THE ANKA CONTROL SYSTEM: ON A PATH TO THE FUTURE

Nigel John Smale[1], Edmund Hertel[1] , Erhard Huttle[1] , Wolfgang Mexner[1] , A.-S. Müller[1] , Sebastian Marsching[2], Igor Kriznar[3] .

[1]*Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany*
[2]aquenos GmbH, Baden-Baden
[3] Cosylab, Ljubljana

Abstract

The machine control system of the synchrotron radiation source ANKA at KIT (Karlsruhe Institute of Technology) is migrating from dedicated I/O microcontroller boards that utilise the LonWorks field bus and are visualised with the ACS Corba based control system to Ethernet TCP/IP devices with an EPICS server layer and visualisation by Control System Studio (CSS). This migration is driven by the need to replace ageing hardware, and in order to move away from the outdated microcontroller's embedded LonWorks bus. Approximately 500 physical devices, such as power supplies, vacuum pumps etc, will need to be replaced (or have their I/O hardware changed) and be integrated to the new EPICS/CSS control system. In this paper we report on the technology choices and discuss justifications of those choices, the progress of migration, and how such a task can be achieved in a transparent way with a fully user operational machine. We also report on the benefits reaped from using EPICS, CSS and BEAST alarming.

INTRODUCTION

ANKA is an electron synchrotron radiation light source located in Karlsruhe, Germany. The storage ring is emptied of electrons twice per day. The refilling process involves a two stage accumulation process. The first stage uses a microtron as a pre-accelerator and a 53-500 MeV 1Hz ramped booster. The second stage is the accumulation of a nominal 200 mA of stored current, which is then ramped from 500 MeV to 2.5 GeV. The machine is then left unattended until the next injection time, which leads to two important demands on the control system, namely, robust and sensitive alarm notification in the case of reduced machine performance and a very intuitive GUI machine interface.

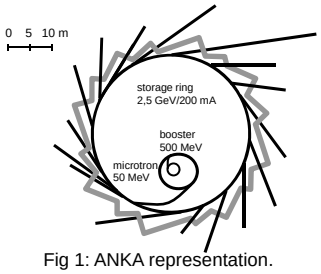

Fig 1: ANKA representation.

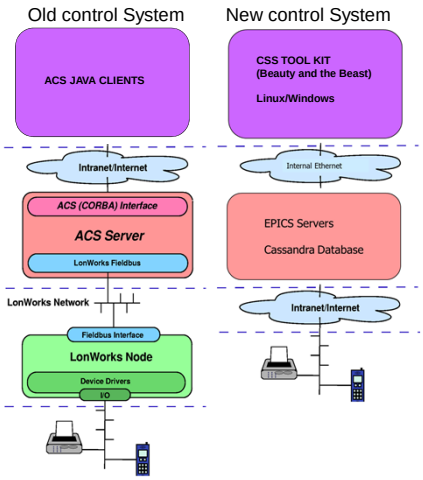

Fig 2: Comparison of old and new control systems.

CONCEPT

The overriding motivation is to increase mean-time-between failures due to the control system by introducing: alarming, post-mortem capabilities, comprehensive diagnostic tools and visualisation of performance data displayed in an automated way. To achieve this in this case means: replacement of ACS and LonWorks hardware interfaces and storage ring field bus to TCP/IP, removal of ACS device servers running on Windows XP machines with EPICS, replacement of ACS GUI panels with CSS and BEAST alarming, and where required replacement of complete hardware units e.g. power supplies.

Some PVs are only changed manually, for example to set a value; others must be read out at 1-10 Hz. Summing up gave ~25000 PVs to be readout, but only 1000 of them at 10Hz and 2000 at 1Hz. Gigabit Ethernet can easily provide the bandwidth required here. Furthermore, Ethernet has become a much standardised product with the physical layer being robust, scalable and common place.

DESIGN APPROACH

In addition to the challenges mentioned in the introduction, as an existing facility the hardware of the ANKA machine was already defined and is in daily operation, where many dependencies have to be considered. Keeping this in mind, a bottom-up approach was taken. First the existing control system hardware layer was logically broken down into four parts. Secondly, parts of the machine were grouped together that could be considered a "fully contained upgrade". This means that these components had no or minimal control-system dependencies to or from components outside this cluster and could be completely installed within one shutdown, which usually is in the order of two weeks. An example would be the replacement of the Beam Positioning Electronics (BPM).

Fig 3: One of two cabinets with the new BPMs.

SCADA Control Software

A widely used synchrotron community control system was selected. The decision to use EPICS was mostly motivated by the proven reliability, the ease in which serial devices can be added to the control system and the availability of an extensive library of commonly used synchrotron hardware control panels and Input Output Controllers (IOCs). In particular, the Libera BPM EPICS driver from Diamond.

Cassandra Database

In order to help operators solve machine errors, or to improve running conditions an ANKA archive system is essential that can hold years of data at an incoming data rate of up to 10Hz for several thousands of PVs. The Cassandra Archiver has been installed at ANKA to provide a simple to use, scalable data-archiving solution. It seamlessly plugs into the Control System Studio (CSS) providing quick and simple access to all archived PVs.

Fast control and Diagnostics

For FDAQ, such as: the processing for the fast feedback orbit correction matrixes, the booster ramping, low level RF, and RF diagnostics and interlocks, to name a few, the MicroTCA.4 system has been chosen. This technology is rapidly evolving to become a viable standard for large-scale research facilities of the high-energy physics and photon science community.

Matlab Middle Layer

The MATLAB Middle Layer (MML) is a collection of scripts for the MATLAB programming environment, designed to control and measure parameters of an accelerator. This software creates an abstraction layer enabling the user to write scripts independent of the accelerator's control system.

CSS and BEAST

All new ANKA GUI panels are developed in CSS. EPICS alarming capabilities in connection with the BEAST alarm server tool-kit from the CSS bundle are used as an alarming solution.

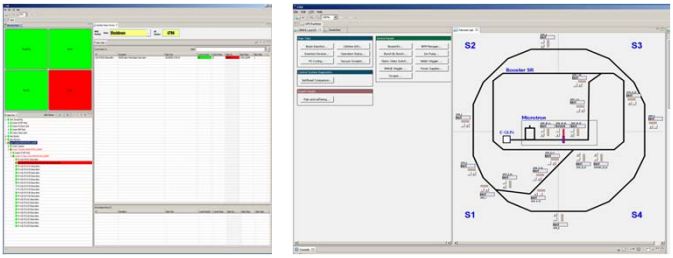

Fig 4: Left Beast Alarm panel; Right CSS top operator control panel.

SUMMARY

ANKA has a clear road map for the complete upgrade of machine devices and migration to the EPICS/CSS control system. The foundations have been laid, and already a substantial amount has been upgraded.