UNIVERSITÄT
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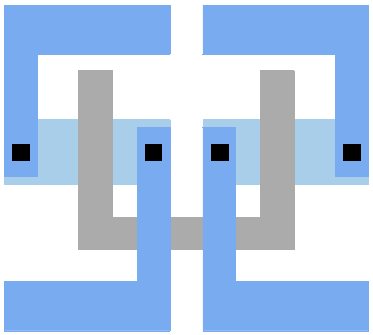
PXD Slow-Control



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10th VXD Belle II Workshop

Santander

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CSS — new baseline version 4.3

- I switched my development to target CSS 4.3.
  Only critical fixes are backported to 4.1.
- Beware the information on the download site
  https://sus.ziti.uni-heidelberg.de/~ritzert/Belle2/CSS/4.3.x/download/
- Needs Oracle Java 8 to work correctly. OpenJFX might solve this.
  - OpenJDK works but for detached views.
  - CSS 4.4 might no longer work so well.
    We'll monitor this and decide whether to switch or not.
- Start only from the css-belle2 subdirectory!
  - The EPICS-Configuration is not found otherwise.
- Does not support epics://, use ca:// or — better — no prefix at all (compatible with the archiver appliance).
- Directory and executable name changed to css-belle2.
- The DQM/NSM module might be broken! I need to verify this.
- Tried automatic build via Bamboo @ DESY, but no luck so far (very strange error from one maven module).

EPICS 3.16?

- EPICS 3.16.1 should be out any minute.
  - Interesting changes:
    - new record types lsi/lso: long string
    - better support for SMP, improved locking granularity
    - histogram record
    - alarm filtering
  - But the core modules are not compatible, yet (e.g. seq).
    ⇒ In the meantime, test our code against 3.**15** to find first problems.
  - I compiled all our code against 3.15.4.
  - Not tested beyond „code compiles“.
    - Some tweaks needed to .dbd files (3.15 fails on duplicate record definitions)
      ⇒ provide minimal support .dbds with only definitions from the module.
    - No other changes required.
    - But 3.16 has a slightly different API in some places (EpicsTime).
  - A repository based on EPICS 3.15.4 is available.
    https://sus.ziti.uni-heidelberg.de/~ritzert/Belle2/EPICS/RPMs/sl7.x-3.15/
    Give it a try if you are brave…
  - No decision yet, if we switch or not!
    This is really just a test to see where we stand and if we gain from 3.16.

- The servers at DESY are stuck at SL6.
  - ⇒ IOC code will have to support SL6 until the end of the testbeam, i.e. until beginning of 2017.
  - Other code can move on to SL7 only as planned.
- All services are back online.
  - Same configuration as at the end of the last testbeam.
    ⇒ please inform me about required updates, e.g. PV name changes relevant to the archiver.
  - With updated RPMs.
- „CSS 4.3 @ DESY“ version in preparation.

- Important workpackages:
  - PSC for DHH and PS
  - RC for ONSEN and DATCON
  - Start of alarm system implementation

Code Quality

- The functionality of the IOCs is by now very good.
  - We can run the system and new functionality is added when required.
- Focus can move to stability.
  - No **known** problems[1], but that doesn't prove that there are none.
  - Memory leaks may not hurt for a day, a week, …
- RPMs are compiled with stack guard enabled.
  - The worst of the worst buffer overruns would have been found by now.
- I checked all packages with the cppcheck static code analyzer.
  - So far only one critical error (array overrun) found (probably in an unused codepath)
    + a few memory leaks in non-IOC code.
  - cppcheck cannot find all errors
    ⇒ needs to be supplemented with analysis during runtime.
- Proposal: Run the IOCs in valgrind for one day at DESY.
  - First finds: use-after-free, mismatching new[]/delete, memory leaks.
  - Needs a prepared exclude file for EPICS-related false positives.

[1] except one bug in the PS that is not yet narrowed down to IOC/µC/protocol.

Alarm System

- After trying Word, Excel, Wiki, …:
  I prepared an XML-based format and XML-to-LaTeX converter to collect and render alarm definitions.
  - The alarms are managed as in the alarm system in a tree-like fashion:
    1 Link down
      1 Sender down
        1 hardware broken
        2 no link detected
      2 Receiver down
      3 no communication possible
        1 handshake failed
        2 cable unplugged
  - Errors propagate up to the root of the tree.
- Using XML also has the advantages
  - that we can present the data on a web page, load it into CSS, whatever we consider useful…
  - that it is plain text ⇒ suitable for collective edits via git.

Alarm System II

- Each group has to think hard and prepare a tree of alarms.
  - We will certainly not think of every possible condition, but we will have some structure to start with.
- Example definitions: ONSEN IPMI by Björn Spruck:

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

- We need to think about the structure of the tree.

Scaling

- DHH: 2 ⇒ 8
- PS: 4 ⇒ 40
- IPMI: 10 ⇒ 42
  - Some problems with SCAN times already observed.
  - No showstopper. Baseline plan is to start several IOCs.
- No problems expected with CPU load or RAM.
- But SCAN periods might be too short ⇒ start several IOCs (= several SCAN loops) in parallel instead of one big IOC.
- Increased UDP traffic might overwhelm small embedded CPUs/ FPGAs.
  - Separating PS and DHH traffic is baseline anyway.
  - Plan so that groups of PS and DHH devices can be separated if urgently required.

Other

- Installation at KEK
  - pxdtest is running at KEK since January. Used for ONSEN-related developments.
  - In October, IBBelle will arrive at KEK. A desktop PC will be set up in E-Hut to control it and connect it to the outside world.
    ⇒ needs power and network in the E-Hut 1F
  - Procurement of final servers to be coordinated with BonnDAQ?
- Access Security
  - For each IOC, decide which PVs are expert-level and shifter-level.
  - The configuration will be „safety first“, i.e. what is not explicitely allowed for shifters is restricted to experts.
  - Access is granted based on the login name of the user.
- The code repositories have been migrated to git @ DESY.
  - SVN @ KEK will remain available (read-only).
  - Left some old code behind.
  - The autobuilder is back online.

Cabling

IBBelle / PS Interlock

- Presented so far: IBBelle interlocks PS via a direct cable.
- New plan:
  - 3 signals from IBBelle: off, failure, temperature not reached,
    all inverted logic (cable disconnected = off = alarm active)
  - received by the VXD interlock PLC.
  - PS connected only to the interlock PLC.
- Why?
  - The interlock PLC is newer than the initial plans.
  - 3 signals ⇒ some kind of logic (AND) required anyway.
  - Using a PLC allows this logic to be flexible.
    Most likely use: Mask interlock signals:
    Disregard the „temperature not reached“ signal in short test runs.
  - Allows more input signals for PS interlocks:
    Actual temperature/humidity in the VXD volume.
    Automatic powerdown on high instantaneous radiation?
  - Allows SVD to also learn about the IBBelle status.

Cabling E-Hut — Special Cables

- Interlock from IBBelle to PLC
  - *n*× „twisted pair“.
- Interlock from PLC to PS.
  - Simple two-wire cable.

Required flammability grade:

難燃グレード	難燃試験	NEC 難燃 Type	主な適用安全規格	備考
	プレナム燃焼試験	CMP	UL910	海外で要求される難燃グレード（主にプレナム空間＊への敷設時に要求）
	ライザー燃焼試験	CMR	UL1666	海外で要求される難燃グレード（主にビル等フロアの垂直配線時に要求）
	垂直トレイ燃焼試験		UL1685(UL1581, Sec.1160) IEEE Std383 JIS C 3521	海外で要求される難燃グレード（国内で要求される最高難燃グレード）
	垂直燃焼試験	CMX	UL1581（UL VW-1）	海外で要求される難燃グレード
	60度傾斜燃焼試験	-	JIC C 3005	国内で要求される難燃グレード
	水平燃焼試験	-	JIC C 3005	国内で要求される難燃グレード

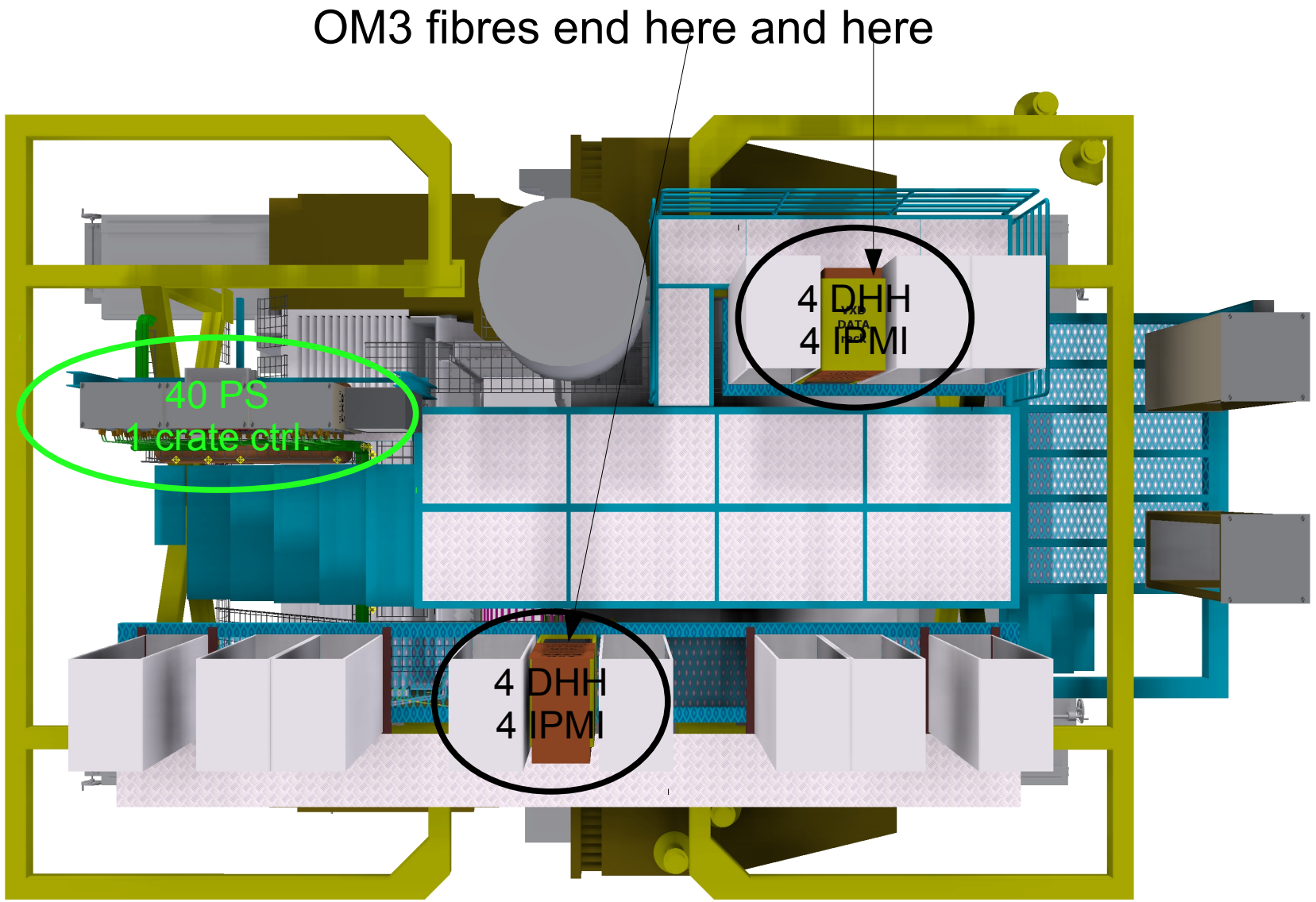
＊エアーダクト内や天井裏、床下など空調により常に空気が流れている空間

- Proposal: ALPHA WIRE 5473L SL005: 3 twisted pairs, 0,22mm², LSZH, CM grade flammability, 100 ft roll, 31,90€.

PXD SC Cabling

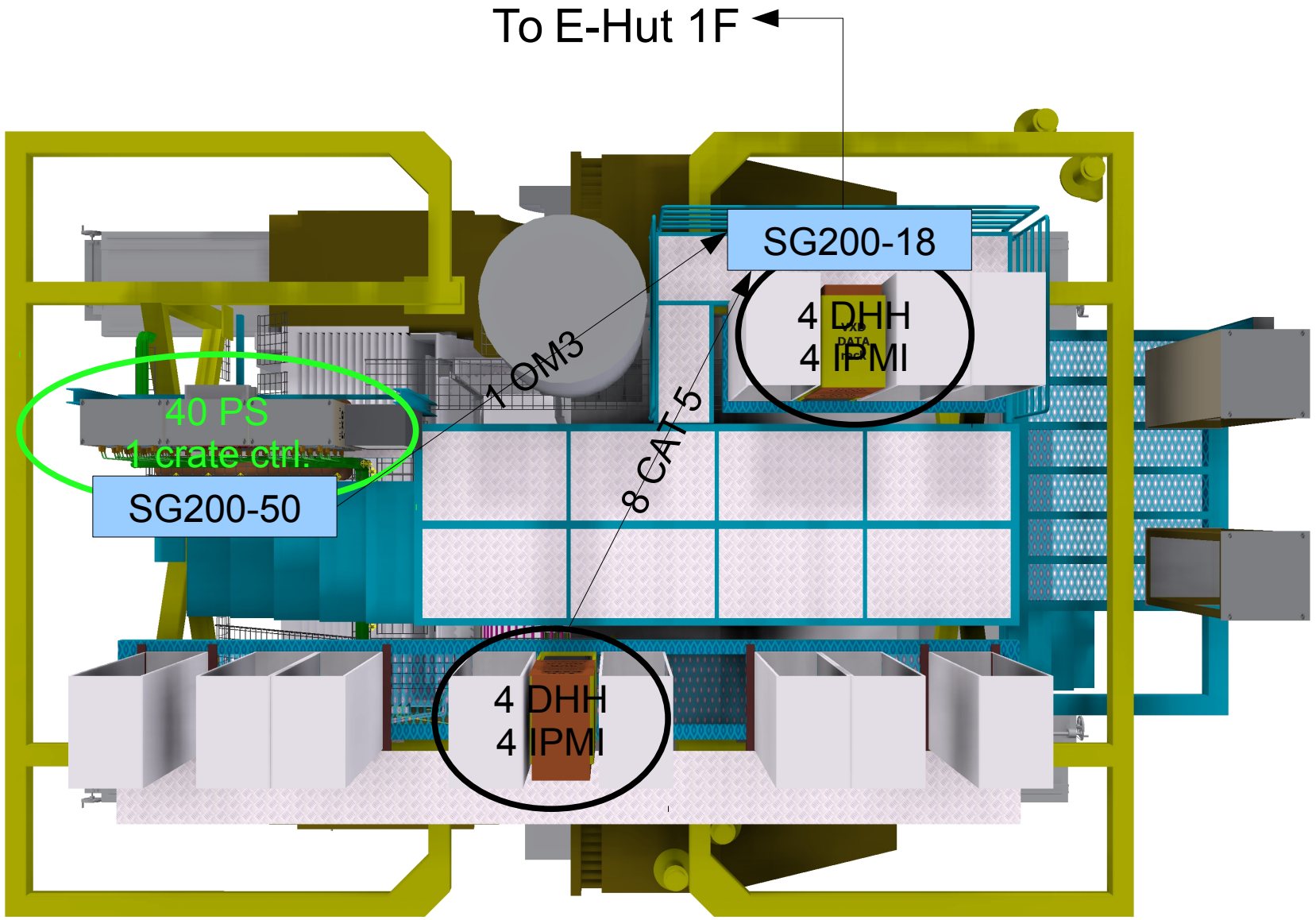
- Requirements
  - Separate network segments for PS, DHH, and IPMI
  - (In case of problems: Group PS and/or DHH into multiple segments.)
  - One physical segment is OK, we can use VLANs.
    ⇒ requires switches that can add VLAN tags per input port.
- Cabling to E-Hut
  - We can use cables foreseen as spares for ONSEN-DHH communication. OM3 between DHH racks and E-Hut 1F.
- Bad luck…
  - 48+2 (uplink) port switches are readily available.
    (more ports would not fit on a 1U 19″ frontpanel)
  - we have 56 cables + 1 uplink…
    ⇒ no chance to use only one switch
- Suitable switches: e.g. SG200 series from Cisco
  - Available: 48+2 ports 600€, 24 + 2 ports, 16+2 ports: 250€
  - Also a good option for the E-Hut side.

Top-of-Detector Layout



background image by Tscharlie

Easiest (?) Solution



Another 250€ investment ⇒ 1 cable instead of 8 between DHH racks.

Is it possible to add a 19″ switch to the PS rack?

background image by Tscharlie

DQM
(Summary from last telcos)

Pedestals

The pedestals situation:

- Taking them and (especially) uploading them takes several minutes ⇒ we should avoid having to do this on run start.
- We cannot skip pedestal taking, unless they are stable.
  - temperature-related drift seems not to be a problem.
  - but sampling time jitter is ⇒ new DHP could help
- The answer to this question has important implications from BonnDAQ to run-control.

Note: When we take them also influences how they are treated:

- Taken on run start ⇒ conditions database, or never saved at all (probably not a good idea…).
- Kept for longer and re-used ⇒ configuration database.

BonnDAQ — yes or no?

- In a BonnDAQ-less PXD, all expert measurements have to be performed via the normal DAQ chain.
  - Requires a special trigger scheme, running TTD, global coordination.
    ⇒ no longer PXD-only „local“ runs.
    ⇒ taking pedestals on run start could be difficult
  - and a lot of algorithms to be ported from BonnDAQ to EVB-DAQ, tested, … ⇒ manpower
- After discussions during Telcos, the baseline now is to <u>install and use BonnDAQ indefinitely</u>.
- Downsides:
  - Money…
  - Another system to maintain.
- Cabling: the required network cables between DHH and E-Hut are already in the list of cables to be installed by the company.

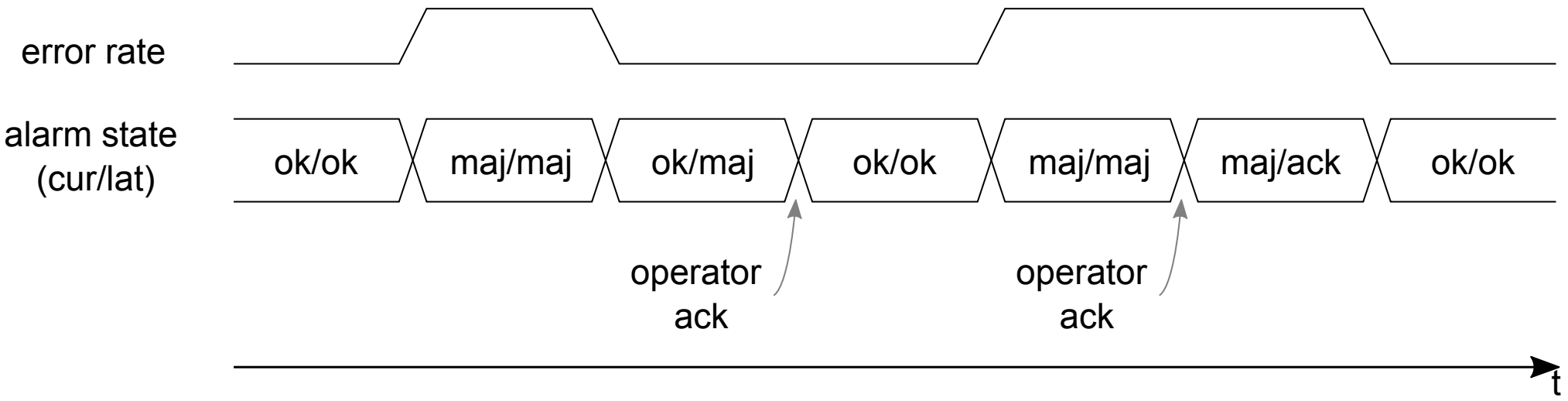
Histograms to be Produced

- Many histograms are obvious, but we still need to write this down somewhere.
  - hit maps
  - occupancy
  - efficiency
  - Landau
- Others are only in some peoples' minds.
  - Please step forward!
- There is a wiki page to collect DQM-related information at https://confluence.desy.de/display/BI/PXD+DQM!
- Also, we need „expected“ histograms to compare against.

DQM Errors to CSS Alarm

- basf2 writes a log message on alarm conditions.
  - This will be converted to some kind of alarm, but not in the alarm system the PXD shifter sees.
- Integration with the BEAST alarm system is not easily possible:
  - basf2 doesn't know all conditions to decide if it is an alarm or not.
    - Not every error is also an alarm!
    - Alarms may already be reported in another location earlier in the data path.
  - We need to learn when the state of the system is back to OK.
    ⇒ we need to keep track of the current alarm state somewhere.
    - Also when data taking stops: error rate is 0, this should be reported as OK.
  - Writing a log message per error is likely to flood the system when things break for good.
  - the log message needs to be parsed to learn which error occurred.
- We will try to get full histogram data (i.e. raw error counts) into the alarm server, generate alarms on value changes.
  - Either as a „fit“, if this NSM2 output is compatible with the NSM2-EPICS-gateway,
  - or I will try and extract the histogram receiver code to produce a data source for the alarm system.

Alarm Flow



- There is both the current alarm state, and a latched state.
- Current state: obvious.
  - Not so interesting in this case: A single DQM error will only produce a very short alarm state.
- Latched: worst state since last acknowledge
  - Can be „acknowledged“.
  - This is what the operator sees.

Other DQM Problems

- **Responsibilities**!

- Full-18MP histograms are not possible.
  - Decide on a strategy to reduce the resolution:
    group by switcher row, DCD column, …
  - Can the DQM framework be extended to allow re-configuration at runtime to request full-resolution histograms for areas of the sensors?
  - Or reduce the required network load to allow them?
    longer update interval? multicast?

Thank you!

Switch usage

- 48+2 ports @ PS:
  - 40× PS CAT5
  - 1× PS crate control
  - 1× uplink to DHH rack OM3
- 16+2 ports @ DHH:
  - 2×4× DHH CAT5
  - 2×4× DHH IPMI CAT5
  - 1 PS switch OM3
  - 1 uplink to E-Hut OM3