Best Ever Alarm System Toolkit

Kay Kasemir,
Xihui Chen,
Katia Danilova,
SNS/ORNL

kasemirk@ornl.gov
Epics Meeting 2010 Fall
Alarm System Components

This talk: Alarm System Technology

See also:


"SNS Alarms Philosophy” (Printout available)

Alarm Rationalization: Practical Experience Rationalizing Alarm Configuration for an Accelerator SubSystem, Xiaosong Geng, etc.,
http://info.ornl.gov/sites/publications/files/Pub22522.PDF
Previous Attempts at SNS, Inspiration

EPICS “ALH”, Generated soft-IOCs and EDM screens

- Old technology
- Static UI layout
- N clicks to see (some of the) active alarms
- Configuration changes were hard (so config. was left in bad shape)

DESY Alarm System

Matthias Clausen, “Alarm Management System”, PCaPAC, Oct 2008, Slovenia and “Managing Alarms … the CSS Way”, this conference

✓ Modern technology, linked into Control System Studio
- Different infrastructure: LDAP vs. RDB
- How does a PV turn into an alarm?

Ideas from “Alarm Management: …” book

- Need multiple views of alarms
- Alarms must have guidance, links to related displays
- Need tools to monitor alarm rate, stale alarms, ... to continually improve configuration
New End-User View

Alarm Tree

Alarm Table
New End-User View: Alarm Table

- **Acknowledge one or multiple alarms**
  - Select by PV or description
  - BNL/RHIC type un-ack’

- **Sort by column**

- **All current alarms**
  - active
  - ack’ed

- **Optional:** Voice Annunciation

## Alarm Table

<table>
<thead>
<tr>
<th>Current Alarms</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td></td>
</tr>
<tr>
<td>Current Sev.</td>
<td>Severity</td>
</tr>
</tbody>
</table>

### Acknowledged Alarms

<table>
<thead>
<tr>
<th>Acknowledged Alarms</th>
<th>Description</th>
<th>Time</th>
<th>Current Sev.</th>
<th>Severity</th>
<th>Status</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Another View: Alarm Tree

See complete configuration
  – Active, ack’ed, inactive, disabled

Hierarchical
  – Optionally only show active alarms
  – Ack’/Un-ack’ PVs or sub-tree

Users choose to display table and/or tree
Guidance, Related Displays Commands

- View Guidance Texts
- Start related displays (EDM)
- Open Web pages
- Run ext. commands

Hierarchical:
- Including info of parent entries
- Merges Guidance etc. from all selected alarms
CSS Integration: Alarm ➔ Data Browser

1. Context menu: Alarm Duration, Guidance, Displays, ...
2. Select Data Browser for PV in alarm
3. View history, annotate
After inspecting alarm PV’s history, post commented plot to E-Log
Directly from Alarm to E-Log

- “Logbook” from context menu creates text with basic info about selected alarms. Edit, submit.
Online Configuration Changes

.. may require Authentication/Authorization (LDAP)

☑ Log in/out while CSS is running
Configure PV

• Again online
• Especially useful for operators to update guidance and related screens.
BEAST Demo

• Virtual Linac
Technical View

FECs/IOCs

PV Updates (Channel Access, …)

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)

FECs/IOCs

Alarm Server
Current Alarms: Latched? Annunciated? Acknowledged?

Log Messages
Annunciations
Alarm Updates
Ack'; Config Updates

JMS

ALARM_SERVER
ALARM_CLIENT

Message RDB

Alarm Cfg & State
RDB

Tomcat
-Reports

Alarm Client GUI

PV Updates (Channel Access, …)
Alarm Server Options

• Latch highest severity, require acknowledgement?
• Annunciate?

• Chatter filter
  • Alarm only if severity persists some minimum time
  • .. or alarm happens >=N times within period

• Optional formula-based alarm enablement:
  – Enable if “(pv_x > 5 && pv_y < 7) || pv_z==1”
  – … but we prefer to move that logic into IOC

• “Maintenance Mode”: Invalid PVs don’t annunciate, automatically acknowledged
Logging

• ..into generic CSS log also used for error/warn/info/debug messages
• Alarm Server: State transitions, Annunciations
• Alarm GUI: Ack/Un-Ack requests, Config changes
• Generic Message History Viewer
  – Example w/ Filter on TEXT=CONFIG
Logging: Get timeline

1. PV triggers, clears, triggers again

2. Alarm Server latches alarm

3. Alarm Triggered again

4. Problem fixed

5. Ack'ed by operator

6. All OK
Numerous Web Reports

Pattern: %, 17-Mar-2009 00:00 for 0 days 24 hours (-)

Statistics based on CURRENT SEVERITY:

Alarms duration frequency (hh:mm:ss):
Within selected time period:
at start: OK
at end: OK
Total alarms: 997
Total time in alarm state: 23:04:59
Severity counts:
MAJOR: 997
MINOR: 0
INVALID: 0
ERROR: 0
Alarm durations (hh:mm:ss):
Minimum: 00:00:00 (less than 1 sec)
Maximum: 00:26:55
Average: 00:56:11
Most frequent: 00:00:00 (less than 1 sec)
Extrema durations:
Less than 1 sec: 555
More than 12 hours: 0

Alarms on time line (10 min slices)

Alarms Active 24.0 h or more

<table>
<thead>
<tr>
<th>#</th>
<th>PV Name</th>
<th>Description</th>
<th>Paths</th>
<th>Alarm Time (HH:MM:SS)</th>
<th>Duration (HH:MM:SS)</th>
<th>Severity</th>
<th>Alarm Message</th>
<th>Current Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MEBT_CIBOP_P1_1V</td>
<td>mebbot chopper power supply one voltage peak</td>
<td>/Users/username/MEBT</td>
<td>2009-03-16 13:37:35</td>
<td>42:58:57</td>
<td>MAJOR</td>
<td>LOLO_ALARM</td>
<td>MAJOR</td>
</tr>
<tr>
<td>4</td>
<td>TMModule_MPSAlarm</td>
<td>Mebbot System MPS Trip</td>
<td>/Users/username/TargetCMS</td>
<td>2009-03-09 09:29:09</td>
<td>934:51:23</td>
<td>INVALID</td>
<td>READ_ALARM</td>
<td>INVALID</td>
</tr>
</tbody>
</table>
Summary

• Tools won’t produce a good configuration, but help to improve it
  – Most frequent alarms?
  – Alarm ‘noise’?

• BEAST operational at SNS since Feb’09
  – Started with previous ALH setup
    • ~300, no guidance, no related displays
    • Now ~400, all with guidance, rel. displays, links to operational procedures
  – Alarm Server stable through IOC reboots, online configuration changes, Oracle updates

• Alarm GUI is ‘best ever’ for SNS
Future of BEAST

- Auto Dialer, Phone System
- Better support for multiple setups
Thank You!

- BEAST Home Page:

- Setup Instruction
  - No downloadable alarm server available. Need to build your own from CSS source repository.
  - [https://ics-web.sns.orl.gov/css/docs/BEAST.doc](https://ics-web.sns.orl.gov/css/docs/BEAST.doc)