

Slow Control Architecture Strategy

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FS Integration/Installation Planning

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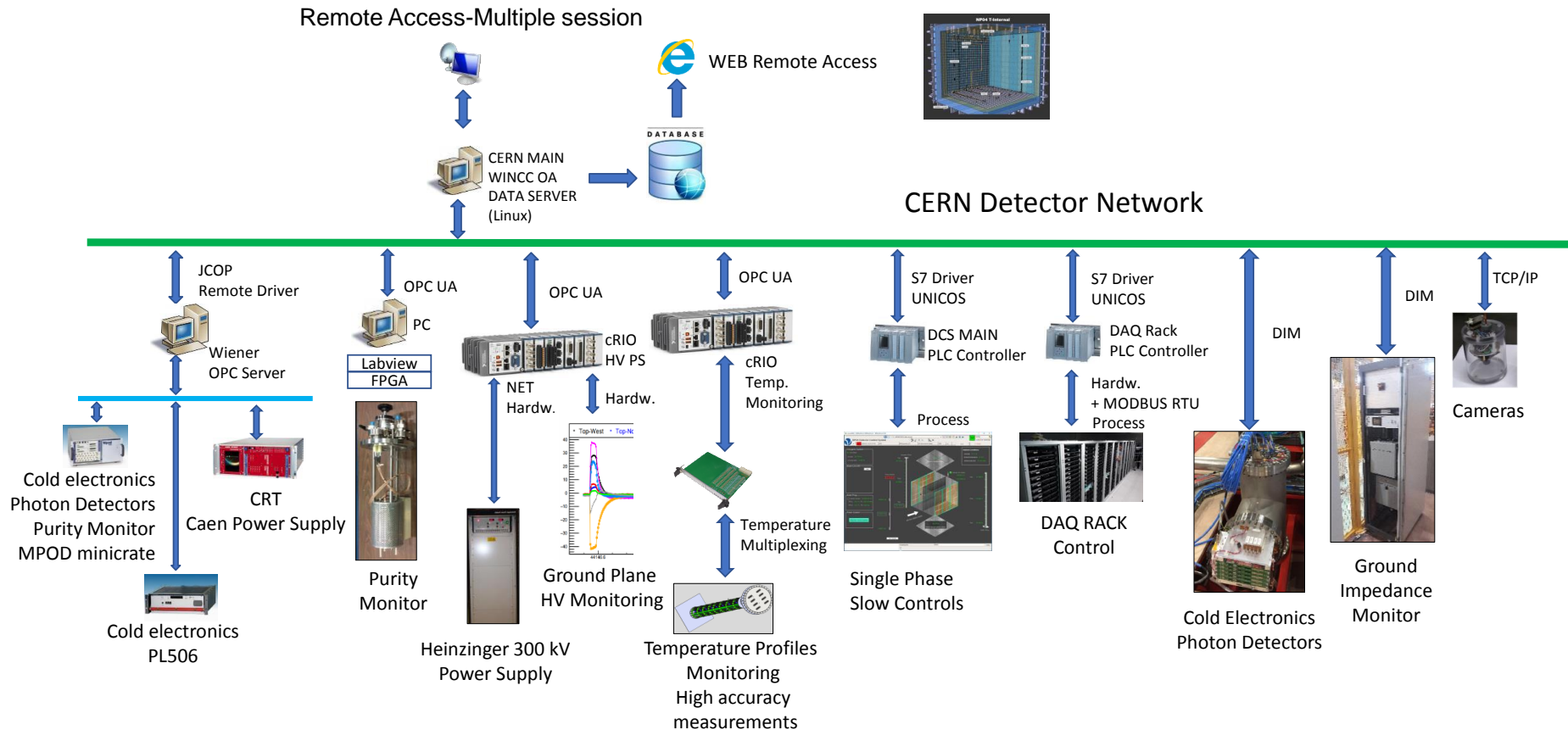


EP-DT
Detector Technologies



Slow control architecture

- Usual industrial control layering



Slow control architecture

- If possible and sufficiently safe, base all user interfaces on web technologies
 - Client authentication & authorization
 - Role based access control
 - Web server behind firewall with reverse proxy?
- Distributed system
 - Independently develop projects for different sub-components
 - Support distributed developers community
 - Be able to combine sub-projects into one overall control system
 - The final user doesn't need to see how the system was built, but rather have a central view on the experiment

SC working group in DUNE

- The SC is organized as one of the working groups within the DAQ/SC consortium
- At present there are no resources to develop a SCADA system
 - Choose a commercial tool with clear licensing/support model
 - **Epics** remains an option, if dedicated resources are committed
- Two solutions are being considered
 - **WinCC OA** -> used in ProtoDUNE, large software/tools base and expertise available at CERN (and in the HEP community through all LHC experiments); linked to other large science projects with similar timescales
 - **Ignition** -> used at SURF for LZ experiment, being considered by cryogenics group for DUNE

Towards a SW choice

- NP04 cold-box control system being re-implemented using Ignition as a first training
 - Connection to power supplies (OPC UA) worked seamlessly
 - Attempting to connection to PLC exposed a bug in the communication (!)
 - Still, good response from support team experienced and work-around provided
- If successful, aim at implementing NP04 control system on Ignition and start getting a more realistic feeling for scalability, data archival, multi-client access,
 - Test web based WinCC OA interface, to compare systems at the same level
- Continue discussions with companies to understand licensing model
- Continue collaboration with DUNE cryogenics control experts in order to share studies and preferences
- Make the final decision at the latest after ProtoDUNE II
 - This is quite late, but feasible, if in the meantime we have a clear inventory of devices to support, control logics to implement and ways of representing the whole of DUNE effectively.

DUNE SC dimensions per module

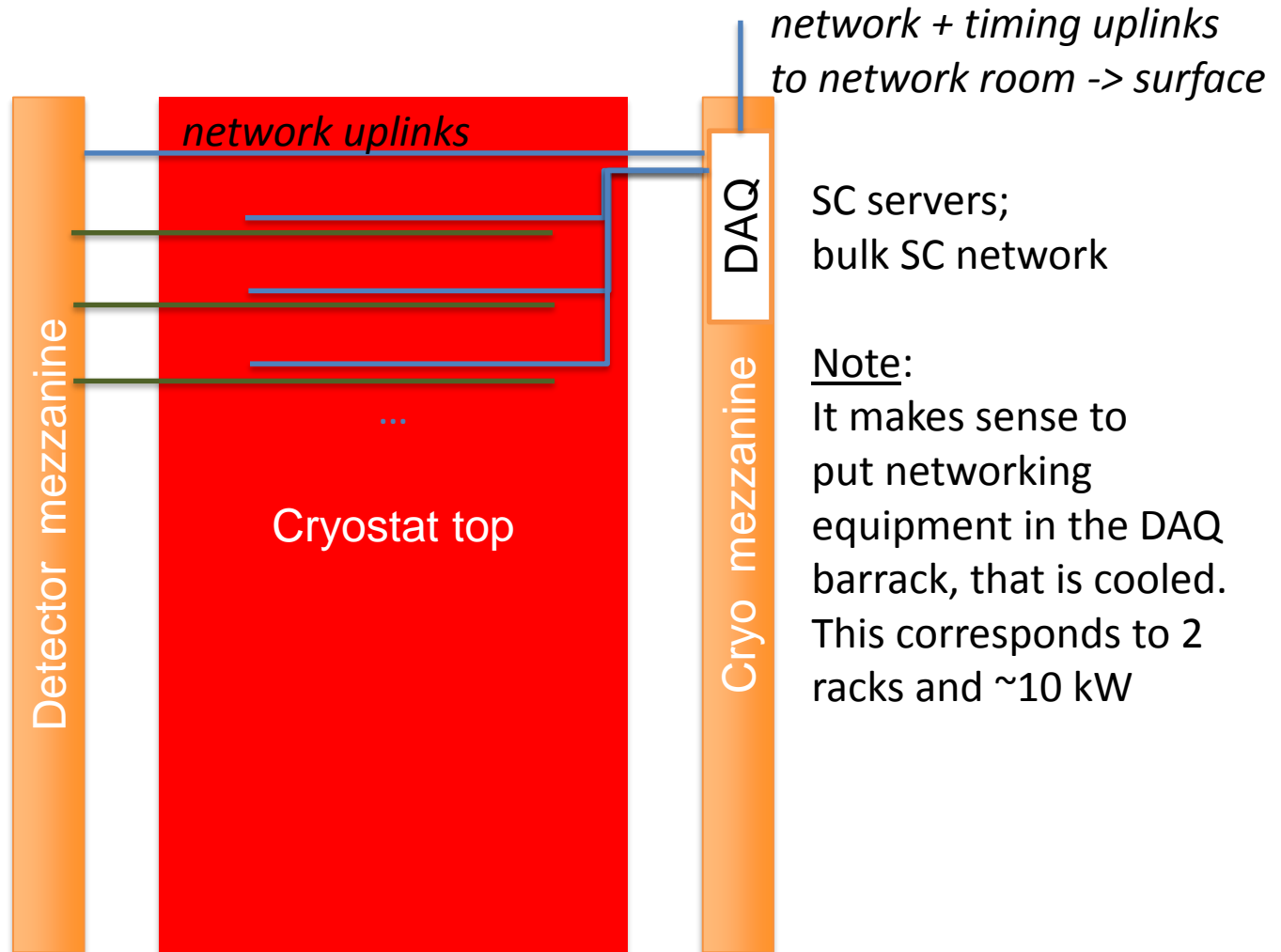
- Preliminary estimate: ~1500 network endpoints
 - ~60x 1G/10G 48-ports switches/routers
 - Part of those network links is shared with DAQ control (CE/PD)
- 1 redundant 100G uplink to surface
- < 10 servers for data collection, processing, archiving
- Number of PLCs and/or FPGAs for interlocks and control logics to be defined, but should be $O(10)$
 - Interfaces to cryogenics instrumentation and calibration to be better clarified
 - Interconnections with cryogenics and general safety to be understood
- Data points to readout/monitor/archive $O(300k)$

A word on costing

- There are almost no material costs specified for SC in the WBS
 - Network (devices + connectivity) is a non negligible cost -> facility?
 - Underground servers were costed and are covered by DAQ
 - Database hardware/administration not costed and probably not negligible
 - Logic control not costed -> still need more detail to understand how much would be needed
 - No license costs included (+support in M&O?)
 - My personal estimate per module ~200k + 20% annual support
 - **To date, no commitment from any institution for funding the SC**

SC underground distribution

Power supplies,
cryogenics
instrumentation,
calibration devices,
control logic and
interlocks;
few concentrator
switches



SC servers;
bulk SC network

Note:

It makes sense to
put networking
equipment in the DAQ
barrack, that is cooled.
This corresponds to 2
racks and ~10 kW

Installation plan

- SC main servers on surface installed first (like surface DAQ)
 - Allows to setup archive and general SCADA sw
- Local stations + network devices installed in DAQ barrack with DAQ
 - Fibers routing paths to be defined
- Installation timeline has to be mapped to the needs of first power supplies and electronics installation
 - Are all power supplies installed in one go?
This is preferable for the SC, even if they are not all connected to their endpoints
 - A lot of development will actually occur during installation and commissioning
 - May be avoidable, in theory, but is unlikely to happen

Summary

- The slow control concept for DUNE is still in an embryonic phase
 - We start understanding where SC equipment can be located
- We know how to structure a large supervisory system
 - 2 commercial tools are candidate solutions and are being evaluated
 - Know-how for user interfaces development is mandatory
- Interfaces definition (and endpoint counts) with the consortia are progressing, but not complete
 - Biggest uncertainty related to CALCI
- Interfaces with facility to be refined
- While SC is surely not a cost driver for the experiment, it still requires funding, which at the moment is neither well defined nor covered
 - Work on WBS aiming to have a first pass by end of February