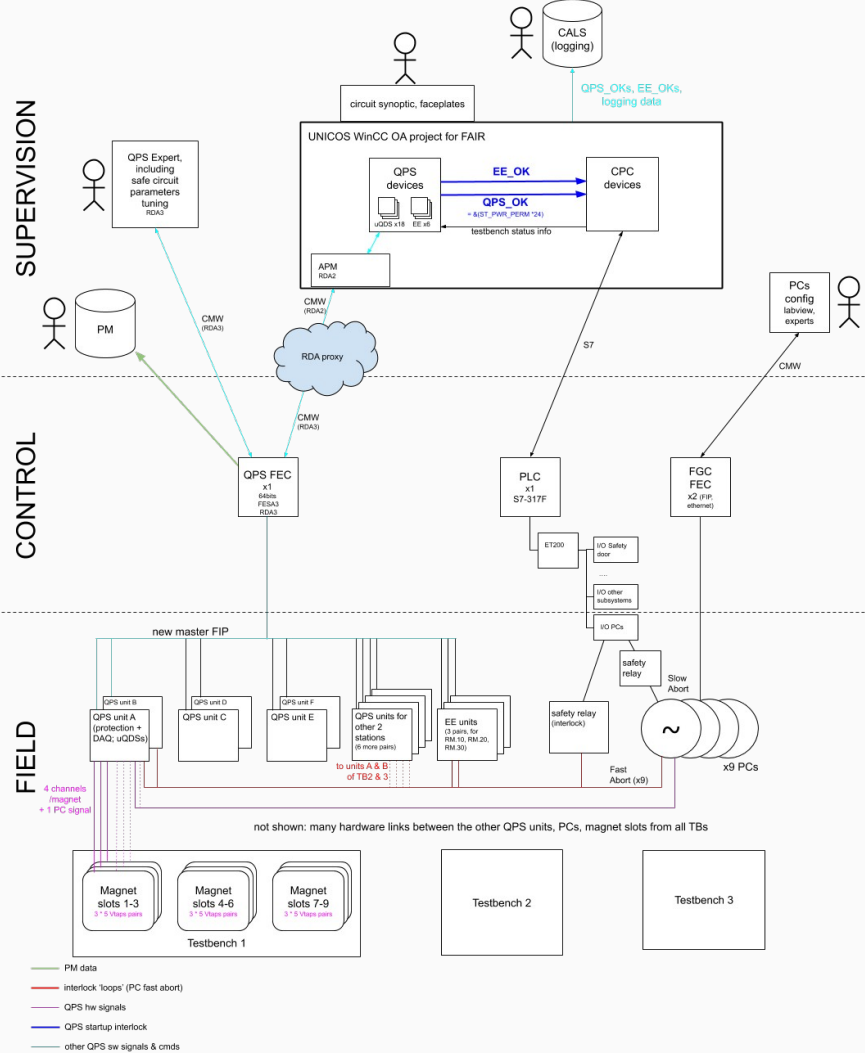


FAIR

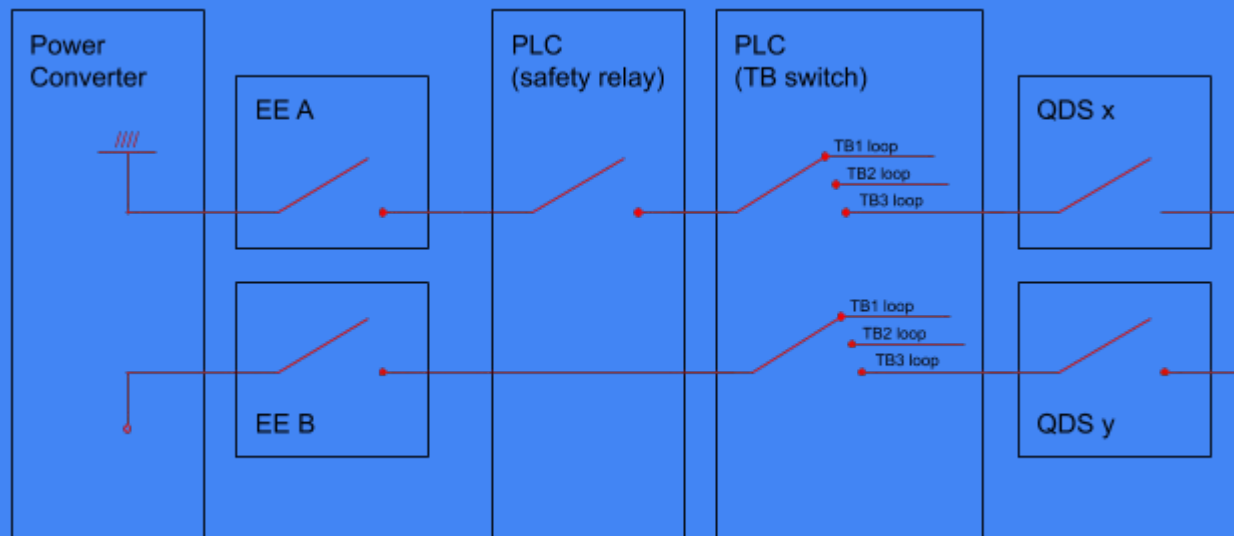
Magnet Protection System  
software layer

# Protection System integration insights

superficial data access



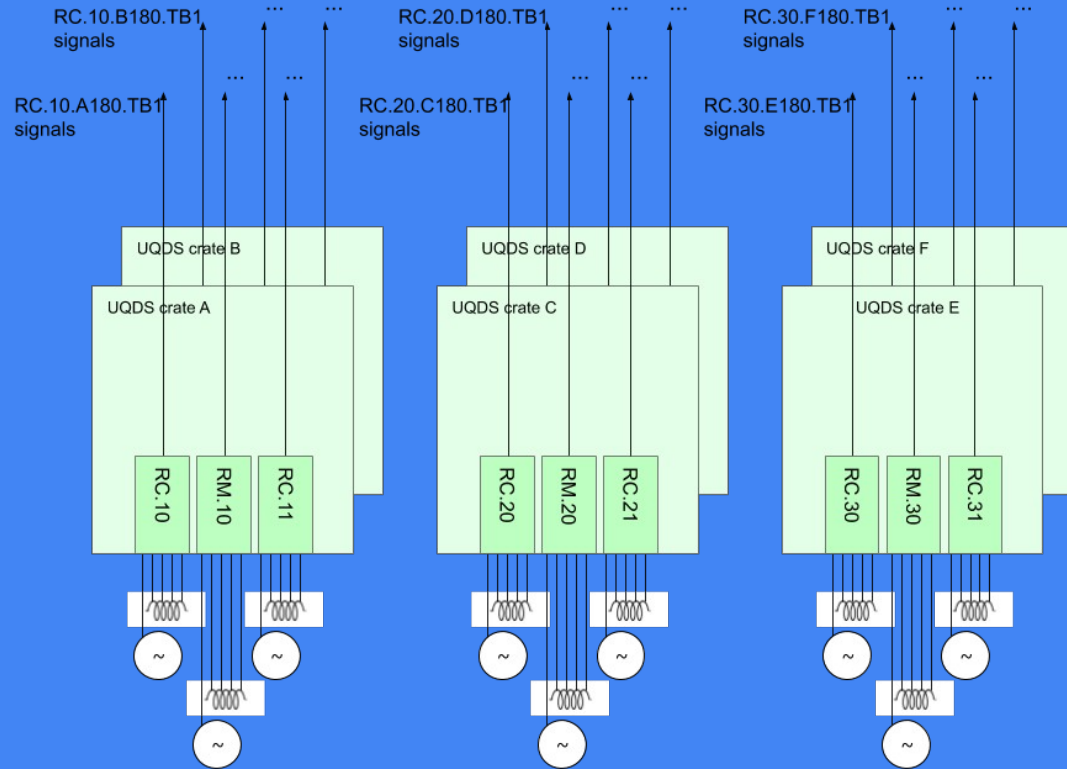
# Protection system setup: interlock loops



## Protection system setup - key points

- There is only one set of 9 Power Converters (+ their Energy Extraction units where relevant) for all 3 testbenches
- QDS units are deployed to all testbenches, not just to circuits
- A switch allows to 'complete' the interlock loop of either testbench, by plugging together PCs and QDS, and thus enabling the protection of all circuits by the protection units dedicated to a particular testbench

# The origin of protection signals



each magnet slot may or

# The origin of signals - key points

- Virtually all protection signals (measurements, interlocks, statuses, etc.) originate from field devices
- Each protection device can protect up to 3 circuits/magnets
- Each testbench has a dedicated set of 3 pairs (for redundancy) of protection devices
  - => each set can protect up to 9 magnets i.e. 1 full long assembly
  - => in total, 18 protection devices will be deployed to the facility
  - => currently only 2 are deployed, to TB1, enough to fully protect the first assembly
- Signals are named consistently, with a clear indication of their origin:
  - The testbench, TB1 or TB2 or TB3
  - The circuit, e.g RC.10 or RM.20
  - The protection device (QDS), A, B, C, D, E or F

# Protection system - detection parameters of the protection devices

- For now, detection parameters are defined and managed by the experts
- A dedicated tool to allow operators to safely adjust them has been foreseen
- It will (or not) be deployed depending on the actual requirements to adjust these parameters; return of experience from both the operators and experts after the tests on the first assembly are required on this point



Supervision tools

# Supervision tools - unified access to tools via the Common Console Manager (CCM)



- WinCC OA supervision
  - Power & interlocks supervision, see Maryline's presentation
  - Protection supervision
- Power application, dedicated supervision tool for Power equipment, see Maryline's presentation
- Data extraction and analysis tools

# Supervision tools - WinCC OA synoptic

	COMMUTATORS			ENABLE	FCL CLOSE CMD	FAST CONTROL LOOP				POWER CONVERTER				CURRENT			
	TB1	TB2	TB3			STATUS	ALM	IOUT	CMD	STATUS	ALM	MCB	PERMIT	MEASURE	THRES.CRYO		
RM10						1									1	0.1 A	0 A
RM20						2									2	0.0 A	0 A
RM30						3									3	0.0 A	0 A
RC10						4									4	0.0 A	0 A
RC11						5									5	0.0 A	0 A
RC20						6									6	0.0 A	0 A
RC21						7									7	0.0 A	0 A
RC30						8									8	0.0 A	0 A
RC31						9									9	0.0 A	0 A

TEST BENCH 1

 TB1 CONNECTED	QPS			ACCESS CONTRO		CRYO SIGNALS				
	CONNECTED							TB1_CRYO_300K_AIR		
RELAY_STAT					DOOR OPENED			TB1_CRYO_OK		
COMMUTE_TO_BENCH_FCL					DOOR CLOSED			TB1_CRYO_MAINTAIN		
					DOOR LOCKED			TB1_Q_TO_CRYO		
					LATFORM FREE					

EE	ENERGY EXTRACTION		CONTROL ROOM		GENERAL SIGNALS		TEST INTERLOCKS			
	RM10_OK			MANUAL STOP			TB1_HV_OK_300K		TB1_AUXPS_DC_OK	
	RM20_OK			GREEN LIGHT			TB1_HV_OK_COLD		TB1_AUXPS_AC_OK	
	RM30_OK			RED LIGHT						

MAIN	TB1	TB2	TB3	Remaining time	Device	Select

# Supervision tools - Protection devices details

The image displays two software windows from a supervision system. The left window, titled "QPS", shows a "QPS Testbench 1" with six testbenches (A-F) arranged in a 2x3 grid. Each testbench has a status indicator (F or P) and a color-coded square (orange or green). Testbenches C and D are green, while A, B, E, and F are orange. Below the grid are "RESET" and "RESET\_INTERLOCKS" buttons. The right window, titled "1 - DQAMGNUMP.C180.TB1 DQAMGNUMP N type for circuit RC.20, RM.20, RC.21", shows the status of the protection device. It includes a "Status" dropdown set to "Trend", a "DQAMGNUMP Status" indicator (green), and a "Last Quench at (UTC)" timestamp of "2019.06.14 08:33:09.973". Below this is a "Logging\_ON, Logging\_Data" indicator (green). The window also displays a table of protection device parameters for three magnets (M1, M2, M3) and their associated testbenches (A, B, C, D, E, F).

Parameter	M1 (Magnet: RC.20.C180.TB1)	M2 (Magnet: RM.20.C180.TB1)	M3 (Magnet: RC.21.C180.TB1)
ST_PWR_PERM_QDS	Green	Green	Green
ST_PWR_PERM	Green	Green	Green
ST_INTERLOCK	Green	Green	Green
ST_MAGNET_OK	Green	Green	Green
U_LEAD_POS	0.00082 V	0.00060 V	-0.00037 V
U_LEAD_NEG	-0.00027 V	0.00002 V	-0.00027 V
U_1	0.00031 V	-0.00084 V	0.00145 V
U_2	0.00430 V	-0.00170 V	-0.00456 V
I_MAG	-0.000 A	0.000 A	0.000 A
U_RES	0.00391 V	-0.00317 V	-0.00195 V

# Supervision tools - Protection devices details

**1 - Panel: vision/QPS\_EE.pnl**

### Energy Extraction Devices

	RM.10	RM.20	RM.30
A			
B			

RESET      CLOSE SWITCHES

**1 - A180.RM.20 DQAMS N type 600A for circuit A180.RM.20**

Status: Trend      A180.RM.20      T D I

CFC\_180\_DQFAIR\_180\_DQFAIR DATA Connection OK

### DQEMC

System Closed	<input type="checkbox"/>	Power Permit	<input type="checkbox"/>
Last open switch at (UTC)	2019.06.14 08:34:34.323		
Switch A		UPS	
Switch B		Remote	
Switch Z			
Capacitor A		2796 V	
Capacitor B		2785 V	
Capacitor Z		2784 V	
Dump Resistor Voltage		2070.0 V	
Temperature Resistor			
Snubber Fuse		Temp EQRES high	
		Fast Power Abort Received	
		Sum Faults	
SOF Mode			
Switch Opening Failure			
Switch Closing Failure			
Switch Opening by itself			
Switch Opening Warning			
		System failure	

DQAMSN600 Status

Logging\_ON,Logging\_Data

DQAMS 600 Command      Select



# Data archiving and access





# Post Mortem data

PM Data Browser

File Options Catalog

Data Dumps

Event time stamp	Received	System	Class	Source	Sender
14/06/2019 09:38:50.973+113114	14/06/2019 09:39:06.911	QPS	DQAMGNUMP_PM	D180.TB1	root@cfc-180-dqfair
14/06/2019 09:41:09.873+113114	14/06/2019 09:41:25.811	QPS	DQAMGNUMP_PM	D180.TB1	root@cfc-180-dqfair
14/06/2019 09:42:49.373+113114	14/06/2019 09:43:05.311	QPS	DQAMGNUMP_PM	D180.TB1	root@cfc-180-dqfair
14/06/2019 09:43:31.473+113114	14/06/2019 09:43:47.411	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 09:45:37.473+113114	14/06/2019 09:45:53.411	QPS	DQAMGNUMP_PM	D180.TB1	root@cfc-180-dqfair
14/06/2019 09:53:34.873+113114	14/06/2019 09:53:50.811	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 09:54:27.773+113114	14/06/2019 09:54:43.711	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 09:54:01.489+000000	14/06/2019 09:54:43.811	QPS	DQAMSN600	B180.RM.20	root@cfc-180-dqfair
14/06/2019 09:54:03.504+000000	14/06/2019 09:54:45.912	QPS	DQAMSN600	A180.RM.20	root@cfc-180-dqfair
14/06/2019 09:55:17.973+113114	14/06/2019 09:55:33.911	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 09:57:50.973+113114	14/06/2019 09:58:06.911	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 09:58:40.873+113114	14/06/2019 09:58:56.811	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 10:02:04.473+113114	14/06/2019 10:02:20.411	QPS	DQAMGNUMP_PM	D180.TB1	root@cfc-180-dqfair
14/06/2019 10:04:41.273+113114	14/06/2019 10:04:57.211	QPS	DQAMGNUMP_PM	D180.TB1	root@cfc-180-dqfair
14/06/2019 10:05:40.873+113114	14/06/2019 10:05:56.811	QPS	DQAMGNUMP_PM	D180.TB1	root@cfc-180-dqfair
14/06/2019 10:07:46.573+113114	14/06/2019 10:08:02.511	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 10:08:20.673+113114	14/06/2019 10:08:36.611	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 10:11:47.773+113114	14/06/2019 10:12:03.711	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 10:20:35.373+113114	14/06/2019 10:21:09.011	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 10:23:13.873+113114	14/06/2019 10:23:29.811	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 10:24:03.673+113114	14/06/2019 10:24:36.611	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 10:24:33.773+113114	14/06/2019 10:25:08.111	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 10:30:13.873+113114	14/06/2019 10:30:29.911	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 10:30:48.073+113114	14/06/2019 10:31:04.011	QPS	DQAMGNUMP_PM	D180.TB1	root@cfc-180-dqfair
14/06/2019 10:33:09.973+113114	14/06/2019 10:33:25.911	QPS	DQAMGNUMP_PM	C180.TB1	root@cfc-180-dqfair
14/06/2019 10:33:09.923+000000	14/06/2019 10:33:52.312	QPS	DQAMSN600	A180.RM.20	root@cfc-180-dqfair
14/06/2019 10:33:09.923+000000	14/06/2019 10:33:52.411	QPS	DQAMSN600	B180.RM.20	root@cfc-180-dqfair
14/06/2019 10:34:34.373+113114	14/06/2019 10:34:50.311	QPS	DQAMGNUMP_PM	D180.TB1	root@cfc-180-dqfair
14/06/2019 10:34:34.323+000000	14/06/2019 10:35:16.712	QPS	DQAMSN600	A180.RM.20	root@cfc-180-dqfair
14/06/2019 10:34:34.323+000000	14/06/2019 10:35:16.811	QPS	DQAMSN600	B180.RM.20	root@cfc-180-dqfair

June 01-30, July 01-04, December

Load selected Unload all

dumps in vi... 30

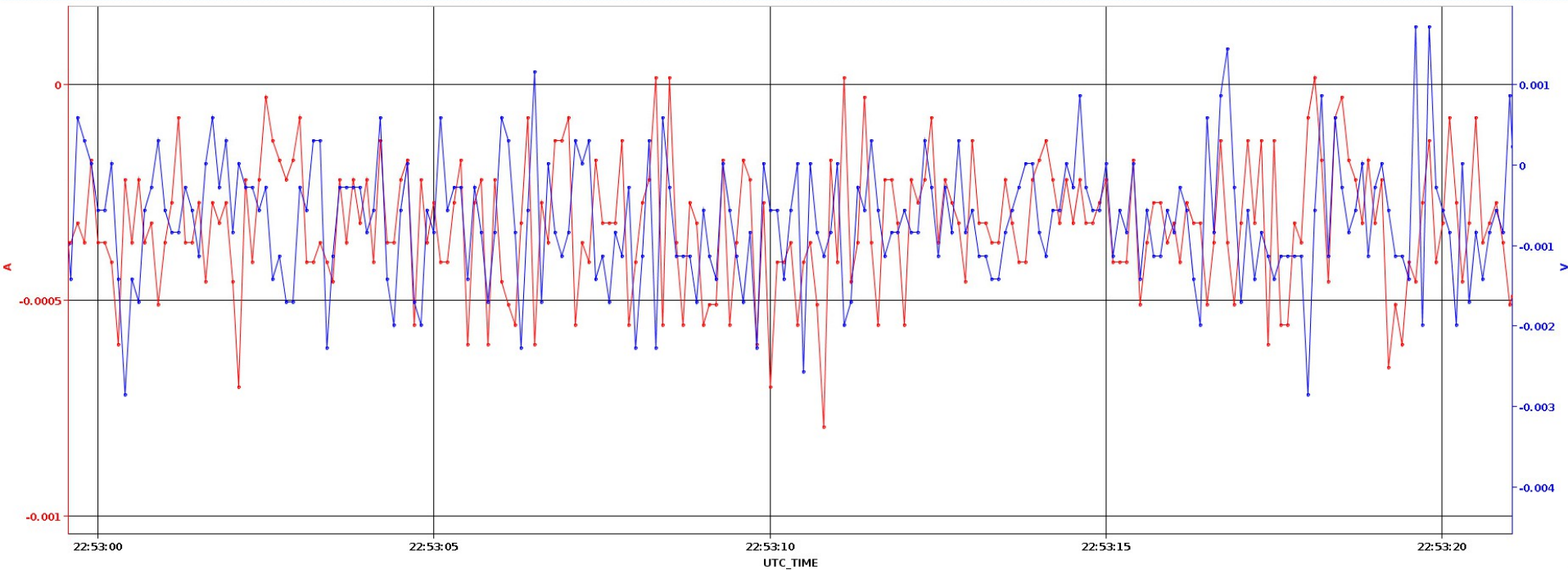
system class source sender selected dump

QPS [ ] [ ] [ ] root@cfc-180-dqf

Show data Save data

# Logging data

RC.20.C180.TB1:U\_MAG RC.20.C180.TB1:U\_1



Future

# Dependency on CERN Accelerators Controls stacks

- Infrastructure and services at CERN evolve, especially during LS2
- This is relevant to FAIR installations, and upgrades to the software infrastructure in particular are foreseen.  
e.g.:
  - redeployment of the control layer before the end of the year, as the current middleware communication infrastructure (RDA2) is retired, superseded by RDA3
  - data acquisition services are replaced by a new generation system (NXCALS)
- In principle, transparent to end users, noting it will require a time slot in the tests plan
- The good news: new and improved tools will come along the upgrades.  
e.g.: Web interfaces for raw data browsing, Advanced data analysis tools (Spark)
  - more of concern to tools providers (e.g. Data Extractor, not the end users)