Commissioning of the New Control System for the PETRA3 Accelerator Complex at DESY

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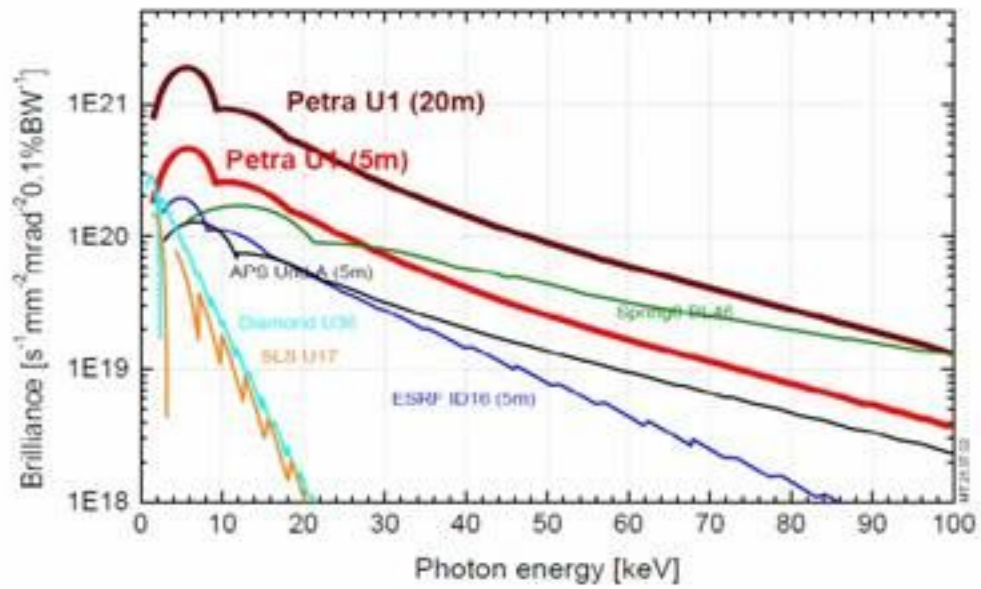
PETRA 3 Light Source

- High-brilliance 3rd-generation light source
- Storage ring: E = 6 GeV, I = 100 mA, $\varepsilon_{transverse}$ = 1 mm mrad
- 14 undulator beam lines operated by HASYLAB, EMBL and GKSS
- Fully remodelled and upgraded between summer 2007 and spring 2009
- First positron beam: April 13th 2009
- First x-ray beam: July 17th 2009
- Start of user beam operation: January 2010



Outline

- Control System Task
  - Basic Design Decisions
  - Collaborative Responsibilities
  - Control System Statistics
  - Project Management Details

- Specific Controls Items
  - The TINE Software Suite
  - Beam-Position System Integration
  - TINE General Purpose Applications
  - Web2c Light-Weight Internet Applications
  - Console Application Manager

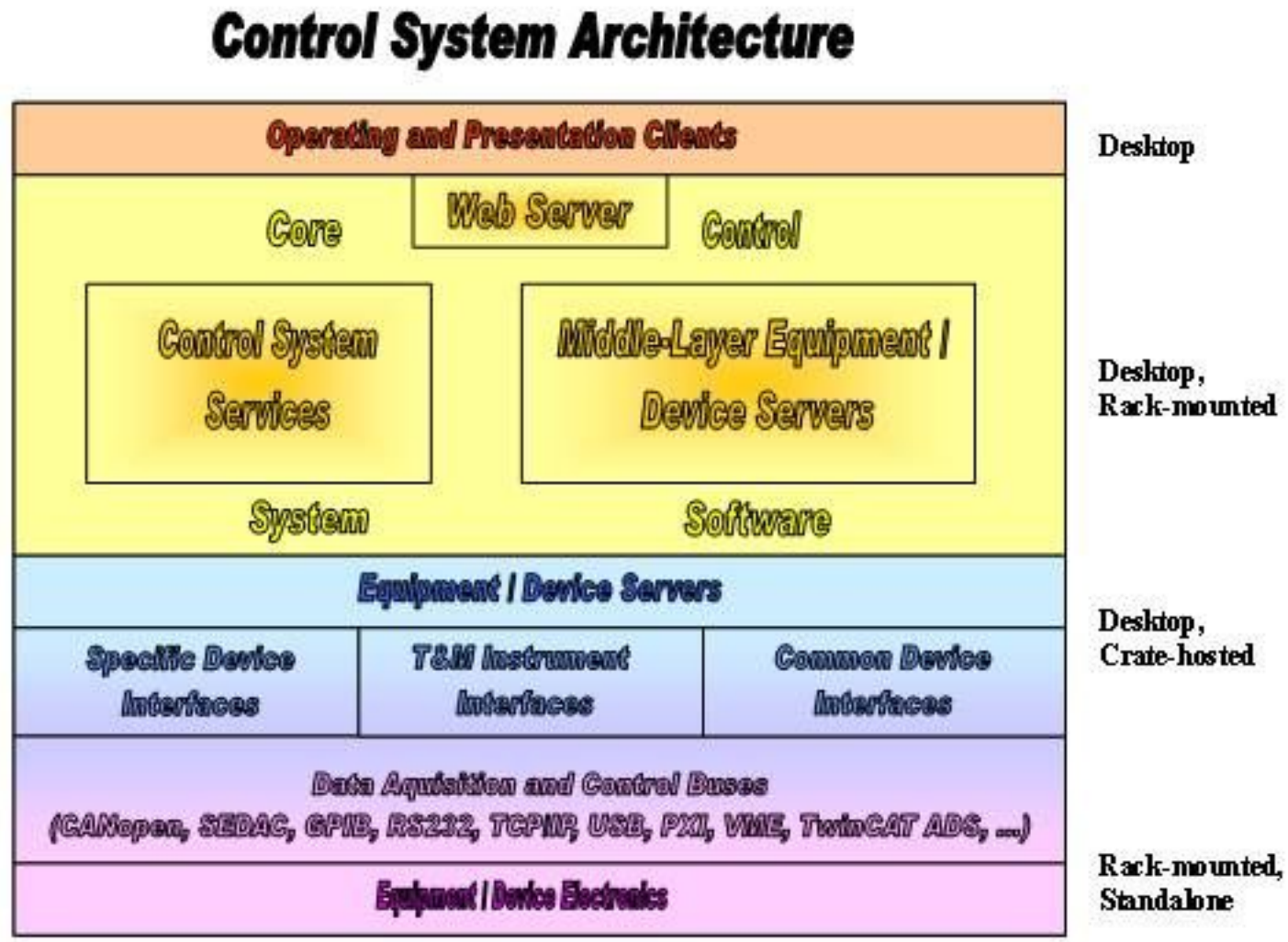
Basic Design Decisions

- Radical revision of the outdated control systems of PETRA and the electron/positron pre-accelerators LINAC 2 and DESY 2
  - Application software (→ Java, C/C++, MATLAB, LabVIEW)
  - Core control system software (→ TINE)
  - Data acquisition systems (→ PXI)
  - Equipment electronics (→ CAN, Ethernet, TwinCAT)
  - Network (→ TCP/IP)
  - Computing infrastructure (→ Windows, Linux)

Java, MATLAB, LabVIEW, HTML / JavaScript

Java, C/C++, VisualBasic

C/C++, Java, VisualBasic, LabView



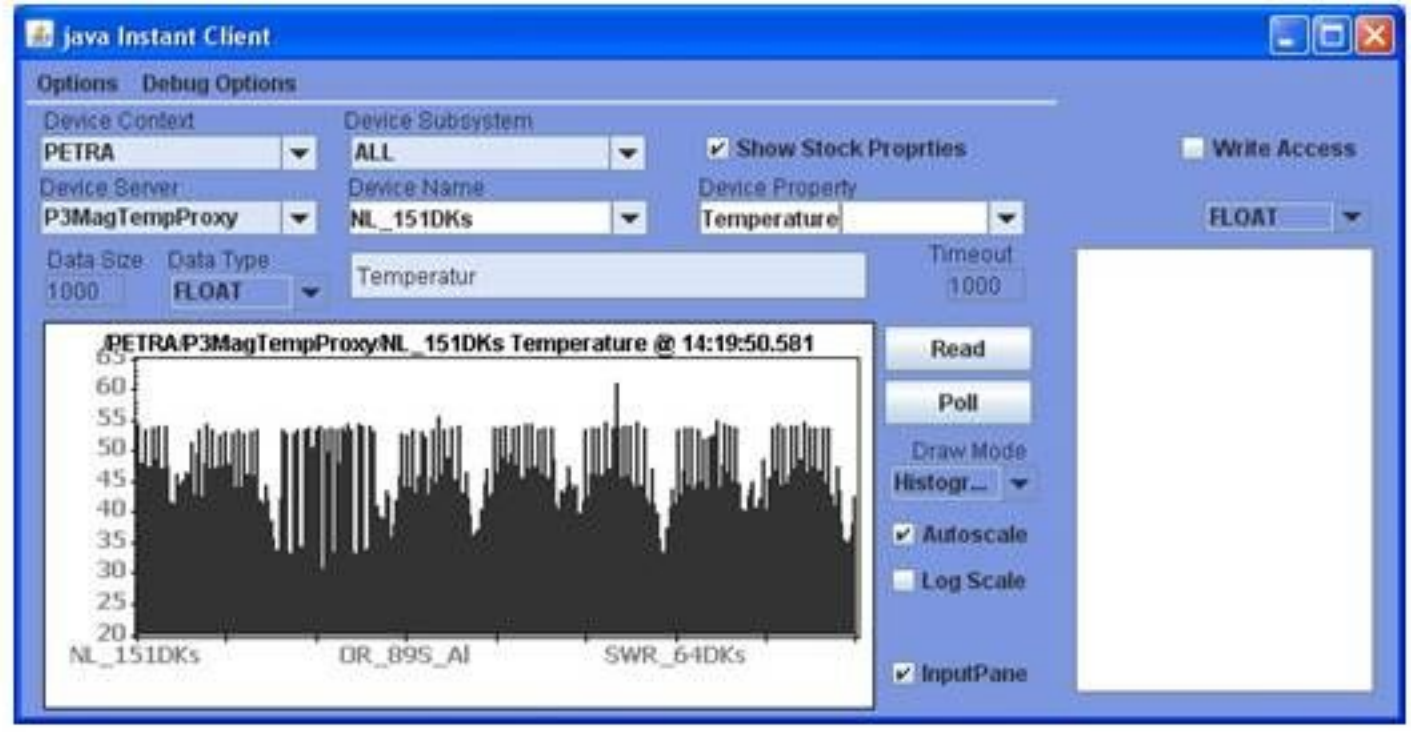
Collaborative Responsibilities

- **Tasks have been partially handled jointly by**
  - Accelerator controls group:
    - Control room, middle-layer and equipment server applications
    - Core control system software and associated services
    - Computing infrastructure and developer tools
  - Technical equipment groups:
    - Equipment server applications
  - Accelerator physics group:
    - High-level beam physics applications
    - Off-line analysis tools

- *Not covered:* **Beamline equipment and experiment control**

Control System Statistics

- Applications:
  - Client: > 200
  - Server: > 100
- Nodes:
  - Network: > 300
  - Fieldbus: O(10^3)
- TINE control points: O(10^5)



- Allocated man-power (2005 – 2009): ≈ 100 man-years
- Investment cost (2005 – 2009): ≈ 1 M€

Project Management Details

- Work breakdown structure:
  - mid-sized tasks, resource-loaded
  - continuously refined and updated
- Meetings:
  - weekly team meetings
  - quarterly individual meetings with each team member
    - to assign / reassign tasks
    - to iterate / review tasks
  - problem-oriented team meetings
  - customer meetings ("wish lists")
- Standardized, semi-automated work processes ("best-practice"):
  - application build & deployment
  - code generation
  - interfacing equipment electronics

TINE Software Suite

- **Threefold Integrated Network Environment (TINE):** → **THP034**
  - **Release:** 4.1 available from http://tine.desy.de
  - **Multi-platform:** runs on Win32/64, 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
- **Kernel:** in C and Java
- **API / Bindings:** provided for Java, VisualBasic, C/C++, LabView, Agilent(HP)Vee, MATLAB, Python, .NET and command line interface for scripting
- **Name service:** with plug-and-play automated server registration and user access control
- **Integrated central services:** data filtering and archiving, event handling, alarm filtering and archiving, central message processing and archiving
- **Connectivity to other control systems:** embedded in DOOCS and EPICS, gateway to TANGO
- **Integrated video capability:** scheduled transmission in multicast mode → **MOD003**

Beam-Position System Integration

- Large-scale distributed system
  - 228 Libera Brilliance BPM modules (Instrumentation Technologies, Slovenia),
  - real internet appliances, communication through the generic Libera Control System Programming Interface (CSPI)
  - n – to – 1 client – server controls topology, all BPM modules are supervised by **1** heavily multi-threaded gateway middle-layer server
  - specific procedures established for remote software installing / updating, restarting and rebooting

→ **WEP073**

TINE General Purpose Applications

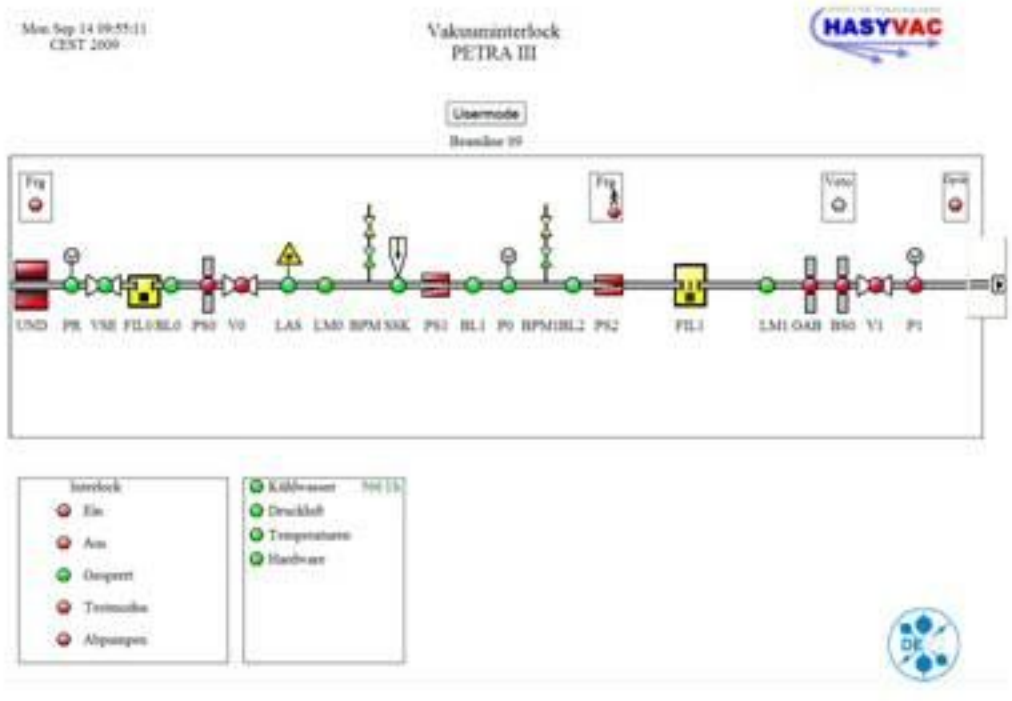
- "Rich-client" Java client applications for the central control system services
  - Archive Viewer, Event Archive Viewer, Multi-Channel Analyzer, Transient Recorder Viewer
  - Alarm Viewer
  - Scope Trace Viewer
  - Operation History Viewer
  - Viewers for configuration management and remote control
- Implemented by Cosylab, Slovenia

→ **TUP034**

Web2c Light-Weight Internet Applications

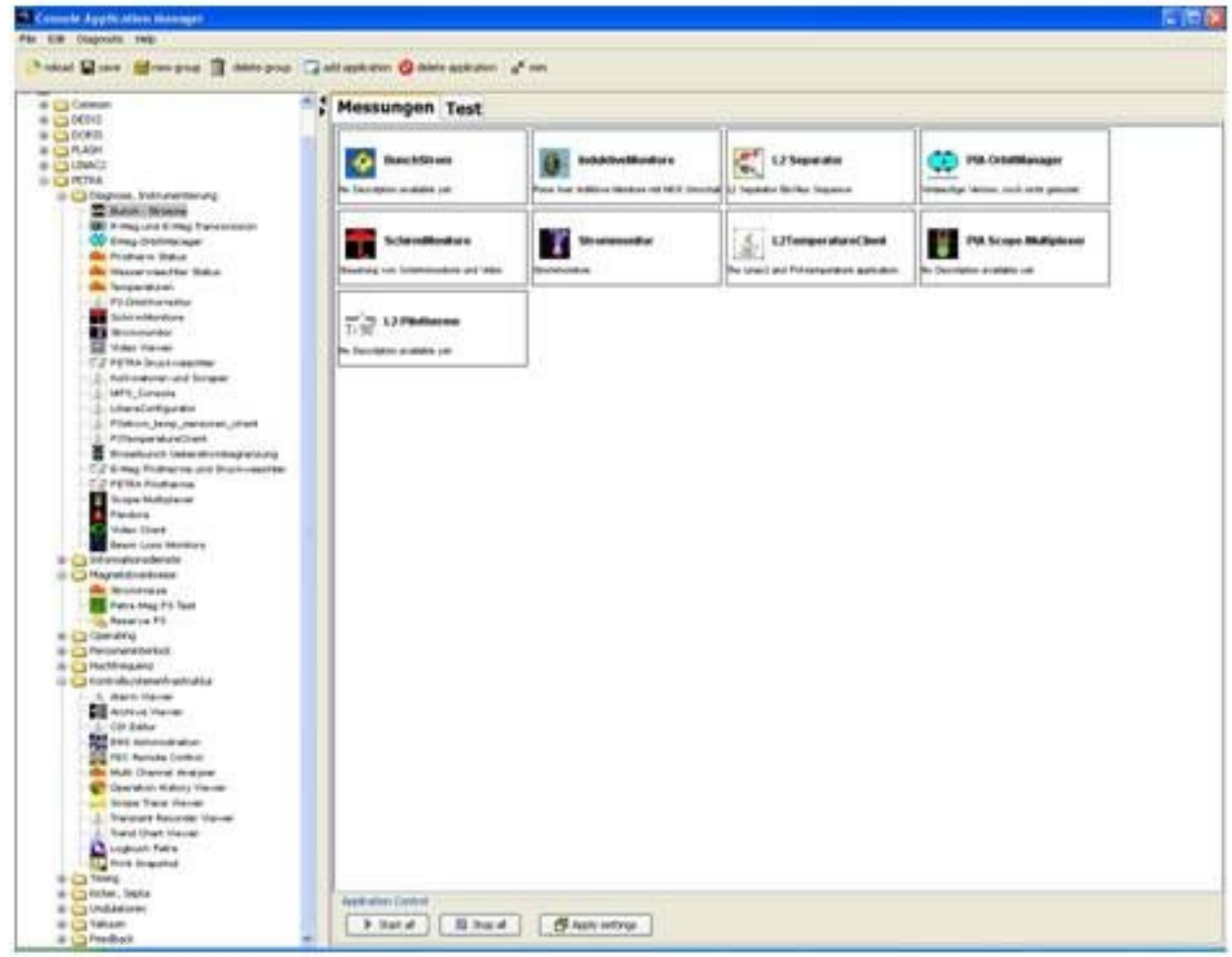
- **Web2cToolkit:**
  - Framework for internet control system applications
    - Connectors for all major control systems (TINE, DOOCS, EPICS, TANGO)
    - Connectors for video streams (RTP/JPEG, TINE embedded video/JPEG)

    → **THP110**
  - Customer-specific, browser-hosted, interactive and graphical clients:
    - Synoptic display viewer (**Web2c**)
    - Graphical synoptic display editor (**Web2cEditor**)
    - Archive viewer (**Web2cArchiveViewer**)



Console Application Manager

- JMX-based management tool with additional support for non-Java applications
  - configurable launching pad for operator's applications
  - combines applications to task-specific groups
  - automates starting and stopping of grouped or single applications
  - re-applies screen attributes of applications (size and position)
  - preserves operator's preferences



→ TUP018