DUNE SAND
Slow Control overview and requirements

C. Mariani

On behalf of the DUNE SAND Slow Monitor WG

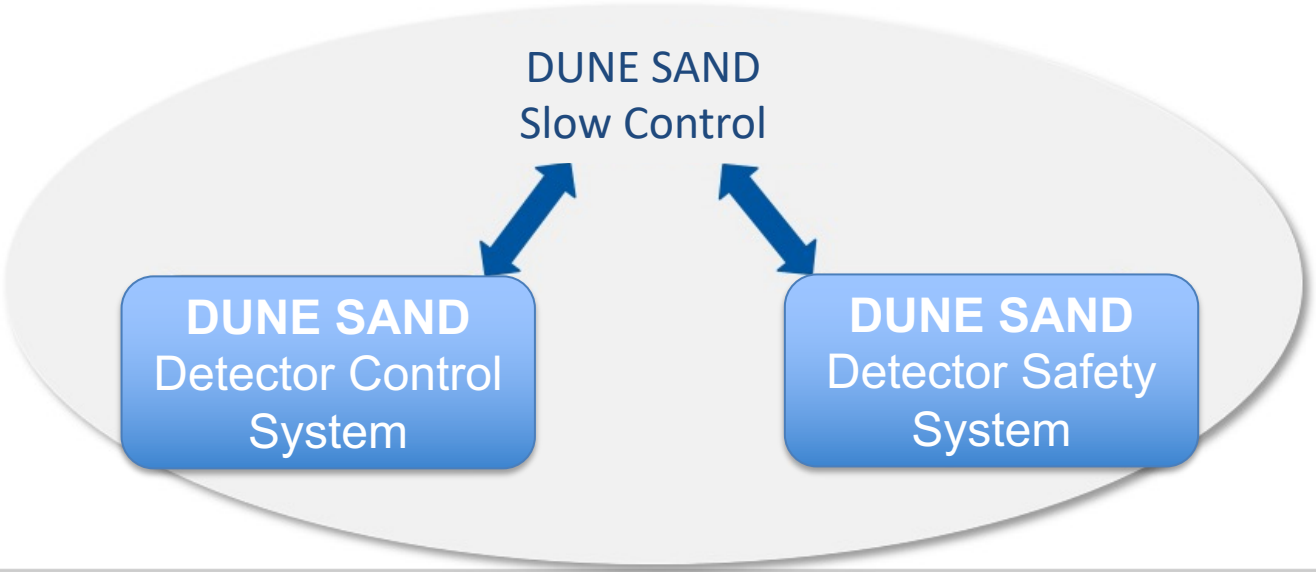
Last update April 2022

Contents

- Introduction
- Example of protoDUNE Single Phase Slow Control Layout
- DUNE SAND Detector Control System DDCS
- DUNE SAND Detector Safety System DDSS
- Requirements
- Discussion points

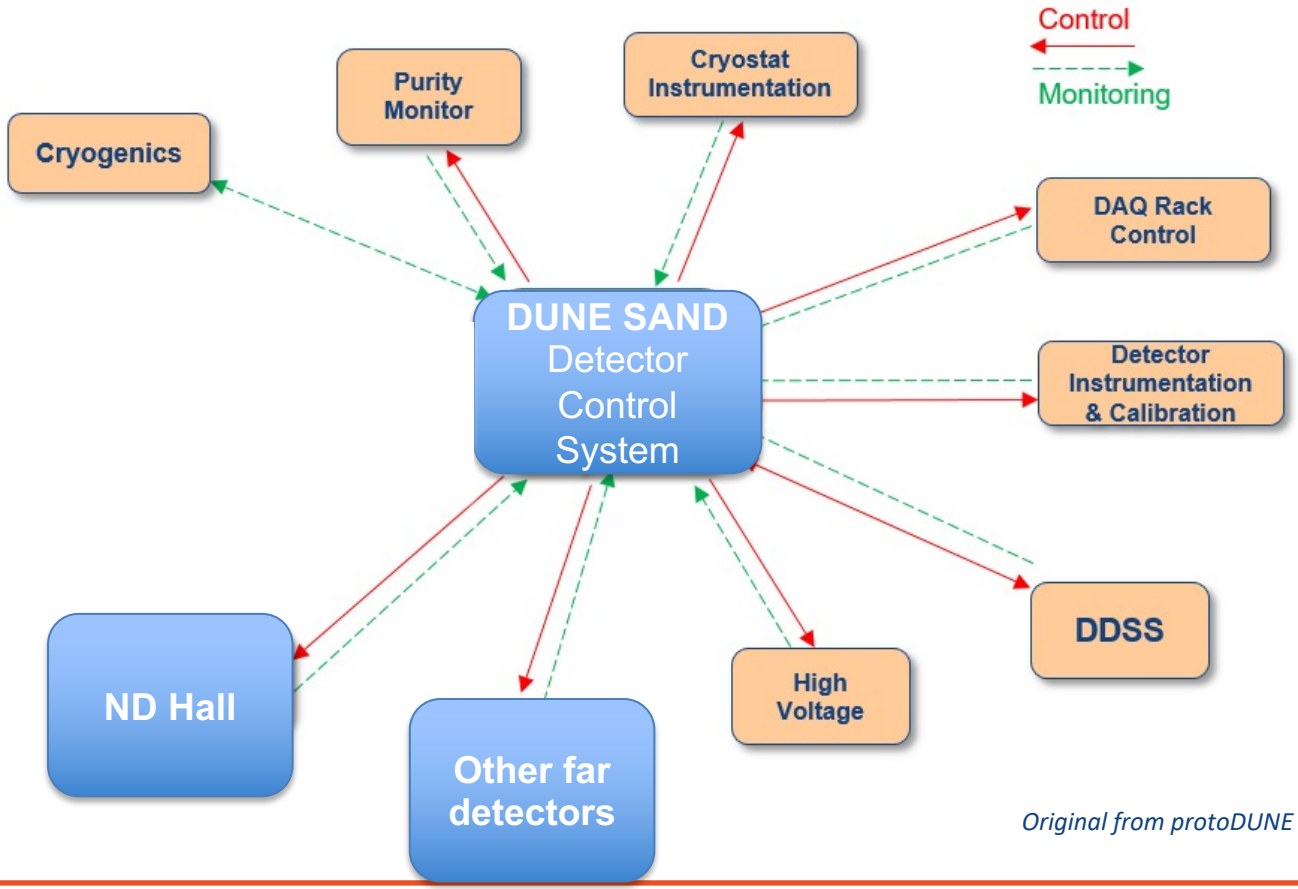
Introduction

- The DUNE SAND slow control system is composed by two subsystems:
  - Detector Control System DDCS
  - Detector Safety System DDSS
- Communicating, exchanging data, controlled, operated by the DUNE Slow Controls



Detector Control System

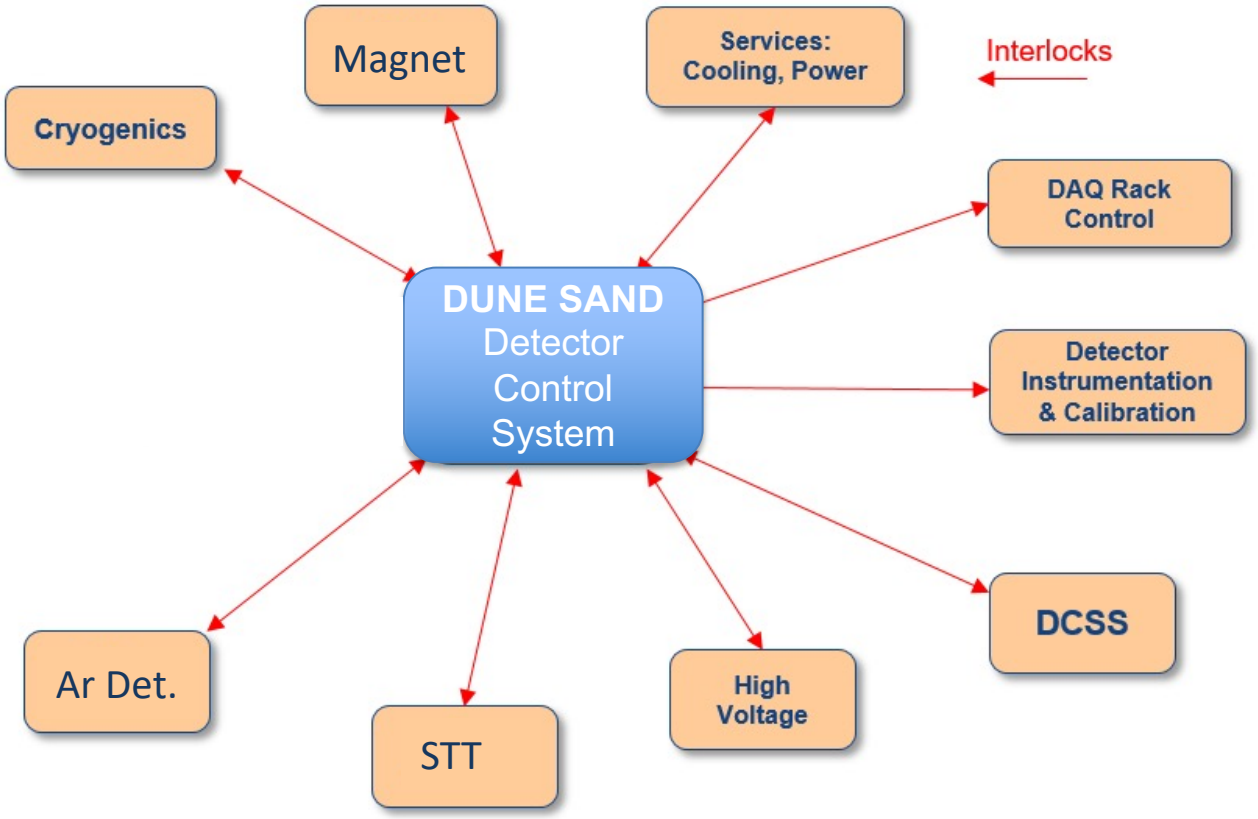
- The Detector Control System DDCS involves all the subsystems and elements (hardware and software) that integrate the detector allowing its correct operation and supervision.



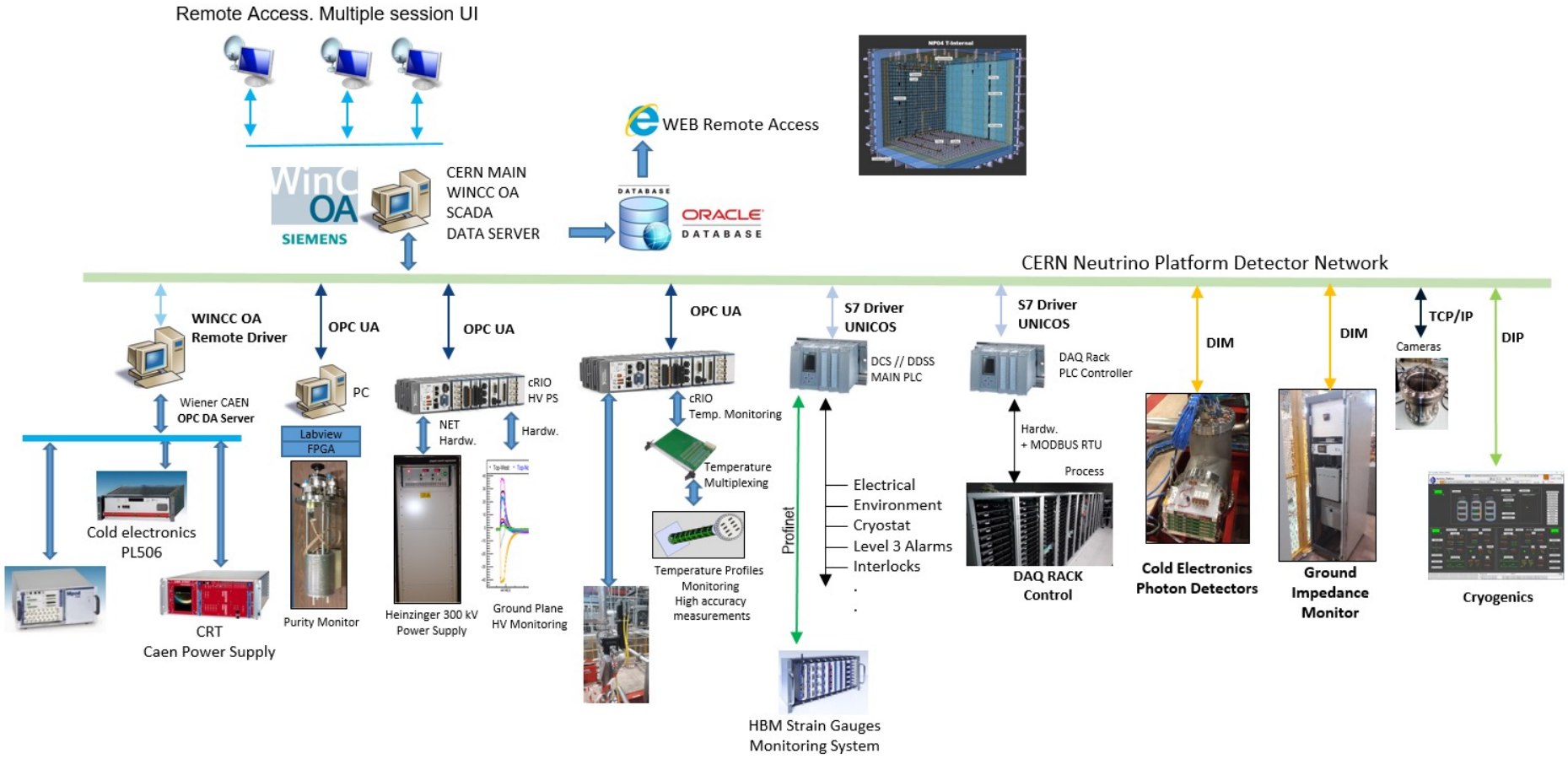
Original from protoDUNE SinglePhase CW 01/2019

Introduction. DDSS

- The Detector Safety System DDSS assures the safety of the detectors , including all subsystems and elements (hardware and software) that integrate the detector, allowing the operation in safe conditions

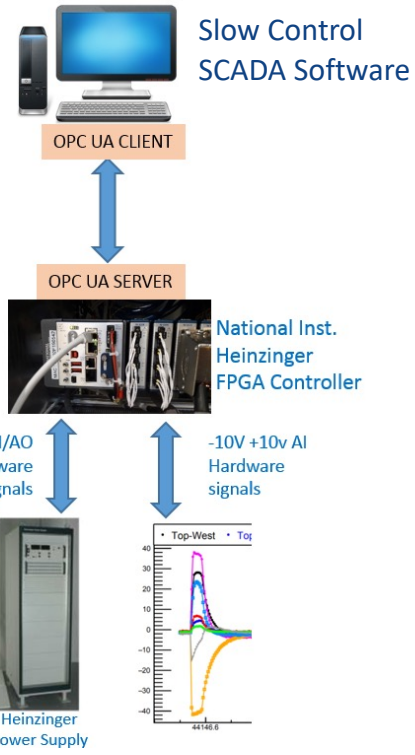


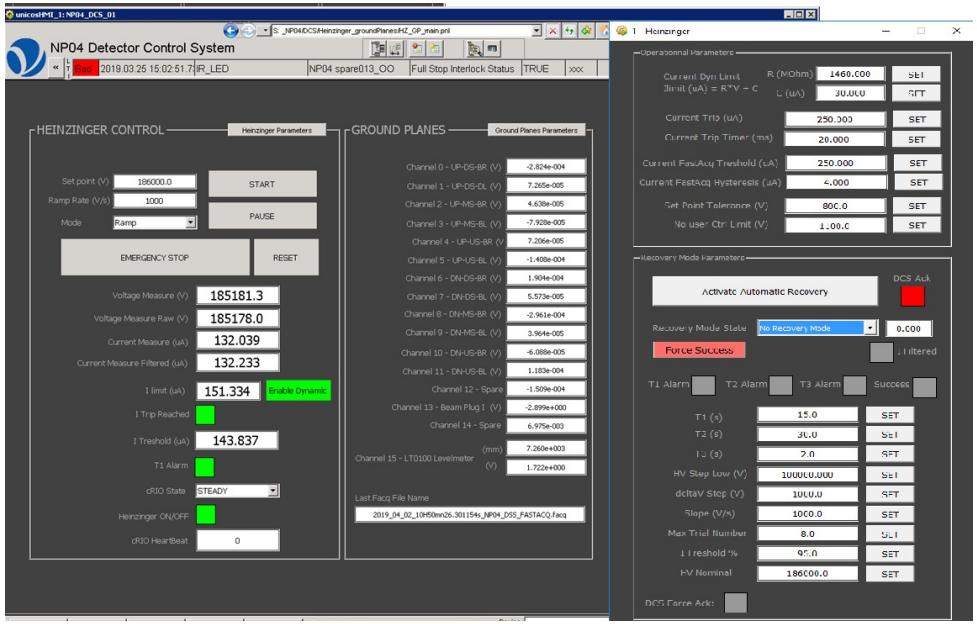
protoDUNE Single Phase Slow Control Layout



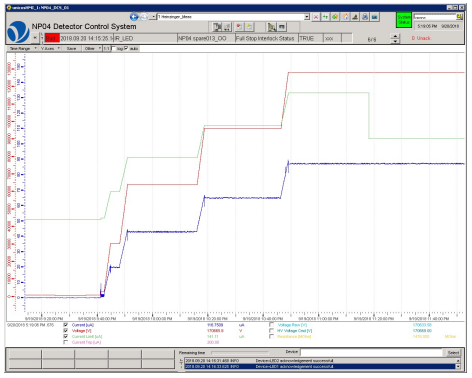
protoDUNE Single Phase Slow Control. HV integration Example

The data is transmitted to Real-Time controller, connected and integrated to the SCADA DCS program by means of the OPC UA driver for HV control, operation and monitor.

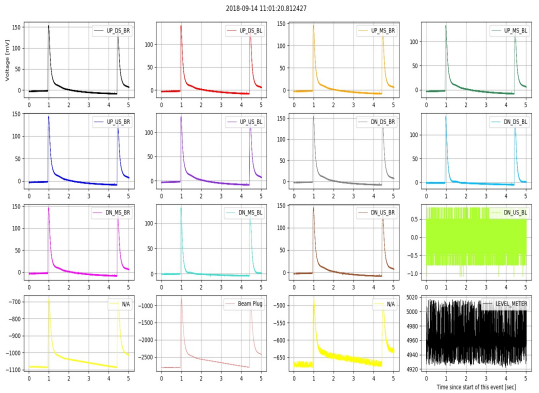




Heinzinger HV Control Panel

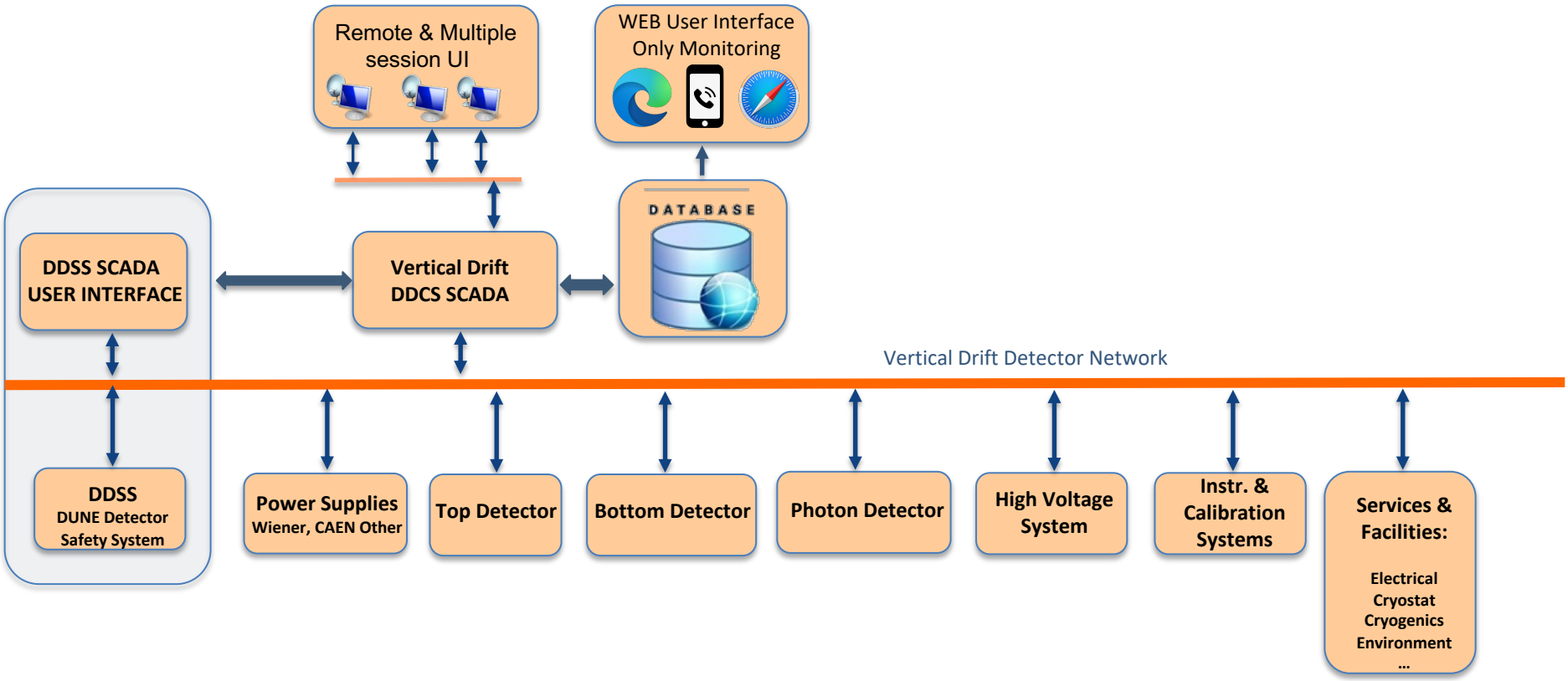


Ramp up by steps on 20/09/2021 at 9:40 PM

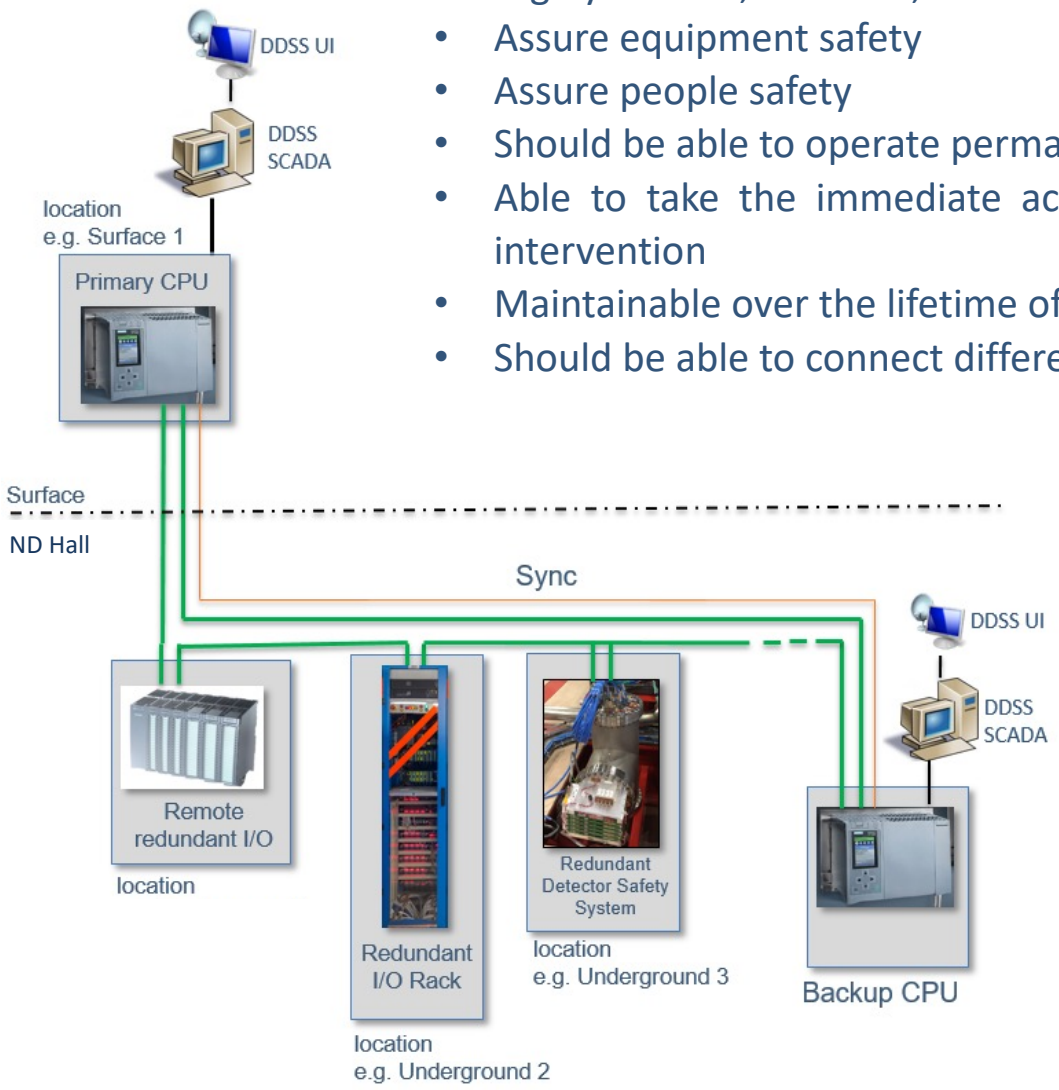


Ground Planes & Beam Plug discharge event on 14/09/2018

Vertical Drift DUNE Detector Control System Layout. DDCS



DUNE Detector Safety System Layout. DDSS



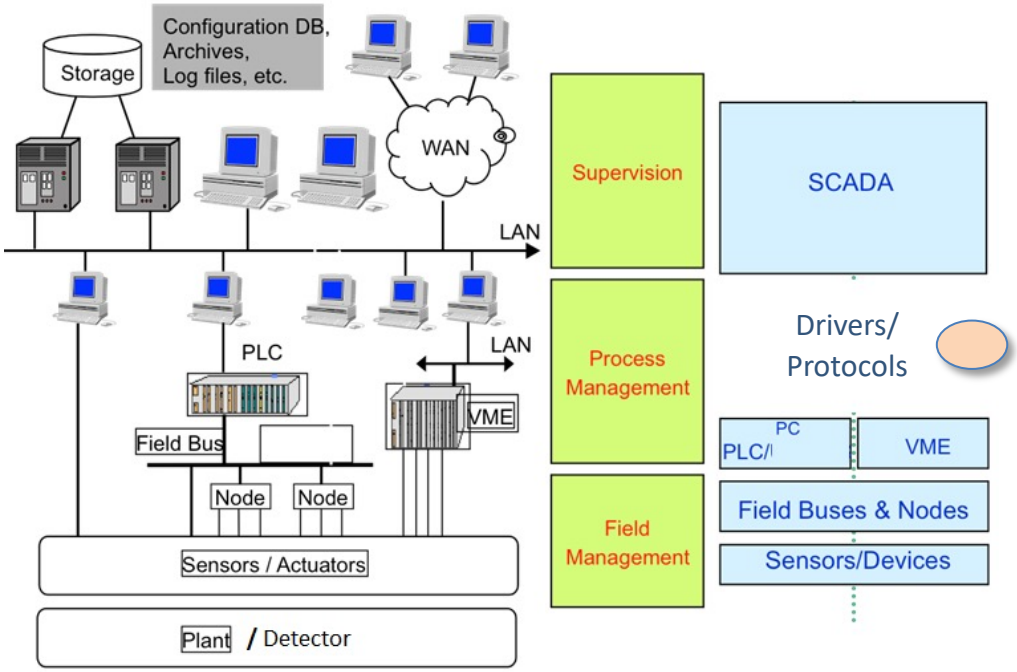
- Highly reliable, available, scalable, as well simple and robust
- Assure equipment safety
- Assure people safety
- Should be able to operate permanently and independently of the DDCS state
- Able to take the immediate action to protect the equipment, no human intervention
- Maintainable over the lifetime of the experiments (25 years)
- Should be able to connect different FDs, other ND, LBNF …

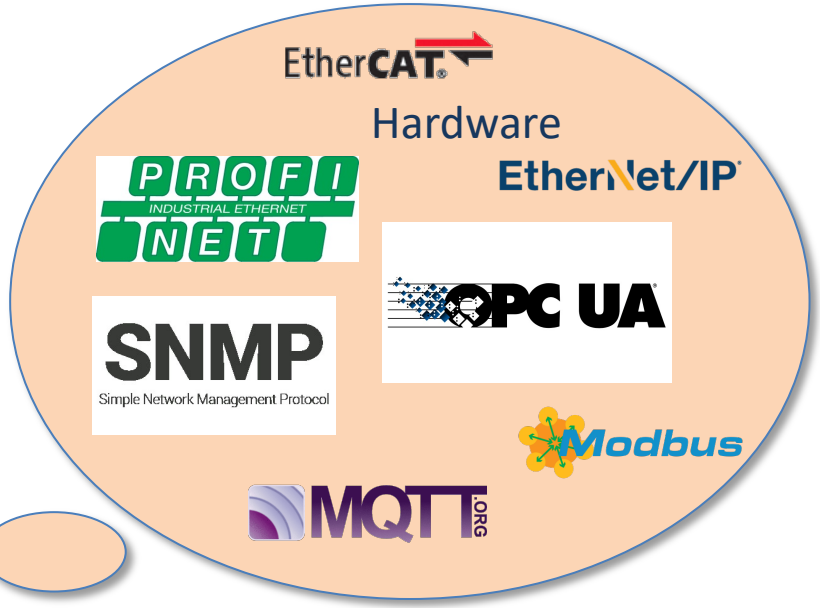
The core of the DDSS –

- redundant PLC, e.g. SIEMENS S7-400H, various locations and various detectors
- Multiple S7-400H CPUS synchronized with optical fiber, run the same code, comparing their states, in case of problem in one CPU, the redundant takes over
- Need to have some on the surface and some in the ND Hall (redundancy and high-availability)

Connectivity – limit user interfaces

- The essential point of the Slow Controls is the connectivity
- Could have a range of drivers or protocols but increase complexity to integrate and maintain them
- OPC UA should be the preferred one





Supervisory or Scada Software Requirements

- Homogeneity. Ideally the SC provides a homogeneous environment into which all its parts can be integrated
- Scalability
    - To connect to different subsystem and devices
    - Capacity to handle huge amounts of data.
- Openness.
    - Possibility of parallel developers
    - Comprehensive range of drivers and Connectivity
    - Priority to the OPC UA
- Data Archiving & Data retrieving
- User Interface. Data reporting, trending…
    - Multi-user system. User interface
    - Access Control. User rights
    - Web User Interface, Mobile User Interface (only monitoring)
- Redundancy (Passive or Active), suitable.

OPC (Open Platform Communications)

OPC Data Access

- OPC Data Access is a group of client-server **standards** that provides specifications for communicating **real-time** data.
- Is based on **Microsoft Windows** technology using the COM/DCOM (Distributed Component Object Model) for the exchange of data between software components.

OPC Unified Architecture

- OPC UA was designed to enhance and surpass the capabilities of the OPC Classic specifications
  - **Functional Equivalence**
  - **Platform Independence**
  - **Security**
  - **Extensible**

See more on: https://opcfoundation.org/

- Data storage