DAQ operation in cosmic/Phase II
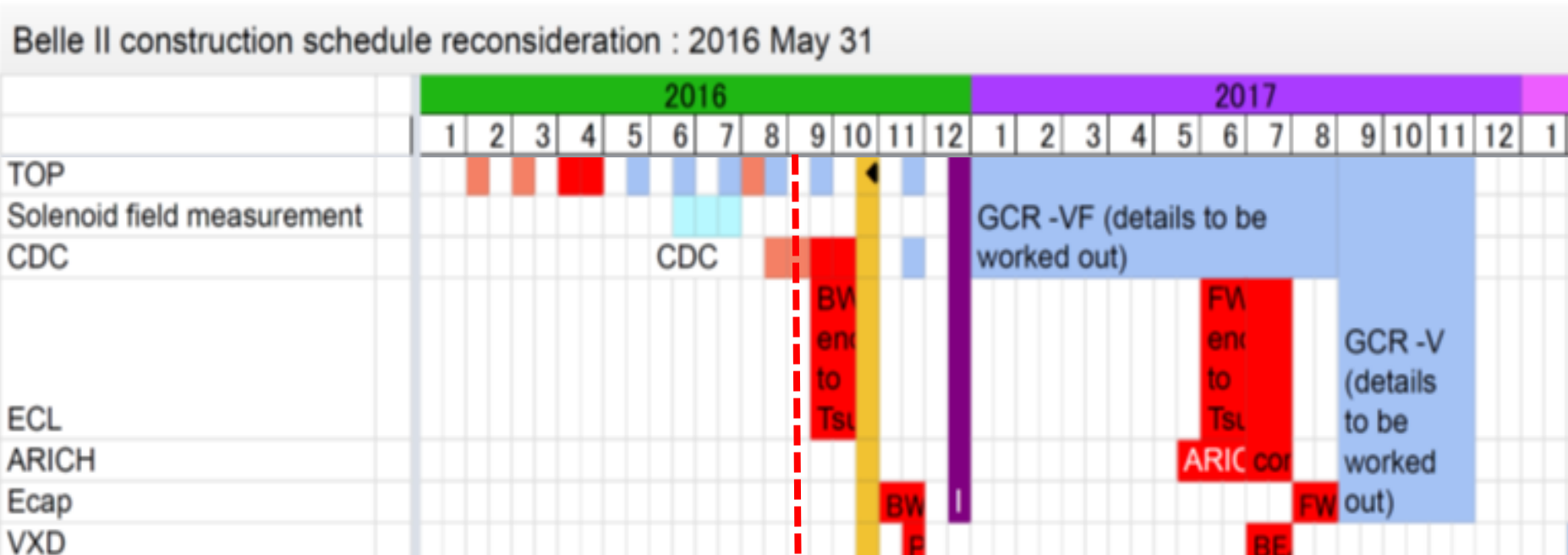
1. DAQ Integration for GCRT
2. Local run DAQ
3. Error handling

S. Yamada (KEK, IPNS)
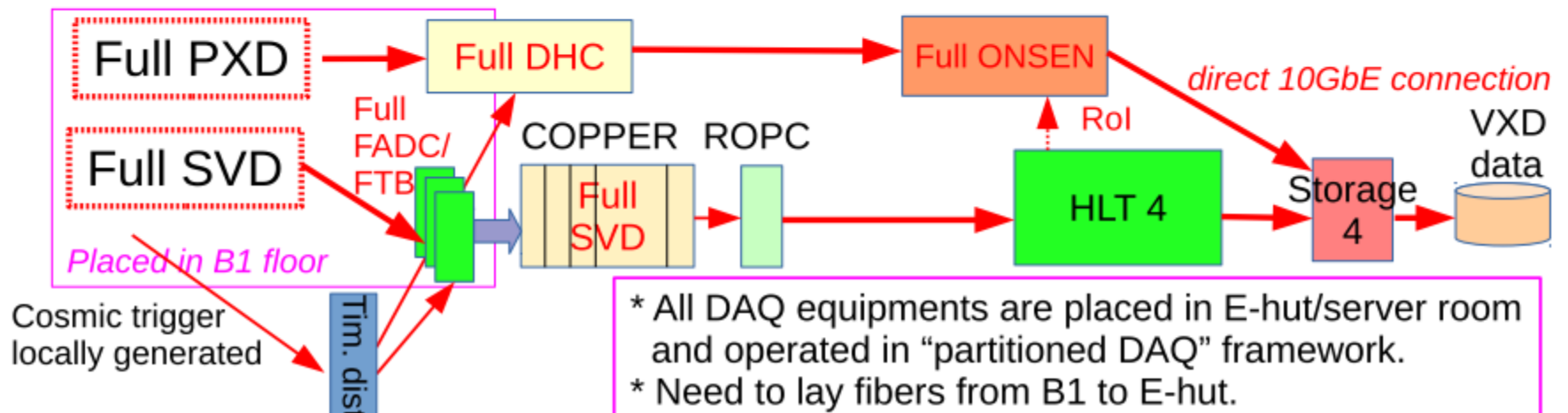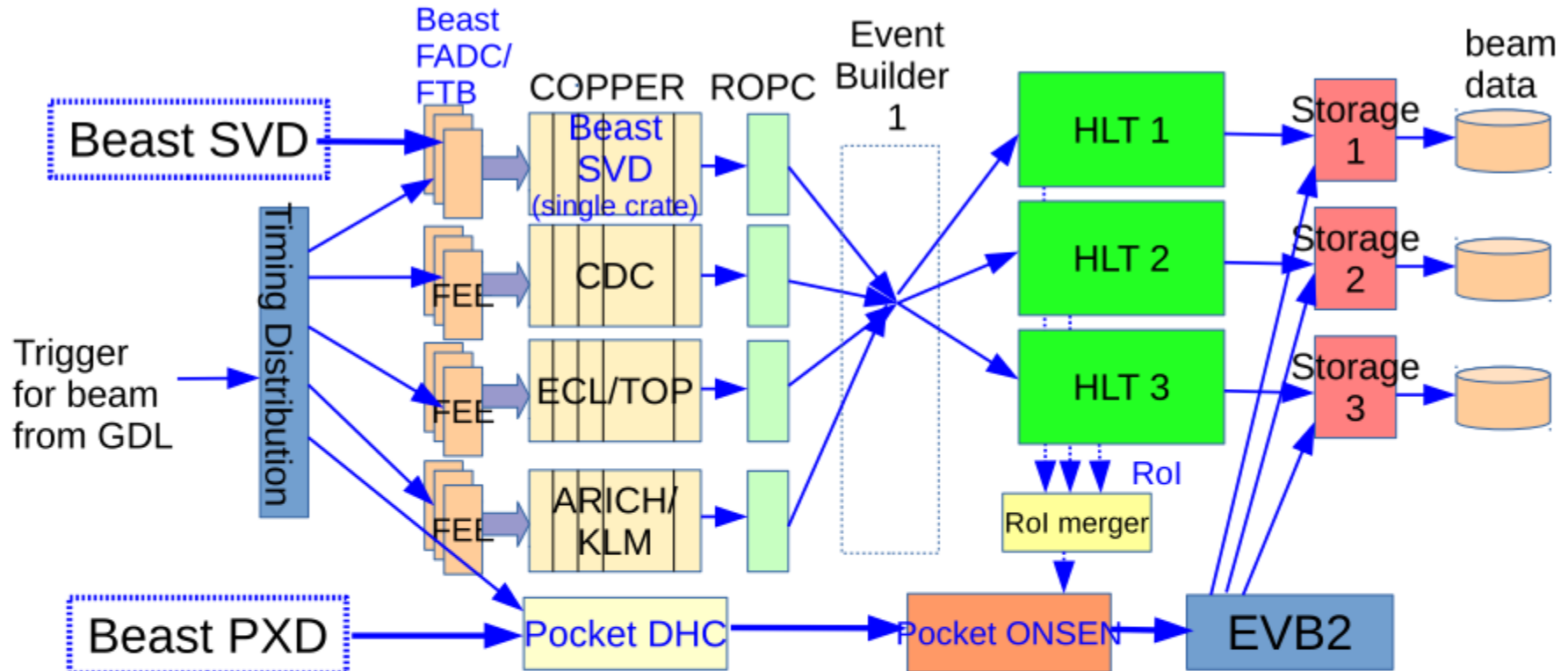
1, DAQ Integration for GCRT

Schedule – possible modification

Belle II construction schedule reconsideration : 2016 May 31

	2016												2017												
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1
TOP																									
Solenoid field measurement													GCR -VF (details to be worked out)												
CDC					CDC																				
ECL								BW end to Tsu										FW end to Tsu						
ARICH																		ARIC cor		GCR -V (details to be worked out)				
Ecap									BW											FW					
VXD									B										BE						

TRG/DAQ workshop

3

Partitioned DAQ operation during Phase II run

(R. Itoh)

DAQ Integration schedule

	Key events	Combined global DAQ (only one system can be operated.)	Standalone global DAQ (independent trigger source and event-building)
Aug.			
Sep.			CDC(+TOP M01), TOP, bECL, KLM
Oct.	CDC installation →		CDC, TOP, bECL, KLM
Nov.	(KLM trg for TOP)? →	CDC+TOP+bECL+KLM	
Dec.	eECL(BW) install → Roll-in →	CDC+TOP+ECL+KLM	Sometimes each sub-detector will take data separately.
Jan.	Global CRT starts		

DAQ issues

	Key events	Combined global DAQ (only one system can be operated.)	Standalone global DAQ (independent trigger source and event-building)
Aug.			**Stable operation for TOP**
Sep.		**COPPER installation for all CDC FEEs**	CDC(+TOP), TOP, bECL, KLM
Oct.	CDC installation	**Include KLM to global DAQ (mainly SLC related work)**	CDC, TOP, bECL, KLM
Nov.	(KLM trg for TOP)?	CDC+TOP+bECL+KLM	
Dec.	eECL(BW) install / Roll-in	CDC+TOP+ECL+KLM	Sometimes each sub-detector will take data separately.
Jan.	Global CRT starts		

Run coordination(local run or GCRT run), shifter, elog, runsheet and database ,etc should be considered, which will be a prototype of those in phase II run.
We don't have a concrete plan yet.

As for run-coordination, at the beginning, I think that [DAQ experts + CRT coordinators from each sub-detector group] can discuss and decide the run coordination.
With the experience, we will start making a framework for the phase II run.

2. Local calibration run

Local run :
-> Independent Trigger Timing Distribution and data-flow
It is basically same as the current CRT situation.
-> Partition DAQ system can be used.

(R.Itoh @ the last TRG/DAQ WS)

Local Run

Issue 6. Calibration scheme
a) "Local run" scheme
  - Dedicated calibration data taking (once per day or so)
  - Special event building scheme (detector by detector basis)
    is required.
  - Also needs 1-to-1 connection of each detector to
    a HLT-Storage unit. Number of HLT-Storage unit is not
    enough to manage all detectors at one time.
      -> Developing "virtual" HLT-Storage unit operation.
        (=Multiple "virtual" units on the same physical unit)
        Slow control should be prepared also for config. mng.
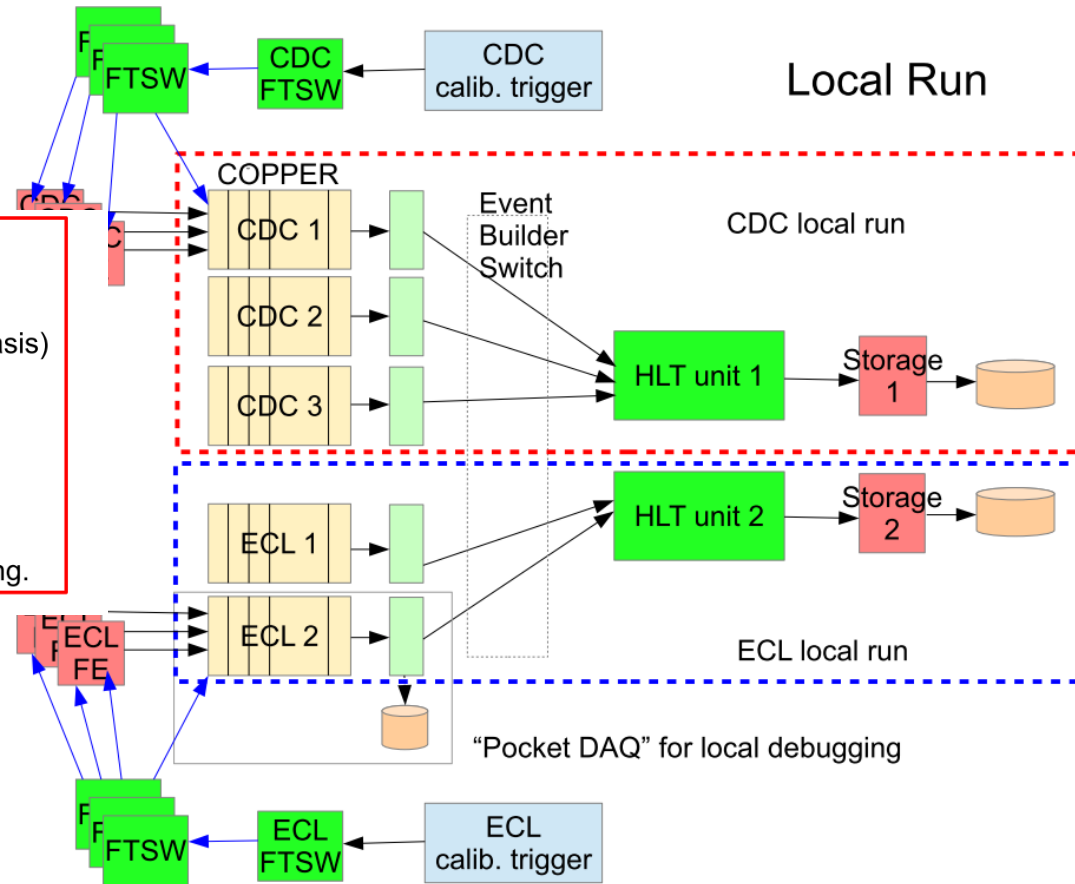
Issues to be solved (R.Itoh @ the last TRG/DAQ WS)

1. Trigger
    a) Local run
       * Each detector group is supposed to provide the specific trigger for the calibration
    b) Partitioned DAQ
       * Two (or more) different trigger sources has to be managed by trigger system
       ex. Beam trigger for Beast II run + Cosmic ray trigger for outside detectors

> TRG/sub-detector group

2. Timing distribution
    a) Local Run
       Trigger distribution to FEE is supposed to be managed by each detector. Local run trigger is fed to the FTSW.
    b) Partitioned DAQ
       The 2nd (or 3rd) master FTSW is placed on the top of FTSW tree.
       How to manage the wiring between down-stream FTSWs?
       Possible to manage "logically" by sharing the same wire connection?

> ☺Each sub-detector's master FTSW can provide trigger/clock independently.
> Two combined TTD trees are not(will not be) available.

3. Data Stream
    a) Local Run/ Partitioned DAQ
       * Multiple COPPER crates + partial event building + single HLT/storage unit.
       * Simultaneous operation of multiple streams.
       * Number of HLT/Storage units is not enough to manage

> ☺ Already demonstrated for CDC and ECL CRT.

4. Run control
    a) Local Run / Partitioned DAQ
       * Multiple run control scheme sharing the same slow control backbone.

> ☺ Already demonstrated for CDC and ECL CRT.

DAQ group's policy for local run :
The TTD and DAQ system should be same as used for physics run.

Issues to be considered

Therefore, for example, we'd like ask sub-detector groups to do the following;

1. Trigger source :
-> Let trigger signal go through the FTSW system so that FTSW can handle busy-handshake and COPPER can build events from the 4 HSLBs.

2. Event #
  ➢ If you split one event to 16, event # attached in header should be modified so that it is incremented by 1 to make backend DAQ work consistently.

If event-tag will be incremented by 1, these tentative measures are not needed.
 e.g. : event0 fragment 0 -> tttag = 0, event0 fragment 1 -> tttag=1 , … ,
Even in this case, online-event building with other sub-detectors or TRG data is not possible.

3. Location of data-file
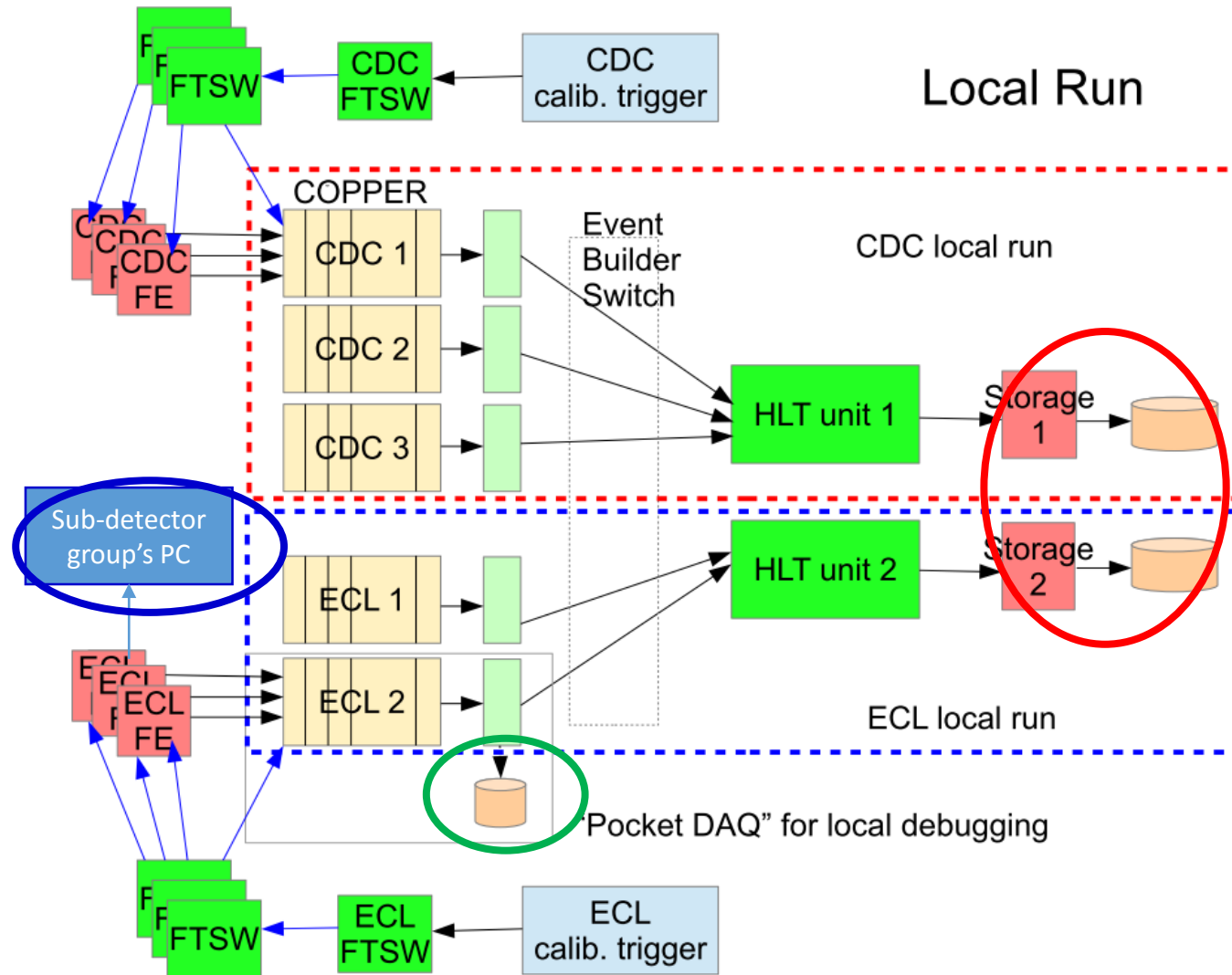
Local Run

Storage:
- Local run's data are stored here.
- Large disk space
- dedicated path to KEKCC

ROPC's disk:
- Limited disk
- No regular backup by DAQ gr.
- Narrow bandwidth to KEKCC (via b2stone)

Each group's PC:
- Narrow bandwidth to KEKCC (via b2stone)

3, Error handling in DAQ operation
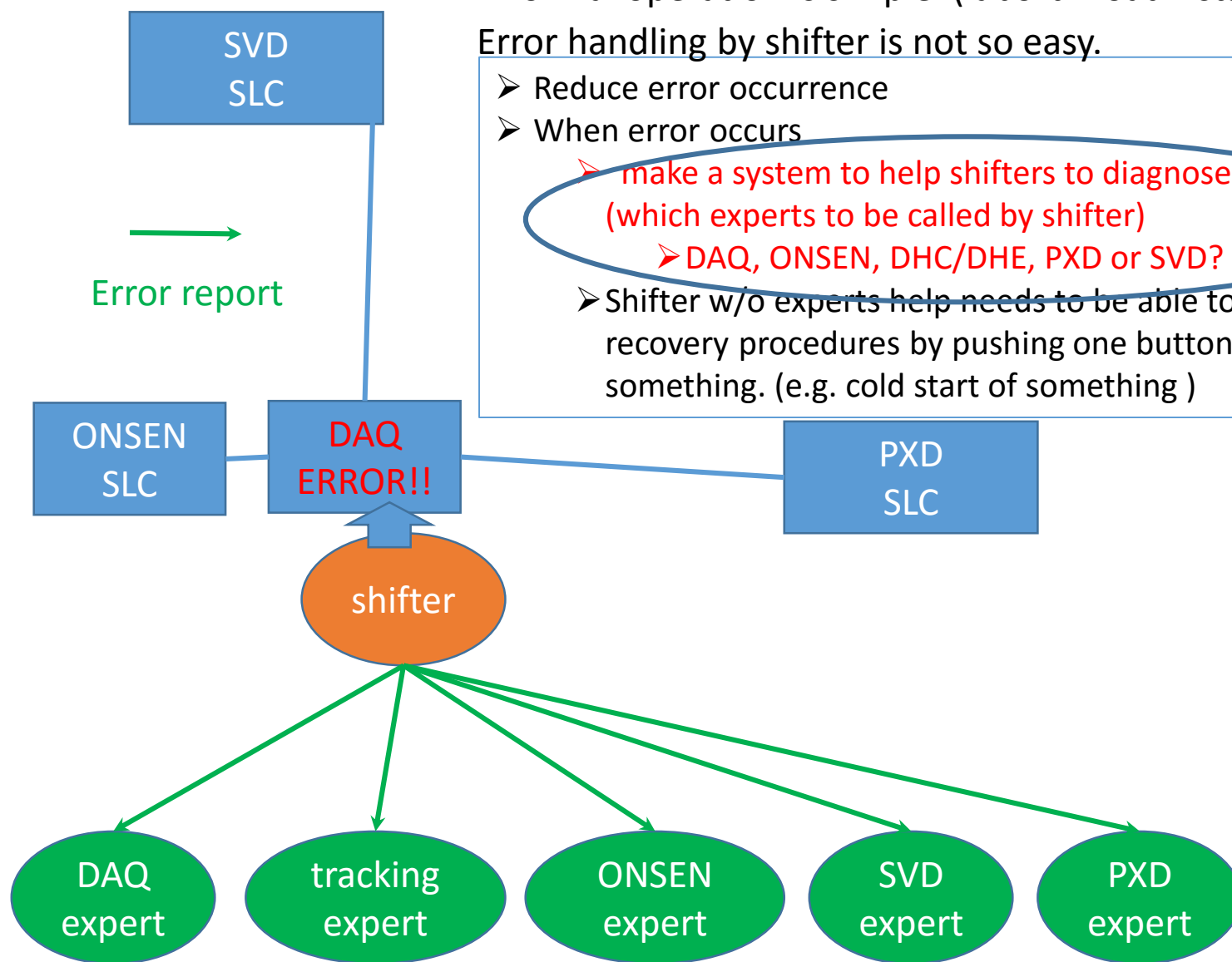
Example : the DESY VXD beam test in April

SVD
SLC

SVD
expert

Error report

ONSEN
SLC

DAQ
ERROR!!

PXD
SLC

ONSEN
expert

DAQ
expert

PXD
expert

tracking
expert
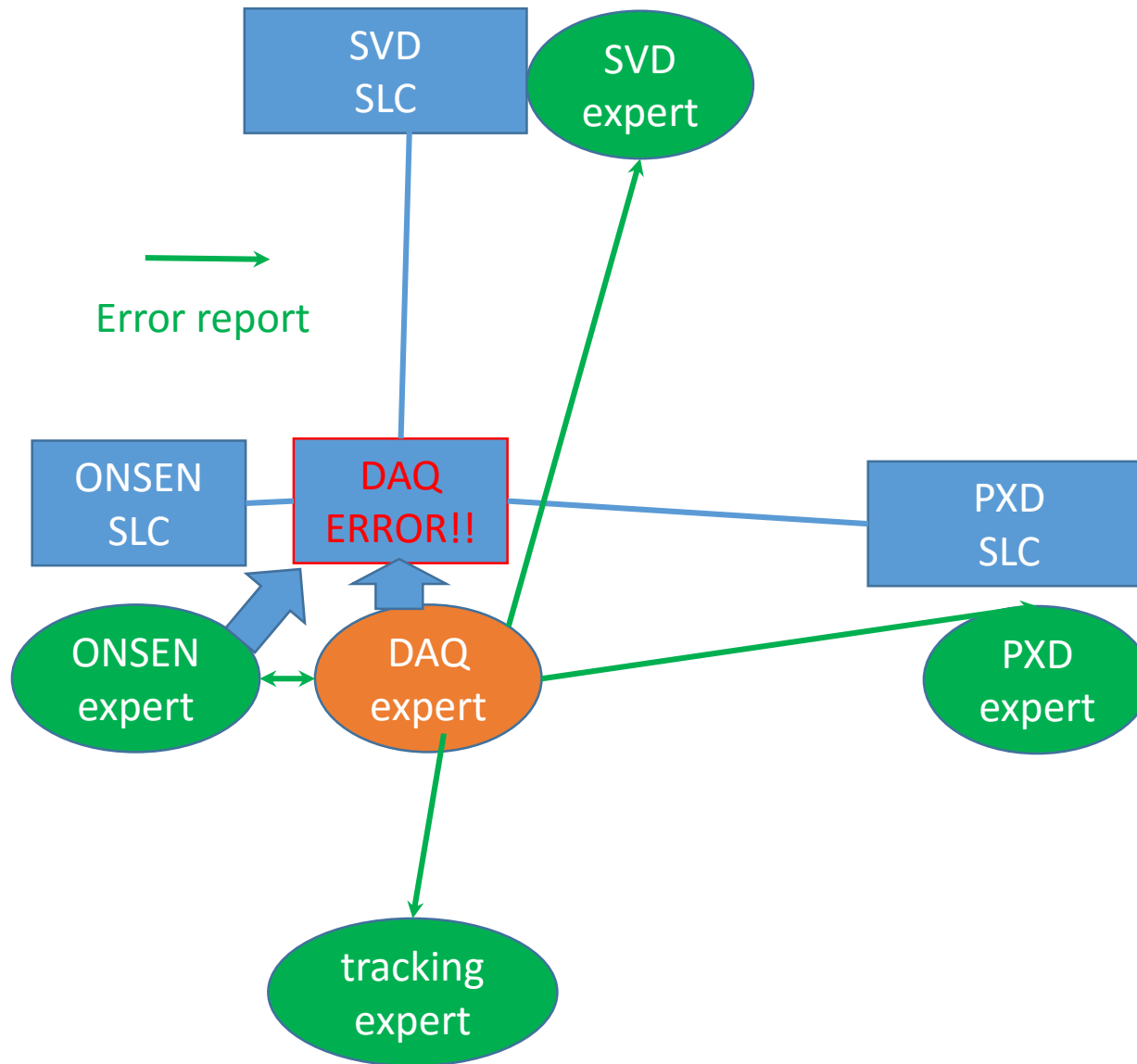
Hopefully, the next DESY beam test or phase II run will be:

Normal operation is simple. (abort->load->start)

Error handling by shifter is not so easy.

- ➤ Reduce error occurrence
- ➤ When error occurs
  - ➤ make a system to help shifters to diagnose error (which experts to be called by shifter)
    - ➤ DAQ, ONSEN, DHC/DHE, PXD or SVD?
  - ➤ Shifter w/o experts help needs to be able to do some recovery procedures by pushing one button or something. (e.g. cold start of something)

SVD
SLC

⟶

Error report

ONSEN
SLC

DAQ
ERROR!!

PXD
SLC

shifter

DAQ
expert

tracking
expert

ONSEN
expert

SVD
expert

PXD
expert

The error diagnostic system should ;

➢ Provide information to shifters what to do
   A) Please call ***gr. experts.
   B) Please restart the run and email to ** experts.
      If the error is not recovered, please call ** gr experts.
   C) I don't know what to do. (The system needs not to cover all errors. Covering 80% of the total occurrences is fine.)

➢ be able to be used by shifters without reading instruction, otherwise the system may not be used.

For errors in the prev. DESY test (1)

How DAQ was stopped unexpectedly in the last DESY VXD beam test:

➢ Failed to start run (stop->abort->load->start)
  ➢ Failed to establish network connection with ONSEN   -> (B) [DAQ]
  ➢ Remaining process in the prev. run occupied a port on COPPER CPU -> (B) [DAQ]
  -> DAQ issue
➢ After DAQ starts running
  ➢ HLT crashed -> tracking issue
    ➢ Mainly due to error handling in tracking modules (e.g. Uncaught exception) -> (B) [tracking]
  ➢ Event mismatch occurred in the DESY test in 2014 did not stop DAQ this time
    ➢ But when ONSEN sent corrupted data to eb2, where magic word was never found, DAQ got stuck. -> (B)[DAQ/ONSEN]
  ➢ DHC/DHE busy -> FW(HW) issue -> (A)[DHH]

➢ Data quality is not good.
  ➢ Event mixing in an event data -> FW(HW) issue
    ➢ Different event # info. between ONSEN(HLT) and DHC
    ➢ Different event # info. Between DHC and DHEs
    -> When it is observed for the first time -> (C). After investigation, it will become (B)[DAQ/ONSEN/DHH].
  ➢ Checked by experts with Data quality monitor -> mis-config. etc -> (A) [SVD/PXD]

-> Accumulating knowledge of frequent errors is important for efficient error handling.

When errors occur, currently we check;

1, log message from DAQ processes

2, output of statft

3, status indicator of SLC system

->

Diagnose these info. and provide shifters what to do.

②

Message windows to shifters ?

When errors are detected by ROPC/COPPER DAQ software:

1. Errors in data(header/trailer)
   - ➢ No magic words
   - ➢ Error of checksum attached by COPPER driver (after b2link)
   - ➢ Different event # between HSLBs on a COPPER
   - ➢ Event # jump, COPPER counter jump

-> Tagged as [FATAL] in log message so that the diagnostic system can know the problematic DAQ part by searching [FATAL] in the log.

2. Data stream errors:
   - ➢ "Connection reset by peer" -> This occurs because other processes dies due to some errors.
   - -> Ignore the error.

When trigger is stopped :


```
                    yamadas@ttd1:/home/usr/yamadas
statft version 20160712 FTSW #200 / ft3o041a - 2016.07.27 14:35:00.794
— READY (reset at 2016.07.27 14:16:01)
16  exprun=00034000 exp 0 run 832 sub 0
17   omask=00009f3e s3q=0 clk=00 o=1f3e LOCAL
1f     jpll=cc008000 clk=in GOOD-CLOCK
20   reset=80000000 no-FIFO
28  seltrg=fff00001 aux
2a/2b trig 3106399(2467.4Hz) -> 0(0.0Hz) -> 0(0.0Hz)
29/2c limit 0 <-> last 0
2d stafifo=10000000 empty trg-DISABLED
30-32 busy=050 bsyin=000 errin=000
25 errport=f0000000
33-35 b2tt-down=000/alive=1f3/up=1f3
36-37 b2l-down=000 pll-down=000
405468   00=1360000f 00000000 04756581 tag=0(0) cnt=0 d=0.00%
415569   o1!1370000f 00000000 020465c3 tag=0(0) cnt=0 d=0.00%
44586c   o4!1860000f b0019ff0 00006500 busy tag=1(3) cnt=40944 d=0.00%
45596d   o5!1870000f 00000000 02c56501 tag=0(0) cnt=0 d=0.00%
465a6e   06=1880000f 83000004 02486549 busy tag=768(0) cnt=4 d=0.00%
475b6f   07=1890000f 00000000 024763c8 tag=0(0) cnt=0 d=0.00%
485c70   o8!1900000f 00000000 0248654a tag=0(0) cnt=0 d=0.00%
7f latency=0c00b000 maxtrig=12 maxtime=351.44us
a0-a7 dead 0.00% (t=0.00% c=0.00% p=0.00% f=0.00% r=0.00%)
```

➢ [BUSY] is usually caused by backend DAQ error.
  -> check log messages.
➢ [ERROR]
  ➢ feeerr
    ➢ call sub-detector DAQ experts ?
  ➢ b2link down
    ➢ Call DAQ experts to reestablish the link.

Hopefully, Nakao-san's b2tt update will help to pin down the error source and its cause.

(M. Nakao)
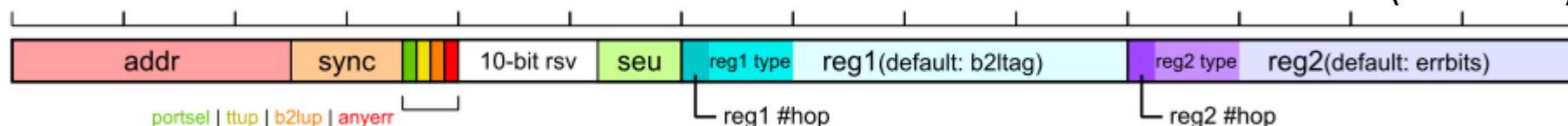
● Two registers as window to access more bits

  ● 2-bit #hop, 6-bit type, 24-bit data

  ● reg1 is state dependent, to tell error source upon error

  ● If no error, b2ltag to tell how many events are written to belle2link

  ● reg2 is user controlable to access more info

Summary

- ➤ DAQ integration is on-going towards global CRT.
  - ➤ First, independent CRT system will be running and after KLM trigger is ready, I think that combined (CDC+TOP+ECL+KLM) can be started.
- ➤ DAQ system for local run in phase II/III is considered.
  - ➤ Our policy is using partitioned DAQ system, whose hardware/software of DAQ/TTD system should be same as for physics run.
  - ➤ Inputs of local run plan from sub-detector groups are important for the preparation.
- ➤ Towards phase II run, error handling system should be prepared so that non-experts can deal with error situation.
  - ➤ The system should tell shifters what kind of error is occurring and what you can do or whom you should contact with.