DEVELOPMENT OF A DATA ACQUISITION WEB SERVICE FOR ACNET CONTROL SYSTEM

PARTI student meeting
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ACNET is a uniform control system at Fermilab

- Experiments use site-wide network of devices, each representing a single measurement point or a control item
- Middle layer servers collect data from frontends and provide it to application level
- Operators and engineers use applications for managing data and system control

Applications

Graphical (mainly Java-based)

Console (old)

Middle Layer (central services for data acquisition)

Data acquisition frontends (~200,000 devices)
PROBLEMS

- ACNET was designed many years ago and was not supposed to provide data outside of the controls’ network.

- Current data acquisition system uses RMI (remote method invocation) technology, which is too complex and heavy-weight for the system in its current state.

- There’s a need in more simple way of reading data from the control system.

Scheme: Java RMI Overview
MAIN PROJECT REQUIREMENTS

◆ In order to make system more light-weight, universal and flexible decision was made to use an HTTP-based request-response text protocol.

◆ The data acquisition from the site-located devices remains RMI-based while outer world will obtain data by text-based protocol.

◆ HTTP responses are available in different formats (e.g. plain-text, XML, Javascript) allowing data to be easily accessible on all major software platforms.

◆ Hardware is resource-limited, while every request can query hundreds of devices, thus caching system was introduced.

◆ Since client could be both human and program, data queries may be encapsulated into easily readable RESTful URL.
CURRENT CONTROLS INFRASTRUCTURE

DAE

Data Pool
(frontends’ façade + consolidation)

Applications

RMI

Frontend
(VxWorks or Linux)

Frontend
(VxWorks or Linux)

Frontend
(VxWorks or Linux)

Frontend
(VxWorks or Linux)

~120 DAE

Acnet
(RETDAT + Get32)
CURRENT CONTROLS INFRASTRUCTURE

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Applications

GetDAQ

Frontend
(VxWorks or Linux)

Acnet
(RETDAT + Get32)

Frontend
(VxWorks or Linux)

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(VxWorks or Linux)

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(VxWorks or Linux)

~120 DAE
GETDAQ APPLICATION ARCHITECTURE

Client Application

Servlet

Marshaller (formats DAQ reply)

DAE (Data Acquisition Engine)

Cache Manager

Parser

Cache Cleaner

HTTP

HTTP

Text

Text

Parser

Cache Entry

Cache Entry

Cache Entry

Servlet

RMI

RMI

binary Java object

binary Java object

 binary Java object
CACHING SYSTEM OVERVIEW

Device
a separate measurement point or control item

Cache Entry
roughly, it represents a DAQ job - separate thread, which obtains needed data

Request containing devices not present in cache leads to creation of a new DAQ job, right after request data from newly created job is usually unavailable.

r:pelcdc.raw
m:outhum
g:tlgm04.reading[0:5]
m:outtmp

Cache Cleaner
removes unnecessary cache entries

Cache Manager
creates new cache entries and starts data acquisition; returns requested data
* Parameters could be tuned through application settings
Marshaller can transform DAQ replies to 4 different formats: XML, HTML (human-readable), plaintext CSV, JSON (Javascript).

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DETAILS

Marshaller can transform DAQ replies to 4 different formats: XML, HTML (human-readable), plaintext CSV, JSON (Javascript).

Cache Cleaner removes DAQ jobs which are not requested during 5 minutes*

* Parameters could be tuned through application settings
Cache Manager exists only in one instance and makes all connections to DAE in a thread-safe manner; hence simultaneous requests will never result in two same parallel DAQ jobs started. Maximum number of simultaneous DAQ jobs is 64*.

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DETAILS

Cache Manager exists only in one instance and makes all connections to DAE in a thread-safe manner; hence simultaneous requests will never result in two same parallel DAQ jobs started. Maximum number of simultaneous DAQ jobs is 64*.

Cache Entry holds an internal array of requested devices and updates data only when it becomes available. Every entry corresponds to one DAQ job. Maximum amount of requested devices can be as large as 128*.

Marshaller can transform DAQ replies to 4 different formats: XML, HTML (human-readable), plaintext CSV, JSON (Javascript).

Cache Cleaner removes DAQ jobs which are not requested during 5 minutes*.

* Parameters could be tuned through application settings.
EXAMPLES

Write your request here (newlines will be trimmed):

m:outtmp
m:outhum
r:pelcdc.raw;g:tlgm04.reading[0:5]

- Brackets-Separated (otherwise semicolon-separated)
- ISO-time
- Quiet
- Include DRF2 request

Type: XML HTML PlainText JSON

Submit

Data-Set
Time: 2011-08-24T08:49:46.807-0500

<table>
<thead>
<tr>
<th>Time</th>
<th>Request</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-08-24T08:49:46.350-0500</td>
<td>m:outtmp</td>
<td>74.68154982924463</td>
<td>DegF</td>
</tr>
<tr>
<td>2011-08-24T08:49:46.350-0500</td>
<td>m:outhum</td>
<td>67.49154262678167</td>
<td>%RH</td>
</tr>
<tr>
<td>2011-08-24T08:49:46.639-0500</td>
<td>r:pelcdc.raw</td>
<td>192</td>
<td></td>
</tr>
<tr>
<td>2011-08-24T08:49:46.650-0500</td>
<td>g:tlgm04.reading[0:5]</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>26957.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>26990.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>28482.0</td>
<td></td>
</tr>
</tbody>
</table>

Done
EXAMPLES

Write your request here (newlines will be trimmed):
m:outtmp
m:outhum
r:pelcdc.raw;g:tlgm04.reading[0:5]

Brackets-Separated (otherwise semicolon-separated)

ISO-time

Quiet

Include DRF2 request

Type: XML HTML PlainText JSON

Submit

Done

http://www-bd.fnal.gov - Mozilla Firefox

unit="DegF"></reply>
+ <reply ref_id="m:outhum" time="2011-08-24T08:51:12.381-0500" type="DoubleSample" unit="%RH"></reply>
+ <reply ref_id="r:pelcdc.raw" time="2011-08-24T08:51:12.669-0500" type="IntegerSample"></reply>
- <reply ref_id="g:tlgm04.reading[0:5]" time="2011-08-24T08:51:13.150-0500" type="DoubleArraySample" unit=""/>
  <request canonical="g:tlgm04.READING[0:5]" device="g:tlgm04" event="U"
    field="SCALED" property="READING" range="[0:5]"/>
  <array size="6">
    <value>4.0</value>
    <value>3.0</value>
    <value>9.0</value>
    <value>26957.0</value>
    <value>26990.0</value>
    <value>28482.0</value>
  </array>
</reply>
</data-set>

Done
EXAMPLES
A web service allowing one to read site-located devices from outside world is up and running on existing infrastructure.

All code is integrated into current control system as well and is available in CVS.

Data could be obtained through an HTTP protocol either by using a RESTful URL or by using a POST request for large sets of data.

Data is available in XML, plaintext and JSON formats for major software platforms and in HTML form for human-readable representation.

Caching system was introduced for mapping of DAQ jobs and to prevent excessive load on DAE servers.

Users may use different parameters to choose the representation format of requested data.
QUESTIONS

Link: http://www-bd.fnal.gov/getdaq