LISE/M

https://www.helmholtz-berlin.de/zentrum/locations/it/software/exsteuer/projekt-m_de.html

HZB Helmholtz Zentrum Berlin

LISE IS STEERING EXPERIMENTS

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MOTIVATION

A system of inhouse-developed hardware and software has been the standard measuring equipment used at the HZB storage ring. The components were working reliably but became more and more difficult to maintain.
First ideas about an improved replacement based on commercial hardware components with a flexible software architecture lead to a first prototype in 2013. In 2015 this development became a regular project watched by the HZB management.

Influenced by results of projects like 'unified log data management' the project started as MoVE (modernisation and unification of experiment control systems at the storage ring BESSYII).
Putting emphasis on a modular design and based on best experiences with PXI hardware and the LabVIEW software stack, these components were chosen as a development base.
In development our focus have been beamlines at the storage ring but the framework should serve as universal experiment control system.

NAMING

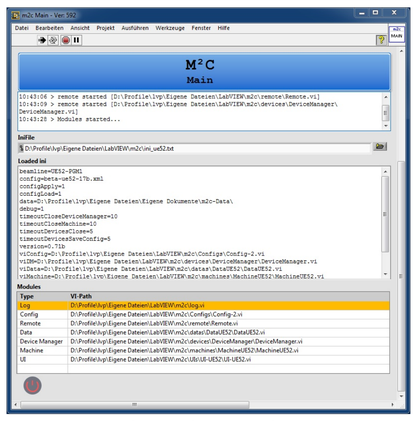
LISE/M (ˈliːə ɛm), this name was given in honour of Lise Meitner (1878-1968) where the first prototypes of our software were just named 'M'.
While the "full name" is somewhat cumbersome, the latter turned out to be too short (no distinct idea what's going on if one told you 'we did it with m'). Ongoing development of the 'modular measurement and control' system lead us to 'm²c': short enough to mark member functions and to prefix dependent modules. So, *m* is short for *m²c* which is short for *LISE/M* - we'll settle this by the end of 2017.

```
<!-- Zusammenstellung der ScanDaten... -->
<datascan>
    <datasources>0,2,1</datasources>
</datascan>

<!-- Ab hier Datenquellen... -->
<datasource>
    <id>0</id>
    <source>index</source>
</datasource>
<datasource>
    <id>1</id>
    <source>timeabsolut</source>
</datasource>
<datasource>
    <id>2</id>
    <item>Ring Current</item>
    <unit>mA</unit>
    <source>device></source>
    <deviceid>0</deviceid>
    <devicechannel>0</devicechannel>
</datasource>
```

sections of a configuration file

main simply controls everything...



main: initial window with status info

```
<datascan>
    <datasources>0,2,1</datasources>
</datascan>

<!-- Ab hier Datenquellen... -->
<datasource>
    <id>0</id>
    <source>index</source>
</datasource>
<datasource>
    <id>1</id>
    <source>timeabsolut</source>
</datasource>
<datasource>
    <id>2</id>
    <item>Ring Current</item>
    <unit>mA</unit>
    <source>device></source>
    <deviceid>0</deviceid>
    <devicechannel>0</devicechannel>
</datasource>
```

Config File

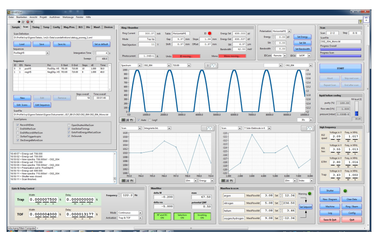
```
# ------------------------------
# Index: 0
# ------------------------------
# 00: Index
# 01: Ring Current in mA
# 02: Time
# ------------------------------
0   300.185975   3561461564.914523
1   300.444933   3561461578.431875
2   301.606067   3561461591.933225
3   301.585834   3561461605.504582
```

Data File

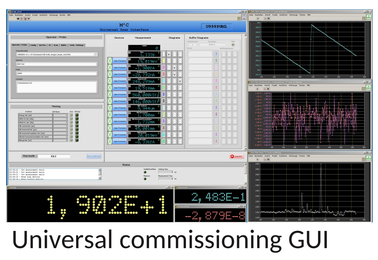
how to configure the data file

The configuration module
- defines all devices and options to be used for scans
- device configurations comprise interface parameters, measurement ranges, scan types etc.

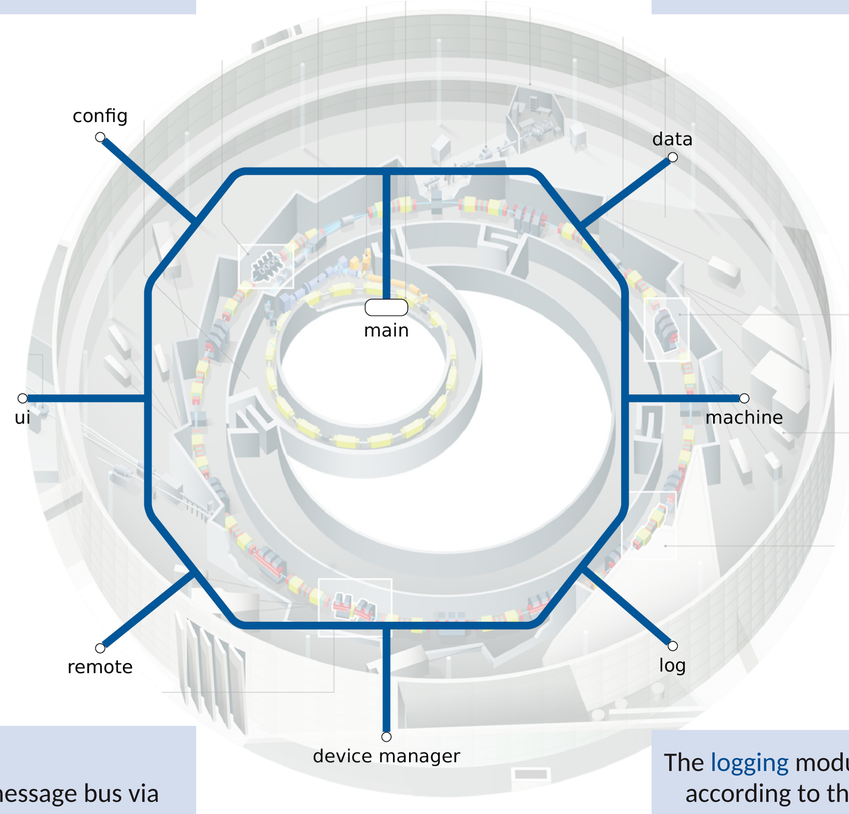
The data module
- processes all measurement data
- provides buffered data for online visualisation
- adds a (beamline specific) header
- writes a measurement file
- connects to ICAT



Specific GUI for UE52-PGM

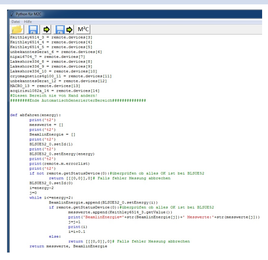


Universal commissioning GUI



The machine
- controls the real measurement (scan)
- provides two modes: fixed or flex scan (the latter as script)
- collates all measurement data and sends it to the data module

The remote module
- offers access to the *m²c* message bus via TCP, websocket and EPICS
- enables remote control of all other *m²c* modules
- is used by scripting modules via python or javascript



python script editor

a basic hardware setup

The device manager
- manages devices system wide
- starts modules according to a configuration and stops these on *m²c* shutdown
- offers dynamic reload of devices
- polls all measurement devices

The logging module stores *m²c* wide events according to the configuration.

```
16:04:37 > DEVICE:0|3588242677.070551|GET-VALUE|OK|300.779825|19|Top Up|0.000000|0.447597|0|6.97|42.5|8.97|9.97|IdOn|HorizontalH1|0|1|remote|0.97|0.98|0.96|1.96|2.96|3.96|
16:04:37 > DEVICE:5|3588242677.817551|GET-VALUE|OK|1.2255E+1|1.3051E+1
16:04:37 > DEVICE:8|3588242677.819051|GET-VALUE|OK|-1.191966E+2|-1.300095E+2|1.070860E+1|-2.247403E+2|-2.367577E+2|2.092815E+1|-3.383306E+2|-3.263806E+2|3.226864E+1|-4.125
16:04:37 > DataUE52.vi|3588242677.821051|DATA-ROW-XT|OK|774|3588242677.815051|300.779825|19|Top Up|0.000000|0.447597|0|6.97|42.5|8.97|9.97|IdOn|HorizontalH1|0|1|remote|0.9
16:04:37 > DEVICE:9|3588242677.821051|GET-VALUE|OK|-1.126182E+2|-1.261565E+2|1.064403E+1|-2.166178E+2|-2.405262E+2|2.172049E+1|-3.346649E+2|-3.443535E+2|3.010581E+1|-4.343
16:04:37 > DEVICE:11|3588242677.825551|GET-VALUE|OK|7.770000E+0|7.700000E+1
```

an extract of logging information

FEATURES

- modular system architecture
- unified message bus
  - message format:
    sender|time stamp|instruction|[parameter]
- central XML configuration file
  - device parameters, EPICS server variables, GUI elements
  - user defined sections for data file columns, additional devices etc.
  - user friendly editor is provided
- one framework for an universal "commissioning" version and beamline specific versions
- universal features
  - free scalable numerical and graphical displays
  - theoretically unlimited number of measurement channels (tested setup: 30 channels)
  - up to 10 nested scan axis
  - up to 32 diagrams with 8 channels each
    - 'live' for current measurement
    - up to 16 buffers (each buffer contains a full measurement cycle with all measuring points)
  - number of measuring points is only limited by RAM
- fixed and flexible built-in scan modes
- variable scan stacking via sequence definitions
- standard xt-mode to display and store values with time stamps (without actually scanning)
- remote interface for max. flexibility
- flexible logging facility
- flexible data (output) module
- dynamic device interface
- simulation mode for devices and modules
- special connector box with 32 BNC sockets to adapt e.g. counter modules
- EPICS as client and server
- D{A,E}MC interface
  - HZB specific control interface via TCP or serial connection
  - for direct control of optical beamline elements
  - for external access to m²c-internal variables, functions and devices
- ICAT interface
  - log and meta data is collected
  - measurement and meta data will be stored in a specific transfer area according to the proposal number of the current measurement
  - the actual transfer into the ICAT system is externally initiated with no impact on the running measurements
- SeCOP interface
  - a first prototype client implementation

CONCLUSION

LISE/M resp. *m²c* was successfully deployed at the first instruments in 2017. Both, the universal ('commissioning') version as well as the individual, special (e.g. 'nano cluster trap') version perform very well.
The results show that the learning curve for the development team is manageable and the chosen approach can be used to tailor the system according to individual needs.
The developed framework should work for a wide range of common measurement tasks. As system it works "out of the box" for typical commissioning tasks - the great flexibility allows approximately any kind of special system setup.

MORE INFORMATION

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