ITER Operation Application Systems for Plant System Integration and Commissioning

Mikyung PARK
ITER Organization

13-17 May 2019

Daejeon, Republic of KOREA

Outlines

- Overview of ITER CODAC (Control, Data Access and Communication)
- Progresses of CODAC Operation Application System
- CODAC for 1st Plant System Commissioning
- Future Plan

ITER CODAC

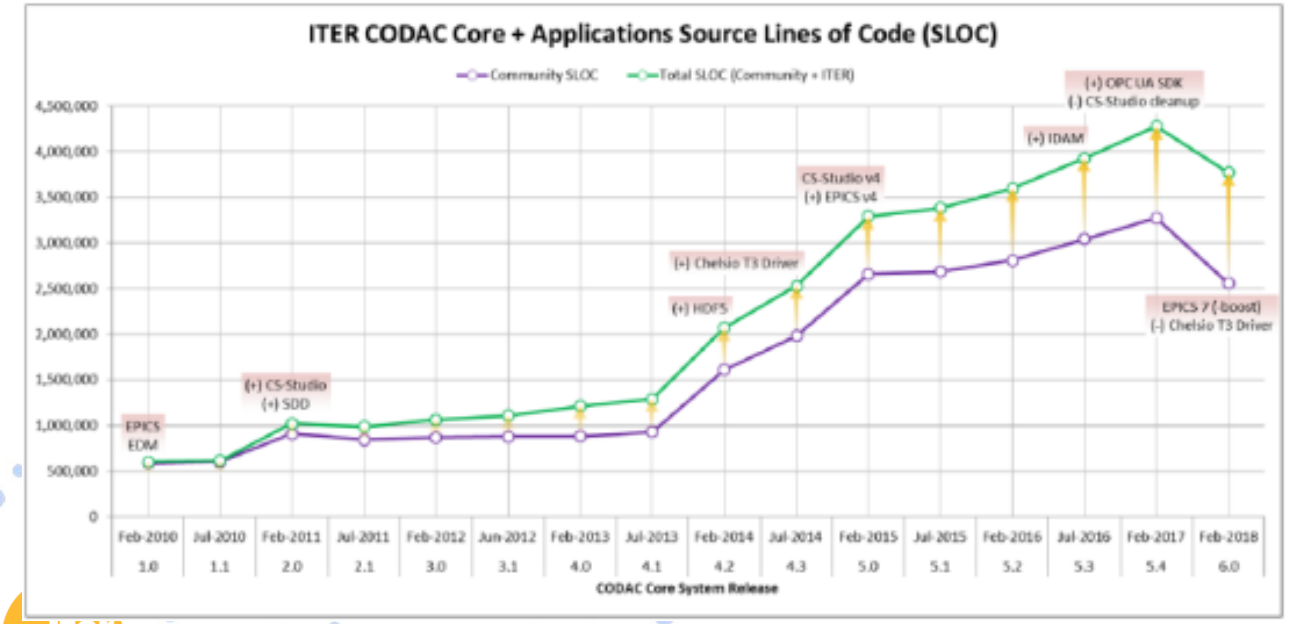
Is the central control system in charge to monitor/control all ITER plant systems and to orchestrate ITER operation and shall deliver;

1. Control Software toolkits/suites for
   - Plant Control System : CODAC Core System (CCS)
   - Operation Support : Operation Application System (OP App)
2. Data Handling (Access/Service) (ITERDB)
3. Control Infrastructure
   - Network Infrastructures
   - Main/Back-up Control Rooms and Main/Back-up Server Rooms
   - Temporary Services (for early plant systems): TCR, T-MCR, T-MSR
4. Supports for Plant System I&Cs
   - Mini-CODAC and I&C Integration Kits (for Plant I&C developments)
   - Control environment for software development and distributions
   - Control System Simulator

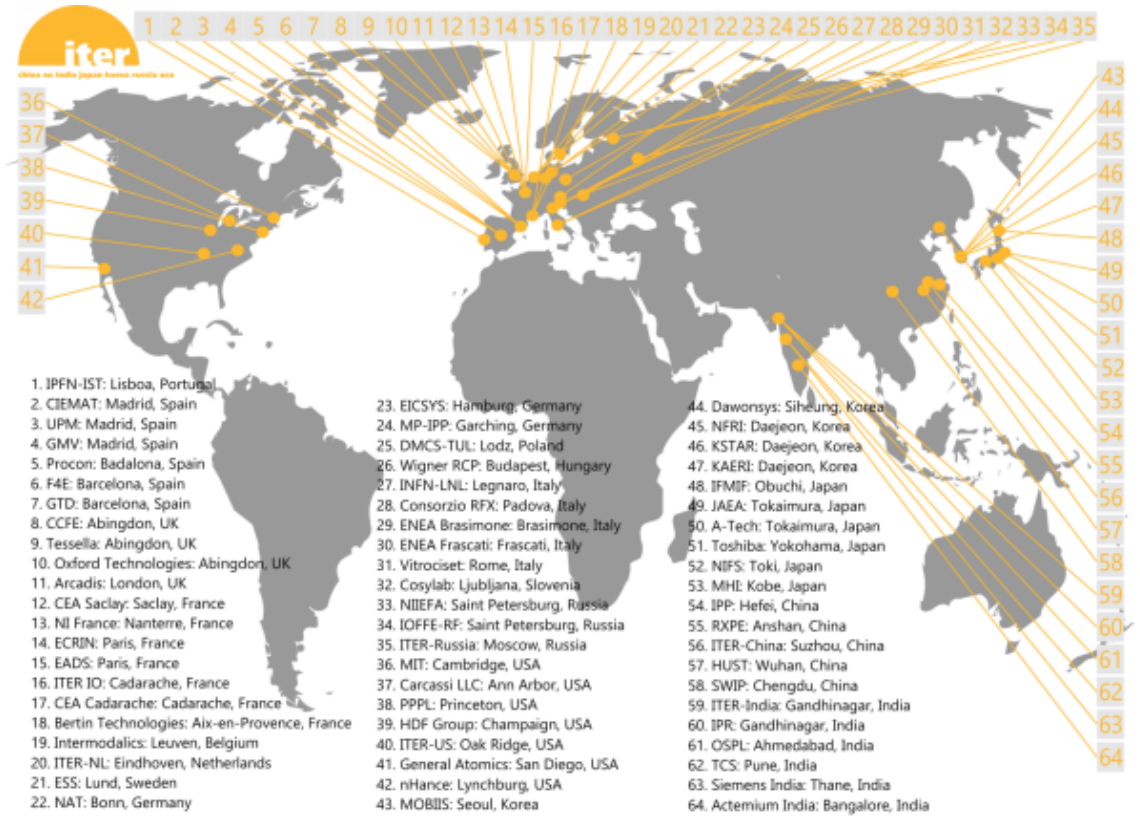
CODAC Core System

- The base software on all CODAC computers *for developments of plant control systems*
  - 154 distributed to 63 organizations (excl. IO-CT)
  - Statistics of CODAC software as of Feb-2018

Number of software units	196
Total number of Software Line of Codes (SLOC)	3,770,910
Total time to develop (year)	7.77
Total cost of development (in 2000's USD)	153,783,627



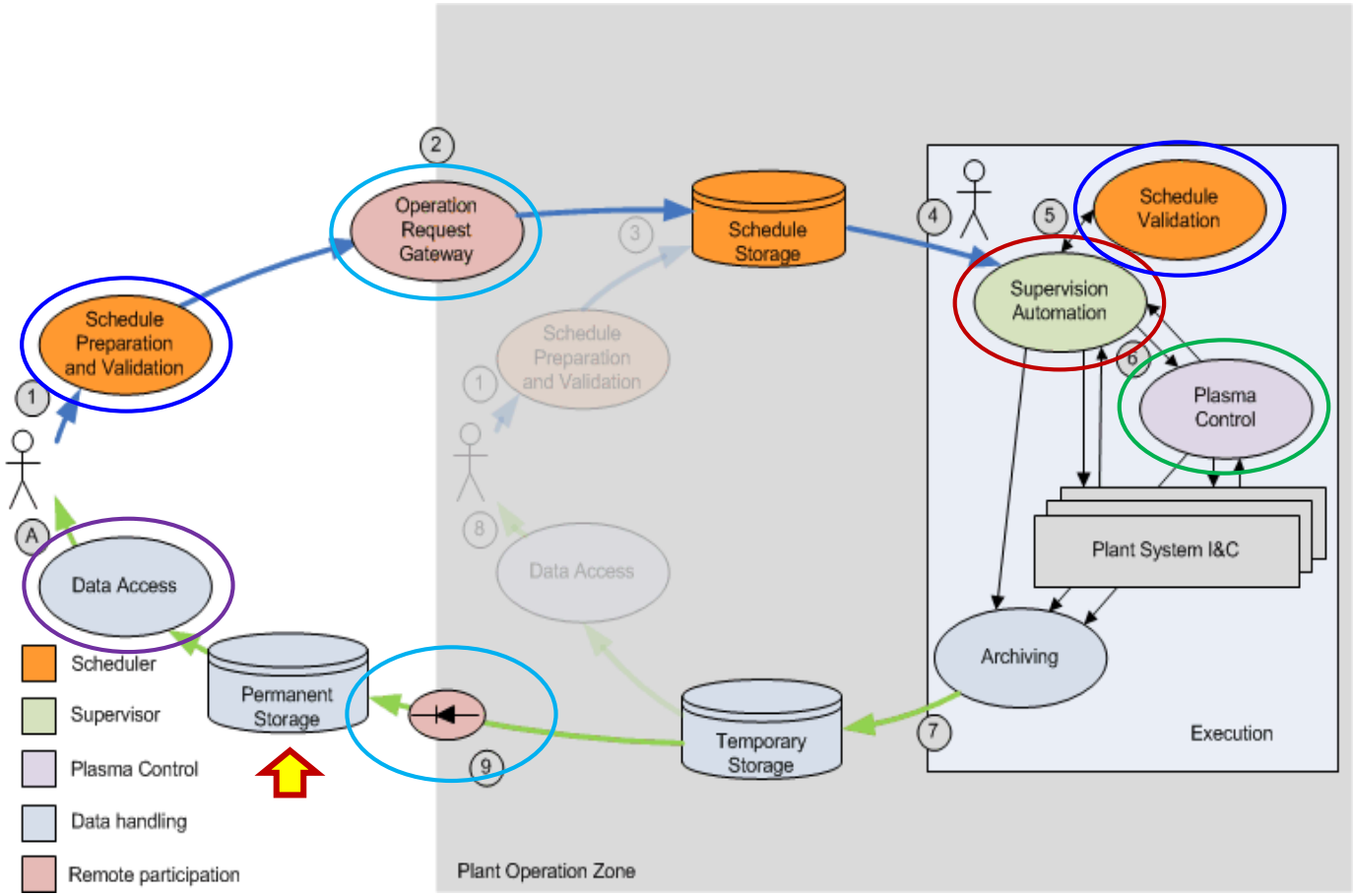
Infra	2013		2014		2015		2016		2017	2018	2019	2020	2021
RHEL 6.3 MRG-R 2.1	4.0	4.1	4.2	4.3	Support								
RHEL 6.5 MRG-R 2.5 EPICS 3.15					5.0	5.1	5.2	5.3	5.4	Support			
RHEL 7.x *EPICS 3.16*										6.0	6.1	6.2	6.3



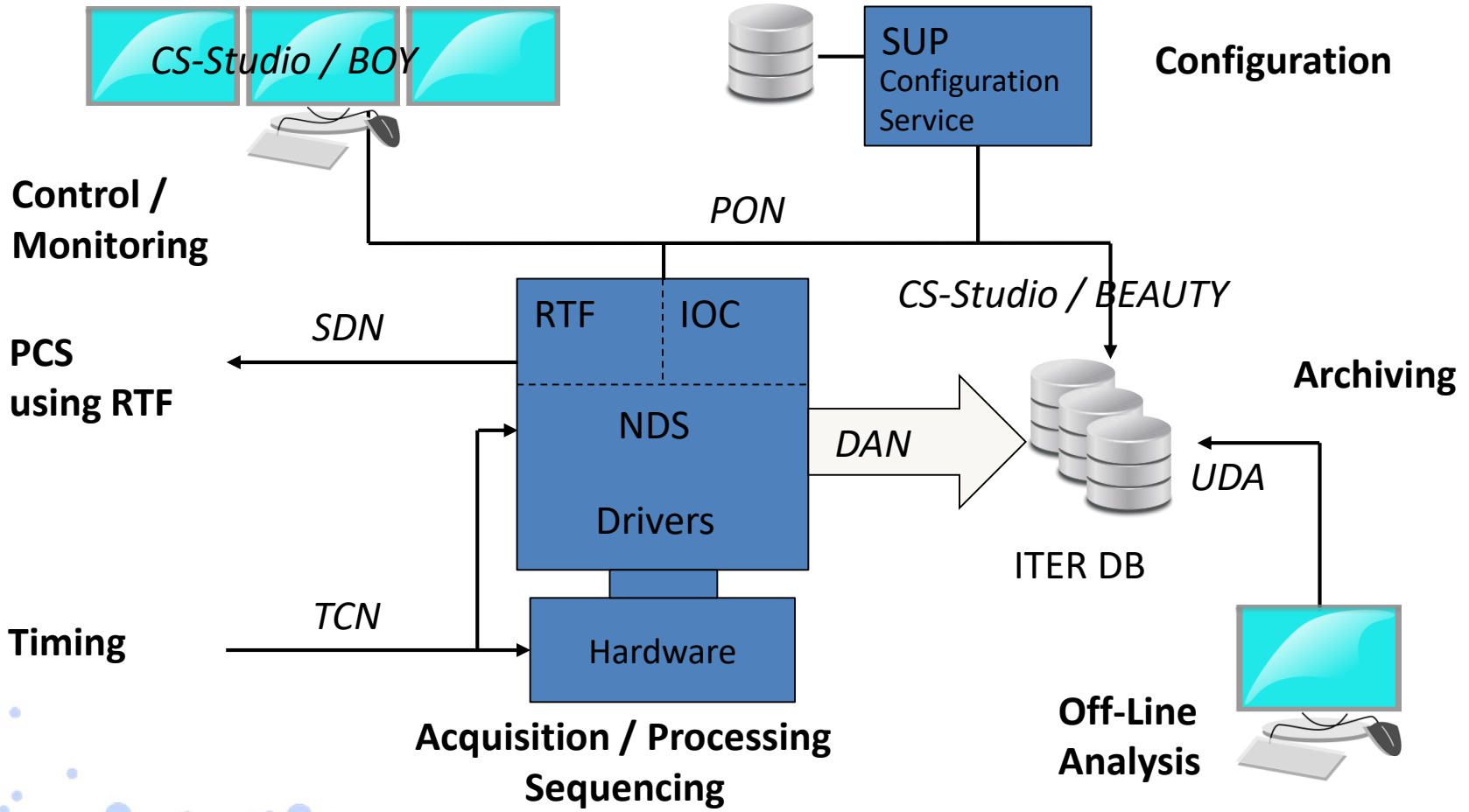
Operation Application System

The software suite for supporting plant system commissioning, tokamak operation and plasma experiments by delivering the following tools;

- Support of plant I&C test & commissioning, '*Configuration Editor*'
- Pulse configuration, validation & verification, '*PSPS*'
- Supervision & Automation, '*SUP & AUTO*'
- Real-time Feedback Control, '*PCS*' on '*RTF*'
- Data Access and Services, '*UDA*'
  1st implementation of UDA in service for plant commissioning
- Remote participation, '*ORG/ODG*'

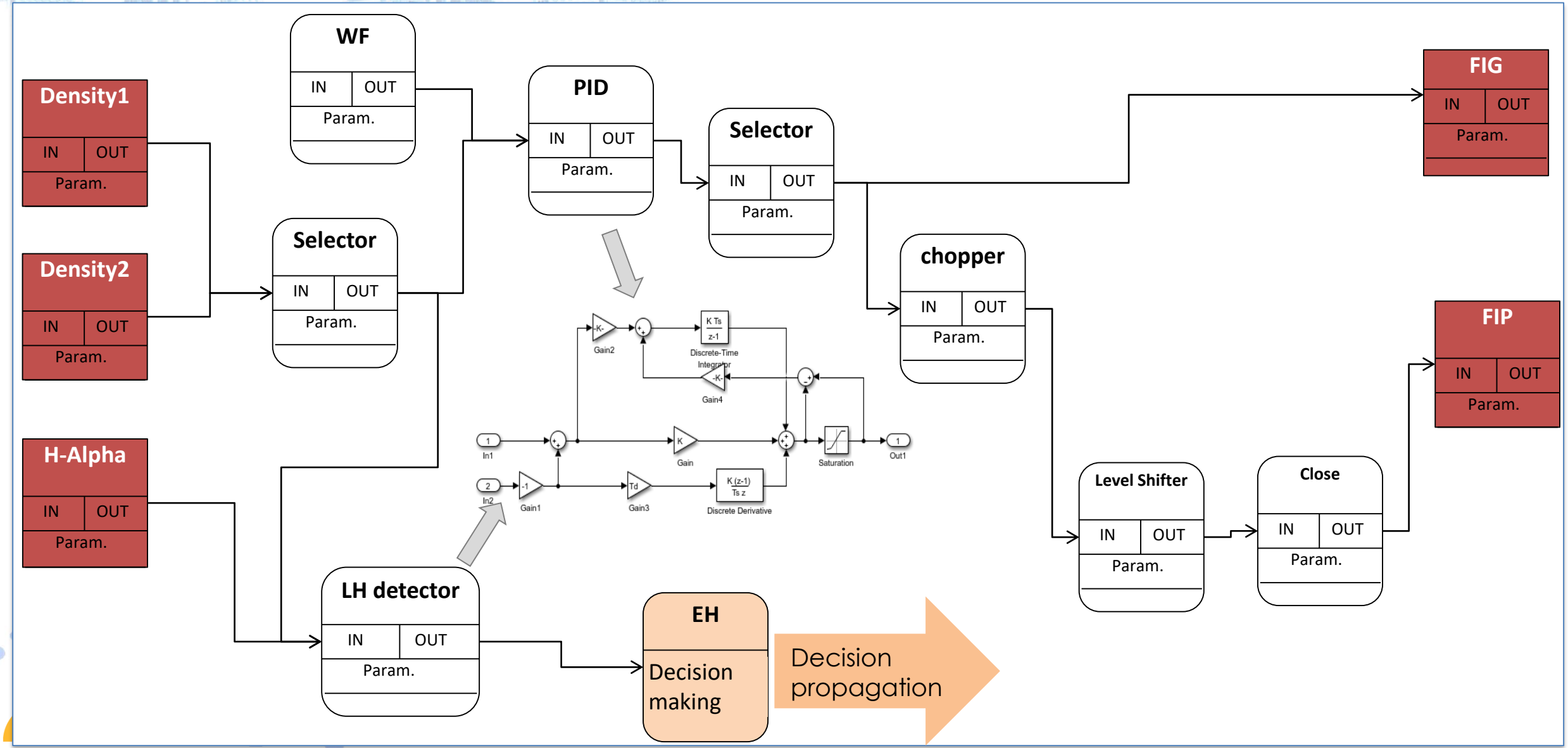


Localization in the Production System

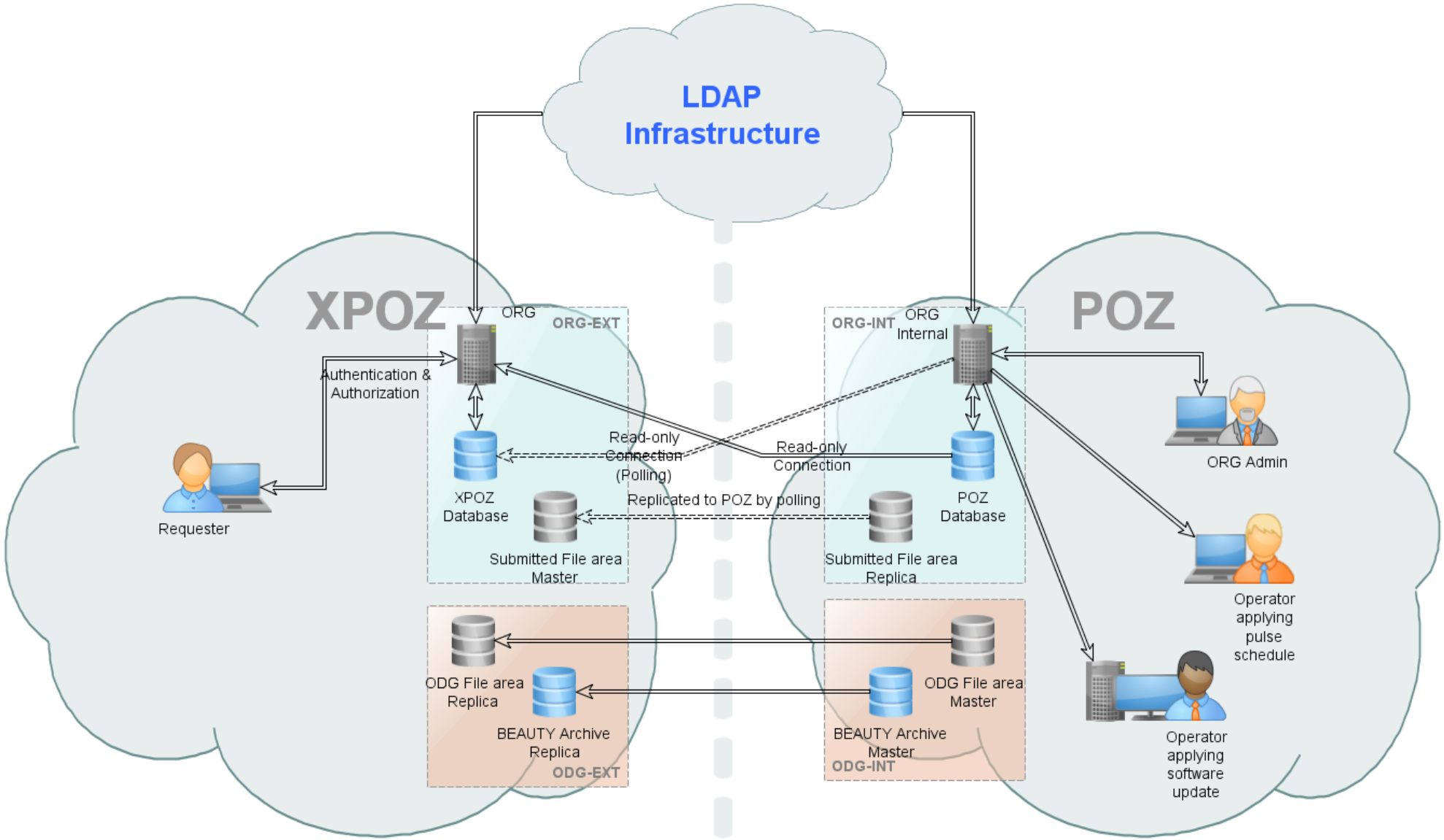


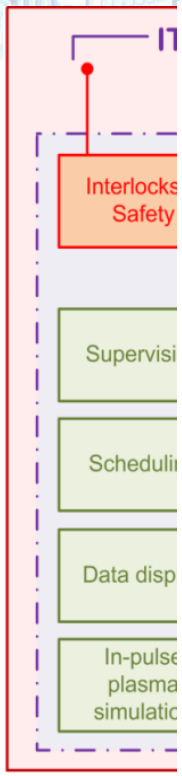
** NDS: Driver framework for data acquisition devices*

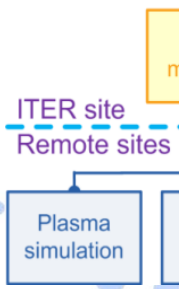
ITER Real-Time Framework



Remote Participation (RP)







of
plant
tworks,

ected to
DZ")
system

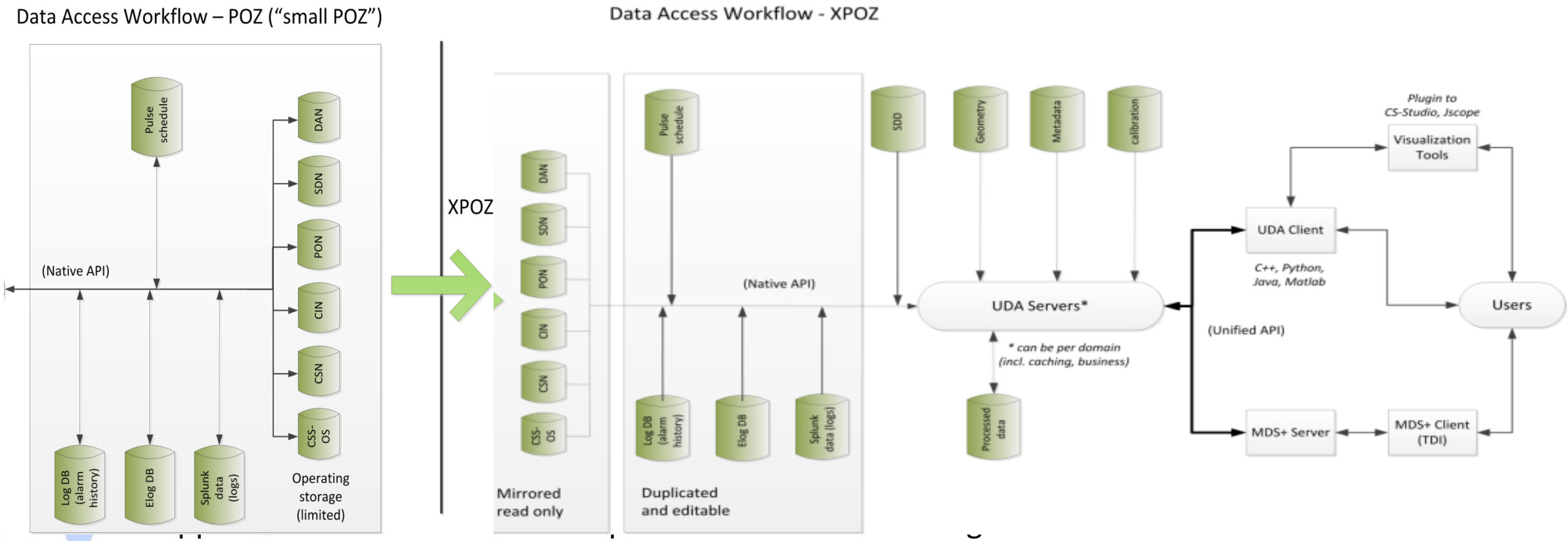
coming

data

uling of

ITER Data Types

- PON Data: EPICS traffic, conventional control/monitoring data, 25-50MB/s, archiving in RDB
- DAN Data : data with high throughput (scientific data), a few MB/s to 50GB/s, archiving to HDF5 file

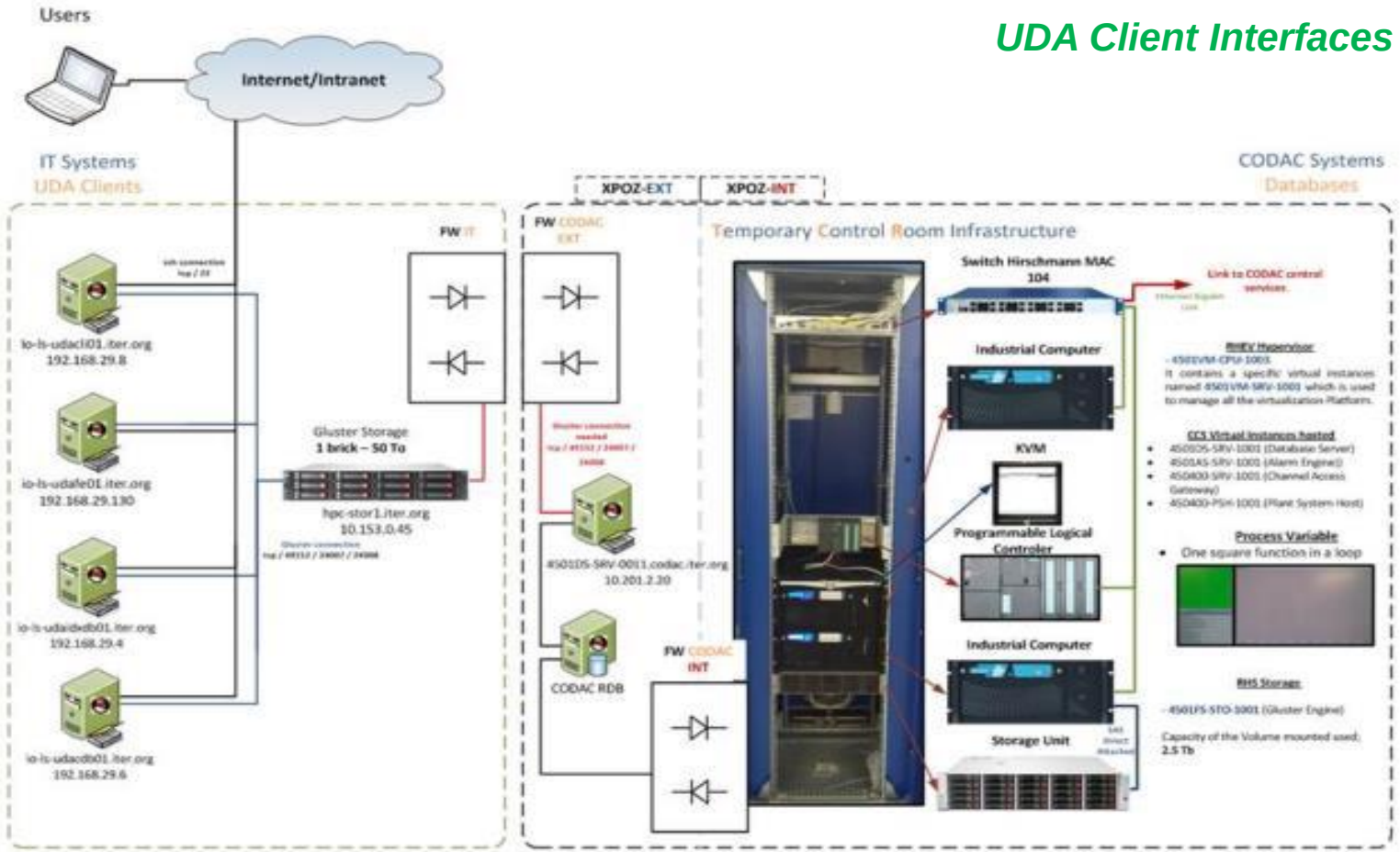


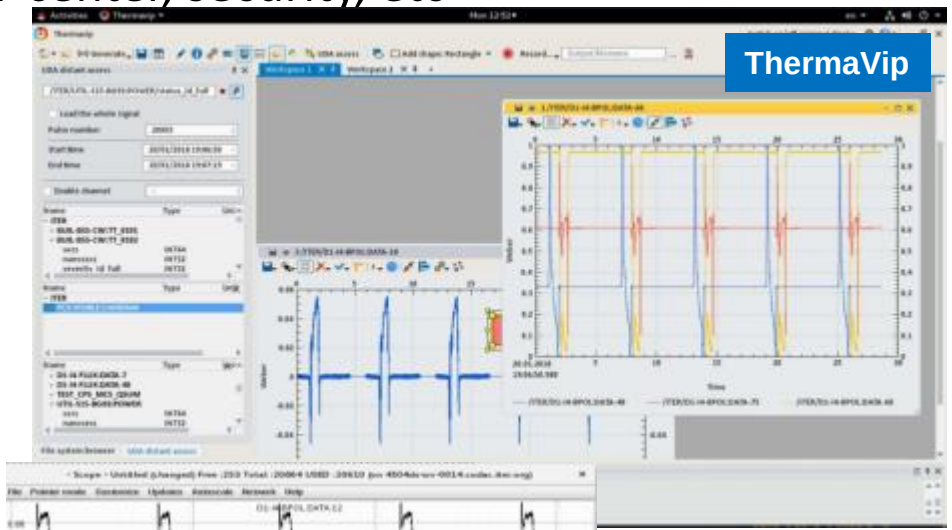
- Plugins to various existing vizualisation tools: CSS databrowser (for continuous data), MDS+ Jscope, Matlab, Uda-itool (Python/Matplotlib), ThermaVip

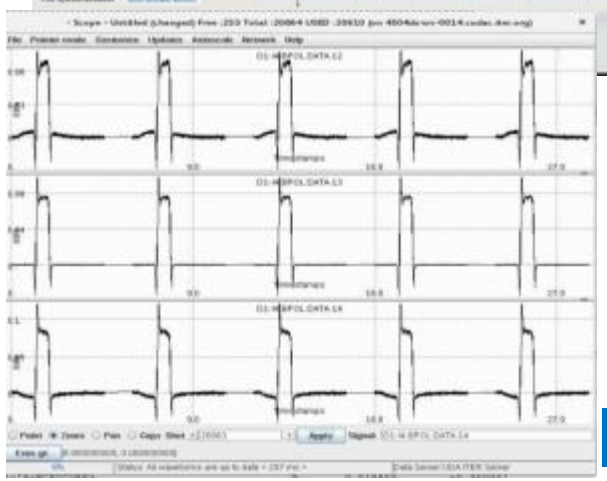
ITER Data System

- Implementing Data Service for Plant System Commissioning
  - Complete 1st implementation of UDA (Unified Data Access) at IT for plant data service, 1st client is UTIL connected to B36 TCR. Plant commissioning data backed up in a storage at IT
- Working on the design of ITER Data System alongside Remote Participation in terms of infrastructure (with IT) : data evolution, data center & disaster center, security, etc

UDA Client Interfaces







Temporary Solutions for Integration and Commissioning

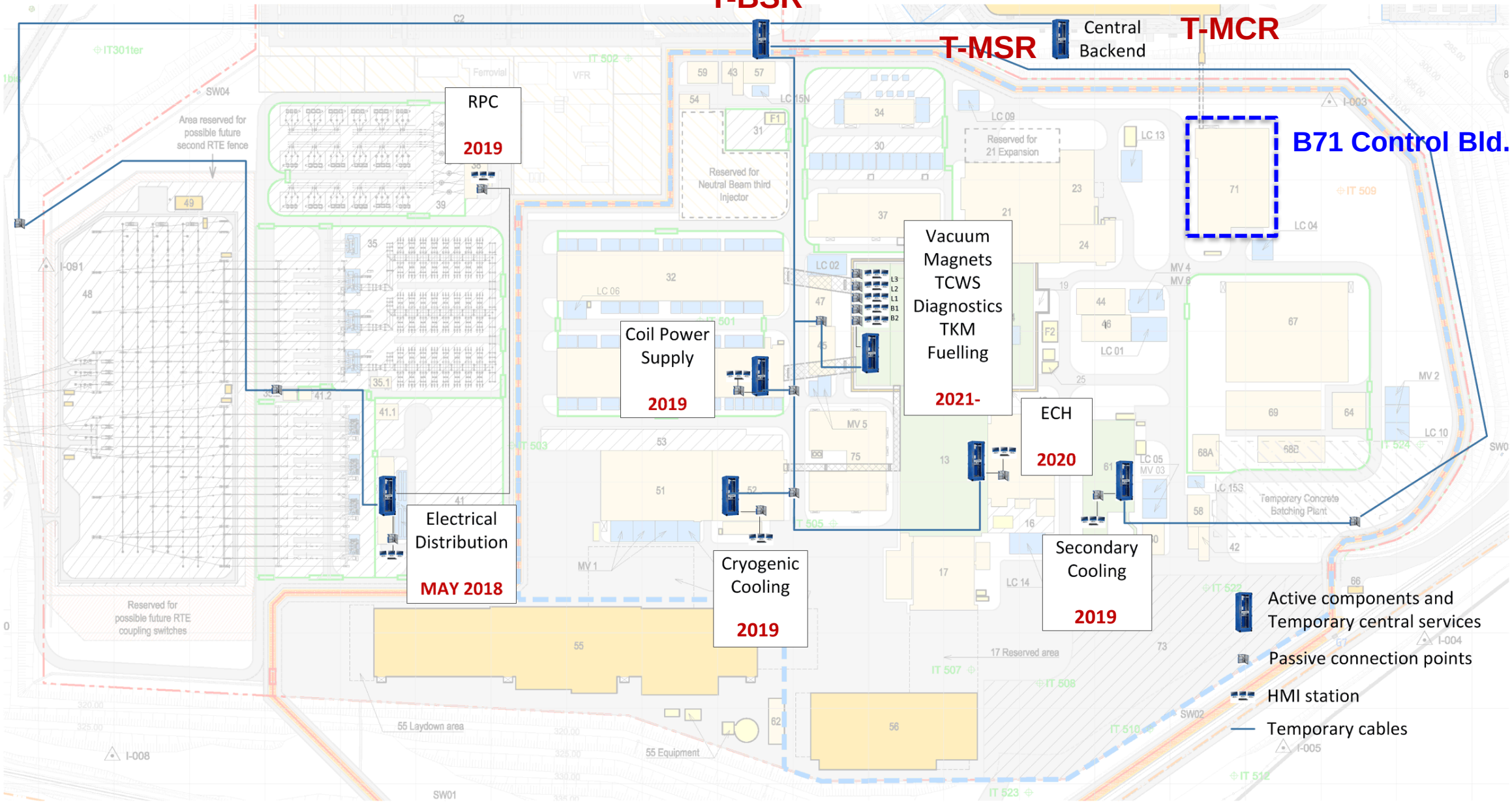
TCR (Temporary Control Room)

- To allow integration of plant I&Cs before the availability of B71N
  - Temporary central services and temporary control rooms in strategic buildings
  - Included plant configuration, data archiving, alarm handling, logging, HMI, gateway and data access together with operator terminals
  - 1st TCR B36 delivered in May-2018 for UTIL-HV and B36 BMS SAT and commissioning

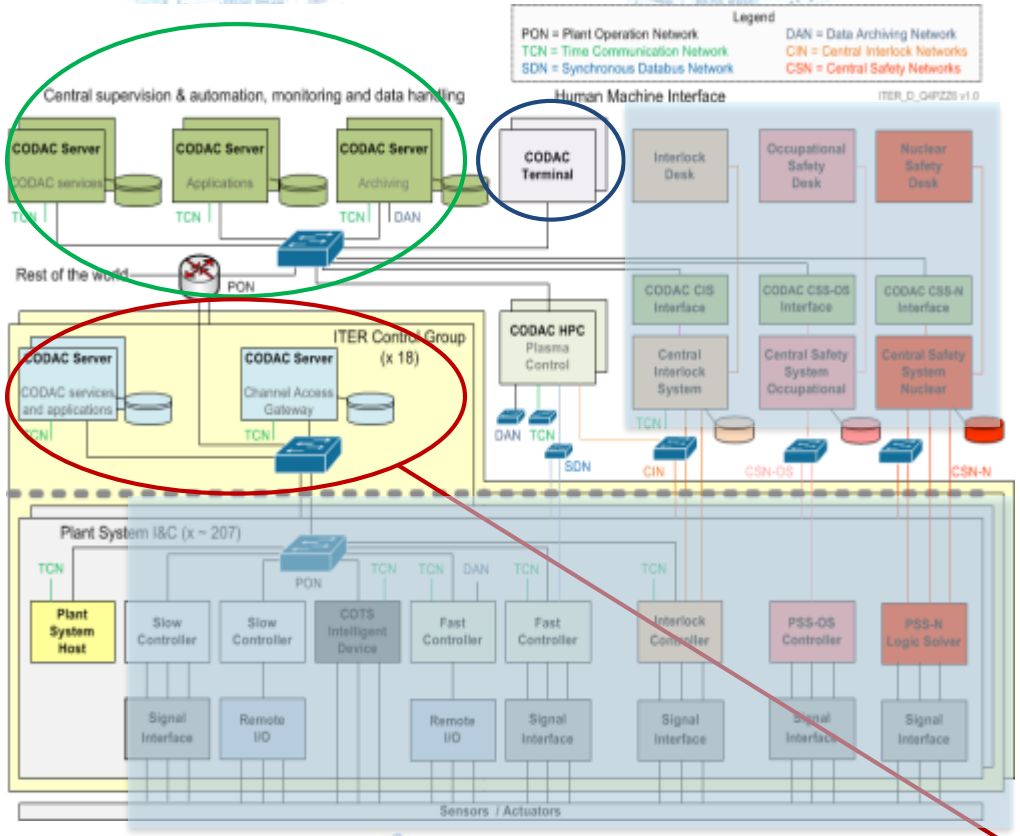
T-MCR (Temporary Main Control Room)

- Functions
  - Supervision and monitoring : at least, 6 plant systems in operation until 2023
  - Plant commissioning and testing
    - Individual and/or multiple plant systems commissioning
  - Remote Participation
    - Tests with multiple DAs on-going and under planning (RF-DA,QST in JA, GA, others)
  - Operator Training
  - Plant simulator
- Construction complete by end of May 2019

Delivery of TCRs



Architecture of TCR

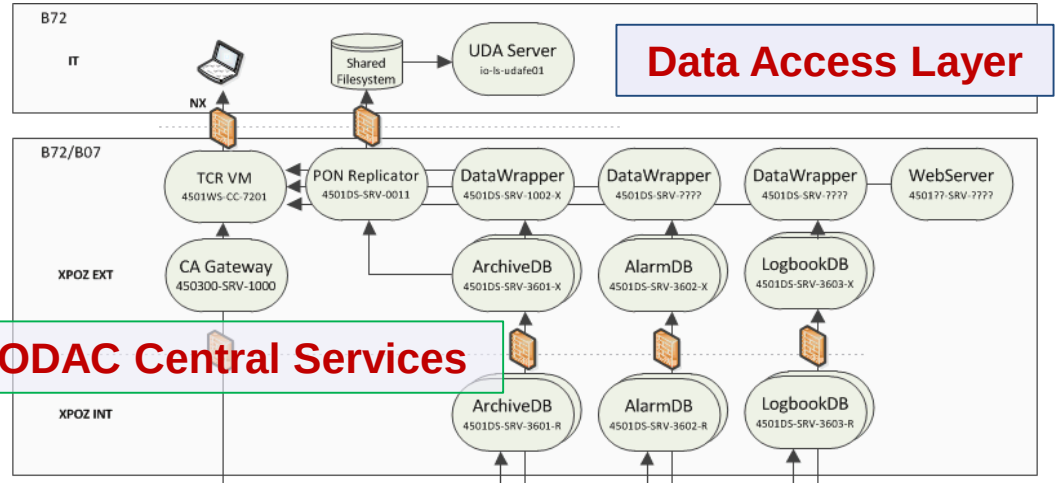


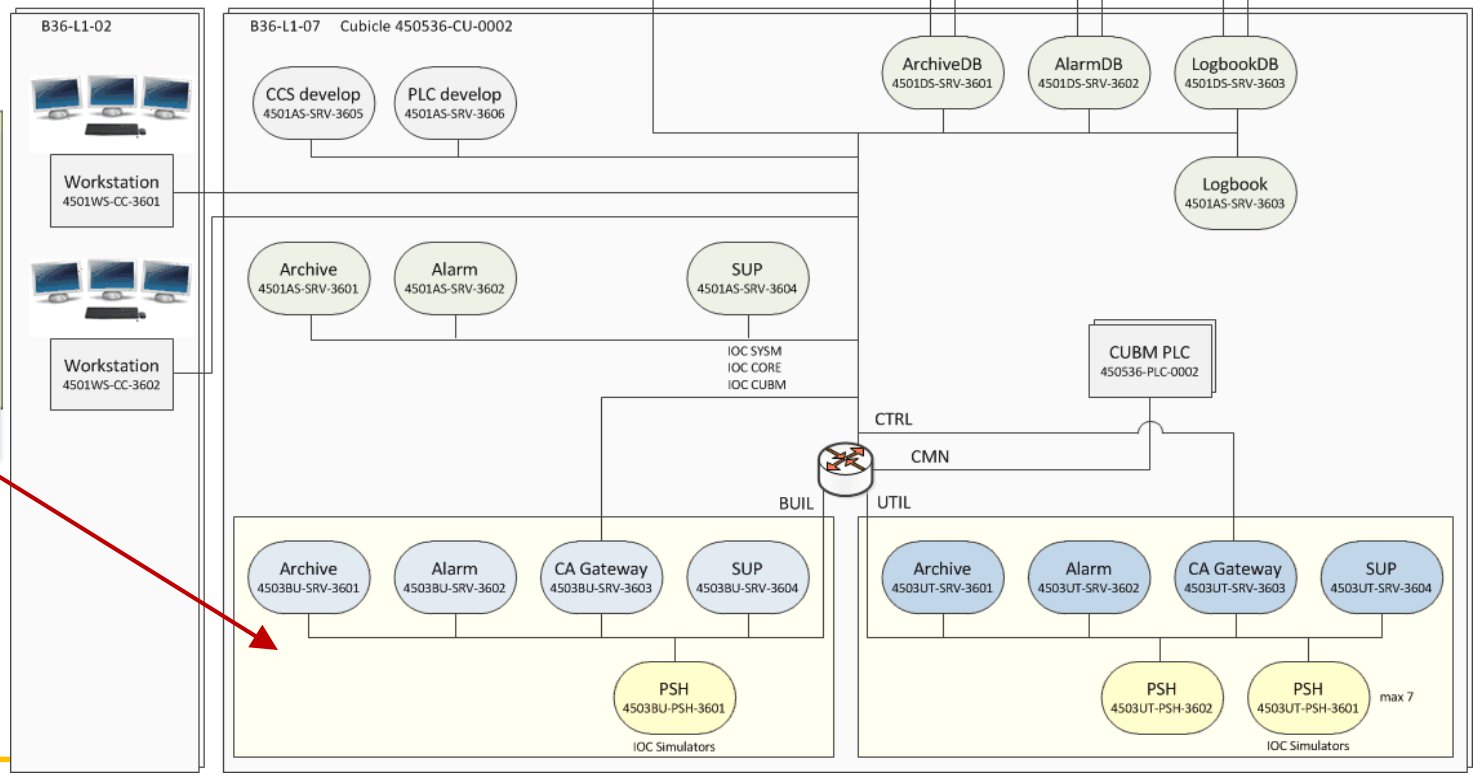
ITER I&C Architecture

Operator Terminal

CODAC Central Services

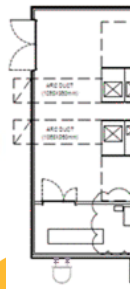
Data Access Layer



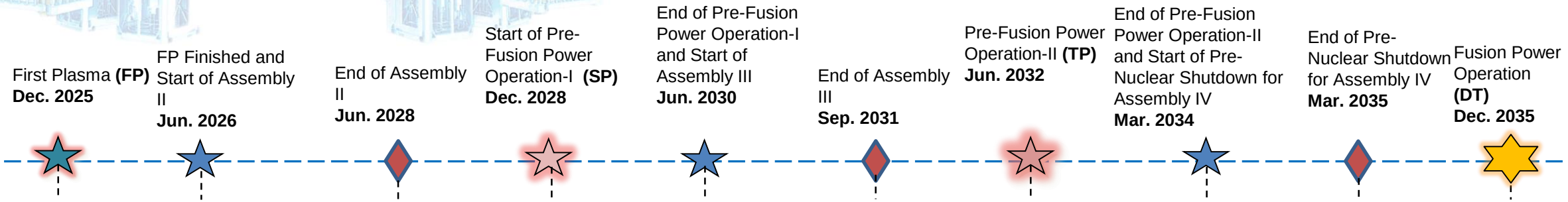


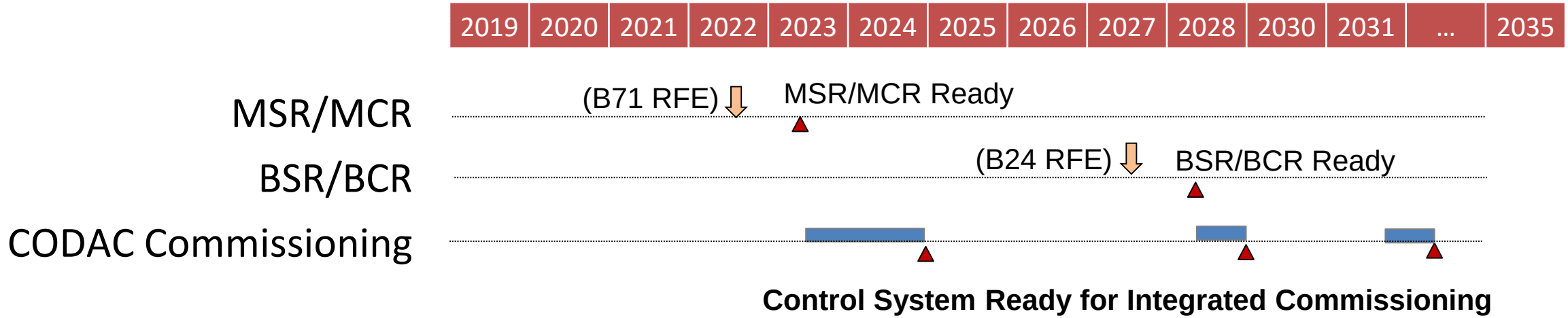
B36 and SSEN SAT/Commissioning

Energization as seen from central data archive



Future Schedule





** Scientific Data Center (SDC), Disaster Recovery Backup, High-Performance Computing under design*