STATUS OF THE SOLARIS CONTROL SYSTEM - COLLABORATIONS AND TECHNOLOGY *

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Abstract

The Solaris is a synchrotron light source starting just now in Krakow, Poland. It is built with strong collaboration with other European accelerator facilities. The MAX-IV project in Lund, Sweden and Tango Community are the most important partners in the project in respect to the control system. Solaris has built a twin copy of MAX-IV 1.5GeV ring and linear accelerator based on the same components as the ones of MAX-IV. Thus, both facilities share know-how and apply similar technologies for the control system, among them the Tango CS is used for software layer. Status of the control system in Krakow as well as collaborations and technological choices impact on its success are presented in this paper.

THE ACCELERATOR AND BEAMLINES

The Solaris machine is 1.5GeV storage ring the same as one of the MAX-IV supplied with a linear accelerator providing electron beam up to 600MeV. Since the linac is not providing full energy beam there is need of energy ramping in the storage ring. This is a difference to MAX-IV setup. The Solaris project includes also two beamlines. One is using bending magnet radiation with XAS and PEEM end-stations and the other is basing on undulator source with an UARPES end-station [1].

The accelerators and beamlines are installed except few components of PEEM beamline and two Landau cavities in the storage ring. There is on-going commissioning of the accelerator [2]. The latest result is accumulation of 20mA current in the storage ring which then has been ramped to full energy of 1.5GeV. Currently certain optimization has been done that let us by the day of writing this paper (17.10.2015) accumulate the current of 48mA. The work is in progress to do energy ramping of this much od current. For now limitation are instabilities due to the ion trapping process.

There is planned upgrade shutdown starting end of November 2015 till beginning of January 2016. During this period the landau cavities will be installed as well as missing components of the PEEM beamline. Network infrastructure will be supplemented with a new core switch to enable 10GBps connections through the whole network. It is also planned to do upgrade of the Tango control system to the newest version of Tango 9.1.

After the shutdown commissioning of the beamlines will proceed. It is expected that the Solaris will be ready for the first external users in second half of 2016.

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THE CONTROL SYSTEM

The control system of the accelerators and beamlines has been deployed and is operational. All major issues has been debugged and solved. However, few low level components still need optimization. Certain high level applications for future simple operation are upon development.

Tango Control System

The Tango Controls [3] is used for systems integration. Since the Solaris and MAX-IV have similar systems most of the software components are shared and lot of them have been developed in Lund [4]. Solaris and MAX-IV are developing their applications with the Python programming language. The PyTango, the Taurus and the Sardana packages developed at ALBA are used for this purpose. An archiving system which role is to store history of controlled signals is using HDB and TDB tools developed at Soleil [5].

Some of the device servers provided by the Tango Community [6] were reused.

The integration work has been contracted by Solaris to a commercial company Cosylab (Ljubljana, Slovenia). They have also developed few device servers and part of GUI applications including an open source ControlProgram which is an application being an entry point to all control system functionalities needed for operation [7]. The ControlProgram has been published on the public Solaris GitHub repository [8].

The Matlab Midlayer with Tango-Matlab binding [9] is used for machine physics control. The basic configuration has been done by the Cosylab then the work has been overtaken by Solaris. The work were conducted with support from Soleil.

Control System Hardware

The timing system has been provided within the contract with Cosylab. The system based on Micro Research

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Finland (MRF) hardware has been delivered with Tango software – device servers and GUIs – developed by the Cosylab.

Following the MAX-IV, Solaris is using as a standard the IcePAP[10] system for motion control. The system has been developed by ESRF and ALBA then it was shared within so called IcePAP collaboration. Even the Solaris, due to formal limitations, is not part of the formal IcePAP collaboration the permission given by the ESRF let us purchase the hardware. Solaris get also permission from ALBA, to use IcePAP Control Management System software and related libraries.

PLC systems

A machine protection PLC system (MPS) is based on Rockwell Automation solutions as the one of MAX-IV. However there are some differences between MAX-IV and Solaris, both systems use the same philosophy of interlock handling. The PLC software has been developed in strong collaboration between engineers from Krakow and Lund.

The personal safety system (PSS) which provides radiation safety is using Siemens hardware. The PSS is outcome of collaboration with Elettra (Trieste, Italy). They have provided conceptual design and software whereas executive design and hardware has been procured locally.

Status

All the control system required for the machine commissioning has been provided. There is about 1500 devices available through the Solaris Tango system providing access to about 5000 signals. All of these devices are available to operator either through generic GUI Taurus panels or through dedicated engineering screens. Dedicated group GUI panels are provided for vacuum, RF, magnet and interlock subsystems.

These applications give very detail information and functionalities which are necessary for the commissioning. Currently work has started on preparation so called operation GUIs which will aggregate information and functionalities to the level required for day to day machine and beamlines operation.

As it was mentioned before, there is already planned upgrade of the network infrastructure (the core switch) to allow 10GBps operation and effective handling of expected beamline data transfers. In parallel the Tango system, its libraries and related packages will be upgraded to the newest versions to make the system ready and up to date for the users. As it is common in the upgrade process there are risks of regression or introducing new issues. To minimize this pre-tests are planned. The schedule of the Solaris which assumes first users coming in second half of 2016 gives enough time to solve possible problems.

COLLABORATIONS

Three international collaborations contributed mostly to the Solaris control system. These are: MAX-IV, Elettra and Tango Community.

MAX-IV

The Solaris adopted concept of the linear accelerator and design of 1.5GeV storage ring provided by the MAX-IV. However, the Solaris and MAX-IV projects are tightly connected these are formally two separate projects realized by two remote organizations. This could potentially bring difficulties in case of weak connections between teams.

For the first 4 years of the project, till October 2013, the MAX-IV hosted in Lund part of the Solaris team. The number of Solaris members staying in Sweden for more than one month varied from 2 to 6 persons. At the beginning the main purpose was to let the Solaris people get knowledge and experience in the field of accelerators. This allows for effective knowledge transfer as well as active participation of the Solaris in both projects. Till now the Solaris people regularly visits MAX-IV. The direct contacts maid have positive impact on continuation of effective cooperation.

As a consequence of sharing the design of machine both facilities shares technologies used for control systems. This prevents duplication of work and lower overall cost of the control system. Due to availability of developers with certain experience, schedule constraints and miscommunication some of packages initially developed by MAX-VI in Python has been re-implemented in C++ for Solaris during tests and validation process. However, in such cases the Tango interface where kept equal.

Elettra

The collaboration with Elettra was based initially on in-kind support and then it was converted to consultancy contract. This allows on one side pay for the support and on other side solves administration issues and limitations that arise in case of in-kind support. For the control system the collaboration lets Solaris cover differences to MAX-IV [11] and supplements Solaris knowledge and experience. As it was mentioned they provide design and software of the PSS system. Elettra developed also the Energy Ramping application. Both of these projects introduced new technologies at Solaris – one is solution based on Siemens PLCs, the other is usage of the C++ QTango library. Elettra has supported control group with among others requirements gathering providing useful reports on prioritization of control system components in respect to commissioning needs.

Tango Community

The Tango Community provided a base of the Solaris control room software – the TANGO Controls suit [3], library of Device Servers [6] and applications. They provide also great support by serving advises and sharing ideas. Formal and informal discussions where useful for decisions making on technical and management aspects.

PL-Grid

There is also local collaboration between Solaris and the PL-Grid Plus project [12] and especially with the ACK Cyfronet AGH. The PL-Grid Plus project prepared so called domain related services built upon the high power

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computing infrastructure in Poland (PL-Grid). Among others services Elegant, Tracy and Virtual Accelerator were implemented giving access to two computational tools used for accelerators design and verification and simulated control system environment used to test Solaris MML configuration. The storage services provided by the PL-Grid will be used to store future experiments' data. The ACK Cyfronet AGH is also supporting Solaris with development of the so called Digital User Office – a system to handle users beam-time applications and conducting of experiments. The system is developed on platform already used for e-gran system of the European Grid Initiative.

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- DESY
- PL-Grid Plus Project
- Others

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