Present status of the computing environment for the experimental instruments in J-PARC/MLF

T. Nakatani[a)], Y. Inamura[a)], T. Ito[a)], T. Ohhara[a)], Y. Kawakita[a)], T. Otomo[b)], J. Suzuki[b)], S. Muto[b)], K. M. Kojima[b)]

[a)]J-PARC/JAEA, [b)]J-PARC/KEK

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3. Software components
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5. Applications of event data analysis
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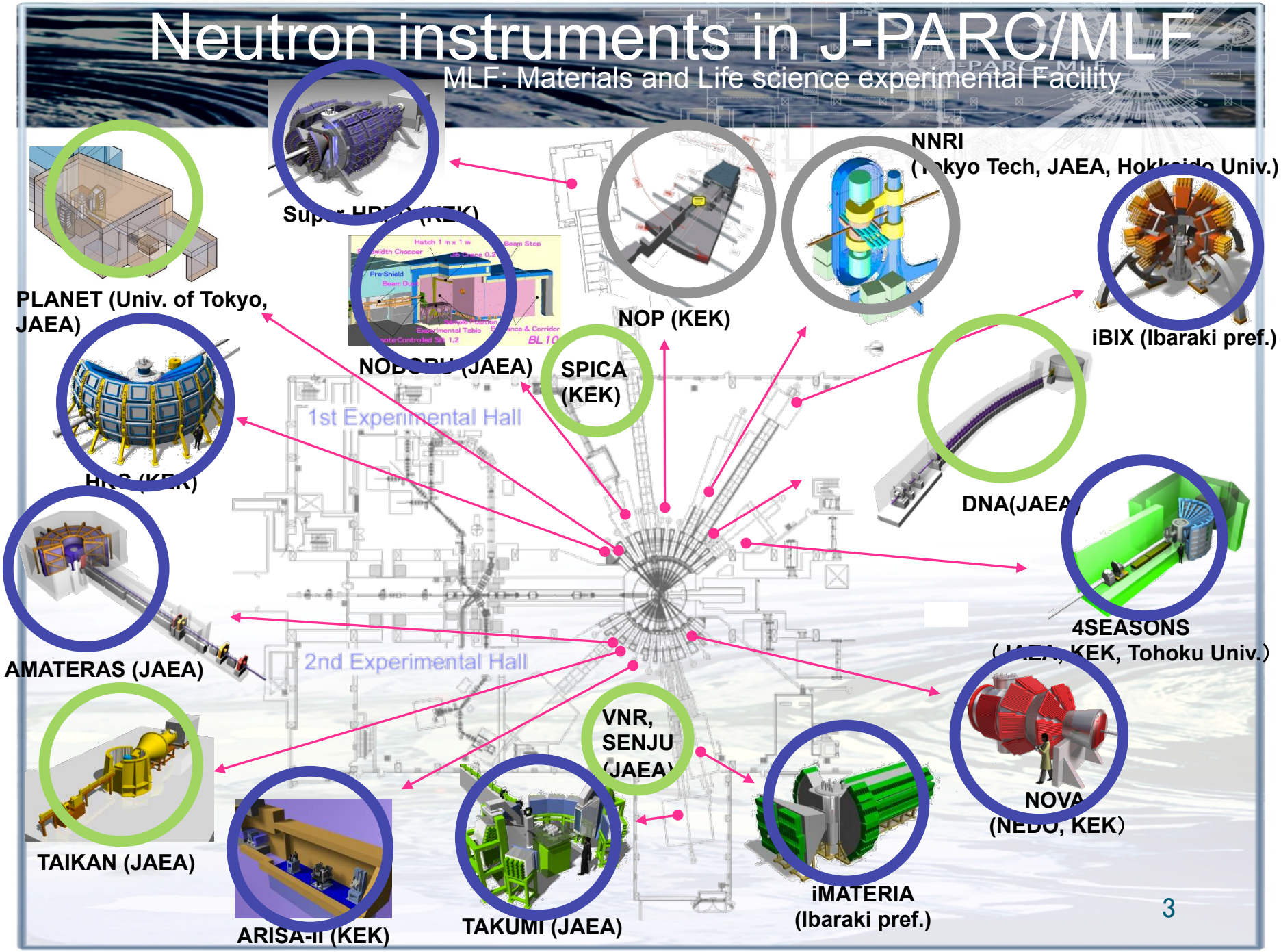
Neutron instruments in J-PARC/MLF

MLF: Materials and Life science experimental Facility



History of MLF computing environment

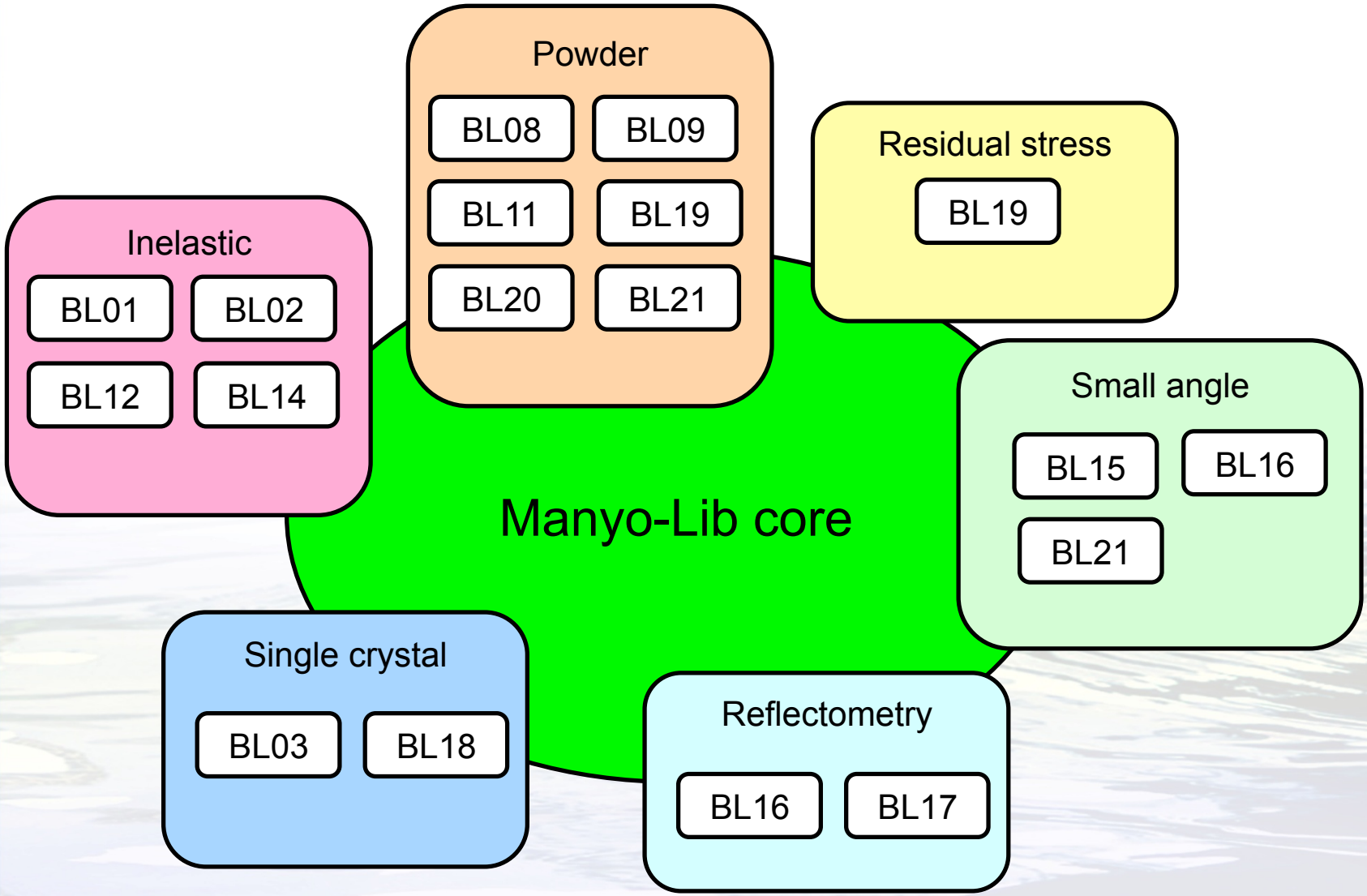
	2002	**Construction J-PARC**
Analysis (Data reduction): Manyo-Lib **"Working Desktop:WD" design** **DAQ software with LabVIEW@KENS**	2003	**Construction MLF building**
	2004	
	2005	
Standardized event mode DAQ **DAQ Middleware** **Viewer of Manyo-lib data-container** **WD and "SW framework" developments** Client-Server model (XML/http), GUI, data I/O **Instruments' software commissioning** **Analysis specified event data** **Database prototyping** **Experiment Scheduler** Determination of name of the SW framework **"IROHA"**	2006	**Construction Neutron instruments** **Linac accelerated first beam**
	2007	**Completion of MLF** **3GeV RCS accelerated proton**
	2008	**First neutron beam** **First muon beam, User operation**
	2009	**Beam power 120kW**
	2010	**Beam power will be 200kW**

Japanese "IROHA" is the ABC's in English, in other words, "IROHA" is the basics of all MLF software.

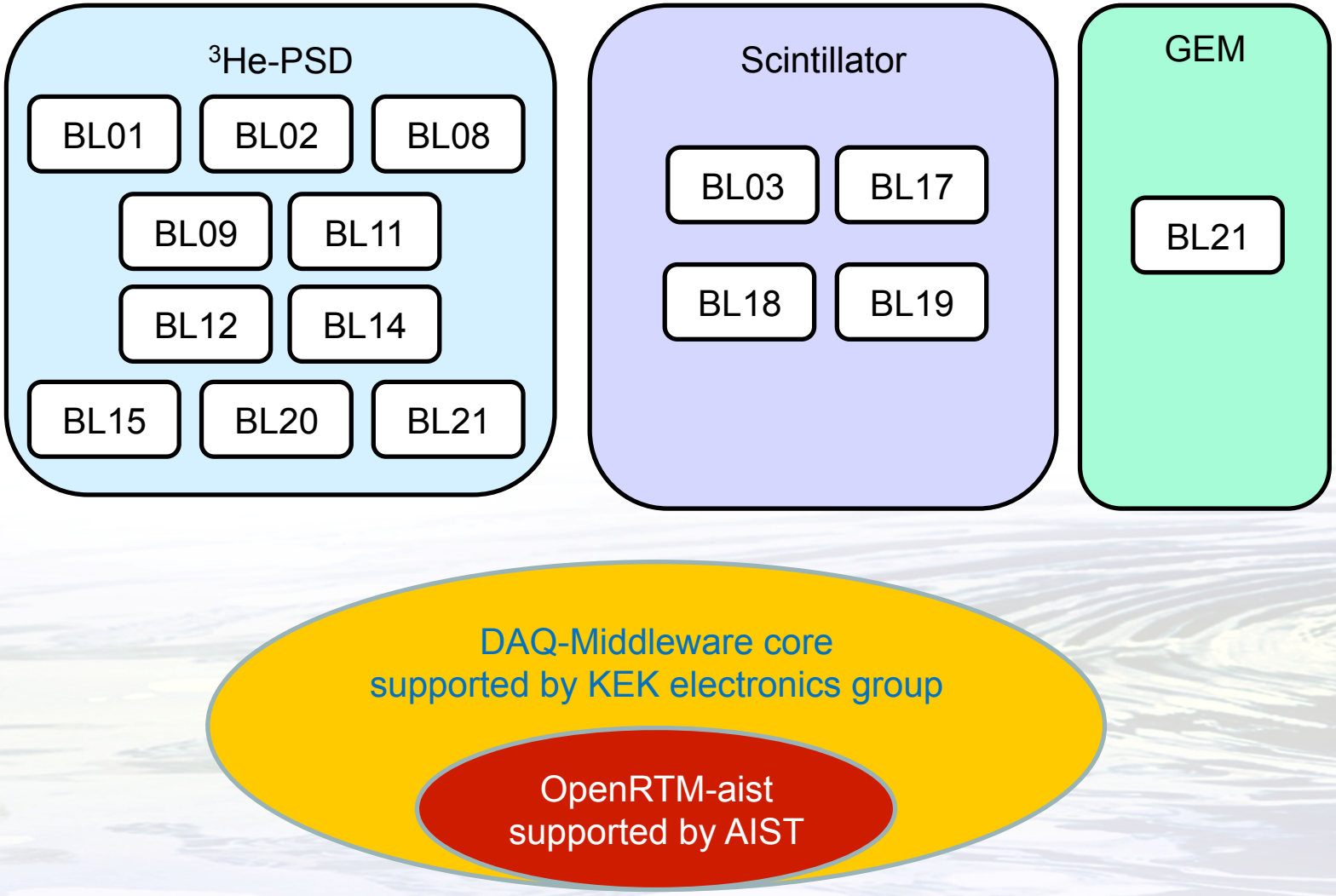
Requirements

- **High throughput of large data analysis**
  - On-line analysis of GB order data during an experiment
  - Interpretation software (simulation) will be used on an experiment
  - Data analysis affect on effective flux of neutron (muon)
    - Fast and reliable data analysis and experiment systems are required
- **Variety of experimental approaches**
  - Extreme experiments will become conventional
    - Flexible instrument control
- **Large number of user**
  - Several ten thousands of cumulative users / year
    - Database for user program should be implemented
    - Computing environment should be user-friendly
  - Security
    - User authentication and authorization are essential to enable flexible access to J-PARC/MLF
- **Collaboratory system will open new style of experiment**

Group: Data Analysis



Group: Data Acquisition

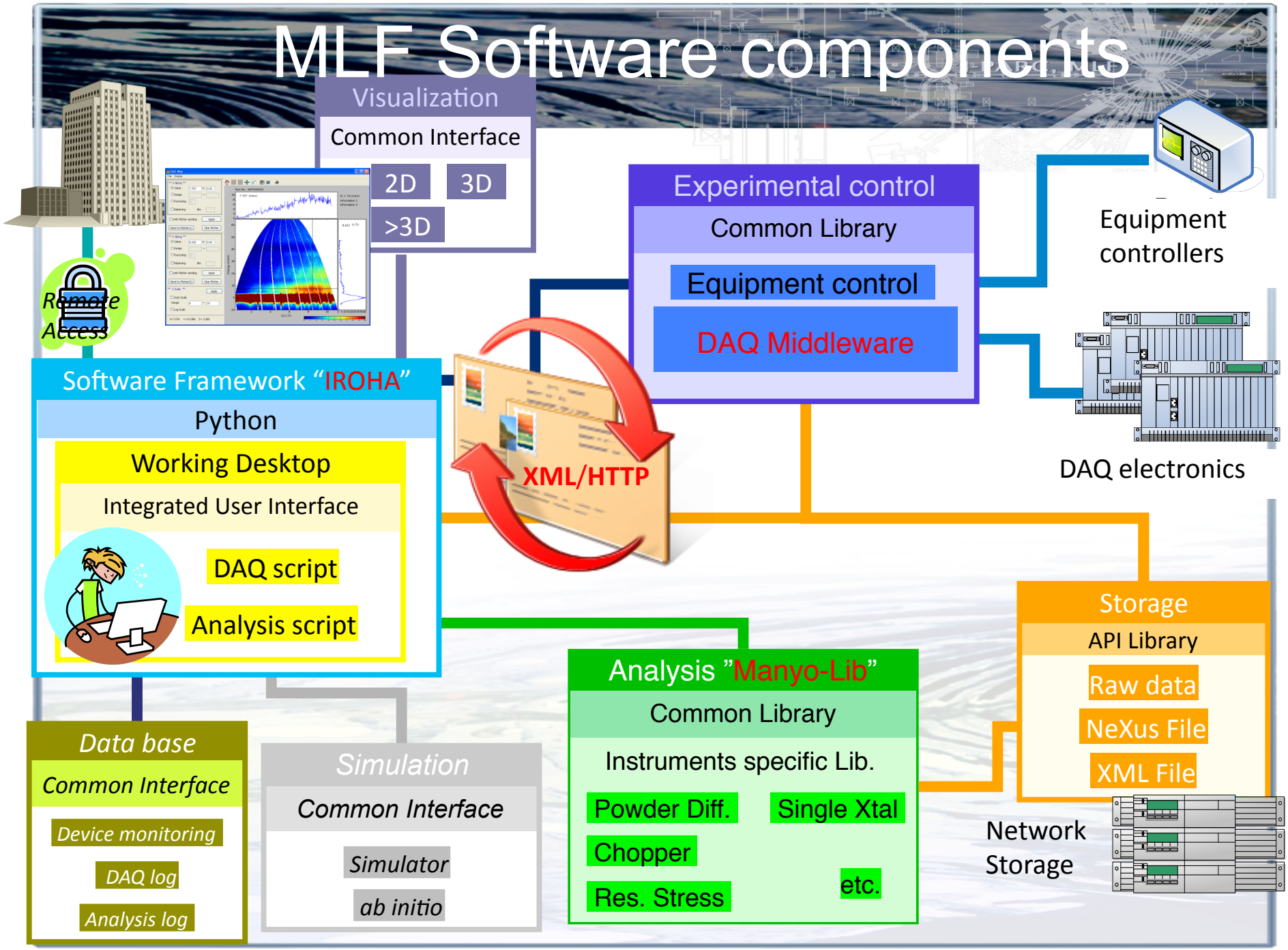


Project management

Sharing the information of software development

- PukiWiki
- Subversion
- Trac

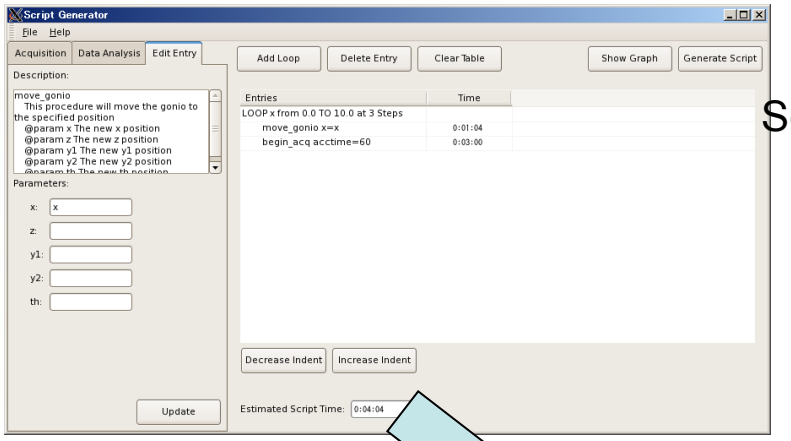
□Data Container (internal data structure) with STL



DAQ "DAQ Middleware"

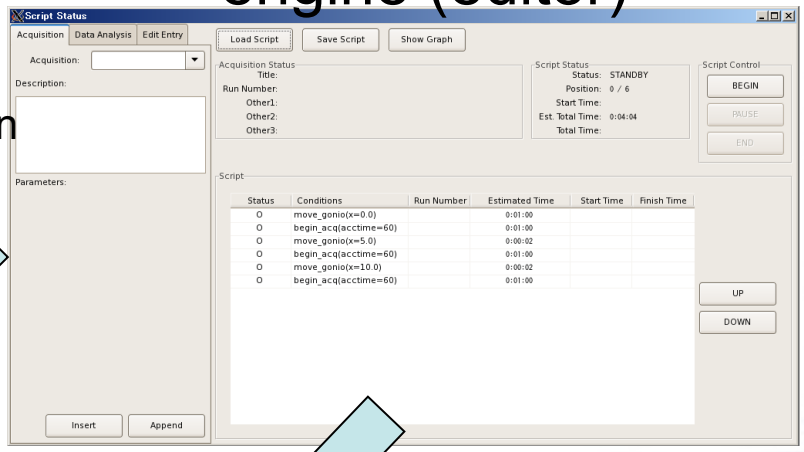
Experiment Scheduler

Script generator
editor

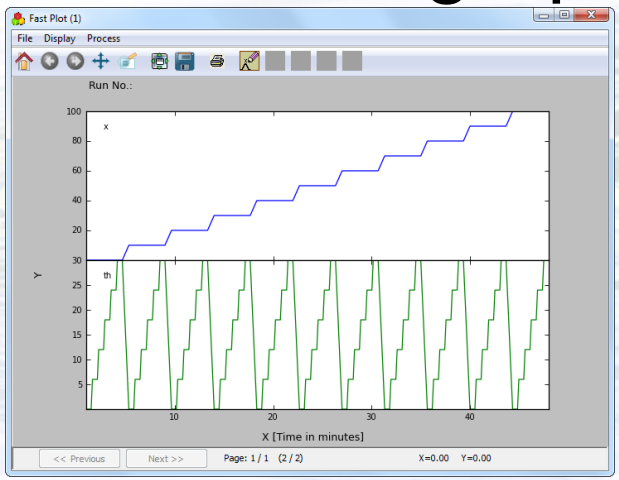


Script written in XML

Script status
engine (editor)



Parameter graph



Integration of measurement and analysis on IROHA

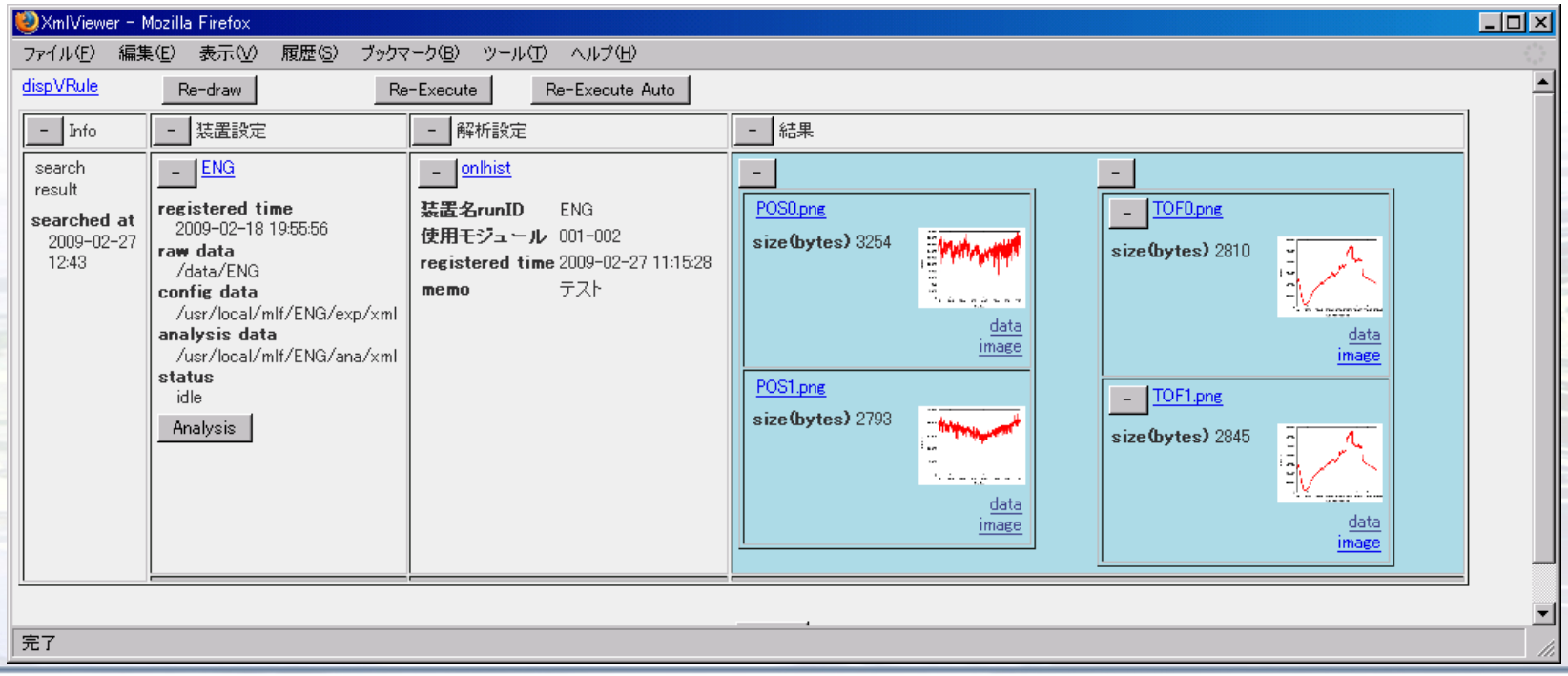
Development with Matt Clarke / ISIS

Database development

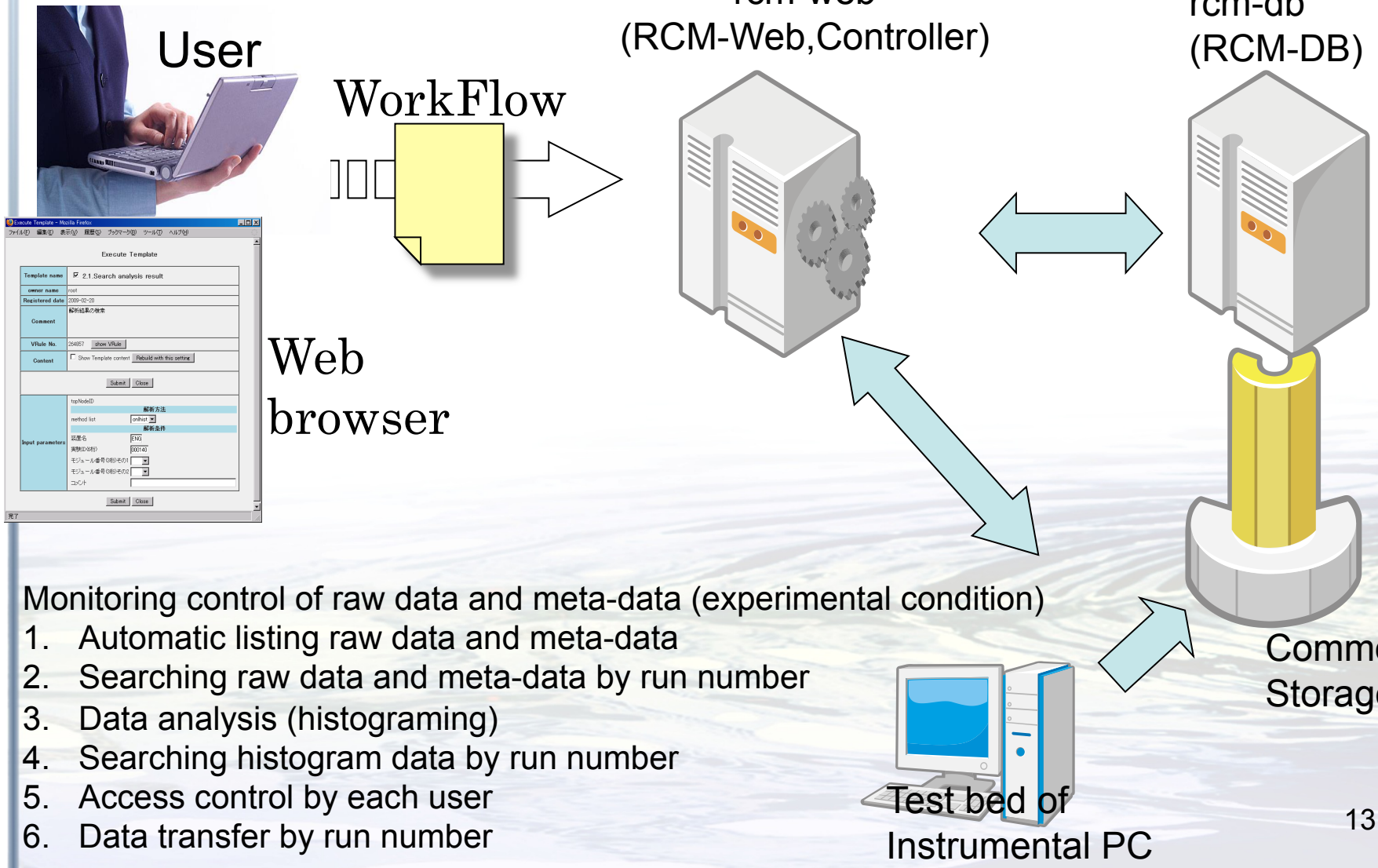
- In use
  - Sample management database (Prototype)
- Under construction
  - Experimental meta-data database (XML Database)
- Under consideration
  - Integration of the proposal information and the user information from Users' office database

XML database

- Commercial XML database management software
  - “RCM (R&D Chain Management) System Software”
- Workflow
  - Written in XML
  - Regular operations written in the “workflow” are available to click the Web button
- Authentication and Authorization
  - Flexible access control to data file in each user and group
  - It is necessary for public data access in the future



Database prototyping

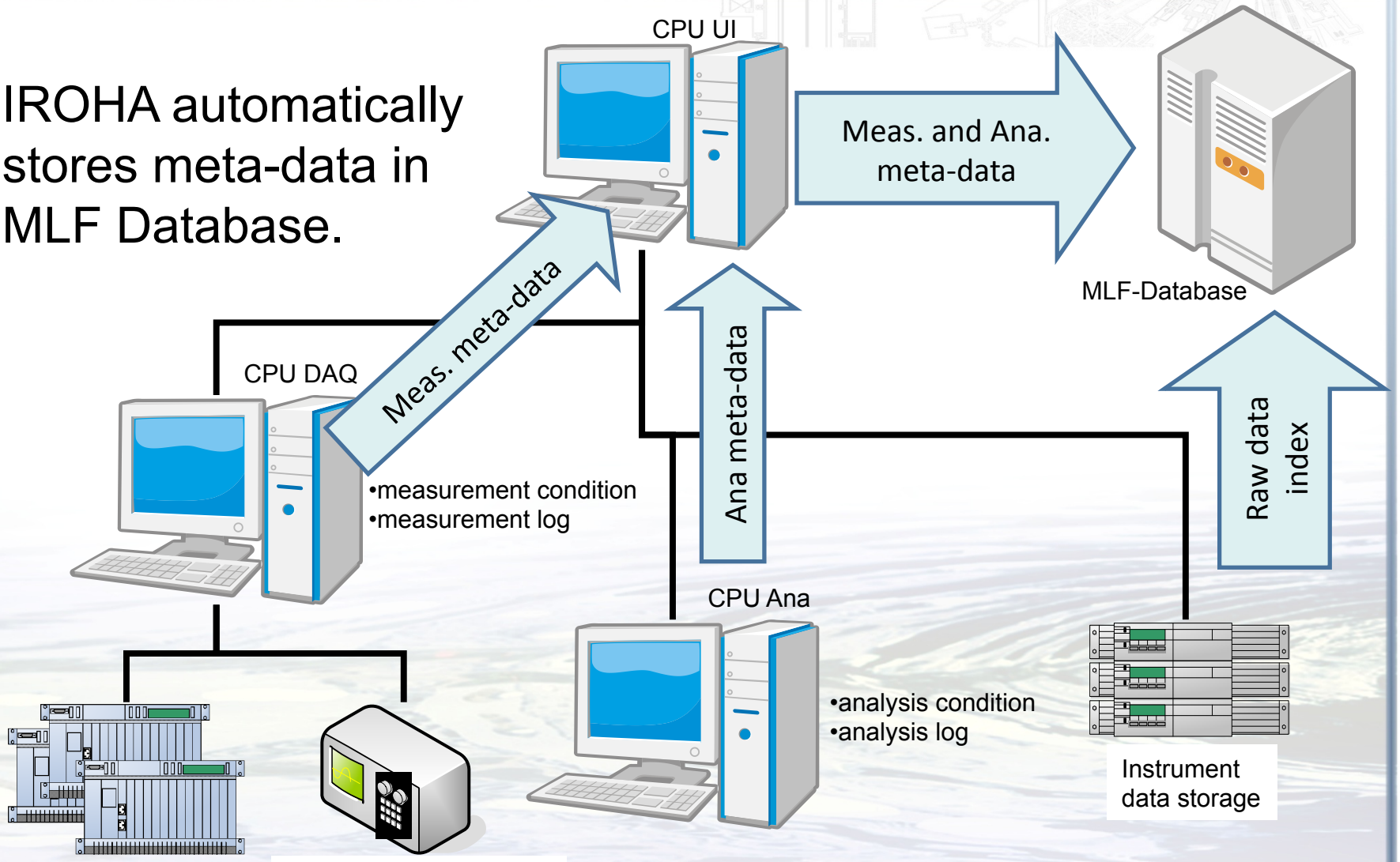


Monitoring control of raw data and meta-data (experimental condition)

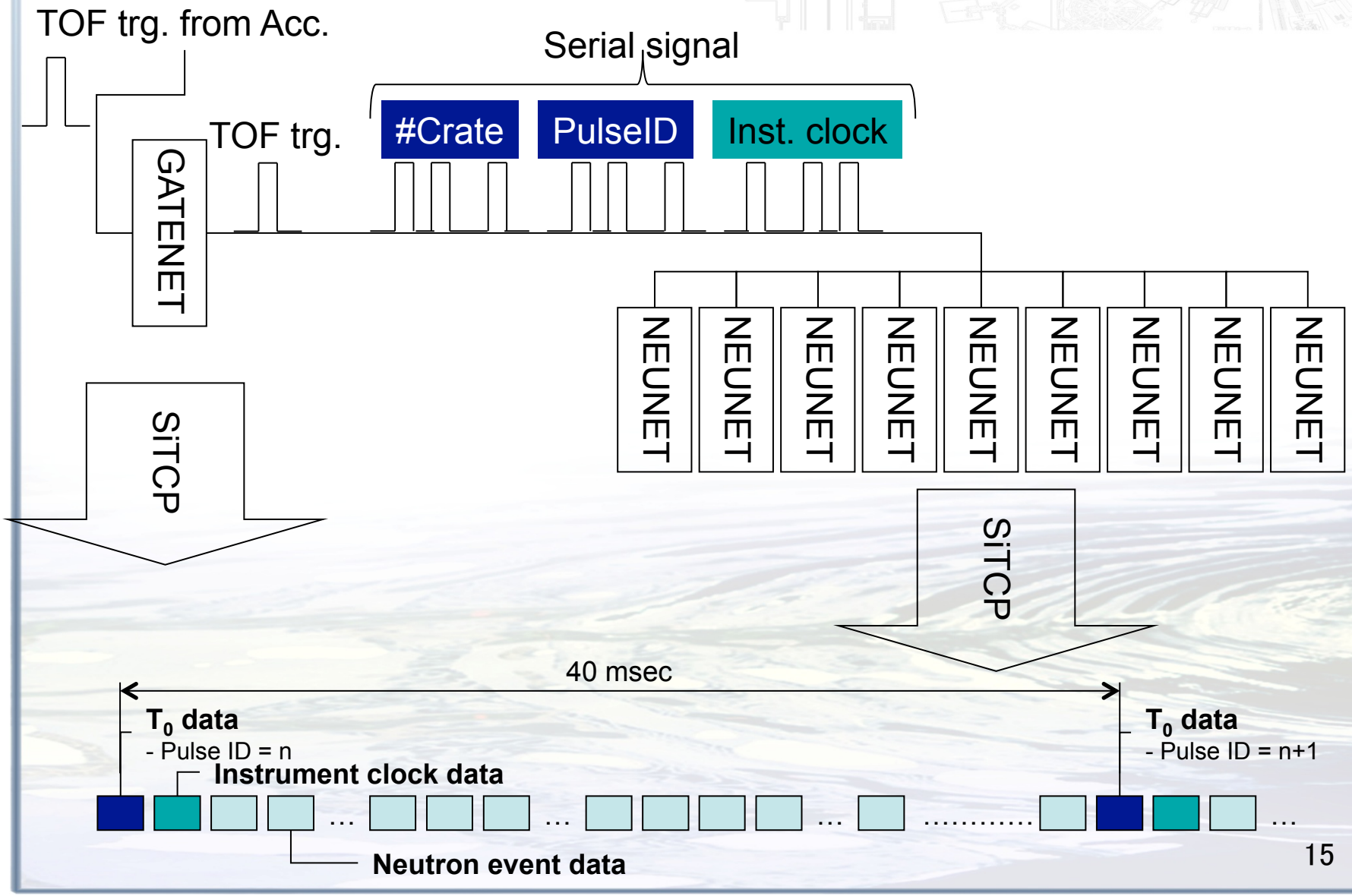
1. Automatic listing raw data and meta-data
2. Searching raw data and meta-data by run number
3. Data analysis (histograming)
4. Searching histogram data by run number
5. Access control by each user
6. Data transfer by run number

Development of meta-data database

IROHA automatically stores meta-data in MLF Database.

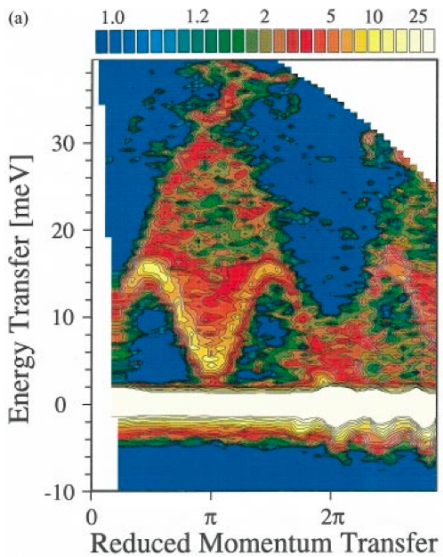


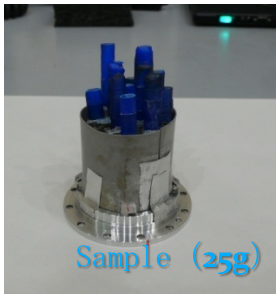
Distribution of PulseID and Instrument clock



Application of event data analysis

$CuGeO_3$, Ei=45meV At MARI in ISIS





Phys. Rev. Lett. 77(1996) 3649)

$CuGeO_3$ measurement @4SEASONS(BL01)

Data reduction and visualization of **4** inelastic energy region from **1** measurement data

We can re-bin after measurement.

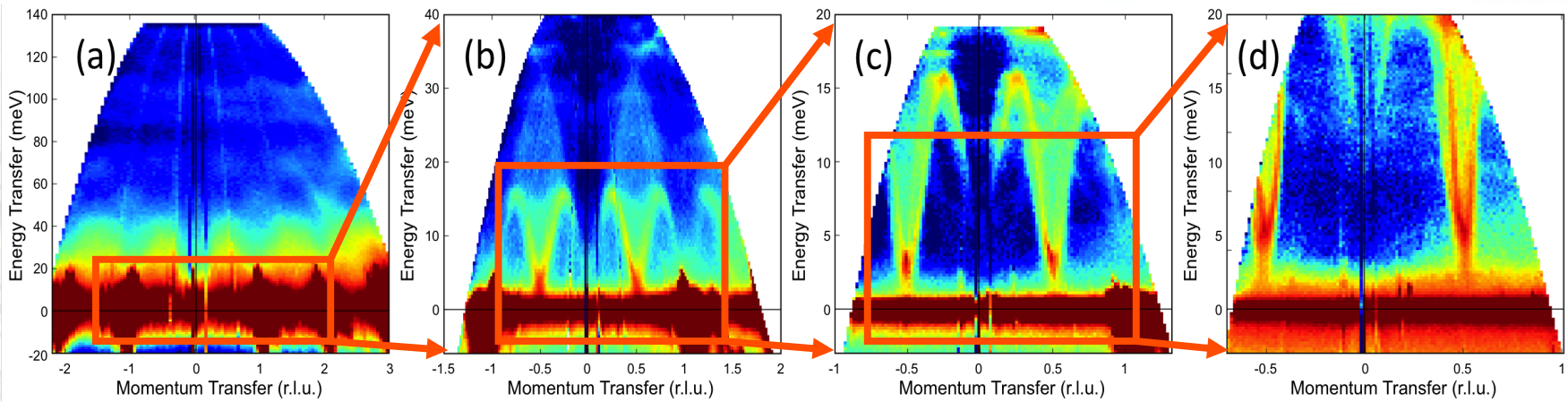


Figure : (a) Ei = 150.7 meV (b) 45.4 meV (c) 21.5 meV (d) 12.6 meV

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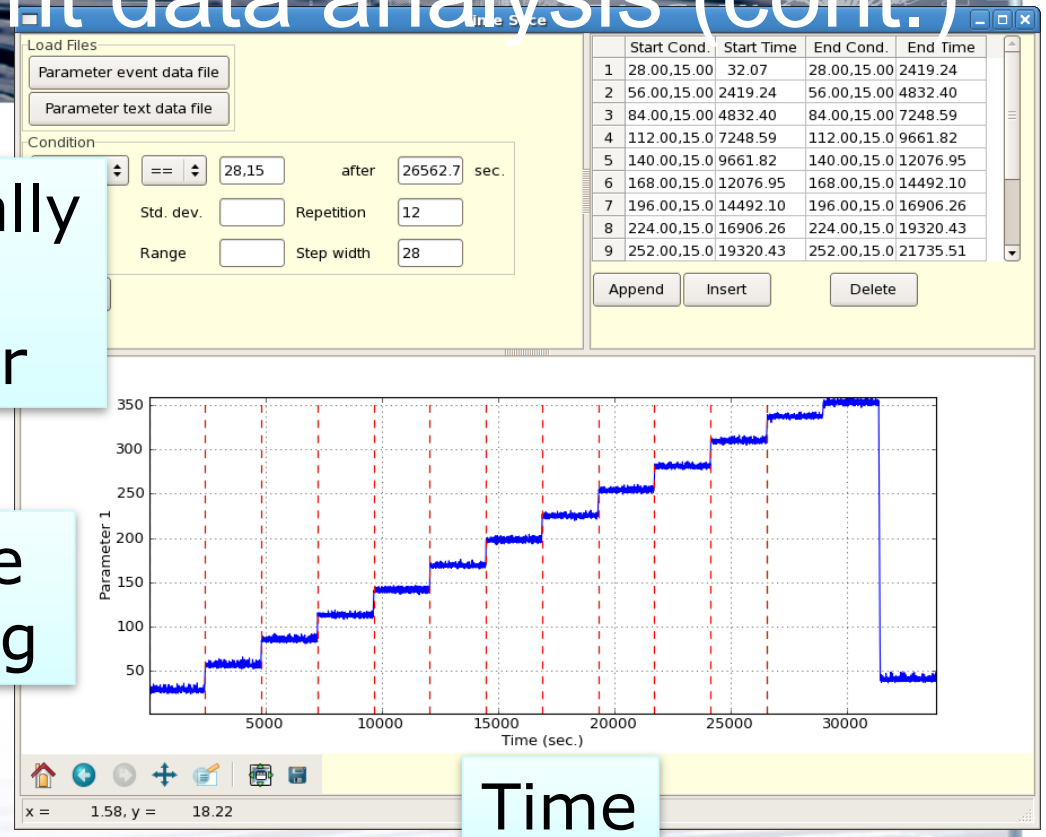
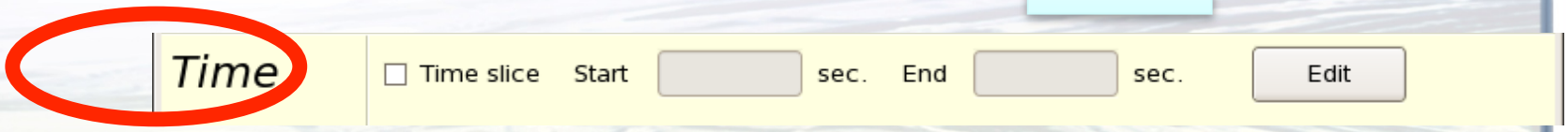
Application of event data analysis (cont.)

Time slicing automatically determined by external field parameter

Tensile loading



Time



Time slicing analysis

Summary

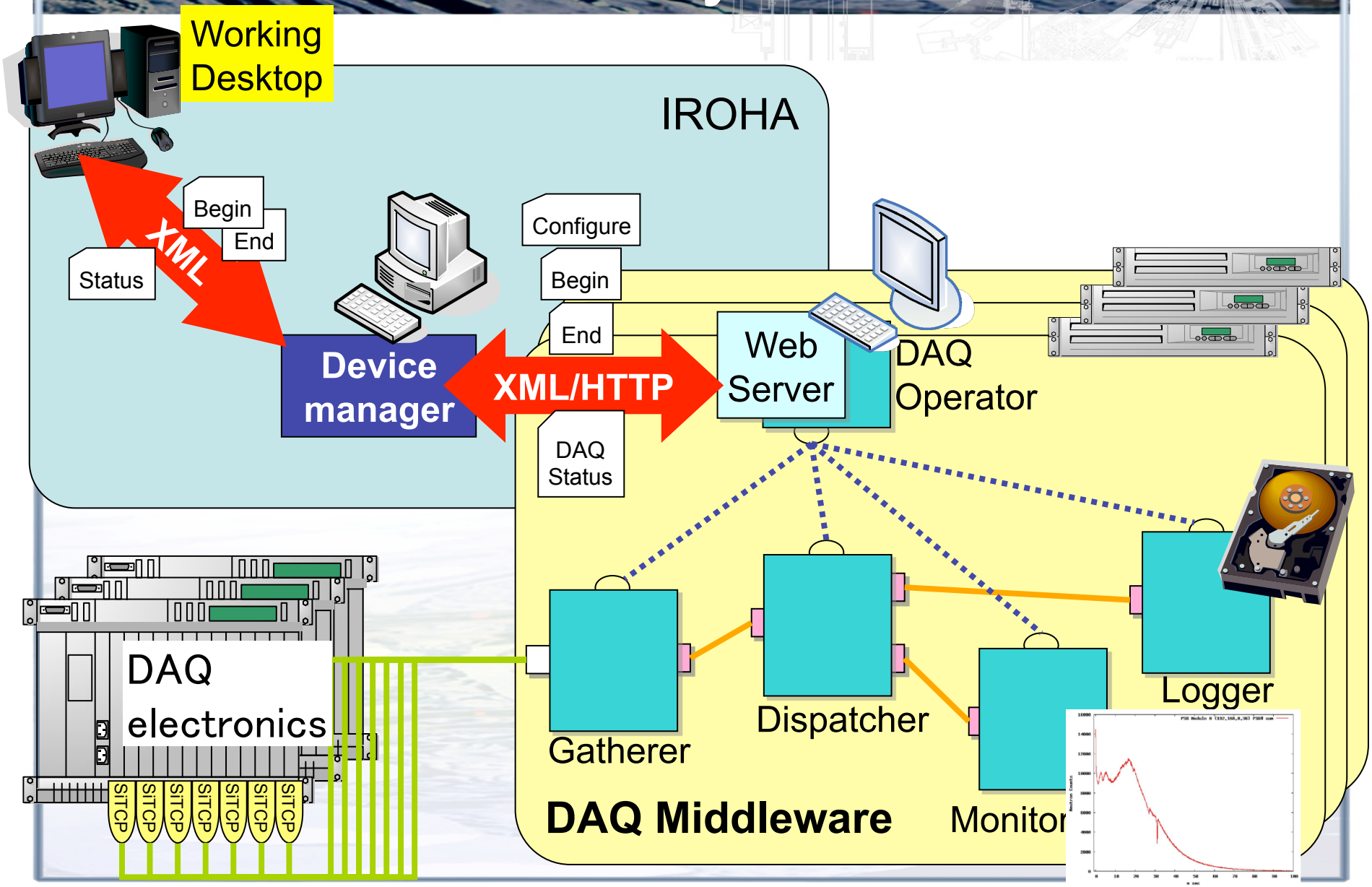
- We had started to develop from nothing of any software, but we have developed the minimum event data processing software until Day-1.
- Experimental meta-data database will be developed in this FY.
- Applications of event data analysis are implemented.
  - But it is difficult because almost of us are partly user-supporting staff.

Lessons learned

- Sub-systems can individually be executed.
- Easy decision making because of the small development team
- At Day-1, we selected the target instrument (BL20), then we concentrated on its software.
- Difficulty of hardware standardized
  - We decided the standard detector interface, but the event data format was changed by detector types.
  - Difference of data reduction software
- Difficulty of parallel development with outsourcing company
  - Japanese comments in the source codes

Appendix

DAQ system


Working Desktop
IROHA
Begin
End
Status
XML
Configure
Begin
End
Device manager
XML/HTTP
Web Server
DAQ Operator
DAQ Status
DAQ electronics
SiTCP
Gatherer
Dispatcher
Monitor
Logger
DAQ Middleware

Analysis / Visualization system

Working Desktop

IROHA

Histograming

Smoothing

Plot

XML

Analysis control

XML/HTTP

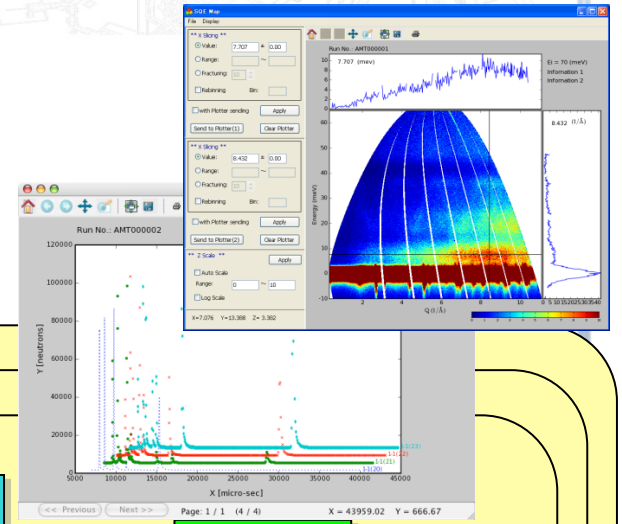
EventToHistogram

Smoothing

MPlot

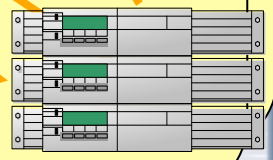
Web Server

Manyo-Lib



MPlot etc.

Time focusing, Smoothing etc.

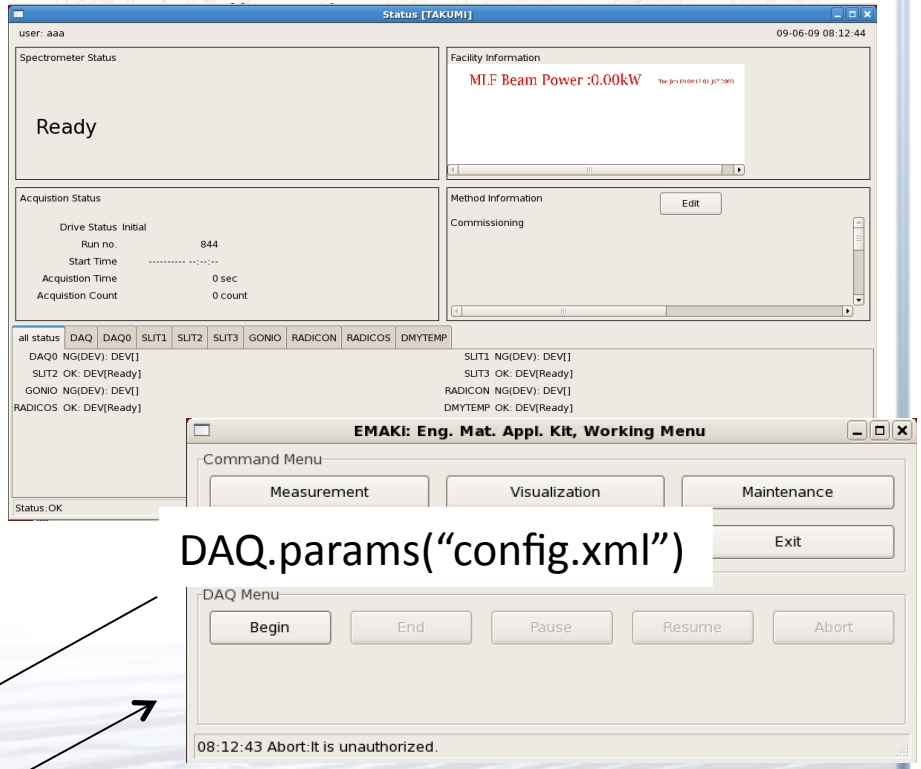


EventToHistogram
He-PSD, Scintillator

Common module

User module

XML messages between IROHA and DAQ Middleware (1)



DAQ.params("config.xml")

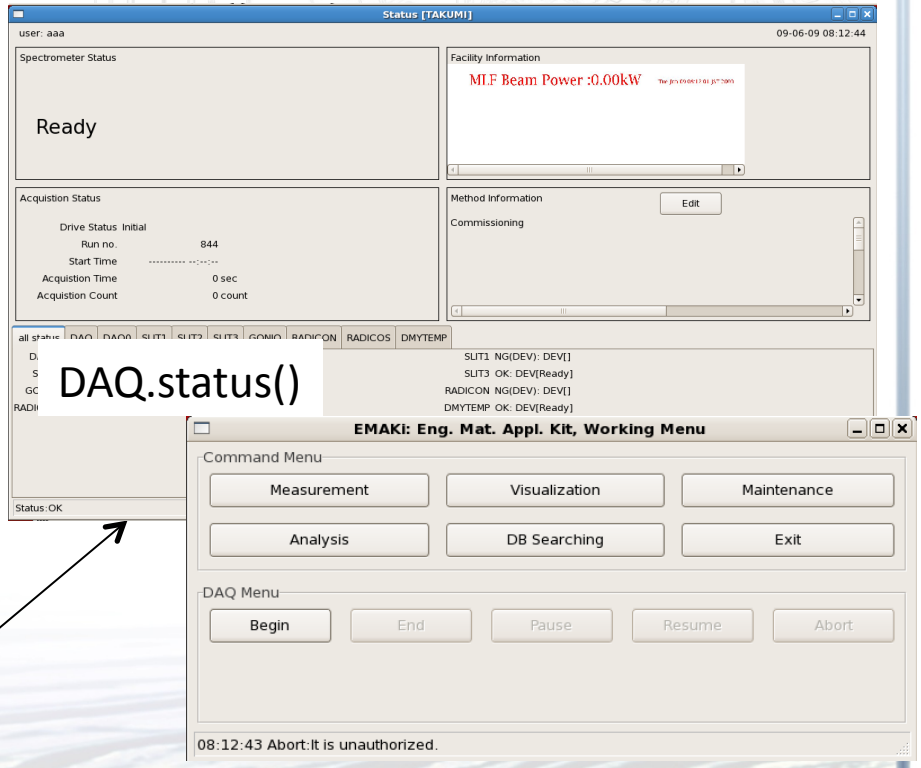
URI : http://DAQContSv/daq/Params
HTTP POST
MINE : text/xml
Parameter :
<params>config.xml</params>

Working Desktop / IROHA

DAQ Middleware

HTTP/1.1
<status>OK</status>

XML messages between IROHA and DAQ Middleware (2)



Working Desktop/ IROHA

URI : http://DAQContSv/daq/Status
HTTP GET
MINE : text/xml

HTTP/1.1
<status>OK</status>
<devStatus>Ready</devStatus>

DAQ Middleware

NEUNET (He-PSD) Event data format

Neutron event data

Header 8bits	TOF ~400 msec 24bits by 40MHz	#module 5bits	#PSD 3bits	Pulse height 1 12bits	Pulse height 2 12bits

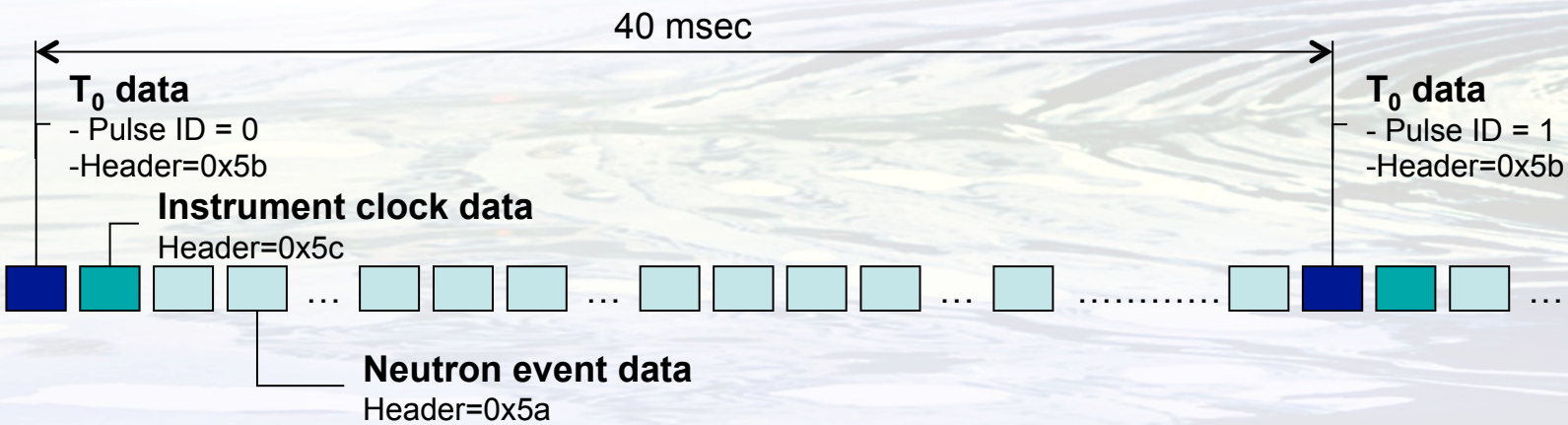
0 8 32 37 40 52 63

T_0 data

Header 8bits	#Crate 8bits	#module 8bits	Pulse ID 40bits ~1394 years

0 8 16 24 63

Instrument clock data

Header 8bits	Clock [sec] 30bits ~34 years	Clock [sub-sec] 15bits by 32kHz	Clock [sub-μsec] 11bits by 40MHz

0 8 38 53 63