THE PSI WEB INTERFACE TO THE EPICS CHANNEL ARCHIVER

Gaudenz Jud, Andreas Luedeke, Werner Portmann. PSI, Villigen, Switzerland

Abstract

The EPICS channel archiver is a powerful tool to collect control system data of thousands of EPICS process variables with rates of many Hertz each to an archive for later retrieval.

Within the package of the channel archiver version 2 you get a Java application for graphical data retrieval and a command line tool for data extraction into different file formats. For the Paul Scherrer Institute (PSI) we wanted a possibility to retrieve the archived data from a web interface. It was desired to have flexible retrieval functions and to allow interchanging data references by e-mail. This web interface has been implemented by the PSI controls group and has now been in operation for several years. This paper will highlight the special features of the PSI web interface to the EPICS channel archiver.

INTRODUCTION

The EPICS channel archiver is used at different facilities at PSI, e.g. for the Swiss Light Source (SLS), the Swiss Free Electron Laser (SwissFEL) injector test facility, the medical cyclotron (Proscan) and others (Fig. 1). Several ten thousand process variables are archived at SLS and for the growing SwissFEL project the number is nearly twenty thousand process variables already. The arching of waveforms becomes increasingly important for the SwissFEL project. Currently more than hundred waveforms are collected at 10 Hertz.

To gain most benefit of the archived data, a simple retrieving tool is essential. It has to be taken into account that not only the machine and experiment experts, but also our maintenance staff are using the Archivers and are dependent on an easy retrieval of the archived data.

Taking everything into account, we decided that it should be possible for everybody to retrieve channel archiver data from every computer standing around. The retrieval has to be possible with a minimum of software installations. A web browser is a tool contained in the standard installation of every PC at PSI. Thus we decided to write a web-based server application which is very intuitive and can be learned to be used within minutes by persons, who are no computer experts. The use of predefined data sets was important as well as the possibility to analyze waveforms. Some export formats should allow the users to accomplish further works on the data according to their wishes.

Process variable names are often rather cryptic. Therefore it is possible to define descriptions for EPICS process variables in a dictionary, which are stored in a database. The descriptions can be used fully equivalent with the process variable names: you can either search for process variables or descriptions, and in the data plots, you can decide whether to use the original name or its description in the agenda and for the y-axis labels.
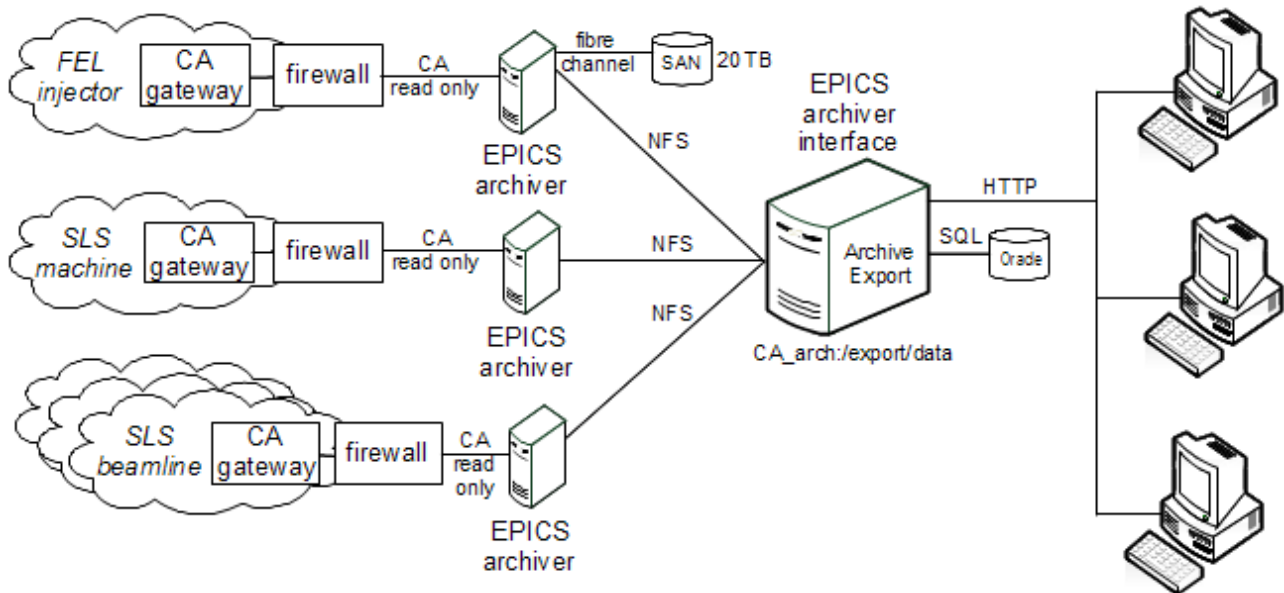

Figure 1: Overview of the EPICS channel archiver realisation at PSI.

GRAPHICAL USER INTERFACE

Scalar Data Plot

Fifty different EPICS archive processes, so-called archive engines, are running currently at PSI. When calling the main page of the archiver data interface, an overview of all these engines is given.

On this main page one can also find a navigation bar on the left. One link of it is **predefined views**, which leads to an overview of several collections of preselected channels, which can be plotted by one click. These predefined views are extremely helpful to examine collections of records routinely (Fig. 2).

Figure 2: Partial view of predefined views.

If the user decides to select one of the archiver engines displayed at the main page, he/she is lead to a page, were the channels of interested can be entered in a text field.

Alternatively channels can be searched by means of regular expressions. The result of such a search is a list, from which the desired channels can be selected.

The next page provides handles to adjust the time range and the formatting of the axis, buttons to process the data for scalar or waveform display or data export, and several more options to format the output (Fig. 3).

Figure 3: Partial view of the adjustment page.

A plot command with the adjustments in Fig. 2 results in the plot shown in Fig. 3.
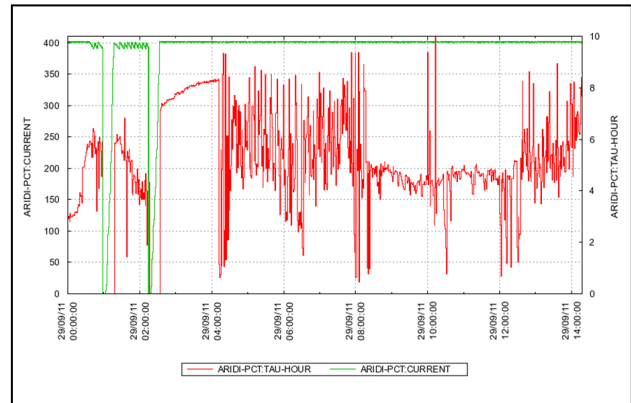

Figure 4: Ring current plot with parameters from figure 3.

Waveform Data Plot

Analogue signals from an AD converter card might be stored as waveforms to achieve a better time resolution. The low level RF group engaged in the development of an injector to be used for the SwissFEL project uses a lot of waveforms. Therefore it is inevitable to provide a tool to analyse the waveform data. A data viewer written in Java was available to perform such analysis.

The java tool was a client application but the users wished a possibility to look at their waveforms data in the same tool as they use for other data in the channel archiver. Therefore we added a waveform viewer on the web server. A lot of ideas were taken from the Java data viewer. The adjustment page of the archiver web interface allows now selecting a waveform display as an option. Then a special page devoted to control the output of the waveforms opens (Fig. 5).
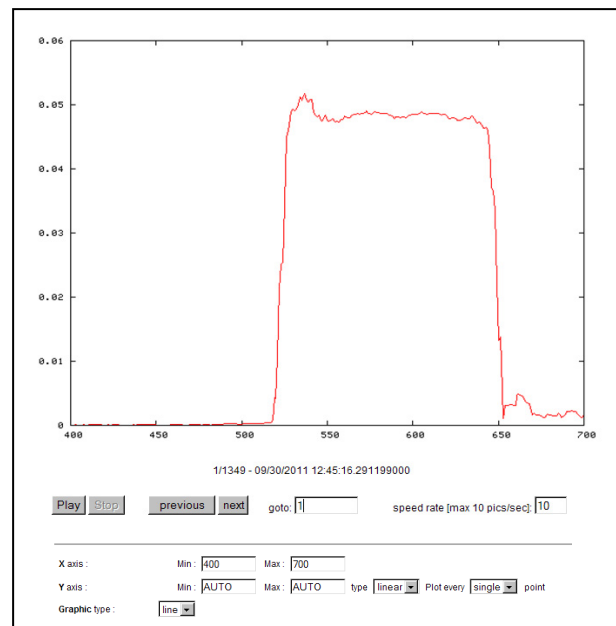

Figure 5: Waveform plot with selectable options.

All waveforms archived during the selected period are created as a sequence of plots. By pressing the play button the sequence is displayed as an oscilloscope display. The speed can be chosen between 1 and 10 waveforms per second. One can step forward and backward plot by plot or choose or choose a dedicated plot within the sequence. The plot can be filled or outlined; the x- as well as the y-axis can be selected. Otherwise an automated wide and height is chosen respectively.

Archiver Data Export

Included in the EPICS channel archiver package version 2 is the command line tool *ArchiveExport*. While useful as a debugging tool, it might be cumbersome to be used for routine data analysis. The data retrieval with our web interface is still done with *ArchiveExport*, but the graphical user interface facilitates its use. All user inputs are translated into a command line using *ArchiveExport*. The retrieved data are processed with the graphical *gnuplot* package to provide the desired plot. The data can be exported either as text, excel sheet or in matlab format.

Uniform Resource Locator (URL)

When using the archiver web interface, one might want to communicate the created plots to somebody else. To fulfil this task, the archiver web interface has an extremely useful behaviour. All features of the interface pages are contained in the URL. Therefore it suffices to copy the URL of a page of interest and send this URL to a recipient. Opening this URL shows exactly the same content as the sender was looking at.

The advantage of interchanging data references as URL compared with interchanging the data itself is many fold. The main benefit is that the recipient can refine the data: he can easily expand the time range or add other process variables in order to correlate events. At the same time the usage of URLs simplifies the access for the user, since he only needs to learn one tool to handle the data retrieval and display. And it saves of course bandwidth, not to interchange the full data of interest by e-mail.

It is possible to go even a step further and to create the URL in another application. This allows web applications to link to the archiver web interface for the display of specific data, with defined formatting for a desired time range. The Operation Event Logging System used at the SLS [1] utilizes this feature of the channel archiver web interface. It creates for each beam event links to related data. For example in case of a beam outage it creates a link to the beam current plot during the outage period, or for each orbit feedback failure it generates a link to the orbit data during the time of the failure.

TECHNICAL REALISATION

Hardware

Using the web server solution to retrieve channel archiver data imposes a powerful hardware. The server hosting the web interface to the channel archiver is a HP Bl460c G6 Proliant Blade Server with 2x quad-core E5506 @ 2.13GHz CPU, 24GB RAM and 1GB/s network. The data are stored on a hardware raid connected with a 4 GB/s fibre channel connection.

Software

The operating system of the server is Scientific Linux SL release 5.1 (Boron) [2]. We choose the development environment Eclipse Galileo [3], used with the Zend Engine v2.1.0 [4] and Xdebug v2.0.5 [5]. The web server is an Apache 2.2.3 [6], PHP used to develop and run the archiver interface has version 5.1.6 [7]. JavaScript is used to perform the control of the waveform output on the client side. The export of data into Matlab format is performed without using the Matlab program. We used the matio-1.3.4 C library [8] to program the Matlab export function. Calling this c module inside PHP enhances the conversion speed remarkably.

SUMMARY

The PSI archiver web interface for the EPICS channel archiver has proven to be a reliable, efficient and effective tool for the access and display of the archived control system data. It is easy to use; it does not depend on other client software than a normal web browser and it provides high flexibility to retrieve the data. Many useful applications derive from its ability to encode all retrieval and display parameters in a URL. This allows other web applications to link to specific data use references to the archiver web interface, instead of incorporating their own measures of data retrieval from the archiver.

ACKNOWLEDGEMENT

The PSI archiver web interface is the successor of the CGIExport tool, which was part of the previous version of the channel archiver [9]. That tool was in use at PSI, too. It was discontinued in version 2 of the channel archiver. We therefore reengineered a new tool with the same layout and functionality. Even the URL interface was kept compatible, but has been extended later for the new functionality of the PSI archiver web interface.

REFERENCES

[1] A. Lüdeke, "Operation event logging system of the Swiss Light Source", Phys. Rev. ST Accel. Beams, **12** (2009) 024701.

[2] Scientific Linux, http://www.scientificlinux.org

[3] Eclipse galileo, http://www.eclipse.org

[4] PHP und ZendEngine, http://www.zend.com

[5] Xdebug Debugger and Profiler Tool for PHP, http://www.xdebug.org

[6] Apache Software Foundation, http://www.apache.org

[7] PHP: Hypertext Pre-processor, http://www.php.net

[8] MAT File I/O Library, http://matio.sourceforge.net

[9] K.U. Kasemir, L.R. Dalesio, "Overview of the Experimental Physics and Industrial Control System (EPICS) Channel Archiver", ICALEPCS'01, San Jose, 27-30 Nov. 2001, pp THAP019