PAUL SCHERRER INSTITUT

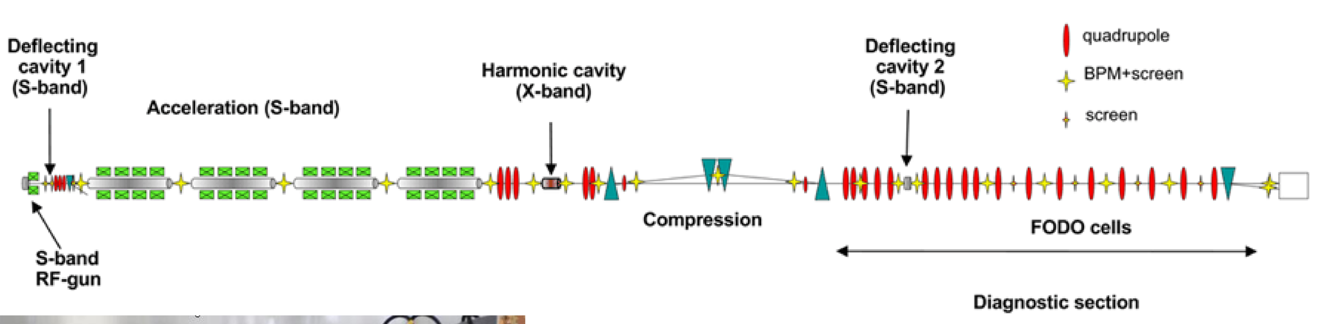
CURRENT STATUS AND PERSPECTIVES OF THE SwissFEL INJECTOR TEST FACILITY CONTROL SYSTEM

P. Chevtsov, M. Dach, and SITF controls team*

INTRODUCTION

The Free Electron Laser (SwissFEL) Injector Test Facility at Paul Scherrer Institute (PSI) has been in operation for more than three years. The Injector Test Facility machine is a valuable development and validation platform for all major SwissFEL subsystems including controls. Based on the experience gained from the Test Facility operations support, the paper presents current and some perspective controls solutions focusing on the future SwissFEL project.

SwissFEL Injector Test Facility (SITF)



SITF is a highly flexible 250 MeV (~100 m long) linear electron accelerator that has been in operations at PSI for more than three years. The facility consists of a laser driven RF gun, which is followed by an S-band booster section, a bunch compression area and a diagnostics section featuring an RF deflector and a series of FODO cells for the beam emittance control.

SITF Control Concept

Basic development tool is EPICS.

Basic backbone architecture: VME64x.

- Ability to provide a very rapid deployment of controls applications required by the SITF project
- Good experience with the SLS and other PSI facilities
- A lot of investment in the developments (e.g. the BPM systems)
- Latest technologies can be implemented within the existing infrastructure (e.g. a standardized interface with FPGAs based on FPGA Mezzanine Cards or FMC)

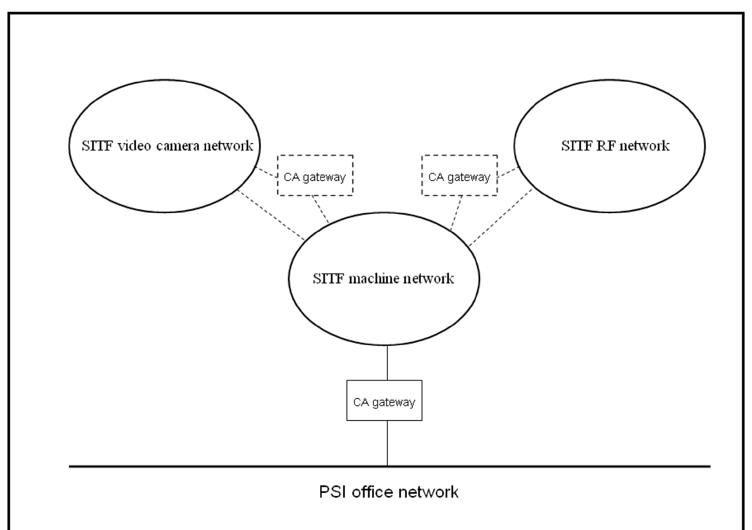
SwissFEL Challenges

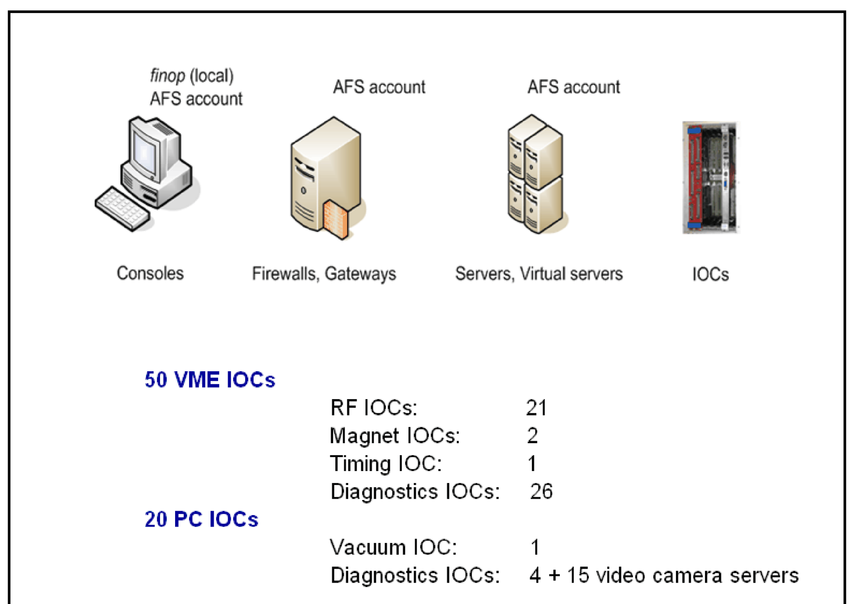
- New advanced technological solutions are required in order to provide extremely high quality electron bunches needed by the SwissFEL project.

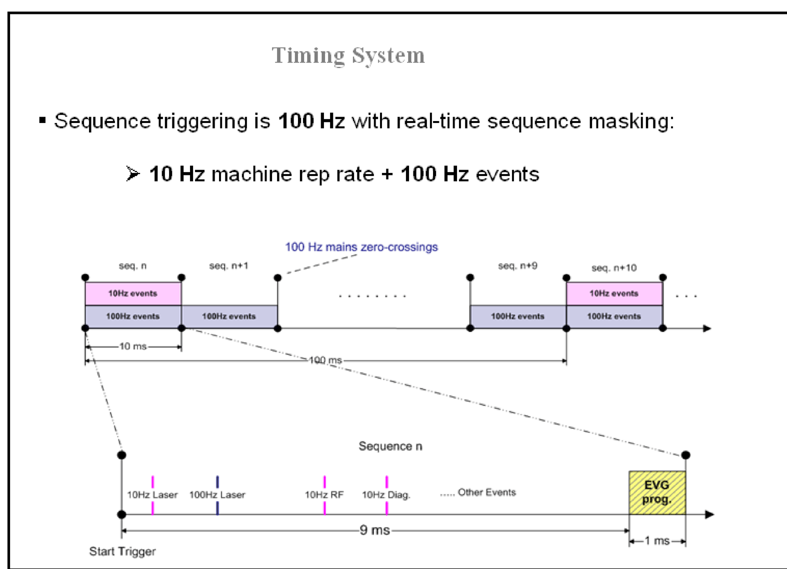
-At the same time, such solutions must fit a relatively low cost SwissFEL budget.

SITF Control System Overview

Computer network and controls resources

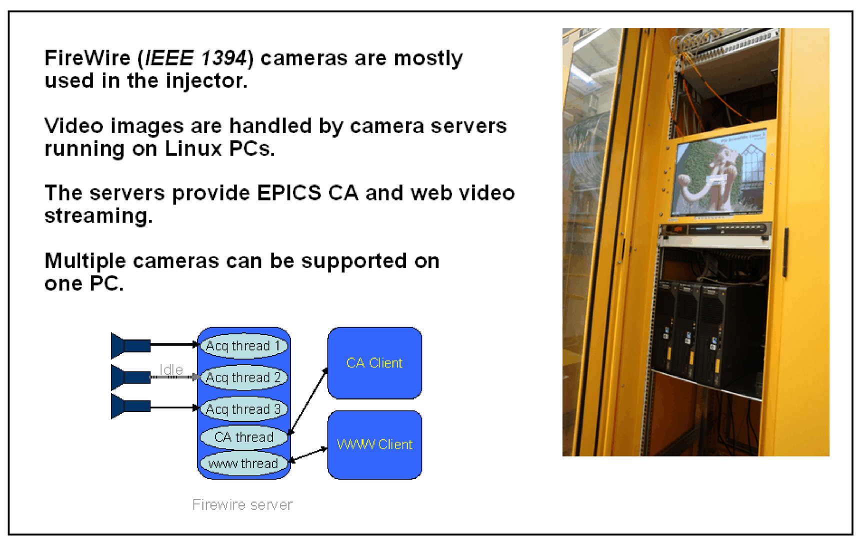


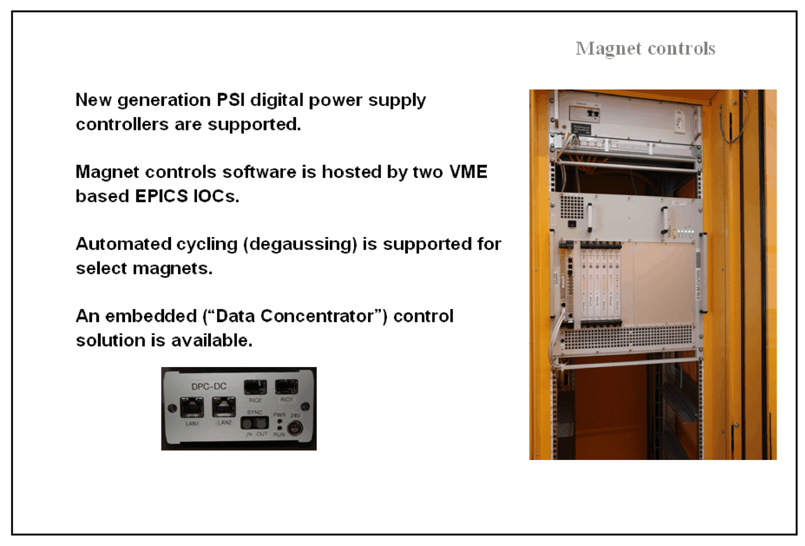


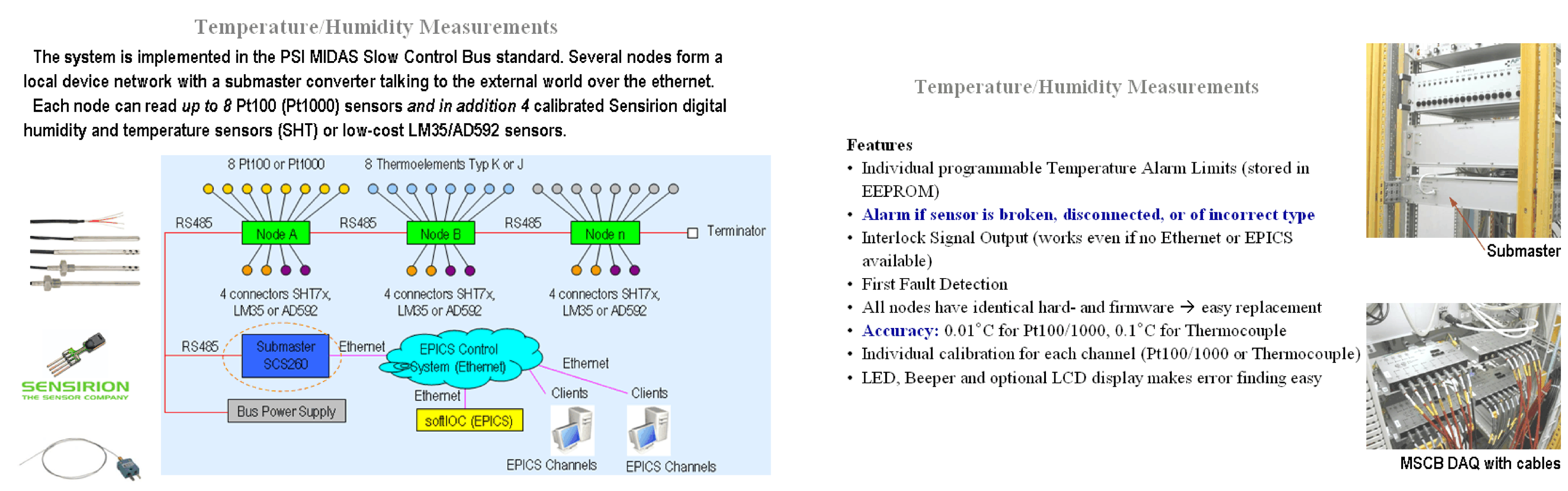


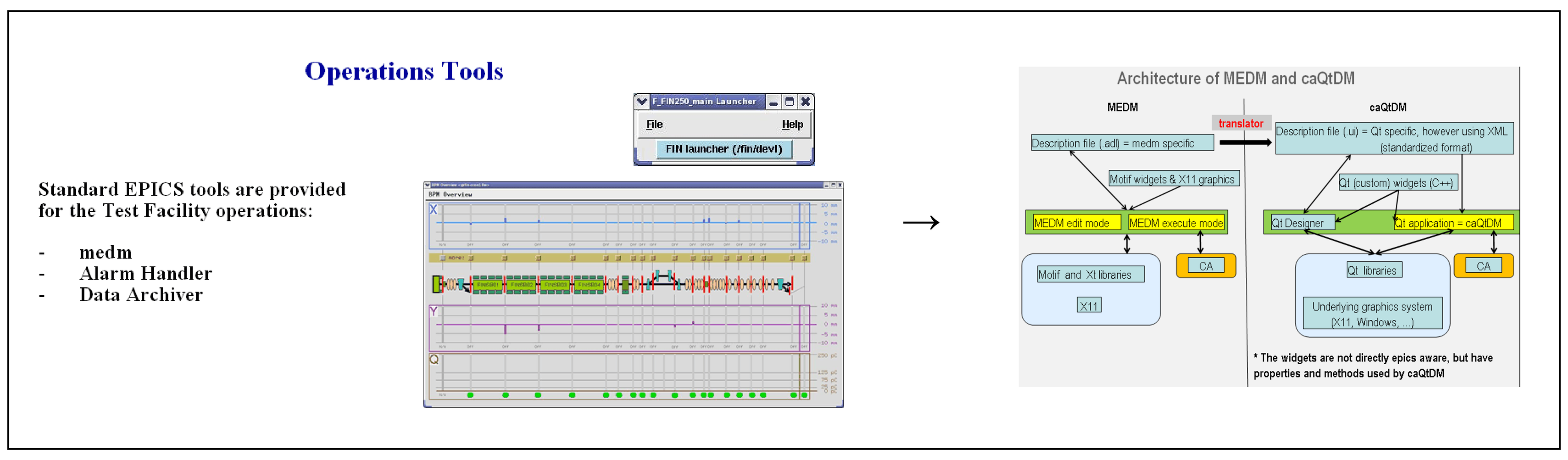
The timing and event distribution system is based on Micro-Research Finland global event distribution products. The SITF machine nominal rate is 10 Hz but some its subsystems (i.e. lasers) require triggering at 100 Hz. As a result the event sequencer is programmed at 100 Hz, which immediately makes the SITF timing system ready for the future SwissFEL project.

-The basic IOC type is a single board computer MVME-5100.
-Major general purpose ADC, DAC, DIO control signals are handled by Hytec Industry Pack modules sitting on VME carrier boards. This solution works well for moderate signal frequencies (up to few hundred kHz).
-Fast ADCs (100 MHz and higher) are handled by Generic PSI ADC Carrier (GPAC) setups.
-The principal PSI platform for motion control applications is the VME MAXv-8000 motor controller. The encoders are accessed either via MAXv transition modules or special counter boards designed by Kramert GmbH.

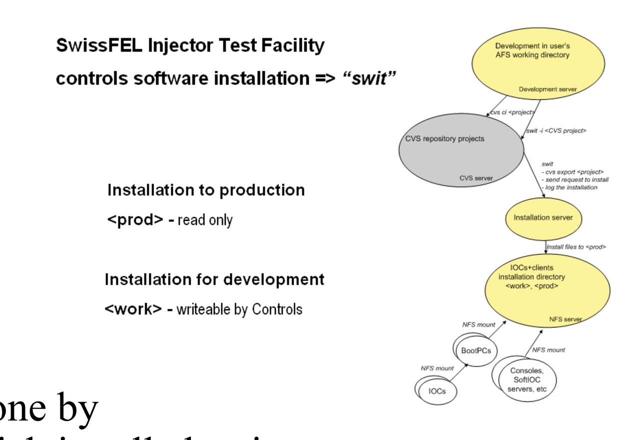






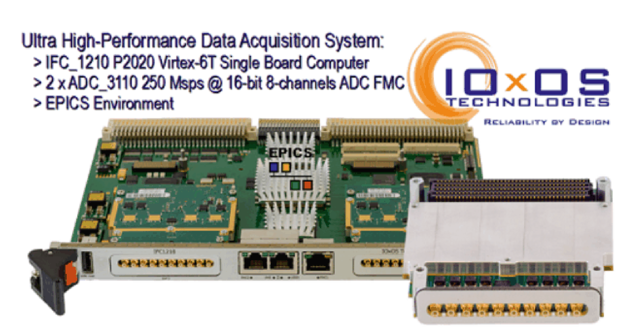


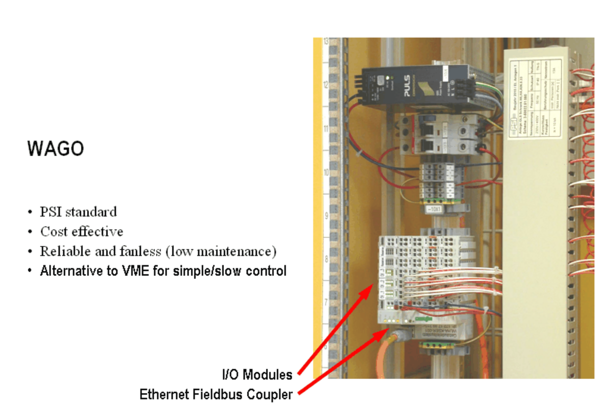
The application development environment at PSI is built around a powerful hardware inventory database together with application building and installation frameworks, which heavily rely on this database. The hardware inventory database contains the information about IOC types, operating systems, and controls hardware components handled by them. A specially developed dynamic compiling and building script fully automates the application building process. All that has to be done by a developer is to reference this script in a project make file.
The control system configuration data and software are installed in a separate directory located on a dedicated NFS file server. All information required to run IOCs and client applications is contained there.



The installation of applications on the computer network is done by means of an in-house created application installation tool, which is called swit. Software revision controls is based on the concurrent version system (CVS).

Some Perspective SITF Controls Developments





-A new IOC, IFC_1210, was developed by the PSI controls team in collaboration with IOxOS Technologies SA. The IFC_1210 is a highly configurable FPGA platform associated with XMC, PMC, and FMC mezzanine slots for custom expansions, a very powerful dual core PowerPC and real time OS. It is built around a high-performance switched PCI Express GEN2 architecture. The VME support firmware implements a complete VME master/slave interface. The PSI controls team plans to gradually switch to IFC_1210 IOCs that will make much more computing power, a higher data throughput, and very flexible I/O features available for software developers.
-Cost efficient WAGO I/O products are considered to be primary solutions for slow controls (temperature and humidity monitoring) and small motor control applications.
-EPICS version 4 is going to become a basic PSI toolkit for writing scientific applications. PSI plays a leading role in this international project.

CONCLUSION

The SITF gives us a unique opportunity to develop and evaluate new ideas in view of the future SwissFEL. It also helps us to understand how to make our work on the control system more efficient. Very successful SITF operations clearly demonstrate that its control system developments are in a good shape to provide all necessary control tools for the future SwissFEL component tests, commissioning, and runs.

* D. Armstrong, E. Divall, M. Heiniger, C. Higgs, M. Janousch, G. Janser, G. Jud, B. Kalantari, R. Kapeller, T. Korhonen, R. Krempaska, M. Laznovsky, A. Mezger, V. Ovinnikov, W. Portmann, D. Vermeulen