

Cosylab for FAIR

Slovenian contribution to controls at FAIR

NUSTAR week 2017

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Your **TRUSTED** Control System Partner



Agenda



- ❑ About Cosylab
- ❑ About Slovenian in-kind contribution for FAIR
- ❑ Contribution to controls
 - Control system services: Alarm System, Diagnostic Logging System, Archiving System, Post Mortem System, Beam Transmission Monitor System
 - Integration of devices into FESA control system (various BPMs, COFB, LLRF, RGA, Ion Source, DSO, etc.)
 - White Rabbit Timing Receiver Boards (development and production)
 - Front-End Controllers (serial, motion)
 - Vacuum Control System
 - Interlock System
- ❑ Conclusion

About Cosylab

About Slovenian in-kind contribution for FAIR

Contribution to controls

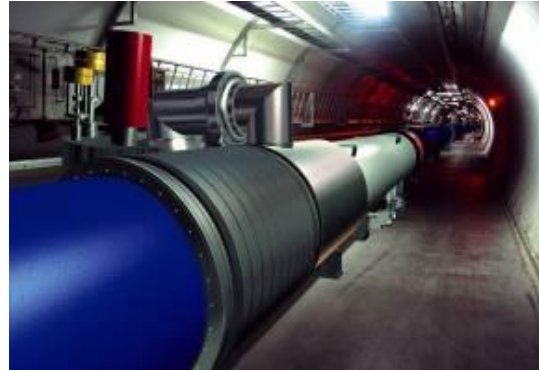
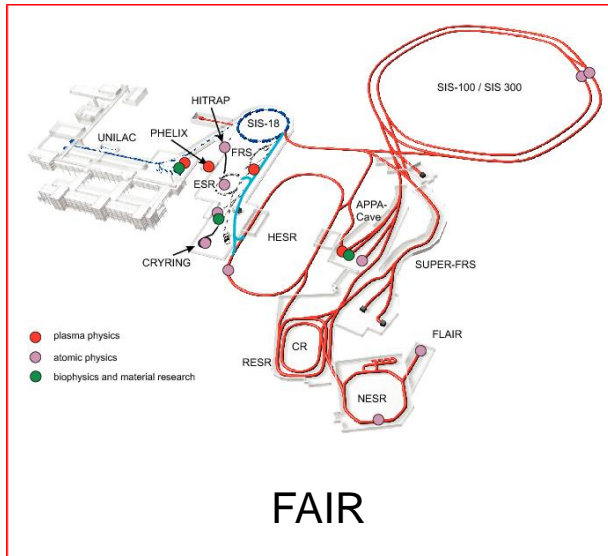
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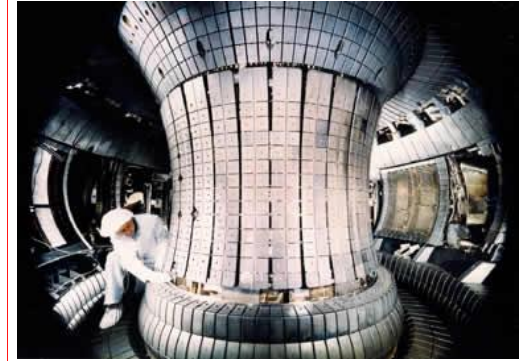
World Leader in Accelerator and Proton Therapy System Integration and Software



- ❑ Customers: many large Big Physics International Projects



CERN Large Hadron Collider

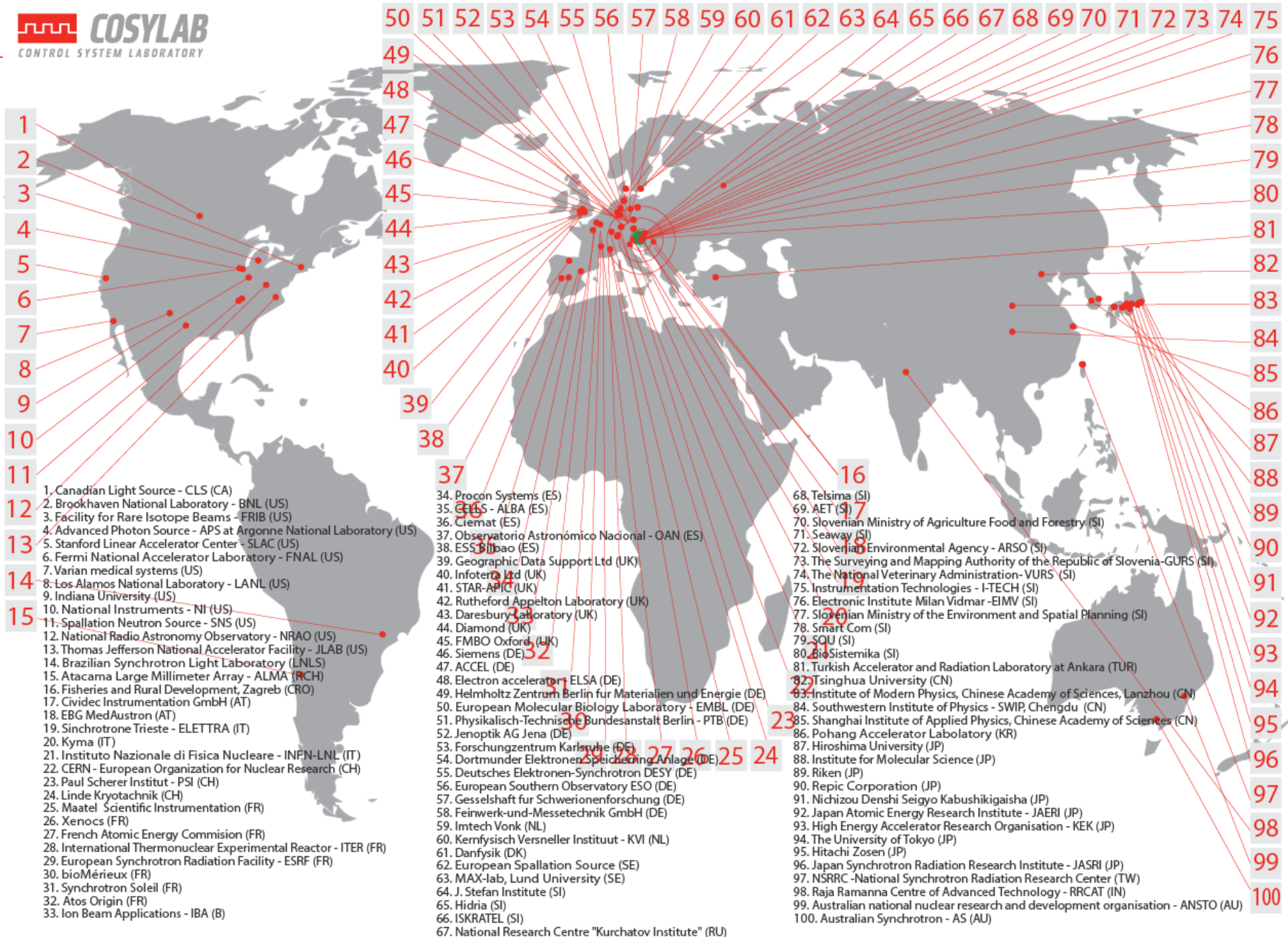


ITER

- ❑ Curing cancer with proton accelerators
- ❑ Over 10 PT projects, such as MedAustron, HIMM (China), etc.



Customers From Nearly All Major Labs Worldwide



6 **Who are we?**



- ❑ 150 people worldwide
 - >100 „developer/engineer“
 - Always ~30 students in the pipeline
- ❑ Branches: Sweden, USA, Japan, China, Switzerland



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How Do We Do It?

People

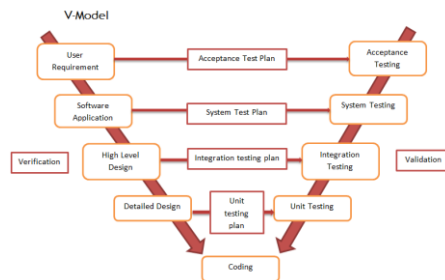
- We know how to recruit best people
- Own education and training system
 - „CosyAcademy“
- Strong company culture and great employee loyalty



Best Employer
in Slovenia 2015 Award

Processes

- ISO9001, ISO13485,
ISO14971, IEC62304



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- ❑ Slovenian contribution is in-kind
- ❑ Consortium of several companies - TEHNODROM
- ❑ Tehnodrom is internally divided into two pillars:
 - Control System, lead by Cosylab
 - Beam Diagnostics, lead by Instrumentation Technologies
- ❑ Control System part has the following partners:
 - Atech elektronika
 - Emsiso
 - Inea
 - iSYSTEM Labs
 - Xlab
 - **and Cosylab as a trustee**

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Control System contributions



- ❑ **C1:** Alarm System (PSP 2.14.10.2.7)
- ❑ **C2:** Diagnostic Logging System (PSP 2.14.10.2.8)
- ❑ **C3:** Archiving System (PSP 2.14.10.2.9)
- ❑ **C5:** FESA device classes (PSP 2.14.10.2.11, 2.14.10.2.12)
- ❑ **C6:** Timing Receiver Boards (PSP 2.14.10.3.3.1, 2.14.10.3.3.2)
- ❑ **C7:** Industrial type FEC systems (PSP 2.14.10.5.9)
- ❑ **C8:** Vacuum Control System (PSP 2.14.10.6.1, 2.14.10.6.2, 2.14.10.6.3, 2.14.10.6.4)
- ❑ **C9:** Interlock System (PSP 2.14.10.11.3)
- ❑ **C10:** Beam Transmission System (PSP 2.14.10.11.4)
- ❑ **C11:** Post Mortem System (PSP 2.14.10.11.5)

Control System Services



- Alarm System
- Diagnostic Logging System
- Archiving System
- Post Mortem System
- Beam Transmission Monitor System

- Application software, written in C++ and Java*
- High performance data storage*
- GUI*

Device integration

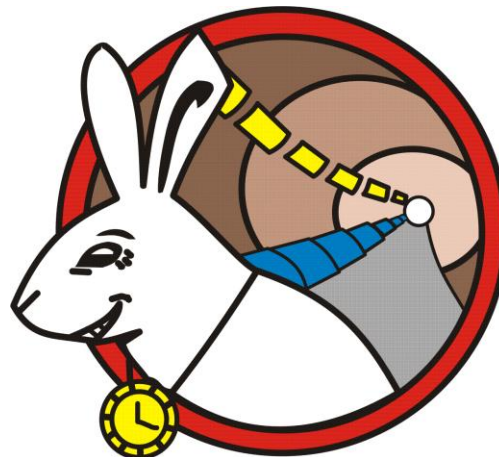


- FESA - Front-End Software Architecture
 - Developed by CERN
 - Extended by GSI
- Integration of:
 - Different devices for p-Linac Ion Source (Impedance Adapter, Magnetron, Mass Flow Controller)
 - Residual Gas Analyser (Spectrometer), including GUI
 - Various Beam Position Monitoring devices (SIS-100, HESR, CR, HEBT, pLinac)
 - Closed Orbit FeedBack system
 - p-Linac RF system
 - Stepper motor controller, including GUI
 - Interlock system, including GUI
 - Other devices: Oscilloscope, Switching matrix
- Software (drivers, FESA classes) written in C++***
- GUI written in Java***

Timing Receiver Boards

❑ White Rabbit Timing System

Wikipedia: **White Rabbit** is the name of a collaborative project including [CERN](#), [GSI Helmholtz Centre for Heavy Ion Research](#), and other partners from universities and industry to develop a fully deterministic [Ethernet](#)-based network for general purpose data transfer and sub-nanosecond accuracy [time transfer](#). Its initial use was as a timing distribution network for control and data acquisition timing of the accelerator sites at CERN as well as in GSI's [Facility for Antiproton and Ion Research](#) (FAIR) project.



Timing Receiver Boards

- Development and production of Timing Receiver Boards
 - PMC form factor



Bringing WR timing to
older systems
(PMC carrier)

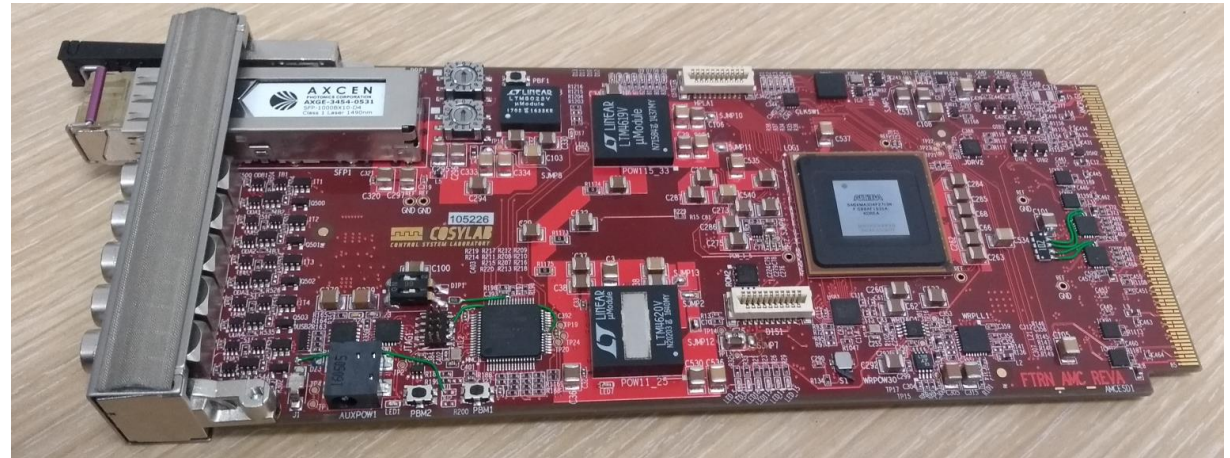


Timing Receiver Boards

□ Development and production of Timing Receiver Boards

■ AMC form factor

- MTCA.0 host
 - PCIe to host
 - IRQs
 - 5 front LEMO Ios



- MTCA.4 host
 - 8 bidirectional IOs on backplane
 - 4 bidirectional clocks on backplane



Timing Receiver Boards



❑ IOs

- LEMO connectors
- Bidirectional, LVTTTL levels
- Capable of driving 50 Ohm load
- Internal 50 Ohm termination
- **Generation of clocks up to 200MHz**
- **Schedule pulse generation (pulse trains) with 1ns resolution**
- **Timestamping of events on inputs**

❑ Interrupt generation to host bus

- PCI or PCI Express

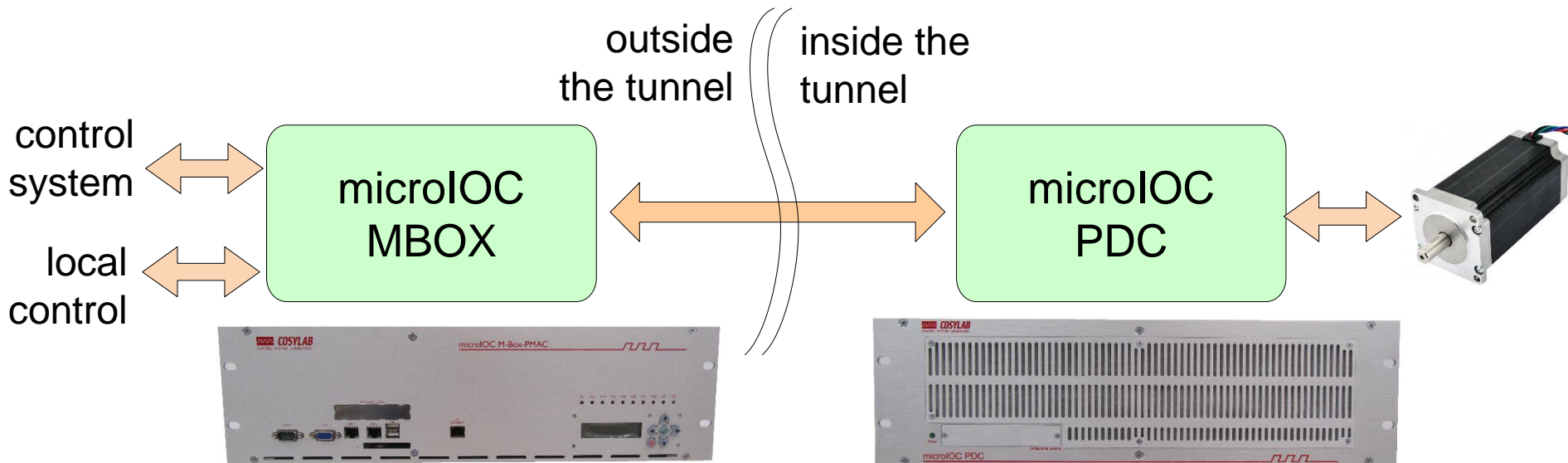
- Development and production of **microIOC serial**
 - For integration of peripheral devices with serial interface
 - Support communication with RS232, RS422, RS485, GPIB, Ethernet or USB type of devices
 - Up to **24** RS232/RS422/RS485 ports
 - Slot for PCI mezzanine card (usually for PMC Timing Receiver Board)



- ❑ Development and production of **microIOC MBOX**
 - For controlling of up to 8 stepper motors
 - 6 output and 6 input signals available per motor
 - Galvanically isolated connection to motor driver unit
 - Slot for PCI mezzanine card (usually for PMC Timing Receiver Board)

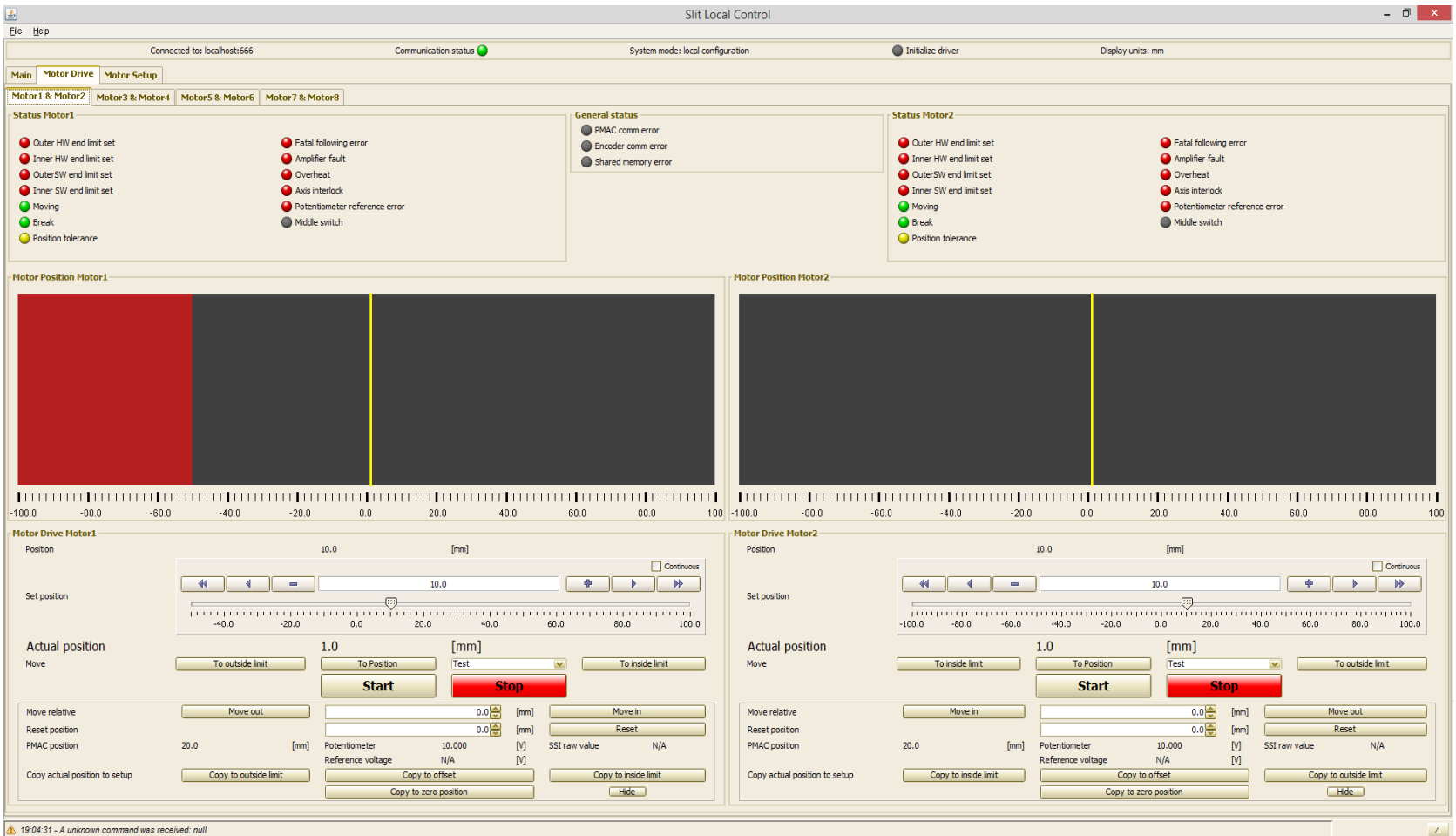


- Development and production of **microIOC PDC**
 - For driving up to four 5-phase stepper motors
 - Support for analog and SSI encoders
 - Up to 300m distance between control and power unit
 - Up to 70m distance between power unit and motor



Front-End Controllers

- Control motors via
 - Control system (FESA, EPICS, etc.)
 - Standalone GUI application



The screenshot displays the 'Slit Local Control' software interface. At the top, it shows connection details: 'Connected to: localhost:666', 'Communication status' (green dot), 'System mode: local configuration', and 'Display units: mm'. The main area is divided into sections for 'Motor1 & Motor2' and 'Motor2'. Each section includes a 'Status' panel with various error indicators (e.g., Outer HW end limit set, Fatal following error, Amplifier fault, Overheat, Axis interlock, Potentiometer reference error, Moving, Break, Position tolerance) and a 'Motor Position' panel with a scale from -100.0 to 100.0 mm. Below the position panels are 'Motor Drive' controls for each motor, including 'Set position' sliders, 'Actual position' displays, and 'Move' buttons (To outside limit, To Position, Test, To inside limit). The interface also features 'Move relative' and 'Reset position' buttons, as well as 'Copy actual position to setup' options.

Front-End Controllers

- ❑ Control motors via
 - Control system (FESA, EPICS, etc.)
 - Standalone GUI application
 - LCD on the front panel of MBOX



- ❑ Control single motor or pair of motors (e.g. slits)

Vacuum Control System

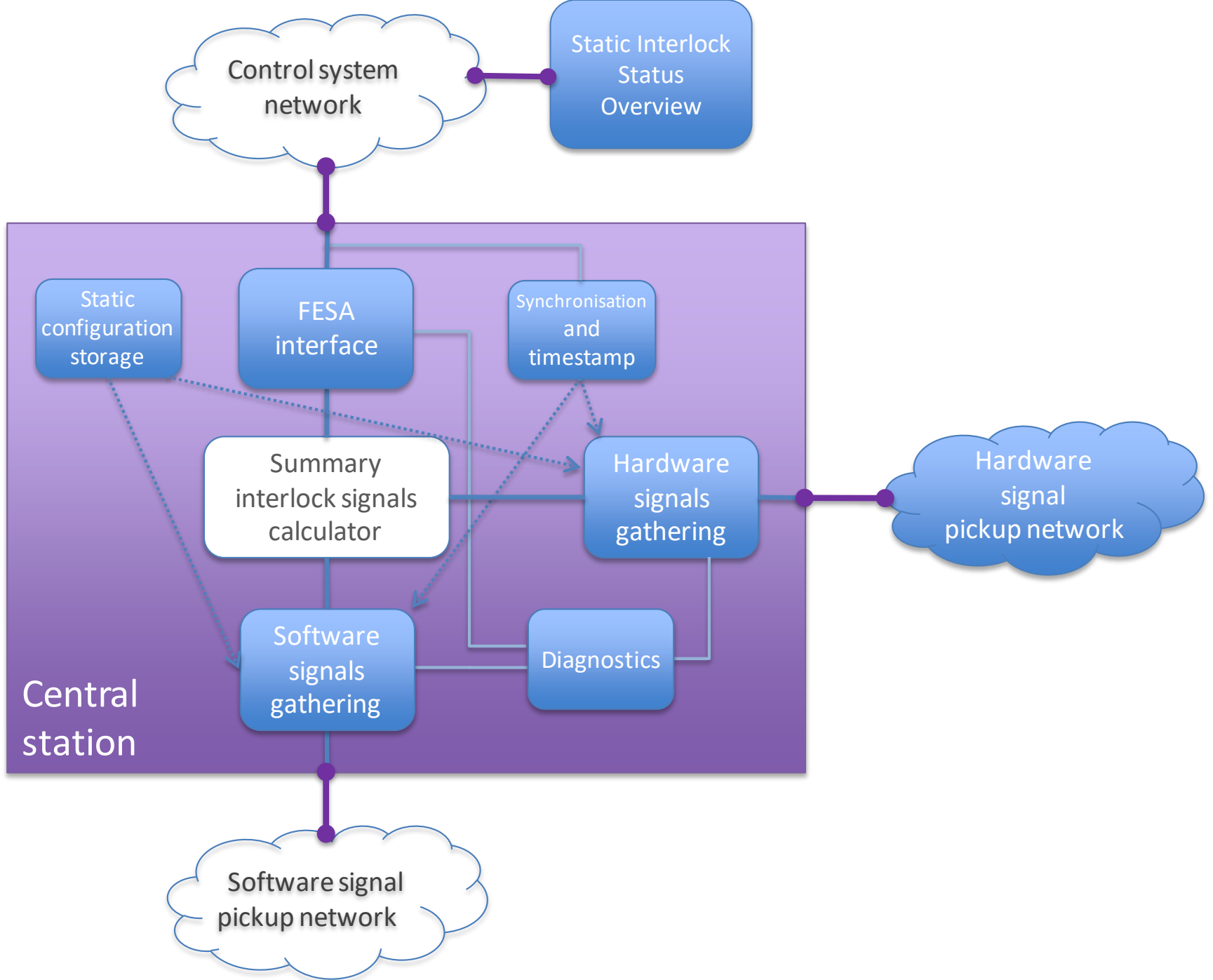


- ❑ Vacuum and Bake-out control system for all FAIR machines
- ❑ Based on Siemens PLC and UNICOS

UNICOS (UNified Industrial Control System) is a CERN-made framework to develop industrial control applications.

<http://unicos.web.cern.ch/>

- ❑ *Control of different devices (pumps, valves, gauges, etc.)*
- ❑ *Software (Unicos, SCL, WinCC Scada)*
- ❑ *Installation of hardware (EPLAN)*



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Conclusion



- ❑ Cosylab is the World Leader in Accelerator, Big Physics and Proton Therapy System Integration and Software
- ❑ Over 150 employees worldwide
- ❑ Working with GSI / FAIR for more than 10 years
- ❑ Experts in
 - Various control systems (EPICS, Tango, LabView, FESA, etc.)
 - Motion control
 - Timing Systems (MRF, White Rabbit)
 - Machine and Personnel Protection Systems
 - Fast MPS (FPGA based, response time in micro-seconds)
 - Interlock system (PLC based)
 - Personnel Protection Systems (Safety PLC based)
 - Proton Therapy systems
 - and more

THANK YOU!

COSYLAB

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