Automation of LLRF and KLYSTRON operation for VUV-FEL

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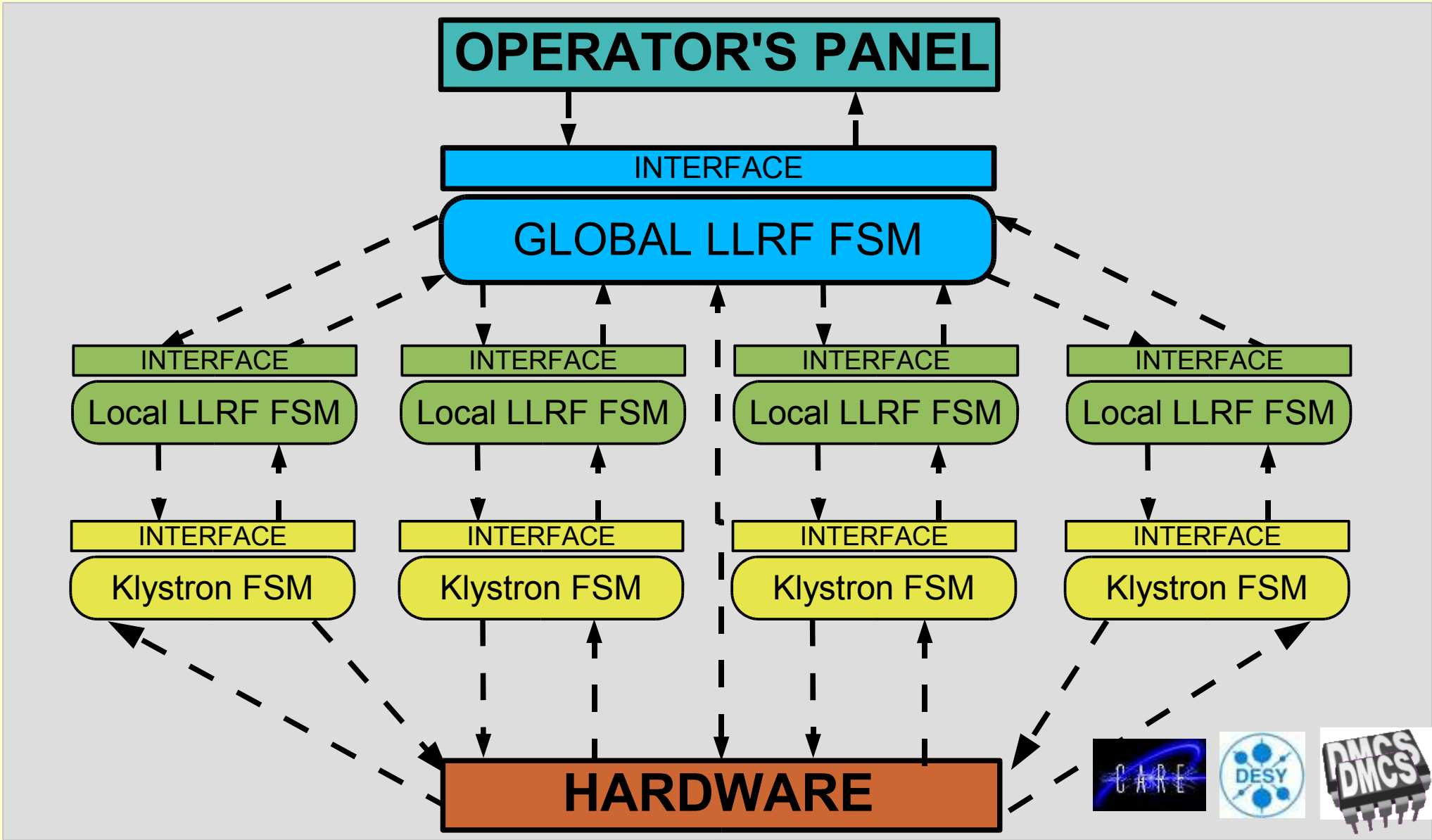
Automation – why so important?

- Manages many complex hardware and software components during machine operation
- Acting as an “expert” makes operators job easier.
- Helps in error detection and recognition process.
- Supports automatic recovery from annoying errors like network glitches.
- Performs calculous of several real-time control alghorithms.

What are the main parts that automation consists of?

- Finite State Machine - Software solution designed to aid LLRF automation and mainteneance (Event driven expert system).Representation of an event-driven (reactive) system. In a such solution, the system makes a transition from one state (mode) to another prescribed state, provided that the condition defining the change is true.
- Applications – there are many applications (standalone C++ applications in DOOCS servers) that are developed in order to solve common problems – concerning both hardware and software part of the RF system.

Fsm for VUV-FEL – overall structure



Application list

under developement, developed, to be evolved.

rotation matrix for gradient calibration
rotation matrix for loop phase
predetuning of vector-sum calibration
field error calculation
feedforward algorithm
beam loading compensation
beam phase measurement
gradient calibration
forward/reflected power calibration· cavity detuning
ADC synchronisation

loaded Q measurement
adaptive feedforward
klystron linearisation
slow (motorized) frequency tuner control
fast (piezo) tuner control
waveguide tuner (phase and loaded Q) control
quench detection
exception handling
momentum management
field control parameter optimisation

and others....

Current work status

- FSM:
  according to the requirements (from LLRF point of view – S. Simrock, klystron & modulator experts – S. Choroba, F.R. Kaiser) a model of FSM for klystron & modulator system was proposed and implemented in Stateflow (MATLAB tool) testing environement.

- Applications:
  The majority of the application was evolved or is in developement stage. Some new ideas appeared during work on requirements for LLRF FSM.

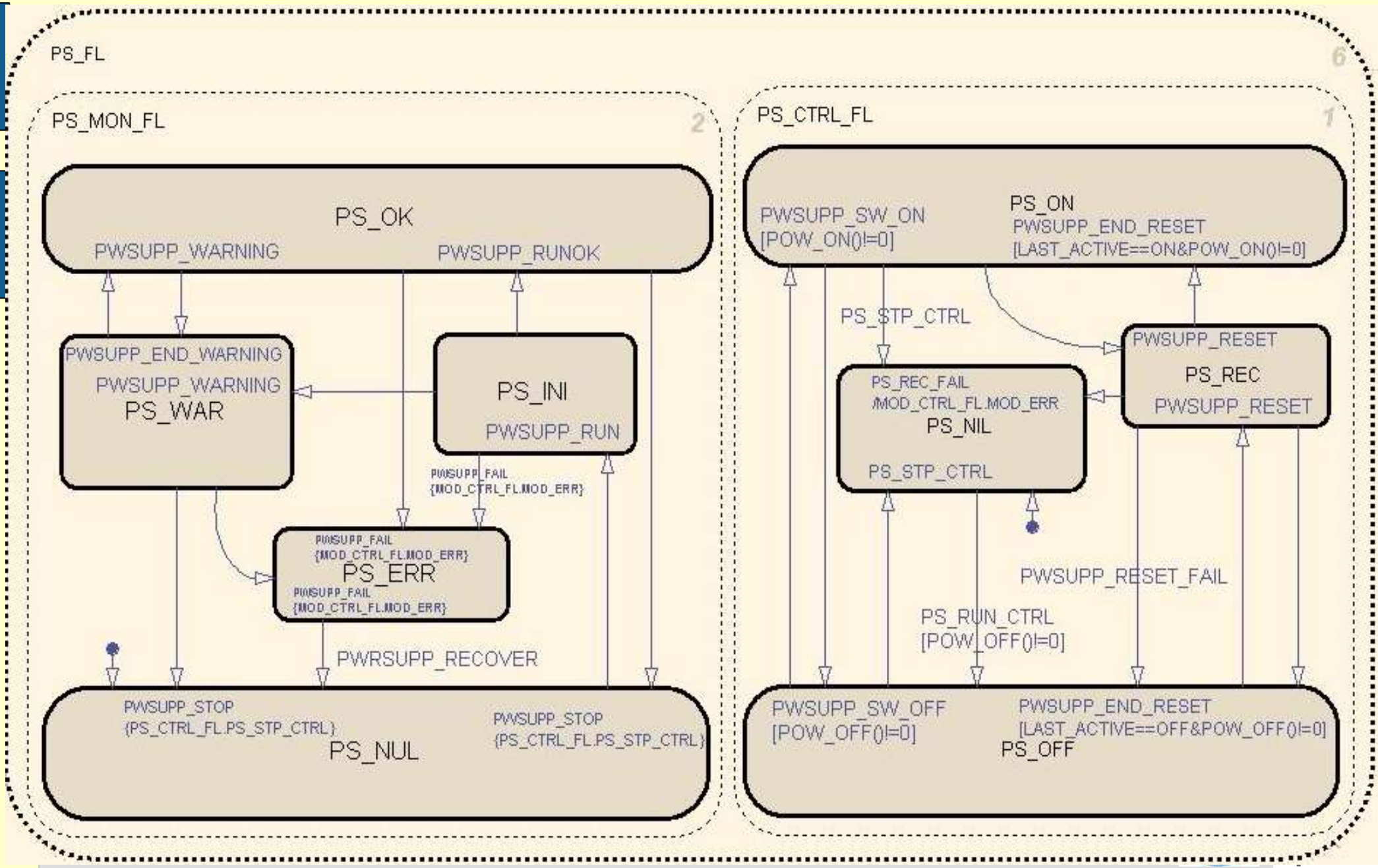
Being prepared

- Proposed FSM model for Klystron&Modulator system is in evaluation phase – stateflow model is tested on Kly 5 in VUV-FEL device,
- Developed algorithms are tested in accelerating modules in VUV-FEL and cavity controler for CHECHIA test facility,
- The requirements are collected and first propostions for LLRF Finite State Machine structure are discussed.

Next steps

- Klystron & modulator FSM final implementation in a DOOCS environement as a standard DOOCS server(s).
- LLRF FSM model proposition and “real world” environement evaluation.
- Final implementation of LLRF FSM in a DOOCS environement.
- Design and implementation of remaining control algorithms

Thank You ....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