Requirements to Controls for Super-FRS commissioning

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General

- SPL : H. Simon, SPL deputy : Martin Winkler
- Inside SFRS project:
  - Data supply 2.4.0.2: WPL S. Pietri
  - Control system design 2.4.19: WPL S. Pietri

Note: Man power for code development comes from students of Technical University Darmstadt ➔ academic time line does not always fit with project planning

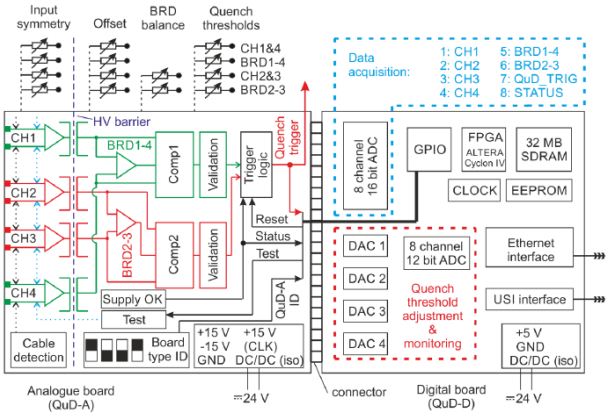
Disclaimer

- Final objective of commissioning with beam: produce and identify exotic nuclei and bring then to a final station, using Super-FRS

- This presentation concentrate on requirement of this advanced operation

- Not included in presentation: all standard FAIR equipment should be commissioned beforehand (power supplies etc..) ➔ Cryo, magnet, diagnostic, need support from control for commissioning (this should be this afternoon?)

Quench detection data readout
- logging, forced post mortem, post mortem



Quench Detection Unit (QuD-U) is composed of two platforms:

- QuD-A:
  - analogue comparison of measured voltage with a predefined threshold and trigger generation.
- QuD-D: Data acquisition platform
  - ring buffer data recording
  - communication to QuD-A
  - communication to the FAIR control system via MFU-SCU system.
- Ring buffer cycle
  - capacity of about 11 MB which covers about 50 seconds of data (16K frames, 32 samples/frame)
  - 8 channels sampled at 10 kHz all the time + additional data makes all together **about 215KB/s**

S-FRS sc circuits are monitored by **221** QuD-U (one per magnet).

QuD-U are integrated in the power converter cabinet.

Magnet current and quench data shall be synchronised (in the control system) for both logging and *post mortem*

Slide from Vivien Raginel

Super-FRS introduction

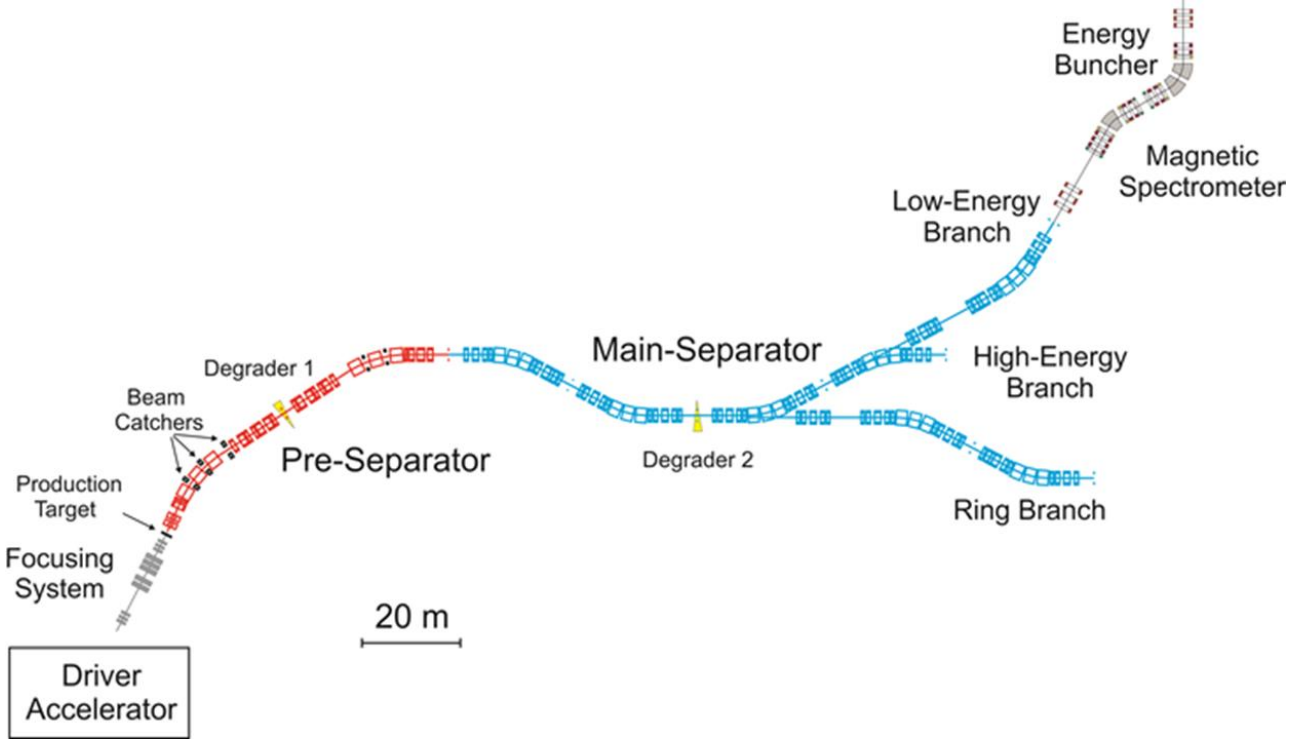
- **Objective of Super-FRS:** produce exotic nuclei
  - use primary beam from SIS18 or SIS100
  - nuclear reaction on target
  - fragments are ejected forward
  - use magnet acceptance, slits and degraders to select some fragments
  - use detectors to identify selected fragments

- at the same time: separator and a spectrometer

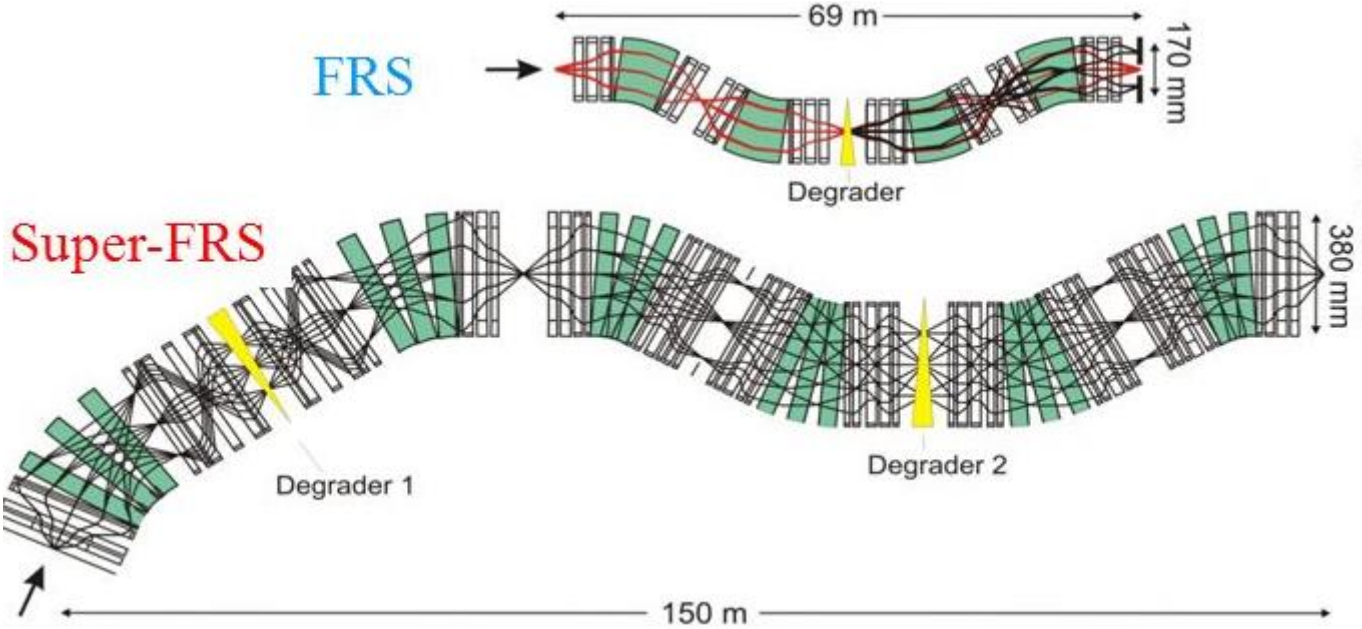
- **Normal operation: matter in the beam line (detectors, degraders)**

Super-FRS layout

- **Super-FRS: DC magnets, drives, vacuum, cryogenics.**



FRS vs Super-FRS

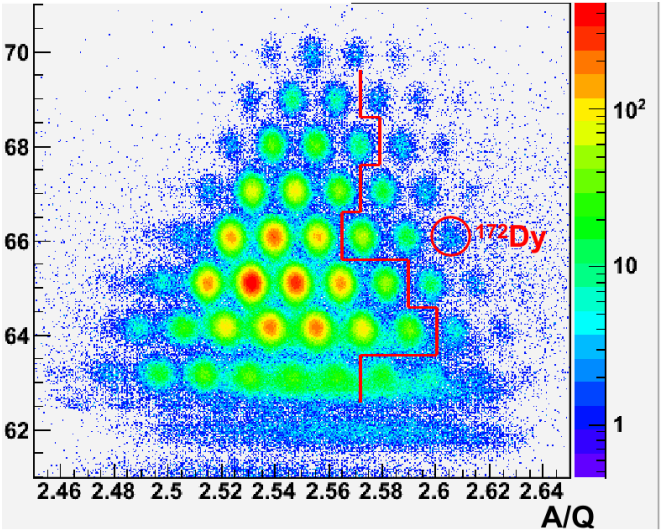


- Intensities being 10 to 100 higher, 5 times more drives or magnets ➔ operation needs different than FRS

Super-FRS goal

- Example of goal of commissioning
- ^{238}U+ ^{9}Be ➔ ^{172}Dy @ 1 A.GeV

- ^{238}U:
  - 92 protons
  - 146 neutrons
- became
- ^{172}Dy:
  - 66 protons
  - 106 neutrons



- This means some physics need to be implemented in SFRS control system

Super-FRS Specifics

- Matter in the beam line for operation: need to know energy loss
  - **as for FRS**
- DC mode for all devices
  - **as HEBT (?), FRS…**
- Identification: Requires Data Acquisition – Control System exchange of information
  - **synergies with most FAIR experiments (CBM, HADES, FRS)**
- Machine protection
  - **specific SFRS?**

History

- Started discussion on Super-FRS Controls in 2012
- 2014: workshop with ACO on specific
- 2015: functional requirements written
- 2016: concept ready

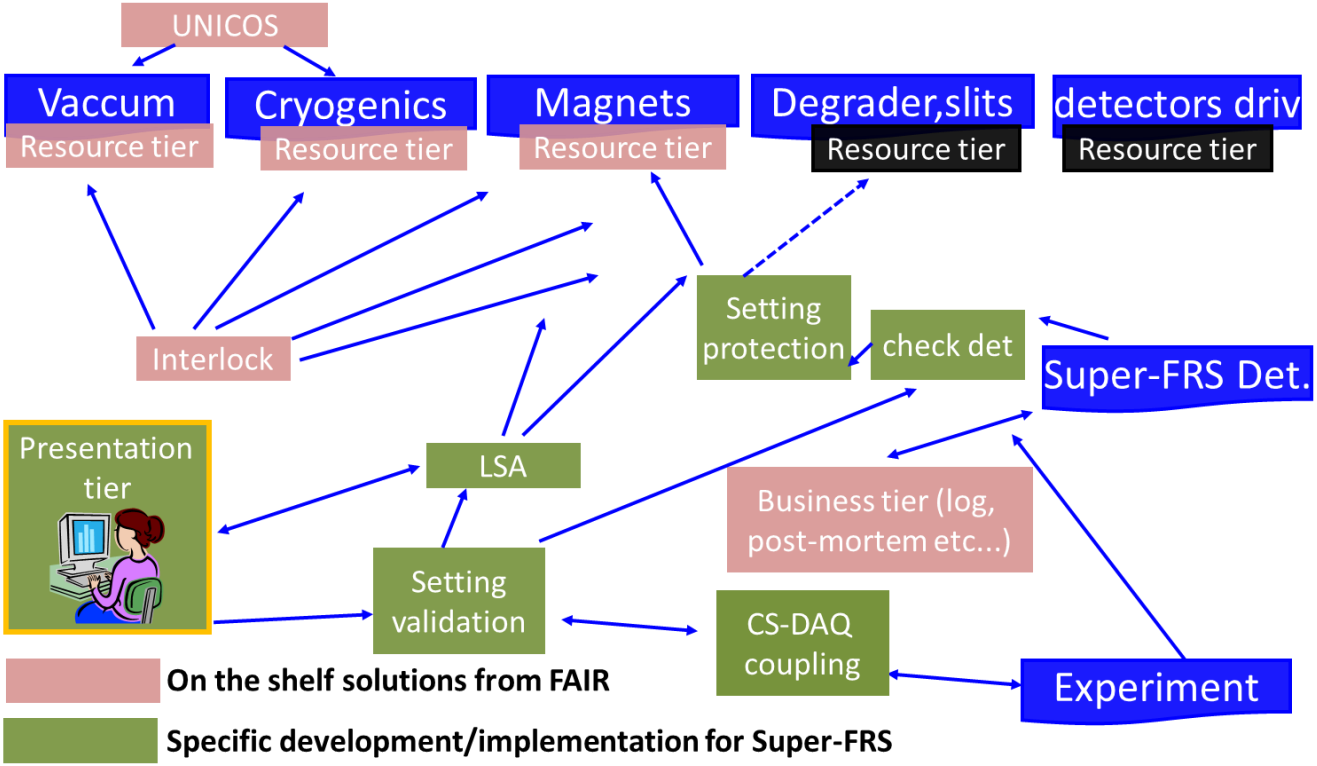
Functional requirement

Quality Management	Document Type:	Document Number:	Date:
FAIR @ GSI	Technical Concept	F-TC-C-XX	16.09.2020
		Template Number: 1.0	Page 1 of 19

Document Title:	**Controls Concept for Super-FRS**
Description:	Technical Concept for the Super-FRS Control System regarding its specificities
Division/Organization:	CSCO / RBFR
Field of application:	Project FAIR@GSI

- **It was sent to FC2WG, ACO etc..**
  - **we never got any feedback!**

Super-FRS control concept



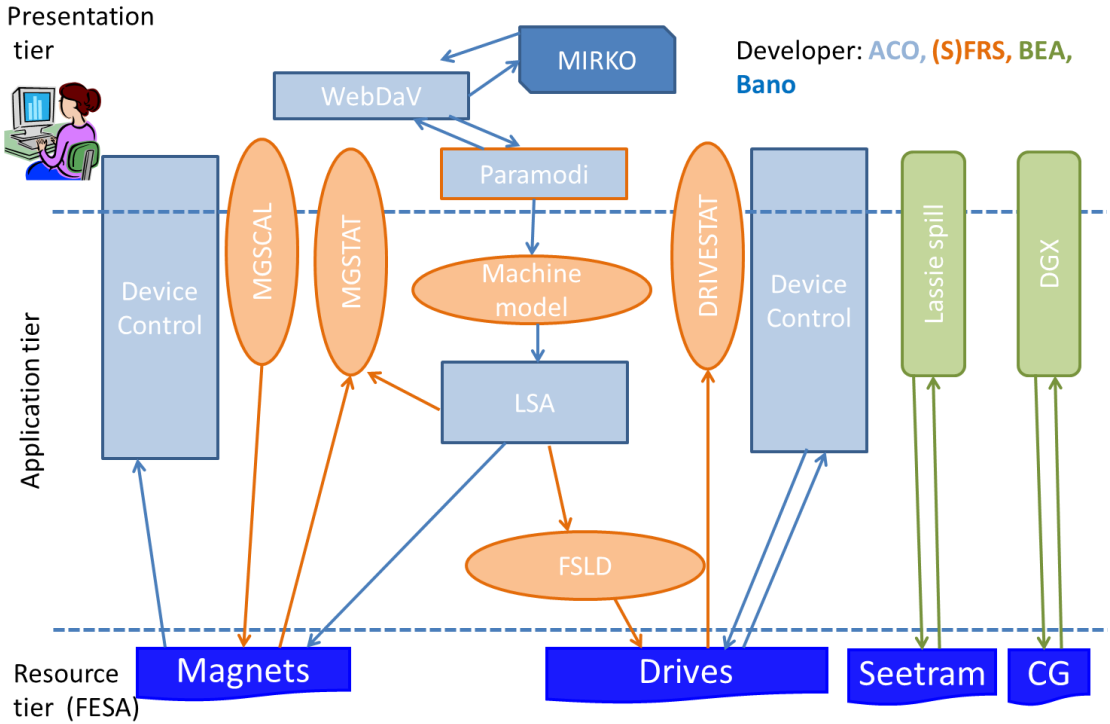
- Details in the coming slides

History

- Started discussion on Super-FRS Controls in 2012
- 2014: workshop with ACO on specific
- 2015: functional requirements written
- 2016: concept ready
- 2016: start working on machine model
- 2017-2020: support implementation for FRS operation for phase-0 (meetings ACO/SFRS/FRS)

- 1.5 FTE on application development (F. Schirru)
- 0.5 FTE on application/update (J.P. Hucka)
- Machine model for FRS ➔ J.P. Hucka
  - tested in machine experiment during engineering run

FRS implementation



- the scheme is a alpha implementation of the functional requirement we wrote

FRS implementation

- **Important for us:**
  - **assure FRS operation as before**
  - use FRS as a test bench for concepts
  - machine model test in machine experiment
  - **permitted to iron out our requirements**
- **Remark**
  - when operation, no more development on system
- **Persons involved:**
  - J.P Hucka, F. Schiru, H. Weick, F. Ameil, R. Mueller, J. Fitzek….
  - ➔see presentation of Christoph

(note F. Schiru was a “good will” participation leaving end September)

Application list

- Request to ACO (direct)
- SFRS specific applications
- SFRS request generic (?)
- Applications SFRS rely on presence from commissioning

- Open questions

Requests to ACO (pending)

- **Request to ACO (direct)**
  - Need options in Paramodi (2)
    - save setting/ load setting with name
    - save part of beam line, load part of beamline
    - disable trims
  - Ist/soll comparaison (3)
  - different classes of users (expert, operator, generic physicist) (4)

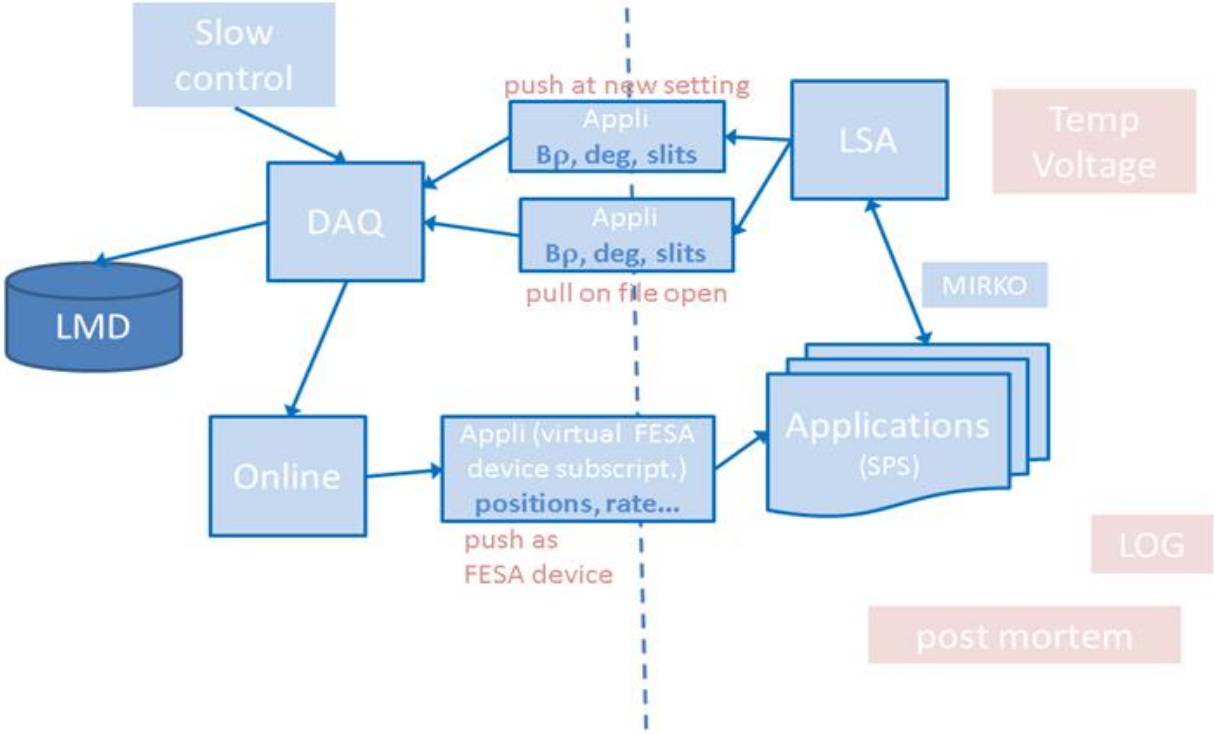
NB: Numbers: priorities as slide 6 of Ralp's presentation roadmap

1. Necessary for operation
2. Operation at resource efficiency cost (unreasonable time for action)
3. no high intensity operation
4. degrader operation possible

SFRS specific applications

- **SFRS specific?**
  - Setting validation (2)
    - intercept operator setting, compare safety to simulation, give status
    - Functional requirement: Master thesis of Heidi Roesh
  - Setting protection (R. Schmidt idea) (3)
    - compare expected value from detector at focal to real one, generate interlock if discrepancy
    - currently pre-concept. Could be a FESA based of a NUSTAR/DAQ based logic sending an interlock
  - CS-DAQ coupling (3)
    - details of possible implementation in SFRS Controls functional requirement

Super-FRS DAQ – Control system coupling



SFRS specific applications

- **SFRS specific**
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  - Setting protection (R. Schmidt idea) (3)
    - compare expected value from detector at focal to real one, generate interlock if discrepancy
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  - CS-DAQ coupling (3)
    - details of possible implementation in SFRS Controls functional requirement
  - Machine model (mention in case other groups interested) (1)
    - Energy loss implemented in LSA (ATIMA code)
    - Aim to use for full operation (drive) from LSA for Super-FRS

SFRS generic(?)

- **SFRS generic**
  - Drivestat/magstat (2)
    - developed by F. Schiru, product owner S. Pietri
    - table visualization of ist/soll values of drives and magnets
    - useful for DC machines
    - maintenance?
  - MGSCKAL (1)
    - pre-cycling of dipoles
  - LSA to DC drives (1)
    - was developed for test SFRS concept in LSA, needed later?
  - Beam alignment/optic change on the fly (2) or (4 as today)
    - solution: generic format to read LSA from external program ➔ no need to discuss which optical program users want to use
    - currently we do it in Perl script from LSA .xml files… or in Mirko

Application we expect to be present

- **Application we expect to be present**
  - Device control (or equivalent) (1)
  - LASSIE (BEA) (1)
  - DGX (BEA) (1)
  - Paramodi (with request point 1) (1)

  - Access to FBAS at some locations (1)

- **For later**
  - Automatic matter thickness calibration (sequencer + DAQ feedback)

Other requirement to controls

- **Planning side, for us (resource wise)**
  - need to know which applications we can rely on and which we should develop
  - when done could end on request to one or two FTE in total for application development (Java- GUI), shall be later in the project, but we do not have java fx developer in our machine…
- **Interface/synergies**
  - how do we join the road map with new requests
  - how do we assure synergies
- Disclaimer: slide made before seeing the roadmap, we were not aware of it until yesterday….

A comment – will it be possible to operate a spectrometer in FAIR?

- **Super-FRS is a FAIR machine,**
  - should be treated at least at the same level than all others. We are not a ring BUT we are a FAIR machine. A full FAIR pillar depend on its operation (NUSTAR)
  - **no Super-FRS operation, no NUSTAR… one FAIR pillar out!**

  - we did all the meetings/document written etc… requested
  - we engaged resource, often for nothing (JPH lost 6 months)
  - we followed all request
  - there as NEVER been an assurance to be heard by ACO

  - NUSTAR phase 0 ran only thanks to a colleague good will (we were promised applications that then the promise was withdrawn in 2017 no resource planned…. beam was due for 2018!)
  - **we were just mimicking old FRS operation with new system**

Homework – just checking

- **Did I get right our activities**
  - check roadmap
  - check status
  - check tables commissioning from SIS100 which include SFRS
  - check prepare commissioning requirement

The main issue

- **Our main problem**
  - **not, even limited, support for application development, we request limited support at a moment in time… not continuous,** (skills not fitting SFRS project)
  - **no easy information on what is available for application: we could end up duplicating work**
  - **if no development plan we can not even count on things we need from current system to be present in 5 years (good will of the product owner) ➔ project risk for Super-FRS**

Conclusion

- …. “En un lugar de la Mancha, de cuyo nombre no quiero acordarme, no ha mucho tiempo que vivía un hidalgo de los de lanza en astillero, adarga antigua, rocín flaco y galgo corredor”