Beamline Control and Data Acquisition

Elder Matias on behalf of CLS
Beamline Expansions

1964

2007

Future
Challenges We Face?

- Accomplish more with same people
  - Fiscal Reality (flat-line budgets)
  - Increasing Number of Beamlines
  - More sophisticated/demanding beamline
  - More complex experiments

- Improved Quality
  - Human Factors
  - Reliability and Availability
  - Stronger Focus on Scientific Results (Papers, HQI, benefit to society)

- Obsolescence
Where we need to go

• More effectively leveraging what we are doing across our beamlines
• Making the facility more accessible across the entire experiment life cycle
• Driving I&C Innovation into the beamlines in a strategic way
• Human Factors
Human Factors

- Continue to move from device based to task based GUIs
- Increased layers of abstraction
- Priority has been tailoring GUI applications to specific beamlines, we now need to look at a common look and feel across the facility
We Changed the Question...

Software User Friendliness
(Good or Excellent Rating by Users)

Drop corresponds to the teething pains of new systems....
Overview of User Cases

User System
- Submit Proposal
- Setup Experiment
- Perform Scan
- Visualise Data
- Analyze Data
- Share Results & Collaborate

Autonomous System
- Safety
- Machine Protection
- Archiving
- Fault Monitoring
- Save Restore

Beamline Back-end Systems
- Setup Beamline
- Manage Proposal
- Respond to Upsets

User «uses» Beamline Scientist «uses» Floor Co-ordinator «uses»
• Conventional technology is VME (320 MB/s) or Compact PCI (528 MB/s)
• Working with Instrumentation Technology on μTCA (5 GB/s) beamline data acquisition solution
• Kontron AM4020 Intel Core i7
<table>
<thead>
<tr>
<th>Beamline</th>
<th>Machine Protection</th>
<th>Motion Control</th>
<th>Beamline Display</th>
<th>Experiment Control</th>
<th>Experiment User Interface</th>
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<tbody>
<tr>
<td>Brockhouse (x2)</td>
<td>Momentum</td>
<td>Prodigy MaxV Newport XPS</td>
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<td>CLS Scan Lib</td>
<td>ScienceStudio Spec Others TBD</td>
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Our Tradition Architecture using:

- Data Acquisition Library
- Interpretative
- EPICS-QT Library
- C++ & Some Python

Built Technique

Specific Applications using these libraries
Current Software Stack (Conventional)

**OPI**
- Data Acquisition Manager Libraries
- IDAV, IDA, nDMapper, etc.
- EPICS Qt
- Scan Lib
- EDM
- Qt
- EPICS Connect
- CA Connect

**IOC**
- IOC Control
- Gateway Services
- Drivers (Detector,)
- IOC Control
- Devices
- Devices on Accel
- Network and Directory Services
• Developed in collaboration with partners at CLS, UWO, IBM, LNLS and ALS.
• Web 2.0
• Uses:
  – REST & MQ.
  – CAS
  – HPC
  – Steams
**Current Software Stack**

**ScienceStudio**

**User Client**
- Web browser

**Server**
- Science Studio Core
- REST Interface to Underlying Services
- JDBC
- mySQL
- Spring

**Beamline Remote Access Security Layer**
- CA Connect

**IOC**
- IOC Control
- Gateway Services
- Drivers
- IOC Control
- Devices
- Devices on Accel
- Network and Directory Services
Acquaman
David Chevrier, Mark Boots, Darren Hunter

- Integrated Experiment & Visualisation Platform
- Qt/C++ based
- Experiment focused
## Current Software Stack (Acquaman)

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<thead>
<tr>
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<th>AM Scan</th>
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<tbody>
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<td>Workflow</td>
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<td>Qt</td>
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### IOC

- CA Connect
- IOC Control
- Drivers
- Devices
How we move forward.....

• Need to effectively bring together out various system to provide a cohesive path forward.
• Reduce duplication by better leveraging our limited resources

Some potential thoughts......
Some potential options?

Portal/Remote Platform
- SS Portal
- SS Remote Control

Conventional Data Acquisition
- Acquaman
- IDAV, IDA, nDMapper, etc.
- Data Acquisition Manager Libraries

Post EDM
- pyEDM/QT

Meta Data
CDMA?
Thank you.... Questions?
Where We Are?

Mixed Environment:

• All beamlines are EPICS Based
• Most beamlines have QT based (IDA, IDAV, nDMapper, etc.)
• User Centric GUI (Acquaman)
• ScienceStudio based Remote Control

We need to find better ways of leveraging what we have done across the facility.
Science Studio

- Web based Remote Beamline Control
- Partners: CLS, UWO, IBM
- Recent development
  - added integration for grid analysis
  - ability to have projects shared across multiple sites
  - Integration with grid computing

Download/Contribute at:
http://sciencestudio.ca/
http://sciencestudioproject.com/
http://sourceforge.net/projects/sciencestudio/
High-level Data Model

Terminology
• Facility = CLS
• Laboratory = Beamline
• Instrument = Endstation
• Project = Proposal

Technology:
• SOA based with integration using REST
• mySQL based database

Goal:
• Provide a mechanism to streamline work processes across the experiment life-cycle and manage
• With the facility table, this provides the ability to have projects span multiple sites
User Experiment Lifecycle

New user office System (from SS)

- Propose
- Plan
- Setup
- Experiment
- Analyse
- Publish

SS (Peakaboo, Foxmas) + many others

ScanLib, Acquaman. SS Remote + others
Some Possibilities ....

- Network and Directory Services
- Machine Protection
- Modbus
- IOC Services
- Gateway Services
- Area Detector
- Drivers (Detector, EPICS Connect)
- EPICS Qt
- EPICS PyQt
- CA Connect
- IOC Control
- Devices
- QuickScan
- BL GUI
- PyEDM
- EPICS Connect
- AM - GUI
- AM - Technique
- AM - Scan
- MPIlot
- Data Man
- CDMA
- Meta Data relational database
- mySQL
- CSS BEAST
- Portal