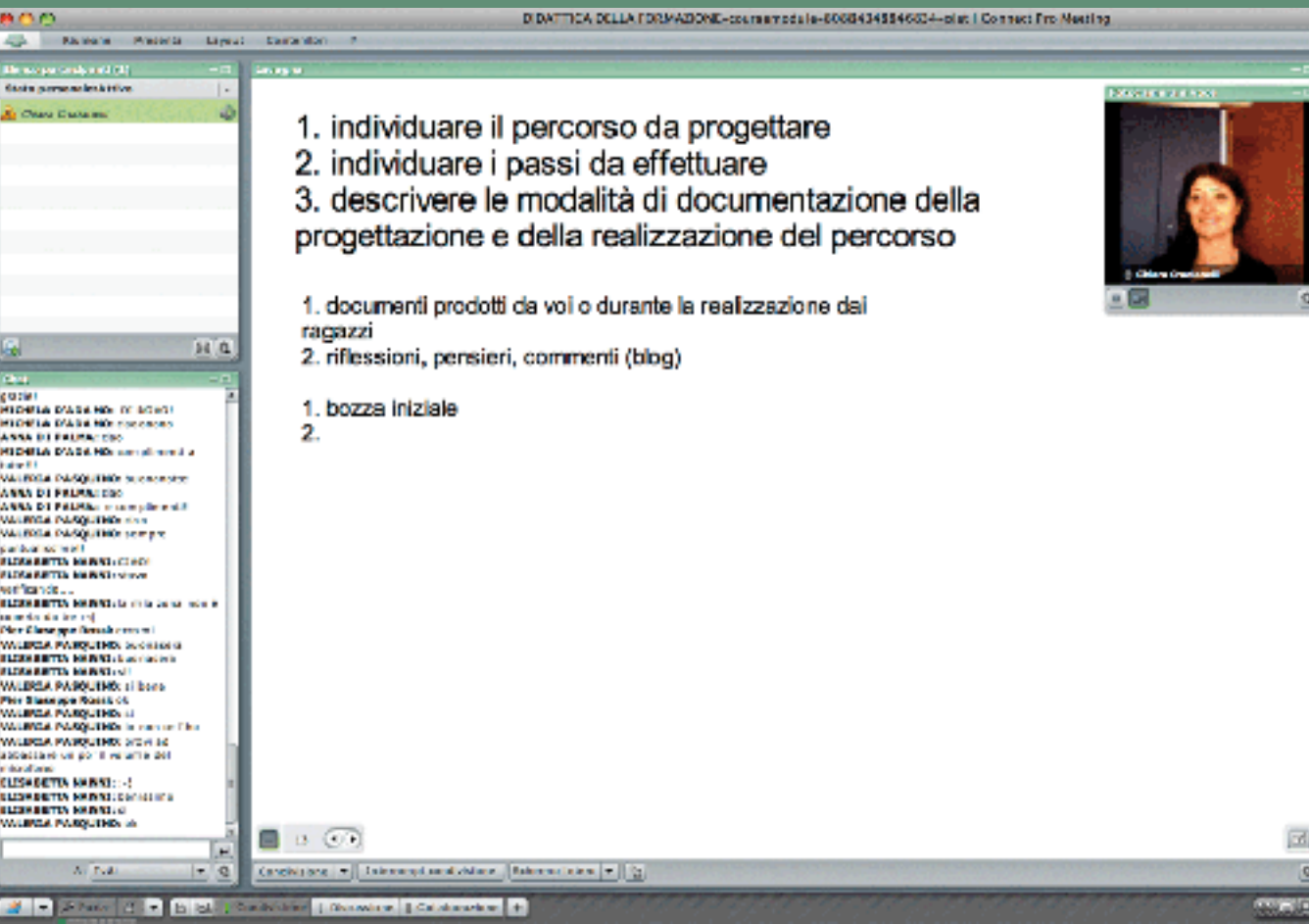
Manolo Micozzi

manolo.micozzi@unimc.it

Diego Bonura

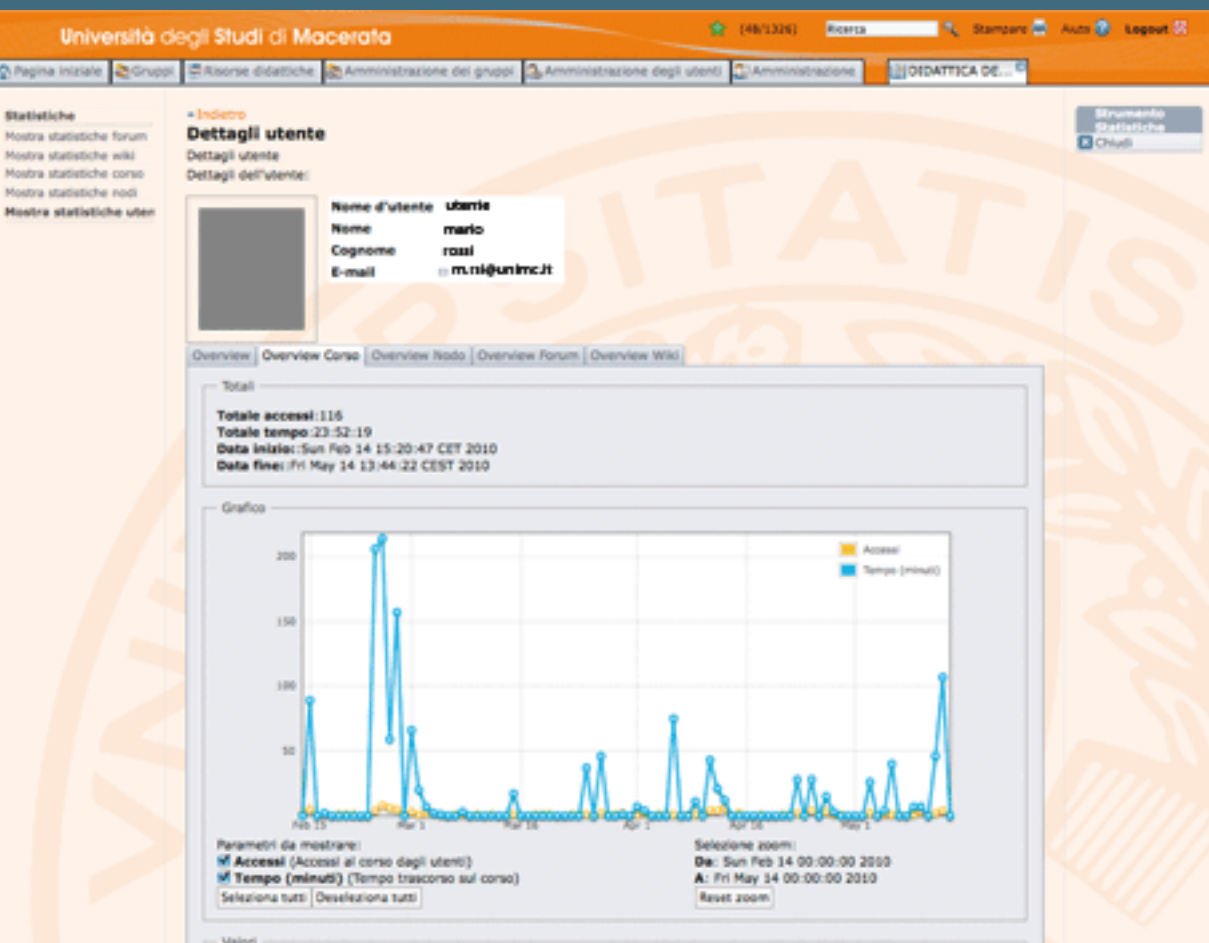
diego.bonura@unimc.it

### Videoconference Service

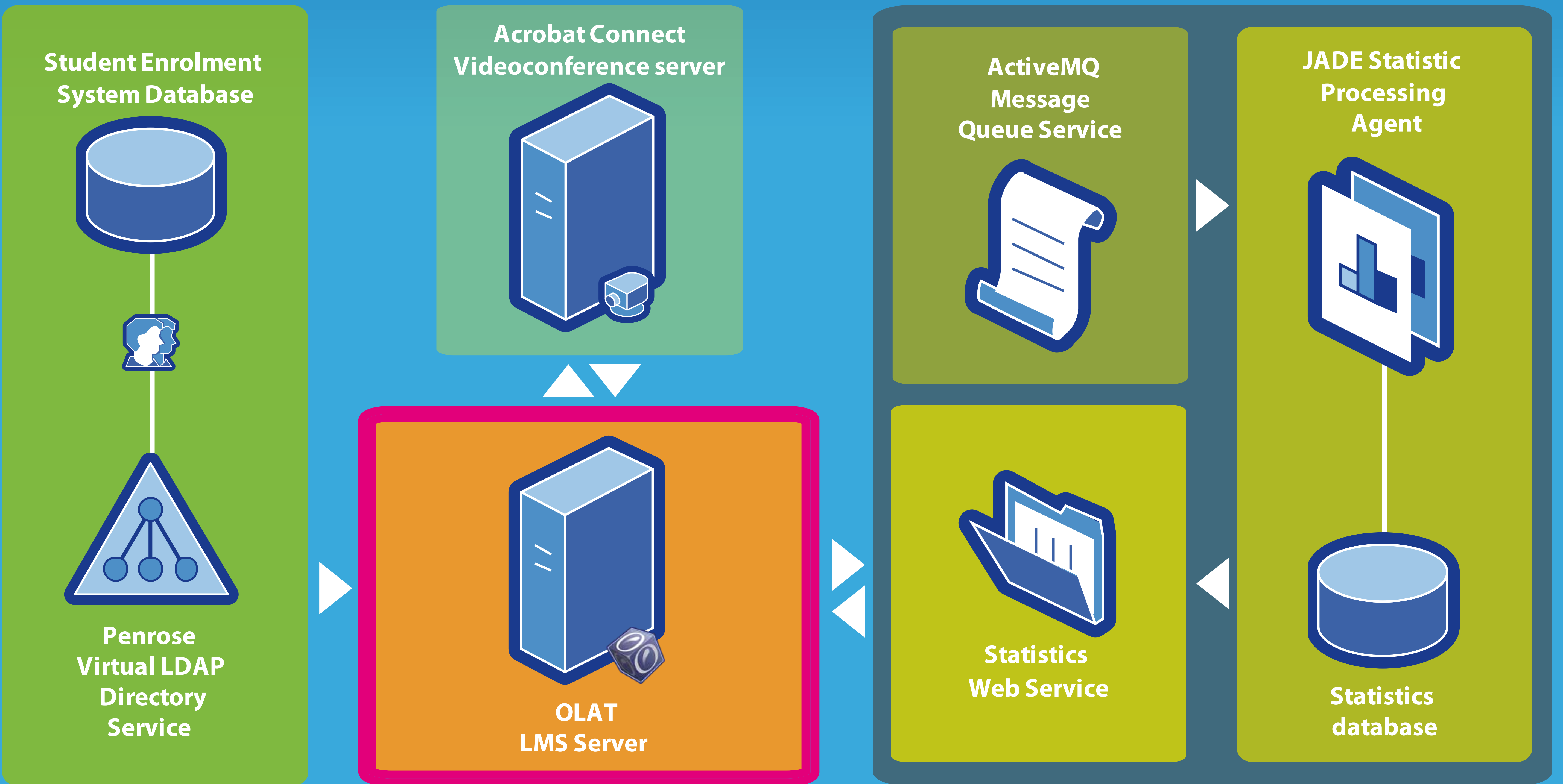


A rich e-learning experience needs a synchronous Audio/Video communication system featuring ease of use and zero-configuration for end users. After testing several Open Source solutions we decided to adopt a commercial platform due to stability and reliability issues; in this case we deployed Adobe Acrobat Connect (formerly known as Breeze) as we reckon it as the most stable, reliable and functional-rich Video Conferencing platform on the market. Connect brings leading edge performance and a full cross-platform, web-based client. We decided to integrate the videoconferencing system into the main LMS instance, as an additional plugin/tool, leading to a seamless login integration from the learning platform to the videoconferencing service, therefore adding a great value to our e-learning platform in terms of functionalities and ease of use.

### Tracking and Monitoring Service



We were not fully satisfied on how OLAT LMS collected platform usage data, so we decided to develop an external users' activity data collection and analysis system. Having started the design of this software component from scratch, we decided that it had to be reusable for multiple, heterogeneous LMSs. The final result is a multilayer component architecture able to house multiple platforms (only one adapter interface needs to be written for each LMS) and to perform real-time, as well as scheduled, data collection by means of Jade-based agents and schedulers. Information obtained from the processed data is then returned to the platform via web services and specific interfaces (instant messaging chatbot).




### Centralized User Provisioning

The system is based upon an Open Source Virtual Directory service, namely Penrose Server. This server provides various aggregation functionality of identity data from multiple heterogeneous sources. Thanks to this tool we are able to collect data from our institution's centralized databases, associate enrolment information to students, teachers and tutors, and finally provide a consolidated view via a customized Directory Information Tree (DIT) exposed as an LDAP interface. From the user and the administrator point of view, this integration leads to multiple advantages:

- real-time, automated update of user records and course access authorization (e.g. no admin intervention required);
- simplified user management with unique login for different systems;
- low overhead on system performance thanks to caching mechanism.

### OLAT LMS

After evaluating different LMSs, we decided to deploy OLAT, a Java Open Source LMS platform designed by the University Of Zurich and developed by a growing community of international e-learning specialists. Currently our three LMS installations in the University of Macerata are providing e-Learning services for more than one thousand undergraduate students in five faculties, 220 students in five postgraduate masters, 175 students in three postgraduate courses, and a total of more than 250 teachers and tutors.



### Layer 1: data collection

For this step we used Apache ActiveMQ, a message brokering service able to collect and distribute several message queues. In our implementation, this component accepts incoming messages from the LMS containing the detail of the actions carried out by end users.

### Layer 2: data elaboration and storing

For this step we developed a multi-agent system (MAS) using JADE (Java Agent Development), a software framework fully implemented in Java language that simplifies the implementation of multi-agent systems. The agent reads usage data from different queues and process actions, storing the results in a MySQL database and consolidating collected data.

### Layer 3: data reporting

For this step we developed different web services providing data to the LMS and other external analysis tools. The data is then rendered in a graphical user interface (GUI) into the LMS using the Protochart open source JavaScript library, to give a high quality graphical representation of usage data with Web 2.0 experiences.



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