

ALICE O2 setup for TPC read-out tests for the LHC run 3

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Introduction

The Time Projection Chamber (TPC) is one of the first detectors to build a small test setup which is comparable to the run3 Online-Offline (O2) computing system. The setup consists of 5 First-Level-Processing servers (FLPs) with two-four Common Readout Units (CRUs) each as input nodes and 2 Event-Processing-Nodes (EPNs). The primary goal is to test the whole readout chain at conditions which are very close to the expected running conditions during run3. It's one of the first small scale setup with the CRU to readout Frontend Cards (FECs), where 4-10 CRUs are used in a single setup. The setup will be extended even further during LS2 to enable the commissioning of the TPC sectors in the clean room. The secondary use case of this setup is to test the O2 software in a realistic scenario with the whole read-out chain as input. Due to a delay in the availability of the CRUs the build up of the test setup was delayed and happened just before CHEP.

Main objectives of the TPC test setup

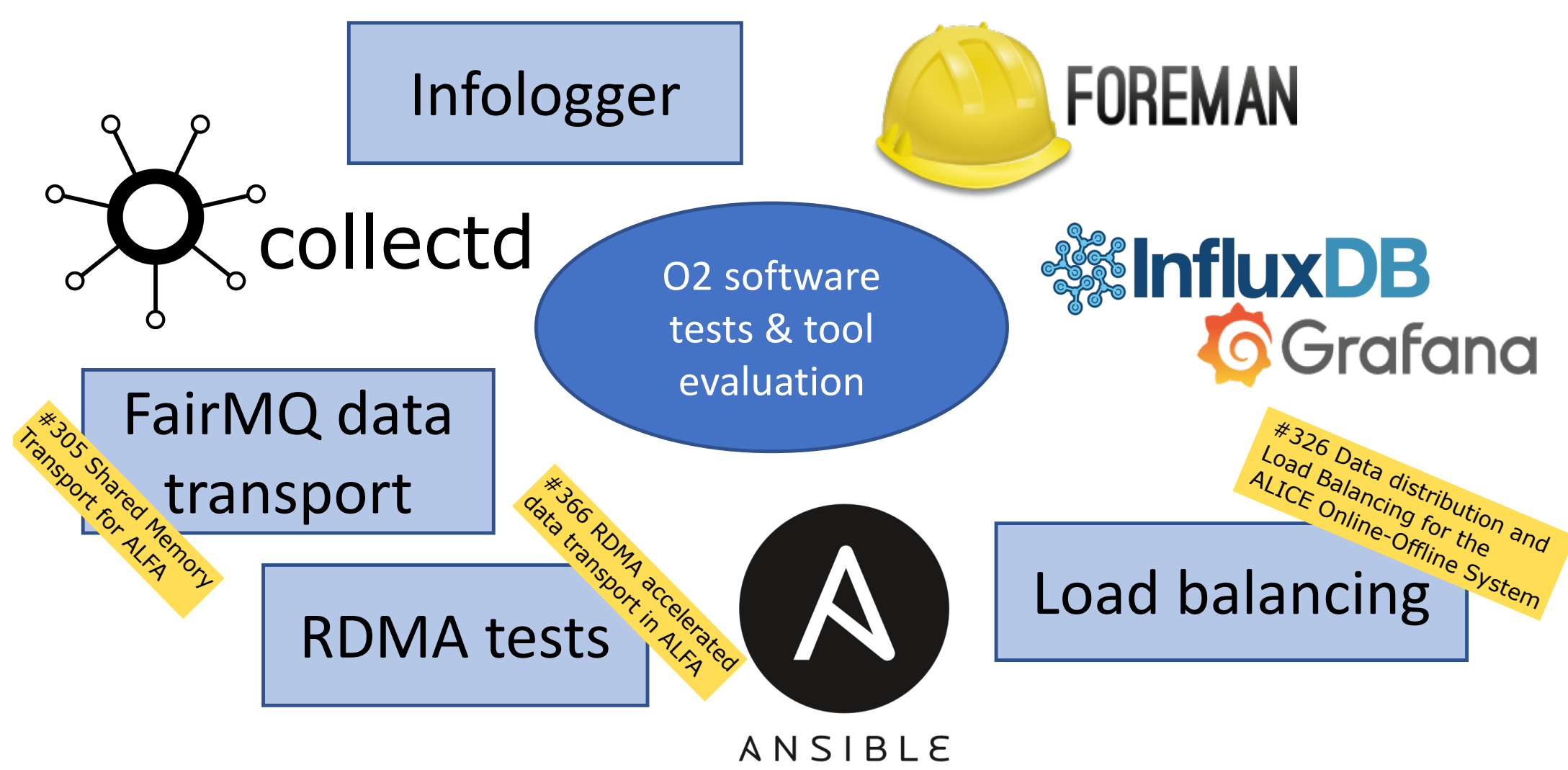
Primary goals for the TPC group

- TPC FEC readout test with CRU as run3 hardware setup
- Testing of a fully equipped Inner Readout Chamber (IROC) with High Voltage (HV) and source
- Later this year testing of a whole TPC sector
- TPC sector commissioning starting during Long Shut-down 2 (LS2) 2019

Secondary goals for the O2 use case

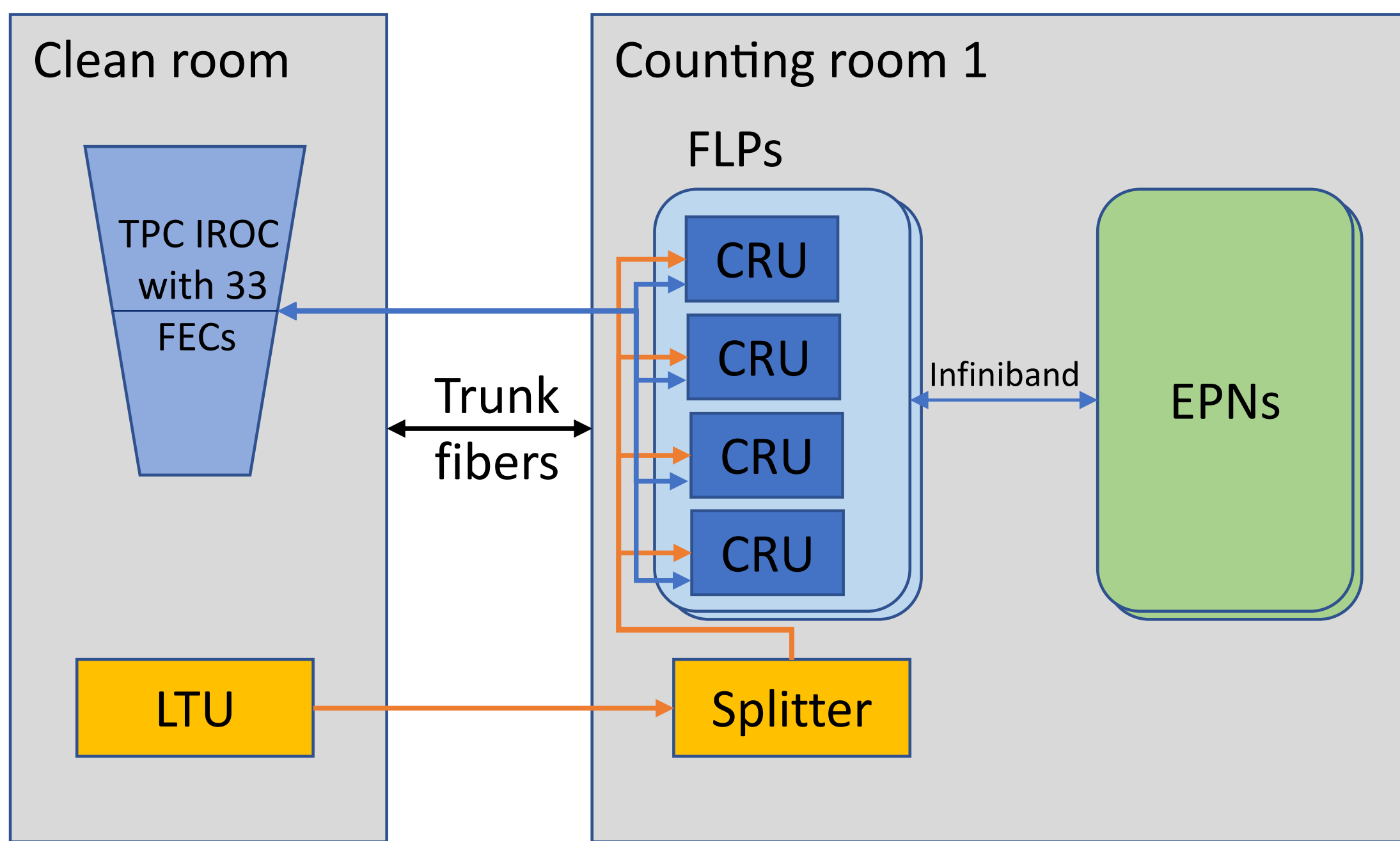
- Providing a software environment which is as close to the run3 environment as possible
- Demonstrating O2 software and tools with the whole detector readout chain as input
- Integrate as much functionality as possible
- Gain experience with the complete software stack and gather feedback to further improve

Preparations: O2 integration cluster

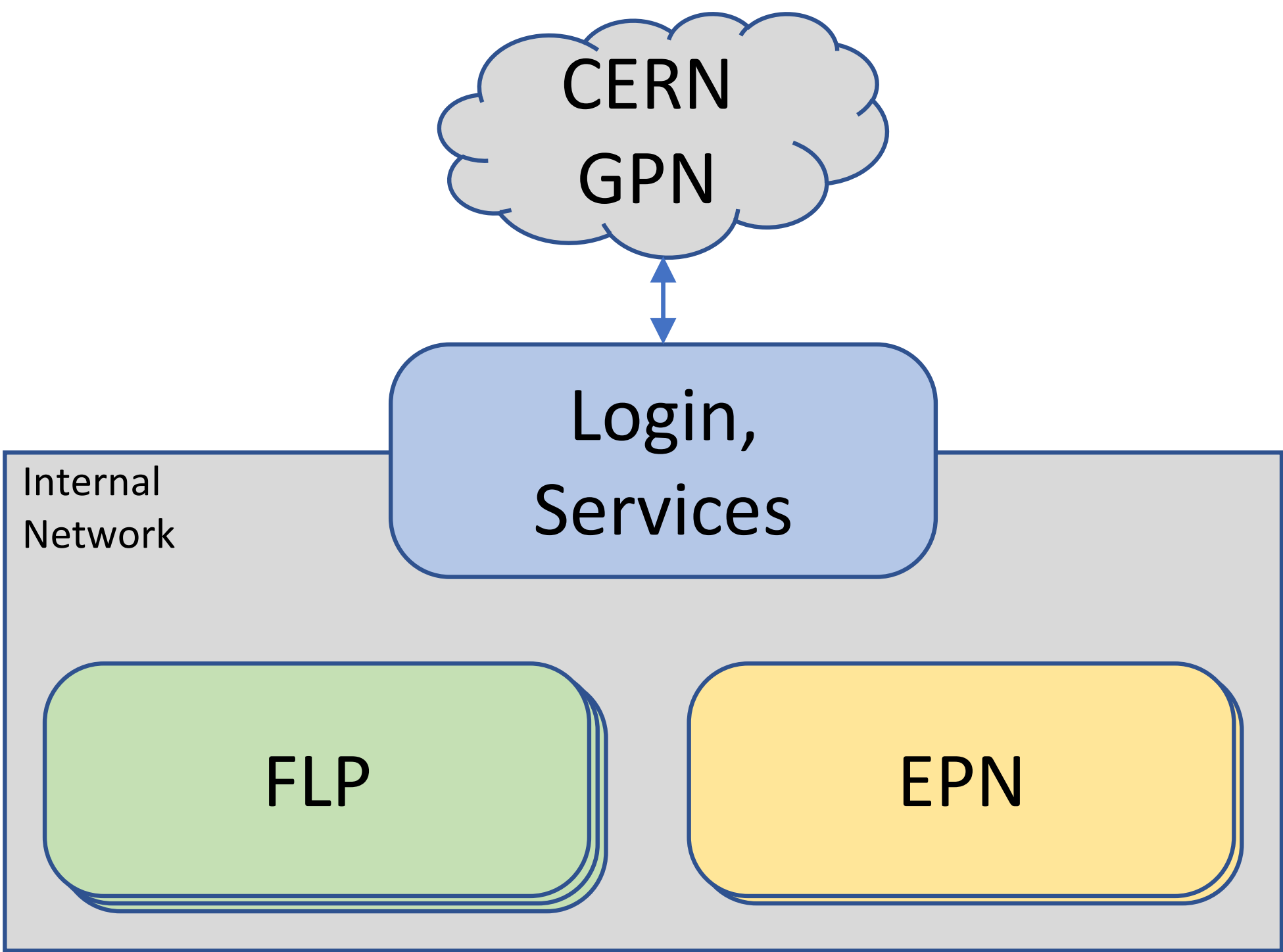


- Provisioning and configuration tools as baseline for run3: Foreman¹ and Ansible²
- Monitoring stack: Collectd³ on the nodes, Influxdb⁴ as the database and Grafana⁵ for visualization
- Data transport demonstration on a medium scale
- Framework logging: Infologger, a custom development already used in run2
- RDMA demonstration with OpenFabrics Interfaces (OFI)
- Evaluation of the run3 load balancing algorithm

TPC read-out setup at Point 2

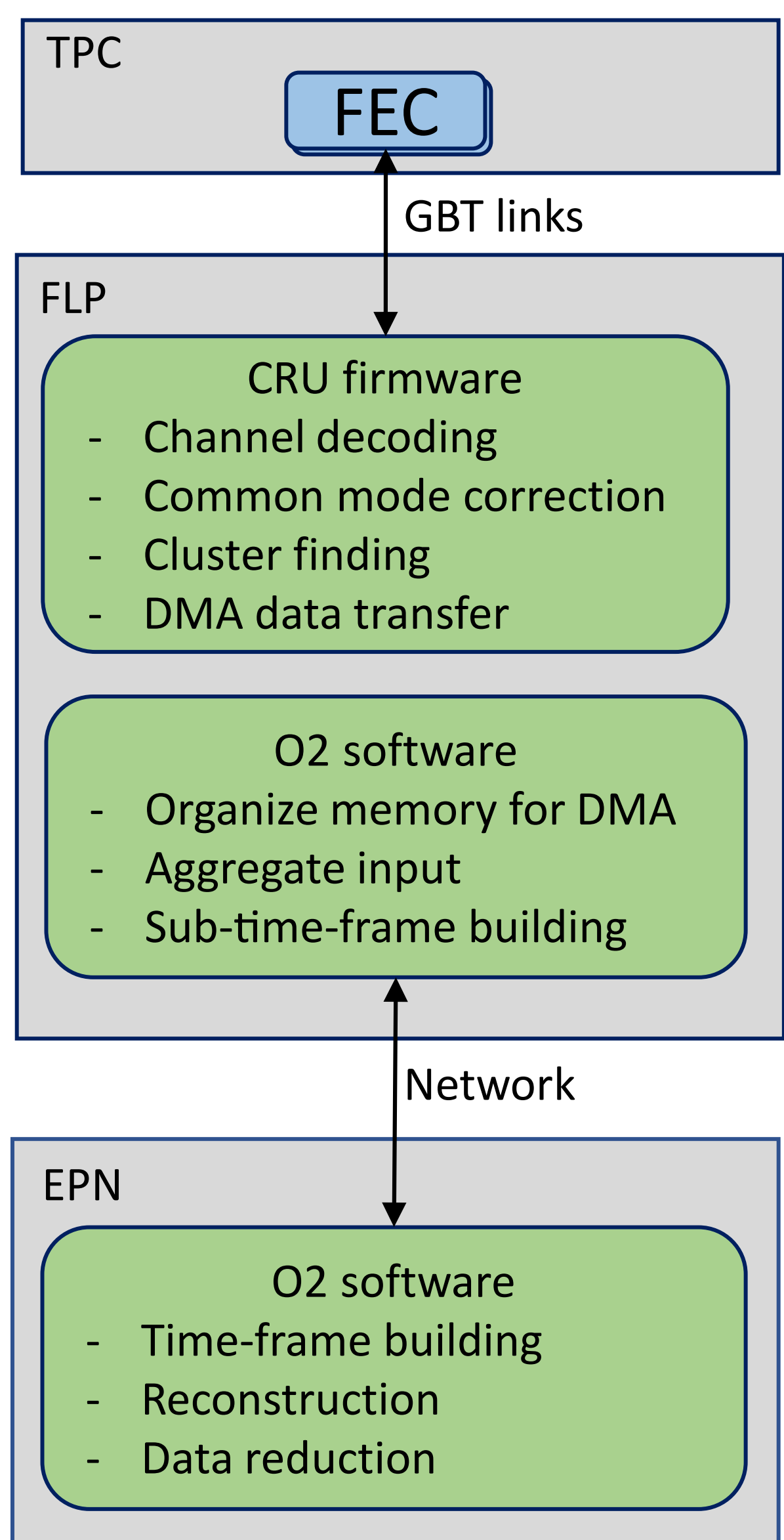


- Clean room:**
 - TPC Inner Readout Chamber (IROC) with 33 Frontend Cards (FECs) mounted on the chamber
 - High Voltage connected and radioactive source to get real detector data input
 - Each FEC has two GBT uplinks and one downlink (4.8 GBits each)
 - Local Trigger Unit (LTU) to trigger readout
- Counting room 1 (CR1)**
 - FLPs with 2-4 CRUs connected to the TPC FECs
 - Up to 20 FECS connected per CRU
 - CRUs connected to the LTU so synchronize multiple CRUs
 - EPNs to enable O2 software demonstration including time frame building



- Login node with GPN connection for remote access of the test system
- Internal isolated network with fast Infiniband FDR 56Gbit
- Internal services like NFS, DHCP, configuration and provisioning
- 5 FLPs as input nodes, not all with CRUs in the beginning
- 2 EPNs to test data transport

Dataflow



- TPC**
 - Continuous raw data from the TPC FECs
 - Data of one FEC split to two CRUs
- FLP**
 - First processing inside the CRU firmware
 - Reduction of the data through common mode correction and cluster finding
 - O2 readout software arranging the data in memory
 - Aggregating of multiple heart beat frames
 - Sub-time-frame building with local available data
 - Data transport and load balancing
- EPN**
 - Aggregation of all sub-time-frames into a time-frame
 - Reconstruction on the full time-frame
 - Compression for further data reduction

The focus of this setup is to test the full readout chain including detector electronics as well as building an O2 reference system to demonstrate the O2 software stack on a small scale.

Next steps

After the initial deployment of the test setup at Point 2 further testing is needed to ensure everything is working. In the beginning only 4 CRUs are available for the IROC readout test. New parts of the O2 software like load balancing will be added step by step as soon as they are available and verified. Later this year the setup will be extended to 10 CRUs to enable the sector tests when the additional CRUs become available. During LS2 this setup will be extended to 20 CRUs to test two sectors in parallel and enable the surface commissioning of the TPC in the clean room at Point 2.

Acknowledgements

Thanks to the TPC group who opened their read-out test setup for the O2 project to build a realistic O2 prototype for further software and integration tests. An early possibility to verify everything even in a small scale is very helpful to improve the software. In addition, thanks to everyone in the O2 project contributing to the setup as well as everyone testing and integrating their software and tools.

References

- [1] <https://www.theforeman.org/>
- [2] <https://www.ansible.com/>
- [3] <https://collectd.org/>
- [4] <https://www.influxdata.com/>
- [5] <https://grafana.com/>