

Status of ONSEN

now JSPS fellow at KEK

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Bundesministerium
für Bildung
und Forschung

IHEP Beijing, Univ. Giessen, KEK, Mainz Univ.

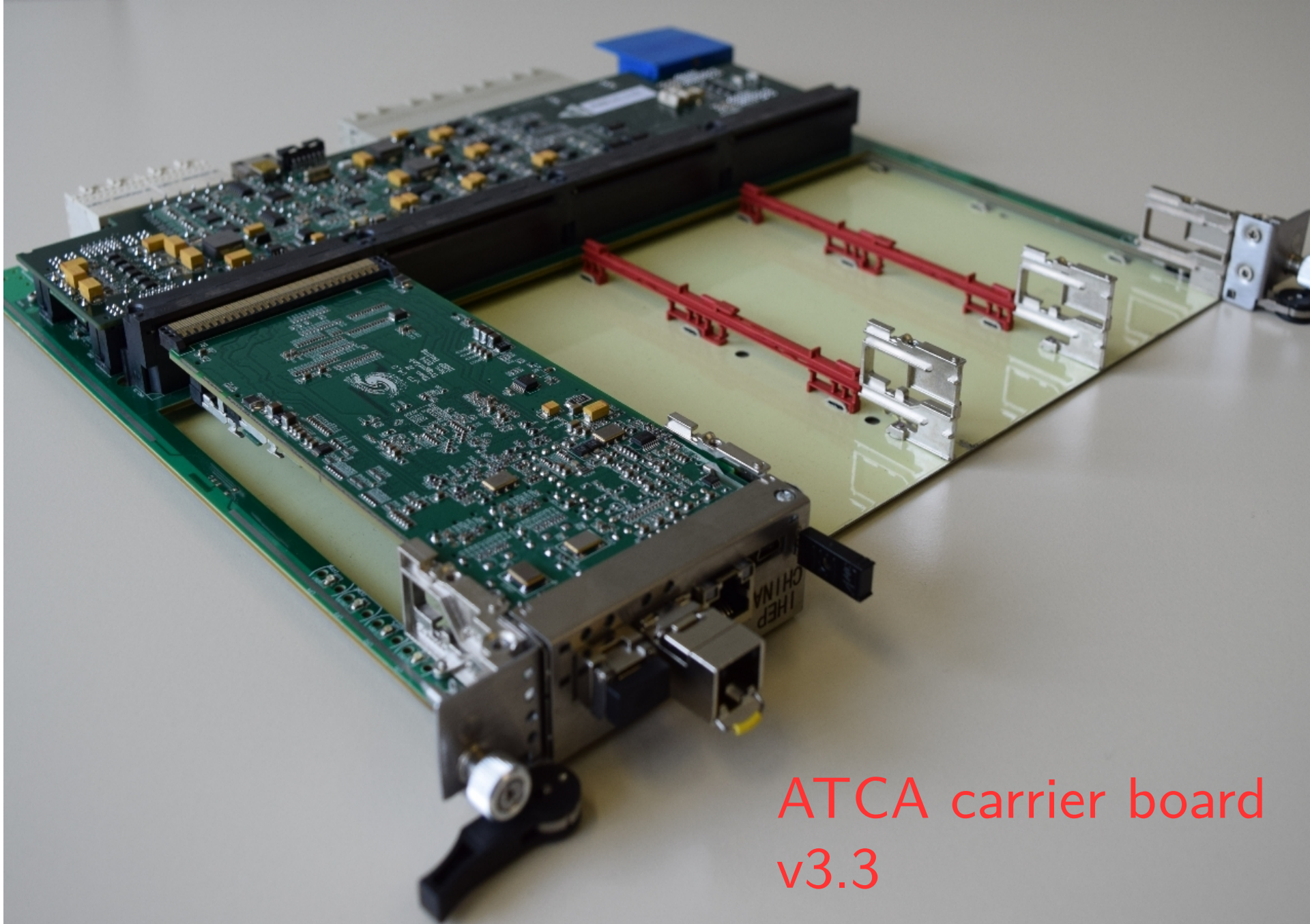
9th Belle II VXD Workshop
Valencia, 13.01.–15.01.2015

OUTLINE

1. Status of hardware
2. Preparations for DESY beamtest
3. Test at KEK
4. BPAC Report

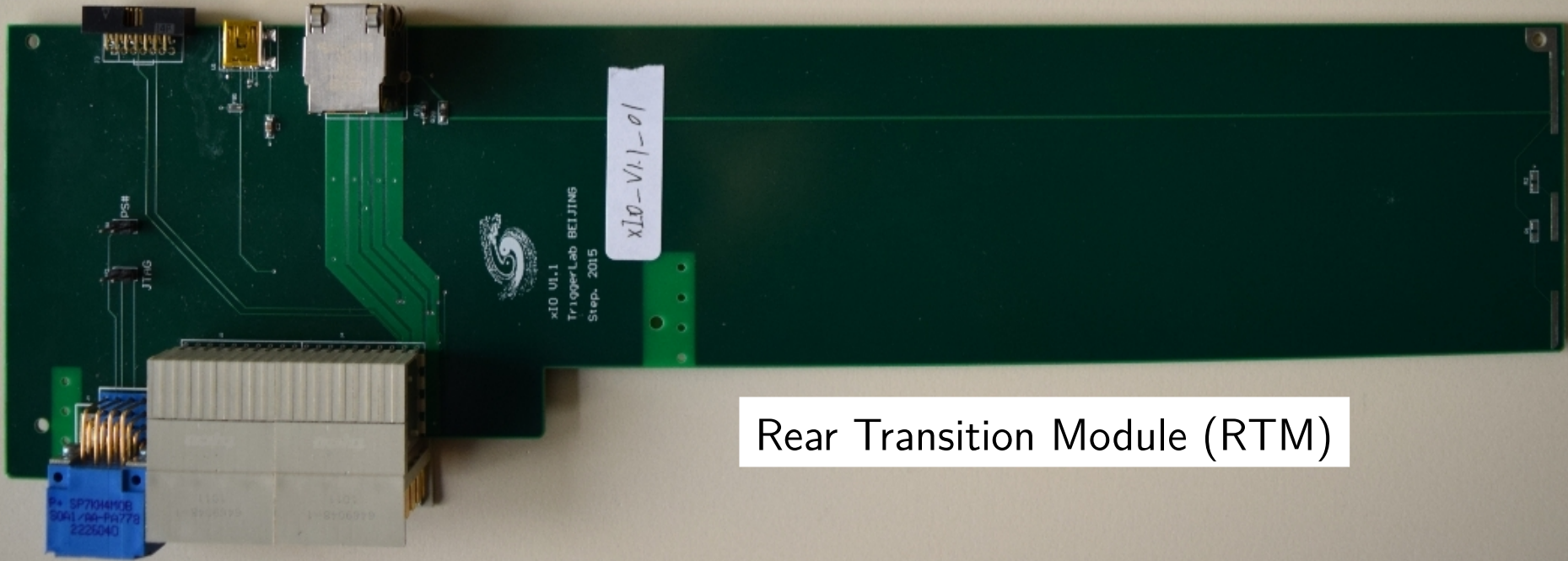
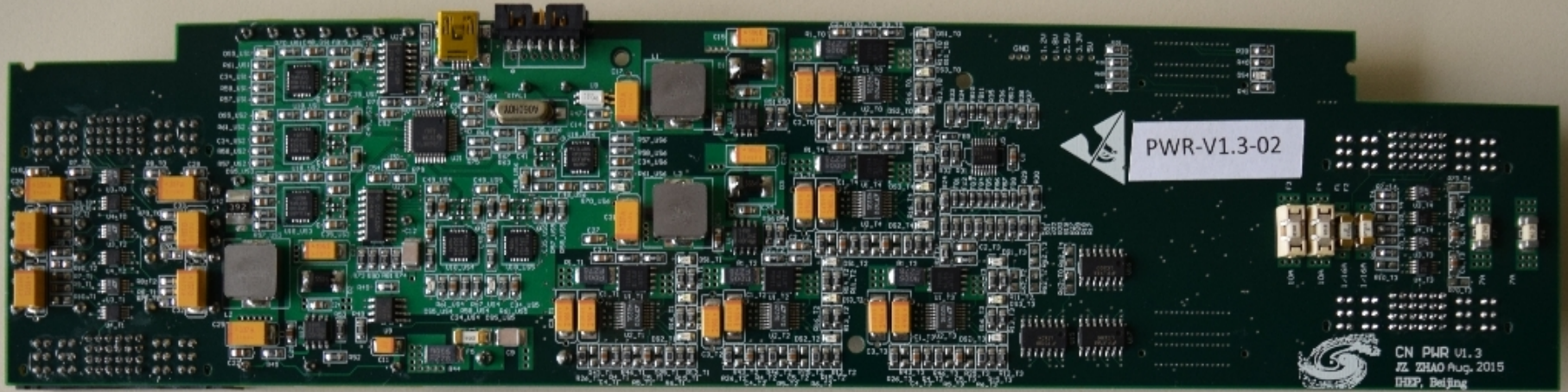
Final ONSEN AMC v4.0 cards, 25.06.2015 (photo taken at Giessen)





ATCA carrier board v3.3

Power Supply Unit (PSU)



Rear Transition Module (RTM)

Status of ONSEN hardware (outside IHEP, delivered and tested)

- ATCA carrier boards, v3.3 (final) required: 9
 - 2 boards in Giessen, but one has JTAG broken
 - * critical for DESY test, more boards hopefully in Feb 2016
 - older versions: only usable for tests (IPMI)
- AMC boards, v4.0 (final) required: 33
 - 7 in Giessen, 2 at KEK
 - older versions: 8 in Giessen, 1 at KEK
- PSU, v1.3 (newest) required: 9
 - 6 in Giessen (not all tested)
- RTM (Rear Transistion Module) required: 9
 - 2 in Giessen

- experience has shown: test at IHEP necessary before shipping
- older versions: slightly different pin layout (different ucf files), and 4 SFP instead of 2 SFP+
- ATCA shelf for KEK, ordered by IHEP (not delivered yet)

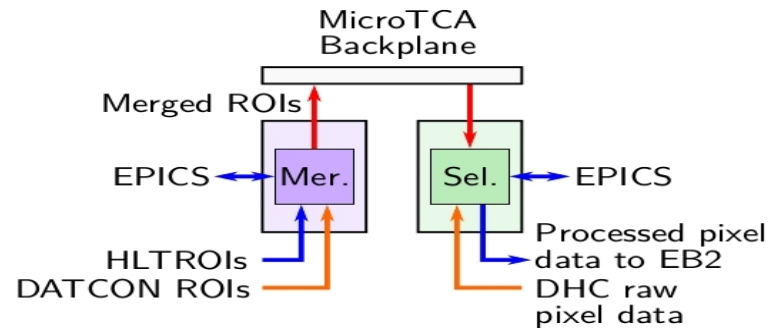
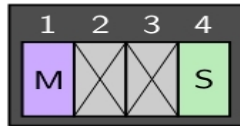
Preparations for DESY Test

What will be new at the DESY test? ONSEN-related hardware and firmware.

- Goal: stable data taking, even at high rate and high occupancy (ONSEN should never crash)
possibly operate up to 8 kHz ?
(in 01/2014 it was 100 Hz, limited by DHH/FTSW)
- Carrier boards will be used
(were not yet available in 01/2014)
- Final AMC boards v4.0 will be used
(older iteration in 01/2014)
- New data format
(run-number in trigger word, for HLT flush)
- ROI distribution system (load balancing)
- Re-check errors observed in 01/2014
e.g. double trigger numbers in data (→ problem for ONSEN!)

Pocket-ONSEN

(used at DESY beamtest 01/2014 and at KEK test)

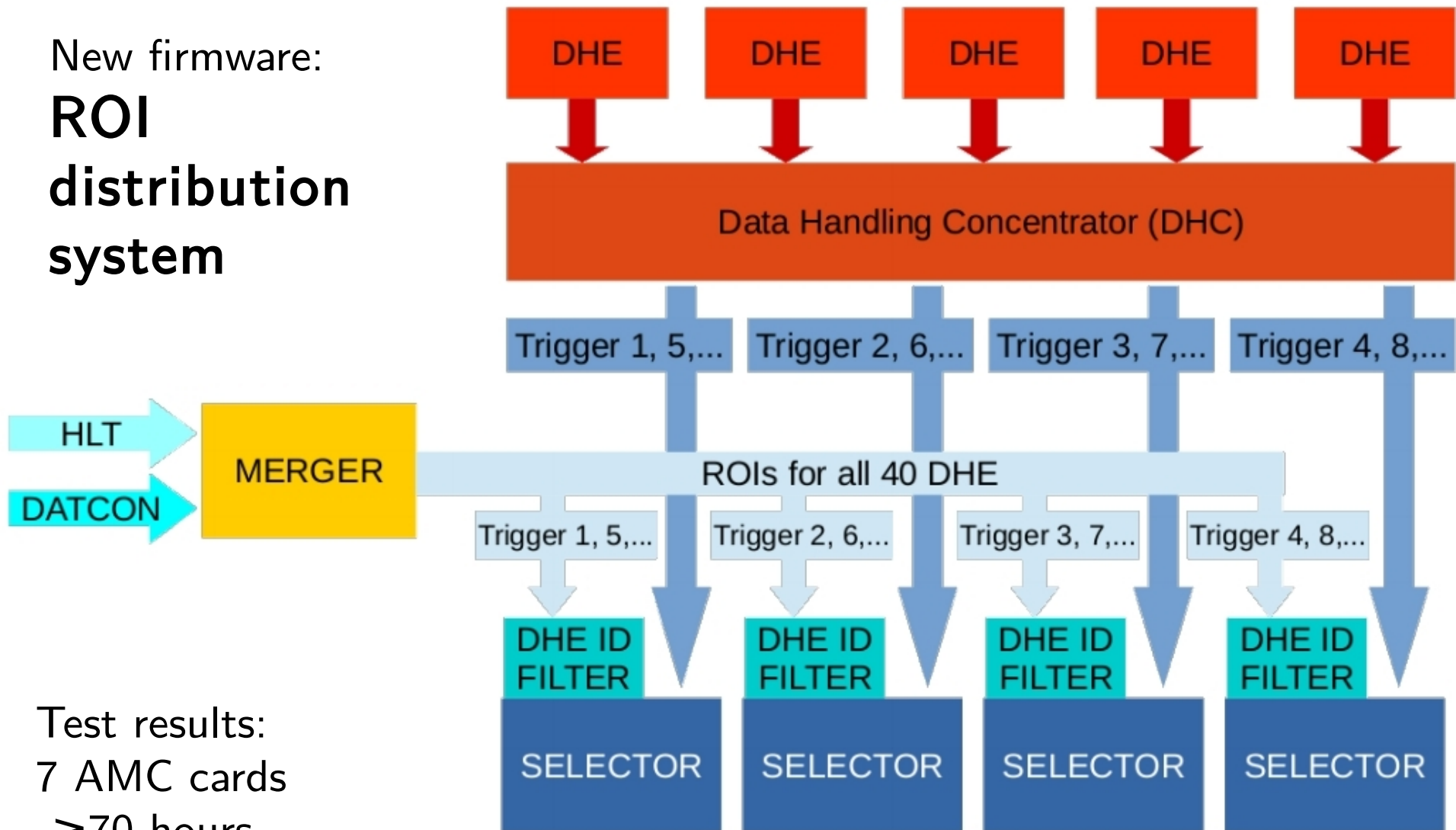


new ONSSEN prototype setup for DESY beamtest 04/2016

- ▶ 2 carrier boards, 1 Merger AMC, up to 4 Selector AMCs
- ▶ ATCA shelf might be a 2-slot "pizza box" shelf



New firmware:
**ROI
distribution
system**



Test results:
7 AMC cards
≥70 hours
 $17,4 \times 10^9$ triggers processed
≥4 TB data processed

Dennis Getzkow

What will be new at the DESY Test ?

ONSEN-related Software.

- **Slow Control and Monitoring**

- updated Linux kernel (4.1.0)
- run start/stop (by epics)
 - init script (on PPC),
buffer flush, set registers will be set (but no bitstream reload)
- crate on/off (reboot)
 - reload bitstreams in flash of carrier board, by CPLD
- IPMI (add-on boards, microcontroller)
 - see talk by Björn Spruck, Slow Control Session, Thursday 16:50

- **basf2 raw data unpackers**

- ready for hit-based data (zero-suppressed)
- ready for full-frame data („pedestal events“)
- also ready for cluster data format, but will not be used in DESY test

PXD RAW UNPACKER, basf2 python script

```
#!/usr/bin/env python3# -*- coding: utf-8 -*-  
  
import os  
import shutil  
from basf2 import *  
  
from basf2 import Module  
  
rawinput = register_module('PXDRawReadRawONSEN')  
rawinput.param('FileName', 'dump.dat')  
  
unpacker = register_module('PXDUntpacker')  
# unpacker.param('DoNotStore', True);  
# unpacker.param('HeaderEndianSwap', False);
```

unpacks hit-based and full-frame, even if mixed in one data file

Klemens Lautenbach, Björn Spruck

PXD RAW UNPACKER, basf2 python script, cont'd

```
histoman = register_module('HistoManager')
histoman.param('histoFileName', 'your_histo_file.root')

simpleoutput = register_module('RootOutput')
simpleoutput.param('outputFileName', 'PXDRawHit.root')
simpleoutput.param('compressionLevel', 0)

main = create_path()

main.add_module(rawinput)
main.add_module(histoman)
main.add_module(unpacker)
main.add_module(register_module('PXDRawDQM'))
main.add_module(register_module('PXDRoidDQM'))
main.add_module(register_module('Progress'))
main.add_module(simpleoutput)

process(main)
```

„basic“ DQM

Klemens Lautenbach, Björn Spruck

Special event types in DESY test 04/2015

full frame events (for pedestal)

- special trigger type on FTSW
 - but will not be implemented in DESY test (info from Itoh-san)
 - solution: dedicated, separated runs
- requires positive HLT trigger (!)
- ONSEN firmware ready (bypass ROI selector, no processing)
- basf2 unpacker ready

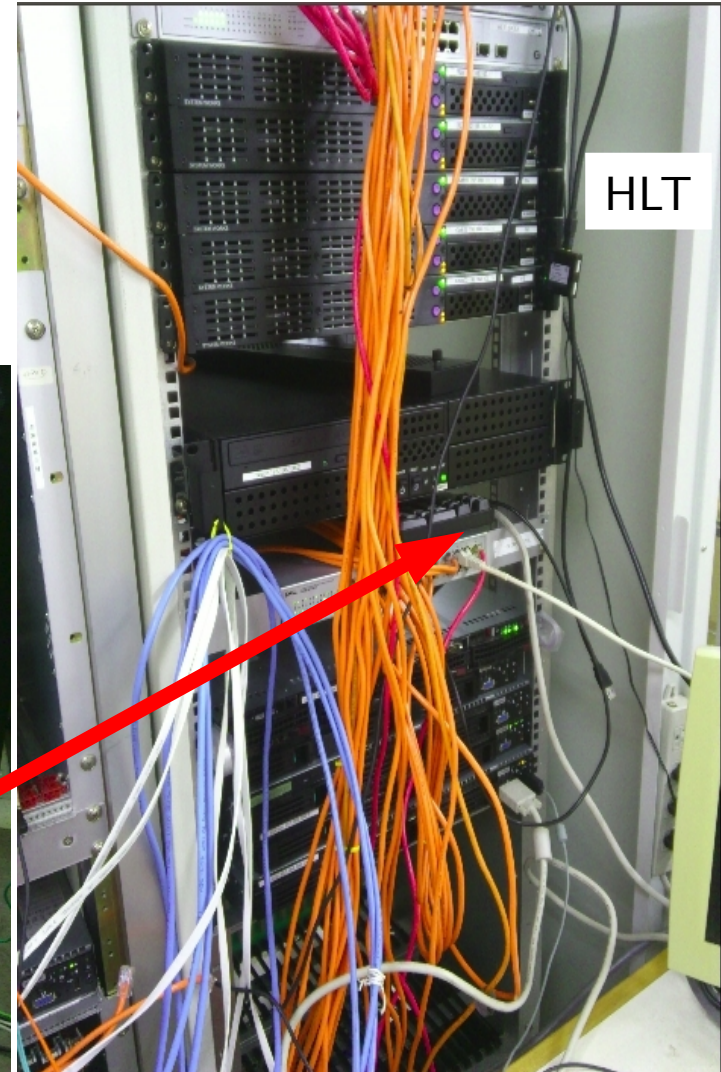
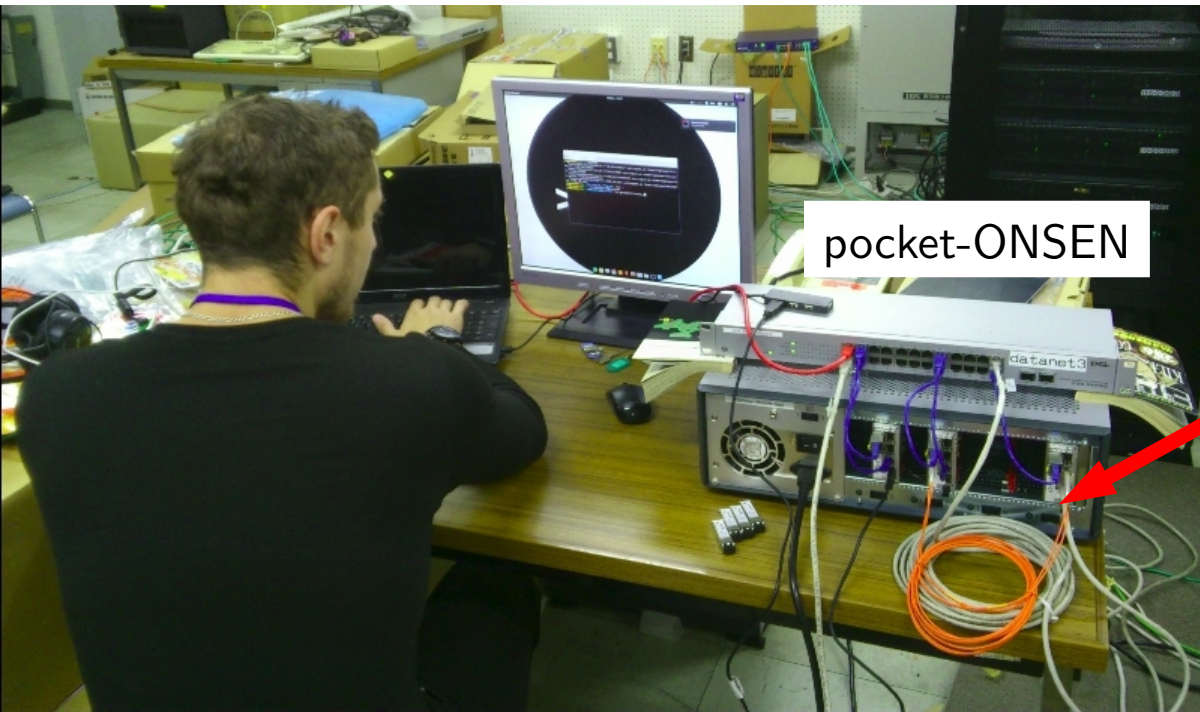
unfiltered events (for ONSEN monitoring)

- downscaled, every 100th event (?)
- requires two special bits in the HLT header (for each event)
 - „SELECT ALL PIXELS“
 - „write ROIs to data stream“
- no extra trigger (!)
- must be prepared for DESY test
(either on HLT or work-around on ONSEN)

KEK Test

Tests at KEK

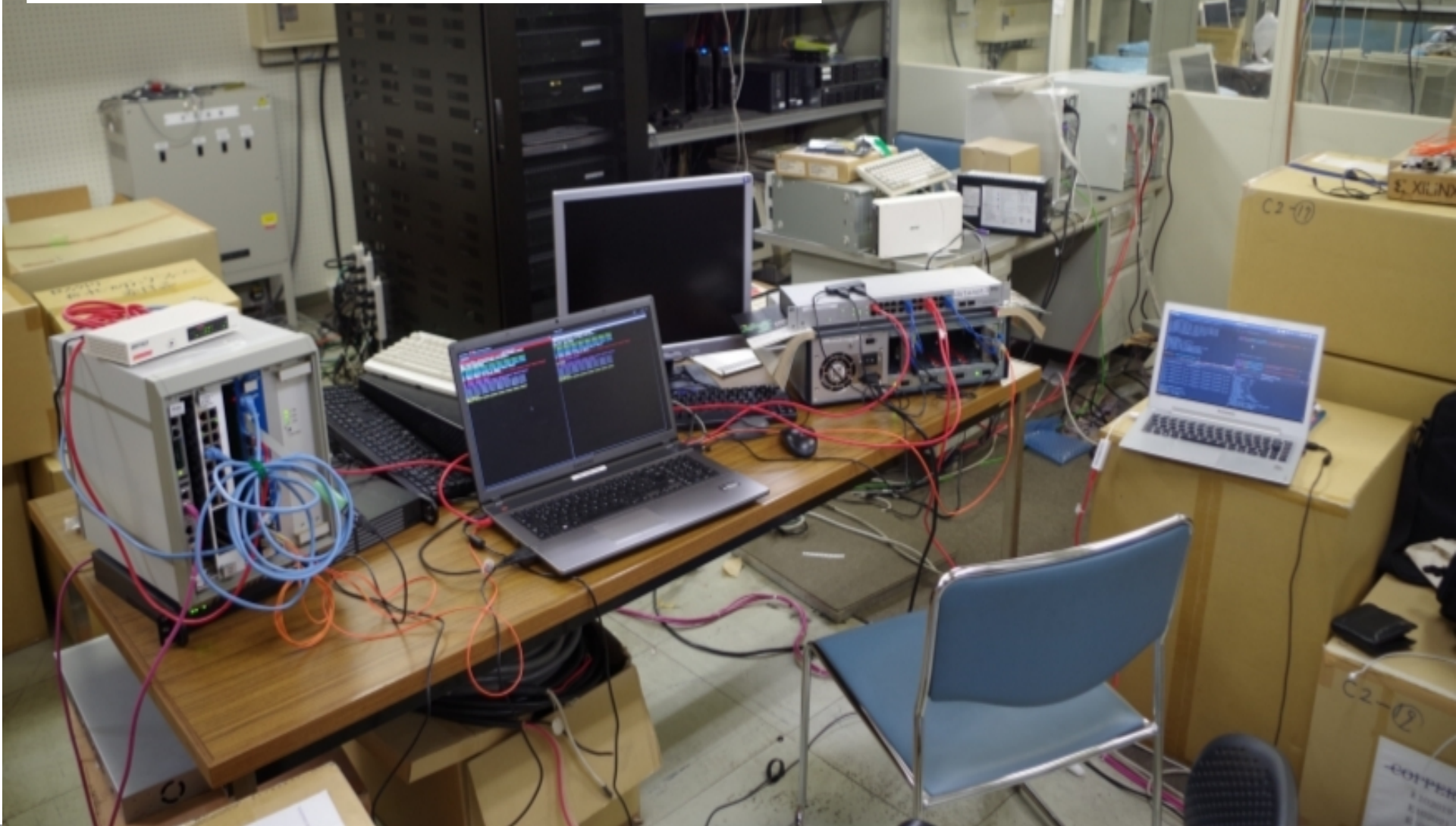
pocket-ONSEN testbench 10/2014
(3 x AMC v3.2)
@ Tsukuba hall B3 (server room)

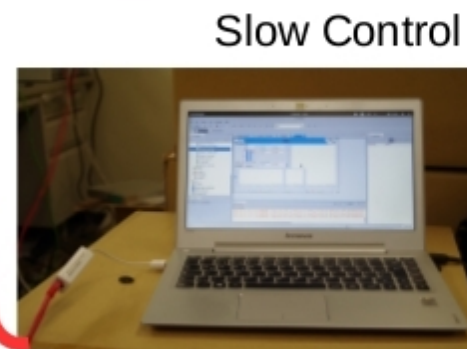
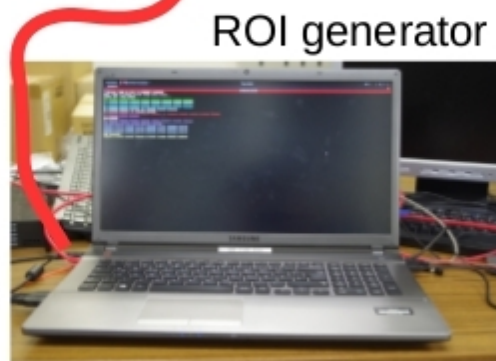
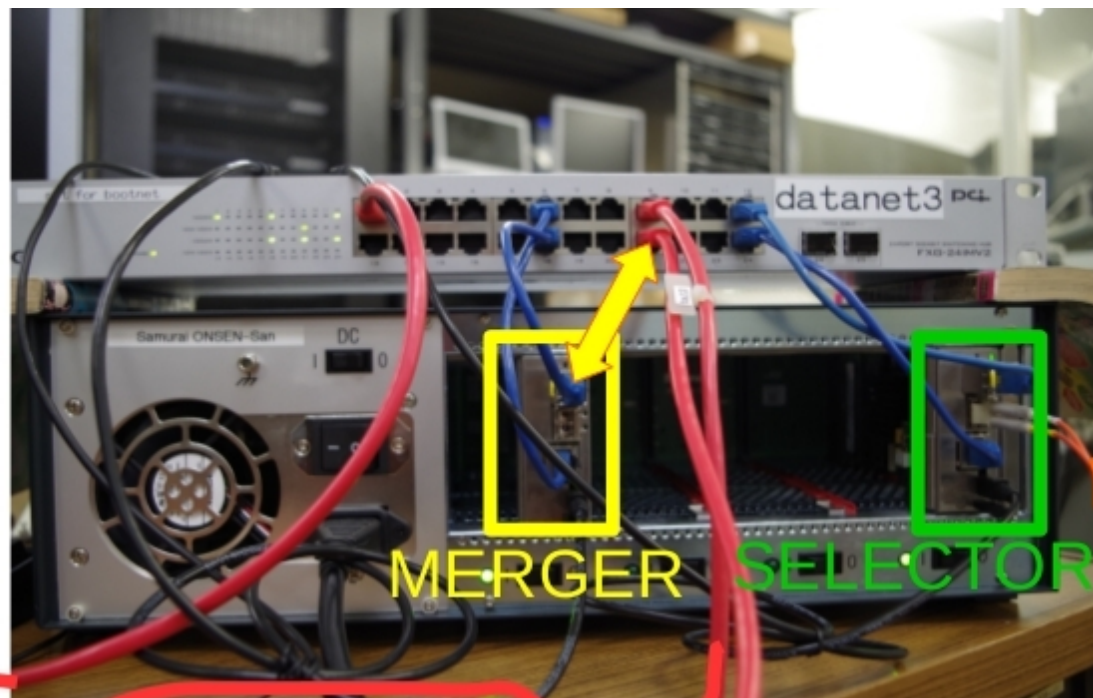


HLT

Klemens Lautenbach, R. Itoh-san

New high rate (30 kHz) test at KEK
ongoing since 10/2015
2 x final AMC boards (v4.0)





Dennis Getzkow & Klemens Lautenbach

Results 10/2015: DHC+ONSEN

ROI selector switched ON (!)

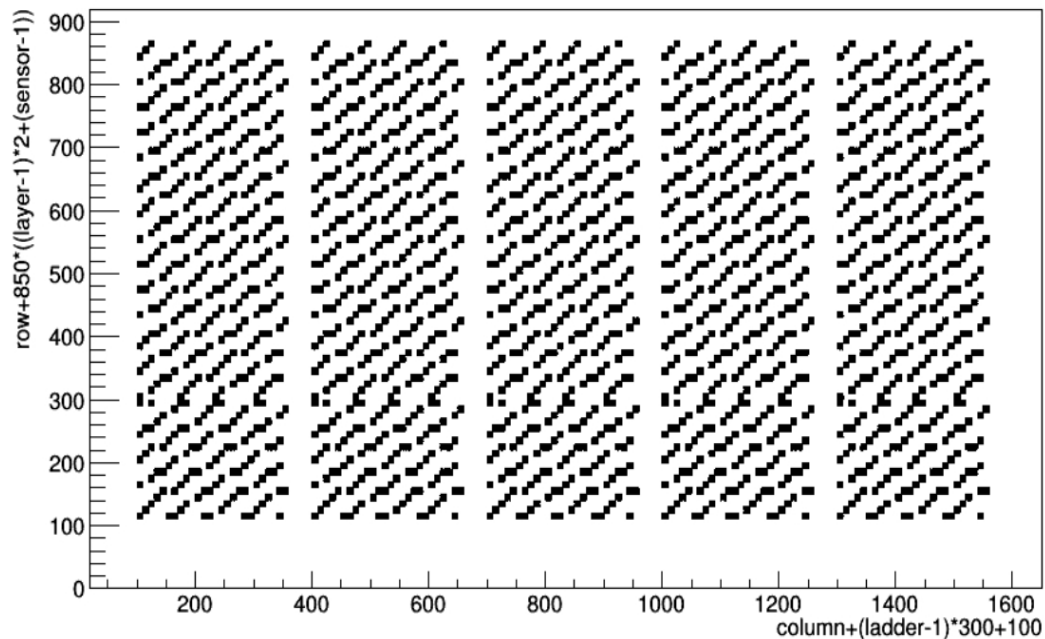
10 kHz achieved

0.4% PXD occupancy (random hits), 10^6 triggers

but

– HLT and EVB2 emulated by PCs (netcat)

– untriggered mode: DHC not connected to trigger (FTSW)



Dennis Getzkow, Klemens Lautenbach

New results 01/2016: DHC+FTSW+ONSEN+HLT

- fixed-interval triggers (not yet Poisson distributed triggers)
- with HLT (required also a COPPER board w/ FTSW input)
 - 3 kHz achieved (limited, as only 1 HLT node)
- w/o HLT, no ROI core
 - 3% occupancy, 7.5 kHz achieved (this was requirement, but Poisson triggers)
- w/o HLT, no ROI core
 - 1% occupancy
 - ≤ 17 kHz stable (requirement: 7.5 kHz)
 - ≥ 17 kHz
 - number of received packets decreases, then system stops
 - after restart DHC (w/o restarting ONSSEN)
 - o.k. again (with decreased rate)
 - not yet understood:
 - FTSW (console) does not report any BUSY from DHC
- backpressure von ONSSEN never observed
- reminder: requirement: $30 \text{ kHz}/4=7.5 \text{ kHz}$ (load balancing)

Thomas Geßler
Igor Konorov,
M. Nakao-san,
R. Itoh-san,
T. Konno-san,
S. Yamada-san

4.3.2 Concerns

For the DAQ there are no concerns regarding the viability of the system. The committee just notes that a wide variety of boards and associated with them firmwares are being used in this system. The number of units for the various boards are small. Nevertheless an adequate number of spares should be ready, ideally no less than a minimum of two for each type. Some thought should be given on how hardware and firmware will be maintained over an expected 10 year life-span. In particular the FPGAs will likely to be very difficult to obtain in case a spare-board beyond the available spares will be needed. Similarly firmware expertise must be kept in the collaboration and the tool-flows to create revisions must be kept in working state and documented.

4.3.3 Recommendations

1. A strategy to deal with spares, firmware updates and component obsolescence for a ten-year life-span should be prepared.
2. Work should start to integrate the PXD and SVD software to the general Belle II reconstruction software. The committee welcomes a presentation of work plan which includes a list of task along with responsibilities and milestones.

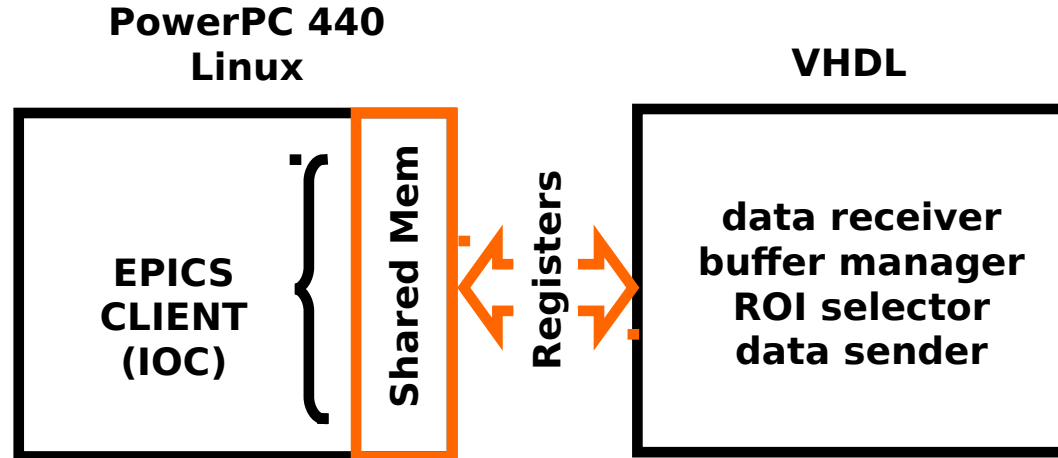
This (probably) means: put DATCON tracking into basf2 (already done ?).

Summary

- Requirements for DESY test achieved,
but so far fixed-interval triggers
(numbers from 01/2014: $\sim 0.8\%$ occupancy, ≤ 8 kHz rate)

BACKUP

EPICS on ONSEN



```
root@localhost:~/src# cat /proc/cpuinfo
processor       : 0
cpu            : 440 in Virtex-5 FXT
clock         : 400.000000MHz
revision      : 25.18 (pvr 7ff2 1912)
bogomips     : 800.00
timebase      : 400000000
platform      : Xilinx Virtex440
model         : testing
Memory        : 768 MB
root@localhost:~/src#
```

~70 ONSEN FPGA registers defined
to be mapped onto EPICS PV variables for monitoring
in final system $\sim 70 \times 32 = \sim 2240$ variables to be monitored

THANK YOU.