〔F18p19〕

# STATUS OF CONTROL AND DATA ACQUISITION SYSTEM FOR JLC X-BAND HIGH FIELD EXPERIMENT

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## Abstract

To study the fabrication of accelerating structures for the main linac of linear collider the high power tests has been started in 1997. The objective of these experiments is to confirm the high field performance of 1.3m long X-band accelerating structures [1]. This paper describes current status and development plans for the control and data acquisition system of high-field experiment. We also introduce our approach to development of Web-enabled control application using HTTP/CGI client-server model.

## Introduction

The basic requirements for control and data acquisition system of X-band high field experiment include fast software development, convenient user interface, multiplatform interoperability and open architecture. Open system architecture is especially important in order to provide support for frequent hardware modifications, which are common in preliminary study experiments. Low cost of software development and maintenance as well as high quality of graphical user interfaces has been achieved in our system by applying an integrated visual development environment (InTouch).

Considering the recent progress in Internet/Intranet technologies and distributed computing based on Java language we conclude that, for modern control and data acquisition systems it is essential to support remote experiment monitoring over the Internet. Below we represent the present system status and our plans for future developments.

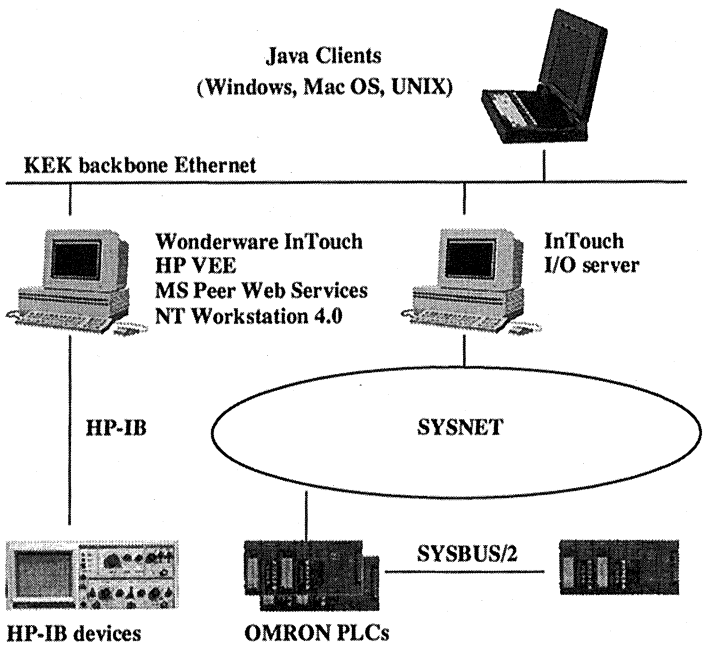


*Figure 1*

## System Overview

Control and data acquisition system provides the users with the possibility to control a number of devices connected to PLCs and through HP-IB interface, automatically store data in a database if certain conditions occur and to perform automated conditioning of accelerating structures. An outline of existing system is represented in the Figure 1. Currently, the system comprises two PCs running Windows operating system; one computer is used as an I/O server and another – as an operator's console (Figure 1). Both computers are connected to backbone KEK Ethernet.

HP-IB board is installed on console computer and controlled using HP-VEE. HP-VEE provides waveforms retrieval from oscilloscopes, waveforms' data storage into a database and off-line visualisation. In order to collect information about conditioning process, VEE application is used to monitor interlock status and to store waveforms, if hardware interlock happens.

Main PLC network is 2 Mbps SYSNET with ring topology and, 1.5 Mbps SYSBUS/2

connection is also used. PLCs are controlled from console PC by InTouch program, which provides convenient user interfaces, SQL database connectivity and an internal scripting language for software development. Currently, around 170 I/O channels are controlled by PLCs through InTouch (Figure 2).

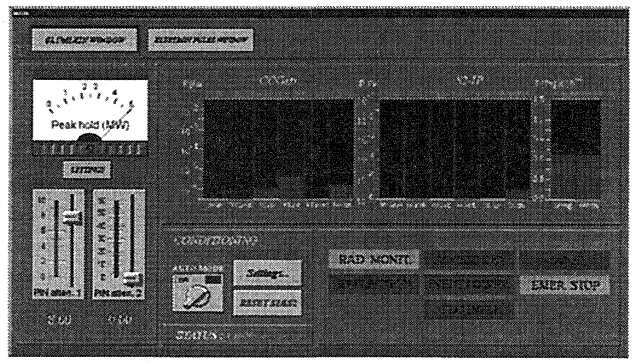


*Figure 2*

Auto-conditioning program monitors vacuum and other parameters and automatically selects a corresponding conditioning regime. Operator can change all the parameters of auto-conditioning algorithm on-line.
The possibility to monitor experimental devices as well as conditioning status through a Java applet is also provided. For this purpose we use a WWW server running on the console computer and providing a HTTP/CGI based interface to an I/O server. A CGI program residing on the console computer communicates to I/O server by NetDDE protocol. Refresh rate for a WWW client inside KEK network depends on backbone network traffic and is around one second for all PLCs' parameters.
A library of reusable Java user-interface components has been developed and an InTouch-to-Java graphics converter is now under evaluation. Since all remote user interfaces are implemented using pure Java, any operating system with Java-enabled browser can be used to run GUI of monitoring applications.

## Future Developments

The existing control and data acquisition system supports automation of many tasks, which should be performed by operator during accelerating structures conditioning and also provides the possibility for off-line analysis and visualisation. However, combining control, acquisition, analysis and auto-conditioning tasks in an integrated system can offer the new opportunities.
Such an integrated system will provide the possibility to analyse conditioning history and optimise parameters of auto-conditioning algorithm using results of analysis (Figure 3).
Using the proposed system the operator can perform conditioning manually or switch to automatic mode. In auto mode, system devices, such as attenuators and power supply are controlled by auto-conditioning program, implementing a parameterised conditioning algorithm.
Relevant system' parameters are stored into off-line database if a predefined event occur. Analysis and

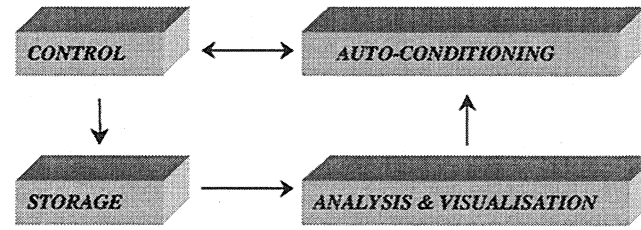


*Figure 3*

visualisation block retrieves the data from off-line storage system and performs a statistical analysis allowing the operator to dynamically modify the analysis algorithm and to visualise results. For experimental data analysis, a combination of existing data-mining techniques can be applied in order to find the correlations between events, such as hardware interlock, and physical parameters of the system [2]. Output of analysis block is a set of parameters, which will be used by auto-conditioning program during the next session. The whole system implements a feedback algorithm, so that the data obtained during previous sessions are analysed in order to improve conditioning algorithm.

## Conclusions

From the results presented in this paper we can see that control, data acquisition and analysis are closely correlated for applications related to conditioning of accelerating structures. Further, we conclude that on the current stage of developments it is necessary to apply the results of theoretical research on data mining to experimental data analysis.
Application of integrated visual programming environment provides high quality of user interfaces and low cost of system development and maintenance.
Current status of research and developments on Java-based Internet computing provides the new opportunities for implementation of distributed control and data acquisition systems. However, in order to exclude code duplication at software development phase, the use of converters from console graphics into Java applets is highly recommended.

## References

[1] High Field Experiment of 1.3m-Long X-Band Structure; T. Higo, D. Dong, H. Fang, J. Nie, M. Gao, E. Kadokura, I. Mejuev, H. Sakai and K. Takata; APAC'98 Proceedings, Tsukuba, Japan.
[2] Knowledge Based Event Oriented Approach in Control Systems; Vikentiev A., Vaguine A., Mikheev V., Poluektov S; ICALEPCS'97 Proceedings, Beijing, China.