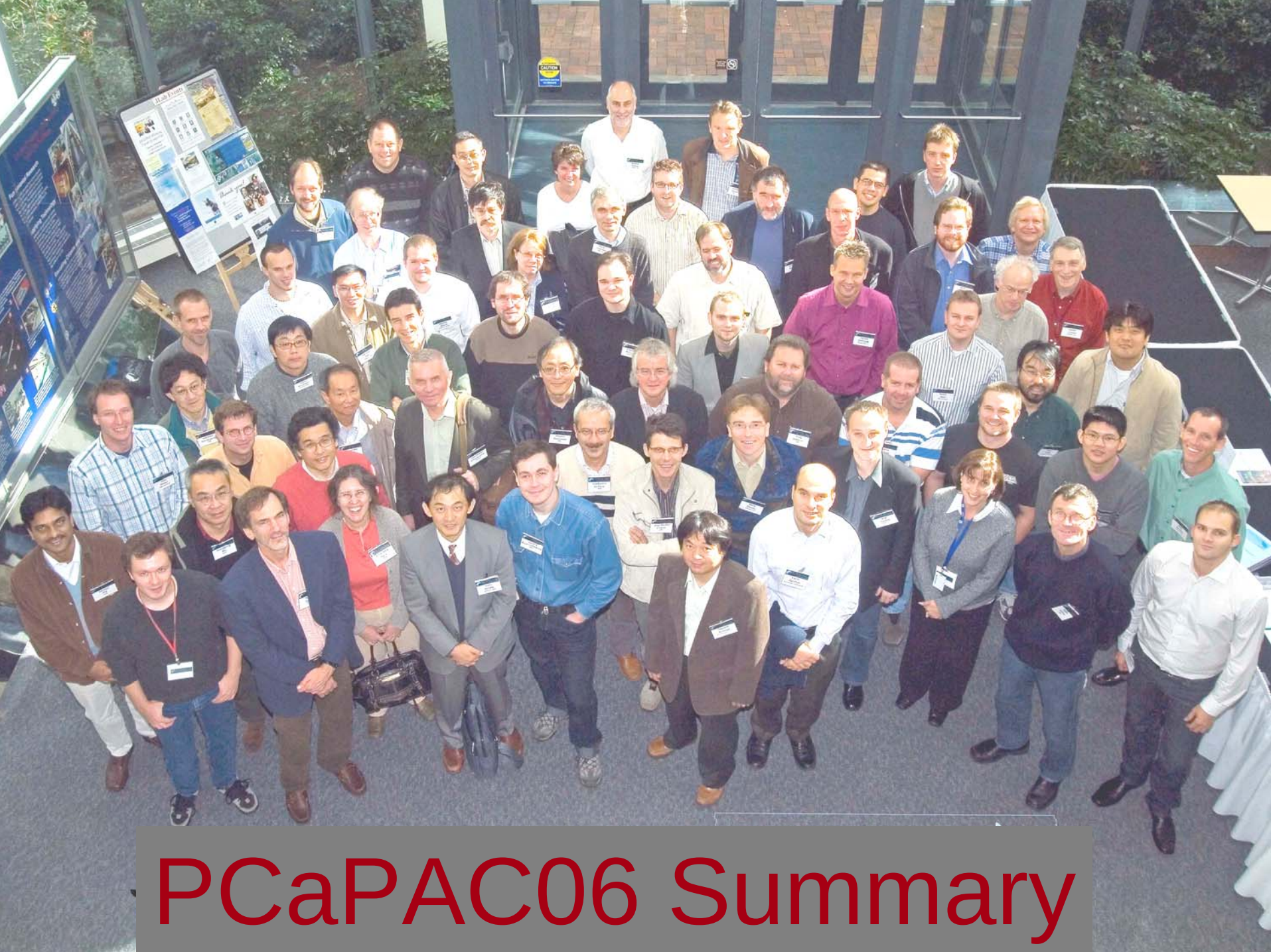


PCaPAC06 Summary

day #1

Tuesday, October 24

9:30 - 10:00	"TANGO control system status"	J.-M. Chaize (ESRF, France)
10:00 - 10:30	"The new control system for future low-emittance light source PETRA 3 at DESY: from conceptual design work to realization"	R. Bacher (DESY, Germany)
11:00 - 11:20	"Status of the SCSS Prototype Accelerator and Control System"	T. Ohata (JASRI/Spring8, Japan)
11:20 - 11:40	"Migrating the STAR Slow Controls System to PCs"	J. Fujita (Creighton Univ, USA)
11:40 - 12:00	"Using the common device interface in TINE"	P. Duval (DESY, Germany)
1:30 - 1:50	"The interconnection of TINE and STARS"	T. Kosuge (KEK, Japan)
1:50 - 2:10	"Embedding a TANGO device into a digital BPM"	G. Gaio (ELETTRA, Italy)
2:10 - 2:30	"Control system for the FFAG complex in KURRI"	M. Tanigaki (Kyoto Univ, Japan)
2:30 - 2:50	"Operational experience with synchrotron light interferometers for CEBAF experimental beam lines"	P.Chevtsov (JLab, USA)
3:30 - 3:50	"Beyond PCs: Accelerator Controls on Programmable Logic"	M. Plesko (Cosylab, Slovenia)
3:50 - 4:10	"Mono for cross-platform control system environment"	H. Nishimura (LBNL, USA)
4:10 - 4:30	"A configurable Interlock system for RF stations at XFEL"	M. Penno (DESY, Germany)
4:30 - 4:50	"PC-based magnetic field mapping for superconducting cyclotron (SCC) at VECC"	S. Pal (VECC, India)
4:50 - 5:10	"MCS-8 eight axis embedded motion control system"	R.Gajsek (Cosylab, Slovenia)
5:10 - 5:30	"Ethernet based embedded system for FEL diagnostics and controls"	J.Yan (JLab, USA)

TANGO

- mature system
- strong collaboration
- co-development

- lots of features
- embedded too

PETRA III

Goal for 2009: PETRA III

- Objectives of the PETRA III work package "Control System":
  - Complete up-grade of the control system of PETRA and the pre-accelerators (LINAC 2, DESY 2)
  - Partial / complete up-grade of the front-end electronics of PETRA and pre-accelerators (LINAC 2, DESY 2)
- Shared Responsibilities:
  - Controls group is fully responsible for:
    - core software and services
    - control room applications
    - system integration, administration and infrastructure
  - Controls group is partially responsible for:
    - device server applications
    - front-end electronics

Reinhard Bacher, DESY PCaPAC 2006

•based on well established technologies: TINE, ACOP, cPCI, CAN, ….

• shared responsibilities

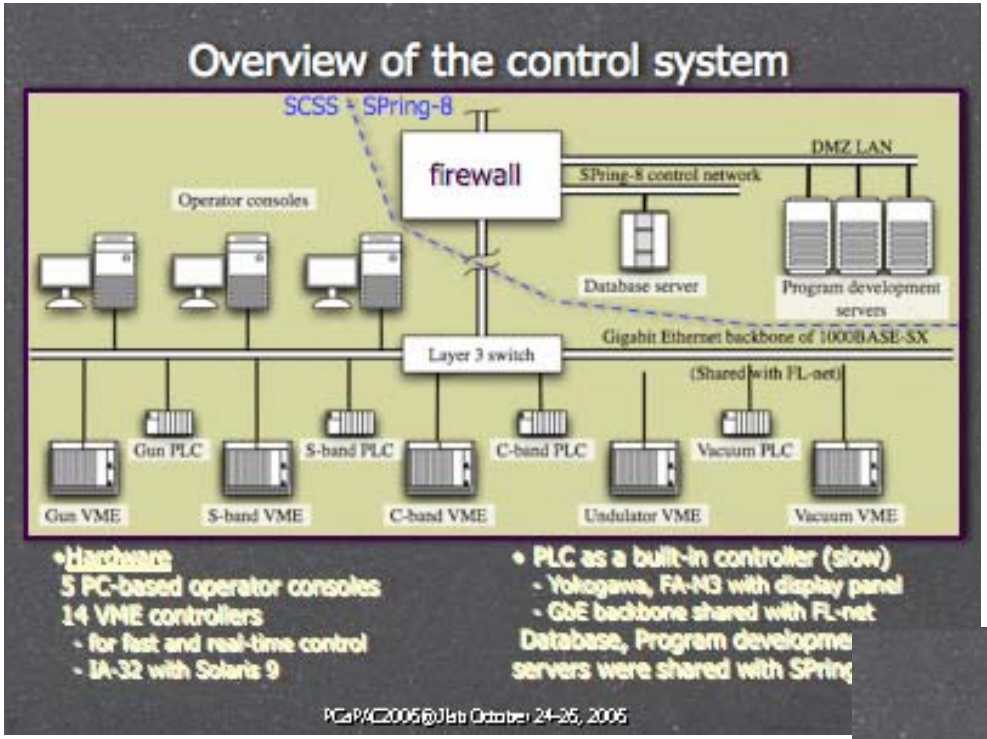
TINE Control System Software Suite

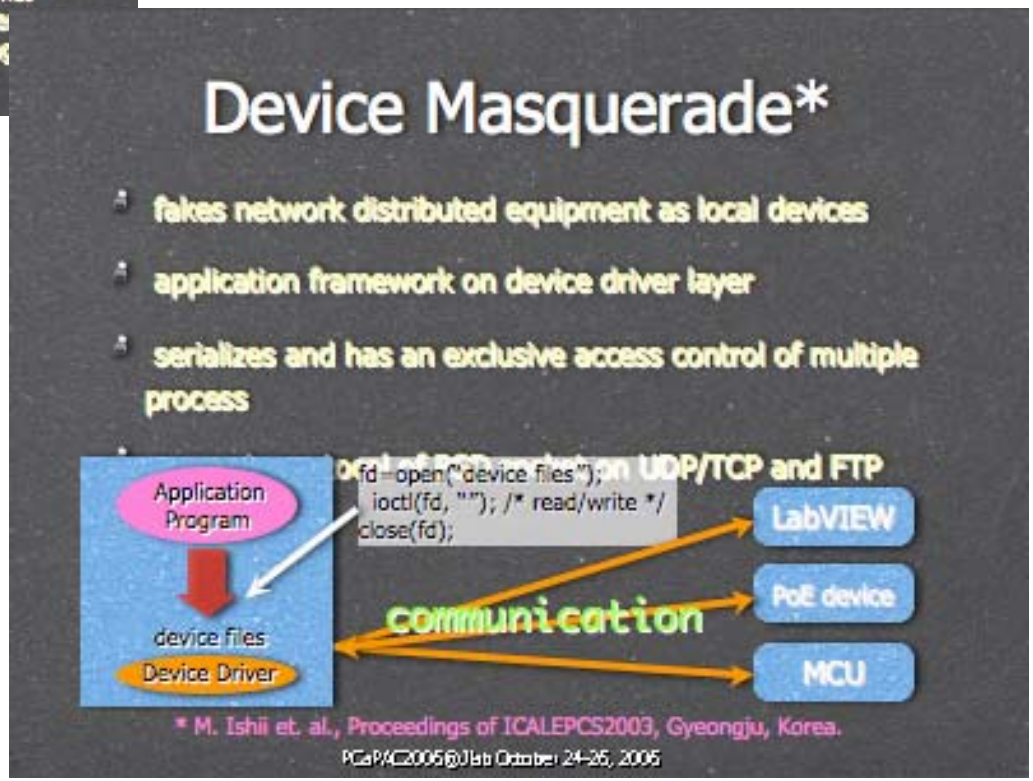
- Multi-platform: runs on Windows, Linux, Unix, MACOS, VxWorks, NIOS
- Multi-architecture: data exchange via client-server, publisher-subscriber, broadcast and multicast communication
- Multi-protocol: supports UDP, TCP/IP and IPX transport protocols
- APIs: provided for Java, VisualBasic, C/C++, LabView, MatLab and command line interface for script languages
- Client / Server implementation: in C and Java
- Name services: with plug-and-play automated server registration and user access control

Reinhard Bacher, DESY PCaPAC 2006 18

SCSS

- VME + network attached equipment
- device masquerade to simplify sw development

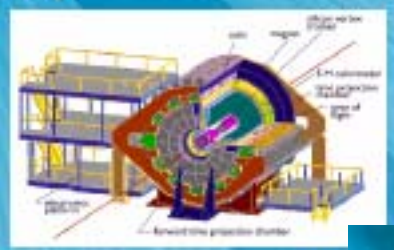




STAR

STAR Detector

- STAR (Solenoidal Tracker At RHIC)
  - RHIC (Relativistic Heavy Ion Collider)
- Located at Brookhaven Natinal Laboratory (Long Island)



- many IOC are in high radiation area -> boot & reset from network

- upgrade EPICS

Original Upgrade Plan

- Transition to EPICS 3.14
- Scientific Linux 3 as host
- PCs running RTEMS (Real-Time Executive for Multiprocessor Systems) for IOC
- MEDM on PCs running Windows

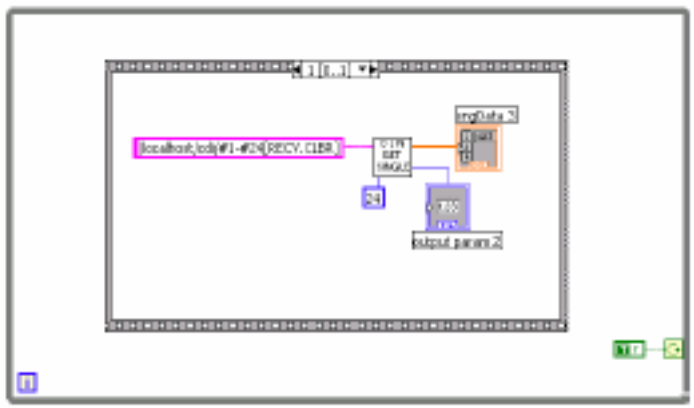
Using the Common Device Interface in TINE

Application Programmers

- either learn an interface API for each hardware bus, or
- use Epics + Epics2Tine or
- use LabView + TINE VIs or
- use DOOCS + run DOOCS via TINE or
- use TINE CDI !

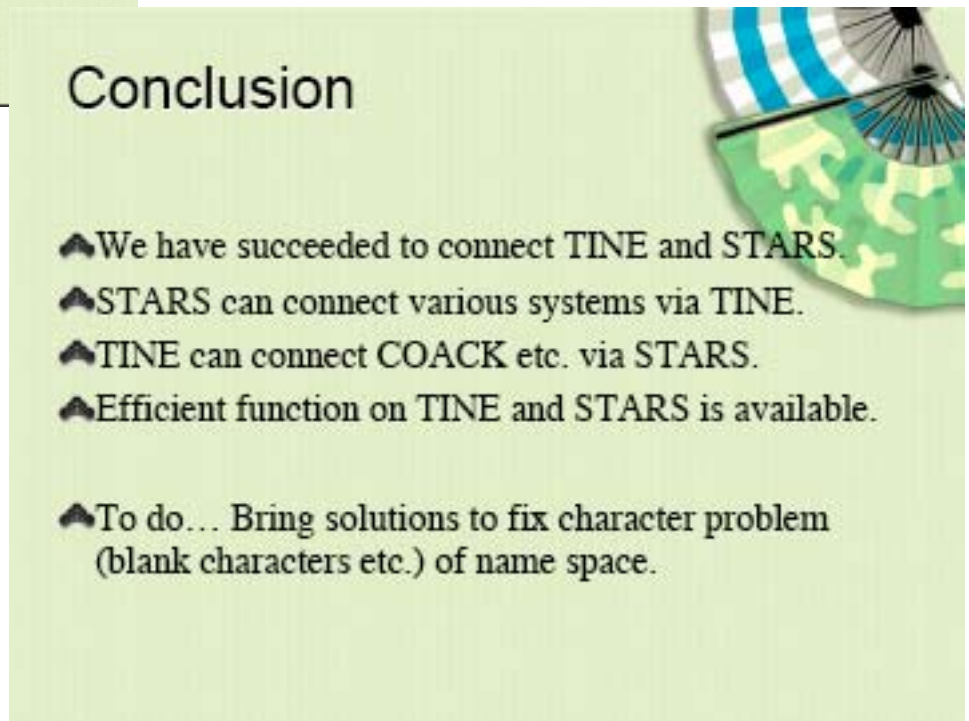
- learn the TINE CDI and use the language you like (Java, LV, VB)

CDI: Practical Example (LabView)



STARS

- TINE and STARS together improved interconnection of systems at KEK



Embedding a TANGO device into a digital BPM

Global Orbit Feedback

- goal: equip Elettra storage ring with a fast digital feedback system to improve orbit stability
- requirements:
  - 10 kHz sampling rate
  - sub-micron resolution
  - dump disturbances up to 150 Hz
  - suppress mains disturbances up to 30

• porting TANGO to an ARM processor

PCaPAC
Newport News
October 24-27, 2006
Embedding a TANGO device into a digital BPM

porting omniORB to ARM

main difficulties to overcome due to:

- mixed “endianess” of ARM
  - ARM is little-endian (like i386)
  - “double” data on ARM is big-endian !
  - this “weird” case not handled by omniORB:

    result: mangled numbers when exchanging data between different platforms

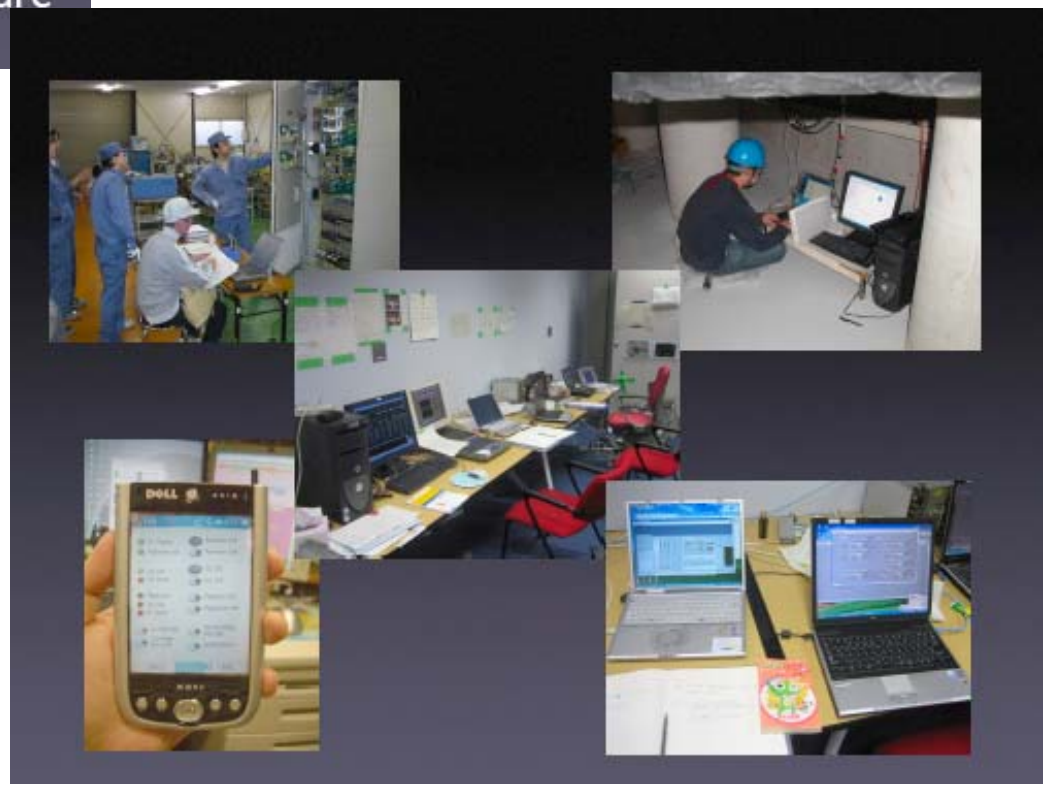
Giulio Gaio, Sincrotrone Trieste S.C.p.A.

Roles of PLC and LabView

- LabView
  - Human Interfaces
  - Highly Integrated Sequence
  - Interfaces to Other Implementations
- PLC
  - Low Level Sequence
  - Device Status to/from D-register
  - Database with Strong Backup Feature

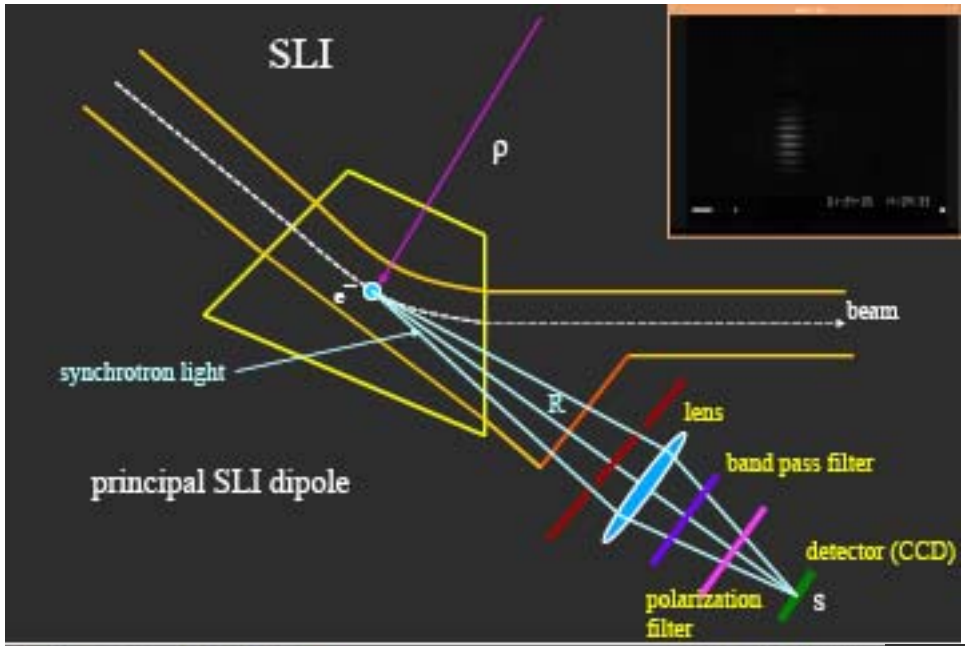
Control system for the FFAG complex in KURRI

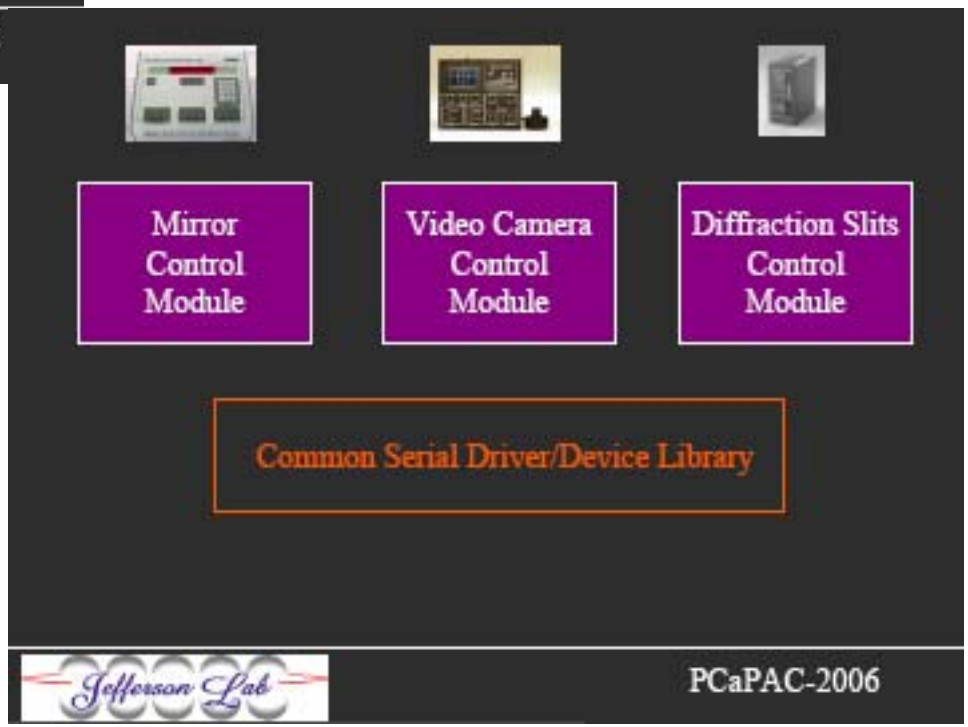
- LabVIEW for semplicity
- PLC for reliability



Operational Experience with Synchrotron Light Interferometers for CEBAF Experimental Beam Lines

- very precise interferometer to measure beam energy spread and size





Part 1: The "non-plus-ultra" Versatile Controller

- A GSI paper* suggests to make a controller with FPGA instead of CPU
  - Same hardware board addresses different I/O needs
  - implement hardware with software
- Motivation:
  - Reconfigurable hardware (FPGA) is much more flexible than general purpose CPUs
    - and even faster despite lower clock rates
    - But implementations and development effort is high
  - vendors offer generic processor cores
    - VHDL code (e.g., Altera NIOS or Xilinx PicoBlaze),
    - multiple powerful cores are fixed on the chip
      - e.g., Xilinx Virtex II includes PowerPC cores
- Mix CPU and logic functionality as needed

*M.Sayed, W.Panschow, Actual FPGAs – The Way Out Of Manifold Hardware Problems

Beyond PCs: Accelerator Controls on Programmable Logic

- FPGA: one hardware for all applications
- JAVA as OS
- our future: FPGaPAC ?

Build Your Own Operating System with Java Code

```
public void init() {
   initDrivers();
   initMemoryManager();
   initFileSystem();
   initNetwork();
   initScheduler();
   initServices();
   run();
}
public void initNetwork() {
   // set the MAC address of the Ethernet adapter
   eth0.setMACVendor(0x00CAFE);
   eth0.setMACSerial((this.getSerial() & 0xFFFF) << 8);

   // initialize the IP protocol (version 4)
   ip = new InternetProtocolV4();
   // tell the Ethernet driver to dispatch events to IP protocol
   eth0.addProtocol(ip);
   ...
}
```

What is Mono?

- An independent implementation of .NET Framework by Ximian ONovell.
- Linux, FreeBSD, UNIX, Mac OS X, Solaris and Windows
- s390/s390x, SPARC, PowerPC, x86, x86-64, IA64, ARM
- Dual Licensed by Novell

HP at www.mono-project.com
Search Mono at www.wikipedia.org

mono for cross mono for cross-platform control system environment

- is .NET on Linux
- with SCA.NET one can build portable EPICS clients

SCA.NET for Mono on Linux

- SCA.NET in C# itself is unchanged.
- "Any CPU" Option to Run Natively on Any CPU.
- DLL Import gets
  CA.dll on Windows
  CA.so on Linux

```
[DllImport("ca.dll")]
public static extern
    short ca_field_type (IntPtr ChanID);
```

Planned future development

- move on-board applications from NIOS/II to another platform
- shrink on-board applications on NIOS/II side
- mount computer-on-board module on controller (f.ex. X86-architecture, X-Board)
- use Linux as operating system

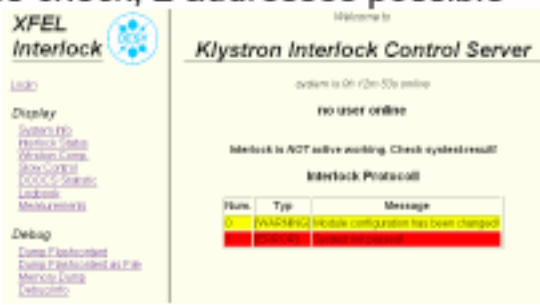
- AMD Geode SC1200 CPU 266 MHz
- Up to 128MB RAM / 128MB Flash on board
- Integrated video controller with up to 4MB DRAM
- Power consumption 3-4Watts
- On board 10/100MBit Ethernet
- IDE interface with UDMA-33 support
- PCI and LPC expansion busses
- 3 USB 1.1 ports OHCI
- 2 serial interfaces (TTL signals)

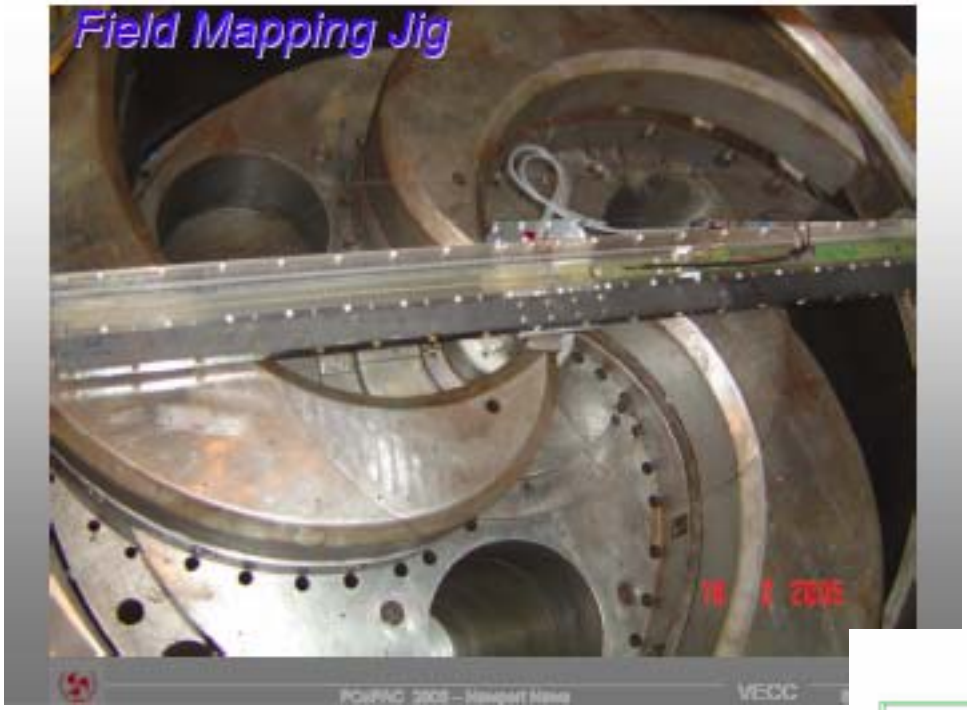
A configurable Interlock system for RF stations at XFEL

- from NIOS/II to Linux
- secure http interface

Interlock HTTP Interface

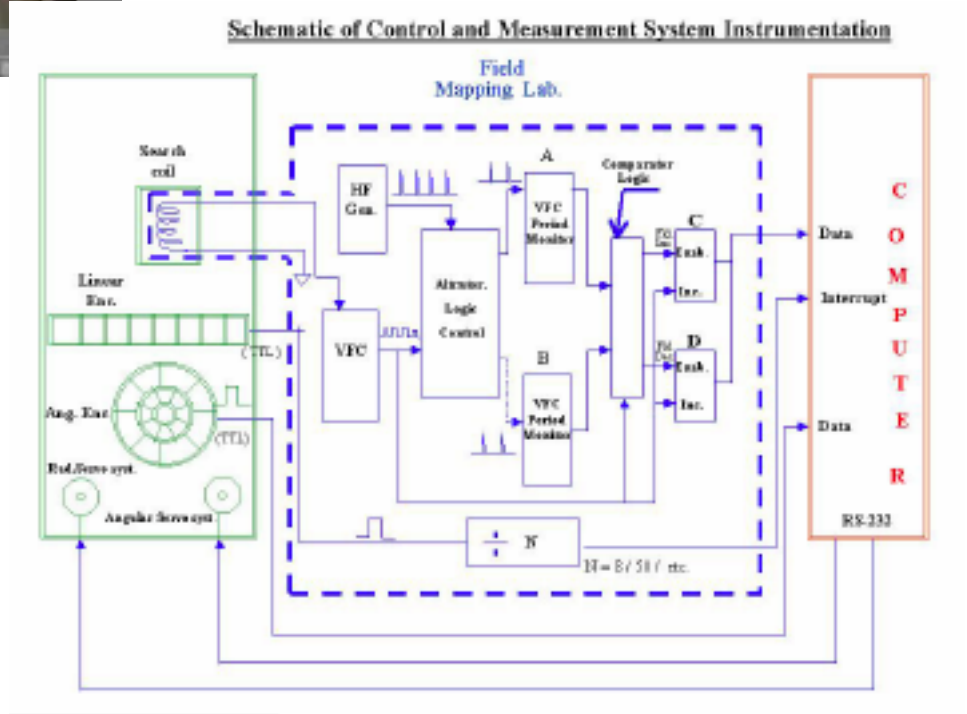
- server runs on the controller *(NIOS/II processor)*
- web-interface, access via browser
- user authentication
- Different User Roles *(chief engineer, engineer, technician)*
- IP-Address check, 2 addresses possible





Magnetic Field Mapping for Superconducting Cyclotron (SCC) in VECC

- Control System for precise measurement of the SC magnet



Motivation

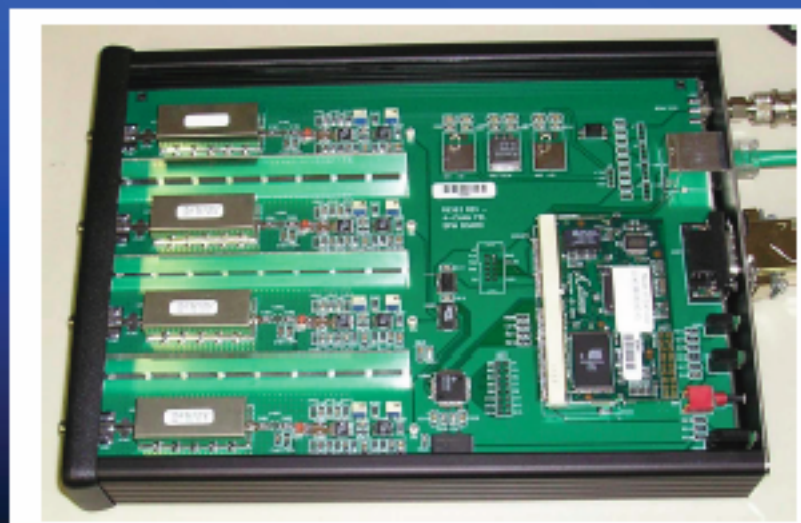
- FEL requirements for additional channels of BeamViewers and BPMs
- The cost for expanding the current configuration is high
- FEL "master plan" is to move away from Crate-Based solutions involving licensed software
- Use distributed processors instead of VME IOCs
- Develop a new I/O connection as a "default" standard
- Embedded Arcturus Coldfire Board chosen to start with
- Chose RTEMS as the real-time operating system for the IOC

PCaPAC 2006

Ethernet Based Embedded System for FEL Diagnostics and Controls at JLab

• upgrading BPM readout using embedded controller instead of VME reduces costs

BPM Board



MCS-8
The 8 axes motion control system

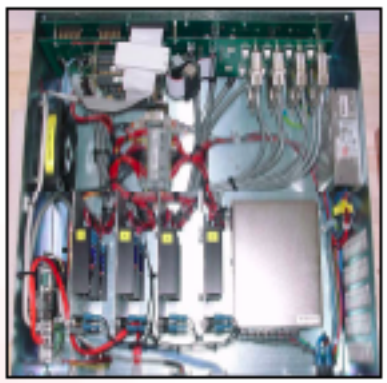
- supports any type of motor
- ..and any type of software

What is the MCS-8?

- 8-axes motion controller box (developed by Oxford Danfysik (UK) and Cosylab)
- Includes:
  - Commercial motion controller (Delta Tau Turbo PMAC2)
  - Embedded **Cosylab microIOC**
  - All the I/O units, including power drivers
- What can we do with it?
  - All kinds of motors: stepper, servo, pico, piezo...
  - Inputs for limit switches, home switches, encoders
  - Control or monitor digital and analog I/O

Hardware

- 4-U case
- 500W power supply
- Sufficient cooling (fans)
- Selectable motor drivers (external drivers possible)
- Over travel limits
- Encoder loss detection



day #2

Wednesday, October 25

9:00 - 9:20	"Virtual machines for EPICS softioc management"	G.Lawson (SNS, USA)
9:20 - 9:40	"MicroIOC: PC and control system longevity"	A.Podborsek (Cosylab, Slovenia)
9:40 - 10:00	"Beam line control at EMBL Hamburg"	U. Ristau (EMBL, Germany)
10:00 - 10:20	"DAQ based high level software applications using MATLAB"	R. Kammering (DESY, Germany)
11:00 - 11:20	"Ethernet based fieldbus functionality for neutron scattering experiments with PROFINET IO"	H. Kleines (FZ Juelich, Germany)
11:20 - 12:00	"XML Tutorial"	D. Quock (ANL, USA)
1:30 - 1:50	"EPICS SCA Clients on .NET x64"	H. Nishimura (LBNL, USA)
1:50 - 2:30	"The Project Management Tutorial"	M. Plesko (Cosylab, Slovenia)
	"Posters in Pills" Session	
2:30 - 2:35	"Standardization of the PSI accelerator control systems"	A. Mezger (PSI. Switzerland)
2:35 - 2:40	"Status of ISAC Control System"	Ch. Payne (TRIUMF, Canada)
2:40 - 2:45	"First operation with SPARC control system"	G. Di Pirro (INFN, Italy)
2:45 - 2:50	"EPICS ArchiveViewer Project Status"	S. Chevtsov (SLAC, USA)
2:50 - 2:55	"Device Address Redirection as a Tool in the TINE Control System"	S. Herb (DESY, Germany)
2:55 - 3:00	"Web GUIs for the TANGO control system"	L. Zambon (ELETTRA, Italy)
3:00 - 3:05	"A Communication Protocol for a Distributed Control System with LabVIEW"	L. Catani (INFN, Italy)
3:05 - 3:10	"Build of Tri-crosscheck Platform for VHDL Design"	L. Hou (Tsinghua Univ, China)

Some issues with current management

- Engineer's sometimes don't ask before they add new SoftIOCs.
  - We get port duplicates.
  - Server reboot won't autostart SoftIOCs.
  - Resources on servers are abused.
- It is difficult to do maintenance on our servers.
  - Users don't want to stop their SoftIOCs.
  - We can't easily transfer a SoftIOC from one server to another.

Using Vmware to manage EPICS SoftIOCs

• Virtual Machines simplify management of SoftIOs

Conclusion

- Virtual Machines make SoftIOC management easier.
- Virtual Machines make SoftIOCs more reliable.
- Virtual Machines are inexpensive.
- Possibilities are numerous for this technology.
- Remember, your mileage may vary….

microIOC: PC AND CONTROL SYSTEM LONGEVITY

- microIOC are reliable and long living
- dedicated to a particular device
- .. providing drivers and good sw interface

microIOC was especially designed with a length-of-service in mind

What is it:

- Embedded PC based peripheral device
- Turn-key solution for any kind of end-point devices being controlled
- Build for use in remote control applications
- use in industrial environments and longer lifetimes
- minimized interfacing and installation effort
- Included support for integration into higher level

What the Final User Needs:

The microIOC is a black box for installation:

- with a built-in EPICS database, or TANGO server
- already with preconfigured records
- but also with easy to use developing environment
- everything must be very user friendly, with wizards, in a plug&play manner..

The FBM API - Motivation

The Feedback and monitor API

- Control and operate FBs from DOOCS
  - Avoid *wildly* running FBs
  - Have one common interface for FBs
- Benefit from standard DOOCS features (histories, …)
- Reduce load on front ends (using central DAQ SHM)
- Have common exception handling
  - e.g. bunch pattern generation
- Generic skeleton for high level software applications
  - Can be used for various purposes (auto calibration, …)

Attach all high level software applications at the FBM

DAQ based high level software applications using MATLAB

- run feedbacks on middle-layer (DAQ)
- reduce load on front end and simplify physicist programming

Summary and conclusions

+ FBM API offers highly configurable interface
+ Good reliability of the interface
+ Approach applicable for many purposes
+ Very complex calculations possible

– Configuration is tricky (→Provide Wizard)
– Currently 10 Hz with complex MATLAB application can not be ensured

Forschungszentrum Jülich
in der Helmholtz-Gemeinschaft

Motivation

- *Connection of process equipment to server computer: PROFIBUS DP*
- *Problem:*
  - *Controller availability for cPCI/Linux*
  - *Continuous device driver modifications*
- *Possible solution: Ethernet*
- *Problem:*
  - *Missing Application Layer*
  - *Inappropriate for the factory floor (RT features, noise, etc.)*
- *Several initiatives during the last years*
  - *Ethernet/IP (Allen Bradley)*
  - *Modbus/TCP (Schneider)*
  - *Powerlink (B&R)*
  - *EtherCAT (Beckhoff)*
  - *PROFINET (PNO, Siemens): PROFINET CBA and IO*

Ethernet-based field bus functionality for Neutron scattering experiments with PROFINET IO

• PROFIBUS to PROFINET: move to network keeping good compatibility with PROFIBUS

Forschungszentrum Jülich
in der Helmholtz-Gemeinschaft

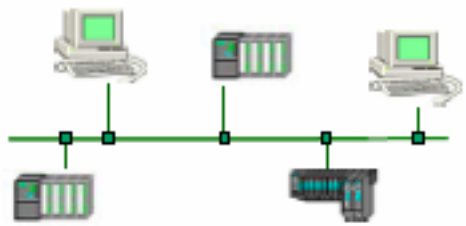
PROFINET IO at JCNS

- *PROFINET IO much simpler than CBA*
- *Similar to PROFIBUS => fits into existing framework*
- *Well-supported by S7-300 PLCs and ET200S*
- *PLC programming almost identical to PROFIBUS DP*

=> Decision: Adopt PROFINET IO as an optional replacement for PROFIBUS DP

- *Problem: Linux-Support*
  - *Avoid communication controllers (also not avail. for cPCI)*
  - *Source Code available for IO device but not for IO controller*

=> Start implementation of PROFINET IO controller subset under Linux



Zentralinstitut für Elektronik

Basics of XML

- Why XML?
- History and Development of Markup Languages
- XML Document
- XML Derivatives: Validation, HTML Style Sheets, DOM Parser
- Examples of XML at Work
- Summary of Key XML Concepts

XML Tutorial

• what is XML and why is such a powerful tool for data modeling
• building and parsing XML docs

Summary - XML Key Concepts

- XML Document is useful for data that is organized in a tree-like structure
- DTDs and Schemas are used to validate XML documents
  - Enforce data composition and data relationship rules
- XSL is a language used to process XML documents
  - Can perform if, when, choose, calculations, and other actions on data
- Server applications built in Java, PHP, Python, JavaScript, etc. can process XML documents

Control experts don't care 64-bit.

Control systems are fine on 32-bit!

However, some of us are already on 64.

Scientific Computing.
Server-side Computing.
Computer Games.

64-bit PC is not expensive.

EPICS SCA Clients on the .net x64 platform

- problems and (mainly) advantages in using 64 bits computing in controls

Conclusion

- Controls systems must support 64-bit on the client side for scientists.

By porting CA to 64-bit on Windows, SCA.NET client can run on 64 without any change.

Tutorial on Project Management

- trying to explain that is not hard work, and is worth doing it

Project Management in Research Institutes

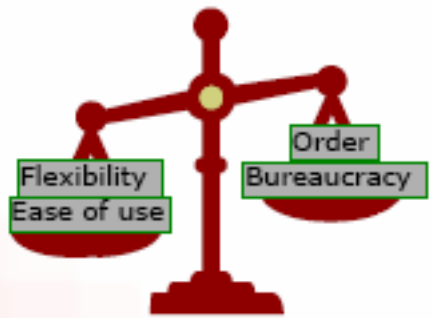
What is project management?

- Entering random numbers into Microsoft project and printing long rolls of paper
- Filling pointless reports nobody looks at
- Something that makes management happy

To sum up: Something I don't need or like

Conclusion

- Management system is always a trade off
- Our solution
  - flexible, little overhead
  - but still has very powerful features



Ideal solution for research institutes!

Poster session

…where we've seen:

- DAQ using MySQL
- program-based Logbook submission
- control systems for monitoring critical states of tasks
- EPICS on a CD
- automatically configured CS using cPCI
- status reports and results from first operation and…

more Embedded IOs, EPICS, ACOP, BEANS, …..

day #3

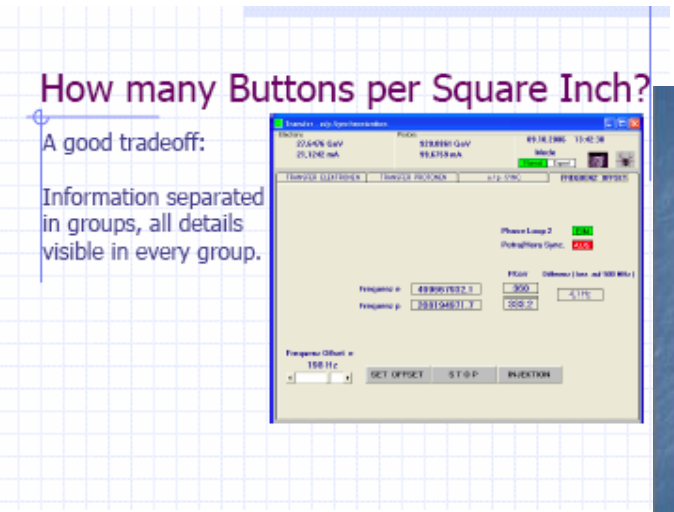
Thursday, October 26

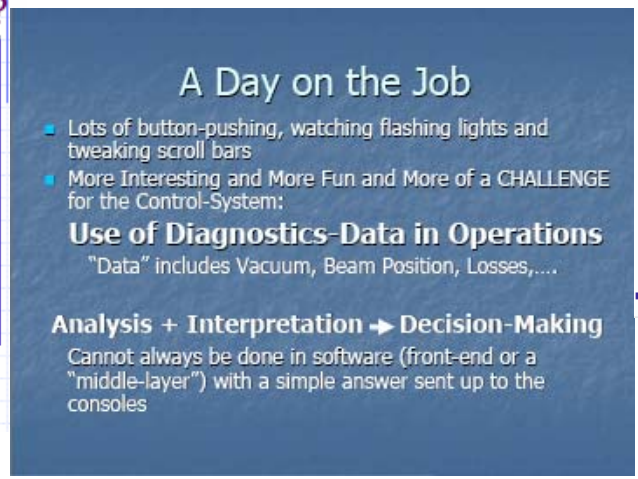
9:00 - 9:20	"User requirements for the PETRA3 control system at DESY"	M.Bieler (DESY, Germany)
9:20 - 9:40	"Off-line analysis goes on-line! or controls ain't just buttons, flashing lights and sliders"	M. Lomperski (DESY, Germany)
9:40 - 10:00	"Control systems design a user's perspective"	I. Carlino (JLab, USA)
10:00 - 10:30	USER'S PERPECTIVES - DISCUSSION - 30 minutes	
11:00 - 11:20	"A prototype of a beam steering assistant tool for accelerator operations"	P. Chevtsov (JLab, USA)
11:20 - 11:40	"Application of interest: a relational database approach to managing control system software applications"	D. Quock (ANL, USA)
11:40 - 12:00	"Accelerator management with web-based GIS"	A. Yamashita, T. Ohata (Spring-8, Japan)
1:30 - 1:50	"GIS at Jefferson Lab"	T. Larrieu (JLab, USA)
1:50 - 2:20	"Status of the CEBAF control system at JLAB"	M. Bickley (JLab, USA)
2:20 - 3:00	"Supercomputing research at Jefferson Lab"	C. Watson (JLab, USA)

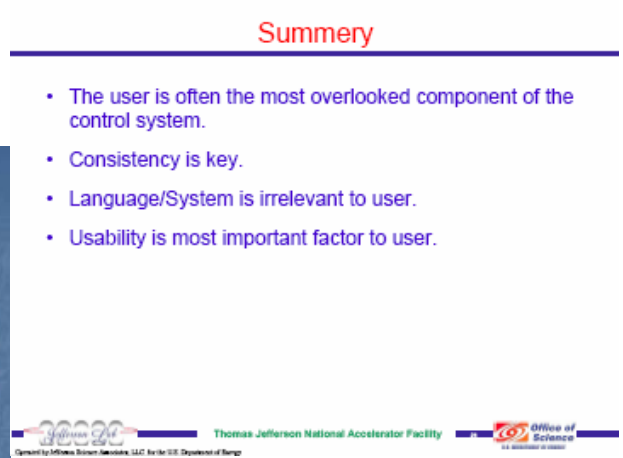
User Requirements

Details on controls from the users point of view:

- simple and user friendly
- good documentation (based on experience, Wiki?) and support for problems solution
- join operations in C.Room to test your GUIs and learn
- follow specs for GUI devel (solution might be there).

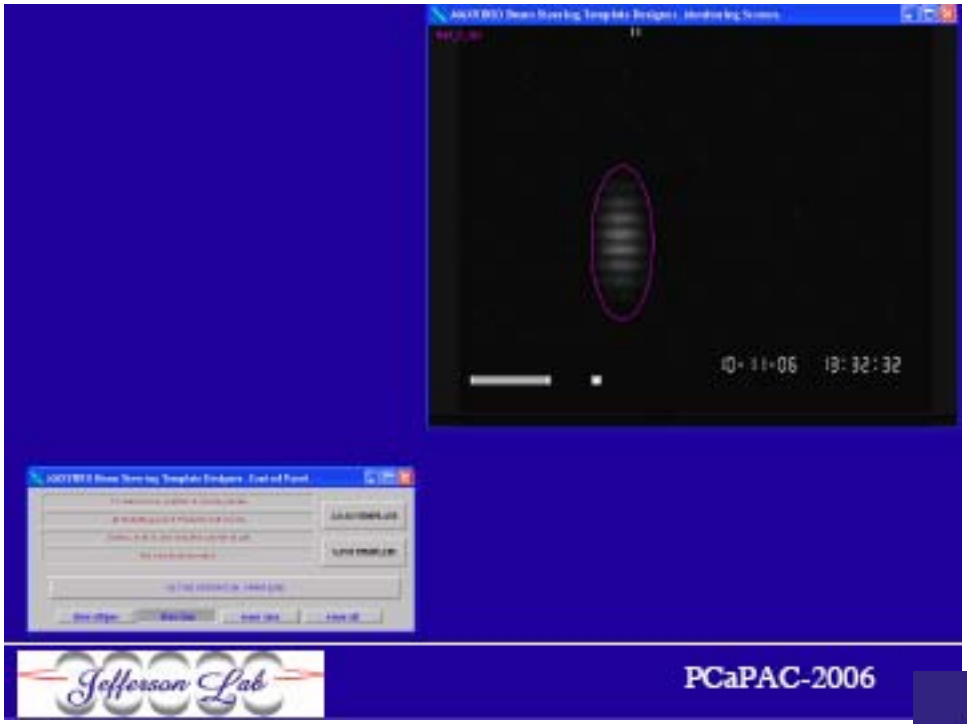


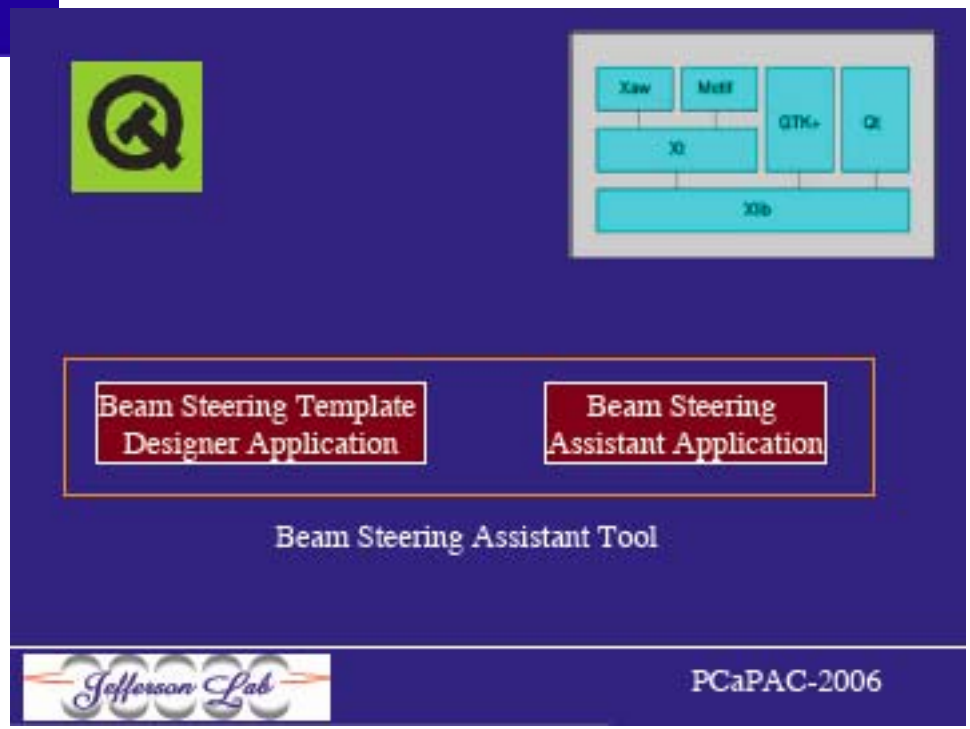




A prototype of a beam steering assistant tool for accelerator operations

- a simple tool that simplifies beam operation very much





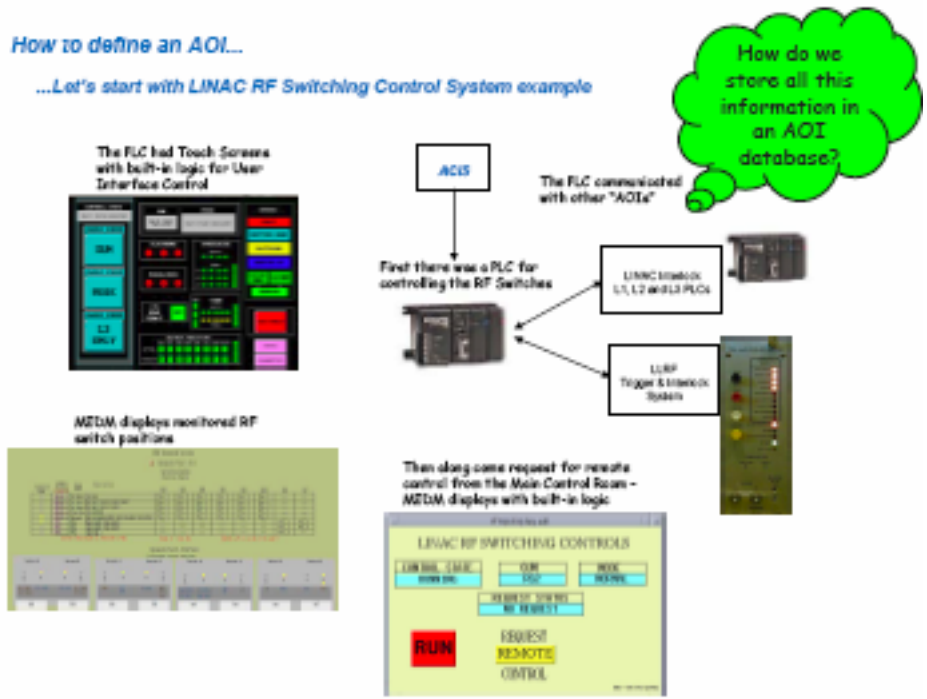
What is an Application of Interest?

- AOI (Applications of Interest) is a database software application that is used as an extension of IRMIS
- Main purpose of AOI is to identify, track, provide links to supporting documentation, and report the state of control system "applications of interest"
- An Application of Interest is any set of code (source code, databases, sequence programs, configuration files, displays) that performs a controls function requested by a customer
- Numerous possibilities exist to integrate AOI with file storage utilities such as SVN and Integrated Content Management System (ICMS), APS operations logging utilities such as the Controls Group Logbooks, APS online work request procedures, and more...
- Examples of AOIs at APS
  - LINAC RF Switching Control System
  - Vacuum Valve Control
  - Machine Protection System (MPS)
  - Over 130 AOIs cataloged already for the APS linac, expect to exceed 300

3

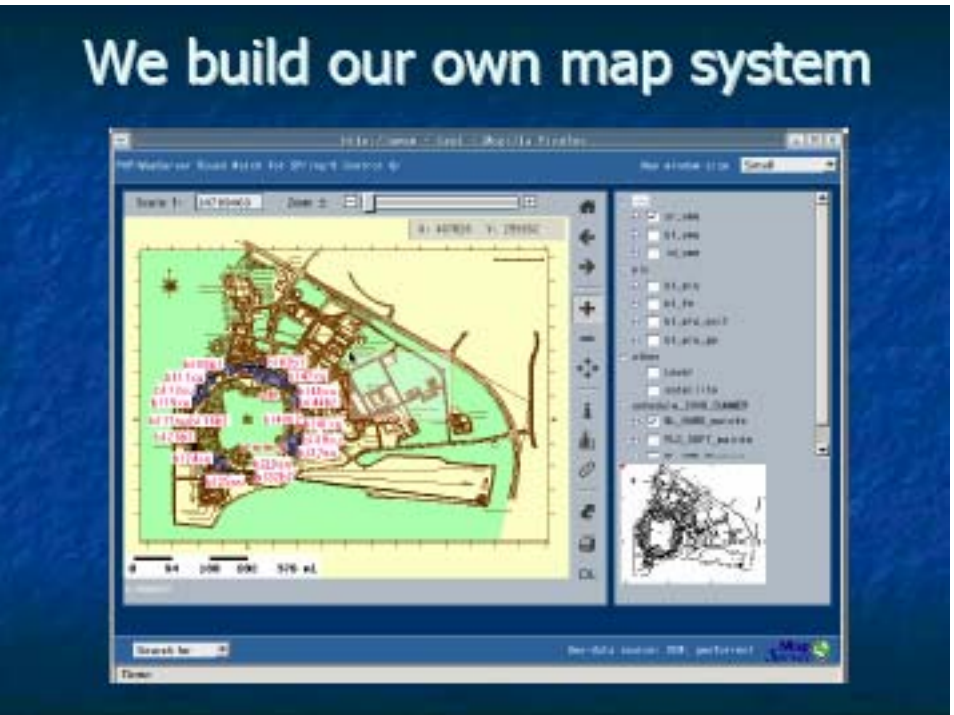
Applications of Interest: A Relational Database Approach to Managing Control System Software Applications

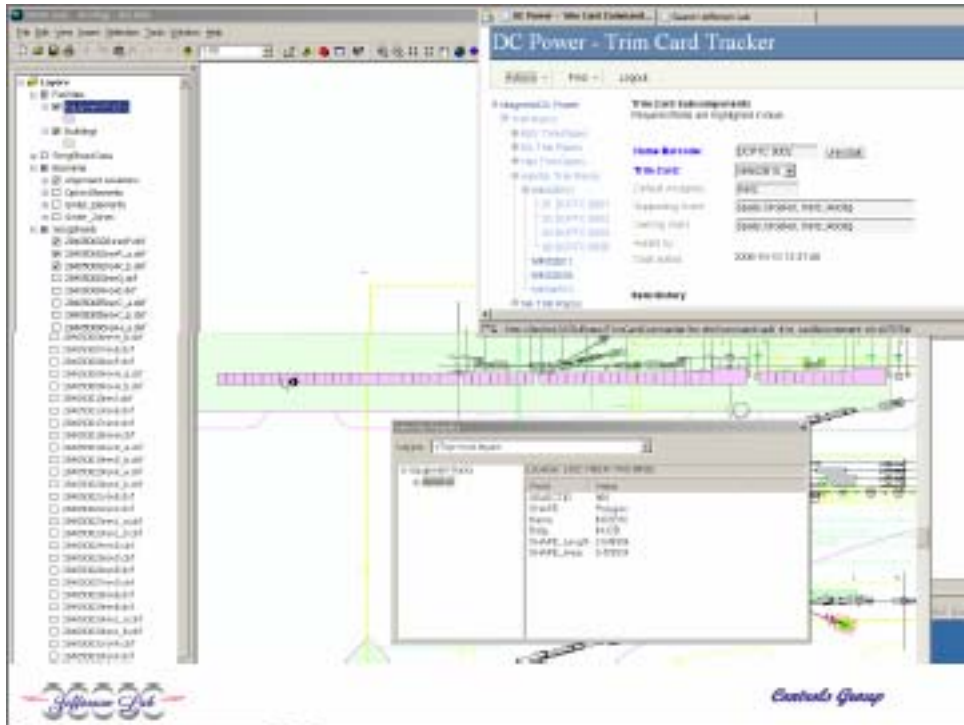
• a database that manages all the different components of a control function: source code, configuration file, display, ..

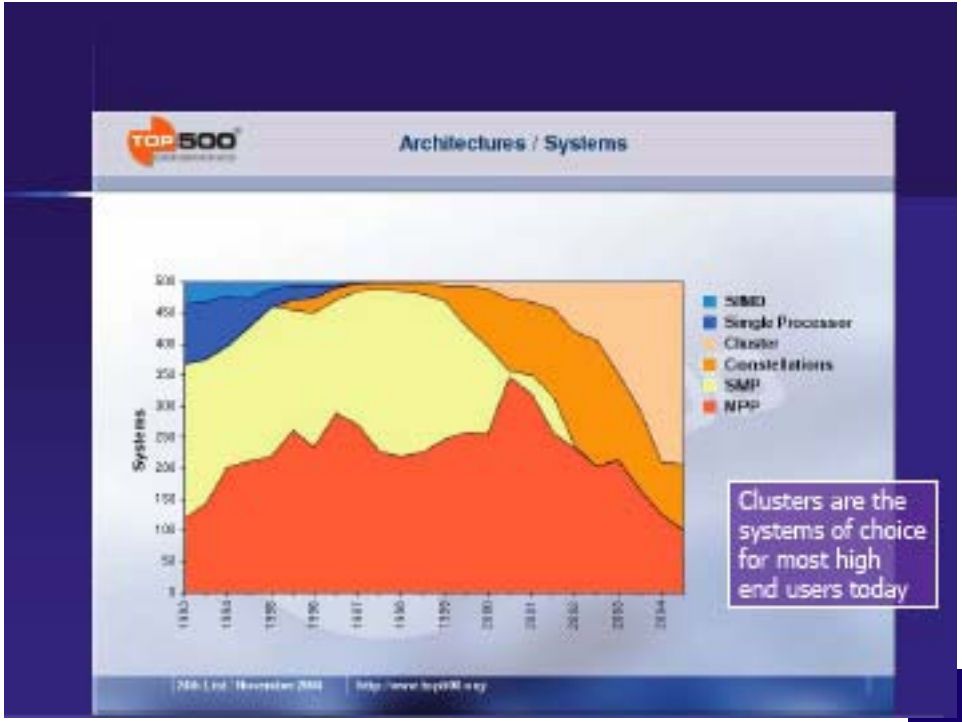


GIS

- use of Geographic Information System to represent an accelerator and easily locate control system components







Supercomputing research at Jefferson Lab

- PC clusters are now leading the world of high power computing
- technologies they use (multi-core CPU, Infiniband) will have an impact on controls too

Application of HPC Technology to Accelerator Controls

- Infiniband fabrics vastly outperform ethernet
  - One tenth latency, 10x bandwidth
  - Creates potential for moving many calculations from real time front end (difficult environment) to Linux hosts
- Cost is still a constraint
  - GigE is "free"
  - Infiniband is ~$600 / node (less for small systems)

  BUT
  - Cost is falling, and could become nearly free as chips get integrated onto motherboards

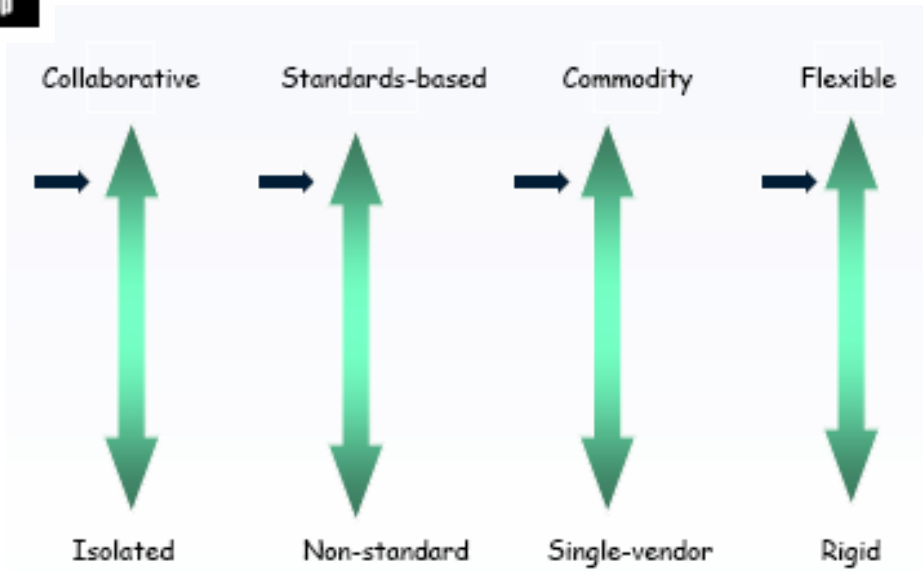
PC 104 Plans at CEBAF

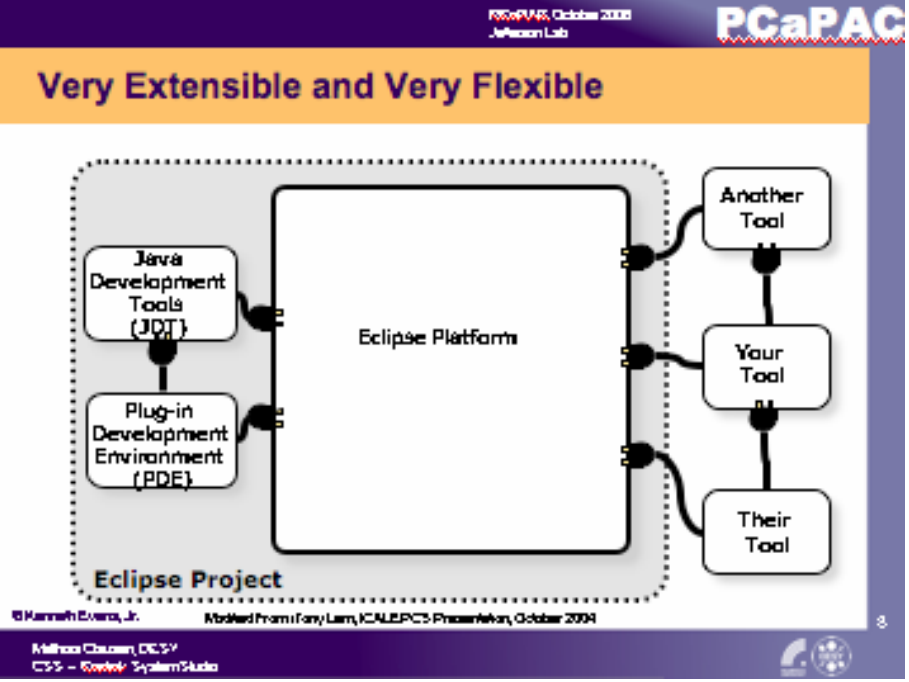
- Implemented as a daughter board
  - Gives digital designers great flexibility
  - Requires only ISA (or PCI for PC 104+) connector
- Interface to fast data acquisition diagnostic system
  - 1-10 Mhz ADC
  - Clean integration into development tools and processes
- Pending success, a prototype for new digital RF system

Status of the CEBAF control system at JLAB

the road to the new (optimum) control system:

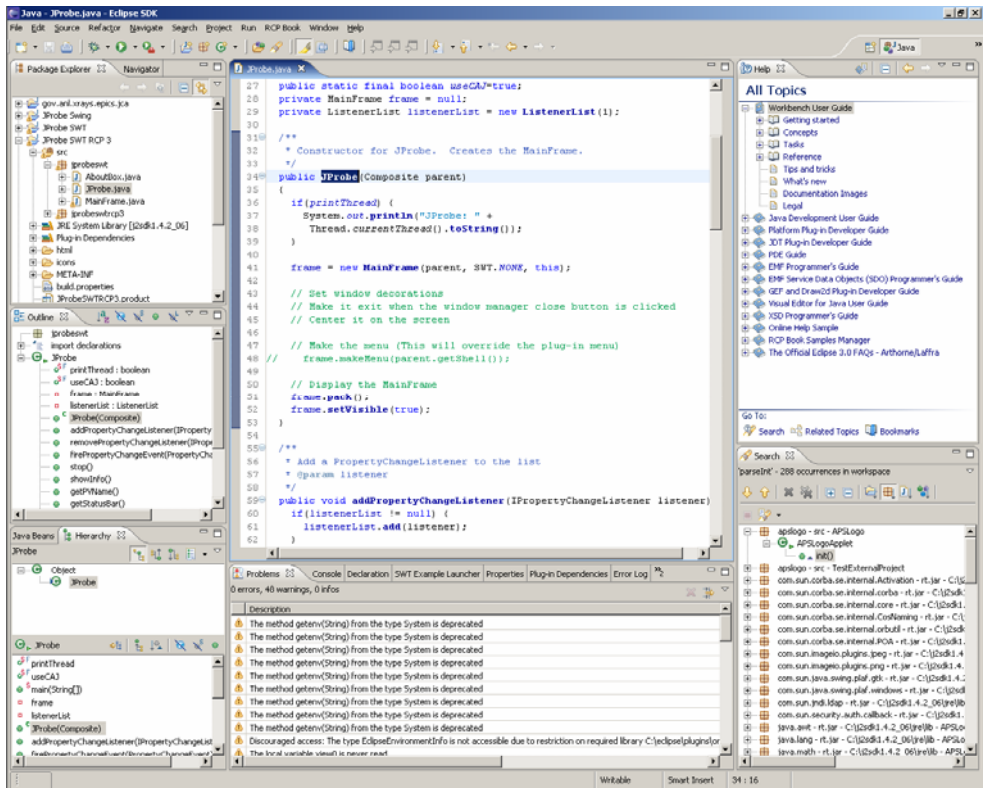
- PC104+VME as Front End
- Sun+Linux as Middle Layer
- Linux+big $cren as Back End





Control system studio

- very complete and flexible environment for GUI development



Living on the Web