FIRST OPERATIONAL EXPERIENCE WITH LASER

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ABSTRACT

During the spring and summer of this year, the new LHC alarm service, LASER, was used operationally for the first time for the commissioning of the LEIR accelerator, for the hardware commissioning for LHC, and by the Technical services' operators.

This presentation will describe the LASER architecture and functionality in general, and what was used this year in particular. It will then summarize the experiences gained and lessons learnt from these three occasions, and conclude by discussing the next steps to be applied for LASER.

INTRODUCTION

LASER addresses the analysis, design and implementation of the alarms management service of the future LHC control system and will deliver an alarm service for the operation of the CERN accelerator chain, i.e. the PS, SPS and LHC accelerators, and technical services, including networks and hosts supporting the former two.

The services provided by LASER are the definition, collection, analysis, archiving and distribution of information regarding abnormal situations, hereafter called fault states (FS), to either dedicated alarm consoles, running mainly in the control rooms, or specialized client applications. The actual detection of a FS is not performed by LASER but by user surveillance programs, USP's, which are either running locally in distributed front-end computers or centrally in server computers.

SYSTEM OVERVIEW

Architecture

LASER is a distributed, layered application. Each layer forms a foundation of services for the layers above and depends on the services provided by the layers below by means of interfaces (see Fig. 1). It is deployed over a 3-tier architecture, where:

- The *resource tier* constitutes the dispersed set of USP's, detecting and triggering FS changes.
- The *business tier* implements the system business logic and its services.
- The *client tier* consists of dedicated alarm consoles and other software components consuming the business services.

Technology

The technology choices made for LASER are based on the Java 2 Enterprise Edition (J2EE) standard for developing multi-tier Java-based applications. The distributed, asynchronous and service aspects of the system are covered by different J2EE specifications: the Java Messaging Service (JMS) for the asynchronous communication between the resource and business tier, and between the business and client tier; and the Enterprise Java Beans (EJB) for the distributed business services provided between the business and the client tier.

LASER is deployed on the Oracle Application Server Containers for J2EE (OC4J) which has been integrated with the SonicMQ JMS messaging system for the asynchronous communication, and Hibernate is used to perform the object-relation mapping between the business tier and the Oracle database.

As the USP's detecting and triggering FS changes run on many different platforms and languages, an interface for the JMS connectivity has been provided for both Java and non-Java platforms.

The LASER alarm service also provides dedicated graphical consoles for viewing the current active FS's, which have been built on top of the NetBeans platform, a framework for developing complex desktop applications.

For a more detailed description of the system, see [1].

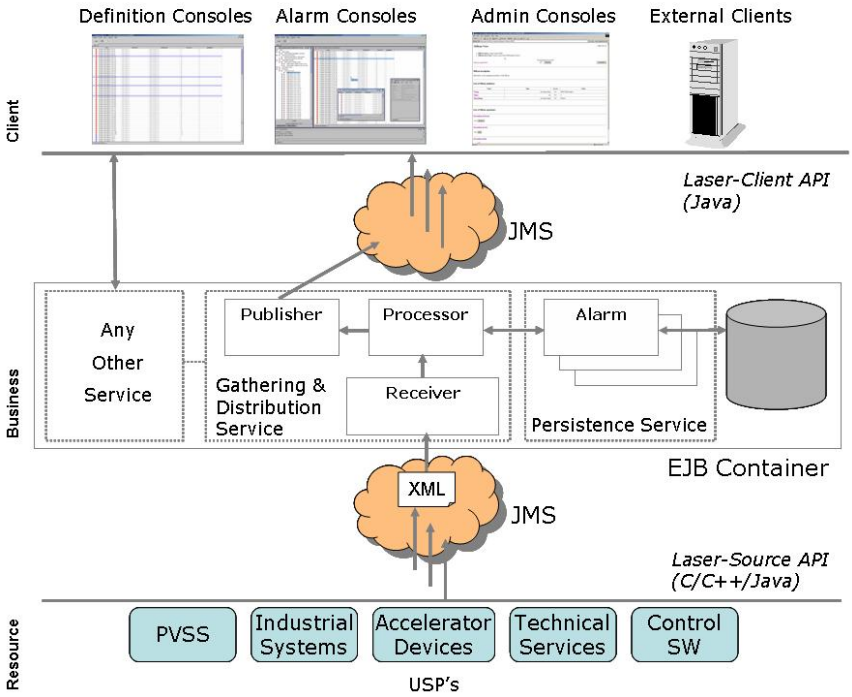

Figure 1: The LASER architecture

OPERATIONAL EXPERIENCES

LASER is being used at mainly three occasions in 2005: to replace the LEP alarm facility [2], a.k.a. the CAS, for the Technical services' operators; for the hardware commissioning for the LHC and for the commissioning of the LEIR accelerator.

The system provided at these three occasions is not complete in all its parts. The main focus has been put on collection, analysis and distribution of FS, including monitoring of the USP's; while only basic archiving facilities are provided. For alarm definition, the monthly update procedure established for the CAS is still being used. Hereafter, it will be referred to as LASER Version 1.

Technical services operations

The operators for the CERN Technical services, hereafter referred to as the TI operators; supervise the technical infrastructure at CERN, including electricity, cooling, ventilation and safety installations. They use the dedicated alarm console provided by the alarm service as their main tool, and it was therefore essential that LASER could fill the role of the CAS.

As LASER is replacing an existing system for the TI operators, this occasion of operational use differs from the other two occasions. The alarm service team had to ensure a smooth transition between the old and the new system, both regarding alarm definitions and functionality. The TI operators were early given a version of LASER which they could run in parallel with the old system, and have provided valuable feedback to the alarm service team regarding features essential to their operational needs and the functioning of the system. With their help, the system evolved into LASER version 1 which will replace the CAS.

As the TI operators are familiar with the CAS alarm console, they did not require training to use the LASER alarm console.

Their experience of LASER is that it has gone from being a quite unstable and unreliable system, missing key features, to a system in which they have complete confidence. Many of the requested key features have been provided but there is still important functionality that needs to be provided.

LHC hardware commissioning

To commission the LHC hardware, each individual LHC system (e.g. vacuum, cryogenics, quench protection, interlocks, powering) will first be tested separately. When each system has been qualified

for operation, each sector of the LHC will be commissioned as a whole, i.e. each system (e.g. powering) with its partners (e.g. interlocks, quench protection).

In July of this year, and continuing during autumn, the LHC power converters were tested and support from several Controls services was requested, among them alarms. The main user of the alarm service was the equipment specialist. More information regarding the LHC power converters and their integration into the high-level control system can be read in [3].

The users were provided LASER version 1 and support was given by the alarm service team to configure a dedicated alarm console for the tests. The USP detecting and triggering the FS changes used the non-Java interface to communicate with LASER. As this was a new USP, not present in the previous alarm system, the alarm service team had to ensure that the FS definitions provided by the equipment specialist were integrated into the database update procedure which was done in a similar way to other, legacy USP's. The complete chain was tested by the equipment specialist in collaboration with the alarm service team.

The users' experience of LASER from this occasion is that it provided its service without problems during the tests itself, but improvements are needed in the off-line services, namely the archive retrieval.

Commissioning of the LEIR accelerator

The Low Energy Ion Ring (LEIR), a new accelerator at CERN, will provide ions for the LHC. In its construction both legacy and new equipment are being used, and both legacy and new controls applications will be used for its commissioning. The experience gained from using the new control system during commissioning is described in more detail in [4]; the focus in this paper is only on the experience with LASER.

Again, for this occasion LASER version 1 will be used. However, in this case more work had to be invested to ensure that the USP's monitoring the equipment could communicate with LASER and that the FS definitions were integrated into the database update procedure. The equipment in question can be divided into two groups depending on the framework used to design and develop the front-end software: the framework used in the legacy PS control system and FESA [5], the front-end software architecture developed for the LHC era. This work was done in collaboration with the team responsible for the front-end software.

For equipment modules developed using the PS style framework, it was agreed to put in place a gateway that would poll the equipment and, in case of FS changes, communicate these changes to LASER. The gateway also has to complete the FS definition with the actual problem description, as this information is not available at FS definition time.

For equipment modules developed using the FESA framework, it was also agreed to put in place a gateway but as FESA supports notification, polling is not needed. The gateway is notified by the equipment module when a FS change has occurred, and it then communicates the change to LASER. Regarding FS definitions, part of the FS definition is retrieved directly from the FESA configuration database while some information has to be entered separately by the equipment module responsible. This required the alarm service team to ensure, by working directly with each equipment module responsible, that the complete FS definition was available and then together test the complete chain.

Since the LEIR operators have not previously worked with the CAS alarm console, they know the PS alarm screen and there are significant differences between the two, an introduction to the LASER alarm console was organized by the alarm service team.

LASER will be used when the LEIR ring is commissioned with beam as this will require alarms from both PS style and FESA equipment modules and the latter are only available via LASER and not via the PS alarm screen. This phase will commence mid-September of this year so the LEIR operators' experience of LASER is not available at the time of writing this paper.

Alarm service team's experience of operations

Above, the three occasions of LASER operational use has been described in some detail, and the experience of using LASER from the user's point-of-view given. In this section, we would like to describe the experience from the alarm service team's perspective.

These experiences have made clear that improvements are needed to facilitate the support of the system. Well-defined procedures for the alarm service must be put in place to handle bug reports, new

requirement requests and releases for new versions, containing corrections or new functionality. A ‘tool-box’ of problem-tracking tools should be put together to allow the alarm service team to quickly diagnose the cause of a problem.

The alarm service team has also realized the importance of protecting the alarm system from external dependencies to allow its alarm processing facility to function at all times. There are especially two scenarios that have to be considered, and that occurred during the test occasions discussed here: 1) the LASER database being unavailable for a longer period of time, and 2) a USP sending FS changes at an extremely high rate (oscillation).

During the work to improve the system to its current state and to prepare for the different test occasions, it was made evident to the team that they will need to review the system design and some of the technical choices made. Some solutions used, even though adequate this year, will not allow the addition of many more USP’s or FS’s in the future, in particular the solutions put in place to deal with PS style and FESA equipment modules as USP’s and the database model.

NEXT STEPS

During the autumn, and into the beginning of 2006, LASER must be extended to take into account the requirements coming from the operators of the PS accelerator complex and the SPS; and a more flexible alarm definition procedure must be implemented, to allow for on-line updates by the USP responsibles and to reduce the time invested by the alarm service team every month for the updates. This must be done in parallel with maintaining and providing the now operational alarm service, for existing and new users, and trying to improve the service according to the conclusions drawn from the experiences of this year.

CONCLUSIONS

Until now, LASER has been used operationally at two separate occasions: to replace the LEP alarm facility for the TI operators and for the LHC hardware commissioning of the LHC power converters. At both occasions, the feedback from the users to the alarm service team has been overall positive. However, LASER is not finished and the continued work will include improvements and extensions to both the system itself and the alarm service. And there will be more occasions for LASER to provide its services ‘in anger’.

REFERENCES

[1] F. Calderini, B. Pawlowski, N. Stapley, M.W. Tyrrell, “Moving towards a common alarm service for the LHC era”, ICALEPCS 2003, Gyeongiu, Korea, October 2003.

[2] M.W. Tyrrell, “The LEP Alarm System”, ICALEPCS 1991, Tsukuba, Japan, 1991.

[3] S. Page, “Integration of the LHC power converters within the high-level control system”.*

[4] M. Pace, S. Jensen, V. Baggiolini, “Experience from the new LEIR control system during machine commissioning”.*

[5] M. Arruat, A. Guerrero, J-J. Gras, S. Jackson, M. Ludwig, J-L. Nougaret, ”CERN Front End Software Architecture for Accelerator Controls”, ICALEPCS 2003, Gyeongiu, Korea, October 2003.

* ICALEPCS 2005