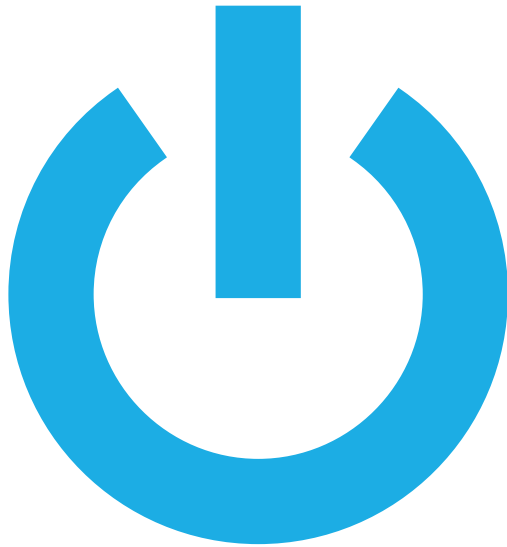




DAQ OPERATION STATUS: AUTO-RESTART SCHEME

S. Yamada (KEK)

Towards “non-stop” DAQ (2022.12 slide)

M.Nakao, S.Y.Suzuki,
R.Itoh, S.Yamada, T.Higuchi,
T.Konno, “Non-Stop Data
Acquisition System for the
Belle II Experiment”, IEEE
Real Time 2014

Steps towards non-stop DAQ

Quick(auto)
initialization
of faulty FEE

Partial-SALS

Auto start
with next subrun
(just resetft)

...

Auto-SALS

Wish

(M. Nakao)

● FEE error recovery without SALS

- **Same** run number, **increment** sub run number, event number just **kept incrementing**
- Original DAQ plan included such a wish
- DAQ system has been too complex and unreliable to work on it
- Now, this workshop is a chance to revisit (similar wishes also in subdetector talks)

● What can be actually done

- Recovery from ttlost / b2llost may be realized in a **O(1sec)** time scale
- Recovery from other FEE errors demands reprogramming and would take longer time of **O(1min)**
- Use **PAUSED** state like HV recovery — still some gain against full SALS

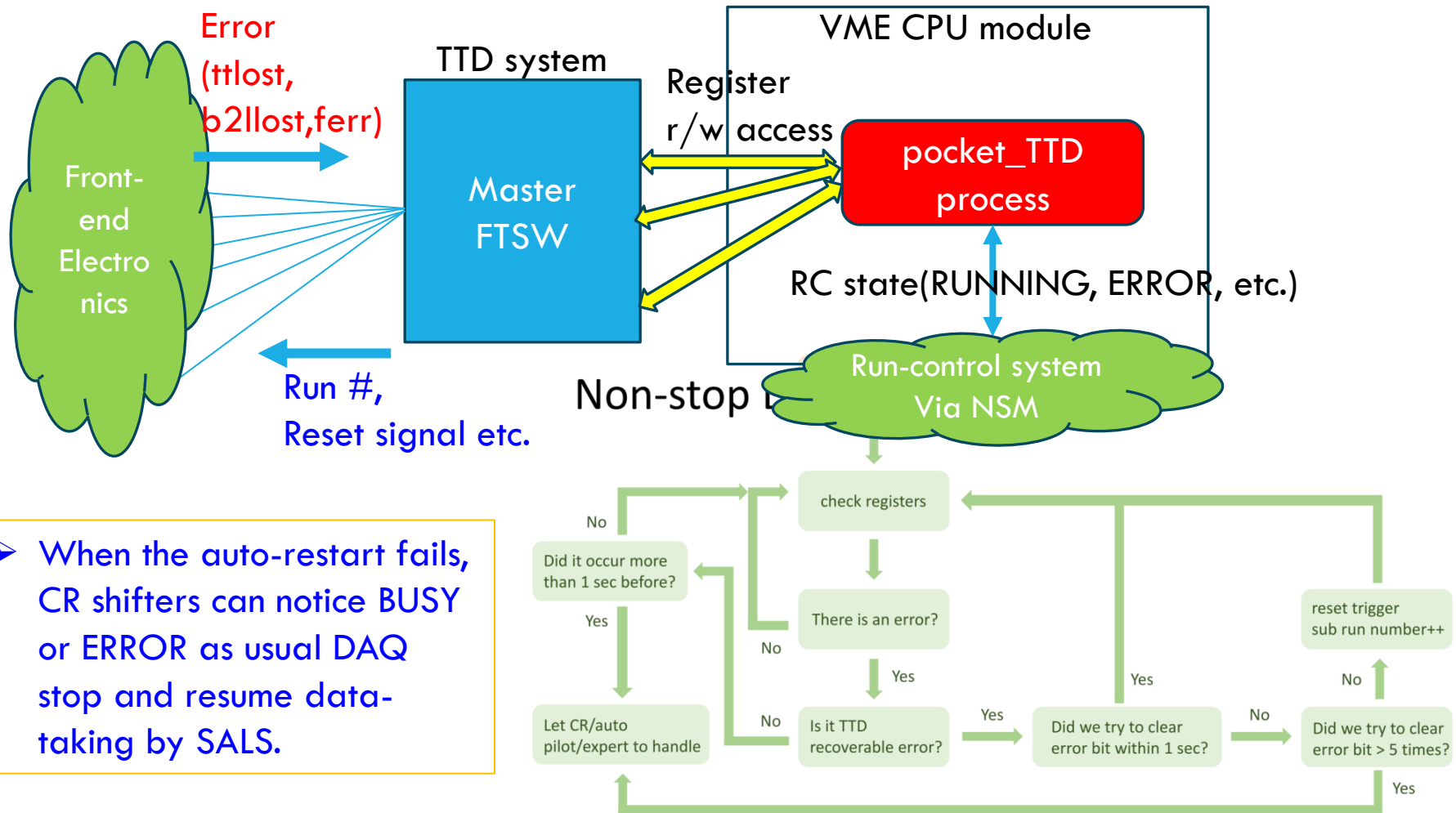
● What have to be involved

- **TTD** is the main player
- FEE errors are also detected as corrupt data at **readout PC**
- Therefore, the recovery sequence has to be handled by an upper level — **RUNCONTROL?**
- And **FEE** should be able to start from a non-zero event number

Auto-restart for TTD detectable errors(e.g. ttlost, b2llost) (JW.Park)

- Instead of going through SALS, the TTD system will quickly clear the error and resume data-taking with an incremented subrun number.

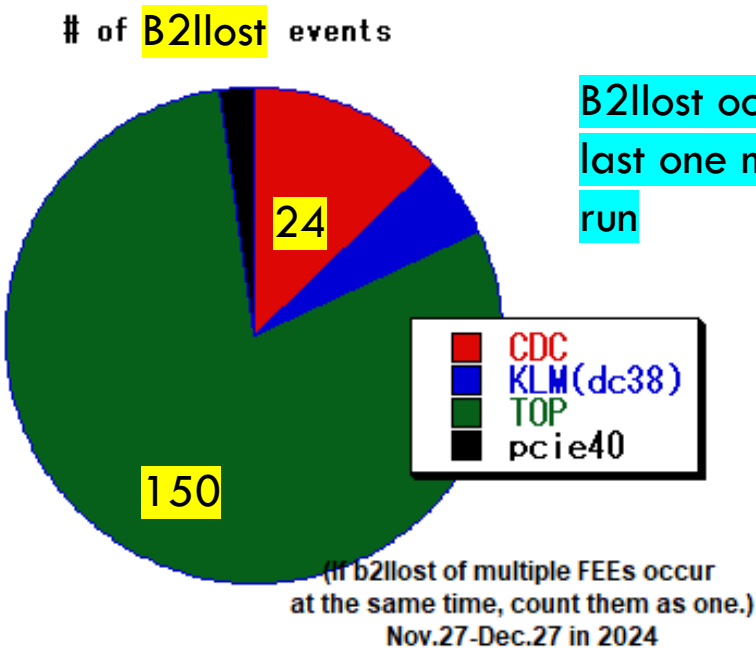
- Full restart(SALS) w/ HLT : around 90 sec.
- Partial restart(SALS) w/o HLT : in the 20sec. Range
- auto-restart w/ a new subrun : O(seconds)



RESULTS OF THE AUTO-RESTART TEST W/ B2LLOST

- Auto-restart was tested by inducing b2lllost through resetting b2link on the PCIe40.
- CDC failure rate is low but TOP and KLM failure rates have room for improvement.
- CDC and TOP (and KLM) caused the large numbers of run-stop errors among sub-detectors in the last 1 month in 2024c.

	# of b2lllost attempts	Failure in restarting	Failure Rate[%]
SVD	83	14	14
CDC	35	1	2.9
TOP	50	8	16 (update recently)
ARICH	14	6	43
ECL	16	2	13
KLM	6	2	33
TRG	86	7	8.1



B2lllost occurrence during the last one month of the 2024c run

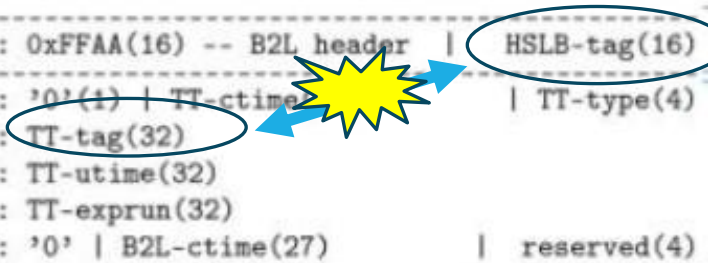
EXAMPLE OF AUTO-RESTART FAILURE

Event # mismatch in b2link header

- In the latest test with TOP in Sep, all errors were the mismatches of event # in two parts in the b2link header was observed.
- Will check PCIe40 fw if it can be aligned.

Data format of b2link header

```
HSL: 0xFFAA(16) -- B2L header | HSLB-tag(16)
B2L: '0'(1) | TT-ctime(32) | TT-type(4)
B2L: TT-tag(32)
B2L: TT-utime(32)
B2L: TT-exprun(32)
B2L: '0' | B2L-ctime(27) | reserved(4)
```



Persistent busy from TOP/KLM FEE

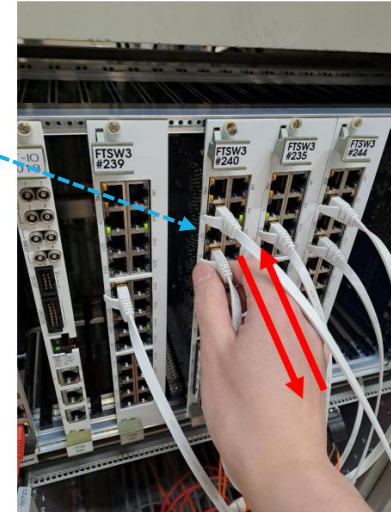
- TOP and KLM FEEs sometimes issue a BUSY signal after auto-restart.
 - In the latest test last week, only KLM issues the BUSY signal for some reason.
 - This is more likely to happen at higher-rate(e.g. 44kHz input) and rarely happen at 1 kHz.
- TOP and KLM are also going to add some diagnostics registers to know the source of the busy signal.

FTSW detected busy from a TOP FEE

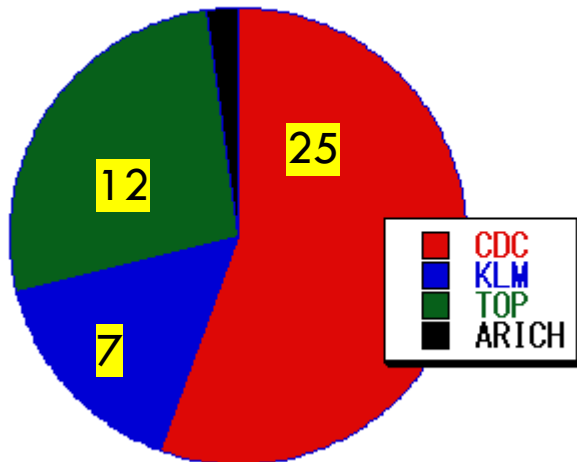
```
3=06500 reg=0a000000 108000f9 BUSY ready tag=0
...
4=17505 4a1c227f ready tag=1843839 [s02a]
5=17506 4a216b10 ready tag=2190096 [s02b]
6=17507 4a216b10 ready tag=2190096 [s02c]
7=17508 4a216b10 ready tag=2190096 [s02d]
2=17600 30800030 min=54
0=17601 4a216b10 ready tag=2190096 [s03a]
1=17602 4a1c227f ready tag=1843839 [s03b]
2=17603 4a216b10 ready tag=2190096 [s03c]
3=17604 4a216b10 ready tag=2190096 [s03d]
4=17605 54010000 busy=none [s04a]
5=17606 4a00000b ready tag=11 [s04b]
6=17607 4a216b10 ready tag=2190096 [s04c]
7=17608 4a216b10 ready tag=2190096 [s04d]
```

TTLOST TEST BY UNPLUGGING CABLE ON FTSW

- Unplugging and plugging CAT7 cable on FTSW to cause ttlost.
 - Auto-restart worked in several attempts.
- On the other hand, causing ttlost by flipping data from FTSW in FEE ends up another error called tagerr and needs SALS to restart data-taking.
- To solve this, it might need modification in firmware in FEE side(b2tt fw core).
 - It will not happen in this shutdown period.



Ttlost occurrence during the last one month of the 2024c run



(If ttlost from multiple FEEs occur at the same time, count them as one.) Nov.27-Dec.27, 2024

```
data_out <= data_out_bef xor data_out_xor;

process (tx_clkout, reset)
begin
  if reset='1' then
    cnt_3min <= (others => '0');
    data_out_xor <= (others => '0');
  elsif rising_edge(tx_clkout) then
    data_out_xor <= (others => '0');
    if cnt_3min > VAL_3MIN then
      data_out_xor <= x"0020";
    end if;
  end if;
end process;
```

Auto-restart under the auto-pilot mode



- Currently, the auto-pilot mode immediately perform auto-SALS
- It performs before the auto-restart finishes resetting.
- I added 5sec. Sleep time for the TTD errors before the auto-pilot starts the auto-SALS
 - It is similar function for the auto-pilot detects persistent BUSY.
- I will make a merge request when we confirm it works.
 - https://gitlab.desy.de/belle2/daq/daq_slc/-/tree/feature/wait_5sec_before_autoSALS_for_subrunchange?ref_type=heads

Summary

- Auto-restart will shorten the recovery time compared to partial SALS.
 - Pocket_TTD process send error reset signal to FEE and PCIe40 via FTSW.
- It can recover from b2llost or ttlost errors, which frequently occurred under high b.g. runs in the 2024c run.
- It will keep run# but subrun# is incremented.
 - So far, the offline group have not found any troublemakers due to non-zero subrun #.
- By resetting b2link from PCIe40, we have performed auto-restart tests.
 - Regarding CDC and TOP, the failure rate is less than 20%.
 - Efforts to reduce the failure rate is ongoing.
- Since any failures of the auto-restart can be recovered by the standard partial SALS restart scheme, we will start using the auto-restart scheme in 2025c run.

backup

PERSISTENT BUSY: INVESTIGATION BY TOP AND KLM FEE EXPERTS

- We performed a test with TOP+KLM, involving Vasiliy-san(TOP) and Chris-san and Horacio-san(KLM).
- Unfortunately, the TOP persistent BUSY was not reproduced somehow.
- KLM BUYS was observed.
 - KLM experts have a new DC firmware running that will report the bits of busysrc as discussed in the meeting last week.
https://gitlab.desy.de/belle2/detector/klm/klm-operation-issues/-/issues/13#note_1276335
 - busysrc was 0 when persistent BUSY was observed.
 - They will add more registers to be monitored.
- Vaisllysan is also going to add some diagnostics related to this to TOP FW. Will we be able to repeat these tests in a couple of days with more detailed test plan?



vasily.shebalin 2 hours ago

this one from b2tt.vhd : `dbgerr(87) <= sta_fifoful;`

7 replies



christopher.ketter 2 hours ago

I did not. I only connected `busysrc` to status registers.



horacio.crotte 2 hours ago

Do you know how can we grab this b2tt register? *Edited*



vasily.shebalin 2 hours ago

I see. Even If `busysrc=0` , b2tt fifo full will still cause b2tt busy.

By connecting `dbgerr` to some register, I think.



christopher.ketter 2 hours ago

That makes sense. I think we should connect everything we can from b2tt and try this test again. Maybe from `belle2link.vhd` as well .

@horacio.crotte , we have to compile a new firmware to have access to those extra registers.



horacio.crotte 2 hours ago

Ok I understand, I was hoping they were available somewhere else. Thanks!