Best Ever Alarm System Toolkit

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

kasemirk@ornl.gov
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Alarm System Components

This talk: Alarm System Technology

See also:

"Alarms Philosophy", Karen White (this conference)

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 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
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

- 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 w/ 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.
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

Filter on TYPE, PV

<table>
<thead>
<tr>
<th>TIME</th>
<th>TYPE</th>
<th>TEXT</th>
<th>SEVERITY</th>
<th>USER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009/04/12 08:31:38.020</td>
<td>talk</td>
<td>MAJOR alarm: mps fault</td>
<td>MAJOR</td>
<td>alarms</td>
</tr>
<tr>
<td>2009/04/12 08:31:29.292</td>
<td>talk</td>
<td>MAJOR alarm: Check SCL 15 Modulator voltage</td>
<td>MAJOR</td>
<td>alarms</td>
</tr>
<tr>
<td>2009/04/12 08:31:28.387</td>
<td>talk</td>
<td>MAJOR alarm: SCL 15 modulator is standby</td>
<td>MAJOR</td>
<td>alarms</td>
</tr>
</tbody>
</table>

1. PV triggers, clears, triggers again

2. Alarm Server latches alarm

3. Alarm Server annunciates

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 (-)

Alarms duration frequency (hh:mm:ss)

Statistics based on CURRENT SEVERITY:

Within selected time period:
at start: OK
at end: OK

Total alarms: 9967
Total time in alarmed state: 23:04:59

Severity counts:
MAJOR: 9967
MINOR: 0
INVALID: 0
ERROR: 0

Alarm durations (hh:mm:ss):
Minimum: 00:00:00 (less than 1 sec)
Maximum: 06:29:55
Average: 00:56:11

Most frequent: 00:00:00 (less than 1 sec)

Extreme durations:
Less than 1 sec: 5505
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>Path</th>
<th>Alarm Time</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_CHOP:PS_1-V</td>
<td>mechatron chopper power supply one voltage fault</td>
<td>/Annunciator/MEBT</td>
<td>2009-03-16</td>
<td>00:58:57</td>
<td>MAJOR</td>
<td>MAJOR_ALARM</td>
<td>MAJOR_ALARM</td>
</tr>
<tr>
<td>2</td>
<td>MEBT_CHOP:PS_2-V</td>
<td>mechatron chopper power supply two voltage fault</td>
<td>/Annunciator/MEBT</td>
<td>2009-03-16</td>
<td>00:58:57</td>
<td>MAJOR</td>
<td>MAJOR_ALARM</td>
<td>MAJOR_ALARM</td>
</tr>
<tr>
<td>3</td>
<td>HEBT_CollCTR2Cond</td>
<td>HEBT_CollCTR2Cond</td>
<td>/Annunciator/HEBT/HEBT_Cooling</td>
<td>2009-03-14</td>
<td>03:53:42</td>
<td>INVALID</td>
<td>INVALID_ALARM</td>
<td>INVALID_ALARM</td>
</tr>
<tr>
<td>4</td>
<td>TMod:Summary_MPS:Alarm</td>
<td>Moderator System MPS Trip</td>
<td>/Annunciator/Targ/CMS</td>
<td>2009-02-07</td>
<td>09:25:09</td>
<td>INVALID</td>
<td>INVALID_ALARM</td>
<td>INVALID_ALARM</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