



# Alarm System

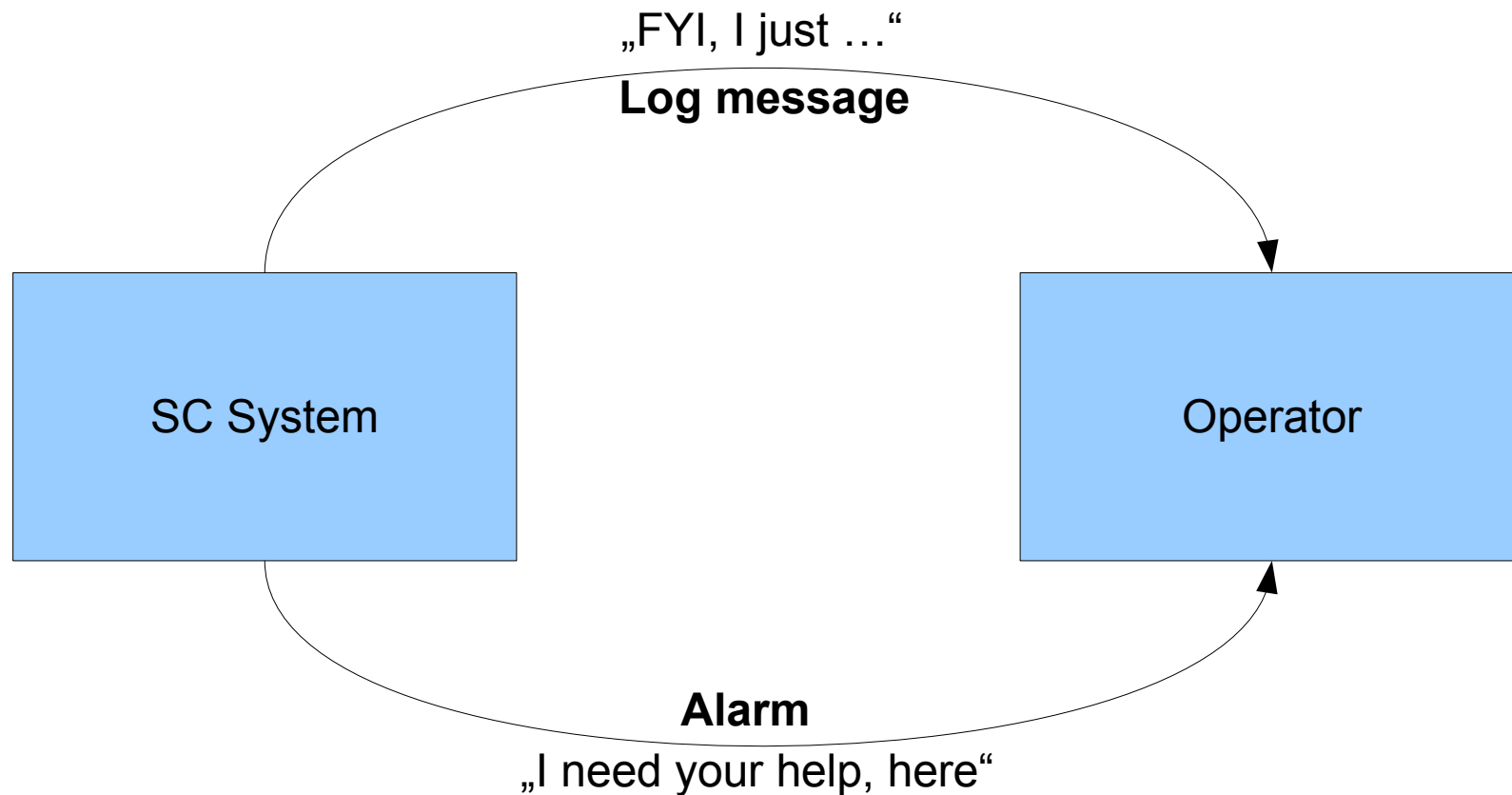


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19.12.2018

# Handling of Problems in the SC System



- Problems that can be resolved automatically  
⇒ Just do it. Tell the operator via a log messages about what just happened.
- Problems that cannot be resolved automatically  
⇒ Raise an alarm to let the operator deal with it.

# What is an Alarm?

**Naive approach:**

**If what comes out is not what I commanded, that's a problem.**

**⇒ This is what would happen:**

| Set Voltage | Power Supply<br>Current Voltage |                  |
|-------------|---------------------------------|------------------|
| 1.8V        | 1.8V                            | all well         |
| 1.8V        | 2.0V                            | wrong<br>voltage |
| 1.8V        | 1.5V                            | wrong<br>voltage |
| 1.8V        | 0V                              | wrong<br>voltage |

**Very simple to implement: Set  $\neq$  Current (+/- Delta)  $\Rightarrow$  Alarm.**

**But this doesn't always highlight the cause of the problems.**

# What is an Alarm?

## Power Supply

| Channel | Set Voltage | Set Current | Current Voltage | Current Current |               |
|---------|-------------|-------------|-----------------|-----------------|---------------|
| on      | 1.8V        | 100mA       | 1.8V            | 10mA            | all well      |
| on      | 1.8V        | 100mA       | 2.0V            | 10mA            | wrong voltage |
| on      | 1.8V        | 100mA       | 1.5V            | 10mA            | wrong voltage |
| on      | 1.8V        | 100mA       | 1.5V            | 100mA           | wrong current |
| off     | 1.8V        | 100mA       | 0V              | 0mA             | all well      |

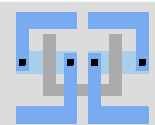
⇒ even in this simple case, the condition is complex:

The voltage is in error,

- if it is lower than the set voltage, but not
  - if the PS is switched off, or
  - if the PS is in the current-limit mode.
- or if it is higher than the set voltage.

⇒ Important: what is **expected** to happen? In current-limit mode, the voltage is expected to drop. The problem is only in the current.

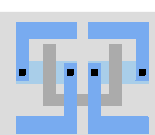
⇒ Defining when a condition is **not** an alarm is very important.



- Alarm: An **unexpected state** of the system that **requires operator intervention**.
- Clear definition of severities:
  - Major: system **is** broken.
  - Minor: act **now**, or system **will** break.
- ⇒ There cannot be a minor alarm without a major alarm.
- ⇒ „This is really bad“ or „that's not that bad after all“ are **not** the definitions of major and minor.
- If the failure is unavoidable, the severity is major right away.

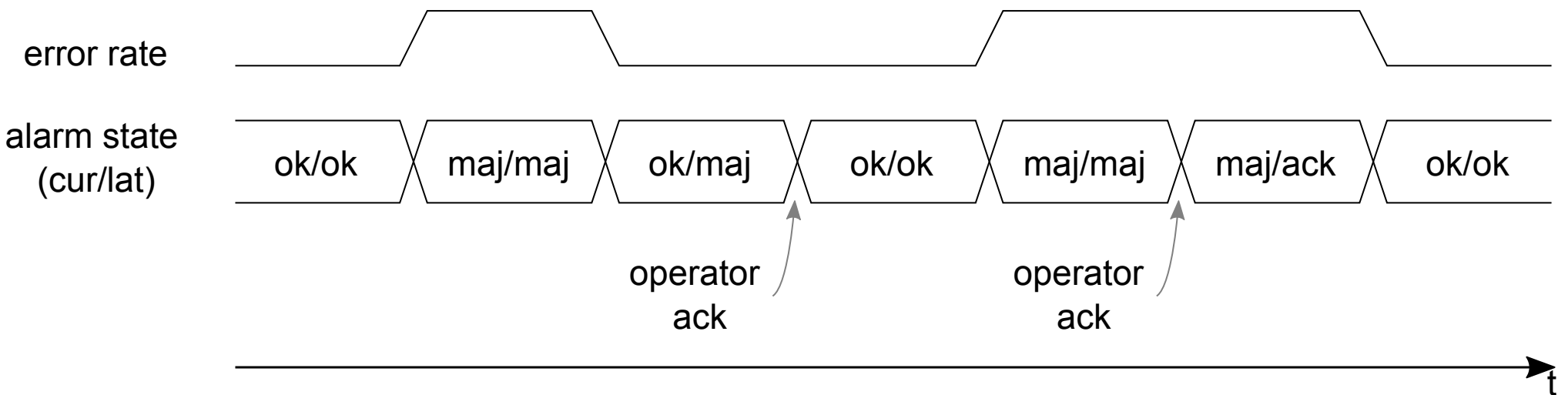
# Alarms Must Be ...

- Relevant for the shifter.
- Non-redundant: Only one alarm per error situation.
- Latching: No alarm may just disappear by itself.  
The operator always needs to acknowledge it.  
Two situations:
  - Condition can disappear without operator action (e.g. overtemperature)  
⇒ Must be latching in the alarm server (default).  
(Should be rare, given that an alarm is a predecessor of guaranteed failure.)
  - Condition needs to be cleared manually (e.g. PS OVP trigger: requires OVP reset).  
⇒ This manual operator action counts as the acknowledgment  
⇒ Alarm can be non-latching in the alarm system.



# Alarm System I

- The **Best Ever Alarm System Toolkit**, a.k.a. **BEAST**.
- Manages alarm conditions in a tree-like structure, propagating alarms up to the root.
- Two states per alarm:
  - current condition, live from the PV
  - „latched“ condition: worst condition since last alarm acknowledge.
- Example alarm lifecycle:



# Alarm System II

- The alarm server is a standalone executable  
⇒ operates independently, backed by a PostgreSQL database.
- In CSS, the alarm module is used to display the alarm.
  - Displays as a tree, or as a table.
- Notifications by mail, sound in the control room are possible.

The screenshot displays two windows from the Alarm System II interface. The 'Alarm Table' window shows a list of current alarms with columns for PV, Description, Time, Current Severity, Severity, and Status. The 'Alarm Tree' window shows a hierarchical tree view of the alarm system, with the 'System: MPS FPAR fault (MAJOR/LINK\_ALARM)' selected.

| PV                         | Description                   | Time                | Current Severity | Severity | Status |
|----------------------------|-------------------------------|---------------------|------------------|----------|--------|
| RFQ_Vac:GV_1B:Sts          | R F Q vacuum valve 1 B cl...  | 2008/11/30 09:06:21 | OK               | MAJOR    | STAT   |
| RFQ_LLRF:ResCtrl1:ResEr... | R F Q low level R F resona... | 2008/11/27 20:39:52 | OK               | MAJOR    | HIHI   |
| MEBT_RF:Bnch03:V_Plt_...   | MEBT three power amplifi...   | 2008/11/28 02:22:11 | OK               | MAJOR    | LOLO   |
| MEBT_RF:Bnch03:I_Plt_PA    | MEBT three power amplifi...   | 2008/11/28 02:22:12 | OK               | MAJOR    | LOLO   |
| FE_MPS:MIOC1A:status_...   | MPS Beam permit               | 2008/11/26 12:16:28 | OK               | MAJOR    | LOLO   |
| DTL_HPRF:Xmtr4:PLC_C...    | Check DTL Xmtr4 PLC par...    | 2008/11/27 20:46:32 | OK               | MAJOR    | HIHI   |
| DTL_HPRF:Xmtr3:PLC_C...    | Check DTL Xmtr3 PLC par...    | 2008/11/27 20:46:50 | OK               | MAJOR    | HIHI   |
| DTL_HPRF:IGBT3:PPS_W...    | DTL3 HP Mod Smoke Alarm       | 2008/11/27 20:20:01 | OK               | MAJOR    | STAT   |
| CHL_ODH:AIT1_Sys:Flt       | CHL ODH System Fault          | 2008/11/30 08:34:30 | OK               | MAJOR    | STAT   |
| TGT_LWS2:Tnk_TE1710...     | Proton beam window halo...    | 2008/11/26 22:22:09 | OK               | MINOR    | HIGH   |
| TGT_LWS2:Tnk_TE1710J:T     | Proton beam window halo...    | 2008/11/26 22:22:50 | OK               | MINOR    | HIGH   |
| TGT_LWS2:Tnk_TE1710I:T     | Proton beam window halo...    | 2008/11/26 22:22:29 | OK               | MINOR    | HIGH   |
| TGT_LWS2:Tnk_TE1710F:T     | Proton beam window halo...    | 2008/11/26 22:20:58 | OK               | MINOR    | HIGH   |
| TGT_LWS2:Tnk_TE1710E:T     | Proton beam window halo...    | 2008/11/26 22:20:47 | OK               | MINOR    | HIGH   |
| TGT_LWS2:Tnk_TE1710B:T     | Proton beam window halo...    | 2008/11/26 22:23:33 | OK               | MINOR    | HIGH   |
| TGT_LWS2:Tnk_TE1710A:T     | Proton beam window halo...    | 2008/11/26 22:23:12 | OK               | MINOR    | HIGH   |
| TGT_IDMP:TP_TE9508O:T      | Ring Guard Temp O             | 2008/11/28 04:58:11 | OK               | MINOR    | HIGH   |

The Alarm Tree view shows the following structure:

- Area: BeamPermit (MAJOR/LINK\_ALARM)
  - System: MPS FPAR fault (MAJOR/LINK\_ALARM)
    - PV: ICS\_MPS:FPAR\_CCL\_BS:FPAR\_MEBT\_BS\_chan\_status
    - PV: ICS\_MPS:FPAR\_EDmp:FPAR\_MEBT\_BS\_chan\_status
    - PV: ICS\_MPS:FPAR\_IDmp:FPAR\_MEBT\_BS\_chan\_status
    - PV: ICS\_MPS:FPAR\_LDmp:FPAR\_MEBT\_BS\_chan\_status
    - PV: ICS\_MPS:FPAR\_MEBT\_BS:FPAR\_MEBT\_BS\_chan\_status
    - PV: ICS\_MPS:FPAR\_Ring:FPAR\_MEBT\_BS\_chan\_status
    - PV: ICS\_MPS:FPAR\_Tgt:FPAR\_MEBT\_BS\_chan\_status
  - System: MPS FPL fault
  - System: MPS BLM fault
  - System: MPS PS fault
  - System: MPS Vacuum fault
  - System: MPS RF fault (MAJOR/LOLO\_ALARM)
- Area: CF
- Area: Diagnostics
- Area: HP\_Mod\_Smoke
- Area: HP\_Mod\_V\_Mon
- Area: HPRF\_PLC\_Check
- Area: HPRF Rack Sts





Thank you!