Simon Ebner :: Paul Scherrer Institut

SwissFEL - Beam Synchronous Data Acquisition - The First Year

ICALEPCS 2017 - TUCPA06

Outline

Overview SwissFEL

Overview
Beam Synchronous DAQ

Lessons Learned

Questions

Overview SwissFEL

SwissFEL - Overview

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People, content...

Labs & User Services | Visitors | Industry | Our Research | Career & Further Education | About PSI

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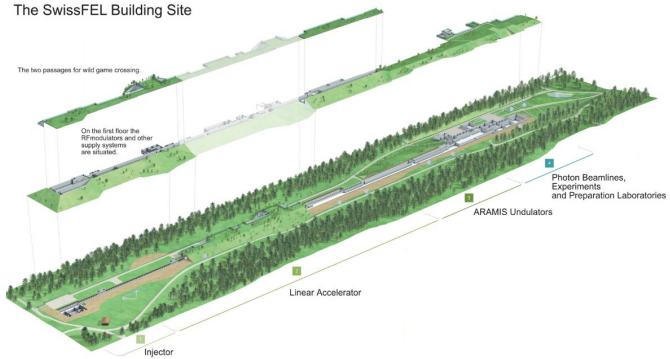
- Overview
- About us
- Highlights
- Publications
- SwissFEL Workshops
- SwissFEL Facility
- SwissFEL Research
- Information for.....

The SwissFEL Building Site



Further information

Film of the future project SwissFEL

SwissFEL construction site

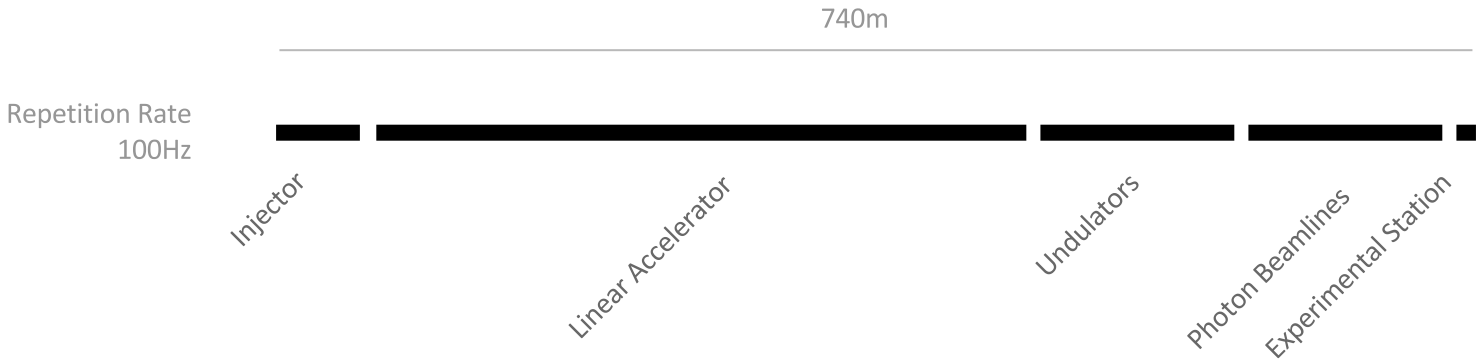
Information and webcams

Current SwissFEL Publications

SwissFEL Technical Design Report Jungfrau Detector

https://www.psi.ch/swissfel

SwissFEL - Overview



SwissFEL - Overview

ONE Beam Synchronous DAQ System

Overview
Beam Synchronous DAQ

Building Blocks

Example Data Sources

Diodes

~ 1 KByte/s

Motors

~ 10 KByte/s

Cameras

1 GByte/s

Endstation Detectors

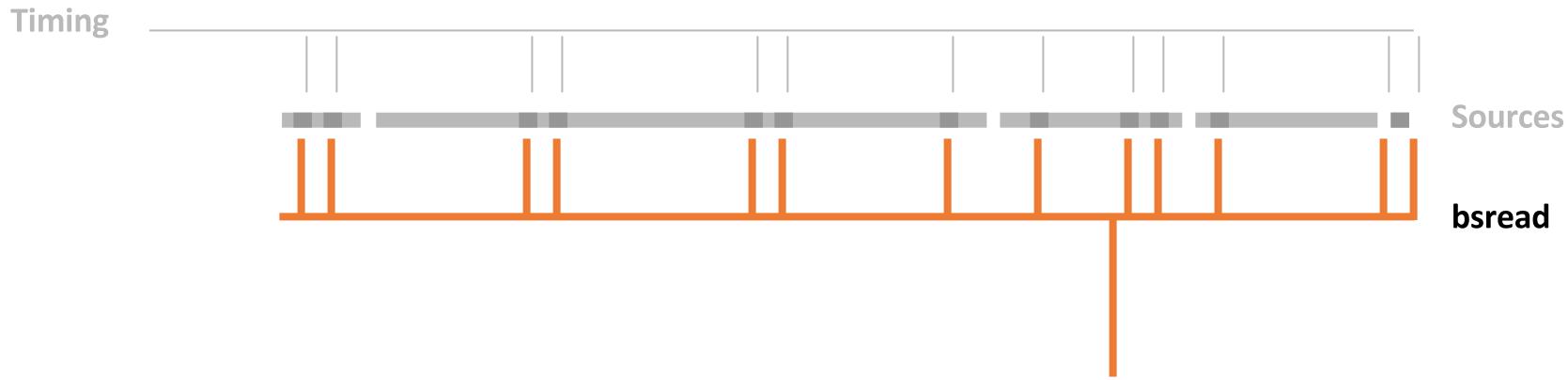
4 GByte/s

23202 Channels

76 (up to 6 running in parallel)

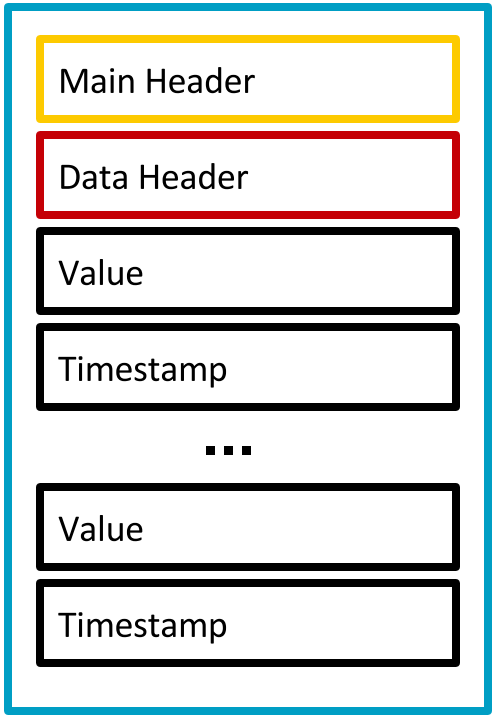
> 3 (not yet in place)

Building Blocks



bsread

ZMQ Message



JSON - pulse-id, global timestamp, ...

JSON - description of coming data

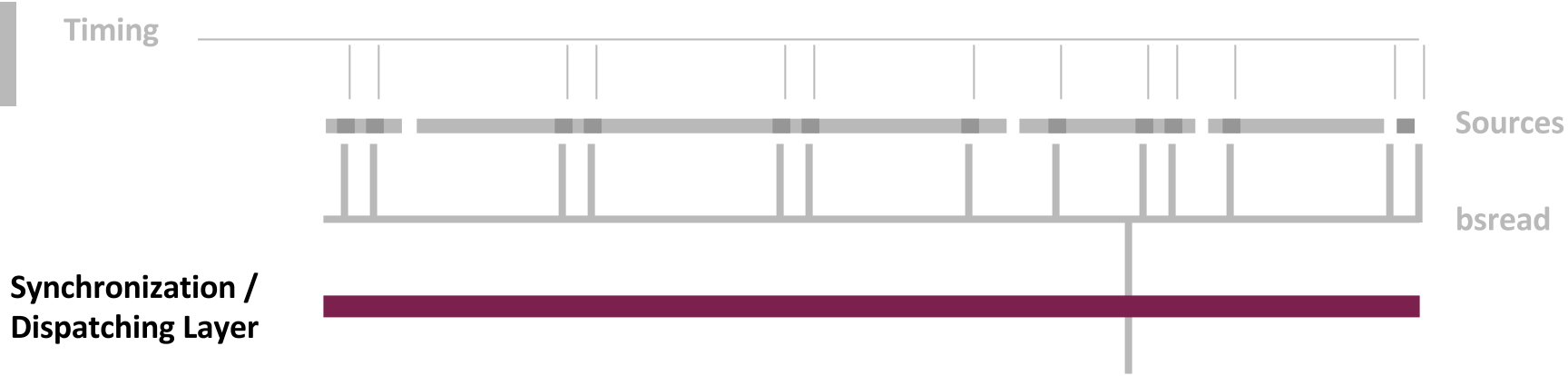
Blob

Blob

Blob

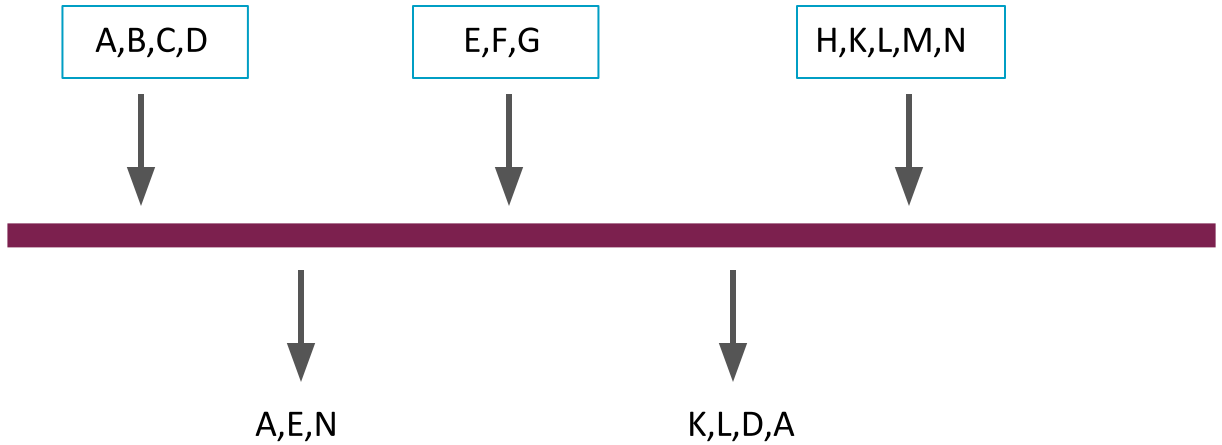
Blob

Building Blocks

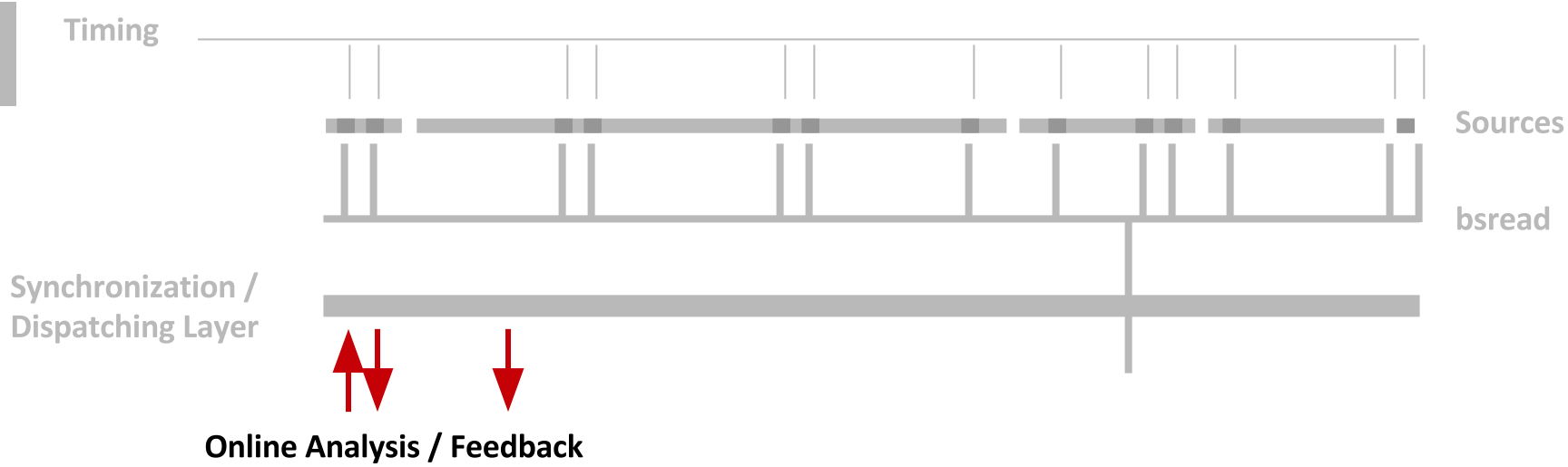


Synchronization / Dispatching Layer

Synchronization / Dispatching Layer



Building Blocks

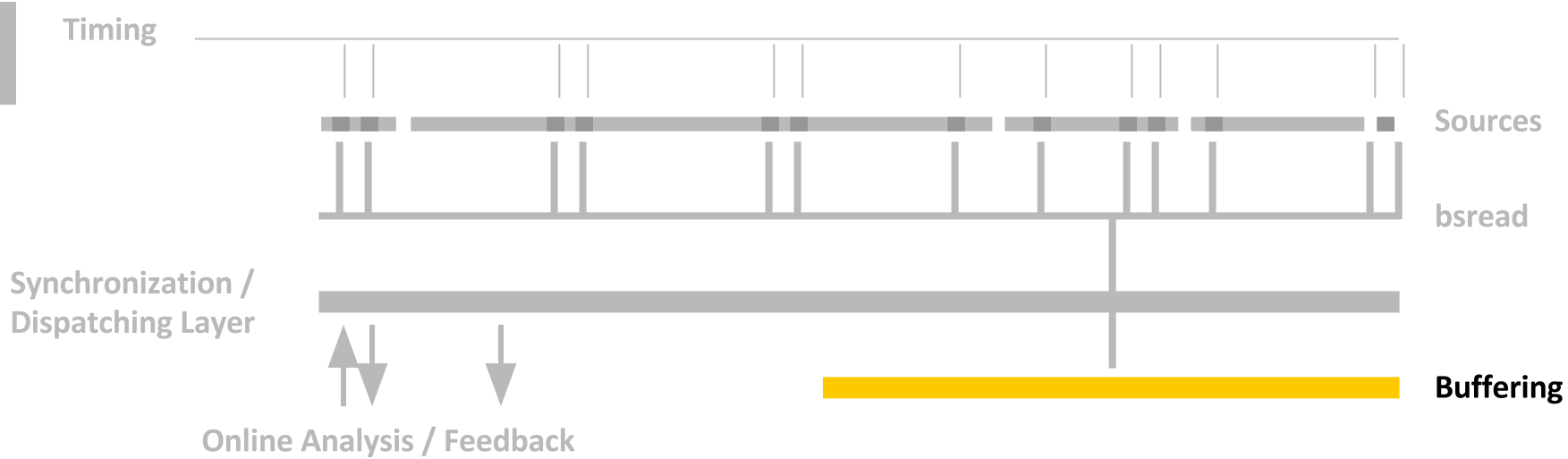


Example Analysis Client

```
from bsread import source

with source(channels=['SINSB02-RIQM-DCP10:FOR-PHASE-AVG', 'SINEG01-RKLY-DCP10:FOR-PHASE-AVG']) as stream:
    while True:
        message = stream.receive()
        print(message.data.data['SINSB02-RIQM-DCP10:FOR-PHASE-AVG'].value)
```

Building Blocks



Buffering Key Figures

Data Buffer

- Right now buffering **2.6TB/day** - 12 Nodes constantly receiving and buffering 25MB/s each
- Data retention period: 2 days scalars, 2 hours waveforms

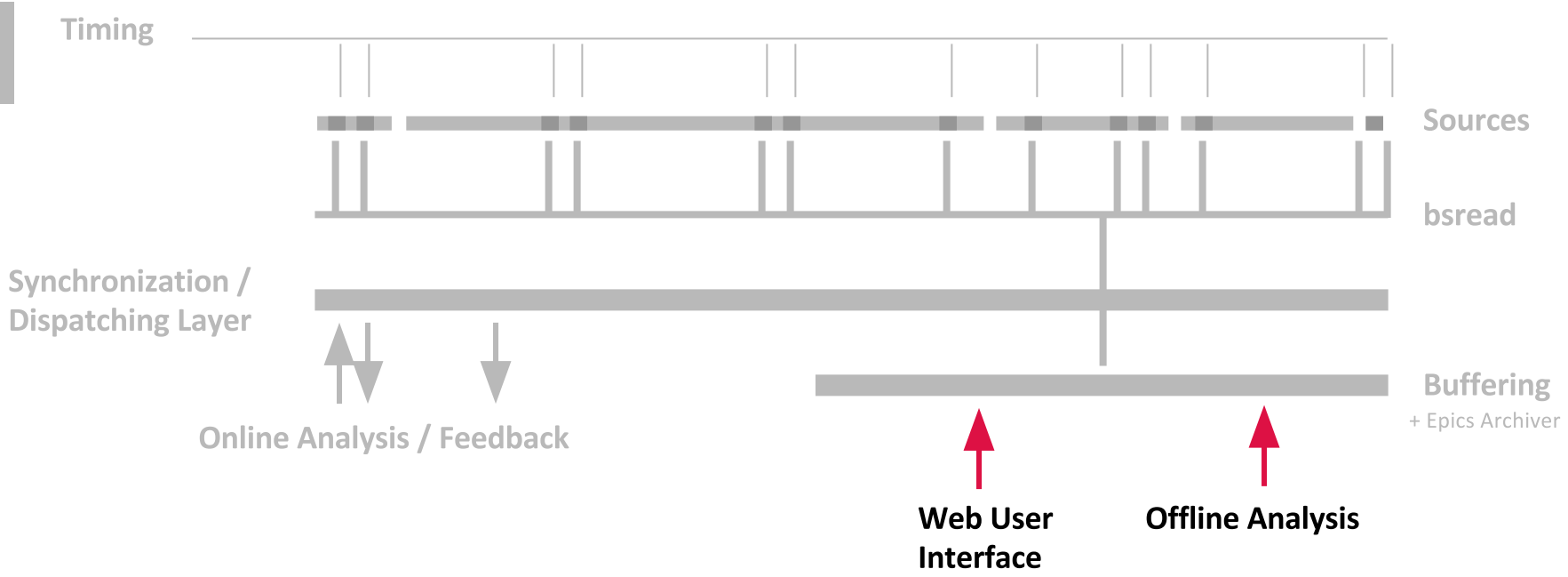
Image Buffer

- Images are buffered on a IBM Spectrum Scale (GPFS) filesystem
- Data retention period: 2 hours

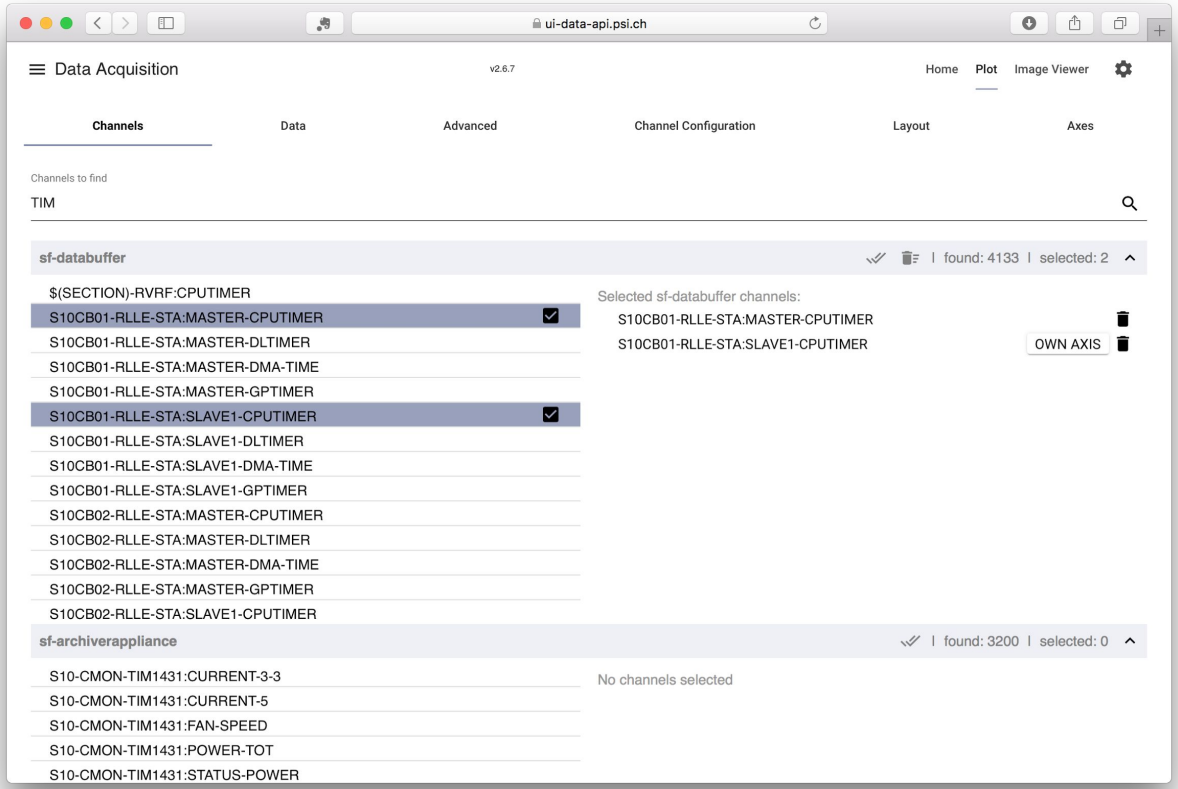
No Buffer

- Endstation detector data is not buffered

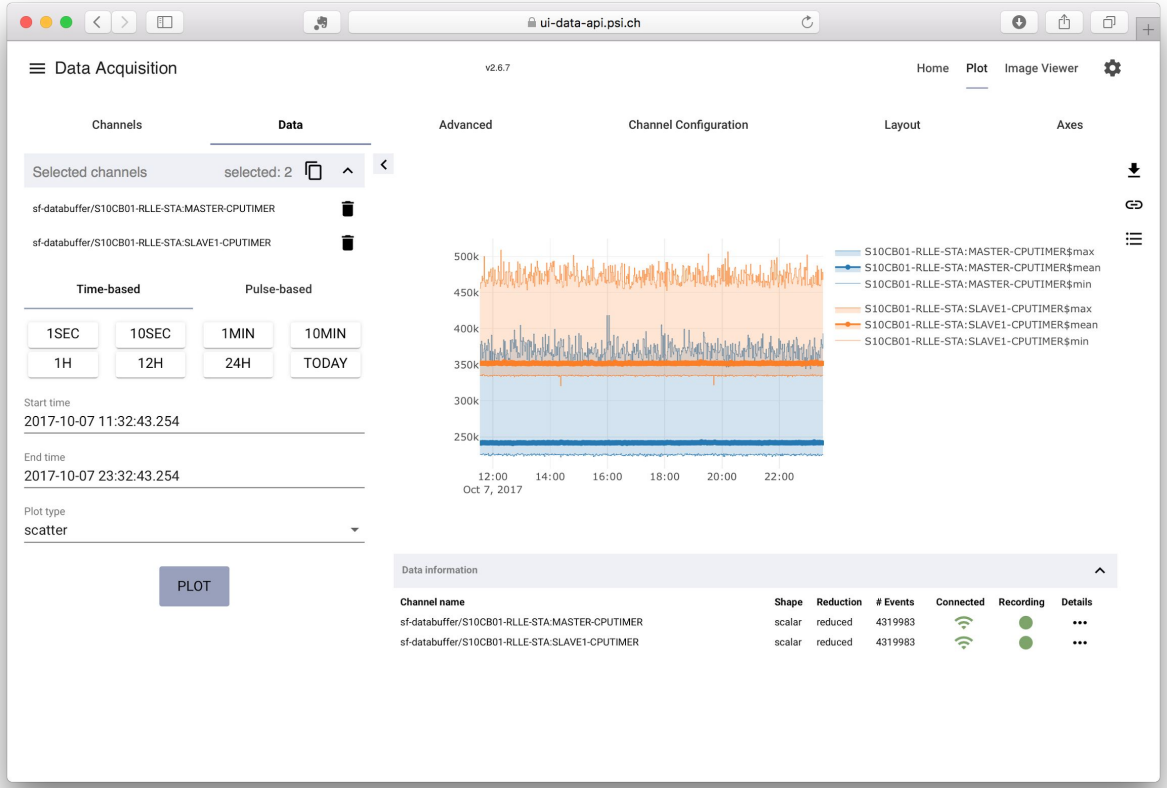
Building Blocks



Web UI


ui-data-api.psi.ch
Data Acquisition
v2.6.7
Home
Plot
Image Viewer
Channels
Data
Advanced
Channel Configuration
Layout
Axes
Channels to find
TIM
sf-databuffer
found: 4133 | selected: 2
$(SECTION)-RVRF:CPUTIMER
S10CB01-RLLE-STA:MASTER-CPUTIMER
S10CB01-RLLE-STA:MASTER-DLTIMER
S10CB01-RLLE-STA:MASTER-DMA-TIME
S10CB01-RLLE-STA:MASTER-GPTIMER
S10CB01-RLLE-STA:SLAVE1-CPUTIMER
S10CB01-RLLE-STA:SLAVE1-DLTIMER
S10CB01-RLLE-STA:SLAVE1-DMA-TIME
S10CB01-RLLE-STA:SLAVE1-GPTIMER
S10CB02-RLLE-STA:MASTER-CPUTIMER
S10CB02-RLLE-STA:MASTER-DLTIMER
S10CB02-RLLE-STA:MASTER-DMA-TIME
S10CB02-RLLE-STA:MASTER-GPTIMER
S10CB02-RLLE-STA:SLAVE1-CPUTIMER
Selected sf-databuffer channels:
S10CB01-RLLE-STA:MASTER-CPUTIMER
S10CB01-RLLE-STA:SLAVE1-CPUTIMER
OWN AXIS
sf-archiverappliance
found: 3200 | selected: 0
S10-CMON-TIM1431:CURRENT-3-3
S10-CMON-TIM1431:CURRENT-5
S10-CMON-TIM1431:FAN-SPEED
S10-CMON-TIM1431:POWER-TOT
S10-CMON-TIM1431:STATUS-POWER
No channels selected

Web UI


ui-data-api.psi.ch
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Home
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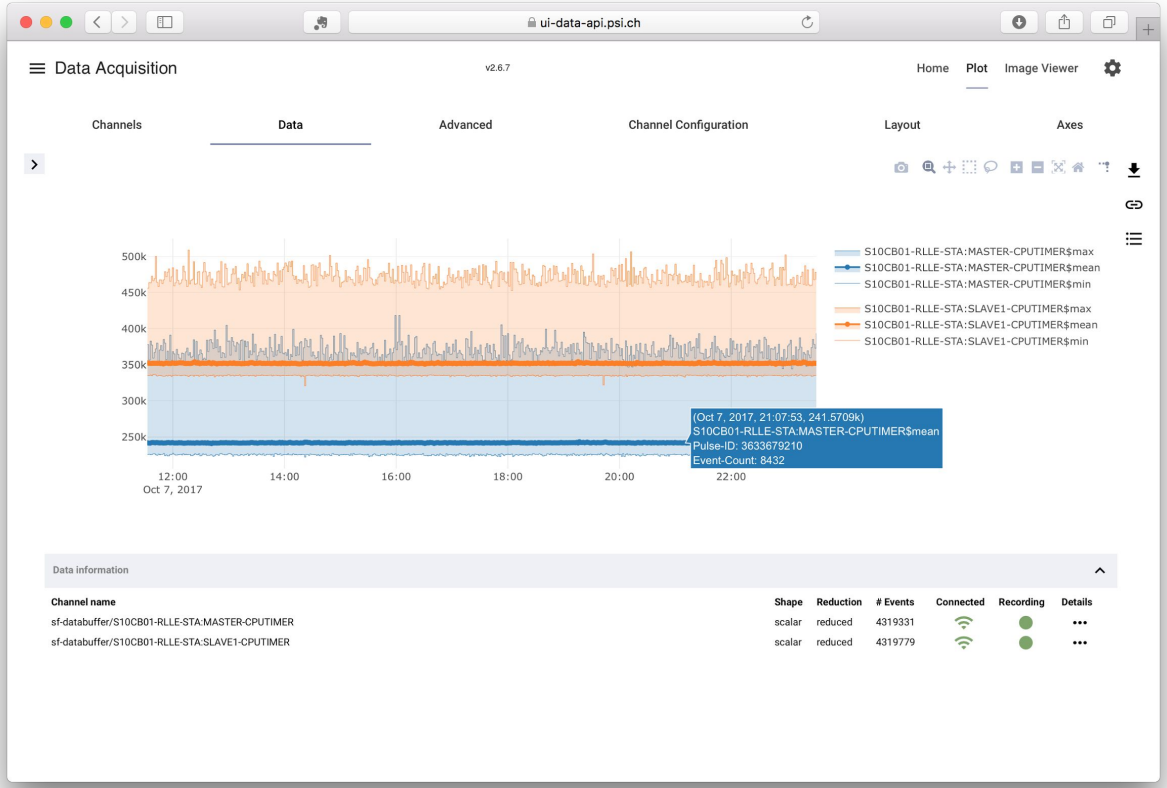
Selected channels
selected: 2
sf-databuffer/S10CB01-RLLE-STA:MASTER-CPUTIMER
sf-databuffer/S10CB01-RLLE-STA:SLAVE1-CPUTIMER
Time-based
Pulse-based
1SEC
10SEC
1MIN
10MIN
1H
12H
24H
TODAY
Start time
2017-10-07 11:32:43.254
End time
2017-10-07 23:32:43.254
Plot type
scatter
PLOT
500k
450k
400k
350k
300k
250k
12:00
Oct 7, 2017
14:00
16:00
18:00
20:00
22:00
S10CB01-RLLE-STA:MASTER-CPUTIMER$max
S10CB01-RLLE-STA:MASTER-CPUTIMER$mean
S10CB01-RLLE-STA:MASTER-CPUTIMER$min
S10CB01-RLLE-STA:SLAVE1-CPUTIMER$max
S10CB01-RLLE-STA:SLAVE1-CPUTIMER$mean
S10CB01-RLLE-STA:SLAVE1-CPUTIMER$min
Data information
Channel name
Shape
Reduction
Events
Connected
Recording
Details
sf-databuffer/S10CB01-RLLE-STA:MASTER-CPUTIMER
scalar
reduced
4319983
sf-databuffer/S10CB01-RLLE-STA:SLAVE1-CPUTIMER
scalar
reduced
4319983

Web UI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12:00
Oct 7, 2017
14:00
16:00
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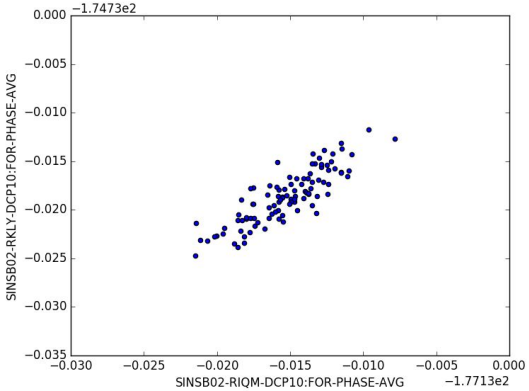
22:00
S10CB01-RLLE-STA:MASTER-CPUTIMER$max
S10CB01-RLLE-STA:MASTER-CPUTIMER$mean
S10CB01-RLLE-STA:MASTER-CPUTIMER$min
S10CB01-RLLE-STA:SLAVE1-CPUTIMER$max
S10CB01-RLLE-STA:SLAVE1-CPUTIMER$mean
S10CB01-RLLE-STA:SLAVE1-CPUTIMER$min
(Oct 7, 2017, 21:07:53, 241.5709k)
S10CB01-RLLE-STA:MASTER-CPUTIMER$mean
Pulse-ID: 3633679210
Event-Count: 8432
Data information
Channel name
Shape
Reduction
Events
Connected
Recording
Details
sf-databuffer/S10CB01-RLLE-STA:MASTER-CPUTIMER
scalar
reduced
4319331
sf-databuffer/S10CB01-RLLE-STA:SLAVE1-CPUTIMER
scalar
reduced
4319779

Example Offline Analysis

```
import data_api
api = data_api.configure()

data = api.get_data(channels=['SINSB02-RIQM-DCP10:FOR-PHASE-AVG', 'SINSB02-RKLY-DCP10:FOR-PHASE-AVG'],
start="2016-07-14 08:05", end="2016-07-14 09:05")

from matplotlib import pyplot
data.plot.scatter("SINSB02-RIQM-DCP10:FOR-PHASE-AVG", "SINSB02-RKLY-DCP10:FOR-PHASE-AVG")
pyplot.show()
```



Building Blocks - Simplified

Lessons Learned

Lessons Learned

Technical

Human

Lessons Learned

Technical

Human

Lessons Learned - Technical

- **Keep things clean, slim and simple**
- REST API vs Libraries
- Avoid data copies
- Compress data
- Avoid premature optimizations
- Use asynchronous processing and concepts
- Use Solid State Disks
- Spend lots of time on the web UI
- Testing
- Collect statistics

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Lessons Learned

Technical

Human

Lessons Learned - Human

- **Mindset** 
- Data owner / retention policy
- Be prepared
- Documentation
- Ecosystem is important

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Lessons Learned - Human

- Mindset
- Data owner / retention policy
- Be prepared
- Documentation
- **Ecosystem is important** 

Questions ?

Advertisement

Mo 09.10.2017 10:45-11:00 - **MOAPL04** - SwissFEL Control System - Overview, Status, and Lessons Learned - Elke Zimoch - Paul Scherrer Institut - Talk

Tue 10.10.2017 14:45-15:00 - **TUCPL04** - SwissFEL Timing System: First Operational Experience - Babak Kalantari - Paul Scherrer Institut - Talk

Tue 10.10.2017 **17:45-18:15** - **TUSH102** - PShell: from SLS beamlines to the SwissFEL control room - Alexandre Gobbo - Paul Scherrer Institut - **Poster**

Thu 12.10.2017 **16:15-16:30** - **THDPL02** - GigaFRoST (Gigabyte Fast Read-Out System for Tomography): Control and DAQ System Design - Tine Celcer - Paul Scherrer Institut - **Talk**

Come to PSI and see the **PSI Eiger 9M** in action in November 2017

Contact

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