Control System Integration of a µTCA.4 based digital LLRF using the ChimeraTK OPC UA Adapter

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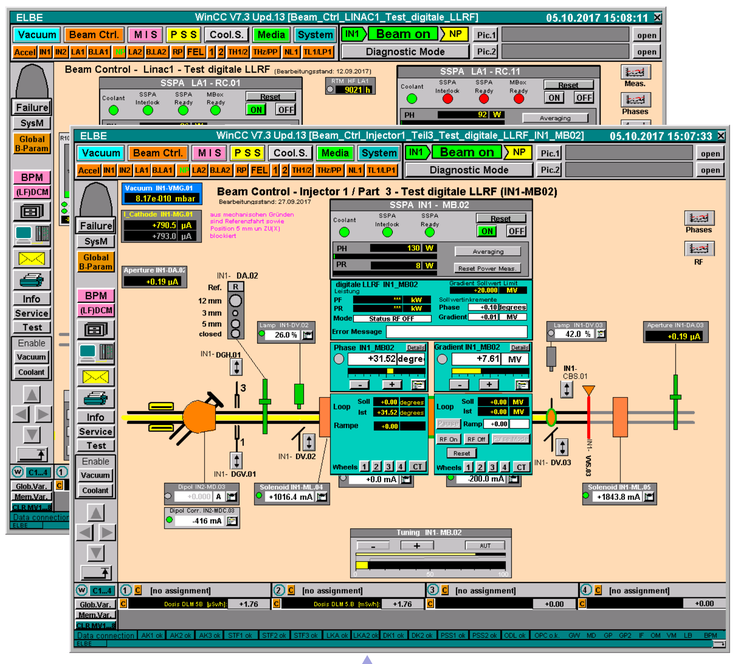
The superconducting linear electron accelerator ELBE at Helmholtz-Zentrum Dresden-Rossendorf is a versatile light source. It operates in continuous wave (CW) mode to provide a high average beam current. To fulfill the requirements for future high resolution experiments the analogue low level radio frequency control (LLRF) is currently replaced by a digital µTCA.4 based LLRF developed at DESY, Hamburg.
Operation and parametrization is realized by a server application implemented by DESY using the ChimeraTK software framework. To interface the WinCC 7.3 based ELBE control system an OPC UA Adapter for ChimeraTK has been developed in cooperation with DESY and Technische Universität Dresden (TUD). The poster gives an overview of the collaborating parties, the variable mapping scheme used to represent LLRF data in the OPC UA server address space and integration experiences with different industrial OPC UA Clients like WinCC 7.3 and LabVIEW.

WinCC (Operator HMI)

- reduced set of scalar variables for LLRF operation (gradient and phase setpoint values, status data)
- reusable uniform LLRF GUI templates
- long term data logging
- comfortable manual setpoint adjustment with ELBE rotary encoders



SIMATIC WinCC 7.3 **OPC UA** Client Channel

PLC

- Siemens S7 400 PLC connection to LLRF OPC UA Server via OPC UA Gateway
- symbolical gateway configuration by means of STEP7 PLC project
- use:
  - reading, writing LLRF operation mode
  - reading LLRF status data for machine protection system (MPS)
  - writing data from ELBE rotary encoders into LLRF setpoints (update rate 10 Hz)

ELBE Beam Guidance PLC

Siemens S7-400

Ethernet Communication via Siemens S7 Protocol (RFC1006)

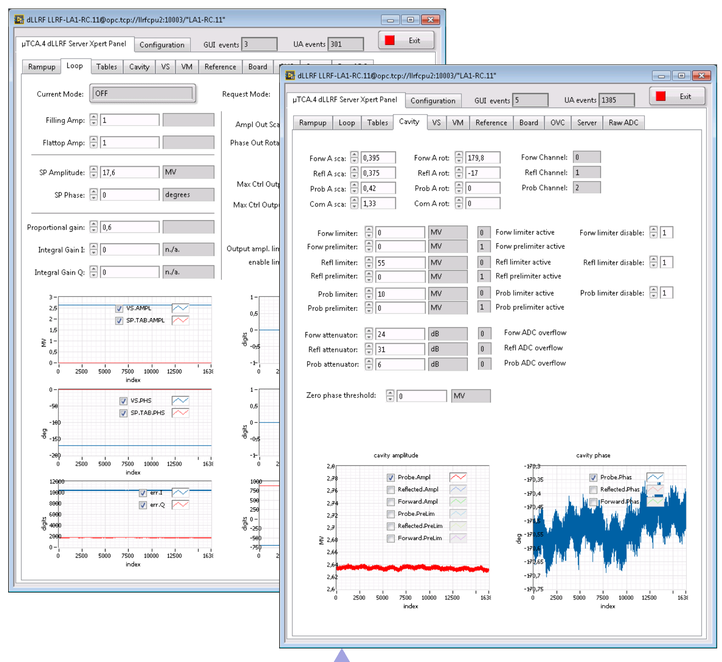
OPC UA Gateway (OPC UA Client/Server)

IBHsoftec IBH Link UA [6]

Unified Automation **OPC UA** Stack

LabVIEW Panel (Expert HMI)

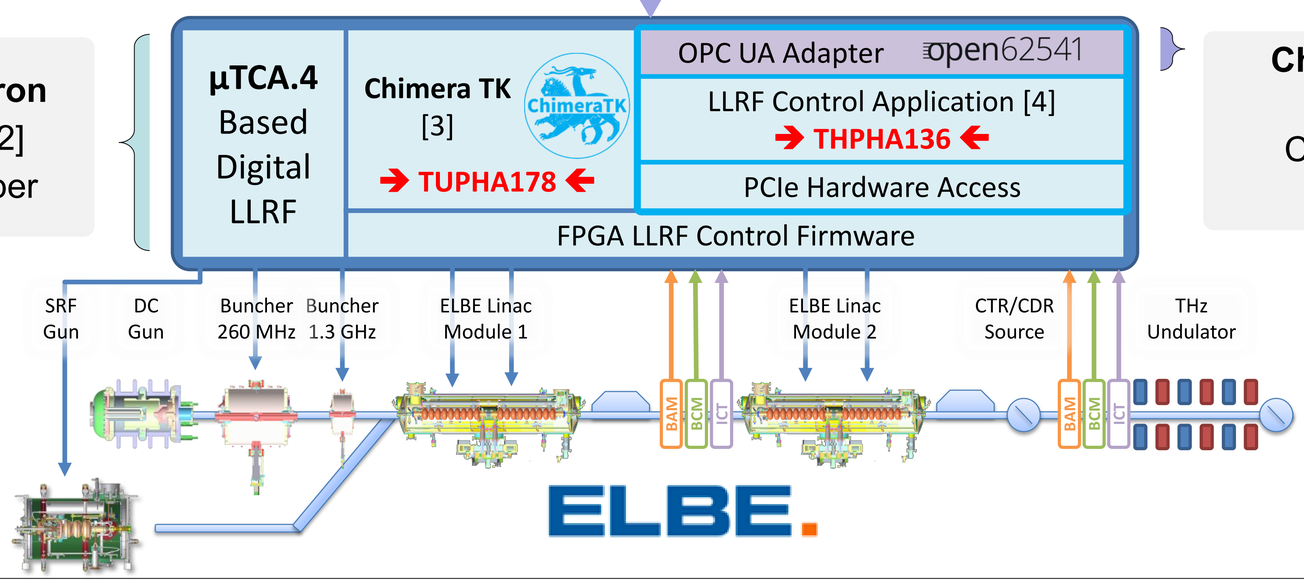
- LabVIEW object-oriented design using NI Actor Framework
- event driven data updates with dynamical adjustment of monitored items according to visible GUI controls
- simultaneous updates of more than 10 traces with 16384 double values per trigger, ~10 Hz update rate



LabVIEW 2015 SP1 **OPC UA** API

Standardized Ethernet Communication via **OPC UA** Protocol

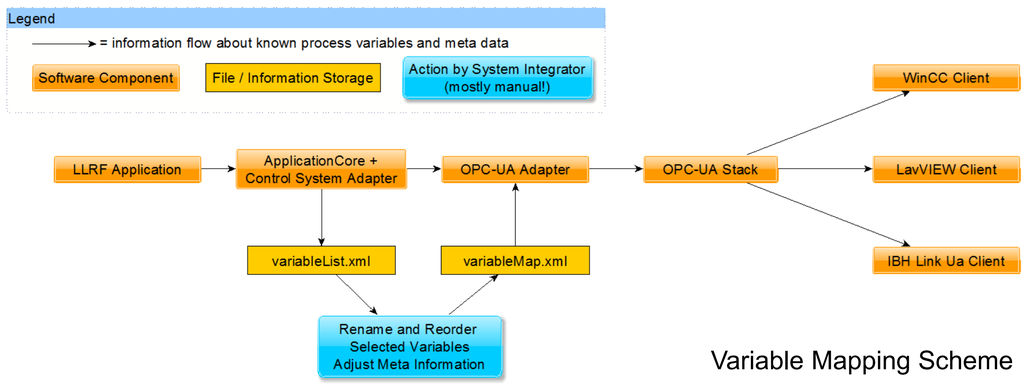
Deutsches Elektronen-Synchrotron
Initiator of µTCA.4 Standard [1], [2]
LLRF Hard- and Software Developer



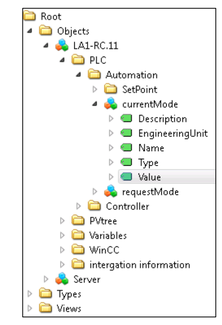
Chair of Process Control System Engineering, TU Dresden
Co-Founder and Co-Developer of open62541 [5]

Process Variable Mapping

- XML based server configuration file for server setup and variable name mapping (renaming, restructuring)
- root folder name identifies controlled device
- grouping of process variables in application specific folders eases integration
- adding additional static integration meta data nodes



Variable Mapping Scheme



Server Address Space

Project Status

- Integration realized and tested for 2 of 7 cavities
- Variable Mapping (ChimeraTK to OPC UA) defined
- LLRF GUIs implemented and tested for WinCC and LabVIEW

Next Steps and Future Plans

- Parallel operation of digital LLRF within 2nd half of 2017 for long term testing
- Experience driven refinement of LLRF server application and GUIs
- Implementation of beam based feedback loops

References

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[5] http://open62541.org/
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