# Computing Infrastructure and its monitoring at the CERN Neutrino Platform prototype experiments

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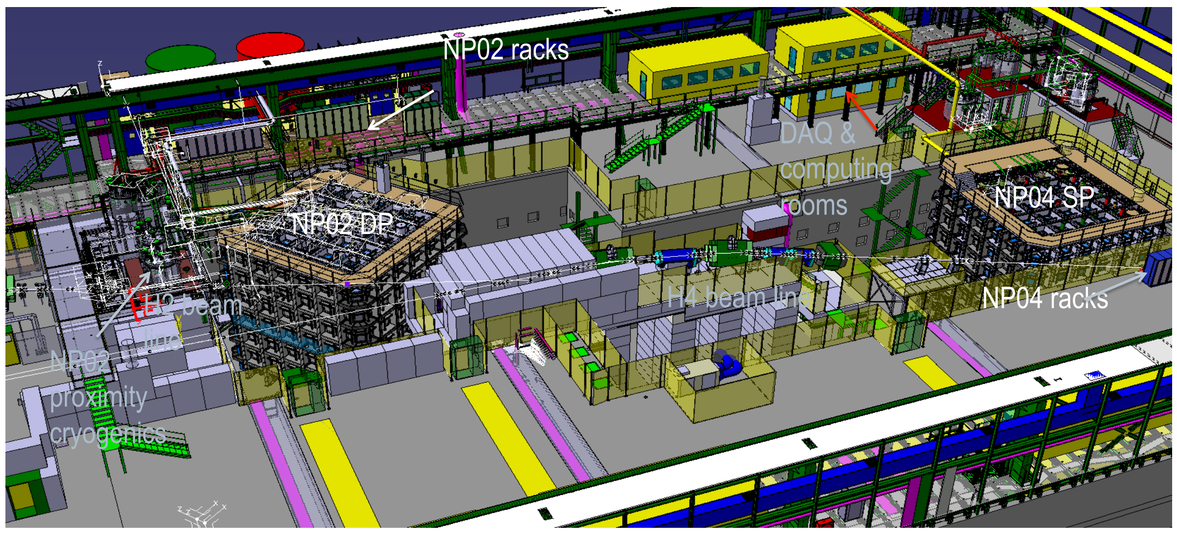
## Introduction

Future Long and Short baseline neutrino programs are considered strategic by EU Particle Physics Community. In this context, the CERN "Neutrino platform", part of present CERN Medium-Term-pan (MTP), has been created to:

- assist the various groups in their R&D phase (detectors and components) in the short and medium term and give coherence to a fragmented European Neutrino Community.
- provide to the ν community a test beam infrastructure (charged particles)
- offer support for future international neutrino experiments
- foster an active involvement of Europe and CERN in the new US and Japanese projects.

As a part of the Neutrino platform facilities, CERN has constructed a large test area (EHN1 extension of SPS North Area, ~53000$ m$^3$) with charged beams capabilities devoted to neutrino prototype detectors.

**Prototypes of the DUNE far detectors:** Two almost identical cryostats, of 700 ton LAr TPCs, but different technologies: double phase (NP02) and single phase (NP04).

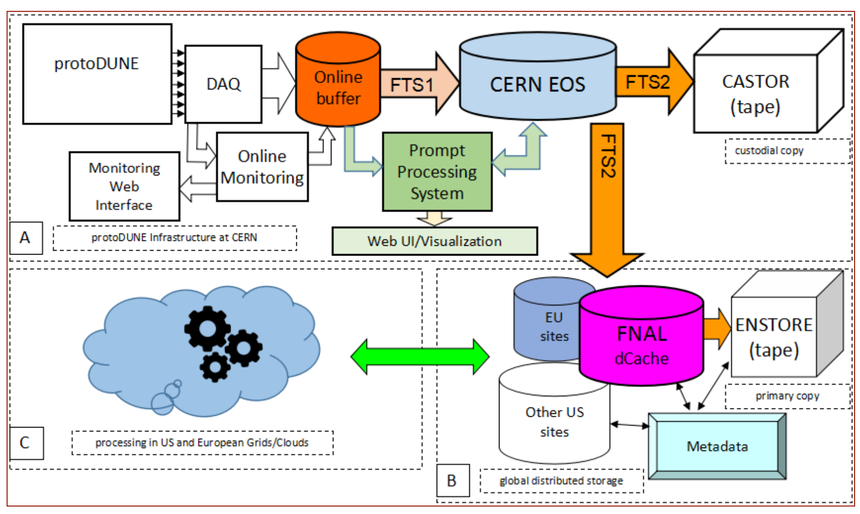



## Computer model

- The prototype detectors will require significant computing resources to acquire, record, process and analyze their data.
- Both will collect physics data in beam during the second half of 2018.
- The beam run is expected to last a few months an dwill terminate with the beginning of CERN's Long Shutdown 2 (LS2).
  - Before and/or after the beam run it is foreseen to have cosmic ray runs.

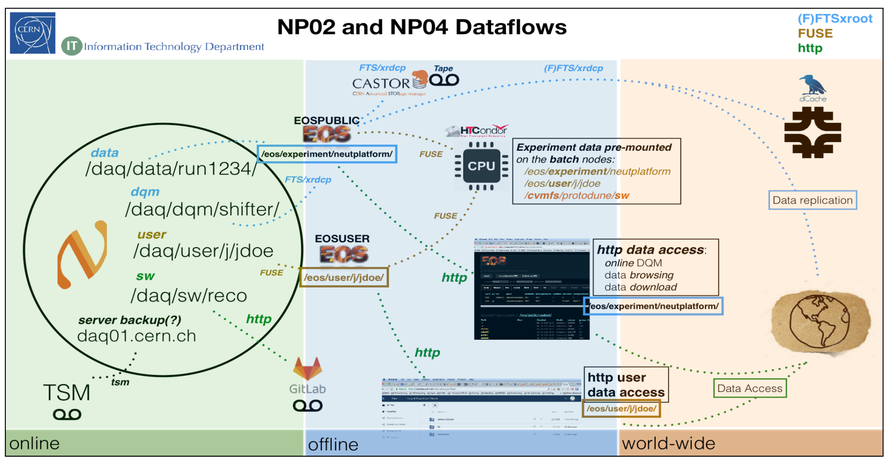
| Resource estimates | NP02 | NP04 |
|---|---|---|
| Beam event triggers | 100M | 50M |
| event size (uncompressed) | 159 MB | 230 MB |
| compression factor | 10 | 4 |
| raw data volume | 3 PB | 2.5 PB |

Resource estimates for both the NP02 and NP04 computing are based on this run plan and it is assumed that both prototypes will take data simultaneously both before and during the beam running.



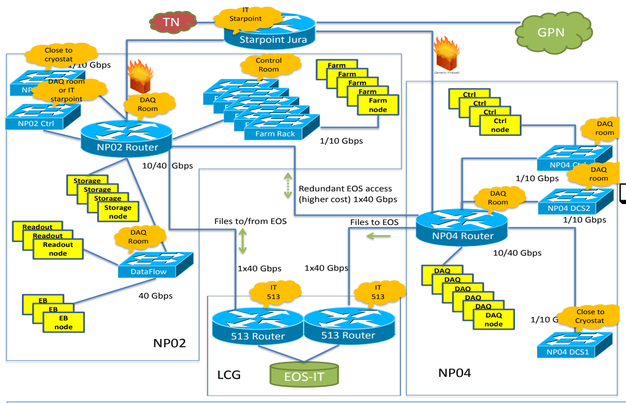

Conceptual diagram of the raw data flow both detector prototypes shows the general logic of data flow and also reflects the central role of EOS in the raw data management scheme.

No substantial difference in the data flow pattern between NP02 and NP04.




EOS serves as the staging area (for data quality monitoring and online/offline processing) from which the data gets committed to CASTOR (tape) and from which it is transmitted to a number of endpoints including principal data centers such as CERN Tier0, FNAL, IN2P3 and others.

## Network and Computing Infrastructure

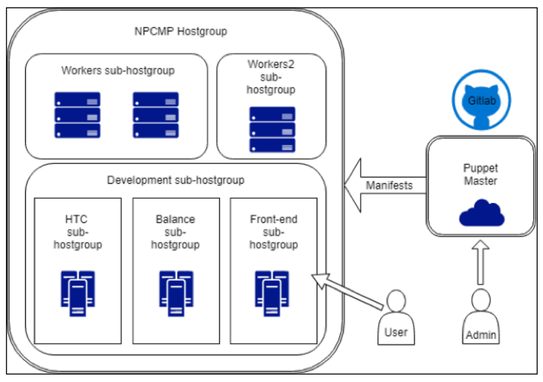



- Draft network for the NP02 and NP04 DAQ and EHN1 computing cluster system. The NP02/NP04 routers connect all the main elements.
- Three 1 Gb/s routers are used for control and DCS networks (with a 10 Gb/s trunk to the main NP02/NP04 router).
- The DAQ and other computing nodes are connected via 10 Gb/s links.

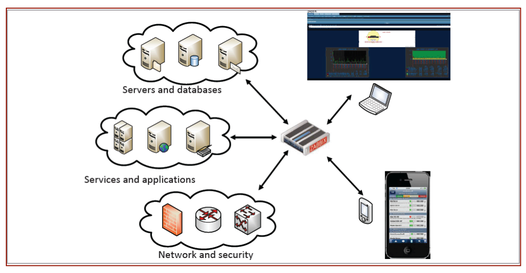
- The CERN General Purpose and Technical Networks are connected through firewalls via the Jura Starpoint.
- CERN IT and EOS are connected via a 40 Gb/s line.

## Why – How - What

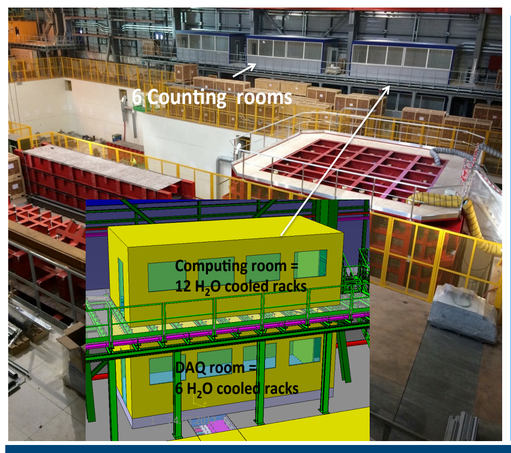
- The EHN1-NP computing cluster (which will serve as NP02 online farm) consists of nearly 2500 cores with various characteristics and the status and health of every host must be constantly monitored to ensure the correct and reliable operation of the whole online/offline data processing system.
- There is an evident need for an automated conguration management system for the cluster. To manage the machines hosted in EHN1, virtual machines (VMs) are hosted on CERN OpenStack Cloud infrastructure.
- The whole system has to be integrated in the CERN Puppet Orchestration.




EHN1 computing cluster and Zabbix monitoring concept



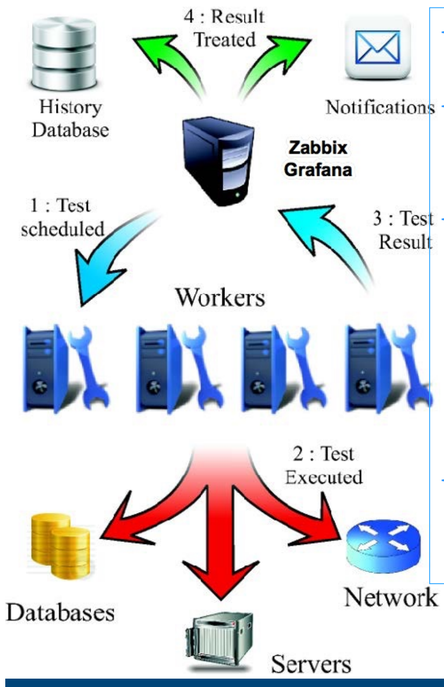

- The monitoring is the first line of defense: it should not only provide alerts in case of failure but, whenever possible, warn of impending issues.




For each node (~250) hardware and system parameters are monitored:

- Hardware:
  - disk raid status, temperature, fan speed, power supplies, current and voltages, ….
- System:
  - cpu, memory and sisk usage
  - Configuration aspects as kernel vesrios, pedding updates,
  - Network, interface status, speed, services as ntp,htttp,mailq

## Monitoiring system




- Zabbix and Grafana monitoring systems have been combined to get a complete picture of the system.
- For active checks and alerting performing with different time intervals ranging between 5 minutes and 24 hours according to the need.
- Zabbix for performance data useful for debugging:
  - Historical data are stored
  - High-scalability and good data visualization
  - Zabbix monitoring agent
    - Runs on each node and gathers data every 20 seconds
    - Some parameters useful for alerting too
- In addition Zabbix/Grafana have been integrated with other data sources, such as SNMP for system information and IPMI for hardware health.

## Conclusions

The computing Infrastructure for the prototype experiments of the future DUNE has been deployed at CERN-EHN1. The online and offline cluster and the associated Web and database services run on either locally or on OpenStack virtual machines (CentOS 7). Installation of the server and client application software is straightforward and fully automatized and monitored promptly.