

Control System Development Roadmap

Workshop on Controls Development for FAIR Commissioning
and GSI Operation of Existing Acc. Complex

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Controls Development Roadmap

Roadmap vs. MSP Plans

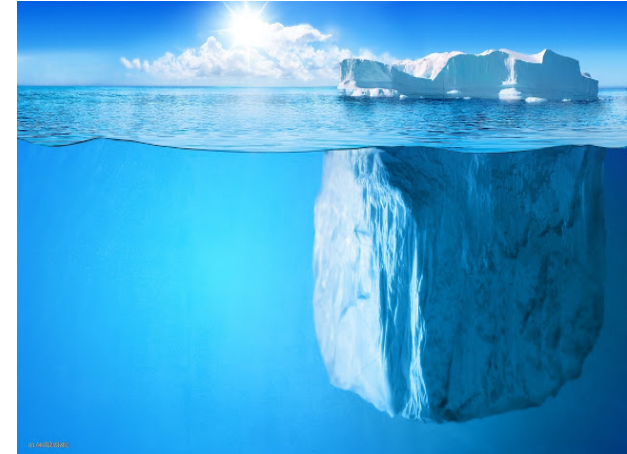
- Development and implementation progress is not adequately visible in MSP plans (PSP 2.14.10.x), internal planning is very detailed; but many internal milestones make no sense for PL/SPL, only "external milestones" are of interest.
- CS development follows not a start/stop development paradigm but an iterative approach (as usual/well proven in IT projects)
- Features and system functions are usually defined along a fixed sequence of **Releases** (due dates) and are implemented step-wise.
- Description of objectives are often too "long" to handle them efficiently in MSP plans

Approach:

- Roadmap sheets with detailed "meaningful" milestone for general features/functions
- Dashboard for discrete systems (e.g. equipment control HW/SW by machine)

Actual plans here:

<https://edms.cern.ch/project/FAIR-000005502>



Relevant Milestones for Users

Year	Setting Management (LSA) System
2020	<p>Until end of 2020:</p> <ul style="list-style-type: none"> LSA: code merge with CERN and code cleanup => done LSA/system: Performance tuning => 1st iteration done, ongoing LSA: support 2 chains in one pattern => done (example for application) Technical concept: BPC start indicator => done (implementation not done yet) <p>R15</p> <p>R16</p> <p>For 12/2020:</p> <ul style="list-style-type: none"> Support SIS-100 string test
2021	<p>Until end of 2021:</p> <ul style="list-style-type: none"> Booster mode preparation: Integrate FG prep-time in preceding BP (10ms time optimization) LSA: Tagging & Restore of good LSA settings (including App) LSA: REST API for read access of parameters System: Update mechanism (notification for apps) on changes (simple version) <p>R17</p> <p>R18</p>
2022	<p>Until end of 2022:</p> <ul style="list-style-type: none"> LSA: Support for UNILAC LSA: Full support of multiple chains in one pattern LSA: Pre/Post in Patterns (automatic, full solution) LSA: REST API for read/write access of parameters (prototype) <p>R19</p> <p>R20</p>
2023	<p>Until end of 2023:</p> <ul style="list-style-type: none"> Chain skipping (prevent execution of BPC) LSA: REST API for read/write access (extension based on user feedback) LSA: Support of transactions LSA/system: support of "rectangle-type patterns" (nested chains) LSA: Change StorageRing -Pattern to SyncMode-Pattern (and return), (first step) <p>R21</p> <p>R22</p>
2024	<p>Until end of 2024:</p> <ul style="list-style-type: none"> LSA: RBAC for LSA parameters integrated LSA/system: Support of "parallelogram-type patterns" (time shifted chains) <p>R23</p> <p>R24</p>
2025	<p>Until end of 2025:</p> <ul style="list-style-type: none"> Full solution for "TV2-Problem" (time-optimized solution) <p>R25</p> <p>R26</p>

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Relevant Milestones for Users

Year	Project: Services (RBAC, cmw, MiTSA, Sequencer, ...)
2020	<p>Beamtime 2020:</p> <ul style="list-style-type: none"> Sequencer: Prototype operation (no service) <p>Release 16:</p> <ul style="list-style-type: none"> RBAC: vertical test (proof of principle: RBAC server, FESA & App demonstrator class) RBAC: Start specification for RBAC Sequencer: Sequencer service prototype (based on Molr) <p>Release 17:</p> <ul style="list-style-type: none"> RFID authentication service prototype for RBAC and consoles MiTSA: Middle Tier Service Architecture framework: conceptual design and prototyping
2021	<p>Beamtime 2021:</p> <ul style="list-style-type: none"> Sequencer service (based on Molr), experimental operation <p>Release 17:</p> <ul style="list-style-type: none"> RBAC specification complete MiTSA (middle tier services framework): prototype implementation <p>Release 18:</p> <ul style="list-style-type: none"> RBAC: Engineering prototype for RBAC management Sequencer: Sequencer service in operation (including GUI)
2022	<p>Release 19:</p> <p>Release 20:</p> <ul style="list-style-type: none"> Rollout RBAC into production system (group/id management & management tool)
2023	<p>Release 21:</p> <p>Release 22:</p> <ul style="list-style-type: none"> LSA supports RBAC (restrict access to LSA parameters)
2024	<p>Release 23:</p> <p>Release 24:</p>
2025	<p>Release 25:</p> <p>Release 26:</p>

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Relevant Milestones for Users

Year	Project: Archiving/PM System (MARS)
2020	<p>Beam time 2020:</p> <ul style="list-style-type: none"> MARS experimental operation (20 TB storage, base version) <p>Release 15:</p> <ul style="list-style-type: none"> SAT complete (in-kind project closed) MARS technical review meeting and definition of future development roadmap <p>Release 16:</p> <ul style="list-style-type: none"> MARS stores LSA context data
2021	<p>Beam time 2021:</p> <ul style="list-style-type: none"> MARS in productive operation (20 TB storage) including REST retrieval API 50 Hz data reduction algorithm mechanism (for UNILAC) <p>Release 17:</p> <ul style="list-style-type: none"> UNICOS vacuum system stores data by SILECS/PLC communication (valves, pressures) <p>Release 18:</p> <ul style="list-style-type: none"> MARS stores BLOBS (binary large objects, file based) Technical concept for UNICOS system integration (for all process variables)
2022	<p>Release 19:</p> <ul style="list-style-type: none"> UNICOS system integration: UNICOS process variables stored in Archiving MARS Data Explorer: First version App (based on Grafana) <p>Until end of 2022:</p> <ul style="list-style-type: none"> Dynamic (rule-based) configuration of storage parameters based on accelerator & beam modes
2023	<p>Release 21:</p> <p>Release 22:</p>
2024	<p>Beam time 2024:</p> <ul style="list-style-type: none"> Post Mortem data integrated in MARS (prototype operation) MARS extended to 100 TB (based on operation request) <p>Release 23:</p> <p>Release 24:</p>
2025	<p>Beam time 2025:</p> <ul style="list-style-type: none"> Post Mortem integration in MARS (full production) <p>Release 25:</p> <p>Release 26:</p>

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Control Room Applications (1)

Application group (APP) mission / goal:

- Provides generic, facility-wide applications for the main control room
- Machine-specific and expert applications are out of scope, but help is provided (e.g. BI expert GUIs, FRS operation program)
- All projects are realized in close collaboration with OPE-APS (strong link to Operations)

Control Room Applications (2)

APP Development Roadmap is based on requirements from:

1. ACO-OPE Steering Meeting (bi-weekly):
balances out requirements from current and future beamtimes with requirements for FAIR
2. Projects in line with other Control System developments and milestones
(e.g. BTM GUI, new LSA features)
3. Replacements for existing applications (e.g. developments for UNILAC and ion sources)
4. Internal technical requirements and developments (adaptations to new APIs etc.)

There is no „fixed 5-year development plan“,
instead the requirements are collected and prioritized by the Steering Meeting

Upcoming Application development (2021):

- BTM App
- Retrieval of good Settings (LSA)
- Several chains in a pattern (functional extension)

Relevant Milestones for Users



Year	Machine Protection Systems
2020	<p>Beam time 2020:</p> <ul style="list-style-type: none"> SIS18 spill abort system: operational => done, needs to be commissioned in BT2021 <p>Release 15:</p> <ul style="list-style-type: none"> FBAS feasibility test done (FBAS signals via WR network, critical technical decision) MASP monitors UNILAC devices (via CAP alarm mechanism) <p>String test (12/2020):</p> <ul style="list-style-type: none"> QD Trigger Matrix (SIS-100): hardware, device software, engineering/expert tool (prototype) DAQ for QD voltages (100 channels): prototype
2021	<p>Release 17:</p> <ul style="list-style-type: none"> BTM system: Prototype & experimental operation, simple GUI <p>Release 18:</p> <ul style="list-style-type: none"> Fast BLM system (SIS-100) prototype: hardware, device software, expert tool (prototype) All PLC-ILK collector stations produced (FAIR)
2022	<p>Beam time 2022:</p> <ul style="list-style-type: none"> BTM system: operational (with GUI) MASP incorporates chain –specific interlocks <p>Release 20:</p> <ul style="list-style-type: none"> MASP specification complete (final version) FBAS SIS-100 & HEFT (fast beam abort system): technical concept ready and approved
2023	<p>Release 21:</p> <ul style="list-style-type: none"> FBAS SIS-100 (fast beam abort system) prototype version <p>Release 22:</p> <ul style="list-style-type: none"> MASP full version (including HW trigger to FBAS), prototype version Magnet power permit / movable devices permit service, prototype version
2024	<p>Release 23:</p> <ul style="list-style-type: none"> MASP full version in production FBAS SIS-100 & HEFT (fast beam abort system) ready for operation
2025	

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	R16 String Test (12/2020): <ul style="list-style-type: none"> DAQ from SCU-bus (FG & multiplexed) devices (ADDA/ACU) continuous mode DAQ for QD voltages (100 channels): prototype
2021	R17 Beam Time 2021: <ul style="list-style-type: none"> Digitizer rollout SIS-18 complete
	R18 Release 18: <ul style="list-style-type: none"> Digitizer rollout ESR complete Until end of 2021: <ul style="list-style-type: none"> Optimization of general DAQ features including triggered mode, data decimation Integration of SDR systems
2022	R19 Until end of 2022: <ul style="list-style-type: none"> Implementation of DAQ systems for 50 Hz (UNILAC operation) Integration of Post Mortem buffer functions in all DAQ systems (freeze upon Event, push/pull to Archive System) DAQ channel directory service for data streams
	R20
2023	R21
	R22
2024	FAIR Control Center Ready to be Commissioned
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2025	R25
	R26

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	R20

Relevant Milestones for Users

Year	Supported Accelerator Modes (Booster, B2B)
2020	Beamtime 2020: <ul style="list-style-type: none"> Transfer SIS18-ESR-CRYRING (old system, but integrated in LSA)
2021	Mid-2021 (end of beam time): <ul style="list-style-type: none"> B2B: proof of principle MD experiment (SIS18-ESR-CRYRING, SIS18-FixedTarget, no system integration) Release 18: <ul style="list-style-type: none"> Ready for SIS-18 booster mode Dry-run test (Proof of principle test: UNI-PZ, 10 ms FG prep time optimization)
2022	Beamtime 2022: <ul style="list-style-type: none"> Booster Mode machine experiment Release 19: <ul style="list-style-type: none"> B2B: Technical concept complete and approved Mid-2022 (end of beam time): <ul style="list-style-type: none"> Booster Mode machine experiment (technical follow up works completed)
2023	Beamtime 2023: <ul style="list-style-type: none"> Booster Mode: routine operation for machine experiments Mid-2023: <ul style="list-style-type: none"> B2B: Existing machines SIS/ESR/CRYRING use new transfer system
2024	Release 23: <ul style="list-style-type: none"> B2B: Prototype system SIS18-SIS100 in Integration system, ready for installation
2025	Release 25: <ul style="list-style-type: none"> B2B ready for operation

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Relevant Milestones for Users

Year	General Developments for UNICOS Controls
2020	<ul style="list-style-type: none"> Tests and Development with WinCC OA V3.16 different SPs at CentOS LINUX Server in order to prepare changeover Restrictions of ULC UX client allows not the full usage for main control room operators Test and Development for usage of Ind. Ethernet / PROFINET with UNICOS based systems Development of tools for better usage of Git for SW projects Development of simulator tools for testing of PLC based programs Development of basics for EPLAN and specfile generator Migration of the systems to new UNICOS/WinCC OA/TIA portal releases Close frame contract for cabinet manufacturing (Vacuum, Bake Out, Insulation Vacuum, Cryo)
2021	<ul style="list-style-type: none"> Development of client concept for main operators with WinCC OA LINUX server Changeover to CentOS LINUX server Conceptual design and start development for UNICOS to long term archiver interface Extension of UNICOS object-related user rights Migration of the systems to new UNICOS/WinCC OA/TIA portal releases
2022	<ul style="list-style-type: none"> Migration of the systems to new UNICOS/WinCC OA/TIA portal releases Finalization of development and start of tests for UNICOS to long term archiver interface Further development of the WinCC OA SCADA system
2023	<ul style="list-style-type: none"> Migration of the systems to new UNICOS/WinCC OA/TIA portal releases Set long term archiver operational Further development of the WinCC OA SCADA system
2024	<ul style="list-style-type: none"> Migration of the systems to new UNICOS/WinCC OA/TIA portal releases Further development of the WinCC OA SCADA system
2025	<ul style="list-style-type: none"> Migration of the systems to new UNICOS/WinCC OA/TIA portal releases Further development of the WinCC OA SCADA system

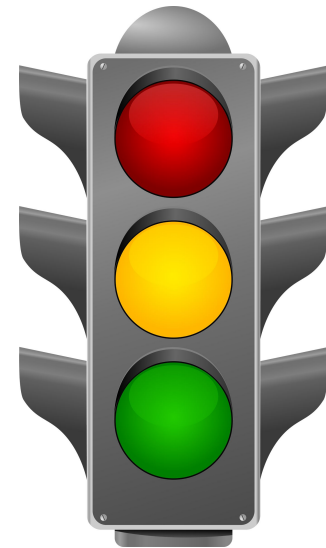
Year	Vacuum Controls (UNICOS)
2020	<p>Beam time 2020:</p> <ul style="list-style-type: none"> UNILAC vacuum controls in UNICOS (production) <p>Cryring + HESR BO:</p> <ul style="list-style-type: none"> Flexible heat group assignment for each channel Change from 57-300 to 57-1500 Development of HESR BO with mobile PLC cabinets and HCS heater system Integration of add. vacuum sector for source etc. into Cryring <p>SIS18/UNILAC/FAIR:</p> <ul style="list-style-type: none"> Development of new structure for easy change of controller to pump/gauge configuration during runtime Development of new drivers for 4UHV, MG15, TPG500 controller Integration of MG15 measurement with new structure into SIS18 Integration of add. turbo pumps and update for small bug fixes of UNILAC <p>FAIR projects:</p> <ul style="list-style-type: none"> Start development of BO and beamline vacuum EPLAN generator incl. customization of the schematic macros Training of Inkind partners for usage and further development of EPLAN generator Support for detailed specifications of vacuum tenders
2021	<p>FAIR projects, incl. tests at prototype systems Cryring/SIS18/UNILAC:</p> <ul style="list-style-type: none"> Support for detailed specifications of vacuum tenders Proceed EPLAN generator development incl. FAT/SAT Procurement of Vacuum controller and bake out cabinets and terminal boxes Supervision of Inkind partner for EPLAN, specfile generator, driver etc. developments Integration and test of new structure at UNILAC and probably Cryring vacuum control system, exchange of 4UHV firmware Start development of flexible integration of mobile pumpstations and NEG systems <ul style="list-style-type: none"> Operate Valves from central control system (via FESA/SILECS interface) Pressure readings from each vac. section is stored in MARKS (via FESA/SILECS interface)
2022	<p>FAIR projects:</p> <ul style="list-style-type: none"> EPLAN generation for HEBT 1-2, manufacturing/FAT/SAT/delivery of cabinets EPLAN generation for SIS100, manufacturing/FAT/SAT of cabinets Supervision of Inkind partner for SW+HW developments Preparation of on-site installation works
2023	<p>FAIR projects:</p> <ul style="list-style-type: none"> Delivery of SIS100 cabinets EPLAN generation for SFRS, manufacturing/FAT/SAT/delivery of cabinets EPLAN generation for HEBT3-5, manufacturing/FAT/SAT/delivery of cabinets Supervision of Inkind partner for SW+HW developments Delivery and usage for testing and commissioning of first vacuum SW version for HEBT1-2/SIS100 On-site installation and supervision, signal-tests of HEBT1-2/SIS100 incl. Bake Out
2024	<p>FAIR projects:</p> <ul style="list-style-type: none"> EPLAN generation for pBar, pLINAC, CR, HESR, manufacturing/FAT/SAT/delivery of cabinets Delivery and usage for testing and commissioning of first vacuum SW version for SFRS/HEBT3-5 On-site installation and supervision, signal-tests of SFRS/HEBT3-5/pBar/pLINAC/CR/HESR incl. Bake Out
2025	<ul style="list-style-type: none"> Commissioning and Operational Support of all vacuum and bake out systems

Year	Cryogenic and Insulation Vacuum Controls (UNICOS)
2020	<ul style="list-style-type: none"> EPLAN generator development for SIS100 Sector, Endbox, Feedbox-Cabinets EPLAN Macro development for typical diagrams (power supply, power distribution, PLC configuration, temp. measurements, valve control, level measurement and heater control) Preparation of String Test (SW+HW) Delivery of Desy Kryo-IO-System SW development for flexible usage of CERN magnet testing facility for the different Multiplet- and Dipoltypes Preparation of Test of ET200P HART Modules and FOM Software for FAIR valve control at the TCFD0 prototype system
2021	<ul style="list-style-type: none"> EPLAN generator development for Distribution System Cabinets EPLAN Macro development for typical diagrams (level measurements and other open issues) Procurement of SIS100 cabinets and DB4 via frame contract Clarification of interfaces to other systems Continuation of the functional analysis SIS100 Support of CERN magnet testing SW commissioning of String Test Development of Insulation Vacuum SW + HW Start Procurement of Insulation Vacuum cabinets via frame contract
2022	<ul style="list-style-type: none"> EPLAN generator development for SFRS/CBM Cabinets Finalization of EPLAN Macro-development Procurement of SFRS and DB2/BB2 and CBM cabinets via frame contract Start of the functional analysis Distribution System and SFRS Support of CERN magnet testing SW development for SIS100 based on functional analysis Development of specfile generator for SIS100/DB4 Start installation and commissioning of SIS100/DB4/INV cabinets Procurement of Insulation Vacuum cabinets via frame contract
2023	<ul style="list-style-type: none"> Support of CERN magnet testing SW development for SFRS based on functional analysis Development of specfile generator for SFRS/DS/CBM Start installation and commissioning of CBM/DS/SFRS/INV cabinets Commissioning of SIS100/CBM/SFRS/DS/INV
2024	<ul style="list-style-type: none"> Commissioning of SIS100/CBM/SFRS/DS/INV
2025	<ul style="list-style-type: none"> Commissioning and Operational Support of SIS100/CBM/SFRS/DS/INV

Controls Progress Dashboard

Progress Dashboard (developed in cooperation with PMO)
Shows the development **progress** steps:

- **General Design**
 - General requirements clear/complete (requires input from equipment experts)
 - General system design done
- **Hardware & Electronics**
 - Electronic hardware design
 - Prototype (including Firmware/Gateware)
 - Firmware/gateware development
 - Production status
 - Readiness for installation?
- **Control Software**
 - Software design
 - Base software (generic root class already available)
 - Prototype version
 - First version
 - Ready for installation / commissioning
 - Advanced version
 - Acceptance test
 - Readiness for beam operation
- **Testing**
 - Integration system (INT)
 - In use (production) already at existing machines



Actual progress dashboard here:

<https://edms.cern.ch/project/FAIR-000005502>



thank you!