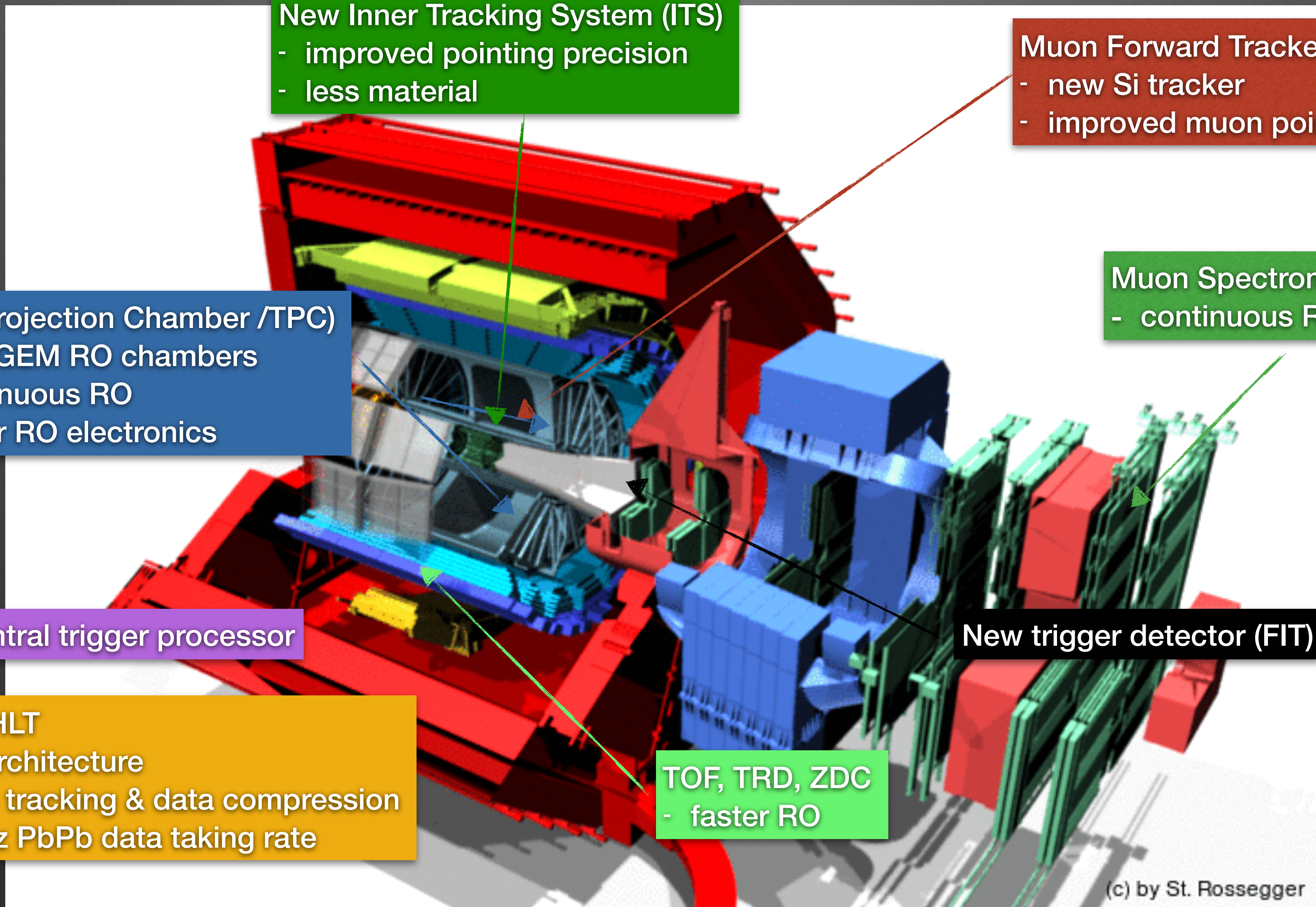
# ALICE

## The $O^2$ project

# The context

The ALICE upgrade

# what




**New Inner Tracking System (ITS)**
- improved pointing precision
- less material

**Muon Forward Tracker (MFT)**
- new Si tracker
- improved muon pointing precision

**Muon Spectrometer**
- continuous RO electronics

**Time Projection Chamber /TPC)**
- new GEM RO chambers
- continuous RO
- faster RO electronics

**New central trigger processor**

**New trigger detector (FIT)**

**DAQ & HLT**
- new architecture
- online tracking & data compression
- 50 kHz PbPb data taking rate

**TOF, TRD, ZDC**
- faster RO

ALICE
A JOURNEY OF DISCOVERY

# objectives

- RUN 1

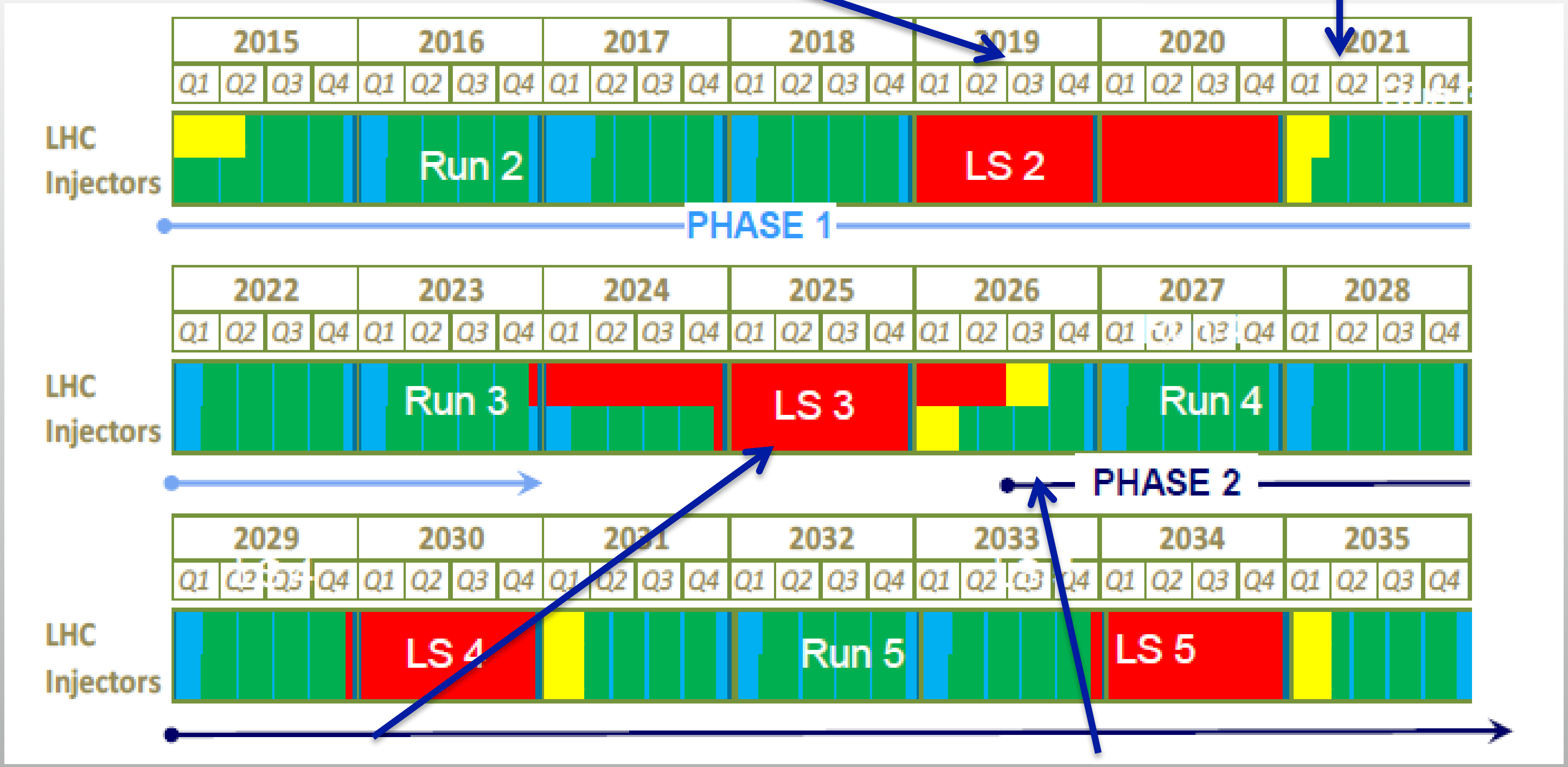
| YEAR | SYSTEM | $\sqrt{s_{NN}}$ (TeV) | $\mathscr{L}_{INTEGRATED}$ |
|---|---|---|---|
| 2010 | Pb-Pb | 2.76 | 0.01 $nb^{-1}$ |
| 2011 | Pb-Pb | 2.76 | 0.1 $nb^{-1}$ |
| 2013 | p-Pb | 5.02 | 30 $nb^{-1}$ |

- RUN 2 (2015-2018): → 1 $nb^{-1}$ at double $\sqrt{s_{NN}}$ and with improved detectors
- RUN 3&4 (2019-2020): → 10 $nb^{-1}$ with upgraded ALICE

# when

PHASE I Upgrade
ALICE, LHCb major upgrade
ATLAS, CMS ‚minor' upgrade

Heavy Ion Luminosity from $10^{27}$ to 7 x$10^{27}$




PHASE II Upgrade
ATLAS, CMS major upgrade

HL-LHC, pp luminosity from $10^{34}$ (peak) to 5 x$10^{34}$ (levelled)

# Requirements

- Interaction rate: 50 kHz Pb-Pb minimum bias (× 100)
- Events statistics: ~ 2-3 × $10^{10}$ Pb(p)-Pb and pp events/year during 6 years
- Event size: ~ 22 MB/event
- Max RO rate: 50 kHz (TPC) → 100 kHz (ITS)
- Max Data rate: ~ 3.3 TB/s

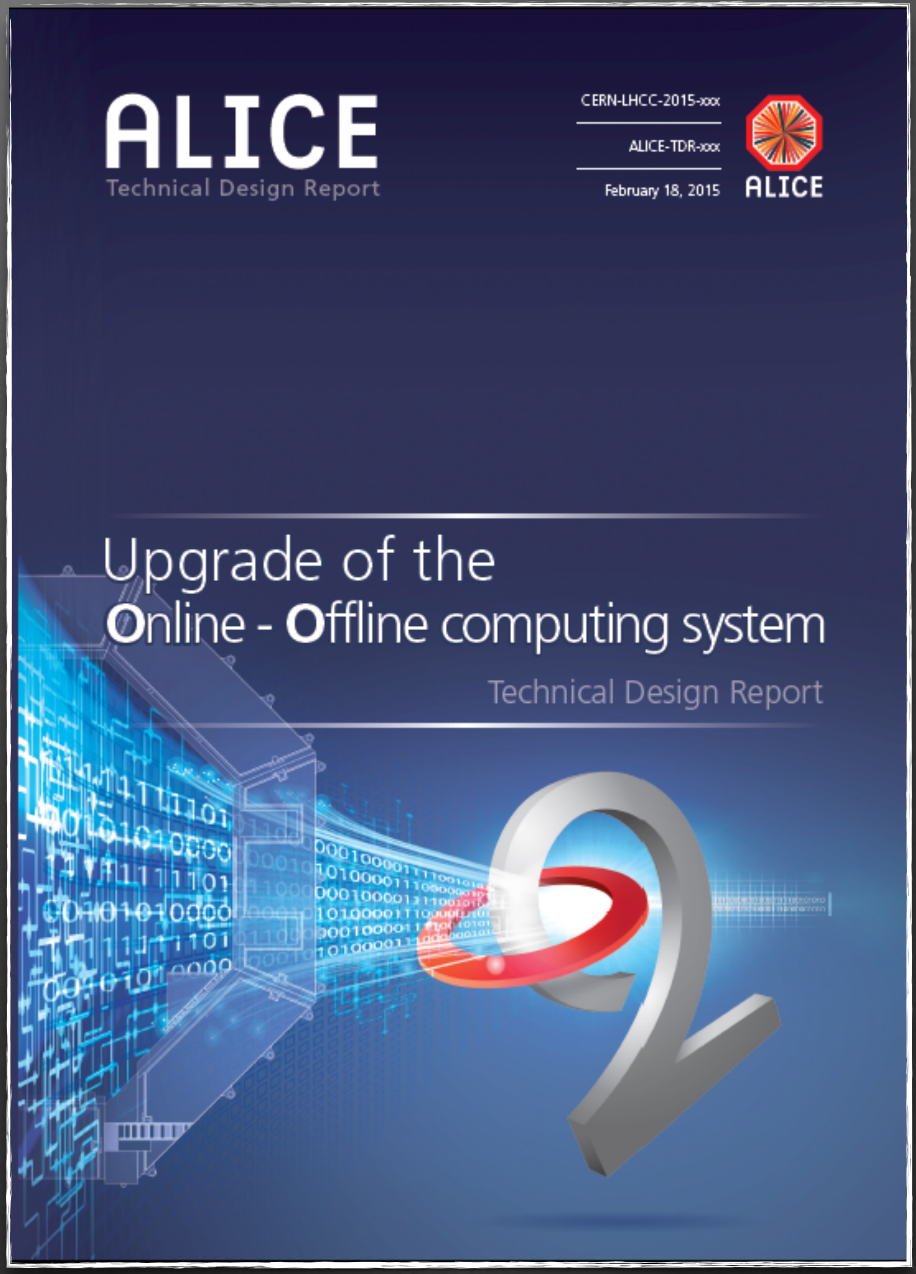
# $O^2$: a paradigm shift

- Read out data for all interactions: 50 kHz
- Online data compression: space points → tracks
- Distribute data to the Grid
- AF: dedicated sites for efficient analysis + AOD storage

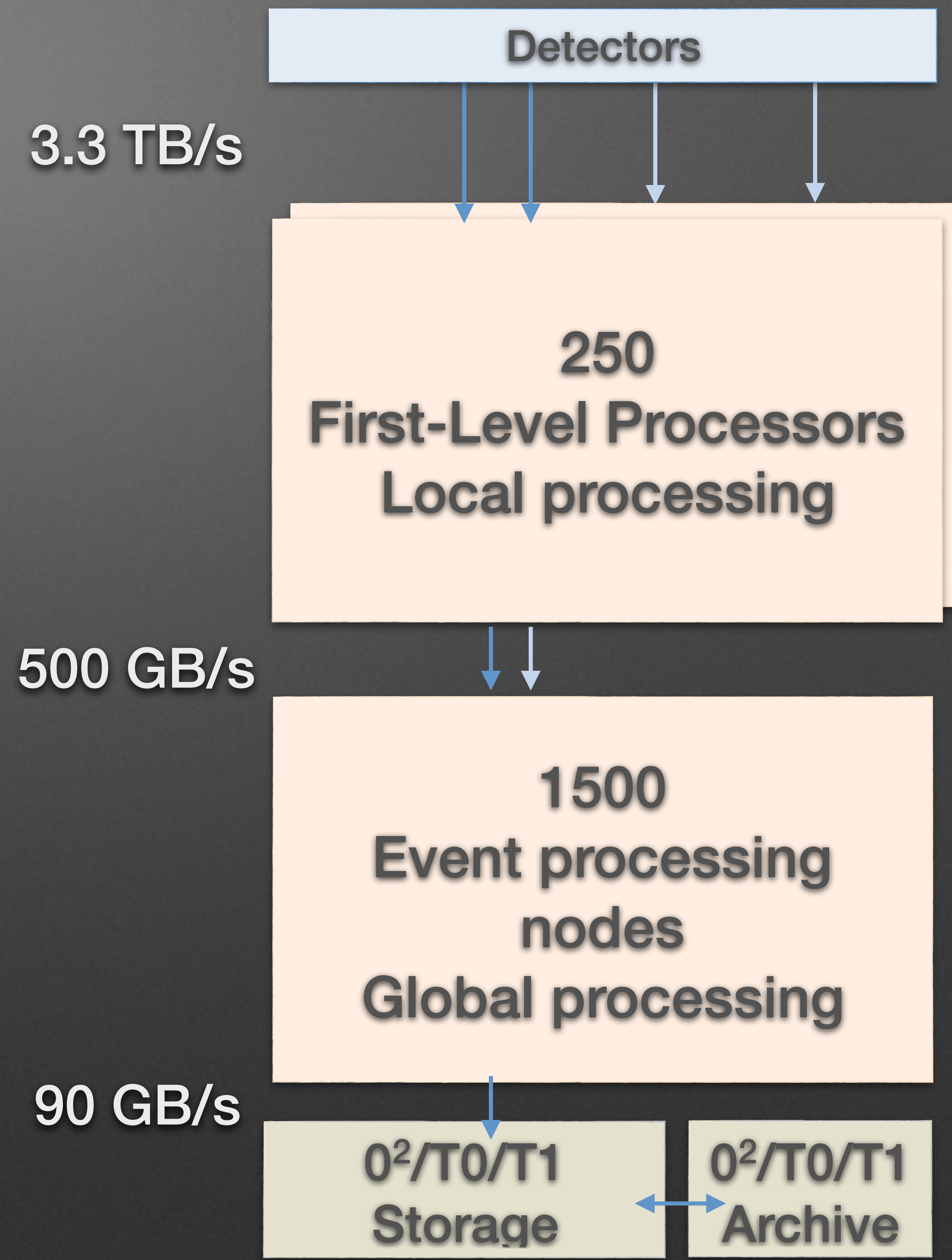
# $O^2$: a paradigm shift

https://cds.cern.ch/record/2011297/files/ALICE-TDR-019.pdf

- Read out data for all interactions: 50 kHz
- Online data compression: space points → tracks
- Distribute data to the Grid
- AF: dedicated sites for efficient analysis + AOD storage



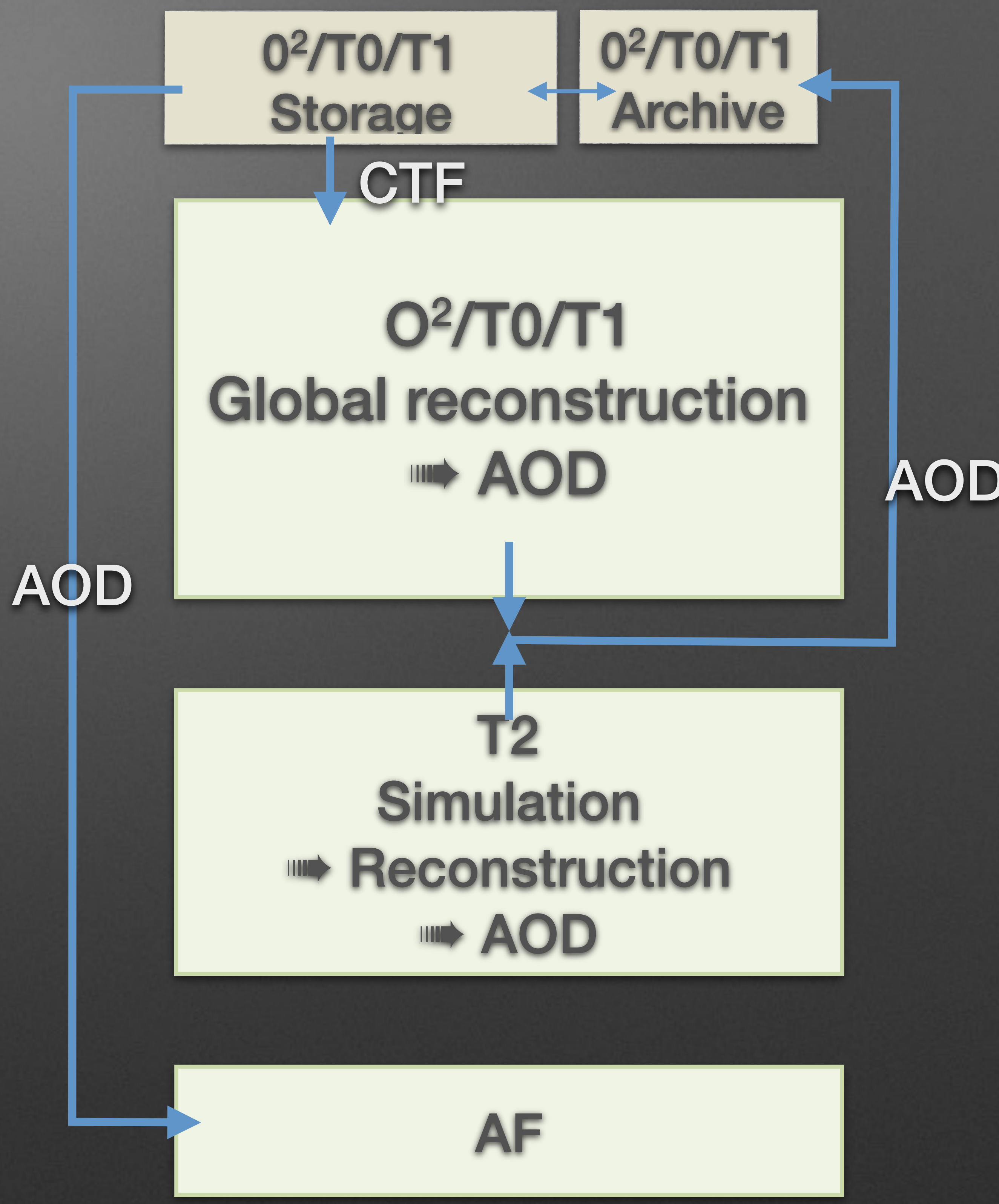
# Data flow & processing



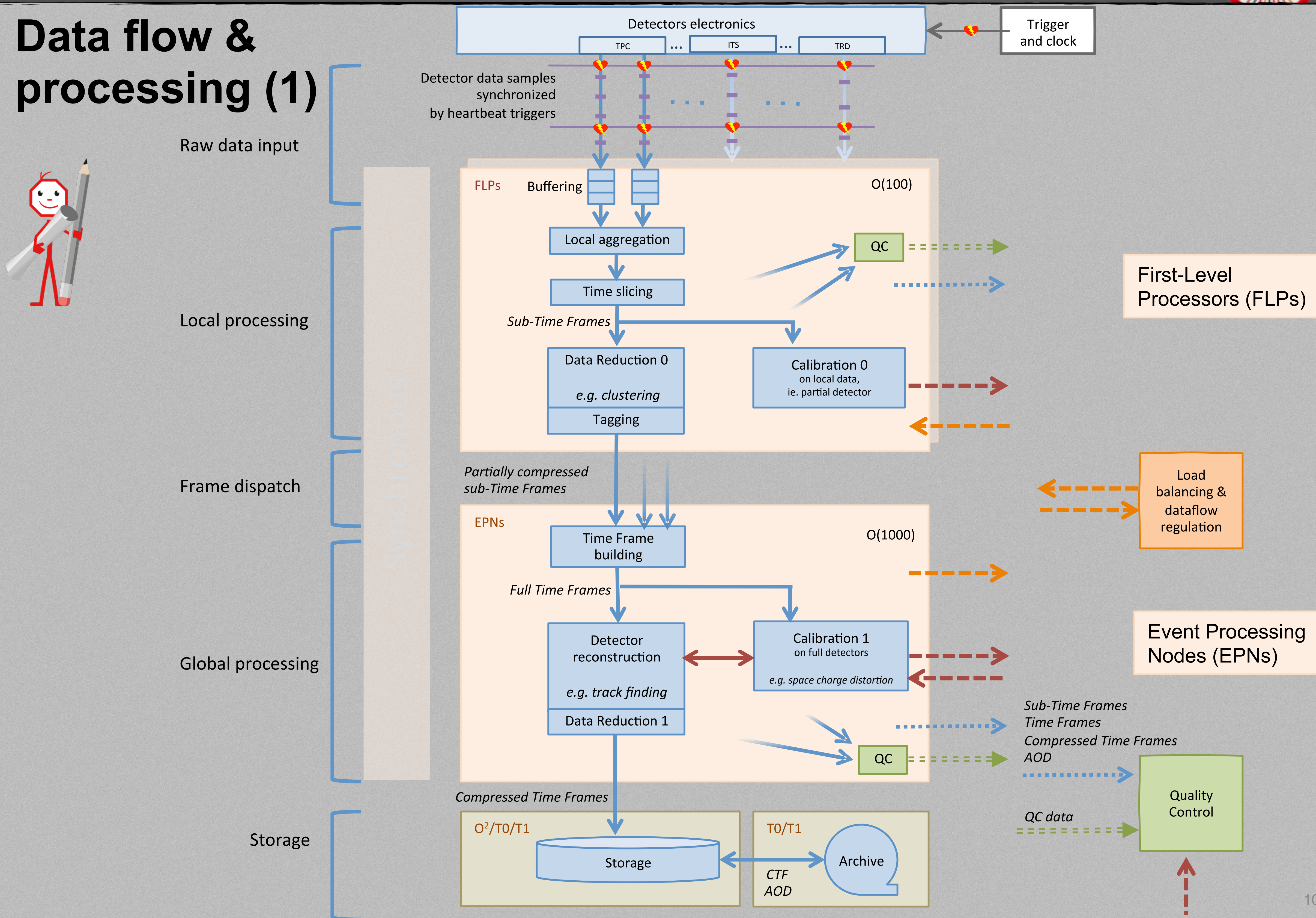

- Processing synchronous with data taking

# Data flow & processing

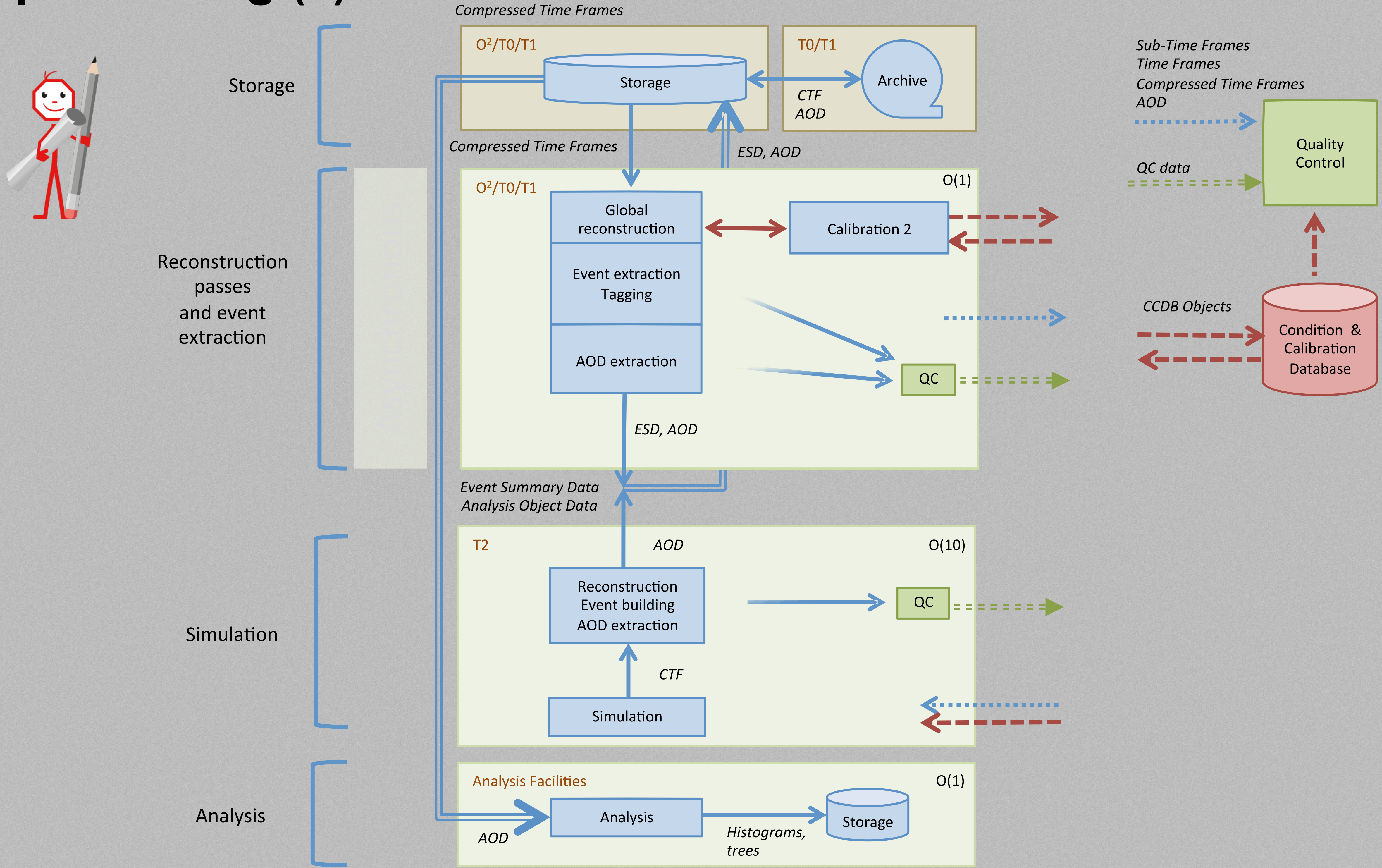
- Processing asynchronous $O$(hours) with data taking



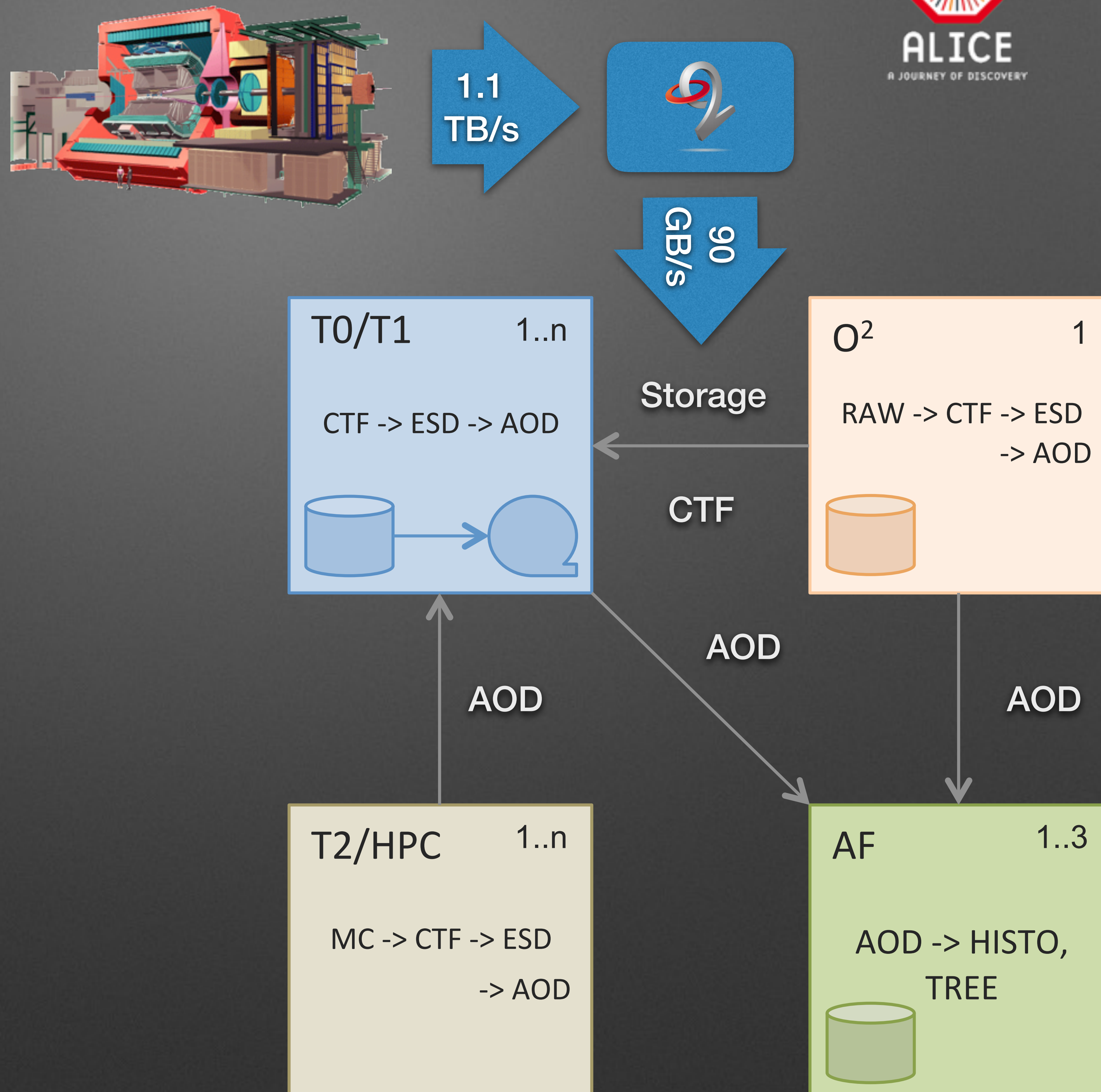
# Data flow & processing (1)



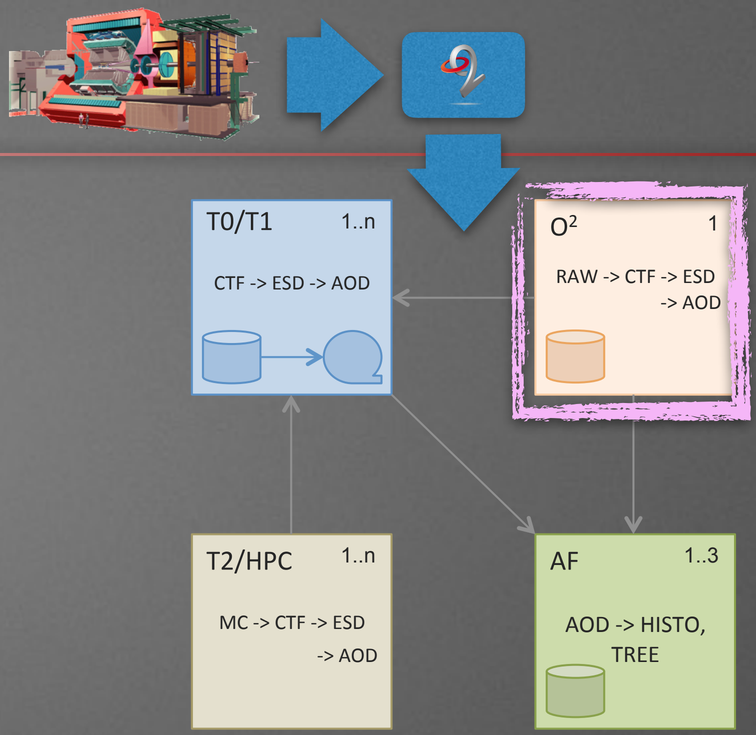
# Data flow & processing (2)



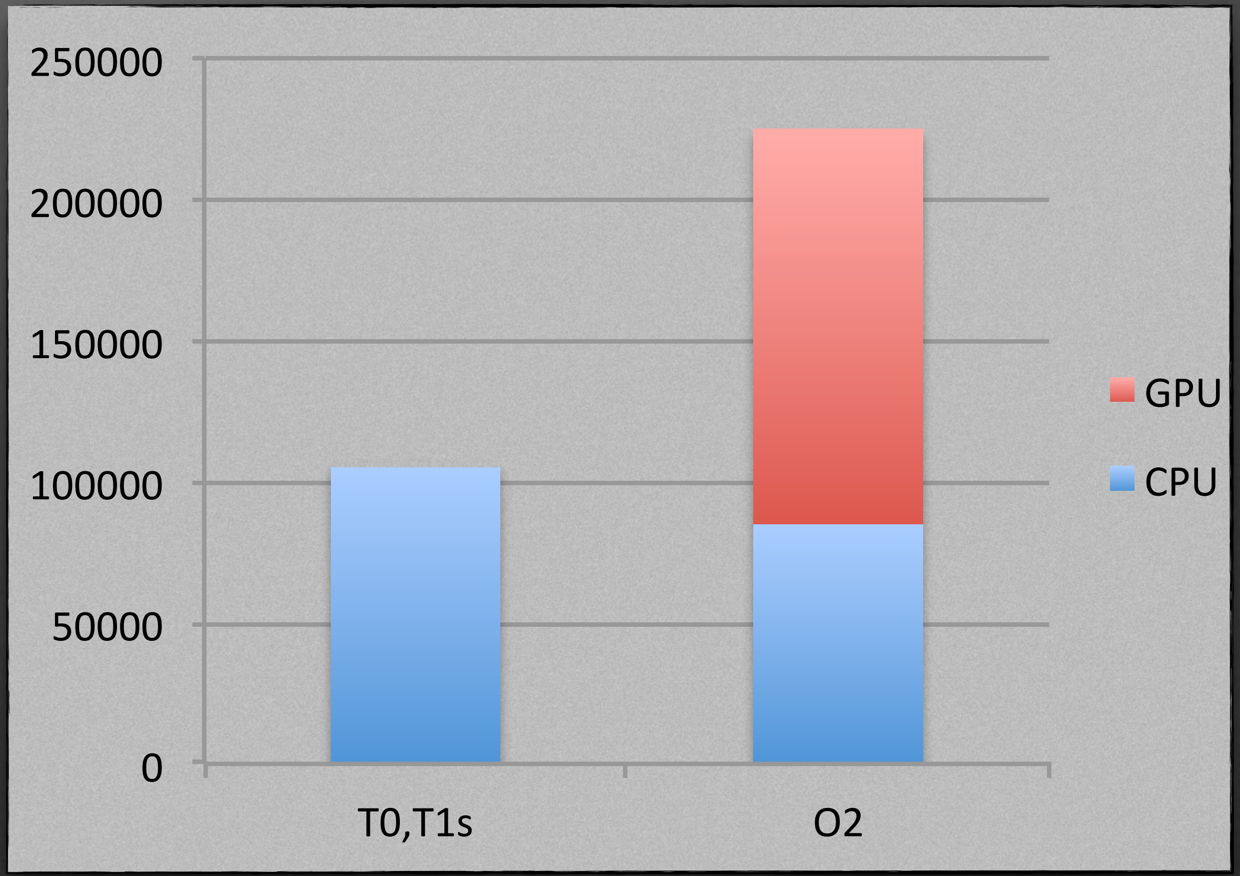
# $O^2$ and WLCG


1.1
TB/s
90
GB/s
T0/T1
1..n
CTF -> ESD -> AOD
Storage
CTF
O²
1
RAW -> CTF -> ESD
-> AOD
AOD
AOD
AOD
T2/HPC
1..n
MC -> CTF -> ESD
-> AOD
AF
1..3
AOD -> HISTO,
TREE

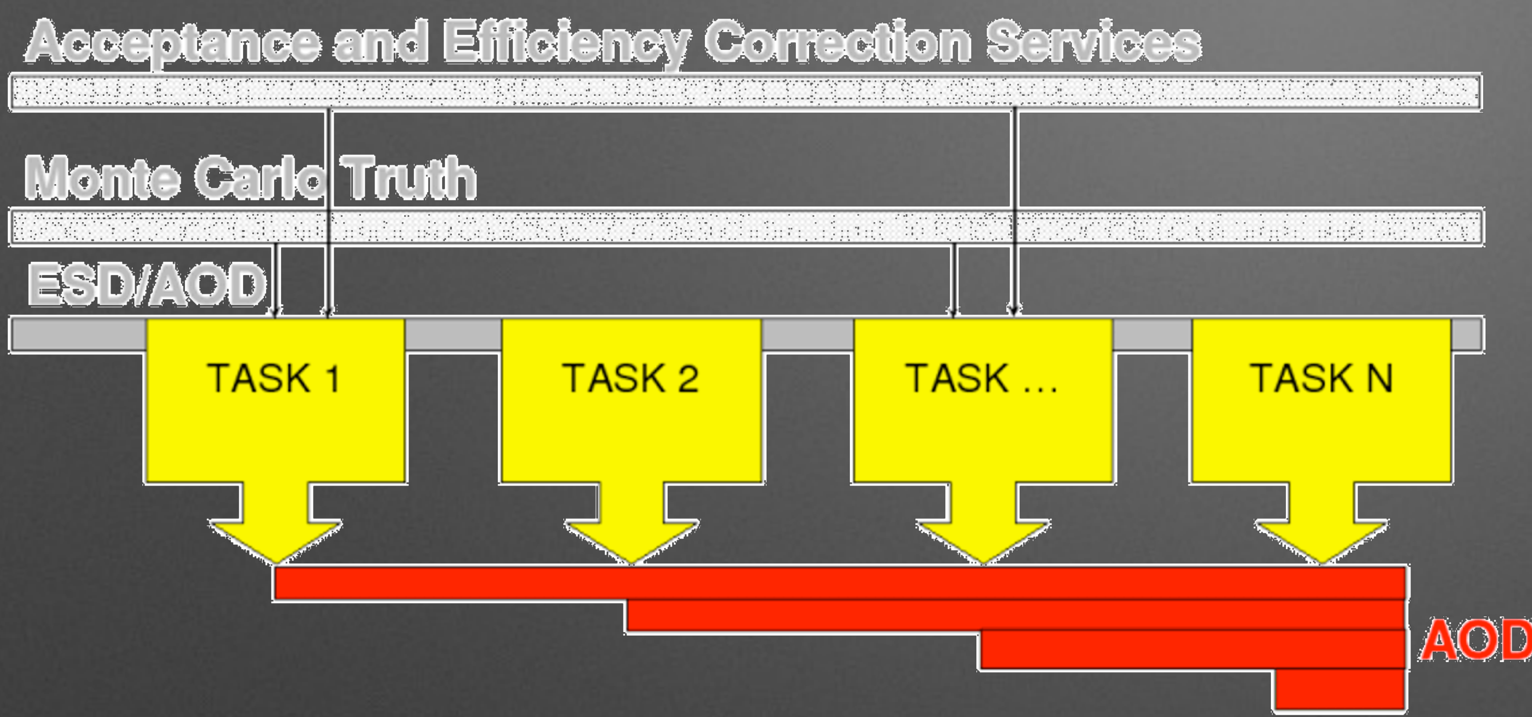
# O² facility

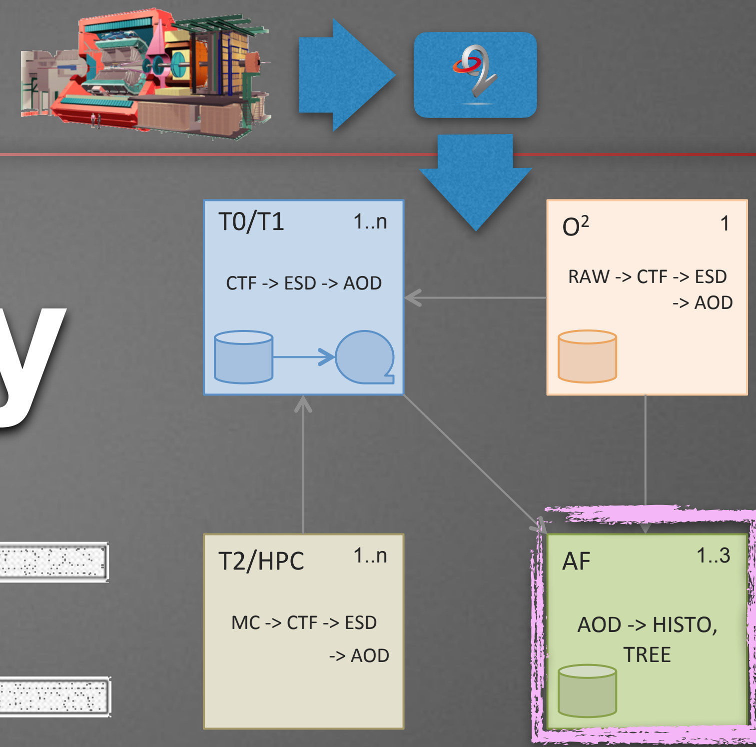



- Computing capacity to be used for online/offline tasks
- 463 FPGA (cluster finder)
- 100’000 CPU cores (÷14 data flow)
- 3’000 GPU (speed up reconstruction)
- 60 PB disk (buffer for further processing)



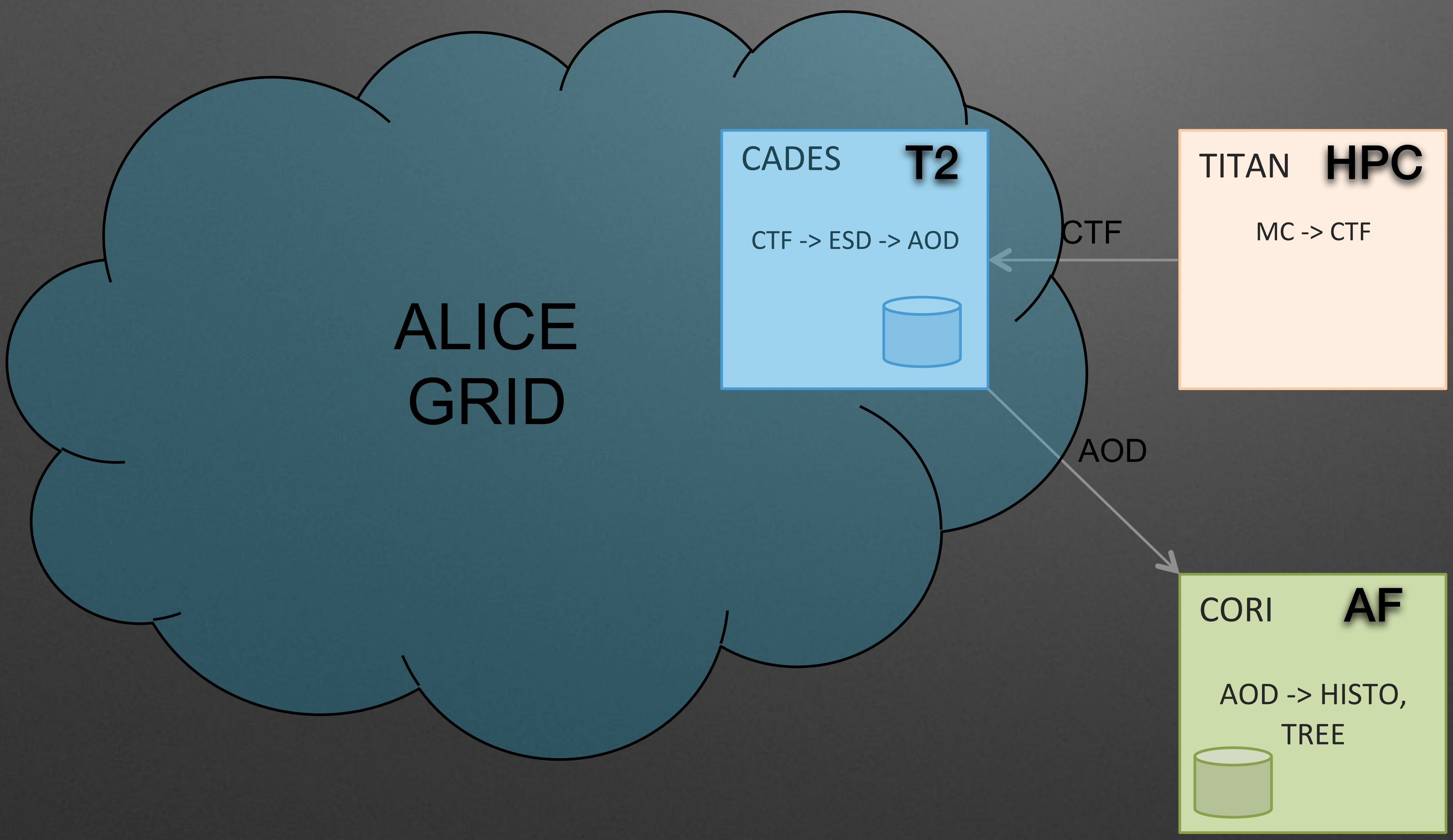
# Analysis Facility




- Collect AODs on a few dedicated sites that are capable of locally processing quickly large data volume
- AF needs to be able to digest more than 5 PB of AODs in a 12 hours period
  - $\mathcal{O}$(20-30k) cores + $\mathcal{O}$(10) PB of disk
  - Cluster file system to serve 20k job slots at an aggregate throughput of 200 GB/s

# Simulation Facility

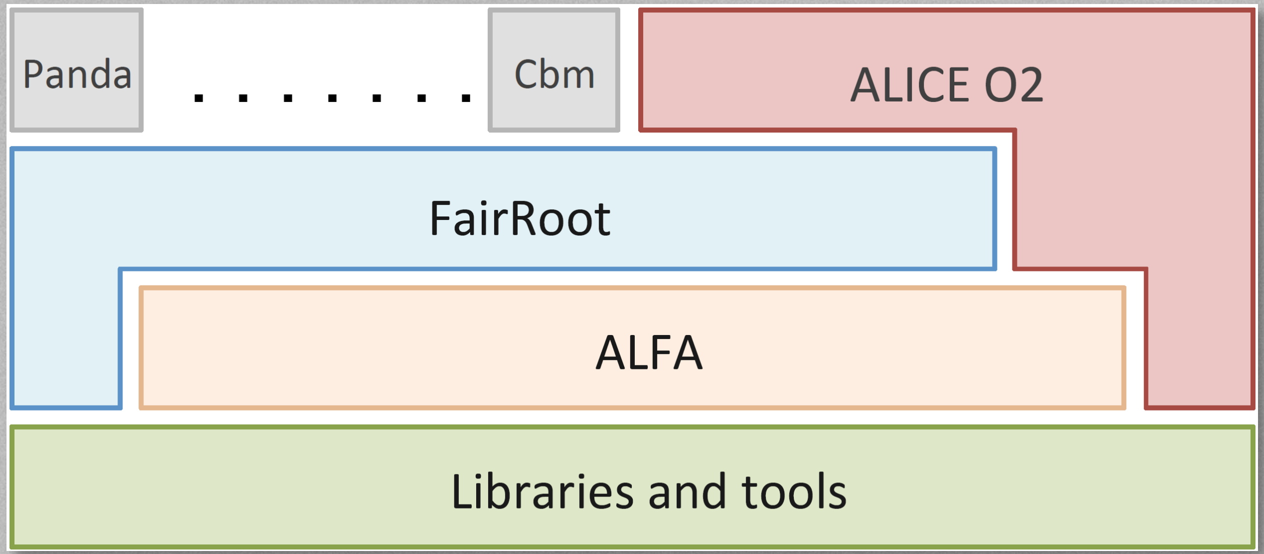



MC data source opportunité usage

Analysis Facility

# Software architecture

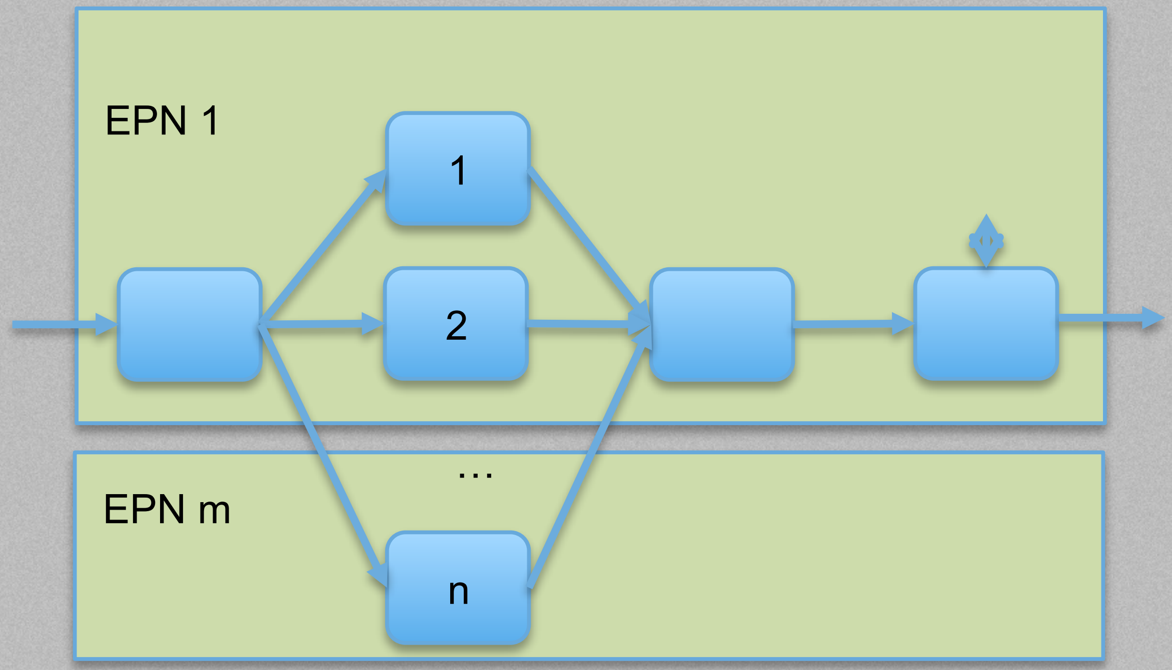
- Documented in chapters 7 and 8 of the TDR
- Message-based multi-processing
  - Ease of development
  - Ease to scale horizontally
  - Possibility to extend with different hardware
  - Multi-threading within processes possible
- ALFA
  - Developed in common by experiments at FAIR and ALICE
  - Based on message transport packages
  - Data transport
  - Dynamic Deployment System




ALICE + FAIR + …

# ALFA

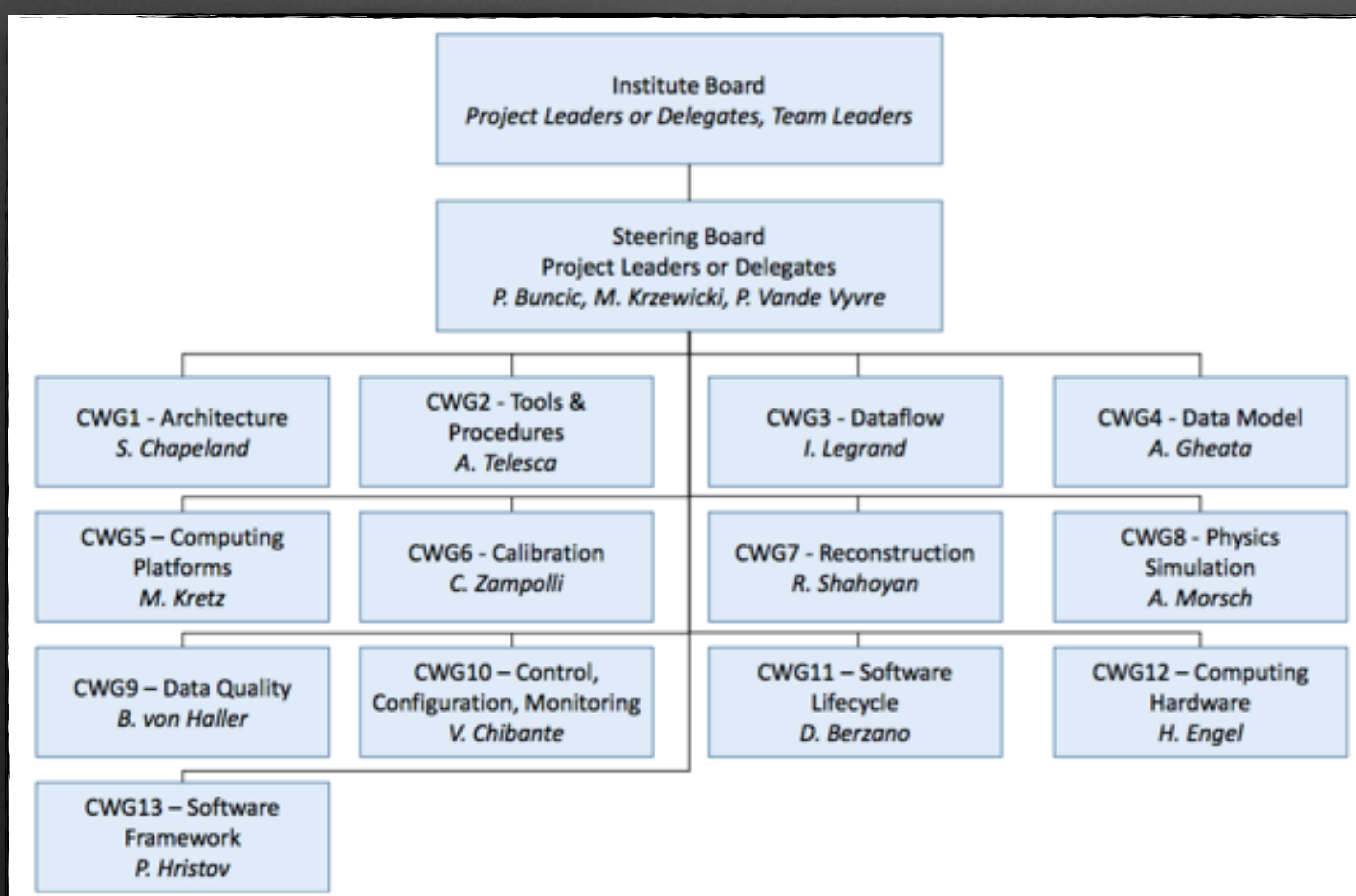
- Large monolithic programs are divided in tasks
- Each task can
  - Run on multiple or different hardware (CPU or hw accelerator)
  - Be written in any of the supported language
  - Be multi-threaded if need be



# Questions

- Q1: $O^2$ task distributions and organization ?

  - ➡ The general project organization is described in the TDR Chapter 11.The task distribution is currently done by the $O^2$ Steering Board constituted by the project leaders of the DAQ, HLT and Offline project or their representative.



- ➡ Institution Board: Discusses and decides about managerial, financial, organizational issues
- ➡ Steering Board (PL of DAQ, HLT, Offline): managerial, financial, technical & organizational issues
- ➡ 7 Computing Working Groups: R&D work

Table 11.1: $O^2$ Project Computing Working Groups and their topics.

| Group | Topic | Group | Topic |
|---|---|---|---|
| CWG 1 | Architecture | CWG 8 | Physics Simulation |
| CWG 2 | Tools & Procedures | CWG 9 | Quality Control, Visualization |
| CWG 3 | Data flow | CWG 10 | Control, Configuration, Monitoring |
| CWG 4 | Data Model | CWG 11 | Software Lifecycle |
| CWG 5 | Computing Platforms | CWG 12 | Hardware |
| CWG 6 | Calibration | CWG 13 | Software framework |
| CWG 7 | Reconstruction | | |

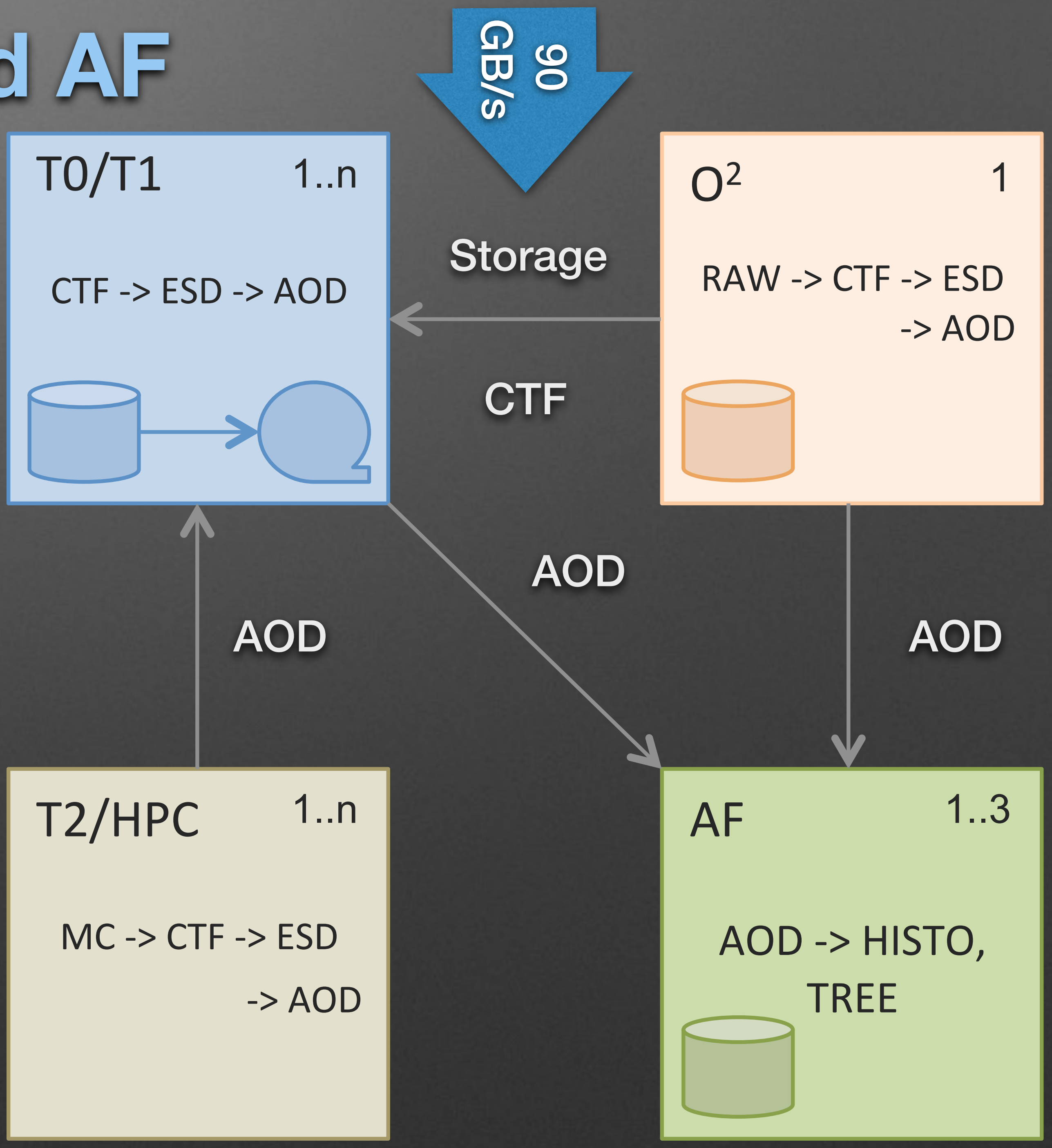
- Q2: Which parts/ tasks are missing most or lack of man power?

  ➡ Here a short list of some specific tasks which are missing manpower:

  - Load balancing & dataflow regulation
  - Benchmarking of different solutions considered for the data management in the $O^2$ facility

# Q3: Role of Tier1/2 and AF

Chapter 4 of TDR



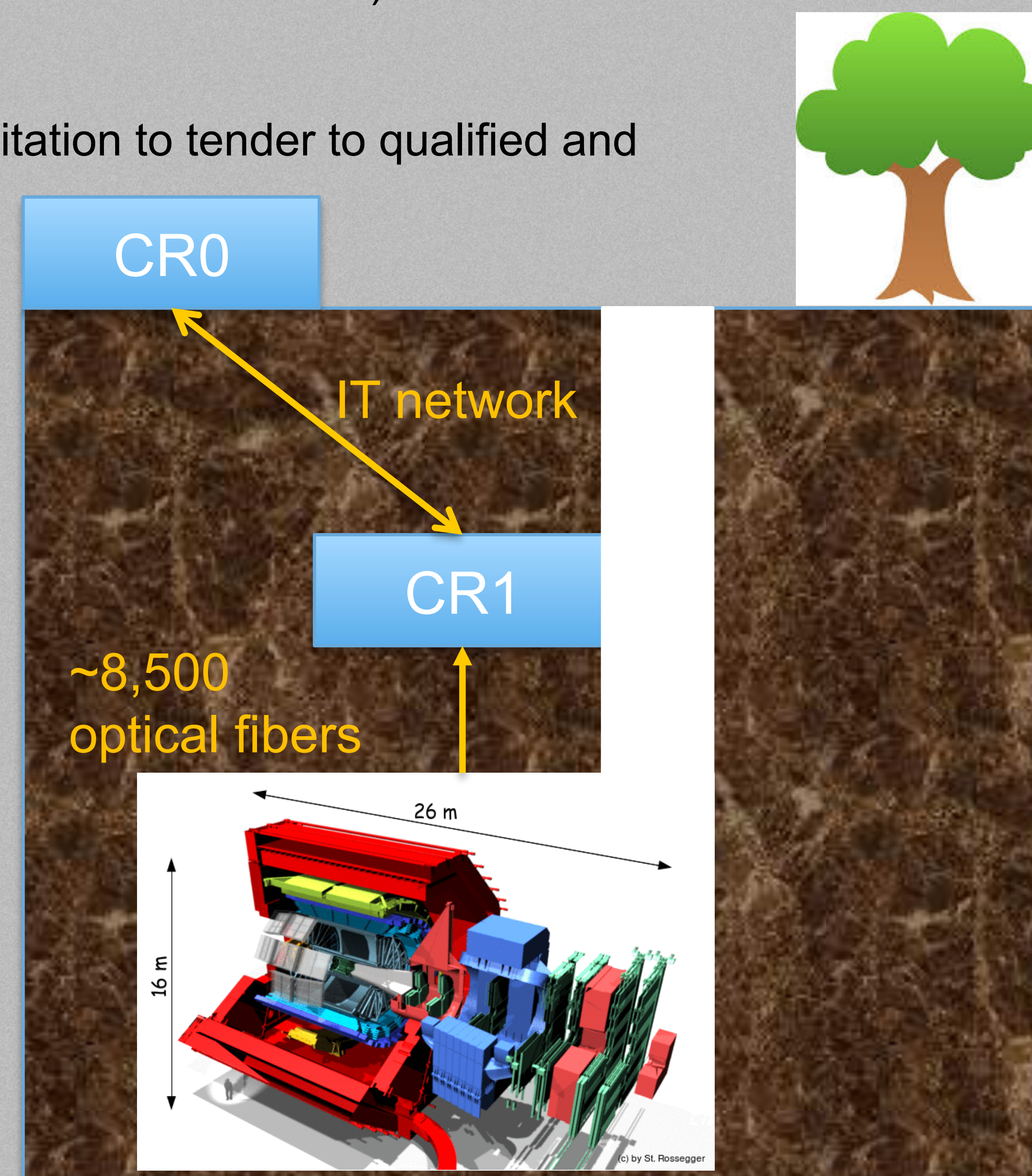
- Q4: AF candidates

  - ➡ The $O^2$ project is looking for one AF candidate in North America, one in Asia and one in Europe. Several computing centers have shown interest but no decision has been taken yet. One AF in Japan would be an excellent solution.

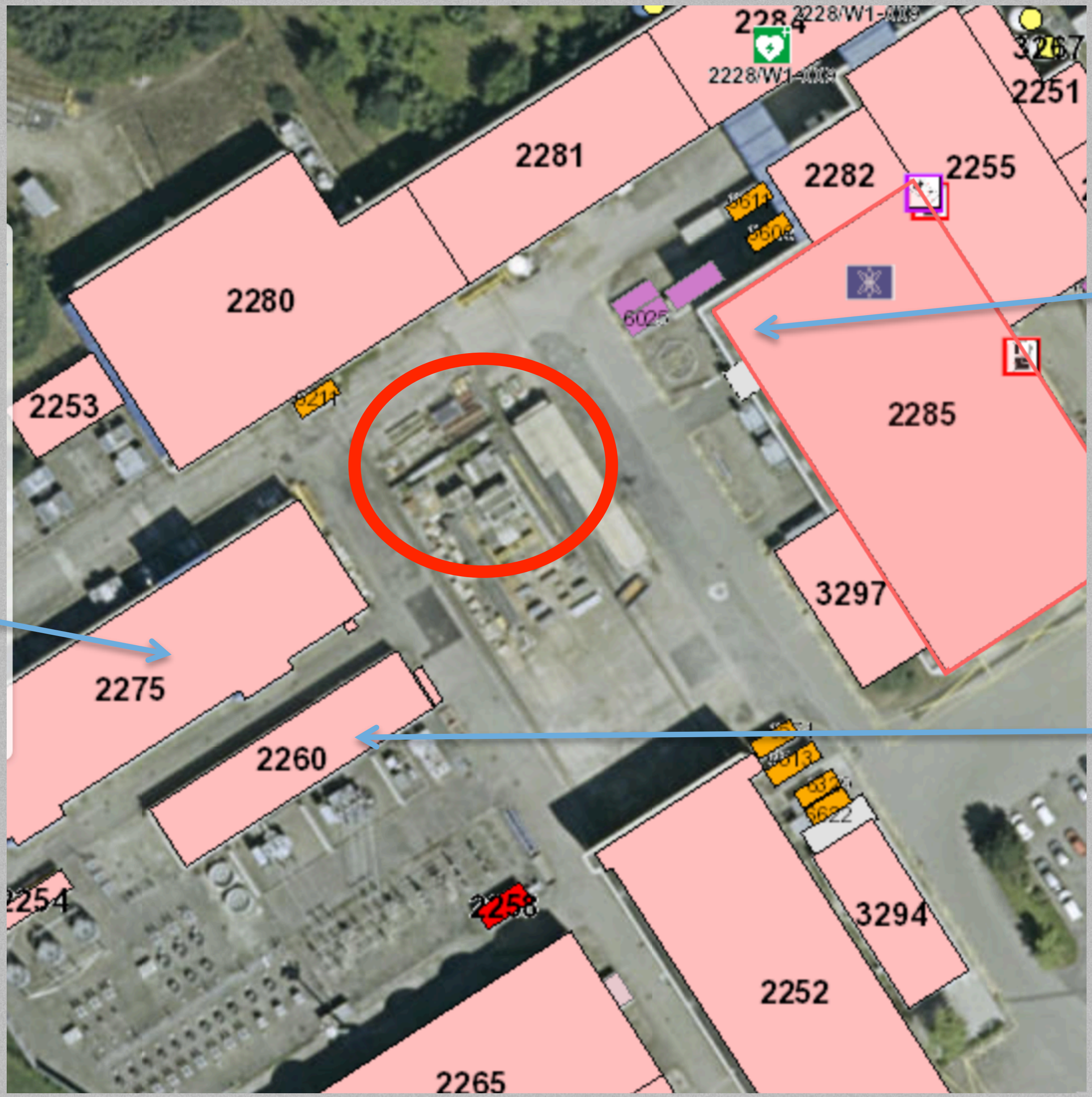
- Q5: detail of CR0/1 status and plan.
    - ➡ The plans for CR0 and CR1 are described in the TDR Chapter 10 (Sections 10.2 and 10.3).The status is that CR1 is ready but is used during Run2 and will be available to be used by the end of 2018.The present baseline for CR0 is to use computing data center containers. A market survey for producers of such containers has been performed and the technical specification for the invitation to tender is being prepared.

# Computing Rooms

- CR0: new room and infrastructure needed on the surface
  - Ongoing Market Survey – Survey of companies for the supply of Container Data Centers (24 companies contacted so far)
  - Water or free air cooled
  - Will be followed by the issue of an invitation to tender to qualified and selected firms in Q3/2016
  - Done with LHCb
- CR1:
  - Reuse existing room
  - Adequate power and cooling for the detector read-out



# CR0 location at P2




UPS

18kV feeder

66kV feeder

# Computing Room 0 (CR0)

- Commercial Container Data Centers
  - 2015-16 Market Survey → Invitation Tender → Purchase lab (20-30 % of the total capacity)
  - 2018 Move lab to P2 and implement first slice of CR0 (10% EPN and DS)
  - 2020 Purchase CR0 addition (70-80 %) and full deployment

- Q6: O2 near term plan

➡ We have several short term milestones in 2016 to release a prototype or a first version of some $O^2$ packages:

- Condition & Calibration DB,
- DQM,
- Control Configuration & Monitoring Modules,
- ALFA,
- ITS/TPC simulation,
- ITS/TPC reconstruction,
- calibration demonstrator.
- A first version of the whole FLP software will be released early 2017.

- Q7: status of participants of ALICE members in O2
  - ➡ 30 Institutes participating

**Table 2.1:** Institutes participating in the O$^2$ Project.

| | Country | City | Institute | Acronym | Team Leader |
|---|---|---|---|---|---|
| 1 | Brasil | São Paulo | University of São Paulo | USP | Marcelo Gameiro Munhoz |
| 2 | CERN | Geneva | European Organization for Nuclear Research | CERN | Wisla Carena |
| 3 | Croatia | Split | Technical University of Split | FESB | Sven Gotovac |
| 4 | Czech Republic | Rez u Prahy | Nuclear Physics Institute, Academy of Sciences of the Czech Republic | ASCR | Michal Sumbera |
| 5 | France | Clermont-Ferrand | Laboratoire de Physique Corpusculaire (LPC), Université Blaise Pascal Clermont-Ferrand, CNRS-IN2P3 | LPC | Philippe Crochet |
| 6 | France | Grenoble | Laboratoire de Physique Subatomique et de Cosmologie (LPSC), Université Grenoble-Alpes, CNRS-IN2P3 | LPSC | Christophe Furget |
| 7 | France | Nantes | SUBATECH, Ecole des Mines de Nantes, Université de Nantes, CNRS-IN2P3 | SUBATECH | Gines Martinez-Garcia |
| 8 | France | Orsay | Institut de Physique Nucléaire (IPNO), Université Paris-Sud, CNRS-IN2P3 | IPNO | Christophe Suire |
| 9 | France | Strasbourg | Institut Pluridisciplinaire Hubert Curien, Université de Strasbourg, CNRS-IN2P3 | IPHC | Christian Kuhn |
| 10 | Germany | Darmstadt | Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung | GSI | Silvia Masciocchi |
| 11 | Germany | Frankfurt | Frankfurt Institute for Advanced Studies, Johann Wolfgang Goethe-Universität | FIAS | Volker Lindenstruth |
| 12 | Germany | Frankfurt | Institut für Informatik, Johann Wolfgang Goethe-Universität Frankfurt | IRI | Udo Kebschull |
| 13 | Hungary | Budapest | Wigner RCP Hungarian Academy of Sciences | WRCP | Gergely Barnafoldi |
| 14 | India | Jammu | University of Jammu | JU | Anju Bhasin |
| 15 | India | Mumbai | Indian Institute of Technology | IIT | Basanta Kumar Nandi |
| 16 | Indonesia | Bandung | Indonesian Institute of Sciences | LIPI | Suharyo Sumowidagdo |
| 17 | Korea | Daejeon | Korea Institute of Science and Technology Information | KISTI | Haeng Jin Jang |
| 18 | Korea | Sejong City | Korea University | KU | Hyoenjoong Cho |
| 19 | Poland | Warsaw | Warsaw University of Technology | WUT | Jan Marian Pluta |
| 20 | Romania | Bucharest | Institute of Space Science | ISS | Catalin-Lucian Ristea |
| 21 | South Africa | Cape Town | University of Cape Town and iThemba LABS | UCT | Thomas Dietel |
| 22 | Thailand | Bangkok | King Mongkut's University of Technology Thonburi | KMUTT | Tiranee Achalakul |
| 23 | Thailand | Bangkok | Thammasat University | TU | Kasidit Chanchio |
| 24 | Turkey | Konya | KTO Karatay University | KTO | Ali Okatan |
| 25 | United States | Berkeley, CA | Lawrence Berkeley National Laboratory | LBNL | Peter Martin Jacobs |
| 26 | United States | Detroit, MI | Wayne State University | WSU | Sergey Voloshin |
| 27 | United States | Houston, TX | University of Houston | UH | Lawrence Pinsky |
| 28 | United States | Knoxville, TN | University of Tennessee | UTK | Kenneth Francis Read |
| 29 | United States | Oak Ridge, TN | Oak Ridge National Laboratory | ORNL | Thomas Michael Cormier |
| 30 | United States | Omaha, NE | Creighton University | CU | Michael Gerard Cherney |
| 31 | United States | Pasadena, CA | California Institute of Technology | CALTECH | Harvey Newman |

- Q7: status of participants of ALICE members in O2
  - ➡ 30 Institutes participating
  - ➡ Personnel needed:
    - PH: physicist
    - SW: software developper
    - FW: firmware developper
    - HW: hardware experts
    - SY: system administrator

**Table 6.1:** Personel needed for the different activities of the $O^2$ project.

| WBS | CWGs | Activity | Contact Person | Competence | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 1 | Architecture | S. Chapeland | PH | 0.5 | 0.5 | | | | 1.0 |
| | | | | SW | 0.5 | 0.5 | | | | 1.0 |
| 8 | 2 | Tools and procedures | A. Telesca | SW | 0.3 | 0.3 | 0.2 | 0.1 | 0.1 | 1.0 |
| 9 | 11 | Software process | D. Berzano | SW | 0.3 | 0.3 | 0.2 | 0.1 | 0.1 | 1.0 |
| 12 | 4, 13 | Software framework and data model | P. Hristov | PH | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 6.0 |
| | | | | SW | 2.0 | 3.0 | 1.0 | 1.0 | 1.0 | 8.0 |
| 17 | 10 | Control, configuration, monitoring and logging | V. Chibante | SW | 2.0 | 2.0 | 2.0 | 3.0 | 4.0 | 13.0 |
| 10 | 3 | Dataflow, detector read-out | I. Legrand | SW | 2.0 | 2.0 | 1.0 | 0.5 | 0.5 | 6.0 |
| | | | | FW | 1.5 | 1.5 | 1.0 | 1.0 | 1.0 | 6.0 |
| 11 | 3 | Modelling and Simulation | I. Legrand | SW | 1.0 | 1.0 | 1.0 | 0.5 | 0.5 | 4.0 |
| 18 | 5 | Computing platforms | M. Kretz | SW | 2.0 | 2.0 | 2.0 | 1.0 | 1.0 | 8.0 |
| | | | | FW | 0.5 | 0.5 | | | | 1.0 |
| 14 | 6 | Calibration software Core | C. Zampolli | PH | 1.5 | 1.0 | 1.0 | 1.0 | 1.0 | 5.5 |
| | | | | SW | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 6.0 |
| | | Detector-specific | | PH | 1.5 | 1.0 | 1.0 | 1.0 | 1.0 | 5.5 |
| | | | | SW | 2.2 | 2.2 | 2.2 | 2.2 | 3.2 | 12.0 |
| 13 | 7 | Reconstruction Core | R. Shahoyan | PH | 2.5 | 2.0 | 2.0 | 2.0 | 2.0 | 10.5 |
| | | | | SW | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 10.0 |
| | | | | FW | 1.0 | 1.0 | 1.5 | 1.5 | 1.0 | 6.0 |
| | | Detector-specific | | PH | 1.5 | 1.0 | 1.0 | 1.0 | 1.0 | 5.5 |
| | | | | SW | 2.2 | 2.2 | 2.2 | 2.2 | 3.2 | 12.0 |
| 15 | 8 | Physics simulation Core | A. Morsch | PH | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 5.0 |
| | | | | SW | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 5.0 |
| | | Detector-specific | | PH | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 10.0 |
| | | | | SW | 2.2 | 2.2 | 2.2 | 2.2 | 3.2 | 12.0 |
| 16 | 9 | Data quality control and visualisation | B. von Haller | PH | | 1.0 | 0.5 | 0.5 | 0.5 | 2.5 |
| | | | | SW | 2.0 | 3.0 | 2.0 | 2.0 | 3.0 | 12.0 |
| 19, 20 | 12 | $O^2$ facility hardware procurement, installation | H. Engel | HW | | | | 1.5 | 3.0 | 4.5 |
| | | | | SY | 0.2 | 0.2 | 0.3 | 1.0 | 1.5 | 3.2 |
| 21 | | $O^2$ facility and Grid deployment | L. Betev | SY | | | 0.3 | 3.0 | 3.0 | 6.3 |
| | | **Grand Total** | | PH | 11.7 | 10.7 | 9.7 | 9.7 | 9.7 | 51.5 |
| | | | | SW | 22.9 | 24.9 | 20.2 | 19.0 | 24.0 | 111.0 |
| | | | | FW | 3.0 | 3.0 | 2.5 | 2.5 | 2.0 | 13.0 |
| | | | | HW | | | | 1.5 | 3.0 | 4.5 |
| | | | | SY | 0.2 | 0.2 | 0.6 | 4.0 | 4.5 | 9.5 |
| | | | | Total | 37.8 | 38.8 | 33.0 | 36.7 | 43.2 | 189.5 |

- Q7: status of participants of ALICE members in O2
  - ➡ 30 Institutes and 90 collaborators participating
  - ➡ Personnel needed
  - ➡ Personnel available

# 2015-2017

**Table 6.2:** Available personnel by country and per year for the different activities of the $O^2$ project during the period 2015-2017.

| Country | 2015 | | | | | 2016 | | | | | 2017 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PH | SW | FW | HW | SY | PH | SW | FW | HW | SY | PH | SW | FW | HW | SY |
| **Brasil** | | | | | | | | | | | | | | | |
| **CERN** | 3.0 | 1.0 | 0.6 | | 0.2 | 2.0 | 2.0 | 0.6 | | 0.2 | 1.0 | 3.0 | 0.6 | 0.5 | 0.7 |
| **Croatia** | | 3.0 | | | | | 3.0 | | | | | 3.0 | | | |
| **Czech Republic** | 0.4 | | | | | 0.4 | | | | | 0.3 | | | | |
| **France** | 1.3 | 2.0 | | | | 1.3 | 2.0 | | | | 1.3 | 2.0 | | | |
| **Germany** | 1.2 | 1.0 | 1.0 | | | 1.2 | 1.0 | 1.0 | | | 1.2 | 1.0 | 1.0 | | |
| **Hungary** | | 2.0 | 2.0 | | | | 2.0 | 2.0 | | | | 2.0 | 2.0 | | |
| **India** | | 0.9 | | | | | 1.4 | | | | | 1.6 | | | |
| **Indonesia** | 1.0 | 4.0 | | | | 1.0 | 4.0 | | | | 1.0 | 4.0 | | | |
| **Korea** | | 3.0 | | | | | 3.0 | | | | | 3.0 | | | |
| **Poland** | 3.0 | 2.0 | | | | 2.0 | 3.0 | | | | 2.0 | 3.0 | | | |
| **Romania** | | 0.3 | | | | | 0.3 | | | | | 0.3 | | | |
| **South Africa** | | | | | | 2.0 | | | | | 2.0 | | | | |
| **Thailand** | | 5.0 | | | | | 4.0 | | | | | 3.0 | | | |
| **Turkey** | 1.0 | | | | | 1.0 | | | | | 2.0 | | | | |
| **United States** | 1.0 | 1.1 | | | | 1.8 | 1.8 | | | | 1.9 | 1.9 | | | |
| **Total** | 11.9 | 25.3 | 3.6 | | 0.2 | 11.7 | 27.5 | 3.6 | | 0.2 | 12.7 | 27.8 | 3.6 | 0.5 | 0.7 |

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# 2018-2019

**Table 6.3:** Available personnel by country and per year for the different activities of the $O^2$ project during the period 2018-2019 and the total for the period 2015-2019.

| Country | 2018 | | | | | 2019 | | | | | Total 2015-2019 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PH | SW | FW | HW | SY | PH | SW | FW | HW | SY | PH | SW | FW | HW | SY |
| **Brasil** | | | | | | | | | | | | | | | |
| **CERN** | 1.0 | 3.0 | | 2.0 | 1.5 | 1.0 | 4.0 | | 3.0 | 2.5 | 8.0 | 13.0 | 1.8 | 5.5 | 5.1 |
| **Croatia** | | 3.0 | | | | | 3.0 | | | | | 15.0 | | | |
| **Czech Republic** | 0.3 | | | | | 0.3 | | | | | 1.7 | | | | |
| **France** | 1.3 | 2.0 | | | | 1.3 | 2.0 | | | | 6.5 | 10.0 | | | |
| **Germany** | 1.2 | 1.4 | 1.0 | | | 1.2 | 1.4 | 1.0 | | | 6.0 | 5.8 | 5.0 | | |
| **Hungary** | | 2.0 | 2.0 | | | | 2.0 | 2.0 | | | | 10.0 | 10.0 | | |
| **India** | | 1.6 | | | | | 1.6 | | | | | 7.1 | | | |
| **Indonesia** | 1.0 | 4.0 | | | | 1.0 | 4.0 | | | | 5.0 | 20.0 | | | |
| **Korea** | | 3.0 | | | | | 3.0 | | | | | 15.0 | | | |
| **Poland** | 2.0 | 3.0 | | | | 2.0 | 3.0 | | | | 11.0 | 14.0 | | | |
| **Romania** | | 0.3 | | | | | 0.3 | | | | | 1.5 | | | |
| **South Africa** | 2.0 | | | | | | | | | | 6.0 | | | | |
| **Thailand** | | | | | | | | | | | | 12.0 | | | |
| **Turkey** | 2.0 | | | | | 3.0 | | | | | 9.0 | | | | |
| **United States** | 2.2 | 2.2 | | | | 2.0 | 2.1 | | | | 8.9 | 9.1 | | | |
| **Total** | 13.0 | 25.5 | 3.0 | 2.0 | 1.5 | 11.8 | 26.4 | 3.0 | 3.0 | 2.5 | 61.1 | 132.5 | 16.8 | 5.5 | 5.1 |
| **Grand Total** | | | | | | | | | | | | | 221.0 | | |

- Q8: O2 long term plan
  - ➡ The long-term plan goals are:
    - H1 2019: simulation challenge
    - H2 2019: 10% data challenge
    - H1 2020: global system commissioning

- Q9 Budget

➡ The budget is briefly described in the TDR Chapter 11 (Section 11.5 and 11.6). Please find attached the UCG document which describes our budget in more details

Table 11.4: Cost estimates and spending profile.

| Item | Cost estimate (kCHF) | Spending profile 2018 (kCHF) | Spending profile 2019 (kCHF) |
|---|---|---|---|
| Infrastructure | 776 | 465 | 310 |
| FLPs and CRUs | 916 | 550 | 366 |
| EPNs | 5,152 | 515 | 4,636 |
| Data storage | 2’168 | 217 | 1,951 |
| Network | 1,018 | 509 | 509 |
| Servers | 438 | 306 | 131 |
| Total | 10,467 | 2,563 | 7,905 |

9,470 + 0,996

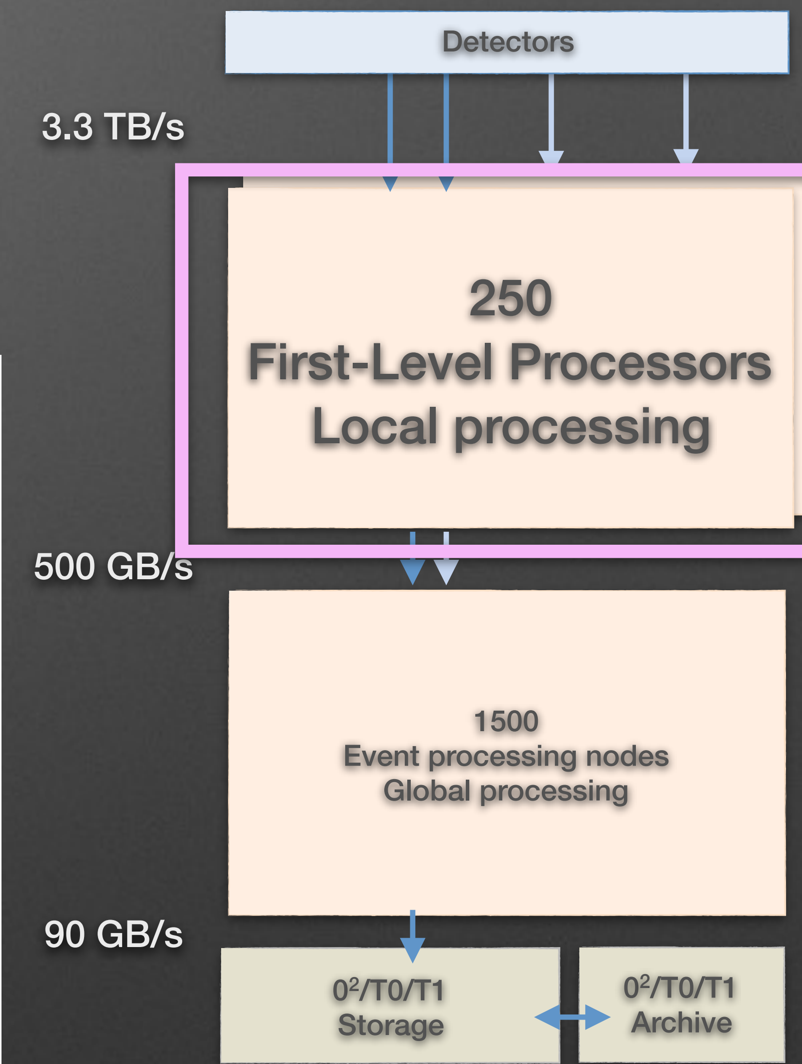
- Q9 **Budget**
  - ➡ Core: 6.579 MCHF ; M&O-A: 2.991 MCHF
  - ➡ Contributions Core

**Table 4.2:** Contributions from the funding agencies.

| Funding Agency | Country | (kEuro) | (kCHF) |
|---|---|---|---|
| Federal Ministry of Education and Research (BMBF) | Germany | 1,000 | 1,044 |
| CERN | Switzerland | | 3,500 |
| Gesellschaft fü Schwerionenforschung (GSI) | Germany | 2,000 | 2,088 |
| National Research, Development and Innovation Office (NRDIO) | Hungary | | 125 |
| Total | | | 6,757 |

- Q10 **Which contributions are expected from Japan?**
  - ➡ This depends very much about your needs, your goals and your resources. Any combination of contributions in the following areas would be welcome:
    - software development
    - (https://docs.google.com/document/d/1QK1JWBnOr_9ciFyip8np0EHXjzudtMkeEz5mizcHWPg/edit)
    - availability of an AF
    - contribution to the project budget

- Q11 Status and detailed plan of EPN and FLP activities, missing parts, manpower, possible contributions from ALICE-J



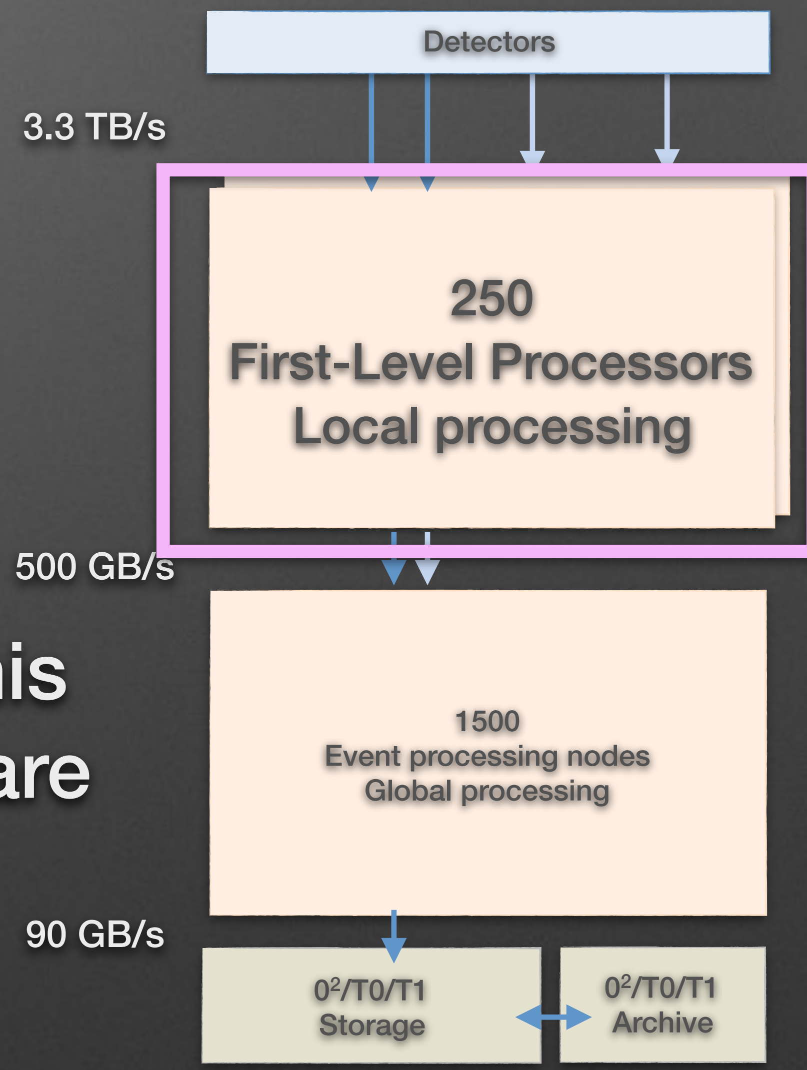

➡ FLP: initial compression -> TF

- 1-2 RO board

Table 10.1: Number of read-out boards and FLPs per detector to $O^2$ system.

| Detector | Number of read-out boards | Read-out board type | Number of FLPs |
|---|---|---|---|
| ACO | 1 | C-RORC | 1 |
| CPV | 1 | C-RORC | 1 |
| CTP | 1 | CRU | 1 |
| DCS | 1 | Network | 1 |
| EMC | 4 | C-RORC | 2 |
| FIT | 1 | C-RORC | 1 |
| HMP | 4 | C-RORC | 2 |
| ITS | 23 | CRU | 23 |
| MCH | 25 | CRU | 13 |
| MFT | 14 | CRU | 7 |
| MID | 2 | CRU | 1 |
| PHS | 4 | C-RORC | 2 |
| TOF | 3 | CRU | 3 |
| TPC | 324 | CRU | 162 |
| TRD | 54 | CRU | 27 |
| ZDC | 1 | CRU | 1 |
| Spares | | | 2 |
| Total | | | 250 |

- Q11 Status and detailed plan of EPN and FLP activities, missing parts, manpower, possible contributions from ALICE-J
    - ➡ FLP: initial compression -> TF
        - 1-2 RO board
        - FLP prototype assembly by the end of this year + several releases of the FLP software (ALICE-J contribution welcome)



- Q11 Status and detailed plan of EPN and FLP activities, missing parts, manpower, possible contributions from ALICE-J

  ➡ EPN: Compression, reconstruction -> CTF

    - 2 CPU × 32 cores (at least)
    - 2 GPU cards × 2 GPUs
    - prototyping activities to start when reconstruction software ready