The JUNO Computing Model

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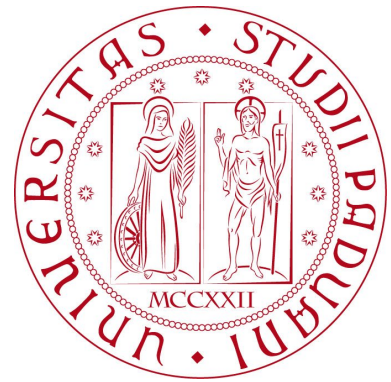
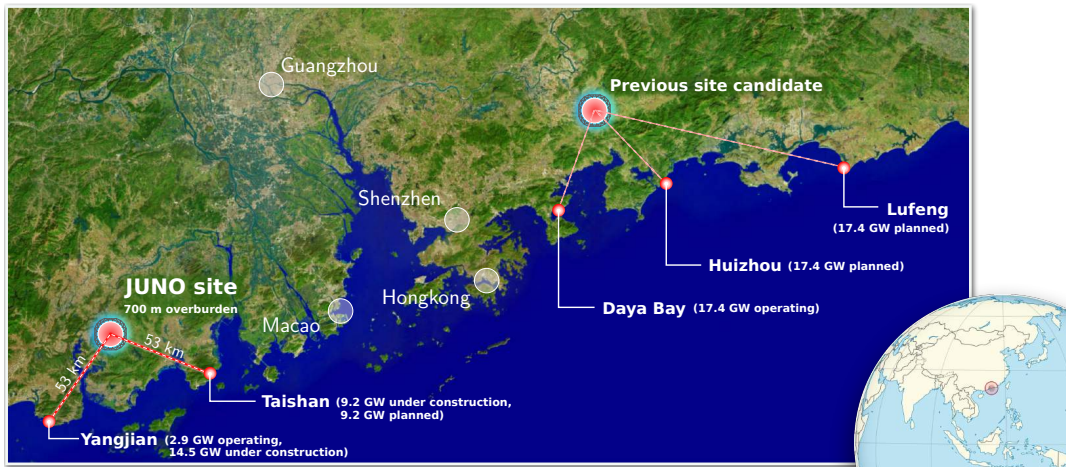
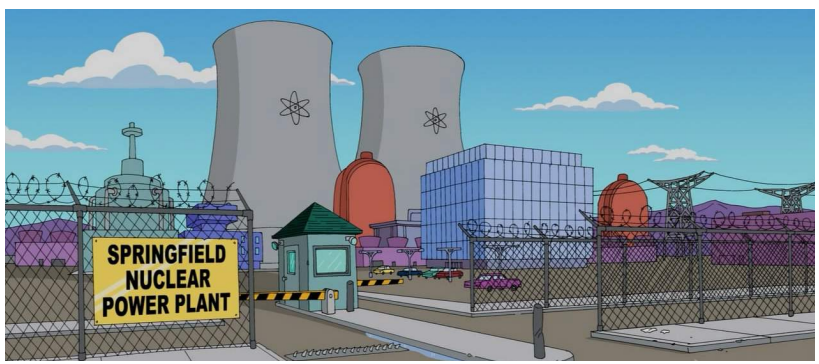
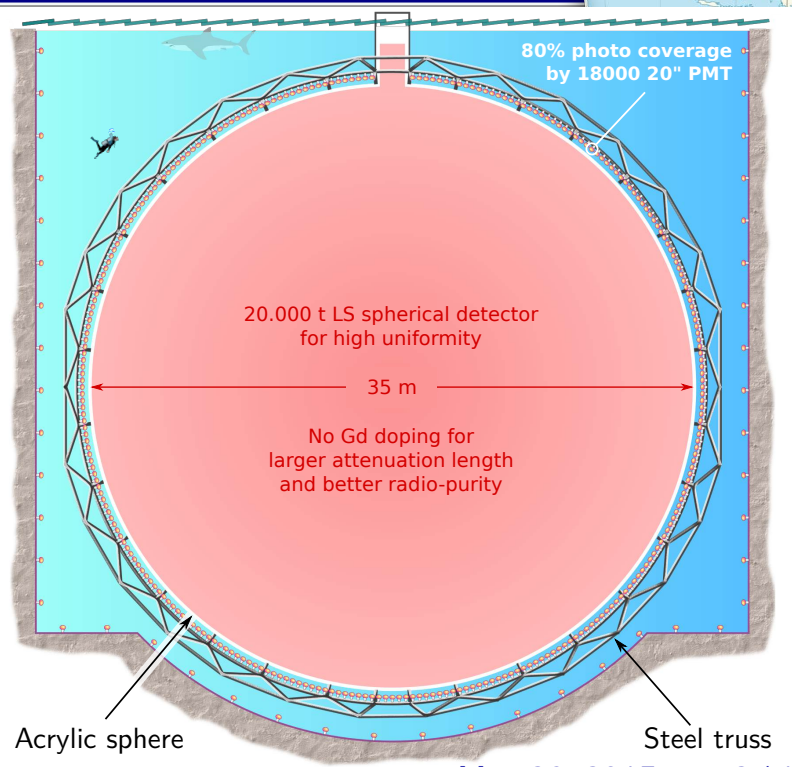


The Jiangmeng Underground Neutrino Observatory

- A 20-kton scintillator based neutrino detector
- ➸ designed to solve the neutrino mass hierarchy problem using reactor antineutrinos
- in constraction phase
- ➜ data taking in 2020
- sensitive to atmospheric ν, geoneutrini, solar e supernova ν

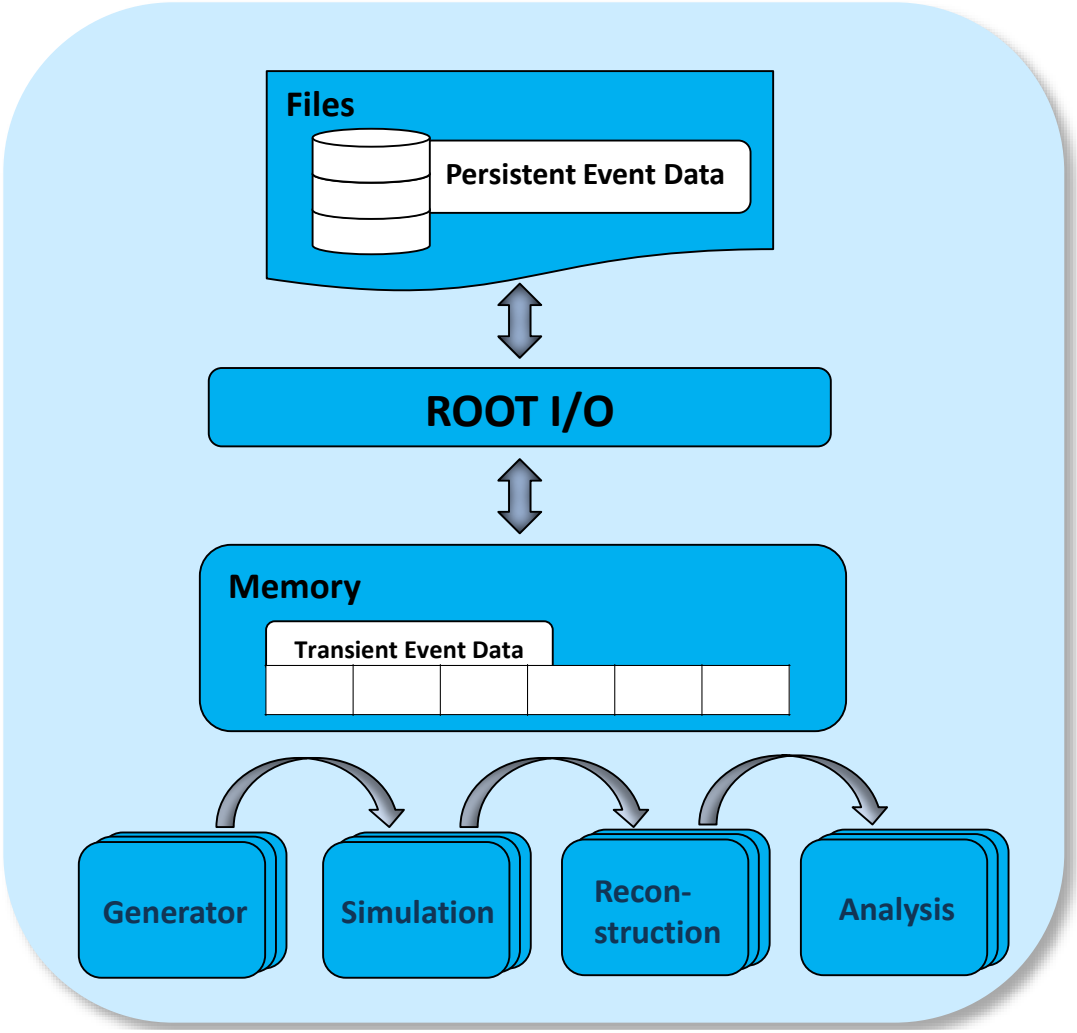






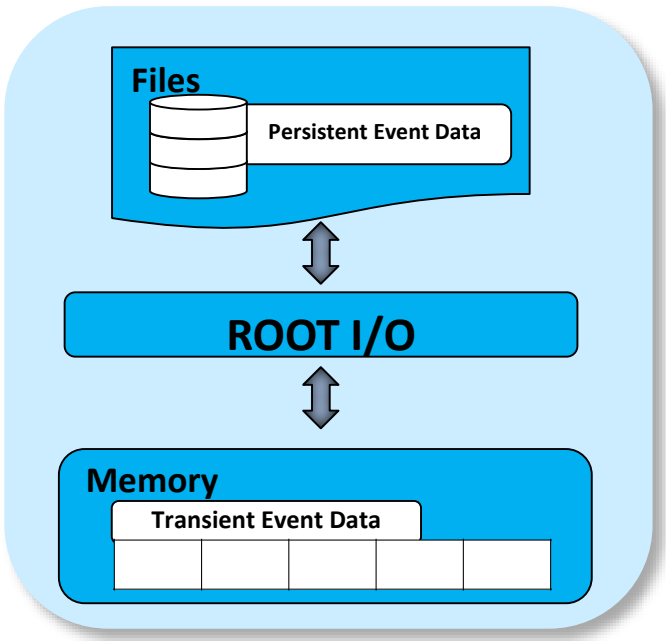
The JUNO Data Model

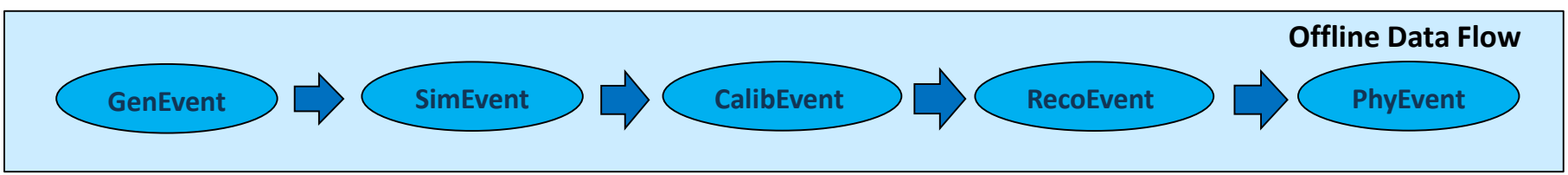
- **Event Data Model**
  - Design of EDM
  - Features
  - XmlObjDesc
  - Summary
- **Root I/O System**
  - Overview
  - Data layout in files
  - Input system
  - Output system
  - Summary



The JUNO Data Model

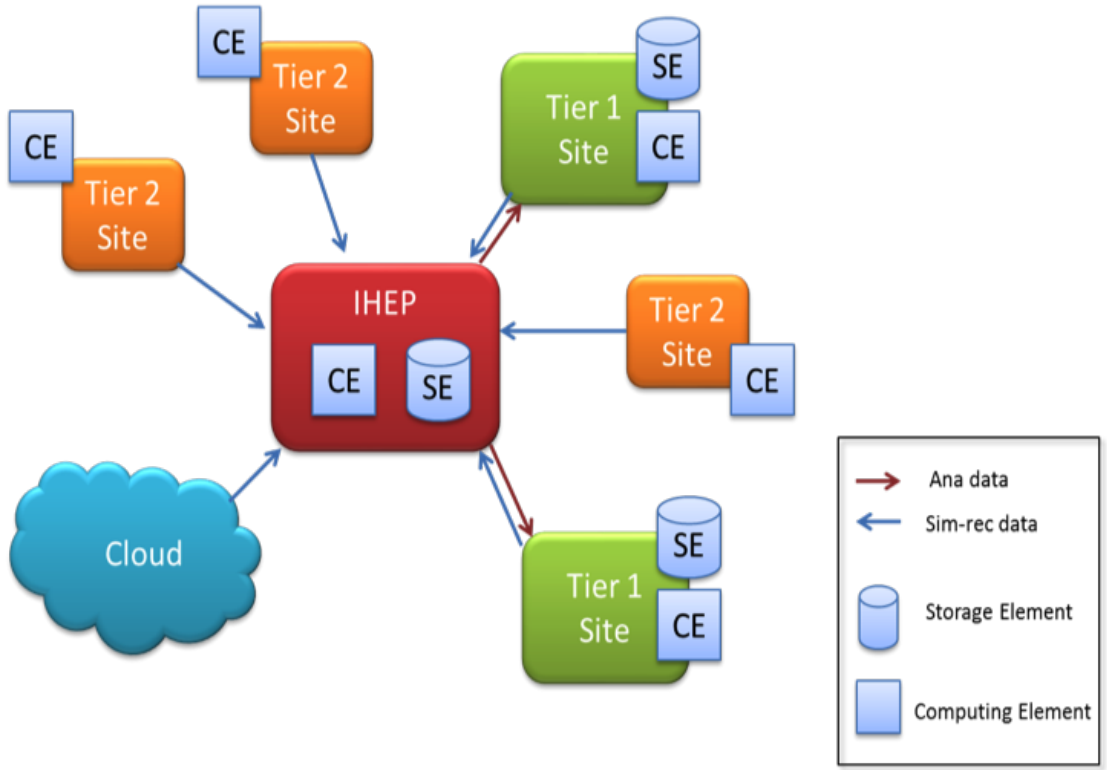
- **There are two types of Event Data in offline data processing:**
  - **Transient Event Data**
    - **In-memory data or data during processing**
    - **Definition of diversity**
  - **Persistent Event Data**
    - **Storage data or data written out**
    - **ROOT format**
- **Typically Objects of C++ Classes**





The IHEP Computing model

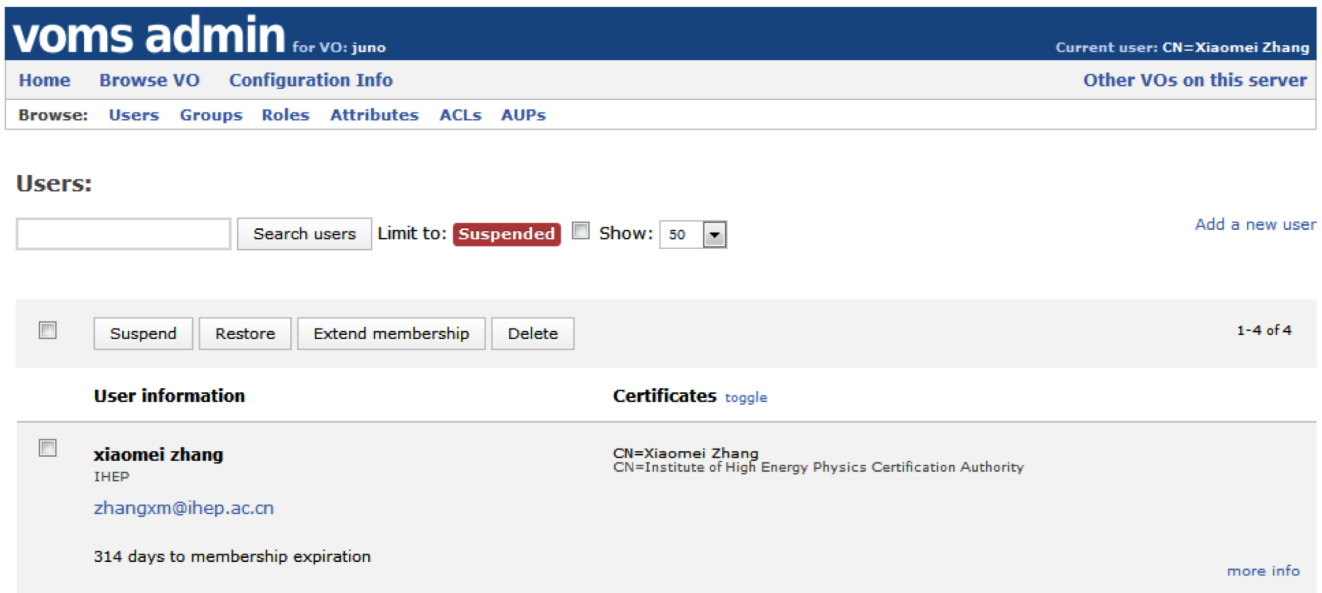
- IHEP as a central site :
  - central storage for all data (raw data, MonteCarlo, . . .)
- connected remote sites :
  - Tier-1 for DST local storage, Monte Carlo production and analyses
  - Tier-2 for mass production



- data flow
  - simulation data produced in remote sites transferred back, or directly written to IHEP for permanent storage
  - some data distribuited to remote sites for data analysis

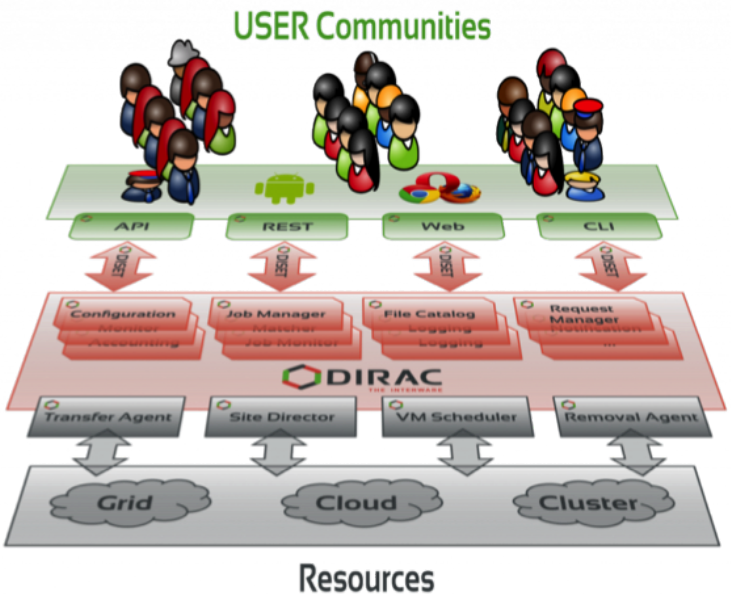
IHEP Authentication and Authorization

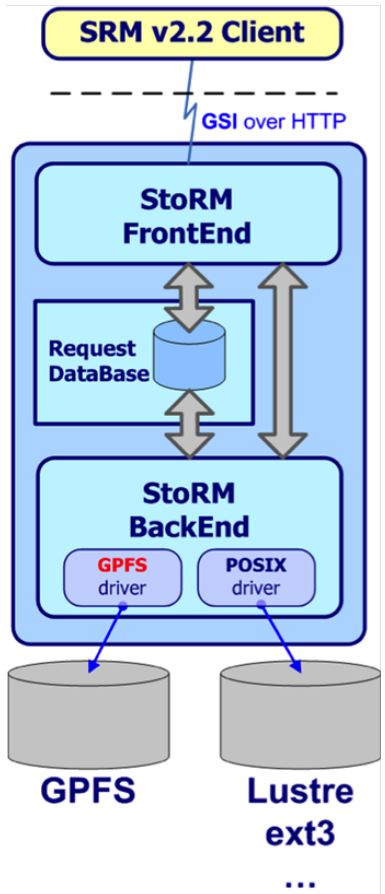
- control access to JUNO distributed resources
  - Grid certificate and Virtual organization Membership Service (VOMS)
  - JUNO is mapped to a Virtual Organization (VO)
  - only VO members are granted access to resources belonging to the VO
- JUNO VOMS has been setup
  - https://voms.ihep.ac.cn:8443/voms/juno



Workload and Data Management

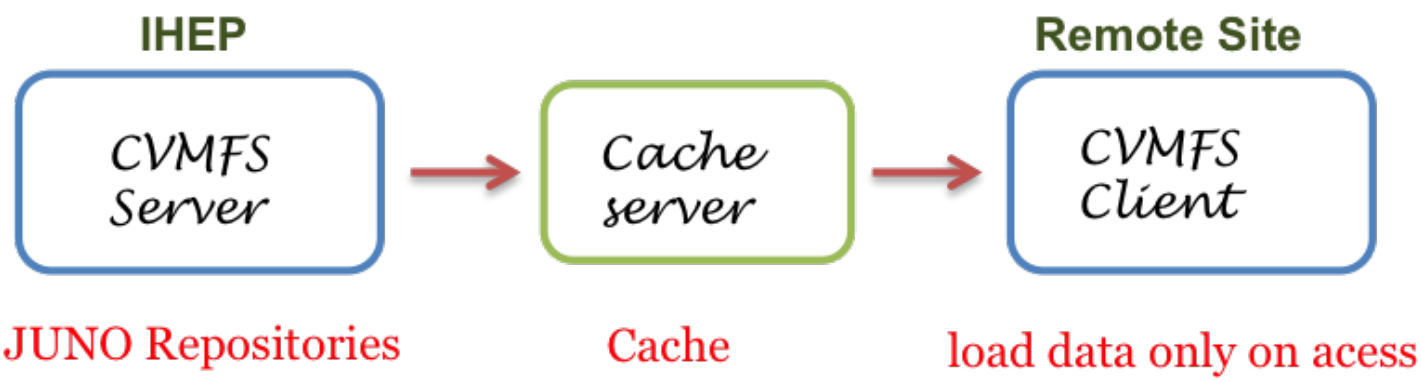
- distributed computing handled by DIRAC
  (Distributed Infrastructure with Remote Agent Control)
- job scheduling, jopb management and resources handing based on DIRAC framework
- data storage, file catalogue, and data transfer :
  - StoRM-based central storage with Lustre as backend
  - existing File Catalogue supports JUNO





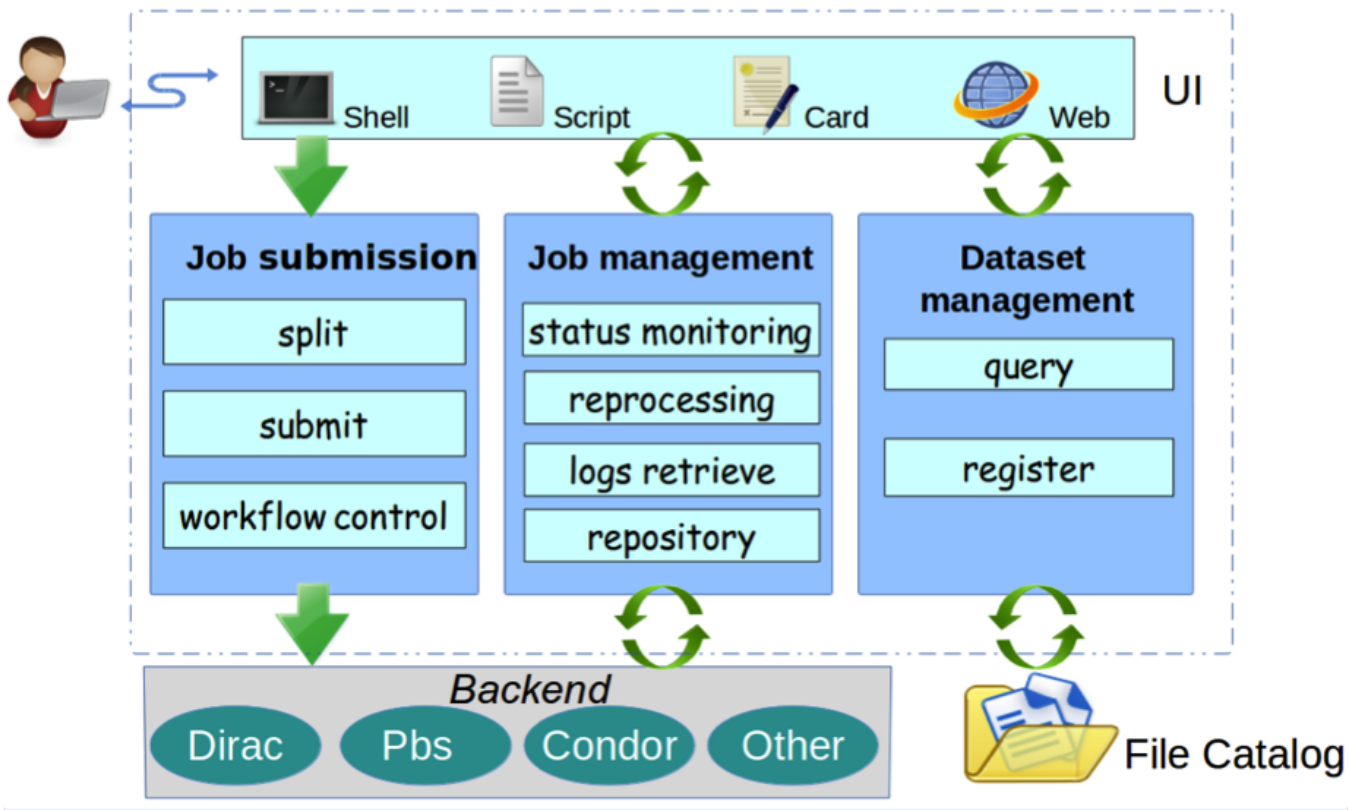
JUNO software deployment with CVMFS

- CVMFS : CERN Virtual Machine File System
  - a client-server file system with web servers for caching
  - greatly simplifies processes of remote software deployment
- JUNO software remote deployment procedure
  - CVMFS server is setup in IHEP
  - JUNO software is installed and published in CVMFS server repositories
  - CVMFS client is deployed in site work node
  - user in remote sites can find JUNO software in "/cvmfs/juno.ihep.ac.cn/"
  - software is loaded only on access, no overloading on local space



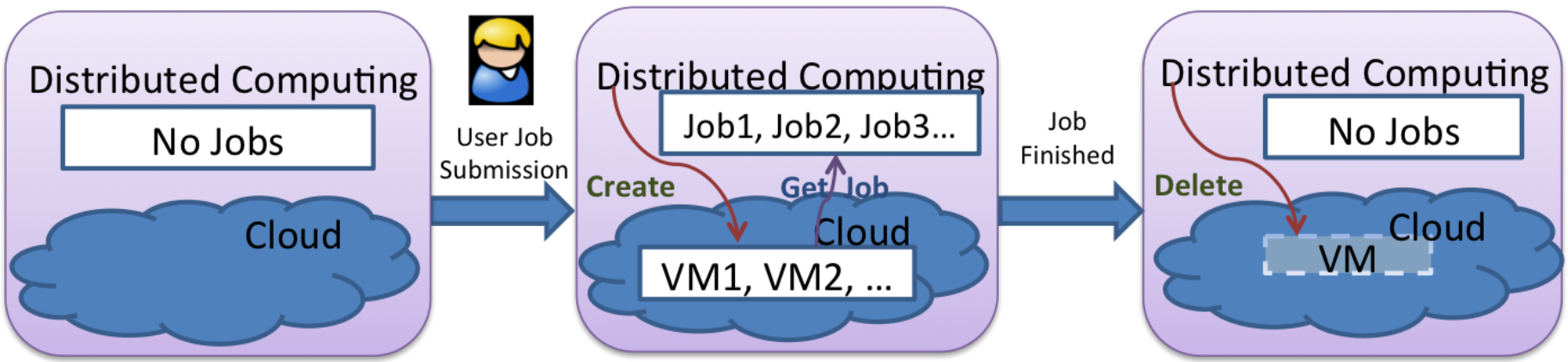
JUNO Job Submission

- user frontend to submit and manage a group of jobs with same properties (Task)
- a task submission and management tool has being developed at IHEP for JUNO users



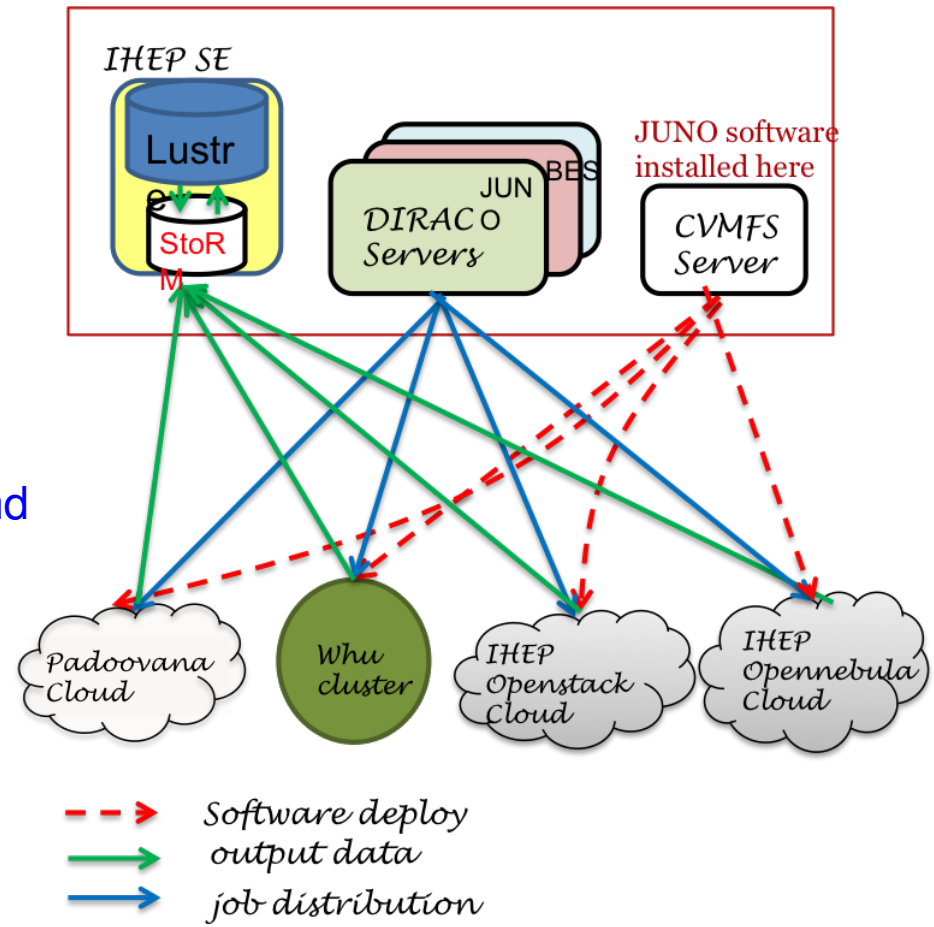
JUNO CLOUD Integration

- JUNO distributed computing able to integrate Cloud resources just like other type of resources :
  - VM scheduler has been developed to support : VM scheduling, interface with Cloud manager and central task queue
  - with flexible feature of cloud and pilot mechanism, the scheduling procedure have been implemented in a dynamic way
  - Cloud resources used by distributed computing can be extended and released in real time according to number of job in task queue
- Openstack and Opennebula based private Clouds supported



JUNO Cloud Usage

- four sites have been connected and used for tests:
  1. Cloud Padovana
  2. Whu Cluster
  3. IHEP Openstack Cloud
  4. IHEP Opennebula Cloud

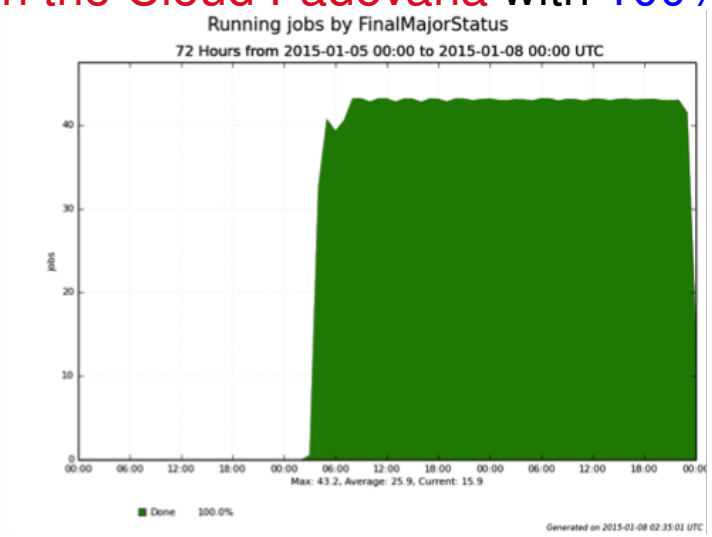


- central SE located at IHEP
  - StoRM with IHEP Lustre as backend
  - output data transferred to IHEP, directly seen and accessible from local farm
- JUNO software deployed in CVMFS server
- DIRAC server configured to accept JUNO VO and setup JUNO user group

IHEP integration with Cloud Padovana

- JUNO images prepared (QCOW2) to provide JUNO run-time environment in Cloud :
  - SL6, with CVMFS client installed
  - JUNO software version J14v1r1 deployed
- INFN Cloud Padovana and IHEP Cloud tested :
  - JUNO images have been uploaded to the Clouds
  - Squid server is setup in Cloud to speed-up access to JUNO software
  - Cloudinit module has been added to support run-time contextualization

➜ More than 700 jobs run from IHEP in the Cloud Padovana with 100% success



JUNO (for Italians) on the Cloud Padovana

- ✓ JUNO has been tested on the Cloud Padovana
- ✓ italian JUNO users authenticate with AII
- ✓ thanks to CVMFS, any default image can be used for JUNO analyses (several tests performed)
- ✓ the IHEP system could be duplicated in Padova to run jobs locally on the Cloud
- ➜ the resources can be very useful and suitabe for interactive work (i.e. ROOT data analysis)

JUNO @ CNAF (for batch running)

- ✓ Data Storage for JUNO created
- ✓ JUNO software installed successfully
- ✓ Test run performed with success in April
- ⊷ Curent release: http://juno.ihep.ac.cn/svn/offline/tags/J14v1r2_MCC15A_b4
- ⊷ JUNO software stored in /opt/exp_software/juno/JUNO-SOFT
- ➜ italian groups have started to use the resources