A Java-based EPICS Archive Viewer with SOAP Interface for Data Retrieval

Kazuro Furukawa, Masanori Satoh,
Igor Mejuev, Keisuke Nakao
Electron/Positron Linac at KEK
<URL:http://www-linac.kek.jp/>
In advanced physics experiment systems like a large particle accelerators, it is important that physicists can easily analyze device behavior based on archived data to achieve an optimal result of the experiment. Standard network and software technologies such as Web, XML, Java, etc would be employed to enable a wider range of environment for analysis tools. To this end a Java tool for displaying EPICS ChannelArchiver has been developed for the KEKB injector linac. The EPICS Archive Viewer is implemented as a pure Java code which utilizes a high-quality commercial software package for charting (JClass Chart). The viewer retrieves archive data by interfacing with an extensible set of "archive data providers". Current implementation includes providers for SOAP and CGI protocols and also allows support for custom, "in-house" archive data providers (e.g. a provider that relies on CORBA/IIOP). The server-side of SOAP archive data provider is represented by a backend service object deployed within the AXIS/Tomcat container. The implementation of all viewer modules is highly portable and offers a potential for data sharing among organizations via the emerging Web Services standards.
Introduction

- Experiment Efficiency for B-Factory
  KEKB Electron Positron Asymmetric Collider
  \( \Rightarrow \) Stable Operation of Linac
  Further Improvement
  with 2-bunch and/or Continuous Injection

- Analysis of Archived Data
  Very Important But...
  There are Several Different Archives, Viewers
  Designed to be Optimal for Specific Needs
  Management is a Nightmare

- EPICS Archiver Introduction
  EPICS Gateway from Linac Controls to Channel Access
  There are Several Different Tools Available
Web Services

- **Need for Data Exchange (Archive Viewing) over Firewalls**
  - http, XML (and Java) are Preferable over Internet
  - Well-defined by Sun and others
    - Java Community Process, Java Web Services Developer Pack
  - Sun releases Reference Implementation JAX-RPC RI
  - Multi-Platform (including Microsoft) and Multi-Language

- **Open Source Implementation**
  - AXIS of Apache Software Foundation
  - Freely Distributed
  - Actively being Developed
  - Employed by Several Vendor Implementations
Viewer Implementation

- Pure Java Application
  Can be Executed as Applet in a Browser with Java Plug-in

- User Interface Implemented with Java Swing

- Need for Good Plotting Package
  Chose Commercial Component JClass JChart
  Has Many Features for our Needs
  One License Covers any Number of Clients

- Can Connect to Different Archive Data Providers
  SOAP Data Provider
  CGI Data Provider (EPICS Archiver CGI)
  Using Class name and Location (URL) as Parameters
Server Implementation

- **Apache Server and CGI/Perl (CGI Provider)**
  CGI Script Utilizes CASI/Perl
to call libIO to access Archived Data

- **SOAP Server (SOAP Provider)**
  Apache AXIS/Tomcat and Java
  Server-side Component Utilizes JNI Wrapper
  for libIO to access Archived Data

- **Other Provider**
  Can be Implemented
  Accepting Class Name and URL
  Such as CORBA/IIOP Provider...
Archiver Implementation

- **EPICS Channel Archiver Engine**
  As Distributed in EPICS

- **Channel Access (CA) Server**
  Built with EPICS 3.14 iocsh
  Old CA Server was Built with EPICS 3.12 PCAS
  Much Easier with iocsh
  Implemented Device Supports to Access Linac Control Data via RPC/Cache Mechanism

- More Data will be Added
  Channel Names are Modified to Accomodate both New and Old CA Servers

Java-based Archive Viewer over SOAP

Outline

EPICS Archive Viewer

- `kek.archiver.ViewerTableModel`
- `kek.archiver.DataProvider`

CGIDataProvider

SOAPDataProvider

CGI GET

SOAP POST

Web Server

- `libIO.pl`
- `CASI for Perl`

ChannelArchiver libIO

EPICS archives

Tomcat/AXIS

- `SOAPProviderServer`
- `LibIOWrapper (JNI)`

SOAP Request

Easy to Debug with ASCII Messages

```
POST /axis/services/EPICSArchiveService HTTP/1.0
Content-Type: text/xml; charset=utf-8
Accept: application/soap+xml, application/dime, multipart/related, text/*
User-Agent: Axis/1.1beta
Host: acacia.linac.kek.jp
Cache-Control: no-cache
Pragma: no-cache
SOAPAction: ""
Content-Length: 904

<?xml version="1.0" encoding="UTF-8"?>
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:xsd="http://www.w3.org/2001/XMLSchema"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <soapenv:Body>
    <ns1:getData soapenv:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
        xmlns:ns1="http://www.linac.kek.jp/SOAPProvider3Server/"/>
    <arg0 xsi:type="xsd:string">furukawa/furukawa test</arg0>
    <arg1 xsi:type="xsd:string"></arg1>
    <arg2 xsi:type="xsd:dateTime">2002-03-26T08:05:00.000Z</arg2>
    <arg3 xsi:type="xsd:dateTime">2002-03-26T08:10:00.000Z</arg3>
    <arg4 href="#id0"/>
  </ns1:getData>
  <multiRef id="id0" soapenc:root="0"
    soapenv:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
    xsi:type="ns2:Vector"
    xmlns:soapenc="http://schemas.xmlsoap.org/soap/encoding/"
    xmlns:ns2="http://xml.apache.org/xml-soap"/>
</soapenv:Body>
</soapenv:Envelope>
```
<soapenv:Envelope
    xmlns:soapenv=http://schemas.xmlsoap.org/soap/envelope/
    xmlns:xsd=http://www.w3.org/2001/XMLSchema
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <soapenv:Body>
    <ns1:getDataResponse
        soapenv:encodingStyle=http://schemas.xmlsoap.org/soap/encoding/
        xmlns:ns1="http://www.linac.kek.jp/SOAPProviderServer/">
      <GetDataReturn xmlns:soapenc="http://schemas.xmlsoap.org/soap/encoding/">
        <item href="#id1"/>
      </GetDataReturn>
    </ns1:getDataResponse>
    <multikef id="id1" soapenc:root="1">
      <name xsi:type="xsd:string">furukawa:jane</name>
    </multikef>
    <y data xsi:type="soapenc:Array" soapenc:arrayType="xsd:double[300]">
      <item>7.6112</item>
    </y data>
    <x time xsi:type="soapenc:Array" soapenc:arrayType="xsd:double[300]">
      <item>1.01712990099506E12</item>
    </x time>
  </soapenv:Body>
</soapenv:Envelope>
Linac Control System

- X-Window Interface for Operation
- Touch Panel Interface
- MS-Windows Interface
- EPICS Gateway to KEKB-Ring

Central Network (FDDI, Ethernet)

- Main Computer Systems (Unix)
  - Multi-Layer Server Software

Equipment Level Network (Optical Ethernet)

- VMEs (~30): Beam Monitor Timing etc.
- PLCs (~150): RF Magnet Vacuum
- CAMACs (~15): Timing
- VXIs (~30): RF Monitor
- PC / GPIB / RS232C

- Red Box is the Gateway from Linac to EPICS
  This time EPICS 3.14 iocsh was employed

Many Different Plot Attributes can be Modified in the Viewer Tool
Several Mouse Controls are Available like Zooming...
Alternative Scenarios

How to Support Realtime Updates

- Linac Change Monitor
- EPICS Archives
- EPICS libIO
- Archive Engine (Java Application)
- UDP
- JNI
- channels
- CGI/CASI script
- UI clients, Java applets or applications
- Linac libraries ~control/lib
Alternative Scenarios

- How to Support Realtime Updates

Diagram:

- UI clients, Java applications
- IP multicast group(s)
- CGI/CASI script
- EPICS libIO
- Notification Server (native executable)
- Archive Engine (native executable, C++)
- EPICS libIO
- EPICS Archives
- Linac Change Monitor
- Linac Libraries -control/lib
- UDP socket
- UDP socket

Conclusion

- System Works as Expected
  Channel Access Server, Archiver Engine, SOAP-based Archive Server, CGI-based Server, SOAP-based Archive Viewer, CGI-based Viewer
  Combination works
  Expect to be Useful in Accelerator Operation

- Performance Comparison
  Transferred Data is Twice Larger in SOAP
  and Slightly Slower

- May Pass through Firewalls
  Need more Configuration

- May Run on Wider Environment
  Java, http, is Helpful
Thank you ...