LOGGING OF SUPERVISORY DATA AT BESSY *

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Abstract

Third generation light sources are facilities requiring ultimate beam stability. Typically component design tries to suppress well known perturbations. During operations a crucial element of the control system is the logging of all signals that might be suited to identify unknown sources of performance degradation. As soon as correlatable data are available it is feasible to plan detailed additional measurements, characterize the systems involved and design appropriate countermeasures (e.g. feedback, component redesign). In this paper the status of the data archiving system in use at BESSY is described. Planned developments and ideas are sketched.

1 SCOPE AND PRIORITIES

At dedicated measurements parameters are stepped intentionally and the resulting effects on other parameters are recorded and evaluated. In contrast the precautionary measure of logging parameters relevant for operational conditions into certain archives has no specific application in mind. Mostly the data are never extracted and analyzed. But if a certain interruption, a slow drift or any other unexpected behavior of the machine has to be analyzed the logged data become invaluable and should be sufficiently complete to contain a clue to the explanation or at least a hint on what should be examined more thoroughly.

1.1 Data of Interest

A vast amount of parameters is required to describe the operation condition of a light source. The basic configuration is given by the strength of all beam guiding, kicking and wiggling fields as well as by the status and performance of the accelerating and damping elements. With stored beam all signals from the diagnostic system become relevant: beam intensity and lifetime, orbit displacements, source point size and shape, etc. Environmental variables like vacuum in the beam pipe, temperature profiles and variations, performance of the cooling systems strongly influence operation conditions. Delivered beam quality also depends on operational modes like fill pattern, status of feed-back systems etc. Frequently changes in the accelerator performance are due to not-intended operator actions or caused by spontaneous and volatile events typically captured by an alarm system.

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1.2 Format and Groupings

Differences between various commonly used recording modes are basically substantiated by the meaningful frequencies of data gathering. The adaptive way of storing date with a fixed, sufficiently high frequency during periods of rapid changes and switching to the recording of monitor events notifying the occasional occurrence of a change is for most signals a universal compromise [1].

In addition snap-shot files are needed for comparison and reload of different accelerator settings. Reading with user-adjustable frequency is needed for online visualized stability monitoring and trending. Short term history buffers help to mediate a quick overview of the present status. Event capturing facilities are used to document (transient) alarms and operator actions. Run book entries hold data measured by hand or comments and observations.

Natural structure for a grouping of the various signals to record with one or the other method is given by the device classes the monitored equipment belongs to.

1.3 Latencies

Acceptable latencies between data recording and viewing vary strongly with the application. For 'online' trend analysis the latency should be negligible, for long term statistical analysis data latency is no issue.

2 ARCHIVING MODES AND TOOLS

At BESSY a couple of signal logging facilities are in use. They cover most of todays needs but do not share a common data format and are thus not suited for combined correlation analysis.

2.1 Snapshot Files

One of the central working horses for the operation is a save/restore tool that allows to keep particular well characterized accelerator set-ups and return to these states by reloading the appropriate data sets[2]. Focus of this tool is given to the flexibility of hierarchical, partial, additive and filtered selection of data subsets for storing, comparison, reload and export. File-sets control the bundling of data gathering and hold the data. They reflect device hierarchies, are easily adaptable to changes in the equipment collections and allow to be systematically backwards corrected if e.g. hardware changes require the use of new units. Today a thousand of files describe 'good' states and can be analyzed with respect to operational changes.

Given a ‘dense’ logging of set-points and read-backs of all devices data duplication could be avoided. An alternative save/restore solution would require only the time stamp and a descriptive comment to tag and save a certain pre-accelerators and storage ring set-up. But then the snapshot data extraction engine had to provide the functionality now covered by file-set configurations.

2.2 Online Stability Monitor Displays

A simple way to find trends and correlations is to connect the signals of interest to a software strip-chart recorder featuring a very flexible update frequency, time span and zooming control. Print outs or data dumps to disk frequently document a first observation of a correlation and trigger often a more systematic precision measurement.

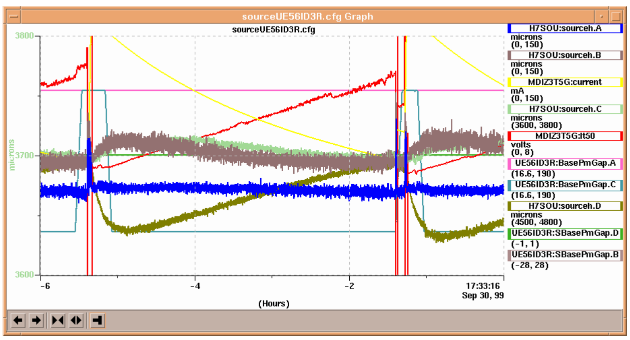

Figure 1: Stability Monitor using StripTool.

2.3 Continuously Monitored Data

A constantly growing list of signals is collected continuously in the background. Initially information about long term power supply stability and vacuum quality was needed. Later all types of beam parameters, RF operation conditions, insertion device changes etc. have been added as the interest in these parameters became apparent.

The data gathering engine is based on periodically restarted SDDSmonitor[3] processes. Semi-automatically generated configuration files provide the list of signals to collect with a fixed frequency. Storage format is one file per day and device class in a simple calendar oriented directory structure.

Beam position data have to be treated differently. The front end computer has to post the orbit measurement periodically in a stream type format for technical reasons. A dedicated program collects the information and stores the ordered, averaged and cleaned data in compact binary form to a similar directory structure.

2.4 Sparse and Irregular Data

All relevant console applications log messages, error conditions, action triggers etc. via cmlog[4] to a message database in a structured, but otherwise free format. This facility is an invaluable tool to pinpoint irregularities or misbehavior within the system. It helps to reconstruct actions

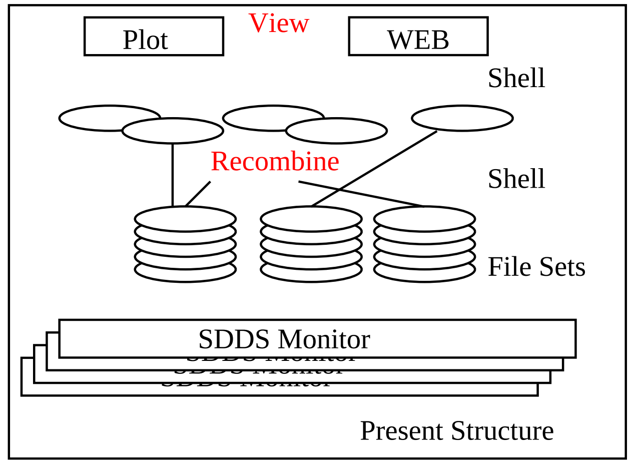

Figure 2: Data Collection and Extraction Engine.

or events and their effect that have not been adequately reported by the operator. Extraction of correlations out of this data pool would require a dedicated application program.

A WEB based electronic run book is provided by a cgi input/output interface to ORACLE database tables set up with a perl package. The stored data allow statistical analysis of delivered beam time, failure frequencies and their causes etc.

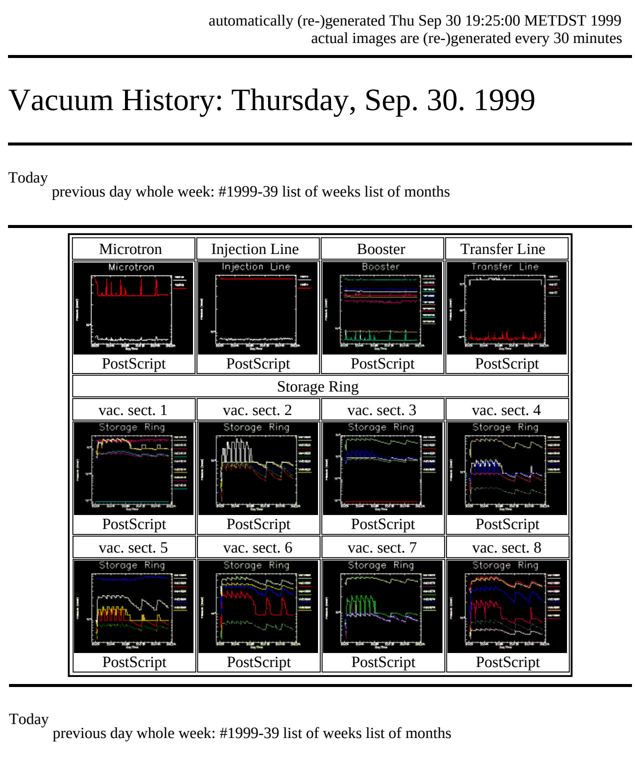

Figure 3: Data presentation on the WEB.

3 RETRIEVAL MODES AND TOOLS

3.1 Statically Presented Overview Data

The parameters of common interest are periodically extracted from the continuously collected archive and converted into static graphs. These plots are accessible in a browsable history on the WEB (Fig. 3). These standard displays provide a sufficiently detailed overview of the average accelerator performance.

3.2 Search and Correlations

The numerous filter programs supplied with the SDDS toolkit[3] support a large variety of data recombinations, mathematical analysis, search for specific signatures and coincidences. A tcl/Tk based wrapper around some SDDS tools helps to scan the archive. It allows for the most common operations like selection of time span, device class, signals of interest and output option. A graphical preview helps to ensure that the data selected contain the desired informations. For further postprocessing these data can be exported to SDDS, ASCII or spread-sheet format.

4 SHORTCOMINGS, IMPROVEMENT PLANS

The deficiencies of the BESSY logging have to be overcome in the near future but the need is not yet urgent.

4.1 Adaptive Logging Frequency, Optimized Retrieval Speed

SDDSmonitor provides only data collection at fixed rates. The compromise in data acquisition frequency misses fast intermediate events and results in a waste of disk space and retrieval speed. That problem can be solved by migration to another collector tool and storage format[1].

4.2 Universal Data Storage Format

Given a file-set based archive networked access besides NFS requires a specific solution. Retrieval tools have to adapt to the data format within the archive. A uniform API requires an additional layer of retrieval calls. In this respect relational databases supply attractive features. With SQL a standard language is available to express correlations. The DB data extraction tools provide networked access to the data and allow for presentations on most common viewing tools like WEB browsers and java virtual machines.

For a relational DB major points of concern are import/export speed especially if flexibility requires a large number of different tables. A possible scenario could be a staged archive: Collectors with adaptive data acquisition rate store their information into file-sets optimized for retrieval speed. For small latency views and rapid scans a limited functionality retrieval tool is available that has access to the specific file set format. For long term statistical analysis and correlation finding a 'digest' process continuously transfers the data from the file-sets into a relational DB and makes it available for SQL based applications (Fig. 4). The same process could also take care of data aging and compression strategies.

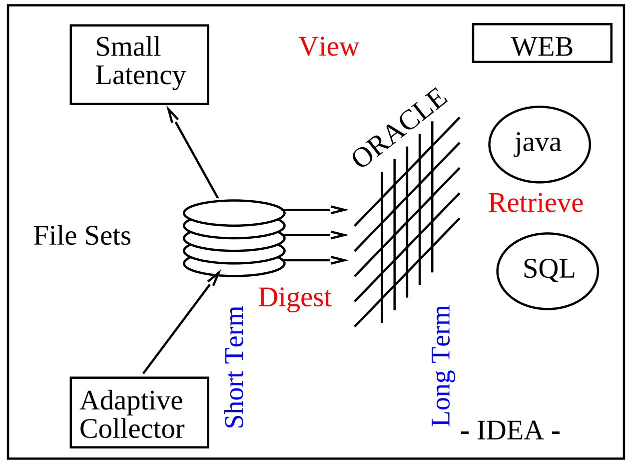

Figure 4: Staged Archive, Universal Storage Format.

4.3 Post Mortem Dump

A 'nice to have' link between the event catching facilities and the continuous monitoring would be a sliding window data buffer holding a (short) time span of specific signals of interest that is dumped to archive on certain triggers. That would help to analyze the vicinity of a (rare) failure condition with high resolution. At BESSY there is no work in progress on this issue but conceptual decisions to come have to be open for a later integration.

5 SUMMARY

The present archiver situation at BESSY is a 'minimum-effort' solution. Basic requirements are adequately covered. Maintainability, accessibility, retrieval speed and flexibility are not totally satisfactory.

Due to the enormous variety of data sources and formats relevant for supervisory analysis universal recording and retrieving tools seem to be not feasible. Nevertheless promising development progress has been reported[1] towards a generic and portable toolkit covering most of the logging requirements.

6 REFERENCES

[1] L.R.Dalesio, W.Watson, M.Bickley, M.Clausen, Data Archiving in Experimental Physics, Proceedings of the 1997 ICALEPCS, Beijing, 1997, p.75

[2] See http://www csr .bessy .de/control/SoftDi st/Sa veResto re/

[3] M. Borland, L. Emery, N. Sereno, Proceedings of the 1995 ICALEPCS, Chicago, 1995, p.382

[4] cmlog has been developed by TJNAF.