SMART STRUCTURED MEASUREMENT PROCESS FOR VERSATILE SYNCHROTRON BEAMLINE DATA AT ANKA

T. Spangenberg*, D. Haas, W. Mexner
KIT, ANKA - Synchroton Light Source, Karlsruhe, Germany

Abstract

An unstructured measurement process might deliver the needed quantity of primary data for an experiment. But the achievement of the scientific results depends more and more from the offered opportunities of embedding these measurement data into its specific context with a metadata description and a complete life cycle management.

Obviously the design of a measurement process influences the potential applicability of an experimental setup for its scientific purpose and of course its options to fulfil a contemporary data management. ANKA's Tango based environment offers in principal varying approaches with different implementation efforts and coverage of scientific or information technology requirements.

At ANKA we have set up a smart structured measurement process which stand out due to its seamless integration into the overall data management, the support of recent control concepts for fast data generation as well as its support of well time-tested SPEC based scan systems. The presented measurement process focuses to the minimal implementation for all involved components without a break of well accepted habits.

INTRODUCTION

Currently at synchrotrons used control systems like EPICS, TACO, or TANGO [1] are focusing to the problem of retrieving and delivering digitized data from the measurement process at the experimental stations as well as at all peripheral equipment.

The growing amount of available digitized measurement data, which is organized by hand in a first straight forward approach, led to a situation which does not permit an automated data management. Solutions for crosslinking and archiving them are strongly demanded. Some effort is done - not only in the synchrotron community, e.g. LSDF[2] and HDRI[3] - to implement an extended data management to these scientific data.

The new at ANKA introduced smart concept offers the base for the implementation of the desired automated overall data management with minimised efforts.

The experimental beamline stations at ANKA were originally designed on the basis of SPEC [4] (see Fig 1, part A). In this context the SPEC output defines which meta- and measurement data will be saved in an ASCII-file. Measured data is collected from fast (~ms) directly by spec driven devices (green part in Fig. 1) or other slow speed-triggered-TANGO-devices (blue part in Fig. 1). As SPEC can be used as TANGO server and client at the same time [5] it is used as a *user interface* as well as a *scan server* for X-ray beamline experiments.

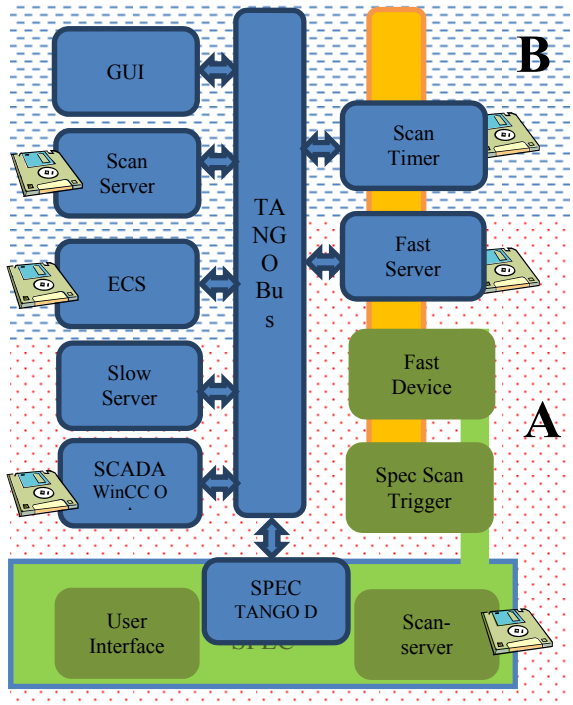

Figure 1: The logical beamline layout (The realised part A and the currently developed extension in part B).

Autonomous devices outside SPEC are partially synchronized and triggered by an electrical signal based trigger and gating system (yellow in Fig. 1). The disadvantage of this scenario is that each device is generating its own unmanaged data file separately. Also the WinCC OA [6] overall SCADA system collects asynchronously and independently peripheral data in parallel. WinCC OA was extended by TANGO server and client capabilities [7].

The resulting already three data sources (symbolised as disks in Fig. 1, part A), indicates a strong evidence that there is a reasonable demand for an *experiment coordination service* (ECS).

The role of such an ECS in the experiment workflow is in general not a new idea and was in our case already implicitly present by the coded scheme of SPEC. The sequential synchronous nature of that data acquisition approach so far was the major reason to separate it from spec and set up a special dedicated ECS device server.

The key for interlinking the retrieved information is the *metadata*. Therefore the objective will be achieved by a careful attention to the dedicated retrieval and processing

*thomas.spangenberg@kit.edu

ISBN 978-3-95450-124-3

this type of data. The currently used control systems are offering no generalised approach to this issue.

The missing standardized functionality on control system level currently is leading to different site dependent solutions. At ANKA we are implementing a new smart approach addressed to that problem which respects the current control system implementation. Very special attention was given to avoid bottlenecks in speed or to loose flexibility for the future.

EXPERIMENT COORDINATION SERVICE

A distributed TANGO setup of independent servers as it is shown in Fig. 1 requires a task scheduler and a dedicated system for collecting metadata. Both are provided by the ECS which acts as a TANGO server and client.

Created data has to be announced to the ECS by the cooperating scan server or other special devices (e.g. WinCC OA). Typical collected information are filenames and data locations, owner of the data and directives for their further processing. The measured data itself is not touched at this stage of processing. Furthermore peripheral logging data (e.g. vacuum pressure, air humidity) can be collected and processed for archiving.

The ECS is focused to the needs of a further automated organisation and archiving of the measured data. The implemented ECS manages an order queue (FIFO) of experimental demands (ED) (see Fig. 2). An ED-tag contains 3 sub tags referencing the scan server, the results and the administration part. As the majority of other interactions to that device they are injected as a string by a simple TANGO command. The string is formatted as a XML based telegram.

A XML telegram might be considered as a container for arbitrary information since any additional content can be added to the ED-tag of the experimental demand. Conforming to XML processing guidelines this additional unchanged content needs to be transferred to following processing stages.

As at ANKA the current user interface and scan server are covered by SPEC, this new ECS approach becomes elegant possible by only a few macro extensions. For any future development no conceptual limitations are expected. The only specific requirement is that GUI and scan server are cooperating by the XML transmitted content.

INTEGRATION

The workflow of measurements with SPEC is on one hand defined by macros and might be easily varied. On the other hand the habits of the users are strongly engrained and therefore recommend a hidden change in the data collecting strategy.

From the users view the data collection is defined by a 3 level process. *First* of all the general output directory for the whole experimental series is defined. This is currently done by an external script. In a *second* step the basis name of any output is defined by a macro in SPECs

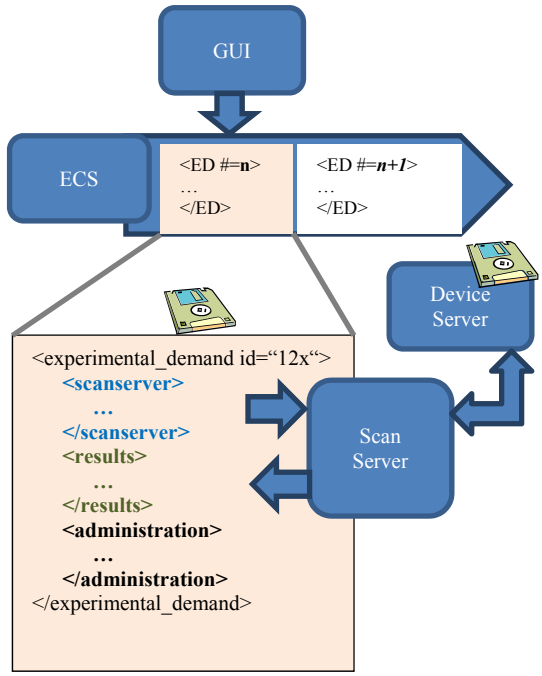

Figure 2: Schematic construction of processing EDs.

command line (newfile). As a *third* step the actual scan macro realises the desired scan and with it the data collection is done. The data is stored in SPECs ASCII file.

Additionally triggered devices - electrically by the yellow trigger or by the TANGO bus (see Fig. 1) are offered directories to store their data. Following-up the smart integration concept the produced results has only to be declared to the ECS. A modification or special adaption of the used device servers with respect to storage behaviours is avoided.

The hook concept of SPEC permits the customisation of the latter two steps in such manner that SPEC respects the ECS order queue and cooperates by exchanging logging information.

Virtually SPEC is divided thereby into a (G)UI and a scan server and becomes a simple server which might trigger other devices. The logical division is not visible for the user but technically the command line UI from SPEC might be used for any scan server and vice versa a separate GUI might drop a SPEC scan server request.

SUMMARY

At ANKA we have set up a new smart structured measurement process (ECS). The new at ANKA introduced smart concept offers the base for the implementation of the desired automated overall data management with minimised efforts. The implemented ECS manages in a first approach an order queue (FIFO) of experimental demands. Currently the ECS is collecting metadata in a XML file added to the experimental results.

ISBN 978-3-95450-124-3

The ECS itself was introduced into the well time-tested SPEC measurement environment without breaking accepted habits and SPEC was improved to act in the TANGO environment as a virtually divided cooperating UI and scan server.

REFERENCES

[1] TANGO, www.tango-controls.org/.
[2] R. Stotzka, W. Mexner, T. Dos Santos Rolo, H. Pasic, J. van Wezel, V. Hartmann, T. Jejkel, A. Garcia, D. Haas, A. Streit, "Large Scale Data Facility for Data Intensive Beamlines", Proceedings of the 13th International Conference on Accelerator and Large Experimental Physics Control Systems, (2011): p. 1216 - 1219.
[3] HDRI, http://www.pni-hdri.de/
[4] SPEC, http://www.certif.com/.
[5] T. Spangenberg, K. Cerff, W. Mexner, "MACRO PACKAGE BASED ENHANCEMENT OF SPEC CONTROLLEDEXPERIMENTAL SETUPS", PCaPAC 2010, Saskatoon, Oct. 2010, THPL015, p 184 (2010), http://epaper.kek.jp/pc10/papers/thpl015.pdf
[6] PVSS2, http://www.pvss.com/.
[7] T. Spangenberg, K. Cerff,W. Mexner V. Kaiser, „Tango Integration of a SIMATIC WinCC Open Architecture SCADA System at ANKA,"Proceedings of the 13th International Conference on Accelerator and Large Experimental Physics Control Systems, (2011): p. 749-752.

ISBN 978-3-95450-124-3