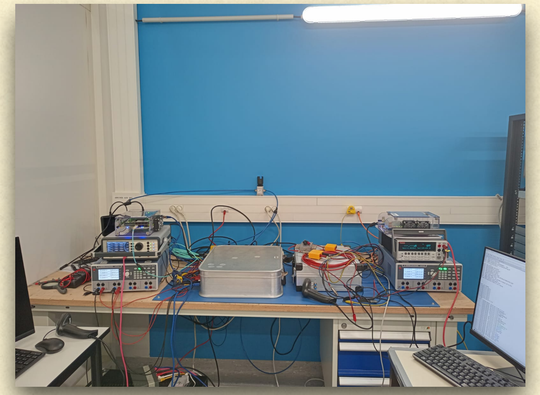
TEDD DEE INTEGRATION @ IP2I

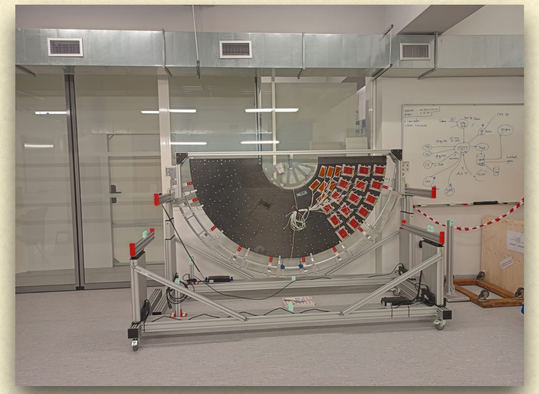
MODULE RECEPTION TEST AND DETECTOR CONTROL SYSTEM

MODULE INTEGRATION ONTO THE DEES AND TESTS

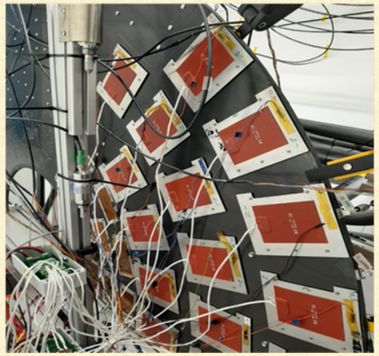
- According to the plan, **each module** will undergo some **functionality tests upon reception**.
  - The reception tests will be done for each module using **module test benches developed by KIT**.
- Once all modules have been integrated on a given dee, the dee will be subjected to a series of tests in order to verify that the modules still perform as expected.
  - **Module tests at Room Temperature.**
  - **Dees to be actively cooled ($-18^{o}C$). Measurement of module quality (Noise) in realistic cold environment.**



Stage 1: Module test upon Reception



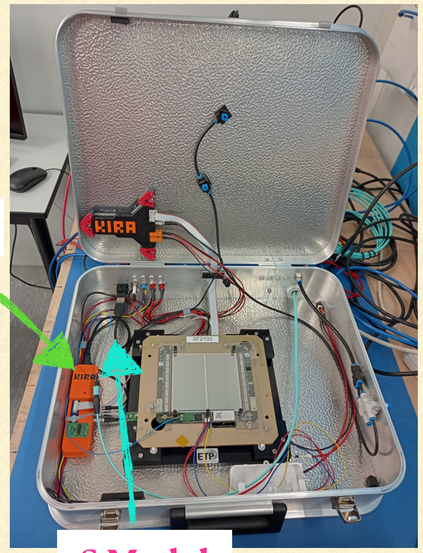
Stage 2: Module test after Integration at Room temperature

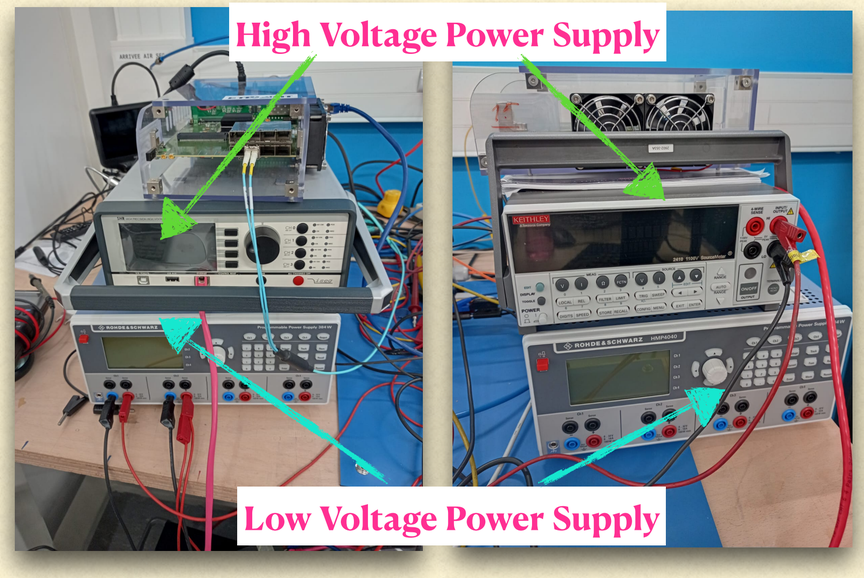


Stage 3: Multi Module test Inside cold chamber

MODULE RECEPTION TEST

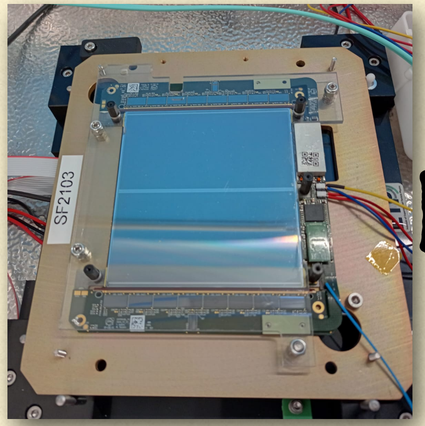
- Modules will be distributed all over the world. To ensure equal testing condition a dedicated test station was developed in KIT.
- The OT module test box is an aluminium-covered box which houses one OT module.
- To read out an OT module in the test bench it is necessary to connect low and high voltage power supplies as well as one FC7.
- We can inject external signals using Karlsruhe InfraRed Array (KIRA) system.
- An Arduino is used to monitor temperature and humidity in the box. It also controls KIRA.



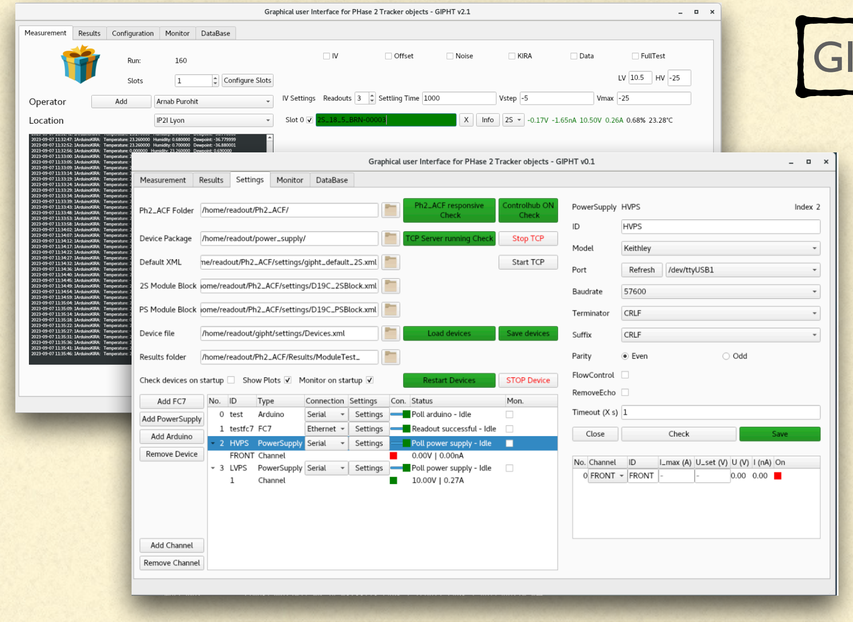


MODULE RECEPTION TEST

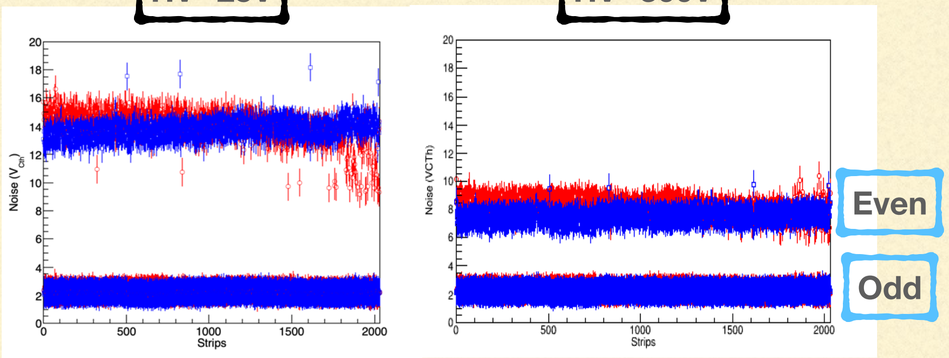
- There are several devices that need to be controlled to test an OT module.
- We use **GIPHT** (Graphical user Interface for PHase 2 Tracker objects) to perform the reception test.
  - The communication with the power supplies and the Arduino in the test box is handled with a software package called **power_supply**.
  - The communication with the FC7, and thus the module readout, is handled by the **Ph2_ACF** software package.

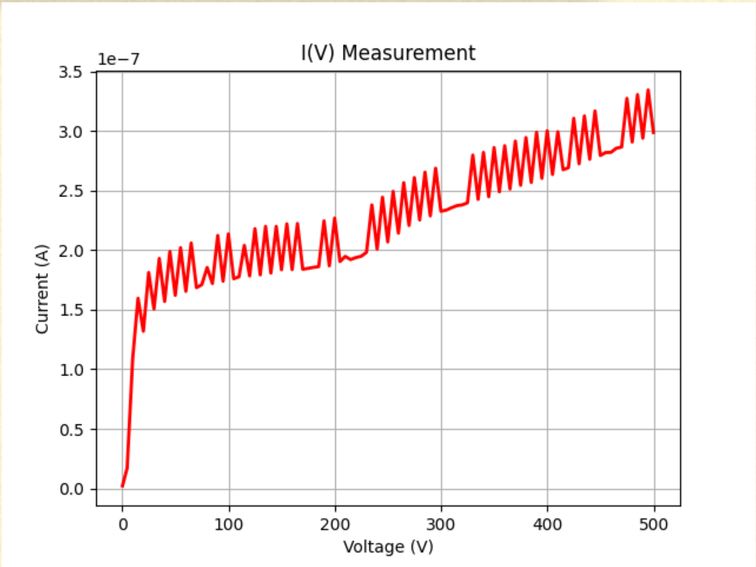


2S Module



GIPHT





DEE INTEGRATION

- **Assembly Bench:**
  The integration of modules on the Dees will take place on a custom cart to hold the Arc frame with the Dee.

- The normal vertical position (U-shaped) is not ideal for integration hence it can be rotated into a horizontal position.

- **The foreseen strategy would be to integrate the modules in the following order:**

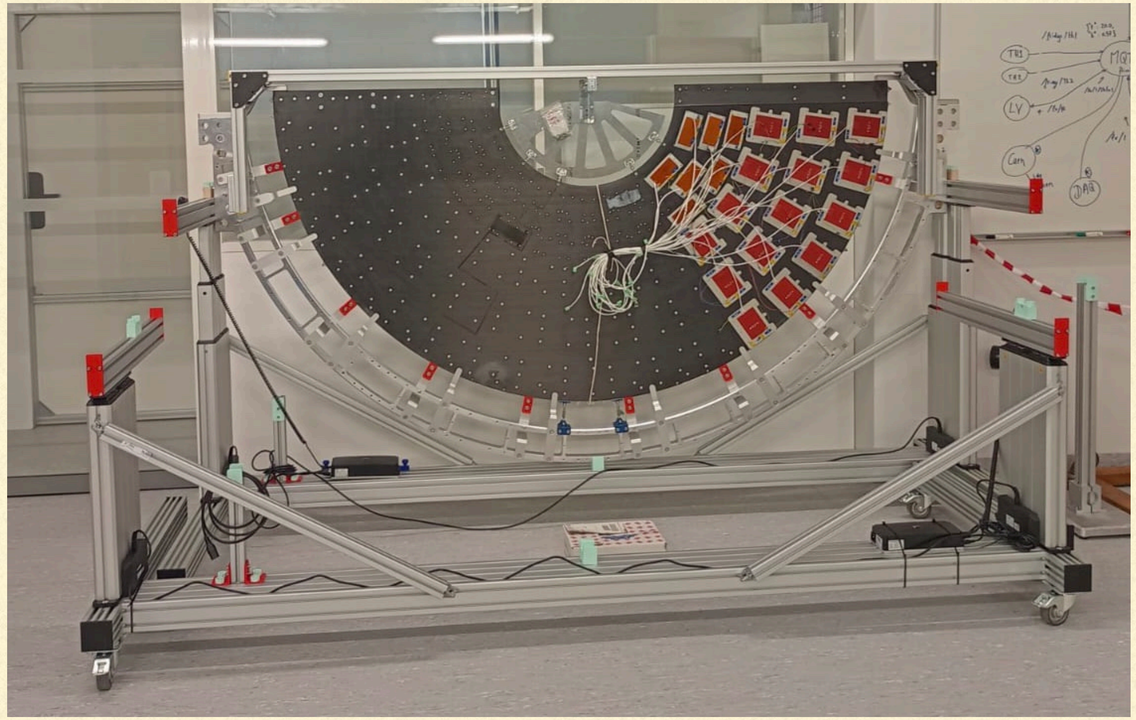
  - There will be 2 operators integrating the modules on the Dees and doing the cabling at the surface

  - One sector at a time in order to allow sector tests if they happen to be needed during integration.

  - Starting by the 2S modules and from the inner rings.

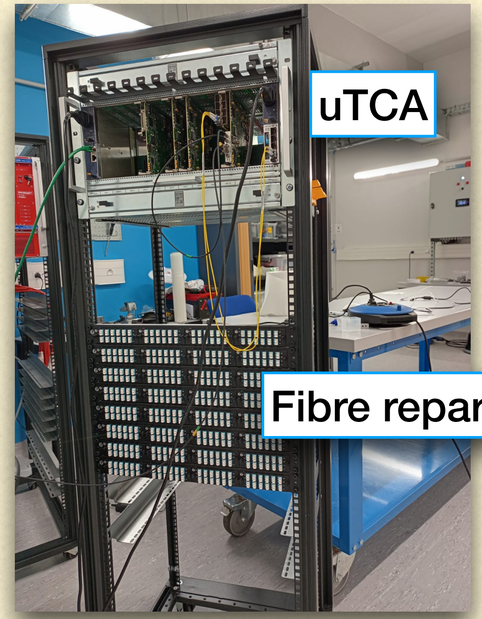
  - Continuing with the PS modules, this time from the outer rings towards the inner ones.

- A DAQ connection test will be performed after the integration.



DEE SECTOR TESTS

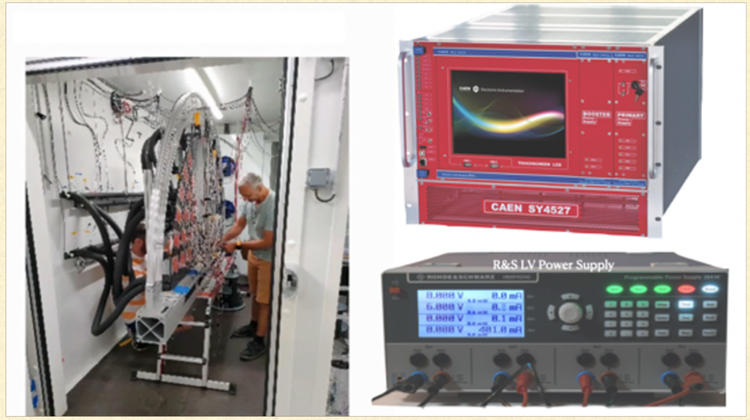
- To verify that the modules perform as expected, and validate the thermal contact between the modules and the dee surface is very important.
- The above tests require the DEEs to be actively cooled.
- We have a custom cold chamber
- Temperature and humidity sensors readout with Labview.

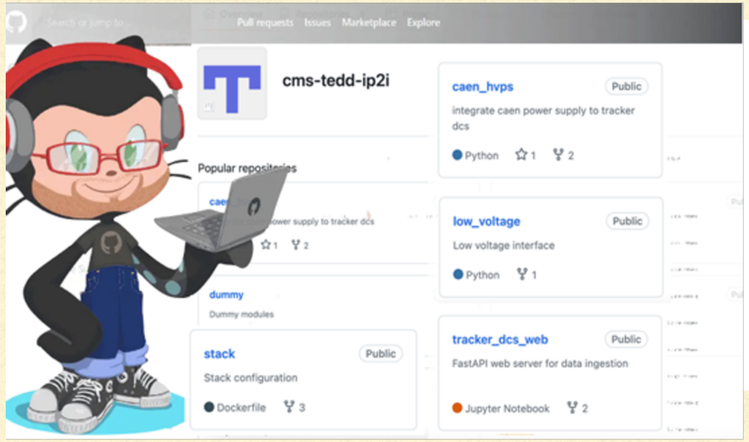


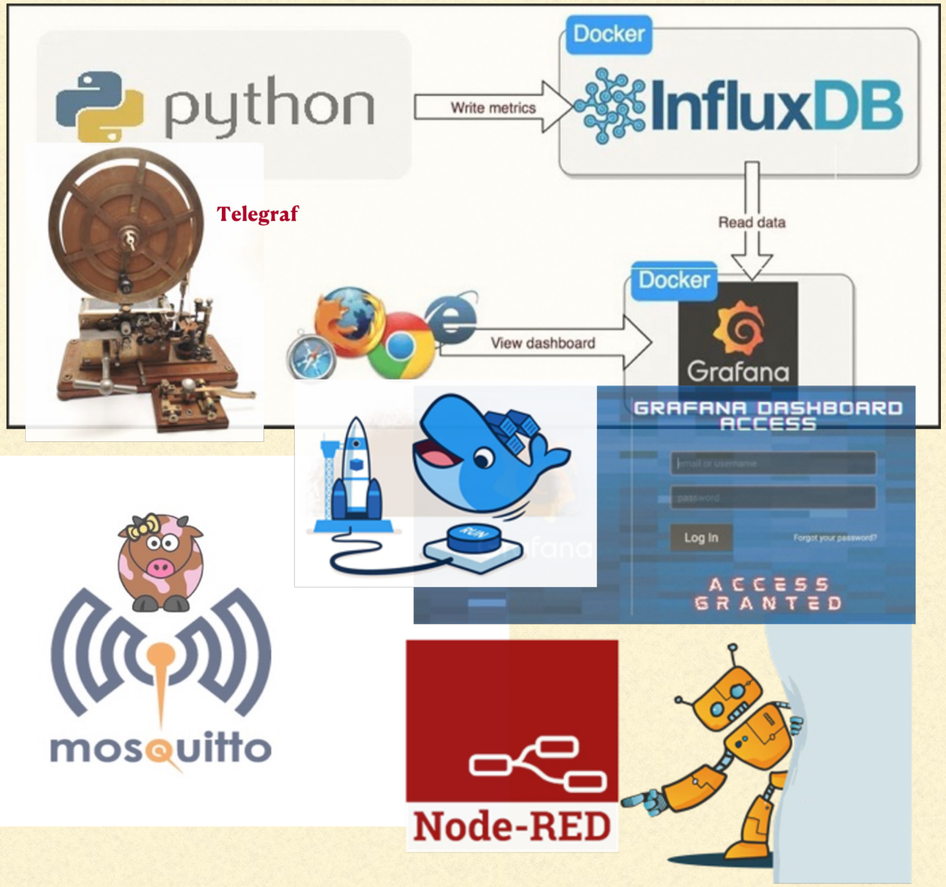
DETECTOR CONTROL SYSTEM

- We need a DCS system to monitor conditions for Dee cold test, and store the results, connect to CMS database.

- A **local DCS system** has been designed and developed using **IoT** (Internet Of Things) data pipe line with modern **open-source** tools.



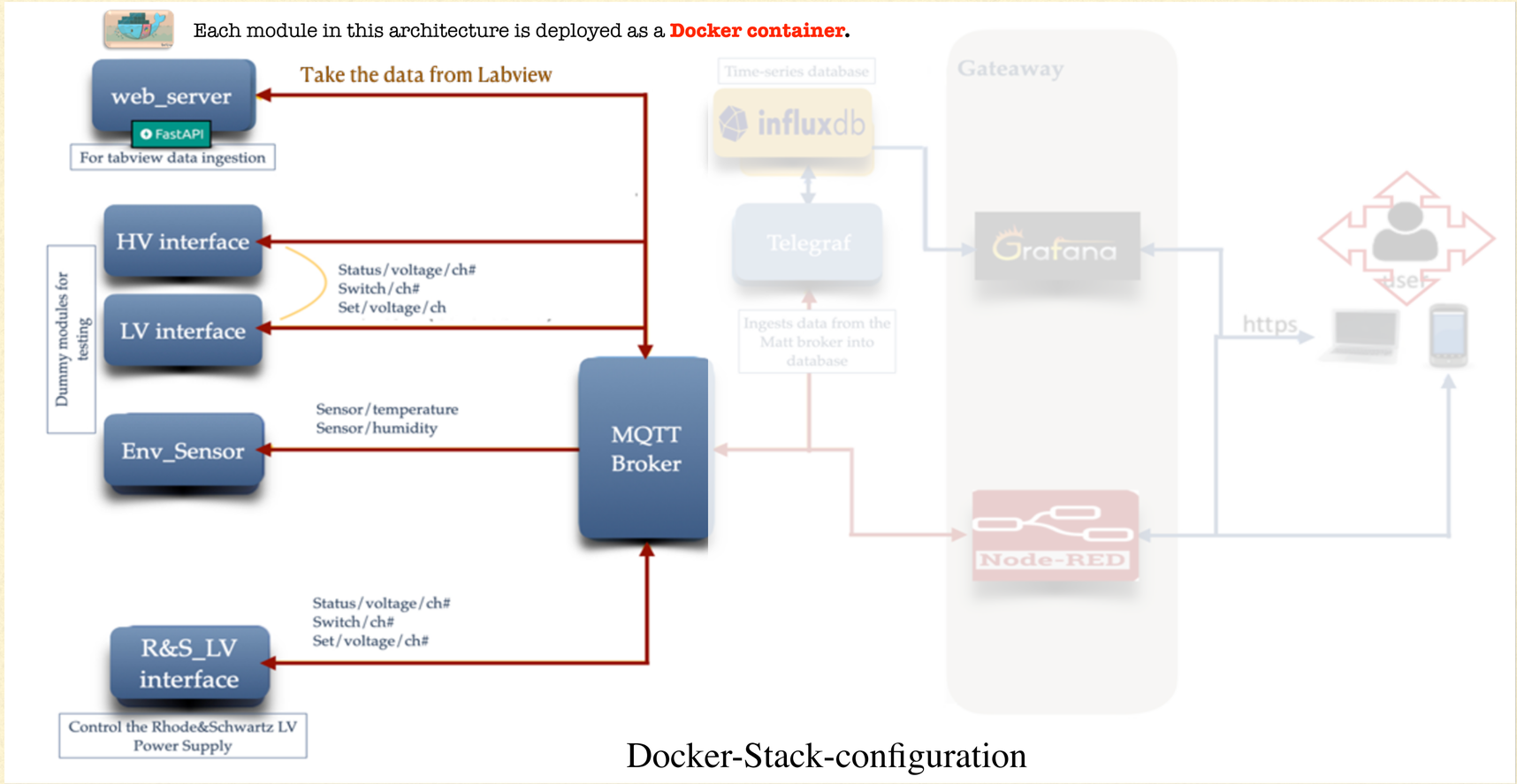




A data pipeline may consist of 3 stages

Stage 1. Time series Data is collected from the interfaces.

These services emit to the topics:
/hv/status
/lv/status
/sensor/measure1 - (temp/humidty)
with a JSON list as payload with one dictionary element per channel.

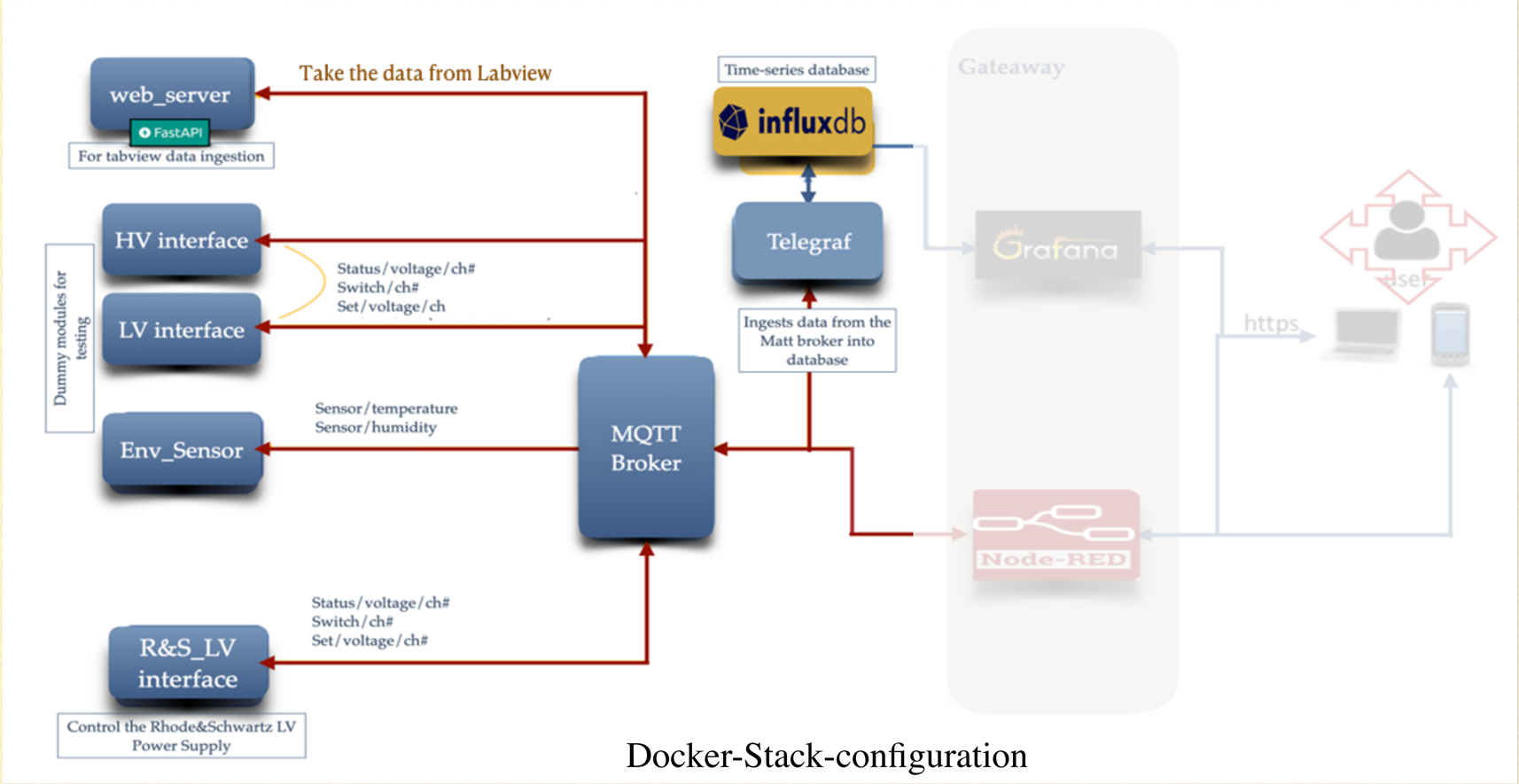


Docker-Stack-configuration

A data pipeline may consist of 3 stages

Stage 2. The data is stored in a Database

InfluxDB: for time series measurements



Docker-Stack-configuration

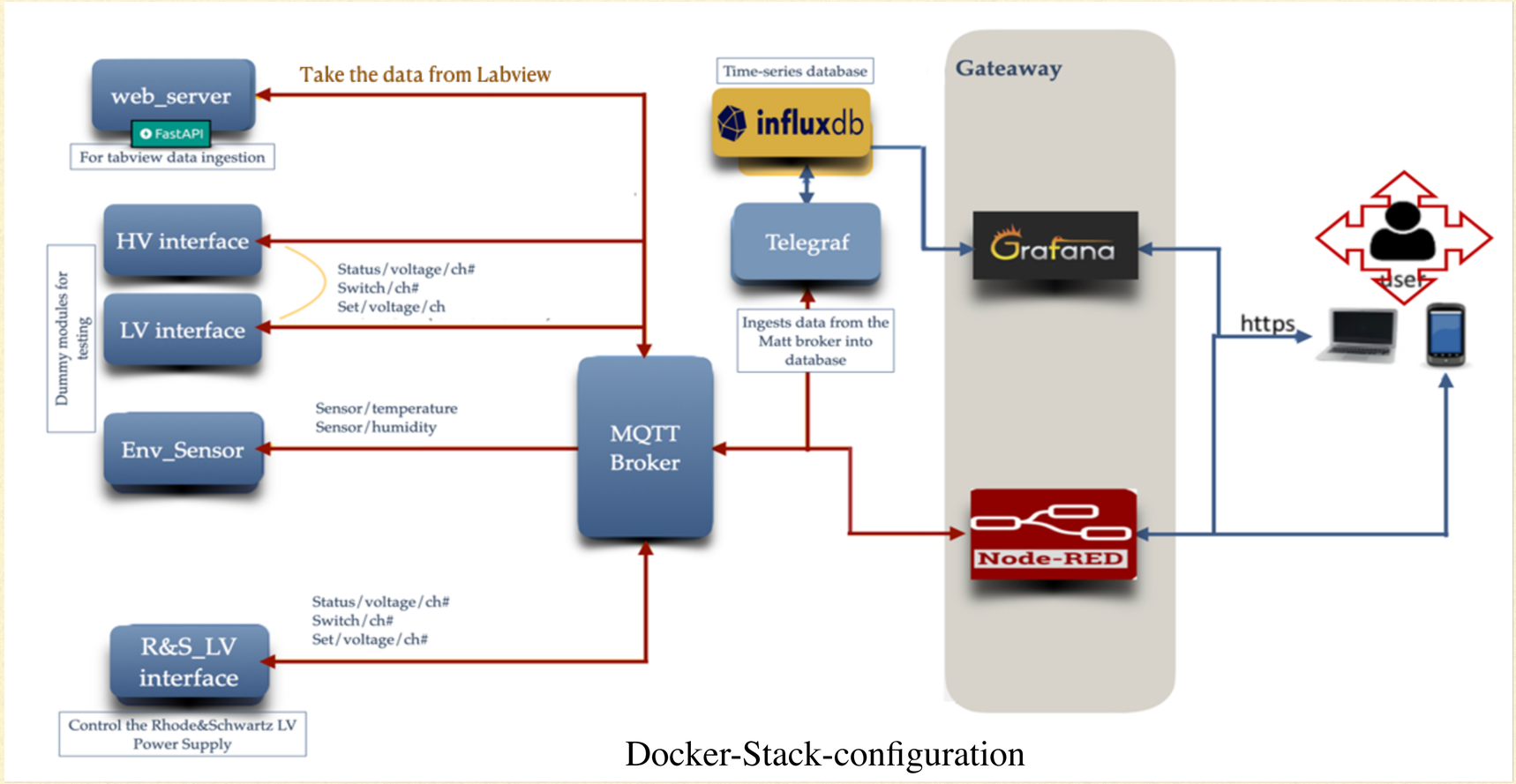
A data pipeline may consist of 3 stages

Stage 3. A Dashboard accesses the database to Visualise the data

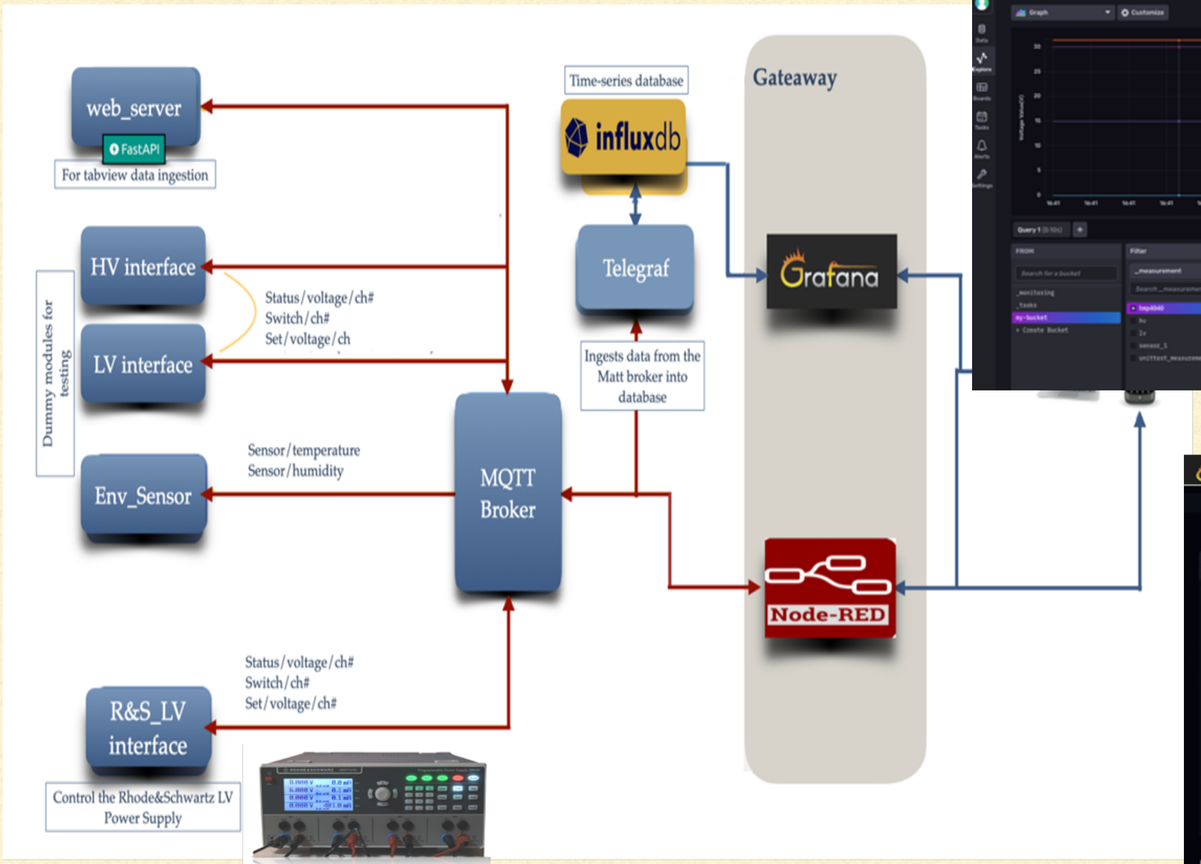
Garafana webserver: Monitoring dashboard

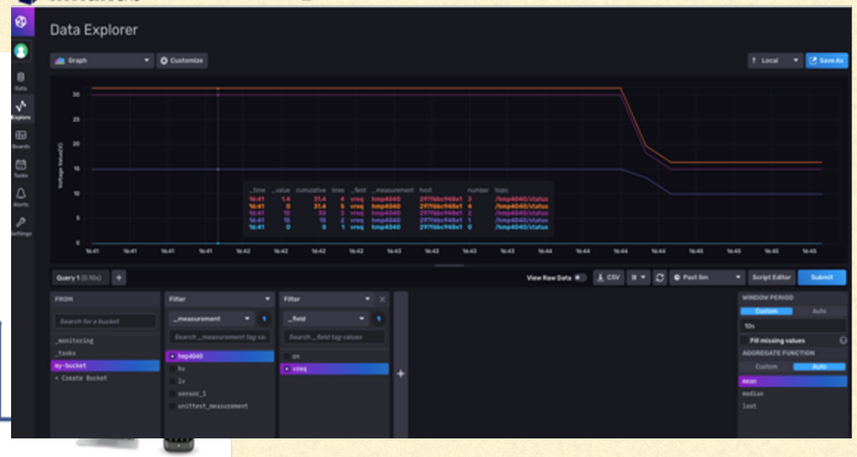
Nod-Red webserver: Labview equivalent for the slow control and logic.

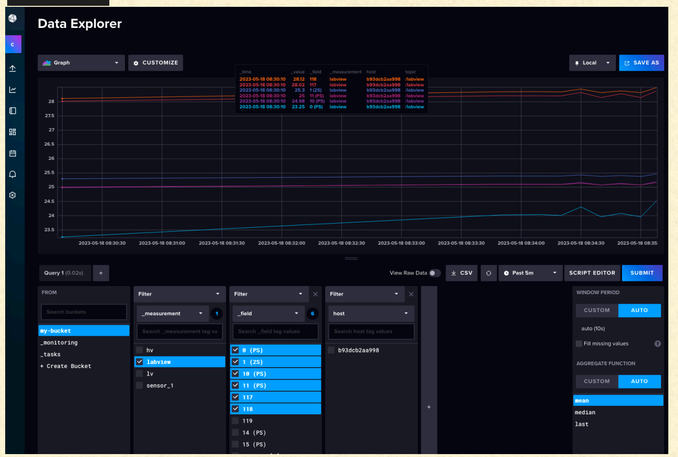
- Users interact with the architecture through a Gateway
- The Connections to these modules is secured with TLS (Transport Layer Security)

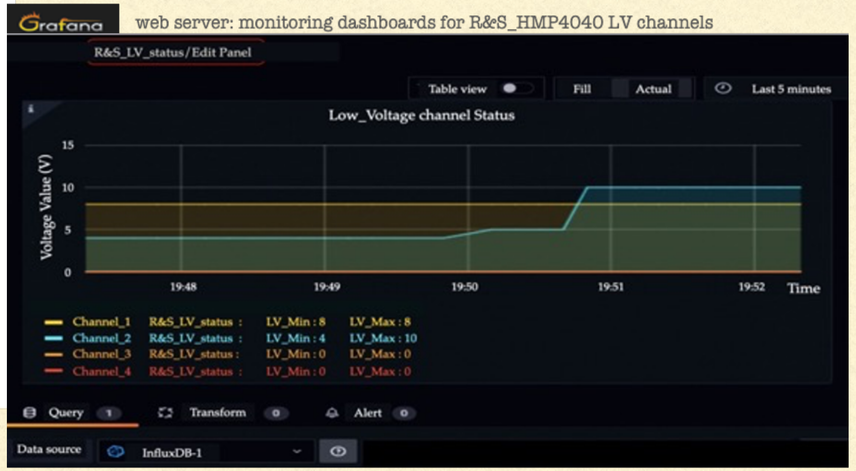


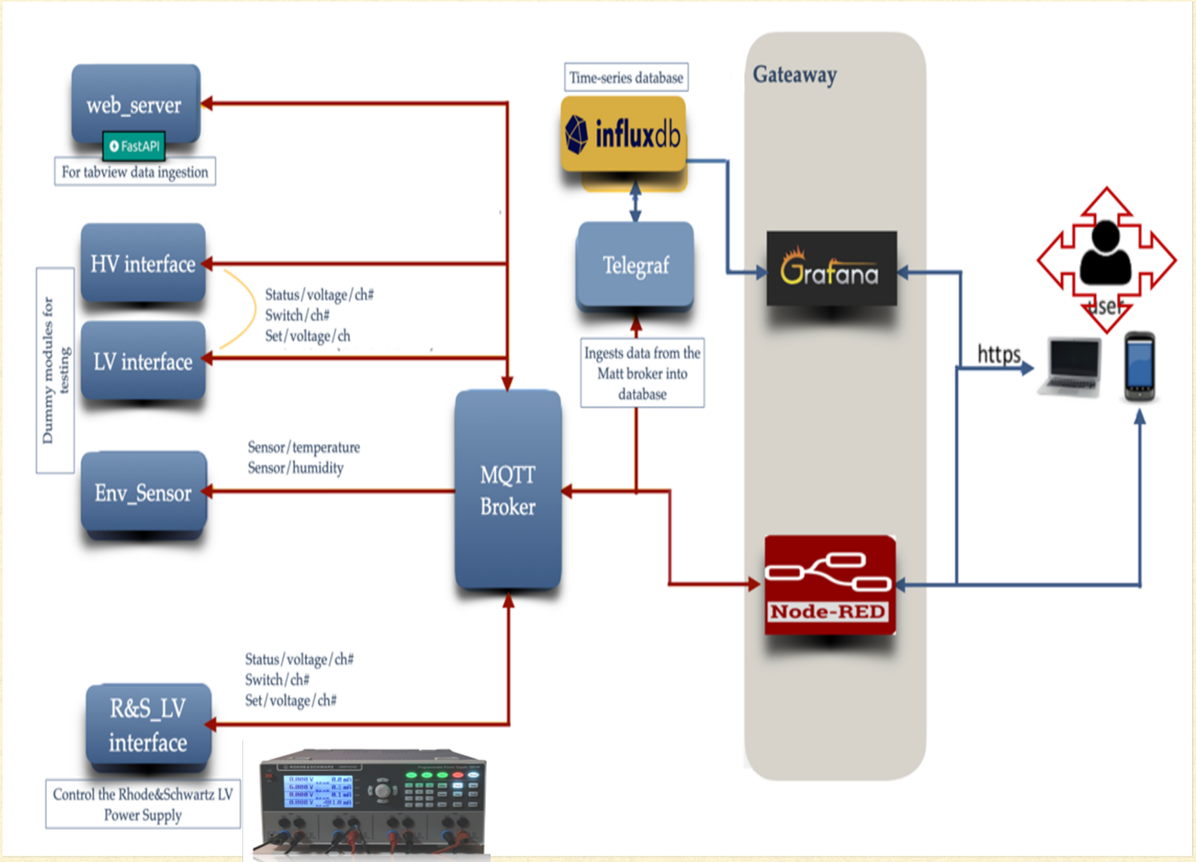
Docker-Stack-configuration

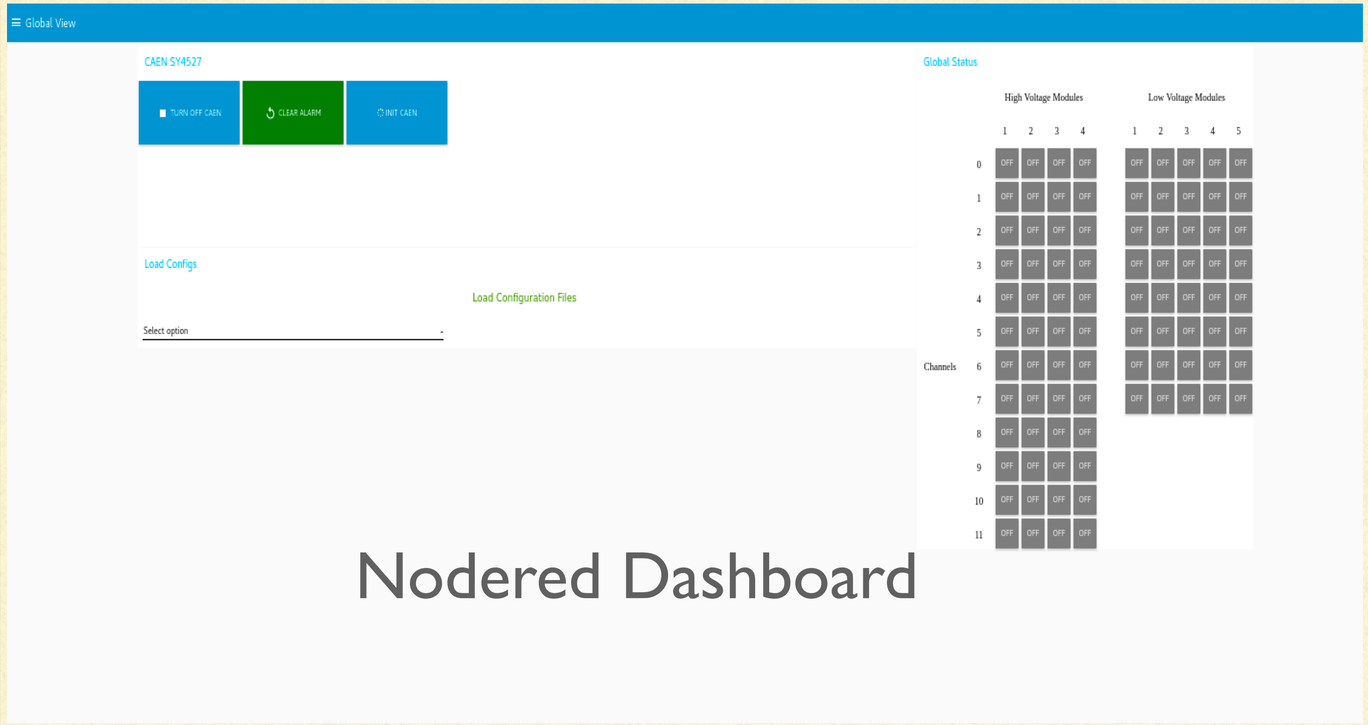

web_server
FastAPI
For tabview data ingestion
Time-series database
influxdb
Gateaway
HV interface
LV interface
Dummy modules for testing
Status/voltage/ch#
Switch/ch#
Set/voltage/ch
Telegraf
Ingests data from the Matt broker into database
Grafana
Env_Sensor
Sensor/temperature
Sensor/humidity
MQTT Broker
Node-RED
Status/voltage/ch#
Switch/ch#
Set/voltage/ch#
R&S_LV interface
Control the Rhode&Schwartz LV Power Supply


influxdb Database for R&S_HMP4040 LV channels
Data Explorer


Grafana
Get and Monitor data from Labview
Data Explorer

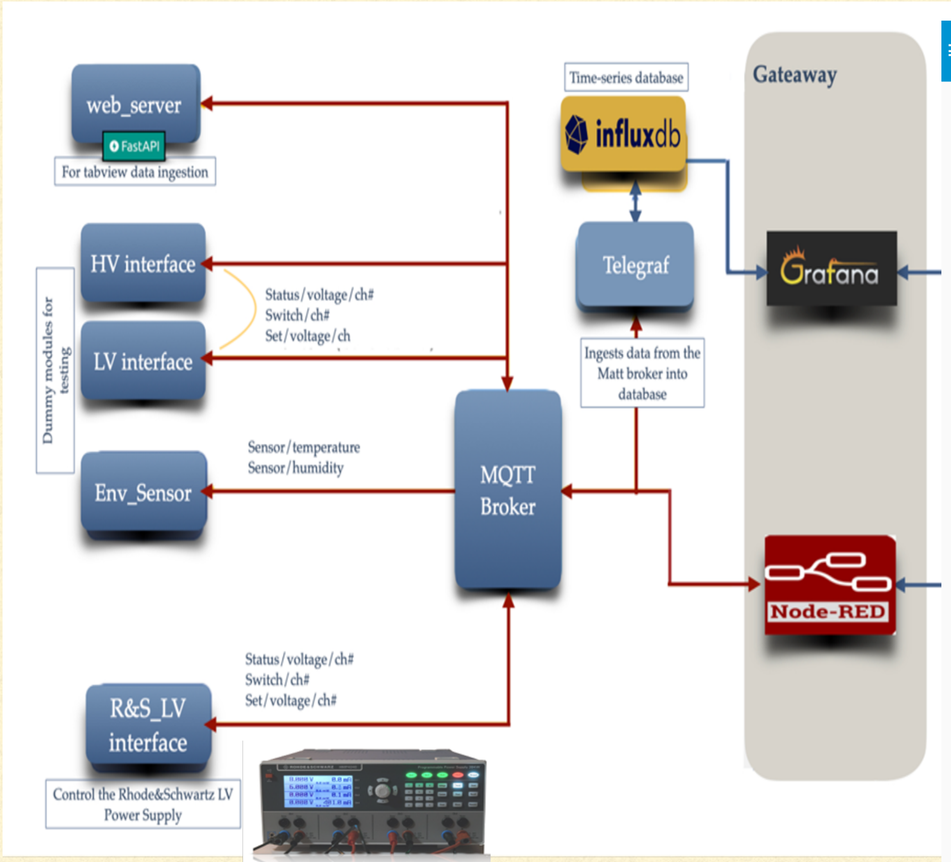

Grafana
web server: monitoring dashboards for R&S_HMP4040 LV channels
R&S_LV_status/Edit Panel
Table view
Fill
Actual
Last 5 minutes
Low_Voltage channel Status
Voltage Value (V)
Time
Channel_1 R&S_LV_status : LV_Min : 8 LV_Max : 8
Channel_2 R&S_LV_status : LV_Min : 4 LV_Max : 10
Channel_3 R&S_LV_status : LV_Min : 0 LV_Max : 0
Channel_4 R&S_LV_status : LV_Min : 0 LV_Max : 0
Query
Transform
Alert
Data source
InfluxDB-1

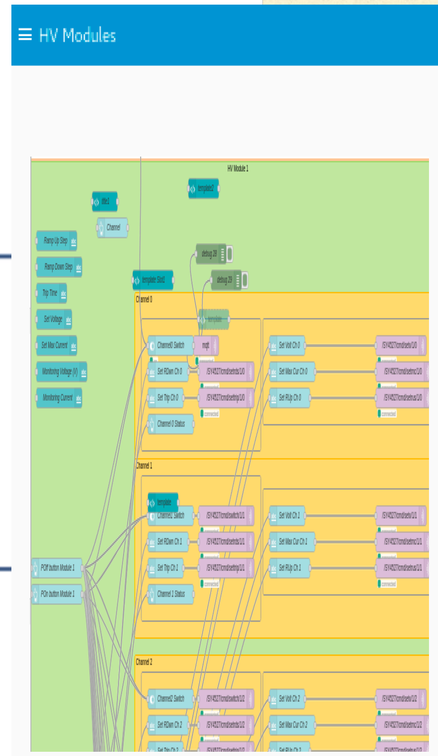




Nodered Dashboard

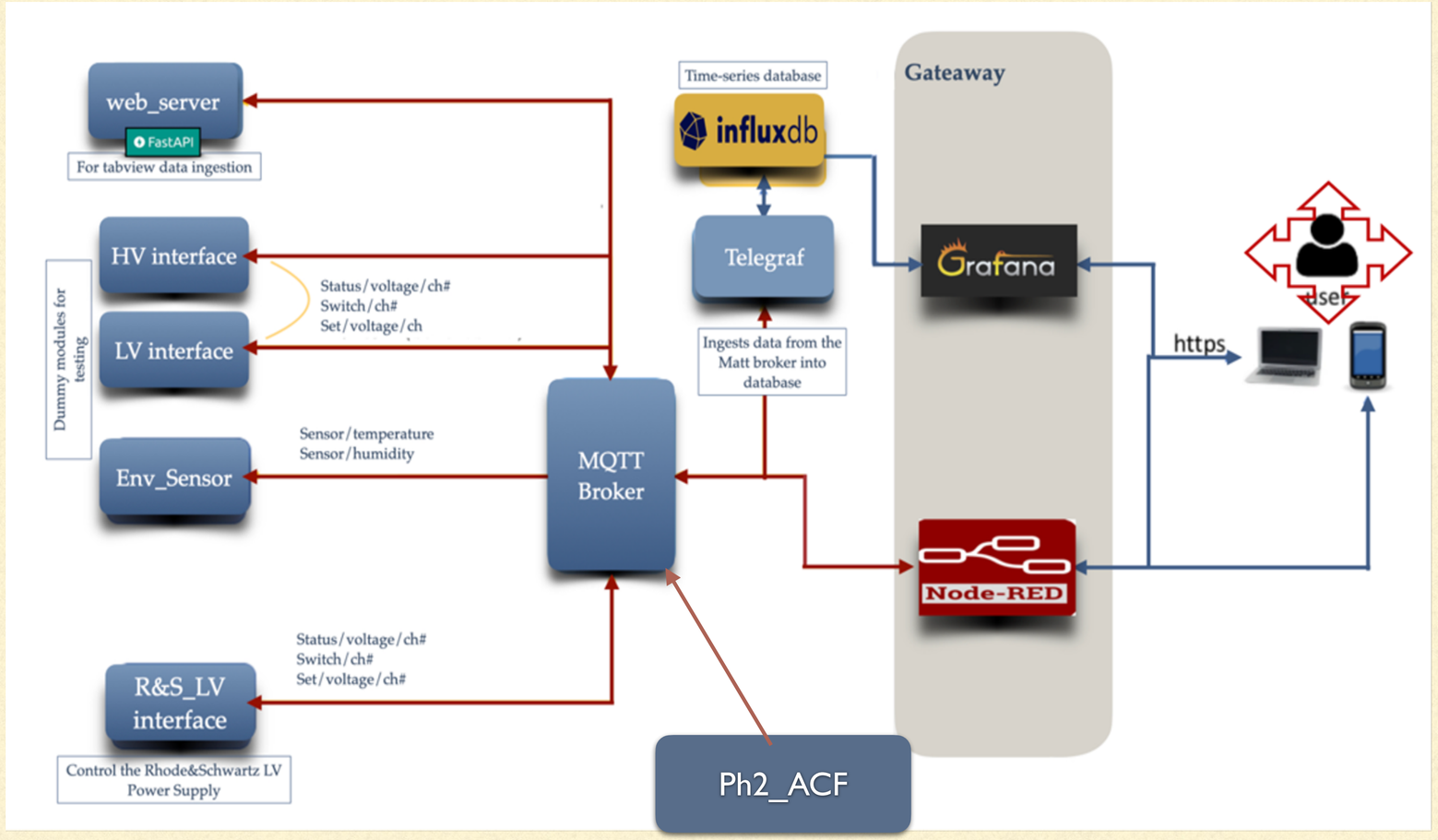
Nodered Dashboard





NEED

- Right now the docker image of Ph2_ACF is deprecated.
- For the Cold sector test we need Ph2_ACF.
- We need the latest version of Ph2_ACF docker image.



NEED

- Design a set of tests which needs to performed for each module after integration onto Dee in both room temperature and in cold chamber.
- We have tested multi module asynchronous test with Ph2_ACF.
- Are there plans for a synchronous multimode DAQ?

Thank you!

Backup