EUROPEAN SPALLATION SOURCE

ICS Handbook

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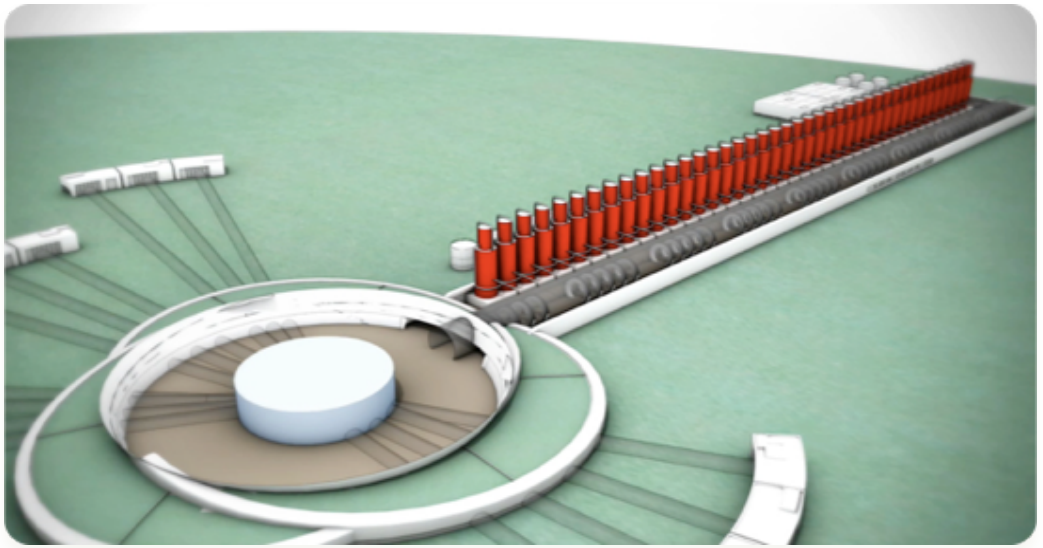
What is ICS about?

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

- For this purpose almost all equipment at the ESS facility is connected to the **Integrated Control System**

- The control system is the ”central nervous system of ESS”
- Examples:
  - Voltage supplies for magnets
  - Vacuum systems
  - Cryogenic equipment
  - RF equipment
  - Air conditioning in the tunnel

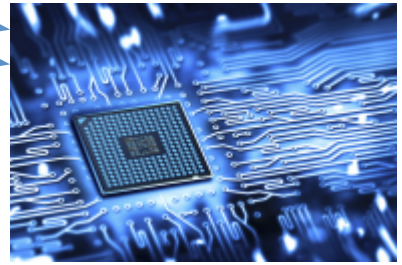
- An estimated **1.5 million** control points will be needed



ICS Work breakdown structure

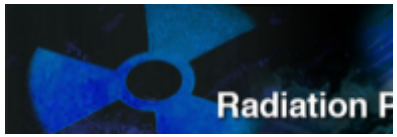
Work package 01	Management and administration
Work package 02	Software Applications
Work package 03	Software core
Work package 04	Hardware core
Work package 05	Machine protection system
Work package 06	Equipment
Work package 07	Control system infrastructure
Work package 08	Physics
Work package 09	Personnel safety system
Work package 10	Integration - Accelerator
Work package 11	Integration - Target
Work package 12	Integration - Instruments
Work package 13	Integration - Conventional facilities
Work package 14	Test Stands
Work package 20	Installation

Software

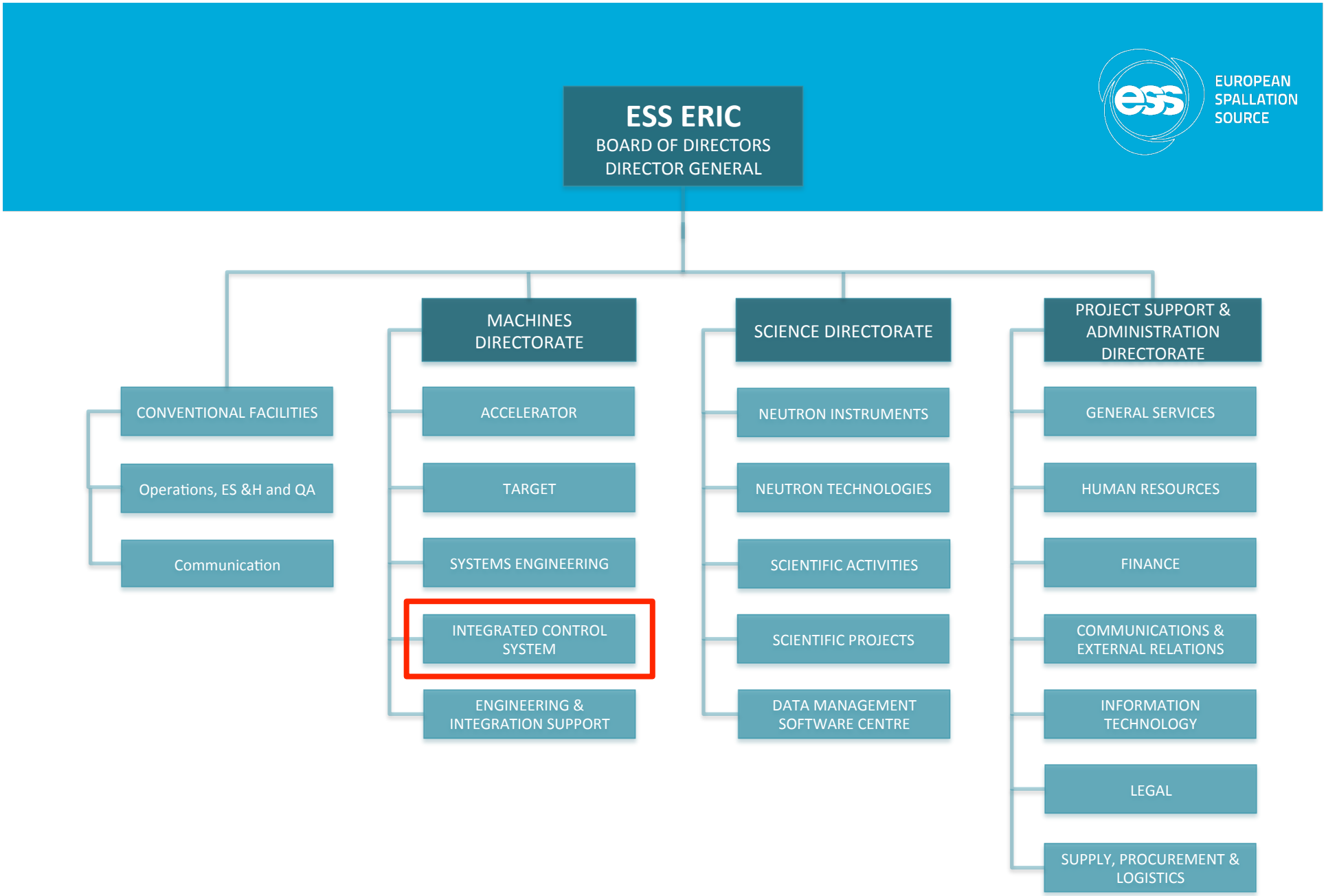


Electronics

Infrastructure

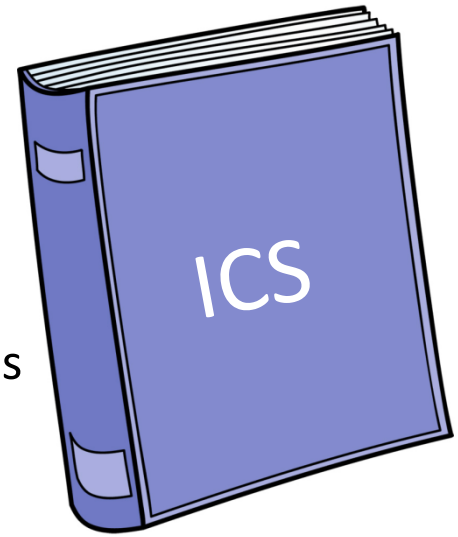


Safety & protection


ESS ERIC
BOARD OF DIRECTORS
DIRECTOR GENERAL
EUROPEAN SPALLATION SOURCE
CONVENTIONAL FACILITIES
Operations, ES &H and QA
Communication
MACHINES DIRECTORATE
ACCELERATOR
TARGET
SYSTEMS ENGINEERING
INTEGRATED CONTROL SYSTEM
ENGINEERING & INTEGRATION SUPPORT
SCIENCE DIRECTORATE
NEUTRON INSTRUMENTS
NEUTRON TECHNOLOGIES
SCIENTIFIC ACTIVITIES
SCIENTIFIC PROJECTS
DATA MANAGEMENT SOFTWARE CENTRE
PROJECT SUPPORT & ADMINISTRATION DIRECTORATE
GENERAL SERVICES
HUMAN RESOURCES
FINANCE
COMMUNICATIONS & EXTERNAL RELATIONS
INFORMATION TECHNOLOGY
LEGAL
SUPPLY, PROCUREMENT & LOGISTICS

The ICS Handbook is

- A guide for ICS developers and users
- Contains technical standards and process descriptions
- Is not a monolithic “Bible” but refers to other documents for details
- Shall be relatively stable
  - Thus details are kept separate
- Aims to be complete
  - Contains pointers to all ICS services, policies and processes
- Is “Work In Progress”
  - Not yet in CHESS, but should be there soon



Contents #1

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- Overview of central requirements
- System architecture description
- Naming convention
- Software standards
- Computing infrastructure
- User Interface tools

Contents #2

- Hardware standards
- Timing system description
- System interfaces
  - Functional
  - Hardware
- Machine protection standards
  - Architecture
  - Interfaces
- Personnel Safety System
  - Architecture, SW, HW

Contents example 1

4.2.1. Connections between systems

In the control system, there are a number of networks or similar systems that connect system components together. **All** ICS systems that use EPICS are connected to the Ethernet network. **Most** systems receive timing signals from the central timing system and are thus connected to the Timing Distribution Network. **Many** systems, mostly in the accelerator, are connected to the beam interlock system.

Connections from the controllers to the physical I/O are can be directly from the (EPICS) I/O Controller (IOC) via either I/O cards (as in MTCA.4 AMCs) or via a fieldbus (e.g., EtherCAT, Serial RS-232 port or regular Ethernet). In many cases, I/O is connected to a PLC using the PLC vendor's modules and the PLC and EPICS IOC communicate via a dedicated Ethernet link.

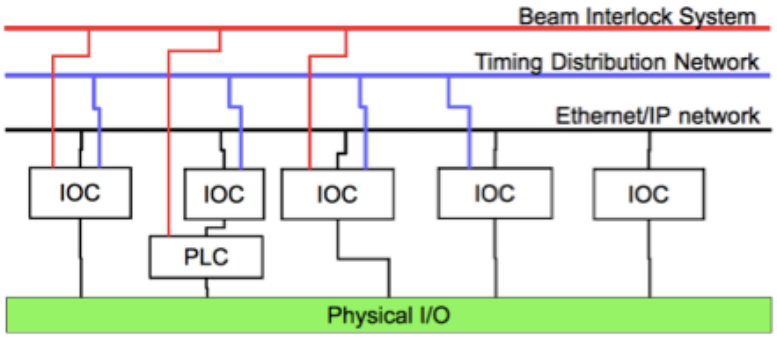

Figure 1 Connections between I/O Controllers

4.2.2. EPICS

All components in the control system that serve or access EPICS channels shall be connected to the network and use the pvAccess protocol to communicate. This setup is schematically shown in Figure 2. Please note that this picture is accelerator-centric. It does not describe all services and components that ICS will support but provides just a schematic overview of the architecture.

General overview(s) of the system architecture

- How are systems interconnected
- Different networks: timing, Ethernet, beam interlock (MPS)

Rules concerning use of EPICS

- What should be available in EPICS
- How do the systems communicate

Contents: example 2

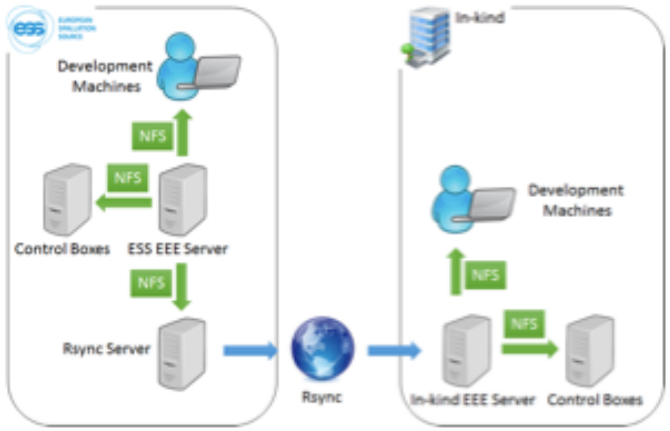

Figure 8 Schematic view of the development system and workflow.

4.4.3. EPICS development

At ESS, EPICS base, EPICS modules and parts of IOC startup are managed with a custom framework called the ESS EPICS Environment (EEE) [wiki at https://ess-ics.atlassian.net/wiki/display/HAR/EPICS+Environment+Overview]. The central functions of EEE are the following:

- Building and installing EPICS modules for multiple EPICS versions, architectures and operating systems.
- Managing all installed versions of EPICS and EPICS modules within a single environment.
- Choosing the versions of EPICS base and EPICS modules to build other modules against.
- Choosing the versions of EPICS base and EPICS modules that a particular IOC uses as part of IOC configuration.
- Resolving dependencies between EPICS modules at build time and IOC startup time.

The EEE framework has been designed to minimize the overhead of managing the above and provide a fast development cycle. EEE consists of the following components:

- EPICS development workflow
  - How to develop controls based on EPICS
  - Workflow and tools
  - System configuration
  - Development at ESS Lund and at in-kind collaborators
  - Delivery/integration to ESS
    - Code repositories, quality control, etc.

Status

- Preliminary document exists
  - Not yet ready for distribution
- A lot of “mapped content” exists already
  - Needs to be organized
  - Moved from Confluence to CHESS, when appropriate
- Work will be distributed in ICS
  - To fill in the details
  - To review and approve contents
- Shall be **complete** in (roughly) 6 months from now
  - All essential items captured