



PXD SC Overview

A **Brief** Introduction Into Our Plans



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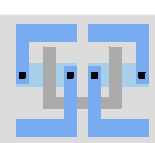
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10th VXD Belle II Workshop

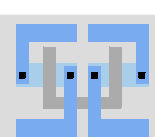
Santander

14.10.2016

- Our OS for servers running IOCs is SL7 x86_64.
- EPICS base version 3.14 at the moment, 3.16 (out soon) is under consideration.
- **RPM repository** with EPICS base, extension modules + own IOCs with automatic build from git repository.
 - Important rule for production servers: No software installations bypassing the RPM database, i.e. no pip install, etc.
 - „rpm -q -a“ should give a complete overview of the system. This is important when performing backups, or setting up replication servers.

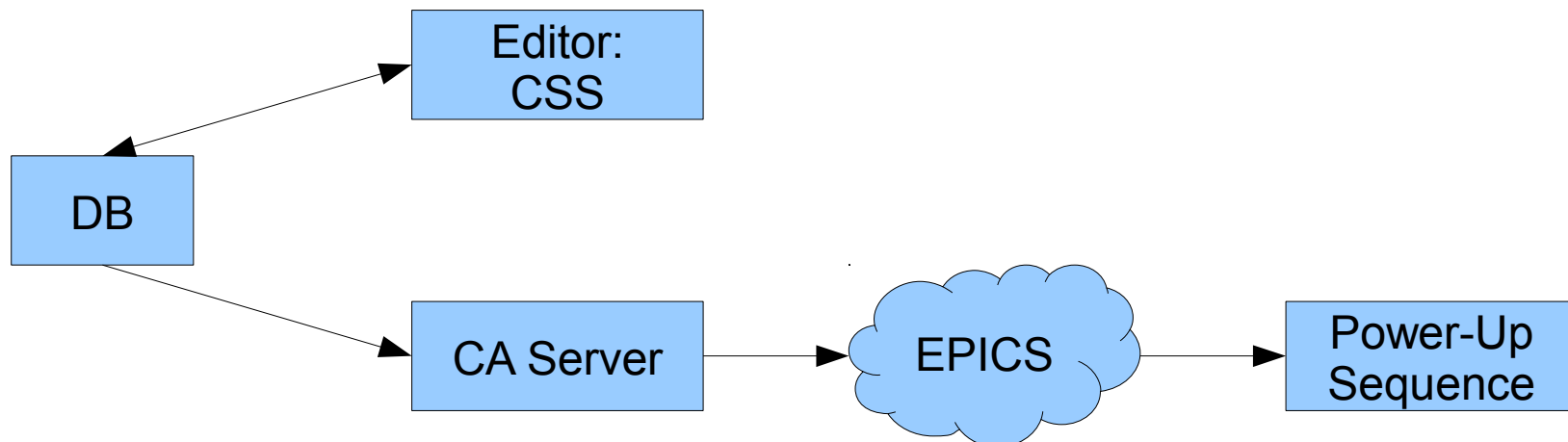


- **Custom build** based on (currently) the **upstream branch 4.3**.
- Our own build includes:
 - Selection of common CSS modules.
 - Configuration database editor
 - NSM2 data source
 - DQM modules
 - Support for CERN UNICOS for IB Belle.
 - Default settings for archiver, alarm system, font and color definitions, etc.
 - Different installations (test system, DESY, KEK), use different configurations \Rightarrow the feature with the configuration changes.

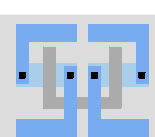


Configuration Database

- Any information needed to start the run — mostly configuration parameters for the system — is taken from the configuration database \Rightarrow ensures reproducibility.
- Data format: XML-like.
- Editor in CSS
- An IOC loads the active configuration and propagates it as PVs.
- The power-up sequence then applies the data to the hardware.
- When in physics mode, access to PVs in the hardware will by default be disallowed when the system is not idle.



- Goal: Define a scheme to encode as much information as possible in the PV name, considering EPICS limitations.
- The PV name should be short (EPICS length limit!), but easily legible
 - Needs some common definitions for structure, abbreviations, ...
- Managed in the [git repository](#).
- Main concepts:
 - Fixed structure of the PV name: device:datapoint:property[:function].
 - device: ONSEN, PS, DHH, ... encoded as one letter, followed by device ID.
 - datapoint: defined individually for each device.
 - property: voltage, current, id, ... with fixed encoding



- Document in [git repository](#) as the outcome of a dedicated meeting in April 2015.
- Covers many topics.
- But not really used in a realistic environment.
- At the meeting, we decided to pilot one implementation for a module, then re-convene to discuss changes to the guidelines based on actual experiences.
 - This has not happened so far.

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B. Overall Layout

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2. Main Section
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C. Widgets

D. Colors

E. Fonts

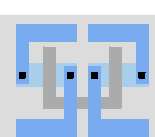
IV. Alarm Display

V. Shifter Overview Screen

VI. Other

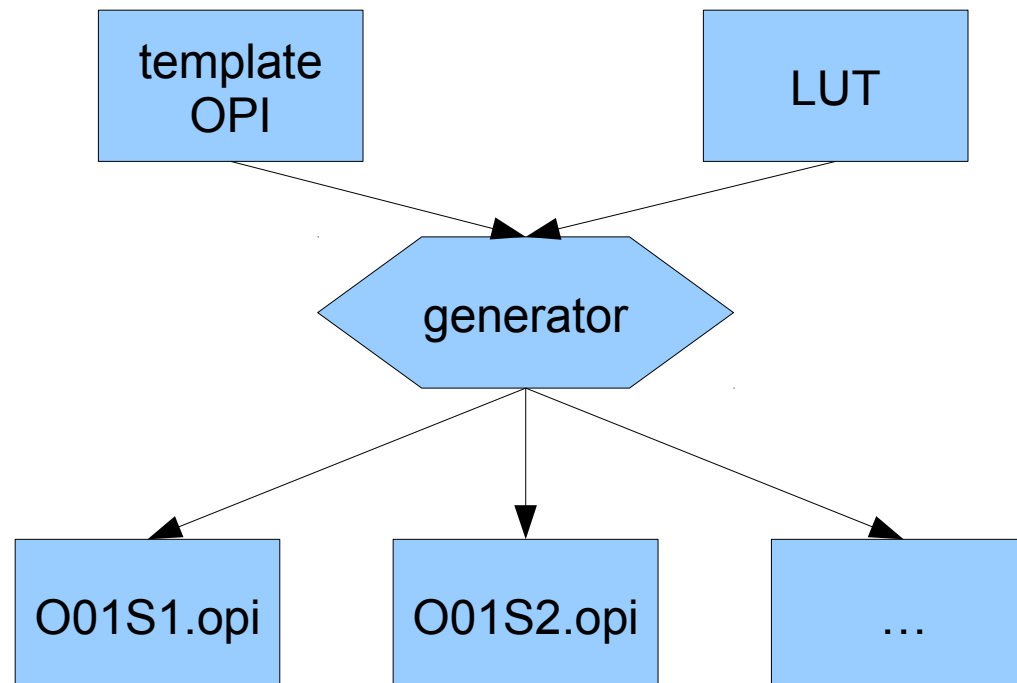
- A. OPI Distribution and Access Rights
- B. Modal Dialogs

References

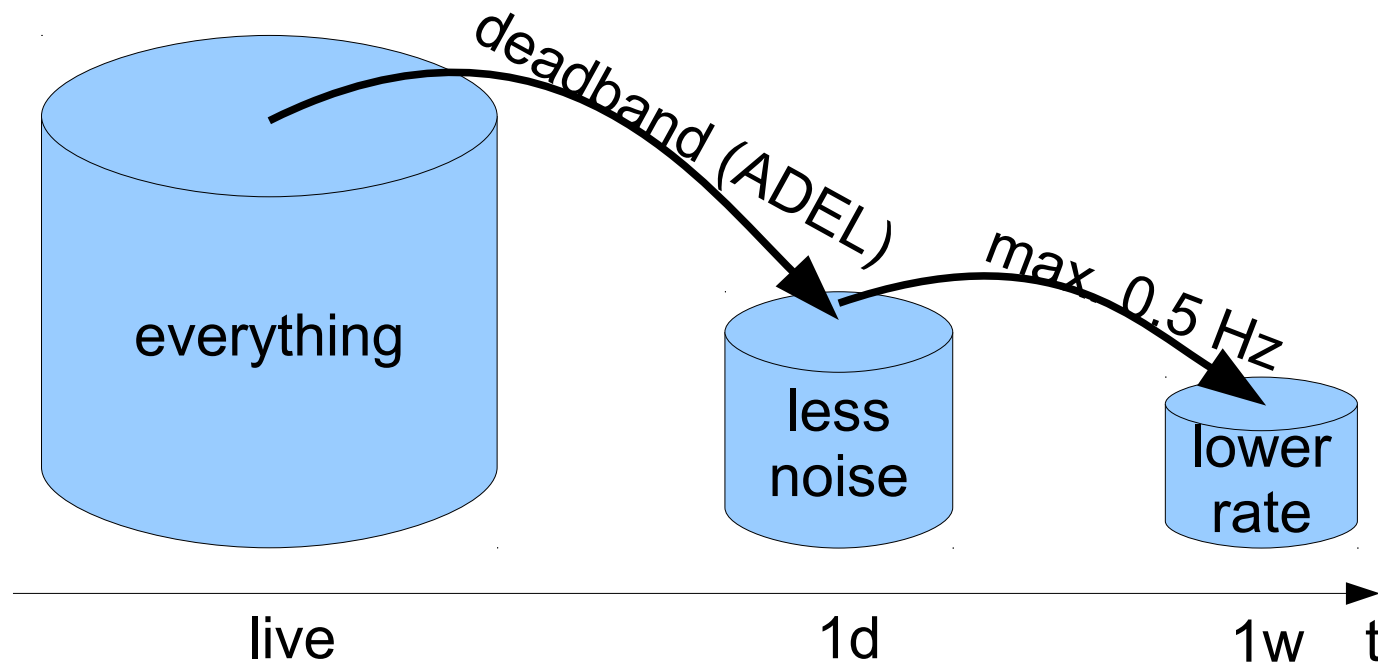


„Precompiled“ OPIs

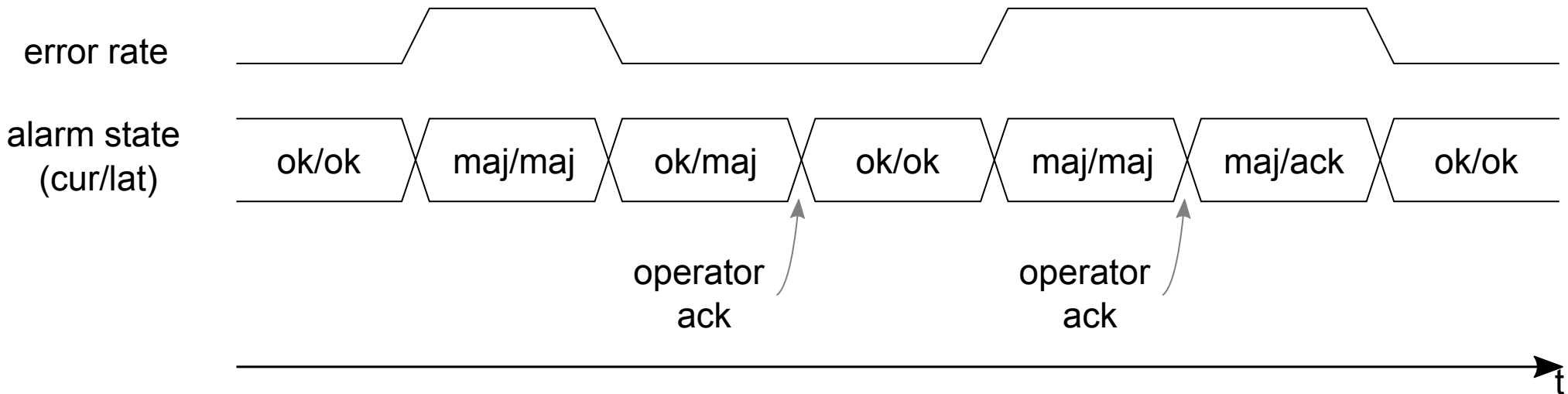
- Adding a sensible navigation (next module, previous module, ...) to the OPIs proved difficult in CSS using only macros.
⇒ invented „precompiled OPIs“.
- A template OPI contains the actual contents, and a LUT (in a Python file) defines the „neighbors“ in the navigation.
- For each instance, a separate OPI is generated.
⇒ Also has advantages when jumping in from outside the hierarchy, e.g. from the alarm screen.



- We switched from the PostgreSQL-based archiver to the **Archiver Appliance**.
 - File-based instead of RDB-based \Rightarrow easier to backup.
 - Convenient HTTP interface returning data in CSV/JSON/... formats.
 - Multiple-tier storage allows us to reduce the data as they age:
All data for a day, 1-sigma deadband for a week, max. rate of one sample every x seconds thereafter. Still $O(20 \text{ TB})$ of data to expect during Belle II.



- The **Best Ever Alarm System Toolkit**, a.k.a. **BEAST** (← how could we use anything else? 😊).
- 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 on the left shows a list of current alarms with columns for PV, Description, Time, Current Severity, Severity, and Status. The 'Alarm Tree' window on the right 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 hierarchy:

- 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

- We collect alarms in an XML file converted to PDF.

2 IPMI

2.1 ONSEN

2.1.1 Errors reported by Shelf Manager

2.1.1.1 PSU failure	Power Unit failure	on device level: FRU, Voltage, Fuse	A shelf will switch off componentent M check remaining redundancy M if redundancy exists, mask error condition. M schedule replacement of the PSU	major
2.1.1.2 Fan failure	Fan Unit failure	on device level: FRU, Speed, Fuse	A shelf will increase other fan speeds M check remaining redundancy M if redundancy exists, mask error condition. M schedule replacement of the fan unit	major

- Columns so far:
 - Unique id, description, conditions,
 - actions: automatic and manual (shown to shifter on alarm condition)
- Clear definition of severities:
 - Major: system **is** broken
 - Minor: act **now**, or system **will** break.

Inhibits unsave settings. E.g. condition: $|\text{clear-on} - \text{clear-off}| \leq 20 \text{ V}$

Off: OK

clear-on	<input type="text" value="0 mA"/>	<input type="text" value="0 mA"/>	<input type="text" value="50 mA"/>	<input type="text" value="0 mV"/>	<input type="text" value="0 mV"/>	<input type="text" value="27000 mV"/>
clear-off	<input type="text" value="0 mA"/>	<input type="text" value="0 mA"/>	<input type="text" value="50 mA"/>	<input type="text" value="0 mV"/>	<input type="text" value="0 mV"/>	<input type="text" value="10000 mV"/>

Difference 22V \Rightarrow inhibited

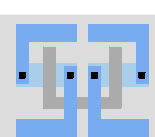
clear-on	<input type="text" value="0 mA"/>	<input type="text" value="10 mA"/>	<input type="text" value="50 mA"/>	<input type="text" value="0 mV"/>	<input type="text" value="22000 mV"/>	<input type="text" value="27000 mV"/>
clear-off	<input type="text" value="0 mA"/>	<input type="text" value="10 mA"/>	<input type="text" value="50 mA"/>	<input type="text" value="0 mV"/>	<input type="text" value="0 mV"/>	<input type="text" value="10000 mV"/>

Difference 19V \Rightarrow OK

clear-on	<input type="text" value="0 mA"/>	<input type="text" value="10 mA"/>	<input type="text" value="50 mA"/>	<input type="text" value="0 mV"/>	<input type="text" value="22000 mV"/>	<input type="text" value="27000 mV"/>
clear-off	<input type="text" value="0 mA"/>	<input type="text" value="10 mA"/>	<input type="text" value="50 mA"/>	<input type="text" value="0 mV"/>	<input type="text" value="3000 mV"/>	<input type="text" value="10000 mV"/>

- Implemented purely as EPICS DB with calc records. Cannot be circumvented.
- Still need to monitor the voltage. Hardware failures (shorts) are possible!

- Commands from global run control / power supply control arrive via NSM2-to-EPICS gateway.
- PXD-intern: Fanout first to all subsystems, then to all instances, e.g. global → all PS → PS #14.
 - Any transition only completes, when all lower controls signal that it's complete.
 - Individual subsystems/devices can be put into „local“ mode to exclude them from global control.
 - ⇒ They will not receive global commands and will not be considered during transitions.
- Implemented in IOCs using the EPICS sequencer.



- Sensors (PS + DHH): PSC
- DAQ (ONSEN + DATCON): RC

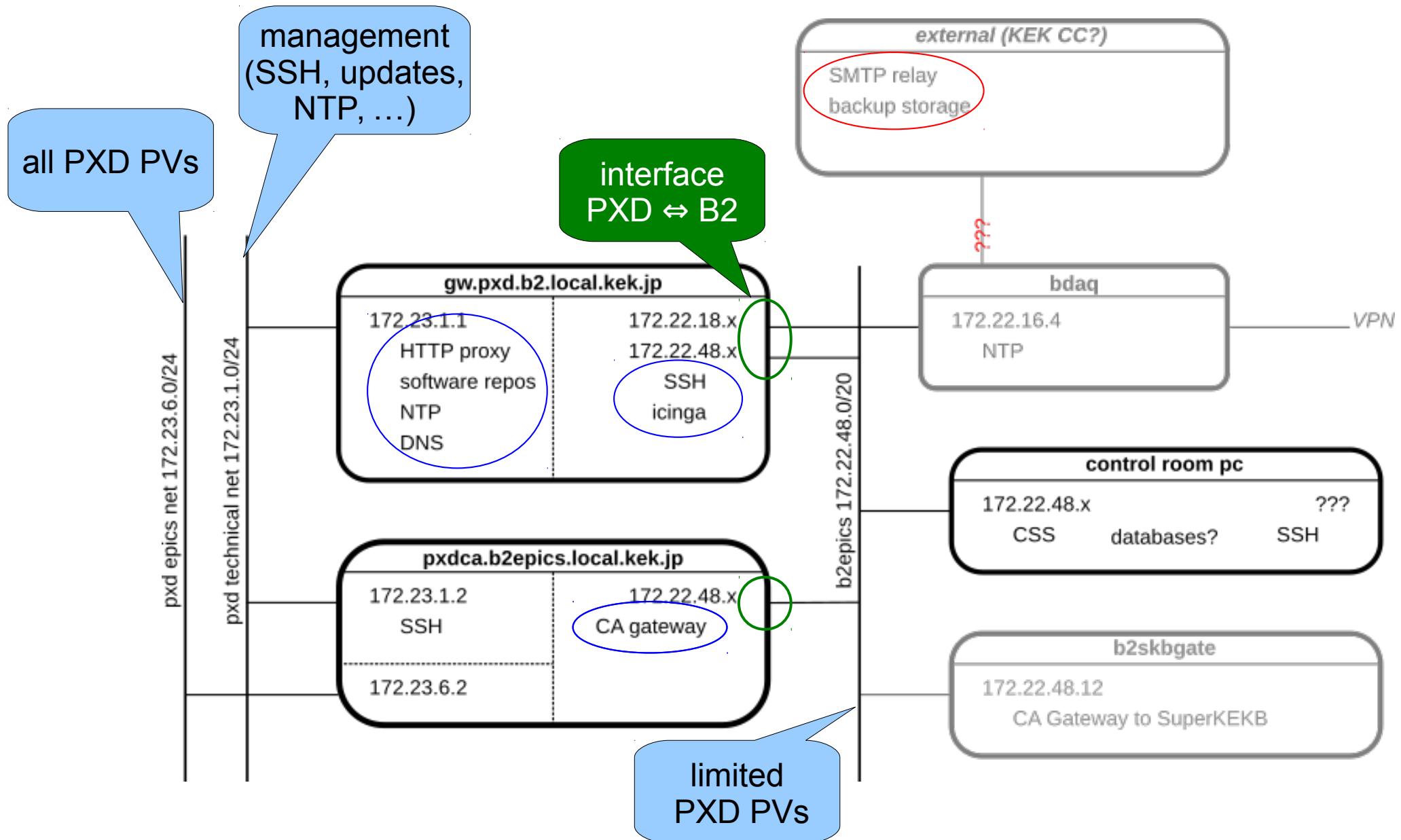
NOTREADY	OFF DHH configured DAQ off	STANDBY ASICs+DHH ready DEPFETs not powered DAQ off	PEAK Frontend sending data DAQ off
	DHH configured DAQ links established	ASICs+DHH ready DEPFETs not powered DAQ links established	Frontend sending data DAQ links established
RUNNING	DHH configured DAQ processing triggers, ROIs. DHH sends dummy data	ASICs+DHH ready DEPFETs not powered DAQ processing triggers, ROIs. DHP sends dummy data	Frontend sending data. DAQ processing triggers, ROIs.

- Log messages are collected in a global database.
 - The applications **send the messages** to an ActiveMQ server.
 - **JMS2RDB** puts them into a (PostgreSQL) database.
 - CSS includes a viewer that reads from the database.
- We try to include as many applications as possible (presently, the archiver appliance is excluded)
 - Eclipse-based applications (CSS, alarm server) are **compatible by default**.
 - For our IOCs, we have a C++ library (see „Logfile“ in the RPM repository) that implements JMS-compatible logging.
 - Also includes automatic backtrace on any crash.

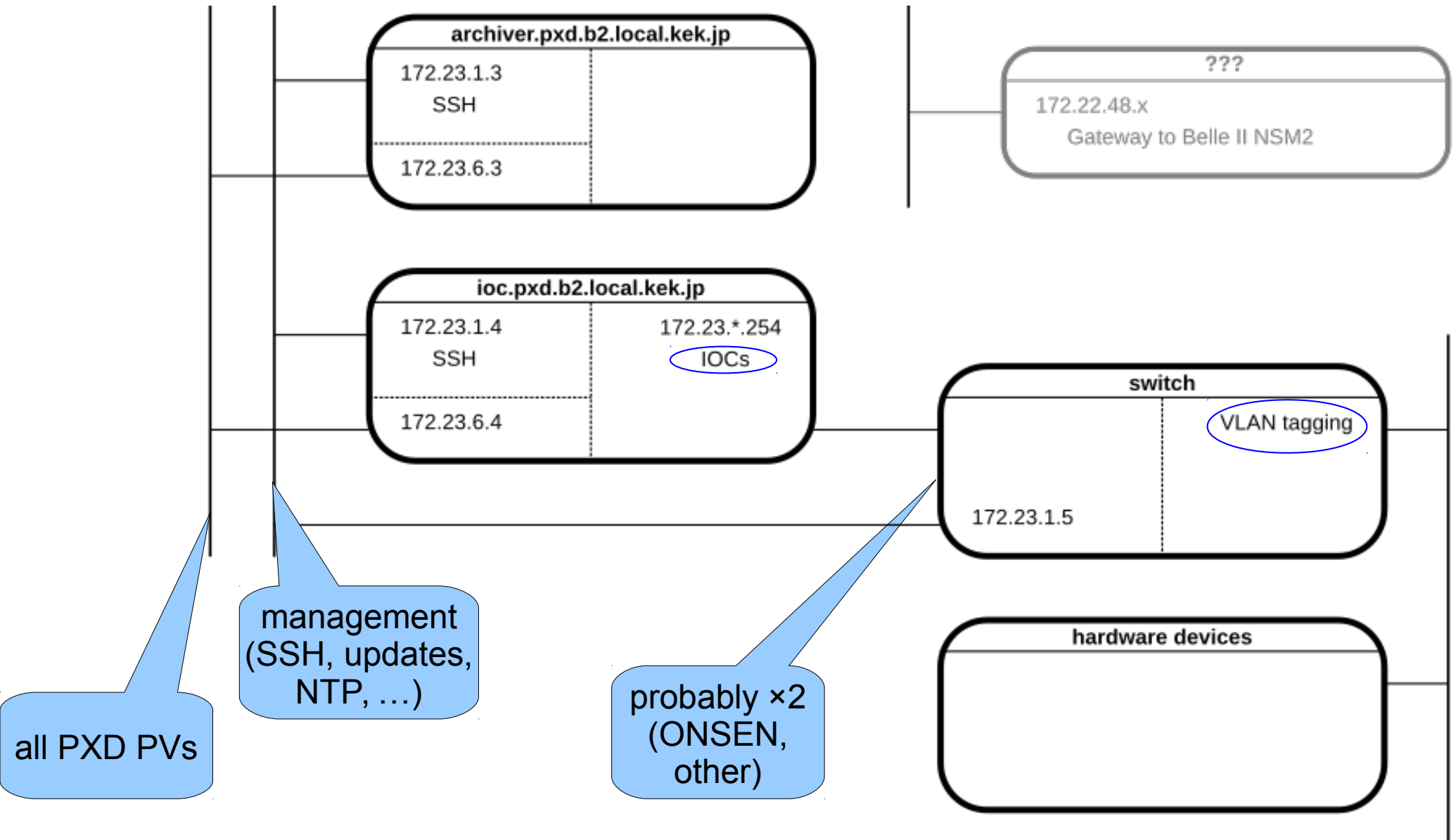
TIME	TEXT	NAME	SEVERITY	CREATETIME	USER	APPLICATION-ID	CLASS
2015/01/05	Internal browser is not a	logging	WARNING	2015-01-05 20:06:39.04	ritzert	CSS	org.csstudio.logging.PluginLogListener
2015/01/05	WARNING: Prevented re	logging	SEVERE	2015-01-05 16:04:41.88	ritzert	CSS	org.csstudio.logging.PluginLogListener
2015/01/05	Operation details	logging	SEVERE	2015-01-05 15:53:53.50	ritzert	CSS	org.csstudio.logging.PluginLogListener
2015/01/05	Operation details	logging	SEVERE	2015-01-05 15:53:53.50	ritzert	CSS	org.csstudio.logging.PluginLogListener
2015/01/05	SIGNAL 11 received.	static void SuS::lo	FATAL	2015-01-05 15:50:59.37	fecmess	app	logger
2015/01/05	final	int main()	WARNING	2015-01-05 15:50:59.37	fecmess	app	example
2015/01/05	info: 9	int main()	INFO	2015-01-05 15:50:59.37	fecmess	app	example
2015/01/05	9	int main()	DEBUG	2015-01-05 15:50:59.37	fecmess	app	example

- When the SC server fails, Belle II stops.
 - ⇒ redundancy is required.
 - We will use pacemaker on two identical servers for automatic switchover.
- We have many devices with small/embedded CPUs.
- When first testing DHH + PS, there was immediate interference between the systems, both using UDP.
 - This particular problem should be fixed by now, but it clearly indicates that we need to separate the systems for best reliability.
 - The data rates are low, so VLANs on top of a single 1Gbit uplink will do.

Network Plan (I)



Network Plan (II)



Note: IP addresses are just placeholders

Thank you!