



EUROPEAN
SPALLATION
SOURCE



Introducing EPICS for industries

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Short introduction

Graduated a long time ago from Lund university, Sweden - Physics

Worked at CERN with control systems for experiments in mid 80's -> mid 90's

Own software development company for 8 years (20 employees) -> logistics and automation for industry

Management career in mobile telecom during 2000's - embedded software development

Managing automation, control systems and MES in food industry for a couple of years

Since 2015 - head of the integrated control systems division at the European spallation source - ESS

Currently chairperson for the EPICS council



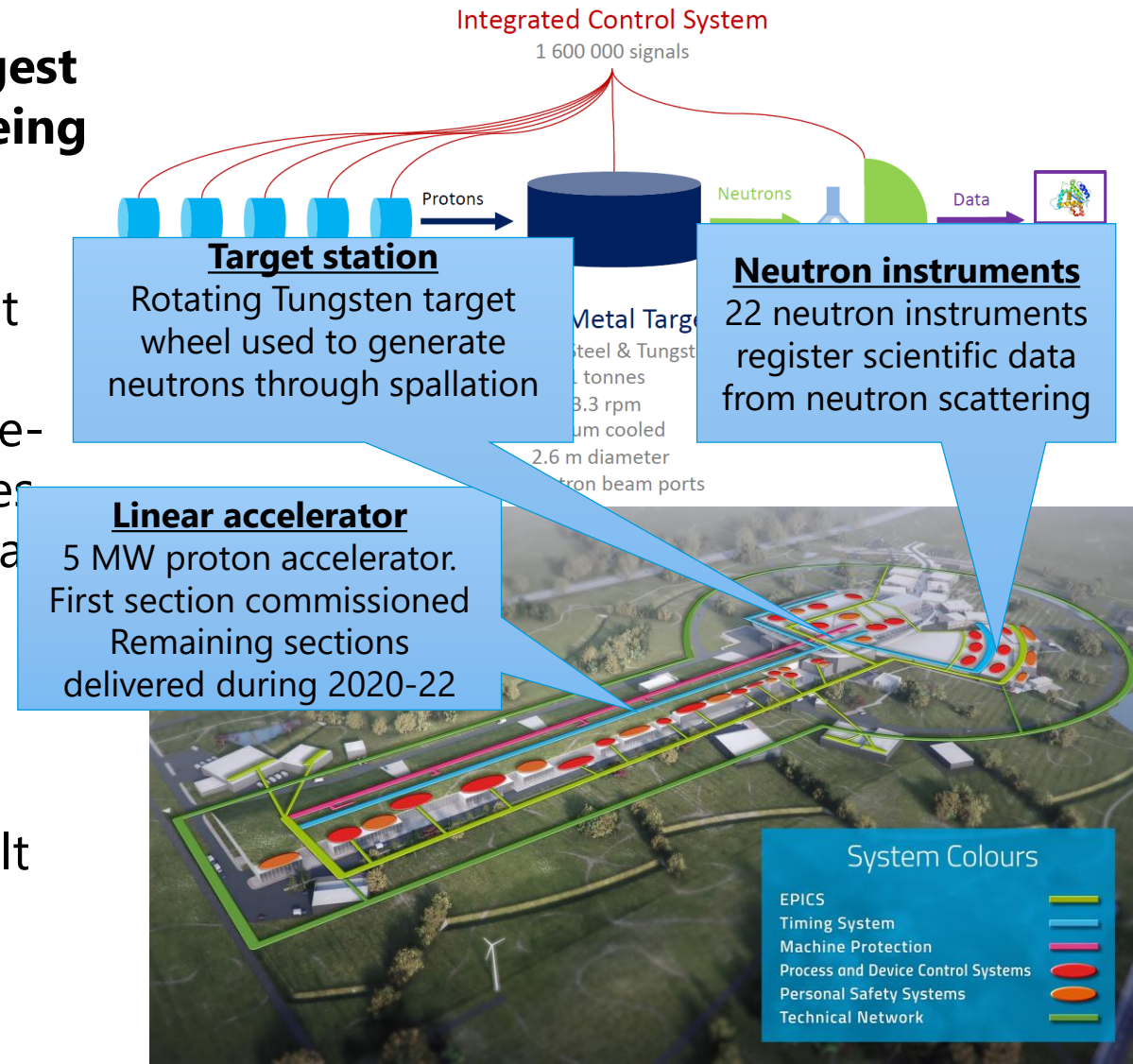
The European spallation source



The European Spallation Source is one of the largest science and technology infrastructure projects being built today

The facility design and construction include the most powerful linear proton accelerator ever built, a five-tonne, helium-cooled tungsten target wheel, 22 state-of-the-art neutron instruments, a suite of laboratories and a supercomputing data management and software development centre.

In the context of its history and future as a scientific organisation, however, it is more than the sum of its parts. It is a brand new Big Science organisation, built from the ground up.



The ESS integrated control system



The ESS facility is a large and complex machine with very much and diverse equipment that needs to work in synchronization and with well-known configurations

The Integrated Control System Division (ICS division) is responsible for the control systems within the ESS facility including controls for

- **Accelerator**
- **Target**
- **Neutron Scattering Systems**
- **Conventional Facilities**

In addition, ICS will implement

- **Machine Protection System**
- **Personnel Safety System**

To build a distributed control system of this size is a major undertaking



The ESS integrated control system



The ESS control system complexity is very high

- About 1 600 000 “process values”
- About 100 000 connected “devices”
- Ambitious approach to automation of control system configuration



Facility availability goals are very high

- ICS plays a key role for the availability of the facility
- High performance and availability requirements on equipment used



Some new approaches will be implemented at ESS/ICS

- Full scale deployment of EPICS 7
 - ESS is committed to contributing to the EPICS community
- Full scale deployment of MicroTCA.4
 - ESS is involved in a public procurement for innovation initiative
- Machine learning/Artificial intelligence assisted control system
 - Project started to explore how machine learning technologies can be applied



EPICS

mv

Experimental physics and industrial control system

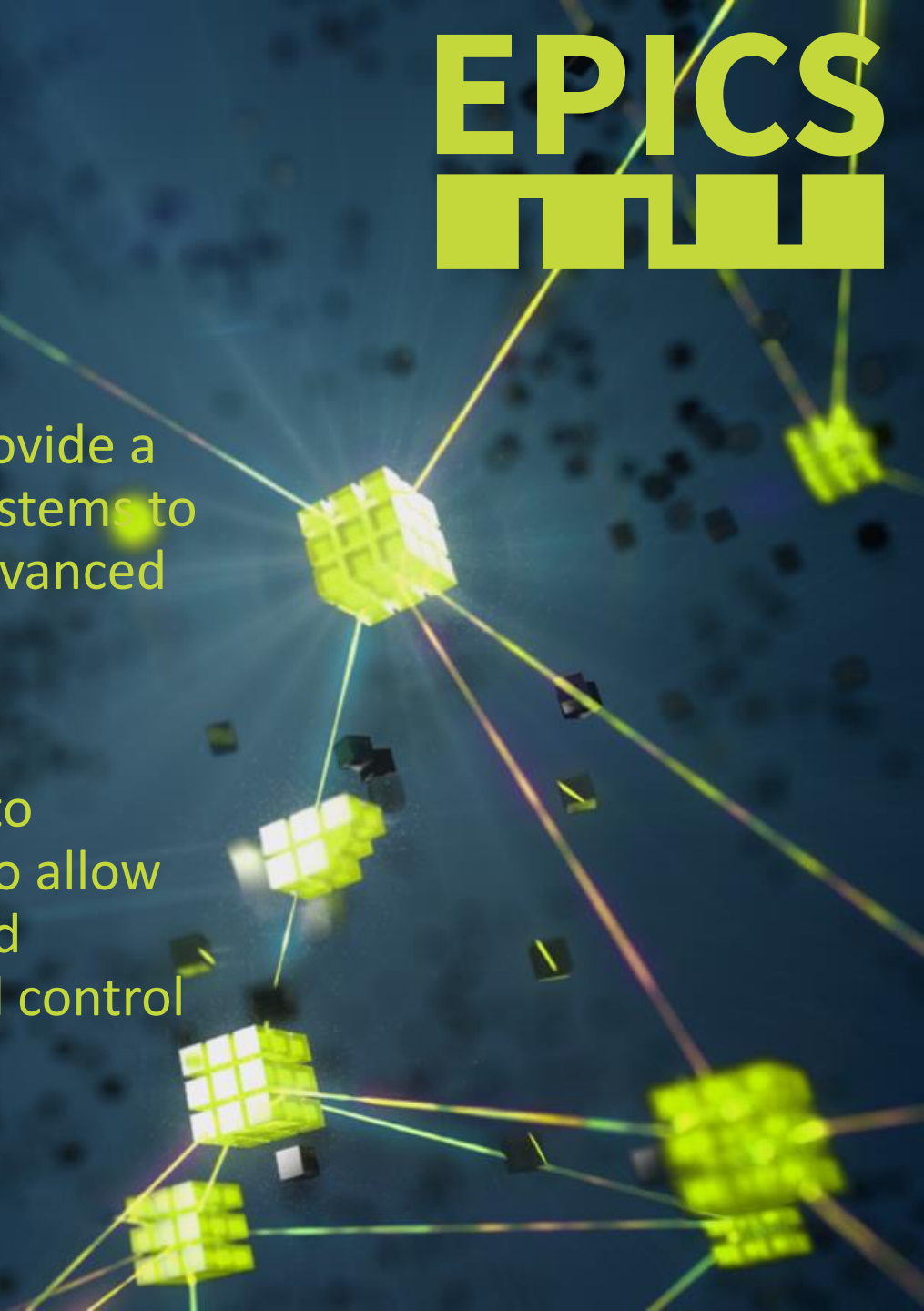


What is EPICS?



EPICS is a set of software tools and applications which provide a software infrastructure for building distributed control systems to operate complex systems such as scientific facilities or advanced industry production processes.

Such distributed control systems typically comprise tens to thousands of computing elements, networked together to allow communication between them and to provide control and feedback of the various parts of the device from a central control room, or even remotely over the internet.

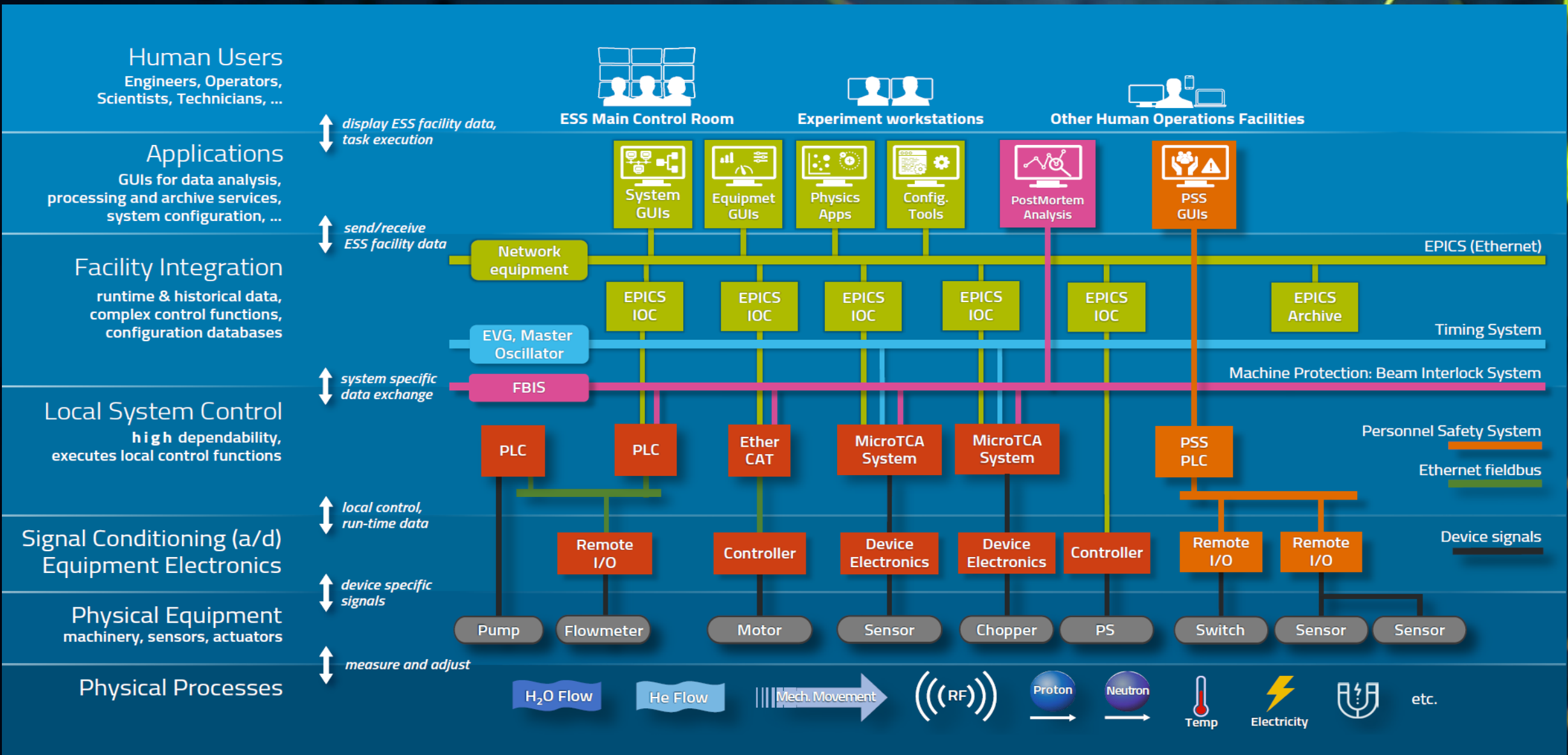


What can EPICS do for you?



- Remote control and monitoring of technical equipment (“universal” compatibility)
- Closed loop control, both slow and fast
- Automatic sequencing of operations
- Handle access security (protecting against user mistakes)
- Equipment operation constraints
- Alarm detection, reporting and logging
- Mode and facility configuration control (save/restore)
- Data acquisition and archiving including image data
- Data conversions and filtering
- Data trending, archiving, retrieval and plotting
- Data analysis - machine learning applications
- Modelling and simulation

Control system hierarchy



Distributed control system

Data centre



IOC

Control room



IOC

IOC:s - input/output controllers
An EPICS control system will contain one or more IOCs
Each IOC has a configuration telling it what to do
The configuration contains "Records" with:

- A unique name
- A behaviour defined by its record type
- Controllable properties
- Associated hardware I/O
- Links to other records



Vision systems



PLC



High speed DAQ



High-end PLC



PLC



Sensors

Benefits with EPICS



RELIABILITY and ROBUSTNESS

Hundreds of millions of run-hours in mission critical, very complex contexts
30+ years of continuous development with consistent community on the leading edge
Data centre virtualisation techniques reduce downtime vulnerabilities

EFFICIENCY

Efficient configuration through centralised/distributed approach and architecture
High engineering efficiency due to unified IOC concept with modular drivers
Ready-made modules for many, many devices/manufacturers/systems

SCALABILITY and FLEXIBILITY

Extremely scalable due to distributed architecture and virtualisation techniques
From 5000 - 20 000 000+ live process values in a unified system
Many API:s and other interfaces available - migration to web/mobile clients
Excellent data management facilities built on requirements from scientific data analyses

COMMUNITY DYNAMICS

Open source and free with a generous license
Very dynamic and supportive community with several, specialised interest groups
EPICS council coordinating major development
Many, many ongoing extension projects



The EPICS model



FREE AND OPEN SOURCE

EPICS is developed as a public open source project.
The source code is freely available according to the EPICS Open License.

DEVELOPED COLLABORATIVELY

EPICS was created through collaborative contributions from scientific facilities since a long time.
It is the preferred choice for complex, large scale distributed control system applications.
The EPICS community is very active, experienced, supportive and growing.

THE EPICS COUNCIL

Prioritize major EPICS upgrade projects, guide resource allocation decisions at investing organisations
Develop a roadmap for future EPICS Core and Extensions development to facilitate planning for all EPICS sites.
Provide support to control system managers, promoting EPICS to their organization leadership
Select semi-annual EPICS Collaboration Meeting sites and dates
Ensure that EPICS continues to be an open collaboration and that contributions are open-source

Thank you

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