Control System Developments at the Electron Storage Ring DELTA

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Web-based Applications

For security reasons, it was necessary to develop an additional alert system, which notifies the operator to machine functions via a mobile phone (mobile alert system).

Test Benches & SBC Applications

For near-field angle measuring of the beam guidance in the laboratory, a SBC, equipped with a standard 5-megapixel CCD camera, is in preparation. A converging lens focuses the beam on the CCD chip. Changes of beam angle yield a shift of the focal point of the Gaussian intensity distribution [33].

Server Maintenance & Consolidation

In the course of this migration, all server and virtual machines have been upgraded to the latest operating system (Debian 7/8 [22]). This upgrade implies also the introduction of systemd [23], a new system and service manager for Linux-OSs and the successor of sysvinit [24]. A new tool administers interlock notifications as well as the machine status (e.g., beam current, machine faults). The communication is established via WiFi inside the DELTA building. An acoustic and vibration alarm will be launched for voltage level matching and interfaced interlock warnings as well as the electronic logbook.

Introduction

Since the number of control system network devices and, thus, the complexity of the network topology increased constantly, it was mandatory to develop a DELTA-specific management tool. With the help of this tool, all individual devices and their connection properties are registered centrally.

Network Administration Tool

The tool administers network interfaces, IP/MAC numbers and assignments to domains. Furthermore, it generates consistent DNS/DHCP configuration files as well as location and network plans and much more. The program is implemented as a web application and is based on the high-level Django /Python framework [7, 8]. All data and configurations are stored in the DELTA MySQL [12] database.

Server Integration

DELTA, a 1.5-GeV electron storage ring, is operated since 1999 by the TU Dortmund University as a synchrotron light source for campus-based, regional and international users. Since 2011 the facility has been extended by a short-pulse source for VUV and THz radiation making use of the CHG (Coherent Harmonic Generation) principle [2-4]. An upgrade to EEEHG (Echo-Enable Harmonic Generation) is in preparation [11]. Not only for these reasons the EPICS-based DELTA control system [1] has been revised and complemented in many fields.

Software Integration

The hardware configuration, such as a setup of motor parameters, is managed by the TwinCAT system manager [5], whereas the motor movement logic is programmed on a PLC controller [5]. The link to EPICS is accomplished via a vendor specific OPC-server [29] and an EPICS IOC-shell with OPC driver support (OPC client) [30, 31]. All three software levels are running on the same Windows-PC internally communicating over DCOM [32].

The software encoding of the stepper motors is imprecise due to slippage and x/y motion coupling. Therefore, determination of the true mirror position must be realized by high-accuracy contact sensors and additional limit switches [26-28].

The analog sensor signals are connected to a converter device providing a standard serial (RS232) communication interface. This port can be used again by RS232 EtherCAT terminal or by a single board controller (SBC, Raspberry-Pi) running Linux and PyEpics [18, 26, 33].

Test Benches & SBC Applications

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All booster magnet power supplies are driven by 16-bit DAC boards. The functionality of these boards is quite crucial and must be checked in advance by a simple SBC-based test bed. A python script on the SBC converts the simulated booster ramping curve to a 16-bit digital I/O signal which is mapped via a photo-coupler adapter card for voltage level matching and finally fed to the DAC-board input.

The resulting analog DAC output value is measured and analyzed under several test conditions (e.g. ramp cycle frequency, curve shape, temperature variation) by a oscilloscope or circuit analyser.

References

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