EXTENDING WINCC OA FOR USE AS ACCELERATOR CONTROL SYSTEM CORE

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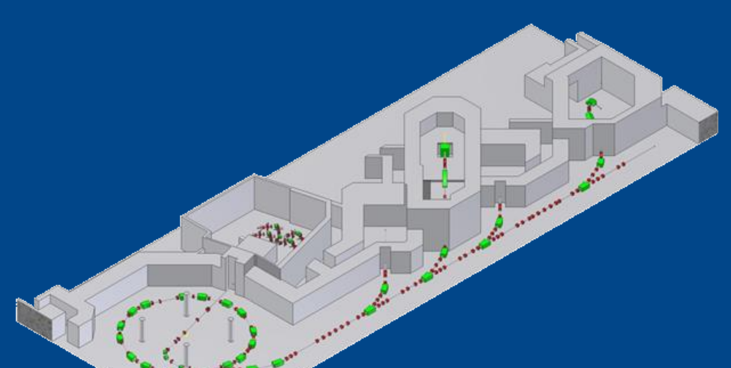
ABSTRACT

The accelerator control system for the MedAustron light-ion medical particle accelerator has been designed under the guidance of CERN in the scope of an EBG MedAustron/CERN collaboration agreement. The core is based on the SIMATIC WinCC OA SCADA tool. Its open API and modular architecture permitted CERN & MedAustron to extend the product with features that go beyond traditional supervisory control and that are vital for directly operating a particle accelerator. Several extensions have been introduced to make WinCC OA fit for accelerator control: (1) Near real-time data visualization, (2) external application launch and monitoring, (3) accelerator settings snapshot and consistent restore, (4) generic panel navigation supporting role based permission handling, (5) native integration with interactive 3D engineering visualization, (6) integration with National Instruments based front-end controllers. The major drawback identified is the lack of support of callbacks from C++ extensions. This prevents asynchronous functions, multithreaded implementations and soft real-time behaviour. We are therefore striving to search for support in the user community to trigger the implementation of this function.



The accelerator, featuring four ion sources, IH-based Linac, synchrotron, three horizontal, one vertical beam line and one proton gantry. Energy ranges from 60 to 800 MeV/u, up to 250 MeV/u proton equivalent for ion therapy

From the “green-field” to start of commissioning in two years from 03/2011 to 03/2013.

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INTRODUCTION

MedAustron is an **ion therapy** and **research centre** presently under construction in Wr. Neustadt, Austria. The facility features multiple ion sources, a Linac, a synchrotron and five beam lines including a proton-gantry. The whole accelerator chain is designed for protons, carbon-ions and other light ions.

MedAustron chose the commercial SCADA tool **SIMATIC WinCC OA** from ETM professional control as core operating system for controlling the particle accelerator.

The tool has been designed following an open, distributed system architecture to accommodate traditional supervisory control and data acquisition tasks.

It offers the possibility to extend the system for tasks that go beyond those traditional tasks.

CONTROL SYSTEM

The MedAustron control system is based on an industrial oriented **4-tier architecture**:

(1) presentation tier with WinCC OA user interface managers, for example the PVSS Navigator and operator panels.

(2) processing tier containing the WinCC OA core system (event-manager, data-manager, control-managers, etc.) that acts as a main communication backbone to the frontend controllers.

(3) equipment tier that consists of all frontend controllers (FEC) that provide a unified interface to the processing tier through OPC or Simatic S7 over TCP to communicate to the WinCC OA core system. Measurement from the FECs are published through MAPS (MedAustron publisher subscriber) that is a protocol based on National Instruments STM. Configuration data that may not be changed during operation is fetched by the FECs from a web-server and can be downloaded through FTP during commissioning.

(4) frontend tier with all frontend devices.

NAVIGATION

The Navigator is the **main entry point** used during operation. It is a container that manages all user interfaces through a **general panel framework** into which individual graphical user interface panels can be plugged in. This framework gives the possibility to **organize panels** in a hierarchical tree so that users can navigate from one panel to a number of other panels. Panels may be reached by navigating along different paths in the tree.

EXTERNAL APPLICATIONS

The **VIP** (**V**irtual **I**nstrument **P**anel) **launcher** is used to start external, device specific interactive applications such as Labview panel applications. The VIP launcher was introduced to **handle** the start and stop **of external applications** directly from the Navigator to keep the Navigator as main entry point and the role based permission handling.

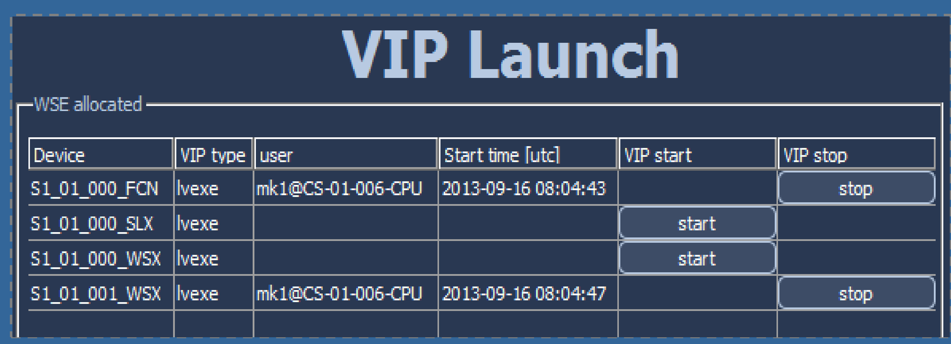

Figure 1: VIP launch table

SHADOW AND RESTORE

The shadow and restore mechanism permits the operator to take a **snapshot** of the currently applied **accelerator settings** in the SCADA system and allows the commissioning team to restore those setting at a later point in time. The MedAustron control system distinguishes between three types of accelerator settings:

(1) Non-cycle dependent values
(2) Cycle dependent simple values
(3) Cycle dependent complex values

The **definition** of device properties that should be taken into account during the shadow and the restore process takes place in the **xml device description** documents which are used to configure the entire control system.

DATA ACQUISITION AND VISUALIZATION

Visualization and correlation of measurement data is a key requirement during accelerator hardware and beam commissioning.

The **near real-time visualisation of measurements** taken by the front end controllers is realized by the Qt based plot **EWO** (**E**xternal **W**idget **O**bject). This EWO can be placed in a **WinCC OA panel** and is configurable via WinCC OA scripts to subscribe to the required measurements

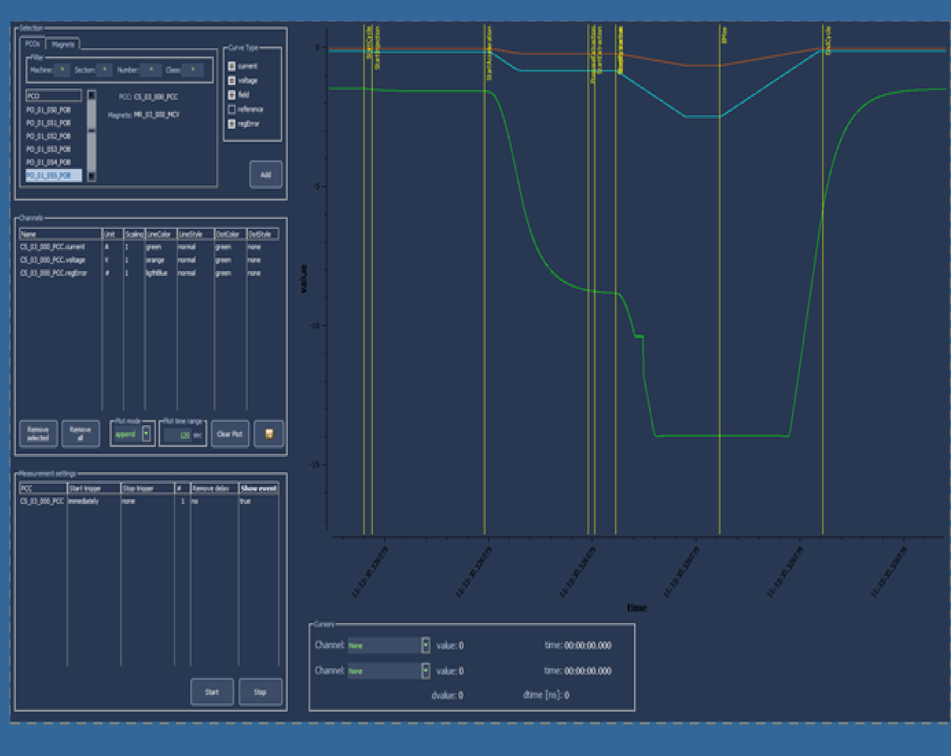

Figure 2: Measurement visualization in the power converter measurement panel.

INTERACTIVE 3D VISUALIZATION

The Synoptics widget for WinCC OA panel based on Qt provides a **3D viewer** for the synoptics layout of the accelerator that is loaded from a step file (.stp).

This widget is used to **visualize** currently allocated parts of the accelerator and for indicating the **current status** of the individual devices.

Figure 3: 3D Visualization

FRONTEND CONTROLLER INTEGRATION

The communication between National Instruments based frontend controllers (PXI and PXIe platforms) and the WinCC OA SCADS system is realized using the **National Instruments Shared Variable Engine** as intermediate communication layer. The Shared Variable Engine (SVE) features on one hand the NI **shared variable protocol** and on the other hand an **OPC interface** to which the WinCC OA connects via an OPC driver.

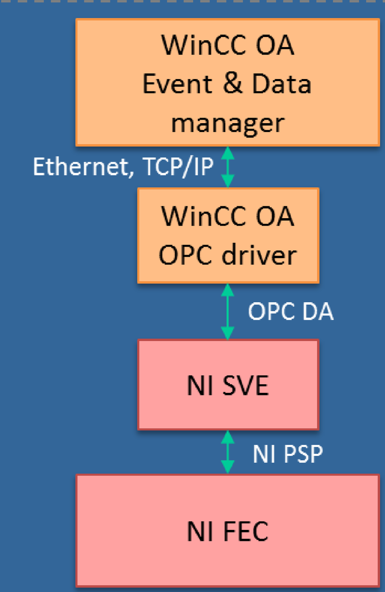

Figure 4: NI FEC communication with WinCC OA

SUMMARY

- System in use since January 2013
- WinCC OA and its open API was the key for the extensions needed for particle accelerator commissioning and operation
- FEC upgrade to LabView 2012 planned to get the advantage of OPC/UA and remove the NI shared variable engine.

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